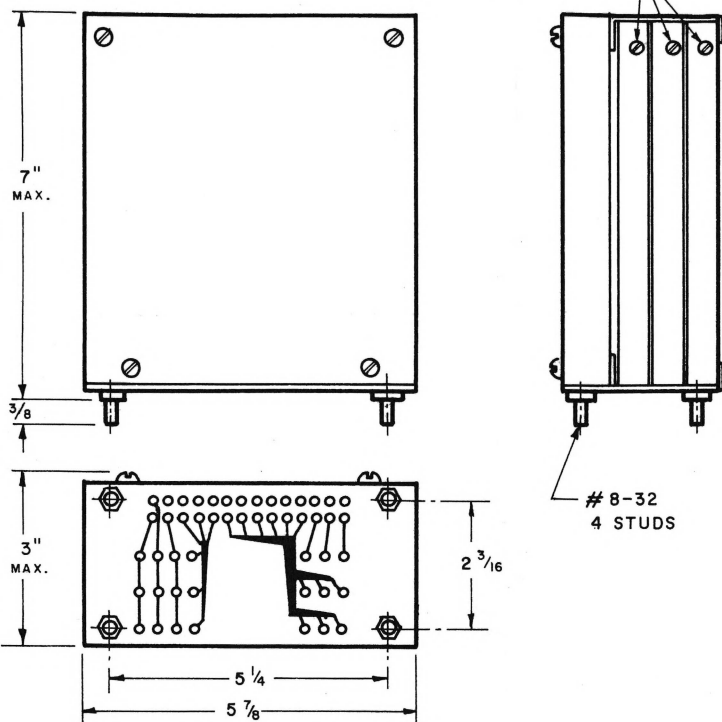


DELAY ADJUST

3 CHANNEL SERIAL MEMORY MODEL MA917



The MA917 (Memory) is a high storage, compact, serial memory for airborne or ordinary computer use. Three independent memory stores, each with a maximum capacity of 8000 bits NRZ, are housed in the package. They can be used as separate channels or can be cascaded to produce a single store of 24,000 bits NRZ capacity. The modules are supplied for use in the three common operating modes: the standard RZ (Return to Zero) mode; the NRZ (Non Return to Zero) mode for maximum storage and the Bi-Polar Mode for high shock and vibration operations.

Maximum Capacity

The storage medium which is a magnetostrictive delay line has a maximum delay of 4000 usec in each of the three channels. At this delay a maximum bit rate of 1Mc, RZ or 2Mc, NRZ is supplied thus providing a maximum capacity per channel of 8000 bits NRZ. The units can be supplied for higher frequency operation but only with shorter delays as follows:

Maximum Delay	RZ	NRZ
4000 usec. sec.	1Mc	2Mc
2000	1.5Mc	3.0Mc
500	2Mc	4.0Mc

Operating Temperature Range:

The delay line storage media of these memories are made to have a stability of up to $\pm 1/2$ PPM/ $^{\circ}$ C over a 0° C to 50° C temperature range, consequently, the delay length and the operating frequency determine the workable range, i. e. at maximum capacity the MA917 can be operated over a range of -5° C to $+65^{\circ}$ C in the RZ mode and 0° C to 50° C in the NRZ and Bi-Polar Mode.

INPUT REQUIREMENTS:

+3 to +30 volts or -3 to -30 volts.

CLOCK INPUT:

3 volts or more..A 50% duty cycle is preferred.

CLOCK STABILITY:

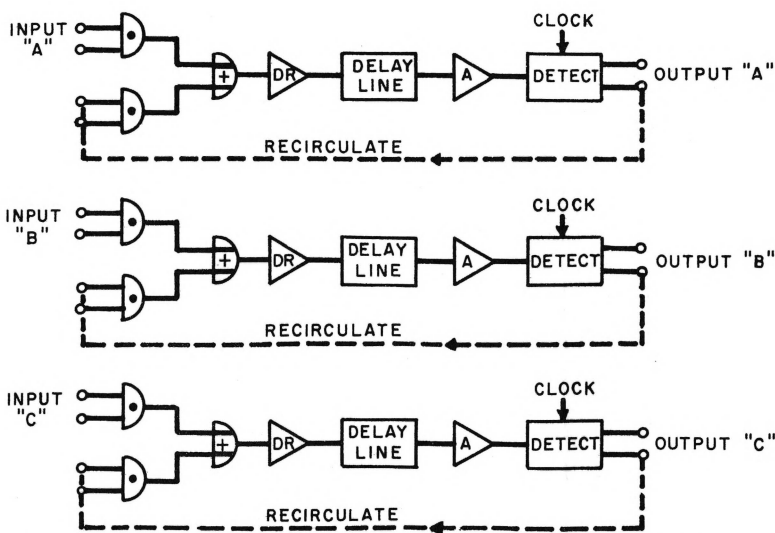
Less than ± 10 PPM

POWER REQUIREMENTS:

