

Bell System Data Communications

TECHNICAL REFERENCE



**DATA SET 103F
INTERFACE
SPECIFICATION**

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May 1964

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

DATA AND TELETYPEWRITER PLANNING ENGINEER



Bell System Data Communications
TECHNICAL REFERENCE MANUAL

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Data Set 103F
Interface Specification

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DATA AND TELETYPEWRITER PLANNING ENGINEER



PREFACE

This specification is specifically intended for designers of data equipment to be used with Bell System Data Set 103F in private line data services.

If additional details on the interface and its operation are needed, please contact:

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New York, N.Y. 10007

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DATA SET 103F – INTERFACE SPECIFICATION



Fig. 1 – Data Set 103F

1. GENERAL

Data Set 103F provides for the transmission of binary serial data on private line data services. The set permits transmission rates up to 300 bauds (300 bits/second maximum) in either or both directions, simultaneously if desired. Provisions for voice transmission, if required, are made external to the data set.

2. PHYSICAL

Data Set 103F, shown in Figure 1, is housed in a two-tone gray plastic cabinet approximately 11" W x 5½" H x 10" D. It is normally mounted horizontally on a table or shelf. Its weight is approximately 15 pounds. A bracket is available to permit mounting the set face up on a vertical surface.

Non-locking test buttons are provided on the front panel. The buttons should only be used

when and as directed by the Telephone Company.

A 5½ foot gray cord is provided between the data set and the telephone line connections. It is attached at the data set by a connector to allow easy maintenance of the set.

The customer must provide a receptacle supplying continuous 120 volt, 60 cycle a-c power. The power consumption of the set is less than 15 watts. The set is equipped with a demountable 10 foot long gray cord, equipped with a U-blade-ground type plug. The power receptacle provided must accept such a plug and supply a valid ground to the ground pin.

The set will perform satisfactorily over a temperature range of 40° to 120°F, and a relative humidity range of 20% to 95%.

A receptacle is provided at the rear of the set for connection of the customer's data equipment.

3. INTERFACE CONNECTOR

3.1 Physical

The customer's data equipment should be equipped with a cable terminating in a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly or equivalent. The receptacle on the data set is equivalent to a Cinch or Cannon DB-19604-433, and is equipped with threaded retaining spacers. The DB-51226-1 hood assembly includes retaining screws which enter these spacers, retaining the plug against accidental disengagement.

The cable should not exceed 50 feet in length.

A detailed discussion of the characteristics of the interface connector is found in: Bell System Data Communications

TECHNICAL REFERENCE DATA SET INTERFACE CONNECTORS

which is available from

Data and Teletypewriter Planning Engineer
American Telephone and Telegraph Co.
195 Broadway
New York, New York 10007

3.2 Pin Assignment

The 25 pins of the interface connector are assigned as follows:

TABLE 1

Pin	Designation	Name	Pin	Designation	Name
1	AA	Protective Ground	14	-	Not Used
2	BA	Transmitted Data	15	-	"
3	BB	Received Data	16	-	"
4	CA*	Request to Send	17	-	"
5	CB	Clear to Send	18	-	"
6	CC*	Data Set Ready	19	-	"
7	AB	Signal Ground	20	-	"
8	CF	Data Carrier Detector	21	-	"
9	+ P	Positive Power	22	-	"
10	- P	Negative Power	23	-	"
11	CY	Originate Mode	24	-	"
12	CX	Local Mode	25	-	"
13	-	Not Used			

* "Fail Safe" Circuit; See Section 4.1

4. INTERFACE ELECTRICAL

4.1 EIA Standard

All data and control circuits in the interface operate with the interchange signals recommended by the Electronic Industries Association in their document RS-232-A, "Interface Between Data Processing Terminal Equipment and Data Communications Equipment."

The following description is in accordance with this document:

All circuits (other than the protective and signal grounds) carry bipolar low-voltage signals suitable for use with electronic circuitry. The two binary conditions conveyed by these signals are:

DATA CIRCUITS	CONTROL CIRCUITS	POLARITY
Mark ("1")	OFF	-
Space ("0")	ON	+

All voltages are measured with respect to circuit AB (Signal Ground) at the point of interconnection; i.e., the interface connector.

The source of an interchange signal shall deliver a voltage of between 5 and 25 volts (positive or negative) into a load whose resistance is not less than 3000 ohms.

The destination shall respond without damage to interchange signals of between 3 and 25 volts (positive or negative). A 2-volt margin is thus assured.

The destination of an interchange signal shall present an essentially resistive load of resistance not less than 3000 ohms. The capacitance of the load (measured from the interface connector) shall not be greater than 2500 pf (uuf).

The load shall not contain an internal potential of more than 2 volts.

