19-2626; Rev 0; 10/02

MAXIM

20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

General Description

The MAX4719 low-voltage, low on-resistance (R_{ON}), dual single-pole/double throw (SPDT) analog switch operates from a single +1.8V to +5.5V supply. The MAX4719 features 20Ω R_{ON} (max) with 1.2Ω flatness and 0.4Ω matching between channels. The switch offers break-before-make switching (1ns) with t_{ON} <80ns and t_{OFF} <40ns at +2.7V. The digital logic inputs are +1.8V logic compatible with a +2.7V to +3.6V supply.

The switch is packaged in a chip-scale package (UCSP™), significantly reducing the required PC board area. The chip occupies only a 2.0mm × 1.50mm area and has a 4 × 3 bump array with a bump pitch of 0.5mm. The MAX4719 is also available in a 10-pin µMAX package.

Applications

Cell Phones

Battery-Operated Equipment

Audio/Video-Signal Routing

Low-Voltage Data-Acquisition Systems

Sample-and-Hold Circuits

PDAs

UCSP is a trademark of Maxim Integrated Products, Inc.
Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

Features

- **-3dB Bandwidth: >300MHz**
- **Low 15pF On-Channel Capacitance**
- **Single-Supply Operation from +1.8V to +5.5V**
- **20Ω R_{ON} (max) Switch**
  0.4Ω (max) R_{ON} Match (+3.0V Supply)
  1.2Ω (max) R_{ON} Flatness (+3.0V Supply)
- **Rail-to-Rail® Signal Handling**
- **High Off-Isolation: -55dB (10MHz)**
- **Low Crosstalk: -80dB (10MHz)**
- **Low Distortion: 0.03%**
- **+1.8V CMOS-Logic Compatible**
- **<0.5nA Leakage Current at +25°C**

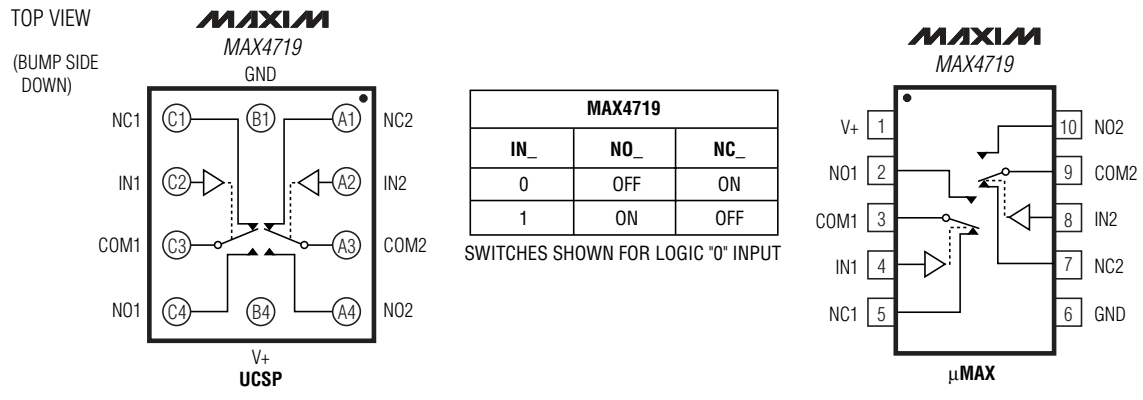
Ordering Information

PART	TEMP RANGE	PIN/BUMP-PACKAGE	TOP MARK
MAX4719EUB	-40°C to +85°C	10 µMAX	—
MAX4719EBC-T*	-40°C to +85°C	12 UCSP-12	ABJ

Note: *UCSP package requires special solder temperature profile described in the Absolute Maximum Ratings section.*

**UCSP reliability is integrally linked to the user's assembly methods, circuit board material, and environment. See the UCSP reliability notice in the UCSP Reliability section of this data sheet for more information.*

Pin Configurations/Functional Diagrams/Truth Table



MAX4719		
IN_	**NO_**	**NC_**
0	OFF	ON
1	ON	OFF

SWITCHES SHOWN FOR LOGIC "0" INPUT

20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

ABSOLUTE MAXIMUM RATINGS

(All Voltages Referenced to GND)
V+, IN_.....-0.3V to +6.0V
COM_, NO_, NC_ (Note 1).....-0.3V to (V+ + 0.3V)
Continuous Current COM_, NO_, NC_.....±100mA
Peak Current COM_, NO_, NC_
(pulsed at 1ms, 10% duty cycle).....±200mA
Continuous Power Dissipation (T_A = +70°C)
10-Pin µMAX (derate 5.6mW/°C above +70°C).....444mW
12-Bump UCSP (derate 11.4mW/°C above +70°C) 909mW
ESD 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) (Note 2)
Infrared (15s) .....+220°C
Vapor Phase (60s) .....+215°C

Note 1: Signals on COM_, NO_, or NC_ exceeding V+ or GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.

Note 2: This device is constructed using a unique set of packaging techniques that impose a limit on the thermal profile the device can be exposed to during board level solder attach and rework. This limit permits only the use of the solder profiles recommended in the industry standard specification, JEDEC 020A, paragraph 7.6, table 3 for IR/VPR and convection reflow. Preheating is required. Hand or wave soldering is not allowed.

