4 Ω Dual SPST Switches

DESCRIPTION

The DG2537, DG2538, and DG2539 are low voltage, precision dual SPST switches that can be operated in a single supply or in a dual supply configuration power supply with low power dissipation. The DG2537, DG2538 and DG2539 can switch both analog and digital signals within the power supply rail, and conduct well in both directions.

Fabricated with advance submicron CMOS process, these switches provide high precision low and flat ON resistance, low leakage current, low parasitic capacitance, and low charge injection.

The DG2537, DG2538 and DG2539 contain two independent Single Pole Single Throw (SPST) switches. Switch-1 and switch-2 are normally open for the DG2537 and normally closed for the DG2538. For the DG2539, switch-1 is normally open and switch-2 is normally closed with a Break-Before-Make switching timing.

The DG2537, DG2538 and DG2539 are the ideal switches for use in low voltage instruments and healthcare devices, fitting the circuits of low voltage ADC and DAC, analog front end gain control, and signal path control.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device termination.

As a further sign of Vishay Siliconix's commitment, the DG2537, DG2538 and D2539 are fully RoHS compliant and halogen-free.

FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- Low and flat switch on resistance, 2.5 Ω/typ
- Low leakage and parasitic capacitance
- 366 MHz, - 3 dB bandwidth
- Latch-up current > 300 mA (JESD78)
- Over voltage tolerant TTL/CMOS compatible
- **Compliant to RoHS Directive 2002/95/EC**

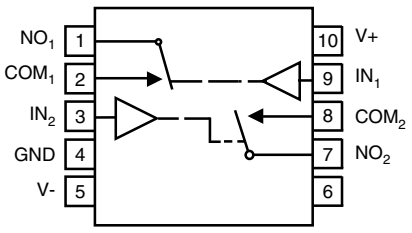
Pb-free
RoHS COMPLIANT
HALOGEN FREE

APPLICATIONS

- Healthcare and medical devices
- Test instruments
- Portable meters
- Data acquisitions
- Control and automation
- PDAs and modems
- Communication systems
- Audio, video systems
- Mechanical reed relay replacement

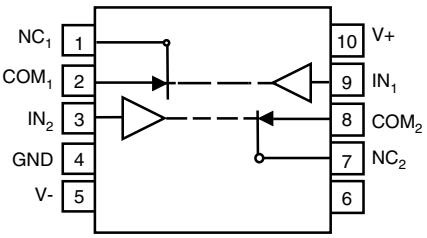
FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

DG2537, MSOP-10



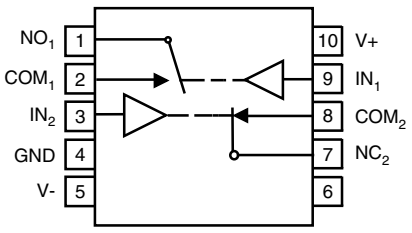
Top View

DG2538, MSOP-10



Top View

DG2539, MSOP-10



Top View

TRUTH TABLE (DG2537, DG2538)

	DG2537	DG2538	Switches
Logic	0	1	Off
	1	0	On

TRUTH TABLE (DG2539)

Logic	Switch-1	Switch-2
0	Off	On
1	On	Off

ORDERING INFORMATION

Temperature Range	Package	Part Number
- 40 °C to 85 °C	MSOP-10	DG2537DQ-T1-GE3
	MSOP-10	DG2538DQ-T1-GE3
	MSOP-10	DG2539DQ-T1-GE3

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ABSOLUTE MAXIMUM RATINGS

Parameter		Limit	Unit
Referenced V+ to GND		- 0.3 to 6	V
IN, COM, NC, NO[a]		- 0.3 to (V+ + 0.3)	
Continuous Current (Any Terminal)		± 50	mA
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		± 200	
Storage Temperature (D Suffix)		- 65 to 150	°C
Power Dissipation (Packages)[b]	MSOP-10[c]	320	mW

Notes:
a. Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
b. All leads welded or soldered to PC board.
c. Derate 4 mW/°C above 70 °C.

