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

General Description

The MAX4356 is a 16 x 16 highly integrated video crosspoint switch matrix with input and output buffers and On-Screen Display (OSD) Insertion. This device operates from dual $\pm 3V$ to $\pm 5V$ 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 75 Ω reverse-terminated video loads.

The switch matrix configuration and output buffer gain are programmed via 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.

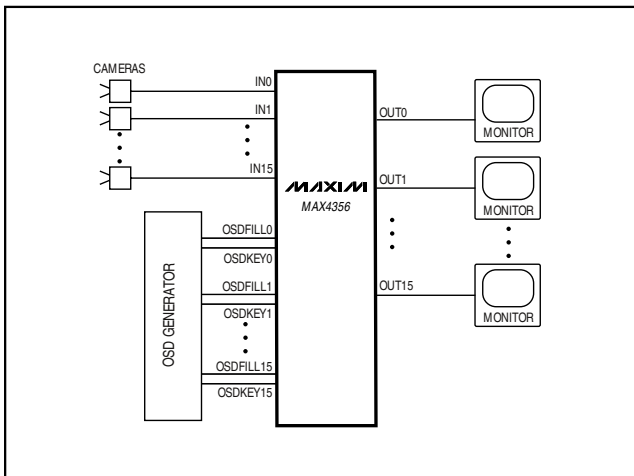
Superior flexibility, high integration, and space-saving packaging make this nonblocking switch matrix ideal for routing video signals in security and video-on-demand systems.

The MAX4356 is available in a 128-pin TQFP package and specified over an extended -40°C to 85°C temperature range.

Applications

- Security Systems
- Video Routing
- Video-on-Demand Systems

Typical Operating Circuit



SPI and QSPI are trademarks of Motorola, Inc.

Features

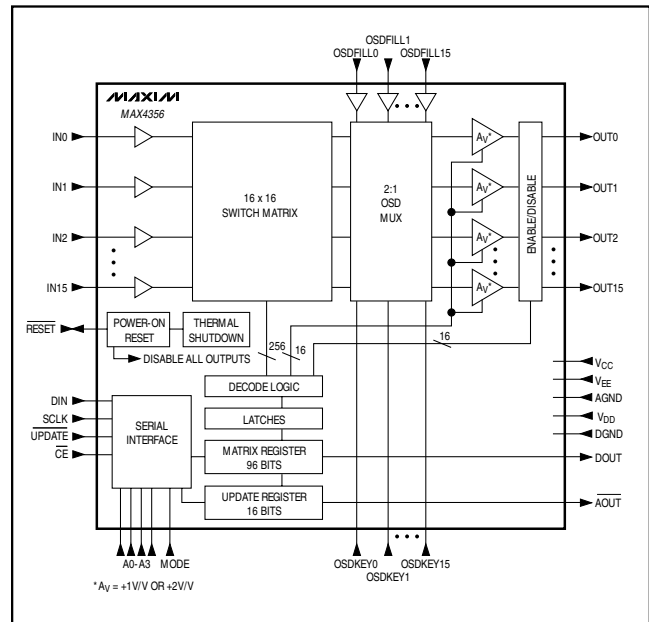
- ◆ 16 x 16 Nonblocking Matrix with Buffered Inputs and Outputs
- ◆ Operates from $\pm 3V$, $\pm 5V$, or +5V Supplies
- ◆ Individually Programmable Output Buffer Gain ($A_V = +1V/V$ or $+2V/V$)
- ◆ High-Impedance Output Disable for Wired-OR Connections
- ◆ Fast-Switching (40ns) 2:1 OSD Insertion Mux
- ◆ 0.1dB Gain Flatness to 14MHz
- ◆ -62dB Crosstalk, -110dB Isolation at 6MHz
- ◆ 0.02%/0.12° Differential Gain/Differential Phase Error
- ◆ Low 195mW Power Consumption (0.76mW per Point)

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX4356ECD	-40°C to +85°C	128 TQFP

Pin Configuration appears at end of data sheet.

Functional Diagram



16 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 ($IN_OSDFILL_$)±50mA
 Current into Any Analog Output Pin ($OUT_$)±75mA
 Continuous Power Dissipation ($T_A = +70^\circ C$)2W
 128-Pin TQFP (derate 25mW/ $^\circ C$ above +70 $^\circ C$)2W
 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 ±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	

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

DC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES $\pm 5V$ (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
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
			$R_L = 150\Omega$	$V_{EE} + 2.5$		$V_{CC} - 2.5$	
		$A_V = +2V/V$	$R_L = 10k\Omega$	$V_{EE} + 3$		$V_{CC} - 3.1$	
			$R_L = 150\Omega$	$V_{EE} + 3.75$		$V_{CC} - 3.75$	
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	μA
Input Resistance	R_{IN}	$(V_{EE} + 1V) < V_{IN_} < (V_{CC} - 1.2V)$		10			$M\Omega$
Output Offset Voltage	V_{OFFSET}	$A_V = +1V/V$		± 5		± 20	mV
		$A_V = +2V/V$		± 10		± 40	
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			Ω
Output Leakage Current, Disable Mode	I_{OD}	$(V_{EE} + 1V) < V_{OUT_} < (V_{CC} - 1.2V)$		0.004		1	μA
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		

16 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	2.000	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	μA
Input Resistance	R_{IN}	$(V_{EE} + 1V) < V_{IN_} < (V_{CC} - 1.2V)$			10		$M\Omega$
Output Offset Voltage	V_{OFFSET}	$A_V = +1V/V$			± 5	± 20	mV
		$A_V = +2V/V$			± 10	± 40	

16 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		Ω
Output Leakage Current, Disable Mode	I_{OD}	$(V_{EE} + 1V) < V_{OUT_} < (V_{CC} - 1.2V)$			0.004	1	μA
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
		$(V_{EE} + 1V) < V_{IN_} < (V_{CC} - 1.2V)$, $A_V = +1V/V$, $R_L = 10k\Omega$		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
			$R_L = 150\Omega$	$V_{EE} + 1$		$V_{CC} - 2.5$	

16 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
Output Voltage Range	V_{OUT}	$A_V = +1V/V$, $R_L = 10k\Omega$		$V_{EE} + 1$		$V_{CC} - 1.2$	V
		$A_V = +1V/V$, $R_L = 150\Omega$		$V_{EE} + 1$		$V_{CC} - 2.5$	
Input Bias Current	I_B				4	11	μA
Input Resistance	R_{IN}	$V_{EE} + 1V < V_{IN_} < V_{CC} - 1.2V$			10		$M\Omega$
Output Offset Voltage	V_{OFFSET}	$A_V = +1V/V$			± 10	± 40	mV
Output Short-Circuit Current	I_{SC}	Sinking or sourcing, $R_L = 1\Omega$			± 35		mA
Enabled Output Impedance	Z_{OUT}	$(V_{EE} + 1V) < V_{IN_} < (V_{CC} - 1.2V)$			0.2		Ω
Output Leakage Current, Disable Mode	I_{OD}	$(V_{EE} + 1V) < V_{OUT_} < (V_{CC} - 1.2V)$			0.004	1	μA
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			

16 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 = 150 Ω 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
		$V_{DD} = +2.7V$		2			
Input Voltage Low Level	V_{IL}	$V_{DD} = +5.0V$				0.8	V
		$V_{DD} = +2.7V$				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
		$V_{DD} = +3V, V_O = +2.7V$		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 $\pm 5V$

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

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Small-Signal -3dB Bandwidth	BW_{SS}	$V_{OUT} = 20mVp-p$	$A_V = +1V/V$		110		MHz
			$A_V = +2V/V$		78		
Medium-Signal -3dB Bandwidth	BW_{MS}	$V_{OUT_} = 200mVp-p$	$A_V = +1V/V$		80		MHz
			$A_V = +2V/V$		75		
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	$BW_{0.1dB-SS}$	$V_{OUT} = 20mVp-p$	$A_V = +1V/V$		14		MHz
			$A_V = +2V/V$		11		
Medium-Signal 0.1dB Bandwidth	$BW_{0.1dB-MS}$	$V_{OUT_} = 200mVp-p$	$A_V = +1V/V$		14		MHz
			$A_V = +2V/V$		11		
Large-Signal 0.1dB Bandwidth	$BW_{0.1dB-LS}$	$V_{OUT_} = 2Vp-p$	$A_V = +1V/V$		14		MHz
			$A_V = +2V/V$		11		
Slew Rate	SR	$V_{OUT_} = 2V$ step, $A_V = +1V/V$			150		V/ μs
		$V_{OUT_} = 2V$ step, $A_V = +2V/V$			150		

16 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 $AGND$, $A_V = +1V/V$, and $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Settling Time	$t_S 0.1\%$	$V_{OUT_} = 0$ 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
			$A_V = +2V/V$		45		
AC Power-Supply Rejection Ratio			$f = 100kHz$		70		dB
			$f = 1MHz$		68		
Differential Gain Error (Note 4)			$R_L = 1k\Omega$		0.002		%
			$R_L = 150\Omega$		0.02		
Differential Phase Error (Note 4)			$R_L = 1k\Omega$		0.02		degrees
			$R_L = 150\Omega$		0.12		
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		μV_{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		Ω
			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}	$V_{OUT_} = 20mV_{p-p}$	$A_V = +1V/V$		110		MHz
			$A_V = +2V/V$		70		
Medium-Signal -3dB Bandwidth	BW_{MS}	$V_{OUT_} = 200mV_{p-p}$	$A_V = +1V/V$		110		MHz
			$A_V = +2V/V$		70		
Large-Signal -3dB Bandwidth	BW_{LS}	$V_{OUT_} = 2V_{p-p}$	$A_V = +1V/V$		32		MHz
			$A_V = +2V/V$		38		
Small-Signal 0.1dB Bandwidth	$BW_{0.1dB-SS}$	$V_{OUT_} = 20mV_{p-p}$	$A_V = +1V/V$		12		MHz
			$A_V = +2V/V$		12		
Medium-Signal 0.1dB Bandwidth	$BW_{0.1dB-MS}$	$V_{OUT_} = 200mV_{p-p}$	$A_V = +1V/V$		12		MHz
			$A_V = +2V/V$		12		
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		

