



1 pC Charge Injection, 100 pA Leakage, +5 V / +3 V, Dual SPST Analog Switches

DESCRIPTION

The DG9232E, DG9233E, and DG9234E are monolithic CMOS switches designed for precision signal switching. The 17 Ω low voltage parts feature low charge injection, leakage, parasitic capacitance, and fast switching.

The DG9232E, DG9233E, and DG9234E can switch both analog and digital signals. Each switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

The DG9232E, DG9233E, and DG9234E contain two independent single pole single throw (SPST) switches. Switch-1 and switch-2 are normally closed for the DG9232E and normally open for the DG9233E. For the DG9234E, switch-1 is normally open and switch-2 is normally closed with a break-before-make switching timing.

The DG9232E, DG9233E, and DG9234E offer 1 nW typical power consumption and 8 kV ESD/HBM, 1 kV ESD/CDM tolerance. They are the ideal switches for use in low voltage instruments and healthcare devices, fitting the circuits of low voltage ADC and DAC, sample and hold, analog front end gain control, and signal path control. The DG9232E, DG9233E, and DG9234E are available in 8-lead MSOP and SOIC packages.

BENEFITS

- Low charge injection and leakage
- Low parasitic capacitance
- Fast switching speed
- High ESD tolerance

FEATURES

- 1 pC charge injection
- Guaranteed 100 pA maximum switch on leakage at 25 °C
- 3.8 pF switch off and 7.8 pF switch on capacitances
- +2.7 V to +5 V single supply operation
- Low on-resistance - $R_{DS(on)}$: 17 Ω / typ. at 5 V
- t_{ON} : 32 ns, t_{OFF} : 10 ns switching time
- Typical power consumption: 1 nW
- Over voltage tolerant TTL / CMOS compatible
- ESD (HBM): 8000 V, ESD (CDM): 1000 V
- Latch-up current: > 300 mA (JESD78)
- Available in MSOP-8 and SOIC-8
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Note

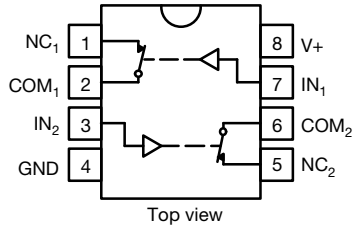
* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.



RoHS*
Available

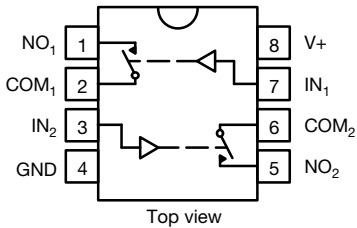
APPLICATIONS

- Automatic test equipment
- Process control and automation
- Data acquisition systems
- Meters and instruments
- Medical and healthcare systems
- Communication systems
- Sample-and-hold systems
- Relay replacements
- Battery powered systems

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

TRUTH TABLE - DG9232E

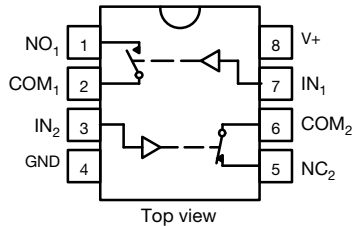
| LOGIC | SWITCH |
|-------|--------|
| 0 | On |
| 1 | Off |

 Logic "0" ≤ 0.8 V

 Logic "1" ≥ 2.4 V

TRUTH TABLE - DG9233E

| LOGIC | SWITCH |
|-------|--------|
| 0 | Off |
| 1 | On |

 Logic "0" ≤ 0.8 V

 Logic "1" ≥ 2.4 V

TRUTH TABLE - DG9234E

| LOGIC | SWITCH-1 | SWITCH-2 |
|-------|----------|----------|
| 0 | Off | On |
| 1 | On | Off |

 Logic "0" ≤ 0.8 V

 Logic "1" ≥ 2.4 V

ORDERING INFORMATION

| TEMPERATURE RANGE | CONFIGURATION | PACKAGE | PART NUMBER | MINIMUM ORDER / PACKAGE QUANTITY |
|------------------------------------|---------------|------------|------------------|----------------------------------|
| -40 °C to +85 °C lead (Pb)-free | DG9232E | 8-pin MSOP | DG9232EDQ-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9232EDY-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9232EDY-GE3 | Tube 500 units |
| | DG9233E | 8-pin MSOP | DG9233EDQ-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9233EDY-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9233EDY-GE3 | Tube 500 units |
| | DG9234E | 8-pin MSOP | DG9234EDQ-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9234EDY-T1-GE3 | Tape and reel 2500 units |
| | | 8-pin SOIC | DG9234EDY-GE3 | Tube 500 units |