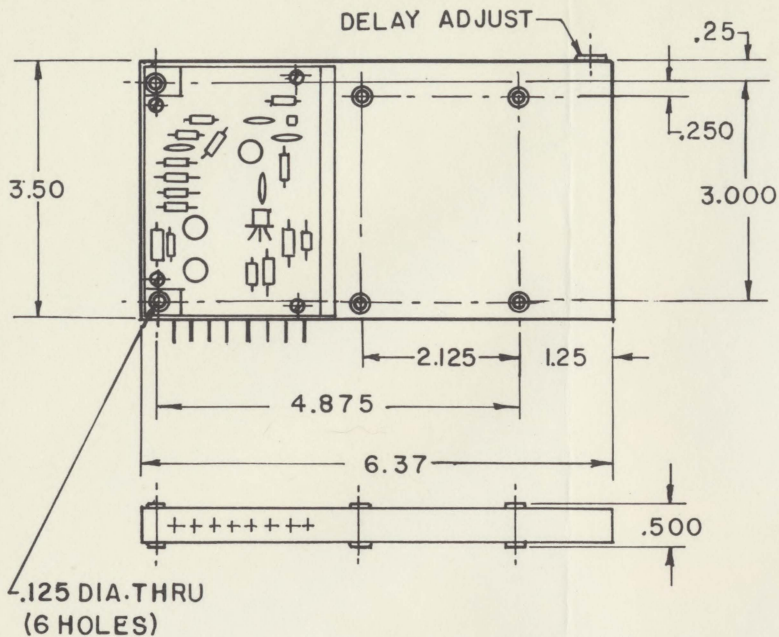
2 Watts total from ± 12 V and -12V supplies.

WHEN ORDERING:

Please specify operating mode, clock frequency, operating environment, delay and/or storage capacity.

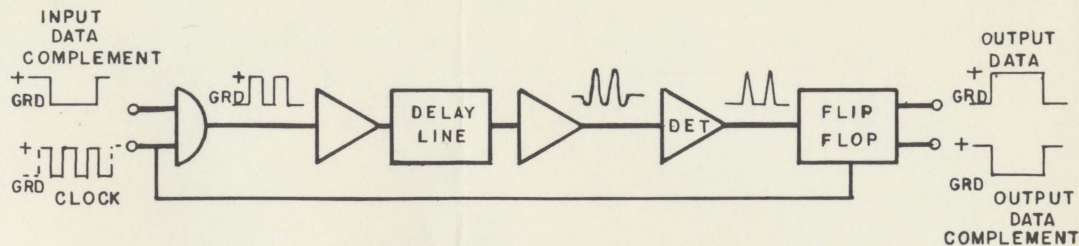


SONIC DELAY LINE MEMORY SYSTEM (THREE CHANNEL)		COMPUTER DEVICES CORP.	
MODEL MA917		6 WEST 18th ST. HUNTINGTON STA., N.Y.	
SCALE NONE		DWN <i>Ruk</i>	
APPVD E.S.W.		CHKD <i>K.P. Stone</i>	
A	91701	SIZE	DWG. NO.
			REV



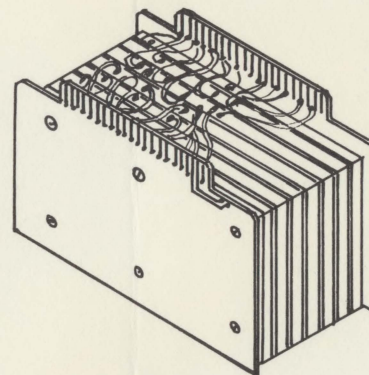
MODEL MS 2064

- DELAY:** Any specified delay from 20 to 1000 microseconds.
- STORAGE:** Maximum of 2000 bits storage is achieved by operating unit at 2 Mc, NRZ, with a delay of 1000 microseconds. Maximum RZ storage is 1000 bits at a bit rate of 1 Mc, with delay of 1000 microseconds.
- BIT RATE:** Any specified bit rate to maximum (shown above).
- POWER REQUIREMENTS:**
- | | |
|-------|---------------|
| +12V | 20 ma maximum |
| -12V | 5 ma maximum |
| +3.2V | 5 ma maximum |
- CLOCK:** 50% duty cycle: typical output from micrologic 909 (Fairchild)
- INPUT:** Typical: complement output (positive voltage to ground signal) of micrologic flip-flop 913 (Fairchild). 2 - 3 volts
- OUTPUT:** "1"s and complement from micrologic flip-flop 913 (Fairchild). 2 volts
- OPER. TEMP.:** ±10°C to +60°C



TYPICAL BLOCK DIAGRAM

NOTE: Standard units are designed to meet commercial specifications. Units can be supplied to meet Military Specifications on special order.



MODEL MA 2064

The MS 2064 is constructed for convenient stacking into memory packs, as shown in Model MA 2064 above. Printed plug-in boards with connectors can be provided as shown or to match your receptacle requirements.

DELAY LINE COMPUTER MEMORY DELCOM MODEL MS 2064		COMPUTER DEVICES CORP.	
SCALE NONE	DWN Lowry	A SIZE	206401 DWG NO.
APPVD EW	CHKD W		

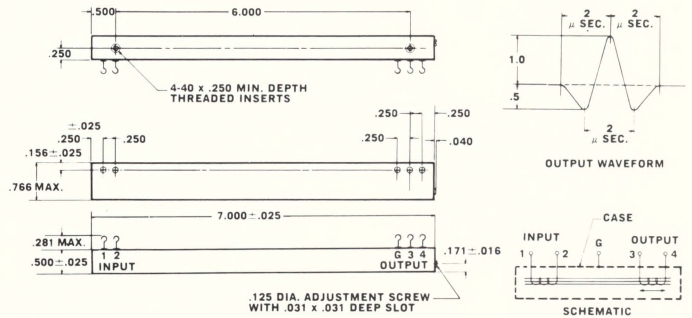
Variable Maglines

- **TIME DELAY:** 2-22 μsec
- **OPTIMUM INPUT PULSE WIDTH:** 1.0 $\mu\text{sec} \pm .2 \mu\text{sec}$
- **MAXIMUM PRF:** 500 Kc/s
- **MAXIMUM AVERAGE POWER INPUT:** 0.1 watt
- **IMPEDANCE RANGE FOR INPUT OR OUTPUT:** 50 to 4000 ohms

