19-2750; Rev 0; 1/03

MAXIM

6-Channel Integrated Video Reconstruction Filters

General Description

The MAX7440/MAX7441/MAX7442 six-channel video reconstruction filters replace 30 or more discrete components. The devices are ideal for digital-to-analog converter (DAC) video reconstruction applications, when analog video is reconstructed from a digital data stream. The MAX7440/MAX7441/MAX7442 operate from a single +5V power supply. The inputs are DC-coupled from the DAC and the output can either be AC- or DC-coupled. The DC-IN, DC-OUT architecture, leads to a perfect line-time distortion performance (zero tilt). The filters have a cutoff frequency optimized for PAL, NTSC, and SDTV video applications and offer three high-frequency boost options. The MAX7440 offers a flat passband response on all six channels; the MAX7441/MAX7442 offer high-frequency boost on the three channels used for CVBS and Y/C. The MAX7440/MAX7441/MAX7442 are available in a 14-pin SO package and are fully specified over the extended temperature range.

Applications

STB	PVR
DVDs	SCART Video Applications
Hard Disk Recorders	General Video Filtering

Features

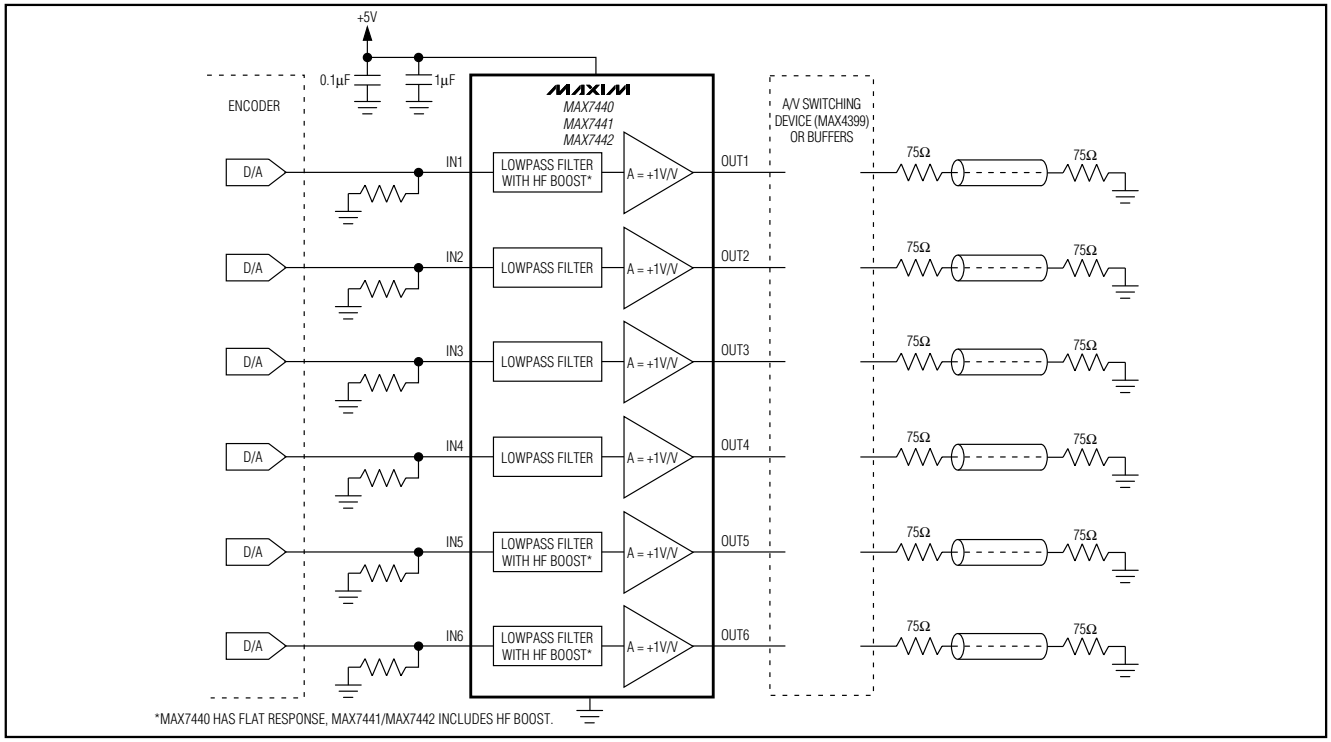
- **Replace 30 or More Discrete Components**
- **Ideal for CVBS, Y/C (S-Video), and RGB or Y Pb Pr Applications**
- **45dB Attenuation at 27MHz**
- **-0.2dB Passband Response**
- **Ideal for STBs with SCART Interface**
- **+5V Single-Supply Voltage**
- **Input Common-Mode Range Includes GND**
- **DC-Coupled Input, DC/AC-Coupled Output**
- **14-Pin SO Package**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	HIGH-FREQUENCY BOOST
MAX7440ESD	-40°C to +85°C	14 SO	No
MAX7441ESD	-40°C to +85°C	14 SO	Yes
MAX7442ESD*	-40°C to +85°C	14 SO	Yes

