# 2 Port, USB 2.0 High Speed (480 Mbps) Switch, DPDT Analog Switch

## DESCRIPTION

The DG2730 is 2 port high speed analog switch optimized for USB 2.0 signal switching. The DG2730 switch is configured in DPDT. It handles bidirectional signal flow, achieving a 900 MHz -3 dB bandwidth, a port to port crosstalk at -36 dB and isolation at -29 dB, measured at 240 MHz.

Processed with high density sub micron CMOS, the DG2730 provide low parasitic capacitance. Signals are routed with minimized phase distortion and attain a bit to bit skew is as low as 40 ps.

The DG2730 is designed for a wide range of operating voltages, from 2.7 V to 5.5 V that can be driven directly from one cell Li-ion battery or 5 V power supply. On-chip circuitry protects against conditions when either the D+ / D- lines are shorted to the $V_{BUS}$ at the USB port. Additionally, logic control pins (S and $\overline{OE}$) can tolerate the presence of voltages that are above the supply power rail (V+). The control logic threshold is guaranteed to be ($V_{IH}$ = 1.3 V/min up to V+ = 3.6 V). Latch up current is 500 mA, as per JESD78, and its ESD tolerance exceeds 5.5 kV.

Packaged in ultra small miniQFN-10 (1.4 mm x 1.8 mm x 0.55 mm), it is ideal for portable high speed mix signal switching application.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device termination. The miniQFN-10 package has a nickel-palladium-gold device termination and is represented by the lead (Pb)-free "-GE4" suffix to the ordering part number. The nickel-palladium-gold device terminations meet all JEDEC® standards for reflow and MSL rating.

As a further sign of Vishay Siliconix's commitment, the DG2730 is fully RoHS-complaint.

## FEATURES

- Wide operation voltage range
- Low on-resistance, 5.5 Ω (typical at 3 V)
- Low capacitance, $C_{ON}$ = 5.8 pF (typical)
- 3 dB high bandwidth: 900 MHz (typical)
- Low bit to bit skew: 40 ps (typical)
- Low power consumption
- Low logic threshold: V
- Power down protection: D+/D- pins can tolerate up to 5.5 V when V+ = 0 V
- 5.5 kV ESD protection (HBM)
- Latch-up current 500 mA per JESD78
- Lead (Pb)-free low profile miniQFN-10 (1.4 mm x 1.8 mm x 0.55 mm)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

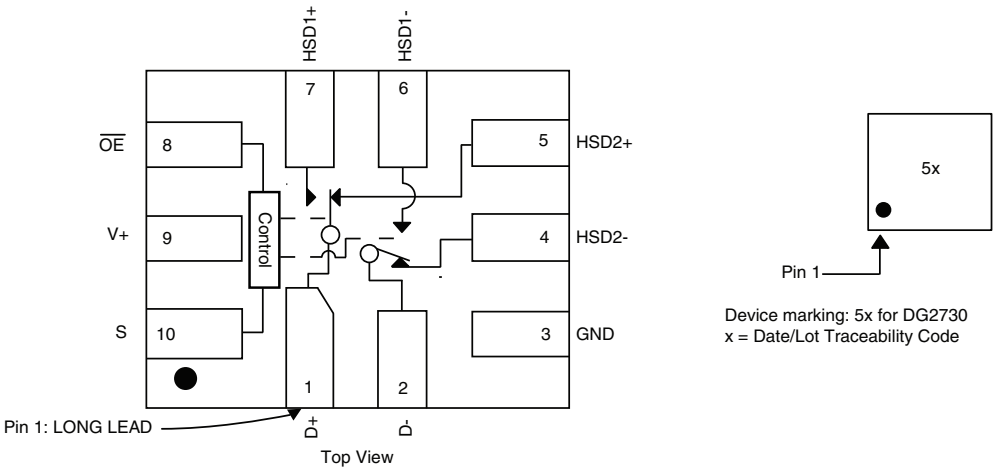
HALOGEN FREE

## APPLICATIONS

- Cellular phones
- Portable media players
- PDA
- Digital camera
- GPS
- Notebook computer
- TV, monitor, and set top box

