0.5Ω LOW VOLTAGE, SINGLE SPDT ANALOG SWITCH

IDTAS4624

Description

The IDTAS4624 low on-resistance (RON), low voltage, single-pole/double-throw (SPDT) analog switch operates from a single +1.8 V to +5.5 V supply. The IDTAS4624 features a 0.5Ω (max) RON for its NC switch and a 0.8Ω (max) RON for its NO switch at a +2.7 V supply. It also features break-before-make switching action (2 ns) with t_{ON} = 50 ns and t_{OFF} = 40 ns at +3 V. The digital logic input is 1.8 V logic-compatible with a +2.7 V to +3.3 V supply.

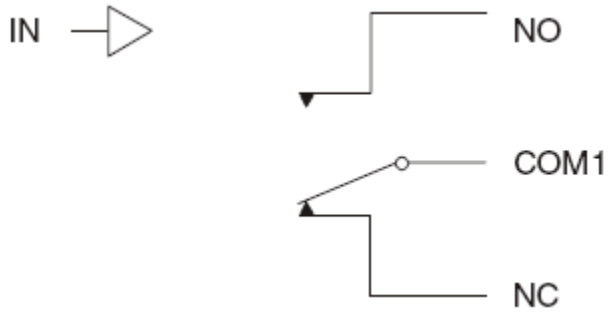
Applications

- Speaker headset switching
- MP3 players
- Battery-operated equipment
- Audio and video signal routing
- PCMCIA cards
- Cellular phones
- Modems

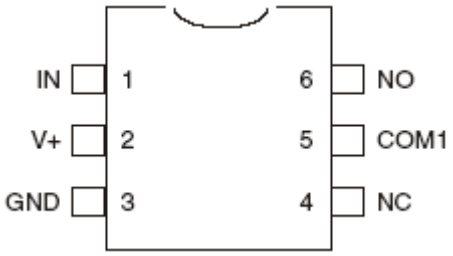
Features

- +1.8 V to +5.5 V single-supply operation
- Rail-to-rail signal handling
- 1.8 V logic compatibility
- R_{ON} match between channels: 0.06Ω (max)
- R_{ON} flatness over signal range: 0.15Ω (max)
- NC Switch R_{ON}: 0.5Ω max (+2.7 V Supply)
- NO Switch R_{ON}: 0.8Ω max (+2.7 V Supply)
- Low crosstalk: -68dB (100 kHz)
- High Off-isolation: -64dB (100 kHz)
- THD: 0.03%
- 50 nA (max) supply current
- Low leakage currents: 1 nA (max) at T_A = +25°C
- 6-pin SOT-23 package

Block Diagram



Pin Assignment (SOT-23)



Truth Table

IN	NO	NC
0	OFF	ON
1	ON	OFF

Note: Switches shown for logic “0” input.

Pin Descriptions

Pin Numbers	Pin Name	Pin Description
4	NC	Analog switch. Normally closed terminal.
1	IN	Digital control input.
5	COM1	Analog switch. Common terminal 1.
6	NO	Analog switch. Normally open terminal.
2	V+	Positive supply voltage input.
3	GND	Ground.

Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the IDTAS4624. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range. All voltages referenced to ground.

Symbol	Rating	Min	Max	Unit
V+, IN		-0.3	+6	V
COM, NO, NC		-0.3	(V+ + 0.3)	V
NO, NC, COM	Continuous current		±300	mA
	Peak current (pulsed at 1ms, 50% duty cycle)		±400	
	Peak current (pulsed at 1ms, 10% duty cycle)		±500	
	Continuous power dissipation (TA = +70°C) and 12-bump UCSP (derate 11.4mW/°C above +70°C)		+909	mW
	Operating temperature range	0	+70	°C
TSTG	Storage temperature range	-65	+150	°C
	Lead temperature (soldering, 10s)		+300	°C
	Bump temperature (soldering, infrared, 15s)		+200	°C
	Vapor phase (60s)		+215	°C

Electrical Characteristics, +3 V Supply (notes 1, 2)

Unless stated otherwise, **V+ = 2.7 V to 3.3 V, V_{IH} = 1.4 V, V_{IL} = 0.5 V, T_A = T_{MIN} to T_{MAX}.** Typical values are at +3 V and 25°C

