

Description

The MAX4597 is a single-pole single-throw (SPST) analog switch that is designed to operate from 2 V to 5.5 V. This device can handle both digital and analog signals, and signals up to V_+ can be transmitted in either direction.

Applications

- Sample-and-Hold Circuits
- Battery-Powered Equipment (Cellular Phones, PDAs)
- Audio and Video Signal Routing
- Communication Circuits
- PCMCIA Cards

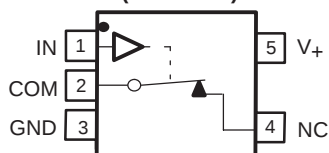
Features

- Low ON-State Resistance (10 Ω)
- ON-State Resistance Flatness (1.5 Ω)
- Control Inputs Are 5.5-V Tolerant
- Low Charge Injection (5 pC Max)
- 300-MHz –3-dB Bandwidth at 25°C
- Low Total Harmonic Distortion (THD) (0.05%)
- 2-V to 5.5-V Single-Supply Operation
- Specified at 5-V and 3.3-V Nodes
- –83-dB OFF Isolation at 1 MHz
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- 0.5-nA Max OFF Leakage
- ESD Performance Tested Per JESD 22
 - 2000-V Human-Body Model (A114-B, Class II)
 - 1000-V Charged-Device Model (C101)
- TTL/CMOS-Logic Compatible

Summary of Characteristics

$V_+ = 5\text{ V}$, $T_A = 25^\circ\text{C}$

SOT-23 OR SC-70 PACKAGE
(TOP VIEW)



FUNCTION TABLE

IN	NC TO COM, COM TO NC
L	ON
H	OFF

Configuration	Single Pole Single Throw (SPST)
Number of channels	1
ON-state resistance (r_{ON})	10 Ω
ON-state resistance flatness ($r_{ON(flat)}$)	1.5 Ω
Turn-on/turn-off time (t_{ON}/t_{OFF})	35 ns/40 ns
Charge injection (Q_C)	5 pC
Bandwidth (BW)	300 MHz
OFF isolation (O_{ISO})	–83 dB at 1 MHz
Total harmonic distortion (THD)	0.05%
Leakage current ($I_{COM(OFF)}/I_{NC(OFF)}$)	±0.05 nA
Power-supply current (I_+)	1 μA
Package option	5-pin SOT-23 or SC-70

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING ⁽²⁾
–40°C to 85°C	SOT (SOT-23) – DBV	Tape and reel	MAX4597DBVR	6SD_
	SOT (SC-70) – DCK	Tape and reel	MAX4597DCKR	SD_

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

(2) DBV/DCK: The actual top-side marking has one additional character that designates the assembly/test site.



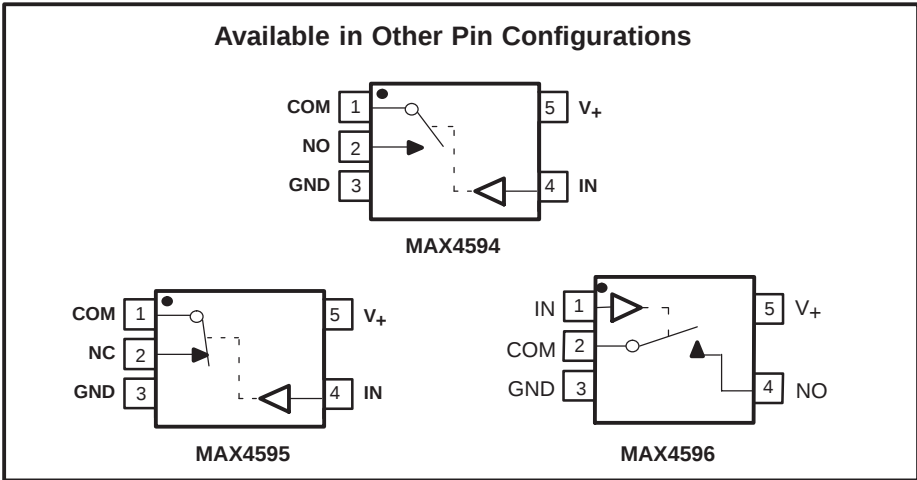
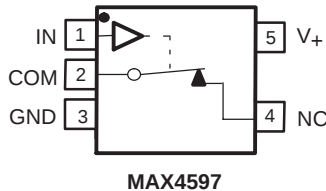
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MAX4597

SINGLE-CHANNEL 10-Ω SPST ANALOG SWITCH

SLLS642 – JANUARY 2005

Pin Configurations



Absolute Minimum and Maximum Ratings⁽¹⁾⁽²⁾

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V ₊	Supply voltage range(3)		-0.3	6	V
V _{NC} V _{COM}	Analog voltage range(3)(4)		-0.3	V ₊ + 0.3	V
I _K	Analog port diode current	V _{NC} , V _{COM} < 0	-50		mA
I _{NC} I _{COM}	On-state switch current	V _{NC} , V _{COM} = 0 to V ₊	-20	20	mA
V _I	Digital input voltage range(3)(4)		-0.3	6	V
I _{IK}	Digital input clamp current	V _I < 0	-50		mA
I ₊	Continuous current through V ₊		100		mA
I _{GND}	Continuous current through GND		-100		mA
θ _{JA}	Package thermal impedance(5)	DBV package	206		°C/W
		DCK package	252		
T _{stg}	Storage temperature range		-65	150	°C

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

(2) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

(3) All voltages are with respect to ground, unless otherwise specified.

(4) The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.

(5) The package thermal impedance is calculated in accordance with JESD 51-7.

Electrical Characteristics for 5-V Supply⁽¹⁾

$V_+ = 4.5\text{ V to }5.5\text{ V}$, $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	T_A	V_+	MIN	TYP	MAX	UNIT
Analog Switch								
Analog signal range	V_{COM}, V_{NC}				0		V_+	V
ON-state resistance	r_{on}	$V_{NC} = 3.5\text{ V}$, $I_{COM} = 10\text{ mA}$, Switch ON, See Figure 13	25°C Full	4.5 V	6.5		10 12	Ω
ON-state resistance flatness	$r_{on(flat)}$	$V_{NC} = 1.5\text{ V}, 2.5\text{ V}, 3.5\text{ V}$, $I_{COM} = 10\text{ mA}$, Switch ON, See Figure 13	25°C Full	4.5 V	0.5		1.5 2	Ω
NC OFF leakage current	$I_{NC(OFF)}$	$V_{NC} = 1\text{ V}, V_{COM} = 4.5\text{ V}$, or $V_{NC} = 4.5\text{ V}, V_{COM} = 1\text{ V}$, Switch OFF, See Figure 14	25°C Full	5.5 V	-0.5 -5	0.01	0.5 5	nA
COM OFF leakage current	$I_{COM(OFF)}$	$V_{COM} = 1\text{ V}, V_{NC} = 4.5\text{ V}$, or $V_{COM} = 4.5\text{ V}, V_{NC} = 1\text{ V}$, Switch OFF, See Figure 14	25°C Full	5.5 V	-0.5 -5	0.01	0.5 5	nA
NC ON leakage current	$I_{NC(ON)}$	$V_{NC} = 1\text{ V}, V_{COM} = 1\text{ V}$, or $V_{NC} = 4.5\text{ V}, V_{COM} = 4.5\text{ V}$, or $V_{NC} = 1\text{ V}, 4.5\text{ V}, V_{COM} = \text{Open}$, Switch ON, See Figure 15	25°C Full	5.5 V	-1 -10	0.01	1 10	nA
COM ON leakage current	$I_{COM(ON)}$	$V_{COM} = 1\text{ V}, V_{NC} = 1\text{ V}$, or $V_{COM} = 4.5\text{ V}, V_{NC} = 4.5\text{ V}$, or $V_{COM} = 1\text{ V}, 4.5\text{ V}, V_{NC} = \text{Open}$, Switch ON, See Figure 15	25°C Full	5.5 V	-1 -10	0.01	1 10	nA
Digital Control Input (IN)								
Input logic high	V_{IH}		Full		2.4		5.5	V
Input logic low	V_{IL}		Full		0		0.8	V
Input leakage current	I_{IH}, I_{IL}	$V_I = 5.5\text{ V or }0$	25°C Full	5.5 V	-1 -1	0.03	1 1	μA

