T-47-13 B-47-19

Typical Applications

* Vertical Aperture Correction
* Comb filter chroma separators
* Border generators
* Image processing
* Drop-out compensation
* Timing Delays

Advantages

* Wide bandwidth
* Excellent phase characteristics
* Temperature stable
* Small size
* Low power

Introduction

Delay lines find wide applications in commercial, industrial, and military systems for temporary storage of electrical signals. For relatively short delays or audio frequencies, electromagnetic wave devices such as coax cable, or lumped constant (L-C) delay lines are used. When wide band, long delays are needed, as for example for storage of one line of video information, electromagnetic wave devices are not practical. Since an electromagnetic wave travels 0.67 ft/ns in coax cable, it would require 8 miles of coax cable to store one line of a standard TV signal. ($\approx 64\mu s$)

Microsonics Ultrasonic glass delay lines are based on the principle that sound waves travel through glass 100,000 times slower than electromagnetic waves through coax requiring only 6.4″ of glass for 64 μs of delay. Modern designs allow this 6.4″ delay path to be "folded" into a package of less than 0.4 cu in. Other storage technologies capable of storing one line of video require complex circuitry, complex filtering, more power and greater cost. Microsonics Ultrasonic glass delay lines provide video storage with the best performance, lowest cost, smallest size and lowest power of any technology.

Description

Microsonics glass delay lines consist of a precision ground piece of zero-temperature coefficient glass to which are attached input and output piezoelectric transducers. These transducers convert an electrical signal impressed on the input to an ultrasonic signal which traverses the glass and is converted to an electrical signal at the output. (see figure 1) The acoustic path may be folded as shown in figure 2 to conserve space and material. The glass delay line is packaged in a sturdy lightweight case to form a rugged component, field-proven to withstand severe environmental stresses found in military and portable equipment applications.

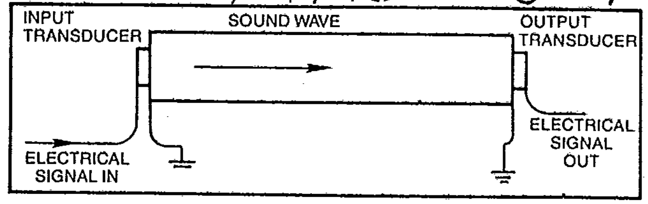


FIG. 1. Principle of Ultrasonic Delay Lines.

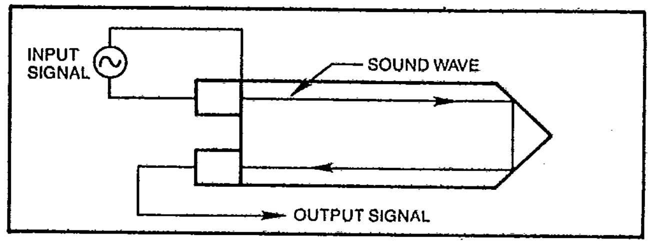


FIG. 2. Folding The Acoustic Path

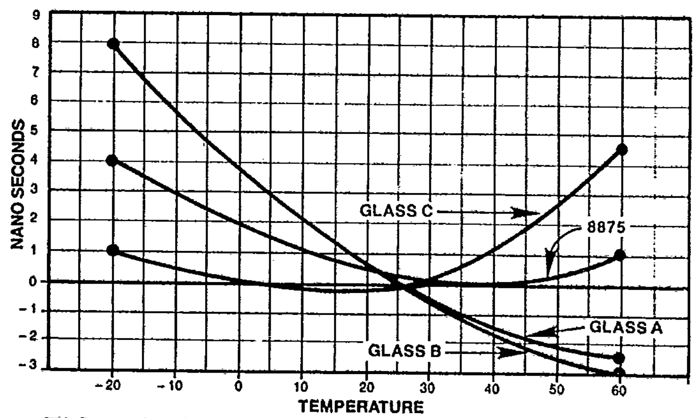


FIG. 3. Delay Line Changes with Temperature

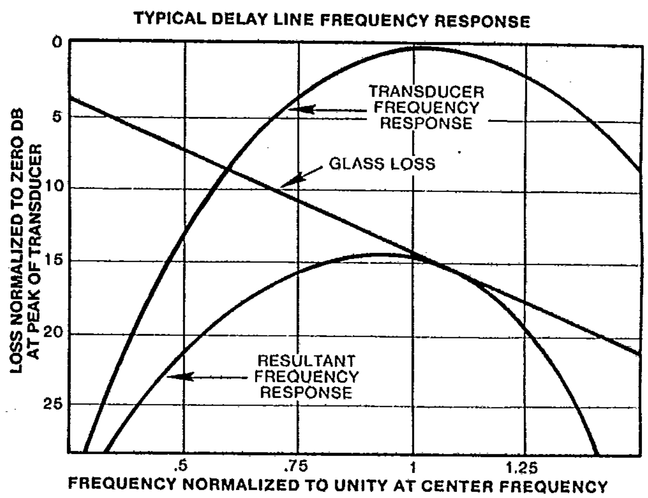


FIG 4. Frequency Response

T-47-13

Delay Medium

In order to provide temperature-stable delays, Microsonics uses a special glass developed by Corning Glass and licensed exclusively to Microsonics. This glass achieves a zero-temperature coefficient of delay by carefully controlling the acoustic velocity through the glass to compensate for the change on path length due to thermal expansion. The Corning 8875 glass is widely recognized as being the best glass available for TV delay lines. Fig. 3 compares the delay stability of Corning 8875 glass to the other delay line glasses.

Delay Line Characteristics

The electrical characteristics of the glass delay line are determined by the following factors:

1. Delay medium composition.
2. Transducer material.
3. Choice of operating frequency.
4. Geometry of design.
5. Quality of bond of transducer to glass.
6. Tuning.

