19-3375; Rev 0; 7/04

Dual SPDT Analog Switches with Over-Rail Signal Handling

General Description

The MAX4850/MAX4850H/MAX4852/MAX4852H family of dual SPDT (single-pole/double-throw) switches operate from a single +2V to +5.5V supply and can handle signals greater than the supply rail. These switches feature low 3.5Ω or 3.5Ω/7Ω on-resistance with low on-capacitance, making them ideal for switching audio and data signals.

The MAX4850/MAX4850H are configured with two SPDT switches and feature two comparators for headphone detection or mute/send key functions. The MAX4852 has two SPDT switches with no comparators for low 1µA supply current.

For over-rail applications, these devices offer either the pass-through or high-impedance option. For the MAX4850/MAX4852, the signal (up to 5.5V) passes through the switch without distortion even when the positive supply rail is exceeded. For the MAX4850H/MAX4852H, the switch input becomes high impedance when the input signal exceeds the supply rail.

The MAX4850/MAX4850H/MAX4852/MAX4852H are available in the space-saving (3mm x 3mm), 16-pin TQFN package and operate over the extended temperature range of -40°C to +85°C.

Applications

USB Switching

Audio-Signal Routing

Cellular Phones

Notebook Computers

PDAs and Other Handheld Devices

Features

- **USB 2.0 Full Speed (12MB) and USB 1.1 Signal Switching Compliant**
- **Switch Signals Greater than V_{CC}**
- **0.1ns Differential Skew**
- **3.5Ω/7Ω On-Resistance**
- **135MHz -3dB Bandwidth**
- **+2V to +5.5V Supply Range**
- **1.8V Logic Compatible**
- **Low Supply Current**
  1µA (MAX4852)
  5µA (MAX4850)
  10µA (MAX4850H/MAX4852H)
- **Available in a Space-Saving (3mm x 3mm), 16-Pin TQFN Package**

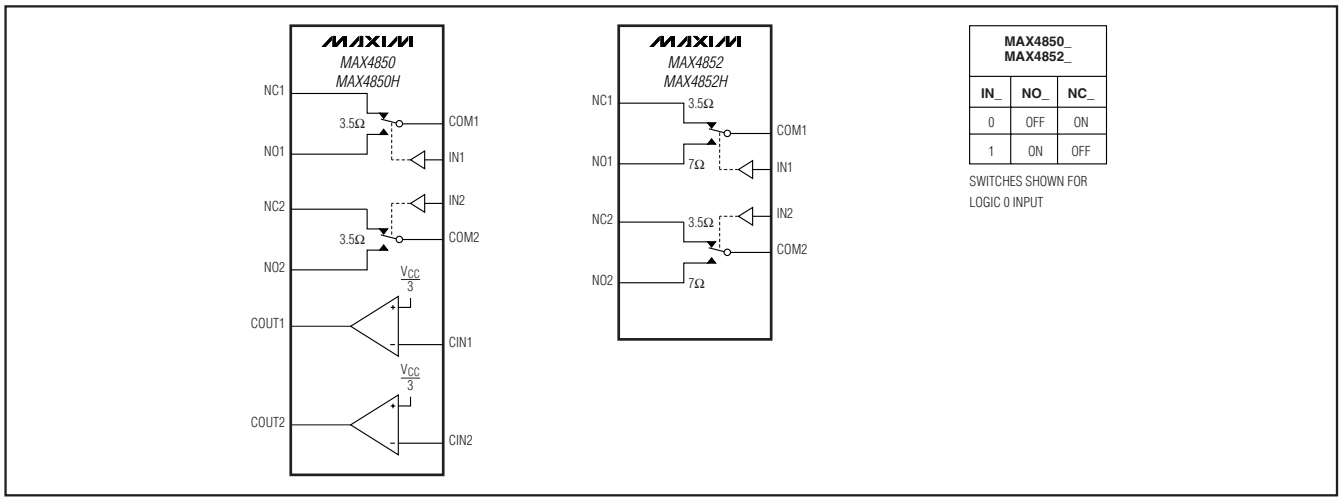
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX4850ETE	-40°C to +85°C	16 TQFN-EP*	ABU
MAX4850HETE	-40°C to +85°C	16 TQFN-EP*	ABV
MAX4852ETE	-40°C to +85°C	16 TQFN-EP*	ABZ
MAX4852HETE	-40°C to +85°C	16 TQFN-EP*	ACA

**EP = Exposed paddle.*

Pin Configurations and Selector Guide appear at end of data sheet.

Block Diagrams/Truth Table



MAX4850_ MAX4852_		
IN_	NO_	NC_
0	OFF	ON
1	ON	OFF

SWITCHES SHOWN FOR LOGIC 0 INPUT

Dual SPDT Analog Switches with Over-Rail Signal Handling

ABSOLUTE MAXIMUM RATINGS

V_{CC}, IN_, CIN_, COM_, NO_, NC_ to GND (Note 1) ..... -0.3V to +6.0V
COUT_ ..... -0.3V to (V_{CC} + 0.3V)
COUT_ Continuous Current ..... ±20mA
Closed Switch Continuous Current COM_, NO_, NC_
3.5Ω Switch ..... ±100mA
7Ω Switch ..... ±50mA
Peak Current COM_, NO_, NC_ (pulsed at 1ms, 50% duty cycle)
3.5Ω Switch ..... ±200mA
7Ω Switch ..... ±100mA
Peak Current COM_, NO_, NC_ (pulsed at 1ms, 10% duty cycle)
3.5Ω Switch ..... ±240mA
7Ω Switch ..... ±120mA
Continuous Power Dissipation (T_A = +70°C)
16-Pin TQFN (derate 20.8mW/°C above +70°C) 1667mW
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 IN, NO, NC, or COM below 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

(V_{CC} = +2.7V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.0V, T_A = +25°C, unless otherwise noted.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}			2.0		5.5	V
Supply Current	I_{CC}	V_{CC} = 5.5V, $V_{IN\_}$ = 0V or V_{CC}	MAX4850		5	10	µA
			MAX4850H/ MAX4852H		10	20	
			MAX4852			1	
ANALOG SWITCH (3.5Ω Switch)							
Analog Signal Range	$V_{NO\_}$, $V_{NC\_}$, $V_{COM\_}$			0		5.5	V
On-Resistance (Note 3)	R_{ON}	V_{CC} = 3V, $I_{COM\_}$ = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 0 to 5.5V (MAX485_) or V_{CC} (MAX485_H)	T_A = +25°C		3.5	4.5	Ω
			T_A = -40°C to +85°C			5	
On-Resistance Match Between Channels (Notes 3, 4)	ΔR_{ON}	V_{CC} = 3V, I_{COM} = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 1.5V	T_A = +25°C		0.1	0.2	Ω
			T_A = -40°C to +85°C			0.25	
On-Resistance Flatness (Note 5)	R_{FLAT}	V_{CC} = 3V, $I_{COM\_}$ = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 1V, 2V, 3V	T_A = +25°C		1.2	1.8	Ω
			T_A = -40°C to +85°C			2	
NO_/NC_ Off-Leakage Current	I_{OFF}	V_{CC} = 5.5V, $V_{NC\_}$ or $V_{NO\_}$ = 1V or 4.5V, $V_{COM\_}$ = 4.5V or 1V	T_A = +25°C	-2		+2	nA
			T_A = -40°C to +85°C	-10		+10	
COM_ On-Leakage Current	I_{ON}	V_{CC} = 5.5V; $V_{NC\_}$ or $V_{NO\_}$ = 1V, 4.5V, or floating; $V_{COM\_}$ = 1V, 4.5V, or floating	T_A = +25°C	-2		+2	nA
			T_A = -40°C to +85°C	-12.5		+12.5	
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF (Figure 5)			100		MHz
NO_/NC_ Off-Capacitance	C_{OFF}	f = 1MHz (Figure 6)			20		pF

