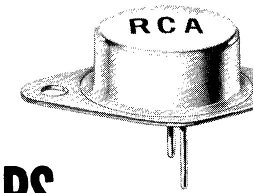
RCA types 40022 and 40254 are alloy-junction power transistors of the germanium p-n-p type, intended primarily for use in high-fidelity amplifiers and other af-amplifier applications. They feature high collector-current and dissipation capabilities, and exceptional linearity of characteristics over the full range of collector current. These transistors are hermetically sealed in the JEDEC TO-3 package and can be operated over the temperature range from -65 to +100° C.

The 40022 is particularly suitable for use in push-pull class B output stages of high-fidelity af-amplifier equipment. A pair of 40022 transistors in a "single-ended push-pull" class B amplifier circuit can deliver up to 10 watts rms power (18 watts EIA music power[a]) into a 4-ohm load with less than 5 per cent total harmonic distortion, and provide a power gain of 25 db (see Fig. 3). When used with an RCA type 2N2613 low-noise transistor in the input stage and RCA type 2N2614 transistors in the intermediate and driver stages, the 40022 makes possible the design of economical high-fidelity-amplifier systems having high power output, low distortion, and wide frequency response.

The 40254 is intended primarily for use in class A af-power-amplifier service in driver and output-stage applications. In these applications the 40254 can deliver power outputs as high as 5 watts rms with less than 5 per cent total harmonic distortion, and provide power gains of up to 36 db.

[a] EIA Standard No. R234, Section 2.1.2.1.
[b] Measured at center of seating surface.

GERMANIUM P-N-P ALLOY-JUNCTION POWER TRANSISTORS



JEDEC TO-3

For High-Fidelity Audio-Frequency-Amplifier Applications

- Up to 18 watts EIA music power output in class B push-pull operation
- DC beta = 50 (typical)
- 5-amp collector-current capability
- exceptional linearity of characteristics over entire collector-current range

Maximum Ratings, *Absolute-Maximum Values:*

	40022 40254	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-32 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE, V_{CER} ($R_{BE} \leq$ 33 ohms)	-32 max.	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-5 max.	volts
COLLECTOR CURRENT, I_C	-5 max.	amp
BASE CURRENT, I_B	-1 max.	amp
TRANSISTOR DISSIPATION, P_T:		
For mounting-flange temperatures[b] up to 81° C	12.5 max.	watts
For mounting-flange temperatures[b] above 81° C	Derate linearly at 0.66 watt/°C	
TEMPERATURE RANGE:		
Storage and operating (Junction)	-65 to +100	°C
PIN TEMPERATURE (During Soldering)		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	255 max.	°C

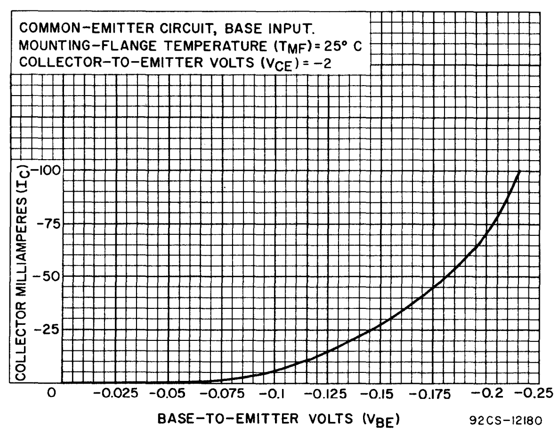


Fig.1 - Typical Transfer Characteristic For Types 40022 and 40254

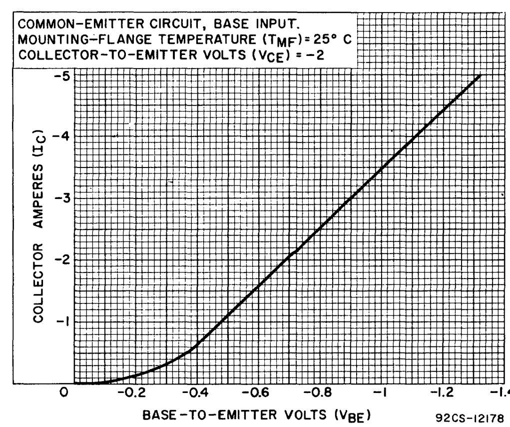
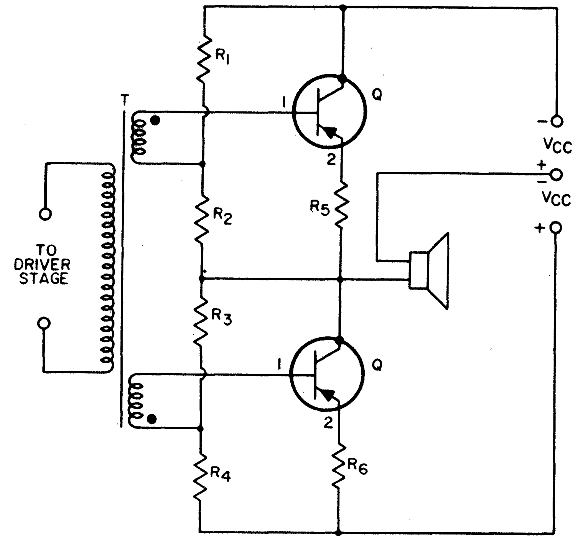


Fig.2 - Typical Transfer Characteristic For Types 40022 and 40254

Printed in U.S.A.
40022, 40254 7-66
Supersedes issue dated 6-64



92CS-11332R2

Q = Transistor Type RCA-40022
R_1,R_3 = 270 ohms ± 10%, 1 watt
R_2,R_4 = 3.9 ohms ± 10%, C 5 watt
R_5,R_6 = 0.56 ohm ± 10%, 0.5 watt
Speaker Voice-Coil Impedance = 4 ohms
T = Driver Transformer. Primary-winding impedance, current-carrying capacity, and dc resistance determined by large-signal characteristics of driver stage; secondary windings bifilar wound impedance of each winding = 100 ohms.

Fig.3 - Circuit of "Single-Ended Push-Pull" Amplifier Stage Using RCA Type 40022 Power Transistors

TYPICAL OPERATION OF TYPE 40022 IN "SINGLE-ENDED PUSH-PULL" CLASS B AF-AMPLIFIER CIRCUIT SHOWN IN FIG.3

For a Mounting-Flange Temperature[b] of 25° C

DC Collector Supply Voltages (V_{CC})[c]	14	volts
Zero-Signal DC Collector Current	-0.025	amp
Zero-Signal Base-Bias Voltage	-0.16	volt
Peak Collector Current	-2.25	amp
Maximum-Signal DC Collector Current	-0.716	amp
Input Impedance of Stage (per base)	60	ohms
Load Impedance (Speaker Voice-Coil)	4	ohms
Power Gain	25	db
Maximum-Signal Power Output	10	watts
Total Harmonic Distortion at Maximum-Signal Power-Output	5	%
Maximum Collector Dissipation (per transistor) under worst-case conditions	5	watts
EIA Music Power Output Rating[a]	18	watts

[a] EIA Standard No.R234, Section 2.1.2.1.
[b] Measured at center of seating surface.
[c] The data shown are for a dc collector supply having 10 per cent regulation.

ELECTRICAL CHARACTERISTICS, *at a Mounting-Flange Temperature[b] of 25° C:*

Characteristic	Symbol	TEST CONDITIONS: DC Collector-to-Base Voltage V_{CB} (volts)	DC Collector-to-Emitter Voltage V_{CE} (volts)	External Base-to-Emitter Resistance R_{BE} (ohms)	DC Collector Current I_C (amp)	DC Emitter Current I_E (amp)	LIMITS: Type 40022 Min.	Typ.	Max.	Type 40254 Min.	Typ.	Max.	Units
Collector-to-Base Breakdown Voltage	BV_{CBO}				-0.005	0	-32	-	-	-32	-	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CER}			33	-0.2		-32	-	-	-32	-	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0	-0.002	-5	-	-	-5	-	-	volts
Collector-Cutoff Current	I_{CBO}	-30				0	-	-	-1	-	-	-3	ma
Collector-Cutoff Saturation Current	$I_{CBO}(sat)$	-0.5				0	-	-	-0.1	-	-	-0.16	ma
DC Forward-Current Transfer Ratio	h_{FE}		-2		-1		38	70	-	30	70	-	
Base-to-Emitter Voltage	V_{BE}		-10		-0.05		-	-0.18	-	-	-	-	volt
Gain-Bandwidth Product	f_T		-5		-0.5		-	300	-	-	300	-	kc
Thermal Resistance Junction-to-Case	θ_{J-C}						-	-	1.5	-	-	1.5	°C/watt

TYPICAL OPERATION OF TYPE 40254 IN CLASS A AF-AMPLIFIER CIRCUIT

For a Mounting-Flange Temperature of 25° C

DC Collector Supply Voltage (V_{CC})	-16	volts
DC Collector-to-Emitter Voltage	-13.2	volts
DC Collector Current	-0.9	amp
Peak Collector Current	-1.8	amp
Input Impedance	15	ohms
Collector Load Impedance	15	ohms
Maximum-Signal Power Output	5	watts
Total Harmonic Distortion at 5 watts Output	5	%
Power Gain	36	db
Maximum Collector Dissipation	12	watts

OPERATING CONSIDERATIONS

Because the metal shells of RCA-40022 and RCA-40254 operate at the collector voltage, consideration should be given to the possibility of shock hazard if the shells are to operate at voltages appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

RCA-40022 and RCA-40254 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

RCA-40022 and RCA-40254 can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistors.

It is essential that the mounting flange which serves as the collector terminal be securely fastened to a heat sink, which may be the equipment chassis. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD THE MOUNTING FLANGE BE SOLDERED TO THE HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

The mounting-flange temperature of RCA-40022 and RCA-40254 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

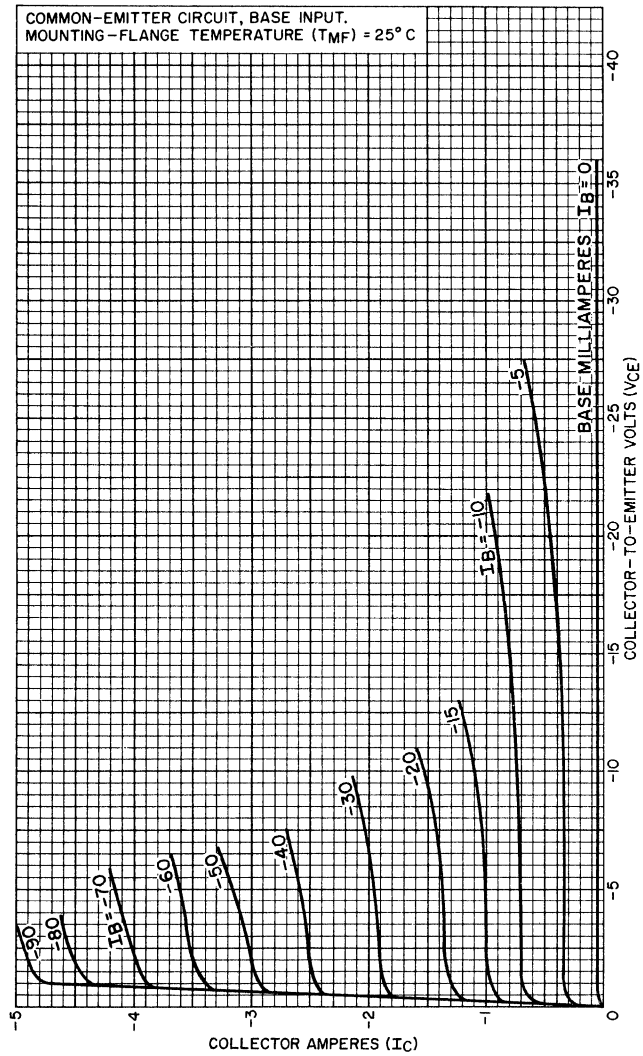


Fig.4 - Typical Collector Characteristics for Types 40022 and 40254

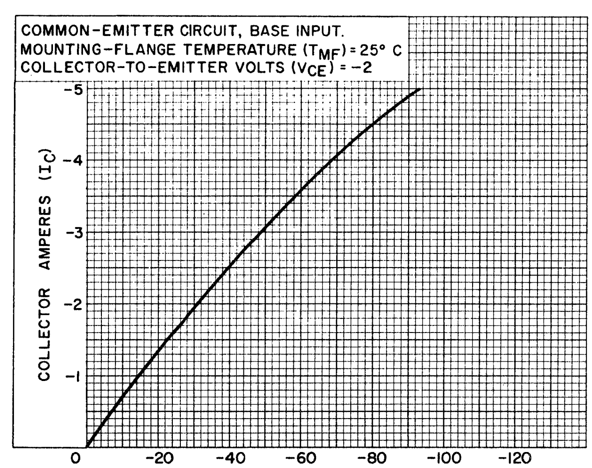


Fig.5 - Typical Current-Transfer Characteristic for Types 40022 and 40254

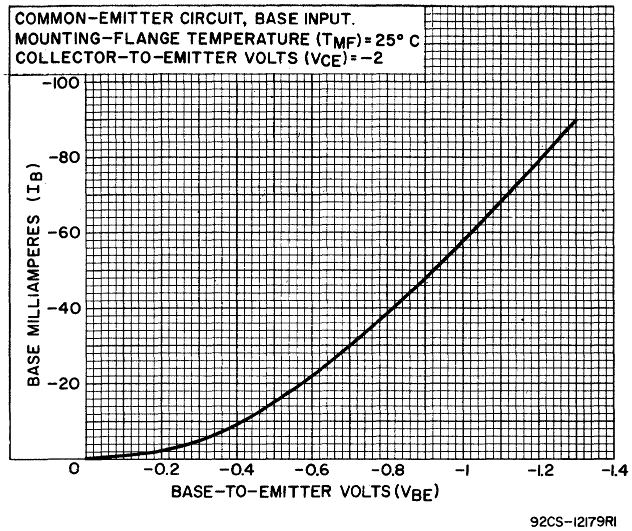
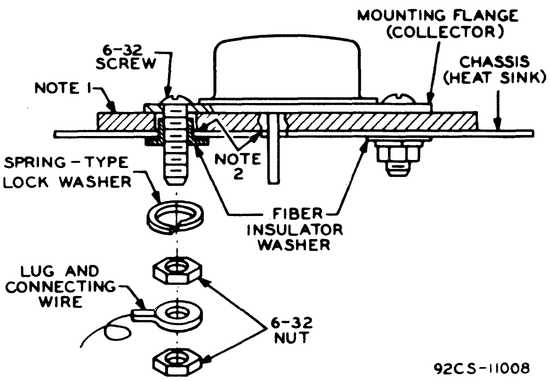


Fig.6 - Typical Input Characteristic for Types 40022 and 40254



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

Mounting hardware items for RCA-40022 and 40254 are available from RCA Distributors under the following RCA Part Numbers:

ITEM	RCA PART NO.
Mica Insulator	495320
Nylon Insulating Washer (2)	495334-7

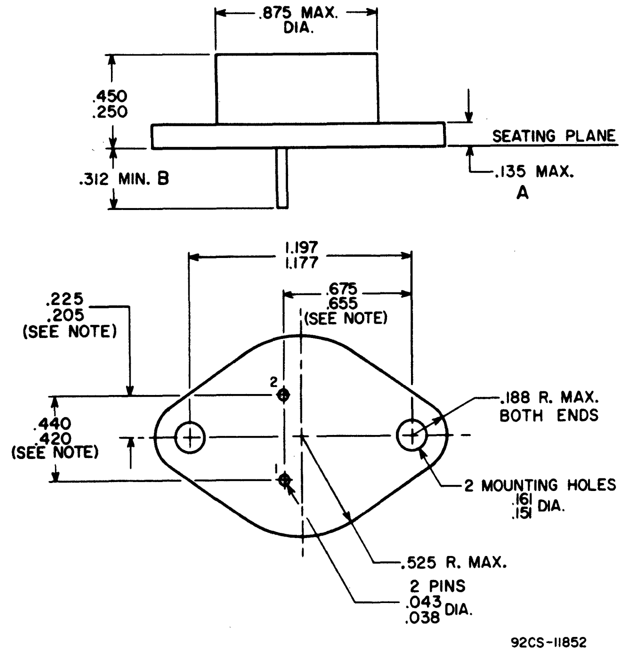
Mica insulators are also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

Insulating shoulder washers are also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

Sockets for RCA-40022 and 40254 and other semiconductor devices utilizing the JEDEC TO-3 package are made by several manufacturers, and are generally available from electronic parts distributors.

Fig.7 - Suggested Mounting Arrangement for Types 40022 and 40254

DIMENSIONAL OUTLINE For Types 40022 and 40054 JEDEC No. TO-3



DIMENSIONS IN INCHES

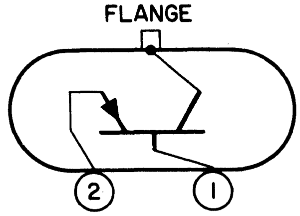
For Types 40022 and 40254:

Mounting-Flange Thickness (A) = 0.050" max.

Pin Length (B) = 0.440" min. 0.480" max.

NOTE: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS .050" (1.270MM) TO .055" (1.397MM) BELOW SEATING PLANE. WHEN GAGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

TERMINAL CONNECTIONS



Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case

RCA-40050 and 40051 are alloy-junction power transistors of the germanium p-n-p type, intended primarily for use in high-fidelity amplifiers and other commercial af-amplifier applications. These transistors feature high collector-current and dissipation capabilities, and exceptional linearity of characteristics over their full ranges of collector current. When used with RCA-2N2613 low-noise transistors in low-level stages and RCA-2N2614 transistors in intermediate-level and driver stages, the 40050 and 40051 make possible the design of economical high-fidelity amplifier systems having high power output, low distortion, and wide frequency response.

The 40050 and 40051 are particularly desirable for use in class B amplifier service in push-pull circuit arrangements. In a "single-ended push-pull" amplifier circuit of the type shown in Fig.2, using direct coupling to a 4-ohm speaker load, a pair of RCA-40051 transistors can deliver up to 25 watts output with sine-wave-signal input or 45 watts music-power output[a], with less than 5 per cent total harmonic distortion and a power gain of 28 db. In the same type of circuit a pair of RCA-40050 transistors can deliver up to 15 watts output with sine-wave-signal input or 25 watts music-power output[a], also with less than 5 per cent total harmonic distortion and a power gain of 28 db.

RCA-40050 and 40051 are also useful as class A power amplifiers in driver and output-stage applications. In this type of service these transistors can provide power outputs as high as 5 watts with less than 5 per cent total harmonic distortion, and power gains as great as 38 db.

The 40051 has a higher collector-to-emitter voltage capability (-50 volts) than the 40050 (-40 volts), and consequently can provide greater power output in direct-coupled amplifier circuits and other applications requiring this capability.

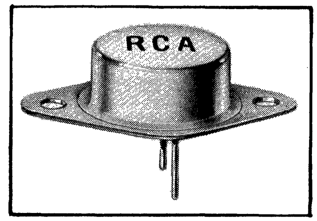
Both the 40050 and the 40051 utilize a hermetically sealed JEDEC TO-3 package.

Maximum Ratings, *Absolute-Maximum Values:*

	40050	40051		
Collector-to-Base Voltage, V_{CBO}	-40	-50	max.	volts
Collector-to-Emitter Voltage, V_{CEO}	-40	-50	max.	volts
Emitter-to-Base Voltage, V_{EBO}	-5	-5	max.	volts
Collector Current, I_C	-5	-5	max.	amp
Base Current, I_B	-1	-1	max.	amp
Transistor Dissipation: At Mounting-Flange Temperatures*—				
Up to 81° C	12.5	12.5	max.	watts
Above 81° C	See *Fig.1*			
Temperature Range: Storage and Operating (Junction)	-65 to +100			°C
Pin Temperature (During Soldering): At distances of not less than 1/32" from seating surface for 10 seconds max.	255	255		°C

* Measured at center of seating surface.

GERMANIUM P-N-P POWER TRANSISTORS



For High-Fidelity, Audio-Frequency-Amplifier Applications

- High Large-Signal (DC) Beta = 90 typ.
- Excellent Beta Linearity — Essentially linear up to 5 amp. I_C
- 40051 Features in Push-Pull Class B Service
  - (a) 45 watts music power output[a]
  - (b) 25 watts sine-wave power output

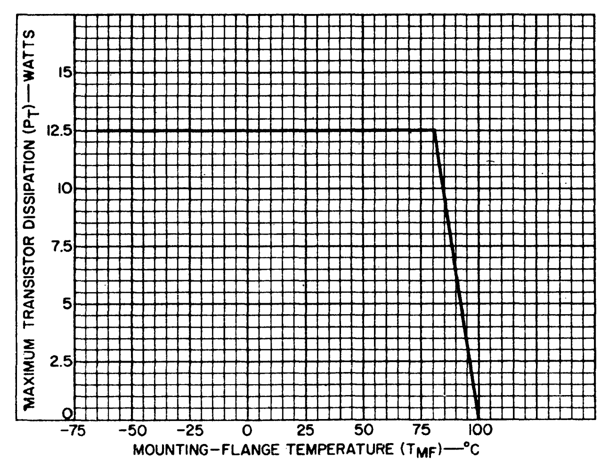
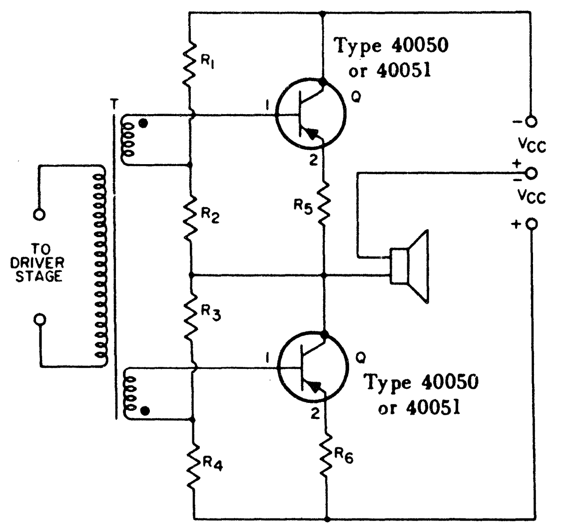


Fig.1 - Rating Chart for Types RCA-40050 and RCA-40051

Electrical Characteristics, *at a Mounting-Flange Temperature, T_{MF}*, of 25° C*

Characteristics	Symbols	TEST CONDITIONS: DC Collector-to Base Voltage V_{CB} volts	DC Collector-to Emitter Voltage V_{CE} volts	DC Collector Current I_C amp	DC Emitter Current I_E ma	External Base-to-Emitter Resistance RBE ohms	LIMITS: Type RCA-40050 Min.	Typ.	Max.	Type RCA-40051 Min.	Typ.	Max.	Units
Collector-to-Base Breakdown Voltage	BV_{CBO}			-0.005	0		-40	-	-	-50	-	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CER}			-0.6		68	-40	-	-	-50	-	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}			0	-2		-5	-	-	-5	-	-	volts
Collector-Cutoff Current	I_{CBO}	-30			0		-	-	-0.5	-	-	-0.5	ma
Saturation Collector-Cutoff Current	$I_{CBO}(sat)$	-0.5			0		-	-	-0.1	-	-	-0.1	ma
DC Forward-Current Transfer Ratio	h_{FE}		-2	-1			50	90	-	50	90	-	
Base-to-Emitter Voltage	V_{BE}		-10	0.5			-	-0.17	-	-	-0.17	-	volt
Thermal-Resistance (Junction-to-case)	θ_{JC}						-	-	1.5	-	-	1.5	°C/watt
Gain-Bandwidth Product	f_T		5	0.5			-	500	-	-	500	-	Kc

* Measured at center of seating surface.



92CS-11332R2

	40051	40050
R_1, R_3	470	390 ohms ± 10%, 1 watt
R_2, R_4	3.9	3.9 ohms ± 10%, 0.5 watt
R_5, R_6	0.33	0.33 ohm ± 10%, 0.5 watt
Speaker: Voice-Coil Impedance.......	4	4 ohms

T: Driver Transformer. Primary-winding impedance, current-carrying capacity, and dc resistance determined by large-signal characteristics of driver stage; secondary windings bifilar wound, impedance of each winding = 100 ohms.

Fig.2 - Single-Ended Push-Pull Class B AF Amplifier Circuit

Typical Operation of Types 40050 and 40051 in "Single-Ended Push-Pull" Class B AF-Amplifier Circuit Shown in Fig.2:

For a Mounting-Flange Temperature of 25°C

	40051	40050	
DC Collector Supply Voltages (V_{CC1}, V_{CC2})[b] . . .	22	18	volts
Zero-Signal DC Collector Current	-0.025	-0.025	amp
Zero-Signal Base-Bias Voltage	-0.16	-0.16	volt
Peak Collector Current. . . .	-3.5	-2.8	amp
Maximum-Signal DC Collector Current	-1.1	-0.8	amp
Input Impedance of Stage (per base).	31	32	ohms
Load Impedance (Speaker Voice Coil)	4	4	ohms
Power Gain.	28	28	db
Maximum-Signal Power Output. .	25	15	watts
Total Harmonic Distortion at Maximum-Signal Power Output.	5	5	%
Maximum Collector Dissipation (per transistor) under worst-case conditions . . .	12.5	7.5	watts
EIA Music Power Output Rating[a]	45	25	watts

[a] EIA Standard No.RS234, Section 2.1.2.1.

[b] The data shown are for a dc collector supply having 10 per cent regulation.

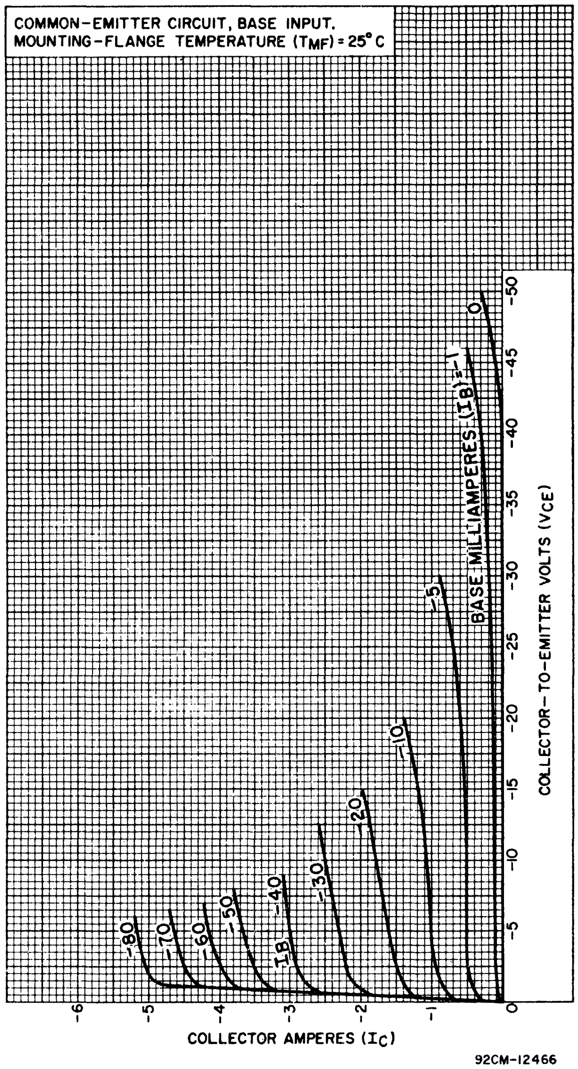


Fig.3 - Typical Collector Characteristics for Types RCA-40050 and RCA-40051.

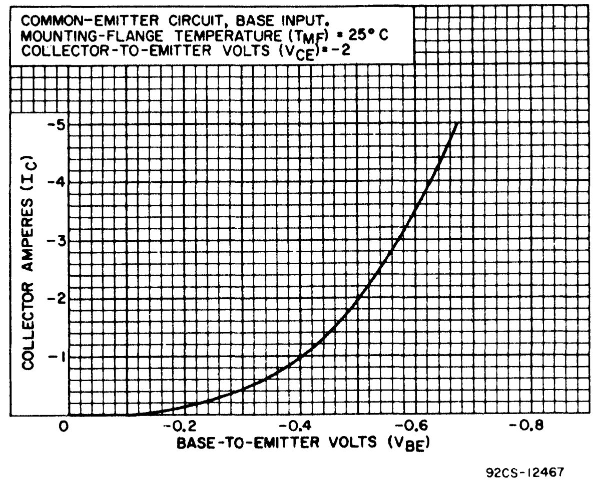


Fig.5 - Typical Transfer Characteristic for Types RCA-40050 and RCA-40051.

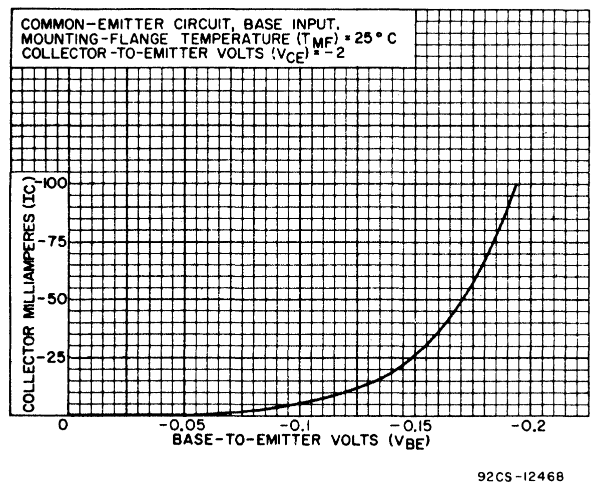


Fig.6 - Typical Transfer Characteristic for Types RCA-40050 and RCA-40051.

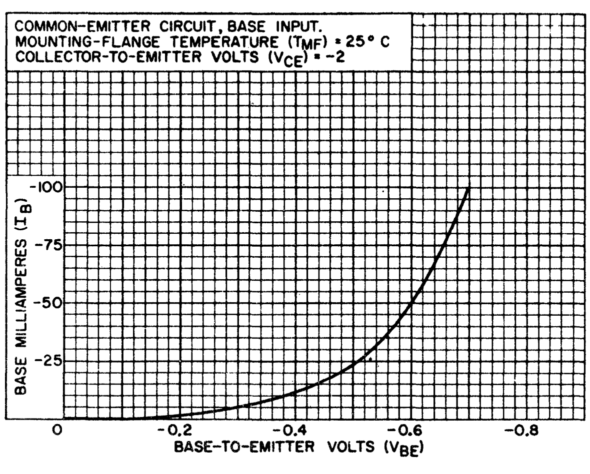


Fig.4 - Typical Input Characteristic for Types RCA-40050 and RCA-40051.

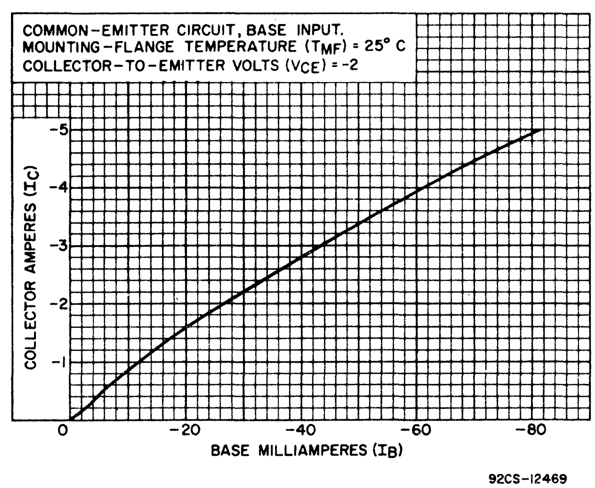


Fig.7 - Typical Current-Transfer Characteristic for Types RCA-40050 and RCA-40051.

OPERATING CONSIDERATIONS

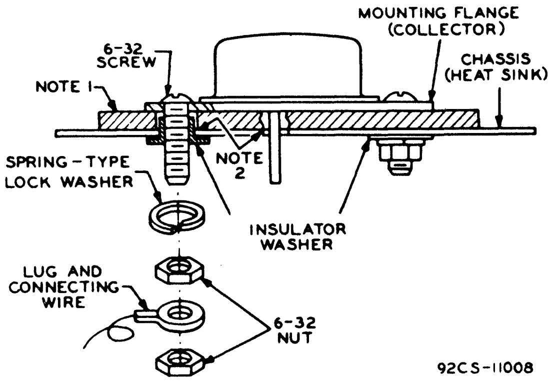
Because the metal shells of these transistors operate at the collector voltage, consideration should be given to the possibility of shock hazard if the shells are to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

The 40050 and 40051 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

These transistors can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistor.

It is essential that the mounting flange which serves as the collector terminal be securely fastened to a heat sink, which may be the equipment chassis. *Under no circumstances, however, should the mounting flange be soldered to the heat sink or chassis because the heat of the soldering operation will permanently damage the transistor.*

The mounting-flange temperature of the 40050 or 40051 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

Mounting hardware items for RCA-40050 and 40051 are available from RCA Distributors under the following RCA Part Numbers:

ITEM	RCA PART NO.
Mica Insulator	495320
Nylon Insulating Washer (2)	495334-7

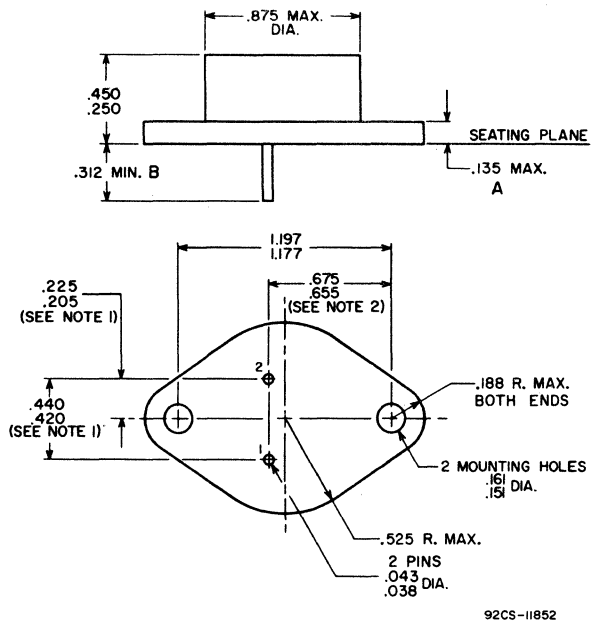
Mica insulators are also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

Insulating shoulder washers are also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

Sockets for RCA-40050 and 40051 and other semiconductor devices utilizing the JEDEC TO-3 package are made by several manufacturers, and are generally available from electronic parts distributors.

Fig.8 - Suggested Mounting Arrangement for Types RCA-40050 and RCA-40051.

JEDEC No. TO-3



DIMENSIONS IN INCHES

For RCA-40050 and RCA-40051

Mounting-Flange Thickness (A) = 0.050" max.

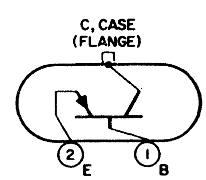
Pin Length (B) = 0.440" min. 0.480" max.

NOTE 1: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS .050" (1.270MM) TO .055" (1.397MM) BELOW SEATING PLANE. WHEN GAGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 2: TWO LEADS.

TERMINAL CONNECTIONS

Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case



SILICON N-P-N PLANAR TRANSISTORS

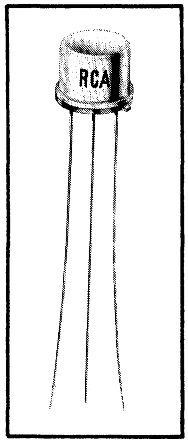
40080 40081
40082 40446

File No. 210

RCA-40080, -40081, -40082, and 40446 are triple-difused, silicon planar n-p-n transistors, specifically designed for application in a 5-watt input, 27 megahertz Citizens Band Transmitter.

Type No.	JEDEC Package	Application
40080	TO-5	Oscillator
40081	TO-5	Driver
40082	TO-39	Power Amplifier
40446	TO-39 + Flange	Power Amplifier

For 27 MHz, 5-Watt Citizens Band Applications



JEDEC TO-5

MAXIMUM RATINGS

PARAMETER	40080	40081	40082	40446	UNITS
V_{CEO}	30	–	–	–	V
V_{CEV}	–	60	60	60	V
V_{EBO}	–	2.0	2.5	2.5	V
I_C (peak)	.250	.250	1.5	1.5	A
Temperature Range 1. Storage 2. Operating (Junct.)	 –65 to 200 –65 to 200	 –65 to 200 –65 to 200	 –65 to 200 –65 to 200	 –65 to 200 –65 to 200	 ^oC ^oC
Transistor Dissipation 1. Case temperature up to 25° C 2. Case temperature above 25° C 3. Free-Air temperature up to 25° C	 – – 0.5	 2.0 See *Fig.1* –	 5.0 See *Fig.1* –	 10.0 See *Fig.1* –	 W W

R.F. PERFORMANCE – 27 MEGAHERTZ

TYPE	V_{cc}	$I_{c}mx$	P_{in}(RF)	P_{out} MIN
40080 – Oscillator	12V	32 mA	–	100 mW
40081 – Driver	12V	85 mA	75 mW	400 mW
40082, 40446 – Power Amplifier	12V	415 mA	350 mW	3.0 W

ELECTRICAL CHARACTERISTICS (T_A = 25° C)

40080

PARAMETER	SYMBOL	TEST CONDITIONS	MINIMUM	MAXIMUM	UNITS
Collector-to-Emitter Voltage	V_{CEO}	I_C = 10 mA; I_B = 0	30	–	V
Collector Current	I_{CBO}	V_{CB} = +15 V; I_E = 0	–	10	μA

40081

PARAMETER	SYMBOL	TEST CONDITIONS	MINIMUM	MAXIMUM	UNITS
Collector-to-Emitter Voltage	V_{CEX}	I_C = 100 μA; V_{BE} = –.5 V	60	–	V
Collector Current	I_{CBO}	V_{CB} = +15 V; I_E = 0	–	10	μA
Emitter-to-Base Voltage	V_{EBO}	I_E = 500 μA; I_C = 0	2.0	–	V

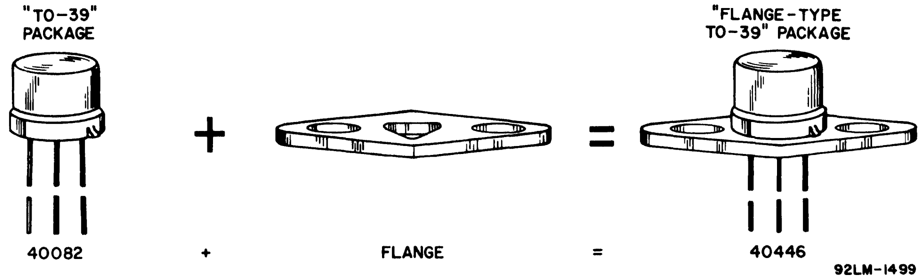
40082 AND 40446

PARAMETER	SYMBOL	TEST CONDITIONS	MINIMUM	MAXIMUM	UNITS
Collector-to-Emitter Voltage	V_{CEX}	I_C = 500 μA; V_{BE} = –.5V	60	–	V
Collector Current	I_{CBO}	V_{CB} = +15 V; I_E = 0	–	10	μA
Emitter-to-Base Voltage	V_{EBO}	I_E = 500 μA; I_C = 0	2.5	–	V

TYPICAL C.B. TRANSMITTER PERFORMANCE (13.8 volt Collector Supply)

STAGE	NO MODULATION		100% MODULATION	
	I_C(mA)	P_o(watts)	I_C(mA)	P_o(watts)
Oscillator	15	–	15	–
Driver	55	–	50	–
Power Amplifier	330	3.5[a]	330	4.8

[a] Adjusted for maximum legal power output.



- Flange provides for mounting convenience and for effective contact with heat sink.
- Greater power-handling capability
- Additional design flexibility

DISSIPATION DERATING CURVE

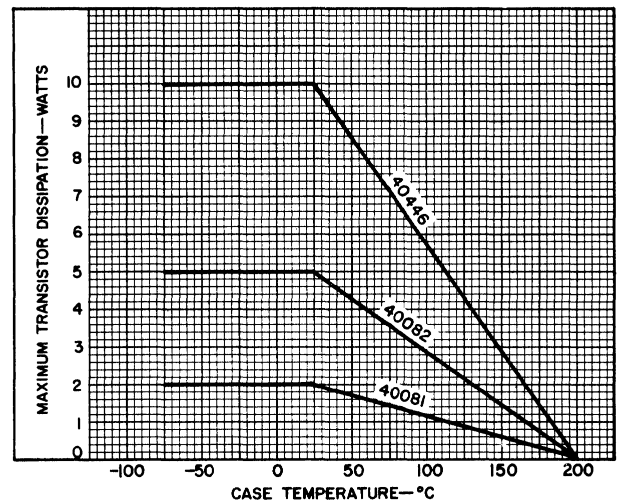
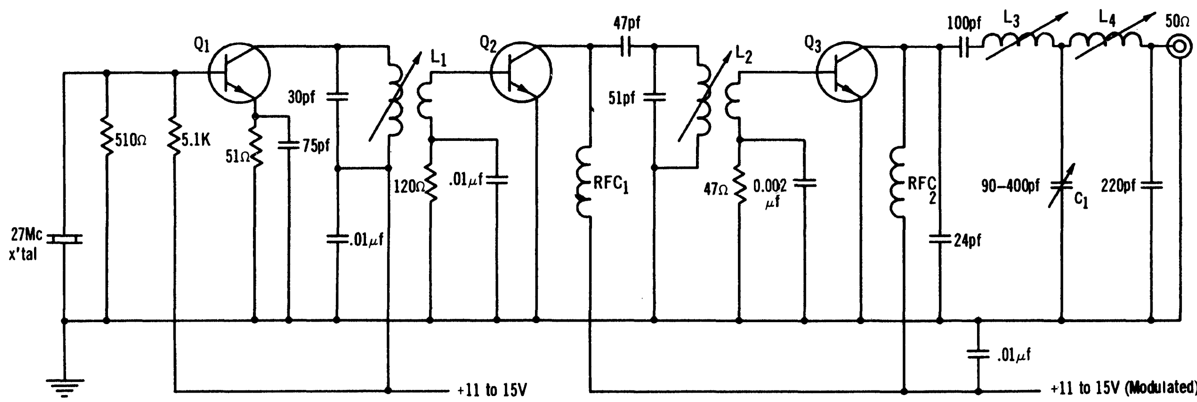


Fig. 1

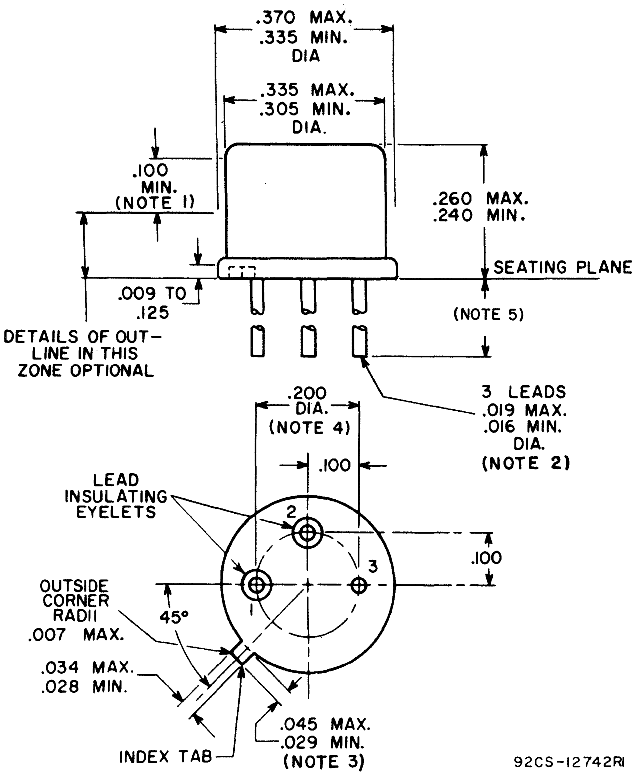
TYPICAL AMPLIFIER CHAIN



L_1	14t:3t	#22 wire ¼" CTC coil form with "green dot" core	0.75–1.2µhy	Q = 100
L_2	14t:2¾t	#22 wire ¼" CTC coil form with "green dot" core	0.75–1.2µhy	Q = 100
L_3	11t	#22 wire ¼" CTC coil form with "green dot" core	0.5–0.9 µhy	Q = 120
L_4	7t	#22 wire ¼" CTC coil form with "green dot" core	0.21–0.34 µhy	Q = 140
RFC 1,2		15 µhy Miller #4624 or equiv.		
C_1		ARCO #429 or equiv.		
Q_1	RCA 40080			
Q_2	RCA 40081			
Q_3	RCA-40082, -40446			

Fig. 2

DIMENSIONAL OUTLINE FOR TYPES 40080, 40081, 40082 JEDEC No. TO-5 and TO-39



DIMENSIONS IN INCHES

NOTE 1: This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed 0.010.

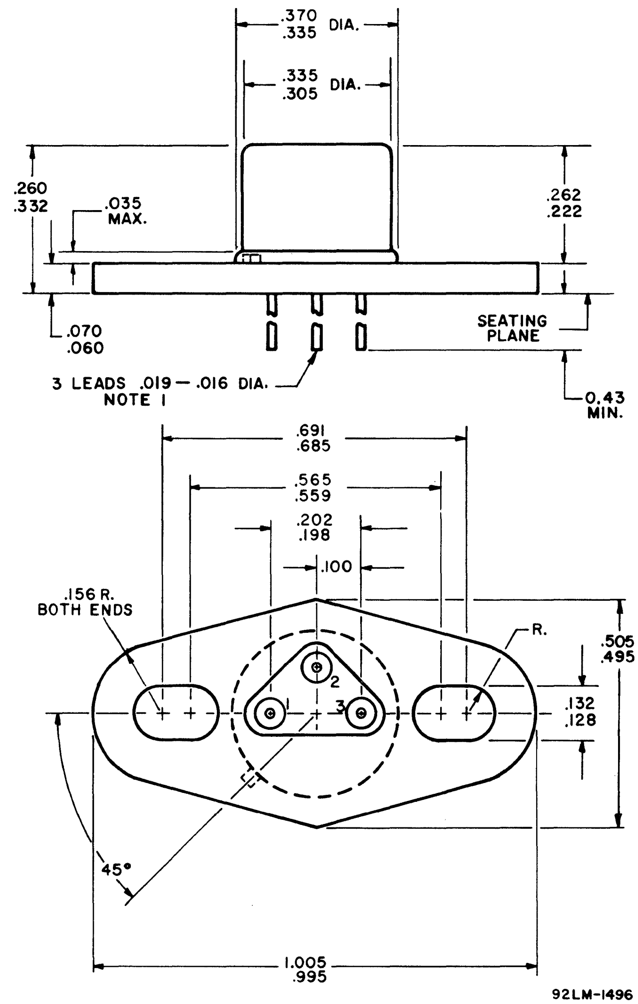
NOTE 2: The specified lead diameter applies in the zone between 0.050 and 0.250 from the seating plane. Beyond 0.250 a maximum of 0.021 diameter is held. Outside of these zones the lead diameter is not controlled.

NOTE 3: Measured from maximum diameter of the actual device.

NOTE 4: Leads having maximum diameter (0.019) measured in gauging plane 0.054 ± 0.001 −0.000 below the seating plane of the device shall be within 0.007 of their true locations relative to a maximum-width tab.

NOTE 5: 1.5 minimum (TO-5) for 40080, 40081; 0.5 minimum (TO-39) for 40082.

DIMENSIONAL OUTLINE FOR TYPE 40446 JEDEC TO-39 + FLANGE



(Bottom View)

DIMENSIONS IN INCHES

NOTE: The specified lead diameter applies in the zone from case to 0.15 from the seating plane. Between 0.15 and 1.40 a maximum of 0.021 diameter is held. The lead diameter is not controlled beyond 1.40.

TERMINAL CONNECTIONS FOR ALL TYPES

Lead No.1 — Emitter

Lead No.2 — Base

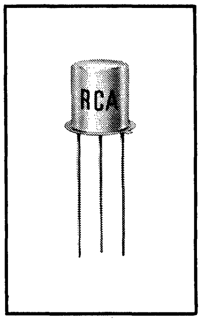
Case, Lead No.3 — Collector

SILICON N-P-N PLANAR TRANSISTOR

40084

RCA-40084 is a general-purpose planar transistor of the silicon n-p-n type intended for a wide variety of small-signal and medium power applications in industrial equipment. It features low noise and leakage characteristics, high switching speed (non-saturating mode), high pulse beta, and very low output capacitance.

For Small-Signal and Medium-Power Applications



JEDEC TO-18

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	60 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE:		
With base open, V_{CEO}	40 max.	volts
With $R_{BE} \leq 10$ ohms, V_{CER}	50 max.	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5 max.	volts
COLLECTOR CURRENT, I_C	1 max.	amp
TRANSISTOR DISSIPATION, P_T:		
At case temperatures up to 25° C.	1.8 max.	watts
At case temperatures above 25° C.	See *Rating Chart*	
At free-air temperatures up to 25° C.	0.5 max.	watt
At free-air temperatures above 25° C.	See *Rating Chart*	
TEMPERATURE RANGE:		
Storage	-65 to +200	°C
Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances $\geq$ 1/32 inch from seating surface for 10 sec. max.	225 max.	°C

- minimum gain-bandwidth product = 100 Mc, useful in applications from dc to 20 Mc
- operation at high junction temperatures—up to 200°C
- low noise and low leakage characteristics
- high switching speed (non-saturating mode)—30 nanoseconds maximum
- very low output capacitance—15 pf maximum

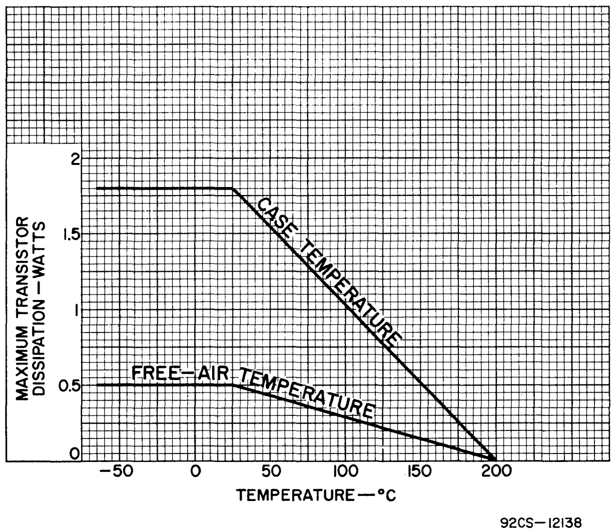


Fig. 1 - Rating Chart for RCA-40084.

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ELECTRICAL CHARACTERISTICS

At Case Temperature (T_C) of 25° C

Characteristic	Symbol	TEST CONDITIONS						LIMITS		Units
		DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter-to-Base Voltage V_{EB}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	RCA 40084		
		volts	volts	volts	ma	ma	ma	Min.	Max.	
Collector-Cutoff Current	I_{CBO}	30				0		-	0.25	μa
Emitter-Cutoff Current	I_{EBO}			4	0			-	0.25	μa
DC Forward-Current Transfer Ratio	h_{FE}		10		150**			50	250	
Collector-to-Base Breakdown Voltage	BV_{CBO}				0.1			60	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}					0.1		5	-	volts
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$				100**			40	-	volts
Collector-to-Emitter Sustaining Voltage with External Base-to-Emitter Resistance (R_{BE}) = 10 ohms	$V_{CER}(sus)$				100**			50	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				150**		15	-	1.4	volts
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				150**		15	-	1.7	volts
Small-Signal Forward-Current Transfer Ratio: At frequency of 20 Mc	h_{fe}		10		50			5	-	
Noise Figure: Generator resistance (R_G) = 500 ohms, circuit bandwidth (BW) = 15 Kc, input frequency (f) = 1 Kc	NF		10		0.3			-	8	db
Output Capacitance	C_{ob}	10				0		-	15	pf
Input Capacitance	C_{ib}			0.5	0			-	80	pf
Thermal Resistance: Junction-to-case Junction-to-free air	θ_{J-C} θ_{J-FA}							- -	97 350	°C/W °C/W

** Pulse Test: Pulse duration, 300 μsec; duty factor, 1.8%.

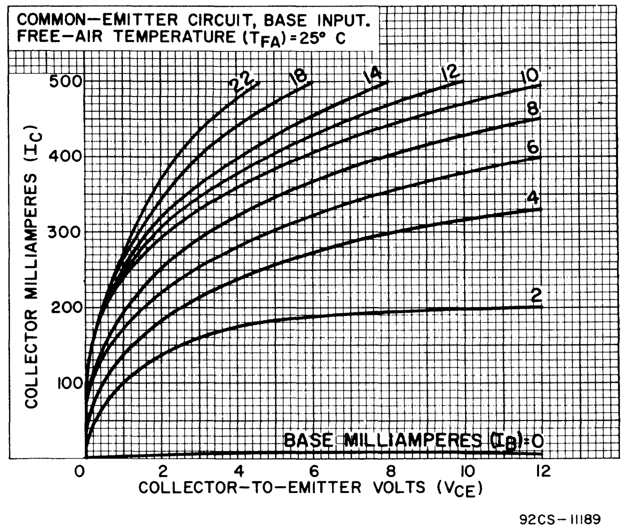


Fig. 2 - Typical Collector Characteristics at 25° C for RCA-40084.

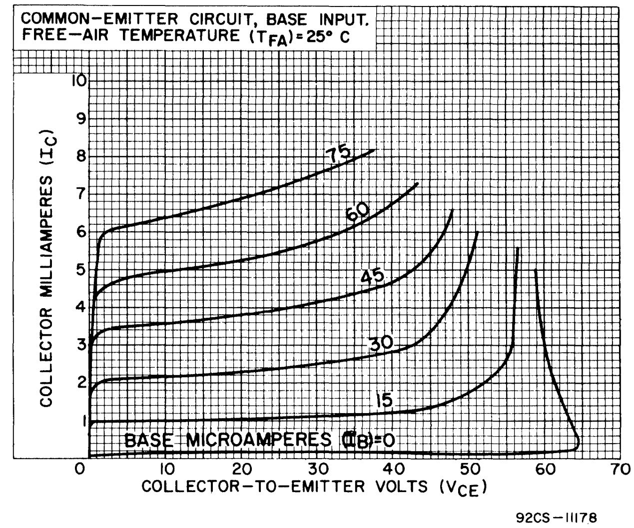


Fig. 3 - Typical Collector Characteristics at 25° C for RCA-40084.

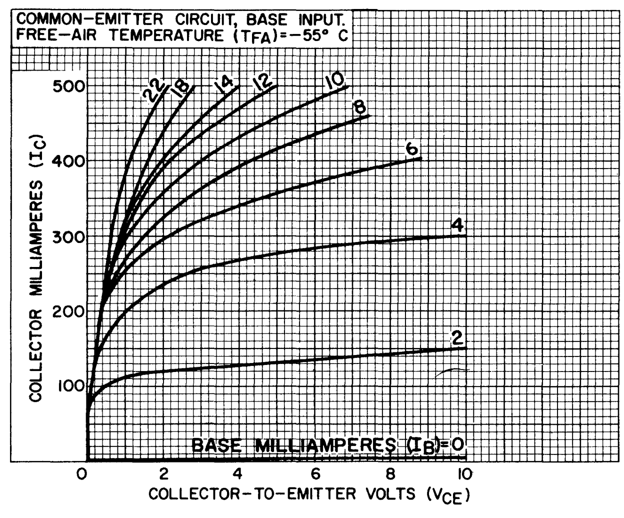


Fig. 4 - Typical Collector Characteristics at -55° C for RCA-40084.

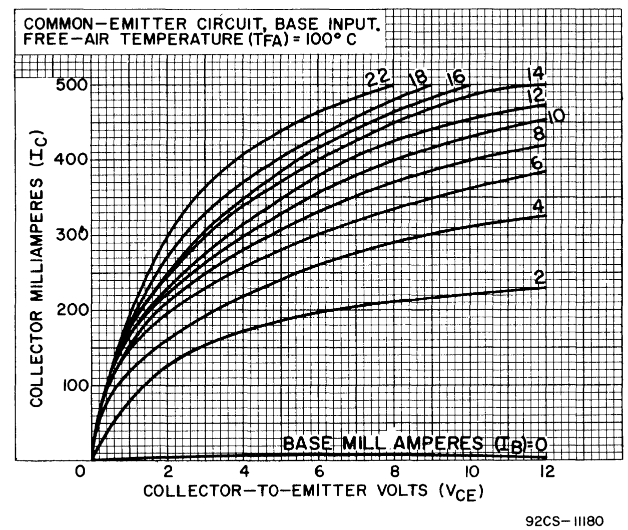


Fig. 5 - Typical Collector Characteristics at 100° C for RCA-40084.

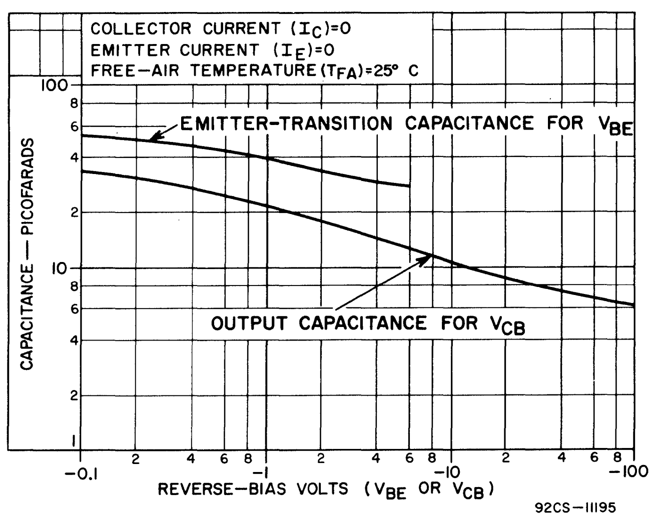
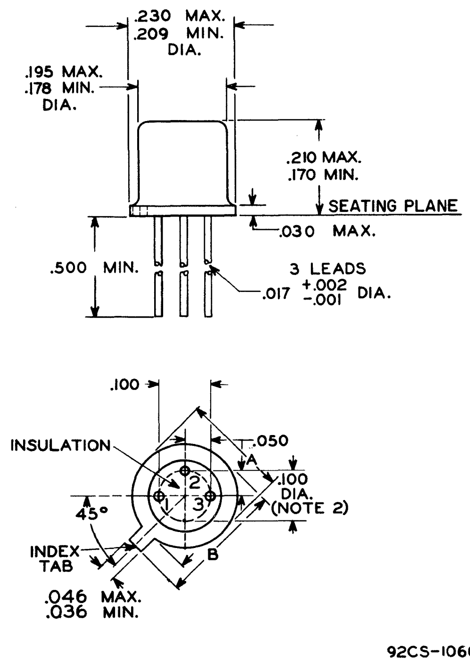


Fig. 6 - Typical Emitter-Transition-Capacitance and Output-Capacitance Characteristics for RCA-40084.

DIMENSIONAL OUTLINE

JEDEC NO. TO-18



NOTE: Tab length to be 0.028" min., 0.048" max. and will be determined by subtracting diameter "A" from dimension "B".

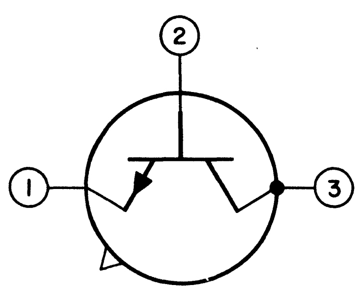
DIMENSIONS IN INCHES

TERMINAL DIAGRAM

Bottom View

LEAD 2 – BASE

LEAD 1 – EMITTER



LEAD 3 – COLLECTOR, CASE

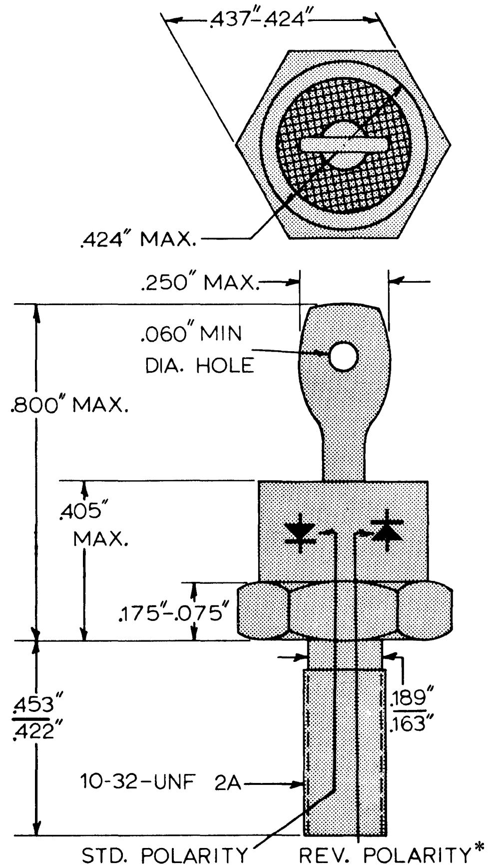
10-AMPERE SILICON RECTIFIERS

40108-40115

Stud-Mounted

Types for Industrial

Power Supplies



* For reverse polarity versions, use the suffix--"R" after number.

DESCRIPTION

These RCA diffused junction silicon rectifiers are for use in industrial applications; the process and the construction provide exceptional uniformity and stability of characteristics. The closure is welded.

NOTE: Mounting nut, and lock-washer included with each unit. Insulating hardware and lug can be supplied if requested.

HALF-WAVE RECTIFIER SERVICE

60 cp/s supply, Single phase operation; with Resistive or Inductive Load.

	40108	40109	40110	40111	40112	40113	40114	40115	UNITS
Peak Reverse Volts - PRV	50	100	200	300	400	500	600	800	volts
DC Blocking - Volts	50	100	200	300	400	500	600	800	volts
Aver. Fwd. Current 150°T_C – I_F	← 10 →								amps.
Peak Recurrent Current	← 40 →								amps.
Peak Surge Current @ 150°C T_C	← 140 →								amps.

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HALF-WAVE RECTIFIER SERVICE, CONTINUED

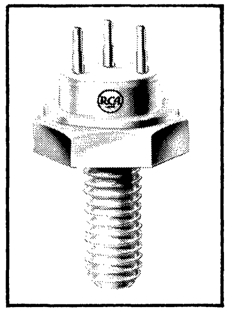
	40108	40109	40110	40111	40112	40113	40114	40115	UNITS
Max. Reverse Current									
Static @ ma 25°C T_C	← .075 →								ma
Dynamic @ ma 150°C T_C	2.0	2.0	1.5	1.5	1.0	.85	.75	.65	ma
Max. Voltage Drop Avg.	← .60 →								volt
Max. Operating Temperature	← 175 →								°C

SILICON N-P-N "overlay" TRANSISTOR 40279

The RCA-40279 is the ultra-high reliability version of the RCA-2N3375 epitaxial silicon N-P-N planar transistor intended for class-A, -B, or -C amplifier, frequency multiplier, or oscillator operation. This device is subjected to special preconditioning tests for selection in ultra-high-reliability, large-signal, high-power, VHF-UHF applications in Space, Military, and Industrial communications equipment.

- **Ultra–High Reliability**
- **Complete Qualification Testing**

High-Power VHF-UHF Amplifier



JEDEC TO–60

RF SERVICE, Maximum Ratings (Absolute-Maximum Values)

Collector-To-Base Voltage, V_{CBO}	65	volts
Collector-To-Emitter Voltage:		
With base open, V_{CEO}	40	volts
With V_{BE} =-1.5 volts, V_{CEV}	65	volts
Emitter-To-Base Voltage, V_{EBO}	4	volts
Collector Current, I_C	1.5	amps.

Transistor Dissipation, P_T:		
At T_C up to 25°C	11.6	watts
At T_C above 25°C	Derate linearly to 0 watts at 200°C	
Temperature Range:		
Storage	-65 to 200	°C
Operating (Junction)	-65 to 200	°C
Lead Temperature (During soldering):		
At distances 1/32" from insulating wafer for 10 sec. max.	230	°C

ELECTRICAL CHARACTERISTICS – Case Temp. = 25°C (Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC COLLECTOR VOLTS		DC BASE VOLTS	DC CURRENT (MILLIAMPERES)			LIMITS		UNITS
		V_{CB}	V_{CE}	V_{BE}	I_E	I_B	I_C	Min.	Max.	
Collector-Cutoff Current	I_{CEO}	–	30	–	–	0	–	–	0.1	μa
Collector To-Base Breakdown Voltage	BV_{CBO}	–	–	–	0	–	0.1	65	–	Volts
Collector-To-Emitter Breakdown Voltage	BV_{CEO}	–	–	–	–	0	0 to 200*	40**	–	Volts
Collector-To-Emitter Breakdown Voltage	BV_{CEV}	–	–	–1.5	–	–	0 to 200*	65**	–	Volts
Emitter-To-Base Breakdown Voltage	BV_{EBO}	–	–	–	0.1	–	0	4	–	Volts
Collector-To-Emitter Saturation Voltage	$V_{CE}(sat)$	–	–	–	–	100	0.5 amp	–	1	Volt
Output Capacitance	C_{ob}	30	–	–	0	–	–	–	10	pf
RF Power Output Amplifier, Unneutralized										
At 100 Mc (See Fig. 1)	P_{OUT}	–	28	–	–	–	–	7.5●	–	Watts
At 400 Mc (See Fig. 2)	P_{OUT}	–	28	–	–	–	–	3▲	–	Watts
Forward Current Transfer Ratio	h_{FE}	–	5	–	–	–	150	10	–	–

* Pulsed through an inductor (25 mh); duty factor = 50%

** Measured at a current where the breakdown voltage is a minimum.

● For P_{IN} = 1.0 w; minimum efficiency = 65%

▲ For P_{IN} = 1.0 w; minimum efficiency = 40%

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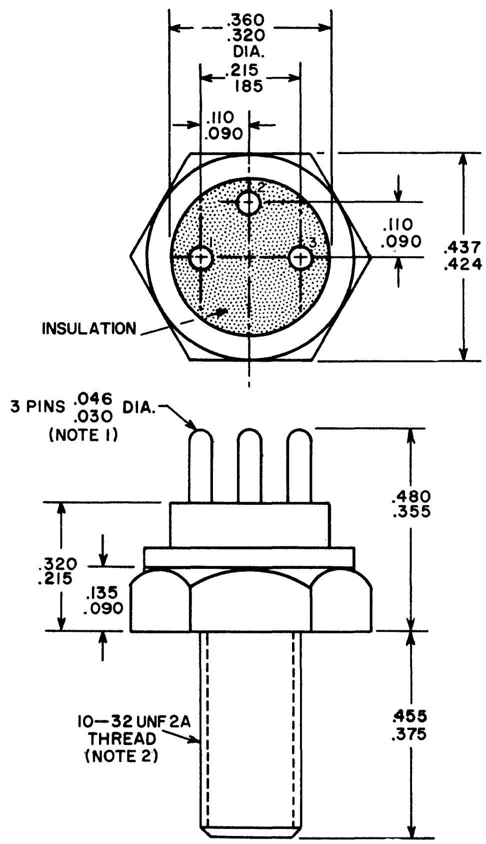
TO-60 DIMENSIONAL OUTLINE

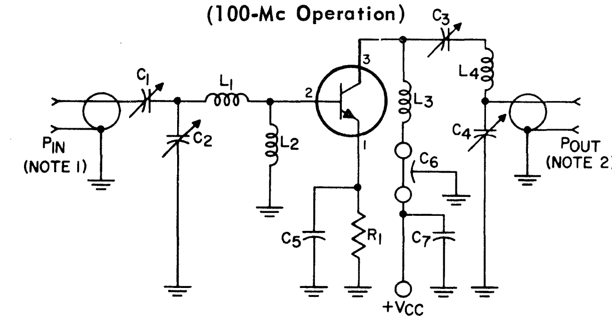


92CS–12045R5

FIGURE 1

RF AMPLIFIER CIRCUIT FOR 40279 POWER-OUTPUT TEST

(100-Mc Operation)



NOTE 1: GENERATOR IMPEDANCE = 50 OHMS.
NOTE 2: LOAD IMPEDANCE = 50 OHMS.

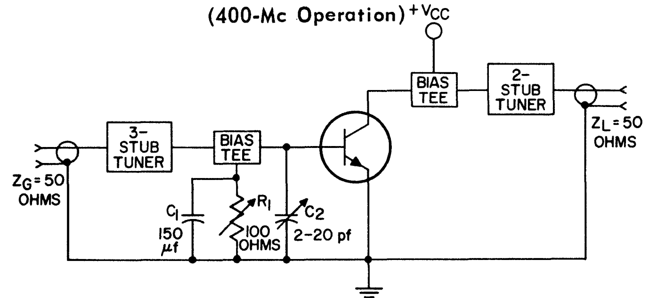
FOR 100-MC OPERATION

C_1, C_2: 7-100 PF
C_3, C_4: 4-40 PF
C_5: 330 PF, DISC CERAMIC
C_6: 1500 PF
C_7: 0.005 μF, DISC CERAMIC
L_1: 3 TURNS NO. 16 WIRE, 1/4" ID, 5/16" LONG
L_2: FERRITE CHOKE, Z = 750 (±20%) OHMS
L_3: 2.4-μH CHOKE
L_4: 5 TURNS NO. 16 WIRE, 5/16" ID, 7/16" LONG
R_1: 1.35 OHMS, NON-INDUCTIVE

FIGURE 2

RF AMPLIFIER CIRCUIT FOR 40279 POWER-OUTPUT TEST

(400-Mc Operation)



RELIABILITY TESTING

Electrically, the RCA-40279 is similar to the RCA-2N3375; the exception being the 40279 I_{CEO} is 100 nanoamperes maximum. In addition to Preconditioning and Group A tests, a Qualification Approval test series (Group B Tests) is performed on a semi-annual basis. All units are tested to assure freedom from second breakdown in Class-A applications.

Preconditioning (100 Per Cent Testing of Each Transistor)

1. Serialization
2. Record I_{CEO}, h_{FE}, V_{CE}(sat)
3. Temperature Cycling-Method 102A of MIL-STD-202, 5 cycles, -65°C +200°C
4. Bake, 72 hours minimum, +200°C
5. Constant Acceleration-Method 2006 of MIL-STD-750, 10, 000G, Y_1 and Y_2 axes
6. Record I_{CEO}, h_{FE}, V_{CE}(sat)
7. Reverse Bias Age, T_A = 150°C, V_{CB} = 28 V, t = 168 hours

*8. Record I_{CEO}, h_{FE}, V_{CE}(sat)

9. Power Age, T_A = 25°C, V_{CB} = 28 V, t = 500 hours, P_D = 2.6 W, free air

*10. Record I_{CEO}, h_{FE}, V_{CE}(sat) at 168 hours and 500 hours

11. Helium Leak, 1 x 10^{-8} cc/sec. max.
12. Methanol Bomb, 70 psig, 18 to 24 hours
13. X-Ray, RCA spec. 1750326
14. Record Subgroups 2 and 3 of Group A Tests

*

Delta criteria after 168 hours Reverse Bias Age and after 168 hours and 500 hour Power Age

ΔI_{CEO}	+100% or +10 nanoamperes whichever is greater
Δh_{FE}	±30%
ΔV_{CE}(sat)	±0.1 V

Group A Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
	Subgroup 1		10				
2071	Visual and Mechanical Examination	–	–	–	–	–	–
	Subgroup 2		5				
3036D	Collector-To-Emitter Cutoff Current	V_{CE} = 30 V, I_B = 0	–	I_{CEO}	–	100	namps
3001D	Collector-To-Base Breakdown Voltage	I_C = 100 μa, I_E = 0	–	BV_{CBO}	65	–	Volts
3026D	Emitter-To-Base Breakdown Voltage	I_E = 100 μa, I_C = 0	–	BV_{EBO}	4	–	Volts
3011D	Collector-To-Emitter Breakdown Voltage	I_C = 0 to 200 ma (Inductive) I_B = 0	–	BV_{CEO}	40	–	Volts
3011A	Collector-To-Emitter Breakdown Voltage	I_C = 0 to 200 ma (inductive) V_{BE} = -1.5 V	–	BV_{CEV}	65	–	Volts
3071	Collector-To-Emitter Saturation Voltage	I_C = 500 ma, I_B = 100 ma	–	V_{CE}(sat)	–	1	Volt
3076	Forward Current Transfer Ratio	I_C = 150 ma V_{CE} = 5 V	–	h_{FE}	10	–	
	Subgroup 3		5				
3236	Output Capacitance	f = 140 Kc, V_{CB} = 30 V, I_E = 0	–	C_{ob}	–	10	pf
See Fig. 1	R.F. Power Output (Min. Eff. = 65%)	V_{CE} = 28 V P_i = 1 W, f = 100 mc	–	P_{OUT}	7.5	–	Watts
See Fig. 2	R.F. Power Output (Min. Eff. = 40%)	V_{CE} = 28 V, P_i = 1 W, f = 400 mc	–	P_{OUT}	3	–	Watts
	Subgroup 4		15				
3036D	Collector Cutoff Current	T_A = 150°C ± 3°C, V_{CB} = 30 V, I_E = 0	–	I_{CBO}	–	100	μamp
3076	Forward Current Transfer Ratio	T_A = 150°C ± 3°C, I_C = 150 ma, V_{CE} = 5 V	–	h_{FE}	–	200	–

Group B Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD*	SYMBOL	LIMITS MIN.	LIMITS MAX.	UNITS
	Subgroup 1 (10 samples)	–	7	–	–	–	–
2066	Physical Dimensions	TO-60	–	–	–	–	–
202/102A	Temperature Cycle	5~, -65°C, 200°C	–	–	–	–	–
1056B	Thermal Shock	0°C, 100°C	–	–	–	–	–
1021	Moisture Resistance	Omit lead fatigue	–	–	–	–	–
2036D	Torque-To-Stud	1 minute, 12 inch pounds	–	–	–	–	–
	Subgroup 2 (10 samples)		7				
2016	Impact Shock	500G, 5 blows X_1, Y_1, Z_1, 1 msec.	–	–	–	–	–
2046	Vibration Fatigue	–	–	–	–	–	–
2056	Vibration Var. Freq.	–	–	–	–	–	–
	Subgroup 3 (10 samples)		7				
2026	Solderability	–	–	–	–	–	–
1066	Dew Point	25°C, -65°C read I_{CEO}	–	–	–	–	–
1001	Barometric Pressure	100,000 ft. read I_{CEO}	–	–	–	–	–
	Subgroup 4 (25 samples)		7				
1031	Storage Life	200°C, 1000 hr	–	–	–	–	–
2006	Constant Acceleration	20,000G, Y_1, Y_2	–	–	–	–	–
	Subgroup 5 (25 samples)		7				
1026	Operating Life	1000 hrs T_C = 140°C, V_{CB} = 28 V, P_D = 4 W	–	–	–	–	–
	End Points Subgroups 1, 2, 3, 4, 5						
3036D	Collector-Cutoff Current	V_{CE} = 30, I_B = 0	–	I_{CEO}	–	1	μamp
3011A	Collector-To-Emitter Breakdown Voltage	I_C = 0 to 200 ma (inductive) V_{BE} = –1.5 V	–	BV_{CEV}	60	–	Volts
	R.F. Power Output (See Fig. 1)	f = 100 mc, V_{CE} = 28 V, P_i = 1 W	–	P_{OUT}	6.5	–	Watts
3076	Forward Current Transfer Ratio	I_C = 150 ma, V_{CE} = 5 V	–	h_{FE}	9	–	–
3026D	Emitter-To-Base Breakdown Voltage	I_E = 100 μa, I_C = 0	–	BV_{EBO}	3.5	–	Volts

* Acceptance/Rejection Criteria of Group B tests: For an LTPD plan of 7% the total sample size is 80 for which the maximum number of rejects allowed is 2. Acceptance is also subject to a maximum of one (1) reject per Subgroup.

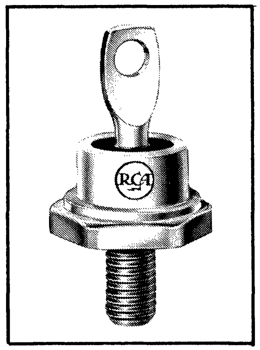
Group B tests are performed once every six months as part of Qualification Approval.

18-AMPERE SILICON RECTIFIERS

40208–40214

These RCA silicon rectifiers are designed for a wide variety of uses in heavy-duty power supplies. In industrial applications, they are well suited for use in battery chargers, ac-to-dc converters, welding equipment, power supplies for dc motors, and in generator-type power supplies for portable equipment.

Stud-Mounted Types for Industrial Power Supplies



JEDEC DO–5

FEATURES:

- Hermetic seals
- Low thermal resistance
- Low forward voltage drop
- High output current:
  up to 48 amperes – 6 rectifiers in 3-phase, full-wave bridge circuit
  up to 36 amperes – 4 rectifiers in single-phase, full-wave bridge circuit
- Welded construction
- Low leakage current
- JEDEC DO-5 outline
- Available in reverse-polarity versions: 40208R, 40209R, 40210R, 40211R, 40212R, 40213R, 40214R
- Diffused-junction process – exceptional uniformity and stability of characteristics

HALF-WAVE RECTIFIER SERVICE

Absolute-Maximum Ratings *for Supply Frequency of 60 Hz, Single-Phase Operation, and with Resistive or Inductive Load*

	40208	40209	40210	40211	40212	40213	40214
Peak reverse volts	50	100	200	300	400	500	600
DC blocking volts	50	100	200	300	400	500	600
Average forward amperes: At 150° C case temperature	18	18	18	18	18	18	18
Peak recurrent amperes	72	72	72	72	72	72	72
Peak surge amperes:[a] One-half cycle sine wave and case temperature = 150° C	250	250	250	250	250	250	250
Maximum operating temperature (°C)	175	175	175	175	175	175	175

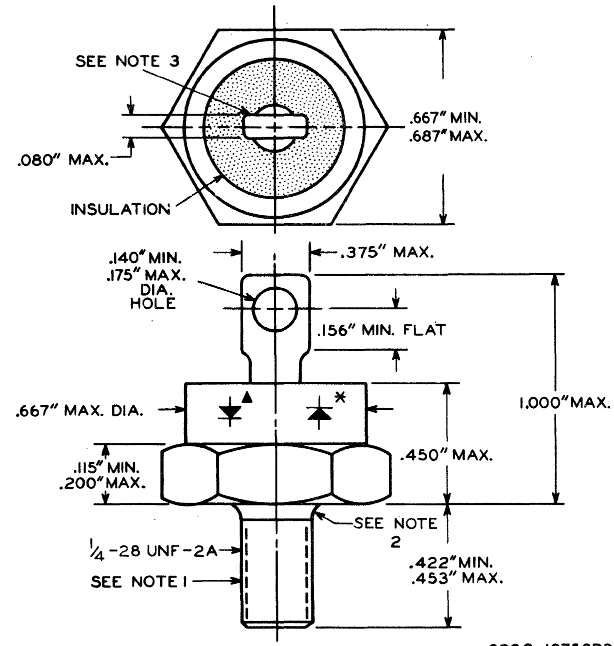
Characteristics							
Maximum forward voltage drop[b] (volts)	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Maximum reverse current (mA):							
Static[c]	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Dynamic[b]	3.0	3.0	2.5	2.5	2.0	1.75	1.5

[a] Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

[b] Average value for one complete cycle at case temperature of 150° C and at maximum rated voltage and average forward current.

[c] DC value, at maximum peak reverse voltage, and case temperature (°C) = 25.

DIMENSIONAL OUTLINE
JEDEC DO-5



Mounting nut and lock-washer included with each unit. Insulating hardware and lug can be supplied if requested.

▲Polarity symbol for types 40208, 40209, 40210, 40211, 40212, 40213, and 40214.

*Polarity symbol for types 40208R, 40209R, 40210R, 40211R, 40212R, 40213R, and 40214R.

Note 1: Must withstand torque of 30 inch-pounds applied to ¼-28 UNF-2B nut assembled on stud thread.

Note 2: Diameter of unthreaded portion: 0.249" maximum, 0.220" minimum.

Note 3: Angular orientation of this terminal undefined.

SILICON CONTROLLED-RECTIFIER

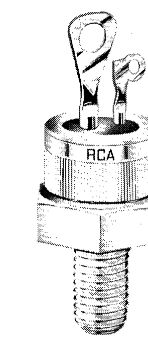
40216

File No. 247

RCA-40216 is an all-diffused, three-junction silicon controlled-rectifier (SCR▲) designed especially for use in radar pulse modulators, inverters, switching regulators, and other applications requiring a large ratio of peak to average current.

It is especially constructed for rapid spread of forward current over the full junction area to achieve a high rate of change of forward current (di/dt) capability and low switching dissipation.

All-Diffused SCR for High-Current Pulse Applications



H-1512

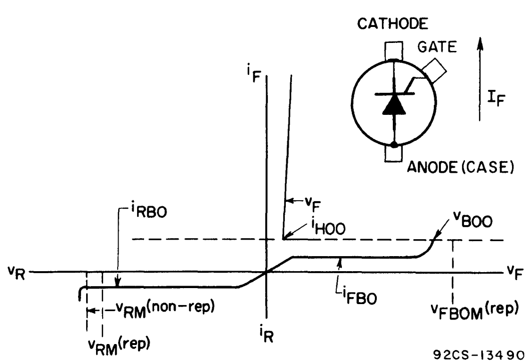
JEDEC TO-48

▲The silicon controlled-rectifier is also known as a reverse-blocking triode thyristor.

FEATURES

- Up to 900 Amperes Peak Forward Current Pulses
- 30 Watts Maximum Average Dissipation
- Forward Current of 35 Amperes (rms value)
- Shorted-Emitter Design
- All-Diffused Construction – Assures Exceptional Uniformity and Stability
- Direct Soldered Internal Construction – Assures Exceptional Resistance to Fatigue

TYPICAL E-I CHARACTERISTIC OF SILICON CONTROLLED-RECTIFIER



Absolute-Maximum Ratings

RATINGS	CONTROLLED-RECTIFIER TYPE 40216	UNITS
Transient Peak Reverse Voltage (Non-Repetitive), v_{RM} (non-rep)[a]	720	volts
Peak Reverse Voltage (Repetitive), v_{RM} (rep)[b]	600	volts
Peak Forward Blocking Voltage (Repetitive), v_{FBOM} (rep)[c]	600	volts
Forward Current:		
For case temperature of +65°C, RMS value, I_{FRMS}[d]	35	amperes
Peak Pulse Current (See *Fig.7*)	900	amperes
Rate of Change of Forward Current, di/dt[e]	See *Fig.7*	
Dynamic Dissipation:		
For case temperature of +65° C	30	watts
For other case temperatures	See *Fig.4*	
Gate Power*:		
Peak, Forward or Reverse, for 10 µs duration, P_{GM}[f] (See *Figs.10 and 11*)	40	watts
Average, P_{GAV}[g]	0.5	watt
Temperature:		
Storage, T_{stg}	−65 to +150	°C
Operating (Case), T_C	−65 to +125	°C

*Any values of peak gate current or peak gate voltage to give the maximum gate power is permissible.

WAVESHAPE OF CRITICAL dv/dt RATING TEST

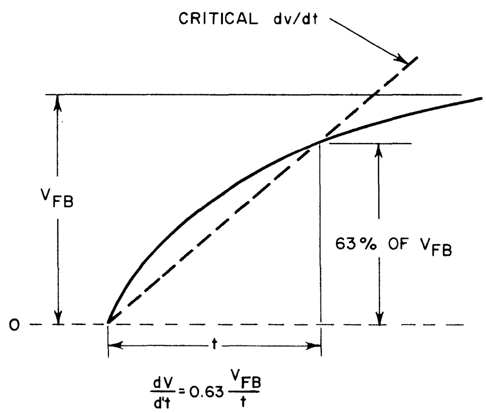


Fig. 1

WAVESHAPE OF t_{on} RATING TEST

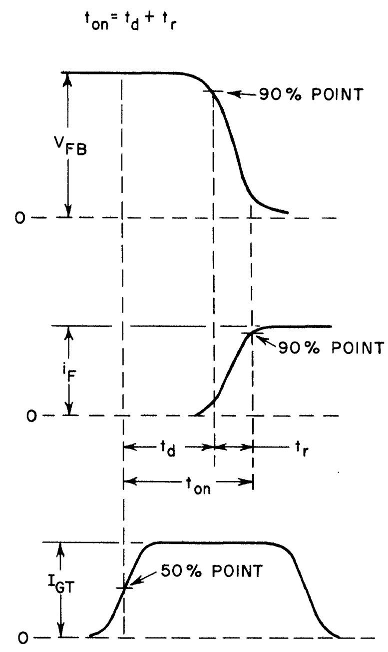


Fig. 2

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

CHARACTERISTICS	CONTROLLED-RECTIFIER TYPE 40216			UNITS
	Min.	Typ.	Max.	
Forward Breakover Voltage, v_{BOO}[h] At T_C = +125° C	600	–	–	volts
Instantaneous Blocking Current, At T_C = +125° C Forward, i_{FBO}[i]	–	–	10	mA
Reverse, i_{RBO}[k]	–	–	10	mA
Forward Voltage Drop, v_F[m]		See *Fig.5*		
DC Gate-Trigger Current, I_{GT}[n]: At T_C = +25° C (See *Fig.10*)	1	25	80	mA(dc)
DC Gate-Trigger Voltage, V_{GT}[p]: At T_C = +25° C (See *Fig.10*)	–	1.1	2	volts(dc)
Holding Current, i_{HOO}[q]: At T_C = +25° C	0.5	20	70	mA
Critical Rate of Applied Forward Voltage, Critical dv/dt[r] V_{FB} = v_{BOO} (min. value), exponential rise, and T_C = +125° C (See waveshape of *Fig.1*)	20	50	–	volts/ microsecond
Turn-On Time, t_{on}[s], (Delay Time + Rise Time) V_{FB} = v_{BOO} (min. value), i_F = 30 A, I_{GT} = 200 mA, 0.1 μs min. rise time, and T_C = +25° C (See waveshapes of *Fig.2*)	–	1.25	–	microsecond
Turn-Off Time, t_{off}[t], (Reverse Recovery Time + Gate Recovery Time) i_F = 18 A, 50 μs pulse width, dv_{FB}/dt = 20 V/μs, di_r/dt = 30 A/μs, I_{GT} = 200 mA, and T_C = +80° C (See waveshapes of *Fig.3*)	15	20	40	microseconds
Thermal Resistance, Junction-to-Case	–	–	2	°C/W

WAVESHAPE OF t_{off} RATING TEST

$t_{off} = t_{rr} + t_{gr}$

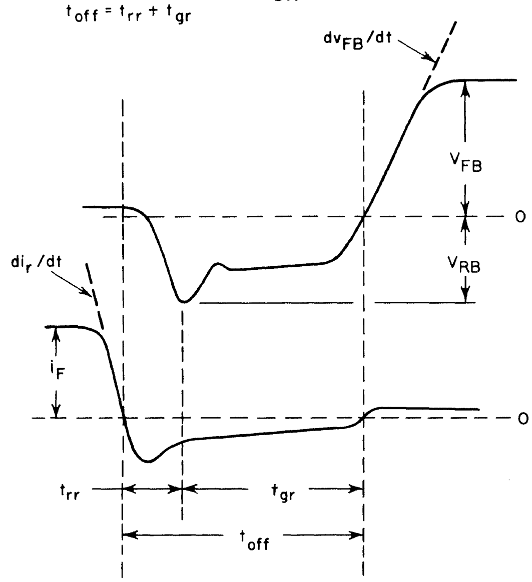


Fig. 3

MAXIMUM AVERAGE TOTAL POWER DISSIPATION AS A FUNCTION OF CASE TEMPERATURE

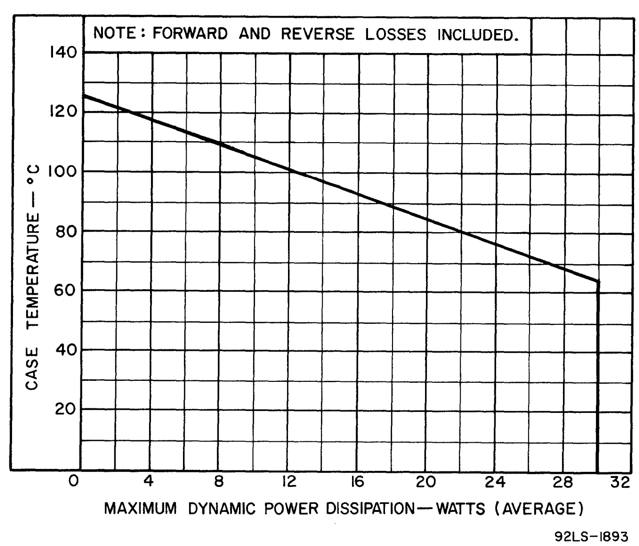


Fig. 4

FORWARD VOLTAGE-CURRENT CHARACTERISTICS AS A FUNCTION OF TIME

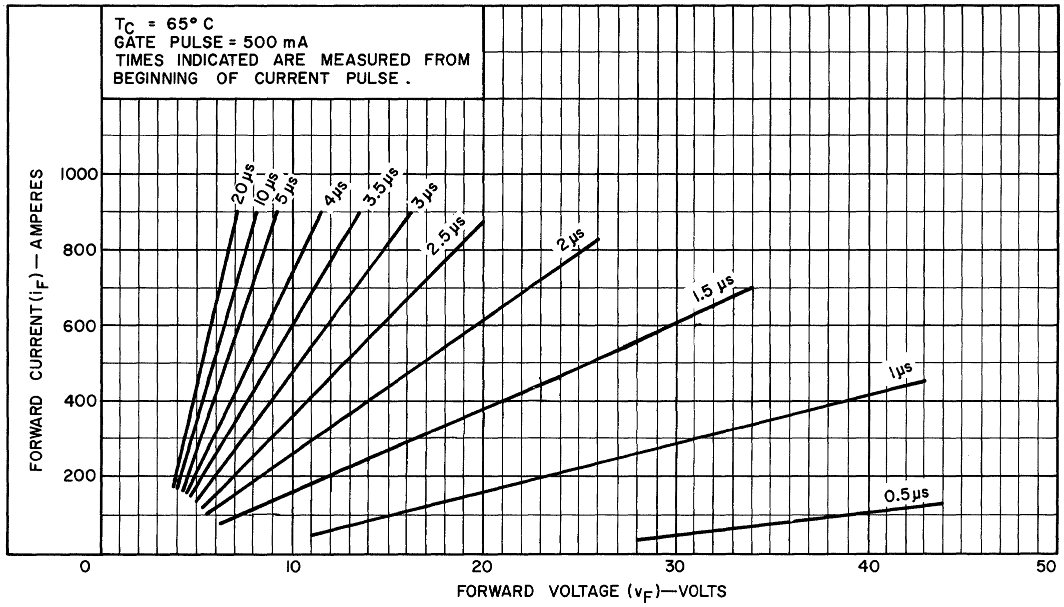


Fig. 5

INSTANTANEOUS FORWARD DISSIPATION-FORWARD CURRENT CHARACTERISTICS AS A FUNCTION OF TIME

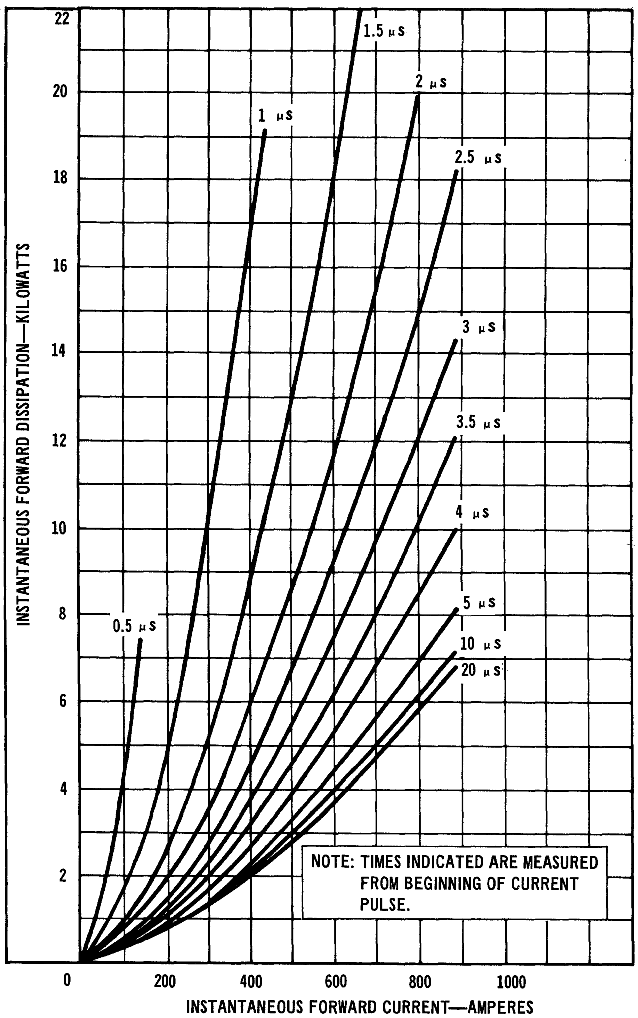


Fig. 6

MAXIMUM CURRENT AS A FUNCTION OF TIME

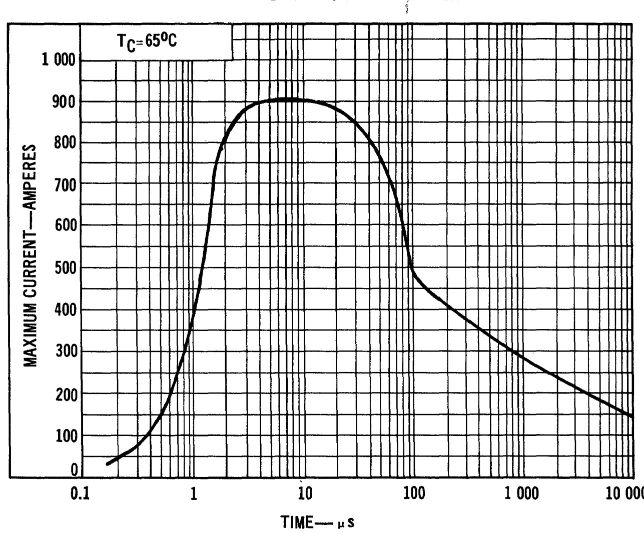


Fig. 7

PEAK CURRENT AS A FUNCTION OF MAXIMUM REPETITION RATE FOR SINE-WAVE PULSE SHAPES

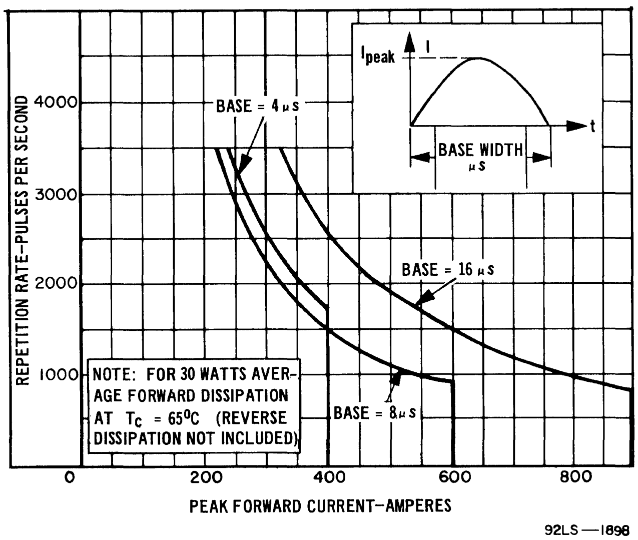


Fig. 8

PEAK CURRENT AS A FUNCTION OF MAXIMUM REPETITION RATE FOR SQUARE-WAVE PULSE SHAPES

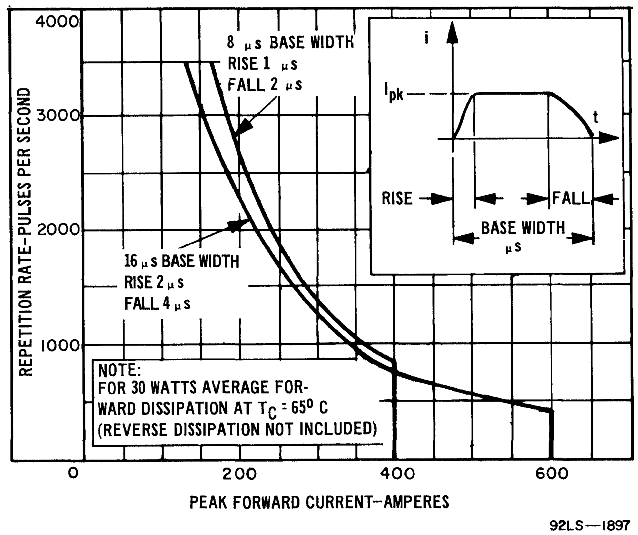


Fig. 9

FORWARD GATE CHARACTERISTICS

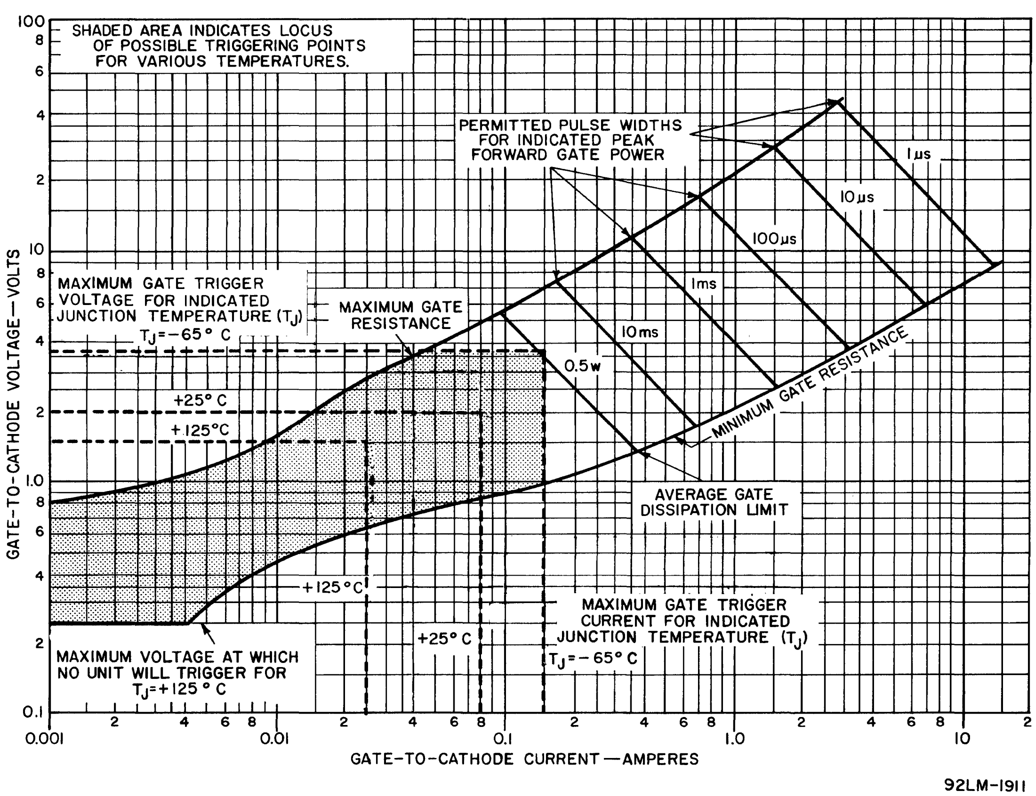


Fig. 10

TRIGGERING CONSIDERATIONS

The construction of the gate-cathode junction used in this device provides a large periphery center gate and employs shorted-emitter design which removes restrictions on both forward and reverse peak gate voltage and peak gate current. Limiting values of volt-ampere products for different gate pulse widths are shown in *Fig.10.* These limits should be adhered to when designing pulse trigger circuits for maximum trigger pulse widths and peak power dissipation. The volt-ampere products in the reverse direction shown in *Fig.11* should be used to determine limitations for reverse gate transients or reverse gate pulses if present. In all cases, total average gate dissipation, both forward and reverse, should not exceed the average gate dissipation rating (P_{GAV}) of 0.5 watt.

Turn-on times for different gate currents are shown in *Fig.12.* These curves may be used to determine the required width of the gate trigger pulses. It is only necessary to maintain the gate trigger pulse until the magnitude of the forward anode current has reached the latching current value. However, conservative design requires that the gate trigger pulse width be at least equal to or somewhat greater than the device turn-on time. Some applications may require wider gate pulse widths for proper circuit operation. Additional information on gate characteristics and triggering requirements for use in pulse applications are contained in RCA Application Note, SMA-39, "Gate Parameters of RCA SCR's for Trigger Circuit Design".

REVERSE GATE CHARACTERISTICS

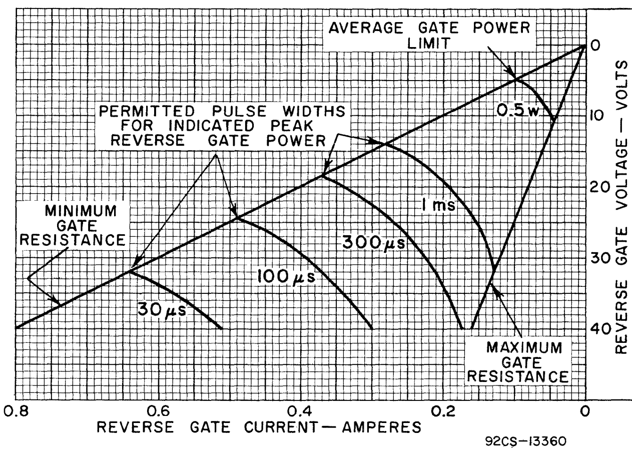


Fig. 11

TURN-ON TIME CHARACTERISTICS

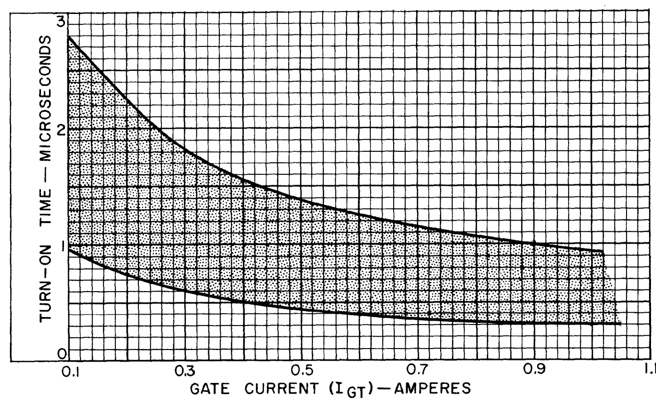
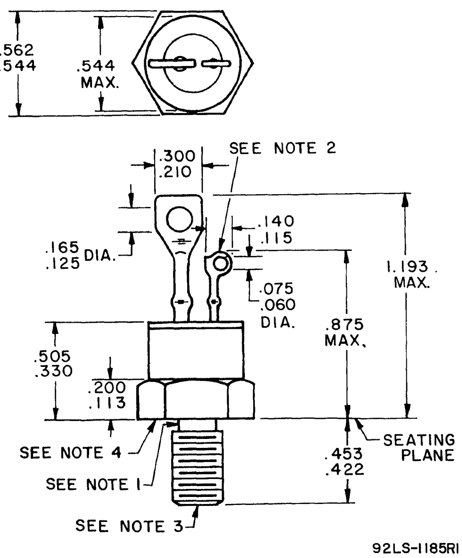


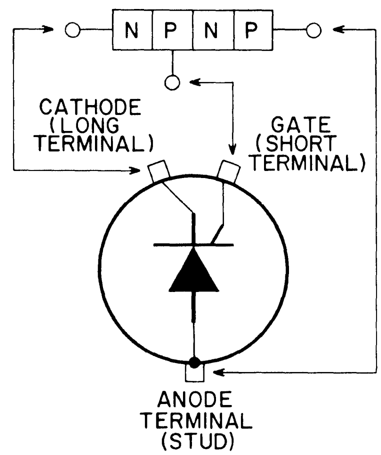
Fig. 12

DIMENSIONAL OUTLINE
JEDEC TO-48



DIMENSIONS IN INCHES

TERMINAL DIAGRAM

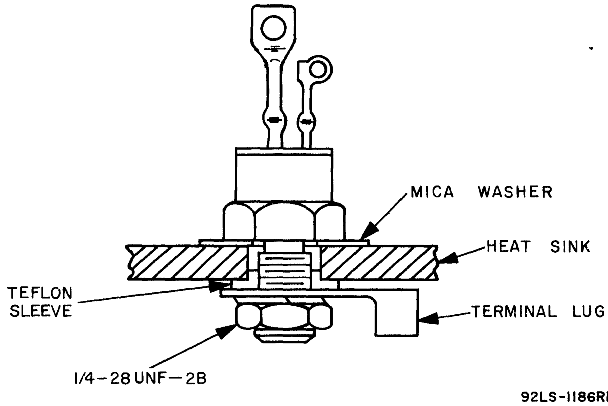


Note 1: Complete threads to extend to within 2-1/2 threads of head. Dia. of unthreaded portion 0.249" maximum, 0.220" minimum.

Note 2: Angular orientation of these terminals is undefined. Square or radius on end of terminal is optional.

Note 3: 1/4-28 UNF-2A. Maximum pitch dia. of plated threads shall be basic pitch dia. 0.2268", minimum pitch dia. 0.2225". Ref. (Screw Thread Standards for Federal Services 1957) Handbook H28 1957 P1.

Note 4: A chamfer (or undercut) on one or both ends of hexagonal portion is optional.



Suggested Mounting Arrangement for Insulating Type 40216 from Heat Sink. Components Shown (Except Heat Sink) are Furnished with Each Device.

CONTROLLED-RECTIFIER TERMS, SYMBOLS, AND DEFINITIONS

a **Transient Peak Reverse Voltage (Non-repetitive)** – v_{RM} (non-rep) – The maximum value of negative (reverse-blocking) voltage which may be applied between the anode and cathode for not more than 5 milliseconds when the gate is open (gate voltage is zero or negative with respect to cathode).

b **Peak Reverse Voltage (Repetitive)** – v_{RM}(rep) – The maximum instantaneous value of negative (reverse-blocking) voltage which may be applied repetitively between the anode and cathode when the gate is open.

c **Peak Forward Blocking Voltage (Repetitive)** – v_{FBOM} (rep) – The maximum instantaneous value of positive (forward-blocking) voltage which may be applied repetitively between the anode and cathode when the gate is open.

d **RMS Forward Current** – I_{FRMS} – The RMS value of the current flowing from anode to cathode in the device.

e **Rate of Change of Forward Current** – di/dt – The maximum rate of change of current which may be imposed on the device immediately after turn on by the gate from a forward blocking condition.

f **Peak Forward and Reverse Gate Power** – P_{GM} – The maximum instantaneous power dissipated between gate and cathode for a specified time duration.

g **Average Forward Gate Power** – P_{GAV} – The average power dissipated between gate and cathode.

h **Forward Breakover Voltage** – v_{BOO} – The value of positive anode voltage at which a controlled rectifier may switch into the conducting state when the gate is open.

i **Instantaneous Forward Blocking Current** – i_{FBO} – The instantaneous value of the forward blocking current of a controlled rectifier with gate open.

k **Instantaneous Reverse Blocking Current** – i_{RBO} – The instantaneous value of the reverse blocking current of a controlled rectifier with gate open.

m **Forward Voltage Drop** – v_F – The instantaneous voltage drop across a controlled rectifier at a given instantaneous forward current i_F and under steady-state conditions.

n **Gate-Trigger Current** – I_{GT} – The gate current required to trigger a controlled rectifier operating at a specified temperature when the anode is at a potential of +6 volts with respect to the cathode.

p **Gate-Trigger Voltage** – V_{GT} – The gate-to-cathode voltage required to trigger a controlled rectifier operating at a specified temperature when the anode is at a potential of +6 volts with respect to the cathode.

q **Holding Current** – i_{HOO} – The instantaneous value of forward current i_F below which a controlled rectifier with its gate open returns to its forward blocking state.

r **Critical Rate of Applied Forward Voltage** – Critical dv/dt – The critical rate of applied forward voltage is the minimum value of the rate of applied forward voltage which will cause switching from the off-state to the on-state under stated conditions.

s **Turn-On Time** – t_{on} – Turn-on time is the time interval between the initiation of the gate signal and the time when the resulting forward current reaches 90 per cent of its maximum value during switching from the off-state to the on-state under stated conditions.

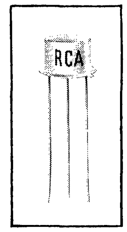
t **Turn-Off Time** – t_{off} – Turn-off time is the time interval between the time when the forward current decreases to zero and the time when the device anode voltage reaches zero and is rising to a stated value of forward blocking voltage at a stated rate of rise without turning on during switching in the external anode circuit from the on-state to the off-state under stated conditions.

RCA COMPUTER TRANSISTORS

40217 40218
40219 40220
40221 40222

SILICON N-P-N HIGH-SPEED TRANSISTORS

Planar Epitaxial Types For Switching Applications



JEDEC TO-52

RCA 40217, 40218, 40219, 40220, 40221 and 40222 are silicon n-p-n types which are electrically identical to the 2N706, 2N706A, 2N708, 2N834, 2N914 and 2N2205 respectively, but utilize the smaller JEDEC TO-52 case.

These devices are especially designed for use in switching and amplifier applications in military and industrial equipment.

Maximum Ratings, *Absolute-Maximum Values:*

Ratings	40217	40218	40219	40220	40221	40222	Units
Collector-to-Base Voltage, V_{CBO}	25	25	40	40	40	25	volts
Collector-to-Emitter Voltage, V_{CEO}	-	-	15	-	15	-	volts
Collector-to-Emitter Voltage, V_{CES} With R_{BE} = 0	-	-	-	30	-	-	volts
Collector-to-Emitter Voltage, V_{CER} With external $R_{BE} \leq$ 10 ohms between base and emitter	20	20	20	-	20	-	volts
Collector-to-Emitter Voltage, V_{CERL} With R_{BE} = 1000 ohms and R_L = 100 ohms	-	-	-	-	-	20	volts
Emitter-to-Base Voltage, V_{EBO}	3	5	5	5	5	3	volts
Collector Current, I_C	-	50	*	200	*	200	ma.
Transistor Dissipation, P_T:							
At case temperatures:							
up to 25° C	1	1	1.2	1	1.2	1	watts
above 25° C derate at	6.67	6.67	6.85	6.67	6.85	6.67	mw/°C
At free-air temperatures:							
up to 25° C	0.3	0.3	0.36	0.3	0.36	0.3	watts
above 25° C derate at	2.0	2.0	2.06	2.0	2.06	2.0	mw/°C
Temperature Range:							
Storage	-	-65 to 175	-65 to 200	-65 to 175	-65 to 200	-65 to 300	°C
Operating Junction Temperature	175	175	200	175	200	175	°C
Lead Temperature (during soldering) at distances not less than 1/16" from seating surface for 10 seconds max.	-	-	300	240	300	235	°C

* Limited by dissipation.

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Printed in U.S.A.
40217 through 40222 7-66
Supersedes issue dated 2-65

ELECTRICAL CHARACTERISTICS

Characteristics	Symbols	TEST CONDITIONS: Free-Air Temperature T_{FA} (°C)	Frequency f (Mc)	DC Collector-to-Base Voltage V_{CB} (volts)	DC Collector-to-Emitter Voltage V_{CE} (volts)	DC Emitter-to-Base Voltage V_{BE} (volts)	DC Emitter Current I_E (ma.)	DC Collector Current I_C (ma.)	DC Base Current I_B (ma.)
Collector-Cutoff Current With emitter open	I_{CBO}	25 150 25 150		15 15 20 20			0 0 0 0		
Collector Current With R_{BE} = 0	I_{CES}	25			30	0			
Collector Current With base forward biased	I_{CEV}	100 125		 20	10 	0.25 0.25			
Emitter-Cutoff Current	I_{EBO}	25				4		0	
Collector-to-Base Breakdown Voltage	BV_{CBO}	25 25 25					0 0 0	0.1 0.01 0.001	
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25 25					0.1 0.01	0 0	
Collector-to-Emitter Breakdown Voltage R_{BE} = 10 ohms	BV_{CER}	25						50	
Collector-to-Emitter Sustaining Voltage With external $R_{BE} \leq$ 10 ohms	$V_{CER}(sus)$	25						30 pulsed	
Collector-to-Emitter Sustaining Voltage With base open	$V_{CEO}(sus)$	25						30 pulsed	
Collector-to-Emitter Breakdown Voltage	BV_{CEO}	25						50	0
Collector-to-Emitter Latching Voltage With R_{BE} = 1000 ohms, R_L = 100 ohms	V_{CERL}	25							
Base-to-Emitter Saturation Voltage	$V_{BE}(Sat)$	25 -55to125						10 7	1 0.7
Collector-to-Emitter Saturation Voltage	$V_{CE}(Sat)$	25 25 25 -55to125						10 50 200 7	1 5 20 0.7
Collector-to-Base Capacitance With emitter open	C_{ob}	25 25	0.140 0.140	10 5			0 0		
Emitter-to-Base Capacitance With collector open	C_{ib}	25	0.140			-0.5			
Static Forward Current-Transfer Ratio	h_{FE}	25 25 25 -55			1 1 5 1			0.5 10 500 10	
Small-Signal Forward Current-Transfer Ratio	h_{fe}	25 25 25	100 100 100		10 10 15			10 20 10	
Turn-on Time	t_d+t_r	25 25		V_{CC} = 5 volts, I_{B1} = 40 ma., I_{B2} = -20 ma. V_{CC} = 3 volts, I_{B1} = 3 ma., I_{B2} = -1 ma.				200 10	
Turn-off Time	t_s+t_f	25 25		V_{CC} = 3 volts, I_{B1} = 3 ma., I_{B2} = -1 ma. V_{CC} = 5 volts, I_{B1} = 40 ma., I_{B2} = -20 ma.				10 200	
Base Spreading Resistance	$r_{b'}$	25	300		10			10	
Storage-Charge Time Constant	τ_s	25 25		V_{CC} = 10 volts, I_C = 10 ma., I_{B1} = 10 ma., I_{B2} = -10 ma., R_L = 1000 ohms V_{CC} = 5 volts, I_C = 10 ma., I_{B1} = 10 ma., I_{B2} = -10 ma., R_C = 240 ohms					
Thermal Resistance Junction-to-case Junction-to-free-air	θ_{J-C} θ_{J-FA}	25 25							

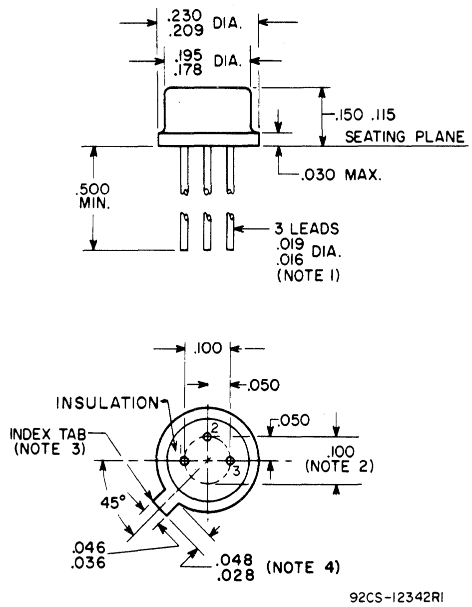
ELECTRICAL CHARACTERISTICS

LIMITS																		UNITS
Type 40217 (2N706)			Type 40218 (2N706A)			Type 40219 (2N708)			Type 40220 (2N834)			Type 40221 (2N914)			Type 40222 (2N2205)			
Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
-	0.005	0.5	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	0.025	μa
-	3.5	30	-	-	30	-	-	-	-	-	-	-	-	-	-	-	15	μa
-	-	-	-	-	-	-	-	0.025	-	-	0.5	-	-	0.025	-	-	-	μa
-	-	-	-	-	-	-	-	15	-	-	30	-	-	15	-	-	-	μa
-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	μa
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	μa
-	-	-	-	-	-	-	-	10	-	-	-	-	-	10	-	-	-	μa
-	-	-	-	-	-	-	-	0.08	-	-	-	-	-	0.1	-	-	-	μa
25	-	-	-	-	-	-	-	-	40	-	-	-	-	-	25	-	-	volts
-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	volts
-	-	-	-	-	-	40	-	-	-	-	-	40	-	-	-	-	-	volts
3	-	-	-	-	-	-	-	-	5	-	-	-	-	-	3	-	-	volts
-	-	-	5	-	-	5	-	-	-	-	-	5	-	-	-	-	-	volts
20	-	-	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	volts
-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-	volts
-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	volts
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	volts
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	volts
-	0.75	0.9	0.7	-	0.9	0.72	-	0.8	-	-	0.9	0.7	-	0.8	0.7	-	0.9	volt
-	-	-	-	-	-	-	-	0.9	-	-	-	-	-	-	-	-	-	volt
-	0.3	0.6	-	-	0.6	-	-	0.4	-	-	0.25	-	-	-	-	-	0.22	volt
-	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	0.35	volt
-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-	volt
-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	volt
-	5	6	-	-	-	-	-	6	-	-	4	-	-	6	-	-	6	pf
-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	pf
-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	pf
-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	
20	-	-	20	-	60	30	-	120	25	-	-	30	-	120	20	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	
-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	2	-	-	3	-	-	-	-	-	-	-	-	2	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	
2	4	-	-	-	-	-	-	-	3.5	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	nsec
-	-	-	-	-	40	-	-	-	-	-	35	-	-	-	-	-	40	nsec
-	-	-	-	-	75	-	-	-	-	-	75	-	-	-	-	-	75	nsec
-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	nsec
-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	ohms
-	-	60	-	-	25	-	-	25	-	-	25	-	-	-	-	-	25	nsec
-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	nsec
-	-	-	-	-	-	-	-	145	-	-	-	-	-	145	-	-	-	°C/watt
-	-	-	-	-	-	-	-	480	-	-	-	-	-	480	-	-	-	°C/watt

DIMENSIONAL OUTLINE FOR RCA TYPES

40217	40218
40219	40220
40221	40222

JEDEC No. TO-52



Dimensions in Inches

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 0.500 INCH OF THE LEAD, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

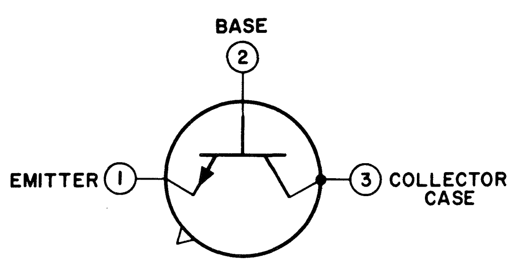
NOTE 2: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH — 0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: MEASURED FROM MAXIMUM DIAMETER OF ACTUAL DEVICE.

TERMINAL DIAGRAM

Bottom View



RCA AF TRANSISTORS

40231 40232
40233 40234

RCA types 40231, 40232, 40233, and 40234 are planar transistors of the silicon n-p-n type, intended primarily for use in af-amplifier circuits operating at low-to-intermediate signal levels, such as those used in preamplifier, "voltage-amplifier", and driver stages in radio and television receivers, phonographs, tape recorders, and similar equipment. These transistors feature low noise and leakage characteristics, high small-signal beta, high dissipation capability, and an operating temperature range of -65 to +175° C.

Types 40231, 40232, and 40234 have different small-signal-beta characteristics, but are otherwise similar. Type 40233 has specially controlled noise and leakage characteristics, and is intended for use in preamplifier and other applications where very low noise, low leakage, and high small-signal beta are important design requirements.

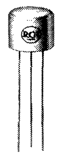
All four types utilize a new, compact, hermetically sealed three-lead package. This package provides an internal connection between the collector electrode and the case, a feature which contributes to the high dissipation capabilities of these transistors. In addition, the provision of a collector lead simplifies equipment design by making it unnecessary to use the case for electrical connections to the collector electrode.

Maximum Ratings, *Absolute Values:*

	40231 40232 40233	40234		
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	18	18	max.	volts
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	18	18	max.	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	5	max.	volts
COLLECTOR CURRENT, I_C	100	100	max.	ma
EMITTER CURRENT, I_E	100	100	max.	ma
BASE CURRENT, I_B	25	25	max.	ma
TRANSISTOR DISSIPATION, P_T:				
For case temperatures[a] up to 125°C	1	1	max.	watt
For case temperatures[a] above 125°C	derate at 20			mW/°C
For free-air temperatures up to 25°C	0.5	-	max.	watt
For free-air temperatures above 25°C	derate at 3.33			mW/°C
For free-air temperatures up to 55°C	-	0.4	max.	watt
For free-air temperatures above 55°C		derate at 3.33		mW/°C
TEMPERATURE RANGE:				
Storage and Operating (Junction)	-65 to +175			°C
LEAD TEMPERATURE (During soldering):				
At distances not closer than 1/32 inch to seating surface for 10 seconds maximum	255		max.	°C

[a] Measured on case perimeter at junction with seating surface.

SILICON N-P-N PLANAR TRANSISTORS



For AF-Amplifier Applications in Consumer and Industrial Equipment

FEATURES:

- **Low Noise Figure (NF):**
  2 db typ. at 10 kc, 4 db typ. at 1 kc for 40233
  2.8 db typ. at 10 kc for 40231, 40232, and 40234
- **High Dissipation Capability (P_T):**
  1 watt max. for case temperatures up to 125° C
- **High Small-Signal Beta (h_{fe}):**
  175 typ. for 40232 and 40233
  80 typ. for 40231 and 40234
- **High Gain-Bandwidth Product (f_T):**
  60 Mc typ. for all types

TYPICAL DC BETA CHARACTERISTICS FOR RCA-40231, 40232, 40233, AND 40234

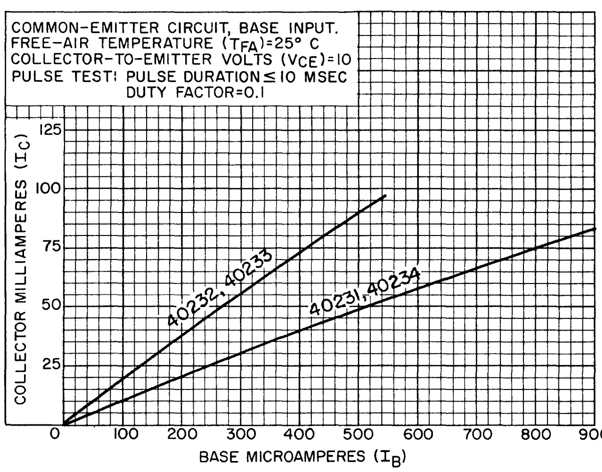


Fig. 1

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
Trademark(s) ® Registered
Marca(s) Registrada(s)
Printed in U.S.A.
40231 to 40234 7-66
Supersedes issue dated 6-64

ELECTRICAL CHARACTERISTICS:

Characteristics	Symbols	TEST CONDITIONS								LIMITS												Units
		Free-Air Temperature T_{FA}	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter-to-Base Voltage V_{EB}	DC Emitter Current I_E	DC Collector Current I_C	DC Base Current I_B	Type 40231			Type 40232			Type 40233			Type 40234			
		°C		volts	volts	volts	ma	ma	ma	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Collector-Cutoff Current	I_{CBO}	25		12			0			-	-	0.5	-	-	0.5	-	-	0.25	-	-	0.5	µa
		85		12			0			-	-	10	-	-	10	-	-	10	-	-	10	µa
Emitter-Cutoff Current	I_{EBO}	25				2.5		0		-	-	0.5	-	-	0.5	-	-	0.25	-	-	0.5	µa
Collector-to-Base Breakdown Voltage	BV_{CBO}	25					0	0.05		18	-	-	18	-	-	18	-	-	18	-	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEO}	25						10	0	18	-	-	18	-	-	18	-	-	18	-	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25					0.05	0		5	-	-	5	-	-	5	-	-	5	-	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25						50	5	-	-	-	-	-	-	-	-	-	-	-	0.2	volt
Small-Signal Forward Current-Transfer Ratio	h_{fe}	25	1 Kc		10			2		55	80	180	90	175	300	90	175	300	35	80	180	
Gain-Bandwidth Product	f_T	25			6			1		-	60	-	-	60	-	-	60	-	-	60	-	Mc
Noise Figure	NF	25	1 Kc[a]		6			0.5		-	-	-	-	-	-	-	4	6	-	-	-	db
		25	10 Kc[a]		6			0.1		-	2.8	-	-	2.8	-	-	2	-	-	2.8	-	db
Intrinsic Base-Lead Resistance	$r_{bb'}$	25	100 Mc		6			1		-	20	-	-	20	-	-	20	-	-	20	-	ohms
Common-Base, Open-Circuit Output Capacitance	C_{ob}	25	1 Mc	6						-	22	-	-	22	-	-	22	-	-	22	-	pf
Thermal Resistance: Junction-to-Case	θ_{J-C}	175[b]								-	-	50	-	-	50	-	-	50	-	-	50	°C/w
Thermal Resistance: Junction-to-Free Air	θ_{J-FA}	175[b]								-	-	300	-	-	300	-	-	300	-	-	300	°C/w

[a] Circuit bandwidth = 1 cps; generator resistance = 1000 ohms.
[b] Junction Temperature.

TYPICAL COLLECTOR CHARACTERISTICS (PULSE CONDITIONS) FOR RCA-40232 AND 40233

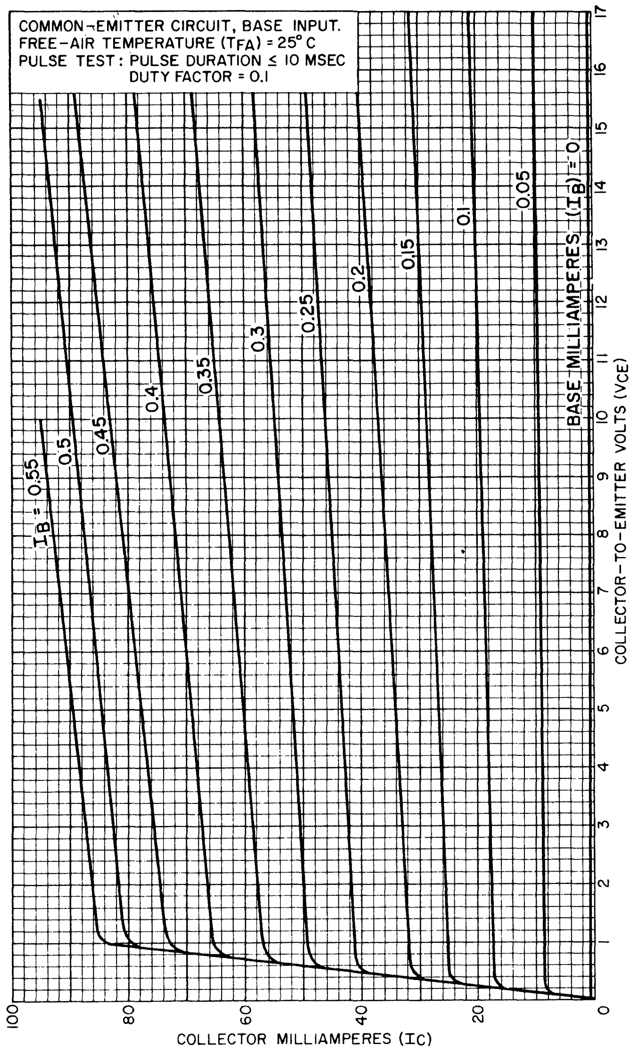


Fig.2

TYPICAL COLLECTOR CHARACTERISTICS (PULSE CONDITIONS) FOR RCA-40231 AND 40234

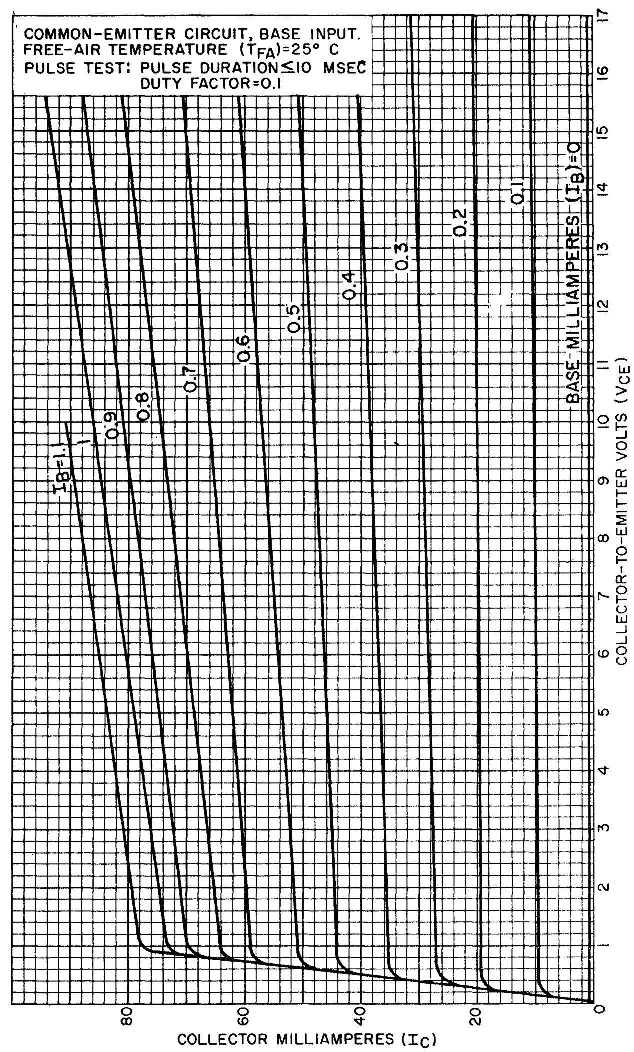


Fig.3

TYPICAL NOISE CHARACTERISTICS FOR RCA-40233

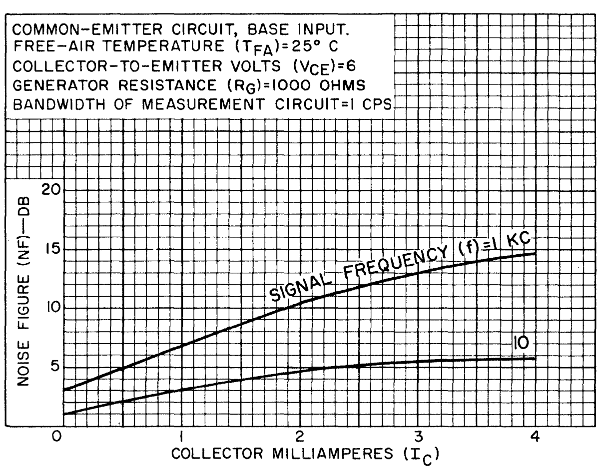


Fig.4

TYPICAL SMALL-SIGNAL-BETA CHARACTERISTICS FOR RCA-40231, 40232, 40233, AND 40234

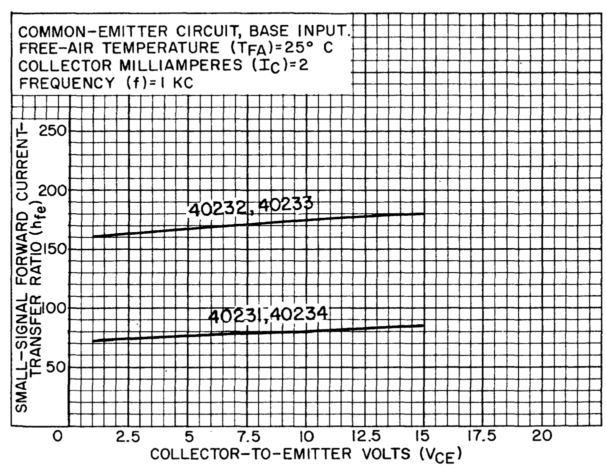


Fig.5

TYPICAL SMALL-SIGNAL-BETA CHARACTERISTICS FOR RCA-40231, 40232, 40233, AND 40234

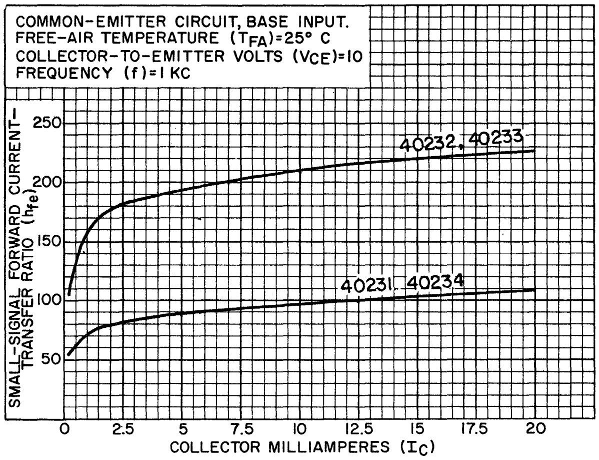


Fig.6

TYPICAL TRANSFER CHARACTERISTIC (PULSE CONDITIONS) FOR RCA-40231, 40232, 40233, AND 40234

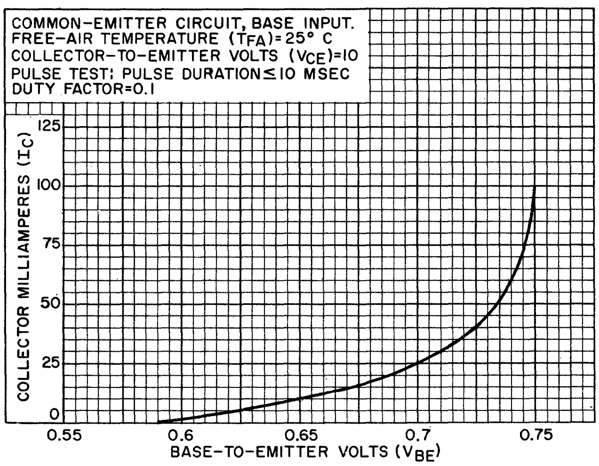
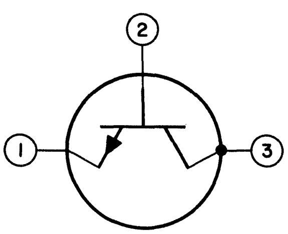


Fig.7

TERMINAL DIAGRAM



Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector, Case

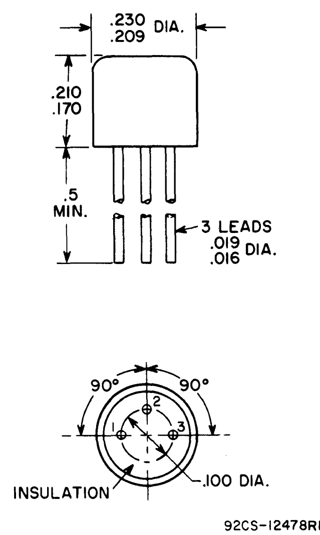
OPERATING CONSIDERATIONS

The 40231, 40232, 40233, and 40234 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

The cases of the 40231, 40232, 40233, and 40234 are connected internally to the collector electrodes of these transistors. Consequently, in circuits where the collectors of these transistors are operated at voltages above or below chassis or heat-sink potential, suitable precautions should be taken to prevent shock hazards and short circuits between the transistors and chassis, heat sinks, and other components.

Electrical connections to the base, emitter, and collector leads of the 40231, 40232, 40233, and 40234 may be soldered directly to the leads provided such connections are made at least 1/32 inch from the transistor seating surface, and provided care is taken to conduct excessive heat away from the lead seals during soldering. Failure to observe these precautions will result in cracking of the lead seals and permanent damage to the transistors.

DIMENSIONAL OUTLINE FOR TYPES 40231, 40232, 40233, AND 40234



DIMENSIONS IN INCHES

RCA-40234, 40395*, and 40396** are a group of four transistors specially designed for use in af-amplifier circuits employing complementary-symmetry output stages. A typical AC-operated phonograph amplifier using these transistors is shown in Fig.1. This amplifier can provide 1 watt (rms) output to a 16-ohm speaker with 10% distortion when driven by a typical 1000-pF crystal cartridge delivering 1.5 to 2 volts output.

RCA-40234 is a silicon npn transistor with high dissipation capability, extended high-frequency response, and exceptional linearity of characteristics. The 40234 is particularly useful as a direct-coupled driver for a complementary-symmetry output stage.

RCA-40395 is a high-gain transistor of the germanium pnp type with controlled noise current,for use in input and other low-level stages operating at signal levels as low as 1/8 microwatt.

RCA-40396 is a matched pair of germanium power transistors (one pnp type 40396 and one npn type 40396) for use in complementary-symmetry output-amplifier stages. The 40396 matched pair can deliver 1 watt (rms) output to a 16-ohm speaker load with 10% total harmonic distortion when used in a circuit of the type shown in Fig.1.

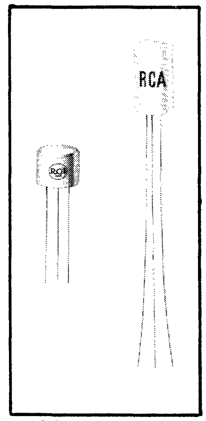
RCA-40234, 40395, and 40396 are hermetically sealed in three-lead metal packages. The active elements of each transistor in the 40396 matched pair are insulated from the case. This feature permits the 40396 transistors to be fastened directly to the same heat sink or metal chassis by means of metal clips such as the RCA-SA2100 shown in Fig.7.

* Formerly Dev. No.TA2802.

** Formerly Dev. Nos.TA2754, TA2755.

FOUR-TRANSISTOR COMPLEMENT

FOR 3-STAGE 1-WATT AF-AMPLIFIERS USING COMPLEMENTARY-SYMMETRY OUTPUT STAGES



40234 40395 40396

FEATURES:

- **3-Stage AC-Operated Amplifier using 40234, 40395, and 40396 matched pair provides:**
  - high gain and 1 W output with low dc supply voltages (less than 18 V)
- **For Input Stages:**
  - RCA 40395 (Germanium PNP)
  - low noise current: 2 nA typ, 10 nA max
  - high gain capability: h_{fe} =250 typ, 170 min
- **For Driver Stages:**
  - RCA 40234 (Silicon NPN)
  - extended high frequency response
  - exceptional linearity
  - high dissipation capability: P_T =400 mW max at 55°C
- **For Complementary-Symmetry Output Stages:**
  - RCA 40396 (One Germanium PNP Type & One Germanium NPN Type)
  - provides 1 W output to 16-ohm load at 10% THD

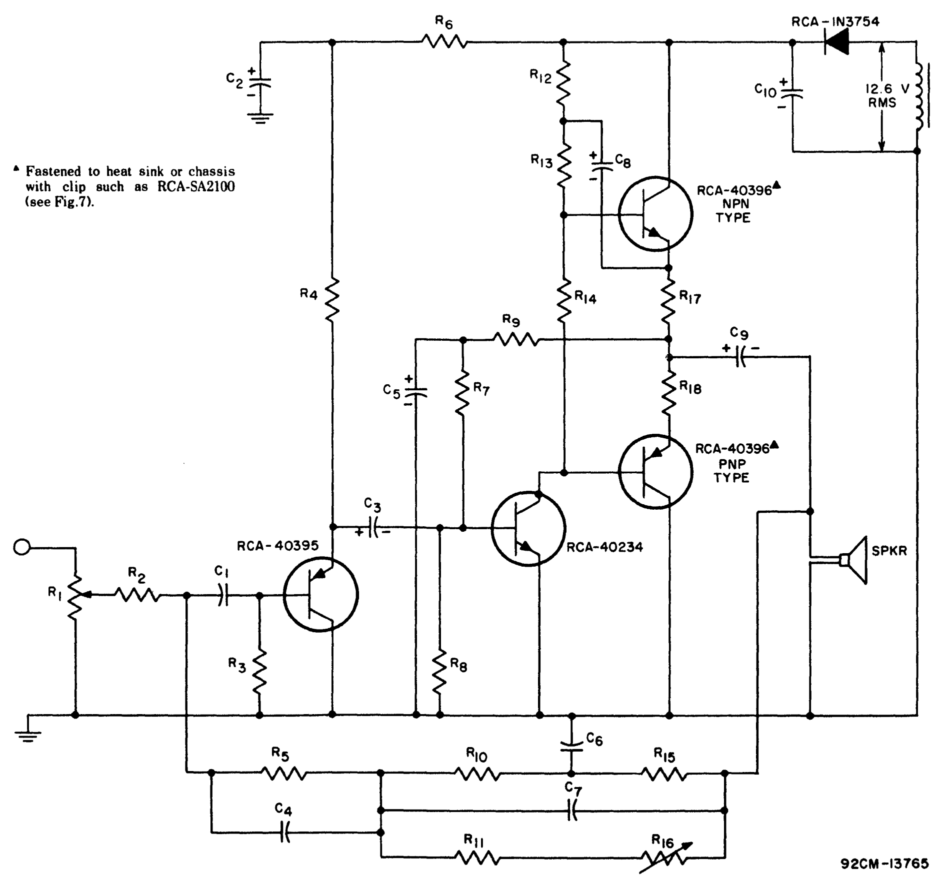
ELECTRICAL CHARACTERISTICS:

Characteristics	Symbols	TEST CONDITIONS								LIMITS												Units
		Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter-to-Base Voltage V_{EB}	DC Emitter Current I_E	DC Collector Current I_C	DC Base Current I_B	Type 40234			Type 40395			40396 Matched Pair Consisting of One 40396 (NPN TYPE)			40396 Matched Pair Consisting of One 40396 (PNP TYPE)			
		^oC	kc/s	V	V	V	mA	mA	mA	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Collector-Cutoff Current	I_{CBO}	25		-20			0			-	-	-	-	-	-12	-	-	-	-	-	-	µA
		25		12			0			-	-	0.5	-	-	-	-	-	14	-	-	-14	µA
		85		12			0			-	-	10	-	-	-	-	-	-	-	-	-	µA
Emitter-Cutoff Current	I_{EBO}	25				20		0		-	-	-	-	-	-12	-	-	-	-	-	-	µA
		25				2.5		0		-	-	0.5	-	-	-	-	-	14	-	-	-14	µA
Collector-to-Emitter Breakdown Voltage	V_{CEO}	25						10	0	18	-	-	-	-	-	-	-	-	-	-	-	V
Collector-to-Emitter Breakdown Voltage	V_{CER}	25				R_{BE} = 10kΩ		-1		-	-	-	-18	-	-	-	-	-	-	-	-	V
		25				R_{BE} = 4.7kΩ		1		-	-	-	-	-	-	18	-	-	-18	-	-	V
Small-Signal Forward Current-Transfer Ratio Cutoff Frequency	f_{hfb}	25			-6			-1		-	-	-	-	10	-	-	-	-	-	1.5	-	Mc/s
		25			6			1		-	-	-	-	-	-	-	2	-	-	-	-	Mc/s
Small-Signal Forward Current-Transfer Ratio	h_{fe}	25	1		-6			-1		-	-	-	170	250	-	-	-	-	-	-	-	
		25	1		10			2		35	80	180	-	-	-	-	-	-	-	-	-	
Gain-Bandwidth Product	f_T	25			6			1		-	60	-	-	-	-	-	-	-	-	-	-	Mc/s
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25						50	5	-	0.5	1	-	-	-	-	-	-	-	-	-	V
		25						250	25	-	-	-	-	-	-	-	0.25	0.5	-	-	-	V
		25						-250	-25	-	-	-	-	-	-	-	-	-	-	-0.25	-0.5	V
Static Forward Current-Transfer Ratio	h_{FE}	25			-1			-50		-	-	-	-	-	-	-	-	-	50	-	-	
		25			-1			-250		-	-	-	-	-	-	-	-	-	30	-	-	
		25			1			50		-	-	-	-	-	-	50	-	-	-	-	-	
		25			1			250		-	-	-	-	-	-	30	-	-	-	-	-	
Noise Current		25	0.05 to 15		-6			-1		-	-	-	-	2	10	-	-	-	-	-	-	nA

MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES:

	40395	40234	40396 Matched Pair: 40396 (NPN Type)	40396 Matched Pair: 40396 (PNP Type)	Units
Collector-to-Base Voltage, V_{CBO}	-20	18	18	-18	max V
Collector-to-Emitter Voltage, V_{CEO}	-	18	-	-	max V
Collector-to-Emitter Voltage, V_{CER} ($R_{BE} \leq 4.7\ k\Omega$)	-18	-	18	-18	max V
Emitter-to-Base Voltage, V_{EBO}	-20	5	2.5	-2.5	max V
Collector Current, I_C	-50	100	500	-500	max mA
Transistor Dissipation, P_T:					
For case temperatures[a] up to 55°C	-	-	300	300	max mW
For case temperatures[a] above 55°C . . *Derate at*	-	-	10	10	mW/°C
For ambient temperatures up to 55°C	120	400	-	-	max mW
For ambient temperatures above 55°C . . *Derate at*	2.6	3.33	-	-	mW/°C
Temperature Range: Storage and Operating (junction)	-65 to +100	-65 to +175	-65 to +85	-65 to +85	°C
Lead Temperature (during soldering): At distances not closer than 1/32 inch to seating surface for 10 seconds maximum	255	255	255	255	max °C

[a]Measured on case perimeter at junction with seating surface.



C_1 0.025 μF
C_2 100 μF, 15 V
C_3 50 μF, 12 V
C_4 390 pF
C_5 100 μF, 6 V
C_6 500 pF
C_7 5 pF
C_8 100 μF, 6 V
C_9 100 μF, 10 V
C_{10} 500 μF, 16 V
R_1 Loudness Control, 2 MΩ
R_2 180 kΩ
R_3 1 MΩ
R_4 1 kΩ
R_5 1.8 MΩ
R_6 2 kΩ mono, 1 kΩ stereo
R_7 1.5 kΩ
R_8 330 Ω
R_9 1.5 kΩ
R_{10} 270 kΩ
R_{11} 22 kΩ
R_{12},R_{13} 220 Ω
R_{14} 18 Ω
R_{15} 270 kΩ
R_{16} Treble Tone Control 3 MΩ (audio taper)
R_{17},R_{18} 1 Ω

Speaker: Voice-Coil impedance = 16 Ω

T = Secondary winding of step-down transformer or auxiliary winding on phonograph motor.

Fig.1 - 1-Watt Phonograph Amplifier with Complementary-Symmetry Output Stage, Using RCA-40395, 40234, and 40396 Matched Pair.

DESCRIPTION OF AMPLIFIER CIRCUIT SHOWN IN FIG.1

Fig.1 shows a typical AC-operated phonograph amplifier utilizing RCA-40395, 40234, and 40396 transistors, and designed for use with a conventional crystal pickup having approximately 1000 pF capacitance and 1.5 to 2 volts output. This amplifier will deliver 1 watt (rms) output to a 16-ohm speaker load, with 10% total harmonic distortion. At 0.5 watt output, THD, hum, and noise combined do not exceed 2%. The frequency response of the amplifier for constant-voltage input (with tone control in "flat" position) is substantially flat from 180 c/s to 20 kc/s. The 12.6-volt ac input for the power supply may be obtained from a step-down transformer or from an auxiliary winding on the phonograph motor.

The amplifier uses feedback-type equalization to compensate for low-frequency roll-off resulting from the relatively low load impedance (180 k ohms) seen by the pickup at the maximum setting of the loudness control. This impedance increases as the control is adjusted to reduce the loudness level. At low loudness settings, therefore, the increased signal-input voltage at low frequencies and the compensation provided by the feedback circuit combine to boost the low-frequency response. This boost is enhanced by the rise in the RIAA recording characteristic at the lower audio frequencies.

The feedback-type equalization circuit also minimizes mid-range distortion, and permits use of a "boost/cut"-type treble tone control without introduction of additional insertion loss.

The output section of the amplifier is a direct-coupled complementary-symmetry stage with conventional "bootstrap" drive. The use of a silicon driver transistor (RCA-40234) and a decoupled low-impedance bias network (R_7, R_8, R_9, C_5) provides excellent thermal stability and eliminates the need for a bias-adjustment potentiometer. To protect the 40396 matched-pair output transistors against thermal runaway these transistors should be fastened to an aluminum heat sink or chassis which provides an effective heat-radiating area of at least 4 square inches per transistor. The transistors should be fastened to the heat sink or chassis by clips having high thermal conductivity, such as RCA Type SA2100 shown in Fig.7.

AMPLIFIER PERFORMANCE CHARACTERISTICS

Sensitivity for 0.5 W output at 1 kc/s	1.2 V*
Hum and Noise at any setting of Loudness Control (Ripple Frequency = 60 c/s)	11 mV
Power Output at 10% THD, f = 1 kc/s	1 W
Combined THD, Hum, and Noise at 1 kc/s, with Loudness Control at Maximum, Tone Control at "Flat" position (output = 0.5 W)	2 %
Frequency Response for Constant Input Voltage*: with Tone Control at "Flat" position:	
Loudness Control at Maximum	3 dB down at 180 c/s and 60 kc/s (See Fig.2a)
Loudness Control at 20 dB below Maximum	3 dB down at 15 c/s and 50 kc/s; 7 dB boost at 100 to 200 c/s (See Fig.2b)

* Measured with a 1000-pF capacitor connected in series with the signal input.

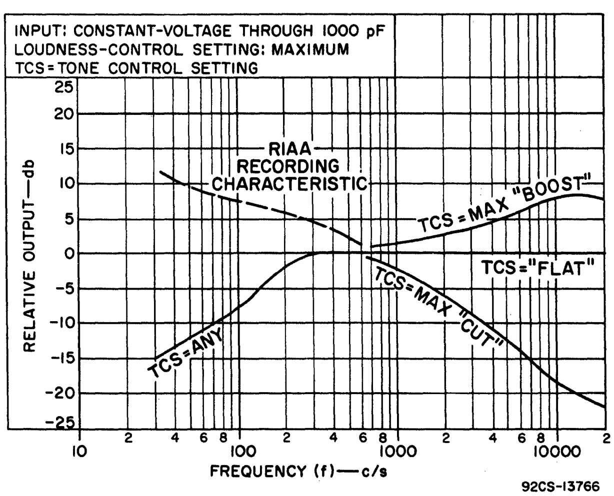


Fig.2a - Frequency Response Characteristics at Maximum Loudness.

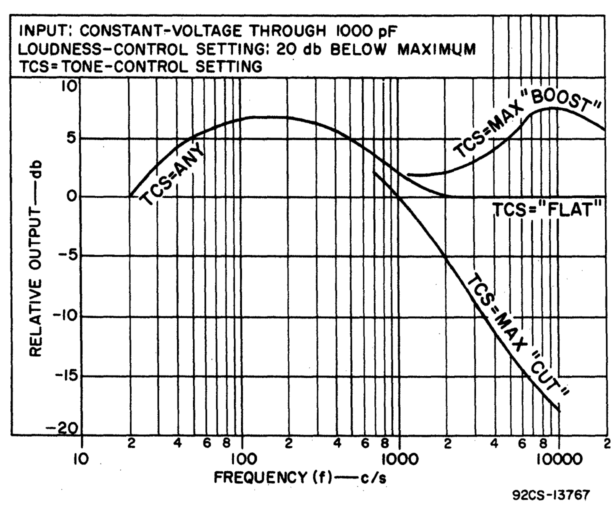


Fig.2b - Frequency Response Characteristics at Reduced Loudness.

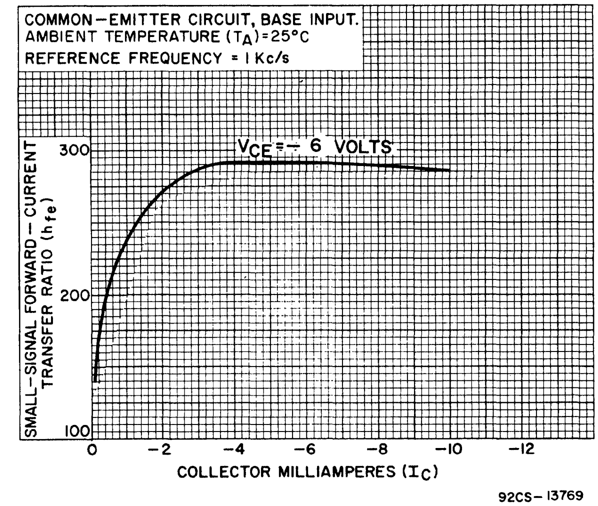


Fig.3 - Small-Signal Beta (h_{fe}) vs I_C for RCA-40395.

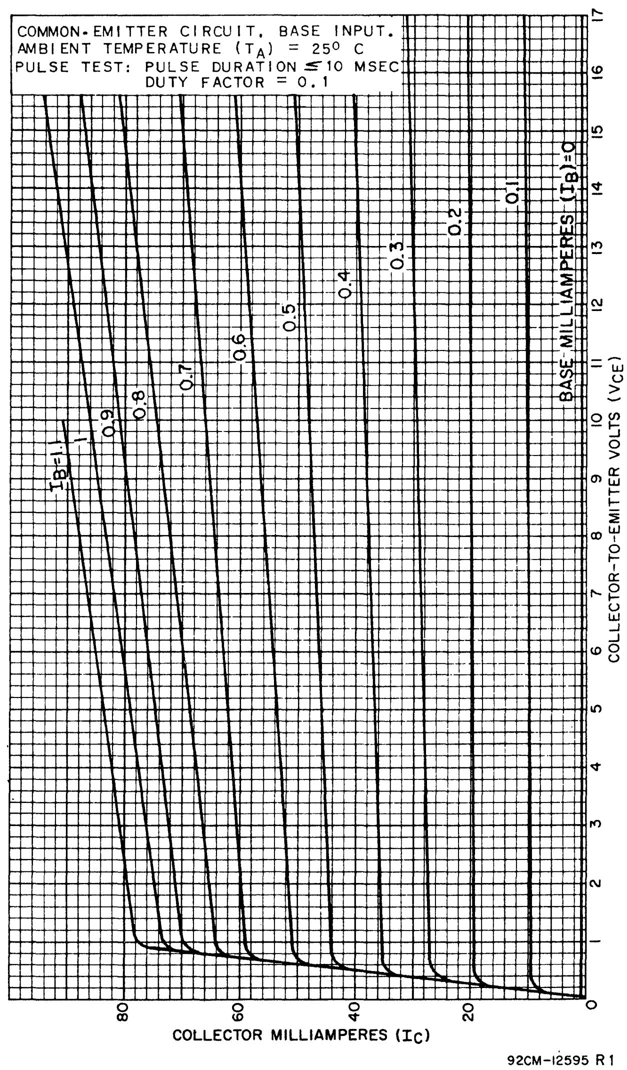


Fig.4 - Collector Characteristics (Pulse Test) for RCA-40234.

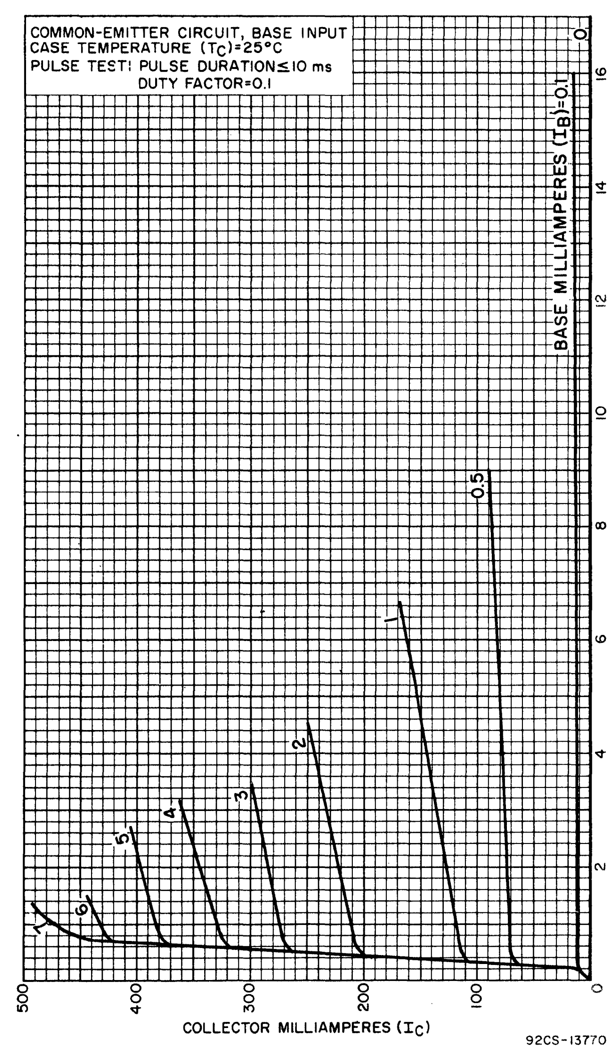


Fig.5 - Collector Characteristics (Pulse Test) for RCA-40396 (NPN Unit).

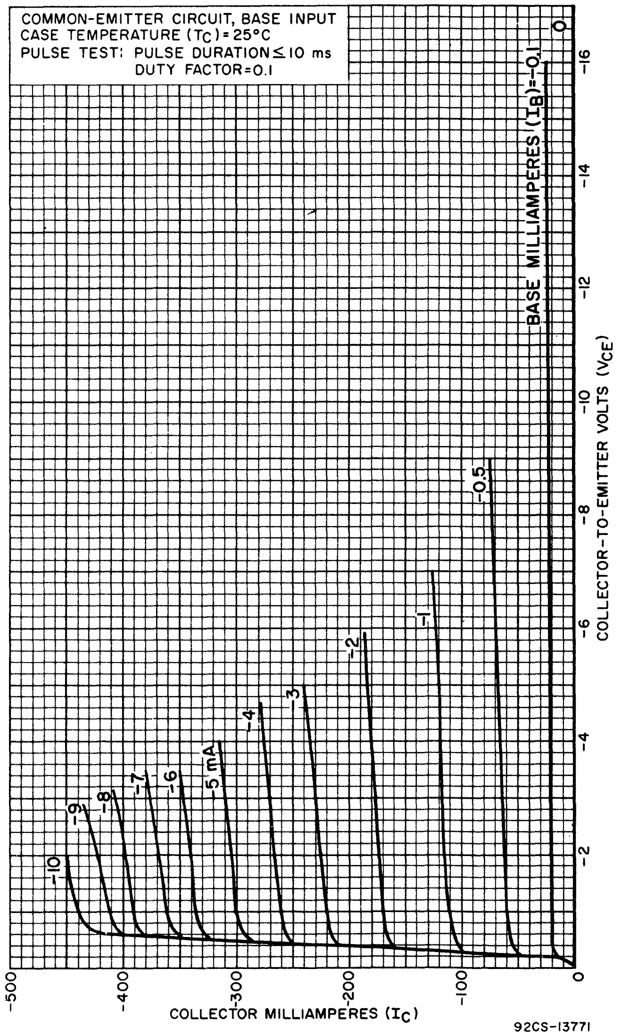


Fig.6 - Collector Characteristics (Pulse Test) for RCA-40396 (PNP Unit)

OPERATING CONSIDERATIONS

RCA-40234, 40395, and 40396 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

The case of RCA-40234 is connected internally to the collector electrode of this transistor. Consequently, in circuits where the collector of the 40234 is operated at voltages above or below chassis or heat-sink potential, suitable precautions should be taken to prevent shock hazards and short circuits between the transistor and chassis, heat sink, and other components.

The cases of the RCA-40396 matched-pair transistors as shown in Fig.1 should always be fastened to an aluminum heat sink which provides an effective heat-radiating area of at least 4 square inches per transistor. The transistors should be fastened to the heat sink or chassis by clips having high thermal conductivity, such as RCA Type SA2100 shown in Fig.7.

Electrical connections to the leads of RCA-40234, 40395 and 40396 may be soldered directly to the leads, provided such connections are made at least 1/32-inch from the transistor seating surface, and provided care is taken to conduct excessive heat away from the lead seals during soldering. Failure to observe these precautions will result in cracking of the lead seals and permanent damage to the transistors.

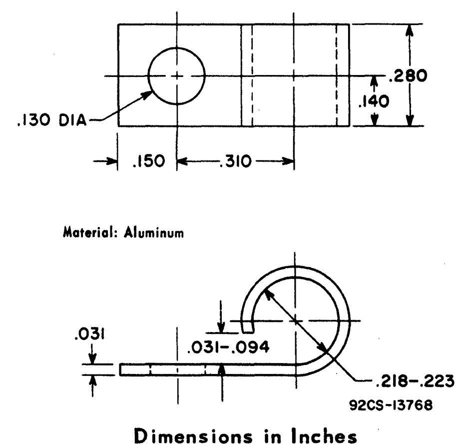
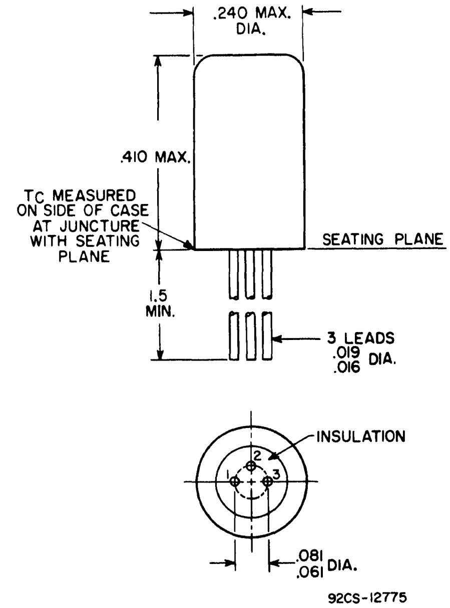


Fig.7 - Detail Drawing of RCA-SA2100 Heat-Sink Attachment Clip.

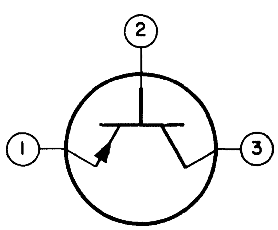
DIMENSIONAL OUTLINE
RCA-40395, 40396
JEDEC No. TO-1



Dimensions in Inches

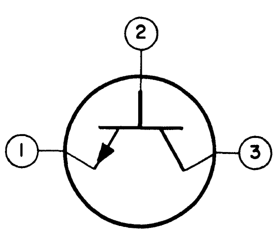
NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

TERMINAL DIAGRAMS



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

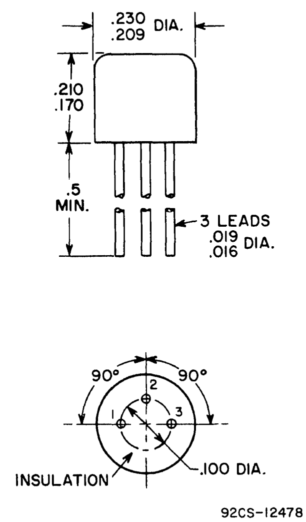
40395 and 40396 (PNP Type)



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector

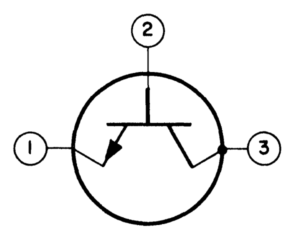
40396 (NPN Type)

DIMENSIONAL OUTLINE
RCA-40234



Dimensions in Inches

TERMINAL DIAGRAM
RCA-40234



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector, case

RCA-40234, -40395, -40396

FOR 3-STAGE 1-WATT AF-AMPLIFIERS USING COMPLEMENTARY-SYMMETRY OUTPUT STAGES

RCA HF TRANSISTORS
For TV Applications

40235 40236
40237 40238
40239 40240

File No. 99

RCA-40235, 40236, 40237, 40238, 40239, and 40240 are high-frequency transistors of the silicon npn type, intended primarily for use in the tuner and if-amplifier circuits of vhf television receivers. These devices are also useful in communications equipment operating at frequencies up to approximately 260 Mc/s.

Types 40235, 40236, and 40237 are vhf types, for use as rf amplifier, mixer, and local oscillator respectively, in TV tuners covering Channels 2 through 13. Types 40238, 40239, and 40240 are for use in 45-Mc/s picture-if amplifiers.

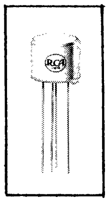
These devices feature high gain-bandwidth products, very low feedback capacitance, and low cutoff currents, in addition to the high-temperature operation capability of silicon.

RCA-40235 through 40240 utilize a hermetically sealed metal case which is electrically isolated from the transistor electrodes. The case is provided with a fourth lead, which may be connected to an rf ground point to minimize collector-to-base interlead capacitance and coupling to other circuit components.

Absolute Maximum Ratings:

	40235 40236 40237 40238 40239 40240	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	45 max.	V
COLLECTOR-TO-BASE VOLTAGE, V_{CBV} (V_{EB} = 1 V)	45 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4.5 max.	V
COLLECTOR CURRENT, I_C	50 max.	mA
TRANSISTOR DISSIPATION, P_T: At free-air temperatures up to 25° C	180 max.	mW
At free-air temperatures above 25° C	See *Fig.1*	
FREE-AIR TEMPERATURE RANGE: Storage and Operating	-65 to +175	°C
LEAD TEMPERATURE (During soldering): At distances not closer than 1/32 inch to seating surface for 10 seconds max.	255 max.	°C

HIGH-FREQUENCY TRANSISTORS



Silicon NPN Types
For TV Tuner and IF-Amplifier Applications

Features:

- high gain-bandwidth products:
  f_T = 1000 Mc/s typ. for tuner types
  800 Mc/s typ. for if-amplifier types
- very low collector-to-base feedback capacitance:
  C_{cb} = 0.5 pF typ. for amplifier and mixer types
- low cutoff currents:
  I_{CBO} = 20 nA max. at V_{CB} = 1 volt for all types
- operation to 175° C
- hermetically sealed 4-lead metal package
- all transistor electrodes electrically isolated from case
- case may be grounded by means of separate lead to minimize interlead capacitance and undesired coupling

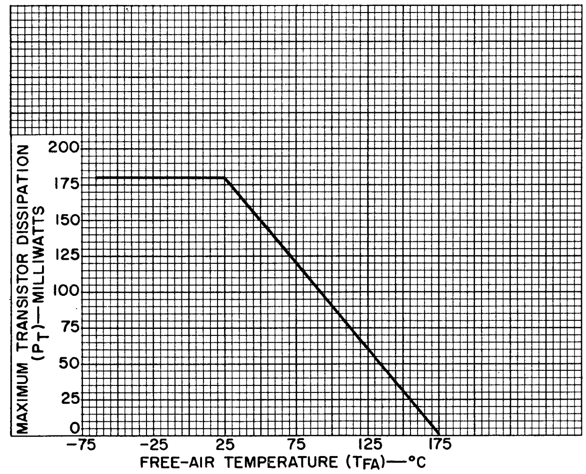


Fig.1 - Rating Chart for RCA 40235, 40236, 40237, 40238, 40239, 40240.

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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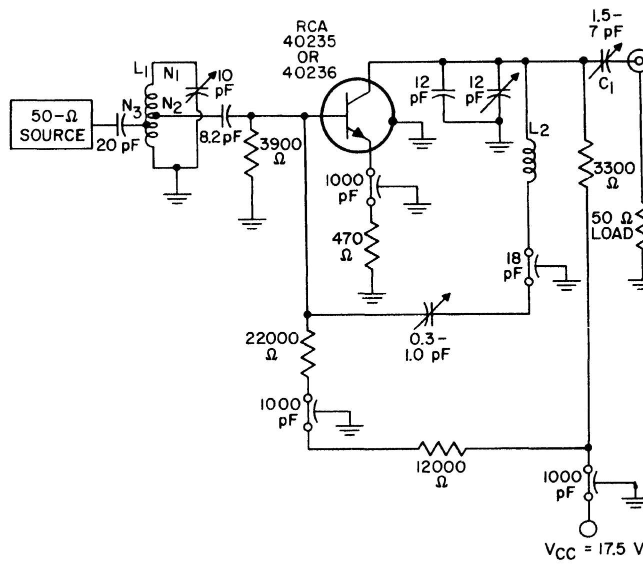
Printed in U.S.A.
40235 through 40240 8-66
Supersedes issue dated 6-65

ELECTRICAL CHARACTERISTICS at $T_{FA} = 25^{o}$ C

CHARACTERISTICS	SYMBOLS & UNITS	LIMITS																		TEST CONDITIONS		
		40235			40236			40237			40238			40239			40240			FREQUENCY f	DC COLLECTOR-TO EMITTER VOLTAGE V_{CE}	DC EMITTER CURRENT I_E
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	Mc/s	VOLTS	mA
COLLECTOR-CUTOFF CURRENT	I_{CBO} μA	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	-	$(V_{CB}) = 1$	
		-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	$(V_{CB}) = 35$	
EMITTER-CUTOFF CURRENT	I_{EBO} μA	-	-	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	$(V_{EB}) = 4.5$	
		-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
STATIC FORWARD CURRENT-TRANSFER RATIO	h_{FE}	40	-	170	40	-	275	27	-	275	40	-	170	27	-	100	27	-	275	-	6	-1
GAIN-BANDWIDTH PRODUCT	f_T Mc/s	-	1000	-	-	1000	-	-	1000	-	-	800	-	-	800	-	-	800	-	100	6	-2
COLLECTOR-TO-BASE FEEDBACK CAPACITANCE	C_{cb} pF	-	0.5	0.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	0.5	0.65	-	0.5	0.8	-	-	-	-	-	-	-	-	-	216	12	-1.5
		-	-	-	-	-	-	-	-	-	-	0.5	0.65	-	0.5	0.65	-	0.5	0.65	216	12	-3
INPUT RESISTANCE	R_i Ω	-	190	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	230	-	-	-	-	-	-	-	-	-	-	-	-	-	216	12	-1.5
		-	-	-	-	-	-	-	-	-	-	480	-	-	480	-	-	480	-	45	12	-3
OUTPUT RESISTANCE	R_o KΩ	-	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	65	-	-	-	-	-	-	-	-	-	-	-	-	-	45	12	-1.5
		-	-	-	-	-	-	-	-	-	-	35	-	-	35	-	-	35	-	45	12	-3
EXTRINSIC TRANS-CONDUCTANCE	g_m mmhos	-	43.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	-	-	-	-	-	-	90	-	-	90	-	-	90	-	45	12	-3
NOISE FIGURE*	NF dB	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	10	-2
CONVERSION GAIN	G_c dB	-	-	-	-	19	-	-	-	-	-	-	-	-	-	-	-	-	-	216 to 45	12	-1.5
OPEN-CIRCUIT COMMON BASE OUTPUT CAPACITANCE	C_{ob} pF	-	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	257	$(V_{CB}) = 12$	$(I_C) = -2.5$
MAX. AVAILABLE AMPLIFIER GAIN	MAG dB	-	29.1	-	-	-	-	-	-	NO. OF STAGES	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	-	-	-	-	1	-	45.3	-	-	45.3	-	-	45.3	-	45	12	-3
		-	-	-	-	-	-	-	-	2	-	45.3	-	-	45.3	-	-	45.3	-	45	12	-3
		-	-	-	-	-	-	-	-	3	-	45.3	-	-	45.3	-	-	45.3	-	45	12	-3
MAX. USABLE AMPLIFIER GAIN (UNNEUTRALIZED)	MUG dB	-	-	-	-	-	-	-	-	NO. OF STAGES	-	-	-	-	-	-	-	-	-			
		-	-	-	-	-	-	-	-	1	-	22.9	-	-	22.9	-	-	22.9	-	45	12	-3
		-	-	-	-	-	-	-	-	2	-	20.7	-	-	20.7	-	-	20.7	-	45	12	-3
		-	-	-	-	-	-	-	-	3	-	19	-	-	19	-	-	19	-	45	12	-3
MAX. USABLE AMPLIFIER GAIN (NEUTRALIZED)	MUG dB	-	18.1*	-	-	-	-	-	-	NO. OF STAGES	-	-	-	-	-	-	-	-	-	216	10	-2
		-	-	-	-	-	-	-	-	1	-	28	-	-	28	-	-	28	-	45	12	-3
		-	-	-	-	-	-	-	-	2	-	25.8	-	-	25.8	-	-	25.8	-	45	12	-3
		-	-	-	-	-	-	-	-	3	-	24.1	-	-	24.1	-	-	24.1	-	45	12	-3

* Measured in circuit shown in Fig.2.



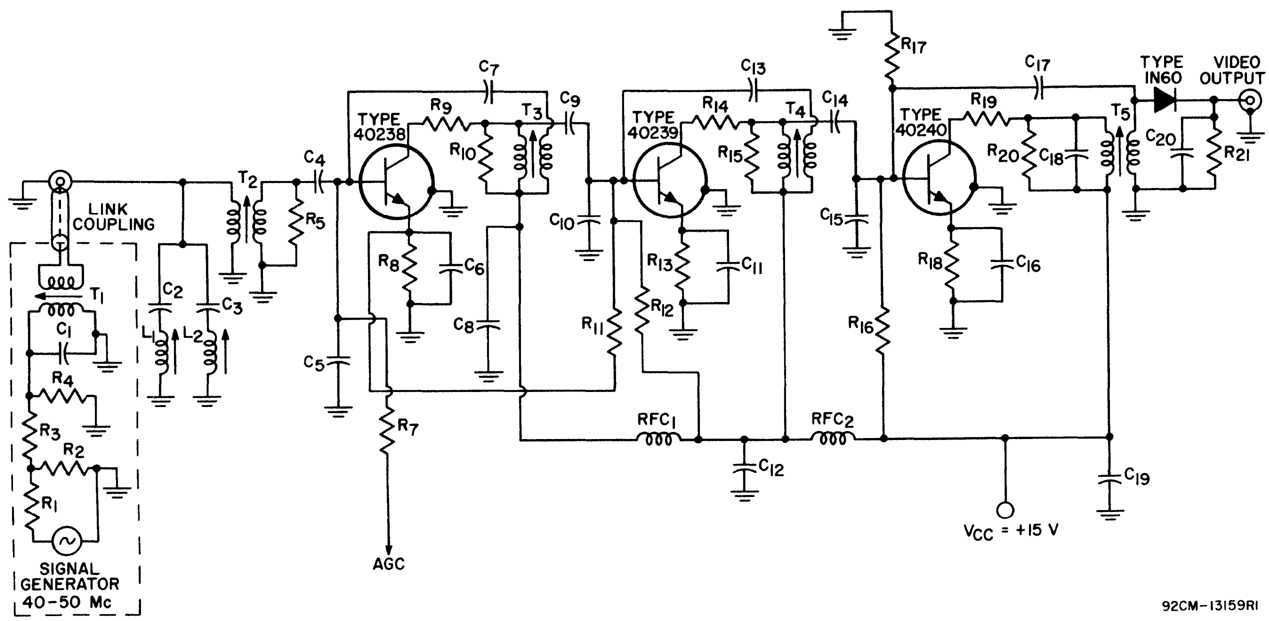
L_1 - Tunes with 10 pF @ 216 Mc/s and has an unloaded Q of 150

Turns Ratio for Base Tap = 2.88
Turns Ratio for Input Tap = 5.36

L_2 - Tunes with 12 pF @ 216 Mc/s

Adjust the unloaded Q of L_2 to reflect 890 ohms at the collector with the 50 ohm load disconnected. Adjust C_1 so that the 50 ohm load is reflected as 775 ohms at the collector with a resultant collector load of 410 ohms.

Fig. 2 - 216-Mc/s Power Gain and Noise Figure Test Circuit for RCA-40235.



C_1, C_9, C_{14}, C_{20} = 10 pF
C_2, C_3 = 12 pF
C_4 = 13 pF
C_5 = 180 pF
C_6, C_8, C_{11}, C_{12}, C_{16} = 0.005 μF
C_7 = 4.7 pF
C_{10} = 56 pF
C_{13} = 6.8 pF
C_{15} = 120 pF

C_{17}, C_{18} = 1.2 pF
C_{19} = 0.01 μF
R_1, R_2 = 50 Ω
R_3 = 68,000 Ω
R_4, R_5 = 18,000 Ω
R_6 = Deleted
R_7, R_8, R_{13} = 2.2 KΩ
R_9, R_{14}, R_{19} = 47 Ω
R_{10}, R_{15} = 1800 Ω

R_{11} = 4.7 KΩ
R_{12} = 82 KΩ
R_{16} = 27 KΩ
R_{17} = 10 KΩ
R_{18} = 1000 Ω
R_{20} = 33 KΩ
R_{21} = 4700 Ω

RFC_1 = 10 μH
RFC_2 = 10 μH

Fig. 3 - Typical 3-Stage 43.5-Mc/s Amplifier Circuit.

