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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## General Description

The MAX4358 is a 32 × 16 highly integrated video crosspoint switch matrix with input and output buffers and On-Screen Display (OSD) Insertion. This device operates from dual ±3V to ±5V supplies or from a single +5V supply. Digital logic is supplied from an independent single +2.7V to +5.5V supply. Individual outputs can be switched between an input video signal source and OSD information through an internal, dedicated fast 2:1 mux (40ns switching times) located before the output buffer. All inputs and outputs are buffered, with all outputs able to drive standard 75Ω reverse-terminated video loads.

The switch matrix configuration and output buffer gain are programmed through an SPI/QSPI™-compatible, three-wire serial interface and initialized with a single update signal. The unique serial interface operates in two modes facilitating both fast updates and initialization. On power-up, all outputs are initialized in the disabled state to avoid output conflicts in large-array configurations.

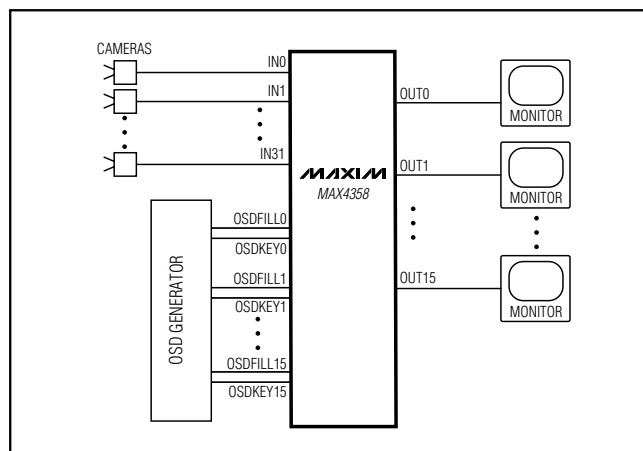
Superior flexibility, high integration, and space-saving packaging make this nonblocking switch matrix ideal for routing video signals in security and video-on-demand systems.

The MAX4358 is available in a 144-pin TQFP package and specified over an extended -40°C to +85°C temperature range. The MAX4358 evaluation kit is available to speed designs.

## Applications

Security Systems  
Video Routing  
Video-On-Demand Systems

## Typical Operating Circuit



SPI/QSPI are trademarks of Motorola, Inc.

## Features

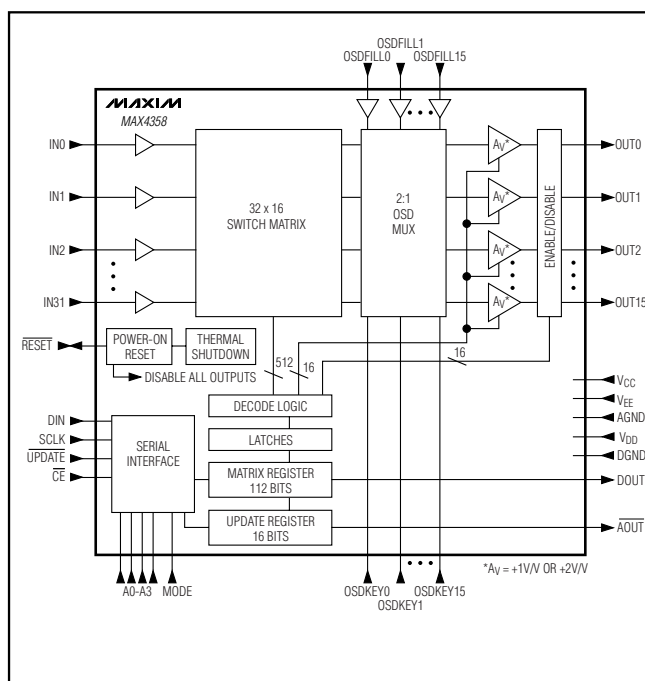
- ◆ 32 × 16 Nonblocking Matrix with Buffered Inputs and Outputs
- ◆ Operates from a ±3V, ±5V, or +5V Supply
- ◆ Fast Switching (40ns) 2:1 OSD Insertion Mux
- ◆ Each Output Individually Addressable
- ◆ Individually Programmable Output Buffer Gain ( $A_V = +1V/V$  or  $+2V/V$ )
- ◆ High-Impedance Output Disable for Wired-OR Connections
- ◆ 0.1dB Gain Flatness to 12MHz
- ◆ Minimum -62dB Crosstalk, -110dB Isolation at 6MHz
- ◆ 0.05%/0.1° Differential Gain/Differential Phase Error
- ◆ Low 195mW Power Consumption (0.38mW per point)

## Ordering Information

PART	TEMP RANGE	PIN PACKAGE
MAX4358ECE	-40°C to +85°C	144 TQFP

Pin Configuration appears at end of data sheet.

## Functional Diagram





# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## ABSOLUTE MAXIMUM RATINGS

Analog Supply Voltage ( $V_{CC} - V_{EE}$ ) ..... +11V  
 Digital Supply Voltage ( $V_{DD} - DGND$ ) ..... +6V  
 Analog Supplies to Analog Ground  
 ( $V_{CC} - AGND$ ) and ( $AGND - V_{EE}$ ) ..... +6V  
 Analog Ground to Digital Ground ..... -0.3V to +0.3V  
 $IN_{-}$ ,  $OSDFILL_{-}$  Voltage Range .... ( $V_{CC} + 0.3V$ ) to ( $V_{EE} - 0.3V$ )  
 $OUT_{-}$  Short-Circuit Duration to  $AGND$ ,  $V_{CC}$ , or  $V_{EE}$  ..... Indefinite  
 $SCLK$ ,  $CE$ ,  $UPDATE$ ,  $MODE$ ,  $A_{-}$ ,  $DIN$ ,  $DOUT$ ,  
 $RESET$ ,  $AOUT$ ,  $OSDKEY_{-}$  ..... ( $V_{DD} + 0.3V$ ) to ( $DGND - 0.3V$ )

Current Into Any Analog Input Pin ( $IN_{-}$ ,  $OSDFILL_{-}$ ) .....  $\pm 50mA$   
 Current Into Any Analog Output Pin ( $OUT_{-}$ ) .....  $\pm 75mA$   
 Continuous Power Dissipation ( $T_A = +70^{\circ}C$ )  
 144-Pin TQFP (derate 28.6mW/ $^{\circ}C$  above  $+70^{\circ}C$ ) ..... 2.23W  
 Operating Temperature Range .....  $-40^{\circ}C$  to  $+85^{\circ}C$   
 Junction Temperature .....  $+150^{\circ}C$   
 Storage Temperature Range .....  $-65^{\circ}C$  to  $+150^{\circ}C$   
 Lead Temperature (soldering, 10s) .....  $+300^{\circ}C$

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.

## DC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 5V$

( $V_{CC} = +5V$ ,  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN_{-}} = 0$ ,  $V_{OSDFILL_{-}} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage Range	$V_{CC} - V_{EE}$	Guaranteed by PSRR test	4.5		10.5	V
Logic Supply Voltage Range	$V_{DD}$ to $DGND$		2.7		5.5	V
Gain (Note 1)	$A_V$	$(V_{EE} + 2.5V) < V_{IN_{-}} < (V_{CC} - 2.5V)$ , $A_V = +1V/V$ , $R_L = 150\Omega$	0.97	0.995	1	V/V
		$(V_{EE} + 2.5V) < V_{IN_{-}} < (V_{CC} - 2.5V)$ , $A_V = +1V/V$ , $R_L = 10k\Omega$	0.99	0.999	1	
		$(V_{EE} + 3.75V) < V_{IN_{-}} < (V_{CC} - 3.75V)$ , $A_V = +2V/V$ , $R_L = 150\Omega$	1.92	1.996	2.08	
		$(V_{EE} + 3.75V) < V_{IN_{-}} < (V_{CC} - 3.75V)$ , $A_V = +2V/V$ , $R_L = 10k\Omega$	1.94	2.008	2.06	
		$(V_{EE} + 1V) < V_{IN_{-}} < (V_{CC} - 1.2V)$ , $A_V = +1V/V$ , $R_L = 10k\Omega$	0.95	0.994	1	
Gain Matching (Channel to Channel)		$R_L = 10k\Omega$		0.5	1.5	%
		$R_L = 150\Omega$		0.5	2	
Temperature Coefficient of Gain	$TC_{AV}$			10		ppm/ $^{\circ}C$
Input Voltage Range	$V_{IN_{-}}$	$A_V = +1V/V$	$R_L = 10k\Omega$	$V_{EE} + 1$	$V_{CC} - 1.2$	V
			$R_L = 150\Omega$	$V_{EE} + 2.5$	$V_{CC} - 2.5$	
		$A_V = +2V/V$	$R_L = 10k\Omega$	$V_{EE} + 3$	$V_{CC} - 3.1$	
			$R_L = 150\Omega$	$V_{EE} + 3.75$	$V_{CC} - 3.75$	

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## DC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES ±5V (continued)

( $V_{CC} = +5V$ ,  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $V_{OSDFILL\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Voltage Range	$V_{OUT}$	$R_L = 10k\Omega$		$V_{EE} + 1$		$V_{CC} - 1.2$	V
		$R_L = 150\Omega$		$V_{EE} + 2.5$		$V_{CC} - 2.5$	V
Input Bias Current	$I_B$				4	11	$\mu A$
Input Resistance	$R_{IN\_}$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$			10		$M\Omega$
Output Offset Voltage	$V_{OFFSET}$	$A_V = +1V/V$			$\pm 5$	$\pm 20$	mV
		$A_V = +2V/V$			$\pm 10$	$\pm 40$	
Output Short-Circuit Current	$I_{SC}$	Sinking or sourcing, $R_L = 1\Omega$			$\pm 40$		mA
Enabled Output Impedance	$Z_{OUT}$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$			0.2		$\Omega$
Output Leakage Current, Disable Mode	$I_{OD}$	$(V_{EE} + 1V) < V_{OUT\_} < (V_{CC} - 1.2V)$			0.004	1	$\mu A$
DC Power-Supply Rejection Ratio	PSRR	$4.5V < (V_{CC} - V_{EE}) < 10.5V$		60	70		dB
Quiescent Supply Current	$I_{CC}$	$R_L = \infty$	Outputs enabled, $T_A = +25^\circ C$		110	160	mA
			Outputs enabled			185	
			Outputs disabled		60	80	
	$I_{EE}$	$R_L = \infty$	Outputs enabled, $T_A = +25^\circ C$		105	160	
			Outputs enabled			185	
			Outputs disabled		55	80	
	$I_{DD}$				4	8	

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## DC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 3V$

