

2.5 Ω , High Bandwidth, Dual SPDT Analog Switch

DESCRIPTION

The DG2032E is a low-voltage dual single-pole / double-throw monolithic CMOS analog switch. Designed to operate from 1.8 V to 5.5 V power supply, the DG2032E achieves a bandwidth of 221 MHz while providing low on-resistance (2.5 Ω), excellent on-resistance matching (0.3 Ω) and flatness (1 Ω) over the entire signal range.

The DG2032E offers the advantage of high linearity that reduces signal distortion, making ideal for audio, video, and USB signal routing applications.

Built on Vishay Siliconix's proprietary sub-micron high-density process, the DG2032E brings low power consumption at the same time as reduces PCB spacing with the QFN12 package.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. The QFN12 package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-GE4" suffix. The nickel-palladium-gold device terminations meet all JEDEC® standards for reflow and MSL ratings.

FEATURES

- 1.8 V to 5.5 V single supply operation
- Low R_{ON} : 2.5 Ω at 4.5 V
- 221 MHz, -3 dB bandwidth
- Low off-isolation, -58 dB at 1 MHz
- +1.6 V logic compatible
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

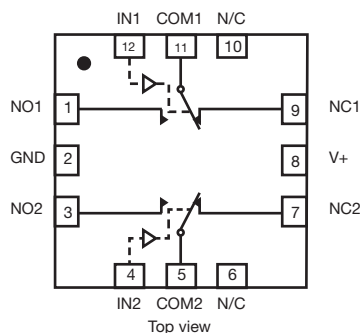
BENEFITS

- High linearity
- Low power consumption
- High bandwidth
- Full rail signal swing range

APPLICATIONS

- USB / UART signal switching
- Audio / video switching
- Cellular phone
- Media players
- Modems
- Hard drives
- PCMCIA

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE

| LOGIC | NC1 AND NC2 | NO1 AND NO2 |
|-------|-------------|-------------|
| 0 | ON | OFF |
| 1 | OFF | ON |

ORDERING INFORMATION

| TEMP. RANGE | PACKAGE | PART NUMBER |
|------------------|-----------------------------|------------------|
| -40 °C to +85 °C | 12-Pin QFN (3 mm x 3 mm) | DG2032EDN-T1-GE4 |

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | LIMIT | UNIT |
|--|---------------------------------------|--------------------|------|
| Reference to GND | | | |
| V+ | | -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 | 12-Pin QFN (3 mm x 3 mm) ^c | 1295 | mW |
| ESD / HBM | EIA / JESD22-A114-A | 7.5k | V |
| ESD / CDM | EIA / JESD22-C101-A | 1.5k | |
| Latch up | JESD78 | 300 | mA |

