



High-Bandwidth, Quad DPDT Switches

General Description

The MAX4760/MAX4761 (DPDT) analog switches operate from a single +1.8V to +5.5V supply. These switches feature a low 25pF capacitance for high-speed data switching applications.

The MAX4760 is a quad double-pole/double-throw (DPDT) switch and the MAX4761 is an octal single-pole/double-throw (SPDT) switch. They have eight 3.5Ω on-resistance, low-capacitance switches to route audio and data signals. The MAX4760 has 4 logic inputs to control the switches in pairs. The MAX4761 has one logic control input and an enable input (EN) to disable the switches.

The MAX4760/MAX4761 are available in a small 36-pin (6mm x 6mm) thin QFN and 36-bump (3mm x 3mm) chip-scale package (UCSP™).

Applications

USB Signal Switching
Audio-Signal Routing
Cellular Phones
PDAs/Hand-Held Devices
Notebook Computers

Features

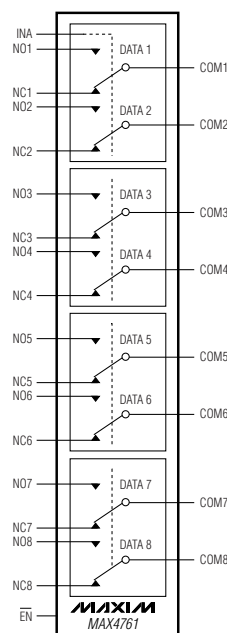
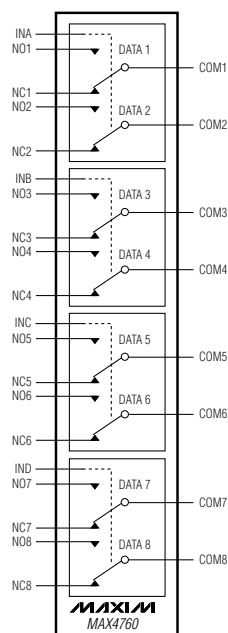
- ◆ USB 1.1 and USB 2.0 (Full Speed) Signal-Switching Compliant
- ◆ Data and Audio Signal Routing
- ◆ Low-Capacitance (25pF) Data Switches
- ◆ Less than 0.2ns Skew
- ◆ -3dB Bandwidth: 325MHz
- ◆ 0.2Ω Channel-to-Channel Matching
- ◆ 0.8Ω On-Resistance Flatness
- ◆ Rail-to-Rail Signal Handling
- ◆ 0.03% THD
- ◆ +1.8V to +5.5V Supply Range
- ◆ Tiny 36-Bump UCSP (3mm x 3mm)
- ◆ 36-Pin Thin QFN (6mm x 6mm)

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX4760EBX-T*	-40°C to +85°C	36 UCSP-36
MAX4760ETX*	-40°C to +85°C	36 Thin QFN (6mm x 6mm)
MAX4761EBX-T	-40°C to +85°C	36 UCSP-36
MAX4761ETX	-40°C to +85°C	36 Thin QFN (6mm x 6mm)

*Future product—contact factory for availability.

Functional Diagrams



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

UCSP is a trademark of Maxim Integrated Products, Inc.



Maxim Integrated Products 1

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

MAX4760/MAX4761

High-Bandwidth, Quad DPDT Switches

ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND.)

V+, IN_, EN_	-0.3V to +6V
COM_, NO_, NC_ (Note 1)	-0.3V to (V+ + 0.3V)
Continuous Current	
NO_, NC_, COM_	±100mA
Peak Current	
(pulsed at 1ms, 10% duty cycle)	±200mA
(pulsed at 1ms, 50% duty cycle)	±300mA
Continuous Power Dissipation (T _A = +70°C)	
36-Bump UCSP (derate 15.3mW/°C above +70°C)....	1221mW
36-Pin Thin QFN (derate 26.3mW/°C above +70°C)...	2105mW

ESD per Method 3015.7	±2kV
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
Bump Temperature (soldering)	
Infrared (15s)	+220°C
Vapor Phase (60s)	+215°C

Note 1: Signals on NO_, NC_, COM_ exceeding V+ 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

(V+ = +2.7V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = 3V, T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{COM_} , V _{NO_} , V _{NC_}		T _{MIN} to T _{MAX}	0		V+	V
On-Resistance (Note 4)	R _{ON}	V+ = 2.7V, I _{COM_} = 10mA, V _{NC_} or V _{NO_} = 0V or V+	+25°C	2.0	3.5	Ω	
			T _{MIN} to T _{MAX}	4			
On-Resistance Match Between Channels (Notes 4, 5)	ΔR _{ON}	V+ = 2.7V, I _{COM_} = 10mA, V _{NO_} or V _{NC_} = 1.5V	+25°C	0.2	0.4	Ω	
			T _{MIN} to T _{MAX}	0.55			
On-Resistance Flatness (Note 6)	R _{FLAT(ON)}	V+ = 2.7V, I _{COM_} = 10mA, V _{NC_} or V _{NO_} = 0V or V+	+25°C	0.8	1.5	Ω	
			T _{MIN} to T _{MAX}	1.8			
NO_, NC_ Off-Leakage Current	I _{NO_(OFF)} , I _{NC_(OFF)}	V+ = 3.6V; V _{COM_} = 3.3V, 0.3V; V _{NO_} or V _{NC_} = 0.3V, 3.3V	+25°C	-5	+5	nA	
			T _{MIN} to T _{MAX}	-25	+25		
COM_ Off-Leakage Current		V+ = 3.6V (MAX4761); V _{COM_} = 3.3V, 0.3V; V _{NO_} or V _{NC_} = 0.3V, 3.3V	+25°C	-5	0.01	+5	nA
			T _{MIN} to T _{MAX}	-25	+25		
COM_ On-Leakage Current	I _{COM_(ON)}	V+ = 3.6V; V _{COM_} = 3.3V, 0.3V; V _{NO_} or V _{NC_} = 3.3V, 0.3V or floating	+25°C	-5	+5	nA	
			T _{MIN} to T _{MAX}	-25	+25		
DYNAMIC							
Turn-On Time	t _{ON}	V _{NO_} or V _{NC_} = 1.5V; R _L = 50Ω; C _L = 35pF, Figure 2	+25°C	45	140	ns	
			T _{MIN} to T _{MAX}	150			
Turn-Off Time	t _{OFF}	V+ = 2.7V, V _{NO_} or V _{NC_} = 1.5V; R _L = 50Ω; C _L = 35pF, Figure 2	+25°C	25	50	ns	
			T _{MIN} to T _{MAX}	60			

High-Bandwidth, Quad DPDT Switches

MAX4760/MAX4761

ELECTRICAL CHARACTERISTICS (continued)

(V+ = +2.7V to +5.5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at V+ = 3V, T_A = +25°C.) (Notes 2, 3)