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.0V, T_A = +25°C, unless otherwise noted.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
COM On-Capacitance	C_{ON}	f = 1MHz (Figure 6)			60		pF
ANALOG SWITCH (7Ω Switch)							
Analog Signal Range	$V_{NO\_}$, $V_{NC\_}$, $V_{COM\_}$			0		5.5	V
On-Resistance	R_{ON}	V_{CC} = 3V, $I_{COM\_}$ = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 0 to 5.5V (MAX4852) or V_{CC} (MAX4852H)	T_A = +25°C		7	9	Ω
			T_A = -40°C to +85°C			10	
On-Resistance Match Between Channels (Notes 3, 4)	ΔR_{ON}	V_{CC} = 3V, I_{COM} = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 1.5V	T_A = +25°C		0.2	0.4	Ω
			T_A = -40°C to +85°C			0.5	
On-Resistance Flatness (Note 5)	R_{FLAT}	V_{CC} = 3V, $I_{COM\_}$ = 10mA, $V_{NC\_}$ or $V_{NO\_}$ = 1V, 2V, 3V	T_A = +25°C		2.5	3.75	Ω
			T_A = -40°C to +85°C			4.0	
NO_/NC_ Off-Leakage Current	I_{OFF}	V_{CC} = 5.5V, $V_{NC\_}$ or $V_{NO\_}$ = 1V or 4.5V, $V_{COM\_}$ = 4.5V or 1V	T_A = +25°C	-2		+2	nA
			T_A = -40°C to +85°C	-10		+10	
COM_ On-Leakage Current	I_{ON}	V_{CC} = 5.5V; $V_{NC\_}$ or $V_{NO\_}$ = 1V, 4.5V, or floating; $V_{COM\_}$ = 1V, 4.5V, or floating	T_A = +25°C	-2		+2	nA
			T_A = -40°C to +85°C	-12.5		+12.5	
-3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω, C_L = 5pF (Figure 5)			135		MHz
NO_/NC_ Off-Capacitance	C_{OFF}	f = 1MHz (Figure 6)			12		pF
COM On-Capacitance	C_{ON}	f = 1MHz (Figure 6)			50		pF
DYNAMIC CHARACTERISTICS							
Signal Over-Rail to High-Z Switching Time	t_{HIZ}	MAX4850H/MAX4852H, $V_{NO\_}$ or $V_{NC\_}$ = V_{CC} to (V_{CC} + 0.5V), V_{CC} < 5V (Figure 1)			0.5	1	µs
High-Z to Low-Z Switching Time	t_{HIZB}	MAX4850H/MAX4852H, $V_{NO\_}$ or $V_{NC\_}$ = (V_{CC} + 0.5V) to V_{CC}, V_{CC} < 5V (Figure 1)			0.5	1	µs
Skew (Note 3)	t_{SKEW}	R_S = 39Ω, C_L = 50pF (Figure 2)			0.1	1	ns
Propagation Delay (Note 3)	t_{PD}	R_S = 39Ω, C_L = 50pF (Figure 2)			0.9	2	ns
Turn-On Time	t_{ON}	V_{CC} = 3V, $V_{NO\_}$ or $V_{NC\_}$ = 1.5V, R_L = 300Ω, C_L = 50pF (Figure 1)	T_A = +25°C		40	60	ns
			T_A = -40°C to +85°C			100	
Turn-Off Time	t_{OFF}	V_{CC} = 3V, $V_{NO\_}$ or $V_{NC\_}$ = 1.5V, R_L = 300Ω, C_L = 50pF (Figure 1)	T_A = +25°C		30	40	ns
			T_A = -40°C to +85°C			60	

Dual SPDT Analog Switches with Over-Rail Signal Handling

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V_{CC} = +3.0V, T_A = +25°C, unless otherwise noted.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Break-Before-Make Time Delay (Note 3)	t_D	V_{CC} = 3V, $V_{NO\_}$ or $V_{NC\_}$ = 1.5V, R_L = 300Ω, C_L = 50pF (Figure 3)	T_A = +25°C		15		ns
			T_A = -40°C to +85°C	2			
Charge Injection	Q	$V_{COM\_}$ = 1.5V, R_S = 0Ω, C_L = 1nF (Figure 4)			8		pC
Off-Isolation (Note 6)	V_{ISO}	f = 100kHz, $V_{COM\_}$= $1V_{RMS}$, R_L = 50Ω, C_L = 5pF (Figure 5)			-80		dB
Crosstalk	V_{CT}	f = 1MHz, $V_{COM\_}$ = $1V_{RMS}$, R_L = 50Ω, C_L = 5pF (Figure 5)			-95		dB
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, $V_{COM\_}$ = 1V + $2V_{P-P}$, R_L = 600Ω			0.04		%
DIGITAL I/O (IN_)							
Input-Logic High Voltage	V_{IH}	V_{CC} = 2V to 3.6V		1.4			V
		V_{CC} = 3.6V to 5.5V		1.8			
Input-Logic Low Voltage	V_{IL}	V_{CC} = 2V to 3.6V				0.5	V
		V_{CC} = 3.6V to 5.5V				0.8	
Input Leakage Current	I_{IN}	$V_{IN\_}$ = 0 or 5.5V		-0.5		+0.5	µA
COMPARATOR							
Comparator Range				0		5.5	V
Comparator Threshold	V_{TH}	V_{CC} = 2V to 5.5V, falling input		0.3 x V_{CC}	0.33 x V_{CC}	0.36 x V_{CC}	V
Comparator Hysteresis		V_{CC} = 2V to 5.5V			50		mV
Comparator Output High Voltage		I_{SOURCE} = 1mA		V_{CC} - 0.4V			V
Comparator Output Low Voltage		I_{SINK} = 1mA				0.4	V
Comparator Switching Time		Rising input (Figure 7)			2.5		µs
		Falling input (Figure 7)			0.5		

Note 2: Specifications are 100% tested at T_A = +85°C only, and guaranteed by design and characterization over the specified temperature range.

Note 3: Guaranteed by design and characterization; not production tested.

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

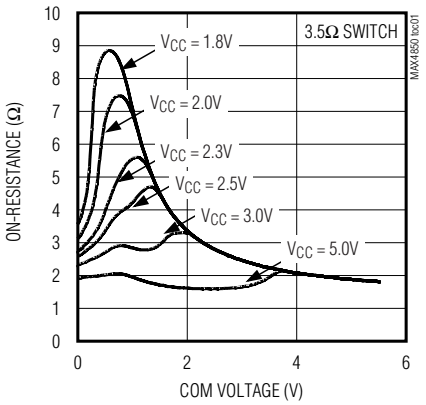
Note 5: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

Note 6: Off-isolation = $20\log_{10} (V_{COM\_} / V_{NO\_})$, $V_{COM\_}$ = output, $V_{NO\_}$ = input to off switch.

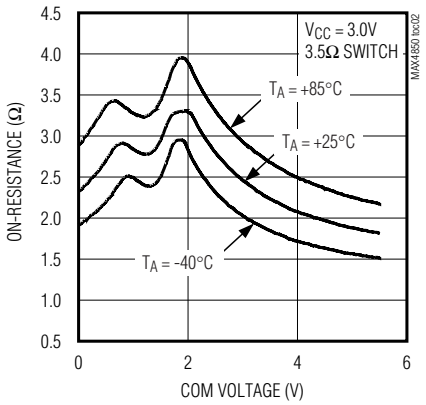
Typical Operating Characteristics

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

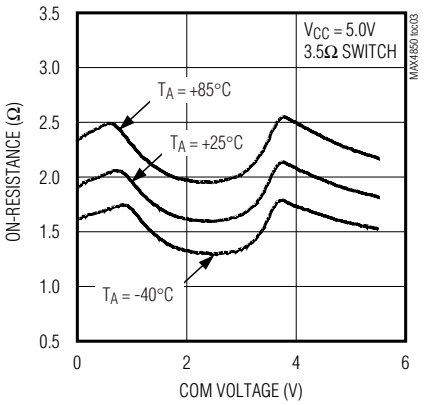
MAX4850/MAX4852
ON-RESISTANCE vs. COM VOLTAGE



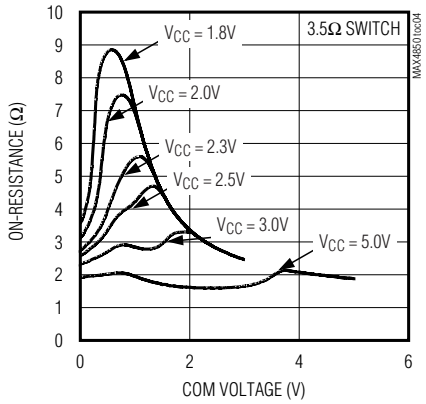
MAX4850/MAX4852
ON-RESISTANCE vs. COM VOLTAGE