Line is stocked in 700 ohm input and output impedance and has the following specific characteristics:

MAXIMUM PULSE VOLTAGE TO REACH SATURATION LEVEL: 40 V peak

MAXIMUM OUTPUT SIGNAL LEVEL: 40 mV peak



7" L x .5"W x .766"H

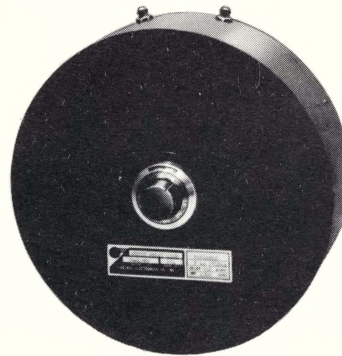
Model VM1020

complies with MIL-STD-202-A

Model VM1030



Model VM1090



MODEL VM 1030	SPECIFICATIONS	MODEL VM 1090
3 to 500 μsec	Delay Range	3 to 4000 μsec
50 ohms to 4K ohms	Impedance Range	50 ohms to 4K ohms
3 μsec	Min. Pulse Spacing	3 μsec
12 mv	Output when driven with 15 V Pk. - 1 μsec pulse	6 mv
10	Turns for full delay	28
4" O.D. x 4.5" L	Size	9" O.D. x 3 3/8" L
2 lb.	Weight	5 lb.



CONTROL ELECTRONICS COMPANY, INC.

153 Florida Street, Farmingdale, L.I., N.Y. 11735 • (516) 694-0125

**LONG DELAYS
OF COMPLEX
0 TO 400 KC
CW SIGNALS**

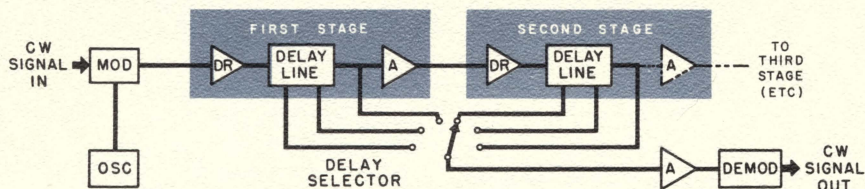
COMPUTER DEVICES

MODULATED CARRIER MAGNETOSTRICTIVE DELAY LINE SYSTEMS

DELAY CONCEPT

Magnetostrictive Delay Lines which are normally used for pulse and digital applications also provide an excellent means for obtaining extremely long delays of complex continuous wave signals by driving the Delay Lines with a carrier frequency and AM or FM modulating the carrier.

C. W. signals with frequency contents from zero up to 400 Kcs are faithfully preserved over very long delays with maximum delay dictated by economics alone. These units are usually supplied as a complete unity gain system which includes the magnetostrictive Delay Line, the line amplifiers and drivers, the carrier frequency oscillator and the modulator and demodulation circuitry; or, if it is preferred, suitable Delay Lines can be provided with recommendations for matching circuitry. A typical system schematic is shown below.



TOTAL DELAY AND TAP DELAYS

Extremely long delay can be provided by cascading stages as shown with no theoretical limit on maximum delay. The delay per stage depends on the carrier frequency used and whether or not the Delay Line must be tapped for intermediate delays. Untapped lines will have a per stage maximum delay of 15 milliseconds with a 500 Kc carrier and 5 milliseconds with a 1 Mc carrier. Carrier frequencies of up to 2 Mc are possible.

CDC's novel method of obtaining tap delays allows as many delay tap points as desired without any deteriorating effects to the signal. In the case of tapped Delay lines, the maximum delay per stage is 6 milliseconds.

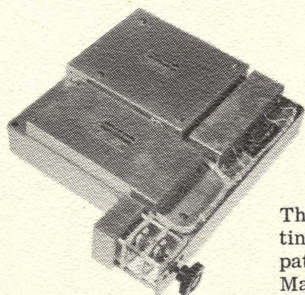
TEMPERATURE STABILITY

These systems are made extremely stable with temperature and are normally 10 PPM/°C. When required, stabilities of better than 1 PPM/°C can be specified.

PERFORMANCE

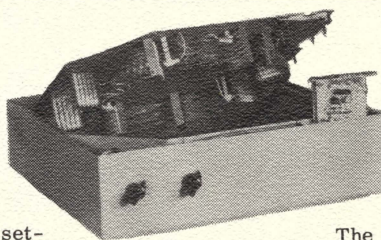
All the characteristics of the input signal are maintained at the delayed output with little or no phase distortion and low VSWR. Dynamic range is better than 20 db.

TYPICAL SYSTEMS



MS 574

The MS574 provides 24 delay settings spaced in an irregular delay pattern to an accuracy of $\pm 1\%$. Maximum delay settings is 10 milliseconds. The unit operates with a 1 Mc carrier which is modulated by a complex FM/AM modulation with a deviation of ± 250 Kc. Size is 12 x 12 x 3".