Frequency Response

Frequency response is primarily determined by the sum of the transducer response and the glass loss vs. frequency (fig. 4) resulting in a band pass characteristic. Bandwidths are typically 50–60% of center frequency, but can be extended by tuning networks. Tuning networks are usually avoided for TV delay lines as they can introduce phase distortion in the RF which results in poor video transient response.

Analog Operation

Since the delay line has a band pass frequency characteristic (see Figure 4), video information to be stored is usually modulated onto a carrier frequency within the pass band of the delay line, sent through the delay line, amplified, then demodulated to recover the video information. The resulting circuit comprises a video delay unit. For faithful reproduction of the input video signal, the delay line must have smooth bandpass response and good phase linearity. Microsonics delay lines are inherently wide band by design and no tuning is used to achieve artificially wide bandwidths as in competitive products. Such tuning introduces phase errors in the RF domain that cause poor transient response in the recovered video. Our many years of video systems experience have been dedicated to the design of delay devices to achieve excellent video performance.

Digital Operation

Digital ultrasonic delay lines are so called because they are constructed such that a digital signal can be applied directly to the delay line eliminating the need to modulate an RF carrier. Thus, higher data rates are possible and system design is simpler than with analog operation. The time domain response of the digital ultrasonic delay line is similar to that of a linear phase bandpass filter of the same center frequency f_C. When digital pulses of width $>> 1/2f_C$ are applied to the delay line, the output is a bipolar pulse (doublet) for each edge of the input pulse. As the input pulse is made narrower, the two doublets merge to a single triplet (tri-polar pulse). The width of the lobes of the doublet and the triplet are determined by delay line design parameters and construction, mainly f_C.

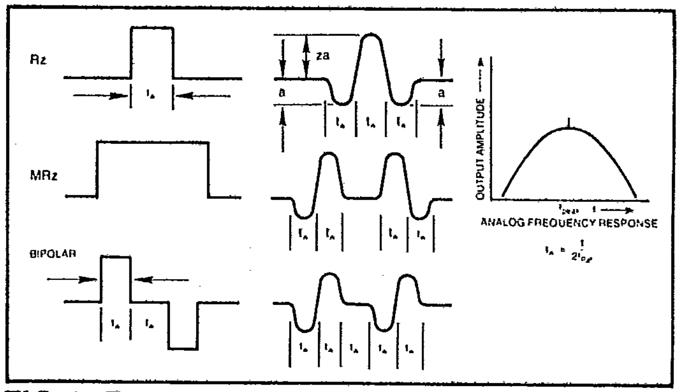
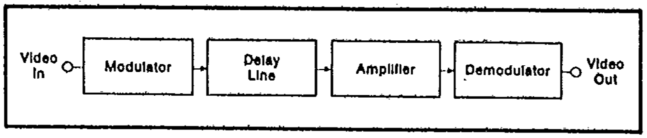


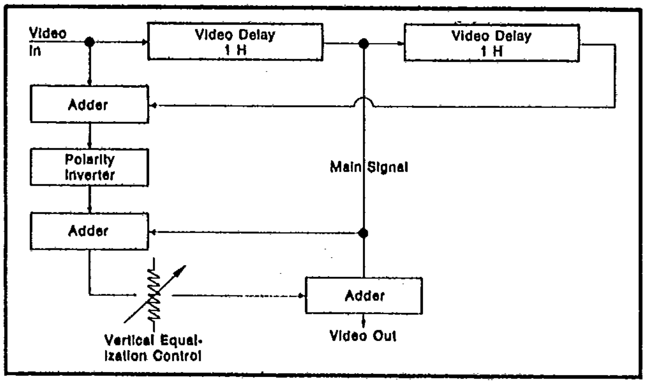
FIG 5. Response to Common Codes

Output amplitude is determined by input pulse amplitude and rise time. Figure 5 shows the response of the digital ultrasonic delay line to some of the common serial data encoding schemes. The NRZ mode is of particular interest in digital border generator applications (edgers) since the character video signal to be processed can be easily converted to an NRZ digital signal which can be applied directly to the delay line for 1H storage and delay. Recovery of the digital signal from the delay line output signal is relatively simple. After linear amplification, the delay line signal is applied to a Schmitt-trigger. Assuming that the Schmitt-trigger is in its low state, the input signal must cross the upper threshold before the trigger will change state. Thus, the leading negative lobe of the delay line output will have no effect on the Schmitt-trigger output. The positive lobe, however, crosses through the upper threshold causing the trigger to change state. Similarly, the trailing edge positive lobe has no effect since the trigger is already in its high state, but the negative lobe will cause the trigger to revert to its low state. The input digital character video signal is thus replicated at the Schmitt-trigger output.



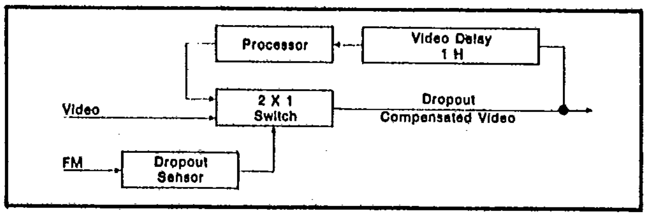
Video Delay Line

Because the delay line is a bandpass device it is necessary to use a modulated RF carrier to insert the video into the delay line. Either amplitude or frequency modulation may be used depending upon the requirements of the system.