( $V_{CC} = +3V$ ,  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $V_{OSDFILL\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Supply Voltage Range	$V_{CC} - V_{EE}$	Guaranteed by PSRR test		4.5		10.5	V
Logic Supply Voltage Range	$V_{DD}$ to $DGND$			2.7		5.5	V
Gain (Note 1)	$A_V$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$ , $A_V = +1V/V$ , $R_L = 150\Omega$		0.94	0.983	1	V/V
		$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$ , $A_V = +1V/V$ , $R_L = 10k\Omega$		0.96	0.993	1	
		$(V_{EE} + 2V) < V_{IN\_} < (V_{CC} - 2.1V)$ , $A_V = +2V/V$ , $R_L = 150\Omega$		1.92	1.985	2.08	
		$(V_{EE} + 2V) < V_{IN\_} < (V_{CC} - 2.1V)$ , $A_V = +2V/V$ , $R_L = 10k\Omega$		1.94	2.00	2.06	
Gain Matching (Channel to Channel)		$R_L = 10k\Omega$			0.5	1.5	%
		$R_L = 150\Omega$			0.5	2	
Temperature Coefficient of Gain	$TC_{AV}$				10		ppm/ $^\circ C$
Input Voltage Range	$V_{IN\_}$	$A_V = +1V/V$	$R_L = 10k\Omega$	$V_{EE} + 1$		$V_{CC} - 1.2$	V
			$R_L = 150\Omega$	$V_{EE} + 1$		$V_{CC} - 1.2$	
		$A_V = +2V/V$	$R_L = 10k\Omega$	$V_{EE} + 2$		$V_{CC} - 2.1$	
			$R_L = 150\Omega$	$V_{EE} + 2$		$V_{CC} - 2.1$	
Output Voltage Range	$V_{OUT}$	$R_L = 10k\Omega$		$V_{EE} + 1$		$V_{CC} - 1.2$	V
		$R_L = 150\Omega$		$V_{EE} + 1$		$V_{CC} - 1.2$	
Input Bias Current	$I_B$				4	11	$\mu A$
Input Resistance	$R_{IN}$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$			10		$M\Omega$
Output Offset Voltage	$V_{OFFSET}$	$A_V = +1V/V$			$\pm 5$	$\pm 20$	mV
		$A_V = +2V/V$			$\pm 10$	$\pm 40$	

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## DC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES ±3V (continued)

( $V_{CC} = +3V$ ,  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $V_{OSDFILL\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Output Short-Circuit Current	$I_{SC}$	Sinking or sourcing, $R_L = 1\Omega$			±40		mA
Enabled Output Impedance	$Z_{OUT}$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$			0.2		$\Omega$
Output Leakage Current, Disable Mode	$I_{OD}$	$(V_{EE} + 1V) < V_{OUT\_} < (V_{CC} - 1.2V)$			0.004	1	$\mu A$
DC Power-Supply Rejection Ratio	PSRR	4.5V < $(V_{CC} - V_{EE})$ < 10.5V		60	75		dB
Quiescent Supply Current	$I_{CC}$	$R_L = \infty$	Outputs enabled		95		mA
			Outputs disabled		50		
	$I_{EE}$	$R_L = \infty$	Outputs enabled		90		
			Outputs disabled		45		
$I_{DD}$				3			

## DC ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY +5V

( $V_{CC} = +5V$ ,  $V_{EE} = 0$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = V_{OSDFILL\_} = +1.75V$ ,  $A_V = +1V/V$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Supply Voltage Range	$V_{CC}$	Guaranteed by PSRR test		4.5		5.5	V
Logic-Supply Voltage Range	$V_{DD}$ to $DGND$			2.7		5.5	V
Gain (Note 1)	$A_V$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 2.5V)$ , $A_V = +1V/V$ , $R_L = 150\Omega$		0.94	0.995	1	V
		$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$ , $A_V = +1V/V$ , $R_L = 10k\Omega$		0.94	0.995	1	
Gain Matching (Channel to Channel)		$R_L = 10k\Omega$			0.5	3	%
		$R_L = 150\Omega$			0.5	3	
Temperature Coefficient of Gain	$TC_{AV}$				10		ppm/ $^\circ C$
Input Voltage Range	$V_{IN}$	$A_V = +1V/V$	$R_L = 10k\Omega$	$V_{EE} + 1$		$V_{CC} - 1.2$	V
			$R_L = 150\Omega$	$V_{EE} + 1$		$V_{CC} - 2.5$	
Output Voltage Range	$V_{OUT}$	$A_V = +1V/V$ , $R_L = 10k\Omega$		$V_{EE} + 1$		$V_{CC} - 1.2$	V
		$A_V = +1V/V$ , $R_L = 150\Omega$		$V_{EE} + 1$		$V_{CC} - 2.5$	

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## DC ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY +5V (continued)

( $V_{CC} = +5V$ ,  $V_{EE} = 0$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = V_{OSDFILL\_} = +1.75V$ ,  $A_V = +1V/V$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Bias Current	$I_B$			4	11	$\mu A$
Input Resistance	$R_{IN}$	$V_{EE} + 1V < V_{IN\_} < V_{CC} - 1.2V$		10		$M\Omega$
Output Offset Voltage	$V_{OFFSET}$	$A_V = +1V/V$		$\pm 10$	$\pm 40$	mV
Output Short-Circuit Current	$I_{SC}$	Sinking or sourcing, $R_L = 1\Omega$		$\pm 35$		mA
Enabled Output Impedance	$Z_{OUT}$	$(V_{EE} + 1V) < V_{IN\_} < (V_{CC} - 1.2V)$		0.2		$\Omega$
Output Leakage Current, Disable Mode	$I_{OD}$	$(V_{EE} + 1V) < V_{OUT\_} < (V_{CC} - 1.2V)$		0.004	1	$\mu A$
DC Power-Supply Rejection Ratio	PSRR	$4.5V < V_{CC} - V_{EE} < 5.5V$	50	65		dB
Quiescent Supply Current	$I_{CC}$	$R_L = \infty$	Outputs enabled, $T_A = +25^\circ C$	85		mA
			Outputs disabled	35		
	$I_{EE}$	$R_L = \infty$	Outputs enabled, $T_A = +25^\circ C$	80		
			Outputs disabled	30		
$I_{DD}$			4			

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## LOGIC-LEVEL CHARACTERISTICS

( $V_{CC} - V_{EE}$ ) = +4.5V to +10.5V,  $V_{DD}$  = +2.7V to +5.5V, AGND = DGND = 0,  $V_{IN\_}$  =  $V_{OSDFILL\_}$  = 0,  $R_L$  = 150Ω to AGND, and  $T_A$  =  $T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A$  = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage High Level	$V_{IH}$	$V_{DD} = +5.0V$		3			V
		$V_{DD} = +3V$		2			
Input Voltage Low Level	$V_{IL}$	$V_{DD} = +5.0V$				0.8	V
		$V_{DD} = +3V$				0.6	
Input Current High Level	$I_{IH}$	$V_I > 2V$	Excluding $\overline{RESET}$	-1	0.01	1	μA
			$\overline{RESET}$	-30	-20		
Input Current Low Level	$I_{IL}$	$V_I < 1V$	Excluding $\overline{RESET}$	-1	0.01	1	μA
			$\overline{RESET}$	-300	-235		
Output Voltage High Level	$V_{OH}$	$I_{SOURCE} = 1mA, V_{DD} = +5V$		4.7	4.9		V
		$I_{SOURCE} = 1mA, V_{DD} = +3V$		2.7	2.9		
Output Voltage Low Level	$V_{OL}$	$I_{SINK} = 1mA, V_{DD} = +5V$			0.1	0.3	V
		$I_{SINK} = 1mA, V_{DD} = +3V$			0.1	0.3	
Output Current High Level	$I_{OH}$	$V_{DD} = +5V, V_O = +4.9V$		1	4		mA
		$V_{DD} = +3V, V_{OUT} = +2.7V$		1	8		
Output Current Low Level	$I_{OL}$	$V_{DD} = +5V, V_O = +0.1V$		1	4		mA
		$V_{DD} = +3V, V_O = +0.3V$		1	8		

## AC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES ±5V

( $V_{CC} = +5V, V_{EE} = -5V, V_{DD} = +5V, AGND = DGND = 0, V_{IN\_} = V_{OSDFILL\_} = 0, R_L = 150\Omega$  to AGND, and  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	$BW_{SS}$	$V_{OUT\_} = 20mVp-p$	$A_V = +1V/V$		95		MHz
			$A_V = +2V/V$		70		
Medium-Signal -3dB Bandwidth	$BW_{MS}$	$V_{OUT\_} = 200mVp-p$	$A_V = +1V/V$		90		MHz
			$A_V = +2V/V$		70		
Large-Signal -3dB Bandwidth	$BW_{LS}$	$V_{OUT\_} = 2Vp-p$	$A_V = +1V/V$		40		MHz
			$A_V = +2V/V$		50		
Small-Signal 0.1dB Bandwidth	$BW_{0.1dB-SS}$	$V_{OUT\_} = 20mVp-p$	$A_V = +1V/V$		15		MHz
			$A_V = +2V/V$		15		
Medium-Signal 0.1dB Bandwidth	$BW_{0.1dB-MS}$	$V_{OUT\_} = 200mVp-p$	$A_V = +1V/V$		15		MHz
			$A_V = +2V/V$		15		
Large-Signal 0.1dB Bandwidth	$BW_{0.1dB-LS}$	$V_{OUT\_} = 2Vp-p$	$A_V = +1V/V$		12		MHz
			$A_V = +2V/V$		12		
Slew Rate	SR	$V_{OUT\_} = 2V$ step, $A_V = +1V/V$			150		V/μs
		$V_{OUT\_} = 2V$ step, $A_V = +2V/V$			160		



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## AC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 5V$ (continued)

( $V_{CC} = +5V$ ,  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = V_{OSDFILL\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Settling Time	$t_{S0.1\%}$	$V_{OUT\_} = 0$ to 2V step	$A_V = +1V/V$		60		ns
			$A_V = +2V/V$		60		
Switching Transient (Glitch) (Note 3)			$A_V = +1V/V$		50		mV
			$A_V = +2V/V$		50		
AC Power-Supply Rejection Ratio			$f = 100kHz$		70		dB
			$f = 1MHz$		68		
Differential Gain Error (Note 4)			$R_L = 1k\Omega$		0.01		%
			$R_L = 150\Omega$		0.05		
Differential Phase Error (Note 4)			$R_L = 1k\Omega$		0.03		degrees
			$R_L = 150\Omega$		0.1		
Crosstalk, All Hostile			$f = 6MHz$		-62		dB
Off-Isolation, Input-to-Output			$f = 6MHz$		-110		dB
Input Noise Voltage Density	$e_n$		$BW = 6MHz$		73		$\mu V_{RMS}$
Input Capacitance	$C_{IN}$				5		pF
Disabled Output Capacitance			Amplifier in disable mode		3		pF
Capacitive Load at 3dB Output Peaking					30		pF
Output Impedance	$Z_{OUT}$	$f = 6MHz$	Output enabled		3		$\Omega$
			Output disabled		4k		

## AC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 3V$

( $V_{CC} = +3V$ ,  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = V_{OSDFILL\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	$BW_{SS}$	$V_{OUT\_} = 20mV_{p-p}$	$A_V = +1V/V$		90		MHz
			$A_V = +2V/V$		65		
Medium-Signal -3dB Bandwidth	$BW_{MS}$	$V_{OUT\_} = 200mV_{p-p}$	$A_V = +1V/V$		90		MHz
			$A_V = +2V/V$		65		
Large-Signal -3dB Bandwidth	$BW_{LS}$	$V_{OUT\_} = 2V_{p-p}$	$A_V = +1V/V$		30		MHz
			$A_V = +2V/V$		35		
Small-Signal 0.1dB Bandwidth	$BW_{0.1dB-SS}$	$V_{OUT\_} = 20mV_{p-p}$	$A_V = +1V/V$		15		MHz
			$A_V = +2V/V$		15		
Medium-Signal 0.1dB Bandwidth	$BW_{0.1dB-MS}$	$V_{OUT\_} = 200mV_{p-p}$	$A_V = +1V/V$		15		MHz
			$A_V = +2V/V$		15		
Large-Signal 0.1dB Bandwidth	$BW_{0.1dB-LS}$	$V_{OUT\_} = 2V_{p-p}$	$A_V = +1V/V$		12		MHz
			$A_V = +2V/V$		12		