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 4 mW/°C above 70 °C



| SPECIFICATIONS (V+ = 3 V) | | | | | | | | | |
|--------------------------------|--------------|---|--------------------------|----------------------------|--------|--------|------|-----|---|
| PARAMETER | SYMBOL | TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 3 V, ± 10 %, VINL = 0.5 V, VINH = 1.5 V e | TEMP. a | LIMITS -40 °C to +85 °C | | | UNIT | | |
| | | | | MIN. c | TYP. b | MAX. c | | | |
| Analog Switch | | | | | | | | | |
| Analog signal range d | VANALOG | | Full | 0 | - | V+ | V | | |
| Drain-source on-resistance | RDS(on) | V+ = 1.8 V, VNC/NO = 0.4 V / V+, INC/NO = 8 mA | Room | - | 7 | 11 | Ω | | |
| | | | Full | - | - | 13 | | | |
| | | V+ = 2.7 V, VCOM = 0.8 V / 1.8 V, ICOM = 10 mA | Room | - | 4.6 | 5.5 | | | |
| | | | Full | - | - | 6.5 | | | |
| On-resistance matching | ΔRDS(on) | V+ = 2.7 V, VCOM = 0.8 V / 1.4 V / 1.8 V, ICOM = 10 mA | Room | - | 0.02 | 0.3 | | | |
| On-resistance flatness d, f | Rflat(on) | | Full | - | - | 0.6 | | | |
| | | | Room | - | 0.62 | 1 | | | |
| | | | Full | - | - | 1.5 | | | |
| Off leakage current g | INC/NO(off) | V+ = 3.6 V, VNC/NO = 1 V / 3.2 V, VCOM = 3.2 V / 1 V | Room | -1 | 0.01 | 1 | nA | | |
| Channel-on leakage current g | ICOM(on) | Full | -5 | - | 5 | | | | |
| | | Room | -1 | 0.01 | 1 | | | | |
| | | Full | -5 | - | 5 | | | | |
| Digital Control | | | | | | | | | |
| Input current d | IINL or IINH | | Full | -1 | - | 1 | μA | | |
| Input high voltage d | VINH | | Full | 1.5 | - | - | V | | |
| Input low voltage d | VINL | | Full | - | - | 0.4 | | | |
| Digital input capacitance d | CIN | | Room | - | 3 | - | pF | | |
| Dynamic Characteristics | | | | | | | | | |
| Turn-on time | tON | VNC/NO = 3 V, CL = 35 pF, RL = 300 Ω | Room | - | 19 | 45 | ns | | |
| Turn-off time | tOFF | | Full | - | - | 50 | | | |
| | | | Room | - | 9 | 35 | | | |
| | | | Full | - | - | 45 | | | |
| | | | Break-before-make time d | tBBM | Room | 4 | | 11 | - |
| Full | 3 | | | | - | - | | | |
| Charge injection d | QINJ | CL = 1 nF, Vgen = 1.5 V, Rgen = 0 Ω | Room | - | -9 | - | pC | | |
| Bandwidth d | BW | CL = 5 pF (set up capacitance) | Room | - | 226 | - | MHz | | |
| Off-isolation d | OIRR | RL = 50 Ω, CL = 5 pF | f = 1 MHz | Room | - | -55 | - | dB | |
| | | | f = 10 MHz | Room | - | -42 | - | | |
| Channel-to-channel crosstalk d | XTALK | RL = 50 Ω, CL = 5 pF | f = 1 MHz | Room | - | -61 | - | | |
| | | | f = 10 MHz | Room | - | -44 | - | | |
| NO, NC off capacitance d | CNO(off) | V+ = 2.7 V, f = 1 MHz | Room | - | 7 | - | pF | | |
| | CNC(off) | | Room | - | 7 | - | | | |
| Channel-on capacitance d | CNO(on) | | Room | - | 23 | - | | | |
| | CNC(on) | | Room | - | 23 | - | | | |
| Power Supply | | | | | | | | | |
| Power supply range | V+ | | | | 2.7 | - | | 3.3 | V |
| Power supply current d | I+ | V+ = 2.7 V, VIN = 0 V or 2.7 V | Full | - | - | 1 | μA | | |

