# 0.37 Ω, Low THD and Capacitance, Dual DPDT / Quad SPDT Analog Switch

## DESCRIPTION

The DG2525, is a four-channel single-pole double-throw (SPDT) analog switch with two control inputs. It is also known as a two-channel double-pole double-throw (DPDT) configuration. The part is designed to operate from 1.8 V to 5.5 V single power rail. All switches conduct equally well in both directions, offering rail to rail signal witching and can be used both as multiplexers as well as de-multiplexers.

The DG2525 offers low leakage, parasitic capacitance, and highly matched low and flat switch resistance over the full signal range. It features break-before-make switching and low control logic threshold. The part exhibits high bandwidth and excellent total harmonic distortion (THD). It is ideal for both analog and digital signal switching in space constrain applications requiring high performance and efficient use of board space.

The DG2525 comes in a small miniQFN-16 lead package of 2.6 mm x 1.8 mm x 0.55 mm.

## BENEFITS

- Low and flat resistance
- Excellent total harmonic distortion
- Low leakage and parasitic capacitance
- Low voltage control interface

## FEATURES

- 1.8 V to 5.5 V single supply operation
- Low resistance: 0.4 Ω/typ. at 2.7 V
- Highly flat and matched $R_{ON}$
- Low parasitic capacitance, $C_{ON}$ = 26 pF, $C_{OFF}$ = 14.5 pF
- Switch off leakage: 5 pA at V+ = 3.3 V, 40 pA at V+ = 5.5 V
- High bandwidth: 310 MHz
- -100 dB THD + N at 1 kHz, 0.9 $V_{RMS}$, $R_{LOAD}$ = 32 Ω
- Guaranteed logic high 1.2 V, logic low 0.3 V
- Break before make switching
- Signal swing over V+ capable
- Power down protection
- Latch up current: 300 mA (JESD78)
- ESD / HBM: > 6 kV
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

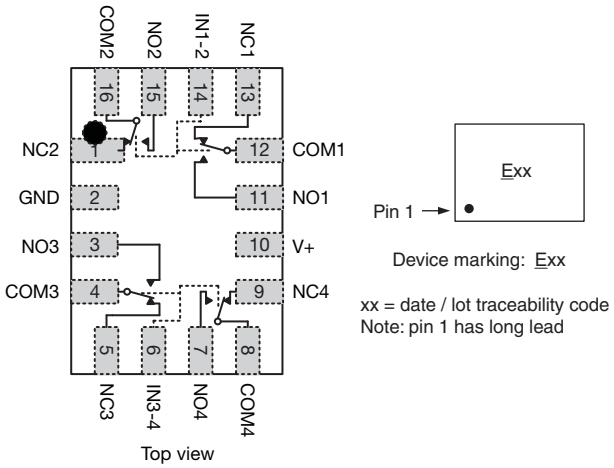
Pb-free

RoHS COMPLIANT

## APPLICATIONS

- Smart phones and tablets
- Portable instrumentation
- Audio and video signal switching
- Modems and peripherals
- Data storage
- Wireless pins
- Relay replacement

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION




| TRUTH TABLE | | |
|---|---|---|
| LOGIC | NC1, 2, 3, and 4 | NO1, 2, 3, and 4 |
| 0 | On | Off |
| 1 | Off | On |



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| ORDERING INFORMATION | | | |
|---|---|---|---|
| **TEMPERATURE RANGE** | **PACKAGE** | **PART NUMBER** | **MIN. ORDER / PACK. QUANTITY** |
| -40 °C to +85 °C lead (Pb)-free | miniQFN-16 | DG2525DN-T1-GE4 | Tape and reel, 3000 units |