Parameter	Symbol	Conditions	T_A	Min.	Typ.	Max.	Units
Analog Switch							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		$T_{MIN\ to}\ T_{MAX}$	0		V+	V
NC On-Resistance	$R_{ON(NC)}$	V+ = 2.7 V, I_{COM} = 100 mA, V_{NC} = 0 to V+; Note 3	+25°C		3.0	0.5	Ω
			$T_{MIN\ to}\ T_{MAX}$			0.5	
NO On-Resistance	$R_{ON(NO)}$	V+ = 2.7 V, I_{COM} = 100 mA, V_{NO} = 0 to V+; Note 3	+25°C		0.45	0.8	Ω
			$T_{MIN\ to}\ T_{MAX}$			0.8	
On-Resistance Match between channels	$\triangle R_{ON}$	V+ = 2.7 V, I_{COM} = 100 mA, V_{NO} or V_{NC} = 1.5 V; Notes 3, 4	+25°C		0	0.6	Ω
			$T_{MIN\ to}\ T_{MAX}$			0.6	
NC On-Resistance Flatness	$R_{FLAT(NC)}$	V+ = 2.7 V, I_{COM} = 100 mA, V_{NC} = 0 to V+; Note 5	$T_{MIN\ to}\ T_{MAX}$			0.15	Ω
NO On-Resistance Flatness	$R_{FLAT(NO)}$	V+ = 2.7 V, I_{COM} = 100 mA, V_{NO} = 0 to V+; Note 5	$T_{MIN\ to}\ T_{MAX}$			0.35	Ω
NO or NC Off-leakage Current	I_{NO}(OFF) or I_{NC}(OFF)	V+ = 3.3 V, V_{NO} or V_{NC} = 3 V, 0.3 V V_{COM} = 0.3 V, 3 V	+25°C	-1		+1	nA
			$T_{MIN\ to}\ T_{MAX}$	-10		+10	
COM On-leakage Current	I_{COM}(ON)	V+ = 3.3 V, V_{NO} or V_{NC} = 3 V, 0.3 V, or floating V_{COM} = 0.3 V, 3 V, or floating	+25°C	-2		+2	nA
			$T_{MIN\ to}\ T_{MAX}$	-20		+20	
Dynamic Characteristics							
Turn-on Time	t_{ON}	V+ = 2.7 V, V_{NO} or V_{NC} = 1.5 V, R_L = 50Ω, C_L = 35 pF	+25°C		30	50	ns
			$T_{MIN\ to}\ T_{MAX}$			60	ns
Turn-off Time	t_{OFF}	V+ = 2.7 V, V_{NO} or V_{NC} = 1.5 V, R_L = 50Ω, C_L = 35 pF	+25°C		25	30	ns
			$T_{MIN\ to}\ T_{MAX}$			40	ns
Break-Before-Make-Delay	t_{BBM}	V+ = 2.7 V, V_{NO} or V_{NC} = 1.5 V, R_L = 50Ω, C_L = 35 pF	$T_{MIN\ to}\ T_{MAX}$	2	15		ns
Charge Injection	Q	COM = 0, RS = 0, C_L = 1 nF	+25°C		200		pC
Off-Isolation	V_{ISO}	C_L = 5 pF; R_L = 50Ω, f = 100 kHz, V_{COM} = 1 V_{RMS}, Note 6	+25°C		-64		dB
Crosstalk	V_{CT}	f = 100 kHz, R_L = 50Ω, C_L = 5 pF, V_{COM} = 1 V_{RMS}	+25°C		-68		dB
Total Harmonic Distortion	THD	R_L = 600Ω, IN = 2 V p-p, f = 20Hz to 20 kHz	+25°C		0.03		%
NC Off-Capacitance	C_{NC}(OFF)	f = 1 MHz	+25°C		84		pF
NC Off-Capacitance	C_{NO}(OFF)	f = 1 MHz	+25°C		37		pF
NC On-Capacitance	C_{NC}(ON)	f = 1 MHz	+25°C		190		pF
NC On-Capacitance	C_{NO}(ON)	f = 1 MHz	+25°C		150		pF