PARAMETER	SYMBOL	CONDITIONS	T _A	MIN	TYP	MAX	UNITS
Break-Before-Make (Note 7)	t _{BBM}	V ₊ = 2.7V, V _{NO_} or V _{NC_} = 1.5V; R _L = 50Ω, C _L = 35pF, Figure 3	+25°C	15		ns	
			T _{MIN} to T _{MAX}	2			
Skew (Note 7)	t _{SKEW}	R _S = 39Ω, C _L = 50pF, Figure 4	+25°C	0.2	0.5	ns	
Charge Injection	Q	V _{GEN} = 0V, R _{GEN} = 0, C _L = 1.0nF, Figure 5	+25°C	15		pC	
On-Channel -3dB Bandwidth	BW	Signal = 0dBm, C _L = 5pF, R _L = 50Ω	+25°C	320		MHz	
Off-Isolation (Note 8)	V _{ISO}	C _L = 5pF, R _L = 50Ω, V _{COM_} = 1V _{P-P} , f = 100kHz, Figure 6	+25°C	100		dB	
Crosstalk (Note 9)	V _{CT}	C _L = 5pF, R _L = 50Ω, V _{COM_} = 1V _{P-P} , f = 100kHz, Figure 6	+25°C	95		dB	
Total Harmonic Distortion	THD	f = 20Hz to 20kHz, 1V _{P-P} , R _L = 600Ω	+25°C	0.03		%	
NO_, NC_ Off-Capacitance	C _{NO_(OFF)} , C _{NC_(OFF)}	V _{NO_} , V _{NC_} = GND, f = 1MHz, Figure 7	+25°C	25		pF	
COM_ On-Capacitance	C _{COM(ON)}	V _{NO_} , V _{NC_} = GND, f = 1MHz, Figure 7	+25°C	54		pF	
COM_ Off-Capacitance	C _{COM(OFF)}	V _{COM_} = GND, f = 1MHz (MAX4761), Figure 7	+25°C	25		pF	
DIGITAL I/O (IN_, $\overline{\text{EN}}$)							
Input Logic High	V _{IH}	V ₊ = 2.7V to 3.6V	T _{MIN} to T _{MAX}	1.4		V	
		V ₊ = 3.6V to 5.5V	T _{MIN} to T _{MAX}	2.0			
Input Logic Low	V _{IL}	V ₊ = 2.7V to 3.6V	T _{MIN} to T _{MAX}	0.5		V	
		V ₊ = 3.6V to 5.5V	T _{MIN} to T _{MAX}	0.6			
Input Leakage Current	I _{IN}	V _{IN} = 0 or V ₊	T _{MIN} to T _{MAX}	1		μA	
POWER SUPPLY							
Power-Supply Range	V ₊		T _{MIN} to T _{MAX}	1.8	5.5	V	
Positive Supply Current	I ₊	V ₊ = 5.5V, V _{IN_} = 0V or V ₊	+25°C	0.01		μA	
			T _{MIN} to T _{MAX}	1.0			

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

Note 3: UCSP packages are 100% tested at +25°C and limits across the full temperature range are guaranteed by correlation and design. Thin QFN packages are 100% tested at +85°C and limits across the full temperature range are guaranteed by correlation and design.

Note 4: R_{ON} and ΔR_{ON} matching specifications are guaranteed by design.

Note 5: ΔR_{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.

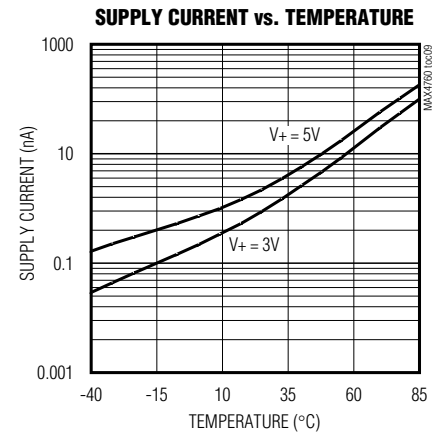
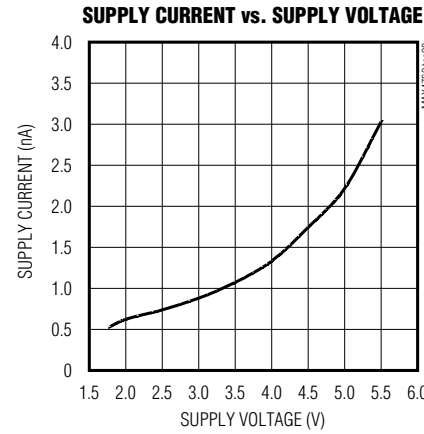
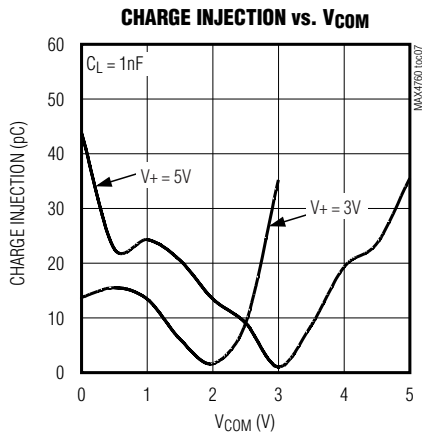
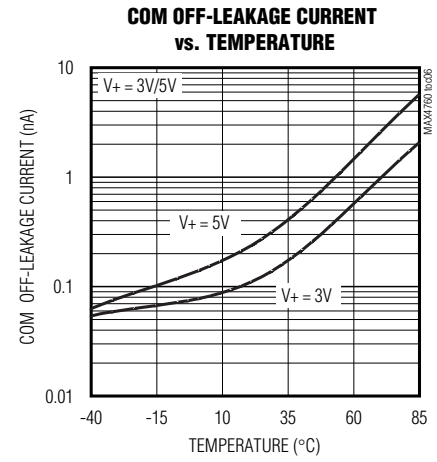
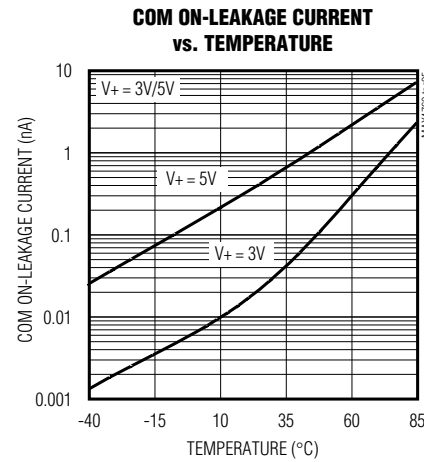
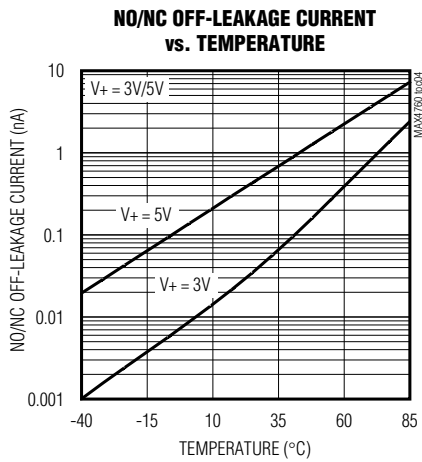
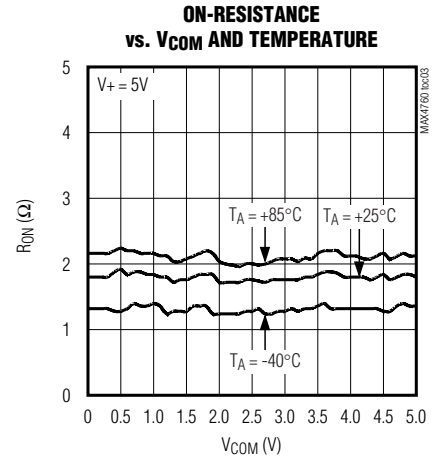
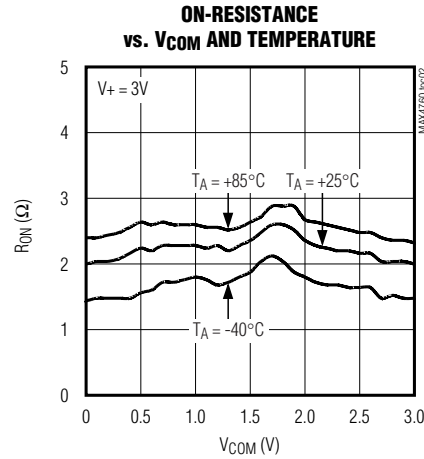
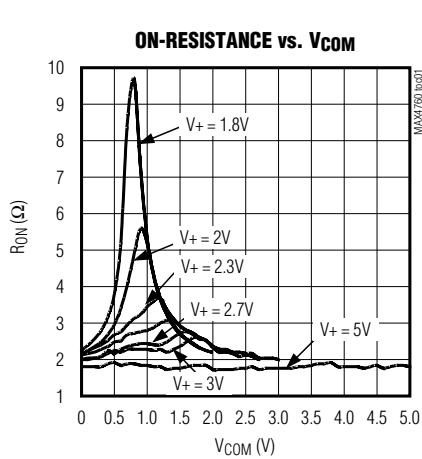
Note 8: Off-isolation = 20log₁₀ [V_{COM_} / (V_{NO_} or V_{NC_})], V_{COM_} = output, V_{NO_} or V_{NC_} = input to off switch.