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

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SINGLE-CHANNEL 10- Ω SPST ANALOG SWITCH

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Electrical Characteristics for 5-V Supply⁽¹⁾ (continued)

$V_+ = 4.5\text{ V to }5.5\text{ V}$, $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T _A	V ₊	MIN	TYP	MAX	UNIT
Dynamic									
Turn-on time	t _{ON}	V _{NC} = 3 V, R _L = 300 Ω,	C _L = 35 pF, See Figure 17	25°C	5 V	20	35	ns	
				Full	4.5 V to 5.5 V		45		
Turn-off time	t _{OFF}	V _{NC} = 3 V, R _L = 300 Ω,	C _L = 35 pF, See Figure 17	25°C	5 V	25	40	ns	
				Full	4.5 V to 5.5 V		50		
Charge injection	Q _C	V _{GEN} = 0, R _{GEN} = 0,	C _L = 1 nF, See Figure 20	25°C	5 V	2	5	pC	
NC OFF capacitance	C _{NC(OFF)}	V _{NC} = 0, f = 1 MHz,	Switch OFF, See Figure 16	25°C	5 V	8		pF	
COM OFF capacitance	C _{COM(OFF)}	V _{COM} = 0, f = 1 MHz,	Switch OFF, See Figure 16	25°C	5 V	8		pF	
NC ON capacitance	C _{NC(ON))}	V _{NC} = 0, f = 1 MHz,	Switch ON, See Figure 16	25°C	5 V	20		pF	
COM ON capacitance	C _{COM(ON)}	V _{COM} = 0, f = 1 MHz,	Switch ON, See Figure 16	25°C	5 V	20		pF	
Digital input capacitance	C _I	V _I = V ₊ or GND,	See Figure 16	25°C	5 V	3		pF	
Bandwidth	BW	R _L = 50 Ω, Signal = 0 dBm,	Switch ON, See Figure 18	25°C	5 V	300		MHz	
OFF isolation	O _{ISO}	R _L = 50 Ω, f = 10 MHz, V _{NC} = 1 V _{RMS} ,	Switch OFF, See Figure 19	25°C	5 V	−83		dB	
Total harmonic distortion	THD	R _L = 600 Ω, C _L = 50 pF, V _{SOURCE} = 5 V _{p-p} ,	f = 20 Hz to 20 kHz, See Figure 21	25°C	5 V	0.05		%	
Supply									
Positive supply current	I ₊	V _I = V ₊ or GND,	Switch ON or OFF	Full	5.5 V		1	μA	

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

Electrical Characteristics for 3-V Supply⁽¹⁾

$V_+ = 2.7\text{ V to }3.6\text{ V}$, $T_A = -40^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		T _A	V ₊	MIN	TYP	MAX	UNIT
Analog Switch									
Analog signal range	V _{COM} , V _{NC}					0		V ₊	V
ON-state resistance	r _{on}	V _{NC} = 1.5 V, I _{COM} = 10 mA,	Switch ON, See Figure 13	25°C	2.7 V	10		20	Ω
				Full				25	
Digital Control Input (IN)									
Input logic high	V _{IH}			Full		2		5.5	V
Input logic low	V _{IL}			Full		0		0.8	V
Input leakage current	I _{IH} , I _{IL}	V _I = V ₊ or 0		25°C	3.6 V	-1	0.03	1	μA
				Full			-1	1	
Dynamic									
Turn-on time	t _{ON}	V _{COM} = 2 V, R _L = 300 Ω,	C _L = 35 pF, See Figure 17	25°C	3 V	25		45	ns
				Full	2.7 V to 3.6 V			55	
Turn-off time	t _{OFF}	V _{COM} = 2 V, R _L = 300 Ω,	C _L = 35 pF, See Figure 17	25°C	3 V	30		50	ns
				Full	2.7 V to 3.6 V			60	
Charge injection	Q _C	V _{NC} = 0, C _L = 1 nF,	See Figure 20	25°C	3 V	2		4	pC
Supply									
Positive supply current	I ₊	V _I = V ₊ or GND,	Switch ON or OFF	Full	3.6 V			1	μA

(1) The algebraic convention, whereby the most negative value is a minimum and the most positive value is a maximum

TYPICAL PERFORMANCE

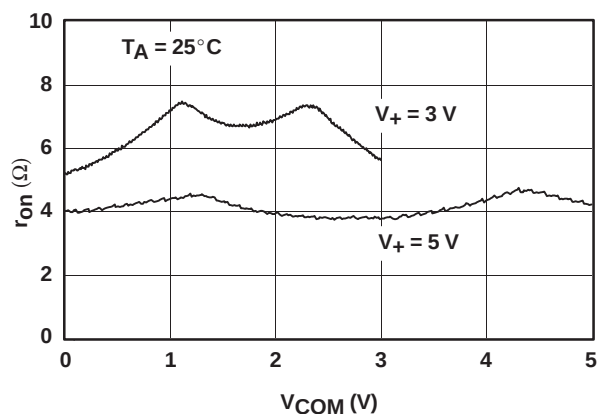


Figure 1. r_{on} vs V_{COM}

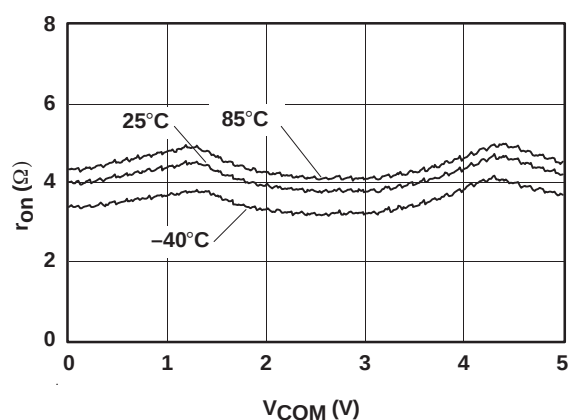


Figure 2. r_{on} vs V_{COM} ($V_+ = 5V$)

