# Low Capacitance, +12 V / +5 V / +3 V, Triple SPDT (Triple 2:1) Analog Switch / Multiplexer

## DESCRIPTION

The DG9454E is a high precision triple SPDT (triple 2:1) analog switch / multiplexer with enhanced performance on low power consumption. The part features low parasitic capacitance, low leakage, and low charge injection over the full signal range which make it an ideal switch for healthcare, data acquisition, and instrument products. Its compact size, light weight, low power consumption, and low voltage control capability are of advantages in portable consumer applications such as goggles.

The DG9454E is designed to operate from a 3 V to 16 V supply at V+, and 2.5 V to 5.5 V at $V_L$, while guarantees 1.8 V logic compatible over the full operation voltage range.

Processed with advanced CMOS technology, the DG9454E conducts equally well in both directions, offers rail to rail analog signal handling and can be used both as a multiplexer as well as a de-multiplexer.

The DG9454E operating temperature is specified from -40 °C to +125 °C. It is available in ultra-compact 1.8 mm x 2.6 mm miniQFN16 package of lead (Pb)-free nickel-palladium-gold device termination. It is represented by the lead (Pb)-free "-E4" suffix. The nickel-palladium-gold device terminations meet all JEDEC® standards for reflow and MSL ratings.

## FEATURES

- Operates with V+ = 3 V to 16 V, $V_L$ = 2.5 V to 5.5 V
- Guaranteed 1.8 V logic control at full V+ range
- Low power consumption, both I+ and $I_L$ < 1 µA
- Low parasitic capacitance:
  $C_{D(ON)}$: 8.8 pF
  $C_{D(OFF)}$: 4 pF
  $C_{S(OFF)}$: 3.1 pF
- High bandwidth: 356 MHz
- Low charge injection over the full signal range
- Compact miniQFN16 package (1.8 mm x 2.6 mm x 0.55 mm)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS COMPLIANT
HALOGEN FREE

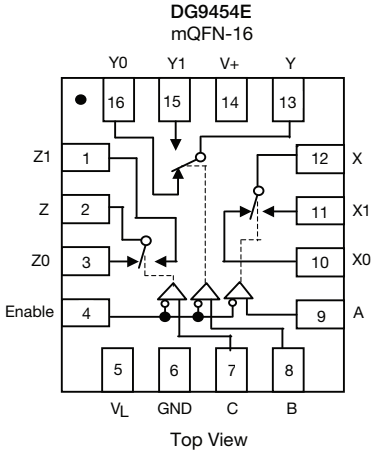
## APPLICATIONS

- Medical and healthcare systems
- Data acquisition systems
- Meters and instruments
- Games and Goggles
- Automatic test equipment
- Process control and automation
- Communication systems
- Battery powered systems

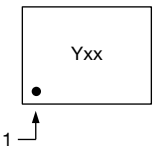
## BENEFITS

- Low power consumption
- Precision switching
- Low voltage logic interface
- Bi-directional rail to rail signal switching
- Compact package option
- Extended operation temperature range

## FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION




Top View




Device Marking: Jxx for DG9454E (miniQFN16)

xx = Date/Lot Traceability Code

## TRUTH TABLE

| ENABLE INPUT | SELECT INPUTS | | | ON SWITCHES |
|---|---|---|---|---|
| | C | B | A | DG9454E |
| H | X | X | X | All Switches Open |
| L | L | L | L | X to X0, Y to Y0, Z to Z0 |
| L | L | L | H | X to X1, Y to Y0, Z to Z0 |
| L | L | H | L | X to X0, Y to Y1, Z to Z0 |
| L | L | H | H | X to X1, Y to Y1, Z to Z0 |
| L | H | L | L | X to X0, Y to Y0, Z to Z1 |
| L | H | L | H | X to X1, Y to Y0, Z to Z1 |
| L | H | H | L | X to X0, Y to Y1, Z to Z1 |
| L | H | H | H | X to X1, Y to Y1, Z to Z1 |

## ORDERING INFORMATION

| TEMP. RANGE | PACKAGE | PART NUMBER | MIN. ORDER / PACK. QUANTITY |
|---|---|---|---|
| -40 °C to +85 °C lead (Pb)-free | 16-Pin miniQFN | DG9454EEN-T1-GE4 | Tape and reel, 3000 units |

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

| PARAMETER | | LIMIT | UNIT |
|---|---|---|---|
| Digital Inputs [a], $V_S$, $V_D$, $V_L$ | | GND - 0.3 to (V+) + 0.3 or 30 mA, whichever occurs first | V |
| V+ to GND | | -0.3 to +18 | |
| Continuous Current (any terminal) | | 30 | mA |
| Peak Current, S or D (pulsed 1 ms, 10 % duty cycle) | | 100 | |
| Storage Temperature | | -65 to +150 | °C |
| Power Dissipation [b] | 16-Pin miniQFN [c, d] | 525 | mW |
| Thermal Resistance [b] | 16-Pin miniQFN [d] | 152 | °C/W |
| Latch-Up (per JESD78) | | 100 | mA |
| ESD Human Body Model (HBM); per ANSI / ESDA / JEDEC JS-001 | | 2500 | V |

**Notes**

a. Signals on SX, DX, $V_L$ or INX 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.*

