





# Improved, Quad, SPST Analog Switches

## General Description

Maxim's redesigned DG444/DG445 analog switches now feature on-resistance matching ( $4\Omega$  max) between switches and guaranteed on-resistance flatness over the signal range ( $9\Omega$  max). These low on-resistance switches conduct equally well in either direction. They guarantee low charge injection ( $10\text{pC}$  max), low power consumption ( $35\mu\text{W}$  max), and an electrostatic discharge (ESD) tolerance of  $2000\text{V}$  (min) per Method 3015.7. The new design offers lower off-leakage current over temperature (less than  $5\text{nA}$  at  $+85^\circ\text{C}$ ).

The DG444/DG445 are quad, single-pole/single-throw (SPST) analog switches. The DG444 has four normally closed switches and the DG445 has four normally open switches. Switching times are less than  $250\text{ns}$  for  $t_{\text{ON}}$  and less than  $70\text{ns}$  for  $t_{\text{OFF}}$ . Operation is from a single  $+10\text{V}$  to  $+30\text{V}$  supply, or bipolar  $\pm 4.5\text{V}$  to  $\pm 20\text{V}$  supplies. Maxim's improved DG444/DG445 continue to be fabricated with a  $44\text{V}$  silicon-gate process.

## Applications

|                              |                          |
|------------------------------|--------------------------|
| Sample-and-Hold Circuits     | Communication Systems    |
| Test Equipment               | Battery-Operated Systems |
| Heads-Up Displays            | PBX, PABX                |
| Guidance and Control Systems | Audio Signal Routing     |
| Military Radios              | Modems/Faxes             |

## New Features

- ◆ Plug-In Upgrades for Industry-Standard DG444/DG445
- ◆ Improved  $R_{\text{ON}}$  Match Between Channels ( $4\Omega$  max)
- ◆ Guaranteed  $R_{\text{FLAT(ON)}}$  Over Signal Range ( $9\Omega$  max)
- ◆ Improved Charge Injection ( $10\text{pC}$  max)
- ◆ Improved Off-Leakage Current Over Temperature ( $< 5\text{nA}$  at  $+85^\circ\text{C}$ )
- ◆ Withstand ESD ( $2000\text{V}$  min) per Method 3015.7

## Existing Features

- ◆ Low  $R_{\text{DS(ON)}}$  ( $85\Omega$  max)
- ◆ Single-Supply Operation  $+10\text{V}$  to  $+30\text{V}$   
Bipolar-Supply Operation  $\pm 4.5\text{V}$  to  $\pm 20\text{V}$
- ◆ Low Power Consumption ( $35\mu\text{W}$  max)
- ◆ Rail-to-Rail Signal Handling
- ◆ TTL/CMOS-Logic Compatible

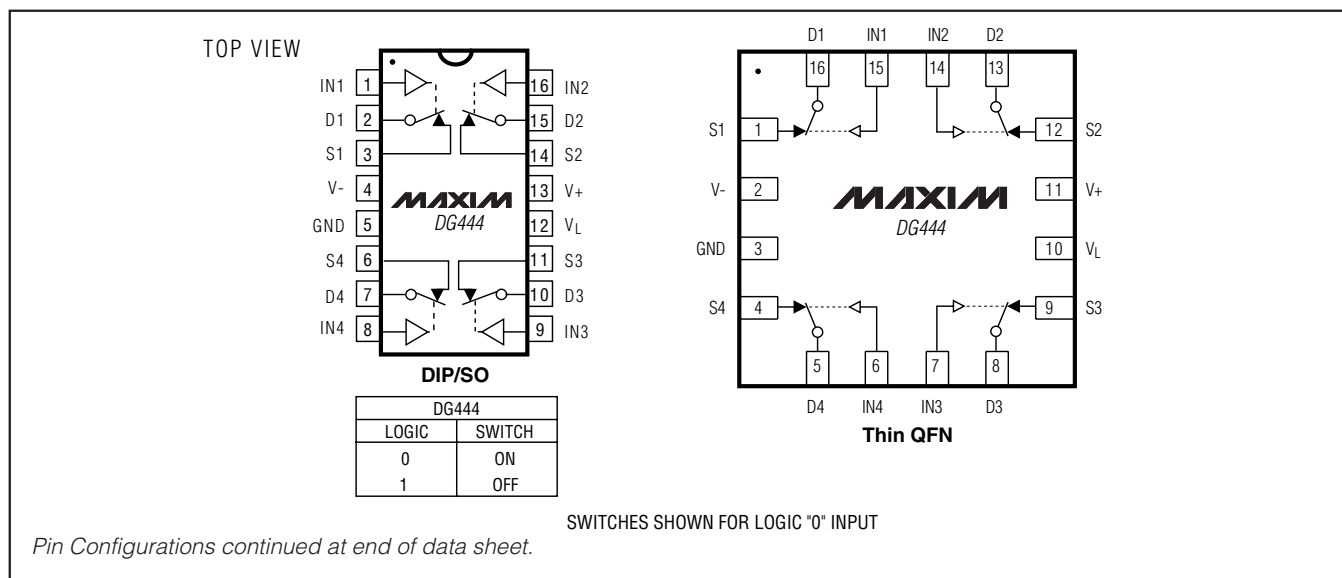
## Ordering Information

| PART     | TEMP RANGE                                 | PIN-PACKAGE    |
|----------|--|----------------|
| DG444CJ  | $0^\circ\text{C}$ to $+70^\circ\text{C}$   | 16 Plastic DIP |
| DG444CY  | $0^\circ\text{C}$ to $+70^\circ\text{C}$   | 16 Narrow SO   |
| DG444C/D | $0^\circ\text{C}$ to $+70^\circ\text{C}$   | Dice*          |
| DG444DJ  | $-40^\circ\text{C}$ to $+85^\circ\text{C}$ | 16 Plastic DIP |
| DG444DY  | $-40^\circ\text{C}$ to $+85^\circ\text{C}$ | 16 Narrow SO   |

Ordering Information continued at end of data sheet.