**ABSOLUTE MAXIMUM RATINGS** ($T_A$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Reference to GND | V+ | | -0.3 to +6 | V |
| | IN, COM, NC, NO [a] | | -0.3 to (V+ + 0.3) | |
| Current (any terminal except NO, NC, or COM) | | | 30 | mA |
| Continuous current (NO, NC, or COM) | | | ± 300 | |
| Peak current (pulsed at 1 ms, 10 % duty cycle) | | | ± 500 | |
| Storage temperature (D suffix) | | | -65 to +150 | °C |
| Package solder reflow conditions [d] | miniQFN-16 | | 250 | |
| Power dissipation (packages) [b] | miniQFN-16 [c] | | 525 | 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 6.6 mW/°C above 70 °C.
d. Manual soldering with iron is not recommended for leadless components. The miniQFN-16 is a leadless package. The end of the lead terminal is exposed copper (not plated) as a result of the singulation process in manufacturing. A solder fillet at the exposed copper lip cannot be guaranteed and is not required to ensure adequate bottom side solder interconnection.

*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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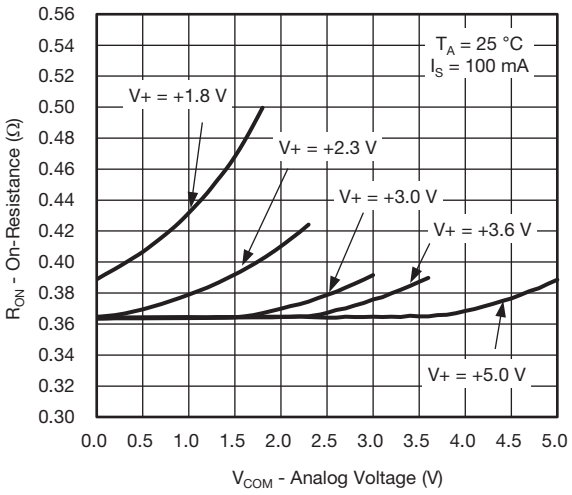
| SPECIFICATIONS (V+ = 3 V) | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS unless otherwise specified V+ = 3 V, ± 10 %, $V_{IN}$ = 0.5 or 1.4 V [e] | TEMP. [a] | LIMITS -40 °C to +85 °C | | | UNIT |
| | | | | MIN. [b] | TYP. [c] | MAX. [b] | |
| **Analog Switch** | | | | | | | |
| Analog signal range [d] | $V_{NO}$, $V_{NC}$, $V_{COM}$ | | Full | 0 | - | V+ | V |
| On-resistance | $R_{ON}$ | V+ = 2.7 V, $V_{COM}$ = 0 to 2.7 V, $I_{NO}$, $I_{NC}$ = 100 mA | Room | - | 0.37 | 0.5 | Ω |
| | | | Full | - | - | 0.6 | |
| $R_{ON}$ flatness [d] | $R_{ON}$ flatness | V+ = 2.7 V, $V_{COM}$ = 0 to V+, $I_{NO}$, $I_{NC}$ = 100 mA | Full | - | 0.03 | 0.08 | |
| $R_{ON}$ match [d] | $\Delta R_{ON}$ | | Room | - | 0.05 | - | |
| Switch off leakage current | $I_{NO(off)}$, $I_{NC(off)}$ | V+ = 5.5 V, $V_{NO}$, $V_{NC}$ = 0.5 V / 4 V, $V_{COM}$ = 4 V / 0.5 V | Room | -1 | 0.04 | 1 | nA |
