



# MIC1700

## HDTV/SDTV 6<sup>th</sup> Order Video Filter for Component

### Video plus Composite Video

### General Description

The MIC1700 is a complete reconstruction filter solution for high definition set-top boxes.

The device has two independent component inputs (Y<sub>R</sub>P<sub>B</sub> or RGB) selectable via a 2-to-1 multiplexer, and a separate S-video input (Y/C). Component channel filters have a selectable cutoff frequency (8MHz or 36MHz) to support both standard (SD) and high definition (HD) applications. S-video filters have fixed cutoff (8MHz) to support legacy composite applications. In addition, S-video channels are summed to provide a filtered CV output for an RF modulator or VCR. All inputs are DC-coupled with a 0V to 1V peak-to-peak range. All outputs are designed to drive 2V peak-to-peak into AC-coupled 150Ω loads. This supports 1V peak-to-peak into a 75Ω load with a 75Ω series source terminator.

Filters have 6<sup>th</sup> order near Butterworth characteristics with cutoffs of 8MHz (SD and CV) and 36MHz (HD). These characteristics are chosen to provide good passband flatness with sufficient stop band attenuation and minimal group delay distortion.

The device operates from a 5VDC supply.

Data sheets and support documentation are available at Micrel's web site, [www.micrel.com](http://www.micrel.com).

### Features

- S-video (Y/C) input, S-video and summed (CV) output
- 2 Y<sub>R</sub>P<sub>B</sub> or RGB inputs, Y<sub>R</sub>P<sub>B</sub> or RGB output
- Y<sub>R</sub>P<sub>B</sub>/RGB 2-1 input multiplexer
- DC coupled inputs – AC-coupled output drive
- 6db output gain for 75Ω source termination
- Component filters selectable for SD or HD cutoffs
- 6<sup>th</sup> order Butterworth characteristic
- Flat passband (HD 0.5dB @ 30MHz typ)
- Low group delay distortion (HD: 12ns @ 30MHz typ)
- Single 5V supply
- 28-pin wide body SOIC package (with exposed pad for improved thermal performance)

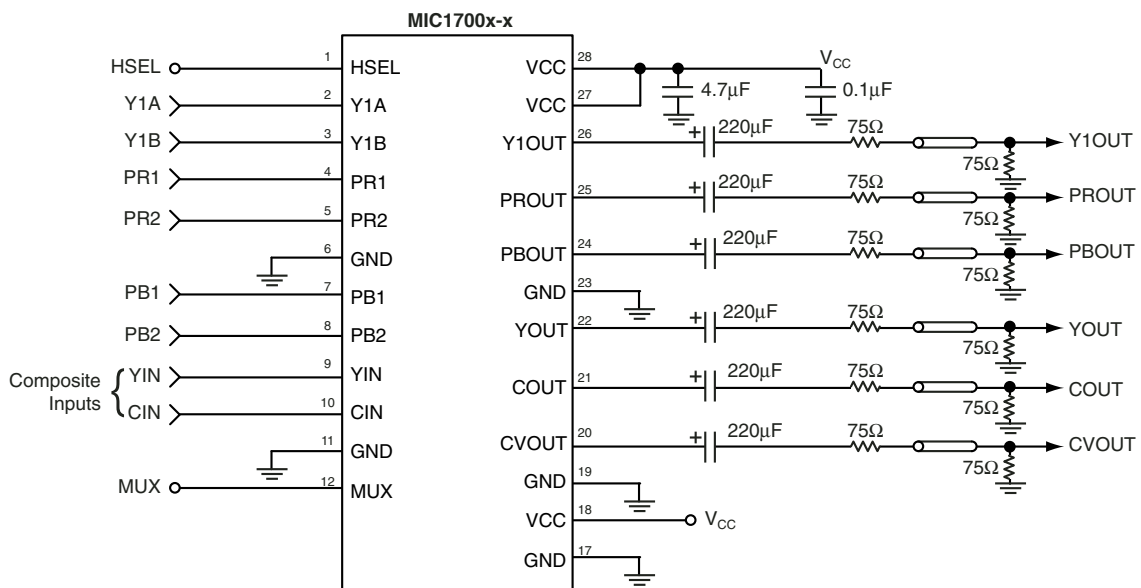
### Applications

- HDTV
- HDTV set-top boxes
- Video games
- HDTV systems
- DVD players
- Digital satellite set-top boxes
- HDTV monitors