Voltage conditions between +3 volts and -3 volts are anomalous and require no specific response except in the case of "fail safe circuits," described below. Data and timing circuits shall have rise times so that the signal remains in this anomalous region during each transition for no more than 3% of the minimum signal element length appropriate to the speed of the channel.

Certain control circuits shall be designed to "fail safe." These include such circuits as "data set ready," "data terminal ready," and "request send," when provided. "Fail safe" operation implies that the destination can interpret the signal condition as "OFF" when the source has lost power. In this case, no potential is applied by the source.

The source of any "fail safe" circuit shall, under conditions of loss of power, provide a resistance to signal ground of not less than 300 ohms. This allows the use in the destination of shunt biasing circuits to insure the "OFF" response under this condition.

4.2 Circuit Functions

Circuit AA (Protective Ground) is tied to the frame of the data set, which is in turn grounded to the power system ground through the power cord. It may be tied to the frame of the customer's data terminal equipment. Such equipment, if operated by commercial power, should also have an appropriate ground applied to its frame.

In no case should Circuit AA be used to provide the sole protective ground to commercially powered data terminal equipment.

Whenever possible the data set and data terminal equipment should obtain their frame grounds from the same receptacle box or ground bus.

Circuit AB (Signal Ground) provides the reference point for all other interchange circuits. In this data set it is tied to the frame. It may be tied to the frame of the customer's data terminal equipment if the circuit so requires.

Circuit BA (Transmitted Data) is used by the data terminal equipment to present the data to be transmitted. It is operative when circuits CA (Request to Send) and CB (Clear to Send) is ON.

Circuit BB (Received Data) delivers the data received by the data set. When the data set is idle, or when circuit CF (Carrier Detector) is OFF, circuit BB is held in the MARK condition.

Circuit CA (Request to Send) is used by the data terminal equipment to turn carrier on or off in the data set depending upon whether the CA lead is placed in the ON or OFF condition.

Circuit CB (Clear to Send) indicates when ON that the data set has established a connection with the distant data set and that signals may be applied to circuit BA (Transmitted Data).

Circuit CC (Data Set Ready) indicates when ON that the data set is in the data mode; that is, that it is not in the idle, talk, test, or local condition, nor is it without power.

Circuit CF (Data Carrier Detector) indicates when ON that data carrier is being received from the distant end. In the method of operation used by Data Set 103F, this circuit and circuit CB (Clear to Send) carry simultaneous signals.

Circuit CX (Local Mode), when placed in the ON condition by the data terminal equipment, holds an OFF condition on the CC circuit and delivers local copy of the data on the BA circuit to the BB circuit. Carrier is not transmitted to the communication channel in this mode.

Circuit CY (Originate Mode) allows the data terminal equipment the option to control operation of the data set in either the ORIGINATE or ANSWER mode. An OFF condition on the CY lead places the data set in the ANSWER mode; whereas, an ON, open circuit, or short circuit condition on the CY lead places the data set in the ORIGINATE mode. If the option to control is not desired, the data set is permanently strapped in either mode as required by the Telephone Company.

4.3 Modulation Rate

The maximum modulation rate of the channel provided by Data Set 103F is 300 bauds (300 bits per second) in each direction, simultaneously if desired. Under the 300 baud limit the length of the shortest signal element to be resolved must be no less than 3.33 ms. Transmission may be at any modulation rate from zero to the maximum.

There is no limit on the interval of MARK or SPACE which may be transmitted.

5. SYSTEM OPERATION

5.1 Frequency Assignment

Two different frequency bands may be simultaneously used by a system of data sets 103F, one carrying data in each direction.

Each band carries a single tone which is shifted to one of two frequencies, one representing the MARK state and one the SPACE state.

The two frequencies in the lower band are designated F1M and F1S for MARK and SPACE, respectively.

The corresponding frequencies in the higher band are designated F2M and F2S.

The data set has two frequency modes called "originating" and "answering." The "originating" data set transmits F1 and receives F2. The "answering" set transmits F2 and receives F1.

These names have nothing to do with the direction of data flow, but are derived by analogy with data sets such as the 103A which are used in DATA-PHONE service.

5.2 Timing (Figure 2)

The CF lead of a given set turns ON after carrier has been received continuously for 150 ms (± 50). It will turn OFF approximately 50 ms (± 25) after carrier is lost if the loss is longer than about 20 ms (± 10).

Until CF is turned ON, the BB circuit is in the MARK HOLD condition. The HOLD is reapplied when CF turns OFF.

A transient may appear on the BB circuit during the 50 ms period after carrier is removed until CF turns OFF and the HOLD is applied. Suitable steps should be taken to prevent misinterpretation of this transient. Such a step might be the use of an "end-of-transmission" code preceding the removal of carrier.

