

Low Power, High Voltage SPST Analog Switches

DESCRIPTION

The DG447, DG448 are dual supply single-pole/single-throw (SPST) switches. On resistance is $25\ \Omega$ maximum and flatness is $2.2\ \Omega$ max over the specified analog signal range. These analog switches were designed to provide high speed, low error switching of precision analog signals. The primary application areas are in the routing and switching in telecommunications and test equipment. Combining low power, low leakages, low on-resistance and small physical size, the DG447, DG448 are also ideally suited for portable and battery powered industrial and military equipment.

The DG447 has one normally closed switch, while the DG448 switch is normally open. They operate either from a single 7 V to 36 V supply or from dual ± 4.5 V to ± 20 V supplies. They are offered in the very popular, small TSOP6 package.

BENEFITS

- Wide dynamic range
- Low signal errors and distortion
- Break-before-make switching action
- Simple interfacing
- Reduced board space
- Improved reliability

FEATURES

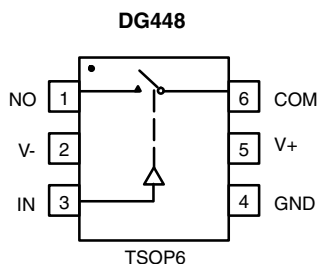
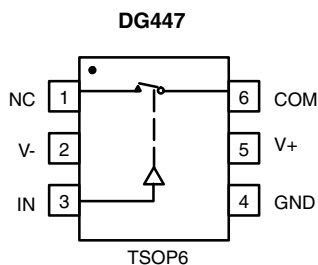
- ± 15 V analog signal range
- On-resistance - $R_{DS(on)}$: $25\ \Omega$ max.
- Fast switching action - t_{on} : 100 ns
- V_L logic supply not required
- TTL CMOS input compatible
- Rail to rail signal handling
- Dual or single supply operation
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

APPLICATIONS

- Precision test equipment
- Precision instrumentation
- Communications systems
- PBX, PABX systems
- Audio equipment
- Redundant systems
- PC multimedia boards
- Hard disc drives

FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



TRUTH TABLE

| LOGIC | DG447 | DG448 |
|-------|-------|-------|
| 0 | On | Off |
| 1 | Off | On |

Note

- Logic "0" ≤ 0.8 V
- Logic "1" ≥ 2.4 V

Device Marking:

DG447DV = G5xxx

DG448DV = G6xxx

ORDERING INFORMATION

| TEMP. RANGE | PACKAGE | PART NUMBER |
|---------------------|------------|---------------|
| DG447, DG448 | | |
| -40 °C to +85 °C | 6-pin TSOP | DG447DV-T1-E3 |
| | | DG448DV-T1-E3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_A = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

| PARAMETER | LIMIT | UNIT |
|---|--|--------------------|
| V_+ | 44 | V |
| GND | 25 | |
| Digital inputs ^a , $V_{NO/NC}$, V_{COM} | (V_-) - 2 to (V_+) + 2 or 30 mA, whichever occurs first | |
| Continuous current (any terminal) | 30 | mA |
| Current (NO or NC or COM) pulsed at 1 ms, 10 % duty cycle | 100 | |
| Storage temperature | -65 to +150 | $^{\circ}\text{C}$ |
| Power dissipation (package) ^b | 6-pin TSOP ^c | 570 |
| | | mW |

Notes

- a. Signals on NO, NC, COM, or IN exceeding V_+ or 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 7 mW/ $^{\circ}\text{C}$ above 70 $^{\circ}\text{C}$