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## AC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 3V$ (continued)

( $V_{CC} = +3V$ ,  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = V_{OSDFILL-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Slew Rate	SR	$V_{OUT-} = 2V$ step $A_V = +1V/V$			120		V/ $\mu s$
		$V_{OUT-} = 2V$ step $A_V = +2V/V$			120		
Settling Time	$t_S 0.1\%$	$V_O = 0$ to 2V step	$A_V = +1V/V$		60		ns
			$A_V = +2V/V$		60		
Switching Transient (Glitch) (Note 3)			$A_V = +1V/V$		15		mV
			$A_V = +2V/V$		20		
AC Power-Supply Rejection Ratio			$f = 100kHz$		60		dB
			$f = 1MHz$		40		
Differential Gain Error (Note 4)			$R_L = 1k\Omega$		0.03		%
			$R_L = 150\Omega$		0.2		
Differential Phase Error (Note 4)			$R_L = 1k\Omega$		0.08		degrees
			$R_L = 150\Omega$		0.2		
Crosstalk, All Hostile			$f = 6MHz$		-63		dB
Off-Isolation, Input to Output			$f = 6MHz$		-112		dB
Input Noise Voltage Density	$e_n$		$BW = 6MHz$		73		$\mu V_{RMS}$
Input Capacitance	$C_{IN-}$				5		pF
Disabled Output Capacitance			Amplifier in disable mode		3		pF
Capacitive Load at 3dB Output Peaking					30		pF
Output Impedance	$Z_{OUT}$	$f = 6MHz$	Output enabled		3		$\Omega$
			Output disabled		4k		

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## AC ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY +5V

( $V_{CC} = +5V$ ,  $V_{EE} = 0$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{INL} = V_{OSDFILL} = 1.75V$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	BW <sub>SS</sub>	$V_{OUT} = 20mVp-p$		90		MHz
Medium-Signal -3dB Bandwidth	BW <sub>MS</sub>	$V_{OUT} = 200mVp-p$		90		MHz
Large-Signal -3dB Bandwidth	BW <sub>LS</sub>	$V_{OUT} = 1.5Vp-p$		38		MHz
Small-Signal 0.1dB Bandwidth	BW <sub>0.1dB-SS</sub>	$V_{OUT} = 20mVp-p$		12		MHz
Medium-Signal 0.1dB Bandwidth	BW <sub>0.1dB-MS</sub>	$V_{OUT} = 200mVp-p$		12		MHz
Large-Signal 0.1dB Bandwidth	BW <sub>0.1dB-LS</sub>	$V_{OUT} = 1.5Vp-p$		12		MHz
Slew Rate	SR	$V_{OUT} = 2V$ step, $A_V = +1V/V$		100		V/ $\mu s$
Settling Time	$t_S$ 0.1%	$V_{OUT} = 0$ to 2V step		60		ns
Switching Transient (Glitch)				25		mV
AC Power-Supply Rejection Ratio		$f = 100kHz$		70		dB
		$f = 1MHz$		69		
Differential Gain Error (Note 4)		$R_L = 1k\Omega$		0.03		%
		$R_L = 150\Omega$		0.15		
Differential Phase Error (Note 4)		$R_L = 1k\Omega$		0.06		degrees
		$R_L = 150\Omega$		0.2		
Crosstalk, All Hostile		$f = 6MHz$		-63		dB
Off-Isolation, Input-to- Output		$f = 6MHz$		-110		dB
Input Noise Voltage	$e_n$	$BW = 6MHz$		73		$\mu V_{RMS}$
Input Capacitance	$C_{IN}$			5		pF
Disabled Output Capacitance		Amplifier in disable mode		3		pF
Capacitive Load at 3dB Output Peaking				30		pF
Output Impedance	$Z_{OUT}$	$f = 6MHz$	Output enabled	3		$\Omega$
			Output disabled	4k		

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## SWITCHING CHARACTERISTICS

(( $V_{CC} - V_{EE}$ ) = +4.5V to +10.5V,  $V_{DD}$  = +2.7V to +5.5V,  $DGND = AGND = 0$ ,  $V_{IN\_} = V_{OSDFILL\_} = 0$  for dual supplies,  $V_{IN\_} = V_{OSDFILL\_} = +1.75V$  for single supply,  $R_L = 150\Omega$  to  $AGND$ ,  $C_L = 100pF$ ,  $A_V = +1V/V$ , and  $T_A = T_{MIN} - T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Delay: $\overline{UPDATE}$ to Video Out	$t_{PdUdVo}$	$V_{IN} = 0.5V$ step			200	450	ns
Delay: $\overline{UPDATE}$ to $\overline{AOUT}$	$t_{PdUdAo}$	MODE = 0, time to $\overline{AOUT} = \text{low}$ after $\overline{UPDATE} = \text{low}$			30	200	ns
Delay: OSDKEY_ to Output	$t_{PdOkVo}/t_{PdOfVo}$	$V_{OUT} = 0.5V$ step	$V_{DD} = +5V$		40		ns
			$V_{DD} = +3V$		60		
Delay: SCLK to DOUT Valid	$t_{PdDo}$	Logic state change in DOUT on active SCLK edge			30	200	ns
Delay: Output Disable	$t_{PdHOeVo}$	$V_{OUT} = 0.5V$ , $1k\Omega$ pulldown to $AGND$			300	800	ns
Delay: Output Enable	$t_{PdLOeVo}$	Output disabled, $1k\Omega$ pulldown to $AGND$ , $V_{IN} = 0.5V$			200	800	ns
Setup: $\overline{CE}$ to SCLK	$t_{SuCe}$					100	ns
Setup: DIN to SCLK	$t_{SuDi}$			100			ns
Hold Time: SCLK to DIN	$t_{HdDi}$			100			ns
Minimum High Time: SCLK	$t_{MnHCk}$			100			ns
Minimum Low Time: SCLK	$t_{MnLCk}$			100			ns
Minimum Low Time: $\overline{UPDATE}$	$t_{MnLUd}$			100			ns
Setup Time: $\overline{UPDATE}$ to SCLK	$t_{SuHUd}$	Rising edge of $\overline{UPDATE}$ to falling edge of SCLK		100			ns
Hold Time: SCLK to $\overline{UPDATE}$	$t_{HdHUd}$	Falling edge of SCLK to falling edge of $\overline{UPDATE}$		100			ns
Setup Time: MODE to SCLK	$t_{SuMd}$	Minimum time from clock edge to MODE with valid data clocking		100			ns
Hold Time: MODE to SCLK	$t_{HdMd}$	Minimum time from clock edge to MODE with valid data clocking		100			ns
Minimum Low Time: $\overline{RESET}$	$t_{MnLRst}$					300	ns
Delay: $\overline{RESET}$	$t_{PdRst}$	$10k\Omega$ pulldown to $AGND$				600	ns

**Note 1:** Associated output voltage may be determined by multiplying the input voltage by the specified gain ( $A_V$ ) and adding output offset voltage. Gain is specified for  $IN_$  and  $OSDFILL_$  signal paths.

**Note 2:** Logic level characteristics apply to the following pins: DIN, DOUT, SCLK,  $\overline{CE}$ ,  $\overline{UPDATE}$ ,  $\overline{RESET}$ , A3-A0, MODE,  $\overline{AOUT}$ , and OSDKEY\_.

**Note 3:** Switching transient settling time is guaranteed by the settling time ( $t_s$ ) specification. Switching transient is a result of updating the switch matrix.

**Note 4:** Input test signal: 3.58MHz sine wave of amplitude 40IRE superimposed on a linear ramp (0 to 100IRE). IRE is a unit of video-signal amplitude developed by the International Radio Engineers: 140IRE = 1.0V.

**Note 5:** All devices are 100% production tested at +25°C. Specifications over temperature limits are guaranteed by design.

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Symbol Definitions

SYMBOL	TYPE	DESCRIPTION
<b>Ao</b>	Signal	Address Valid Flag (AOUT)
<b>Ce</b>	Signal	Clock Enable ( $\overline{CE}$ )
<b>Ck</b>	Signal	Clock (SCLK)
<b>Di</b>	Signal	Serial Data In (DIN)
<b>Do</b>	Signal	Serial Data Output (DOUT)
<b>Md</b>	Signal	MODE
<b>Oe</b>	Signal	Output enable
<b>Rst</b>	Signal	Reset Input (RESET)
<b>Ud</b>	Signal	UPDATE
<b>Vo</b>	Signal	Video Out (OUT)
<b>H</b>	Property	High- or Low-to-High transition
<b>Hd</b>	Property	Hold
<b>L</b>	Property	Low- or High-to-Low transition
<b>Mn</b>	Property	Minimum
<b>Mx</b>	Property	Maximum
<b>Pd</b>	Property	Propagation delay
<b>Su</b>	Property	Setup
<b>Tr</b>	Property	Transition
<b>W</b>	Property	Width

## Naming Conventions:

- All parameters with time units are given "t" designation, with appropriate subscript modifiers.
- Propagation delays for clocked signals are from active edge of clock.
- Propagation delay for level sensitive signals is from input to output at 50% point of a transition.
- Setup and Hold times are measured from 50% point of signal transition to 50% point of clocking signal transition.
- Setup time refers to any signal that must be stable before active clock edge, even if signal is not latched or clocked itself.
- Hold time refers to any signal that must be stable during and after active clock edge, even if signal is not latched or clocked.
- Propagation delays to unobservable internal signals are modified to setup and hold designations applied to observable IO signals.