## SPECIFICATIONS FOR UNIPOLAR SUPPLIES

| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, $V_L$ = 2.7 V $V_{IN(A, B, C \text{ and enable})}$ = 1.8 V, 0.5 V [a] | TEMP.[b] | TYP.[c] | -40 °C to +125 °C | | -40 °C to +85 °C | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN.[d] | MAX.[d] | MIN.[d] | MAX.[d] | |
| **Analog Switch** | | | | | | | | | |
| Analog Signal Range [e] | $V_{ANALOG}$ | | Full | - | 0 | 12 | 0 | 12 | V |
| On-Resistance | $R_{ON}$ | $I_S$ = 1 mA, $V_D$ = 0.7 V, 6 V, 11.3 V | Room | 85 | - | 103 | - | 103 | Ω |
| | | | Full | - | - | 133 | - | 125 | |
| On-Resistance Match | $\Delta R_{ON}$ | $I_S$ = 1 mA, $V_D$ = 0.7 V, 11.3 V | Room | 1.24 | - | 8 | - | 8 | |
| | | | Full | - | - | 8 | - | 8 | |
| On-Resistance Flatness | $R_{FLATNESS}$ | $I_S$ = 1 mA, $V_D$ = 0.7 V, 6 V, 11.3 V | Room | 27 | - | 37 | - | 37 | |
| | | | Full | - | - | 44 | - | 43 | |
| Switch Off Leakage Current | $I_{S(off)}$ | V+ = 13.2 V, $V_L$ = 2.7 V $V_D$ = 1 V / 12.2 V, $V_S$ = 12.2 V / 1 V | Room | ± 0.05 | -1 | 1 | -1 | 1 | nA |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| | $I_{D(off)}$ | | Room | ± 0.07 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| Channel On Leakage Current | $I_{D(on)}$ | V+ = 13.2 V, $V_L$ = 2.7 V $V_D$ = $V_S$ = 1 V / 12.2 V | Room | ± 0.07 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| **Digital Control** | | | | | | | | | |
| Logic Low Input Voltage | $V_{INL}$ | $V_L$ = 2.7 V | Full | - | - | 0.5 | - | 0.5 | V |
| Logic High Input Voltage | $V_{INH}$ | | Full | - | 1.8 | - | 1.8 | - | |
| Logic Low Input Current | $I_L$ | $V_{IN(A0, A1, A2 \text{ and enable})}$ under test = 0.5 V | Full | 0.02 | -1 | 1 | -1 | 1 | µA |
| Logic High Input current | $I_H$ | $V_{IN(A0, A1, A2 \text{ and enable})}$ under test = 1.8 V | Full | 0.02 | -1 | 1 | -1 | 1 | |
| **Dynamic Characteristics** | | | | | | | | | |
| Transition Time | $t_{TRANS}$ | $R_L$ = 300 Ω, $C_L$ = 35 pF see Fig. 1, 2, 3 | Room | 79 | - | 119 | - | 119 | ns |
| | | | Full | - | - | 134 | - | 126 | |
| Enable Turn-On Time | $t_{ON(EN)}$ | | Room | 70 | - | 110 | - | 110 | |
| | | | Full | - | - | 130 | - | 116 | |
| Enable Turn-Off Time | $t_{OFF(EN)}$ | | Room | 51 | - | 91 | - | 91 | |
| | | | Full | - | - | 95 | - | 94 | |
| Break-Before-Make Time Delay | $t_D$ | | Room | 17 | - | - | - | - | |
| | | | Full | - | 1 | - | 1 | - | |
| Charge Injection [e] | Q | $C_L$ = 1 nF, $R_{GEN}$ = 0 Ω, $V_{GEN}$ = 0 V | Full | 5.84 | - | - | - | - | pC |
| Off Isolation [e] | OIRR | f = 1 MHz, $R_L$ = 50 Ω, $C_L$ = 5 pF 100 kHz | Room | -95 | - | - | - | - | dB |
| | | 1 MHz | Room | -85 | - | - | - | - | |
| | | 10 MHz | Room | -65 | - | - | - | - | |
| Crosstalk [e] | $X_{TALK}$ | 100 kHz | Room | -92 | - | - | - | - | |
| | | 1 MHz | Room | -73 | - | - | - | - | |
| | | 10 MHz | Room | -53 | - | - | - | - | |
| Bandwidth, -3 dB [e] | BW | $R_L$ = 50 Ω | Room | 356 | - | - | - | - | MHz |
| Source Off Capacitance [e] | $C_{S(off)}$ | f = 1 MHz | Room | 3.1 | - | - | - | - | pF |
| Drain Off Capacitance [e] | $C_{D(off)}$ | | Room | 4 | - | - | - | - | |
| Channel On Capacitance [e] | $C_{D(on)}$ | | Room | 8.8 | - | - | - | - | |
| Total Harmonic Distortion [e] | THD | Signal = 1 $V_{RMS}$, 20 Hz to 20 kHz, $R_L$ = 600 Ω | Room | 0.075 | - | - | - | - | % |

| SPECIFICATIONS FOR UNIPOLAR SUPPLIES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 12 V, $V_L$ = 2.7 V $V_{IN(A, B, C \text{ and enable})}$ = 1.8 V, 0.5 V [a] | TEMP.[b] | TYP.[c] | -40 °C to +125 °C | | -40 °C to +85 °C | | UNIT |
| | | | | | MIN.[d] | MAX.[d] | MIN.[d] | MAX.[d] | |
| **Power Supply** | | | | | | | | | |
| Power Supply Range | I+ | $V_{IN(A, B, C \text{ and enable})}$ = 0 V or 12 V | Room | 0.05 | - | 1 | - | 1 | µA |
| | | | Full | - | - | 10 | - | 10 | |
| Ground Current | $I_{GND}$ | | Room | 0.05 | -1 | - | -1 | - | |
| | | | Full | - | -10 | - | -10 | - | |
| Logic Supply Current | $I_L$ | $V_L$ = 2.7 V | Room | 0.05 | - | 1 | - | 1 | |
| | | | Full | - | - | 10 | - | 10 | |

**Notes**

a. $V_{IN}$ = input voltage to perform proper function.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
e. Guaranteed by design, not subject to production test.