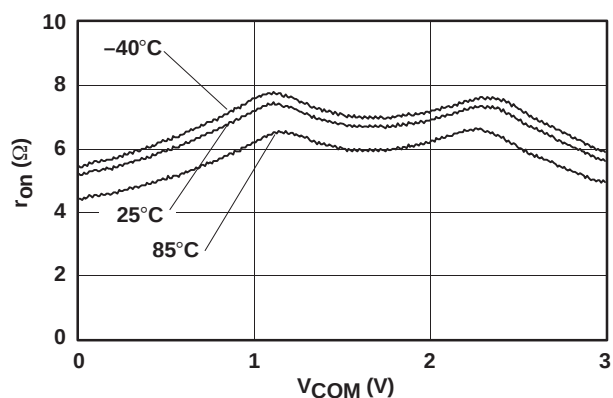


Figure 3. r_{on} vs V_{COM} ($V_+ = 3V$)

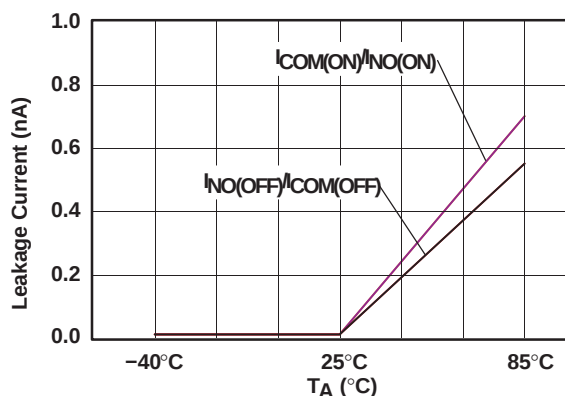


Figure 4. Leakage Current vs Temperature ($V_+ = 5V$)

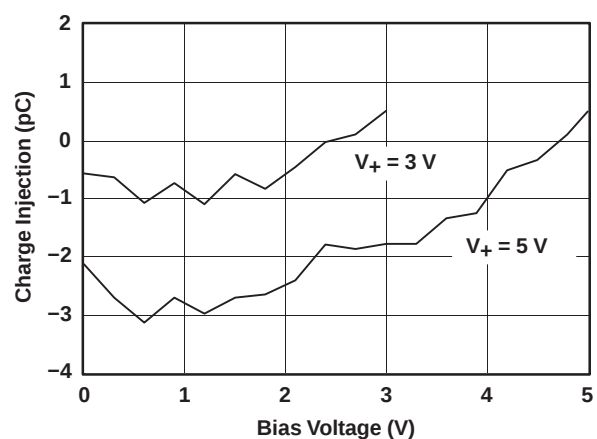


Figure 5. Charge-Injection (Q_C) vs V_{COM}

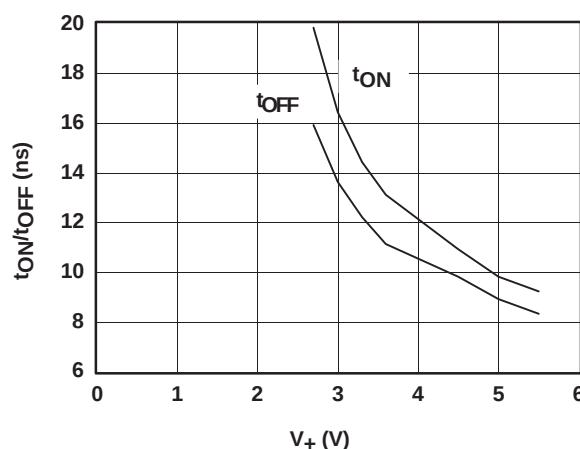


Figure 6. t_{ON} and t_{OFF} vs Supply Voltage

TYPICAL PERFORMANCE

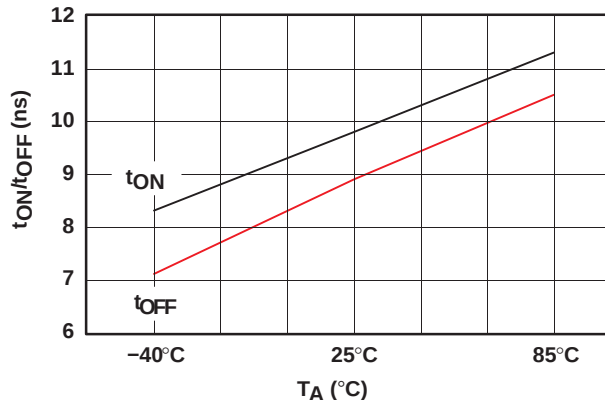


Figure 7. t_{ON} and t_{OFF} vs Temperature ($V_+ = 5$ V)

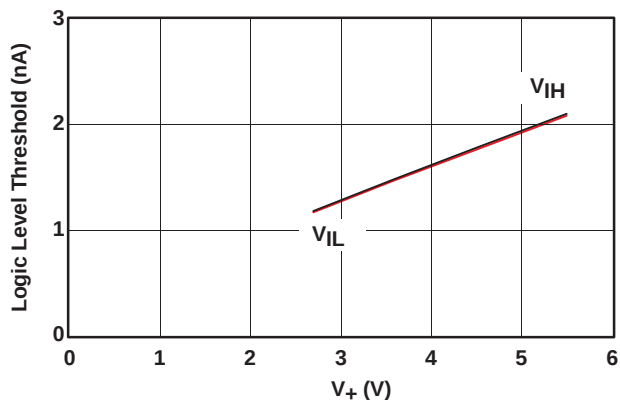


Figure 8. Logic-Level Threshold vs V_+

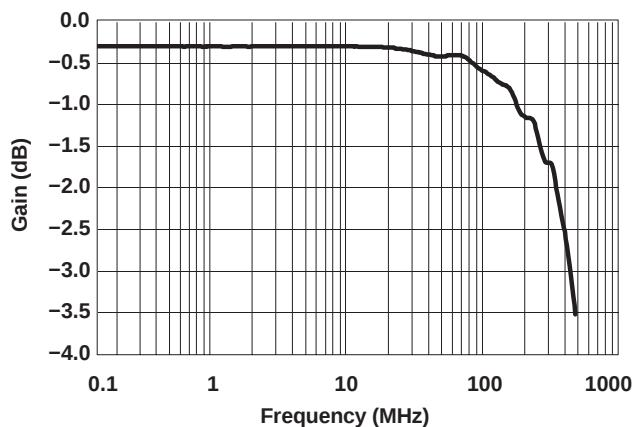


Figure 9. Bandwidth (Gain vs Frequency) ($V_+ = 5$ V)

