



# 0.7 $\Omega$ , Low-Voltage, Quad 2:1 Analog Multiplexers

**MAX4780/MAX4784**

## General Description

The MAX4780/MAX4784 are low on-resistance, low-voltage, quad 2:1 analog multiplexers that operate from a single +1.6V to +4.2V supply. These devices have fast switching speeds ( $t_{ON} = 20\text{ns}$ ,  $t_{OFF} = 8\text{ns}$ ), handle rail-to-rail analog signals, and consume less than  $1\mu\text{W}$  of quiescent power.

When powered from a +2.7V supply, the MAX4780/MAX4784 feature low  $0.7\Omega$  on-resistance ( $R_{ON}$ ), and  $0.1\Omega$   $R_{ON}$  flatness (+2.7V Supply).

The MAX4780/MAX4784 are available in 16-pin TSSOP and 3mm x 3mm thin QFN packages.

## Applications

Power Routing  
Battery-Powered Systems  
Audio and Video Signal Routing  
Low-Voltage Data-Acquisition Systems  
Communications Circuits  
PCMCIA Cards  
Cellular Phones  
Modems  
Hard Drives

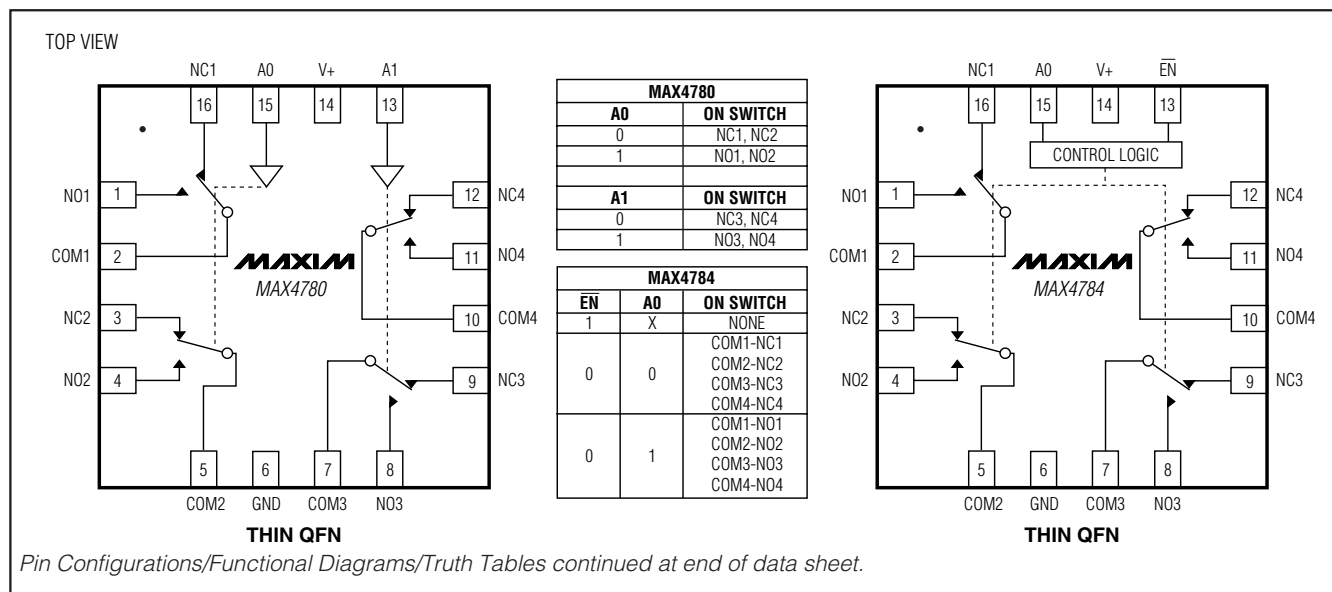
## Features

- ◆ Single-Supply Operation from 1.6V to 4.2V
- ◆ Low  $R_{ON}$   
     $0.7\Omega$  (+2.7V Supply)  
     $2\Omega$  (+1.8V Supply)
- ◆  $0.1\Omega$   $R_{ON}$  Flatness (+2.7V Supply)
- ◆ 3mm x 3mm Thin QFN Package
- ◆ +1.8V CMOS Logic Compatible
- ◆ Fast Switching:  $t_{ON} = 20\text{ns}$ ,  $t_{OFF} = 8\text{ns}$

## Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX4780ETE	-40°C to +85°C	16 Thin QFN
MAX4780EUE	-40°C to +85°C	16 TSSOP
MAX4784ETE	-40°C to +85°C	16 Thin QFN
MAX4784EUE	-40°C to +85°C	16 TSSOP

## Pin Configurations/Functional Diagrams/Truth Tables



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## ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to GND

V+, A <sub>+</sub> , $\overline{\text{EN}}$ .....	-0.3V to +4.6V
COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> (Note 1) .....	-0.3V to (V+ + 0.3V)
Continuous Current COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> .....	±300mA
Peak Current COM <sub>-</sub> , NO <sub>-</sub> , NC <sub>-</sub> (pulsed at 1ms 10% duty cycle) .....	±500mA

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

16-Pin Thin QFN (derate 14.7mW/°C above +70°C) .....	1176.5mW
16-Pin TSSOP (derate 9.4mW/°C above +70°C) .....	755mW
Operating Temperature Range .....	-40°C to +85°C
Maximum Junction Temperature .....	+150°C
Storage Temperature Range .....	-65°C to +150°C

