19-2522; Rev 0; 7/02

MAXIM

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

General Description

The MAX4781/MAX4782/MAX4783 are high-speed, low-voltage, low on-resistance, CMOS analog multiplexers/switches configured as an 8-channel multiplexer (MAX4781), two 4-channel multiplexers (MAX4782), and three single-pole/double-throw (SPDT) switches (MAX4783).

These devices operate with a +1.6V to +3.6V single supply. When powered from a +3V supply, MAX4781/MAX4782/MAX4783 feature a 1Ω max on-resistance (R_{ON}), with 0.4Ω (max) R_{ON} matching between channels, and 0.2Ω (max) R_{ON} flatness. These devices handle Rail-to-Rail® analog signals and offer fast switching times of less than 25ns while consuming less than 3µW of quiescent power. They are available in space-saving 16-pin QFN (4mm x 4mm) and TSSOP packages.

Applications

Battery-Operated Equipment

Audio Signal Routing

Low-Voltage Data-Acquisition Systems

Communications Circuits

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

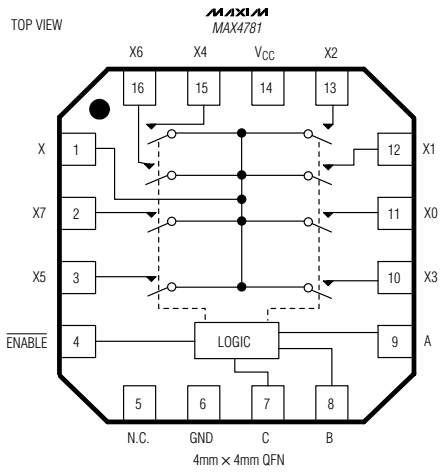
Features

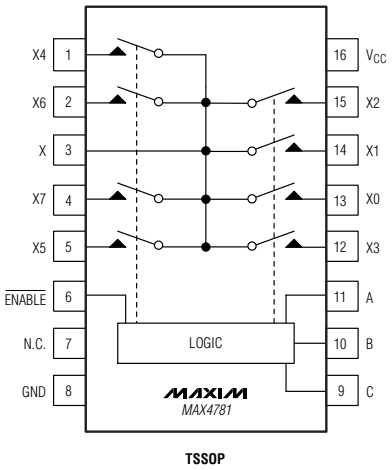
- **On-Resistance**
  1Ω (max) (+3V Supply)
  2.5Ω (max) (+1.8V Supply)
- **On-Resistance Match Between Channels**
  0.4Ω (max) (+3V Supply)
- **On-Resistance Flatness**
  0.2Ω (max) (+3V Supply)
- **+1.6V to +3.6V Single-Supply Operation**
- **High-Current Handling Capacity (150mA Continuous)**
- **+1.8V CMOS-Logic Compatible (+3V Supply)**
- **Fast Switching Times: t_{ON} = 25ns, t_{OFF} = 15ns**
- **Pin Compatible with Industry-Standard 74HC4051/74HC4052/74HC4053 and MAX4617/MAX4618/MAX4619**
- **Available in 4mm x 4mm 16-Pin QFN**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX4781EUE	-40°C to +85°C	16 TSSOP
MAX4781EGE	-40°C to +85°C	16 QFN (4mm x 4mm)
MAX4782EUE	-40°C to +85°C	16 TSSOP
MAX4782EGE	-40°C to +85°C	16 QFN (4mm x 4mm)
MAX4783EUE	-40°C to +85°C	16 TSSOP
MAX4783EGE	-40°C to +85°C	16 QFN (4mm x 4mm)

Pin Configurations/Functional Diagrams





Pin Configurations/Functional Diagrams continued at end of data sheet.

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND
V_{CC}, A, B, C, and $\overline{ENABLE}$ .....-0.3V to +4V
Voltage at Any Other Terminal
(Note 1).....-0.3V to (V_{CC} + 0.3V)
Continuous Current into A, B, C, $\overline{ENABLE}$.....±10mA
Continuous Current into X, Y, Z, X_, Y_, Z_ .....±150mA
Peak Current into X, Y, Z, X_, Y_, Z_
(pulsed at 1ms, 10% duty cycle).....±300mA

Continuous Power Dissipation
16-Pin QFN (derate 18.5mW/°C above +70°C) 1481mW
16-Pin TSSOP (derate 5.7mW/°C above +70°C) 457mW
Operating Temperature Range .....-40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: Signals on X, Y, Z, X_, Y_, and Z_ exceeding V_{CC} or GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.

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—Single +3V Supply

(V_{CC} = +2.7V to +3.6V, GND = 0, V_{IH} = 1.4V, V_{IL} = 0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_X, V_Y, V_Z, $V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$			0		V_{CC}	V
On-Resistance (Note 4)	R_{ON}	V_{CC} = +2.7V; $I_{X\_}$, $I_{Y\_}$, $I_{Z\_}$ = 100mA; V_X, V_Y, V_Z = 1.7V	+25°C		0.7	1	Ω
			T_{MIN} to T_{MAX}			1.2	
On-Resistance Match Between Channels (Notes 4, 5)	ΔR_{ON}	V_{CC} = +2.7V; $I_{X\_}$, $I_{Y\_}$, $I_{Z\_}$ = 100mA; V_X, V_Y, V_Z = 1.7V	+25°C		0.3	0.4	Ω
			T_{MIN} to T_{MAX}			0.6	
On-Resistance Flatness (Note 6)	$R_{FLAT(ON)}$	V_{CC} = +2.7V; $I_{X\_}$, $I_{Y\_}$, $I_{Z\_}$ = 100mA; V_X, V_Y, V_Z = 0, 0.7V, 1.7V	+25°C		0.1	0.2	Ω
			T_{MIN} to T_{MAX}			0.2	
X_, Y_, Z_ Off-Leakage Current	$I_{X\_(OFF)}$ $I_{Y\_(OFF)}$ $I_{Z\_(OFF)}$	V_{CC} = +3.6V; $V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 3.3V, 0.3V; V_X, V_Y, V_Z = 0.3V, 3.3V	+25°C	-2	0.002	+2	nA
			T_{MIN} to T_{MAX}	-5		+5	
X, Y, Z Off-Leakage Current	$I_{X(OFF)}$ $I_{Y(OFF)}$ $I_{Z(OFF)}$	V_{CC} = +3.6V; $V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 3.3V, 0.3V; V_X, V_Y, V_Z = 0.3V, 3.3V	+25°C	-2	0.002	+2	nA
			T_{MIN} to T_{MAX}	-25		+25	
X, Y, Z On-Leakage Current	$I_{X(ON)}$ $I_{Y(ON)}$ $I_{Z(ON)}$	V_{CC} = +3.6V V_X, V_Y, V_Z = 0.3V, 3.3V; $V_{X\_}$, $V_{Y\_}$; V_Z = 0.3V, 3.3V or floating	+25°C	-2	0.002	+2	nA
			T_{MIN} to T_{MAX}	-25		+25	

ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V_{CC} = +2.7V to +3.6V, GND = 0, V_{IH} = 1.4V, V_{IL} = 0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS		T_A	MIN	TYP	MAX	UNITS
SWITCH DYNAMIC CHARACTERISTICS								
Turn-On Time	t_{ON}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.5V; R_L = 50Ω; C_L = 35pF; Figure 1		+25°C		11	25	ns
				T_{MIN} to T_{MAX}			27	
Turn-Off Time	t_{OFF}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.5V; R_L = 50Ω; C_L = 35pF; Figure 1		+25°C		4	15	ns
				T_{MIN} to T_{MAX}			20	
Address Transition Time	t_{TRANS}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.5V; R_L = 50Ω; C_L = 35pF; Figure 2		+25°C		11	25	ns
				T_{MIN} to T_{MAX}			27	
Break-Before-Make Time (Note 7)	t_{BBM}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.5V; R_L = 50Ω; C_L = 35pF; Figure 3		+25°C		18		ns
				T_{MIN} to T_{MAX}	2			
Charge Injection	Q	V_{GEN} = 0, R_{GEN} = 0, C_L = 1nF, Figure 4		+25°C		-110		pC
Input Off-Capacitance	$C_{X\_(OFF)}$, $C_{Y\_(OFF)}$, $C_{Z\_(OFF)}$	f = 1MHz, Figure 6		+25°C		38		pF
Output Off-Capacitance	$C_{X(OFF)}$, $C_{Y(OFF)}$, $C_{Z(OFF)}$	f = 1MHz, Figure 6	MAX4781	+25°C		310		pF
			MAX4782			158		
			MAX4783			75		
Output On-Capacitance	$C_{X(ON)}$ $C_{Y(ON)}$ $C_{Z(ON)}$	f = 1MHz, Figure 6	MAX4781	+25°C		380		pF
			MAX4782			224		
			MAX4783			140		
Off-Isolation (Note 8)	V_{ISO}	R_L = 50Ω, C_L = 35pF, Figure 5	f = 10MHz			-75		dB
			f = 1MHz			-90		
Channel-to-Channel Crosstalk (Note 9)	V_{CT}	R_L = 50Ω, C_L = 35pF, Figure 5	f = 10MHz			-65		dB
			f = 1MHz			-80		
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, 0.5V_{P-P}, R_L = 32Ω				0.045		%
DIGITAL I/O								
Input Logic High	V_{IH}			T_{MIN} to T_{MAX}	1.4			V
Input Logic Low	V_{IL}			T_{MIN} to T_{MAX}			0.5	V
Input Leakage Current	$I_{IN\_}$	V_A, V_B, V_C = $V_{\overline{ENABLE}}$ = 0 or 3.6V		T_{MIN} to T_{MAX}	-1	0.0005	+1	µA
POWER SUPPLY								
Power-Supply Range	V_{CC}				+1.6		+3.6	V
Positive Supply Current	I_{CC}	V_{CC} = 3.6V; V_A, V_B, V_C; $V_{\overline{ENABLE}}$ = 3.6V or 0					1	µA

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

ELECTRICAL CHARACTERISTICS—Single +1.8V Supply

(V_{CC} = +1.8V, GND = 0, V_{IH} = 1V, V_{IL} = 0.4V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$, V_X, V_Y, V_Z			0		V_{CC}	V
On-Resistance (Note 4)	R_{ON}	V_{CC} = 1.8V; $I_{X\_}$, $I_{Y\_}$, $I_{Z\_}$ = 10mA; V_X, V_Y, V_Z = 1.0V	+25°C		1.6	2.5	Ω
			T_{MIN} to T_{MAX}			3.5	
On-Resistance Match Between Channels (Notes 4, 5)	ΔR_{ON}	V_{CC} = 1.8V; $I_{X\_}$, $I_{Y\_}$, $I_{Z\_}$ = 10mA; V_X, V_Y, V_Z = 1.0V	+25°C		0.3	0.4	Ω
			T_{MIN} to T_{MAX}			0.6	
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.0V; R_L = 50Ω; C_L = 35pF; Figure 1	+25°C		17	30	ns
			T_{MIN} to T_{MAX}			32	
Turn-Off Time	t_{OFF}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.0V; R_L = 50Ω; C_L = 35pF; Figure 1	+25°C		8	20	ns
			T_{MIN} to T_{MAX}			22	
Address Transition Time	t_{TRANS}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1.0V; R_L = 50Ω; C_L = 35pF; Figure 2	+25°C		17	30	ns
			T_{MIN} to T_{MAX}			32	
Break-Before-Make Time (Note 7)	t_{BBM}	$V_{X\_}$, $V_{Y\_}$, $V_{Z\_}$ = 1V; R_L = 50Ω; C_L = 35pF; Figure 3	+25°C		26		ns
			T_{MIN} to T_{MAX}	1			
Charge Injection	Q	V_{GEN} = 0, R_{GEN} = 0, C_L = 1nF, Figure 4	+25°C		-40		pC
DIGITAL I/O							
Input Logic High	V_{IH}		T_{MIN} to T_{MAX}	1			V
Input Logic Low	V_{IL}		T_{MIN} to T_{MAX}			0.4	V
Input Leakage Current	$I_{IN\_}$	V_A, V_B, V_C = $V_{\overline{ENABLE}}$ = 0 or 3.6V	T_{MIN} to T_{MAX}	-1	0.000	+1	µA
POWER SUPPLY							
Power-Supply Range	V_{CC}			1.6		3.6	V
Positive Supply Current	I_{CC}	V_{CC} = 3.6V; V_A, V_B, V_C, $V_{\overline{ENABLE}}$ = 0 or 3.6V				1	µA

Note 2: The algebraic convention is used in this data sheet; the most negative value is shown in the minimum column.

Note 3: Devices are tested at maximum hot temperature and are guaranteed by design and correlation at T_A = +25°C and -40°C specifications.

Note 4: R_{ON} and ΔR_{ON} matching specifications for QFN-packaged parts are guaranteed by design.

Note 5: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

Note 6: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Note 7: Guaranteed by design; not production tested.

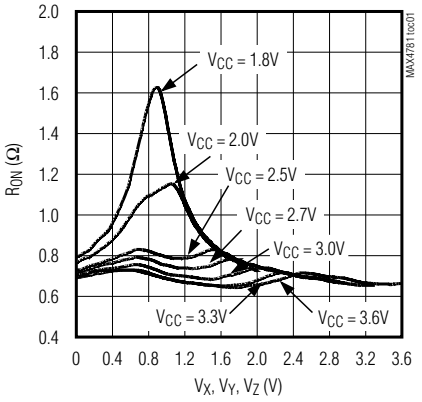
Note 8: Off-isolation = 20log10($V_{COM\_}$ / V_{NO}), $V_{COM\_}$ = output, V_{NO} = input to off switch.

Note 9: Between any two channels.

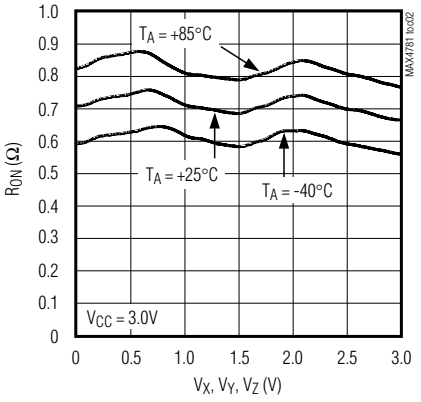
Typical Operating Characteristics

(GND = 0, T_A = +25°C, unless otherwise noted.)