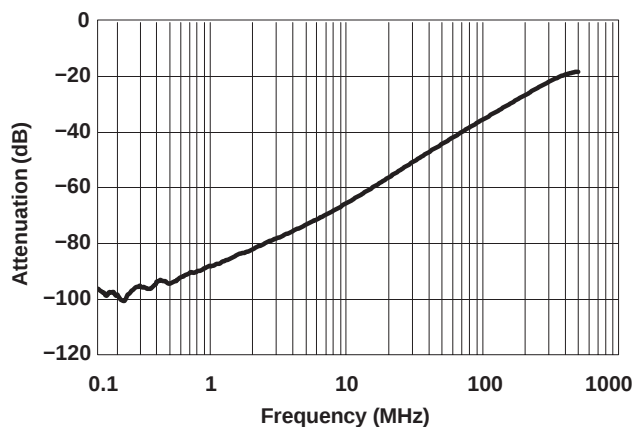


Figure 10. Off Isolation vs Frequency

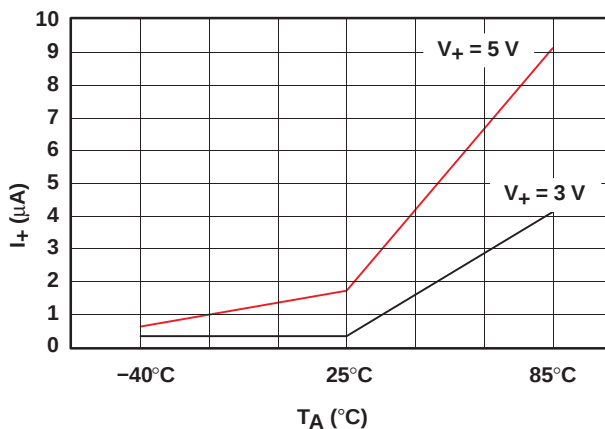


Figure 11. Power-Supply Current vs Temperature

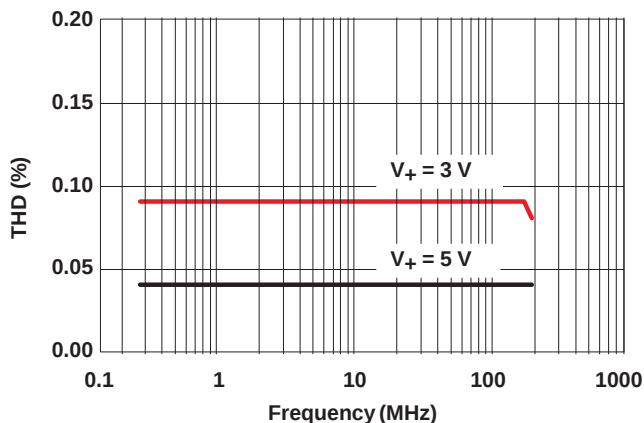


Figure 12. Total Harmonic Distortion vs Frequency

PIN DESCRIPTION

PIN NUMBER	NAME	DESCRIPTION
1	IN	Digital control pin to connect COM to NC
2	COM	Common
3	GND	Digital ground
4	NC	Normally closed
5	V ₊	Power supply

PARAMETER DESCRIPTION

SYMBOL	DESCRIPTION
V _{COM}	Voltage at COM
V _{NC}	Voltage at NC
r _{on}	Resistance between COM and NC ports when the channel is ON
r _{on(flat)}	Difference between the maximum and minimum value of r _{on} in a channel over the specified range of conditions
I _{NC(OFF)}	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the OFF state
I _{NC(ON)}	Leakage current measured at the NC port, with the corresponding channel (NC to COM) in the ON state and the output (COM) open
I _{COM(OFF)}	Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the OFF state
I _{COM(ON)}	Leakage current measured at the COM port, with the corresponding channel (COM to NC) in the ON state and the output (NC) open
V _{IH}	Minimum input voltage for logic high for the control input (IN)
V _{IL}	Maximum input voltage for logic low for the control input (IN)
V _I	Voltage at the control input (IN)
I _{IH} , I _{IL}	Leakage current measured at the control input (IN)
t _{ON}	Turn-on time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog output (COM or NC) signal when the switch is turning ON.
t _{OFF}	Turn-off time for the switch. This parameter is measured under the specified range of conditions and by the propagation delay between the digital control (IN) signal and analog output (COM or NC) signal when the switch is turning OFF.
Q _C	Charge injection is a measurement of unwanted signal coupling from the control (IN) input to the analog (NC or COM) output. This is measured in coulomb (C) and measured by the total charge induced due to switching of the control input. Charge injection, $Q_C = C_L \times \Delta V_{COM}$, C _L is the load capacitance, and ΔV _{COM} is the change in analog output voltage.
C _{NC(OFF)}	Capacitance at the NC port when the corresponding channel (NC to COM) is OFF
C _{NC(ON)}	Capacitance at the NC port when the corresponding channel (NC to COM) is ON
C _{COM(OFF)}	Capacitance at the COM port when the corresponding channel (COM to NC) is OFF
C _{COM(ON)}	Capacitance at the COM port when the corresponding channel (COM to NC) is ON
C _I	Capacitance of control input (IN)
O _{ISO}	OFF isolation of the switch is a measurement of OFF-state switch impedance. This is measured in dB in a specific frequency, with the corresponding channel (NC to COM) in the OFF state.
BW	Bandwidth of the switch. This is the frequency in which the gain of an ON channel is –3 dB below the DC gain.
THD	Total harmonic distortion describes the signal distortion caused by the analog switch. This is defined as the ratio of root mean square (RMS) value of the second, third, and higher harmonic to the absolute magnitude of the fundamental harmonic.
I ₊	Static power-supply current with the control (IN) pin at V ₊ or GND

PARAMETER MEASUREMENT INFORMATION

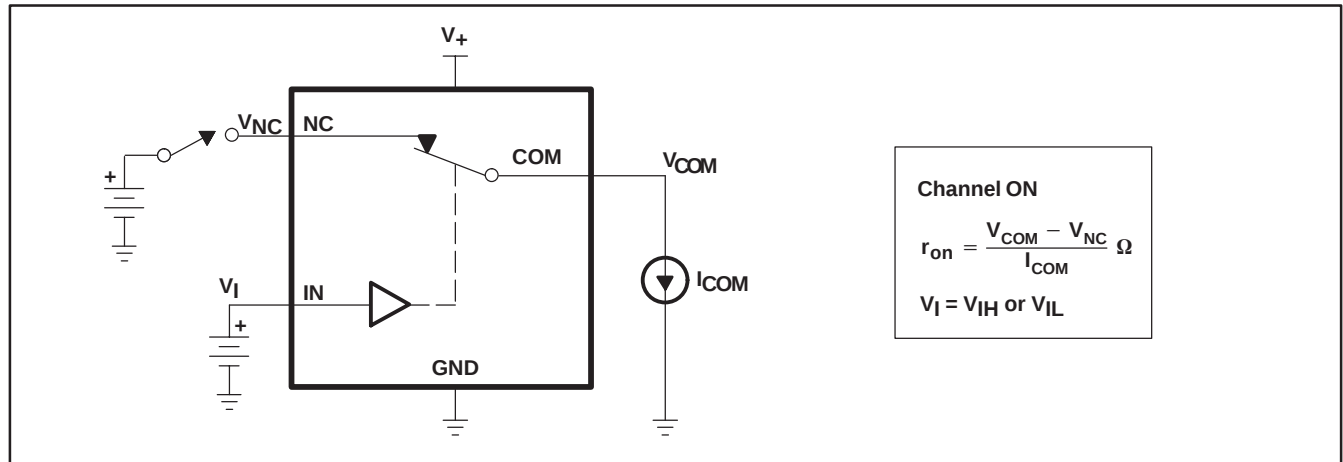


Figure 13. ON-State Resistance (r_{on})