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | LIMIT | UNIT |
|--|-------------------------------------|-------------|
| Reference V+ to GND | -0.3 to +6 | V |
| IN, COM, NC, NO ^a | -0.3 to (V+ + 0.3) | |
| Continuous current (any terminal) | ± 20 | mA |
| Peak current (pulsed at 1 ms, 10 % duty cycle) | ± 40 | |
| ESD (HBM) (MIL-STD-883, method 3015) | > 8000 | V |
| ESD (CDM) (ANSI / ESDA / JEDEC® JS-002) | > 1000 | V |
| Latch up current, per JESD78 | 300 | mA |
| Storage temperature | D suffix | -65 to +125 |
| Power dissipation (packages) ^b | 8-pin narrow body SOIC ^c | 400 |
| | | mW |

Notes

- Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- All leads welded or soldered to PC board.
- Derate 6.5 mW/°C above 70 °C.

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.



| SPECIFICATIONS ($V_+ = 3\text{ V}$) | | | | | | | |
|---|------------------------|--|--------------------|------------------------------|-------------------|-------------------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS OTHERWISE UNLESS SPECIFIED $V_+ = 3\text{ V}, \pm 10\%, V_{IN} = 0.8\text{ V or }2.4\text{ V}^e$ | TEMP. ^a | D SUFFIX -40 °C to +85 °C | | | UNIT |
| | | | | MIN. ^c | TYP. ^b | MAX. ^c | |
| Analog Switch | | | | | | | |
| Analog signal range ^d | V_{ANALOG} | | Full | 0 | - | 3 | V |
| Drain-source on-resistance | $R_{DS(on)}$ | V_{NO} or $V_{NC} = 1.5\text{ V}, V_+ = 2.7\text{ V}$ $I_{COM} = 5\text{ mA}$ | Room | - | 35 | 50 | Ω |
| | | | Full | - | 35 | 65 | |
| $R_{DS(on)}$ match ^d | $\Delta R_{DS(on)}$ | V_{NO} or $V_{NC} = 1.5\text{ V}$ | Room | - | 0.4 | 2 | |
| $R_{DS(on)}$ flatness ^d | $R_{DS(on)}$ flatness | V_{NO} or $V_{NC} = 1\text{ V and }2\text{ V}$ | Room | - | 4 | 8 | |
| NO or NC off leakage current ^g | $I_{NO/NC(off)}$ | V_{NO} or $V_{NC} = 1\text{ V/2 V}, V_{COM} = 2\text{ V/1 V}$ | Room | -100 | 5 | 100 | pA |
| | | | Full | -5000 | 5 | 5000 | |
| COM off leakage current ^g | $I_{COM(off)}$ | $V_{COM} = 1\text{ V/2 V}, V_{NO}$ or $V_{NC} = 2\text{ V/1 V}$ | Room | -100 | 5 | 100 | |
| | | | Full | -5000 | 5 | 5000 | |
| Channel-on leakage current ^g | $I_{COM(on)}$ | $V_{COM} = V_{NO}$ or $V_{NC} = 1\text{ V/2 V}$ | Room | -200 | 5 | 200 | |
| | | | Full | -10 000 | 5 | 10 000 | |
| Digital Control | | | | | | | |
| Input current | I_{INL} or I_{INH} | | Full | - | 0.001 | - | μA |
| Dynamic Characteristics | | | | | | | |
| Turn-on time | t_{ON} | V_{NO} or $V_{NC} = 1.5\text{ V}$ | Room | - | 43 | 120 | ns |
| | | | Full | - | - | 200 | |
| Turn-off time | t_{OFF} | | Room | - | 16 | 50 | |
| | | | Full | - | - | 120 | |
| Charge injection ^d | Q_{INJ} | $C_L = 1\text{ nF}, V_{GEN} = 0\text{ V}, R_{GEN} = 0\ \Omega$ | Room | - | -0.28 | - | pC |
| Off-isolation | OIRR | $R_L = 50\ \Omega, C_L = 5\text{ pF}, f = 1\text{ MHz}$ | Room | - | -80 | - | dB |
| Crosstalk | X_{TALK} | | Room | - | -108 | - | |
| NC and NO capacitance | $C_{S(off)}$ | $f = 1\text{ MHz}$ | Room | - | 4 | - | pF |
| Channel-on capacitance | $C_{COM(on)}$ | | Room | - | 8 | - | |
| COM-off capacitance | $C_{COM(off)}$ | | Room | - | 4 | - | |
| Power Supply | | | | | | | |
| Positive supply range | V_+ | | | 2.7 | - | 5.5 | V |
| Power supply current | I_+ | $V_+ = 3.3\text{ V}, V_{IN} = 0\text{ V or }3.3\text{ V}$ | | 0.0003 | - | 1 | μA |