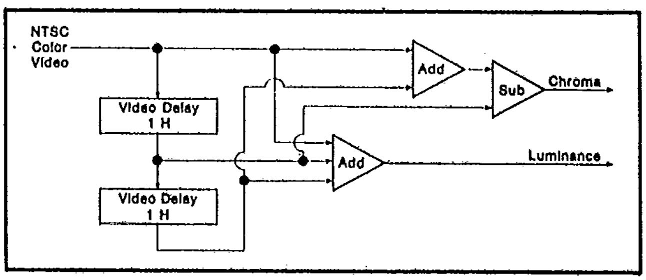
Vertical Aperture Correction

Vertical transitions can be sharpened using Microsonics Ultrasonic Delay Lines. By comparing the signal delayed one line to the undelayed and twice delayed signals a correction signal can be derived then added to the main signal for correction.



Drop-Out Compensation

Particles of dust, imperfections in the tape, and other random sources of error can cause video information to be partially or totally lost during playback. The simple dropout compensation circuit at left replaces the lost video information with a line of stored information.



Comb Filters

Due to the characteristics of the NTSC standards luminance and chroma can be separated using Comb Filters for high quality signal processing.

B-47-19
T-47-13

Vertical Aperture Corrector

Vertical resolution in TV cameras is impaired by the finite spot size of the electron beam in the pick up tube. By the use of Microsonics glass delay lines, vertical aperture loss correction can be applied to "sharpen" the television picture. By comparing the video signal delayed one TV line (main signal) to the undelayed and twice-delayed signals a correction signal is derived which is added to the main signal to compensate for aperture loss and sharpen vertical transitions. Since the main signal of the camera passes through the 1H video delay unit, the glass line must have wide bandwidth and good transient response to insure good video waveform response, and low loss to minimize noise. Gamma correction in the camera places stringent requirements on delay line spurious levels as gamma tends to emphasize the spurious signal at black level. Microsonics has been making delay lines for this application from the time when vertical aperture corrections were first used in cameras. Our long and varied experience solving problems for major camera makers is continually applied to the design and development of delay lines for vertical aperture correctors.

Comb Filters

NTSC and PAL TV systems achieve spectrum economy by the use of Shared-Bandwidth Encoding for the luminance and chroma information. Often video processing equipment must separate luminance and chroma for further independent processing. Use of conventional L-C low pass and bandpass filters limits performance since luminance bandwidth is lost in the low-pass filter and chroma information is contaminated by luminance information falling in the passband of the color filter. Comb filters using Microsonics glass delay lines provide high quality signal processing by "combing" the chroma information from the luminance. The superior delay stability of Microsonics delay lines insures consistently deep combing. Typical comb filter applications include composite chroma keyers, chroma inverters, NTSC and PAL decoders, and decoders in digital component video systems.

Drop Out Compensation, Velocity Error Correction

Microsonics glass delay lines are used in Broadcast video tape recorder designs to help solve two problems; drop out compensation and velocity error correction.

Drop Out Compensation

Particles of dust, imperfections in the tape, and other sources of random error can cause temporary loss of video information during tape playback. The lost information can be replaced by recirculating video stored in the 1H delay.

T-47-13

Velocity Error Correction

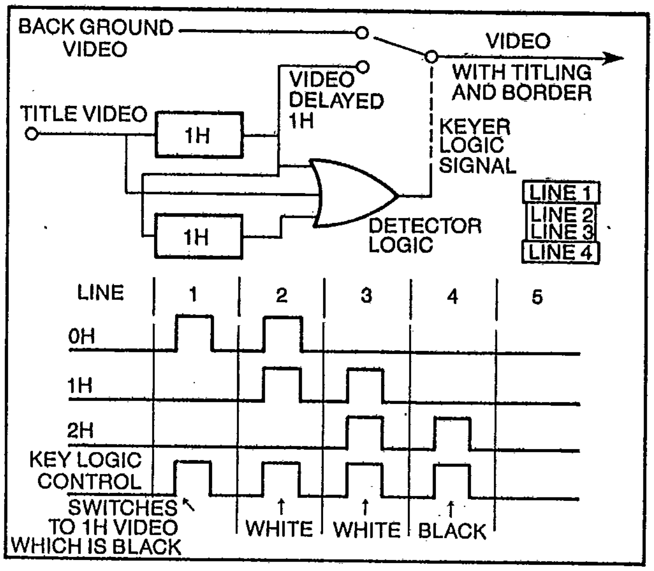
Due to minute dimensional changes in the tape and mechanical imperfections in the tape machine, the reproduced video will have time base errors which, for the most part, can be corrected by a time base corrector (TBC) circuit. There remains a residual error called velocity error which cannot be corrected by the TBC alone. If not corrected, noticeable color streaks appear in the reproduced picture. Velocity error can be detected by comparing burst of one line of video with the burst of the previous line of video stored in a 1H delay. An error signal derived in this manner is applied to the video signal emerging from the 1H video.

Since the video always passes through the 1H delay, multiple generations of recording require multiple passes through the 1H delay unit magnifying any distortion. Microsonics delay lines offer excellent transient response, bandpass smoothness, and stability to minimize the effect of these multiple passes.

Border Generators

Titles for TV programs often consist of white letters superimposed on background video. In portions of the picture where the video is white, the legibility of the title letters is impaired due to poor contrast with the background video. Colored letters offer little improvement since the colored background video may not have great contrast with the letters. Border generators using Microsonics delay lines eliminate this problem by creating a contrasting border around the letters.

The title video is delayed one and two lines by 1H delay units. Assuming that on line 1 there is a white video pulse corresponding to the input character video. This white signal is detected by the border generator logic to switch the keyer to the 1H-delayed character video which is black at this time. On line 2, the keyer is again switched to the character video which at this time is white. Thus the output video has a black line immediately above the character. The bottom border is similarly generated. L-C delays are used in like fashion to generate the borders at either side.