| | | | Full | -5 | - | 5 | |
| | $I_{COM(off)}$ | | Room | -1 | 0.17 | 1 | |
| | | | Full | -5 | - | 5 | |
| Channel-on leakage current | $I_{COM(on)}$ | V+ = 5.5 V, $V_{NO}$, $V_{NC}$ = $V_{COM}$ = 0.5 V / 4 V | Room | -1 | 0.17 | 1 | |
| | | | Full | -5 | - | 5 | |
| **Digital Control** | | | | | | | |
| Input high voltage | $V_{INH}$ | | Full | 1.2 | - | - | V |
| Input low voltage | $V_{INL}$ | | | - | - | 0.3 | |
| Input capacitance | $C_{IN}$ | | Full | - | 5 | - | 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 $V_{NC}$ = 1.5 V, $R_L$ = 50 Ω, $C_L$ = 35 pF | Room | - | 38 | 60 | µs |
| | | | Full | - | - | 70 | |
| Turn-off time | $t_{OFF}$ | | Room | - | 0.43 | 1 | |
| | | | Full | - | - | 3 | |
| Break-before-make time | $t_d$ | | Full | 1 | - | - | |
| Charge injection [d] | $Q_{INJ}$ | $C_L$ = 1 nF, $V_{GEN}$ = 1.5 V, $R_{GEN}$ = 0 Ω | Room | - | -19 | - | pC |
| -3 dB bandwidth | BW | $R_L$ = 50 Ω, $C_L$ = 5 pF | Room | - | 310 | - | MHz |
| Off-isolation [d] | OIRR | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 100 kHz | Room | - | -82 | - | dB |
| | | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz | | - | -55 | - | |
| Crosstalk [d, f] | $X_{TALK}$ | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 100 kHz | | - | -89 | - | |
| | | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 1 MHz | | - | -61 | - | |
| Total harmonic distortion plus noise | THD + N | 2.5 V, signal peak to peak voltage $R_L$ = 32 Ω, f = 1 kHz | | - | -100 | - | |
| NO, NC off capacitance [d] | $C_{NO(off)}$ | f = 1 MHz | Room | - | 14.5 | - | pF |
| | $C_{NC(off)}$ | | | - | 14.5 | - | |
| Channel-on capacitance [d] | $C_{NO(on)}$ | | | - | 26 | - | |
| | $C_{NC(on)}$ | | | - | 26 | - | |
| **Power Supply** | | | | | | | |
| Power supply range | V+ | | | 1.8 | - | 5.5 | V |
| Power supply current | I+ | $V_{IN}$ = 0 or V+ | Full | - | 29 | 60 | µA |