**Future product—contact factory for availability.*

Typical Application Circuit



6-Channel Integrated Video Reconstruction Filters

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....+6V
All Other Pins to GND.....-0.3V to (V_{CC} + 0.3V)
Maximum Current into Any Pin .....±50mA
Continuous Power Dissipation (T_A = +70°C)
14-Pin SO (derate 8.3mW/°C above +70°C).....666.7mW

Operating Temperature Range .....-40°C to +85°C
Storage Temperature Range .....-65°C to +150°C
Junction Temperature.....+150°C
Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +5V ±5%, R_L = 5kΩ, C_L = 0 to 20pF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Passband Response		DC to 3.5MHz, MAX7440/MAX7441 (channels 2, 3, 4)		-0.40	-0.2	+0.10	dB
		DC to 5MHz, MAX7440/MAX7441 (channels 2, 3, 4)		-0.80	-0.5	0	
Stopband Attenuation	A_{sb}	f = 27MHz		37	45		dB
Boost Amplitude		f = 4.5MHz	+1dB HF boost, MAX7441	0.4	0.60	0.91	dB
			+2dB HF boost, MAX7442		1.2		
Differential Gain	dG	5-step modulated staircase			0.05		%
Differential Phase	dB	5-step modulated staircase			0.05		Degrees
Signal-to-Noise Ratio	SNR	Peak signal ($1V_{P-P}$) to RMS noise, f = 10Hz to 100MHz			71		dB
Group Delay Matching	$t_{g(MATCH)}$	Low-frequency channel-to-channel matching, f = 200kHz	Channels 2, 3, 4		2		ns
			Channels 1, 5, 6		2		
Group Delay Deviation	Δ_g	Deviation from 100kHz to 4.5MHz	MAX7440/MAX7441/ MAX7442		10		ns
			MAX7441 (channels 1, 5, 6)		17		
			MAX7442 (channels 1, 5, 6)		17		
Line-Time Distortion	H_{dist}	18µs, 100IRE bar		-3	0	+3	mV
Field-Time Distortion	V_{dist}	130 lines, 18µs, 100IRE bar		-4		+4	mV
Low-Frequency Gain Variation	A_V	Gain at f = 100kHz		-0.25		+0.25	dB
Low-Frequency Gain					0.975		V/V
Low-Frequency Gain Matching	t_g	f = 100kHz		-3		+3	%
Input Voltage Range				0		1.75	V
Channel-to-Channel Crosstalk	X_{TALK}	Channel-to-channel crosstalk, DC to 5MHz			71		dB
Input Leakage Current	I_{IN}	V_{IN} = 0V		2	6	25	µA

ELECTRICAL CHARACTERISTICS (continued)

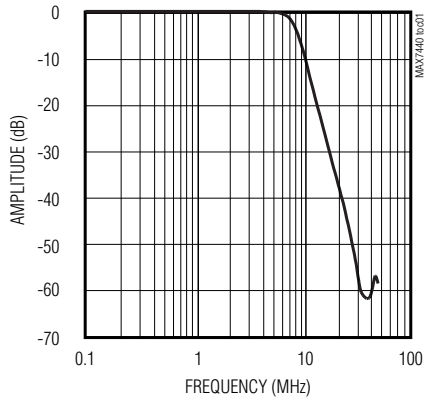
(V_{CC} = +5V ±5%, R_L = 5kΩ, C_L = 0 to 20pF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Resistance				200			kΩ
Input Capacitance					20		pF
Supply Voltage Range	V_{CC}			4.75		5.25	V
Supply Current	I_{CC}	V_{CC} = +5.5V, no load			57	78	mA
Power-Supply Rejection Ratio	PSRR	V_{IN} = 100mV_{P-P}	DC		39		dB
			f = 0 to 1MHz		30		
DC Level Shift		OUT_ to IN_			0.85	1.05	V