Analog and Digital Border Generators

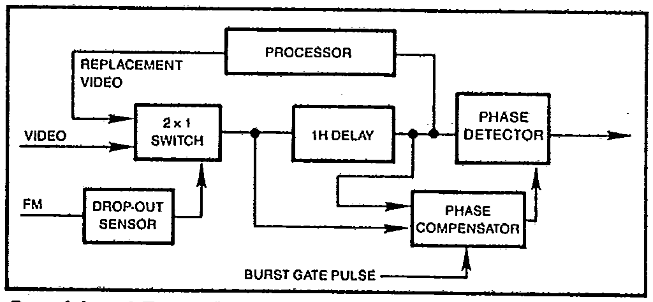
Two different approaches to border generator design are in common use; each requiring different delay line characteristics.

Digital Border Generator

Digital border generators convert the analog title video signal to a one-bit digital signal that can be processed using common integrated circuit logic for functions other than one-line delays and therefore offers simplicity and economy. Microsonics Digital glass delay lines provide simple, economical storage of the digital signal, interfacing easily with the logic circuits. Input drive to the delay line can be from TTL logic. Simple sense amplifiers amplify and detect the output signal and convert back to TTL levels. (See Digital Operation)

Analog Border Generators

The operation of the analog border generator is similar to the digital border generator except that the title video is delayed in its analog form using analog glass delay lines thus allowing encoded color video to be used as the keyed video.



Combined Drop Out Compensator and Velocity Error Corrector

Video Timing

In many system applications such as CATV and military systems there is a need to compensate for path delay difference caused by the miles of coax cable in such systems. Microsonics delay lines and modules allow retiming video paths while introducing very little noise or distortion.

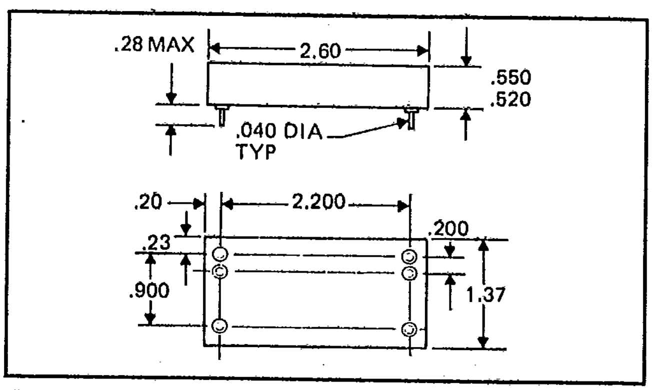
Analog Delay Lines

B-47-19
T-47-13

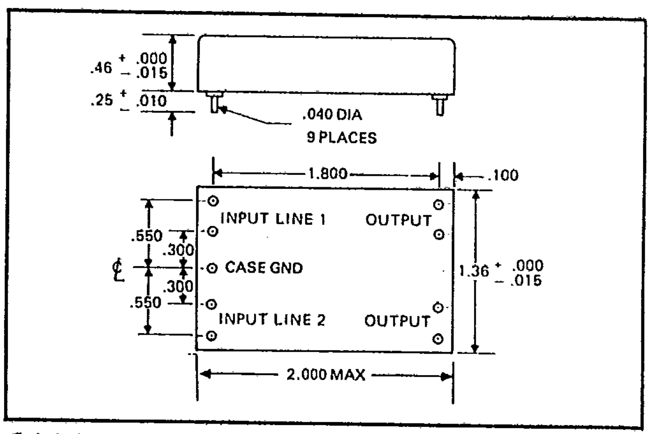
ANALOG DELAY LINES	SINGLE 1H 1945	DUAL 1H 2185	SUPER SINGLE DUAL	3305 DUAL	MINI DUAL	MINI DUAL HP	BASEBAND SUBCARRIER NTSC PALM	BASEBAND SUBCARRIER PAL SECAM
Operating Frequency (MHz)[1]	27	27	27	27	27	27 30	3.58[2]	4.43
Bandwidth (MHz)	14	14	12	12	14	12	TYP 1.5[3]	TYP 1.8[3]
Delay (μs)	63.556[4]							63.943
Delay Tolerance (ns)	±10						±5	
Delay Stability	3 Ns MAX RELATIVE TO 25°C							
Insertion Loss at Peak Frequency (dB)	30±3	30±4	20±2	30 MAX	30	30	10±2	10±2
Third Time Echo (dB down)	45	45	50	45	45	45	30	30
Random Spurious (dB down)	56	56	62		50	55	40	40
Feedthrough (dB down)	50	50	50	50	50	50	50	50
Input Capacitance (pF MAX)	250	250	180	—	180	180	—	—
Bandpass Ripple (dB)	.5	.5	.2	.5	.5	.5	—	—
Drive Impedance (Ω)	50	50	50	100[5]	50	50	100[6]	100
Load Impedance (Ω)	50	50	50	50	50	50	100	100
Operating Temp. Range (°C)[7]	0 to 55							
Case Size	1	2	SINGLE 1 DUAL 2	3	5	5	4	4

Notes:

1. *Operating frequency in range of 26.5 MHz to 32 MHz available.*
2. *Operating frequency in range of 3.5 to 4.5 MHz available.*
3. *Untuned bandwidth, tuning will increase BW.*
4. *Delay time in range of 15 to 70 μs available. Case sizes may vary for delays outside the range of 60–65 μs, consult factory.*
5. *Transformer input, 50 Ω available.*
6. *May be used at other impedances. Works with most single chip chroma decoders.*
7. *Extended temp range of −20 to +70°C available.*