Note 9: Between any two switches.

High-Bandwidth, Quad DPDT Switches

Typical Operating Characteristics

($V_+ = 3V$, $T_A = +25^\circ C$, unless otherwise noted.)

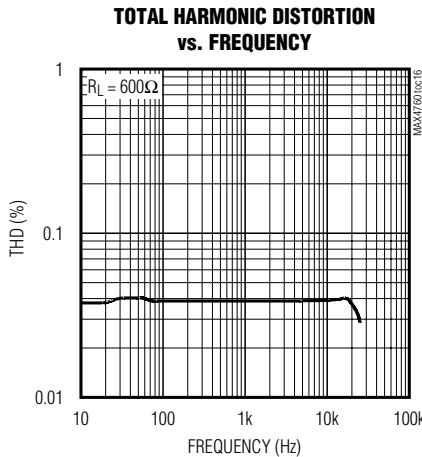
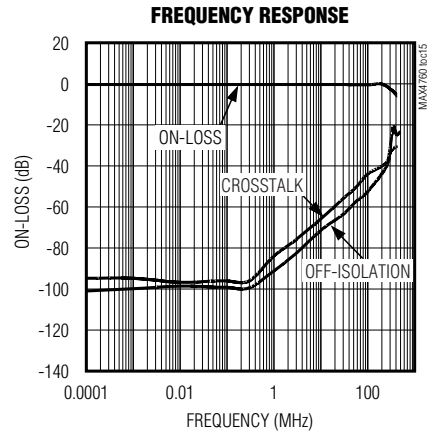
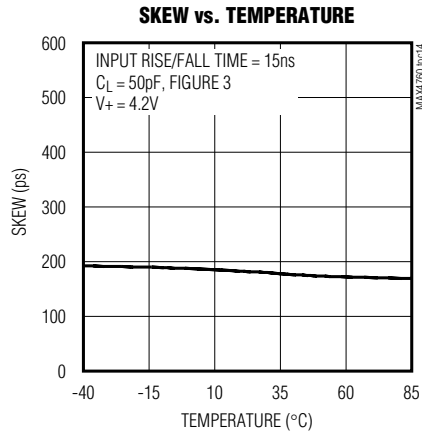
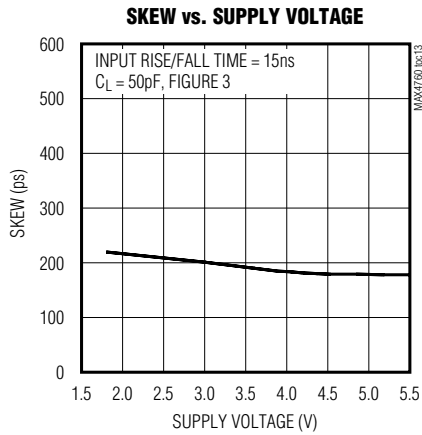
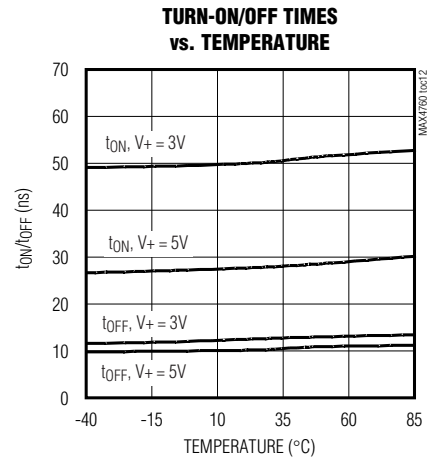
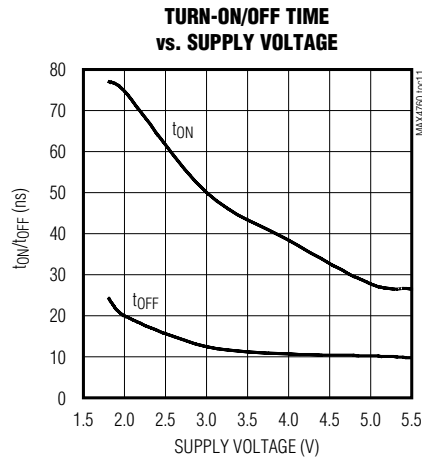
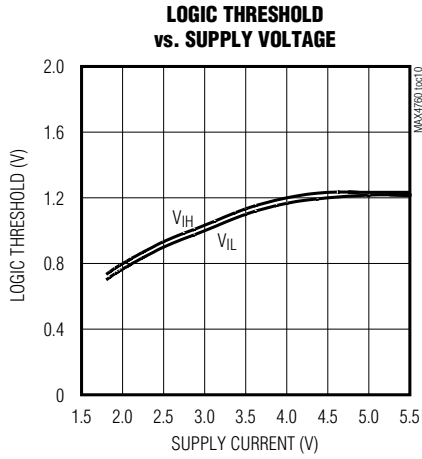


High-Bandwidth, Quad DPDT Switches

MAX4760/MAX4761

Typical Operating Characteristics (continued)

($V_+ = 3V$, $T_A = +25^\circ C$, unless otherwise noted.)