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

MAX4356

AC ELECTRICAL CHARACTERISTICS—DUAL SUPPLIES ±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 $A_V = +1V/V$			125		V/ μs
		$V_{OUT_} = 2V$ step $A_V = +2V/V$			125		
Settling Time	$t_{S0.1\%}$	$V_O = 0$ to $2V$ step	$A_V = +1V/V$		60		ns
			$A_V = +2V/V$		60		
Switching Transient (Glitch) (Note 3)		$A_V = +1V/V$			20		mV
		$A_V = +2V/V$			20		
AC Power-Supply Rejection Ratio		$f = 100kHz$			72		dB
		$f = 1MHz$			71		
Differential Gain Error (Note 4)		$R_L = 1k\Omega$			0.02		%
		$R_L = 150\Omega$			0.15		
Differential Phase Error (Note 4)		$R_L = 1k\Omega$			0.05		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		μV_{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		Ω
			Output disabled		4k		

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

AC ELECTRICAL CHARACTERISTICS—SINGLE SUPPLY +5V

($V_{CC} = +5V$, $V_{EE} = 0$, $V_{DD} = +5V$, $AGND = DGND = 0$, $V_{IN_} = V_{OSDFILL_} = 1.75V$, $R_L = 150\Omega$ 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 _{SS}	$V_{OUT_} = 20mVp-p$		100		MHz
Medium-Signal -3dB Bandwidth	BW _{MS}	$V_{OUT_} = 200mVp-p$		100		MHz
Large-Signal -3dB Bandwidth	BW _{LS}	$V_{OUT_} = 1.5Vp-p$		40		MHz
Small-Signal 0.1dB Bandwidth	BW _{0.1dB-SS}	$V_{OUT_} = 20mVp-p$		10		MHz
Medium-Signal 0.1dB Bandwidth	BW _{0.1dB-MS}	$V_{OUT_} = 200mVp-p$		12		MHz
Large-Signal 0.1dB Bandwidth	BW _{0.1dB-LS}	$V_{OUT_} = 1.5Vp-p$		14		MHz
Slew Rate	SR	$V_{OUT_} = 2V$ step, $A_v = +1V/V$		100		V/ μs
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)		$R_L = 1k\Omega$		0.1		%
		$R_L = 150\Omega$		0.2		
Differential Phase Error (Note 4)		$R_L = 1k\Omega$		0.05		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 Density	e_n	$BW = 6MHz$		73		μV_{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		Ω
			Output disabled	4k		

16 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 = 150Ω to AGND, C_L = 100pF, A_v = +1V/V, and T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Delay: $\overline{\text{UPDATE}}$ to Video Out	t _{PdUdVo}	V _{IN} = 0.5V step		200	450	ns
Delay: $\overline{\text{UPDATE}}$ to $\overline{\text{AOUT}}$	t _{PdUdAo}	MODE = 0, time to $\overline{\text{AOUT}}$ = low after $\overline{\text{UPDATE}}$ = 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 _{PdHOe}	V _{OUT} = 0.5V, 1kΩ pulldown to AGND		300	800	ns
Delay: Output Enable	t _{PdLOe}	Output disabled, 1kΩ pulldown to AGND, V _{IN} = 0.5V		200	800	ns
Setup: $\overline{\text{CE}}$ 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: $\overline{\text{UPDATE}}$	t _{MnLUd}		100			ns
Setup Time: $\overline{\text{UPDATE}}$ to SCLK	t _{SuHUd}	Rising edge of $\overline{\text{UPDATE}}$ to falling edge of SCLK	100			ns
Hold Time: SCLK to $\overline{\text{UPDATE}}$	t _{HdHUd}	Falling edge of SCLK to falling edge of $\overline{\text{UPDATE}}$	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: $\overline{\text{RESET}}$	t _{MnLRst}				300	ns
Delay: $\overline{\text{RESET}}$	t _{PdRst}	10kΩ pulldown to AGND, 0.5V step			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, $\overline{\text{CE}}$, $\overline{\text{UPDATE}}$, $\overline{\text{RESET}}$, A3–A0, MODE, $\overline{\text{AOUT}}$, 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 T_A = +25°C. Specifications over temperature limits are guaranteed by design.

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

Symbol Definitions

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

Naming Conventions

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

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

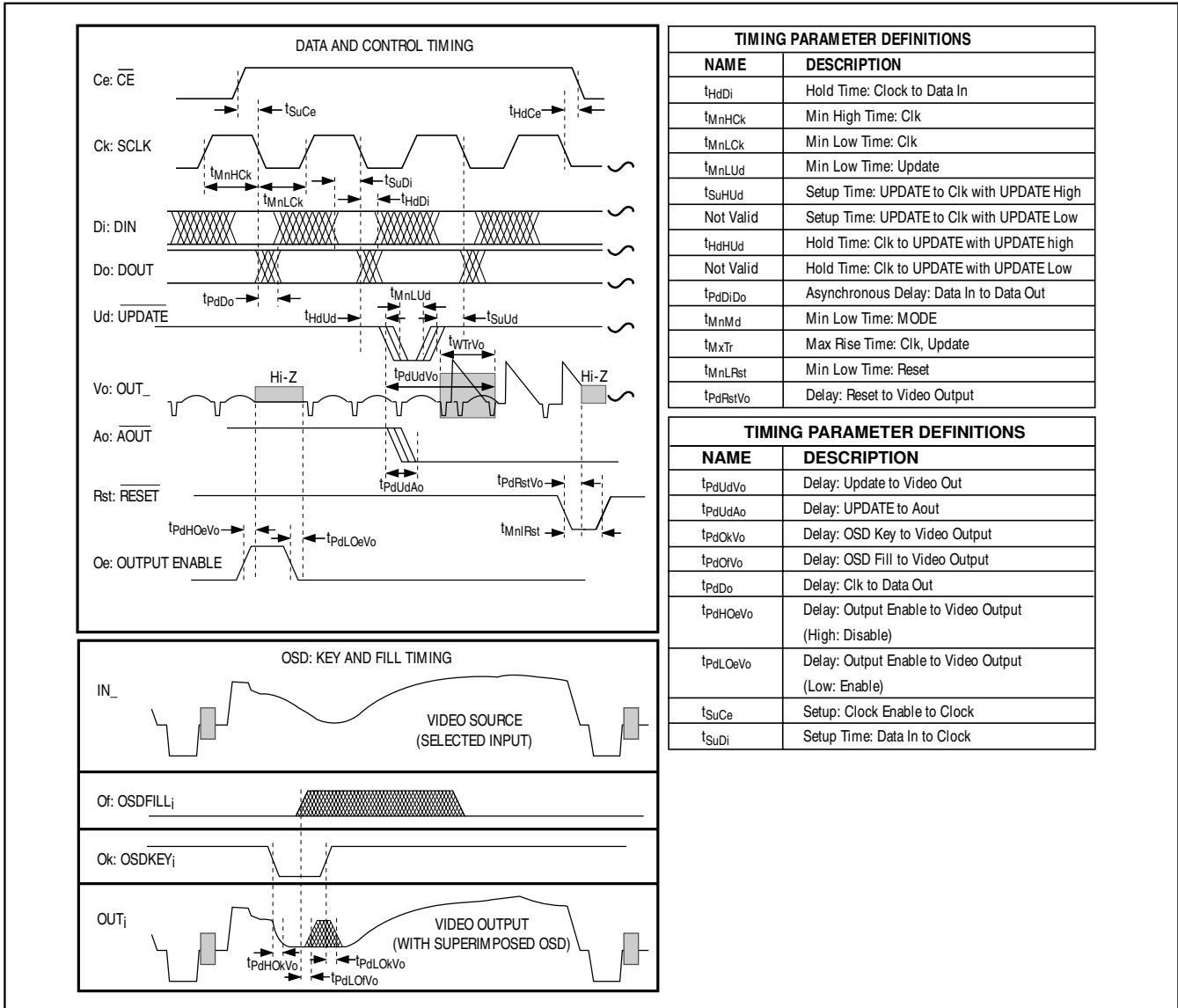
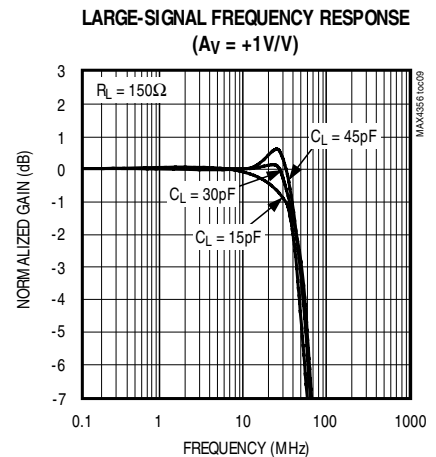
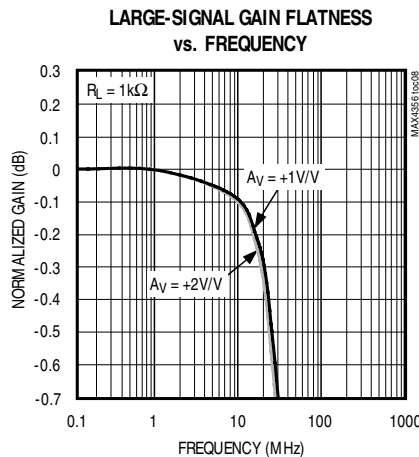
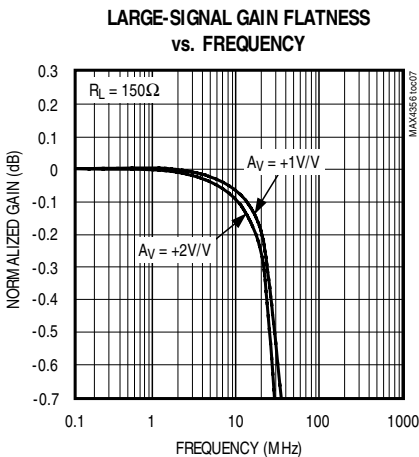
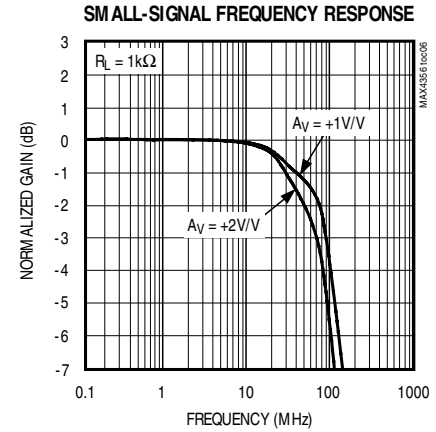
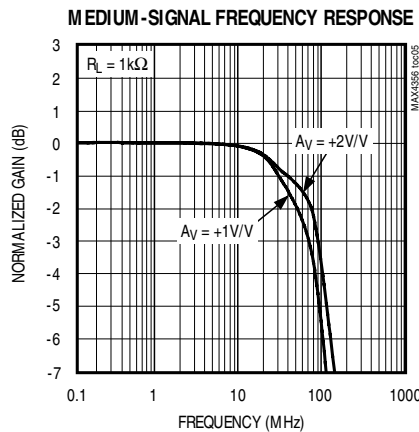
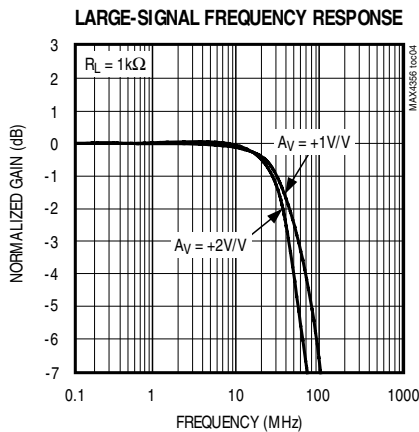
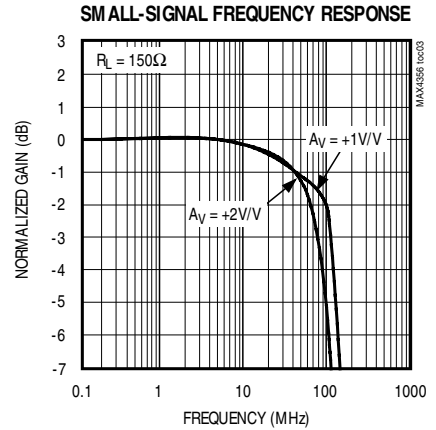
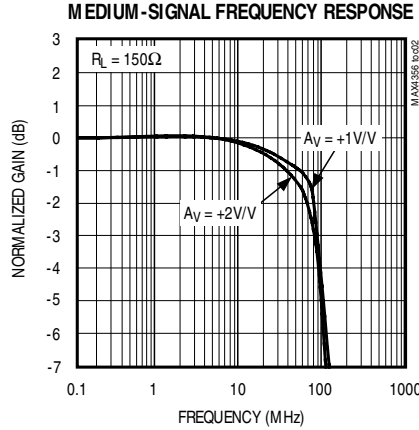
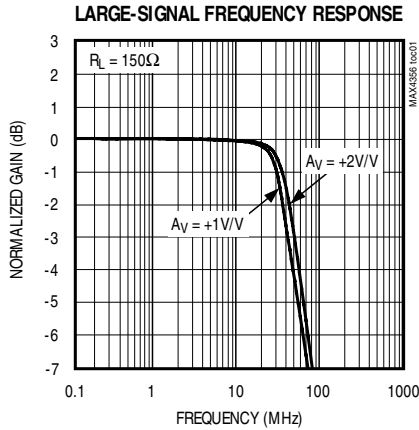