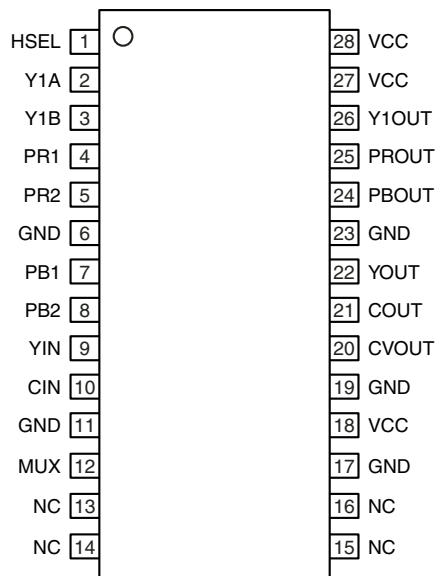
### Ordering Information

Part Number	Junction Temp. Range	Package
MIC1700BWME	0°C to +70°C	SOIC-28

### Typical Application



## Pin Configuration



28-Pin Wide Body SOIC (WM)

## Pin Description

Pin Number	Pin Name	Pin Function
1	HSEL	Digital (Input): selects for the HD or SD filtering. A high selects HD filters.
2	Y1A	Y (Input): component channel 1, selected when the MUX is high. 0V to 1V range.
3	Y1B	Y (Input): component channel 2, selected when the MUX is low. 0V to 1V range.
4	PR1	$P_R$ (Input): component channel 1, selected when the MUX is high. 0V to 1V range.
5	PR2	$P_R$ (Input): component channel 2, selected when the MUX is low. 0V to 1V range.
6, 11, 17, 19, 23	GND	Ground.
7	PB1	$P_B$ (Input): component channel 1, selected when the MUX is high. 0V to 1V range.
8	PB2	$P_B$ (Input): component channel 2, selected when the MUX is low. 0V to 1V range.
9	YIN	Legacy (S-video): luminance input, 0V to 1V.
10	CIN	Legacy (S-video): chroma input, 0V to 1V.
12	MUX	Digital MUX control to select input 1 or 2 of the component channel. A high selects input 1.
13, 14, 15, 16	NC	No connect. <b>Do not</b> connect these pins.
18, 27, 28	VCC	Positive side of the 5V power supply.
20	CVOUT	Legacy composite video output, typically 1V to 3V.
21	COUT	Legacy chroma output, typically 1V to 3V.
22	YOUT	Legacy luminance video output, typically 1V to 3V.
24	PBOUT	PB color component output, either SD or HD, typically 1V to 3V.
25	PROUT	PR color component output, either SD or HD, typically 1V to 3V.
26	Y1OUT	Luminance component output, either SD or HD, typically 1V to 3V.

**Truth Table**

<b>HSEL</b>	<b>MUX Select Pin</b>	
	<b>H</b>	<b>L</b>
	<b>H</b>	HDTV Mode Y1A, PB1, PR1 Inputs
<b>L</b>	SD Mode Y1A, PB1, PR1 Inputs	SD Mode Y1B, PB2, PR2 Inputs

**Absolute Maximum Ratings (Note 1)**

Maximum Input Voltage .....	$V_{CC}$
Supply Voltage .....	6V
Lead Temperature (soldering, 5 sec) .....	260°C
ESD Rating, .....	<b>Note 3</b>

**Operating Ratings (Note 2)**

Analog Input Voltage Range .....	0V to 1.1V
Digital Input Voltage Range .....	0 to $V_{CC}$
Supply Voltage ( $V_{CC}$ ) .....	5V±5%
Ambient Temperature Range .....	-0°C to +70°C
Package Thermal Resistance	
SOIC ( $\theta_{JA}$ ), <b>Note 4, 6</b> .....	35°C/W