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Timing Diagram

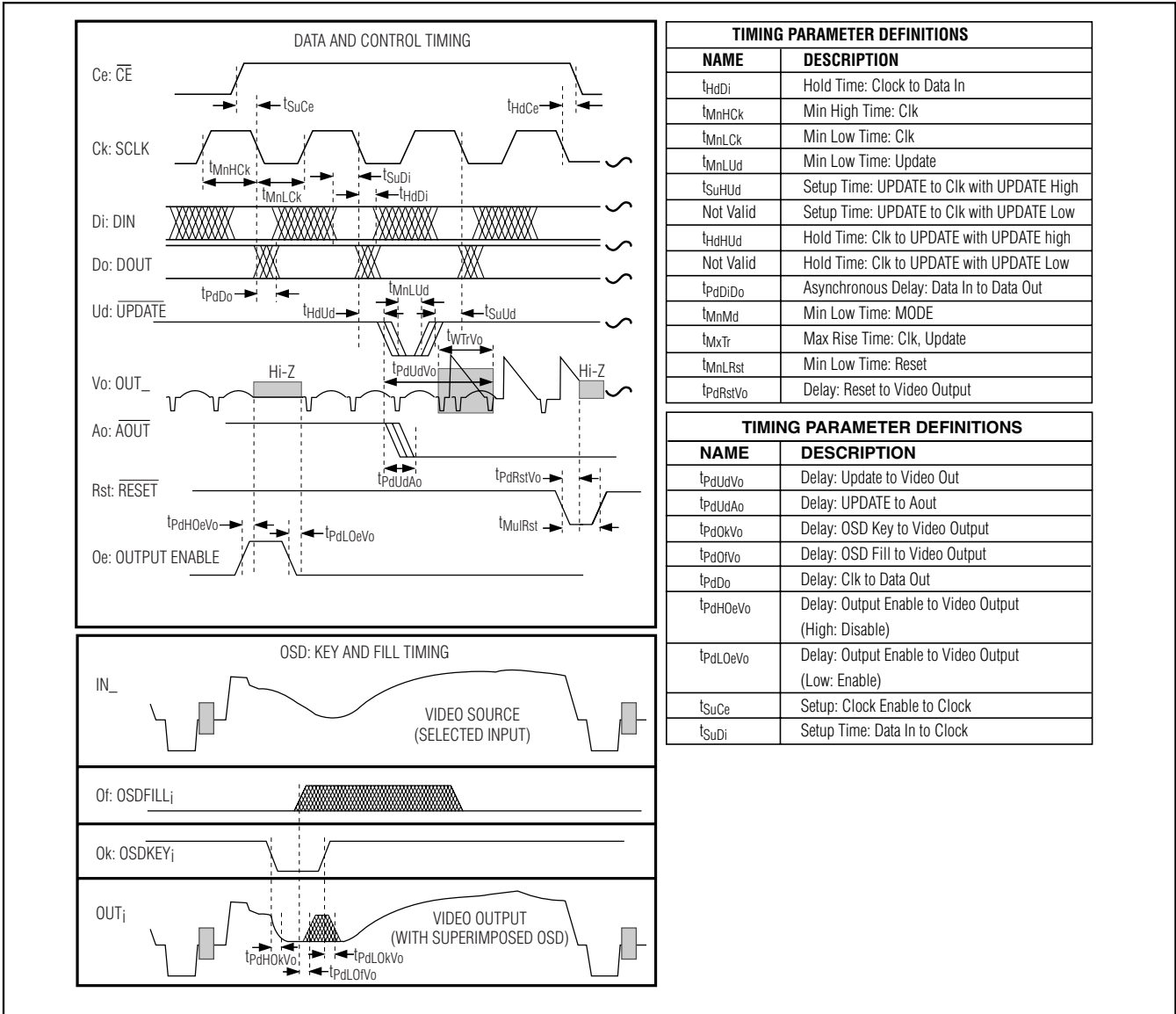
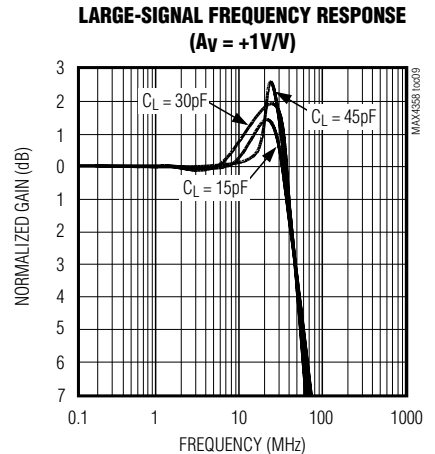
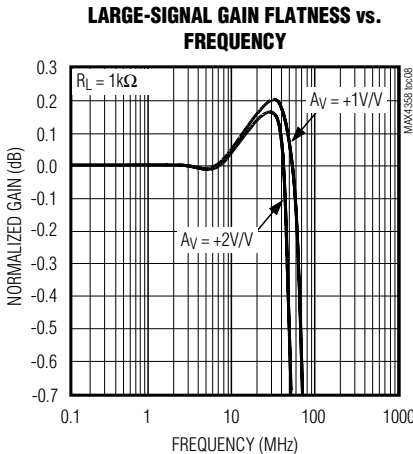
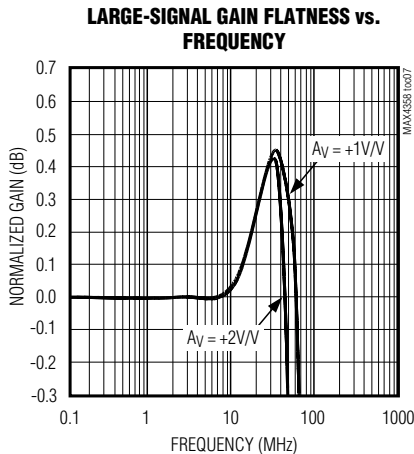
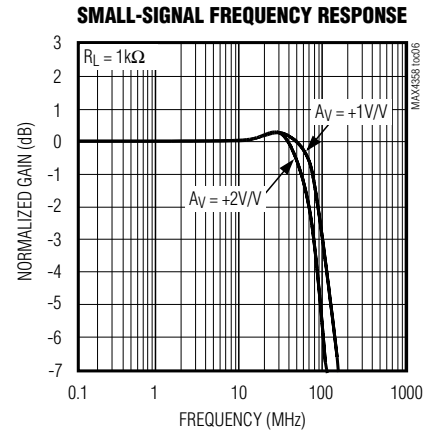
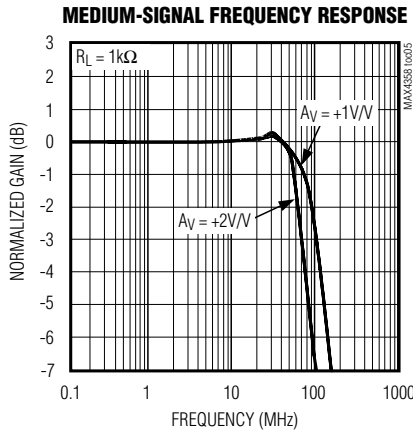
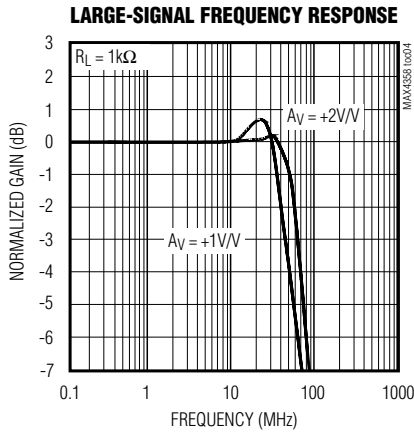
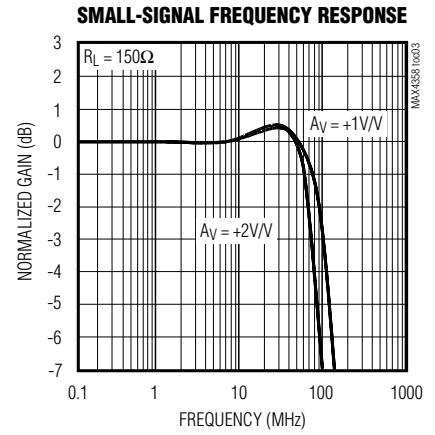
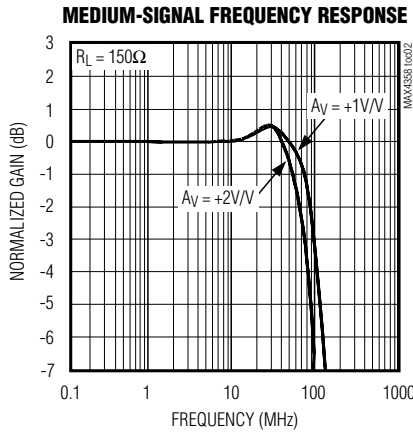
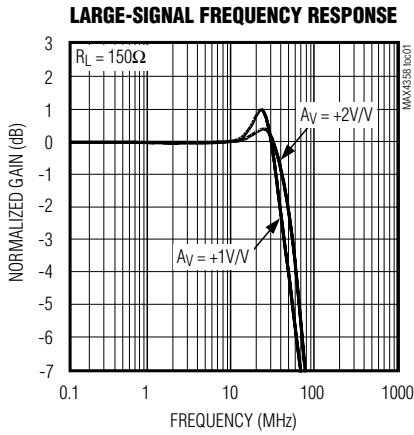


Figure 1. Timing Diagram

# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 5V$

( $V_{CC} = +5V$  and  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

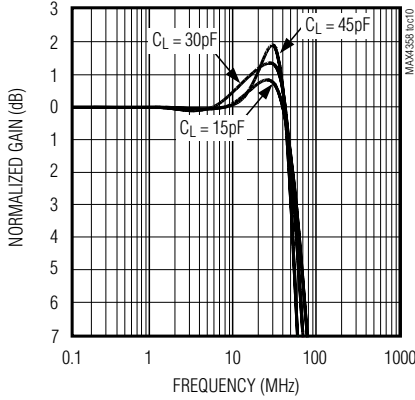


# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

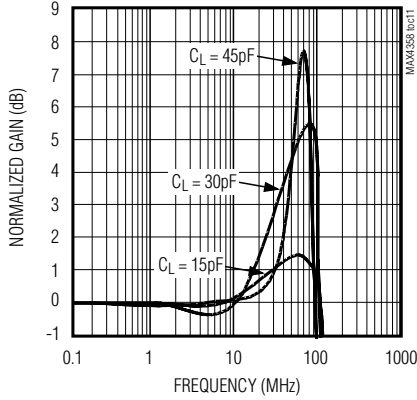
## Typical Operating Characteristics—Dual Supplies $\pm 5V$ (continued)

( $V_{CC} = +5V$  and  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_v = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

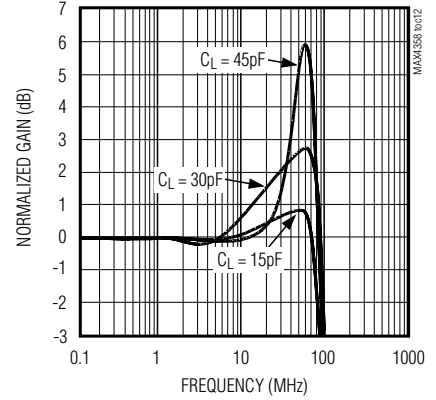
**LARGE-SIGNAL FREQUENCY RESPONSE**  
( $A_v = +2V/V$ )



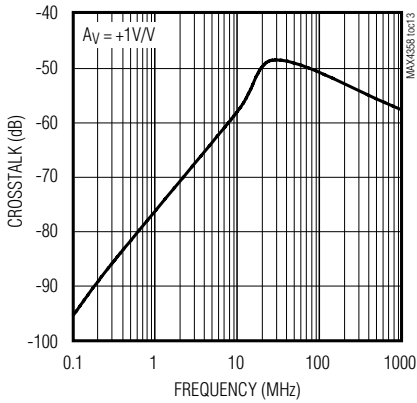
**MEDIUM-SIGNAL FREQUENCY RESPONSE**  
( $A_v = +1V/V$ )



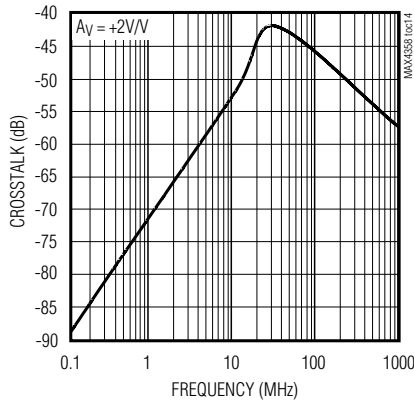
**MEDIUM-SIGNAL FREQUENCY RESPONSE**  
( $A_v = +2V/V$ )