\*Contact factory for dice specifications.

## Pin Configurations/Functional Diagrams/Truth Tables



DG444/DG445

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## ABSOLUTE MAXIMUM RATINGS

(Voltage Referenced to V-)

|   |  |
|---|--|
| V+ .....  | 44V  |
| GND .....   | 25V  |
| V <sub>L</sub> .....  | (GND - 0.3V) to (V+ + 0.3V)                                |
| Digital Inputs V <sub>S</sub> , V <sub>D</sub> (Note 1) ..... | (V- - 2V) to (V+ + 2V) or 30mA<br>(whichever occurs first) |
| Continuous Current (any terminal) .....                       | 30mA   |
| Peak Current, S or D (pulsed at 1ms, 10% duty cycle max) ..   | 100mA  |

Continuous Power Dissipation (T<sub>A</sub> = +70°C)

|   |                 |
|---|-----------------|
| 6-Pin Narrow SO (derate 8.70mW/°C above +70°C) .. | 696mW           |
| 16-Pin PDIP (derate 10.53mW/°C above +70°C) ..... | 842mW           |
| 16-Pin Thin QFN (derate 33.3mW/°C above +70°C) .. | 2667mW          |
| Operating Temperature Ranges                      |                 |
| DG444C/DG445C .....                               | 0°C to +70°C    |
| DG444D, E/DG445D, E .....                         | -40°C to +85°C  |
| Storage Temperature Range .....                   | -65°C to +150°C |
| Lead Temperature (soldering, 10s) .....           | +300°C          |

**Note 1:** Signals on S, D, or IN exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current rating.

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.

## ELECTRICAL CHARACTERISTICS—Dual Supplies

(V+ = 15V, V- = -15V, V<sub>L</sub> = 5V, GND = 0, V<sub>INH</sub> = 2.4V, V<sub>INL</sub> = 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.)

| PARAMETER                                     | SYMBOL   | CONDITIONS  | MIN   | TYP<br>(Note 2) | MAX   | UNITS |       |    |
|---|--|---|---|-----------------|-------|-------|-------|----|
| <b>SWITCH</b>                                 |  |   |   |                 |       |       |       |    |
| Analog Signal Range                           | V <sub>ANALOG</sub>                            | (Note 3)  | -15   |                 | +15   | V     |       |    |
| Drain-Source On-Resistance                    | R <sub>D(S)ON</sub>                            | V+ = 13.5V, V- = -13.5V, V <sub>D</sub> = ±8.5V, I <sub>S</sub> = -10mA   | T <sub>A</sub> = +25°C                                |                 | 50    | 85    | Ω     |    |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 |       | 100   |       |    |
| On-Resistance Match Between Channels (Note 4) | ΔR <sub>D(S)ON</sub>                           | V <sub>D</sub> = ±10V, I <sub>S</sub> = -10mA                             | T <sub>A</sub> = +25°C                                |                 |       | 4     | Ω     |    |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 |       | 5     |       |    |
| On-Resistance Flatness (Note 4)               | R <sub>FLAT(ON)</sub>                          | V <sub>D</sub> = ±5V, I <sub>S</sub> = -10mA                              | T <sub>A</sub> = +25°C                                |                 |       | 9     | Ω     |    |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 |       | 15    |       |    |
| Source Leakage Current (Note 5)               | I <sub>S(OFF)</sub>                            | V+ = 16.5V, V- = -16.5V, V <sub>D</sub> = ±15.5V, V <sub>S</sub> = ±15.5V | T <sub>A</sub> = +25°C                                |                 | -0.50 | +0.01 | +0.50 | nA |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 | -5    |       | +5    |    |
| Drain Off-Leakage Current (Note 5)            | I <sub>D(OFF)</sub>                            | V+ = 16.5V, V- = -16.5V, V <sub>D</sub> = ±15.5V, V <sub>S</sub> = ±15.5V | T <sub>A</sub> = +25°C                                |                 | -0.50 | +0.01 | +0.50 | nA |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 | -5    |       | +5    |    |
| Drain On-Leakage Current (Note 5)             | I <sub>D(ON)</sub><br>or<br>I <sub>S(ON)</sub> | V+ = 16.5V, V- = -16.5V, V <sub>D</sub> = ±15.5V, V <sub>S</sub> = ±15.5V | T <sub>A</sub> = +25°C                                |                 | -0.50 | +0.08 | +0.50 | nA |
|   |  |   | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                 | -10   |       | +10   |    |
| <b>INPUT</b>                                  |  |   |   |                 |       |       |       |    |
| Input Current with Input Voltage High         | I <sub>INH</sub>                               | V <sub>IN</sub> = 2.4V, all others = 0.8V                                 | -0.5  | -0.00001        | +0.5  | μA    |       |    |
| Input Current with Input Voltage Low          | I <sub>INL</sub>                               | V <sub>IN</sub> = 0.8V, all others = 2.4V                                 | -0.5  | -0.00001        | +0.5  | μA    |       |    |

