Not Recommended for New Designs

This product was manufactured for Maxim by an outside wafer foundry using a process that is no longer available. It is not recommended for new designs. The data sheet remains available for existing users.

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General Description

The MAX442 combines a 140MHz video amplifier with a high-speed, 2-channel multiplexer in an 8-pin package. With its 36ns switching time and low differential gain (0.07%) and phase (0.09°) errors, it is ideal for broadcast-quality video applications. The device is designed to drive both 50Ω and 75Ω cables, and can directly drive a 75 Ω load to ±3V.

The MAX442 video amplifier is compensated for unitygain stability, and features a 140MHz bandwidth and a 250V/µs slew rate. The multiplexer's low input capacitance (4pF with the channel on or off) maximizes highspeed performance, and a ground pin separating the two input channels minimizes crosstalk and simplifies board layout.

The MAX442 operates from $\pm 5V$ supplies and typically consumes 300mW. For applications that require more input channels, see the data sheets for the MAX440 8channel mux/amp and the MAX441 4-channel mux/amp.

Applications

Broadcast-Quality Video-Signal Multiplexing

Coaxial-Cable Drivers

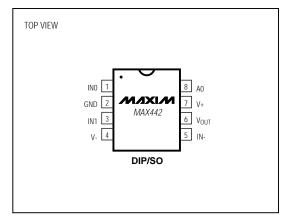
Video Editing

Video Security Systems

Medical Imaging

High-Speed Signal Processing

Pin Configuration



Features

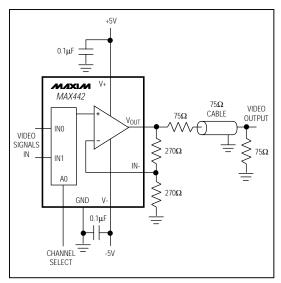
- **♦ 140MHz Unity-Gain Bandwidth**
- ♦ 250V/µs Slew Rate
- ♦ 0.07%/0.09° Differential Gain/Phase Error
- 36ns Channel Switch Time
- No External Compensation Components
- ♦ 8-Pin DIP and SO Packages
- ♦ Directly Drives 50 Ω and 75 Ω Cables

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX442CPA	0°C to +70°C	8 Plastic DIP
MAX442CSA	0°C to +70°C	8 SO
MAX442C/D	0°C to +70°C	Dice*
MAX442EPA	-40°C to +85°C	8 Plastic DIP
MAX442ESA	-40°C to +85°C	8 SO

*Dice are specified at $T_A = +25$ °C, DC parameters only.

Typical Operating Circuit



/VIXI/VI

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ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V+ to V-)	12V
Analog Input Voltage(V+ + 0.3V) to (V 0.3V)
Digital Input Voltage0.3V	to $(V + + 0.3V)$
Short-Circuit Current Duration	1 minute
Input Current to Any Pin, Power On or Off	±50mA
Continuous Power Dissipation (T _A = +70°C)	
Plastic DIP (derate 9.09mW/°C above +70°C)	727mW
SO (derate 5.88mW/°C above +70°C)	471mW