CASE 1



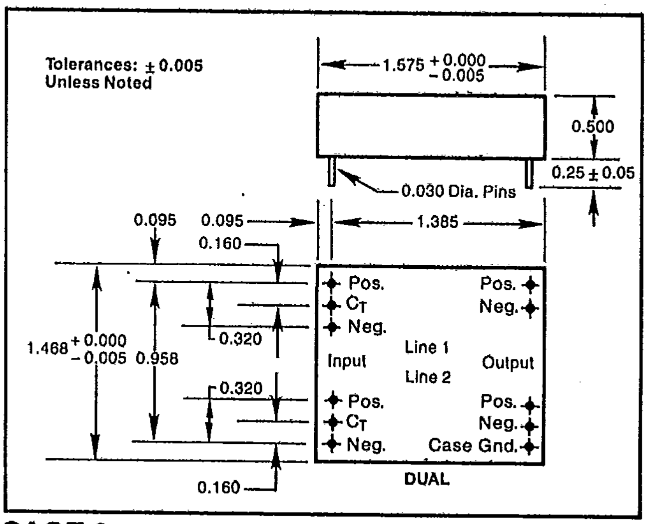
CASE 2

B-47-23
T-47-13

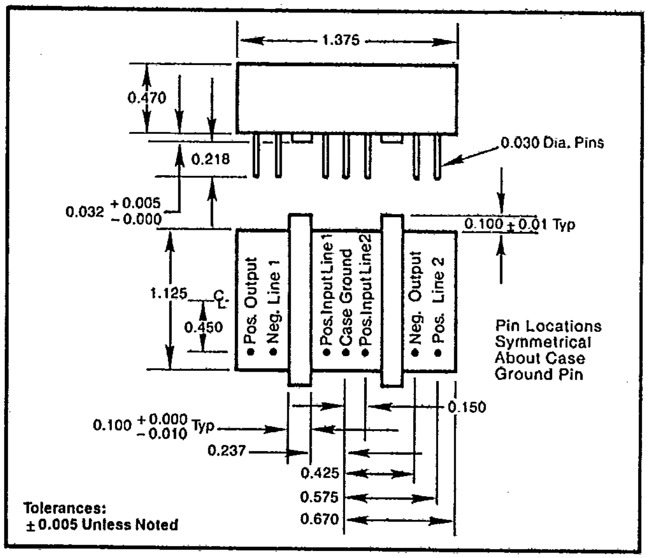
Digital Storage Lines

STORAGE	SINGLE 1H	SINGLE, 1H DUAL 1H
Center Frequency (MHz)	10	20
Delay Time (μs)	63.556	63.556
Delay Tolerance (ns)	±10	±10
Delay Stability (ns)	5	5
Attenuation (dB Max)	40	40
Attenuation Stability dB)	3	3
Resolution (ns)	100	45
Signal-To-Noise (dB)	10	10
Input/Output Impedance (Ω)	50	50
Input Capacitance (pF Max)	350	300
Operating Temp. Range	0 to 60°C	
Case[1]	6	SINGLE-1 DUAL-2

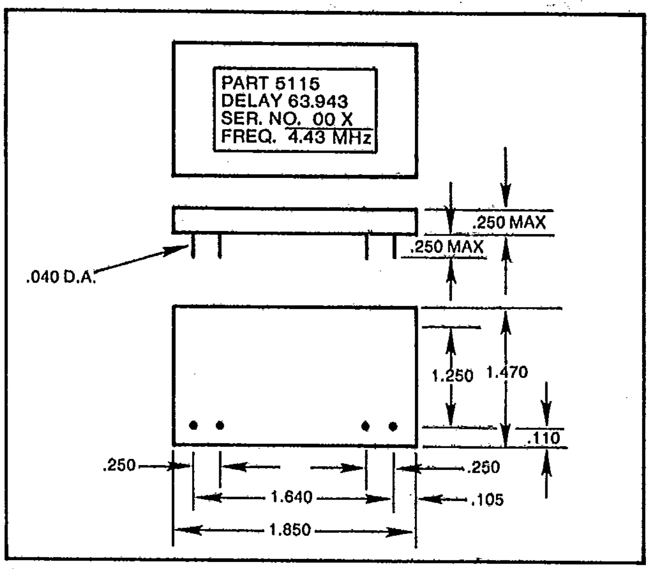
1. OTHER CASE SIZES AND STYLES AVAILABLE



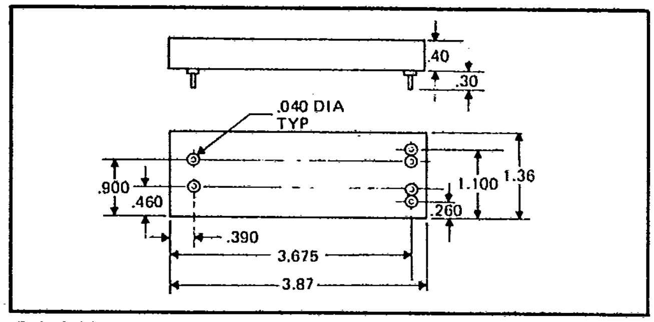
CASE 3



CASE 5



CASE 4



CASE 6

How To Order Please Specify

1. Delay time in microseconds to 3 decimal places Example: 63.556 μs
2. Operating Frequency
3. Case Size
4. Nearest Catalog Item

DELAY MODULES FOR VIDEO PROCESSING

T-47-13

Delay Modules For Video Processing

High Performance
Bandwidths > 15 MHz (HDTV)
Low Spurious > 62 dB down (Teleproduction)

Small Size
7.9 in.^{2} (49 cm^2) (VDM 44)

Easy video in/video out interface

Wide Range of Formats
1H (60–65 μs) MCA, VDM 14
2H With 1H Tap; Custom Design, Teleproduction
2 Channel 63–64 us Each Channel VDM 34, VDM 44

Low Power
< 300 mw/channel

Low Noise
> 70 dB S/N

Introduction

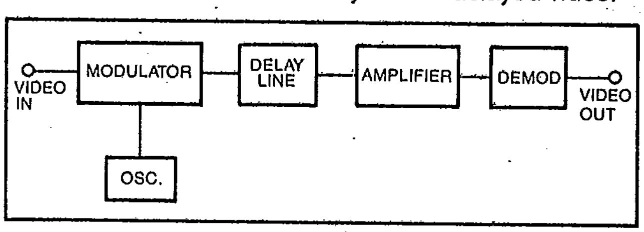
Video delay modules provide this system designer with the advantages of ultrasonic glass delay lines and the convenience of a simple video in/ video out interface. Modules contain all the video and R.F. Circuitry carefully matched to the delay for optimum performance.

