

# ML6415

## S-Video Filter with Summed Composite Output, Sound Trap, and Group Delay Compensation

### Features

- 7.1MHz Y and C filters, with CV out
- 14dB notch at 4.5MHz for sound trap
- 42dB stopband attenuation at 27MHz on Y, C, and CV
- Better than 1dB flatness to 4.5 MHz on Y, C, and CV
- RF Modulator output differential group delay between 400kHz and 3.58MHz is typically -170ns.
- No external frequency select components or clocks
- 9ns group delay flatness on Y, C, and CV output
- AC coupled inputs and outputs
- 0.4% differential gain on Y, C and CV channels, 0.4° differential phase on Y, C and CV channels
- 0.8% total harmonic distortion on all channels
- DC restore with low tilt

### Applications

- Cable Set-top Boxes
- Satellite Set-top Boxes
- DVD Players

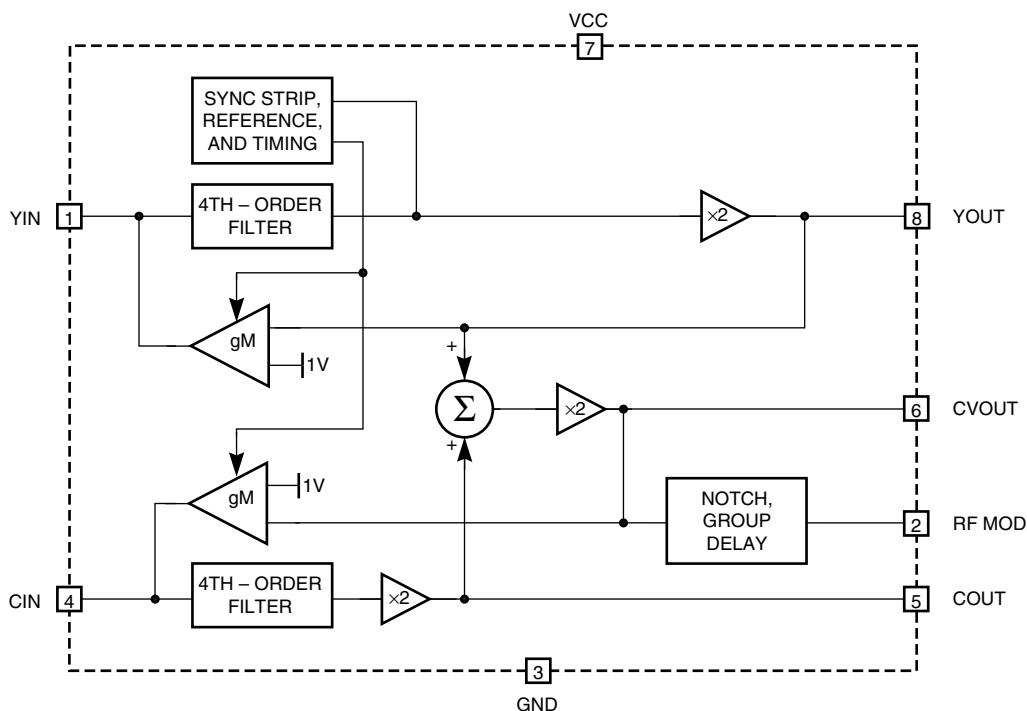
### General Description

The ML6415 is a dual Y/C 4th-order Butterworth lowpass video filter optimized for minimum overshoot and flat group delay. The device also contains a summing circuit to generate filtered composite video, an audio trap and group delay compensation circuit to notch-out audio, providing an area for the addition of the FM audio carrier(s) and mimic the group delay distortion introduced at the transmitter. The group delay predistortion compensates for the nominal TV receiver IF filter distortion.