Figure 1. Timing Diagram

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

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

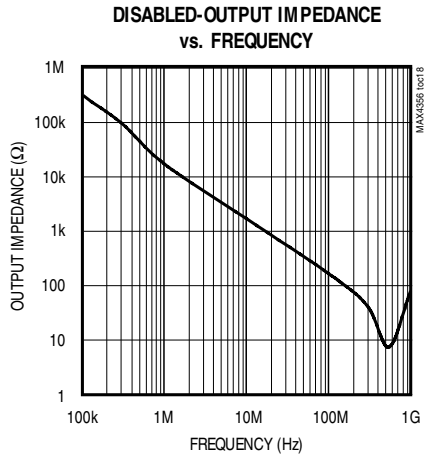
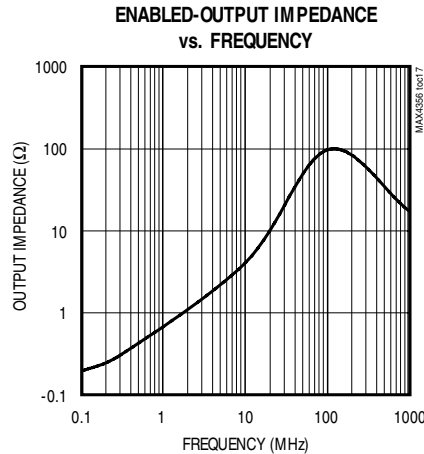
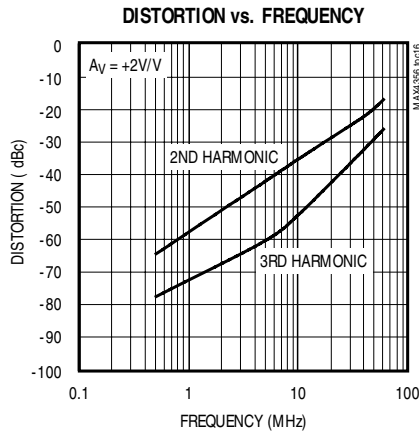
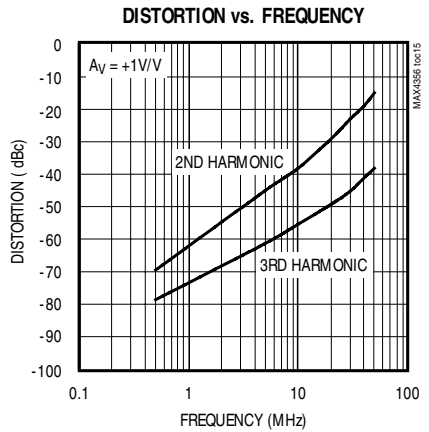
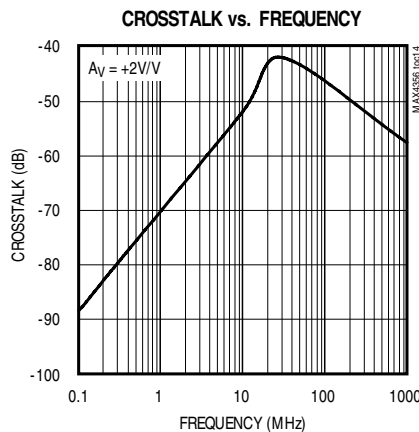
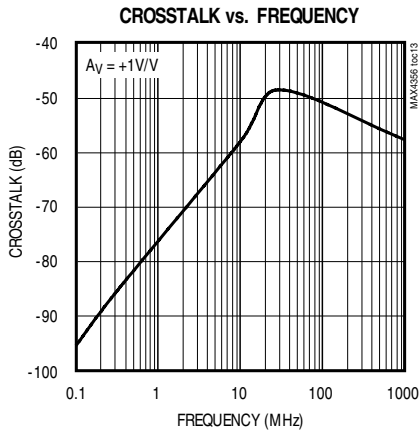
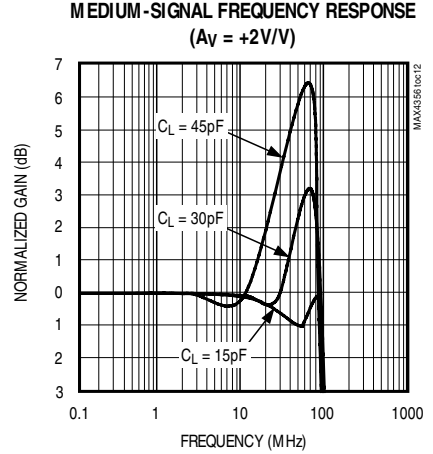
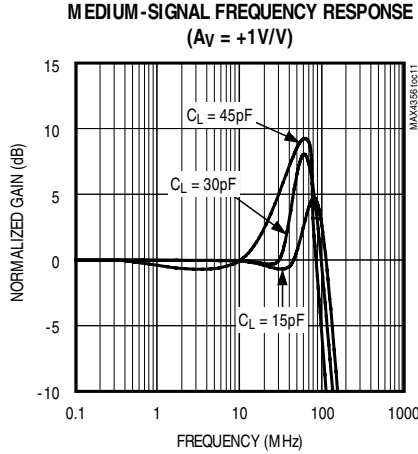
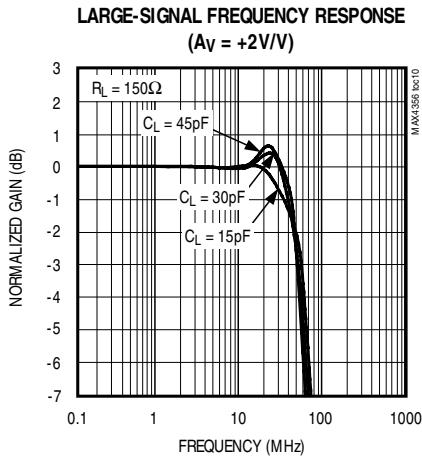
($V_{CC} = +5V$ and $V_{EE} = -5V$, $V_{DD} = +5V$, $AGND = DGND = 0$, $V_{IN-} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