## SPECIFICATIONS FOR UNIPOLAR SUPPLIES

| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 5 V, $V_L$ = 2.7 V, $V_{IN(A, B, C \text{ and enable})}$ = 1.8 V, 0.5 V [a] | TEMP. [b] | TYP. [c] | -40 °C to +125 °C | | -40 °C to +85 °C | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN. [d] | MAX. [d] | MIN. [d] | MAX. [d] | |
| **Analog Switch** | | | | | | | | | |
| Analog Signal Range [e] | $V_{ANALOG}$ | | Full | - | 0 | 5 | 0 | 5 | V |
| On-Resistance | $R_{ON}$ | $I_S$ = 1 mA, $V_D$ = 0 V, 3.5 V | Room | 125 | - | 147 | - | 147 | Ω |
| | | | Full | - | - | 176 | - | 168 | |
| On-Resistance Match | $\Delta R_{ON}$ | $I_S$ = 1 mA, $V_D$ = 3.5 V | Room | 1.33 | - | 8 | - | 8 | |
| | | | Full | - | - | 8 | - | 8 | |
| On-Resistance Flatness | $R_{FLATNESS}$ | $I_S$ = 1 mA, $V_D$ = 0 V, 3 V | Room | 21 | - | 31 | - | 31 | |
| | | | Full | - | - | 25 | - | 29 | |
| Switch Off Leakage Current | $I_{S(off)}$ | V+ = 5.5 V, V- = 0 V, $V_D$ = 1 V / 4.5 V, $V_S$ = 4.5 V / 1 V | Room | ± 0.03 | -1 | 1 | -1 | 1 | nA |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| | $I_{D(off)}$ | | Room | ± 0.03 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| Channel On Leakage Current | $I_{D(on)}$ | V+ = 5.5 V, V- = 0 V, $V_D$ = $V_S$ = 1 V / 4.5 V | Room | ± 0.03 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| **Digital Control** | | | | | | | | | |
| $V_{IN(A, B, C \text{ and enable})}$ Low | $V_{IL}$ | $V_L$ = 2.7 V | Full | - | - | 0.6 | - | 0.6 | V |
| $V_{IN(A, B, C \text{ and enable})}$ High | $V_{IH}$ | $V_L$ = 2.7 V | Full | - | 1.8 | - | 1.8 | - | |
| Input Current, $V_{IN}$ Low | $I_L$ | $V_{IN(A, B, C \text{ and enable})}$ under test = 0.6 V | Full | 0.02 | -1 | 1 | -1 | 1 | µA |
| Input Current, $V_{IN}$ High | $I_H$ | $V_{IN(A, B, C \text{ and enable})}$ under test = 1.8 V | Full | 0.02 | -1 | 1 | -1 | 1 | |
| **Dynamic Characteristics** | | | | | | | | | |
| Transition Time | $t_{TRANS}$ | $R_L$ = 300 Ω, $C_L$ = 35 pF, see Fig. 1, 2, 3 | Room | 95 | - | 135 | - | 135 | ns |
| | | | Full | - | - | 164 | - | 152 | |
| Enable Turn-On Time | $t_{ON}$ | | Room | 80 | - | 120 | - | 120 | |
| | | | Full | - | - | 138 | - | 129 | |
| Enable Turn-Off Time | $t_{OFF}$ | | Room | 58 | - | 98 | - | 98 | |
| | | | Full | - | - | 106 | - | 103 | |
| Break-Before-Make Time Delay | $t_D$ | | Room | 45 | - | - | - | - | |
| | | | Full | - | 24 | - | 15 | - | |
| Charge Injection [e] | Q | $V_g$ = 0 V, $R_g$ = 0 Ω, $C_L$ = 1 nF | Full | 1.44 | - | - | - | - | pC |
| Off Isolation [e] | OIRR | $R_L$ = 50 Ω, $C_L$ = 5 pF, f = 100 kHz | Room | -95 | - | - | - | - | dB |
| Channel-to-Channel Crosstalk [e] | $X_{TALK}$ | | Room | -92 | - | - | - | - | |
| Source Off Capacitance [e] | $C_{S(off)}$ | f = 1 MHz | Room | 3.5 | - | - | - | - | pF |
| Drain Off Capacitance [e] | $C_{D(off)}$ | | Room | 4.5 | - | - | - | - | |
| Channel On Capacitance [e] | $C_{D(on)}$ | | Room | 10.2 | - | - | - | - | |
| **Power Supply** | | | | | | | | | |
| Power Supply Current | I+ | $V_{IN(A, B, C \text{ and enable})}$ = 0 V or 5 V | Room | 0.05 | - | 1 | - | 1 | µA |
| | | | Full | - | - | 10 | - | 10 | |
| Ground Current | $I_{GND}$ | | Room | -0.05 | -1 | - | -1 | - | |
| | | | Full | - | -10 | - | -10 | - | |
| Logic Supply Current | $I_L$ | $V_L$ = 2.7 V | Room | 0.05 | - | 1 | - | 1 | |
| | | | Full | - | - | 10 | - | 10 | |

**Notes**

a. $V_{IN}$ = input voltage to perform proper function.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
e. Guaranteed by design, not subject to production test.