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 +3.6V, V_{IH} = +1.4V, V_{IL} = +0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +3.0V, T_A = +25°C, unless otherwise noted.) (Notes 3, 4)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
Analog Signal Range	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$		T_{MIN} to T_{MAX}	0		V+	V
ANALOG SWITCH							
On-Resistance (Note 5)	R_{ON}	V+ = 2.7V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 1.5V	+25°C		14	20	Ω
			T_{MIN} to T_{MAX}			25	
On-Resistance Match Between Channels (Notes 5, 6)	ΔR_{ON}	V+ = 2.7V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 1.5V	+25°C		0.15	0.4	Ω
			T_{MIN} to T_{MAX}			0.5	
On-Resistance Flatness (Note 7)	$R_{FLAT(ON)}$	V+ = 2.7V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 1.0V, 1.5V, 2.0V	+25°C		0.6	1.2	Ω
			T_{MIN} to T_{MAX}			1.5	
NO_, NC_ Off-Leakage Current (Note 8)	$I_{NO\_(OFF)}$, $I_{NC\_(OFF)}$	V+ = 3.6V, $V_{COM\_}$ = 0.3V, 3.3V; $V_{NO\_}$ or $V_{NC\_}$ = 3.3V, 0.3V	+25°C	-0.5	0.01	+0.5	nA
			T_{MIN} to T_{MAX}	-1		+1	
COM_ On-Leakage Current (Note 8)	$I_{COM\_(ON)}$	V+ = 3.6V, $V_{COM\_}$ = 0.3V, 3.3V; $V_{NO\_}$ or $V_{NC\_}$ = 0.3V, 3.3V, or floating	+25°C	-1	0.01	+1	nA
			T_{MIN} to T_{MAX}	-2		+2	
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	$V_{NO\_}$, $V_{NC\_}$ = 1.5V; R_L = 300Ω, C_L = 35pF, Figure 1	+25°C		40	80	ns
			T_{MIN} to T_{MAX}			100	

ELECTRICAL CHARACTERISTICS—Single +3V Supply (continued)

(V+ = +2.7V to +3.6V, V_{IH} = +1.4V, V_{IL} = +0.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +3.0V, T_A = +25°C, unless otherwise noted.) (Notes 3, 4)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
Turn-Off Time	t_{OFF}	$V_{NO\_}$, $V_{NC\_}$ = 1.5V; R_L = 300Ω, C_L = 35pF, Figure 1	+25°C		20	40	ns
			T_{MIN} to T_{MAX}			50	
Break-Before-Make Time Delay (Note 8)	t_{BBM}	$V_{NO\_}$, $V_{NC\_}$ = 1.5V; R_L = 300Ω, C_L = 35pF, Figure 2	+25°C		8		ns
			T_{MIN} to T_{MAX}	1			
Charge Injection	Q	V_{GEN} = 2V, R_{GEN} = 0Ω; C_L = 1.0nF, Figure 3	+25°C		18		pC
Off-Isolation	V_{ISO}	f = 10MHz; $V_{NO\_}$, $V_{NC\_}$ = $1V_{P-P}$; R_L = 50Ω, C_L = 5pF, Figure 4	+25°C		-55		dB
		f = 1MHz; $V_{NO\_}$, $V_{NC\_}$ = $1V_{P-P}$; R_L = 50Ω, C_L = 5pF, Figure 4			-80		
Crosstalk (Note 9)	V_{CT}	f = 10MHz; $V_{NO\_}$, $V_{NC\_}$ = $1V_{P-P}$; R_L = 50Ω, C_L = 5pF, Figure 4	+25°C		-80		dB
		f = 1MHz; $V_{NO\_}$, $V_{NC\_}$ = $1V_{P-P}$; R_L = 50Ω, C_L = 5pF, Figure 4			-110		
On-Channel -3dB Bandwidth	BW	Signal = 0dBm, R_L = 50Ω; C_L = 5pF, Figure 4	+25°C		300		MHz
Total Harmonic Distortion	THD	V_{COM} = $2V_{P-P}$, R_L = 600Ω	+25°C		0.03		%
NO_, NC_ Off-Capacitance	$C_{NO\_(OFF)}$ $C_{NC\_(OFF)}$	f = 1MHz, Figure 5	+25°C		9		pF
Switch On-Capacitance	C_{ON}	f = 1MHz, Figure 5	+25°C		20		pF
DIGITAL I/O							
Input Logic High Voltage	V_{IH}		T_{MIN} to T_{MAX}	1.4			V
Input Logic Low Voltage	V_{IL}		T_{MIN} to T_{MAX}			0.5	V
Input Leakage Current	I_{IN}	V+ = +3.6V, $V_{IN\_}$ = 0V or 5.5V	T_{MIN} to T_{MAX}	-100		+100	nA
POWER SUPPLY							
Power-Supply Range	V+		T_{MIN} to T_{MAX}	1.8		5.5	V
Supply Current	I+	V+ = +5.5V, $V_{IN\_}$ = 0V or V+	T_{MIN} to T_{MAX}			1	µA

20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

ELECTRICAL CHARACTERISTICS—Single +5V Supply

(V+ = +4.2V to +5.5V, V_{IH} = +2.0V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +5.0V, T_A = +25°C, unless otherwise noted.) (Notes 3, 4)