Notes

- a. Room = 25 °C, full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- d. Guarantee by design, nor subjected to production test.
- e. V_{IN} = input voltage to perform proper function.
- f. Difference of min. and max. values.
- g. Guaranteed by 5 V leakage tests, not production tested.

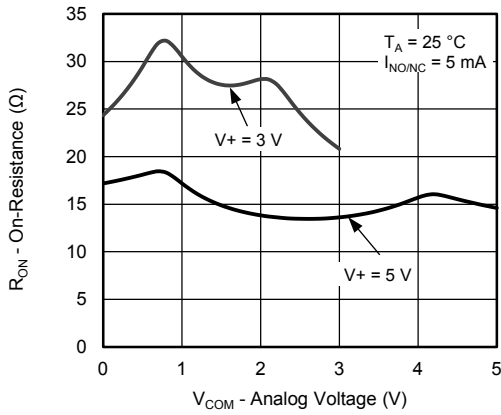


| SPECIFICATIONS (V+ = 5 V) | | | | | | | |
|---|---------------------|--|--------------------|-----------------------------|-------------------|-------------------|------|
| PARAMETER | SYMBOL | TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 5 V, ± 10 %, VIN = 0.8 V or 2.4 V ^e | TEMP. ^a | D SUFFIX -40 °C to +85°C | | | UNIT |
| | | | | MIN. ^c | TYP. ^b | MAX. ^c | |
| Analog Switch | | | | | | | |
| Analog signal range ^d | VANALOG | | Full | 0 | - | 5 | V |
| Drain-source on-resistance | RDS(on) | VNO or VNC = 3.5 V, V+ = 4.5 V ICOM = 5 mA | Room | - | 17 | 25 | Ω |
| | | | Full | - | 17 | 35 | |
| RDS(on) match ^d | ΔRDS(on) | VNO or VNC = 3.5 V | Room | - | 0.4 | 2 | |
| RDS(on) flatness ^d | RDS(on) flatness | VNO or VNC = 1 V, 2 V, and 3 V | Room | - | 3.5 | 6 | |
| NO or NC off leakage current ^g | INO/NC(off) | VNO or VNC = 1 V/4 V, VCOM = 4 V/1 V | Room | -100 | 10 | 100 | pA |
| | | | Full | -5000 | 10 | 5000 | |
| COM off leakage current | ICOM(off) | VCOM = 1 V/4 V, VNO or VNC = 4 V/1 V | Room | -100 | 10 | 100 | |
| | | | Full | -5000 | 10 | 5000 | |
| Channel-on leakage current | ICOM(on) | VCOM = VNO or VNC = 1 V/4 V | Room | -200 | - | 200 | |
| | | | Full | -10 000 | - | 10 000 | |
| Digital Control | | | | | | | |
| Input current | IINL or IINH | | Full | - | 0.001 | - | μA |
| Dynamic Characteristics | | | | | | | |
| Turn-on time | tON | VNO or VNC = 3 V | Room | - | 32 | 75 | ns |
| | | | Full | - | - | 150 | |
| Turn-off time | tOFF | | Room | - | 10 | 50 | |
| | | | Full | - | - | 100 | |
| Charge injection ^d | QINJ | CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω | Room | - | -0.78 | - | pC |
| Off-isolation | OIRR | RL = 50 Ω, CL = 5 pF, f = 1 MHz | Room | - | -80 | - | dB |
| Crosstalk | XTALK | | Room | - | -108 | - | |
| NC and NO capacitance | C(off) | f = 1 MHz | Room | - | 3.8 | - | pF |
| Channel-on capacitance | CD(on) | | Room | - | 7.8 | - | |
| COM-off capacitance | CD(off) | | Room | - | 3.8 | - | |
| Power Supply | | | | | | | |
| Positive supply range | V+ | | | 2.7 | - | 5.5 | V |
| Power supply current | I+ | V+ = 5.5 V, VIN = 0 V or 5.5 V | | - | - | 1 | μA |

