



# Low Voltage, Dual DPDT in miniQFN16

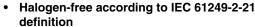
### DESCRIPTION

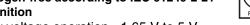
The DG2599 is a  $C_{MOS}$  Dual DPDT (Dual Double Pole Double Throw) analog switch that operates over a wide voltage range of 1.65 V to 5 V. It is optimized for portable applications switching audio, SIM card signals, and other low power signals.

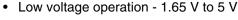
The DG2599 features low ON resistance of 2.8  $\Omega$  at 3 V power supply, fast switching speed, and low power consumption even when control logic signals are below V+ power supply voltage. The well matched dual DPDT switches conduct signals equally in both directions. The DG2599 is designed to guarantee break before make switching.

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with lead (Pb)-free device terminations. DG2599 are offered in a miniQFN package. The miniQFN package has a nickel palladium- gold device termination and 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**







- Low on-resistance 2.8  $\Omega$  at V+ = 3 V
- Power off protection on COM1 and COM2 pins Latch up current great than 300 mA per JESD78



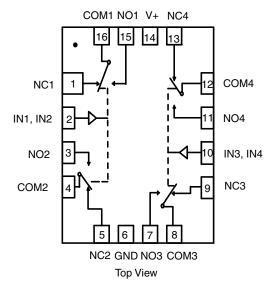


HALOGEN FREE

### **APPLICATIONS**

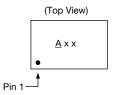
- · Cellular phones
- · PMPs and PDAs
- Modems and peripherals
- Computers and ebooks
- Tablet devices
- Displays and gaming
- STB

| ORDERING INFORMATION |                           |  |  |  |  |
|----------------------|---------------------------|--|--|--|--|
| Part Number          | Package                   |  |  |  |  |
| DG2599DN-T1-GE4      | miniQFN16 1.8 mm x 2.6 mm |  |  |  |  |



| TRUTH TABLE (DG2599) |                 |                  |  |  |  |
|----------------------|-----------------|------------------|--|--|--|
| Logic                | NC1, 2, 3 and 4 | NO 1, 2, 3 and 4 |  |  |  |
| 0                    | ON              | OFF              |  |  |  |
| 1                    | OFF             | ON               |  |  |  |

Device Marking: A xx xx = Date/Lot Traceability Code



Note: Pin 1 has long lead



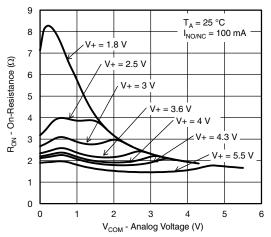
| <b>ABSOLUTE MAXIMUM RATINGS</b> (T <sub>A</sub> = 25 °C, unless otherwise noted) |                              |             |                     |    |  |  |
|----------------------------------------------------------------------------------|------------------------------|-------------|---------------------|----|--|--|
| Parameter                                                                        | Symbol                       | Limit       | Unit                |    |  |  |
| Reference to GND                                                                 | V+                           |             | - 0.3 to 5          | V  |  |  |
| Reference to GIND                                                                | IN, COM, NC, NO <sup>a</sup> |             | - 0.3 to (V+ + 0.3) | ¬  |  |  |
| Current (any terminal except NO, NC or                                           |                              | 30          |                     |    |  |  |
| Continuous Current (NO, NC, or COM)                                              |                              | ± 300       | mA                  |    |  |  |
| Peak Current (pulsed at 1 ms, 10 % duty                                          |                              | ± 500       |                     |    |  |  |
| Storage Temperature (D Suffix)                                                   |                              | - 65 to 150 |                     |    |  |  |
| Package Solder Reflow Conditions <sup>d</sup>                                    | miniQFN16                    |             | 250                 | °C |  |  |
| Power Dissipation (Packages) <sup>b</sup>                                        | miniQFN16 <sup>c</sup>       |             | 525                 | mW |  |  |

- 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.