**Note 1:** Signals on COM<sub>-</sub>, NO<sub>-</sub>, or NC<sub>-</sub> exceeding V+ or GND are clamped by internal diodes. Limit forward 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+ = +2.7V to +4.2V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at V+ = +3.0V, T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS
<b>ANALOG SWITCH</b>							
Analog Signal Range	V <sub>COM-</sub> , V <sub>NO-</sub> , V <sub>NC-</sub>			0		V+	V
On-Resistance (Note 4)	R <sub>ON</sub>	V+ = 2.7V, I <sub>COM-</sub> = 100mA, V <sub>NO-</sub> or V <sub>NC-</sub> = 1.5V	+25°C		0.7	1	$\Omega$
			T <sub>MIN</sub> to T <sub>MAX</sub>			1.2	
On-Resistance Match Between Channels (Notes 4, 5)	$\Delta R_{ON}$	V+ = 2.7V, I <sub>COM-</sub> = 100mA, V <sub>NO-</sub> or V <sub>NC-</sub> = 1.5V	+25°C		0.1	0.15	$\Omega$
			T <sub>MIN</sub> to T <sub>MAX</sub>			0.2	
On-Resistance Flatness (Note 6)	R <sub>FLAT(ON)</sub>	V+ = 2.7V, I <sub>COM-</sub> = 100mA, V <sub>NO-</sub> or V <sub>NC-</sub> = 1V, 1.5V, 2V	+25°C		0.1	0.2	$\Omega$
			T <sub>MIN</sub> to T <sub>MAX</sub>			0.3	
NO <sub>-</sub> or NC <sub>-</sub> Off-Leakage Current (Note 7)	I <sub>NO-(OFF)</sub> , I <sub>NC-(OFF)</sub>	V+ = 3.6V, V <sub>COM-</sub> = 0.3V, 3.3V, V <sub>NO-</sub> or V <sub>NC-</sub> = 3.3V, 0.3V	+25°C	-1	±0.002	+1	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-5		+5	
COM <sub>-</sub> Off-Leakage Current (MAX4784 Only) (Note 7)	I <sub>COM-(OFF)</sub>	V+ = 3.6V, V <sub>COM-</sub> = 0.3V, 3.3V, V <sub>NO-</sub> or V <sub>NC-</sub> = 3.3V, 0.3V, or floating	+25°C	-1	±0.002	+1	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-5		+5	
COM <sub>-</sub> On-Leakage Current (Note 7)	I <sub>COM-(ON)</sub>	V+ = 3.6V, V <sub>COM-</sub> = 3.3V, 0.3V, V <sub>NO-</sub> or V <sub>NC-</sub> = 3.3V, 0.3V, or floating	+25°C	-2	±0.002	+2	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-10		+10	

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## ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +2.7V to +4.2V, V<sub>IH</sub> = +1.4V, V<sub>IL</sub> = +0.5V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at V+ = +3.0V, T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time	t <sub>ON</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 1	+25°C	20	25	ns	
			T <sub>MIN</sub> to T <sub>MAX</sub>	30			
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 1	+25°C	8	10	ns	
			T <sub>MIN</sub> to T <sub>MAX</sub>	18			
Break-Before-Make (Note 8)	t <sub>BBM</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.5V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 2	+25°C	7		ns	
			T <sub>MIN</sub> to T <sub>MAX</sub>	1			
Charge Injection	Q	V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1.0nF, Figure 3	+25°C	5		pC	
NO_ or NC_ Off-Capacitance	C <sub>OFF</sub>	f = 1MHz, Figure 4	+25°C	33		pF	
COM_ Off-Capacitance	C <sub>COM_(OFF)</sub>	f = 1MHz, Figure 4	+25°C	60		pF	
COM_ On-Capacitance	C <sub>COM_(ON)</sub>	f = 1MHz, Figure 4	+25°C	85		pF	
-3dB On-Channel Bandwidth	BW	Signal = 0, R <sub>IN</sub> = R <sub>OUT</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5		123		MHz	
Off-Isolation (Note 9)	V <sub>ISO</sub>	f = 1MHz, V <sub>COM_</sub> = 1V <sub>P-P</sub> , R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figure 5	+25°C	-67		dB	
Crosstalk (Note 10)	V <sub>CT</sub>	f = 1MHz, V <sub>COM_</sub> = 1V <sub>P-P</sub> , R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Figures 4, 5	+25°C	-95		dB	
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, V <sub>COM_</sub> = 2V <sub>P-P</sub> , R <sub>L</sub> = 32Ω	+25°C	0.008		%	
LOGIC INPUT (A_, $\overline{\text{EN}}$ )							
Input Logic High	V <sub>IH</sub>			1.8		V	
Input Logic Low	V <sub>IL</sub>			0.5		V	
Input Leakage Current	I <sub>IN</sub>	$\overline{\text{V}}\overline{\text{EN}}$ = 0 or +3.6V, V <sub>A0</sub> = 0 or +3.6V		-1	0.005	+1	μA
POWER SUPPLY							
Power-Supply Range	V+			1.6	3.6	V	
Positive Supply Current	I+	V+ = 3.6V, $\overline{\text{EN}}$ , A0 = 0 or V+, all channels on or off	T <sub>MIN</sub> to T <sub>MAX</sub>	2		μA	

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## ELECTRICAL CHARACTERISTICS—Single +1.8V Supply