DESIGN DATA FOR IF TRANSFORMERS AND TRAPS SHOWN IN FIG.3

ALL COILS ARE WOUND OF FORMVAR*, OR EQUIVALENT, WIRE ON 9/32-INCH O.D. FORMS EMBOSSED OR TAPPED TO ACCOMMODATE 1/4 x 28 THREAD SLUGS, 0.375-INCH LONG, MADE OF ARNOLD# TYPE SF OR EQUIVALENT MATERIAL.

T_1/T_2: Double-tuned, overcoupled transformer ($K = 1.73\ K_C$), with link coupling
  Primary (T_1): 9 turns No.30, close-wound
  Secondary (T_2): same as primary
  Coupling link: 1 turn No.26, wound over ground end of primary

T_3: Single-tuned transformer
  Primary: 10 turns No.26, close-wound
  Secondary: 1 turn No.30, wound over ground end of primary

T_4: Single-tuned transformer
  Primary: 11 turns No.26, close-wound, tapped at 1 turn from ground end. DC collector-supply voltage is connected to tap; neutralizing capacitor (C_{13}) is connected to ground end

T_5: Single-tuned transformer
  Primary: 14 turns No.30, close-wound
  Secondary: 7 turns No.30, close-wound next to ground end of primary

L_1: 39.75-Mc/s trap
  12 turns No.30, close-wound

L_2: 47.25-Mc/s trap
  9 turns No.30, close-wound

* Trade Mark, Shawinidan Products Corp.

\# Arnold Magnetics Corp., Los Angeles, Calif.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended servise is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The *flexible leads* of the 40235, 40236, 40237, 40238, 40239, and 40240 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using these devices, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.031" of the metal case.

The devices described in this bulletin should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the devices.

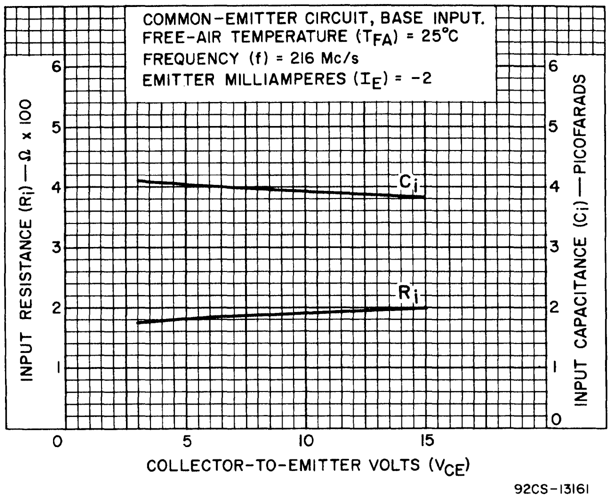


Fig.4 - Typical Input Characteristics at 216 Mc/s for RCA-40235.

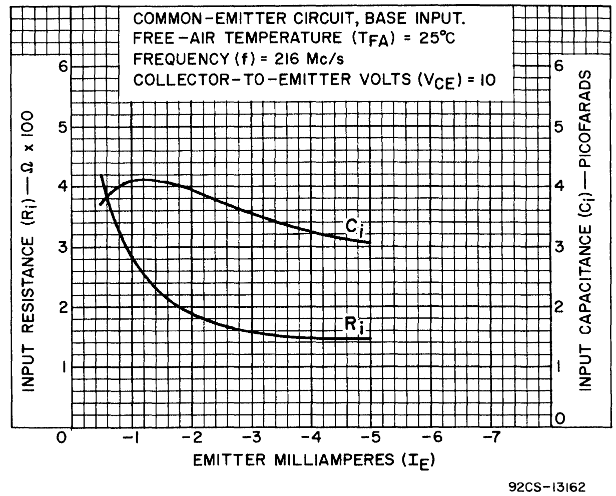


Fig.5 - Typical Input Characteristics at 216 Mc/s for RCA-40235.

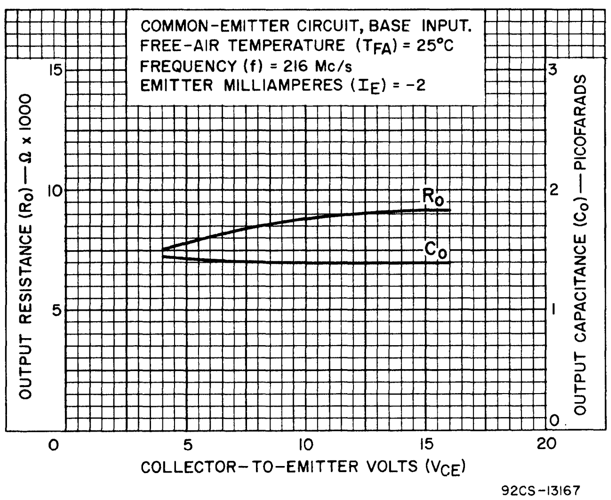


Fig.6 - Typical Output Characteristics at 216 Mc/s for RCA-40235.

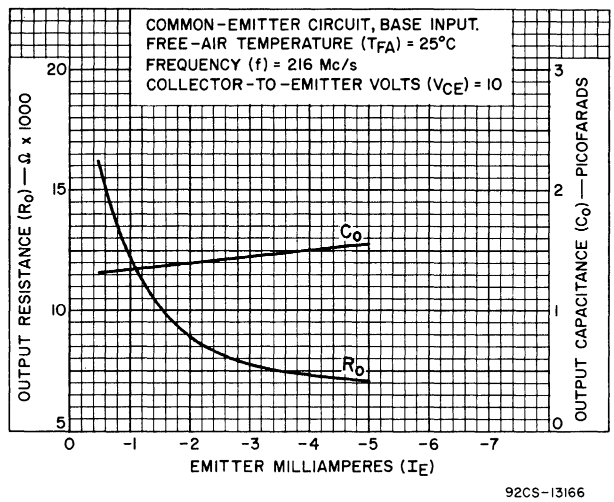


Fig.7 - Typical Output Characteristics at 216 Mc/s for RCA-40235.

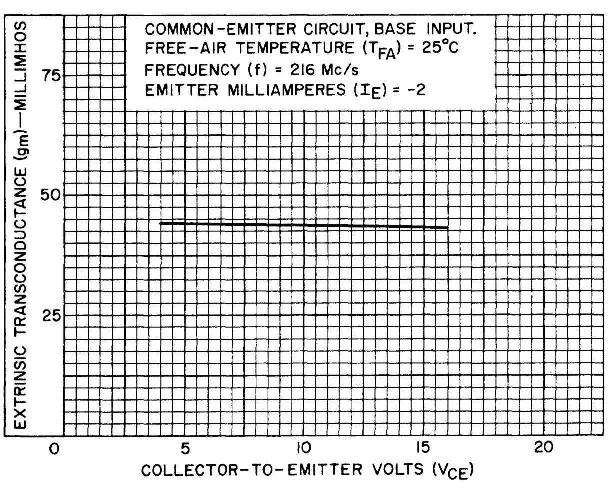


Fig.8 - Typical Extrinsic-Transconductance Characteristics at 216 Mc/s for RCA-40235.

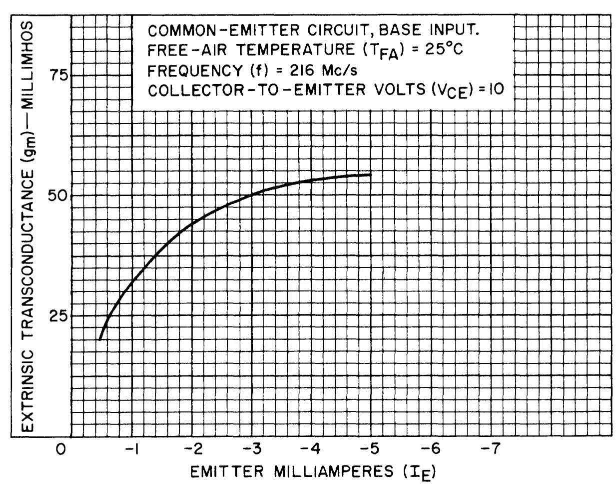


Fig.9 - Typical Extrinsic-Transconductance Characteristics at 216 Mc/s for RCA-40235.

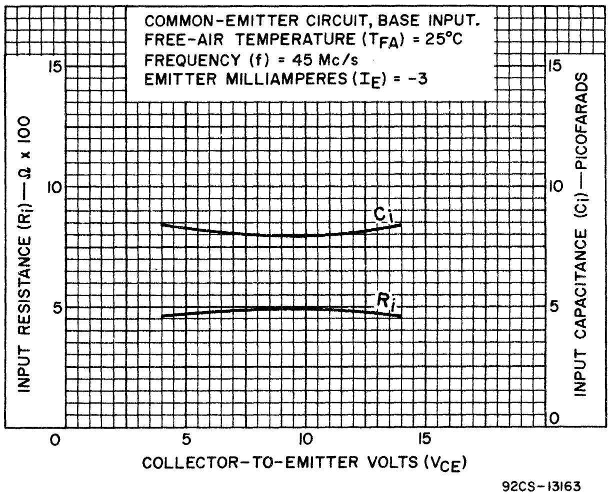


Fig.10 - Typical Input Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

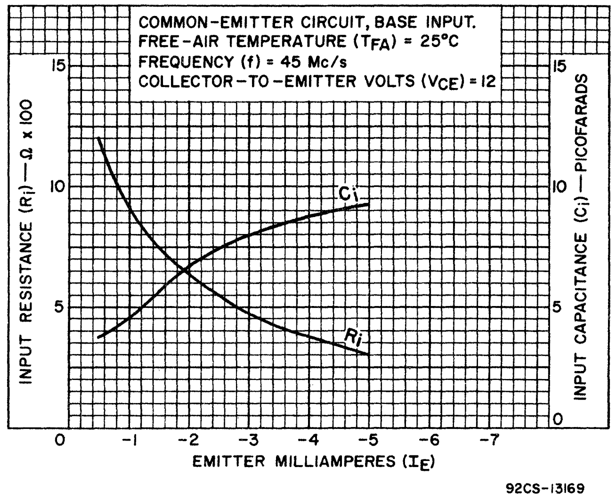


Fig.11 - Typical Input Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

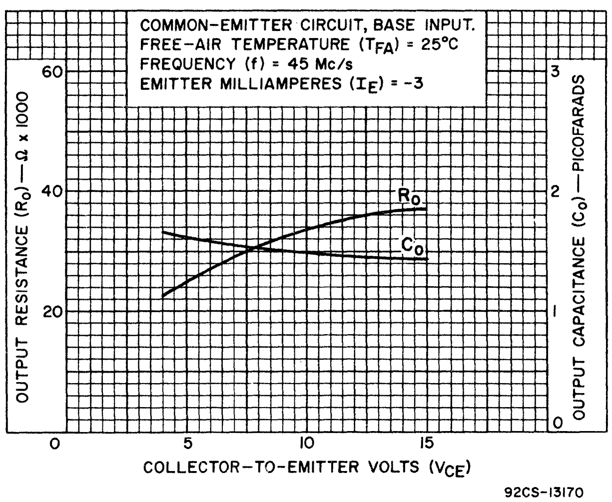


Fig.12 - Typical Output Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

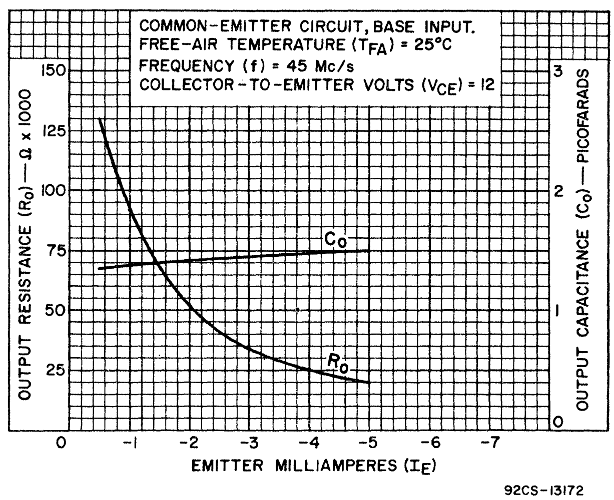


Fig.13 - Typical Output Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

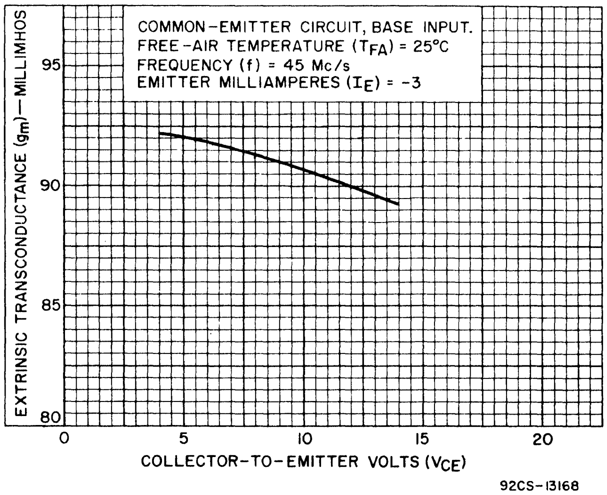


Fig.14 - Typical Extrinsic-Transconductance Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

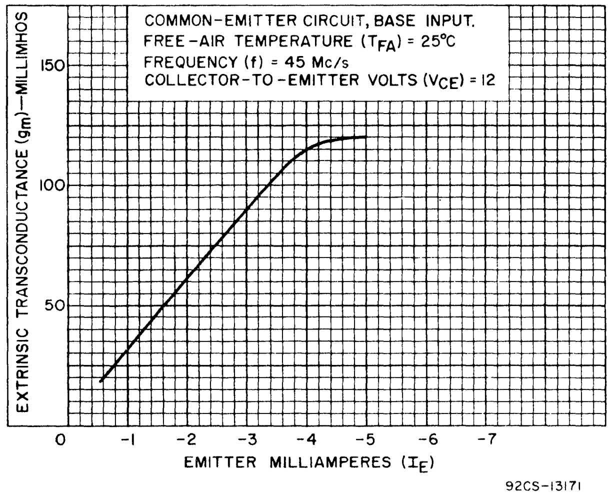


Fig.15 - Typical Extrinsic-Transconductance Characteristics at 45 Mc/s for RCA 40238, 40239, 40240.

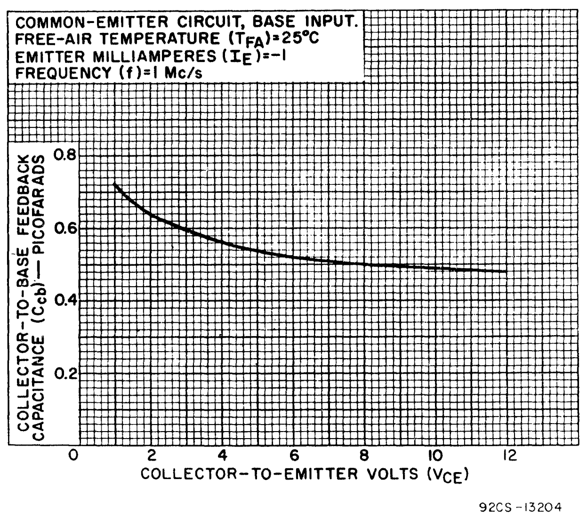
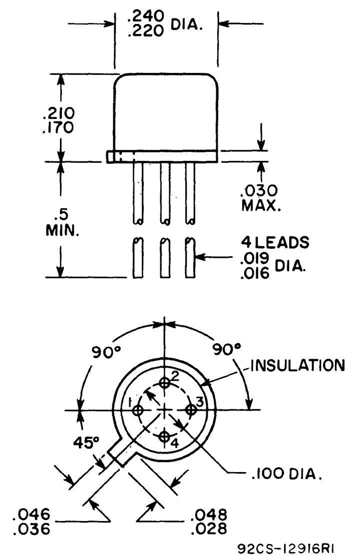


Fig.16 - Typical Feedback Capacitance Characteristics for RCA 40235, 40236, 40237, 40238, 40239, 40240.

DIMENSIONAL OUTLINE

40235, 40236, 40237
40238, 40239, 40240

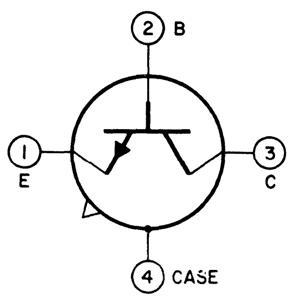


DIMENSIONS IN INCHES

TERMINAL DIAGRAM

Bottom View

Lead 1 – Emitter
Lead 2 – Base



Lead 3 – Collector
Lead 4 – Connected to Case

RCA HIGH-FREQUENCY TRANSISTORS
For FM & AM/FM Stereo-Multiplex Receivers

40242 40243 40244 40245 40246

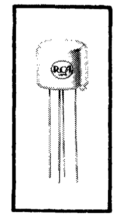
File No. 95

RCA-40242, 40243, 40244, 40245, and 40246 are silicon n-p-n planar transistors specifically designed for use in "front-end" and if-amplifier stages of FM and AM/FM receivers operating at frequencies up to approximately 110 MHz. These new RCA devices provide the equipment designer with a complete circuit complement of hermetically sealed transistors combining the high-temperature capability of silicon with low feedback capacitances, low noise, and high useful power gains in their recommended applications:

40242—rf amplifier
40243—mixer
40244—hf oscillator
40245 &
40246—if amplifiers

Types 40242, 40243, 40244, 40245, and 40246 utilize a hermetically sealed four-lead JEDEC TO-104 package. All active elements of the transistors are insulated from the case. The case may be grounded by means of the fourth lead to minimize interlead capacitances and undesired coupling between the transistors and other circuit components.

SILICON NPN HIGH-FREQUENCY TRANSISTORS



JEDEC TO-104

For "Front-End" and IF-Amplifier Stages of FM and AM/FM Stereo-Multiplex Receivers

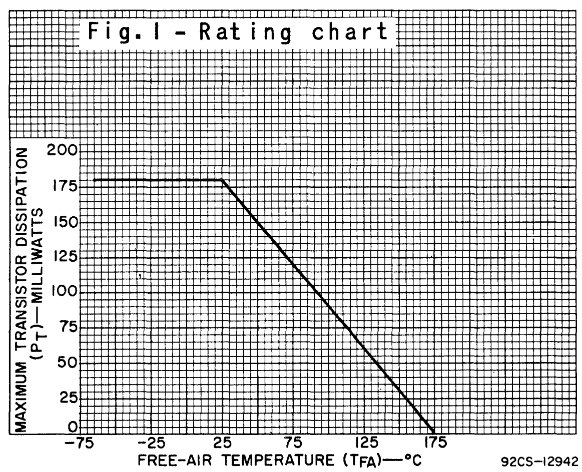
FEATURES

- low feedback capacitance—C_{ob} = 0.5 pF typ for amplifier and mixer types
- low noise—NF = 2.5 dB typ at 100 MHz for rf-amplifier type
- high useful power gains for rf ampl. types:
  21.5 dB neutralized
  16.4 dB unneutralized } at 100 MHz
  for if-amplifier types—
  33.2 dB typical neutralized
  28.1 dB typical unneutralized } at 10.7 MHz

Maximum Ratings, *Absolute-Maximum Values:*

	40242	40243	40244	40245	40246	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	45	45	45	45	45	V
COLLECTOR-TO-BASE VOLTAGE, V_{CBV} (V_{EB} = -1 V)	45	45	45	45	45	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	45	45	45	45	45	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4.5	4.5	4.5	4.5	4.5	V
COLLECTOR CURRENT, I_C	50	50	50	50	50	mA
TRANSISTOR DISSIPATION, P_T:						
At ambient temperatures up to 25°C	180	180	180	180	180	mW
At ambient temperatures above 25°C		See Fig. 1				
AMBIENT TEMPERATURE RANGE:						
Storage and operating.		-65 to +175				°C
LEAD TEMPERATURE (During soldering):						
At distances not closer than 1/32 inch to seating surface for 10 sec. max.	255	255	255	255	255	°C

Fig. 1 - Rating chart



ELECTRICAL CHARACTERISTICS, At an Ambient Temperature (T_A) = 25°C

Characteristics	Symbol and Unit	TEST CONDITIONS f	V_{CE}	I_E	LIMITS Type 40242 RF Amplifier			Type 40243 Mixer			Type 40244 Oscillator			Type 40245 IF Amplifier			Type 40246 IF Amplifier		
		MHz	V	mA	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
Collector-Cutoff Current	I_{CBO} µA		1	0	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02
Emitter-Cutoff Current	I_{EBO} µA		1.5		-	-	1	-	-	1	-	-	1	-	-	1	-	-	1
Collector-to-Base Breakdown Voltage	BV_{CBO} V			I_C = 0.001	45	-	-	45	-	-	45	-	-	45	-	-	45	-	-
Collector-to-Base Breakdown Voltage	BV_{CBV} V		V_{EB} = -1		45	-	-	45	-	-	45	-	-	45	-	-	45	-	-
Collector-to-Emitter Breakdown Voltage	BV_{CEO} V			-0.5	45	-	-	45	-	-	45	-	-	45	-	-	45	-	-
Emitter-to-Base Breakdown Voltage	BV_{EBO} V			-0.001	4.5	-	-	4.5	-	-	4.5	-	-	4.5	-	-	4.5	-	-
Static Forward Current-Transfer Ratio	h_{FE}		6	-1	40	80	170	40	80	170	27	65	170	70	130	275	27	55	90
Feedback Capacitance	C_{ob} pF	1	8	0	-	0.5	0.65	-	0.5	0.65	-	0.6	0.8	-	0.5	0.65	-	0.5	0.65
Input Resistance	R_{IN} Ω	100	7.5	-1.5	-	450	-	-	-	-	-	-	-	-	-	-	-	-	-
				-1	-	-	-	-	650	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	-	-	1500	-	-	1200	-
Input Capacitance	C_{IN} pF	100	7.5	-1.5	-	5.2	-	-	-	-	-	-	-	-	-	-	-	-	-
				-1	-	-	-	-	4.5	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2											8.2			8.2	-
Output Resistance	R_{OUT} Ω	100	7.5	-1.5	-	30000	-	-	-	-	-	-	-	-	-	-	-	-	-
				-1	-	-	-	-	30000	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	-	-	80000	-	-	90000	-
Output Capacitance	C_{OUT} pF	100	7.5	-1.5	-	1.35	-	-	-	-	-	-	-	-	-	-	-	-	-
				-1	-	-	-	-	1.35	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	-	-	1.5	-	-	1.5	-
Extrinsic Transconductance	g_m mmho	100	7.5	-1.5	-	45	-	-	-	-	-	-	-	-	-	-	-	-	-
				-1	-	-	-	-	32	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	-	-	70	-	-	70	-
Device Noise Figure (Source Resistance, R_g = 300 ohms)	NF dB	100	See Fig.15		-	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Oscillator Output Voltage (Common-Base Circuit)	V_O mV	120	See Fig.16		-	-	-	-	-	-	-	55	-	-	-	-	-	-	-
Maximum Available Amplifier Gain	MAG dB	100	7.5	-1.5	-	38.3	-	-	-	-	-	-	-	-	-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	-	-	51.4	-	-	51.2	-
Maximum Available Conversion Gain	MAG_C dB	100 to 10.7	7.5	-1	-	-	-	-	37.64	-	-	-	-	-	-	-	-	-	-
Maximum Usable Amplifier Gain (Neutralized)	MUG dB	100	7.5	-1.5	-	21.5	-	-	-	-	-	-	No. OF STAGES		-	-	-	-	-
		10.7	See Fig.17		-	-	-	-	-	-	-	-	1		33.2	-	-	33.2	-
					-	-	-	-	-	-	-	-	2		31	-	-	31	-
					-	-	-	-	-	-	-	-	3		29.2	-	-	29.2	-
													4		28.5	-	-	28.5	-
Maximum Usable Amplifier Gain (Unneutralized)	MUG dB	100	See Fig.15		-	16.4	-	-	-	-	-	-	-		-	-	-	-	-
		10.7	7.5	-2	-	-	-	-	-	-	-	-	1		28.1	-	-	28.1	-
					-	-	-	-	-	-	-	-	2		25.9	-	-	25.9	-
					-	-	-	-	-	-	-	-	3		24.1	-	-	24.1	-
					-	-	-	-	-	-	-	-	4		23.4	-	-	23.4	-

FM TUNER SECTION OF AM/FM STEREO MULTIPLEX RECEIVERS

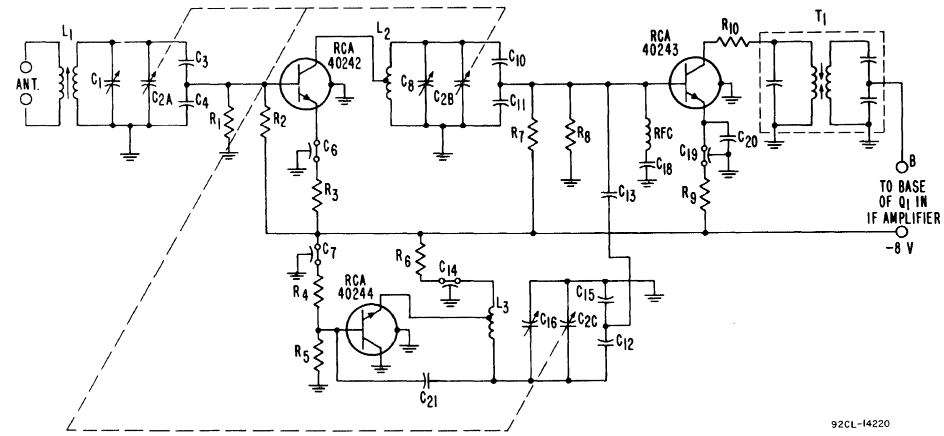


Fig.2A

PARTS LIST

C_1, C_8: Trimmer, approx. 17 pF max
C_{2A}, C_{2B}: 7.25 to 19 pF, ganged tuning capacitor
C_{2C}: 6 to 21 pF
C_3, C_{21}: 3.3 pF
C_4: 47 pF
C_6, C_7, C_{14}, C_{19}: 1000 pF, feed-through type
C_{10}: 5 pF
C_{11}: 6.2 pF
C12: 20 pF
C13: 0.47 pF
C15: 68 pF
C16: 1.5 to 10 pF approx., trimmer capacitor
C18: 240 pF
C20: 0.01 μF

L_1, L_2, L_3: See Tuner Coil Data Chart page 15
R_1: 18 K
R_2: 3.3 K
R_3: 330 Ω
R_4: 4.7 K
R_5: 8.2 K
R_6: 1000 Ω
R_7: 3.9 K
R_8: 12 K
R_9: 820 Ω
R_{10}: 100 Ω
R_{FC}: 1 μH
T_1: See IF Transformer Design Chart page 11

Note: (a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified
(b) Capacitors are in microfarads, unless otherwise specified.

OPERATING CONDITIONS

RCA-40242 V_{CE} = 7.5V; I_E = -1.5 mA
RCA-40244 V_{CE} = 7.5V; I_E = -2.5 mA
RCA-40243 V_{CE} = 7.5V; I_E = -1.5 mA

IF AMPLIFIER SECTION OF AM/FM STEREO MULTIPLEX RECEIVER

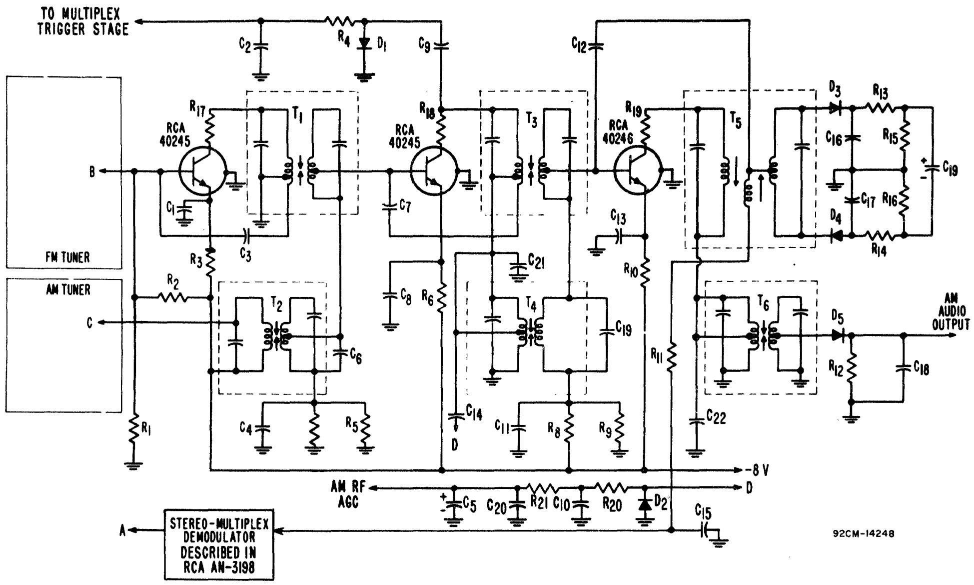


Fig.2B

PARTS LIST

C_1, C_2, C_4, C_8, C_{10}, C_{11}, C_{13}, C_{20}: 0.05 µF
C_3, C_7: 4.7 pF, zero-temperature coefficient
C_5, C_{19}: 5 µF, 10 V, electrolytic
C_6: 0.01 µF
C_9: 5 pF, zero-temperature coefficient
C_{12}: 1 pF, zero-temperature coefficient
C_{14}: 180 pF
C_{15}: 220 pF
C_{16}, C_{17}: 330 pF, silver mica
C_{18}, C_{19}: 0.02 µF
C_{21}, C_{22}: 1000 pF
D_1, D_2, D_5: 1N295 Diode
D_3, D_4: 1N541 Diode
R_1, R_5, R_9: 12 K
R_2, R_7, R_8, R_{21}: 2.7 K
R_3, R_6, R_{10}, R_{17}, R_{18}: 220 Ω
R_4: 22 K
R_{11}: 68 Ω
R_{12}: 10 K
R_{13}: 1.5 K
R_{14}: 1000 Ω
R_{15}, R_{16}: 6.8 K
R_{19}: 470 Ω
R_{20}: 3 K
T_1, T_2, T_3, T_4, T_5, T_6: See pages 10 & 11

Note: (a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.

OPERATING CONDITIONS FOR RCA-40245 and 40246

$V_{CE} = 7.5\,V$, $I_E = -3$ mA

TYPICAL PERFORMANCE CHARACTERISTICS OF RECEIVER SHOWN IN FIGURES 2A & 2B

FM Section (Measured at 98 MHz with 300-ohm unbalanced input):		
Sensitivity:		
For 20 dB quieting	4.4	µV
For 30 dB quieting	8	µV
For 3 dB limiting	5.2	µV
Overall Bandwidth at -6 dB points*	270	kHz
Rejection:		
IF	85	dB
1/2 IF	90	dB
Image	63	dB
IF-Amplifier gain	88	dB
AM IF Amplifier:		
Bandwidth at -6 dB points	9.6	kHz
Gain	60	dB

* Measured with 10 µV input to antenna terminal.

LOW-COST AM/FM TUNER

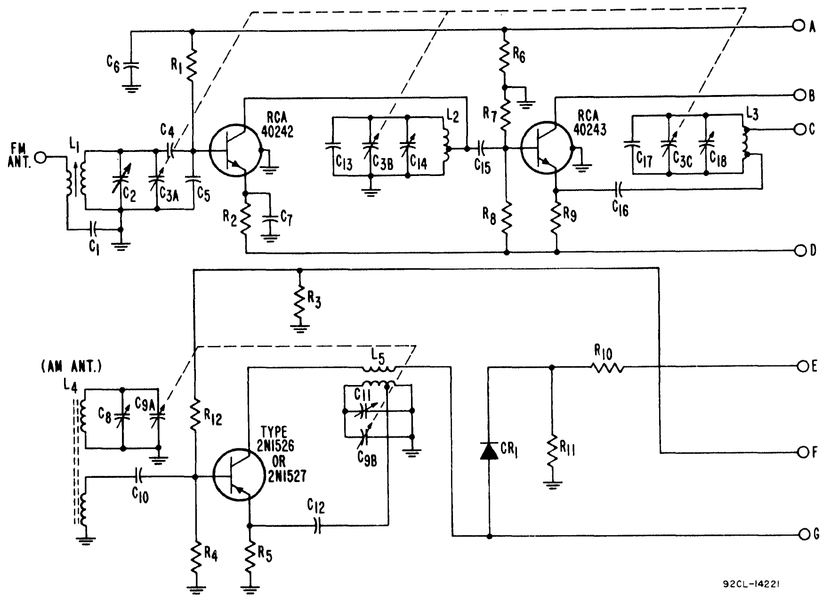


Fig.3A

PARTS LIST

C_1: 120 pF
C_2, C_{14}: Trimmer capacitor 17 pF max.
C_{3A}, C_{3B}: FM ganged tuning capacitor, 7.25 to 19 pF
C_{3C}: FM ganged tuning capacitor, 6 to 21 pF
C_4, C_{13}, C_{17}: 15 pF
C_5: 27 pF
C_6, C_7: 0.001 μF
C_8, C_{18}: Trimmer capacitor 10 pF max.
C_{9A}: AM ganged tuning capacitor, 9 to 176 pF
C_{9B}: AM ganged tuning capacitor, 18 to 126 pF
C_{10}: 0.05 μF
C_{11}: Trimmer capacitor 20 pF max.
C_{12}: 0.025 μF
C_{15}: 0.01 μF
C_{16}: 100 pF
CR_1: 1N295 Diode

L_1, L_2, L_3, L_4, L_5: See Tuner Coil Data Chart page 15
R_1, R_9: 2.2 K
R_2: 390 Ω
R_3: 3.3 K
R_4: 3.9 K
R_5: 1.8 K
R_6: 56 K
R_7: 68 K
R_8: 5.6 K
R_{10}: 4.7 Ω
R_{11}: 18 K
R_{12}: 33 K

Note: (a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.

LOW-COST AM/FM-IF AMPLIFIER CIRCUIT

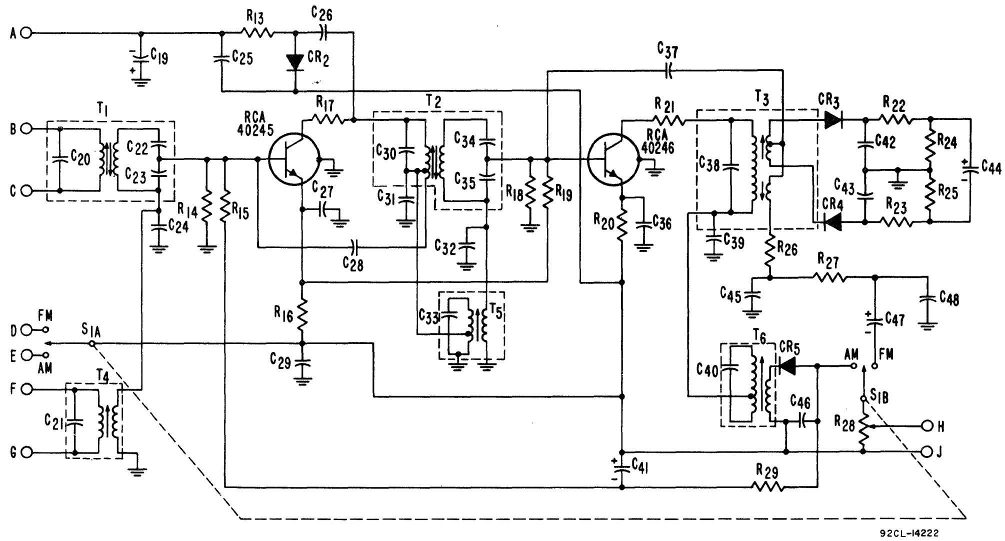


Fig.3B

PARTS LIST

C_{19}, C_{41}, C_{44}: 5 μF, 15 V electrolytic
C_{20}: part of T_1, See page 11
C_{21}: part of T_4, See page 12
C_{22}, C_{23}: part of T_1, See page 11
C_{24}, C_{32}, C_{46}: 0.01
C_{25}, C_{27}, C_{29}, C_{36}: 0.05 μF
C_{26}: 5 pF
C_{28}: 5.6 pF
C_{30}: part of T_2, See page 10
C_{31}, C_{39}: 0.001 μF
C_{32}, C_{46}: 0.01 μF
C_{33}: part of T_5, See page 12
C_{34}, C_{35}: part of T_2, See page 10
C_{37}: 1.5 pF
C_{38}: part of T_3, See page 11
C_{40}: part of T_6, See page 12
C_{42}, C_{43}: 330 pF
C_{45}: 0.0082 μF
C_{47}: 10 μF, 15 V electrolytic
C_{48}: 0.02 μF
CR_2, CR_5: 1N295 Diode
CR_3, CR_4: 1N541 Diode
R_{15}: 2.2 K
R_{16}, R_{17}, R_{21}: 220 Ω
R_{18}: 18 K
R_{19}: 2.7 K
R_{20}: 390 Ω
R_{22}: 1.5 K
R_{23}: 1000 Ω
R_{24}, R_{25}: 6.8 K
R_{26}: 68 Ω
R_{27}: 3.9 K
R_{28}: 10K, 0.5W audio taper potentiometer
R_{29}: 15 K
S_{1A}, S_{1B}: AM/FM-mode switch
T_1: 1st. FM-IF amplifier transformer, See page 11
T_2: 2nd. FM-IF amplifier transformer, See page 10
T_3: Ratio detector transformer, See page 11
T_4: 1st. AM-IF amplifier transformer, See page 12
T_5: 2nd. AM-IF amplifier transformer, See page 12
T_6: AM detector transformer, See page 12

Note: (a) Resistor are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.

TYPICAL PERFORMANCE DATA FOR AM/FM LOW-COST RADIO RECEIVERS SHOWN IN FIGS. 3A AND 3B

FM Section of Receiver

	Signal Frequency (MHz) 100
Sensitivity for 50-mW output	1.4 μV
Sensitivity for 20 dB signal-to-noise ratio	2 μV
Sensitivity for 30 dB signal-to-noise ratio	4 μV
Sensitivity for 3 dB limiting	25 μV
Image Rejection	52 dB

AM Section of Receiver

Signal Frequency (kHz)	600	1000	1400	
Sensitivity for 50-mW output	150	130	100	μV/m
Sensitivity for 20 dB signal-to-noise ratio	200	200	130	μV/m
Overall bandwidth at -6 dB points	6.5	8.5	9	kHz
Overall bandwidth at -20 dB points	20.6	23.5	26	kHz
AGC Figure of merit for Input Signal Strength = 50,000 μV/m	–	40	–	dB
RF Overload	–	400,000	–	μV/m

TUNER SECTION OF LOW-COST FM RECEIVER

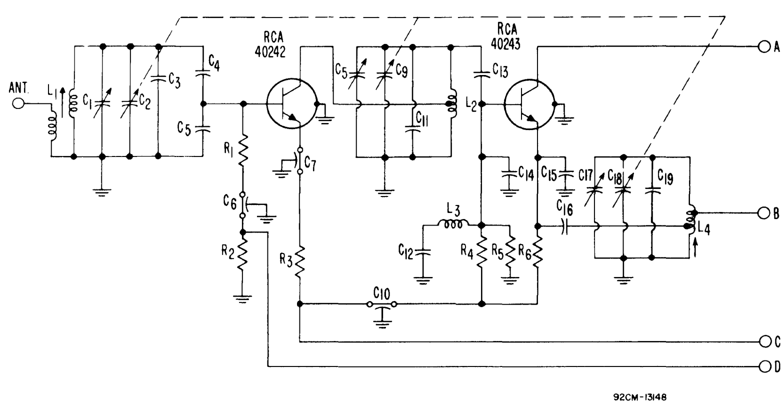


Fig.4A

PARTS LIST

C_1, C_8: Trimmer, approx. 17 pF max.
C_2, C_9: 7.25 to 19 pF ganged tuning type
C_3, C_{11}, C_{13}: 4.7 pF zero-temperature coefficient type
C_4: 6.8 pF zero-temperature coefficient type
C_5, C_{16}: 15 pF zero-temperature coefficient type
C_6, C_7, C_{10}: 1000 pF, feedthrough type
C_{12}: 240 pF
C_{14}: 12 pF
C_{15}: 56 pF
C_{17}: 1.5 to 10 pF approx., trimmer
C_{18}: 6 to 21 pF ganged tuning type
C_{19}: 18 pF zero temperature coefficient type
L_1: Antenna Coil- See Tuner Coil Chart page 15
L_2: Interstage Coil - See Tuner Coil Chart page 15
L_3: RF choke, 1 μH
L_4: Oscillator Coil - See Tuner Coil Chart page 15
R_1, R_6: 2.2 K
R_2: 56 K
R_3: 390 Ω
R_4: 4.7 K
R_5: 5.6 K

Note: (a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.

IF AMPLIFIER FOR LOW-COST FM RECEIVER

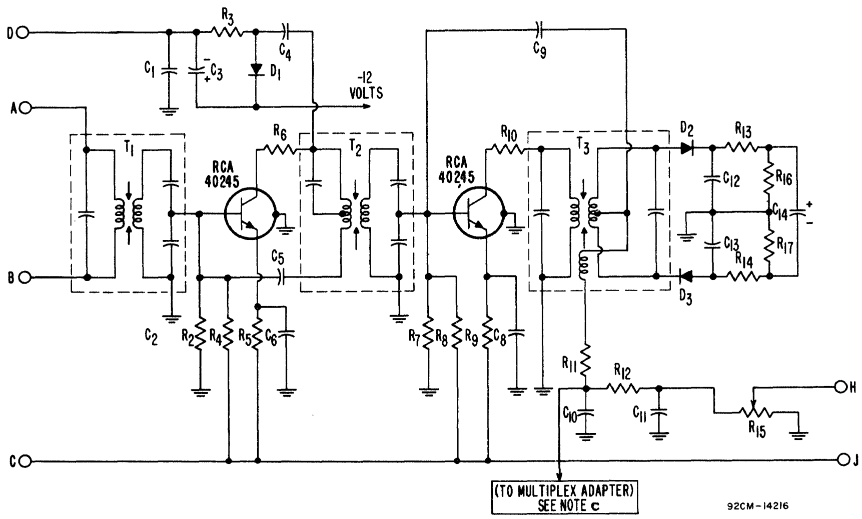


Fig. 4B

PARTS LIST

C_1: 0.05 µF
C_6, C_8: 0.01 µF
C_3, C_{14}: 5 µF, 15 V, electrolytic
C_4: 5 pF, zero-temperature coefficient type
C_5: 4.7 pF zero-temperature coefficient type
C_9: 1.5 pF, zero-temperature coefficient type
C_{10}: 100 pF
C_{11}: 0.02 µF
C_{12}, C_{13}: 330 pF, silver-mica
D_1: 1N295 Diode
D_2, D_3: 1N541 Diode

R_{16}, R_{17}: 6.8 K
R_2, R_7: 4.7 K
R_3: 6.8 K
R_4, R_8: 2.7 K
R_5, R_9: 680 Ω
R_6, R_{10}: 220 Ω
R_{11}: 68 Ω
R_{12}: 3.9 K
R_{13}: 1.5 K
R_{14}: 1000 Ω
R_{15}: 10 kΩ, 0.5 W audio taper potentiometer
T_1, T_2, T_3: See pages 10 & 11

Note: (a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.
(c) Omit R_{12}, R_{15}, C_{11} when using Multiplex Demodulator

OPERATING CONDITIONS

RCA-40245 $V_{CE} = 7.5$ V, $I_E = -5$ mA

TYPICAL PERFORMANCE CHARACTERISTICS OF LOW-COST FM RECEIVER SHOWN IN FIGURES 4A & 4B

Measured with 75-ohm Unbalanced Input

	Signal Frequency	98 MHz
Sensitivity:		
For 20 dB signal-to-noise ratio		2 µV
For 30 dB signal-to-noise ratio		3.5 µV
For 3 dB limiting		35 µV
Overall bandwidth at -6 dB points for an input signal of 10 µV		240 kHz
Rejection:		
IF		86 dB
1/2 IF		65 dB
Image		50 dB
IF-Amplifier gain		65.2 dB

AF AMPLIFIER AND POWER SUPPLY FOR LOW-COST AM/FM RADIO RECEIVER SHOWN IN FIGS.3A & 3B, AND LOW-COST FM RECEIVER SHOWN IN FIGS.4A & 4B

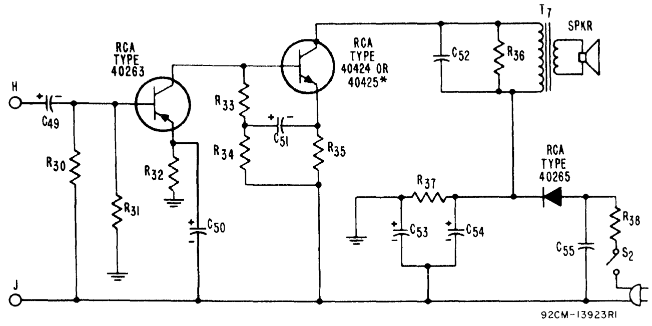


Fig.5

PARTS LIST

C_{49}: 10 μF, 15 V electrolytic
C_{50}, C_{51}: 25 μF, 6 V electrolytic
C_{52}, C_{55}: 0.01 μF, 300 V
C_{53}: 100 μF, 15 V electrolytic
C_{54}: 100 μF, 150 V electrolytic
R_{30}: 15 K
R_{31}: 3.3 K
R_{32}, R_{33}: 820 Ω
R_{34}: 470 Ω
R_{35}: 100 Ω
R_{36}: 10 K
R_{37}: 4.7 K, 2 W
R_{38}: 250 Ω, 4 W
S_2: On-Off Switch
T_7: Output Transformer: primary impedance, 2500 Ω; secondary impedance, 3.2 Ω; efficiency, 80 percent; Triad type S-12X or equivalent

Note: *40425 may be mounted directly on printed-circuit board with no additional heat sink for operation at ambient temperatures up to 55°C.

(a) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
(b) Capacitors are in microfarads, unless otherwise specified.
(c) For additional design characteristics on types 40263, 40424, and 40425 refer to RCA bulletin, "RCA Solid-State Devices for Line-Operated Radio Receivers and Phonographs", File No.79.

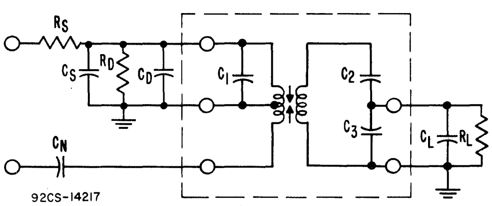
DESIGN REQUIREMENTS FOR IF TRANSFORMERS USED IN CIRCUITS SHOWN IN FIGURES 2A, 2B, 3B, AND 4B

Components Inside Dashed Outlines of Schematics are Parts of Transformer or Tank Circuits, Components Outside Dashed Outlines Represent Actual or Equivalent Values for Source and Load Circuits.

DEFINITIONS FOR SYMBOLS USED IN IF-TRANSFORMER AND TANK CIRCUIT DESIGN DATA (Typical Symbols Used by Coil Manufacturers)

R_S = Source resistance (Output resistance of preceding stage)
C_S = Source shunt capacitance (Stray output capacitance of preceding stage)
R_D = External shunt resistance, (AGC, etc.)
C_D = External shunt capacitance (AGC, etc.)
C_N = Neutralizing capacitance (To transistor base of preceding stage)
C_L = Load shunt capacitance (Input capacitance of following stage or external capacitance of transformer secondary).
R_L = Load resistance (Input resistance of following stage)
f = Operating frequency.
A = Transformer input impedance (Transformer impedance seen by source)
KQ = Per cent of critical coupling
N_1/N_2 = Turns ratio: full primary to tapped portion of primary (applies to single-tuned, double-tuned transformer)
N_2/N_3 = Turns ratio: tapped portion of primary to full secondary; for ratio detector transformer, full primary to tertiary
N_3/N_4 = Turns ratio: full secondary to tapped portion of secondary (applies to double-tuned transformer only)
Q_{OU}' = Unloaded, uncoupled Q of primary
Q_{LU}' = Loaded, uncoupled Q of primary
Q_{OU}'' = Unloaded, uncoupled Q of secondary
Q_{LU}'' = Loaded, uncoupled Q of secondary

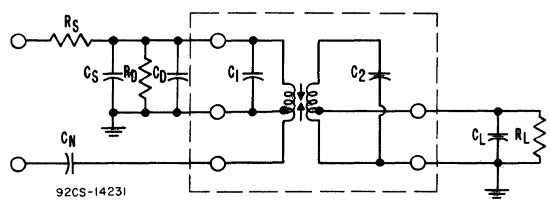
Fig.6 - FM IF TRANSFORMER



Part No.T2 in Figures 3B & 4B

Symbols	Circuit Values T2	Units
A	5500	Ω
C_1	63	pF
C_2	28	pF
C_3	820	pF
C_L	17	pF
C_N	4.7	pF
C_D	5	pF
C_S	1.5	pF
f	10.7	MHz
KQ	85	%
N_1/N_2	7.27	
N_3/N_4	1	
Q_{OU}'	77.5	
Q_{LU}'	40	
Q_{OU}''	73.7	
Q_{LU}''	69.5	
R_L	700	Ω
R_D	30000	Ω
R_S	42000	Ω

Fig.7 - FM IF TRANSFORMER

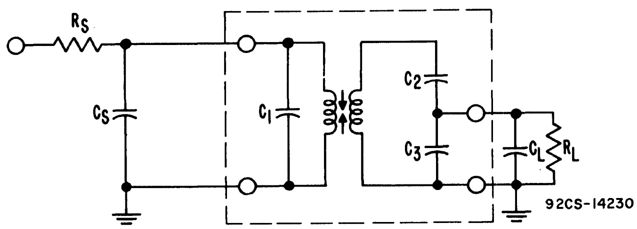


Parts No.T1 and T3 in Figure 2B

Symbols	Circuit Values T1	T3	Units
A	6070	6070	Ω
C_1	88.3	55.15	pF
C_2	37.8	36.59	pF
C_L	9.6	9.6	pF
C_N	4.7	4.7	pF
C_S	1.5	6.5	pF
f	10.7	10.7	MHz
KQ	90	90	%
N_1/N_2	7.27	7.27	
N_3/N_4	26.65	27.5	
Q_{OU}'	72.4	82.8	
Q_{LU}'	60	41.2	
Q_{OU}''	62.3	64.2	
Q_{LU}''	60	61.85	
R_L	900	900	Ω
R_D	–	30000	Ω
R_S	58000	58000	Ω
C_D	–	5.0	pF

IF TRANSFORMER DESIGN DATA

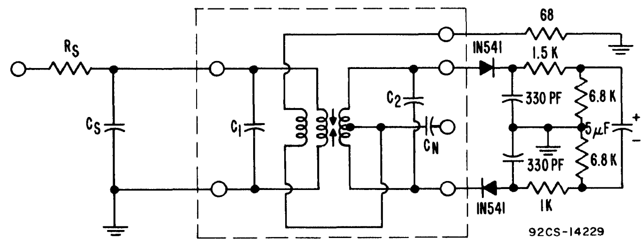
Fig.8 - FM IF TRANSFORMER



Part No.T1 in Figures 2A, 3B & 4B

Symbols	Circuit Values T1(2A, 3B)	Circuit Values T1(4B)	Units
A	6070	5500	Ω
C_1	85.6	69.2	pF
C_2	39.3	37.2	pF
C_3	1000	820	pF
C_L	9.6	17	pF
C_S	1.5	1.5	pF
f	10.7	10.7	MHz
K_Q	90	85	%
Q_{OU}'	68.15	60.8	
Q_{LU}'	60	52.8	
Q_{OU}''	62.3	56	
Q_{LU}''	60	52.8	
R_L	900	700	Ω
R_S	86000	86000	Ω
N_1/N_2	1	–	Ω
N_3/N_4	26.67	–	

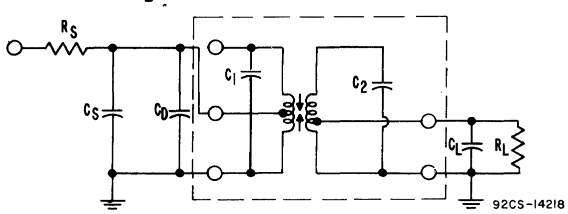
Fig.9 - RATIO DETECTOR TRANSFORMER



Parts T5 Fig.2B, T3 Figs.3B & 4B

Symbols	Circuit Values T5(2B)	Circuit Values T3(3B 4B)	Units
A	6070	3650	Ω
C_1	50	50	pF
C_2	47	47	pF
C_L	See secondary network (outside dotted line)		
C_N	1	1	pF
C_S	1.5	1.5	pF
f	10.7	10.7	MHz
K_Q	70.8	70.8	%
N_1/N_2	1	1	
N_2/N_3	2.5	2.5	
Q_{OU}'	65	65	
Q_{LU}'	28.5	27	
Q_{OU}''	65	65	
Q_{LU}''	24.75	24.75	
R_L	See secondary network (outside dotted line)		
R_S	58000	42000	Ω

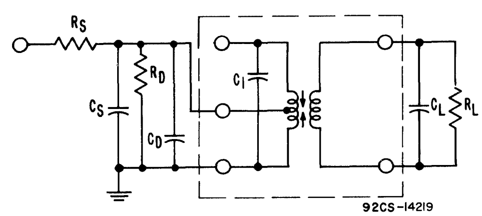
Fig.10 - AM IF TRANSFORMER



Parts No.T2 & T6 in Figure 2B

Symbols	Circuit Values T2(2B)	Circuit Values T6(2B)	Units
A	18000	1600	Ω
C_1	470	1000	pF
C_2	470	100	pF
C_L	0.02	–	μF
C_S	1.5	1.5	pF
f	455	455	kHz
K_Q	85	85	%
N_1/N_2	1	8.06	
N_3/N_4	19.1	7.71	
Q_{OU}'	43.4	60.2	
Q_{LU}'	41	57.5	
Q_{OU}''	44.8	85	
Q_{LU}''	41	42.5	
R_L	900	5000	Ω
R_S	560000	560000	Ω
C_D	–	1000	pF

Fig.11 - AM IF TRANSFORMER

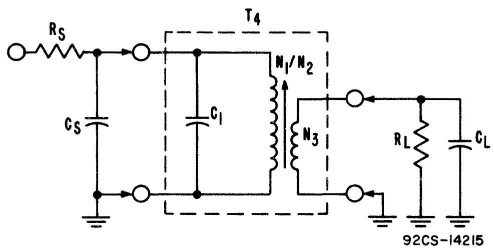


Part No.T4 shown in Figure 2B

Symbols	Circuit Values T4(2B)	Units
A	3050	Ω
C_1	1000	pF
C_D	1180	pF
C_L	0.02	μF
C_S	1.5	pF
f	455	kHz
N_1/N_2	6.35	
N_2/N_3	7.66	
R_D	31000	Ω
R_L	900	Ω
R_S	560000	Ω
Q_O	57.5	
Q_L	46.1	

IF TRANSFORMER DESIGN DATA—Cont'd

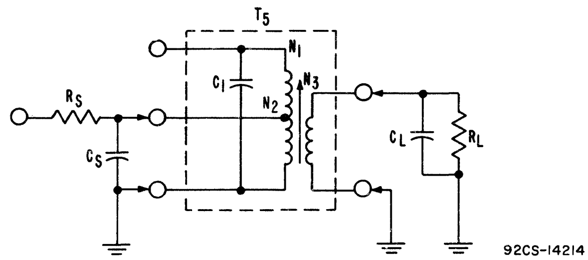
Fig. 12 - AM IF TRANSFORMER



Part No. T4 shown in Figure 3B

Symbols	Circuit Values	Units
C_1	860	pF
C_L	0.01	μF
C_S	4	pF
f	455	kHz
N_1/N_2	1	
N_2/N_3	31	
Q_O	54.4	
Q_L	50.4	
R_L	620	Ω
R_S	480	kΩ

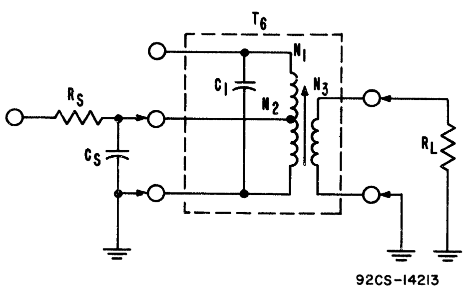
Fig. 13 - AM IF TRANSFORMER



Part No. T5 shown in Figure 3B

Symbols	Circuit Values	Units
C_1	185	pF
C_L	0.01	μF
C_S	0.001	μF
f	455	kHz
N_1/N_2	3.12	
N_2/N_3	8.39	
Q_O	60	
Q_L	45	
R_1	620	Ω
R_S	43.5	kΩ

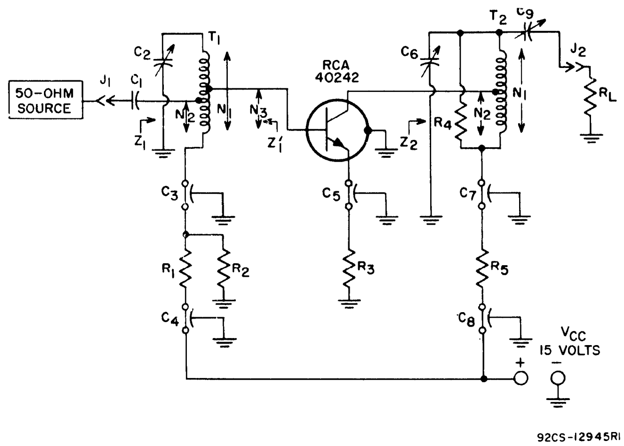
Fig. 14 - AM IF TRANSFORMER



Part No. T6 shown in Figure 3B

Symbols	Circuit Values	Units
C_1	185	pF
C_S	0.001	μF
f	455	kHz
N_1/N_2	2.81	
N_2/N_3	0.76	
Q_O	60	
Q_L	25	
R_L	12.5	kΩ
R_S	43.5	kΩ

100-MHz POWER GAIN AND NOISE FIGURE TEST CIRCUIT FOR RCA-40242



C_1: 50 pF, silver mica type

C_2, C_6: 2.8–17.5 pF, variable, Hammarlund Type HF-15 or equivalent

C_3, C_4, C_5, C_7, C_8: 1500 pF, feedthrough type

C_9: 0.7–3 pF tubular trimmer, Erie Type 535-4R or equivalent (See T_2)

J_1, J_2: BNC-type coaxial connector, for 50-Ω termination.

R_1*: 39000 Ω approx., 0.25 watt

R_2: 3900 Ω ± 1%, 0.25 watt

R_3: 330 Ω ± 1%, 0.25 watt

R_4: 27000 Ω ± 5%, 0.5 watt (See T_2)

R_5: 4700 Ω 1%, 0.5 watt

T_1: 4 turns B & W Type 3002 Miniductor or equivalent. Q_O = 280, Q_L = 28

N_1/N_2 = 5.6 (Adjusted for Z_1 = 250 Ω with no secondary termination)

N_2/N_3 = 0.31 (Adjusted for Z'_1 = 1795 Ω with no primary termination)

Z_1 = 50 Ω when secondary is terminated with 450 Ω in parallel with 5.2 pF

Z'_1 = 300 Ω when primary is terminated with 50 Ω

T_2: 4 turns B & W Type 3002 Miniductor or equivalent. Q_O (with R_4 = 27000 Ω) = 80, Q_L = 39.6

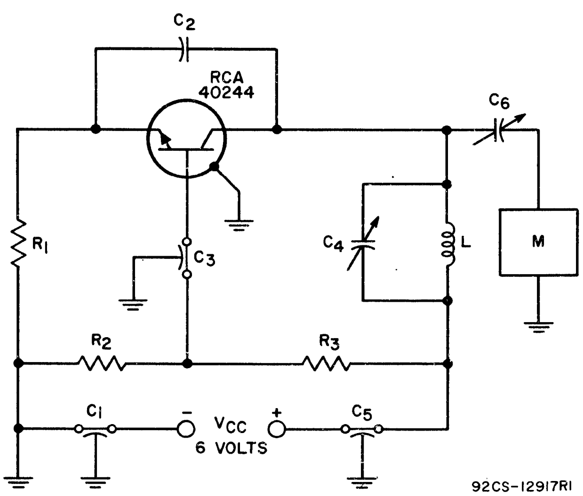
N_1/N_2 = 10.35 (Adjusted for Z_2 = 243 Ω with no secondary termination)

with secondary terminated in 50 Ω, Adjusted C_9 for Z_2 = 121 Ω

* Select to obtain in proper current with nominal transistor.

Fig.15

120-MHz OSCILLATOR VOLTAGE OUTPUT TEST CIRCUIT FOR RCA-40244



C_1, C_5: 1500 pF, feedthrough capacitors

C_2: 3.3 pF, tubular ceramic type

C_3: 1000 pF minimum value, feedthrough capacitor

C_4: 3–35 pF, Trimmer capacitor, Arco Type 403 or equivalent

C_6: 1.6 pF, ceramic capacitor

L: 4 turns B & W Type 3002 Miniductor or equivalent

M: RF voltmeter, 50 Ω input impedance, Boonton Model 91D with 50 Ω adapter, or equivalent

R_1: 1200 ± 10% Ω, 0.25 watt

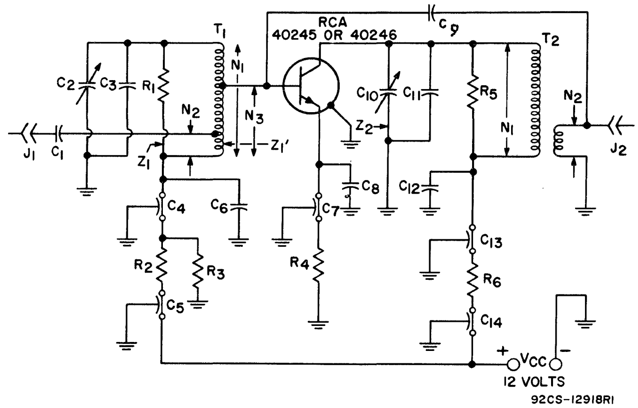
R_2: 10000 ± 10% Ω, 0.25 watt

R_3: 47000 ± 10% Ω, 0.25 watt

R_L: Load, 50 Ω

Fig.16

10.7-MHz NEUTRALIZED AMPLIFIER CIRCUIT USED TO MEASURE POWER GAIN OF RCA-40245 AND 40246



C_1, C_6, C_8, C_{12}: 0.05 μF, ceramic disc type
C_2, C_{10}: 3.7–52 pF, Hammarlund Type HF–50 or equivalent
C_3: 560 pF, mica
C_4, C_5, C_7, C_{13}, C_{14}: 1500 pF, feedthrough type
C_9: 8.2 pF (may vary from this value depending on circuit layout), moulded composition type
J_1, J_2: Type BNC connector for 50-Ω coaxial cable

R_1: 2400 Ω approx. (See T_1)
R_2: 16000 Ω, 0.5 watt
R_3: 1800 Ω ± 1%, 0.5 watt
R_4: 240 Ω ± 1%, 0.5 watt
R_5: 24000 Ω approx. (See T_2)

TRANSFORMER DATA

	Winding	N_1/N_2	N_2/N_3	Q_0	Q_L	Z_1	Z'_1	Z_2
T_1	6 turns B & W No. 3006 Mini-ductor, or equivalent	5.2	0.561	60 (shunted by R_1)	26.25	57.1 ohms with secondary unterminated; 50 ohms with secondary terminated in 1250 ohms parallel with 8.3 pF.	179 ohms with primary unterminated	–
T_2	Primary: 35 turns Secondary: 3 turns approx. wound over supply end of primary. #30 "Grip-Eze"* or equivalent wire on 1/4"-dia. form	–	–	41.4 (shunted by R_5)	18.2	–	–	5750 ohms with secondary terminated in 50 ohms

* Trade Mark, Phelps-Dodge Copper Products Co.

Fig. 17

FIG.18 DESIGN CHART FOR COILS USED IN TUNERS SHOWN IN FIGURES 2A, 3A, AND 4A

CIRCUIT REFERENCE			COIL FORM	SLUG	PRIMARY	SECONDARY
Fig.	Part	Function				
2A	L_1	FM Antenna Coil	7/32" O.D.	Arnold♦ Type "J" or equivalent, 0.181"D. 0.250"L.	3 turns #30 "Grip-Eze"* wire, close-wound next to ground end of secondary; adjust for R_T = 316 ohms●	4 turns #22 bare tinned copper wire, spaced one wire diameter; R_T = 6100 ohms● Tunes to 100 MHz with 27 pF
2A	L_2	FM Inter-stage Coil	5/16" O.D. (Remove after winding)	None	3-1/2 turns #18 bare tinned copper wire R_T (full winding) = 6100 ohms● R_T (tap to ground end) = 2250 ohms● Tunes to 100 MHz with 27 pF	
2A	L_3	FM Oscil-lator Coil	7/32" O.D. (Remove after winding)	None	3-1/2 turns #18 bare tinned copper wire, tapped 1 turn from ground end, spaced occupy a winding length of approx. 1/4"	
3A 4A	L_1	FM Antenna Coil	7/32" O.D.	Arnold♦ Type "J" or equivalent, 0.181"D. 0.250"L.	1-1/2 turns #30 "Grip-Eze"* wire R_T = 145 ohms●	4 turns #22 bare tinned copper wire, spaced one wire diameter R_T = 6100 ohms● Tunes to 100 MHz with 27 pF
3A 4A	L_2	FM Inter-stage Coil	5/16" O.D. (Remove after winding)	None	3-1/2 turns #18 bare tinned copper wire R_T (full winding) = 6100 ohms● R_T (tap to ground end) = 230 ohms● Tunes to 100 MHz with 27 pF	
3A 4A	L_4	FM Oscil-lator Coil	7/32" O.D.	Arnold♦ Type "J" or equivalent, 0.181"D. 0.250"L.	2-1/2 turns #22 bare tinned copper wire, tapped at 1/4 turn and 1 turn from ground end; spaced to occupy a winding length of 3/8". Tunes to 110.7 MHz with 37 pF	
3A	L_4	AM Antenna Coil	5/16" O.D. (Ferrite Rod 5-1/4" long)	None	108 turns #2/38 Litz spaced 35 turns per inch	5 turns #38 nyleze*
3A	L_5	AM Oscil-lator Coil	9/32" O.D. paper	Ferrite 1/4" Dia. 3/8" long	115 turns #2/38 Litz tapped at 4 turns (Both windings are "universal" wound using a 1/8" cam and two crossovers per turn)	12 turns #2/38 Litz

♦ Arnold Engineering Co., Marengo, Illinois.
* Trade Mark, Phelps Dodge Copper Products Corp., Ft. Wayne, Indiana.
● R_T values measured at 100 MHz on an RX meter.

TYPICAL FEEDBACK-CAPACITANCE CHARACTERISTIC FOR TYPES 40242, 40243, 40245 AND 40246

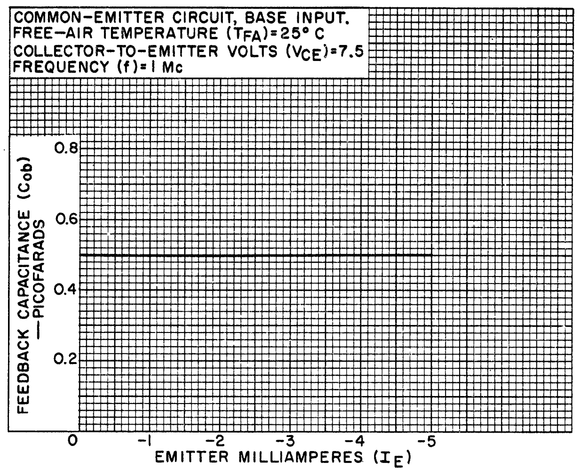


Fig.19

TYPICAL FEEDBACK-CAPACITANCE CHARACTERISTIC FOR TYPES 40242, 40243, 40245 AND 40246

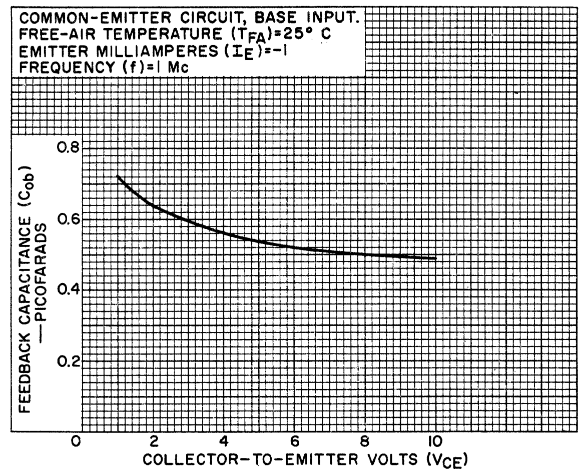


Fig.20

TYPICAL TRANSCONDUCTANCE CHARACTERISTICS AT 100 MC FOR TYPE 40242

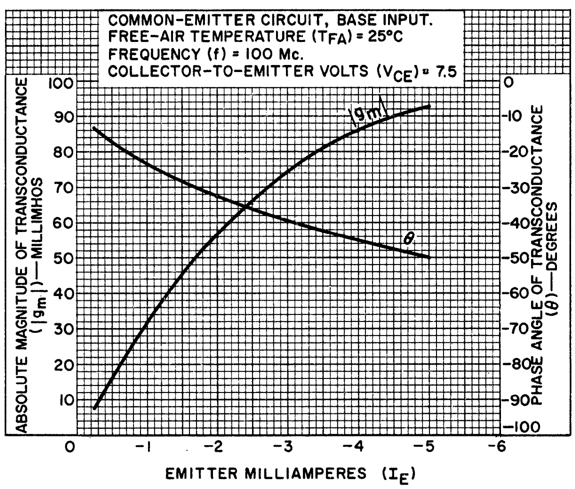


Fig.21

TYPICAL TRANSCONDUCTANCE CHARACTERISTICS AT 100 MC FOR TYPE 40242

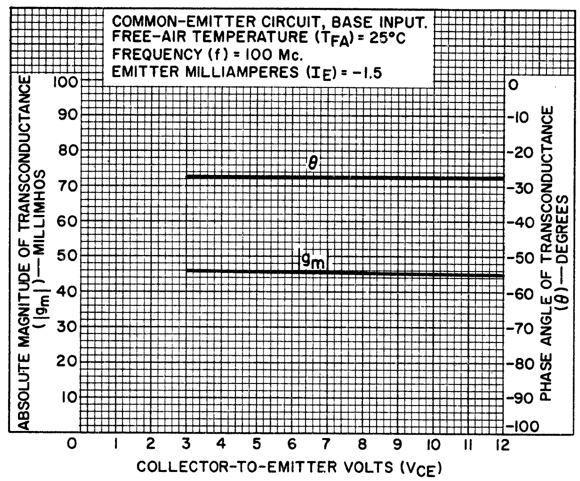


Fig.22

TYPICAL EXTRINSIC-TRANSCONDUCTANCE CHARACTERISTIC FOR TYPES 40245 AND 40246

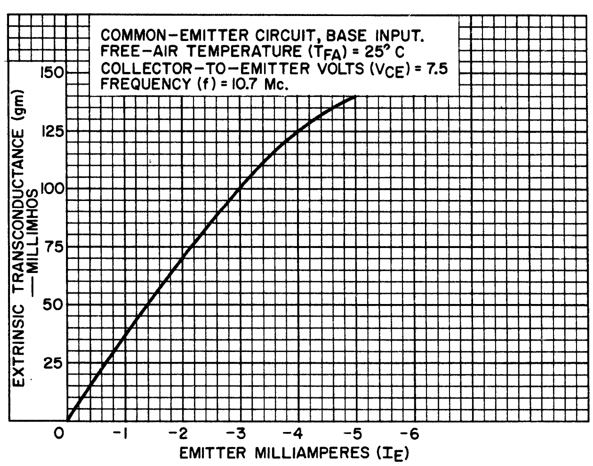


Fig.23

TYPICAL INPUT CHARACTERISTICS AT 100 MC FOR TYPES 40242 AND 40243

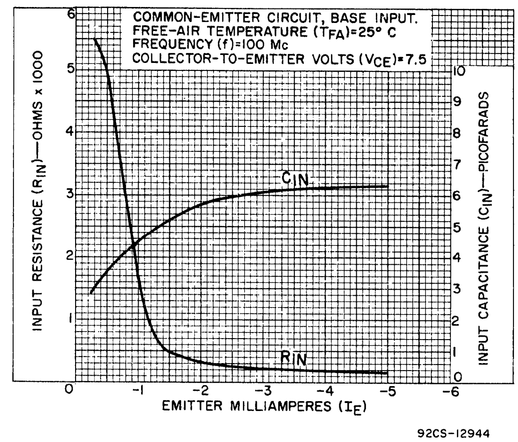


Fig.24

TYPICAL INPUT CHARACTERISTICS AT 100 MC FOR TYPES 40242 AND 40243

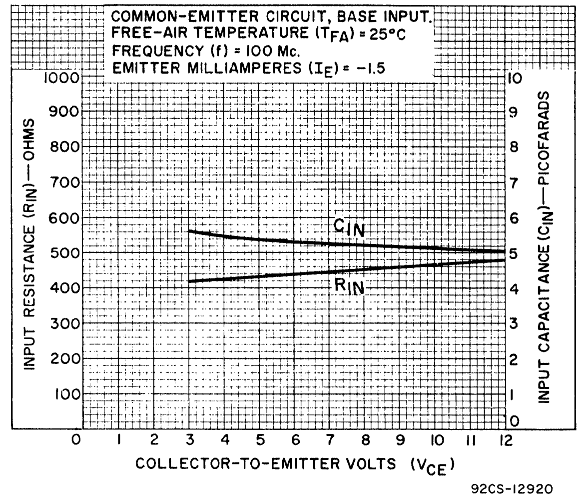


Fig.25

TYPICAL OUTPUT CHARACTERISTICS AT 100 MC FOR TYPES 40242 AND 40243

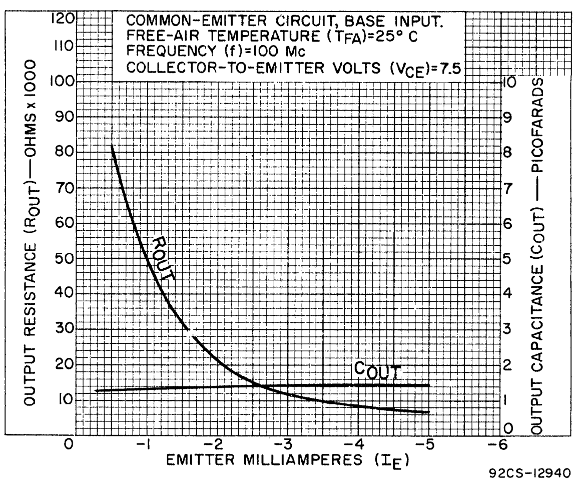


Fig.26

TYPICAL OUTPUT CHARACTERISTICS AT 100 MC FOR TYPES 40242 AND 40243

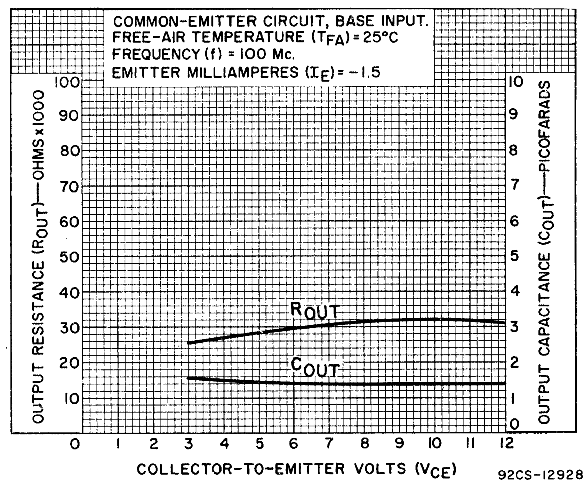


Fig.27

TYPICAL INPUT CHARACTERISTICS AT 10.7 MC FOR TYPES 40245 AND 40246

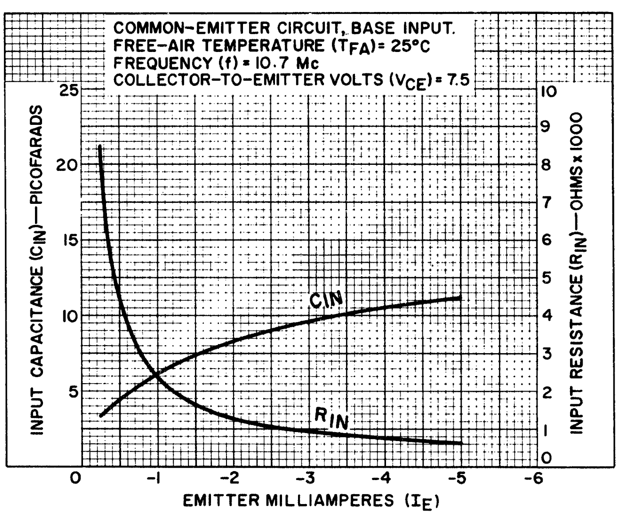


Fig.28

TYPICAL INPUT CHARACTERISTICS AT 10.7 MC FOR TYPES 40245 AND 40246

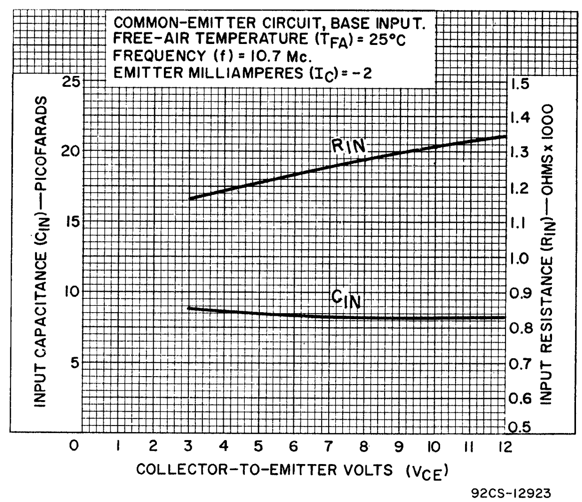


Fig.29

TYPICAL OUTPUT CHARACTERISTICS AT 10.7 MC FOR TYPES 40245 AND 40246

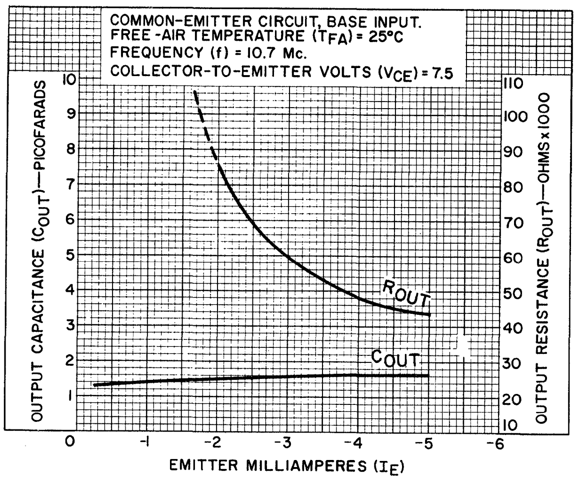


Fig.30

TYPICAL OUTPUT CHARACTERISTICS AT 10.7 MC FOR TYPES 40245 AND 40246

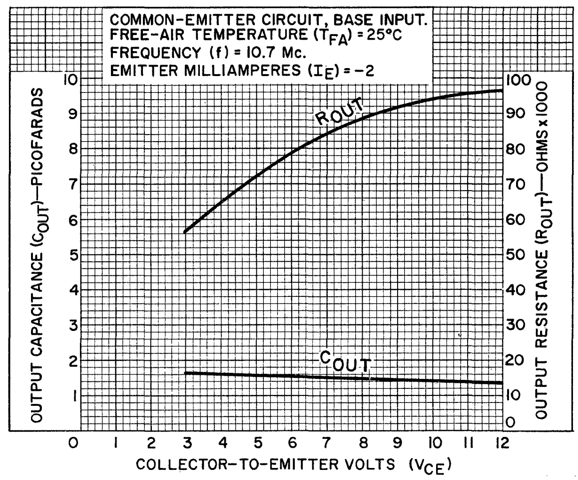


Fig.31

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially, and throughout life, no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variations equipment component variation, signal variation, environmental conditions, and variations in device characteristics.

The *flexible leads* of the 40242, 40243, 40244, 40245, 40246, 40263*, and 40265* are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in each lead, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using these devices, the temperature of the solder should not exceed 255°C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip-soldered within 0.031" of the metal case.

The devices described in this bulletin should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the devices.

Because the metal shell of the 40424* and 40425* operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

It is essential that the mounting flange of the 40424*, which is internally connected to the collector, be securely fastened to a heat sink, which may be the equipment chassis. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD THE MOUNTING FLANGE BE SOLDERED TO THE HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

The mounting-flange temperature of the 40424* will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

Depending on the application, the heat sink or chassis may be connected to either the positive or negative terminal of the voltage supply.

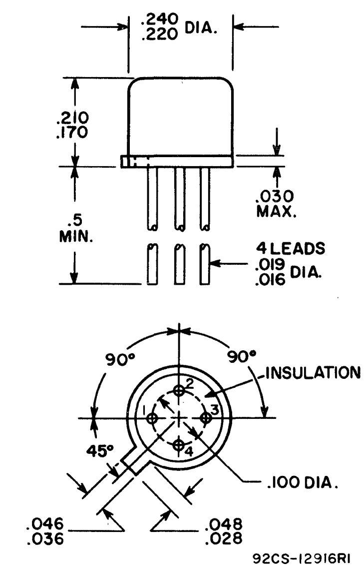
In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized aluminum washer having high thermal conductivity, or a 0.003"-thick mica insulator between the mounting flange and the chassis. If an aluminum washer is used, it should be drilled or punched to provide the two mounting holes and the clearance hole for the emitter and base leads. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolts and the chassis, it is is important that an insulating washer be used between each bolt and the chassis as shown in the technical bulletins for the RCA-40424 and 40425.

A *surge-limiting impedance* should always be used in series with the 40265* rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

The 40265* is designed to provide reliable performance when operated within the maximum ratings. For measurement of the reverse characteristics of this device, peak reverse voltages as high as 30 per cent above the maximum rated values may be applied for a period not exceeding 10 seconds. UNDER NO CIRCUMSTANCES SHOULD PEAK REVERSE VOLTAGES GREATER THAN 30% ABOVE THE MAXIMUM-RATED VALUES BE APPLIED TO THE 40265*, EVEN MOMENTARILY.

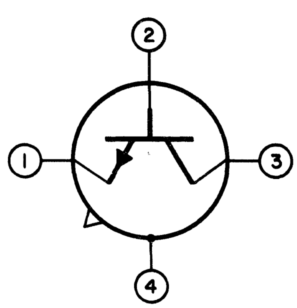
* For additional design characteristics on types 40263, 40265, 40424 and 40425 refer to RCA bulletin, "RCA Solid-State Devices For Line-Operated Radio Receivers and Phonographs". File No.79.

DIMENSIONAL OUTLINE JEDEC TO-104 40242, 40243, 40244, 40245 AND 40246



DIMENSIONS IN INCHES

TERMINAL DIAGRAM



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector
Lead 4 - Connected to Case

SILICON N-P-N POWER TRANSISTORS

40250
40250V1*
40251

RCA-40250, 40250V1, and 40251 are "HOMETAXIAL"-BASE** diffused-junction, silicon n-p-n transistors intended for a wide variety of intermediate- and high-power applications. These transistors are especially suitable for use in audio and inverter circuits in 12-volt mobile radio and portable communications equipment.

Type 40250V1, with an attached heat radiator, is intended for those applications which require a rugged transistor for mounting on a printed-circuit board. Tabs are provided on the underside of the radiator for mounting purposes and for making electrical connection to the collector (which is connected internally to the mounting flange of the TO-66 Package).

- **Designed to assure freedom from second breakdown in class-A operation at maximum ratings**

40250

- **JEDEC TO-66 package for mounting convenience and positive heat-sink contact**
- **V_{CEV} = 50 V min.**
- **f_T = 1.0 Mc/s typ.**
- **R(sat) = 1 Ω max.**

40250V1

- **Heat-radiator package with mounting tabs for printed-circuit-board application**
- **5.8-W dissipation capability (at 25°C free-air temperature)**
- **V_{CEV} = 50 V min.**
- **f_T = 1.0 Mc/s typ.**
- **R(sat) = 1 Ω max.**

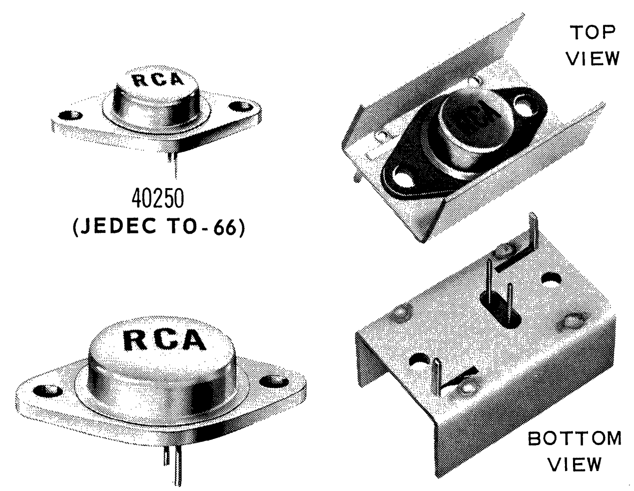
40251

- **High-dissipation capability — 117 W max.**
- **V_{CEV} = 50 V min.**
- **R(sat) = 0.1875 Ω max.**
- **f_T = 0.5 Mc/s typ.**

General-Purpose Types for Industrial and Commercial Applications

* The "V1" suffix in the type number "40250V1" designates the first variant of the basic type 40250. The V1-version is a type 40250 transistor with an attached heat radiator for free-air operation.

** "Hometaxial" was coined by RCA from "homogeneous" and "axial". Hometaxial types employ a structure in which the base region has homogeneous resistivity silicon material in the axial direction (emitter-to-collector). These devices are made by using the single-diffused process.



40250 (JEDEC TO-66)

40251 (JEDEC TO-3)

40250V1 (JEDEC TO-66 WITH HEAT RADIATOR)

MAXIMUM RATINGS

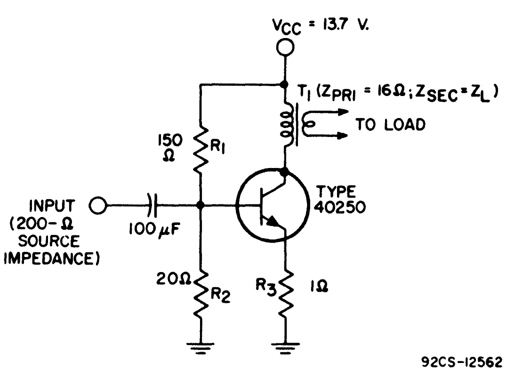
Absolute-Maximum Values:	*40250*	*40250V1*	*40251*	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	50	50	50	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With 1.5 volts of reverse bias, V_{CEV}	50	50	50	V
With base open, V_{CEO}	40	40	40	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	5	5	V
COLLECTOR CURRENT, I_C	4	4	15	A
BASE CURRENT, I_B	2	2	7	A
TRANSISTOR DISSIPATION, P_T:				
At case temperatures up to 25°C	29	-	117	W
At free-air temperatures up to 25°C	-	5.8	-	W
At temperatures above 25°C	See Fig.3	See Fig.4	See Fig.5	
TEMPERATURE RANGE:				
Storage & Operating (Junction)	←	-65 to 200	→	°C
PIN TEMPERATURE (During soldering):				
At distances ≥ 1/32 in. from seating plane for 10 s max	←	235	→	°C

ELECTRICAL CHARACTERISTICS

Case Temperature (T_C) of 25°C Unless Otherwise Specified

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Emitter or Base Volts V_{EB}	DC Emitter or Base Volts V_{BE}	DC Current (Amperes) I_C	DC Current (Amperes) I_E	DC Current (Amperes) I_B	LIMITS: Types 40250 40250V1 Min.	Types 40250 40250V1 Max.	Type 40251 Min.	Type 40251 Max.	Units
Collector-Cutoff Current	I_{CBO}	30					0		-	1	-	-	mA
	I_{CEV}		40		-1.5				-	-	-	2	mA
At T_C = 150° C	I_{CBO}	30					0		-	5	-	-	mA
	I_{CEV}		40		-1.5				-	-	-	10	mA
Emitter-Cutoff Current	I_{EBO}			5		0			-	5	-	10	mA
DC Forward-Current Transfer Ratio	h_{FE}		4 4			1.5 8			25 -	100 -	- 15	- 60	
Collector-to-Base Breakdown Voltage	BV_{CBO}					0.05 0.1			50 -	- -	- 50	- -	V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}				-1.5 -1.5	0.05 0.1			50 -	- -	- 50	- -	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$					0.1 0.2			40 -	- -	- 40	- -	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}					0 0	0.005 0.01		5 -	- -	- 5	- -	V
Base-to-Emitter Voltage	V_{BE}		4 4			1.5 8			- -	2.2 -	- -	- 2.2	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					1.5 8		0.15 0.8	- -	1.5 -	- -	- 1.5	V
Power Rating Test	PRT		39			3			-	-	-	1	s
Thermal Resistance: Junction-to-Case	θ_{J-C}								6.0 (max.) 40250		-	1.5	°C/W
Junction-to-Free-Air	θ_{J-FA}								30 (max.) 40250V1		-	-	°C/W

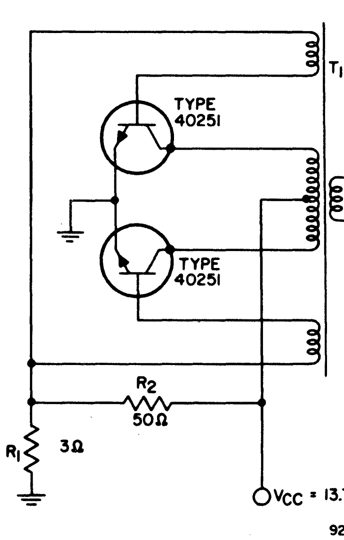
TYPICAL AUDIO-AMPLIFIER CIRCUIT FOR TYPE 40250



Distortion = 6.5% at P_{OUT} = 4 W
= 2% at P_{OUT} = 400 mW, f = 1 kc/s

Fig.1

TYPICAL INVERTER CIRCUIT EMPLOYING A PAIR OF TYPE 40251's



Circuit Efficiency = 82%
at P_{IN} = 110 W, f = 3.5 kc/s

T_1: Core – toroid, 3" o.d., 1/2" x 1" cross-section (Allen-Bradley T3000H 106B), RO-3 material or equivalent.

Pri: 16 turns, No.20 wire, c.t.

Feedback Winding: 8 turns, No.22 wire, c.t.

Fig.2

TYPICAL OPERATION CHARACTERISTICS FOR TYPE 40251

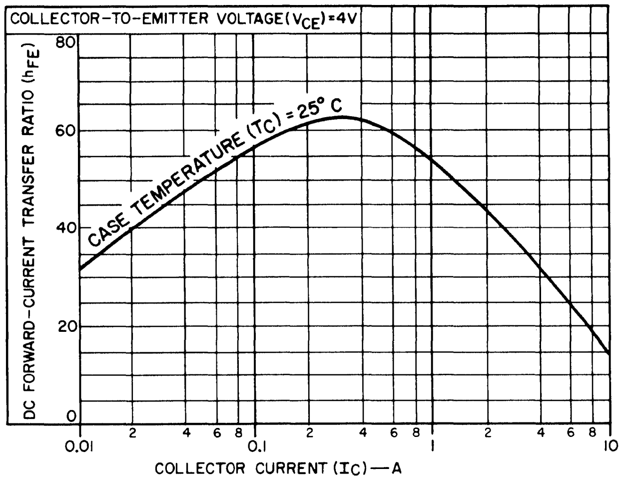


Fig.9

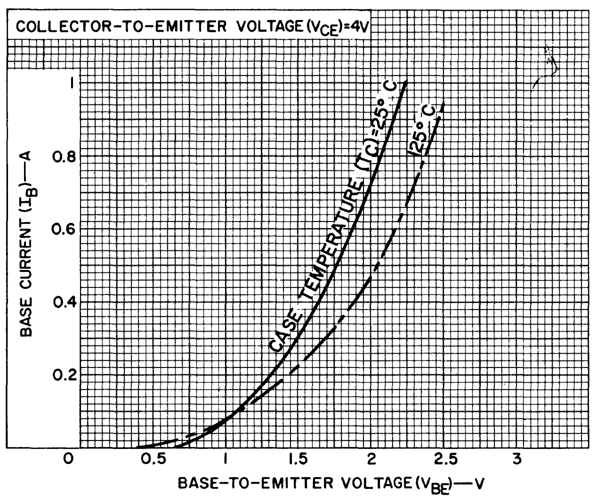


Fig.10

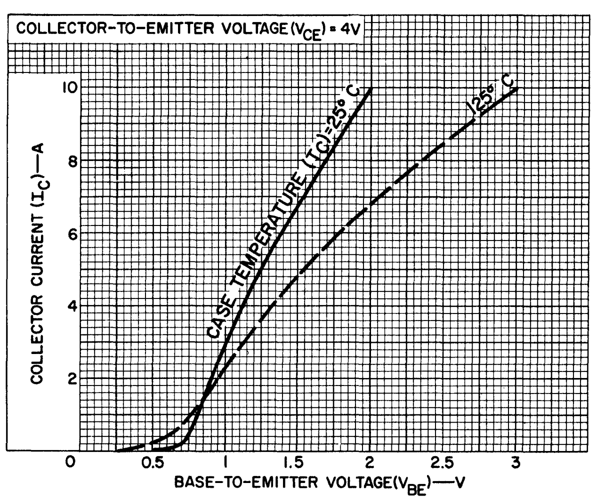
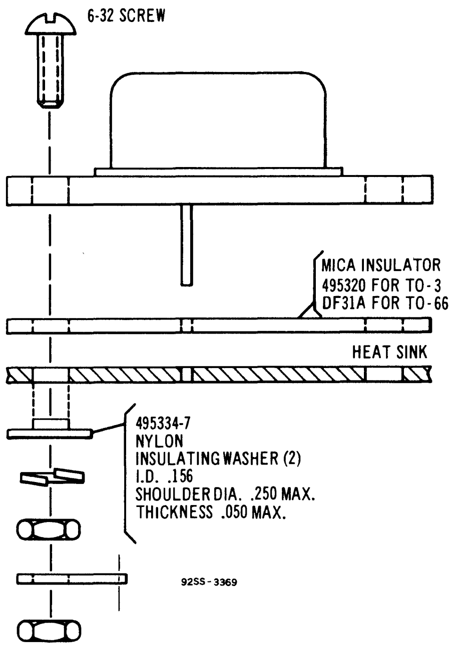


Fig.11

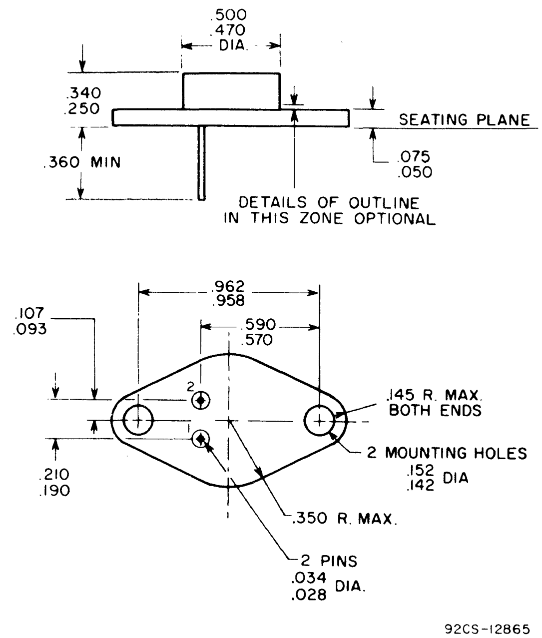
SUGGESTED MOUNTING ARRANGEMENT FOR TYPES 40250 & 40251



NOTE: Hardware With Part Numbers Supplied.

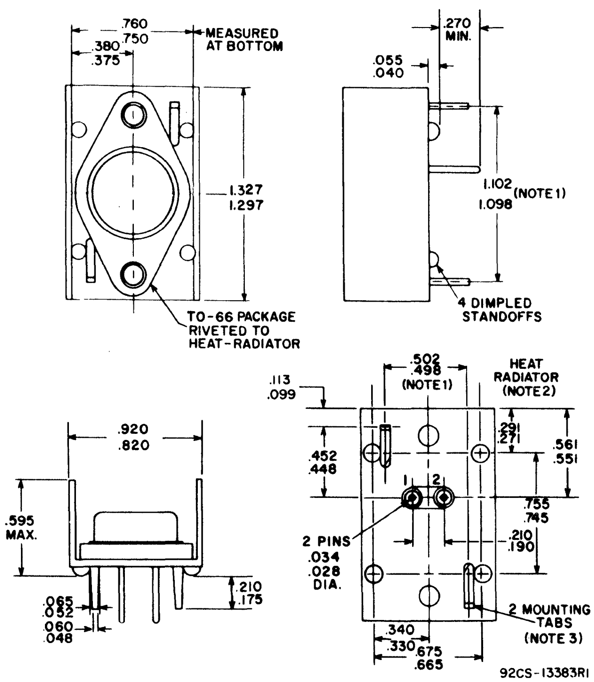
Fig. 12

DIMENSIONAL OUTLINE FOR TYPE 40250 JEDEC No. TO-66



Dimensions in Inches

DIMENSIONAL OUTLINE FOR TYPE 40250V1 JEDEC No. TO-66 WITH HEAT RADIATOR



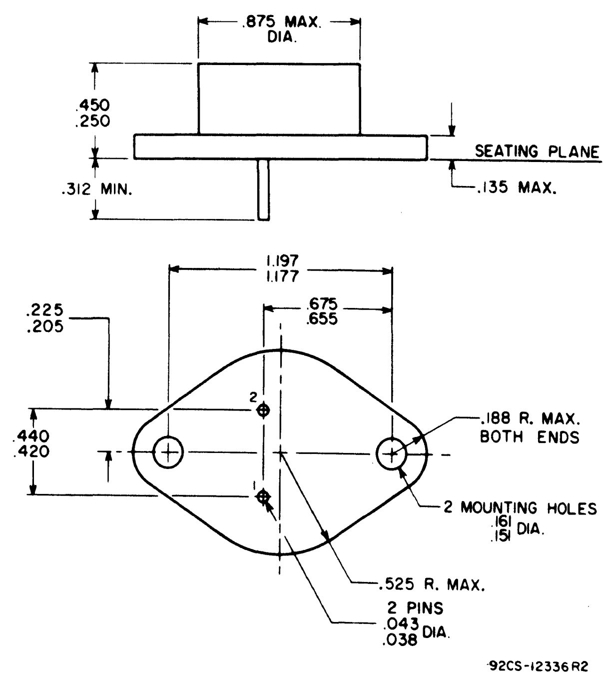
NOTE 1: Measured at bottom of heat-radiator.

NOTE 2: 0.035 C.R.S., tin plated.

NOTE 3: Recommended hole size for printed-circuit boards is 0.070 dia.

Dimensions in Inches

DIMENSIONAL OUTLINE FOR TYPE 40251 JEDEC No. TO-3



Dimensions in Inches

DISSIPATION DERATING CURVE FOR TYPE 40250

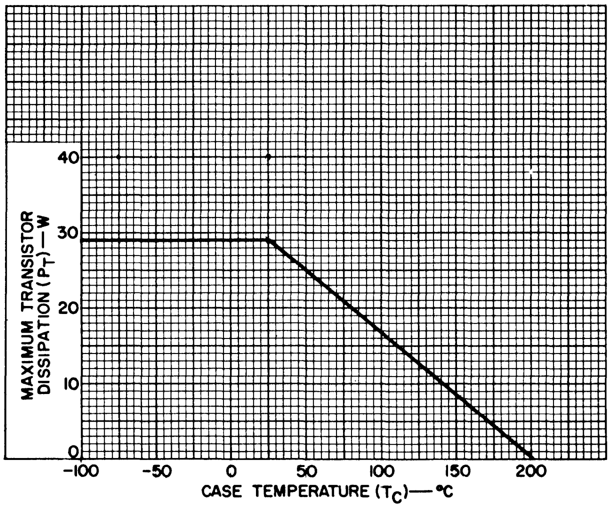


Fig.3 92CS-13005RI

TYPICAL OPERATION CHARACTERISTICS FOR TYPES 40250 & 40250V1

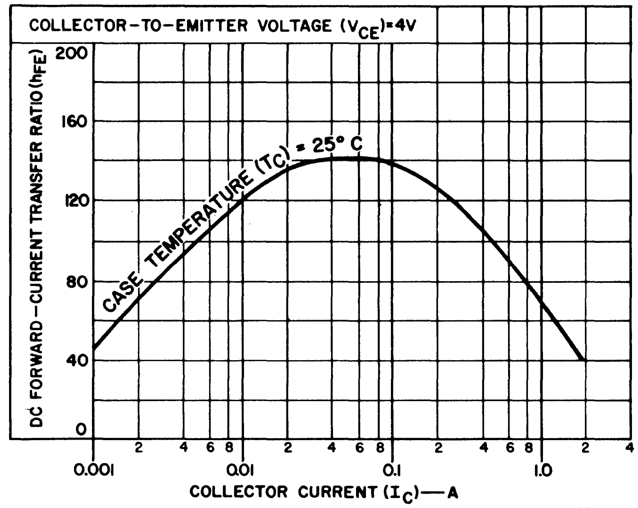


Fig.6 92CS-12564RI

DISSIPATION DERATING CURVE FOR TYPE 40250V1

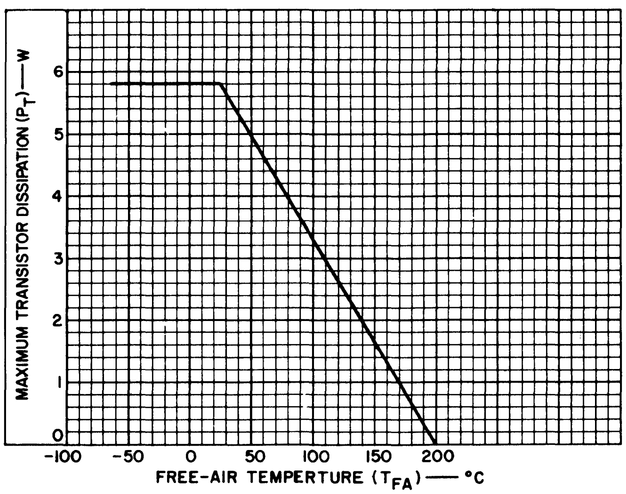


Fig.4 92CS-13373

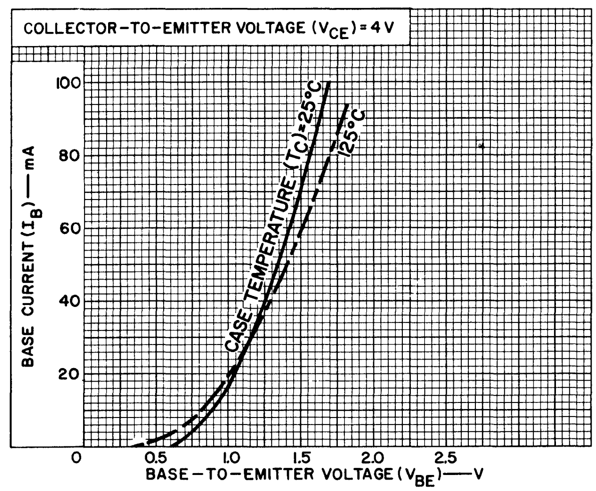


Fig.7 92CS-12305RI

DISSIPATION DERATING CURVE FOR TYPE 40251

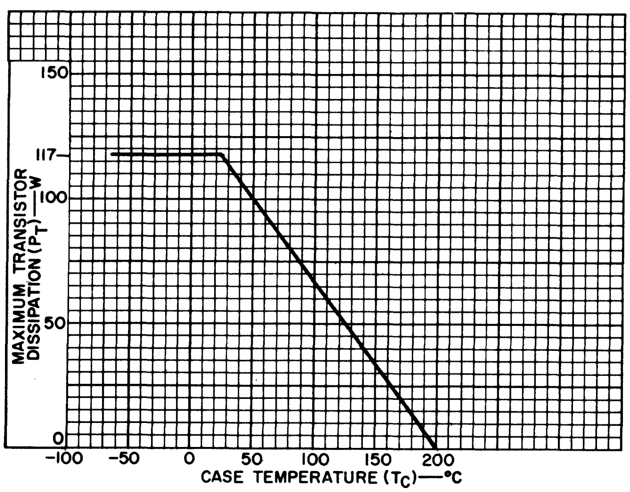


Fig.5. 92CS-13031RI

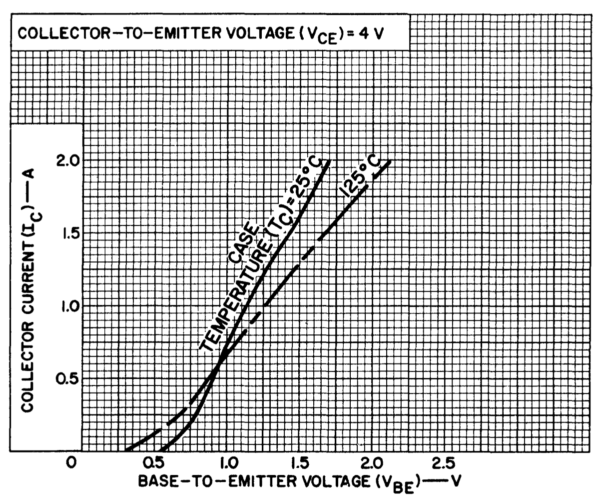


Fig.8 92CS-12325RI

TERMINAL CONNECTIONS
FOR TYPES 40250, 40250V1, & 40251

Pin 1 - Base
Pin 2 - Emitter
Flange, Case - Collector (For 40250 & 40251)
Heat Radiator - Collector (For 40250V1)

RCA Type 40253 is an alloy-junction transistor of the germanium p-n-p type intended primarily for class B af-amplifier applications. The 40253 features high collector-current capability (-500 max. ma), high dissipation capability (650 max. mw), and exceptional linearity of beta over its entire range of collector current.

The 40253 utilizes a hermetically sealed JEDEC TO-1 package, and has all leads insulated from the case.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-25 max.	volts
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	-25 max.	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-2.5 max.	volts
COLLECTOR CURRENT, I_C	-500 max.	ma
EMITTER CURRENT, I_E	500 max.	ma
BASE CURRENT, I_B	-100 max.	ma
TRANSISTOR DISSIPATION:		
At case temperatures[a] up to 64° C	650[b] max.	mw
At case temperatures[a] above 64° C	See *Fig.1*	
At free-air temperatures up to 55° C	125 max.	mw
At free-air temperatures above 55° C	See *Fig.1*	
TEMPERATURE RANGE:		
Storage and operating (junction)	-65 to +90	°C
LEAD TEMPERATURE (during soldering):		
At distances not closer than 1/32 inch to seating surface for 10 seconds max.	255 max.	°C

[a] Measured on case perimeter at junction with seating surface.

[b] This dissipation rating may be exceeded for measurements of music-power output at an ambient temperature of 25°C, using a regulated power supply (see EIA Standard RS-234-A).

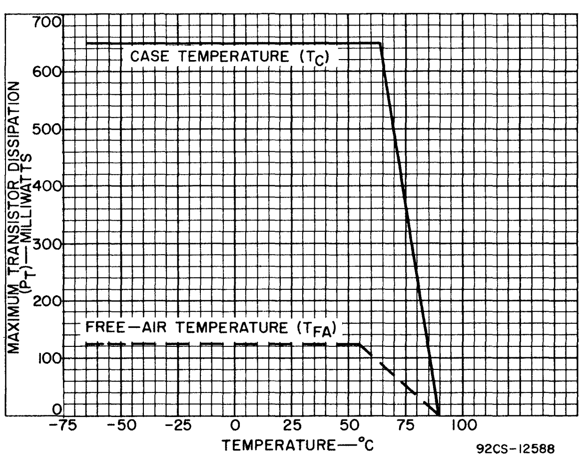
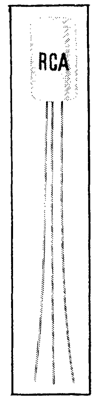


Fig.1 - Rating Chart for Type 40253.

GERMANIUM P-N-P TRANSISTOR

For Class B AF-Amplifier Applications in Consumer-Product and Industrial Equipment



JEDEC TO-1

- high collector-current capability: I_C = -500 max. ma
- high dissipation capability: P_T = 650 max. mw for case temperatures to 64° C; = 125 max. mw for free-air temperatures to 55° C
- exceptional linearity of dc beta over entire collector-current range

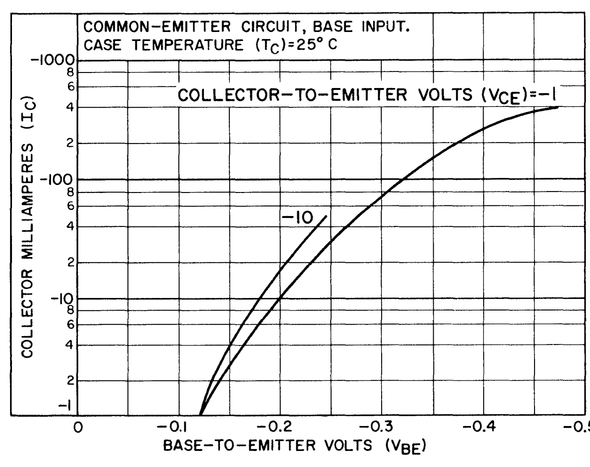


Fig.2 - Typical Transfer Characteristic for Type 40253.

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ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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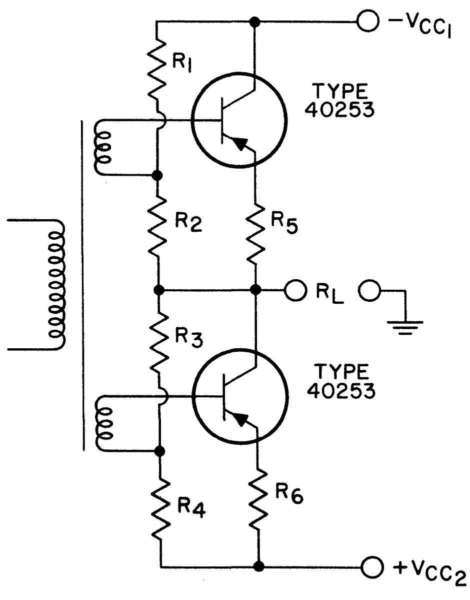
Marca(s) Registrada(s)

Printed in U.S.A.
40253 7-66
Supersedes issue dated 8-64

ELECTRICAL CHARACTERISTICS:

Characteristics	Symbols	TEST CONDITIONS: Case Temperature[a] T_C (°C)	DC Collector-to-Base Voltage V_{CB} (volts)	DC Collector-to-Emitter Voltage V_{CE} (volts)	DC Emitter-to-Base Voltage V_{EB} (volts)	DC Emitter Current I_E (ma)	DC Collector Current I_C (ma)	DC Base Current I_B (ma)	LIMITS Type 40253 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	25	-12			0			-	-	-14	μa
Emitter-Cutoff Current	I_{EBO}	25			-2.5		0		-	-	-14	μa
Collector-to-Base Breakdown Voltage	BV_{CBO}	25				0	-0.05		-25	-	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEO}	25					-2	0	-25	-	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25				0.014	0		-2.5	-	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25					-400	-20	-	-0.5	-	volt
Base-to-Emitter Voltage	V_{BE}	25		-10 -1			-5 -400		- -	-0.15 -0.45	- -	volt volt
DC Forward-Current Transfer Ratio	h_{FE}	25		-1			-400		50	75	-	
Gain-Bandwidth Product	f_T	25		-6			-1		-	1	-	Mc
Thermal Resistance, Junction to Case	θ_{J-C}								-	-	40	°C/w

[a] Measured on case perimeter at junction with seating surface.



R_1, R_3 = 270 ohms
R_2, R_4 = 3.9 ohms
R_5, R_6 = 0.51 ohm
R_L = Load (speaker voice-coil) impedance = 20 ohms
V_{CC_1}, V_{CC_2} = DC collector supply voltages = 11 volts*
Zero-signal DC collector current = -5 ma
Zero-signal base-bias voltage = -0.15 volt
Peak collector current at maximum power output = -500 ma
Average collector current at maximum power output = -159 ma
Input impedance of stage (per base) = 100 ohms
Power gain (typical) = 32 db
Maximum collector dissipation = 600 mw
Music power output** = 2.5 watts

* Obtained from regulated power supply designed to deliver constant voltage over the indicated range of collector current.

** EIA standard #RS-234-A, section 2.1.2.1

Fig. 3 - Typical Class B Push-Pull Output Stage Using RCA-40253 Transistors.

OPERATING CONSIDERATIONS

The maximum ratings in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment-component variations, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The 40253 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

Electrical connections to the base, emitter, and collector leads of the 40253 may be soldered directly to the leads provided such connections are made at least 1/32 inch from the seating surface of the transistor, and provided care is taken to conduct excessive heat away from the lead seals during soldering. Failure to observe these precautions will result in cracking of the lead seals and permanent damage to the transistor.

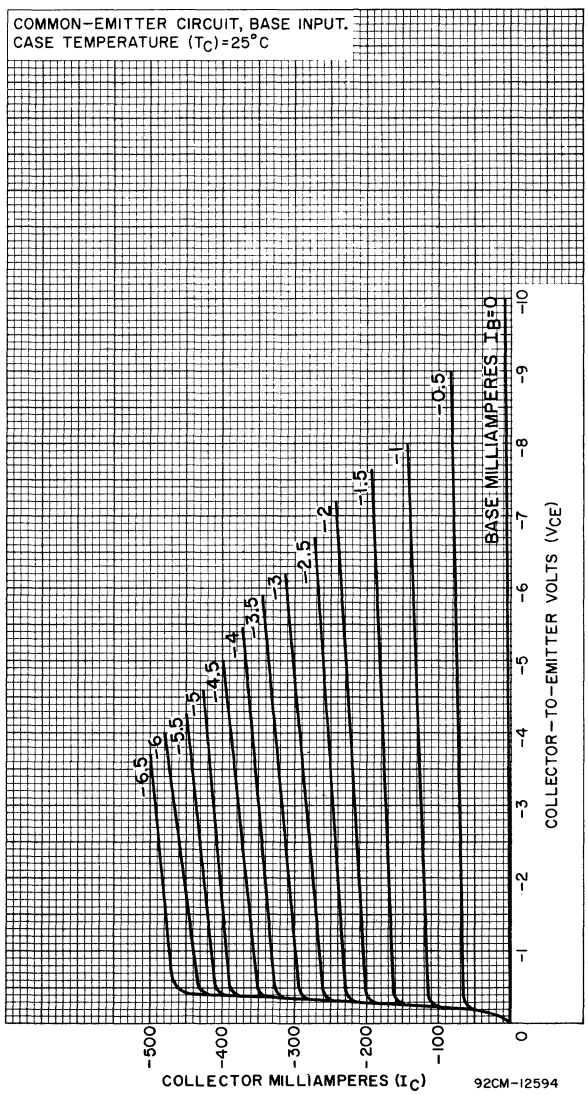


Fig.4 - Typical Collector Characteristics for Type 40253.

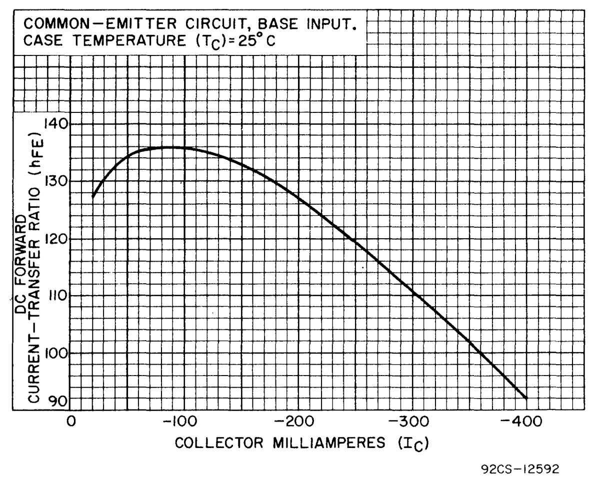
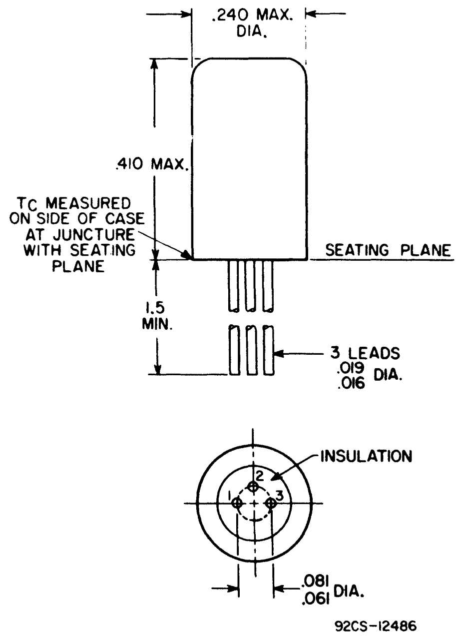


Fig.5 - Typical DC Beta Characteristic for Type 40253.

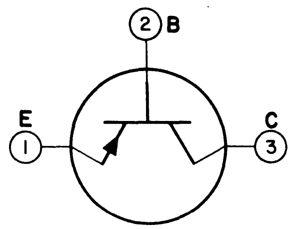
DIMENSIONAL OUTLINE
JEDEC No. TO-1



DIMENSIONS IN INCHES

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

TERMINAL DIAGRAM



LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR

12-AMPERE SILICON RECTIFIER

40259

RCA-40259 is a high-reliability 12-ampere 600-volt stud-mounted silicon rectifier in a JEDEC DO-4 package. This rectifier has evolved from RCA's participation in many aerospace programs.

HALF-WAVE RECTIFIER SERVICE

***ABSOLUTE-MAXIMUM RATINGS** for*

Single-Phase Operation, and with Resistive or Inductive Load

PEAK REVERSE VOLTS 600

TRANSIENT REVERSE VOLTS, NON-REPETITIVE (5-msec max. duration and case temperature range of 0 to 200°C) 800

RMS SUPPLY VOLTS 424

DC BLOCKING VOLTS 600

AVERAGE FORWARD AMPERES:
- At 150°C case temperature 12
- At other case temperatures . . . . . . See Fig. 1

PEAK RECURRENT AMPERES 50

PEAK SURGE AMPERES:[a]
- One-half cycle, sine wave, 60 cps. 250
- For one, or more than one cycle . . . . See Fig. 6

CASE-TEMPERATURE RANGE:
- Operating and Storage -65 to +200°C

CHARACTERISTICS:

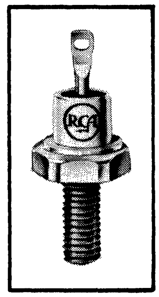
Max. Forward Voltage Drop[b] (Volts). 0.55

Max. Reverse Current (Ma.):
- Dynamic at 60 cps[b]. 0.6
- Static[c] 0.002

Max. Thermal Resistance, Junction-to-Case. . . . . 2°C/Watt

a Superimposed on device operating within the maximum voltage, current, and temperature ratings and may be repeated after sufficient time has elapsed for the device to return to the presurge thermal-equilibrium conditions.

High-Reliability Type for Aerospace and Military Applications



JEDEC DO-4

FEATURES

- All Stress-Screening Data and two (X_1 and Z_1 axes) X-ray photographs supplied with each "serialized" 40259
- 5 special manufacturing steps
- 9 special Stress-Screening procedures
- Diffused-junction process – exceptional uniformity and stability of characteristics
- Welded construction
- Hermetic seals
- Low leakage current
- JEDEC DO-4 package
- Low thermal resistance
- Low forward voltage drop
- High surge current:

  up to 30 amperes – 6 rectifiers in 3-phase full-wave bridge circuit

  up to 24 amperes – 4 rectifiers in single-phase full-wave bridge circuit

b Average value for one complete cycle at case temperature of 150°C and at maximum rated voltage and average forward current.

c DC value, at maximum peak reverse voltage, and case temperature (°C) = 25.

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ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

Printed in U.S.A.
40259 5/66
Reprinted from 40259 4/65

RATING CHART

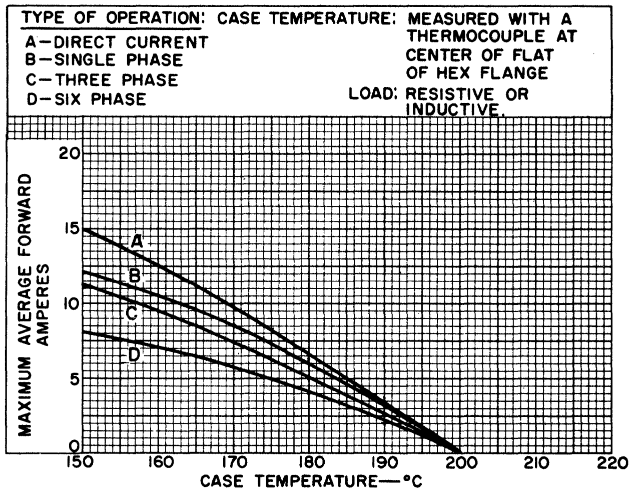


Fig. 1

To achieve high reliability, it is necessary to understand the failure mechanisms of the device under consideration. This understanding is then fed back into the manufacturing operation, where manufacturing processes are modified accordingly, and the appropriate quality controls are instituted.

Next, the testing limits are set to assure tighter than normal parameter distributions.

Finally, and most important, the devices are submitted to Stress Screening. Specific parameter values are recorded throughout this process, enabling the device to be screened for both the absolute parameter value and the delta shift of the parameter value.

Stress Screening removes from the selected population both early failures and the sub-population of "maverick" units.

One-hundred per-cent Stress Screening supersedes sampling procedures for life test. The former method *assures* reliable performance, whereas the latter method can only predict the degree of reliability.

SPECIAL MANUFACTURING PROCEDURES

EACH 40259 IS SUBJECTED TO THE FIVE SPECIAL MANUFACTURING STEPS SPECIFIED BELOW.

1. Visual Mount Test – critical visual inspection with high-power optical system to assure part alignment, proper soldering, and to reveal mechanical defects.
2. Helium Bomb Test – to assure hermetic sealing.
3. Stabilization Bake – for 96 hours to assure electrical and mechanical stability.
4. Controlled Gold-Plating – 30 to 40 microinches to provide improved resistance to adverse environments and to facilitate the making of proper electrical connections to rectifier terminals.
5. Preliminary Electrical Tests – measurement of average forward voltage, peak forward voltage, static reverse current, and dynamic reverse current.

FOLLOWING STRESS SCREENING, EACH 40259 IS RECRITICIZED FOR ELECTRICAL PERFORMANCE ACCORDING TO THE FOLLOWING TABLE; AND THE READINGS OBTAINED ARE RECORDED.

Characteristic	Symbol	Test Conditions	Maximum Limits	Max. Drift Screen Criteria (delta-shift)	Units
Average Forward Voltage (Full Cycle)	V_{F_1}	I_F = 12A, T_C = 150°C	0.55	0.1	Volt
Average Reverse Current (Full Cycle)	I_{R_1}	I_F = 12A, T_C = 150°C V_R (Peak) = 600 V	0.6	0.2	ma
Peak Forward Voltage	V_{F_2}	I_F (Peak) = 12A T_C = 25°C	1.1	0.1	Volts
Static Reverse Current	I_{R_2}	V_R = 600 vdc, T_C = 25°C	0.002	0.001	ma

EACH UNIT IS PACKAGED INDIVIDUALLY, AND RECORDED ELECTRICAL DATA AS WELL AS X-RAY FILM RECORDS ARE INCLUDED WITH EACH SHIPMENT.

FORWARD CHARACTERISTICS

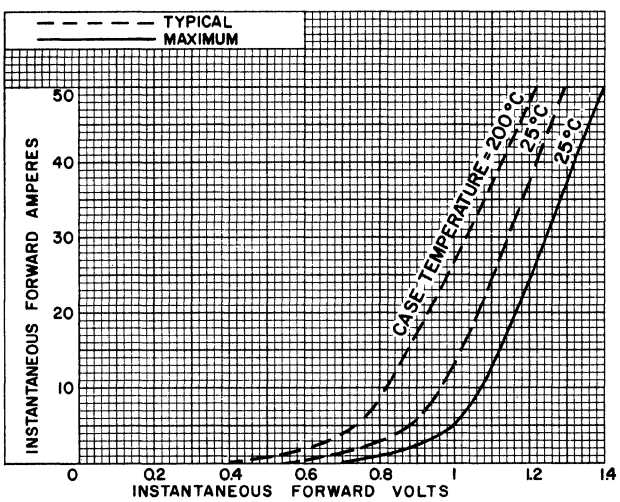


Fig. 2

TYPICAL REVERSE CHARACTERISTICS

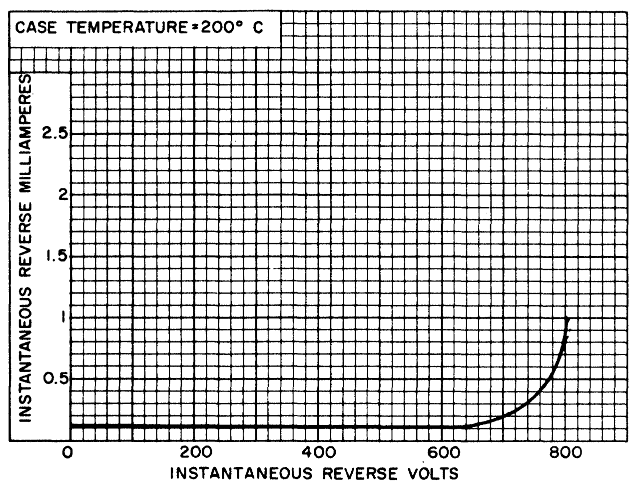
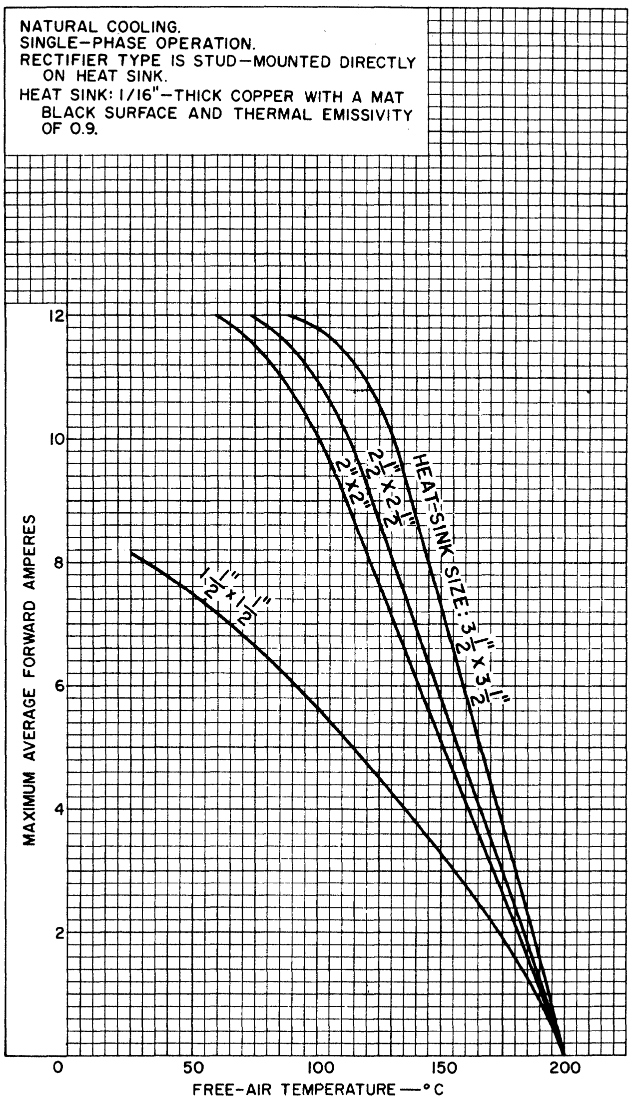


Fig. 3

OPERATION GUIDANCE CHARTS

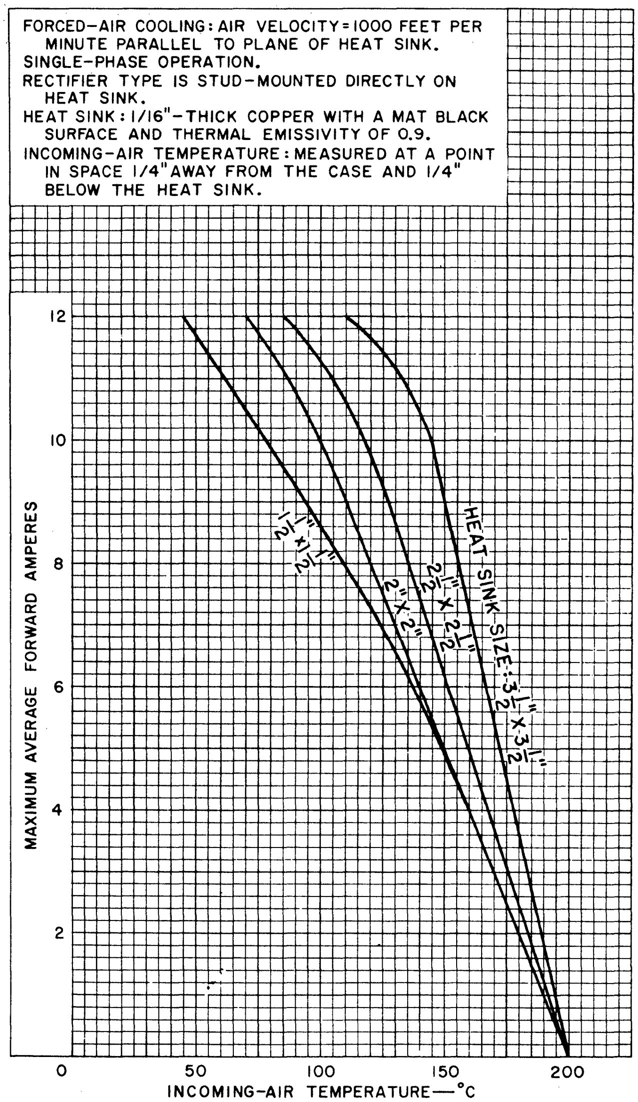
NATURAL COOLING



92CM-11068R1

Fig. 4

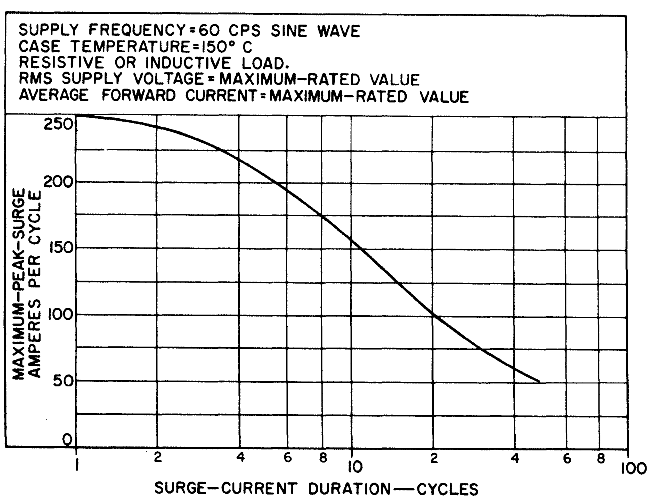
FORCED-AIR COOLING



92CM-11067R1

Fig. 5

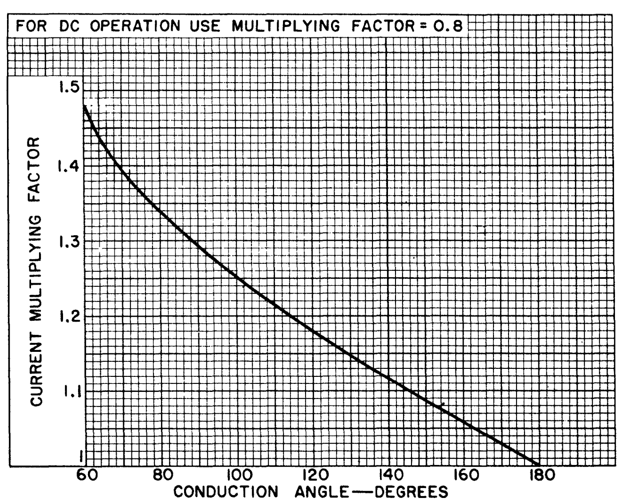
PEAK SURGE-CURRENT RATING CHART



92CS-13113

Fig. 6

CURRENT-MULTIPLYING-FACTOR CHART FOR POLYPHASE AND DC OPERATION



92CS-10910

Fig. 7

EACH 40259 IS ASSIGNED AN INDIVIDUAL SERIAL NUMBER AND THEN TESTED AT MAXIMUM RATINGS FOR THE FOLLOWING ELECTRICAL CHARACTERISTICS. THE MEASURED VALUES ARE RECORDED.

Characteristic	Symbol	Test Conditions	Maximum Limits	Units
Average Forward Voltage (Full Cycle)	V_{F_1}	I_F = 12A, T_C = 150°C	0.55	Volt
Average Reverse Current (Full Cycle)	I_{R_1}	I_F = 12A, T_C = 150°C V_R (Peak) = 600 V	0.6	ma
Peak Forward Voltage	V_{F_2}	I_F (Peak) = 12A T_C = 25°C	1.1	Volts
Static Reverse Current	I_{R_2}	V_R = 600 vdc, T_C = 25°C	0.002	ma

STRESS-SCREENING PROCEDURES

40259'S WHICH MEET THE PRECEDING TIGHT LIMITS ARE THEN SUBJECTED TO THE FOLLOWING STRESS-SCREENING PROCEDURES.

1. Temperature Cycling—per Method 102A of MIL-STD-202B: 10 cycles; temperature range, -65°C to +200°C.
2. High-Temperature Storage—continuous storage at a minimum temperature of 200°C for a minimum of 96 hours.
3. Constant Acceleration – per Method 2006 of MIL-STD-750: 10,000 g's; acceleration for 3 minutes in each of three orthogonal axes (X_1, Y_1, Z_1).
4. Operational Vibration – at a frequency of 57 ± 2 cycles per second with a minimum displacement of 0.1 inch for 30 seconds. Rated voltage, at 60 cps, is applied during the test and the trace is monitored on an oscilloscope. Observed discontinuities, flutter, drift, or shift constitute rejection items.
5. Helium Bomb Test – 50 PSIG, 4 hours. Post test criterion, 1 x 10^{-8} cc atmos/sec.
6. Methanol Bomb Test – 70 PSIG, 18 hours.
7. High-Temperature Burn-In—under the following conditions; V_R = 600 volts (peak); case temperature (T_C) = 180°C; duration = 250 hours.
8. X-Ray Inspection – In X_1 and Z_1 axes.
9. Visual Reinspection – complete visual reinspection with high-power optical system.

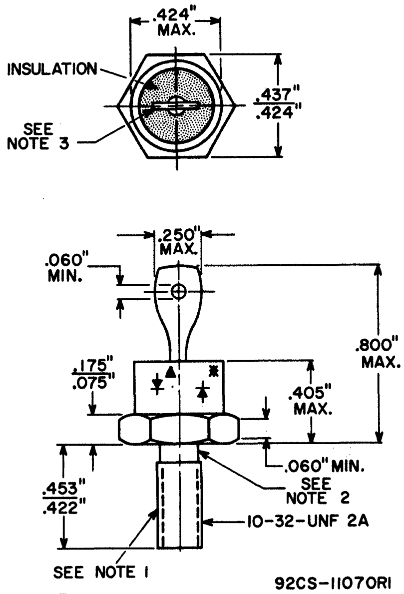
OPERATING CONSIDERATIONS

Because this rectifier may operate at voltages which are dangerous, care should be taken in the design of equipment to prevent the operator from coming in contact with the rectifier.

The recommended installation torque is 15 to 20 inch-pounds applied to a 10/32 UNF-2B hex nut assembled on stud thread.

The applied torque during installation should not exceed 25 inch-pounds.

DIMENSIONAL OUTLINE JEDEC DO-4



Dimensions in Inches

Note 1: Normal installation torque is 15 to 20 inch-pounds applied to a 10/32 UNF-2B hex nut assembled on stud thread. The applied torque during installation should not exceed 25 inch-pounds.

Note 2: Diameter of unthreaded portion: 0.189" max., 0.163" min.

Note 3: Angular orientation of this terminal is undefined.

Note 4: The device may be operated in any position.

TRANSISTOR-RECTIFIER COMPLEMENT

For Line-Operated AM Broadcast-Band Radio Receivers and Phonographs

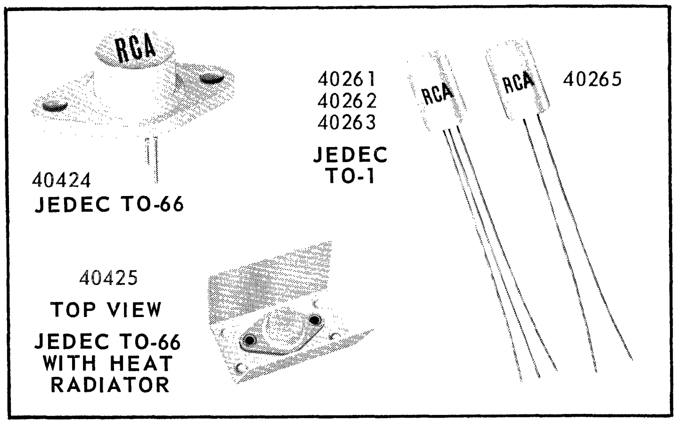
RCA-40261, 40262, 40263, 40424, 40425 and 40265 are a group of five transistors and one silicon rectifier specially designed to provide a complement of high-performance hermetically sealed semiconductor devices for line-operated AM broadcast-band radio receivers and phonographs.

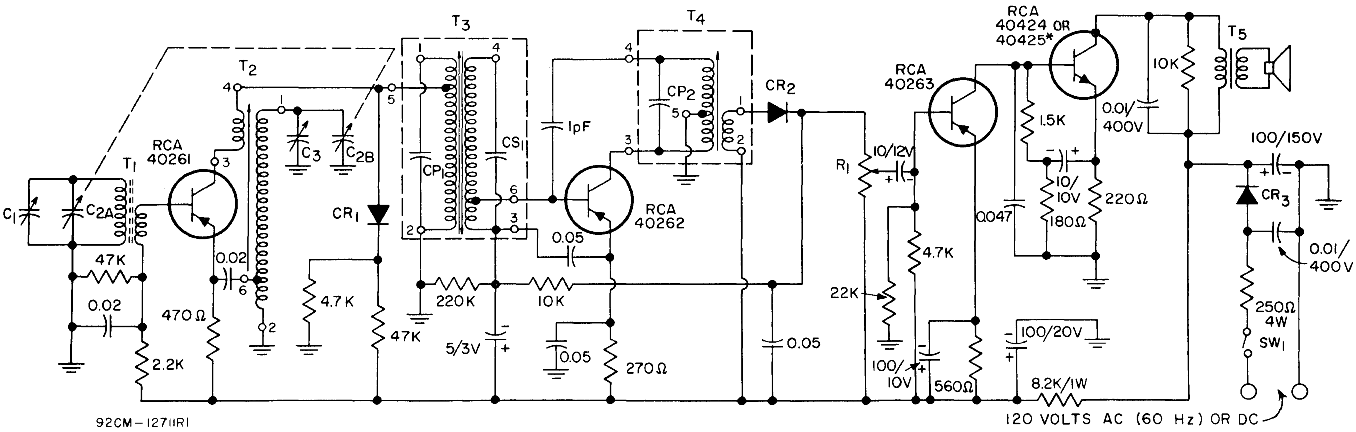
RCA-40261 and 40262 are drift-field transistors of the germanium p-n-p alloy type for converter and IF-amplifier stages, respectively.

RCA-40263 is a germanium p-n-p alloy-junction transistor with extremely high beta and exceptional linearity of characteristics for low-level AF-amplifier and driver stages.

RCA-40424 and 40425 are high-voltage power transistors of the silicon n-p-n type, for class A amplifiers in AF-output stages of ac- and ac/dc-line-operated entertainment-type electronic equipment. The 40424 and 40425 utilize JEDEC TO-66 flanged metal packages, and differ only in that the 40425 is provided with an integral aluminum heat radiator and is intended for mounting on printed-circuit boards.

RCA-40265 is a diffused-junction silicon rectifier of single-ended design, for power-supplies of receivers and phonograph amplifiers employing all or part of the associated transistor complement.





C_1, C_3:	Trimmers for ganged tuning-capacitor, See Fig.21
C_{2A}, C_{2B}:	Ganged tuning capacitor, See Fig.21
CP_1, CS_1:	110 pF, part of T_3, See Fig.21
CP_2:	170 pF, part of T_4, See Fig.21
CR_1, CR_2:	Germanium diode type 1N295
CR_3:	Silicon rectifier RCA-40265
R_1:	Volume control, 10 kΩ/0.5 W Audio taper potentiometer
SW_1:	On-off switch, part of R_1
T_1:	Antenna transformer, See Fig.21
T_2:	Oscillator transformer, See Fig.21
T_3:	1st. IF-transformer, See Fig.21
T_4:	2nd. IF-transformer, See Fig.21
T_5:	Output transformer: primary impedance, 2500 Ω; secondary impedance, 3.2 Ω; efficiency, 80 per cent; Triad Type S-12X or equivalent.

*40425 may be mounted directly on printed-circuit board with no additional heat sink for operation at ambient temperatures up to 55°C.

(a) PERFORMANCE DATA, See page 5.

(b) Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.

(c) Capacitors are in microfarads, unless otherwise specified.

Fig.1 - Circuit of Line-Operated, AM-Broadcast-Band Receiver Using RCA-40261, 40262, 40263, 40424, 40425 Transistors, and RCA-40265 Silicon Rectifier.

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Printed in U.S.A.
40261 - 40263, 40424, 40425, 40265 9-66
Supersedes 1CE-313 Issue Dated 9-64

ELECTRICAL CHARACTERISTICS

Characteristic	Symbols & Units	TEST CONDITIONS: Temperature °C T_A	T_{MF}	DC Collector-to-Base Voltage V_{CB} V	DC Collector-to-Emitter Voltage V_{CE} V	DC Emitter-to-Base Voltage V_{EB} V	External Base-to-Emitter Resistance R_{BE} Ω	Peak Reverse Voltage PRV V	DC Collector Current I_C mA	DC Emitter Current I_E mA	DC Base Current I_B mA	DC Forward Current I_F mA	LIMITS: 40261 Min.	40261 Typ.	40261 Max.	40262 Min.	40262 Typ.	40262 Max.	40263 Min.	40263 Typ.	40263 Max.	40424 40425 Min.	40424 40425 Typ.	40424 40425 Max.	40265 Min.	40265 Typ.	40265 Max.
Collector-Cutoff Current	I_{CBO} µA	25 25 -	- - 25	-12 -20 +300						0 0 0			- - -	- - -	-12 - -	- - -	- - -	-12 - -	- - -	- - -	- -12 -	- - -	- - -	- - 100	- - -	- - -	- - -
Collector-Cutoff Current	I_{CEX} mA	-	25		+300						+0.005		-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
Emitter-Cutoff Current	I_{EBO} µA	25	-			-0.5 -2.5			0 0				- -	- -	-12 -	- -	- -	-12 -	- -	- -	- -12	- -	- -	- -	- -	- -	- -
Collector-to-Base Breakdown Voltage	BV_{CBO} V	25 -	- 25						-0.05 +0.1	0 0			-50 -	- -	- -	-50 -	- -	- -	- -	- -	- -	- 300	- -	- -	- -	- -	- -
Collector-to-Base Breakdown Voltage	BV_{CBV} V	25	-			-0.5			-0.05				-34	-	-	-34	-	-	-	-	-	-	-	-	-	-	-
Collector-to-Emitter Breakdown Voltage	BV_{CER} V	25	-				10000		-5				-	-	-	-	-	-	-18	-	-	-	-	-	-	-	-
Collector-to-Emitter Breakdown Voltage	BV_{CEX} V	-	25						+1		+0.005		-	-	-	-	-	-	-	-	-	300	-	-	-	-	-
Emitter-to-Base Breakdown Voltage	BV_{EBO} V	25 25 -	- - 25						0 0 0	-0.012 -0.05 +0.1			-1.5 - -	- - -	- - -	-0.5 - -	- - -	- - -	- -2.5 -	- - -	- - -	- - 2	- - -	- - -	- - -	- - -	- - -
Static Forward Current-Transfer-Ratio	h_{FE}	-	25		+10				+50				-	-	-	-	-	-	-	-	-	30	60	150	-	-	-
Gain-Bandwidth Product	f_T MHz	25 -	- 25		-12 +50				-1 +20				- -	40 -	- -	- -	30 -	- -	- -	- -	- -	- -	- 25	- -	- -	- -	- -
Small-Signal Forward Current-Transfer Ratio (Measured at 1 kHz)	h_{fe}	25	-		-6				-1				27	80	170	82	150	350	100	160	325	-	-	-	-	-	-
Small-Signal Forward Current-Transfer Ratio Cutoff Frequency	f_{hfb} MHz	25	-		-6				-1				-	-	-	-	-	-	-	10	-	-	-	-	-	-	-
Extrinsic Base-Lead Resistance (Measured at 100 MHz)	$r_{bb'}$ Ω	25 25 -	- - 25		-12 -6 +50				-1 -1 +20				- - -	25 - -	- - -	- - -	25 - -	- - -	- - -	- 200 -	- - -	- - -	- - 20	- - -	- - -	- - -	- - -
Feedback Capacitance	C_{cb} pF	25 -	- 25	-12 +50						0 0			- -	- -	3.7 -	- -	- -	3.4 -	- -	- -	- -	- -	- 5	- -	- -	- -	- -
Thermal Resistance Junction to Mounting Flange	θ_{J-MF} °C/W	-	-										-	-	-	-	-	-	-	-	-	40424 -	8	10	-	-	-
Thermal Resistance Junction to Ambient	θ_{J-A} °C/W	-	-										-	-	-	-	-	-	-	-	-	40425 -	-	25	-	-	-
Instantaneous Forward Voltage Drop	V_F V	25	-									125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Dynamic Reverse Current	i_R mA	65	-					400				125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.4
Static Reverse Current	I_R µA	25	-					400				0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-6

FEATURES

- hermetically sealed packages
- 40261 - converter
  40262 - IF-amplifier
  low feedback capacitance, C_{cb}
  40261 = 3.7 max. pF
  40262 = 3.4 max. pF
- 40263 - low-level af-amplifier/driver
  high beta at 1 KHz,
  $h_{fe} = \begin{cases} 100 \text{ min.} \\ 325 \text{ max.} \end{cases}$ at $I_C = -1$ mA
- 40424, 40425 - class A output amplifiers
  high breakdown voltages,
  BV_{CBO}, BV_{CEX} = 300 V min.
  excellent high frequency response, f_T = 25 MHz, typ.

  JEDEC TO-66 metal package with collector internally connected to case for efficient heat transfer; pin-type base and emitter terminals
- 40425 - JEDEC TO-66 metal package with integral aluminum cooling flange. Designed for direct mounting on printed-circuit boards.
  P_T = 3.8 W at T_A to 55°C

Maximum Ratings, *Absolute-Maximum Values:*

	40261 Converter	40262 IF Ampl.	40263 AF Ampl.	40424 PWR. Ampl.	40425 PWR. Ampl.	40265 Rectifier	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-50	-50	-20	+300	+300	-	max. V
COLLECTOR-TO-BASE VOLTAGE, V_{CBV} (V_{EB} = -0.5 V, I_C = -50 μA)	-34	-34	-	-	-	-	max. V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CER} ($R_{BE} \leq 10000\,\Omega$)	-	-	-18	-	-	-	max. V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEX} (I_C = 5 mA, I_B = 5 μA)	-	-	-	+300	+300	-	max. V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-0.5	-0.5	-2.5	+2	+2	-	max. V
COLLECTOR CURRENT, I_C	-10	-10	-50	+150	+150	-	max. mA
BASE CURRENT, I_B	-	-	-	+150	+150	-	max. mA
EMITTER CURRENT, I_E	+10	+10	+50	-150	-150	-	max. mA
TRANSISTOR DISSIPATION, P_T:							
At ambient temperatures up to 25°C	80	80	-	-	-	-	max. mW
At ambient temperatures above 25°C	(See Fig.2)		-	-	-	-	
At ambient temperatures up to 55°C	-	-	0.12	-	3.8	-	max. W
At ambient temperatures above 55°C	-	-	See Fig.3	-	See Fig.4	-	
At mounting-flange temperatures▲ up to 70°C	-	-	-	8	-	-	max. W
At mounting-flange temperatures▲ above 70°C	-	-	-	See Fig.4	-	-	
PEAK REVERSE VOLTAGE, PRV	-	-	-	-	-	400	max. V
RMS SUPPLY VOLTAGE, V_{RMS}	-	-	-	-	-	140	max. V
FORWARD CURRENT: At ambient temperatures up to 65°C (For ambient temperatures above 65°C see Fig.5)							
DC, I_F	-	-	-	-	-	125	max. mA
PEAK REPETITIVE, i_{FR}	-	-	-	-	-	1.3	max. A
SURGE CURRENT, i_S: For "turn-on" time of 2 milliseconds at a ambient temperature of 25°C	-	-	-	-	-	30	max. A
At ambient temperatures above 25°C	-	-	-	-	-	See Fig.5	
TEMPERATURE RANGE: Operating and Storage	-65 to +85	-65 to +85	-65 to +100	-65 to +150	-65 to +150	-65 to +175	°C
LEAD TEMPERATURE (During Soldering): At distances not closer than 1/32" to seating surface, for 10 seconds max.	255	255	255	255	255	255	max. °C

▲Measured at center of seating surface.

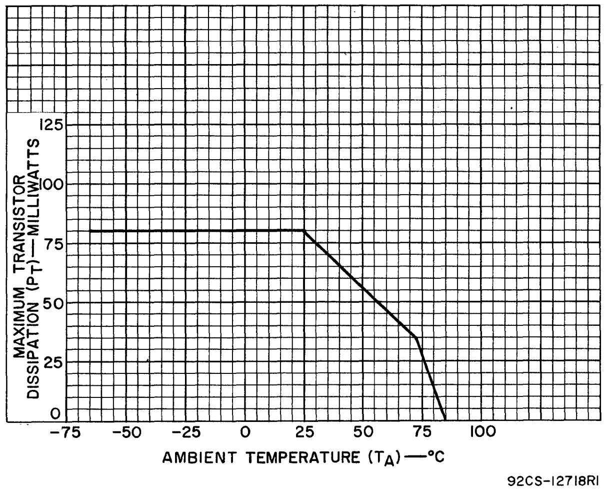


Fig.2 - Rating Chart for RCA-40261 and 40262.

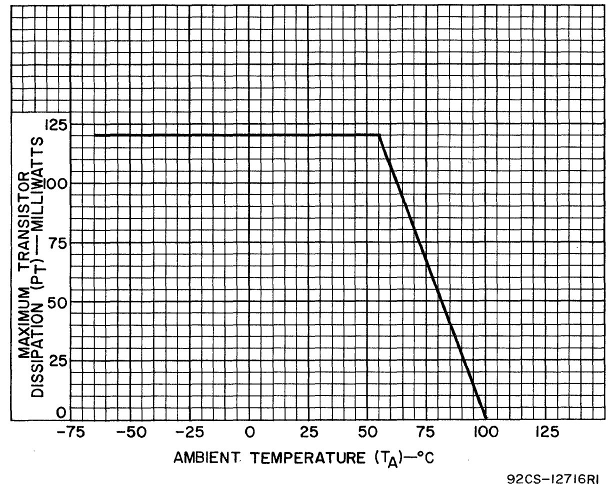


Fig.3 - Rating Chart for RCA-40263.

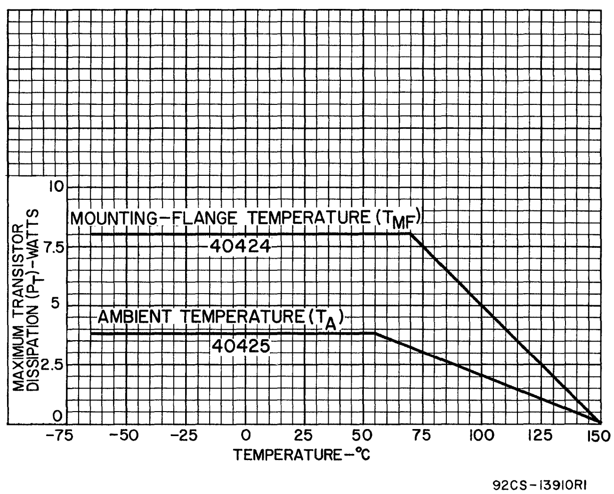


Fig.4 - Rating Chart for RCA-40424 and 40425.

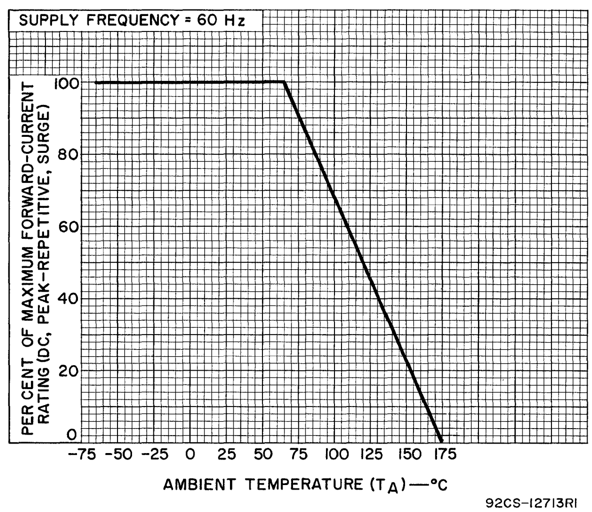


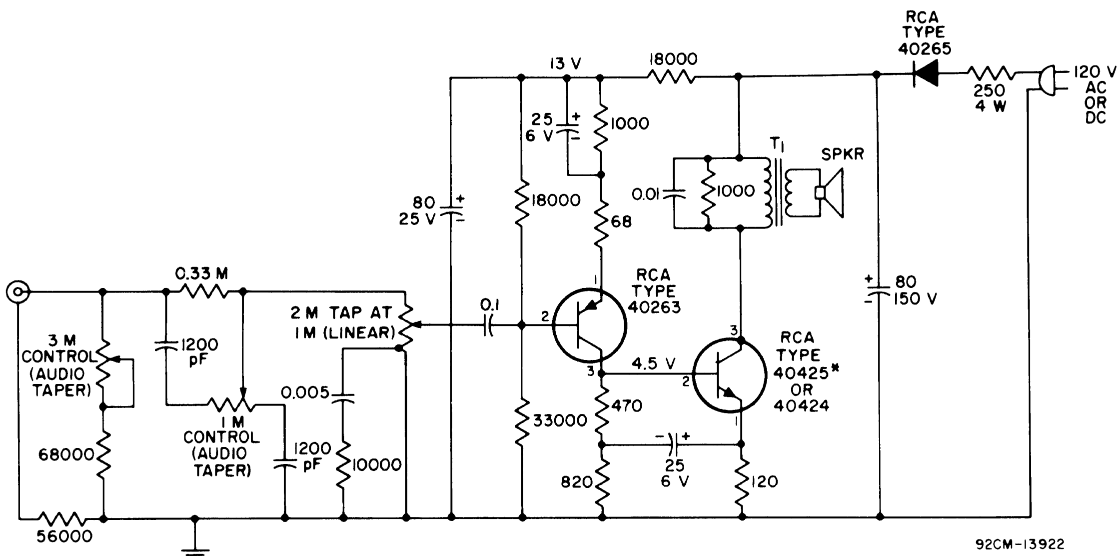
Fig.5 - Rating Chart for RCA-40265.

PROTECTION AGAINST TRANSIENT VOLTAGES

Harmful transient voltages can occur in a class A audio-output stage that uses transformer coupling between the transistor and the load. Such transient voltages can occur as a result of intense radiation which exists during electrical storms, or the radiation emitted by fluorescent lighting equipment. These forms of radiation cause transient pulses to appear at the detector circuit or af-input circuit. Transient pulses, when amplified, may reach instantaneous values as great as 5 to 7 times the dc supply voltage. High-voltage transients are also developed when the transistor is overdriven to a very high value of collector current and is then abruptly cut off.

The peak value of the transient voltage depends on the inductance, capacitance, and resistance of the output transformer and load, and on the value of the collector current immediately prior to cutoff. The reactive components of the transformer and load act as a parallel-resonant circuit, with series and shunt damping (loss) elements provided by the associated resistances. For a given set of load-circuit conditions, the peak value of the transient voltage is directly proportional to the collector current, and can be limited to a value within the maximum rating for the transistor by limiting the maximum value of the collector current (i.e., by limiting the dynamic range of the transistor).

In most cases, this type of limiting can be accomplished, and the desired maximum power output obtained without clipping and without compromise in performance or cost factors, by a judicious choice of circuit constants. The af-amplifiers shown in Fig.1 and Fig.6 provide protection against excessive collector voltages without the use of transient-suppression devices.



* 40425 may be mounted directly on printed-circuit board with no additional heat sink for operation at ambient temperatures up to 55°C.

PERFORMANCE DATA

Power Output = 1 W min. at 10% total harmonic distortion
Sensitivity: 3 mV for 50 mW output
16 mV for 1 W output

Power Gain: 72 dB
Z_{in}: 3000 Ω typ.
Hum & Noise: Zero vol. -70 dB } 1 W
Full vol. -58 dB } Ref.

Freq. Resp.: 120 Hz to 7.6 KHz (-3 dB)

1. All measurements taken at 120 V line input and at signal frequency 1 KHz.
2. All voltages referred to circuit ground.
3. T_1: 2500 Ω-to-voice-coil: Freed Type RGA-8 or Triad Type S-12X or similar commercial-grade plate-to-voice coil transformer.
4. Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
5. Capacitors are in microfarads.

Fig.6 - 1-Watt Line-Operated Phonograph Amplifier using RCA-40263 and 40424 or 40425.

Typical Performance Data for AM Broadcast-Band Radio Receiver Shown in Fig.1 at Line Voltage = 120 Volts, 60 Hz

	Signal Frequency (KHz) 600	1000	1400	
Sensitivity to 50-mW output	220	160	210	μV/m
Sensitivity for 500-mW output	-	310	-	μV/m
Sensitivity for 20 dB signal-to-noise ratio	250	200	210	μV/m
Signal-to-noise ratio at 50 mW output	17	18	20	dB
AGC Figure of Merit for Input Signal Strength = 50,000 μV/m	34	34	33	dB
Adjacent-Channel Attenuation (Bandwidth) at 1000 μV/m level:				
6 dB down	6	9	10	KHz
20 dB down	14	18	22	KHz
Image Rejection	50	42	38	dB
IF Rejection	37	45	52	dB
RF Overload Level for 10% Total Harmonic Distortion:				
30% modulation	-	2	-	V/m
80% modulation	-	0.1	-	V/m
Total Harmonic Distortion at 200 mW output for 10,000 μV/m input, signal modulated 30% at 1 KHz	-	3	-	%

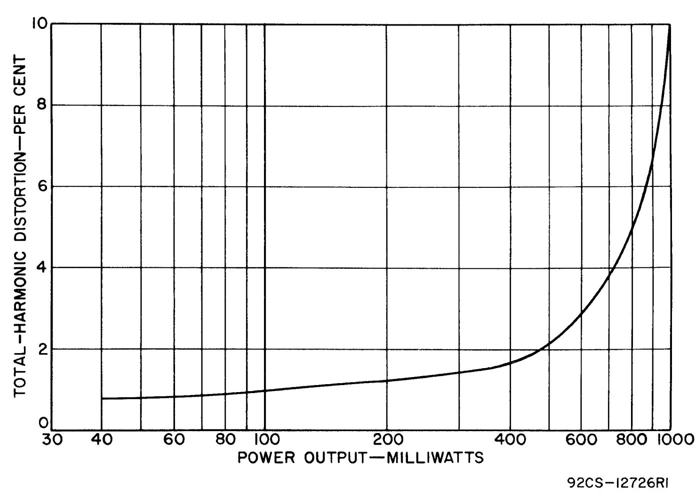


Fig.7 - Distortion of Phonograph Amplifier Shown in Fig.6 as a Function of Power Output.

Typical Operation of RCA-40262 in a Single-Stage 455-KHz Amplifier Circuit, at $T_A = 25°C$

Common-Emitter Circuit, Base Input

DC Collector-Supply Voltage, V_{CC}	18	V
DC Collector-to-Emitter Voltage, V_{CE}	-17	V
DC Emitter Current, I_E	2	mA
Input Resistance, R_{IN}	1550	Ω
Output Resistance, R_{OUT}	0.25	MΩ
Collector-to-Base Capacitance, C_{cb}	2.9	pF
Power Gain:		
Maximum Available Gain,* MAG	56	dB
Useful Gain:		
Circuit neutralized	40	dB
Circuit not neutralized	35	dB

* Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power (transformer insertion losses not included).

Typical Operation of RCA-40261 at 1.5 MHz in a Self-Excited Converter Circuit, at $T_A = 25°C$

Common-Emitter Circuit, Base Input

DC Collector-Supply Voltage, V_{CC}	18	V
DC Collector-to-Emitter Voltage, V_{CE}	-17	V
DC Emitter Current, I_E	1.5	mA
Input Resistance, R_{IN}	1500	Ω
Output Resistance, R_{OUT}	0.35	MΩ
Base-to-Emitter Oscillator Injection Voltage	100	mV
Conversion Power Gain, G_c:		
Maximum Available Gain, MAG	53	dB
Useful Gain	43	dB

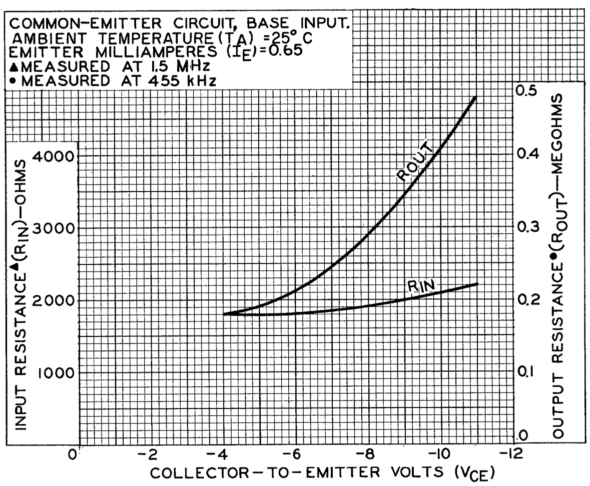


Fig.8 - Typical Performance Characteristics for Type 40261.

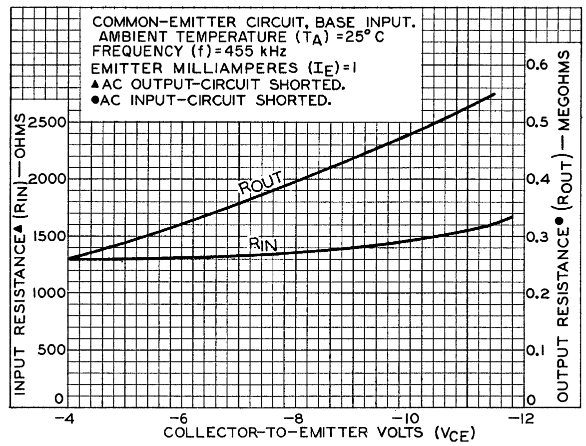


Fig.9 - Typical Performance Characteristics for Type 40262.

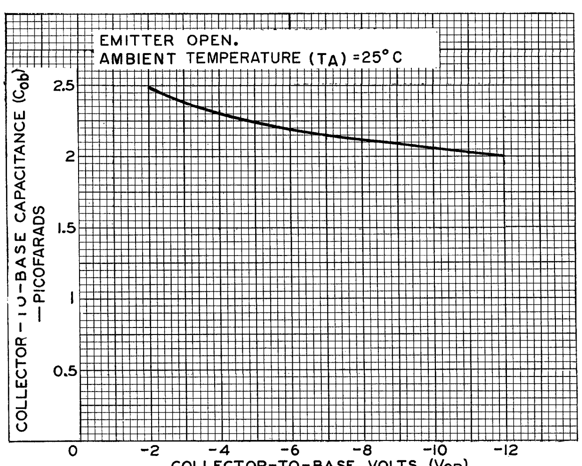


Fig.10 - Typical Characteristic for Type 40262.

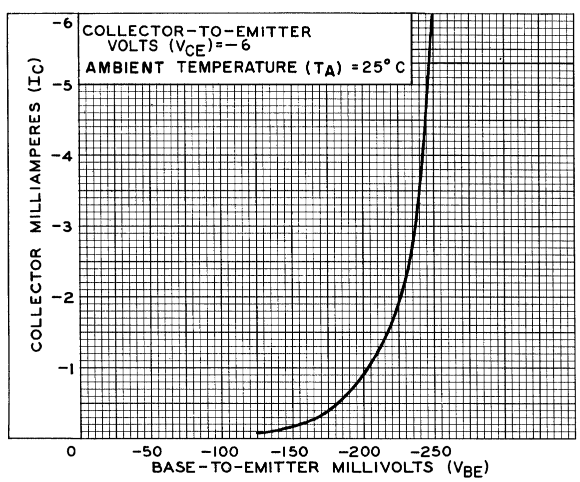
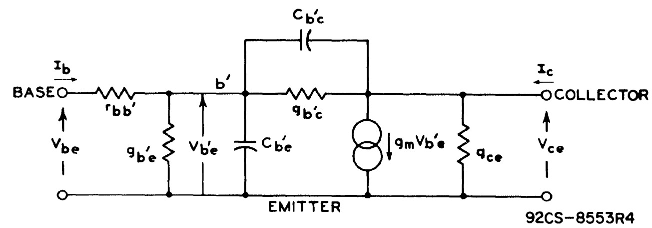


Fig.11 - Typical Characteristic for Types 40261 and 40262.

EQUIVALENT CIRCUIT
With corresponding Small-Signal Parameters for RCA-40263



V_{ce}	=	-6	V
I_c	=	-1	mA
$r_{bb'}$	=	300	Ω
$g_{b'e}$	=	250	μmho
$g_{b'c}$	=	0.35	μmho
g_{ce}	=	6	μmho
$C_{b'e}$	=	750	pF
$C_{b'c}$	=	9	pF
gm	=	38500	μmho

NOTE: The approximate frequency f, for unity power amplification based on this equivalent circuit is given by:

$$f = \frac{1}{4\pi}\sqrt{\frac{gm}{r_{bb'}\,C_{b'c}\,C_{b'e}}}$$

Fig.12 - "Hybrid π" Equivalent Circuit for Type 40263.

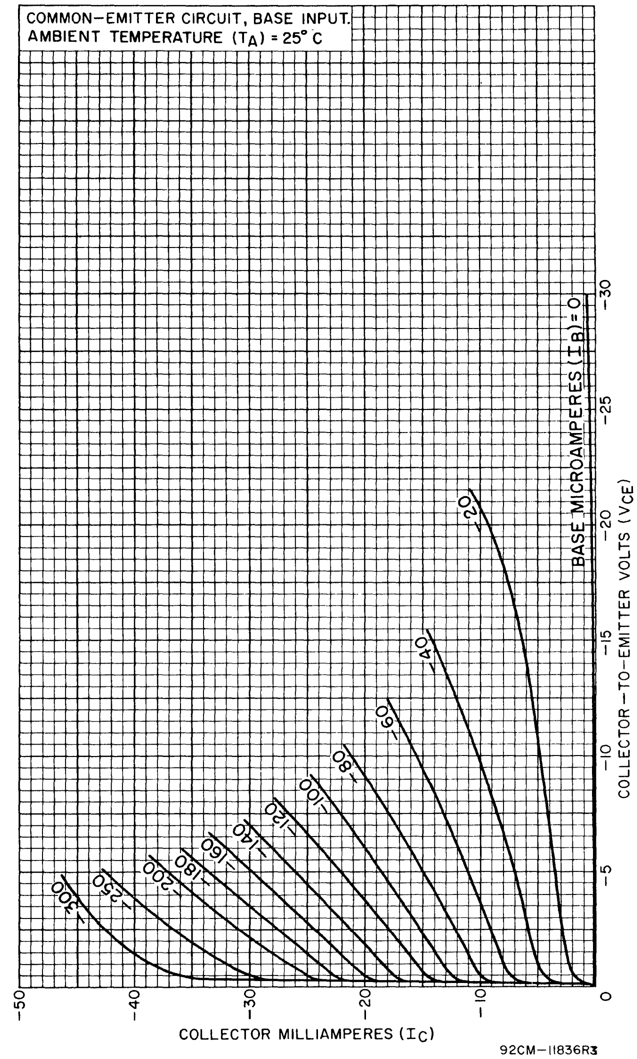


Fig.13 - Typical Collector Characteristics for Type 40263.

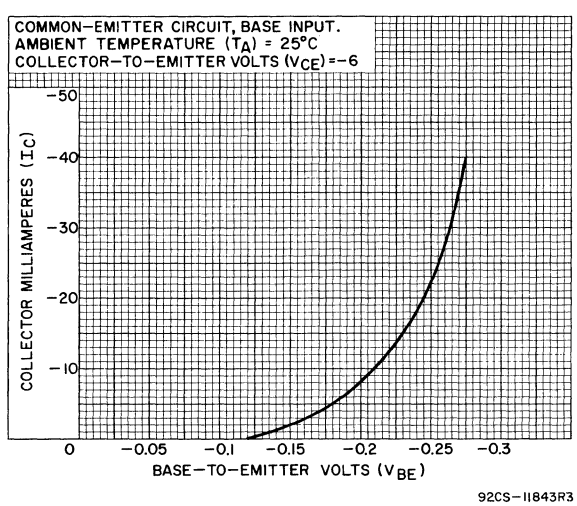


Fig.14 - Typical Transfer Characteristic for Type 40263.

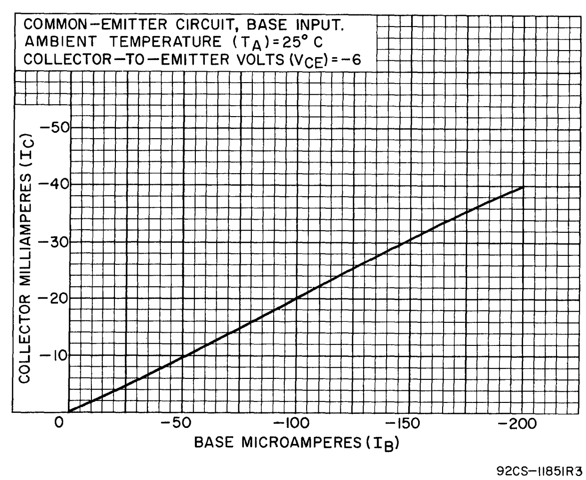


Fig.15 - Typical Transfer Characteristic for Type 40263.

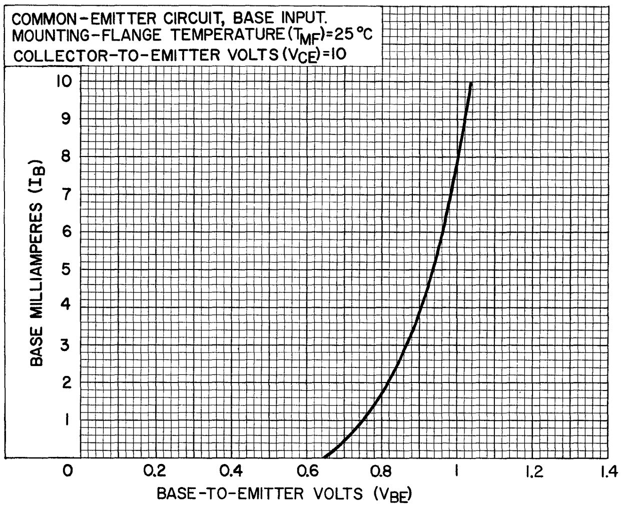


Fig.16 - Typical Input Characteristic for Types 40424 and 40425.

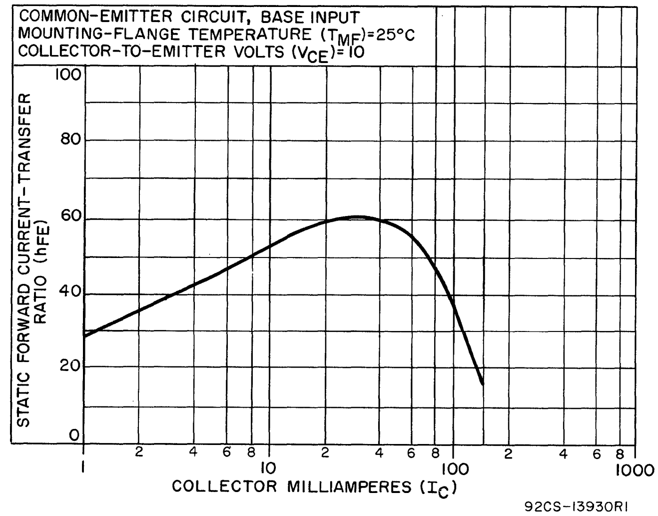


Fig.17 - Typical Static Beta (h_{FE}) Characteristic for Types 40424 and 40425

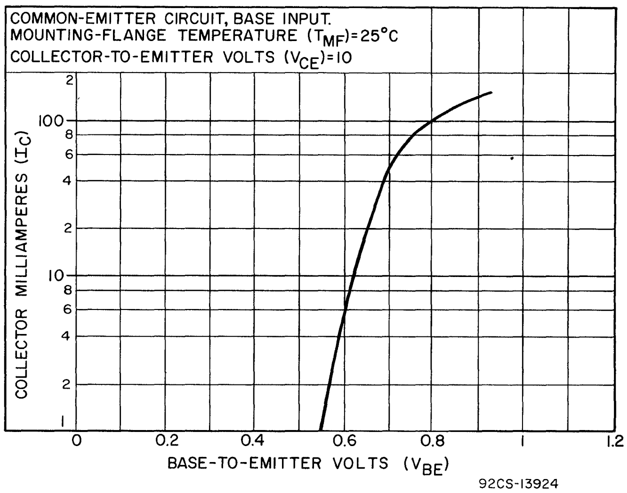


Fig.18 - Typical Transfer Characteristic for Types 40424 and 40425.

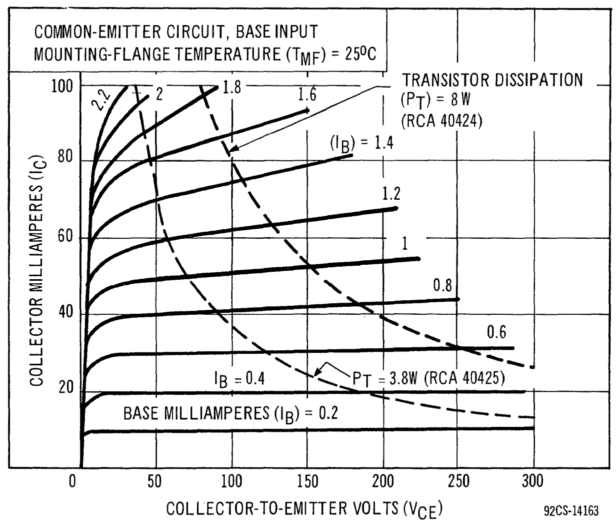


Fig.19 - Typical Collector Characteristics for Types 40424 and 40425.

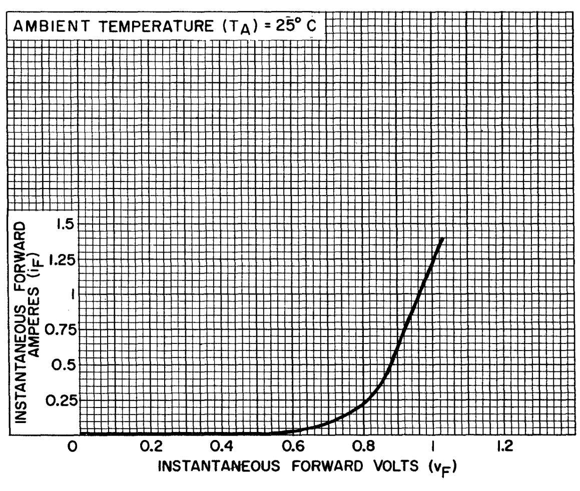
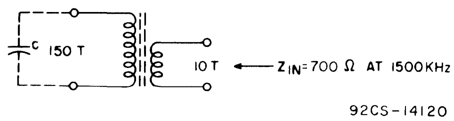


Fig.20 - Typical Forward Characteristic for Type 40265.