**Notes**

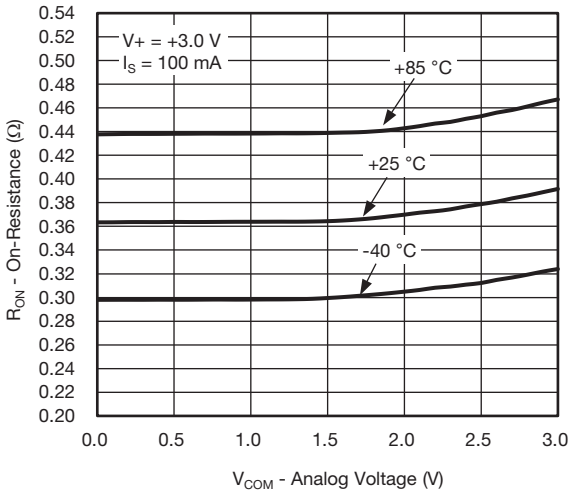
a. Room = 25 °C, full = as determined by the operating suffix.
b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
c. Typical values are for design aid only, not guaranteed nor subject to production testing.
d. Guarantee by design, not subjected to production test.
e. $V_{IN}$ = input voltage to perform proper function.
f. Crosstalk measured between channels.


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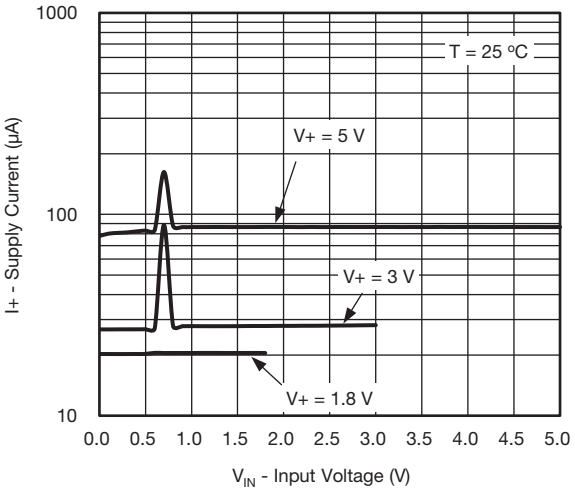
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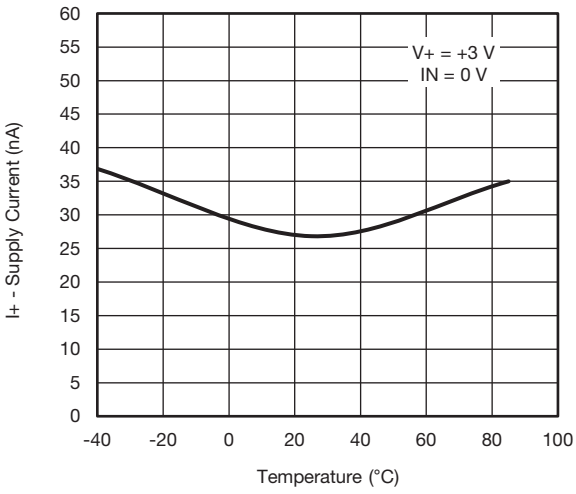