Parameter	Symbol	Conditions	T_A	Min.	Typ.	Max.	Units
Digital I/O							
Input Logic HIGH	V_{IH}		$T_{MIN\ to}$ T_{MAX}	1.4			V
Input Logic LOW	V_{IL}		$T_{MIN\ to}$ T_{MAX}			0.5	V
IN Input Leakage Current	I_{IN}	V_{IN} = 0 or V+	$T_{MIN\ to}$ T_{MAX}	-1		1	µA
Power Supply							
Power Supply Range	V+		$T_{MIN\ to}$ T_{MAX}	1.8		5.5	V
Supply Current	I+	V+ = 5.5 V, V_{IN} = 0 or V+, Note 3	+25°C	-50	+0.04	+50	nA
			$T_{MIN\ to}$ T_{MAX}	-200		+200	

Notes:

1. The algebraic convention used in this data sheet is where the most negative value is a minimum and the most positive value a maximum.
2. UCSP parts are 100% tested at +25°C only and guaranteed by design and correlation at the full hot-rated temperature.
3. Guaranteed by design.
4. $\triangle R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$, between NC and NO.
5. Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal ranges.
6. Off-isolation = 20log10 (V_{COM} / V_{CO}), V_{COM} = output, V_{CO} = input to off switch.

Electrical Characteristics, +5 V Supply (Note 1)

Unless stated otherwise, **V+ = 5 V ±10%, GND = 0, V_{IH} = +2.4 V, V_{IL} = +0.8 V, T_A = T_{MIN} to T_{MAX}.** Typical values are at +3 V and +25°C

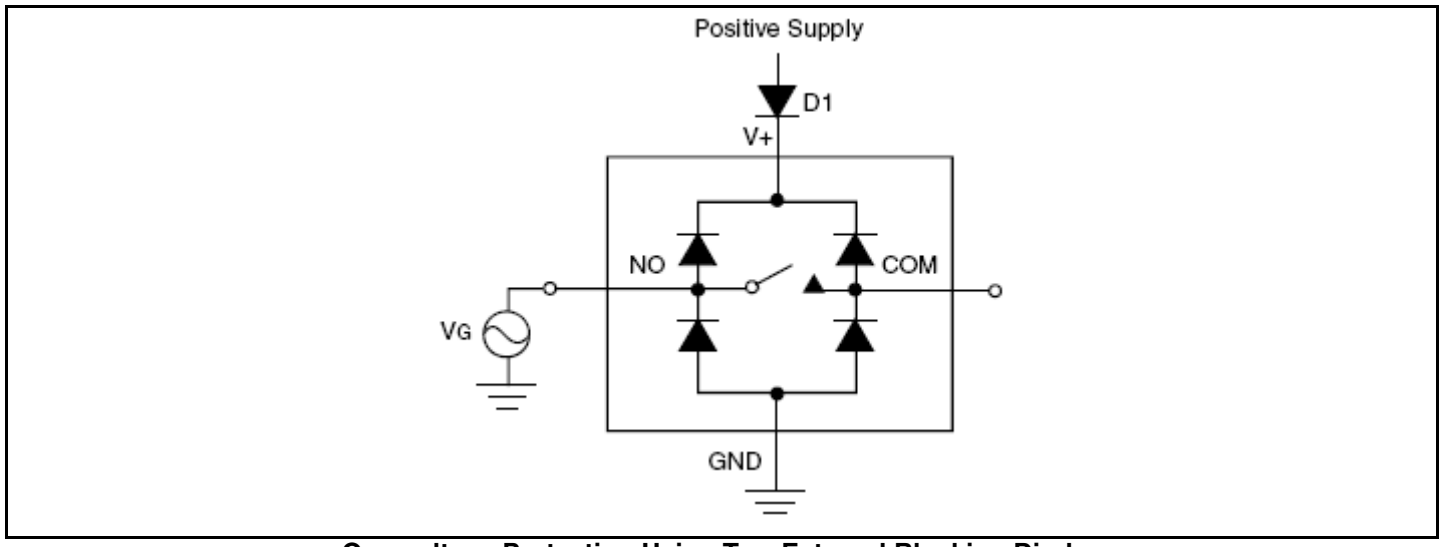
Parameter	Symbol	Conditions	T_A	Min.	Typ.	Max.	Units
Analog Switch							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}			0		V+	V
On-Resistance	R_{ON}	V+ = 4.5 V, I_{COM} = 100 mA, V_{NC} or V_{NO} = 3.5 V	+25°C		0.65	1	Ω
			$T_{MIN\ to}\ T_{MAX}$			1.2	
On-Resistance Match between channels	$\triangle R_{ON}$	V+ = 4.5 V, I_{COM} = 100 mA, V_{NC} or V_{NO} = 3.5 V	+25°C		0.6	0.12	Ω
			$T_{MIN\ to}\ T_{MAX}$			0.15	
On-Resistance Flatness	$R_{FLAT(ON)}$	V+ = 4.5 V, I_{COM} = 100 mA, V_{NC} or V_{NO} = 0V, 1 V, 2 V, Note 3	+25°C		0.8	0.12	Ω
			$T_{MIN\ to}\ T_{MAX}$			0.15	
NO or NC Off-leakage Current	I_{NO}(OFF) or I_{NC}(OFF)	V+ = 5.5 V, V_{NO} or V_{NC} = 1 V, 4.5 V V_{COM} = 1 V, 4.5 V	+25°C	-2	0.01	+2	nA
			$T_{MIN\ to}\ T_{MAX}$	-20		+20	
COM On-leakage Current	I_{COM}(ON)	V+ = 5.5 V, V_{NO} or V_{NC} = 1 V, 4.5 V, or floating V_{COM} = 1 V, 4.5 V	+25°C	-4	0.3	+4	nA
			$T_{MIN\ to}\ T_{MAX}$	-40		+40	
Overcurrent-Protection Current Threshold		T_A = +25°C			1.2		A
Dynamic Characteristics							
Turn-on Time	t_{ON}	V_{NO} or V_{NC} = 3 V	+25°C		40	50	ns
			$T_{MIN\ to}\ T_{MAX}$			60	
Turn-off Time	t_{OFF}	V_{NO} or V_{NC} = 3 V	+25°C		40	50	ns
			$T_{MIN\ to}\ T_{MAX}$			60	
Break-Before-Make-Delay	t_{BBM}	Note 4	+25°C	1	20		ns
			$T_{MIN\ to}\ T_{MAX}$	1			
Charge Injection	Q	V_{GEN} = 0, R_{GEN} = 0, C_L = 1 nF	+25°C		200		pC
Off-Isolation	O_{IRR}	C_L = 5 pF; R_L = 50Ω, f = 1 MHz	+25°C		-64		dB
Crosstalk	V_{CT}	C_L = 5 pF; R_L = 50Ω, f = 1 MHz, Note 5	+25°C		-68		dB
NC or NO Off-Capacitance	C_{OFF}	f = 1 MHz	+25°C		37		pF
COM On-Capacitance	C_{COM}(ON)	f = 1 MHz	+25°C		190		pF