Notes

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

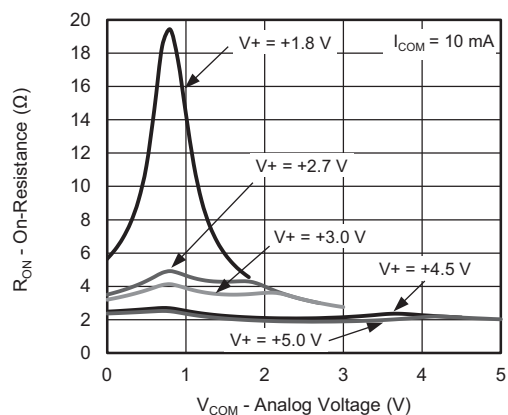
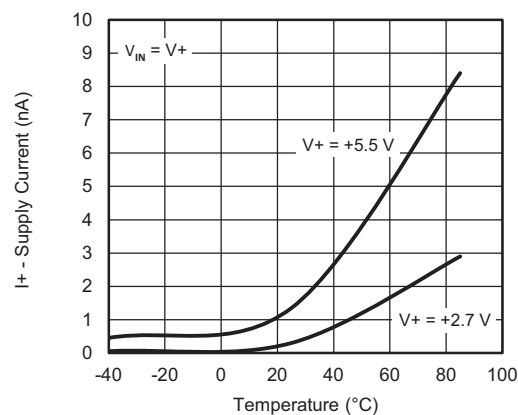
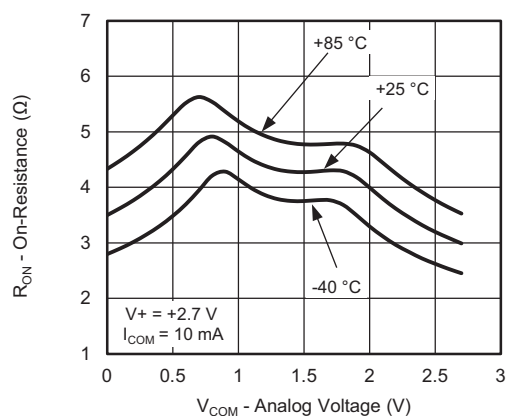
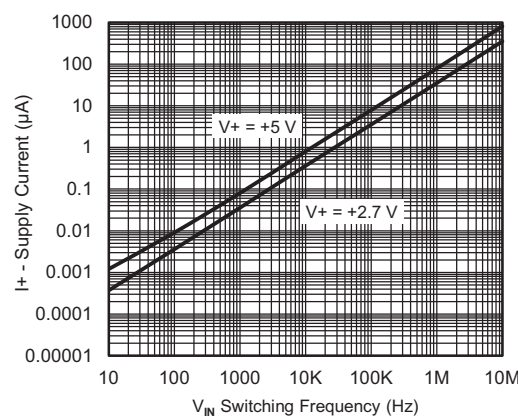
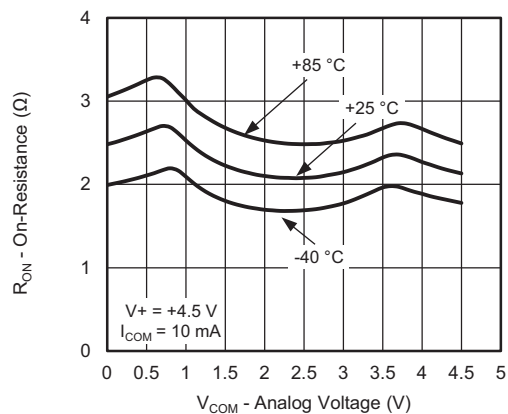
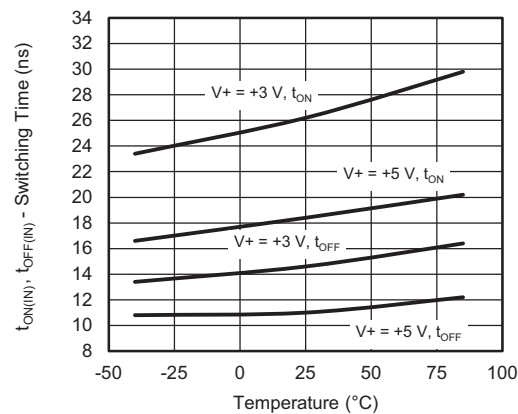


