19-2758; Rev 1; 11/09

MAXIM

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

General Description

The MAX4023–MAX4026 family of voltage feedback multiplexer-amplifiers combine low-glitch switching and excellent video specifications with fixed or settable gain. The MAX4024/MAX4026 are triple and quad 2:1 multiplexers, respectively, with amplifiers that have a fixed gain of +2. The MAX4023/MAX4025 are triple and quad 2:1 multiplexers, respectively, with adjustable gain amplifiers optimized for unity-gain stability. All devices have 25ns channel switching time and low 10mV$_{P-P}$ switching transients, making them ideal for high-speed video-switching applications. These devices operate from a single +4.5V to +11V supply or from dual supplies of ±2.25V to ±5.5V, and feature an input common-mode voltage range that extends to the negative supply rail. A low-power disable mode places the output in a high-impedance state.

The MAX4023/MAX4025 have -3dB bandwidths of 260MHz and up to 330V/µs slew rates with a settable gain to equalize long cable runs. The MAX4024/MAX4026, with 200MHz -3dB bandwidths and 363V/µs slew rates, have a fixed gain of +2 for driving short back-terminated cables. The MAX4023/MAX4025 internal amplifiers maintain an open-loop output impedance of only 18Ω over the full output voltage range, and minimize the gain error and bandwidth changes under loads typical of most rail-to-rail amplifiers. These devices are ideal for broadcast video applications with differential gain and phase errors of 0.07% and 0.07°, respectively.

Applications

Set-Top Boxes

In-Car Navigation/Entertainment

Servers

Security Systems

Video Projectors

Notebook Computers

Broadcast Video

Video Crosspoint Switching

Features

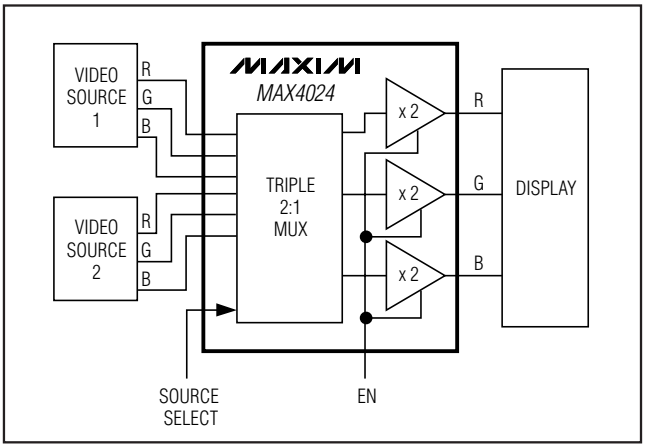
- **Single +5V or Dual ±5V Operation**
- **260MHz -3dB Bandwidth (MAX4023/MAX4025)**
- **200MHz -3dB Bandwidth (MAX4024/MAX4026)**
- **363V/µs Slew Rate (MAX4024/MAX4026)**
- **25ns Channel Switching Time**
- **Ultra-Low 20mV$_{P-P}$ Switching Transient**
- **0.012%/0.05° Differential Gain/Phase Error**
- **Input Common-Mode Range Includes Negative Rail (MAX4023/MAX4025)**
- **Low-Power Disable Mode**
- **Available in Space-Saving 14-Pin TSSOP and 16-Pin QSOP Packages**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX4023EEE	-40°C to +85°C	16 QSOP
MAX4023ESE	-40°C to +85°C	16 Narrow SO
MAX4024EUD	-40°C to +85°C	14 TSSOP
MAX4024ESD	-40°C to +85°C	14 Narrow SO
MAX4025EUP	-40°C to +85°C	20 TSSOP
MAX4025EWP	-40°C to +85°C	20 Wide SO
MAX4026EUP	-40°C to +85°C	20 TSSOP
MAX4026EWP	-40°C to +85°C	20 Wide SO

Selector Guide and Pin Configurations appear at end of data sheet.

Typical Operating Circuit



For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC} to V_{EE}) 12V
IN_A, IN_B, FB_ ..... (V_{EE} - 0.3V) to (V_{CC} + 0.3V)
REF, EN, A/B ..... (V_{EE} - 0.3V) to (V_{CC} + 0.3V)
Current Into IN_A, IN_B, FB_ ..... ±20mA
Short-Circuit Duration (OUT_ to GND or V_{EE}) ..... Continuous
Short-Circuit Duration (OUT_ to V_{CC}) ..... (Note 1)
Continuous Power Dissipation (T_A = +70°C)
14-Pin TSSOP (derate 9.1mW/°C above +70°C) 727mW
14-Pin Narrow SO (derate 8.3mW/°C above +70°C) ... 667mW
16-Pin QSOP (derate 8.3mW/°C above +70°C) 667mW
16-Pin Narrow SO (derate 8.7mW/°C above +70°C) ... 696mW
20-Pin TSSOP (derate 10.9mW/°C above +70°C) 879mW
20-Pin Wide SO (derate 10mW/°C above +70°C) 800mW
Operating Temperature Range ..... -40°C to +85°C
Junction Temperature ..... +150°C
Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (soldering, 10s) ..... +300°C

Note 1: Do not short OUT_ to V_{CC}.

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.

DC ELECTRICAL CHARACTERISTICS—Dual Supply

(V_{CC} = +5V, V_{EE} = -5V, R_L = ∞, EN = +5V, V_{CM} = REF = OUT_ = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Supply Voltage Range	V_S	Guaranteed by PSRR		±2.25		±5.5	V
Quiescent Supply Current	I_S	OUT = 0V	MAX4023/MAX4024		25	36	mA
			MAX4025/MAX4026		34	48	
Disable Supply Current		EN = 0V	MAX4023/MAX4024		3.6	6	mA
			MAX4025/MAX4026		4.4	6	
Input Voltage Range	V_{IN}	MAX4023/MAX4025, inferred from CMRR		V_{EE}		V_{CC} - 2.8	V
		MAX4024/MAX4026, inferred from A_{VCL}		V_{EE} + 2.9		V_{CC} - 2.8	
Input Offset Voltage	V_{OS}	MAX4023/MAX4025			±0.5	±15	mV
		MAX4024/MAX4026			±1	±18	
Input Offset Voltage Matching	ΔV_{OS}	MAX4023/MAX4025			±1		mV
		MAX4024/MAX4026			±1.5		
Input Offset Voltage Drift	TC_{VOS}	MAX4023/MAX4025			15		µV°C
		MAX4024/MAX4026			23		
Input Bias Current	I_B				4	14	µA
Input Offset Current	I_{OS}	MAX4023/MAX4025			±0.1	±2	µA
Differential Input Resistance	R_{IND}	MAX4023/MAX4025, -10mV < V_{IND} < +10mV			50		kΩ
Input Resistance	R_{IN}	MAX4023/MAX4025, common mode			4.5		MΩ
		MAX4024/MAX4026, single ended			4.5		
Output Resistance	R_{OUT}	MAX4023/MAX4025	Open loop		18		Ω
			Closed loop, A_{VCL} = +1		0.025		
		MAX4024/MAX4026			0.15		

DC ELECTRICAL CHARACTERISTICS—Dual Supply (continued)

(V_{CC} = +5V, V_{EE} = -5V, R_L = ∞, EN = +5V, V_{CM} = REF = OUT_ = 0V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Disable Output Resistance	R_{OUT}	MAX4023/MAX4025, EN = 0V			75		kΩ
		MAX4024/MAX4026, EN = 0V			1		
Power-Supply Rejection Ratio	PSRR	±2.25V < V_S < ±5.5V		50	64		dB
Common-Mode Rejection Ratio	CMRR	MAX4023/MAX4025, V_{EE} < V_{CM} < V_{CC} - 2.8V		50	68		dB
Open-Loop Gain	A_{VOL}	MAX4023/MAX4025, R_L = 150Ω, -4.3V < V_{OUT} < +4.3V		70	85		dB
Voltage Gain	A_{VCL}	MAX4024/MAX4026, R_L = 150Ω, V_{EE} + 2.9V < V_{IN} < V_{CC} - 2.8V		5.5	6.0	6.5	dB
Gain Matching	ΔA_{VCL}	MAX4024/MAX4026			1		%
Output Voltage Swing	V_{OUT}	MAX4023/MAX4025	R_L = 150Ω	V_{CC} - 0.7	V_{CC} - 0.5		V
					V_{EE} + 0.5	V_{EE} + 0.7	
			R_L = 75Ω	V_{CC} - 1.2	V_{CC} - 0.8		
					V_{EE} + 0.8	V_{EE} + 1.2	
		MAX4024/MAX4026	R_L = 150Ω	V_{CC} - 0.7	V_{CC} - 0.5		
					V_{EE} + 0.3	V_{EE} + 0.7	
			R_L = 75Ω	V_{CC} - 1.2	V_{CC} - 0.8		
					V_{EE} + 0.5	V_{EE} + 1.2	
LOGIC INPUT CHARACTERISTICS							
Logic-Low Threshold	V_{IL}	EN, A/B				V_{CC} - 3.85	V
Logic-High Threshold	V_{IH}	EN, A/B		V_{CC} - 3.3			V
Logic-Low Input Current	I_{IL}	EN, A/B; EN or A/B = 0V			5	10	µA
Logic-High Input Current	I_{IH}	EN, A/B; EN or A/B = V_{CC}			2	8	µA