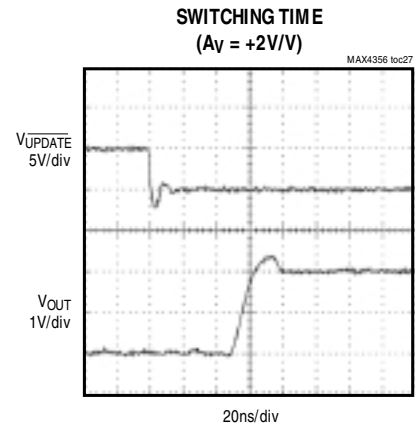
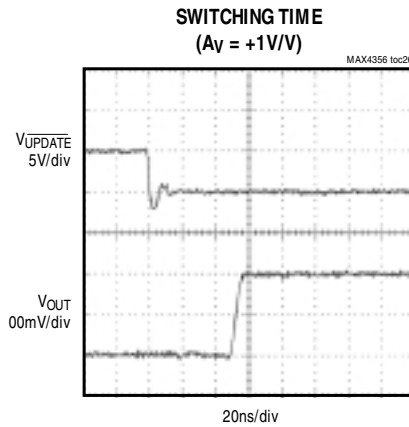
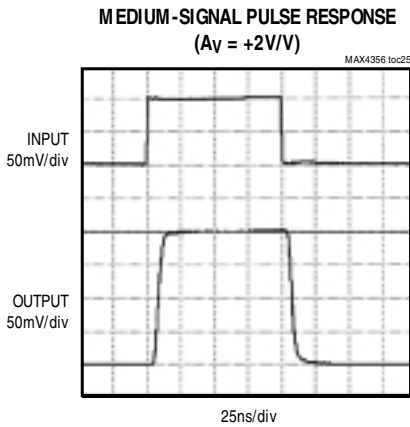
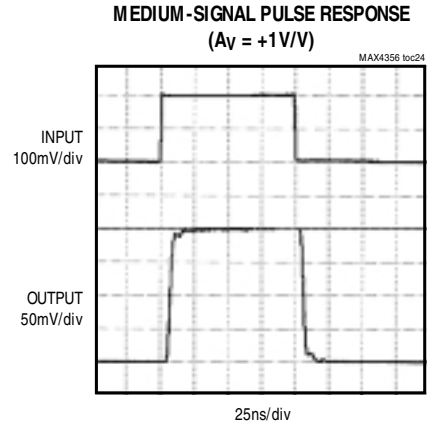
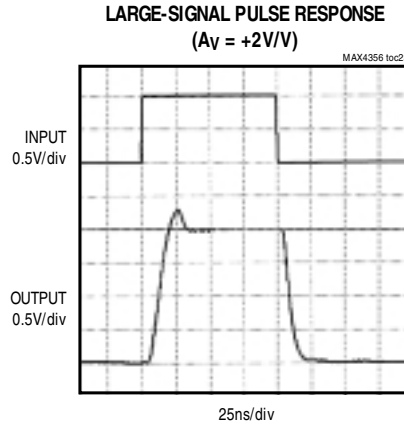
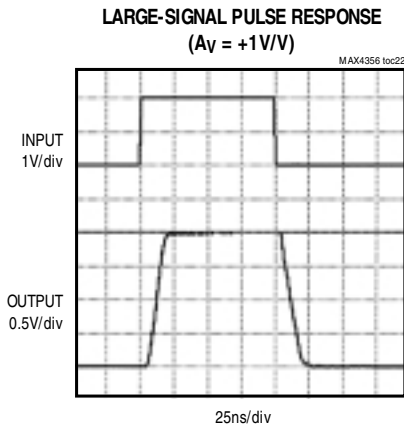
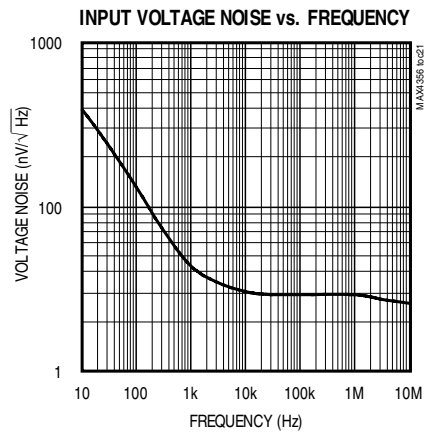
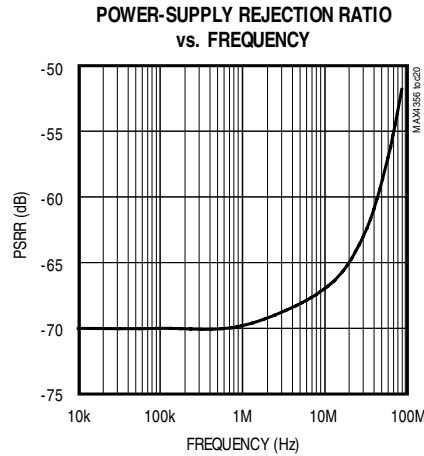
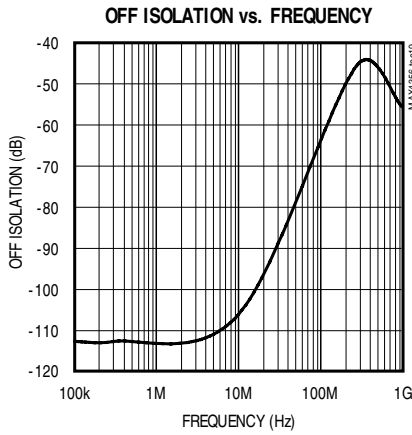
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16 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

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

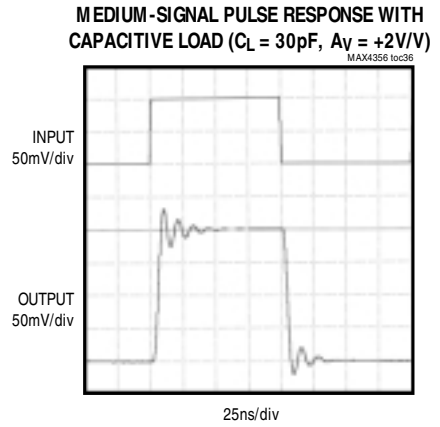
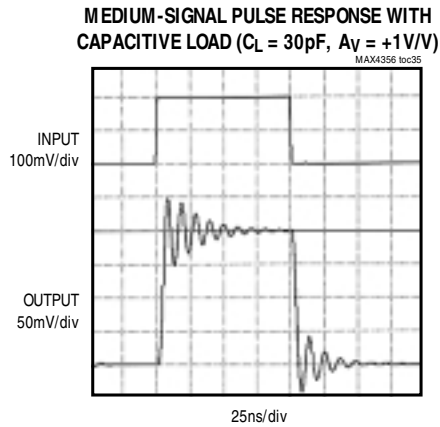
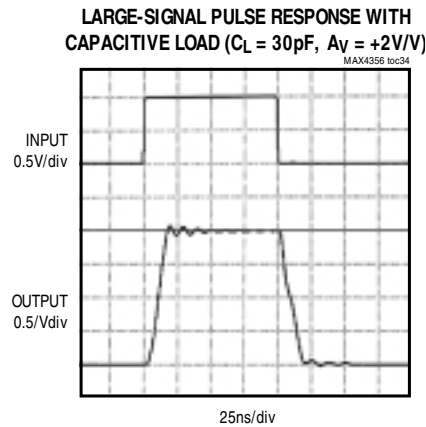
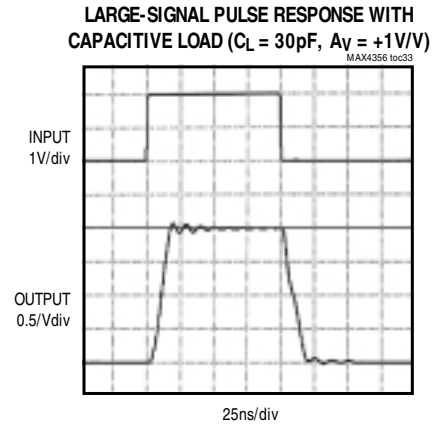
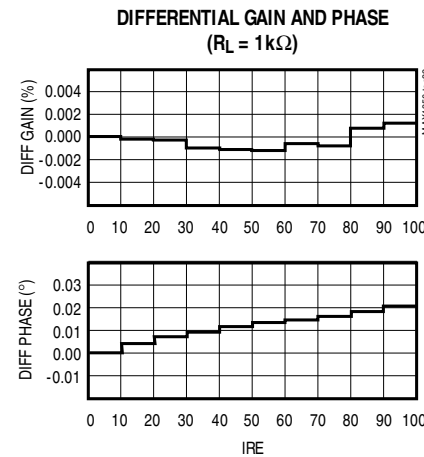
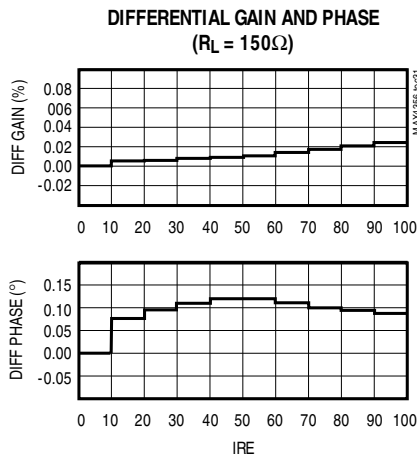
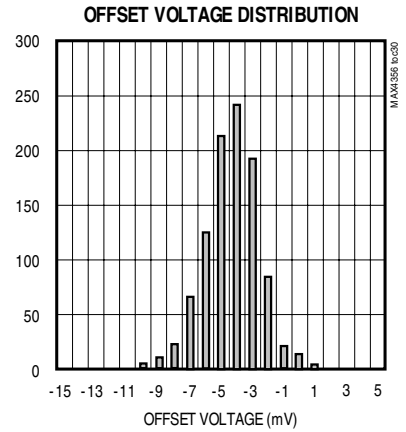
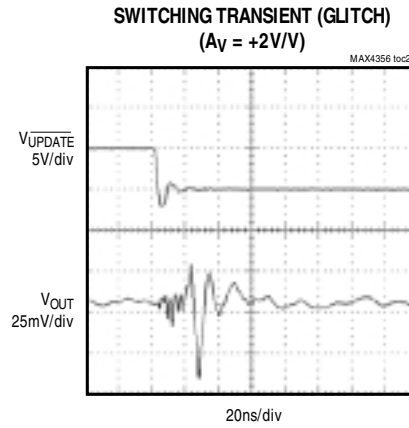
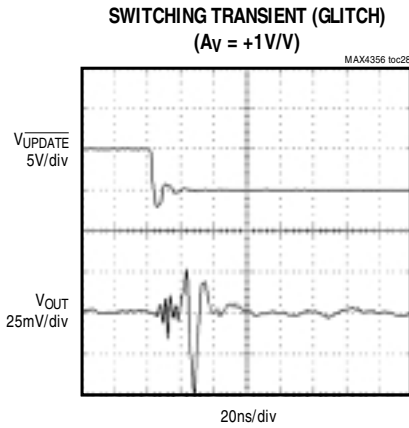
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16 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