SPECIFICATIONS ^a

| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS SPECIFIED V ₊ = 15 V, V ₋ = -15 V, V _{IN} = 2.4 V, 0.8 V ^f | TEMP. ^b | D SUFFIX -40 °C TO +85 °C | | | UNIT |
|-------------------------------------|-----------------------------|--|--------------------|------------------------------|-------------------|-------------------|------|
| | | | | MIN. ^d | TYP. ^c | MAX. ^d | |
| Analog Switch | | | | | | | |
| Analog signal range ^e | V _{ANALOG} | | Full | -15 | - | 15 | V |
| Drain-source on-resistance | R _{ON} | I _{NO/NC} = 10 mA, V _{COM} = 10 V, V ₊ = 13.5 V, V ₋ = -13.5 V | Room | - | 17 | 25 | Ω |
| | | | Full | - | - | 30 | |
| On-resistance flatness | R _{ON} flatness | I _{NO/NC} = 10 mA, V _{COM} = ± 5 V, 0 V, V ₊ = 13.5 V, V ₋ = -13.5 V | Room | - | 0.8 | 2.2 | Ω |
| | | | Full | - | - | 3 | |
| Switch off leakage current | I _{NO/NC(off)} | V ₊ = 16.5, V ₋ = -16.5 V, V _{COM} = ± 15.5 V, V _{NO/NC} = -/+ 15.5 V | Room | -1 | -0.1 | 1 | nA |
| | Full | | -10 | - | 10 | | |
| | I _{COM(off)} | | Room | -1 | -0.1 | 1 | |
| | | | Full | -10 | - | 10 | |
| Channel on leakage current | I _{COM(on)} | V ₊ = 16.5 V, V ₋ = -16.5 V, V _{COM} = V _{NO/NC} = ± 15.5 V | Room | -1 | -0.1 | 1 | nA |
| | | | Full | -10 | - | 10 | |
| Digital Control | | | | | | | |
| Input, high voltage | I _{INH} | | Full | 2.4 | - | - | V |
| Input, low voltage | I _{INL} | | Full | - | - | 0.8 | |
| Input capacitance ^e | C _{IN} | | Room | - | 5 | - | pF |
| Input current | I _{IN} | V _{IN} = 0 V or 5 V | | -1 | - | 1 | μA |
| Dynamic Characteristics | | | | | | | |
| Turn-on time | t _{on} | R _L = 300 Ω, C _L = 35 pF V _{NO/NC} = ± 10 V | Room | - | 100 | 130 | ns |
| | | | Full | - | - | 140 | |
| Turn-off time | t _{off} | | Room | - | 50 | 95 | |
| | | | Full | - | - | 110 | |
| Charge injection ^e | Q | C _L = 10 nF, V _{gen} = 0 V, R _{gen} = 0 Ω | Room | - | 10 | - | pC |
| Off-isolation ^e | OIRR | C _L = 5 pF, R _L = 50 Ω, f = 1 MHz | Room | - | -72 | - | dB |
| Source off capacitance ^e | C _{S(off)} | f = 1 MHz | Room | - | 19 | - | pF |
| Drain off capacitance ^e | C _{D(off)} | | Room | - | 8 | - | |
| Channel on capacitance ^e | C _{D(on)} | f = 1 MHz | Room | - | 30 | - | |
| Power Supplies | | | | | | | |
| Positive supply current | I ₊ | V ₊ = 16.5 V, V ₋ = -16.5 V, V _{IN} = 0 V or 5 V | Room | - | 16 | 30 | μA |
| | | | Full | - | - | 50 | |
| Negative supply current | I ₋ | | Room | -1 | -0.02 | - | |
| | | | Full | -10 | - | - | |