Operating Temperature Ranges	
MAX442C_A	0°C to +70°C
MAX442E_A	40°C to +85°C
Storage Temperature Range	65°C to +150°C
Lead Temperature (soldering, 10sec)	+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+ = 5V, V- = -5V, RL = 150 Ω , TA = TMIN to TMAX, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS	
DC PERFORMANCE								
Input Voltage Range	V _{IN}			-2		2	V	
	Vos	T _A = +25°C			±1.5	±7.0		
Input Offset Voltage (All Channels)		MAX442C				±10	mV	
(All Charliels)		MAX442E				±12		
Offset Matching		$T_A = +25^{\circ}C$			±1	±2.5	mV	
(V _{OS0} -V _{OS1})		TA = TMIN to TMAX				±5.0		
Input Bias Current	le.	VIN = 0V	T _A = +25°C		±0.6	±2	μА	
(Channel On)	IB		$T_A = T_{MIN}$ to T_{MAX}			±5		
Input Leakage Current	luura	VIN = 0V	T _A = +25°C		±0.5	±50	nA	
(Channel Off)	ILKG		TA = TMIN to TMAX			±1	μΑ	
Input Resistance	Dur	RINI I-2V < VCM < 2V	T _A = +25°C	0.5	2.0		MΩ	
(Channel On) (Note 1)	KIN		$T_A = T_{MIN}$ to T_{MAX}	0.2				
Input Capacitance	CIN	Channel on or off			4		pF	
DC Output Decistance		$A_V = 0dB$			25		mO	
DC Output Resistance	Rout	$A_V = 6dB$			50		mΩ	
Open-Loop Voltage Gain	Avol	$R_L = 75\Omega$, $-2V \le V_{OUT} \le +2V$	T _A = +25°C	50	60		dB	
			TA = TMIN to TMAX	46				
Common Made Dejection Datio	CMRR	-2V ≤ V _{IN} ≤ +2V	T _A = +25°C	46	50		dB	
Common-Mode Rejection Ratio	CIVIRR		TA = TMIN to TMAX	46				
Power-Supply Rejection Ratio	PSRR	±4.75V to ±5.25V	T _A = +25°C	54	80		dB	
			TA = TMIN to TMAX	54				
Output Voltage Swing	Vour	$R_1 = 75\Omega$	$T_A = +25^{\circ}C$	±2.5	±3.0		V	
	Vout	$T_A = T_{MIN}$ to T_{MAX}	±2.0] '		

ELECTRICAL CHARACTERISTICS (continued)

 $(V + = 5V, V - = -5V, R_L = 150\Omega, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted.})$

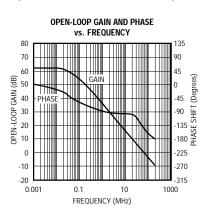
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DYNAMIC PERFORMANCE							
-3dB Bandwidth	BW	$A_V = 0$ dB, $R_L = 100\Omega$			140		MHz
Slew Rate	SR1				250		V/µs
Differential Phase Error	DP	Figure 1			0.09		degrees
Differential Gain Error	DG	Figure 1			0.07		%
Settling Time	t _S	To 0.1% of final value, Av = 0dB, R_L = 150 Ω , 2V step input			50		ns
Crosstalk	XTALK	f = 10MHz, Rs =	75Ω , A _V = 0dB, Figure 6		76		dB
Input Noise-Voltage Density	en	f = 10kHz	f = 10kHz		12		nV/√Hz
POWER REQUIREMENTS							
Operating Supply-Voltage Range	Vs			±4.75		±5.25	V
	Icc	VIN = 0V	T _A = +25°C	25	30	35	mA
Positive Supply Current			MAX442C	22		38	
			MAX442E	19		41	
	lee	VIN = 0V	T _A = +25°C	23	28	35	
Negative Supply Current			MAX442C	20		38	mA
			MAX442E	17		41	
SWITCHING CHARACTERISTIC	S		·				
Logic Low Voltage	VIL					0.8	V
Logic High Voltage	ViH			2.4		•	V
Address Propagation Delay	t _{APD}	Figure 7			24		ns
Channel Switching Time	tsw	Figure 7 (Note 2)			36		ns

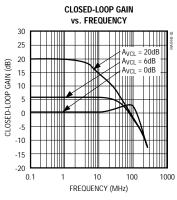
Note 1: Incremental resistance for a common-mode voltage between ±2V.

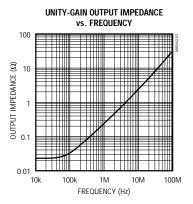
Note 2: Channel Switching Time specified between two grounded input channels; does not include signal rise/fall times for switching between channels with different input voltages.