Typical Applications

*Vertical aperture correction
*Comb filters
*Border generators
*Image processing
*Drop out compensation
*Velocity error correction

Description

Microsonics Video Delay Modules were developed from our ultrasonic glass delay lines made with Corning 8875 glass to provide temperature-stable delays in the range of 15 to 256 μs at video bandwidths. Since the glass delay line is a bandpass device, video is modulated onto a carrier which is passed through the delay line, then amplified and demodulated to yield the delayed video.



Video Delay vs. Delay Line

Video delay modules offer significant savings in design time to the equipment designer. The engineer can specify the video performance required in his application and not worry about how to relate delay line RF parameters to video performance.

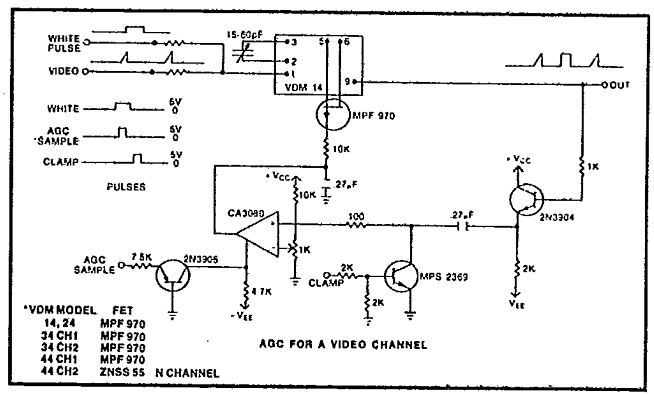
The engineer's factory saves as well. The video delay module can be treated just like any other video module and tested on video equipment. No complex RF test set ups are required by incoming Q.C. or factory test. Integration into the system is easy since there is no need to set up tricky RF modulators and demodulators. Microsonics is well experienced in the design and manufacture of video delay modules and delay lines. By having control of both the module and the glass delay line manufacture, we can carefully match characteristics of both thereby insuring good performance.

Modules At A Glance

MCA 5.03/5400 Series
Low Cost Plug-In PC Card 15 to 65μs

MCA 5.04/5100 Series
High Performance Plug-In PC Card
75 Ω In/Out 15 to 70 μs

VDM Series Piggy Back Modules
Designed to Mount on "Mother" Boards
14 — ONE CHANNEL 60 to 70 μs
24 — ONE CHANNEL 15 to 60 μs
34 — TWO CHANNEL 15 to 70 μs
44 — MINIATURE TWO CHANNEL 15 to 65 μs



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DELAY MODULES FOR VIDEO PROCESSING

T-47-13

PRODUCTS / CHARACTERISTICS	MCA-5.03 (1H)	MCA-5.04 (1H)	VDM 14 (1H)	VDM 24 (1/2H)	VDM 34 (2H)	VDM 44 (2H)	HDTV MODULES (TYP) 30-50 us one Ch.	TELEPRODUCTION (2H)	1H & 2H MODULES
			STANDARD		EACH CHANNEL		CUSTOM DESIGN		
Input impedance	2KΩ	75Ω	50KΩ	50KΩ	50KΩ	50KΩ	50KΩ	50KΩ	50KΩ
Output impedance	<25Ω	<75Ω	<100Ω	<100Ω	<100Ω	<100Ω	<100Ω	<100Ω	As Req'd.
Gain flatness: (dB)	±.5	±.25	±.25	±.35	±.25	±.25	±.25	±.1	±.2
To — (MHz)	3.58	5	6	6	6	6	10	4	6
Upper — 3 dB (MHz)	4.5	8	8	8	8	8	15	10	>8
Tilt (50Hz sq. wave) %	2	1	1	1	1	1	.5	.5	.5
Signal Noise (dB) (.7 V PP Signal/RMS noise)	55	60	60	60	60	60	56 (MHz)	60	65-70
Input signal level (V)	1	1	.5	.5	.5	.35	1	1	1 Typ
Output signal level (V)	1(75Ω)	1(75Ω)	1(1KΩ)	1(1KΩ)	1(1KΩ)	.7(1KΩ)	1	1	1 Typ
Diff. gain (%)	2.5	1	1	1	1	—	1	1	.5
Diff. phase (degrees)	2.5	1	1	1	1	—	1	1	.5
Delay tolerance (NS)	±25	±3.5	±10	±10	±10	±10	±3.5	±3.5	±3.5
Gain stability (%)	5	2	3	3	3	3	2	.5 (AGC)	.5 (AGC)
Power (V)	±6	±12	±12[1]	±12[1]	±12[1]	±9[1]	±12[1]	±12[1]	as required
Current drain (mA) + supply	75	150	58	58	100	75	100	130	100 ma typ
− supply	75	150	58	58	100	75	100	130	100 ma
Spurious Level (dB down)	—	50	50 56 LS	50	50 56 LS	56	60	62	56.60
Third time	—	45	45	40	45	45	45	45	45, So
Size (LWH) inches	4.5×3 .5	6.5×4.5 1	3.8×1.85 .5	3.8×1.855 .5	.5×2.7 .5	3.6×2.1 .5	as required	as required	as required
Applications	3,4,5,6,8,9	3,4,5,6,8	3,4,5,6,8	7	3,4,5,6,8	1,2,3,4,5,6,8	1,2,4,6,8	1	1 thru 9

Applications: 1 Studio cameras/telecine 2 Eng/EFP cameras 3 Comb filters 4 Image enhancers 5 Chroma keyers 6 Drop out correction 7 Video disc 8 General composite video delay 9 TBC gyro error delay

Notes 1 ±8V to ±15V available

Rack Mount Frame for 5100 Series Video Delay Modules

The Microsonics 4005 series rack mount frame provides a convenient means to have video delay modules in video studio and CATV systems.