Transmission of data should not begin until at least 265 ms (± 65) after CA is turned ON to allow the distant end to detect carrier and remove its HOLD condition. CB is turned ON to indicate the end of this interval.

5.3 Network Configurations

Data transmission networks may be divided into two generic types, two-point and multi-point.

Each has its own philosophies of circuit operation.

5.31 Two-point Circuits

A two-point circuit consists of a single segment terminating in a data set at each end. When data sets 103F are used on such a circuit the set at one end operates in the OR ("Originate") frequency mode, and that at the other in the AN ("Answer") frequency mode. Thus, two-way communication is possible using F1 for one direction of transmission and F2 for the other. In general, it is immaterial which end is which. In some cases, for transmission reasons, the Telephone Company will recommend a particular arrangement.

Either station may turn its CA lead ON and send data to the other at any time. An interval of at least 265 ms should be allowed after turning CA on before data is sent to allow carrier recognition and BB circuit enablement at the far end, as discussed under 5.2 - Timing.

Alternatively, the far end, when it receives the CF signal, may respond by turning on its CA, returning carrier to the near end. The appearance of a CF signal at the near end verifies the integrity of the channel and indicates that the near end may send.

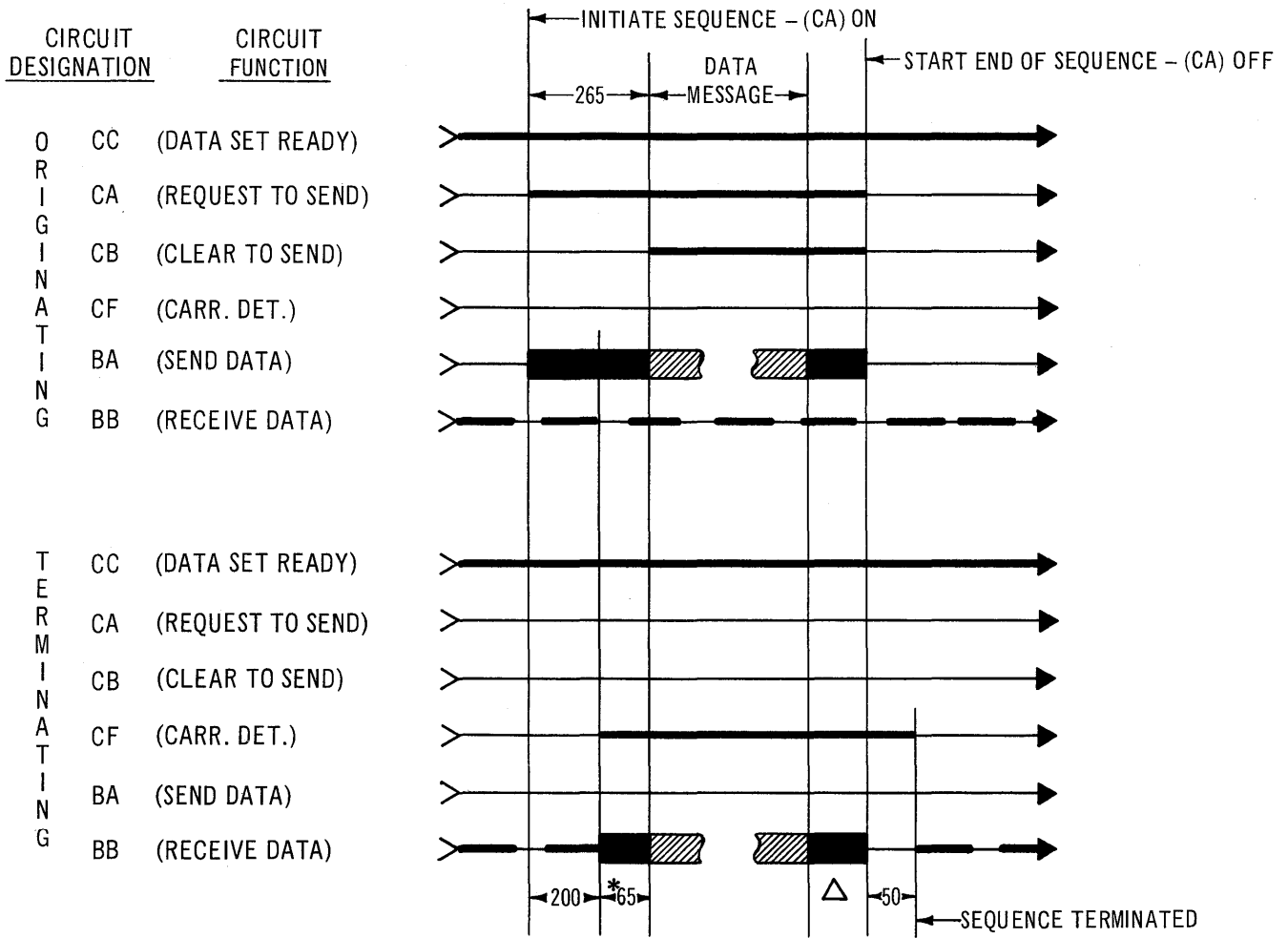
It is of course possible to leave both CA leads on at all times. Either end may begin to send at any time, and the CF leads give continuous monitoring of channel integrity.