(V<sub>+</sub> = +1.8V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V <sub>COM_</sub> , V <sub>NO_</sub> , V <sub>NC_</sub>			0		V <sub>+</sub>	V
On-Resistance	R <sub>ON</sub>	I <sub>COM_</sub> = 10mA, V <sub>NO_</sub> or V <sub>NC_</sub> = 1.0V	+25°C		2	3	Ω
			T <sub>MIN</sub> to T <sub>MAX</sub>			5	
NO_ or NC_ Off-Leakage Current (Note 7)	I <sub>NO_(OFF)</sub> , I <sub>NC_(OFF)</sub>	V <sub>COM_</sub> = 0.3V, 1.5V, V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V, 0.3V	+25°C	-1		+1	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-5		+5	
COM_ Off-Leakage Current (MAX4784 Only) (Note 7)	I <sub>COM_(OFF)</sub>	V <sub>COM_</sub> = 0.3V, 1.5V, V <sub>NO_</sub> or V <sub>NC_</sub> = 1.5V, 0.3V	+25°C	-1		+1	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-5		+5	
COM_ On-Leakage Current (Note 7)	I <sub>COM_(ON)</sub>	V <sub>COM_</sub> = 0.3V, 1.5V, V <sub>NO_</sub> or V <sub>NC_</sub> = 0.3V, 1.5V, or floating	+25°C	-2		+2	nA
			T <sub>MIN</sub> to T <sub>MAX</sub>	-10		+10	
SWITCH DYNAMIC CHARACTERISTICS							
Turn-On Time	t <sub>ON</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 1	+25°C		25	30	ns
			T <sub>MIN</sub> to T <sub>MAX</sub>			35	
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 1	+25°C		10	15	ns
			T <sub>MIN</sub> to T <sub>MAX</sub>			20	
Break-Before-Make (Note 8)	t <sub>BBM</sub>	V <sub>NO_</sub> , V <sub>NC_</sub> = 1.0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Figure 2	+25°C		10		ns
			T <sub>MIN</sub> to T <sub>MAX</sub>	1			
Charge Injection	Q	V <sub>GEN</sub> = 0, R <sub>GEN</sub> = 0, C <sub>L</sub> = 1nF, Figure 3	+25°C		5		pC

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## ELECTRICAL CHARACTERISTICS—Single +1.8V Supply (continued)

(V<sub>+</sub> = +1.8V, V<sub>IH</sub> = +1.0V, V<sub>IL</sub> = +0.4V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise specified. Typical values are at T<sub>A</sub> = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T <sub>A</sub>	MIN	TYP	MAX	UNITS
<b>LOGIC INPUT (A<sub>-</sub>, <math>\overline{\text{EN}}</math>)</b>							
Input Logic High	V <sub>IH</sub>			1.8			V
Input Logic Low	V <sub>IL</sub>					0.4	V
Input Leakage Current	I <sub>IN</sub>	V $\overline{\text{EN}}$ = 0 or +3.6V, V <sub>A0</sub> = 0 or +3.6V		-1		+1	μA

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

**Note 3:** -40°C specifications are guaranteed by design.

**Note 4:** R<sub>ON</sub> and ΔR<sub>ON</sub> matching specifications for QFN packaged parts are guaranteed by design.

**Note 5:** ΔR<sub>ON</sub> = R<sub>ON</sub>(MAX) - R<sub>ON</sub>(MIN).

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

**Note 7:** Leakage parameters are 100% tested at T<sub>A</sub> = +85°C, and guaranteed by correlation over the full rated temperature range.

**Note 8:** Guaranteed by design.

**Note 9:** Off-isolation = 20log<sub>10</sub>(V<sub>COM</sub>/V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

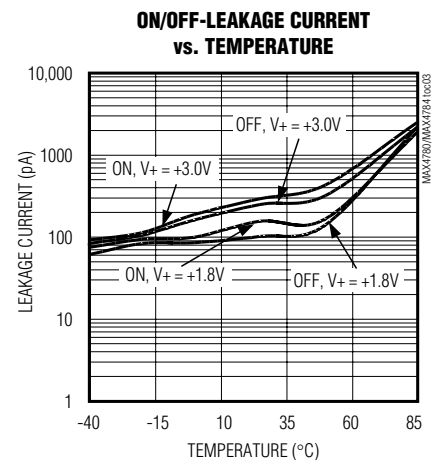
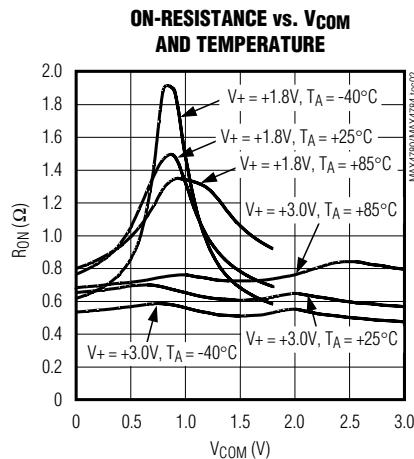
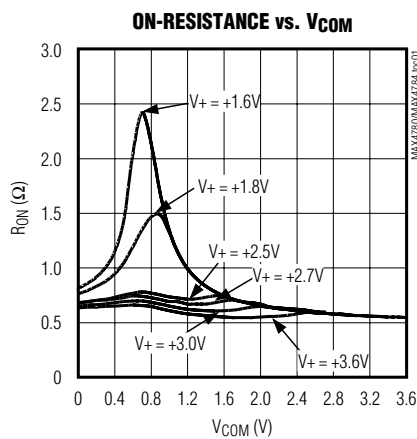
**Note 10:** Between two switches.

**Note 11:** Parts are guaranteed to 1 million cycles of operation. (Cycle = switch on → switch off → switch on.)

**Note 12:** The minimum load resistance is 8Ω. (See the *Typical Application Circuit*.)

## Typical Operating Characteristics

(T<sub>A</sub> = +25°C, unless otherwise noted.)