Parameter	Symbol	Conditions	T_A	Min.	Typ.	Max.	Units
Logic Input							
Input Voltage HIGH	V_{INH}			2.4			V
Input Voltage LOW	V_{INL}					0.8	V
Logic Input Current	I_{IN}			-1		+1	µA
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Positive Supply Current	I+	V+ = 5.5 V, V_{IN} = 0 or V+				10	nA

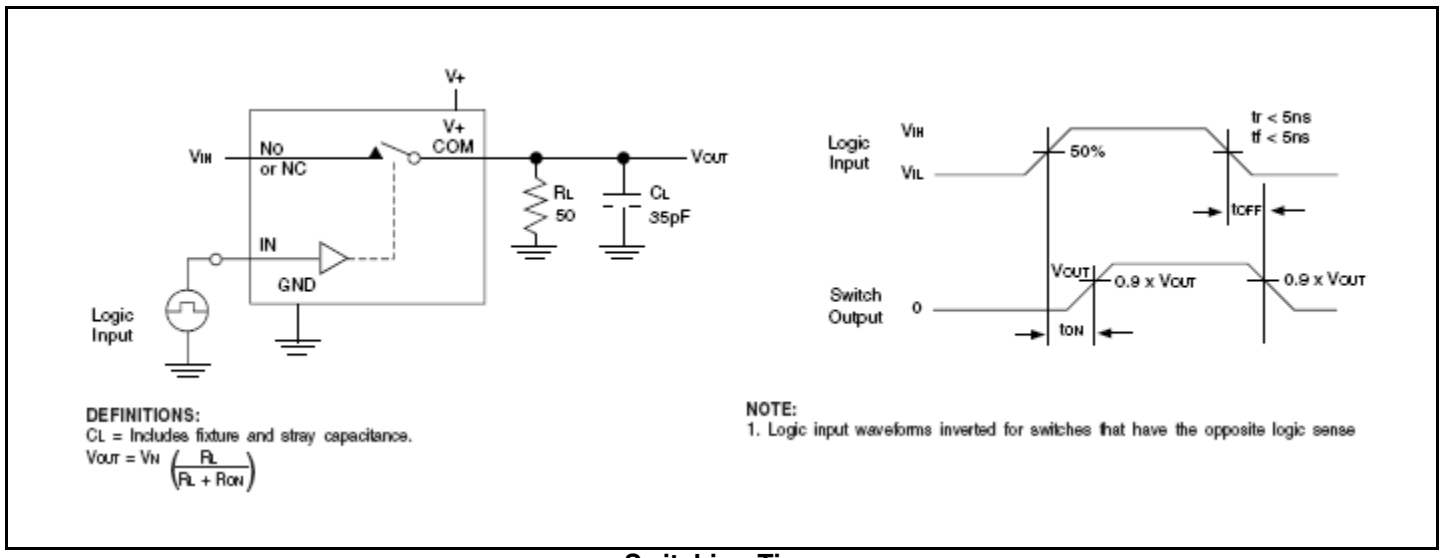
Notes:

1. The algebraic convention used in this data sheet is where the most negative value is a minimum and the most positive value a maximum.
2. Guaranteed by design.
3. $\triangle R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$, between NC and NO.
4. Flatness is defined as the difference between the maximum and minimum value of on resistance as measured over the specified analog signal ranges.
5. Off-isolation = 20log10 (V_{COM} / V_{CO}), V_{COM} = output, V_{CO} = input to off switch.

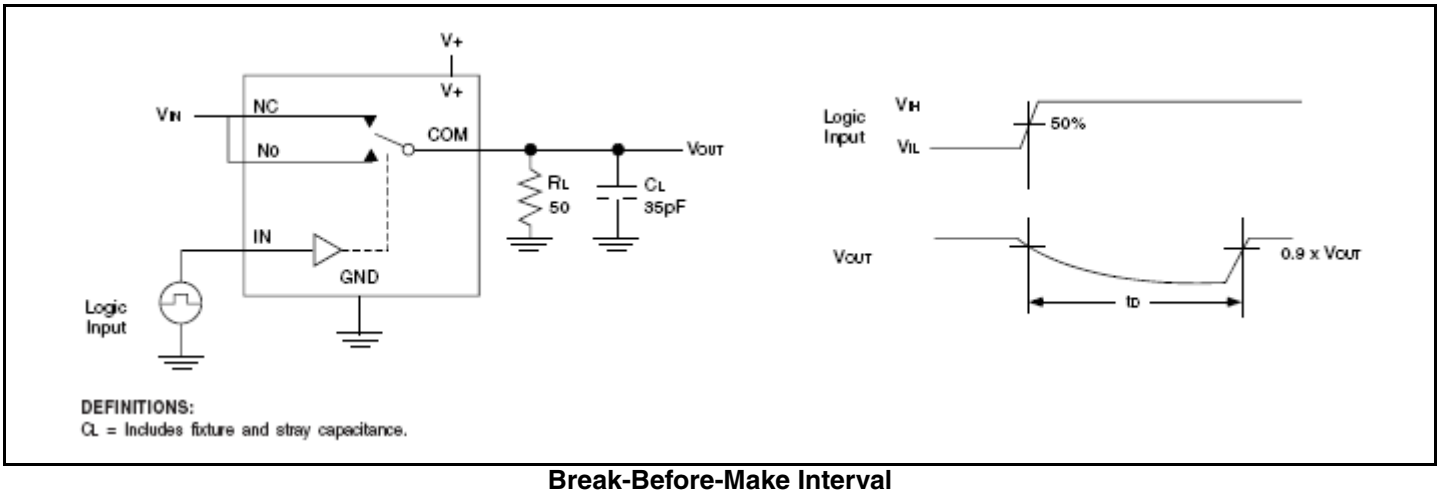
Test Circuits and Timing Diagrams



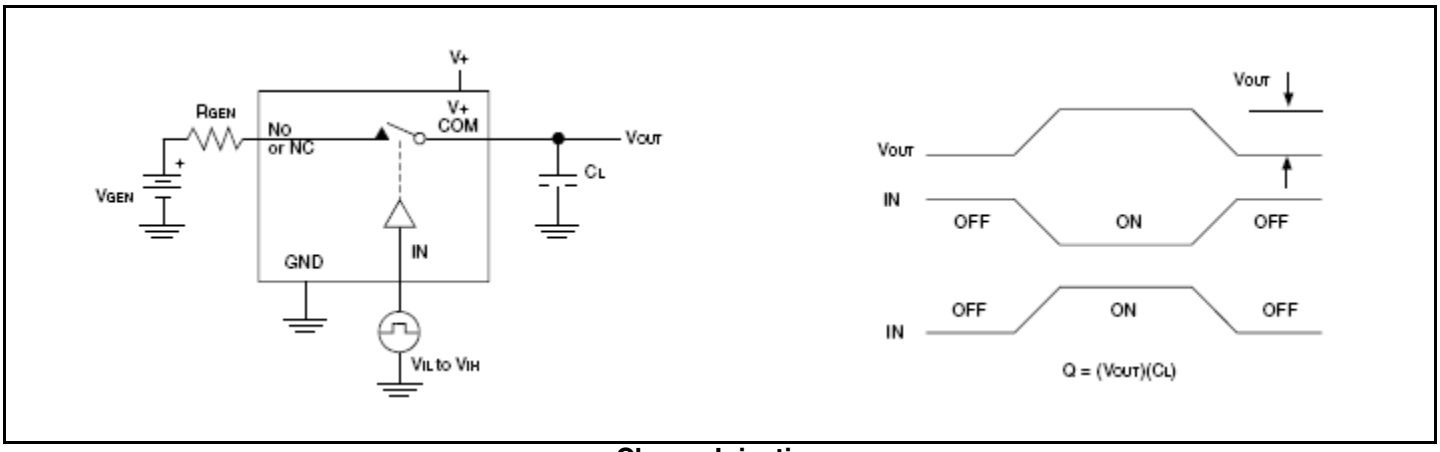
Overvoltage Protection Using Two External Blocking Diodes