MS 400
(SHOWN PARTIALLY
DISASSEMBLED)

The MS400 is a unity gain delay system which provides 7 delays to a 70 Kc carrier which is modulated with a 5 to 5000 cycle C.W. signal. Delay is switch selected, giving a choice of delay settings from 100 to 6000 microseconds in a single stage Delay Line. Delay accuracy of ± 1 usec is maintained over a temperature range of 20 to 120°F. Size is 13 x 13 x 4".

TECHNICAL ASSISTANCE

CDC engineers are always available to assist you in determining the most economical specifications to meet your Delay Line requirements. A telephone call often saves many hours of research.



COMPUTER DEVICES CORP.
6 W. 18TH STREET, HUNTINGTON STA., L.I., N.Y.
TEL: 516 - AR1-0666, TWX: 516 - 421-4235

SPECIFICATIONS

Delay: Choice of any delay between 50 and 1500 usec.

Delay adjustment: ± 3 usec from specified nominal.

Pulse repetition frequency: 700 Kcs to 1.2 Mcs RZ (specify your requirement)

C. W. Bandwidth: 500 Kcs to 1.5 Mcs

Input Impedance: 300 ohms

Input Current: 40 to 50 ma

Input Pulse Width: Depends on bit rate (.4 usec for 1 ^{MC} ma)

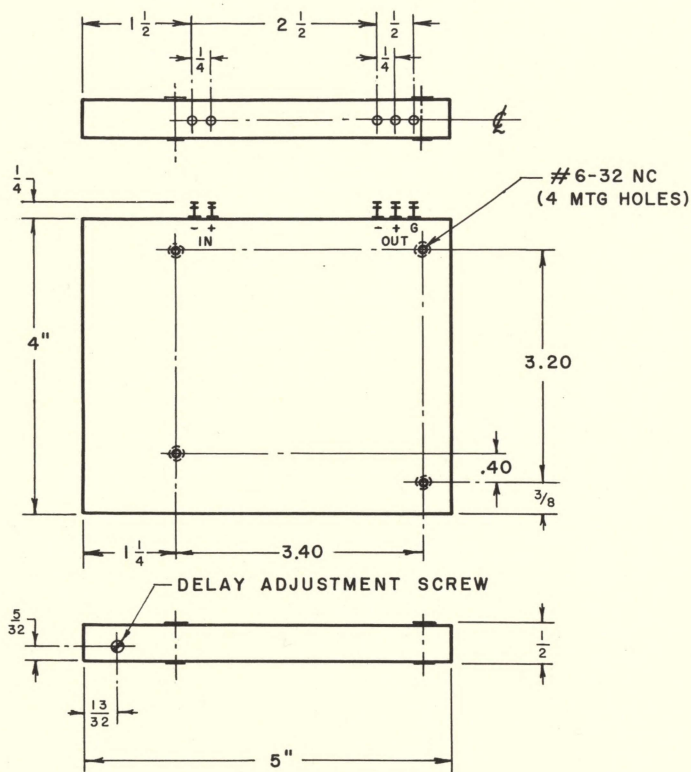
Output: Terminated in 2000 ohms and 50 picofarads

Output Voltage: 25 millivolts at 500 usec
15 millivolts at 1500 usec

Temperature Stability: 1 PPM/ $^{\circ}$ C (0 to 50 $^{\circ}$ C)

Construction: Aluminum case - gold anodized finish

Price: 1 through 30 pieces - \$70.00 each



Accessories

Transistorized input and output electronics. Mounts directly on DM544 case (adds 5/8" to thickness of unit). Provides unity gain to input signal.

Power required: +12 VDC
-12 VDC

Input Pulse Amplitude: grd to +5 volts

Price: 1 - 30 pieces - \$75.00 each

DELAY LINE,
MAGNETOSTRICTIVE
SERIES DM544

COMPUTER DEVICES
CORP.
6 WEST 18th ST.
HUNTINGTON STA., N.Y.

SCALE -
APPVD E.W.

DWN NK 3/31/64
CHKD H. Dumas

A
SIZE

54401
DWG NO.

REV

WIRE SONIC DELAY LINE MODEL MT766
(For Delays 5 to 12 Millisec)

The MT766 Wire Sonic Delay Line provides delays of up to 12,000 usec and is primarily designed for use in digital computers as a storage medium. It is supplied for recording in any of the three standard modes: RZ, NRZ and Bipolar, and the intended mode of operation must be specified when ordering.

Specifications and electrical characteristics vary with operating frequency. The following specifications are for maximum delay at maximum bit rate for mode indicated.

SPECIFICATIONS AND ELECT. CHARACTERISTICS		RECORDING MODE			
		RZ	NRZ	BIPOLAR	
MAXIMUM DELAY		10,000 USEC	10,000 USEC	12,000 USEC	
MAXIMUM BIT RATE		1 MC	2 MC	1 MC	
STORAGE CAPACITY		10,000 BITS	20,000 BITS	12,000 BITS	
INPUT (FIG. 4)	VOLTAGE	12 V	12 V	12 V	
	PULSE WIDTH	0.4 USEC	10 USEC (SEE FIG. 2)	0.4 USEC	
	CURRENT	50 mA	50 mA	50 mA	
OUTPUT (FIG. 4)	LOAD	3300 OHMS	3300 OHMS	3300 OHMS	
	PULSE WIDTH	SEE FIG. 1	SEE FIG. 2	SEE FIG. 3	
	MINIMUM VOLTAGE	5 mV	2 mV	5 mV	
	SIGNAL TO NOISE $\frac{VP}{VN}$	STATIC	12:1	7:1	N/A
		DYNAMIC	5:1	4:1	N/A