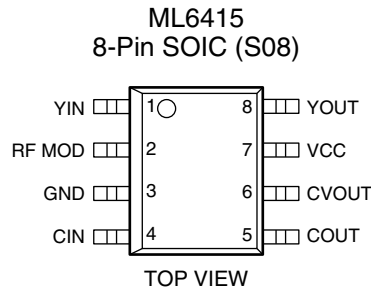
In a typical application, the Y and C input signals from DACs are AC coupled into the filter. Both channels have DC restore circuitry to clamp the DC input levels during video sync. The Y and C channels use a separate feedback clamp. The clamp pulse is derived from the Y channel.

The outputs are AC coupled. The Y, C, CV, and modulator outputs can drive 2V<sub>pp</sub> into a 150Ω load (1V<sub>pp</sub> 75Ω coax load). The Y, C, CV, and notch channels have a gain of approximately 2 (6dB) with 1V<sub>pp</sub> input levels.

### Block Diagram



## Pin Configuration



## Pin Descriptions

Pin #	Signal Name	Description
1	YIN	Luminance input
2	RF MOD	Output to RF modulator driver
3	GND	Ground
4	CIN	Chrominance input
5	COUT	Chrominance output
6	CVOUT	Composite video output
7	VCC	5V supply
8	YOUT	Luminance output

## Functional Description

### Introduction

This product is a dual monolithic continuous time video filter designed for reconstructing the luminance and chrominance signals from an S-Video D/A source. Composite video output is generated by summing the Y and C outputs. The chip is intended for use in applications with AC coupled input and AC coupled outputs. (See Figure 1)

The reconstruction filters approximate a 4th-order Butterworth characteristic with an optimization toward low overshoot and flat group delay. Y, C, and CV outputs are capable of driving 2V<sub>pp</sub> into AC coupled 150Ω video loads, with up to 35pF of load capacitance at the output pin.

All channels are clamped during sync to establish the appropriate output voltage swing range. Thus the input coupling capacitors do not behave according to the conventional RC time constant. Clamping for all channels settles to less than 10mv within 5ms of a change in video input sources.

In most applications the input coupling capacitors are 0.1μF. The Y and C input typically sinks 1μA during active video,

which nominally tilts a horizontal line by about 2mV at the Y output. During sync, the clamp typically sources 20μA to restore the DC level. The net result is that the average input current is zero.

Any change in the input coupling capacitor's value will inversely alter the amount of tilt per line. Such a change will also linearly affect the clamp response times.

This product is robust and stable under all stated load and input conditions. Capacitive bypassing VCC directly to ground ensures this performance.

### Luminance (Y) I/O

The luma input is driven by either a low impedance source of 1V<sub>p-p</sub> or the output of a 75Ω terminated line. The input is required to be AC coupled via a 0.1μF coupling capacitor which allows for a settling time of 5ms. The luma output is capable of driving an AC coupled 150Ω load at 2V<sub>pp</sub>, or 1V<sub>pp</sub> into a 75Ω load. Up to 35pF of load capacitance (at the output pin) can be driven without stability or slew issues. The output is AC coupled with a 400μF or larger AC coupling capacitor.

### Chrominance (C) I/O

The chroma input is driven by a low impedance source of 0.7V<sub>pp</sub> or the output of a 75Ω terminated line. The input is required to be AC coupled via a 0.1μF coupling capacitor which allows for a clamp setting time of 5ms. The chroma output is capable of driving an AC coupled 150Ω load at 2VP-P, or 1VP-P into a 75Ω load. Up to 35pF of load capacitance can be driven without stability or slew issues. A 0.1μF AC coupling capacitor is recommended at the output. (This reduces the circuit cost as chroma does not contain low frequency components.)

### Composite Video (CV) Output

The composite video output is capable of driving 2 loads to 2VP-P. It is intended to drive a TV and a VCR. Either the TV input or the VCR input can be shorted to ground and the other output will still meet specifications. Up to 35pF of load capacitance (at the output pin) can be driven without stability or slew issues.

### RF Modulator Output

The RF modulator output is capable of driving a 600Ω load to 2VP-P, but is primarily intended to drive a modulator load.