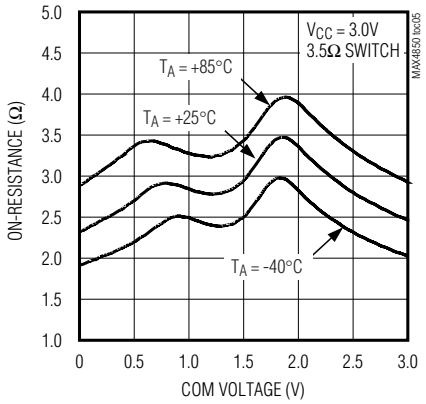
MAX4850/MAX4852
ON-RESISTANCE vs. COM VOLTAGE



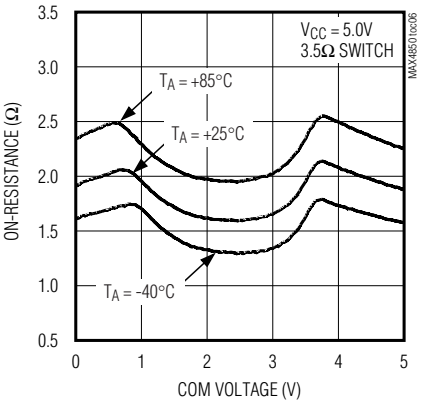
MAX4850H/MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



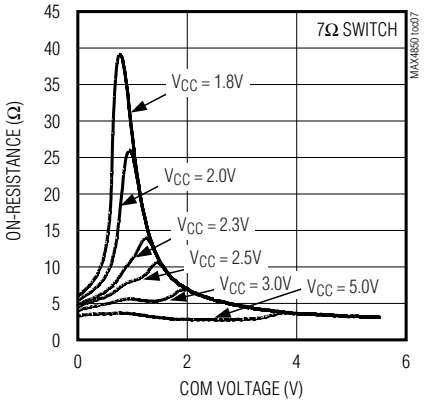
MAX4850H/MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



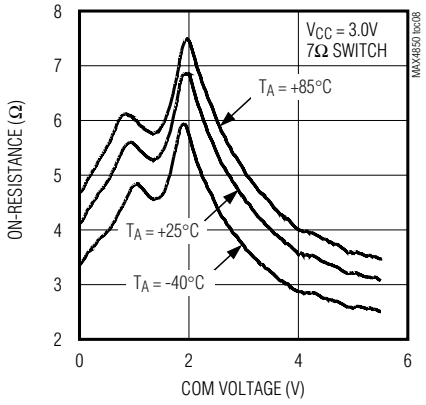
MAX4850H/MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



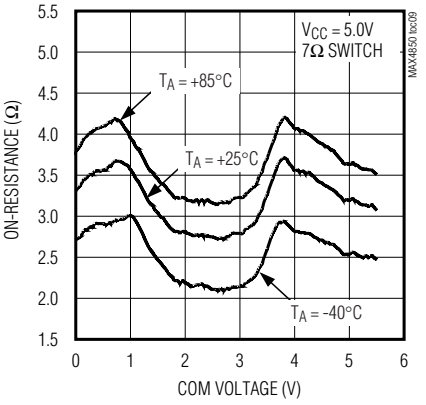
MAX4852
ON-RESISTANCE vs. COM VOLTAGE



MAX4852
ON-RESISTANCE vs. COM VOLTAGE



MAX4852
ON-RESISTANCE vs. COM VOLTAGE

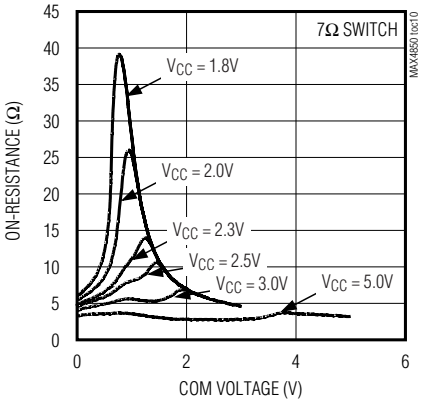


Dual SPDT Analog Switches with Over-Rail Signal Handling

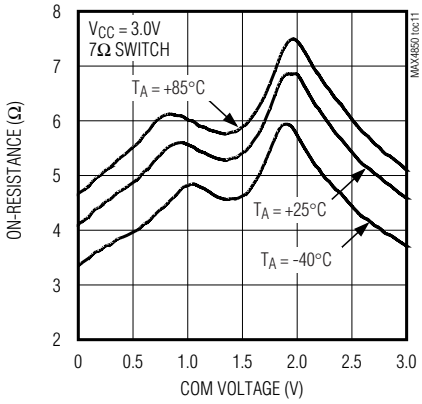
Typical Operating Characteristics (continued)

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

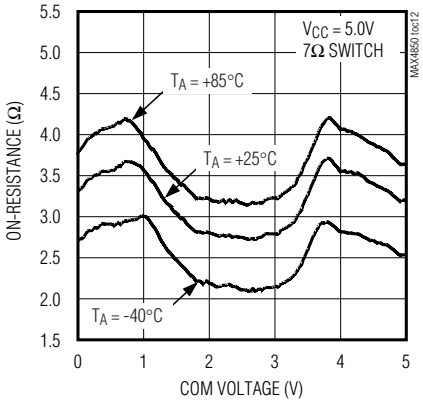
MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



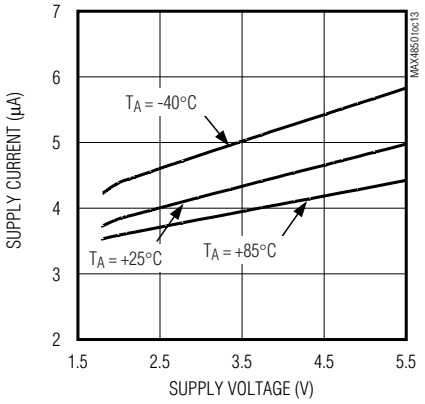
MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



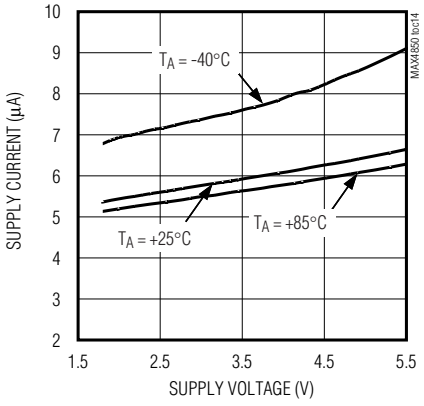
MAX4852H
ON-RESISTANCE vs. COM VOLTAGE



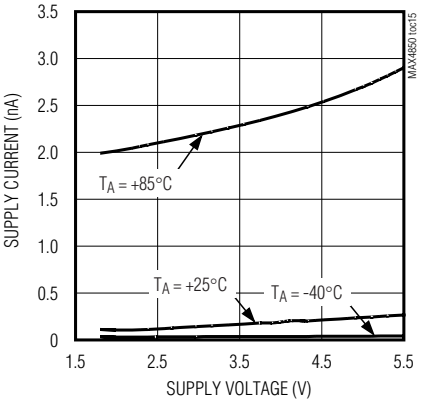
MAX4850
SUPPLY CURRENT vs. SUPPLY VOLTAGE



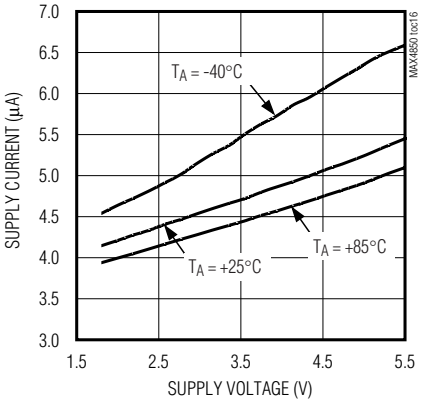
MAX4850H
SUPPLY CURRENT vs. SUPPLY VOLTAGE