SPECIFICATIONS (V+ = 3 V, V- = 0 V)

Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, V- = 0 V, ± 10 %, V_{IN} = 0.4 V or 1.5 V[e]	Temp.[a]	Limits - 40 °C to 85 °C Min.[b]	Typ.[c]	Max.[b]	Unit
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC} V_{COM}		Full	0		V+	V
On-Resistance	R_{ON}	V+ = 2.7 V, V- = 0 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = - 10 mA	Room Full		6.5	 10	Ω
R_{ON} Flatness[d]	R_{ON} Flatness	V+ = 2.7 V, V- = 0 V, V_{COM} = 1.1 V to 1.6 V, I_{NO}, I_{NC} = - 10 mA	Room		0.4		
R_{ON} Match[d]	R_{ON} Match	V+ = 2.7 V, V- = 0 V, V_D = 1.1 V to 1.6 V, I_D = - 10 mA	Room Full		0.3	 0.9	
Switch Off Leakage Current	$I_{NO(off)}$ $I_{NC(off)}$	V+ = 3.3 V, V- = 0 V, V_{NO}, V_{NC} = 1 V/3 V, V_{COM} = 3 V/1 V	Room Full	- 0.25 - 0.35		0.25 0.35	nA
	$I_{COM(off)}$		Room Full	- 0.25 - 0.35		0.25 0.35	
Channel-On Leakage Current	$I_{COM(on)}$	V+ = 3.3 V, V- = 0 V, V_{NO}, V_{NC} = V_{COM} = 1 V/3 V	Room Full	- 0.25 - 0.35		0.25 0.35	
Digital Control							
Input High Voltage	V_{INH}		Full	2			V
Input Low Voltage	V_{INL}		Full			0.4	
Input Capacitance[d]	C_{in}	f = 1 MHz	Full		2.4		pF
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+	Full	- 1		1	µA
Dynamic Characteristics							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 2 V, R_L = 300 Ω, C_L = 35 pF, figures 1 and 2	Room Full		16	 55	ns
Turn-Off Time	t_{OFF}		Room Full		7	 40	
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, figure 3	Room		1.8		pC
Bandwidth[d]	BW	V+ = 3 V, R_L = 50 Ω, C_L = 5 pF, - 3dB	Room		319		MHz
Off-Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		- 67		dB
Crosstalk[d]	X_{TALK}		Room		- 92		
Off-Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room		- 47		
Crosstalk[d]	X_{TALK}		Room		- 90		
Source-Off Capacitance[d]	$C_{NC/NO(off)}$	V_{IN} = 0 or V+, f = 1 MHz	Room		8		pF
Drain-Off Capacitance[d]	$C_{COM(off)}$		Room		9		
Channel-On Capacitance[d]	C_{ON}		Room		22		
Power Supply							
Power Supply Current	I+	V_{IN} = 0 or V+, V+ = 3.3 V				1	µA

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SPECIFICATIONS (V+ = 5 V, V- = 0 V)							
Parameter	**Symbol**	**Test Conditions Otherwise Unless Specified** V+ = 5 V, V- = 0 V, ± 10 %, V_{IN} = 0.8 V or 2.4 V[e]	**Temp.[a]**	**Limits - 40 °C to 85 °C** Min.[b]	Typ.[c]	Max.[b]	**Unit**
Analog Switch							
Analog Signal Range[d]	V_{NO}, V_{NC} V_{COM}		Full	0		V+	V
On-Resistance	R_{ON}	V+ = 4.5 V, V- = 0 V, V_{COM} = 0 V to V+, I_{NO}, I_{NC} = 10 mA	Room Full		2.5	4.5 5	Ω
R_{ON} Flatness[d]	R_{ON} Flatness	V+ = 4.5 V, V- = 0 V,' V_{COM} = 1.3 V to 3 V, I_{NO}, I_{NC} = 10 mA	Room		0.75	1.5	
R_{ON} Match[d]	R_{ON} Match	V+ = 4.5 V, V- = 0 V, I_D = 10 mA, V_{COM} = 1.3 V to 3 V	Room		0.2	0.9	
Switch Off Leakage Current	$I_{NO(off)}$ $I_{NC(off)}$	V+ = 5.5 V, V- = 0 V, V_{NO}, V_{NC} = 1 V/4.5 V, V_{COM} = 4.5 V/1 V	Room Full	- 0.25 - 0.35		0.25 0.35	nA
	$I_{COM(off)}$		Room Full	- 0.25 - 0.35		0.25 0.35	
Channel-On Leakage Current	$I_{COM(on)}$	V+ = 5.5 V, V- = 0 V, V_{NO}, V_{NC} = V_{COM} = 1 V/4.5 V	Room Full	- 0.25 - 0.35		0.25 0.35	
Digital Control							
Input High Voltage	V_{INH}		Full	2.4			V
Input Low Voltage	V_{INL}		Full			0.8	
Input Capacitance	C_{in}	f = 1 MHz	Full		2.2		pF
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+	Full	- 0.1	0.005	0.1	µA
Dynamic Characteristics							
Turn-On Time[d]	t_{ON}	V_{NO} or V_{NC} = 3 V, R_L = 300 Ω, C_L = 35 pF, figures 1 and 2	Room Full		17	30 40	ns
Turn-Off Time[d]	t_{OFF}		Room Full		9	35	
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω, figure 3	Room		2.2		pC
Bandwidth[d]	BW	V+ = 5 V, R_L = 50 Ω, C_L = 5 pF, - 3 dB	Room		366		MHz
Off-Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 1 MHz	Room		- 67		dB
Crosstalk[d]	X_{TALK}		Room		- 90		
Off-Isolation[d]	OIRR	R_L = 50 Ω, C_L = 5 pF, f = 10 MHz	Room		- 47		
Crosstalk[d]	X_{TALK}		Room		- 90		
Source-Off Capacitance[d]	$C_{NC/NO(off)}$	V_{IN} = 0 or V+, f = 1 MHz	Room		8		pF
Drain-Off Capacitance[d]	$C_{COM(off)}$		Room		9		
Channel-On Capacitance[d]	C_{ON}		Room		22		
Power Supply							
Power Supply Range	V+			2.6		4.3	V
Power Supply Current	I+	V_{IN} = 0 or V+, V+ = 5.5 V	Full			2	µA