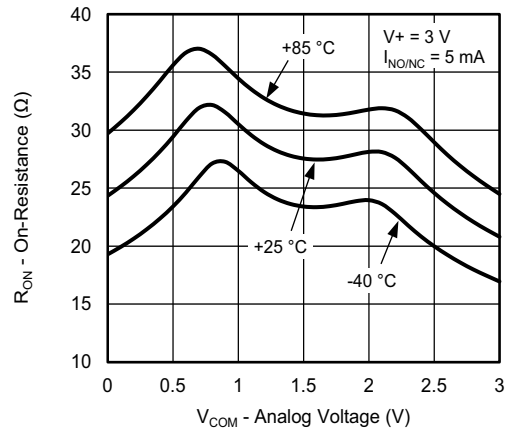
Notes

- a. Room = 25 °C, full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
- d. Guarantee by design, nor subjected to production test.
- e. VIN = input voltage to perform proper function.
- f. Difference of min. and max. values.

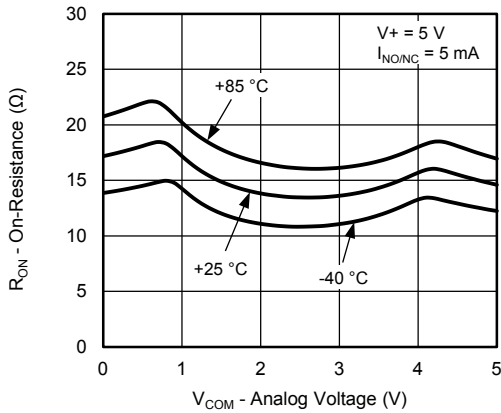
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