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

DC ELECTRICAL CHARACTERISTICS—Single Supply

(V_{CC} = +5V, V_{EE} = 0V, R_L = ∞, EN = +5V, V_{CM} = REF = OUT = 0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage Range	V_S	Guaranteed by PSRR	4.5		11	V
Quiescent Supply Current	I_S	MAX4023/MAX4024, OUT = 0V		19	32	mA
		MAX4025/MAX4026, OUT = 0V		31	43	
Disable Supply Current		MAX4023/MAX4024, EN = 0V		3.3	6	mA
		MAX4025/MAX4026, EN = 0V		3.9	6	
Input Voltage Range	V_{IN}	MAX4023/MAX4025, inferred from CMRR	V_{EE}		V_{CC} - 2.8	V
		MAX4024/MAX4026, inferred from A_{VCL}	V_{EE} + 0.28		V_{CC} - 2.8	
Input Offset Voltage	V_{OS}	MAX4023/MAX4025		±1	±18	mV
		MAX4024/MAX4026		±3	±20	
Input Offset Voltage Matching	ΔV_{OS}	MAX4023/MAX4025		±1		mV
		MAX4024/MAX4026		±1.5		
Input Offset Voltage Drift	TC_{VOS}	MAX4023/MAX4025		9		µV°C
		MAX4024/MAX4026		13		
Input Bias Current	I_B			4.5	14	µA
Input Offset Current	I_{OS}	MAX4023/MAX4025		±0.1	±2	µA
Differential Input Resistance	R_{IND}	MAX4023/MAX4025, -10mV < V_{IND} < +10mV		50		kΩ
Input Resistance	R_{IN}	MAX4023/MAX4025, common mode		4.5		MΩ
		MAX4024/MAX4026, single ended		4.5		
Output Resistance	R_{OUT}	MAX4023/MAX4025, Open loop		18		Ω
		MAX4023/MAX4025, Closed loop, A_{VCL} = +1		0.025		
		MAX4024/MAX4026		0.15		
Disable Output Resistance	R_{OUT}	MAX4023/MAX4025, EN = 0V		75		kΩ
		MAX4024/MAX4026, EN = 0V		1		
Power-Supply Rejection Ratio	PSRR	±4.5V < V_S < ±11V	50	64		dB
Common-Mode Rejection Ratio	CMRR	MAX4023/MAX4025, V_{EE} < V_{CM} < V_{CC} - 2.8V	50	91		dB
Open-Loop Gain	A_{VOL}	MAX4023/MAX4025, R_L = 150Ω, 0.3V < V_{OUT} < 4.3V	70	85		dB
Voltage Gain	A_{VCL}	MAX4024/MAX4026, R_L = 150Ω, V_{EE} + 0.28V < V_{IN} < V_{CC} - 2.8V	5.5	6.0	6.5	dB
Gain Matching	ΔA_{VCL}	MAX4024/MAX4026		1		%

DC ELECTRICAL CHARACTERISTICS—Single Supply (continued)

(V_{CC} = +5V, V_{EE} = 0V, R_L = ∞, EN = +5V, V_{CM} = REF = OUT = 0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Voltage Swing	V_{OUT}	MAX4023/MAX4025	R_L = 150Ω to GND	V_{CC} - 1.1	V_{CC} - 0.5		V
					V_{EE} + 0.03	V_{EE} + 0.175	
			R_L = 75Ω to GND	V_{CC} - 1.1	V_{CC} - 0.8		
					V_{EE} + 0.03	V_{EE} + 0.175	
		MAX4024/MAX4026	R_L = 150Ω to GND	V_{CC} - 1.1	V_{CC} - 0.5		
					V_{EE} + 0.03	V_{EE} + 0.09	
			R_L = 75Ω to GND	V_{CC} - 1.1	V_{CC} - 0.8		
					V_{EE} + 0.04	V_{EE} + 0.08	
LOGIC INPUT CHARACTERISTICS							
Logic-Low Threshold	V_{IL}	EN, A/B				V_{CC} - 3.85	V
Logic-High Threshold	V_{IH}	EN, A/B		V_{CC} - 3.3			V
Logic-Low Input Current	I_{IL}	EN, A/B; EN or A/B = 0V			5	10	µA
Logic-High Input	I_{IH}	EN, A/B; EN or A/B = V_{CC}			2	8	µA

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

AC ELECTRICAL CHARACTERISTICS—Dual Supply

(V_{CC} = +5V, V_{EE} = -5V, R_{IN} = 75Ω to GND, R_L = 150Ω to GND, EN = +5V, V_{CM} = 0V, REF = 0V, A_{VCL} = +1 (MAX4023/MAX4025). Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	BW_{SS}	V_{OUT} = 100mV_{P-P}	MAX4023/MAX4025		260		MHz
			MAX4024/MAX4026		200		
Large-Signal -3dB Bandwidth	BW_{LS}	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		85		MHz
			MAX4024/MAX4026		110		
Small-Signal 0.1dB Gain-Flatness Bandwidth	$BW_{0.1dBSS}$	V_{OUT} = 100mV_{P-P}	MAX4023/MAX4025		30		MHz
			MAX4024/MAX4026		32		
Large-Signal 0.1dB Gain-Flatness Bandwidth	$BW_{0.1dBLS}$	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		22		MHz
			MAX4024/MAX4026		24		
Slew Rate	SR	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		300		V/µs
			MAX4024/MAX4026		363		
Settling Time to 0.1%	t_S	V_{OUT} = 2V step	MAX4023/MAX4025		32		ns
			MAX4024/MAX4026		32		
Power-Supply Rejection Ratio	PSRR	f = 100kHz			60		dB
Output Impedance		f = 10MHz			1.5		Ω
Differential Gain Error	DG	NTSC, PAL, A_{VCL} = +2	MAX4023/MAX4025		0.012		%
			MAX4024/MAX4026		0.015		
Differential Phase Error	DP	NTSC, PAL, A_{VCL} = +2	MAX4023/MAX4025		0.05		Degrees
			MAX4024/MAX4026		0.077		
Group Delay	D/dT	f = 3.58MHz or 4.43MHz, A_{VCL} = +2	MAX4023/MAX4025		1.6		ns
			MAX4024/MAX4026		1.8		
Peak Signal to RMS Noise	SNR	V_{OUT} = 2V_{P-P}, 10MHz BW, A_{VCL} = +2	MAX4023/MAX4025		90		dB
			MAX4024/MAX4026		86		
Crosstalk		f = 10MHz			-61		dB
SWITCHING CHARACTERISTICS							
Channel Switching Time	t_{SW}	MAX4023/MAX4025			25		ns
		MAX4024/MAX4026			25		
Enable Time	t_{ON}	V_{IN} = 0.5V			60		ns
Disable Time	t_{OFF}	V_{IN} = 0.5V			0.45		µs
Switching Transient		MAX4023/MAX4025			20		mV_{P-P}
		MAX4024/MAX4026			20		

AC ELECTRICAL CHARACTERISTICS—Single Supply

(V_{CC} = +5V, V_{EE} = 0V, R_{IN} = 75Ω to V_{CM}, R_L = 150Ω to GND, EN = +5V, V_{CM} = 0.5V, REF = V_{CM}, A_{VCL} = +1 (MAX4023/MAX4025). Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	BW_{SS}	V_{OUT} = 100mV_{P-P}	MAX4023/MAX4025		260		MHz
			MAX4024/MAX4026		200		
Large-Signal -3dB Bandwidth	BW_{LS}	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		83		MHz
			MAX4024/MAX4026		110		
Small-Signal 0.1dB Gain-Flatness Bandwidth	$BW_{0.1dBSS}$	V_{OUT} = 100mV_{P-P}	MAX4023/MAX4025		40		MHz
			MAX4024/MAX4026		44		
Large-Signal 0.1dB Gain-Flatness Bandwidth	$BW_{0.1dBLS}$	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		22		MHz
			MAX4024/MAX4026		25		
Slew Rate	SR	V_{OUT} = 2V_{P-P}	MAX4023/MAX4025		300		V/µs
			MAX4024/MAX4026		363		
Settling Time to 0.1%	t_S	V_{OUT} = 2V step	MAX4023/MAX4025		32		ns
			MAX4024/MAX4026		32		
Power-Supply Rejection Ratio	PSRR	f = 100kHz			60		dB
Output Impedance		f = 10MHz			1.5		Ω
Differential Gain Error	DG	NTSC, PAL, A_{VCL} = +2	MAX4023/MAX4025		0.016		%
			MAX4024/MAX4026		0.02		
Differential Phase Error	DP	NTSC, PAL, A_{VCL} = +2	MAX4023/MAX4025		0.054		Degrees
			MAX4024/MAX4026		0.085		
Group Delay	D/dT	f = 3.58MHz or 4.43MHz, A_{VCL} = +2	MAX4023/MAX4025		1.6		ns
			MAX4024/MAX4026		1.9		
Peak Signal to RMS Noise	SNR	V_{OUT} = 2V_{P-P}, 10MHz BW, A_{VCL} = +2	MAX4023/MAX4025		90		dB
			MAX4024/MAX4026		86		
Crosstalk		f = 10MHz			-61		dB
SWITCHING CHARACTERISTICS							
Channel Switching Time	t_{SW}	MAX4023/MAX4025			25		ns
		MAX4024/MAX4026			25		
Enable Time	t_{ON}	V_{IN} = 0.5V			90		ns
Disable Time	t_{OFF}	V_{IN} = 0.5V			0.45		µs
Switching Transient		MAX4023/MAX4025			10		mV_{P-P}
		MAX4024/MAX4026			10		

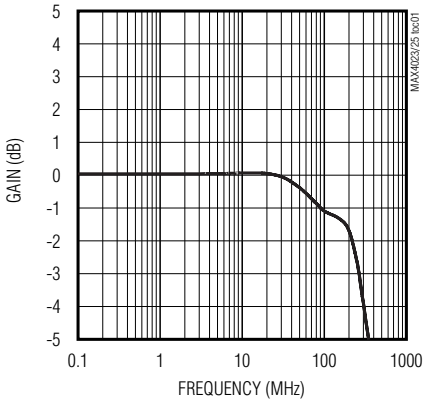
Note 2: All devices are 100% production tested at T_A = +25°C. Specifications over temperature are guaranteed by design.