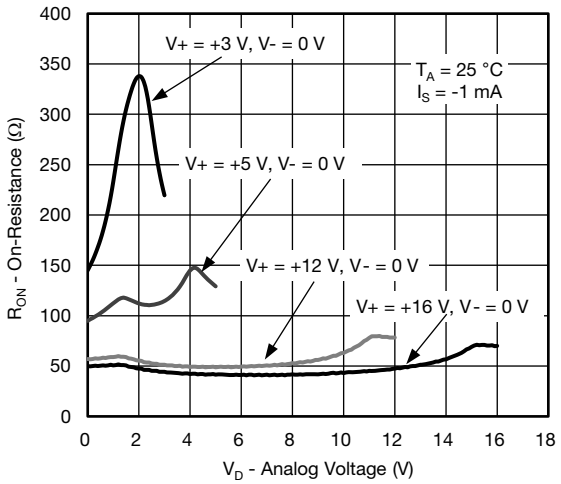
## SPECIFICATIONS FOR UNIPOLAR SUPPLIES

| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS OTHERWISE SPECIFIED V+ = 3 V, $V_L$ = 2.7 V $V_{IN(A, B, C AND ENABLE)}$ = 1.5 V, 0.6 V [a] | TEMP. [b] | TYP. [c] | -40 °C to +125 °C | | -40 °C to +85 °C | | UNIT |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | MIN. [d] | MAX. [d] | MIN. [d] | MAX. [d] | |
| **Analog Switch** | | | | | | | | | |
| Analog Signal Range [e] | $V_{ANALOG}$ | | Full | - | 0 | 3 | 0 | 3 | V |
| On-Resistance | $R_{ON}$ | $I_S$ = 1 mA, $V_D$ = 1.5 V | Room | 221 | - | - | - | - | Ω |
| | | | Full | - | - | - | - | - | |
| Switch Off Leakage Current | $I_{S(off)}$ | V+ = 3.3 V, $V_L$ = 2.7 V $V_D$ = 0.3 V / 3 V, $V_S$ = 3 V / 0.3 V | Room | ± 0.02 | -1 | 1 | -1 | 1 | nA |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| | $I_{D(off)}$ | | Room | ± 0.02 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| Channel On Leakage Current | $I_{D(on)}$ | V+ = 3.3 V, $V_L$ = 2.7 V $V_S$ = $V_D$ = 0.3 V / 3 V | Room | ± 0.02 | -1 | 1 | -1 | 1 | |
| | | | Full | - | -50 | 50 | -5 | 5 | |
| **Digital Control** | | | | | | | | | |
| Logic Low Input Voltage | $V_{INL}$ | $V_L$ = 2.7 V | Full | - | - | 0.6 | - | 0.6 | V |
| Logic High Input Voltage | $V_{INH}$ | | Full | - | 1.8 | - | 1.8 | - | |
| Logic Low Input Current | $I_L$ | $V_{IN(A0, A1, A2 and enable)}$ under test = 0.6 V | Full | 0.02 | -1 | 1 | -1 | 1 | µA |
| Logic High Input Current | $I_H$ | $V_{IN(A0, A1, A2 and enable)}$ under test = 1.8 V | Full | 0.02 | -1 | 1 | -1 | 1 | |
| **Dynamic Characteristics** | | | | | | | | | |
| Transition Time | $t_{TRANS}$ | $R_L$ = 300 Ω, $C_L$ = 35 pF see Fig. 1, 2, 3 | Room | 161 | - | - | - | - | ns |
| | | | Full | - | - | - | - | - | |
| Enable Turn-On Time | $t_{ON(EN)}$ | | Room | 120 | - | - | - | - | |
| | | | Full | - | - | - | - | - | |
| Enable Turn-Off Time | $t_{OFF(EN)}$ | | Room | 79 | - | - | - | - | |
| | | | Full | - | - | - | - | - | |
| Break-Before-Make Time Delay | $t_D$ | | Room | 98 | - | - | - | - | |
| | | | Full | - | - | - | - | - | |
| Charge Injection [e] | Q | $C_L$ = 1 nF, $R_{GEN}$ = 0 Ω, $V_{GEN}$ = 0 V | Full | 0.58 | - | - | - | - | pC |
| Off Isolation [e] | OIRR | f = 1 MHz, $R_L$ = 50 Ω, $C_L$ = 5 pF, 100 kHz | Room | -95 | - | - | - | - | dB |
| Crosstalk [e] | $X_{TALK}$ | 100 kHz | Room | -92 | - | - | - | - | |
| Source Off Capacitance [e] | $C_{S(off)}$ | f = 1 MHz | Room | 3.7 | - | - | - | - | pF |
| Drain Off Capacitance [e] | $C_{D(off)}$ | | Room | 4.7 | - | - | - | - | |
| Channel On Capacitance [e] | $C_{D(on)}$ | | Room | 10.4 | - | - | - | - | |
| **Power Supply** | | | | | | | | | |
| Power Supply Range | I+ | $V_{IN (A, B, C and enable)}$ = 0 V or 3 V | Room | 0.05 | - | 1 | - | 1 | µA |
| | | | Full | - | - | 10 | - | 10 | |
| Ground Current | $I_{GND}$ | | Room | 0.05 | -1 | - | -1 | - | |
| | | | Full | - | -10 | - | -10 | - | |
| Logic Supply Current | $I_L$ | $V_L$ = 2.7 V | Room | 0.05 | - | 1 | - | 1 | |
| | | | Full | - | - | 10 | - | 10 | |