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION

**miniQFN-10L**



| ORDERING INFROMATION | | |
|---|---|---|
| **TEMP. RANGE** | **PACKAGE** | **PART NUMBER** |
| -40 °C to 85 °C | miniQFN-10 | DG2730DN-T1-GE4 |

| TRUTH TABLE | | |
|---|---|---|
| **$\overline{OE}$ (PIN 8)** | **S (PIN 10)** | **FUNCTION** |
| 0 | 1 | D+ = HSD1+ and D- = HSD1- |
| 0 | 0 | D+ = HSD2+ and D- = HSD2- |
| 1 | X | Disconnect |

| PIN DESCRIPTIONS | |
|---|---|
| **PIN NAME** | **DESCRIPTION** |
| $\overline{OE}$ | Bus switch enable |
| S | Select input |
| HSD1±, HSD2±, D± | Data port |

| ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25 °C, unless otherwise noted) | | | |
|---|---|---|---|
| **PARAMETER** | | **LIMIT** | **UNIT** |
| Reference to GND | V+ | -0.3 to 6 | V |
| | S, $\overline{OE}$, D±, HSD1±, HSD2± [a] | -0.3 to (V+ + 0.3) | |
| Current (Any Terminal Except S, $\overline{OE}$, D±, HSD1±, HSD2±) | | 30 | mA |
| Continuous Current (S, $\overline{OE}$, D±, HSD1±, HSD2±) | | ± 250 | |
| Peak Current (Pulsed at 1 ms, 10 % duty cycle) | | ± 500 | |
| Storage Temperature (D suffix) | | -65 to +150 | °C |
| Power Dissipation (Packages) [b] | miniQFN-10 [c] | 208 | mW |
| ESD (Human body model) | | 5.5 | kV |
| Latch-Up (Current injection) | | 500 | mA |

**Notes**

a. Signals on S, $\overline{OE}$, D±, HSD1±, HSD2± 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 2.6 mW/°C above 70 °C.

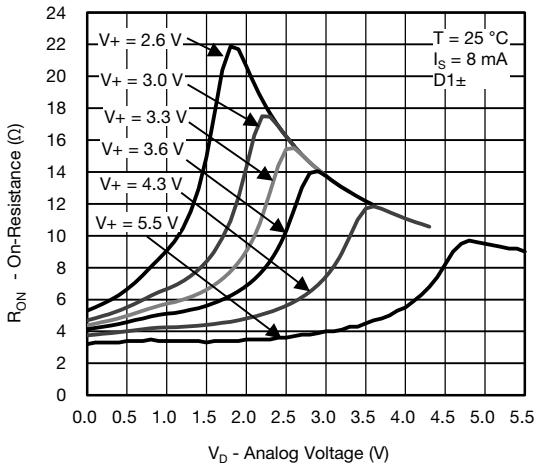
*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