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DG444/DG445

## ELECTRICAL CHARACTERISTICS—Dual Supplies (continued)

(V+ = 15V, V- = -15V, VL = 5V, GND = 0, VINH = 2.4V, VINL = 0.8V, TA = TMIN to TMAX, unless otherwise noted.)

| PARAMETER                              | SYMBOL  | CONDITIONS  |                   | MIN  | TYP<br>(Note 2) | MAX   | UNITS |
|--|---------|---|-------------------|------|-----------------|-------|-------|
| <b>SWITCH</b>                          |         |   |                   |      |                 |       |       |
| Power-Supply Range                     | V+, V-  |   |                   | ±4.5 |                 | ±20.0 | V     |
| Positive Supply Current                | I+      | All channels on or off, V+ = 16.5V, V- = -16.5V, VIN = 0V or 5V | TA = +25°C        | -1   | -0.001          | +1    | µA    |
|  |         |   | TA = TMIN to TMAX | -5   |                 | +5    |       |
| Negative Supply Current                | I-      | All channels on or off, V+ = 16.5V, V- = -16.5V, VIN = 0V or 5V | TA = +25°C        | -1   | -0.0001         | +1    | µA    |
|  |         |   | TA = TMIN to TMAX | -5   |                 | +5    |       |
| Logic Supply Current                   | IL      | All channels on or off, V+ = 16.5V, V- = -16.5V, VIN = 0V or 5V | TA = +25°C        | -1   | -0.001          | +1    | µA    |
|  |         |   | TA = TMIN to TMAX | -5   |                 | +5    |       |
| Ground Current                         | IGND    | All channels on or off, V+ = 16.5V, V- = -16.5V, VIN = 0V or 5V | TA = +25°C        | -1   | -0.0001         | +1    | µA    |
|  |         |   | TA = TMIN to TMAX | -5   |                 | +5    |       |
| <b>INPUT</b>                           |         |   |                   |      |                 |       |       |
| Turn-On Time                           | tON     | VS = ±10V, Figure 2   | TA = +25°C        |      | 150             | 250   | ns    |
| Turn-Off Time                          | tOFF    | DG444, VS = ±10V, Figure 2                                      | TA = +25°C        |      | 90              | 120   | ns    |
|  |         | DG445, VS = ±10V, Figure 2                                      | TA = +25°C        |      | 110             | 170   | ns    |
| Charge Injection (Note 3)              | Q       | CL = 1nF, VGEN = 0, RGEN = 0Ω, Figure 3                         | TA = +25°C        |      | 5               | 10    | pC    |
| Off-Isolation Rejection Ratio (Note 6) | OIRR    | RL = 50Ω, CL = 5pF, f = 1MHz, Figure 4                          | TA = +25°C        |      | 60              |       | dB    |
| Crosstalk (Note 7)                     |         | RL = 50Ω, CL = 5pF, f = 1MHz, Figure 5                          | TA = +25°C        |      | 100             |       | dB    |
| Source Off-Capacitance                 | CS(OFF) | f = 1MHz, Figure 6  | TA = +25°C        |      | 4               |       | pF    |
| Drain Off-Capacitance                  | CD(OFF) | f = 1MHz, Figure 6  | TA = +25°C        |      | 4               |       | pF    |
| Source On-Capacitance                  | CS(ON)  | f = 1MHz, Figure 7  | TA = +25°C        |      | 16              |       | pF    |
| Drain On-Capacitance                   | CD(ON)  | f = 1MHz, Figure 7  | TA = +25°C        |      | 16              |       | pF    |

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## ELECTRICAL CHARACTERISTICS—Single Supply

( $V_+ = 12V$ ,  $V_- = 0$ ,  $V_L = 5V$ ,  $GND = 0$ ,  $V_{INH} = 2.4V$ ,  $V_{INL} = 0.8V$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted.)

| PARAMETER                  | SYMBOL        | CONDITIONS  | MIN                          | TYP<br>(Note 2) | MAX     | UNITS    |         |
|----------------------------|---------------|---|------------------------------|-----------------|---------|----------|---------|
| <b>SWITCH</b>              |               |   |                              |                 |         |          |         |
| Analog Signal Range        | $V_{ANALOG}$  | (Note 3)  | 0                            |                 | 12      | V        |         |
| Drain-Source On-Resistance | $R_{DS(ON)}$  | $V_+ = 10.8V$ ; $V_L = 5.25V$ ;<br>$V_D = 3V, 8V$ ; $I_S = -10mA$ | $T_A = +25^\circ C$          | 100             | 160     | $\Omega$ |         |
|                            |               |   | $T_A = T_{MIN}$ to $T_{MAX}$ |                 | 200     |          |         |
| <b>SUPPLY</b>              |               |   |                              |                 |         |          |         |
| Power-Supply Range         | $V_+$ , $V_-$ |   | 10.8                         |                 | 24.0    | V        |         |
| Power-Supply Current       | $I_+$         | All channels on or off,<br>$V_{IN} = 0V$ or $5V$                  | $T_A = +25^\circ C$          | -1              | +0.001  | +1       | $\mu A$ |
|                            |               |   | $T_A = T_{MIN}$ to $T_{MAX}$ | -5              |         | +5       |         |
| Negative Supply Current    | $I_-$         | All channels on or off,<br>$V_{IN} = 0V$ or $5V$                  | $T_A = +25^\circ C$          | -1              | -0.0001 | +1       | $\mu A$ |
|                            |               |   | $T_A = T_{MIN}$ to $T_{MAX}$ | -5              |         | +5       |         |
| Logic Supply Current       | $I_L$         | All channels on or off,<br>$V_{IN} = 0V$ or $5V$                  | $T_A = +25^\circ C$          | -1              | +0.001  | +1       | $\mu A$ |
|                            |               |   | $T_A = T_{MIN}$ to $T_{MAX}$ | -5              |         | +5       |         |
| Ground Current             | $I_{GND}$     | All channels on or off,<br>$V_{IN} = 0V$ or $5V$                  | $T_A = +25^\circ C$          | -1              | -0.0001 | +1       | $\mu A$ |
|                            |               |   | $T_A = T_{MIN}$ to $T_{MAX}$ | -5              |         | +5       |         |
| <b>DYNAMIC</b>             |               |   |                              |                 |         |          |         |
| Turn-On Time               | $t_{ON}$      | $V_S = 8V$ , Figure 2   |                              | 300             | 400     | ns       |         |
| Turn-Off Time              | $t_{OFF}$     | $V_S = 8V$ , Figure 2   |                              | 60              | 200     | ns       |         |
| Charge Injection (Note 3)  | $Q$           | $C_L = 1nF$ , $V_{GEN} = 0$ ,<br>$R_{GEN} = 0\Omega$ , Figure 3   |                              | 5               | 10      | pC       |         |