High-Bandwidth, Quad DPDT Switches

Pin Description

PIN				NAME	FUNCTION
MAX4760		MAX4761			
THIN QFN	UCSP	THIN QFN	UCSP		
1	A1	1	A1	NC1	Analog Switch 1, Normally Closed Terminal 1
2	B2	2	B2	COM2	Analog Switch 2, Common Terminal 2
3	A2	3	A2	NC2	Analog Switch 2, Normally Closed Terminal 2
4	A3	4	A3	INA	Logic Control Digital Input for the MAX4760 Switch 1 and Switch 2 Digital control input for all MAX4761 switches.
5	C3, D4	5	C3, D4	V+	Positive Supply Voltage
6	A4	—	—	INB	Logic Control Digital Input for Switches 3 and 4
7	A5	7	A5	NC3	Analog Switch 3, Normally Closed Terminal 3
8	B5	8	B5	COM3	Analog Switch 3, Common Terminal 2
9	A6	9	A6	NC4	Analog Switch 4, Normally Closed Terminal 4
10	B6	10	B6	COM4	Analog Switch 4, Common Terminal 4
11, 14, 17, 29, 32, 35	—	6, 11, 14, 17, 24, 29, 32, 35	A4, F3	N.C.	No Connection. Not internally connected.
12	C5	12	C5	NO3	Analog Switch 3, Normally Open Terminal 3
13	C6	13	C6	NO4	Analog Switch 4, Normally Open Terminal 4
15	D6	15	D6	NO8	Analog Switch 8, Normally Open Terminal 8
16	D5	16	D5	NO7	Analog Switch 7, Normally Open Terminal 7
18	E6	18	E6	COM8	Analog Switch 8, Common Terminal 8
19	F6	19	F6	NC8	Analog Switch 8, Normally Closed Terminal 8
20	E5	20	E5	COM7	Analog Switch 7, Common Terminal 7
21	F5	21	F5	NC7	Analog Switch 7, Normally Closed Terminal 7
22	F4	—	—	IND	Logic Control Digital Input for Switches 7 and 8
23	C4, D3	23	C4, D3	GND	Ground
24	F3	—	—	INC	Logic Control Digital Input for Switches 5 and 6
25	F2	25	F2	NC6	Analog Switch 6, Normally Closed Terminal 2
26	E2	26	E2	COM6	Analog Switch 6, Common Terminal 6
27	F1	27	F1	NC5	Analog Switch 5, Normally Closed Terminal 5
28	E1	28	E1	COM5	Analog Switch 5, Common Terminal 5
30	D2	30	D2	NO6	Analog Switch 6, Normally Open Terminal 6
31	D1	31	D1	NO5	Analog Switch 5, Normally Open Terminal 5
33	C1	33	C1	NO1	Analog Switch 1, Normally Open Terminal 1
34	C2	34	C2	NO2	Analog Switch 2, Normally Open Terminal 1
36	B1	36	B1	COM1	Analog Switch 1, Common Terminal 1
—	—	22	F4	EN	Output Enable, Active Low
EP	—	EP	—	EP	Exposed Pad, Connect to GND.

High-Bandwidth, Quad DPDT Switches

Detailed Description

The MAX4760 quad double-pole/double-throw (DPDT) and the MAX4761 octal single-pole/double-throw (SPDT) analog switches operate from a single +1.8V to +5.5V supply. These devices are fully specified for +3V applications.

The MAX4760/MAX4761 have a guaranteed 3.5Ω (max) on-resistance to switch data or audio signals. The low 25pF capacitance and 0.2ns change in skew makes them ideal for data switching applications. The MAX4760 has 4 logic inputs to control two switches in pairs and the MAX4761 has one logic control input and an enable input ($\overline{\text{EN}}$) to disable the switches.

Applications Information

Digital Control Inputs

The MAX4760/MAX4761 logic inputs accept up to +5.5V regardless of the supply voltage. For example, with a +3.3V supply, IN_- can be driven low to GND and high to +5.5V, which allows mixed logic levels in a system. Driving the control logic inputs rail-to-rail also minimizes power consumption. For a +3V supply voltage, the logic thresholds are 0.5V (low) and 1.4V (high).

For the MAX4761, drive $\overline{\text{EN}}$ low to enable. When $\overline{\text{EN}}$ is high, COM_- is high impedance.

Analog Signal Levels

Analog signal inputs over the full voltage range (0V to V_+) are passed through the switch with minimal change in on-resistance (see the *Typical Operating Characteristics*). The switches are bidirectional so NO_- , NC_- , and COM_- can be either inputs or outputs.

Power-Supply Bypassing

Power-supply bypassing improves noise margin and prevents switching noise from propagating from the V_+ supply to other components. A 0.1 μF capacitor connected from V_+ to GND is adequate for most applications.

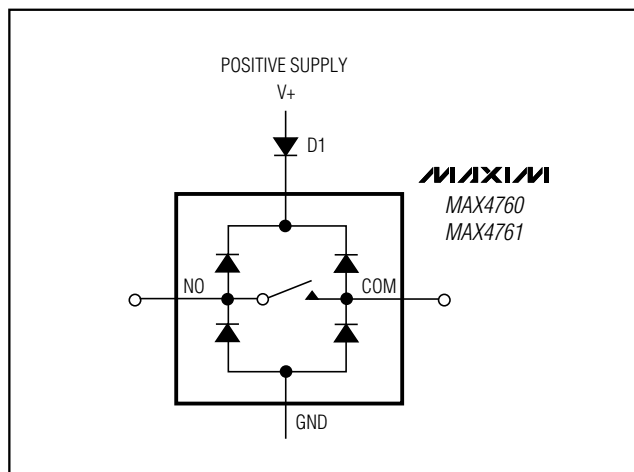


Figure 1. Overvoltage Protection Using an External Blocking Diode

Power-Supply Sequencing

CMOS devices require proper power-supply sequencing. Always apply V_+ before the analog signals, especially if the input signal is not current limited. If sequencing is not possible, and the input signal is not current limited to less than 20mA, add a small-signal diode (Figure 1). Adding the diode reduces the analog range to a diode drop (0.7V) below V_+ and increases the on-resistance slightly. The maximum supply voltage must not exceed +6V at any time.

UCSP Applications Information

For the latest application details on UCSP construction, dimensions, tape carrier information, printed circuit board techniques, bump-pad layout, and recommended reflow temperature profile, as well as the latest information on reliability testing results, go to the Maxim website at www.maxim-ic.com/ucsp for the Application Note, "UCSP—A Wafer-Level Chip-Scale Package."

