8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

ABSOLUTE MAXIMUM RATINGS

Voltage Referenced to V-
V+ .....-0.3V, 44V
GND .....-0.3V, 25V
Digital Inputs, NO, COM (Note 1).....(V- - 2V) to (V+ + 2V) or 30mA (whichever occurs first)
Continuous Current (any terminal).....30mA
Peak Current, NO or COM
(pulsed at 1ms, 10% duty cycle max) 100mA

Continuous Power Dissipation (TA = +70°C)
Plastic DIP (derate 10.53mW/°C above +70°C) 842mW
Narrow SO (derate 8.70mW/°C above +70°C) 696mW
16-Pin TQFN (derate 21.3mW/°C above +70°C) 1702mW
CERDIP (derate 10.00mW/°C above +70°C).....800mW
Operating Temperature Ranges
MAX33_C__ .....0°C to +70°C
MAX33_E__.....-40°C to +85°C
MAX33_MJE .....-55°C to +125°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10sec) .....+300°C

Note 1: Signals on NO, COM, EN, A0, A1, or A2 exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.

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

ELECTRICAL CHARACTERISTICS—Dual Supplies

(V+ = +15V, V- = -15V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS				MIN	TYP (Note 2)	MAX	UNITS
SWITCH									
Analog Signal Range	V_{NO}, V_{COM}	(Note 3)				-15		15	V
On-Resistance	R_{ON}	I_{NO} = 0.2mA, V_{COM} = ±10V		T_A = +25°C			220	400	Ω
				T_A = T_{MIN} to T_{MAX}				500	
On-Resistance Matching Between Channels	ΔR_{ON}	I_{NO} = 0.2mA, V_{COM} = ±10V (Note 4)		T_A = +25°C			4	10	Ω
				T_A = T_{MIN} to T_{MAX}				15	
NO-Off Leakage Current (Note 5)	$I_{NO(OFF)}$	V_{COM} = ∓10V, V_{NO} = ±10V, V_{EN} = 0V		T_A = +25°C		-0.02	0.001	0.02	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-1.25		1.25	
					M	-20		20	
COM-Off Leakage Current (Note 5)	$I_{COM(OFF)}$	V_{NO} = ±10V, V_{COM} = ∓10V, V_{EN} = 0V	MAX338	T_A = +25°C		-0.05	0.005	0.05	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-3.25		3.25	
					M	-40		40	
		V_{NO} = ∓10V, V_{COM} = ±10V, V_{EN} = 0V	MAX339	T_A = +25°C		-0.05	0.005	0.05	
				T_A = T_{MIN} to T_{MAX}	C, E	-1.65		1.65	
					M	-20		20	
COM-On Leakage Current (Note 5)	$I_{COM(ON)}$	V_{COM} = ±10V, V_{NO} = ±10V, sequence each switch on	MAX338	T_A = +25°C		-0.05	0.006	0.05	nA
				T_A = T_{MIN} to T_{MAX}	C, E	-3.25		3.25	
					M	-40		40	
			MAX339	T_A = +25°C		-0.05	0.008	0.05	
				T_A = T_{MIN} to T_{MAX}	C, E	-1.65		1.65	
					M	-20		20	

ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = +15V, V- = -15V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP (Note 2)	MAX	UNITS
INPUT								
Input Current with Input Voltage High	I_{AH}	V_A = 2.4V or 15V			-1.0	0.001	1.0	µA
Input Current with Input Voltage Low	I_{AL}	V_{EN} = 0V or 2.4V, V_A = 0V			-1.0		1.0	µA
SUPPLY								
Power-Supply Range					±4.5		±20	V
Positive Supply Current	I+	V_{EN} = V_A = 0V		T_A = +25°C		50	100	µA
				T_A = T_{MIN} to T_{MAX}			150	
		V_{EN} = 2.4V, $V_{A(ALL)}$ = 2.4V		T_A = +25°C		290	500	µA
				T_A = T_{MIN} to T_{MAX}			600	
Negative Supply Current	I-	V_{EN} = 0V or 2.4V, $V_{A(ALL)}$ = 0V, 2.4V or 5V		T_A = +25°C	-1		1	µA
				T_A = T_{MIN} to T_{MAX}	-10		10	
DYNAMIC								
Transistion Time	t_{TRANS}	Figure 2		T_A = +25°C		200	500	ns
Break-Before-Make Interval	t_{OPEN}	Figure 4		T_A = +25°C	10	140		ns
Enable Turn-On Time	$t_{ON(EN)}$	Figure 3		T_A = +25°C		160	500	ns
				T_A = T_{MIN} to T_{MAX}			750	
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 3		T_A = +25°C		100	500	ns
				T_A = T_{MIN} to T_{MAX}			750	
Charge Injection (Note 3)	Q	C_L = 100pF, V_{NO} = 0V, R_S = 0Ω, Figure 6		T_A = +25°C		1.5	5	pC
Off Isolation (Note 6)	V_{ISO}	V_{EN} = 0V, R_L = 1kΩ, f = 100kHz		T_A = +25°C		-75		dB
Crosstalk Between Channels	V_{CT}	V_{EN} = 2.4V, f = 100kHz, V_{GEN} = $1V_{P-P}$, R_L = 1kΩ, Figure 7		T_A = +25°C		-92		dB
Logic Input Capacitance	C_{IN}	f = 1MHz		T_A = +25°C		2		pF
NO-Off Capacitance	$C_{NO(OFF)}$	f = 1MHz, V_{EN} = V_{NO} = 0V, Figure 8		T_A = +25°C		3		pF
COM-Off Capacitance	$C_{COM(OFF)}$	f = 1MHz, V_{EN} = 0.8V, V_{COM} = 0V, Figure 8	MAX338	T_A = +25°C		11		pF
			MAX339			6		
COM-On Capacitance	$C_{COM(ON)}$	f = 1MHz, V_{EN} = 2.4V, V_{COM} = 0V, Figure 8	MAX338	T_A = +25°C		16		pF
			MAX339			9		