**Note 2:** Typical values are for **design aid only**, are not guaranteed, and are not subject to production testing. The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

**Note 3:** Guaranteed by design.

**Note 4:** On-resistance match between channels and flatness are guaranteed only with bipolar-supply operation. Flatness is defined as the difference between the maximum and the minimum value of on-resistance as measured at the extremes of the specified analog signal range.

**Note 5:** Leakage parameters  $I_{S(OFF)}$ ,  $I_{D(OFF)}$ ,  $I_{D(ON)}$ , and  $I_{S(ON)}$  are 100% tested at the maximum rated hot temperature and guaranteed at  $+25^\circ C$ .

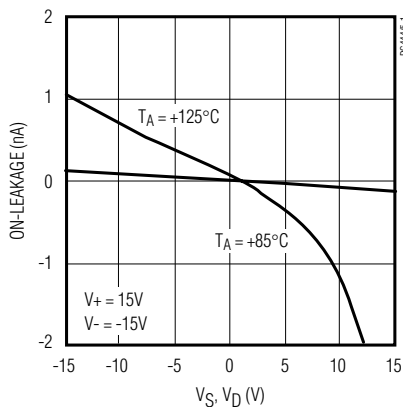
**Note 6:** Off-Isolation Rejection Ratio =  $20\log(V_D/V_S)$ ,  $V_D$  = output,  $V_S$  = input to off switch.

**Note 7:** Between any two switches.

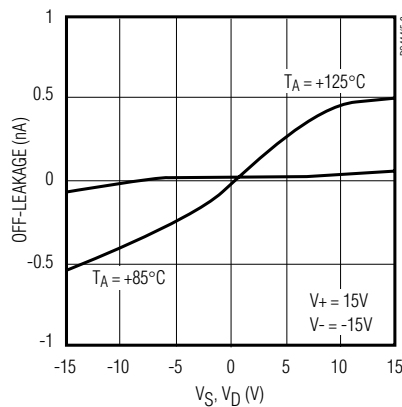
## Typical Operating Characteristics

( $T_A = +25^\circ C$ , unless otherwise noted.)

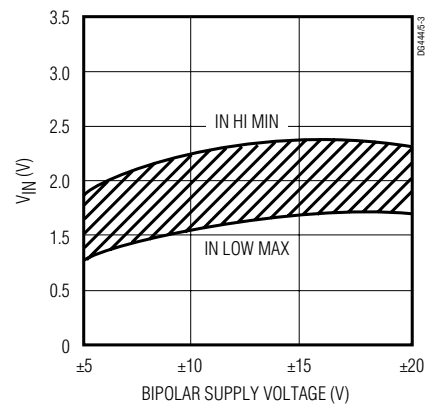
**ON-LEAKAGE CURRENTS**



**OFF-LEAKAGE CURRENTS**



**SWITCHING THRESHOLD vs. BIPOLAR SUPPLY VOLTAGE**



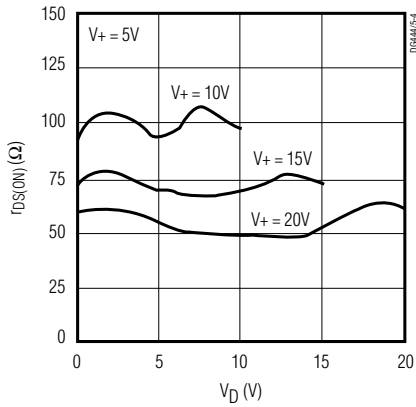
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## Typical Operating Characteristics

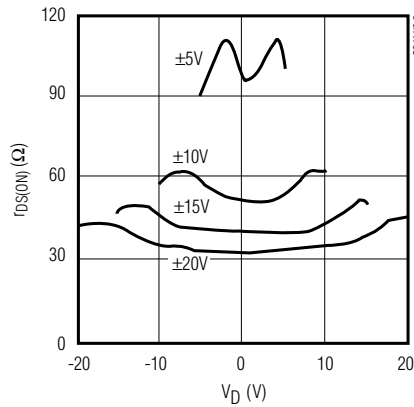
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