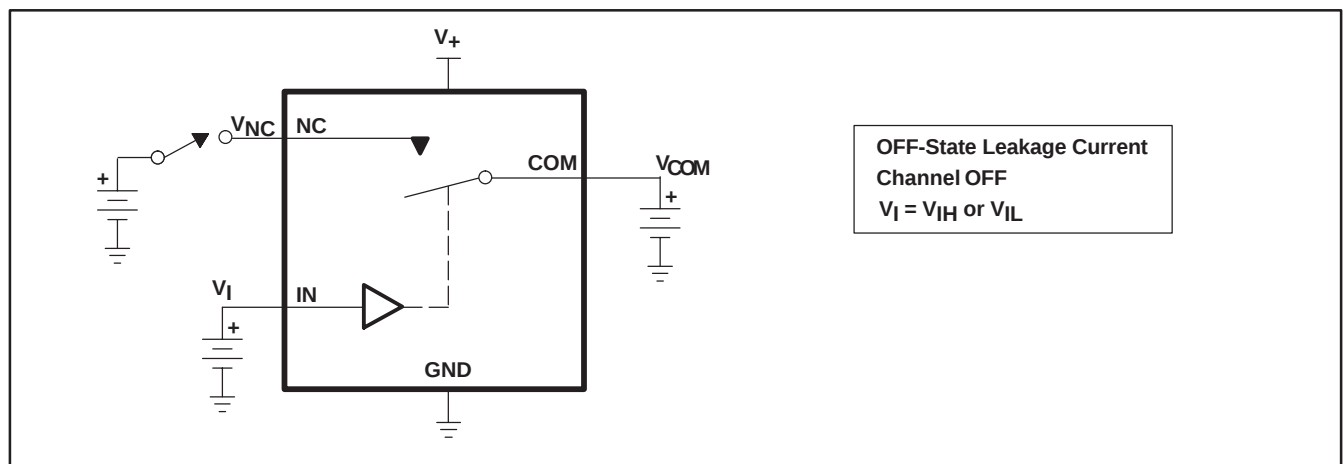


Figure 14. OFF-State Leakage Current ($I_{COM(OFF)}$, $I_{NC(OFF)}$)

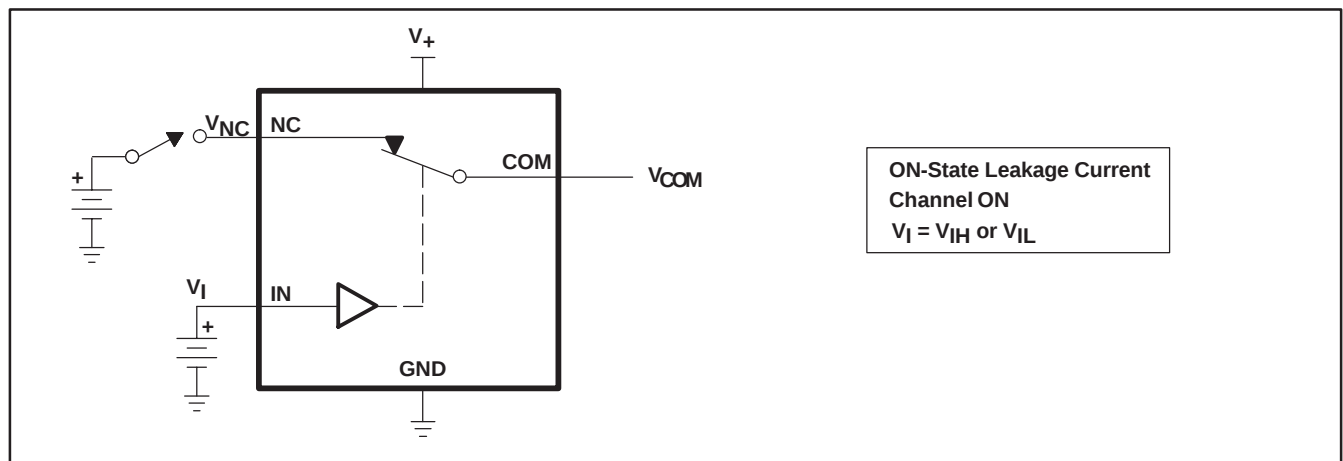


Figure 15. ON-State Leakage Current ($I_{COM(ON)}$, $I_{NC(ON)}$)