8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

ELECTRICAL CHARACTERISTICS—Single Supply

(V+ = +12V, V- = 0V, GND = 0V, V_{AH} = +2.4V, V_{AL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP (Note 2)	MAX	UNITS
SWITCH							
Analog Signal Range	V_{NO}, V_{COM}	(Note 3)		0		12	V
On-Resistance	R_{ON}	I_{NO} = 0.2mA V_{COM} = 3V or 10V	T_A = +25°C		460	650	Ω
DYNAMIC							
Transition Time (Note 3)	t_{TRANS}	V_{NO1} = 8V, V_{NO8} = 0V, V_{IN} = 2.4V, Figure 1	T_A = +25°C		210	500	ns
Enable Turn-On Time (Note 3)	$t_{ON(EN)}$	V_{INH} = 2.4V, V_{INL} = 0V, V_{NO1} = 5V, Figure 3	T_A = +25°C		280	500	ns
Enable Turn-Off Time (Note 3)	$t_{OFF(EN)}$	V_{INH} = 2.4V, V_{INL} = 0V, V_{NO1} = 5V, Figure 3	T_A = +25°C		110	500	ns
Charge Injection (Note 3)	Q	C_L = 100pF, V_{NO} = 0V, R_S = 0Ω	T_A = +25°C		1.8	5	pC

Note 2: The algebraic convention where the most negative value is a minimum and the most positive value a maximum is used in this data sheet.

Note 3: Guaranteed by design.

Note 4: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

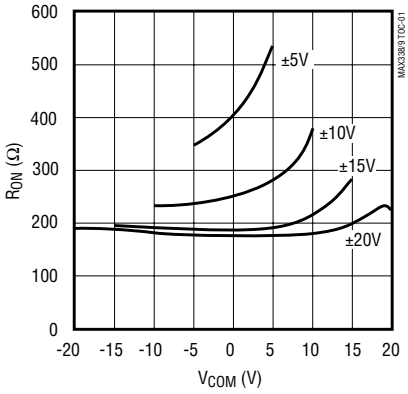
Note 5: Leakage parameters are 100% tested at the maximum rated hot temperature and guaranteed by correlation at +25°C.

Note 6: Worst-case isolation is on channel 4 because of its proximity to the drain pin. Off isolation = 20log V_{COM}/V_{NO}, where V_{COM} = output and V_{NO} = input to off switch.

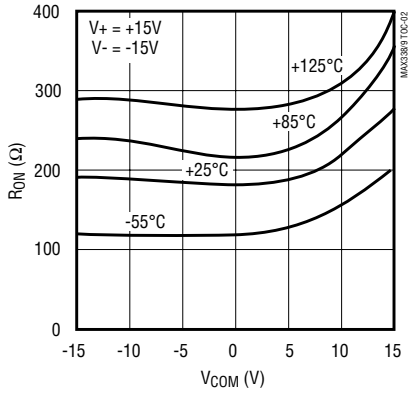
Typical Operating Characteristics

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

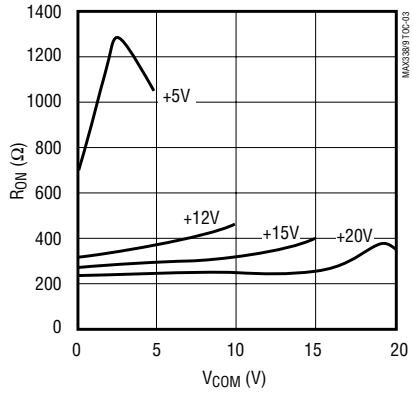
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



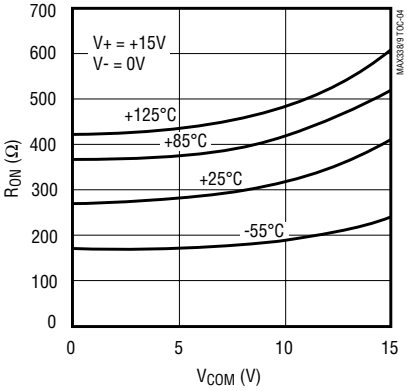
ON-RESISTANCE vs. V_{COM} OVER TEMPERATURE (DUAL SUPPLIES)



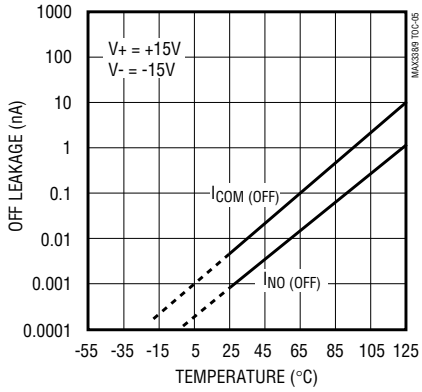
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



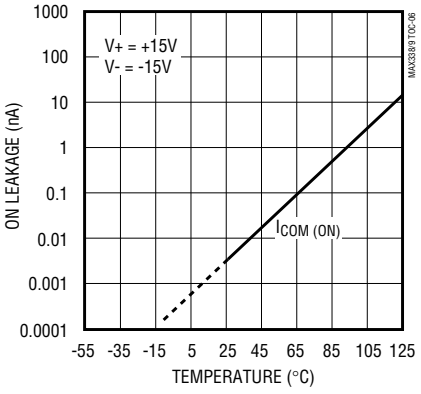
ON-RESISTANCE vs. V_{COM} OVER TEMPERATURE (SINGLE SUPPLY)