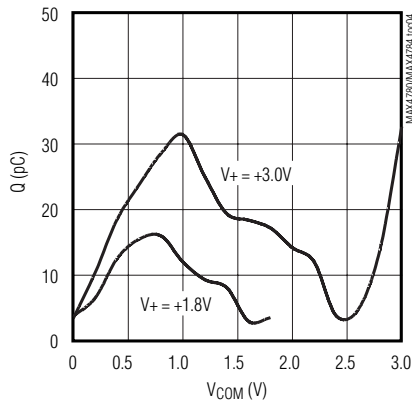


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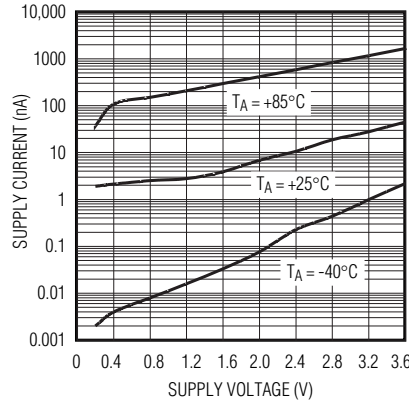
## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

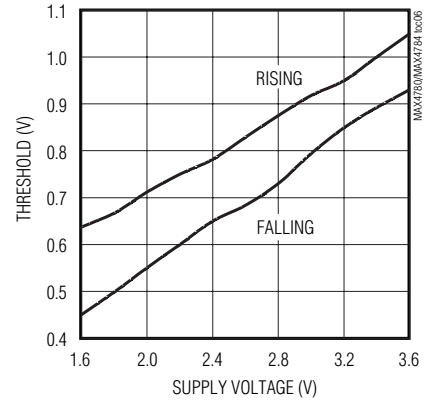
**CHARGE INJECTION vs.  $V_{COM}$**



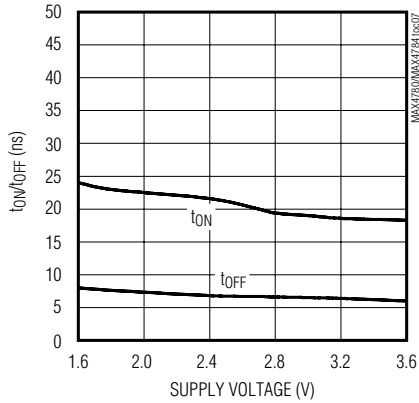
**SUPPLY CURRENT vs. SUPPLY VOLTAGE AND TEMPERATURE**



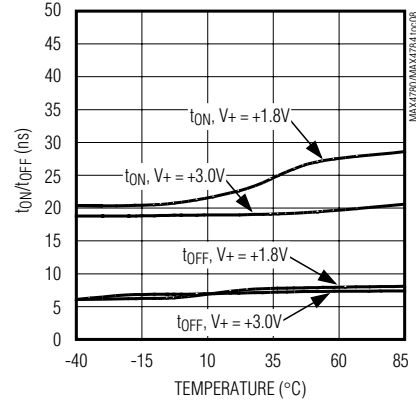
**LOGIC-LEVEL THRESHOLD vs. SUPPLY VOLTAGE**



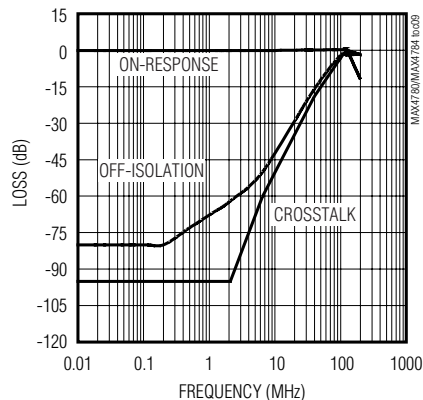
**TURN-ON/OFF TIME vs. SUPPLY VOLTAGE**



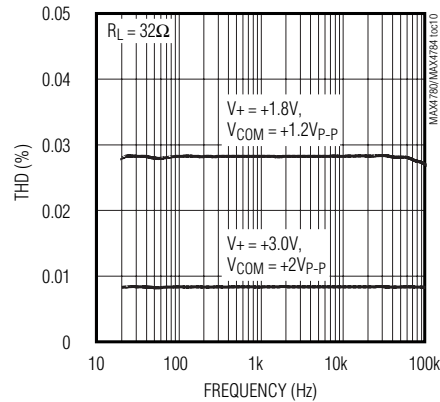
**TURN-ON/OFF TIMES vs. TEMPERATURE**



**FREQUENCY RESPONSE**



**TOTAL HARMONIC DISTORTION vs. FREQUENCY**



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## Pin Description

PIN				NAME	FUNCTION
MAX4780		MAX4784			
TSSOP	THIN QFN	TSSOP	THIN QFN		
1	15	1	15	A0	Address Input
2	16	2	16	NC1	Normally Closed Terminal
3	1	3	1	NO1	Normally Open Terminal
4	2	4	2	COM1	Analog Switch Common Terminal
5	3	5	3	NC2	Normally Closed Terminal
6	4	6	4	NO2	Normally Open Terminal
7	5	7	5	COM2	Analog Switch Common Terminal
8	6	8	6	GND	Ground
9	7	9	7	COM3	Analog Switch Common Terminal
10	8	10	8	NO3	Normally Open Terminal
11	9	11	9	NC3	Normally Closed Terminal
12	10	12	10	COM4	Analog Switch Common Terminal
13	11	13	11	NO4	Normally Open Terminal
14	12	14	12	NC4	Normally Closed Terminal
15	13	—	—	A1	Address Input
—	—	15	13	$\overline{\text{EN}}$	Enable. Connect to GND for normal operation. Connect to logic-level high to turn all switches off.
16	14	16	14	V+	Positive Supply Voltage

MAX4780/MAX4784

## Detailed Description

The MAX4780/MAX4784 are low 0.7Ω (at V+ = +2.7V) on-resistance, low-voltage, quad 2:1 analog multiplexers/demultiplexers that operate from a +1.6V to +4.2V single supply. CMOS switch construction allows switching analog signals that are within the supply voltage range (GND to V+).