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SPECIFICATIONS (V+ = + 2.5 V, V- = - 2.5 V)							
Parameter	**Symbol**	**Test Conditions Otherwise Unless Specified** V+ = + 2.5 V, V- = - 2.5 V, ± 10 %, V_{IN} = 0.8 V or 2.4 V[e]	**Temp.[a]**	**Limits** - 40 °C to 85 °C **Min.[b]**	**Typ.[c]**	**Max.[b]**	**Unit**
Analog Switch							
Analog Signal Range	V_{NO}, V_{NC} V_{COM}		Full	V-		V+	V
On-Resistance	R_{ON}	V+ = + 2.25 V, V- = - 2.25 V, V_{COM} = V- to V+, I_{NO}, I_{NC} = 10 mA	Room Full		3.6	4.5 5	Ω
R_{ON} Flatness	R_{ON} Flatness	V+ = + 2.25 V, V- = - 2.25 V, V_{COM} = ± 1.2 V, 0 V, I_{NO}, I_{NC} = 10 mA	Room		0.7	1.5	
R_{ON} Match	R_{ON} Match	V+ = + 2.25 V, V- = - 2.25 V, V_{COM} = ± 1.4 V, I_{NO}, I_{NC} = 10 mA	Room		0.2	0.9	
Switch Off Leakage Current	$I_{NO(off)}$ $I_{NC(off)}$	V+ = + 2.75 V, V- = - 2.75 V, V_S = ± 2.5 V, V_D = ± 2.5 V	Room Full	- 0.25 - 0.35		0.25 0.35	nA
	$I_{COM(off)}$		Room Full	- 0.25 - 0.35		0.25 0.35	
Switch on Leakage	$I_{COM(on)}$	V+ = + 2.75 V, V- = - 2.25 V, V_S = V_D = ± 2.5 V	Room Full	- 0.25 - 0.35		0.25 0.35	
Digital Control							
Input High Voltage	V_{INH}		Full	2.4			V
Input Low Voltage	V_{INL}		Full			0.8	
Input Capacitance	C_{in}	f = 1 MHz	Full		2.2		pF
Input Current	I_{INL} or I_{INH}	V_{IN} = 0 or V+	Full	- 0.1		0.1	µA
Dynamic Characteristics							
Turn-On Time[d]	t_{ON}	V_{NO} or V_{NC} = 2 V, R_L = 300 Ω, C_L = 35 pF	Room Full			35 40	ns
Turn-Off Time[d]	t_{OFF}		Room Full			20 25	
Charge Injection[d]	Q_{INJ}	C_L = 1 nF, V_{GEN} = 0 V, R_{GEN} = 0 Ω	Room		2.2		pC
Bandwidth[d]	BW	V+ = + 2.5 V, V- = - 2.5 V, R_L = 50 Ω, C_L = 5 pF, - 3dB	Room		366		MHz
Off-Isolation[d]	OIRR	V+ = + 2.5 V, V- = - 2.5 V, R_L = 50 Ω, C_L = 5 pF, - 3dB, f = 1 MHz	Room		- 67		dB
Crosstalk[d]	X_{TALK}		Room		- 90		
Off-Isolation[d]	OIRR	V+ = + 2.5 V, V- = - 2.5 V, R_L = 50 Ω, C_L = 5 pF, - 3dB, f = 10 MHz	Room		- 47		
Crosstalk[d]	X_{TALK}		Room		- 90		
Source-Off Capacitance[d]	$C_{NC/NO(off)}$	V_{IN} = 0 or V+, f = 1 MHz	Room		6		pF
Drain-Off Capacitance[d]	$C_{COM(off)}$		Room		12		
Channel-On Capacitance[d]	C_{ON}		Room		24		
Power Supply							
Power Supply Range	V+			1.25		2.75	V
Power Supply	I+	V_{IN} = 0 or V+, V+ = 2.5 V				2	µA