5.32 Multi-Point Networks

A multi-point network interconnects three or more stations. It may be a "broadcast" network, in which case one point transmits to all others. In general, such a network may be arranged so that any point may send to all others.

A variety of operational disciplines may be applied to multi-point networks equipped with data sets 103F. The basic restrictions underlying the design of such systems are as follows:

1. No more than one station may be in the OR frequency mode with its CA circuit ON (i.e., sending F1) at any given time. Its transmission will be received by all stations which are in the AN mode.
2. No more than one station may be in the AN frequency mode with its CA lead ON (i.e., sending F2) at any given time. Its transmissions will be received by all stations which are in the OR mode.



NOTES:

*65 MS PERIOD IN WHICH DATA MAY BE RECEIVED (NOT RECOMMENDED)
 VARIABLE TIME BETWEEN "END OF MESSAGE" AND STARTING OF
 TERMINATING SEQUENCE - ALL TIMES IN MILLISECONDS, NOT TO
 SCALE - PROPAGATION TIMES IGNORED

LEGEND

<u>TRANSMITTED SIGNAL</u>	<u>CIRCUIT BB</u>	<u>CIRCUITS C-</u>
— NONE	— MARK HOLD	— OFF
□ SPACE	□ SPACE	— ON
■ MARK	■ MARK	RECEIVED FROM OTHER END
▨ DATA FROM BA	▨ DATA	

Fig. 2 - Data Set 103F Timing Sequence

Suitable "non-contention" arrangements must be made in the system design to prevent any two sets from attempting to transmit simultaneously in the same mode, or to resolve the conflict if it does occur.

5.33 Use of CY Lead

In multi-point networks it is often necessary to change the data set from operation in one frequency mode to another in the course of operation. The CY lead controls the frequency mode. If it is desired to operate in the OR mode, the CY lead should be held ON. To transfer to the AN mode the CY lead should be held OFF.

If a given station is to remain permanently in the AN or OR mode, the Telephone Company may so arrange. In this case the CY lead is not used.

5.4 Loss of Circuit

Loss of continuity of either direction of the telephone channel will cause the CF lead to go OFF and BB to the MARK HOLD condition at the end or ends losing tone. This may be used to call attention to this loss if its time of occurrence does not coincide with an expected carrier loss.

5.5 Local Mode

When the LOCAL circuit is turned ON, the data set enters the local mode. In this mode, the signals applied to the BA circuit are repeated out through the BB circuit. This permits a "loop-back" test of the customer's interface cable, the interface connectors, and the signal handling stages in the customer's equipment adjacent to the interface.

In the local mode, the CC lead is OFF. In addition, the data set is prevented from transmitting until the local mode is turned OFF. The carrier detector and CF lead remain operative.

5.6 Test Mode

Data Set 103F is equipped with circuitry which allows the Telephone Company Data Test Center to test the performance of both transmitting and receiving functions. The test buttons on the front panel of the set are used to activate the test modes. They should only be used as directed by the Telephone Company. The opera-

tion would typically be as follows:

When directed to do so, a test button is pressed and held. When the Data Test Center applies its test signal the test button is illuminated. It may then be released; the set remains in the test mode until released by a special signal from the Data Test Center. At this time the illumination of the test button is removed.

When the set is in the test mode the CC and CF leads are OFF, the CA and BA circuits are deactivated, and the BB circuit opened. The local mode is inoperative while in the test mode.

If the test buttons are accidentally pressed when no carrier is being received, the test mode is invoked, but will not lock in. Releasing the button will restore the set to normal.

If the test buttons are accidentally pressed while carrier is being received, it will have no effect.

In either case the button is not illuminated.

If a button should accidentally be pressed just as carrier is received, the set may enter the test mode, indicated by illumination of the button.

In this case the set may be restored to normal by pressing and releasing the test button.

6. SUMMARY OF OPTIONS

6.1 Installer Options

The following option must be specified and will be invoked by the Telephone Company upon installation:

Mode: Either "Answer" or "Originate" at all times or Controlled by CY lead

6.2 Customer Options

The following options are selectable where appropriate through the interface, and may be changed at will:

Local Copy (OFF LINE)	Yes (CX ON)
Mode: (if controlled by CY lead)	"Originate" (CY ON) "Answer" (CY OFF)