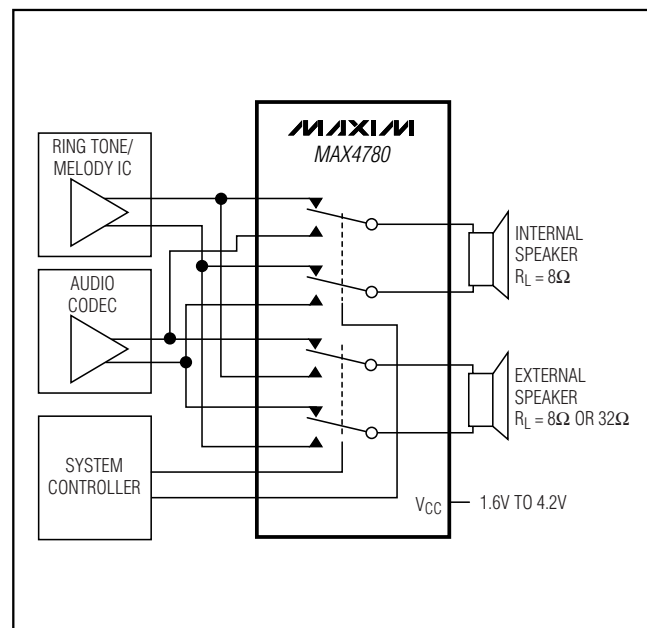
When powered from a +2.7V supply, the 0.7Ω RON allows high continuous currents to be switched in a variety of applications.

## Applications Information

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings, because stresses beyond the listed ratings can cause permanent damage to the devices. Always sequence V+ on first, followed by NO\_, NC\_, or COM\_.

Although it is not required, power-supply bypassing improves noise margin and prevents switching noise propagation from the V+ supply to other components. A 0.1μF capacitor, connected from V+ to GND, is adequate for most applications.

## Typical Application Circuit



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## Logic Inputs

The MAX4780/MAX4784 logic inputs can be driven up to +4.2V regardless of the supply voltage. For example, with a +1.8V supply,  $A_-$  and  $\overline{EN}$  may be driven low to GND and high to +4.2V. Driving  $A_-$  and  $\overline{EN}$  rail-to-rail minimizes power consumption. Drive  $\overline{EN}$  low to enable the  $COM_-$  outputs. When  $\overline{EN}$  is high, the  $COM_-$  outputs are high impedance.

## Analog Signal Levels

Analog signals that range over the entire supply voltage ( $V_+$  to GND) can be passed with very little change in on-

resistance (see the *Typical Operating Characteristics*). The switches are bidirectional, so the  $NO_-$ ,  $NC_-$ , and  $COM_-$  pins can be used as either inputs or outputs.

## Layout

High-speed switches require proper layout and design procedures for optimum performance. Reduce stray inductance and capacitance by keeping traces short and wide. Ensure that bypass capacitors are as close to the device as possible. Use large ground planes where possible.

## Test Circuits/Timing Diagrams

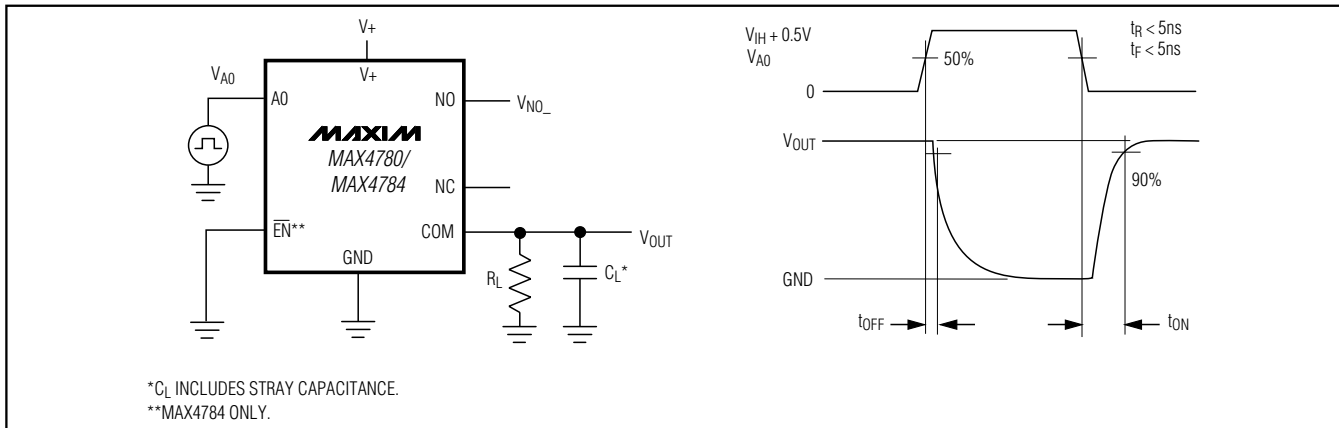


Figure 1. Turn-On and Turn-Off Times

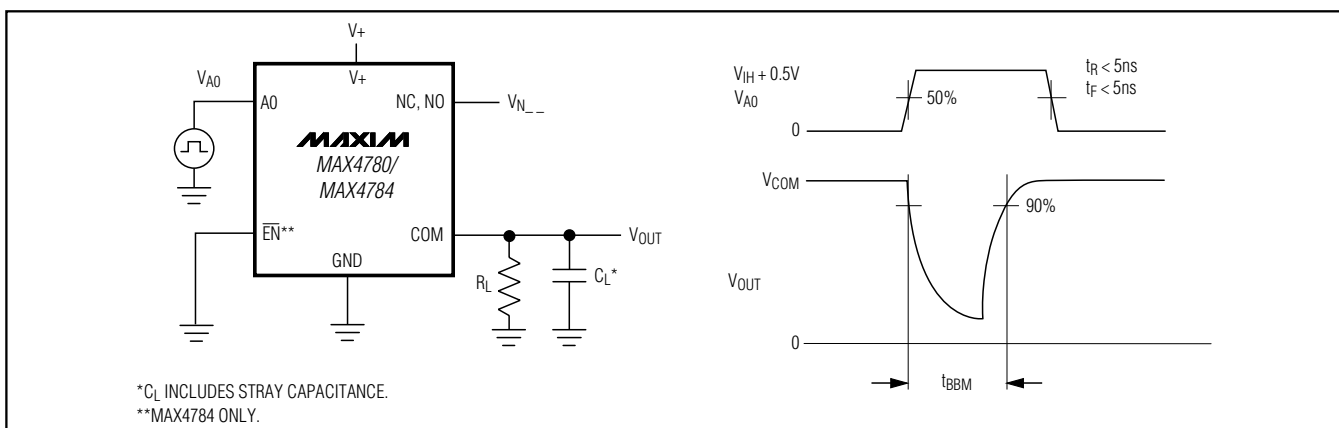


Figure 2. Break-Before-Make Interval



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## Test Circuits/Timing Diagrams (continued)