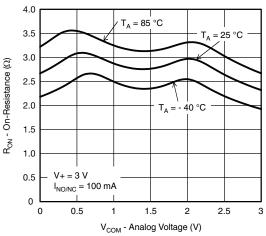
| Parameter                       | Test Conditions                                                                               | Temp.        | Min.  | Тур.  | Max. | Unit  |  |
|---------------------------------|-----------------------------------------------------------------------------------------------|--------------|-------|-------|------|-------|--|
| Power Supply and Signal         |                                                                                               |              |       |       |      |       |  |
| V+ Supply Voltage               |                                                                                               | Full         | 1.65  |       | 5    | V     |  |
| V+ Supply Current               | V <sub>IN</sub> = 0 or V+                                                                     | Full         |       | 0.001 | 2    | μΑ    |  |
| Analog Signal Range             |                                                                                               | Full         | 0     |       | V+   | V     |  |
| Switch On-Resistance and Leakag | е                                                                                             |              |       |       |      |       |  |
| Drain-Source On-Resistance      | V+ = 3 V, I <sub>NO/NC</sub> = 100 mA, V <sub>COM</sub> = 0.9 V, 2.3 V                        |              |       | 2.8   | 3.3  | Ω     |  |
| Brain Gource On Tresistance     |                                                                                               |              |       |       | 3.6  |       |  |
| On-Resistance Flatness          | $V+ = 3 \text{ V}, I_{NO/NC} = 100 \text{ mA}, V_{COM} = 0 \text{ to } V+$                    | Room         |       | 0.24  | 1.1  | 3.2   |  |
| On Hosistanoo Hatricos          | VI = 0 V, INO/NC = 100 III/I, VCOM = 0 to VI                                                  | Full         |       |       | 1.3  |       |  |
| Switch Off Leakage Current      | $V_{+} = 4.3 \text{ V}, V_{NO/NC} = 0.3 \text{ V/4 V}, V_{COM} = 4 \text{ V} / 0.3 \text{ V}$ | Room         | - 10  | 0.1   | 10   |       |  |
| Ownor on Leanage Carrent        | V 1 = 4.5 V, V <sub>NO/NC</sub> = 0.5 V/4 V, V <sub>COM</sub> = 4 V / 0.5 V                   | Full         | - 100 |       | 100  | nA    |  |
| Channel On-Leakage Current      | $V+ = 4.3 \text{ V}, V_{NO/NC} \text{ and } V_{COM} = 0.3 \text{ V} / 4 \text{ V}$            | Room         | - 10  | 0.1   | 10   | - IIA |  |
| Charmer on Leanage Carrent      | V1 = 4.8 V, V <sub>NO/NC</sub> and V <sub>COM</sub> = 8.8 V / 4 V                             | Full         | - 100 |       | 100  |       |  |
| Digital Control                 |                                                                                               |              |       |       |      |       |  |
| Input, High Voltage             | V+ = 4.3 V                                                                                    | Full         | 1.6   |       |      |       |  |
| mpat, riigir voltage            | V+ = 3 V                                                                                      |              | 1.3   |       |      | V     |  |
| Input, Low Voltage              | V+ = 4.3 V                                                                                    | Full         |       |       | 0.6  |       |  |
| mput, 2011 Voltago              | V+ = 3 V                                                                                      |              |       |       | 0.5  |       |  |
| Input, Bias Current             | $V_{IN} = V+$                                                                                 | Full         | - 1   | 0.01  | 1    | μΑ    |  |
| Dynamic Characteristics         |                                                                                               |              |       |       |      |       |  |
| Turn On-Time                    | $V_{COM}$ or $V_{NO/NC} = 3$ V, $R_L = 50 \Omega$ , $C_L = 35$ pF                             | Room         |       |       | 90   |       |  |
|                                 | COM S. THOING S.                                          | Full         |       |       | 115  |       |  |
| Turn Off-Time                   | $V_{COM}$ or $V_{NO/NC} = 3$ V, $R_L = 50 \Omega$ , $C_L = 35$ pF                             | Room         |       |       | 70   | ns    |  |
|                                 | COM S. THOING S.                                          | Full         |       |       | 85   |       |  |
| Break Before Make Time          | $V_{COM}$ or $V_{NO/NC} = 3$ V, $R_L = 50 \Omega$ , $C_L = 35$ pF                             | Room<br>Full | 2     |       |      |       |  |
| Broak Boloro Make Time          |                                                                                               |              | 2     |       |      |       |  |
| Charge Injection                | $C_L = 1 \text{ nF, } R_{GEN} = 0 \Omega$                                                     | Room         |       | ± 10  |      | рC    |  |
| Off Isolation                   | $R_L = 50 \Omega, C_L = 5 pF, f = 1 MHz$                                                      |              |       | - 66  |      |       |  |
| Crosstalk                       | $R_L = 50 \ \Omega, \ C_L = 5 \ pF, \ f = 1 \ MHz$<br>Non-adjacent channels                   |              |       | - 110 |      | dB    |  |
| 3dB Bandwith                    | $C_L = 5 \text{ pF}, R_L = 50 \Omega$                                                         |              |       | 186   |      | MHz   |  |
| Source Off Capacitance          | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                          |              |       | 9     |      |       |  |
| Channel On Capacitance          | V <sub>IN</sub> = 0 or V+, f = 1 MHz                                                          |              |       | 26    |      | pF    |  |