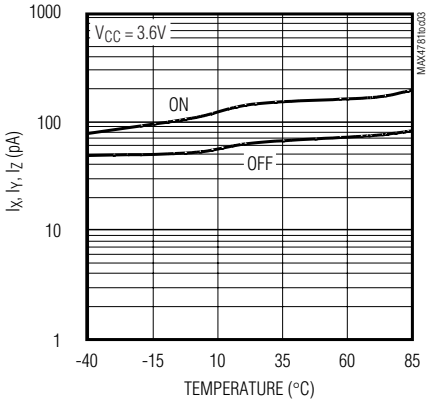
ON-RESISTANCE vs. V_X, V_Y, V_Z



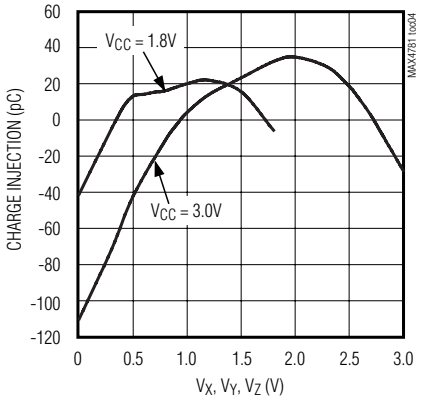
ON-RESISTANCE vs. V_X, V_Y, V_Z, AND TEMPERATURE



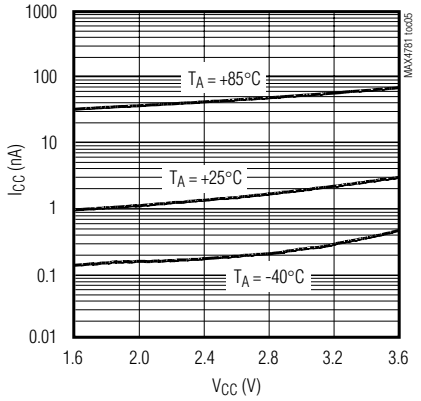
LEAKAGE CURRENT vs. TEMPERATURE



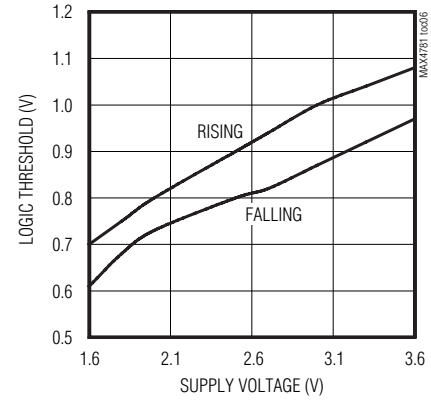
CHARGE INJECTION vs. V_X, V_Y, V_Z



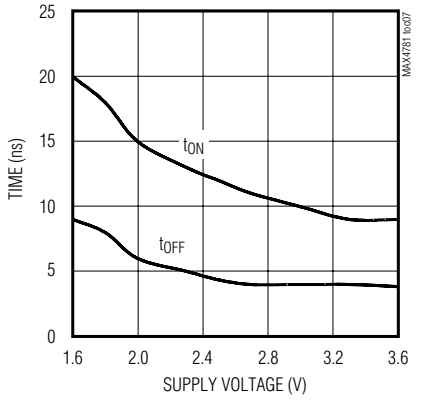
SUPPLY CURRENT vs. TEMPERATURE



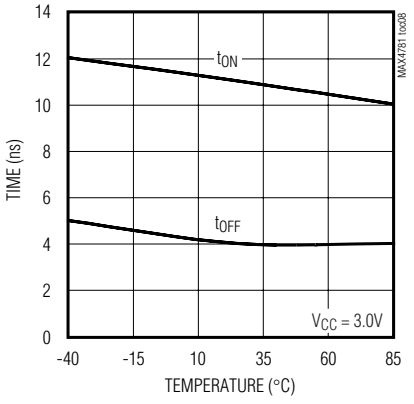
LOGIC THRESHOLD vs. SUPPLY VOLTAGE



TURN-ON/TURN-OFF TIME vs. SUPPLY VOLTAGE



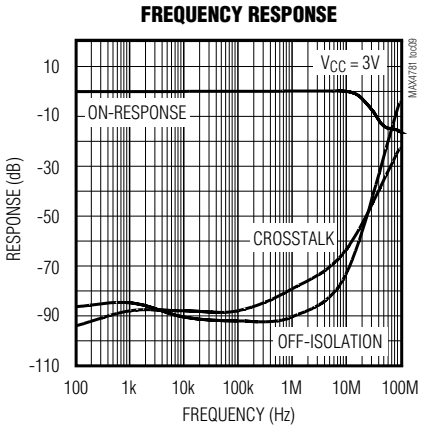
TURN-ON/TURN-OFF TIME vs. TEMPERATURE

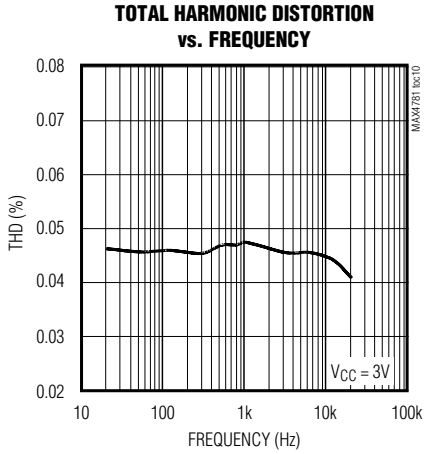


High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Typical Operating Characteristics (continued)

(GND = 0, T_A = +25°C, unless otherwise noted.)





MAX4781 Pin Description

PIN		NAME	FUNCTION
TSSOP	QFN		
3	1	X	Analog Switch Output
6	4	$\overline{ENABLE}$	Digital Enable Input. Normally connect to GND. Drive to logic high to set all switches off.
7	5	N.C.	No Connection. Not internally connected.
8	6	GND	Ground
9	7	C	Digital Address C Input
10	8	B	Digital Address B Input
11	9	A	Digital Address A Input
13, 14, 15, 12, 1, 5, 2, 4	11, 12, 13, 10, 15, 3, 16, 2	X0–X7	Analog Switch Inputs X0–X7
16	14	V_{CC}	Positive Analog and Digital Supply Voltage Input

MAX4782 Pin Description

PIN		NAME	FUNCTION
TSSOP	QFN		
1, 5, 2, 4	15, 3, 16, 2	Y0–Y3	Analog Switch Y Inputs Y0–Y3
3	1	Y	Analog Switch Y Output
6	4	$\overline{ENABLE}$	Digital Enable Input. Normally connect to GND. Drive to logic high to set all switches off.
7	5	N.C.	No Connection. Not internally connected.
8	6	GND	Ground
9	7	B	Digital Address B Input
10	8	A	Digital Address A Input
12, 14, 15, 11	10, 12, 13, 9	X0–X3	Analog Switch X Inputs X0–X3
13	11	X	Analog Switch X Output
16	14	V_{CC}	Positive Analog and Digital Supply Voltage Input