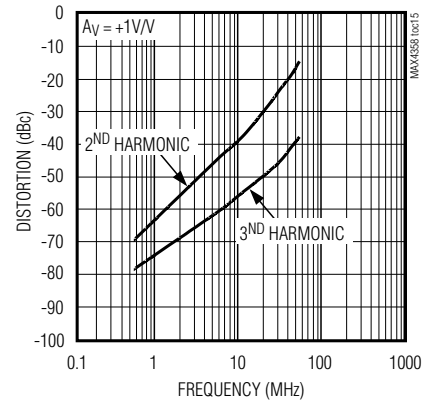
**CROSSTALK vs. FREQUENCY**



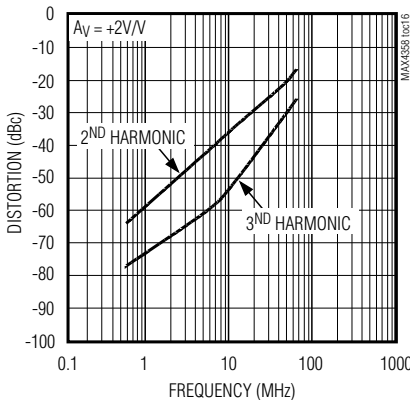
**CROSSTALK vs. FREQUENCY**



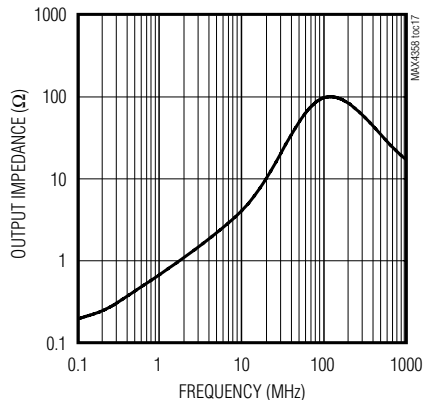
**DISTORTION vs. FREQUENCY**



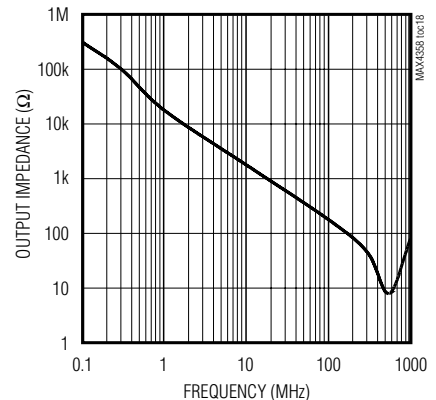
**DISTORTION vs. FREQUENCY**



**ENABLED-OUTPUT IMPEDANCE vs. FREQUENCY**



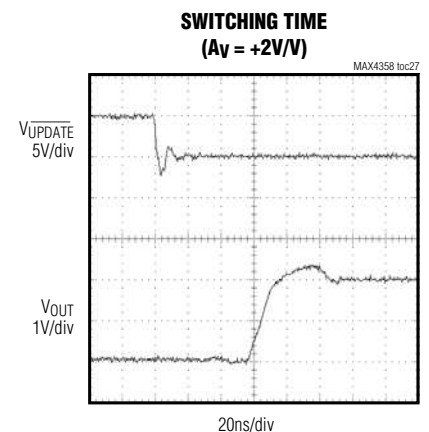
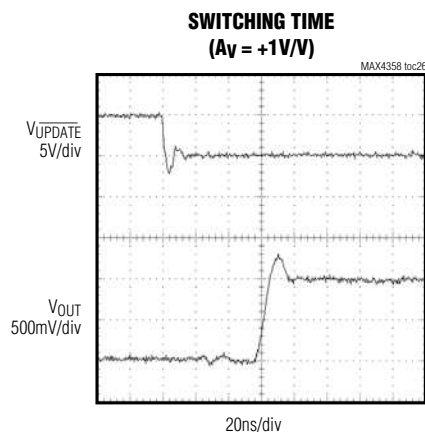
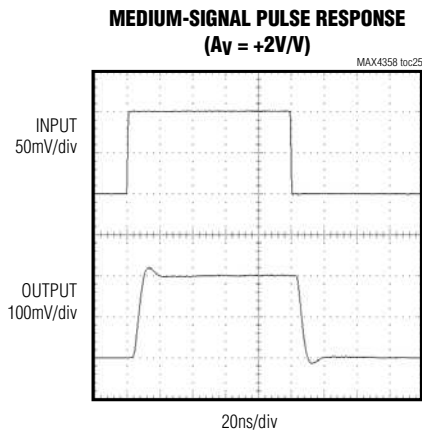
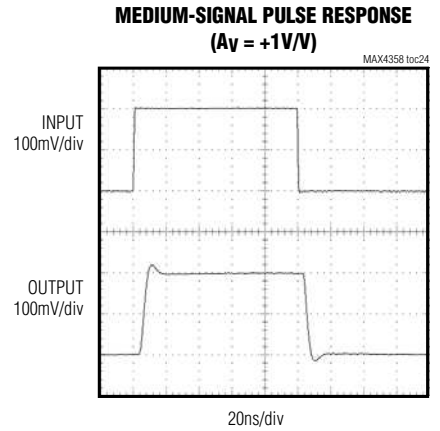
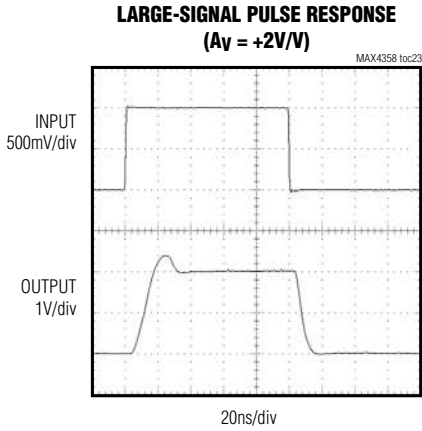
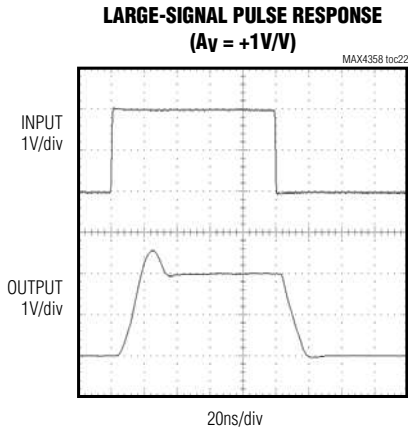
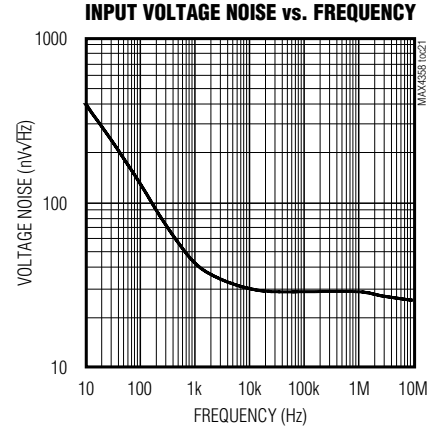
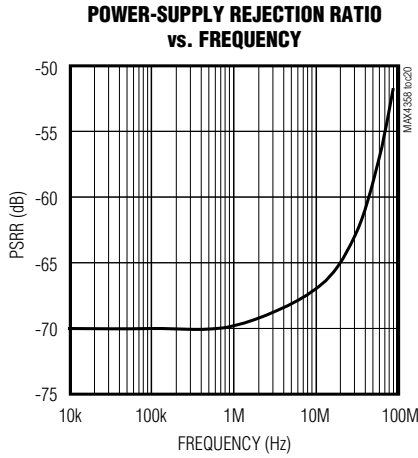
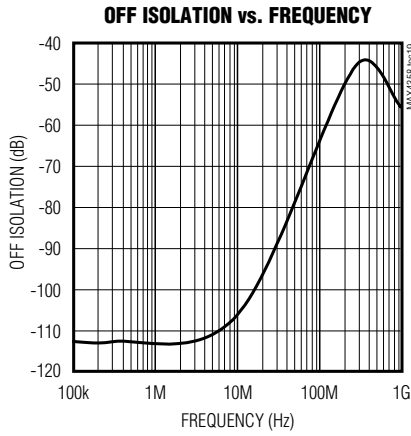
**DISABLED OUTPUT IMPEDANCE vs. FREQUENCY**



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 5V$ (continued)

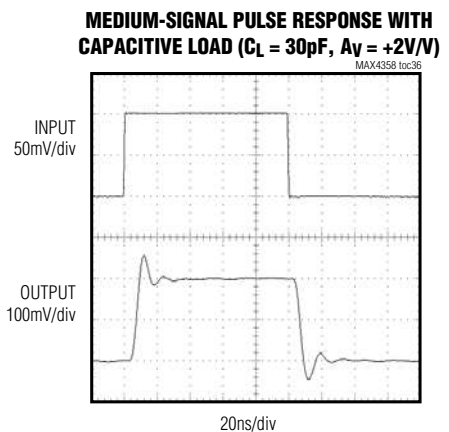
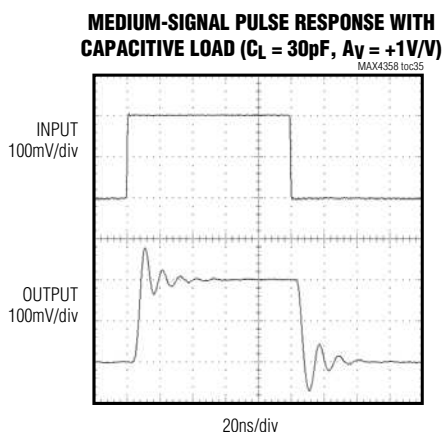
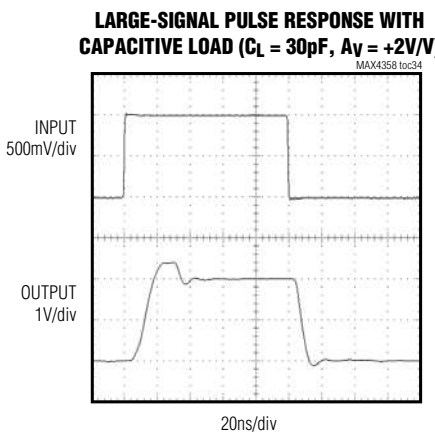
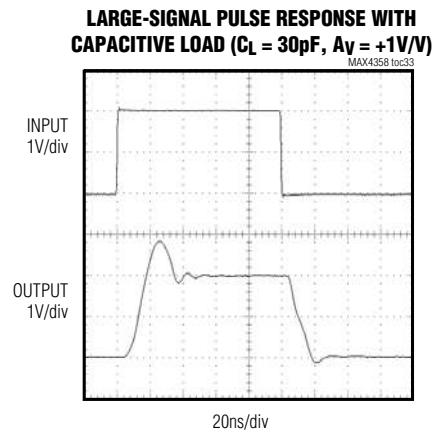
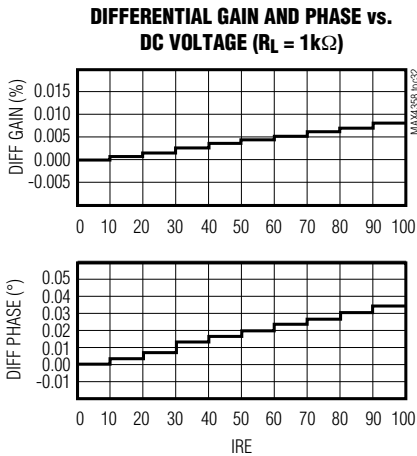
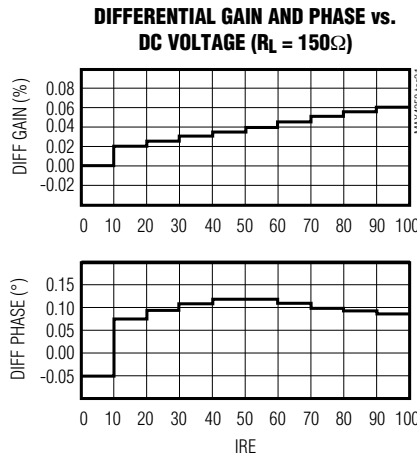
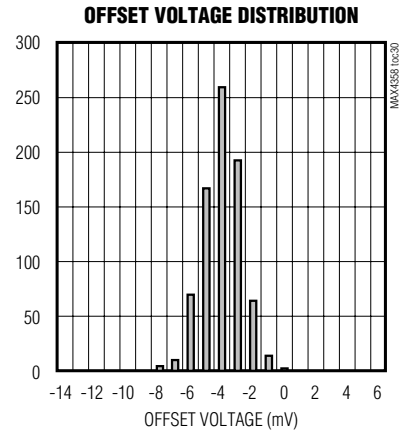
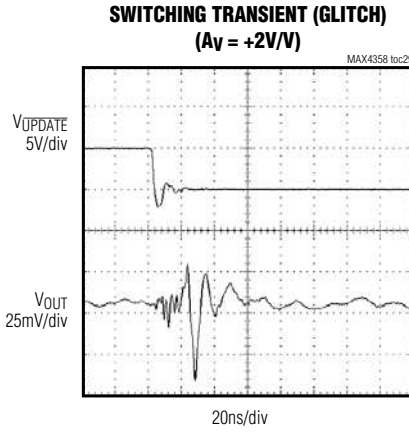
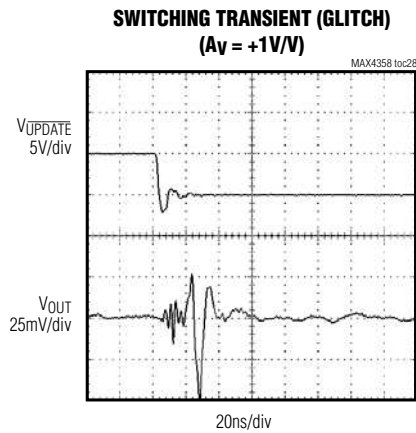
( $V_{CC} = +5V$  and  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 5V$ (continued)