**Electrical Characteristics (Note 5)**

$V_{CC}$  = 4.75V to 5.25V,  $T_A$  = 25°C. Values in **bold** apply over entire operating temperature range.  $T_A$  from 0°C to +70°C. Values apply to all channels unless noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$P_D$	Power Dissipation	No load		725	<b>900</b>	mW
$V_O$	Linear Output Range	$R_L = 150\Omega$ , AC-Coupled		2.0	<b>2.2</b>	V
$Z_{IN}$	Input Impedance, <b>Note 7</b>	$V_{IN} = 0V$ to 1V		1		M $\Omega$
$I_{IN}$	Input Bias Current, <b>Note 7</b>	$V_{IN} = 0V$ to 1V		40		$\mu A$
	Crosstalk, <b>Note 7</b>	channel-to-channel, $f = 3MHz$ , NTSC Mode		-70		dB
	Crosstalk, <b>Note 7</b>	channel-to-channel, $f = 20MHz$ , HDTV Mode		-64		dB
	Crosstalk, <b>Note 7</b>	between MUX inputs, $f = 3MHz$		-60		dB
PSSR	Power Supply Rejection Ratio	at 400kHz		40		dB

**Filter Specifications, HD Operating Mode**

$f_{-3dB}$	-3dB Bandwidth	$V_{AC} = 0.5V_{p-p}$ , $V_{DC} = 0.5V$	<b>33</b> <b>30</b>	36		MHz
$f_{-1dB}$	-1dB Bandwidth	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$		30		MHz
$A_{74MHz}$	74MHz Attenuation	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$	25	30		dB
$A_v$	Low Frequency Gain	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$ at 400kHz	<b>5.5</b>	6	6.3	dB
$A_v$	Gain Matching	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$ channel-to-channel		1		%
$P_K$	Peaking, <b>Note 7</b>			1		dB
$T_D$	Baseband Delay	$f = 100kHz$		65		ns
$T_{GD}$	Group Delay distortion	$f = 3.6MHz$ $f = 6.0MHz$		5 20		ns ns
SNR	Signal to Noise, <b>Note 7</b>	<b>Note 2</b>		77		dB
DG	Differential Gain, <b>Note 7</b>	40IRE modulated ramp		2		%
DP	Differential Phase, <b>Note 7</b>	@ both 3.58MHz and 4.43MHz		2		°

**Filter Specifications, NTSC/PAL Operating Mode**

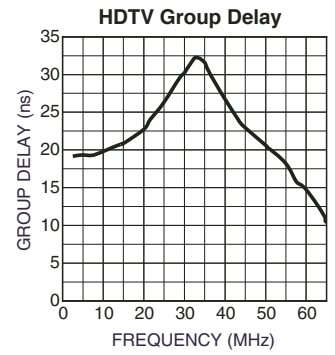
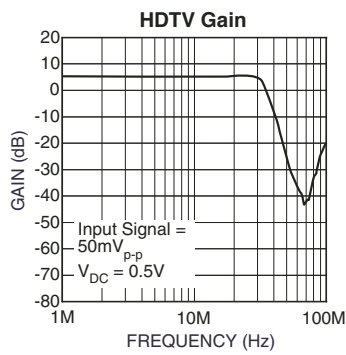
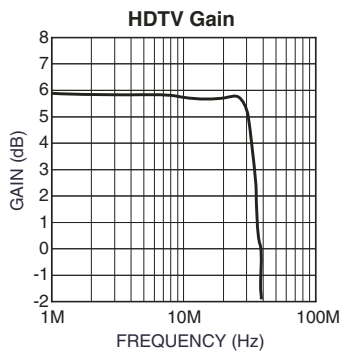
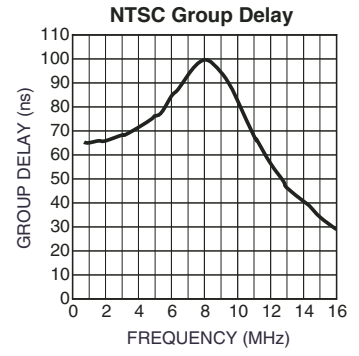
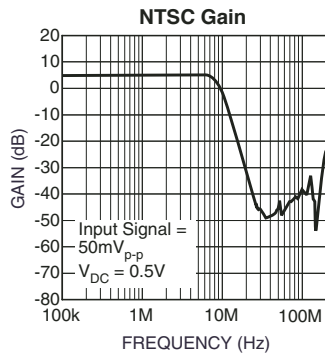
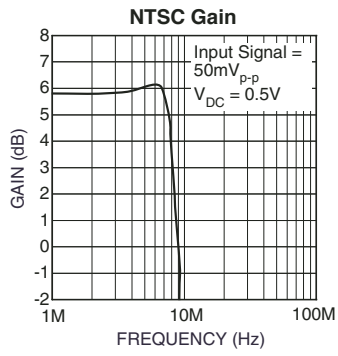
$f_{-1dB}$	-1dB Bandwidth	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$		7.9		MHz
$f_{-3dB}$	-3dB Bandwidth	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$	<b>7.6</b>	8.7		MHz
$A_{27MHz}$	27MHz Attenuation	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$	<b>36</b>	44		dB
$A_v$	Low Frequency Gain	$V_{AC} = 0.5V_{pk-pk}$ , $V_{DC} = 0.5V$ at 400kHz	<b>5.5</b>	6	<b>6.3</b>	dB
$A_v$	Gain Matching	channel-to-channel		1		%
$G_D$	Group Delay, <b>Note 7</b>	$f = 3.6MHz$		70		ns
SNR	Signal to Noise, <b>Note 7</b>	<b>Note 8</b>		68		dB