DG4444/DG4445

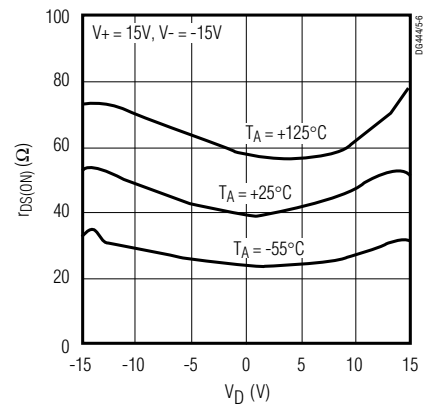
**ON-RESISTANCE vs.  $V_D$  AND UNIPOLAR-SUPPLY VOLTAGE**



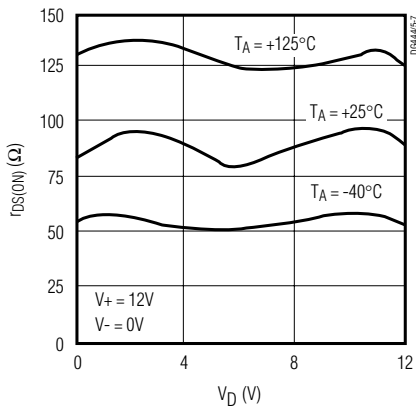
**ON-RESISTANCE vs.  $V_D$  AND BIPOLAR-SUPPLY VOLTAGE**



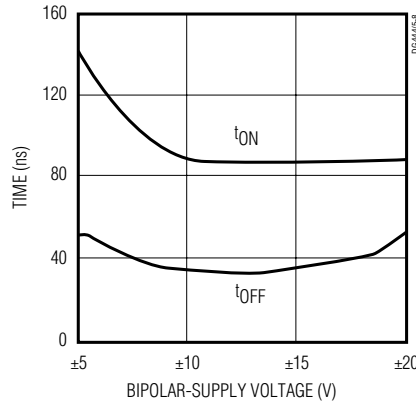
**ON-RESISTANCE vs.  $V_D$ , BIPOLAR-SUPPLY VOLTAGE AND TEMPERATURE**



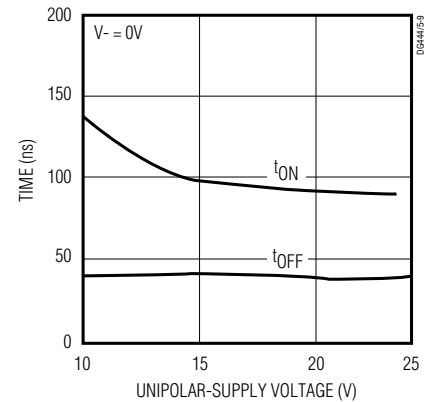
**ON-RESISTANCE vs.  $V_D$ , UNIPOLAR-SUPPLY VOLTAGE AND TEMPERATURE**



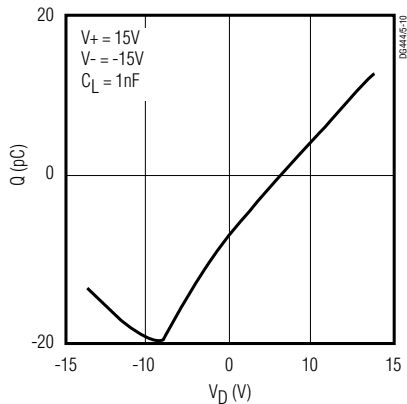
**SWITCHING TIME vs. BIPOLAR-SUPPLY VOLTAGE**



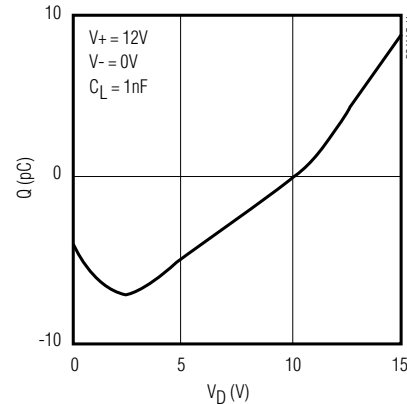
**SWITCHING TIME vs. UNIPOLAR-SUPPLY VOLTAGE**



**CHARGE INJECTION vs.  $V_D$  VOLTAGE**



**CHARGE INJECTION vs.  $V_D$  VOLTAGE**



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## Pin Description

| PIN          |              | NAME    | FUNCTION   |
|--------------|--------------|---------|--|
| DIP/SO       | THIN QFN     |         |  |
| 1, 16, 9, 8  | 15, 14, 7, 6 | IN1-IN4 | Logic Control Inputs                                 |
| 2, 15, 10, 7 | 16, 13, 8, 5 | D1-D4   | Drain Outputs  |
| 3, 14, 11, 6 | 1, 12, 9, 4  | S1-S4   | Source Outputs                                       |
| 4            | 2            | V-      | Negative-Supply Voltage Input                        |
| 5            | 3            | GND     | Ground   |
| 12           | 10           | VL      | Logic-Supply Voltage Input                           |
| 13           | 11           | V+      | Positive-Supply-Voltage Input—Connected to Substrate |
| —            | EP           | PAD     | Exposed Pad Connect Pad to V+                        |

## Applications Information

### General Operation

- Switches are open when power is off.
- IN, D, and S should not exceed V+ or V-, even with the power off.
- Switch leakage is from each analog switch terminal to V+ or V-, not to other switch terminals.

### Operation with Supply Voltages Other than ±15V

Using supply voltages other than ±15V will reduce the analog signal range. The DG444/DG445 switches oper-

ate with ±4.5V to ±20V bipolar supplies or with a +10V to +30V single supply; connect V- to 0V when operating with a single supply. Also, all device types can operate with unbalanced supplies such as +24V and -5V. VL must be connected to +5V to be TTL compatible, or to V+ for CMOS-logic level inputs. The *Typical Operating Characteristics* graphs show typical on-resistance with ±20V, ±15V, ±10V, and ±5V supplies. (Switching times increase by a factor of two or more for operation at ±5V.)

### Overvoltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Do not exceed the absolute maximum ratings because stresses beyond the listed ratings may cause permanent damage to the devices. Always sequence V+ on first, followed by VL, V-, and logic inputs. If power-supply sequencing is not possible, add two small, external signal diodes in series with supply pins for overvoltage protection (Figure 1). Adding diodes reduces the analog signal range to 1V below V+ and 1V above V-, but low switch resistance and low leakage characteristics are unaffected. Device operation is unchanged, and the difference between V+ and V- should not exceed +44V.

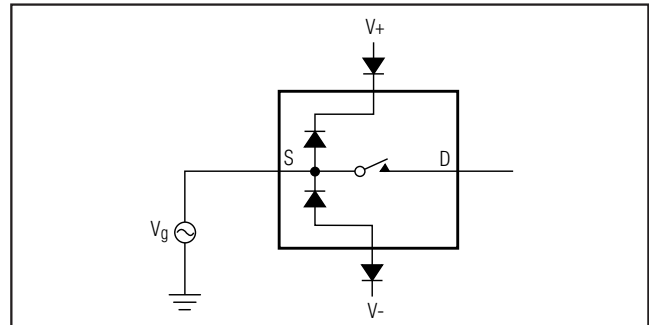


Figure 1. Overvoltage Protection Using External Blocking Diodes

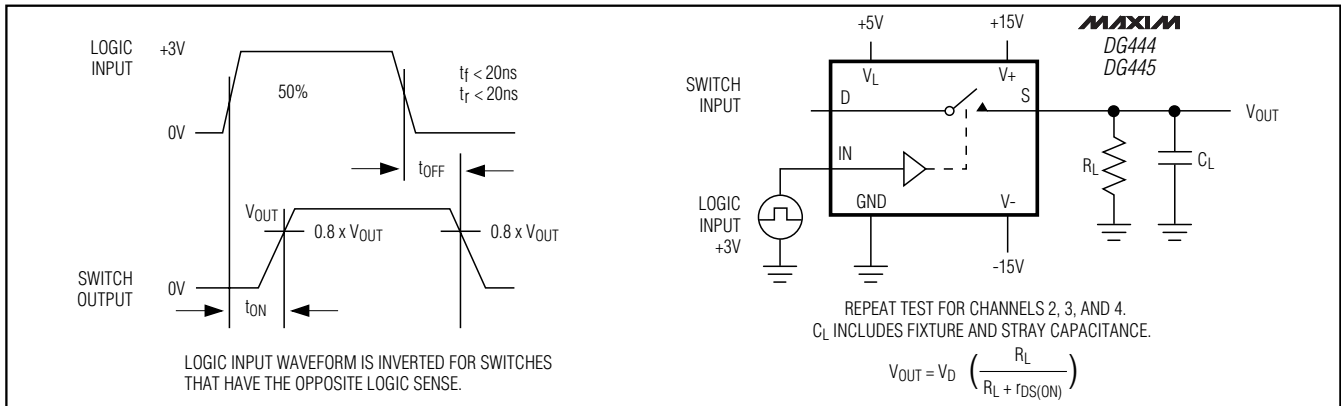


Figure 2. Switching Time

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**DG444/DG445**

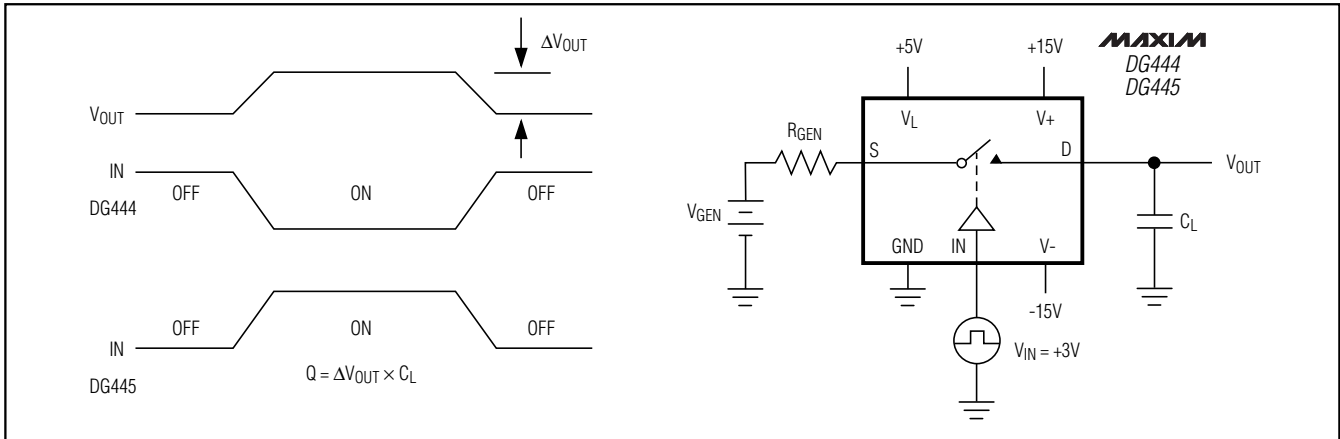


Figure 3. Charge Injection

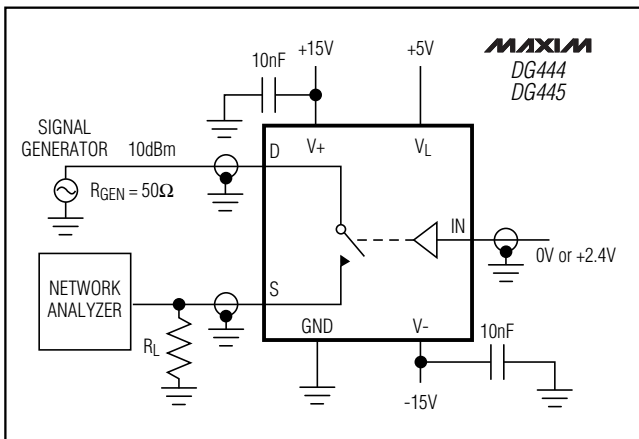


Figure 4. Off-Isolation Rejection Ratio

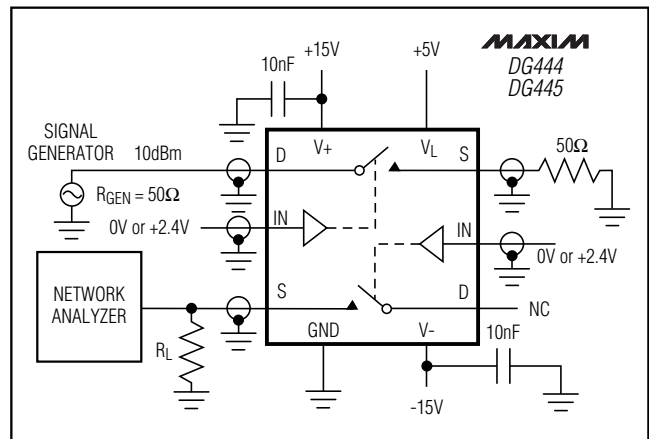


Figure 5. Crosstalk

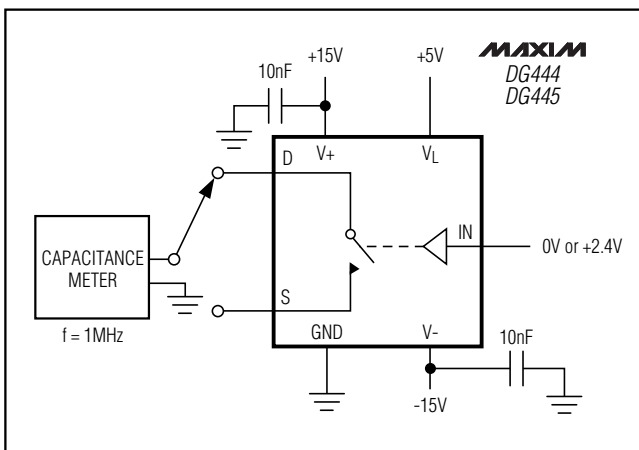


Figure 6. Source/Drain Off-Capacitance

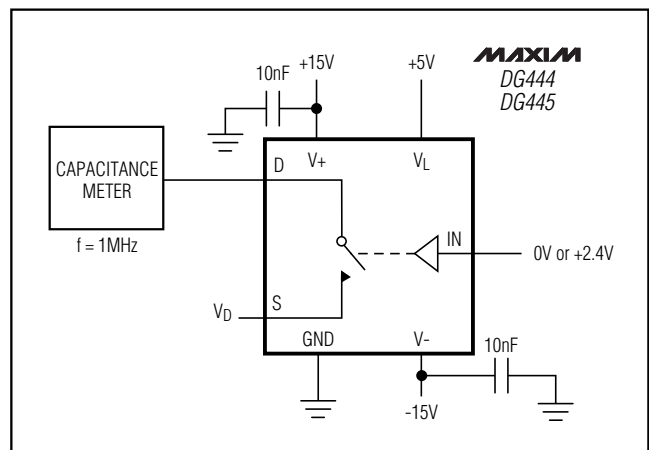
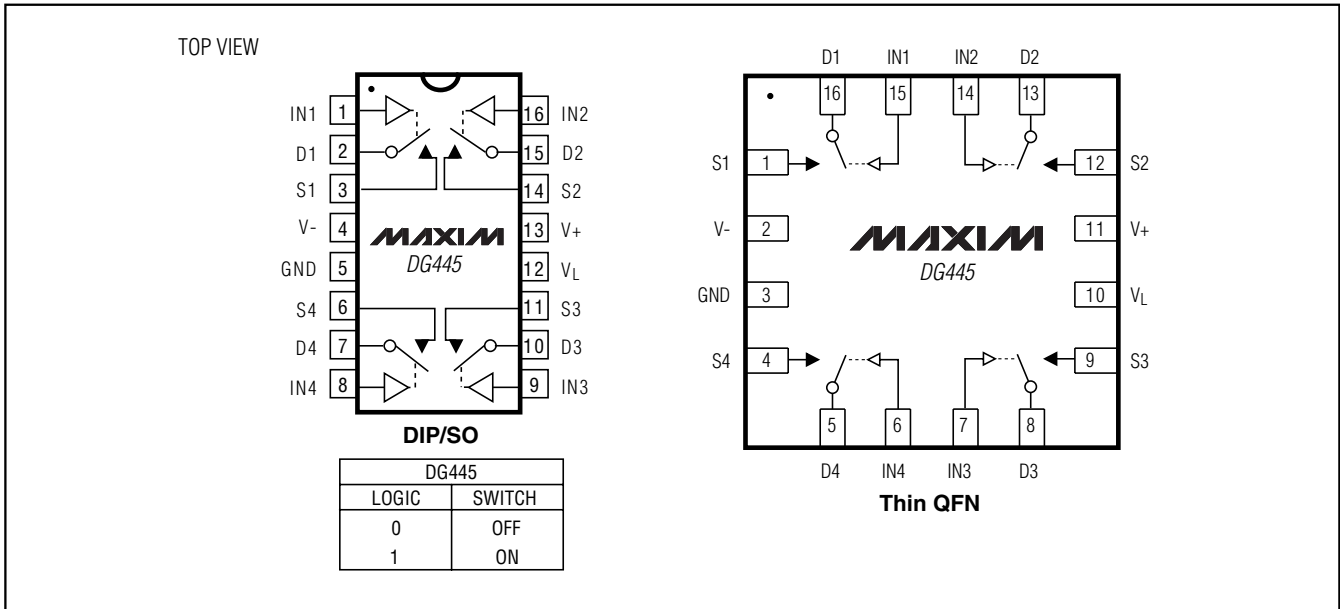