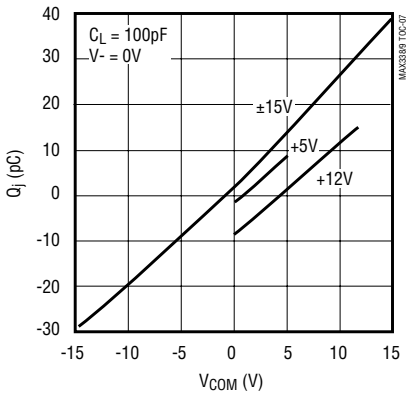
OFF LEAKAGE vs. TEMPERATURE



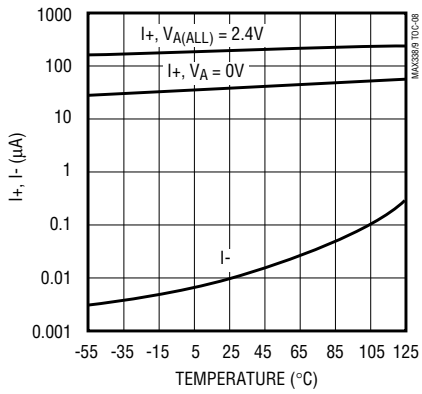
ON LEAKAGE vs. TEMPERATURE



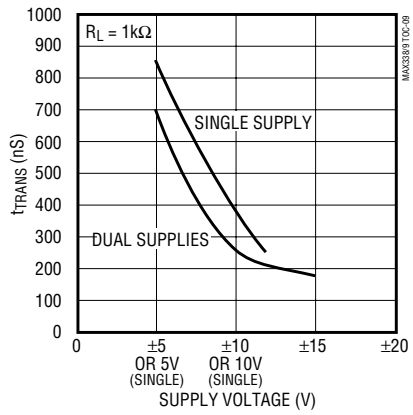
CHARGE INJECTION vs. V_{COM}



SUPPLY CURRENT vs. TEMPERATURE



TRANSITION TIME vs. POWER SUPPLIES



8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

Pin Description

PIN				NAME	FUNCTION
MAX338		MAX339			
DIP/SO	THIN QFN	DIP/SO	THIN QFN		
1, 15, 16,	15, 14, 13	—	—	A0, A2, A1	Address Inputs
—	—	1, 16	15, 14	A0, A1	Address Inputs
2	16	2	16	EN	Enable
3	1	3	1	V-	Negative-Supply Voltage Input
4–7	2–5	—	—	NO1–NO14	Analog Inputs—Bidirectional
—	—	4–7	2–5	NO1A–NO4A	Analog Inputs—Bidirectional
8	6	—	—	COM	Analog Output—Bidirectional
—	—	8, 9	6, 7	COMA, COMB	Analog Outputs—Bidirectional
9–12	7–10	—	—	NO8–NO5	Analog Inputs—Bidirectional
—	—	10–3	8–11	NO4B–NO1B	Analog Inputs—Bidirectional
13	11	14	12	V+	Positive-Supply Voltage Input
14	12	15	13	GND	Ground
—	EP	—	EP	Exposed Pad	Exposed Pad. Connect to V+.

Applications Information

Operation with Supply Voltages Other than 15V

Using supply voltages less than ±15V will reduce the analog signal range. The MAX338/MAX339 switches operate with ±4.5V to ±20V bipolar supplies or with a +4.5V to +30V single supply. Connect V- to GND when operating with a single supply. Both device types can also operate with unbalanced supplies such as +24V and -5V. The *Typical Operating Characteristics* graphs show typical on-resistance with 20V, 15V, 10V, and 5V supplies. (Switching times increase by a factor of two or more for operation at 5V.)

Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings may cause permanent damage to the devices. Always sequence V+ on first, then V-, followed by the logic inputs NO and COM. If power-supply sequencing is not possible, add two small signal diodes in series with supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to 1V below V+ and 1V above V-, but does not affect the devices' low switch resistance and low leakage characteristics. Device operation is unchanged, and the difference between V+ and V- should not exceed 44V.