Ganged Tuning Capacitors

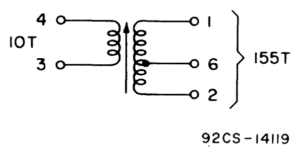
Trimmer Settings (C_1 and C_3)	Capacitance Ranges – pF: Antenna Section (C_1 and C_{2A})		Capacitance Ranges – pF: Oscillator Section (C_3 and C_{2B})	
	Min.	Max.	Min.	Max.
Minimum	10	135	9.8	89
Maximum	28	152	28	110

T_1(Antenna Transformer)



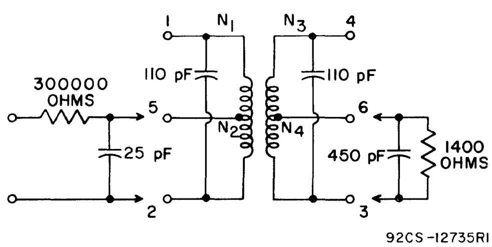
Primary tunes to 535 kHz with C = 135 pF
WINDING INFORMATION: 115 turns No.36 Grip-Eze* wire wound over 3" on a 3/8"-dia. ferrite rod 5" long.

T_2(Oscillator Transformer)



Q_0 = 55-60
Oscillator Transformer (T2) part No.TRW20704● or equivalent

T_3(1st IF Transformer)

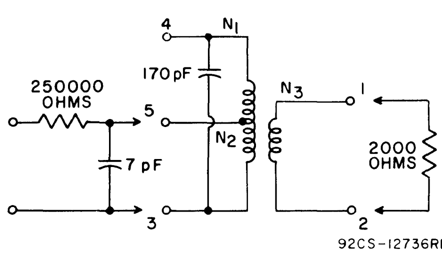


	PRI		SEC
Q_0	= 60	Q_0	= 60
Q_L	= 53.5	Q_L	= 53.5
N_1/N_2	= 2.25	N_3/N_4	= 38.2
A	= 23.5 K		

K/K_c = 0.7

1st IF Transformer (T3)-part No.TRW17793● or equivalent.

T_4(2nd IF Transformer)



Q_0 = 70 N_1/N_2 = 2.08
Q_L = 48 N_2/N_3 = 6.55
A = 25 K

2nd IF Transformer (T4)-part No.TRW17796● or equivalent.

● TRW Electronic Components Div.
666 Garland Pl.
Des Plaines, Ill. 60016

* Trade Mark, Phelps-Dodge Copper Products Co.

Fig.21 - Characteristics of Tuned Circuit Components for Receiver Shown in Fig.1

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The *flexible leads* of the 40261, 40262, 40263, and 40265 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in each lead, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using these devices, the temperature of the solder should not exceed 255°C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.25" of the metal case.

The devices described in this bulletin should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the devices.

Because the metal shell of the 40424 and 40425 operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

It is essential that the mounting flange of the 40424 which is internally connected to the collector, be securely fastened to a heat sink, which may be the equipment chassis. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD THE MOUNTING FLANGE BE SOLDERED TO THE HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

The mounting-flange temperature of the 40424 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

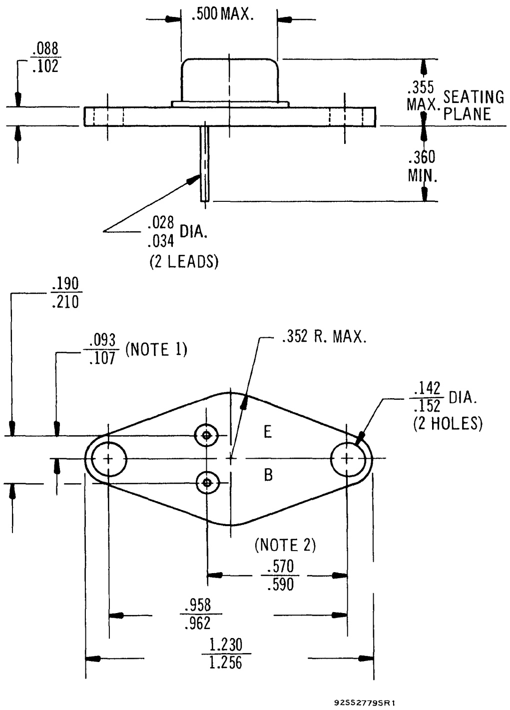
Depending on the application, the heat sink or chassis may be connected to either the positive or negative terminal of the voltage supply.

In applications where the chassis is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized aluminum washer having high thermal conductivity, or a 0.003" thick mica insulator between the mounting flange and the chassis. If an aluminum washer is used, it should be drilled or punched to provide the two mounting holes and the clearance hole for the emitter and base leads. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit bethe mounting bolts and the chassis, it is important that an insulating washer be used between each bolt and the chassis as shown on page 11.

A *surge-limiting impedance* should always be used in series with the 40265 rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

The 40265 is designed to provide reliable performance when operated within the maximum ratings shown in this bulletin. For measurement of the reverse characteristics of this device, peak reverse voltages as high as 30 per cent above the maximum rated values may be applied for a period not exceeding 10 seconds. UNDER NO CIRCUMSTANCES SHOULD PEAK REVERSE VOLTAGES GREATER THAN 30% ABOVE THE MAXIMUM RATED VALUES BE APPLIED TO THE 40265, EVEN MOMENTARILY.

DIMENSIONAL OUTLINE 40424



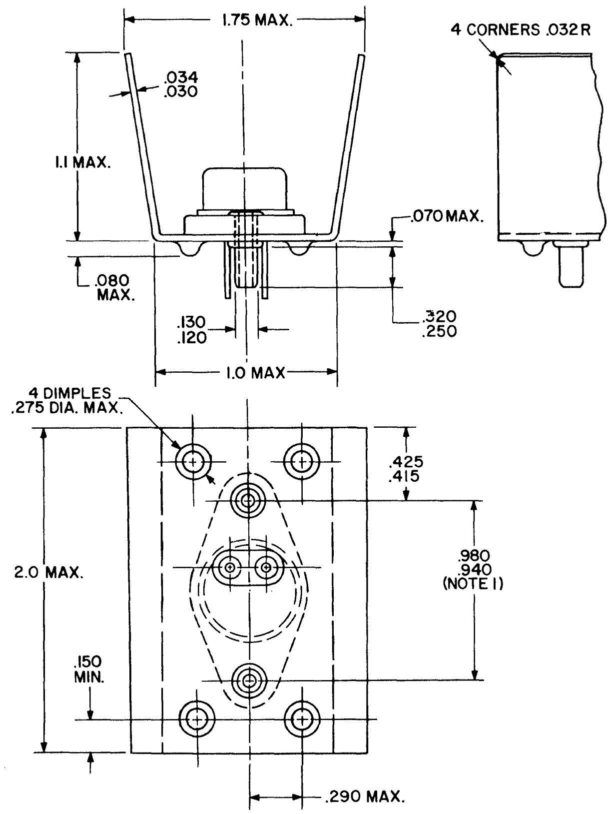
Dimensions in Inches

NOTE 1: MEASURED AT SEATING PLANE

NOTE 2: MEASURED AT SEATING PLANE ON RCA-40424

MEASURED AT UNDERSIDE OF ALUMINUM COOLING FLANGE ON RCA-40425

DIMENSIONAL OUTLINE 40425

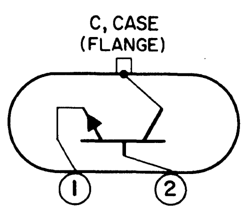


92CS-14109

Dimensions in Inches

NOTE 1: MEASURED BETWEEN CENTER LINES OF TIPS OF MOUNTING PINS

TERMINAL DIAGRAM 40424, 40425

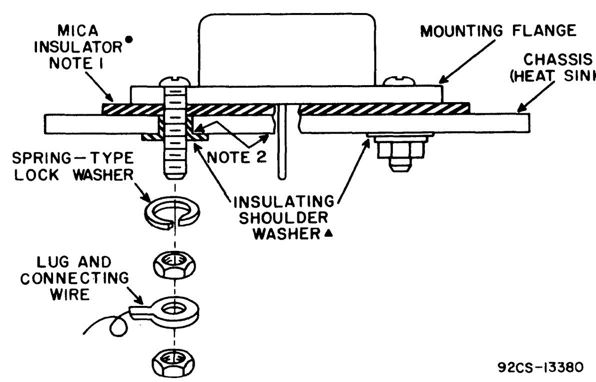


Pin 1 - Emitter

Pin 2 - Base

Mounting Flange - Collector, Case

SUGGESTED MOUNTING ARRANGEMENT 40424□



NOTE 1: 0.002" thick mica or anodized aluminum insulator drilled or punched with burrs removed.

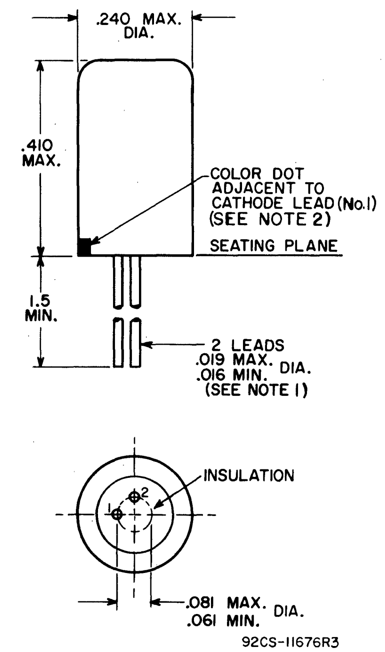
NOTE 2: Remove burrs from chassis holes.

● Available from RCA Distributors as Part No.DF31A. Also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

▲ Available from RCA Distributors as Part No.495334-7. Also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

□ RCA-40424 fit socket PTS-4 (United International Dynamics Corp., 2029 Taft St., Hollywood, Fla.), or equivalent.

DIMENSIONAL OUTLINE
40265



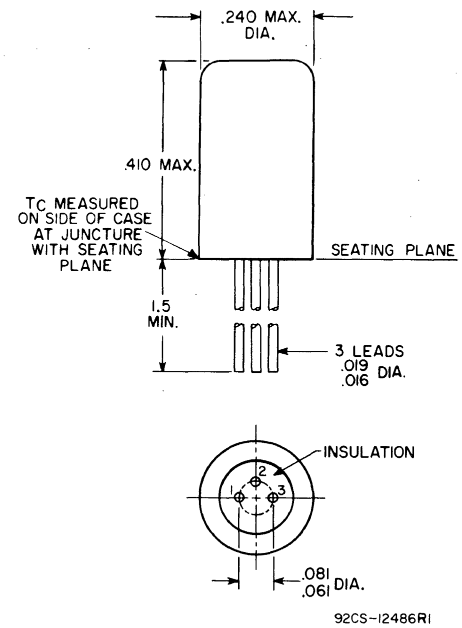
Dimensions in Inches

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50" A MAXIMUM OF 0.21" DIAMETER IS HELD.

NOTE 2: FORWARD (EASY) CURRENT FLOW THROUGH THE DEVICE IS IN THE DIRECTION TOWARD THE LEAD ADJACENT TO THE POLARITY MARK.

DIMENSIONAL OUTLINE
40261, 40262, 40263

JEDEC No.TO-1

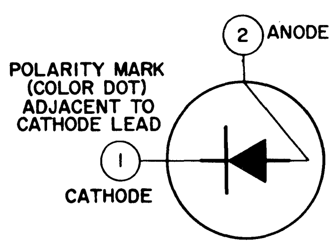


Dimensions in Inches

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE. BETWEEN 0.250" AND 1.5", A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

TERMINAL DIAGRAM
40265

Bottom View

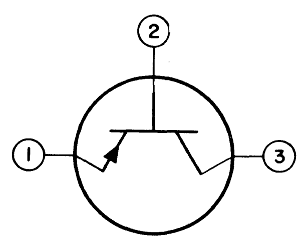


Lead 1 - Cathode (Color dot adjacent to cathode lead)

Lead 2 - Anode

The arrow indicates direction of forward (easy) current flow as indicated by dc ammeter.

TERMINAL DIAGRAM
40261, 40262, 40263



Lead 1 - Emitter

Lead 2 - Base

Lead 3 - Collector

RCA DIFFUSED JUNCTION SILICON RECTIFIERS

40266
40267

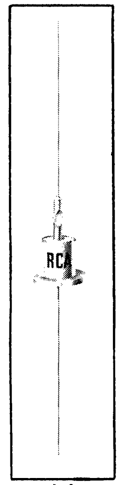
RCA-40266 and 40267 are hermetically sealed silicon rectifiers of the diffused junction type, intended principally for use in power supplies for transistor high-fidelity amplifiers. They are also useful in other applications requiring large dc supply currents at relatively low voltages.

These rectifiers are designed for use with capacitor-input filters, and have a dc forward current capability of 2 amperes at case temperatures up to 105°C, and of 500 milliamperes at free-air temperatures up to 75°C. They differ only in their Peak Reverse Voltage ratings (100 volts max. for RCA-40266; 200 volts max. for RCA-40267).

The 40266 and 40267 feature the same superior junction characteristics as the industry proved, extensively used RCA-1N1763 and 1N1764 — characteristics made possible by RCA's special, precisely-controlled diffusion technique. They also utilize the same welded, hermetically sealed, axial-lead package (JEDEC DO-1) for protection against moisture and contamination.

DIFFUSED-JUNCTION SILICON RECTIFIERS

For Industrial and Consumer-Product Applications



Features:

- high output-current capabilities
  2 amperes max. for heat-sink operation
  0.5 ampere max. for free-air operation
- superior junction characteristics
- hermetically sealed JEDEC DO-I package

RECTIFIER SERVICE

Maximum Ratings — *Absolute-Maximum Values*
For supply frequency of 60 cps and with capacitor-input filter

	40266	*40267*		
PEAK REVERSE VOLTAGE, PRV.	100	200	max.	volts
RMS SUPPLY VOLTAGE, V_{RMS} .	35	70	max.	volts
FORWARD CURRENT:				
At case temperatures up to 105° C:				
DC, I_F	2	2	max.	amp
PEAK REPETITIVE, i_{PR} .	10	10	max.	amp
SURGE, i_S*	35	35	max.	amp
At case temperatures above 105° C	See *Fig.1*			

	40266	*40267*		
At free-air temperatures up to 75° C:				
DC, I_F	500	500	max.	ma
PEAK REPETITIVE, i_{PR} .	5	5	max.	amp
SURGE, i_S*	35	35	max.	amp
At free-air temperatures above 75° C.	See *Fig.2*			

* For a "turn-on" transient of 2 milliseconds duration.

RATING CHARTS FOR RCA-40266 AND 40267

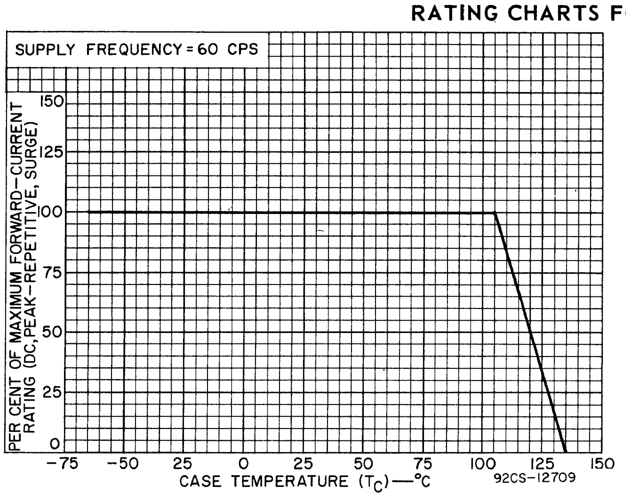


Fig.1

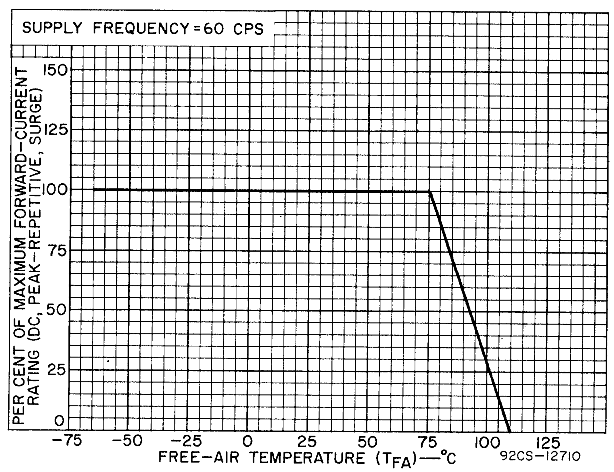


Fig.2

Maximum Ratings (cont'd)

	40266	40267	
TEMPERATURE RANGE:			
Storage	-65 to +150		°C
Operating:			
Free-air	-65 to +110		°C
Case	-65 to +135		°C
LEAD TEMPERATURE (During Soldering):			
At distances not closer to rectifier body than indicated by Points A and B on Outline Drawing, for 10 seconds max.	255	255 max.	°C

Electrical Characteristics,
at a Free-Air Temperature of 25° C:

	40266	40267	
Maximum instantaneous forward voltage at instantaneous forward current of 15 amperes	3	3	volts
Maximum reverse current:			
At a peak reverse voltage of 100 volts	10	-	µa
At a peak reverse voltage of 200 volts	-	10	µa

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data for the RCA-40266 and 40267 are limiting values above which the serviceability of these rectifiers may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed the absolute ratings, the equipment designer has the responsibility of determining an average design value below each absolute rating by an amount such that the absolute values will never be exceeded under any usual conditions of ambient-temperature variation, supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

A *surge-limiting resistance* or *impedance* should always be connected in series with the rectifier. The value of this resistance or impedance must be sufficient to limit the peak and surge currents to the values specified under the maximum ratings.

The *flexible leads* of the 40266 and 40267 are usually soldered to the circuit elements. These rectifiers may also be mounted in holders of the fuse-clip type. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the rectifiers. To absorb some of the heat, grip the flexible lead of the rectifier between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuitry using the 40266 and 40267, the temperature of the solder should not exceed 255°C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered beyond points A and B indicated on the Outline Drawing.

Because the cathode of the 40266 or 40267 is connected to the metal case, the case operates at potentials which are dangerous. Care, therefore, should be taken in the design of equipment to prevent the operator from coming in contact with the metal case. It is recommended that the rectifier be mounted on the underside of the chassis.

TYPICAL FORWARD VOLTAGE AND CURRENT CHARACTERISTIC FOR TYPES 40266 AND 40267

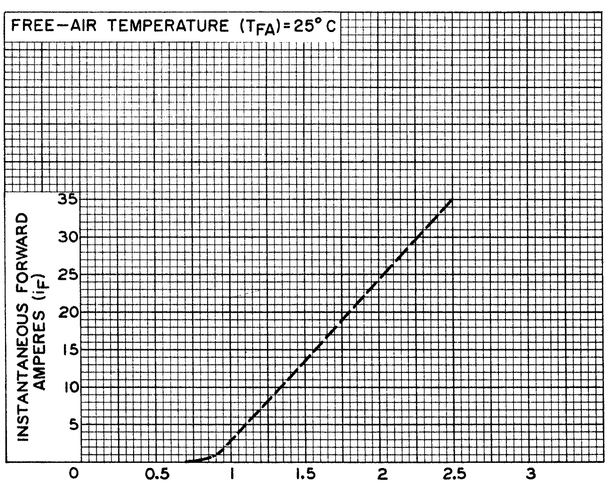
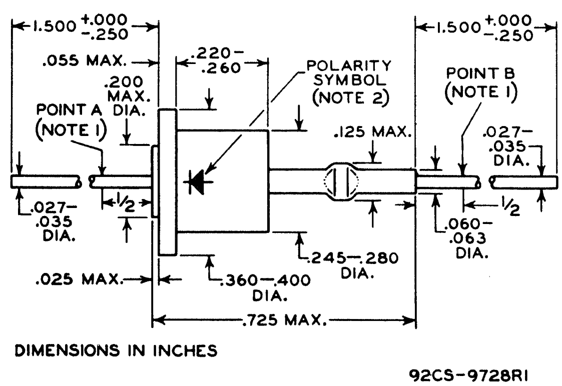


Fig.3

DIMENSIONAL OUTLINE (JEDEC-DO-1)
For Types 40266 and 40267



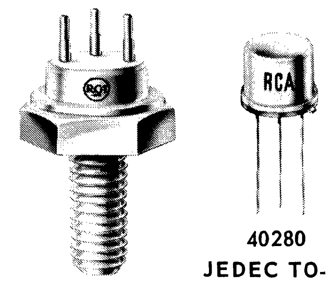
NOTE 1: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.
NOTE 2: DO NOT DIP SOLDER BEYOND POINTS "A" AND "B".

SILICON N-P-N "overlay" TRANSISTORS

RCA-40280, -40281, and -40282 are epitaxial silicon n-p-n planar transistors of the "overlay" emitter electrode construction. They are intended especially for high power output, VHF Class-C-amplifier service in low-voltage-supply applications.

In the overlay structure, there are a number of individual emitter sites which are all connected in parallel and used in conjunction with a single base and collector region. When compared with other structures, this arrangement provides a substantial increase in emitter periphery for higher current or power, and a corresponding decrease in emitter and collector areas for lower input and output capacitances. The overlay structure thus offers greater power output, gain, efficiency, and frequency capability.

High-Power VHF Amplifier



40281, 40282 JEDEC TO-60 H-1307

40280 JEDEC TO-39 H-1381

- **For Low Voltage Supplies**
- **High Output Power at 175 MHz, Unneutralized, Class-C Amplifier**
  - 40280 1 watt (min.)
  - 40281 4 watts (min.)
  - 40282 12 watts (min.)
- **High Efficiency at 175 MHz**
  - 40280 60% at P_{IN} = 0.125 watt
  - 40281 70% at P_{IN} = 1 watt
  - 40282 80% at P_{IN} = 4 watts
- **Low Input Impedance**
  - 40280 10 ohms (typ.)
  - 40281 7 ohms (typ.)
  - 40282 5 ohms (typ.)

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

		40280	40281	40282	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	36	36	36	V
COLLECTOR-TO-EMITTER VOLTAGE:					
With base open	V_{CEO}	18	18	18	V
With V_{BE} = −1.5 V	V_{CEV}	36	36	36	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	4	4	V
COLLECTOR CURRENT	I_C	0.5	1	2	A
TRANSISTOR DISSIPATION	P_T				
At case temperatures up to 25° C		7.0	11.6	23.2	W
At case temperatures above 25° C		Derate linearly to 0 watts at 200° C			
TEMPERATURE RANGE:					
Storage & Operating (Junction)		−65 to 200			°C
LEAD TEMPERATURE (During soldering):					
At distances ≥ 1/32 in. from insulating wafer (TO-60) package or from seating plane (TO-39 package) for 10 s max		230			°C

TYPICAL RF POWER OUTPUT vs. RF POWER INPUT
175-MHz Operation

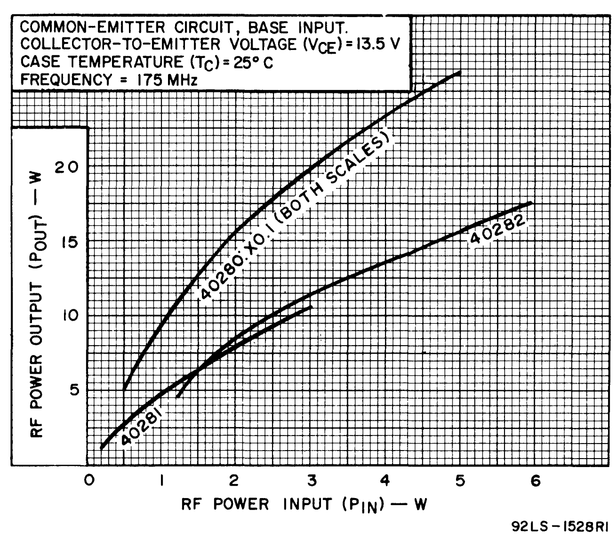


Fig. 1

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5/67
Supersedes 1/67

ELECTRICAL CHARACTERISTICS
At Case Temperature (T_C) = 25 °C

Characteristics	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	DC Current (Milliamperes) I_B	DC Current (Milliamperes) I_C	LIMITS: Type 40280 Min.	Type 40280 Max.	Type 40281 Min.	Type 40281 Max.	Type 40282 Min.	Type 40282 Max.	Units
Collector Cutoff Current	I_{CEO}		15			0		–	100	–	100	–	250	µA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0 0		0.25 0.50	36 –	– –	36 –	– –	– 36	– –	V V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.10 0.25		0 0	4 –	– –	4 –	– –	– 4	– –	V V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			−1.5			200[a]	36	–	36	–	36	–	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$					0	200[a]	18	–	18	–	18	–	V
Real Part of Common-Emitter High Frequency Input Impedance (At f = 175 MHz)	hie (real)		13.5 13.5 13.5				100 400 800	10 (typ.) – –	 – –	– 7 (typ.) –	– –	– – 5 (typ.)	– – 	Ω Ω Ω
RF Power Output: As Class-C Amplifier, Unneutralized (At f = 175 MHz) See *Fig.2*	P_{OUT}		13.5					1[b]	–	4[c]	–	12[b]	–	W
Gain-Bandwidth Product	f_T		13.5 13.5 13.5				100 400 800	550 (typ.) – –	 – –	– 400 (typ.) –	– –	– – 350 (typ.)	– – 	MHz MHz MHz
Collector-to-Base Capacitance (At f = 1 MHz)	C_{ob}	13.5			0			–	15	–	22	–	45	pF
Collector-to-Case Capacitance	C_s							–	–	–	5	–	5	pF
Thermal Resistance Junction-to-Case	ΘJ-C							–	25	–	15	–	7.5	°C/W

[a] Pulsed through an inductor (25 mH); duty factor = 50%.

[b] For P_{IN} = 0.125 w; minimum efficiency = 60%.

[c] For P_{IN} = 1.0 W; minimum efficiency = 70%.

[d] For P_{IN} = 4.0 W; minimum efficiency = 80%.

RF AMPLIFIER CIRCUIT FOR POWER-OUTPUT TEST TYPES 40281 & 40282 (175-MHz Operation)

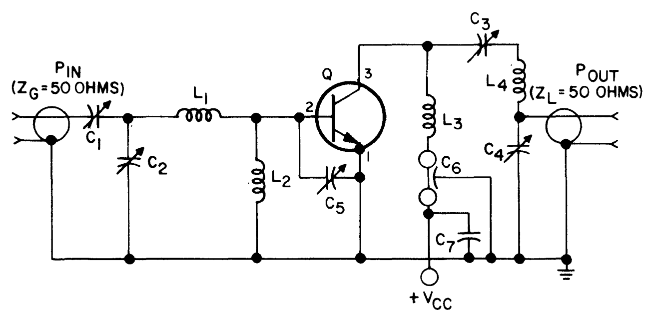


Fig. 2

C_1, C_2, C_3, & C_4: 7-100 pF
C_5: 8-60 pF
C_6: 1,000 pF
C_7: 0.01 µF
L_1: 3 turns No. 16 wire, 3/16" ID, 5/16" long
L_2: Ferrite Choke, Z = 450 ohms
L_3: 1 turn No. 16 wire, 1/4" ID, 3/8" long
L_4: 2 turns No. 16 wire, 1/4" ID, 1/4" long
Q: 40281, 40282

RF AMPLIFIER CIRCUIT FOR POWER-OUTPUT TEST TYPE 40280 (175-MHz Operation)

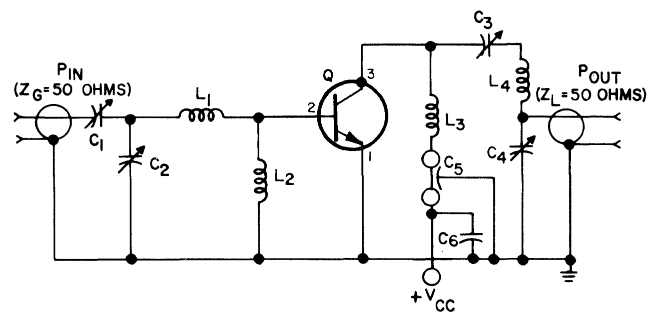
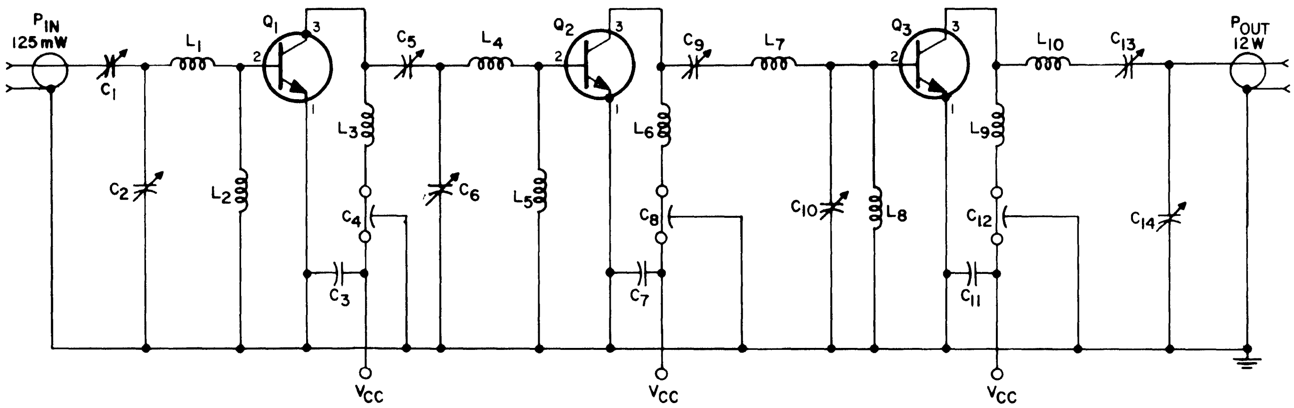


Fig. 3

C_1, C_2, C_3, & C_4: 3-30 pF
C_5: 1,000 pF
C_6: 0.01 µF
L_1: 2 turns No. 16 wire, 3/16" ID, 1/4" long
L_2: Ferrite choke, Z = 450 ohms
L_3: 2 turns No. 16 wire, 1/4" ID, 1/4" long
L_4: 4 turns No. 16 wire, 3/8" ID, 3/8" long
Q: 40280

TYPICAL 175 MHz AMPLIFIER



92LM-2149

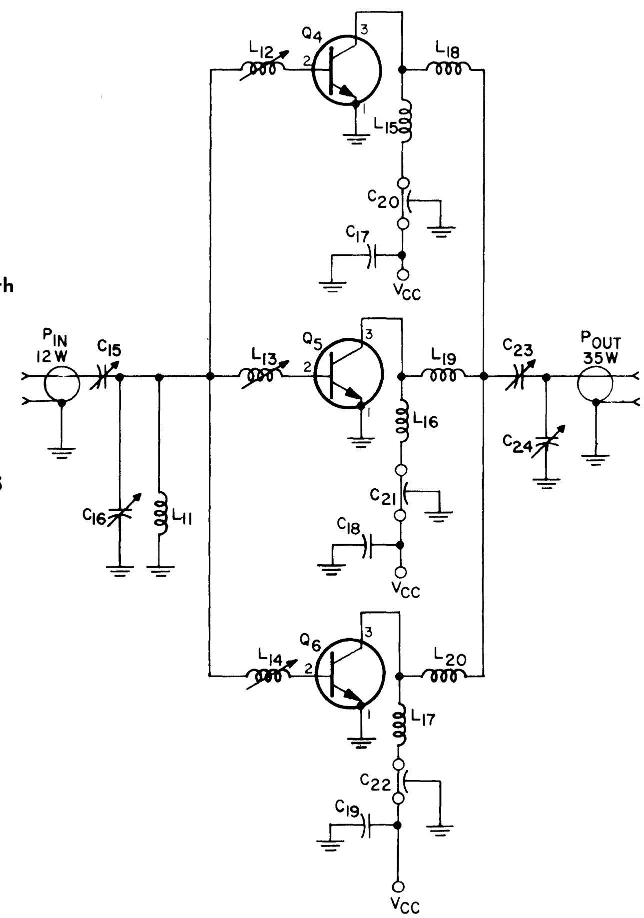
Capacitors

C_1: 3-35 pF
C_2, C_6, C_{10}, C_{24}: 8-60 pF
C_3, C_7, C_{11}: 0.01 µF
C_4, C_8, C_{12}: 1500 pF
C_9, C_{10}, C_{13}, C_{14}, C_{23}: 7-100 pF
C_{15}: 1.5-20 pF
C_{17}, C_{18}, C_{19}: 0.2 pF
C_{20}, C_{21}, C_{22}: 1500 pF

Inductors	Turns	Wire Size	ID (in.)	Length (in.)
L_1	2	16	3/16	1/4
L_2, L_5, L_8: ferrite choke, Z = 450 Ω				
L_3, L_6, L_{11}: 1 µH choke				
L_4, L_7	3	16	3/16	1/4
L_9	1-1/2	16	1/4	3/8
L_{10}	2	16	1/4	5/16
L_{12}, L_{13}, L_{14} (adjustable core)	3-1/2	16	1/4	3/8
L_{15}, L_{16}, L_{17}	2	18	1/8	1/8
L_{18}, L_{19}, L_{20}	2	18	1/4	1/4

Q_1: 40280
Q_2: 40281
Q_3-Q_6: 40282

DIMENSIONS IN INCHES



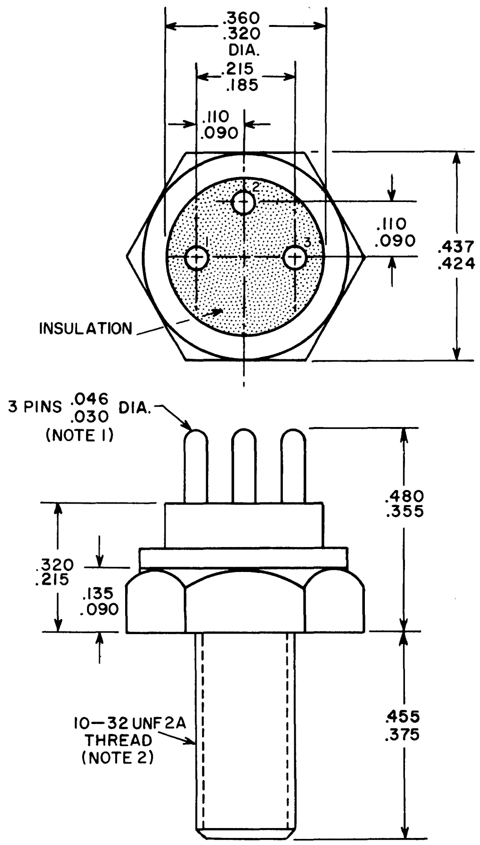
92LM-2150

Note: Driver and final supply voltages, V_{CC} = 13.5 V

Fig. 4

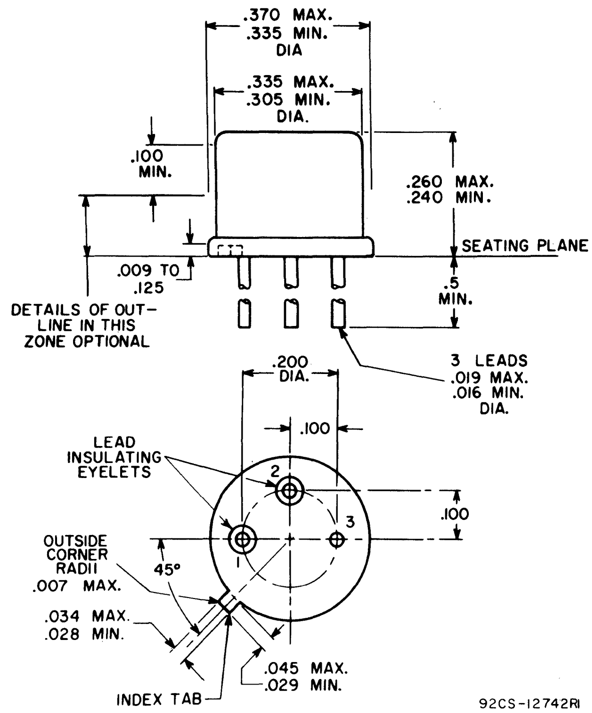
DIMENSIONAL OUTLINES

FOR TYPES 40281, 40282 JEDEC TO-60



DIMENSIONS IN INCHES

FOR TYPE 40280 JEDEC TO-39



DIMENSIONS IN INCHES

NOTE 1: The pin spacing permits insertion in any socket having a pin-circle diameter of 0.200" and contacts which will accommodate pins having a diameter of 0.035" min., 0.045" max.

NOTE 2: The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.

NOTE 3: This device may be operated in any position.

TERMINAL CONNECTIONS

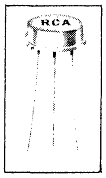
Pin or Lead No.1 – Emitter (40280)
Emitter, Case (40281, 40282)

Pin or Lead No.2 – Base

Pin or Lead No.3 – Collector (40281, 40282)
Collector, Case (40280)

SILICON N-P-N HIGH-VOLTAGE TRANSISTOR

For Core-Driver Service in Data-Processing Equipment and other Critical Industrial Applications



JEDEC TO-46

RCA-40283▲ is a double-diffused epitaxial planar transistor of the silicon n-p-n type.

It features high breakdown voltages, low saturation voltages, high power handling capability, and high switching speed over a wide range of collector current. These features make the 40283 well suited for core-driver and line-driver service in high performance computers and in other critical industrial applications requiring considerable output power.

The 40283 is hermetically sealed in the compact JEDEC TO-46 package and is designed to provide very low thermal resistance. This construction permits the device to dissipate substantial amounts of power internally in high-duty-factor or non-saturating applications. These features make the RCA-40283 desirable for military and space applications where small component size is an important consideration.

The 40283 provides virtually the same electrical characteristics as the 2N3512 in a much smaller package, without drastic reduction in dissipation capability.

▲Formerly Developmental No. TA-2643.

- Extreme compactness — Miniature hermetically sealed TO-46 package
- Excellent power handling capability — 2 max. watts at T_C = 25°C

Typical Performance Characteristics:

- High gain-bandwidth product — f_T = 375 Mc
- Very low collector saturation voltages $V_{CE}(sat)$ — 0.28 volt at I_C = 150 ma, I_B = 7.5 ma; 0.45 volt at I_C = 500 ma, I_B = 50 ma
- High switching speeds — t_{on} = 16 nsec at I_C = 150 ma; t_{off} = 27 nsec at I_C = 150 ma
- Low output capacitance — C_{ob} = 5.8 pf

SWITCHING SERVICE

Maximum Ratings, *Absolute-Maximum Values:*

Collector-to-Base Voltage, V_{CBO}	60 max.	volts
Collector-to-Emitter Voltage, V_{CEO}	30 max.	volts
Emitter-to-Base Voltage, V_{EBO}	5 max.	volts
Collector Current, I_C	limited by dissipation	
Transistor Dissipation, P_T:		
For operation with heat sink:		
At case temperatures* (up to 25°C)	2 max.	watts
At case temperatures* (above 25°C)	See *Fig. 1*	
For operation in free air:		
At free-air temperatures (up to 25°C)	0.4 max.	watt
At free-air temperatures (above 25°C)	See *Fig. 1*	
Temperature Range:		
Storage and Operating (Junction)	-65 to +200	°C
Lead Temperature (During soldering):		
At distances not closer than 1/32" to seating surface for 10 seconds max.	265 max.	°C

* Measured at center of seating surface.

RATING CHART

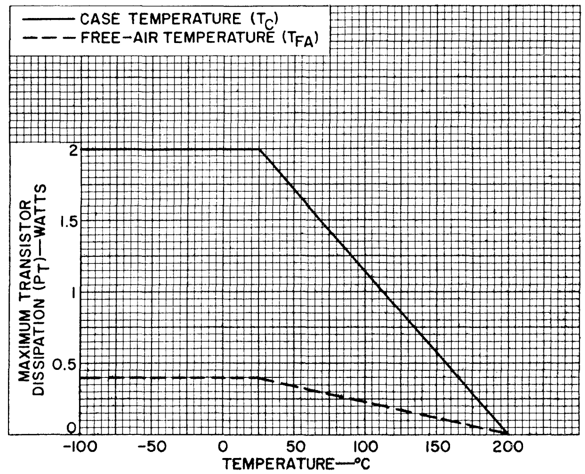


Fig. 1

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ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
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Marca(s) Registrada(s)
Printed in U.S.A.
40283 7-66
Supersedes issue dated 12-64

ELECTRICAL CHARACTERISTICS

Characteristics	Symbols	TEST CONDITIONS: Free-Air Temperature T_{FA} (°C)	Frequency f (Mc)	DC Collector-to-Base Voltage V_{CB} (volts)	DC Collector-to-Emitter Voltage V_{CE} (volts)	DC Emitter-to-Base Voltage V_{EB} (volts)	DC Emitter Current I_E (ma)	DC Collector Current I_C (ma)	DC Base Current I_B (ma)	LIMITS Type 40283 Min.	Typ.	Max.	Units
Collector Cutoff Current	I_{CEV}	25 100			30 30	0.3 0.3				- -	- -	0.5 100	μa μa
Base Cutoff Current	I_{BEV}	25			30	0.3				-	-	0.5	μa
Collector-to-Emitter Breakdown Voltage	BV_{CEO}	25						50	0	30	-	-	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25					0.1	0		5	-	-	volts
Collector-to-Base Breakdown Voltage	BV_{CBO}	25					0	0.01		60	-	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$	25						150 500	7.5 50	- -	0.28 0.45	0.4 1	volt volt
Base-to-Emitter Voltage	V_{BE}	25						150 500	7.5 50	- -	0.82 1.16	1	volt volts
DC Forward-Current Transfer Ratio	h_{FE}*	25			1			500		10	-	-	
Small-Signal Forward-Current Transfer Ratio	h_{fe}	25	100		10			50		2.5	3.75	-	
Output Capacitance	C_{ob}	25	0.14	10			0			-	5.8	10	pf
Turn-On Time (Delay time + rise time) (See *Fig.20*)	t_{on}	25						150	I_{B1}= 15 I_{B2}=-15	-	16	30	nsec
Storage Time (See *Fig.21*)	t_s	25						150	I_{B1}= 15	-	17	30	nsec
Turn-Off Time (Storage time + fall time) (See *Fig.21*)	t_{off}	25						150	I_{B1}= 15 I_{B2}=-15	-	27	45	nsec

* Pulsed conditions - Pulse duration ≤ 400 μsec, duty factor ≤ 0.03.

TYPICAL DC BETA (h_{FE}) CHARACTERISTICS

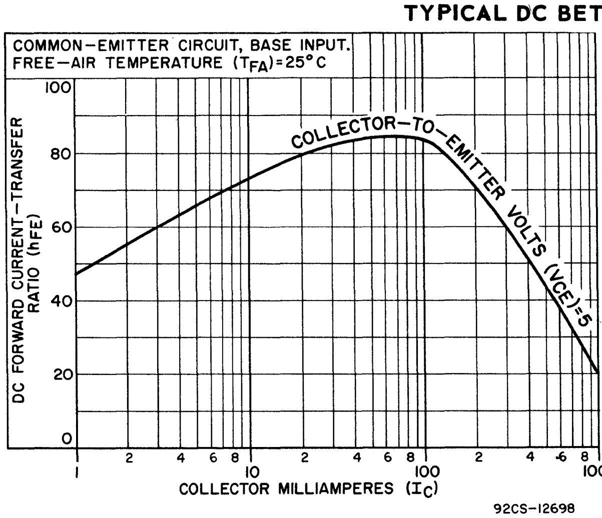


Fig.2

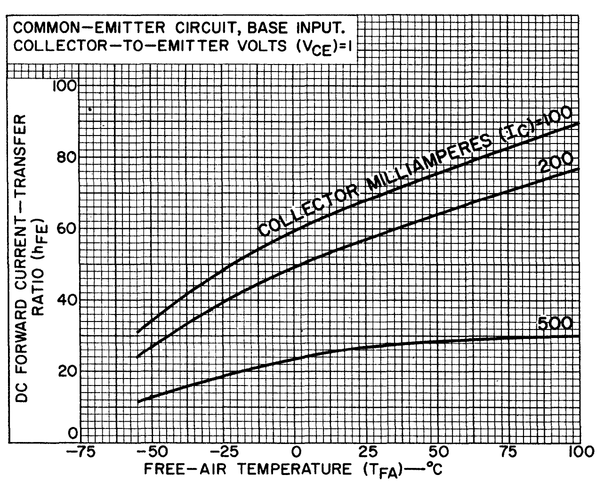


Fig.3

TYPICAL CAPACITANCE CHARACTERISTICS

INPUT (C_{ob})

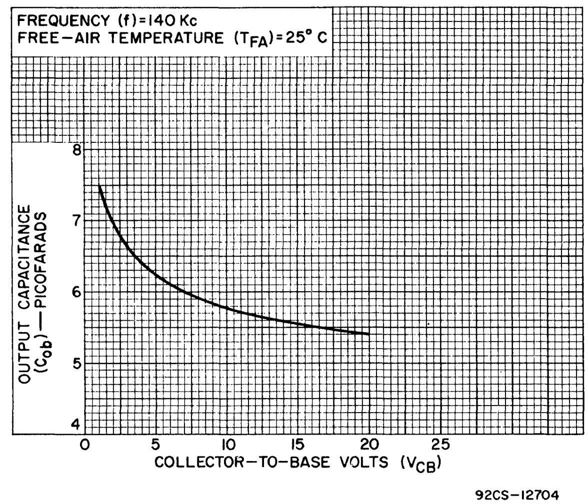


Fig. 10

OUTPUT (C_{ib})

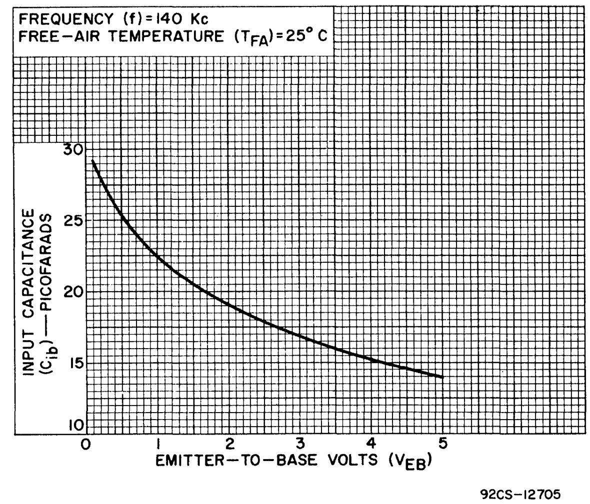


Fig. 11

TYPICAL FALL-TIME (t_f) CHARACTERISTICS

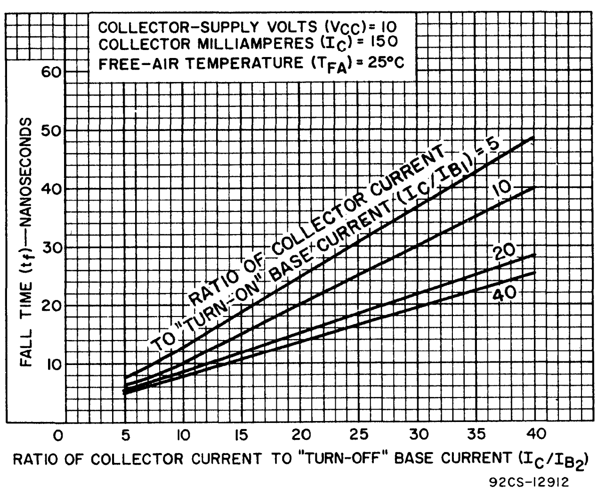


Fig. 12

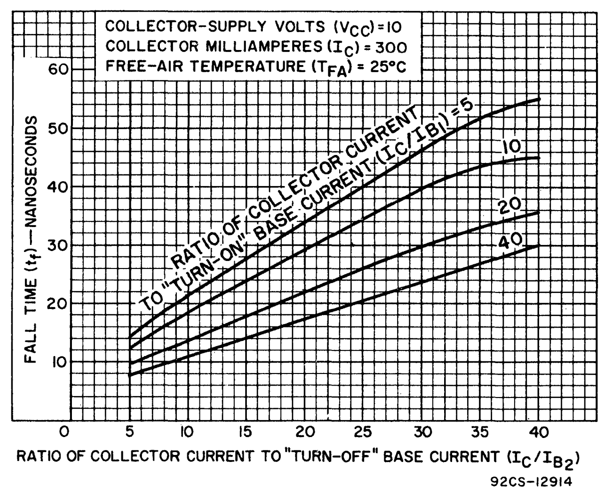


Fig. 13

TYPICAL FALL-TIME (t_f) CHARACTERISTICS

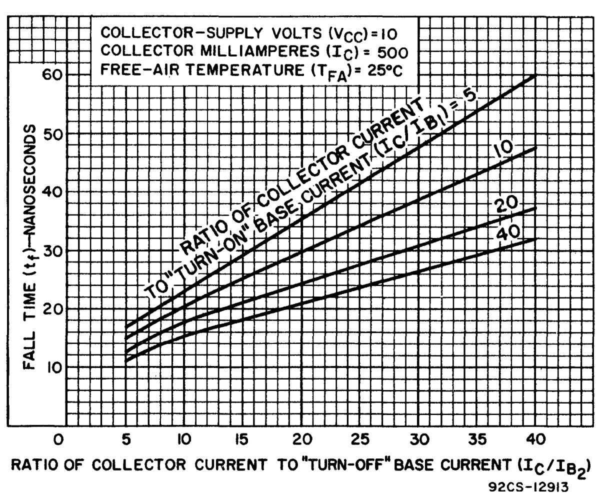


Fig. 14

TYPICAL STORAGE TIME (t_s) CHARACTERISTICS

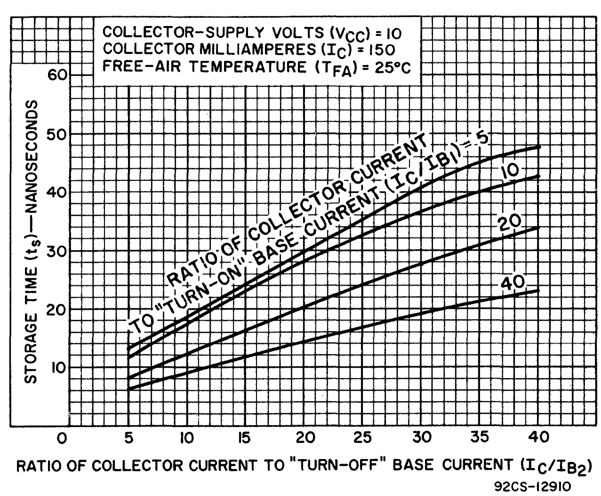


Fig. 15

TYPICAL STORAGE TIME (t_s) CHARACTERISTICS

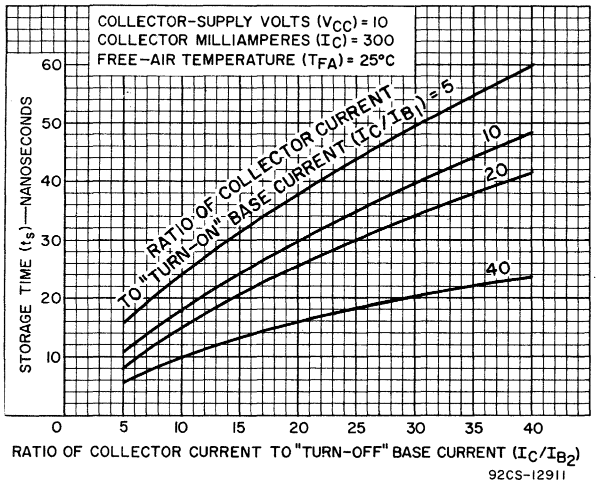


Fig. 16

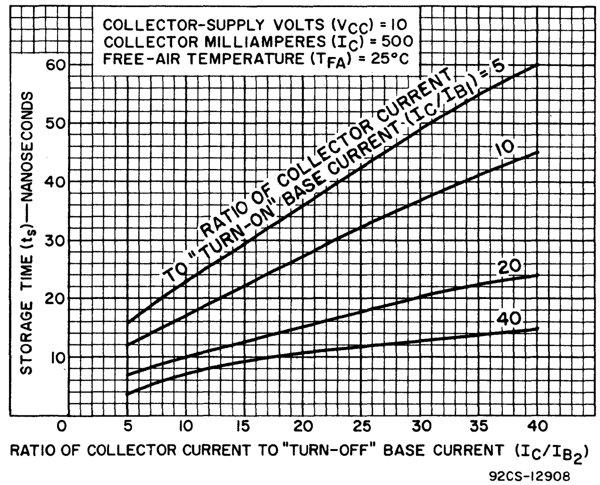


Fig. 17

TYPICAL "TURN-ON" TIME (t_{on}) CHARACTERISTICS

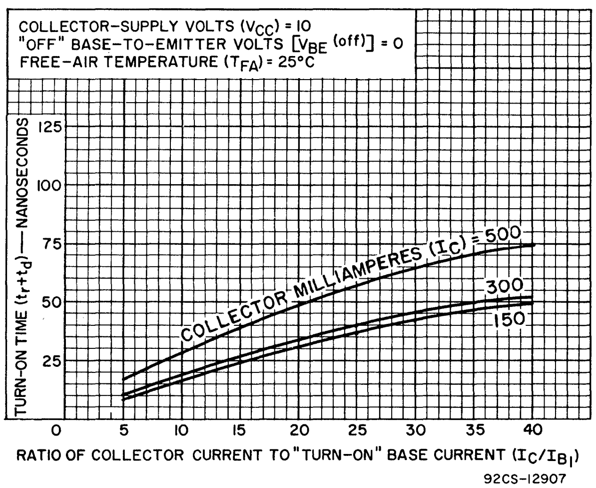


Fig. 18

TYPICAL RISE TIME (t_r) CHARACTERISTICS

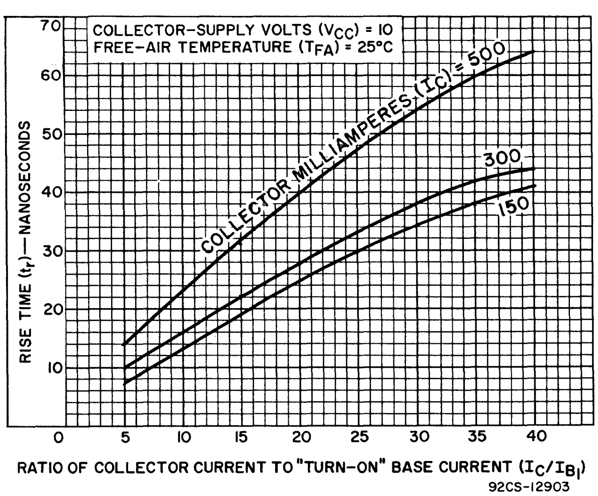
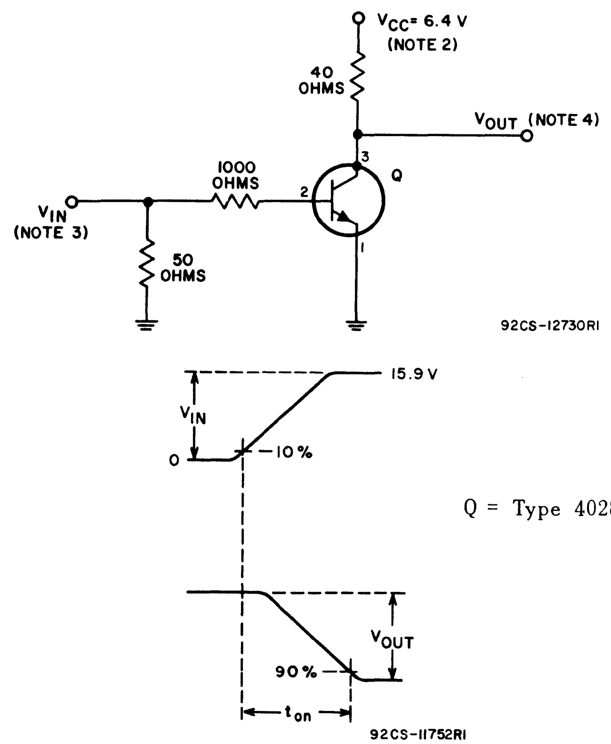


Fig. 19

CIRCUIT USED TO MEASURE TURN-ON TIME (t_{on})



Q = Type 40283

NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 2 NSEC; PULSE DURATION > 150 NSEC; AND DUTY FACTOR < 2%.

NOTE 4: INPUT AND OUTPUT WAVE FORMS MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NSEC; INPUT CAPACITANCE OF PROBE < 2.5 pf WITH SHUNT RESISTANCE OF 1 MEGOHM.

Fig. 20

TYPICAL SMALL-SIGNAL BETA (h_{fe}) CHARACTERISTICS

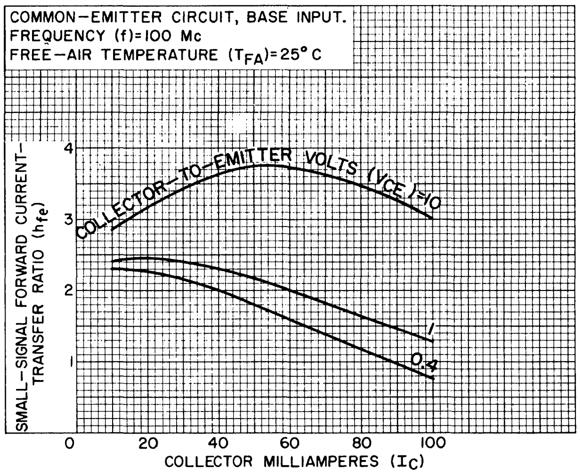


Fig.4

TYPICAL CUTOFF-CURRENT CHARACTERISTICS

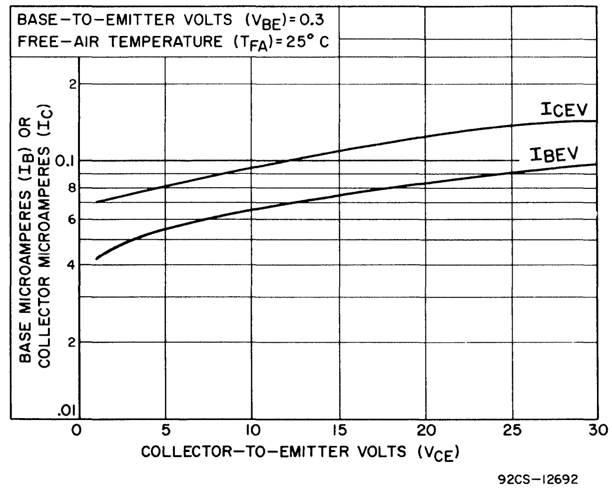


Fig.5

TYPICAL BASE-TO-EMITTER VOLTAGE CHARACTERISTICS

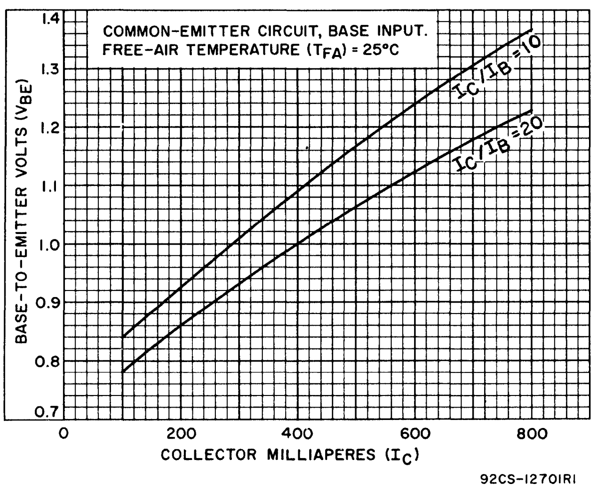


Fig.6

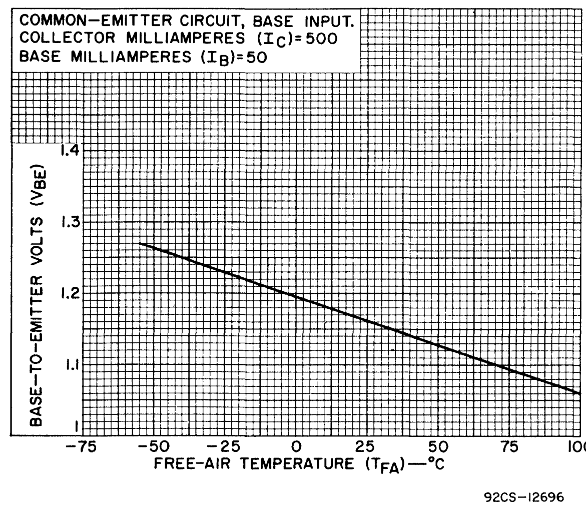


Fig.7

TYPICAL SATURATION CHARACTERISTICS

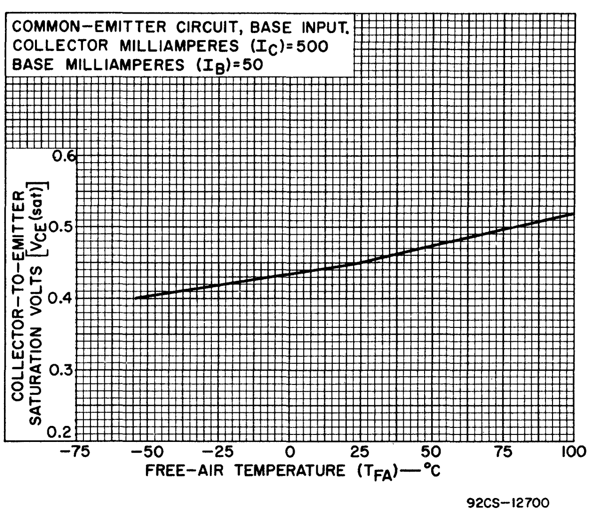


Fig.8

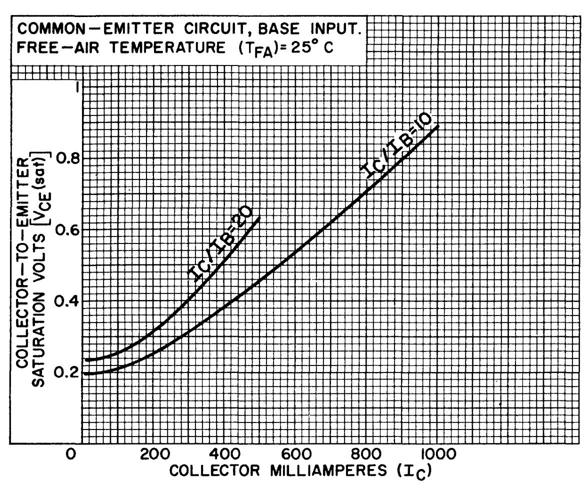
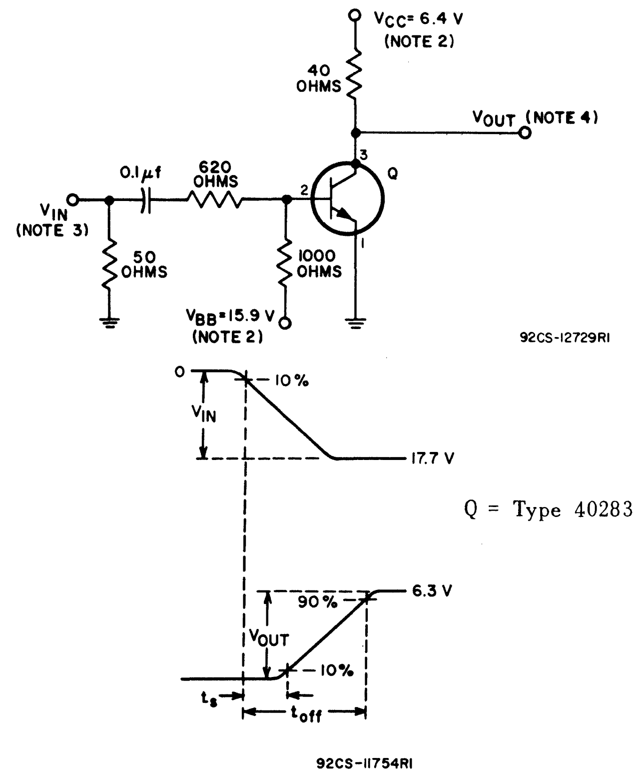


Fig.9

CIRCUIT USED TO MEASURE TURN-OFF TIME (t_{off}) AND STORAGE TIME (t_s)



NOTE 1: ALL RESISTANCE VALUES HAVE ± 1 PER CENT TOLERANCE.

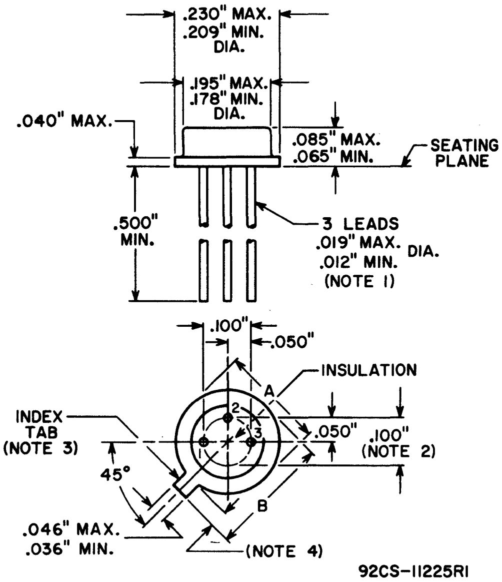
NOTE 2: WITH CERTAIN TYPES OF POWER SUPPLIES, IT MAY BE NECESSARY TO CONNECT 25-μf DECOUPLING CAPACITORS ACROSS THE POWER-SUPPLY TERMINALS FOR V_{CC} AND V_{BB}.

NOTE 3: INPUT VOLTAGE (V_{IN}) OBTAINED FROM MERCURY-RELAY TYPE PULSE GENERATOR HAVING AN OUTPUT IMPEDANCE OF 50 OHMS. V_{IN} RISE TIME < 2 NSEC; PULSE DURATION > 150 NSEC; AND DUTY FACTOR < 2%.

NOTE 4: INPUT AND OUTPUT WAVE FORMS MONITORED BY MEANS OF A SAMPLING OSCILLOSCOPE HAVING A RISE TIME < 0.5 NSEC; INPUT CAPACITANCE OF PROBE < 2.5 pf WITH SHUNT RESISTANCE OF 1 MEGOHM.

Fig.21

DIMENSIONAL OUTLINE JEDEC No. TO-46



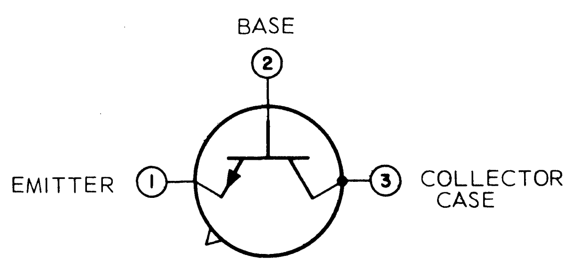
NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE CASE SEAT. FROM 0.250" TO THE END OF THE LEAD, A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" − 0.000" BELOW CASE SEAT TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAX. WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT CASE SEAT.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM − 0.048" MAXIMUM AND WILL BE DETERMINED BY SUBTRACTING DIAMETER A FROM DIMENSION B.

TERMINAL DIAGRAM (Bottom View)



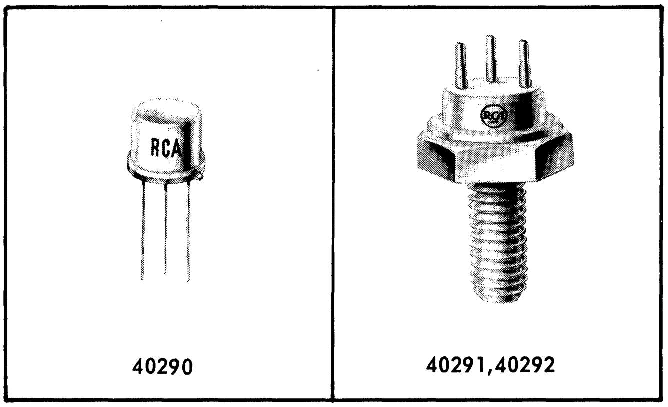
SILICON N-P-N "overlay" TRANSISTORS

40290–40292

RCA-40290, 40291, and 40292 are epitaxial planar transistors of the silicon n-p-n type. They employ an "overlay" emitter electrode design and are intended for low-voltage, high-power output, amplitude modulated, VHF Class-C amplifier service.

The voltage ratings for these transistors include RF voltage breakdown characteristics necessary to assure safe transistor operation with high RF voltages on the collector; a condition normally encountered in amplitude-modulated Class-C amplifiers.

For Low Supply Voltage, High Power Output, Amplitude Modulated, VHF Class-C Amplifier Service in Aircraft, Military, and Industrial Communications Equipment



40290 — JEDEC TO-39 | 40291, 40292 — JEDEC TO-60

RF SERVICE

Maximum Ratings, *Absolute-Maximum Values:*

	40290	40291	40292	
COLLECTOR-TO-EMITTER VOLTAGE:				
With V_{BE} = -1.5 volts, V_{CEX}	50	50	50	volts
At f = 100 Mc, V_{CEV}(RF)	90	90	90	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	4	4	volts
COLLECTOR CURRENT, I_C	0.5	0.5	1.25	amperes
TRANSISTOR DISSIPATION, P_T:				
At case temperatures up to 25° C.	7.0	11.6	23.2	watts
At case temperatures above 25° C.	Derate linearly to 0 watts at 200° C			
TEMPERATURE RANGE:				
Storage	-65 to 200°C			
Operating (Junction)	-65 to 200°C			
PIN OR LEAD TEMPERATURE (During soldering): At distances ≥ 1/32 from insulating wafer (TO-60 package) or from seating plane (TO-39 package) for 10 seconds maximum		230		°C

FEATURES

- High carrier output power as 135 Mc Class-C amplifier with 12.5 volt collector supply voltage
  - 40290 — 2 watts (min.) at P_{IN} = 0.5 watt
  - 40291 — 2 watts (min.) at P_{IN} = 0.5 watt
  - 40292 — 6 watts (min.) at P_{IN} = 2.0 watts
- 100% testing of all transistors performed to assure excellent upward modulation characteristics
- High collector efficiency at 135 Mc
- All electrodes isolated from case (40291 and 40292)

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ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
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Printed in U.S.A.
40290-40292 5/66
Reprinted from 40290-40292 3/65

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25° C*

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS: Type 40290 Min.	Type 40290 Max.	Type 40291 Min.	Type 40291 Max.	Type 40292 Min.	Type 40292 Max.	Units
Collector Cutoff Current	I_{CEO}		15			0		-	100	-	100	-	250	μa
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1		0	4.0	-	4.0	-	-	-	volts
					0.25		0	-	-	-	-	4.0	-	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEX}			-1.5			200[a]	50	-	50	-	50	-	volts
	$V_{CEV}(RF)$			-2			50	90[b]	-	90[b]	-	-	-	volts
				-2			100	-	-	-	-	90[b]	-	volts
Real Part of Common-Emitter Input Impedance (At f = 135 Mc)	$h_{ie(real)}$		12.5				100	12 (typ.)		12 (typ.)		-	-	ohms
			12.5				400	-	-	-	-	6.5 (typ.)		ohms
RF Carrier Power Output: As Class-C Amplifier, (At f = 135 Mc)	P_{OUT}		12.5					2.0[c]	-	2.0[c]	-	6.0[d]	-	watts
Gain-Bandwidth Product	f_T		12.5				100	500 (typ.)		500 (typ.)		-	-	Mc
			12.5				400	-	-	-	-	300 (typ.)		Mc
Collector-to-Base Capacitance (At f = 1 Mc)	C_{ob}	12.5			0			-	17	-	17	-	30	pf
Collector-to-Case Capacitance	C_s							-	-	-	6.0	-	6.0	pf
Thermal Resistance (Junction-to-Case)	$\theta_{J\text{-}C}$							-	25	-	15	-	7.5	°C/w

[a] Pulsed through an inductor (25 mh); R_{BE} = 39 ohms; duty factor = 50%.
[b] At frequencies of 100 Mc or higher.
[c] For P_{IN} = 0.5 w; minimum efficiency = 70%.
[d] For P_{IN} = 2.0 w; minimum efficiency = 70%.

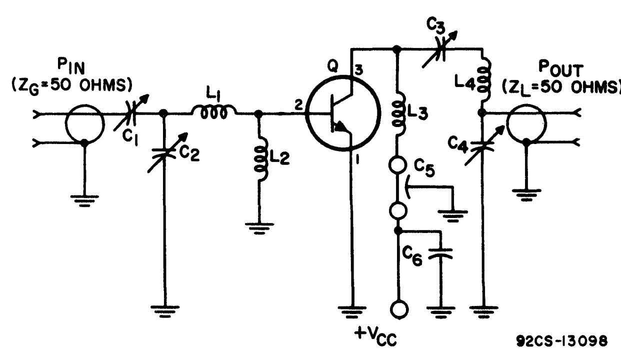
RF AMPLIFIER CIRCUIT FOR POWER-OUTPUT TEST (135-Mc Operation)

Q = 40290, 40291

- C_1, C_3 = 3-35 pf
- C_2, C_4 = 8-60 pf
- C_5 = 1000 pf
- C_6 = 0.02 μf
- L_1 = 3 turns No.16 wire, 5/16" ID, 5/16" long
- L_2 = Ferrite choke, Z = 450 ohms
- L_3 = 3 turns No.18 wire, 1/4" ID, 5/16" long
- L_4 = 5 turns No.16 wire, 7/16" ID, 5/8" long

Q = 40292

- C_1, C_3 = 3-35 pf
- C_2, C_4 = 8-60 pf
- C_5 = 1000 pf
- C_6 = 0.02 μf
- L_1 = 3 turns No.16 wire, 5/16" ID, 5/16" long
- L_2 = wire wound resistor, R = 2.4 ohms
- L_3 = 1 turn No.16 wire, 5/16" ID, 1/8" long
- L_4 = 4 turns No.16 wire, 7/16" ID, 3/8" long

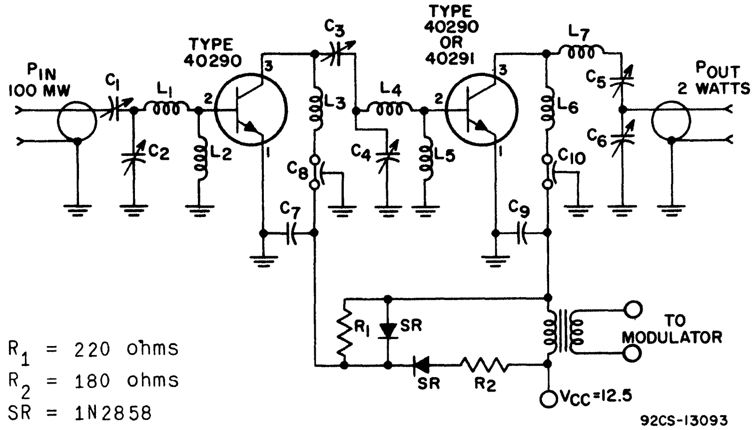


AMPLITUDE-MODULATED AMPLIFIER

135-Mc Operation, Carrier Power = 2 watts minimum, Bandwidth = 5%

C_1, C_3, C_5 = 3–35 pf
C_2, C_4, C_6 = 8–60 pf
C_7, C_9 = 0.03 μf
C_8, C_{10} = 1000 pf
L_1 = 3 turns No.16 wire, 1/4" ID, 1/4" long
L_2, L_5 = Ferrite choke, Z = 450 ohms
L_3 = RF choke, 1.5 μh
L_4 = 4 turns No.16 wire, 1/4" ID, 3/8" long
L_6 = 3 turns No.18 wire, 3/16" ID, 3/8" long
L_7 = 5 turns No.16 wire, 3/8" ID, 1/2" long

R_1 = 220 ohms
R_2 = 180 ohms
SR = 1N2858

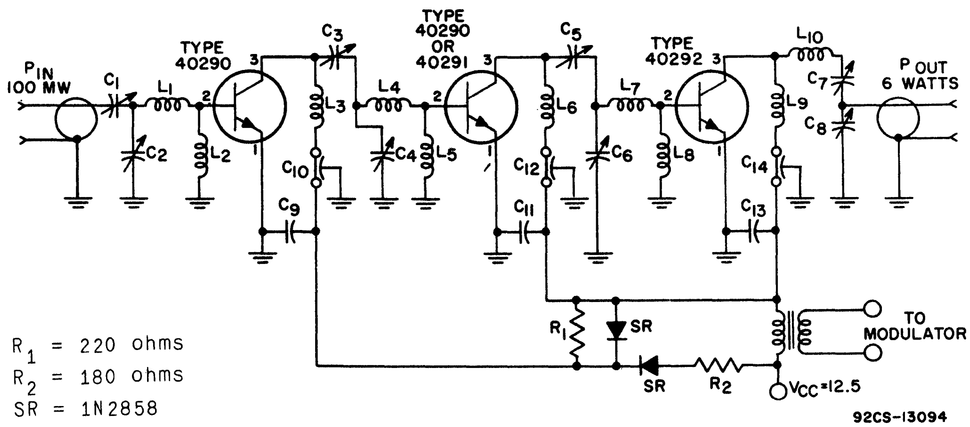


AMPLITUDE-MODULATED AMPLIFIER

135-Mc Operation, Carrier Power = 6 watts minimum, Bandwidth = 5%

C_1, C_3, C_5, C_7 = 3–35 pf
C_2, C_4, C_6, C_8 = 8–60 pf
C_9, C_{11}, C_{13} = 0.03 μf
C_{10}, C_{12}, C_{14} = 1000 pf
L_1, L_9 = 3 turns No.16 wire, 1/4" ID, 1/4" long
L_2, L_5 = Ferrite choke, Z = 450 ohms
L_3 = RF choke, 1.5 μh
L_4, L_7 = 4 turns No.16 wire, 1/4" ID, 3/8" long
L_6 = RF choke, 1.0 μh
L_8 = wire wound resistor, R = 2.4 ohms
L_{10} = 5 turns No.16 wire, 3/8" ID, 1/2" long

R_1 = 220 ohms
R_2 = 180 ohms
SR = 1N2858

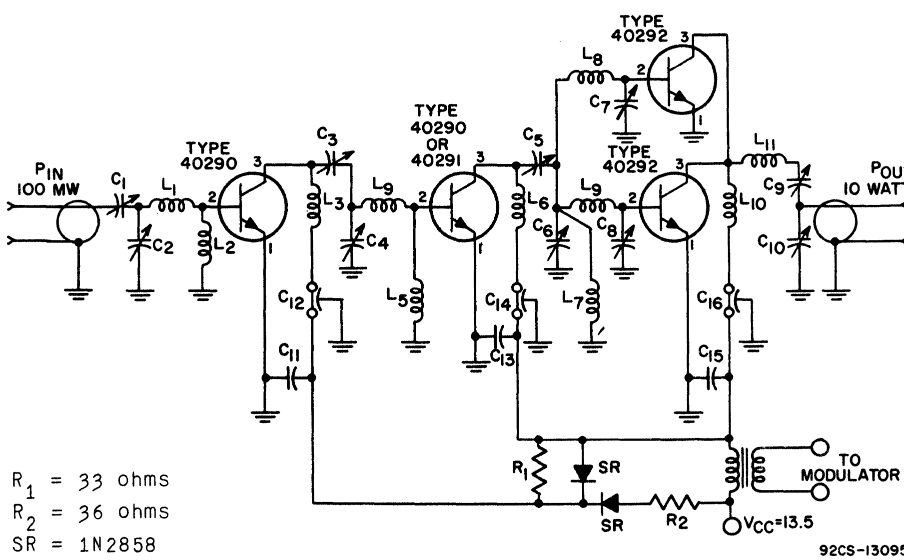


AMPLITUDE-MODULATED AMPLIFIER

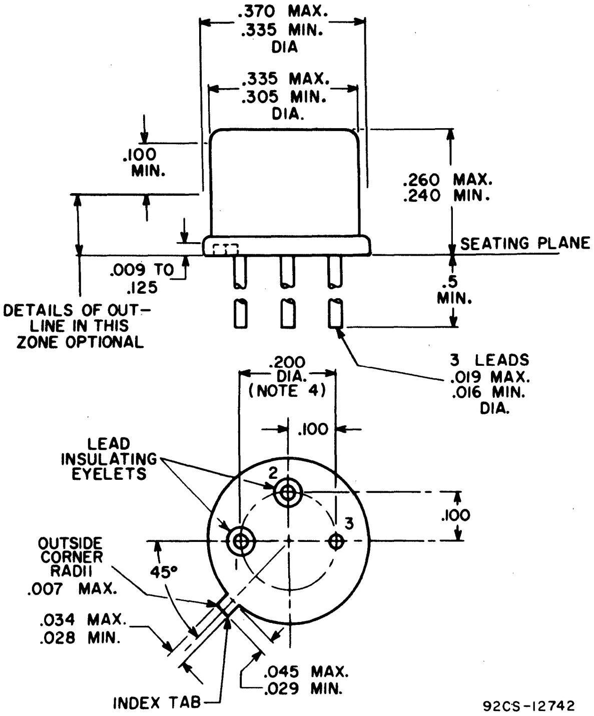
135-Mc Operation, Carrier Power = 10 watts minimum, Bandwidth = 5%

C_1, C_3, C_5, C_9 = 3–35 pf
C_2, C_4, C_6, C_{10} = 8–60 pf
C_7, C_8 = 1.5–20 pf
C_{11}, C_{13}, C_{15} = 0.03 μf
C_{12}, C_{14}, C_{16} = 1000 pf
L_1 = 3 turns No.16 wire, 1/4" ID, 1/4" long
L_2, L_5 = Ferrite choke, Z = 450 ohms
L_3 = RF choke, 1.5 μh
L_4 = 4 turns No.16 wire, 1/4" ID, 3/8" long
L_6, L_7 = RF choke, 1.0 μh
L_8, L_9 = 3 turns No.16 wire, 1/4" ID, 3/8" long
L_{10} = 1 turn No.16 wire, 5/16" ID, 1/8" long
L_{11} = 4 turns No.16 wire, 3/8" ID, 1/2" long

R_1 = 33 ohms
R_2 = 36 ohms
SR = 1N2858



DIMENSIONAL OUTLINE FOR TYPE 40290 JEDEC TO-39



Dimensions in Inches

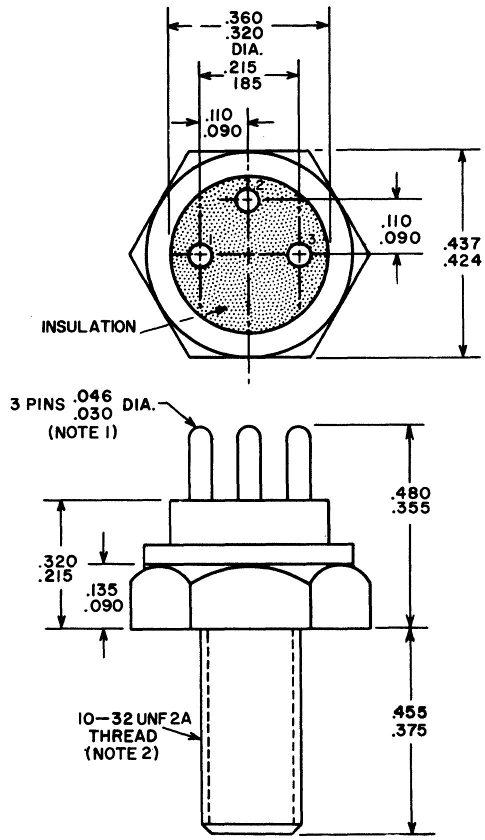
NOTE 1: THIS ZONE IS CONTROLLED FOR AUTOMATIC HANDLING. THE VARIATION IN ACTUAL DIAMETER WITHIN THE ZONE SHALL NOT EXCEED 0.010".

NOTE 2: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE. BETWEEN 0.250" AND 1.5", A MAXIMUM OF 0.021" DIAMETER IS HELD. OUTSIDE OF THESE ZONES THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 3: MEASURED FROM MAXIMUM DIAMETER OF THE ACTUAL DEVICE.

NOTE 4: LEADS HAVING MAXIMUM DIAMETER (0.019") MEASURED IN GAUGING PLANE OF 0.054" + 0.001" − 0.000" BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007" OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

DIMENSIONAL OUTLINE FOR TYPES 40291 & 40292 JEDEC TO-60



Dimensions in Inches 92CS-12045R5

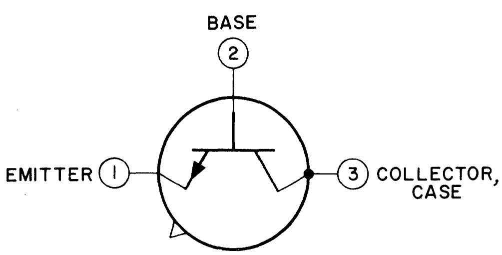
NOTE 1: THE PIN SPACING PERMITS INSERTION IN ANY SOCKET HAVING A PIN-CIRCLE DIAMETER OF 0.200" AND CONTACTS WHICH WILL ACCOMMODATE PINS HAVING A DIAMETER OF 0.035" MINIMUM, 0.045" MAXIMUM.

NOTE 2: THE TORQUE APPLIED TO A 10-32 HEX NUT ASSEMBLED ON THE THREAD DURING INSTALLATION SHOULD NOT EXCEED 12 INCH-POUNDS.

NOTE 3: THIS DEVICE MAY BE OPERATED IN ANY POSITION.

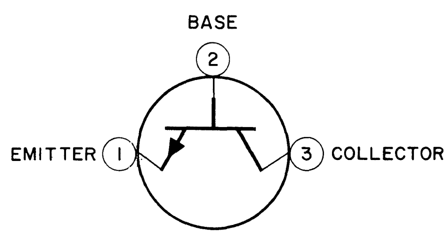
NOTE 4: ALL ELECTRODES ISOLATED FROM CASE.

TERMINAL DIAGRAM



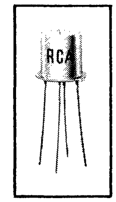
(Bottom View)

TERMINAL DIAGRAM



(Bottom View)

ULTRA-HIGH-RELIABILITY SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-72

For UHF Applications in Critical Aerospace and Military Equipment

RCA-40294 is an ultra-high-reliability double-diffused, epitaxial planar transistor of the silicon NPN type for low-noise amplifier, mixer, and oscillator applications at frequencies up to 500 MHz (common-emitter configuration), and up to 1200 MHz (common-base configuration).

This transistor is electrically and mechanically like RCA-2N2857, but is specially processed, preconditioned, and tested for critical aerospace and military applications.

The 40294 utilizes a hermetically sealed JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by a fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the technical bulletin for RCA-2N2857 also apply for RCA-40294.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures* up to 25°C	300 max.	mW
At case temperatures* above 25°C	Derate at 1.72	mW/°C
For operation in free air:		
At ambient temperatures up to 25°C	200 max.	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds maximum	265 max.	°C

* Measured at center of seating surface.

Features

- Meets performance requirements of TX2N2857 MIL-S-19500/343 USAF, 7 March 1966
- Extra-rigorous control and inspection of all parts, materials, and internal assemblies before sealing
- 100% thermal and mechanical preconditioning after sealing
- complete electrical and mechanical QUALITY CONFORMANCE test program
- 100% RELIABILITY ASSURANCE testing
- 100% PERFORMANCE-REQUIREMENTS testing
- 100% Noise Figure and Power Gain Tests at 450 MHz
- high gain-bandwidth product – f_T = 1000 MHz min.
- very low Device Noise Figure – NF = 4.5 dB max. at 450 MHz
- high power gain as neutralized amplifier – G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator – P_o = 30 mW min. at 500 MHz
- low collector-to-base time constant – $r_b'C_c$ = 15 ps max.

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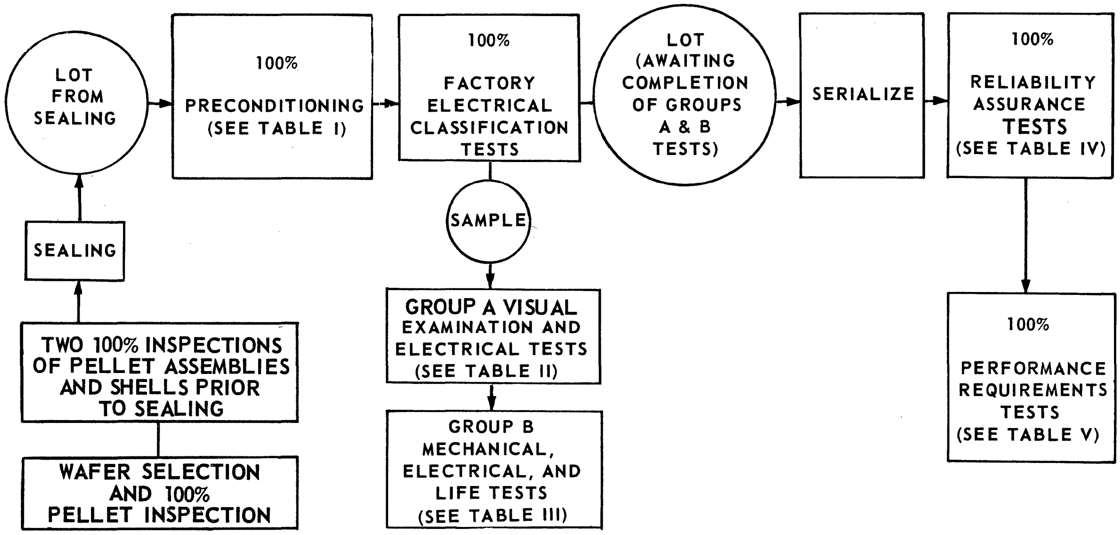


Fig. 1 - High-Reliability Testing Process Flow Diagram

TABLE I 100% PRECONDITIONING BEFORE FACTORY, QUALITY, RELIABILITY-ASSURANCE AND PERFORMANCE REQUIREMENTS TESTS

STABILIZATION BAKE	48 hours minimum at 200° C
TEMPERATURE CYCLING (PER MIL-STD-750 METHOD 1051, COND. C)	5 complete cycles from -65° C to +200° C, each including 15 minutes at -65° C, 15 minutes at +200° C, and 5 minutes at 25° C
HELIUM-LEAK TEST (PER MIL-STD-202, METHOD 112 COND. C, PROC.IIIA)	Leakage may not exceed 10^{-8} atm cc/s
BUBBLE TEST (PER MIL-STD-202, METHOD 112 COND. A)	150° C minimum, 1 minute, ethylene glycol
CONSTANT-ACCELERATION (CENTRIFUGE) TEST (PER MIL-STD-750, METHOD 2006)	20,000 G's; Y_1 plane, 1 minute

TABLE II

GROUP A TESTS

Sub-group	Lot Tolerance Per Cent Defective	Characteristic Test	Symbol	MIL-STD 750 Reference Test Method	Ambient Temperature T_A (°C)	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Collector Current I_C (mA)	DC Emitter Current I_E (mA)	DC Base Current I_B (mA)	RCA 40294 Limits Min.	RCA 40294 Limits Max.	Units
1	5	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	--	
2	3	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
		Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		16				--	100	nA
		Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		30	--	V
		Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	15	--	V
		Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	-0.001		2.5	--	V
		Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
		Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		1	3			30	150	
3	10	Small-Signal Power Gain▲ (See Fig. 2 for Test Circuit)	G_{pe}		25±3	450		6	1.5			12.5	19	dB
		Device Noise Figure◈: Generator Resistance (R_G) = 50 Ω (See Fig. 3 for Test Circuit)	NF		25±3	450		6	1.5			--	4.5	dB
		Measured Noise Figure Generator Resistance R_G = 50Ω (See Fig. 3 for test circuit)▲	NF		25±3	450		6	1.5			--	5.0	dB
		Collector-to-Base Time Constant▲ (See Fig. 4 for Test Circuit)	$r_{b'}C_c$		25±3	31.9		6		-2		4	15	ps
		Oscillator Power Output (See Fig. 5 for Test Circuit)	P_o		25±3	≥500	10			-12		30	--	mW
		Collector-to-Base Feedback Capacitance ●	C_{cb}		25±3	≥0.1 ≤1	10			0		--	1	pF
4	10	Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55±3	--		1	3			10	--	
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-5}	--	15			0		--	1	μA
		Small-Signal, Short Circuit Forward Current-Transfer Ratio▲	h_{fe}	3206	25±3	0.001		6	2			50	220	
		Magnitude of Small-Signal, Short-Circuit Forward Current Transfer Ratio▲	$\|h_{fe}\|$	3206	25±3	100		6	5			10	19	

* Pulse Test

▲ Lead No. 4 (Case) Grounded

◈ Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test amplifier and the contribution of the following stages in the test setup.

● Three-terminal measurement with emitter and case leads guarded.

TABLE III
GROUP B TESTS

Subgroup	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective %	Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40294 Initial Values Min.	RCA-40294 Initial Values Max.	RCA-40294 End Point Values Min.	RCA-40294 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 7)	2066	20	--	--	--	--	--	--	--	
2	SOLDERABILITY Solder Temp. = 260±5°C	2026	10	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0^{+5}_{-0}$ °C $T_{max} = 100^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	30	150	
	MOISTURE-RESISTANCE TEST	1021									
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 ms 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	10	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ±20 Hz, 20 G's	2046		h_{FE}	3076	T_A =25±3°C V_{CE}=1 V I_C=3 mA	30	150	30	150	
	VIBRATION VARIABLE-FREQUENCY TEST	2056									
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	TERMINAL STRENGTH TEST	2036 Test Condition E	20	Helium Leak Test	MIL-STD 202 Method 112 Condition C Procedure III A		--	--	--	10^{-8}	atm cm^3/s
				Bubble Test	MIL-STD 202 Condition A	T_A=150°C (min.) 1 minute					
5	SALT-ATMOSPHERE TEST	1041	20	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
				h_{FE}	3076	T_A =25±3°C V_{CE}=1 V I_C=3 mA	30	150	30	150	
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A =200±10°C Duration=1000 hrs.	1031	λ= 7%	I_{CBO}	3036D	T_A =25±3° C V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3°C V_{CE}=1 V I_C=3 mA	30	150	24	180	
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit T_A =25±3° C V_{CB}=12.5±0.5 V P_T=200 mW Duration=1000 hrs.	1026	λ= 7%	I_{CBO}	3036D	T_A=25±3°C V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	24	180	

TABLE IV

100% RELIABILITY ASSURANCE TEST

THE CUMULATIVE REJECTS OF TABLES IV AND V SHALL NOT EXCEED 10% OF THE LOT

Test	MIL-STD 750 Reference	INITIAL AND ENDPOINT CHARACTERISTICS TESTS				
		Characteristic Test	RCA-40294 Initial Value	RCA-40294 Endpoint Value	MIL-STD 750 Reference	Test Conditions
POWER BURN-IN: Common-Base Circuit T_A =25±3 °C V_{CB}=12.5±0.5 V P_T=200 mW Duration=340 hours	1026	ΔI_{CBO}	10 max. nA	Δ= ±5 nA	3036 Bias Condition D	T_A =25±3 °C V_{CB}=15 V
		Δh_{FE}	30 min. 150 max.	Δ=±15%	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA

TABLE V

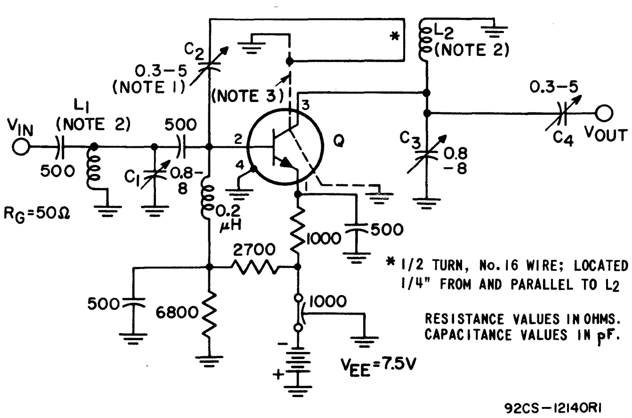
100% PERFORMANCE REQUIREMENTS TESTS

THE CUMULATIVE REJECTS OF TABLES IV AND V SHALL NOT EXCEED 10% OF THE LOT

Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS: Ambient Temperature T_A (°C)	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Collector Current I_C (mA)	DC Emitter Current I_E (mA)	DC Base Current I_B (mA)	LIMITS RCA 40294 Min.	LIMITS RCA 40294 Max.	Units
Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		16				--	100	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		30	--	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	15	--	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	−0.001		2.5	--	V
Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		1	3			30	150	
Device Noise Figure▲: Generator Resistance (R_G)=50 Ohms (See Fig. 3 for Test Circuit)	NF	--	25±3	450		6	1.5			--	4.5	dB
Measured Noise Figure Generator Resistance R_G = 50Ω (See Fig.3 for test circuit)▲	NF		25±3	450		6	1.5			--	5.0	dB
Visual Examination (External) Under 20-Power Magnification		Examine leads, header, and shell for visual defects.										

* Pulse Test

▲ Lead No. 4 (Case) Grounded



Q = RCA Type 40294

NOTE 1: (NEUTRALIZATION PROCEDURE): (A) CONNECT A 450-MHz SIGNAL GENERATOR (WITH R_g = 50 OHMS) TC THE INPUT TERMINALS OF THE AMPLIFIER. (B) CONNECT A 50-OHM RF VOLTMETER ACROSS THE OUTPUT TERMINALS OF THE AMPLIFIER. (C) APPLY V_{EE}, AND WITH THE SIGNAL GENERATOR ADJUSTED FOR 5 mV OUTPUT FROM THE AMPLIFIER, TUNE C_1, C_3, AND C_4 FOR MAXIMUM OUTPUT. (D) INTERCHANGE THE CONNECTIONS TO THE SIGNAL GENERATOR AND THE RF VOLTMETER. (E) WITH SUFFICIENT SIGNAL APPLIED TO THE OUTPUT TERMINALS OF THE AMPLIFIER, ADJUST C_2 FOR A MINIMUM INDICATION AT THE INPUT (F) REPEAT STEPS (A), (B), AND (C) TO DETERMINE IF RETUNING IS NECESSARY.

NOTE 2: L_1 & L_2—SILVER-PLATED BRASS ROD, 1-1/2" LONG x 1/4" DIA. INSTALL AT LEAST 1/2" FROM NEAREST VERTICAL CHASSIS SURFACE.

NOTE 3: EXTERNAL INTERLEAD SHIELD TO ISOLATE THE COLLECTOR LEAD FROM THE EMITTER AND BASE LEADS.

Fig. 2 – Neutralized Amplifier Circuit Used to Measure 450-MHz Power Gain and Noise Figure for RCA-40294

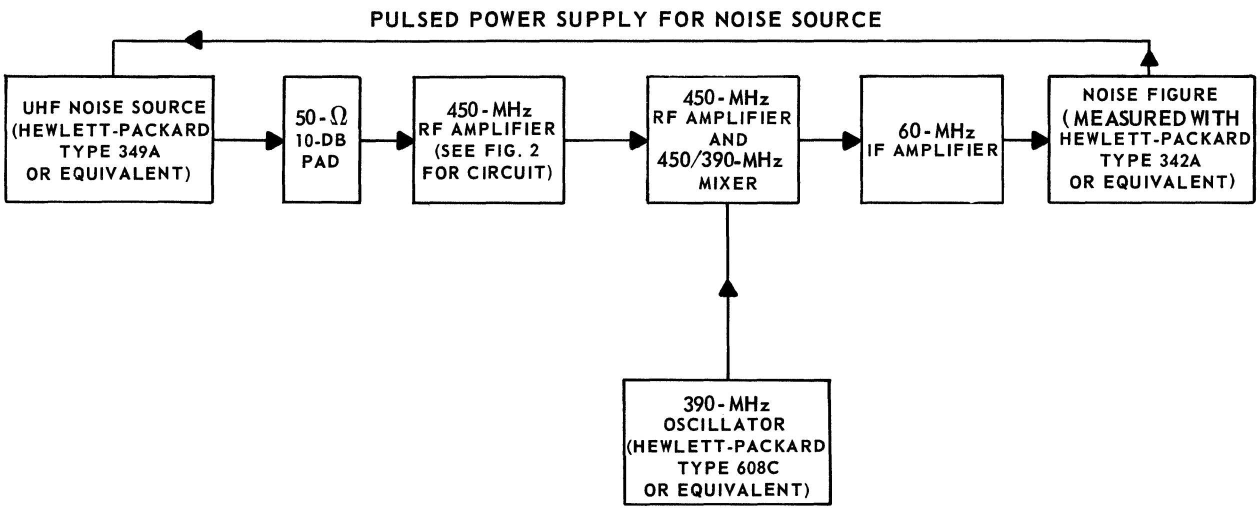
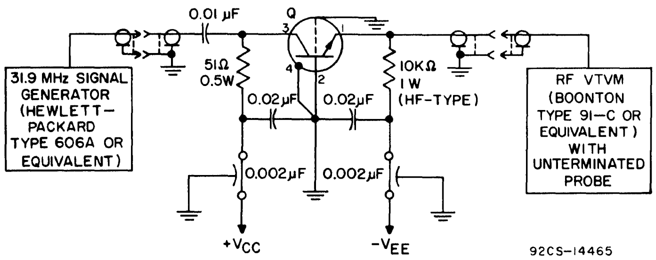


Fig. 3 - Block Diagram of 450-MHz Noise-Figure Test Circuit for RCA-40294



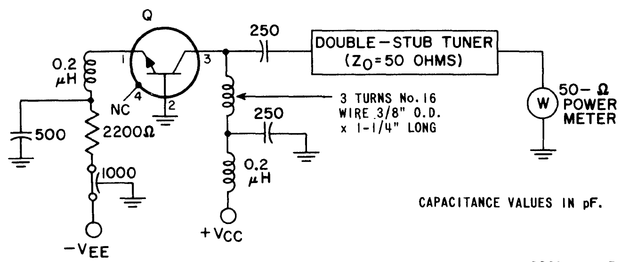
Q = RCA Type 40294

NOTE: **Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.**

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 6 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

Fig.4 - Collector-to-Base Time Constant Measurement Circuit

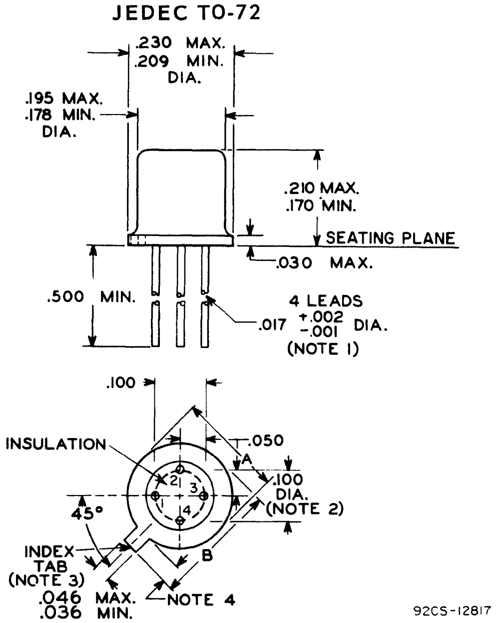


Q = RCA Type 40294

Fig.5 - Oscillator Circuit Used to Measure 500-MHz Power Output for RCA-40294

DIMENSIONAL OUTLINE

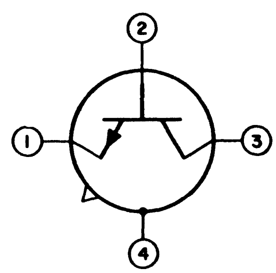
JEDEC TO-72



TERMINAL DIAGRAM

Bottom View

LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE



NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE. FROM 0.250" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" – 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAX. WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

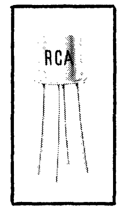
NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM – 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER A FROM DIMENSION B.

RCA-40294

ULTRA-HIGH-RELIABILITY SILICON NPN TRANSISTOR FOR UHF APPLICATIONS

ULTRA-HIGH-RELIABILITY SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



TO-72

For Critical VHF and UHF Applications in Aerospace and Military Equipment

RCA-40295 is an ultra-high-reliability double-diffused, epitaxial planar transistor of the silicon npn type, for critical amplifier and mixer applications at frequencies up to 200 MHz and oscillator applications up to 500 MHz.

The 40295 is electrically and mechanically like the RCA-2N2708, but is specially processed, preconditioned, and tested for aerospace and military applications.

The 40295 utilizes a hermetically sealed JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by a fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the technical bulletin for the RCA-2N2708 also apply for RCA-40295.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	35 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	20 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION:		
At case temperatures: Up to 25°C	300 max.	mW
At case temperatures: Above 25°C	derate at 1.71 mW/°C	
At ambient temperatures: Up to 25°C	200 max.	mW
At ambient temperatures: Above 25°C	derate at 1.14 mW/°C	
TEMPERATURE RANGE:		
Storage and operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distances not less than 1/32" from seating surface for 10 seconds max.	265 max.	°C

Features:

- **extra-rigorous controls and inspections of all components and internal assemblies before sealing**
- **100% thermal and mechanical preconditioning after sealing**
- **complete electrical and mechanical QUALITY CONFORMANCE test program**
- **100% RELIABILITY-ASSURANCE testing**
- **100% PERFORMANCE REQUIREMENTS testing**
- **high gain-bandwidth product:** f_T = 700 MHz min.
- **low collector-to-base time constant:** $r_b'C_c$ = 33 ps max.
- **high VHF power gain** G_{pe} = 15 dB min. at 200 MHz (neutralized) = 12 dB typ. at 200 MHz (unneutralized)

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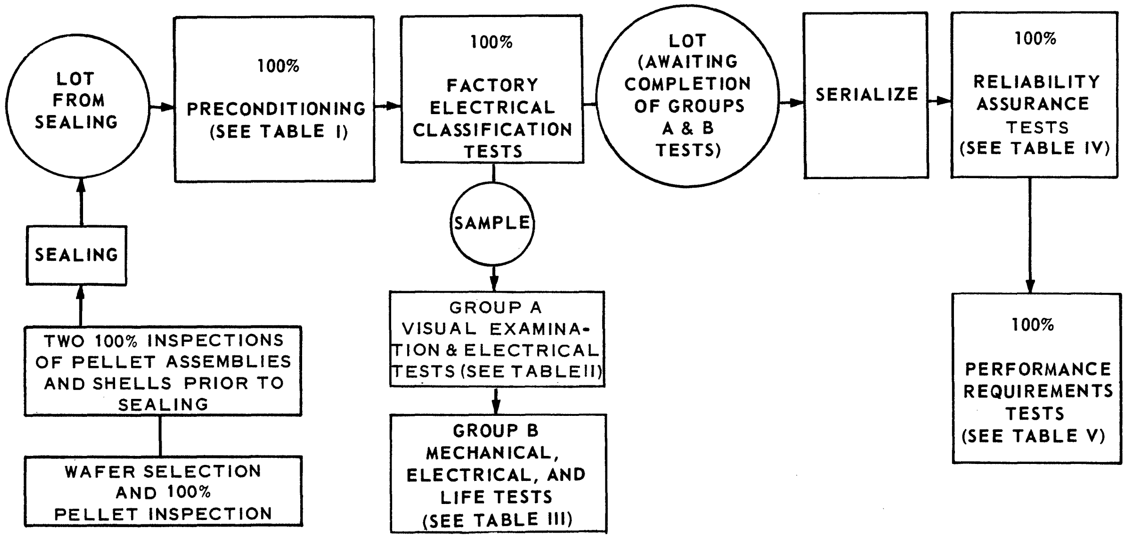


Fig.1 — High-Reliability Testing Process Flow Diagram

TABLE I
100% PRECONDITIONING AFTER SEALING
BEFORE FACTORY, QUALITY, RELIABILITY-ASSURANCE AND PERFORMANCE REQUIREMENTS TESTS

STABILIZATION BAKE	48 hours minimum at 200°C
TEMPERATURE CYCLING (PER MIL-STD-750 METHOD 1051, COND. C)	5 complete cycles from -65°C to +200°C, each including 15 minutes at -65°C, 15 minutes at +200°C, and 5 minutes at 25°C
HELIUM-LEAK TEST (PER MIL-STD-202 METHOD 112, COND. C, PROC. IIIA)	Leakage may not exceed 10^{-8} atm cc/s
BUBBLE TEST (PER MIL-STD-202, METHOD 112, COND. A)	150°C minimum, 1 minute
CONSTANT-ACCELERATION (CENTRIFUGE) TEST (PER MIL-STD-750, METHOD 2006)	20,000 G's; Y_1 plane, 1 minute

TABLE II

GROUP A TESTS

Sub-group	Lot Tolerance Per Cent Defective	Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	LIMITS: RCA 40295 Min.	Max.	Units
					°C	MHz	V	V	mA	mA	mA	Min.	Max.	
1	5	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	--	--
		Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
2	3	Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		22				--	100	nA
		Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		35	--	V
		Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	20	--	V
		Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	0.001		3	--	V
		Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
		Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		2	2			30	200	--
3	10	Small-Signal Power Gain▲ (See Fig. 2 for Test Circuit)	G_{pe}	--	25±3	200		15	2			15	22	dB
		Noise Figure● Generator Resistance (R_G) = 50 Ohms (See Fig. 3 for Test Circuit)	NF	--	25±3	200		15	2			--	7.5	dB
		Collector-to-Base Time Constant●(See Fig. 4 for Test Circuit)	$r_b'C_c$	--	25±3	31.9	15			-2		9	33	ps
		Small-Signal, Short-Circuit, Forward Current-Transfer Ratio●	$\|h_{fe}\|$	3306	25±3	100		15	2			7	12	--
4	10	Collector-to-Base Feedback Capacitance▲	C_{cb}		25±3	≥0.1 ≤1	15			0		--	1	pF
		Small-Signal, Short-Circuit Forward Current-Transfer Ratio	h_{fe}	3206	25±3	0.001						30	180	--
		Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55±3	--		2	2			10	--	--
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-3}	--	15					--	1	μA

*Pulse Test

▲Three-Terminal Measurement with Emitter and Case Leads Guarded.

● Lead No. 4 (Case) Grounded

TABLE III

GROUP B TESTS

Subgroup	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective (%)	Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40295 Initial Values Min.	RCA-40295 Initial Values Max.	RCA-40295 End Point Values Min.	RCA-40295 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 7)	2066	20	--	--	--	--	--	--	--	--
2	SOLDERABILITY: Solder Temperature = 260 ± 5°C	2026	10	I_{CBO}	3036D	T_A =25±3° C, V_{CB}=15 V	--	10	--	10	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0^{+5}_{-0}$ °C, $T_{max} = 100^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A =25±3° C, V_{CE}=2 V, I_C=2 mA	30	200	30	200	--
	MOISTURE-RESISTANCE TEST	1021									
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 msec, 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	10	I_{CBO}	3036D	T_A =25±3° C, V_{CB}=15 V	--	10	--	10	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ±20 Hz, 20 G's	2046		h_{FE}	3076	T_A =25±3° C, V_{CE}=2 V, I_C=2 mA	30	200	30	200	--
	VIBRATION VARIABLE-FREQUENCY TEST	2056									
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	TERMINAL STRENGTH TEST	2036 Test Condition E	15	Helium Leak Test	MIL-STD 202 METHOD 112 CONDITION C Procedure IIIA	--	--	--	--	10^{-8}	atm cc/s
				Bubble Test	MIL-STD 202 Condition A	T_A=150°C min. 1 minute					
5	SALT-ATMOSPHERE TEST	1041	20	I_{CBO}	3036D	T_A =25±3° C, V_{CB}=15 V	--	10	--	10	nA
				h_{FE}	3076	T_A =25±3° C, V_{CE}=2 V, I_C=2 mA	30	200	30	200	--
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A =200±10° C, Duration=1000 hrs.	1031	λ= 7%	I_{CBO}	3036D	T_A =25±3° C, V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3° C, V_{CE}=2 V, I_C=2 mA	30	200	24	240	--
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit, T_A =25±3° C, V_{CB}=19.5±0.5 Volts, P_T=200 mw, Duration=1000 hrs.	1026	λ= 7%	I_{CBO}	3036D	T_A =25±3° C, V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3°C, V_{CE}=2 V, I_C=2 mA	30	200	24	240	--

TABLE IV

100% RELIABILITY ASSURANCE TEST

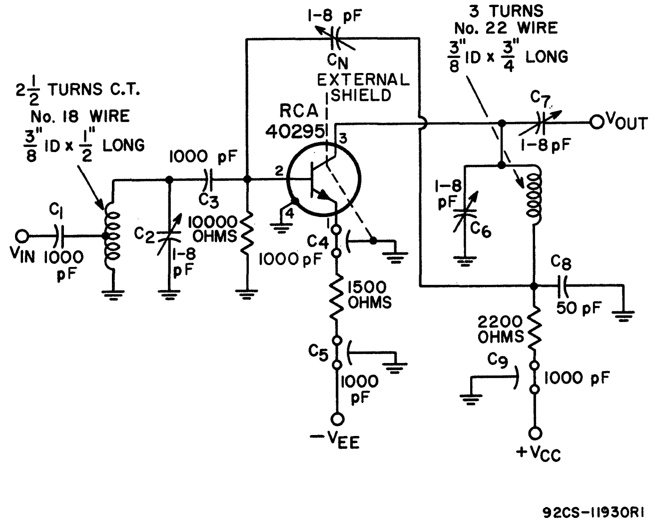
Test	MIL-STD 750 Reference	INITIAL AND ENDPOINT CHARACTERISTICS TESTS				
		Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40295 Initial Value	RCA-40295 Endpoint Value
POWER BURN-IN: Common-Base Circuit T_A 25±3° C V_{CB}=19.5±0.5 V P_T=200 mW Duration=340 hours	1026	ΔI_{CBO}	3036 Bias Condition D	T_A =25±3° C V_{CB}=15 V	10 max. nA	Δ=± 5 nA
		Δh_{FE}	3076	T_A =25±3° C V_{CE}=2 V I_C=2 mA	30 min. 200 max.	Δ=± 15%

TABLE V

100% PERFORMANCE REQUIREMENTS TESTS

Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	LIMITS RCA 40295 Min.	LIMITS RCA 40295 Max.	Units
			°C	MHz	V	V	mA	mA	mA	Min.	Max.	
Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		22				--	100	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		35	--	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	20	--	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	0.001		3	--	V
Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		2	2			30	200	--
Noise Figure▲: Generator Resistance (R_G)=50 Ω (See Fig.3 for Test Circuit)	NF	--	25±3	200		15	2			--	7.5	dB
Visual Examination (External) Under 20-Power Magnification			Examine leads, header, and shell for visual defects									

* Pulse Test ▲ Lead No. 4 (Case) Grounded



NOTE: (Neutralization Procedure): (a) Connect a 200-MHz signal generator (with Z_{out} = 50 ohms) to the input terminals of the amplifier. (b) Connect a 50-ohm rF voltmeter across the output terminals of the amplifier. (c) Apply V_{EE} and V_{CC}, and with the signal generator adjusted for 10 mV output, tune C_2, C_6, and C_7 for maximum output. (d) Interchange the connections to the signal generator and the output indicator. (e) With sufficient signal applied to the output terminals of the amplifier, adjust C_N for a minimum indication at the input. (f) Repeat steps (a), (b), and (c) to determine if retuning is necessary.

Fig.2 – Circuit of Neutralized Amplifier Used to Measure Power Gain at 200 MHz for RCA-40295

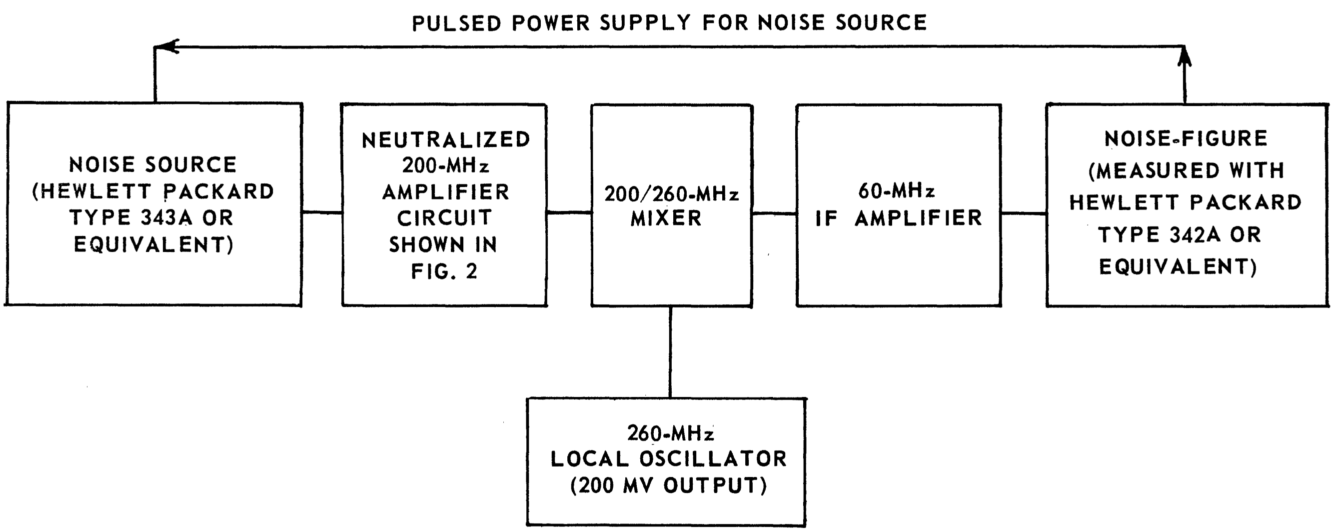


Fig.3 – Block Diagram of 200-MHz Noise-Figure Test Circuit for RCA-40295

NOTE: Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 15 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

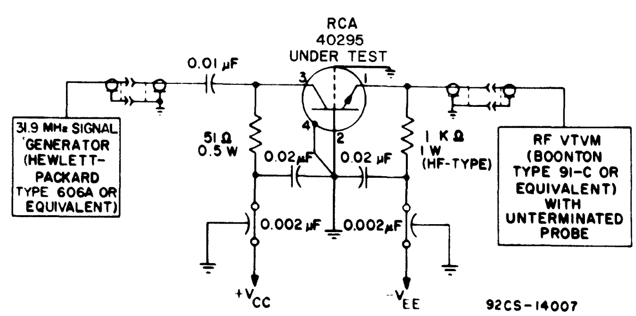
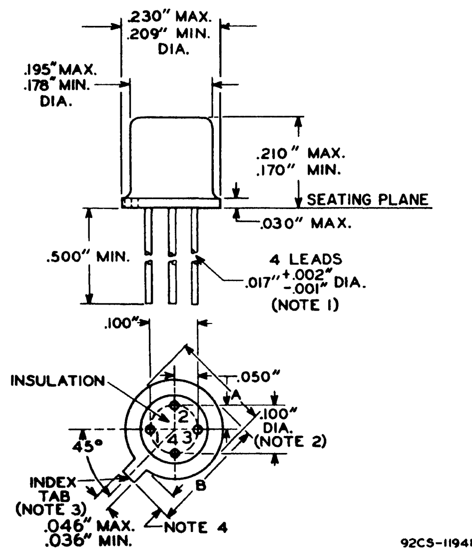


Fig.4 – Collector-to-Base Time Constant Measurement Circuit

DIMENSIONAL OUTLINE
TO-72



NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE, FROM 0.250" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

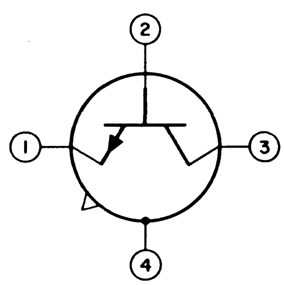
NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" – 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAX. WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM – 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER A FROM DIMENSION B.

TERMINAL DIAGRAM
Bottom View

LEAD 1 – EMITTER
LEAD 2 – BASE



LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE

RCA-40295

ULTRA-HIGH RELIABILITY

VHF/UHF TRANSISTOR

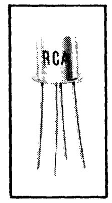
For Aerospace and Military Equipment

RCA UHF TRANSISTORS
For Aerospace and Military Applications

40296

File No. 246

ULTRA-HIGH-RELIABILITY SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-72

For UHF Applications in Critical Aerospace and Military Equipment

RCA-40296 is an ultra-high-reliability double-diffused, epitaxial planar transistor of the silicon NPN type for low-noise amplifier, mixer, and oscillator applications at frequencies up to 500 MHz (common-emitter configuration), and up to 1200 MHz (common-base configuration). The 40296 is a lower-noise version of the RCA-40294.

This transistor is electrically and mechanically like RCA-2N3839, but is specially processed, preconditioned, and tested for critical aerospace and military applications.

The 40296 utilizes a hermetically sealed JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by a fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the technical bulletin for RCA-2N3839 also apply for RCA-40296.

Maximum Ratings, *Absolute-Maximum Values*:

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures* up to 25°C	300 max.	mW
At case temperatures* above 25°C	Derate at 1.72	mW/°C
For operation in free air:		
At ambient temperatures up to 25°C	200 max.	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds maximum	265 max.	°C

* Measured at center of seating surface.

Features

- Extra-rigorous control and inspection of all parts, materials, and internal assemblies before sealing
- 100% thermal and mechanical preconditioning after sealing
- complete electrical and mechanical **QUALITY CONFORMANCE** test program
- 100% **RELIABILITY ASSURANCE** testing
- 100% **PERFORMANCE-REQUIREMENTS** testing
- 100% Noise Figure and Power Gain Tests at 450 MHz
- high gain-bandwidth product — f_T = 1000 MHz min.
- very low Device Noise Figure — NF = 3.4 dB max. at 450 MHz
- high power gain as neutralized amplifier — G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator — P_o = 30 mW min. at 500 MHz
- low collector-to-base time constant — $r_{b'}C_c$ = 7 ps typ.

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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Printed in U.S.A.
40296 12-66

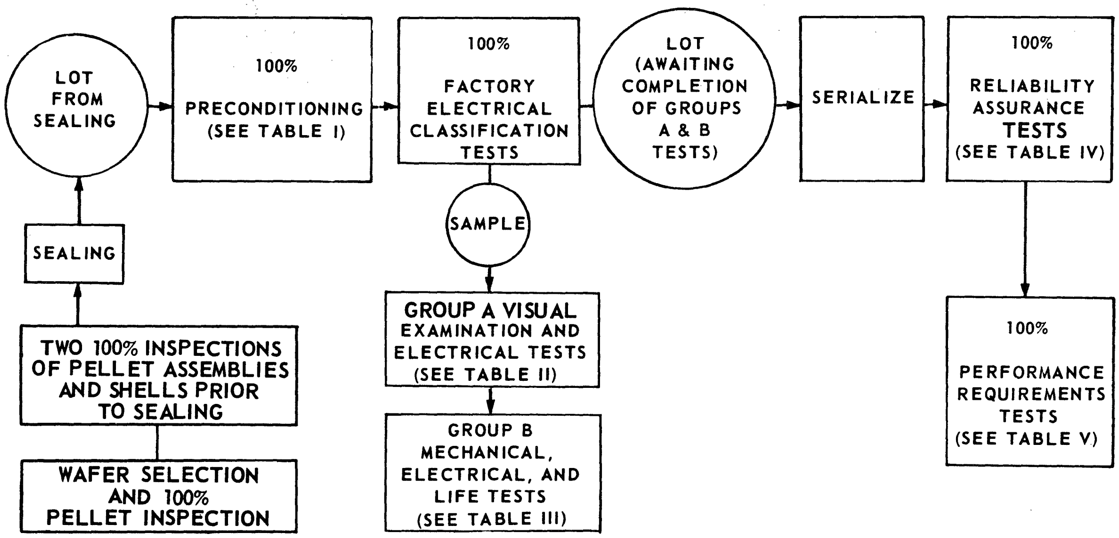


Fig. 1 - High-Reliability Testing Process Flow Diagram

TABLE I 100% PRECONDITIONING
BEFORE FACTORY, QUALITY, RELIABILITY-ASSURANCE AND PERFORMANCE REQUIREMENTS TESTS

STABILIZATION BAKE	48 hours minimum at 200° C
TEMPERATURE CYCLING (PER MIL-STD-750 METHOD 1051, COND. C)	5 complete cycles from -65° C to +200° C, each including 15 minutes at -65° C, 15 minutes at +200° C, and 5 minutes at 25° C
HELIUM-LEAK TEST (PER MIL-STD-202, METHOD 112 COND. C, PROC.IIIA)	Leakage may not exceed 10^{-8} atm cc/s
BUBBLE TEST (PER MIL-STD-202, METHOD 112 COND. A)	150° C minimum, 1 minute, ethylene glycol
CONSTANT-ACCELERATION (CENTRIFUGE) TEST (PER MIL-STD-750, METHOD 2006)	20,000 G's; Y_1 plane, 1 minute

TABLE II
GROUP A TESTS

Sub-group	Lot Tolerance Per Cent Defective	Characteristic Test	Symbol	MIL-STD 750 Reference Test Method	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	LIMITS RCA 40296 Min.	Max.	Units
					°C	MHz	V	V	mA	mA	mA	Min.	Max.	
1	5	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	--	
2	3	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
		Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		16				--	100	nA
		Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		30	--	V
		Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	15	--	V
		Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	-0.001		2.5	--	V
		Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
		Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		1	3			30	150	
3	10	Small-Signal Power Gain▲ (See Fig. 2 for Test Circuit)	G_{pe}		25±3	450		6	1.5			12.5	19	dB
		Device Noise Figure⊕▲ Generator Resistance (R_G) = 50 Ω (See Fig. 3 for Test Circuit)	NF		25±3	450		6	1.5			--	3.4	dB
		Measured Noise Figure▲ Generator Resistance (R_G) = 50 Ω (See Fig. 3 for Test Circuit)	NF		25±3	450		6	1.5			--	3.9	dB
		Collector-to-Base Time Constant▲ (See Fig. 4 for Test Circuit)	$r_{b'}C_c$		25±3	31.9		6		-2		1	15	ps
		Oscillator Power Output (See Fig. 5 for Test Circuit)	P_o		25±3	≥500	10			-12		30	--	mW
		Collector-to-Base Feedback Capacitance ●	C_{cb}		25±3	≥0.1 ≤1	10			0		--	1	pF
4	10	Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55±3	--		1	3			10	--	
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-5}	--	15			0		--	1	μA
		Small-Signal, Short Circuit Forward Current-Transfer Ratio▲	h_{fe}	3206	25±3	0.001		6	2			50	220	
		Magnitude of Small-Signal, Short-Circuit Forward Current Transfer Ratio▲	$\|h_{fe}\|$	3206	25±3	100		6	5			10	20	

* Pulse Test

▲ Lead No. 4 (Case) Grounded

⊕ Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test amplifier and the contribution of the following stages in the test setup.

● Three-terminal measurement with emitter and case leads guarded.

TABLE III
GROUP B TESTS

Subgroup	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective %	Charac-teristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40296 Initial Values Min.	RCA-40296 Initial Values Max.	RCA-40296 End Point Values Min.	RCA-40296 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 7)	2066	20	--	--	--	--	--	--	--	
2	SOLDERABILITY Solder Temp. = 260±5°C	2026	10	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0^{+5}_{-0}$ °C $T_{max} = 100^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	30	150	
	MOISTURE-RESISTANCE TEST	1021									
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 ms, 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	10	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ±20 Hz, 20 G's	2046		h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	30	150	
	VIBRATION VARIABLE-FREQUENCY TEST	2056									
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	TERMINAL STRENGTH TEST	2036 Test Condition E	20	Helium Leak Test	MIL-STD 202 Method 112 Condition C Procedure III A		--	--	--	10^{-8}	atm cm^3/s
				Bubble Test	MIL-STD 202 Condition A	T_A=150°C (min.) 1 minute					
5	SALT-ATMOSPHERE TEST	1041	20	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	10	nA
				h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	30	150	
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A =200±10°C Duration=1000 hrs.	1031	λ= 7%	I_{CBO}	3036D	T_A =25±3° C V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	24	180	
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit T_A =25±3° C V_{CB}=12.5±0.5 V P_T=200 mW Duration=1000 hrs.	1026	λ= 7%	I_{CBO}	3036D	T_A =25±3 °C V_{CB}=15 V	--	10	--	20	nA
				h_{FE}	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA	30	150	24	180	

TABLE IV

100% RELIABILITY ASSURANCE TEST

THE CUMULATIVE REJECTS OF TABLES IV AND V SHALL NOT EXCEED 10% OF THE LOT

Test	MIL-STD 750 Reference	INITIAL AND ENDPOINT CHARACTERISTICS TESTS				
		Characteristic Test	RCA-40296 Initial Value	RCA-40296 Endpoint Value	MIL-STD 750 Reference	Test Conditions
POWER BURN-IN: Common-Base Circuit T_A =25±3°C V_{CB}=12.5±0.5 V P_T=200 mW Duration=340 hours	1026	ΔI_{CBO}	10 max. nA	Δ= ±5 nA	3036 Bias Condition D	T_A =25±3 °C V_{CB}=15 V
		Δh_{FE}	30 min. 150 max.	Δ=±15%	3076	T_A =25±3 °C V_{CE}=1 V I_C=3 mA

TABLE V

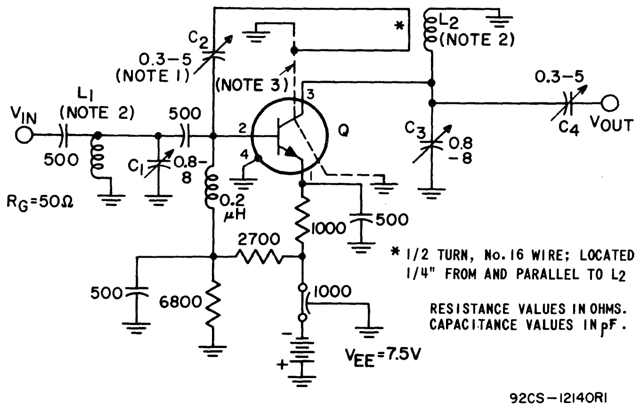
100% PERFORMANCE REQUIREMENTS TESTS

THE CUMULATIVE REJECTS OF TABLES IV AND V SHALL NOT EXCEED 10% OF THE LOT

Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS: Ambient Temperature T_A (°C)	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Collector Current I_C (mA)	DC Emitter Current I_E (mA)	DC Base Current I_B (mA)	LIMITS RCA 40296 Min.	LIMITS RCA 40296 Max.	Units
Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0		--	10	nA
Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25±3	--		16				--	100	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0		30	--	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*		0	15	--	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	-0.001		2.5	--	V
Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25±3	--			10		1	--	1	V
Collector-to-Emitter Voltage	V_{CE}	3071	25±3	--			10		1	--	0.4	V
Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		1	3			30	150	
Device Noise Figure▲: Generator Resistance (R_G)=50 Ohms (See Fig. 3 for Test Circuit)	NF	--	25±3	450		6	1.5			--	3.4	dB
Measured Noise Figure▲: Generator Resistance (R_G)=50 Ohms (See Fig. 3 for Test Circuit)	NF	--	25±3	450		6	1.5			--	3.9	dB
Visual Examination (External) Under 20-Power Magnification		Examine leads, header, and shell for visual defects.										

* Pulse Test

▲ Lead No. 4 (Case) Grounded



NOTE 1: (NEUTRALIZATION PROCEDURE): (A) CONNECT A 450-MHz SIGNAL GENERATOR (WITH R_g = 50 OHMS) TO THE INPUT TERMINALS OF THE AMPLIFIER. (B) CONNECT A 50-OHM RF VOLTMETER ACROSS THE OUTPUT TERMINALS OF THE AMPLIFIER. (C) APPLY V_{EE}, AND WITH THE SIGNAL GENERATOR ADJUSTED FOR 5 mV OUTPUT FROM THE AMPLIFIER, TUNE C_1, C_3, AND C_4 FOR MAXIMUM OUTPUT. (D) INTERCHANGE THE CONNECTIONS TO THE SIGNAL GENERATOR AND THE RF VOLTMETER. (E) WITH SUFFICIENT SIGNAL APPLIED TO THE OUTPUT TERMINALS OF THE AMPLIFIER, ADJUST C_2 FOR A MINIMUM INDICATION AT THE INPUT. (F) REPEAT STEPS (A), (B), AND (C) TO DETERMINE IF RETUNING IS NECESSARY.

NOTE 2: L_1 & L_2—SILVER-PLATED BRASS ROD, 1-1/2" LONG x 1/4" DIA. INSTALL AT LEAST 1/2" FROM NEAREST VERTICAL CHASSIS SURFACE.

NOTE 3: EXTERNAL INTERLEAD SHIELD TO ISOLATE THE COLLECTOR LEAD FROM THE EMITTER AND BASE LEADS.

Q = RCA Type 40296

Fig. 2 – Neutralized Amplifier Circuit Used to Measure 450-MHz Power Gain and Noise Figure for RCA-40296

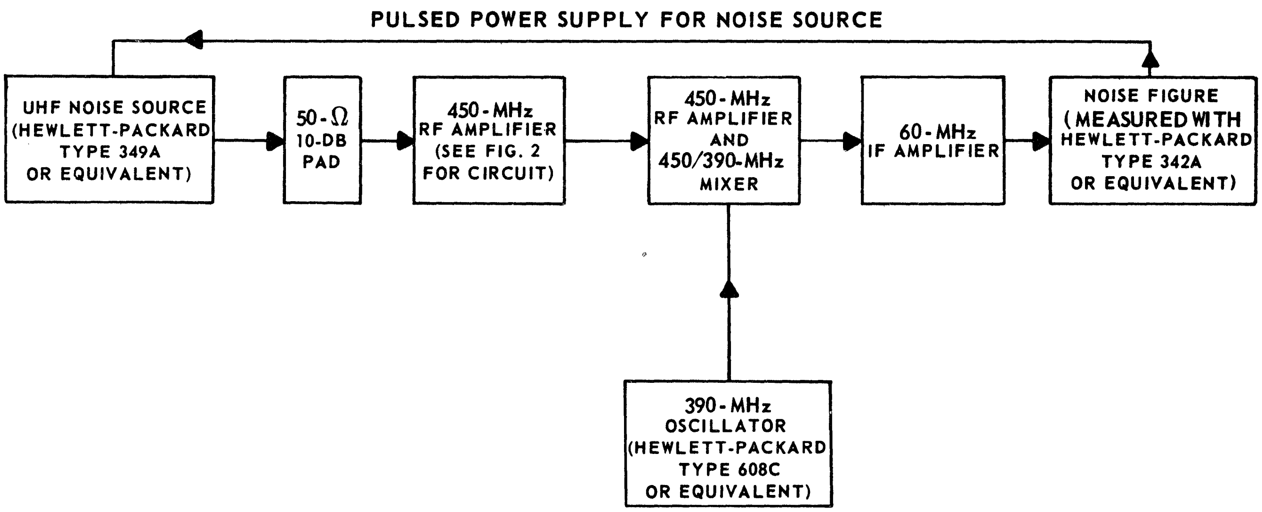
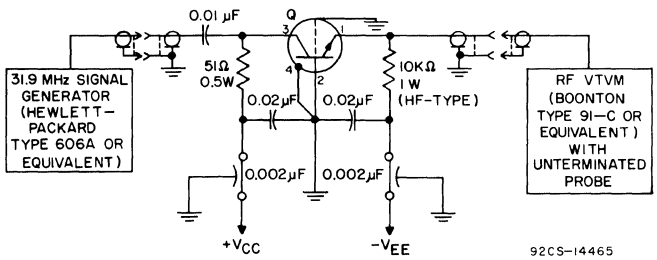


Fig. 3 - Block Diagram of 450-MHz Noise-Figure Test Circuit for RCA-40296



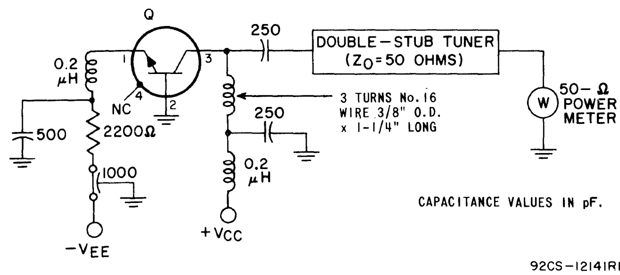
Q = RCA Type 40296

NOTE: Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 6 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

Fig.4 - Collector-to-Base Time Constant Measurement Circuit

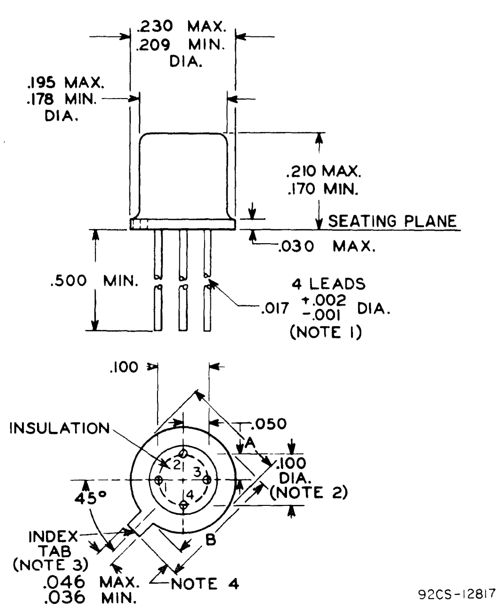


Q = RCA Type 40296

Fig.5 - Oscillator Circuit Used to Measure 500-MHz Power Output for RCA-40296

DIMENSIONAL OUTLINE

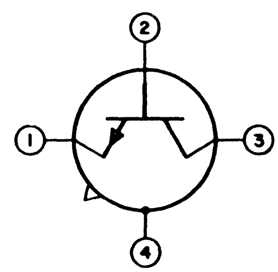
JEDEC TO-72



TERMINAL DIAGRAM

Bottom View

LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE



NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE. FROM 0.250" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" – 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAX. WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM – 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER A FROM DIMENSION B.

RCA-40296

ULTRA-HIGH-RELIABILITY SILICON NPN TRANSISTOR FOR UHF APPLICATIONS

SILICON N-P-N "overlay" TRANSISTORS

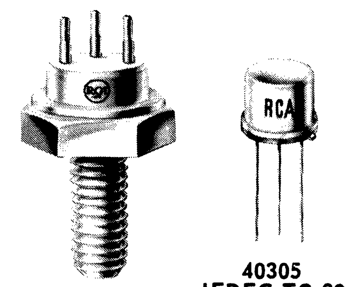
40305
40306
40307

RCA-40305, 40306, and 40307 are high-reliability variants of RCA-2N3553, 2N3375, and 2N3632 epitaxial silicon n-p-n overlay transistors. They are intended for Class-A▲, -B, or -C amplifier, frequency multiplier, or oscillator operation.

These devices are subjected to special preconditioning tests for selection in high-reliability, large-signal, high-power, VHF-UHF applications in Space, Military, and Industrial communications equipment.

High Reliability

High-Power VHF-UHF Amplifier



40306
40307
JEDEC TO-60

40305
JEDEC TO-39

FEATURES

- High-Reliability Assured By Seven (7) Preconditioning Steps
- Data Recorded Before and After "Power-Age Test" and Held to Critical Delta Criteria
- High Voltage Ratings —
  V_{CBO} = 65 volts max.
  V_{CEV} = 65 volts max.
  V_{CEO} = 40 volts max.
- 100 Per-Cent Tested to Assure Freedom from Second Breakdown for Operation in Class-A Applications
- High Power Output, P_{OUT}, Unneutralized Class-C Amplifier —
  At 400 Mc, 3 w min. (40306)
  175 Mc { 13.5 w min. (40307); 2.5 w min. (40305) }
  100 Mc, 7.5 w min. (40306)

RF SERVICE▲

Maximum Ratings, *Absolute-Maximum Values*

	40305	40306	40307	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	65	65	65	volts
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open, V_{CEO}	40	40	40	volts
With V_{BE} = -1.5 volts, V_{CEV}	65	65	65	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	4	4	volts
COLLECTOR CURRENT, I_C	1.0	1.5	3.0	amperes
TRANSISTOR DISSIPATION, P_T▲:				
At case temperatures up to 25° C	7.0	11.6	23	watts
At case temperatures above 25° C	Derate linearly to 0 watts at 200° C			
TEMPERATURE RANGE:				
Storage	-65 to 200			°C
Operating (Junction)	-65 to 200			°C
PIN OR LEAD TEMPERATURE (During soldering):				
At distances ≧ 1/32" from insulating wafer (TO-60 package) or from seating plane (TO-39 package) for 10 sec. max.	230			°C

▲Secondary breakdown considerations limit maximum DC operating conditions — contact your RCA representative for specific data.

ELECTRICAL CHARACTERISTICS
Case Temperature = 25° C

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_E	I_B	I_C	LIMITS 40305 Min.	40305 Max.	40306 Min.	40306 Max.	40307 Min.	40307 Max.	Units
Collector-Cutoff Current	I_{CEO}		30			0		-	0.1	-	0.1	-	0.25	µamp
Collector-to-Base Breakdown Voltage	BV_{CBO}				0 0 0		0.1 0.3 0.5	- 65 -	- - -	65 - -	- - -	- - 65	- - -	volts
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1 0.25		0 0	4 -	- -	4 -	- -	- 4	- -	volts
Collector-to-Emitter Breakdown Voltage	BV_{CEO}					0	0 to 200[a]	40[b]	-	40[b]	-	40[b]	-	volts
	BV_{CEX}			-1.5			0 to 200[a]	65[b]	-	65[b]	-	65[b]	-	volts
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					100 50	500 250	- -	- 1	- -	1 -	- -	1 -	volt
DC Forward-Current Transfer Ratio	h_{FE}		5 5				150 300	10 -	- -	10 -	- -	- 10	- -	
Collector-to-Base Capacitance Measured at 1 Mc	C_{ob}	30			0			-	10	-	10	-	20	pf
RF Power Output Amplifier, Unneutralized At 100 Mc (See *Fig.2*) 175 Mc (See *Fig.1*) 175 Mc (See *Fig.3*) 400 Mc (See *Fig.4*)	P_{OUT}		 28 28 28 28					 - 2.5[d] - -	 - - - -	 7.5[c] - - 3[f]	 - - - -	 - - 13.5[e] -	 - - - -	watts

[a] Pulsed through an inductor (25 mh); duty factor = 50%.
[b] Measured at a current where the breakdown voltage is a minimum.
[c] For P_{IN} = 1.0 w; minimum efficiency = 65%.
[d] For P_{IN} = 1/4 w; minimum efficiency = 50%.
[e] For P_{IN} = 3.5 w; minimum efficiency = 70%.
[f] For P_{IN} = 1.0 w; minimum efficiency = 40%.

RELIABILITY TESTING

RCA types 40305, 40306, and 40307 are electrically similar to RCA-2N3553, 2N3375, and 2N3632 respectively; but they differ in that they have substantially lower collector-cutoff current. I_{CEO} for the 40305 and 40306 is 100 nanoamperes maximum and I_{CEO} for the 40307 is 250 nanoamperes maximum.

Preconditioning (100 Per-Cent Testing of Each Transistor)

1. Helium Leak, 1 x 10^{-8} cc/sec. max.
2. Temperature Cycling-Method 102A of MIL-STD-202, 3 cycles, -65° C to +200° C
3. Methanol Bomb, 70 psig, 16 hours minimum
4. Bake, 72 hours minimum, +200° C
5. Constant Acceleration-Method 2006 of MIL-STD-750, 10,000 G, Y_1 axis
6. Serialization
7. Record I_{CEO}, h_{FE}, $V_{CE}(sat)$
8. Power Age, T_A = 25° C, V_{CB} = 28 V, t = 168 hours, free air
   P_D(40305) = 1 watt
   P_D(40306, 40307) = 2.6 watts

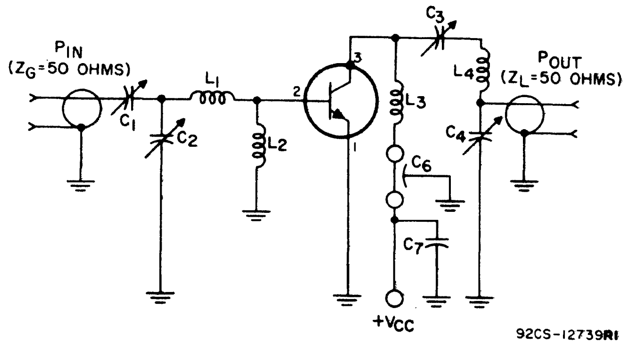
* 9. Record I_{CEO}, h_{FE}, $V_{CE}(sat)$

10. X-Ray Inspection, RCA Spec. 1750326
11. Record Subgroups 2 and 3 of Group A Tests.

* Delta criteria after 168 hours Power Age

I_{CEO}	40305 40306	+100% or +10 nanoamperes whichever is greater
I_{CEO}	40307	+100% or +25 nanoamperes whichever is greater
h_{FE}		±30%
$V_{CE}(sat)$		±0.1 V

RF AMPLIFIER CIRCUIT FOR 40305 POWER-OUTPUT TEST (175-Mc Operation)



C_1, C_2, C_3, C_4: 3-35 pf

C_6: 1,000 pf

C_7: 0.005 µf, disc ceramic

L_1: 2 turns No.16 wire, 3/16" ID, 1/4" long

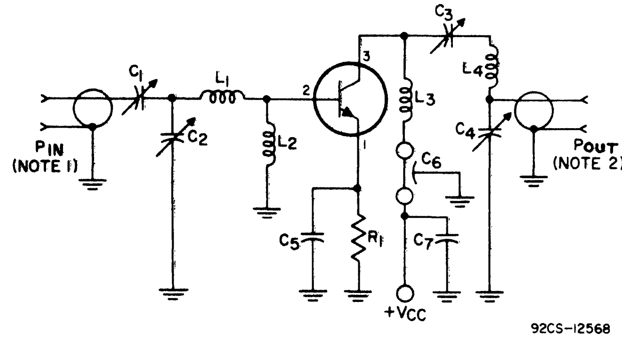
L_2: Ferrite choke, Z = 450 ohms

L_3: 2 turns No.16 wire, 1/4" ID, 1/4" long

L_4: 4 turns No.16 wire, 3/8" ID, 3/8" long

Fig.1

RF AMPLIFIER CIRCUIT FOR 40306 POWER-OUTPUT TEST (100-Mc Operation)



NOTE 1: GENERATOR IMPEDANCE = 50 OHMS.

NOTE 2: LOAD IMPEDANCE = 50 OHMS.

For 100-Mc Operation:

C_1, C_2: 7-100 pf

C_3, C_4: 4-40 pf

C_5: 330 pf, disc ceramic

C_6: 1500 pf

C_7: 0.005 µf, disc ceramic

L_1: 3 turns No.16 wire, 1/4" ID, 5/16" long

L_2: Ferrite choke, Z = 750(±20%) ohms

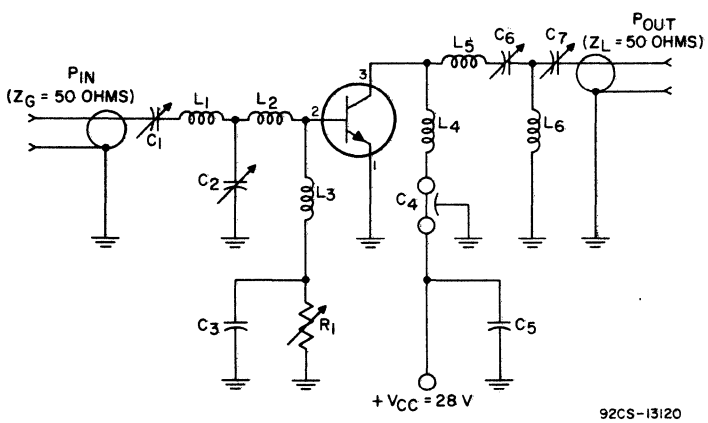
L_3: 2.4-µh choke

L_4: 5 turns No.16 wire, 5/16" ID, 7/16" long

R_1: 1.35 ohms, non-inductive

Fig.2

RF AMPLIFIER CIRCUIT FOR 40307 POWER-OUTPUT TEST (175-Mc Operation)



For 175-Mc Operation:

C_1, C_6: 3-35 pf

C_2, C_7: 8-60 pf

C_4: 1,000 pf

C_3, C_5: 0.005 µf, disc ceramic

L_1, L_5: 4 turns No.18 wire, 1/4" ID, 3/16" long

L_2: 1 turn No.16 wire, 1/4" ID, 3/16" long

L_3: Ferrite choke, Z = 450 ohms

L_4: RF choke, 1.0 µh

L_6: 2-1/2 turns No.16 wire, 1/4" ID, 1/4" long

R_1: 50 ohms

Fig.3

RF AMPLIFIER CIRCUIT FOR 40306 POWER-OUTPUT TEST (400-Mc Operation)

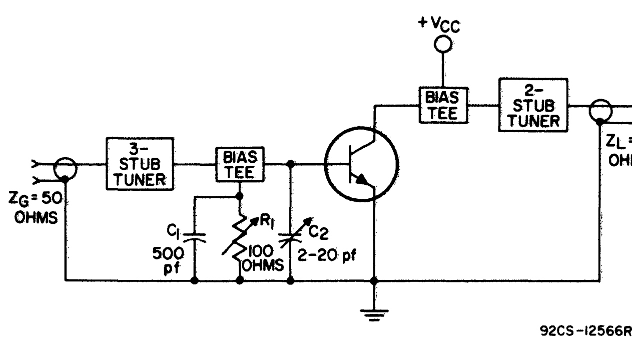
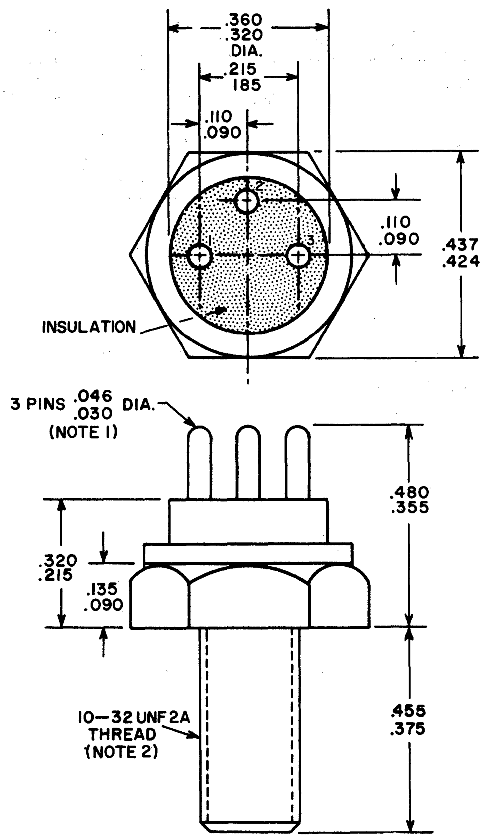


Fig.4

DIMENSIONAL OUTLINES

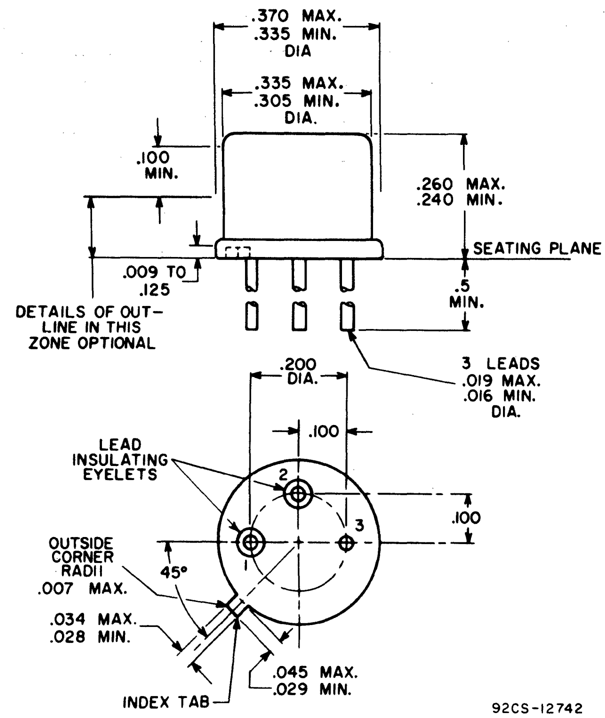
FOR TYPES 40306, 40307
JEDEC TO-60



92CS–12045R5

Dimensions in Inches

FOR TYPE 40305
JEDEC TO-39



92CS-12742

Dimensions in Inches

NOTE 1: THE PIN SPACING PERMITS INSERTION IN ANY SOCKET HAVING A PIN-CIRCLE DIAMETER OF 0.200" AND CONTACTS WHICH WILL ACCOMMODATE PINS HAVING A DIAMETER OF 0.035" MIN., 0.045" MAX.

NOTE 2: THE TORQUE APPLIED TO A 10-32 HEX NUT ASSEMBLED ON THE THREAD DURING INSTALLATION SHOULD NOT EXCEED 12 INCH-POUNDS.

NOTE 3: THIS DEVICE MAY BE OPERATED IN ANY POSITION.

TERMINAL CONNECTIONS

Pin or Lead No.1 - Emitter

Pin or Lead No.2 - Base

Pin or Lead No.3 - Collector (For 40306, 40307)
Collector, Case (For 40305)

Group A Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	SYMBOL	CONDITIONS	LTPD	LIMITS 40305 Min.	40305 Max.	40306 Min.	40306 Max.	40307 Min.	40307 Max.	UNITS
	Subgroup 1			10							
2071	Visual and Mechanical Examination	-	-	-	-	-	-	-	-	-	-
	Subgroup 2			5							
3041D	Collector-To-Emitter Cutoff Current	I_{CEO}	$V_{CE} = 30$ V, $I_B = 0$	-	-	0.1	-	0.1	-	0.25	μamp
3001D	Collector-To-Base Breakdown Voltage	BV_{CBO}	$I_C = 300$ μa, $I_E = 0$	-	65	-	-	-	-	-	volts
			$I_C = 100$ μa, $I_E = 0$	-	-	-	65	-	-	-	volts
			$I_C = 500$ μa, $I_E = 0$	-	-	-	-	-	65	-	volts
3026D	Emitter-To-Base Breakdown Voltage	BV_{EBO}	$I_E = 100$ μa, $I_C = 0$	-	4	-	4	-	-	-	volts
			$I_E = 250$ μa, $I_C = 0$	-	-	-	-	-	4	-	volts
3011D	Collector-To-Emitter Breakdown Voltage	BV_{CEO}	$I_C = 0$ to 200 ma[a], $I_B = 0$	-	40[b]	-	40[b]	-	40[b]	-	volts
3011A	Collector-To-Emitter Breakdown Voltage	BV_{CEX}	$I_C = 0$ to 200 ma[a], $V_{BE} = -1.5$ V	-	65[b]	-	65[b]	-	65[b]	-	volts
3071	Collector-To-Emitter Saturation Voltage	$V_{CE}(sat)$	$I_C = 250$ ma, $I_B = 50$ ma	-	-	1	-	-	-	-	volts
			$I_C = 500$ ma, $I_B = 100$ ma	-	-	-	-	1	-	1	volts
3076	Forward Current Transfer Ratio	h_{FE}	$I_C = 150$ ma, $V_{CE} = 5$ V	-	10	-	10	-	-	-	
			$I_C = 300$ ma, $V_{CE} = 5$ V	-	-	-	-	-	10	-	
	Subgroup 3			5							
3236	Open Circuit Output Capacitance	C_{ob}	f = 1 Mc, $V_{CB} = 30$ V, $I_E = 0$	-	-	10	-	10	-	20	pf
See Fig.1	R. F. Power Output	P_{OUT}	$V_{CE} = 28$ V, $P_{IN} = 0.25$ watt, f = 175 Mc, Min. Effic. = 50%	-	2.5	-	-	-	-	-	watts
See Fig.2			$V_{CE} = 28$ V, $P_{IN} = 1$ watt, f = 100 Mc, Min. Effic. = 65%	-	-	-	7.5	-	-	-	watts
See Fig.3			$V_{CE} = 28$ V, $P_{IN} = 3.5$ watts, f = 175 Mc, Min. Effic. = 70%	-	-	-	-	-	13.5	-	watts
See Fig.4			$V_{CE} = 28$ V, $P_{IN} = 1$ watt, f = 400 Mc, Min. Effic. = 40%	-	-	-	3	-	-	-	watts
	Subgroup 4			15							
3036D	Collector Cutoff Current	I_{CBO}	$T_A = 150^\circ C \pm 3^\circ C$, $V_{CB} = 30$ V, $I_E = 0$	-	-	100	-	100	-	250	μamp
3076	Forward Current Transfer Ratio	h_{FE}	$T_A = 150^\circ C \pm 3^\circ C$, $I_C = 150$ ma, $V_{CE} = 5$ V	-	-	200	-	200	-	-	
			$T_A = 150^\circ C \pm 3^\circ C$, $I_C = 300$ ma, $V_{CE} = 5$ V	-	-	-	-	-	-	200	

[a] Pulsed through an inductor (25 mh); duty factor = 50%.

[b] Measured at a current where the breakdown voltage is a minimum.

SILICON POWER TRANSISTORS

40309–40328
40360–40364

File No. 78

RCA transistors 40309–40328 and 40360–40364 are diffused-junction, silicon n-p-n and p-n-p transistors intended for specific applications in audio amplifiers, giving high-quality performance economically. These types cover applications from low-level input stages to high-power output stages of 5 to 50 watts. Supply voltages range from the nominal 12-volt vehicular type to 117-volt ac-dc type.

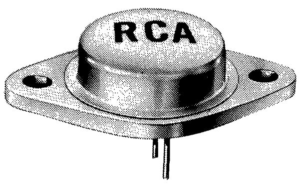
The use of all-silicon devices permits more flexibility in the mechanical and electrical design of amplifiers since the output heat sinks can be held to a minimum.

Information on audio circuits employing these types may be obtained by requesting booklets ATC-401 – 406, from RCA, Commercial Engineering, Harrison, N. J.

N-P-N and P-N-P Types for AF Amplifier Applications

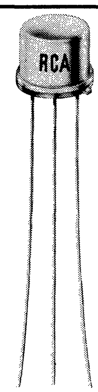
- JEDEC TO-3, TO-5 and TO-66, hermetically-sealed packages
- Operation at case temperatures up to 257°F
- Freedom from second breakdown in operating region
- Pellet bonded to header
  - for greater power-handling capability
  - for greater shock resistance

40325
40363



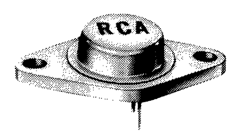
TO-3 **A•**

40309 40311 40314 40315 40317 40319 40320 40321 40323 40326 40327 40360 40361 40362



TO-5 **B•**

40310 40312 40313 40316 40318 40322 40324 40328 40364



TO-66 **C•**

MAXIMUM RATINGS (Absolute-Maximum Values)

CHARACTERISTIC	40325	40363	40309	40323	40311	40315	40314	40317	40319	40320	40326	40321	40327	40360	40361	40362	40310	40324	40316	40312	40313	40318	40322	40328	40364	UNITS
V_{CEO} (sus)	35	–	18	18	30	35	40	40	-40	40	40	–	–	70	–	–	35	35	–	–	–	–	–	–	–	V
V_{CER} (sus)*	–	70	–	–	–	–	–	–	–	–	–	300	300	–	70	-70	–	–	40	60	300	300	300	300	60	V
V_{CEV}**	35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V
V_{EBO}	5	4	2.5	2.5	2.5	2.5	2.5	2.5	-2.5	2.5	2.5	5	5	4	4	-4	2.5	2.5	5	2.5	2.5	6	6	6	4	V
V_{CBO}	35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	V
I_C	15	15	0.7	0.7	0.7	0.7	0.7	0.7	-0.7	0.7	0.7	1	1	0.7	0.7	-0.7	4	4	4	4	2	2	2	2	7	A
I_B	7	7	0.2	0.2	0.2	0.2	0.2	0.2	-0.2	0.2	0.2	0.5	0.5	0.2	0.2	-0.2	2	2	2	2	1	1	1	1	5	A
P_T:***																										
T_C up to 25°C	117	115	5	5	5	5	5	5	5	5	5	5	5	5	5	5	29	29	29	29	35	35	35	35	35	W
T_{FA} up to 25°C	–	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	–	–	–	–	–	–	–	–	–	W
T_C of 175°C	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	5	5	5	–	W
TEMP. RANGE: Oper. Junction	-65 to 200°C																									°C

*R_{BE} = 500 Ω
R_{BE} = 1,000 Ω for 40327
R_{BE} = 200 Ω for 40361, 40362, & 40363
R_{BE} = 150 Ω for 40364

**V_{BE} = -1.5 V

*** At other temperatures see derating curves

●See page 3, 4, or 5 for electrical characteristics for these types.

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40309 - 40328, 40360 - 40364 6/66
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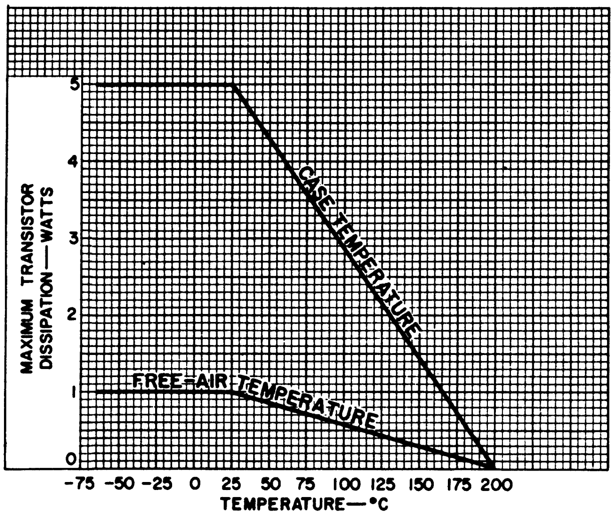
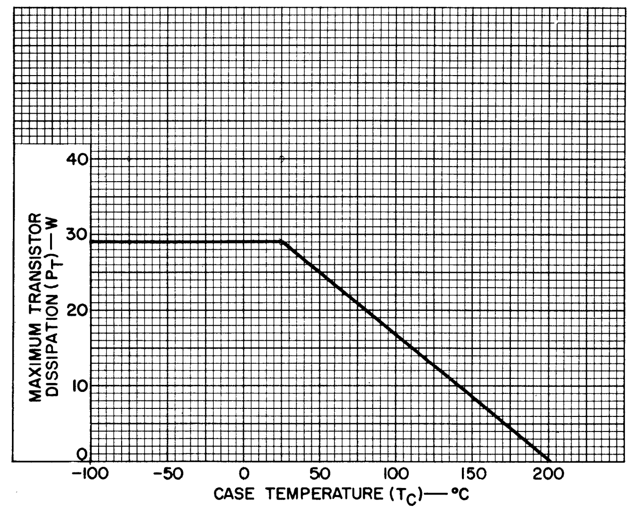
DISSIPATION RATING CURVES FOR TYPES 4309, 40311, 40314, 40315, 40317, 40319, 40320, 40323, 40326, 40360, 40361, AND 40362



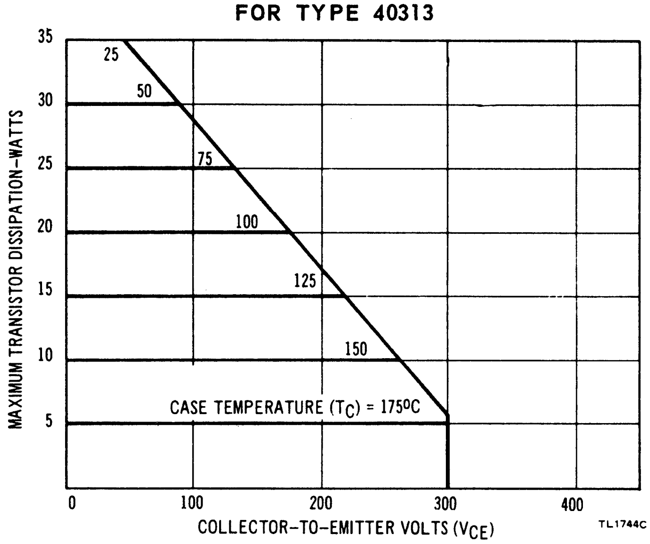
92CS-11172RI

DISSIPATION DERATING CURVE FOR TYPES 40310, 40312, 40316, AND 40324



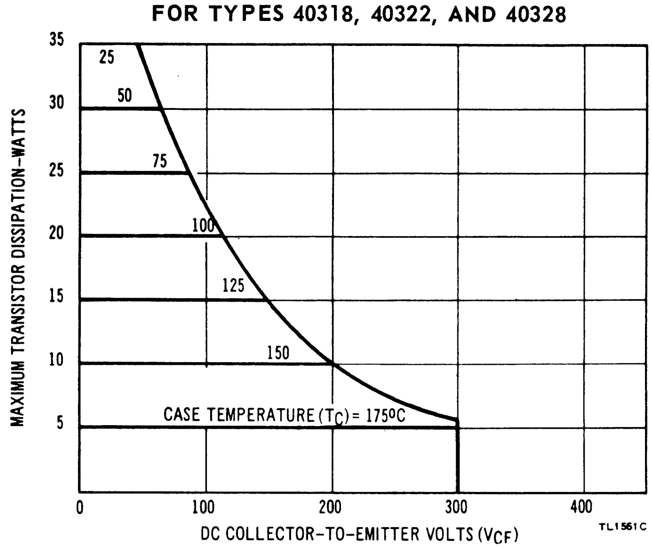
92CS-13005RI

DISSIPATION DERATING CURVE FOR TYPE 40313



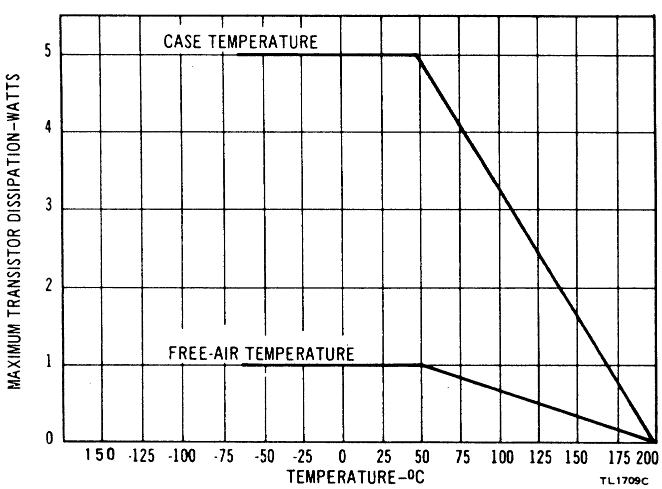
TL1744C

DISSIPATION DERATING CURVE FOR TYPES 40318, 40322, AND 40328



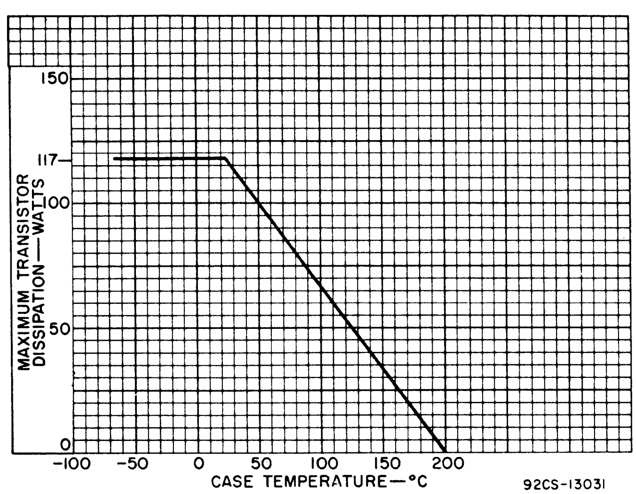
TL1561C

DISSIPATION DERATING CURVES FOR TYPES 40321 AND 40327



TL1709C

DISSIPATION DERATING CURVE FOR TYPE 40325



92CS-13031

B ELECTRICAL CHARACTERISTICS (40309, 40311, 40314, 40315, 40317, 40319, 40320, 40321, 40323, 40326, 40327, 40360, 60361, and 40362)

CHARACTERISTIC	TEST CONDITIONS					LIMITS													
	V_{CB}	V_{CE}	V_{EB}	I_C	T_C	40309	40311	40314	40315	40317	40319	40320	40321	40323	40326	40327	40360	40361	40362
	Volts			mA	°C														
I_{CEO}		60			25												1 µA (Max.)		
		60			150												250 µA (Max.)		
I_{CBO}	15				25	0.25 µA (Max.)	0.25 µA (Max.)	0.25 µA (Max.)	0.25 µA (Max.)	0.25 µA (Max.)		0.25 µA (Max.)		0.25 µA (Max.)	0.25 µA (Max.)				
	-15				25						-0.25 µA (Max.)								
	15				150	1 mA (Max.)	1 mA (Max.)	1 mA (Max.)	1 mA (Max.)	1 mA (Max.)		1 mA (Max.)		1 mA (Max.)	1 mA (Max.)				
	-15				150						-1 mA (Max.)								
	150				150								100 µA (Max.)			100 µA (Max.)			
I_{CER}■		150											5 µA (Max.)			5 µA (Max.)			
		60†			25													1 µA (Max.)	-1 µA (Max.)
		60†			150													100 µA (Max.)	-100 µA (Max.)
I_{EBO}			2.5			1 mA (Max.)	1 mA (Max.)	1 mA (Max.)	1 mA (Max.)	1 mA (Max.)		1 mA (Max.)		1 mA (Max.)	1 mA (Max.)				
			-2.5								-1 mA (Max.)								
			5										100 µA (Max.)			100 µA (Max.)			
			4†														1 mA (Max.)	1 mA (Max.)	-1 mA (Max.)
V_{CEO} (sus)				100*		18 V● (Min.)	30 V (Min.)	40 V (Min.)	35 V● (Min.)	40 V (Min.)		40 V (Min.)		18 V● (Min.)	40 V (Min.)		70 V (Min.)		
				-100*							-40 V♦ (Min.)								
V_{BE}		4		50		1 V (Max.)	1 V (Max.)	1 V (Max.)	1 V (Max.)					1 V (Max.)				1 V (Max.)	
		4		10						1 V (Max.)		1 V (Max.)			1 V (Max.)		1 V (Max.)		
		-4		-50							-1.0 V (Max.)								-1 V (Max.)
		10		50									2 V (Max.)			2 V (Max.)			
V_{CE} (sat)				150♦				1.4 V (Max.)			-1.4 V (Max.)						1.4V (Max.)	1.4V (Max.)	-1.4V (Max.)
V_{CER} (sus)■				50									300 V (Min.)			300 V (Min.)			
				100														70 V (Min.)	-70 V (Min.)
h_{FE}		4		50		70-350	70-350	70-350	70-350					70-350				70-350	
		-4		-50							35-200								35-200
		4		10						40-200		40-200			40-200		40-200		
		10		20									25-200			40-250			
θ_{J-C}						35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	30°C/W (Max.)	35°C/W (Max.)	30°C/W (Max.)	30°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)	35°C/W (Max.)
θ_{J-FA}						175°C/W (Max.)	175°C/W (Max.)	175°C/W (Max.)	175°C/W (Max.)	175°C/W (Max.)	175°C/W (Max.)			175°C/W (Max.)			175°C/W (Max.)	175°C/W (Max.)	175°C/W (Max.)
f_T		10		50		100Mc/s (Typ.)	100Mc/s (Typ.)		100Mc/s (Typ.)					100Mc/s (Typ.)					
		-4		-50							100 Mc/s (Typ.)								100Mc/s (Typ.)
		4		50				100Mc/s (Typ.)									100Mc/s (Typ.)	100Mc/s (Typ.)	

* Pulsed; pulse duration = 300µsec, duty factor ≤ 2%

♦ I_B = 15 mA

■ R_{BE} = 1,000 ohms

● BV_{CEO} value

R_{BE} = 200 Ω for 40361 & 40362

† Negative value for 40362

C ELECTRICAL CHARACTERISTICS (40310, 40312, 40313, 40316, 40318, 40322, 40324, 40328, and 40364)

CHARACTERISTIC	CONDITIONS V_{CB} (Volts)	V_{CE} (Volts)	V_{EB} (Volts)	I_C	T_C (°C)	LIMITS 40310	40312	40313	40316	40318	40322	40324	40328	40364
I_{CEO}		150						5 mA (Max.)		5 mA (Max.)			5 mA (Max.)	
I_{CEV}		300	1.5⊞		25			10 mA (Max.)						
		300	1.5⊞		150			10 mA (Max.)						
		150	1.5⊞		150					10 mA (Max.)			10 mA (Max.)	
		150	1.5⊞		25					5 mA (Max.)			10 mA (Max.)	
I_{CER}▲		50			25									0.5 mA (Max.)
		50			150									2 mA (Max.)
I_{CBO}	15				25	10 µA (Max.)	10 µA (Max.)		10 µA			10 µA (Max.)		
	15				150	5 mA (Max.)	5 mA (Max.)		5 mA (Max.)			5 mA (Max.)		
I_{EBO}			2.5			5 mA (Max.)	5 mA (Max.)	5 mA (Max.)				5 mA (Max.)		
			5						5 mA (Max.)					
			6							5 mA (Max.)	5 mA (Max.)		5 mA (Max.)	
			4											5 mA (Max.)
V_{CEO} (sus)				100* mA		35 V● (Min.)						35 V● (Min.)		
V_{BE}		2		1 A		1.4 V (Max.)	1.4 V (Max.)		1.4 V (Max.)			1.4 V (Max.)		
		10		100 mA				1.5 V (Max.)						
		10		500 mA						1.5 V (Max.)				
		10		1 A									1.5 V (Max.)	
		5		2.5 A										1.8 V (Max.)
V_{CE} (sat)				2.5 A										2 V□ (Max.)
V_{CER} (sus)				100* mA			60 V** (Min.)		40 V** (Min.)					
				200 mA				300 V** (Min.)		300 V** (Min.)	300 V♦ (Min.)		300 V** (Min.)	70 V▲ (Min.)
h_{FE}		2		1 A		20-120	20-120		20-120			20-120		
		5		0.5 A										35-175
		5		2.5 A										20 (Min.)
		10		100 mA				40-250						
		10		500 mA				40 (Min.)		50 (Min.)	75 (Min.)			
		10		20 mA						40 (Min.)	40 (Min.)		40 (Min.)	
		10		1 A									20 (Min.)	
f_T		4		500 mA		750 kc/s (Typ.)	750 kc/s (Typ.)		750 kc/s (Typ.)			750 kc/s (Typ.)		
		10		2.5 A										15 Mc/s (Typ.)
$I_{S/b}$#		150						150 mA (Min.)		100 mA# (Min.)	100 mA (Min.)		100 mA (Min.)	
		40												750 mA (Min.)
$E_{S/b}$■			4							50 µJ (Min.)	50 µJ (Min.)			
$\theta_{J\text{-}C}$						6°C/W (Max.)	6°C/W (Max.)	5°C/W (Max.)	6°C/W (Max.)	5°C/W (Max.)	5°C/W (Max.)	6°C/W (Max.)	5°C/W (Max.)	5°C/W (Max.)