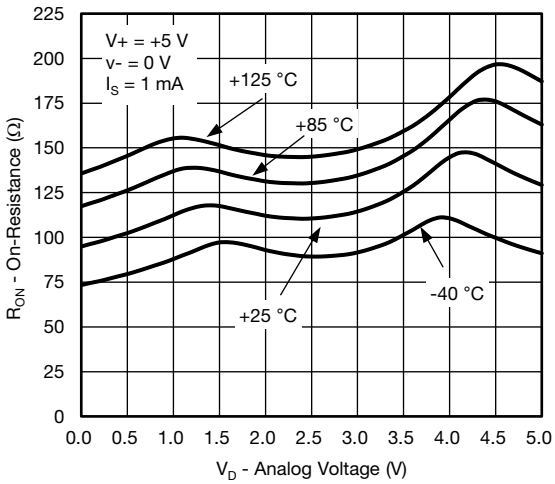
**Notes**

a. $V_{IN}$ = input voltage to perform proper function.
b. Room = 25 °C, Full = as determined by the operating temperature suffix.
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this datasheet.
e. Guaranteed by design, not subject to production test.

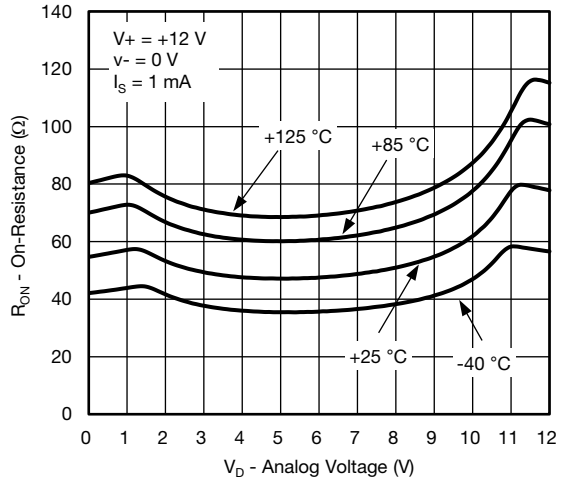
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