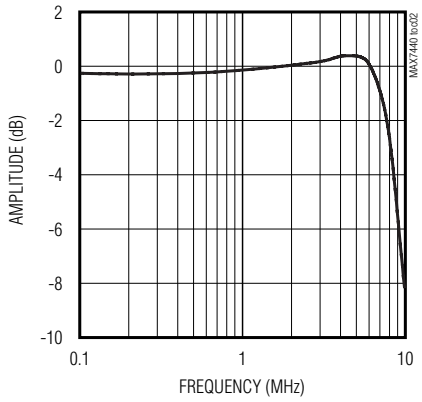
Typical Operating Characteristics

(V_{CC} = +5V, R_L = 5kΩ, T_A = +25°C, unless otherwise noted.)

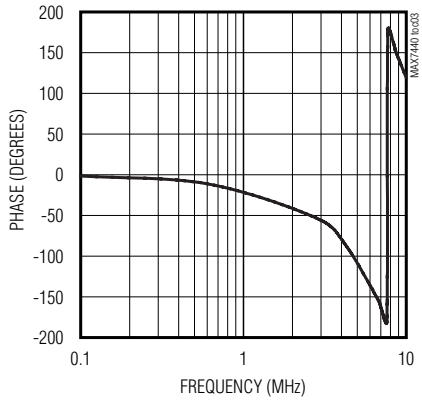
AMPLITUDE vs. FREQUENCY



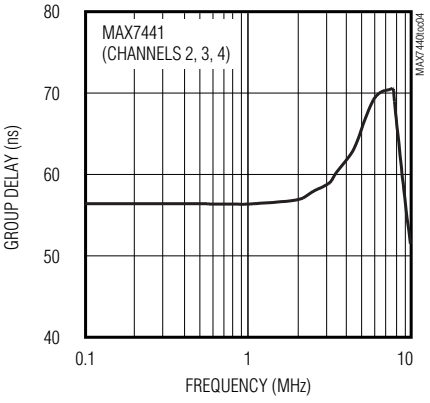
PASSBAND AMPLITUDE vs. FREQUENCY



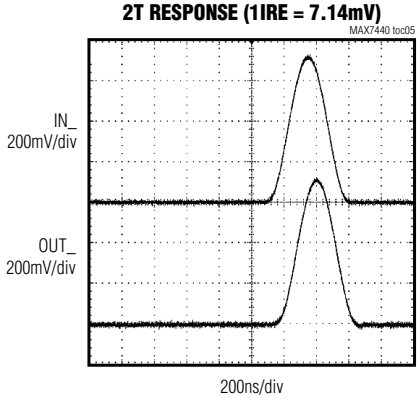
PHASE RESPONSE vs. FREQUENCY



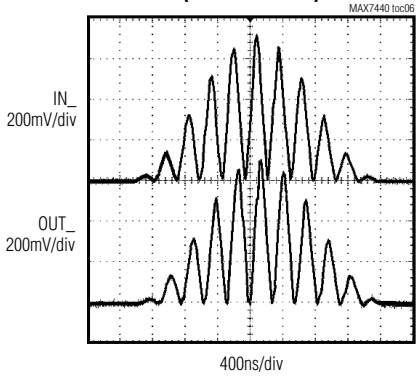
GROUP DELAY vs. FREQUENCY



2T RESPONSE (1IRE = 7.14mV)



MODULATED 12.5T RESPONSE (1IRE = 7.14mV)

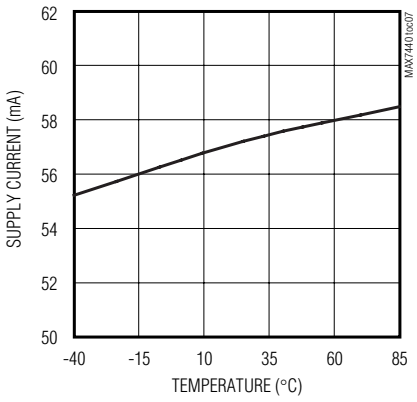


6-Channel Integrated Video Reconstruction Filters

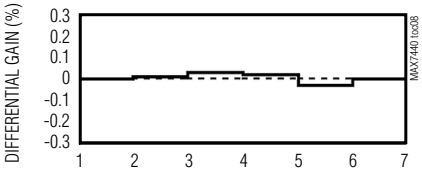
Typical Operating Characteristics (continued)

(V_{CC} = +5V, R_L = 5kΩ, T_A = +25°C, unless otherwise noted.)