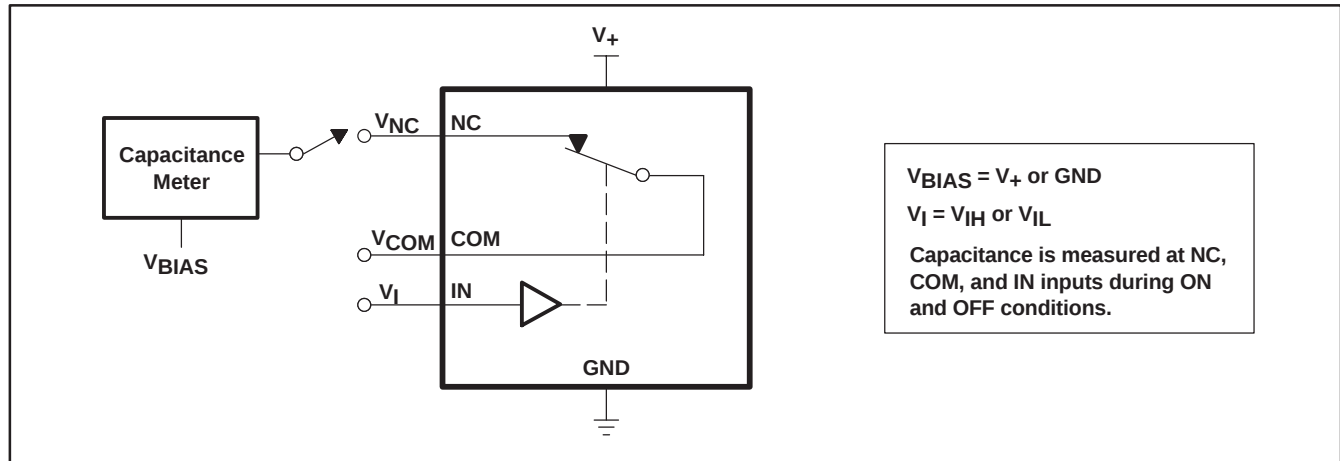
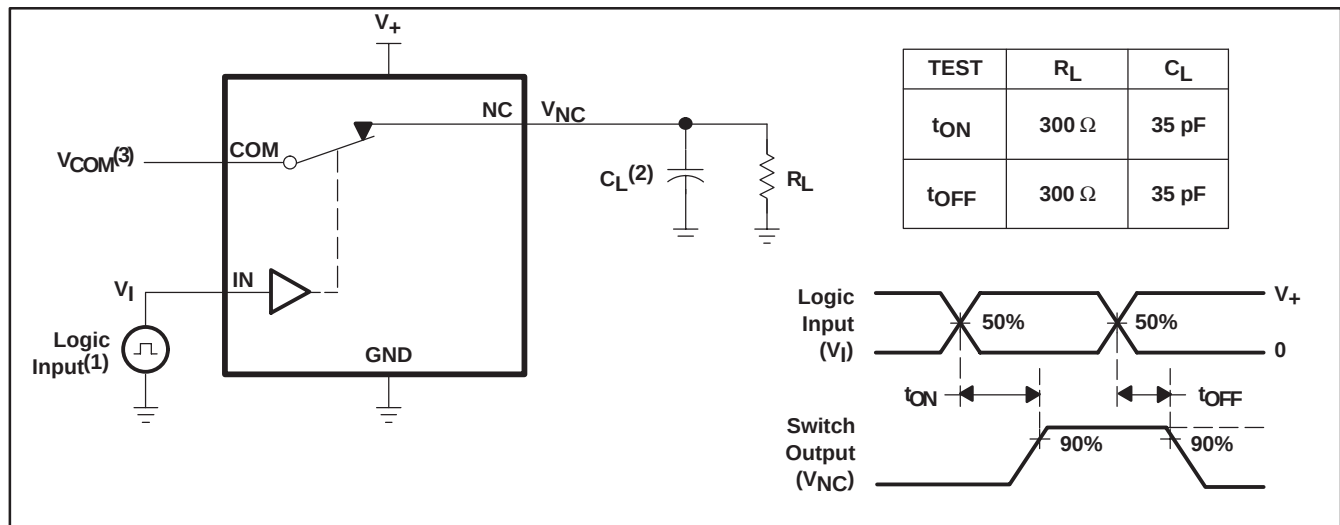


Figure 16. Capacitance (C_I , $C_{COM(OFF)}$, $C_{COM(ON)}$, $C_{NC(OFF)}$, $C_{NC(ON)}$)



- (1) All input pulses are supplied by generators having the following characteristics: PRR $\leq$ 10 MHz, $Z_O = 50 \Omega$, $t_r < 5$ ns, $t_f < 5$ ns.
(2) C_L includes probe and jig capacitance.
(3) See Electrical Characteristics for V_{COM} .

Figure 17. Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})

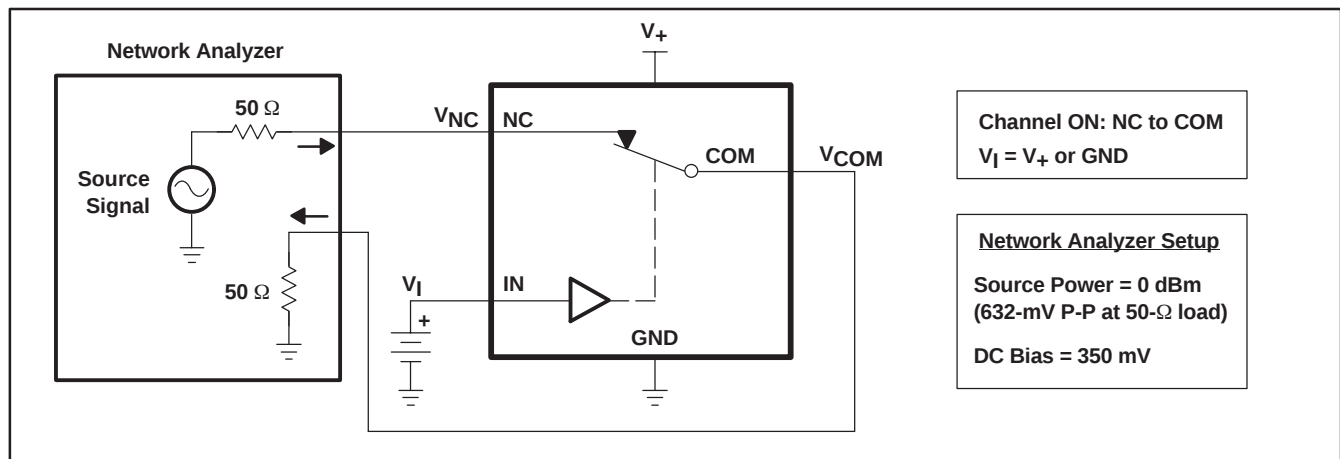


Figure 18. Bandwidth (BW)

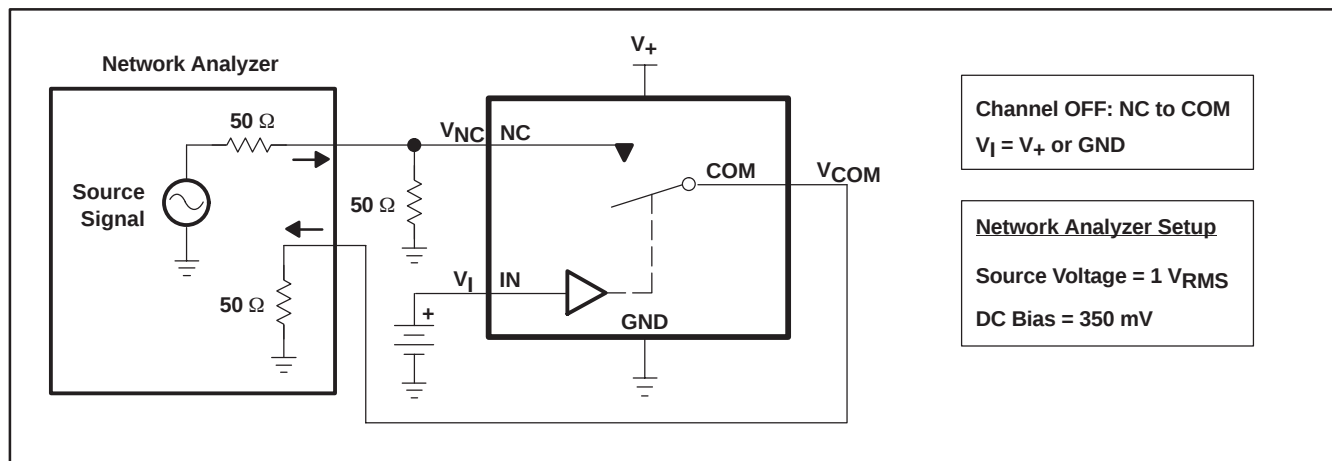
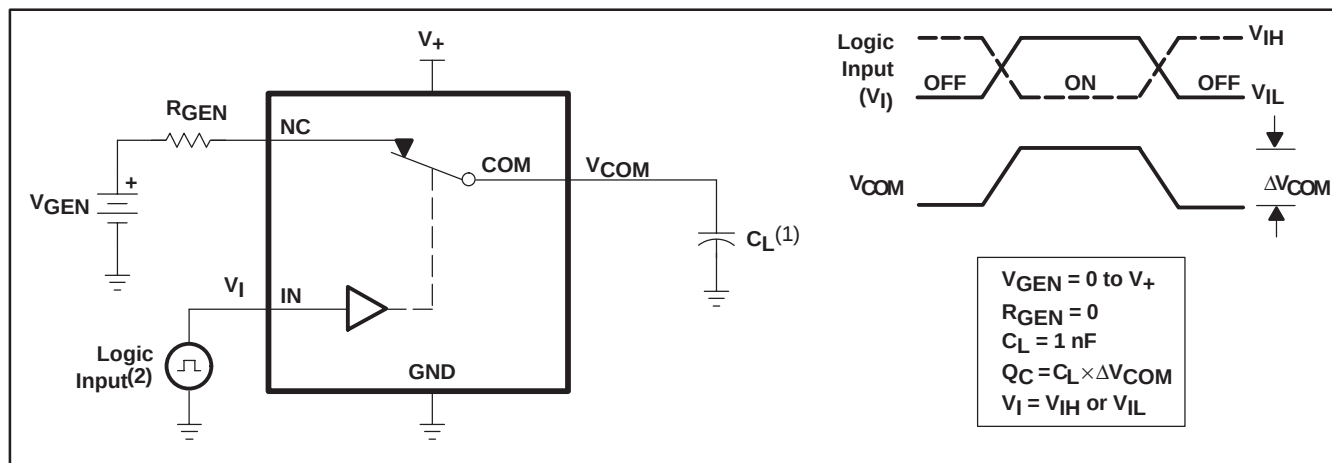