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

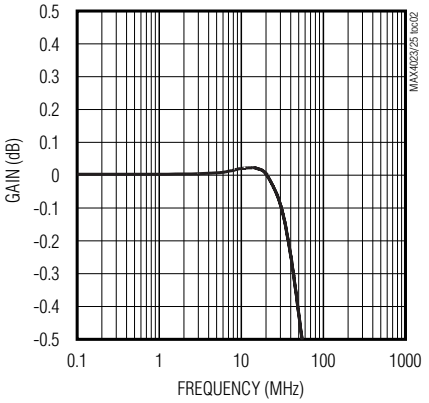
Typical Operating Characteristics—±5V Dual Supply

(V_{CC} = +5V, V_{EE} = -5V, V_{CM} = REF = 0V, EN = +5V, R_{IN} = 75Ω to GND, R_L = 150Ω to GND, A_{VCL} = +1V/V (MAX4023/MAX4025), A_{VCL} = +2V/V (MAX4024/MAX4026), T_A = +25°C, unless otherwise noted.)

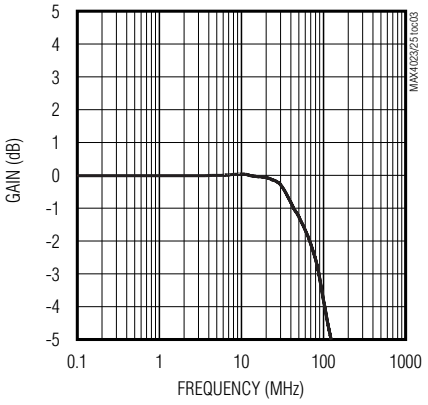
MAX4023/MAX4025
SMALL-SIGNAL BANDWIDTH vs. FREQUENCY



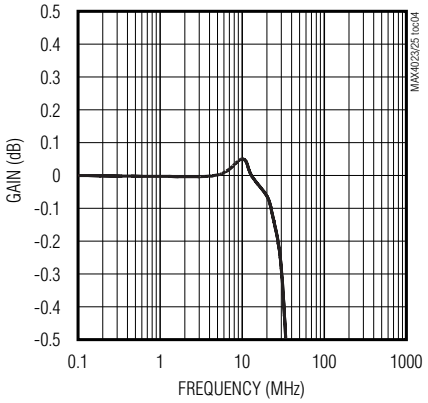
MAX4023/MAX4025
SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



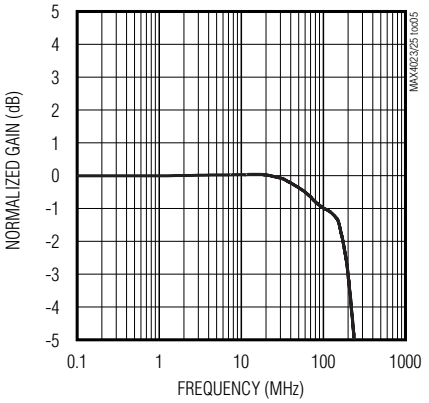
MAX4023/MAX4025
LARGE-SIGNAL BANDWIDTH vs. FREQUENCY



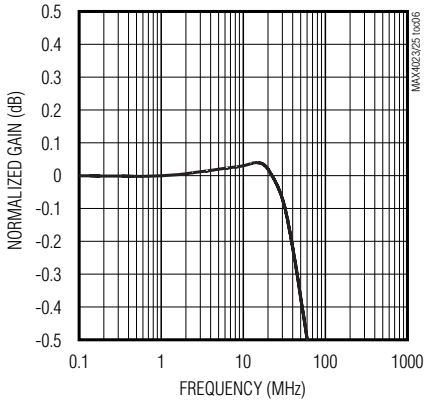
MAX4023/MAX4025
LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY



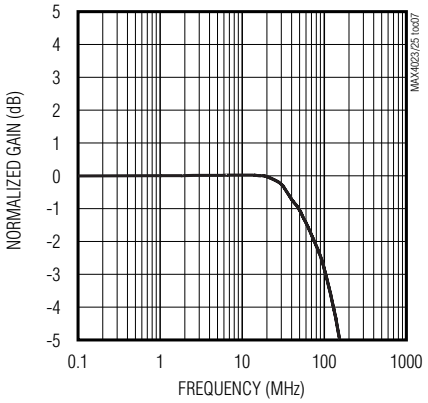
MAX4024/MAX4026
SMALL-SIGNAL BANDWIDTH vs. FREQUENCY



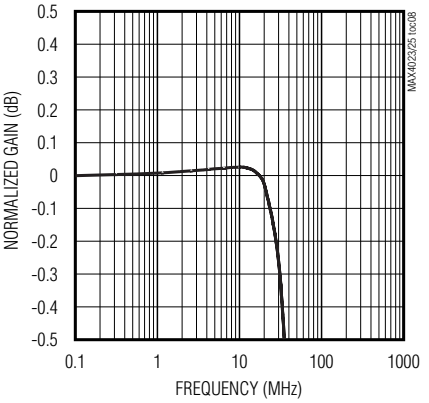
MAX4024/MAX4026
SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



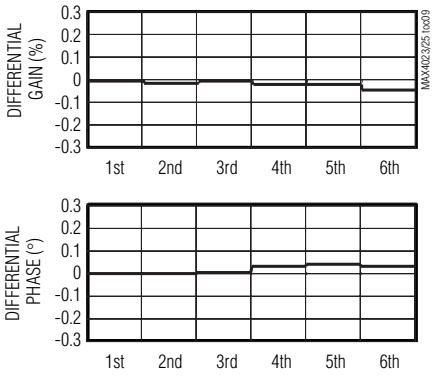
MAX4024/MAX4026
LARGE-SIGNAL BANDWIDTH vs. FREQUENCY



MAX4024/MAX4026
LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY



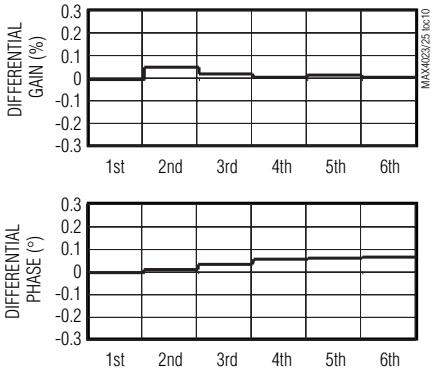
MAX4023/MAX4025
DIFFERENTIAL GAIN AND PHASE



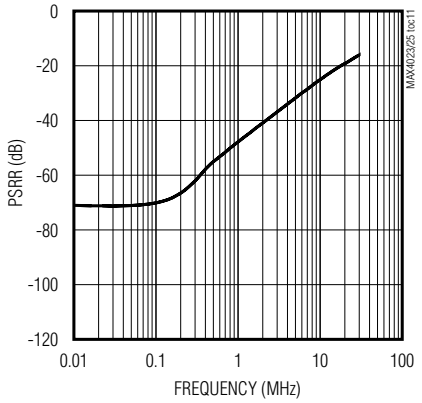
Typical Operating Characteristics—±5V Dual Supply (continued)

(V_{CC} = +5V, V_{EE} = -5V, V_{CM} = REF = 0V, EN = +5V, R_{IN} = 75Ω to GND, R_L = 150Ω to GND, A_{VCL} = +1V/V (MAX4023/MAX4025), A_{VCL} = +2V/V (MAX4024/MAX4026), T_A = +25°C, unless otherwise noted.)

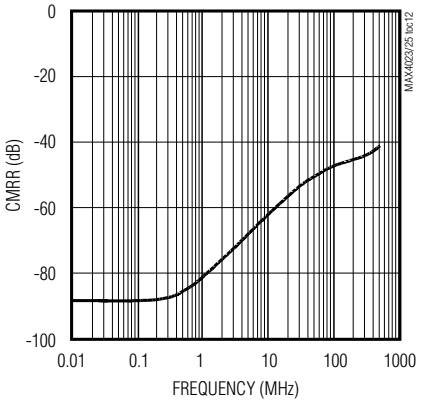
MAX4024/MAX4026 DIFFERENTIAL GAIN AND PHASE



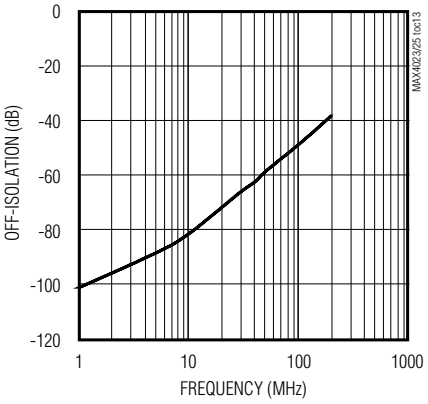
POWER-SUPPLY REJECTION RATIO vs. FREQUENCY



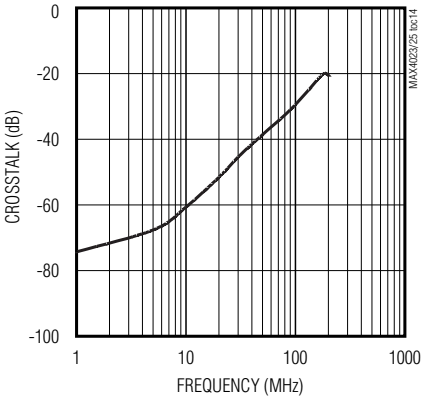
MAX4023/MAX4025 COMMON-MODE REJECTION RATIO vs. FREQUENCY