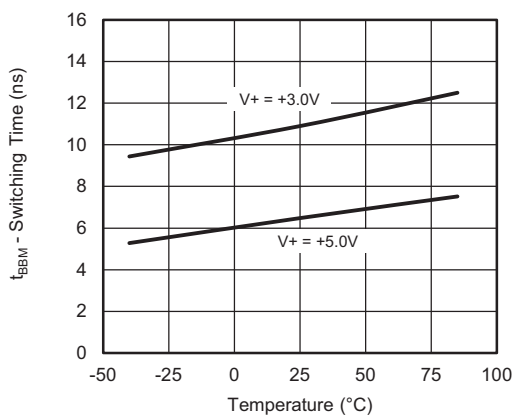
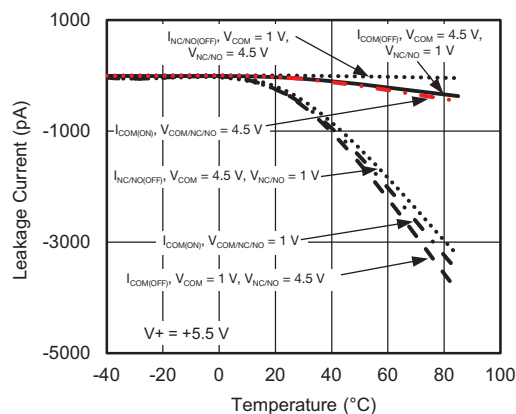
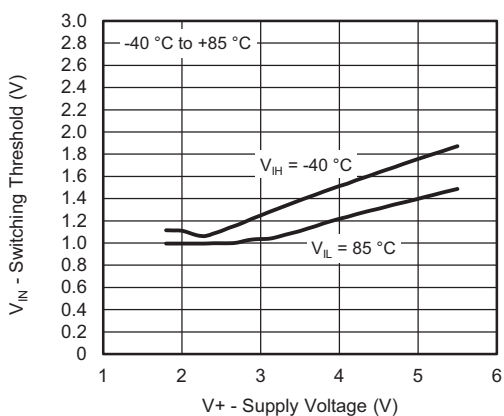
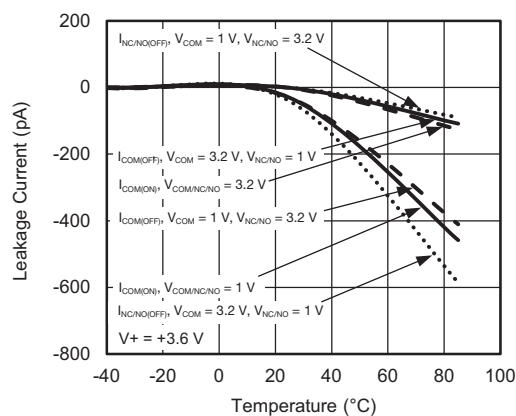
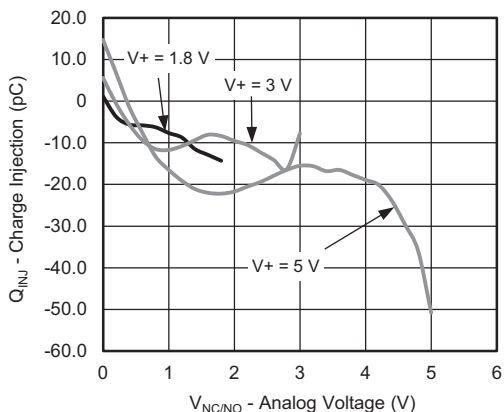
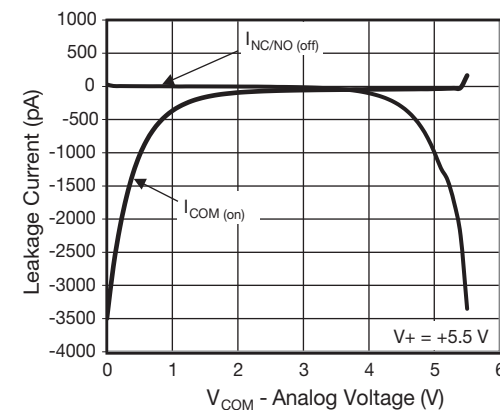
| SPECIFICATIONS (V+ = 5 V) | | | | | | | | |
|--------------------------------|--------------|---|------------|----------------------------|--------|--------|------|----|
| PARAMETER | SYMBOL | TEST CONDITIONS OTHERWISE UNLESS SPECIFIED V+ = 5 V, ± 10 %, VINL = 0.5 V, VINH = 2 V e | TEMP. a | LIMITS -40 °C to +85 °C | | | UNIT | |
| | | | | MIN. c | TYP. b | MAX. c | | |
| Analog Switch | | | | | | | | |
| Analog signal range d | VANALOG | | Full | 0 | - | V+ | V | |
| Drain-source on-resistance | RDS(on) | V+ = 4.5 V, VCOM = 0.8 V / 3.5 V; ICOM = 10 mA | Room | - | 2.5 | 3.1 | Ω | |
| | | | Full | - | - | 4 | | |
| On-resistance matching | ΔRDS(on) | V+ = 4.5 V, VCOM = 0.8 V / 2.5 V / 3.5 V, ICOM = 10 mA | Room | - | 0.01 | 0.4 | | |
| | | | Full | - | - | 0.6 | | |
| On-resistance flatness d, f | Rflat(on) | | Room | - | 0.61 | 1 | | |
| | | | Full | - | - | 1.5 | | |
| Off leakage current g | INC/NO(off) | V+ = 5.5 V, VNC/NO = 1 V / 4.5 V, VCOM = 4.5 V / 1 V | Room | -2 | 0.15 | 2 | nA | |
| | | | Full | -10 | - | 10 | | |
| Channel-on leakage current g | ICOM(on) | V+ = 5.5 V, VCOM = VNC/NO = 1 V / 4.5 V | Room | -2 | 0.20 | 2 | | |
| | | | Full | -10 | - | 10 | | |
| Power down leakage d | IPD | V+ = 0 V, VCOM = 5.5 V, NC/NO open | Full | - | 0.01 | 5 | μA | |
| | | V+ = 0 V, VNC/NO = 5.5 V, COM, open | Full | - | 0.01 | 3 | mA | |
| Digital Control | | | | | | | | |
| Input current d | IINL or IINH | | Full | -1 | - | 1 | μA | |
| Input high voltage d | VINH | | Full | 2 | - | - | V | |
| Input low voltage d | VINL | | Full | - | - | 0.5 | | |
| Digital input capacitance d | CIN | | Room | - | 3 | - | pF | |
| Dynamic Characteristics | | | | | | | | |
| Turn-on time | tON | VNC/NO = 3 V, CL = 35 pF, RL = 300 Ω | Room | - | 13 | 40 | ns | |
| | | | Full | - | - | 43 | | |
| Turn-off time | tOFF | | Room | - | 7 | 33 | | |
| | | | Full | - | - | 35 | | |
| Break-before-make time d | tBBM | | Room | 3 | 6 | - | | |
| | | | Full | 2 | - | - | | |
| Propagation delay d | tpd | V+ = 5 V, no RL | Room | - | 380 | - | ps | |
| Charge injection d | QINJ | CL = 1 nF, Vgen = 2.5 V, Rgen = 0 Ω | Room | - | -19.4 | - | pC | |
| Bandwidth d | BW | CL = 5 pF (set up capacitance) | Room | - | 221 | - | MHz | |
| Off-isolation d | OIRR | RL = 50 Ω, CL = 5 pF | f = 1 MHz | Room | - | -58 | - | dB |
| | | | f = 10 MHz | Room | - | -43 | - | |
| Channel-to-channel crosstalk d | XTALK | RL = 50 Ω, CL = 5 pF | f = 1 MHz | Room | - | -62 | - | |
| | | | f = 10 MHz | Room | - | -47 | - | |
| NO, NC off capacitance d | CNO(off) | V+ = 5 V, f = 1 MHz | Room | - | 7 | - | pF | |
| | CNC(off) | | Room | - | 7 | - | | |
| Channel-on capacitance d | CNO(on) | | Room | - | 23 | - | | |
| | CNC(on) | | Room | - | 23 | - | | |
| | | | | | | | | |
| Power Supply | | | | | | | | |
| Power supply range | V+ | | | 4.5 | - | 5.5 | V | |
| Power supply current d | I+ | V+ = 5.5 V, VIN = 0 V or 5.5 V | Full | - | - | 1 | μA | |