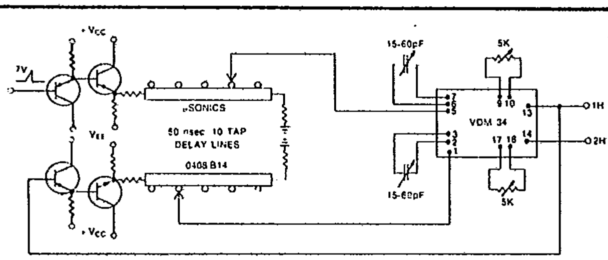
Specification:

size: 5¼″ × 19″ × 12″ rack mountable
capacity: 4-5100 series delay modules*
power: 115VAC, 48-60 Hz
30 watts max with 6 modules
(220 VAC available)

Video connectors: BNC.

Module extender for servicing included. Custom designs incorporating fail-safe redundancy are available for CATV and satellite network applications.

*can be expanded to 8 modules.



TRIMMING OF CHANNEL DELAYS

NOTE: Specify delay of a module to be equal to total the delay needed minus one-half of the total delay of the tapped delay line.

EXAMPLE: For needed delay of 64.000 us one should request 64.000 - ½ (.050) 63.975 us as the module delay.

Custom Designs

Microsonics has extensive TV systems design experience in cameras, video recorders, video switchers, special effects units, etc. We understand the requirements of system designers and can discuss in detail your video delay problems and applications, usually a standard design can be used to solve your problem. If not, we can design and manufacture a module on subsystem to meet your requirements. Please contact your local Microsonics representative or call the factory for details. Military versions of modules are available.

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DELAY MODULES FOR VIDEO PROCESSING

T-47-13

Electrical Performance VDM 14, 24, 34, 44

CHARACTERISTIC	LEVEL	CHARACTERISTIC	LEVEL
Input impedance	>50 KΩ	Current drain	
Output impedance	<100 Ω	for VDM 14, 24	
Gain flatness	± .25 dB to 6 MHz	Positive	58 mA @ 12 V
Upper −3 dB	>8 MHz	Negative	58 mA @ 12 V
Tilt (50 Hz sq. wave)	<1%	for VDM 34 (Package Total)	
Signal/Noise (.7 V PP signal/RMS noise)	60 dB	Positive	100 mA @ 12 V
Input signal level	.35 V (.5 V)[1]	Negative	100 mA @ 12 V
Output signal level	.7 V (1V)[1]	for VDM 44 (Package Total)	75 mA @ 9 V
Diff. gain	<1%[2]	Third time	>45 dB down
Diff. phase	<1'[2]	Spurious level	
Delay tolerance	± 10 ns.	for VDM 14	>50 dB down
Gain stability	± 3%[3]	for VDM 14LS	>56 dB down
Power	± 12 V[4]	for VDM 34 (each channel)	>50 dB down
		for VDM 34LS, 44 (each channel)	>56 dB down

[1]Composite video
[2]Diff. gain and diff. phase measured with > 1 K load at 3.58 or 4.43 MHz as appropriate.
[3]0° to 50° C.
[4]± 9 V to ± 15 V option available.

Electrical Specifications

CHARACTERISTIC	01-5100 SERIES "HIGH PERFORMANCE"			UNITS	NOTES
	MIN.	TYPICAL	MAX#		
Input Impedance	75 or >1000 bridging			Ohm	
Output Impedance		75		Ohm	
−3 dB Upper Bandwidth	7	8		MHz	
Tilt (60 Hz)		1.0	2.0	%	
Bandpass Flatness to 5 MHz		±0.20	±.25	dB	
Signal/Noise (PP/RMS)	60	65		dB	
Input Signal		1.0	1.25	Volt	
Output Signal		1.0	1.25	Volt	
Differential Gain		0.5	1.0	%	
Differential Phase		0.5	1.0	deg.	
Gain Stability 0 to 55°C		2.0	4.0	%	
Delay Tolerances		±3.5		nS	
Power Supplies					
+ voltage	11.4	12.0	12.6	Volt	
− voltage	11.4	12.0	12.6	Volt	
Current Drain					
+ voltage		100	150	mA	
− voltage		100	150	mA	
Temperature					
Operating	0		+55	°C	
Storage	−20		+80	°C	

MECHANICAL SPECIFICATIONS

Dimensions — W × L × H = 4.5″ × 6.5″ × 1.0″ Max. (114 mm × 165 mm × 25 mm)
Weight — Approximately 6 ounces (170 grammes)
Connector — Requires 44-pin double row connector 0.156 centers.