Notes:

a. Room = 25 °C, Full = as determined by the operating suffix.

b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

c. Typical values are for design aid only, not guaranteed nor subject to production testing.

d. Guarantee by design, nor subjected to production test.

e. V_{IN} = input voltage to perform proper function.

f. Not production tested.

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.

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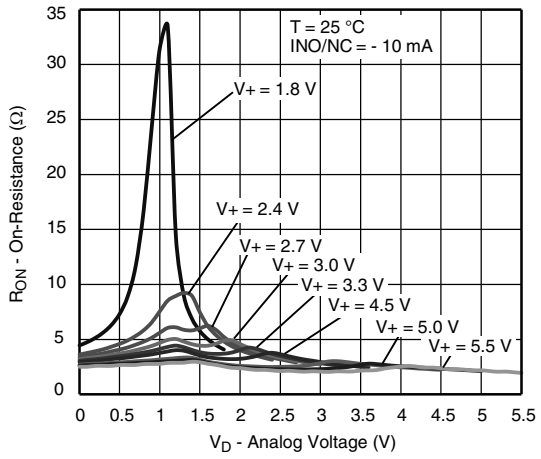
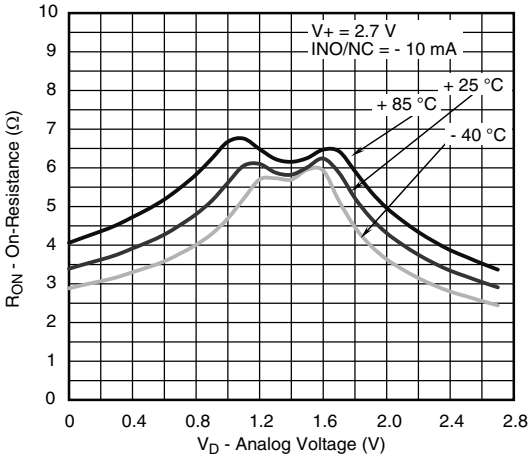
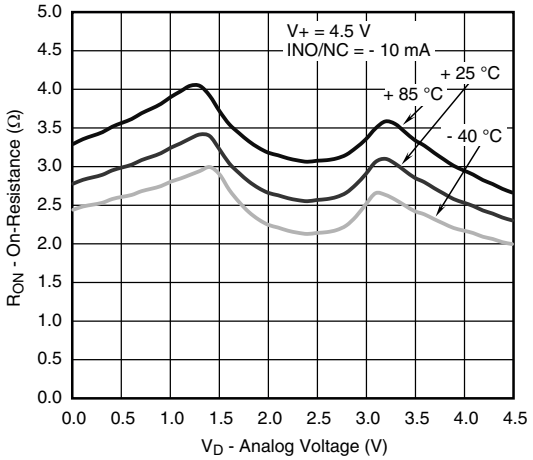
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



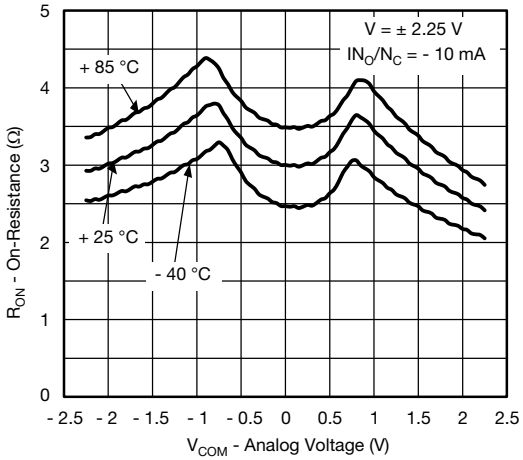
R_{ON} vs. V_D and Single Supply Voltage