| **SPECIFICATIONS** (V+ = 3 V) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS OTHERWISE UNLESS SPECIFIED** | **TEMP.** [a] | **LIMITS -40 °C to +85 °C** | | | **UNIT** |
| | | | | **MIN.** [b] | **TYP.** [c] | **MAX.** [b] | |
| **Analog Switch** | | | | | | | |
| Analog Signal Range [d] | $V_{ANALOG}$ | $R_{DS(on)}$ | Full | 0 | - | V+ | V |
| On-Resistance | $R_{DS(on)}$ | V+ = 3 V, $I_{D±}$ = 8 mA, $V_{HSD1/2±}$ = 0.4 V | Room | - | 5.5 | 8 | Ω |
| | | | Full | - | - | 9 | |
| On-Resistance Match [d] | $\Delta R_{ON}$ | V+ = 3 V, $I_{D±}$ = 8 mA, $V_{HSD1/2±}$ = 0.4 V | Room | - | 0.8 | - | |
| On-Resistance Flatness [d] | $R_{ON}$ Flatness | V+ = 3 V, $I_{D±}$ = 8 mA, $V_{HSD1/2±}$ = 0 V, 1 V | Room | - | 2 | - | |
| Switch Off Leakage Current | $I_{off}$ | V+ = 4.3 V, $V_{HSD1/2±}$ = 0.3 V, 3 V, $V_{D±}$ = 3 V, 0.3 V | Full | -100 | - | 100 | nA |
| Channel On Leakage Current | $I_{on}$ | V+ = 4.3 V, $V_{HSD1/2±}$ = 0.3 V, 4 V, $V_{D±}$ = 4 V, 0.3 V | Full | -200 | - | 200 | |
| **Digital Control** | | | | | | | |
| Input Voltage High | $V_{INH}$ | V+ = 3 V to 3.6 V | Full | 1.3 | - | - | V |
| | | V+ = 4.3 V | Full | 1.5 | - | - | |
| Input Voltage Low | $V_{INL}$ | V+ = 3 V to 4.3 V | Full | - | - | 0.5 | |
| Input Capacitance | $C_{IN}$ | | Full | - | 6.5 | - | pF |
| Input Current | $I_{INL}$ or $I_{INH}$ | $V_{IN}$ = 0 or V+ | Full | -1 | - | 1 | µA |
| **Dynamic Characteristics** | | | | | | | |
| Break-Before-Make Time [d] | $t_{BBM}$ | V+ = 3 V, $V_{D1/2 ±}$ = 1.5 V, $R_L$ = 50 Ω, $C_L$ = 35 pF | Room | - | 5 | - | ns |
| | | | Full | - | 5 | - | |
| S, $\overline{OE}$ Turn-On Time [d] | $t_{ON}$ | | Room | - | - | 30 | |
| | | | Full | - | - | 30 | |
| S, $\overline{OE}$ Turn-Off Time [d] | $t_{OFF}$ | | Room | - | - | 25 | |
| | | | Full | - | - | 25 | |
| Charge Injection [d] | $Q_{INJ}$ | $C_L$ = 1 nF, $R_{GEN}$ = 0 Ω, $V_{GEN}$ = 0 V | Room | - | 3 | - | pC |
| Off-Isolation [d] | OIRR | V+ = 3 V to 3.6 V, $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 240 MHz | | - | -29 | - | dB |
| Crosstalk [d, e] | $X_{TALK}$ | | | - | -36 | - | |
| Bandwidth [d] | BW | V+ = 3 V to 3.6 V, $R_L$ = 50 Ω, - 3 dB | | - | 900 | - | MHz |
| D+/D- On Capacitance | $C_{ON}$ | V+ = 3.3 V, $\overline{OE}$ = 0 V, f = 240 MHz | | - | 5.8 | - | pF |
| D1n, D2n Off Capacitance | $C_{OFF}$ | V+ = $\overline{OE}$ = 3.3 V, f = 240 MHz | | - | 2.2 | - | |
| Channel-to-Channel Skew [d] | $t_{SK(O)}$ | V+ = 3 V to 3.6 V, $R_L$ = 50 Ω, $C_L$ = 5 pF | | - | 50 | - | ps |
| Skew Off Opposite Transitions of the Same Output [d] | $t_{SK(p)}$ | | | - | 20 | - | |
| Total Jitter [d] | $t_J$ | | | - | 200 | - | |
| **Power Supply** | | | | | | | |
| Power Supply Range | V+ | | - | 2.6 | - | 5.5 | V |
| Power Supply Current | I+ | $V_{IN}$ = 0 V, or V+ | Full | - | - | 2 | µA |

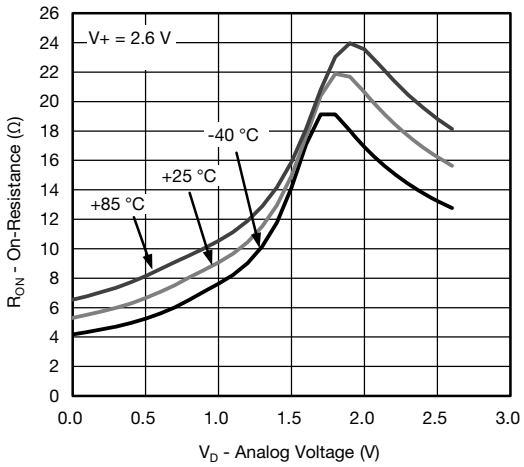
**Notes**

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 datasheet.
c. Typical values are for design aid only, not guaranteed nor subject to production testing.
d. Guaranteed by design, not subjected to production test.
e. Crosstalk measured between channels.