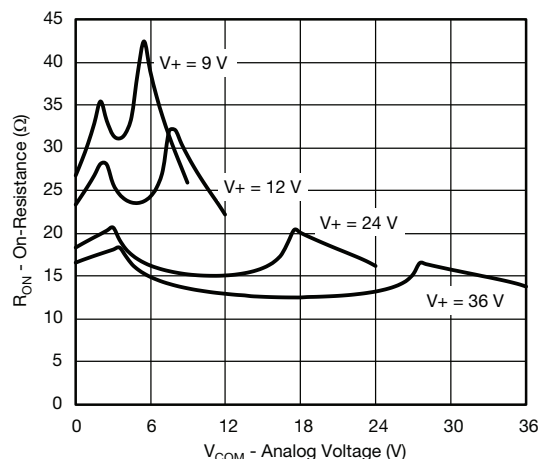
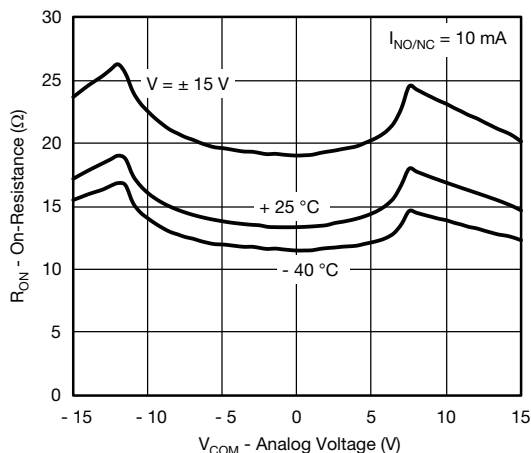
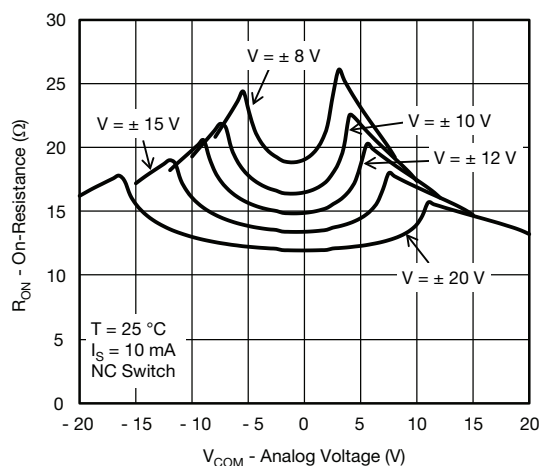
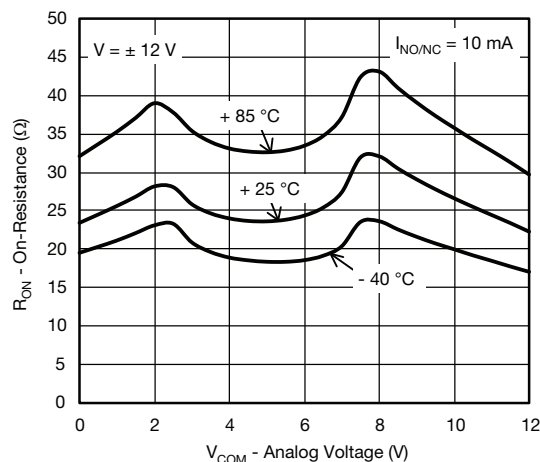
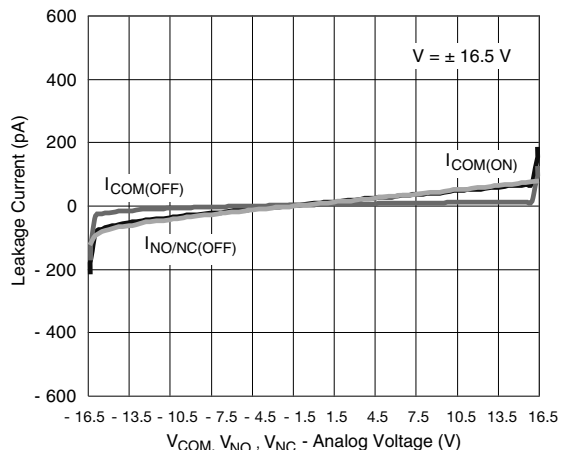
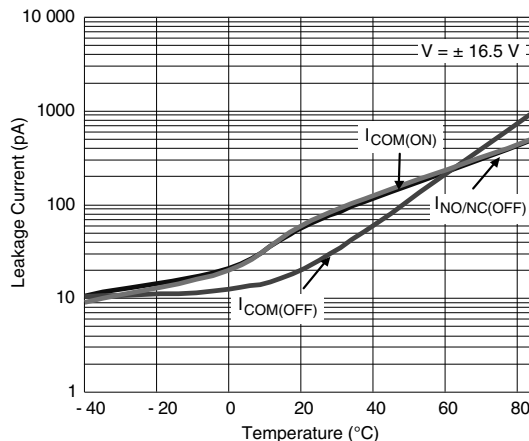