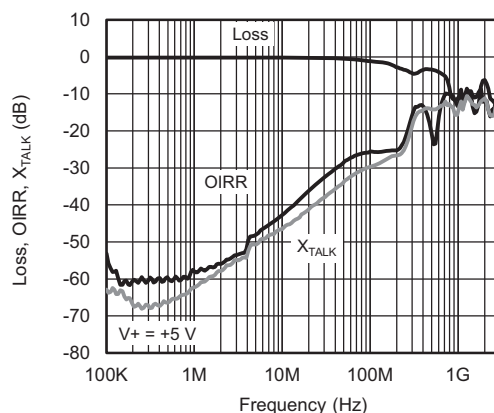
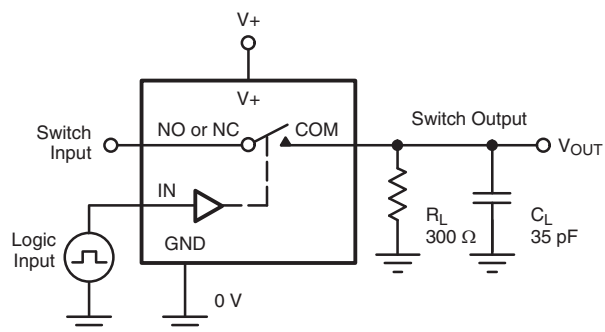
Notes

- 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, not 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 testing