MAX4780/MAX4784

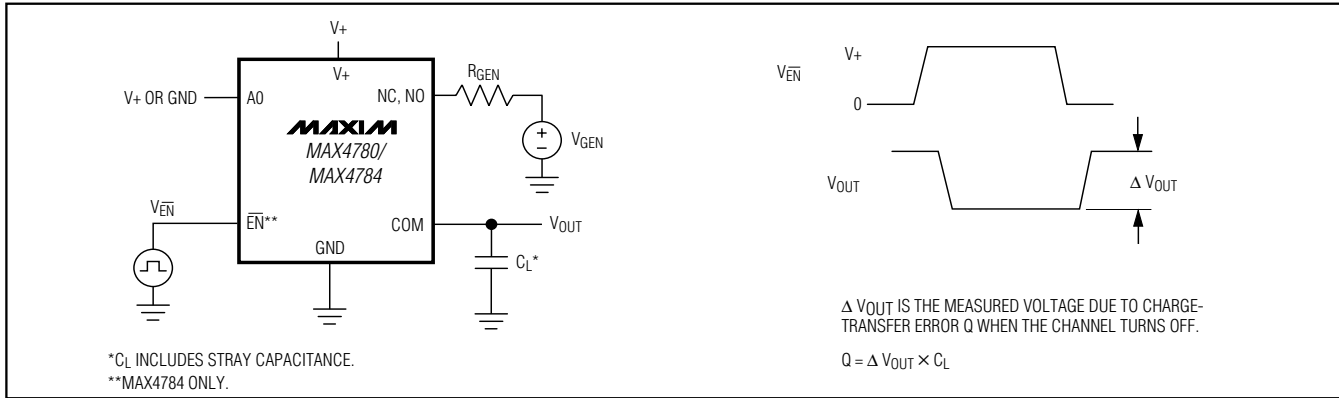


Figure 3. Charge Injection

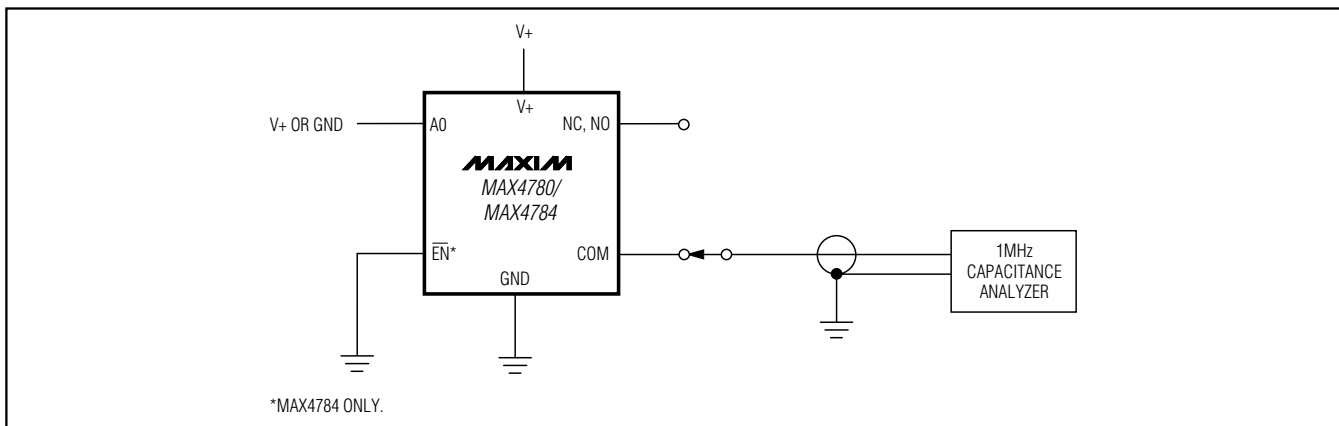


Figure 4. Capacitance

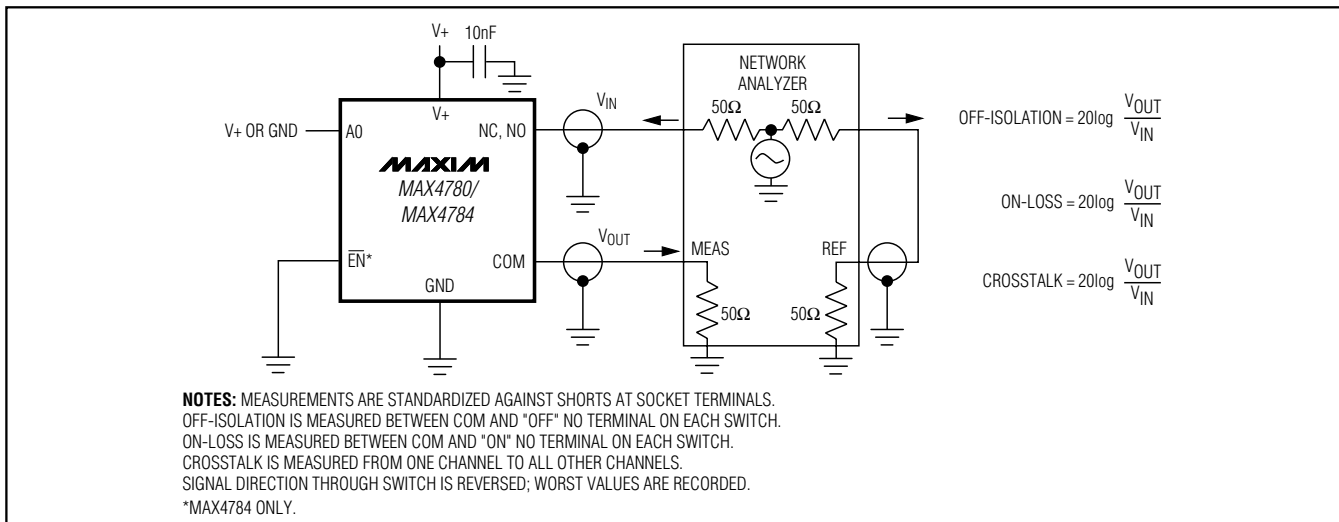
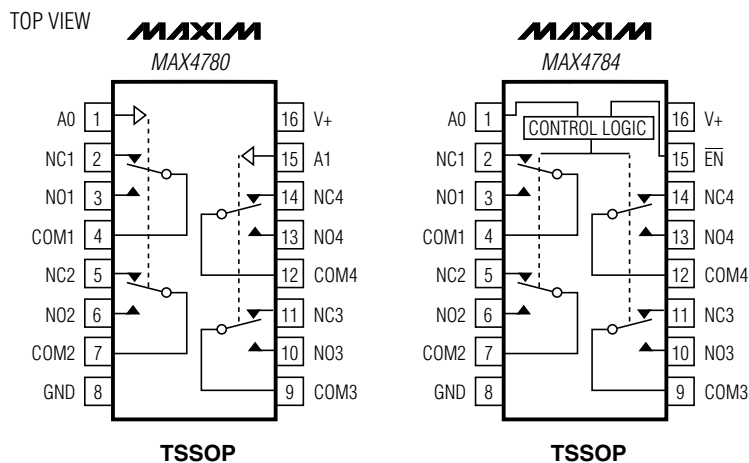


Figure 5. Off-Isolation, On-Loss, and Crosstalk