## Typical Applications Diagram

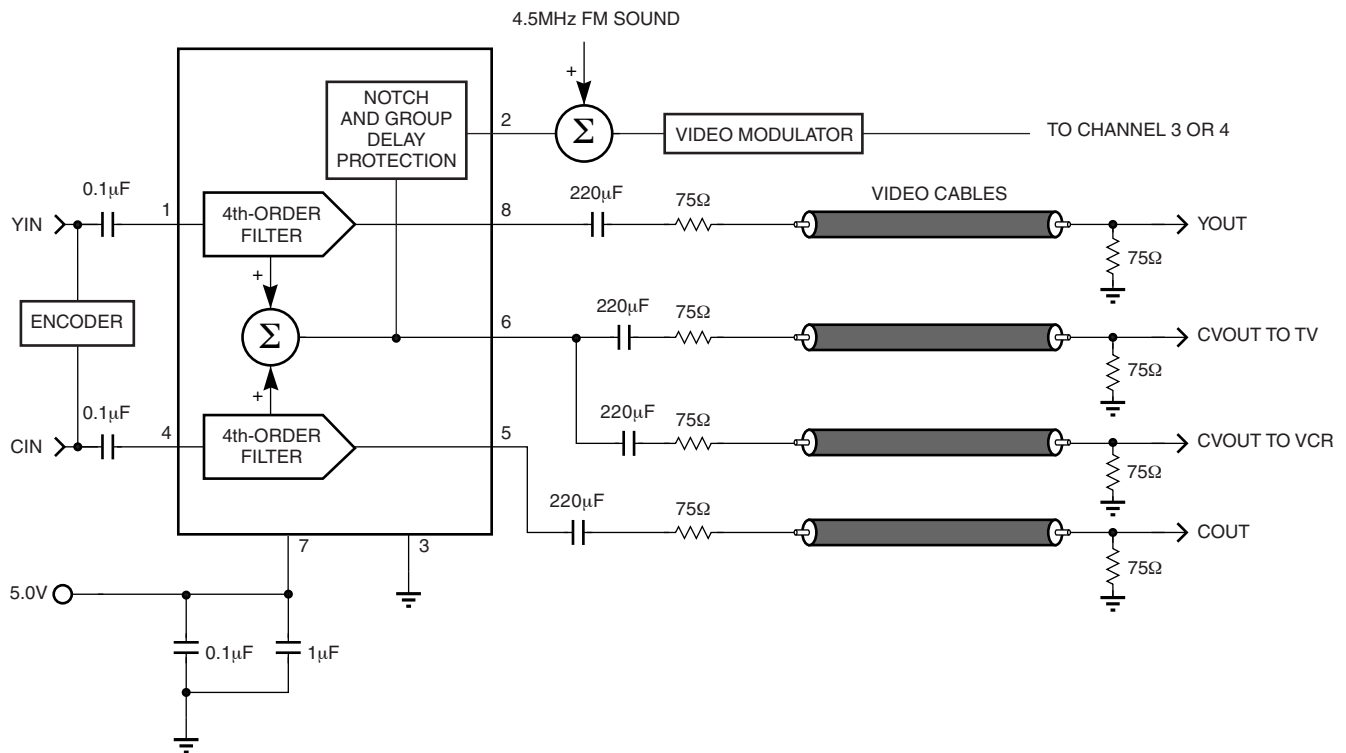


Figure 1. Coupled S-Video, Composite Video Line Driver, Sound Trap, and Group Delay Pre-distortion

## Absolute Maximum Ratings

Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

Parameter	Min.	Max.	Units
DC Supply Voltage	-0.3	7	V
Analog & Digital I/O	GND - 0.3	V <sub>CC</sub> + 0.3	V
Output Current (Continuous)			
CV Channel		60	mA
C and Y Channels		30	mA
Junction Temperature		150	°C
Storage Temperature Range	-65	150	°C
Lead Temperature (Soldering, 10s)		260	°C
Thermal Resistance ( $\theta_{JA}$ )		115	°C/W