**$R_{ON}$ vs. $V_{COM}$ and Supply Voltage**



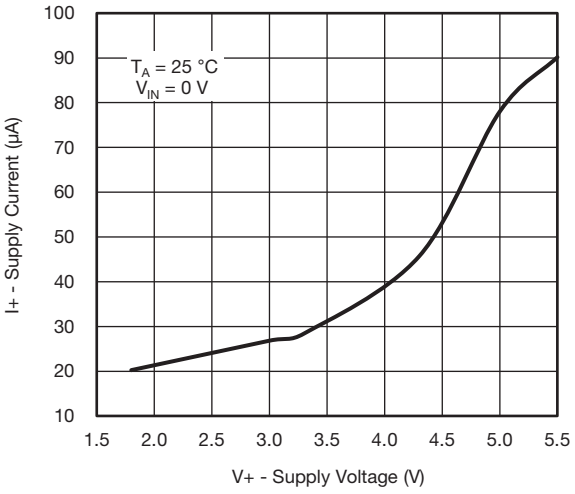

**$R_{ON}$ vs. Analog Voltage and Temperature**



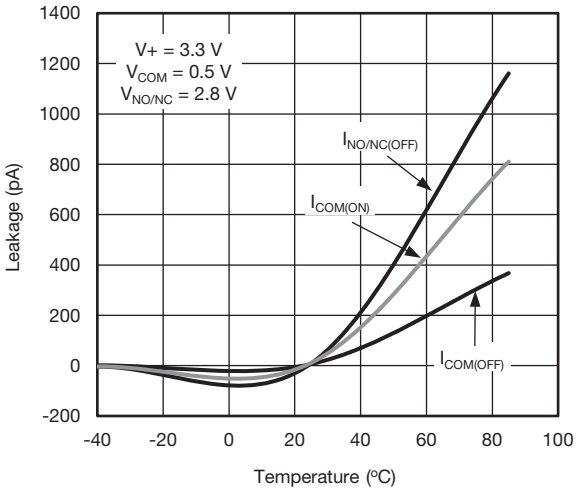

**Supply Current vs. Input Voltage**




**Supply Current vs. Temperature**



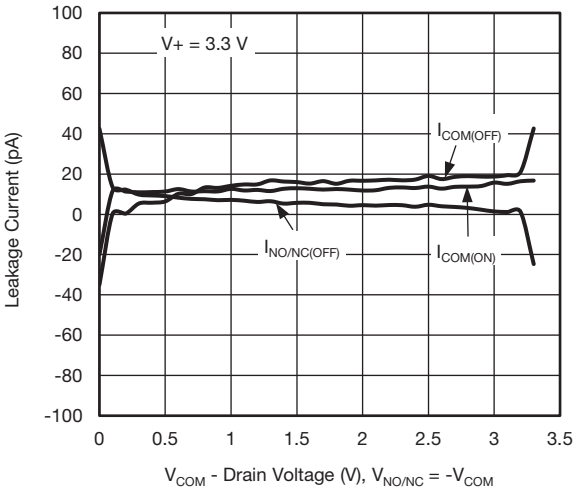

**Supply Current vs. Supply Voltage**



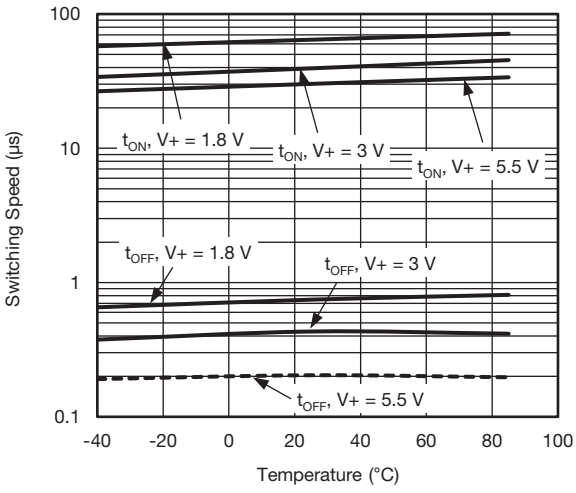

**Leakage Current vs. Temperature**


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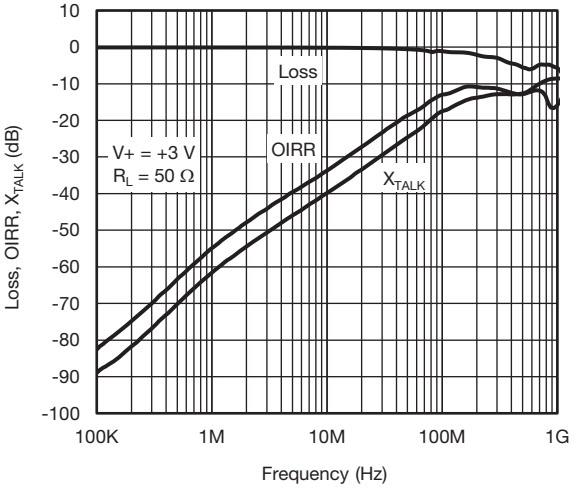
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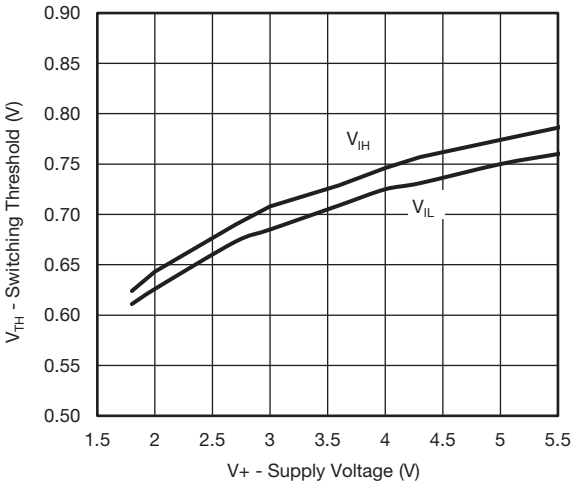