PARAMETER	SYMBOL	CONDITIONS	T_A	MIN	TYP	MAX	UNITS
Analog Signal Range	$V_{COM\_}$, $V_{NO\_}$, $V_{NC\_}$		T_{MIN} to T_{MAX}	0		V+	V
ANALOG SWITCH							
On-Resistance (Note 5)	R_{ON}	V+ = 4.2V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 3.5V	+25°C		12	20	Ω
			T_{MIN} to T_{MAX}			25	
On-Resistance Match Between Channels (Notes 5, 6)	ΔR_{ON}	V+ = 4.2V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 3.5V	+25°C		0.15	0.4	Ω
			T_{MIN} to T_{MAX}			0.5	
On-Resistance Flatness (Note 7)	$R_{FLAT(ON)}$	V+ = 4.2V, $I_{COM\_}$ = 10mA; $V_{NO\_}$ or $V_{NC\_}$ = 1.0V, 2.0V, 4.5V	+25°C		0.4	1	Ω
			T_{MIN} to T_{MAX}			1.2	
NO_, NC_ Off-Leakage Current (Note 8)	$I_{NO\_(OFF)}$, $I_{NC\_(OFF)}$	V+ = 5.5V; $V_{COM\_}$ = 1.0V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 4.5V, 1.0V	+25°C	-0.5	+0.01	+0.5	nA
			T_{MIN} to T_{MAX}	-1		+1	
COM_ On-Leakage Current (Note 8)	$I_{COM\_(ON)}$	V+ = 5.5V, $V_{COM\_}$ = 1.0V, 4.5V; $V_{NO\_}$ or $V_{NC\_}$ = 1.0V, 4.5V, or floating	+25°C	-1	+0.01	+1	nA
			T_{MIN} to T_{MAX}	-2		+2	
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	$V_{NO\_}$, $V_{NC\_}$ = 3.0V; R_L = 300Ω, C_L = 35pF, Figure 1	+25°C		30	80	ns
			T_{MIN} to T_{MAX}			100	
Turn-Off Time	t_{OFF}	$V_{NO\_}$, $V_{NC\_}$ = 3.0V; R_L = 300Ω, C_L = 35pF, Figure 1	+25°C		20	40	ns
			T_{MIN} to T_{MAX}			50	
Break-Before-Make Time Delay (Note 8)	t_{BBM}	$V_{NO\_}$, $V_{NC\_}$ = 3.0V; R_L = 300Ω, C_L = 35pF, Figure 2	+25°C		8		ns
			T_{MIN} to T_{MAX}	1			
DIGITAL I/O							
Input Logic High Voltage	V_{IH}		T_{MIN} to T_{MAX}	2.0			V
Input Logic Low Voltage	V_{IL}		T_{MIN} to T_{MAX}			0.8	V
Input Leakage Current	I_{IN}	V+ = 5.5V, $V_{IN\_}$ = 0V or V+	T_{MIN} to T_{MAX}	-0.1		+0.1	µA

ELECTRICAL CHARACTERISTICS—Single +5V Supply (continued)

(V+ = +4.2V to +5.5V, V_{IH} = +2.0V, V_{IL} = +0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V+ = +5.0V, T_A = +25°C, unless otherwise noted.) (Notes 3, 4)

PARAMETER	SYMBOL	CONDITIONS	TA	MIN	TYP	MAX	UNITS
POWER SUPPLY							
Power-Supply Range	V+		T_{MIN} to T_{MAX}	1.8		5.5	V
Supply Current	I+	V+ = 5.5V, $V_{IN\_}$ = 0V or V+	T_{MIN} to T_{MAX}			1	µA

Note 3: UCSP parts are 100% tested at +25°C only, and guaranteed by design over the specified temperature range. µMAX parts are 100% tested at T_{MAX} and guaranteed by design over the specified temperature range.

Note 4: The algebraic convention used in this data sheet is where the most negative value is a minimum and the most positive value is a maximum.

Note 5: Guaranteed by design for UCSP parts.

Note 6: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

Note 7: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

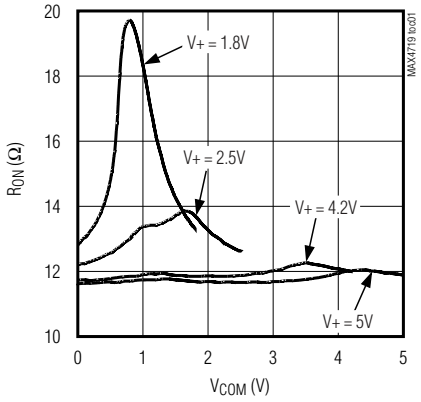
Note 8: Guaranteed by design.

Note 9: Between any two switches.