**Digital I/O**

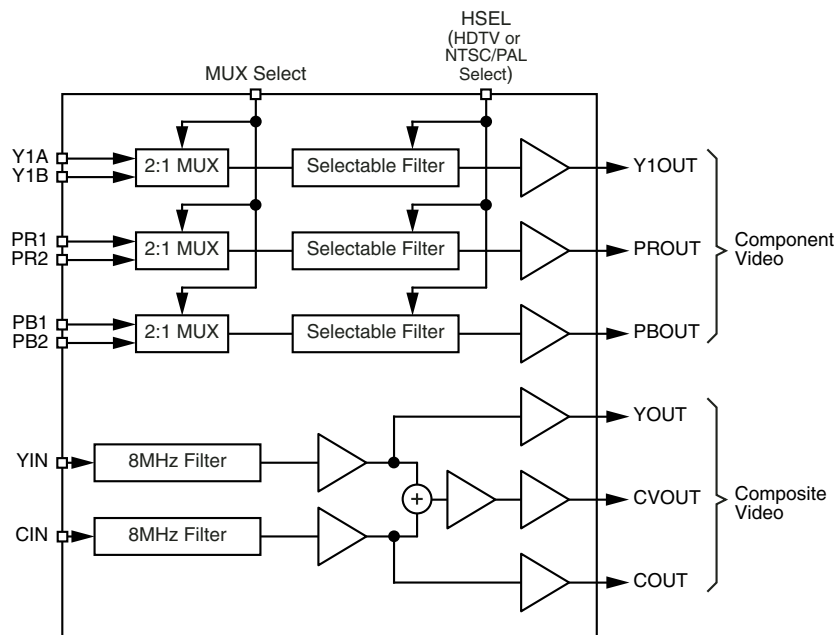
$V_{IH}$	Input High	HSTL and MUX pin	<b>2.0</b>			V
$V_{IL}$	Input Low	HSTL and MUX pin			<b>0.5</b>	V

- Note 1.** Exceeding the absolute maximum rating may damage the device.
- Note 2.** The device is not guaranteed to function outside its operating rating.
- Note 3.** Devices are ESD sensitive. Handling precautions recommended.
- Note 4.** With SOIC attached by leads only.
- Note 5.** Specification for packaged product only.
- Note 6.** When thermally enhanced SOIC heatsink pad is soldered to a copper pad on a single layer PCB.
- Note 7.** Guaranteed by design and characterization.
- Note 8.** Low pass filter enabled.  $V_{IN} = 1V_{pk-pk}$ . Wideband noise floor over 20MHz.

# Typical Characteristics



## Functional Diagram



MIC1700 Block Diagram

## Functional Description

The MIC1700 is a multi-channel active filtering device with channels for both component and composite video signals. Component channel filters have selectable SD or HD bandwidths while composite filters have fixed bandwidth. One of two component inputs may be selected via a 2-to-1 mux. Output drivers are sufficient to drive 1V signals into 75 $\Omega$  loads via a 75 $\Omega$  source terminator.

### Input

Inputs are all high impedance with low input bias current. Signal excursions at the inputs are limited to a specified range of 0V to 1V to meet distortion and other performance specifications. Two groups of three pins each comprise the two selectable component inputs, intended for YP<sub>R</sub>P<sub>B</sub> or RGB applications. One group of two pins comprises the composite S-video input, intended for legacy applications.