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

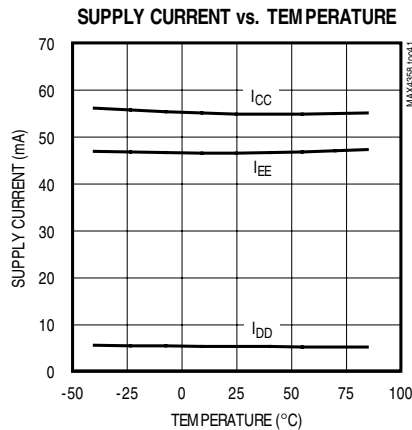
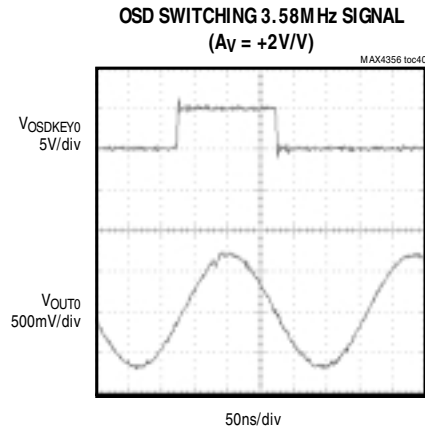
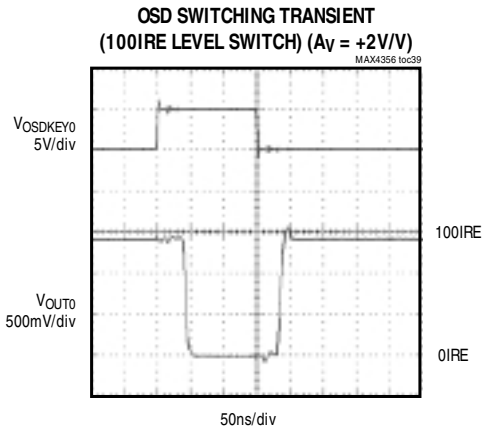
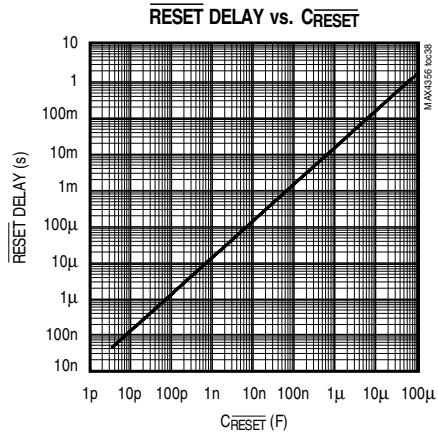
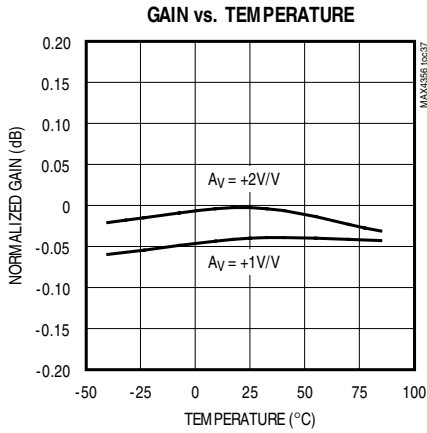
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16 x 16 Nonblocking Video Crosspoint Switch with On-Screen Display Insertion and I/O Buffers

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

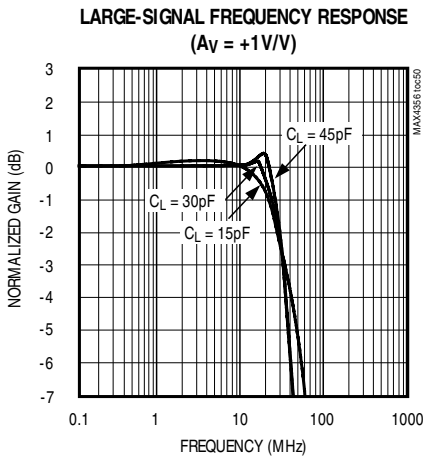
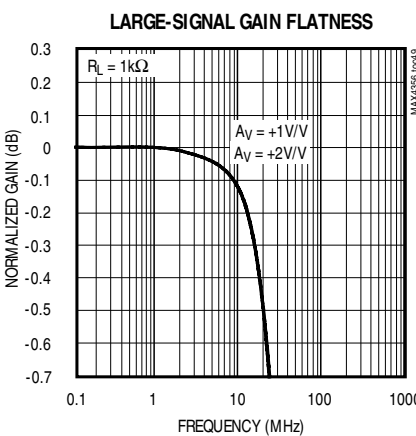
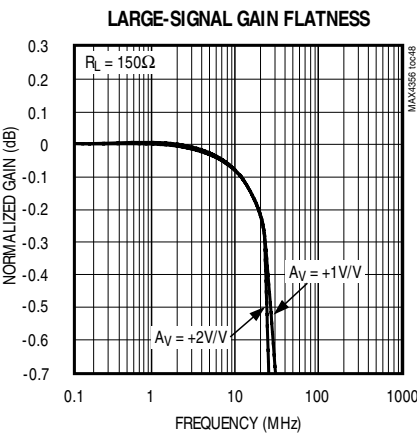
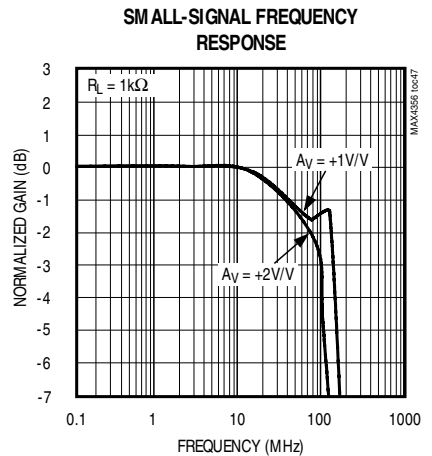
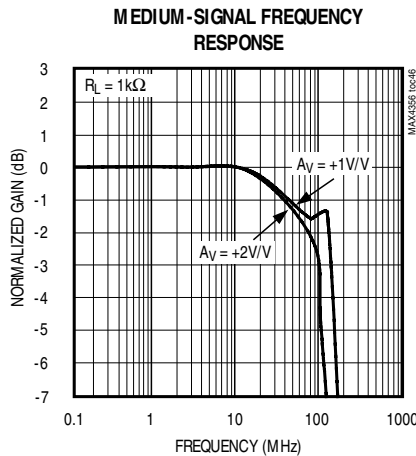
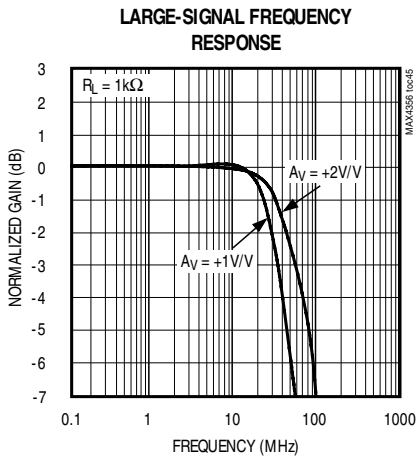
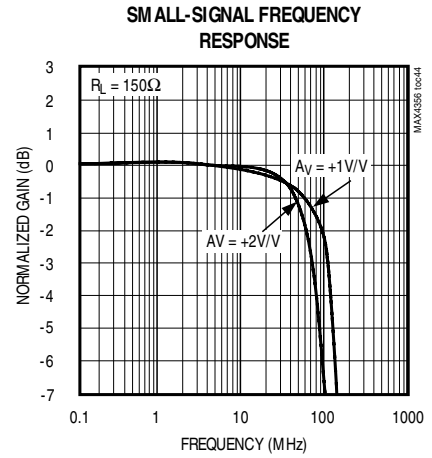
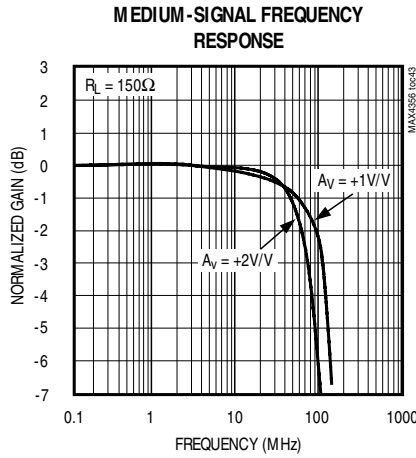
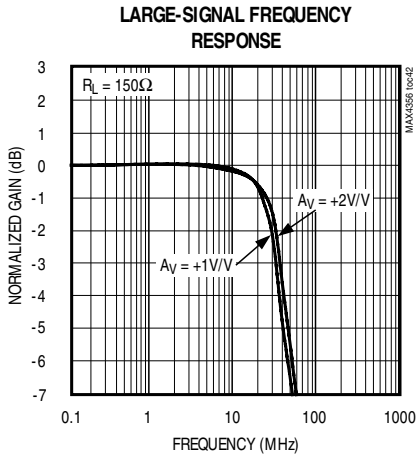
($V_{CC} = +5V$ and $V_{EE} = -5V$, $V_{DD} = +5V$, $AGND = DGND = 0$, $V_{IN_} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