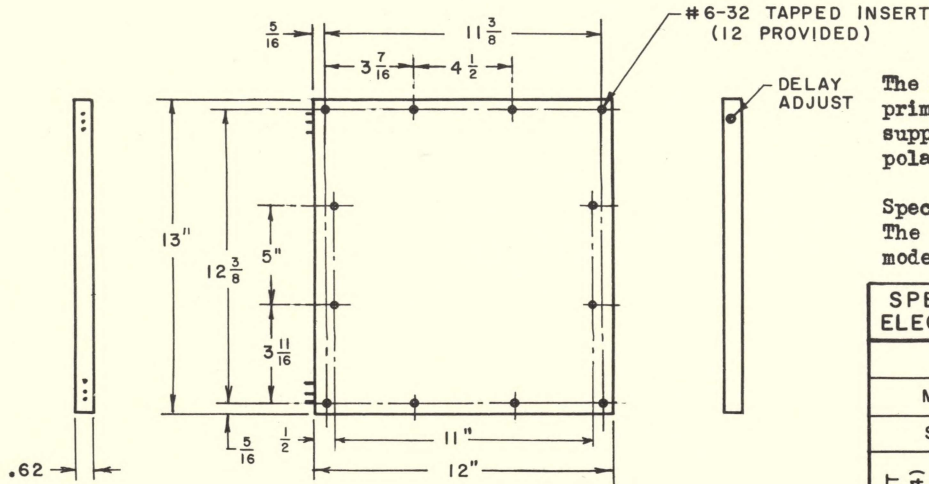
TEMP. VARIATIONS		5 MILLISEC LINE	10 MILLISEC LINE
DRIFT	10 TO 40°C	0.1 USEC MAX.	0.2 USEC MAX.
	0 TO 50°C	0.25 USEC MAX.	0.5 USEC MAX.

Amplitude Temperature Dependence: $\frac{VP_{Max.} - VP_{Min.}}{VP_{Max.}} \times 100\% \leq 20\%$

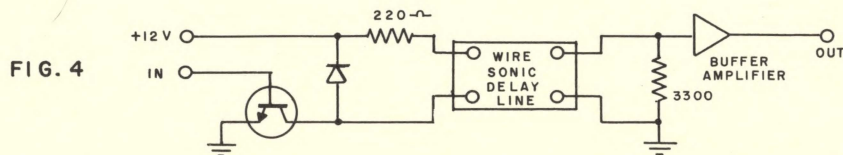
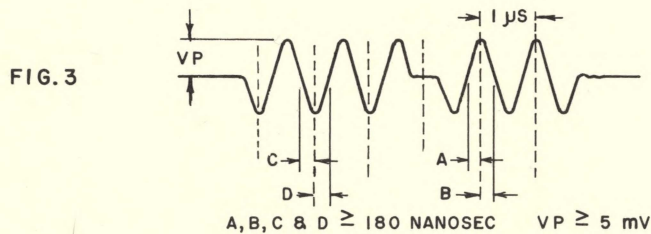
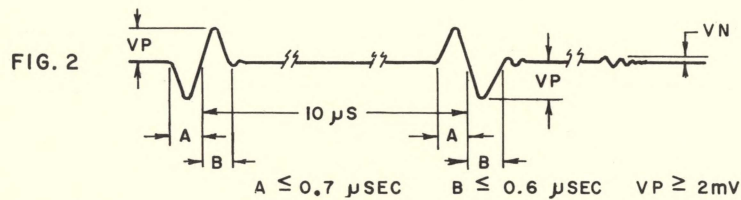
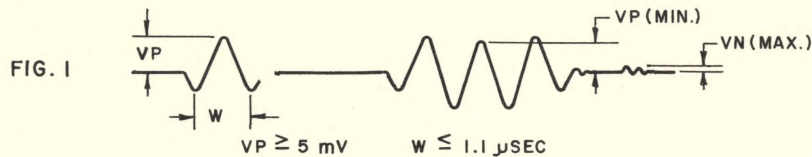
Storage Temperature: -65 to +100°C

Mechanical Construction:

Solder sealed steel case with "O" ring seal on adjustment shaft.
Finished with gray lacquer per Mil-E-15090.



NOTE: FOR CIRCUIT MOUNTING ACCESSORIES, SEE DWG. A 77602



DELAY LINE,
WIRE SONIC
MODEL MT 766

COMPUTER DEVICES
CORP.
6 WEST 18th ST.
HUNTINGTON STA., N. Y.

SCALE NONE DWN *Rud* 5/22/64
APPVD E.S.W. CHKD *Ken Deane*

A 76601
SIZE DWG NO.

REV.

STANDARD CDC SONIC DELAY LINE MEMORIES FOR DIRECT COMPUTER APPLICATION

THE CDC SONIC DELAY LINE MEMORIES ARE COMPLETE DYNAMIC STORAGE DEVICES CAPABLE OF ANY CAPACITY FROM 10 BITS TO 20,000 BITS. THESE MEMORIES UTILIZE A MAGNETOSTRICTIVE DELAY LINE AS THE STORAGE MEDIUM AND INCLUDE ASSOCIATED INPUT/OUTPUT CIRCUITRY, INPUT DRIVERS AND OUTPUT AMPLIFIERS, TO PROVIDE A COMPLETE RECIRCULATING MEMORY PACKAGE.