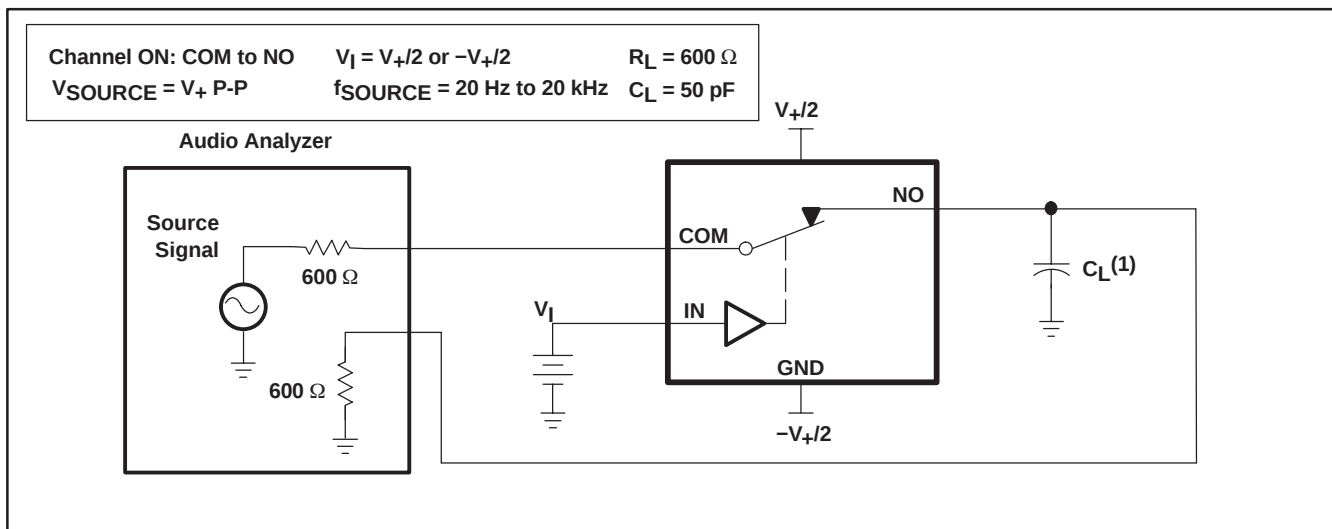
Figure 19. OFF Isolation (O_{ISO})



(1) C_L includes probe and jig capacitance.

(2) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50 Ω, t_r < 5 ns, t_f < 5 ns.

Figure 20. Charge Injection (Q_C)



(1) C_L includes probe and jig capacitance.

Figure 21. Total Harmonic Distortion (THD)

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
MAX4597DBVR	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	6SDR
MAX4597DBVR.B	Active	Production	SOT-23 (DBV) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	6SDR
MAX4597DCKR	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	SDR
MAX4597DCKR.B	Active	Production	SC70 (DCK) 5	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	SDR

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION


*All dimensions are nominal

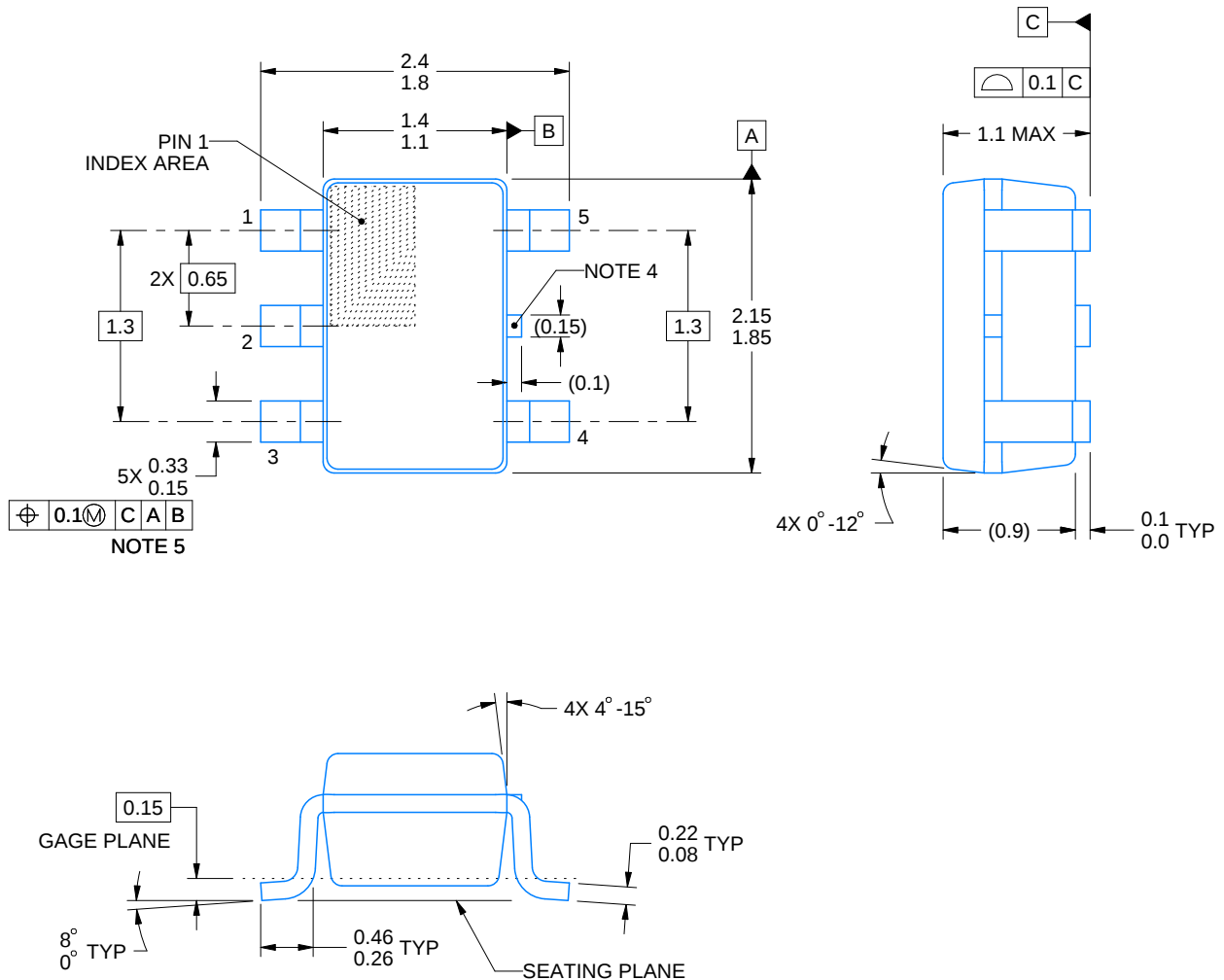
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
MAX4597DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.23	3.17	1.37	4.0	8.0	Q3
MAX4597DCKR	SC70	DCK	5	3000	180.0	8.4	2.47	2.3	1.25	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