Typical Operating Characteristics

 $(T_A = +25^{\circ}C, \text{ unless otherwise noted.})$

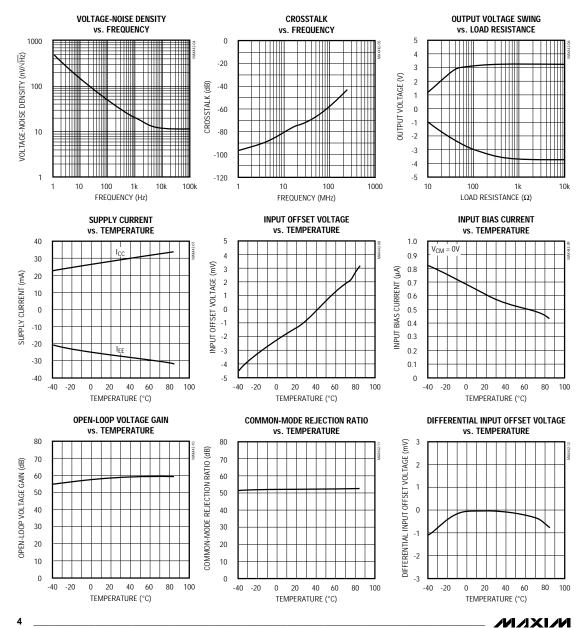






_Typical Operating Characteristics (continued)

(T_A = +25°C, unless otherwise noted.)



Pin Description

PIN	NAME	FUNCTION	
1	INO	Analog Input, channel 0	
2	GND	Ground	
3	IN1	Analog Input, channel 1	
4	V-	Negative Power Supply, -5V	
5	IN-	Amplifier Inverting Input	
6	Vout	Amplifier Output	
7	V+	Positive Power Supply, +5V	
8	A0	Channel Address Input: A0 = logic 0 selects channel 0, A0 = logic 1 selects channel 1	

Applications Information

The MAX442's bipolar construction results in a typical channel input capacitance of only 4pF, whether the channel is on or off. As with all ICs, the mux's input capacitance forms a single-pole RC lowpass filter with the signal source's output impedance. This filter can limit the system's signal bandwidth if the RC product becomes too large. However, the MAX442's low channel input capacitance allows full AC performance of the amplifier, even with source impedances as great as 250Ω —a significant improvement over common mux or switch alternatives.

Feedback resistors should be limited to no more than 500Ω to ensure that the RC time constant formed by the resistors, the circuit board's capacitance, and the capacitance of the amplifier input pins does not limit the system's high-speed performance.

Power-Supply Bypassing and Board Layout

Realizing the full AC performance of high-speed amplifiers requires careful attention to power-supply bypassing and board layout. Use a low-impedance ground plane with the MAX442. With multilayer boards, the ground plane should be located on the PC board's component side to minimize impedance between the components and the ground plane. For single-layer boards, components should be mounted on the board's copper side and the ground plane should include the entire portion of the board that is not dedicated to a specific signal trace.

To prevent oscillation and unwanted signal coupling, minimize trace area at the circuit's critical high-impedance nodes, especially the amplifier summing junction (the amplifier's inverting input). Surround these critical nodes with a ground trace, and include ground traces between all signal traces to minimize parasitic coupling that can degrade crosstalk and/or amplifier stability. Keep signal paths as short as possible to minimize inductance, and keep all input channel traces at equal lengths to maintain the phase relationship between the input channels.

Bypass all power-supply pins directly to the ground plane with $0.1\mu F$ ceramic capacitors, placed as close to the supply pins as possible. For high-current loads, it may be necessary to include $1\mu F$ tantalum or aluminum-electrolytic capacitors in parallel with the $0.1\mu F$ ceramic bypass capacitors. Keep capacitor lead lengths as short as possible to minimize series inductance; surface-mount (chip) capacitors are ideal for this application.

Differential Gain and Phase Errors

In color video applications, lowest differential gain and phase errors are critical for an IC, because they cause changes in contrast and color of the displayed picture. Typically, the MAX442's multiplexer/amplifier combination has a differential gain and phase error of only 0.07% and 0.09°, respectively. This low differential gain and phase error makes the MAX442 ideal for use in broadcast-quality color video systems.

Coaxial-Cable Drivers

High-speed performance and excellent output current capability make the MAX442 ideal for driving 50Ω or 75Ω coaxial cables. The MAX442 will drive 50Ω and 75Ω coaxial cables to $\pm 3 \text{V}.$

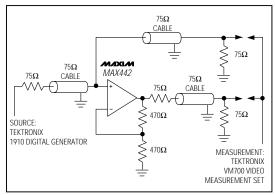


Figure 1. Differential Gain and Phase Error Test Circuit

The Typical Operating Circuit shows the MAX442 driving a back-terminated 75Ω video cable. The back-termination resistor (at the MAX442 output) is included to match the impedance of the cable's driven end to the characteristic impedance of the cable itself. This, plus the load-termination resistor, eliminates signal reflections from the cable's ends. The back-termination resistor forms a voltage divider with the load impedance, which attenuates the signal at the cable output by one-half. The amplifier is operated with a 2V/V closed-loop gain to provide unity gain at the cable's video output.