# 0.7Ω, Low-Voltage, Quad 2:1 Analog Multiplexers

## Pin Configurations/Functional Diagrams/Truth Tables (continued)



## Chip Information

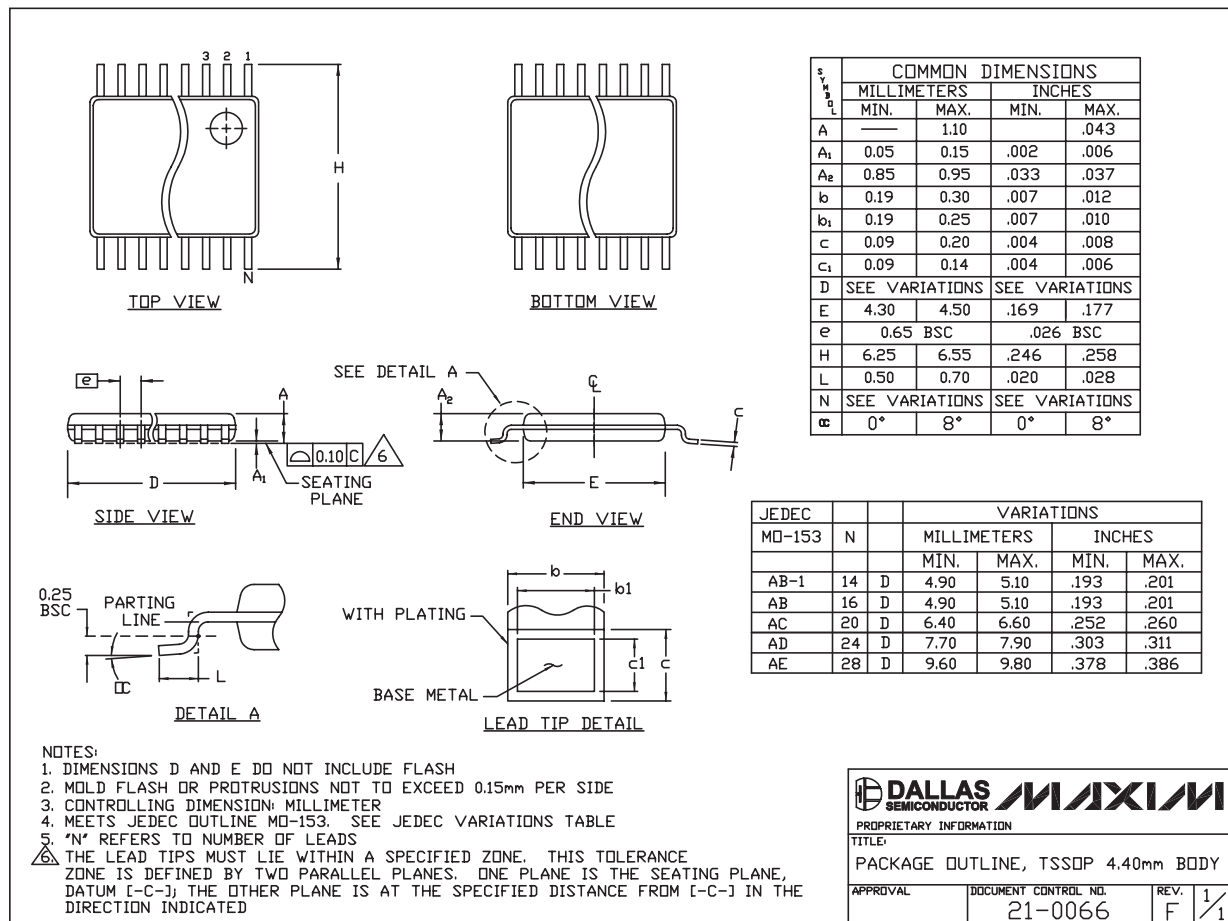
TRANSISTOR COUNT: 543

PROCESS: CMOS

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## 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](http://www.maxim-ic.com/packages).)