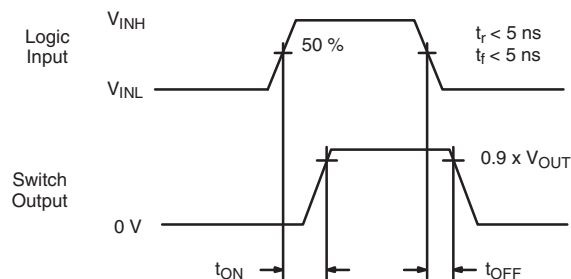
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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

 R_{ON} vs. V_{COM} and Single Supply Voltage

Supply Current vs. Temperature

 R_{ON} vs. Analog Voltage and Temperature

Positive Supply Current vs. Switching Frequency

 R_{ON} vs. Analog Voltage and Temperature

Switching Time vs. Temperature

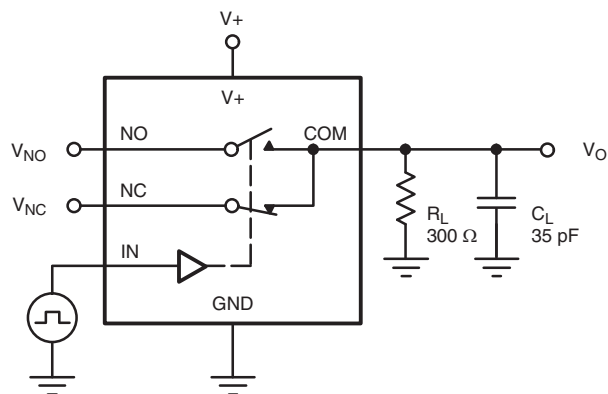
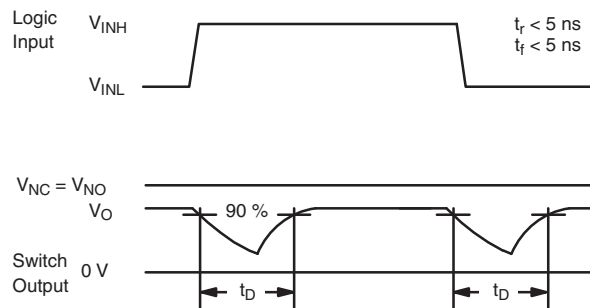
TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

Switching Time vs. Temperature

Leakage Current vs. Temperature

Switching Threshold vs. Supply Voltage

Leakage Current vs. Temperature

Charge Injection vs. Source Voltage

Leakage Current vs. Analog Voltage

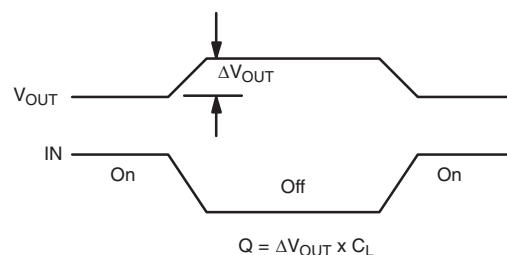
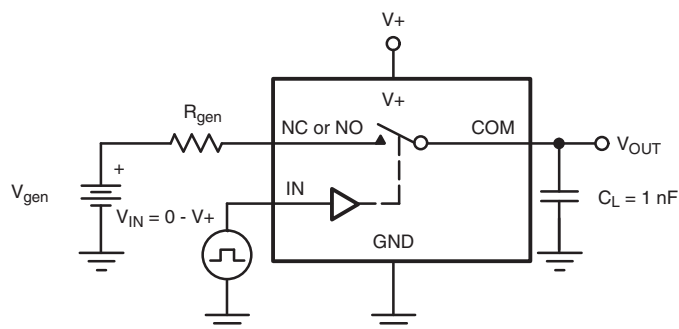
TYPICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, unless otherwise noted)

Loss, OIRR, X_{TALK} vs. Frequency
TEST CIRCUITS

 C_L (includes fixture and stray capacitance)