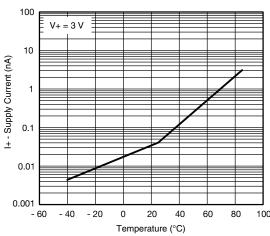
## TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise noted)



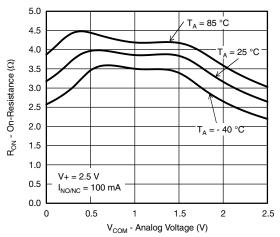
 $\rm R_{ON}$  vs.  $\rm V_{COM}$  and Single Supply Voltage



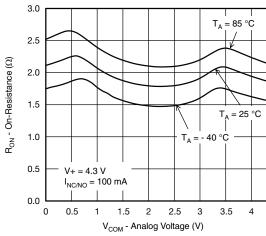
**R<sub>ON</sub> vs. Analog Voltage and Temperature** 



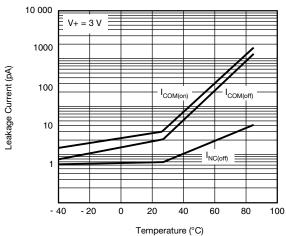
Supply Current vs. Temperature



R<sub>ON</sub> vs. Analog Voltage and Temperature

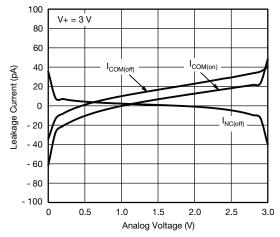


R<sub>ON</sub> vs. Analog Voltage and Temperature

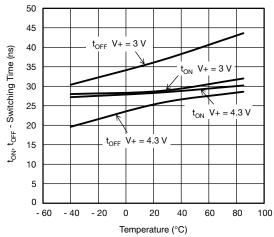


Leakage Current vs. Temperature

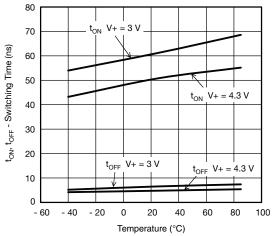
## **TYPICAL CHARACTERISTICS** (T<sub>A</sub> = 25 °C, unless otherwise noted)