**Leakage Current vs. Drain Voltage**




**Switching Time vs. Temperature**



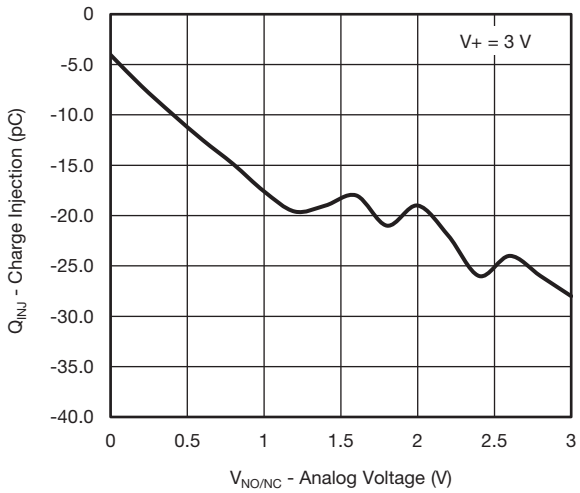

**Insertion Loss, Off-Isolation Crosstalk vs. Frequency**



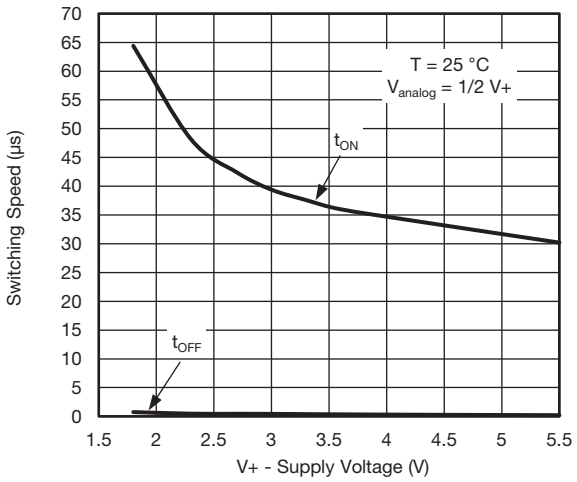

**Switching Threshold vs. Supply Voltage**


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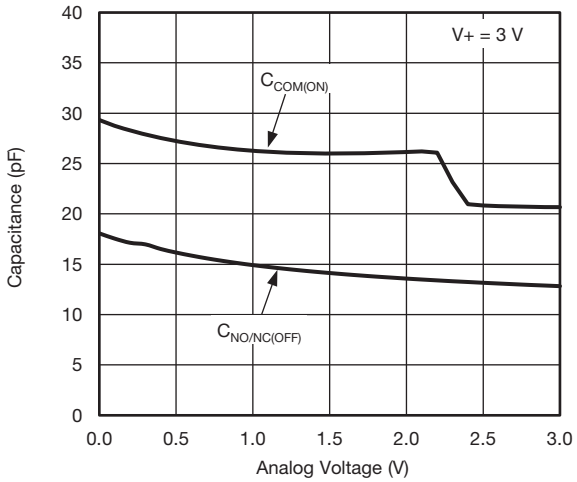
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)




**Charge Injection vs. Analog Voltage**



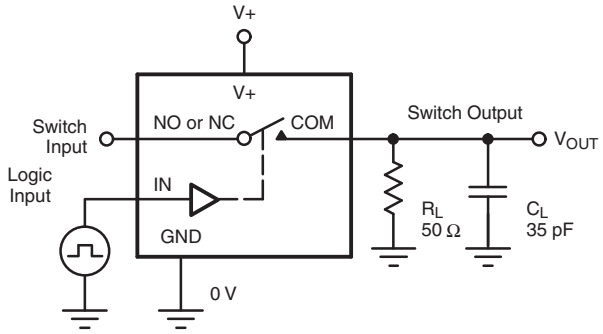

**Switching Time vs. Supply Voltage**




**Capacitance vs. Analog Voltage**

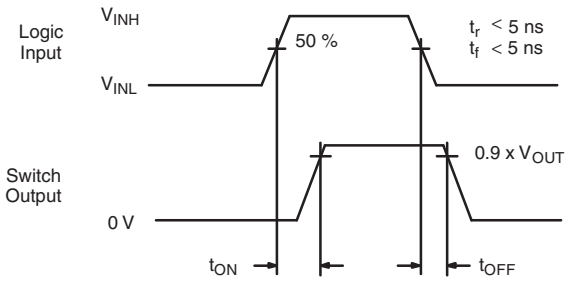

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## TEST CIRCUITS



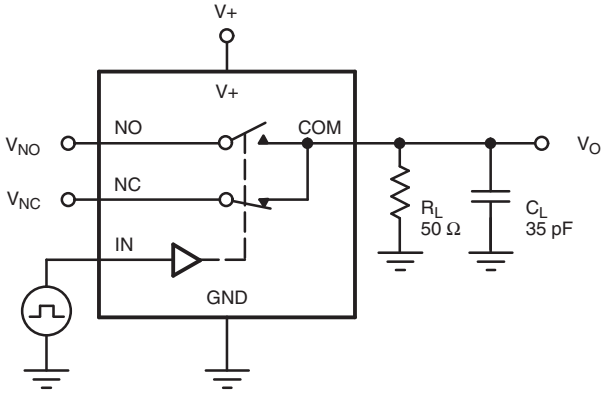

$C_L$ (includes fixture and stray capacitance)