Capacitive-Load Driving

Driving large capacitive loads increases the likelihood of oscillation in most amplifier circuits. This is especially true for circuits with high loop gains, like voltage fol-

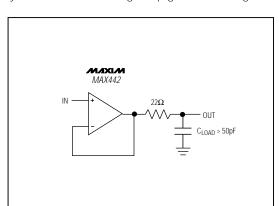


Figure 2. Capacitive-Load-Driving Circuit

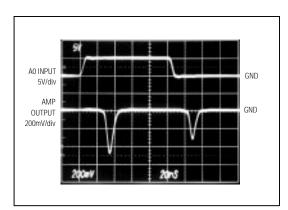


Figure 3. Output Switching Transient when Switching Between Two Grounded Inputs with R_L = 100Ω

lowers. The amplifier's output impedance and the capacitive load form an RC filter that adds a pole to the loop response. If the pole frequency is low enough, as when driving a large capacitive load, the circuit phase margin is degraded and oscillation may occur.

With capacitive loads greater than approximately 50pF and the MAX442 configured as a unity-gain buffer, use an isolation resistor in series with the load, as shown in Figure 2. The resistor removes the pole from the loop response caused by the load capacitance.

Channel Switching Time/Transient

When the MAX442 multiplexer is switched from one channel to another, a small glitch will appear at the output. Figure 3 shows the results of putting a 0V to 5V pulse 100ns wide into A0.

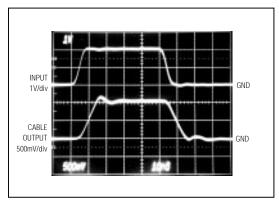


Figure 4. Pulse Response with RL = 100 Ω (50 Ω back-terminated cable), A_{VCL} = +1V/V

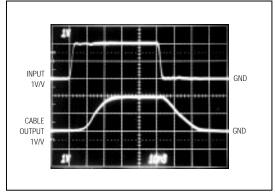


Figure 5. Pulse Response with RL = 100 Ω (50 Ω back-terminated cable), A_{VCL} = +2V/V

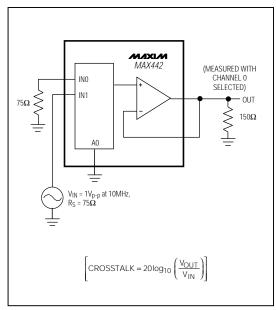


Figure 6. Crosstalk Test Circuit

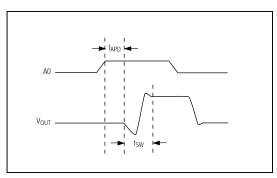
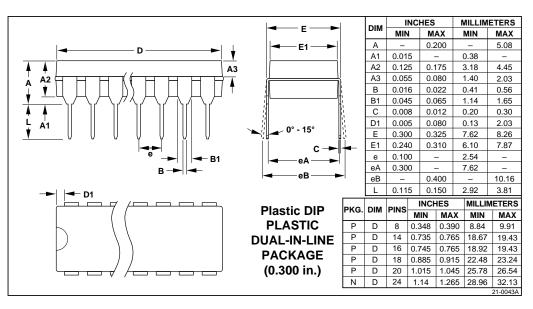


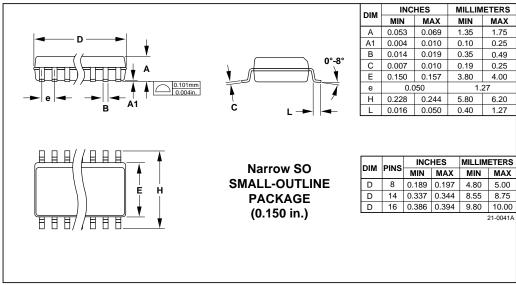
Figure 7. Switch Timing

Chip Topography A0 V+ 0.066" (1.676mm) IN1 V 0.066" (1.676mm)

TRANSISTOR COUNT: 137 SUBSTRATE CONNECTED TO V-

_Package Information





Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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