| SPECIFICATIONS ^a | | | | | | | |
|----------------------------------|-----------------------------|--|--------------------|-------------------------------|-------------------|-------------------|------|
| PARAMETER | SYMBOL | TEST CONDITIONS UNLESS SPECIFIED V ₊ = 12 V, V ₋ = 0 V, V _{IN} = 2.4 V, 0.8 V ^f | TEMP. ^b | D SUFFIX - 40 °C TO +85 °C | | | UNIT |
| | | | | MIN. ^d | TYP. ^c | MAX. ^d | |
| Analog Switch | | | | | | | |
| Analog signal range ^e | V _{ANALOG} | | Full | 0 | - | 12 | V |
| Drain-source on-resistance | R _{ON} | I _{NO/NC} = -10 mA, V _{COM} = 8 V, V ₊ = 10.8 V | Room | - | 32 | 45 | Ω |
| | | | Full | - | - | 60 | |
| On-resistance flatness | R _{ON} flatness | I _{NO/NC} = 10 mA, V _{COM} = 2 V, 6 V, 8 V V ₊ = 10.8 V | Room | - | 2 | 6 | |
| | | | Full | - | - | 8 | |
| Dynamic Characteristics | | | | | | | |
| Turn-on time | t _{on} | V _{NO, NC} = ± 10 V, R _L = 300 Ω, C _L = 35 pF | Room | - | 140 | 175 | ns |
| | | | Full | - | - | 225 | |
| Turn-off time | t _{off} | | Room | - | 50 | 120 | |
| | | | Full | - | - | 150 | |
| Charge injection ^e | Q | C _L = 10 nF, V _{gen} = 0 V, R _{gen} = 0 Ω | Room | - | 12 | - | pC |
| Power Supplies | | | | | | | |
| Positive supply current | I ₊ | V ₊ = 13.2 V, V _{IN} = 0 V, 5 V | Room | - | 22 | 50 | μA |
| | | | Full | - | - | 75 | |

Notes

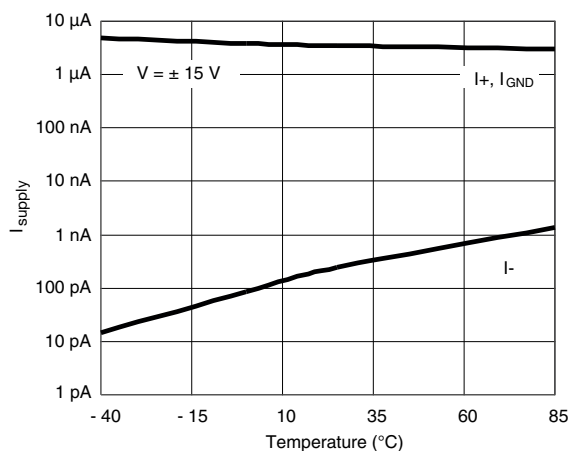
- a. Refer to PROCESS OPTION FLOWCHART
b. Room = 25 °C, full = as determined by the operating temperature suffix
c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing
d. The algebraic convention whereby the most negative value is a minimum and the most positive a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

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.

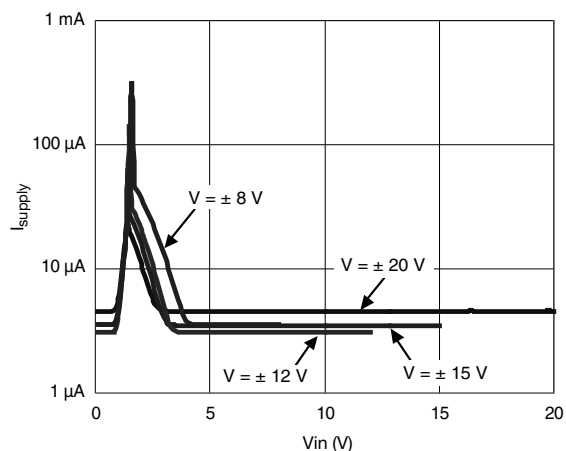
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

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

 R_{ON} vs. Analog Voltage and Temperature

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

 R_{ON} vs. Analog Voltage and Temperature

Leakage vs. Analog Voltage

Leakage Current vs. Temperature



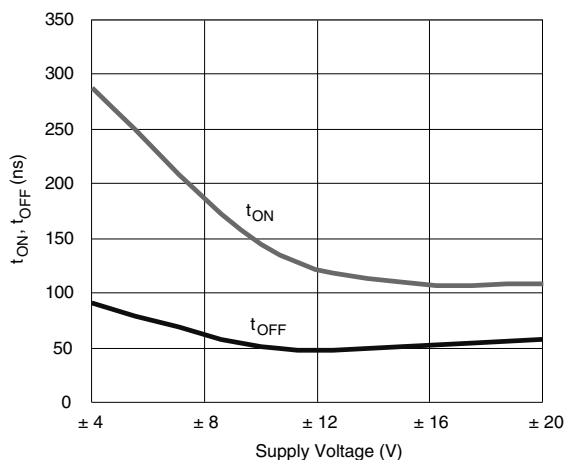
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