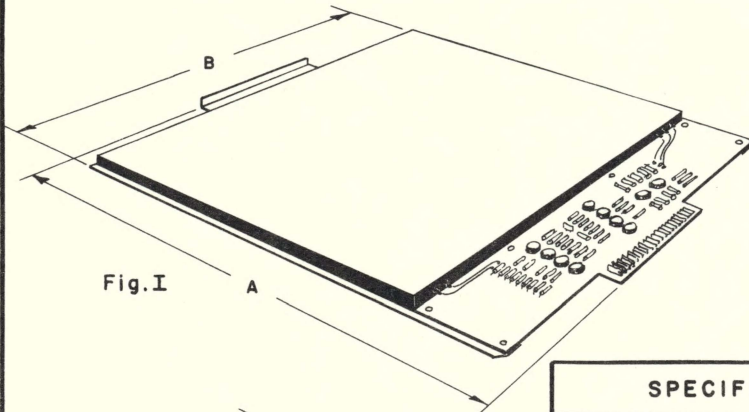


Fig. I

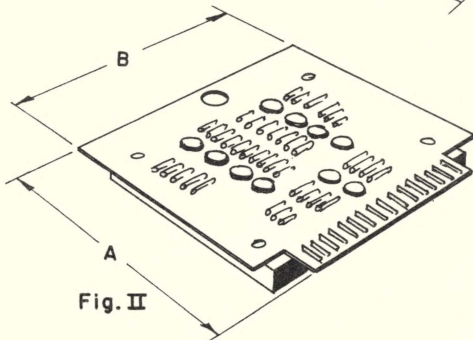
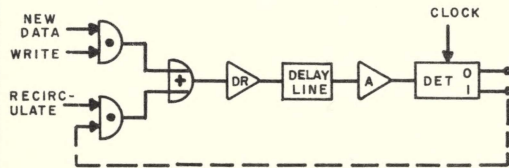


Fig. II

FUNCTIONAL DIAGRAM



SPECIFICATION		MODEL MS776A	MODEL MS774A	MODEL MS772A	MODEL MS890	MODEL MS892
MAXIMUM STORAGE CAPACITY (BITS) AND MAXIMUM CLOCK FREQUENCY (MC) (SEE NOTE 4)	NRZ *	20,000 @ 2 MC	10,000 @ 2 MC	5400 @ 2 MC	4000 @ 2 MC	2400 @ 2 MC
	RZ **	10,000 @ 1 MC	5000 @ 1 MC	2700 @ 1 MC	2000 @ 1 MC	1200 @ 1 MC
	BIPOLAR	12,000 @ 1 MC	6000 @ 1 MC	3000 @ 1 MC	2000 @ 1 MC	1200 @ 1 MC
DELAY RANGE		5 MS TO 12 MS	2 MS TO 6 MS	500 μS - 2700 μS	200 μS - 2000 μS	50 μS - 1500 μS
OPERATING TEMPERATURE	NRZ AND BIPOLAR	15° TO 40° C	5° TO 45° C	-5° TO +50° C	0° TO 60° C	-15° TO +60° C
	RZ	10° TO 45° C	0° TO 50° C	-15° TO +55° C	-15° TO +65° C	-35° TO +75° C
INPUT LOADING	DC INPUTS	+6 V TO +30 V AND -6 V TO -30 V				
	CLOCK INPUT	(NORMALLY) ONE LOGIC LEAD				
	CLOCK STABILITY	± 2 PPM	± 5 PPM	± 10 PPM	± 15 PPM	± 15 PPM
POWER REQUIREMENTS		1 WATT TYPICAL FOR +12V AND -12V SUPPLIES				
FIGURE NUMBER		I	I	II	II	II
OVERALL DIMENSIONS (INCHES)	LENGTH A	15.94	10.44	5.12	4.37	5.00
	WIDTH B	13.28	8.00	6.25	4.50	5.75
	THICKNESS	1.25 .69	1.25 .69	1.37	1.75	1.12
MATING CONNECTOR (SEE NOTE 2)		ELCO # 00-7008-035-139-001		ELCO # 00-6016-046-932	ELCO # 00-7008-035-139-001	

NOTES:

1. OUTLINE CONFIGURATIONS AND DIMENSIONS ARE STANDARD AS SHOWN. CLOCK FREQUENCY, NUMBER OF BITS STORED, DELAY TIME AND CIRCUITRY ARE ADJUSTED TO BE COMPATIBLE WITH CUSTOMER'S EQUIPMENT.
2. CIRCUIT BOARDS ARE PROVIDED WITH LOWER TIER PINS UNLESS OTHERWISE SPECIFIED BY CUSTOMER.
3. NON-STANDARD CONFIGURATIONS TO MEET SPECIAL DIMENSIONAL LIMITS ARE SUPPLIED FOR SPECIFIC APPLICATION.
4. ANY STORAGE CAPACITY AND FREQUENCY (BIT RATE) UP TO THE MAXIMUM SHOWN MAY BE SPECIFIED.

* NON RETURN TO ZERO
** RETURN TO ZERO

SONIC
DELAY LINE
MEMORIES

COMPUTER DEVICES
CORP.
6 WEST 18th ST.
HUNTINGTON STA., N.Y.