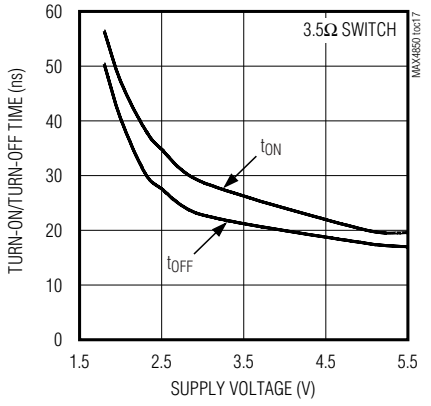
MAX4852
SUPPLY CURRENT vs. SUPPLY VOLTAGE



MAX4852H
SUPPLY CURRENT vs. SUPPLY VOLTAGE



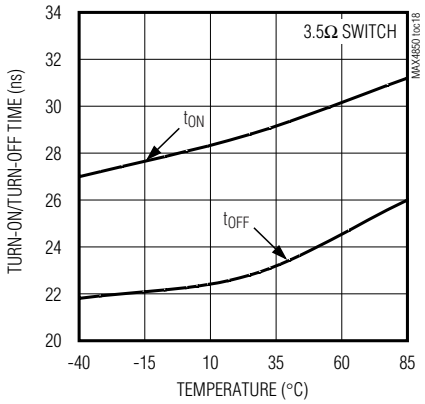
TURN-ON/TURN-OFF TIME
vs. SUPPLY VOLTAGE



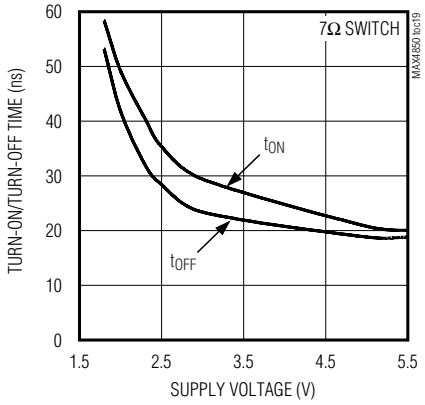
Typical Operating Characteristics (continued)

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

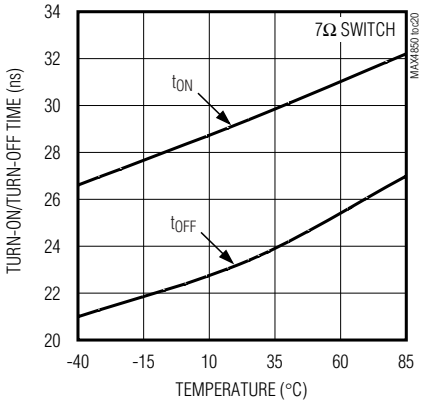
TURN-ON/TURN-OFF TIME vs. TEMPERATURE



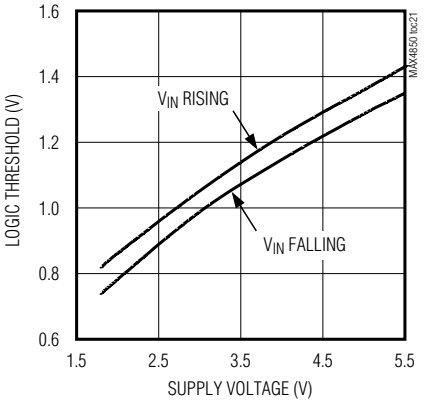
TURN-ON/TURN-OFF TIME vs. SUPPLY VOLTAGE



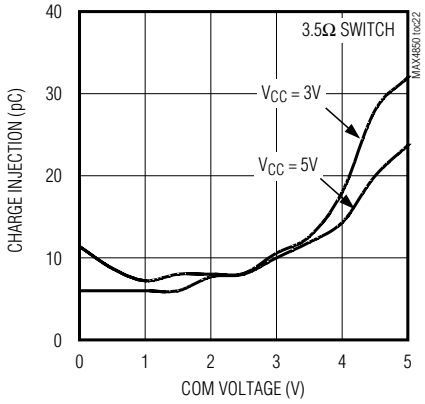
TURN-ON/TURN-OFF TIME vs. TEMPERATURE



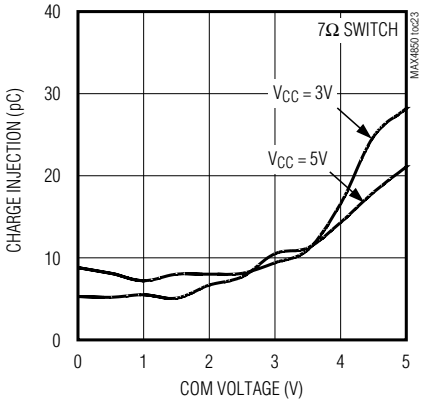
LOGIC THRESHOLD vs. SUPPLY VOLTAGE



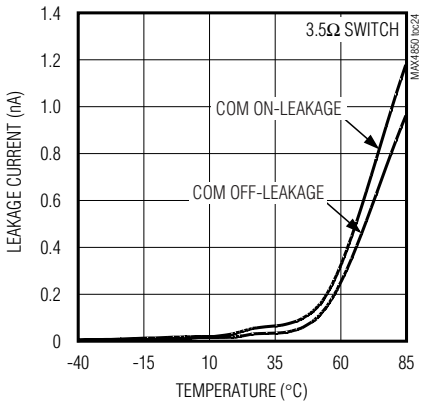
CHARGE INJECTION vs. COM VOLTAGE



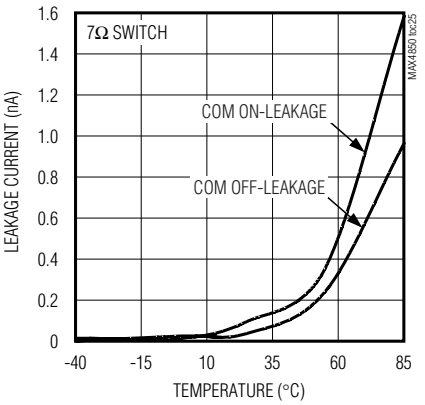
CHARGE INJECTION vs. COM VOLTAGE



LEAKAGE CURRENT vs. TEMPERATURE



LEAKAGE CURRENT vs. TEMPERATURE

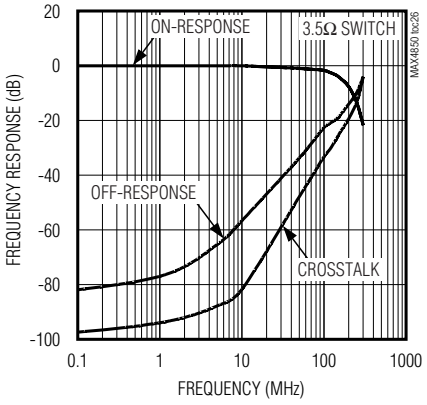


Dual SPDT Analog Switches with Over-Rail Signal Handling

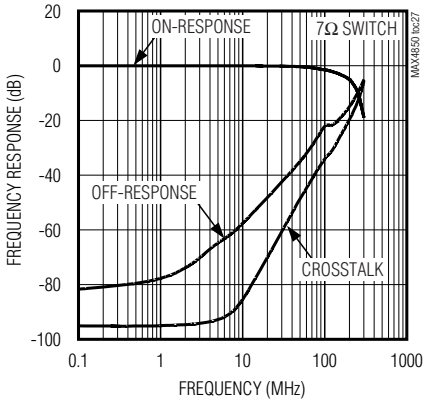
Typical Operating Characteristics (continued)