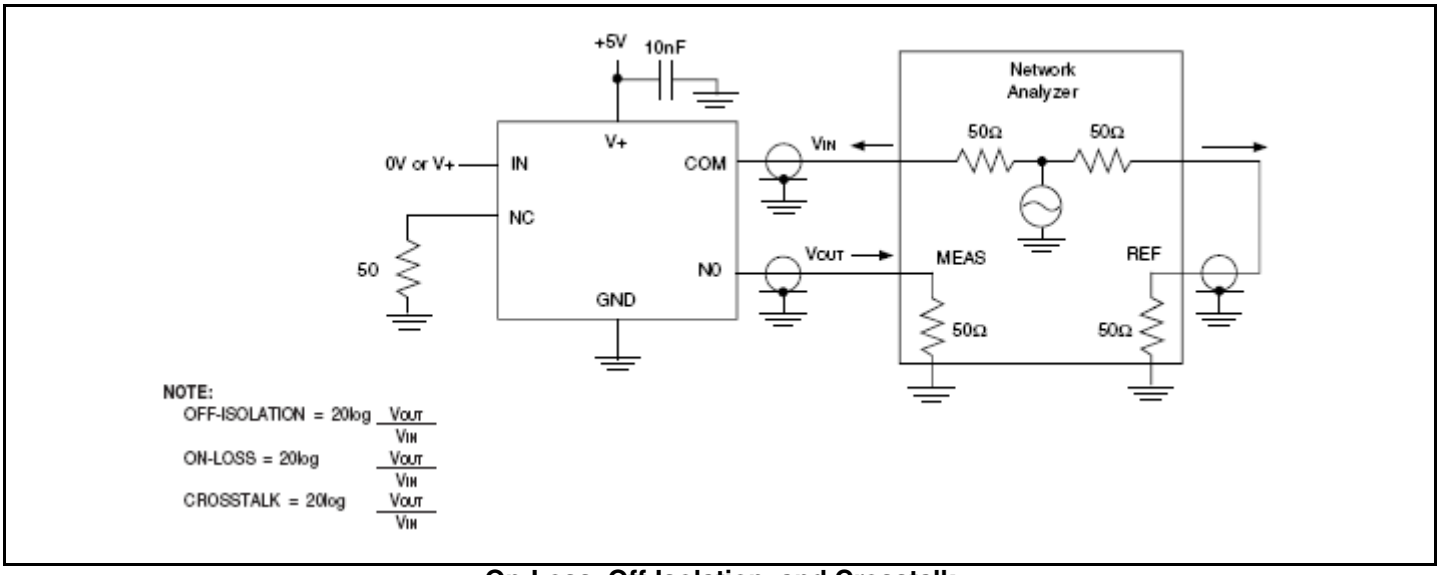
Switching Time



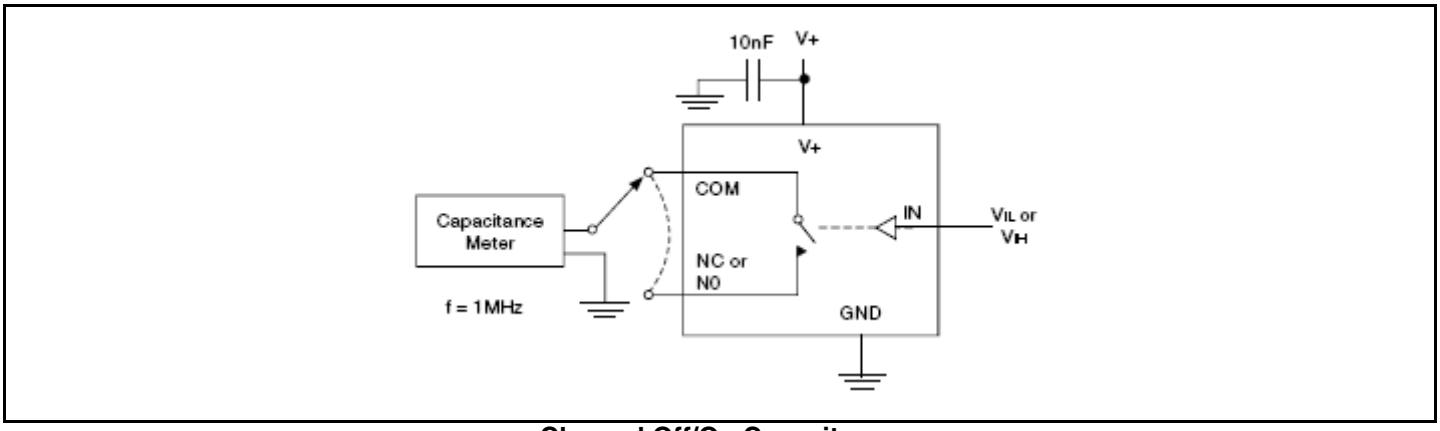
Break-Before-Make Interval



Charge Injection

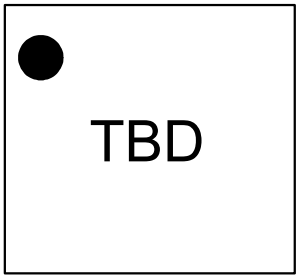


On-Loss, Off-Isolation, and Crosstalk



Channel Off/On Capacitance

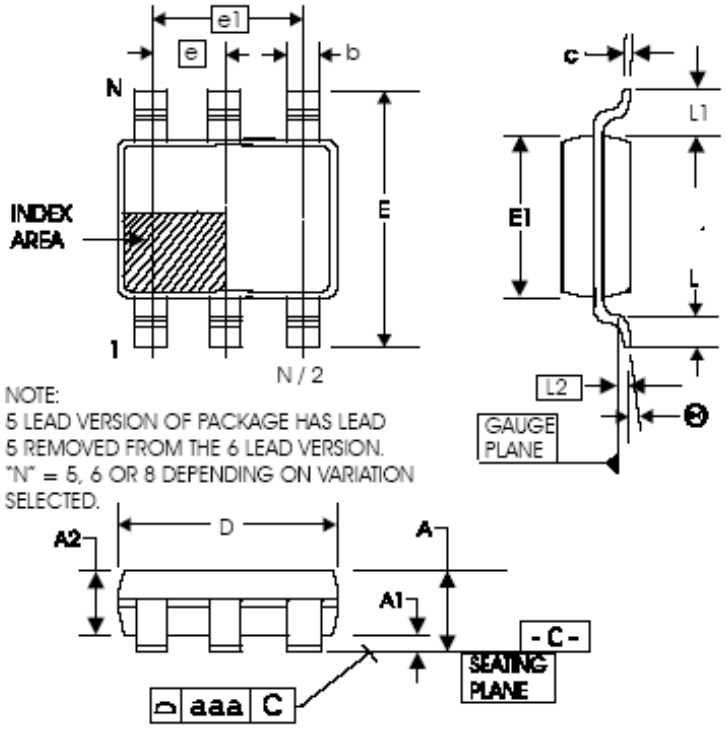
Marking Diagram (SOT-23)



Notes:
1. “Z” is the device step (1 to 2 characters).
2. YYWW is the last two digits of the year and week that the part was assembled.
3. “$” is the assembly mark code.
4. “G” after the two-letter package code designates RoHS compliant package.
5. “I” at the end of part number indicates industrial temperature range.
6. Bottom marking: country of origin if not USA.