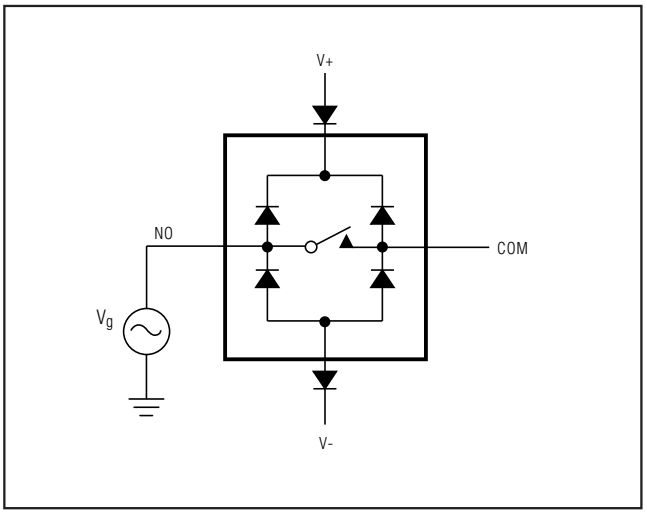


Figure 1. Overvoltage Protection Using External Blocking Diodes

Test Circuits/Timing Diagrams

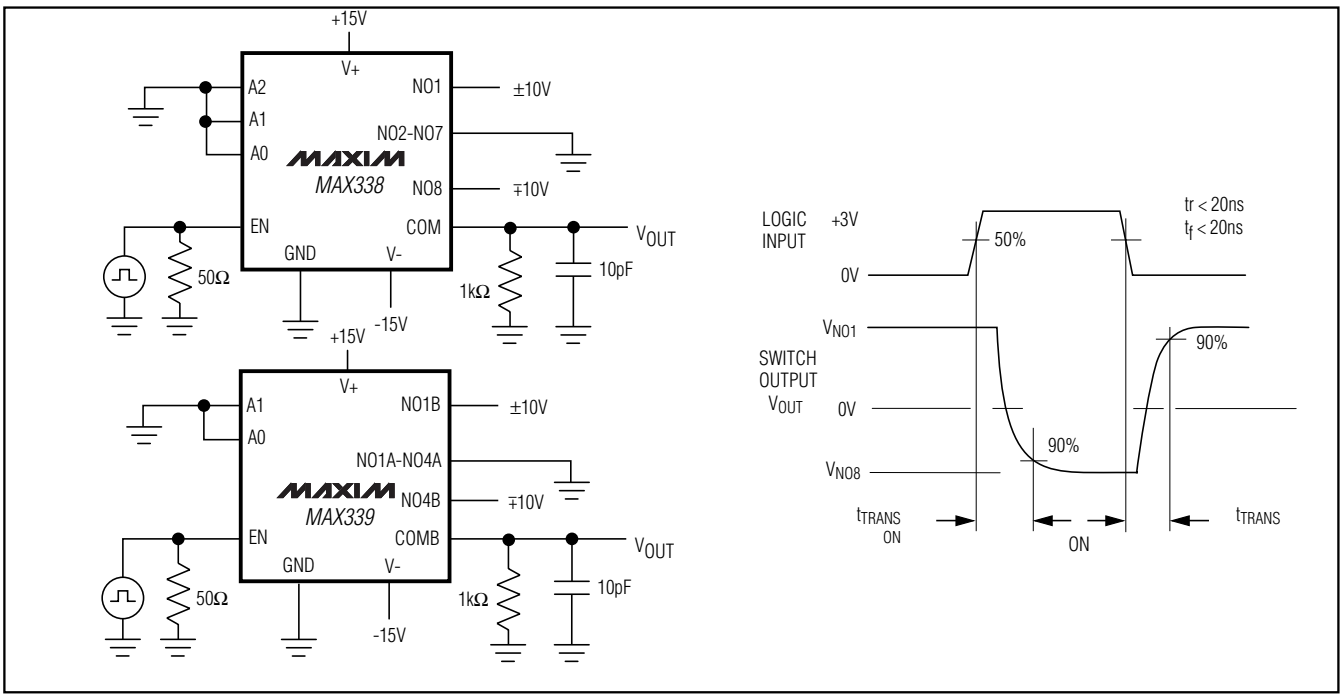


Figure 2. Transition Time

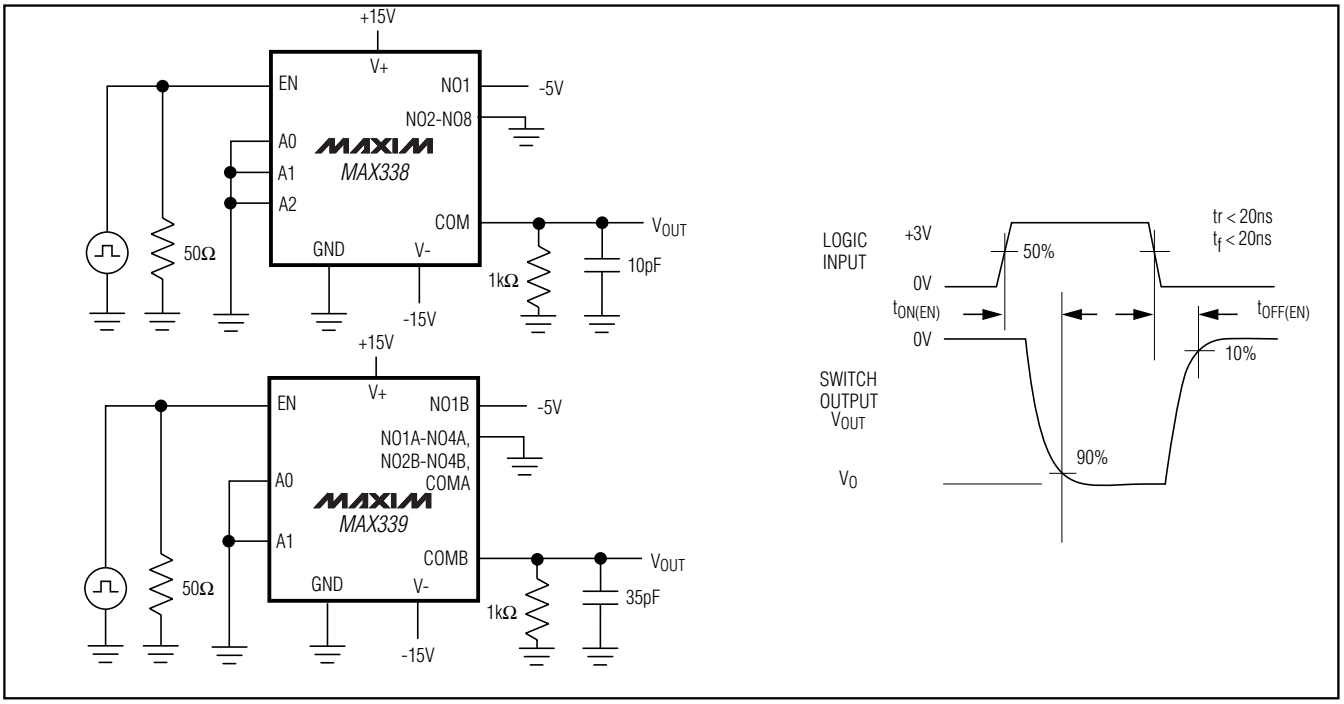


Figure 3. Enable Switching Time

8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

Test Circuits/Timing Diagrams (continued)