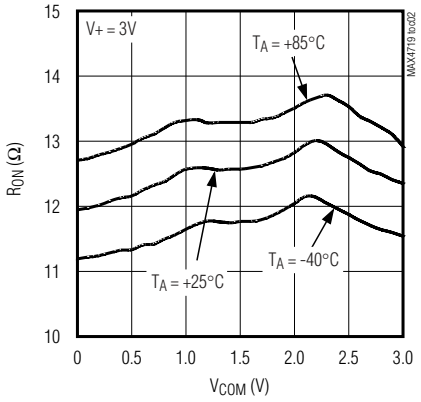
Typical Operating Characteristics

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

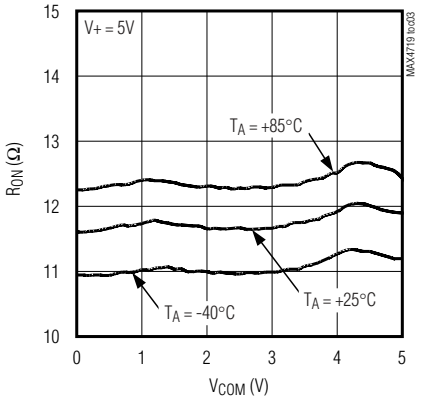
ON-RESISTANCE vs. V_{COM}



ON-RESISTANCE vs. V_{COM}



ON-RESISTANCE vs. V_{COM}

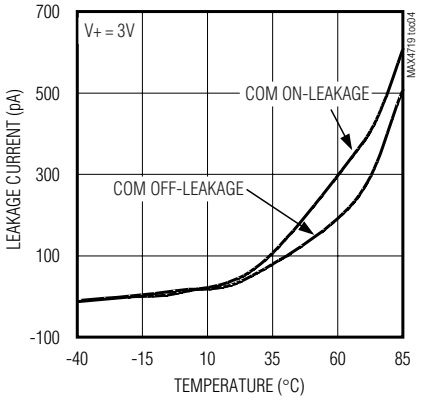


20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

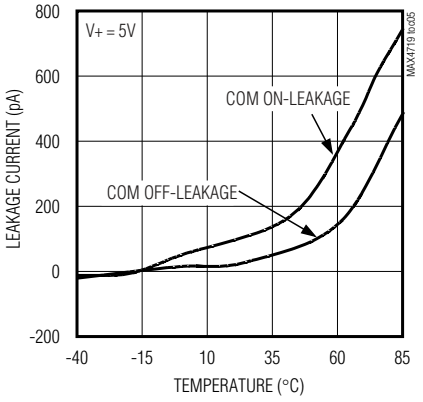
Typical Operating Characteristics (continued)