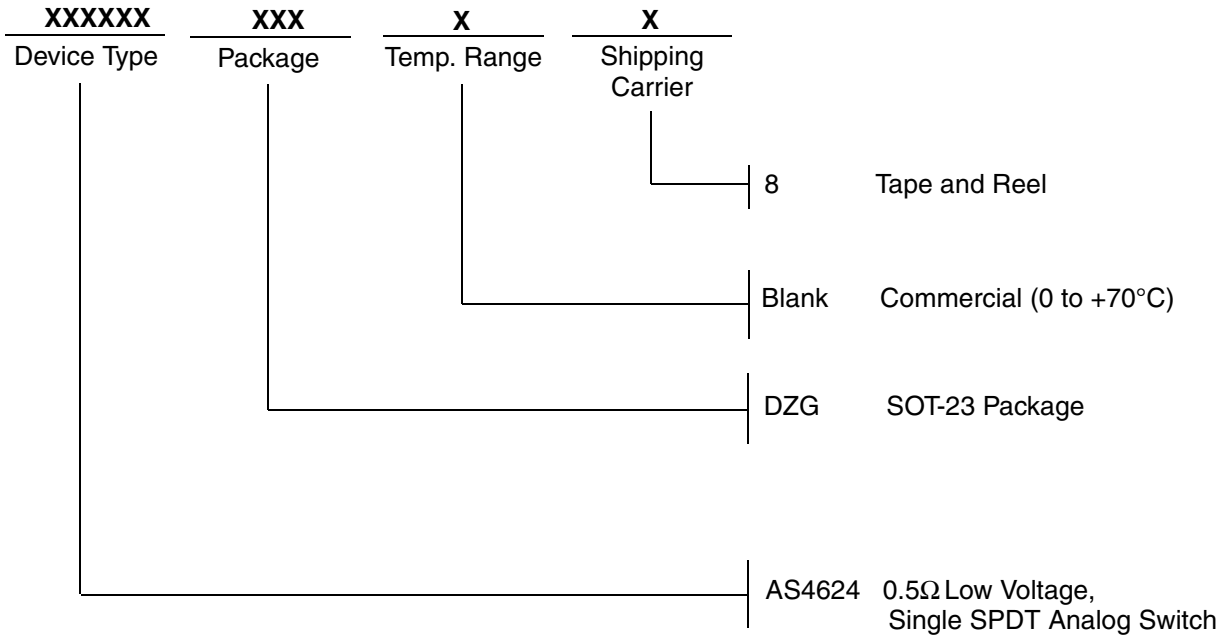
Package Outline and Package Dimensions (SOT-23-6)

Package dimensions are kept current with JESD Publication No. 95-1,



	Millimeters		Inches	
Symbol	**Min**	**Max**	**Min**	**Max**
A	0.90	1.45	.0354	.0571
A1	0	0.15	0	.0059
A2	0.90	1.30	.0354	.0512
b	0.35	0.50	.0138	.0197
c	0.09	0.22	.0036	.0087
D	2.80	3.00	.1102	.1181
E	2.60	3.00	.1024	.1181
E1	1.50	1.75	.0591	.0689
e	0.95 BASIC		0.0374 BASIC	
e1	1.90 BASIC		0.0748 BASIC	
L	0.35	0.55	.0138	.0217
L1	0.50	0.70	.0197	.0276
L2	0.25 BASIC		.0098 BASIC	
θ	0°	10°	0°	10°
aaa	—	0.10	—	.0039

Ordering Information



Revision History

Rev.	Originator	Date	Description of Change
B		6/12/07	Created datasheet in new template; added marking diagram.
C		05/07/09	Updated Ordering information.
D	S. S.	08/12/09	Updated truth table pg.2; block diagram.

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