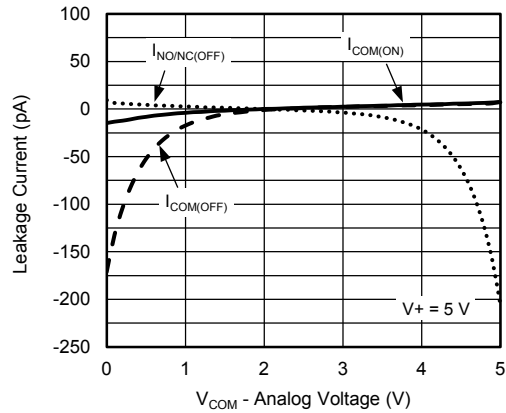
On-Resistance vs. Analog Voltage



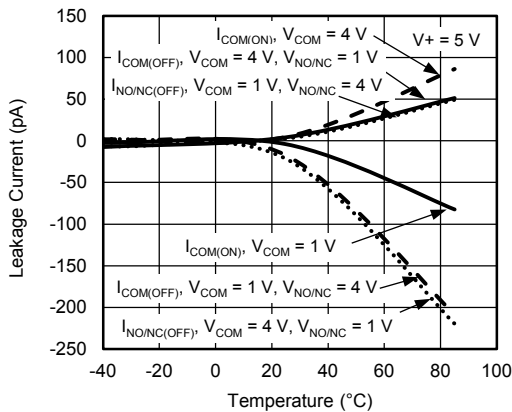
On-Resistance vs. Analog Voltage



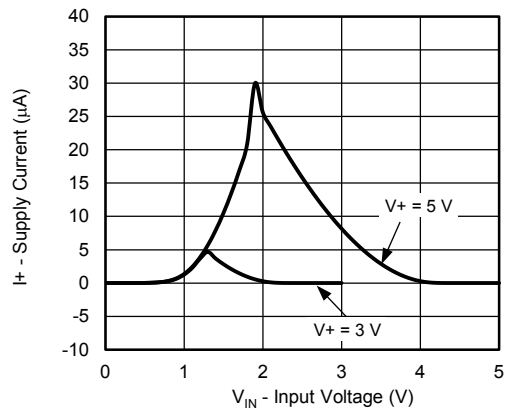
On-Resistance vs. Analog Voltage



Leakage Current vs. Analog Voltage



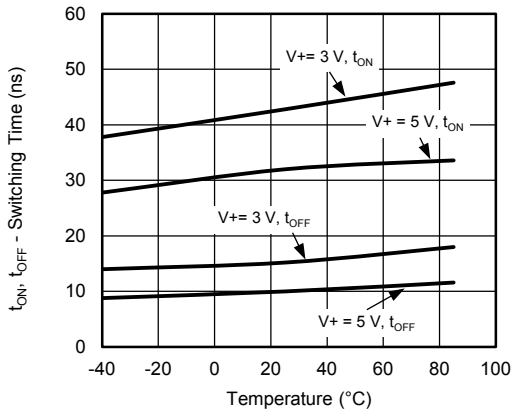
Leakage Current vs. Temperature



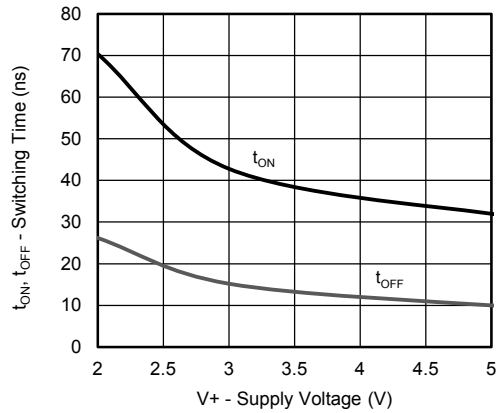
Supply Current vs. Input Voltage



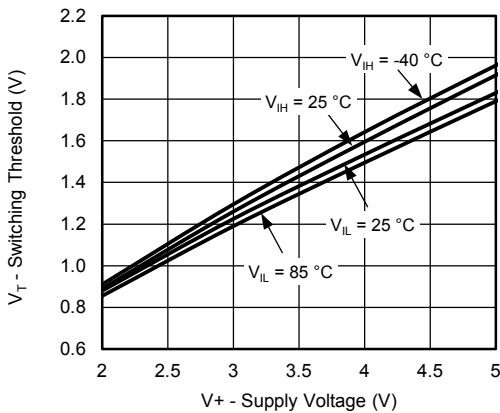
TYPICAL CHARACTERISTICS (T_A = 25 °C, unless otherwise noted)