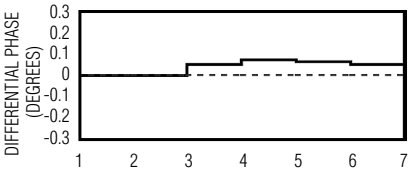
SUPPLY CURRENT vs. TEMPERATURE



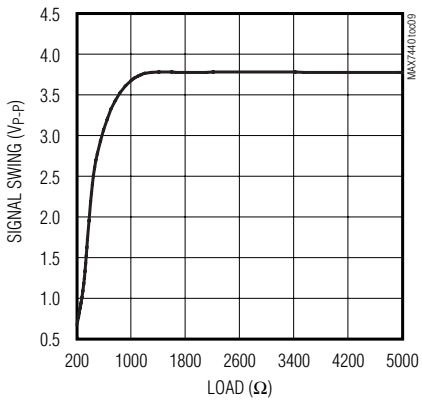
DIFFERENTIAL GAIN



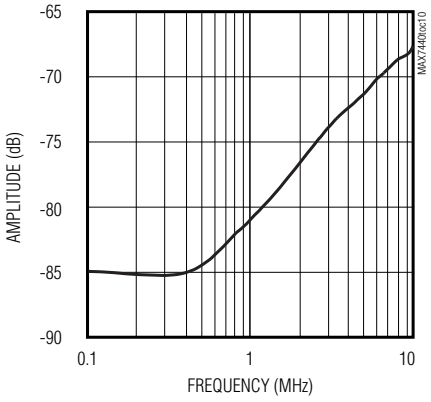
DIFFERENTIAL PHASE



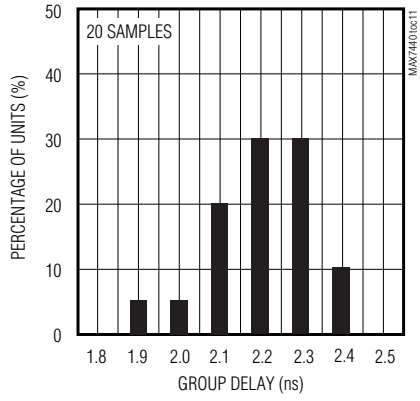
SIGNAL SWING vs. LOAD



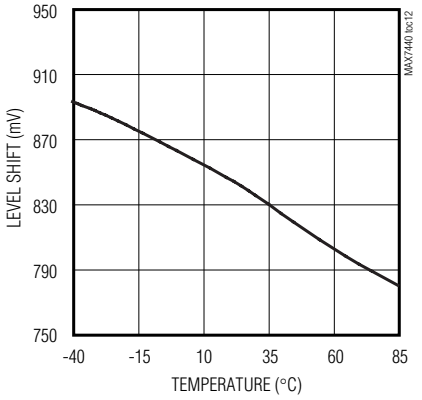
CHANNEL-TO-CHANNEL CROSSTALK vs. FREQUENCY



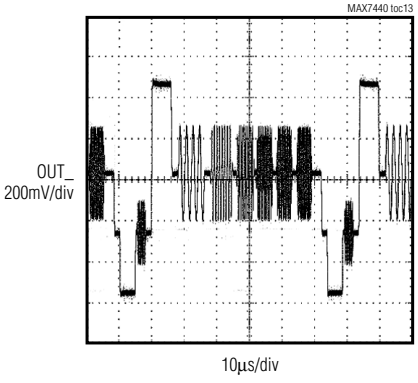
GROUP DELAY MATCHING DISTRIBUTION



INPUT/OUTPUT LEVEL SHIFT vs. TEMPERATURE



MULTIBURST RESPONSE



Pin Description

PIN	NAME	FUNCTION
1	IN1	Channel 1 Filter Input (Optional Boosted Channel)
2	IN2	Channel 2 Filter Input
3	IN3	Channel 3 Filter Input
4	V_{CC}	+5V Power Supply. Bypass to GND with a 0.1µF and 1µF capacitor.
5	IN4	Channel 4 Filter Input
6	IN5	Channel 5 Filter Input (Optional Boosted Channel)
7	IN6	Channel 6 Filter Input (Optional Boosted Channel)
8	OUT6	Channel 6 Filter Output
9	OUT5	Channel 5 Filter Output
10	OUT4	Channel 4 Filter Output
11	GND	Ground
12	OUT3	Channel 3 Filter Output
13	OUT2	Channel 2 Filter Output
14	OUT1	Channel 1 Filter Output

Detailed Description

The MAX7440/MAX7441/MAX7442 filter the outputs of DAC encoder chipsets that process digital video information in applications such as set-top boxes, hard disk recorders, DVD players, DVD recorders, and digital VCRs. These devices also filter and clean up analog video signals by rejecting out-of-band noise. Each channel in the MAX7440/MAX7441/MAX7442 includes a 4th-order lowpass filter and a gain of +1V/V output stage, as shown in the *Typical Application Circuit*.