MAX4783 Pin Description

PIN		NAME	FUNCTION
TSSOP	QFN		
1	15	Y1	Analog Switch Y Normally Open Input
2	16	Y0	Analog Switch Y Normally Closed Input
3	1	Z1	Analog Switch Z Normally Open Input
4	2	Z	Analog Switch Z Output
5	3	Z0	Analog Switch Z Normally Closed Input
6	4	$\overline{ENABLE}$	Digital Enable Input. Normally connect to GND. Drive to logic high to set all switches off.
7	5	N.C.	No Connection. Not internally connected.
8	6	GND	Ground
9	7	C	Digital Address C Input
10	8	B	Digital Address B Input
11	9	A	Digital Address A Input
12	10	X0	Analog Switch X Normally Closed Input
13	11	X1	Analog Switch X Normally Open Input
14	12	X	Analog Switch X Output
15	13	Y	Analog Switch Y Output
16	14	V_{CC}	Positive Analog and Digital Supply Voltage Input

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Applications Information

Power-Supply Considerations

Overview

The MAX4781/MAX4782/MAX4783 construction is typical of most CMOS analog switches. There are two supply inputs: V_{CC} and GND. V_{CC} and GND drive the internal CMOS switches and set the limits of the analog voltage on any switch. Internal reverse ESD-protection diodes are connected between each analog signal input and both V_{CC} and GND. If any analog signal exceeds V_{CC} or GND, one of these diodes conducts. During normal operation, these and other reverse-biased ESD diodes leak, forming the only current drawn from V_{CC} or GND.

Virtually all the analog leakage current comes from the ESD diodes. Although the ESD diodes on a given signal input are identical and therefore fairly well balanced, they are reverse-biased differently. Each diode is biased by either V_{CC} or GND and the analog signal. Their leakages vary as the signal varies. The difference in the two diodes' leakages to V_{CC} and GND constitutes the analog-signal-path leakage current. All analog leakage current flows between each input and one of the supply terminals, not to the other switch terminal. Both sides of a given switch can show leakage currents of either the same or opposite polarity.

V_{CC} and GND power the internal logic and set the input logic limits. Logic inputs have ESD-protection diodes to ground.

Power Supply

The MAX4781/MAX4782/MAX4783 operate from a single supply between +1.6V and +3.6V. Switch on-resistance increases as the supply voltage is lowered.

High-Frequency Performance

In 50Ω systems, signal response is reasonably flat up to 50MHz (see the *Typical Operating Characteristics*). Above 20MHz, the on-response has several minor peaks that are highly layout dependent. In the off state, the switch acts like a capacitor and passes higher frequencies with less attenuation. At 10MHz, off-isolation is approximately -50dB in 50Ω systems, becoming worse (approximately 20dB per decade) as frequency increases. Higher circuit impedance also degrades off-isolation. Adjacent channel attenuation is approximately 3dB above that of a bare IC socket and is entirely because of capacitive coupling.

Pin Nomenclature

The MAX4781/MAX4782/MAX4783 are pin compatible with the industry-standard 74HC4051/74HC4052/74HC4053 and the MAX4617/MAX4618/MAX4619. In single-supply applications, they function identically and have identical logic diagrams, although these parts differ electrically. The pin designations and logic diagrams in this data sheet conform to the original 1972 specifications published by RCA for the CD4051/CD4052/CD4053. These designations differ from the standard Maxim switch and mux designations found on other Maxim data sheets such as the MAX4051/MAX4052/MAX4053. Designers who are more comfortable with Maxim's standard designations are advised that the pin designations and logic diagrams on the MAX4051/MAX4052/MAX4053 data sheet can be applied to the MAX4781/MAX4782/MAX4783.

Table 1. Truth Table/Switch Programming

ENABLE INPUT	SELECT INPUT			ON SWITCHES		
	C*	B	A	MAX4781	MAX4782	MAX4783
H	✓	✓	✓	All switches open	All switches open	All switches open
L	L	L	L	X-X0	X-X0 Y-Y0	X-X0 Y-Y0 Z-Z0
L	L	L	H	X-X1	X-X1 Y-Y1	X-X1 Y-Y0 Z-Z0
L	L	H	L	X-X2	X-X2 Y-Y2	X-X0 Y-Y1 Z-Z0
L	L	H	H	X-X3	X-X3 Y-Y3	X-X1 Y-Y1 Z-Z0
L	H	L	L	X-X4	X-X0 Y-Y0	X-X0 Y-Y0 Z-Z1
L	H	L	H	X-X5	X-X1 Y-Y1	X-X1 Y-Y0 Z-Z1
L	H	H	L	X-X6	X-X2 Y-Y2	X-X0 Y-Y1 Z-Z1
L	H	H	H	X-X7	X-X3 Y-Y3	X-X1 Y-Y1 Z-Z1

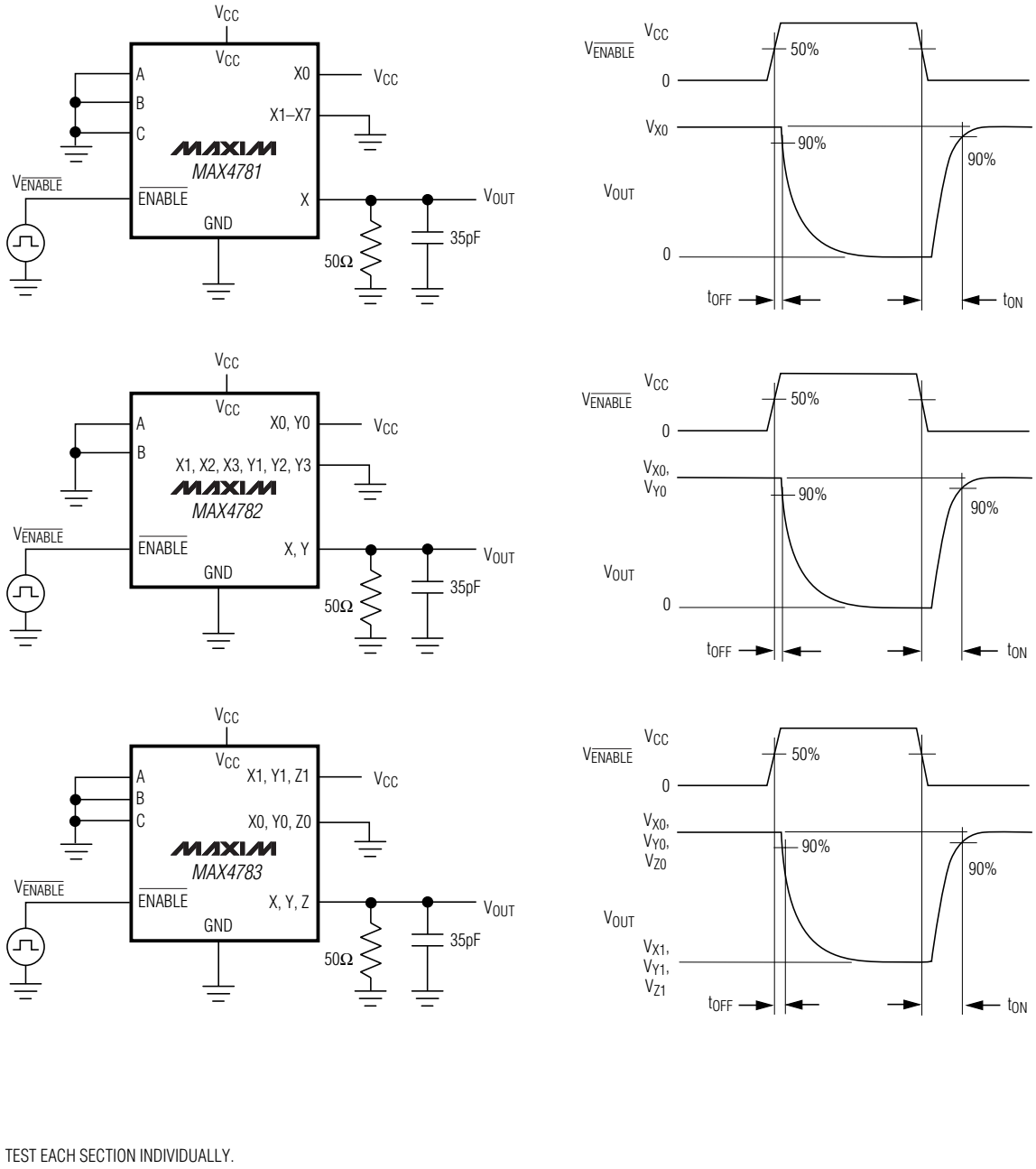
✓ = Don't care.