## Operating Conditions

Parameter	Min.	Max.	Units
Temperature Range	0	70	°C
V <sub>CC</sub> Range	4.5	5.5	V

## Electrical Characteristics

Unless otherwise specified, V<sub>CC</sub> = 5.0V ±10%, All inputs AC coupled with 100nF, T<sub>A</sub> = Operating Temperature Range

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
I <sub>CC</sub>	Supply Current			60	85	mA
V <sub>CC</sub>	Supply Range		4.5	5.0	5.5	V
AV <sub>YC</sub>	Low Frequency Gain (Y <sub>OUT</sub> , C <sub>OUT</sub> )	at 400KHz	5.75	6.0	6.25	dB
AV <sub>RFMOD</sub>	Low Frequency Gain (RFMOD)	at 400KHz	6.1	6.7	7.3	dB
AV <sub>CV</sub>	Low Frequency Gain (C <sub>VOUT</sub> )	at 400KHz	5.55	5.9	6.25	dB
	C <sub>OUT</sub> Output Level (During Sync)	Sync Present on Y <sub>IN</sub>	1.6	2.0	2.4	V
	Y <sub>OUT</sub> Output Level (During Sync)	Sync Present on Y <sub>IN</sub>	0.75	1.0	1.25	V
	C <sub>VOUT</sub> Output Level (During Sync)	Sync Present on Y <sub>IN</sub>	0.75	1.0	1.25	V
	RFMOD Output Level (During Sync)	Sync Present on Y <sub>IN</sub>	0.65	1.0	1.35	V
t <sub>CLAMP</sub>	Clamp Response Time (Y Channel)	Settled to Within 10mV, 0.1μF cap on Y <sub>IN</sub> and C <sub>IN</sub>		5		ms
f <sub>1dB</sub>	-1.0dB Bandwidth (Flatness) (Y <sub>OUT</sub> , C <sub>OUT</sub> , and C <sub>VOUT</sub> )		4.0	4.5		MHz
f <sub>C</sub>	-3dB Bandwidth (Flatness) (Y <sub>OUT</sub> , C <sub>OUT</sub> , and C <sub>VOUT</sub> )			7.1		MHz
f <sub>SB</sub>	Stopband Rejection (Y <sub>OUT</sub> , C <sub>OUT</sub> , and C <sub>VOUT</sub> )	f <sub>IN</sub> = 27MHz to 100MHz worst case	-37	-42		dB
V <sub>i</sub>	Input Signal Dynamic Range (All Channels)	AC Coupled	1.2	1.4		V <sub>pp</sub>
I <sub>SC</sub>	Output Short Circuit Current (All Channels)	C <sub>OUT</sub> , Y <sub>OUT</sub> , C <sub>VOUT</sub> , or RFMOD to GND (Note 1)		40	80	mA

**Electrical Characteristics** (continued)

Unless otherwise specified,  $V_{CC} = 5.0V \pm 10\%$ , All inputs AC coupled with 100nF,  $T_A$  = Operating Temperature Range