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

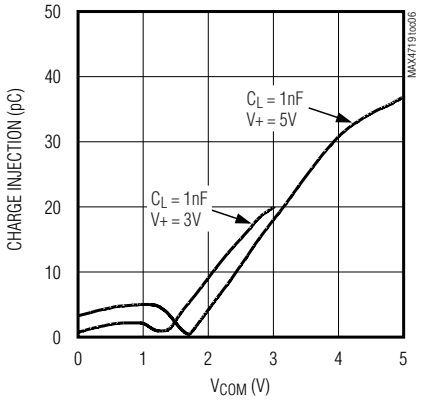
LEAKAGE CURRENT vs. TEMPERATURE



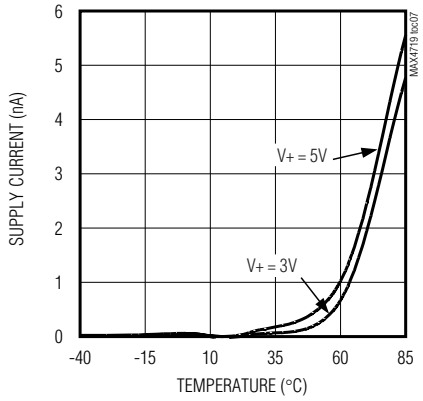
LEAKAGE CURRENT vs. TEMPERATURE



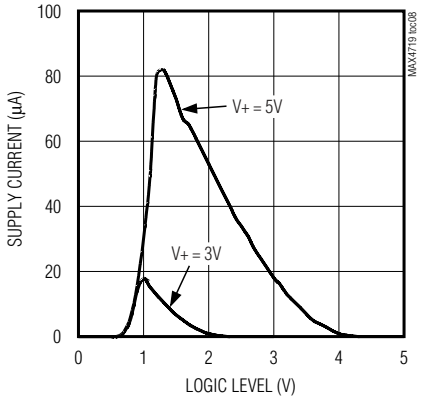
CHARGE INJECTION vs. V_{COM}



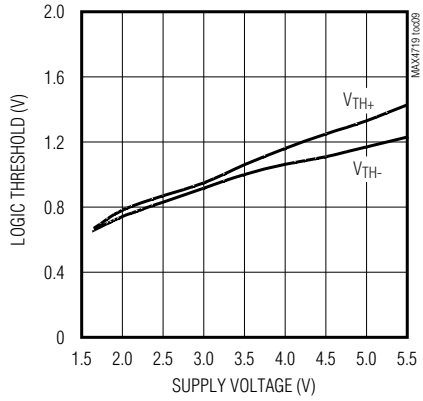
SUPPLY CURRENT vs. TEMPERATURE



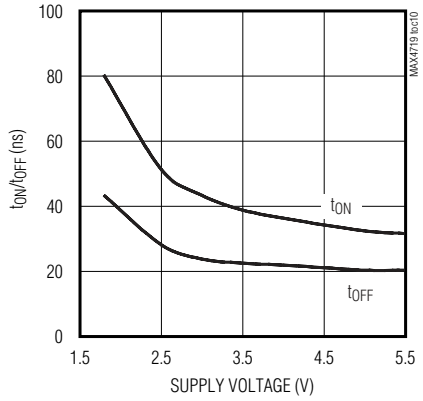
SUPPLY CURRENT vs. LOGIC LEVEL



LOGIC THRESHOLD vs. SUPPLY VOLTAGE



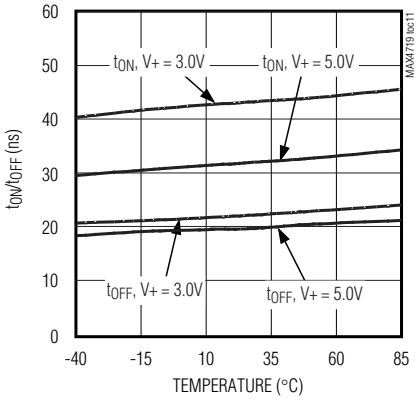
TURN-ON/OFF TIME vs. SUPPLY VOLTAGE



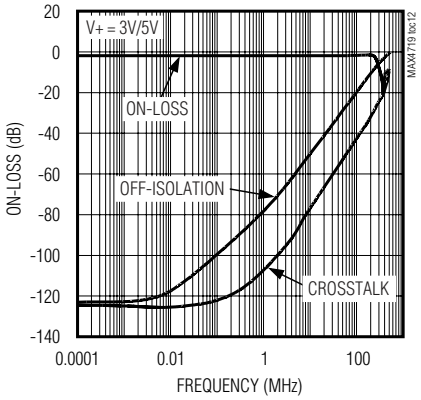
Typical Operating Characteristics (continued)

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

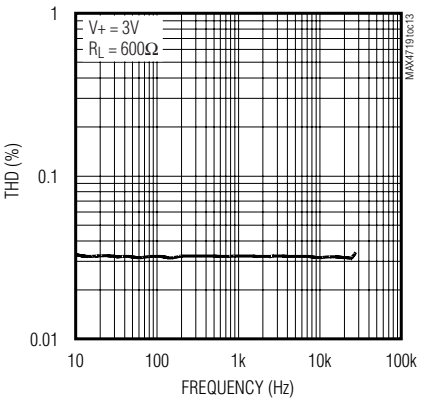
TURN-ON/OFF TIME vs. TEMPERATURE



FREQUENCY RESPONSE



TOTAL HARMONIC DISTORTION vs. FREQUENCY



Pin Description

PIN		NAME	FUNCTION
UCSP	µMAX		
A1	7	NC2	Analog Switch 2—Normally Closed Terminal
A2	8	IN2	Digital Control Input for Analog Switch 2
A3	9	COM2	Analog Switch 2—Common Terminal
A4	10	NO2	Analog Switch 2—Normally Open Terminal
B1	6	GND	Ground
B4	1	V+	Positive-Supply Voltage Input
C1	5	NC1	Analog Switch 1—Normally Closed Terminal
C2	4	IN1	Digital Control Input for Analog Switch 1
C3	3	COM1	Analog Switch 1—Common Terminal
C4	2	NO1	Analog Switch 1—Normally Open Terminal

Detailed Description

The MAX4719 high-speed, low-voltage, 20Ω R_{ON}, dual SPDT analog switch operates from a single +1.8V to +5.5V supply. The switch features break-before-make switching operation and fast switching speeds (t_{ON} = 80ns (max), t_{OFF} = 40ns (max)).

Applications Information

Digital Control Inputs

The MAX4719 logic inputs accept up to +5.5V regardless of supply voltage. For example, with a +3.3V supply, IN_ can be driven low to GND and high to +5.5V allowing for mixing of logic levels in a system. Driving the control logic inputs rail-to-rail minimizes power consumption. For a +3V 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 2.0V (high).

Analog Signal Levels

The on-resistance of the MAX4719 changes very little for analog input signals across the entire supply voltage range (see the *Typical Operating Characteristics*). The switches are bidirectional, so the NO_, NC_, and COM_ pins can be either inputs or outputs.

20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

Power-Supply Sequencing and Overvoltage Protection

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+ before applying analog signals, especially if the analog signal is not current-limited.

UCSP Package Considerations

For general UCSP package information and PC layout considerations, please refer to the Maxim Application Note (Wafer-Level Chip-Scale Package).

UCSP Reliability

The chip-scale package (UCSP) represents a unique packaging form factor that may not perform equally to a packaged product through traditional mechanical reliability tests. UCSP reliability is integrally linked to the user's assembly methods, circuit board material, and usage environment. The user should closely review these areas when considering use of a UCSP package. Performance through Operating Life Test and Moisture Resistance remains uncompromised as it is primarily determined by the wafer-fabrication process.

Mechanical stress performance is a greater consideration for a UCSP package. UCSPs are attached through direct solder contact to the user's PC board, foregoing the inherent stress relief of a packaged product lead frame. Solder joint contact integrity must be considered. Information on Maxim's qualification plan, test data, and recommendations are detailed in the UCSP application note, which can be found on Maxim's website at www.maxim-ic.com.