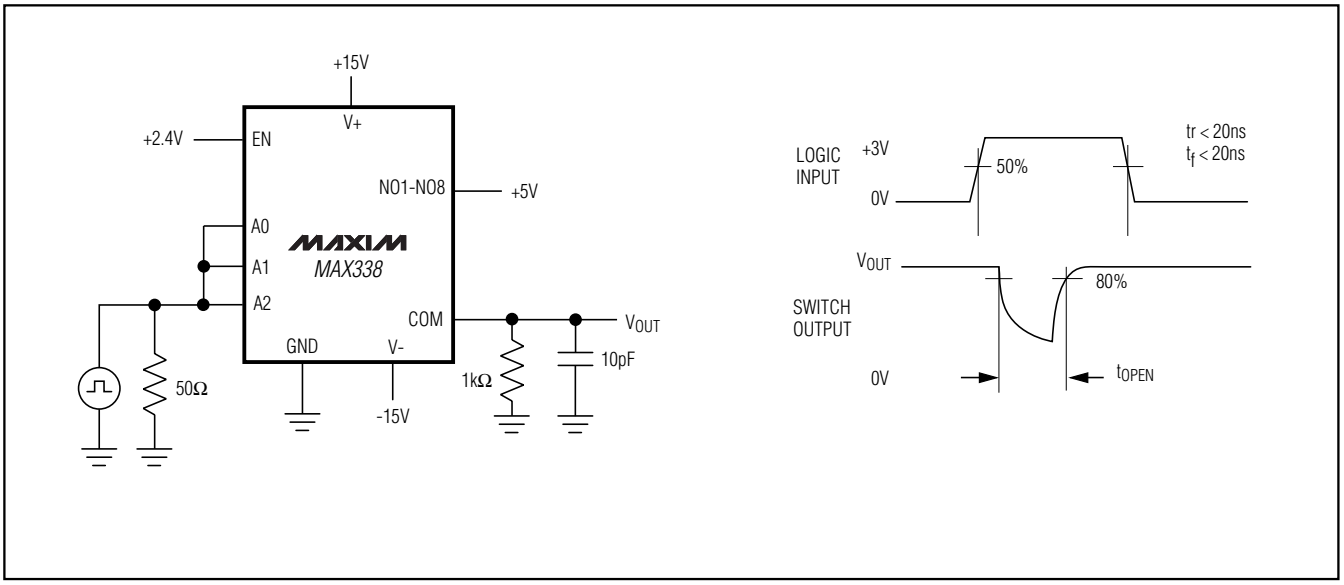


Figure 4. Break-Before-Make Interval

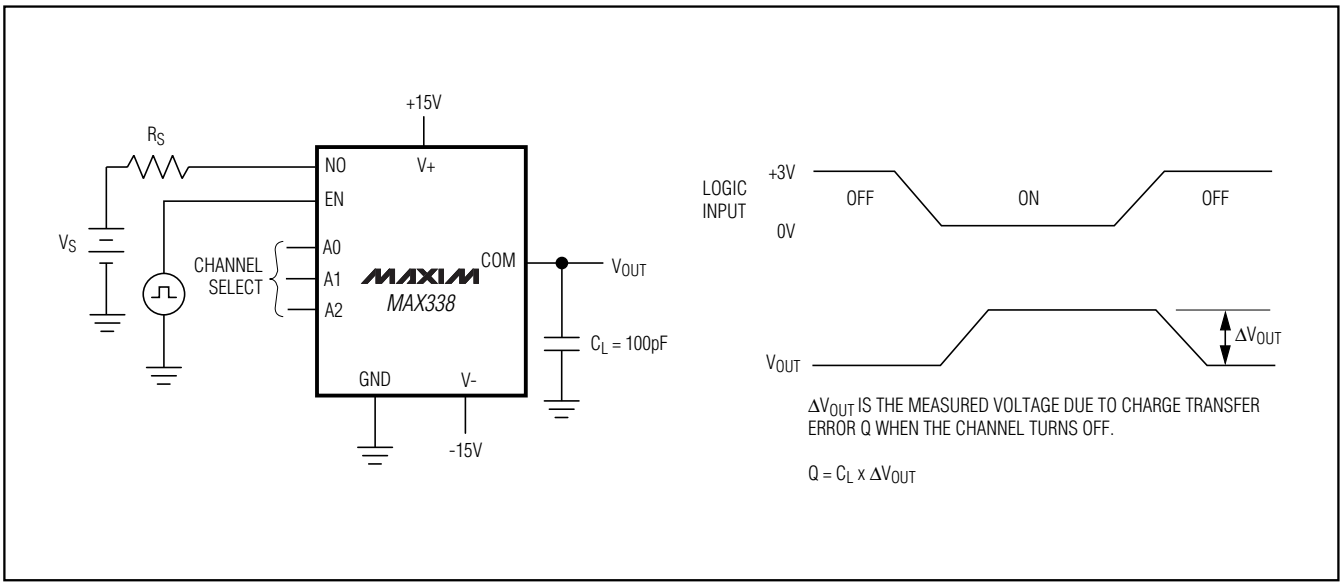


Figure 5. Charge Injection

Test Circuits/Timing Diagrams (continued)