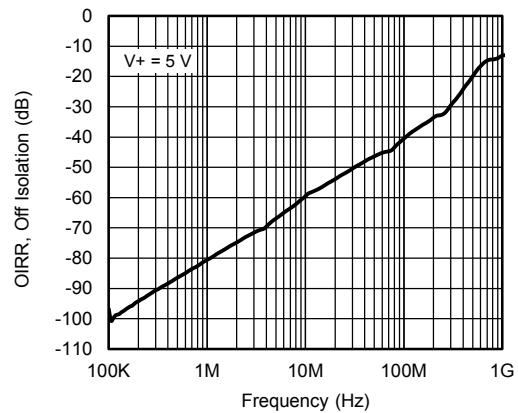
Switching Time vs. Temperature



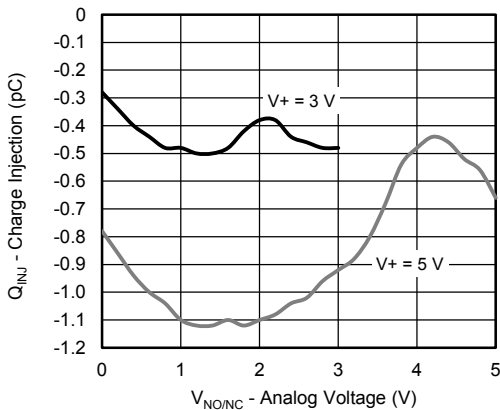
Switching Time vs. Supply Voltage



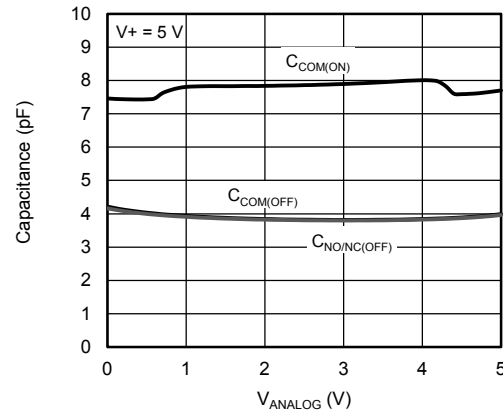
Switching Threshold vs. Supply Voltage



OIRR, Off Isolation vs. Frequency

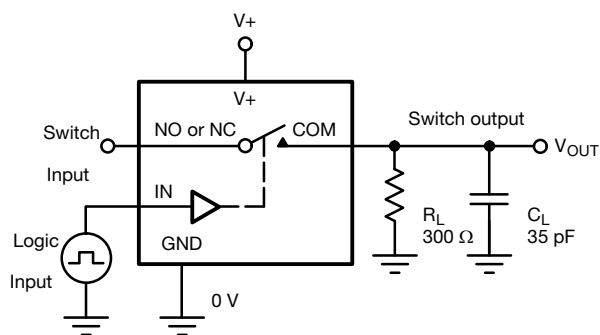


Charge Injection vs. Analog Voltage



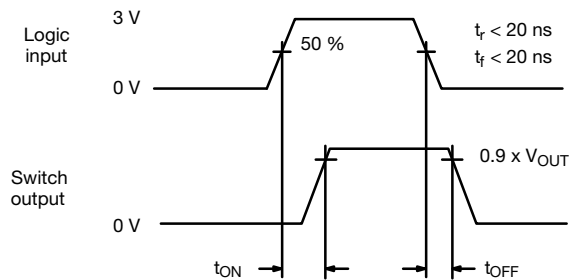
Capacitance

TEST CIRCUITS



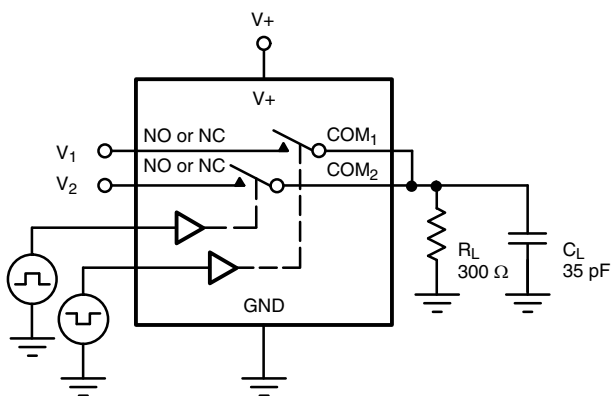
C_L (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM} \left(\frac{R_L}{R_L + R_{ON}} \right)$$



Logic "1" = switch on
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time



C_L (includes fixture and stray capacitance)

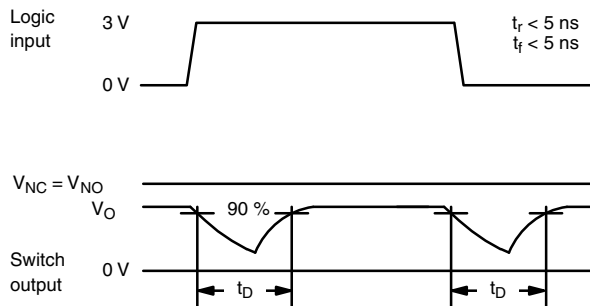
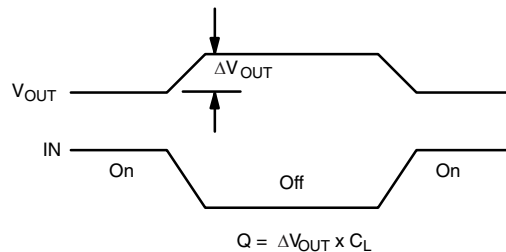
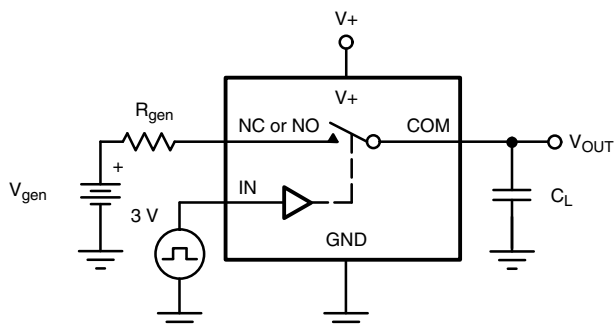


Fig. 2 - Break-Before-Make Interval



IN depends on switch configuration: input polarity determined by sense of switch.