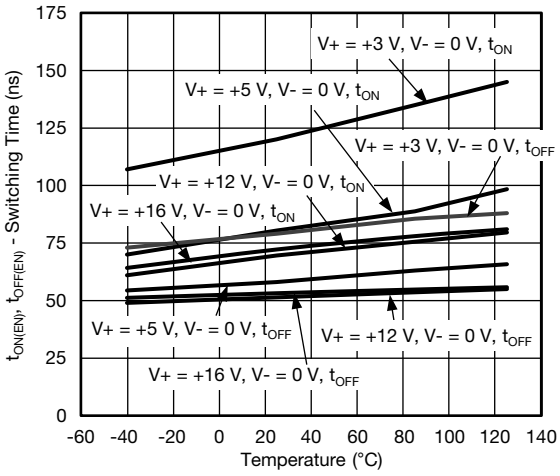

**On-Resistance vs. $V_D$ and Signal Supply Voltage**



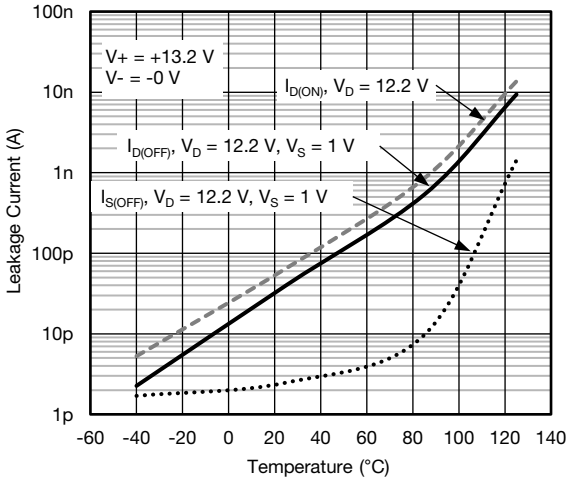

**On-Resistance vs. Analog Voltage and Temperature**



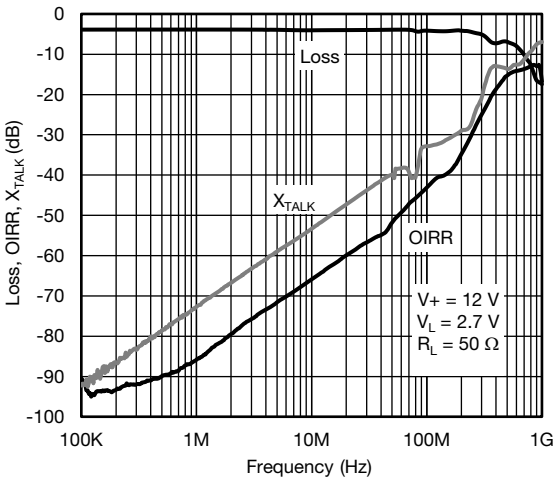

**On-Resistance vs. Analog Voltage and Temperature**




**Switching Time vs. Temperature**

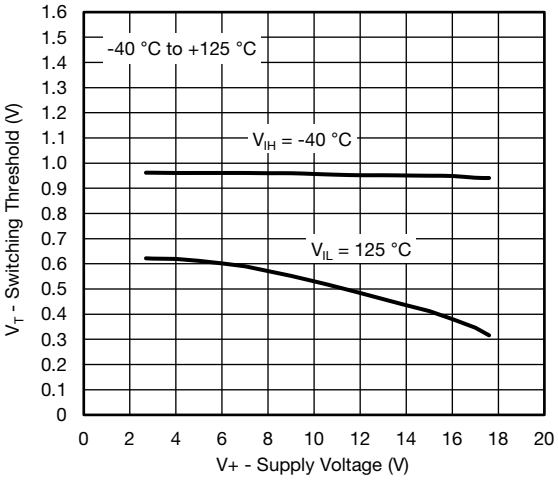



**Leakage Current vs. Temperature**

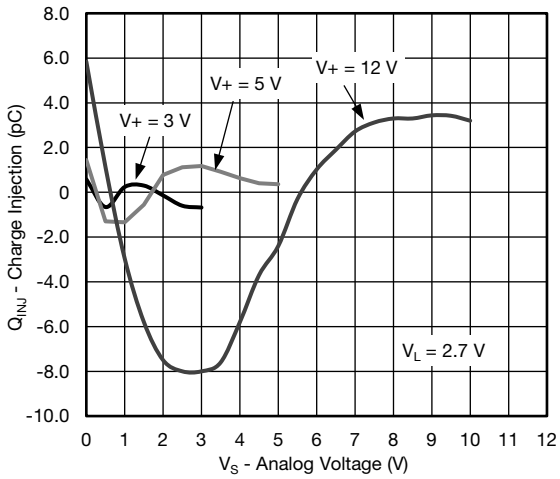



**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**

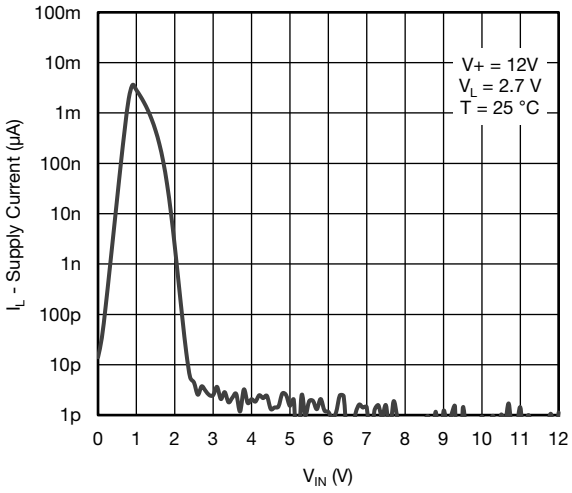
## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