Chip Information

TRANSISTOR COUNT: 235

PROCESS: BiCMOS

Test Circuits/Timing Diagrams

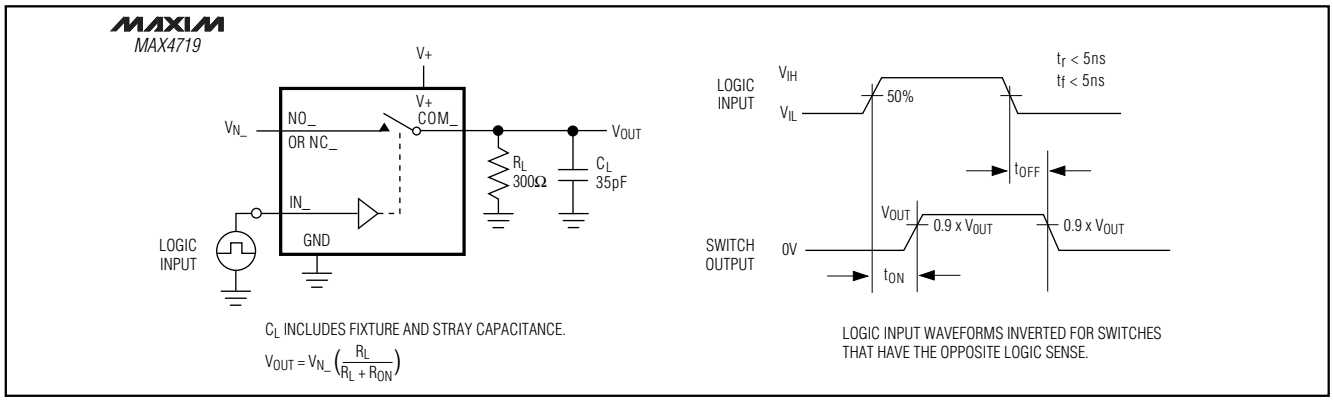


Figure 1. Switching Time

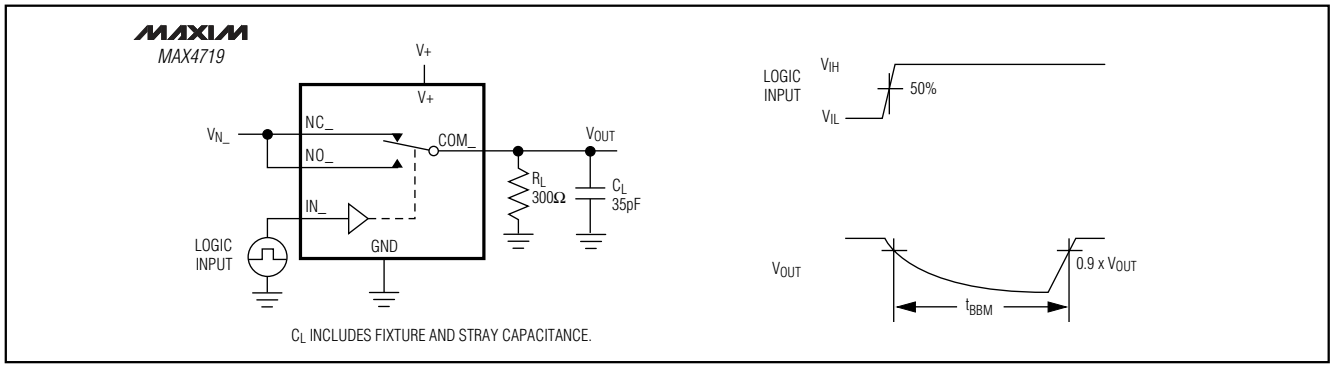


Figure 2. Break-Before-Make Interval

Test Circuits/Timing Diagrams (continued)