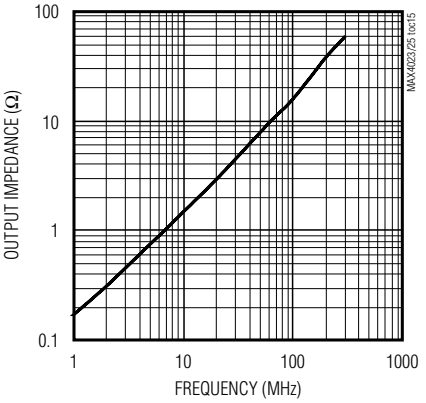
OFF-ISOLATION vs. FREQUENCY



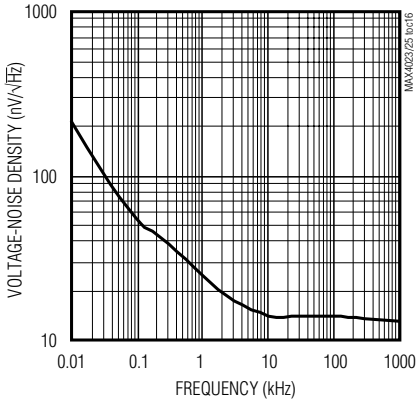
ALL-HOSTILE CROSSTALK vs. FREQUENCY



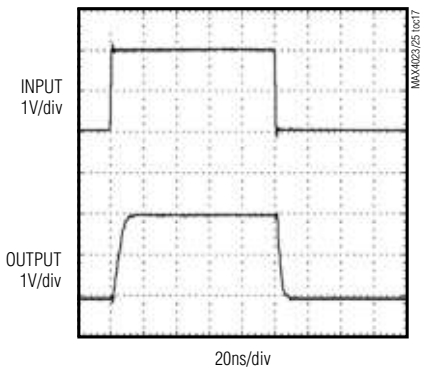
OUTPUT IMPEDANCE vs. FREQUENCY



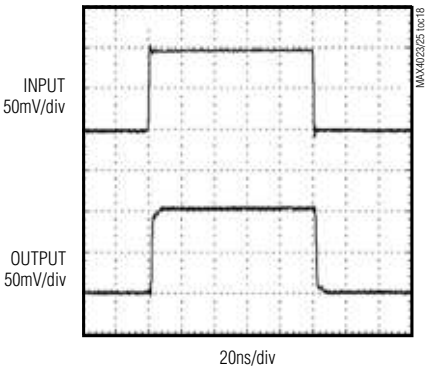
INPUT VOLTAGE-NOISE DENSITY vs. FREQUENCY



MAX4023/MAX4025 LARGE-SIGNAL TRANSIENT RESPONSE



MAX4023/MAX4025 SMALL-SIGNAL TRANSIENT RESPONSE

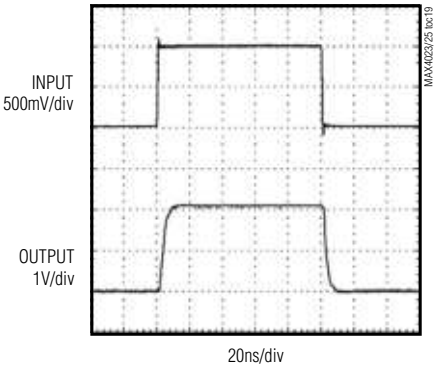


Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

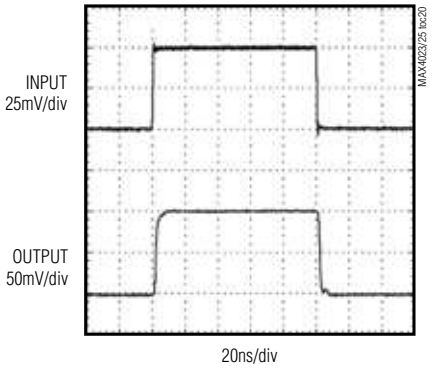
Typical Operating Characteristics—±5V Dual Supply (continued)

(V_{CC} = +5V, V_{EE} = -5V, V_{CM} = REF = 0V, EN = +5V, R_{IN} = 75Ω to GND, R_L = 150Ω to GND, A_{VCL} = +1V/V (MAX4023/MAX4025), A_{VCL} = +2V/V (MAX4024/MAX4026), T_A = +25°C, unless otherwise noted.)

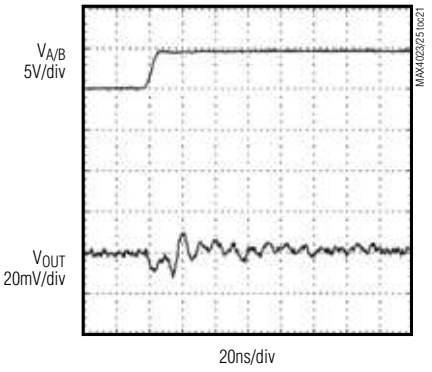
MAX4024/MAX4026 LARGE-SIGNAL TRANSIENT RESPONSE



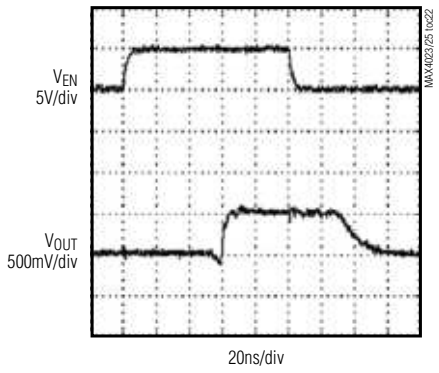
MAX4024/MAX4026 SMALL-SIGNAL TRANSIENT RESPONSE



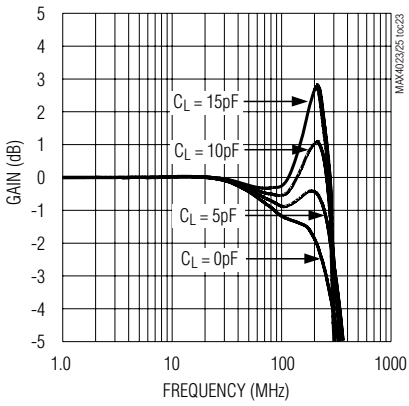
CHANNEL SWITCHING TRANSIENT



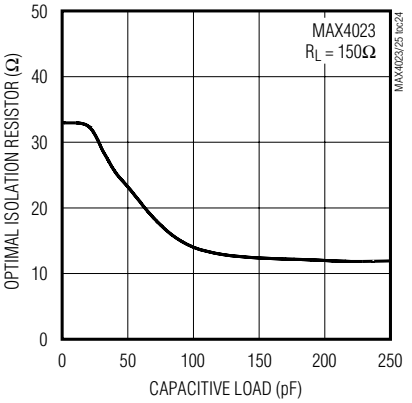
ENABLE RESPONSE TIME



MAX4023/MAX4025 SMALL-SIGNAL BANDWIDTH vs. FREQUENCY vs. C_L



OPTIMAL ISOLATION RESISTOR vs. CAPACITIVE LOAD

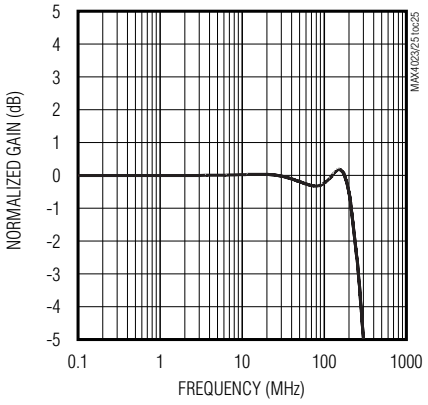


Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

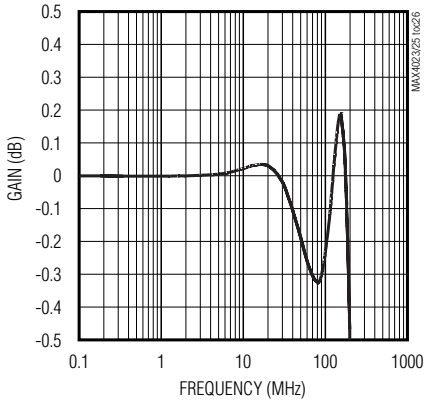
Typical Operating Characteristics—+5V Single Supply

(V_{CC} = +5V, V_{EE} = 0V, V_{CM} = 0.5V, V_{REF} = V_{CM}, EN = +5V, R_{IN} = 75Ω to V_{CM}, R_L = 150Ω to GND, A_{VCL} = +1V/V (MAX4023/MAX4025), A_{VCL} = +2V/V (MAX4024/MAX4026), T_A = +25°C, unless otherwise noted.)