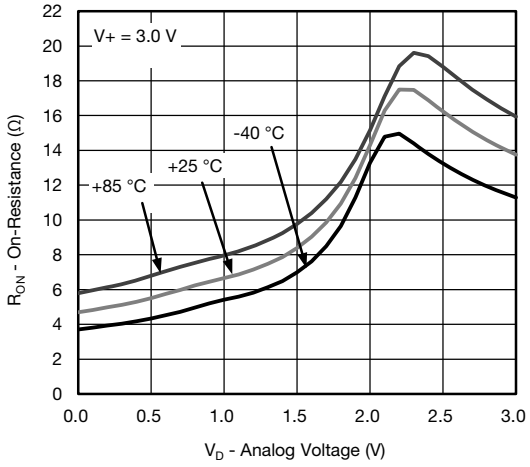
## TYPICAL CHARACTERISTICS ($T_A$ = 25 °C, unless otherwise noted)



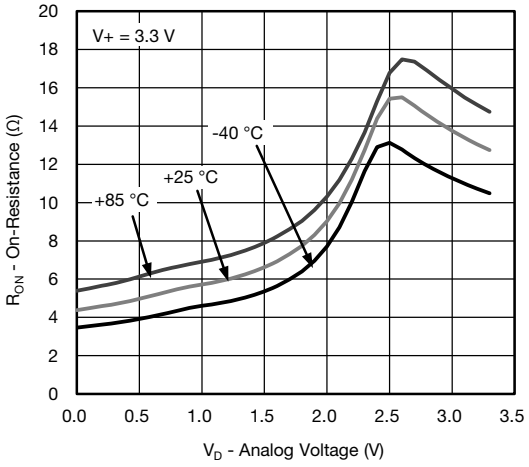

**$R_{ON}$ vs. $V_D$ and Single Supply Voltage**



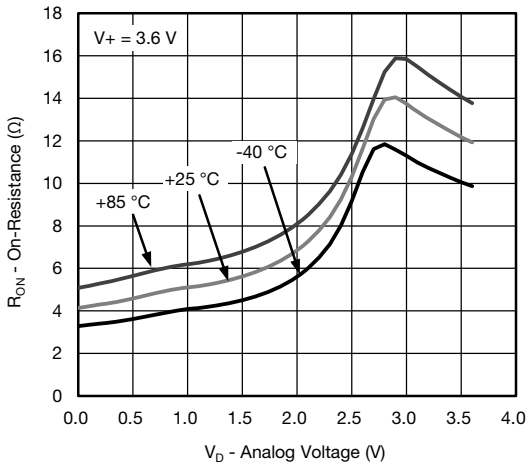

**$R_{ON}$ vs. Analog Voltage and Temperature**



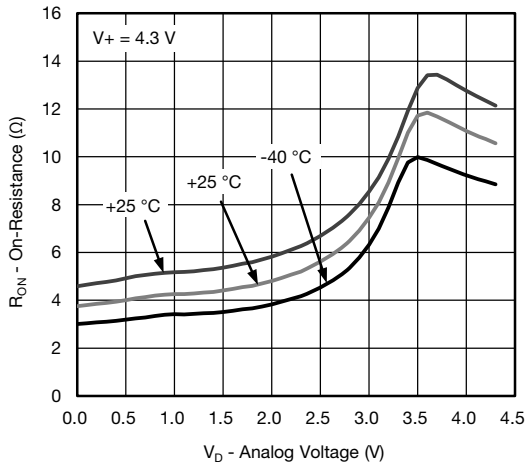

**$R_{ON}$ vs. Analog Voltage and Temperature**




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

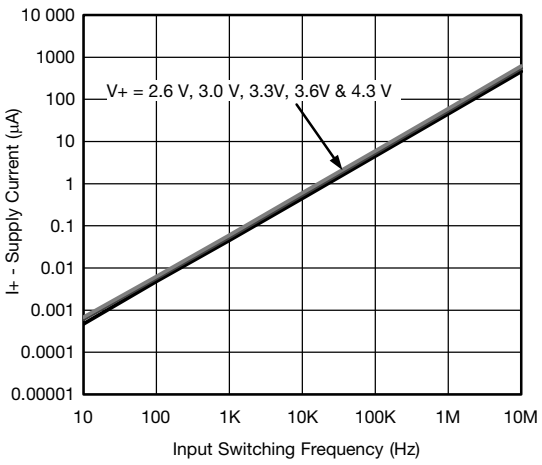



**$R_{ON}$ vs. Analog Voltage and Temperature**

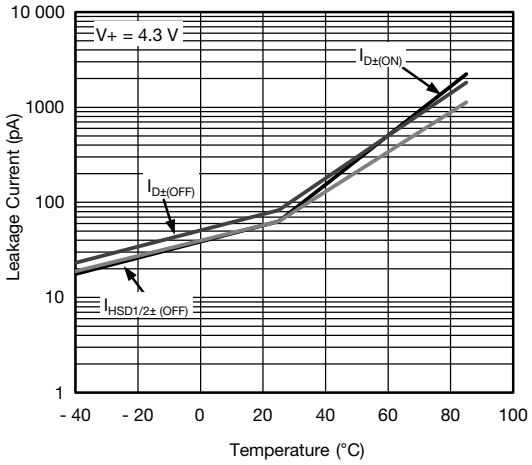



**$R_{ON}$ vs. Analog Voltage and Temperature**

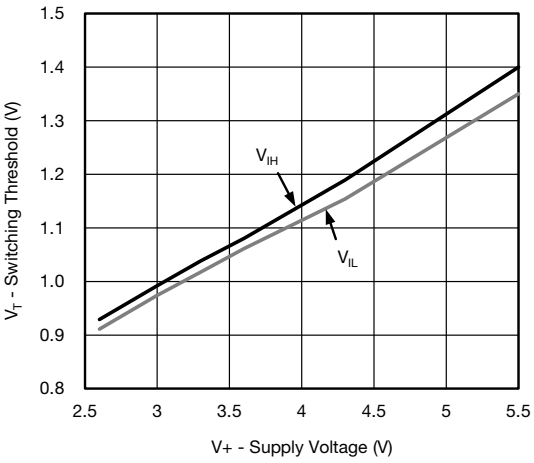
**TYPICAL CHARACTERISTICS**($T_A$ = 25 °C, unless otherwise noted)