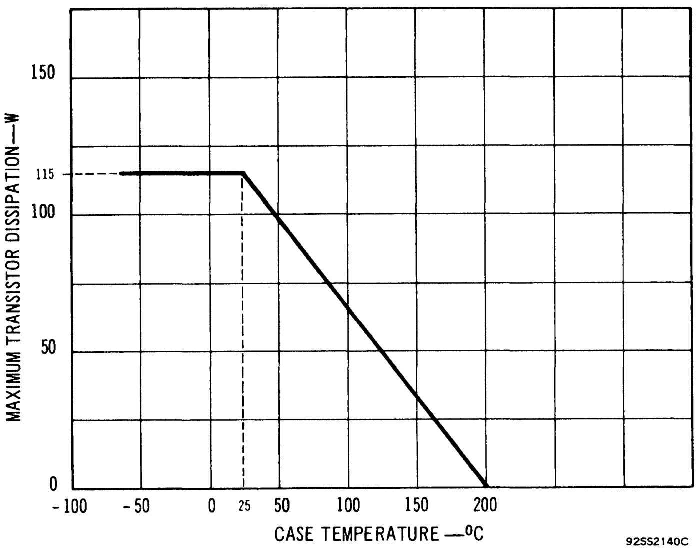
* Pulsed; Pulse duration = 300 µsec, duty factor < 2%. ⊞ R_{BE} value ■ R_{BE} = 20 ohms & L = 100 µh ♦ R_{BE} = 200 Ω, L = 5 mH

$I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased

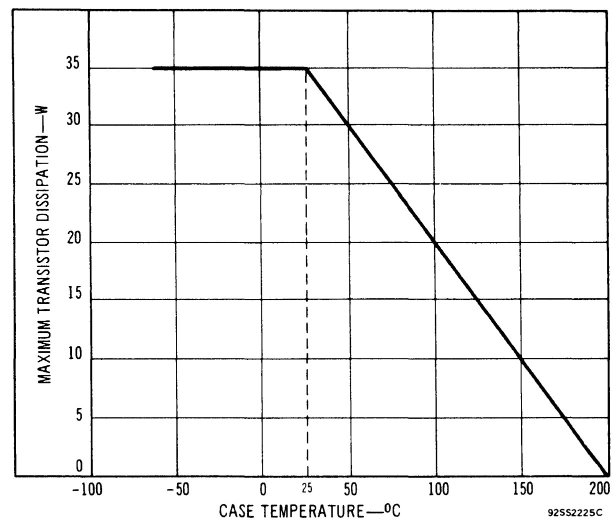
■ $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b} = \frac{1}{2}LI^2$, where L is a series load or leakage inductance and I is the peak collector current.

▲ R_{BE} = 150 Ω □ I_B = 0.25 A ● BV_{CEO} value.

DISSIPATION DERATING CURVE FOR TYPE 40363



DISSIPATION DERATING CURVE FOR TYPE 40364

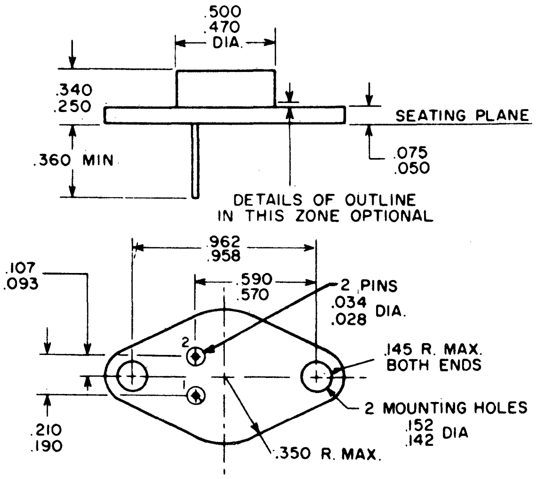


A ELECTRICAL CHARACTERISTICS (40325 and 40363)

CHARACTERISTIC	TEST CONDITIONS					LIMITS	
	V_{CB}	V_{CE}	V_{EB}	I_C	T_C	40325	40363
	Volts			mA	°C		
I_{CBO}	30				25	5 mA (Max.)	
	30				150	10 mA (Max.)	
I_{CER}		60			25		1 mA (Max.)
		60			150		10 mA (Max.)
I_{EBO}			5			10 mA (Max.)	
			4				5 mA (Max.)
BV_{CEO} (sus)				200		35 V (Min.)	
V_{CER} (sus)				200			70 V (Min.)
BV_{CBO}				100		35 V (Min.)	
V_{BE}		4		8 A		2 V (Max.)	
		4		4 A			1.8 V (Max.)
V_{CE} (sat)				8 A*		1.5 V (Max.)	
				4 A**			1.1 V (Max.)
h_{FE}		4		8 A		12-60	
		4		4 A			20-70
θ_{J-C}						1.5°C/W (Max.)	1.5°C/W (Max.)
f_T		4		3 A			700 kc/s (Typ.)

*I_B = 800 mA **I_B = 400 mA ▲R_{BE} = 200 Ω

DIMENSIONAL OUTLINE
JEDEC No. TO-66



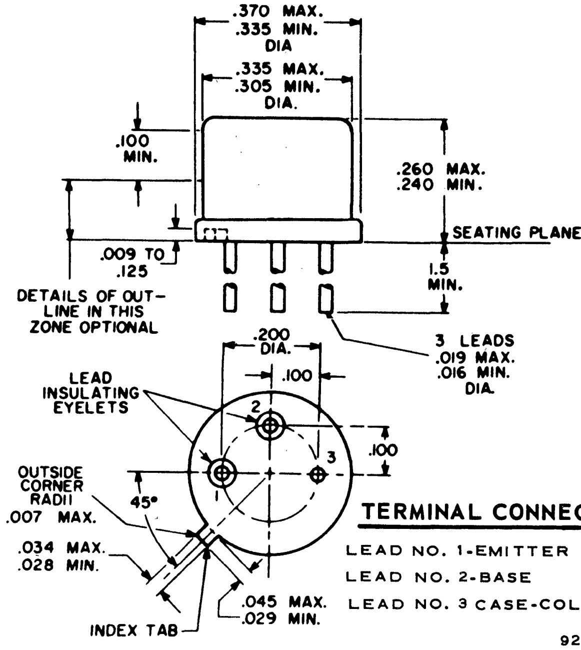
TERMINAL CONNECTIONS

PIN NO. 1-BASE
PIN NO. 2-EMITTER
FLANGE, CASE-COLLECTOR

92CS-12865

Dimensions in Inches

DIMENSIONAL OUTLINE
JEDEC No. TO-5



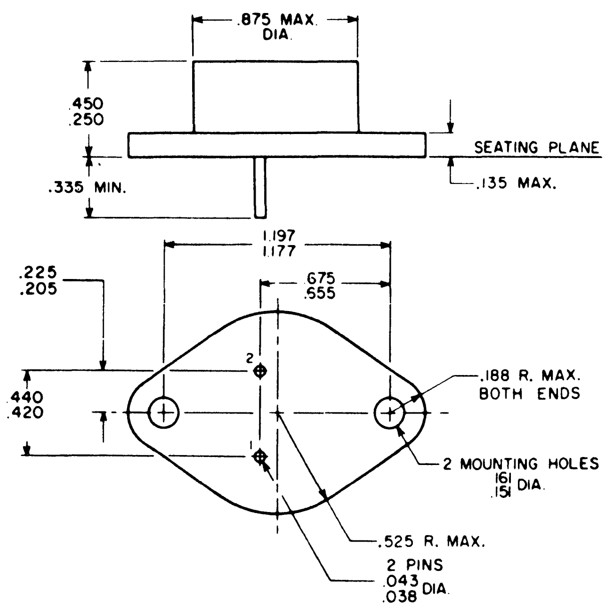
TERMINAL CONNECTIONS

LEAD NO. 1-EMITTER
LEAD NO. 2-BASE
LEAD NO. 3 CASE-COLLECTOR

92CS-12656

Dimensions in Inches

DIMENSIONAL OUTLINE
JEDEC No. TO-3



TERMINAL CONNECTIONS

PIN NO. 1-BASE
PIN NO. 2-EMITTER
FLANGE, CASE-COLLECTOR

92CS-12336R2

Dimensions in Inches

RCA-40329[Δ] is an alloy-junction transistor of the germanium pnp type, with ratings and characteristics which make it extremely useful for low-level, intermediate-level, and class-A driver stages in consumer and industrial af-amplifier equipment. Typical applications in which the 40329 can provide outstanding performance include: input stages of phonograph amplifiers using crystal pickups, tone-control stages, preamplifier and other low-level stages operating with as little as 1/4 microwatt of signal input power. The 40329 is also particularly useful in class A driver stages required to handle collector current swings as great as 50 ma peak-to-peak, or collector voltage swings as great as 20 volts peak-to-peak with low distortion.

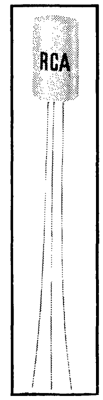
AMPLIFIER SERVICE, Absolute-Maximum Ratings

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-25	volts
COLLECTOR-TO-EMITTER VOLTAGE, V_{CER}: $R_{BE} \leq 4700$ ohms	-25	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-2.5	volts
COLLECTOR CURRENT, I_C	-100	ma
EMITTER CURRENT, I_E	100	ma
BASE CURRENT, I_B	-20	ma
TEMPERATURE RANGE:		
Storage	-65 to +100	°C
Operating (Junction)	-65 to +100	°C
TRANSISTOR DISSIPATION, P_T:		
With infinite heat sink:		
At case temperatures up to 55° C	375	mw
At case temperatures above 55° C	*Derate at 8.35 mw/°C*	
With practical heat sink (θ = 50° C/w):		
At free-air temperatures up to 55° C	265	mw
At free-air temperatures above 55° C	*Derate at 5.9 mw/°C*	
Without heat sink:		
At free-air temperatures up to 55° C	125	mw
At free-air temperatures above 55° C	*Derate at 2.8 mw/°C*	
LEAD TEMPERATURE (During Soldering): At distances not closer than 1/32 inch to seating surface for 10 sec. maximum	255	°C

Δ Formerly Developmental No. TA2684.

GERMANIUM PNP ALLOY TRANSISTOR

For AF-Amplifier Applications in Consumer and Industrial Equipment



JEDEC TO-1

FEATURES:

- wide application capability –
  - low-level and preamplifier stages
  - input stages for phonographs using crystal pick-ups
  - tone control and pre-driver stages
  - Class A driver stages
- controlled for low noise over entire af range –
  - low noise operation in stages operating with as little as ¼ μwatt of signal input power
- high dissipation capability –
  - P_T = 375 mw at T_C to 55°C
  - up to 265 mw at T_{FA} to 55°C
- low distortion –
  - exceptional linearity of beta over wide range of I_C and V_C
- controlled beta over wide range of operating points
- high gain and low distortion in driver stages operating with large reflected load impedances –
  - h_{oe} = 175 μmhos typical
  - h_{re} = 300 x 10^{-6} typical
- large output capability in driver stages –
  - V_C swings to 20 volts peak-to-peak
  - I_C swings to 50 ma peak-to-peak
- hermetically sealed JEDEC TO-1 package

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Printed in U.S.A.
40329 8-66
Reprinted from Issue dated 5-65

ELECTRICAL CHARACTERISTICS, at a Case Temperature (T_C) of 25° C:

Characteristics	Symbols & Units	LIMITS RCA 40329 Min.	Typ.	Max.	TEST CONDITIONS f kc	V_{CB} volts	V_{CE} volts	V_{EB} volts	I_C ma
Collector-Cutoff Current	I_{CBO} µa	-	-	-14		-12			
Emitter-Cutoff Current	I_{EBO} µa	-	-	-14				-2	0
Collector-to-Base Breakdown Voltage	BV_{CBO} volts	-25	-	-					-0.05
Collector-to-Emitter Breakdown Voltage	BV_{CER} volts	-25	-	-				R_{BE} = 4700 ohms	-1
Emitter-to-Base Breakdown Voltage	BV_{EBO} volts	-2.5	-	-					-0.05(I_E)
Static Forward Current-Transfer Ratio	h_{FE}	50	90	200			-1		-25
Small-Signal Forward Current-Transfer Ratio	h_{fe}	75 50	120 85	300 200	1 1		-10 -6		-10 -1
Small-Signal Forward Current-Transfer Ratio Cutoff Frequency	f_{hfb} Mc	-	1.5	-		-6			-1
Collector-to-Base Capacitance	C_{ob} pf	-	35	-	1	-6			
Small-Signal Input Impedance	h_{ie} ohms	-	400	-	1		-10		-10
Small-Signal Output Admittance	h_{oe} µmhos	-	175	-	1		-10		-10
Small-Signal Reverse Voltage-Transfer Ratio	h_{re}	-	300×10^{-6}	-	1		-10		-10
Equivalent RMS Noise Input Current	i_N µa	-	-	0.02	20 cps to 20 kc		-6		-0.5
Extrinsic Base-Lead Resistance	$r_{bb'}$ ohms	-	100	-	20 Mc		-6		-1

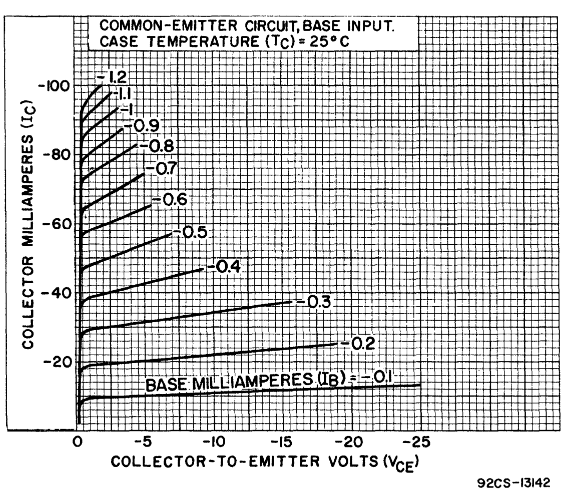


Fig. 1 - Typical Collector Characteristics

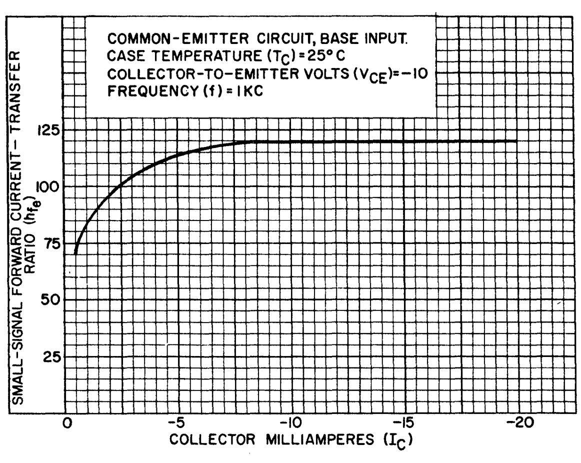


Fig. 2 - Typical Small-Signal Beta (h_{fe}) Characteristic

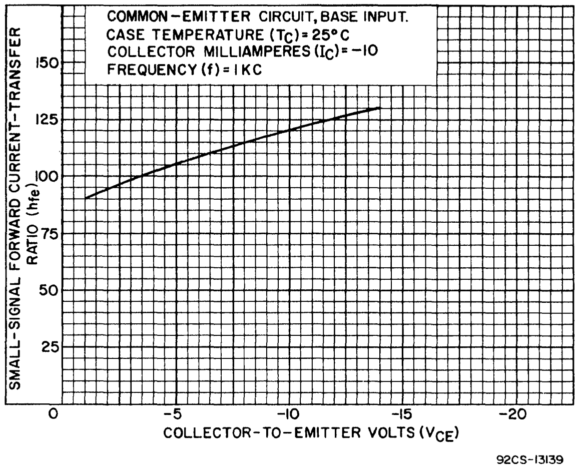


Fig. 3 - Typical Small-Signal Beta (h_{fe}) Characteristic.

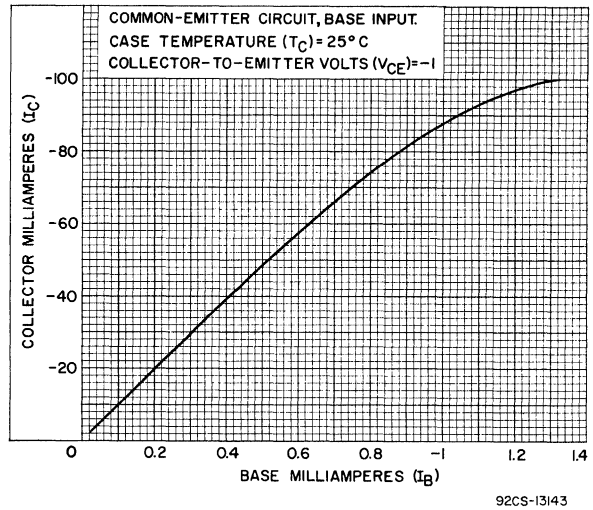


Fig. 6 - Typical Transfer Characteristic.

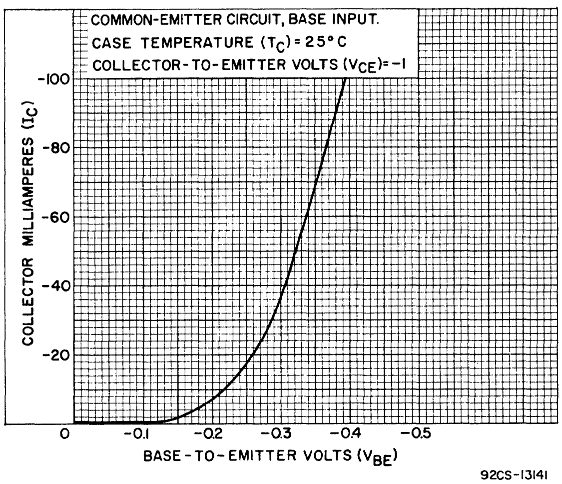
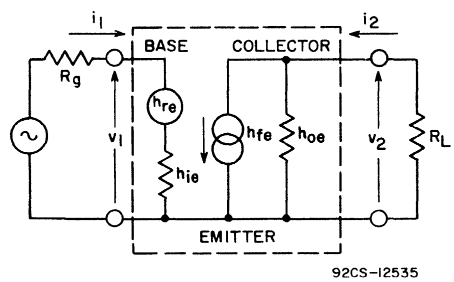


Fig. 4 - Typical Transfer Characteristic.



$$\text{Input Resistance} = \frac{v_1}{i_1} = \frac{h_{ie} + (\Delta^h R_L)}{1 + (h_{oe} R_L)}$$

$$\text{Output Resistance} = \frac{v_2}{i_2} = \frac{h_{ie} + R_g}{\Delta^h + (h_{oe} R_g)}$$

$$\text{Forward Current-Transfer Ratio} = \frac{i_2}{i_1} = \frac{h_{fe}}{1 + (h_{oe} R_L)}$$

$$\text{Forward Voltage-Transfer Ratio} = \frac{v_2}{v_1} = \frac{-h_{fe} R_L}{h_{ie} + (\Delta^h R_L)}$$

v_1 = ac input signal voltage
i_1 = ac base current
v_2 = ac output signal voltage
i_2 = ac collector current
h_{ie} = small-signal short-circuit input impedance
h_{oe} = small-signal open-circuit output admittance
h_{re} = small-signal open-circuit reverse voltage-transfer ratio
h_{fe} = small-signal short-circuit forward current-transfer ratio
Δ^h = $(h_{ie} h_{oe}) - (h_{re} h_{fe})$
R_g = generator resistance
R_L = load resistance

Fig. 7 - Low-Frequency Small-Signal Equivalent Circuit Characteristics of RCA-40329.

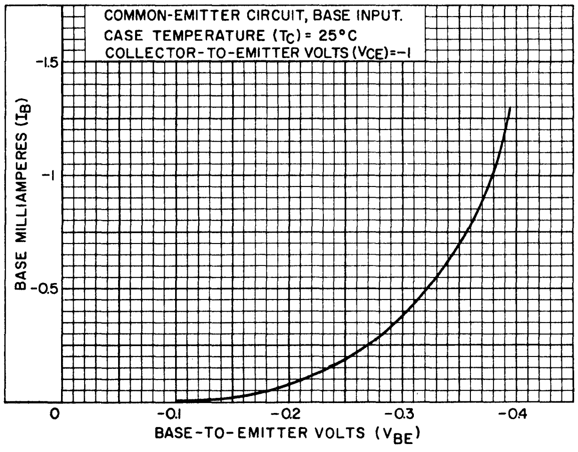


Fig. 5 - Typical Input Characteristic.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

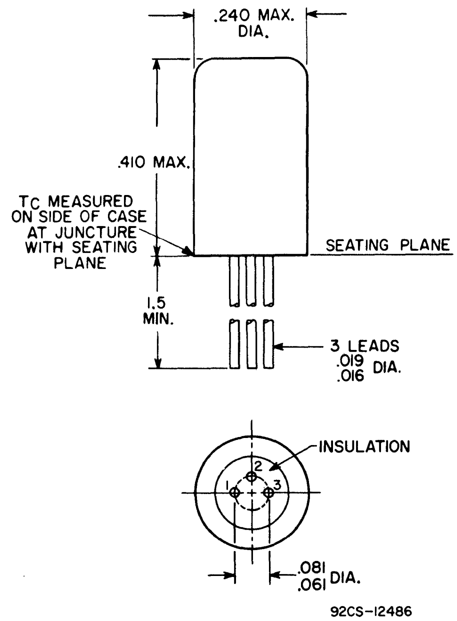
The *flexible leads* of the 40329 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using the 40329, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.25" of the metal case.

RCA-40329 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the device.

UNDER NO CIRCUMSTANCES SHOULD THE CASE OF THE 40329 BE SOLDERED TO A HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

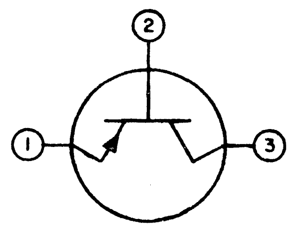
DIMENSIONAL OUTLINE JEDEC No.TO-1



Dimensions in Inches

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

TERMINAL DIAGRAM



LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR

SILICON N-P-N "overlay" TRANSISTORS

40340
40341

File No. 74

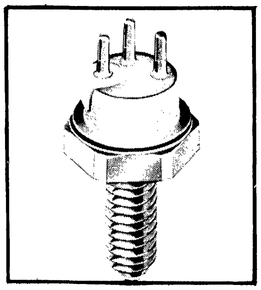
RCA-40340 and -40341 are epitaxial silicon n-p-n planar transistors of the "overlay" emitter electrode construction. They are intended especially for high power output, class-C amplifier service at frequencies up to 100 MHz.

In the overlay structure, there are a number of individual emitter sites which are all connected in parallel and used in conjunction with a single base and collector region. When compared with other structures, this arrangement provides a substantial increase in emitter periphery for higher current or power, and a corresponding decrease in emitter and collector areas for lower input and output capacitances. The overlay structure thus offers greater power output, gain, efficiency, and frequency capability.

High Power

VHF

Amplifier



JEDEC TO-60
with Clip

Maximum Ratings, *Absolute-Maximum Values:*

		40340	40341	
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	25	35	V
With V_{BE} = –1.5 volts	V_{CEV}	60	70	V
COLLECTOR-TO-BASE VOLTAGE . . .	V_{CBO}	60	70	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4.0	4.0	V
PEAK COLLECTOR CURRENT.		10	10	A
CONTINUOUS COLLECTOR CURRENT	I_C	3.3	3.3	A
JUNCTION TEMPERATURE	T_J	200	200	^oC
DISSIPATION (At 25°C case temperature).	P_T	70	70	W

ELECTRICAL CHARACTERISTICS *Case Temperature (T_C) = 25 °C*

Characteristic	Symbol	Test Conditions	Limits 40340	Limits 40341	Units
Collector-to-Emitter Breakdown Voltage	BV_{CEV}	I_C = 200 mA▲, V_{BE} = –1.5V	60	70	V (min.)
Collector-to-Emitter Breakdown Voltage	BV_{CEO}	I_C = 200 mA▲, I_B = 0	25	35	V (min.)
Emitter-to-Base Breakdown Voltage	BV_{EBO}	I_E = 10 mA, I_C = 0	4	4	V (min.)
Collector-Cutoff Current	I_{CEO}	V_{CE} = 30 V, I_B = 0	–	1.0	mA (max.)
		V_{CE} = 15 V, I_B = 0	1.0	–	mA (max.)
Collector-Cutoff Current	I_{CBO}	V_{CB} = 50 V, I_E = 0	–	10	mA (max.)
		V_{CB} = 40 V, I_E = 0	10	–	mA (max.)
Collector-Base Capacitance	C_{ob}	V_{CB} = 30 V, I_E = 0	–	85	pF (max.)
		V_{CB} = 15 V, I_E = 0	120	–	pF (max.)
RF Output Power (50 MHz) (See *Fig.1*)	P_{OUT}	V_{CE} = 24 V, P_{IN} = 3 W Eff. (min.) = 60%	–	30	W (min.)
		V_{CE} = 13.5 V, P_{IN} = 5 W Eff. (min.) = 60%	25	–	W (min.)
Thermal Resistance (Junction-to-Case)	$\theta_{J.C}$		2.5	2.5	°C/W (max.)

▲Pulsed through a 25-mH inductor, duty factor = 50%.

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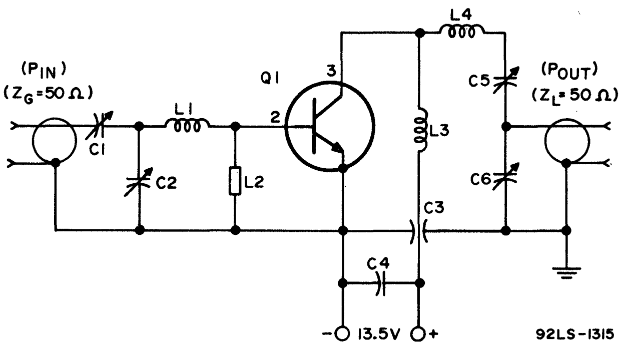
40340, 40341 6/66
Supersedes 40340, 40341 4/65

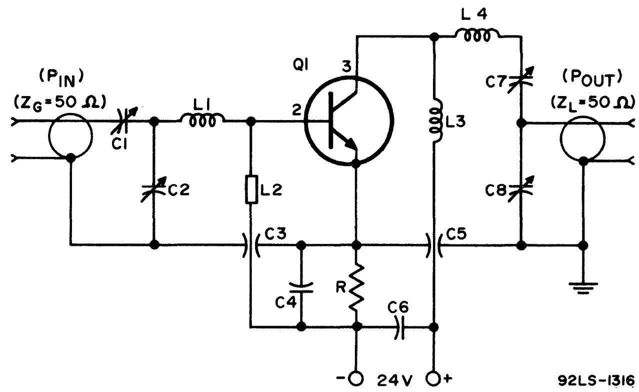
RF AMPLIFIER CIRCUIT FOR 40340 POWER OUTPUT TEST (50 MHz Operation)



C_1: 14–150 pF
C_2: 90–400 pF
C_3: 1000 pF
C_4: .02 μF
C_5: 32–250 pF
C_6: 32–250 pF
L_1: 1 turn, No.16 wire, 5/16" ID, 1/8" long
L_2: Ferrite Choke, Z = 450 Ω
L_3: 10 turns, No.20 enamel wire, close wound, 1/4" ID
L_4: 3 turns, No.10 wire, 3/4" ID, 3/4" long
Q_1: RCA-40340

Fig.1

RF AMPLIFIER CIRCUIT FOR 40341 POWER OUTPUT TEST (50 MHz Operation)



C_1: 14–150 pF
C_2: 110–580 pF
C_3, C_5: 1000 pF
C_4: .0018 μF
C_6: 0.2 μF
C_7: 140–680 pF
C_8: 32–250 pF
L_1: 2 turns, No.16 wire, 1/4" ID, 1/4" long
L_2: Ferrite Choke, Z = 450 Ω
L_3: 10 turns, No.20 enamel wire, close wound, 1/4" ID
L_4: 3 turns, No.10 wire, 3/4" ID, 3/4" long
R : 0.33 ohms
Q_1: RCA-40341

Fig.3

TYPICAL PERFORMANCE OF TYPE 40340 IN THE COMMON-EMITTER AMPLIFIER CIRCUIT SHOWN IN FIG.1

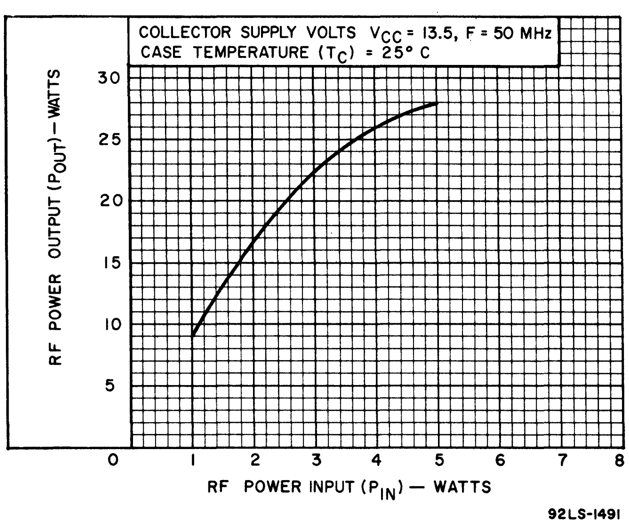


Fig.2

TYPICAL PERFORMANCE OF TYPE 40341 IN THE COMMON-EMITTER AMPLIFIER CIRCUIT SHOWN IN FIG.3

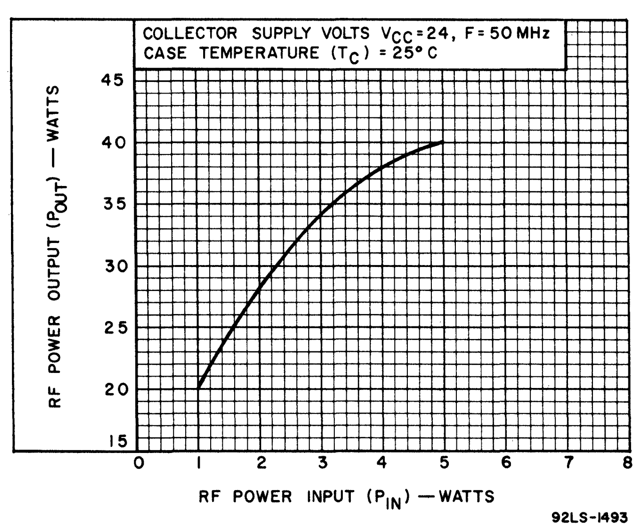
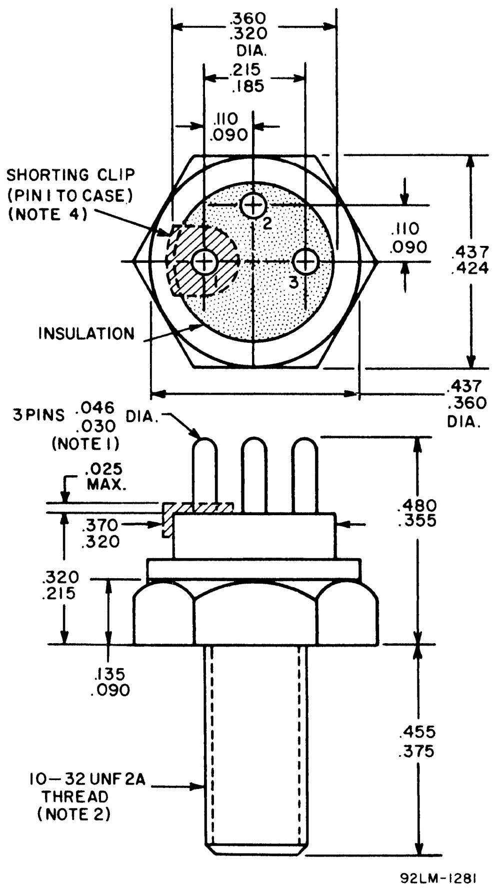


Fig.4

DIMENSIONAL OUTLINE
TO-60 and Pin 1-to-Case Shorting Clip



DIMENSIONS IN INCHES

TERMINAL CONNECTIONS

Pin No.1 - See Note 4
Pin No.2 - Base
Pin No.3 - Collector
Case, Mounting Stud - Emitter

NOTE 1: The pin spacing permits insertion in any socket having a pin-circle diameter of 0.200" and contacts which will accommodate pins having a diameter of 0.030" min., 0.046" max.

NOTE 2: The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.

NOTE 3: This device may be operated in any position.

NOTE 4: The emitter is connected internally to the case. If it is desirable to use pin No.1 as the external connection to the emitter, the supplied shorting clip must be installed. It will provide a low-inductance connection between the emitter case and pin No.1.

The shorting clip is installed as follows:

A. Place the clip over pin No.1 with edge overhanging the case.

B. Apply soldering flux.

CAUTION
Do **Not** apply solder.
The clip is supplied with a special solder coating.

C. Heat the entire case to 200 °C max. with a temperature-regulated heating device, such as a hot plate or soldering iron.

D. Allow solder to flow.

E. Allow unit to cool in ambient air.

F. Clean off flux with hot water or TCE.

SILICON N-P-N TRANSISTORS

40346 40412
40346V1 40412V1
40346V2 40412V2

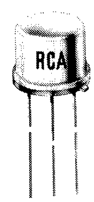
RCA-40346, -40346V1, -40346V2, -40412, -40412V1, and -40412V2 are triple-diffused silicon n-p-n transistors having high breakdown voltages, high frequency-response capability, and fast switching speeds.

These transistors are intended for a wide variety of low-and medium-power, high-voltage applications. Types 40346, 40346V1, and 40346V2 are especially useful in such devices as neon indicator and NIXIE* driver circuits and in differential and operational amplifiers. Types 40412, 40412V1, and 40412V2 are especially suited for Class-A AC/DC audio-amplifier service.

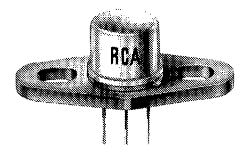
Types 40346 and 40412 are supplied in a JEDEC TO-5 package; types 40346V1 and 40412V1 in a JEDEC TO-5 package with a factory-attached heat radiator for greater free-air dissipation capability; and types 40346V2 and 40412V2 are supplied in a TO-5 package with an attached flange for increased power dissipation and mounting convenience.

*Nixie is a Registered Trademark of Burroughs Corporation, Electronic Components Division, Plainfield, N. J.

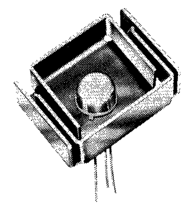
For High-Voltage Switching and Linear-Amplifier Applications in Military, Industrial, and Commercial Applications



40346
40412
JEDEC TO-5 PACKAGE



40346V2
40412V2
JEDEC TO-5
PACKAGE WITH FLANGE



40346V1
40412V1
JEDEC TO-5 PACKAGE
WITH HEAT RADIATOR

MAXIMUM RATINGS

Absolute-Maximum Values:

	40346	40346V1	40346V2	40412	40412V1	40412V2	
COLLECTOR-TO-EMITTER VOLTAGE, $V_{CER}(sus)$:							
With R_{BE} = 1,000 ohms	175	175	175	–	–	–	V
With R_{BE} = 10,000 ohms	–	–	–	250	250	250	V
COLLECTOR CURRENT, I_C	1	1	1	1	1	1	A
BASE CURRENT, I_B	0.5	0.5	0.5	0.5	0.5	0.5	A
TRANSISTOR DISSIPATION, P_T:							
At case temperatures up to 25° C	10	–	10	10	–	10	W
At free-air temperatures up to 50° C	1	–	–	1	–	–	W
At free-air temperatures up to 25° C	–	4	–	–	4	–	W
At other temperatures	←		See *Fig. 1*			→	
OPERATING TEMPERATURE RANGE	←		–65 to +200			→	°C

ELECTRICAL CHARACTERISTICS

Case Temperature (T_C) = 25° C, Unless Otherwise Specified

Characteristic	Symbol	DC Collector Volts V_{CE}	DC Collector Volts V_{CB}	DC Emitter Volts V_{EB}	DC Current (mA) I_C	DC Current (mA) I_E	DC Current (mA) I_B	LIMITS 40346 Min.	40346 Max.	40346V1 Min.	40346V1 Max.	40346V2 Min.	40346V2 Max.	40412 Min.	40412 Max.	40412V1 Min.	40412V1 Max.	40412V2 Min.	40412V2 Max.	UNITS
Collector-Cutoff Current:																				
With base open	I_{CEO}	100	–	–	–	–	–	–	5	–	5	–	5	–	–	–	–	–	–	µA
With R = 10,000 ohms	I_{CER}	100	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	1	mA
With base reverse-biased:																				
T_C=25° C	I_{CEV}	200	–	1.5	–	–	–	–	10	–	10	–	10	–	–	–	–	–	–	µA
T_C=150° C	I_{CEV}	200	–	1.5	–	–	–	–	1	–	1	–	1	–	–	–	–	–	–	mA
T_C=150° C	I_{CEV}	150	–	1.5	–	–	–	–	–	–	–	–	–	–	2	–	2	–	2	mA
Emitter-Cutoff Current	I_{EBO}	–	–	4	–	–	–	–	5	–	5	–	5	–	–	–	–	–	–	µA
	I_{EBO}	–	–	3	–	–	–	–	–	–	–	–	–	–	100	–	100	–	100	µA
Collector-To-Emitter Sustaining Voltage: With external base-emitter resistor																				
R_{BE}=1,000 ohms	$V_{CER(sus)}$	–	–	–	50	–	–	175	–	175	–	175	–	–	–	–	–	–	–	V
R_{BE}=10,000 ohms	$V_{CER(sus)}$	–	–	–	50	–	–	–	–	–	–	–	–	250	–	250	–	250	–	V
Collector-To-Emitter Saturation Voltage	$V_{CE(sat)}$	–	–	–	10	–	1	–	0.5	–	0.5	–	0.5	–	–	–	–	–	–	V
Base-To-Emitter Voltage	V_{BE}	10	–	–	10	–	–	–	1	–	1	–	1	–	–	–	–	–	–	V
Second-Breakdown Current (Safe-operating region)	$I_{S/b}$●	200	–	–	–	–	–	–	–	–	–	–	–	50	–	50	–	50	–	mA
DC Forward-Current Transfer Ratio	h_{FE}	10	–	–	10	–	–	25	–	25	–	25	–	–	–	–	–	–	–	
	h_{FE}	20	–	–	30	–	–	–	–	–	–	–	–	40	–	40	–	40	–	
Small-Signal Forward-Current Transfer Ratio at F=5 MHz	h_{fe}	10	–	–	10	–	–	2	–	2	–	2	–	2	–	2	–	2	–	
Output Capacitance (At 1 MHz)	C_{ob}	–	10	–	–	0	–	–	–	–	–	–	–	–	10	–	10	–	10	pF
Thermal Resistance: Junction-to-case	$\theta_{J\text{-}C}$	–	–	–	–	–	–	–	15	–	–	–	15	–	15	–	–	–	15	°C/W
Junction-to-free air	$\theta_{J\text{-}FA}$	–	–	–	–	–	–	–	–	–	45	–	–	–	–	–	45	–	–	°C/W

● $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage.

DISSIPATION DERATING CURVES

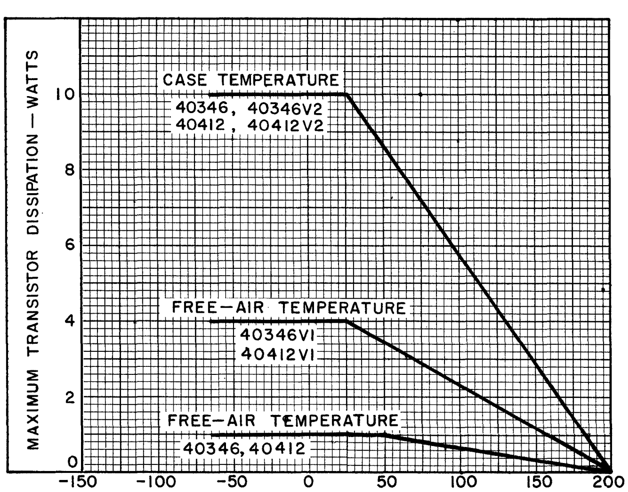


Fig. 1

TYPICAL DC-BETA CHARACTERISTICS FOR ALL TYPES

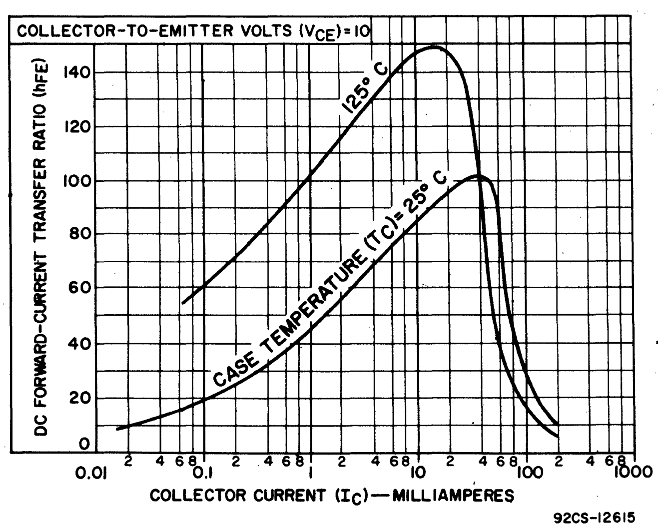


Fig. 2

TYPICAL OUTPUT CHARACTERISTICS FOR ALL TYPES

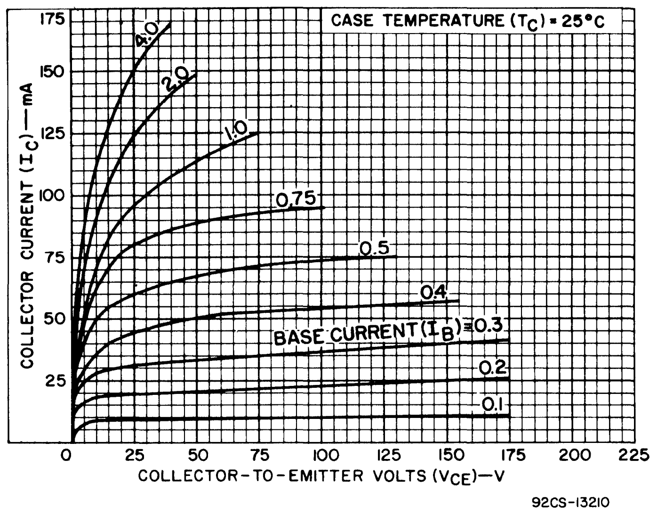


Fig. 3

TYPICAL OPERATION CHARACTERISTICS FOR ALL TYPES

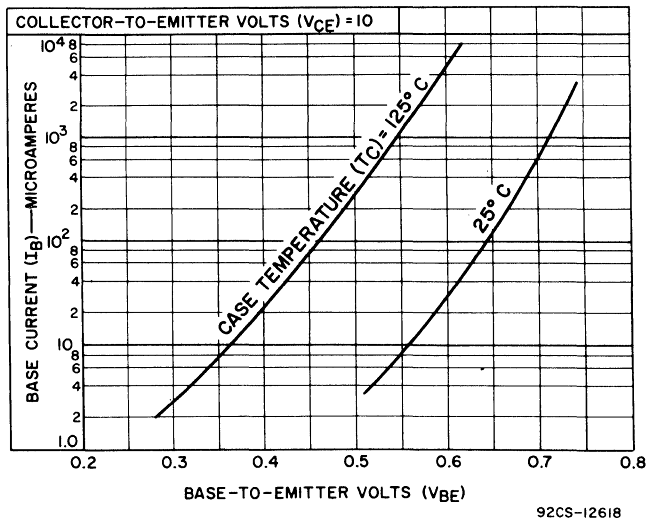


Fig. 4

TYPICAL OPERATION CHARACTERISTICS FOR ALL TYPES

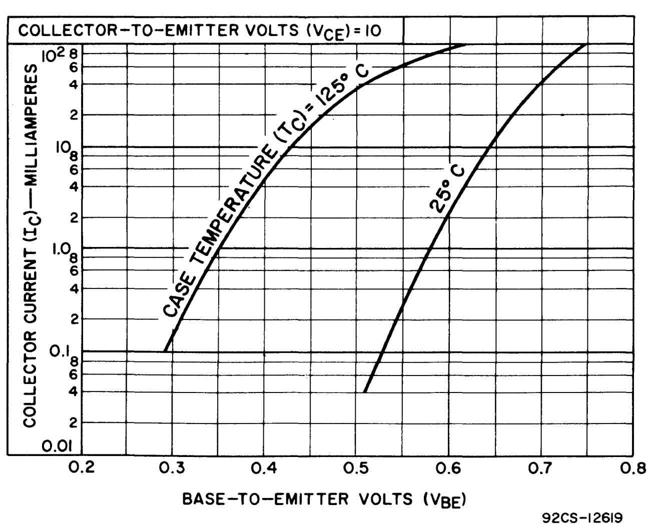
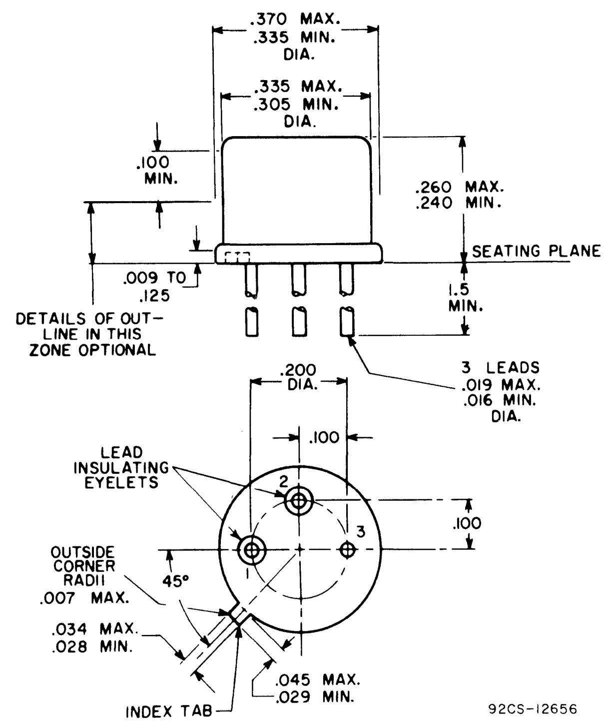


Fig. 5

DIMENSIONAL OUTLINE FOR TYPES 40346 & 40412 JEDEC TO-5

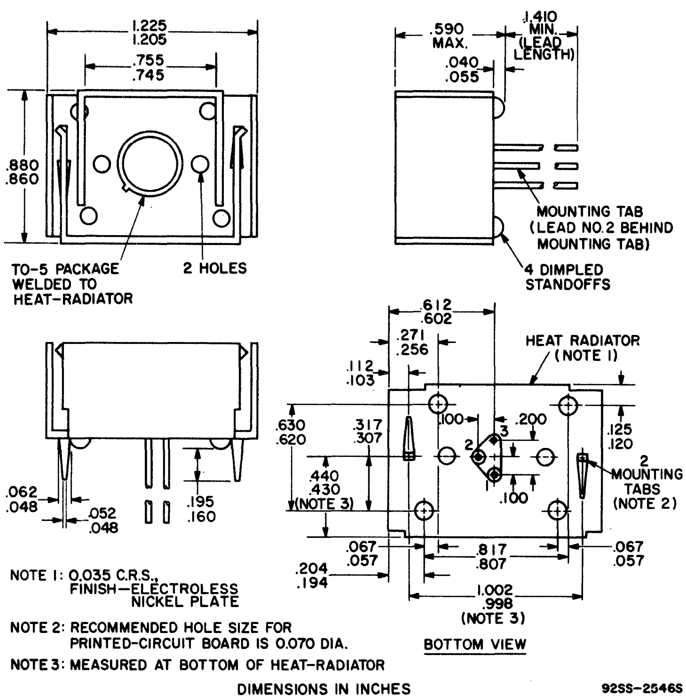


DIMENSIONS IN INCHES

TERMINAL CONNECTIONS

Lead 1: Emitter
Lead 2: Base
Lead 3: Collector, Case

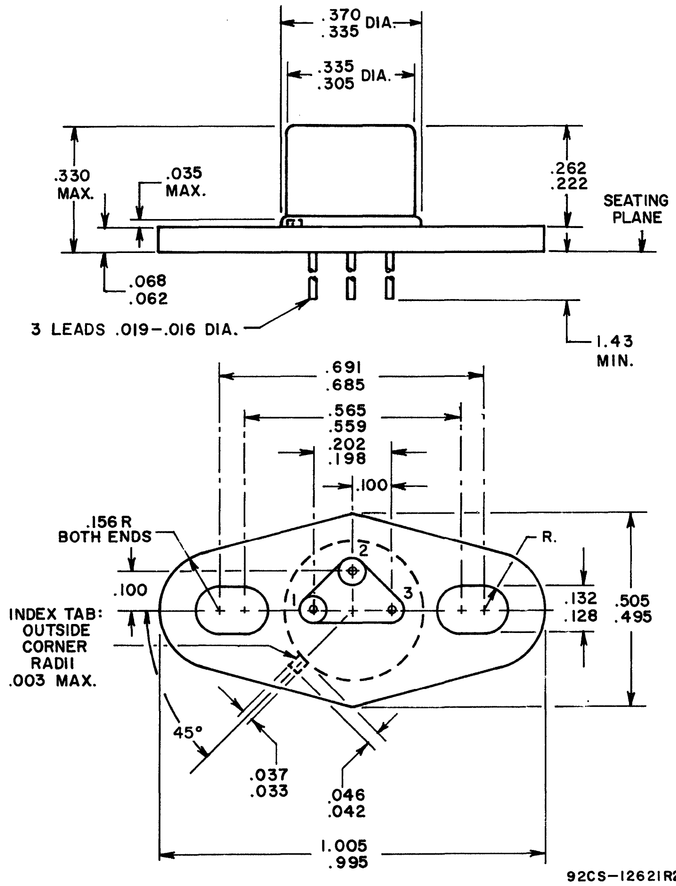
DIMENSIONAL OUTLINE FOR TYPES 40346V1, 40412V1 JEDEC TO-5 WITH HEAT RADIATOR



TERMINAL CONNECTIONS

Lead 1: Emitter
Lead 2: Base
Lead 3: Collector, Case

DIMENSIONAL OUTLINE FOR TYPES 40346V1, 40412V2



DIMENSIONS IN INCHES

(Bottom View)

TERMINAL CONNECTIONS

Lead 1: Emitter
Lead 2: Base
Flange, Lead 3: Collector

RCA POWER TRANSISTORS

40347
40348
40349

RCA-40347, 40348, and 40349 are Hometaxial-base*, silicon n-p-n transistors intended for a wide variety of low- and medium-power applications requiring medium- and high-voltage power transistors.

All three of these devices employ the popular TO-5 package; they differ primarily in their breakdown-voltage ratings.

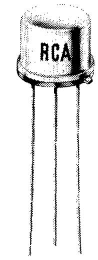
Typical applications for these transistors include: switching regulators, converters, inverters, relay controls, oscillators, pulse amplifiers, and audio amplifiers (in low-power driver and output stages). These transistors are especially suitable for use in low-cost AC/DC af amplifier circuits.

*"Hometaxial" was coined by RCA from "homogeneous" and "axial" to describe a single-diffused transistor with a base region of homogeneous resistivity silicon in the axial direction.

"HOMETAXIAL"-BASE* SILICON N-P-N MEDIUM AND HIGH-VOLTAGE TYPES

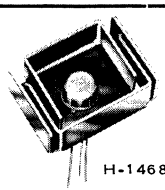
General Purpose Transistors for Industrial, Commercial, and Military Equipment

H-1380



40347
40348
40349
(JEDEC TO-5)

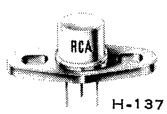
ALSO AVAILABLE. . .



H-1468

40347V1
40348V1
40349V1

Types 40347V1, 40348V1, and 40349V1 are 40347, 40348, and 40349, respectively, with factory-attached heat-radiators; they are intended for printed circuit-board applications.



H-1375

40347V2
40348V2
40349V2

Types 40347V2, 40348V2, and 40349V2, are 40347, 40348, and 40349, respectively, with factory-attached diamond-shaped mounting flanges.

- High second-breakdown resistance
- V_{CE}(sat) typically less than 1 volt at 1 ampere for types 40347 & 40348
- V_{CEV}(sus) for type 40349 is 160 volts min.
- Hermetically-sealed packages

MAXIMUM RATINGS

		40347 40347V1 40347V2	40348 40348V1 40348V2	40349 40349V1 40349V2	
Absolute-Maximum Values					
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	60	90	160	V
COLLECTOR-TO-EMITTER VOLTAGE:					
With − 1.5 V (V_{BE}) of reverse bias	V_{CEV}	60	90	160	V
With base open	V_{CEO}	40	65	140	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	7	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	1.5	1.5	1.5	A
PEAK COLLECTOR CURRENT		3.0	3.0	3.0	A
CONTINUOUS BASE CURRENT	I_B	0.5	0.5	0.5	A
TRANSISTOR DISSIPATION	P_T				
At case temperatures up to 25 °C		11.7 (40347V2)	11.7 (40348V2)	11.7 (40349V2)	W
		8.75 (40347)	8.75 (40348)	8.75 (40349)	W
At case temperatures above 25 °C		← See Figs. 5 & 6. →			
At free-air temperatures up to 25 °C		1.0 (40347)	1.0 (40348)	1.0 (40349)	W
		4.4 (40347V1)	4.4 (40348V1)	4.4 (40349V1)	W
At free-air temperatures above 25 °C		← See Fig. 1. →			
TEMPERATURE RANGE:					
Storage & Operating (Junction)		← − 65 to 200 →			°C
LEAD TEMPERATURE (During soldering):					
At distances ⩾ 1/32 in. from seating plane for 10 s max.		← 230 →			°C

RADIO CORPORATION OF AMERICA
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Supersedes issue dated 9/65

ELECTRICAL CHARACTERISTICS

Case Temperature (T_C) of 25 °C Unless Otherwise Specified

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts	DC Emitter or Base Volts		DC Current (Amperes)		LIMITS: Type 40347		Type 40348		Type 40349		Units
		V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current R_{BE} = 1,000 Ω	I_{CER}	30 60 90					– – –	1.0 – –	– – –	– 1.0 –	– – –	– – 1.0	μA μA μA
R_{BE} = 1,000 Ω T_C = 150 °C	I_{CER}	30 60 90					– – –	1.0 – –	– – –	– 1.0 –	– – –	– – 1.0	mA mA mA
Emitter-Cutoff Current	I_{EBO}		7				–	10	–	10	–	10	μA
DC Forward-Current Transfer Ratio	h_{FE}	4 4 4 4			0.15 0.30 0.45 1.00		– – 20 –	– – 80 –	– 30 – 10	– 100 – –	25 – 10 –	100 – – –	
Collector-to-Emitter Sustaining Voltage: *(See Figs. 2, 3, & 4)* With base-emitter junction reverse biased	$V_{CEV}(sus)$			-1.5	.050		60	–	90	–	160[a]	–	V
With base open	$V_{CEO}(sus)$				.050		40	–	65	–	140[a]	–	V
Base-to-Emitter Voltage	V_{BE}	4 4 4			0.15 0.30 0.45		– – –	– – 1.5	– – –	– 1.3 –	– – –	1.1 – –	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				0.15 0.30 0.45	15 mA 30 mA 45 mA	– – –	– – 1.0	– – –	– 0.75 –	– – –	0.5 – –	V V V
Thermal Resistance: Junction-to-Case	θ_{J-C}						20(max.) 40347 15(max.) 40347V2		20(max.) 40348 15(max.) 40348V2		20(max.) 40349 15(max.) 40349V2		°C/W
Thermal Resistance: Junction-to-Free Air	θ_{J-FA}						40(max.) 40347V1		40(max.) 40348V1		40(max.) 40349V1		°C/W

[a] Pulsed; pulse duration = 300 μs, duty factor = 1.8 %.

DISSIPATION DERATING CURVE FOR TYPES 40347V1, 40348V1, & 40349V1

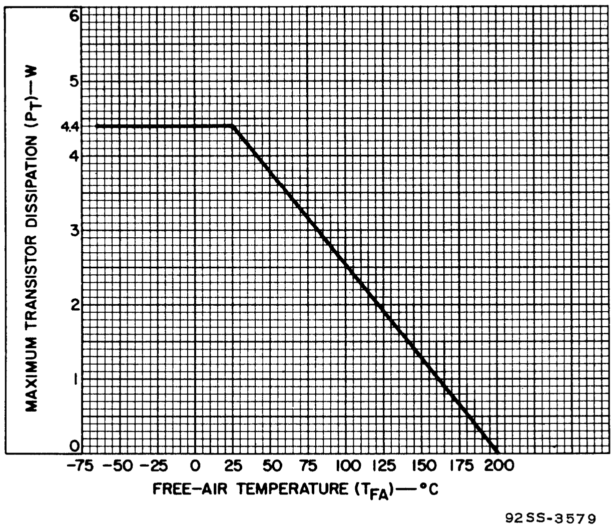


Fig. 1

SUSTAINING VOLTAGE vs. BASE-TO-EMITTER RESISTANCE FOR TYPES 40347, 40347V1, & 40347V2

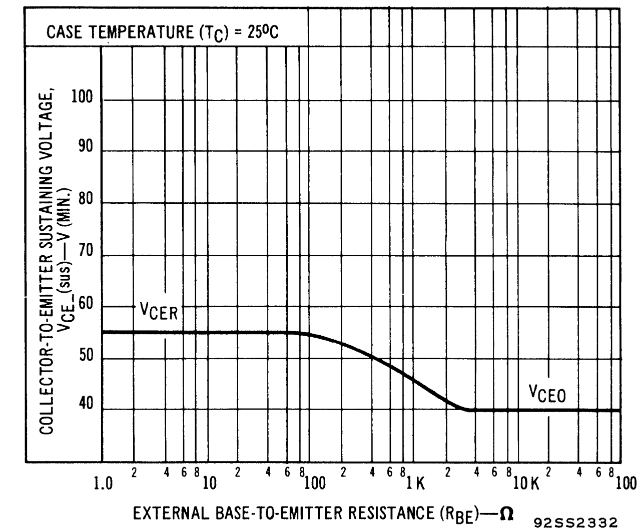


Fig. 2

SUSTAINING VOLTAGE vs. BASE-TO-EMITTER RESISTANCE FOR TYPES 40348, 40348V1, & 40348V2

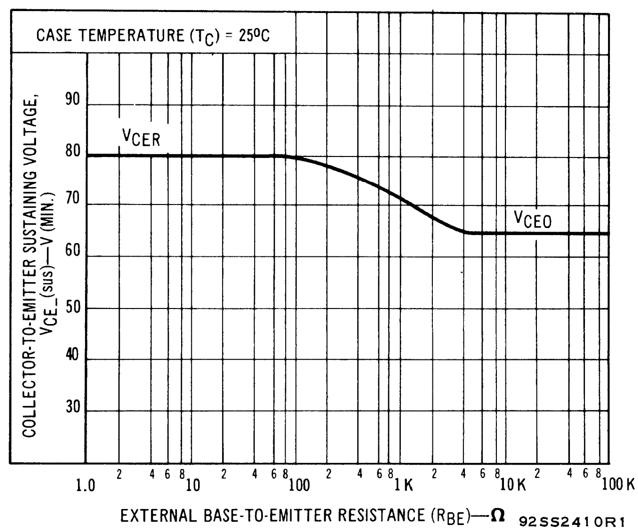


Fig. 3

SUSTAINING VOLTAGE vs. BASE-TO-EMITTER RESISTANCE FOR TYPES 40349, 40349V1, & 40349V2

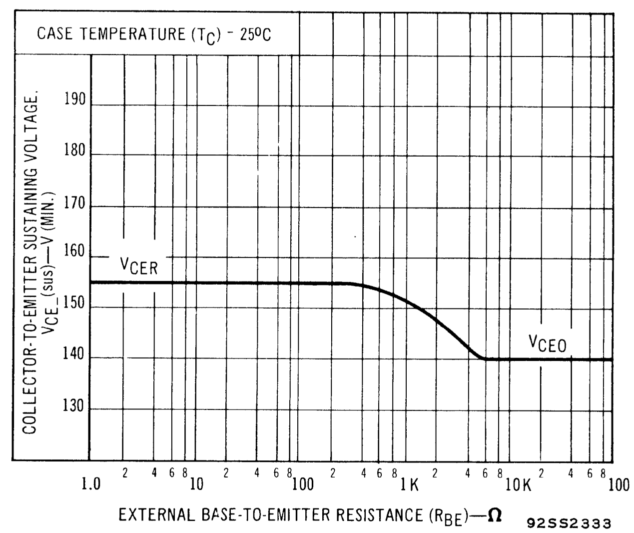


Fig. 4

MAXIMUM AREA-OF-OPERATION

Figure 6 shows the maximum operating area curve for types 40347, 40348, and 40349 at a case temperature of 25° C. The curves, shown on a log-log plot, have slopes equal to –1 when thermal (dissipation) limitation exists.

Non-Repetitive Pulse. *Figure 6* allows direct calculation of maximum dissipation limits for types 40347, 40348, and 40349 when only a single-pulse condition occurs.

Repetitive Pulse. The collector-current limitation values and the normalized power multiplier values, shown in *Figure 6,* must be reduced when repetitive pulses are applied to types 40347, 40348, and 40349. The amount of current derating is determined by the slope of the dissipation derating curve *(Figure 5)* where T_{EFF} is the effective case temperature produced by the pulses.

The effective case temperature may be calculated by using the following equation:

$$T_{EFF} = T_C + (P_{AVG})\,(\theta_{J\text{-}C})$$

Where:

T_C = Case temperature, °C

P_{AVG} = Average power of the applied repetitive pulses, W

$\theta_{J\text{-}C}$ = Junction-to-case thermal resistance, °C/W.

DISSIPATION DERATING CURVE FOR TYPES 40347, 40348, & 40349

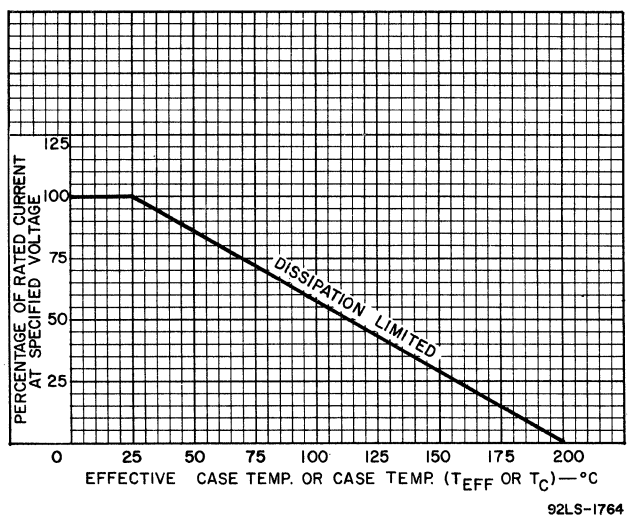


Fig. 5

MAXIMUM OPERATING AREAS FOR TYPES
40347, 40348, & 40349

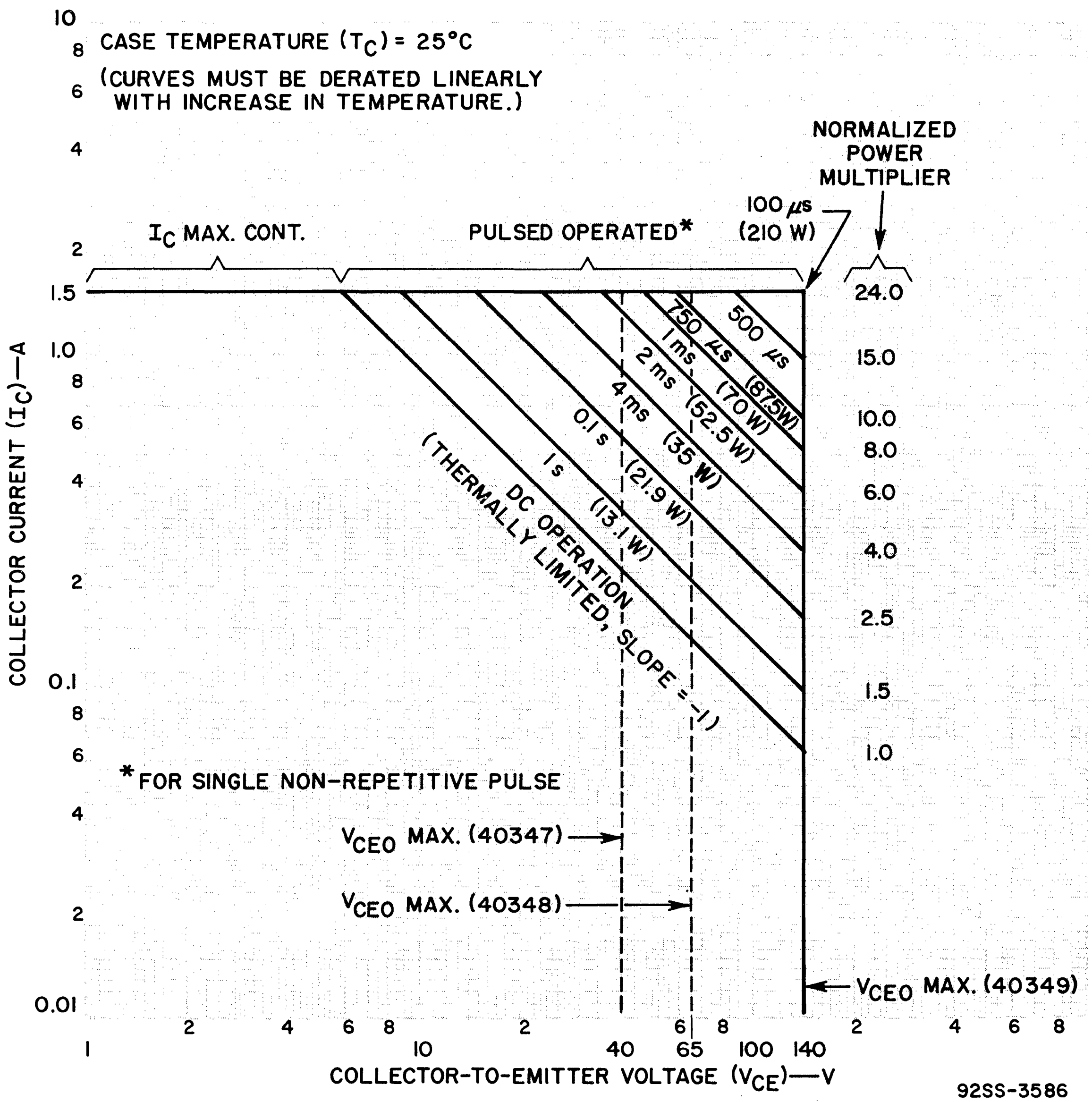


Fig. 6

SECOND BREAKDOWN

Second breakdown (S/b) is a potentially destructive phenomenon which occurs in bipolar transistors (n-p-n and p-n-p) and results from the transistor absorbing a critical amount of energy. The initiation of second breakdown is characterized by an abrupt decrease in collector-to-emitter voltage, V_{CE}, with a small positive dynamic resistance in the second-breakdown region. In general, transistors with higher-frequency response or faster switching speed characteristics, and higher collector-to-emitter voltage-breakdown capabilities are more susceptible to failure from second breakdown. The critical energy required to produce second breakdown is a variable which depends on operating conditions.

With the emitter-base junction forward biased for transistor operation in the active region, the severity of second breakdown depends on the operating collector-to-emitter voltage, duration of the applied voltage, and transistor temperature.

Figure 6 shows the DC and pulse current derating curves applicable for types 40347, 40348, and 40349. The portion of the curves with slope equal to −1 on these logarithmic plots indicates the regions where the device is thermally limited (i.e., maximum allowable power dissipation is constant with voltage).

The energy required to induce second breakdown when the transistor is turned off depends on the current during the "on" condition, the emitter-to-base voltage and resistance when the transistor is turned off, and the amount of inductance in series with the collector. It is much lower than that required in the forward-bias mode. The curves shown in *Figure 7* should prove useful in the design of circuits having inductance loads (such as solenoid- or relay-control circuits, magnetic-circuits, magnetic-deflection circuits, and switching regulators) without protective zener diodes across the collector-to-emitter terminals. Also, these curves can be used when designing circuits where some leakage inductance is present (such as in inverters, converters, and transformer-coupled power amplifiers).

In general, reverse-bias, second breakdown energy ($E_{S/b}$) capability increases with a decrease in inductance. Therefore, the allowable energy shown in the above mentioned curves (calculated from $E_{S/b} = \frac{1}{2}LI^2$, where L is a series load or leakage inductance and I is the peak collector current from the curves) will be conservative for smaller inductance loads. For further information on second breakdown, write for RCA publication ST-3186 "Second-Breakdown Effects on Transistor Applications" or consult RCA Application Notes SMA-21, "Characterization of Second Breakdown in Silicon Power Transistors," and SMA-30, "Second Breakdown in Transistors Under Conditions of Cutoff."

REVERSE-BIAS, SECOND-BREAKDOWN CHARACTERISTICS FOR TYPES 40347, 40348, & 40349

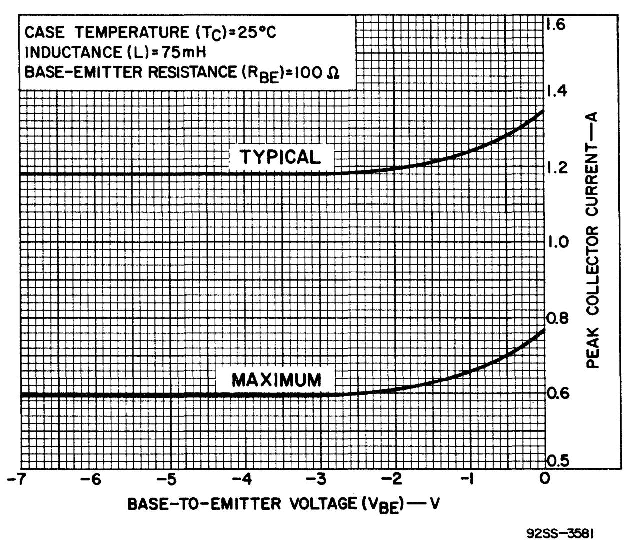


Fig. 7

TYPICAL GAIN-BANDWIDTH PRODUCT vs. COLLECTOR CURRENT FOR TYPES 40347, 40348 & 40349

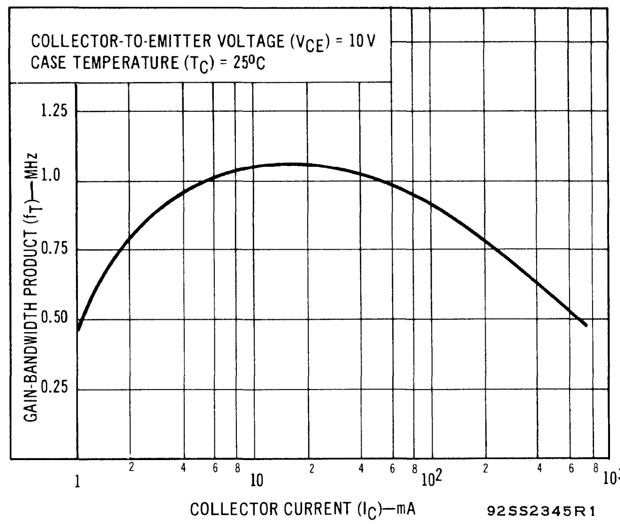


Fig. 8

TYPICAL OUTPUT CHARACTERISTIC FOR TYPES 40347 & 40348

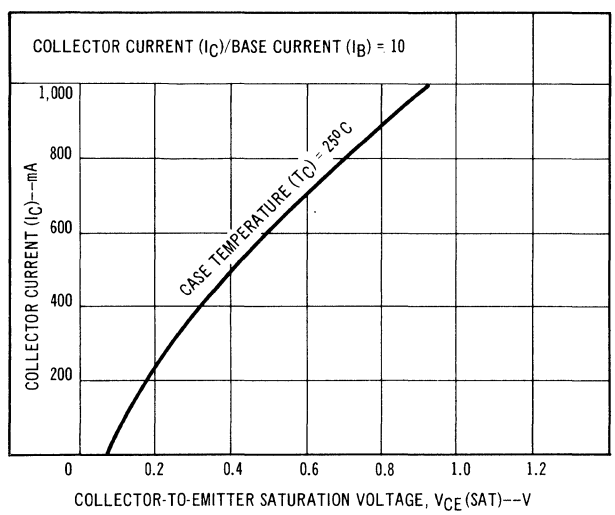


Fig. 9

TYPICAL OUTPUT CHARACTERISTICS FOR TYPE 40347

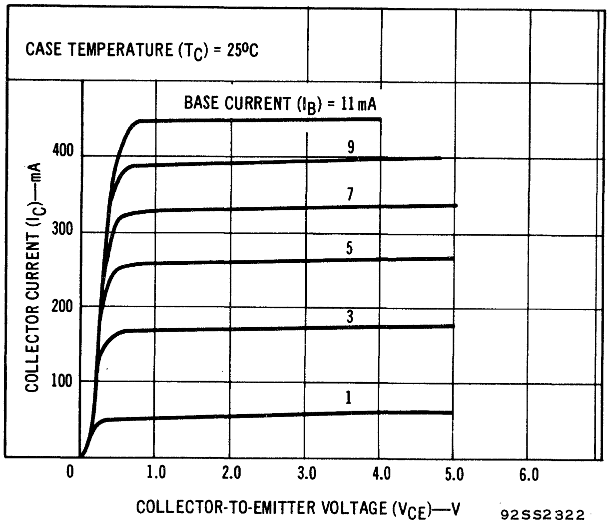


Fig. 10

TYPICAL DC-BETA CHARACTERISTICS FOR TYPE 40347

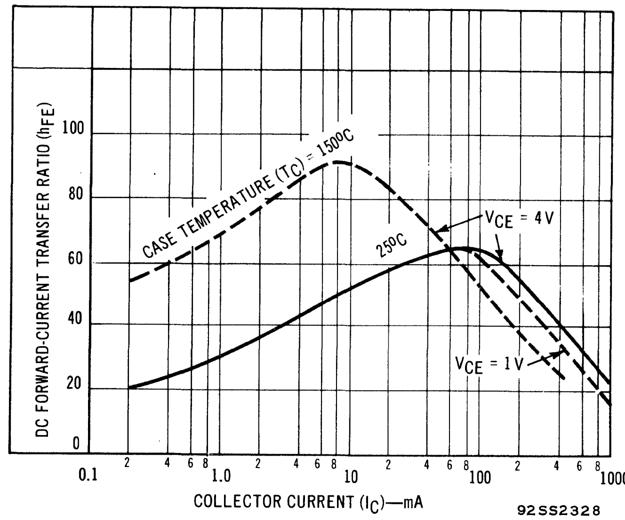


Fig. 11

TYPICAL TRANSFER CHARACTERISTICS FOR TYPE 40347

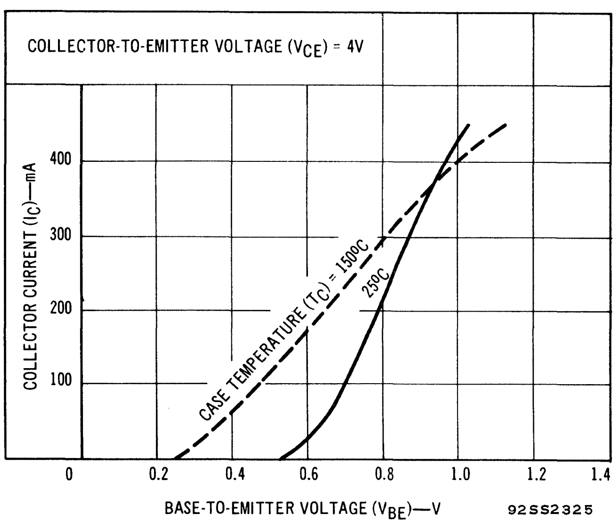


Fig. 12

COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC FOR TYPE 40347

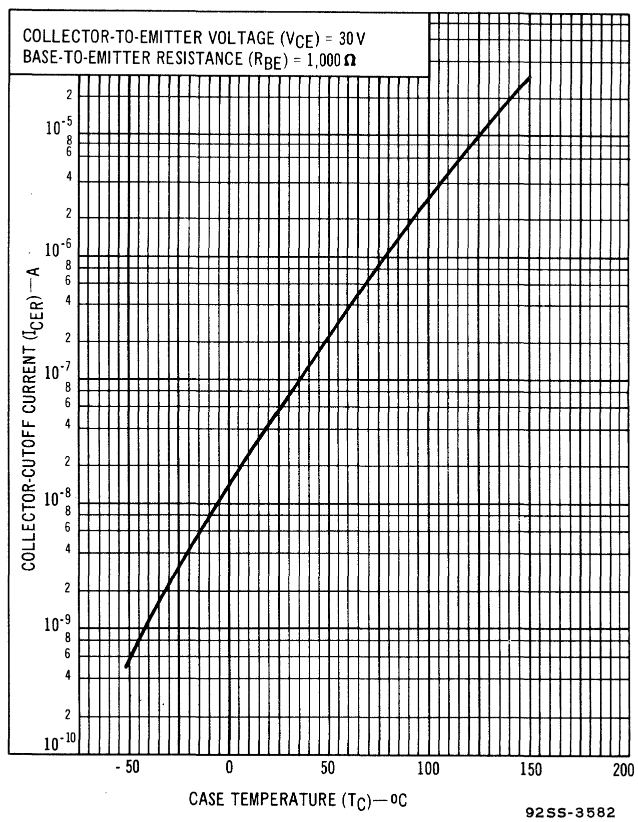


Fig. 13

TYPICAL OUTPUT CHARACTERISTICS FOR TYPE 40348

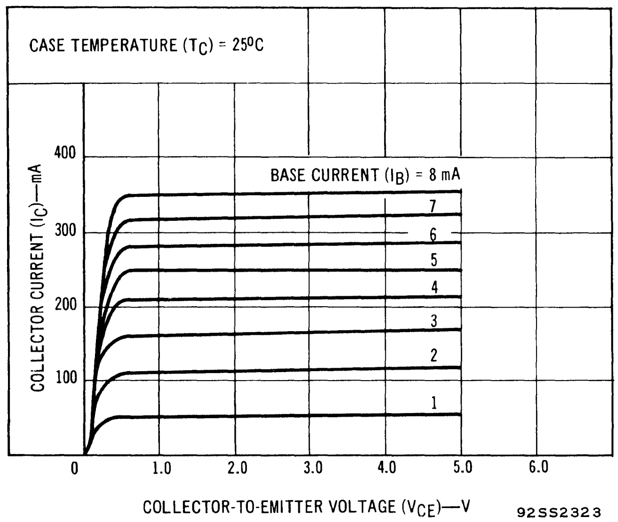


Fig. 14

TYPICAL DC-BETA CHARACTERISTICS FOR TYPE 40348

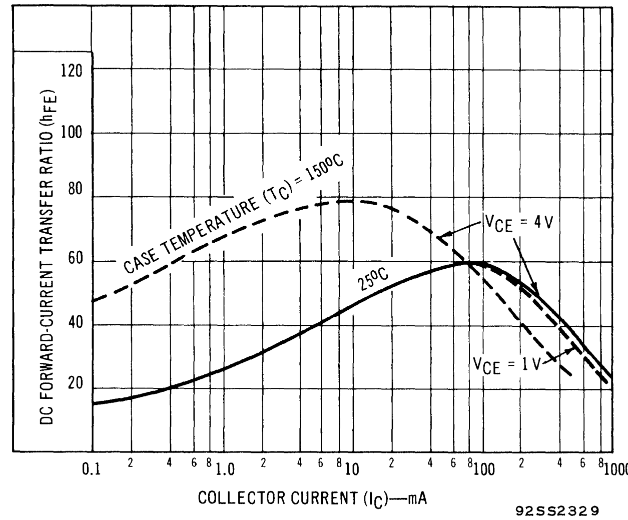


Fig. 15

TYPICAL TRANSFER CHARACTERISTICS FOR TYPE 40348

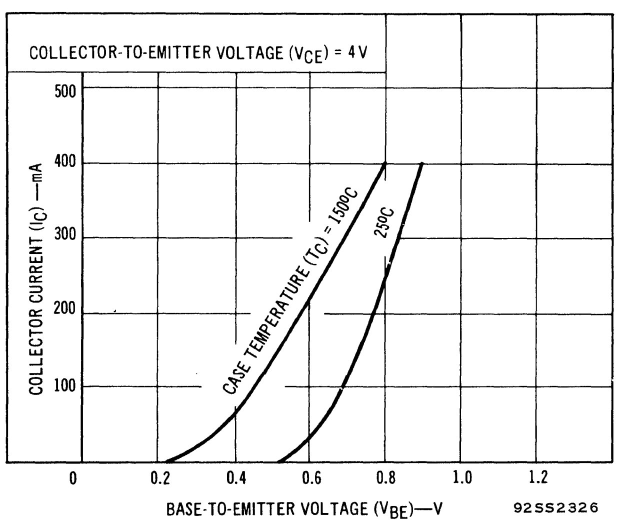


Fig. 16

COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC FOR TYPE 40348

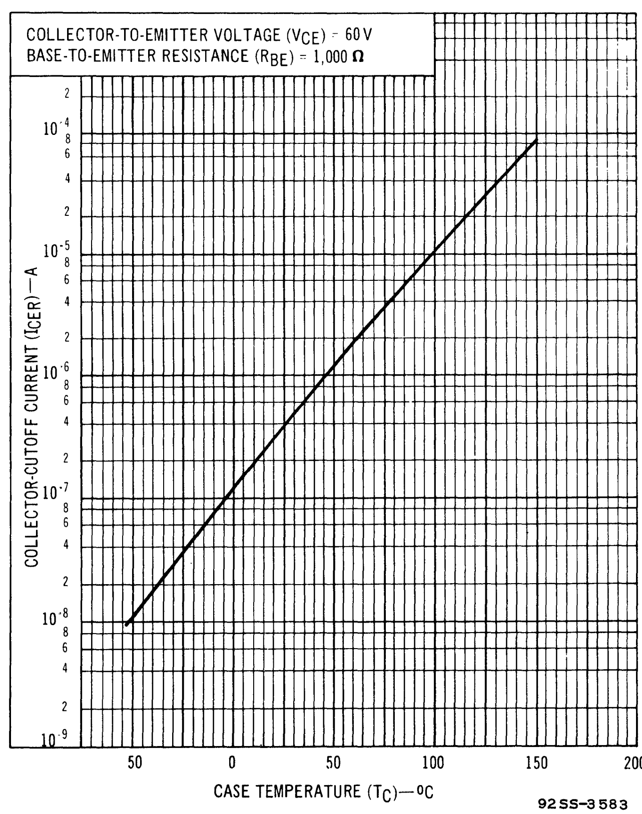


Fig. 17

TYPICAL OUTPUT CHARACTERISTICS FOR TYPE 40349

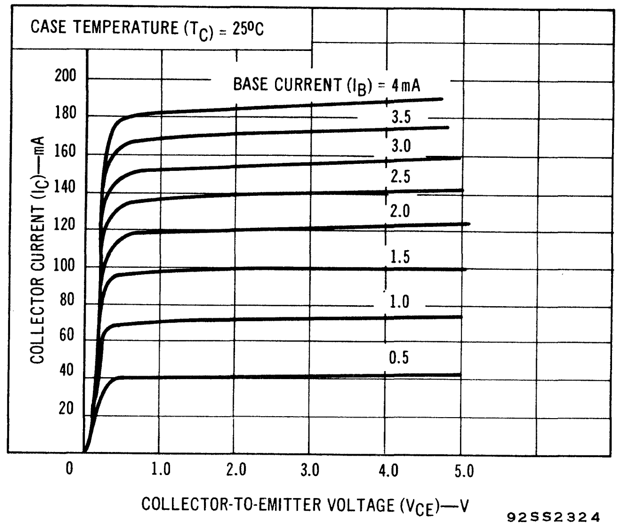


Fig. 18

TYPICAL DC-BETA CHARACTERISTICS FOR TYPE 40349

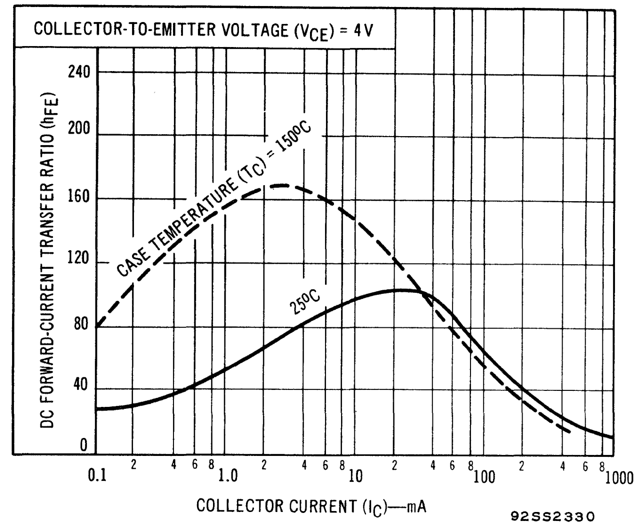


Fig. 19

TYPICAL TRANSFER CHARACTERISTICS FOR TYPE 40349

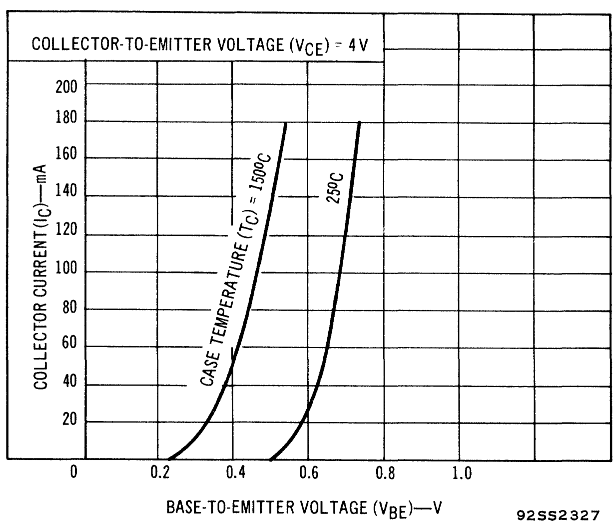


Fig. 20

COLLECTOR-CUTOFF-CURRENT CHARACTERISTIC FOR TYPE 40349

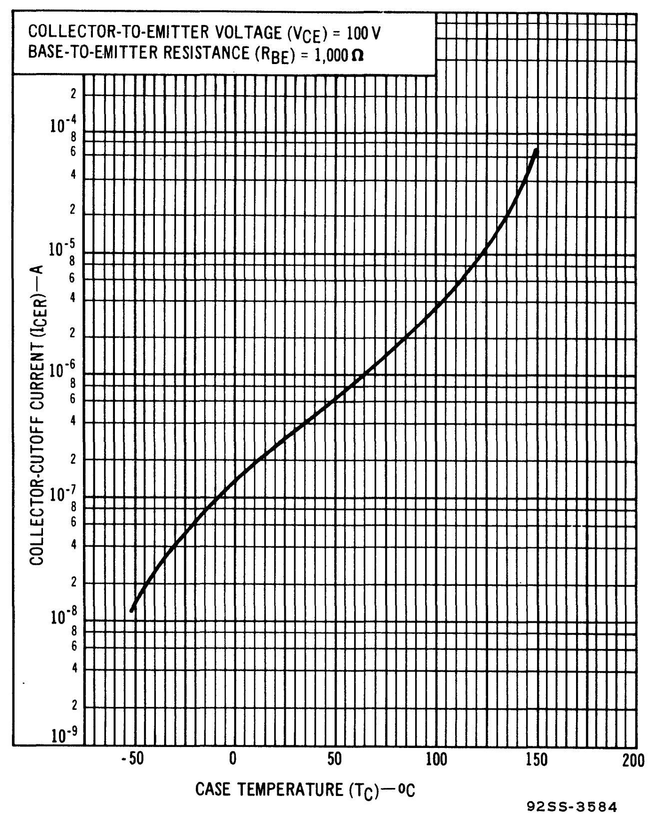
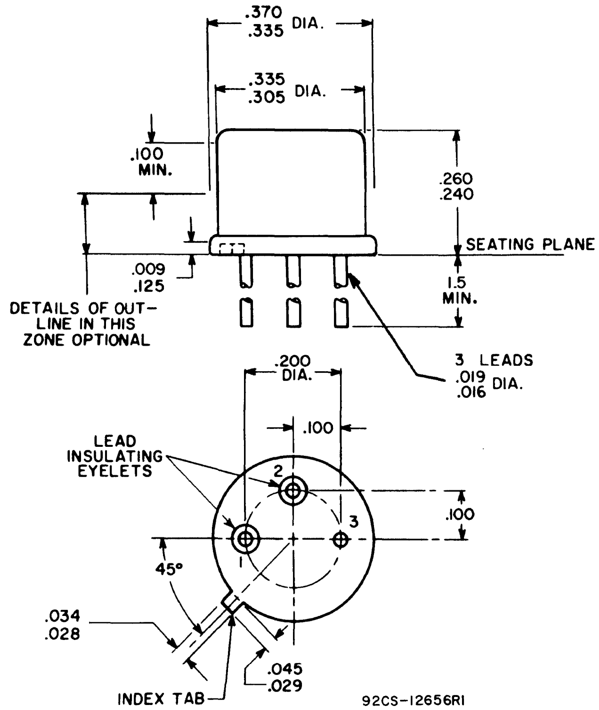


Fig. 21

DIMENSIONAL OUTLINE FOR TYPES 40347, 40348, & 40349 JEDEC No. TO-5



Dimensions in Inches

TERMINAL CONNECTIONS FOR TYPES 40347, 40348, & 40349

Lead 1 - Emitter

Lead 2 - Base

Case, Lead 3 - Collector

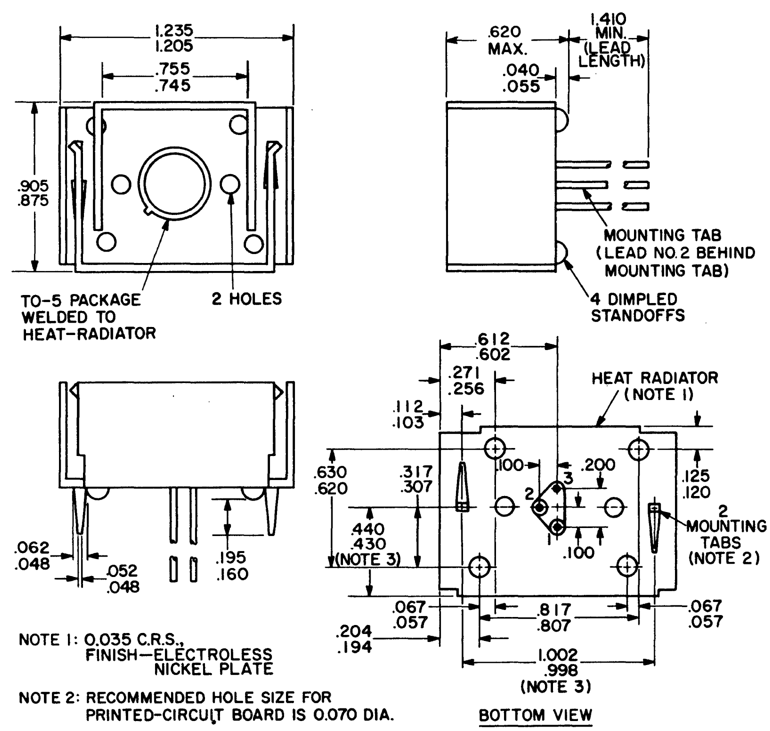
DIMENSIONAL OUTLINE FOR TYPES 40347V1, 40348V1, & 40349V1 JEDEC TO-5 WITH HEAT RADIATOR

TERMINAL CONNECTIONS FOR TYPES 40347V1, 40348V1, & 40349V1

Lead 1 - Emitter

Lead 2 - Base

Heat Radiator, Lead 3 - Collector



NOTE 1: 0.035 C.R.S., FINISH—ELECTROLESS NICKEL PLATE

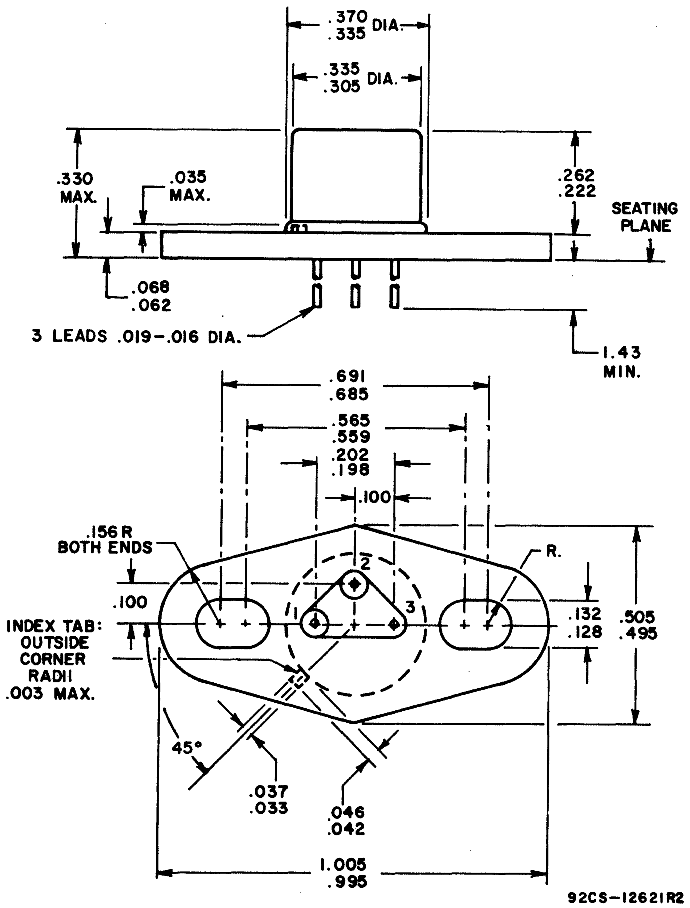
NOTE 2: RECOMMENDED HOLE SIZE FOR PRINTED-CIRCUIT BOARD IS 0.070 DIA.

NOTE 3: MEASURED AT BOTTOM OF HEAT-RADIATOR

Dimensions in Inches

92SS-2546RI

DIMENSIONAL OUTLINE FOR TYPES 40347V2, 40348V2, & 40349V2 JEDEC TO-5 WITH FLANGE



Dimensions in Inches

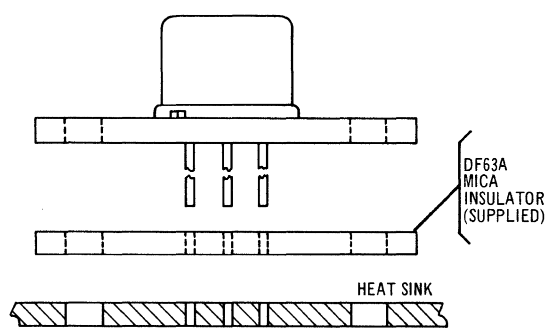
TERMINAL CONNECTIONS FOR TYPES 40347V2, 40348V2, & 40349V2

Lead 1-Emitter

Lead 2-Base

Case, Lead 3-Collector

SUGGESTED HARDWARE FOR TYPES 40347V2, 40348V2, & 40349V2



92SS-3375R1

RCA TV TRANSISTORS

For Video Output Amplifier Service

40354
40355

RCA-40354 and 40355* are transistors of the silicon npn type, specifically intended for use in video-output-amplifier stages of black-and-white television receivers. The 40354 and 40355 differ only in package configuration and dissipation capability. The 40355 is provided with an integral heat sink which gives this transistor twice the dissipation capability of the 40354.

The 40354 and 40355 feature substantially linear transfer characteristics, low saturation voltage, and low collector-to-base feedback capacitance. These features, combined with a high collector-to-emitter breakdown-voltage (150 V min., 180 V typ.) and a typical gain-bandwidth product of 100 Mc/s (50 Mc/s min.) provide the sensitivity, frequency response, and output-voltage capability required in high-performance video output-amplifier stages.

Both devices utilize a compact, hermetically sealed metal package, and have the collector internally connected to the case. The case of the 40355 is provided with an integral cylindrical heat sink of 16-gauge aluminum.

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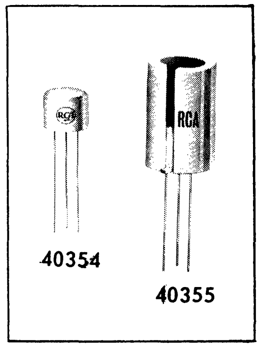
* Formerly Dev. Nos. TA2529 and TA2679, respectively.

SILICON NPN TRANSISTORS



For Video Output Amplifier Applications In Television Receivers

FEATURES:

- high collector-to-emitter breakdown voltage capability:
  BV_{CEO} = 150 V min., 180 V typ.
- low collector-to-base feedback capacitance:
  C_{cb} = 2.8 pF typ., 3.5 pF max.
- low saturation voltage:
  $V_{CE}(sat)$ = 1 V typ. at I_C = 30 mA, I_B = 1 mA
- hermetically sealed 3-lead metal packages – collector internally connected to case
- RCA-40355 has integral heat sink for increased dissipation capability

AMPLIFIER SERVICE

Absolute-Maximum Ratings:

	RCA 40354	RCA 40355	
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	150	150 max.	volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5	5 max.	volts
COLLECTOR CURRENT, I_C	50	50 max.	mA
TRANSISTOR DISSIPATION, P_T:			
At ambient temperatures up to 25° C	0.5	1 max.	watt
At ambient temperatures above 25° C	See Fig. 1		
TEMPERATURE RANGE:			
Storage and operating (Junction)	-65 to +175		°C
LEAD TEMPERATURE (During soldering):			
At distances not closer than 1/32" to seating surface for 10 seconds max.	255	255 max.	°C

RATING CHART FOR RCA-40354 AND 40355

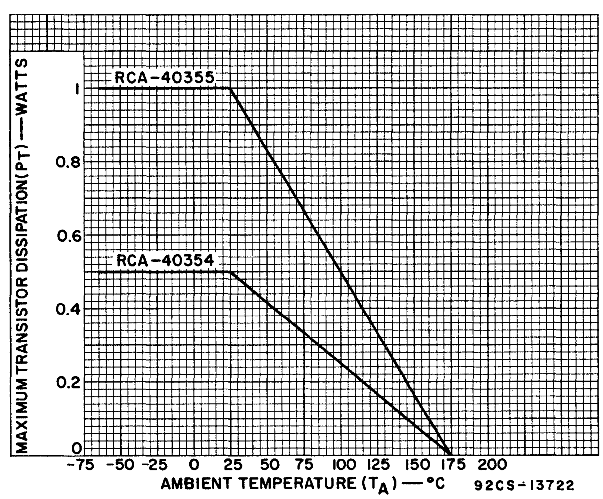


Fig. 1

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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Marca(s) Registrada(s)

Printed in U.S.A.
40354, 40355 6-66
Reprinted from Issue dated 2-66

ELECTRICAL CHARACTERISTICS, *at an Ambient Temperature (T_A) of 25° C*

CHARACTERISTICS	SYMBOLS AND UNITS	LIMITS RCA 40354 40355 Min.	Typ.	Max.	TEST CONDITIONS: DC Collector-Voltage V_{CB} or V_{CE} volts	DC Base Current I_B mA	DC Collector Current I_C mA	DC Emitter Current I_E µA
Collector-Cutoff Current	I_{CBO} nA	–	5	100	V_{CB} = 120			0
Collector-to-Emitter Breakdown Voltage	BV_{CEO} volts	150	180	–		0	1	
Emitter-to-Base Breakdown Voltage	BV_{EBO} volts	5	7	–			0	-10
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$ volts	–	1	5		1	30	
Static Forward Current-Transfer Ratio	h_{FE}	–	55	–	V_{CE} = 10	–	10	–
Collector-to-Base Feedback Capacitance	C_{cb} pF	–	2.8	3.5	V_{CE} = 10		30	
Gain-Bandwidth Product	f_T Mc/s	50 50	100 100	– –	V_{CE} = 10 140		30 2	
Thermal Resistance, Junction-to-Case	θ_{J-C} °C/Watt	–	45	60	–	–	–	–

TYPICAL VIDEO-AMPLIFIER CIRCUIT UTILIZING RCA 40354

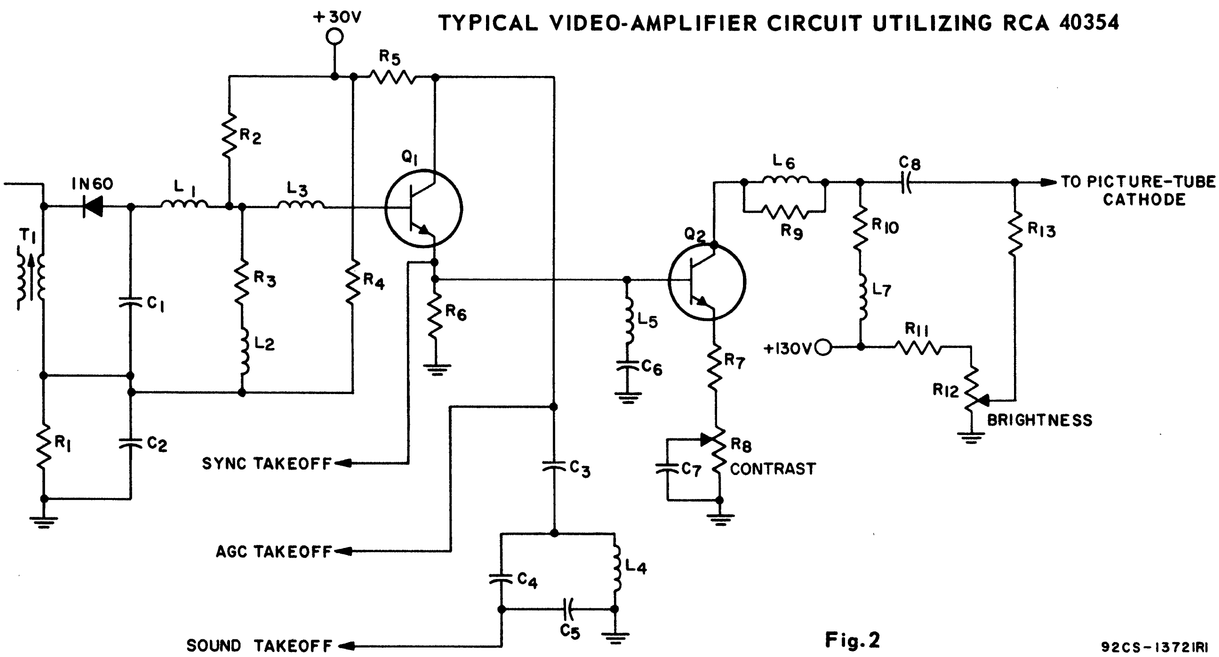


Fig.2

T_1 - I.F. Transformer
L_1, L_3 - 10 µH
L_2, L_6 - 220 µH
L_4, L_5 - 12.5 µH, $Q_o \approx 75$
L_7 - 100 µH
C_1 - 8 pF
C_2 - 0.005 µF
C_3 - 22 pF
C_4, C_6 - 100 pF
C_5 - 0.003 µF
C_7 - 1000 µF
C_8 - 0.2 µF
Q_1 - Dev. No. TA2783
Q_2 - RCA-40354 mounted on a heat sink having an effective radiating area of 4 sq. in. (10-mil copper, 1" x 2")
R_1 - 330 Ω
R_2, R_{13} - 68 kΩ
R_3, R_9 - 3.9 kΩ
R_4 - 1.2 kΩ
R_5 - 1 kΩ
R_6 - 680 Ω
R_7 - 33 Ω
R_8 - Potentiometer, 250Ω
R_{10} - 5 kΩ
R_{11} - 47 kΩ
R_{12} - Potentiometer, 100kΩ

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

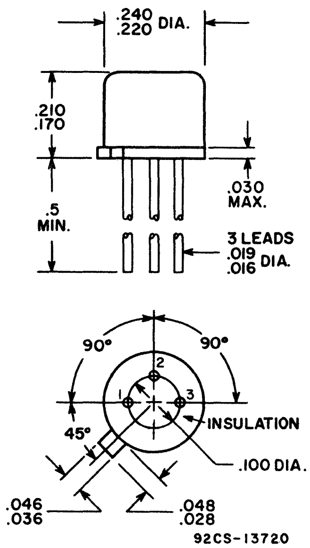
The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

Because the metal shells of these transistors operate at the collector voltage, consideration should be given to the possibility of shock hazard if the shells are to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

RCA-40354 and 40355 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

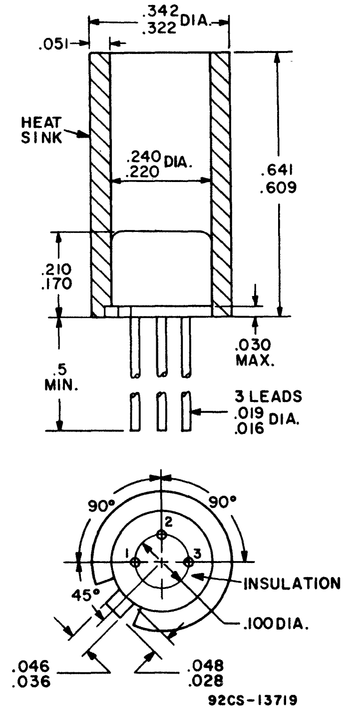
These transistors can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistor.

DIMENSIONAL OUTLINE FOR RCA-40354



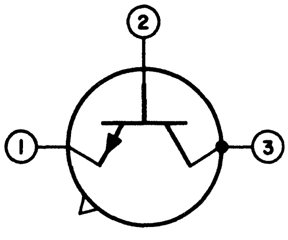
DIMENSIONS IN INCHES

DIMENSIONAL OUTLINE FOR RCA-40355



DIMENSIONS IN INCHES

TERMINAL DIAGRAM FOR RCA-40354 AND 40355



Lead 1 - Emitter

Lead 2 - Base

Lead 3 - Collector, Case

RCA AF TRANSISTOR

40359

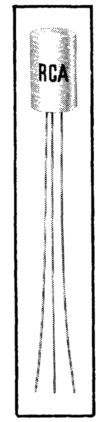
RCA-40359 is an alloy-junction transistor of the germanium pnp type, intended primarily for af-amplifier applications.

The 40359 has features which make it highly desirable for use in driver stages and other amplifier stages operating at moderately high signal levels. These features include:

- high small-signal beta (h_{fe}) – 100 typ.
- beta constant over entire collector-current range and over entire audio-frequency spectrum
- high cutoff frequency (f_{hfb}) – 10 MHz typ.
- hermetically sealed metal JEDEC TO-1 package
- high dissipation capability (P_T) – 120 mW max. to 55°C

GERMANIUM P-N-P TRANSISTOR

For AF-Amplifier Applications in Consumer-Product and Industrial Equipment



JEDEC TO-1

Maximum Ratings, *Absolute-Maximum Values:*

	RCA 40359	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-20 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CER} ($R_{BE} \leq 10000$ ohms)	-18 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-2.5 max.	V
COLLECTOR CURRENT, I_C	-50 max.	mA
EMITTER CURRENT, I_E	+50 max.	mA
TRANSISTOR DISSIPATION:		
At ambient temperatures up to 55° C	120 max.	mW
At ambient temperatures above 55° C	See Fig.1	
TEMPERATURE RANGE:		
Storage	-65 to +100	°C
Operating	-65 to +100	°C
LEAD TEMPERATURE (During Soldering):		
At distances not closer than 1/32" to seating surface, for 10 seconds max.	255 max.	°C

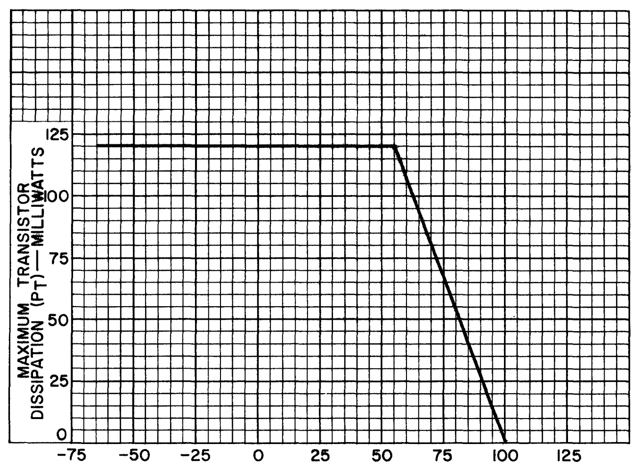


Fig.1 - Rating chart for RCA-40359

Printed in U.S.A.
40359 6-66

ELECTRICAL CHARACTERISTICS, at T_A = 25°C

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS					LIMITS			
		DC COLLECTOR-TO-BASE VOLTAGE V_{CB}	DC COLLECTOR-TO-EMITTER VOLTAGE V_{CE}	DC EMITTER-TO-BASE VOLTAGE V_{EB}	DC COLLECTOR CURRENT I_C	DC EMITTER CURRENT I_E	RCA 40359			
		V	V	mA	mA	mA	Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	-15				0	-	-	-12	μA
Emitter-Cutoff Current	I_{EBO}			+2.5	0		-	-	-12	μA
Collector-to-Emitter Breakdown Voltage	BV_{CER}			R_{BE} = 10 kΩ	-1		-18	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0	-0.05	+2.5	-	-	V
Small-Signal Forward Current-Transfer Ratio	h_{fe}	f = 1 kHz	-6		-1		40	100	165	-
Small-Signal Forward Current-Transfer Ratio Cutoff Frequency	f_{hfb}		-6		-1		-	10	-	MHz
Extrinsic Base-Lead Resistance	$r_{bb'}$	f = 100 MHz	-6		-1		-	200	-	Ω

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The *flexible leads* of the 40359 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the device. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using the 40359, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.25" of the metal case.

RCA-40359 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the device.

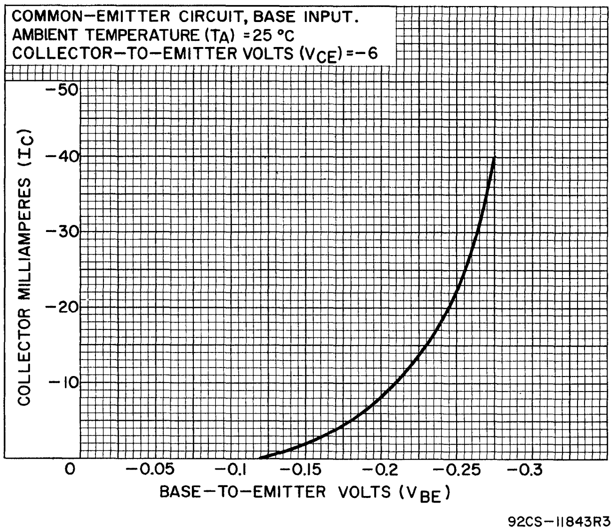


Fig.2 - Typical transfer characteristic for RCA-40359

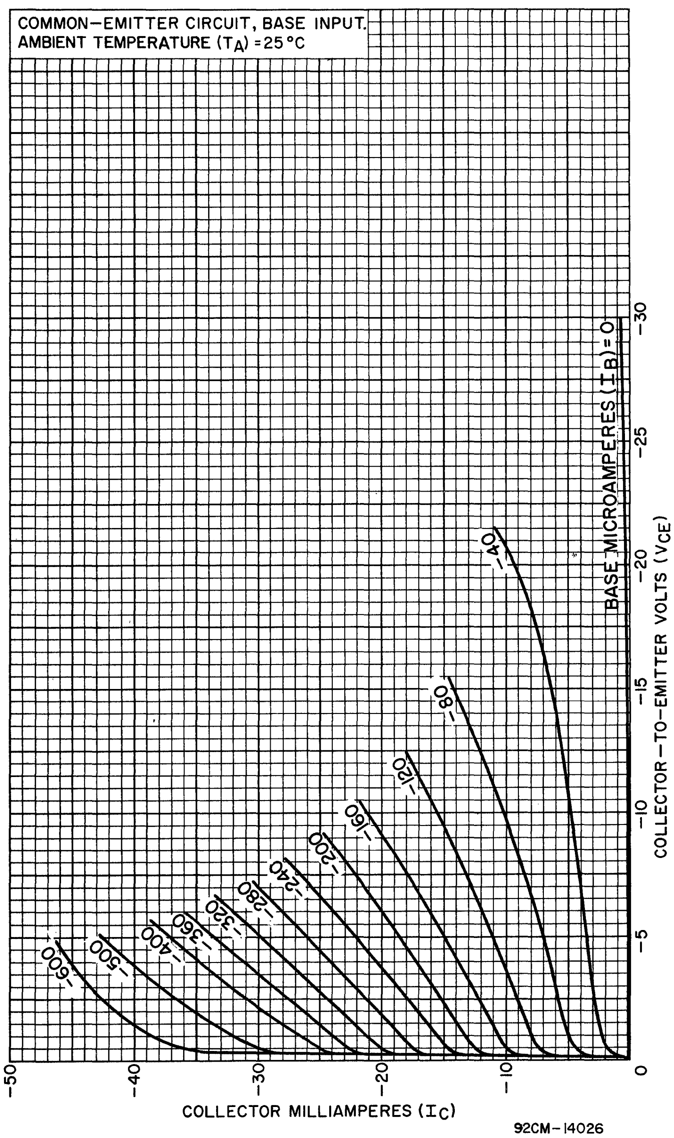
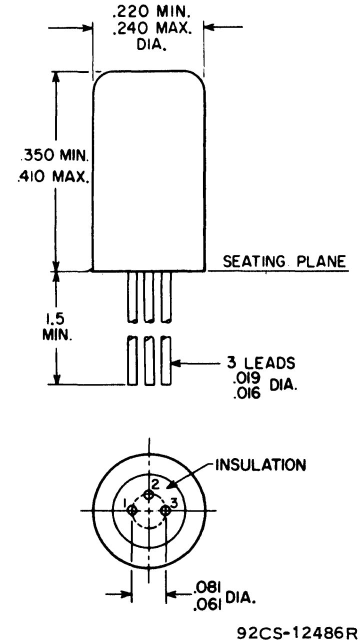


Fig.3 - Typical collector characteristics for RCA-40359

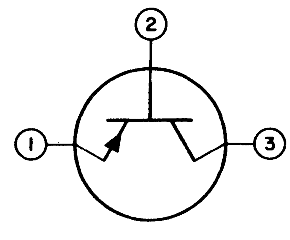
DIMENSIONAL OUTLINE
RCA-40359
JEDEC No. TO-1



Dimensions in Inches

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

TERMINAL DIAGRAM
RCA-40359



Lead 1 - Emitter

Lead 2 - Base

Lead 3 - Collector

RCA-40359

GERMANIUM P-N-P TRANSISTOR

For AF-Amplifier Applications in Consumer-Product and Industrial Equipment

HIGH-RELIABILITY POWER TRANSISTORS

40366-40369
40385

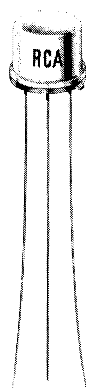
File No. 215

FEATURES

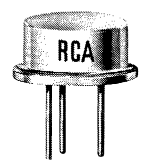
- High reliability assured by five preconditioning steps
- Group-A test data included *
- Transistors utilize JEDEC "TO-"packages:
  TO–5 (40366, 40367 & 40385)
  TO–8 (40368)
  TO–3 (40369)
- High-voltage ratings:
  V_{CER} = 80 V max. (40366)
  V_{CEV} = 100 V max. (40367, 40368 & 40369)
  V_{CEO} = 350 V max. (40385)
- High-power-dissipation capability:
  P_T = 5 W max. (40366, 40367 & 40385)
  = 25 W max. (40368)
  = 75 W max. (40369)

* Group-A test data shown on pages 2 & 3.

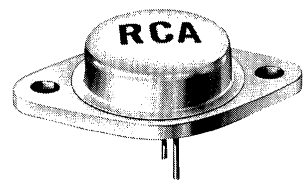
Silicon N-P-N Types for Power Switching and Amplifier Applications



40366 40367 40385
JEDEC TO-5
H-1380



40368
JEDEC TO-8
H-1015



40369
JEDEC TO-3
H-1339

MAXIMUM RATINGS

ABSOLUTE-MAXIMUM VALUES:

		40366	40367	40368	40369	40385	
Collector-to-Base Voltage	V_{CBO}	120	100	100	100	450	V
Collector-to-Emitter Voltage:							
With external base-to-emitter resistance (R_{BE}) ≤ 10 Ω	V_{CER}	80	-	-	-	-	V
With 1.5 V of reverse bias	V_{CEV}		100	100	100	–	V
With base open	V_{CEO}	65	55	55	55	350	V
Emitter-to-Base Voltage	V_{EBO}	7	12	12	10	7	V
Collector Current	I_C	1	1.5	3	6	1	A
Base Current	I_B	–	1	1.5	3	–	A
Transistor Dissipation:	P_T						
At case temperatures up to 25°C		5	5	25	75	5	W
At free-air temperatures up to 25°C		1	1	–	–	1	W
At temperatures above 25°C		Derate linearly to 0 watts at 200°C					
Temperature Range: Storage & Operating (Junction)		← - 65 to 200 →					°C
Pin or Lead Temperature: At distances ≥ 1/32" from seating plane, for 10 s max.		255	255	235	235	255	°C

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Printed in U.S.A.
40366–40369 & 40385 9/66
Supersedes 40366-40369 11-65

ELECTRICAL CHARACTERISTICS Case Temperature (T_C) = 25° C

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts		DC Emitter Volts	DC Current (Milliamperes)			LIMITS: Type 40366		Type 40367		Type 40368		Type 40369		Type 40385		Units
		V_{CB}	V_{CE}	V_{EB}	I_C	I_E	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current	I_{CBO}	30				0		–	–	–	4.0	–	9.0	–	10	–	–	μA
		60				0		–	2.0	–	–	–	–	–	–	–	–	nA
	I_{CEO}		300				0	–	–	–	–	–	–	–	–	–	20	μA
	I_{CEV}		450	1.5				–	–	–	–	–	–	–	–	–	500	μA
Emitter-Cutoff Current	I_{EBO}			5	0			–	5.0	–	–	–	–	–	–	–	–	nA
				6	0			–	–	–	–	–	–	–	–	–	20	μA
				10	0			–	–	–	–	–	–	–	6.0	–	–	μA
				12	0			–	–	–	2.0	–	5.0	–	–	–	–	μA
DC Forward-Current Transfer Ratio	h_{FE}		4		200			–	–	35	100	–	–	–	–	–	–	
			4		750			–	–	–	–	35	100	–	–	–	–	
			4		1500			–	–	–	–	–	–	25	75	–	–	
			10		0.01			10	–	–	–	–	–	–	–	–	–	
			10		0.1			20	–	–	–	–	–	–	–	–	–	
			10		2			–	–	–	–	–	–	–	–	30	–	
			10		20			–	–	–	–	–	–	–	–	40	160	
			10		150•			40	120	–	–	–	–	–	–	–	–	
			10		500•			25	–	–	–	–	–	–	–	–	–	
			10		1000•			10	–	–	–	–	–	–	–	–	–	
Collector-to-Base Breakdown Voltage	BV_{CBV}			1.5	0.1			120	–	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			1.5	0.25			–	–	100	–	100	–	100	–	–	–	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}					0.1		7.0	–	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER}(sus)$				100•			80	–	–	–	–	–	–	–	–	–	V
With base open	$V_{CEO}(sus)$				50		0	–	–	55	–	–	–	–	–	350	–	V
					100•		0	65	–	–	–	–	–	–	–	–	–	
					100		0	–	–	–	–	55	–	55	–	–	–	
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				50		4	–	–	–	–	–	–	–	–	–	0.5	V
					150•		15	–	0.5	–	–	–	–	–	–	–	–	
					200		10	–	–	–	1.4	–	–	–	–	–	–	
					750		40	–	–	–	–	–	0.75	–	–	–	–	
					1300		100	–	–	–	–	–	–	–	1.0	–	–	
Base-to-Emitter Saturation Voltage	$V_{BE}(sat)$				150•		15	–	1.1	–	–	–	–	–	–	–	–	V
					50		4	–	–	–	–	–	–	–	–	–	1.3	
Base-to-Emitter Voltage	V_{BE}		4		200		–	–	–	–	3.0	–	–	–	–	–	–	V
			4		750		–	–	–	–	–	–	2.5	–	–	–	–	
			4		1500		–	–	–	–	–	–	–	–	2.5	–	–	

•Pulsed; pulse duration = 300 μs, duty factor = 1.8%.

GROUP-A TESTS (IN ACCORDANCE WITH MIL-S-19500)

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD*	SYMBOL	LIMITS: 40366		40367		40368		40369		40385		UNITS
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
2071	**Subgroup 1** Visual and Mechanical Examination	–	10 –	–	-	-	-	-	-	-	-	-	-	-	-
3036D	**Subgroup 2** Collector-Cutoff Current	V_{CB} = 30V, I_E = 0	5	I_{CBO}	-	–	–	4.0	–	9.0	–	10	–	–	μA
		V_{CB} = 60V, I_E = 0	–	I_{CBO}	-	2.0	–	–	–	–	–	–	–	-	nA
3041A	Collector-Cutoff Current	V_{CE} = 450V, V_{BE} = -1.5V	–	I_{CEV}	–	–	–	–	–	–	–	–	–	500	μA
3041D	Collector-Cutoff Current	V_{CE} = 300V, I_E = 0	–	I_{CEO}	–	–	–	–	–	–	–	–	–	20	μA

The RCA-40366, 40367, 40368, 40369 and 40385 are high-reliability versions of the RCA-2N2102, 2N1482, 2N1486, 2N1490 and 2N3439*, respectively. These transistors are intended for medium- and high-power switching and amplifier applications in military and industrial equipment.

The 40366 and 40385 are triple-diffused, silicon n-p-n types that utilize the popular JEDEC TO-5 package and have a power-dissipation capability of 5 watts each.

The 40367 is a silicon n-p-n, *hometaxial type* that utilizes a JEDEC TO-5 package and has a power-dissipation capability of 5 watts.

The 40368 is a silicon n-p-n, *hometaxial type* in a JEDEC TO-8 package with a power-dissipation capability of 25 watts.

The 40369 is a silicon n-p-n, *hometaxial type* in the popular JEDEC TO-3 package and has a dissipation capability of 75 watts.

The 40366, the high reliability version of the 2N2102, features linear-beta characteristics which are controlled over a wide range of collector currents (0.01 mA to 1 A).

The 40367, 40368, and 40369, the high-reliability versions of the 2N1482, 2N1486, and 2N1490, respectively, feature rugged construction, low saturation voltage, high-beta at high currents, and are designed to assure freedom from forward-bias second breakdown when operated with specified limits.

The 40385, the high-reliability version of the 2N3439, features low saturation voltage, high collector-to-base and collector-to-emitter voltages, and high resistance to second breakdown when operated with specified limits.

Typical applications for these transistors include: power-switching circuits such as dc-to-dc converters, inverters, choppers, solenoid- and relay-controls; oscillator, regulator, and pulse-amplifier circuits; Class-A and Class-B push-pull audio-and servo-amplifiers.

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* Complete data for types 2N1482, 2N1486, 2N1490, 2N2102 & 2N3439 are given in separate technical bulletins. Bulletins are available by writing to: Commercial Engineering, RCA Electronic Components and Devices, Harrison, N. J.

RELIABILITY TESTING

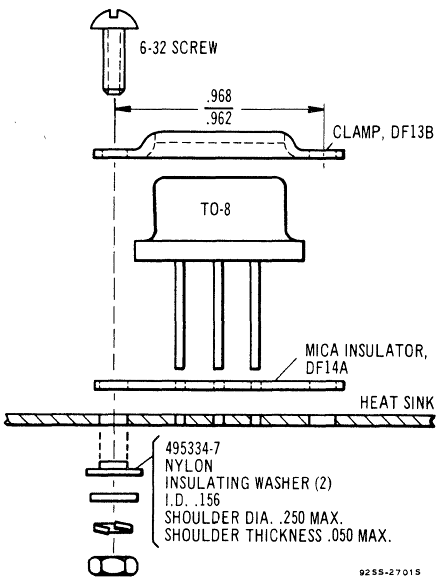
Each RCA-40366, 40367, 40368, 40369 and 40385 is subjected to the following preconditioning steps:

1. Temperature Cycling-Method 102A of MIL-STD-202, 5 cycles, -65° C to 200° C
2. Bake, 72 hours min., 200° C
3. Helium Leak, 1×10^{-8} cc/s max.
4. (a) Methanol Bomb, 70 psig, 16 hours min. (For 40366)
   (b) Bubble Test (Per MIL-STD-202, COND. A), 125° C min., 1 minute, ethylene glycol (For 40367, 40368, 40369 & 40385)
5. Serialization
6. (a) Record I_{CBO} and h_{FE} (150 mA) (For 40366)
   (b) Record I_{CBO} and h_{FE} (For 40367, 40368, & 40369)
   (c) Record I_{CEV} and h_{FE} (20 mA) (For 40385)
7. (a) Power Age, $T_{FA} = 25^{\circ}$ C, $V_{CB} = 60$ V, t= 168 hours, $P_T = 1$ W, free-air (For 40366 & 40367)
   (b) Power Age, $T_C = 125^{\circ}$ C, $V_{CB} = 24$ V, t= 168 hours,
   $P_T = 10.5$ W, with heat-sink (For 40368)
   $P_T = 32$ W, with heat-sink (For 40369)
   (c) Power Age, $T_{FA} = 25^{\circ}$ C, $V_{CB} = 200$ V, t= 168 hours, $P_T = 800$ mW, free air (For 40385)
8. (a) For 40366, †record I_{CBO}, h_{FE}(150 mA), BV_{CBV}, $V_{CEO}(sus)$, BV_{EBO}, $V_{CE}(sat)$. Data furnished with transistor.
   (b) For 40367, 40368, & 40369, †record I_{CBO}, h_{FE}, BV_{CEV}, $V_{CEO}(sus)$, I_{EBO}, $V_{CE}(sat)$. Data furnished with transistors.
   (c) For 40385, †record I_{CEO}, I_{EBO}, $V_{CEO}(sus)$, I_{CEV}, $V_{CE}(sat)$, and h_{FE}(20 mA). Data furnished with transistor.

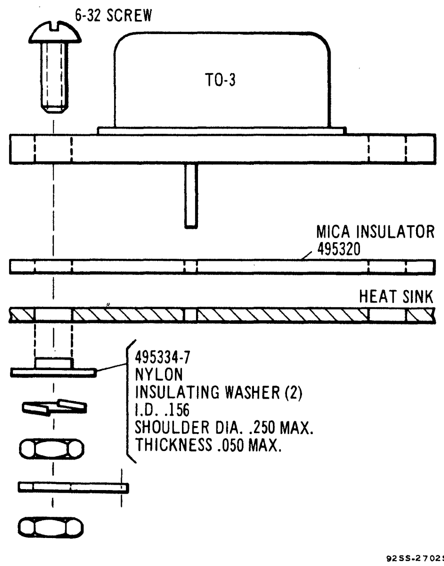
† Delta criteria after 168 hours Power Age:
$\Delta h_{FE} \pm 25\%$ (For all types) $\Delta I_{CBO} + 1\ \mu A$ (For 40367, 40368, & 40369)

SUGGESTED HARDWARE

FOR TYPE 40368

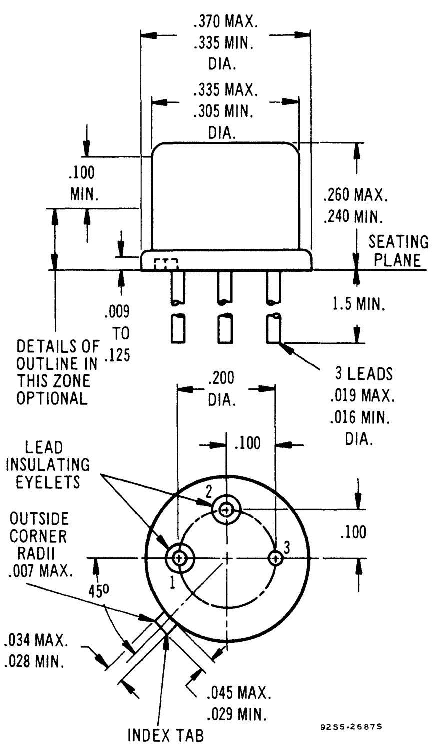


FOR TYPE 40369



NOTE: HARDWARE WITH PART NUMBERS ARE SUPPLIED.

DIMENSIONAL OUTLINE FOR TYPES 40366, 40367 & 40385 JEDEC TO-5

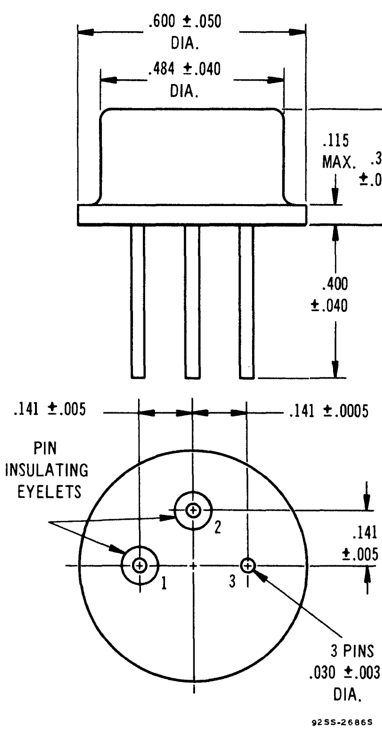


DIMENSIONS IN INCHES

TERMINAL CONNECTIONS FOR TYPES 40366, 40367 & 40385

LEAD NO. 1 - EMITTER
LEAD NO. 2 - BASE
CASE, LEAD NO. 3 - COLLECTOR

DIMENSIONAL OUTLINE FOR TYPE 40368 JEDEC TO-8

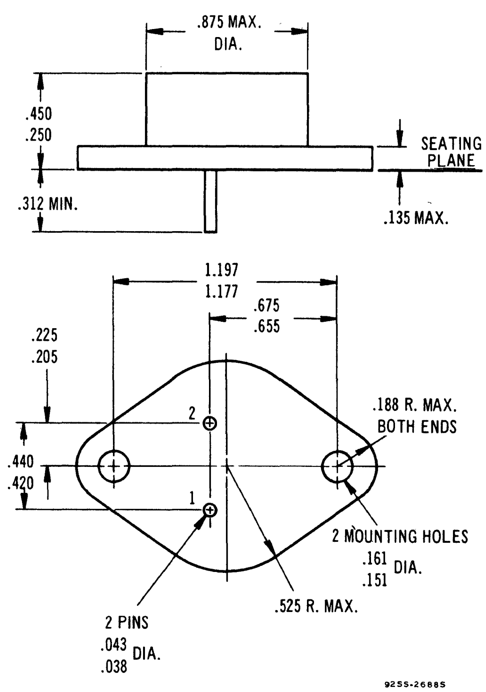


DIMENSIONS IN INCHES

TERMINAL CONNECTIONS FOR TYPE 40368

PIN 1 - EMITTER
PIN 2 - BASE
CASE, PIN 3 - COLLECTOR

DIMENSIONAL OUTLINE FOR TYPE 40369 JEDEC TO-3



DIMENSIONS IN INCHES

TERMINAL CONNECTIONS FOR TYPE 40369

PIN 1 - BASE
PIN 2 - EMITTER
FLANGE, CASE - COLLECTOR

GROUP-A TESTS (CONT.)

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD*	SYMBOL	LIMITS 40366 Min.	Max.	40367 Min.	Max.	40368 Min.	Max.	40369 Min.	Max.	40385 Min.	Max.	UNITS
3061D	Emitter-Cutoff Current	V_{EB} = 5V, I_C = 0	–	I_{EBO}	–	5.0	–	–	–	–	–	–	–	–	nA
		V_{EB} = 6V, I_C = 0	–	I_{EBO}	–	–	–	–	–	–	–	–	–	20	µA
		V_{EB} = 10V, I_C = 0	–	I_{EBO}	–	–	–	–	–	–	–	6.0	–	–	µA
		V_{EB} = 12V, I_C = 0	–	I_{EBO}	–	–	–	2.0	–	5.0	–	–	–	–	µA
3001A	Collector-to-Base Breakdown Voltage	I_C = 100µA, V_{EB} = 1.5V	–	BV_{CBV}	120	–	–	–	–	–	–	–	–	–	V
3026D	Emitter-to-Base Breakdown Voltage	I_E = 100µA, I_C = 0	–	BV_{EBO}	7.0	–	–	–	–	–	–	–	–	–	V
3011A	Collector-to-Emitter Breakdown Voltage	I_C = 0.25mA, V_{EB} = 1.5V	–	BV_{CEV}	–	–	100	–	100	–	–	–	–	–	V
		I_C = 0.5mA, V_{EB} = 1.5V	–	BV_{CEV}	–	–	–	–	–	–	100	–	–	–	V
3011D	Collector-to-Emitter Sustaining Voltage	I_C = 50mA, I_B = 0	–	$V_{CEO}(sus)$	–	–	55	–	–	–	–	–	350	–	V
		I_C = 100mA•, I_B = 0	–	$V_{CEO}(sus)$	65	–	–	–	–	–	–	–	–	–	V
		I_C = 100mA, I_B = 0	–	$V_{CEO}(sus)$	–	–	–	–	55	–	55	–	–	–	V
3011B	Collector-to-Emitter Sustaining Voltage	I_C = 100mA•, R_{BE} = 10 Ω	–	$V_{CER}(sus)$	80	–	–	–	–	–	–	–	–	–	V
	Subgroup 3														
3071	Collector-to-Emitter Saturation Voltage	I_C = 50mA, I_B = 4mA	–	$V_{CE}(sat)$	–	–	–	–	–	–	–	–	–	0.5	V
		I_C = 150mA•, I_B = 15mA	5	$V_{CE}(sat)$	–	0.5	–	–	–	–	–	–	–	–	V
		I_C = 200mA, I_B = 10mA	–	$V_{CE}(sat)$	–	–	–	1.4	–	–	–	–	–	–	V
		I_C = 750mA, I_B = 40mA	–	$V_{CE}(sat)$	–	–	–	–	–	0.75	–	–	–	–	V
		I_C = 1.5A, I_B = 100mA	–	$V_{CE}(sat)$	–	–	–	–	–	–	–	1.0	–	–	V
3066A	Base-to-Emitter Saturation Voltage	I_C = 50mA, I_B = 4mA	–	$V_{BE}(sat)$	–	–	–	–	–	–	–	–	–	1.3	V
		I_C = 150mA•, I_B = 15mA	–	$V_{BE}(sat)$	–	1.1	–	–	–	–	–	–	–	–	V
3066A	Base-to-Emitter Voltage	I_C = 200mA, V_{CE} = 4V	–	V_{BE}	–	–	–	3.0	–	–	–	–	–	–	V
		I_C = 750mA, V_{CE} = 4V	–	V_{BE}	–	–	–	–	–	2.5	–	–	–	–	V
3076	DC Forward-Current Transfer Ratio	I_C = 0.01mA, V_{CE} = 10V	–	h_{FE}	10	–	–	–	–	–	–	–	–	–	
		I_C = 0.1mA, V_{CE} = 10V	–	h_{FE}	20	–	–	–	–	–	–	–	–	–	
		I_C = 2 mA, V_{CE} = 10V	–	h_{FE}	–	–	–	–	–	–	–	–	30	–	
		I_C = 20 mA, V_{CE} = 10V	–	h_{FE}	–	–	–	–	–	–	–	–	40	160	
		I_C = 150mA•, V_{CE} = 10V	–	h_{FE}	40	120	–	–	–	–	–	–	–	–	
		I_C = 200mA, V_{CE} = 4V	–	h_{FE}	–	–	35	100	–	–	–	–	–	–	
		I_C = 500mA•, V_{CE} = 10V	–	h_{FE}	25	–	–	–	–	–	–	–	–	–	
		I_C = 750mA, V_{CE} = 4V	–	h_{FE}	–	–	–	–	35	100	–	–	–	–	
		I_C = 1 A•, V_{CE} = 10V	–	h_{FE}	10	–	–	–	–	–	–	–	–	–	
		I_C = 1.5 A, V_{CE} = 4V	–	h_{FE}	–	–	–	–	–	–	25	75	–	–	

•Pulsed; pulse duration = 300µs, duty factor = 1.8%. *Lot tolerance per cent defective.

SILICON CONTROLLED-RECTIFIERS

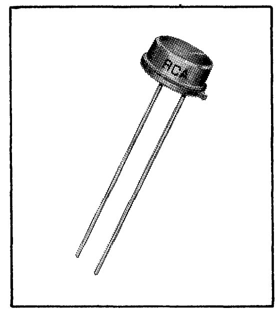
40378 40379

RCA-40378* and 40379* are all-diffused, three-junction silicon controlled-rectifiers (SCR's▲). They are intended for use in power-control and power-switching applications requiring a blocking voltage capability of up to 600 volts and a forward current capability of 7 amperes (rms) or 4.5 amperes (average value) at a case temperature of 60°C.

* Formerly Dev. Types TA2682 and TA2683, respectively.

▲ The silicon controlled-rectifier is also known as a reverse-blocking triode thyristor.

All-Diffused SCR's for Low-Cost Power-Control and Power-Switching Applications



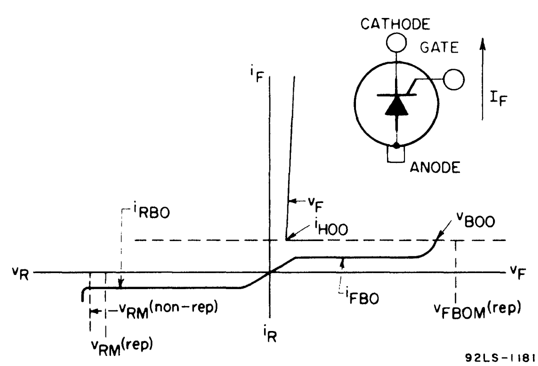
"Low-Profile" Package

40378	For 120-Volt Line Operation
40379	For 240-Volt Line Operation

FEATURES

- Small size for ultra-compact systems
- Shorted emitter gate-cathode construction
- Forward and reverse gate dissipation ratings
- Designed especially for high-volume low-cost electro-mechanical control
- High dv/dt capability
- All-diffused construction – assures exceptional uniformity and stability of characteristics
- Direct-soldered internal construction – assures exceptional resistance to fatigue
- Symetrical gate-cathode construction – provides uniform current density, rapid electrical conduction, and efficient heat dissipation
- All-welded construction and hermetic sealing
- Low switching losses
- Low leakage currents, both forward and reverse
- Low forward voltage drop at high current levels
- Low thermal resistance

TYPICAL E-I CHARACTERISTIC OF SILICON CONTROLLED-RECTIFIER



Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at a Frequency between 50 and 400 cps, and with Resistive or Inductive Load

RATINGS	CONTROLLED-RECTIFIER TYPES 40378	40379	UNITS
Transient Peak Reverse Voltage (Non-Repetitive), $v_{RM}(non\text{-}rep)^a$	330	660	volts
Peak Reverse Voltage (Repetitive), $v_{RM}(rep)^b$	200	400	volts
Peak Forward Blocking Voltage (Repetitive), $v_{FBOM}(rep)^c$	600	600	volts
Forward Current:			
For case temperature (T_C) of + 60° C			
Average DC value at a conduction angle of 180°, I_{FAV}^d	4.5	4.5	amperes
RMS value, I_{FRMS}^e	7	7	amperes
For other conditions, See *Figure 5*.			
Peak Surge Current, $i_{FM}(surge)^f$:			
For one cycle of applied voltage	80	80	amperes
For more than one cycle of applied voltage	See Fig. 7	See Fig. 7	
Gate Power*:			
Peak, Forward or Reverse, for 10 μs duration, P_{GM}^g (See *Figures 2 and 3*)	13	13	watts
Average, P_{GAV}^h	0.2	0.2	watt
Temperature♦:			
Storage, T_{stg}	−40 to +150	−40 to +150	°C
Operating (Case), T_C	−40 to +100	−40 to +100	°C
For Rated Peak Forward Breakover Voltage □	100	100	°C
For Rated Peak Reverse Voltage□	175	175	°C

* Any values of peak gate current or peak gate voltage to give the maximum gate power is permissible.

♦ For information on permissible soldering temperature and on the reference zone of temperature measurement, see *Cooling Considerations* on page 6 and *Dimensional Outline* on page 7, respectively.

□ These devices are operated normally at a junction temperature (T_j) of up to 100 °C. Occasional operation, under conditions such as overload, is permissible up to a junction temperature of 175 °C; but above 100 °C, forward blocking voltage will not be maintained.

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

CHARACTERISTICS	CONTROLLED-RECTIFIER TYPES						UNITS
	40378			40379			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Forward Breakover Voltage, v_{BOO}[j]:							
At T_C = +100 °C	200	–	–	400	–	–	volts
Peak Blocking Current, at T_C = +100 ° C:							
Forward, I_{FBOM}[k]	–	0.1	1.0	–	0.2	2	mA
V_{FBO}[m] = v_{BOO} (min. value)							
Reverse, I_{RBOM}[n]	–	0.05	0.5	–	0.1	1	mA
V_{RBO}[m] = v_{RM}(rep) value							
Forward Voltage Drop, v_F[p]:							
At a Forward Current of 30 amperes and a T_C = +25°C (See *Figure 8*)	–	1.9	2.5	–	1.9	2.5	volts
DC Gate-Trigger Current, I_{GT}[q]:							
At T_C = +25°C (See *Figure 2*)	–	8	15	–	8	15	mA(dc)
Gate-Trigger Voltage, V_{GT}[r]:							
At T_C = +25°C (See *Figure 2*)	–	1.2	2	–	1.2	2	volts (dc)
Holding Current, i_{HOO}[s]:							
At T_C = +25°C	–	12	–	–	12	–	mA
Critical Rate of Applied Forward Voltage, Critical dv/dt[t]	10	200	–	20	200	–	volts/μs
V_{FB} = v_{BOO} (min. value), exponential rise, TC = 100°C (See waveshape of *Figure 1*)							
Thermal Resistance, Junction-to-Case	–	–	5	–	–	5	°C/W

WAVESHAPE OF CRITICAL dv/dt RATING TEST

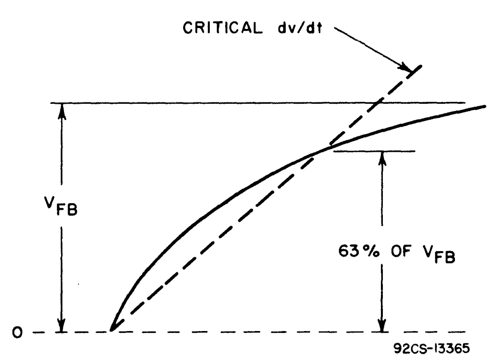


Figure 1

FORWARD GATE CHARACTERISTICS

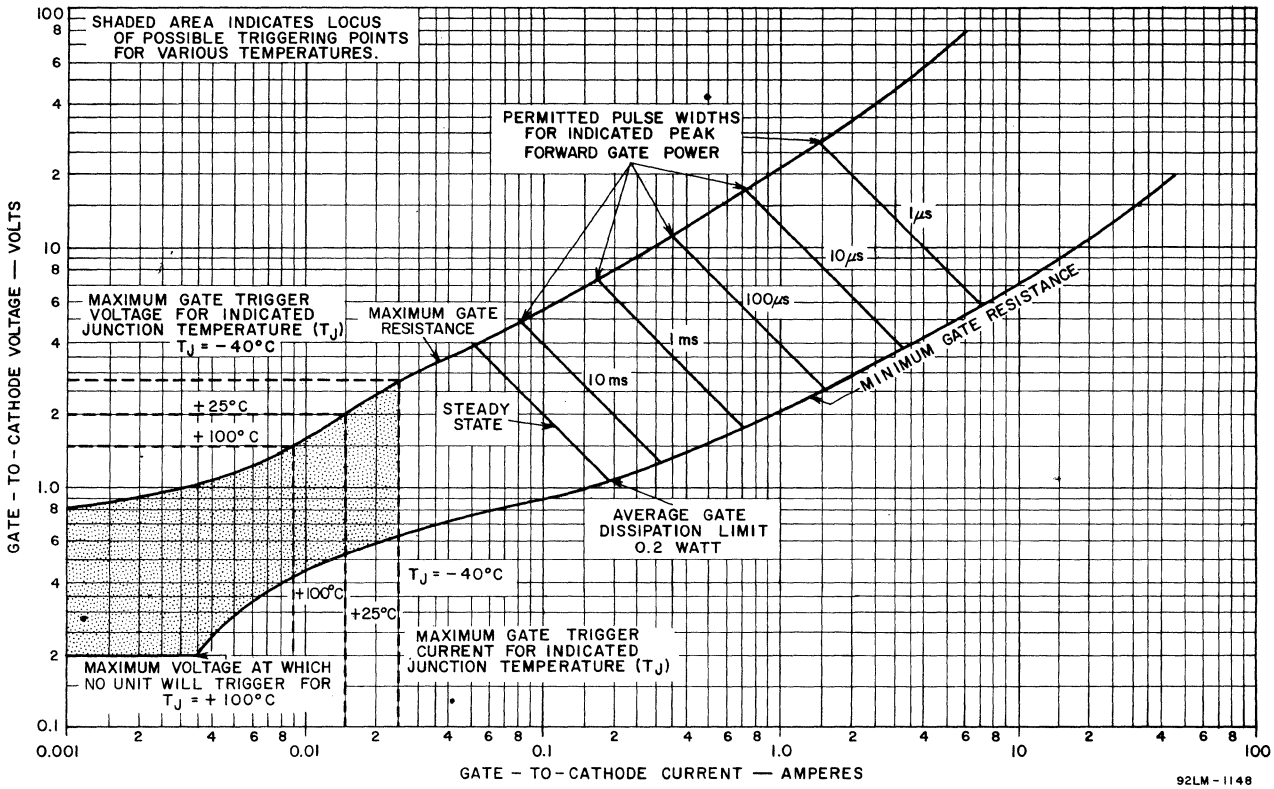


Figure 2

REVERSE GATE CHARACTERISTICS

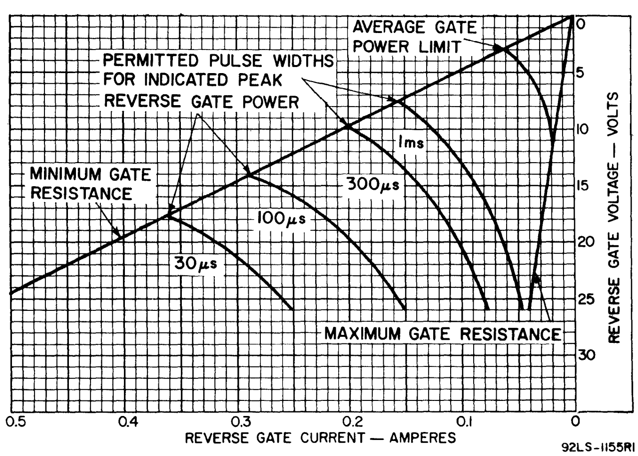


Figure 3

TRIGGERING CONSIDERATIONS

The construction of the gate-cathode junction used in these devices provides a large periphery center gate and employs shorted-emitter design which removes restrictions on both forward and reverse peak gate voltage and peak gate current. Limiting values of volt-ampere products for different gate pulse widths are shown in Figure 2. These limits should be adhered to when designing pulse trigger circuits for maximum trigger pulse widths and peak power dissipation. The volt-ampere products in the reverse direction shown in Figure 3 should be used to determine limitations for reverse gate transients or reverse gate pulses if present. In all cases, total average gate dissipation, both forward and reverse, should not exceed the average gate dissipation rating (P_{GAV}) of 0.2 watt.

Turn-on times for different gate currents are shown in Figure 4. These curves may be used to determine the required width of the gate trigger pulses. It is only necessary to maintain the gate trigger pulse until the magnitude of the forward anode current has reached the latching current value. However, conservative design requires that the gate trigger pulse width be at least equal to or somewhat greater than the device turn-on time. Some applications may require wider gate pulse widths for proper circuit operation. Additional information on gate characteristics and triggering requirements for use in pulse applications are contained in RCA Application Note, SMA-39, "Gate Parameters of RCA SCR's for Trigger Circuit Design".

TURN-ON TIME CHARACTERISTICS

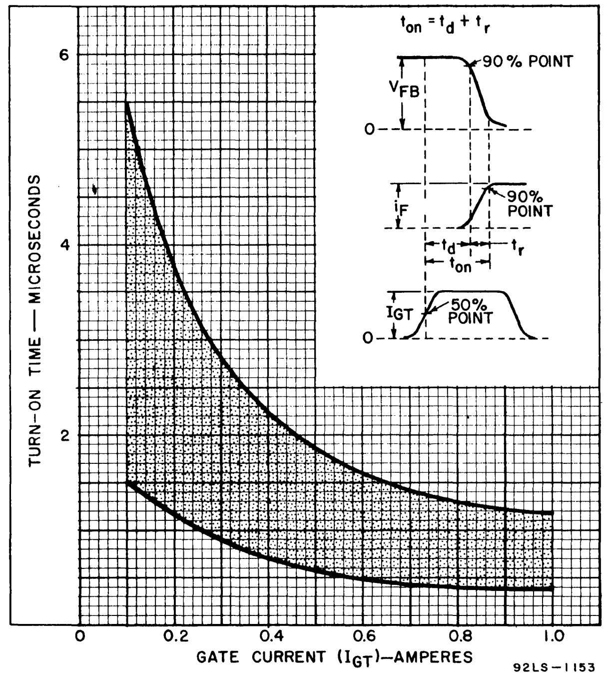


Figure 4

RATING CHART (CASE TEMPERATURE)

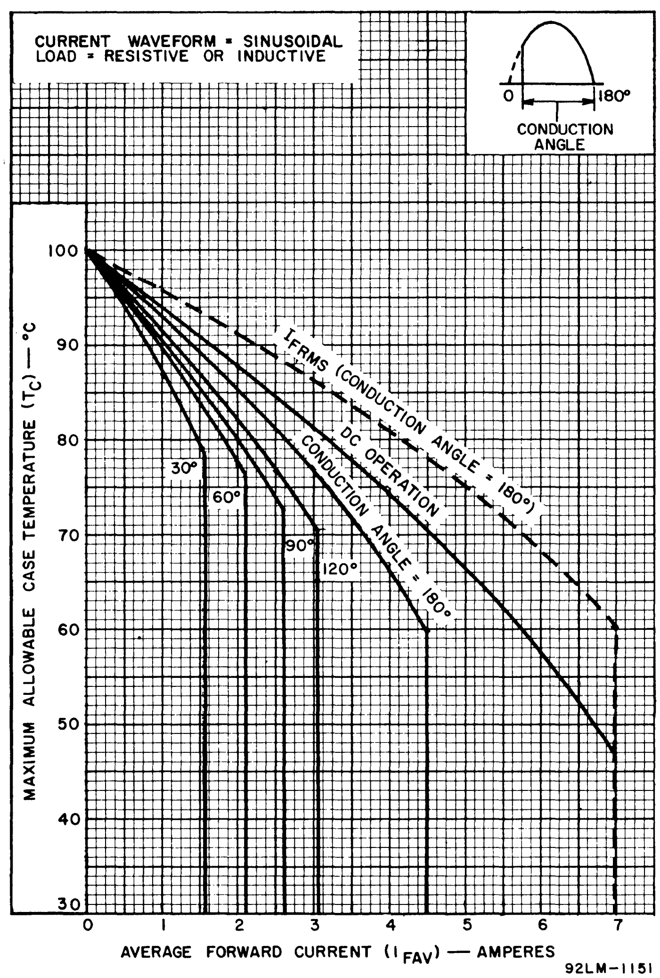


Figure 5

POWER DISSIPATION

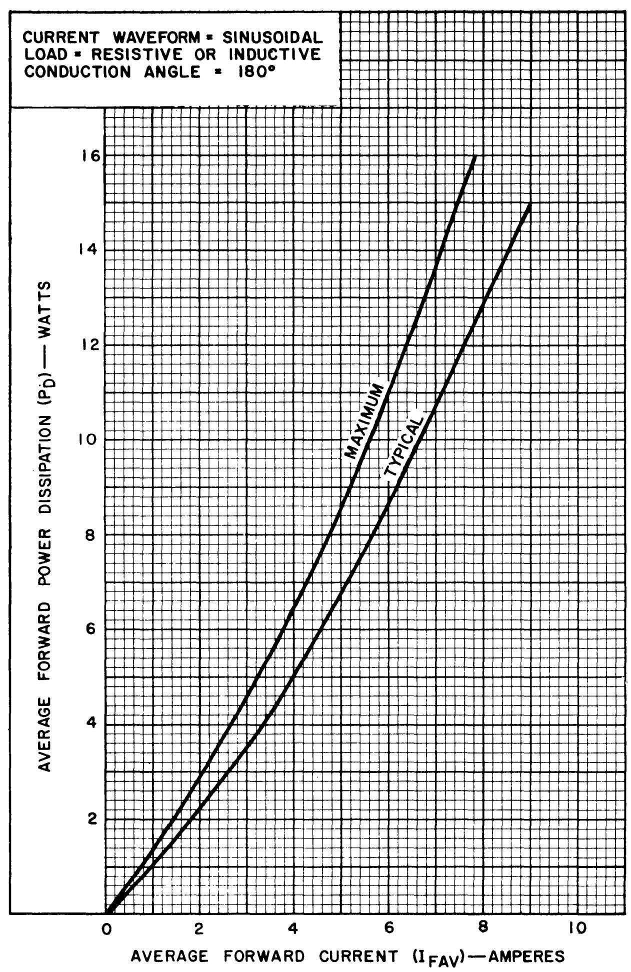


Figure 6

SURGE CURRENT RATING

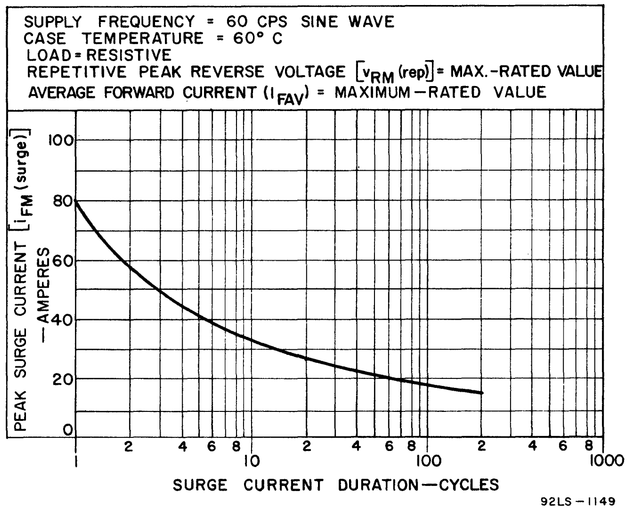


Figure 7

FORWARD CHARACTERISTICS

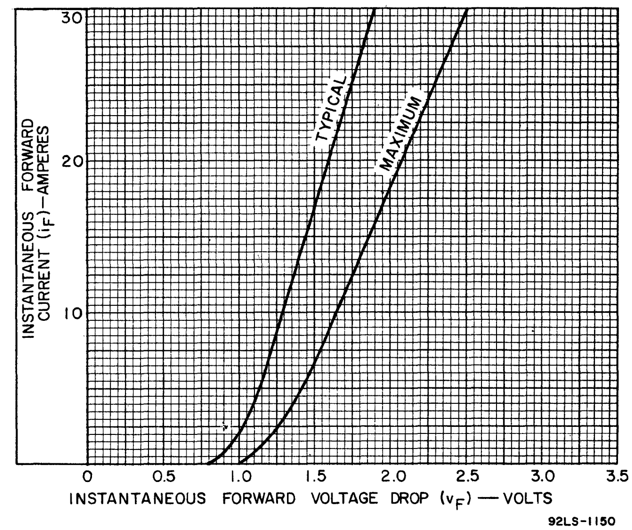


Figure 8

COOLING CONSIDERATIONS

HEAT SINK GUIDANCE

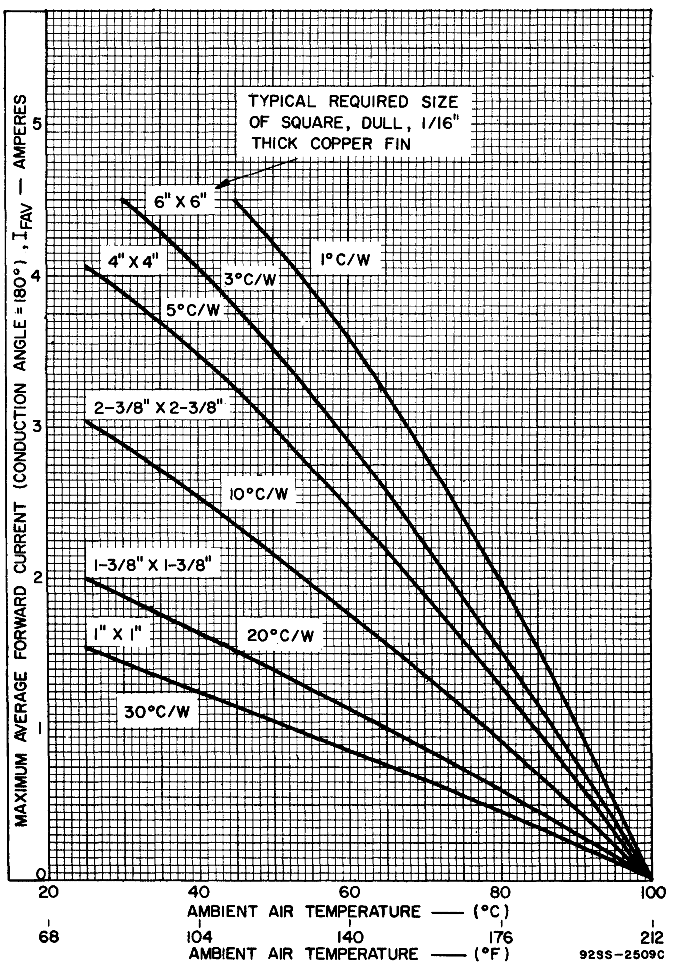


Figure 9

The thermal resistance of the heat sink needed to operate these devices at a given temperature and a specific ambient air temperature, when the unit is soldered base to the heat sink, is shown in Figure 9. For example: at a forward current of 2 amperes and an ambient air temperature of 54.5° C (130° F), the maximum allowable thermal resistance for the required heat sink is 10° C/W. When the device is mounted in this manner, the heat sink should be in contact with at least half of the base area.

Mounting is also possible with the cap top soldered to the heat sink, however, an additional thermal resistance requirement of 8° C/W from case to heat sink is encountered. Thus, with the device mounted in this manner and at the forward current of 2 amperes and the ambient air temperature of 54.5° C, the maximum allowable thermal resistance for the heat sink is 2° C/W.

When these devices are soldered directly to the heat sink, a 60-40 solder which has a melting point of 188°C should be used. Exposure time should only be sufficient to cause the solder to flow freely.

CONTROLLED-RECTIFIER TERMS, SYMBOLS, AND DEFINITIONS

a **Transient Peak Reverse Voltage (Non-repetitive)**— v_{RM}(non-rep) - The maximum value of negative (reverse blocking) voltage which may be applied between the anode and cathode for not more than 5 milliseconds when the gate is open (gate voltage is zero or negative with respect to cathode).

b **Peak Reverse Voltage (Repetitive)** - v_{RM}(rep) - The maximum instantaneous value of negative (reverse blocking) voltage which may be applied repetitively between the anode and cathode when the gate is open.

c **Peak Forward Blocking Voltage (Repetitive)** - v_{FBOM}(rep) - The maximum instantaneous value of positive (forward blocking) voltage which may be applied repetitively between the anode and cathode when the gate is open.

d **Average Forward Current** - I_{FAV} - The average (dc) value of the current flowing from anode to cathode in the device.

e **RMS Forward Current** - I_{FRMS} - The RMS value of the current flowing from anode to cathode in the device.

f **Peak Surge Current** - i_{FM}(surge) - The maximum total instantaneous value of forward current which may be imposed during one forward half-cycle with the device operating within its specified maximum voltage, average-forward-current, gate-power, and temperature ratings in a single-phase circuit with 60-cps supply and resistive load. The peak surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

g **Peak Forward and Reverse Gate Power** - P_{GM} - The maximum instantaneous power dissipated between gate and cathode for a specified time duration.

h **Average Forward Gate Power** - P_{GAV} - The average power dissipated between gate and cathode.

i **Forward Breakover Voltage** - v_{BOO} - The value of positive anode voltage at which a controlled rectifier may switch into the conducting state when the gate is open.

k **Peak Forward Blocking Current** - I_{FBOM} - The maximum value of the forward blocking current of a controlled rectifier with gate open.

m **Forward and Reverse Blocking Voltage** - V_{FBO}, V_{RBO} - The value of voltage applied between anode and cathode with the gate open.

n **Peak Reverse Blocking Current** - I_{RBOM} - The maximum value of the reverse blocking current of a controlled rectifier with gate open.

p **Forward Voltage Drop** - v_F - The instantaneous voltage drop across a controlled rectifier at a given instantaneous forward current i_F and under steady-state conditions.

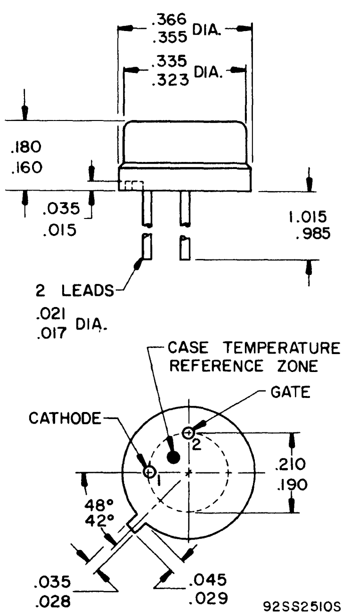
q **Gate-Trigger Current** - I_{GT} - The gate current required to trigger a controlled rectifier operating at a specified temperature when the anode is at a potential of +6 volts with respect to the cathode.

r **Gate-Trigger Voltage** - V_{GT} - The gate-to-cathode voltage required to trigger a controlled rectifier operating at a specified temperature when the anode is at a potential of +6 volts with respect to the cathode.

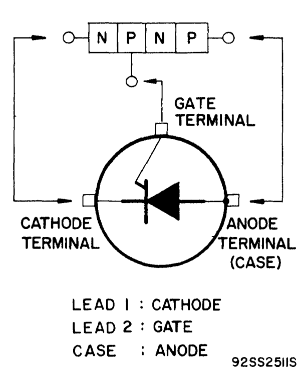
s **Holding Current** - i_{HOO} - The instantaneous value of forward current i_F below which a controlled rectifier with its gate open returns to its forward blocking state.

t **Critical Rate of Applied Forward Voltage** - Critical dv/dt - The critical rate of applied forward voltage is the minimum value of the rate of applied forward voltage which will cause switching from the off-state to the on-state under stated conditions.

DIMENSIONAL OUTLINE



TERMINAL DIAGRAM



RF TRANSISTOR

40404

RCA-40404* is an epitaxial planar transistor of the silicon npn type, particularly suitable for low-level class-C rf-amplifier and frequency-multiplier service at output frequencies up to 170 Mc/s.

As a straight-through power amplifier, the 40404 can deliver up to 500 mW of rf output power at relatively low supply voltages. As a frequency doubler, it can deliver 70 mW (typ.) at an output frequency of 86 Mc/s.

The 40404 is especially useful in battery-operated transmitter systems and other applications requiring high efficiency and high power gain at low supply voltages.

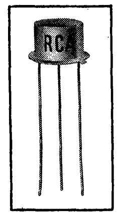
The 40404 is hermetically sealed in the compact JEDEC TO-52 package.

ABSOLUTE-MAXIMUM RATINGS:

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}		40 V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}		16 V
EMITTER-TO-BASE VOLTAGE, V_{EBO}		5 V
COLLECTOR CURRENT, I_C		500 mA
TRANSISTOR DISSIPATION, P_T:		
For case temperatures	up to 25°C	1 W
	above 25°C	See Fig. 1
For ambient temperatures	up to 25°C	0.3 W
	above 25°C	See Fig. 1
TEMPERATURE RANGE:		
Storage		-65 to +200°C
Operating		-65 to +175°C
LEAD TEMPERATURE (During Soldering):		
At distances greater than 1/16" from seating surface for 10 seconds max.		300°C

*Formerly Developmental Type TA2726.

SILICON NPN EPITAXIAL PLANAR TRANSISTOR



For Low-Level Class C RF-Amplifier and Frequency-Multiplier Service in Communications Equipment

- Excellent performance as a frequency multiplier—
  - P_{OUT} = 70 mW typ., G_P = 11.5 db typ., η = 40% typ. — As 43 to 86 Mc/s Doubler
  - P_{OUT} = 30 mW typ., G_P = 7.5 dB typ., η = 20% typ. — As 40 to 120 Mc/s Tripler
- High power gain and power output as unneutralized class C amplifier—
  - G_{pe} = 10 dB typ., P_{OUT} = 100 mW typ. — At 86 Mc/s
- Low output capacitance—
  - C_{ob} = 2.5 pF typ.
- High gain-bandwidth product—
  - f_T = 700 Mc/s typ.
- Hermetically sealed JEDEC TO-52 package

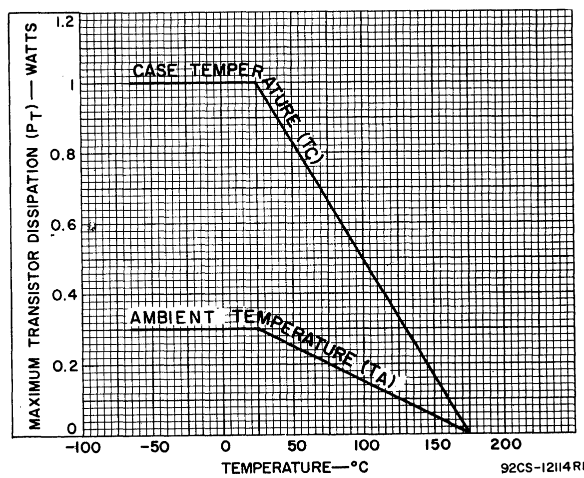


Fig.1 - Rating Chart for RCA-40404.

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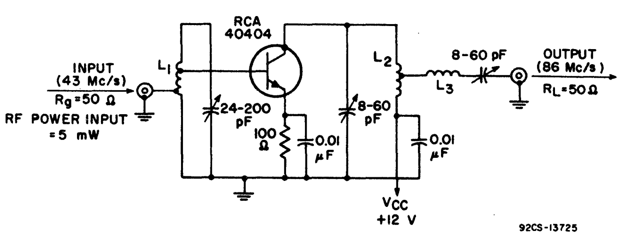
40404 6-66
Reprinted from Issue dated 12-65

ELECTRICAL CHARACTERISTICS, at $T_A = 25°C$

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS: FREQUENCY f (Mc/s)	DC COLLECTOR VOLTAGE V_{CB} (V)	DC COLLECTOR VOLTAGE V_{CE} (V)	DC EMITTER CURRENT I_E (mA)	DC BASE CURRENT I_B (mA)	DC COLLECTOR CURRENT I_C (mA)	LIMITS RCA 40404 Min.	Max.	Units
Collector-Curoff Current	I_{CBO}		20		0			-	25	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.1	40	-	V
Collector-to-Emitter Breakdown Voltage*	BV_{CEO}					0	10	16	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.01		0	5	-	V
Static Forward Current-Transfer Ratio	h_{FE}			2			50	25	65	
Common-Base, Open-Circuit Output Capacitance	C_{ob}	0.1 to 1	5		0			-	4	pF
RF Power Output as a Frequency Doubler	P_{OUT}	f_{IN} = 43 Mc/s, f_{OUT} = 86 Mc/s, RF Power Input = 5 mW	See Fig.2					50	-	mW
Efficiency as a Frequency Doubler	η	f_{IN} = 43 Mc/s, f_{OUT} = 86 Mc/s	See Fig.2					35	-	%

*Pulse Test: Pulse Duration ≤ 100 ns, Duty Factor ≤ 0.02.



TYPICAL PERFORMANCE CHARACTERISTICS

RF Output Power . . . . 70 mW
Power Gain . . . . 11.5 dB
Efficiency . . . . 40 %

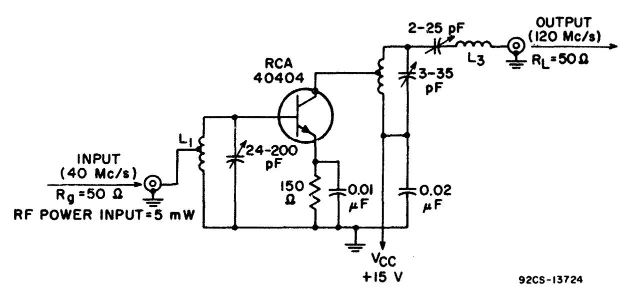
L_1: 4 turns, tapped at 1 turn and 3 turns from rf-ground end

L_2: 5 turns, tapped at 2 turns from rf-ground end

L_3: 4-1/2 turns

All windings #16 AWG, 1/4" I.D., turns spaced approximately 1 wire diameter.

Fig.2 - Typical Frequency Doubler (43 Mc/s to 86 Mc/s) Circuit Using RCA-40404.



TYPICAL PERFORMANCE CHARACTERISTICS

RF Output Power (120 Mc/s) . . . . 30 mW
Power Gain . . . . 7.5 dB
Efficiency . . . . 20 %

L_1: 4 turns #16 AWG, 1/4" I.D.; tapped at 2-1/2 turns from rf-ground end

L_2: 3-1/2 turns #16 AWG, 1/4" I.D.; tapped at 3 turns from rf-ground end

L_3: 2 turns #16 AWG, 3/16" I.D.

Turns on all windings spaced approximately 1 wire diameter.

Fig.3 - Typical Frequency-Tripler (40 Mc/s - 120 Mc/s) Circuit Using RCA-40404.

TYPICAL CHARACTERISTICS

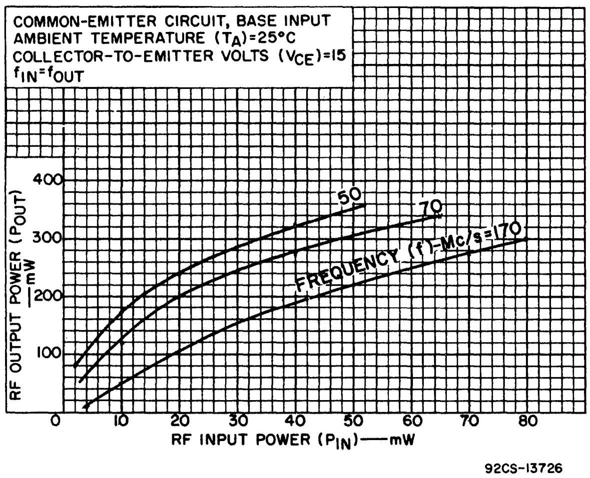


Fig.4 - RF Output Power vs. RF Input Power for RCA-40404.

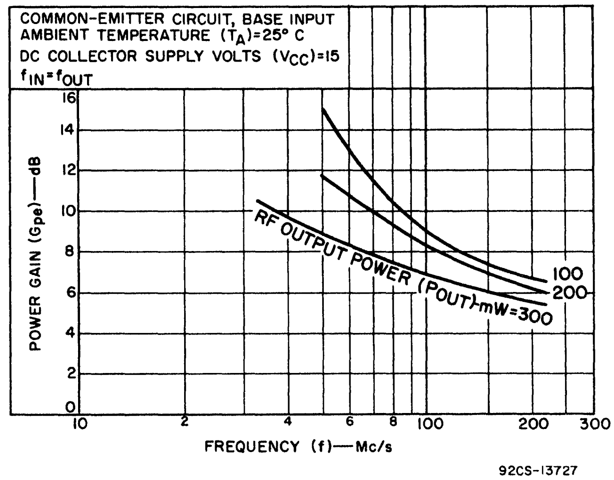


Fig.5 - Power Gain vs. Frequency for RCA-40404.

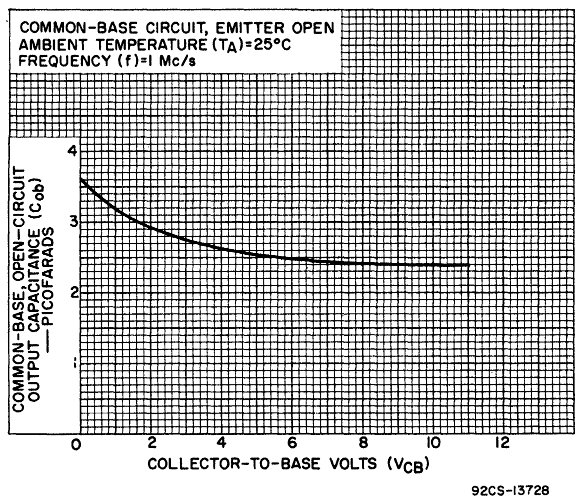
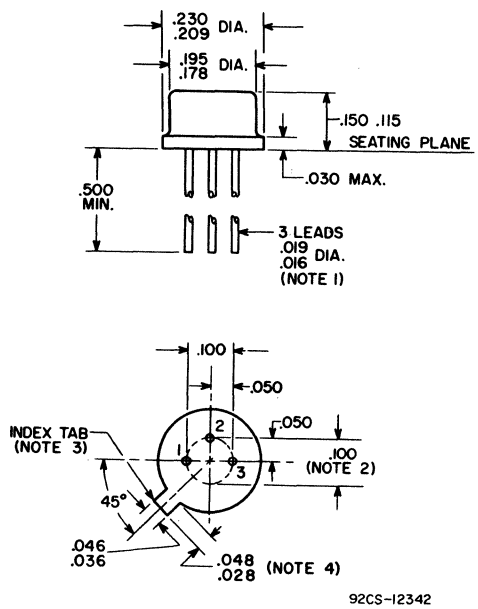


Fig.6 - Output Capacitance vs. Collector-to-Base Voltage for RCA-40404.

DIMENSIONAL OUTLINE
JEDEC No. TO-52



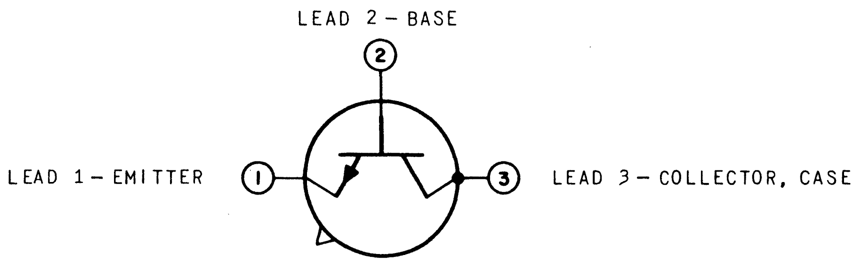
Note 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 0.500 INCH OF THE LEAD, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH–0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: MEASURED FROM MAXIMUM DIAMETER OF ACTUAL DEVICE.

TERMINAL DIAGRAM
Bottom View



RCA-40405* is an epitaxial planar transistor of the silicon npn type, particularly suitable for class-C rf power-amplifier, driver, and frequency-multiplier service at output frequencies up to 400 Mc/s. The 40405 is especially useful in battery-operated transmitter systems and other applications requiring high efficiency and high power gain at low supply voltages.

As a straight-through power amplifier or driver the 40405 can deliver up to 700 mW of rf output power. In a typical amplifier application (see Fig.2) it can provide a power output of 400 mW with a power gain of 6 dB and an efficiency of 50% at 240 Mc/s.

As a frequency multiplier, the 40405 can double, triple, and quadruple with high efficiency and high power gain. In a typical application as a frequency doubler from 120 to 240 Mc/s (see Fig.4) the 40405 can provide a power output of 160 mW with a power gain of 6.5 dB and an efficiency of 55%.

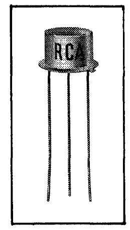
The 40405 is hermetically sealed in the compact JEDEC TO-52 package.

* Formerly Developmental Type TA2629.