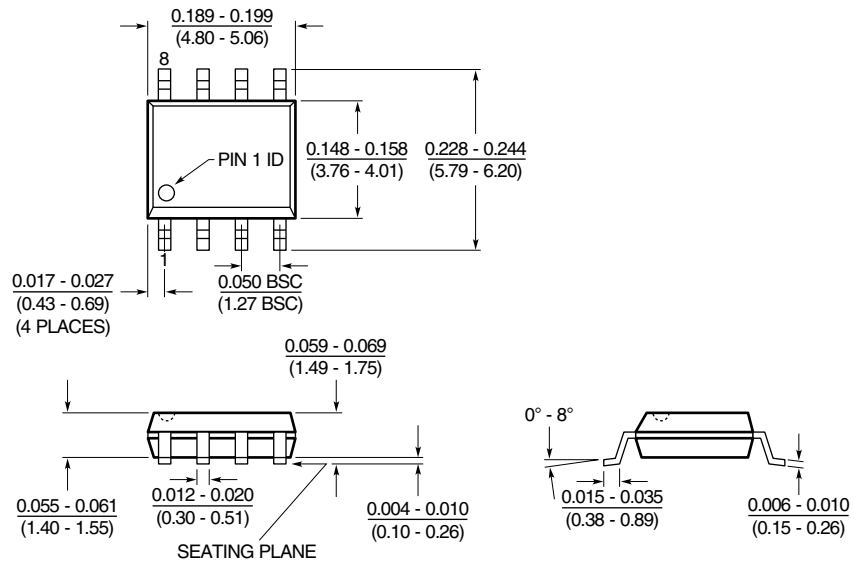
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
CL	Output Shunt Capacitance (All Channels)	All Outputs		35		pF
dG	Differential Gain	Y <sub>OUT</sub> , C <sub>OUT</sub> , and CV <sub>OUT</sub>		0.4		%
dP	Differential Phase	Y <sub>OUT</sub> , C <sub>OUT</sub> , and CV <sub>OUT</sub>		0.4		°
THD	Output Distortion (All Channels)	V <sub>OUT</sub> = 1.8V <sub>pp</sub> , Y/C Out at 3.58MHz		0.8		%
XTALK	Crosstalk	From C <sub>IN</sub> of 0.5V <sub>pp</sub> at 3.58MHz to Y <sub>OUT</sub>		-55		dB
		From Y <sub>IN</sub> of 0.4V <sub>pp</sub> at 3.58MHz, to C <sub>OUT</sub>		-58		dB
PSRR	PSRR (All Channels)	0.5V <sub>pp</sub> (100kHz) at V <sub>CC</sub>		-40		dB
SNR	Y, C Channel	NTC-7 weighting 4.2MHz lowpass		-75		dB
	CV Channel	NTC-7 weighting 4.2MHz lowpass		-69		dB
	RFMOD Channel	NTC-7 weighting 4.2MHz lowpass		-60		dB
tpd	Group Delay (Y, C, CV)			70		ns
Δtpd	Group Delay Deviation from Flatness (Y, C, and CV)	to 3.58MHz (NTSC)		9		ns
tSKEW	Skew Between Y <sub>OUT</sub> and C <sub>OUT</sub>	at 1MHz		0		ns
Tpd	Group Delay RFMOD	f = 3.58MHz (referenced to 400kHz)	-230	-170	-130	ns
Tpass	Pass Delay, RFMOD Output	f = 200kHz to 3MHz	-50		50	ns
dGRFMOD	Differential Gain	RFMOD Channel		1.5		%
dPRFMOD	Differential Phase	RFMOD Channel		1.0		°
pK	Gain Peaking (Note 2)	RFMOD Channel at 2.0MHz	-0.5	0.5	0.75	dB
MCF	Modulator Channel Flatness (Note 2)	at 3.75MHz	-0.5		+0.75	dB
AV	Notch Attenuation (Note 2)	From 4.425MHz to 4.63MHz	14			dB
AV	Notch Attenuation (Note 2)	at 4.2MHz			8	dB
PSRR <sub>mt</sub>	Supply Sensitivity Modulator Channel Flatness	V <sub>CC</sub> = 4.5V to 5.5V at 3.58MHz		0.12		dB/V
TC <sub>m</sub>	Modulator Channel Flatness Temperature Sensitivity	V <sub>CC</sub> = 5V at 3.58MHz		-0.04		dB/°C

**Notes**

1. Sustained short circuit protection limited to 10 seconds
2. Referenced to 400kHz
3. Group delay is tested down to 400kHz but guaranteed by design to 200kHz.

# Mechanical Dimensions inches/(millimeters)

Package: S08  
8-Pin SOIC



## Ordering Information

Part Number	Temperature Range	Package
ML6415CS	0° to 70°	8 Pin SOIC (S08)

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