High-Bandwidth, Quad DPDT Switches

Timing Circuits/Timing Diagrams

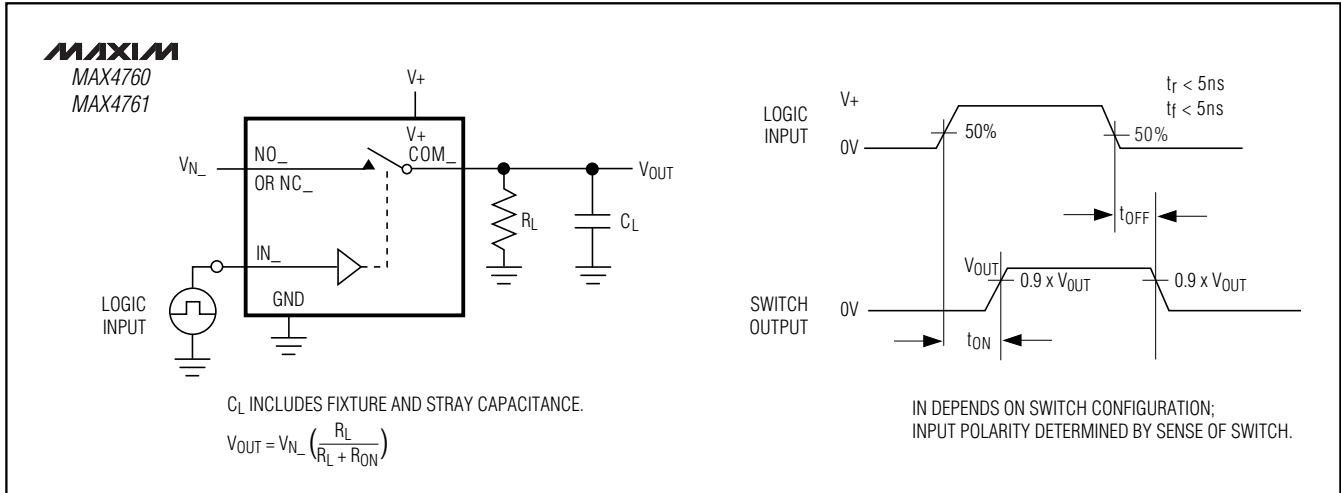


Figure 2. Switching Time

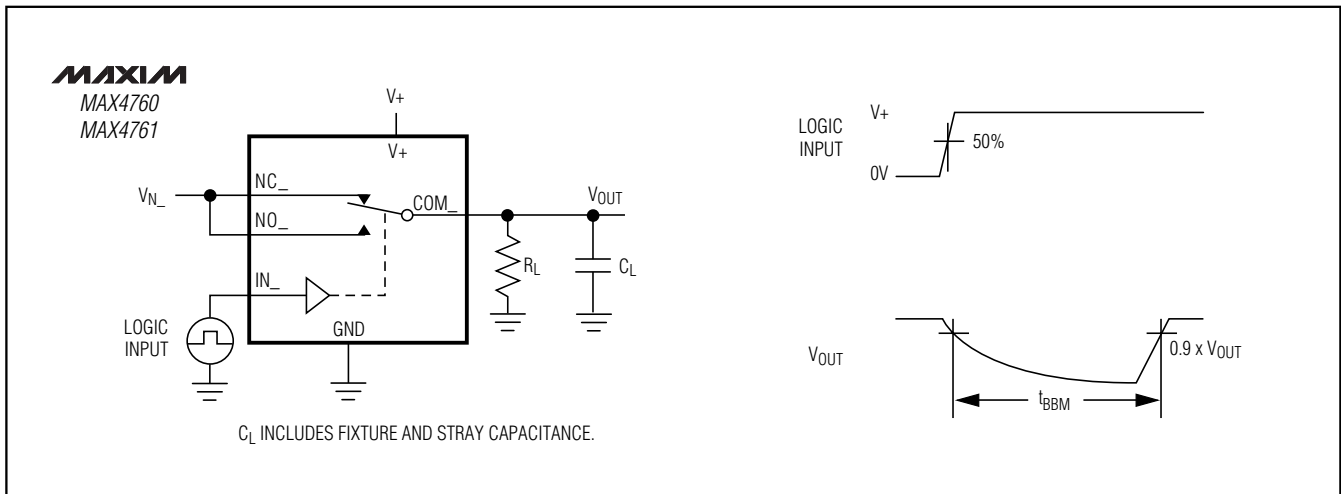


Figure 3. Break-Before-Make Interval

High-Bandwidth, Quad DPDT Switches

MAX4760/MAX4761

Timing Circuits/Timing Diagrams (continued)