### Component Multiplexer

Either of two component inputs may be selected using the component input multiplexer. The output of this high isolation multiplexer feeds the internal component filters. Input characteristics are not altered by the action of the multiplexer.

### Component Filters

The component filters are 6<sup>th</sup> order with near Butterworth response characteristics. Cutoff frequencies are selectable

between 8MHz SD (Standard Definition) and 36MHz HD (High Definition). The 6<sup>th</sup> order Butterworth characteristic provides a maximally flat passband with 39dB of attenuation an octave above cutoff, and low group delay distortion minimizes overshoots in the time domain.

### Composite Filters

The composite filters have the same characteristics as the SD mode of the component filters. These filters are additionally specified for DG (differential gain, variation of subcarrier amplitude with luma level) and DP (differential phase, variation of subcarrier phase with luma level). These distortions (which are intermodulation distortions) cannot occur with true S-video inputs applied, since luma and chroma are in separate channels. However, the composite filters can also be used with full legacy composite signals. In these cases, the DG and DP specifications are applicable.

### Output Drivers

The output drivers are configured to provide low distortion 2V peak-to-peak swing into a 150 $\Omega$  load from a single +5V supply. To achieve this, the operating range is approximately from 1V to 3V for normal inputs. AC-coupling at the outputs helps keep power dissipation within specification while preventing excessive DC components from coupling to downstream equipment.

## Applications Information

**Achieving Additional Stop Band Attenuation**  
 For customers requiring greater stop band attenuation, a simple passive filter can be added to the input of MIC1700. The following circuit increases stop band attenuation above 60MHz by at least 15dB. Attenuation at the critical clocking frequency of 74MHz is increased by at least 20dB even allowing for typical value variations (we recommend 5% inductor, 2% capacitors).

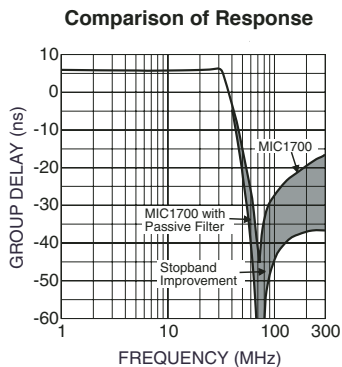


Figure 1. Comparison of Response

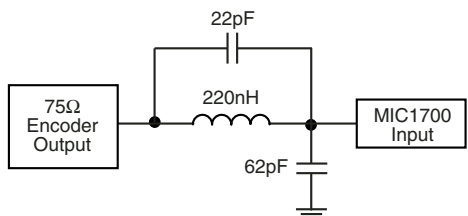


Figure 2. Passive Filter Circuit for 75Ω source

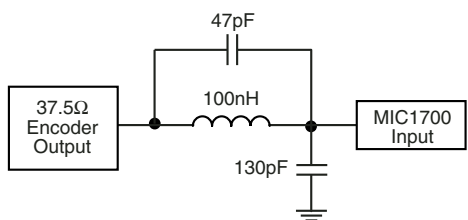
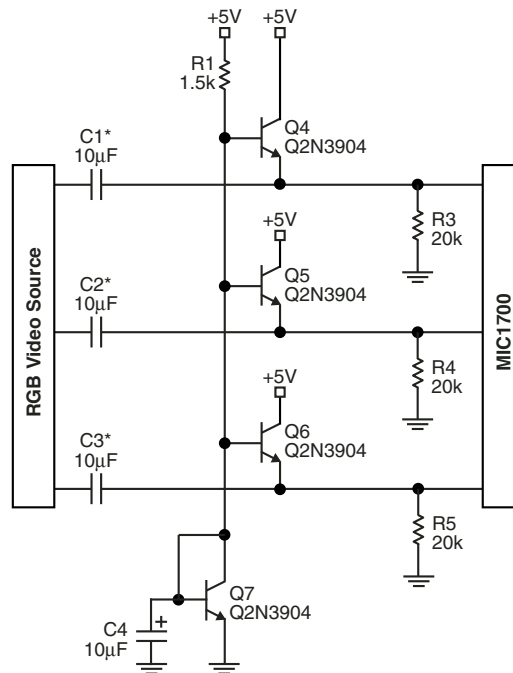