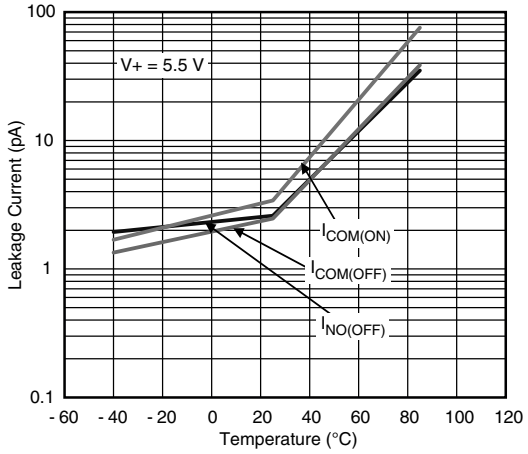
R_{ON} vs. Analog Voltage and Temperature



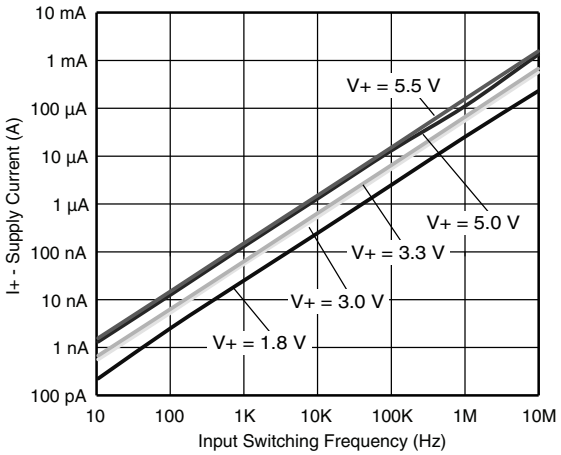
R_{ON} vs. Analog Voltage and Temperature



R_{ON} vs. Analog Voltage and Temperature



Leakage Current vs. Temperature



Supply Current vs. Input Switching Frequency

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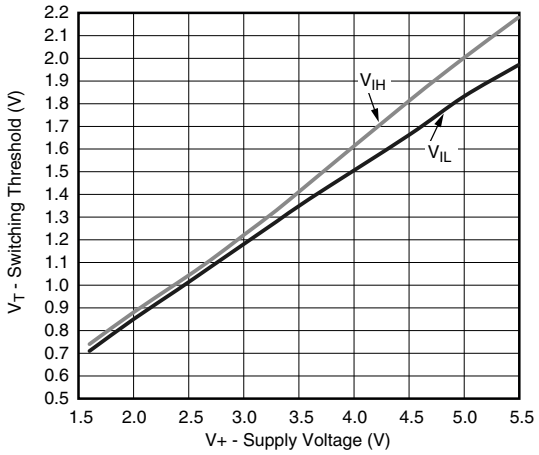
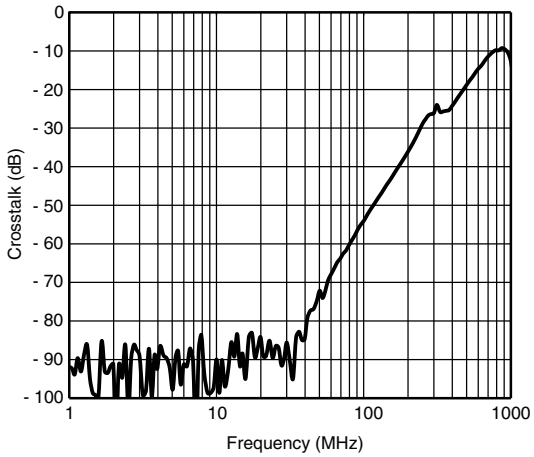
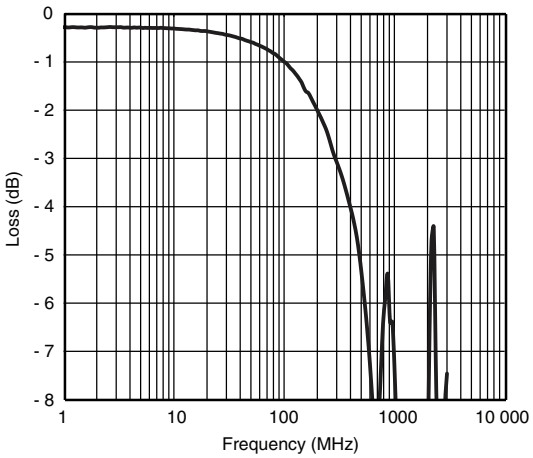
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