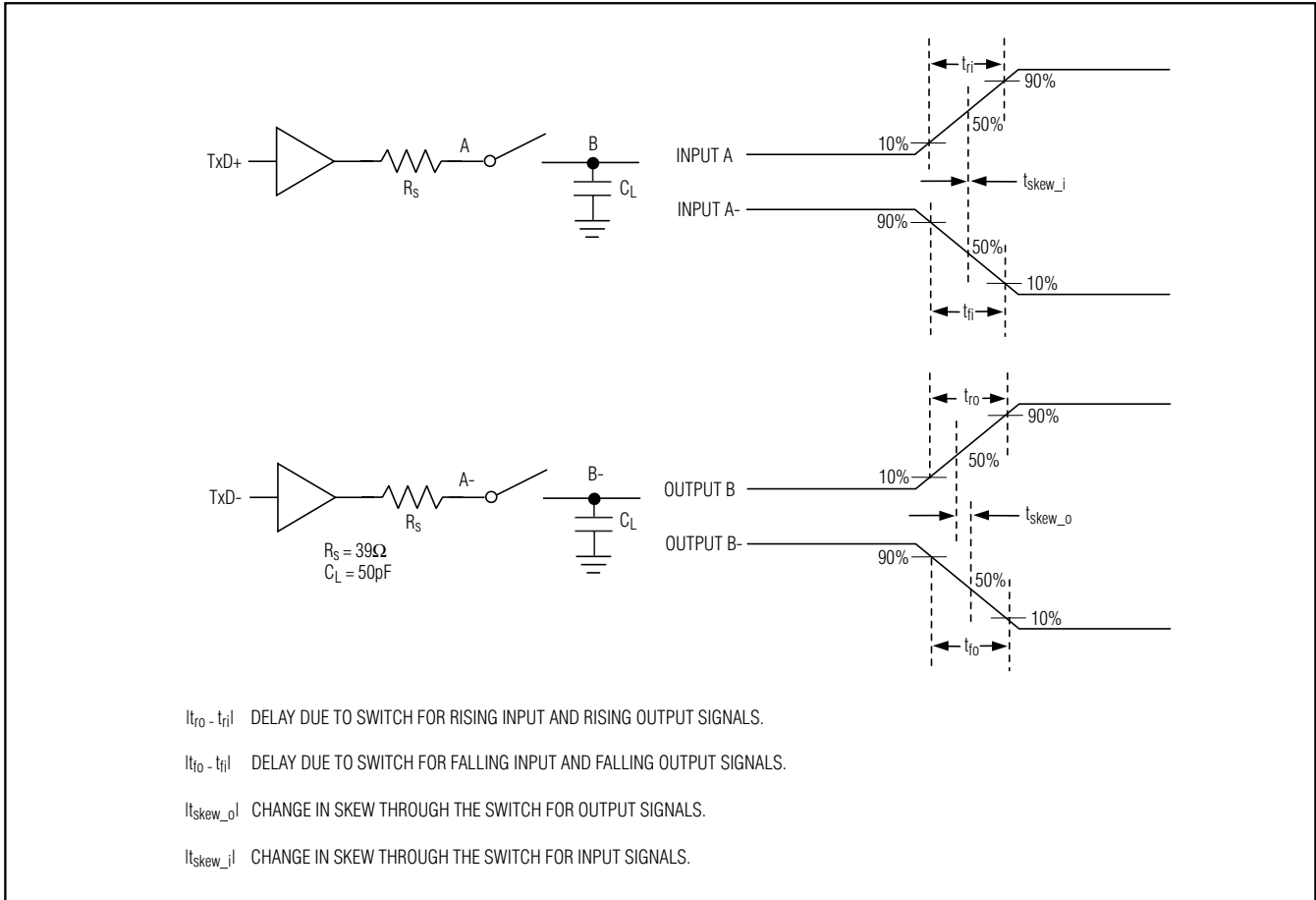


Figure 4. Input/Output Skew Timing Diagram

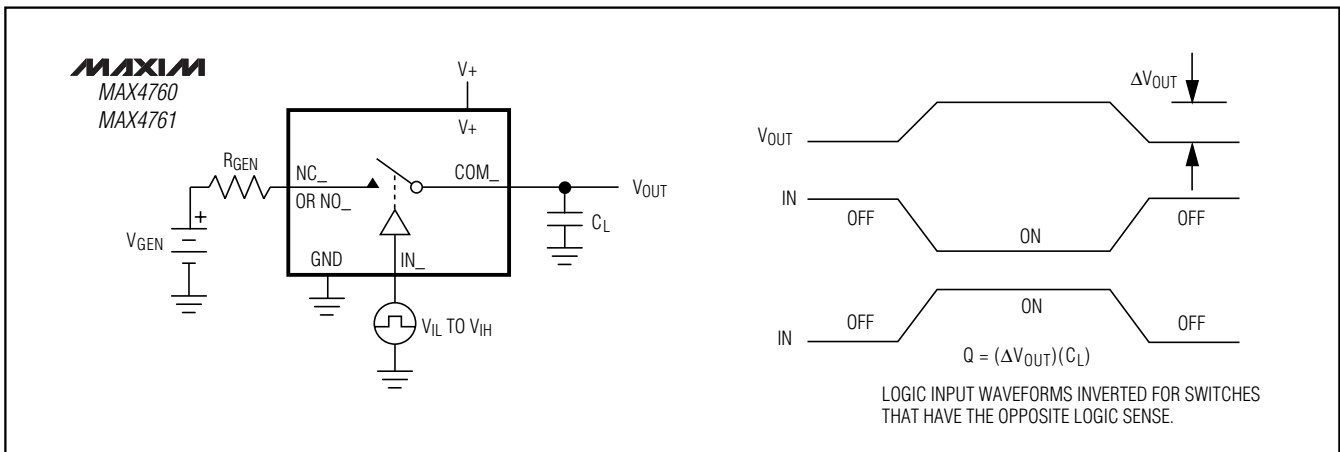


Figure 5. Charge Injection

High-Bandwidth, Quad DPDT Switches

Timing Circuits/Timing Diagrams (continued)