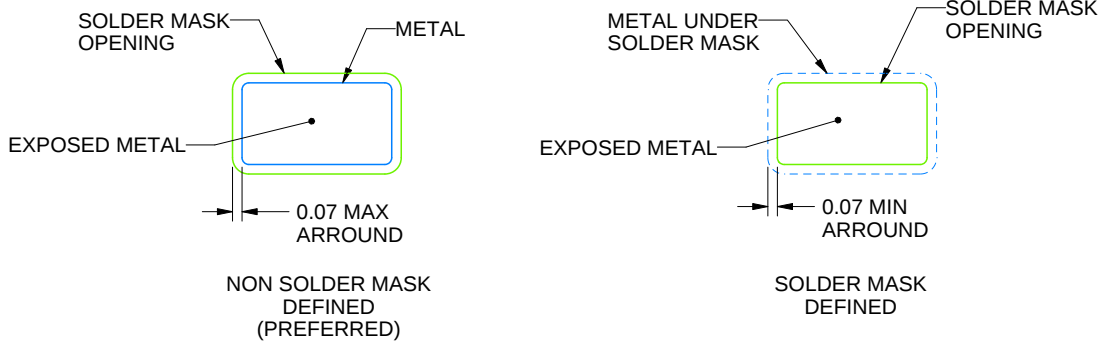
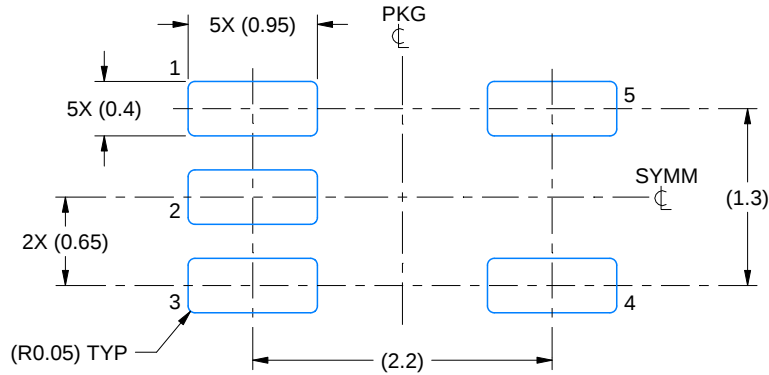


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX4597DBVR	SOT-23	DBV	5	3000	202.0	201.0	28.0
MAX4597DCKR	SC70	DCK	5	3000	202.0	201.0	28.0



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NOTES: (continued)

7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



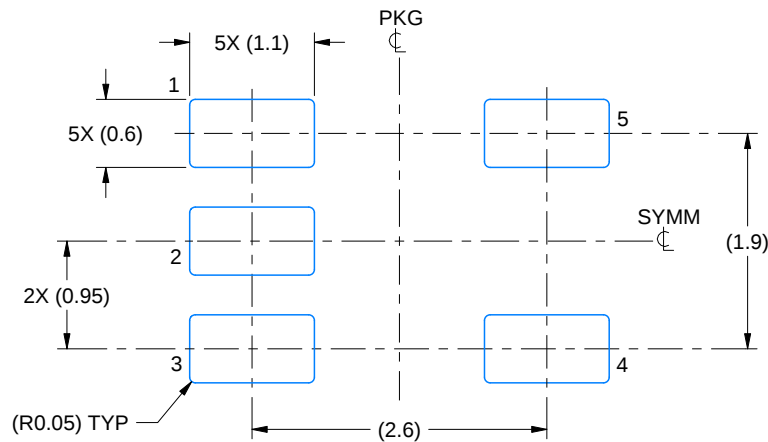
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.

EXAMPLE BOARD LAYOUT

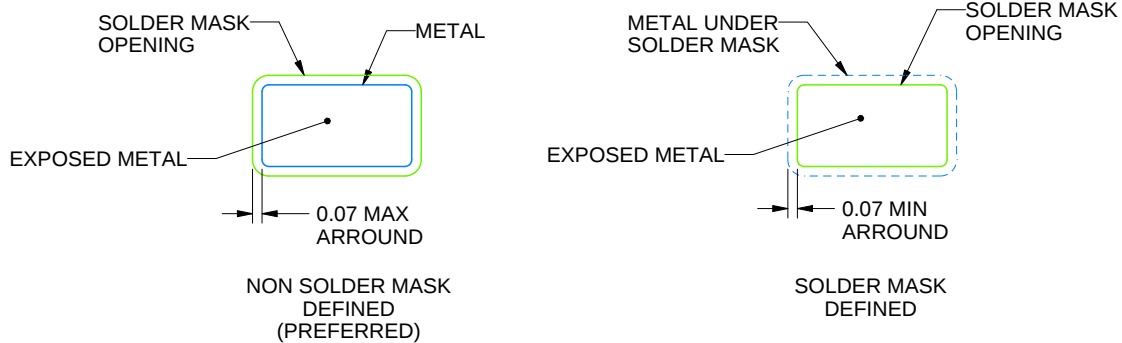
DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0005A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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