( $V_{CC} = +5V$  and  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

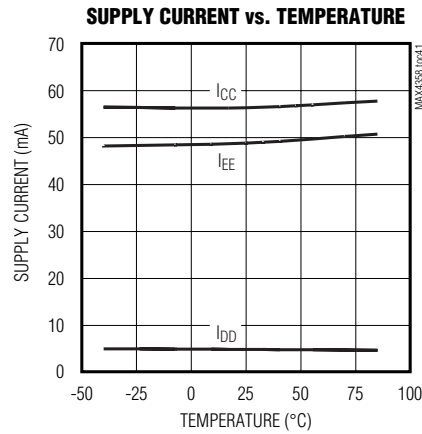
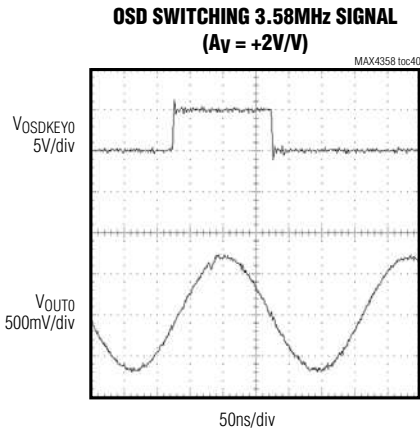
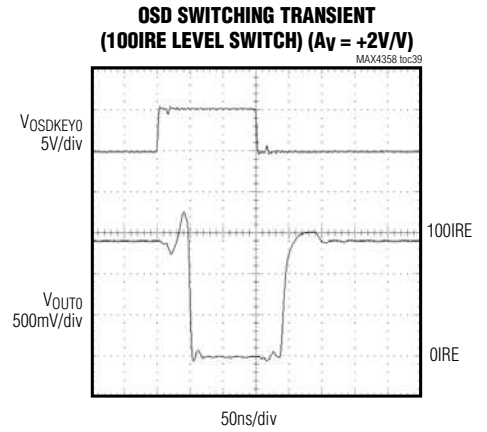
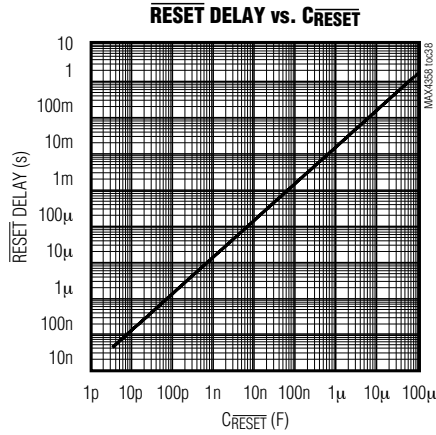
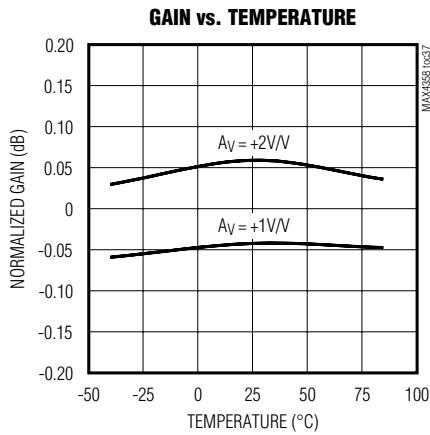




# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 5V$ (continued)

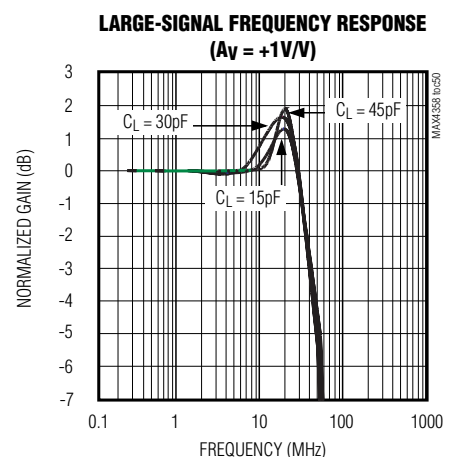
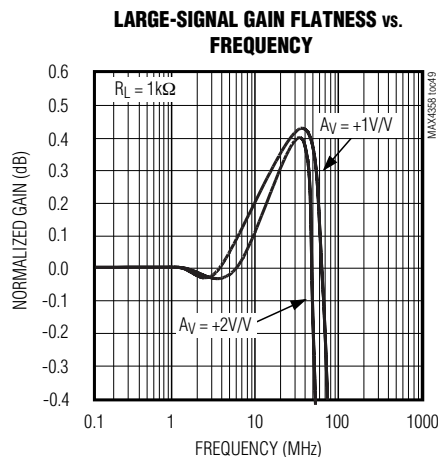
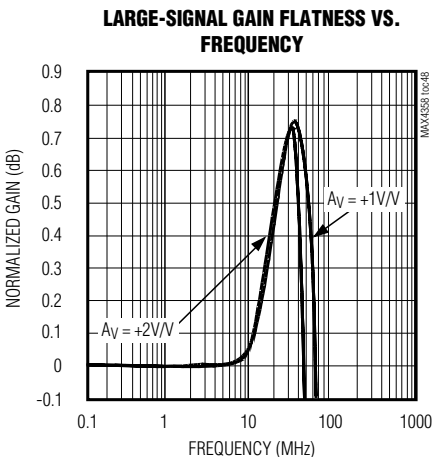
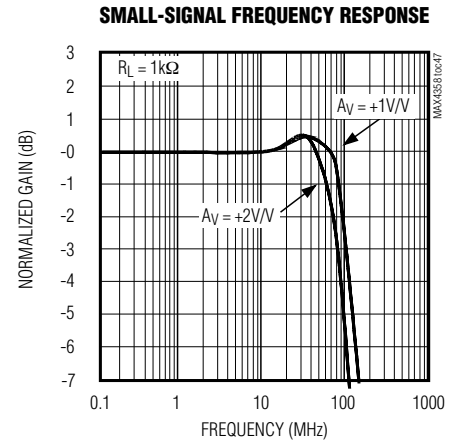
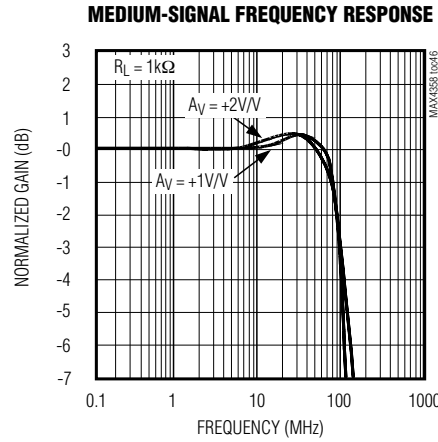
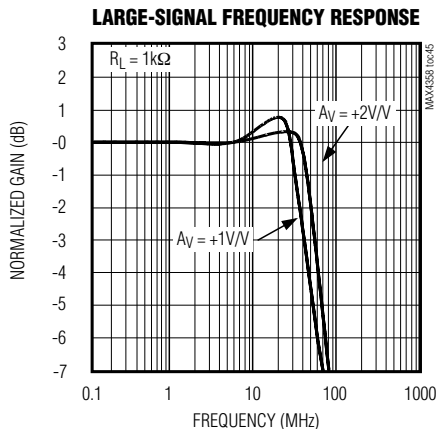
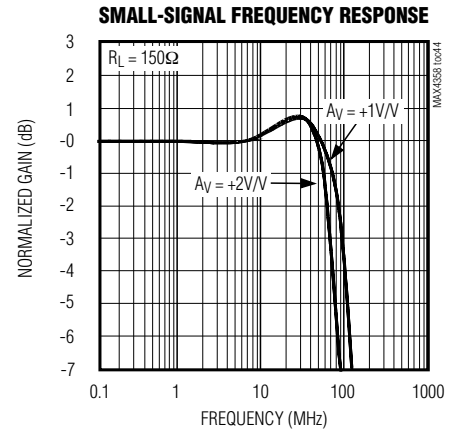
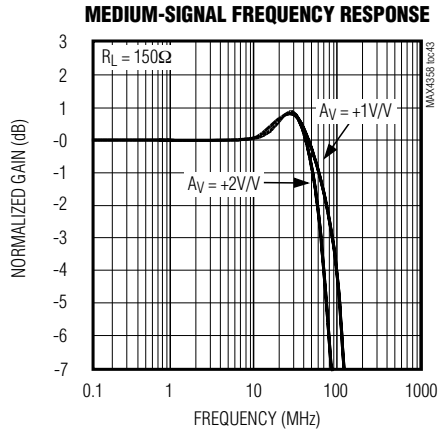
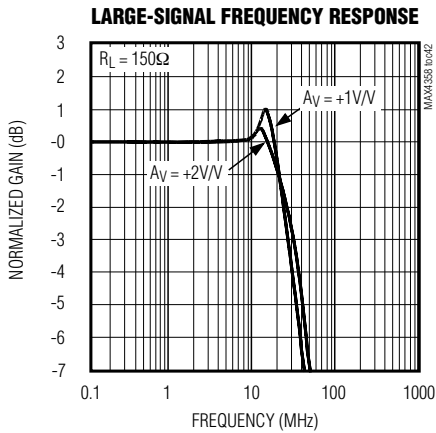
( $V_{CC} = +5V$  and  $V_{EE} = -5V$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 3V$