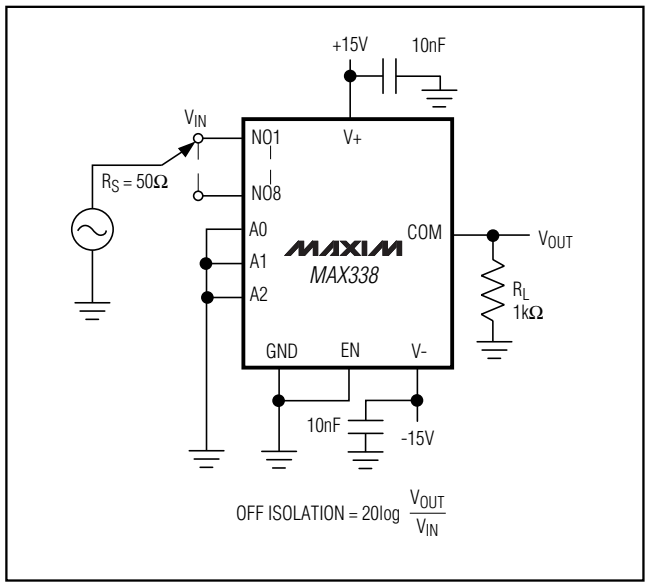


Figure 6. Off-Isolation

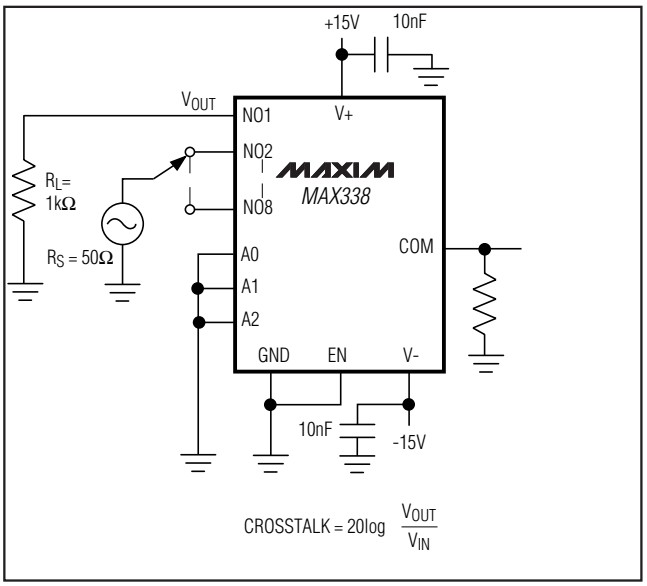


Figure 7. Crosstalk

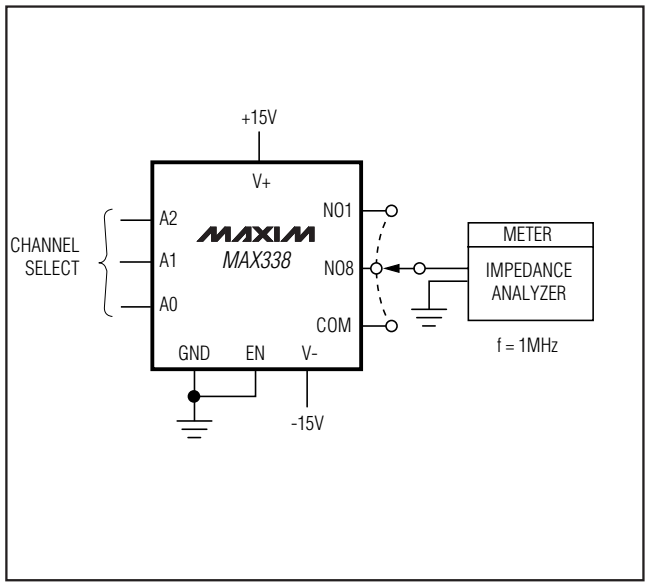
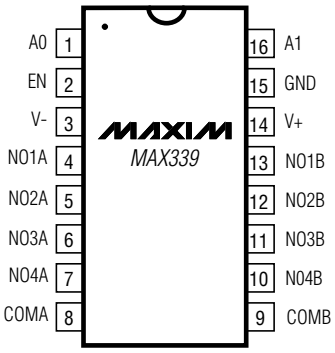


Figure 8. NO/COM Capacitance

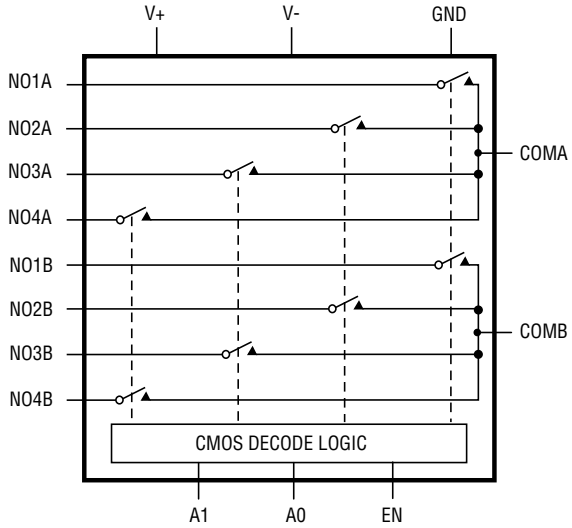
8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

Pin Configurations/Functional Diagrams/Truth Tables (continued)