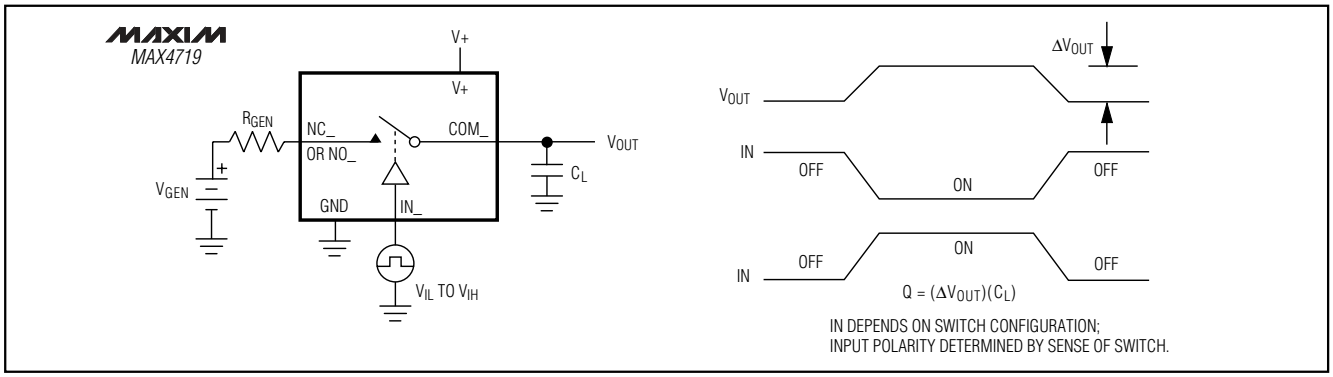


Figure 3. Charge Injection

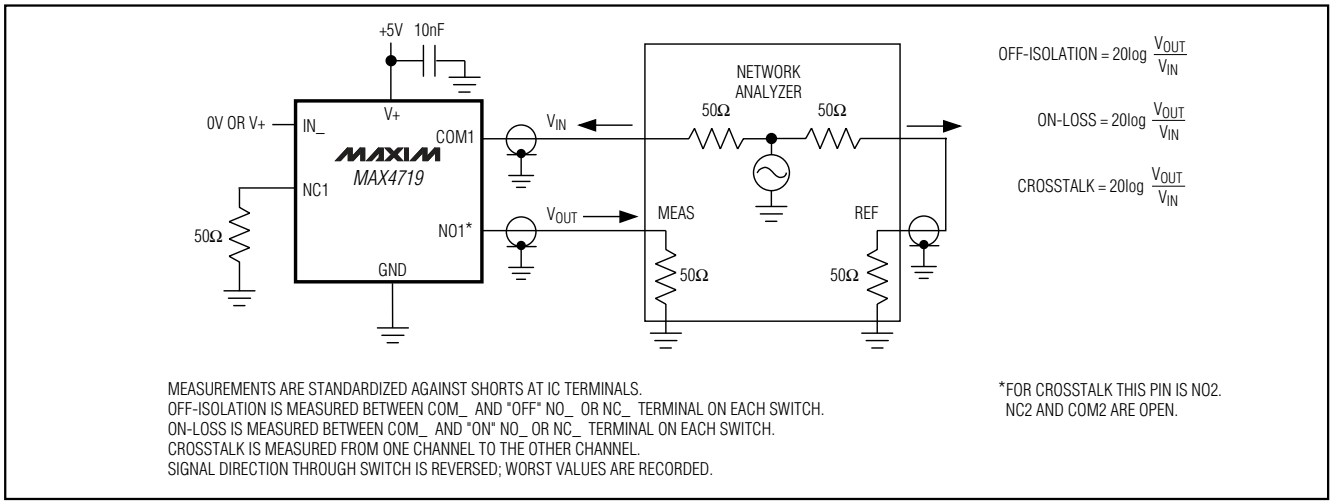


Figure 4. On-Loss, Off-Isolation, and Crosstalk

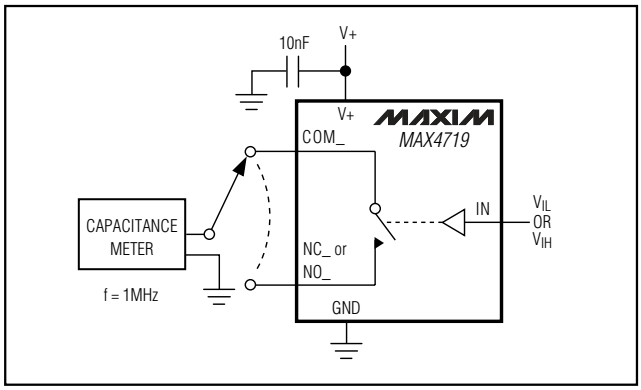


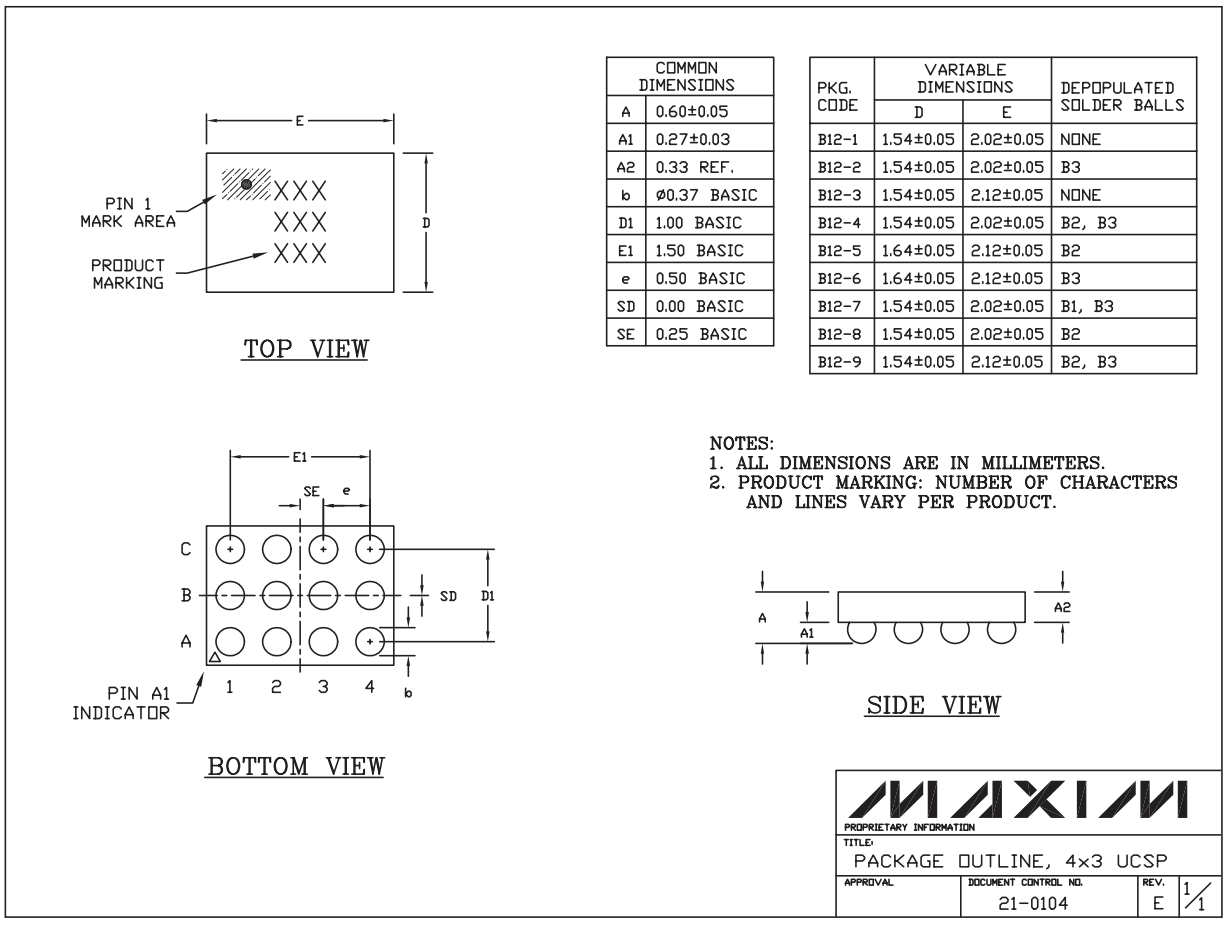
Figure 5. Channel Off/On-Capacitance

20Ω, 300MHz Bandwidth, Dual SPDT Analog Switch in UCSP

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**.)

12L, UCSP 4x3.EPS



COMMON DIMENSIONS	
A	0.60±0.05
A1	0.27±0.03
A2	0.33 REF.
b	ø0.37 BASIC
D1	1.00 BASIC
E1	1.50 BASIC
e	0.50 BASIC
SD	0.00 BASIC
SE	0.25 BASIC

PKG. CODE	VARIABLE DIMENSIONS		DEPOPULATED SOLDER BALLS
	D	E	
B12-1	1.54±0.05	2.02±0.05	NONE
B12-2	1.54±0.05	2.02±0.05	B3
B12-3	1.54±0.05	2.12±0.05	NONE
B12-4	1.54±0.05	2.02±0.05	B2, B3
B12-5	1.64±0.05	2.12±0.05	B2
B12-6	1.64±0.05	2.12±0.05	B3
B12-7	1.54±0.05	2.02±0.05	B1, B3
B12-8	1.54±0.05	2.02±0.05	B2
B12-9	1.54±0.05	2.12±0.05	B2, B3

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. PRODUCT MARKING: NUMBER OF CHARACTERS AND LINES VARY PER PRODUCT.

PROPRIETARY INFORMATION