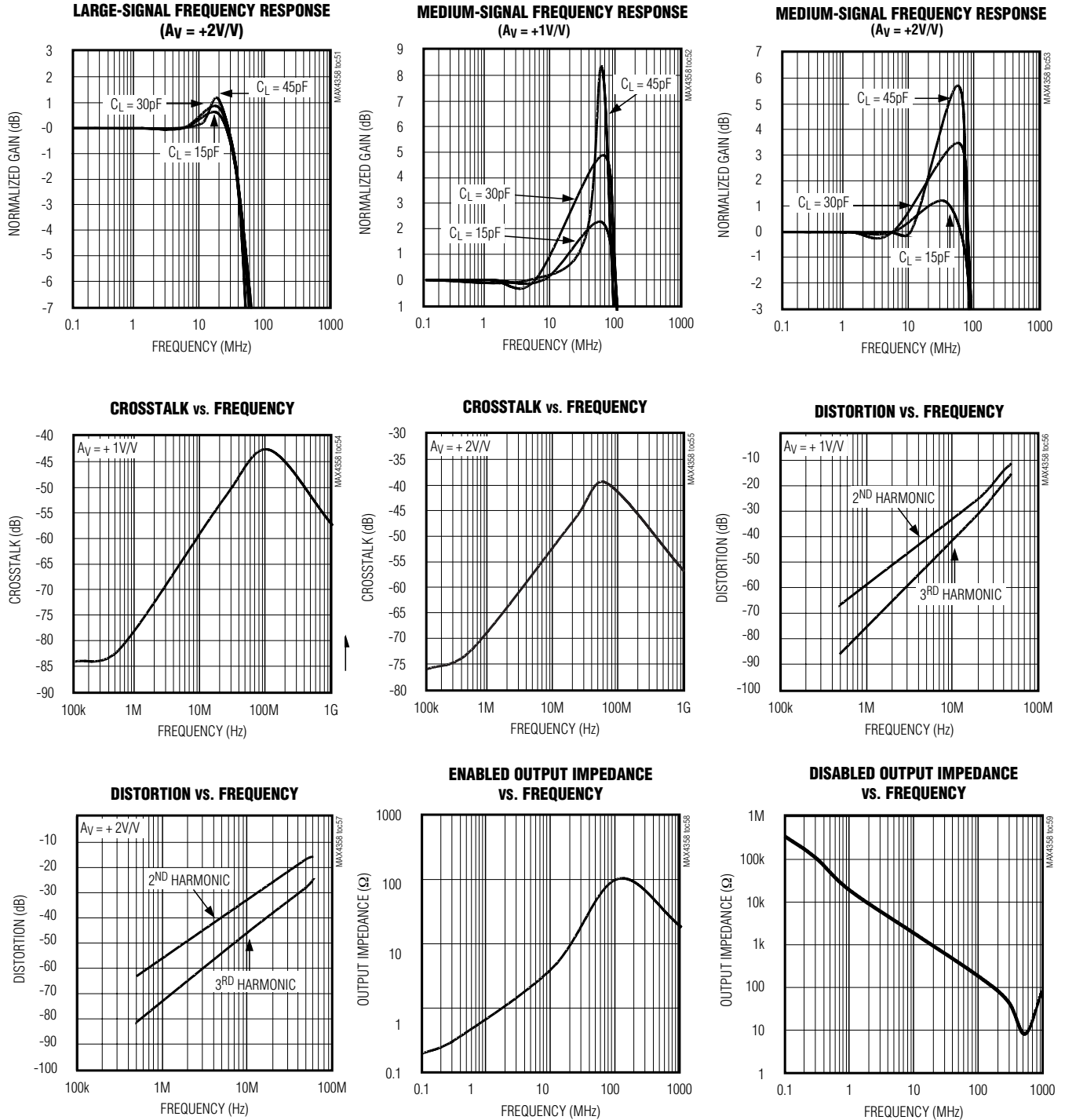
( $V_{CC} = +3V$  and  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 3V$ (continued)

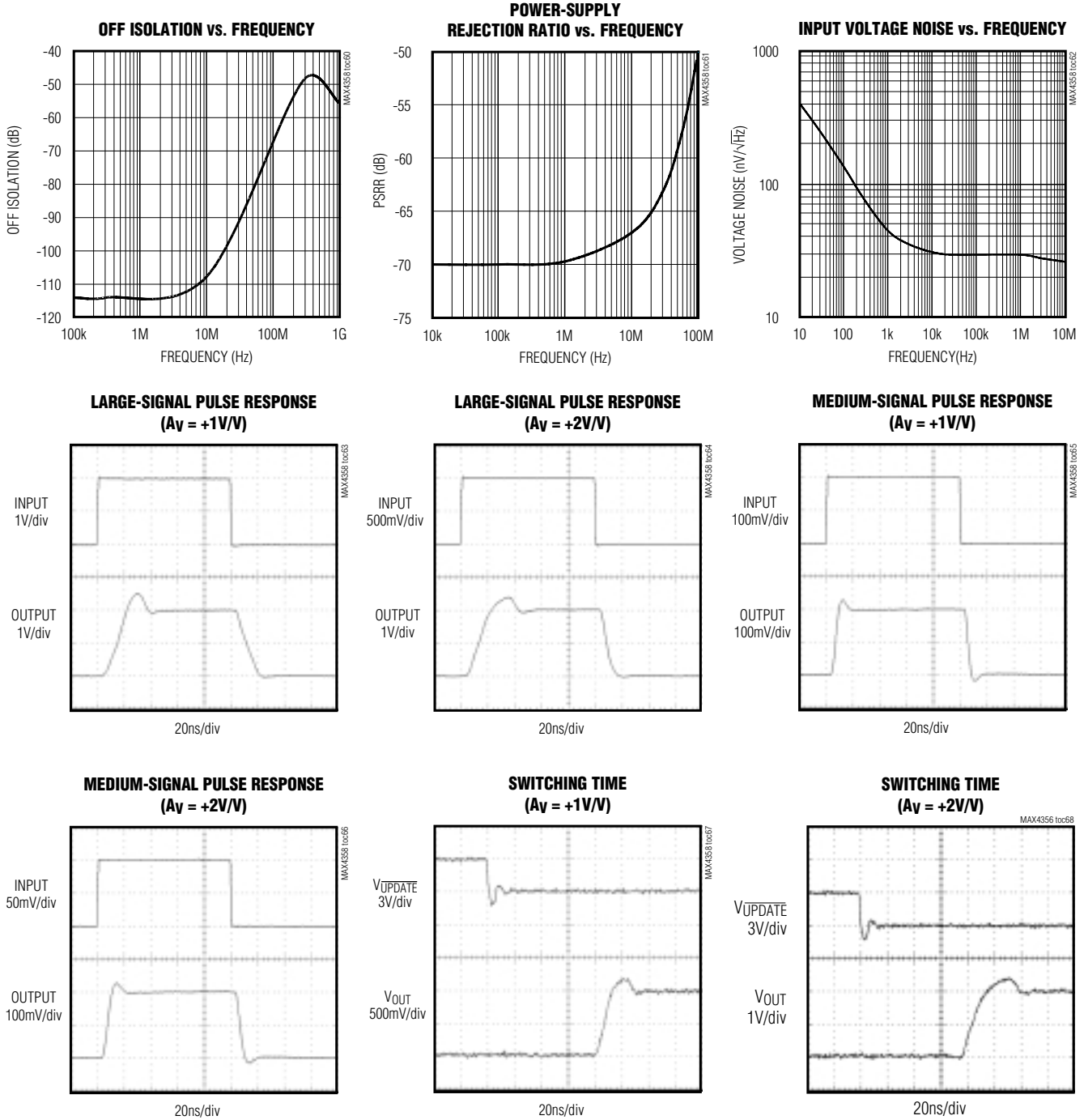
( $V_{CC} = +3V$  and  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies $\pm 3V$ (continued)

( $V_{CC} = +3V$  and  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

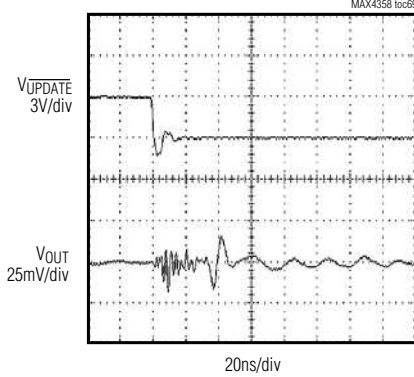


# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

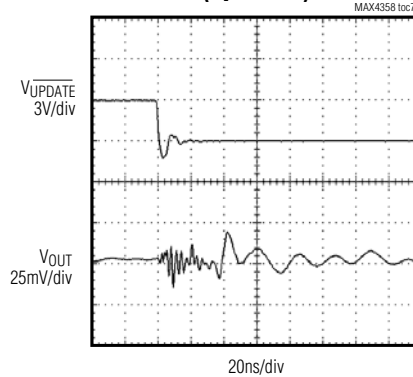
## Typical Operating Characteristics—Dual Supplies $\pm 3V$ (continued)

( $V_{CC} = +3V$  and  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

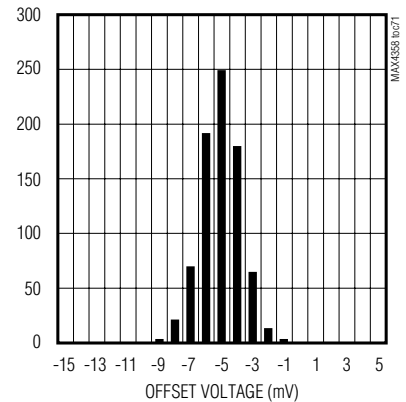
**SWITCHING TRANSIENT GLITCH**  
( $A_V = +1V/V$ )



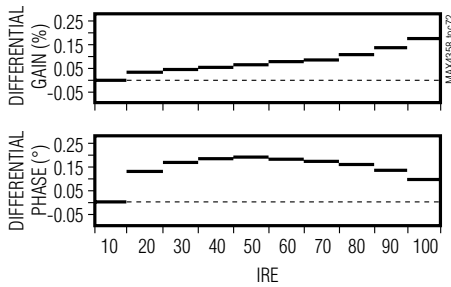
**SWITCHING TRANSIENT GLITCH**  
( $A_V = +2V/V$ )



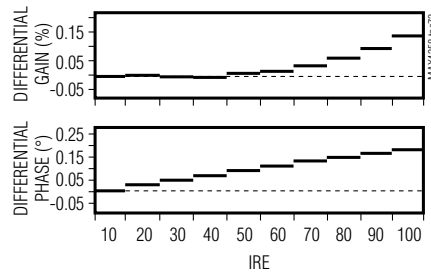
**OFFSET VOLTAGE DISTRIBUTION**



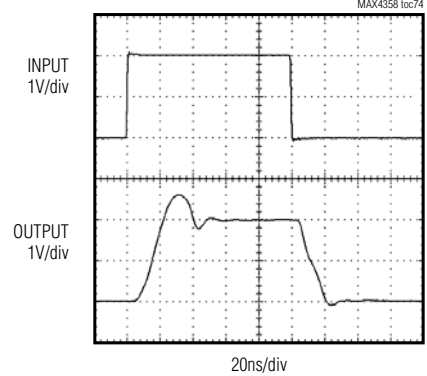
**DIFFERENTIAL GAIN AND PHASE**  
( $R_L = 150\Omega$ )