Fig. 3 - Charge Injection

TEST CIRCUITS

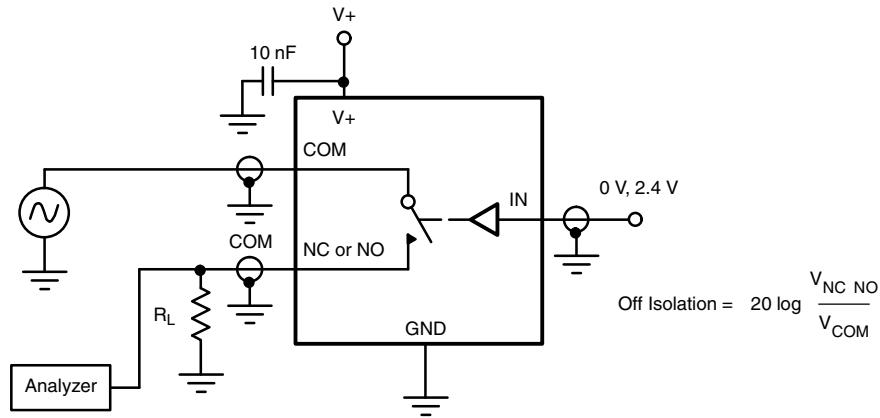


Fig. 4 - Off-Isolation

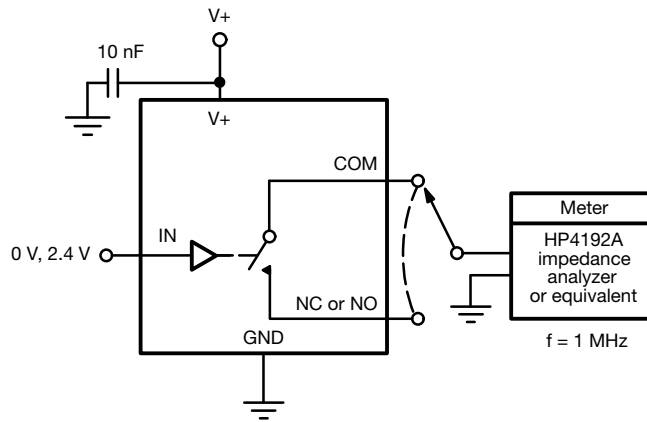


Fig. 5 - Channel Off/On Capacitance

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?75165.