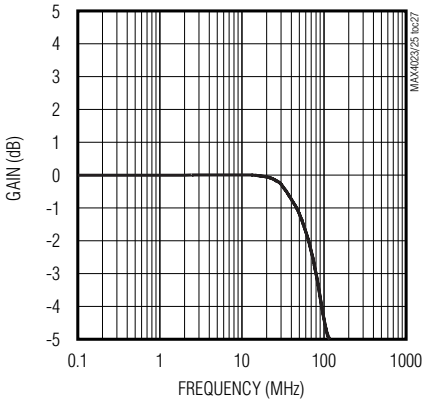
MAX4023/MAX4025
SMALL-SIGNAL BANDWIDTH vs. FREQUENCY



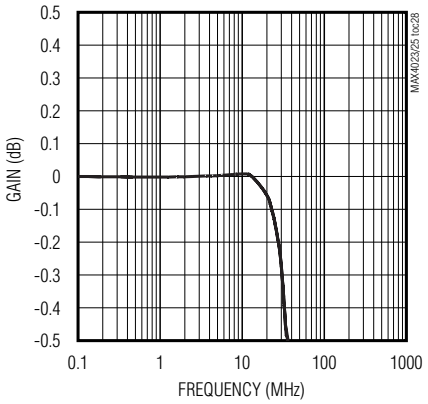
MAX4023/MAX4025
SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



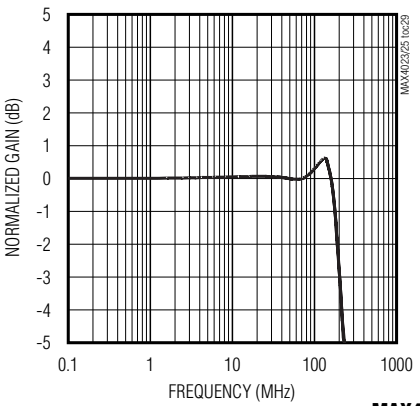
MAX4023/MAX4025
LARGE-SIGNAL BANDWIDTH vs. FREQUENCY



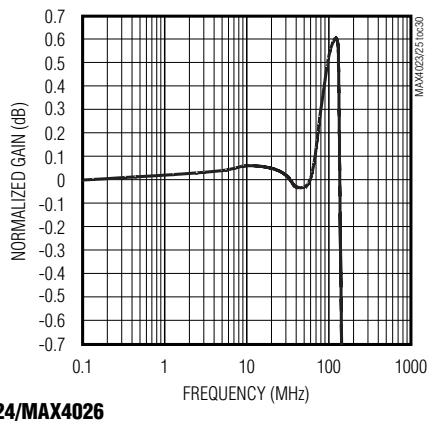
MAX4023/MAX4025
LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY



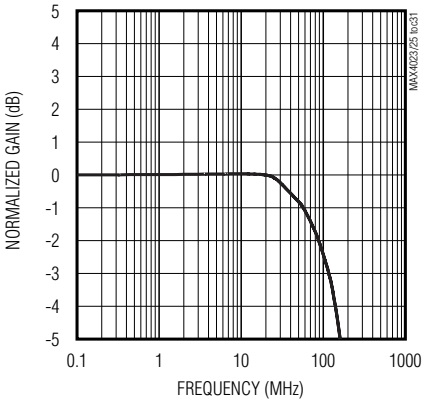
MAX4024/MAX4026
SMALL-SIGNAL BANDWIDTH vs. FREQUENCY



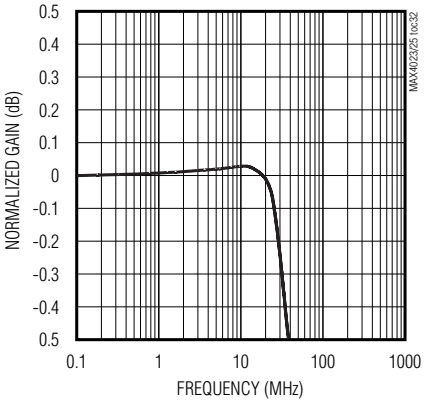
MAX4024/MAX4026
SMALL-SIGNAL GAIN FLATNESS vs. FREQUENCY



MAX4024/MAX4026
LARGE-SIGNAL BANDWIDTH vs. FREQUENCY



MAX4024/MAX4026
LARGE-SIGNAL GAIN FLATNESS vs. FREQUENCY

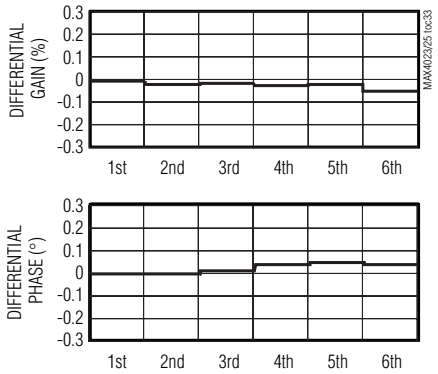


Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

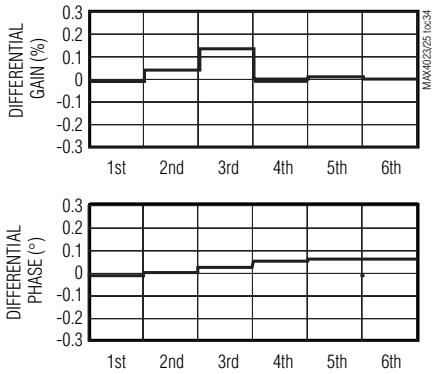
Typical Operating Characteristics—+5V Single Supply (continued)

(V_{CC} = +5V, V_{EE} = 0V, V_{CM} = 0.5V, V_{REF} = V_{CM}, EN = +5V, R_{IN} = 75Ω to V_{CM}, R_L = 150Ω to GND, A_{VCL} = +1V/V (MAX4023/MAX4025), A_{VCL} = +2V/V (MAX4024/MAX4026), T_A = +25°C, unless otherwise noted.)

MAX4023/MAX4025
DIFFERENTIAL GAIN AND PHASE



MAX4024/MAX4026
DIFFERENTIAL GAIN AND PHASE



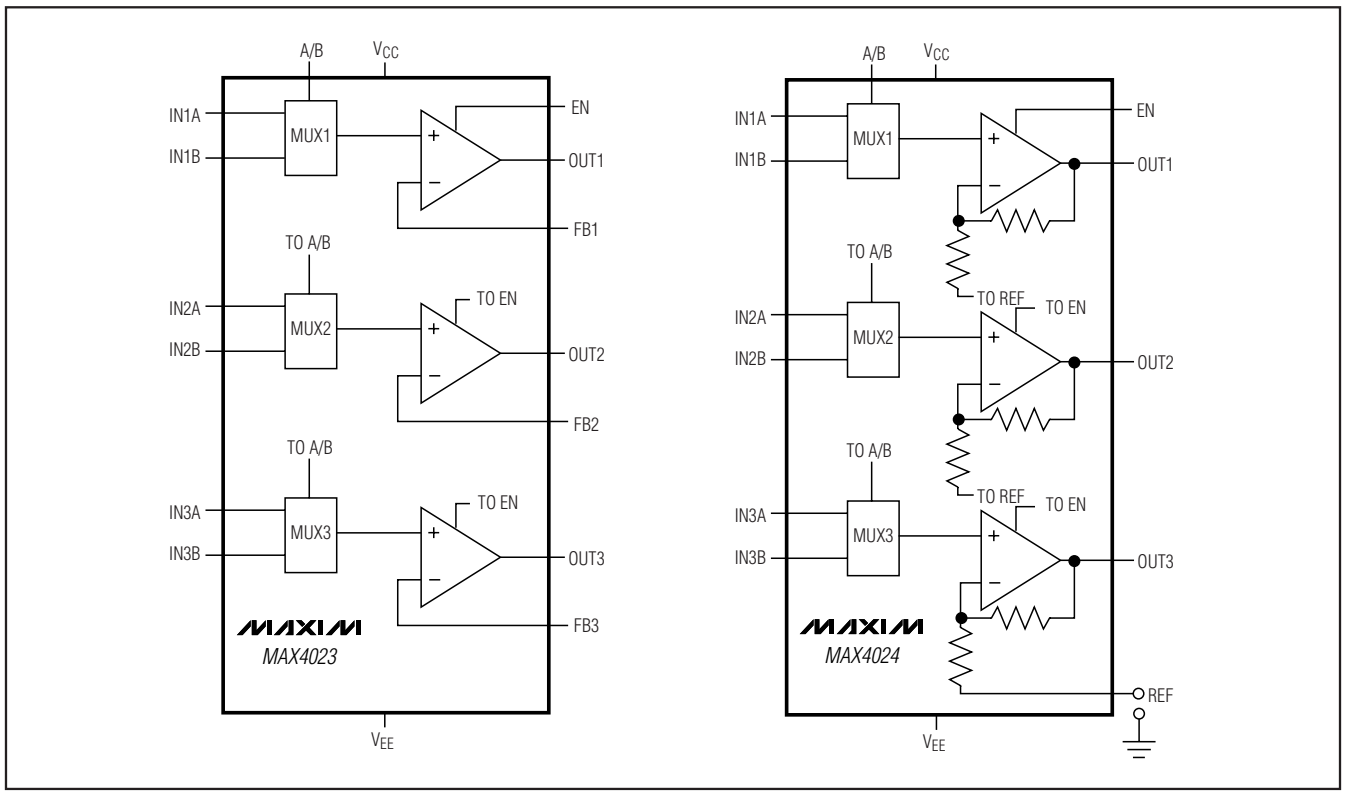
Pin Description

PIN				NAME	FUNCTION
MAX4023 SO/QSOP	MAX4024 SO/TSSOP	MAX4025 SO/TSSOP	MAX4026 SO/TSSOP		
1	1	1	1	IN1A	Amplifier Input 1A
2	2	2	2	IN2A	Amplifier Input 2A
3	3	3	3	IN3A	Amplifier Input 3A
4	4	5	5, 6	V_{EE}	Negative Power-Supply Voltage. Bypass V_{EE} to GND with a 0.1µF capacitor. Connect V_{EE} to GND for single-supply operation.
5	13	6	17	A/B	Channel Select Input. Pull A/B high to select channel A. Drive A/B low to select channel B.
6	5	7	7	IN1B	Amplifier Input 1B
7	6	8	8	IN2B	Amplifier Input 2B
8	7	9	9	IN3B	Amplifier Input 3B
9	—	14	—	FB3	Amplifier Feedback Input for Amplifier 3
10	9	13	13	OUT3	Amplifier Output 3
11	10	18	18	OUT2	Amplifier Output 2
12	—	17	—	FB2	Amplifier Feedback Input for Amplifier 2
13	11	15	14	EN	Enable Input. Pull EN high for normal operation. Drive EN low to disable all outputs.