Filter

Filter Response

Each channel of the reconstruction filter consists of a 4th-order Sallen-Key filter configured as two 2nd-order stages. The filter features a maximally flat passband for NTSC, PAL, and SDTV bandwidths. The stopband offers typically 45dB of attenuation at sampling frequencies of 27MHz and above (see *Typical Operating Characteristics*). The filter exhibits a Butterworth-type response resulting in excellent group delay deviation performance.

High-Frequency Boost

The high-frequency (HF) boost compensates for signal degradation and rolloff in the signal path prior to the filter. This performance increases the image sharpness. The MAX7441/MAX7442 offer a high-frequency boost on channels OUT1, OUT5, and OUT6.

Output Stage

The output stages of the MAX7440/MAX7441/MAX7442 are designed to drive $1V_{P-P}$ signals into high-impedance (>5kΩ) loads. They require external buffers to drive standard video cables. Most standard audio/video switching devices include these buffers for STB applications.

Applications Information

MAX7440/MAX7441/MAX7442 with an A/V Switching Device

The MAX7440/MAX7441/MAX7442 are designed to directly interface to an audio/video switching device used in video applications (i.e., STBs) with SCART interfaces (see *Typical Application Circuit*). The output of the analog filters can drive the high-impedance load of the switching device. The switching device provides the buffering to drive standard 150Ω video loads.

MAX7440/MAX7441/MAX7442 with External Buffers

External buffering is required for the MAX7440/MAX7441/MAX7442 to drive standard 150Ω video loads. Figure 1 shows the MAX4394 triple op amp, configured with a gain of +2V/V to drive standard video loads from the MAX7440/MAX7441/MAX7442.