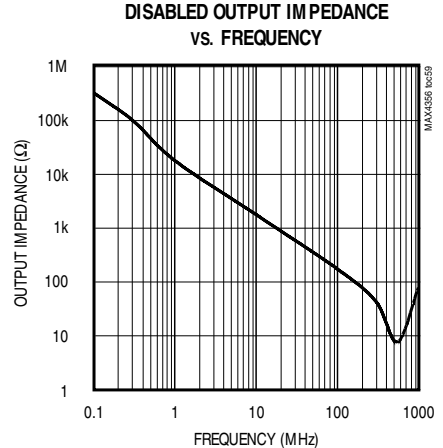
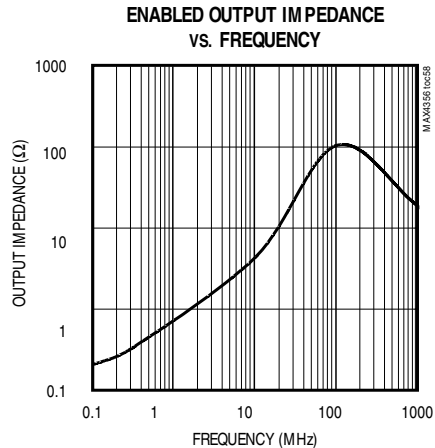
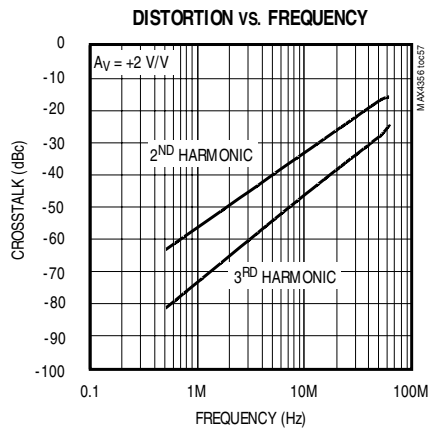
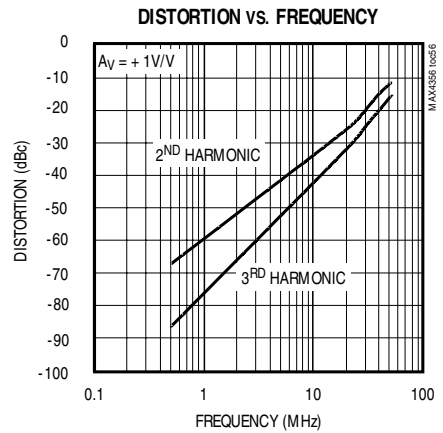
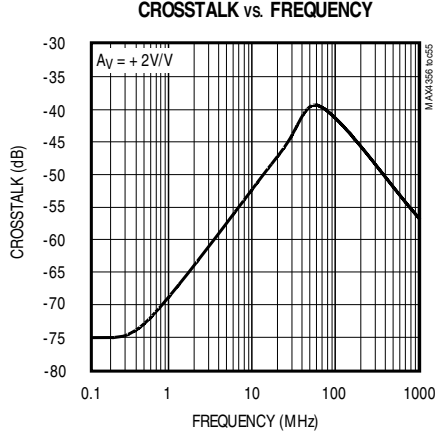
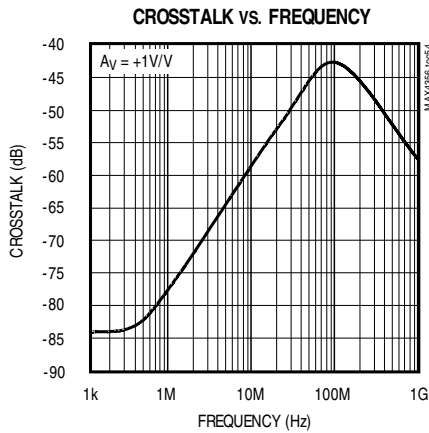
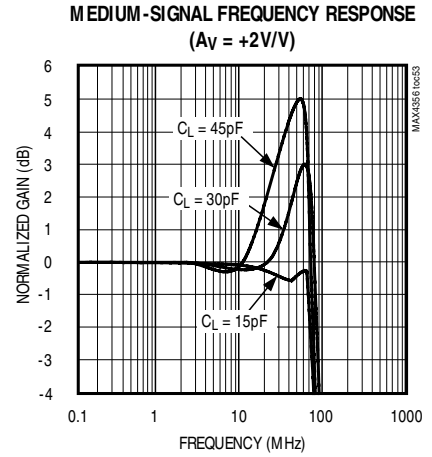
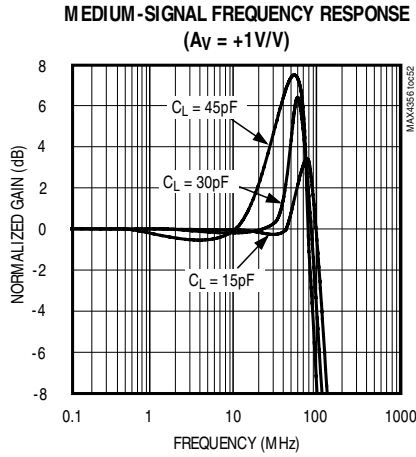
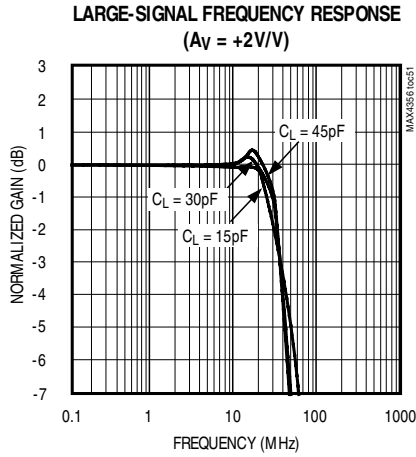
($V_{CC} = +3V$ and $V_{EE} = -3V$, $V_{DD} = +3V$, $AGND = DGND = 0$, $V_{IN-} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