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

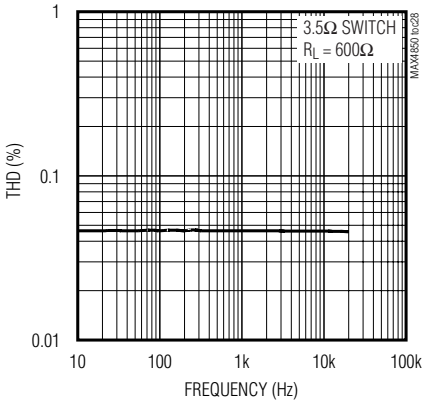
FREQUENCY RESPONSE



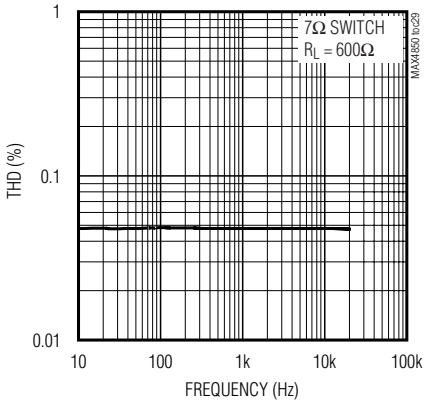
FREQUENCY RESPONSE



TOTAL HARMONIC DISTORTION vs. FREQUENCY



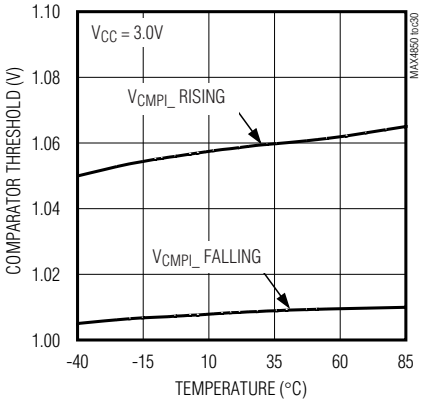
TOTAL HARMONIC DISTORTION vs. FREQUENCY



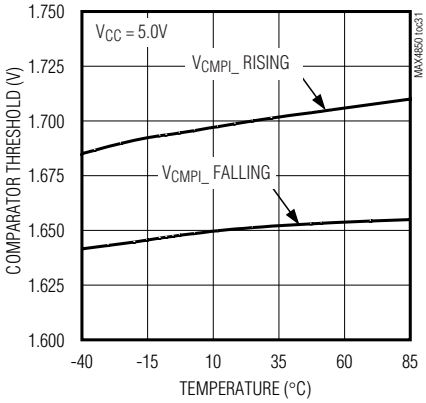
Typical Operating Characteristics (continued)

(V_{CC} = 3.0V, T_A = +25°C, unless otherwise noted.)

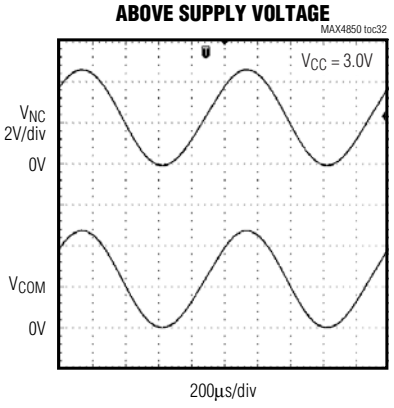
COMPARATOR THRESHOLD vs. TEMPERATURE



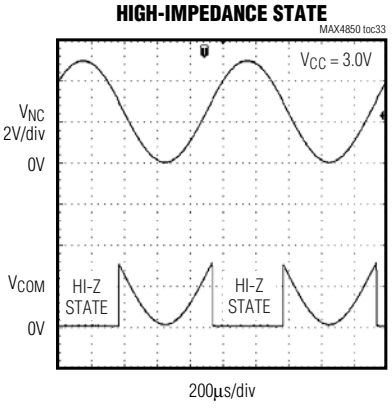
COMPARATOR THRESHOLD vs. TEMPERATURE



MAX4850/MAX4852 SWITCH PASSING SIGNALS ABOVE SUPPLY VOLTAGE



MAX4850H/MAX4852H SWITCH ENTERING HIGH-IMPEDANCE STATE



Dual SPDT Analog Switches with Over-Rail Signal Handling

Pin Descriptions

MAX4850/MAX4850H

PIN	NAME	FUNCTION
1, 8	N.C.	No Connection. Not internally connected.
2	CIN1	Inverting Input for Comparator 1
3	CIN2	Inverting Input for Comparator 2
4	COM1	Common Terminal for Analog Switch 1
5	NO1	Normally Open Terminal for Analog Switch 1
6	GND	Ground
7	NC2	Normally Closed Terminal for Analog Switch 2
9	IN2	Digital Control Input for Analog Switch 2. A logic LOW on IN2 connects COM2 to NC2 and a logic HIGH connects COM2 to NO2.
10	COM2	Common Terminal for Analog Switch 2
11	COUT1	Output for Comparator 1
12	NO2	Normally Open Terminal for Analog Switch 2
13	COUT2	Output for Comparator 2
14	V_{CC}	Supply Voltage. Bypass to GND with a 0.01µF capacitor as close to the pin as possible.
15	IN1	Digital Control Input for Analog Switch 1. A logic LOW on IN1 connects COM1 to NC1 and a logic HIGH connects COM1 to NO1.
16	NC1	Normally Closed Terminal for Analog Switch 1
EP	—	Exposed Paddle. Connect to PC board ground plane.

MAX4852/MAX4852H

PIN	NAME	FUNCTION
1, 2, 3, 8, 11, 13	N.C.	No Connection. Not internally connected.
4	COM1	Common Terminal for Analog Switch 1
5	NO1	Normally Open Terminal for Analog Switch 1
6	GND	Ground
7	NC2	Normally Closed Terminal for Analog Switch 2
9	IN2	Digital Control Input for Analog Switch 2. A logic LOW on IN2 connects COM2 to NC2 and a logic HIGH connects COM2 to NO2.
10	COM2	Common Terminal for Analog Switch 2
12	NO2	Normally Open Terminal for Analog Switch 2
14	V_{CC}	Supply Voltage. Bypass to GND with a 0.01µF capacitor as close to the pin as possible.
15	IN1	Digital Control Input for Analog Switch 1. A logic LOW on IN1 connects COM1 to NC1 and a logic HIGH connects COM1 to NO1.
16	NC1	Normally Closed Terminal for Analog Switch 1
EP	—	Exposed Paddle. Connect to PC board ground plane.

Detailed Description

The MAX4850/MAX4850H/MAX4852/MAX4852H are low on-resistance, low-voltage, analog switches that operate from a +2V to +5.5V single supply and are fully specified for nominal 3.0V applications. These devices feature over-rail signal capability that allows signals up to 5.5V with supply voltages down to 2.0V. These devices are configured as dual SPDT switches.

These switches have low 50pF on-channel capacitance, which allows for 12Mbps switching of the data signals for USB 2.0 full speed/1.1 applications. The MAX485__ are designed to switch D+ and D- USB signals with a guaranteed skew of less than 1ns (see Figure 1), as measured from 50% of the input signal to 50% of the output signal.

The MAX4850_ feature a comparator that can be used for headphone or mute detection. The comparator threshold is internally generated to be approximately 1/3 of V_{CC}.

Applications Information

Digital Control Inputs

The logic inputs (IN_) accept up to +5.5V even if the supply voltages are below this level. For example, with a +3.3V V_{CC} supply, IN_ can be driven low to GND and high to +5.5V, allowing for mixing of logic levels in a system. Driving IN_ rail-to-rail minimizes power consumption. For a +2V supply voltage, the logic thresholds are 0.5V (low) and 1.4V (high); for a +5V supply voltage, the logic thresholds are 0.8V (low) and 1.8V (high).

Analog Signal Levels

The on-resistance of these switches changes very little for analog input signals across the entire supply voltage range (see *Typical Operating Characteristics*). The switches are bidirectional, so NO_, NC_, and COM_ can be either inputs or outputs.

Comparator

The positive terminal of the comparator is internally set to $V_{CC}/3$. When the negative terminal (CIN_) is below the threshold ($V_{CC}/3$), the comparator output (COUT_) goes high. When CIN_ rises above $V_{CC}/3$, COUT_ goes low.

The comparator threshold allows for detection of headphones since headphone audio signals are typically biased to $V_{CC}/2$.

Power-Supply Sequencing

Caution: Do not exceed the absolute maximum ratings because stresses beyond the listed ratings may cause permanent damage to the device.

Proper power-supply sequencing is recommended for all CMOS devices. Always apply V_{CC} before applying analog signals, especially if the analog signal is not current-limited.