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

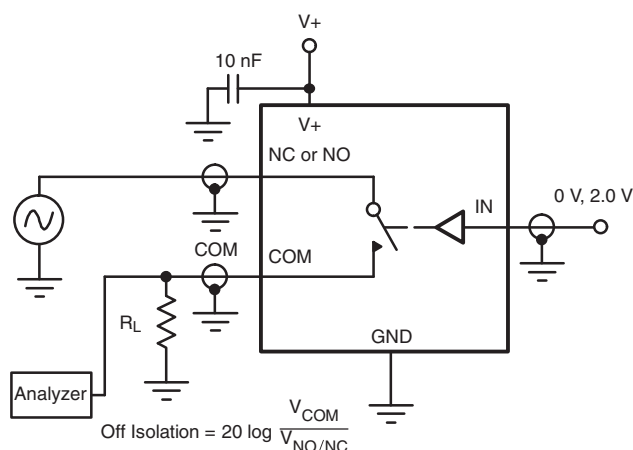
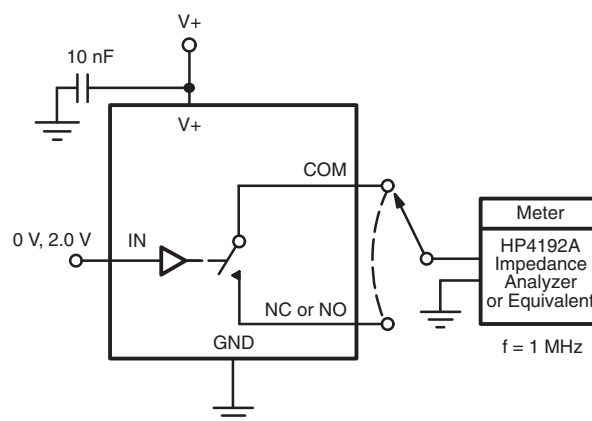
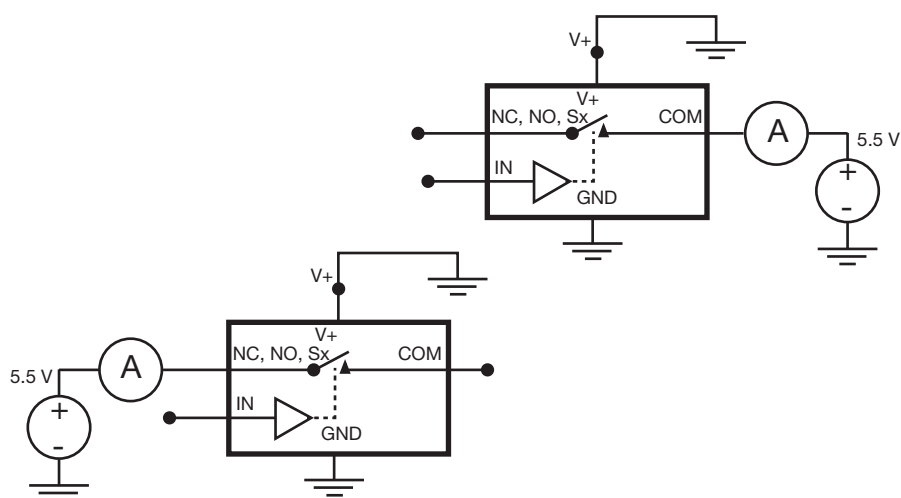


Logic "1" = Switch On
Logic input waveforms inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time

 C_L (includes fixture and stray capacitance)