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




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)

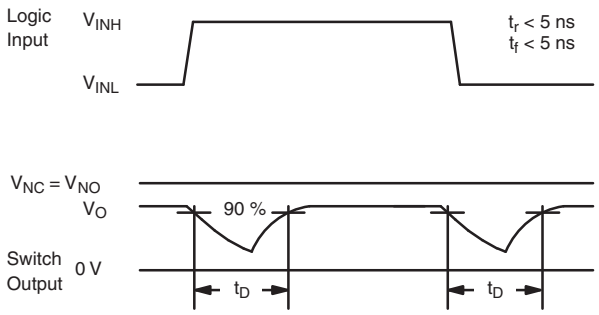
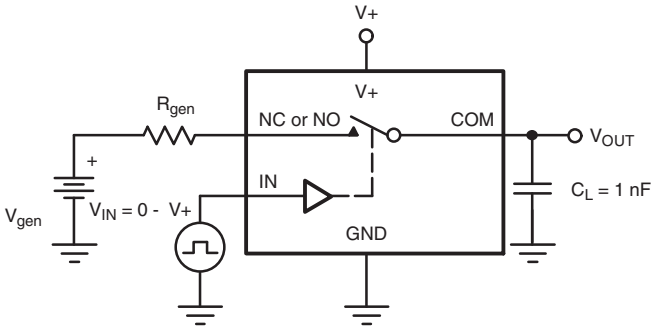
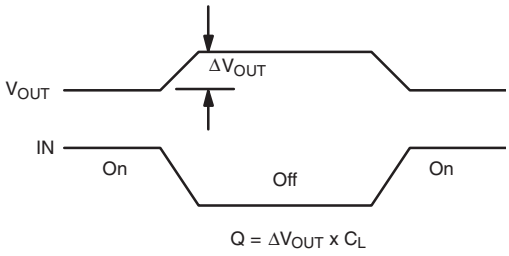



**Fig. 2 - Break-Before-Make Interval**




$Q = \Delta V_{OUT} \times C_L$

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

**Fig. 3 - Charge Injection**


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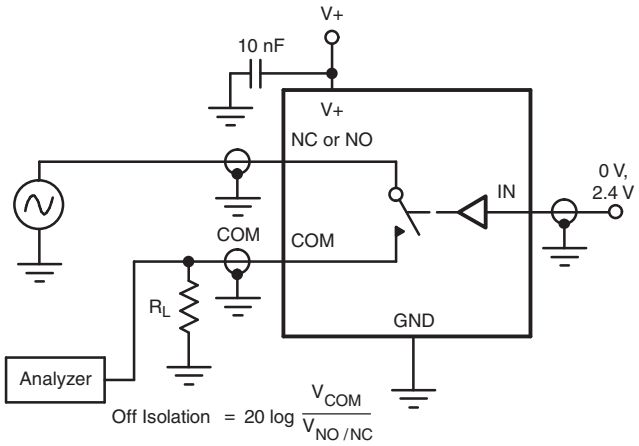