SOIC (NARROW): 8-LEAD

JEDEC Part Number: MS-012

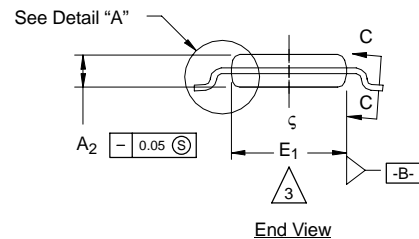
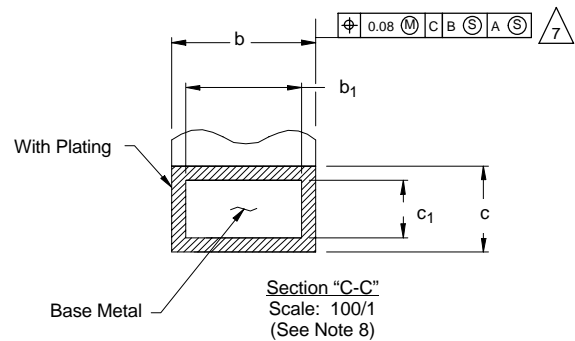
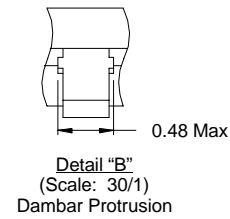
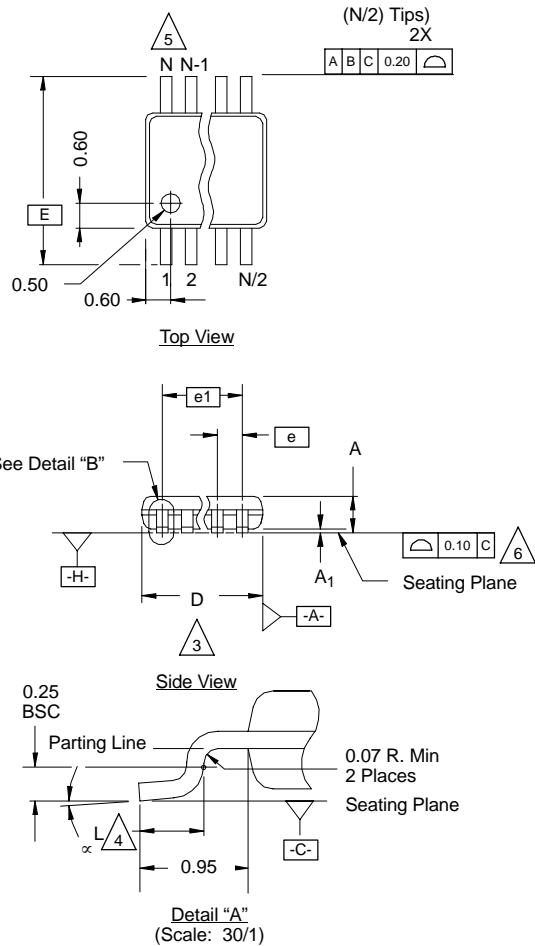


| DIM | MILLIMETERS | | INCHES | |
|--------------------------------|-------------|------|-----------|-------|
| | Min | Max | Min | Max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A ₁ | 0.10 | 0.20 | 0.004 | 0.008 |
| B | 0.35 | 0.51 | 0.014 | 0.020 |
| C | 0.19 | 0.25 | 0.0075 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.196 |
| E | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| H | 5.80 | 6.20 | 0.228 | 0.244 |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.50 | 0.93 | 0.020 | 0.037 |
| q | 0° | 8° | 0° | 8° |
| S | 0.44 | 0.64 | 0.018 | 0.026 |
| ECN: C-06527-Rev. I, 11-Sep-06 | | | | |
| DWG: 5498 | | | | |



MSOP: 8-LEADS

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



NOTES:

- Die thickness allowable is 0.203 ± 0.0127 .
- Dimensioning and tolerances per ANSI.Y14.5M-1994.
- Dimensions "D" and "E₁" 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.
- Dimension is the length of terminal for soldering to a substrate.
- Terminal positions are shown for reference only.
- Formed leads shall be planar with respect to one another within 0.10 mm at seating plane.
- 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".
- Section "C-C" to be determined at 0.10 mm to 0.25 mm from the lead tip.
- Controlling dimension: millimeters.
- This part is compliant with JEDEC registration MO-187, variation AA and BA.
- Datums [-A-] and [-B-] to be determined Datum plane [-H-].
- Exposed pad area in bottom side is the same as teh leadframe pad size.

N = 8L

| Dim | MILLIMETERS | | | Note |
|----------------------|-------------|------|------|------|
| | Min | Nom | Max | |
| A | - | - | 1.10 | |
| A₁ | 0.05 | 0.10 | 0.15 | |
| A₂ | 0.75 | 0.85 | 0.95 | |
| b | 0.25 | - | 0.38 | 8 |
| b₁ | 0.25 | 0.30 | 0.33 | 8 |
| c | 0.13 | - | 0.23 | |
| c₁ | 0.13 | 0.15 | 0.18 | |
| D | 3.00 BSC | | | 3 |
| E | 4.90 BSC | | | |
| E₁ | 2.90 | 3.00 | 3.10 | 3 |
| e | 0.65 BSC | | | |
| e₁ | 1.95 BSC | | | |
| L | 0.40 | 0.55 | 0.70 | 4 |
| N | 8 | | | 5 |
| α | 0° | 4° | 6° | |

ECN: T-02080—Rev. C, 15-Jul-02
 DWG: 5867

RECOMMENDED MINIMUM PADS FOR SO-8



Recommended Minimum Pads
Dimensions in Inches/(mm)

[Return to Index](#)



Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.