SCALE	NONE	DWN	N.S.
APPVD	BSW.	CHKD	KanDuma

A 77602
SIZE DWG NO.

REV

OSCILLATOR - Model MO-965 SPECIFICATION

The Model MO-965 Low Frequency Oscillator utilizes a Wire Sonic Delay Line as the frequency determining element. This ultra stable Delay Line is employed in a loop in which the loop delay represents one-half wave length ($\lambda/2$). The Oscillator frequency is therefore the reciprocal of the wavelength ($f = 1/\lambda$). A special transistor circuit is used in the loop to insure that the oscillator is initially triggered and to insure that no extraneous pulses are circulated in the loop.

Frequency Range:

Any frequency within a range from a fraction of a cycle up to 25 Kc is supplied with one package size.

Frequency Accuracy:

Frequency can be set to any required accuracy within measurable means. Because the time keeping delay line is provided with an external adjustment that is continuously variable by means of a screw with a resolution of approximately 0.17 usec per turn it is possible to adjust a 400 cps oscillator to $\pm 0.001\%$ with relative ease. The Model MO-965 has an adjustment range of ± 2 usec.

Frequency Stability:

The MO-965 oscillators are designed to a temperature stability of less than ± 0.5 ppm/°C over a temperature range of 0 to 50°C ($\pm 0.0025\%$). Figure 1 illustrates the various temperature effects possible. Curves A and B are the maximum limits and represent a maximum shift of $\pm 0.05\%$ over a 50°C range. Curve C represents best achievable results. On a yield basis 90% of all units can be held within $\pm 0.005\%$ deviation over a range of 0 to 50°C and 10% within $\pm 0.0025\%$.

Note: No long term frequency stability information is presently available, however, based on existing delay line data, it is anticipated that the delay shift shall be less than ± 0.1 usec for 10,000 hours. Frequency deviation due to mechanical vibration of this type Delay Line has been noted not to exceed ± 0.05 usec for a 20 G level between 55 to 2000 cps.

Electrically Variable:

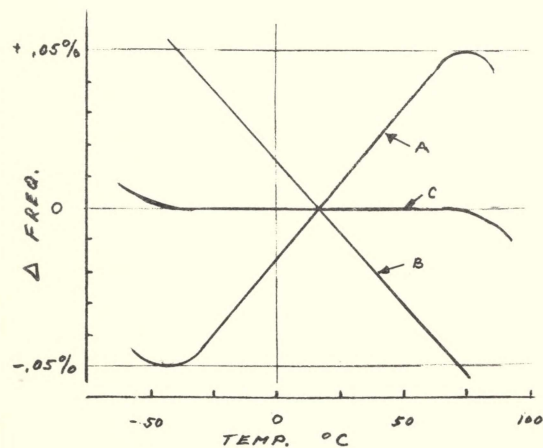
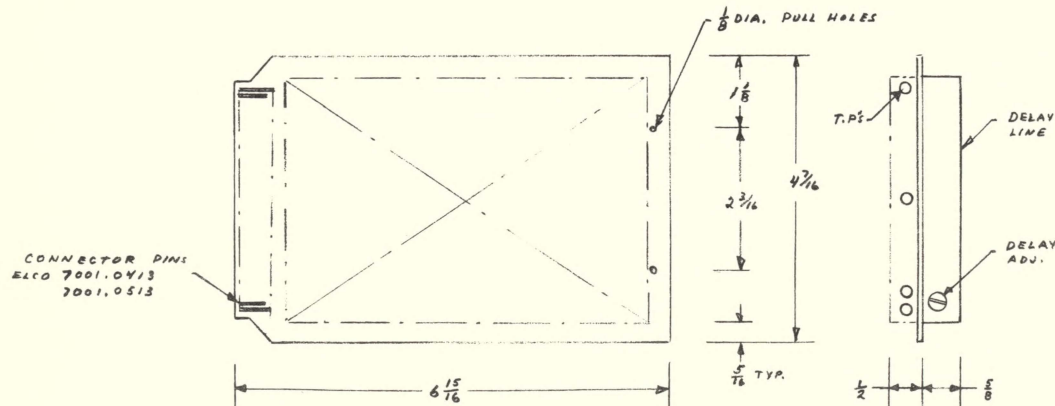
An electrically variable feature is optional. By encompassing a variable delay network in the Delay Line loop, it is possible to vary the frequency up to $\pm 25\%$ of its center frequency by means of an analog signal. The analog source must supply up to 5 ma of current. The response time of this variation is limited to one half the lowest frequency limit. The stability of this electrically variable feature can be held to within $\pm 0.05\%$ (0 to 50°C) by means of temperature compensation. The linearity (freq. vs applied voltage) can be held within $\pm 5\%$ - 2% for a 10% deviation of the center frequency. See Figure 2.

Output

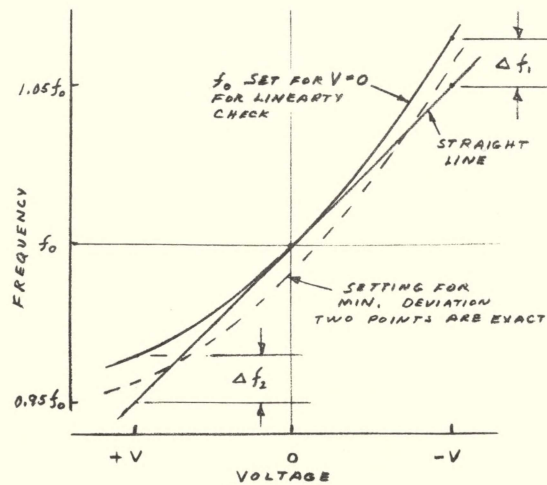
The output of this oscillator consists of two square waves 180° out of phase, with rise and fall times less than .1 usec. The output level is optional (up to 5 volts peak into 50 ohms).