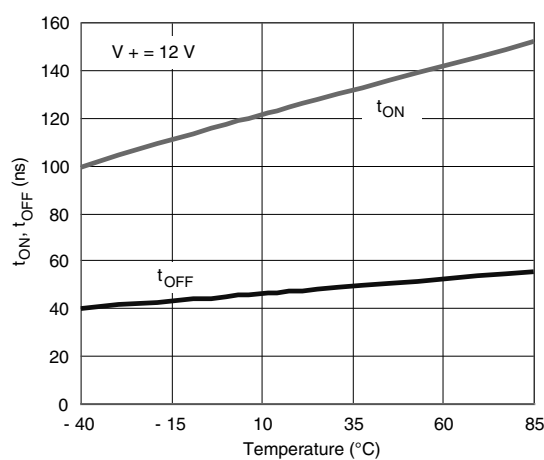
Supply Current vs. Temperature



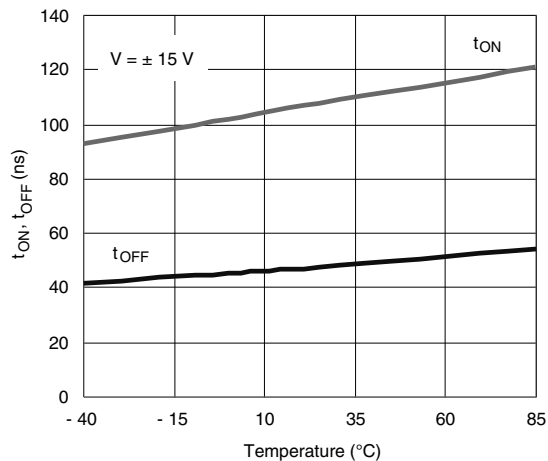
Supply Current vs. V_{IN}



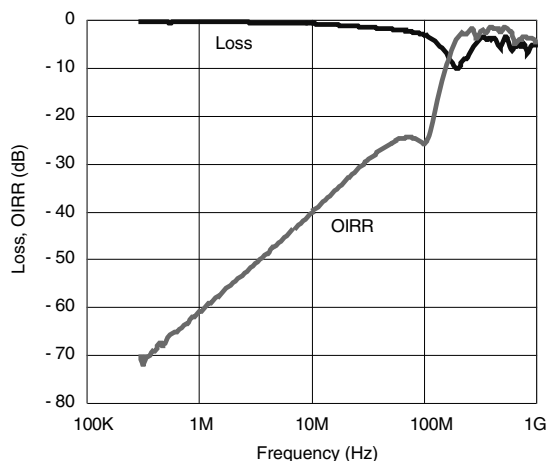
Switching Time vs. Supply Voltages



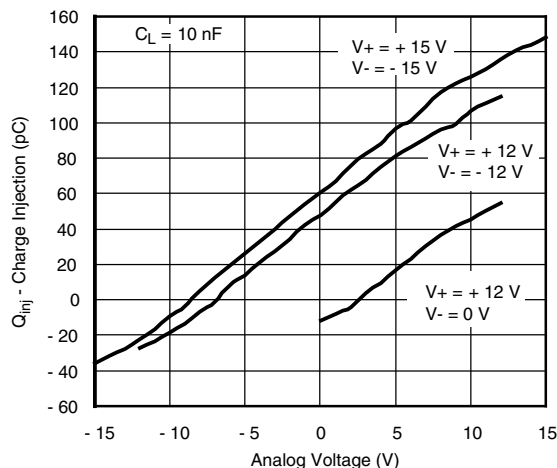
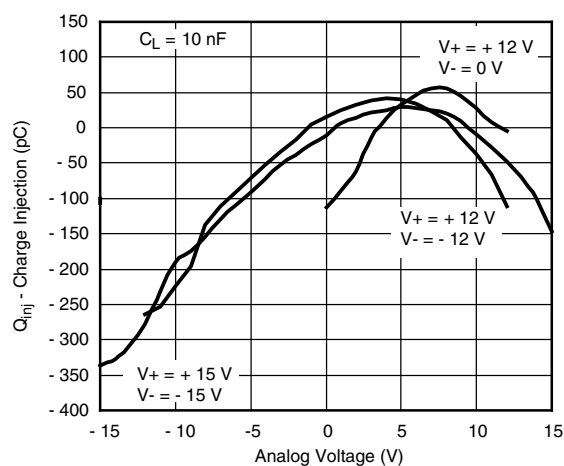
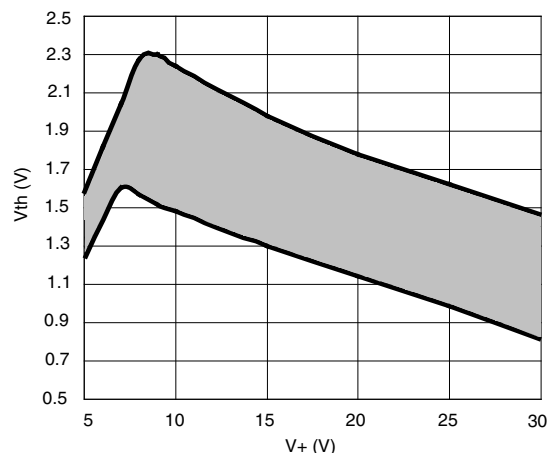
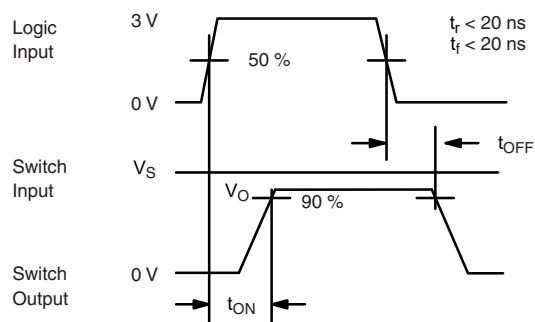
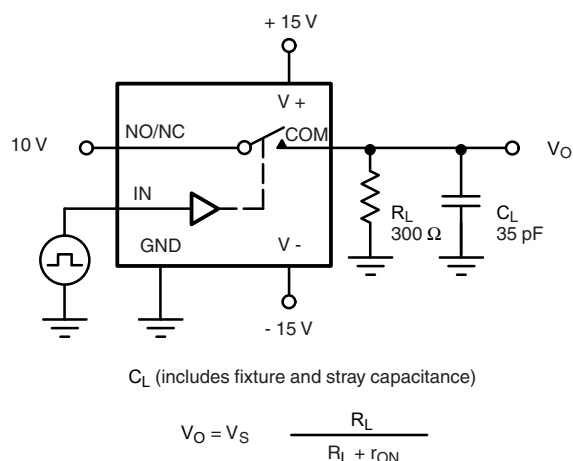
Switching Time vs. Temperature



Switching Time vs. Temperature



Off Isolation and Insertion Loss vs. Frequency

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Charge Injection vs. Analog Voltage (Measured at COM pin)

Charge Injection vs. Analog Voltage (Measured at NC or NO pin)

Input Switching Threshold vs. Supply Voltage
TEST CIRCUITS
 V_O is the steady state output with the switch on.


Note: Logic input waveform is inverted for switches that have the opposite logic sense.

Fig. 1 - Switching Time

TEST CIRCUITS

V_O is the steady state output with the switch on.