6-Channel Integrated Video Reconstruction Filters

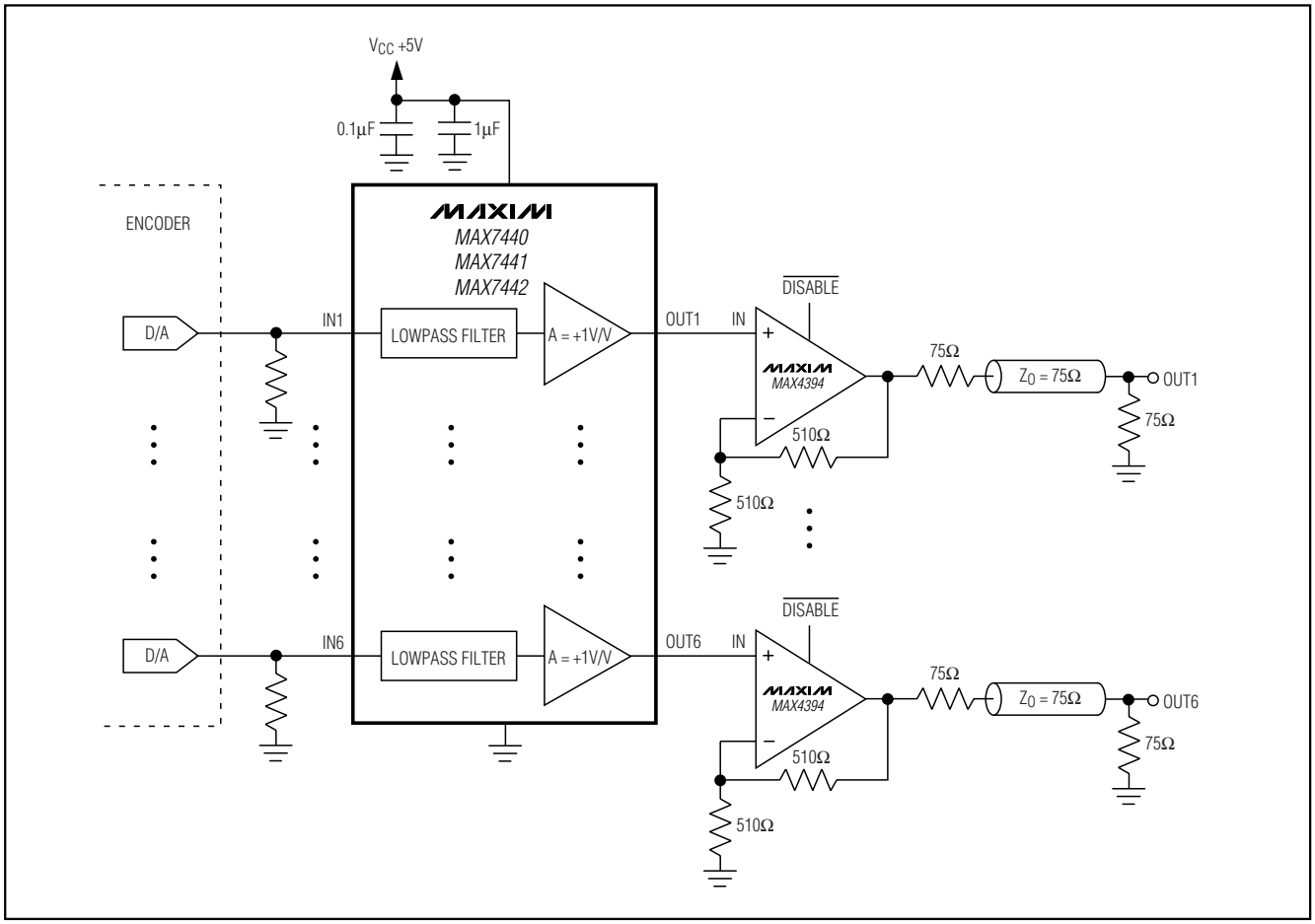
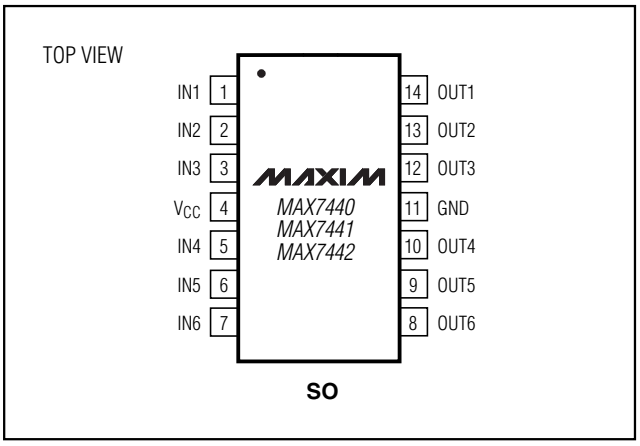


Figure 1. Typical Application Circuit with External Buffers

Pin Configuration



Power-Supply Bypassing and Layout

The MAX7440/MAX7441/MAX7442 operate from a single +5V supply. Bypass V_{CC} to GND with a 0.1µF and 1µF capacitor. These capacitors filter all frequencies over 1MHz. Place all external components as close to the devices as possible. To maintain good crosstalk performance ensure that input and output lines do not run parallel for any distance. If it is necessary to have parallel lines, run a ground trace in between each line. Refer to the *MAX7440 Evaluation Kit* for a proven PC board layout example.

Chip Information

TRANSISTOR COUNT: 3691

PROCESS: BiCMOS

6-Channel Integrated Video Reconstruction Filters

Package Information

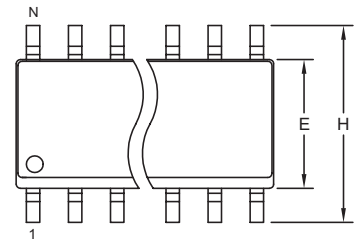
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)

SOICN .EPS

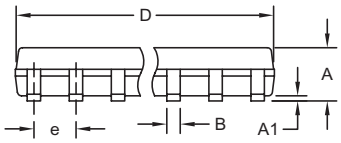
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27

VARIATIONS:

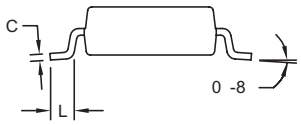
	INCHES		MILLIMETERS			
DIM	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	AA
D	0.337	0.344	8.55	8.75	14	AB
D	0.386	0.394	9.80	10.00	16	AC



TOP VIEW



FRONT VIEW



SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
4. CONTROLLING DIMENSION: MILLIMETERS.
5. MEETS JEDEC MS012.
6. N = NUMBER OF PINS.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, .150" SOIC

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0041	B	1/1