**Not present on MAX4782.*

Note: *Input and output pins are identical and interchangeable. Either can be considered an input or output. Signals pass equally well in either direction.*

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Test Circuits/Timing Diagrams



TEST EACH SECTION INDIVIDUALLY.

Figure 1. Enable Switching Times

Test Circuits/Timing Diagrams (continued)

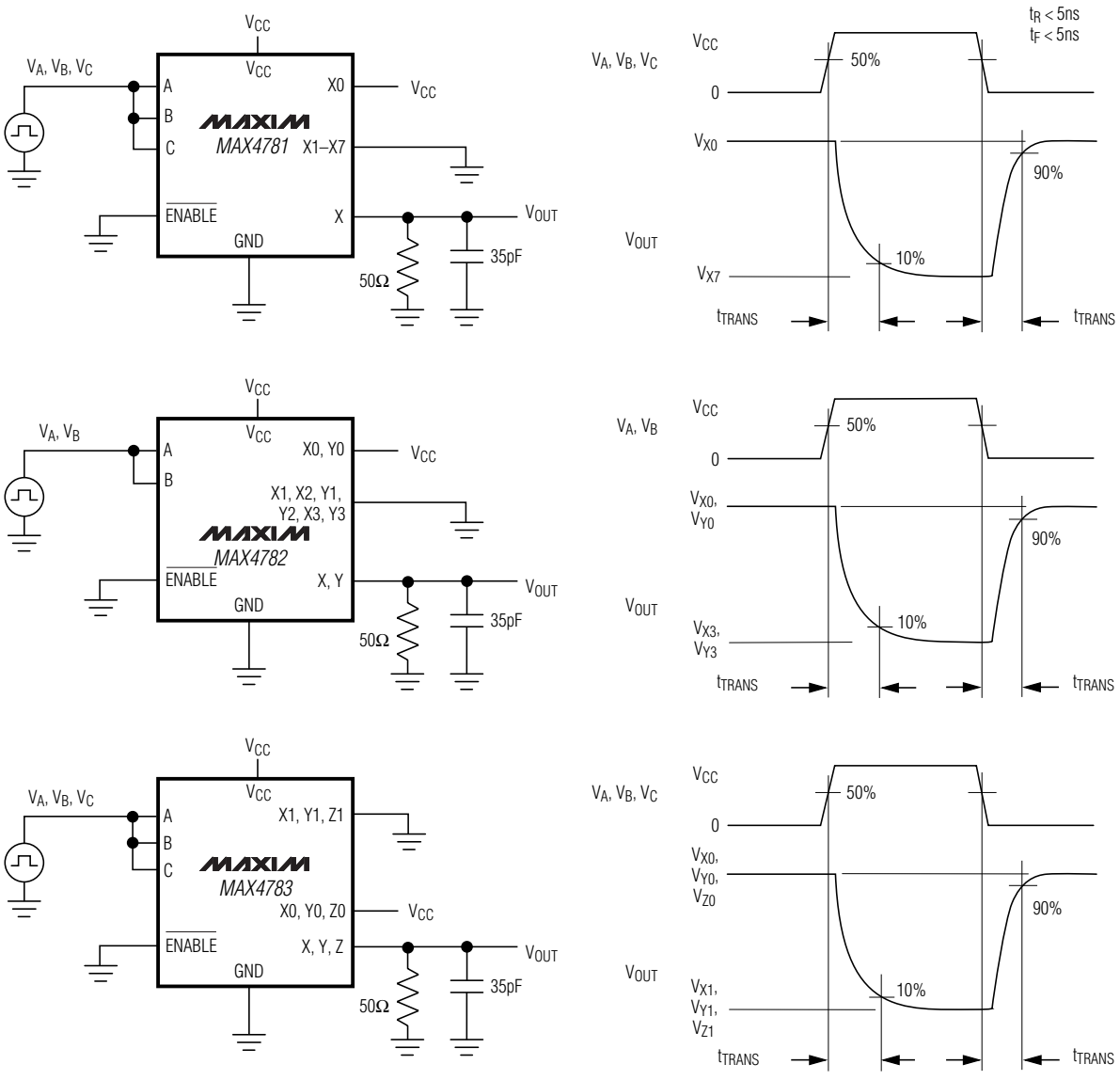


Figure 2. Address Transition Times

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Test Circuits/Timing Diagrams (continued)