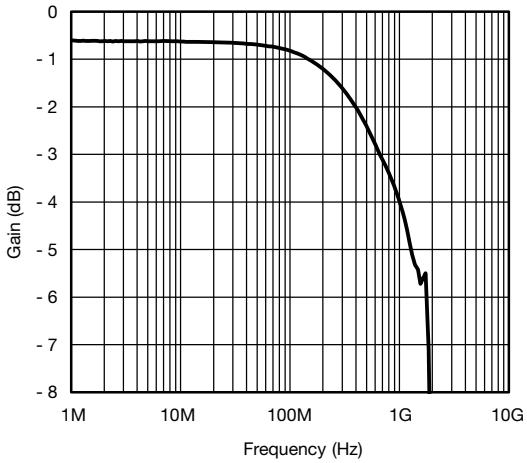

**Supply Current vs. Input Switching Frequency**



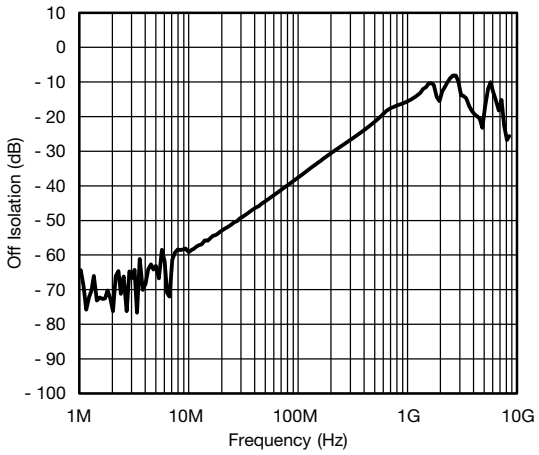

**Leakage Current vs. Temperature**



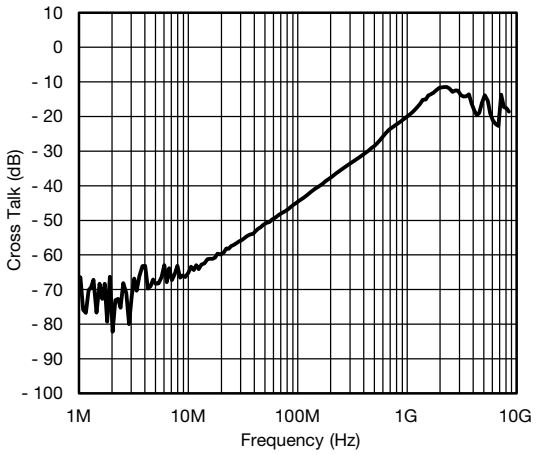

**Switching Threshold vs. Supply Voltage**




**Gain vs. Frequency, V+ = 3.3 V**

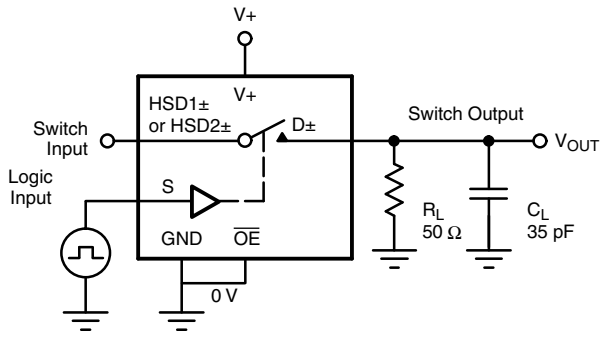



**Off-Isolation, V+ = 3.3 V**



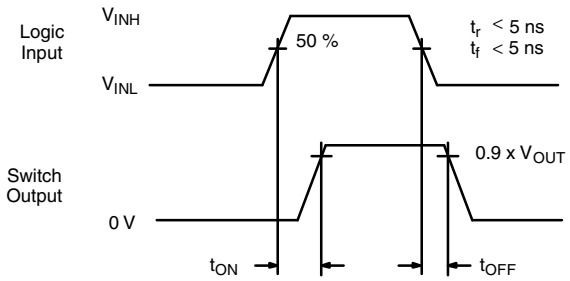