**Fig. 4 - Off-Isolation**

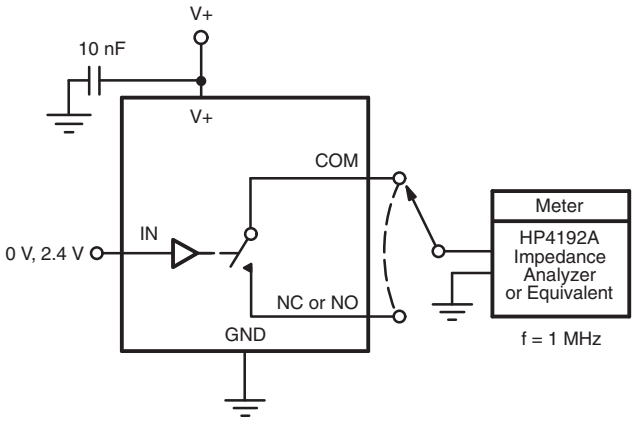
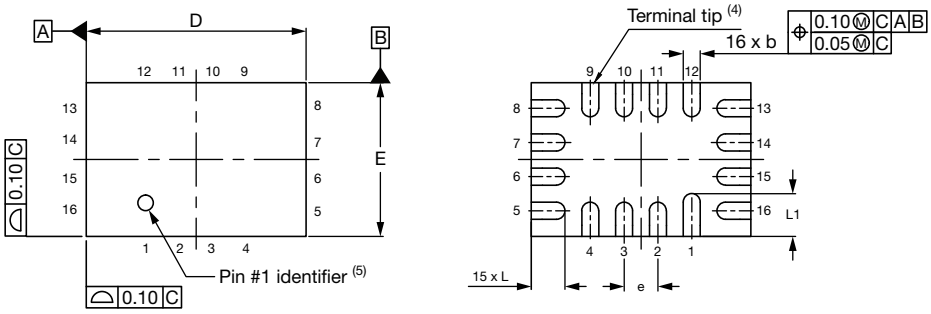



**Fig. 5 - Channel Off / On Capacitance**

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# Thin miniQFN16 Case Outline




| DIMENSIONS | MILLIMETERS (1) | | | INCHES | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.50 | 0.55 | 0.60 | 0.020 | 0.022 | 0.024 |
| A1 | 0 | - | 0.05 | 0 | - | 0.002 |
| A3 | 0.15 ref. | | | 0.006 ref. | | |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| D | 2.50 | 2.60 | 2.70 | 0.098 | 0.102 | 0.106 |
| e | 0.40 BSC | | | 0.016 BSC | | |
| E | 1.70 | 1.80 | 1.90 | 0.067 | 0.071 | 0.075 |
| L | 0.35 | 0.40 | 0.45 | 0.014 | 0.016 | 0.018 |
| L1 | 0.45 | 0.50 | 0.55 | 0.018 | 0.020 | 0.022 |
| N (3) | 16 | | | 16 | | |
| Nd (3) | 4 | | | 4 | | |
| Ne (3) | 4 | | | 4 | | |

**Notes**

(1) Use millimeters as the primary measurement.

(2) Dimensioning and tolerances conform to ASME Y14.5M. - 1994.

(3) N is the number of terminals. Nd and Ne is the number of terminals in each D and E site respectively.

(4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

(5) The pin 1 identifier must be existed on the top surface of the package by using identification mark or other feature of package body.

(6) Package warpage max. 0.05 mm.

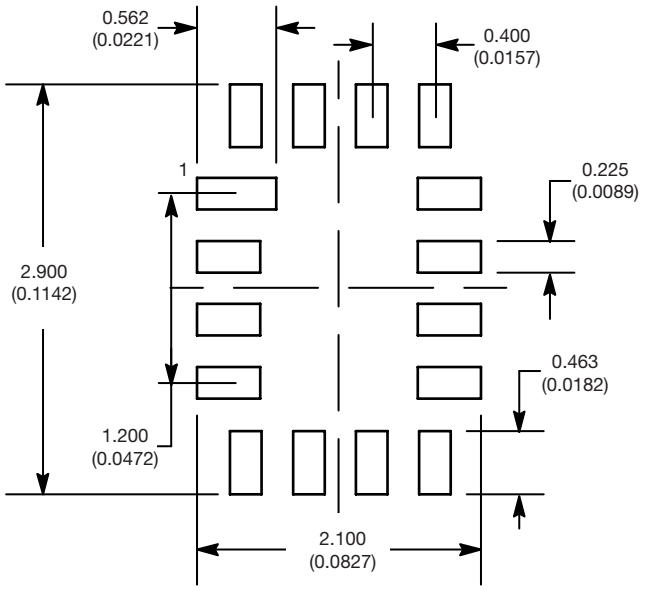
ECN: T16-0226-Rev. B, 09-May-16
DWG: 6023



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**RECOMMENDED MINIMUM PADS FOR MINI QFN 16L**




Mounting Footprint
Dimensions in mm (inch)

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