Dual SPDT Analog Switches with Over-Rail Signal Handling

Test Circuits/Timing Diagrams

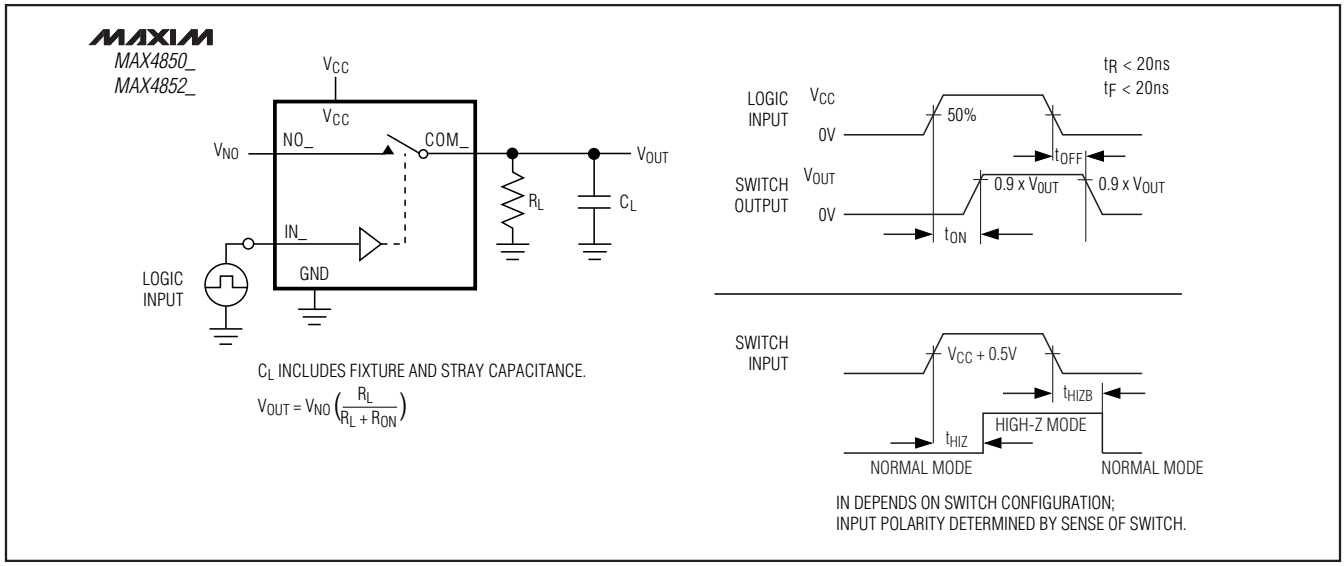


Figure 1. Switching Time

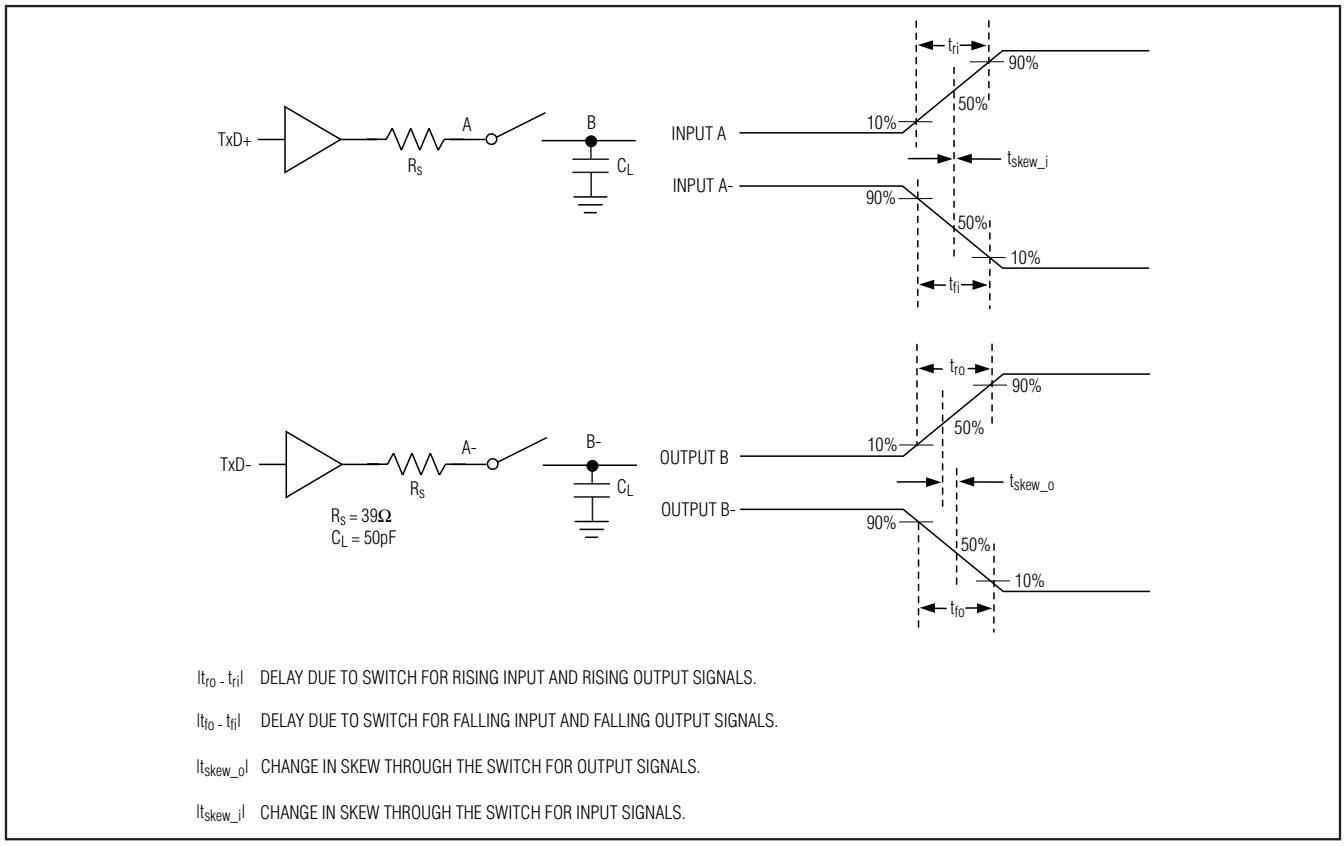


Figure 2. Input/Output Skew Timing Diagram

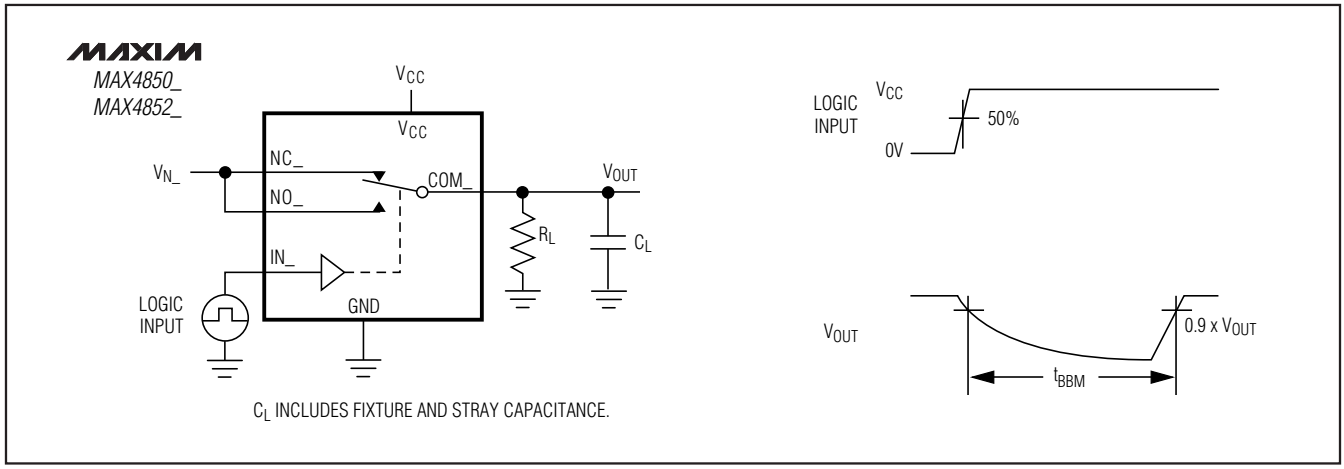


Figure 3. Break-Before-Make Interval

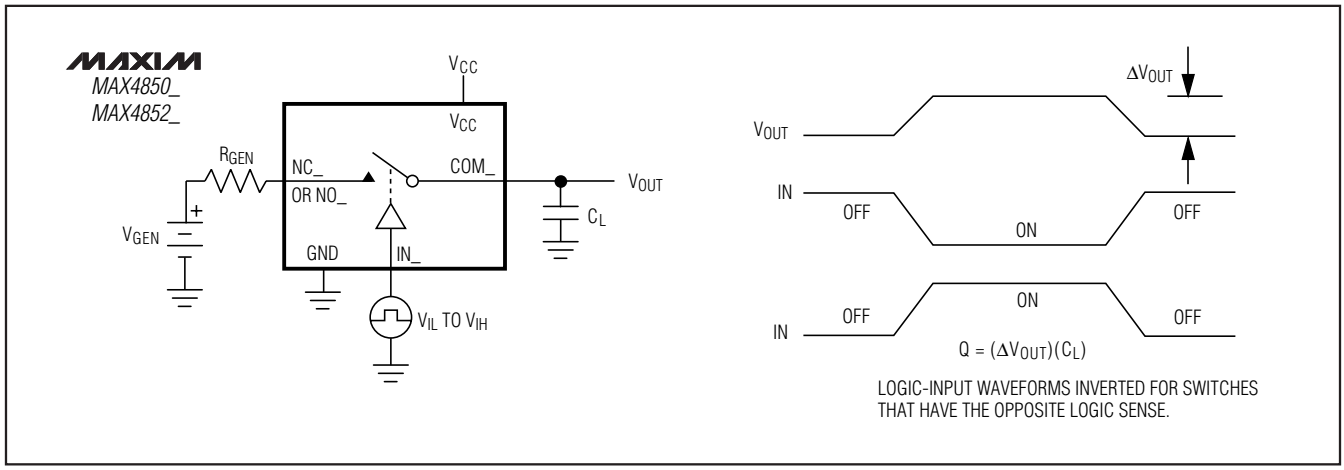


Figure 4. Charge Injection

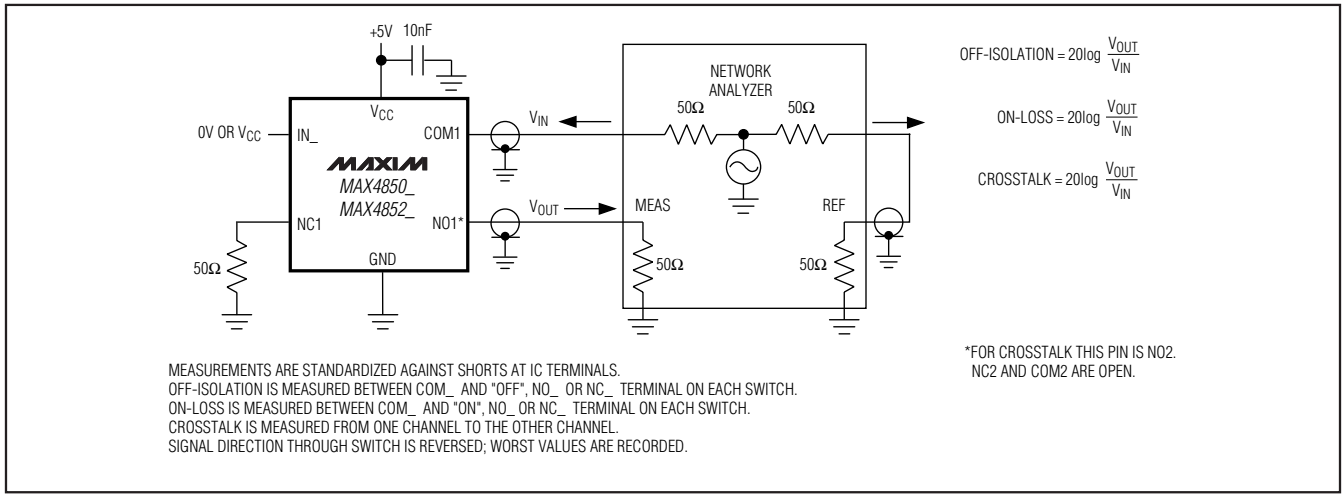


Figure 5. On-Loss, Off-Isolation, and Crosstalk

Dual SPDT Analog Switches with Over-Rail Signal Handling

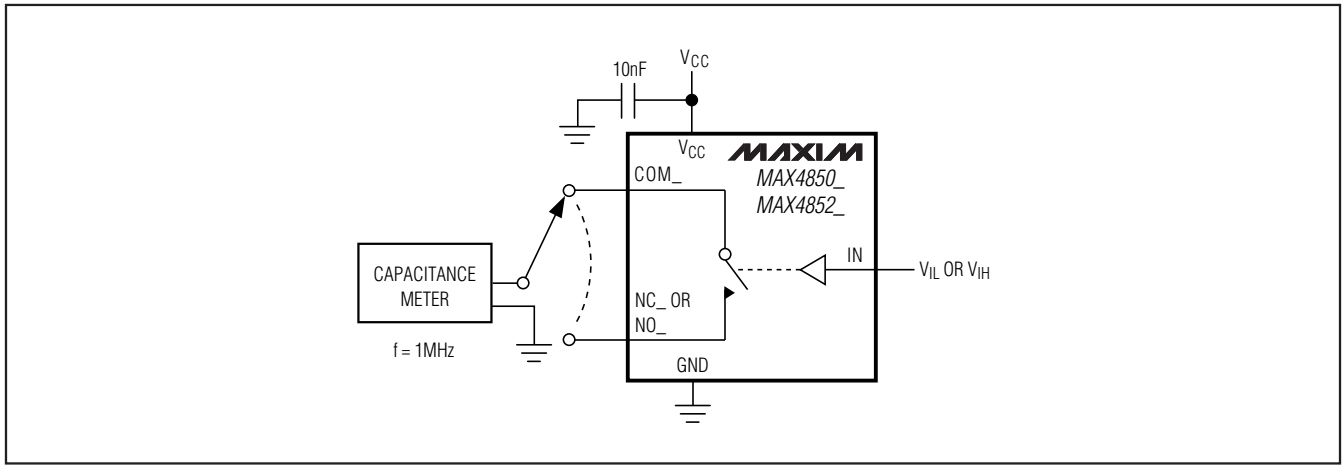


Figure 6. Channel Off-/On-Capacitance

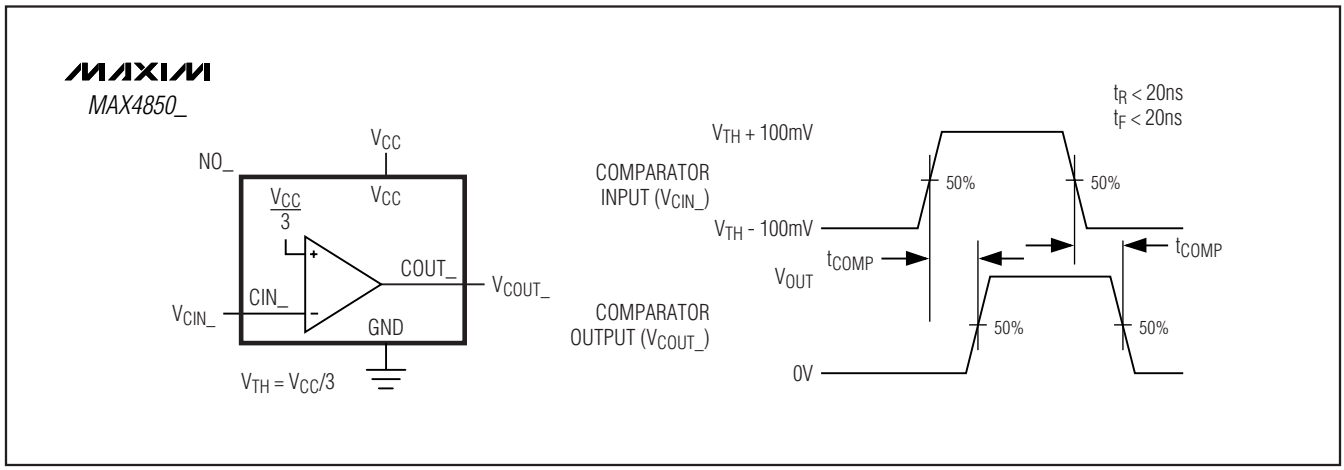
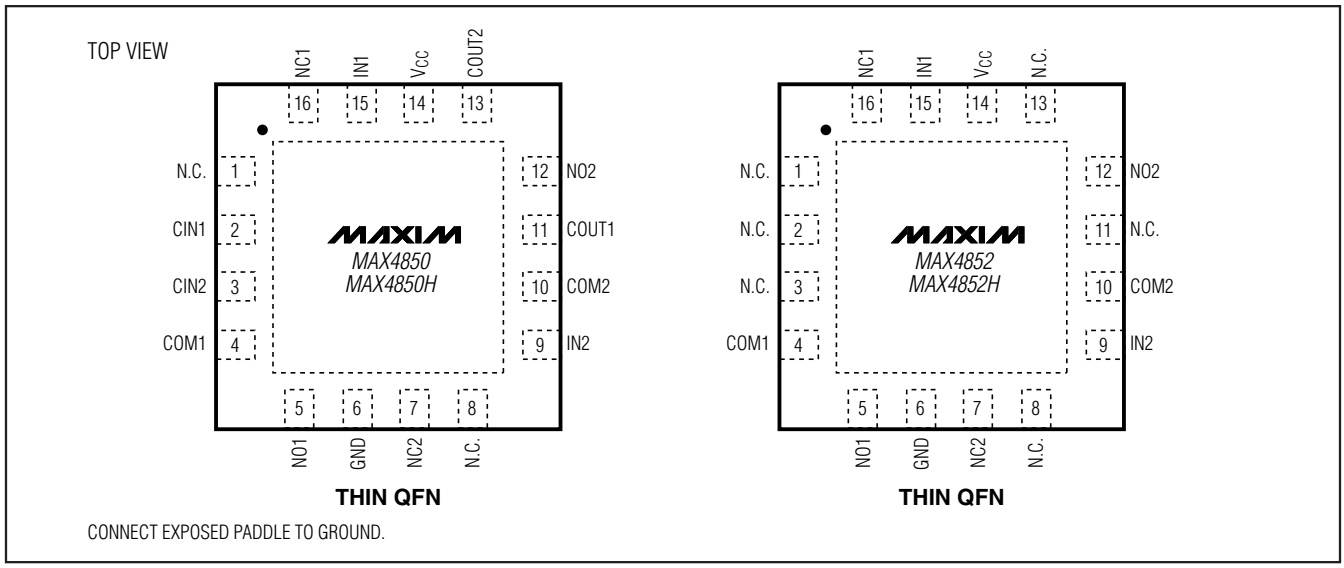


Figure 7. Comparator Switching Time

Dual SPDT Analog Switches with Over-Rail Signal Handling

Pin Configurations



CONNECT EXPOSED PADDLE TO GROUND.

Selector Guide

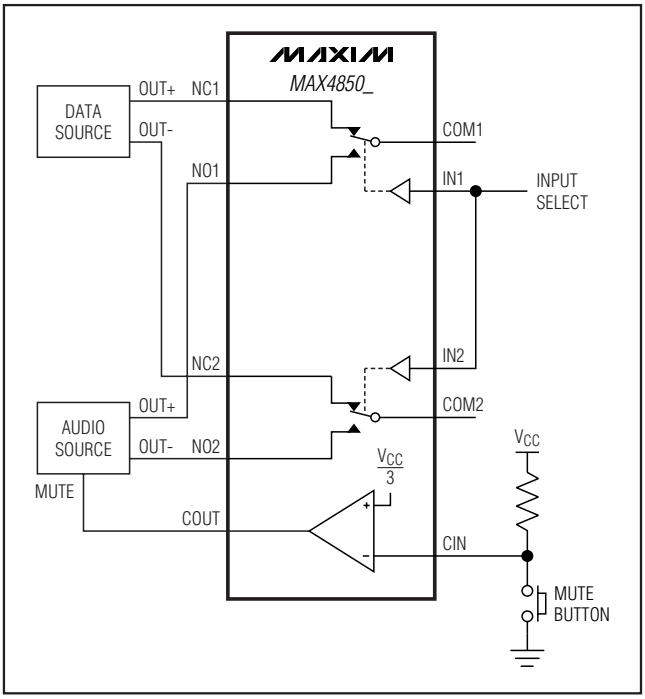
PART	R_{ON} NC_/NO_ (Ω)	COMPARATORS	OVER-RAIL HANDLING