TOP VIEW



DIP/SO



MAX339 DUAL 4-CHANNEL MULTIPLEXER

A2	A1	A0	EN	ON SWITCH
X	X	X	0	None
0	0	0	1	1
0	0	1	1	2
0	1	0	1	3
0	1	1	1	4
1	0	0	1	5
1	0	1	1	6
1	1	0	1	7
1	1	1	1	8

MAX338

LOGIC "0" $V_{AL} \leq 0.8V$, LOGIC "1" $V_{AH} \geq 2.4V$

A1	A0	EN	ON SWITCH
X	X	0	None
0	0	1	1
0	1	1	2
1	0	1	3
1	1	1	4

MAX339

LOGIC "0" $V_{AL} \leq 0.8V$, LOGIC "1" $V_{AH} \geq 2.4V$

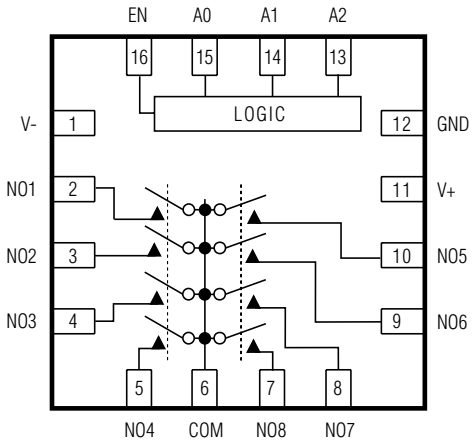
Ordering Information (continued)

PART	TEMP RANGE	PIN-PACKAGE
MAX339CPE	0°C to +70°C	16 Plastic DIP
MAX339CSE	0°C to +70°C	16 Narrow SO
MAX339C/D	0°C to +70°C	Dice*
MAX339ETE	-40°C to +85°C	16 Thin QFN (5mm x 5mm)
MAX339EPE	-40°C to +85°C	16 Plastic DIP
MAX339ESE	-40°C to +85°C	16 Narrow SO
MAX339EJE	-40°C to +85°C	16 CERDIP
MAX339MJE	-55°C to +125°C	16 CERDIP**

**Contact factory for dice specifications.*
***Contact factory for availability.*

Pin Configurations/Functional Diagrams/Truth Tables (continued)

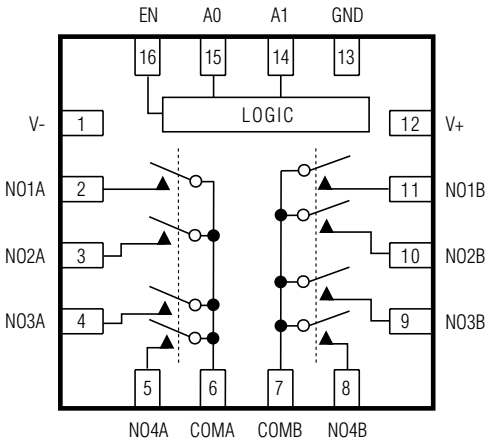
TOP VIEW



MAXIM

MAX338

Thin QFN



MAXIM

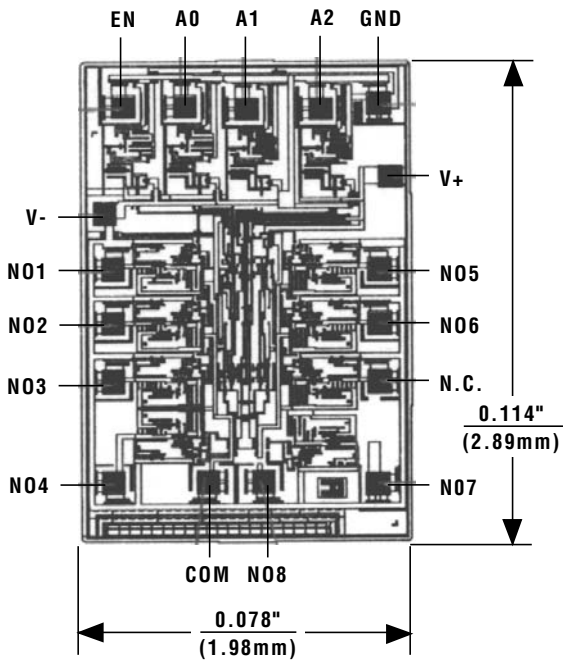
MAX339

Thin QFN

8-Channel/Dual 4-Channel, Low-Leakage, CMOS Analog Multiplexers

Chip Topographies

MAX338

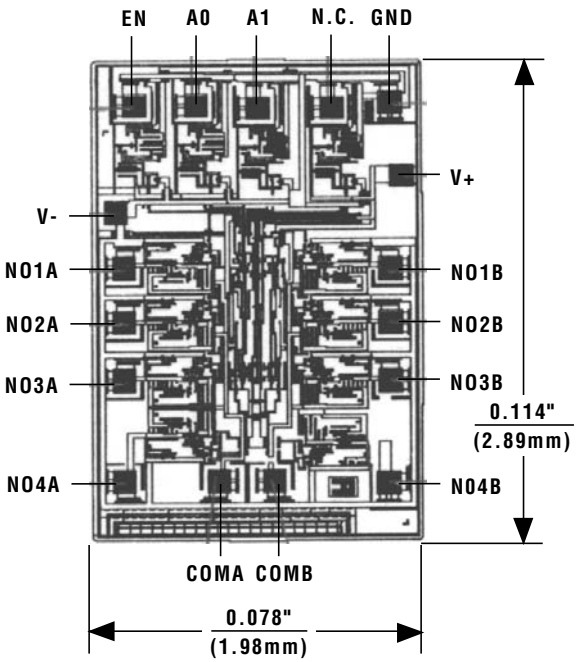


TRANSISTOR COUNT: 224

SUBSTRATE IS INTERNALLY CONNECTED TO V+

Note: On Thin QFN packages connect exposed pad to V+.