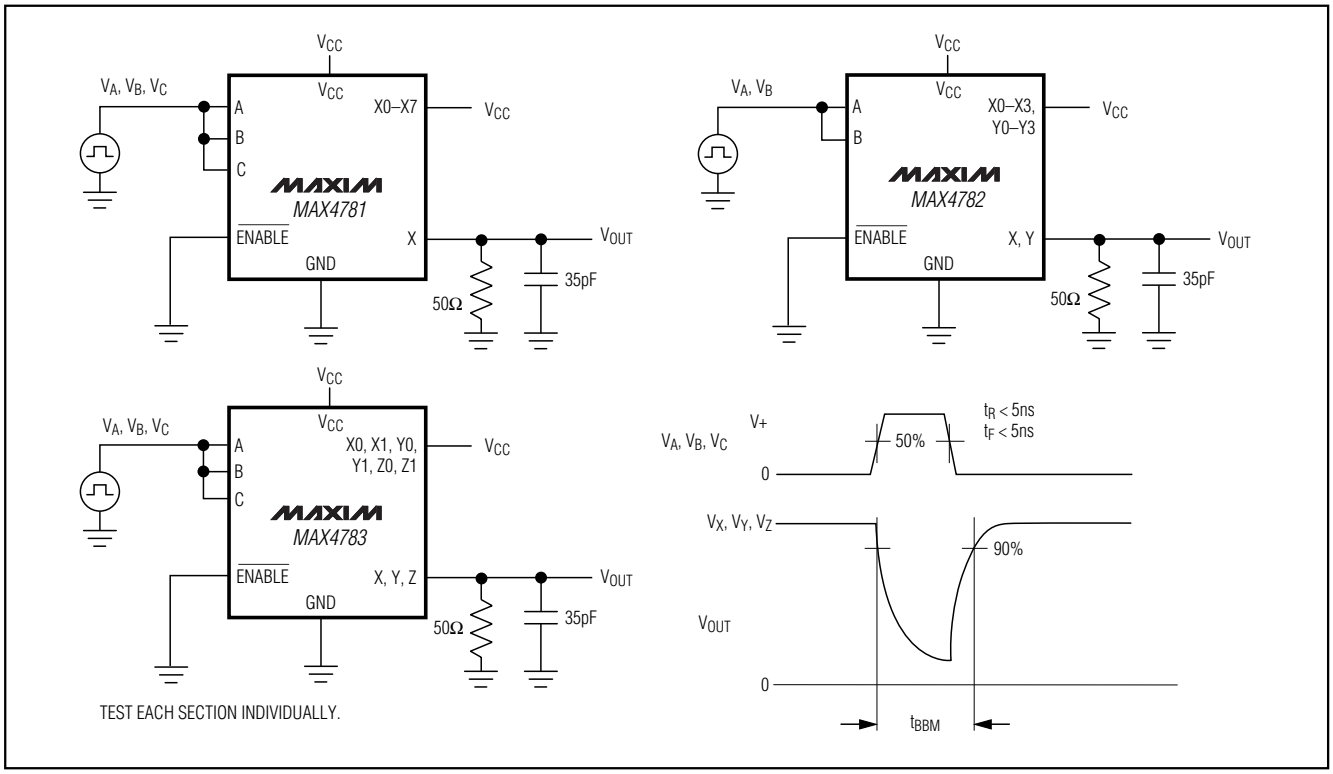


Figure 3. Break-Before-Make Interval

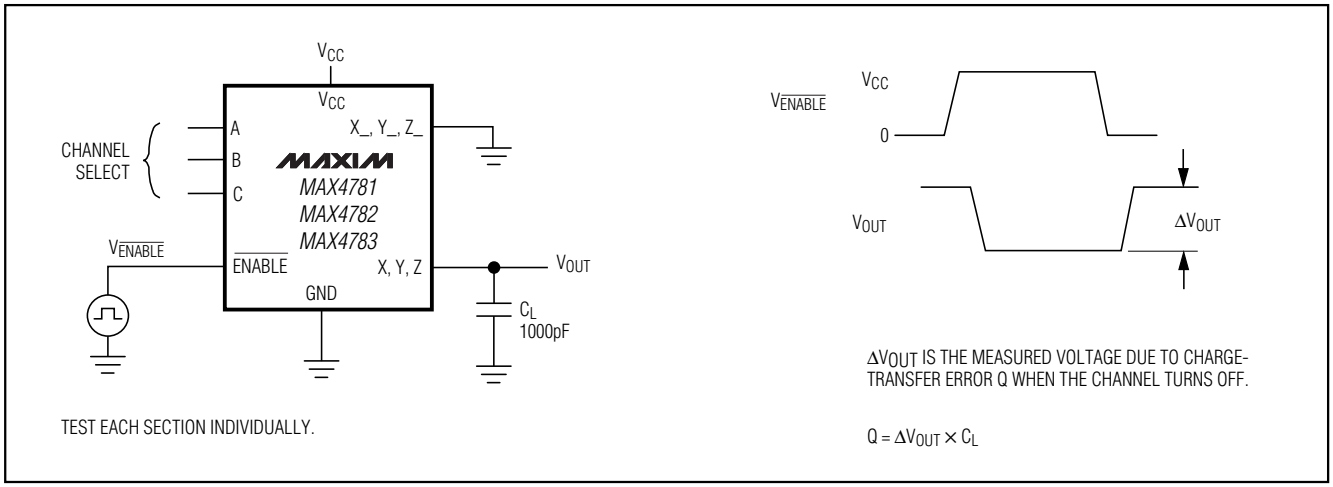
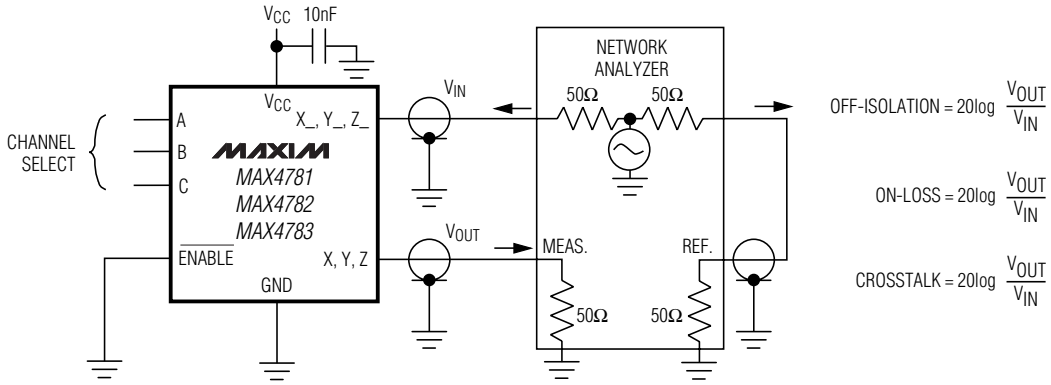


Figure 4. Charge Injection

Test Circuits/Timing Diagrams (continued)



NOTES: MEASUREMENTS ARE STANDARDIZED AGAINST SHORT AT SOCKET TERMINALS.
OFF-ISOLATION IS MEASURED BETWEEN COM AND "OFF" NO TERMINAL ON EACH SWITCH.
ON-LOSS IS MEASURED BETWEEN COM AND "ON" NO TERMINAL ON EACH SWITCH.
CROSSTALK IS MEASURED BETWEEN ADJACENT CHANNELS WITH ONE CHANNEL ON AND THE OTHER OFF.
SIGNAL DIRECTION THROUGH SWITCH IS REVERSED; WORST VALUES ARE RECORDED.