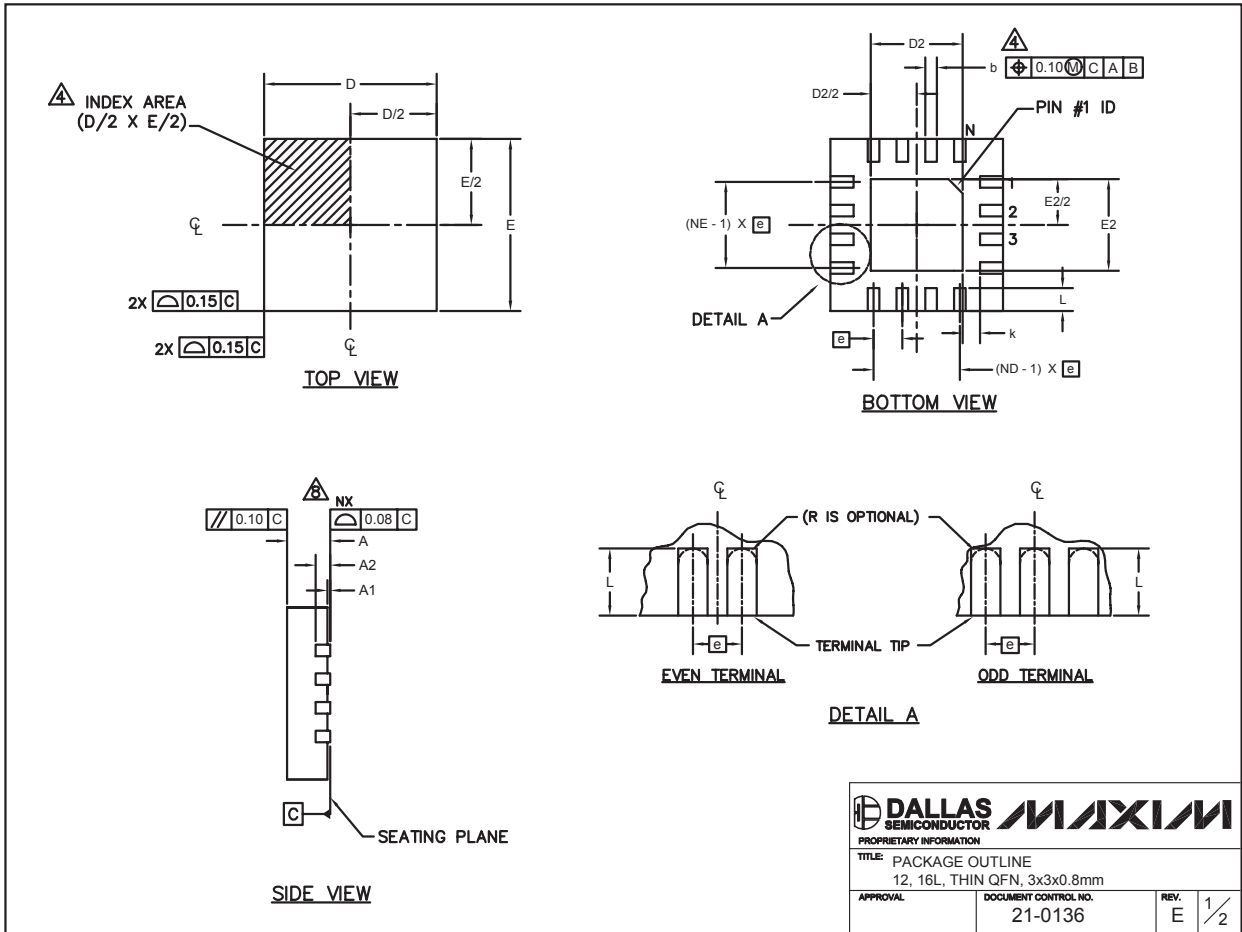
TSSOP4.40mm:EPS

MAX4780/MAX4784

# 0.7Ω, Low-Voltage, Quad 2:1 Analog 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](http://www.maxim-ic.com/packages).)



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MAX4780/MAX4784

PKG	12L 3x3			16L 3x3		
REF.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.70	0.75	0.80
b	0.20	0.25	0.30	0.20	0.25	0.30
D	2.90	3.00	3.10	2.90	3.00	3.10
E	2.90	3.00	3.10	2.90	3.00	3.10
e	0.50 BSC.			0.50 BSC.		
L	0.45	0.55	0.65	0.30	0.40	0.50
N	12			16		
ND	3			4		
NE	3			4		
A1	0	0.02	0.05	0	0.02	0.05
A2	0.20 REF			0.20 REF		
k	0.25	-	-	0.25	-	-

EXPOSED PAD VARIATIONS									
PKG. CODES	D2			E2			PIN ID	JEDEC	DOWN BONDS ALLOWED
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.			
T1233-1	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-1	NO
T1233-3	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-1	YES
T1633-1	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2	NO
T1633-2	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2	YES
T1633F-3	0.65	0.80	0.95	0.65	0.80	0.95	0.225 x 45°	WEED-2	N/A
T1633-4	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2	NO

### NOTES:

- DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
- ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
- N IS THE TOTAL NUMBER OF TERMINALS.
- 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.
- DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.20 mm AND 0.25 mm FROM TERMINAL TIP.
- ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
- DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
- COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
- DRAWING CONFORMS TO JEDEC MO220 REVISION C.

		<b>DALLAS SEMICONDUCTOR</b>			
PROPRIETARY INFORMATION					
TITLE: PACKAGE OUTLINE 12, 16L, THIN QFN, 3x3x0.8mm					
APPROVAL		DOCUMENT CONTROL NO. 21-0136		REV. E	2/2

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