Pin Description (continued)

PIN				NAME	FUNCTION
MAX4023 SO/QSOP	MAX4024 SO/TSSOP	MAX4025 SO/TSSOP	MAX4026 SO/TSSOP		
14	12	16	15, 16	V_{CC}	Positive Power-Supply Voltage. Bypass V_{CC} to GND with a 0.1µF capacitor.
15	14	19	19	OUT1	Amplifier Output 1
16	—	20	—	FB1	Amplifier Feedback Input for Amplifier 1
—	8	—	11, 20	REF	Reference Pin for Internal Gain Resistor Network
—	—	4	4	IN4A	Amplifier Input 4A
—	—	10	10	IN4B	Amplifier Input 4B
—	—	11	—	FB4	Amplifier Feedback Input for Amplifier 4
—	—	12	12	OUT4	Amplifier Output 4

Functional Diagrams



Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

Detailed Description

The MAX4024/MAX4026 combine three and four 2:1 multiplexers, respectively, with a fixed gain of 2 amplifier. The MAX4023/MAX4025 combine three and four 2:1 multiplexers, respectively, with an adjustable gain output amplifier optimized for a closed-loop gain of +1 or greater. These devices operate from a single-supply voltage of +4.5V to +11V or from dual supplies of ±2.25V to ±5.5V. The outputs may be placed in a high-impedance state and the supply current minimized by forcing the EN pin low. The input multiplexers feature short 25ns channel-switching times and small 10mV$_{P-P}$ switching transients. These devices feature voltage-feedback output amplifiers that achieve up to 363V/µs slew rates and up to 220MHz -3dB bandwidths. They also feature excellent differential gain/phase performance.

The MAX4023–MAX4026 feature an A/B pin, which is an input pin for selecting either channel A or B. Drive A/B high to select channel A or drive A/B low to select channel B. Channel A is automatically selected if A/B is left unconnected.

Applications Information

Feedback and Gain Resistor Selection (MAX4023/MAX4025)

Select the MAX4023/MAX4025 gain-setting feedback R_F and R_G resistors to fit your application. Large resistor values increase voltage noise and interact with the amplifier's input and PC board capacitance. This can generate undesirable poles and zeros, and can decrease bandwidth or cause oscillations.

Stray capacitance at the FB pin produces peaking in the frequency-response curve. Keep the capacitance at FB as low as possible by using surface-mount resistors and by avoiding the use of a ground plane beneath or beside these resistors and the FB pin. Some capacitance is unavoidable. If necessary, its effects can be neutralized by adjusting R_F. Use 1% resistors to maintain gain accuracy.

Low-Power Shutdown Mode

All parts feature a low-power shutdown mode that is activated by driving the EN input low. Placing the amplifier in shutdown mode reduces the quiescent supply current to below 4mA and places the output into a high-impedance state, typically 75kΩ (MAX4023/MAX4025). Multiple devices may be paralleled to construct larger switch matrices by connecting the outputs of several devices together and disabling all but one of the paralleled amplifiers' outputs.

For MAX4023/MAX4025 application circuits operating with a closed-loop gain of +1 or greater, consider the external-feedback network impedance of all devices used in the mux application when calculating the total load on the output amplifier of the active device. The MAX4024/MAX4026 have a fixed gain of +2 that is internally set with two 500Ω thin-film resistors. The impedance of the internal feedback resistors must be taken into account when operating multiple MAX4024/MAX4026s in large multiplexer applications.

For normal operation, drive EN high. Note that the MAX4023–MAX4026 have internal pullup circuitry on EN, so if left unconnected, it is automatically pulled up to V_{CC}.

Layout and Power-Supply Bypassing

The MAX4023–MAX4026 have high bandwidths and consequently require careful board layout, including the possible use of constant-impedance microstrip or stripline techniques.

To realize the full AC performance of these high-speed amplifiers, pay careful attention to power-supply bypassing and board layout. The PC board should have at least two layers: a signal and power layer on one side, and a large, low-impedance ground plane on the other side. The ground plane should be as free of voids as possible, with one exception: The feedback (FB) should have as low a capacitance to ground as possible. Whether or not a constant-impedance board is used, it is best to observe the following guidelines when designing the board:

1) Do not use wire-wrapped boards or breadboards.
2) Do not use IC sockets; they increase parasitic capacitance and inductance.
3) Keep signal lines as short and straight as possible. Do not make 90° turns; round all corners.
4) Observe high-frequency bypassing techniques to maintain the amplifier's accuracy and stability.
5) Use surface-mount components. They generally have shorter bodies and lower parasitic reactance, yielding better high-frequency performance than through-hole components.

The bypass capacitors should include a 0.1µF ceramic surface-mount capacitor between each supply pin and the ground plane, located as close to the package as possible. Optionally, place a 10µF tantalum capacitor at the power-supply's point of entry to the PC board to ensure the integrity of incoming supplies. The power-supply traces should lead directly from the tantalum capacitor to the V_{CC} and V_{EE} pins. To minimize para-

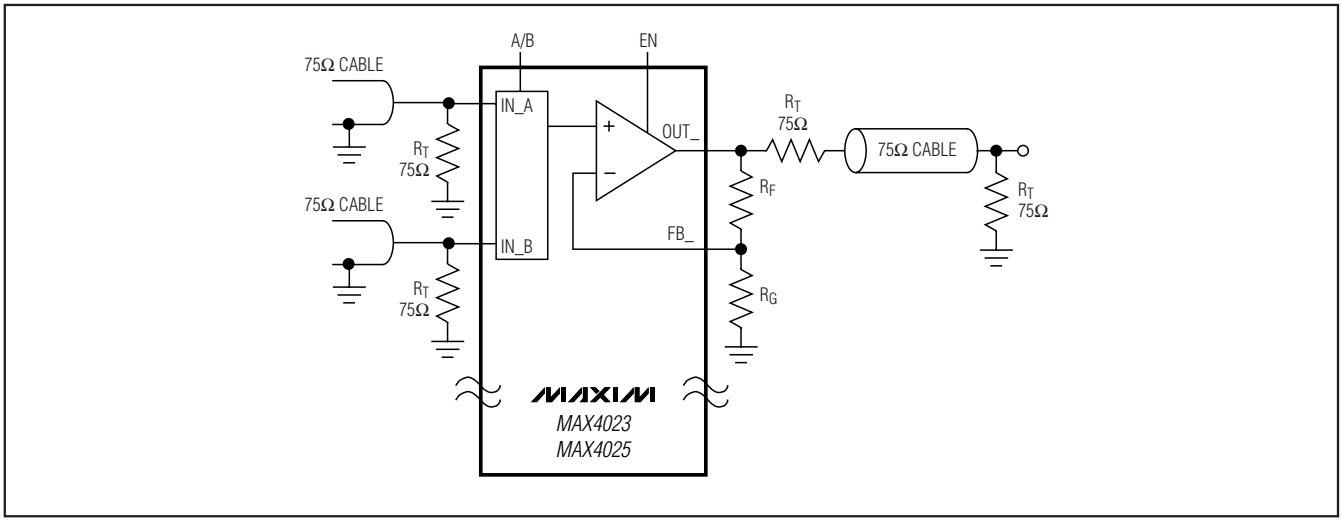


Figure 1. MAX4023/MAX4025 Noninverting Gain Configuration

sitic inductance, keep PC traces short and use surface-mount components.

If input termination resistors and output back-termination resistors are used, they should be surface-mount types, and should be placed as close to the IC pins as possible.

Video Line Driver

The MAX4024/MAX4026 are well suited to drive short coaxial transmission lines when the cable is terminated at both ends (as shown in Figure 2a) where the fixed gain of +2 compensates for the loss in the resistors. The MAX4023/MAX4025 have settable gain to equalize long cables. The MAX4023/MAX4025 allow adding functions that normally require additional op amps. For example, a cable driver can "boost" the high frequencies for long runs, making the part perform multiple functions. Figure 2b shows the "cable booster" using the MAX4023/MAX4025.

Driving Capacitive Loads

A correctly terminated transmission line is purely resistive and presents no capacitive load to the amplifier. Reactive loads decrease phase margin and may produce excessive ringing and oscillation (see *Typical Operating Characteristics*).

Another concern when driving capacitive loads is the amplifier's output impedance, which appears inductive at high frequencies. This inductance forms an L-C resonant circuit with the capacitive load, which causes peaking in the frequency response and degrades the amplifier's phase margin.

Although the MAX4023–MAX4026 are optimized for AC performance and are not designed to drive highly capacitive loads, they are capable of driving up to 33pF without oscillations. However, some peaking may occur in the frequency domain (Figure 3). To drive larger capacitive loads or to reduce ringing, add an isolation resistor between the amplifier's output and the load (Figure 4). The value of R_{ISO} depends on the circuit's gain and the capacitive load (Figure 5). Also note that the isolation resistor forms a divider that decreases the voltage delivered to the load.