**Crosstalk, V+ = 3.3 V**

## TEST CIRCUITS



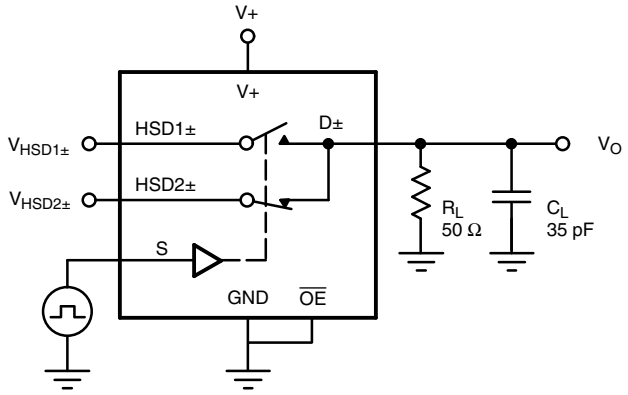

$C_L$ (includes fixture and stray capacitance)

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




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)

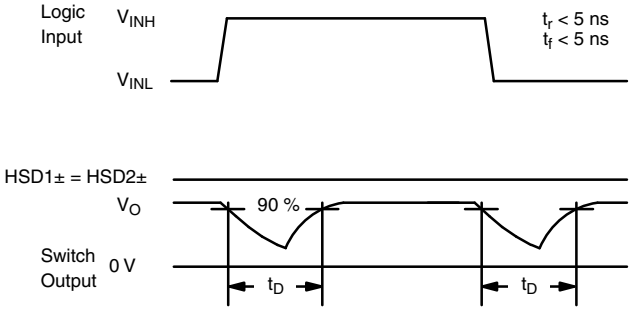
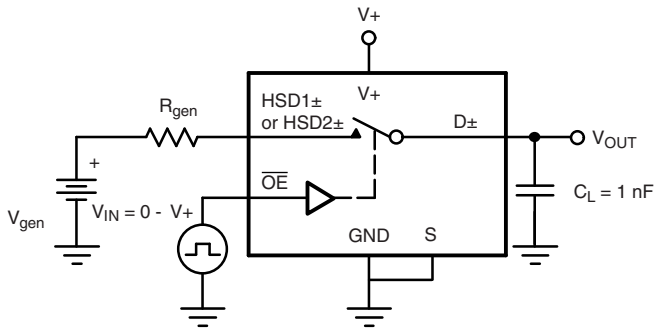
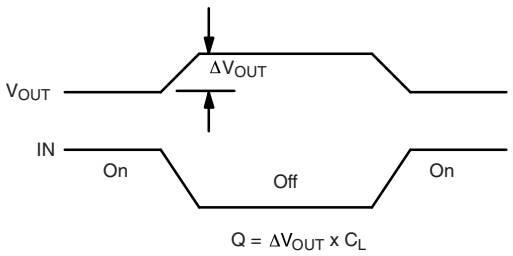