Figure 5. Off-Isolation, On-Loss, and Crosstalk

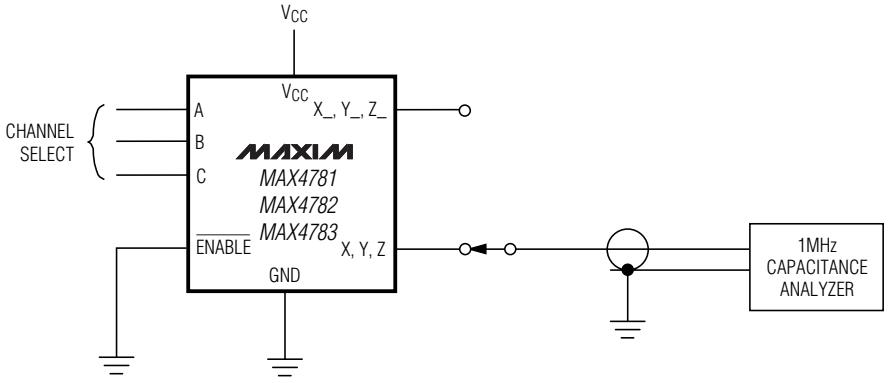


Figure 6. Capacitance

Chip Information

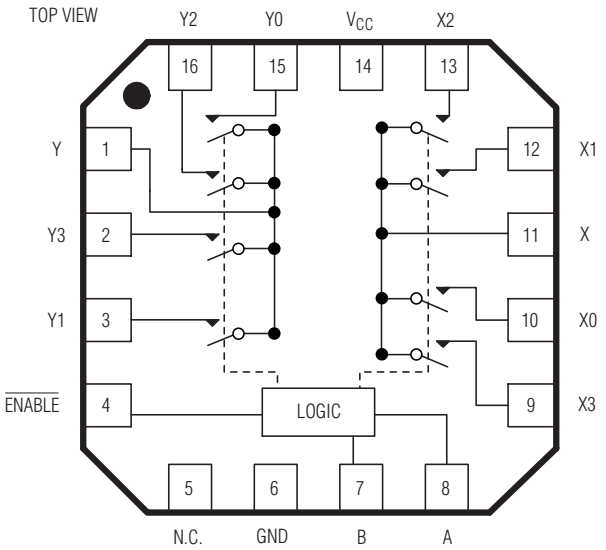
TRANSISTOR COUNT: 659

PROCESS: CMOS

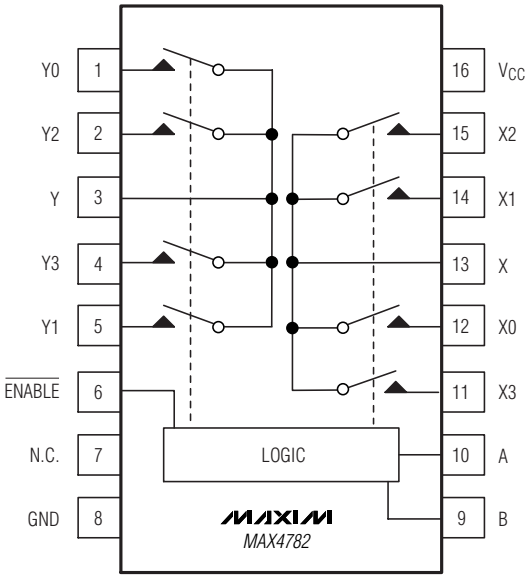
High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Pin Configurations/Functional Diagrams (continued)