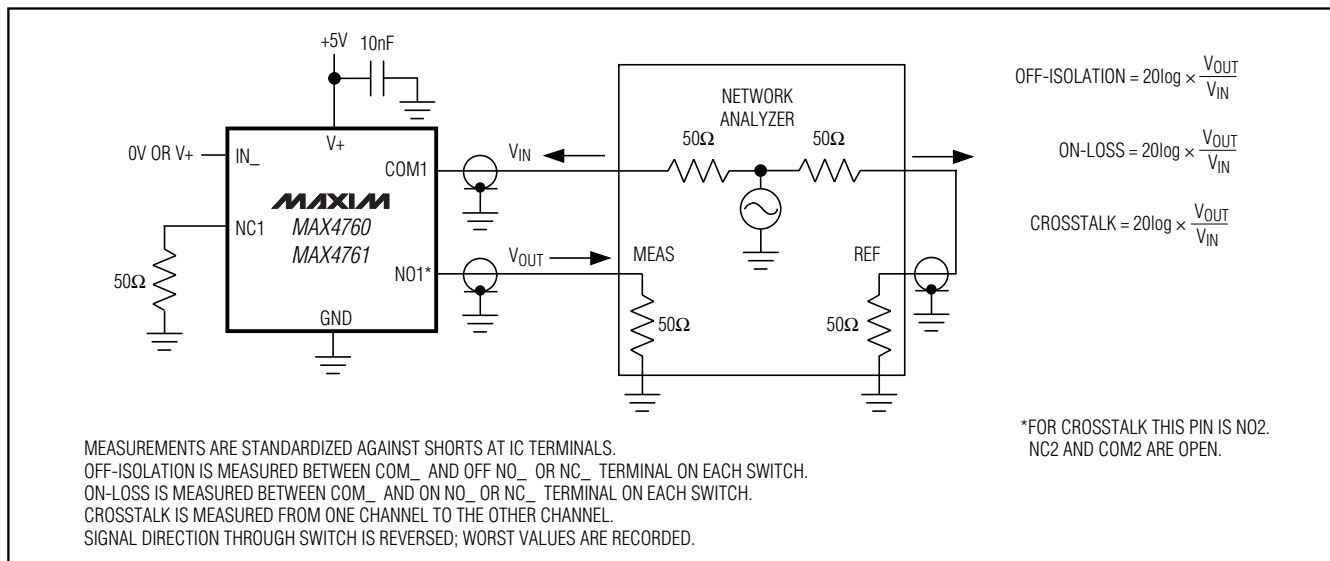


Figure 6. On-Loss, Off-Isolation, and Crosstalk

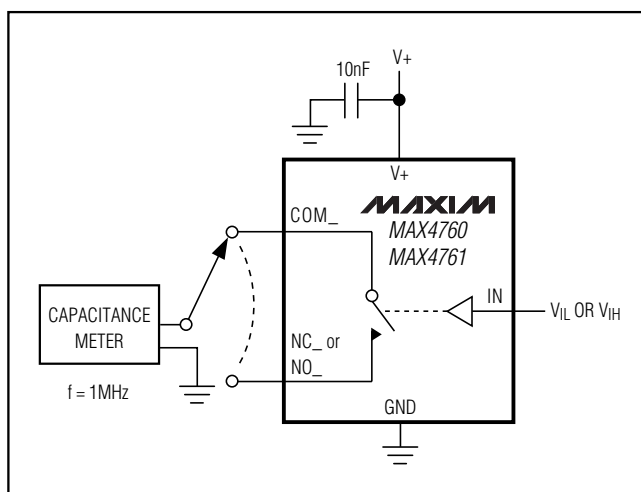
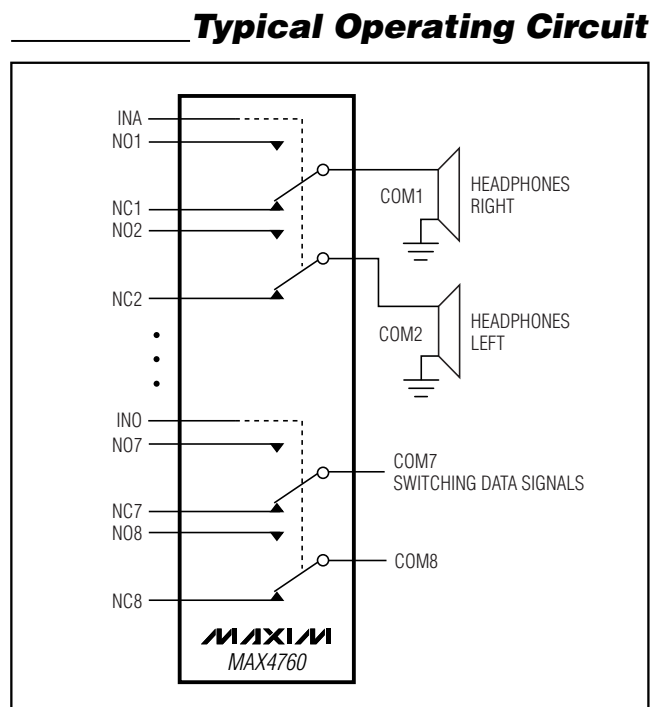


Figure 7. Channel On-/Off-Capacitance



High-Bandwidth, Quad DPDT Switches

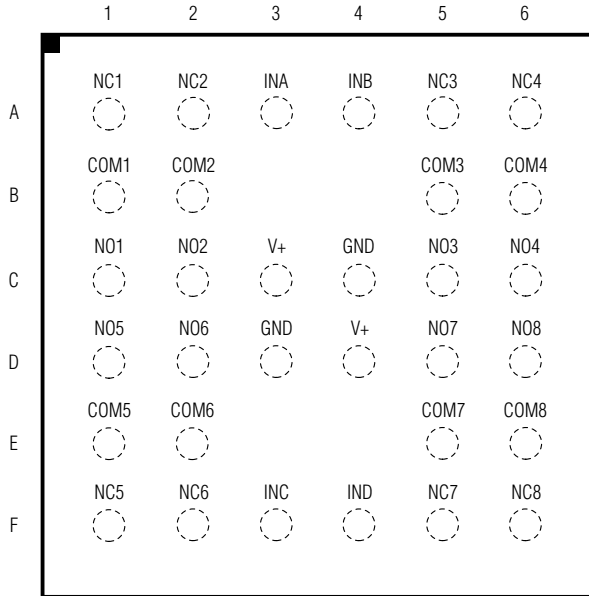
Pin Configurations/Truth Tables

MAX4760/MAX4761

TOP VIEW

MAXIM
MAX4760

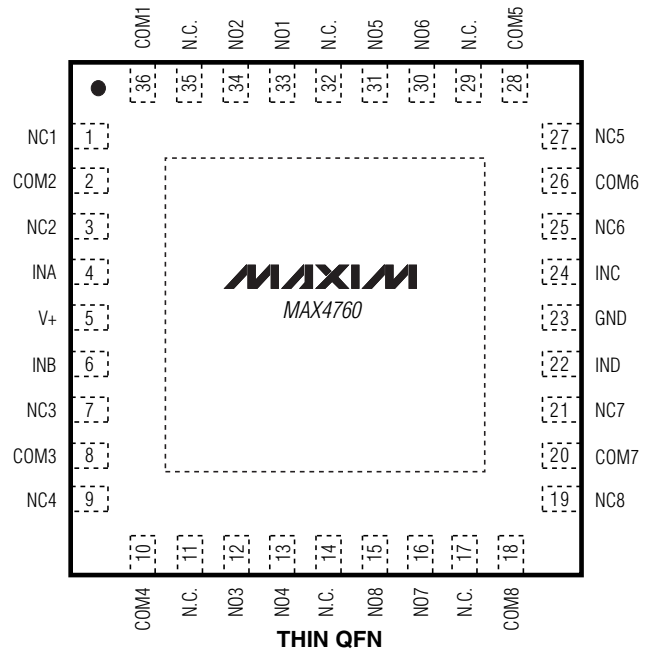
(BUMP SIDE DOWN)



UCSP

MAX4760

INA	NO1/NO2	NC1/NC2
LOW	OFF	ON
HIGH	ON	OFF
INB	NO3/NO4	NC3/NC4
LOW	OFF	ON
HIGH	ON	OFF
INC	NO5/NO6	NC5/NC6
LOW	OFF	ON
HIGH	ON	OFF
IND	NO7/NO8	NC7/NC8
LOW	OFF	ON
HIGH	ON	OFF



THIN QFN

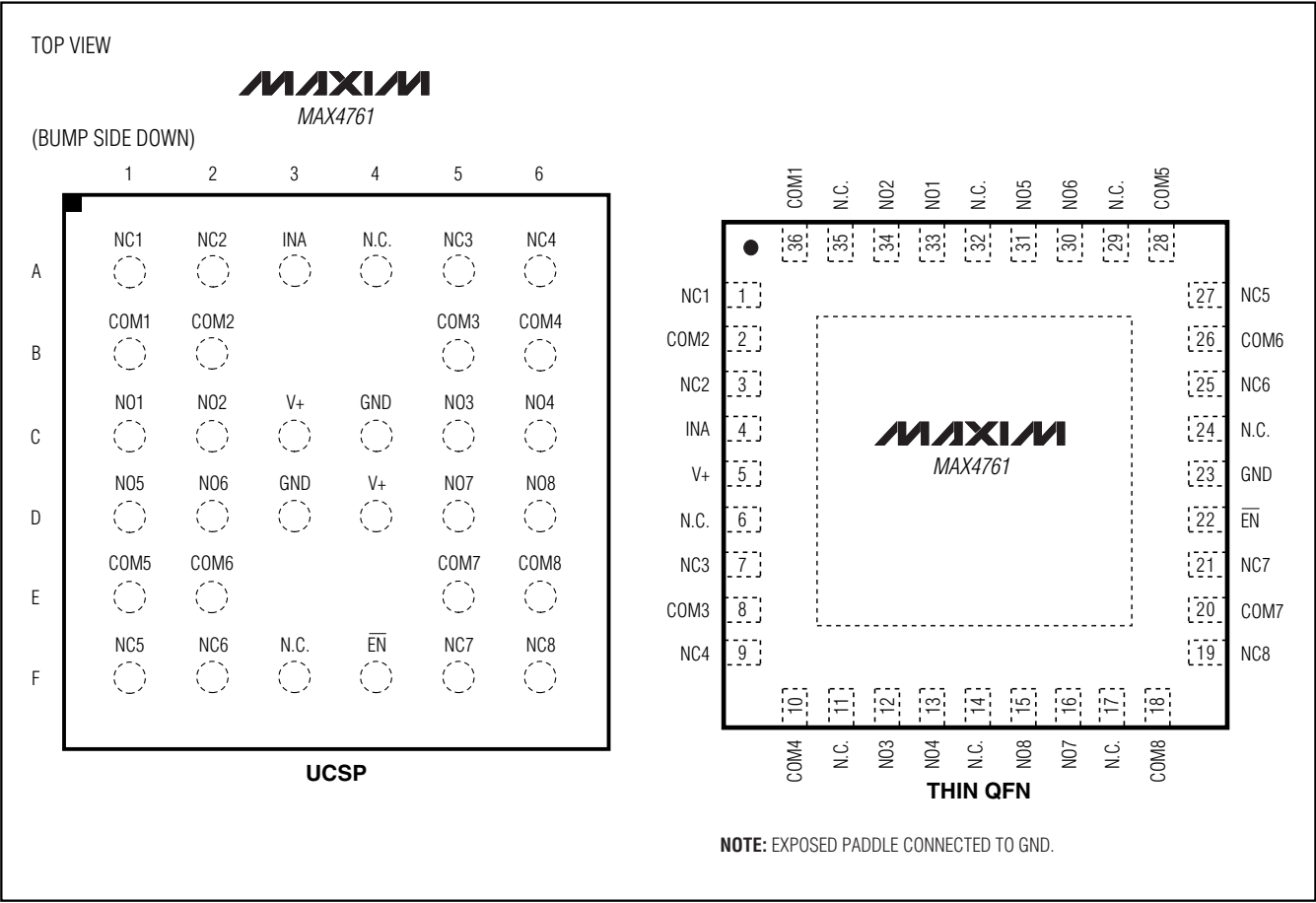
NOTE: EXPOSED PADDLE CONNECTED TO GND OR FLOATING.