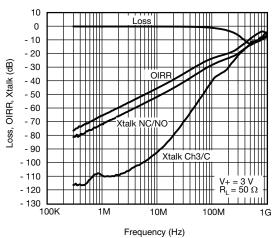
Leakage vs. Analog Voltage



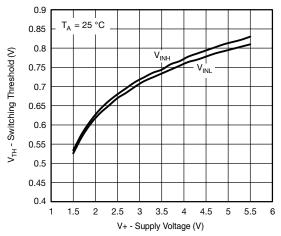
(NO) Switching Time vs. Temperature



(NC) Switching Time vs. Temperature

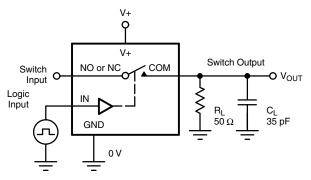


Insertion Loss, Off Isolation and Crosstalk



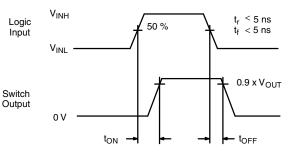
Switching Threshold vs. Supply Voltage

### **TEST CIRCUITS**



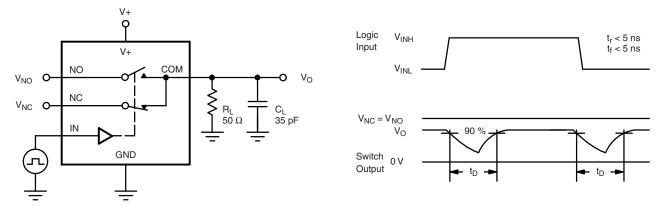
C<sub>L</sub> (includes fixture and stray capacitance)

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



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

Figure 1. Switching Time



C<sub>L</sub> (includes fixture and stray capacitance)

Figure 2. Break-Before-Make Interval

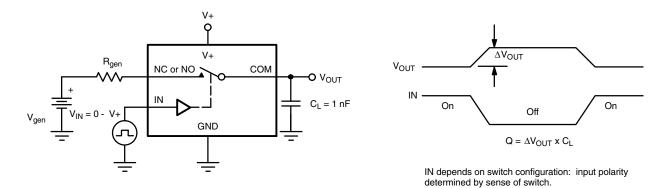


Figure 3. Charge Injection

### **TEST CIRCUITS**

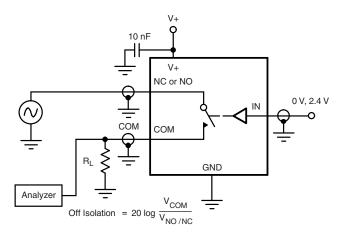


Figure 4. Off-Isolation

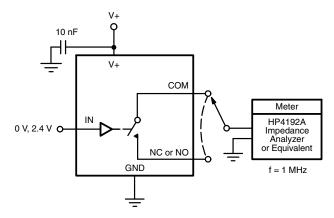
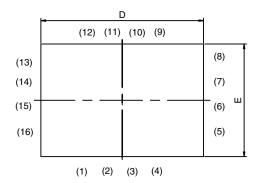


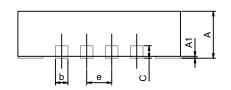
Figure 5. Channel Off/On Capacitance

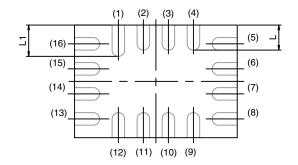
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### **MINI QFN-16L**







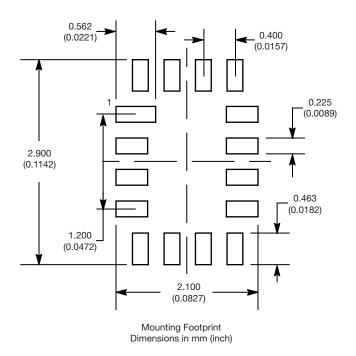
BACK SIDE VIEW

| DIM | MILLIMETERS |      |      | INCHES     |        |        |  |
|-----|-------------|------|------|------------|--------|--------|--|
|     | MIN.        | NAM  | MAX. | MIN.       | NAM    | MAX.   |  |
| Α   | 0.70        | 0.75 | 0.80 | 0.0275     | 0.0295 | 0.0315 |  |
| A1  | 0           | -    | 0.05 | 0          | -      | 0.002  |  |
| b   | 0.15        | 0.20 | 0.25 | 0.0059     | 0.0078 | 0.0098 |  |
| С   | 0.15        | 0.20 | 0.25 | 0.0059     | 0.0078 | 0.0098 |  |
| D   | 2.60 BSC    |      |      | 0.1023 BSC |        |        |  |
| Е   | 1.80 BSC    |      |      | 0.0708 BSC |        |        |  |
| е   | 0.40 BSC    |      |      | 0.0157 BSC |        |        |  |
| L   | 0.35        | 0.40 | 0.45 | 0.0137     | 0.0157 | 0.0177 |  |
| L1  | 0.45        | 0.50 | 0.55 | 0.0177     | 0.0196 | 0.0216 |  |

ECN T-06380-Rev. A, 14-Aug-06 DWG: 5954



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





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Revision: 02-Oct-12 Document Number: 91000