MAXIM
MAX4782

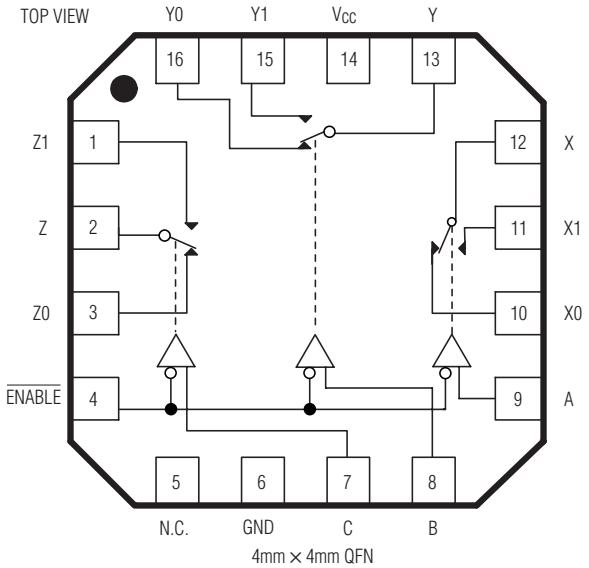


4mm × 4mm QFN

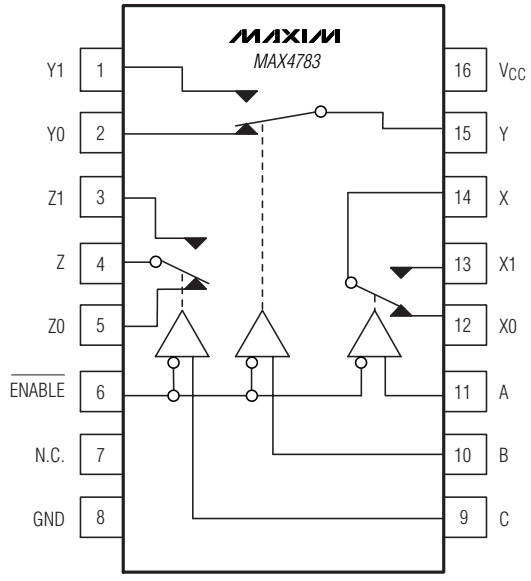


TSSOP

MAXIM
MAX4783



4mm × 4mm QFN

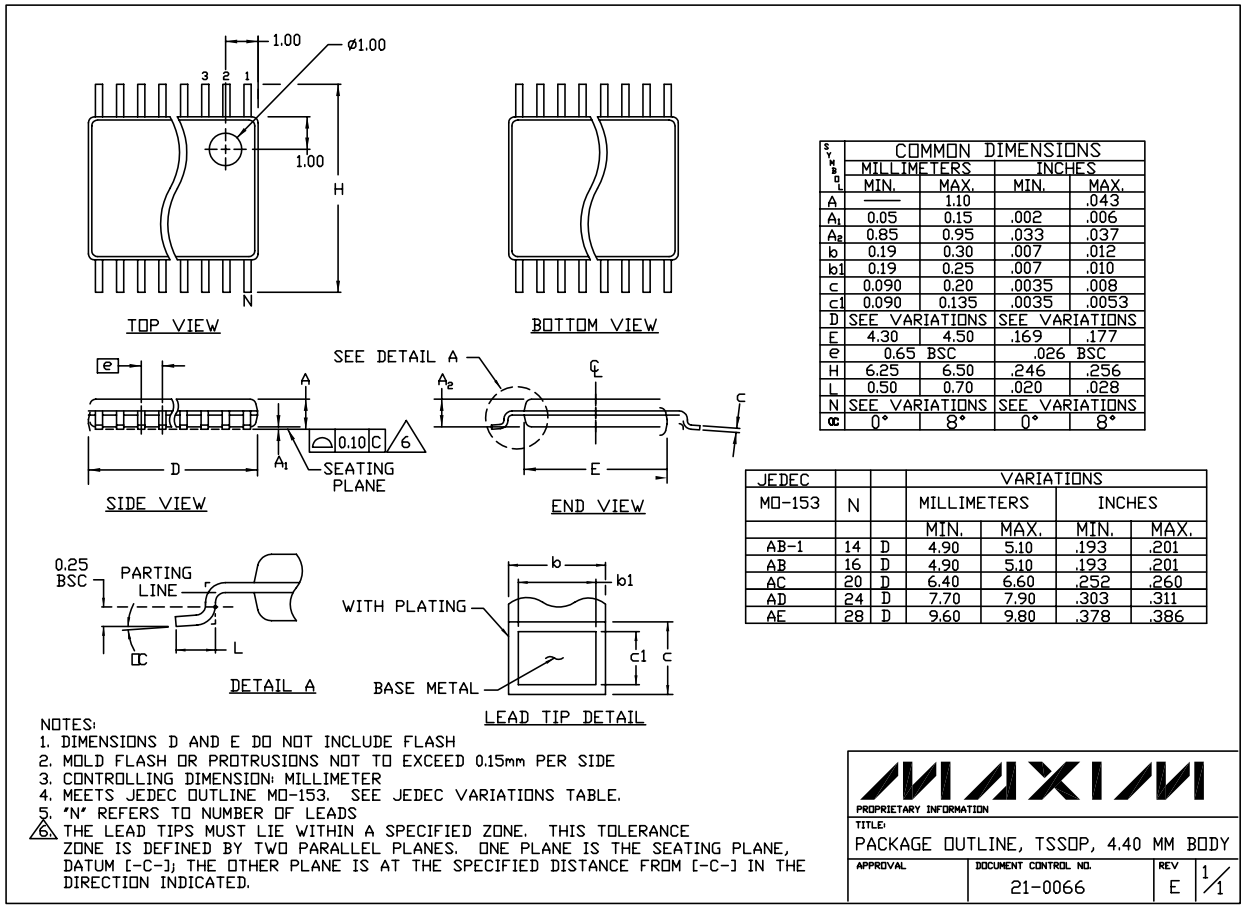


TSSOP

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**.)

TSSOP,NO PADS.EPS



SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	———	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b1	0.19	0.25	.007	.010
c	0.090	0.20	.0035	.008
c1	0.090	0.135	.0035	.0053
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.50	.246	.256
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°

JEDEC			VARIATIONS			
MO-153	N		MILLIMETERS		INCHES	
			MIN.	MAX.	MIN.	MAX.
AB-1	14	D	4.90	5.10	.193	.201
AB	16	D	4.90	5.10	.193	.201
AC	20	D	6.40	6.60	.252	.260
AD	24	D	7.70	7.90	.303	.311
AE	28	D	9.60	9.80	.378	.386

NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE.
5. "N" REFERS TO NUMBER OF LEADS
6. THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-]; THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED.

MAXIM
PROPRIETARY INFORMATION

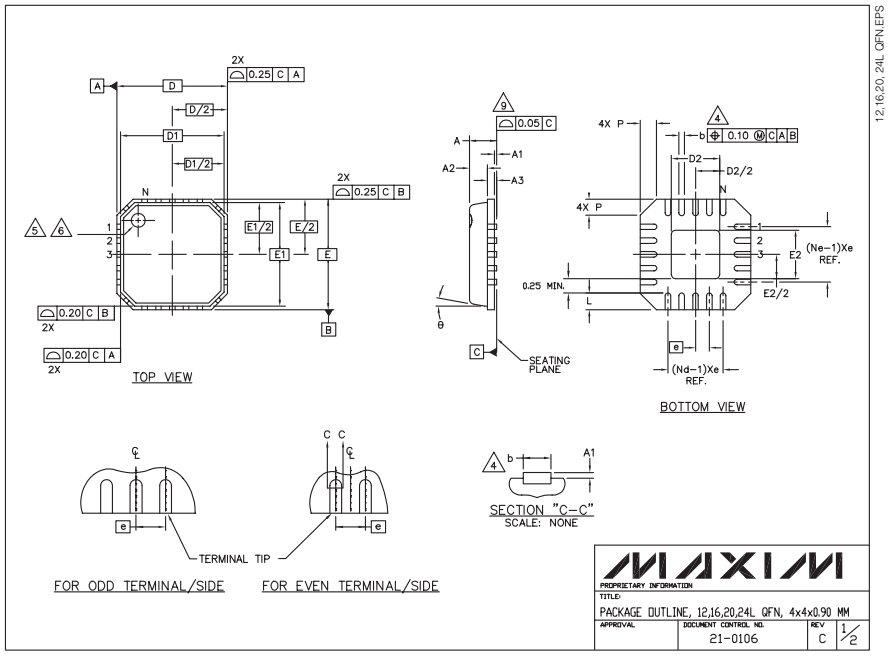
TITLE: PACKAGE OUTLINE, TSSOP, 4.40 MM BODY

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

High-Speed, Low-Voltage, 1Ω CMOS Analog Switches/Multiplexers

Package Information (continued)

(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**.)



NOTES:

1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
2. DIMENSIONING & TOLERANCES CONFORM MUST TO ASME Y14.5M. – 1994.
3. N IS THE NUMBER OF TERMINALS.
   Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &
   Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED.
6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
7. ALL DIMENSIONS ARE IN MILLIMETERS.
8. PACKAGE WARPAGE MAX 0.05mm.
9. APPLIED FOR EXPOSED PAD AND TERMINALS.
   EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
10. MEETS JEDEC MO220.
11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

SYMBOL	COMMON DIMENSIONS MIN.	NOM.	MAX.	NOTE
A	0.80	0.90	1.00	
A1	0.00	0.01	0.05	
A2	0.00	0.65	0.80	
A3		0.20 REF.		
D		4.00 BSC		
D1		3.75 BSC		
E		4.00 BSC		
E1		3.75 BSC		
θ	0°		12°	
P	0.00	0.42	0.60	
D2	0.75		2.25	
E2	0.75		2.25	

SYMBOL	PITCH VARIATION A MIN.	NOM.	MAX.	NOTE	SYMBOL	PITCH VARIATION B MIN.	NOM.	MAX.	NOTE	SYMBOL	PITCH VARIATION C MIN.	NOM.	MAX.	NOTE	SYMBOL	PITCH VARIATION D MIN.	NOM.	MAX.	NOTE
e		0.80 BSC			e		0.65 BSC			e		0.50 BSC			e		0.50 BSC		
N		12		3	N		16		3	N		20		3	N		24		3
Nd		3		3	Nd		4		3	Nd		5		3	Nd		6		3
Ne		3		3	Ne		4		3	Ne		5		3	Ne		6		3
L	0.50	0.60	0.75		L	0.50	0.60	0.75		L	0.50	0.60	0.75		L	0.30	0.40	0.55	
b	0.28	0.33	0.40	4	b	0.23	0.28	0.35	4	b	0.18	0.23	0.30	4	b	0.18	0.23	0.30	4

PROPRIETARY INFORMATION
TITLE:
PACKAGE OUTLINE, 12,16,20,24L QFN, 4x4x0.90 MM
APPROVAL
DOCUMENT CONTROL NO.
21-0106
REV
C
2/2