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

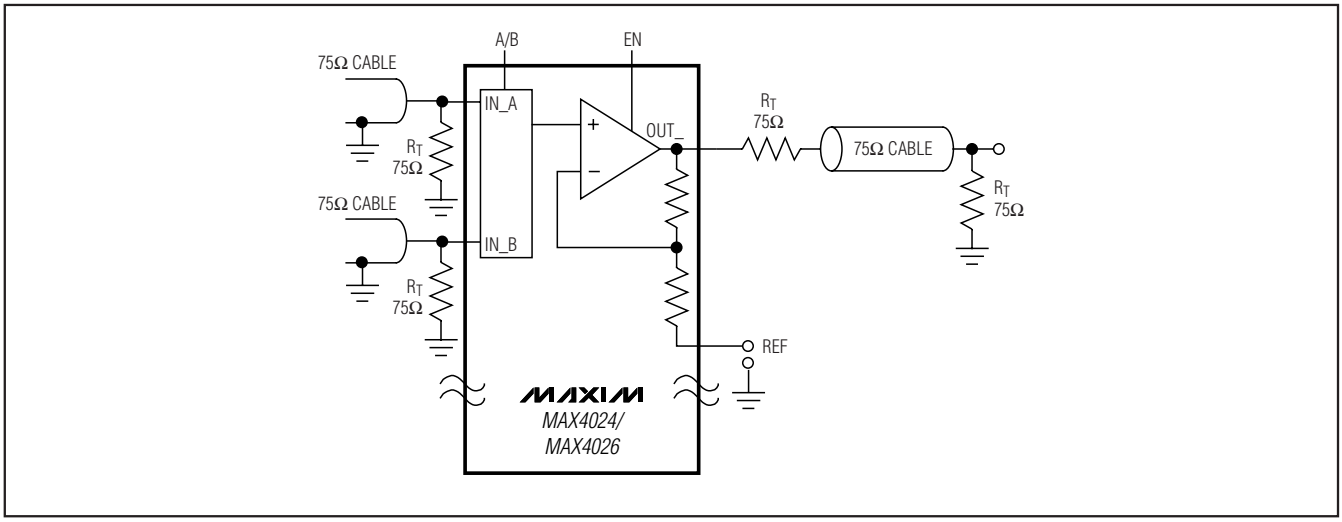


Figure 2a. Video Line Driver

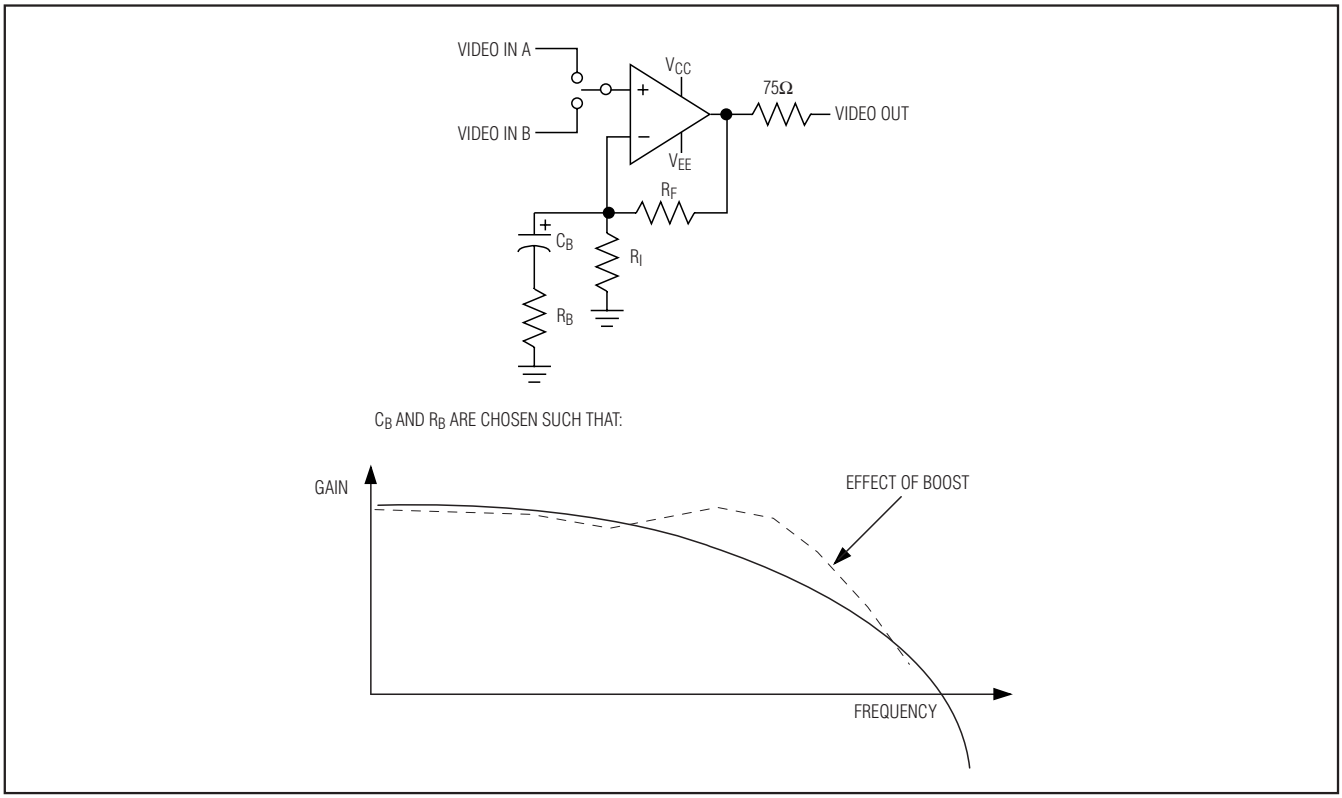


Figure 2b. Cable Booster Using the MAX4023/MAX4025

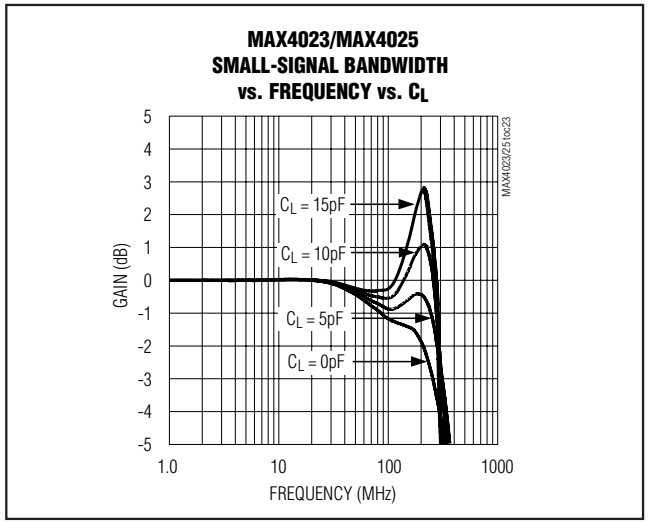


Figure 3. Small-Signal Bandwidth vs. Frequency with Capacitive Load and No Isolation Resistor

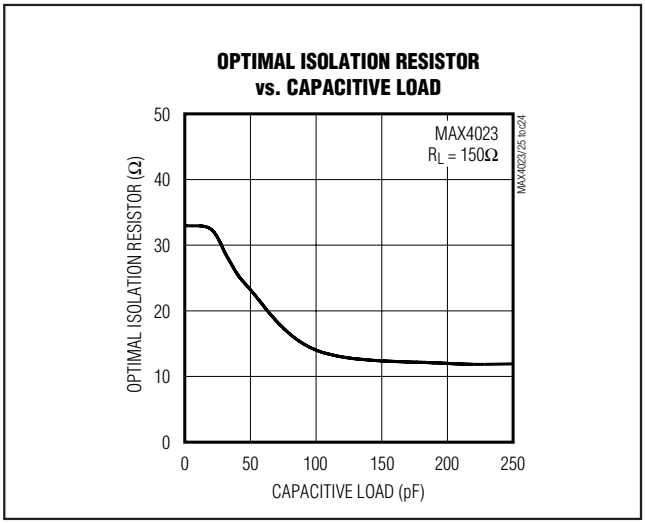


Figure 5. Optimal Isolation Resistance vs. Capacitive Load

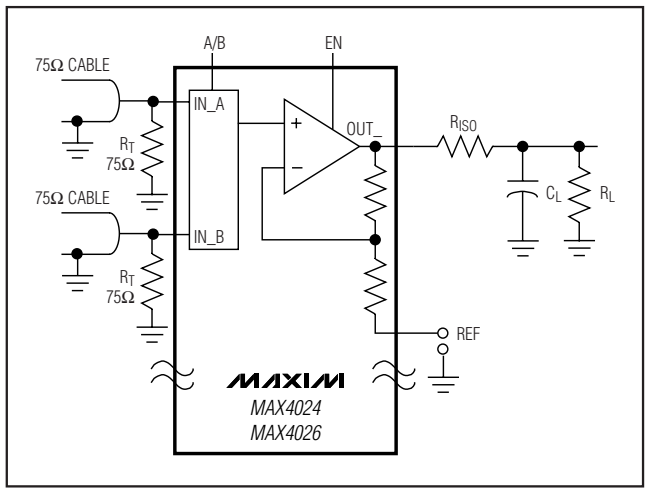


Figure 4. Using an Isolation Resistor (R_{ISO}) for a High-Capacitive Load

Selector Guide

PART	PIN-PACKAGE	NO. OF VIDEO MUX-AMPS	AMPLIFIER GAIN (V/V)
MAX4023	16 SO/QSOP	3	≥+1
MAX4024	14 SO/TSSOP	3	+2
MAX4025	20 SO/TSSOP	4	≥+1
MAX4026	20 SO/TSSOP	4	+2