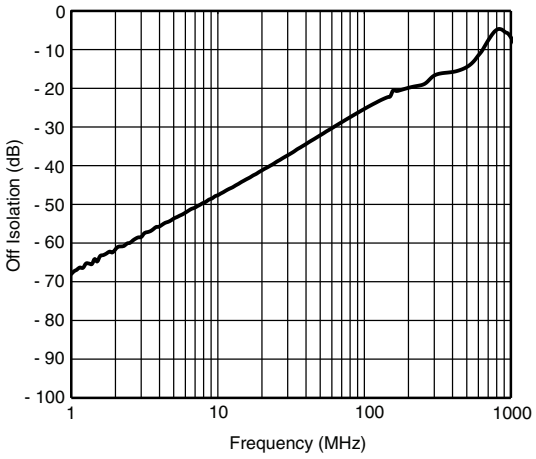
Switching Threshold vs. Supplz Voltage



Crosstalk vs. Frequency

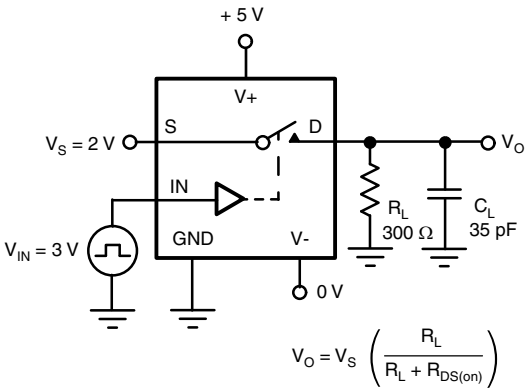


Insertion Loss vs. Frequency



Off Isolation vs. Frequency

TEST CIRCUITS



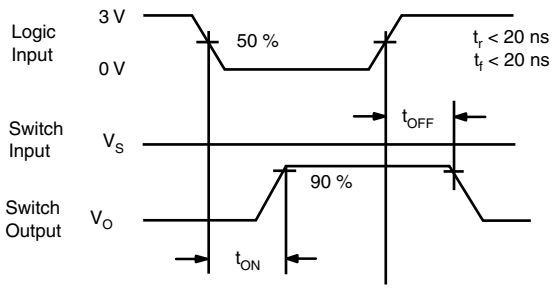


Figure 1. Single Supply Switching Time

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TEST CIRCUITS

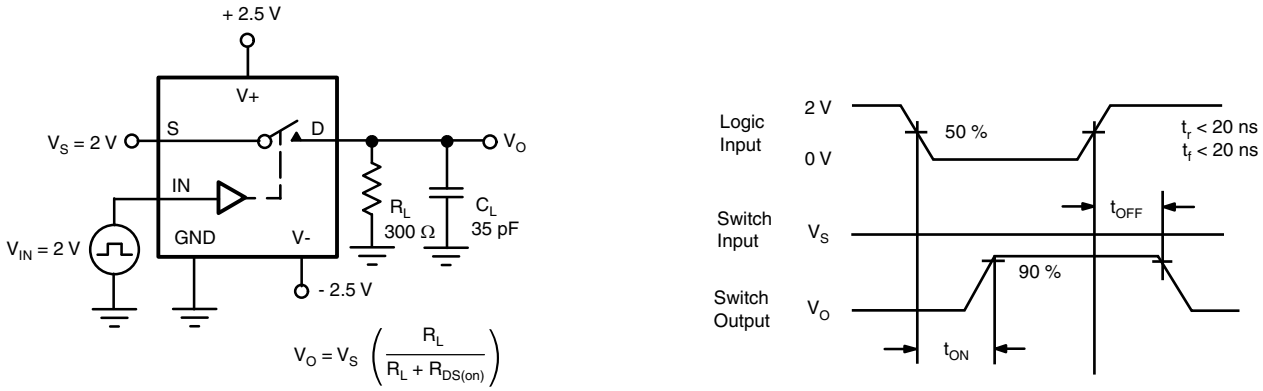

Figure 2. Dual Supply Switching Time

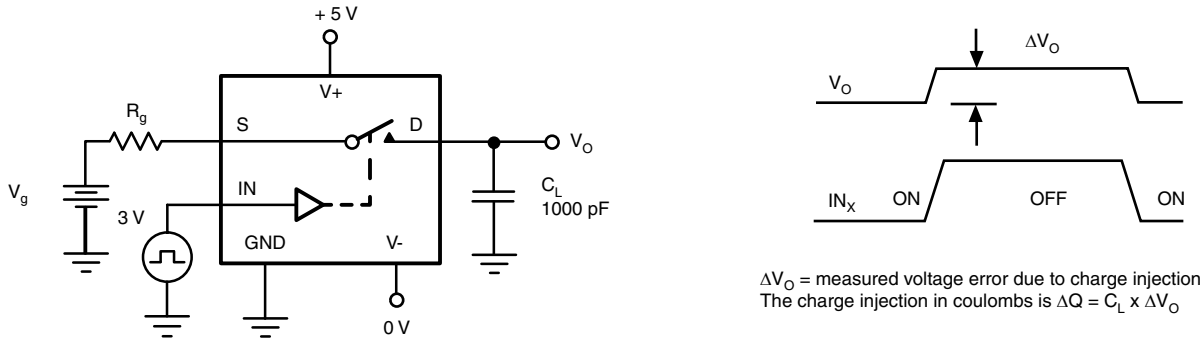

Figure 3. Charge Injection

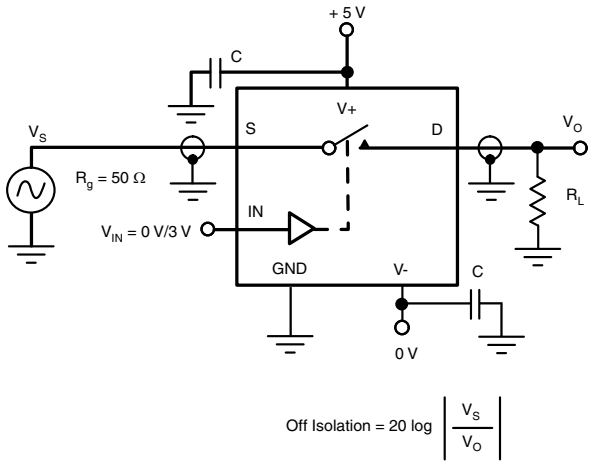

Figure 4. Off-Isolation

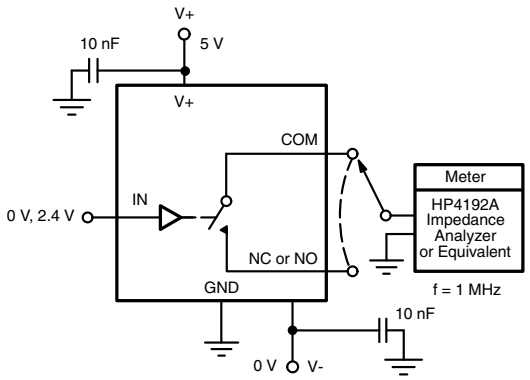

Figure 5. Channel Off/On Capacitance

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TEST CIRCUITS

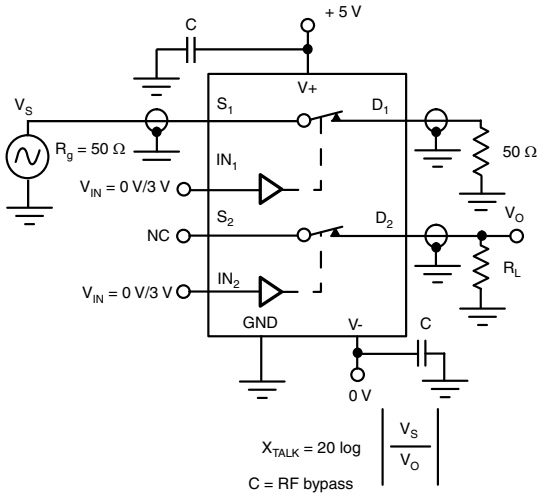

Figure 6. Channel to Channel Crosstalk

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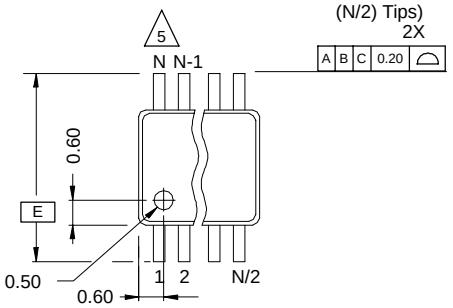
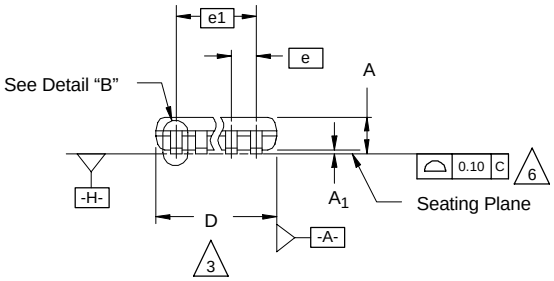