Absolute-Maximum Ratings:

COLLECTOR-TO-EMITTER VOLTAGE, V_{CES}	40 V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	16 V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	6 V
COLLECTOR CURRENT, I_C	500 mA
TRANSISTOR DISSIPATION, P_T:	
For case temperatures up to 25° C	1 W
For case temperatures above 25° C	See Fig.1
For ambient temperatures up to 25° C	0.3 W
For ambient temperatures above 25° C	See Fig.1
TEMPERATURE RANGE:	
Storage	-65 to +200° C
Operating	-65 to +175° C
LEAD TEMPERATURE (During soldering):	
At distances greater that 1/16" from seating surface for 10 seconds max.	300° C

SILICON NPN EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-52

For Class-C RF-Amplifier, Driver, and Frequency-Multiplier Service in Battery-Operated Communications Equipment

FEATURES:

- High power gain and high efficiency as unneutralized class C amplifier –
  - G_{pe} = 10 dB typ., P_{OUT} = 250 mW typ., η = 60% typ. } at 170 Mc/s
  - G_{pe} = 6 dB typ., P_{OUT} = 400 mW typ., η = 50% typ. } at 240 Mc/s
- Excellent performance as a frequency multiplier –
  - G_{pe} = 6.5 dB typ., P_{OUT} = 160 mW typ., η = 55% typ. } as 120 -240 Mc/s doubler
- High minimum gain-bandwidth product at high current and low voltage –
  - f_T = 300 Mc/s min. at I_C = 100 mA, V_{CE} = 1 V
- High typical gain-bandwidth product –
  - f_T = 850 Mc/s typ. at I_C = 10 mA, V_{CE} = 10 V
- Low output capacitance –
  - C_{ob} = 1.8 pF typ.
- Hermetically sealed JEDEC TO-52 package

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40405 6-66
Reprinted from Issue dated 12-65

ELECTRICAL CHARACTERISTICS, at $T_A = 25^o C$

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS: FREQUENCY f (Mc/s)	DC COLLECTOR-TO-BASE VOLTAGE V_{CB} (V)	DC COLLECTOR TO-EMITTER VOLTAGE V_{CE} (V)	DC BASE-TO EMITTER VOLTAGE V_{BE} (V)	DC BASE CURRENT I_B (mA)	DC EMITTER CURRENT I_E (mA)	DC COLLECTOR CURRENT I_C (mA)	LIMITS RCA 40405 Min.	Max.	Units
Collector-Cutoff Current	I_{CES}			15	0				–	0.4	μA
Collector-to-Emitter Breakdown Voltage*	BV_{CEO}					0		10	16	–	V
Collector-to-Emitter Breakdown Voltage	BV_{CES}				0			5	40	–	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}						0.01	0	6	–	V
Static Forward Current-Transfer Ratio	h_{FE}			1				100	20	–	–
Small-Signal Forward Current-Transfer Ratio	h_{fe}	100		1				100	3	–	–
Common-Base, Open-Circuit Output Capacitance	C_{ob}	0.1 to 1	5				0		–	3.5	pF
Power Output as a Frequency Doubler	P_{OUT}	f_{IN}=86 Mc/s f_{OUT}=172 Mc/s RF Power Input=30 mW		See Fig.3					200	–	mW
Efficiency as a Frequency Doubler	η	f_{IN}=86 Mc/s f_{OUT}=172 Mc/s		See Fig.3					35	–	%

* Pulse Test: Pulse Duration ≤ 100μs, Duty Factor ≤ 0.02.

RATING CHART FOR RCA-40405

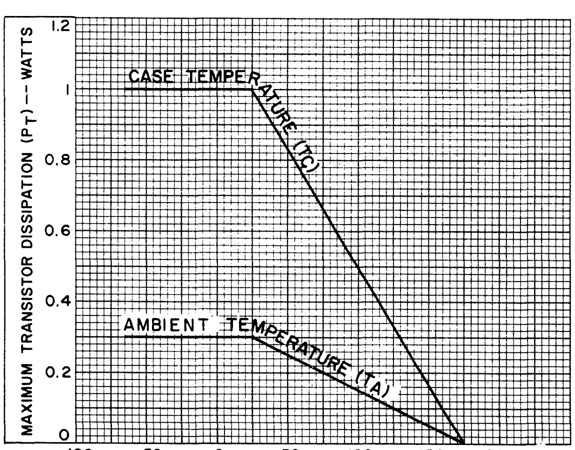
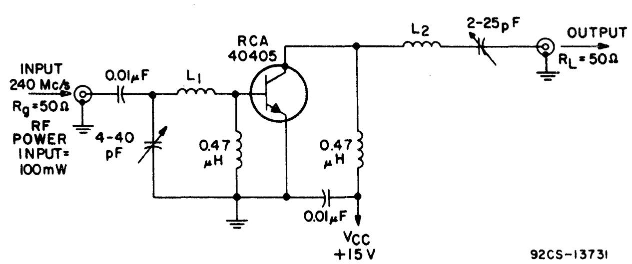


Fig.1

TYPICAL 240-Mc/s CLASS-C POWER-AMPLIFIER CIRCUIT USING RCA-40405



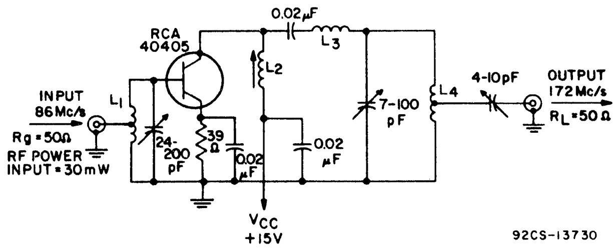
L_1: 2 turns #16 AWG, 1/8"I.D.
L_2: 3-1/2 turns #16 AWG, 1/4" I.D.
Turns spaced approximately 1 wire diameter

TYPICAL PERFORMANCE CHARACTERISTICS

Operating Frequency	240 Mc/s
RF Output Power	400 mW
Power Gain	6 dB
Efficiency	50 %

Fig.2

TYPICAL FREQUENCY DOUBLER (86 Mc/s - 172 Mc/s) CIRCUIT USING RCA-40405



L_1: 5 turns #16 AWG, tapped 3-1/2 turns from rf-ground end

L_2: 4 turns #18 AWG, slug-tuned

L_3: 6 turns #18 AWG

L_4: 3-1/2 turns #16 AWG, tapped 2-1/2 turns from rf-ground end

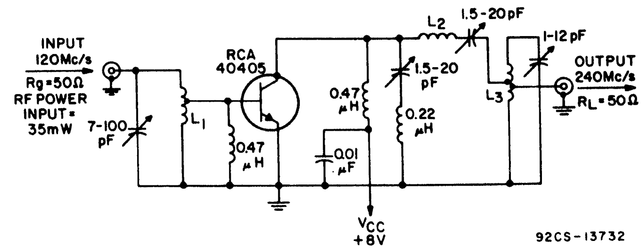
All windings 1/4"I.D.; turns spaced approximately 1 wire diameter

TYPICAL PERFORMANCE CHARACTERISTICS

RF Output Power (172 Mc/s)	250	mW
Power Gain	9.2	dB
Efficiency	40	%

Fig.3

TYPICAL FREQUENCY-DOUBLER (120 to 240 Mc/s) CIRCUIT USING RCA-40405



L_1: 3-1/2 turns #18 AWG, 1/4" I.D., tapped at 2 turns from rf-ground end

L_2: 3-1/2 turns #20 AWG, 1/8" I.D.

L_3: 3 turns #16 AWG, 1/8" I.D., tapped at 1 turn and 1-1/2 turns from rf-ground end

Turns on all windings spaced approximately 1 wire diameter

TYPICAL PERFORMANCE CHARACTERISTICS

RF Power Output (240 Mc/s).	160	mW
Power Gain	6.5	dB
Efficiency	55	%

Fig.4

RF OUTPUT POWER VS FREQUENCY FOR RCA-40405.

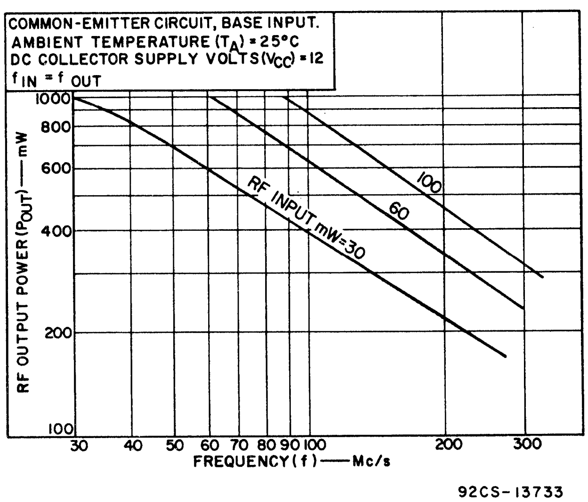


Fig.5

GAIN-BANDWIDTH PRODUCT VS COLLECTOR CURRENT FOR RCA-40405

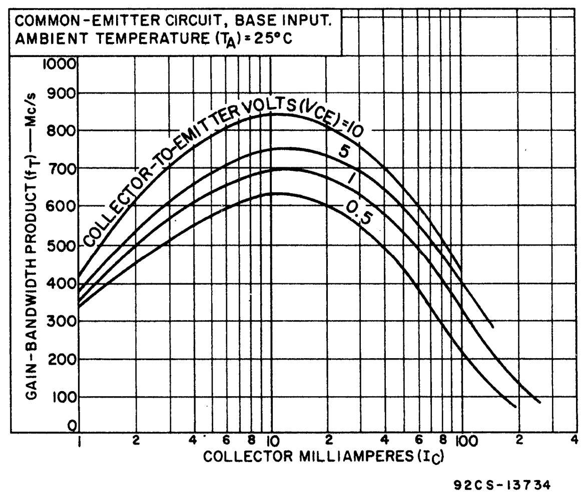
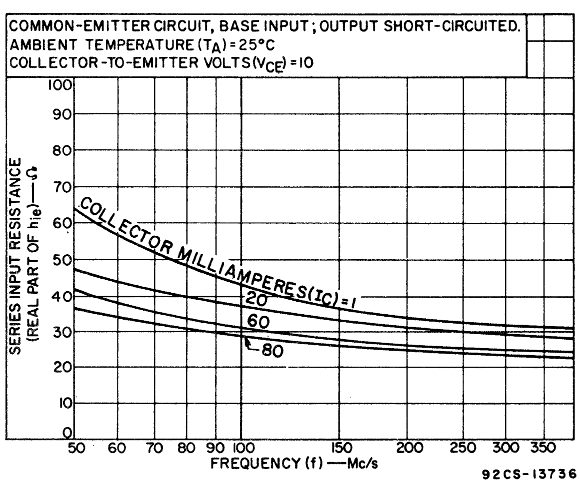


Fig.6



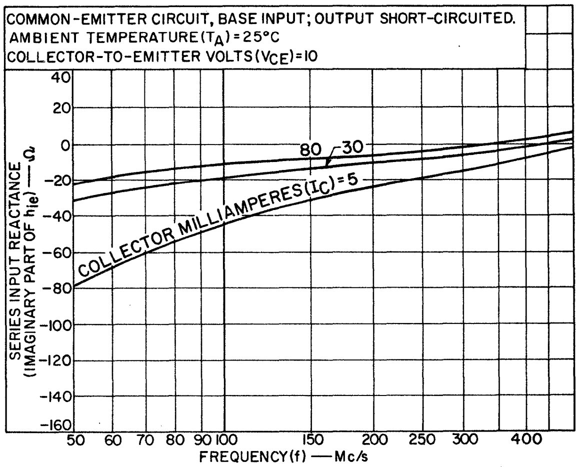
SERIES INPUT RESISTANCE VS FREQUENCY FOR RCA-40405

Fig.7

TYPICAL CHARACTERISTICS

TYPICAL CHARACTERISTICS

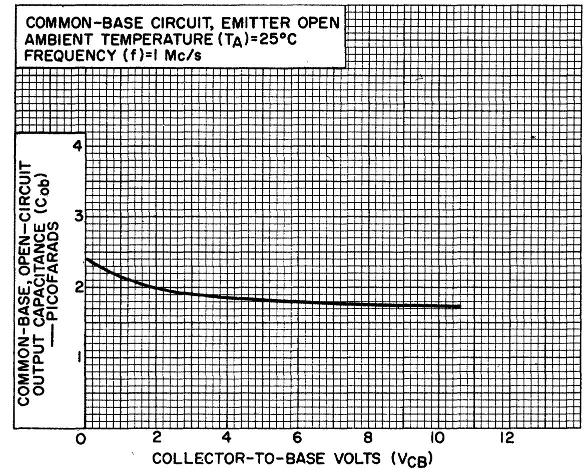
SERIES INPUT REACTANCE VS FREQUENCY FOR RCA-40405



92CS-13735

Fig.8

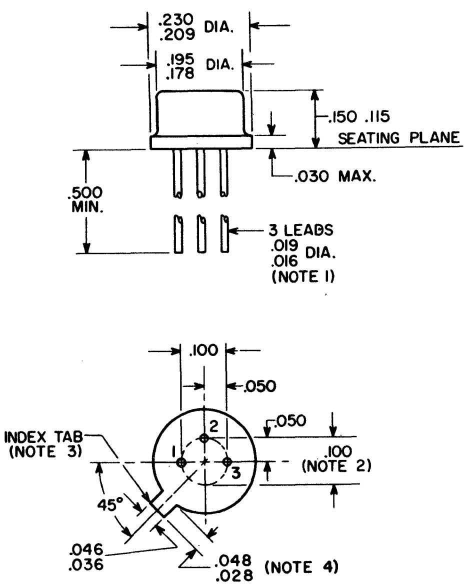
OUTPUT CAPACITANCE VS COLLECTOR-TO-BASE VOLTAGE FOR RCA-40405



92CS-13729

Fig.9

DIMENSIONAL OUTLINE
JEDEC No. TO-52



92CS-12342

Dimensions in Inches

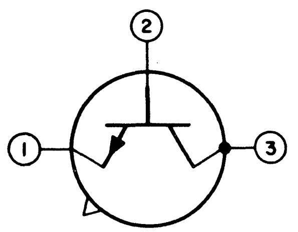
Note 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 0.500 INCH OF THE LEAD, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: LEADS HAVING MAXIMUM DIAMETER (0.019 INCH) MEASURED IN GAUGING PLANE 0.054 INCH + 0.001 INCH–0.000 INCH BELOW THE SEATING PLANE OF THE DEVICE SHALL BE WITHIN 0.007 INCH OF THEIR TRUE LOCATIONS RELATIVE TO A MAXIMUM-WIDTH TAB.

NOTE 3: INDEX TAB FOR VISUAL ORIENTATION ONLY.

NOTE 4: MEASURED FROM MAXIMUM DIAMETER OF ACTUAL DEVICE.

TERMINAL DIAGRAM
Bottom View



LEAD 1 – EMITTER

LEAD 2 – BASE

LEAD 3 – COLLECTOR, CASE

RCA-40406 through 40411 are diffused-junction, silicon n-p-n and p-n-p transistors intended for a variety of uses in audio amplifiers. Giving high-quality performance economically, these 6 devices have power dissipation ratings of 1 to 150 watts. Supply voltages for these types range from 50 volts for the 40406 and 40407, to 90 volts for the 40408-40411.

Silicon N-P-N & P-N-P Power Transistors for Audio Amplifier Applications

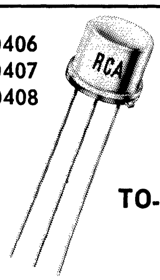
40406 & 40407
- V_{CEO}(sus) = −50 V max. (40406)
- V_{CEO}(sus) = 50 V max. (40407)
- Type 40406 is P-N-P complement of type 40407
- 1 watt dissipation rating
- TO-5 package

40408
- V_{CEO}(sus) = 90 V max.
- 1 watt dissipation rating
- N-P-N type in JEDEC TO-5 package

40409 & 40410
- V_{CER}(sus) = 90 V max. (40409)
- V_{CER}(sus) = −90 V max. (40410)
- Type 40410 is P-N-P complement of type 40409
- 3 watt free-air dissipation rating
- TO-5 package with heat radiator

40411
- V_{CER}(sus) = 90 V max.
- "Hometaxial-base" type
- 150 watt dissipation rating
- N-P-N type in JEDEC TO-3 package

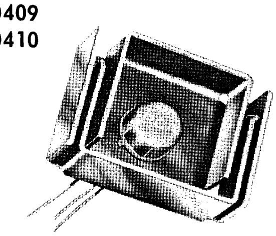
40406
40407
40408



TO-5

H-1380

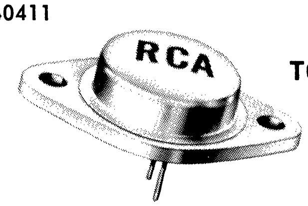
40409
40410



TO-5 with Heat Radiator

H-1468

40411



TO-3

H-1339

MAXIMUM RATINGS *Absolute-Maximum Values:*	40406	40407	40408	40409	40410	40411	UNITS
DC Collector-to-Emitter Sustaining Voltage:							
With Base Open, V_{CEO}(sus)	−50	50	90	–	–	–	V
With R_{BE} = 100 Ω, V_{CER}(sus)	–	–	–	90	−90	90	V
DC Emitter-to-Base Voltage:							
With Collector Open, V_{EBO}	−4	4	4	4	−4	4	V
DC Collector Current, I_C	−0.7	0.7	0.7	0.7	−0.7	30	A
DC Base Current, I_B	−0.2	0.2	0.2	0.2	−0.2	15	A
Transistor Power Dissipation (P_T):							
At Free Air Temperatures up to 25° C	1	1	1	–	–	–	W
At Free Air Temperatures up to 50° C	–	–	–	3	3	–	W
At Case Temperatures up to 25° C	–	–	–	–	–	150	W
At Other Temperatures		See *Fig.1*			See *Fig.2*	See *Fig.3*	
Operating Junction Temperature Range				−65 to +200			°C

ELECTRICAL CHARACTERISTICS

Characteristic	TEST CONDITIONS						LIMITS											
	V_{CB}	V_{CE}	V_{EB}	I_C	I_B	T_C	40406		40407		40408		40409		40410		40411	
	Volts			mA		°C	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
I_{CEO}		40[a]				25		-1μA		1μA								
		80				25						1μA						
		40[a]				150		-10μA		100μA								
		80				150						250μA						
I_{CER}[b]		80[a]				25								1μA		-1μA		500μA
		80[a]				150								100μA		-100μA		2mA
I_{CBO}	10									0.25 μA								
I_{EBO}			4[a]					-1 mA		1 mA		1 mA		1 mA		-1 mA		5 mA
$V_{CEO}(sus)$				100[a]			-50 V		50 V		90 V							
$V_{CER}(sus)$[b]				100[a]									90 V		-90 V			
				200													90 V	
$V_{CE}(sat)$				150[a]	15							1.4 V		1.4 V		-1.4 V		
				4A	400													0.8 V
V_{BE}		-10		-0.1				-0.8 V										
		10		1						0.8 V								
		4		10								1V						
		4[a]		150[a]										1 V		-1 V		
		4		4 A														1.2 V
h_{FE}		-10		-0.1			30	200										
		10		1					40	200								
		4		10							40	200						
		4		150									50	250				
		-4		-150											50	250		
		4		4 A													35	100
h_{fe}[c]		10		50					6									
f_T		4[a]		50[a]			← 100 MHz (Typ) →											
		4		4 A													800 kHz (Typ)	
θ_{J-C}								35° C/W		35° C/W		35° C/W						1.17° C/W
θ_{J-FA}								175° C/W		175°C/W		175°C/W		50° C/W		50° C/W		
C_{ob}[d]	10								15 pF									
PRT[e]		40		5 A													1 sec	

[a] Negative for types 40406 & 40410

[b] $R_{BE} = 100\ \Omega$

[c] F = 20 MHz

[d] F = 1 MHz, $I_E = 0$

[e] Power rating test at 200 watts

DISSIPATION DERATING CURVE FOR TYPES 40406, 40407, AND 40408

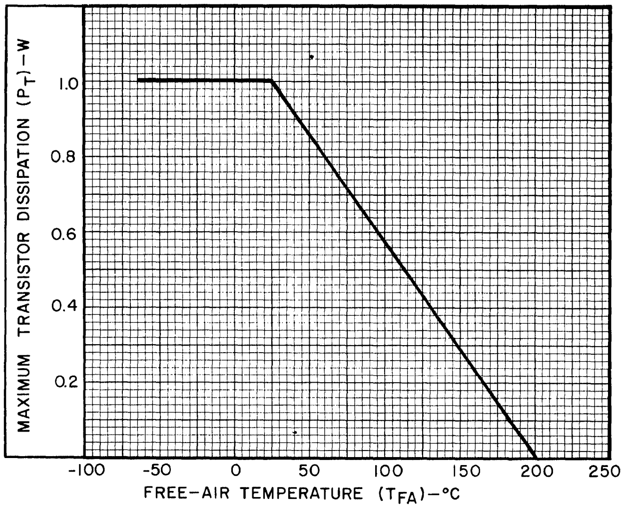


Fig. 1

DISSIPATION DERATING CURVE FOR TYPES 40409 AND 40410

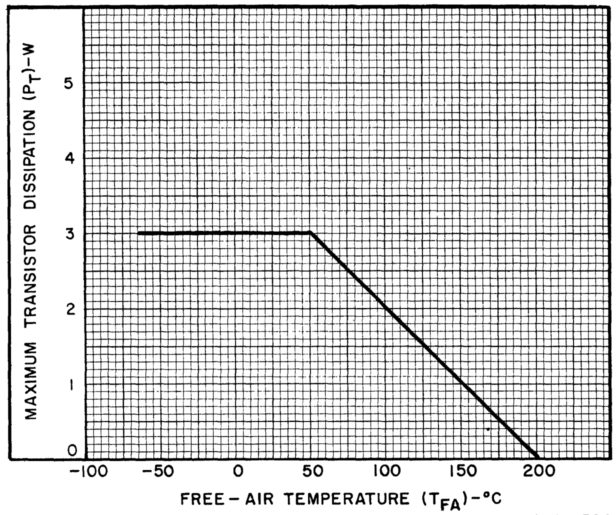


Fig. 2

DISSIPATION DERATING CURVE FOR TYPE 40411

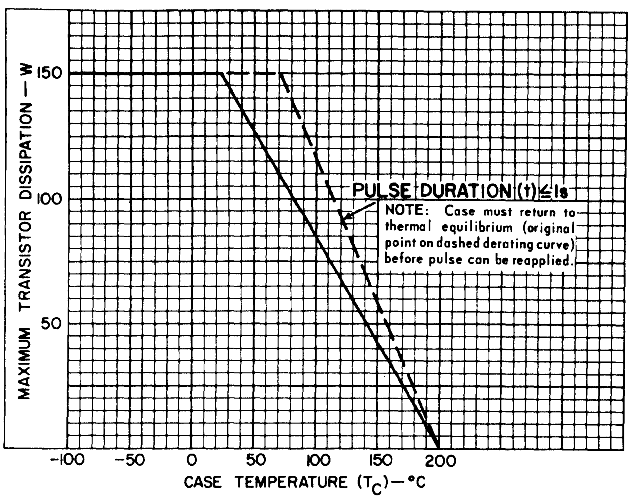


Fig. 3

TYPICAL OPERATION CHARACTERISTIC FOR TYPE 40411

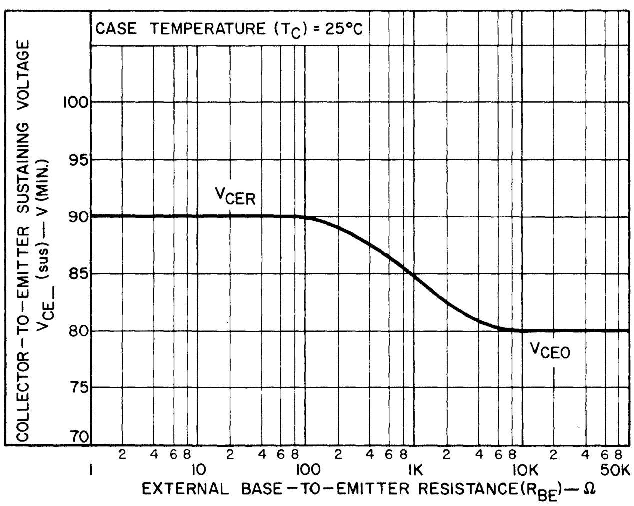


Fig. 4

TYPICAL OPERATION CHARACTERISTICS FOR TYPES 40406 & 40410

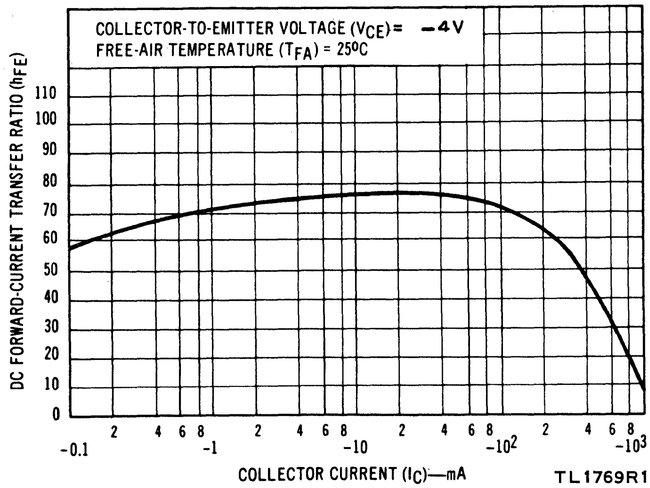


Fig. 5

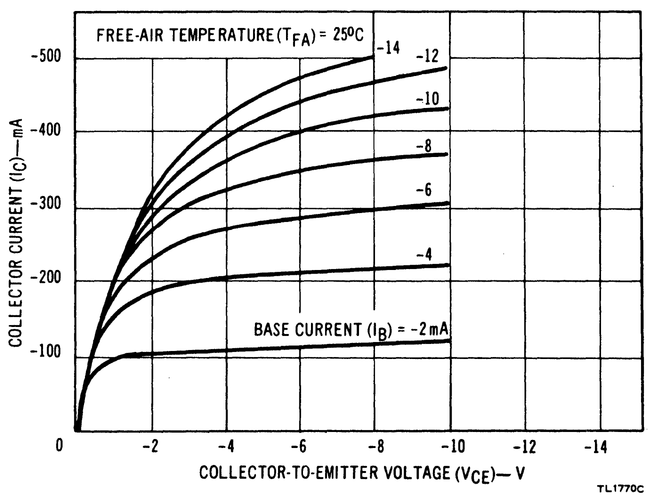


Fig. 6

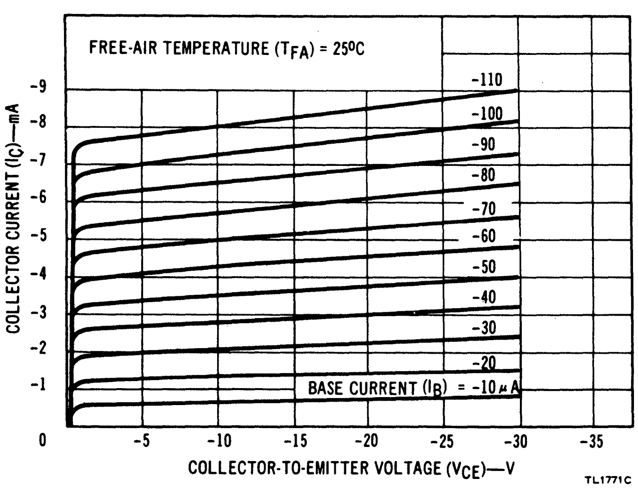


Fig. 7

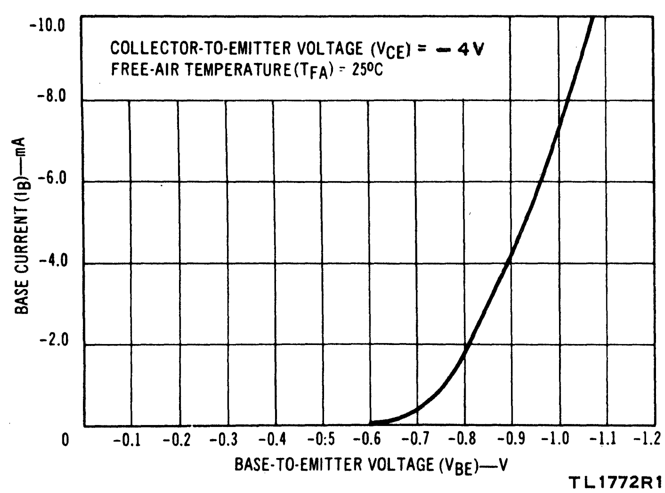


Fig. 8

TYPICAL OPERATION CHARACTERISTICS FOR TYPES 40407, 40408, & 40409

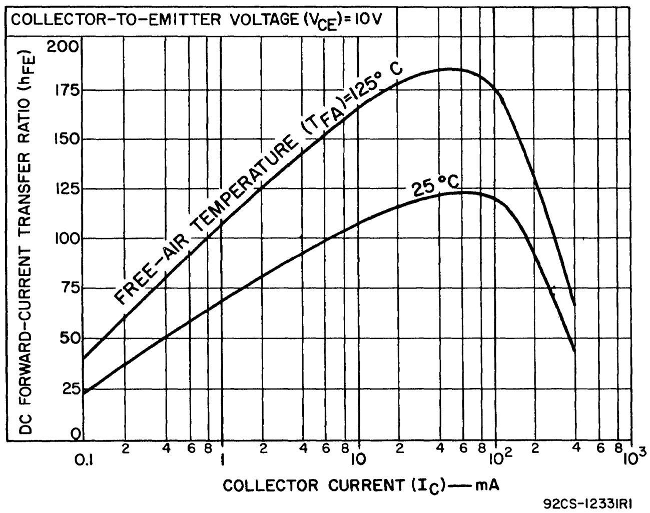


Fig. 9

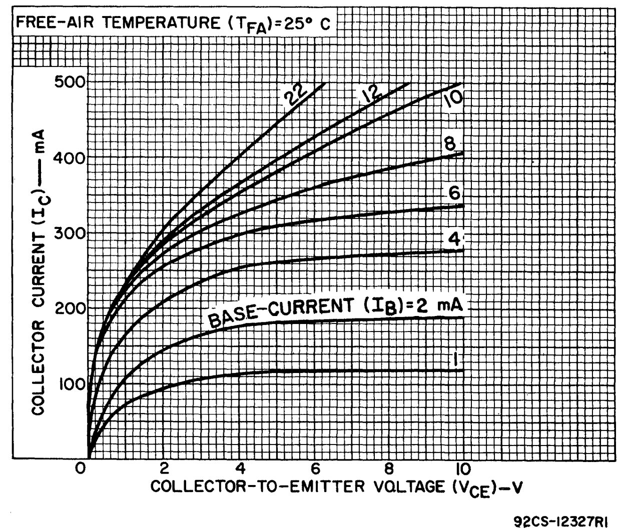


Fig. 10

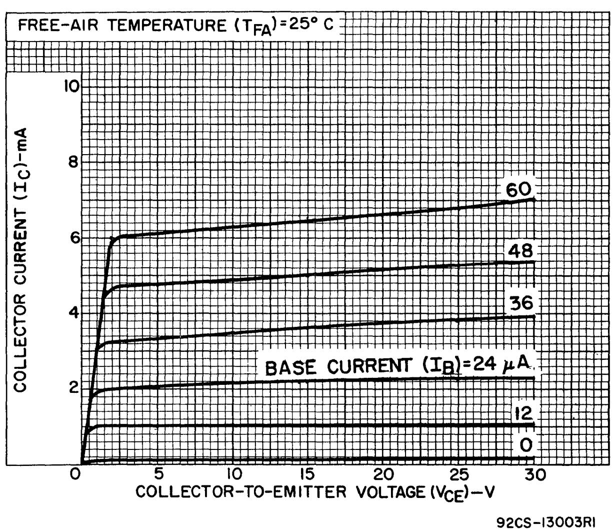


Fig. 11

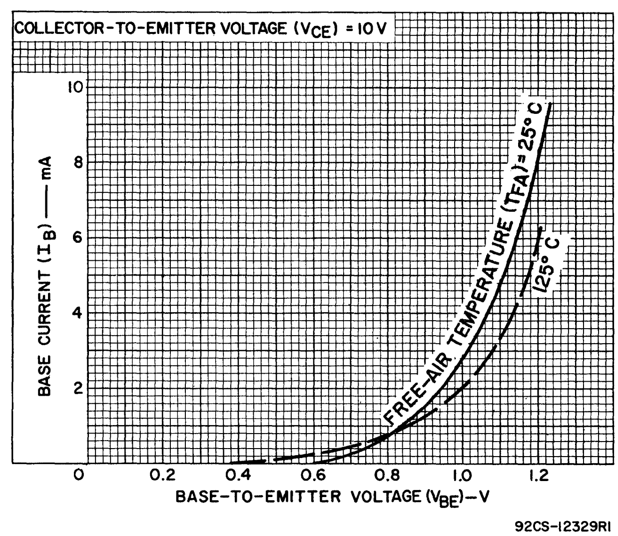


Fig. 12

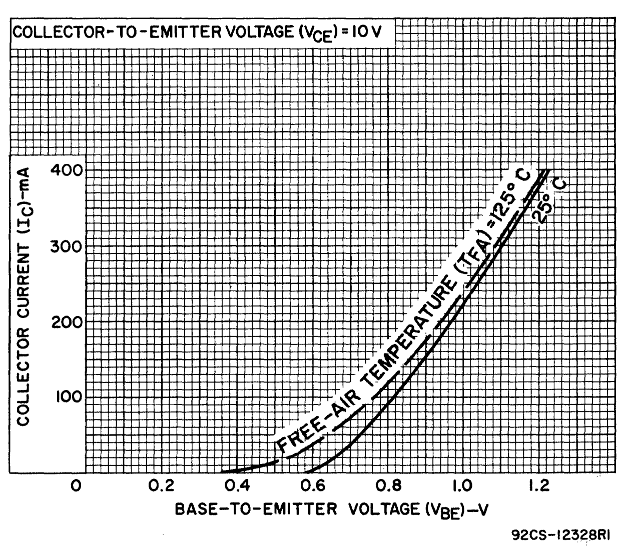


Fig. 13

TYPICAL OPERATION CHARACTERISTICS FOR TYPE 40411

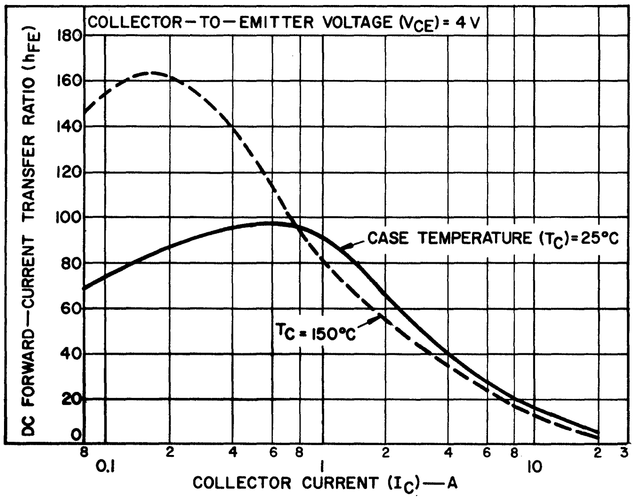


Fig. 14

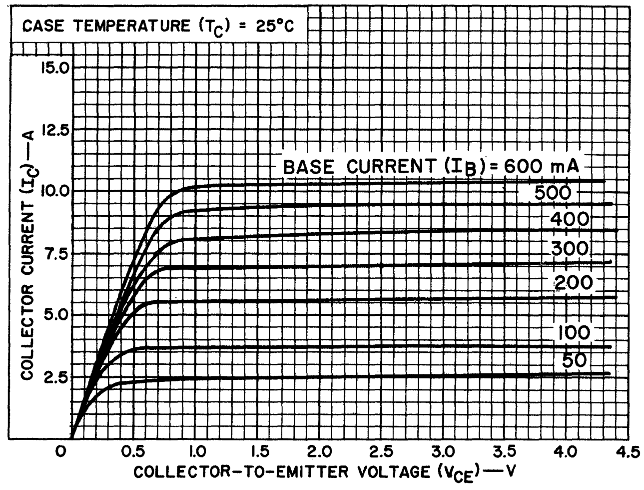


Fig. 15

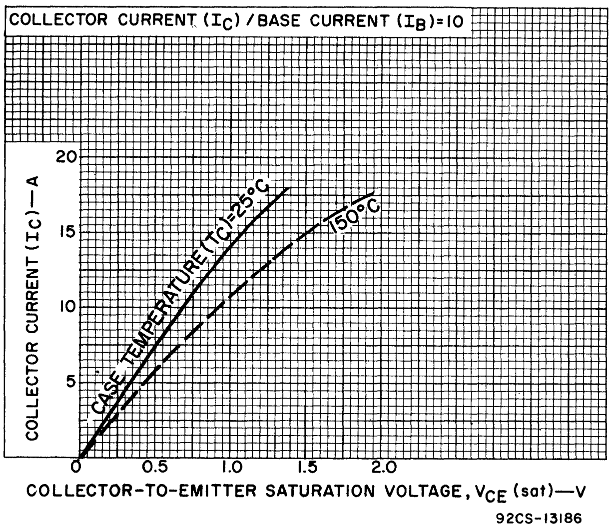


Fig. 16

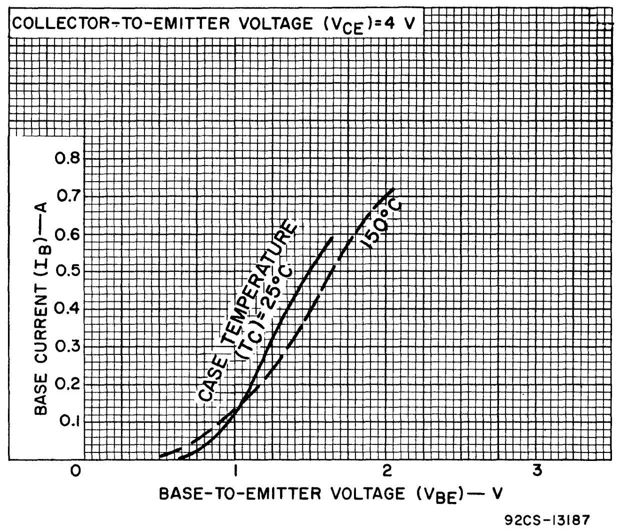


Fig. 17

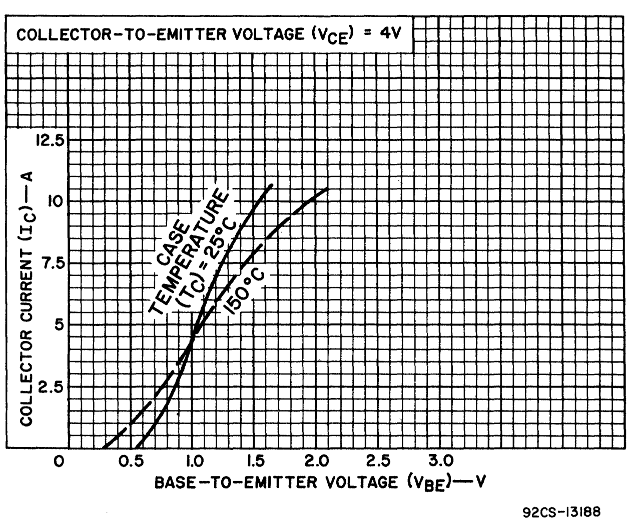
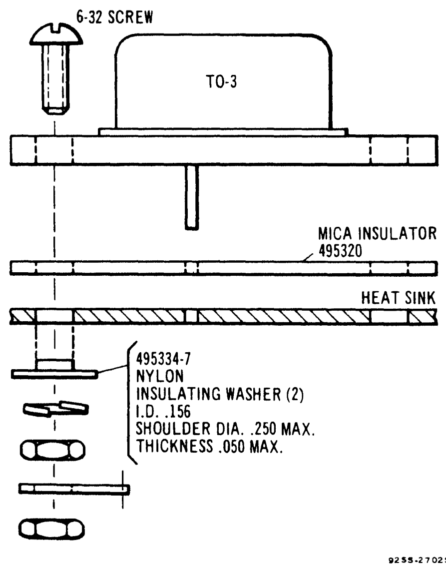


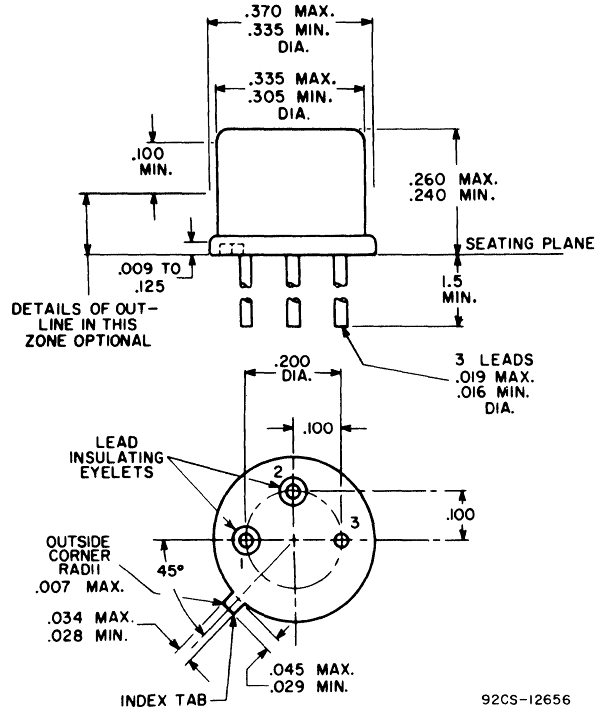
Fig. 18

SUGGESTED HARDWARE FOR TYPE 40411

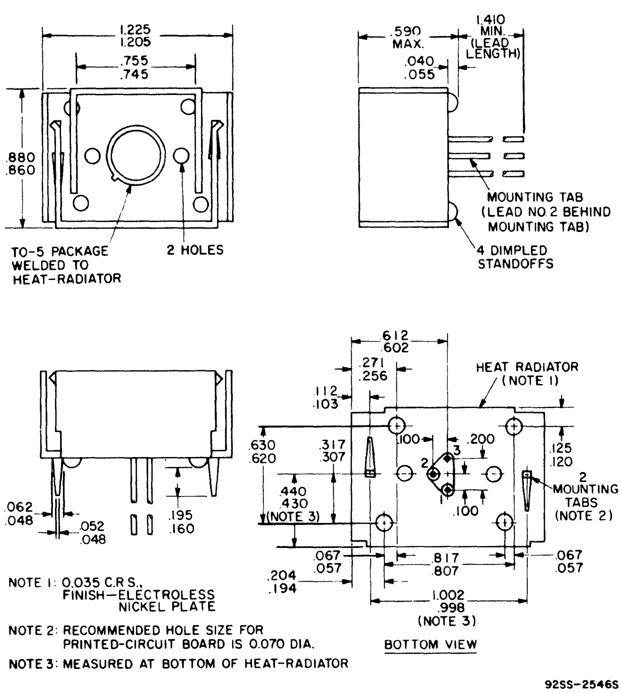


NOTE: Hardware with part numbers supplied.

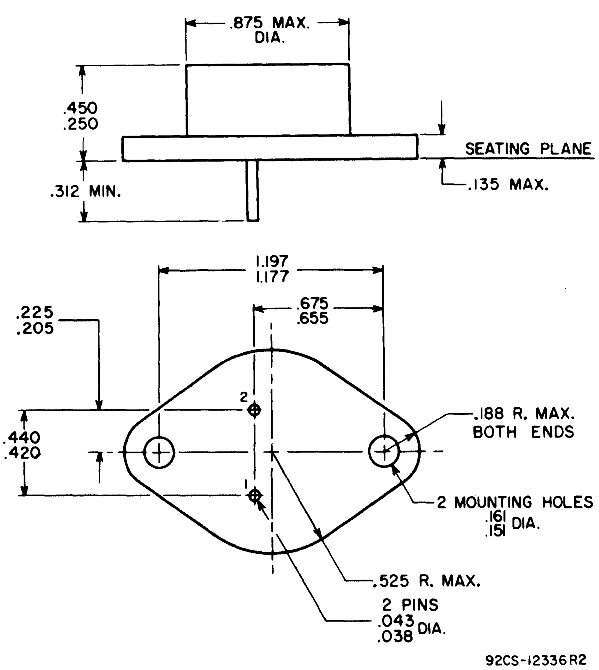
DIMENSIONAL OUTLINE FOR TYPES 40406, 40407, & 40408 JEDEC No. TO-5



DIMENSIONAL OUTLINE FOR TYPES 40409 & 40410 JEDEC TO-5 WITH HEAT RADIATOR



DIMENSIONAL OUTLINE FOR TYPE 40411 JEDEC No. TO-3



DIMENSIONS IN INCHES

TERMINAL CONNECTIONS

FOR TYPES 40406, 40407, 40408, 40409, & 40410

Lead 1-Emitter
Lead 2-Base
Case, Lead 3-Collector (For 40406, 40407, & 40408)
Heat Radiator, Lead 3-Collector (For 40409, & 40410)

FOR TYPE 40411

Pin 1-Base
Pin 2-Emitter
Case, Flange-Collector

RCA

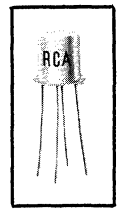
RCA-40413 is a silicon n-p-n double-diffused epitaxial-type planar transistor intended for amplifier and mixer applications at frequencies up to 200 MHz, and for oscillator applications at frequencies up to 500 MHz.

The 40413 is electrically and mechanically like the RCA-2N2708, but each shipment of the RCA-40413 is accompanied by a certified summary of the results of the Group A Electrical Tests and the Group B Environmental Tests shown in Tables I and II, respectively. The Test Data Summary and Certification shown in the Speciman Copy on page 5 are the results of the acceptance tests for the production lot from which the shipment is made.

RCA-40413 utilizes a hermetically sealed 4-lead JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by means of the fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the Technical Bulletin for RCA-2N2708 also apply for RCA-40413.

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-72

For VHF and UHF Applications

FEATURES

- high gain-bandwidth product (f_T) – 700 MHz min.
- high neutralized power gain (G_{pe}) – 15 dB min. at 200 MHz
- high unneutralized power gain (G_{pe}) – 12 dB typ. at 200 MHz
- low collector-to-base feedback capacitance (C_{cb}) – 1 pF max.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	35 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	20 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max.	V
COLLECTOR CURRENT, I_C	Limited by dissipation	
TRANSISTOR DISSIPATION, P_T:		
At case temperatures* — Up to 25°C	300 max.	mW
At case temperatures* — Above 25°C	derate at 1.72	mW/°C
At ambient temperatures — Up to 25°C	200 max.	mW
At ambient temperatures — Above 25°C	derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances not less than 1/16" from seating surface for 10 seconds max.	265 max.	°C

* Measured at center of seating surface.

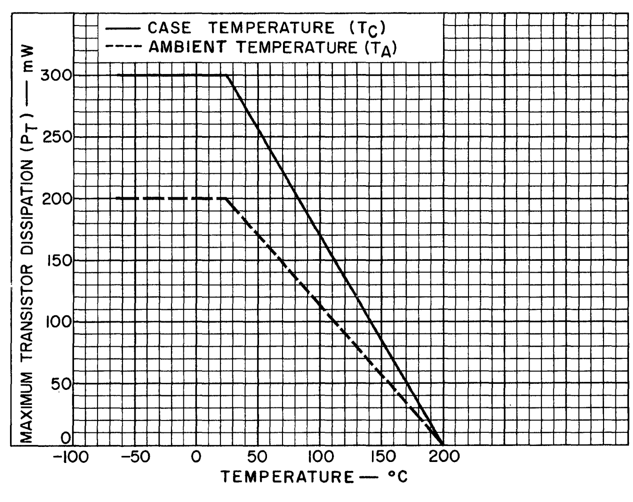


Fig.1 - Rating Chart for RCA-40413.

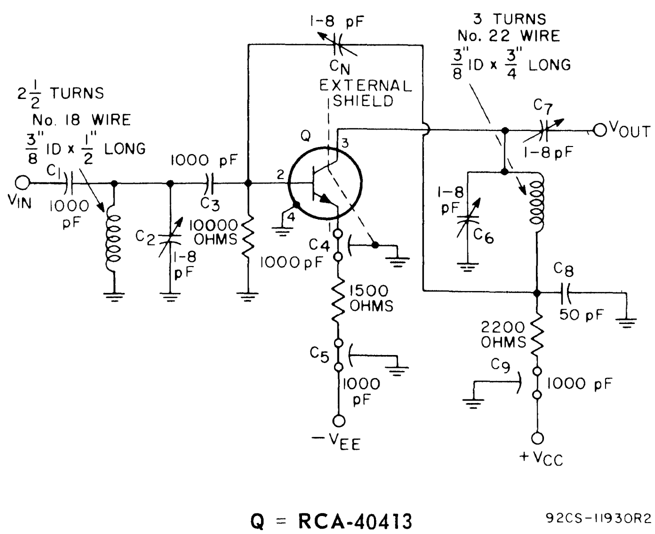
TABLE I
GROUP A TESTS

Sub-group	Lot Tolerance Per Cent Defective	Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	LIMITS RCA 40413		Units
					°C	MHz	V	V	mA	mA	mA	Min.	Max.	
1	10	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	--	--
2	5	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25 ±3	--	15			0		--	10	nA
		Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	3001 Test Condition D	25 ±3	--			0.001	0		35	--	V
		Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011 Test Condition D	25 ±3	--			3*		0	20	--	V
		Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	3026 Test Condition D	25 ±3	--			0	−0.01		3	--	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25 ±3	--		2	2			30	200	--
3	10	Small-Signal Power Gain▲ (See Fig.2 for Test Circuit)	G_{pe}	--	25 ±3	200		15	2			15	22	dB
		Noise Figure● Generator Resistance (R_G) = 50 Ohms (See Fig.3 for Test Circuit)	NF	--	25 ±3	200		15	2			--	7.5	dB
		Collector-to-Base Time Constant● (See Fig.4 for Test Circuit)	$r_b'C_c$	--	25 ±3	31.9	15			-2		9	33	ps
		Collector-to-Base Feedback Capacitance▲	C_{cb}	--	25 ±3	≥0.1 ≤1	15			0		--	1	pF
4	20	Magnitude of Small-Signal, Short-Circuit, Forward Current-Transfer Ratio●	$\|h_{fe}\|$	3306	25 ±3	100		15	2			7	12	--
		Small-Signal, Short-Circuit Forward Current-Transfer Ratio	h_{fe}	3206	25 ±3	0.001						30	180	--
		Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55±3	--		2	2			10	--	--
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-3}	--	15					--	1	μA

* Pulse Test

▲ Three-Terminal Measurement with Emitter and Case Leads Guarded.

● Lead No.4 (Case) Grounded.



NOTE: (Neutralization Procedure): (a) Connect a 200-MHz signal generator (with Z_{out} = 50 ohms) to the input terminals of the amplifier. (b) Connect a 50-ohm rF voltmeter across the output terminals of the amplifier. (c) Apply V_{EE} and V_{CC}, and with the signal generator adjusted for 5 mV output, tune C_2, C_6, and C_7 for maximum output. (d) Interchange the connections to the signal generator and the output indicator. (e) With sufficient signal applied to the output terminals of the amplifier, adjust C_N for a minimum indication at the input. (f) Repeat steps (a), (b), and (c) to determine if retuning is necessary.

Fig.2 - Circuit of Neutralized Amplifier Used to Measure Power Gain at 200 MHz for RCA-40413.

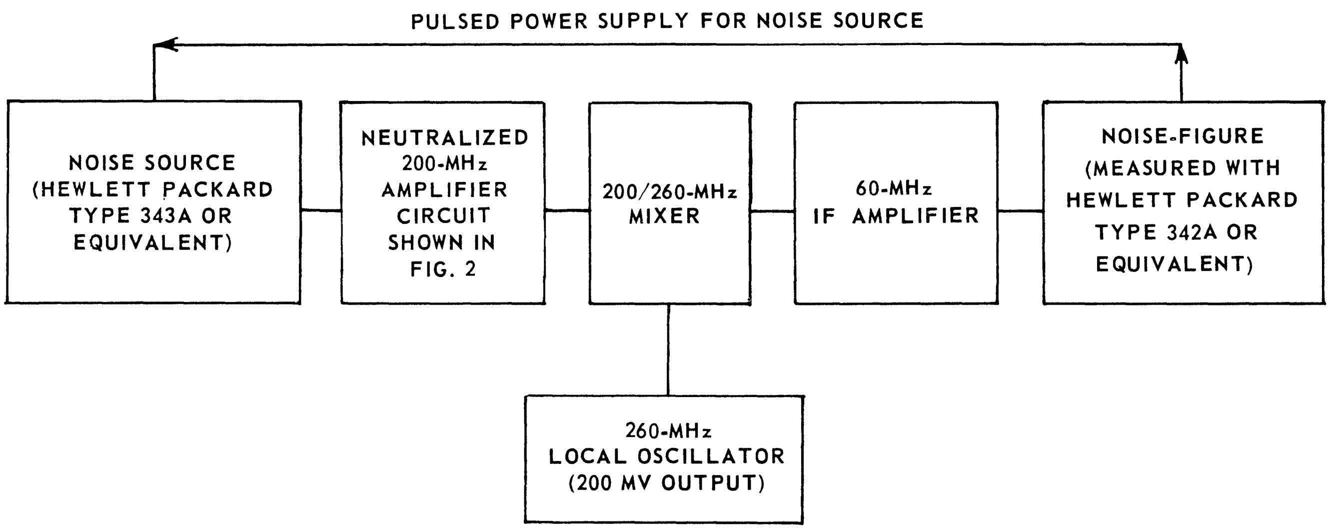
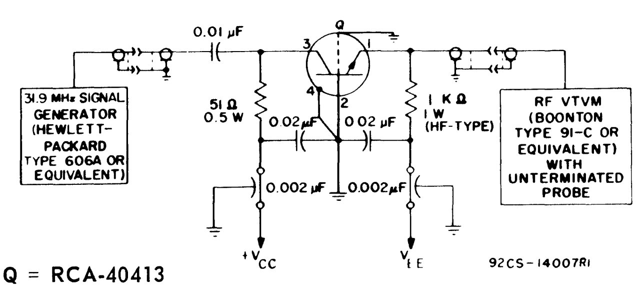


Fig.3 - Block Diagram of 200-MHz Noise-Figure Test Circuit for RCA-40413.

NOTE: **Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.**

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 15 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).



Q = RCA-40413

Fig.4 - Collector-to-Base Time Constant Measurement Circuit.

ELECTRONIC COMPONENTS AND DEVICES
HARRISON, NEW JERSEY

TEST DATA SUMMARY AND CERTIFICATION

RCA TYPE 40413 LOT IDENTITY ____________

TEST DATA SUMMARY

ITEM	TEST DESCRIPTION	LTPD	SAMPLE SIZE	DEFECTS ALLOWED	DEFECTS FOUND
	GROUP A TESTS				
Subgroup 1	Visual and Mechanical Examination	10			
Subgroup 2	Electrical	5			
Subgroup 3	Electrical	10			
Subgroup 4	Electrical	20			
	GROUP B TESTS				
Subgroup 1	Physical Dimensions	20			
Subgroup 2	Solderability; Temperature Cycling; Thermal Shock; Moisture Resistance	20			
Subgroup 3	Shock, Vibration Fatigue, Vibration, Variable Frequency, Constant Acceleration	20			
Subgroup 4	Terminal Strength	20			
Subgroup 5	Salt Atmosphere	20			
Subgroup 6	High-Temperature Life, Non-Operating	$\lambda = 10\%$			
Subgroup 7	Steady-State Operation Life	$\lambda = 10\%$			

CERTIFICATION

I hereby certify that the data listed above is complete, accurate and representative of the product week indicated. The above data was obtained in accordance with RCA specifications.

SEAL

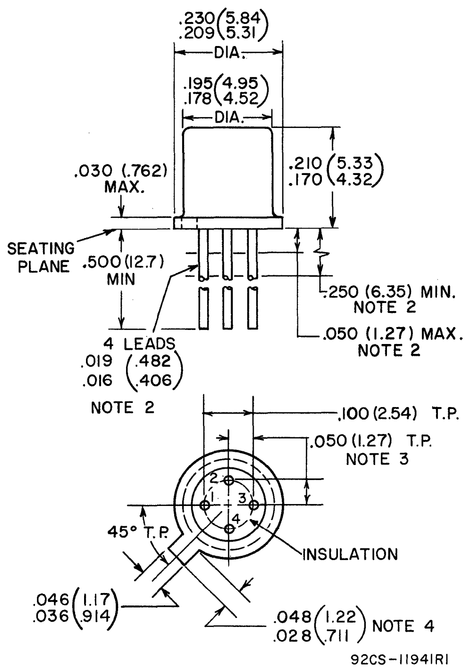
SIGNATURE ____________ DATE ____________

QUALITY CONTROL MANAGER

TABLE II
GROUP B TESTS

Subgroup	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective %	Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40413 Initial Values Min.	RCA-40413 Initial Values Max.	RCA-40413 End Point Values Min.	RCA-40413 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 6)	2066	20	--	--	--	--	--	--	--	--
2	SOLDERABILITY (Without Aging)	2026	20	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	50	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0^{+5}_{-0}$ °C, $T_{max} = 100^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 2 V I_C = 2 mA	30	200	22.5	--	--
	MOISTURE-RESISTANCE TEST	1021									
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 msec, 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	20	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	50	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ± 20 Hz, 20 G's	2046									
	VIBRATION VARIABLE-FREQUENCY TEST	2056		h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 2 V I_C = 2 mA	30	200	22.5	--	--
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	TERMINAL STRENGTH TEST	2036 Test Condition E	20	--	--	--	--	--	--	--	--
5	SALT-ATMOSPHERE TEST	1041	20	--	--	--	--	--	--	--	--
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A = 200 ±10°C Duration = 1000 hrs.	1031	λ = 10%	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	50	nA
				h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 2 V I_C = 2 mA	30	200	22.5	--	--
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit T_A = 25 ±3°C V_{CB} = 19.5 ±0.5 Volts P_T = 200 mW Duration = 1000 hrs.	1026	λ = 10%	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	50	nA
				h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 2 V I_C = 2 mA	30	200	22.5	--	--

DIMENSIONAL OUTLINE
JEDEC TO-72



Dimensions in inches and millimeters

Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

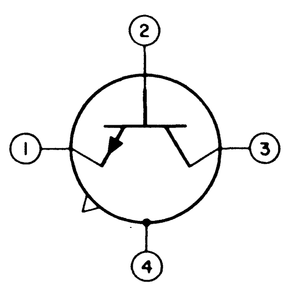
Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) - 0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM
Bottom View

LEAD 1 – EMITTER
LEAD 2 – BASE



LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE

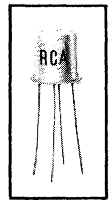
RCA-40414 is a double-diffused epitaxial planar transistor of the silicon n-p-n type. It is extremely useful in low-noise-amplifier, oscillator, and converter applications at frequencies up to 500 MHz in the common-emitter configuration, and up to 1200 MHz in the common-base configuration.

The 40414 is electrically and mechanically like the RCA-2N2857, but each shipment of the RCA-40414 is accompanied by a certified summary of the results of the Group A Electrical Tests and the Group B Environmental Tests shown in Tables I and II, respectively. The Test Data Summary and Certification shown in the Specimen Copy on page 5 are the results of the acceptance tests for the production lot from which the shipment is made.

RCA-40414 utilizes a hermetically sealed 4-lead JEDEC TO-72 package. All active elements of the transistor are insulated from the case, which may be grounded by means of the fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the Technical Bulletin for RCA-2N2857 also apply for RCA-40414.

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-72

For UHF Applications in Industrial and Military Equipment

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At case temperatures* up to 25°C	300 max.	mW
At case temperatures* above 25°C	Derate at 1.72	mW/°C
At ambient temperatures up to 25°C	200 max.	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	265 max.	°C

* Measured at center of seating surface.

FEATURES

- high gain-bandwidth product — f_T = 1000 MHz min.
- high converter (450-to-30 MHz) gain — G_c = 15 dB typ. for circuit bandwidth of approximately 2 MHz
- high power gain as neutralized amplifier — G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator — P_o = 30 mW min., 40 mW typ. at 500 MHz; 20 mW typ., at 1 GHz
- low device noise figure — NF = 4.5 dB max. as 450 MHz amplifier; 7.5 dB typ. as 450-to-30 MHz converter
- low collector-to-base time constant — $r_b'C_c$ = 7 ps typ.
- low collector-to-base feedback capacitance — C_{cb} = 0.6 pF typ.

TABLE I – GROUP A TESTS

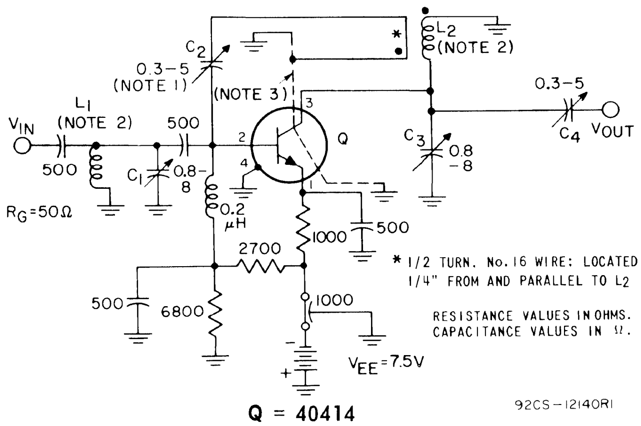
Sub-group	Lot Tolerance Per Cent Defective	Characteristic Test	Symbol	MIL-STD 750 Reference Test Method	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	LIMITS RCA 40414 Min.	Max.	Units
					°C	MHz	V	V	mA	mA	Min.	Max.	
1	10	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	
2	5	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25±3	--	15			0	--	10	nA
		Collector-to-Base Breakdown Voltage	BV_{CBO}	3001 Test Condition D	25±3	--			0.001	0	30	--	V
		Collector-to-Emitter Breakdown Voltage	BV_{CEO} (sus)	3011 Test Condition D	25±3	--			3*	I_B = 0	15	--	V
		Emitter-to-Base Breakdown Voltage	BV_{EBO}	3026 Test Condition D	25±3	--			0	-0.01	2.5	--	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25±3	--		1	3		30	150	
3	15	Small-Signal Power Gain▲ (See Fig.1 for Test Circuit)	G_{pe}		25±3	450		6	1.5		12.5	19	dB
		Device Noise Figure◈: Generator Resistance (R_G) = 50 Ω (See Fig.2 for Test Circuit)	NF		25±3	450		6	1.5		--	4.5	dB
		Measured Noise Figure: Generator Resistance (R_G) = 50 Ω (See Fig.2 for test circuit)▲	NF		25±3	450		6	1.5		--	5.0	dB
		Collector-to-Base Time Constant▲ (See Fig.3 for Test Circuit)	$r_b'C_c$		25±3	31.9	6		2		4	15	ps
		Oscillator Power Output (See Fig.4 for Test Circuit)	P_o		25±3	≥500	10			-12	30	--	mW
		Collector-to-Base Feedback Capacitance●	C_{cb}		25±3	≥ 0.1 ≤ 1	10			0	--	1	pF
4	15	Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55 ±3	--		1	3		10	--	
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-5}	--	15			0	--	1	μA
		Small-Signal, Short Circuit Forward Current-Transfer Ratio▲	h_{fe}	3206	25±3	0.001		6	2		50	220	
		Magnitude of Small-Signal, Short-Circuit Forward Current-Transfer Ratio▲	$\|h_{fe}\|$	3206	25±3	100		6	5		10	19	

* Pulse Test

▲Lead No.4 (Case) Grounded

●Three-terminal measurement with emitter and case leads guarded.

◈Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test amplifier and the contribution of the following stages in the test setup.



NOTE 1: (NEUTRALIZATION PROCEDURE): (A) CONNECT A 450-MHz SIGNAL GENERATOR (WITH R_g = 50 OHMS) TO THE INPUT TERMINALS OF THE AMPLIFIER. (B) CONNECT A 50-OHM RF VOLTMETER ACROSS THE OUTPUT TERMINALS OF THE AMPLIFIER. (C) APPLY V_{EE}, AND WITH THE SIGNAL GENERATOR ADJUSTED FOR 5 mV OUTPUT FROM THE AMPLIFIER, TUNE C_1, C_3, AND C_4 FOR MAXIMUM OUTPUT. (D) INTERCHANGE THE CONNECTIONS TO THE SIGNAL GENERATOR AND THE RF VOLTMETER. (E) WITH SUFFICIENT SIGNAL APPLIED TO THE OUTPUT TERMINALS OF THE AMPLIFIER, ADJUST C_2 FOR A MINIMUM INDICATION AT THE INPUT. (F) REPEAT STEPS (A), (B), AND (C) TO DETERMINE IF RETUNING IS NECESSARY.

NOTE 2: L_1 & L_2—SILVER-PLATED BRASS ROD, 1-1/2" LONG x 1/4" DIA. INSTALL AT LEAST 1/2" FROM NEAREST VERTICAL CHASSIS SURFACE.

NOTE 3: EXTERNAL INTERLEAD SHIELD TO ISOLATE THE COLLECTOR LEAD FROM THE EMITTER AND BASE LEADS.

Fig.1 - Neutralized Amplifier Circuit Used to Measure 450-HMz Power Gain and Noise Figure for RCA-40414.

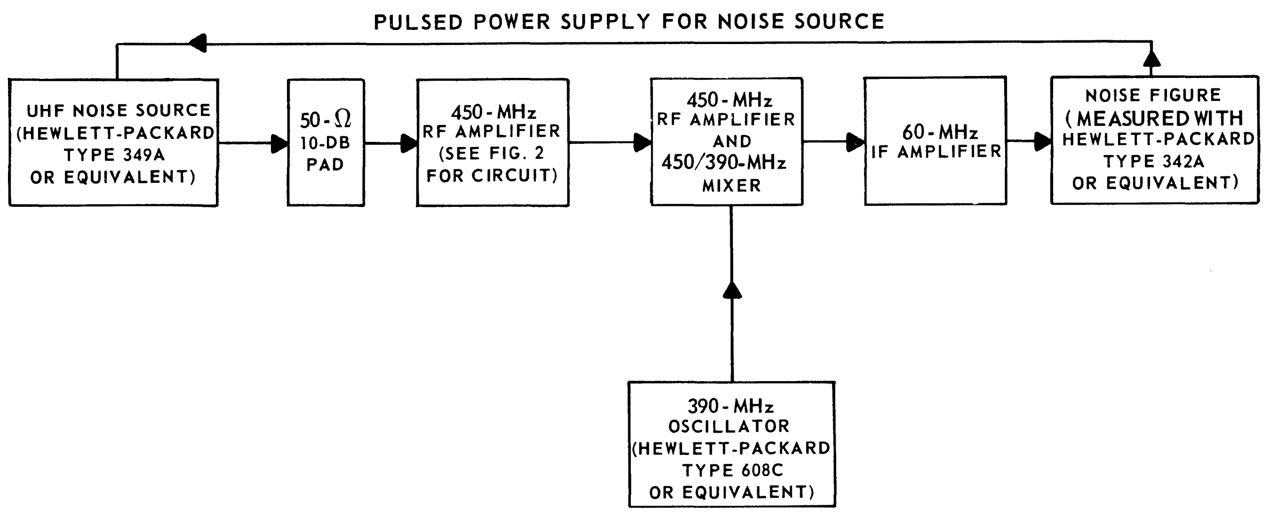
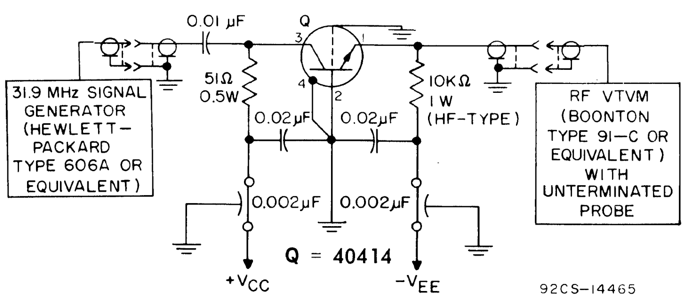


Fig.2 - Block Diagram of 450-MHz Noise-Figure Test Circuit for RCA-40414.



NOTE: **Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.**

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 6 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

Fig.3 - Collector-to-Base Time Constant Measurement Circuit.

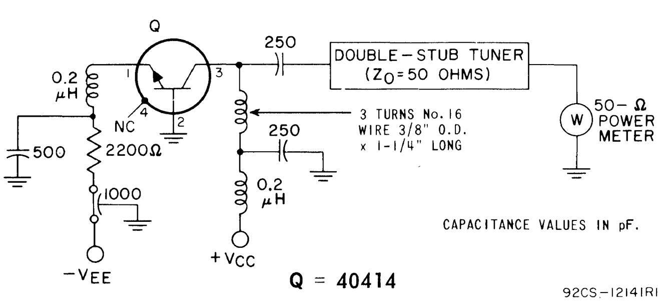


Fig.4 - Oscillator Circuit Used to Measure 500-MHz Power Output for RCA-40414.

ELECTRONIC COMPONENTS AND DEVICES
HARRISON, NEW JERSEY

TEST DATA SUMMARY AND CERTIFICATION

RCA TYPE 40414 LOT IDENTITY ____________

TEST DATA SUMMARY

ITEM	TEST DESCRIPTION	LTPD	SAMPLE SIZE	DEFECTS ALLOWED	DEFECTS FOUND
	GROUP A TESTS				
Subgroup 1	Visual and Mechanical Examination	10			
Subgroup 2	Electrical	5			
Subgroup 3	Electrical	15			
Subgroup 4	Electrical	15			
	GROUP B TESTS				
Subgroup 1	Physical Dimensions	20			
Subgroup 2	Solderability; Temperature Cycling; Thermal Shock; Moisture Resistance	20			
Subgroup 3	Shock, Vibration Fatigue, Vibration, Variable Frequency, Constant Acceleration	20			
Subgroup 4	Terminal Strength	20			
Subgroup 5	Salt Atmosphere	20			
Subgroup 6	High-Temperature Life, Non-Operating	$\lambda = 10\%$			
Subgroup 7	Steady-State Operation Life	$\lambda = 10\%$			

CERTIFICATION

I hereby certify that the data listed above is complete, accurate and representative of the product week indicated. The above data was obtained in accordance with RCA specifications.

SEAL

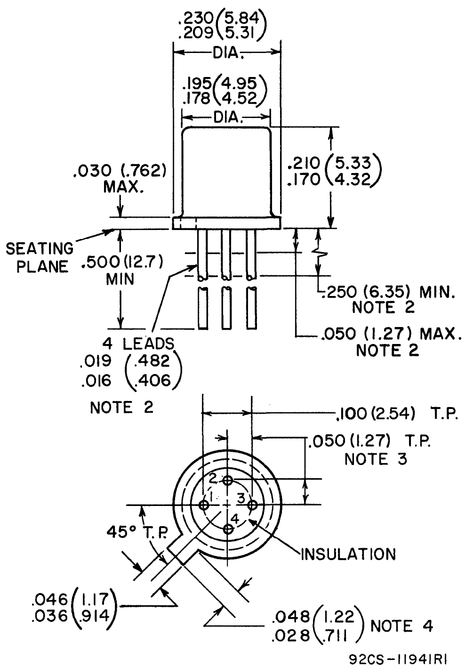
SIGNATURE ____________________ DATE ____________

QUALITY CONTROL MANAGER

TABLE II – GROUP B TESTS

Subgroup	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective %	Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40414 Initial Values Min.	RCA-40414 Initial Values Max.	RCA-40414 End Point Values Min.	RCA-40414 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 6)	2066	20	--	--	--	--	--	--	--	
2	SOLDERABILITY Without Aging	2026	20	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	30	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0^{+5}_{-0}$ °C, $T_{max} = 100^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A = 25 ± 3°C V_{CE} = 1 V I_C = 3 mA	30	150	18	--	
	MOISTURE-RESISTANCE TEST	1021									
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 ms 5 blows each in X_1, Y_1, Y_2 and Z_1 planes	2016	20	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	30	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ± 20 Hz, 20 G's	2046									
	VIBRATION VARIABLE-FREQUENCY TEST	2056		h_{FE}	3076	T_A = 25 ± 3°C V_{CE} = 1 V I_C = 3 mA	30	150	18	--	
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	TERMINAL STRENGTH TEST	2036 Test Condition E	20	--	--	--	--	--	--	--	
				--	--	--	--	--	--	--	
5	SALT-ATMOSPHERE TEST	1041	20	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	30	nA
				h_{FE}	3076	T_A = 25 ± 3°C V_{CE} = 1 V I_C = 3 mA	30	150	18	--	
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A = 200 ± 10°C Duration = 1000 hrs.	1031	λ= 10%	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	30	nA
				h_{FE}	3076	T_A = 25 ± 3°C V_{CE} = 1 V I_C = 3 mA	30	150	18	--	
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit T_A = 25 ± 3°C V_{CB} = 12.5 ± 0.5 V P_T = 200 mW Duration = 1000 hrs.	1026	λ= 10%	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	30	nA
				h_{FE}	3076	T_A = 25 ± 3°C V_{CE} = 1 V I_C = 3 mA	30	150	18	--	

DIMENSIONAL OUTLINE
JEDEC TO-72



Dimensions in Inches and Millimeters

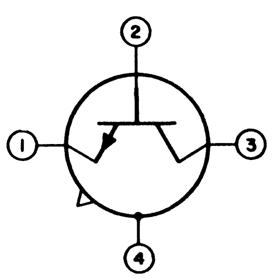
Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) at their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM
Bottom View



LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE

DRIFT-FIELD POWER TRANSISTOR SEMICONDUCTOR DIODE

40421
40428

RCA-40421* is a diffused-collector, graded-base power transistor of the germanium pnp type intended for use in high-fidelity amplifiers and other af amplifiers which are required to provide relatively large power outputs over a wide frequency range with low distortion. This transistor utilizes a combination of diffusion and alloying techniques to provide a built-in accelerating field in the base region. This accelerating field makes possible a wide frequency response and a linearity of characteristics not available in conventional power transistors.

RCA-40421 is intended for use in class B amplifier service, and has specially controlled breakdown-voltage and collector-saturation-current characteristics to provide dependable performance in this type of service. A pair of 40421 transistors in a "single-ended push-pull" class B amplifier stage of the type shown in Fig.1 can deliver 25 watts output at less than 0.5% total harmonic distortion directly to a 4-ohm speaker, and provide a power gain of 25 dB.

RCA-40428# is a germanium, alloy-junction diode. It is designed to compensate for the effects of temperature and supply-voltage changes on the operation of class B push-pull af power amplifier stages using drift-field power transistors such as RCA Types 40421, 2N2147, 2N2148, and similar types. When used in the type of circuit shown in Fig.1 the 40428 will stabilize the idling current of the output stage against variations of both supply voltage and ambient temperature.

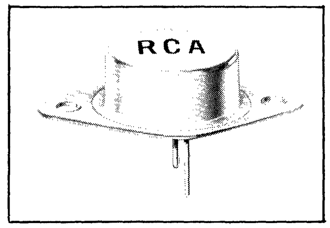
Because of its low dynamic impedance, the 40428 reduces variations in idling current caused by variations in component values as well as by changes in dc supply voltage due to both line-voltage fluctuations and poor power-supply regulation. This feature reduces harmonic distortion in the class B amplifier stage and, in addition, reduces the power requirements for the driver stage.

Both RCA-40421 and RCA-40428 are hermetically sealed in metal cases. RCA-40421 utilizes the standard JEDEC TO-3 package; RCA-40428 utilizes a JEDEC TO-1-size case and has its electrical elements insulated from the case to permit use of a common heat sink for the 40428 and the associated power transistors (see OPERATING CONSIDERATIONS).

*Formerly Dev. No.TA2862.
#Formerly Dev. No.TA2870.

40421

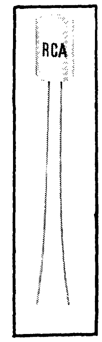
GERMANIUM P-N-P DRIFT-FIELD POWER TRANSISTOR



For High-Fidelity Amplifier Applications

40428

GERMANIUM ALLOY-TYPE DIODE



For Temperature- and Voltage-Compensation Applications

RCA-40421

- excellent power sensitivity over entire audio-frequency spectrum
- high dc beta at high current levels:
  $h_{FE} = \begin{cases} 62 \text{ min. at } I_C = 1\text{ A} \\ 40 \text{ min. at } I_C = 4\text{ A} \end{cases}$
- high gain-bandwidth product provides exceptional high-frequency response (no loss of gain to over 20 KHz):
  f_T = 4 MHz typ.
- low base resistance – minimizes driving-voltage requirements
- linear transfer characteristics
- 100% pulse tested to prevent secondary breakdown
- completely welded, hermetically sealed JEDEC TO-3 package

RCA-40428

- compensates for effects of changes in temperature, supply voltage, and component values
- low dynamic impedance minimizes amplifier distortion and driving-power requirements
- hermetically sealed TO-1 size metal package – electrical elements insulated from case

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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40421, 40428 6-66
Reprinted from Issue dated 3-66

Maximum Ratings, *Absolute-Maximum Values:*

RCA-40421

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-75	max. volts
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	-50	max. volts
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-1.5[a]	max. volts
COLLECTOR CURRENT, I_C	-5	max. amp
BASE CURRENT, I_B	-1	max. amp
EMITTER CURRENT, I_E	+5	max. amp
TRANSISTOR DISSIPATION, P_T:		
Average: For mounting-flange temperatures[b] up to 81°C	12.5	max. watts
Derate linearly: 0.66 watt/°C		
Peak: Determined by operating conditions — See *Fig.4*		
TEMPERATURE RANGE:		
Storage	-65°C to +100°C	
Operating (Junction)	-65°C to +100°C	
PIN TEMPERATURE (During soldering):		
At distances of not less than 1/16" from seating surface for 10 seconds max.	255	max. °C

[a] This rating may be exceeded provided the combined dissipation in the emitter and the collector does not exceed the maximum dissipation rating for the device, and provided the driver stage (transformer coupled) is capable of providing the emitter-to-base current drawn by the transistors under the emitter-to-base voltage conditions (reverse-bias) shown.

[b] Measured at center of seating surface.

RCA-40421

ELECTRICAL CHARACTERISTICS, at a Mounting-Flange Temperature (T_{MF}) of 25°C*

Characteristics	Symbols	DC Base-to-Emitter Voltage V_{BE} (V)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Base Current I_B (mA)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	RCA 40421 Min.	RCA 40421 Typ.	RCA 40421 Max.	Units
Collector-Cutoff Current	I_{CBO}		-40			0		-	-	-1	mA
Collector-Cutoff Saturation Current	$I_{CBO}(sat)$		-0.5			0		-	-	-70	μA
Emitter-Cutoff Current	I_{EBO}	1.5					0	-	-	-2.5	mA
Collector-to-Base Breakdown Voltage**	BV_{CBO}					0	-10	-75	-	-	V
Collector-to-Emitter Sustaining Voltage	$V_{CEO}(sus)$				0		-100	-50	-	-	V
Base-to-Emitter Voltage	V_{BE}			-10 -2			-50 -1	0.21 -	0.24 -	0.28 0.5	V V
Static Forward Current-Transfer Ratio	h_{FE}			-2 -2			-1000 -4000	62 40	100 -	175 -	- -
Gain-Bandwidth Product	f_T			-5			-500	2	4	-	MHz
Thermal Resistance: Junction-to-Mounting Flange*	θ_{J-MF}							-	-	1.5	°C/W

* Measured at center of seating surface.

** Pulse Test: Pulse duration $\geq$ 300 μs; duty factor = 0.01.

RCA-40428
TEMPERATURE- AND VOLTAGE-COMPENSATION SERVICE

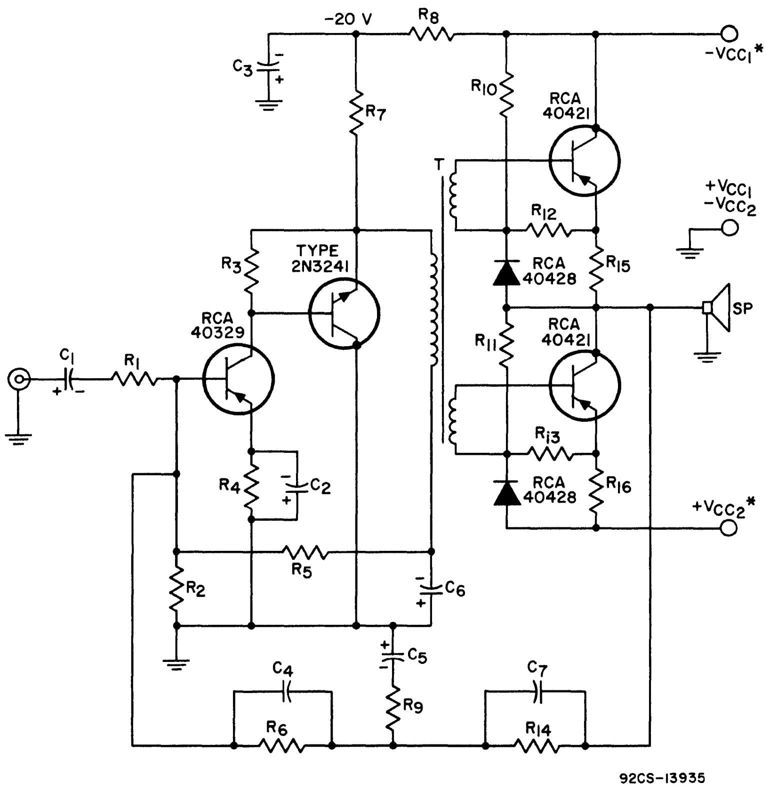
REVERSE VOLTAGE, V_R[c]	-0.5 max.	V
DC FORWARD CURRENT, I_F	100 max.	mA
PEAK FORWARD CURRENT, i_F(max). . .	200 max.	mA
AMBIENT TEMPERATURE RANGE:		
Storage and operating.	-65 to +85	°C
LEAD TEMPERATURE (During soldering):		
At distances not closer than 1/32" to seating surface for 10 seconds max. .	255 max.	°C

ELECTRICAL CHARACTERISTICS, at a DC Forward Current (I_F) of 80 mA, and under conditions of thermal equilibrium

	Min.	Typ.	Max.	Units
Forward Voltage Drop V_F:				
At Case Temperature (T_C)* = 25°C. . .	235	260	285	mV
At Ambient Temperature (T_A) = 25°C .	225	250	275	mV

[c] RCA-40428 is not intended for operation with reverse voltages.

*Measured on case perimeter at junction with seating surface.



C_1 = 5 μF, 3 V, electrolytic
C_2 = 200 μF, 3 V, electrolytic
C_3 = 2500 μF, 35 V, electrolytic
C_4,C_7 = 39 pF, mica
C_5 = 10 μF, 3 V, electrolytic
C_6 = 250 μF, 15 V, electrolytic
R_1 = 1500 Ω, 0.5 W
R_2 = 22 KΩ, 0.5 W
R_3 = 270 Ω, 0.5 W
R_4,R_9 = 1 KΩ, 0.5 W
R_5 = 56 KΩ, 0.5 W
R_6 = 22 KΩ, 0.5 W
R_7 = 330 Ω, 1 W
R_8 = Selected to provide 20 V across C_3 under zero-signal conditions
R_{10},R_{11} = 270 Ω, 2 W
R_{12},R_{13} = 22 Ω, 5 W
R_{14},= 33 KΩ, 0.5 W
R_{15},R_{16} = 0.47 Ω, 0.5 W
T = Driver Transformer:
Turns ratio, primary to each secondary: 3:1
Primary impedance: 400 Ω
Primary dc: 0 mA
* V_{CC_1}, V_{CC_2}: Zero-signal value = 22 V (I = 150 mA)
Maximum-signal value = 20 V (I = 1 A)

Performance Specifications for 4 Ω Speaker Load:

Continuous (Sine-Wave) Power Output = 25 W
EIA Music Power Output# = 40 W
Total Harmonic Distortion at 25 W output, F = 1 kHz = 0.5%
Sensitivity = 50 mV rms input for 25 W output at 1 kHz
Frequency Response = 1 - 1 dB down at 20 Hz and 20 kHz
2 - 3 dB down at 15 Hz and 35 kHz
Input Resistance = 1500 Ω
Hum and Noise - 80 dB below 25 W, input open or shorted

EIA Standard No.RS 234, Section 2.1.2.1

Fig.1 - Schematic Diagram of 25-Watt High-Quality Power Amplifier Using RCA-40421, 40329, and 2N3241 Transistors, and RCA-40428 Compensating Diodes.

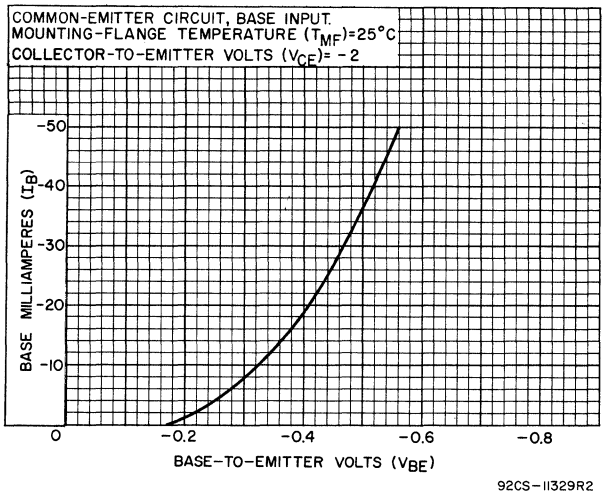


Fig.2 - Typical Input Characteristic for RCA-40421.

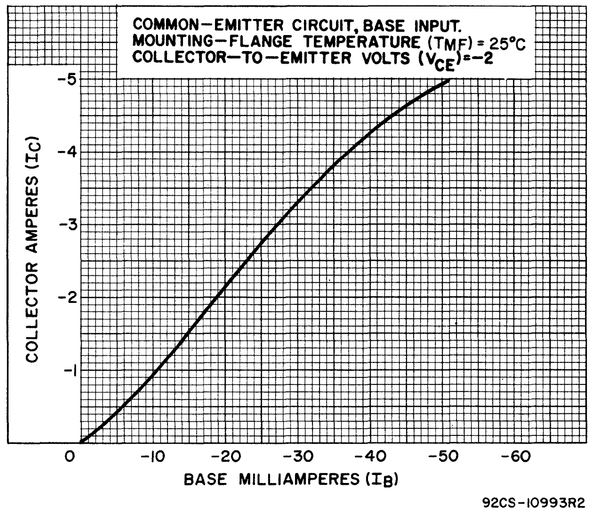


Fig.3 - Typical Current-Transfer Characteristic for RCA-40421.

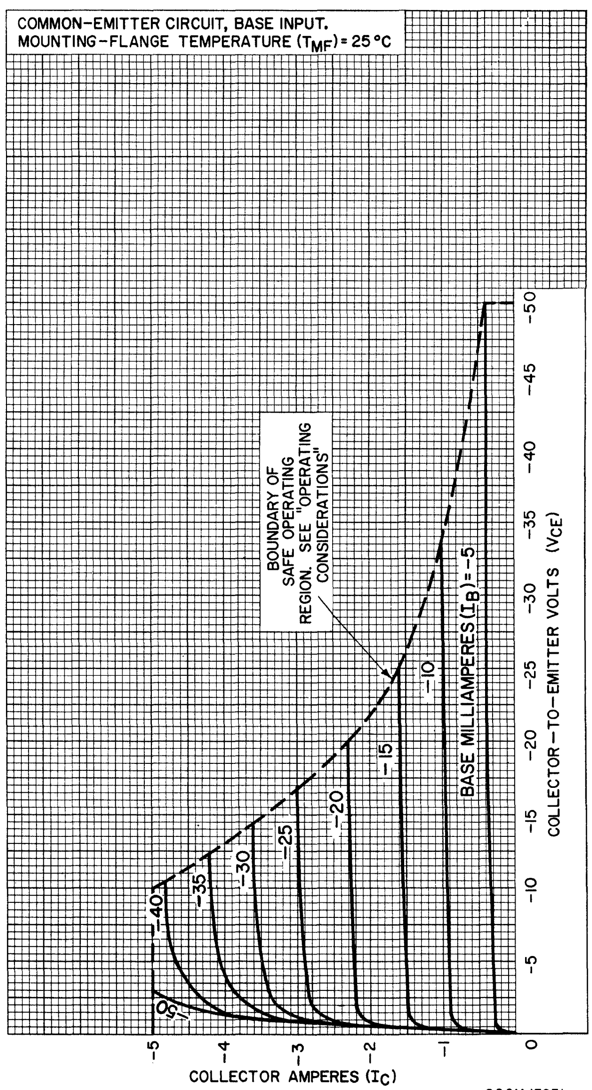


Fig.4 - Typical Collector Characteristics for RCA-40421.

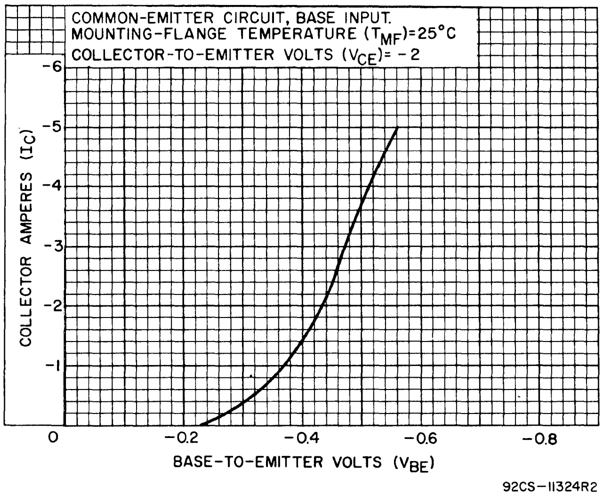


Fig.5 - Typical Transfer Characteristic for RCA-40421.

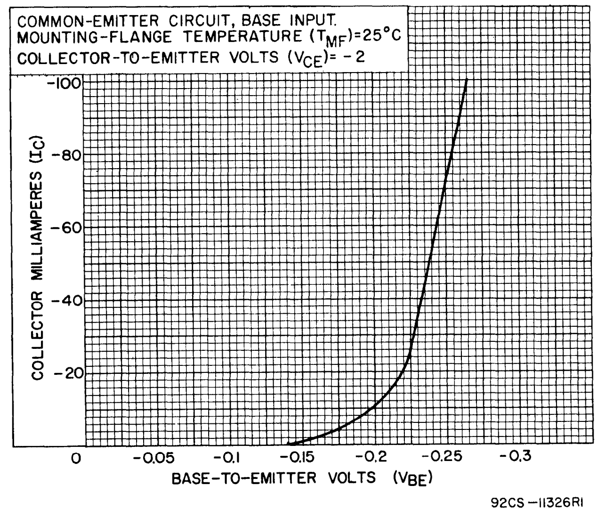


Fig.6 - Typical Transfer Characteristic for RCA-40421.

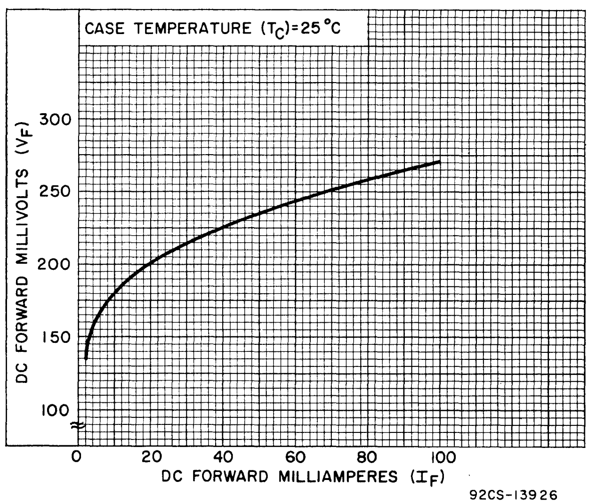


Fig.7 - Typical Forward Characteristic for RCA-40428.

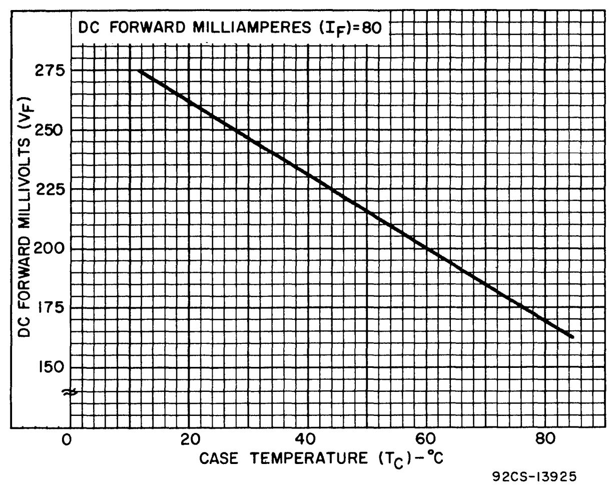


Fig.8 - Forward Voltage vs Temperature for RCA-40428.

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

In the design of amplifier circuits using RCA-40421 it is extremely important to assure that the operating characteristic does not, under any foreseeable combination of operating conditions, extend outside the safe operating region shown in Fig.4. EVEN MOMENTARY EXCURSION OF THE TRANSISTOR OPERATING CHARACTERISTIC OUTSIDE THIS REGION, OR MOMENTARY OPERATION OF THE TRANSISTOR ABOVE ANY OF ITS MAXIMUM RATINGS CAN RESULT IN PERMANENT DAMAGE TO THE TRANSISTOR.

To assure that the 40421 is operated at all times within the safe region shown in Fig.4 the circuit designer should take into account the possible effects of the following factors:

(1) phase shift due to circuit capacitances and/or speaker resonance
(2) parasitic oscillations, such as "ringing" caused by excessive or improperly neutralized feedback
(3) high line voltage
(4) variations in speaker impedance
(5) overdriving of transistors
(6) non-sinusoidal signal waveforms

Any of these factors, or combination, can change the character and value of the transistor load sufficiently to cause operation outside the safe operating region shown in Fig.4.

Because the metal shell of RCA-40421 operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

The 40421 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

RCA-40421 can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistor.

It is essential that the mounting flange which serves as the collector terminal be securely fastened to a heat sink, which may be the equipment chassis. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD THE MOUNTING FLANGE BE SOLDERED TO THE HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

The mounting-flange temperature of RCA-40421 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

Depending on the application, the heat sink or chassis may be connected to either the positive or negative terminal of the voltage supply.

In applications where the chassis is connected to the positive terminal of the voltage supply, it will be necessary to use either an anodized aluminum insulator having high thermal conductivity, or a 0.002" thick mica insulator between the mounting flange and the chassis. If an aluminum washer is used, it should be drilled or punched to provide the two mounting holes and the clearance holes for the emitter and base pins. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolts and the chassis, it is important that an insulating washer be used between each bolt and the chassis as shown in Fig. 9.

The forward current through RCA-40428 should be chosen so that at the reference ambient temperature the zero-signal collector current of the associated transistor or transistors has the desired value. The 40428 will then maintain the zero-signal collector current essentially constant with variations in temperature or supply voltage.

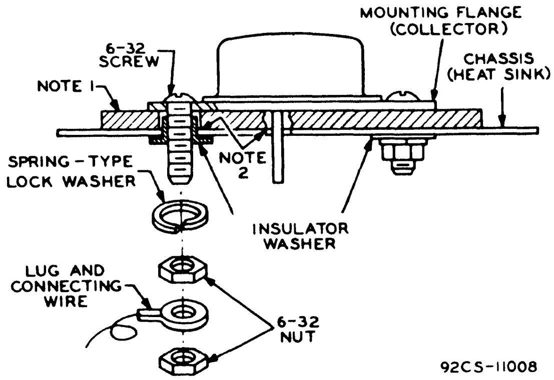
To provide most effective stabilization of transistor idling current, RCA-40428 should be attached to the same heat sink as that used for the associated output transistor or transistors. This arrangement will provide the best possible thermal tracking. The 40428 may be attached to the heat sink by means of a simple clip such as RCA-SA2100, see Fig.10.

To prevent premature clipping in an amplifier stage using RCA-40428, the circuit must be designed to assure that the 40428 is operated under forward-bias conditions at all times. This requirement may be met either by (a) making the dc forward current through the 40428 greater than the peak base current of the associated output transistor (or one of the associated output transistors), or (b) providing a separate source of driving current for the transistor. Such a source is provided in the circuit shown in Fig.1 by resistors R_{12} and R_{13}. These resistors provide driving current to the output transistors during intervals when the peak current through R_{10} or R_{11} is below the required value.

The *flexible leads* of RCA-40428 are usually soldered to the circuit elements. Soldering of the leads may be done to within 1/32 inch of the glass stem provided care is taken to conduct excessive heat away from the lead seals. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the diode.

The 40428 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the diode or the associated circuits.

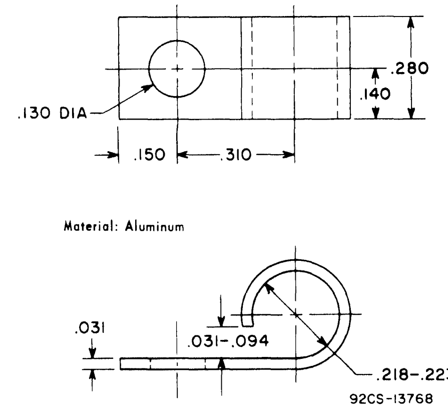
When dip soldering is employed in the assembly of printed circuits using the 40428 the temperature of the solder should not exceed 255°C for a maximum immersion period of 10 seconds.



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

Fig. 9 - Suggested Mounting Arrangement for RCA-40421.



Dimensions in Inches

Fig.10 - Detail Drawing of RCA-SA2100 Heat-Sink Attachment Clip.

Mounting hardware for RCA-40421 is available from RCA Distributors under the following RCA Part Numbers:

ITEM	RCA PART NO.
Mica Insulator	495320
Nylon Insulating Washer (2)	495334-7

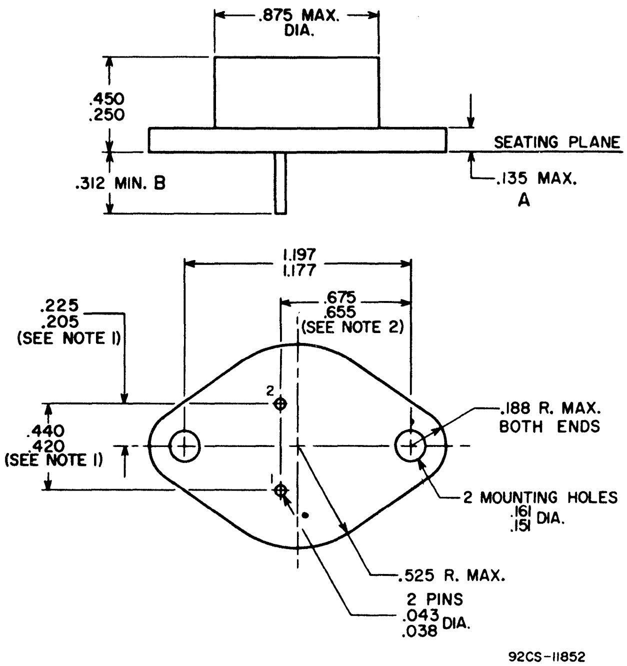
Mica insulators are also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

Insulating shoulder washers are also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

Sockets for RCA-40421 and other semiconductor devices utilizing the JEDEC TO-3 package are made by several manufacturers, and are generally available from electronic parts distributors.

DIMENSIONAL OUTLINE (JEDEC TO-3)

RCA-40421



DIMENSIONS IN INCHES

NOTE 1: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS .050" (1.270MM) TO .055" (1.397MM) BELOW SEATING PLANE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 2: TWO LEADS.

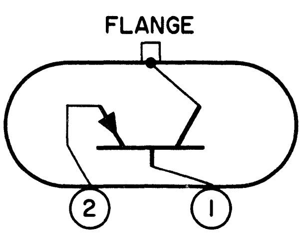
RCA-40421

Mounting-Flange Thickness (A) = 0.050" max.

(B) = {0.440" min. / 0.480" max.}

TERMINAL CONNECTIONS

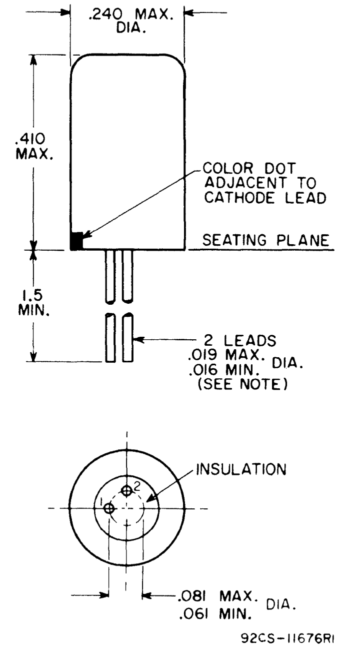
RCA-40421



Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case

DIMENSIONAL OUTLINE

RCA-40428



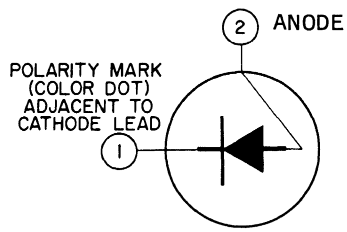
DIMENSIONS IN INCHES

NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE BASE SEAT. BETWEEN 0.250" AND 1.50" A MAXIMUM OF 0.21" DIAMETER IS HELD.

NOTE 2: FORWARD (EASY) CURRENT FLOW THROUGH THE DEVICE IS IN THE DIRECTION TOWARD THE LEAD ADJACENT TO THE POLARITY MARK.

TERMINAL DIAGRAM

RCA-40428



RCA-40422, 40423, 40424, 40425, 40426, and 40427* are high-voltage power transistors of the silicon npn type, primarily intended for use as class A amplifiers in af-output stages of ac- and ac/dc-line-operated radio receivers, phonographs, television receivers, and other entertainment-type electronic equipment.

These transistors have very high collector-voltage ratings (300 V max.), high dissipation capabilities (up to 8 W max.), low feedback capacitance (5 pF typ.), and a high gain-bandwidth product (25 MHz). They can provide high power output with low distortion and excellent frequency-response characteristics in economical circuit designs.

Types 40422 through 40427 comprise two groups of three transistors each (40422, 40424, 40426 and 40423, 40425, 40427), which differ only in mechanical configuration and dissipation capability. The three transistors in each group provide a choice of three different dc beta (h_{FE}) ranges, but are identical in all other respects.

Types 40422, 40424, and 40426 are hermetically sealed in JEDEC TO-66 flanged metal packages, and are intended for applications in which the mounting-flange (case) temperature is controlled by the use of external heat sinks or other means. These types have a maximum dissipation capability of 8 watts at mounting-flange temperatures up to 70° C.

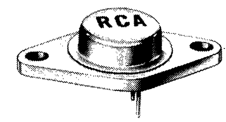
Types 40423, 40425, and 40427 are also hermetically sealed devices in JEDEC TO-66 packages, but are provided with integral aluminum cooling flanges and solder-type mounting pins. These types are intended for mounting on printed-circuit boards, and have a maximum dissipation capability of 3.8 watts at ambient temperatures up to 55° C.

In typical line-operated amplifier circuits (see Figs. 2, 3, and 4) RCA-40422, 40424, and 40426 can deliver power outputs of 2 watts or more, and RCA-40423, 40425, and 40427 power outputs of 1 watt or more, with less than 10% total harmonic distortion.

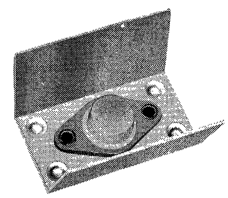
* Formerly Dev. Nos. TA2868, TA2868A, TA2700, TA2702, TA2867, and TA2867A, respectively.

SILICON NPN HIGH-VOLTAGE POWER TRANSISTORS

For Class A AF Power-Amplifier Service In Line-Operated Radios, Phonographs, and Television Receivers



40422, 40424, 40426
(JEDEC TO-66)



40423, 40425, 40427
TOP VIEW
JEDEC TO-66
WITH HEAT RADIATOR

- **High breakdown voltages:**
  BV_{CBO}, BV_{CEX} = 300 V min.
- **High dissipation capabilities:**
  40422, 40424, 40426: P_T = 8 W max. at T_{MF} to 70° C
  40423, 40425, 40427: P_T = 3.8 W max. at T_A to 55° C
- **High power-output capabilities in economical line-operated circuit designs:**
  40422, 40424, 40426: $P_O \geq 2$ W at < 10% THD
  40423, 40425, 40427: $P_O \geq 1$ W at < 10% THD
- **High gain-bandwidth product for excellent hf response:**
  f_T = 25 MHz typ.
- **Low output capacitance:**
  C_{ob} = 5 pF typ.
- **Hermetically sealed JEDEC TO-66 metal packages**
- **Collector internally connected to mounting-flange and case for effective heat transfer**
- **Pin-type base and emitter terminals**

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

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Printed in U.S.A.
40422 through 40427 8-66
Supersedes issue dated 3-66

Maximum Ratings, *Absolute-Maximum Values:*

	40422 40424 40426	40423 40425 40427	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	300	300 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEX}: (Sustaining value at I_C = 5 mA, I_B = 5 μA)	300	300 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2	2 max.	V
COLLECTOR CURRENT, I_C	150	150 max.	mA
BASE CURRENT, I_B	150	150 max.	mA
EMITTER CURRENT, I_E	150	150 max.	mA
TRANSISTOR DISSIPATION, P_T:			
At mounting-flange temperatures** up to 70° C	8	–	W
At mounting-flange temperatures** above 70° C	See Fig.1	–	–
At ambient temperatures up to 55° C	–	3.8 max.	W
At ambient temperatures above 55° C	–	See Fig.1	
TEMPERATURE RANGE: Storage and operating	-65 to +150		°C
LEAD TEMPERATURE (During soldering): At distances not closer than 1/32 inch to seating surface for 10 seconds max.	255	255 max.	°C

** Measured at center of seating surface.

RATING CHART FOR 40422, 40423, 40424, 40425, 40426, AND 40427

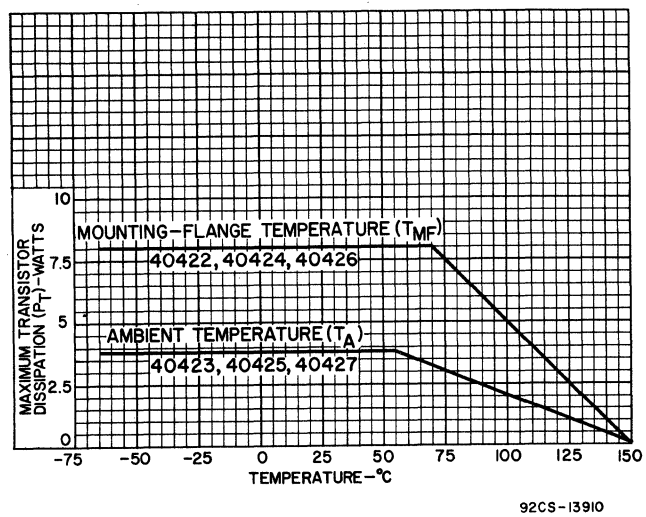


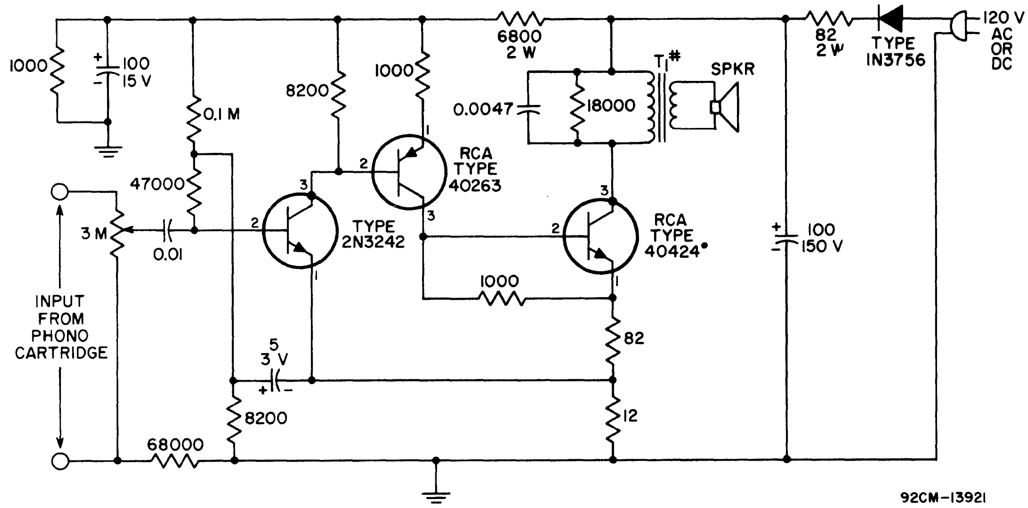
Fig.1

ELECTRICAL CHARACTERISTICS, *at a Mounting-Flange Temperature (T_{MF}) of 25° C**

Characteristics	Symbols	TEST CONDITIONS: DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Base Current I_B (μA)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	LIMITS: RCA 40422 40423 Min.	Typ.	Max.	RCA 40424 40425 Min.	Typ.	Max.	RCA 40426 40427 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	300			0		–	–	100	–	–	100	–	–	100	μA
Collector-Cutoff Current	I_{CEX}		300	5			–	–	5	–	–	5	–	–	5	mA
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1	0	2	–	–	2	–	–	2	–	–	V
Static Forward Current-Transfer Ratio	h_{FE}		10			50	50	80	250	30	60	150	20	35	100	—
Gain-Bandwidth Product	f_T		50			20	–	25	–	–	25	–	–	25	–	MHz
Open-Circuit Common-Base Output Capacitance	C_{ob}	50			0		–	5	–	–	5	–	–	5	–	pF
Extrinsic Base-Lead Resistance	$r_{bb'}$	f = 100 MHz	50			20	–	20	–	–	20	–	–	20	–	Ω
Thermal Resistance: Junction-to-Mounting Flange*	θ_{J-MF}						RCA-40422 –	8	10	RCA-40424 –	8	10	RCA-40426 –	8	10	°C/W
Thermal Resistance: Junction-to-Free Air	θ_{J-FA}						RCA-40423 –	–	25	RCA-40425 –	–	25	RCA-40427 –	–	25	°C/W

* Measured at center of seating surface.

2-WATT LINE-OPERATED PHONO-AMPLIFIER USING RCA-40424



TYPICAL PERFORMANCE CHARACTERISTICS:

Sensitivity for 2 W output at 1 kHz = 550 mV
Power output at 10% total harmonic distortion = 2 W (RMS)
Frequency response 100 Hz to 10 KHz
Hum and noise -63 dB (below 2 W)

#T_1 = 2500: 3.2 ohms
(Freed type RGA-8, Triad type S-12X, or equivalent)

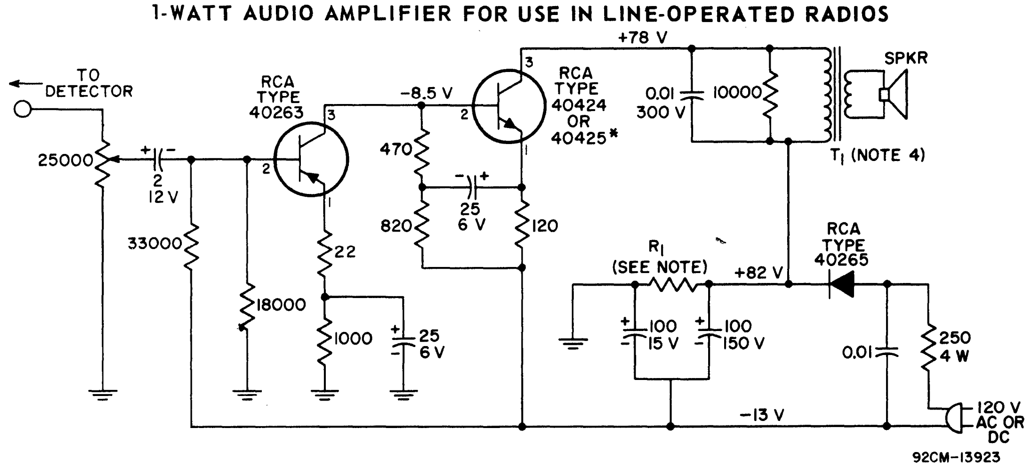
• RCA 40424 mounted on heat sink having a thermal resistance ≤ 5° C/W

All resistors in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified

All capacitors in microfarads

Fig.2

1-WATT AUDIO AMPLIFIER FOR USE IN LINE-OPERATED RADIOS



PERFORMANCE DATA

Power Output = 1 W min. at 10% total harmonic distortion
Sensitivity: 3 mV for 50 mW output
16 mV for 1 W output

Power Gain: 72 dB
Z_{in}: 3000 Ω typ.
Hum & Noise: Zero vol. -70 dB } 1 W
Full vol. -58 dB } Ref.

Freq. Resp.: 120 Hz to 7.6 KHz (-3 dB)

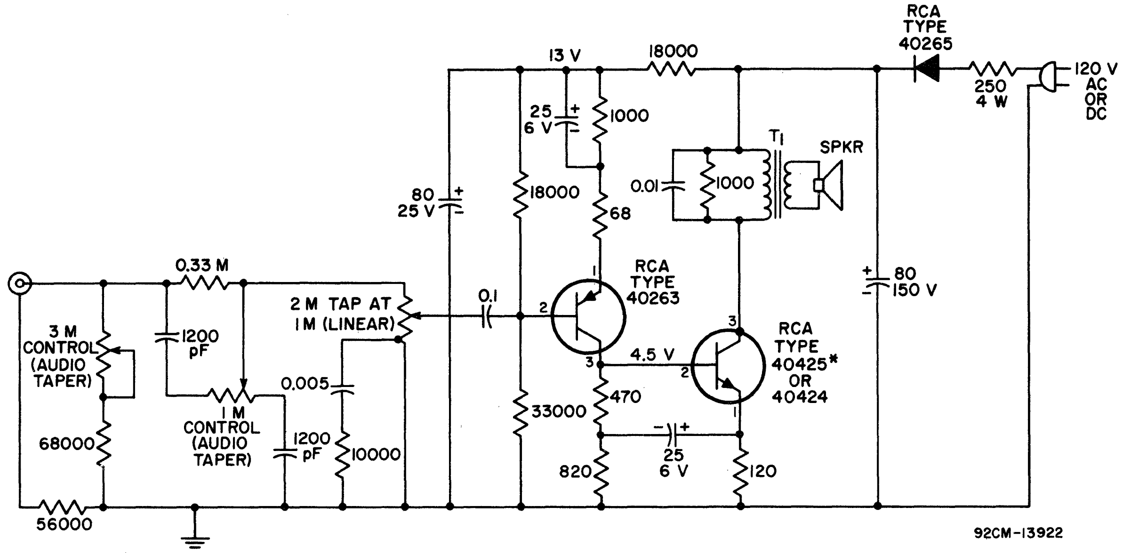
* 40425 may be mounted directly on printed-circuit board with no additional heat sink for operation at ambient temperatures up to 55° C.

NOTES

1. All measurements taken at 120 V line input and at frequency of 1 KHz.
2. All voltages referred to circuit ground.
3. Value for R_1 is 3900 Ω/2 watts based on 15 mA front-end drain-not including 40263 current.
4. T_1: 2500 Ω to voice coil impedance Freed Type RGA-8 or Triad Type S-12X or similar commercial-grade plate-to-voice coil transformer.
5. Resistors are in ohms, 1/2 watt, composition, 10% tolerance, unless otherwise specified.
6. Capacitors are in microfarads

Fig.3

1-WATT LINE-OPERATED PHONO-AMPLIFIER FOR USE WITH CRYSTAL CARTRIDGES



Power Output = 1 W. @ 10% total harmonic distortion
Sensitivity: 2 V for 1 W output
T_1: 2500 to 3.2 ohms
(Freed Type RGA-8 or Triad Type S-12X or equiv.)

All resistors in ohms, 1/2-watt, composition, 10% tolerance, unless otherwise specified

All capacitors in microfarads unless otherwise specified

* 40425 may be mounted directly on printed-circuit board with no additional heat sink for operation at ambient temperatures up to 55° C.

Fig.4

TYPICAL INPUT CHARACTERISTIC FOR RCA TYPES 40422, 40423, 40424, 40425, 40426, AND 40427

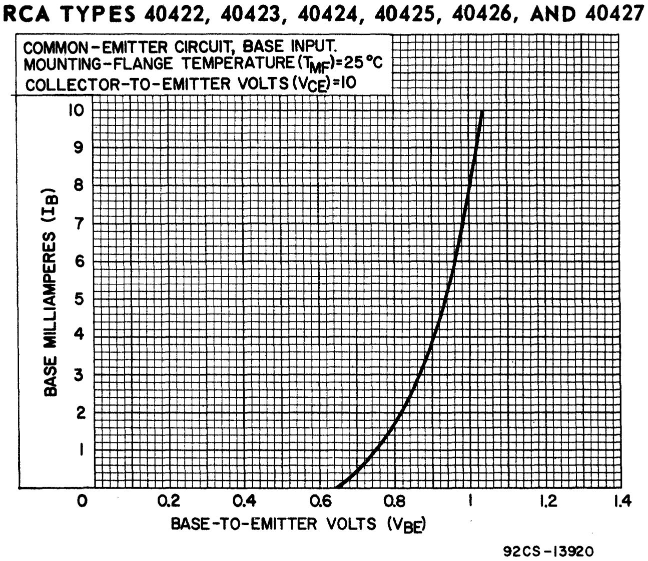


Fig.5

TYPICAL TRANSFER CHARACTERISTIC FOR RCA TYPES 40422, 40423, 40424, 40425, 40426, AND 40427

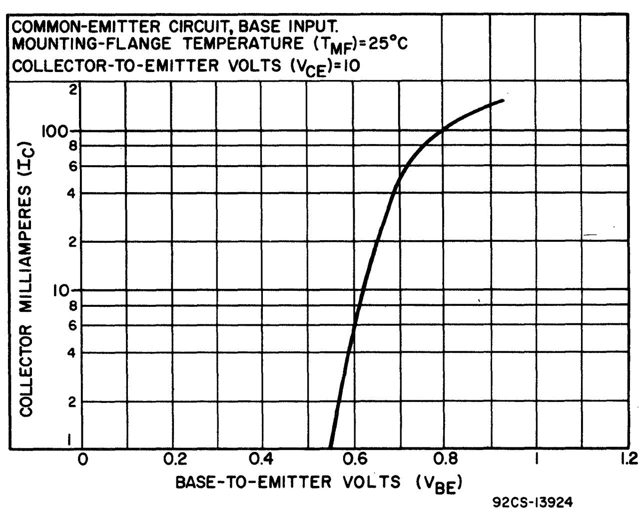


Fig.6

STATIC BETA (h_{FE}) vs. COLLECTOR CURRENT FOR RCA TYPES 40422 AND 40423, 40424 AND 40425, AND 40426 AND 40427

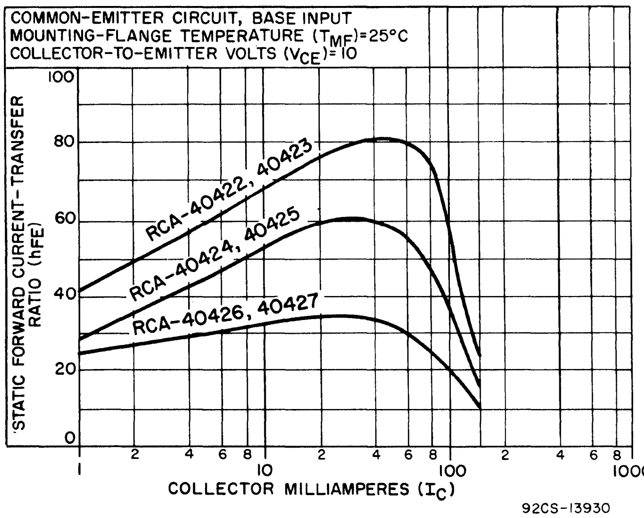


Fig.7

TYPICAL COLLECTOR CHARACTERISTICS FOR RCA TYPES 40422, 40423, 40424, 40425, 40426, AND 40427

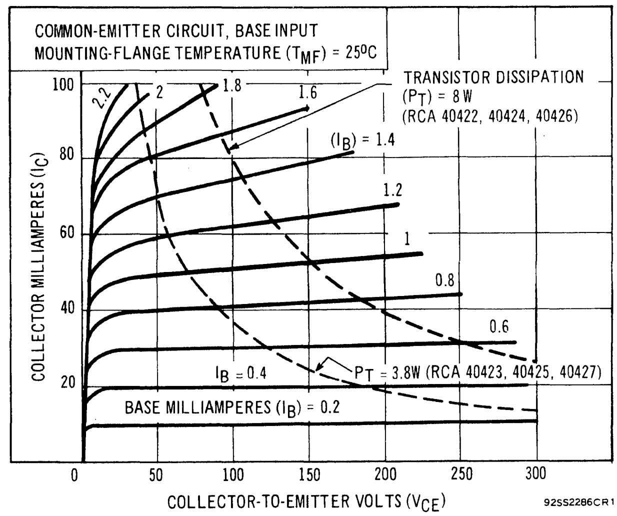


Fig.8

OPERATING CONSIDERATIONS

The *maximum ratings* in the tabulated data are established in accordance with the following definition of the *Absolute-Maximum Rating System* for rating electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environment variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The devices described in this bulletin should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the devices.

Because the metal shells of these transistors operate at the collector voltage, consideration should be given to the possibility of shock hazard if the shells are to operate at voltages appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

It is essential that the mounting flanges of the 40422, 40424, and 40426, which are internally connected to the collectors, be securely fastened to heat sinks, which may be the equipment chassis. UNDER NO CIRCUMSTANCES, HOWEVER, SHOULD THE MOUNTING FLANGE BE SOLDERED TO THE HEAT SINK OR CHASSIS BECAUSE THE HEAT OF THE SOLDERING OPERATION WILL PERMANENTLY DAMAGE THE TRANSISTOR.

The mounting-flange temperature of the 40422, 40424, or 40426 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

Depending on the application, the heat sink or chassis may be connected to either the positive or negative terminal of the voltage supply.

In applications where the 40422, 40424, or 40426 is mounted on a chassis which is connected to the negative terminal of the voltage supply, it will be necessary to use an anodized aluminum washer having high thermal conductivity, or a 0.002" thick mica insulator between the mounting flange and the chassis. If an aluminum washer is used, it should be drilled or punched to provide the two mounting holes and the clearance holes for the emitter lead and base lead. The burrs should then be removed from the washer and the washer finally anodized. To insure that the anodized insulating layer is not destroyed during mounting, it will also be necessary to remove the burrs from the holes in the chassis. Furthermore, to prevent a short circuit between the mounting bolts and the chassis, it is important that an insulating washer be used between each bolt and the chassis.

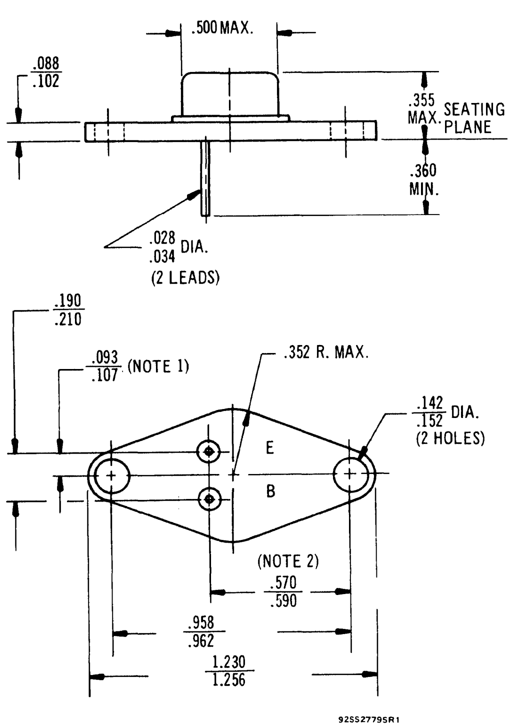
Protection Against Transient Voltages

In a transistor class A af output-amplifier stage using transformer coupling between the transistor and the load, the collector voltage may reach instantaneous values as great as 5 to 7 times the dc supply voltage. These high voltages are usually transients developed when the transistor is overdriven to a very high value of collector current and is then abruptly cut off.

The peak value of the transient voltage will depend on the inductance, capacitance, and resistance of the output transformer and load, and on the value of the collector current immediately prior to cutoff. [The reactive components of the transformer and load act like a parallel-resonant circuit, with series and shunt damping (loss) elements provided by the associated resistances.] For a given set of load-circuit conditions the peak value of the transient voltage will be directly proportional to the collector current, and can be limited to a value within the maximum rating for the transistor by limiting the maximum value of the collector current – that is, by limiting the dynamic range of the transistor.

In most cases this type of limiting can be accomplished, and the desired maximum power output obtained without clipping and without compromise in performance or cost factors, by a judicious choice of circuit constants. The amplifier circuits shown in Figs. 2, 3, and 4 of this Bulletin have been designed with these considerations in mind, and provide protection against excessive collector voltages without the use of transient-suppression devices. It is also possible to use other combinations of circuit constants which will provide the degree of collector-current limiting and output-circuit damping necessary to keep transient-voltage peaks within the collector-voltage rating for the output transistor. For further information on this subject consult your RCA Field Representative.

DIMENSIONAL OUTLINE
40422, 40424, 40426



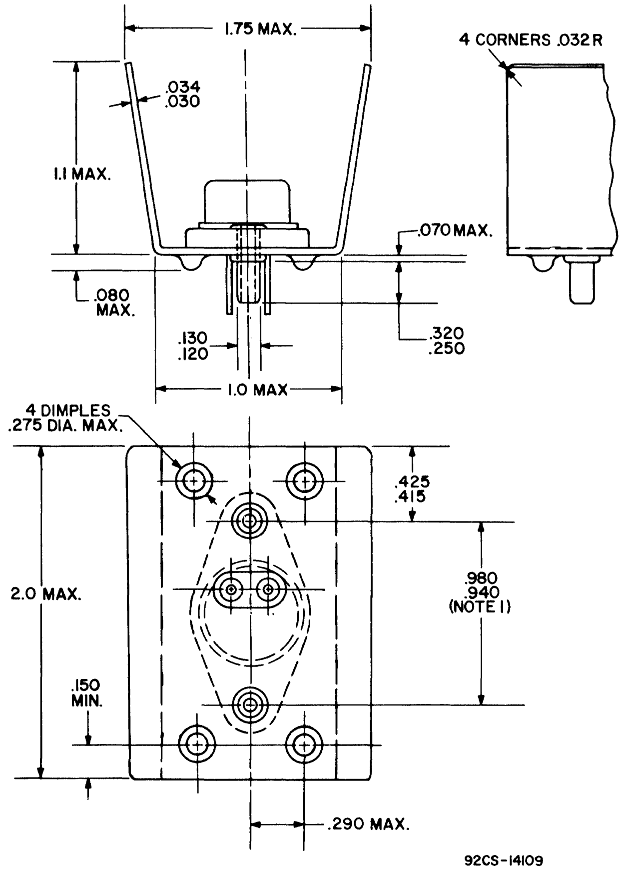
Dimensions in Inches

NOTE 1: MEASURED AT SEATING PLANE

NOTE 2: MEASURED AT SEATING PLANE ON RCA 40422, 40424, 40426

MEASURED AT UNDERSIDE OF ALUMINUM COOLING FLANGE ON RCA 40423, 40425, 40427

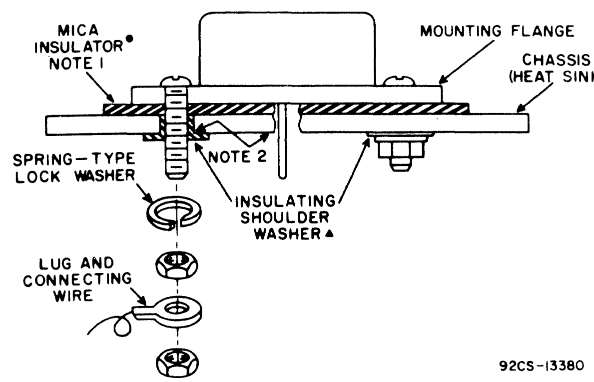
DIMENSIONAL OUTLINE
40423, 40425, 40427



Dimensions in Inches

NOTE 1: MEASURED BETWEEN CENTER LINES OF TIPS OF MOUNTING PINS

SUGGESTED MOUNTING ARRANGEMENT FOR RCA-40422, 40424, 40426 ■



NOTE 1: 0.002" thick mica or anodized aluminum insulator drilled or punched with burrs removed.

NOTE 2: Remove burrs from chassis holes.

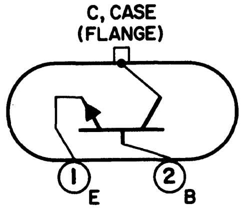
● Available from RCA Distributors as Part No.DF31A. Also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

▲ Available from RCA Distributors as Part No.495334-7. Also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

■ RCA-40422, 40424, and 40426 fit socket PTS-4 (United International Dynamics Corp., 2029 Taft St., Hollywood, Fla.), or equivalent.

TERMINAL DIAGRAM

RCA
40422, 40423
40424, 40425
40426, 40427



Pin 1 - Emitter

Pin 2 - Base

Mounting Flange - Collector, Case

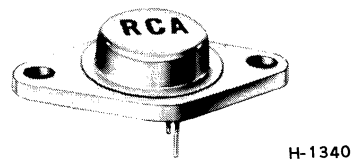
RCA

GATED BIDIRECTIONAL SILICON THYRISTORS FOR AC LOAD CONTROL

RCA Triac types 40429 and 40430 are gate-controlled full-wave ac silicon switches. They are designed to switch from an off-state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

They are intended primarily for the control of ac loads in applications such as lighting, heating, motor control, and static switching. In addition, the excellent gate sensitivity of the 40429 and the 40430 enables them to be controlled with economical transistorized circuits.

The 40429 and 40430 are hermetically-sealed in a JEDEC TO-66 package. They have an rms on-state current capability of 6 amperes at a case temperature of +75° C. The 40429 has a repetitive peak off-state voltage rating of 200 volts and the 40430, 400 volts.



JEDEC TO-66

40429	For 120-Volt Line Operation
40430	For 240-Volt Line Operation

- **Excellent gate sensitivity – reduces cost of triggering components**
- **Shorted-emitter and center-gate design – removes restrictions on forward and reverse gate voltage and peak gate current**
- **Direct soldered internal construction – assures exceptional resistance to fatigue**

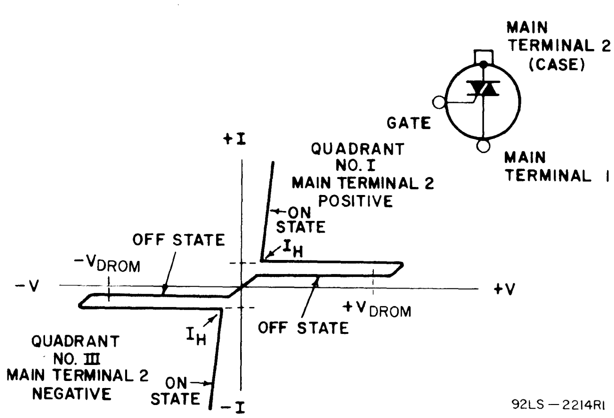
40429

- **Controls Loads Up to 720 Watts at 120 V, 60 Hz**

40430

- **Controls Loads Up to 1440 Watts at 240 V, 60 Hz**

PRINCIPAL VOLTAGE-CURRENT CHARACTERISTIC



Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is higher than the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

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ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
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Marca(s) Registrada(s)
Printed in U.S.A.
1/68
Supersedes issue dated 10/66

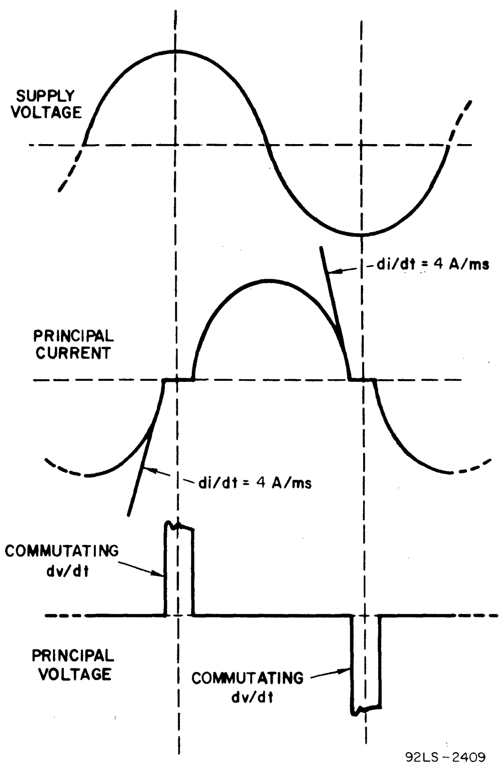
Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at Frequencies of 50 and 60 Hz, and with Resistive or Inductive Load

For Definitions of Terms and Symbols, See Pages 7 and 8.

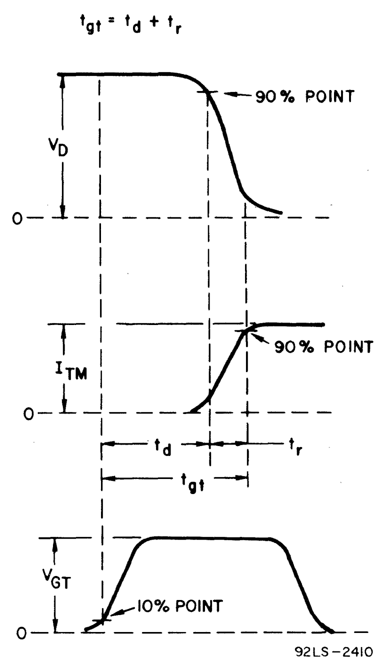
RATINGS	TRIAC TYPES 40429	TRIAC TYPES 40430	UNITS
Repetitive Peak Off-State Voltage♦, V_{DROM}:			
Gate Open			
For T_j = -40° C to +100° C	200	400	V
RMS On-State Current, $I_{T(RMS)}$:			
For case temperature (T_C) of +75° C and a conduction angle of 360°	6	6	A
Peak Surge (Non-Repetitive) On-State Current, I_{TSM}:			
For one full cycle of applied sinusoidal principal voltage	100	100	A
For more than one full cycle of applied voltage	See *Fig.3*	See *Fig.3*	
Peak Gate-Trigger Current■, I_{GTM}:			
For 1 μs max.	4	4	A
Gate Power:			
Peak■, P_{GM}			
For 1 μs max. and $I_{GTM} \leq 4$ A (peak)	16	16	W
Average, $P_{G(AV)}$	0.2	0.2	W
Temperature●			
Storage, T_{stg}	-40 to +150	-40 to +150	°C
Operating (case), T_C	-40 to +100	-40 to +100	°C

♦For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.
●For information on the reference point of temperature measurement, see *Dimensional Outline*.

WAVESHAPES OF COMMUTATING dv/dt CHARACTERISTICS



WAVESHAPES OF t_{gt} CHARACTERISTICS TEST



Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)
For Definitions of Terms and Symbols, See Pages 7 and 8.

CHARACTERISTICS	TRIAC TYPES 40429 Min.	40429 Typ.	40429 Max.	40430 Min.	40430 Typ.	40430 Max.	UNITS
Peak Off-State Current[♦], I_{DROM} Gate Open							
At T_j = +100° C and V_{DROM} = Max. rated value	–	0.1	2	–	0.2	4	mA
Instantaneous On-State Voltage[♦], v_T							
For i_T = 30 A (peak) and T_C = +25° C	–	1.6	2.2	–	1.6	2.2	V(peak)
DC Holding Current[♦], I_H							
Initial principal current = 150 mA (dc)							
At T_C = +25° C	–	10	30	–	10	30	mA(dc)
For other case temperatures		See *Fig.5*			See *Fig.5*		
Critical Rate of Applied Commutating Voltage[♦], **Commutating dv/dt:** *							
For v_D = V_{DROM}, $I_{T(RMS)}$ = 6 A, commutating di/dt = 4 A/ms, and gate unenergized							
At T_C = +75° C	–	5	–	–	5	–	V/μs
At T_C = +50° C	–	8	–	–	8	–	V/μs
Critical Rate of Rise of Off-State Voltage[♦], **Critical dv/dt:**							
For v_D = V_{DROM}, exponential voltage rise, gate open							
At T_C = +100° C	–	30	–	–	30	–	V/μs
DC Gate-Trigger Current[♦■], I_{GT}:							
For v_D = 6 volts (dc), R_L = 12 ohms, T_C = +25° C, and Specified Triggering Mode:							
I^+ Mode: V_{MT2} is positive, V_G is positive . . .	–	10	25	–	10	25	mA(dc)
I^- Mode: V_{MT2} is positive, V_G is negative . . .	–	20	25	–	20	25	mA(dc)
III^+ Mode: V_{MT2} is negative, V_G is positive . . .	–	20	25	–	20	25	mA(dc)
III^- Mode: V_{MT2} is negative, V_G is negative . . .	–	10	25	–	10	25	mA(dc)
For other case temperatures		See *Fig.8*			See *Fig.8*		
DC Gate-Trigger Voltage[♦■], V_{GT}							
All Triggering Modes							
For v_D = 6 volts (dc) and R_L = 12 ohms							
At T_C = +25° C	–	1	2.2	–	1	2.2	V(dc)
For other case temperatures		See *Fig.9*			See *Fig.9*		
For v_D = V_{DROM} and R_L = 125 ohms							
At T_C = +100° C	0.2	–	–	0.2	–	–	V(dc)
Gate-Controlled Turn-On Time, t_{gt} (Delay Time + Rise Time)							
For v_D = V_{DROM}, I_{GT} = 80 mA, 0.1 μs rise time, and i_T = 10 A(peak)							
At T_C = +25° C	–	2.2	–	–	2.2	–	μs
Thermal Resistance, Junction to case, θ_{J-C}	–	–	4	–	–	4	°C/W

♦For either polarity of main terminal 2 voltage (V_{MT2}) with reference to main terminal 1.

*Variants of these devices having dv/dt characteristics selected specifically for inductive loads are available on request.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

ON-STATE CURRENT RATING CHART (CASE TEMPERATURE)

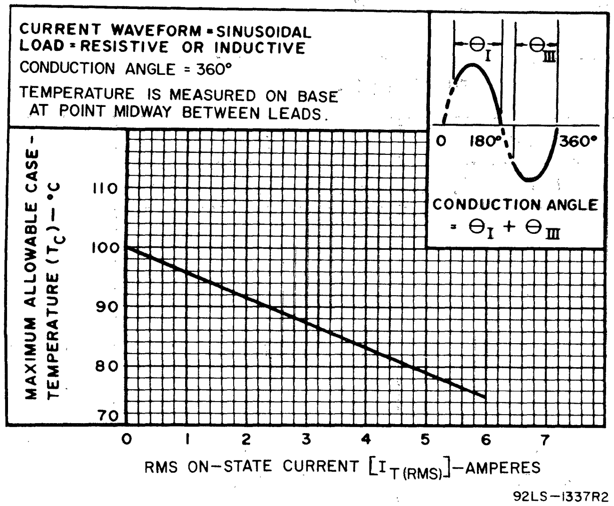


Fig. 1

POWER DISSIPATION CURVES

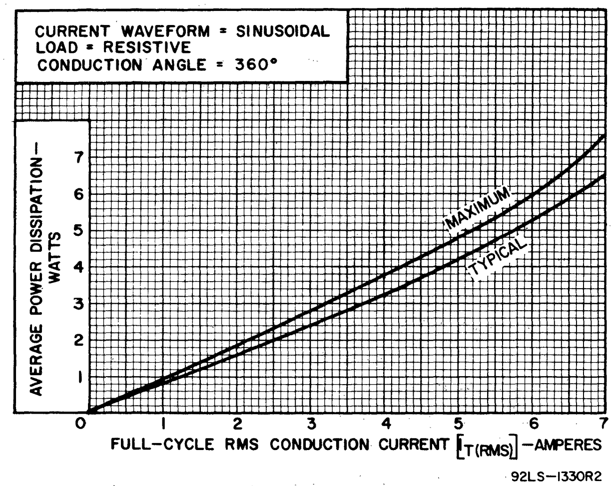


Fig. 2

SURGE CURRENT RATING CHART

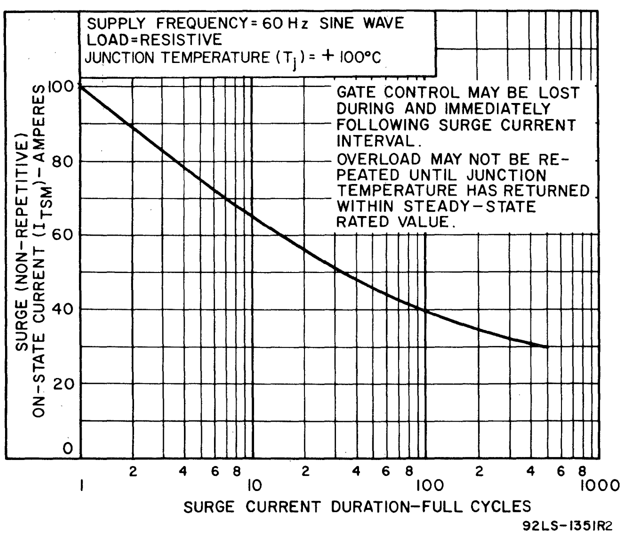


Fig. 3

ON-STATE CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

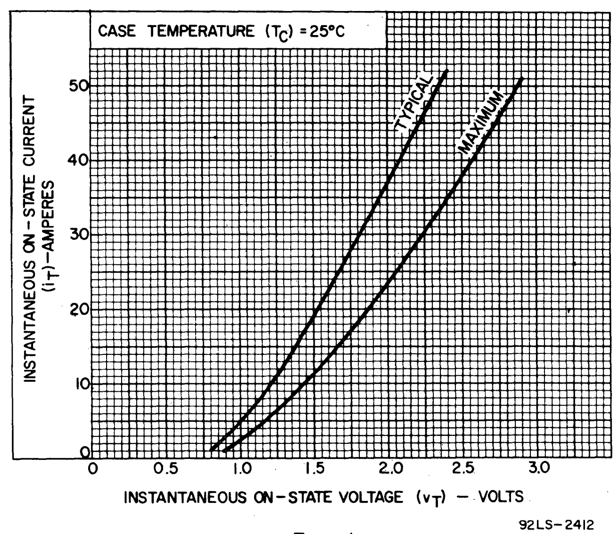


Fig. 4

DC HOLDING CURRENT CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

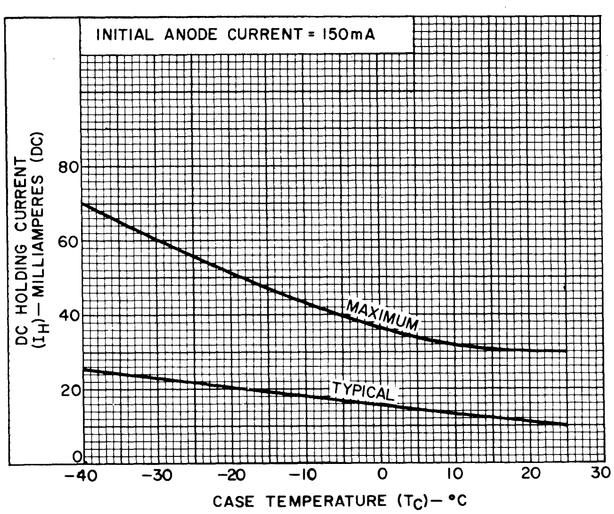


Fig. 5

TYPICAL TURN-ON TIME CHARACTERISTIC

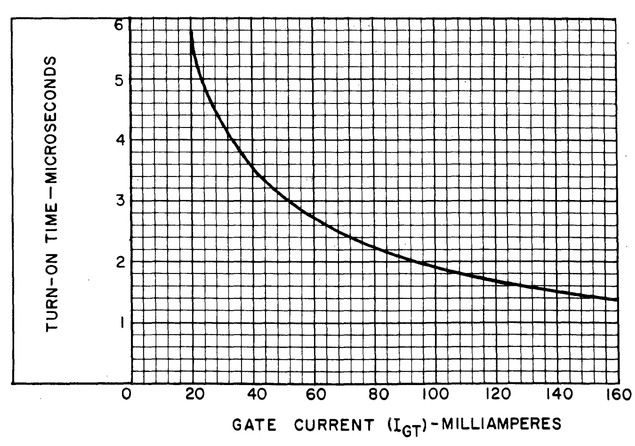


Fig. 6

GATE CHARACTERISTICS

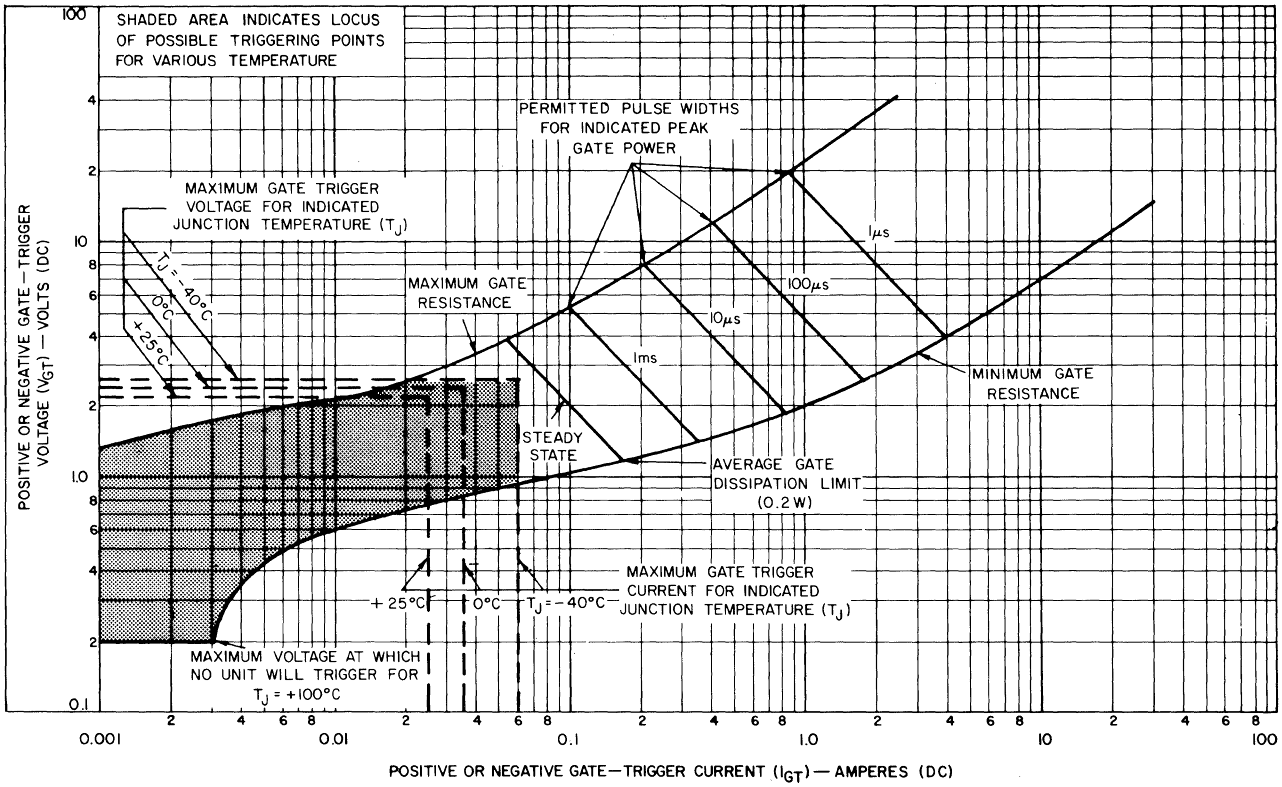


Fig. 7

DC GATE-TRIGGER CURRENT CHARACTERISTICS

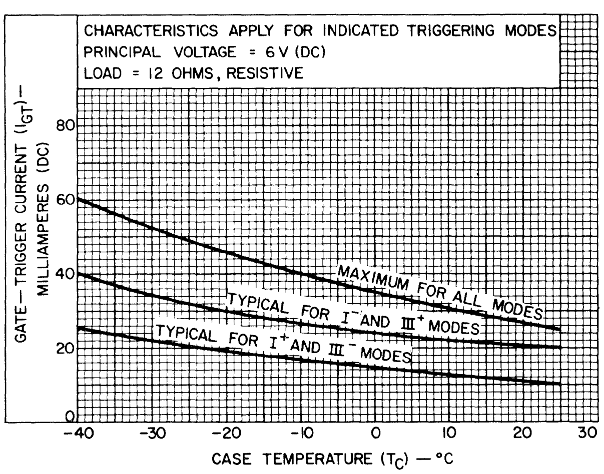


Fig. 8

DC GATE-TRIGGER VOLTAGE CHARACTERISTICS

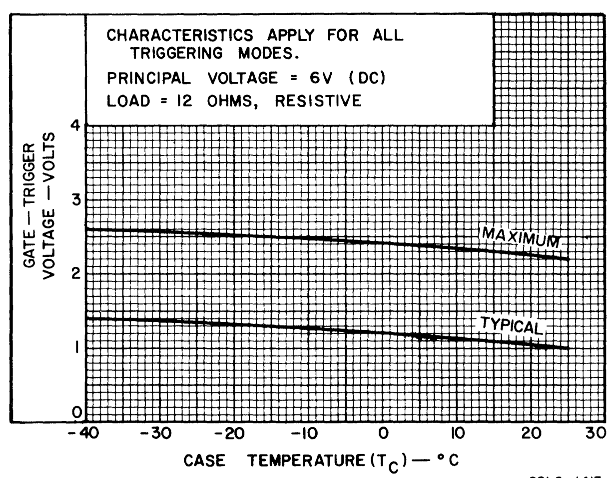


Fig. 9

TRANSIENT THERMAL RESISTANCE
AS A FUNCTION OF TIME

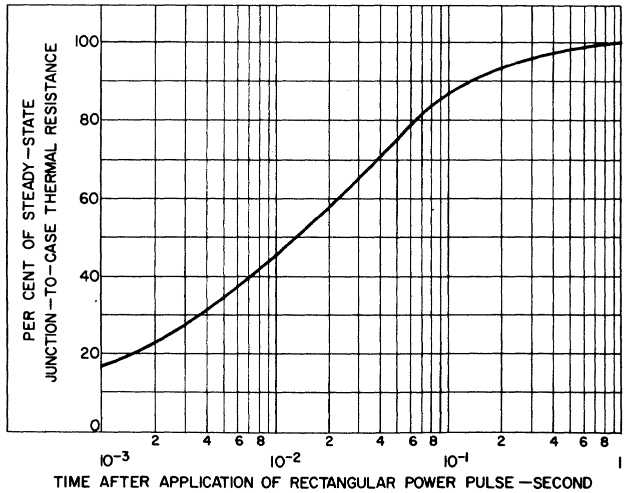
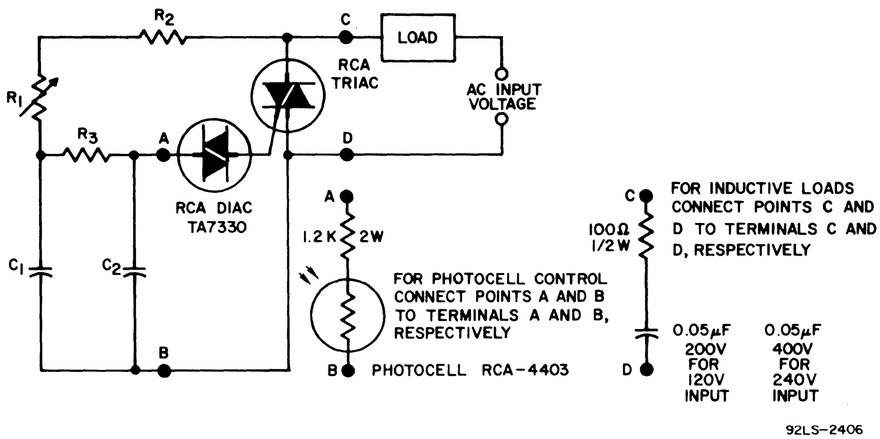


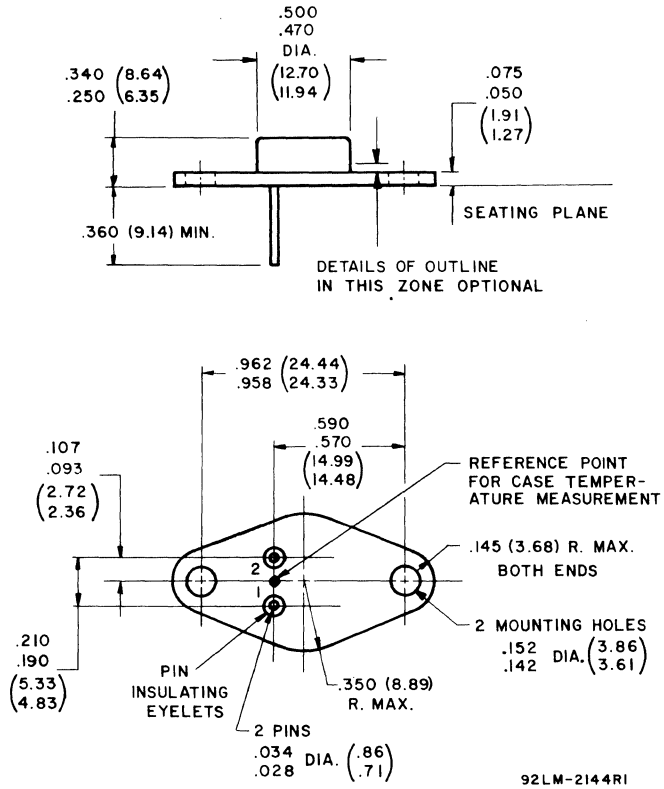
Fig. 10

TYPICAL PHASE-CONTROL CIRCUIT FOR
LAMP DIMMING, HEAT CONTROLS, AND
UNIVERSAL MOTOR SPEED CONTROLS



AC INPUT VOLTAGE	C_1	C_2	R_1	R_2	R_3	RCA TRIAC TYPES
120 VAC 60 Hz	0.1 µF 200 V	0.1 µF 100 V	100 K 1/2 W	1 K 1/2 W	15 K 2 W	40429 40485
240 VAC 60 Hz	0.05 µF 400 V	0.1 µF 100 V	200 K 1/2 W	7.5 K 2 W	7.5 K 2 W	40430 40486

DIMENSIONAL OUTLINE JEDEC No.TO-66

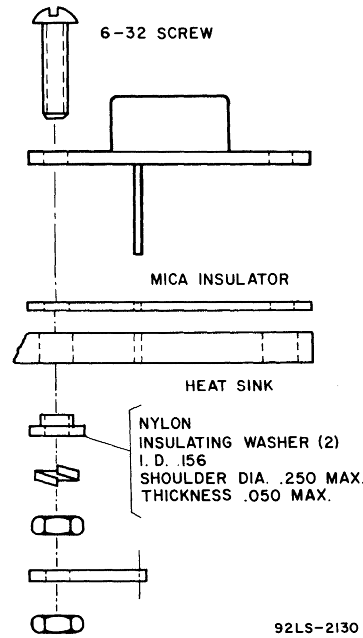


DIMENSIONS IN INCHES AND MILLIMETERS

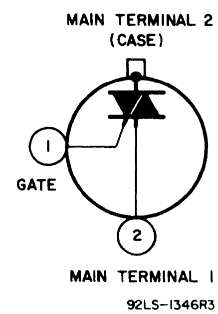
Note: Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions that are shown.

Pin 1: Gate
Pin 2: Main Terminal 1
Case: Main Terminal 2

SUGGESTED INSULATED MOUNTING ARRANGEMENT



TERMINAL DIAGRAM



DEFINITIONS OF TERMS AND SYMBOLS

These terms and symbols follow the latest recommended standards of JEDEC. For convenience, formerly used symbols have been cross-referenced to the new standards.

PRINCIPAL VOLTAGE DEFINITIONS

Repetitive Peak Off-State Voltage – V_{DROM} (Formerly V_{BOM}) – The maximum instantaneous value of principal off-state voltage which may be applied to the thyristor, including all repetitiye transient voltages, which will not switch the thyristor from the off-state to the on-state with the gate open and at specified conditions of thyristor junction temperature.

Instantaneous Off-State Voltage – v_D (Formerly v_{BX}) – The instantaneous value of principal voltage, positive or negative, applied between main terminals 1 and 2 when the thyristor is in the off-state.

Instantaneous On-State Voltage – v_T (Formerly v_{AA}) – The instantaneous value of principal voltage, positive or negative, when the thyristor is in the on-state at a given instantaneous current.

Critical Rate of Rise of Off-State Voltage – Critical dv/dt – The value of the exponential rate of rise of principal voltage below which switching from the off-state to the on-state will not occur, and above which switching may occur, under specified conditions. This rate of rise is defined as follows:

$$dv/dt = \frac{0.63\ V_{DROM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 of V_{DROM}.

Critical Rate of Applied Commutating Voltage – Commutating dv/dt – The instantaneous rate of rise of principal voltage occuring during commutation which will not cause the thyristor to switch to the on-state under specified conditions.

PRINCIPAL CURRENT DEFINITIONS

RMS On-State Current – $I_{T(RMS)}$ (Formerly I_{ON}) – The RMS value of the principal current when the thyristor is in the on-state.

Instantaneous On-State Current – i_T (Formerly i_{AA}) – The instantaneous value of principal current when the thyristor is in the on-state.

Peak Surge (Non-Repetitive) On-State Current – I_{TSM} (Formerly i_{SM}) – An overload on-state current of specific time duration, and peak value, which may be conducted through the thyristor for one full cycle from a 60-Hz supply in a single-phase circuit with a resistive load. The thyristor shall be operating within its specified operating voltage, RMS current, gate power, and temperature ratings prior to the surge current. The surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

Peak Off-State Current – I_{DROM} (Formerly I_{BOM}) – The current which flows through the main terminals when the thyristor is in the off-state and when the principal voltage is V_{DROM} under specified conditions of junction temperature and with the gate open.

DC Holding Current – I_H (Formerly I_{HOX}) – The principal current required to maintain the thyristor in the on-state for a specified temperature.

GATE DEFINITIONS

DC Gate-Trigger Current – I_{GT} – The gate current which will switch a thyristor from the off-state to the on-state under specified conditions of principal voltage and case temperature.

DC Gate-Trigger Voltage – V_{GT} – The gate voltage required to produce the gate-trigger current necessary to switch a thyristor from the off-state to the on-state for specified conditions of principal voltage and case temperature.

Peak Gate-Trigger Current – I_{GTM} – The maximum gate-trigger current, positive or negative, which is allowed in switching a thyristor from the off-state to the on-state for a specified time duration.

Peak Gate Power Dissipation – P_{GM} – The maximum power which may be dissipated between the gate and main terminal 1 for a specified time duration.

Average Gate Power Dissipation – $P_{G(AV)}$ – The value of gate power which may be dissipated between the gate and main terminal 1 averaged over a full cycle.

MISCELLANEOUS

Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is higher than the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Gate-Controlled Turn-On Time – t_{gt} (Formerly t_{on}) – The time interval between the 10 per-cent point at the beginning of the gate-trigger voltage pulse and the instant when the principal current has risen to the 90 per-cent point of its peak value during switching of the thyristor from the off-state to the on-state by a gate pulse.

Load Resistance – R_L – The value of fixed resistance connected in series with a main terminal of the thyristor and the power source.

Thermal Resistance, Junction to Case – $\theta_{J\text{-}C}$ – The temperature difference between the thyristor junction and the thyristor case divided by the power dissipation causing the temperature difference under conditions of thermal equilibrium.

For basic thyristor theory, circuits, and application information on Triacs, refer to "RCA Silicon Power Circuits Manual," SP-50.

RCA TRIACS

40431
40432

GATED BIDIRECTIONAL SILICON THYRISTORS HAVING AN INTEGRAL TRIGGER FOR AC LOAD CONTROL

RCA Triac types 40431* and 40432* are gate-controlled full-wave ac silicon switches having an integral trigger. They are designed to switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

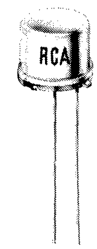
They are intended primarily for the phase control of ac loads in applications such as light dimming, universal and induction motor control, and heater control.

The 40431 and 40432 are hermetically sealed in all-welded tin-plated modified TO–5 packages. The small size of this package makes these devices especially suitable for use in equipment where space restrictions are of prime importance. In addition, because they are tin-plated, they can be soldered directly to a heat sink, thereby allowing the use of mass-produced pre-punched parts, and batch soldering techniques to eliminate many of the difficulties associated with mechanical mounting and heat sinking. Suggested methods are described on page 6.

The 40431 is intended for applications requiring a repetitive peak off-state voltage of up to 200 volts and an RMS on-state current capability of 6 amperes at a case temperature of +75° C.

The 40432 is intended for applications requiring a repetitive peak off-state voltage of up to 400 volts and an RMS on-state current capability of 6 amperes at a case temperature of +75° C.

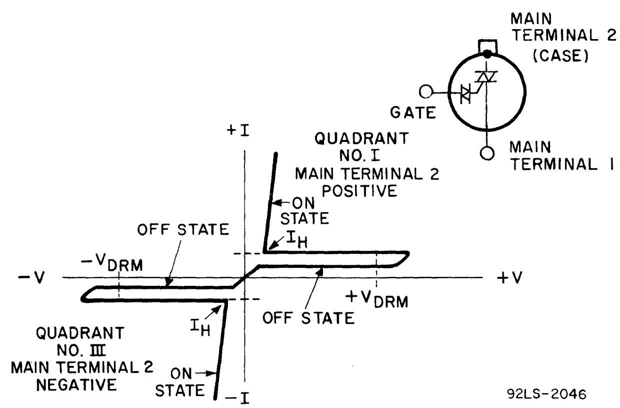
*Formerly Dev. Types TA2728 and TA2729, respectively.



Modified TO-5 Package

40431	For 120-Volt Line Operation
40432	For 240-Volt Line Operation

PRINCIPAL VOLTAGE-CURRENT CHARACTERISTIC



Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

FEATURES

- **Integral triggering – no additional triggering components required**
- **Symmetrical breakover**
- **Shorted-emitter design**
- **All-diffused-construction – assures exceptional uniformity and stability**
- **Direct soldered internal construction – assures exceptional resistance to fatigue**

40431
- **Controls 720 Watts at 120 V, 60 Hz**

40432
- **Controls 1440 Watts at 240 V, 60 Hz**

Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at a Frequency between 50 and 400 Hz, and with Resistive or Inductive Load

For definitions of terms and symbols, see pages 7 and 8.

RATINGS	TRIAC TYPES		UNITS
	40431	40432	
Repetitive Peak Off-State Voltage♦, V_{DRM}:			
Gate open			
For T_j = −40° C to +100° C	200	400	volts
RMS On-State Current, $I_{T(rms)}$			
For case temperature (T_C) of +75° C and a conduction angle of 360°	6	6	amperes
Surge (Non-Repetitive) On-State Current, I_{TSM}:			
For one full cycle of applied sinusoidal principal voltage	100	100	amperes
For more than one full cycle of applied voltage	*See Fig.3*	*See Fig.3*	
Peak Gate-Trigger Current■, I_{GTM}			
For 2 μs max.	1	1	ampere
Gate Power:			
Peak■, P_{GM}			
For 2 μs max. and $I_{GTM} \leq$ 1 A (peak)	20	20	watts
Average, P_{GAV}	0.2	0.2	watt
Temperature●*:			
Storage, T_{stg}	−40 to +150	−40 to +150	°C
Operating (case), T_C	−40 to +100	−40 to +100	°C

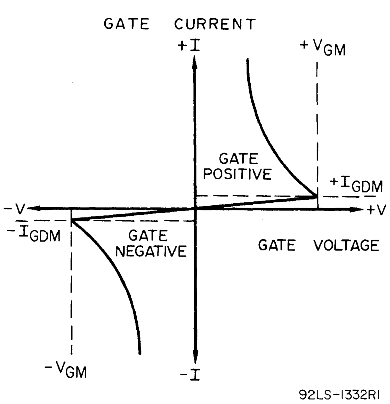
♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

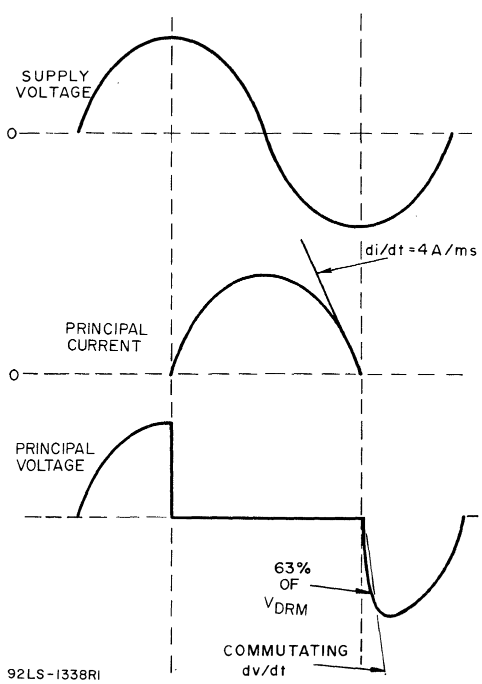
●For information on the reference point of temperature measurement, see *Dimensional Outline*.

*When these devices are soldered directly to the heat sink, a 60–40 solder should be used. Exposure time should only be sufficient to cause the solder to flow freely.

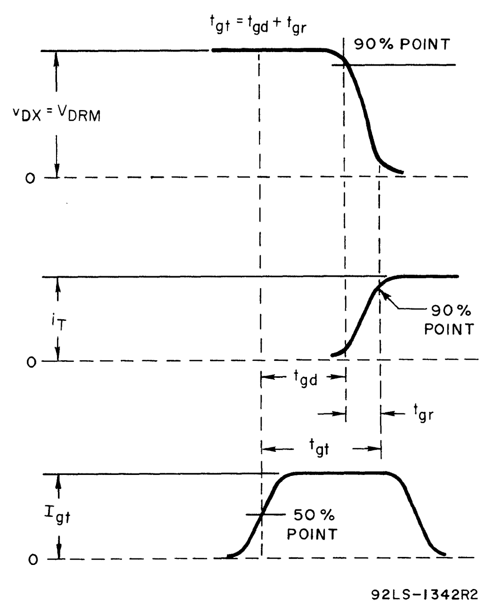
GATE-TO-MAIN TERMINAL 1 E-I CHARACTERISTIC



WAVESHAPES OF COMMUTATING dv/dt CHARACTERISTICS



WAVESHAPES OF t_{gt}– CHARACTERISTICS TEST



Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

For definitions of terms and symbols, see pages 7 and 8.

CHARACTERISTICS	TRIAC TYPES						UNITS
	40431			40432			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current♦, I_{DM}: Gate open							
At T_j = +100° C and V_{DRM} = Max. rated value. .	–	0.1	2	–	0.2	4	mA
On-State Voltage♦, v_T:							
For i_T = 30 A (peak) and T_C = +25° C	–	1.6	2.25	–	1.6	2.25	V(peak)
DC Holding Current♦, I_H: Initial principal current = 150 mA (dc)							
At T_C = +25° C	–	10	30	–	10	30	mA(dc)
For other case temperatures		*See Fig.5*			*See Fig.5*		
Critical Rate of Applied Commutating Voltage♦, Commutating dv/dt: For v_{DX} = V_{DRM}, $I_{T(rms)}$ = 6 A, commutating di/dt = 4 A/ms, and gate open							
At T_C = +75° C	–	5	–	–	5	–	volts/μs
At T_C = +50° C	–	8	–	–	8	–	volts/μs
Critical Rate of Rise of Off-State Voltage♦, dv/dt: For v_{DX} = V_{DRM}, exponential voltage rise, gate open							
At T_C = +100° C	–	30	–	–	20	–	volts/μs
Peak Gate Firing Voltage, V_{GM}:							
At T_C = +25° C	20	35	40	20	35	40	volts
For other case temperatures		*See Fig.8*			*See Fig.8*		
Gate Symmetry, Peak Voltage, $\lvert V_{GM}+ \rvert - \lvert V_{GM}- \rvert$	–	±1	±3	–	±1	±3	volts
Peak Gate Off-State Current, I_{GDM}:							
At T_C = +25° C	–	40	200	–	40	200	μA
For other case temperatures		*See Fig.7*			*See Fig.7*		
Gate Trigger Capacity: V_{DX} = 6 volts (dc), R_L = 12 ohms, and T_C = +100° C	0.1	–	2.0	0.1	–	2.0	μF
Gate-Controlled Turn-On Time, t_{gt} (Delay Time + Rise Time): For v_{DX} = V_{DRM}, I_{GT} = 80 mA, 0.1 μs rise time, and i_T = 10 A (peak)							
At T_C = +25° C	–	2.2	–	–	2.2	–	μs

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

CONDUCTION RATING CHART (CASE TEMPERATURE)

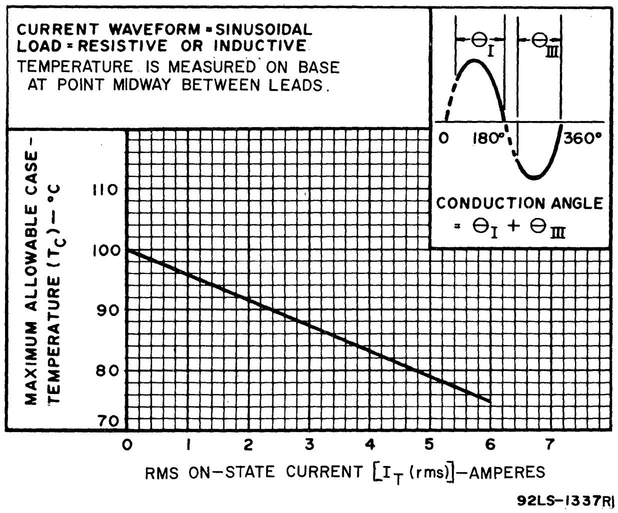


Fig. 1

POWER DISSIPATION CURVE

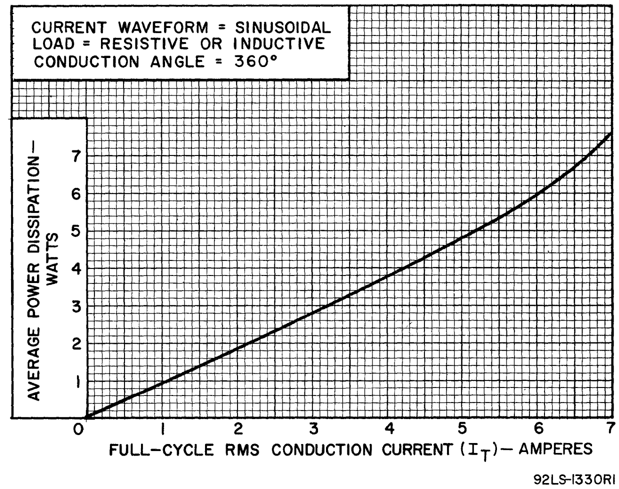


Fig. 2

SURGE CURRENT RATING CHART

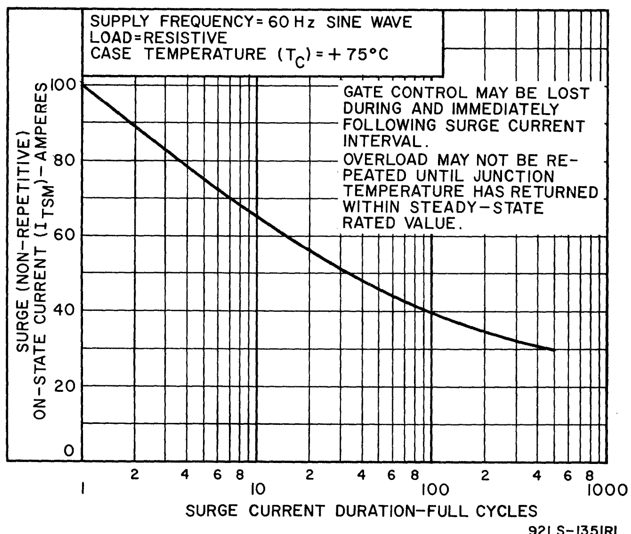


Fig. 3

ON-STATE CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

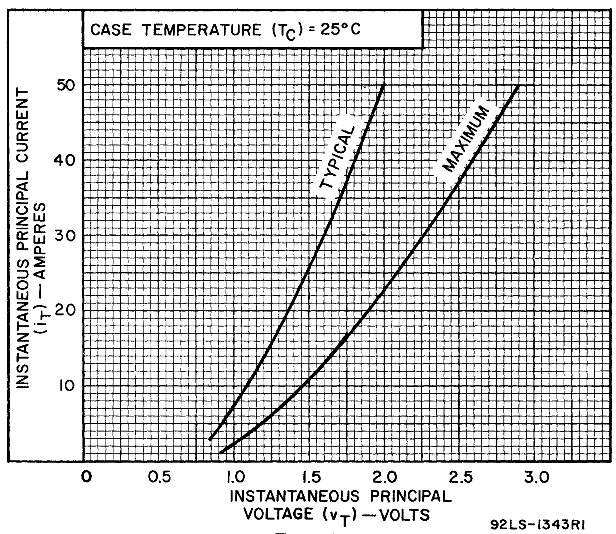


Fig. 4

DC HOLDING CURRENT CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

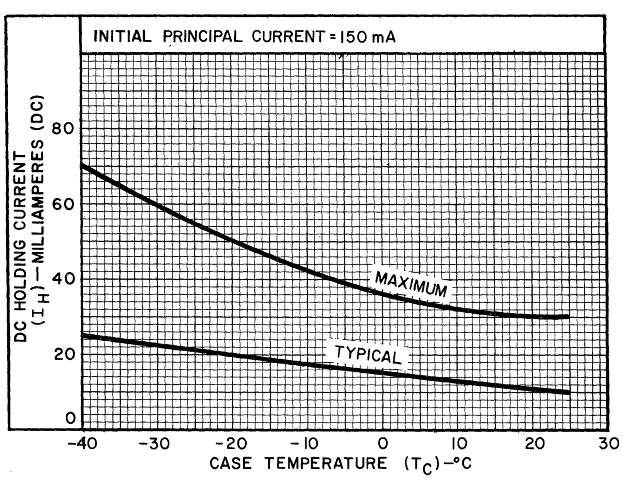


Fig. 5

TYPICAL TURN-ON TIME CHARACTERISTIC

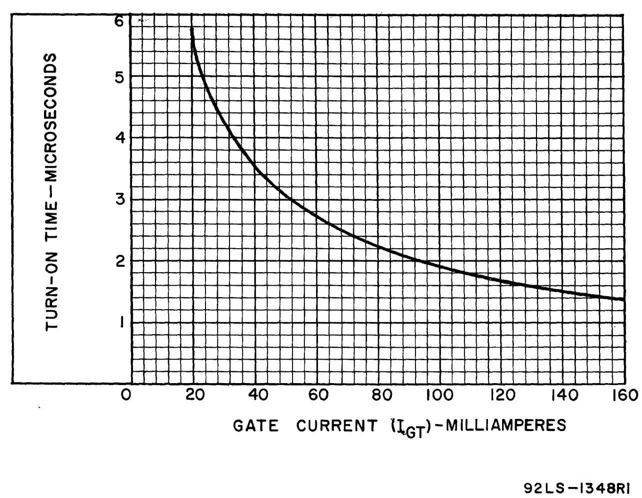


Fig. 6

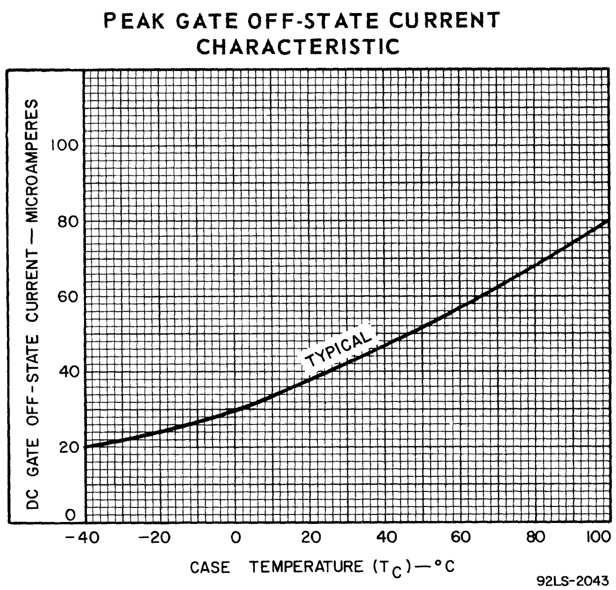


Fig. 7

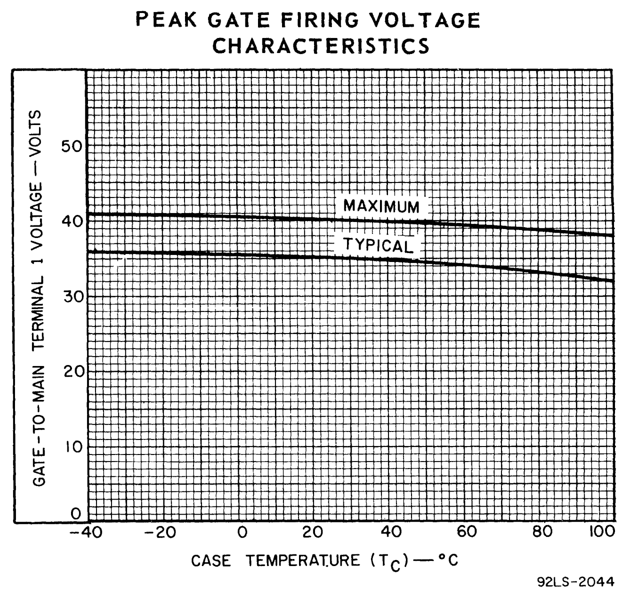


Fig. 8

TYPICAL PHASE-CONTROL CIRCUIT FOR LAMP DIMMING, HEAT CONTROLS, AND UNIVERSAL MOTOR SPEED CONTROLS

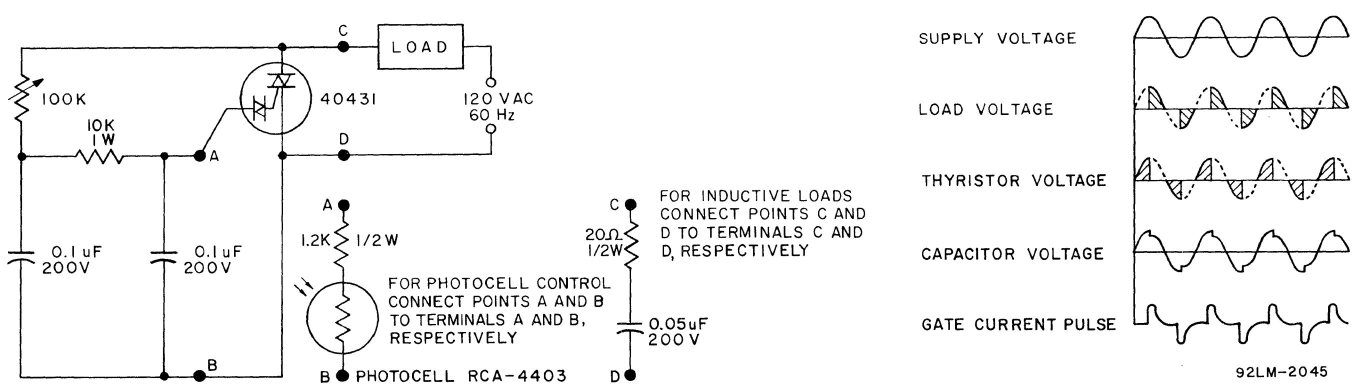


Fig. 9

MOUNTING AND HEAT SINKING SYSTEMS

Consideration must be given to heat sinking the thyristor when the device is operated at or near its maximum rated current. The most effective method of providing good thermal conductance is to solder the thyristor directly to the heat sink. When direct soldering is impractical, other methods of providing heat transfer can be employed.