**Switching Threshold vs. Logic Supply Voltage**

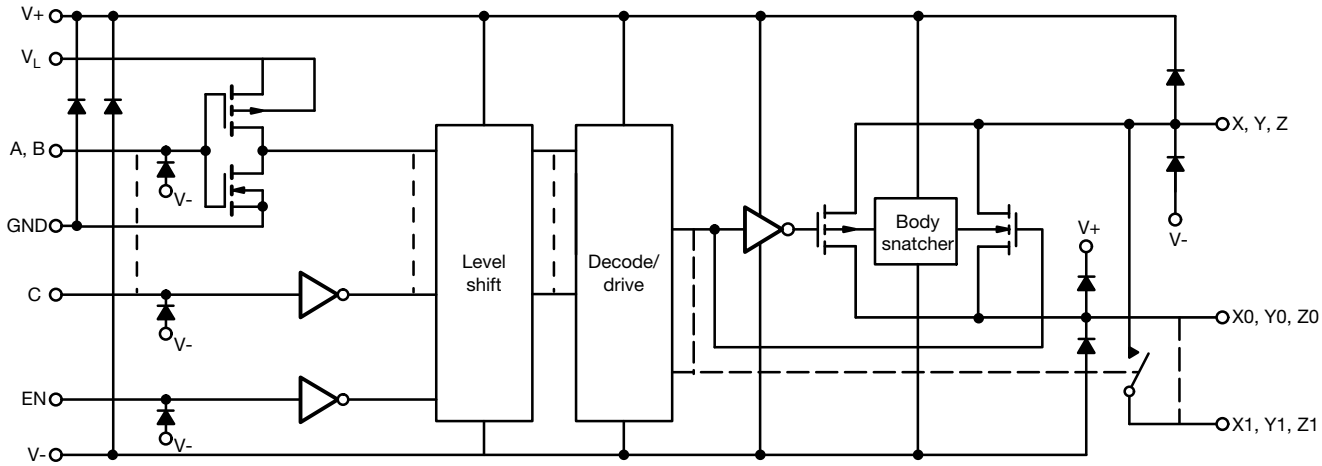



**Charge Injection vs. Analog Voltage**




**$I_L$ vs. $V_{IN}$**

## SCHEMATIC DIAGRAM (typical channel)



## TEST CIRCUITS

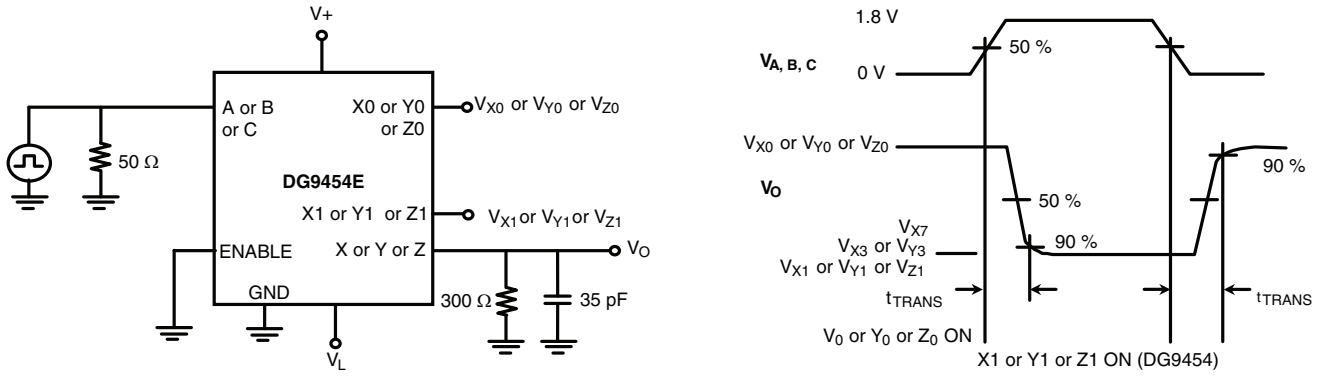



**Fig. 1 - Transition Time**

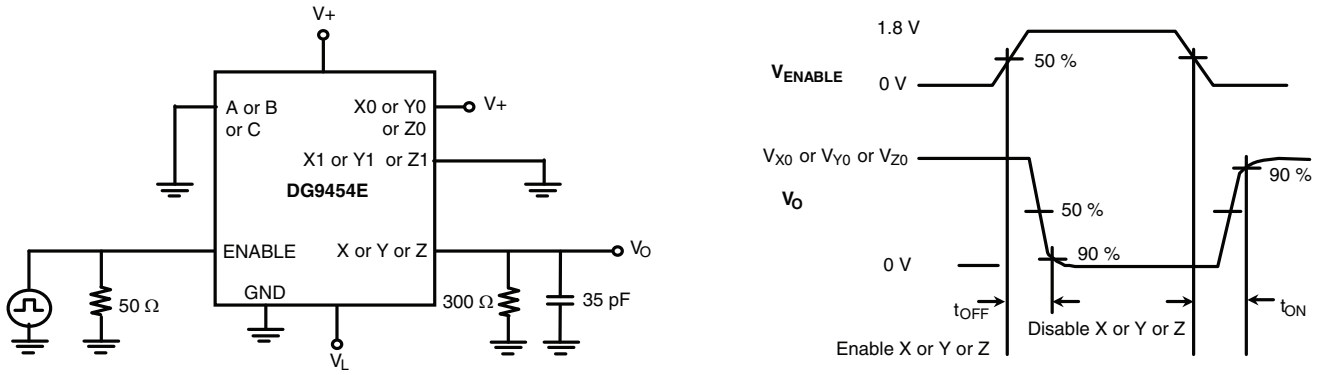



**Fig. 2 - Enable Switching Time**

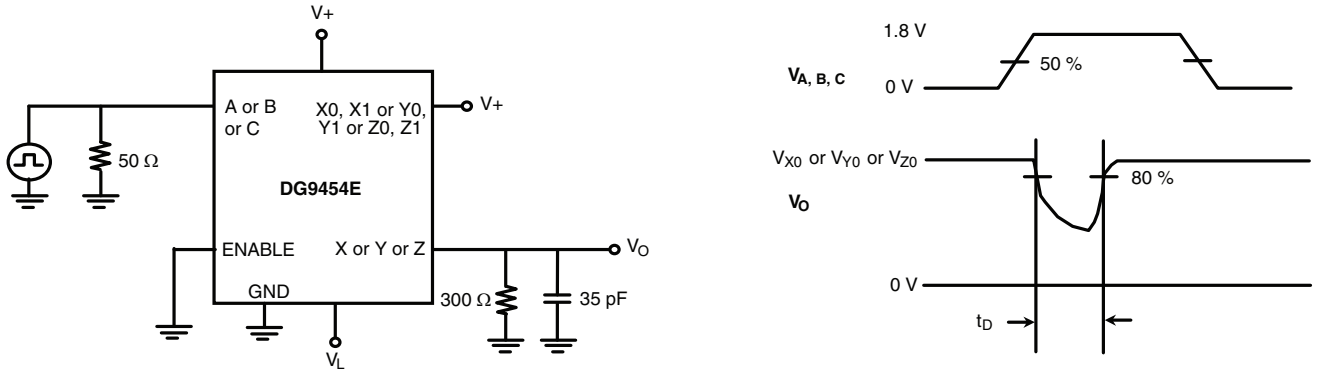
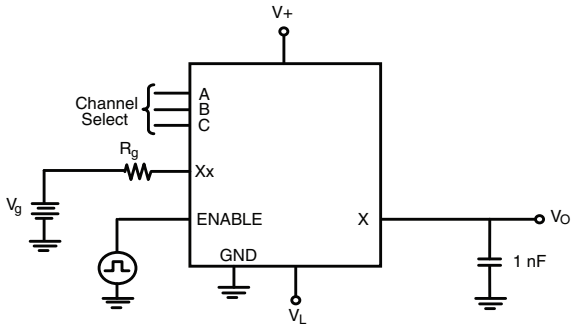