MAX339



N.C. = NO INTERNAL CONNECTION

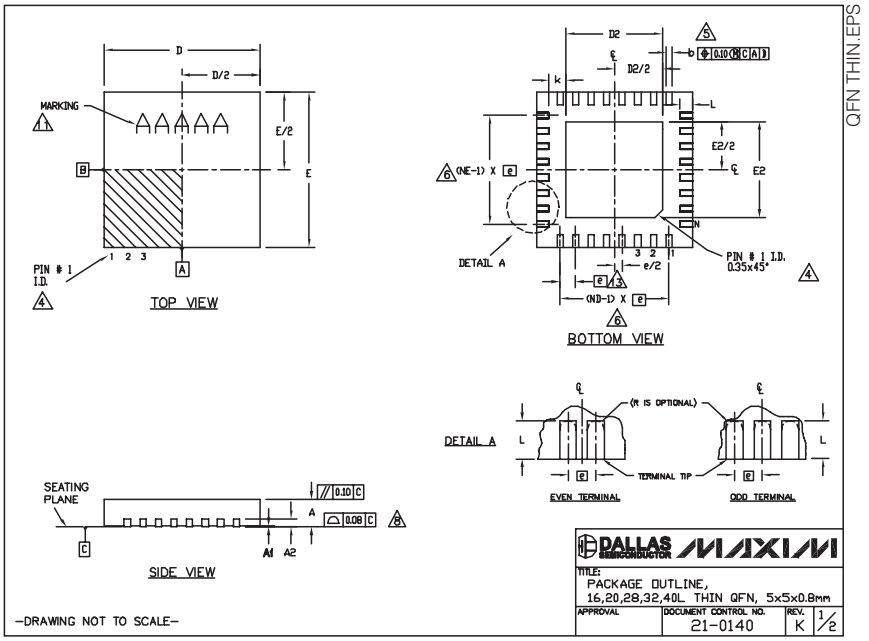
TRANSISTOR COUNT: 224

SUBSTRATE IS INTERNALLY CONNECTED TO V+

Package Information

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

QFN THIN.EPS



COMMON DIMENSIONS

PKG.	16L 5x5			20L 5x5			28L 5x5			32L 5x5			40L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80	0.70	0.75	0.80
A1	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05	0	0.02	0.05
A2	0.20 REF.			0.20 REF.			0.20 REF.			0.20 REF.			0.20 REF.		
b	0.25	0.30	0.35	0.25	0.30	0.35	0.20	0.25	0.30	0.20	0.25	0.30	0.15	0.20	0.25
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
e	0.80 BSC.			0.65 BSC.			0.50 BSC.			0.50 BSC.			0.40 BSC.		
k	0.25	-	-	0.25	-	-	0.25	-	-	0.25	-	-	0.25	-	-
L	0.30	0.40	0.50	0.45	0.55	0.65	0.45	0.55	0.65	0.30	0.40	0.50	0.30	0.40	0.50
N	16			20			28			32			40		
ND	4			5			7			8			10		
NE	4			5			7			8			10		
JEDEC	WHHB			WHHC			WHHD-1			WHHD-2			-----		

EXPOSED PAD VARIATIONS

PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
T1655-2	3.00	3.10	3.20	3.00	3.10	3.20
T1655-3	3.00	3.10	3.20	3.00	3.10	3.20
T1655N-1	3.00	3.10	3.20	3.00	3.10	3.20
T2055-3	3.00	3.10	3.20	3.00	3.10	3.20
T2055-4	3.00	3.10	3.20	3.00	3.10	3.20
T2055-5	3.15	3.25	3.35	3.15	3.25	3.35
T2055M-5	3.15	3.25	3.35	3.15	3.25	3.35
T2855-3	3.15	3.25	3.35	3.15	3.25	3.35
T2855-4	2.60	2.70	2.80	2.60	2.70	2.80
T2855-5	2.60	2.70	2.80	2.60	2.70	2.80
T2855-6	3.15	3.25	3.35	3.15	3.25	3.35
T2855-7	2.60	2.70	2.80	2.60	2.70	2.80
T2855-8	3.15	3.25	3.35	3.15	3.25	3.35
T2855N-1	3.15	3.25	3.35	3.15	3.25	3.35
T3255-3	3.00	3.10	3.20	3.00	3.10	3.20
T3255-4	3.00	3.10	3.20	3.00	3.10	3.20
T3255M-4	3.00	3.10	3.20	3.00	3.10	3.20
T3255-5	3.00	3.10	3.20	3.00	3.10	3.20
T3255N-1	3.00	3.10	3.20	3.00	3.10	3.20
T4055-1	3.40	3.50	3.60	3.40	3.50	3.60
T4055-2	3.40	3.50	3.60	3.40	3.50	3.60

NOTES:
1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
9. DRAWING CONFORMS TO JEDEC MO220, EXCEPT EXPOSED PAD DIMENSION FOR T2855-3, T2855-6, T4055-1 AND T4055-2.
10. WARPAGE SHALL NOT EXCEED 0.10 mm.
11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
13. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION 'e', ±0.05.

DRAWING NOT TO SCALE

DALLAS SEMICONDUCTOR MAXIM
TITLE: PACKAGE OUTLINE, 16,20,28,32,40L THIN QFN, 5x5x0.8mm
APPROVAL
DOCUMENT CONTROL NO. 21-0140
REV. K
2/2