**Fig. 2 - Break-Before-Make Interval**




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

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

**Fig. 3 - Charge Injection**

## TEST CIRCUITS

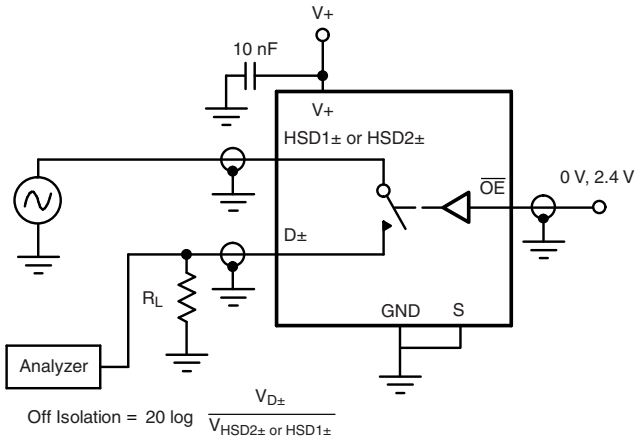



**Fig. 4 - Off-Isolation**

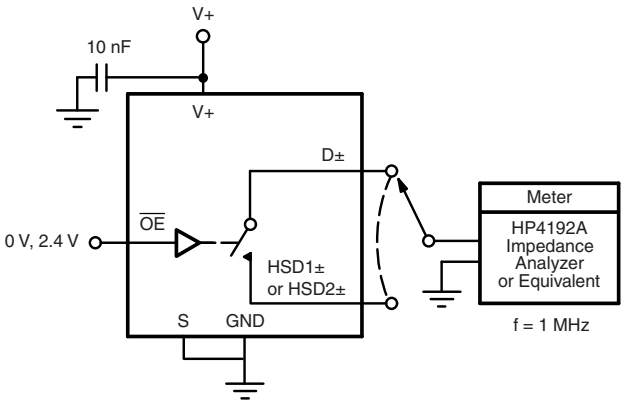
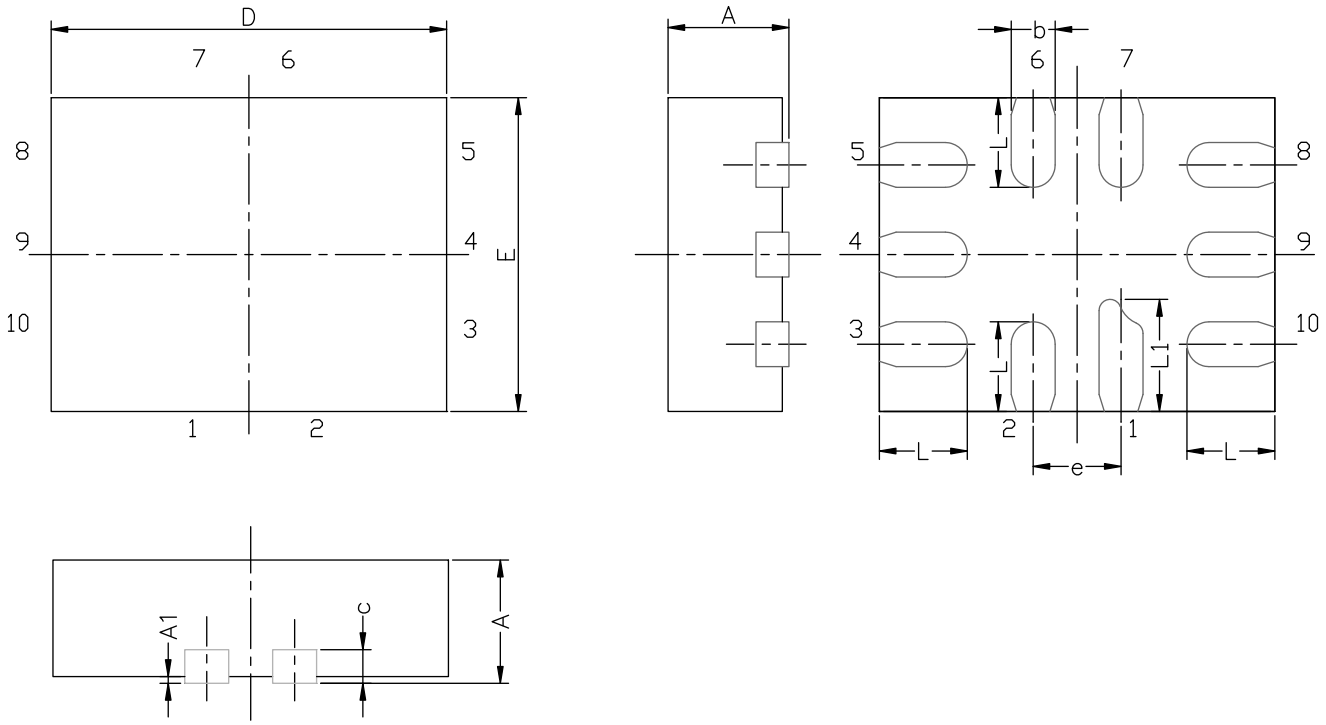