DC Power

These units are designed for two dc supplies of 6 volts or more with regulation, ripple and noise restricted to $\pm 5\%$ of nominal.



TYPICAL TEMPERATURE VS FREQUENCY CURVES
FIG. 1



$$+2\% \leq \left(\frac{\Delta f_1}{1.05f_0} \right) \times 100\% \leq +5\%$$

$$+3\% \leq \left(\frac{\Delta f_2}{1.05f_0} \right) \times 100\% \leq +7\%$$

FIG 2

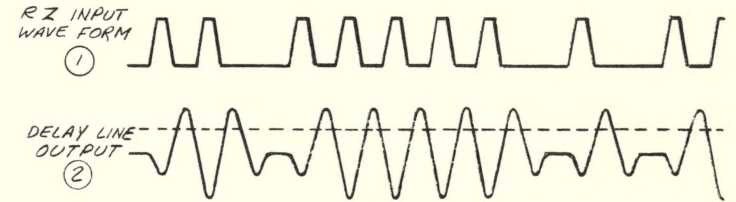
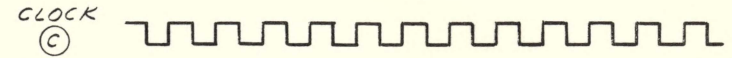
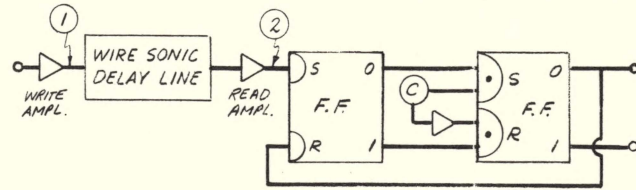
PRELIMINARY DATA SHEET

COMPUTER DEVICES CORP. 6 WEST 18 STREET HUNTINGTON STA., NEW YORK	OSCILLATOR Model MO-965	MAT.	DATE
		DWG	REV.

RECORDING MODES FOR WIRE SONIC DELAY LINES

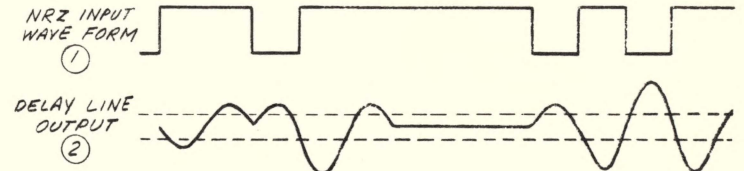
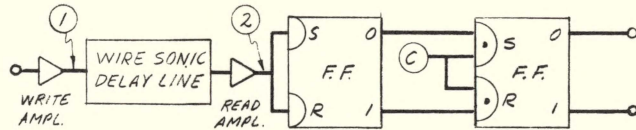
RETURN TO ZERO (RZ) RECORDING

This is the simplest modulation mode. A digit ONE is represented by the presence of a pulse, a digit ZERO by its absence. In this form of recording only one threshold detection level is necessary. This simplified the circuitry and the timing tolerances. It is useful for low-to-medium capacity for digital storage.



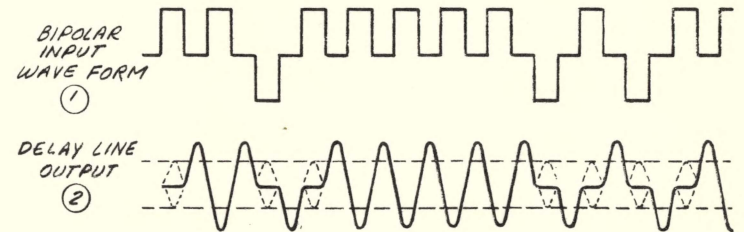
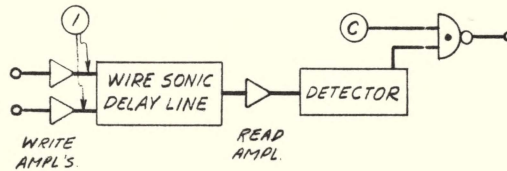
NON-RETURN TO ZERO (NRZ) RECORDING

Amplitude levels instead of pulses are used in this mode to represent binary ONES and ZEROS. The NRZ modulation offers maximum storage capacity for a given Delay Line. For a given amount of storage, only one-half the access time is required. The information storage is twice that of the RZ or Bipolar techniques. The NRZ is well suited for larger capacity Delay Lines and high speed operation.



BIPOLAR RECORDING TECHNIQUE

The Bipolar modulation is intended to suppress noise by having a signal always present. This continual signal is possible by employing a push-pull form of RZ recording in which both ONES and ZEROS are written into the line, but in opposite polarities. This type of modulation is particularly well suited where reliable performance under adverse conditions is required, as in military or other severe applications.



COMPUTER DEVICES CORP.
6 WEST 18 STREET
HUNTINGTON STA., NEW YORK

RECORDING MODES
WSDL

MAT.	DATE
DWG MDLS 10	REV.