Heat spreaders, designed specifically for RCA thyristors using the modified TO–5 package, are available from RCA (RCA Part No.NR 166B) and from the General Stamping Co.* (Part No.14-110), or equivalent. The thyristor is inserted in this heat spreader, as shown in *Fig.9A*, the mounting tab is heated with a soldering iron, and a 60-40 solder is applied to the thyristor base. The thyristor case temperature should not exceed 225° C during soldering. Because both the thyristor package and the heat spreader are tin-plated, a good solder bond is easily achieved.

For rapid solder control assemblies, a solder preform♦, such as that shown in *Fig.9B* is placed in the heat spreader prior to inserting the thyristor. The assembly can then be placed on a hot plate, or in an oven, operating at a temperature of 225° C ± 10° C. This temperature should be applied to the assembly only long enough to allow the solder to flow freely.

This heat spreader is easily adapted to mechanical mounting because of indentations provided in the spreader that assist in the final mechanical assembly. The distinct advantage offered by the wide base of this heat spreader is utilized in systems requiring electrical isolation. In such systems, Scotch♠ Brand Electrical Tape No.27 can be attached to the chassis and the heat spreader "epoxyed■" to the tape. An electrical isolation system is shown in *Fig.9A*.

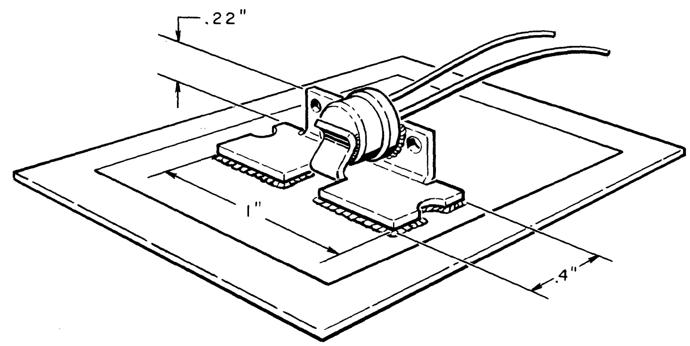


Fig. 9A

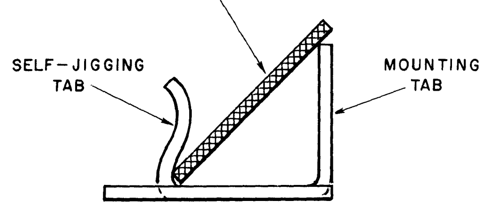


Fig. 9B

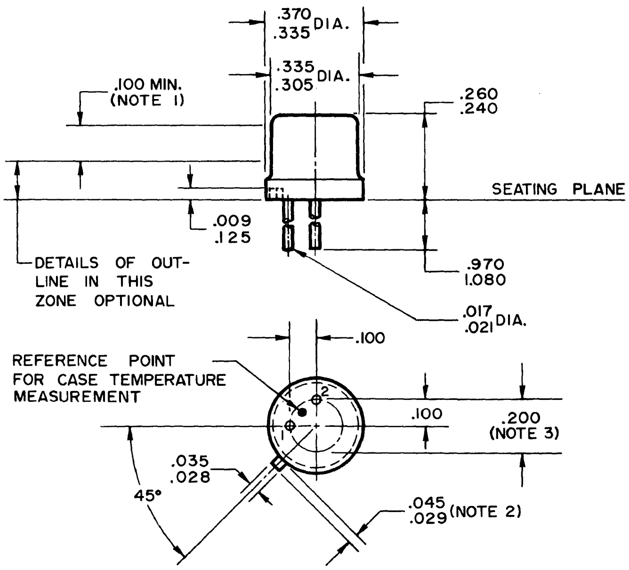
*General Stamping Co., Inc., Denville, N.J. 07834.

♦Available from RCA as Part No.NR184A or from Kester Solder Co., Newark, N.J. 07105, as Part No.KSFD-375005, or equivalent.

♠Made by Minnesota Mining & Mfg. Co., St. Paul, Minnesota.

■An epoxy such as Hysol-Epoxy Patch Kit 6C, or equivalent, is recommended. This epoxy is made by Hysol Corporation, Olean, N.Y. 14761.

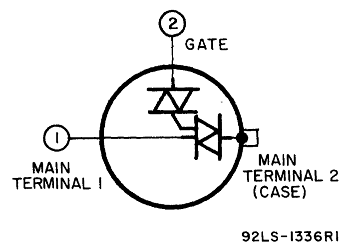
DIMENSIONAL OUTLINE



Lead 1: Main Terminal 1
Lead 2: Gate
Case: Main Terminal 2

DIMENSIONS IN INCHES

TERMINAL DIAGRAM



Note 1: This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed .010".

Note 2: Measured from max. diameter of the actual device.

Note 3: Leads having maximum diameter (0.019") measured in gauging plane 0.054" + 0.001" –0.000" below the seating plane of the device shall be within .007" of their true locations relative to a maximum-width tab.

DEFINITIONS OF TERMS AND SYMBOLS

These terms and symbols follow the latest recommended standards of JEDEC. For convenience, formerly used symbols have been cross-referenced to the new standards.

PRINCIPAL VOLTAGE DEFINITIONS

Repetitive Peak Off-State Voltage – V_{DRM} (Formerly V_{BOM}) – The maximum instantaneous value of principal voltage which may be applied to the thyristor, including all repetitive transient voltages, which will not switch the thyristor from the off state to the on state at specified conditions of thyristor junction temperature and gate bias.

Main Terminal 1 to Main Terminal 2 Voltage – v_{DX} (Formerly v_{BX}) – The instantaneous value of voltage, positive or negative, applied between main terminals 1 and 2 when the thyristor is in the off state.

On-State Voltage – v_T (Formerly v_{AA}) – The instantaneous value of principal voltage when the thyristor is in the on state at a given instantaneous current.

Critical Rate of Applied Commutating Voltage – Commutating dv/dt – The rate of exponential rise of the principal voltage which the thyristor can maintain during commutation under specified conditions. This rate of rise is defined as follows:

$$\text{Commutating dv/dt} = \frac{0.63\ V_{DRM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 of V_{DRM}.

Critical Rate of Rise of Off-State Voltage – dv/dt – The value of the exponential rate of rise of principal voltage below which switching from the off state to the on state will not occur, and above which switching may occur, under stated conditions. This rate of rise is defined as follows:

$$dv/dt = \frac{0.63\ V_{DRM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 V_{DRM}.

PRINCIPAL CURRENT DEFINITIONS

RMS On-State Current – $I_{T(rms)}$ (Formerly I_{ON}) – The rms value of the principal current when the thyristor is in the on state.

On-State Current – i_T (Formerly i_{AA}) – The instantaneous value of principal current when the thyristor is in the on state.

Surge (Non-Repetitive) On-State Current – I_{TSM} (Formerly i_{SM}) – An overload on-state current of specific time duration, waveshape, and peak value which may be conducted through the thyristor for one full cycle from a 60 Hz supply in a single-phase circuit with a resistive load. The thyristor shall be operating within its specified operating voltage, rms current, gate power, and temperature ratings prior to the surge current. The surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

Peak Off-State Current – I_{DM} (Formerly I_{BOM}) – The maximum current which flows through the main terminals when the thyristor is in the off state for specified values of principal voltage, gate bias, and junction temperature.

DC Holding Current – I_H (Formerly I_{HOX}) – The minimum principal current required to maintain the thyristor in the on state with the gate open for a specified case temperature.

GATE DEFINITIONS

Peak Gate Off-State Current – I_{GDM} – The instantaneous value of gate current, positive or negative, flowing between the gate and main terminal 1 prior to triggering.

Peak Gate Firing Voltage – V_{GM} – The maximum instantaneous value of voltage between gate and main terminal 1, positive or negative, prior to triggering.

Peak Gate-Trigger Current – I_{GTM} (Formerly I_{GT}) – The maximum gate trigger current, positive or negative, which may flow from the gate to main terminal 1 for a specified time duration.

Peak Gate Power – P_{GM} – The maximum power which may be dissipated between gate and main terminal 1 for a specified time duration.

Average Gate Power – P_{GAV} – The value of gate power which may be dissipated between the gate and main terminal 1 averaged over a full cycle.

Gate Symmetry – The absolute value of the difference between positive and negative peak gate firing voltage.

Gate Trigger Capacitance – The value of external capacitance between gate and main terminal 1 required for triggering.

MISCELLANEOUS

Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Gate-Controlled Turn-On Time – t_{gt} (Formerly t_{on}) – The time interval between the time when the gate-trigger current pulse reaches its 50 per-cent point and the time when the resulting principal current flowing through the main terminals of the thyristor reaches the 90 per-cent point of its maximum value when switching from the off state to the on state under specified conditions.

Load Resistance – R_L – The value of fixed resistance connected in series with a main terminal of the thyristor and the power source.

SILICON N-P-N "overlay" TRANSISTOR

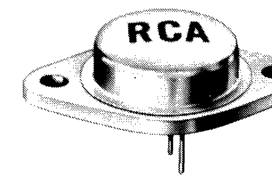
40444

File No. 223

RCA–40444 is an epitaxial silicon n–p–n transistor of the "overlay" emitter electrode construction. It is especially designed to provide high power as a Class B and C rf amplifier for MF Marine communications service (2 to 3 MHz) with amplitude modulation and 13–volt power supply.

In the overlay structure, there are a number of individual emitter sites which are all connected in parallel and used in conjunction with a single base and collector region. When compared with other structures, this arrangement provides a substantial increase in emitter periphery for higher current or power, and a corresponding decrease in emitter and collector areas for lower input and output capacitances. The overlay structure thus offers greater power output, gain, efficiency, and frequency capability.

High-Power Amplifier for 13–Volt AM MF Marine Communication



H-1340

JEDEC No. TO-3

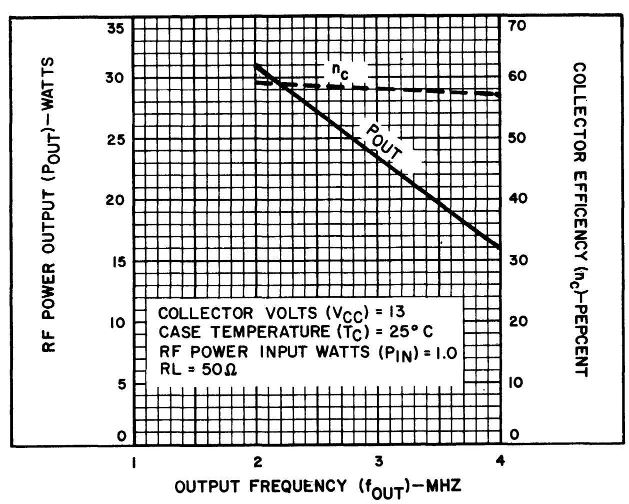
- **20 Watts Output AM Carrier (Min.); at 2.5 MHz, 1 Watt RF Power Input, and 13-Volt Collector Supply**
- **Typical Gain–Bandwidth Product (F_T): 100 MHz at 3A**
- **High Voltage Ratings**

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR–TO–BASE VOLTAGE	V_{CBO}	120	volts
COLLECTOR–TO–EMITTER VOLTAGE:			
With V_{BE} =-1.5 volts	V_{CEV}	120	volts
With external base–to–emitter resistance (R_{BE}) = 50Ω	V_{CER} (sus)	80	volts
With base open	V_{CEO}	60	volts
EMITTER–TO–BASE VOLTAGE	V_{EBO}	7	volts
COLLECTOR CURRENT	I_C	20	A
BASE CURRENT	I_B	10	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 25°C		140	watts
At case temperatures above 25°C		See *Fig.* 11	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		-65 to 200	°C
LEAD TEMPERATURE (During soldering).			
At distances≥1/32 in. from insulating wafer for 10 s max.		230	°C

TYPICAL POWER OUTPUT & COLLECTOR EFFICIENCY vs. OUTPUT FREQUENCY



92LS-1723

Fig. 1

RF AMPLIFIER CIRCUIT FOR POWER OUTPUT TEST

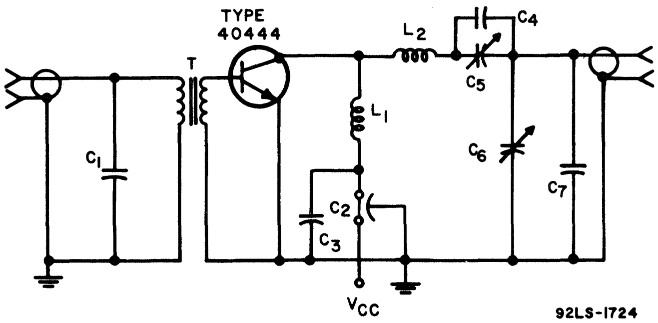


Fig.2

C_1: 2000 pF
C_2: .001 μF
C_3: 0.1 μF
C_4: 750 pF
C_5: 650-1890 pF
C_6: 1300-2830 pF
C_7: 1000 pF

L_1: 2.1 μH, 10 turns, B & W No.3018 or equivalent
L_2: 3 μH, 13-3/4 turns, B & W No.3018 or equivalent
Q: RCA-40444
T: Toriod Core; 1-1/4" OD, Primary— 15 Turns No.20 Wire Secondary—6 Turns No.22 Wire

MAXIMUM DC OPERATING AREA

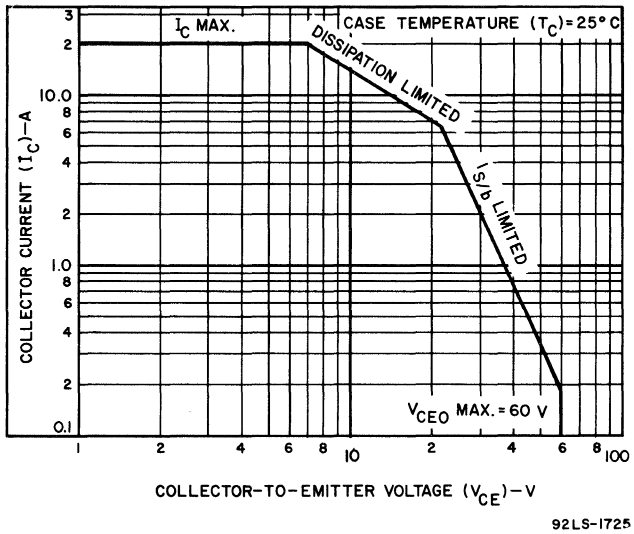


Fig.3

TYPICAL RF POWER OUTPUT & COLLECTOR EFFICIENCY VS. RF POWER INPUT

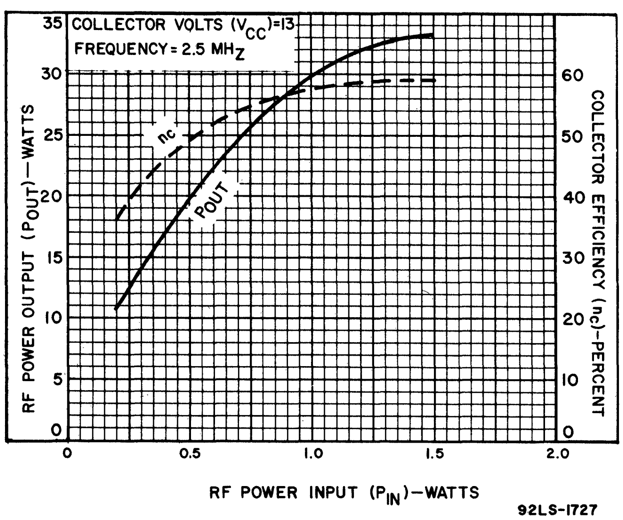


Fig.4

TYPICAL RF POWER OUTPUT & COLLECTOR EFFICIENCY VS. COLLECTOR SUPPLY VOLTAGE

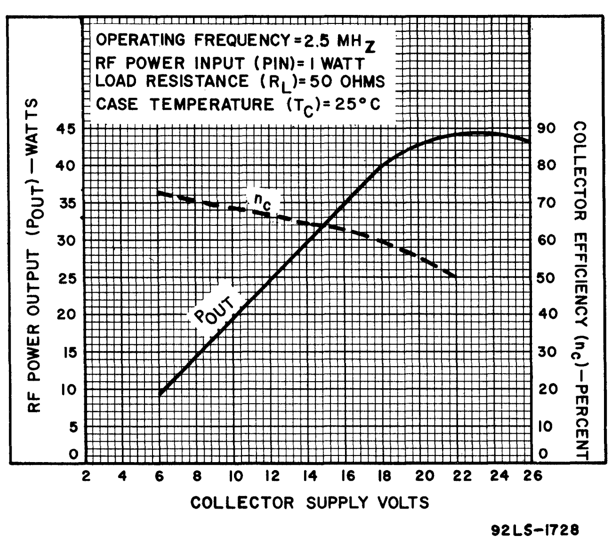


Fig.5

DISSIPATION DERATING CURVE

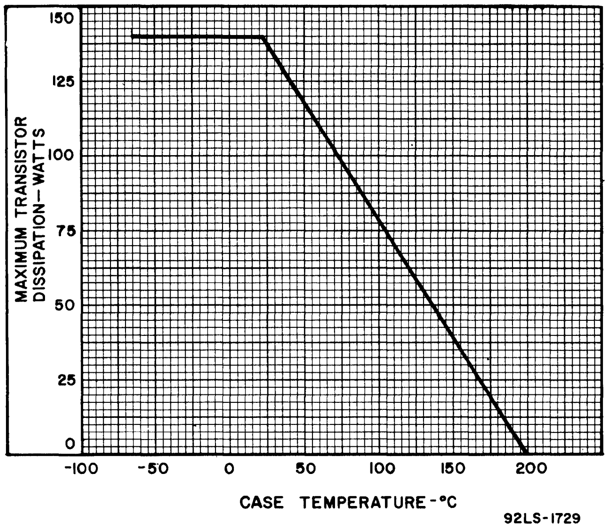


Fig.10

TYPICAL GAIN–BANDWIDTH PRODUCT vs. COLLECTOR CURRENT FOR TYPES

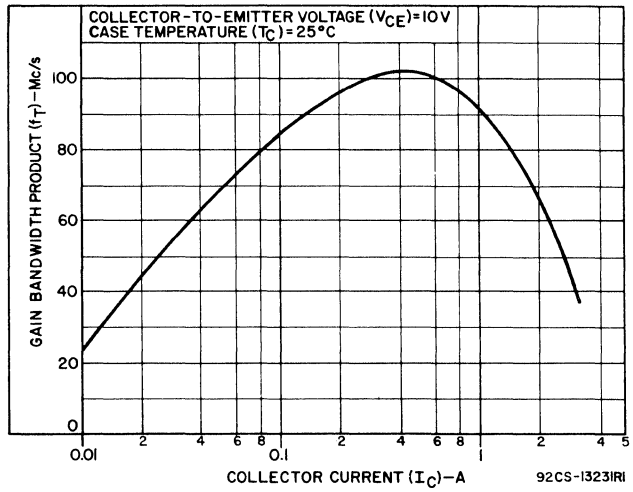


Fig.11

CIRCUIT USED TO MEASURE SUSTAINING VOLTAGES $V_{CEO}(sus)$ & $V_{CEV}(sus)$

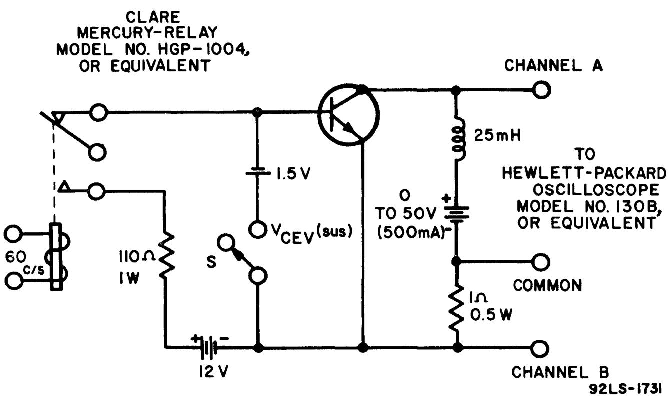
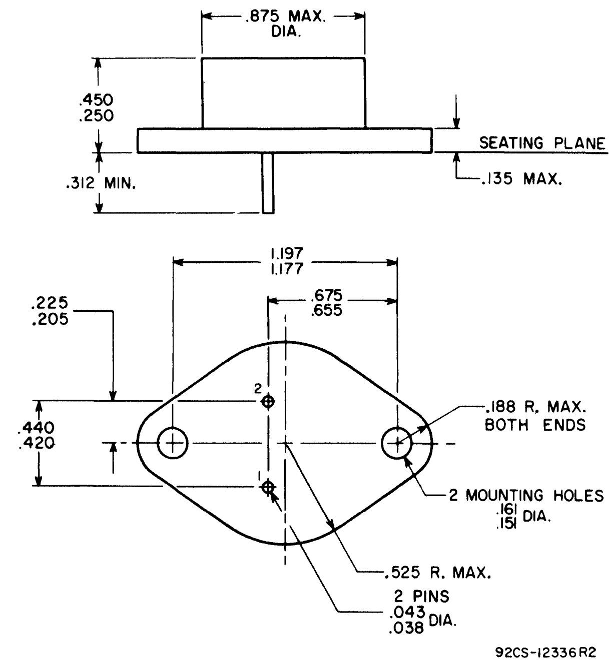


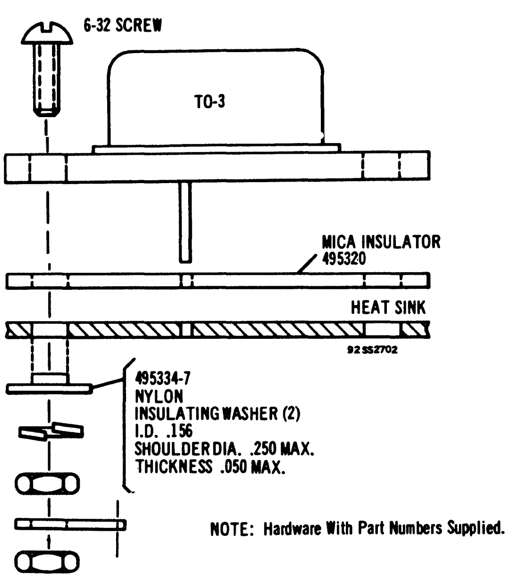
Fig.12

DIMENSIONAL OUTLINE JEDEC No. TO-3



DIMENSIONS IN INCHES

SUGGESTED HARDWARE



TERMINAL CONNECTIONS

Pin 1 - Base

Pin 2 - Emitter

Flange, Case-Collector

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ELECTRICAL CHARACTERISTICS

Case Temperature (T_C) = 25°C Unless Otherwise Specified

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	V_{CE}	DC Emitter or Base Volts V_{EB}	V_{BE}	DC Current (Amperes) I_C	I_E	I_B	Limits Min.	Max.	Units
Collector-Cutoff Current	I_{CEO}		40					0	–	20	mA
	I_{CEV}		80		-1.5				–	20	mA
At T_C = 150°C	I_{CEV}		80		-1.5				–	20	mA
Emitter-Cutoff Current	I_{EBO}			5		0			–	15	mA
DC Forward-Current Transfer Ratio	h_{FE}		5 5			2[a] 10[a]			30 20 –	150 – –	
Collector-to-Emitter Sustaining Voltage: With base open	$V_{CEO(sus)}$					0.2		0	60[b]	–	V
	$V_{CEV(sus)}$				-1.5	0.2		0	120[b]	–	V
Emitter-to-Base Voltage	V_{EBO}					0	0.05		7	–	V
Base-to-Emitter Voltage	V_{BE}		5			10[a]			–	1.8	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$					10[a]		1.0	– –	1.0 –	V V
Output Capacitance (At 1 MHz)	C_{ob}	10					0		–	500	pF
Second-Breakdown Collector Current With base forward biased	$I_{S/b}$[c]		30 45						2.0 0.5	– –	A A
Gain-Bandwidth Product (At 5 MHz)	f_T		10			2			60	–	MHz
RF Power Output, AM Carrier *(See Fig.2)*	P_{out}		13						20[d]		W

[a] Pulsed; pulse duration $\leq$ 350 µs, duty factor = 2%

[b] CAUTION: The sustaining voltages V_{CEO}(sus) and V_{CER}(sus) MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in *Fig.13*.

[c] $I_{S/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward biased for transistor operation in the active region.

[d] For Pin = 1W; at 2.5 MHz; Minimum efficiency = 55%

TYPICAL DC–BETA CHARACTERISTICS

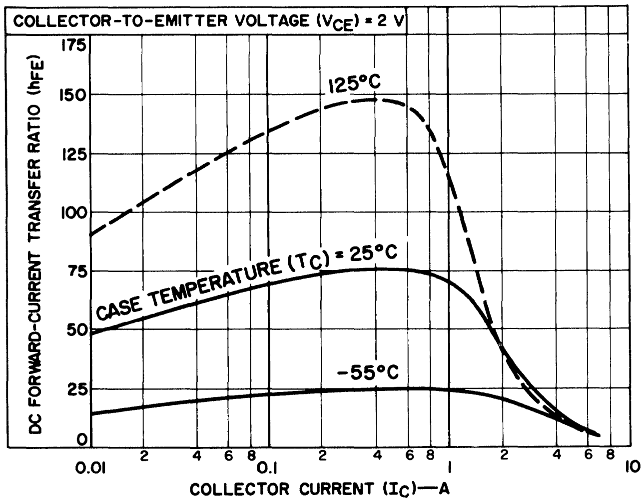


Fig.6

TYPICAL COLLECTOR CHARACTERISTICS

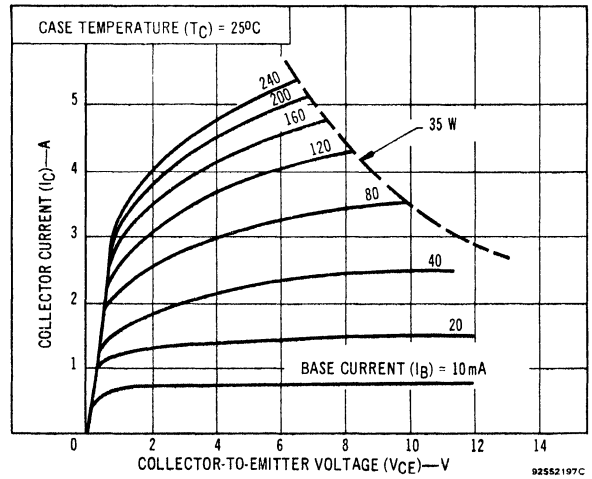


Fig.7

TYPICAL TRANSFER CHARACTERISTICS

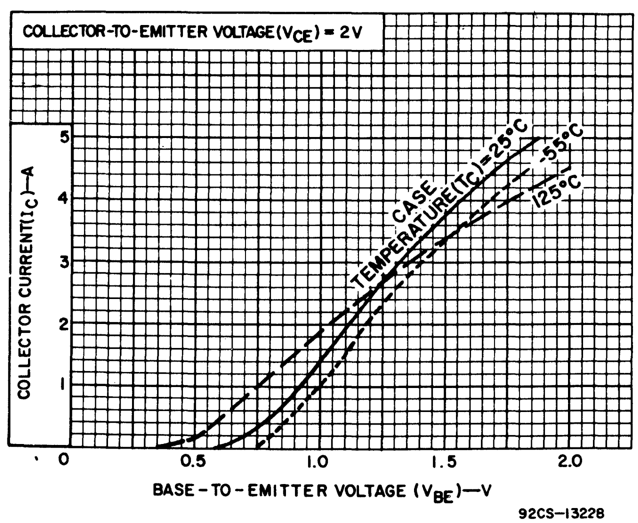


Fig.8

TYPICAL INPUT CHARACTERISTICS

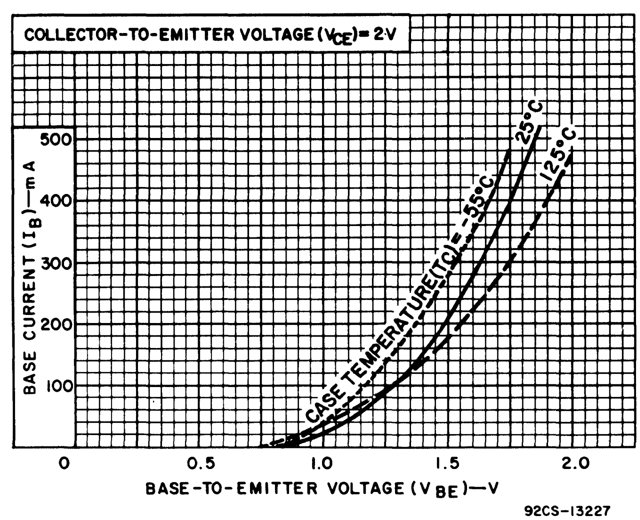
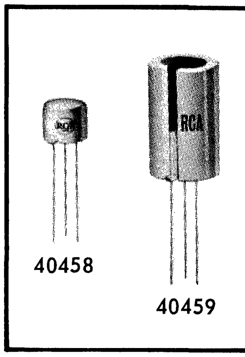


Fig.9

SILICON N-P-N EPITAXIAL PLANAR TRANSISTORS

For High-Peak-Current Amplifier Applications In Commercial and Industrial Equipment

For High-Current Switching Service in Computer Equipment



RCA-40458 and 40459 are double-diffused epitaxial planar transistors of the silicon n-p-n type with high beta, low-leakage characteristics, and high peak-current capabilities which make them especially useful for critical amplifier applications in the audio and video frequency ranges.

The 40458 and 40459 also feature low saturation voltages, high switching speeds and high voltage-breakdown capabilities, which make these transistors desirable for switching and driver applications in computer equipment.

RCA-40458 and 40459 are also useful in other applications where transistors having excellent linearity of characteristics over a wide range of collector current, high dissipation capabilities, and a high maximum operating temperature are essential.

The 40458 and 40459 utilize a hermetically sealed, 3-lead metal package. An internal connection between the collector and the case provides a low-resistance path for effective heat transfer. RCA-40459 has an integral heat radiator which decreases the junction-to-ambient thermal resistance by a factor of two, thereby providing increased dissipation capability.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	40458	40459	
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	40	40 max.	V
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	60	60 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	8	8 max.	V
COLLECTOR CURRENT, I_C	1	1 max.	A
TRANSISTOR DISSIPATION, P_T:			
At ambient temperatures: up to 25°C	0.5	1 max.	W
At ambient temperatures: above 25°C derate at	3.3	6.6	mW/°C
At case temperatures[a]: up to 75°C	2	2 max.	W
At case temperatures[a]: above 75°C derate at	20	20	mW/°C
TEMPERATURE RANGE:			
Storage and operating (junction)	-65 to +175		°C
LEAD TEMPERATURE (During soldering):			
At distances not closer than 1/32 inch to seating surface for 10 seconds max.	265	265 max.	°C

[a] Measured on case perimeter at junction with seating surface.

FEATURES

- Low leakage currents —
  I_{CBO} = 10 nA max. at 25°C, V_{CB} = 25 V; 1 μA max. at 85°C, V_{CB} = 25 V
  I_{EBO} = 10 nA max. at 25°C, V_{EB} = 2.5 V
- High collector-to-emitter breakdown voltage —
  BV_{CEO} = 40 V min. at I_C = 100 mA
  BV_{CBO} = 60 V min. at I_C = 0.1 mA
- High collector current operation —
  I_C = 1 A max.
- Low saturation voltages —
  $V_{CE}(sat)$ = 0.3 V max., $V_{BE}(sat)$ = 1.5 V max. at I_C = 300 mA, I_B = 15 mA
- High dissipation capabilities —
  P_T = 1 W max. at T_A = 25°C – 40459; 0.5 W max. at T_A = 25°C – 40458; 2 W max. at T_C = 75°C – 40458 & 40459
- Hermetically sealed 3-lead metal package
- Collector lead internally connected to case

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Printed in U.S.A.
40458, 40459 9-66

STATIC CHARACTERISTICS

Characteristics	Symbols	TEST CONDITIONS: Ambient Temperature T_A (°C)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Emitter-to-Base Voltage V_{EB} (V)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	DC Base Current I_B (mA)	LIMITS Types 40458 40459 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}	25	25			0			-	-	10	nA
		85	25			0			-	-	1	μA
Emitter-Cutoff Current	I_{EBO}	25			2.5		0		-	-	10	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}	25					0.1		60	-	-	V
Collector-to-Emitter Breakdown Voltage*	BV_{CEO}(sus)	25					100	0	40	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}	25				0.05	0		8	-	-	V
Collector-to-Emitter Saturation Voltage	V_{CE}(sat)	25					300	15	-	0.24	0.3	V
Base-to-Emitter Saturation Voltage	V_{BE}(sat)	25					300	15	-	0.93	1.5	V
Static Forward Current-Transfer Ratio	h_{FE}			10			10		100	150	300	
				10			150		-	150	-	
				1			300		50	75	-	

*Pulsed: pulse duration, 300 μs, duty factor 0.018.

DYNAMIC CHARACTERISTICS, at $T_A = 25°C$

Characteristics	Symbols	TEST CONDITIONS: Frequency	V_{CB} (V)	V_{CE} (V)	I_E (mA)	I_C (mA)	LIMITS Types 40458 40459 Min.	Typ.	Max.	Units
Small-Signal Forward Current-Transfer Ratio	h_{fe}	1 kHz		12		10	75	175	-	
Small-Signal Short-Circuit Input Impedance	h_{ie}	1 kHz		12		10	-	600	-	Ω
Small-Signal Open-Circuit Output Admittance	h_{oe}	1 kHz		12		10	-	75	-	mmho
Small-Signal Open-Circuit Reverse Voltage-Transfer Ratio	h_{re}	1 kHz		12		10	-	125×10^{-6}	-	
Collector-to-Base Feedback Capacitance	C_{cb}‡	1 MHz	6		0		-	-	20	pF
Gain-Bandwidth Product	f_T	50 MHz		1		50	150	200	-	MHz
Extrinsic Base-Lead Resistance	$r_{bb'}$	100 MHz		6		1	-	20	-	Ω
Thermal Resistance: Junction to Case	θ_{J-C}						-	-	50	°C/W
Thermal Resistance: Junction to Ambient	θ_{J-A}						40458			
							-	-	300	°C/W
							40459			
							-	-	150	°C/W

‡This is a three-terminal measurement with the emitter lead guarded.

TYPICAL CHARACTERISTICS FOR 40458 and 40459.

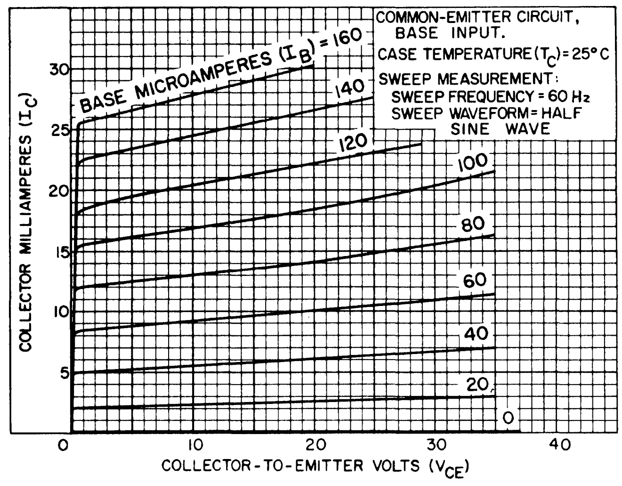


Fig.2 - Collector Characteristics.

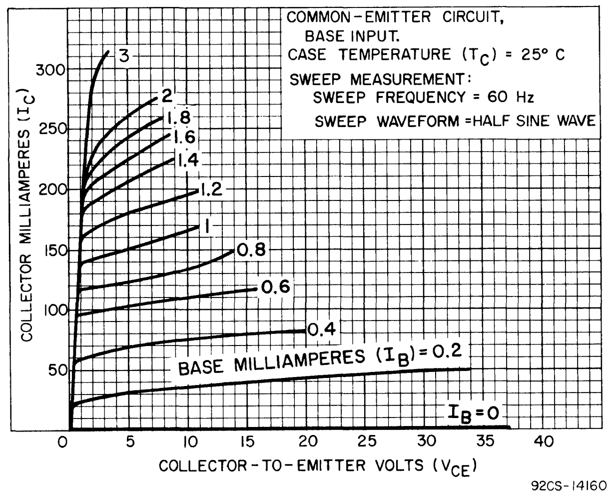


Fig.3 - Collector Characteristics.

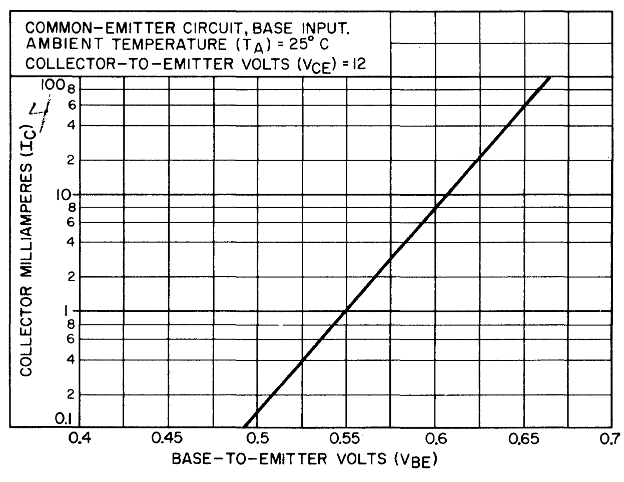


Fig.4 - Transfer Characteristic.

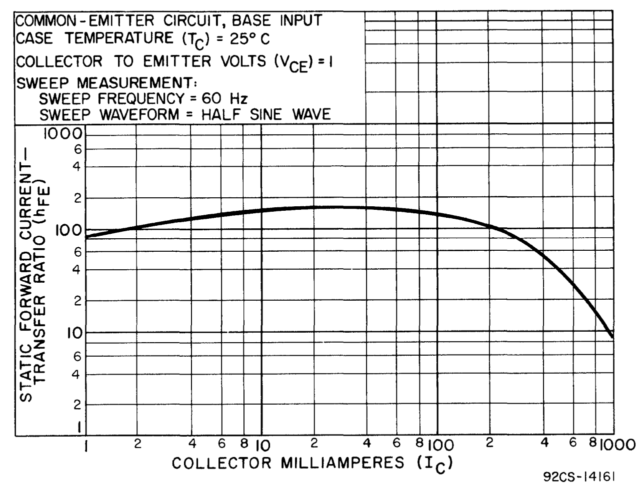


Fig.5 - Static Beta Characteristic.

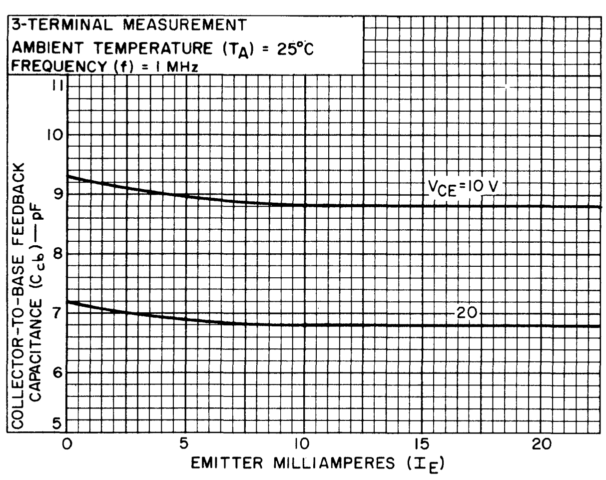


Fig.6 - Feedback Capacitance Characteristics.

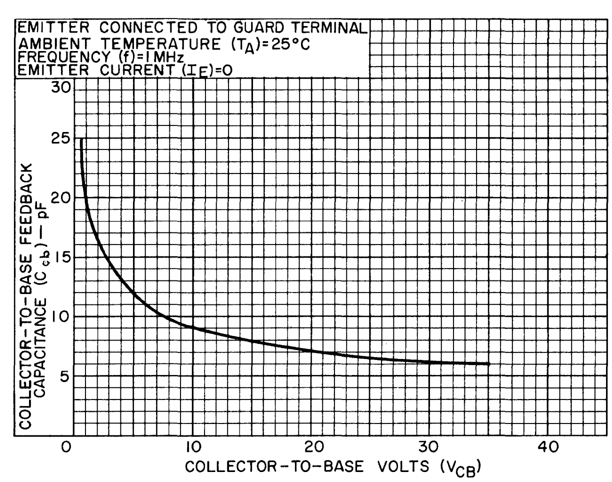


Fig.7 - Feedback Capacitance Characteristic.

TYPICAL CHARACTERISTICS FOR 40458 and 40459.

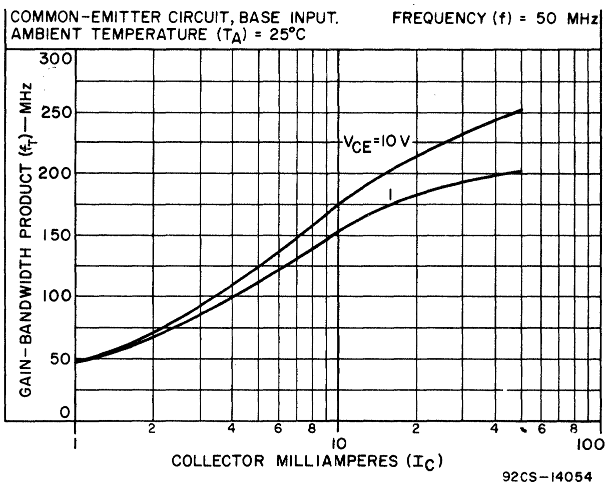


Fig.8 - Gain-Bandwidth Product Characteristics.

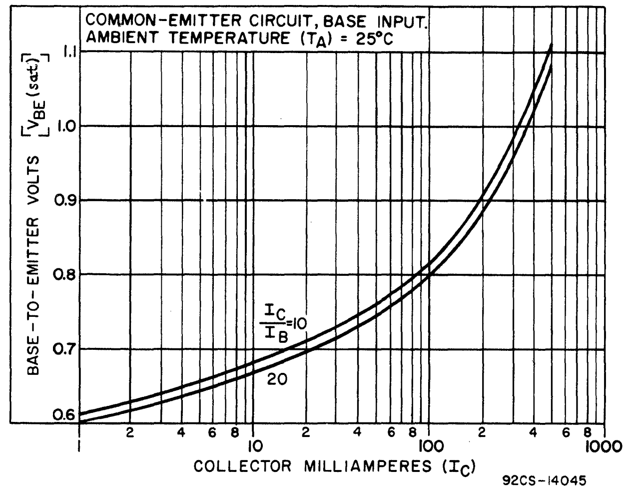


Fig.9 - V_{BE}(sat) Characteristics.

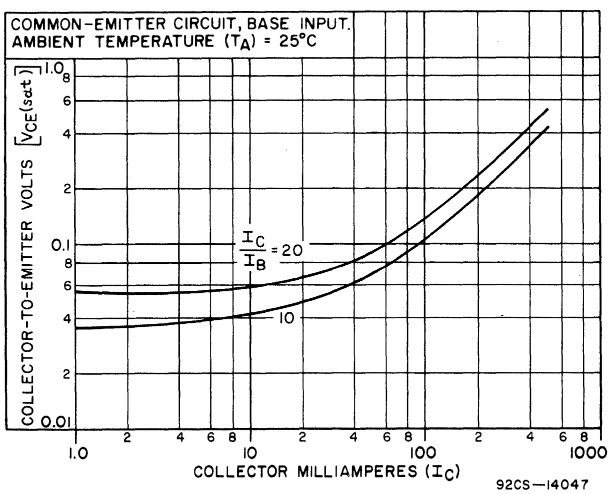


Fig.10 - V_{CE}(sat) Characteristics.

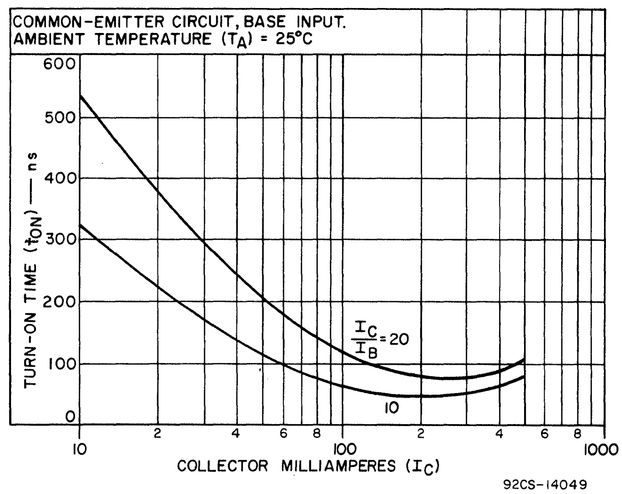


Fig.11 - "Turn-On" Time Characteristics.

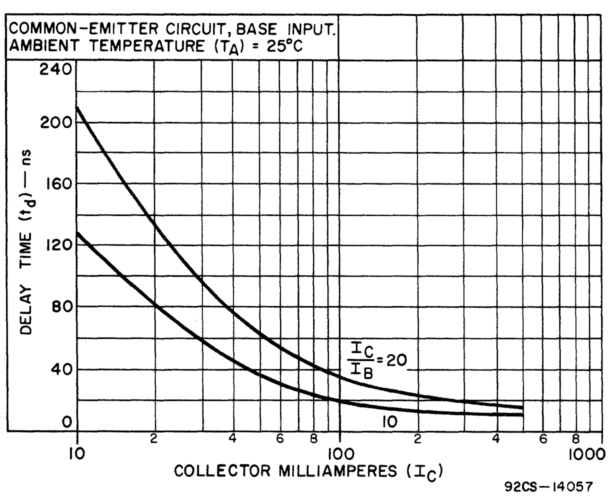


Fig.12 - Delay Time Characteristics.

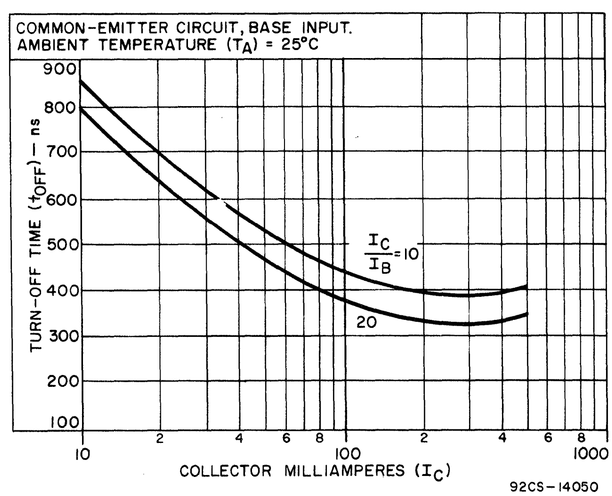
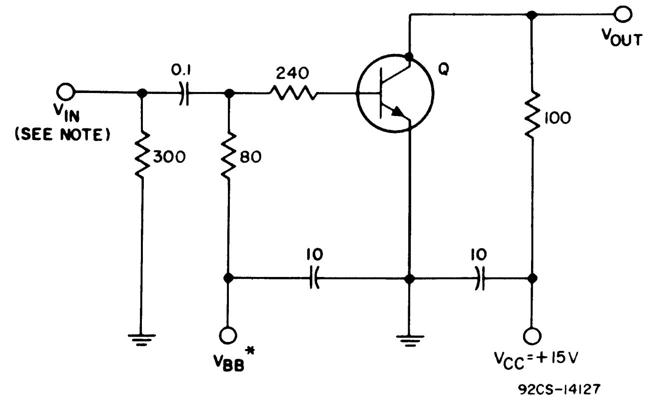


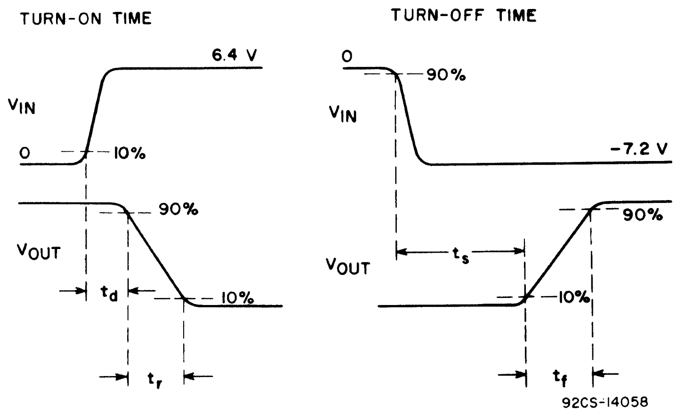
Fig.13 - "Turn-Off" Time Characteristics.



Note: V_{in} rise time $\leq$ 1 ns, pulse width $\geq$ 100 ns, duty factor $\leq$0.02.
Resistance values in ohms, Capacitance values in μF.

* For t_{on} Test V_{BB} = -2 V
For t_{off} Test V_{BB} = +5.6 V

Q = RCA-40458 or 40459.



$$t_{on} = t_d + t_r$$
$$t_{off} = t_s + t_f$$

Fig.1 - Turn-On and Turn-Off Time Test Circuit and Waveforms for 40458 and 40459.

SWITCHING CHARACTERISTICS AT T_A = 25°C
(Measured in Test Circuit Shown in Fig.1)

Characteristics	Symbols	TEST CONDITIONS					MAX. VALUES
		"Off" Base-to-Emitter Voltage V_{BE}(off)	"Turn-On" Base Current I_{B1}	"On" Collector Current I_C	"On" Base-to-Emitter Voltage V_{BE}(on)	"Turn-Off" Base Current I_{B2}	Types 40458 and 40459
		V	mA	mA	V	mA	ns
Turn-On-Time	t_{on}						
Delay Time	t_d	-2	15	150	-	-	25
Rise Time	t_r	-2	15	150	-	-	50
Turn-Off-Time	t_{off}						
Storage Time	t_s	-	-	150	5.6	-15	500
Fall Time	t_f	-	-	150	5.6	-15	75

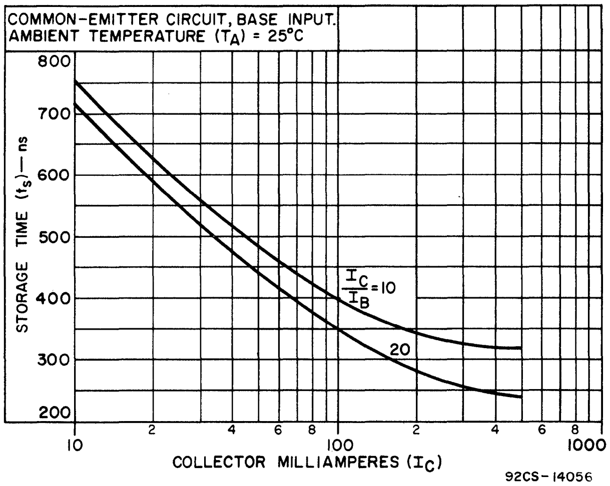


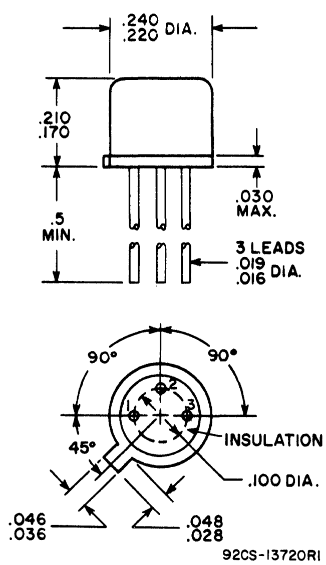
Fig.14 - Storage Time Characteristics.

OPERATING CONSIDERATIONS

RCA-40458 and 40459 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistors.

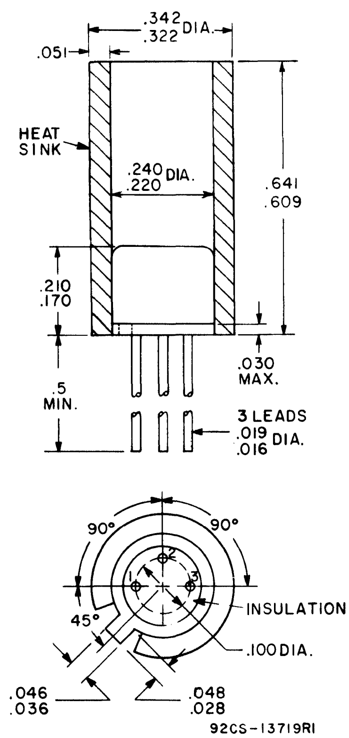
In both the 40458 and 40459 the collector is connected to the case. Consequently, in applications where the collectors of these transistors are operated at voltages above or below ground potential suitable precautions should be observed.

DIMENSIONAL OUTLINE
40458



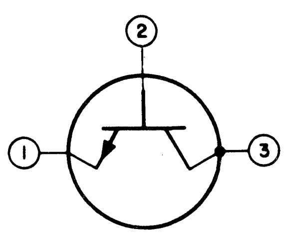
Dimensions in Inches

DIMENSIONAL OUTLINE
40459



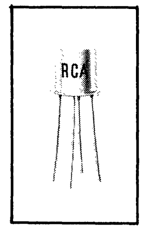
Dimensions in Inches

TERMINAL DIAGRAM
40458, 40459



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector, Case

SILICON MOS TRANSISTOR– N-Channel Depletion Type



JEDEC TO-72

For Critical Chopper Applications and Multiplex Service up to 60 MHz:

in Military Communications, Navigation, and Instrumentation Equipment

in Industrial Instrumentation and Control Circuits

RCA 40460* is a silicon, N-channel, depletion-type MOS♦ (insulated full-gate field effect) transistor primarily designed for chopper applications at frequencies up to 60 MHz. The 40460 is also useful in multiplex applications.

The insulated gate provides a very high value of input resistance (10^{14} ohms typ.) which is relatively insensitive to temperature and is independent of gate-bias conditions (positive, negative, or zero bias). The 40460 also features low input capacitance (4 picofarads typ.) and zero inherent offset voltage.

This device features a gate metallization that covers the entire source-to-drain channel for added long-term stability. The full gate construction also allows the drain and source to be interchanged for symmetrical chopper applications.

The 40460 is hermetically sealed in the standard, 4-lead, JEDEC TO-72 package.

* Formerly Dev. No. TA2701.

♦ Metal-Oxide Semiconductor.

Maximum Ratings, *Absolute-Maximum Values:*
(Substrate connected to source unless otherwise specified)

DRAIN-TO-SOURCE VOLTAGE, V_{DS}▲	+25 / -25	max.	V
DRAIN-TO-SUBSTRATE VOLTAGE, V_{DB}	+25 / -0.3	max.	V
SOURCE-TO-SUBSTRATE VOLTAGE, V_{SB}	+25 / -0.3	max.	V
DC GATE-TO-SOURCE VOLTAGE, V_{GS}	±10	max.	V
PEAK GATE-TO-SOURCE VOLTAGE, v_{GS}	±25	max.	V
DRAIN CURRENT, I_D	Limited by Dissipation		
TRANSISTOR DISSIPATION, P_T: At ambient temperatures from -65 to +125°C	150	max.	mW
AMBIENT TEMPERATURE RANGE: Storage	-65 to +150	max.	°C
Operating	-65 to +125	max.	°C
LEAD TEMPERATURE (During Soldering): At distances ≥ 1/32 inch from seating surface for 10 seconds max.	265	max.	°C

▲ Substrate connected to drain.

For negative chopper-input levels greater than 0.3 volt peak, the substrate must be returned to a negative dc supply.

FEATURES

- zero offset voltage
- high "off" resistance
  $R_{ds}(off) = 10^{10}\ \Omega$ typ.
- low "on" resistance
  $R_{ds}(on) = 240\ \Omega$ typ. ($V_{GS} = 0$ V)
- low input capacitance
  $C_{iss} = 4$ pF typ.
- symmetrical configuration—
  permits interchangeability of drain and source

ELECTRICAL CHARACTERISTICS: *At T_A = 25°C, Unless Otherwise Specified. Substrate Connected to Source.*

CHARACTERISTIC	SYMBOL	CONDITIONS	LIMITS Min.	Typ.	Max.	UNITS
Forward Transconductance	g_{fs}	V_{DS} = 12 V, V_{GS} = 0, f = 1 kHz	-	3500	-	μmho
Drain Current	I_{DSS}	V_{DS} = 12 V, V_{GS} = 0	-	9	-	mA
Gate-Leakage Current	I_{GSS}	V_{DS} = 0, V_{GS} = ±10 V V_{DS} = 0, V_{GS} = ±10 V, T_A = 125°C	- -	0.1 20	10 200	pA pA
Small-Signal, Short-Circuit, Input Capacitance	C_{iss}	V_{DS} = 0, V_{GS} = -6 V, f = 0.1-1 MHz	-	4	5	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance	C_{rss}	V_{DS} = 0, V_{GS} = -6 V, f = 0.1-1 MHz	-	0.75	1.2	pF
"On" Drain-to-Source Resistance	$R_{DS}(on)$	V_{DS} = 0, V_{GS} = +10, f = 1 kHz V_{DS} = 0, V_{GS} = 0, T_A = 125°C, f = 1 kHz	- -	90 350	- -	Ω Ω
Cutoff (Drain-to-Source) Current	$I_{DS}(off)$	V_{DS} = 1 V, V_{GS} = -10 V V_{DS} = 1 V, V_{GS} = -10 V, T_A = 125°C	- -	0.1 0.1	0.5 0.5	nA μA
Offset Voltage	V_O	V_{DS} = 0, V_{GS} = ±10 V	-	0*	-	V

* In measurements of Offset Voltage, thermocouple effects and contact potentials in the measurement setup may cause erroneous readings of 1 microvolt or more. These errors may be minimized by the use of solder having a low thermal e.m.f., such as Leeds & Northrup No.107-1.0.1, or equivalent.

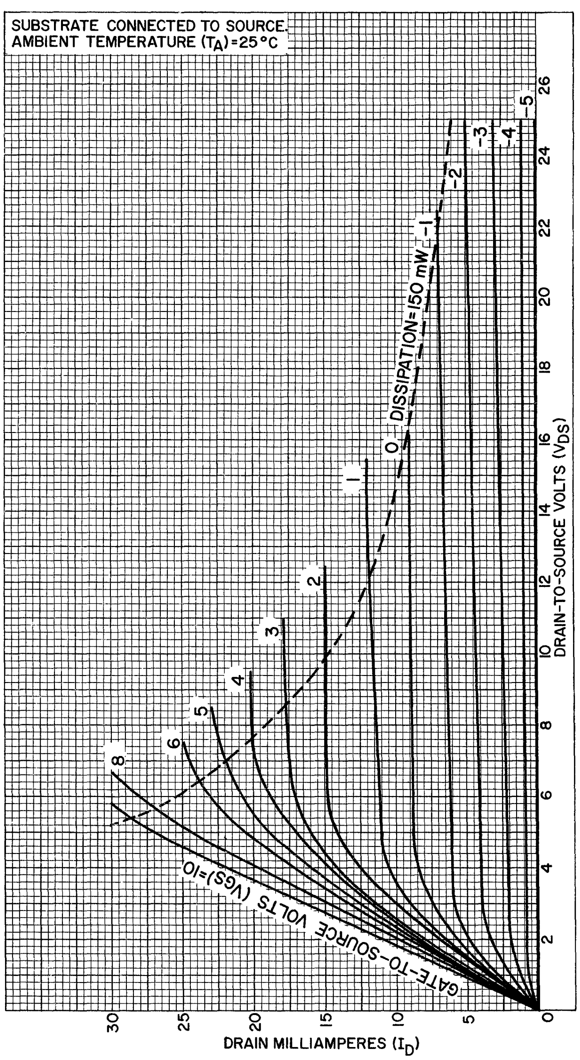


Fig.1 - Drain current vs. drain-to-source voltage.

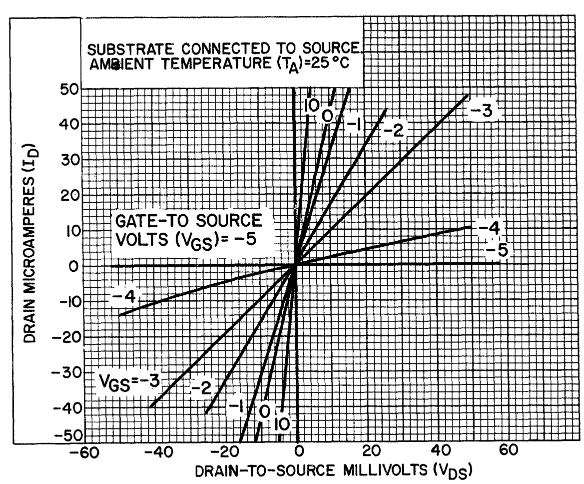


Fig.2 - Low-level drain current vs. drain-to-source voltage.

TYPICAL CHARACTERISTICS FOR RCA-40460

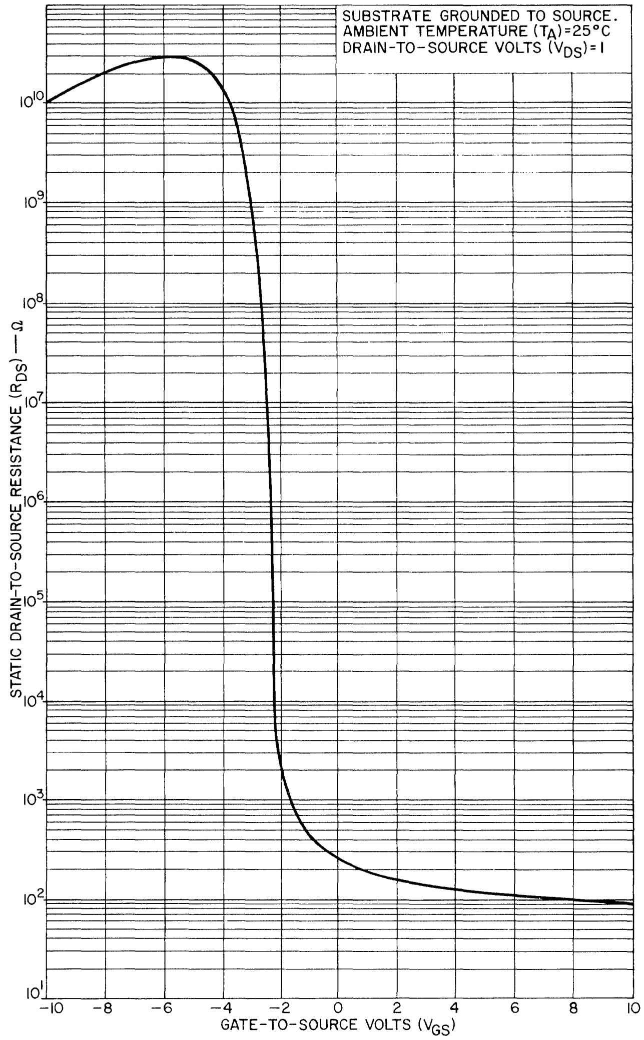


Fig.3 - Static drain-to-source resistance vs. gate-to-source voltage.

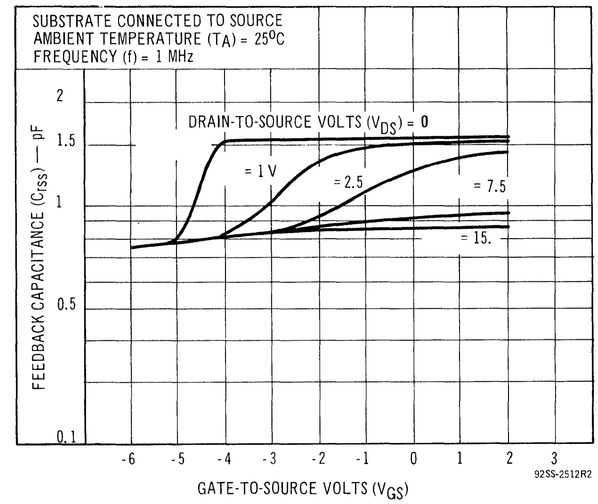


Fig.4 - Gate-to-drain capacitance vs. gate-to-source voltage.

HANDLING AND OPERATING CONSIDERATIONS

CAUTION

These devices, like conventional (bipolar) high-frequency silicon transistors, are susceptible to the detrimental effects of high-potential electrostatic discharges applied to their input terminals.

The polystyrene insulating snow, commonly used as a convenient carrying tray for semiconductor devices, can acquire high static charges and should not be used unless it has been specially treated to make it electrically conductive ($R \leq 10\ k\Omega/in^3$).

To avoid the possibility of subjecting these devices to high ac voltages that may be present on the tips of soldering irons, some means for grounding these tips should be provided.

RCA 40460 should never be inserted in or removed from circuits with the power on because transient voltages may permanently damage the device. AC-operated power supplies for the 40460 should also have provision for suppression of transients during turn-on and turn-off. If such suppression is not provided, the following procedure should be used in applying power to the 40460.

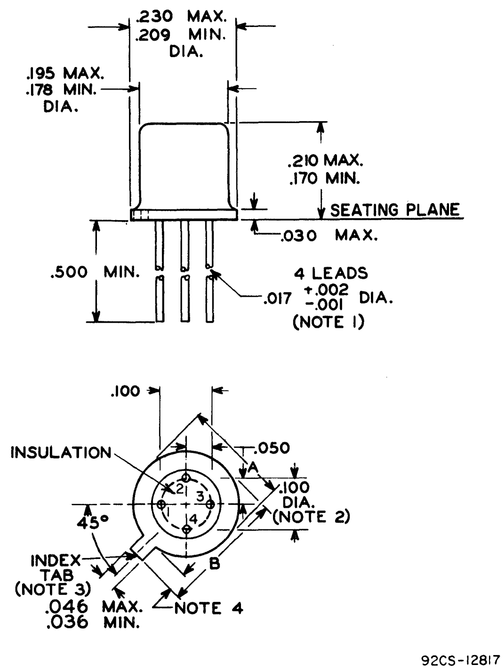
1 - Before inserting the 40460 in the equipment turn ac line switch on and reduce the dc output of the power supply to zero.

2 - Insert the 40460.

3 - Increase the dc supply voltage to the desired value.

This procedure should be reversed when the 40460 is taken out of the equipment.

DIMENSIONAL OUTLINE
JEDEC TO-72



Dimensions in Inches

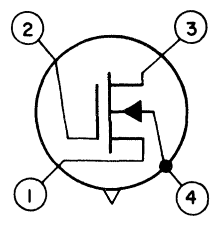
Note 1: The specified lead diameter applies in the zone between 0.050" and 0.250" from the seating plane. From 0.250" to the end of the lead a maximum diameter of 0.021" is held. Outside of these zones, the lead diameter is not controlled.

Note 2: Maximum diameter leads at a gauging plane 0.054" + 0.001" - 0.000" below seating plane to be within 0.007" of their true location relative to max. width tab and to the maximum 0.230" diameter measured with a suitable gauge. When gauge is not used, measurement will be made at seating plane.

Note 3: For visual orientation only.

Note 4: Tab length to be 0.028" minimum, 0.048" maximum, and will be determined by subtracting diameter A from dimension B.

TERMINAL DIAGRAM



Lead 1 - Source

Lead 2 - Insulated Gate

Lead 3 - Drain

Lead 4 - Bulk (Substrate) and Case

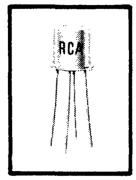
RCA 40461* is a silicon, N-channel, depletion-type MOS† (insulated-gate field-effect) general purpose transistor especially suited for audio and wideband-amplifier applications up to 60 MHz. The insulated gate provides a very high input resistance (10^{14} Ω typ.) which is relatively insensitive to temperature and is independent of gate-bias conditions (positive, negative, or zero bias). The 40461 has a high transconductance and a low value of input capacitance (4 pF typ.).

This unit also features a gate metallization that completely covers the source-drain channel to provide added long-term stability. The 40461 is hermetically sealed in the 4-lead JEDEC TO-72 package.

* Formerly Dev. No. TA2769.

† Metal-Oxide-Semiconductor.

SILICON MOS TRANSISTOR– N-Channel Depletion Type



JEDEC TO-72

For Audio, Wide-Band, and Tuned Amplifier Applications up to 60 MHz

in Military Communications, Navigation, and Instrumentation

in Mobile and Fixed Communication Equipment

in Industrial Instrumentation and Control Circuits

Maximum Ratings, *Absolute-Maximum Values:*

(Substrate connected to source unless otherwise specified)

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	25 max.	V
DRAIN-TO-SUBSTRATE VOLTAGE, V_{DB}	$^{+25}_{-0.3}$ max.	V
SOURCE-TO-SUBSTRATE VOLTAGE, V_{SB}	$^{+20}_{-0.3}$ max.	V
DC GATE-TO-SOURCE VOLTAGE, V_{GS}	±10 max.	V
PEAK GATE-TO-SOURCE VOLTAGE, v_{GS}	±25 max.	V
DRAIN CURRENT, I_D	Limited by Dissipation	
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures from -65 to +125 °C	150 max.	mW
AMBIENT TEMPERATURE RANGE:		
Storage	-65 to +150	°C
Operating	-65 to +125	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	265 max.	°C

FEATURES

- high input resistance
  $R_{GS} = 10^{14}$ Ω typical
- high forward transconductance
  g_{fs} (I_D = 4 mA, f = 1 kHz) = 2500 μmho typ.
- low input capacitance
  C_{iss} = 4 pF typ.
- high power gain
  G_{ps} = 14 dB typical at 60 MHz
- low noise figure
  NF = 5.9 dB typ. at 60 MHz
- low gate leakage current
  I_{GSS} = 0.1 pA typ.

ELECTRICAL CHARACTERISTICS: *At T_A = 25°C Unless Otherwise Specified. Substrate Connected to Source*

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	LIMITS Min.	Typ.	Max.	Units
Forward Transconductance	g_{fs}	V_{DS} = 12 V, V_{GS} = 0 V_{DS} = 12 V, I_D = 4 mA, f = 1 kHz	- 1600	3500 2500	- -	μmho μmho
Drain Current	I_{DSS}	V_{DS} = 12 V, V_{GS} = 0	4	9	14	mA
Gate Leakage Current	I_{GSS}	V_{DS} = 0, V_{GS} = ±10 V V_{DS} = 0, V_{GS} = ±10 V, T_A = 125°C	- -	0.1 20	10 200	pA pA
Gate-to-Source Cutoff Voltage	$V_{GS(off)}$	V_{DS} = 12 V, I_D = 50 μA	-	-4.5	-6	V
Small-Signal, Short-Circuit, Input Capacitance	C_{iss}	V_{DS} = 12 V, V_{GS} = 0, f = 0.1-1 MHz	-	4	5	pF
Small-Signal, Short-Circuit, Reverse Transfer Capacitance	C_{rss}	V_{DS} = 12 V, V_{GS} = 0, f = 0.1-1 MHz	-	0.9	1.2	pF
Output Resistance	r_d	V_{DS} = 12 V, I_D = 4 mA, f = 1 kHz	9000	13,000	-	Ω
Power Gain	G_{ps}	V_{DS} = 12 V, I_D = 4 mA, f = 60 MHz BW = 1.5 MHz	-	14	-	dB
Noise Figure	NF	V_{DS} = 12 V, I_D = 4 mA, f = 60 MHz BW = 1.5 MHz	-	5.9	-	dB
Equivalent Input Noise Voltage	E_N	V_{DS} = 12 V, I_D = 4 mA, R_g = 0, f = 1 kHz	-	0.16	0.25	$\mu V/\sqrt{f(Hz)}$
Noise Figure*	NF	V_{DS} = 12 V, I_D = 4 mA, R_g = 1 MΩ f = 1 kHz	-	4*	-	dB

* Noise Figure = $10 \log_{10} \left[1 + \frac{E_N}{4\,KTBWR_g}\right]$ where $K = 1.38 \times 10^{-23}$; T = Temperature in °Kelvin; BW = Bandwidth in Hz; R_g = Generator resistance.

TYPICAL CHARACTERISTICS FOR RCA-40461

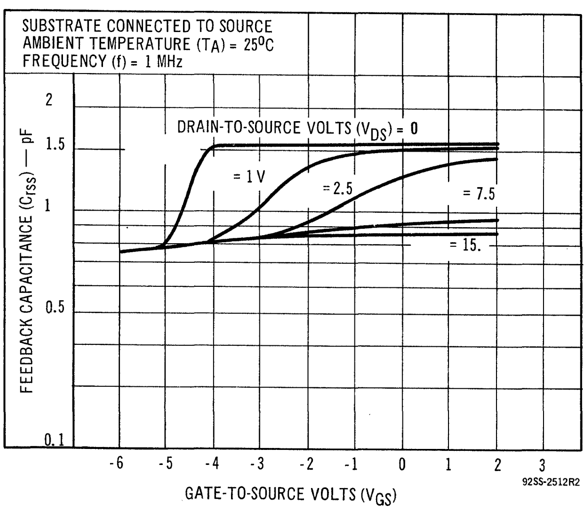


Fig.1 - Gate-to-Drain Capacitance vs. Gate-to-Source Voltage

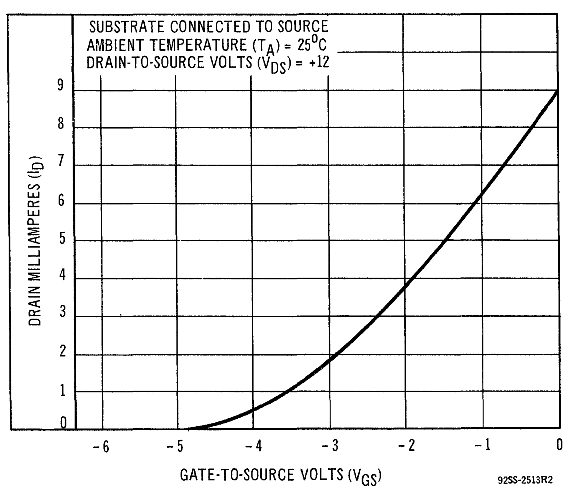


Fig.2 - Drain Current vs. Gate-to-Source Voltage

TYPICAL CHARACTERISTICS FOR RCA-40461

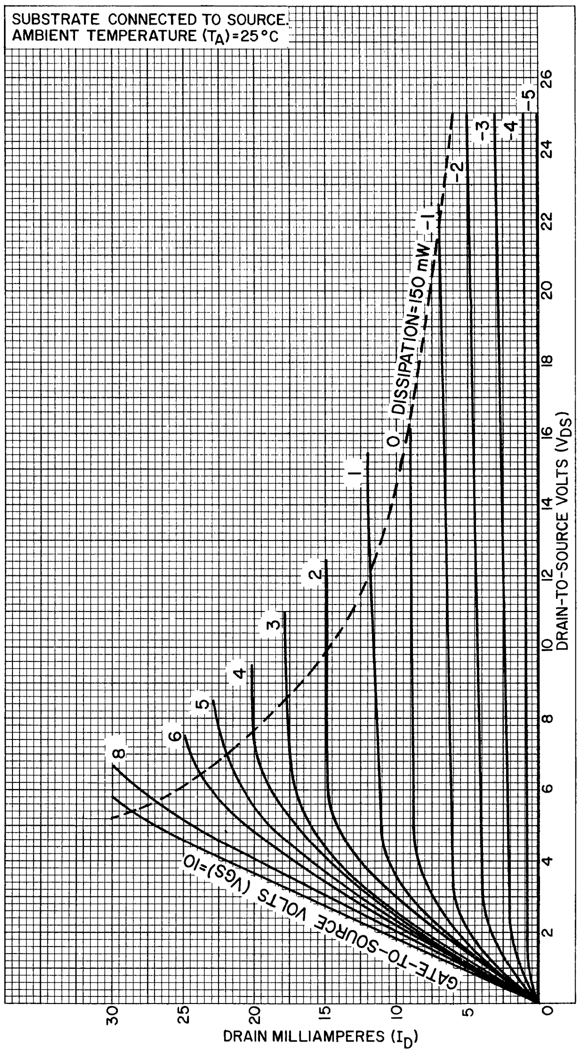


Fig.3 - Drain Current vs. Drain-to-Source Voltage

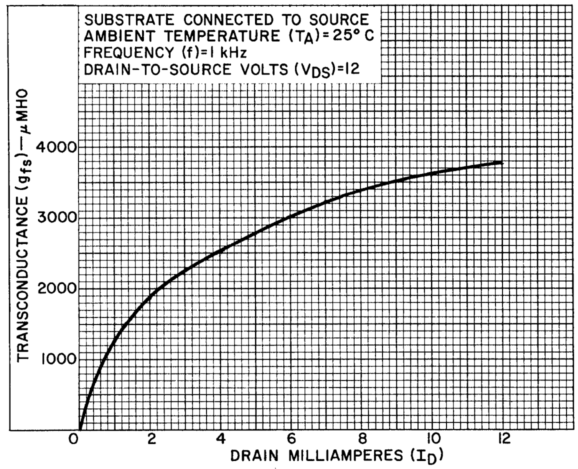


Fig.4 - Transconductance vs. Drain Current Connected to Source

HANDLING AND OPERATING CONSIDERATIONS

CAUTION

RCA-40461, like conventional (bipolar) high-frequency silicon transistors, is susceptible to the detrimental effects of high-potential electrostatic discharges applied to its input terminals.

The polystyrene insulating snow, commonly used as a convenient carrying tray for semiconductor devices, can acquire high static charges and should not be used unless it has been specially treated to make it electrically conductive ($R \leq 10\ k\Omega/in^3$).

To avoid the possibility of subjecting the 40461 to high ac voltages that may be present on the tips of soldering irons, some means for grounding these tips should be provided.

RCA-40461 should never be inserted in or removed from circuits with the power on because transient voltages may permanently damage the device. AC-operated power supplies for the 40461 should also have provision for suppression of transients during turn-on and turn-off. If such suppression is not provided, the following procedure should be used in applying power to the 40461.

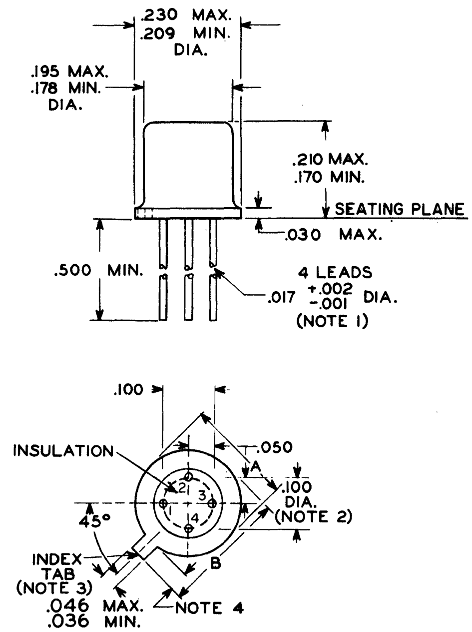
1 - Before inserting the 40461 in the equipment turn ac line switch on and reduce the dc output of the power supply to zero.

2 - Insert the 40461.

3 - Increase the dc supply voltage to the desired value.

This procedure should be reversed when the 40461 is taken out of the equipment.

DIMENSIONAL OUTLINE
JEDEC TO-72



92CS-12817

Dimensions in Inches

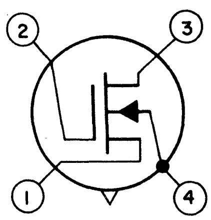
NOTE 1: THE SPECIFIED LEAD DIAMETER APPLIES IN THE ZONE BETWEEN 0.050" AND 0.250" FROM THE SEATING PLANE. FROM 0.250" TO THE END OF THE LEAD A MAXIMUM DIAMETER OF 0.021" IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

NOTE 2: MAXIMUM DIAMETER LEADS AT A GAUGING PLANE 0.054" + 0.001" - 0.000" BELOW SEATING PLANE TO BE WITHIN 0.007" OF THEIR TRUE LOCATION RELATIVE TO MAX. WIDTH TAB AND TO THE MAXIMUM 0.230" DIAMETER MEASURED WITH A SUITABLE GAUGE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 3: FOR VISUAL ORIENTATION ONLY.

NOTE 4: TAB LENGTH TO BE 0.028" MINIMUM, 0.048" MAXIMUM, AND WILL BE DETERMINED BY SUBTRACTING DIAMETER A FROM DIMENSION B.

TERMINAL DIAGRAM



Lead 1 – Source
Lead 2 - Insulated Gate
Lead 3 - Drain
Lead 4 - Bulk (Substrate) and Case

RCA-40462* is an alloy-junction power transistor of the germanium pnp type, intended primarily for use in high-fidelity amplifiers and other large-signal af-amplifier applications. The 40462 features high collector-current and dissipation capabilities, and exceptional linearity of characteristics over its full range of collector current. It is similar to RCA-2N2869/2N301, but has the advantages of a higher gain-bandwidth product (600 kHz typ.), and the ability to idle at lower currents with low crossover distortion.

When used with RCA-2N2613 low-noise transistors in low-level stages and RCA-2N2614 transistors in intermediate-level and driver stages, the 40462 makes possible the design of economical high-fidelity amplifier systems having high power output, low distortion, and wide frequency response.

The 40462 is particularly desirable for use in class B amplifier service in push-pull circuit arrangements. In a "single-ended push-pull" amplifier circuit of the type shown in Fig. 2, using direct coupling to a 4-Ω speaker load, a pair of RCA-40462 transistors can deliver up to 15 W output with sine-wave signal input, or 25 W music-power output[a], with less than 5 per cent total harmonic distortion and a power gain of 25 dB.

The 40462 is hermetically sealed in a JEDEC TO-3 package.

* Formerly Dev. No. TA2672.
a EIA Standard No. RS234, Section 2.1.2.1.
b Measured at center of seating surface.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-40 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	-40 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-5 max.	V
COLLECTOR CURRENT, I_C	-5 max.	A
BASE CURRENT, I_B	-1 max.	A
TRANSISTOR DISSIPATION, P_T:		
At Mounting-Flange Temperatures[b] up to 81° C	12.5 max.	W
At Mounting-Flange Temperatures[b] above 81° C	See Fig. 1	
TEMPERATURE RANGE:		
Storage and operating (Junction)	-65 to +100	°C
PIN TEMPERATURE (During soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	255 max.	°C

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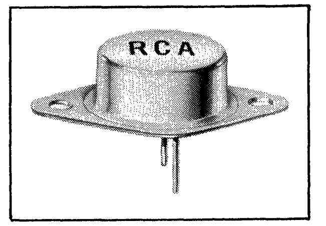
GERMANIUM P-N-P POWER TRANSISTOR



JEDEC TO-3

For AF Power-Amplifier and other Large-Signal Applications in Commercial, Industrial, and Military Equipment

FEATURES

- high collector-current capability— I_C = -5 A max.
- high gain-bandwidth product— f_T = 600 kHz typ.
- high dissipation capability— P_T = 12.5 W max. at mounting flange temperatures to 81° C
- exceptionally low idling current with low crossover distortion
- beta substantially constant over entire range of collector current
- hermetically sealed JEDEC TO-3 package

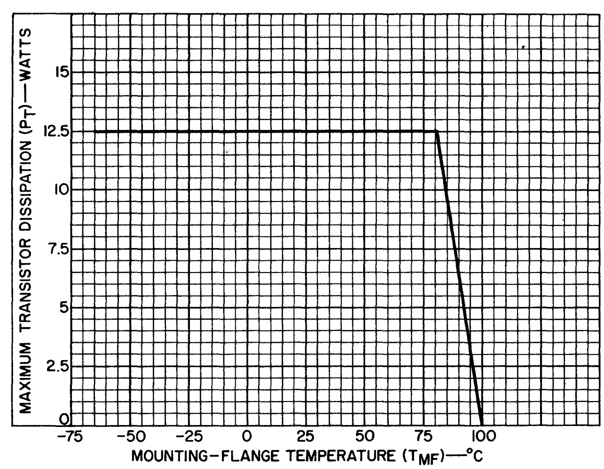


Fig. 1 - Rating chart

ELECTRICAL CHARACTERISTICS, *at a Mounting Flange Temperature*, T_{MF}●, *of* 25°C

Characteristics	Symbols	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	External Base-to-Emitter Resistance R_{BE}	LIMITS TYPE 40462 Min.	Typ.	Max.	Units
		V	V	A	mA	Ω				
Collector-to-Base Breakdown Voltage	BV_{CBO}			-0.005	0		-40	-	-	V
Collector-to-Emitter Break-down Voltage	BV_{CER}			-0.6		68	-40	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}			0	-2		-5	-	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$			5		I_B = -0.5A	-	-	1	V
Collector-Cutoff Current	I_{CBO}	-30			0		-	-	-0.5	mA
Saturation Collector-Cutoff Current	$I_{CBO}(sat)$	-0.5			0		-	-	-0.1	mA
Static Forward-Current Transfer Ratio	h_{FE}		-2	-1			50	90	-	—
Base-to-Emitter Voltage	V_{BE}		-10	-0.05			-	-0.19	-	V
Thermal-Resistance (Junction-to-case)	θ_{JC}						-	-	1.5	°C/W
Gain-Bandwidth Product	f_T		5	-0.5			-	600	-	kHz

● Measured at center of seating surface.

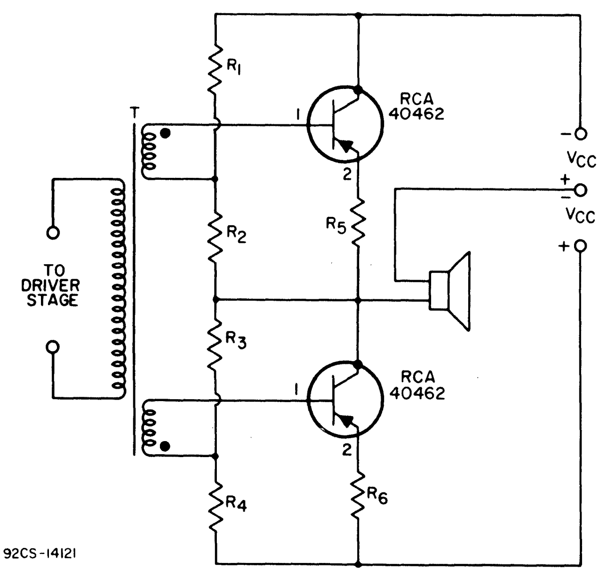
Typical Operation of RCA-40462 in the "Single-Ended Push-Pull" Class B AF-Amplifier Circuit Shown in Fig.2:

For a Mounting-Flange Temperature of 25°C

DC Collector Supply Voltages (V_{CC})[a]	18	V
Zero-Signal DC Collector Current	-12	mA
Zero-Signal Base-Bias Voltage	-0.15	V
Peak Collector Current	-2.8	A
Maximum-Signal DC Collector Current	-1	A
Input Impedance of Stage (per base)	32	Ω
Load Impedance (Speaker Voice Coil)	4	Ω
Power Gain	25	dB
Maximum-Signal Power Output	15	W
Total Harmonic Distortion at Maximum-Signal Power Output	5	%
Maximum Collector Dissipation (per transistor) under worst-case conditions	7.5	W
EIA Music Power Output Rating[b]	25	W

[a] The data shown are for a dc collector supply having 10 per cent regulation.

[b] EIA Standard No.RS234, Section 2.1.2.1.



R_1, R_3	470 Ω ± 10%, 1 W
R_2, R_4	3.9 Ω ± 10%, 0.5 W
R_5, R_6	0.33 Ω ± 10%, 0.5 W
Speaker: Voice Coil Impedance	4 Ω

T: Driver Transformer. Primary-winding impedance, current-carrying capacity, and dc resistance determined by large-signal characteristics of driver stage; secondary windings bifilar wound, impedance of each winding = 100 Ω.

Fig.2 - Single-ended push-pull class B AF amplifier circuit.

TYPICAL CHARACTERISTICS

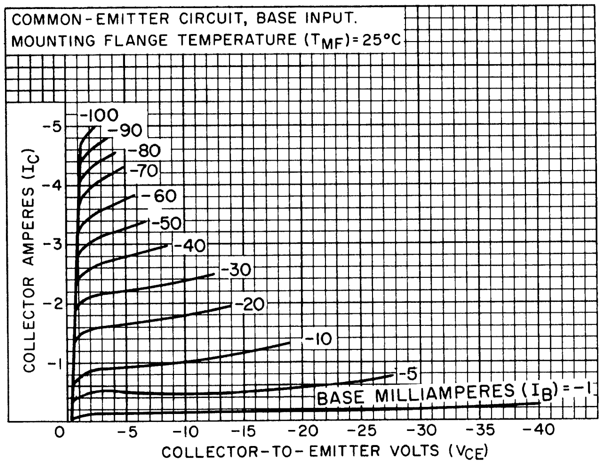


Fig.3 - Collector characteristics

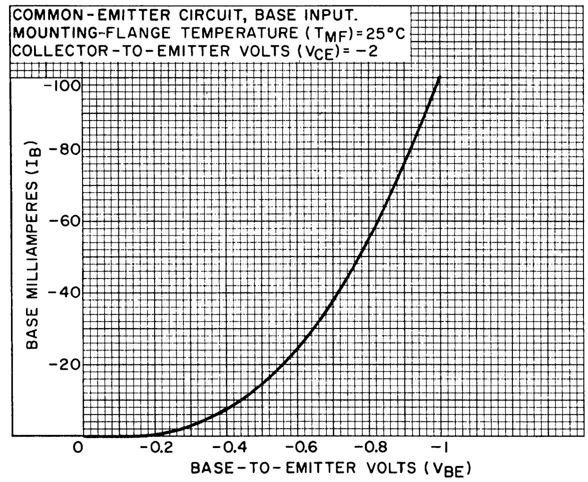


Fig.4 - Input characteristic

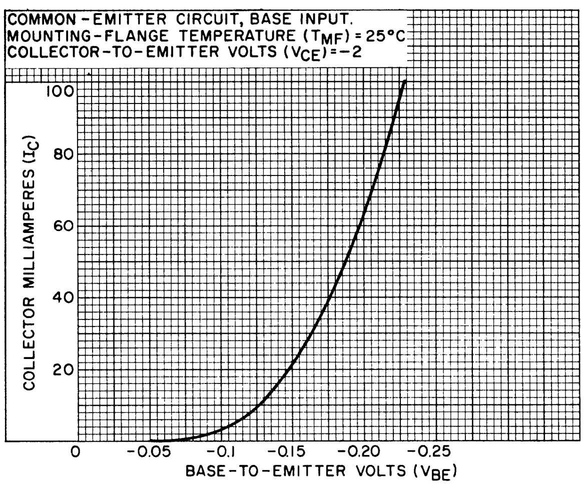


Fig.5 - Transfer characteristic

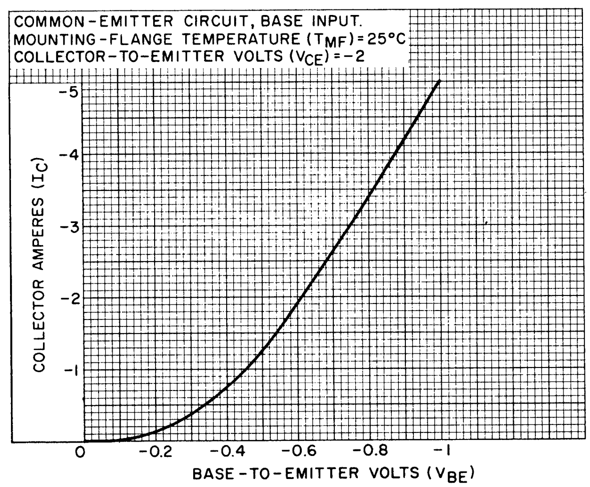


Fig.6 - Transfer characteristic

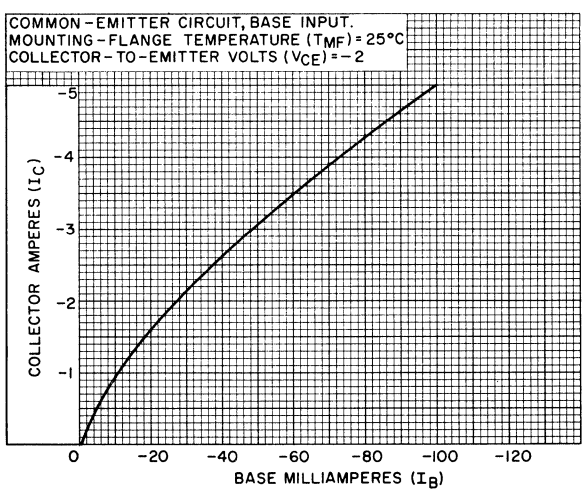


Fig.7 - Current-transfer characteristic

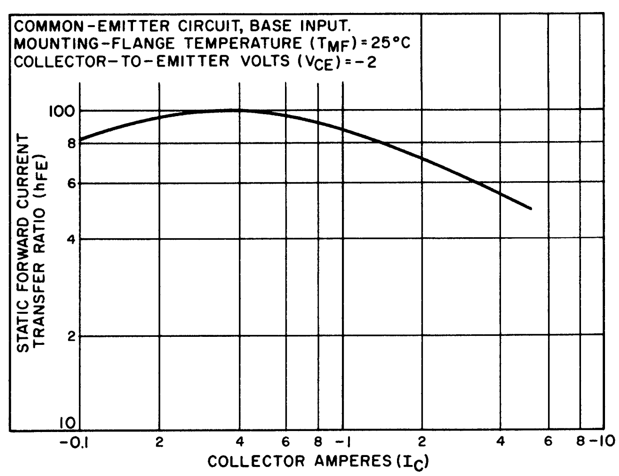


Fig.8 - Static forward current-transfer ratio characteristic

OPERATING CONSIDERATIONS

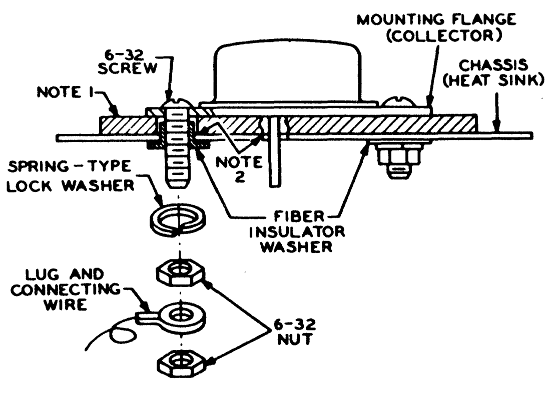
Because the metal shell of this transistor operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

The 40462 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

This transistor can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistor.

It is essential that the mounting flange which serves as the collector terminal be securely fastened to a heat sink, which may be the equipment chassis. *Under no circumstances, however, should the mounting flange be soldered to the heat sink or chassis because the heat of the soldering operation will permanently damage the transistor.*

The mounting-flange temperature of the 40462 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

Fig.9 - Suggested mounting arrangement

Mounting hardware for **RCA-40462** is available from RCA Distributors under the following RCA Part Numbers:

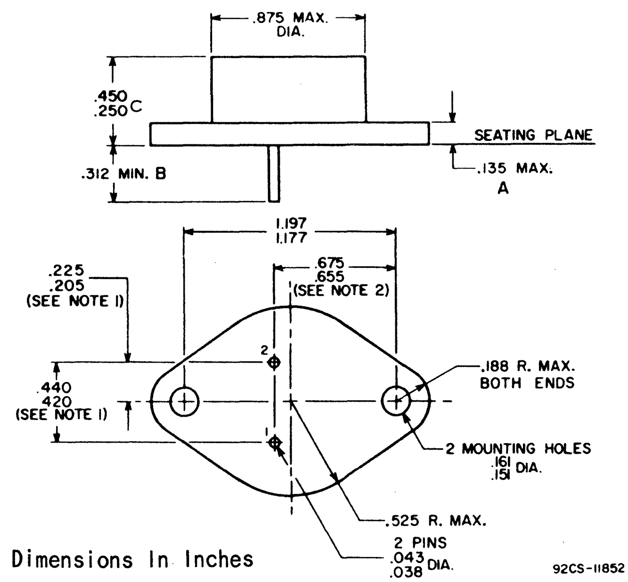
ITEM	RCA PART No.
Mica Insulator	495320
Nylon Insulating Washer (2)	495334-7

Mica insulators are also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

Insulating shoulder washers are also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

Sockets for **RCA-40462** and other semiconductor devices utilizing the JEDEC TO-3 package are made by several manufacturers, and are generally available from electronic parts distributors.

DIMENSIONAL OUTLINE



Dimensions In Inches

NOTE 1: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS .050" (1.270 MM) TO .055" (1.397 MM) BELOW SEATING PLANE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 2: TWO LEADS.

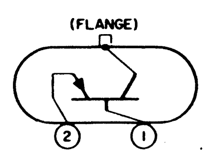
For RCA-40462

Mounting-Flange Thickness (A) = 0.050" max.

Pin Length (B) = { 0.440" min. / 0.480" max. }

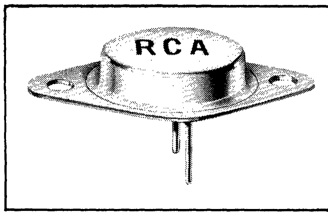
Seated Height (C) = 0.325" max.

TERMINAL CONNECTIONS



Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case

SILICON NPN EPITAXIAL-BASE POWER TRANSISTORS



For High-Fidelity Audio-Frequency-Amplifier Applications

RCA-40464, 40465, and 40466* are epitaxial-base power transistors of the silicon npn type, intended primarily for use in high-fidelity amplifiers and other af amplifiers which are required to deliver relatively large power outputs with low distortion, over wide frequency ranges.

The 40465 and 40466 are especially useful in conjunction with Types 2N2147 and 2N2148 germanium pnp drift-field power transistors in complementary-symmetry af power-output stages. Such combinations can provide typical music-power outputs** of up to 50 watts directly to speaker loads in economical line-operated amplifier circuits of the types shown in Figs.2 and 3.

All three devices are extremely useful for class A power-amplifier service because of their ability to sustain high currents at high collector voltages.

Features of the 40464, 40465, and 40466 which make them desirable for af power-amplifier applications include high voltage, current, and dissipation ratings, linearity of beta over a wide range of collector current, and a high gain-bandwidth product (f_T = 5 MHz typ.) which makes it possible to achieve extended high-frequency response (flat to 20 kHz) in economical circuit designs.

RCA-40464, 40465, and 40466 are hermetically sealed devices, utilizing the JEDEC TO-3 package, and have a maximum operating-temperature capability of 150°C.

* Formerly Dev. Nos.TA7083, TA2577A, and TA2577D, respectively.
** EIA Standard RS-234, Section 2.1.2.1.

FEATURES

RCA-40465, 40466:

- **High static betas at high collector currents:** h_{FE} = 50 min., 90 typ. at I_C = 2 A; 70 min., 150 typ. at I_C = 1 A
- **100-W Pulse-handling capability:** $I_{s/b}$ = 4 A at V_{CE} = 25 V

RCA-40464, 40465, 40466:

- **High gain-bandwidth product:** f_T = 5 MHz typ.
- **High dissipation capabilities in breakdown region:** $V_{CER}(sus) = V_{CEO}$ for I_C to 1.5 A, $R_{BE} \geq 33\ \Omega$
- **Hermetically sealed JEDEC TO-3 metal packages**

Maximum Ratings, *Absolute-Maximum Values:*

	40464	40465	40466		
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	35	40	50	max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	35	40	50	max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	4	4	4	max.	V
COLLECTOR CURRENT, I_C	5	5	5	max.	A
TRANSISTOR DISSIPATION, P_T:					
At mounting-flange temperatures*** up to 70°C	40	40	40	max.	W
At mounting-flange temperatures*** above 70°C	Derate linearly at 0.5 W/°C				
TEMPERATURE RANGE:					
Storage and operating (junction)	-65°C to +150°C				
LEAD TEMPERATURE (During soldering):					
At distances ≥ 1/16" from seating surface for 10 seconds maximum	265	265	265	max.	°C

*** Measured at center of seating surface.

ELECTRICAL CHARACTERISTICS, at T_{MF} = 25°C

Characteristics	Symbols	TEST CONDITIONS: DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter-to-Base Voltage V_{EB}	DC Collector Current I_C	DC Base Current I_B	DC Emitter Current I_E	LIMITS: RCA 40464 Min.	RCA 40464 Typ.	RCA 40464 Max.	RCA 40465 Min.	RCA 40465 Typ.	RCA 40465 Max.	RCA 40466 Min.	RCA 40466 Typ.	RCA 40466 Max.	Units
		V	V	V	A	A	A	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}	35					0	-	-	0.25	-	-	-	-	-	-	mA
		40					0	-	-	-	-	-	0.1	-	-	-	mA
		50					0	-	-	-	-	-	-	-	-	0.1	mA
Emitter-Cutoff Current	I_{EBO}			1.5	0			-	-	2.5	-	-	2.5	-	-	2.5	mA
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$				0.1	0		35	-	-	40	-	-	50	-	-	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				0		0.01	4	-	-	4	-	-	4	-	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				2	0.2		-	0.25	-	-	0.25	-	-	0.25	-	V
Collector-to-Emitter Sustaining Voltage	$V_{CER}(sus)$*			R_{BE} = 33Ω	1.5			35	-	-	40	-	-	50	-	-	V
Base-to-Emitter Voltage	V_{BE}		1		2			-	0.9	-	-	0.9	-	-	0.9	-	V
			10		0.05			-	0.55	-	-	0.55	-	-	0.55	-	V
Static Forward Current-Transfer Ratio	h_{FE}		1		1			40	80	-	70	150	-	70	150	-	-
			1		2			30	60	170	50	90	170	50	90	170	-
"Second-Breakdown" Collector Current	$I_{s/b}$▲		25					2.5	-	-	4	-	-	4	-	-	A
Gain-Bandwidth Product	f_T		6		0.5			2	5	-	3	5	-	3	5	.	MHz

* CAUTION: The sustaining voltages $V_{CEO}(sus)$ and $V_{CER}(sus)$ MUST NOT be measured on a curve tracer. These sustaining voltages should be measured by means of the test circuit shown in Fig.4.

▲$I_{s/b}$ is defined as the current at which second breakdown occurs at a specified collector voltage with the emitter-base junction forward-biased for transistor operation in the active region.

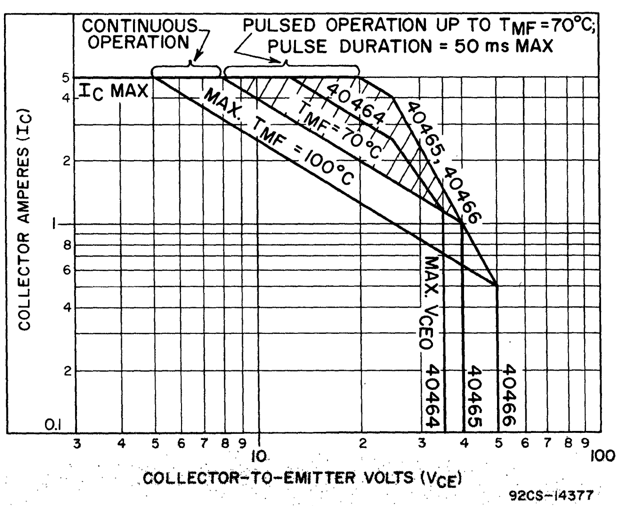
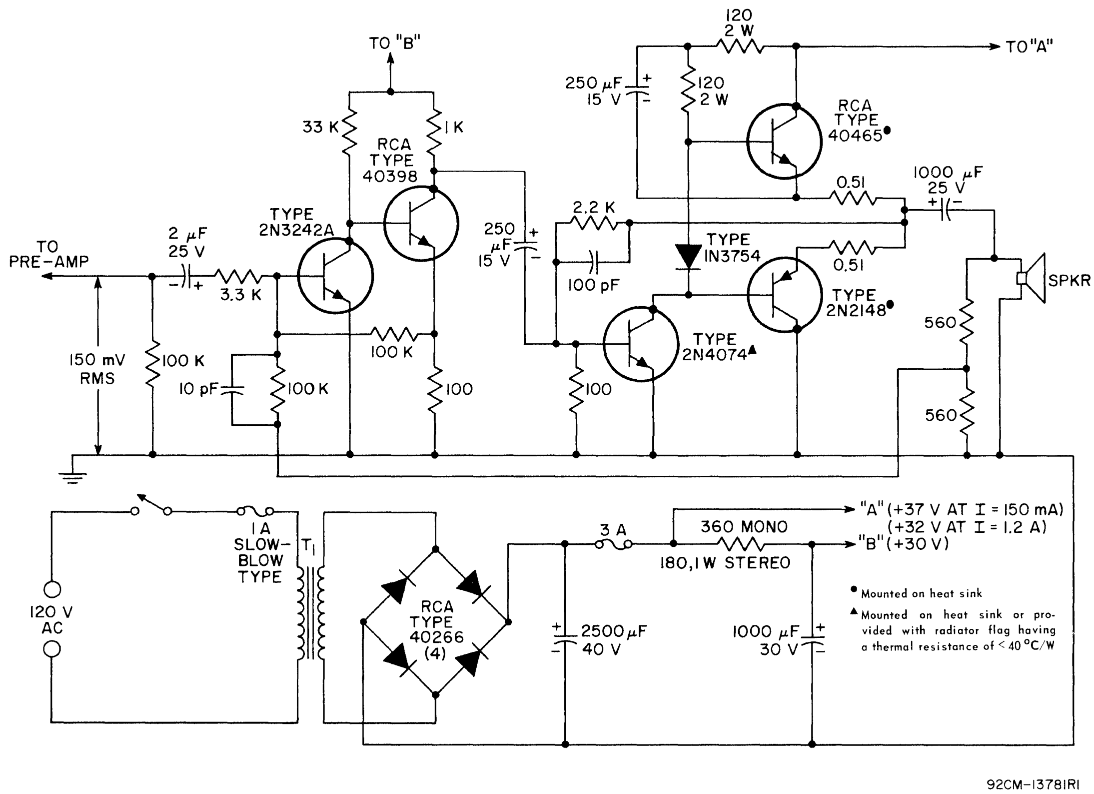


Fig.1 - Area of operation for 40464, 40465, and 40466.



All resistance values are in ohms. All resistors are 0.5-watt unless otherwise specified.

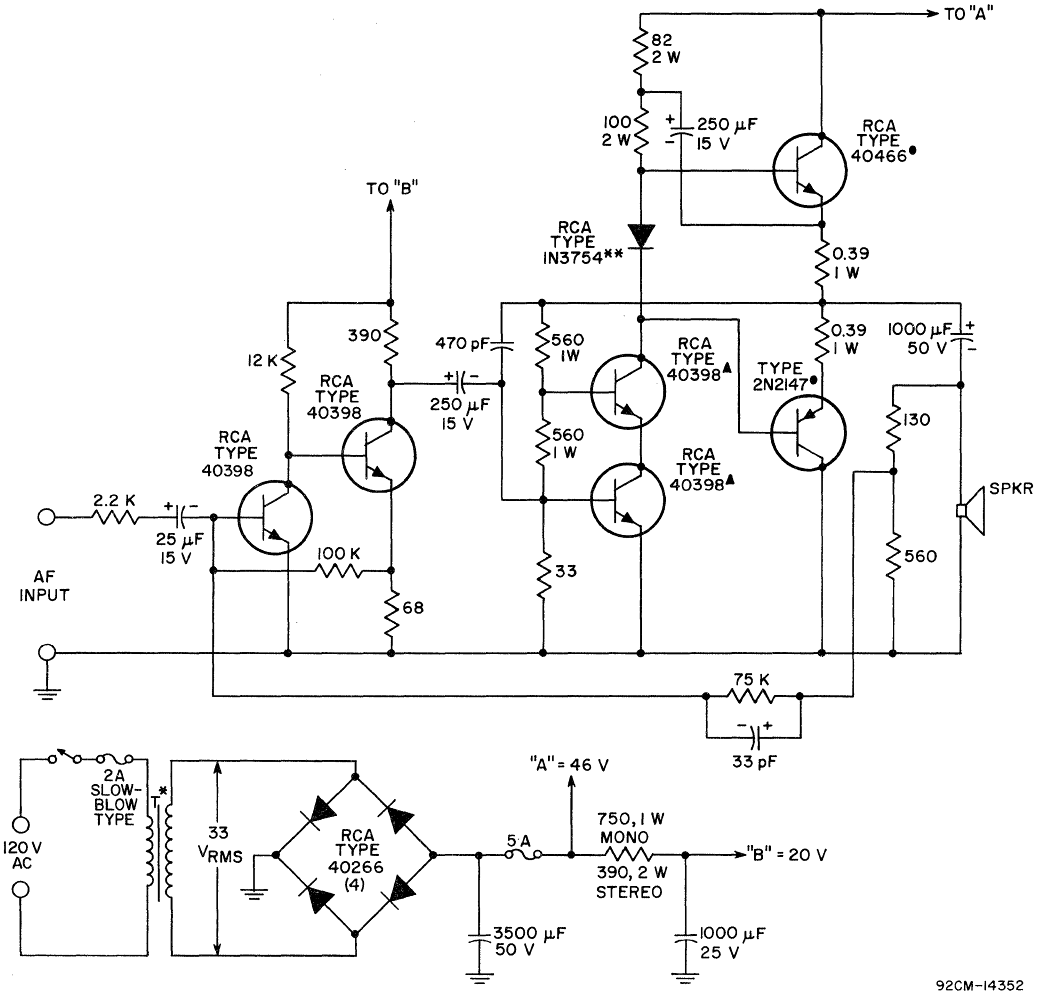
T_1: Better Coil & Transformer Co. Type 99P11, C. P. Electronics Type 9999, or equivalent.

Fig.2 - Typical ac-operated 20-watt (IHFM power output per channel) af amplifier using RCA-40465 and RCA-2N2148 in complementary-symmetry output stage.

TYPICAL PERFORMANCE CHARACTERISTICS PER CHANNEL OF AMPLIFIER CIRCUIT SHOWN IN FIG.2

	LOAD IMPEDANCE OHMS 4	LOAD IMPEDANCE OHMS 8	
EIA Power Output Rating	20	15	W
Continuous Power Output (THD = 1%, f = 1 kHz)	15	10	W
Total Harmonic Distortion:			
At 8 W Power Output, f = 25 Hz	0.25	0.1	%
= 1 kHz	0.15	0.05*	%
= 20 kHz	0.4	0.15	%
At 1 W Power Output, f = 1 kHz	0.06*	0.05*	%
Frequency Response	+0 dB, -3 dB, 13 Hz to 100 kHz		
Hum and Noise – Input terminals open	90 dB below 10 W Output		
Sensitivity	160 mV (rms) for 8 W Output		
Input Resistance	3300		Ω

*Accuracy of measurement limited by generator distortion.



●Mounted on Heat Sink.

** Mounted on same Heat Sink as 40466 and 2N2147 by means of RCA SA-2100 clip.

▲Mounted on common 1-1/2" x 2-1/4" Aluminum Heat Sink by means of RCA SA2100 clips which are bonded to Heat Sink with Thermally Conductive, Electrically non-conductive adhesive such as a Wakefield "Delta Bond 152" or equivalent.

*T: Better Coil and Transformer Co. Type 99P25, CP Electronics Type X10307, or equivalent. A commercial type, multi-voltage power transformer such as TRIAD Type F-610 or equivalent may be used, provided the transformer is connected to assure that the secondary voltage does not exceed 33 V_{RMS} to avoid damage to circuit components. Use of this type of transformer may result in a slight reduction in maximum power output, due to regulation factors. Such transformers are available from most Electronic Parts Distributors.

Fig.3 - Typical ac-operated 50-watt (IHFM power output per channel) amplifier using RCA-40466 and RCA-2N2147 in complementary-symmetry output stage.

TYPICAL PERFORMANCE CHARACTERISTICS PER CHANNEL OF AMPLIFIER CIRCUIT SHOWN IN FIG.3

	LOAD IMPEDANCE OHMS		
	4	8	
EIA Power Output Rating	50	37.5	W
Continuous Power Output (THD = 1%, f = 1 kHz).	30	25	W
Total Harmonic Distortion:			
At 20 W Power Output, f = 25 Hz	0.18	0.11	%
= 1 kHz	0.13	0.08	%
= 20 kHz	0.22	0.15	%
At 1 W Power Output, f = 1 kHz	0.05*	0.05*	%
Frequency Response	+0 dB, -3 dB, 10 Hz to 80 kHz		
Hum and Noise – Input terminals open. . . .	86 dB below 20 W Output		
Sensitivity.	230 mV (rms) for 10 W Output		
Input Resistance.	2200		Ω

*Accuracy of measurement limited by generator distortion.

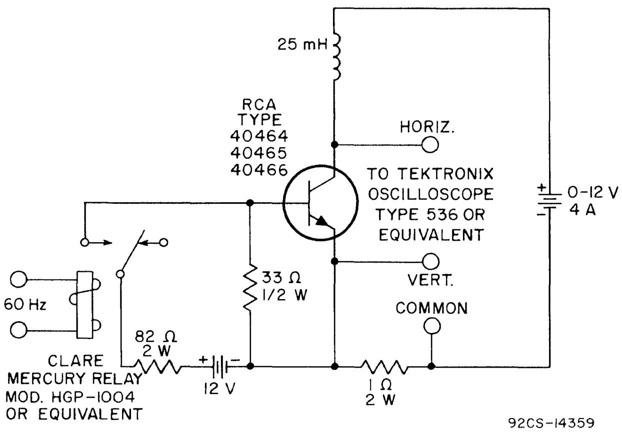
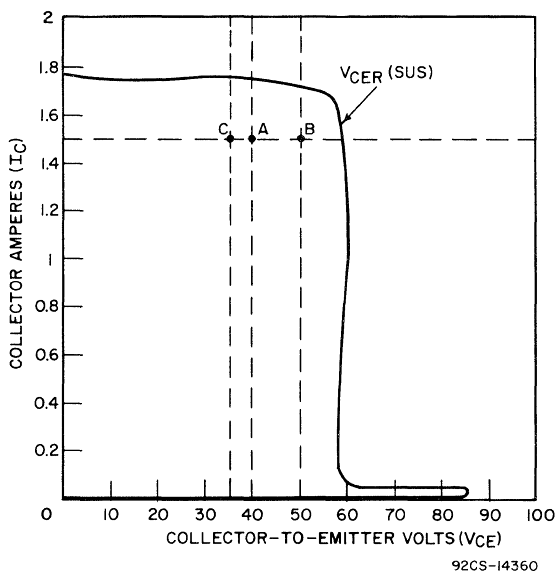


Fig.4 - Circuit Used to Measure Sustaining Voltage [V_{CER}(sus)] for RCA-40464, 40465, and 40466.



NOTE: The sustaining voltage V_{CER}(sus) is acceptable when the trace falls above and to the right of point A for Type 40465, point B for Type 40466 and point C for Type 40464.

Fig.5 - Oscilloscope Display for Measurement of Sustaining Voltage [V_{CER}(sus)] for RCA-40464, 40465, and 40466.

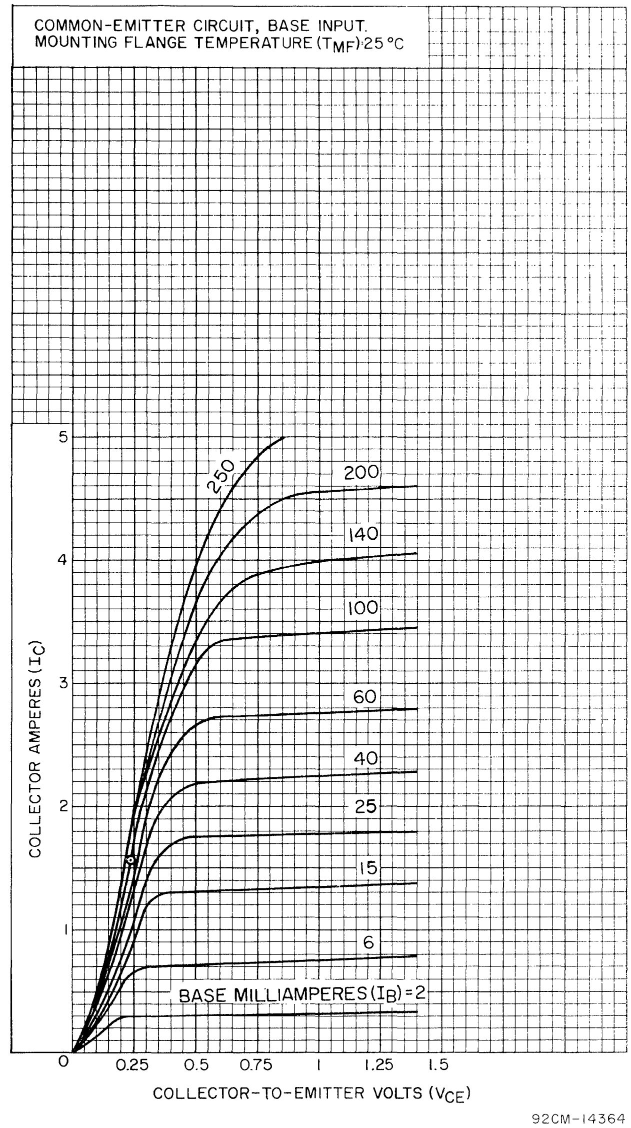


Fig.6 - Typical Collector Characteristics for RCA-40464.

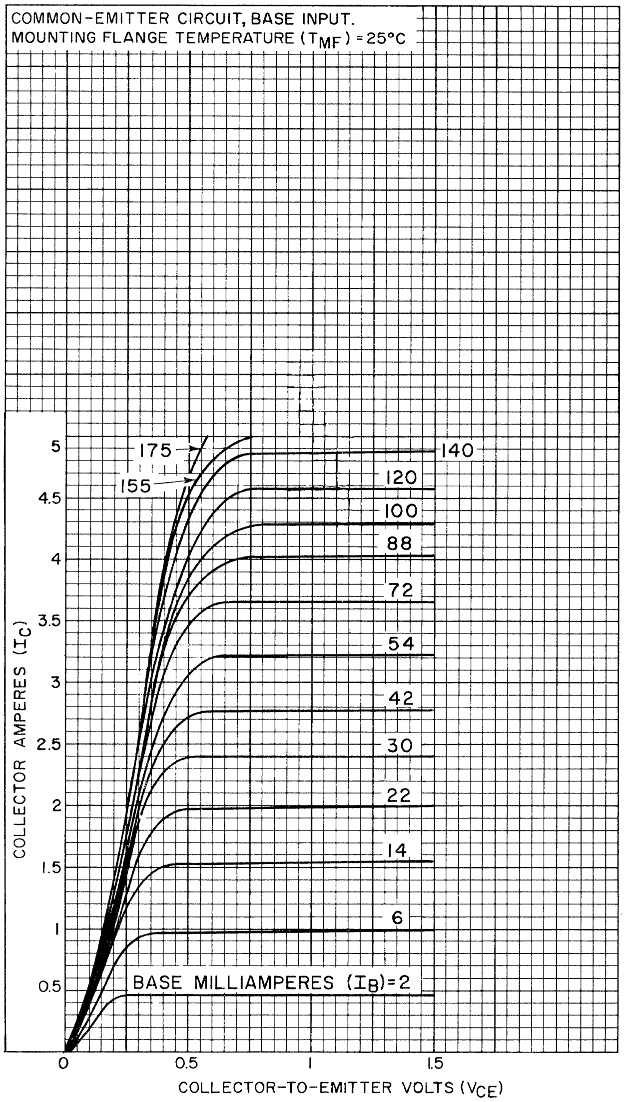


Fig.7 - Typical Collector Characteristics for RCA-40465 and 40466.

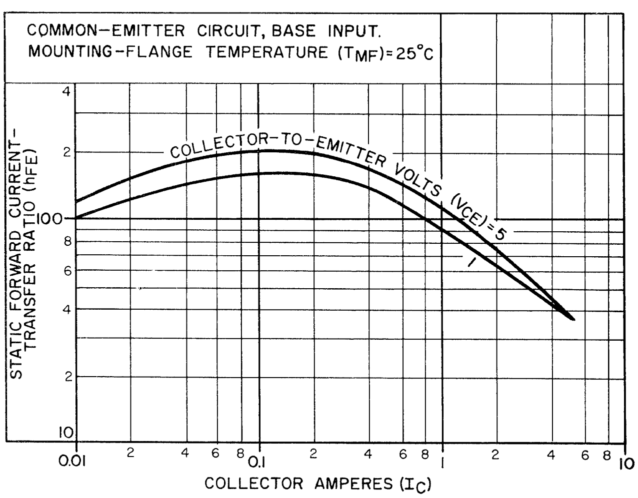


Fig.8 - Typical Static Beta vs Collector Current for RCA-40464.

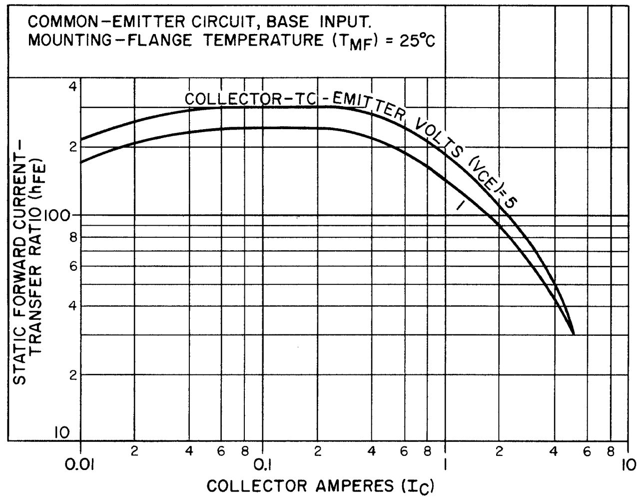


Fig.9 - Typical Static Beta vs Collector Current for RCA-40465 and 40466.

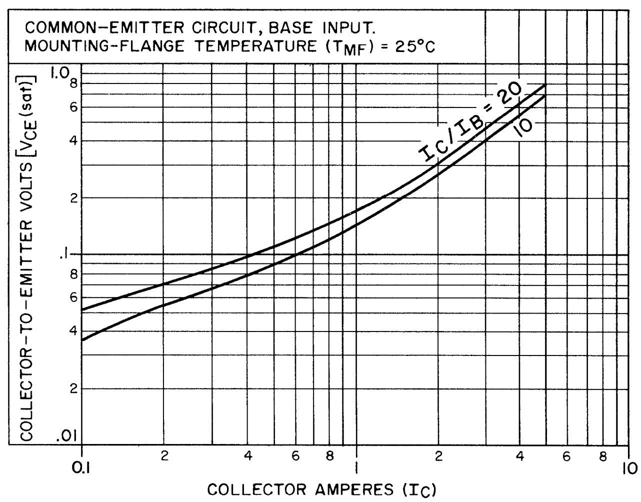


Fig.10 - Typical Collector-to-Emitter Saturation Voltage [$V_{CE}(sat)$] vs Collector Current for RCA-40465 and 40466.

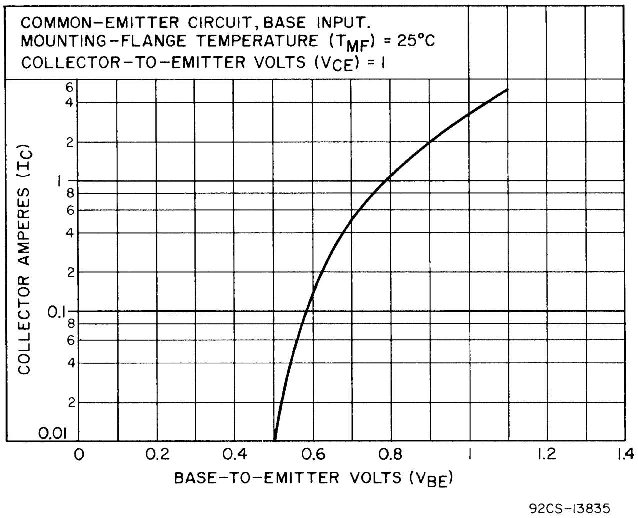


Fig.11 - Typical Transfer Characteristic for RCA-40465 and 40466.

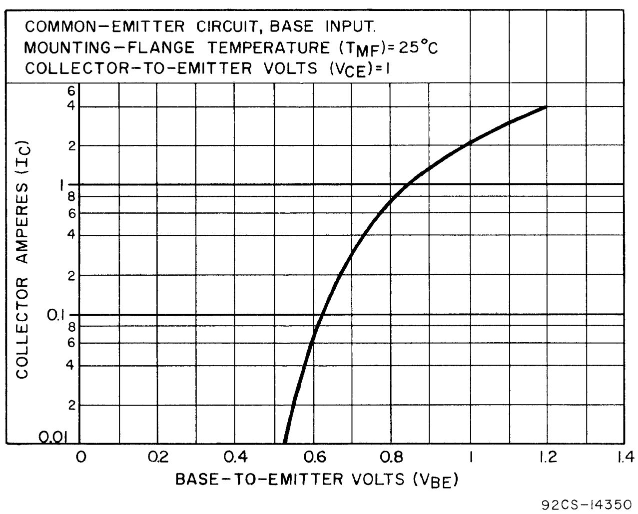


Fig.12 - Typical Transfer Characteristic for RCA-40464.

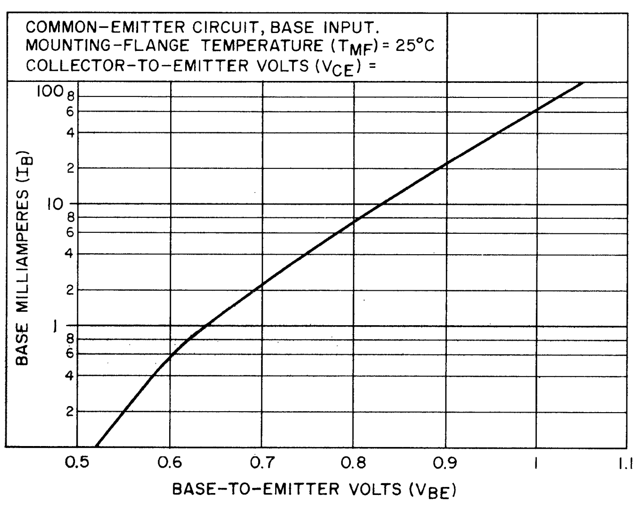


Fig.13 - Typical Input Characteristic for RCA-40464, 40465, and 40466.

OPERATING CONSIDERATIONS

Because the metal shell of this transistor operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

The 40464, 40465, and 40466 should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the transistor.

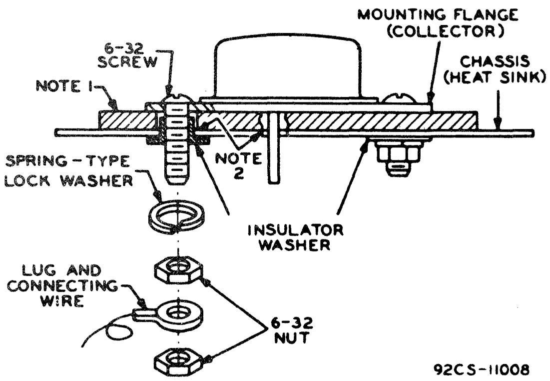
This transistor can be installed in commercially available sockets. Electrical connection to the base and emitter pins may also be made by soldering directly to these pins. Such connections may be soldered to the pins close to the pin seals provided care is taken to conduct excessive heat away from the seals. Otherwise the heat of the soldering operation will crack the pin seals and damage the transistor.

It is essential that the mounting flange which serves as the collector terminal be securely fastened to a heat sink, which may be the equipment chassis. *Under no circumstances, however, should the mounting flange be soldered to the heat sink or chassis because the heat of the soldering operation will permanently damage the transistor.*

The mounting-flange temperature of the 40464, 40465, and 40466 will be higher than the ambient (free-air) temperature by an amount which depends on the heat sink used. The heat sink must have sufficient thermal capacity to assure that the heat dissipated in the heat sink itself does not raise the transistor-mounting-flange temperature above the design value.

RCA-40398▲ transistors shown in Fig.3 may be mounted on an aluminum heat sink approximately 1-1/2" x 2-1/4" by means of RCA-SA2100 heat sink attachment clips which are bonded to the heat sink with thermally conductive, electrically non-conductive adhesive such as "Wakefield Delta-Bond 152" or equivalent. A suitable heat sink may be pruchased from Wakefield Electronics, Wakefield, Massachusetts, Part No. A-3049 or equivalent.

RCA-SA2100 heat sink attachment clip may be secured to any suitable heat sink by coating the clip with Wakefield "Delta-Bond 152" or equivalent. The heat sink should have a maximum thermal resistance (case-to-ambient) of 20°C per watt per transistor.



NOTE 1: 0.002" MICA INSULATOR OR ANODIZED ALUMINUM INSULATOR (DRILLED OR PUNCHED WITH BURRS REMOVED).

NOTE 2: REMOVE BURRS FROM CHASSIS HOLES.

Mounting hardware items for RCA-40464, 40465, and 40466 are available from RCA Distributors under the following RCA Part Numbers:

ITEM	RCA PART NO.
Mica Insulator	495320
Nylon Insulating Washer (2)	495334-7

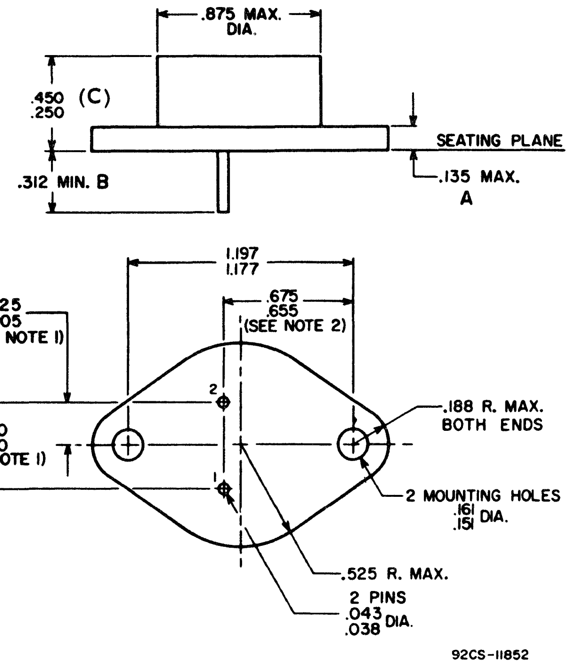
Mica insulators are also available from Reliance Mica Co., 341-351 39th St., Brooklyn, N.Y. 10032, United Mineral & Chemical Corp., 16 Hudson St., N.Y., N.Y. 10014, and other suppliers of similar components.

Insulating shoulder washers are also available from Contour Plastics, Minneapolis, Minn. and other suppliers of similar components.

Sockets for RCA-40464, 40465, and 40466 and other semiconductor devices utilizing the JEDEC TO-3 package are made by several manufacturers, and are generally available from electronic parts distributors.

Fig.14 - Suggested mounting arrangement for RCA-40464, 40465, and 40466.

DIMENSIONAL OUTLINE
For Types 40464, 40465, 40466
JEDEC No.TO-3



DIMENSIONS IN INCHES

NOTE 1: THESE DIMENSIONS SHOULD BE MEASURED AT POINTS .050" (1.270MM) TO .055" (1.397MM) BELOW SEATING PLANE. WHEN GAUGE IS NOT USED, MEASUREMENT WILL BE MADE AT SEATING PLANE.

NOTE 2: TWO LEADS.

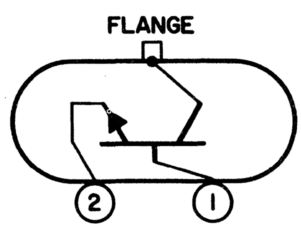
FOR RCA-40464, 40465, and 40466

Mounting-Flange Thickness (A) = 0.050" max.

Pin Length (B) = 0.440" min. / 0.480" max.

Maximum Seated Height (C) = 0.325

TERMINAL CONNECTIONS



Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case

RCA-40468 and 40559† are silicon insulated-gate field-effect transistors of the N-channel depletion type utilizing the MOS* construction. They are intended primarily for use as the RF amplifier and mixer, respectively, in FM receivers covering the 88 to 108 MHz band, but can be used for general amplifier applications at frequencies up to 125 MHz. For circuit design and typical performance data for "An FM Tuner Using Single-Gate MOS Field-Effect Transistors as RF Amplifier and Mixer" refer to RCA Application Note AN3535.

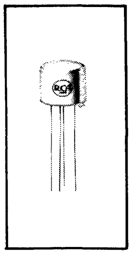
The wide dynamic range of these transistors reduces cross-modulation effects in AM receivers and minimizes the generation of spurious responses in FM receivers.

Operating as a neutralized amplifier at 100 MHz, the 40468 can provide a power gain of 17 dB (typ.). A power gain of 14 dB (typ.) can be realized without neutralization.

† Formerly Dev. Nos. TA7119 and TA7307, respectively.
* Metal-Oxide-Semiconductor.

SILICON INSULATED-GATE FIELD-EFFECT TRANSISTORS

N-Channel Depletion Types



TO-104

For RF Amplifier and Mixer Applications In FM and AM/FM Receivers

Maximum Ratings, Absolute-Maximum Values:

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	+20 max.	V
GATE-TO-SOURCE VOLTAGE, V_{GS}:		
Continuous	0 to −8 max.	V
Instantaneous	±15 max.	V
DRAIN CURRENT, I_D	20 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 100°C	100 max.	mW
At ambient temperatures above 100°C	Derate at 4mW/°C	
AMBIENT TEMPERATURE RANGE:		
Storage	−65 to +125	°C
Operating	−65 to +125	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32″ from seating surface for 10 seconds max.	265 max.	°C

Features

- **reduced spurious responses in FM tuners**
- **reduced cross-modulation effects in AM receivers**
- **high forward transadmittance — 7500μmho typ. at 100 MHz**
- **low feedback capacitance — 0.2pF max.**
- **high useful power gains —**
  neutralized: 17dB typ.; unneutralized: 14dB typ. — at 100MHz for 40468
- **hermetically sealed TO-104 metal package**

ELECTRICAL CHARACTERISTICS, at T_A = 25° C With Bulk (Substrate) Connected to Source

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS: FREQUENCY f (MHz)	DC DRAIN-TO-SOURCE V_{DS} (V)	DC DRAIN CURRENT I_D (mA)	RCA-40468 RF AMPLIFIER Min.	Typ.	Max.	RCA-40559 MIXER Min.	Typ.	Max.	UNITS
Gate-to-Source Cutoff Voltage	$V_{GS}(off)$	—	20	0.05	—	−4	−6	—	−4	−6	V
Gate Reverse Current	I_{GSS}	—	0	$V_{GS} = -8$	—	—	0.2	—	—	1	nA
Zero-Gate-Voltage Drain Current	I_{DSS}	—	15	$V_{GS} = 0$	5	20	50	5	20	50	mA
Small-Signal, Short-Circuit Reverse-Transfer Capacitance (Drain-to-Gate)	C_{rss}	1	15	5	0.1	0.12	0.2	0.1	0.12	0.2	pF
Input Resistance	r_{is}	100 100	15 15	5 2	2 —	4.5 —	— —	— —	4.5 5	— —	KΩ KΩ
Output Resistance	r_{os}	100 10.7	15 15	5 5	2.25 —	4.2 —	— —	— —	4.2 —	— 18	KΩ KΩ
Input Capacitance	C_{iss}	100	15	5	—	5.5	10	—	5.5	—	pF
Output Capacitance	C_{oss}	100 10.7	15 15	5 2	— —	1.4 —	— —	— —	— 1.4	— —	pF pF
Magnitude of Forward Transadmittance	$\|y_{fs}\|$	100	15	5	—	7.5	—	—	—	—	mmho
Forward Conversion Conductance	g_c	100	15	2	—	—	—	—	—	1.3	mmho
Maximum Available Power-Gain	MAG	100	15	5	—	24	—	—	—	—	dB
Maximum Usable Power Gain (Unneutralized)	MUG	100	15	5	—	14	—	—	—	—	dB
Maximum Usable Power Gain (Neutralized)	MUG	100	15	5	14	17	—	—	—	—	dB
Maximum Available Conversion Gain	MAG_c	$f_{IN} = 100$ $f_{OUT} = 10.7$	15	2	—	—	—	—	25.8	—	dB
Noise Figure	NF	100	15	5	—	4	5	—	—	—	dB

OPERATING CONSIDERATIONS

The flexible leads of the 40468 and 40559 are usually soldered to the circuit elements. As in the case of any high-frequency semiconductor device, the tips of soldering irons should be grounded, and appropriate precautions should be taken to protect the devices against high electric fields.

These devices should not be connected into, or disconnected from, circuits with the power on because high transient voltages may cause permanent damage to the devices.

TYPICAL y PARAMETER CHARACTERISTICS

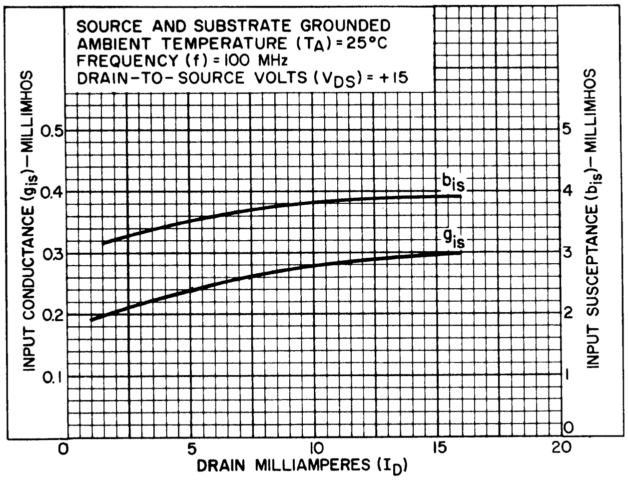


Fig. 1 – Input Admittance (y_{is}) vs Drain Current (I_D)

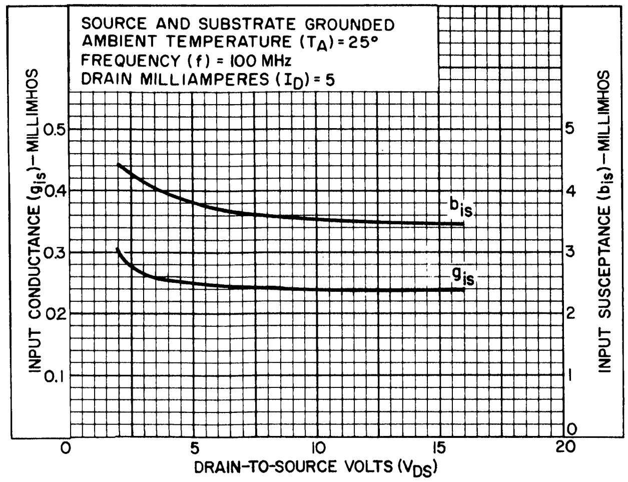


Fig. 2 – Input Admittance (y_{is}) vs Drain-to-Source Voltage (V_{DS})

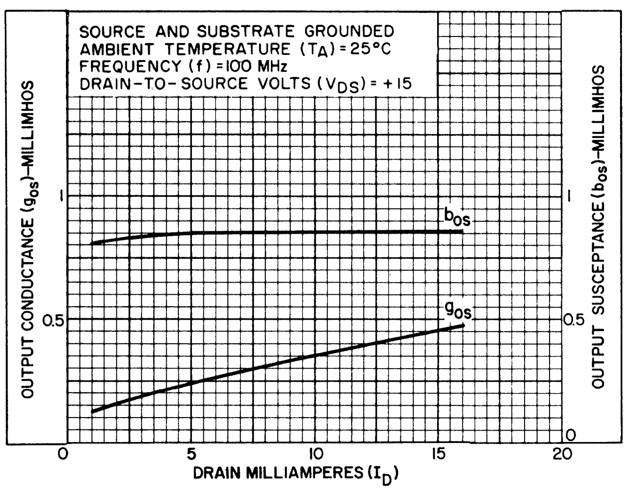


Fig. 3 – Output Admittance (y_{os}) vs Drain Current (I_D)

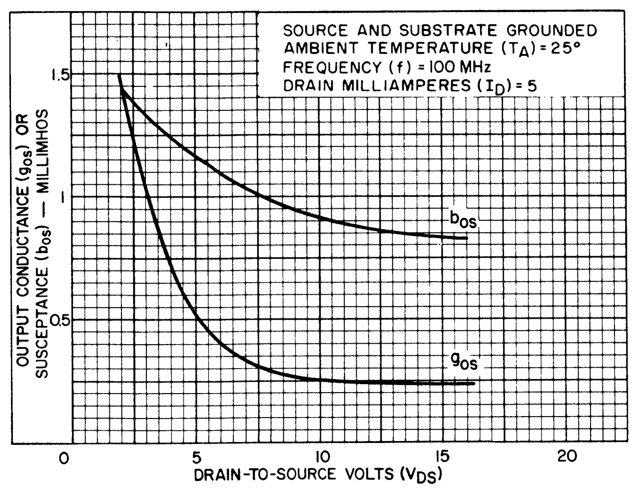


Fig. 4 – Output Admittance (y_{os}) vs Drain-to-Source Voltage (V_{DS})

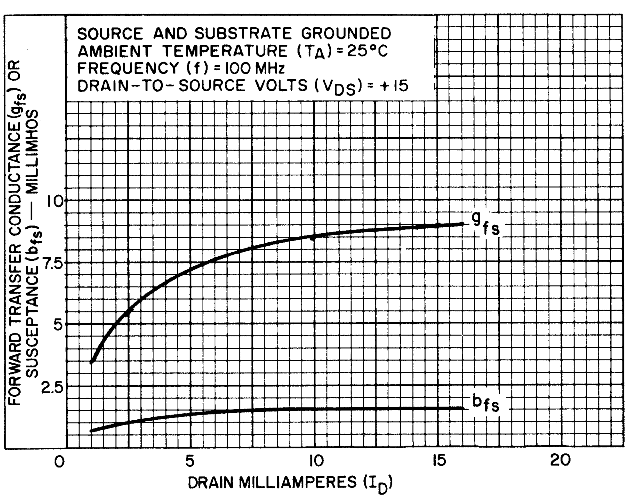


Fig. 5 – Forward Transadmittance (y_{fs}) vs Drain Current (I_D)

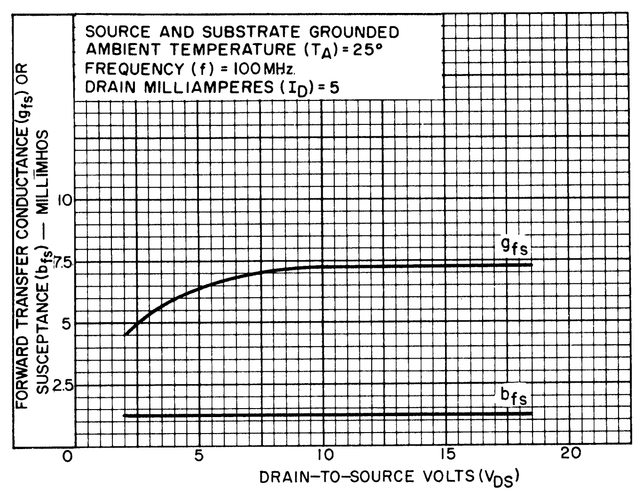


Fig. 6 – Forward Transadmittance (y_{fs}) vs Drain-to-Source Voltage (V_{DS})

TYPICAL y PARAMETER CHARACTERISTICS

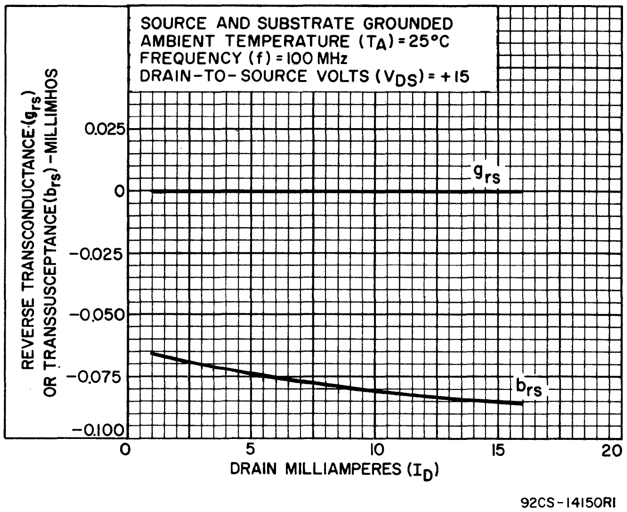


Fig. 7 – Reverse Transadmittance (y_{rs}) vs Drain Current (I_D)

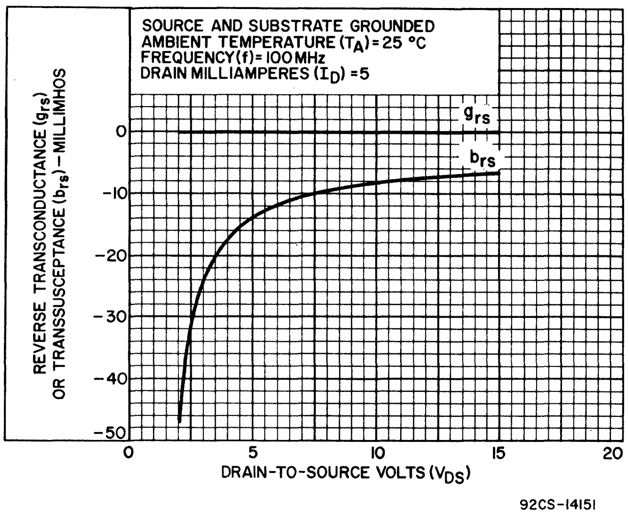


Fig. 8 – Reverse Transadmittance (y_{rs}) vs Drain-to-Source Voltage (V_{DS})

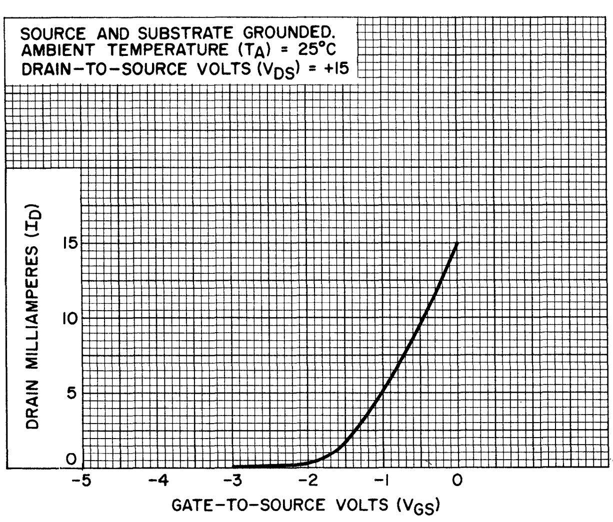
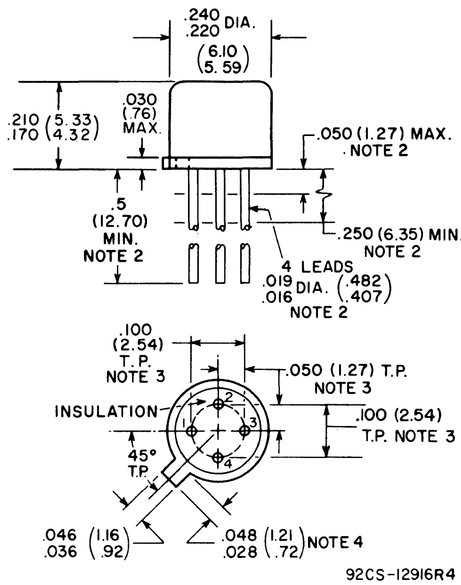


Fig. 9 – Typical Characteristic of Drain Current (I_D) vs Gate-to-Source Voltage (V_{GS})

DIMENSIONAL OUTLINE

TO-104



DIMENSIONS IN INCHES AND MILLIMETERS

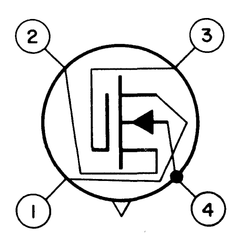
Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maxi-width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM



LEAD 1 - DRAIN
LEAD 2 - SOURCE
LEAD 3 - INSULATED GATE
LEAD 4 - BULK (SUBSTRATE) AND CASE

"Stars and Stripes" HF TRANSISTORS

For TV Applications

40469 40470 40471

RCA-40469, 40470, and 40471* are high-frequency transistors of the silicon n-p-n type having controlled forward AGC characteristics. They are intended primarily for use in the tuner and if-amplifier circuits of VHF television receivers. The 40469 is intended for use as an rf amplifier in tuners covering channels 2 through 13. The 40470 and 40471 are intended for use in 45-MHz picture-if-amplifiers.

These types feature a New Terminal Arrangement in which the emitter and base connections are interchanged to provide maximum isolation between the output (collector) and the input (base) terminals. Although this new basing configuration does not appreciably change the measured device feedback capacitance, it permits the use of external inter-terminal shields to reduce feedback due to external capacitances, particularly on printed circuit boards. This feature makes it possible to achieve greater circuit stability or higher useable gain per stage in critical circuit designs.

The 40469, 40479, 40471 also feature very low feedback capacitance, low noise, high useful power gains in their recommended applications, and a high-temperature capability permiting operation up to 175° C.

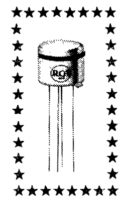
RCA-40469, 40470, and 40471 utilize a hermetically sealed JEDEC TO-104 metal package in which the case is electrically isolated from the transistor electrodes. The case is provided with a separate lead which may be grounded to minimize collector-to-base interlead capacitance and coupling to other circuit components.

* Formerly Dev. Nos. TA2848, TA2858, TA2859.

ABSOLUTE MAXIMUM RATINGS:

COLLECTOR-TO BASE VOLTAGE, V_{CBO}	45 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max.	V
COLLECTOR CURRENT, I_C	50 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25° C	180 max.	mW
At ambient temperatures above 25° C	derate at 1.2 mW/°C	
TEMPERATURE RANGE:		
Storage and Operating (Junction) . . .	-65 to +175	°C
LEAD TEMPERATURE (During soldering):		
At distances not less than 1/32" from seating surface for 10 seconds max.	255 max.	°C

HIGH-FREQUENCY TRANSISTORS



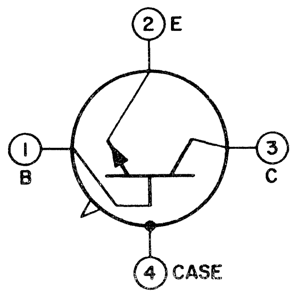
JEDEC TO-104

Silicon N-P-N Types With Controlled Forward AGC Characteristics For TV Tuner and IF-Amplifier Applications

FEATURES

- New Terminal Arrangement For Superior High-Frequency Performance

1 - Base
2 - Emitter
3 - Collector
4 - Case



- Low Collector-to-Base Feedback Capacitance (C_{cb}):
  For 40469.....0.19 pF typ.
  For 40470, 40471.....0.18 pF typ.
- Controlled Forward AGC Characteristics:
  Gain Reduction = 44 dB typ. for change in I_E from -5 to -12 mA
- Low Device Noise Figure (NF):
  For 40469 at 200 MHz.....3.3 dB typ.
- High Useful Power Gains (MUG):
  For 40469 at 200 MHz.....
  28 dB typ. (neutralized)
  For 40470, 40471 at 44 MHz.....
  34.2 dB typ. (neutralized)
  29.3 dB typ. (unneutralized)
- High Operating Temperature Capability..... to 175° C
- Hermetically Sealed 4-Lead TO-104 Metal Package

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

ELECTRICAL CHARACTERISTICS at T_A = 25° C

CHARACTERISTICS	SYMBOLS	LIMITS 40469 MIN	40469 TYP	40469 MAX	40470 MIN	40470 TYP	40470 MAX	40471 MIN	40471 TYP	40471 MAX	TEST CONDITIONS: FREQUENCY (MHz)	DC COLLECTOR-TO EMITTER VOLTAGE V_{CE} (VOLTS)	DC EMITTER CURRENT I_E (mA)	UNITS
COLLECTOR-CUTOFF CURRENT	I_{CBO}	-	-	0.02	-	-	0.02	-	-	0.02	-	(V_{CB}) = 1	0	µA
		-	-	1	-	-	1	-	-	1	-	(V_{CB}) = 45	0	µA
EMITTER-CUTOFF CURRENT	I_{EBO}	-	-	1	-	-	1	-	-	1	-	(V_{EB}) = 3	I_C = 0	µA
STATIC FORWARD CURRENT-TRANSFER RATIO	h_{FE}	40	-	170	40	-	170	27	-	100	-	6	-1	-
GAIN-BANDWIDTH PRODUCT	f_T	-	800	-	-	700	-	-	700	-	100	6	-2	MHz
INPUT RESISTANCE	R_{IN}	-	75	-	-	-	-	-	-	-	200	10	-3	Ω
		-	-	-	-	500	-	-	500	-	44	12	-4	
OUTPUT RESISTANCE	R_{OUT}	-	6	-	-	-	-	-	-	-	200	10	-3	kΩ
		-	-	-	-	25	-	-	25	-	44	12	-4	kΩ
MAGNITUDE OF FORWARD TRANSADMITTANCE	$\|y_{fe}\|$	-	75	-	-	-	-	-	-	-	200	10	-3	mmho
		-	-	-	-	110	-	-	110	-	44	12	-4	mmho
DEVICE NOISE FIGURE*	NF	-	3.3	-	-	-	-	-	-	-	200	10	-3	dB
COLLECTOR-TO-BASE FEEDBACK CAPACITANCE	C_{cb}	-	0.19	-	-	-	-	-	-	-	200	10	-3	pF
		-	-	-	-	0.18	-	-	0.18	-	44	12	-4	pF
MAX. AVAILABLE AMPLIFIER GAIN	MAG	-	28	-	-	-	-	-	-	-	200	10	-3	dB
		-	-	-	-	45.8	-	-	45.8	-	44	12	-4	dB
MAX. USABLE AMPLIFIER GAIN (UNNEUTRALIZED)	MUG	-	24.8	-	-	-	-	-	-	-	200	10	-3	dB
				NO. OF STAGES										
		-	-	1		29.3	-	-	29.3	-	44	12	-4	dB
		-	-	2		27.1	-	-	27.1	-	44	12	-4	dB
		-	-	3		25.3	-	-	25.3	-	44	12	-4	dB
MAX. USABLE AMPLIFIER GAIN (NEUTRALIZED)	MUG	-	28**	-	-	-	-	-	-	-	200	10	-3	dB
				NO. OF STAGES										
		-	-	1		34.2	-	-	34.2	-	44	12	-4	dB
		-	-	2		32.0	-	-	32.0	-	44	12	-4	dB
		-	-	3		30.2	-	-	30.2	-	44	12	-4	dB
EMITTER CURRENT FOR 30 dB GAIN REDUCTION	I_E	-	-9	-	-	-	-	-	-	-	200	-	-	mA
		-	-	-	-	-10	-	-	-10	-	44	-	-	mA

* SOURCE RESISTANCE = 50 Ω.

** DEVICE IS CAPABLE OF ACHIEVING MAG.

TYPICAL CHARACTERISTICS

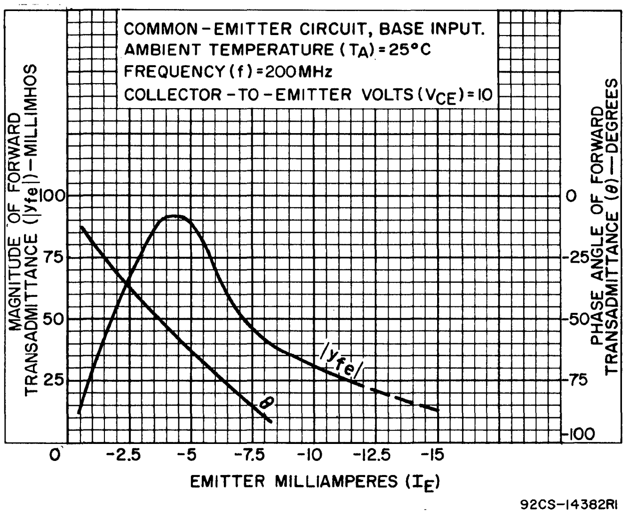


Fig.5 - Forward Transadmittance ($y_{fe} \angle\theta$) vs. Emitter Current (I_E) for 40469.

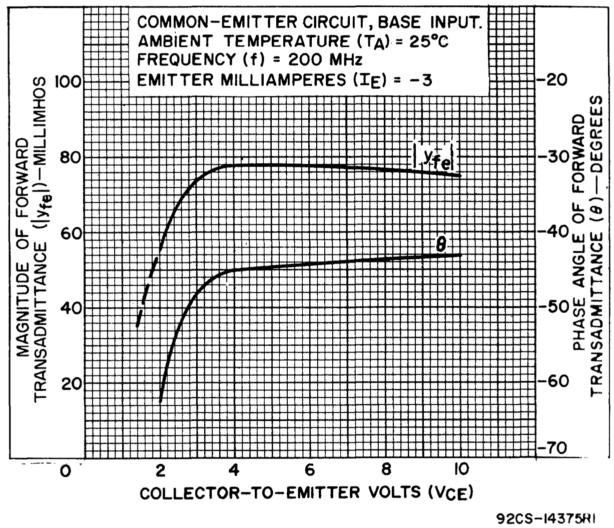


Fig.6 - Forward Transadmittance ($y_{fe} \angle\theta$) vs. Collector-To-Emitter Volts (V_{CE}) for 40469.

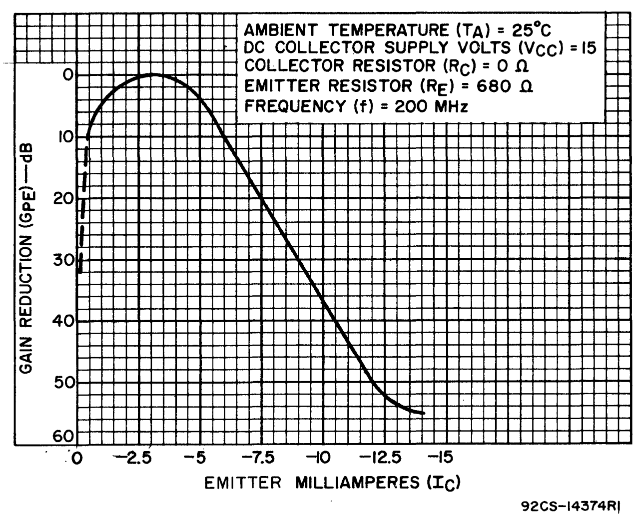


Fig.7 - Gain Reduction vs. Emitter Current for 40469.

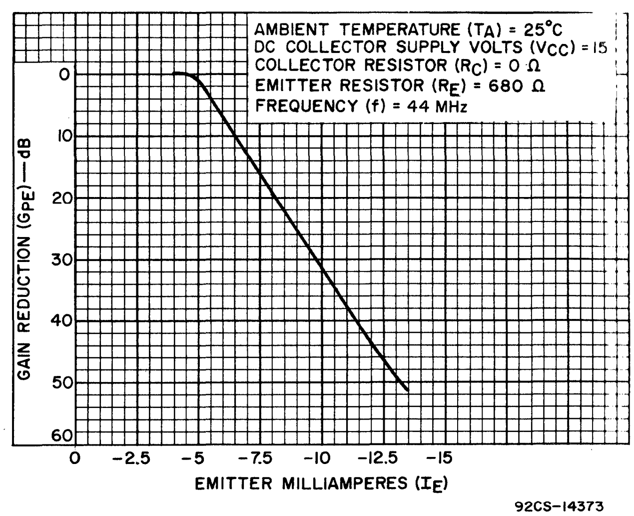


Fig.8 - Gain Reduction vs. Emitter Current for 40470 and 40471.

TYPICAL CHARACTERISTICS FOR 40470 AND 40471

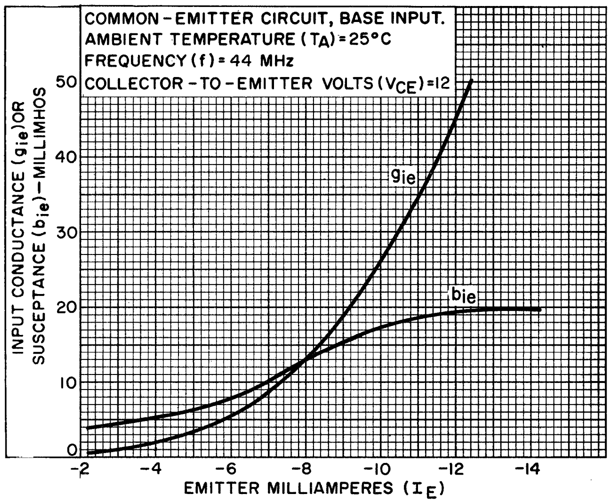


Fig.9 - Input Admittance (y_{ie}) vs. Emitter Current (I_E).

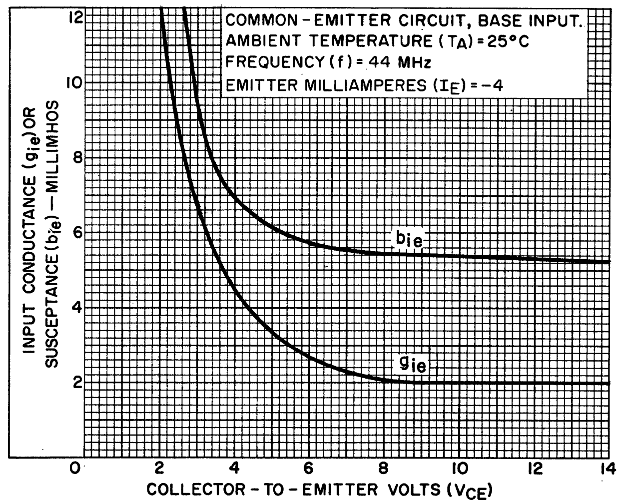


Fig.10 - Input Admittance (y_{ie}) vs. Collector-to-Emitter Volts (V_{CE}).

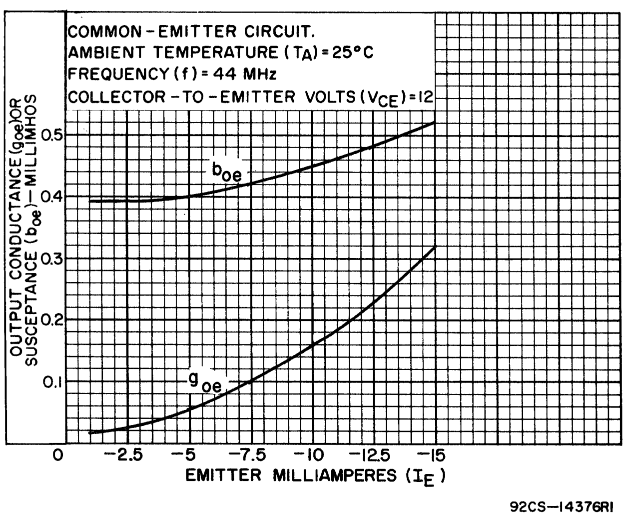


Fig.11 - Output Admittance (y_{oe}) vs. Emitter Current (I_E).

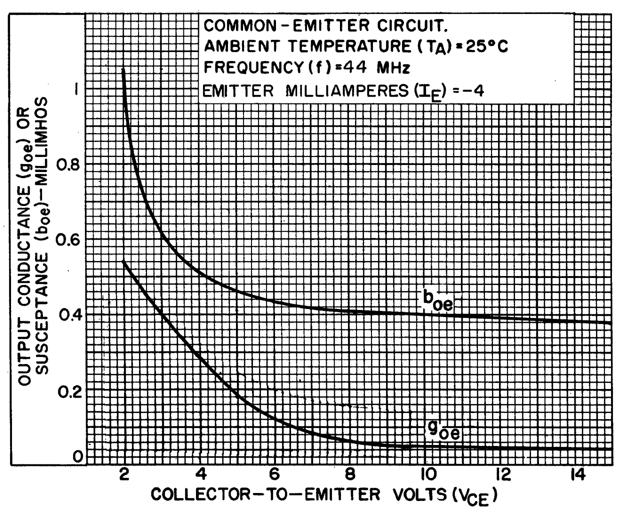


Fig.12 - Output Admittance (y_{oe}) vs. Collector-to-Emitter Volts (V_{CE}).

TYPICAL CHARACTERISTICS FOR 40469

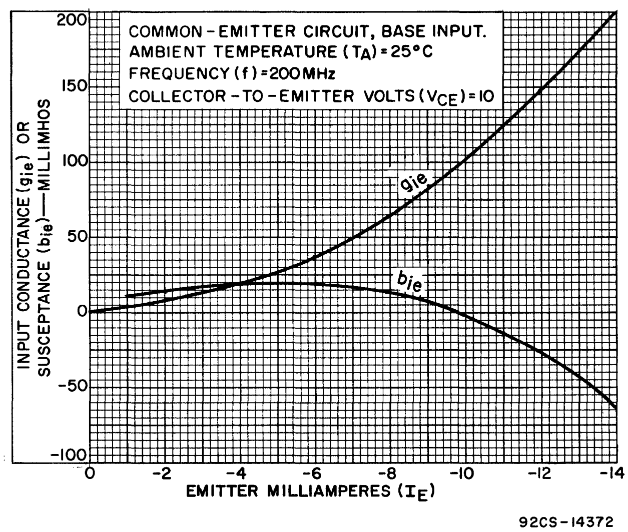


Fig.1 - Input Admittance (y_{ie}) vs. Emitter Current (I_E).

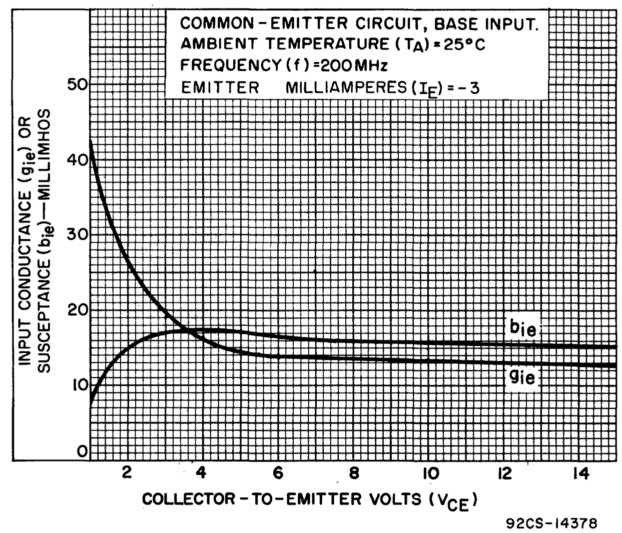


Fig.2 - Input Admittance (y_{ie}) vs. Collector-to-Emitter Volts (V_{CE}).

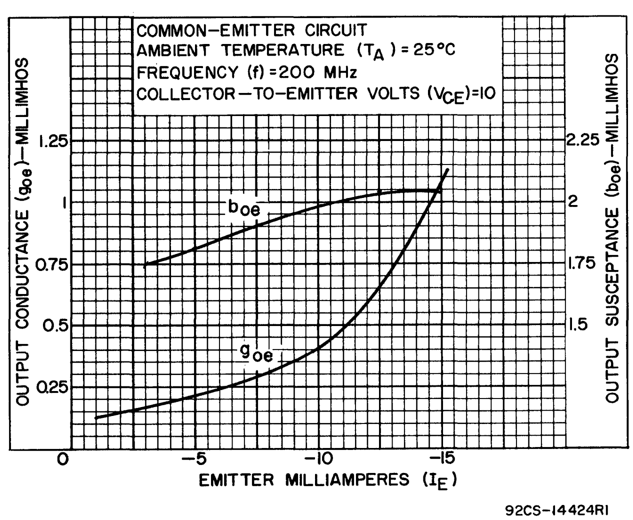


Fig.3 - Output Admittance (y_{oe}) vs. Emitter Current (I_E).

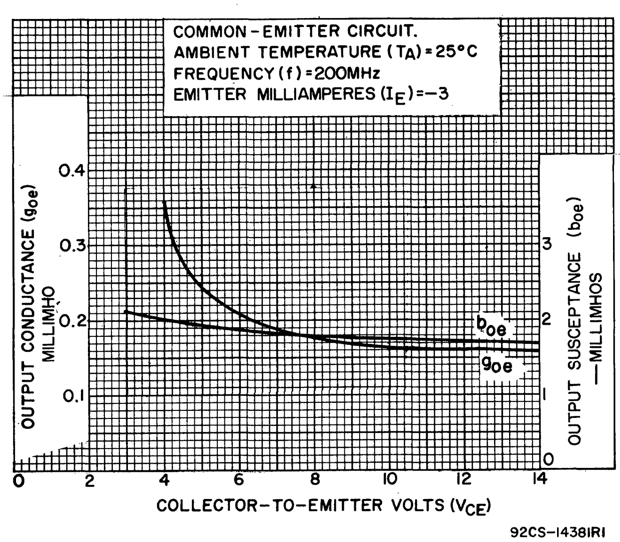


Fig.4 - Output Admittance (y_{oe}) vs. Collector-to-Emitter Volts (V_{CE}).

TYPICAL CHARACTERISTICS

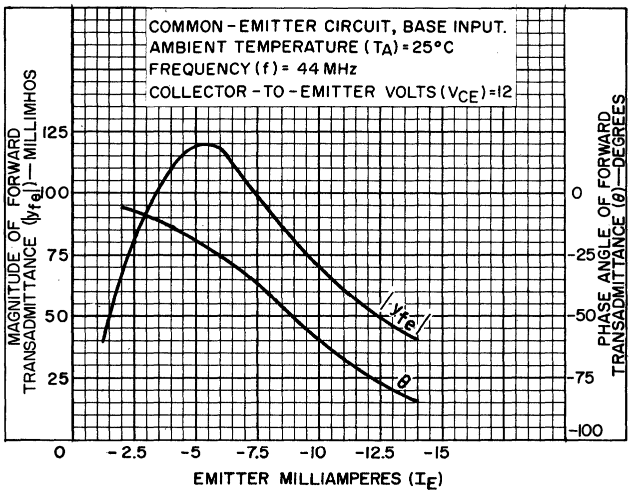


Fig.13 - Forward Transadmittance (y_{fe} $\angle\theta$) vs. Emitter Current (I_E) for 40470 and 40471.

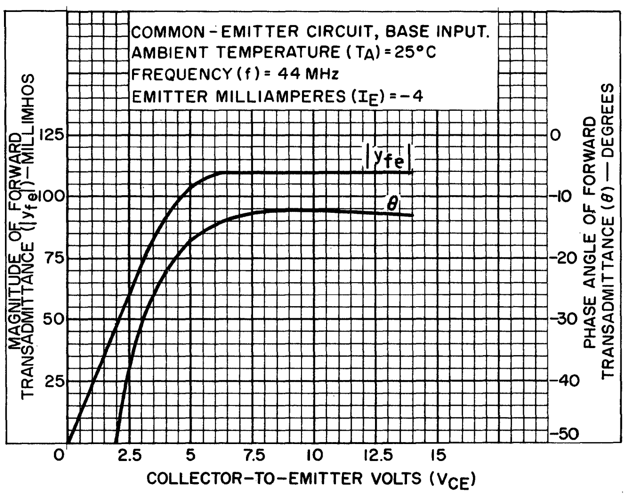


Fig.14 - Forward Transadmittance (y_{fe} $\angle\theta$) vs. Collector-to-Emitter Volts (V_{CE}) for 40470 and 40471.

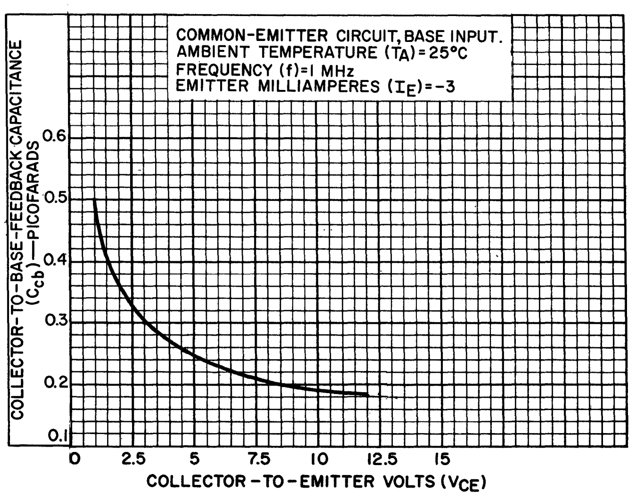
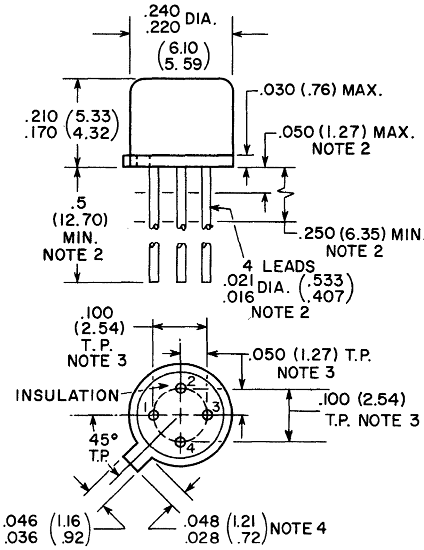


Fig.15 - Feedback Capacitance (C_{cb}) vs. Collector-to-Emitter Volts (V_{CE}) for 40469, 40470, and 40471.

DIMENSIONAL OUTLINE
TO-104



Dimensions in inches and millimeters

Note 1: *Dimensions in paranthesis are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.019" (0.482 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.117 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

OPERATING CONSIDERATIONS

The *flexible leads* of the 40469, 40470, & 40471 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in the leads, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using these devices, the temperature of the solder should not exceed 255° C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.031" of the case.