Figure 3. Passive Filter Circuit for 37.5Ω source



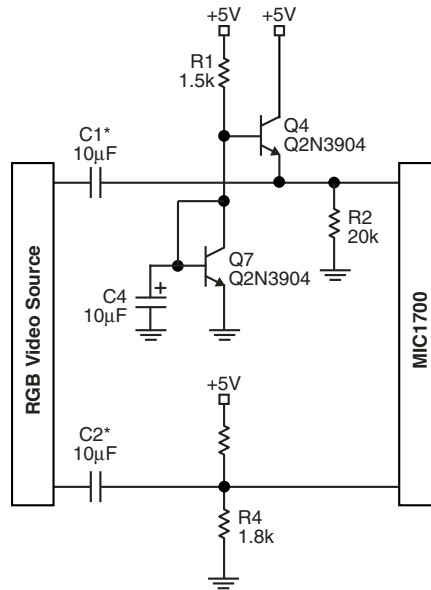
\*Polarity dependant on DC operating point of source

Figure 4. Triple Clamp for RGB Applications

### Clamps for AC-Coupled Inputs

For RGB or Composite inputs that do not meet the DC input requirements MIC1700 can be driven via sync tip clamps (RGB sources work best with sync on all channels). These clamps work with signals that are unipolar, in which the sync tip is the most negative excursion of the signal. Current is bled from the input capacitor during active video causing a slow droop in average level. This rate of droop is a critical video parameter and should be well under 1% for all operating conditions. The droop is controlled by the load resistance (plus additional load currents) and the coupling cap. Charge removed from the coupling cap during active video is replaced during sync tip by the emitter current of the clamping transistor. The  $V_{BE}$  drop during sync will be a function of the replacement current which is a function of sync tip duty cycle. Sync tip duty cycle for SD is  $4.7\mu s / 63.5\mu s = 0.074$  or 7.4%. For HD trilevel sync the duty cycle is about half of this or 0.037. Assuming a droop current of about  $100\mu A$ , this gives a maximum replacement current (for HD signals) of 2.7mA. To keep this sync tip at or above GND, the biasing transistor should be operated at the same current, giving a biasing resistor of 1.5kΩ. This will bias HD sources with the sync tip at GND, with SD sources slightly above GND. The luma channel of S-video sources can be clamped the same as component RGB channels, but the chroma channel should simply be AC-coupled with a bias of 0.5V. Realization of these schemes is shown in Figure 4 and 5.

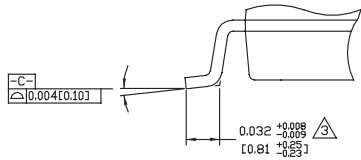
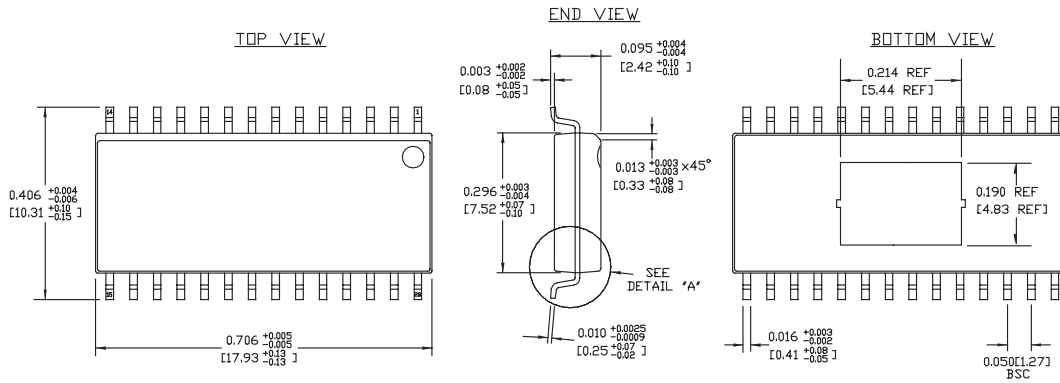




\*Polarity dependant on DC operating point of source

**Figure 5. Clamp and AC Biasing for S-Video Applications**

# Package Information



DETAIL "A"

## NOTES:

1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.006[0.15] PER SIDE.

## 28-Pin Wide Body SOIC (WM)

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