MAX4850	3.5/3.5	2	Input signal passes through the switch
MAX4850H	3.5/3.5	2	High-impedance switch input
MAX4852	3.5/7	—	Input signal passes through the switch
MAX4852H	3.5/7	—	High-impedance switch input

Chip Information

TRANSISTOR COUNT: 735

PROCESS: CMOS

Typical Operating Circuit

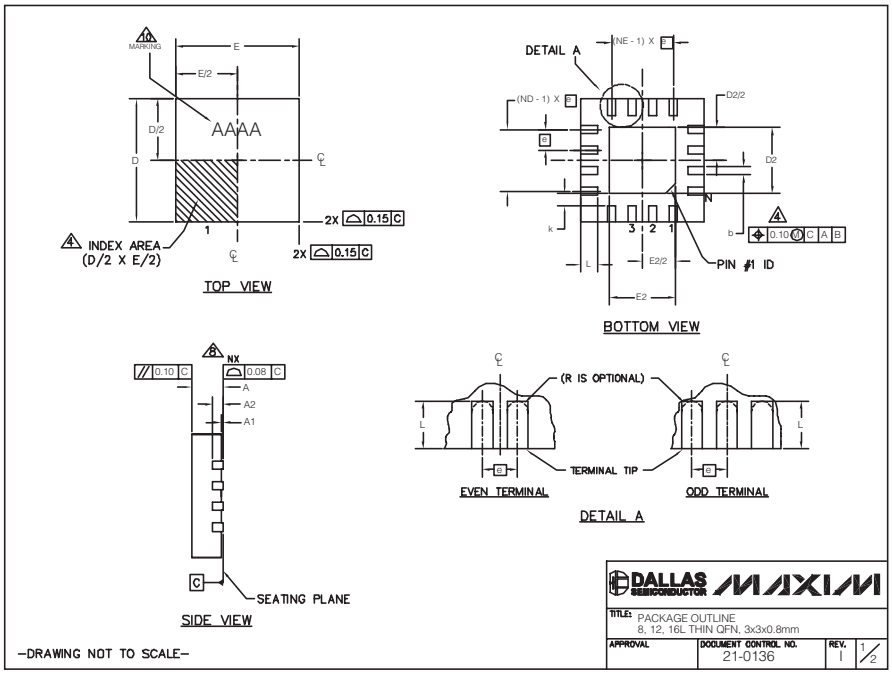


Dual SPDT Analog Switches with Over-Rail Signal Handling

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**.)

12x16L QFN THIN.EPS



PKG	8L 3x3			12L 3x3			16L 3x3		
REF.	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
b	0.25	0.30	0.35	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	2.90	3.00	3.10
E	2.90	3.00	3.10	2.90	3.00	3.10	2.90	3.00	3.10
e	0.65 BSC.			0.50 BSC.			0.50 BSC.		
L	0.35	0.55	0.75	0.45	0.55	0.65	0.30	0.40	0.50
N	8			12			16		
ND	2			3			4		
NE	2			3			4		
A1	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		
k	0.25	-	-	0.25	-	-	0.25	-	-

EXPOSED PAD VARIATIONS

PKG. CODES	D2			E2			PIN ID	JEDEC
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.		
TQ833-1	0.25	0.70	1.25	0.25	0.70	1.25	0.35 x 45°	WEEC
T1233-1	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-1
T1233-3	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-1
T1233-4	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-1
T1633-2	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2
T1633F-3	0.65	0.80	0.95	0.65	0.80	0.95	0.225 x 45°	WEED-2
T1633FH-3	0.65	0.80	0.95	0.65	0.80	0.95	0.225 x 45°	WEED-2
T1633-4	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2
T1633-5	0.95	1.10	1.25	0.95	1.10	1.25	0.35 x 45°	WEED-2

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 0.20 mm AND 0.25 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 REVISION C.
10. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
11. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
12. WARPAGE NOT TO EXCEED 0.10mm.

DRAWING NOT TO SCALE

DALLAS SEMICONDUCTOR MAXIM
TITLE: PACKAGE OUTLINE 8, 12, 16L THIN QFN, 3x3x0.8mm
APPROVAL
DOCUMENT CONTROL NO. 21-0136
REV. I
2/2