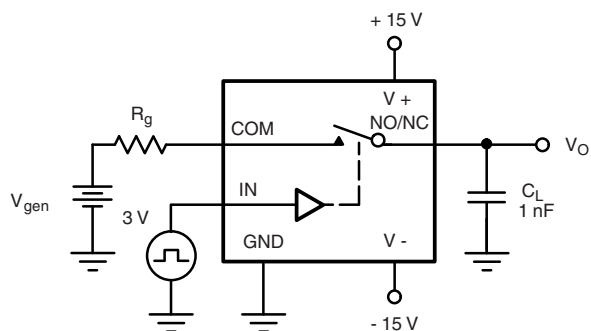


Fig. 2 - Charge Injection

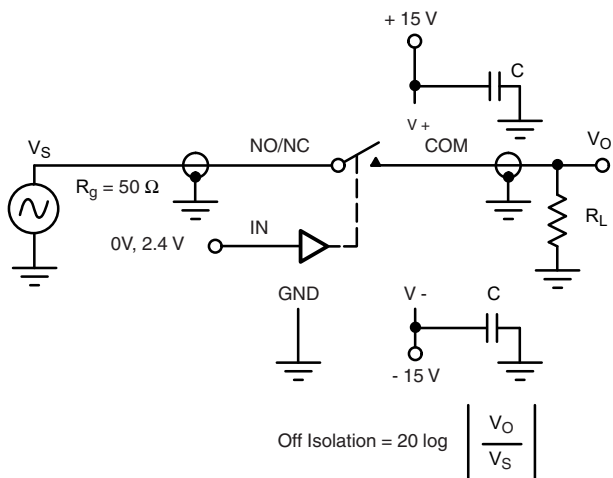


Fig. 3 - Off Isolation

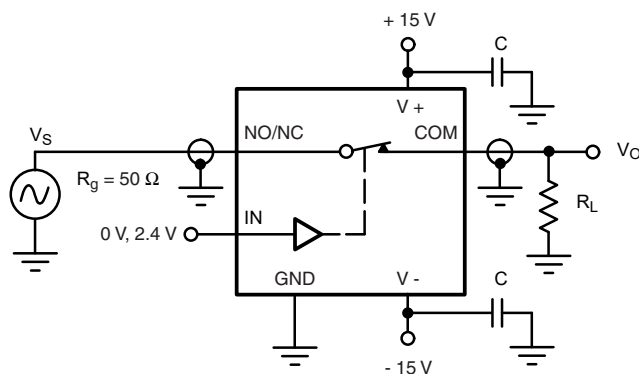


Fig. 4 - Insertion Loss

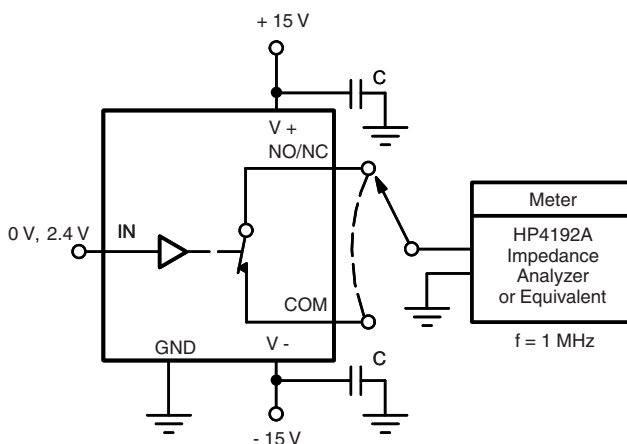


Fig. 5 - Source/Drain Capacitances



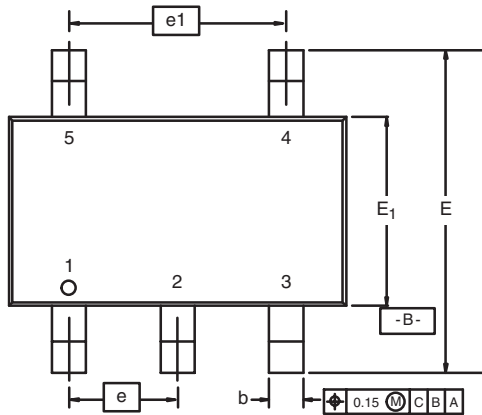
| PRODUCT SUMMARY | | |
|-----------------------------------|--|--|
| Part number | DG447 | DG448 |
| Status code | 2 | 2 |
| Configuration | SPST x 1, NO | SPST x 1, NO |
| Single supply min. (V) | 7 | 7 |
| Single supply max. (V) | 36 | 36 |
| Dual supply min. (V) | 4.5 | 4.5 |
| Dual supply max. (V) | 22 | 22 |
| On-resistance (Ω) | 32 | 32 |
| Charge injection (pC) | 12 | 12 |
| Source on capacitance (pF) | 30 | 30 |
| Source off capacitance (pF) | 8 | 8 |
| Leakage switch on typ. (nA) | 0.1 | 0.1 |
| Leakage switch off max. (nA) | 1 | 1 |
| -3 dB bandwidth (MHz) | - | - |
| Package | TSOP-6 | TSOP-6 |
| Functional circuit / applications | Multi purpose, instrumentation, medical and healthcare | Multi purpose, instrumentation, medical and healthcare |
| Interface | Parallel | Parallel |
| Single supply operation | Yes | Yes |
| Dual supply operation | Yes | Yes |
| Turn on time max. (ns) | 130 | 130 |
| Crosstalk and off isolation | -72 | -72 |