MSOP: 10-LEADS

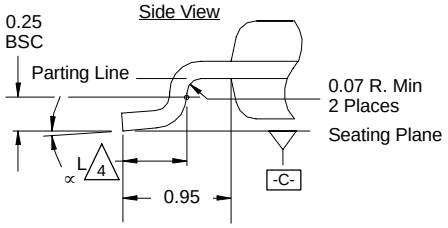
JEDEC Part Number: MO-187, (Variation AA and BA)



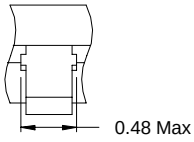
Top View



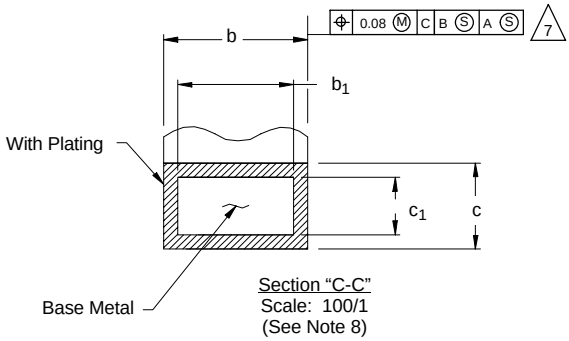
Side View



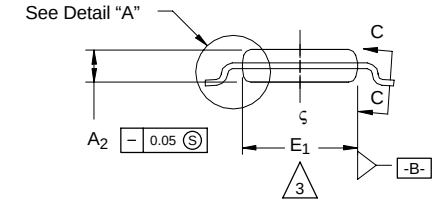
Detail "A"
(Scale: 30/1)



Detail "B"
(Scale: 30/1)
Dambar Protrusion



Section "C-C"
Scale: 100/1
(See Note 8)



End View

NOTES:

1. Die thickness allowable is 0.203 ± 0.0127.
2. Dimensioning and tolerances per ANSI.Y14.5M-1994.
3. Dimensions "D" and "E_1" do not include mold flash or protrusions, and are measured at Datum plane -H- , mold flash or protrusions shall not exceed 0.15 mm per side.
4. Dimension is the length of terminal for soldering to a substrate.
5. Terminal positions are shown for reference only.
6. Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
7. The lead width dimension does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08 mm total in excess of the lead width dimension at maximum material condition. Dambar cannot be located on the lower radius or the lead foot. Minimum space between protrusions and an adjacent lead to be 0.14 mm. See detail "B" and Section "C-C".
8. Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
9. Controlling dimension: millimeters.
10. This part is compliant with JEDEC registration MO-187, variation AA and BA.
11. Datums -A- and -B- to be determined Datum plane -H- .
12. Exposed pad area in bottom side is the same as teh leadframe pad size.

N = 10L

Dim	MILLIMETERS			Note
	Min	Nom	Max	
A	-	-	1.10	
A_1	0.05	0.10	0.15	
A_2	0.75	0.85	0.95	
b	0.17	-	0.27	8
b_1	0.17	0.20	0.23	8
c	0.13	-	0.23	
c_1	0.13	0.15	0.18	
D	3.00 BSC			3
E	4.90 BSC			
E_1	2.90	3.00	3.10	3
e	0.50 BSC			
e_1	2.00 BSC			
L	0.40	0.55	0.70	4
N	10			5
∝	0°	4°	6°	

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DWG: 5867

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