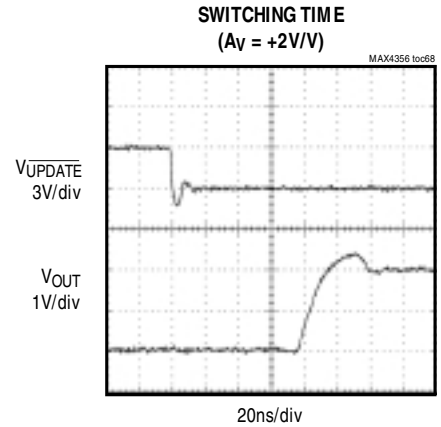
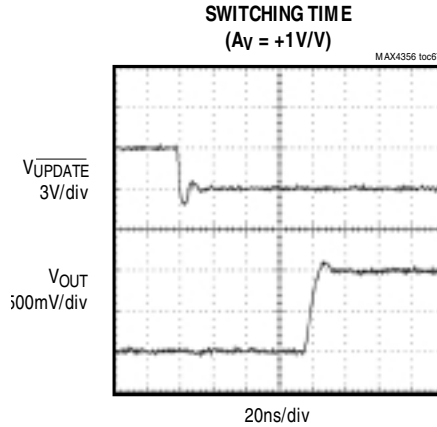
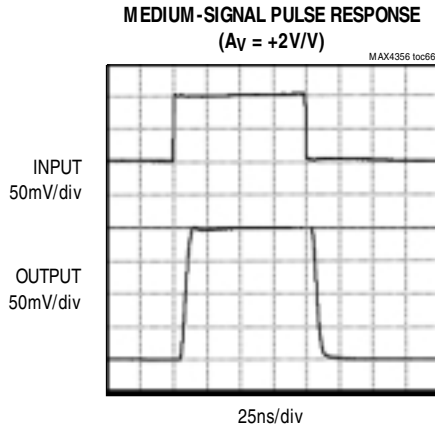
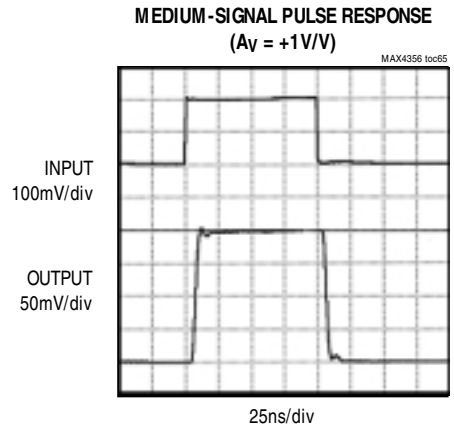
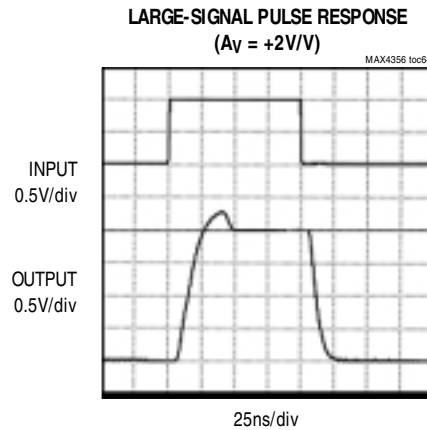
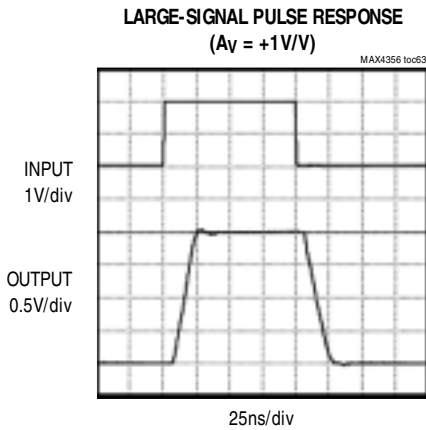
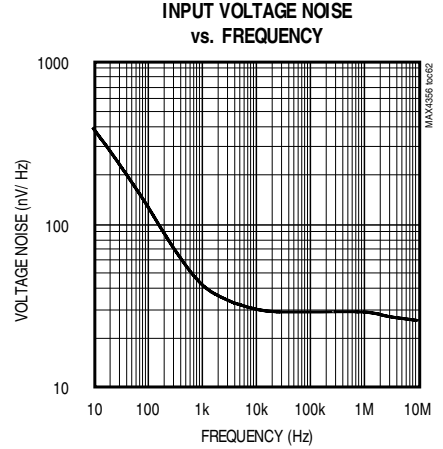
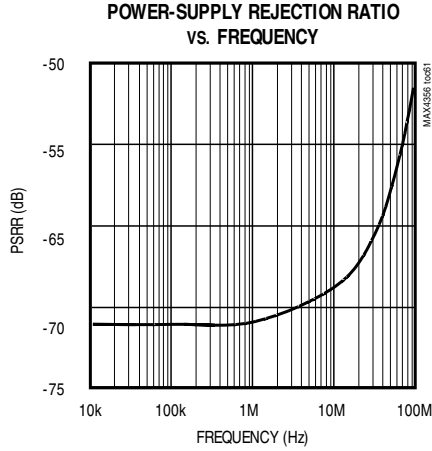
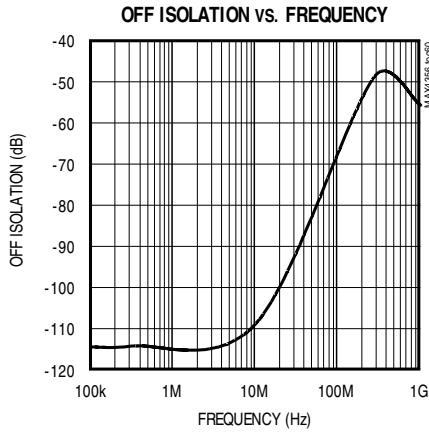
($V_{CC} = +3V$ and $V_{EE} = -3V$, $V_{DD} = +3V$, $AGND = DGND = 0$, $V_{IN_} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

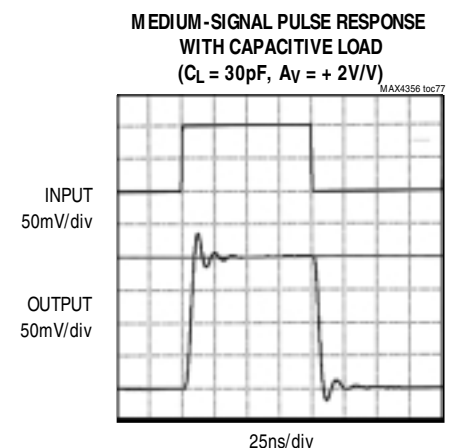
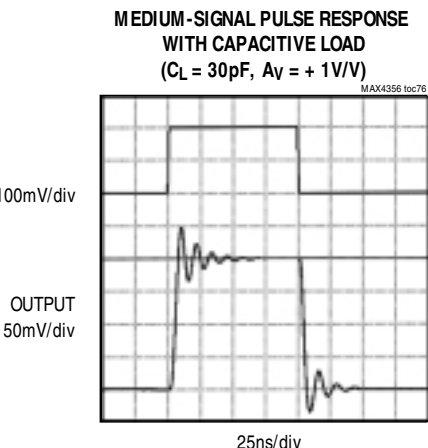
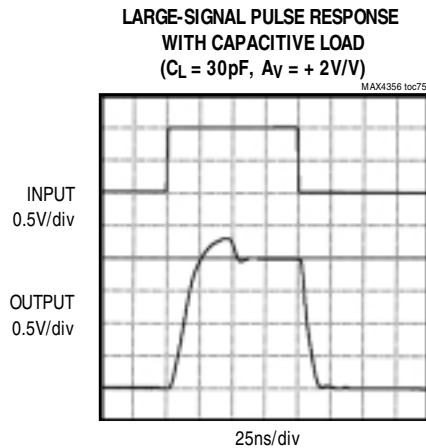
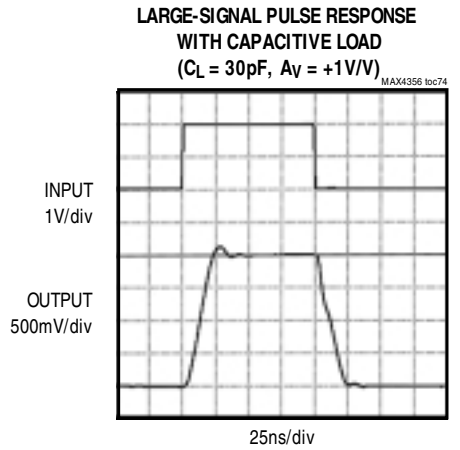
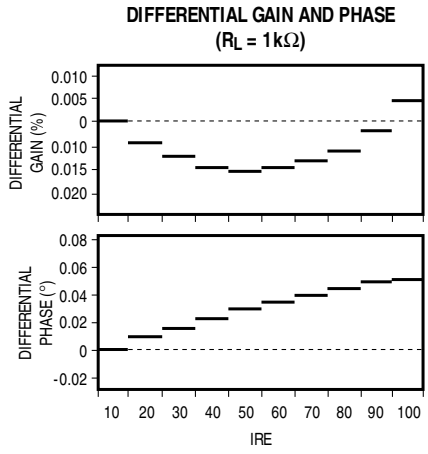
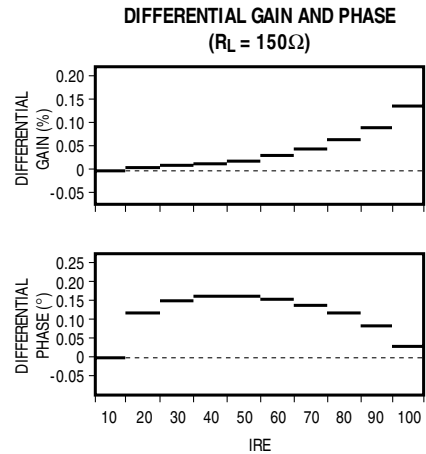
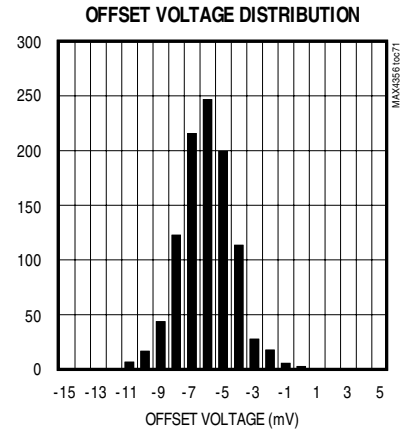
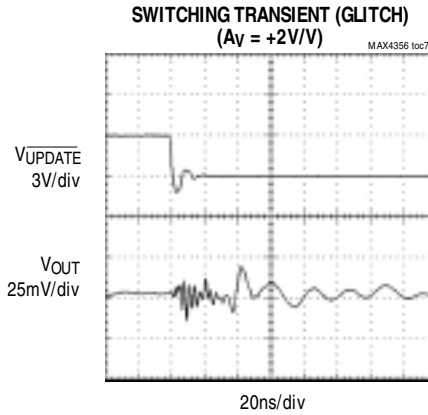
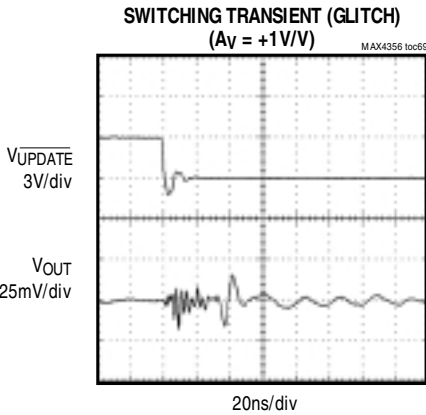
($V_{CC} = +3V$ and $V_{EE} = -3V$, $V_{DD} = +3V$, $AGND = DGND = 0$, $V_{IN_} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