"Stars and Stripes" HF TRANSISTORS

For Television Applications

40472 40475
40473 40476
40474 40477

File No. 251

RCA 40472, 40473, 40474, 40475, 40476, and 40477* are high-frequency transistors of the silicon npn type, intended primarily for use in tuner and if amplifier circuits of vhf television receivers. These devices are also useful in communications equipment operating at frequencies up to approximately 260 MHz.

These transistors feature a New Terminal Arrangement in which the emitter and base connections are interchanged to provide maximum isolation between the output (collector) and the input (base) terminals. Although this new basing configuration does not appreciably change the measured device feedback capacitance, it permits the use of external inter-terminal shields to reduce the feedback due to external capacitances, particularly on printed circuit boards. This feature makes it possible to achieve greater circuit stability or higher useable gain per stage.

The 40472, 40473, and 40474 are intended for use as rf amplifier, mixer, and local oscillator, respectively, in TV tuners covering channels 2 through 13. Types 40475, 40476, and 40477 are for use in 45-MHz picture-if amplifiers.

These devices feature high gain-bandwidth products, very low feedback capacitances, and low cutoff currents, in addition to the high-temperature-operation capability of silicon.

RCA-40472 through 40477 utilize a hermetically sealed metal JEDEC TO-104 package which is electrically isolated from the transistor electrodes. The case is provided with a fourth lead, which may be connected to an rf groundpoint to minimize collector-to-base interlead capacitance and coupling to other circuit components.

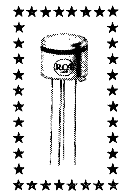
* Formerly Dev. Nos. TA2813 through TA2818, respectively.

ABSOLUTE MAXIMUM RATINGS:

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	45 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max.	V
COLLECTOR CURRENT, I_C	50 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25°C	180 max.	mW
At ambient temperatures above 25°C	derate at 1.2 mW/°C	
FREE-AIR TEMPERATURE RANGE:		
Storage and Operating	-65 to +175	°C
LEAD TEMPERATURE (During Soldering):		
At distances not closer than 1/32 inch to seating surface for 10 sec. max.	255 max.	°C

HIGH-FREQUENCY TRANSISTORS

Silicon NPN Types For TV Tuner and IF-Amplifier Applications

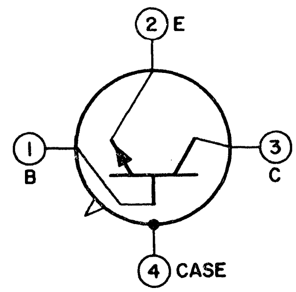


JEDEC TO-104

FEATURES

- New Terminal Arrangement . . . permits use of shielding between input and output terminals for superior high-frequency performance

1 - Base
2 - Emitter
3 - Collector
4 - Case



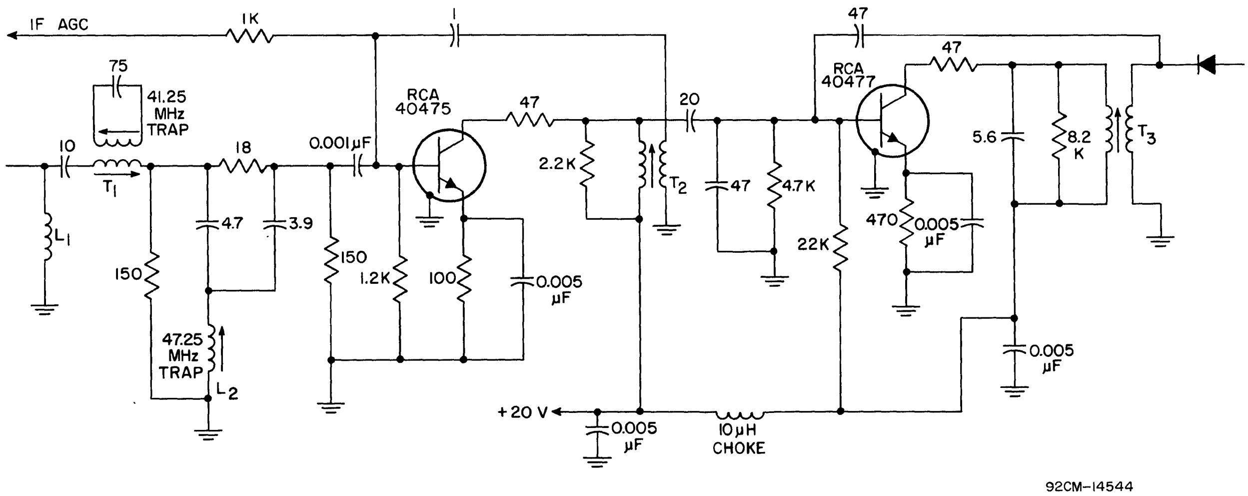
- high gain-bandwidth products (f_T)
  900 MHz typ. (40472-40474)
  800 MHz typ. (40475-40477)
- very low collector-to-base feedback capacitances (C_{cb})
  0.19 pF typ. (40472,40473)
  0.18 pF typ. (40475-40477)
- low noise figure (NF)
  3.3 dB typ. at 200 Mhz (40472)
- high usable gain
  At 200 MHz (40472) neutralized . . . . . . 27 dB typ.
  At 44 MHz (40475-40477) neutralized, 35 dB typ.
  unneutralized, 29 dB typ.
- low collector-cutoff currents (I_{CBO})
  20 nA max. at V_{CB} = 1 V
- operation to 175°C
- hermetically sealed 4-lead metal JEDEC TO-104 package

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

ELECTRICAL CHARACTERISTICS at T_A = 25°C

Characteristics	Symbols	TEST CONDITIONS			LIMITS																		Units
		Frequency f MHz	DC Collector-to-Emitter Voltage V_{CE} Volts	DC Emitter Current I_E mA	RF Amplifier 40472			Mixer 40473			HF Oscillator 40474			IF Amplifier 40475			IF Amplifier 40476			IF Amplifier 40477			
					Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}	- -	(V_{CB}) = 1 (V_{CB}) = 45	0 0	- -	- -	0.02 1	- -	- -	0.02 1	- -	- -	0.02 1	- -	- -	0.02 1	- -	- -	0.02 1	- -	- -	0.02 1	μA
Emitter-Cutoff Current	I_{EBO}	-	V_{EB} = 3	I_C = 0	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	μA
Static Forward Current-Transfer Ratio	h_{FE}	-	6	-1	40	-	170	40	-	275	27	-	275	40	-	170	27	-	100	27	-	275	-
Gain-Bandwidth Product	f_T	100	6	-2	-	900	-	-	900	-	-	900	-	-	800	-	-	800	-	-	800	-	MHz
Collector-to-Base Feedback Capacitance	C_{cb}	200 200 44	10 12 12	-2 -1.5 -3	- - -	0.19 - -	- - -	- - -	- 0.19 -	- - -	- - -	- - -	- - -	- - -	- - 0.18	- - -	- - -	- - 0.18	- - -	- - -	- - 0.18	- - -	pF
Input Resistance	R_{IN}	200 44 44	10 12 12	-2 -1.5 -3	- - -	180 - -	- - -	- - -	- 270 -	- - -	- - -	- - -	- - -	- - -	- - 575	- - -	- - -	- - 575	- - -	- - -	- - 575	- - -	Ω
Output Resistance	R_{OUT}	200 44 44	10 12 12	-2 -1.5 -3	- - -	5.5 - -	- - -	- - -	- 4.6 -	- - -	- - -	- - -	- - -	- - -	- - 25	- - -	- - -	- - 25	- - -	- - -	- - 25	- - -	kΩ
Magnitude of Forward Transadmittance	$\|y_{fe}\|$	200 44	10 12	-2 -3	- -	61 -	- -	- -	- -	- -	- -	- -	- -	- -	- 100	- -	- -	- 100	- -	- -	- 100	- -	mmho
Noise Figure*	NF	200	10	-2	-	3.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	dB
Max. Available Conversion Gain	MAG_C	200 to 44	12	-1.5	-	-	-	-	22.7	-	-	-	-	-	-	-	-	-	-	-	-	-	dB
Max. Available Amplifier Gain	MAG	200 44	10 12	-2 -3	- -	29.6 -	- -	- -	- -	- -	- -	- -	- -	- -	- 45.6	- -	- -	- 45.6	- -	- -	- 45.6	- -	dB
Max. Usable Amplifier Gain (Unneutralized)	MUG	200 44 44 44	10 12 12 12	-2 -3 -3 -3	- - - -	21.8 - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	No. of Stages 1 2 3		- 28.5 26.2 24.8	- - - -	- - - -	- 28.5 26.2 24.8	- - - -	- - - -	- 28.5 26.2 24.8	- - - -	dB
Max. Usable Amplifier Gain (Neutralized)	MUG	200 44 44 44	10 12 12 12	-2 -3 -3 -3	- - - -	26.9 - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	No. of Stages 1 2 3		- 33.5 31.3 29.5	- - - -	- - - -	- 33.5 31.3 29.5	- - - -	- - - -	- 33.5 31.3 29.5	- - - -	dB

* Source Resistance = 90 Ω



Capacitors in pF unless otherwise specified.
Resistors in ohms.

Coil Data

L_1 = 8 Turns No.26 Heavy Formvar,* close-wound on 3/16" dia, air core.

L_2 = 12 Turns No.28 Heavy Formvar,* close-wound on 1/4" dia, (47.25 MHz Trap)

T_1 = Main coil (bottom) - 12 Turns No.28 Heavy Formvar*-close-wound on 1/4" dia.

Trap coil (top) - 4 Turns No.18 Heavy Formvar*-close wound - spaced approx. 7/16" from main coil

T_2 = Primary - 7 Turns No.28 Heavy Formvar* close-wound on 1/4" dia.

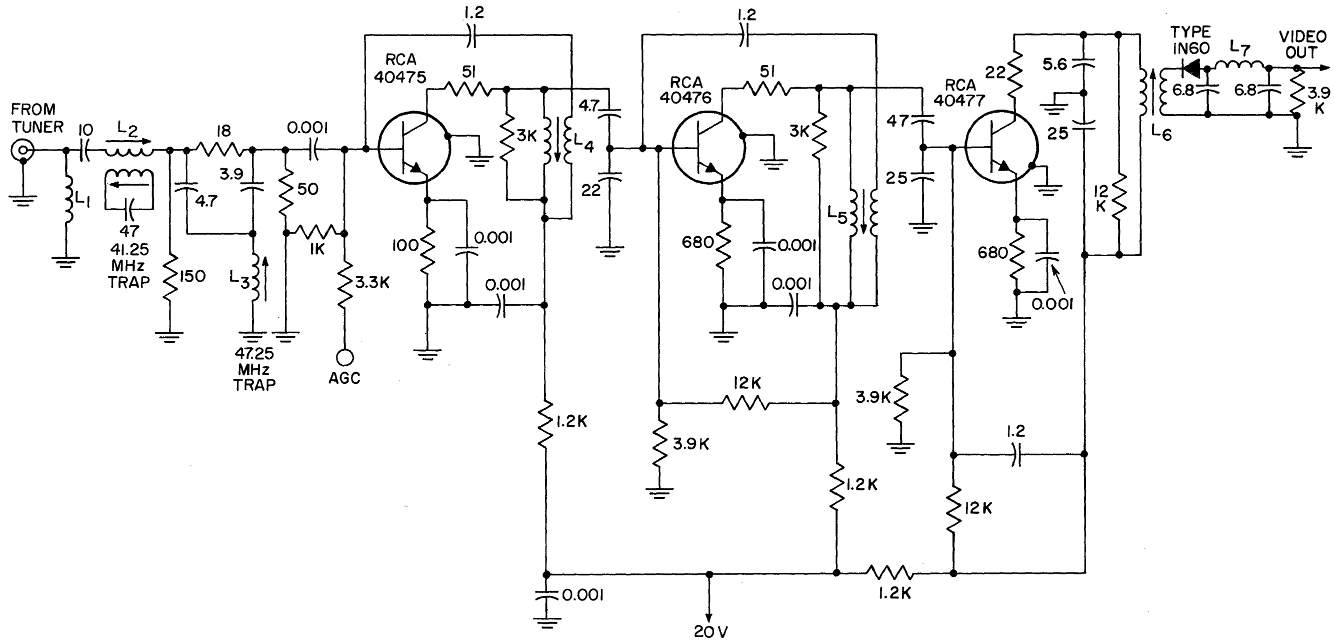
Secondary - 2 Turns No.28 Heavy Formvar* close-wound adjacent to primary

T_3 = Primary - 12 Turns No.28 Heavy Formvar* close-wound on 1/4" dia.

Secondary - 7 Turns No.28 Heavy Formvar* close-wound adjacent to primary

* Trademark, Shawinidan Products Corp.

Fig.1 - Typical 2-Stage IF Strip — Reverse AGC from Hybrid Receiver.



92CM-14545

Design Data for IF Transformers and Traps

L_1 - 9 Turns No.20 close-wound on 3/16" dia., air core

L_2 - Main Coil: 13½ Turns No.20 close wound

Trap Coil: 6 Turns No.20 close wound and spaced for max. attenuation (approx. ½") from main coil

L_3 - Trap, 13½ Turns No.20 close wound

L_4, L_5 - Single-Tuned Transformers:

Primary, 14-2/3 Turns No.20 close wound

Secondary, 3-1/2 Turns No.21 close wound over primary

L_6 - Single-Tuned Transformer:

Primary, 14-2/3 Turns No.20 close wound

Secondary, 8-1/3 Turns No.20 close wound over primary

L_7 - Peaking Coil, 10 μH

Note: All coils (except L_1) are wound of Formvar,* or equivalent, wire on 9/32-inch O.D. forms embossed or tapped to accommodate 1/4 x 28 thread slugs, 0.375-inch long, made of Arnold† Type J, or equivalent, material.

* Trademark, Shawinidan Products Corp.

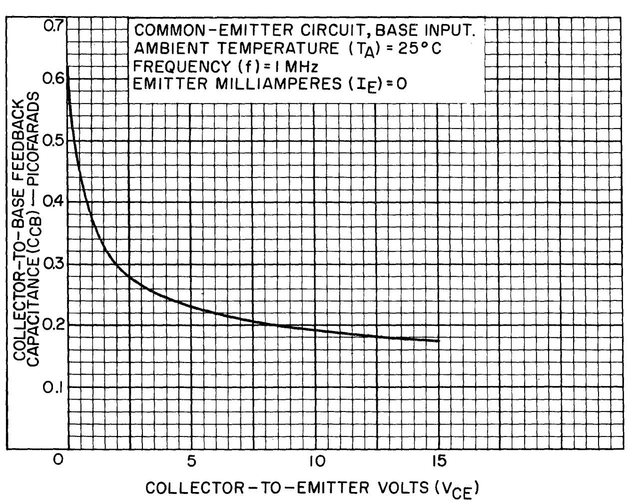
† Arnold Magnetics Corp., Los Angeles, Calif.

Performance Data

IF Gain - 50 Ω Signal Generator at First Base to 1 Volt D.C. at Video Output . . . . 84.5 dB

Bandwidth - At 6 dB points, 3.5 MHz

Fig.2 - Typical 3-Stage 44 MHz Amplifier Circuit.



92CS-14548

Fig.3 - Typical Collector-to-Base Feedback Capacitance Characteristics for RCA Types 40472, 40473, 40474, 40475, 40476, and 40477.

TYPICAL y-PARAMETER CHARACTERISTICS

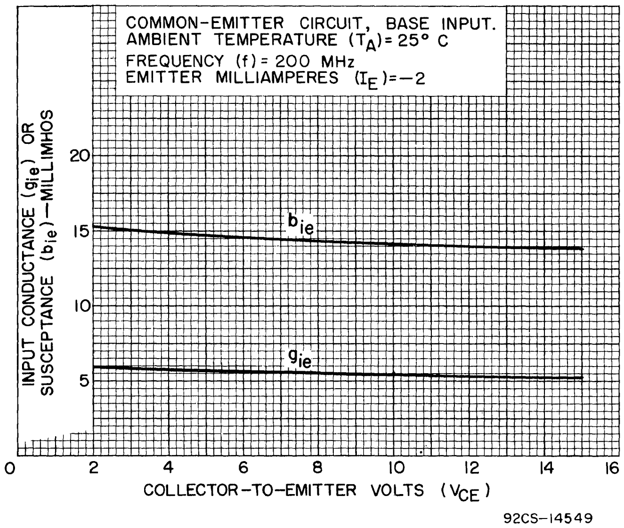


Fig.4 - Input Admittance (y_{ie}) vs. Collector-to-Emitter Volts for RCA Types 40472 and 40473.

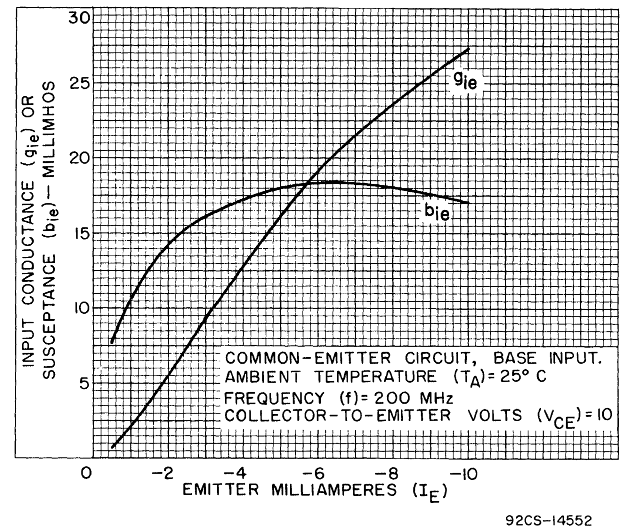


Fig.7 - Input Admittance (y_{ie}) vs. Emitter Current for RCA Types 40472 and 40473.

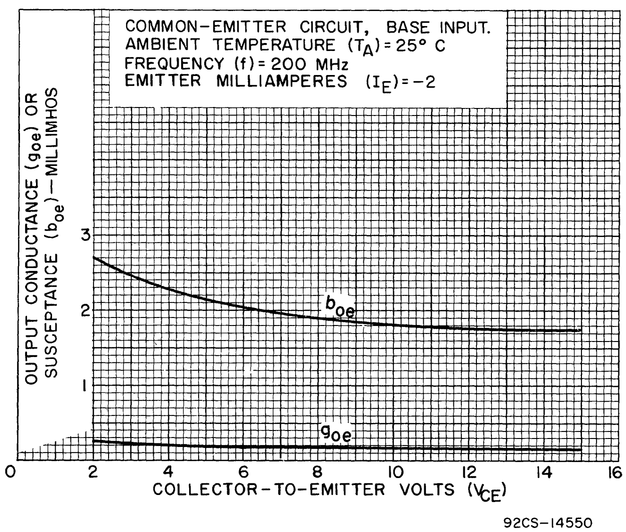


Fig.5 - Output Admittance (y_{oe}) vs. Collector-to-Emitter Volts for RCA Types 40472 and 40473.

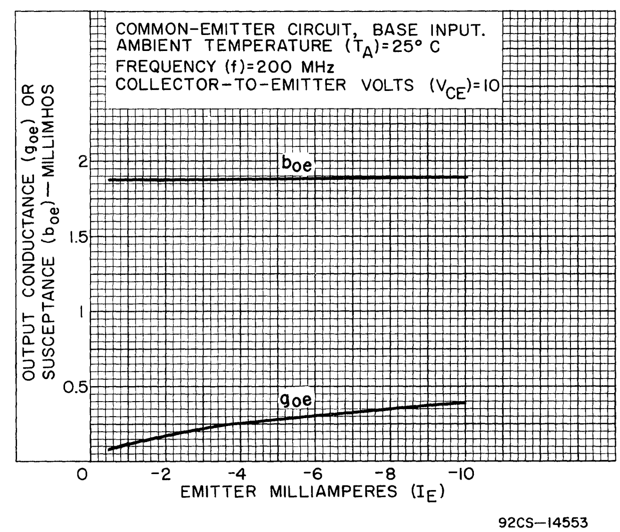


Fig.8 - Output Admittance (y_{oe}) vs. Emitter Current for RCA Types 40472 and 40473.

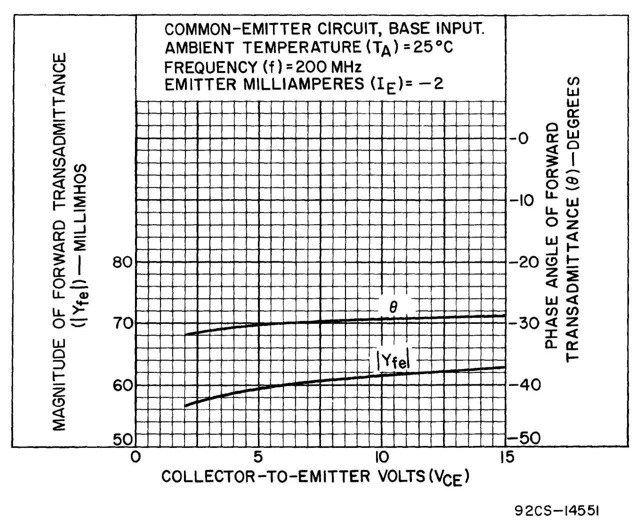


Fig.6 - Forward Transadmittance (y_{fe}) vs. Collector-to-Emitter Volts for RCA Types 40472 and 40473.

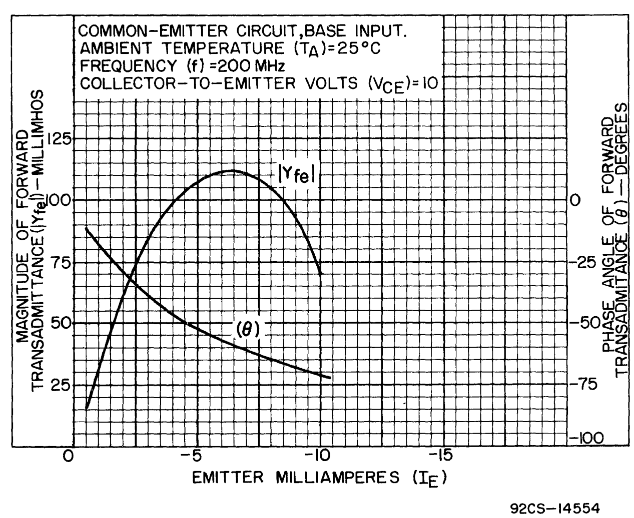


Fig.9 - Forward Transadmittance (y_{fe}) vs. Emitter Current for RCA Types 40472 and 40473.

TYPICAL y-PARAMETER CHARACTERISTICS

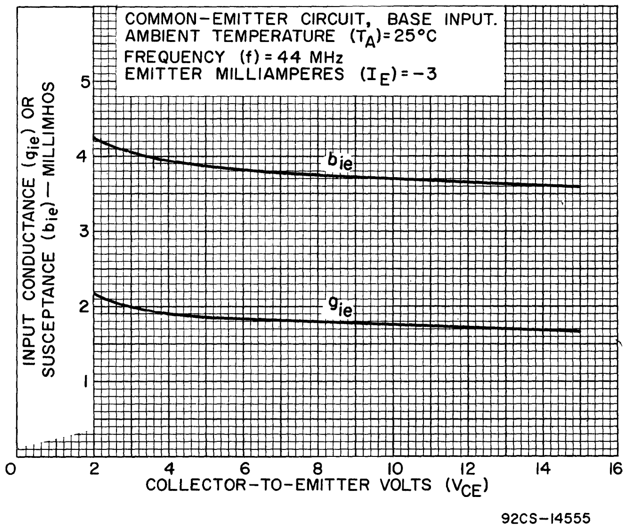


Fig.10 - Input Admittance (y_{ie}) vs. Collector-to-Emitter Volts for RCA Types 40475, 40476, and 40477.

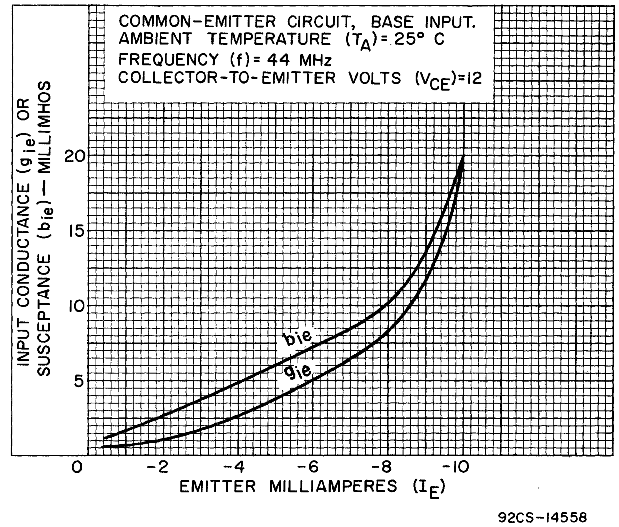


Fig.13 - Input Admittance (y_{ie}) vs. Emitter Current for RCA Types 40475, 40476, and 40477.

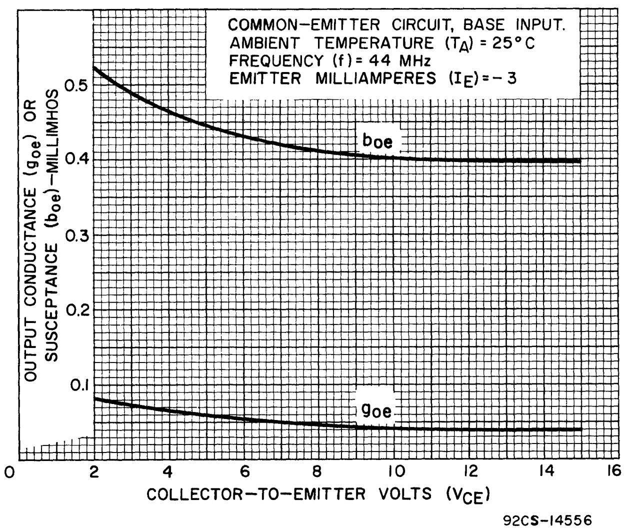


Fig.11 - Output Admittance (y_{oe}) vs. Collector-to-Emitter Volts for RCA Types 40475, 40476, and 40477.

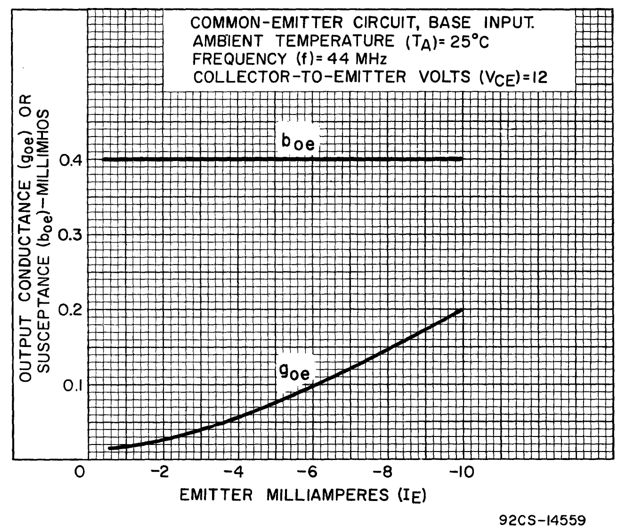


Fig.14 - Output Admittance (y_{oe}) vs. Emitter Current (I_E) for RCA Types 40475, 40476, and 40477.

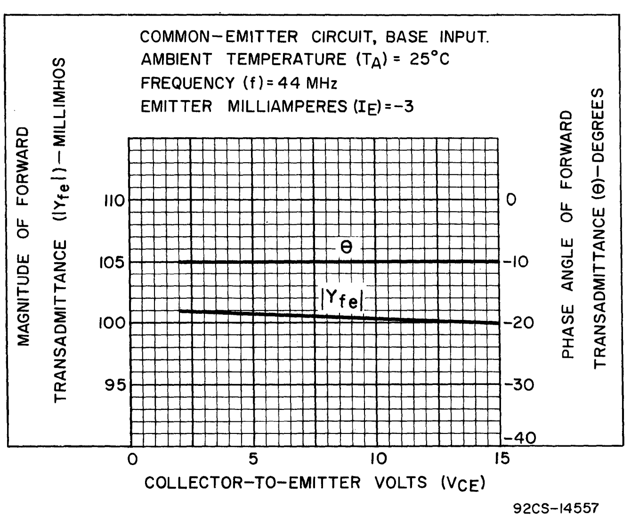


Fig.12 - Forward Transadmittance (y_{fe}) vs. Collector-to-Emitter Volts for RCA Types 40475, 40476, and 40477.

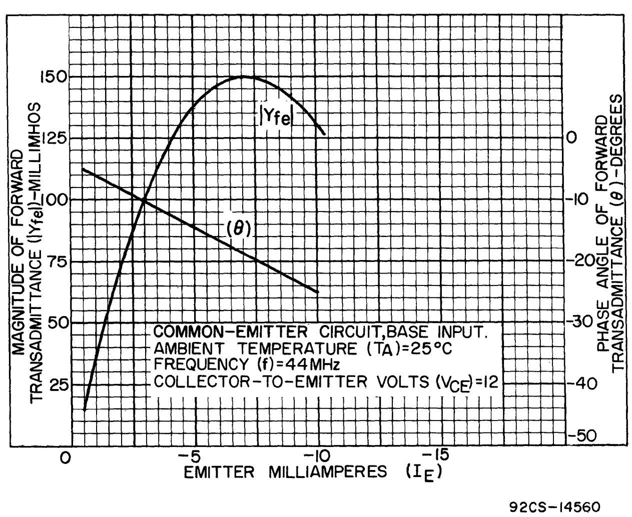


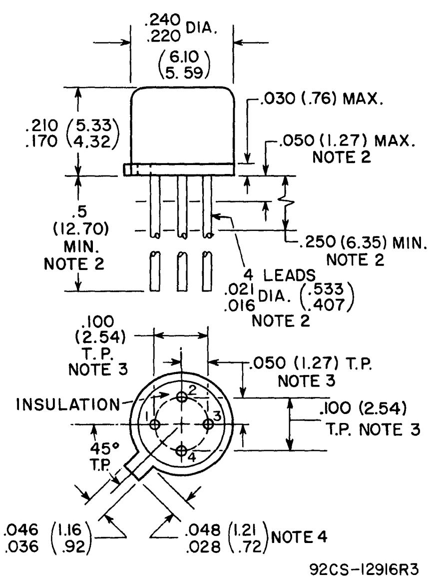
Fig.15 - Forward Transadmittance (y_{fe}) vs. Emitter Current for RCA Types 40475, 40476, and 40477.

OPERATING CONSIDERATIONS

The flexible leads of the 40472, 40473, 40474, 40475, 40476, and 40477 are usually soldered to the circuit elements. As in the case of any high-frequency semiconductor device, the tips of soldering irons should be grounded, and appropriate precautions should be taken to protect the device against high electric fields.

This device should not be connected into or disconnected from circuits with the power on because high transient voltages may cause permanent damage to the device.

DIMENSIONAL OUTLINE
TO-104



Dimensions in Inches

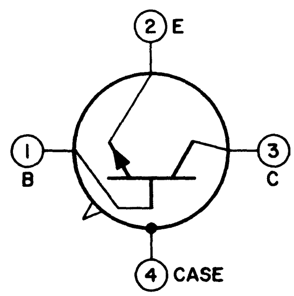
Note 1: *Dimensions in paranthesis are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.019" (0.482 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.117 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

ATTENTION!
NEW TERMINAL ARRANGEMENT



1 - Base
2 - Emitter
3 - Collector
4 - Case

40472, 40473, 40474, 40475, 40476, 40477

"Stars and Stripes" HF TRANSISTORS

For Television Applications

"Stars and Stripes" RF TRANSISTORS

HF Types For FM & AM/FM Receivers

40478 40479 40480 40481 40482

RCA-40478, 40479, 40480, 40481, and 40482* are silicon npn transistors specifically designed for use in "front-end" and if-amplifier stages of FM and AM/FM receivers operating at frequencies up to approximately 110 MHz.

40478 rf amplifier
40479 mixer
40480 hf oscillator
40481, 40482 } if amplifiers

These devices feature very low feedback capacitances, low noise, and high useful power gains in their recommended applications, as well as the high-temperature capability of silicon.

These transistors feature a New Terminal Arrangement in which the emitter and base connections are interchanged to provide maximum isolation between the output (collector) and the input (base) terminals. Although this new basing configuration does not appreciably change the measured device feedback capacitance, it permits the use of external inter-terminal shields to reduce feedback due to external capacitances, particularly on printed circuit boards. This feature makes it possible to achieve greater circuit stability or higher usable gain per stage in critical circuit designs.

These devices utilize a hermetically sealed metal JEDEC TO-104 package which is electrically isolated from the transistor electrodes. The case is provided with a separate lead which may be grounded to minimize collector-to-base interlead capacitance and coupling to other circuit components.

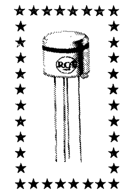
* Formerly Developmental Types TA2849, TA2850, TA2851, TA2853 and TA2854, respectively.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	45 max.	V
COLLECTOR-TO-BASE VOLTAGE, V_{CBV} (V_{EB} = -1 V)	45 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	3 max.	V
COLLECTOR CURRENT, I_C	50 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 25° C	180 max.	mW
At ambient temperatures above 25° C	derate at 1.2	mW/°C
TEMPERATURE RANGE:		
Storage and operating	-65 to +175	°C
LEAD TEMPERATURE (During soldering): At distances not closer than 1/32 inch to seating surface for 10 sec. max.	255 max.	°C

SILICON NPN TRANSISTORS

For FM & AM/FM Receivers

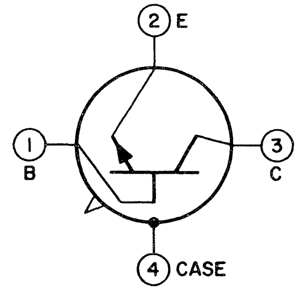


JEDEC TO-104

FEATURES

- New Terminal Arrangement — permits use of shielding between input and output terminals for superior high-frequency performance

1 - Base
2 - Emitter
3 - Collector
4 - Case



- **Low Collector-to-Base Feedback Capacitance (C_{cb}) — 0.2 pF (typ)**
- **Low device Noise Figure (NF) (40478) — 2.5 dB (typ)**
- **High Usable Power Gain**
  40478 at 100 MHz 20 dB typ (unneutralized)
  25 dB typ (neutralized
  40481, 40482 at 10.7 MHz 28 dB typ (unneutralized)
  33 dB typ (neutralized)
- **High Operating Temperature Capability — to 175° C**
- **Hermetically sealed in 4-lead metal JEDEC TO-104 package**

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.
Trademark(s) ® Registered
Marca(s) Registrada(s)
Printed in U.S.A.
40478 - 40482 2-67

ELECTRICAL CHARACTERISTICS at $T_A = 25° C$

Characteristics	Symbols	TEST CONDITIONS: Frequency f MHz	DC Collector-to Emitter Voltage V_{CE} Volts	DC Emitter Current I_E mA	LIMITS: RF Ampl. 40478 Min.	Typ.	Max.	Mixer 40479 Min.	Typ.	Max.	HF Osc. 40480 Min.	Typ.	Max.	IF Ampl 40481 Min.	Typ.	Max.	IF Ampl. 40482 Min.	Typ.	Max.	Units
Collector-Cutoff Current	I_{CBO}		1	0	-	–	0.02	-	-	0.02	-	-	0.02	-	-	0.02	-	-	0.02	μA
Emitter-Cutoff Current	I_{EBO}		3.0		-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	μA
Collector-to-Base Breakdown Voltage	BV_{CBO}			I_C = 0.001	45	-	-	45	-	-	45	-	-	45	-	-	45	-	-	V
Collector-to-Base Breakdown Voltage	BV_{CBV}		V_{EB}=-1		45	-	-	45	-	-	45	-	-	45	-	-	45	-	-	V
Collector-to-Emitter Breakdown Voltage	BV_{CEO}			-0.5	45	-	-	45	-	-	45	-	-	45	-	-	45	-	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}			-0.001	3.0	-	-	3.0	-	-	3.0	-	-	3.0	-	-	3.0	-	-	V
Static Forward Current-Transfer Ratio	h_{FE}	-	6	-1	40	-	170	40	-	170	27	-	275	70	-	275	27	-	90	-
Gain-Bandwidth Product	f_T	10.7 100	7.5 7.5	-2 -1.5	- -	- 800	- -	- -	- 800	- -	- -	- 800	- -	- -	860 -	- -	- -	860 -	- -	MHz
Collector-to-Base Feedback Capacitance	C_{cb}	10.7 100	7.5 7.5	-2 -1.5	- -	- 0.2	- -	- -	- 0.2	- -	- -	- 0.2	- -	- -	0.2 -	- -	- -	0.2 -	- -	pF pF
Input Capacitance	C_{IN}	10.7 100	7.5 7.5	-2 -1.5	- -	- 8.5	- -	- -	- 8.5	- -	- -	- -	- -	- -	11 -	- -	- -	11 -	- -	pF pF
Output Capacitance	C_{OUT}	10.7 100	7.5 7.5	-2 -1.5	- -	- 1.4	- -	- -	- 1.4	- -	- -	- -	- -	- -	1.35 -	- -	- -	1.35 -	- -	pF pF
Input Resistance	R_{IN}	10.7 100	7.5 7.5	-2 -1.5	- -	- 550	- -	- -	- 550	- -	- -	- -	- -	- -	1500 -	- -	- -	1300 -	- -	Ω Ω
Output Resistance	R_{OUT}	10.7 100	7.5 7.5	-2 -1.5	- -	- 24	- -	- -	- 24	- -	- -	- -	- -	- -	85 -	- -	- -	100 -	- -	kΩ kΩ
Forward Transadmittance	$\|y_{fe}\|$	10.7 100	7.5 7.5	-2 -1.5	- -	- 38	- -	- -	- -	- -	- -	- -	- -	- -	64 -	- -	- -	64 -	- -	mmho mmho
Noise Figure	NF	100	7.5	-1.5	-	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	dB
Max. Available Gain	MAG	10.7 100	7.5 7.5	-2 -1.5	- -	- 37	- -	- -	- 35*	- -	- -	- -	- -	- -	51 -	- -	- -	51 -	- -	dB dB
Max. Usable Gain Unneutralized	MUG	100	7.5	-1.5	-	20	-	-	-	-	-	No. of Stages			-	-	-	-	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	1			32	-	-	32	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	2			28	-	-	28	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	3			27.5	-	-	27.5	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	4			26	-	-	26	-	dB
Max. Usable Gain Neutralized	MUG	100	7.5	-1.5	-	25	-	-	-	-	-	No. of Stages			-	-	-	-	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	1			37	-	-	37	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	2			35	-	-	35	-	dB
		10.7	7.5	-2	-	-	-	-	-	-	-	3			33	-	-	33	-	dB
		10.7	7.5	-2	–	-	-	-	-	-	-	4			32	-	-	32	-	dB

* Maximum available conversion gain.

TYPICAL FORWARD TRANSADMITTANCE CHARACTERISTICS AT 10.7 MHz FOR RCA TYPES 40481 AND 40482

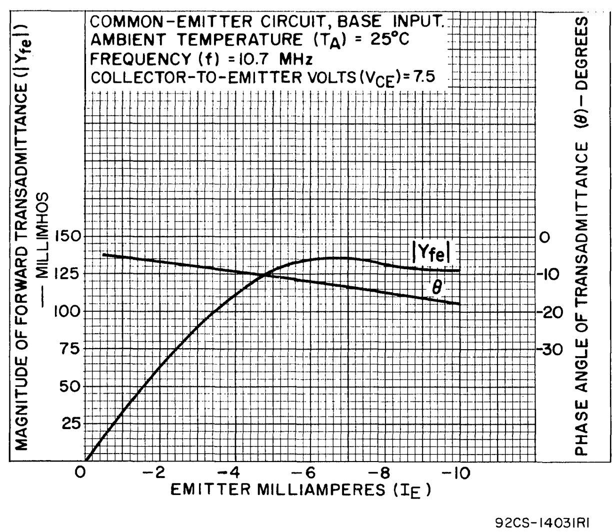


Fig.5

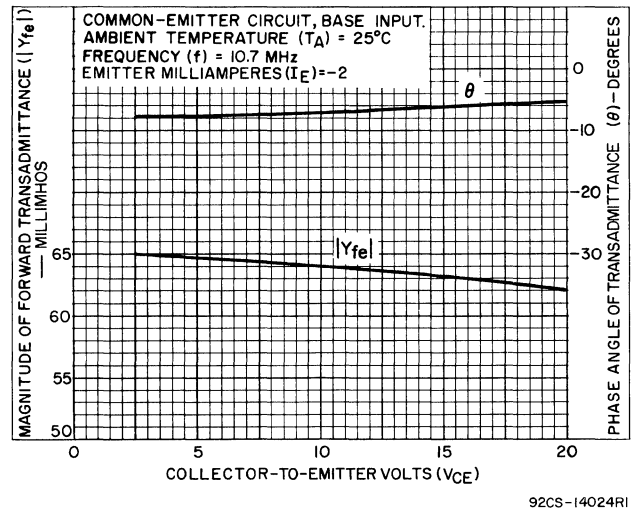


Fig.6

TYPICAL INPUT CHARACTERISTICS AT 100 MHz FOR RCA TYPES 40478 AND 40479

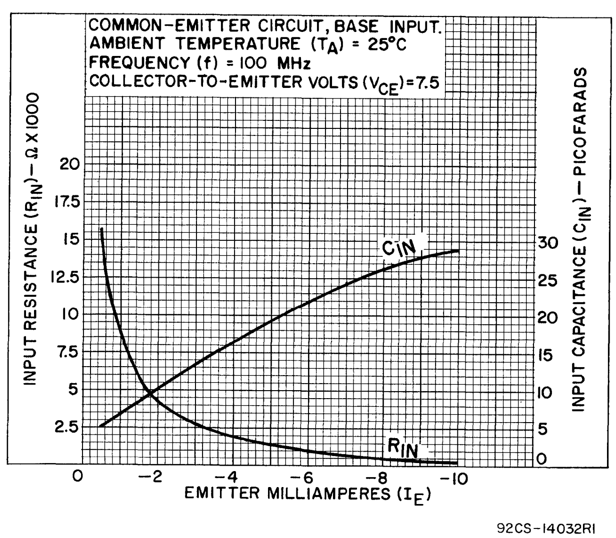


Fig.7

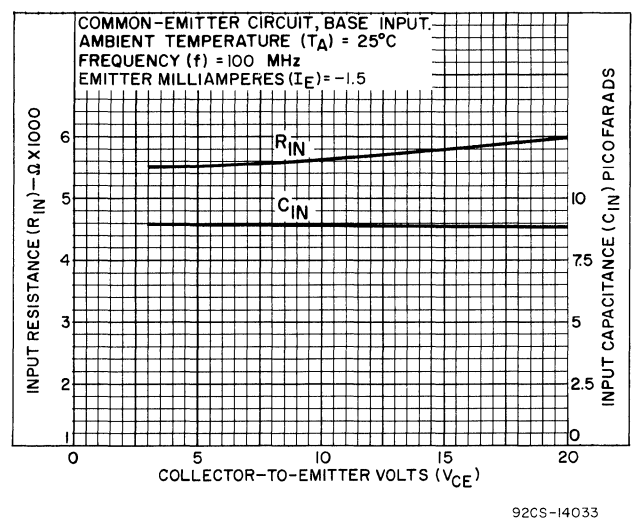


Fig.8

TYPICAL OUTPUT CHARACTERISTICS AT 100 MHz FOR RCA TYPES 40478 AND 40479

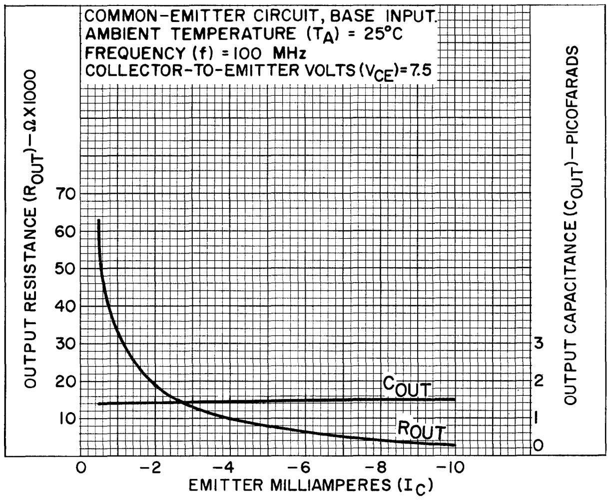


Fig.9

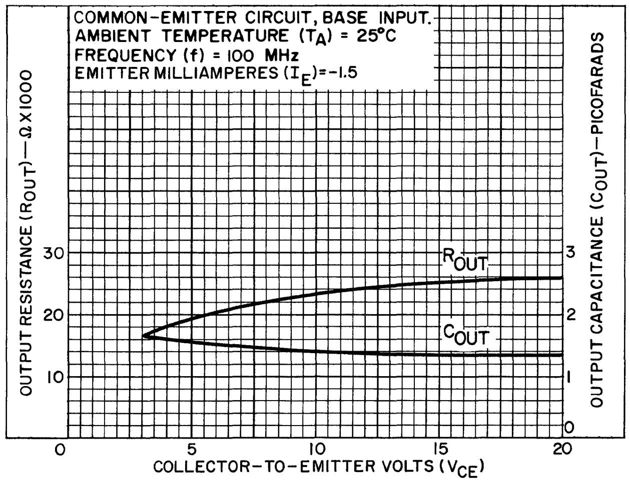


Fig. 10

TYPICAL FORWARD TRANSADMITTANCE CHARACTERISTICS AT 100 MHz FOR RCA TYPE 40478

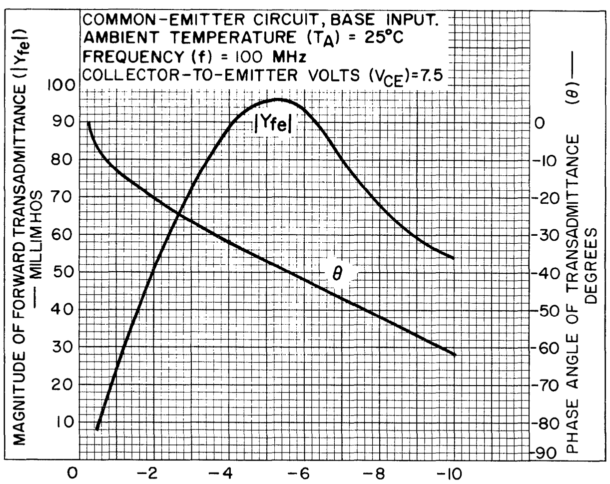


Fig. 11

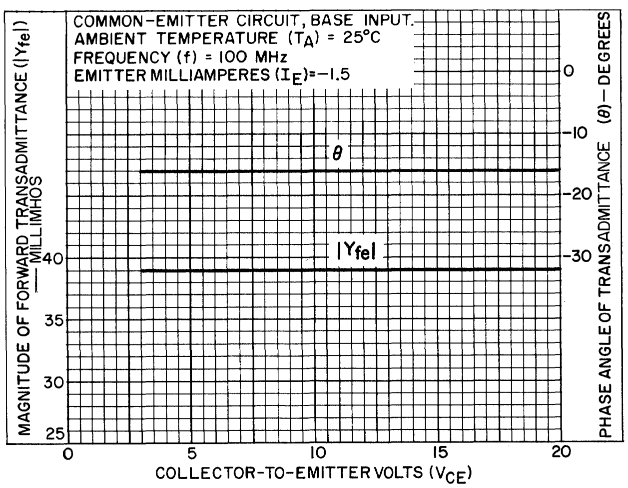


Fig. 12

TYPICAL INPUT CHARACTERISTICS AT 10.7 MHz FOR RCA TYPES 40481 AND 40482

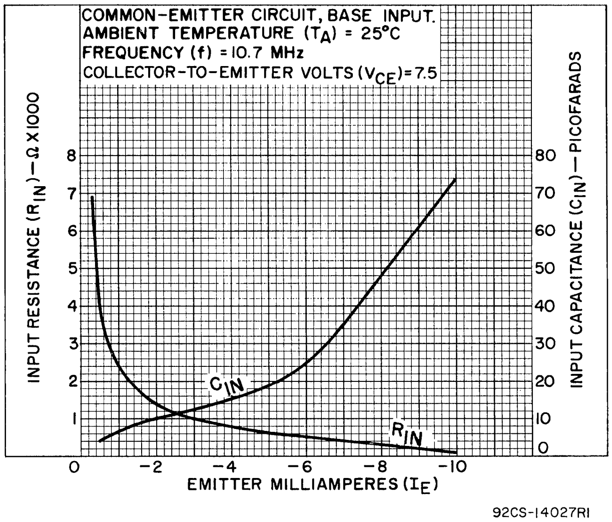


Fig. 1

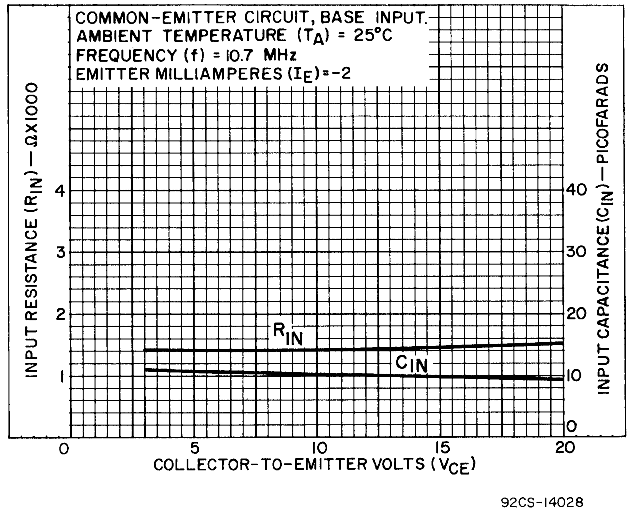


Fig. 2

TYPICAL OUTPUT CHARACTERISTICS AT 10.7 MHz FOR RCA TYPES 40481 AND 40482

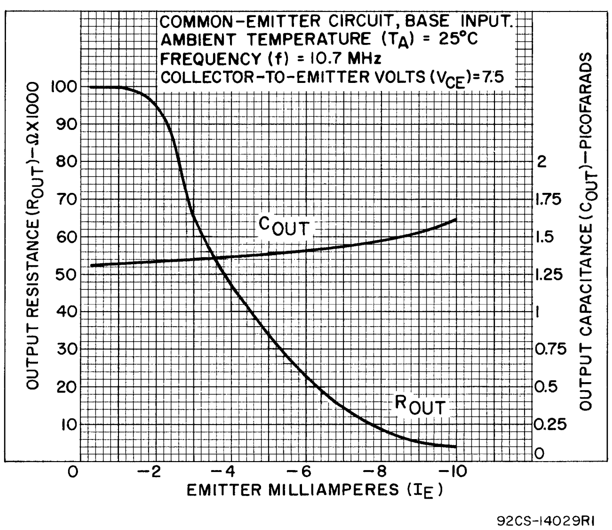


Fig. 3

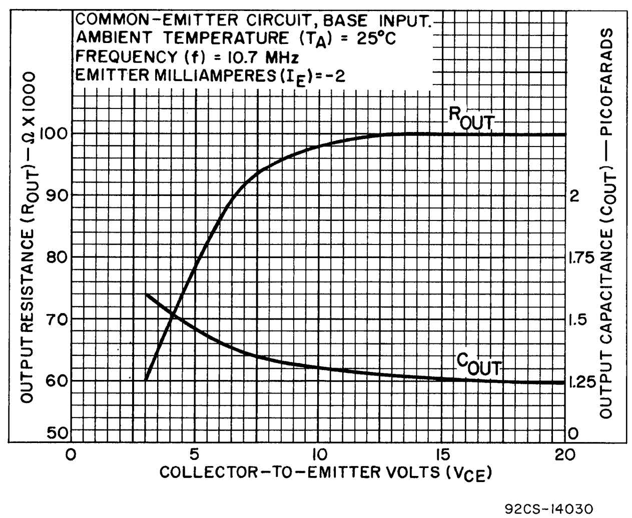


Fig. 4

TYPICAL |h_{fe}| CHARACTERISTICS AT 100 MHz FOR RCA TYPES 40478 AND 40479

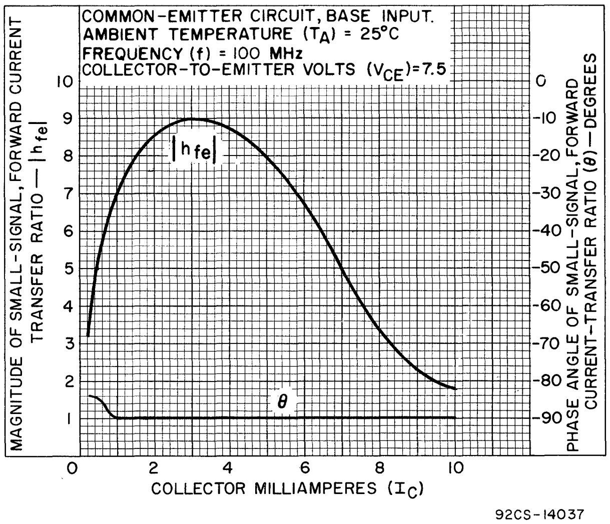


Fig. 13

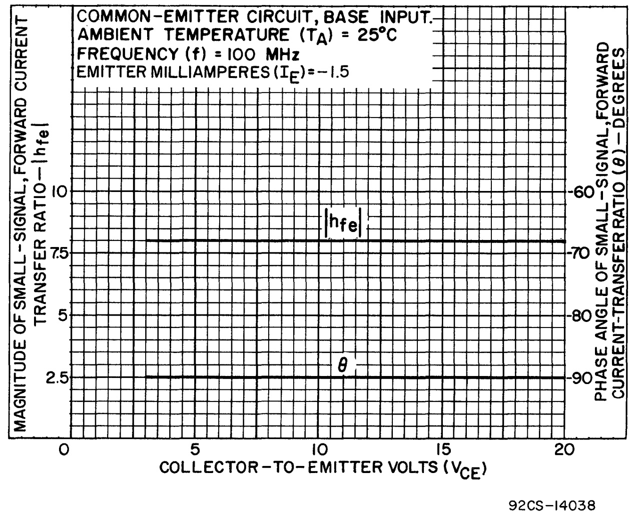
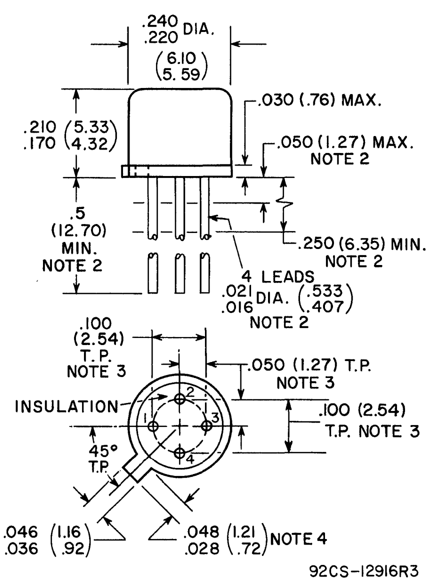


Fig. 14

DIMENSIONAL OUTLINE



Dimensions in Inches

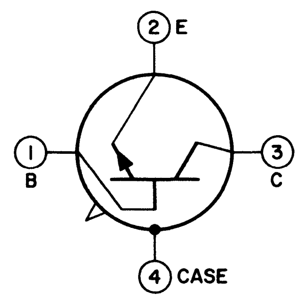
Note 1: *Dimensions in paranthesis are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35mm) from the seating plane. From 0.250"(6.35 mm) to the end of the lead a maximum diameter of 0.019" (0.482 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019"(0.482 mm) at a gauging plane of 0.054" (1.372 mm) +0.001" (0.025 mm) -0.000" (0.000 mm) below seating plane shall be within 0.007" (0.117mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM



1 - Base
2 - Emitter
3 - Collector
4 - Case

RCA TRIACS

40485
40486

GATED BIDIRECTIONAL SILICON THYRISTORS FOR AC LOAD CONTROL

RCA Triac types 40485* and 40486* are gate-controlled full-wave ac silicon switches designed to switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

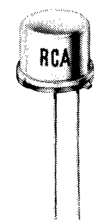
They are intended primarily for the phase control of ac loads in applications such as light dimming, universal and induction motor control, and heater control.

The 40485 and 40486 are hermetically sealed in all-welded tin-plated modified TO-5 packages. The small size of this package makes these devices especially suitable for use in equipment where space restrictions are of prime importance. In addition, because they are tin-plated, they can be soldered directly to a heat sink, thereby allowing the use of mass-produced pre-punched parts, and batch soldering techniques to eliminate many of the difficulties associated with mechanical mounting and heat sinking. Suggested mounting methods are described on page 6.

The 40485 is intended for applications requiring a repetitive peak off-state voltage of up to 200 volts and an RMS on-state current capability of 6 amperes at a case temperature of +75° C.

The 40486 is intended for applications requiring a repetitive peak off-state voltage of up to 400 volts and an RMS on-state current capability of 6 amperes at a case temperature of +75° C.

*Formerly Dev. Types TA2918 and TA2919, respectively.

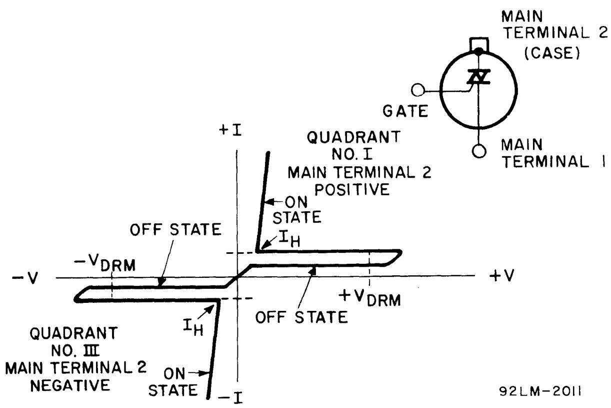


H-1380

Modified TO-5 Package

40485	For 120-Volt Line Operation
40486	For 240-Volt Line Operation

PRINCIPAL VOLTAGE-CURRENT CHARACTERISTIC



Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

FEATURES

- **Excellent gate sensitivity – reduces cost of triggering components**
- **Shorted-emitter design**
- **All-diffused-construction – assures exceptional uniformity and stability**
- **Direct soldered internal construction – assures exceptional resistance to fatigue**

40485
- **Controls 720 Watts at 120 V, 60 Hz**

40486
- **Controls 1440 Watts at 240 V, 60 Hz**

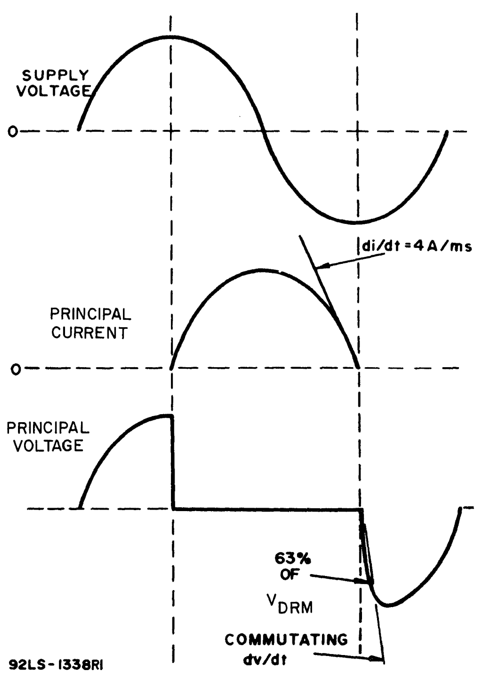
Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at a Frequency between 50 and 400 Hz, and with Resistive or Inductive Load

For Definitions of Terms and Symbols, See Page 8.

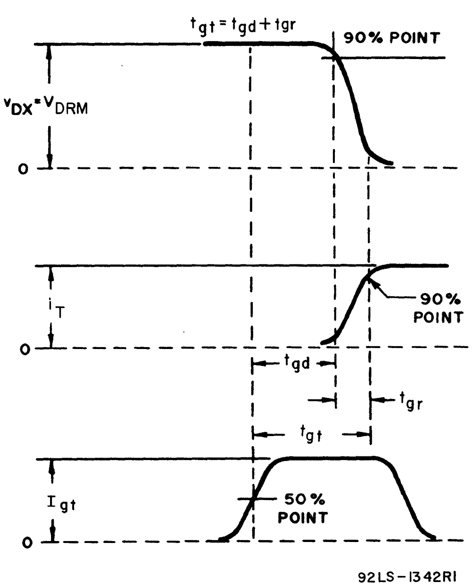
RATINGS	TRIAC TYPES		UNITS
	40485	40486	
Repetitive Peak Off-State Voltage♦, V_{DRM}:			
Gate open			
For $T_j = -40^o$ C to $+100^o$ C	200	400	volts
RMS On-State Current, I_T (rms):			
For case temperature (T_C) of $+75^o$ C and a conduction angle of 360^o	6	6	amperes
Surge (Non-Repetitive) On-State Current, I_{TSM}:			
For one full cycle of applied sinusoidal principal voltage	100	100	amperes
For more than one full cycle of applied voltage	See *Fig.3*	See *Fig.3*	
Peak Gate-Trigger Current■, I_{GTM}:			
For 2 μs max.	1	1	ampere
Gate Power:			
Peak■, P_{GM}			
For 2 μs max. and $I_{GTM} \leq 1$ A (peak)	20	20	watts
Average, P_{GAV}	0.2	0.2	watt
Temperature●*:			
Storage, T_{stg}	–40 to +150	–40 to +150	^oC
Operating (case), T_C	–40 to +100	–40 to +100	^oC

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.
■For either polarity of gate voltage (V_G) with reference to main terminal 1.
●For information on the reference point of temperature measurement, see *Dimensional Outline*.
*When these devices are soldered directly to the heat sink, a 60-40 solder should be used. Exposure time should only be sufficient to cause the solder to flow freely.

WAVESHAPES OF COMMUTATING dv/dt CHARACTERISTICS



WAVESHAPES OF t_{gt} CHARACTERISTICS TEST



Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C).

For Definitions of Terms and Symbols, See Page 8.

CHARACTERISTICS	TRIAC TYPES						UNITS
	40485			40486			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current♦, I_{DM}: Gate open							
At T_j = +100° C and V_{DRM} = Max. rated value .	–	0.1	2	–	0.2	4	mA
On-State Voltage♦, V_T:							
For i_T = 30 A (peak) and T_C = +25° C	–	1.6	2.25	–	1.6	2.25	V(peak)
DC Holding Current♦, I_H: Initial principal current = 150 mA (dc)							
At T_C = +25° C	–	10	30	–	10	30	mA(dc)
For other case temperatures		See *Fig.5*			See *Fig.5*		
Critical Rate of Applied Commutating Voltage♦, Commutating dv/dt: For v_{DX} = V_{DRM}, I_T(rms) = 6 A, commutating di/dt = 4 A/ms, and gate open							
At T_C = +75° C	–	5	–	–	5	–	volts/μs
At T_C = +50° C	–	8	–	–	8	–	volts/μs
Critical Rate of Rise of Off-State Voltage♦, dv/dt: For v_{DX} = V_{DRM}, exponential voltage rise, gate open							
At T_C = +100° C	–	30	–	–	20	–	volts/μs
DC Gate-Trigger Current♦■, I_{GT}: For v_{DX} = 6 volts (dc), R_L = 12 ohms, T_C =+25° C, and Specified Triggering Mode:							
I^+ Mode: V_{T2} is positive, V_G is positive	–	10	25	–	10	25	mA(dc)
I^- Mode: V_{T2} is positive, V_G is negative.	–	20	25	–	20	25	mA(dc)
III^+ Mode: V_{T2} is negative, V_G is positive . . .	–	20	25	–	20	25	mA(dc)
III^- Mode: V_{T2} is negative, V_G is negative . . .	–	10	25	–	10	25	mA(dc)
For other case temperatures		See *Fig.8*			See *Fig.8*		
DC Gate-Trigger Voltage♦■, V_{GT}: For v_{DX} = 6 volts (dc) and R_L = 12 ohms							
At T_C = +25° C	–	1	2.2	–	1	2.2	volts
For other case temperatures		See *Fig.9*			See *Fig.9*		
For v_{DX} = V_{DRM} and R_L = 125 ohms							
At T_C = +100° C	0.2	–	–	0.2	–	–	volt
Gate-Controlled Turn-On Time, t_{gt} (Delay Time + Rise Time) For v_{DX} = V_{DRM}, I_{GT} = 80 mA, 0.1 μs rise time, and i_T = 10 A (peak)							
At T_C = +25° C	–	2.2	–	–	2.2	–	μs

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

CONDUCTION RATING CHART
(CASE TEMPERATURE)

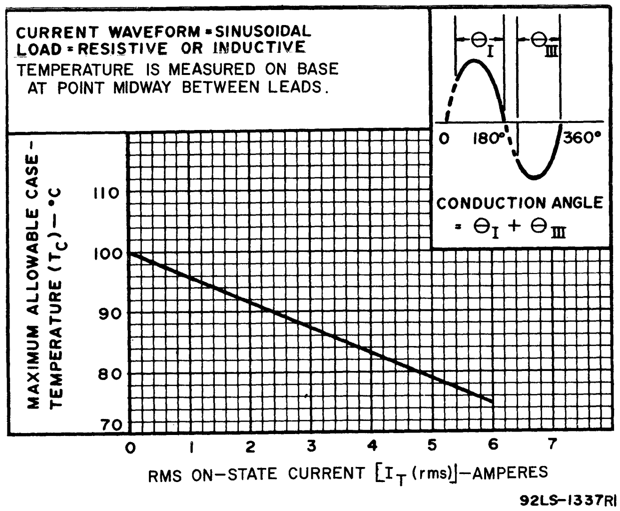


Fig. 1

POWER DISSIPATION CURVE

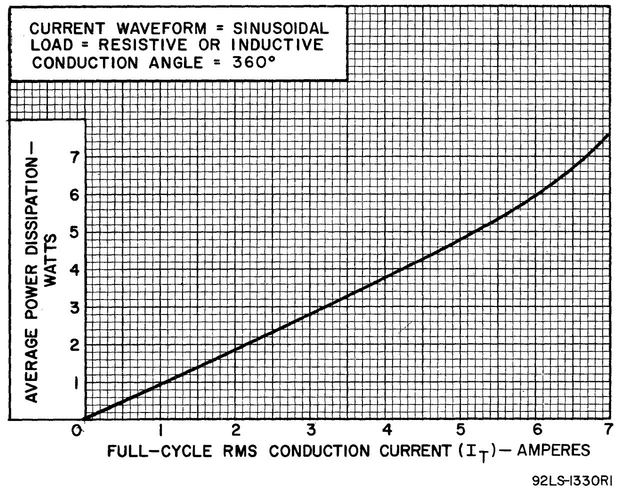


Fig. 2

SURGE CURRENT RATING CHART

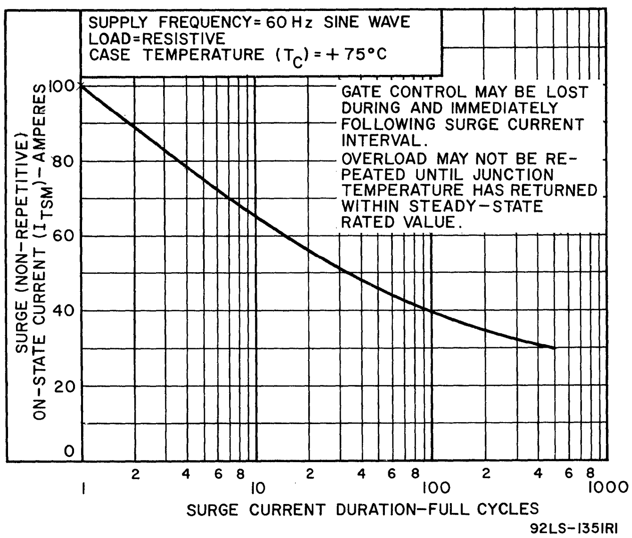


Fig. 3

ON-STATE CHARACTERISTICS FOR
EITHER DIRECTION OF PRINCIPAL CURRENT

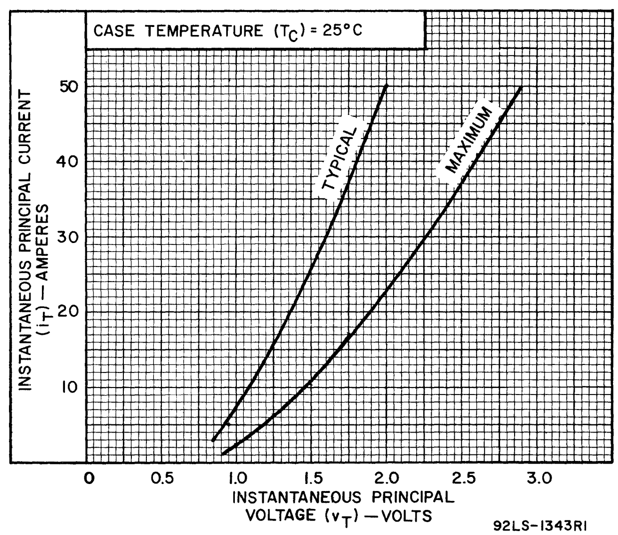


Fig. 4

DC HOLDING CURRENT CHARACTERISTICS FOR
EITHER DIRECTION OF PRINCIPAL CURRENT

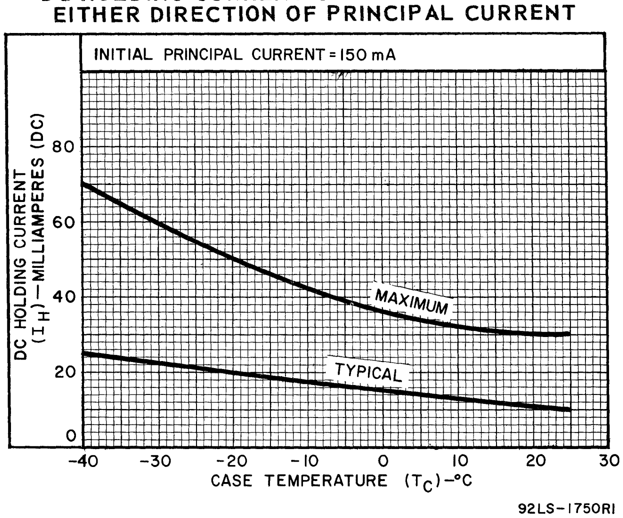


Fig. 5

TYPICAL TURN-ON TIME CHARACTERISTIC

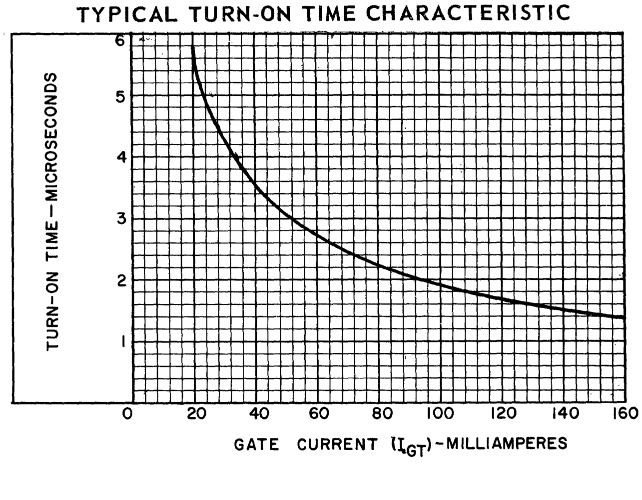


Fig. 6

GATE CHARACTERISTICS

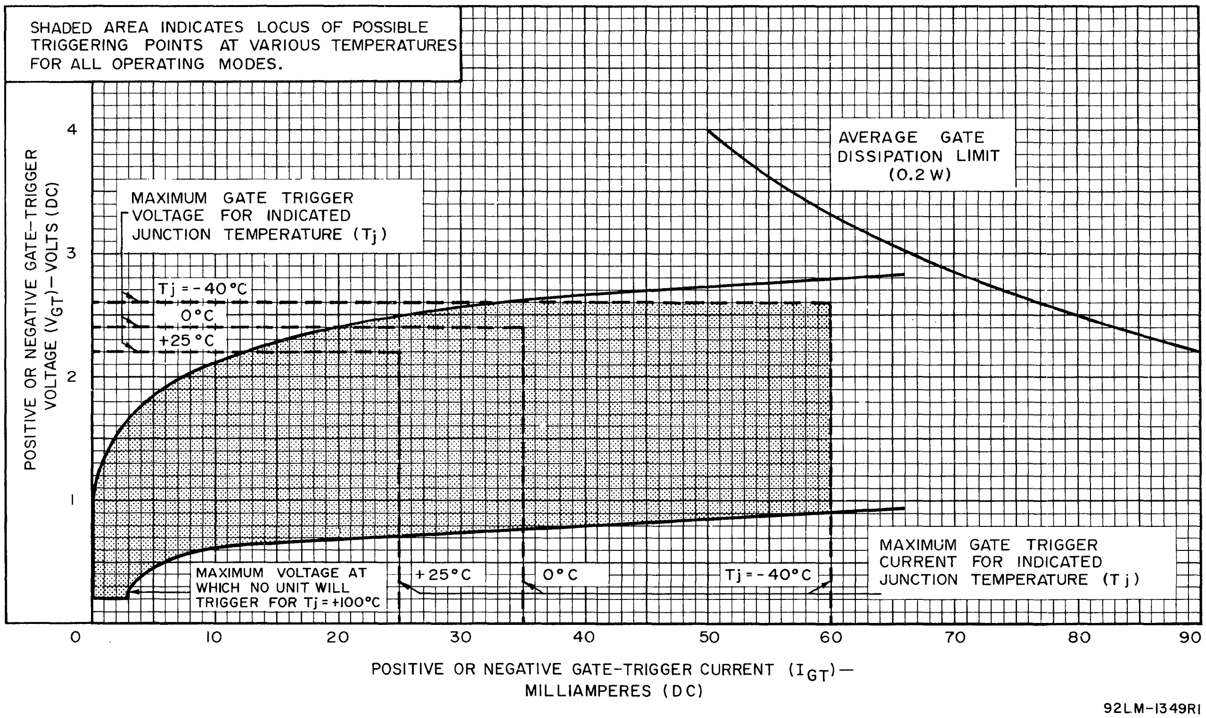


Fig. 7

DC GATE-TRIGGER CURRENT CHARACTERISTICS

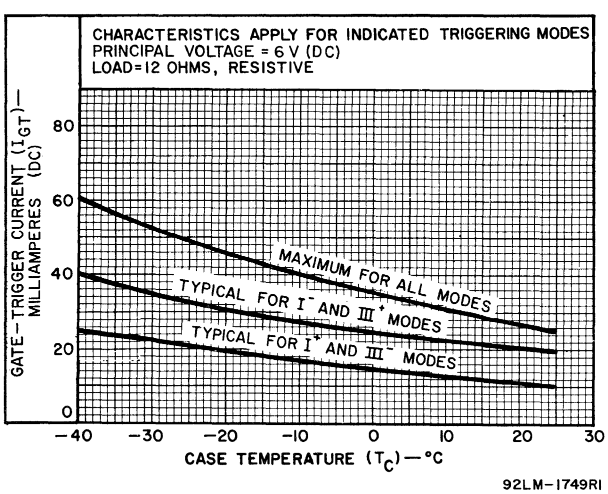


Fig. 8

DC GATE-TRIGGER VOLTAGE CHARACTERISTICS

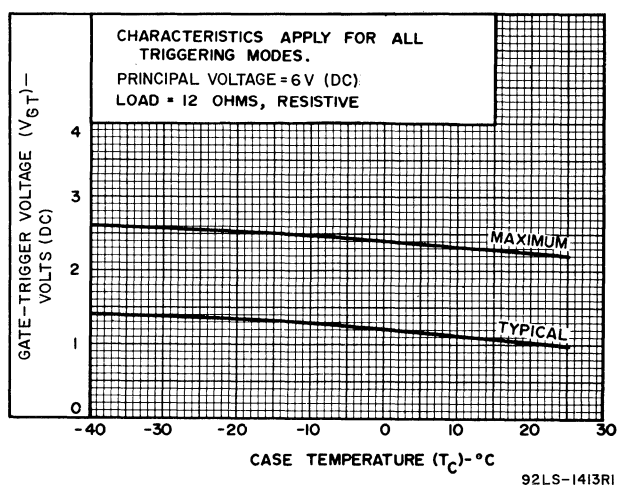


Fig. 9

MOUNTING AND HEAT SINKING SYSTEMS

Consideration must be given to heat sinking the thyristor when the device is operated at or near its maximum rated current. The most effective method of providing good thermal conductance is to solder the thyristor directly to the heat sink. When direct soldering is impractical, other methods of providing heat transfer can be employed.

Heat spreaders, designed specifically for RCA thyristors using the modified TO-5 package, are available from RCA (RCA Part No.NR166B) and from the General Stamping Co.* (Part No.14-110), or equivalent. The thyristor is inserted in this heat spreader, as shown in *Fig.10A*, the mounting tab is heated with a soldering iron, and a 60-40 solder is applied to the thyristor base. The thyristor case temperature should not exceed 225° C during soldering. Because both the thyristor package and the heat spreader are tin-plated, a good solder bond is easily achieved.

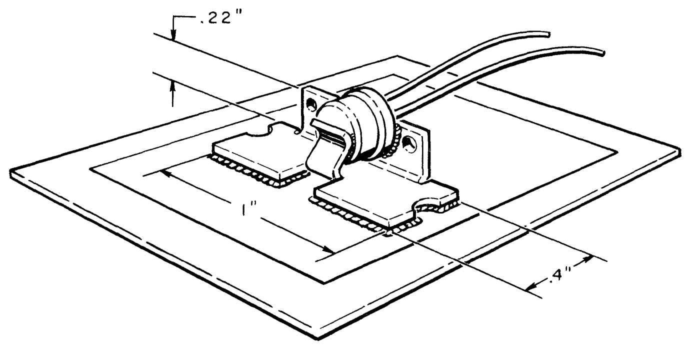


Fig. 10A

For rapid solder control assemblies, a solder preform♦, such as that shown in *Fig.10B* is placed in the heat spreader prior to inserting the thyristor. The assembly can then be placed on a hot plate, or in an oven, operating at a temperature of 225° C ± 10° C. This temperature should be applied to the assembly only long enough to allow the solder to flow freely.

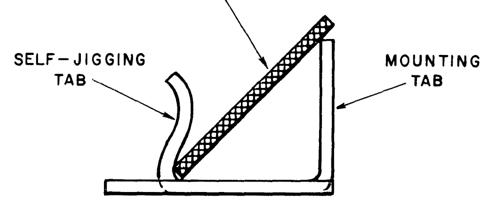


Fig. 10B

This heat spreader is easily adapted to mechanical mounting because of indentations provided in the spreader that assist in the final mechanical assembly. The distinct advantage offered by the wide base of this heat spreader is utilized in systems requiring electrical isolation. In such systems, Scotch♠ Brand Electrical Tape No.27 can be attached to the chassis and the heat spreader "epoxyed■" to the tape. An electrical isolation system is shown in *Fig.10A*.

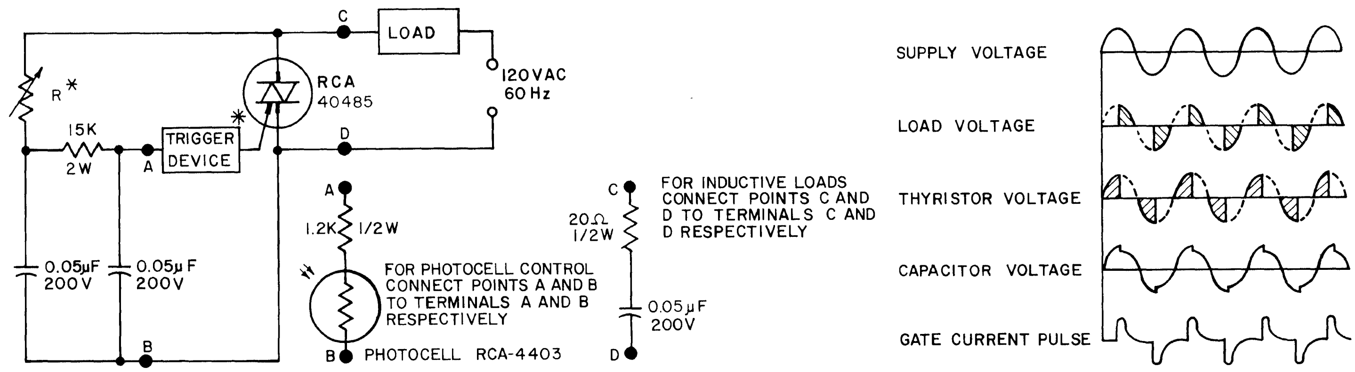
*General Stamping Co., Inc., Denville, N.J. 07834

♦Available from RCA as Part No.NR184A or from Kester Solder Co., Newark, N.J. 07105, as Part No.KSFD-375005, or equivalent.

♠Made by Minnesota Mining & Mfg. Co., St. Paul, Minnesota

■An epoxy such as Hysol-Epoxy Patch Kit 6C, or equivalent, is recommended. This epoxy is made by Hysol Corporation, Olean, N.Y. 14761

TYPICAL PHASE-CONTROL CIRCUIT FOR LAMP DIMMING, HEAT CONTROLS, AND UNIVERSAL MOTOR SPEED CONTROLS

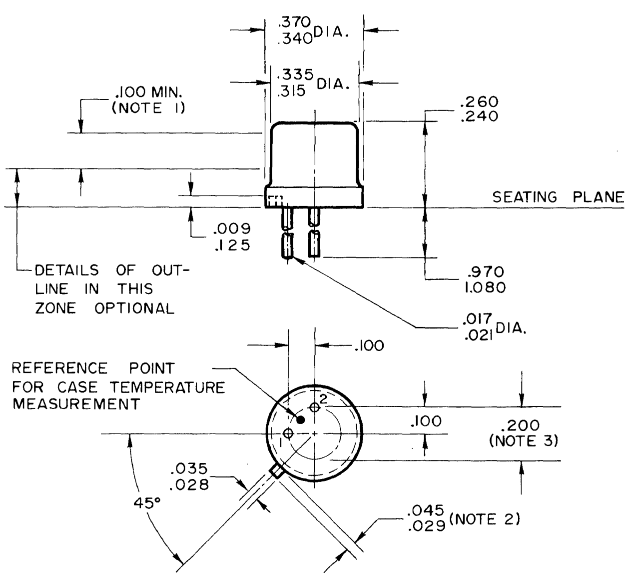


92LM-1568RI

Fig. 11

TRIGGER DEVICE*	RESISTOR (R)* VALUE
Neon-Glow Lamp 5 AH, or Equivalent	75 K
Mallory Trigger Diode Type STD-36, or Equivalent	200 K

DIMENSIONAL OUTLINE 2-LEAD "MODIFIED TO-5"



92LM-1335RI

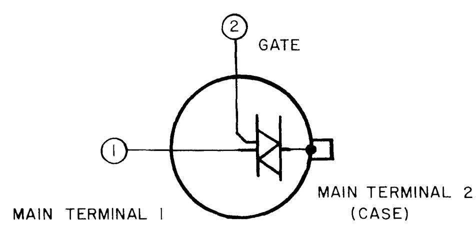
DIMENSIONS IN INCHES

NOTE 1: This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed 0.010".

NOTE 2: Measured from max. diameter of the actual device.

NOTE 3: Leads having maximum diameter (0.019") measured in gauging plane 0.054" + 0.001" −0.000" below the seating plane of the device shall be within 0.007" of their true locations relative to a maximum-width tab.

TERMINAL DIAGRAM



92LS-2010

Lead No.1: Main Terminal 1
Lead No.2: Gate
Case: Main Terminal 2

DEFINITIONS OF TERMS AND SYMBOLS

These terms and symbols follow the latest recommended standards of JEDEC. For convenience, formerly used symbols have been cross-referenced to the new standards.

PRINCIPAL VOLTAGE DEFINITIONS

Repetitive Peak Off-State Voltage — V_{DRM} (Formerly V_{BOM}) — The maximum instantaneous value of principal voltage which may be applied to the thyristor, including all repetitive transient voltages, which will not switch the thyristor from the off state to the on state at specified conditions of thyristor junction temperatures and gate bias.

Main Terminal 1 to Main Terminal 2 Voltage — v_{DX} (Formerly v_{BX}) — The instantaneous value of voltage, positive or negative, applied between main terminals 1 and 2 when the thyristor is in the off state.

On-State Voltage — v_T (Formerly v_{AA}) — The instantaneous value of principal voltage when the thyristor is in the on state at a given instantaneous current.

Critical Rate of Rise of Off-State Voltage — dv/dt — The value of the exponential rate of rise of principal voltage below which switching from the off state to the on state will not occur, and above which switching may occur, under stated conditions. This rate of rise is defined as follows:

$$dv/dt = \frac{0.63\ V_{DRM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 of V_{DRM}.

Critical Rate of Applied Commutating Voltage — Commutating dv/dt — The rate of exponential rise of the principal voltage which the thyristor can maintain during commutation under specified conditions. This rate of rise is defined as follows:

$$\text{Commutating } dv/dt = \frac{0.63\ V_{DRM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 of V_{DRM}.

PRINCIPAL CURRENT DEFINITIONS

RMS On-State Current — I_T (rms) (Formerly I_{ON}) — The RMS value of the principal current when the thyristor is in the on state.

On-State Current — i_T (Formerly i_{AA}) — The instantaneous value of principal current when the thyristor is in the on state.

Surge (Non-Repetitive) On-State Current — I_{TSM} (Formerly i_{SM}) — An overload on-state current of specific time duration, waveshape, and peak value which may be conducted through the thyristor for one full cycle from a 60 Hz supply in a single-phase circuit with a resistive load. The thyristor shall be operating within its specified operating voltage, rms current, gate power, and temperature ratings prior to the surge current. The surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

Peak Off-State Current — I_{DM} (Formerly I_{BOM}) — The maximum current which flows through the main terminals when the thyristor is in the off state for specified values of principal voltage, gate bias, and junction temperature.

DC Holding Current — I_H (Formerly I_{HOX}) — The minimum principal current required to maintain the thyristor in the on state with the gate open for a specified case temperature.

GATE DEFINITIONS

DC Gate-Trigger Current — I_{GT} — The minimum gate current which will switch a thyristor from the off state to the on state under specified conditions of principal voltage and case temperature.

DC Gate-Trigger Voltage — V_{GT} — The gate voltage required to produce the gate trigger current necessary to switch a thyristor from the off state to the on state for specified conditions of principal voltage and case temperature.

Peak Gate-Trigger Current — I_{GTM} (Formerly I_{GT}) — The maximum gate trigger current, positive or negative, which may flow from the gate to main terminal 1 for a specified time duration.

Peak Gate Power — P_{GM} — The maximum power which may be dissipated between gate and main terminal 1 for a specified time duration.

Average Gate Power — P_{GAV} — The value of gate power which may be dissipated between the gate and main terminal 1 averaged over a full cycle.

MISCELLANEOUS

Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Gate-Controlled Turn-On Time — t_{gt} (Formerly t_{on}) — The time interval between the time when the gate-trigger current pulse reaches its 50-per cent point and the time when the resulting principal current flowing through the main terminals of the thyristor reaches the 90-per cent point of its maximum value when switching from the off state to the on state under specified conditions.

Load Resistance — R_L — The value of fixed resistance connected in series with a main terminal of the thyristor and the power source.

TRANSISTOR-RECTIFIER COMPLEMENT

For Line-Operated AM Broadcast-Band Radio Receivers and Phonographs

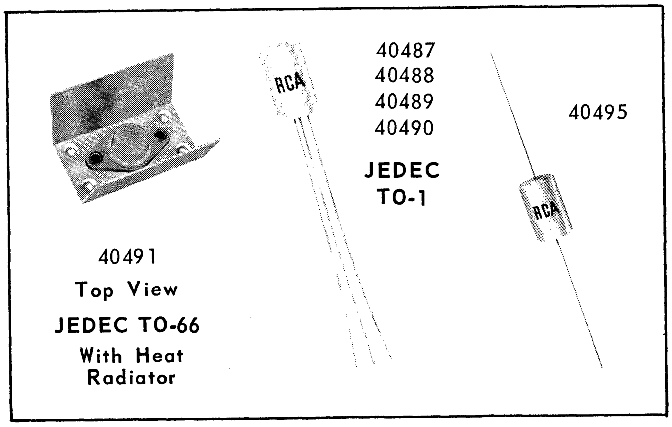
RCA-40487, 40488, 40489, 40490, 40491 and 40495 are a group of five transistors and one silicon rectifier specially designed to provide a complement of high-performance hermetically sealed semiconductor devices for line-operated AM broadcast-band radio receivers. For circuit design and typical performance data on such a receiver, refer to RCA Application Note AN3369, "A Solid-State Table Model AM/FM Receiver".

RCA-40487, 40488 and 40489 are drift-field transistors of the germanium p-n-p alloy type for mixer, oscillator and if-amplifier stages, respectively.

RCA-40490 is a germanium p-n-p alloy-junction transistor with extremely high beta and exceptional linearity of characteristics for low-level af-amplifier and driver stages.

RCA-40491 is a high-voltage power transistor of the silicon n-p-n type for class A amplifier service in af-output stages of ac and ac/dc-line-operated entertainment-type electronic equipment. The 40491 utilizes a JEDEC TO-66 flanged metal package and is provided with an integral aluminum heat radiator which permits the device to be mounted directly on printed-circuit boards.

RCA-40495 is a diffused-junction silicon rectifier of axial-lead design, for power-supplies of receivers and phonograph amplifiers employing all or part of the associated transistor complement.



FEATURES

- hermetically sealed packages
- 40487 - mixer 40488 - oscillator
  40489 - IF-amplifier - -
  low feedback capacitance, C_{cb}
  40487, 40488 = 3.7 pF, max.
  40489 = 3.4 pF, max.
- 40490 - low-level af-amplifier/driver - -
  high beta at 1 KHz,
  $h_{fe} = \begin{cases} 170 \text{ min. at } I_C = -1 \text{ mA} \\ 425 \text{ max. at } I_C = -1 \text{ mA} \end{cases}$
- 40491 - class A output amplifier - -
  high breakdown voltages,
  $V_{(BR)CBO}$, $V_{(BR)CEO}$ = 300 V min.
  excellent high-frequency response,
  f_T = 25 MHz, typ.
- 40491 - JEDEC TO-66 metal package with integral aluminum cooling flange. Designed for direct mounting on printed-circuit boards
  P_T = 3.8 W at T_A to 55°C

ELECTRICAL CHARACTERISTICS, at T_A = 25°C, Unless Otherwise Specified.

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS							LIMITS																		UNITS
		DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Emitter-to-Base Voltage V_{EB}	Peak Reverse Voltage PRV	DC Collector Current I_C	DC Emitter Current I_E	DC Forward Current I_F	40487 Mixer			40488 Oscillator			40489 IF Amplifier			40490 AF Amplifier			40491 PWR Amplifier			40495 Rectifier			
		V	V	V	V	mA	mA	mA	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Collector-Cutoff Current	I_{CBO}	-12 -20 +300					0 0 0		– – –	– – –	-12 – –	– – –	– – –	-12 – –	– – –	– – –	-12 – –	– – –	– – –	– -12 –	– – –	– – –	– – 100	– – –	– – –	– – –	µA µA µA
Collector-Cutoff Current	I_{CEO}		+300				I_B = 0		–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	mA
Emitter-Cutoff Current	I_{EBO}			-0.5 -1.5 -2.5		0 0 0			– – –	– – –	– -16 –	– – –	– – –	-16 – –	– – –	– – –	-16 – –	– – –	– – –	– – -12	– – –	– – –	– – –	– – –	– – –	– – –	µA µA µA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$					-0.05 +0.1	0 0		-50 –	– –	– –	-12 –	– –	– –	-50 –	– –	– –	– –	– –	– –	– 300	– –	– –	– –	– –	– –	V V
Collector-to-Base Breakdown Voltage	$V_{(BR)CBV}$			-0.5		-0.05			-34	–	–	–	–	–	-34	–	–	–	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CER}$	R_{BE} = 10 KΩ				-1			–	–	–	–	–	–	–	–	–	-18	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$					+5			–	–	–	–	–	–	–	–	–	–	–	–	300	–	–	–	–	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$					0 0 0	+0.016 +0.05 +0.1		-1.5 – –	– – –	– – –	-0.5 – –	– – –	– – –	-0.5 – –	– – –	– – –	– -2.5 –	– – –	– – –	– – 2	– – –	– – –	– – –	– – –	– – –	V V V
Static Forward Current-Transfer Ratio	h_{FE}		+10			+50			–	–	–	–	–	–	–	–	–	–	–	–	30	60	250	–	–	–	
Gain-Bandwidth Product	f_T		-12 +50			-1 +20			– –	40 –	– –	– –	30 –	– –	– –	30 –	– –	– –	– –	– –	– –	– 25	– –	– –	– –	– –	MHz MHz
Small-Signal Forward Current-Transfer Ratio	h_{fe}	f = 1 kHz	-6			-1			40	150	275	27	80	275	40	180	350	170	300	425	–	–	–	–	–	–	
Small-Signal Forward Current-Transfer Ratio Cutoff Frequency	f_{hfb}		-6			-1			–	–	–	–	–	–	–	–	–	–	10	–	–	–	–	–	–	–	MHz
Extrinsic Base-Lead Resistance Measured at f = 100 MHz	$r_{bb'}$		-12 -6 +50			-1 -1 +20			– – –	25 – –	– – –	– – –	25 – –	– – –	– – –	25 – –	– – –	– – –	– 200 –	– – –	– – –	– – 20	– – –	– – –	– – –	– – –	Ω Ω Ω
Collector-to-Base Feedback Capacitance	C_{cb}	-12 +50					0 0		– –	– –	3.7 –	– –	– –	3.7 –	– –	– –	3.4 –	– –	– –	– –	– –	– 5	– –	– –	– –	– –	pF pF
Thermal Resistance: Junction-to-Mounting Flange	θ_{JMF}								–	–	–	–	–	–	–	–	–	–	–	–	–	8	10	–	–	–	°C/W
Thermal Resistance: Junction-to-Ambient	θ_{JA}								–	–	390	–	–	390	–	–	390	–	–	390	–	–	25	–	–	–	°C/W
Instantaneous Forward Voltage Drop	v_F							500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1.5	V
Dynamic Reverse Current	i_R	T_A = 65°C			400			500	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-0.4	mA
Static Reverse Current	I_R				400			0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	-6	µA

Maximum Ratings, *Absolute-Maximum Values:*	**40487 Mixer**	**40488 Oscillator**	**40489 IF Ampl.**	**40490 AF Ampl.**	**40491 PWR. Ampl.**	**40495 Rectifier**	
COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	-50	-12	-50	-20	+300	–	max. V
COLLECTOR-TO-BASE VOLTAGE, V_{CBV} (V_{EB} = -0.5 V, I_C = -50 μA)	-34	-12	-34	–	–	–	max. V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CER} ($R_{BE} \leq$ 10000 Ω)	–	–	–	-18	–	–	max. V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO} (I_C = 5 mA, I_B = 0)	–	–	–	–	+300	–	max. V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	-1.5	-0.5	-0.5	-2.5	+2	–	max. V
COLLECTOR CURRENT, I_C	-10	-10	-10	-20	+150	–	max. mA
EMITTER CURRENT, I_E	+10	+10	+10	+20	-150	–	max. mA
TRANSISTOR DISSIPATION, P_T:							
At ambient temperatures up to 25°C	80	80	80	–	–	–	max. mW
At ambient temperatures above 25°C		See *Fig.2*		–	–	–	
At ambient temperatures up to 55°C	–	–	–	0.12	3.8	–	max. W
At ambient temperatures above55°C	–	–	–	See *Fig.3*	See *Fig.4*	–	
PEAK REVERSE VOLTAGE, PRV	–	–	–	–	–	400	max. V
RMS SUPPLY VOLTAGE, V_{RMS}	–	–	–	–	–	140	max. V
FORWARD CURRENT: At ambient temperatures up to 65°C (For ambient temperatures above 65°C, *Fig.5*)							
DC, I_F	–	–	–	–	–	500	max. mA
PEAK, REPETITIVE, i_{PR}	–	–	–	–	–	5	max. A
SURGE CURRENT, i_S:							
For "turn-on" time of 2 milliseconds at an ambient temperature of 25°C	–	–	–	–	–	25	max. A
At ambient temperatures above 25°C	–	–	–	–	–	See *Fig.5*	
TEMPERATURE RANGE: Operating and Storage	-65 to +85	-65 to +85	-65 to +85	-65 to +100	-65 to +150	-65 to +175	°C
LEAD TEMPERATURE (During Soldering): At distances not closer than 1/32" to seating surface, for 10 seconds max.	255	255	255	255	255	255	max. °C

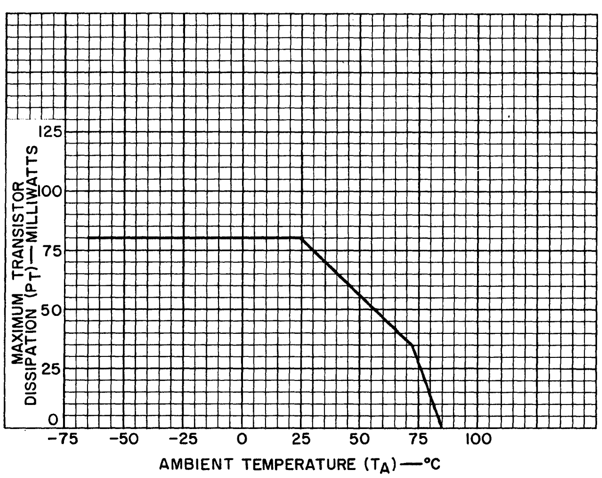


Fig.1 - Rating Chart for RCA-40487, 40488 and 40489.

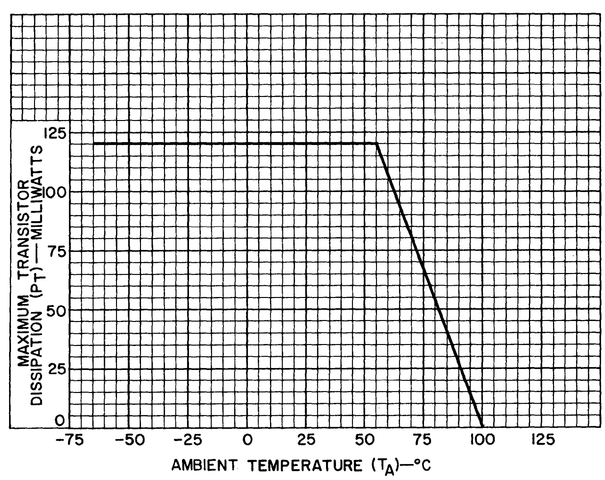


Fig.2 - Rating Chart for RCA-40490.

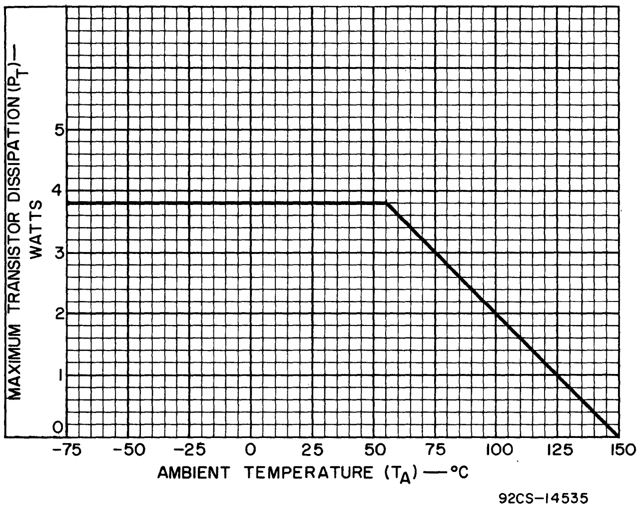


Fig.3 - Rating Chart for RCA-40491.

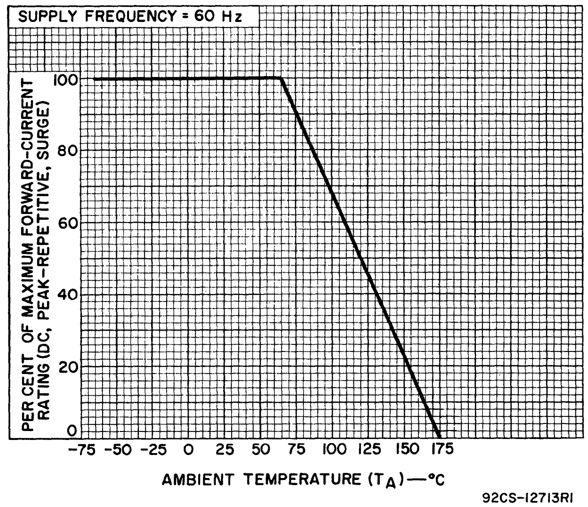


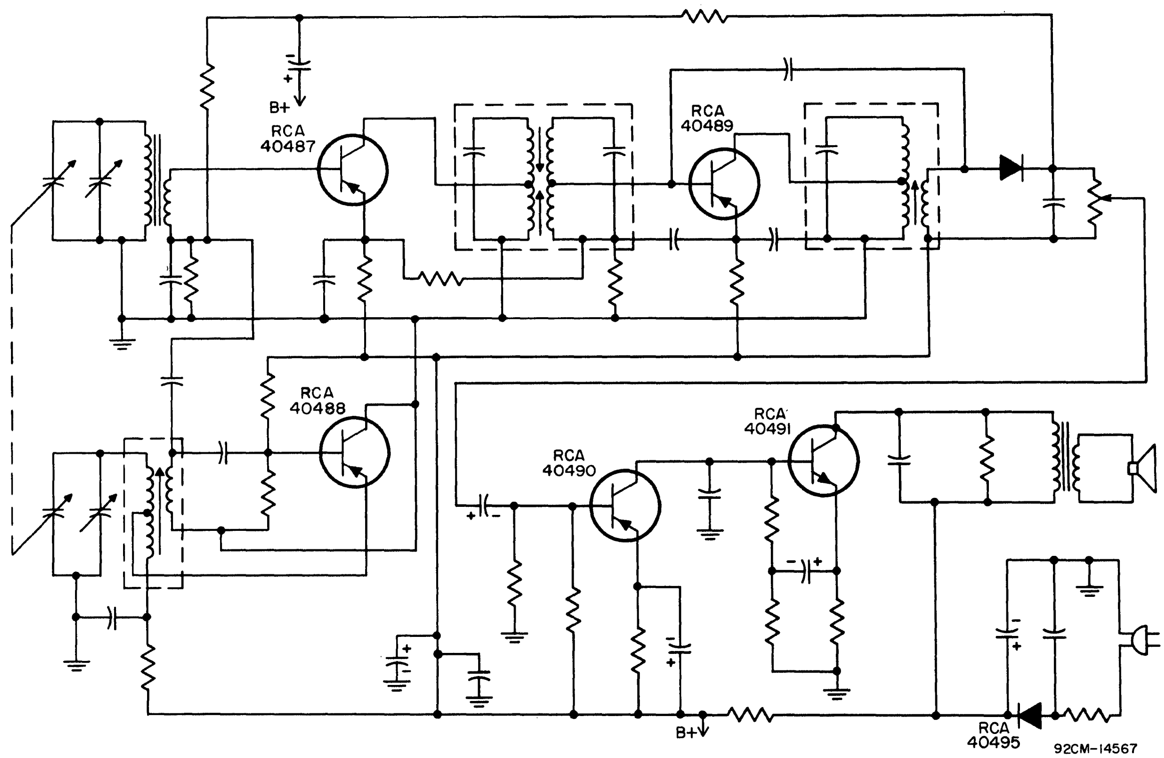
Fig.4 - Rating Chart for RCA-40495.

PROTECTION AGAINST TRANSIENT VOLTAGES

Harmful transient voltages can occur in a class A audio-output stage that uses transformer coupling between the transistor and the load. Such transient voltages can occur as a result of intense radiation which exists during electrical storms, or the radiation emitted by fluorescent lighting equipment. These forms of radiation cause transient pulses to appear at the detector circuit or af-input circuit. Transient pulses, when amplified, may reach instantaneous values as great as 5 to 7 times the dc supply voltage. High-voltage transients are also developed when the transistor is over-driven to a very high value of collector current and is then abruptly cut off.

The peak value of the transient voltage depends on the inductance, capacitance, and resistance of the output transformer and load, and on the value of the collector current immediately prior to cut-off. The reactive components of the transformer and load act as a parallel-resonant circuit, with series and shunt damping (loss) elements provided by the associated resistances. For a given set of load-circuit conditions, the peak value of the transient voltage is directly proportional to the collector current, and can be limited to a value within the maximum rating for the transistor by limiting the maximum value of the collector current (i.e., by limiting the dynamic range of the transistor).

In most cases, this type of limiting can be accomplished, and the desired maximum power output obtained without compromise in performance or cost factors, by a judicious choice of circuit constants.



For detailed information on circuit and component values; see Application Note AN3369

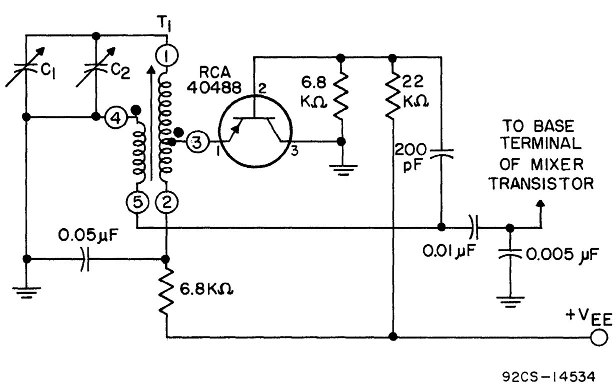
OPERATING CONDITIONS

Line Voltage = 120 V, 60 Hz
Signal frequency = 1000 kHz
Signal modulated 30% at 400 Hz

PERFORMANCE DATA

Sensitivity for 50-mW output	150	μV/m
Sensitivity for 500-mW output. . . .	320	μV/m
Sensitivity for 20 dB signal-to-noise ratio.	150	μV/m
RF Overload Level for 10% Total Harmonic Distortion:		
30% modulation	3	V/m
80% modulation	1.2	V/m
Total Harmonic Distortion at 200 mW output for 10,000 μV/m input	1.5	%

Fig.5 - Typical AC/DC Receiver Circuit Utilizing Types 40487, 40488, 40489, 40490, 40491 and 40495.



PARTS SPECIFICATIONS

C_1: 6-85 pF, tuning capacitor
C_2: 3-30 pF, trimmer capacitor
T_1: oscillator coil; primary tunes to 990 kHz with 100 pF

$$\frac{N_{①-②}}{N_{③-②}} = \frac{26}{1}$$

N = number of turns between indicated terminals.

$$\frac{N_{①-②}}{N_{④-⑤}} = \frac{9.6}{1}$$

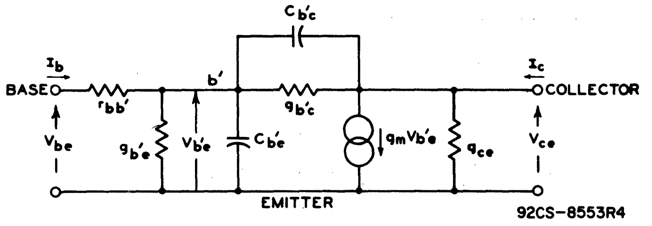
Q = 70 at 990 KHz

Resistors are 0.5 watt, composition, 5% tolerance

PERFORMANCE DATA

DC Supply Voltage, V_{EE}	20	V
DC Collector-to-Emitter Voltage, V_{CE}	-5	V
DC Emitter Current, I_E	2.2	mA
Oscillator Output Voltage V_O	120	mV (rms)

Fig.6 - Typical 1.5 MHz Oscillator Circuit and Performance Data for RCA-40488.



V_{ce}	= -10	V		g_{ce}	= 6	μmho
I_c	= -3	mA		$C_{b'e}$	= 1600	pF
$r_{bb'}$	= 200	Ω		$C_{b'c}$	= 9	pF
$g_{b'e}$	= 330	μmho		gm	= 115	mmho
$g_{b'c}$	= 0.25	μmho				

NOTE: The approximate frequency f, for unity power amplification based on this equivalent circuit is given by:

$$f = \frac{1}{4\pi}\sqrt{\frac{gm}{r_{bb'}\,C_{b'c}\,C_{b'e}}}$$

Fig.7 - "Hybrid π" Equivalent Circuit With Corresponding Small-Signal Parameters for RCA-40490.

Typical Operation of RCA-40487 at 1.5 MHz in a Separately Excited Mixer Circuit, at $T_A = 25^oC$

Common-Emitter Circuit, Base Input

DC Collector-Supply Voltage, V_{CC} . . .	-20	V
DC Collector-to-Emitter Voltage, V_{CE} . .	-19	V
DC Emitter Current, I_E	1.5	mA
Input Resistance, R_{IN}	1500	Ω
Output Resistance, R_{OUT}	0.35	MΩ
Base-to-Emitter Oscillator Injection Voltage	120	mV
Conversion Power Gain, G_c:		
Maximum Available Gain, MAG	53	dB
Useful Gain	43	dB

Typical Operation of RCA-40489 in a Single-Stage 455-kHz Amplifier Circuit, at $T_A = 25^oC$

Common-Emitter Circuit, Base Input

DC Collector-Supply Voltage, V_{CC} . . .	-20	V
DC Collector-to-Emitter Voltage, V_{CE} .	-18	V
DC Emitter Current, I_E	2.5	mA
Input Resistance, R_{IN}	825	Ω
Output Resistance, R_{OUT}	0.28	MΩ
Collector-to-Base Capacitance, C_{cb} . .	2.5▲	pF
Magnitude of Forward Transfer Admittance, $\lvert Y_{fe} \rvert$	86.5	mmho
Power Gain:		
Maximum Available Gain,* MAG	56	dB
Useful Gain:		
Circuit neutralized	41	dB
Circuit not neutralized	36	dB

* Measured in a single-tuned unilateralized circuit matched to the generator and load impedances for maximum transfer of power (transformer insertion losses not included).

▲ The maximum deviation from this value is 0.5 pF.

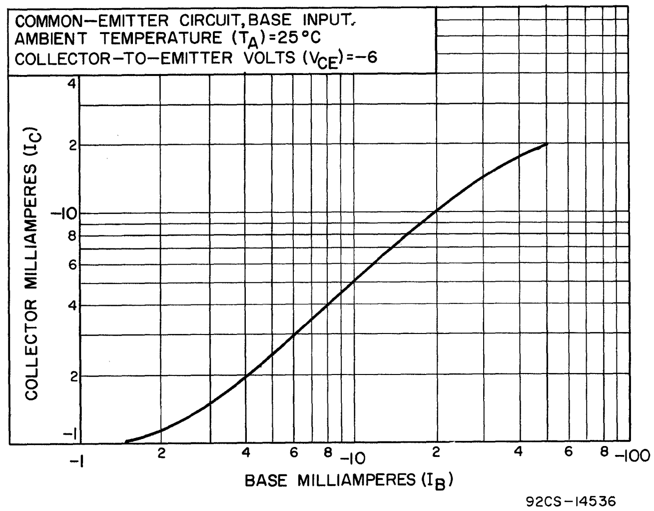


Fig.8 - Typical Current-Transfer Characteristic for Type 40490.

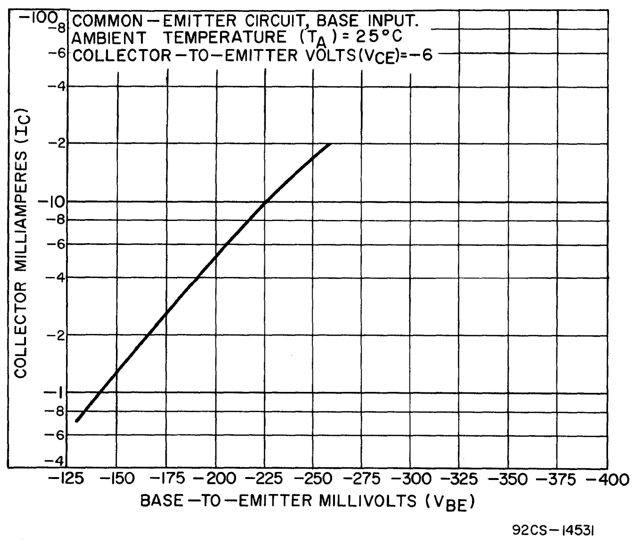


Fig.9 - Typical Transfer Characteristic for RCA-40490.

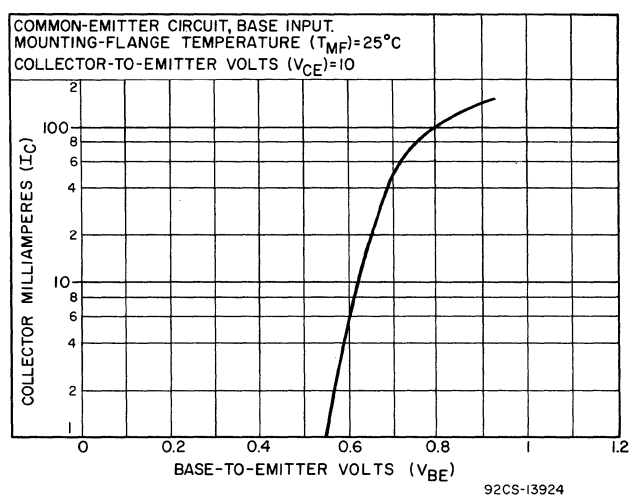


Fig.10 - Typical Transfer Characteristic for Type 40491.

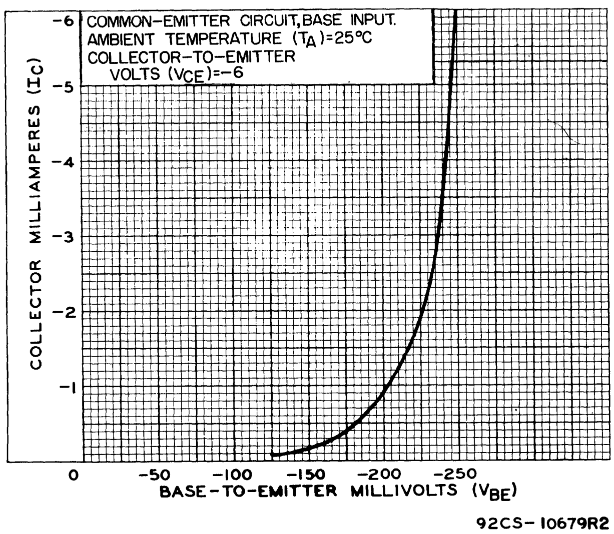


Fig.11 - Typical Characteristic for RCA-40487, 40488 and 40489.

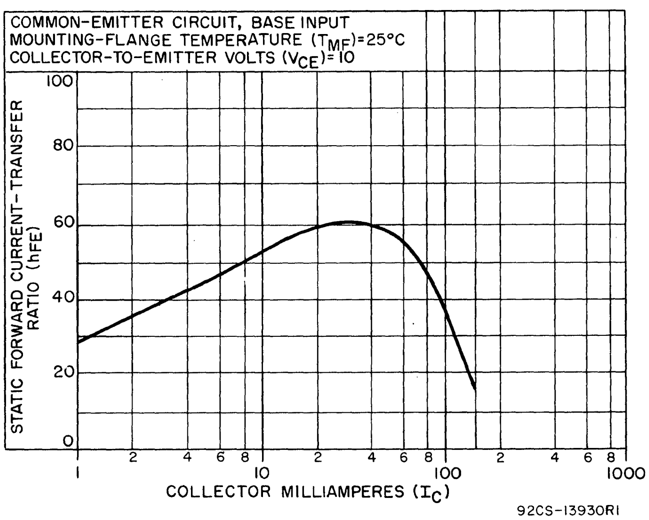


Fig.12 - Typical Static Beta (h_{FE}) Characteristic for RCA-40491.

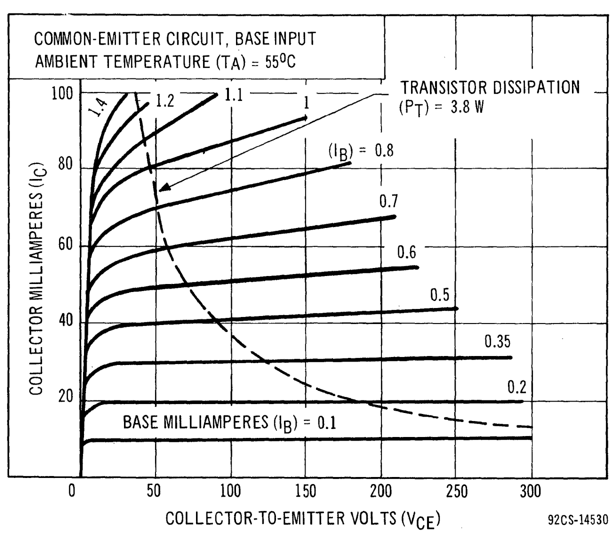


Fig.13 - Typical Collector Characteristics for RCA-40491.

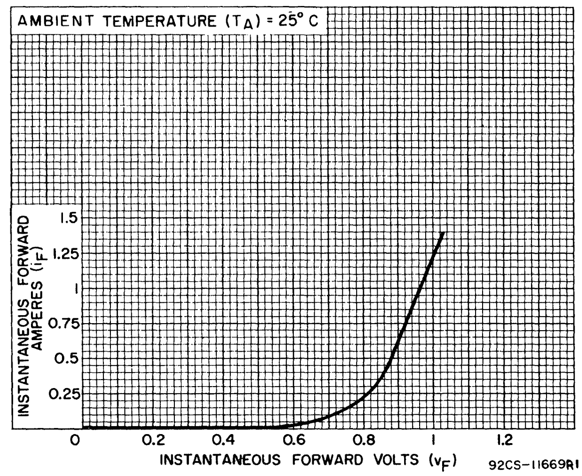


Fig.14 - Typical Forward Characteristic for RCA-40495.

OPERATING CONSIDERATIONS

The *flexible leads* of the 40487, 40488, 40489, 40490 and 40495 are usually soldered to the circuit elements. It is desirable in all soldering operations to provide some slack or an expansion elbow in each lead, to prevent excessive tension on the leads. It is important during the soldering operation to avoid excessive heat in order to prevent possible damage to the devices. To absorb some of the heat, grip the flexible lead of the device between the case and the soldering point with a pair of pliers.

When dip soldering is employed in the assembly of printed circuits using these devices, the temperature of the solder should not exceed 255°C for a maximum immersion period of 10 seconds. Furthermore, the leads should not be dip soldered within 0.25" of the metal case.

The devices described in this bulletin should not be connected into or disconnected from circuits with the power on because high transient currents may cause permanent damage to the devices.

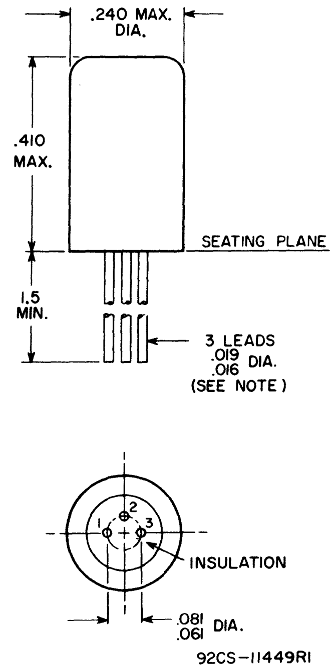
Because the metal shell of the 40491 operates at the collector voltage, consideration should be given to the possibility of shock hazard if the shell is to operate at a voltage appreciably above or below ground potential. In such cases, suitable precautionary measures should be taken.

A *surge-limiting impedance* should always be used in series with the 40495 rectifier. The impedance value must be sufficient to limit the surge current to the value specified under the maximum ratings. This impedance may be provided by the power transformer windings, or by an external resistor or choke.

The 40495 is designed to provide reliable performance when operated within the maximum ratings shown in this bulletin. For measurement of the reverse characteristics of this device, peak reverse voltages as high as 30 per cent above the maximum rated values may be applied for a period not exceeding 10 seconds. UNDER NO CIRCUMSTANCES SHOULD PEAK REVERSE VOLTAGES GREATER THAN 30% ABOVE THE MAXIMUM RATED VALUES BE APPLIED TO THE 40495, EVEN MOMENTARILY.

DIMENSIONAL OUTLINES

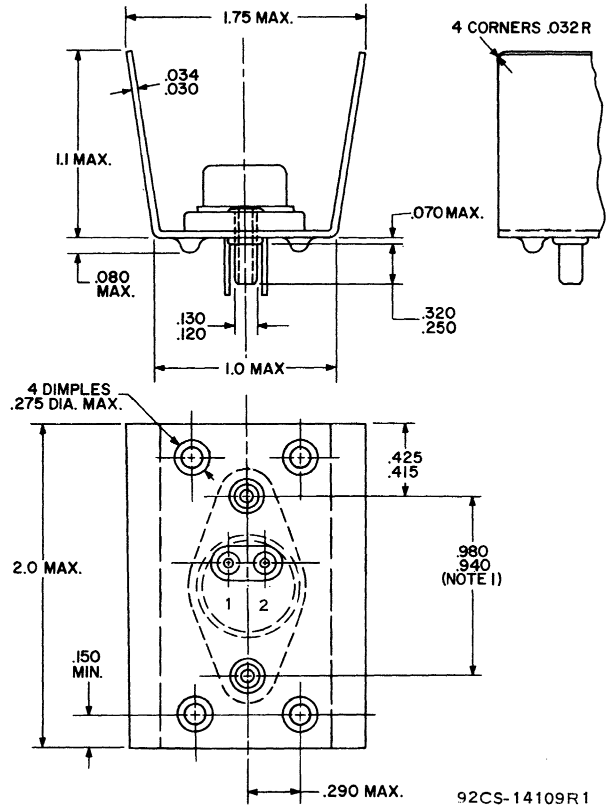
40487, 40488, 40489, 40490
JEDEC No. TO-1



Dimensions in Inches

NOTE: THE SPECIFIED LEAD DIAMETER APPLIES IN ZONE BETWEEN 0.050 INCH AND 0.250 INCH FROM THE SEATING PLANE. BETWEEN 0.250 INCH AND 1.5 INCHES, A MAXIMUM DIAMETER OF 0.021 INCH IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIAMETER IS NOT CONTROLLED.

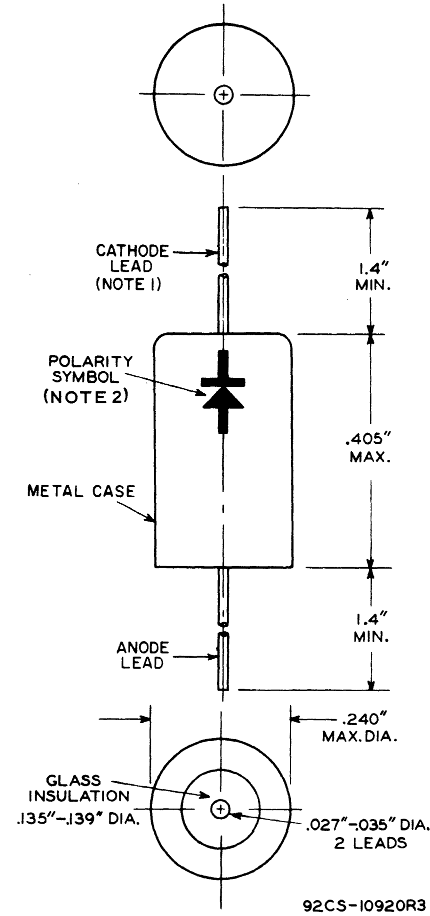
40491



Dimensions in Inches

NOTE 1: MEASURED BETWEEN CENTER LINES OF TIPS OF MOUNTING PINS.

40495

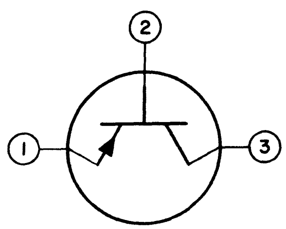


Dimensions in Inches

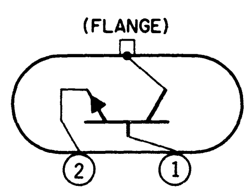
NOTE 1: CONNECTED TO METAL CASE.

NOTE 2: ARROW INDICATES DIRECTION OF FORWARD (EASY) CURRENT FLOW AS INDICATED BY DC AMMETER.

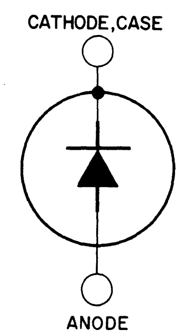
TERMINAL DIAGRAMS



Lead 1 - Emitter
Lead 2 - Base
Lead 3 - Collector



Pin 1 - Base
Pin 2 - Emitter
Mounting Flange - Collector, Case



RCA MOS FIELD-EFFECT TRANSISTOR

For FM and AM/FM RF-Amplifier Applications

40468

RCA 40468[†] is a silicon, insulated-gate field-effect transistor of the N-channel depletion type utilizing the MOS* construction. It is intended primarily for use as the RF amplifier in FM receivers covering the 88 to 108 MHz band, but can be used for general amplifier applications at frequencies up to 125 MHz. For circuit design and typical performance data for an FM tuner using this device, refer to RCA Application Note AN-3453.

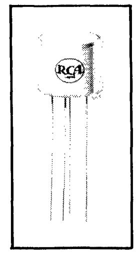
The wide dynamic range of the 40468 reduces cross-modulation effects in AM receivers and minimizes the generation of spurious responses in FM receivers.

Operating as a neutralized amplifier at 100 MHz, the 40468 can provide a power gain of 17 dB. A power gain of 14 dB can be realized in the unneutralized configuration.

† Formerly Dev. No. TA7119.
* Metal-Oxide-Semiconductor.

SILICON MOS TRANSISTOR

N-Channel Depletion Type



TO-104

For RF Amplifier Applications in FM and AM/FM Receivers

Maximum Ratings, *Absolute-Maximum Values:*

DRAIN-TO-SOURCE VOLTAGE, V_{DS}	+20 max.	V
GATE-TO-SOURCE VOLTAGE, V_{GS}:		
Continuous	0 to -8 max.	V
Instantaneous	±15 max.	V
DRAIN CURRENT, I_D	20 max.	mA
TRANSISTOR DISSIPATION, P_T:		
At ambient temperatures up to 85°C	100 max.	mW
At ambient temperatures above 85°C	Derate at 6.67	mW/°C
AMBIENT TEMPERATURE RANGE:		
Storage	-65 to 100	°C
Operating	-65 to 100	°C
LEAD TEMPERATURE (During Soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds max.	265 max.	°C

FEATURES

- reduces spurious responses in FM tuners
- reduces cross-modulation effects in AM receivers
- high forward transadmittance — — 7500 μmho typ. at 100 MHz
- low feedback capacitance — — 0.2 pF max.
- high useful power gain — — neutralized 17 dB typ., unneutralized 14 dB typ. at 100 MHz
- hermetically sealed TO-104 metal package

RADIO CORPORATION OF AMERICA
ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.

Printed in U.S.A.
40468 4-67

ELECTRICAL CHARACTERISTICS AT T_A = 25°C WITH BULK (SUBSTRATE) CONNECTED TO SOURCE

CHARACTERISTICS	SYMBOLS	TEST CONDITIONS			LIMITS			UNITS
		FREQUENCY f	DC DRAIN-TO-SOURCE VOLTAGE V_{DS}	DC DRAIN CURRENT I_D	40468			
		MHz	V	mA	Min.	Typ.	Max.	
Gate-to-Source Cutoff Voltage	$V_{GS}(off)$		20	0.1	-	-5	-8	V
Gate Reverse Current	I_{GSS}		0	V_{GS} = -8 V	-	-	200	pA
Drain Current*	I_D	V_{DD} = 20 V, R_S = 240 Ω, R_D = 620 Ω			-	5	-	mA
Small-Signal, Short-Circuit Reverse-Transfer Capacitance (Drain-to-Gate)	C_{rss}	1	15	5	0.1	0.12	0.2	pF
Input Resistance	r_{is}	100	15	5	-	4.5	-	KΩ
Input Capacitance	C_{iss}	100	15	5	-	5.5	-	pF
Output Resistance	r_{os}	100	15	5	-	4.2	-	KΩ
Output Capacitance	C_{oss}	100	15	5	-	1.4	-	pF
Magnitude of Forward Transadmittance	$\|y_{fs}\|$	100	15	5	-	7.5	-	mmho
Maximum Available Power Gain	MAG	100	15	5	-	24	-	dB
Maximum Usable Power Gain (Unneutralized)	MUG	100	15	5	-	14	-	dB
Maximum Usable Power Gain (Neutralized)	MUG	100	15	5	-	17	-	dB
Noise Figure	NF	100	15	5	-	4.0	5.0	dB

* Pulse test: Pulse Duration 20 ms max. Duty Factor $\leq$ 0.15.

OPERATING CONSIDERATIONS

The flexible leads of the 40468 are usually soldered to the circuit elements. As in the case of any high-frequency semiconductor device, the tips of soldering irons should be grounded, and appropriate precautions should be taken to protect the device against high electric fields.

This device should not be connected into, or disconnected from, circuits with the power on because high transient voltages may cause permanent damage to the device.

TYPICAL Y-PARAMETER CHARACTERISTICS

INPUT ADMITTANCE (y_{is}) vs. DRAIN CURRENT (I_D)

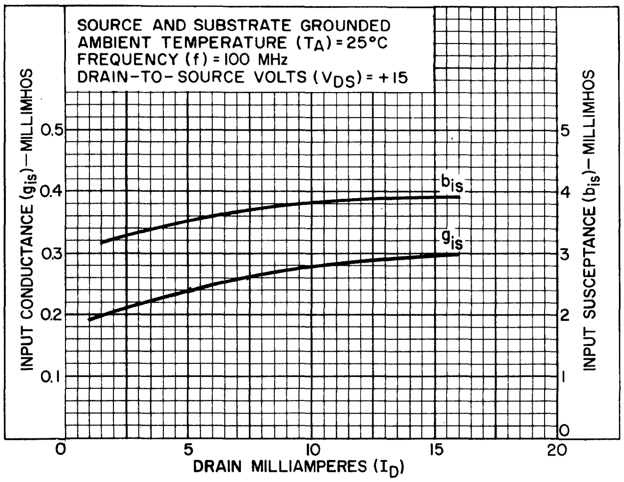


Fig.2

INPUT ADMITTANCE (y_{is}) vs. DRAIN-TO-SOURCE VOLTAGE (V_{DS})

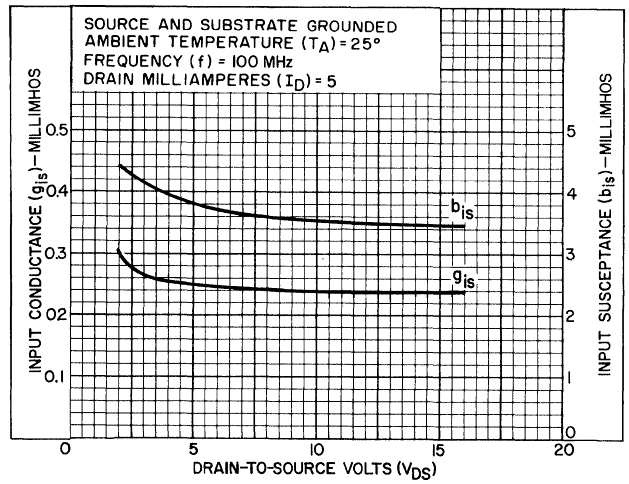


Fig.3

OUTPUT ADMITTANCE (y_{os}) vs. DRAIN CURRENT (I_D)

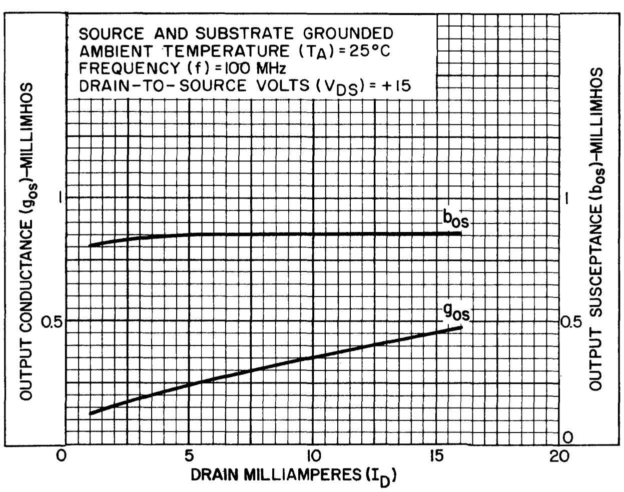


Fig.4

OUTPUT ADMITTANCE (y_{os}) vs. DRAIN-TO-SOURCE VOLTAGE (V_{DS})

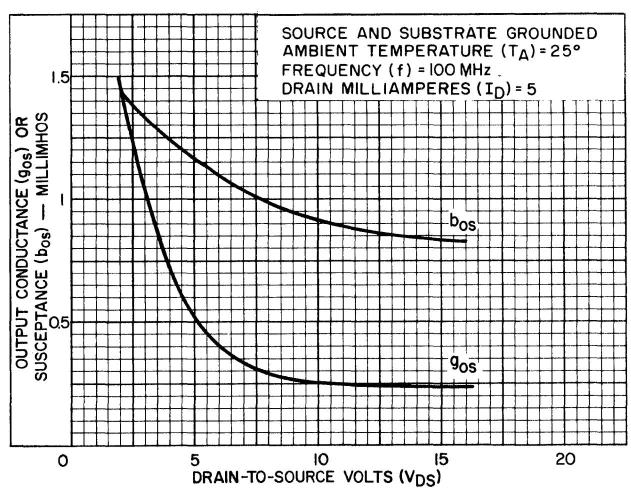


Fig.5

TYPICAL Y-PARAMETER CHARACTERISTICS

FORWARD TRANSADMITTANCE (y_{fs}) vs. DRAIN CURRENT (I_D)

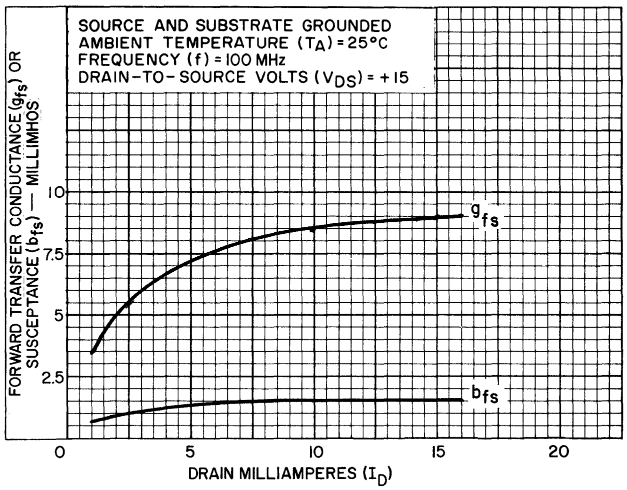


Fig.6

FORWARD TRANSADMITTANCE (y_{fs}) vs. DRAIN-TO-SOURCE VOLTAGE (V_{DS})

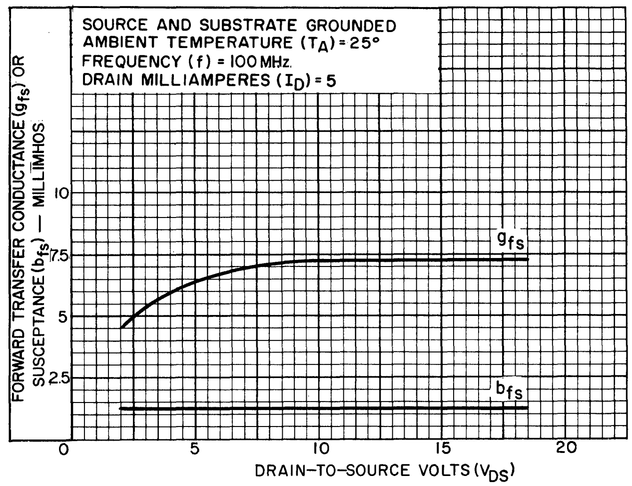


Fig.7

REVERSE TRANSADMITTANCE (y_{rs}) vs. DRAIN CURRENT (I_D)

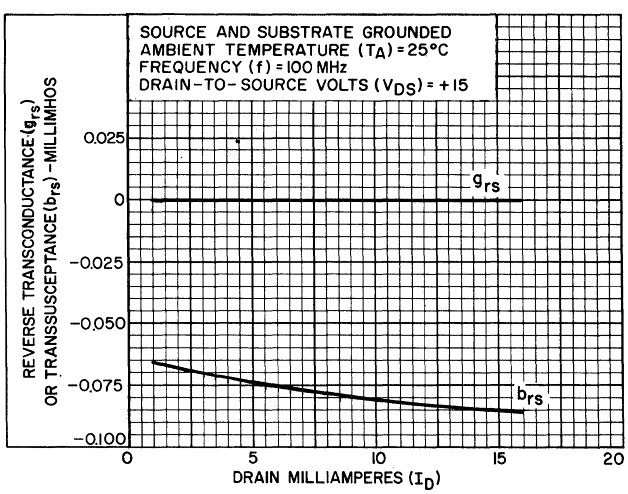


Fig.8

REVERSE TRANSADMITTANCE (y_{rs}) vs. DRAIN-TO-SOURCE VOLTAGE (V_{DS})

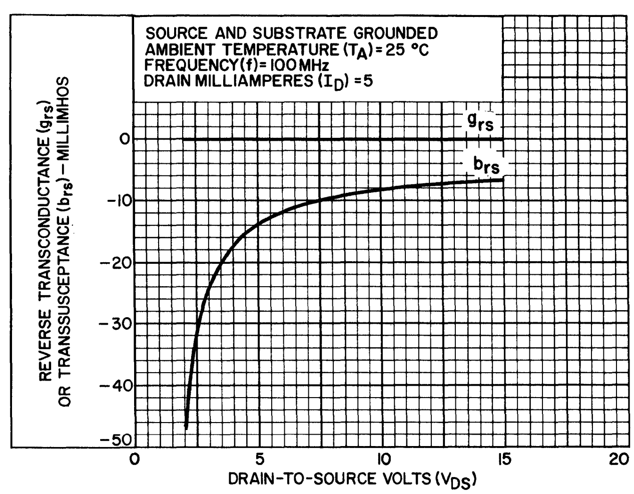


Fig.9

TYPICAL FM RECEIVER FRONT END USING RCA 40468

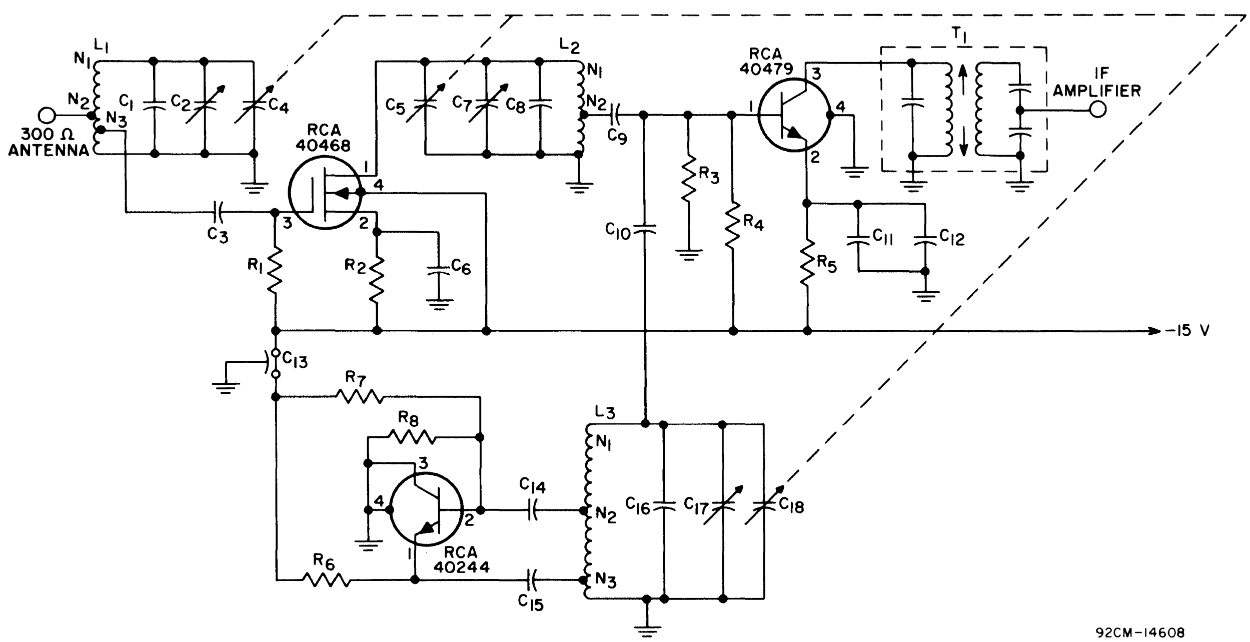


Fig. 1

C_1, C_8, C_{16} = 16 pF
C_2, C_7, C_{17} = 10 pF max., Trimmer
C_3, C_6, C_{11}, C_{14}, C_{15} = 1000 pF
C_4, C_5, C_{18} = 7-21 pF, ganged tuning capacitor
C_9 = 5000 pF
C_{10} = 2.2 pF
C_{12} = 0.01 μF
C_{13} = 1000 pF feedthrough type

R_1 = 100 K
R_2 = 270
R_3 = 43 K
R_4 = 47 K
R_5 = 4.7 K
R_6 = 8.2 K
R_7 = 120 K
R_8 = 22 K

All resistors are in ohms and are 1/4 W.

L_1 = #18 bare copper wire, 4 turns, 1/4" I.D., 7/16" winding length, Q_o = 130 mounted on chassis,
$\frac{N_1}{N_2} = 4.2$, $\frac{N_1}{N_3} = 4$

L_2 = #18 bare copper wire, 4 turns, 1/4" I.D., 7/16" winding length, Q_o = 115 mounted on chassis,
$\frac{N_1}{N_2} = 5.6$

L_3 = #18 bare copper wire, 4 turns, 7/32" I.D., 7/16" winding length, Q_o = 120 mounted on chassis,
$\frac{N_1}{N_2} = 3.2$, $\frac{N_1}{N_3} = 4$

T_1 = 10.7 MHz transformer, Z_{in} = 6 KΩ, coupling = 90% of critical value, Z_{out} = 18.7 Ω.

TYPICAL TUNER PERFORMANCE

Sensitivity (IHF):	
for 20 dB Quieting	1.75 μV
for 30 dB Quieting	2.0 μV
for 3 dB Limiting	2.0 μV
Rejection:	
Half IF	91 dB
IF	91 dB
Image	72 dB
Other Spurious Responses	> 100 dB (0.2 V test signal)
Gain:	
RF Amplifier Stage	12.7 dB
Mixer Stage	21.8 dB MUG
Front-End (with matched load)	34.5 dB
IF Amplifier	94 dB

TYPICAL CHARACTERISTIC OF DRAIN CURRENT (I_D) vs. GATE-TO-SOURCE VOLTAGE (V_{DS})

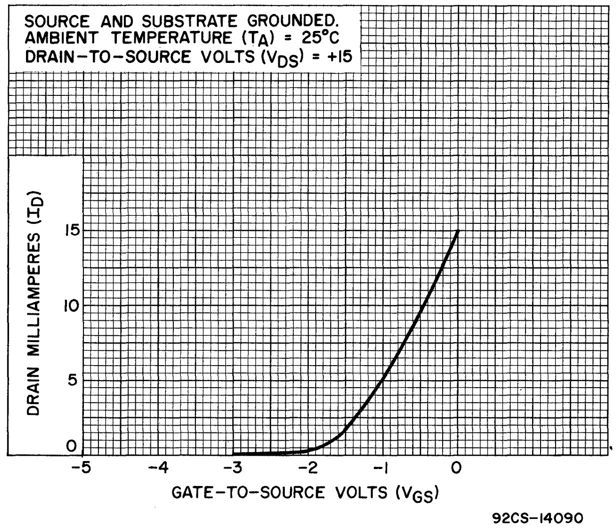
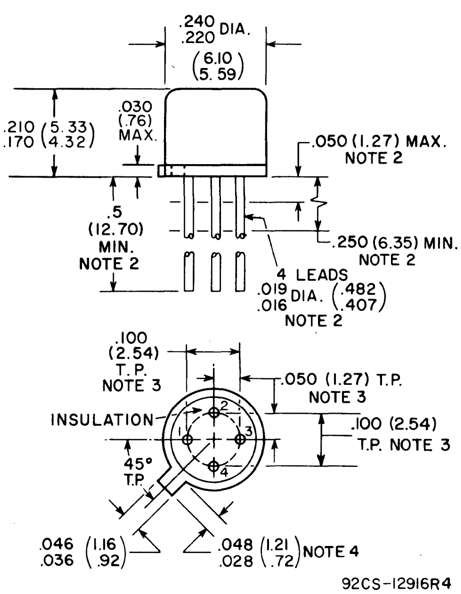


Fig. 10

DIMENSIONAL OUTLINE TO-104



DIMENSIONS IN INCHES AND MILLIMETERS

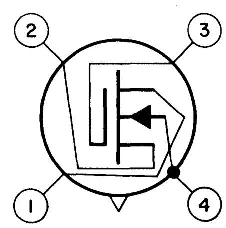
Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250"(6.35 mm) from the seating plane. From 0.250"(6.35 mm) to the end of the lead a maximum diameter of 0.021"(0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054"(1.372 mm) + 0.001" (0.025 mm) -0.000"(0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maxi-width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM



LEAD 1 - DRAIN
LEAD 2 - SOURCE
LEAD 3 - INSULATED GATE
LEAD 4 - BULK (SUBSTRATE) AND CASE

RCA TRIACS

Having Factory-Attached Heat Radiators

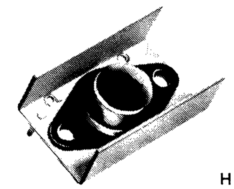
40502–40503

This bulletin sheet is to be used in conjunction with the data sheet for types 40429 and 40430 dated 10/66.

RCA 40502 and 40503 are gated bidirectional silicon thyristors having integral heat radiators. They are variants of the 40429 and 40430, respectively.

The 40502 and 40503 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.


H-1470A

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40502	40429
40503	40430

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)

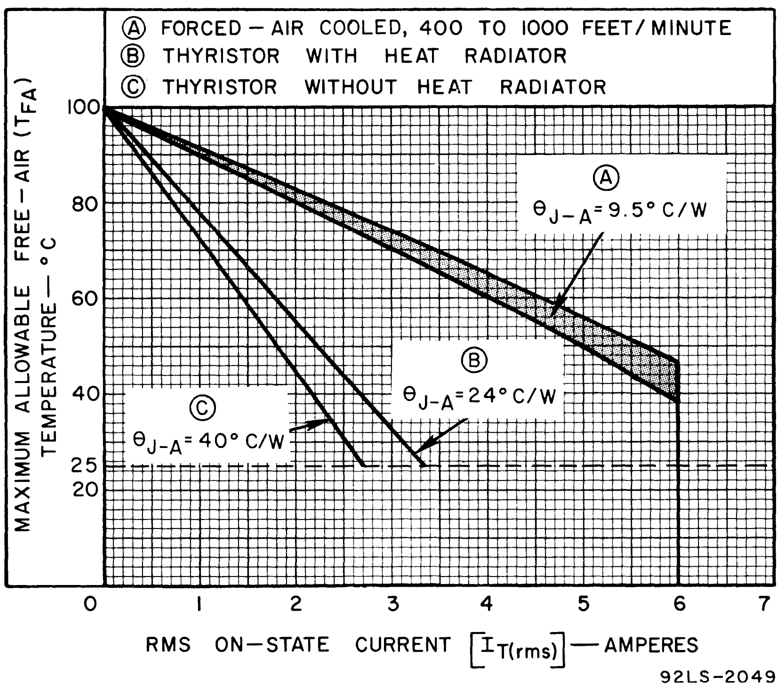


Fig. 1

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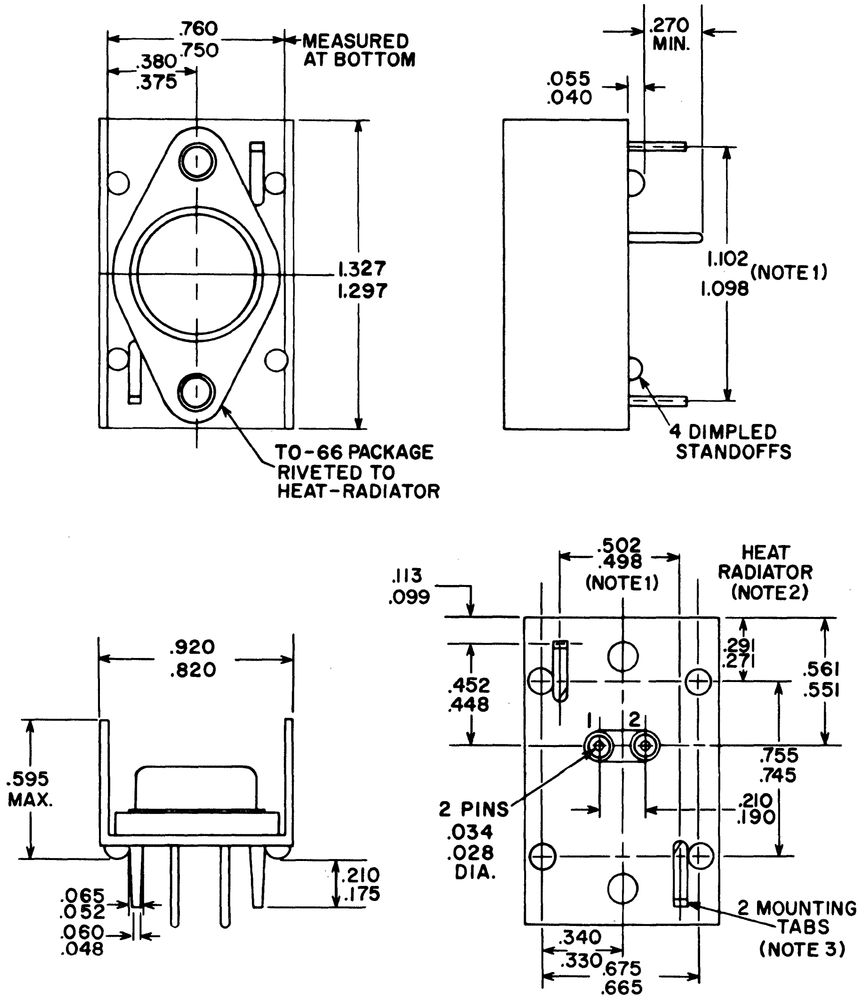
DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note 1: Measured at bottom of heat-radiator.

Note 2: 0.035 C.R.S., tin plated.

Note 3: Recommended hole size for printed-circuit boards if 0.070 dia.

TERMINAL CONNECTIONS

Pin 1: Gate

Pin 2: Main Terminal 1

Radiator, Case: Main Terminal 2

RCA SILICON CONTROLLED-RECTIFIERS

Having Factory-Attached Heat Radiators

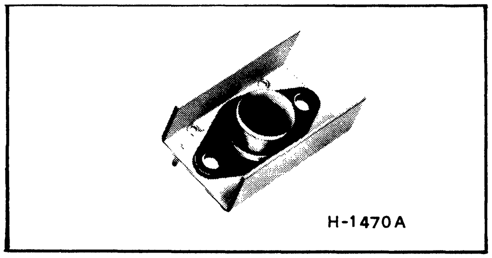
40504–40505
40506

This bulletin sheet is to be used in conjunction with the data sheet for types 2N3228, 2N3525, and 2N4101 dated 5/66.

RCA 40504, 40505, and 40506 are all-diffused, three-junction silicon controlled-rectifiers having integral heat radiators. They are variants of the 2N3228, 2N3525, and 2N4101, respectively.

The 40504, 40505, and 40506 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.



H-1470A

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40504	2N3228
40505	2N3525
40506	2N4101

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)

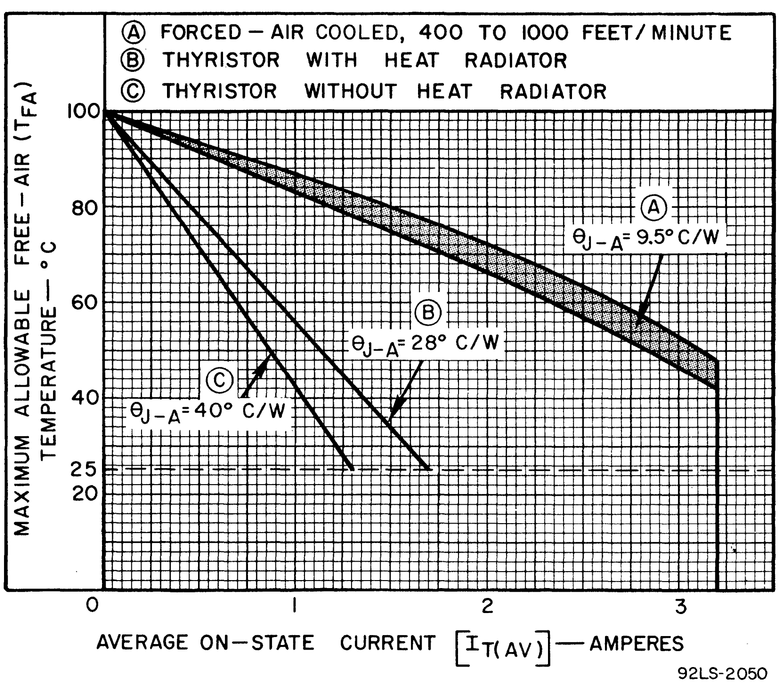


Fig. 1

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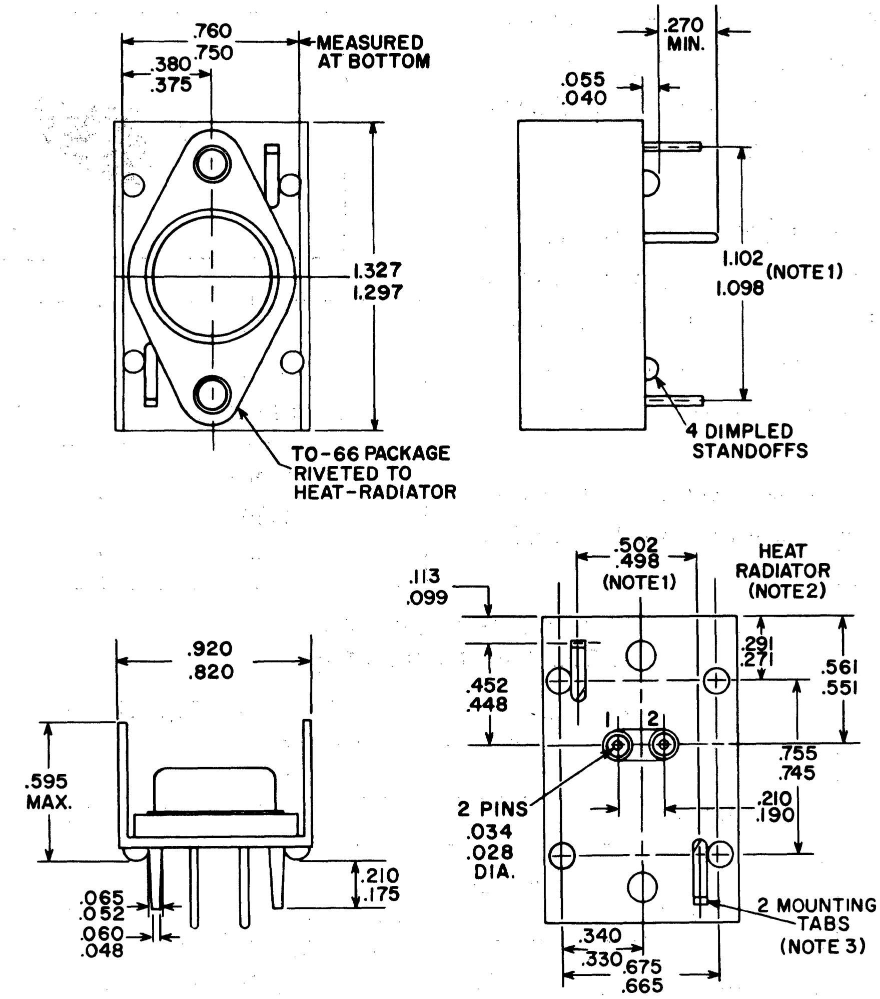
DIMENSIONAL OUTLINE



Note 1: Measured at bottom of heat-radiator.

Note 2: 0.035 C.R.S., tin plated.

Note 3: Recommended hole size for printed-circuit boards is 0.070 dia.

TERMINAL CONNECTIONS

Pin 1: Gate
Pin 2: Cathode
Radiator, Case: Anode

RCA SILICON CONTROLLED-RECTIFIERS

Having Factory-Attached Heat Radiators

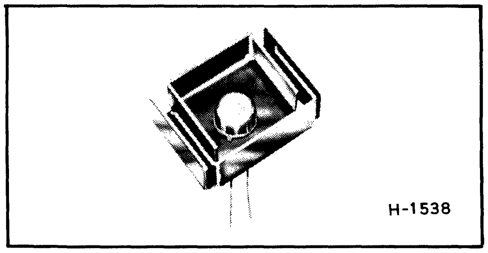
40507-40508

This bulletin sheet is to be used in conjunction with the data sheet for types 40378 and 40379 dated 5/66.

RCA 40507 and 40508 are all-diffused, three-junction silicon controlled-rectifiers having integral heat radiators. They are variants of the 40378 and 40379, respectively.

The 40507 and 40508 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.



H-1538

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40507	40378
40508	40379

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)

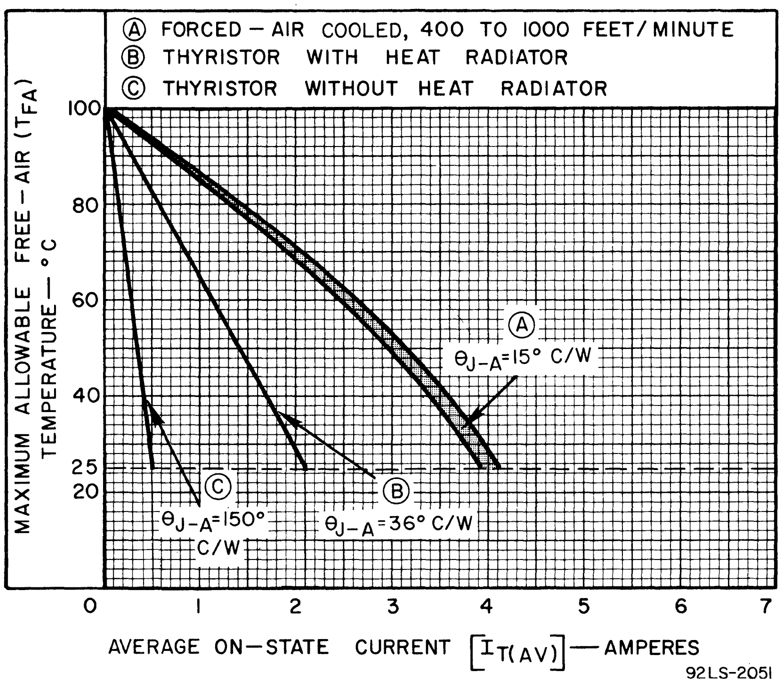
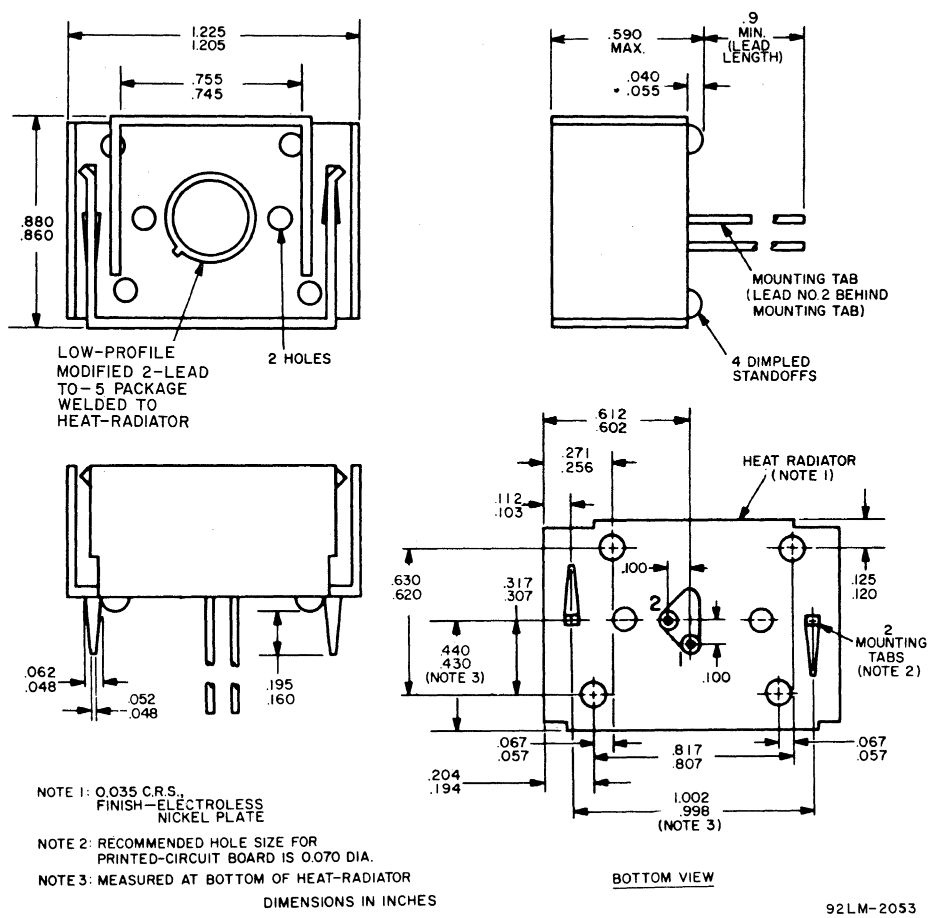


Fig. 1

DIMENSIONAL OUTLINE



TERMINAL CONNECTIONS

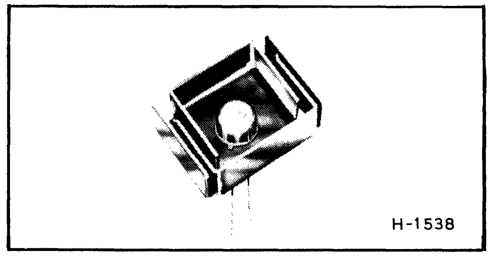
Pin 1: Cathode
Pin 2: Gate
Radiator, Case: Anode

RCA TRIACS

Having Factory-Attached Heat Radiators

40509–40510

This bulletin sheet is to be used in conjunction with the data sheet for types 40485 and 40486 dated 1/67.



RCA 40509 and 40510 are gated bidirectional silicon thyristors having integral heat radiators. They are variants of the 40485 and 40486, respectively.

The 40409 and 40510 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40509	40485
40510	40486

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)

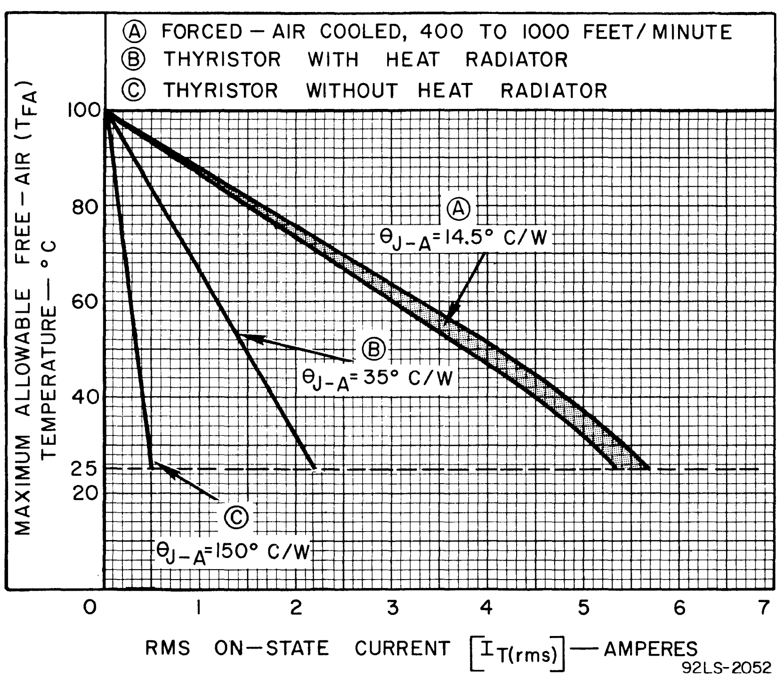


Fig. 1

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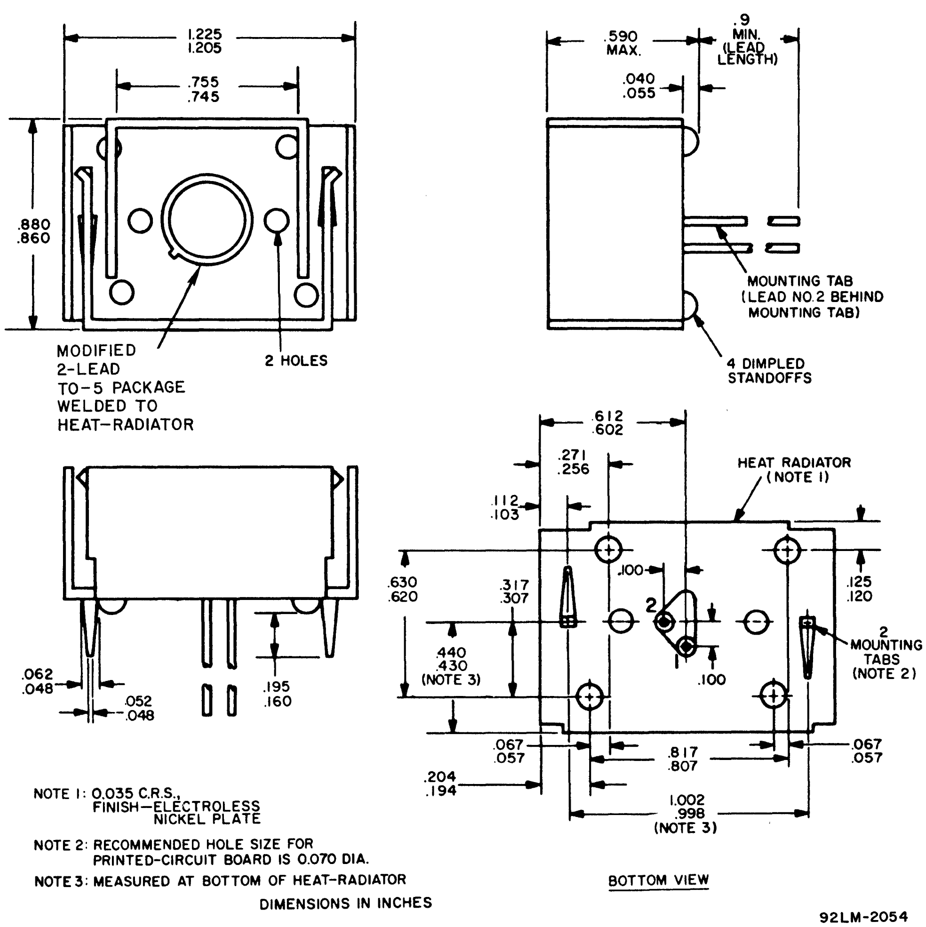
DIMENSIONAL OUTLINE



TERMINAL CONNECTIONS

Lead 1: Main Terminal 1

Lead 2: Gate

Radiator, Case: Main Terminal 2

RCA TRIACS

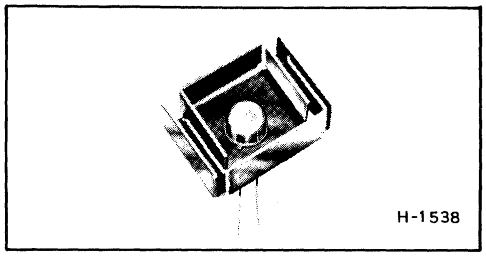
Having Factory-Attached Heat Radiators

40511 – 40512

File No. 263

This bulletin sheet is to be used in conjunction with the data sheet for types 40431 and 40432 dated 3/67.

RCA 40511 and 40512 are integral-trigger type gated bidirectional thyristors having integral heat radiators. They are variants of the 40431 and 40432, respectively.



H-1538

The 40511 and 40512 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40511 40512	40431 40432

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)

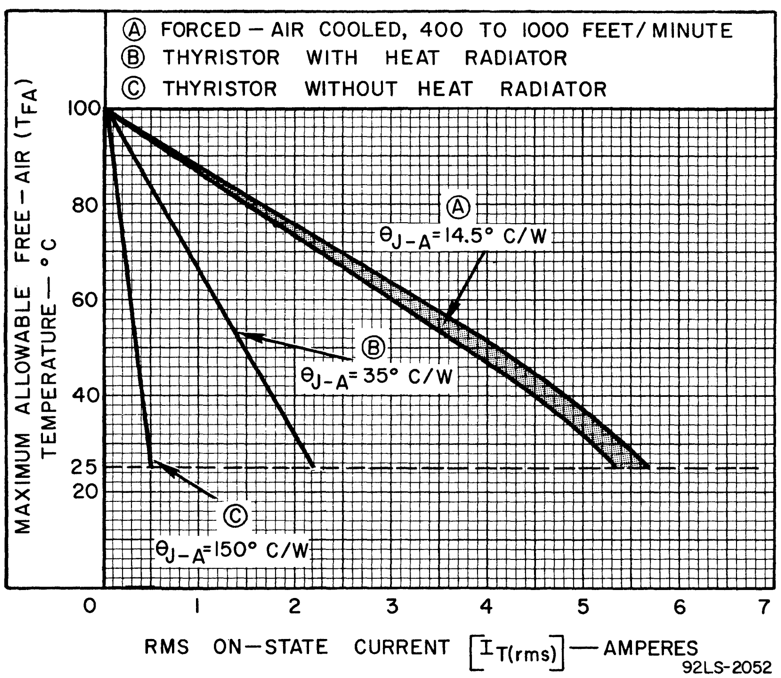


Fig. 1

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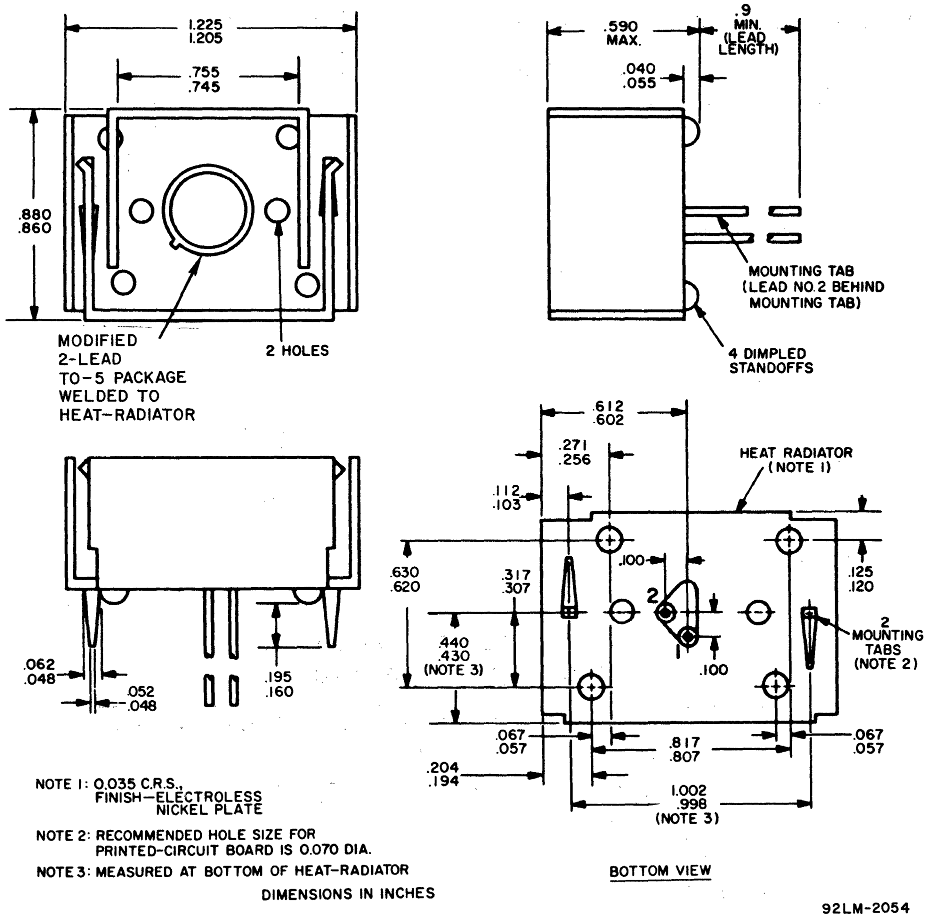
DIMENSIONAL OUTLINE



TERMINAL CONNECTIONS

Lead 1: Main Terminal 1

Lead 2: Gate

Radiator, Case: Main Terminal 2

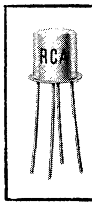
RCA-40517 is a double-diffused, epitaxial planar transistor of the silicon n-p-n type for low-noise amplifier, mixer, and oscillator applications at frequencies up to 500 MHz in a common-emitter configuration and up to 1200 MHz in a common-base configuration.

This transistor is electrically and mechanically similar to the 2N3839, the low-noise version of the 2N2857. The RCA-40517 is intended for use in Military applications and meets the performance requirements of MIL-S-19500/343.

The 40517 utilizes a hermetically sealed JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by a fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the technical bulletin for RCA-2N3839 also apply for RCA-40517.

LOW-NOISE SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC TO-72

For UHF Applications in Military Equipment

Features

- meets performance requirements of MIL-S-19500/343
- complete electrical and mechanical QUALITY CONFORMANCE test program
- 100% Noise Figure and Power Gain Tests at 450 MHz
- high gain-bandwidth product — f_T = 1000 MHz min.
- very low device noise figure — NF = 3.4 dB max. at 450 MHz
- high power gain as neutralized amplifier — G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator — P_o = 30 mW min. at 500 MHz
- low collector-to-base time constant — $r_{b'}C_c$ = 7 ps typ.

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE V_{CBO}	30 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures* up to 25°C	300 max.	mW
At case temperatures* above 25°C	Derate at 1.72	mW/°C
For operation in free air:		
At ambient temperatures up to 25°C	200 max.	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	−65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds maximum	265 max.	°C

*Measured at center of seating surface.

TABLE I
GROUP A TESTS

Sub-group	Lot Tolerance Per Cent Defective	Characteristic Test	Symbol	MIL-STD 750 Reference Test Method	TEST CONDITIONS: Ambient Temperature T_A (°C)	Frequency f (MHz)	DC Collector-to-Emitter Voltage V_{CE} (V)	DC Collector Current I_C (mA)	DC Emitter Current I_E (mA)	DC Base Current I_B (mA)	LIMITS RCA 40517 Min.	Max.	Units
1	10	Visual and Mechanical Examination	—	2071	—	—	—	—	—	—	—	—	—
2	5	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25 ± 3	—	V_{CB} = 15		0		—	10	nA
		Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25 ± 3	—	16			V_{BE}=0	—	100	nA
		Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	3001 Test Condition D	25 ± 3	—		0.001	0		30	—	V
		Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$ (sus)	3011 Test Condition D	25 ± 3	—		3*		0	15	—	V
		Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	3026 Test Condition D	25 ± 3	—		0	−0.01		2.5	—	V
		Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25 ± 3	—		10		1	—	1	V
		Collector-to-Emitter Voltage	V_{CE}	3071	25 ± 3	—		10		1	—	0.4	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25 ± 3	—	1	3			30	150	
3	15	Small-Signal Power Gain▲ (See Fig. 1 for Test Circuit)	G_{pe}		25 ± 3	450	6	1.5			12.5	21.0	dB
		Device Noise Figure ♦▲ Generator Resistance (R_G) = 50 Ω (See Fig. 2 for Test Circuit)	NF		25 ± 3	450	6	1.5			—	3.4	dB
		Measured Noise Figure▲ Generator Resistance (R_G) = 50 Ω (See Fig. 2 for Test Circuit)	NF		25 ± 3	450	6	1.5			—	3.9	dB
		Collector-to-Base Time Constant▲ (See Fig. 3 for Test Circuit)	$r_b'C_c$		25 ± 3	31.9	6		−2		4.0	15	ps
		Oscillator Power Output (See Fig. 4 for Test Circuit)	P_o		25 ± 3	≥500	V_{CB} = 10		−12		30	—	mW
		Collector-to-Base Feedback Capacitance●	C_{obo}	3236	25 ± 3	≥0.1 ≤1	V_{CB} = 10		0		—	1.5	pF
4	15	Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	−55±3	—	1	3			10	—	
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-5}	—	V_{CB} = 15		0		—	1	µA
		Small-Signal, Short Circuit Forward Current-Transfer Ratio▲	h_{fe}	3206	25 ± 3	0.001	6	2			50	220	
		Magnitude of Small-Signal, Short-Circuit Forward Current Transfer Ratio▲	$\|h_{fe}\|$	3206	25 ± 3	100	6	5			10	19	

* Pulse Test. ▲ Lead No. 4 (Case) Grounded.