Pin Connections

20 Video In
2 Video Out
7, 16 +12 V Use Either 7 or 11
11, 12 −12 V Use Either 11 or 12
A → Z GND

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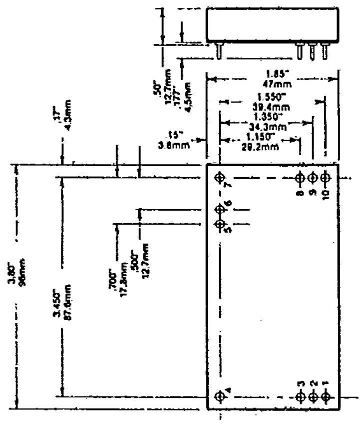
DELAY MODULES FOR VIDEO PROCESSING

T-47-13

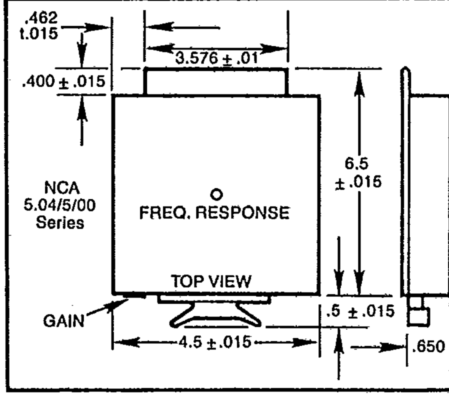
DIMENSIONS AND PIN OUTS



TERMINAL FUNCTIONS

1. Video Input
2. Response Adjustment
3. Response Adjustment
4. Ground
5. Gain Adjustment
6. Gain Adjustment
7. $-V_{EE}$
8. Ground
9. Video Out
10. $+V_{CC}$

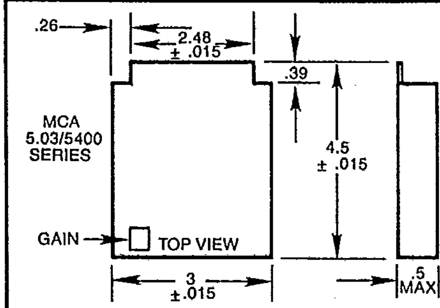
VDM 14, 24



Connections

PIN	FUNCTION
2	Video Out
7, 16	+12 V
11, 12	−12 V
20	Video In
A → Z	Ground

MATING CONNECTOR
44 PIN DOUBLE ROW
.156 CENTERS



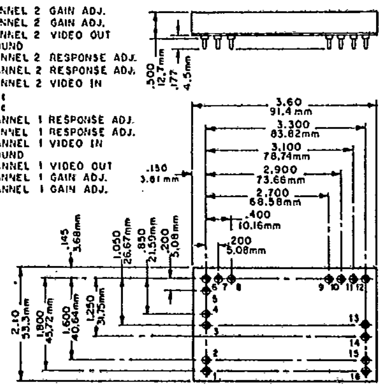
Connections

PIN	FUNCTION
2	Video Out
6, 10	+ 6 V (Must Use Both)
8	−6 V
13	Video In
A → Z	Ground

MATING CONNECTOR:
15 PIN DOUBLE RUN
.156 CENTERS

TERMINAL FUNCTIONS

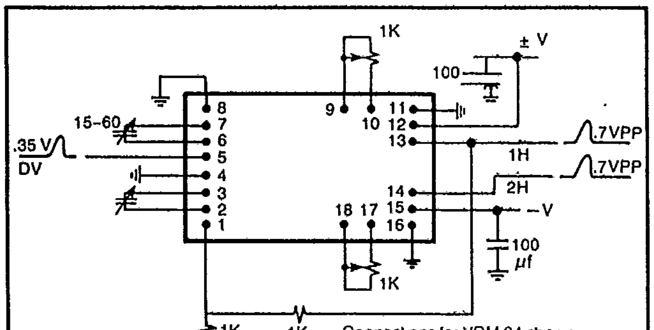
1. CHANNEL 2 GAIN ADJ.
2. CHANNEL 2 GAIN ADJ.
3. CHANNEL 2 VIDEO OUT
4. GROUND
5. CHANNEL 2 RESPONSE ADJ.
6. CHANNEL 2 RESPONSE ADJ.
7. CHANNEL 2 VIDEO IN
8. $-V_{EE}$
9. $+V_{CC}$
10. CHANNEL 1 RESPONSE ADJ.
11. CHANNEL 1 RESPONSE ADJ.
12. CHANNEL 1 VIDEO IN
13. GROUND
14. CHANNEL 1 VIDEO OUT
15. CHANNEL 1 GAIN ADJ.
16. CHANNEL 1 GAIN ADJ.



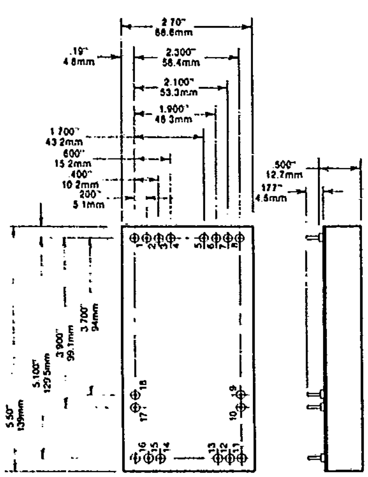
NUMBERS BY PINS ARE FOR REFERENCE ONLY (NOT MARKED ON CASE). .040" (1mm) DIAMETER SOLDERABLE PINS

DRAWINGS NOT TO SCALE
TOLERANCES
.XX = ± .01" ± .25 mm
.XXX = ± .005" ± .13 mm

VDM 44



Connections for VDM 34 shown
Connections for VDM 14, 24, 44 similar
Use appropriate pins for given model.



TERMINAL FUNCTIONS

1. Channel 2 Video In
2. Channel 2 Response Adj.
3. Channel 2 Response Adj.
4. Ground
5. Channel 1 Video In
6. Channel 1 Response Adj.
7. Channel 1 Response Adj.
8. Ground
9. Channel 1 Gain Adj.
10. Channel 1 Gain Adj.
11. Ground
12. $+V_{CC}$
13. Channel 1 Video Out
14. Channel 2 Video Out
15. $-V_{EE}$
16. Ground
17. Channel 2 Gain Adj.
18. Channel 2 Gain Adj.

VDM 34 2H

How To Order

MCA 5.03/5400 Series } Specify Delay Time
MCA 5.04/5100 Series }

VDM 14, 24, 34, 44
Specify:
Delay Time
Operating Voltages
Spurious Level Required

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