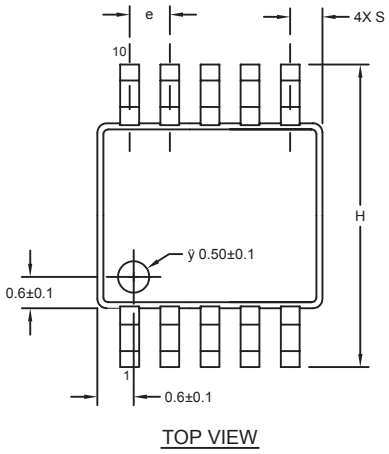
TITLE: PACKAGE OUTLINE, 4x3 UCSP

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0104	E	1/1

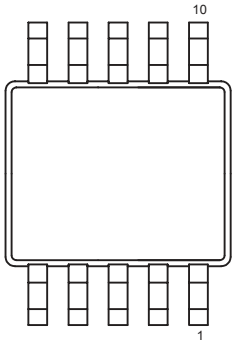
Package Information (continued)

(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**.)

10LUMAX.EPS

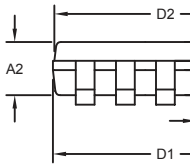


TOP VIEW

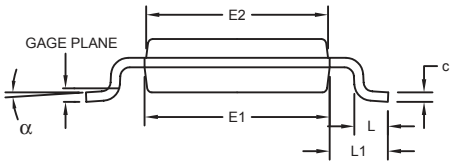


BOTTOM VIEW

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	-	0.043	-	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
D1	0.116	0.120	2.95	3.05
D2	0.114	0.118	2.89	3.00
E1	0.116	0.120	2.95	3.05
E2	0.114	0.118	2.89	3.00
H	0.187	0.199	4.75	5.05
L	0.0157	0.0275	0.40	0.70
L1	0.037 REF		0.940 REF	
b	0.007	0.0106	0.177	0.270
e	0.0197 BSC		0.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		0.498 REF	
α	0∞	6∞	0∞	6∞



FRONT VIEW



SIDE VIEW

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-BA.

DALLAS SEMICONDUCTOR MAXIM

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 10L uMAX/uSOP

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0061	I	1/1