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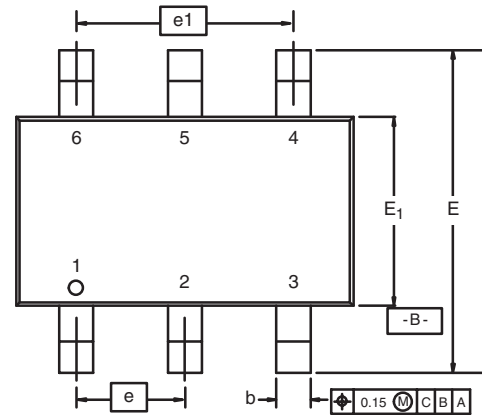


TSOP: 5/6-LEAD

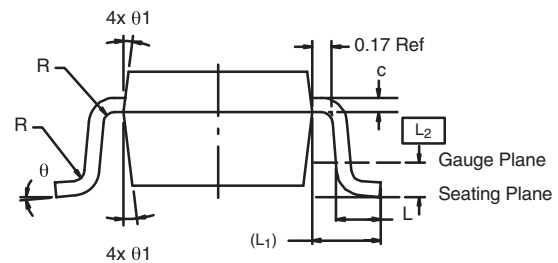
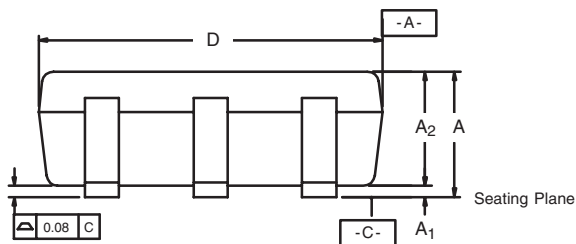
JEDEC Part Number: MO-193C



5-LEAD TSOP



6-LEAD TSOP



| Dim | MILLIMETERS | | | INCHES | | |
|--------------------------------|-------------|------|------|------------|-------|-------|
| | Min | Nom | Max | Min | Nom | Max |
| A | 0.91 | - | 1.10 | 0.036 | - | 0.043 |
| A ₁ | 0.01 | - | 0.10 | 0.0004 | - | 0.004 |
| A ₂ | 0.90 | - | 1.00 | 0.035 | 0.038 | 0.039 |
| b | 0.30 | 0.32 | 0.45 | 0.012 | 0.013 | 0.018 |
| c | 0.10 | 0.15 | 0.20 | 0.004 | 0.006 | 0.008 |
| D | 2.95 | 3.05 | 3.10 | 0.116 | 0.120 | 0.122 |
| E | 2.70 | 2.85 | 2.98 | 0.106 | 0.112 | 0.117 |
| E ₁ | 1.55 | 1.65 | 1.70 | 0.061 | 0.065 | 0.067 |
| e | 0.95 BSC | | | 0.0374 BSC | | |
| e ₁ | 1.80 | 1.90 | 2.00 | 0.071 | 0.075 | 0.079 |
| L | 0.32 | - | 0.50 | 0.012 | - | 0.020 |
| L ₁ | 0.60 Ref | | | 0.024 Ref | | |
| L ₂ | 0.25 BSC | | | 0.010 BSC | | |
| R | 0.10 | - | - | 0.004 | - | - |
| θ | 0° | 4° | 8° | 0° | 4° | 8° |
| θ ₁ | 7° Nom | | | 7° Nom | | |
| ECN: C-06593-Rev. I, 18-Dec-06 | | | | | | |
| DWG: 5540 | | | | | | |



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