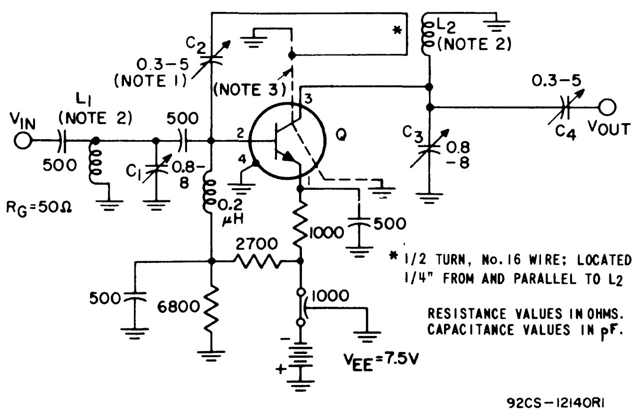
♦ Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test amplifier and the contribution of the following stages in the test setup.

● Two-terminal measurement with emitter and case leads open.

TABLE III
GROUP C TESTS*

Sub-group	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective	INITIAL AND ENDPOINT CHARACTERISTICS TESTS							Units
				Charac-teristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40517				
							Initial Values		End Point Values		
			%				Min.	Max.	Min.	Max.	
1	BAROMETRIC PRESSURE REDUCED (ALT. OPER.) Measurement during test	1001	15			Normal mounting Pressure 8 mm Hg for 60 seconds min.					
	COLLECTOR CUTOFF CURRENT			I_{CBO}	3036D	V_{CB} = 30 V dc	—	1.0	—	—	μA
	THERMAL RESISTANCE			θ_{j-A}	3151			0.875			°C/mW

* This inspection shall be conducted on the initial lot and thereafter every 6 months.



Q = RCA Type 40517

NOTE 1: (NEUTRALIZATION PROCEDURE): (A) CONNECT A 450-MHz SIGNAL GENERATOR (WITH Rg = 50 OHMS) TO THE INPUT TERMINALS OF THE AMPLIFIER. (B) CONNECT A 50-OHM RF VOLTMETER ACROSS THE OUTPUT TERMINALS OF THE AMPLIFIER. (C) APPLY V_{EE}, AND WITH THE SIGNAL GENERATOR ADJUSTED FOR 5 mV OUTPUT FROM THE AMPLIFIER, TUNE C_1,C_3, AND C_4 FOR MAXIMUM OUTPUT. (D) INTERCHANGE THE CONNECTIONS TO THE SIGNAL GENERATOR AND THE RF VOLTMETER. (E) WITH SUFFICIENT SIGNAL APPLIED TO THE OUTPUT TERMINALS OF THE AMPLIFIER, ADJUST C_2 FOR A MINIMUM INDICATION AT THE INPUT. (F) REPEAT STEPS (A), (B), AND (C) TO DETERMINE IF RETUNING IS NECESSARY.

NOTE 2: L_1 & L_2—SILVER-PLATED BRASS ROD, 1-1/2" LONG x 1/4" DIA. INSTALL AT LEAST 1/2" FROM NEAREST VERTICAL CHASSIS SURFACE.

NOTE 3: EXTERNAL INTERLEAD SHIELD TO ISOLATE THE COLLECTOR LEAD FROM THE EMITTER AND BASE LEADS.

Fig. 1 - Neutralized amplifier circuit used to measure 450-MHz power gain and noise figure for RCA-40517

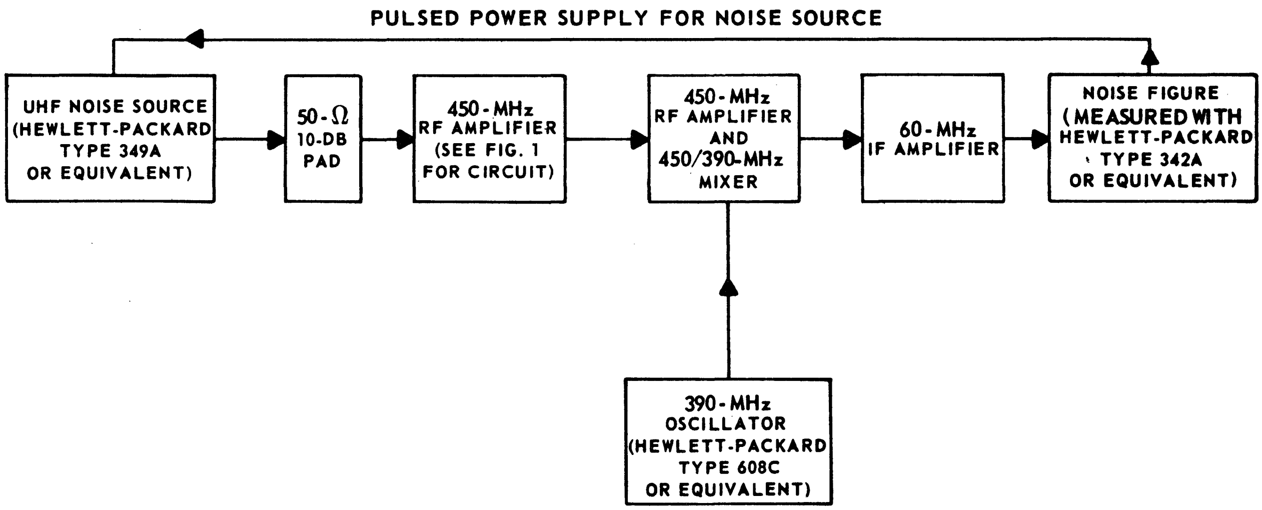
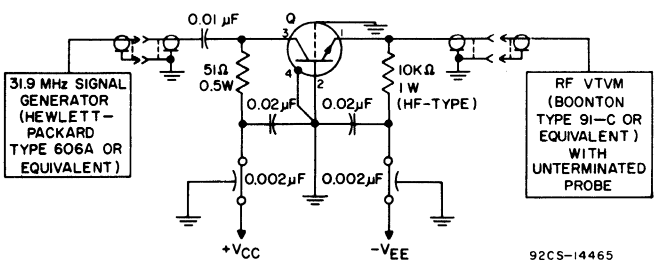


Fig. 2 - Block diagram of 450-MHz noise-figure test circuit for RCA-40517



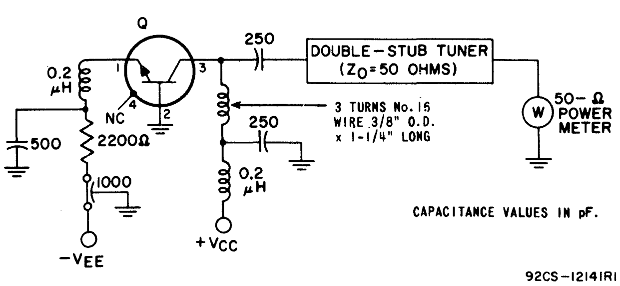
Q = RCA Type 40517

NOTE: Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for $V_{CB} = 6$ V, $I_C = 2$ mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

Fig. 3 - Collector-to-base time constant measurement circuit



Q = RCA Type 40517

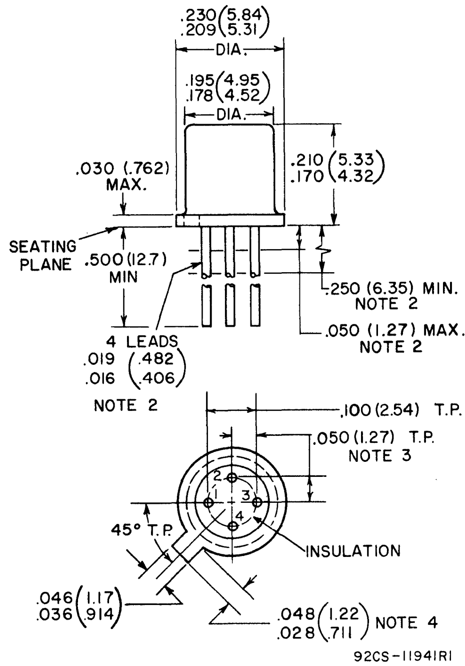
Fig. 4 - Oscillator circuit used to measure 500-MHz power output for RCA-40517

TABLE II
GROUP B TESTS

Sub-group	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective	INITIAL AND ENDPOINT CHARACTERISTICS TESTS							Units
				Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40517				
							Initial Values		End Point Values		
			%				Min.	Max.	Min.	Max.	
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 6)	2066	20	—	—	—	—	—	—	—	
2	SOLDERABILITY Solder Temp. = 230 ± 5°C	2026 Omit Aging	10	I_{CBO}	3036D	$T_A = 25 \pm 3°C$ $V_{CB} = 15$ V	—	10	—	10	nA
	TEMPERATURE-CYCLING TEST (Condition C)	1051									
	THERMAL-SHOCK TEST: $T_{min} = 0\ ^{+5}_{-0}$ °C $T_{max} = 100\ ^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	$T_A = 25 \pm 3°C$ $V_{CE} = 1$ V $I_C = 3$ mA	30	150	30	—	
	SEAL LEAK RATE TEST Helium leak test			Helium Leak Test	MIL-STD 202 Method 112 Condition C Procedure III A		—	—	—	5×10^{-7}	atm cm^3/s
	Bubble test			Bubble Test	MIL-STD 202 Condition A	$T_A = 150°C$ (min.) 1 minute					
	MOISTURE-RESISTANCE TEST	1021		I_{CBO}	3036D	$T_A = 25 \pm 3°C$ $V_{CB} = 15$ V	—	10	—	10	nA
				h_{FE}	3076	$T_A = 25 \pm 3°C$ $V_{CE} = 1$ V $I_C = 3$ mA	30	150	30	—	
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 ms 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	10	I_{CBO}	3036D	$T_A = 25 \pm 3°C$ $V_{CB} = 15$ V	—	10	—	10	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ± 20 Hz, 20 G's	2046									
	VIBRATION VARIABLE-FREQUENCY TEST	2056		h_{FE}	3076	$T_A = 25 \pm 3°C$ $V_{CE} = 1$ V $I_C = 3$ mA	30	150	30	—	
	CONSTANT-ACCELERATION TEST: 20,000 G's	2006									
4	SALT-ATMOSPHERE TEST	1041	20	—	—	—	—	—	—	—	—
5	TERMINAL STRENGTH TEST	2036 Test Condition E	20	—	—	—	—	—	—	—	—
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): $T_A = 200 \pm 10°C$ Duration = 1000 hrs.	1031	λ = 10%	I_{CBO}	3036D	$T_A = 25 \pm 3°C$ $V_{CB} = 15$ V	—	10	—	20	nA
				h_{FE}	3076	$T_A = 25 \pm 3°C$ $V_{CE} = 1$ V $I_C = 3$ mA	30	150	24	—	
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit $T_A = 25 \pm 3°C$ $V_{CB} = 10$ to 15 V dc $P_T = 200$ mW Duration = 1000 hrs.	1026	λ = 10%	I_{CBO}	3036D	$T_A = 25 \pm 3°C$ $V_{CB} = 15$ V	—	10	—	20	nA
				h_{FE}	3076	$T_A = 25 \pm 3°C$ $V_{CE} = 1$ V $I_C = 3$ mA	30	150	24	—	

DIMENSIONAL OUTLINE

JEDEC-TO-72



Dimensions in inches and millimeters

Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

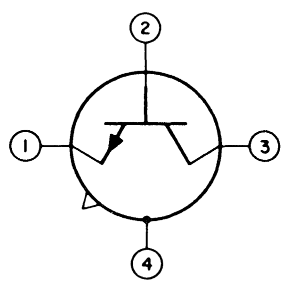
Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) - 0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM

Bottom View

LEAD 1—EMITTER
LEAD 2—BASE
LEAD 3—COLLECTOR
LEAD 4—CONNECTED TO CASE



RCA-40518 is a high-reliability double-diffused, epitaxial planar transistor of the silicon n-p-n type for low-noise amplifier, mixer, and oscillator application at frequencies up to 500 MHz in a common-emitter configuration and up to 1200 MHz in a common-base configuration.

This transistor is electrically and mechanically similar to the 2N3839, the low-noise version of the 2N2857. The RCA-40518 is specially preconditioned and tested for high-reliability Aerospace and Military applications and meets the performance requirements of MIL-S-19500/343.

The 40518 utilizes a hermetically sealed JEDEC TO-72 package. All active transistor elements are insulated from the case, which may be grounded by a fourth lead in applications requiring shielding of the device.

The curves of Typical Characteristics shown in the technical bulletin for RCA-2N3839 also apply for RCA-40518.

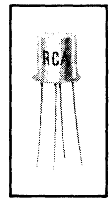
Maximum Ratings, Absolute-Maximum Values:

COLLECTOR-TO-BASE VOLTAGE, V_{CBO}	30 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	15 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	2.5 max.	V
COLLECTOR CURRENT, I_C	40 max.	mA
TRANSISTOR DISSIPATION, P_T:		
For operation with heat sink:		
At case temperatures* up to 25°C	300 max.	mW
At case temperatures* above 25°C	Derate at 1.72	mW/°C
For operation in free air:		
At ambient temperatures up to 25°C	200 max.	mW
At ambient temperatures above 25°C	Derate at 1.14	mW/°C
TEMPERATURE RANGE:		
Storage and Operating (Junction)	-65 to +200	°C
LEAD TEMPERATURE (During soldering):		
At distances ≥ 1/32 inch from seating surface for 10 seconds maximum	265 max.	°C

* Measured at center of seating surface.

LOW-NOISE HIGH-RELIABILITY SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR

For UHF Applications in Aerospace and Military Equipment



JEDEC TO-72

Features

- meets performance requirements of MIL-S-19500/343
- 100% thermal and mechanical preconditioning after sealing
- complete electrical and mechanical QUALITY CONFORMANCE test program
- 100% RELIABILITY ASSURANCE testing
- 100% PERFORMANCE-REQUIREMENTS testing
- 100% Noise Figure and Power Gain Tests at 450 MHz
- high gain-bandwidth product — f_T = 1000 MHz min.
- very low device noise figure — NF = 3.4 dB max. at 450 MHz
- high power gain as neutralized amplifier — G_{pe} = 12.5 dB min. at 450 MHz for circuit bandwidth of 20 MHz
- high power output as uhf oscillator — P_o = 30 mW min. at 500 MHz
- low collector-to-base time constant — $r_b'C_c$ = 7 ps typ.

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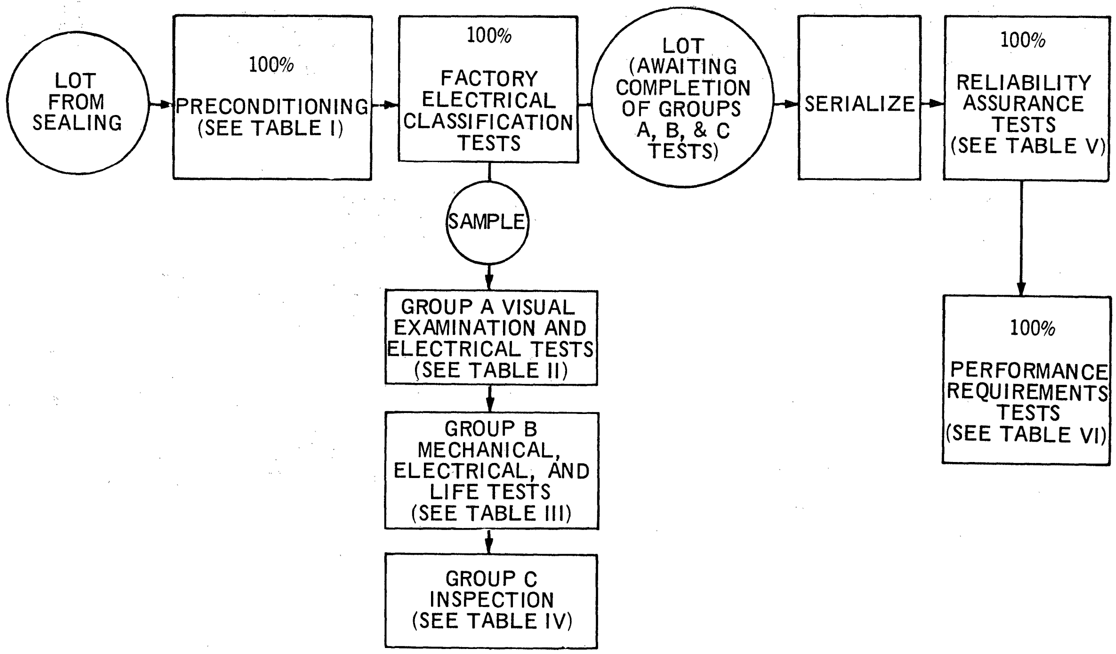


Fig.1 - High-reliability testing process flow diagram

TABLE I 100% PRECONDITIONING
BEFORE FACTORY, QUALITY, RELIABILITY-ASSURANCE AND PERFORMANCE REQUIREMENTS TESTS

STABILIZATION BAKE	48 hours minimum at 200° C
TEMPERATURE CYCLING (PER MIL-STD-750 METHOD 1051, COND. C)	5 complete cycles from -65° C to +200° C, each including 15 minutes at -65° C, 15 minutes at +200° C, and 5 minutes at +25° C
HELIUM-LEAK TEST (PER MIL-STD-202, METHOD 112 COND. C, PROC.IIIA). . .	Leakage may not exceed 5×10^{-7} atm cc/s
BUBBLE TEST (PER MIL-STD-202, METHOD 112 COND. A)	150° C minimum, 1 minute, ethylene glycol
CONSTANT-ACCELERATION (CENTRIFUGE) TEST (PER MIL-STD-750, METHOD 2006). .	20,000 G's; Y_1 plane, 1 minute

TABLE II
GROUP A TESTS

Subgroup	Lot Tolerance Per Cent Defective	Characteristic Test	Symbol	MIL-STD 750 Reference Test Method	TEST CONDITIONS: Ambient Temperature T_A	Frequency f	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	LIMITS RCA 40518		Units
					°C	MHz	V	mA	mA	mA	Min.	Max.	
1	5	Visual and Mechanical Examination	--	2071	--	--	--	--	--	--	--	--	
2	3	Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25 ±3	--	V_{CB} = 15		0		--	10	nA
		Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25 ±3	--	16			V_{BE} = 0	--	100	nA
		Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	3001 Test Condition D	25 ±3	--		0.001	0		30	--	V
		Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$	3011 Test Condition D	25 ±3	--		3*		0	15	--	V
		Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	3026 Test Condition D	25 ±3	--		0	-0.010		2.5	--	V
		Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25 ±3	--		10		1	--	1	V
		Collector-to-Emitter Voltage	V_{CE}	3071	25 ±3	--		10		1	--	0.4	V
		Static Forward Current-Transfer Ratio	h_{FE}	3076	25 ±3	--	1	3			30	150	
3	10	Small-Signal Power Gain▲ (See Fig.2 for Test Circuit)	G_{pe}		25 ±3	450	6	1.5			12.5	21.0	dB
		Device Noise Figure♦▲ Generator Resistance (R_G) = 50 Ω (See Fig.3 for Test Circuit)	NF		25 ±3	450	6	1.5			--	3.4	dB
		Measured Noise Figure▲ Generator Resistance (R_G) = 50 Ω (See Fig.3 for Test Circuit)	NF		25 ±3	450	6	1.5			--	3.9	dB
		Collector-to-Base Time Constant▲ (See Fig.4 for Test Circuit)	$r_{b'}C_c$		25 ±3	31.9	6		-2		4.0	15	ps
		Oscillator Power Output (See Fig.5 for Test Circuit)	P_o		25 ±3	$\geq$500	V_{CB} = 10		-12		30	—	mW
		Collector-to-Base Feedback Capacitance●	C_{obo}	3236	25 ±3	$\geq$0.1 $\leq$1	V_{CB} = 10		0		--	1.5	pF
4	10	Static Forward Current Transfer Ratio (Low Temperature)	h_{FE}	3076	-55 ±3	--	1	3			10	--	
		Collector-Cutoff Current (High Temperature)	I_{CBO}	3036 Bias Condition D	150^{+0}_{-5}	--	V_{CB} = 10		0		--	1	μA
		Small-Signal, Short Circuit Forward Current-Transfer Ratio▲	h_{fe}	3206	25 ±3	0.001	6	2			50	220	
		Magnitude of Small-Signal, Short-Circuit Forward Current Transfer Ratio▲	$\|h_{fe}\|$	3206	25 ±3	100	6	5			10	19	

* Pulse Test

▲ Lead No.4 (Case) Grounded

♦ Device noise figure is approximately 0.5 dB lower than the measured noise figure. The difference is due to the insertion loss at the input of the test amplifier and the contribution of the following stages in the test setup.

● Two-terminal measurement with emitter and case leads open.

TABLE III
GROUP B TESTS

Sub-group	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective (%)	Characteristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40518 Initial Values Min.	RCA-40518 Initial Values Max.	RCA-40518 End Point Values Min.	RCA-40518 End Point Values Max.	Units
1	PHYSICAL DIMENSIONS (See Dimensional Outline Drawing on page 8)	2066	20	--	--	--	--	--	--	--	
2	SOLDERABILITY Solder Temp. = 230 ± 5°C TEMPERATURE-CYCLING TEST (Condition C)	2026 Omit Aging 1051	10	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	10	nA
	THERMAL-SHOCK TEST: $T_{min} = 0 {}^{+5}_{-0}$ °C, $T_{max} = 100 {}^{+0}_{-5}$ °C	1056 Test Condition A		h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 1 V I_C = 3 mA	30	150	30	--	
	SEAL LEAK RATE TEST Helium leak test Bubble test		10	Helium Leak Test	MIL-STD 202 Method 112 Condition C Procedure III A		--	--	--	$5x10^{-7}$	atm cm^3/s
				Bubble Test	MIL-STD 202 Condition A	T_A = 150°C (min.) 1 minute					
	MOISTURE-RESISTANCE TEST	1021	10	I_{CBO}	3036D	T_A = 25 ± 3°C V_{CB} = 15 V	--	10	--	10	nA
				h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 1 V I_C = 3 mA	30	150	30	--	
3	SHOCK TEST: NON-OPERATING 1500 G's, 0.5 ms 5 blows each in X_1, Y_1, Y_2, and Z_1 planes	2016	10	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	10	nA
	VIBRATION FATIGUE TEST: NON-OPERATING 60 ± 20 Hz, 20 G's VIBRATION VARIABLE-FREQUENCY TEST CONSTANT-ACCELERATION TEST: 20,000 G's	2046 2056 2006		h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 1 V I_C = 3 mA	30	150	30	--	
4	SALT-ATMOSPHERE TEST	1041	20	--	--	--	--	--	--	--	--
5	TERMINAL STRENGTH TEST	2036 Test Condition E	20	--	--	--	--	--	--	--	--
6	HIGH-TEMPERATURE LIFE TEST (NON-OPERATING): T_A = 200 ±10°C Duration = 1000 hrs.	1031	λ = 7%	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	20	nA
				h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 1 V I_C = 3 mA	30	150	24	--	
7	STEADY-STATE OPERATION LIFE TEST: Common-Base Circuit T_A = 25 ±3°C V_{CB} = 10 to 15 V P_T = 200 mW Duration = 1000 hrs.	1026	λ = 7%	I_{CBO}	3036D	T_A = 25 ±3°C V_{CB} = 15 V	--	10	--	20	nA
				h_{FE}	3076	T_A = 25 ±3°C V_{CE} = 1 V I_C = 3 mA	30	150	24	--	

TABLE IV
GROUP C TESTS*

Sub-group	Test	MIL-STD 750 Reference	Lot Tolerance Per Cent Defective %	INITIAL AND ENDPOINT CHARACTERISTICS TESTS: Charac-teristic Test	MIL-STD 750 Reference	Test Conditions	RCA-40518 Initial Values Min.	RCA-40518 Initial Values Max.	RCA-40518 End Point Values Min.	RCA-40518 End Point Values Max.	Units
1	BAROMETRIC PRESSURE REDUCED (ALT. OPER.) Measurement during test	1001	15			Normal mounting Pressure 8 mm Hg for 60 seconds min.					
	COLLECTOR CUTOFF CURRENT			I_{CBO}	3036D	$V_{CB} = 30$ V dc	--	1.0	--	--	μA
	THERMAL RESISTANCE			θ_{J-A}	3151			0.875			$^oC/mW$

* This inspection shall be conducted on the initial lot and thereafter every 6 months.

TABLE V
100% RELIABILITY ASSURANCE TEST
THE CUMULATIVE REJECTS OF TABLES V AND VI SHALL NOT EXCEED 10% OF THE LOT

Test	MIL-STD 750 Reference	INITIAL AND ENDPOINT CHARACTERISTICS TESTS: Characteristic Test	RCA-40518 Initial Value	RCA-40518 Endpoint Value	MIL-STD 750 Reference	Test Conditions
POWER BURN-IN: Common-Base Circuit $T_A = 25 \pm 3^oC$ $V_{CB} = 15$ V min. $P_T = 200$ mW Duration = 168 hours	1026	ΔI_{CBO}	10 max. nA	$\Delta = 100\%$♦ $\Delta = \pm 5$ nA	3036 Bias Condition D	$T_A = 25 \pm 3^oC$ $V_{CB} = 15$ V
		Δh_{FE}	30 min. 150 max.	$\Delta = \pm 15\%$	3076	$T_A = 25 \pm 3^oC$ $V_{CE} = 1$ V $I_C = 3$ mA

♦ 100% or 5 mA, whichever is greater

TABLE VI

100% PERFORMANCE REQUIREMENTS TESTS

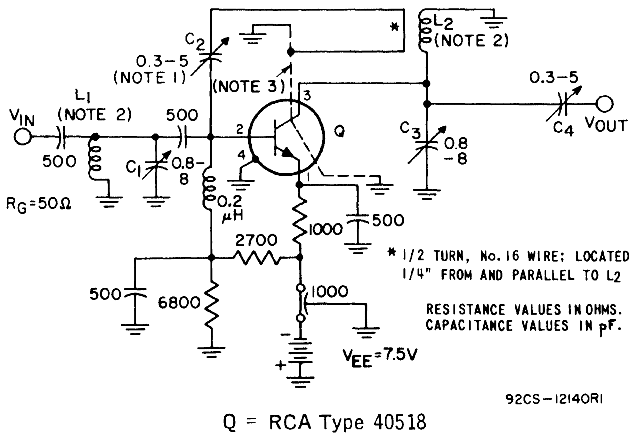
THE CUMULATIVE REJECTS OF TABLES V AND VI SHALL NOT EXCEED 10% OF THE LOT

TABLE VI SHALL BE TESTED TO A LTPD OF 5%

Test	Symbol	MIL-STD 750 Reference	TEST CONDITIONS							LIMITS		Units
			Ambient Temperature T_A	Frequency f	DC Collector-to-Base Voltage V_{CB}	DC Collector-to-Emitter Voltage V_{CE}	DC Collector Current I_C	DC Emitter Current I_E	DC Base Current I_B	RCA 40518		
			°C	MHz	V	V	mA	mA	mA	Min.	Max.	
Collector-Cutoff Current	I_{CBO}	3036 Bias Condition D	25 ± 3	--	15			0		--	10	nA
Collector-Cutoff Current	I_{CES}	3041 Bias Condition C	25 ± 3	--		16				--	100	nA
Collector-to-Base Breakdown Voltage	$V_{(BR)CBO}$	3001 Test Condition D	25 ± 3	--			0.001	0		30	--	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$ (sus)	3011 Test Condition D	25 ± 3	--			3*		0	15	--	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$	3026 Test Condition D	25 ± 3	--			0	-0.010		2.5	--	V
Base-to-Emitter Voltage	V_{BE}	3066 Test Condition A	25 ± 3	--			10		1	--	1	V
Collector-to-Emitter Voltage	V_{CE}	3071	25 ± 3	--			10		1	--	0.4	V
Static Forward Current-Transfer Ratio	h_{FE}	3076	25 ± 3	--		1	3			30	150	
Device Noise Figure▲: Generator Resistance (R_G) = 50 Ohms (See Fig.3 for Test Circuit)	NF	--	25 ± 3	450		6	1.5			--	3.4	dB
Measured Noise Figure▲: Generator Resistance (R_G) = 50 Ohms (See Fig.3 for Test Circuit)	NF	--	25 ± 3	450		6	1.5			--	3.9	dB
Visual Examination (External) Under 20-Power Magnification		Examine leads, header, and shell for visual defects.										

* Pulse Test

▲ Lead No.4 (Case) Grounded



NOTE 1: (NEUTRALIZATION PROCEDURE): (A) CONNECT A 450-MHz SIGNAL GENERATOR (WITH R_g = 50 OHMS) TO THE INPUT TERMINALS OF THE AMPLIFIER. (B) CONNECT A 50-OHM RF VOLTMETER ACROSS THE OUTPUT TERMINALS OF THE AMPLIFIER. (C) APPLY V_{EE}, AND WITH THE SIGNAL GENERATOR ADJUSTED FOR 5 mV OUTPUT FROM THE AMPLIFIER, TUNE C_1, C_3, AND C_4 FOR MAXIMUM OUTPUT. (D) INTERCHANGE THE CONNECTIONS TO THE SIGNAL GENERATOR AND THE RF VOLTMETER. (E) WITH SUFFICIENT SIGNAL APPLIED TO THE OUTPUT TERMINALS OF THE AMPLIFIER, ADJUST C_2 FOR A MINIMUM INDICATION AT THE INPUT. (F) REPEAT STEPS (A), (B), AND (C) TO DETERMINE IF RETUNING IS NECESSARY.

NOTE 2: L_1 & L_2—SILVER-PLATED BRASS ROD, 1-1/2" LONG x 1/4" DIA. INSTALL AT LEAST 1/2" FROM NEAREST VERTICAL CHASSIS SURFACE.

NOTE 3: EXTERNAL INTERLEAD SHIELD TO ISOLATE THE COLLECTOR LEAD FROM THE EMITTER AND BASE LEADS.

Fig.2 - Neutralized amplifier circuit used to measure 450-MHz power gain and noise figure for RCA-40518

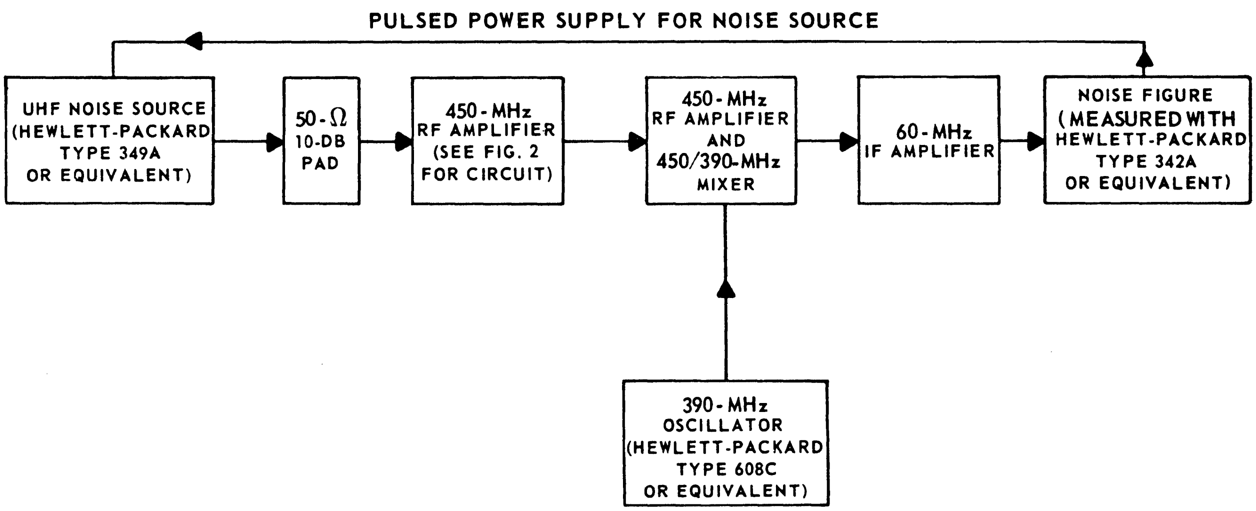
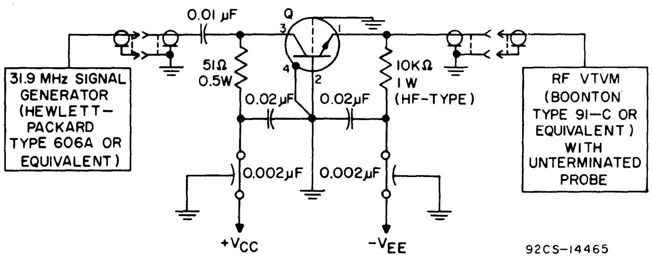


Fig.3 - Block diagram of 450-MHz noise-figure test circuit for RCA-40518



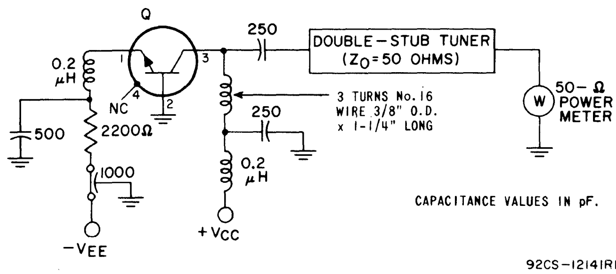
Q = RCA Type 40518

NOTE: Careful shielding must be used between input and output to keep signal feed-through to an absolute minimum.

PROCEDURE:

1. Before inserting the transistor in the test fixture, connect a short circuit between the collector and emitter terminals of the fixture and adjust the 31.9-MHz input for 0.5 V RMS at the emitter terminal.
2. Remove the short circuit between the collector and emitter terminals of the fixture, insert the transistor to be tested, and adjust V_{CC} and V_{EE} for V_{CB} = 6 V, I_C = 2 mA.
3. Read $r_b'C_c$ on rf-voltmeter scale ($r_b'C_c$ in picoseconds = 10 times meter indication in millivolts) (1 millivolt = 10 picoseconds).

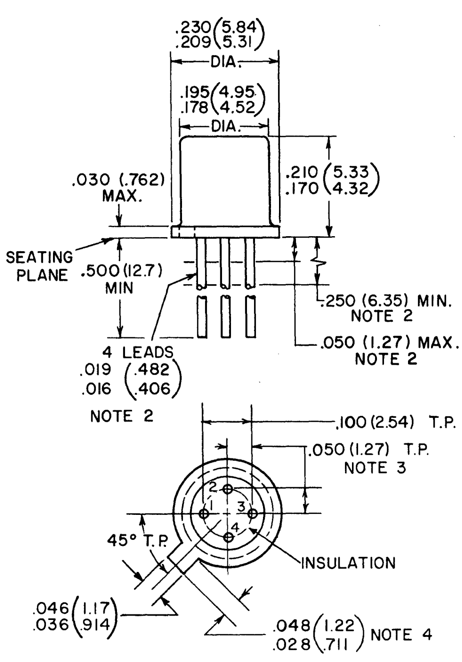
Fig.4 - Collector-to-base time constant measurement circuit



Q = RCA Type 40518

Fig.5 - Oscillator circuit used to measure 500-MHz power output for RCA-40518

DIMENSIONAL OUTLINE JEDEC TO-72

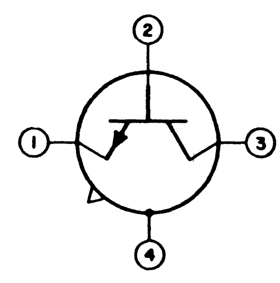


Dimensions in inches and millimeters

TERMINAL DIAGRAM

Bottom View

LEAD 1 – EMITTER
LEAD 2 – BASE
LEAD 3 – COLLECTOR
LEAD 4 – CONNECTED TO CASE



Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050" (1.27 mm) and 0.250" (6.35 mm) from the seating plane. From 0.250" (6.35 mm) to the end of the lead a maximum diameter of 0.021" (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019" (0.482 mm) at a gauging plane of 0.054" (1.372 mm) + 0.001" (0.025 mm) - 0.000" (0.000 mm) below seating plane shall be within 0.007" (0.177 mm) of their true position (location) relative to a maximum width of tab.

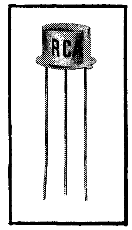
Note 4: Measured from actual maximum diameter.

RCA-40519 is an epitaxial planar transistor of the silicon n-p-n type, particularly suitable for class-C rf power-amplifier, driver, and frequency-multiplier service at output frequencies up to 400 MHz. The 40519 is especially useful in battery-operated transmitter systems and other applications requiring high efficiency and high power gain at low supply voltages.

As a frequency multiplier, the 40519 can double, triple, or quadruple with high efficiency and high power gain. In a typical application as a frequency doubler from 120 to 240 MHz (see Fig. 4) the 40519 can provide a power output of 100 mW with a power gain of 5.5 dB and an efficiency of 50%.

The 40519 is hermetically sealed in the compact JEDEC TO-52 package.

SILICON N-P-N EPITAXIAL PLANAR TRANSISTOR



JEDEC
TO-52

For Class-C RF Amplifier, Driver, and Frequency-Multiplier Service in Battery-Operated Communications Equipment

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE, V_{CES}	40 max.	V
COLLECTOR-TO-EMITTER VOLTAGE, V_{CEO}	16 max.	V
EMITTER-TO-BASE VOLTAGE, V_{EBO}	5 max.	V
COLLECTOR CURRENT, I_C	500 max.	mA
TRANSISTOR DISSIPATION, P_T:		
For case temperatures up to 25° C	1 max.	W
For case temperatures above 25° C	See Fig. 1	
For ambient temperatures up to 25° C	0.3 max.	W
For ambient temperatures above 25° C	See Fig. 1	
TEMPERATURE RANGE:		
Storage	−65 to +200	° C
Operating	−65 to +175	° C
LEAD TEMPERATURE (During soldering):		
At distances greater than 1/16″ from seating surface for 10 seconds max.	265° max.	C

Features

- **High power gain and high efficiency as unneutralized class C amplifier —**
  - $G_{pe} = 8$ dB typ., $P_{OUT} = 200$ mW typ., $\eta = 50\%$ typ. — at 170 MHz
  - $G_{pe} = 5$ dB typ., $P_{OUT} = 300$ mW typ., $\eta = 40\%$ typ. — at 240 MHz
- **Excellent performance as a frequency multiplier —**
  - $G_{pe} = 5.5$ dB typ., $P_{OUT} = 100$ mW typ., $\eta = 50\%$ typ. — as 120-240 MHz doubler
- **High minimum gain-bandwidth product at high current and low voltage —**
  $f_T = 300$ MHz min. at $I_C = 50$ mA, $V_{CE} = 1$ V
- **High typical gain-bandwidth product —**
  $f_T = 850$ MHz typ. at $I_C = 10$ mA, $V_{CE} = 10$ V
- **Low output capacitance —**
  $C_{obo} = 1.8$ pF typ.
- **Hermetically sealed JEDEC TO-52 package**

ELECTRICAL CHARACTERISTICS, at $T_A = 25°C$

Characteristics	Symbols	Frequency f (MHz)	DC Collector-to-Base Voltage V_{CB} (V)	DC Collector to-Emitter Voltage V_{CE} (V)	DC Base-to Emitter Voltage V_{BE} (V)	DC Base Current I_B (mA)	DC Emitter Current I_E (mA)	DC Collector Current I_C (mA)	RCA 40519 Min.	RCA 40519 Max.	Units
Collector-Cutoff Current	I_{CBO}		20		0		0		—	25	nA
Collector-to-Emitter Breakdown Voltage*	$V_{(BR)CEO}$					0		10	16	—	V
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CES}$				0			5	40	—	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$						—0.01	0	5	—	V
Static Forward Current-Transfer Ratio	h_{FE}			1				50	20	—	—
Magnitude of Small-Signal Forward Current-Transfer Ratio	$\|h_{fe}\|$	100		1				50	3	—	—
Common-Base, Open-Circuit Output Capacitance	C_{obo}	0.1 to 1	5				0		—	3.5	pF
Power Output as a Frequency Doubler	P_{OUT}	$f_{IN} = 86$ $f_{OUT} = 172$		See Fig. 3 RF Power Input = 15 mW					70	—	mW
Efficiency as a Frequency Doubler	η	$f_{IN} = 86$ $f_{OUT} = 172$		See Fig. 3					20	—	%

* Pulse Test: Pulse Duration ≤ 100μs, Duty Factor ≤ 0.02.

RATING CHART FOR RCA-40519

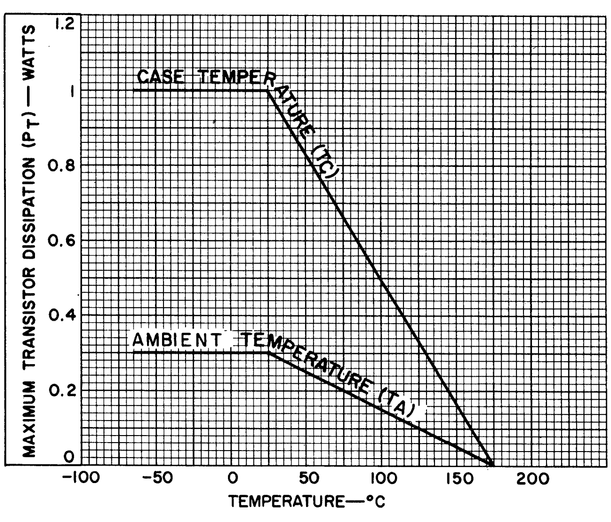
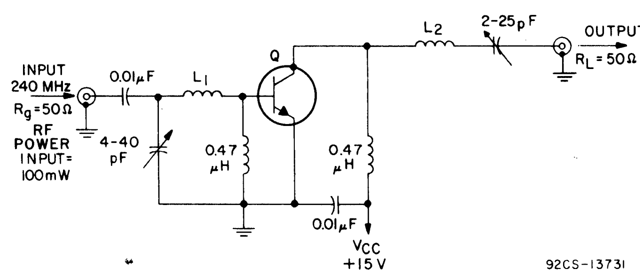


Fig. 1

TYPICAL 240-MHz CLASS-C POWER-AMPLIFIER CIRCUIT USING RCA-40519



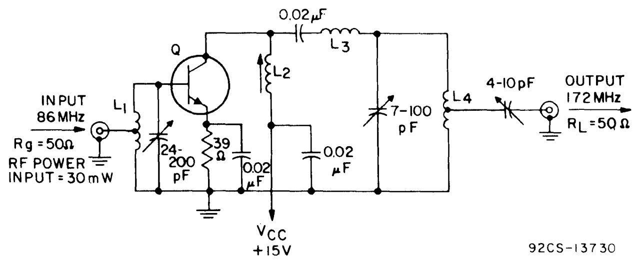
L_1: 2 turns #16 AWG, 1/8" I.D. Turns spaced approximately 1 wire diameter
L_2: 3-1/2 turns #16 AWG, 1/4" I.D.

TYPICAL PERFORMANCE CHARACTERISTICS

Operating Frequency	240	MHz
RF Output Power	300	mW
Power Gain	5	dB
Efficiency	40	%

Fig. 2

TYPICAL FREQUENCY DOUBLER (86 MHz TO 172 MHz) CIRCUIT USING RCA-40519



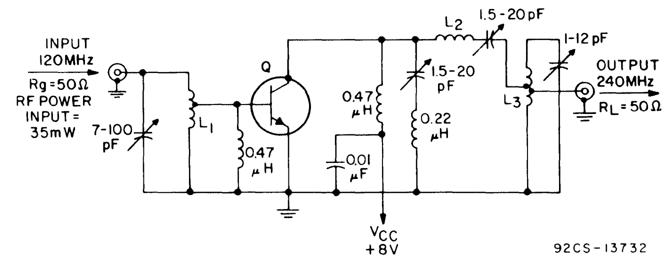
Q = RCA-40519
L_1: 5 turns #16 AWG, tapped 3-1/2 turns from rf-ground end
L_2: 4 turns #18 AWG, slug-tuned
L_3: 6 turns #18 AWG
L_4: 3-1/2 turns #16 AWG, tapped 2-1/2 turns from rf-ground end
All windings 1/4″ I.D.; turns spaced approximately 1 wire diameter

TYPICAL PERFORMANCE CHARACTERISTICS

RF Output Power (172 MHz)	90	mW
Power Gain	8.0	dB
Efficiency	30	%

Fig. 3

TYPICAL FREQUENCY DOUBLER (120 MHz TO 240 MHz) CIRCUIT USING RCA-40519



Q = RCA-40519
L_1: 3-1/2 turns #18 AWG, 1/4″ I.D., tapped at 2 turns from rf-ground end
L_2: 3-1/2 turns #20 AWG, 1/8″ I.D.
L_3: 3 turns #16 AWG, 1/8″ I.D., tapped at 1 turn and 1-1/2 turns from rf-ground end
Turns on all windings spaced approximately 1 wire diameter

TYPICAL PERFORMANCE CHARACTERISTICS

RF Power Output (240 MHz)	100	mW
Power Gain	5.5	dB
Efficiency	50	%

Fig. 4

RF OUTPUT POWER VS FREQUENCY FOR RCA-40519

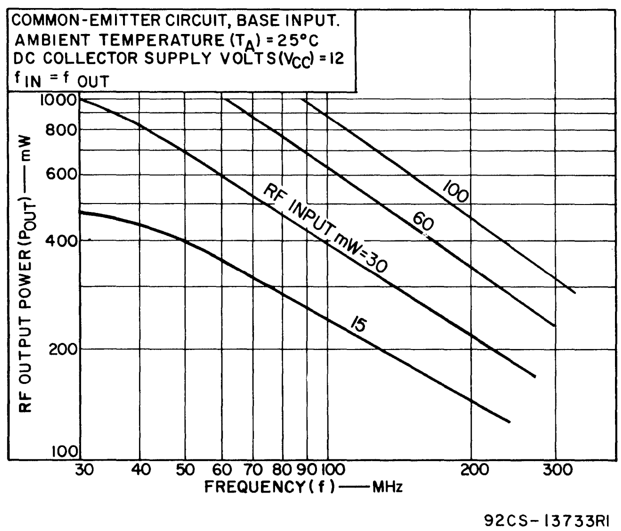


Fig. 5

GAIN-BANDWIDTH PRODUCT VS COLLECTOR CURRENT FOR RCA-40519

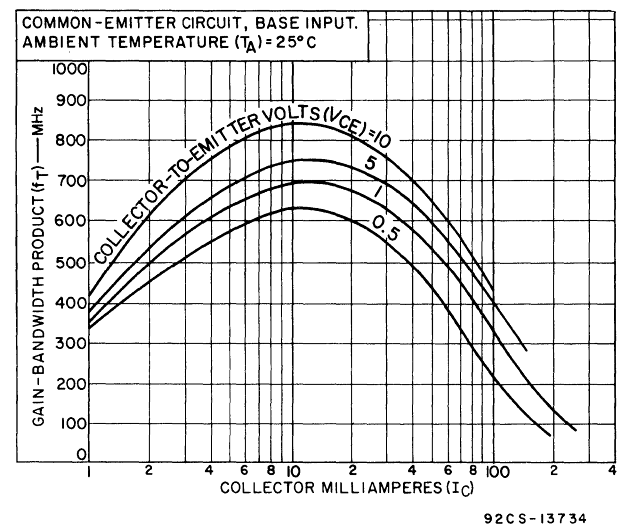
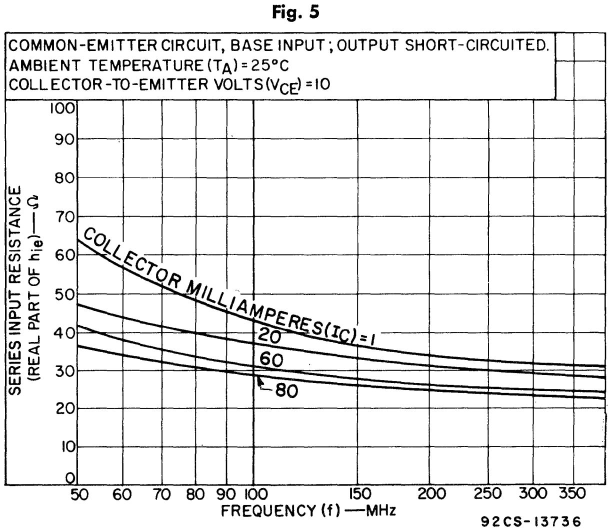


Fig. 6



TYPICAL CHARACTERISTICS

SERIES INPUT RESISTANCE VS FREQUENCY FOR RCA-40519

Fig. 7

TYPICAL CHARACTERISTICS

SERIES INPUT REACTANCE VS FREQUENCY FOR RCA-40519

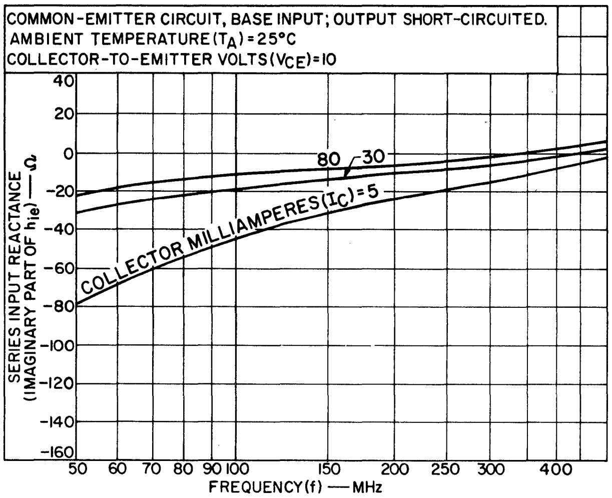


Fig. 8

OUTPUT CAPACITANCE VS COLLECTOR-TO-BASE VOLTAGE FOR RCA-40519

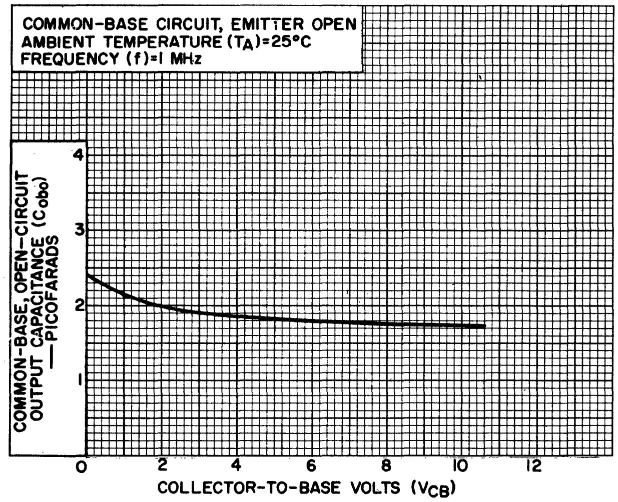
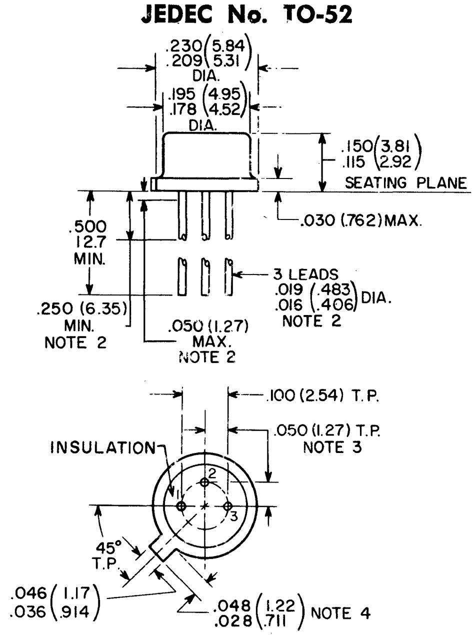


Fig. 9

DIMENSIONAL OUTLINE
JEDEC No. TO-52



Dimensions in Inches and Millimeters

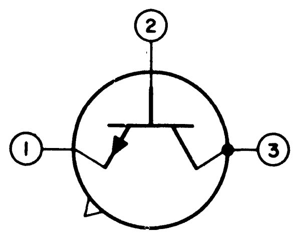
Note 1: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

Note 2: The specified lead diameter applies in the zone between 0.050″ (1.27 mm) and 0.250″ (6.35 mm) from the seating plane. From 0.250″ (6.35 mm) to the end of the lead a maximum diameter of 0.021″ (0.533 mm) is held. Outside of these zones, the lead diameter is not controlled.

Note 3: Leads having a maximum diameter of 0.019″ (0.482 mm) at a gauging plane of 0.054″ (1.372 mm) + 0.001″ (0.025 mm) − 0.000″ (0.000 mm) below seating plane shall be within 0.007″ (0.177 mm) of their true position (location) relative to a maximum width of tab.

Note 4: Measured from actual maximum diameter.

TERMINAL DIAGRAM
Bottom View



LEAD 1 — EMITTER
LEAD 2 — BASE
LEAD 3 — COLLECTOR, CASE

RCA TRIACS

40525 40528
40526 40529
40527 40530

File No. 261

SENSITIVE-GATE, LOW-CURRENT THYRISTORS

RCA 40525 through 40530*are gate-controlled full-wave ac silicon switches. They are designed to switch from a blocking state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

The 40528, 40529, and 40530 differ from types 40525, 40526, and 40527 in that they have higher dv/dt capability and higher gate trigger current requirements. The high gate sensitivity of these triacs enables them to be controlled with economical transistorized circuits and enhances their use in low-power phase-control and load-switching applications.

The 40525, 40526, and 40527 have rms on-state current ratings of 2.5 amperes at a case temperature of +60° C while the 40528, 40529, and 40530 have the same ratings at a case temperature of +70° C.

The repetitive peak off-state voltage rating for the 40525 and 40528 is 100 volts; for the 40526 and 40529, 200 volts; and for the 40527 and 40530, 400 volts.

*Formerly Dev. Types TA2892, TA2893, TA2894, TA2892A, TA2893A, and TA2894A.

40525 40528	For Low-Voltage Operation
40526 40529	For 120-Volt Line Operation
40527 40530	For 240-Volt Line Operation

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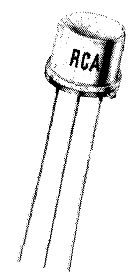
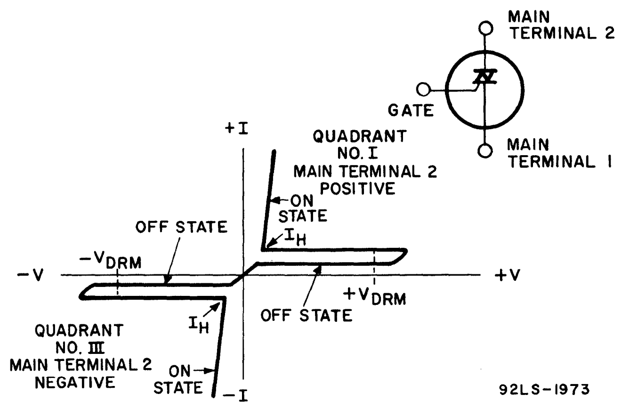


Modified TO-5

H-1380

- **Very High Gate Sensitivity**
  3 mA max. for types 40525, 40526, 40527
  10 mA max. for types 40528, 40529, 40530
- **2.5 A (rms) On-State Current Ratings**
- **Modified TO-5 Package**
- **Shorted-Emitter Design**

PRINCIPAL VOLTAGE-CURRENT CHARACTERISTIC



Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

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5/67

Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at Frequencies of 50 and 60 Hz, and with Resistive or Inductive Load

For definitions of terms and symbols, see page 8.

RATINGS	TRIAC TYPES						UNITS
	40525	40526	40527	40528	40529	40530	
Repetitive Peak Off-State Voltage♦**, V_{DRM}:**							
Gate open							
For T_j = -40° C to +90° C	100	200	400	–	–	–	V
For T_j = -40° C to +100° C	–	–	–	100	200	400	V
RMS On-State Current, I_T(rms):							
For case temperature (T_C) of +60° C and a conduction angle of 360°		2.5					A
For case temperature (T_C) of +70° C and a conduction angle of 360°					2.5		A
For free-air temperature (T_{FA}) of +25° C and a conduction angle of 360°		0.35			0.40		A
For other conditions and mounting methods	See *Figs.1, 2, 3,* and *4*						
Surge (Non-Repetitive) On-State Current, I_{TSM}:							
For one full cycle of applied sinusoidal principal voltage		25			25		A
For more than one full cycle of applied voltage	See *Fig.5*						
Peak Gate-Trigger Current■**, I_{GTM}:**							
For 1 μs max.		0.5			0.5		A
Gate Power:							
Peak■**, P_{GM}**							
For 1 μs max.		10			10		W
Average, P_{GAV}:							
For T_{FA} = +25° C		0.05			0.05		W
For T_C = +60° C		0.15			0.15		W
Temperature●**:**							
Storage, T_{stg}		-40 to +150			-40 to +150		°C
Operating (case), T_C.		-40 to +90			-40 to +100		°C

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

●For information on the reference point of temperature measurement, see *Dimensional Outline*.

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C)

For definitions of terms and symbols, see page 8.

CHARACTERISTICS	TRIAC TYPES						UNITS
	40525	40526	40527	40528	40529	40530	
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current♦, I_{DM}:							
Gate open							
At T_j = +100° C and V_{DRM} = Max. rated value	–	–	–	–	0.2	0.75	mA
At T_j = +90° C and V_{DRM} = Max. rated value	–	0.2	0.75	–	–	–	mA
On-State Voltage♦, v_T:							
For i_T = 10 A (peak) and T_C = +25° C	–	1.7	2.2	–	1.7	2.2	V(peak)
DC Holding Current♦, I_H:							
Initial principal current = 150 mA (dc)							
At T_C = +25° C	–	2	5	–	6.5	15	mA(dc)
For other case temperatures		See *Fig.11*			See *Fig.12*		
Critical Rate of Rise of Off-State Voltage♦, dv/dt:							
For v_{DX} = V_{DRM}, exponential voltage rise, gate open							
At T_C = +100° C	–	–	–	–	10	–	V/μs
At T_C = +90° C	–	5	–	–	–	–	V/μs
DC Gate-Trigger Current♦■, I_{GT}:							
For v_{DX} = 6 volts (dc), R_L = 39 ohms, T_C = +25° C, and Specified Triggering Mode:							
I^+ Mode: V_{T2} is positive, V_G is positive	–	1	3	–	3.5	10	mA(dc)
I^- Mode: V_{T2} is positive, V_G is negative	–	2	3	–	7	10	mA(dc)
III^+ Mode: V_{T2} is negative, V_G is positive	–	2	3	–	7	10	mA(dc)
III^- Mode: V_{T2} is negative, V_G is negative	–	1	3	–	3.5	10	mA(dc)
For other case temperatures		See *Fig.9*			See *Fig.10*		
DC Gate-Trigger Voltage♦■, V_{GT}:							
For v_{DX} = 6 volts (dc) and R_L = 39 ohms							
At T_C = +25° C	–	1	2.2	–	1	2.2	V
For other case temperatures			See *Fig.8*				
For v_{DX} = V_{DRM} and R_L = 125 ohms							
At T_C = +100° C	–	–	–	0.15	–	–	V
At T_C = +90° C	0.15	–	–	–	–	–	V

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

CONDUCTION RATING CHART (CASE TEMPERATURE)

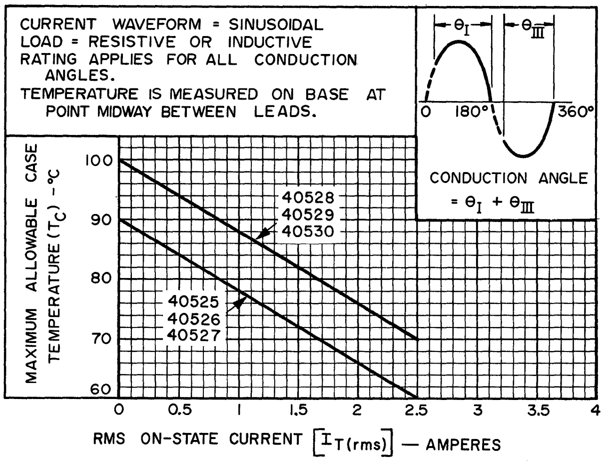


Fig. 1

CONDUCTION CHARACTERISTICS AS A FUNCTION OF MOUNTING METHOD

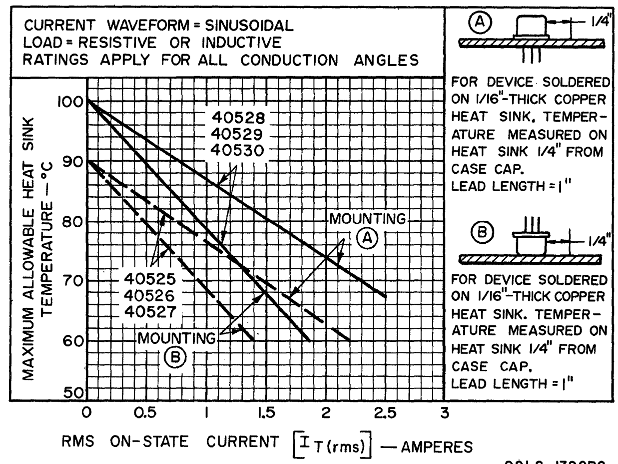


Fig. 2

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)
For 40525, 40526, and 40527

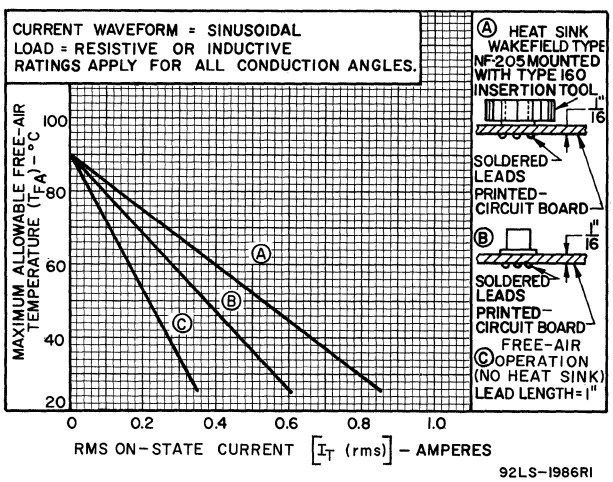


Fig. 3

CONDUCTION RATING CHART (FREE-AIR TEMPERATURE)
For 40528, 40529, and 40530

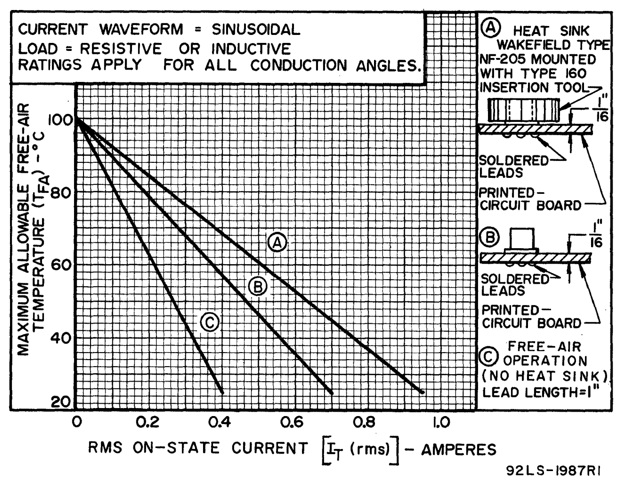


Fig. 4

SURGE-CURRENT RATING CHART
For All Types

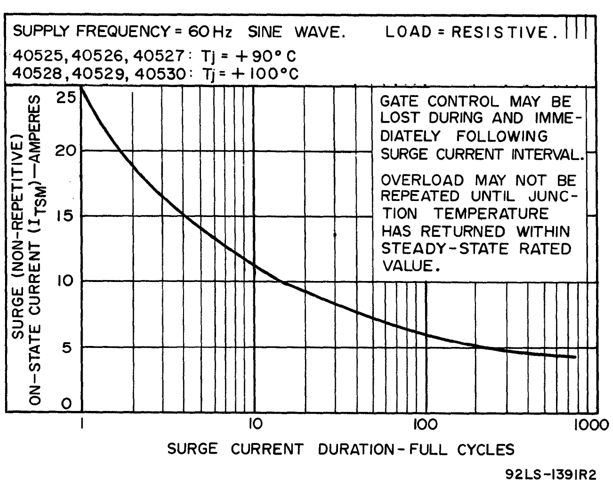


Fig. 5

POWER DISSIPATION CURVES
For All Types

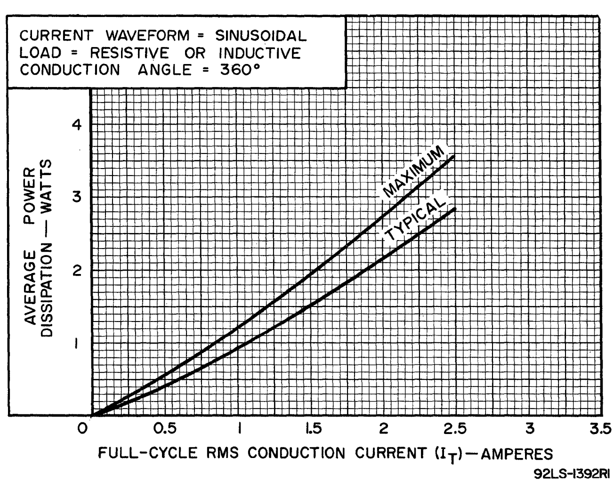


Fig. 6

ON-STATE CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT
For All Types

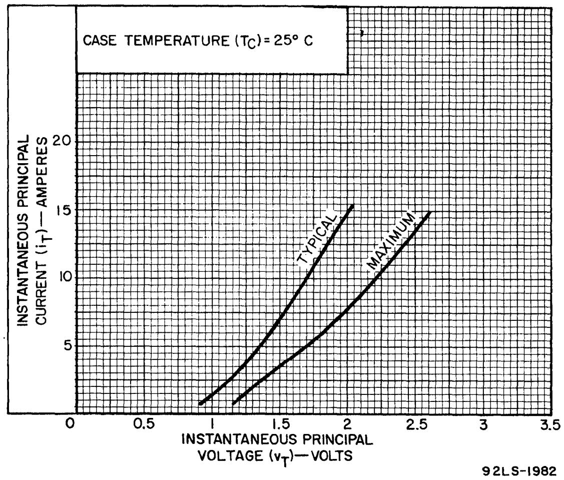


Fig. 7

DC GATE-TRIGGER VOLTAGE CHARACTERISTICS
For All Types

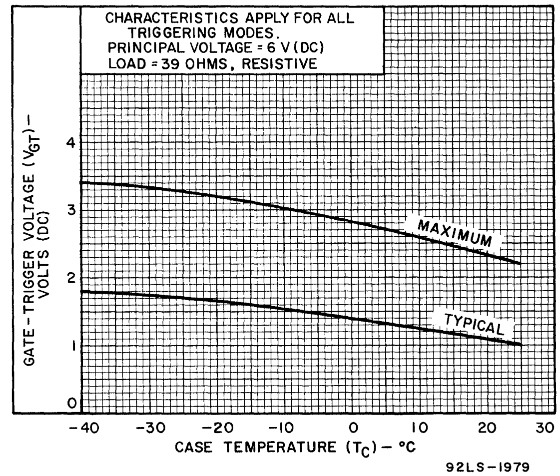


Fig. 8

DC GATE-TRIGGER CURRENT CHARACTERISTICS

For 40525, 40526, and 40527

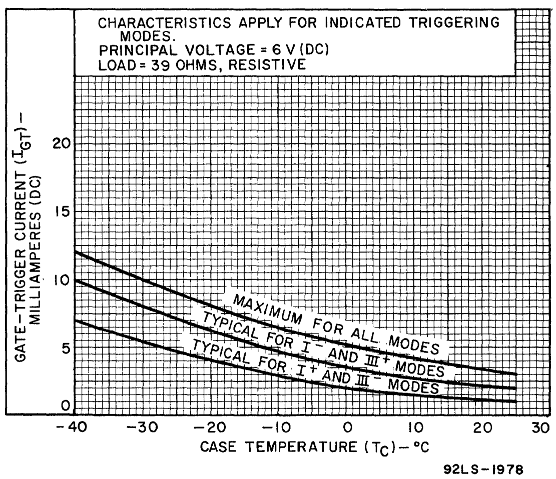


Fig. 9

For 40528, 40529, and 40530

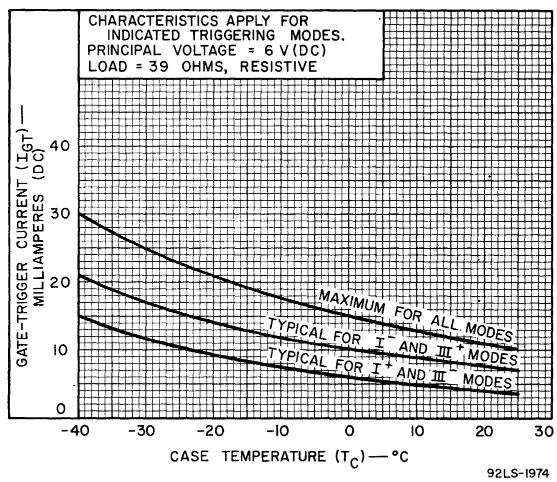


Fig. 10

DC HOLDING CURRENT CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

For 40525, 40526, and 40527

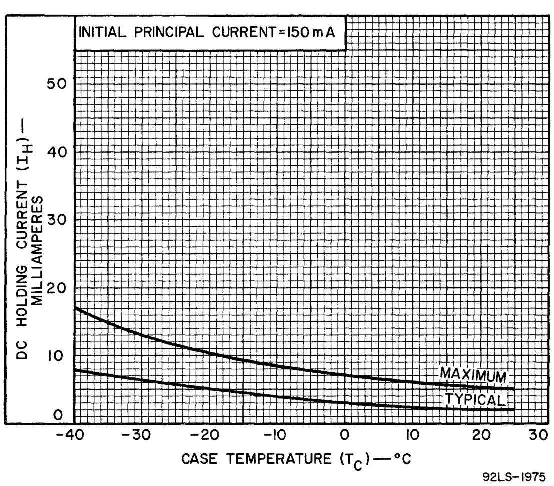


Fig. 11

For 40528, 40529, and 40530

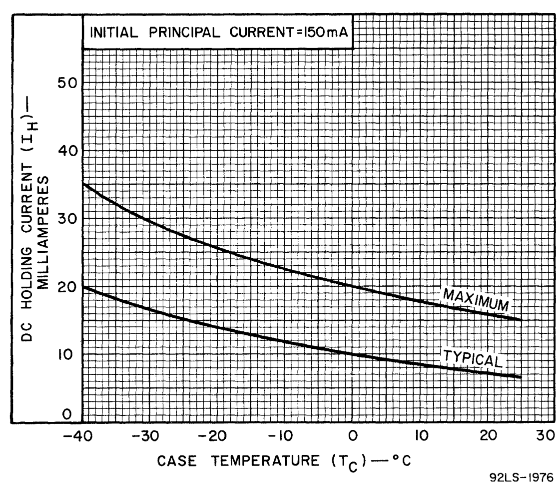


Fig. 12

GATE CHARACTERISTICS
For 40525, 40526, and 40527

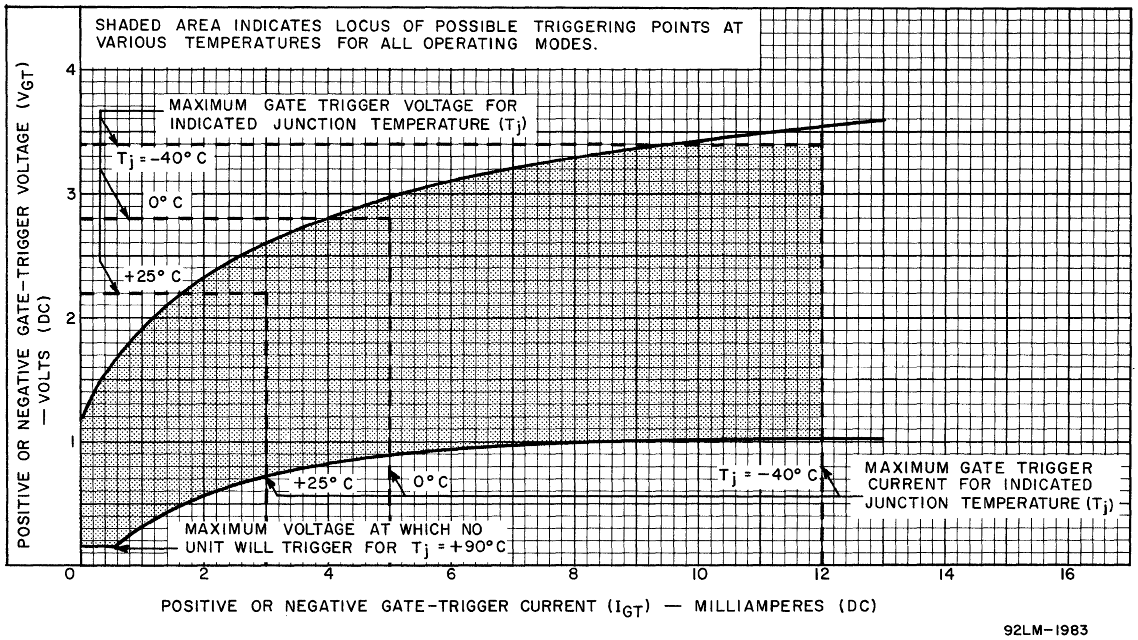


Fig. 13

GATE CHARACTERISTICS
For 40528, 40529, and 40530

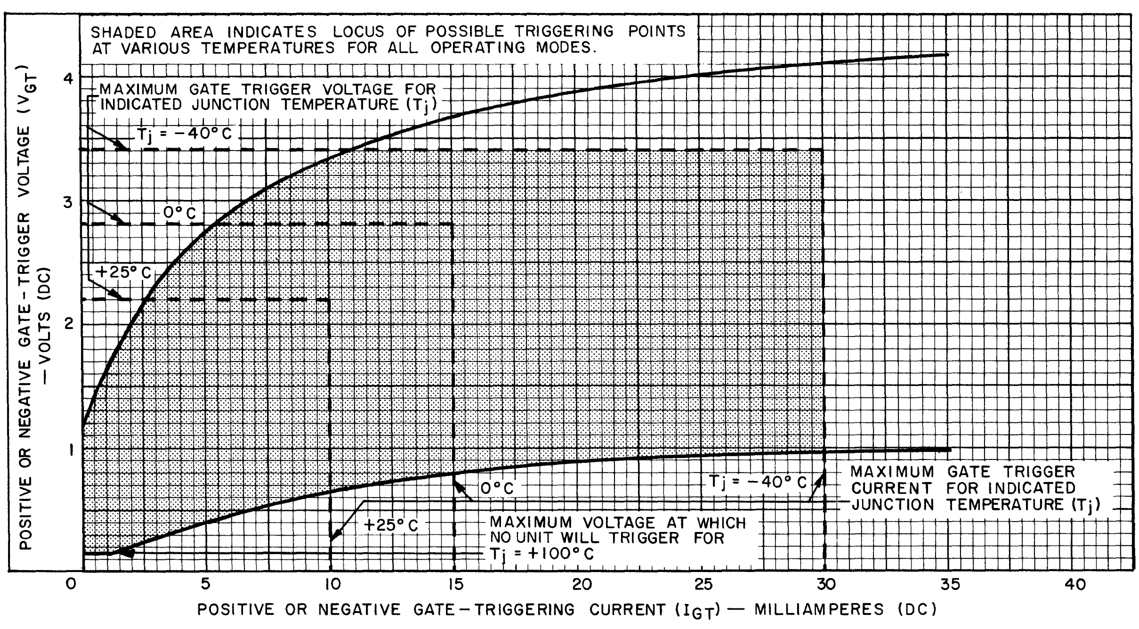
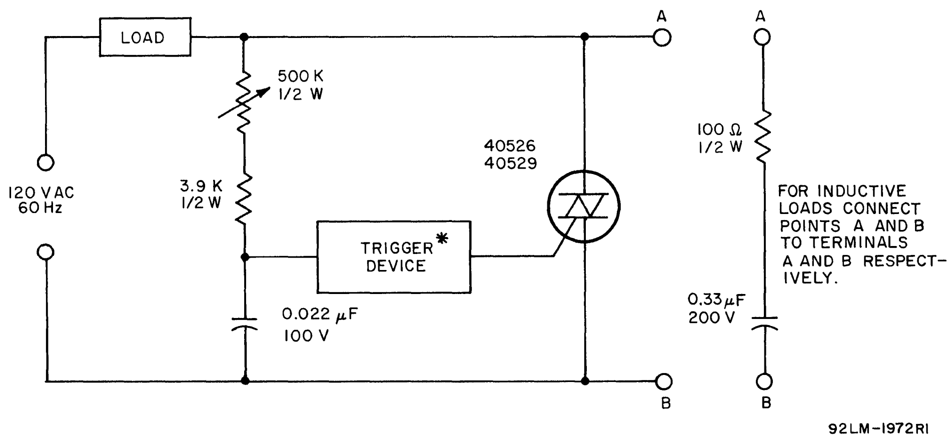


Fig. 14

TYPICAL PHASE CONTROL CIRCUIT

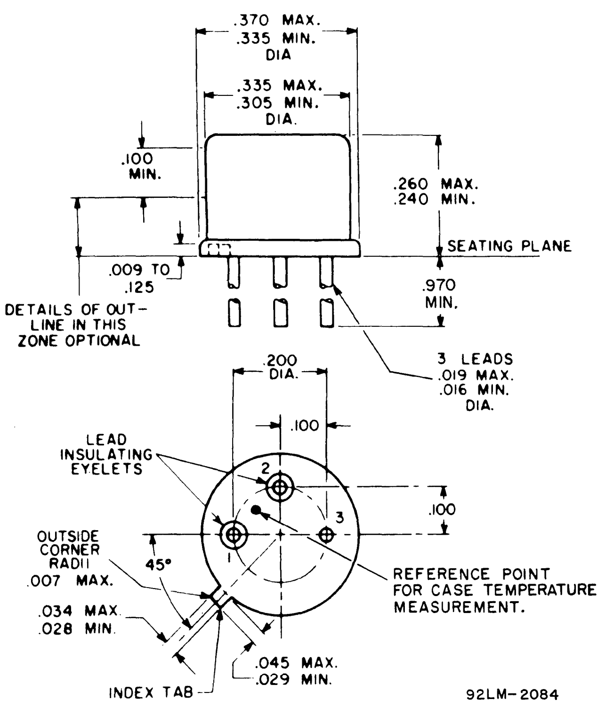


*5AH neon-glow lamp or Mallory Trigger Diode type STD-36, or equivalent

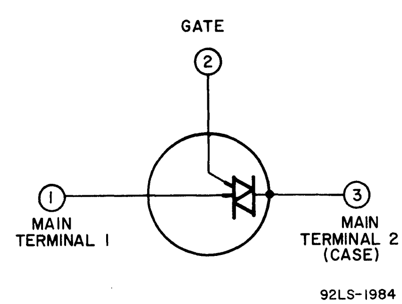
NOTE: For incandescent lamp loads which produce burnout current surges with I^2t values greater than 2.5 ampere^2 seconds, connect a 10-ohm resistor of appropriate wattage rating in series with the load. The appropriate wattage rating can be determined as follows:

$$\text{Wattage Rating of 10-ohm Resistor} = 10 \times (\text{rms load current})^2$$

DIMENSIONAL OUTLINE
MODIFIED TO-5



TERMINAL DIAGRAM



Lead 1: Main Terminal 1
Lead 2: Gate
Case, Lead 3: Main Terminal 2

DEFINITIONS OF TERMS AND SYMBOLS

These terms and symbols follow the latest recommended standards of JEDEC. For convenience, formerly used symbols have been cross-referenced to the new standards.

PRINCIPAL VOLTAGE DEFINITIONS

Repetitive Peak Off-State Voltage – V_{DRM} (Formerly V_{BOM}) – The maximum instantaneous value of principal voltage which may be applied to the thyristor, including all repetitive transient voltages, which will not switch the thyristor from the off state to the on state at specified conditions of thyristor junction temperature and gate bias.

Main Terminal 1 to Main Terminal 2 Voltage – v_{DX} (Formerly v_{BX}) – The instantaneous value of voltage, positive or negative, applied between main terminals 1 and 2 when the thyristor is in the off state.

On-State Voltage – v_T (Formerly v_{AA}) – The instantaneous value of principal voltage when the thyristor is in the on state at a given instantaneous current.

Critical Rate of Rise of Off-State Voltage – dv/dt – The value of the exponential rate of rise of principal voltage below which switching from the off state to the on state will not occur, and above which switching may occur, under stated conditions. This rate of rise is defined as follows:

$$dv/dt = \frac{0.63\ V_{DRM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 V_{DRM}.

PRINCIPAL CURRENT DEFINITIONS

RMS On-State Current – $I_{T(rms)}$ (Formerly I_{ON}) – The RMS value of the principal current when the thyristor is in the on state.

On-State Current – i_T (Formerly i_{AA}) – The instantaneous value of principal current when the thyristor is in the on state.

Surge (Non-Repetitive) On-State Current – I_{TSM} (Formerly i_{SM}) – An overload on-state current of specific time duration, waveshape, and peak value which may be conducted through the thyristor for one full cycle from a 60 Hz supply in a single-phase circuit with a resistive load. The thyristor shall be operating within its specified operating voltage, rms current, gate power, and temperature ratings prior to the surge current. The surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

Peak Off-State Current – I_{DM} (Formerly I_{BOM}) – The maximum current which flows through the main terminals when the thyristor is in the off state for specified values of principal voltage, gate bias, and junction temperature.

DC Holding Current – I_H (Formerly I_{HOX}) – The minimum principal current required to maintain the thyristor in the on state with the gate open for a specified case temperature.

GATE DEFINITIONS

DC Gate-Trigger Current – I_{GT} – The minimum gate current which will switch a thyristor from the off state to the on state under specified conditions of principal voltage and case temperature.

DC Gate-Trigger Voltage – V_{GT} – The gate voltage required to produce the gate trigger current necessary to switch a thyristor from the off state to the on state for specified conditions of principal voltage and case temperature.

Peak Gate-Trigger Current – I_{GTM} (Formerly I_{GT}) – The maximum gate trigger current, positive or negative, which may flow from the gate to main terminal 1 for a specified time duration.

Peak Gate Power – P_{GM} – The maximum power which may be dissipated between gate and main terminal 1 for a specified time duration.

Average Gate Power – P_{GAV} – The value of gate power which may be dissipated between the gate and main terminal 1 averaged over a full cycle.

MISCELLANEOUS

Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is positive with respect to the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Load Resistance – R_L – The value of fixed resistance connected in series with a main terminal of the thyristor and the power source.

RCA TRIACS

Having Factory-Attached Heat Radiators

40531 40534
40532 40535
40533 40536

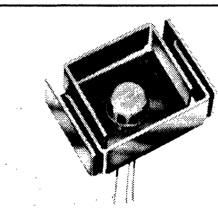
File No. 262

This bulletin sheet is to be used in conjunction with the data sheet for types 40525, 40526, 40527, 40528, 40529, and 40530 dated 4-67.

RCA 40531 through 40536 are gated bidirectional silicon thyristors having integral heat radiators. They are variants of the RCA Triac Types 40525 through 40530.

The 40531 through 40536 are designed to meet the needs of many power-control and power-switching applications in which heat sinking is required but where the design of special cooling systems to achieve the full current rating of the thyristor is not warranted.

The radiator design of these devices has tabs to allow printed-circuit board mounting and holes to allow chassis mounting if desired.

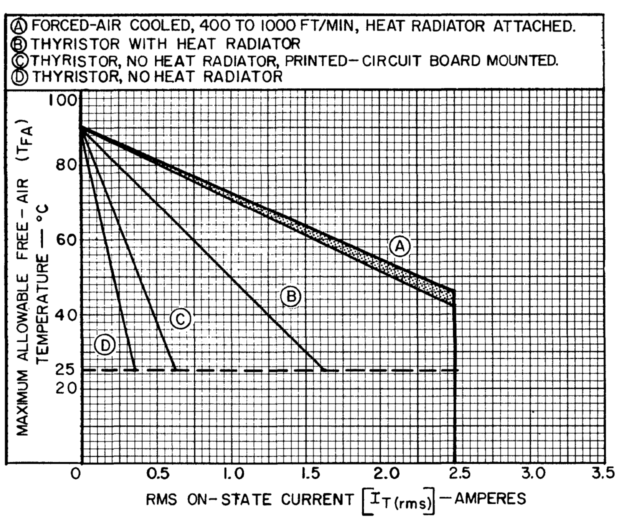


H-1468

Thyristor with Heat Radiator	Thyristor without Heat Radiator
40531	40525
40532	40526
40533	40527
40534	40528
40535	40529
40536	40530

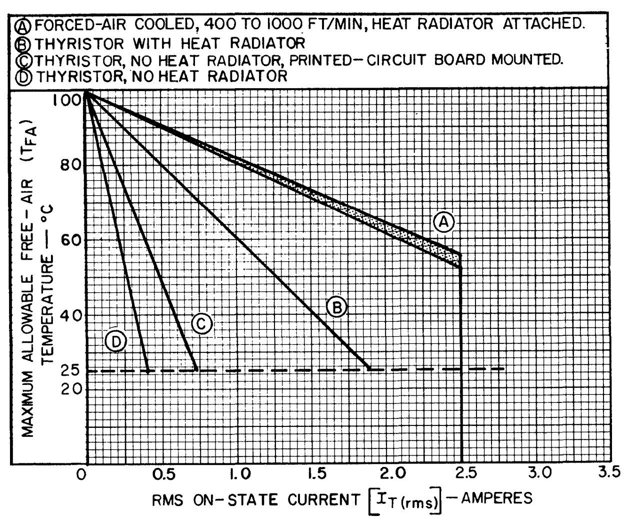
CONDUCTION RATING CHARTS (FREE-AIR TEMPERATURE)

For Types 40531, 40532, and 40533



92LS-2096

For Types 40534, 40535, and 40536



92LS-2097

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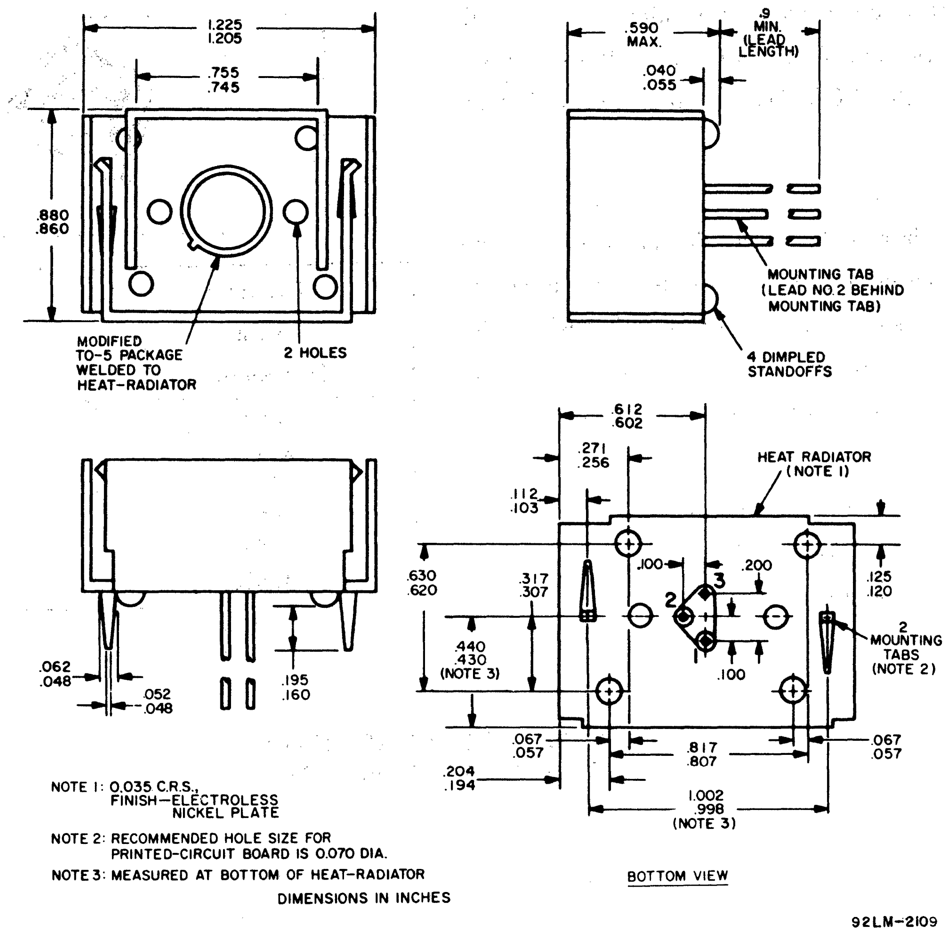
Printed in U.S.A.
4/67

DIMENSIONAL OUTLINE



TERMINAL CONNECTIONS

Lead 1: Main Terminal 1

Lead 2: Gate

Lead 3, Radiator, Case: Main Terminal 2

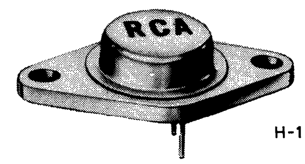
GATED BIDIRECTIONAL SILICON THYRISTORS FOR AC LOAD CONTROL

RCA 40575* and 40576* are gate-controlled full-wave ac silicon switches. They are designed to switch from an off-state to a conducting state for either polarity of applied voltage with positive or negative gate triggering.

These devices are intended primarily for the control of ac loads in applications such as space heater, oven, and furnace controls.

The 40575 and 40576 are hermetically sealed in a JEDEC TO-66 package. They have an rms on-state current capability of 15 amperes at a case temperature of +70° C. The 40575 has a repetitive peak off-state voltage rating of 200 volts and the 40576, 400 volts.

*Formerly Dev. Types TA2834 and TA2835, respectively.



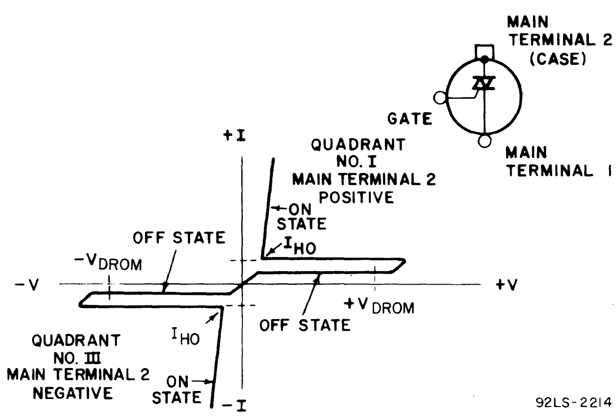
JEDEC TO-66

40575	For 120-Volt Line Operation
40576	For 240-Volt Line Operation

FEATURES

- 15 A (rms) On-State Current Ratings
- 100 A Surge Current Rating
- Shorted-Emitter Design
- 40575 Controls 1800 W at 120 V, 60 Hz
- 40576 Controls 3600 W at 240 V, 60 Hz

PRINCIPAL VOLTAGE-CURRENT CHARACTERISTIC



Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is higher than the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Absolute-Maximum Ratings, for Operation with Sinusoidal AC Supply Voltage at Frequencies of 50 and 60 Hz, and with Resistive or Inductive Load

For Definitions of Terms and Symbols, See Pages 7 and 8.

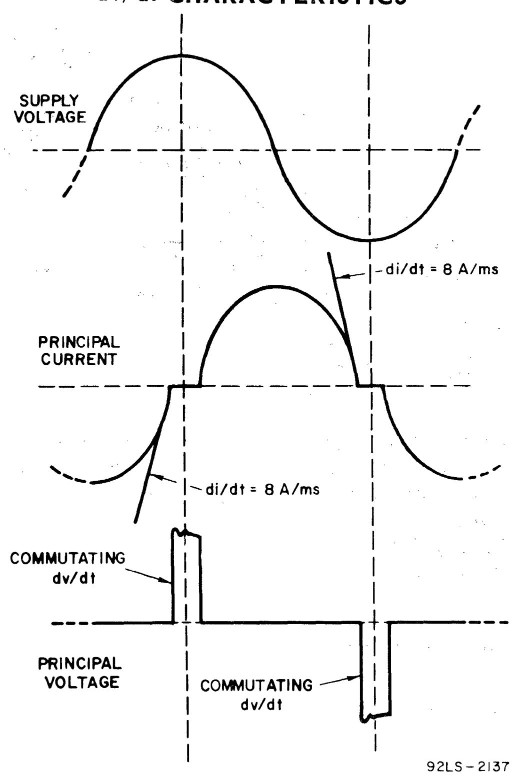
RATINGS	TRIAC TYPES 40575	TRIAC TYPES 40576	UNITS
Repetitive Peak Off-State Voltage♦, V_{DROM}:			
Gate Open			
For T_j = -40° C to +100° C	200	400	V
RMS On-State Current, $I_{T(RMS)}$:			
For case temperature (T_C) of +70° C and a conduction angle of 360°	15	15	A
Peak Surge (Non-Repetitive) On-State Current, I_{TSM}:			
For one full cycle of applied sinusoidal principal voltage	100	100	A
For more than one full cycle of applied voltage	See *Fig.3*	See *Fig.3*	
Peak Gate-Trigger Current■, I_{GTM}:			
For 2 μs max.	1	1	A
Gate Power:			
Peak■, P_{GM}			
For 2 μs max. and I_{GTM} = ≤1 A (peak)	20	20	W
Average, $P_{G(AV)}$	0.45	0.45	W
Temperature●			
Storage, T_{stg}	-40 to +150	-40 to +150	°C
Operating (case), T_C	-40 to +100	-40 to +100	°C

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

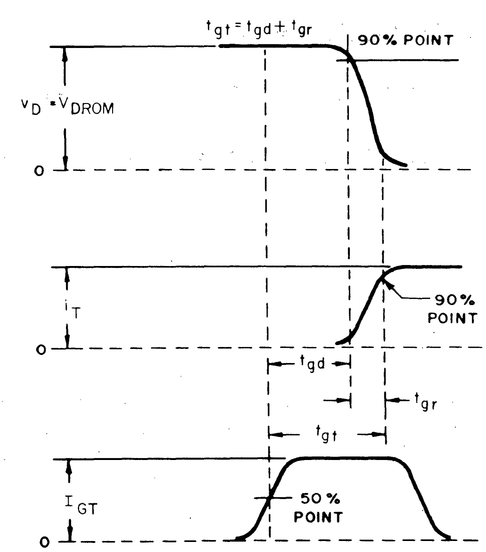
●For information on the reference point of temperature measurement, see *Dimensional Outline*.

WAVESHAPES OF COMMUTATING dv/dt CHARACTERISTICS



92LS-2137

WAVESHAPES OF t_{gt} CHARACTERISTICS TEST



92LS-1342R3

Characteristics at Maximum Ratings (unless otherwise specified), and at Indicated Case Temperature (T_C).

For Definitions of Terms and Symbols, See Pages 7 and 8.

CHARACTERISTICS	TRIAC TYPES						UNITS
	40575			40576			
	Min.	Typ.	Max.	Min.	Typ.	Max.	
Peak Off-State Current♦, I_{DROM}							
Gate open							
At T_j = +100° C and V_{DROM} = Max. rated value	–	0.2	4	–	0.2	4	mA
Instantaneous On-State Voltage♦, v_T							
For i_T = 30 A (peak) and T_C = +25° C	–	1.6	2.0	–	1.6	2.0	V(peak)
DC Holding Current♦, I_{HO}:							
Gate Open							
Initial principal current = 150 mA (dc)							
At T_C = +25° C	–	15	60	–	15	60	mA(dc)
For other case temperatures		See *Fig.5*			See *Fig.5*		
Critical Rate of Applied Commutating Voltage♦, Commutating dv/dt:							
For v_D = V_{DROM}, $I_{T(RMS)}$ = 15 A, commutating di/dt = 8 A/ms, and gate unenergized							
At T_C = +70° C	–	10	–	–	10	–	V/μs
Critical Rate of Rise of Off-State Voltage♦, Critical dv/dt:							
For v_D = V_{DROM}, exponential voltage rise, gate open							
At T_C = +100° C	–	40	–	–	40	–	V/μs
DC Gate-Trigger Current♦■, I_{GT}:							
For v_D = 6 volts (dc), R_L = 12 ohms, T_C = +25° C, and Specified Triggering Mode:							
I^+ Mode: V_{T2} is positive, V_G is positive	–	15	30	–	15	30	mA(dc)
I^- Mode: V_{T2} is positive, V_G is negative . . .	–	35	80	–	35	80	mA(dc)
III^+ Mode: V_{T2} is negative, V_G is positive . .	–	35	80	–	35	80	mA(dc)
III^- Mode: V_{T2} is negative, V_G is negative . .	–	15	30	–	15	30	mA(dc)
For other case temperatures		See *Figs.9 & 10*			See *Figs.9 & 10*		
DC Gate-Trigger Voltage♦■, V_{GT}:							
For v_D = 6 volts (dc) and R_L = 12 ohms							
At T_C = +25° C	–	1	2.5	–	1	2.5	V(dc)
For other case temperatures		See *Fig.11*			See *Fig.11*		
For v_D = V_{DROM} and R_L = 125 ohms							
At T_C = +100° C	0.2	–	–	0.2	–	–	V(dc)
Gate-Controlled Turn-On Time, t_{gt}							
(Delay Time + Rise Time)							
For v_D = V_{DROM}, I_{GT} = 160 mA, 0.1 μs rise time, and i_T = 25 A (peak)							
At T_C = +25° C	–	3	–	–	3	–	μs
Thermal Resistance, Junction to case, θ_{J-C}	–	–	1.3	–	–	1.3	°C/W

♦For either polarity of main terminal 2 voltage (V_{T2}) with reference to main terminal 1.

■For either polarity of gate voltage (V_G) with reference to main terminal 1.

CONDUCTION RATING CHART (CASE TEMPERATURE)

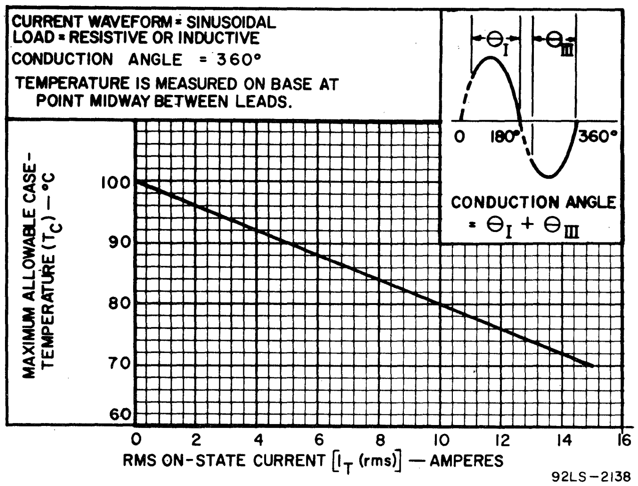


Fig. 1

POWER DISSIPATION CURVE

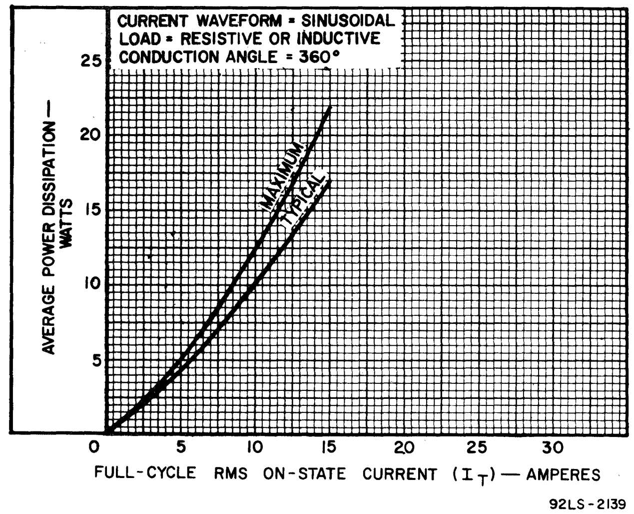


Fig. 2

SURGE CURRENT RATING CHART

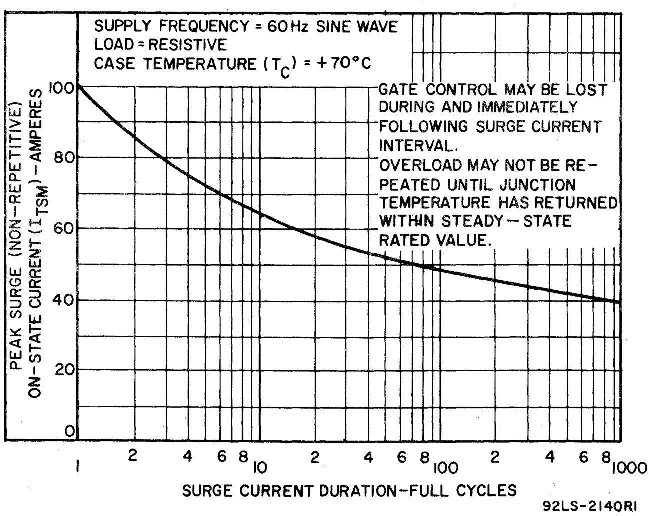


Fig. 3

ON-STATE CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

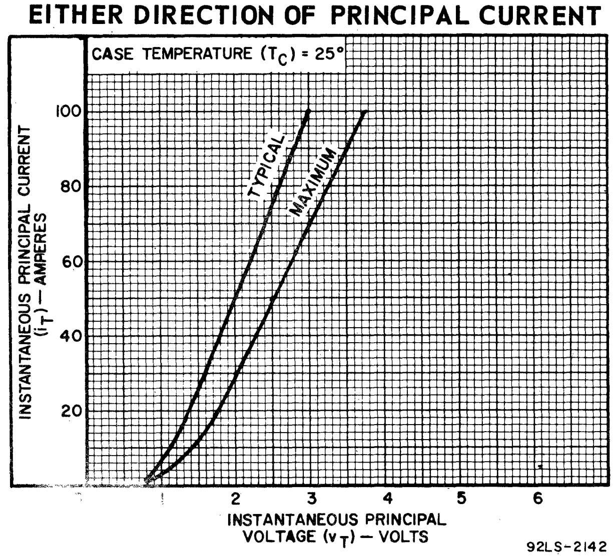


Fig. 4

DC HOLDING CURRENT CHARACTERISTICS FOR EITHER DIRECTION OF PRINCIPAL CURRENT

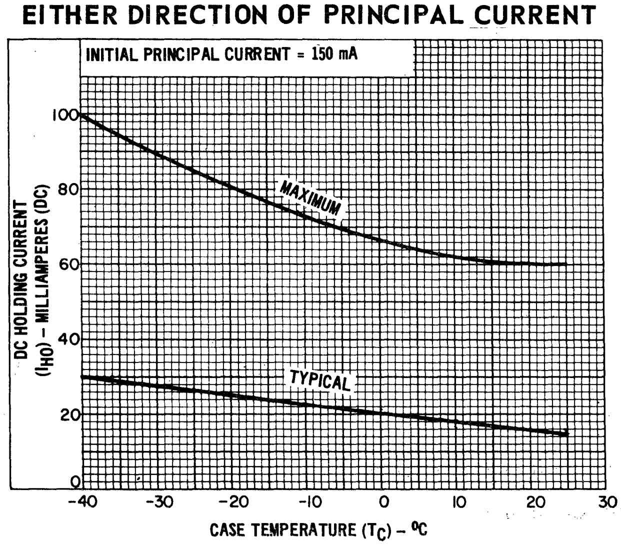


Fig. 5

TYPICAL TURN-ON TIME CHARACTERISTIC

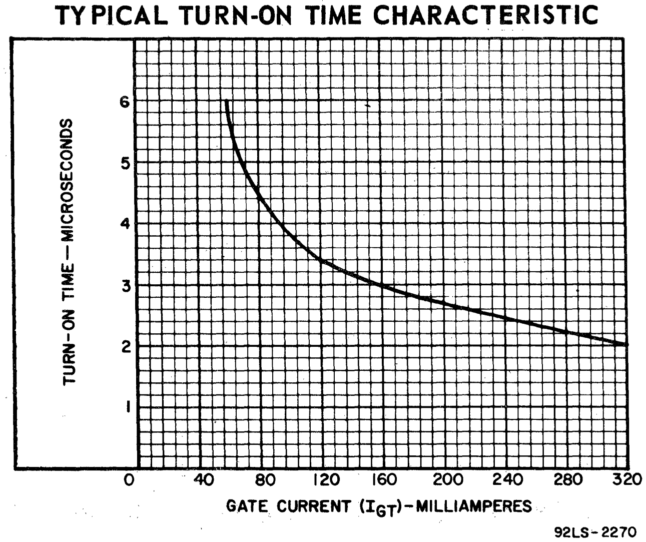


Fig. 6

GATE CHARACTERISTICS FOR I^+ and III^- TRIGGERING MODES

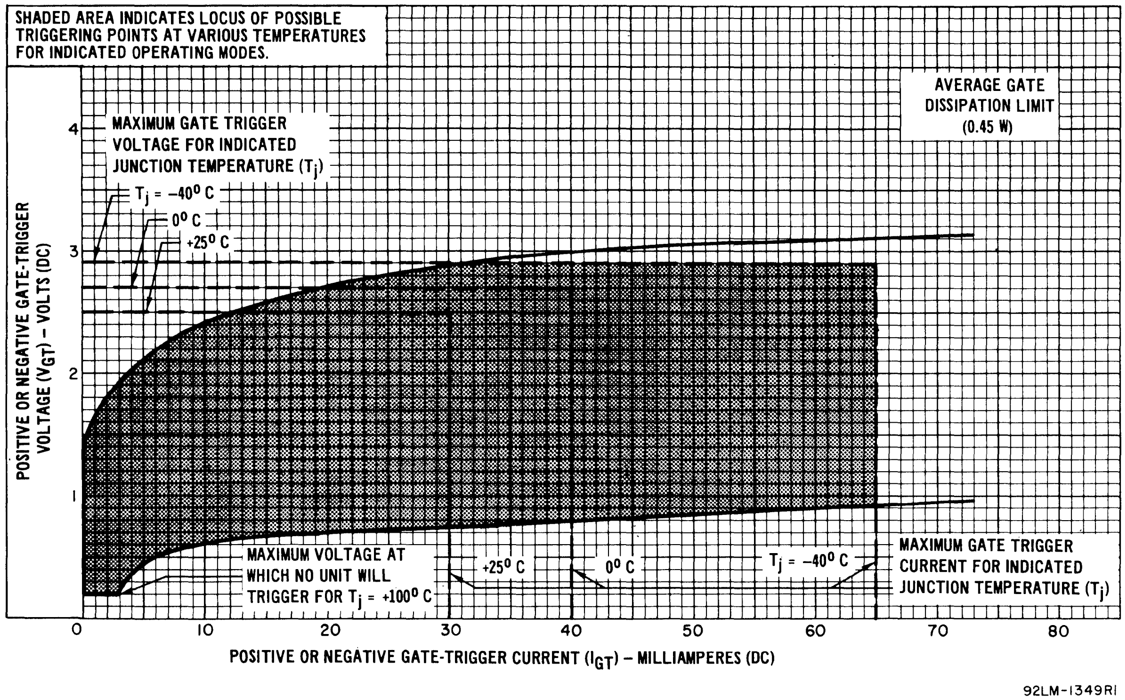


Fig. 7

GATE CHARACTERISTICS FOR I^- and III^+ TRIGGERING MODES

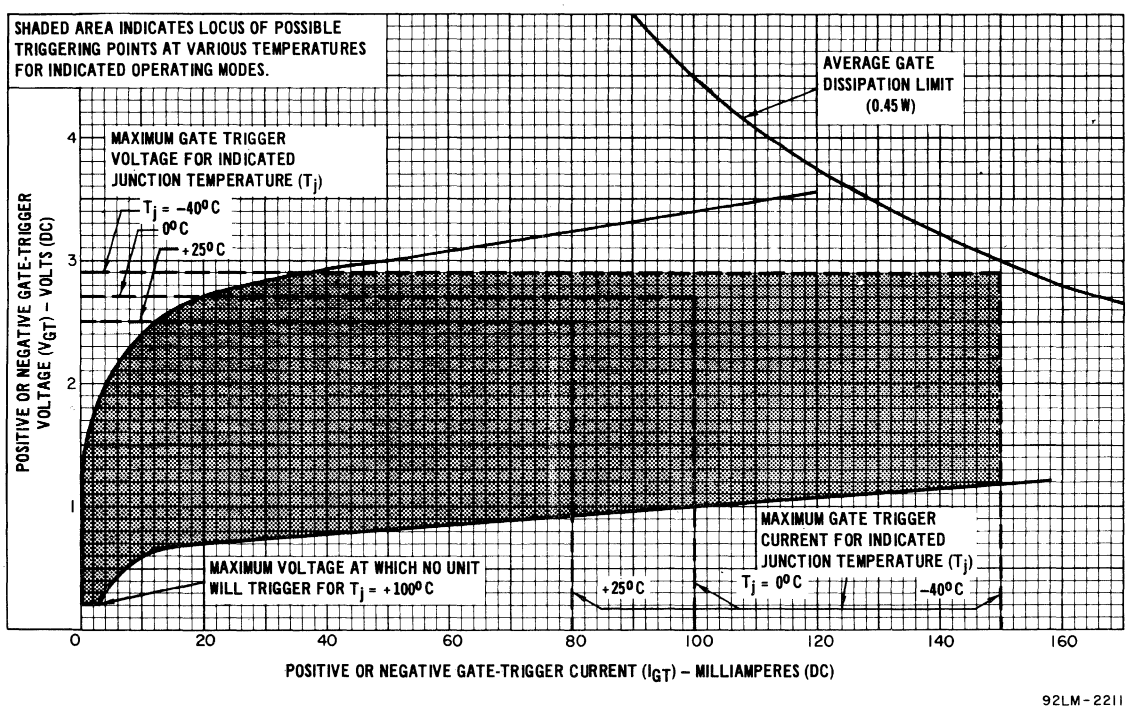


Fig. 8

DC GATE-TRIGGER CURRENT CHARACTERISTICS FOR I+ and III− MODES

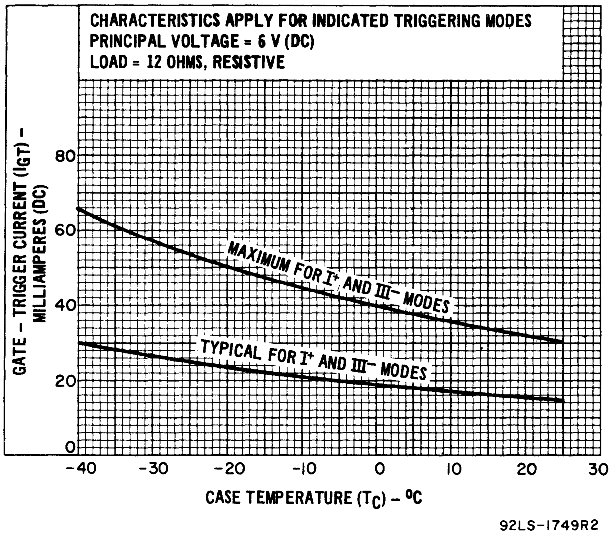


Fig. 9

DC GATE-TRIGGER CURRENT CHARACTERISTICS FOR I− and III+ MODES

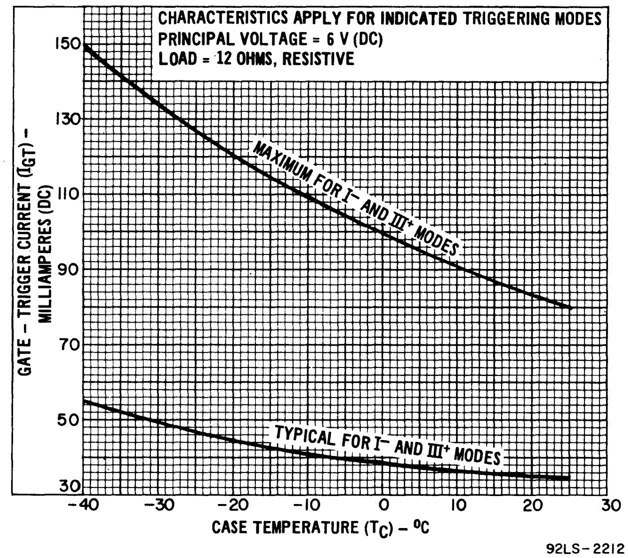


Fig. 10

DC GATE-TRIGGER VOLTAGE CHARACTERISTICS

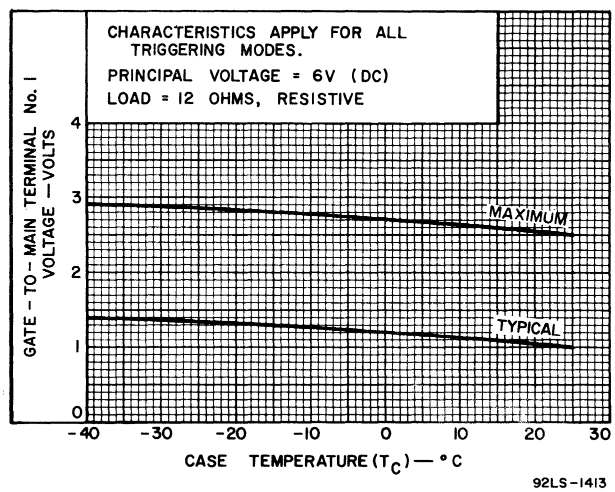
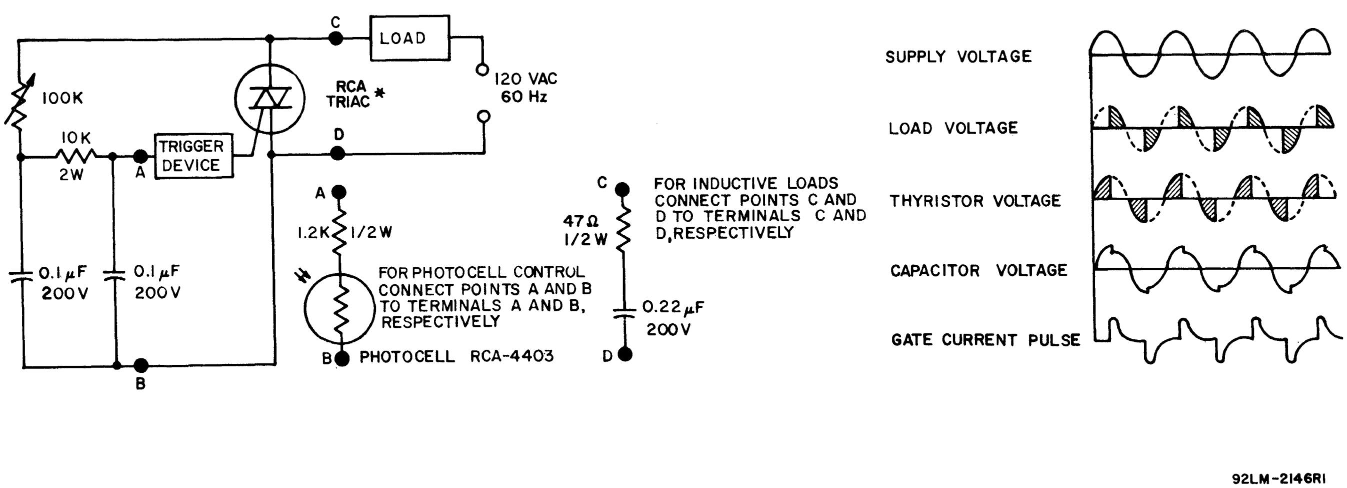


Fig. 11

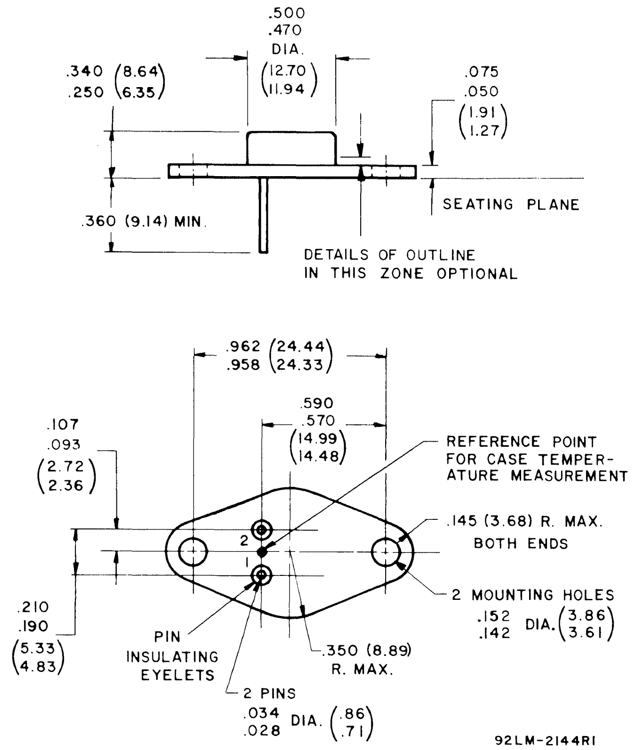
TYPICAL PHASE-CONTROL CIRCUIT



*RCA TRIAC: 40575

Fig. 12

DIMENSIONAL OUTLINE
JEDEC NO. TO-66

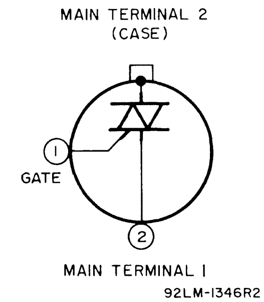


DIMENSIONS IN INCHES AND MILLIMETERS

Note: Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions that are shown.

Pin 1: Gate
Pin 2: Main Terminal 1
Case: Main Terminal 2

TERMINAL DIAGRAM



Pin 1: Gate 1
Pin 2: Main Terminal 1
Case: Main Terminal 2

DEFINITIONS OF TERMS AND SYMBOLS

These terms and symbols follow the latest recommended standards of JEDEC. For convenience, formerly used symbols have been cross-referenced to the new standards.

PRINCIPAL VOLTAGE DEFINITIONS

Repetitive Peak Off-State Voltage – V_{DROM} (Formerly V_{BOM}) – The maximum instantaneous value of principal off-state voltage which may be applied to the thyristor, including all repetitive transient voltages, which will not switch the thyristor from the off-state to the on-state with the gate open and at specified conditions of thyristor junction temperature.

Instantaneous Off-State Voltage – v_D (Formerly v_{BX}) – The instantaneous value of principal voltage, positive or negative, applied between main terminals 1 and 2 when the thyristor is in the off-state.

Instantaneous On-State Voltage – v_T (Formerly v_{AA}) – The instantaneous value of principal voltage, positive or negative, when the thyristor is in the on-state at a given instantaneous current.

Critical Rate of Rise of Off-State Voltage – Critical dv/dt – The value of the exponential rate of rise of principal voltage below which switching from the off-state to the on-state will not occur, and above which switching may occur, under specified conditions. This rate of rise is defined as follows:

$$dv/dt = \frac{0.63\ V_{DROM}}{t}$$

where t is the time required for the principal voltage to rise from zero to 0.63 of V_{DROM}.

Critical Rate of Applied Commutating Voltage – Commutating dv/dt – The instantaneous rate of rise of principal voltage occuring during commutation which will not cause the thyristor to switch to the on-state under specified conditions.

PRINCIPAL CURRENT DEFINITIONS

RMS On-State Current – $I_{T(RMS)}$ (Formerly I_{ON}) – The RMS value of the principal current when the thyristor is in the on-state.

Instantaneous On-State Current – i_T (Formerly i_{AA}) – The instantaneous value of principal current when the thyristor is in the on-state.

Peak Surge (Non-Repetitive) On-State Current – I_{TSM} (Formerly i_{SM}) – An overload on-state current of specific time duration, and peak value, which may be conducted through the thyristor for one full cycle from a 60-Hz supply in a single-phase circuit with a resistive load. The thyristor shall be operating within its specified operating voltage, RMS current, gate power, and temperature ratings prior to the surge current. The surge current may be repeated after sufficient time has elapsed for the device to return to pre-surge thermal equilibrium conditions.

Peak Off-State Current – I_{DROM} (Formerly I_{BOM}) – The current which flows through the main terminals when the thyristor is in the off-state and when the principal voltage is V_{DROM} under specified conditions of junction temperature and with the gate open.

DC Holding Current – I_{HO} (Formerly I_{HOX}) – The principal current required to maintain the thyristor in the on-state for a specified temperature and with the gate open.

GATE DEFINITIONS

DC Gate-Trigger Current – I_{GT} – The gate current which will switch a thyristor from the off-state to the on-state under specified conditions of principal voltage and case temperature.

DC Gate-Trigger Voltage – V_{GT} – The gate voltage required to produce the gate-trigger current necessary to switch a thyristor from the off-state to the on-state for specified conditions of principal voltage and case temperature.

Peak Gate-Trigger Current – I_{GTM} – The maximum gate-trigger current, positive or negative, which is allowed in switching a thyristor from the off-state to the on-state for a specified time duration.

Peak Gate Power Dissipation – P_{GM} – The maximum power which may be dissipated between the gate and main terminal 1 for a specified time duration.

Average Gate Power Dissipation – $P_{G(AV)}$ – The value of gate power which may be dissipated between the gate and main terminal 1 averaged over a full cycle.

MISCELLANEOUS

Principal Voltage is the voltage between the main terminals. The principal voltage is called positive when the potential of main terminal 2 is higher than the potential of main terminal 1.

Principal Current is the current that flows through the main terminals.

Gate-Controlled Turn-On Time – t_{gt} (Formerly t_{on}) – The time interval between the 50 per-cent point at the beginning of the gate pulse and the instant when the principal current reaches 90 per cent of its maximum value during switching of the thyristor from the off-state to the on-state by a gate pulse under specified conditions.

Load Resistance – R_L – The value of fixed resistance connected in series with a main terminal of the thyristor and the power source.

Thermal Resistance, Junction-to-Case – θ_{J-C} – The temperature difference between the thyristor junction and the thyristor case divided by the power dissipation causing the temperature difference under conditions of thermal equilibrium.

SILICON N-P-N "overlay" TRANSISTOR

40577

HIGH-RELIABILITY TRANSISTOR

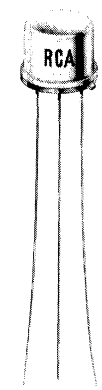
High-Gain Device for Class A or C Operation in VHF Circuits

RCA–40577* is a high-reliability variant of the RCA–2N3118, a triple-diffused transistor. It is especially processed for high reliability. It is intended for Class A and C amplifier, frequency multiplier or oscillator operation in high-reliability, large-signal, high-power VHF applications in Space, Military, and Industrial communications equipment.

High reliability is assured by eight preconditioning steps, including drift temperature measurements after the High Temperature Reverse Bias and Power Age tests. The 40577 also features complete qualification and lot acceptance testing.

*Formerly RCA-Dev. No. TA7079

- 8 Preconditioning Steps
- Complete Qualification and Lot Acceptance Testing
- 1.0 Watt Output Min. at 50 MHz
- 0.4 Watt Output Min. at 150 MHz



JEDEC TO–5

H–1380

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-EMITTER VOLTAGE:			
With V_{BE} = –1.5 volts	V_{CEV}	85	V
With base open	V_{CEO}	60	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
COLLECTOR CURRENT	I_C	0.5	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 25° C		3	W
At free-air temperatures up to 25° C		0.5	W
At case temperatures above 25° C		See *Fig.4*	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		–65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. from insulating wafer for 10 s max.		230	°C

TYPICAL POWER OUTPUT vs. POWER INPUT

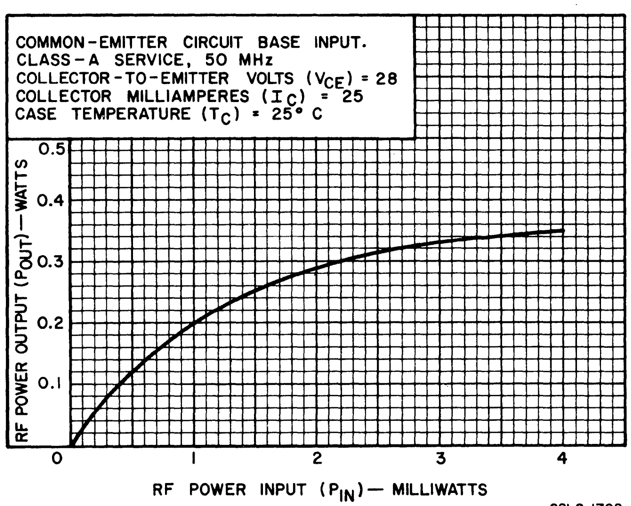


Fig. 1

ELECTRICAL CHARACTERISTICS
Case Temperature = 25° C
Except As Indicated

Characteristics	Symbols	TEST CONDITIONS: Frequency (MHz) f	DC Collector-to-Base Voltage (volts) V_{CB}	DC Collector-to-Emitter Voltage (volts) V_{CE}	DC Base Volts V_{BE}	DC Current (Milliamperes) I_C	I_E	I_B	LIMITS Min.	Max.	Units
Collector-Cutoff Current 25 °C[a]	I_{CBO}		30				0			10	nA
Collector-Cutoff Current 150 °C[a]	I_{CBO}		30				0			5	µA
Emitter-to-Base Breakdown Voltage	BVEBO					0	0.1		4		volts
Collector-to-Emitter Breakdown Voltage (Sustaining)	$BV_{CEO}(sus)$					10 pulsed[b]		0	60		volts
Reverse Collector-to-Emitter Breakdown Voltage	BV_{CEX}				−1.5	0.1			85		volts
Output Capacitance	C_{ob}	1	28			0				6	pF
$r_{bb'}C_{b'c}$ Product	$r_{bb'}C_{b'c}$	50		28		25				60	ps
DC Forward-Current Transfer Ratio[b]	h_{FE}			5		100			50	275	
Small-Signal Forward-Current Transfer Ratio	h_{fe}	50		28		25			5		
Real Part of Short-Circuit Input Impedance	$h_{ie(real)}$	50		28		25			25	75	ohms
Real Part of Short-Circuit Output Impedance	$1/Y_{22(real)}$	50		28		25			500	1000	ohms
Output Power Class-C Service Pin = 0.1 watt (with heat sink)	P_{OUT}	50[c] 150[d]		28 28					1.0 0.4		watt watt
Power Gain Class-A Service P_{out} = 0.2 watt (with heat sink)	PG	50[e]		28		25			18		dB

[a] T_{FA} = free air temperature.
[b] Pulse duration 300 µs; duty factor, less than 1.8%.
[c] See Figure 9.
[d] See Figure 3.
[e] See Figure 5.

TYPICAL LARGE-SIGNAL OPERATION, CLASS–C SERVICE

150 MHz

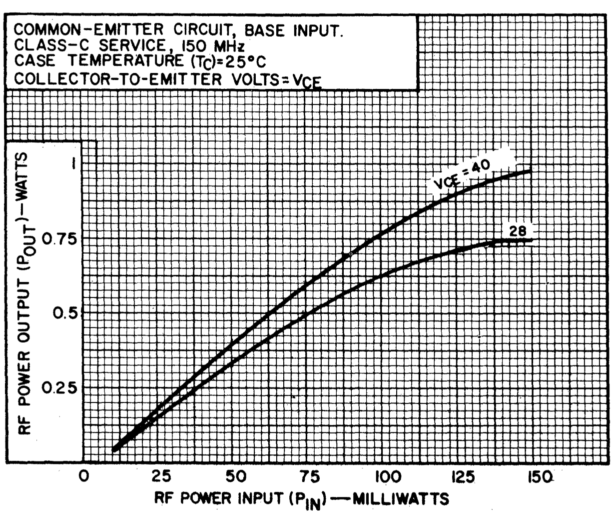
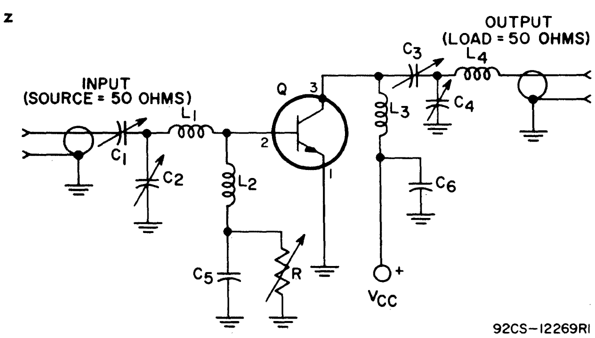


Fig. 2



C_1, C_2: 1.5–20 pF
C_3: 4–40 pF
C_4: 7–100 pF
C_5: 1800 pF
C_6: 0.01 µF
R: 100 ohms, variable

L_1: 0.1 µH, 4 turns, No.18 wire, 1/4" ID, closely wound
L_2: 750–ohm ferrite choke
L_3: 0.075 µH, 4 turns, No.16 wire, 1/4" ID x 3/8" long
L_4: 0.055 µH, 3 turns, No.16 wire, 1/4" ID x 1/4" long
Q: 40577

Fig. 3

RELIABILITY SPECIFICATIONS . . . .

In addition to Preconditioning and Group A tests, a Qualification Approval test series (Group B tests) is performed on each lot.

Preconditioning (100 Per Cent Testing of Each Transistor)

1. Serialization
2. Record I_{CBO}, h_{FE}
3. Temperature Cycling-Method 107B, Cond. C of MIL-STD-202, 5 cycles, -65^{o} C to 200^{o} C
4. Bake, 72 hours minimum, 200^{o} C
5. Constant Acceleration-Method 2006 of MIL-STD-750, 10,000g, Y_1 and Y_2 axes
6. X-Ray
7. Record I_{CBO}, h_{FE}
8. Reverse Bias Age, $T_A = 175^{o}$ C, $V_{CB} = 60$ V, t = 96 hours
9. [d] Record I_{CBO}, h_{FE}.
10. Power Age, $T_A = 25^{o}$ C, $V_{CB} = 28$ V, t = 340 hours, $P_T = 1$ W, free air
11. [d] Record I_{CBO}, h_{FE} at 340 hours
12. Helium Leak, 1 x 10^{-7} cc/sec. max.
13. Gross Leak, MIL-STD-202, Method 112
14. Record Subgroups 2 and 3 of Group A Tests

[d] Delta criteria after 96 hours Reverse Bias Age and 340 hours Power Age.

ΔI_{CBO}	+100% or +5 nanoamperes whichever is greater
Δh_{FE}	±20%

Definitions

Delta (Δ): Delta shall be determined by subtracting the parameter value measured before application of stress from the value measured after the application of stress.

Group A Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD	SYMBOL	LIMITS Min.	LIMITS Max.	UNITS
	Subgroup 1		10				
2071	Visual and Mechanical Examination	–	–	–	–	–	–
	Subgroup 2		5				
3036D	Collector-Cutoff Current	$V_{CB} = 30V$, $I_E = 0$	–	I_{CBO}	–	10	nA
3001D	Collector-to-Emitter Breakdown Voltage	$I_C = 100\ \mu A$, $V_{BE} = -1.5$ V	–	BV_{CEV}	85[g]	–	volts
3026D	Emitter-to-Base Breakdown Voltage	$I_E = 100\ \mu A$, $I_C = 0$	–	BV_{EBO}	4	–	volts
3011D	Collector-to-Emitter Breakdown Voltage	$I_C = 10$ mA[f] $I_B = 0$	–	V_{CEO}	60[g]	–	volts
3076	DC Forward-Current Transfer Ratio	$I_C = 100$ mA, $V_{CE} = 5V$	–	h_{FE}	50	275	
	Subgroup 3		5				
3236	Output Capacitance	f = 0.1 to 1.0 MHz, $V_{CB}=28V$, $I_E = 0$	–	C_{ob}	–	6.0	pF
See *Fig.3*	Power Output	f = 50 MHz, $V_{CE} = 28V$ Pin = 0.1 W	–	P_{OUT}	1.0	–	watts
See *Fig.5*	RF Power Output (Min. Eff. = 45%)	$V_{CE} = 28$ V, $P_{IN} = 0.1$ W f = 150 MHz	–	P_{OUT}	0.4	–	watts
3306	Small-Signal Forward-Current Transfer Ratio	$I_C = 25$ mA, $V_{CE} = 28$ V f = 50 MHz	–	h_{fe}	–	5.0	
	Subgroup 4		15				
3036D	Collector-Cutoff Current	$T_A = 150^{o}$ C, $V_{CB} = 30$ V	–	I_{CBO}	–	5	μA
3201	Input Impedance	$V_{CE} = 28$ V, $I_C = 25$ mA f = 50 MHz	–	h_{ie}	25	75	ohms
3231	Output Admittance	$V_{CE} = 28$ V, $I_C = 25$ mA f = 50 MHz	–	Y_{22}	1	2	mmho

[f] Pulsed through an inductor (25 μH); duty factor = 50%.

[g] Measured at a current where the breakdown voltage is a minimum.

General Reliability Specifications that are applicable to all rf power transistors are given in booklet RFT–701 and must be used in conjunction with the specific Preconditioning, Group A Tests, and Group B Tests shown below.

Group B Tests[h]

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS
	Subgroup 1	(13 Samples)
2066	Physical Dimensions	JEDEC TO-5 Pkg.
	Subgroup 2	(13 Samples)
2026	Solderability	Omit aging, Dwell time = 10 s ± 1 s
1051	Thermal Shock (Temp. Cycling)	Test Condition C
1056	Thermal Shock (Glass Strain)	Test Condition B
	Seal (Leak Rate)	Method 112 of MIL-STD-202 Test Cond. C, procedure III; Test Cond. A for gross leaks
1021	Moisture Resistance	
	Subgroup 3	(13 Samples)
2016	Shock	1,500 g, 0.5 ms, 5 blows each orientation: X_1, Y_1, Y_2, Z_1
2046	Vibration Fatigue	Nonoperating
2056	Vibration Var. Freq.	–
2006	Constant Acceleration	20,000 G Y_1, Y_2
	Subgroup 4	(13 Samples)
2036	Terminal Strength (Lead Fatique)	Test Cond. E
	Subgroup 5	(13 Samples)
1041	Salt Atmosphere	
	Subgroup 6	(25 Samples)
1031	High Temperature Life (Non-operating)	$T_{storage} = 200^\circ$ C t = 1000 hrs.
	Subgroup 7	(25 Samples)
1026	Steady-State Operation	$P_T = 1.5$ W, $T_C = 100^\circ$ C t = 1000 hrs. $V_{CB} = 40$ V

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	SYMBOL	LIMITS		UNITS
				Min.	Max.	
	End Points Subgroups (2, 3, 5, 6)					
3036D	Collector Base Cutoff Current	$V_{CB} = 30$ V, $I_E = 0$	I_{CBO}		1.0	μA
3001D	Collector Base Breakdown Voltage	$V_{BE} = -1.5$ V, $I_C = 100$ μA	BV_{CEV}	80		
3076	DC Forward-Current Transfer Ratio	$I_C = 100$ mA, $V_{CE} = 5$ V	h_{FE}	35	325	–

[h]Acceptance/Rejection Criteria of Group B tests: For an LTPD plan of 7% the total sample size is 115 for which the maximum number of rejects allowed is 4. Acceptance is also subject to a maximum of one (1) reject per Sub-group. Group B tests are performed on each lot for Qualification or Lot Acceptance.

[i]Pulsed through an inductor (25 mH); duty factor = 50%.

[k]Measured at a current where the breakdown voltage is a minimum.

TYPICAL CLASS A-SERVICE OPERATION, 50 MHz NEUTRALIZED

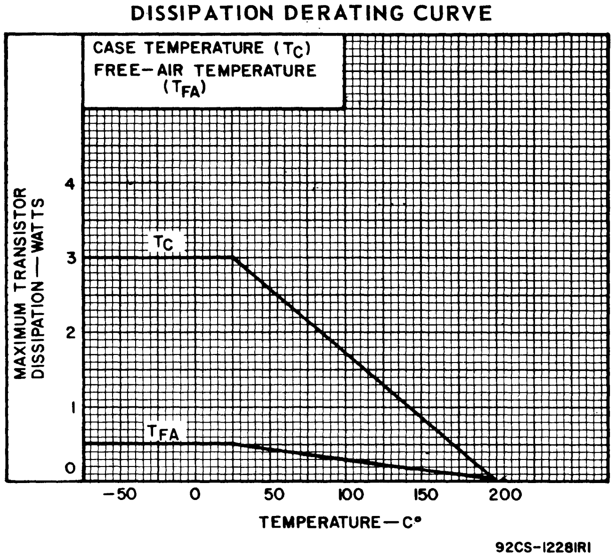
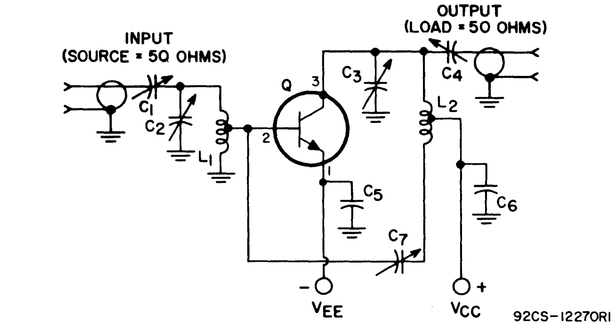


Fig. 4



C_1: 7–100 pF
C_2: 8–60 pF
C_3: 14–150 pF
C_4: 6–80 pF
C_5, C_6: 0.005 μF
C_7: 0.9–7 pF

L_1: 0.12 μH, 3 turns, No.16 wire, 7/16" ID x 1/4" long, tap at 1 turn from ground
L_2: 0.23 μH, 5 turns, No.16 wire, 7/16" ID x 1/2" long, tap at 3 turns from collector terminal
Q: 4057

Fig. 5

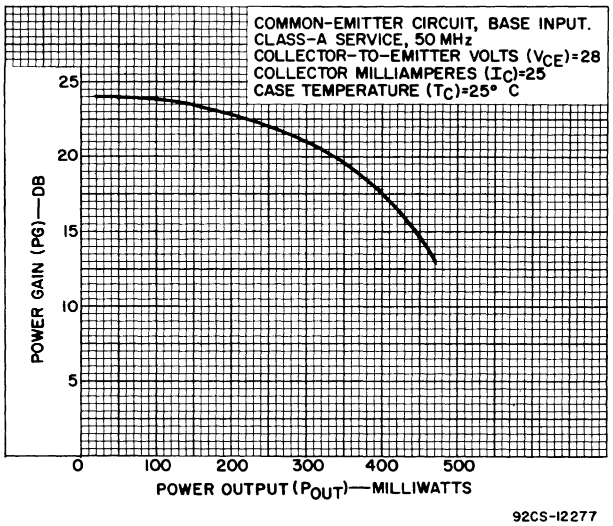


Fig. 6

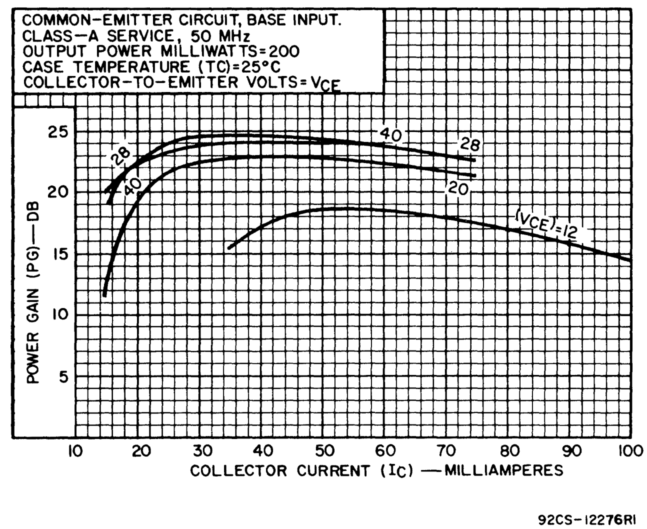


Fig. 7

TYPICAL LARGE-SIGNAL OPERATION, CLASS-C SERVICE, 50 MHz

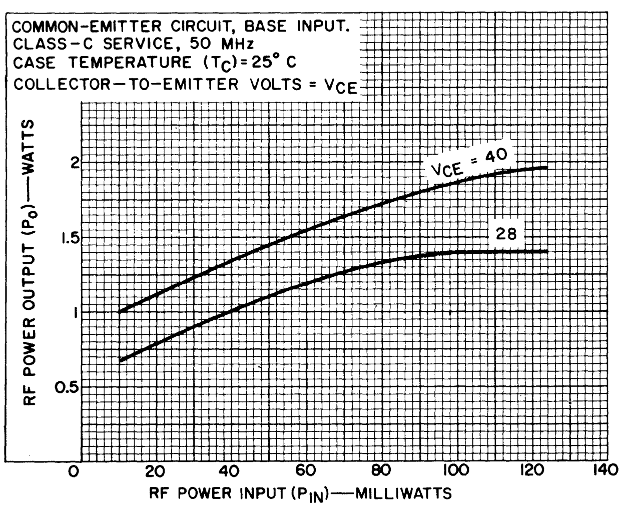
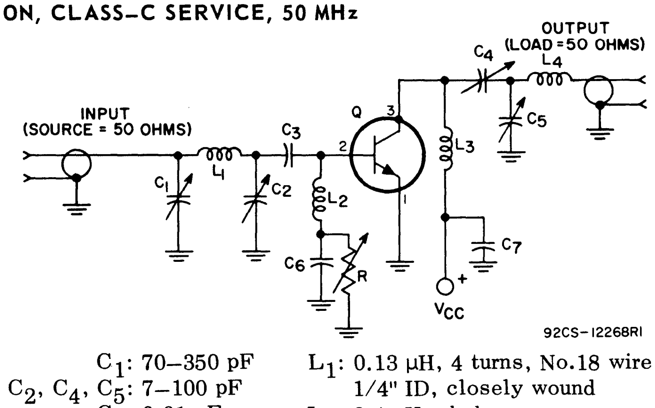


Fig. 8



C_1: 70–350 pF
C_2, C_4, C_5: 7–100 pF
C_3: 0.01 μF
C_6: 0.002 μF
C_7: 0.02 μF
R: 1000 ohms, variable

L_1: 0.13 μH, 4 turns, No.18 wire, 1/4" ID, closely wound
L_2: 2.4 μH, choke, Miller Part No.4606
L_3: 0.6 μH, 10 turns, No.18 wire, 3/8" ID, closely wound
L_4: 0.6 μH, 10 turns, No.18 wire, 3/8" ID, closely wound
Q: 40577

Fig. 9

TYPICAL SMALL-SIGNAL OPERATION CHARACTERISTICS

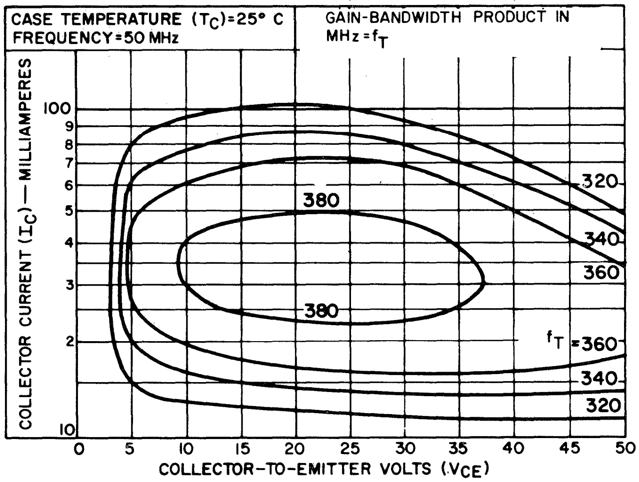


Fig. 10

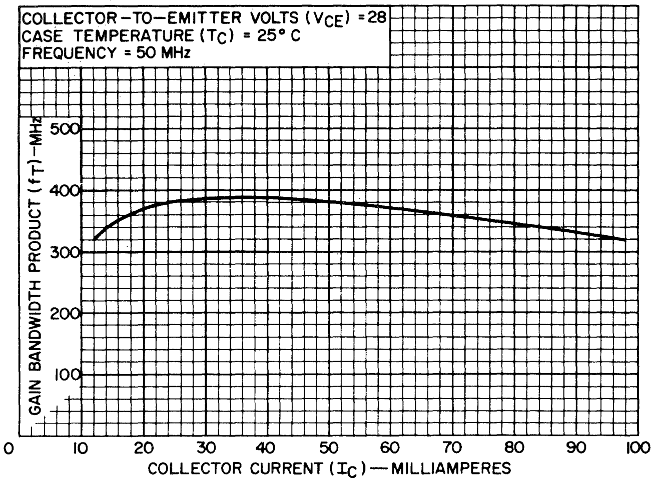


Fig. 11

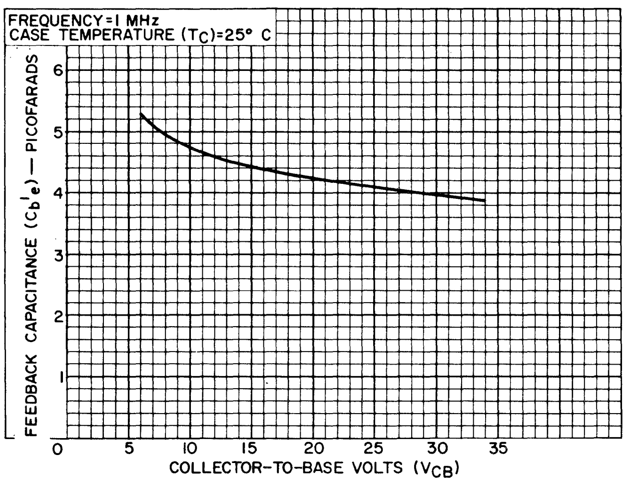


Fig. 12

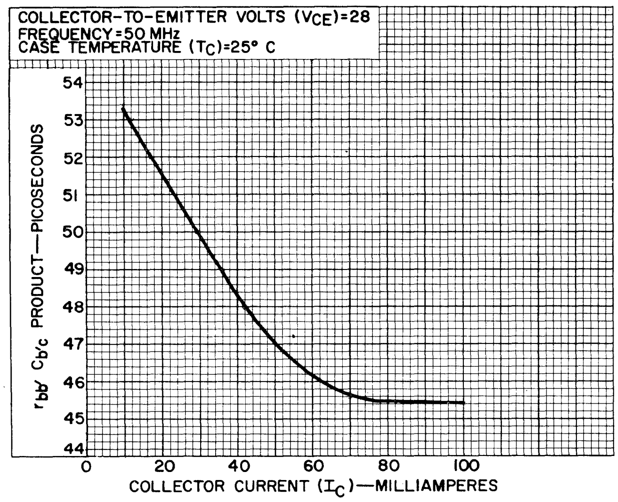


Fig. 13

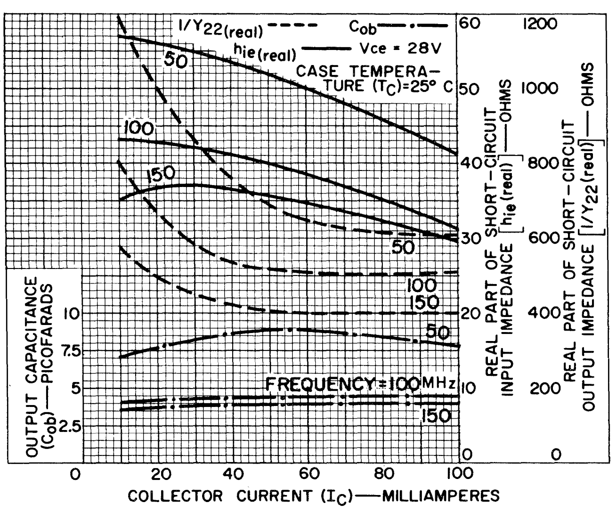


Fig. 14

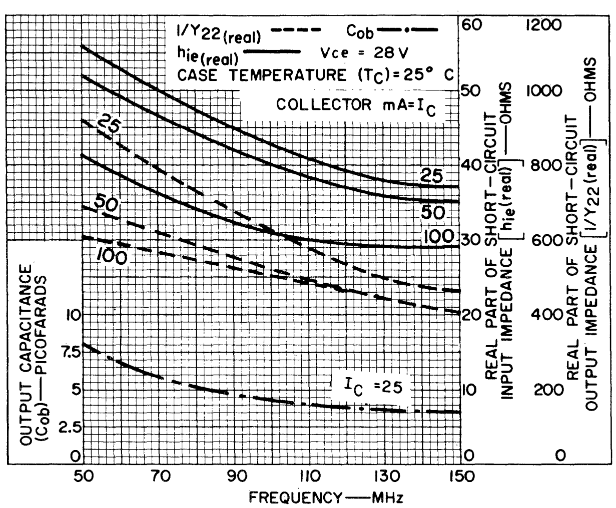
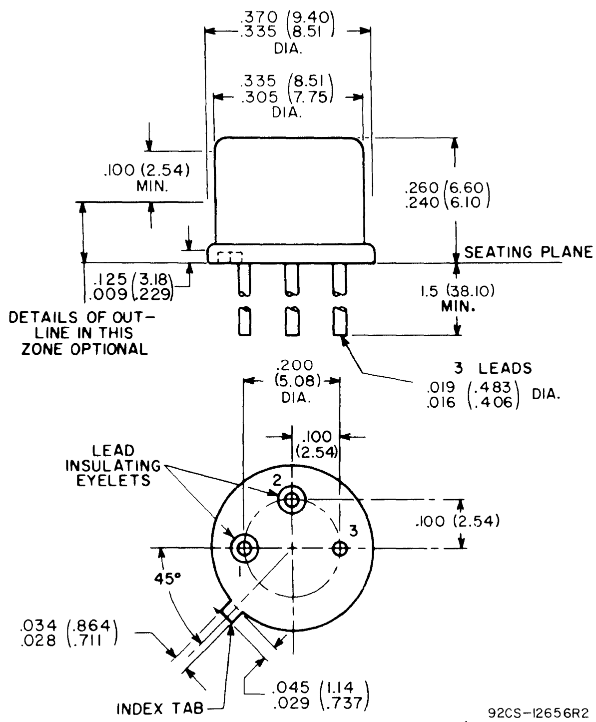


Fig. 15

DIMENSIONAL OUTLINE
JEDEC No.TO-5



Note *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

TERMINAL CONNECTIONS

Lead 1 – Emitter
Lead 2 – Base
Lead 3 – Collector, Case

SILICON N-P-N "overlay" TRANSISTOR

40578

File No. 298

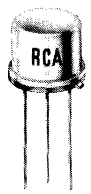
HIGH-RELIABILITY TRANSISTOR

RCA–40578* is a high-reliability variant of the RCA–2N3866, an epitaxial n-p-n planar transistor of "overlay" emitter electrode construction. It is especially processed for high reliability. It is intended for Class A, B, and C amplifier, frequency multiplier, or oscillator operation in high-reliability, driver or pre-driver stages, VHF-UHF applications in Space, Military, and Industrial communications equipment.

High reliability is assured by eight preconditioning steps, including drift temperature measurements after the High Temperature Reverse Bias and Power Age tests. The 40578 also features complete qualification and lot acceptance testing.

* Formerly RCA–Dev. No. TA7080

High-Gain Device for Class A,B, or C Operation in VHF-UHF Circuits



JEDEC TO-39

H-1381

- 8 Preconditioning Steps
- Complete Qualification and Lot Acceptance Testing
- High Power Gain, Unneutralized Class C Amplifier
  At 400 MHz, 1 W output with 10 dB gain (min.)
  250 MHz, 1 W output with 15 dB gain (typ.)
  175 MHz, 1 W output with 17 dB gain (typ.)
  100 MHz, 1 W output with 20 dB gain (typ.)

RATINGS

Maximum Ratings, *Absolute-Maximum Values:*

COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	55	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With external base-to-emitter resistance R_{BE} = 10 ohms	V_{CER}	55	V
With base open	V_{CEO}	30	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	3.5	V
COLLECTOR CURRENT	I_C	0.4	A
TRANSISTOR DISSIPATION	P_T		
At case temperatures up to 25° C		5	W
At free-air temperatures up to 25° C		1.0	W
At temperatures above 25° C		See *Fig. 1*	
TEMPERATURE RANGE:			
Storage & Operating (Junction)		–65 to 200	°C
LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. from seating plane for 10 s max.		230	°C

DISSIPATION DERATING CURVE

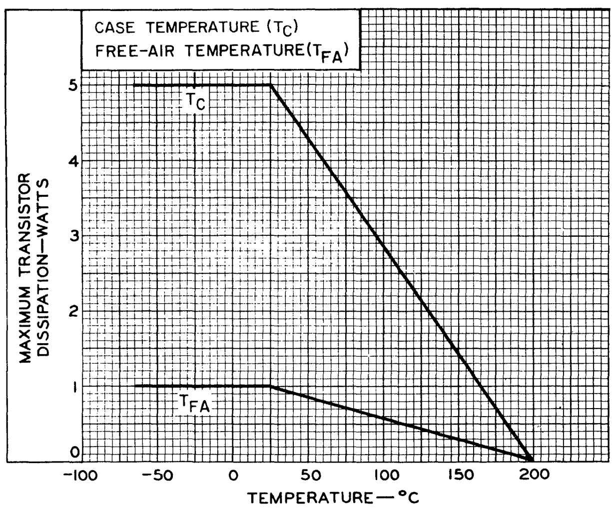


Fig. 1

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ELECTRICAL CHARACTERISTICS

Case Temperature = 25° C

Characteristic	Symbol	TEST CONDITIONS: DC Collector Volts V_{CB}	DC Collector Volts V_{CE}	DC Base Volts V_{BE}	DC Current (mA) I_E	DC Current (mA) I_B	DC Current (mA) I_C	LIMITS Min.	LIMITS Max.	Units
Collector-Cutoff Current	I_{CEO}		28			0		-	100	nA
Collector-to-Base Breakdown Voltage	BV_{CBO}				0		0.1	55	-	V
Collector-to-Emitter Voltage (Sustaining)	$V_{CER}(sus)$[a]						5	55	-	V
	$V_{CEO}(sus)$					0	5	30	-	V
Emitter-to-Base Breakdown Voltage	BV_{EBO}				0.1		0	3.5	-	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$					20	100	-	1.0	V
Collector-to-Base Capacitance (Measured at 1 MHz)	C_{ob}	30			0			-	3.0	pF
RF Power Output Class-C Amplifier, Unneutralized At 100 MHz At 250 MHz At 400 MHz (See Fig.3)	P_{OUT}		 28[b] 28[b] 28[b]					 1.8 (typ.)[c] 1.5 (typ.)[d] 1.0[e]		W
Gain-Bandwidth Product	f_T		15				50	800 (typ.)		MHz

[a]With external base-emitter resistance (R_{BE}) = 10 Ω.
[b]V_{CC} value.
[c]For P_{IN} = 0.05 W; minimum efficiency = 60%.
[d]For P_{IN} = 0.1 W; minimum efficiency = 50%.
[e]For P_{IN} = 0.1 W; minimum efficiency = 45%.

POWER OUTPUT vs. FREQUENCY

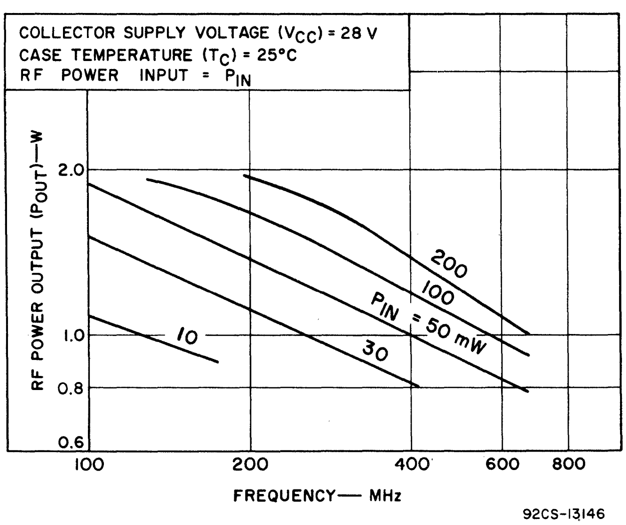
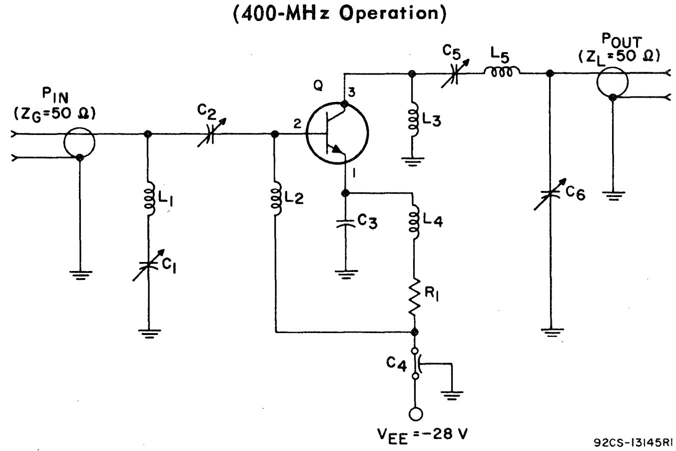


Fig. 2

RF AMPLIFIER CIRCUIT FOR POWER-OUTPUT TEST (400-MHz Operation)



C1: 3-35 pF
C2,C5: 8-60 pF
C3: 12 pF
C4: 1,000 pF
C6: 0.9-7 pF
L1: 2 turns No.18 wire, 1/4" ID, 1/8" long
L2: Ferrite rf choke, 1 turn, Z = 450 Ω
L3,L4: RF choke, 0.1 μH
L5: 2-1/2 turns, No.18 wire, 1/4" ID, 3/16" long
R1: 5.6 Ω, 1 W
Q: 40578

Fig. 3

RELIABILITY SPECIFICATIONS . . . .

In addition to Preconditioning and Group A tests, a Qualification Approval test series (Group B tests) is performed on each lot.

Preconditioning (100 Per Cent Testing of Each Transistor)

1. Serialization
2. Record I_{CEO}, h_{FE}
3. Temperature Cycling-Method 107B Cond. C of MIL-STD-202, 5 cycles, -65^{o} C to 200^{o} C
4. Bake, 72 hours minimum, 200^{o} C
5. Constant Acceleration-Method 2006 of MIL-STD-750, 10,000g, Y_1 and Y_2 axes
6. X-Ray
7. Record I_{CEO}, h_{FE}
8. Reverse Bias Age, $T_A = 200^{o}$ C, $V_{CB} = 50V$, t = 96 hours
9. [d] Record I_{CEO}, h_{FE}
10. Power Age, $T_A = 25^{o}$ C, $V_{CB} = 28V$, t = 340 hours, $P_T = 1$ W, free air
11. [d] Record I_{CEO}, h_{FE}, V_{CE} at 340 hours
12. Helium Leak, 1 x 10^{-7} cc/sec. max.
13. Gross Leak, MIL-STD-202, Method 112
14. Record Subgroups 2 and 3 of Group A Tests

[d] Delta criteria after 96 hours Reverse Bias Age and 340 hours Power Age

ΔI_{CEO}	+100% or +20 nanoamperes whichever is greater
Δh_{FE}	±20%

Definitions

Delta (Δ): Delta shall be determined by subtracting the parameter value measured before application of stress from the value measured after the application of stress.

Group A Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD	SYMBOL	LIMITS Min.	LIMITS Max.	UNITS
	Subgroup 1		10				
2071	Visual and Mechanical Examination	–	–	–	–	–	–
	Subgroup 2		5				
3041D	Collector-Cutoff Current	$V_{CE} = 28$ V	–	I_{CEO}	–	100	nA
3001D	Collector-to-Base Breakdown Voltage	$I_C = 100$ µA	–	BV_{CBO}	55	–	volts
3026D	Emitter-to-Base Breakdown Voltage	$I_E = 100$ µA	–	BV_{EBO}	3.5	–	volts
3011D	Collector-to-Emitter Breakdown Voltage	$I_C = 0$ to 5 mA[f]	–	BV_{CEO}	30[g]	–	volts
3011B	Collector-to-Emitter Breakdown Voltage	$I_C = 0$ to 5 mA[f], $R_{BE} = 10\ \Omega$	–	BV_{CER}	55[g]	–	volts
3071	Collector-to-Emitter Saturation Voltage	$I_C = 100$ mA, $I_B = 20$ mA	–	$V_{CE}(sat)$	–	1	volt
3076	DC Forward-Current Transfer Ratio	$I_C = 100$ mA, $V_{CE} = 5$ V	–	h_{FE}	10	–	–
	Subgroup 3		5				
3236	Output Capacitance	$V_{CB} = 30$ V	–	C_{ob}	–	3.0	pF
3261	Extrapolated Unity Gain Frequency	$I_C = 50$ mA, $V_{CE} = 15$ V, f = 200 MHz	–	f_T	500	–	MHz
See *Fig. 3*	RF Power Output (Min. Eff. = 45%)	$V_{CE} = 28$ V, $P_{IN} = .1$ W, f = 400 MHz	–	P_{OUT}	1.0	–	watts
	Subgroup 4		15				
3036D	Collector-Cutoff Current	$T_A = 150^{o}$ C ± 3^{o} C, $V_{CB} = 30$ V	–	I_{CBO}	–	100	µA
3076	DC Forward-Current Transfer Ratio	$T_A = -55^{o}$ C ± 3^{o} C, $I_C = 100$ mA, $V_{CE} = 5$ V	–	h_{FE}	5	–	–

[f] Pulsed through an inductor (25 µH); duty factor = 50%.
[g] Measured at a current where the breakdown voltage is a minimum.

General Reliability Specifications that are applicable to all rf power transistors are given in booklet RFT-701 and must be used in conjunction with the specific Preconditioning, Group A Tests, and Group B Tests shown below.

Group B Tests

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS
	Subgroup 1	(13 Samples)
2066	Physical Dimensions	
	Subgroup 2	(13 Samples)
2026	Solderability	
1051	Thermal Shock (Temp. Cycling)	Test Condition C
1056	Thermal Shock (Glass Strain)	Test Condition B
2036	Terminal Strength (Tension)	Test Condition A, weight = 5 lbs. time = 15 s each terminal
	Seal (Leak Rate)	Method 112 of MIL-STD-202 Test Cond. C, procedure IIIa, Test Cond. A for gross leaks
1021	Moisture Resistance	10-8 cc/s
	Subgroup 3	(13 Samples)
2016	Shock	1,500 g, 0.5 ms, 5 blows each orientation: X_1, Y_1, Z_1, (15 blows total)
2046	Vibration Fatigue	Nonoperating
2056	Vibration Var. Freq.	–
2006	Constant Acceleration	20,000 G Y_1, Y_2
	Subgroup 4	(13 Samples)
2036E	Terminal Strength (Lead Fatigue)	
	Subgroup 5	(13 Samples)
1041	Salt Atmosphere	
	Subgroup 6	(25 Samples)
1031	High Temperature Life (Nonoperating)	$T_{storage}$ = 200° C
	Subgroup 7	(25 Samples)
1026	Steady-State Operation	T_{FA} = 25° C t = 1000 hrs. P_T = 1 W, V_{CB} = 28 V free air, no heat sink

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	SYMBOL	LIMITS Min.	LIMITS Max.	UNITS
	End Points Subgroups (2, 3, 5, 6, 7)					
3041D	Collector-to-Emitter Cutoff Current	V_{CE} = 28 V	I_{CEO}	–	1.0	μA
3011B	Collector-to-Emitter Breakdown Voltage	I_C = 5 mA (Inductive)[i] R_{BE} = 10	BV_{CER}	50[k]	–	volts
See *Fig. 3*	RF Power Output (Min. Eff. = 45%)	V_{CE} = 28 V, P_{IN} = 0.1 W, f = 400 MHz	P_{OUT}	0.95	–	watts
3076	DC Forward-Current Transfer Ratio	I_C = 100 mA V_{CE} = 5 V	h_{FE}	9	–	–
3026D	Emitter-to-Base Breakdown Voltage	I_E = 100 mA	BV_{EBO}	3.0	–	volts

[h]Acceptance/Rejection Criteria of Group B tests: For an LTPD plan of 7% the total sample size is 115 for which the maximum number of rejects allowed is 4. Acceptance is also subject to a maximum of one (1) reject per Sub-group. Group B tests are performed on each lot for Qualification or Lot Acceptance.

[i] Pulsed through an inductor (25 mH); duty factor = 50%.

[k]Measured at a current where the breakdown voltage is a minimum.

GAIN-BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

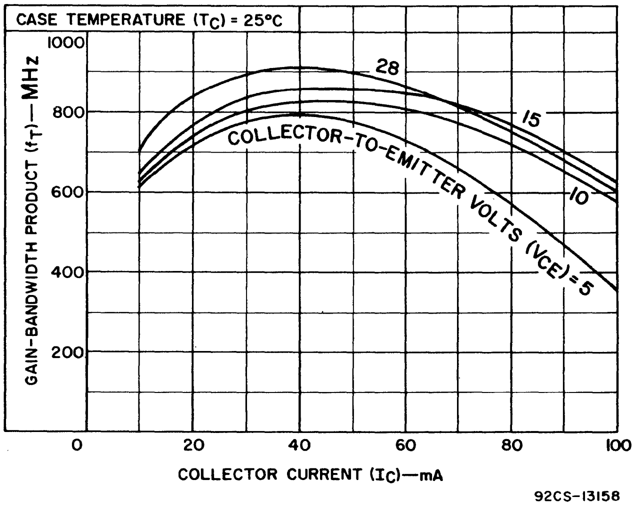


Fig.4

SERIES INPUT RESISTANCE vs. FREQUENCY

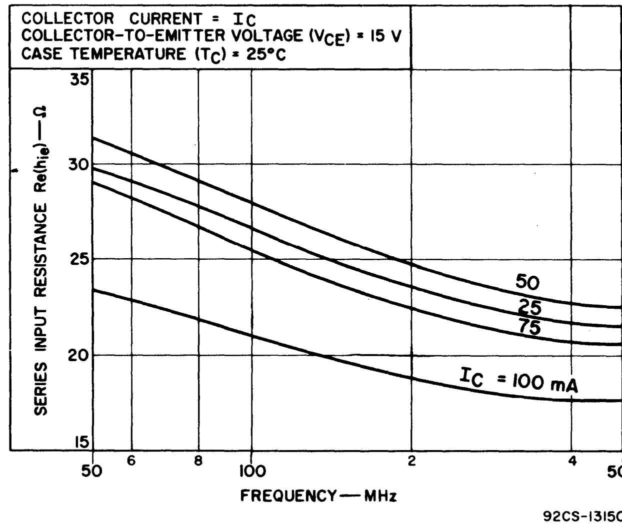


Fig. 5

SERIES INPUT REACTANCE vs. FREQUENCY

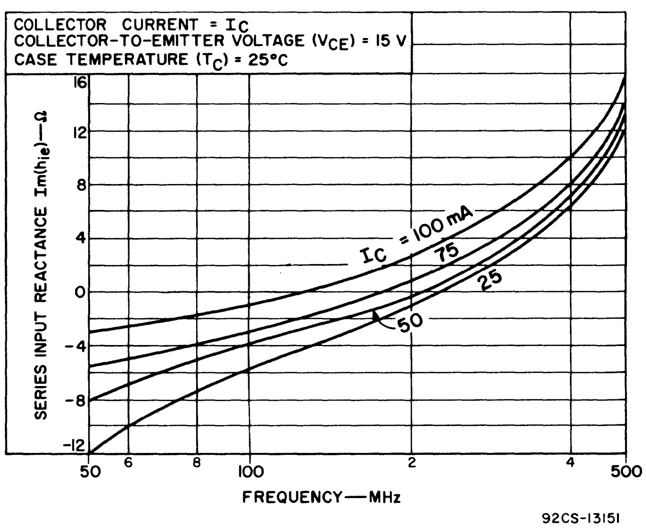


Fig.6

SERIES INPUT RESISTANCE & REACTANCE vs. FREQUENCY

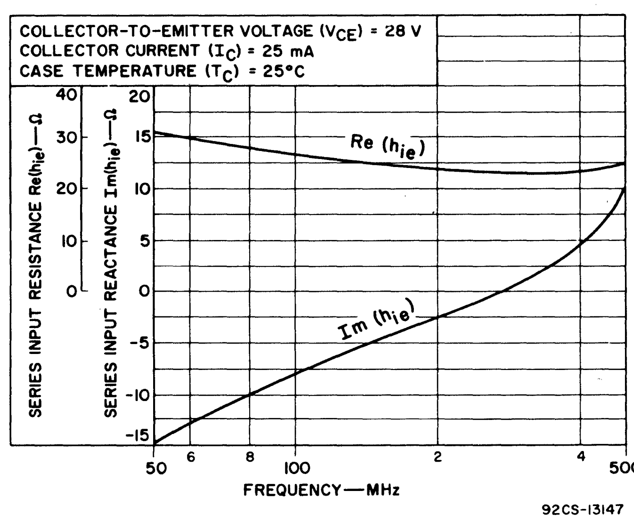


Fig.7

PARALLEL OUTPUT RESISTANCE vs. FREQUENCY

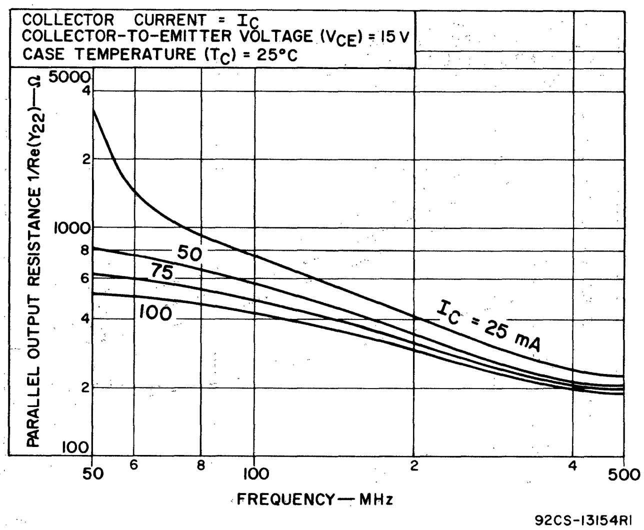


Fig.8

PARALLEL OUTPUT CAPACITANCE vs. FREQUENCY

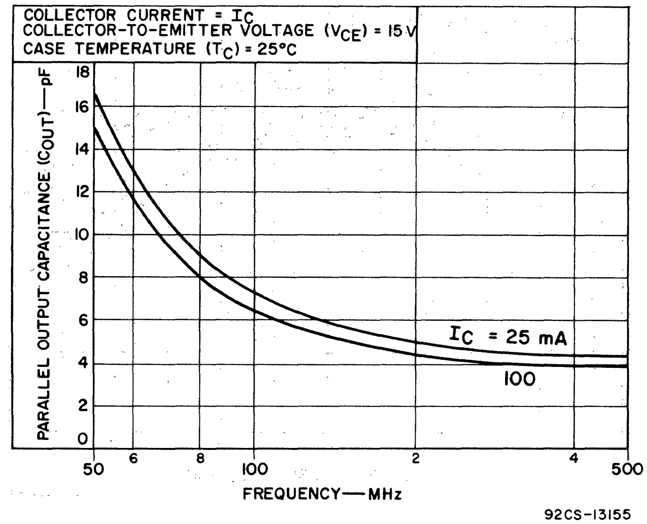


Fig.9

PARALLEL OUTPUT RESISTANCE & CAPACITANCE vs. FREQUENCY

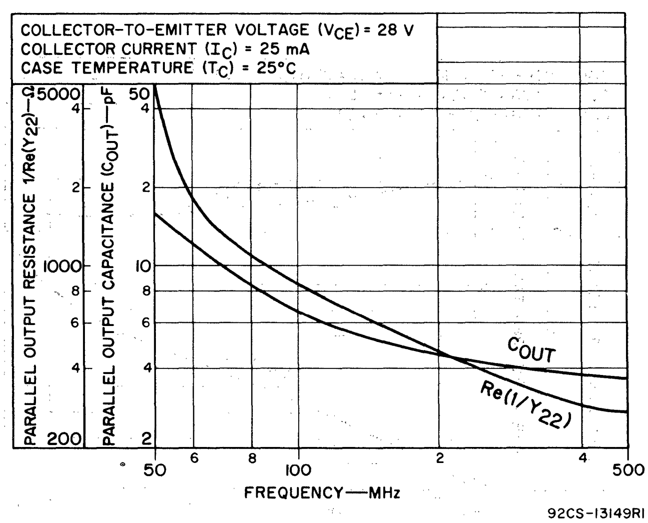


Fig. 10

VARIATION OF COLLECTOR-TO-BASE CAPACITANCE

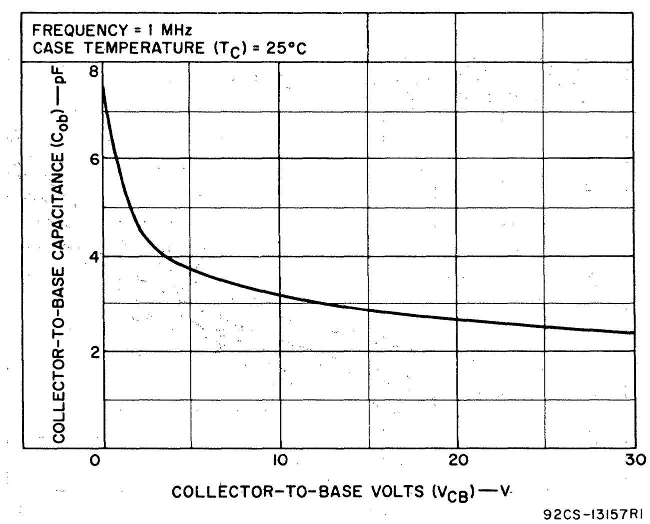
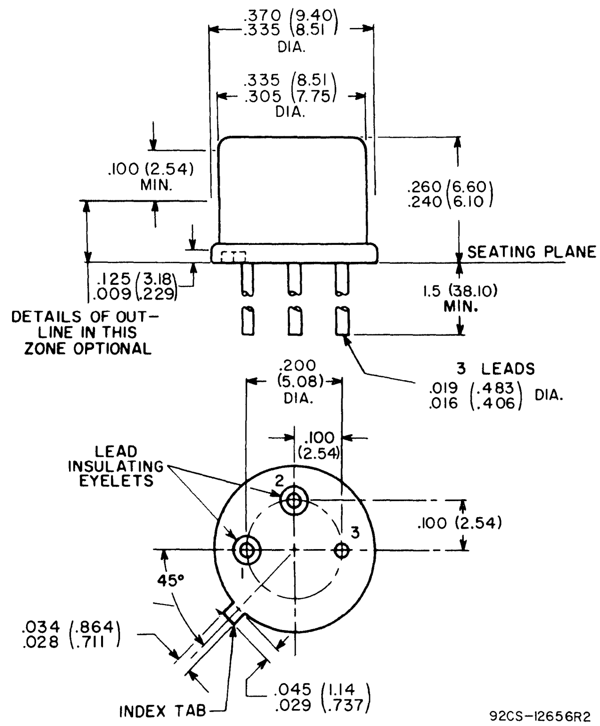


Fig. 11

DIMENSIONAL OUTLINE
JEDEC TO-39



DIMENSIONS IN INCHES AND MILLIMETERS

Note: *Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated.*

TERMINAL CONNECTIONS

Lead No. 1 – Emitter
Lead No. 2 – Base
Case, Lead No. 3 – Collector