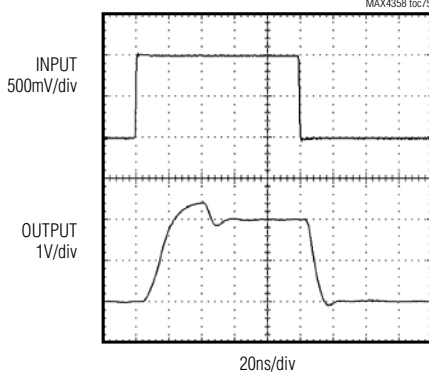
**DIFFERENTIAL GAIN AND PHASE**  
( $R_L = 1k\Omega$ )



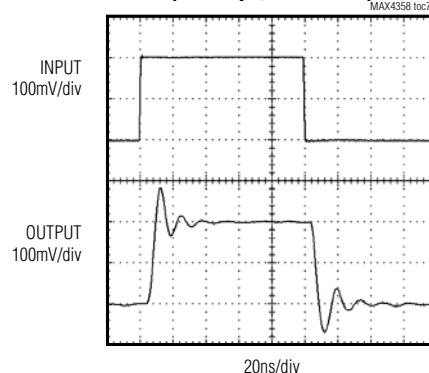
**LARGE-SIGNAL PULSE RESPONSE WITH CAPACITIVE LOAD**  
( $C_L = 30pF$ ,  $A_V = +1V/V$ )



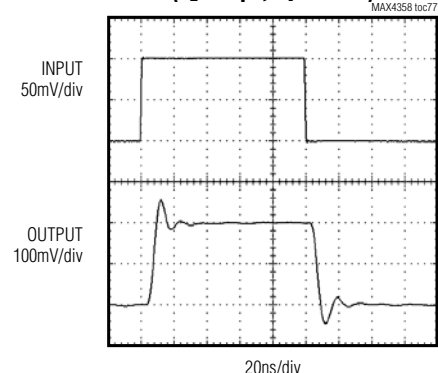
**LARGE-SIGNAL PULSE RESPONSE WITH CAPACITIVE LOAD**  
( $C_L = 30pF$ ,  $A_V = +2V/V$ )



**MEDIUM-SIGNAL PULSE RESPONSE WITH CAPACITIVE LOAD**  
( $C_L = 30pF$ ,  $A_V = +1V/V$ )



**MEDIUM-SIGNAL PULSE RESPONSE WITH CAPACITIVE LOAD**  
( $C_L = 30pF$ ,  $A_V = +2V/V$ )

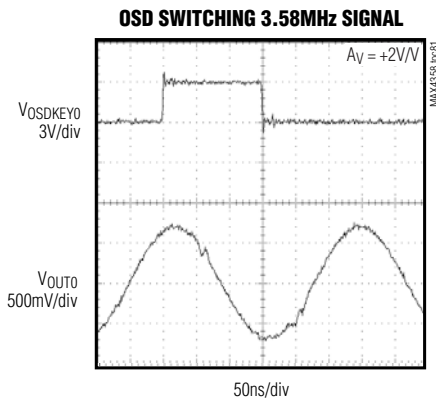
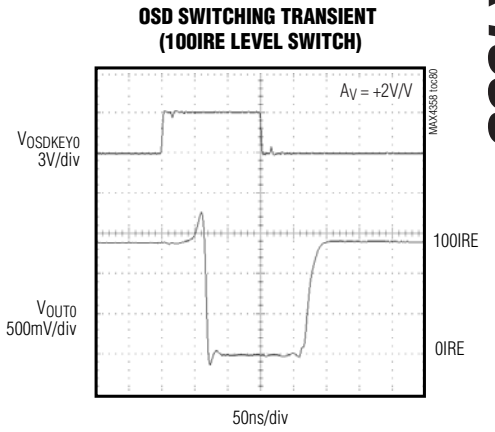
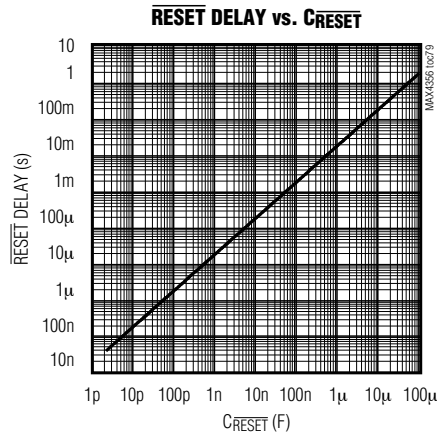
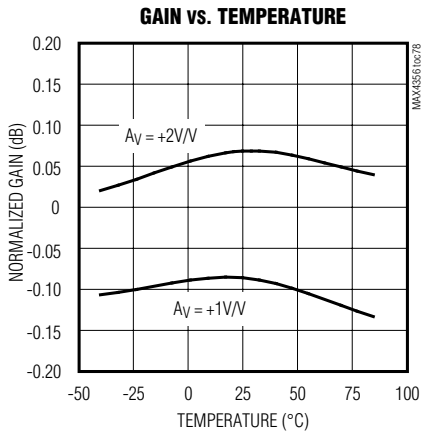




# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Dual Supplies ±3V (continued)

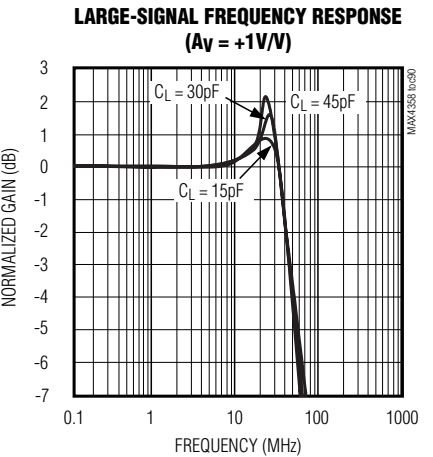
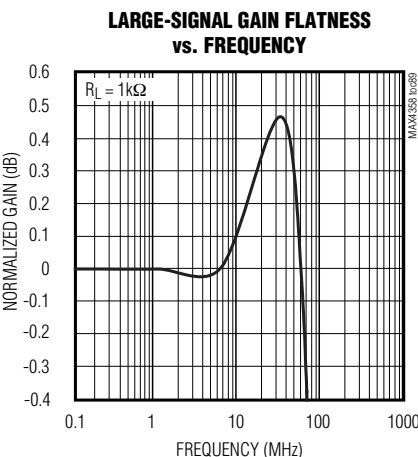
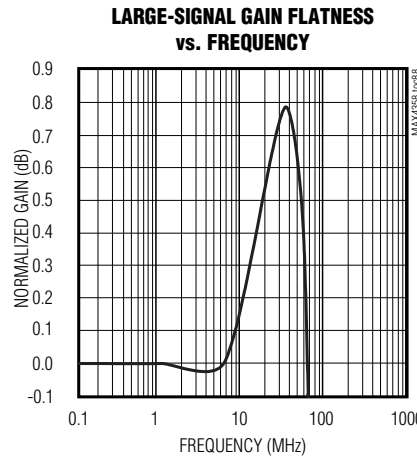
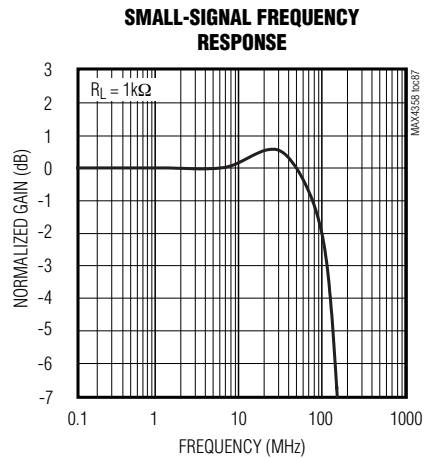
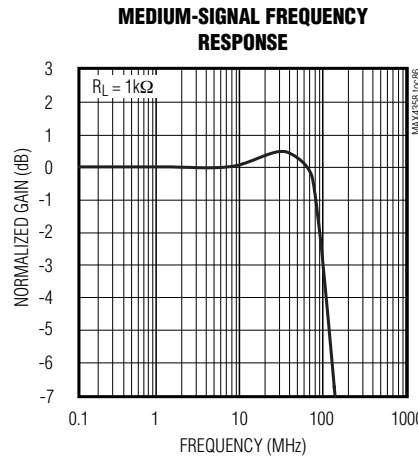
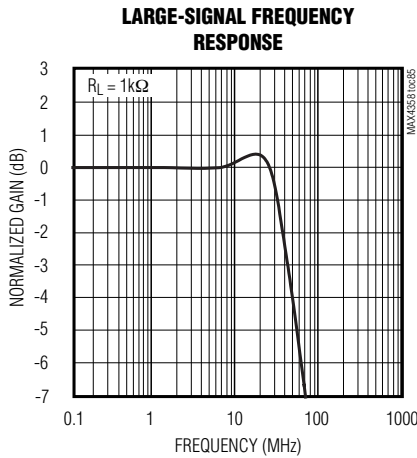
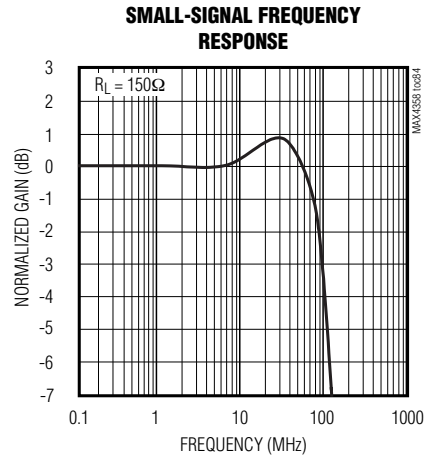
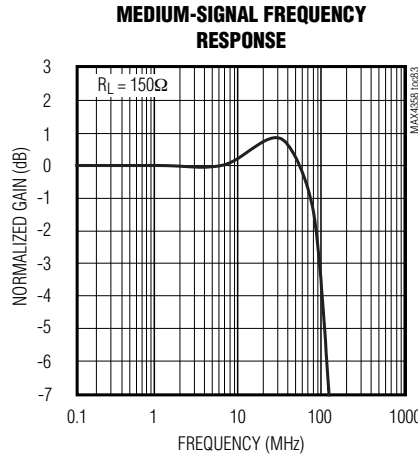
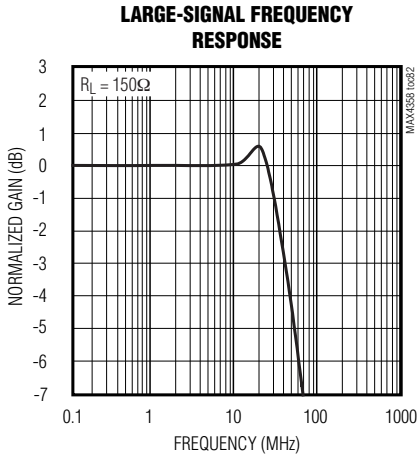
( $V_{CC} = +3V$  and  $V_{EE} = -3V$ ,  $V_{DD} = +3V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

## Typical Operating Characteristics—Single Supply +5V

( $V_{CC} = +5V$  and  $V_{EE} = 0$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN\_} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)



# 32 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

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

( $V_{CC} = +5V$  and  $V_{EE} = 0$ ,  $V_{DD} = +5V$ ,  $AGND = DGND = 0$ ,  $V_{IN-} = 0$ ,  $R_L = 150\Omega$  to  $AGND$ ,  $A_V = +1V/V$ , and  $T_A = +25^\circ C$ , unless otherwise noted.)