**Fig. 5 - Channel Off/On Capacitance**

*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?67786*

# MINI QFN-10L CASE OUTLINE



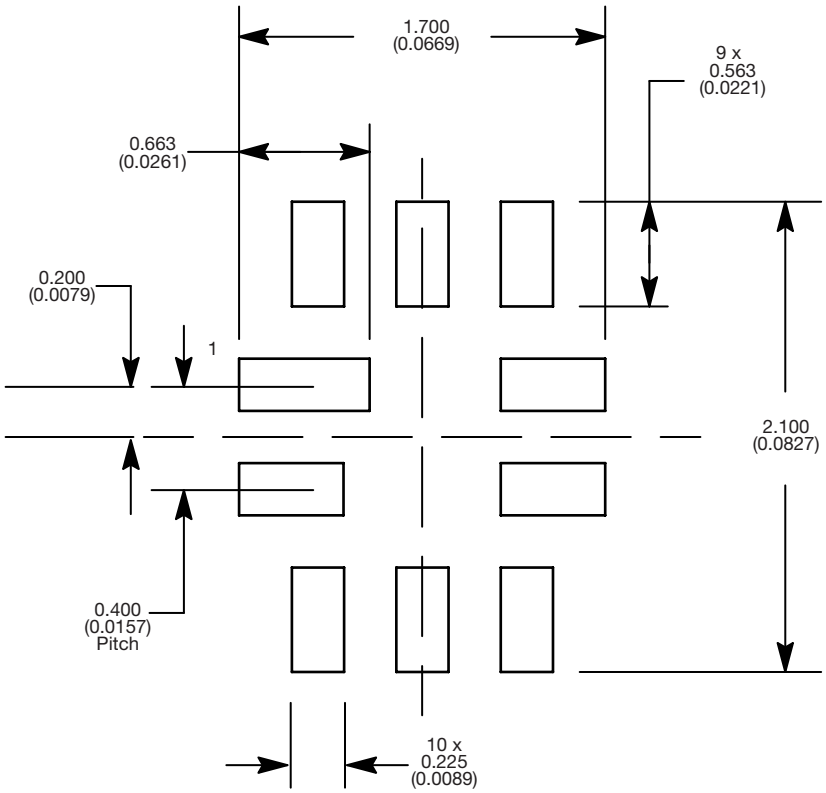

| DIM | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| | MIN. | NAM. | MAX. | MIN. | NAM. | MAX. |
| A | 0.45 | 0.55 | 0.60 | 0.0177 | 0.0217 | 0.0236 |
| A1 | 0.00 | - | 0.05 | 0.000 | - | 0.002 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| c | 0.150 or 0.127 REF (1) | | | 0.006 or 0.005 REF (1) | | |
| D | 1.70 | 1.80 | 1.90 | 0.067 | 0.071 | 0.075 |
| E | 1.30 | 1.40 | 1.50 | 0.051 | 0.055 | 0.059 |
| e | 0.40 BSC | | | 0.016 BSC | | |
| L | 0.35 | 0.40 | 0.45 | 0.014 | 0.016 | 0.018 |
| L1 | 0.45 | 0.50 | 0.55 | 0.0177 | 0.0197 | 0.0217 |

**Note**

(1) The dimension depends on the leadframe that assembly house used.

ECN T16-0163-Rev. B, 16-May-16
DWG: 5957

**RECOMMENDED MINIMUM PADS FOR MINI QFN 10L**




Mounting Footprint
Dimensions in mm (inch)

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