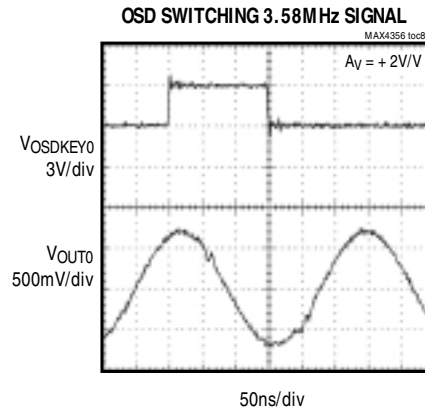
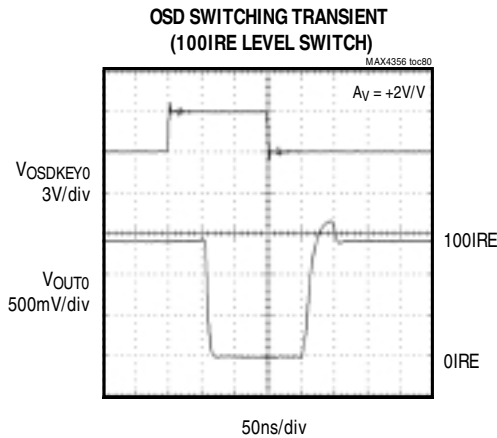
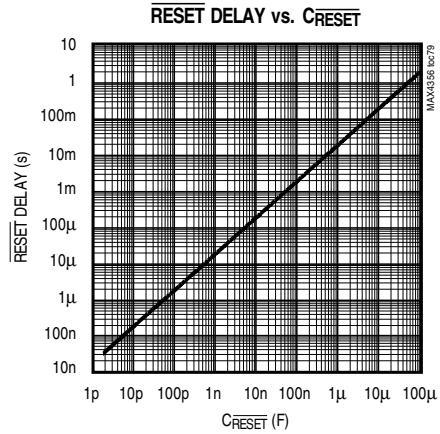
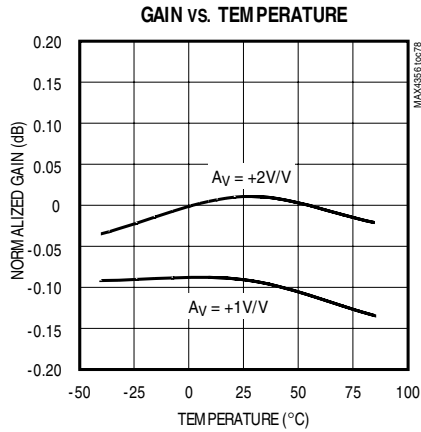
($V_{CC} = +3V$ and $V_{EE} = -3V$, $V_{DD} = +3V$, $AGND = DGND = 0$, $V_{IN_} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



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

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

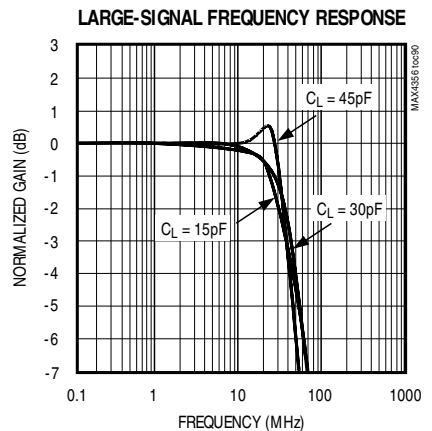
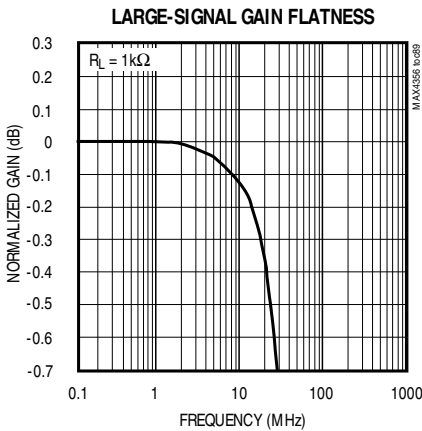
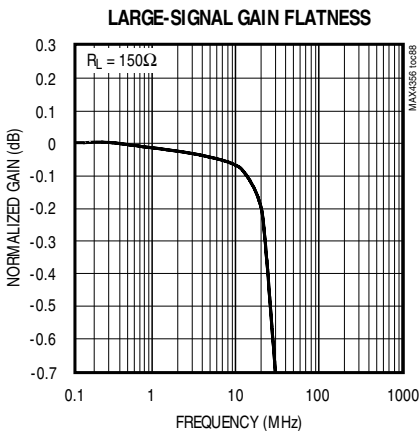
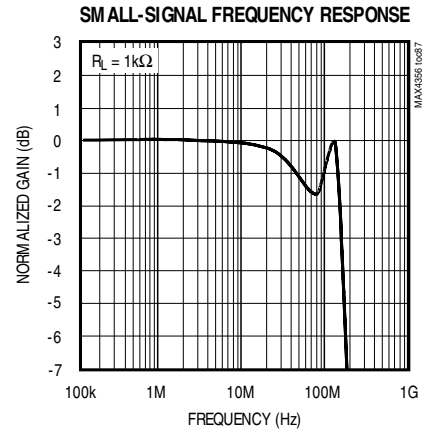
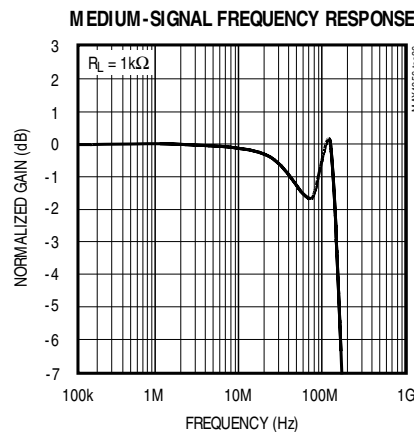
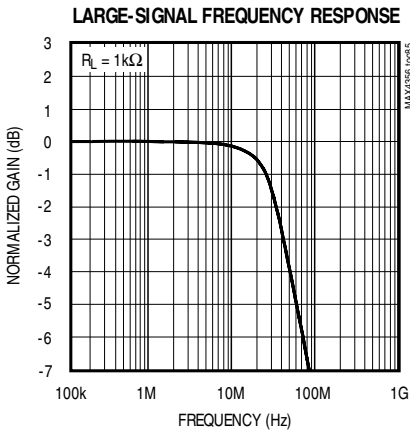
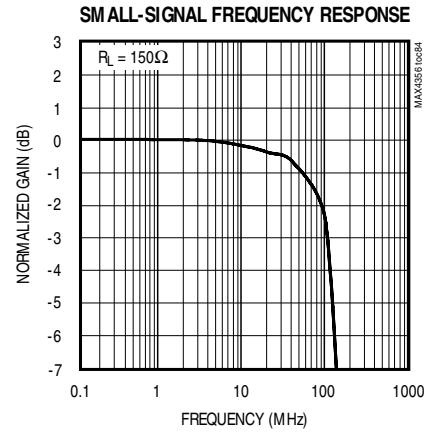
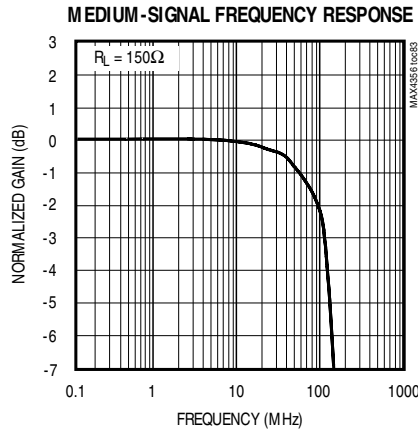
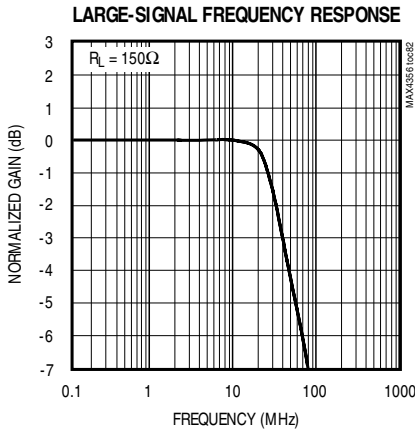
($V_{CC} = +3V$ and $V_{EE} = -3V$, $V_{DD} = +3V$, $AGND = DGND = 0$, $V_{IN_} = 0$, $R_L = 150\Omega$ to $AGND$, and $T_A = +25^\circ C$, unless otherwise noted.)



16 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.)



16 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.)