**Fig. 3 - Break-Before-Make**

## TEST CIRCUITS



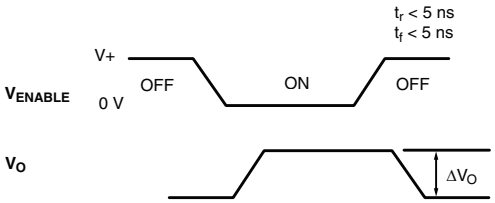
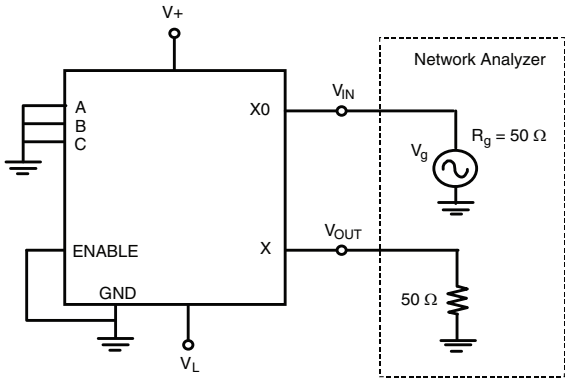
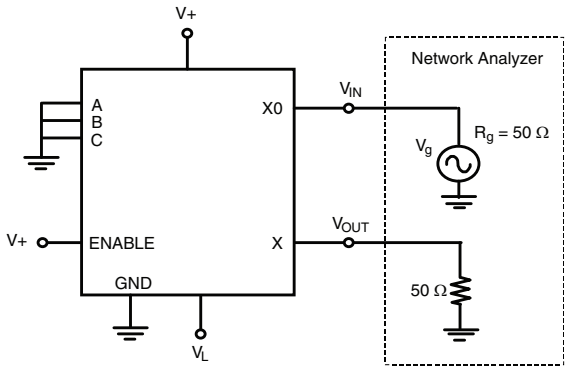




**Fig. 4 - Charge Injection**



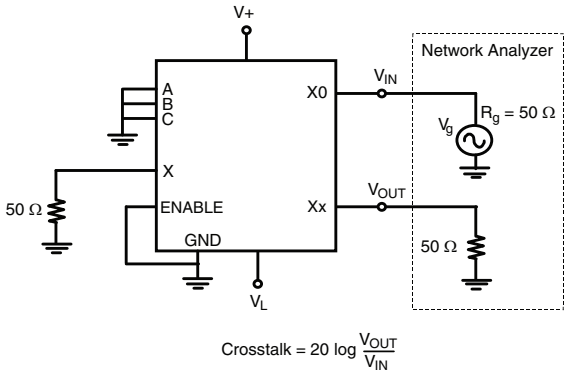

$$\text{Insertion Loss} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

**Fig. 5 - Insertion Loss**




$$\text{Off Isolation} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

**Fig. 7 - Off Isolation**




$$\text{Crosstalk} = 20 \log \frac{V_{OUT}}{V_{IN}}$$

**Fig. 6 - Crosstalk**

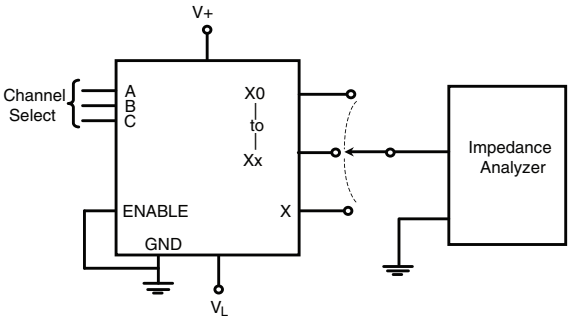



**Fig. 8 - Source, Drain Capacitance**

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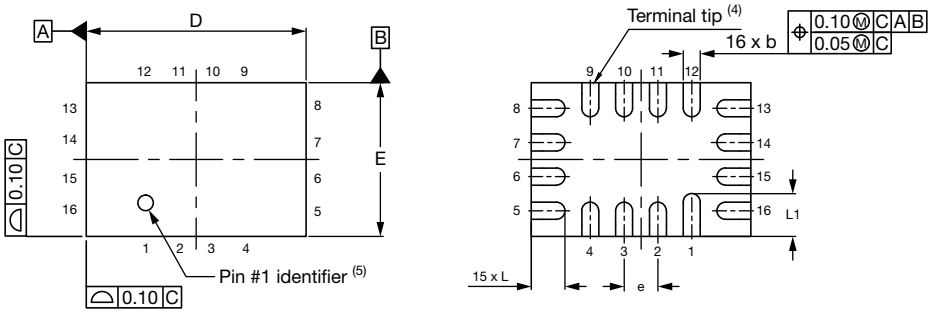
# Thin miniQFN16 Case Outline




| 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.

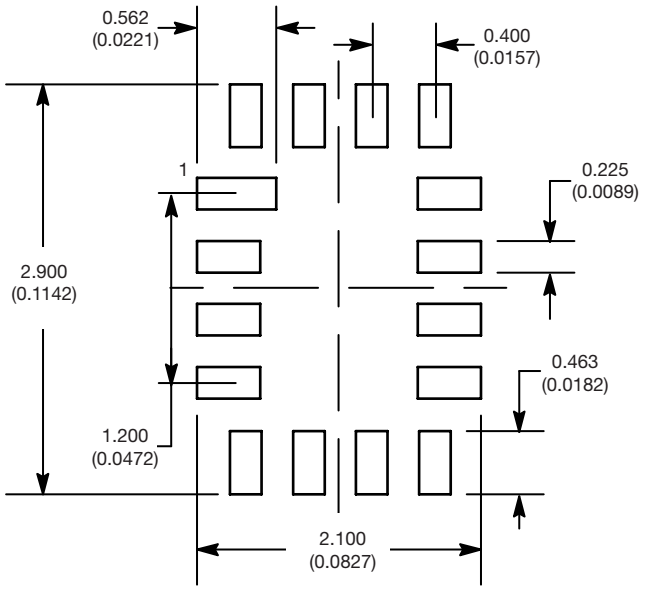
(4) Dimensions b applies to plated terminal and is measured between 0.15 mm and 0.30 mm from terminal tip.

(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

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




Mounting Footprint
Dimensions in mm (inch)

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