Chip Information

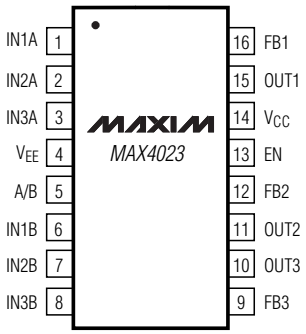
TRANSISTOR COUNT: 655

PROCESS: Bipolar

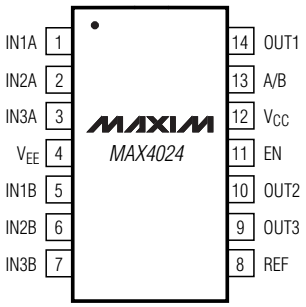
Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

Pin Configurations

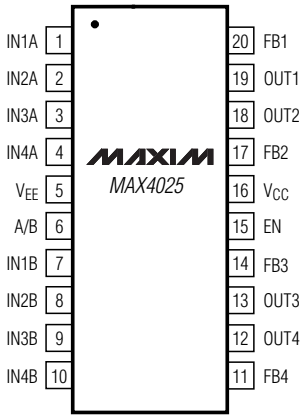
TOP VIEW



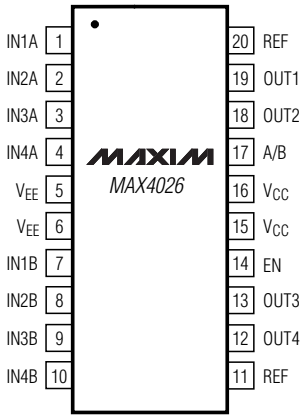
SO/QSOP



SO/TSSOP



SO/TSSOP



SO/TSSOP

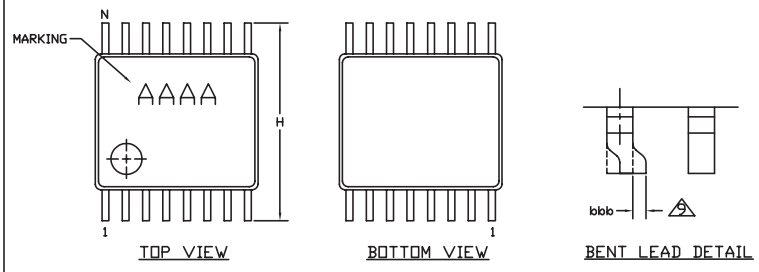
Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

Package Information

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	DOCUMENT NO.
14, 20 TSSOP	U14-2, U20-2	21-0066
14, 16 SOIC	S14-1, S16-1	21-0041
16 QSOP	E16-1	21-0055
20 SOIC	W20-1	21-0042

TSSOP4.40mm.EPS



SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	——	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b_1	0.19	0.25	.007	.010
c	0.09	0.20	.004	.008
c_1	0.09	0.14	.004	.006
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.55	.246	.258
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°
bbb	0.10 MAX			

JEDEC MO-153	N		PKG. CODES	VARIATIONS			
				MILLIMETERS		INCHES	
				MIN.	MAX.	MIN.	MAX.
AB-1	14	D	U14-1, U14-2	4.90	5.10	.193	.201
AB	16	D	U16-1, U16-2	4.90	5.10	.193	.201
AC	20	D	U20-2, U20M-2 U20-3	6.40	6.60	.252	.260
AD	24	D	U24-1	7.70	7.90	.303	.311
AE	28	D	U28-1, U28-2, U28-3	9.60	9.80	.378	.386

NOTES
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. LEAD COPLANARITY 0.10 MM MAX.
7. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY
8. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY
9. BENT LEAD 0.10 MM MAX.
10. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PBFREE (+) PKG. CODES.

—DRAWING NOT TO SCALE—

MAXIM

TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY

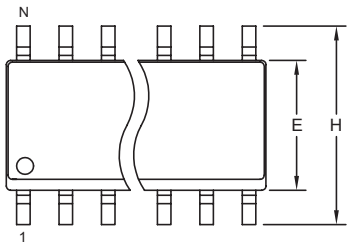
APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0066	J	1/1

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

Package Information (continued)

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SOICN .EPS

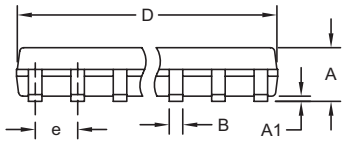


TOP VIEW

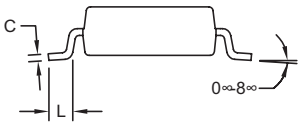
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27

VARIATIONS:

DIM	INCHES		MILLIMETERS		N	MS012
	MIN	MAX	MIN	MAX		
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



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

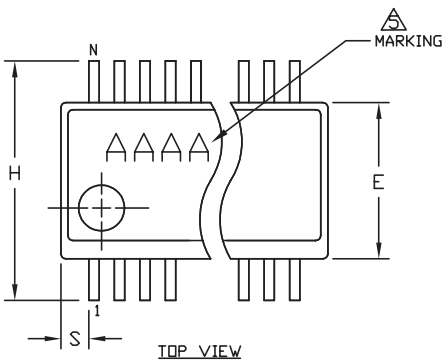
APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0041	B	1/1

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

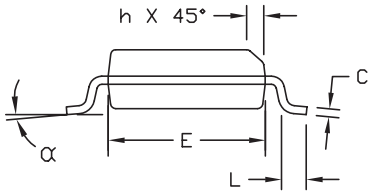
Package Information (continued)

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

QSOP.EPS

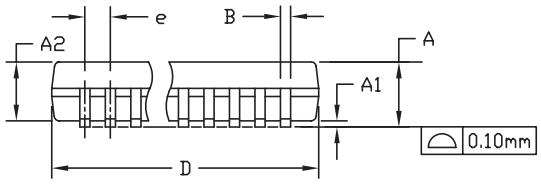


TOP VIEW



SIDE VIEW

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	.053	.069	1.35	1.75
A1	.004	.010	.102	.254
A2	.049	.065	1.245	1.651
B	.008	.012	0.20	0.30
C	.0075	.0098	0.191	0.249
D	SEE VARIATIONS			
E	.150	.157	3.81	3.99
e	.025 BSC		0.635 BSC	
H	.230	.244	5.84	6.20
h	.010	.016	0.25	0.41
L	.016	.035	0.41	0.89
N	SEE VARIATIONS			
α	0°	8°	0°	8°



SIDE VIEW

VARIATIONS:

	INCHES		MILLIMETERS			
	MIN.	MAX.	MIN.	MAX.	N	PKG CODES
D	.189	.196	4.80	4.98	16	E16-1, E16M-1, E16-4, E16-5, E16-6, E16-8F
S	.0020	.0070	0.05	0.18		
D	.337	.344	8.56	8.74	20	E20-1, E20-2
S	.0500	.0550	1.270	1.397		
D	.337	.344	8.56	8.74	24	E24-1, E24-2
S	.0250	.0300	0.635	0.762		
D	.386	.393	9.80	9.98	28	E28-1, E28M-1, E28-2
S	.0250	.0300	0.635	0.762		

NOTES:
1. D & E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .006" PER SIDE.
3. CONTROLLING DIMENSIONS: INCHES.
4. MEETS JEDEC MO137.
5. MARKING SHOWN IS FOR PKG. ORIENTATION ONLY.
6. ALL DIMENSIONS APPLY TO BOTH LEADED (-) AND PbFREE (+) PKG. CODES.

–DRAWING NOT TO SCALE–

MAXIM

TITLE:
PACKAGE OUTLINE
QSOP .150", .025" LEAD PITCH

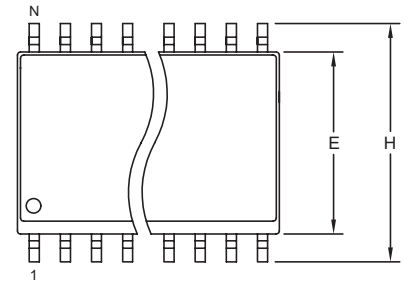
APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0055	H	1/1

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

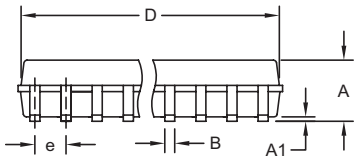
Package Information (continued)

For the latest package outline information and land patterns, go to **www.maxim-ic.com/packages**. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

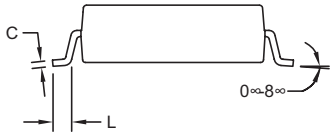
SOICW.EPS



TOP VIEW



FRONT VIEW



SIDE VIEW

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.093	0.104	2.35	2.65
A1	0.004	0.012	0.10	0.30
B	0.014	0.019	0.35	0.49
C	0.009	0.013	0.23	0.32
e	0.050		1.27	
E	0.291	0.299	7.40	7.60
H	0.394	0.419	10.00	10.65
L	0.016	0.050	0.40	1.27

VARIATIONS:

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	N	MS013
D	0.398	0.413	10.10	10.50	16	AA
D	0.447	0.463	11.35	11.75	18	AB
D	0.496	0.512	12.60	13.00	20	AC
D	0.598	0.614	15.20	15.60	24	AD
D	0.697	0.713	17.70	18.10	28	AE

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 MS013.
6. N = NUMBER OF PINS.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, .300" SOIC

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0042	B	1/1

Triple and Quad, 2:1 Video Multiplexer-Amplifiers with Fixed and Settable Gain

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/03	Initial release	—
1	11/09	Updated TOC16	9

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