MAX4761

$\overline{EN}$	INA	NO ₋	NC ₋
LOW	LOW	OFF	ON
LOW	HIGH	ON	OFF
HIGH	X	OFF	OFF
HIGH	X	OFF	OFF

High-Bandwidth, Quad DPDT Switches

Pin Configurations/Truth Tables (continued)



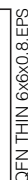
Chip Information

TRANSISTOR COUNT: 1432

PROCESS: CMOS

MAX4760/MAX4761

(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.)



PKG. CODES	EXPOSED PAD VARIATIONS						DOWN BOWLS ALLOWED
	D2			E2			
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
T3666-1	3.60	3.70	3.80	3.60	3.70	3.80	NO
T3666-2	3.60	3.70	3.80	3.60	3.70	3.80	YES
T3666-3	3.60	3.70	3.80	3.60	3.70	3.80	NO
T4068-1	4.00	4.10	4.20	4.00	4.10	4.20	NO
T4068-2	4.00	4.10	4.20	4.00	4.10	4.20	YES
T4068-3	4.00	4.10	4.20	4.00	4.10	4.20	YES
T4068-4	4.00	4.10	4.20	4.00	4.10	4.20	NO
T4068-5	4.00	4.10	4.20	4.00	4.10	4.20	NO
T4866-1	4.20	4.30	4.40	4.20	4.30	4.40	YES

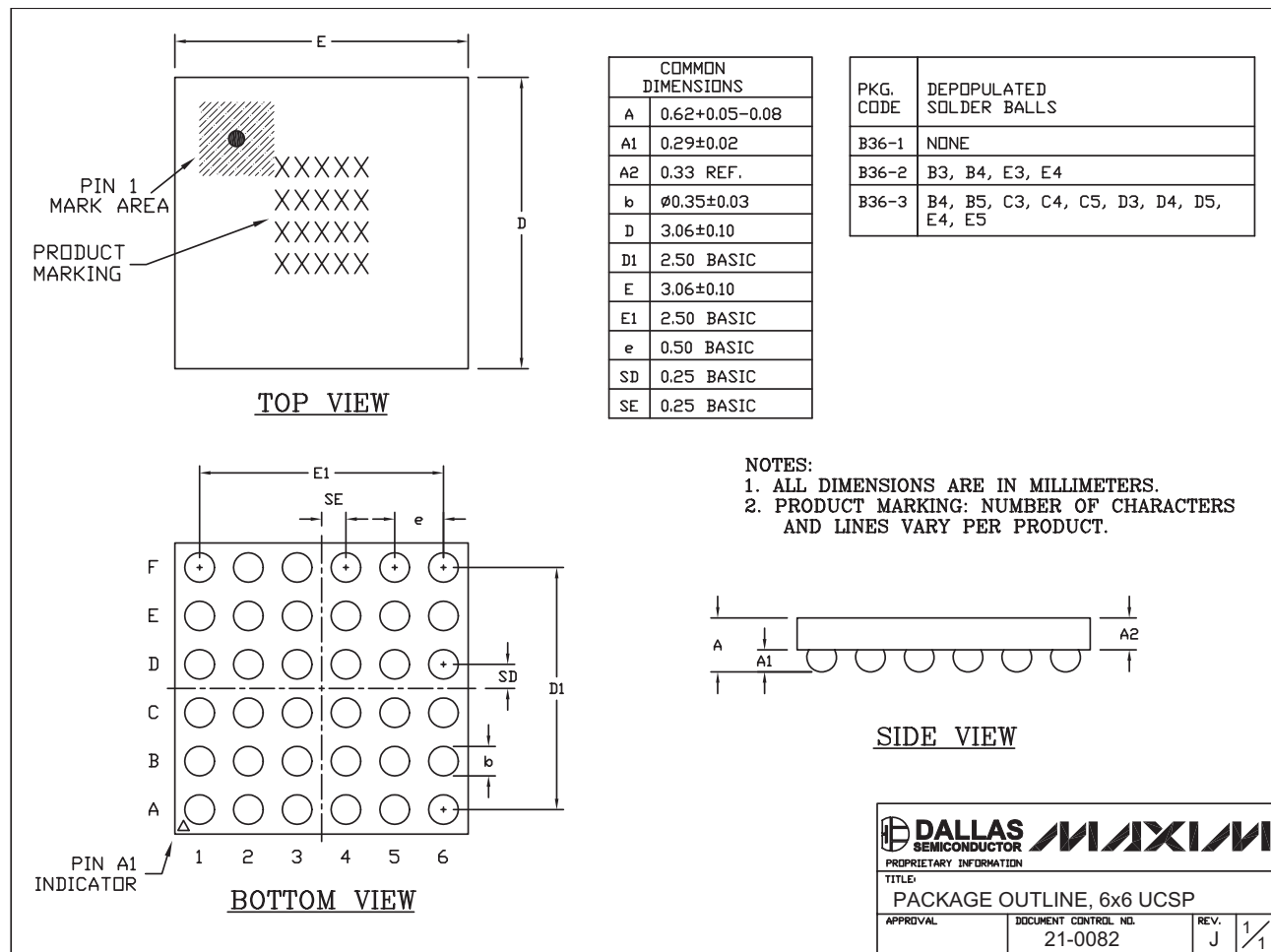
10. WARPAGE SHALL NOT EXCEED 0.10 mm.



High-Bandwidth, Quad DPDT Switches

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.)



36L UCSP.EPS

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

14 Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600