Fig. 2 - Break-Before-Make Interval

TEST CIRCUITS


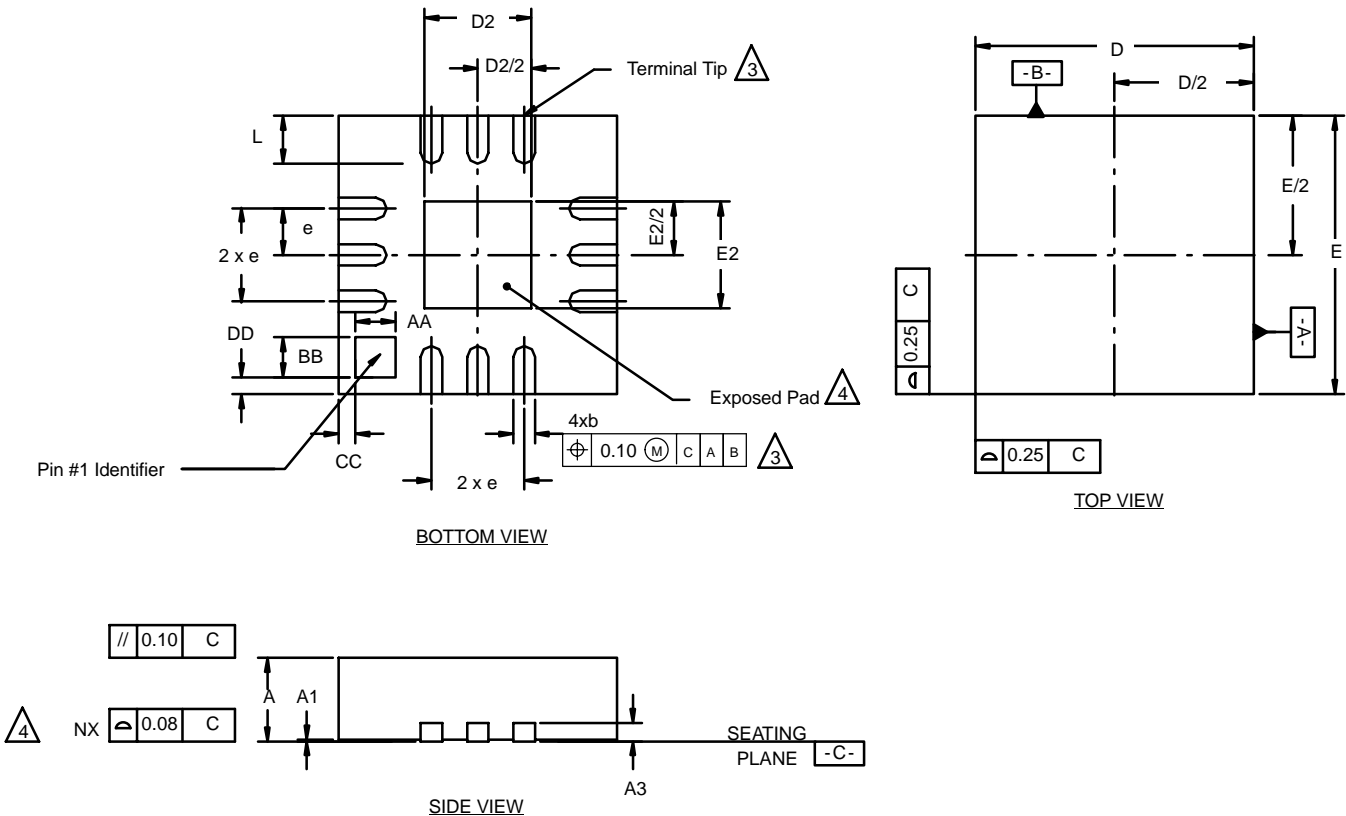
IN depends on switch configuration: input polarity determined by sense of switch.

Fig. 3 - Charge Injection

Fig. 4 - Off-Isolation

Fig. 5 - Channel Off / On Capacitance

Fig. 6 - Source / Drain Power Down Leakage

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?78604.



QFN-12 LEAD (3 X 3)



NOTES:

1. All dimensions are in millimeters.
2. N is the total number of terminals.
3. Dimension b applies to metallized terminal and is measured between 0.25 and 0.30 mm from terminal tip.
4. Coplanarity applies to the exposed heat sink slug as well as the terminal.
5. The pin #1 identifier may be either a mold or marked feature, it must be located within the zone indicated.

| Dim | MILLIMETERS | | | INCHES | | |
|---|-------------|------|------|-----------|-------|-------|
| | Min | Nom | Max | Min | Nom | Max |
| A | 0.80 | 0.90 | 1.00 | 0.032 | 0.035 | 0.039 |
| b | 0.18 | 0.23 | 0.30 | 0.007 | 0.009 | 0.012 |
| D | 3.00 BSC | | | 0.118 BSC | | |
| D2 | 1.00 | 1.15 | 1.25 | 0.039 | 0.045 | 0.049 |
| E | 3.00 BSC | | | 0.118 BSC | | |
| E2 | 1.00 | 1.15 | 1.25 | 0.039 | 0.045 | 0.049 |
| e | 0.50 BSC | | | 0.02 BSC | | |
| L | 0.45 | 0.55 | 0.65 | 0.018 | 0.022 | 0.026 |
| AA | 0.435 | | | 0.017 | | |
| BB | 0.435 | | | 0.017 | | |
| CC | 0.18 | | | 0.007 | | |
| DD | 0.18 | | | 0.007 | | |
| ECN: C-03092—Rev. A, 14-Apr-03 DWG: 5898 | | | | | | |



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