Figure 7. Source/Drain On-Capacitance

# Improved, Quad, SPST Analog Switches

## Pin Configurations/Functional Diagrams (continued)



## Ordering Information (continued)

| PART           | TEMP RANGE     | PIN-PACKAGE             |
|----------------|----------------|-------------------------|
| DG444ETE       | -40°C to +85°C | 16 Thin QFN (5mm x 5mm) |
| <b>DG445CJ</b> | 0°C to +70°C   | 16 Plastic DIP          |
| DG445CY        | 0°C to +70°C   | 16 Narrow SO            |
| DG445C/D       | 0°C to +70°C   | Dice*                   |
| DG445DJ        | -40°C to +85°C | 16 Plastic DIP          |
| DG445DY        | -40°C to +85°C | 16 Narrow SO            |
| DG445ETE       | -40°C to +85°C | 16 Thin QFN (5mm x 5mm) |

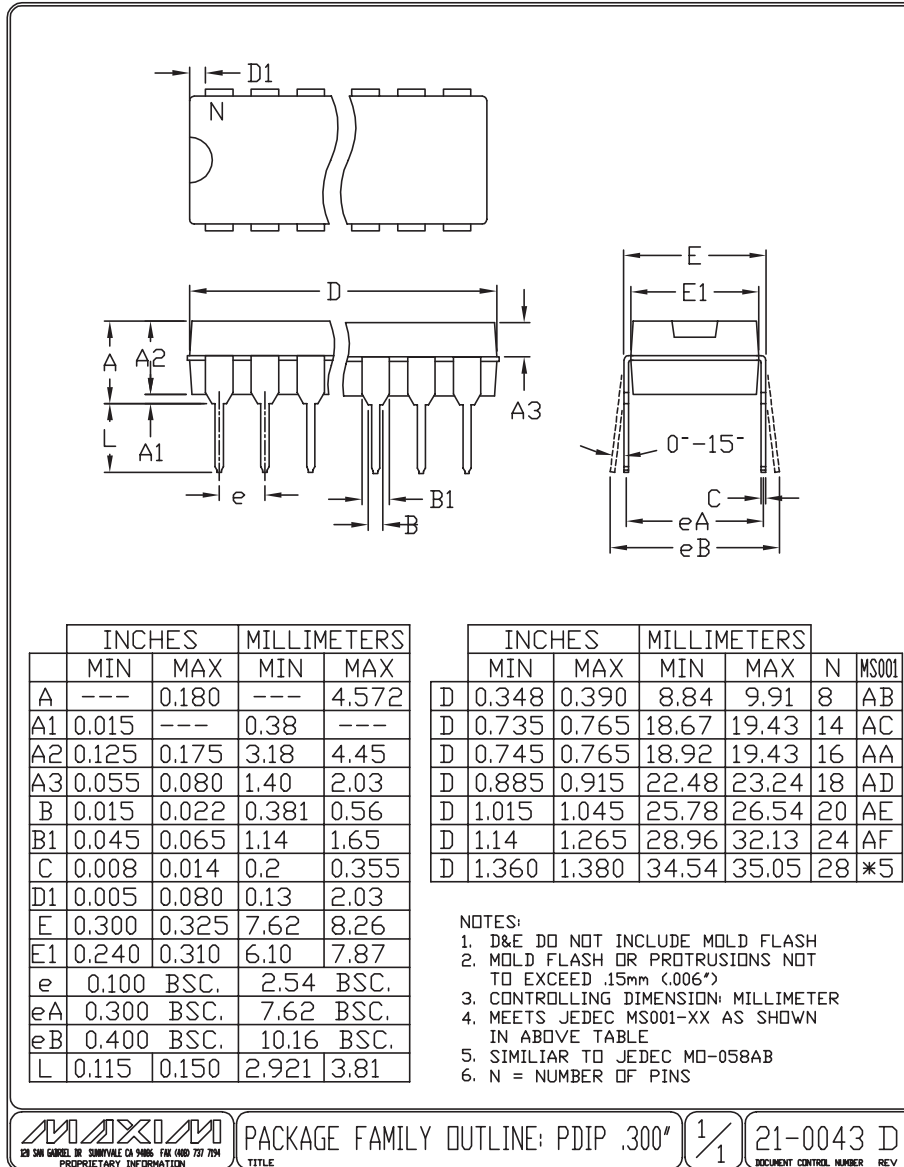
\*Contact factory for dice specifications.

# Improved, Quad, SPST Analog Switches

## Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)

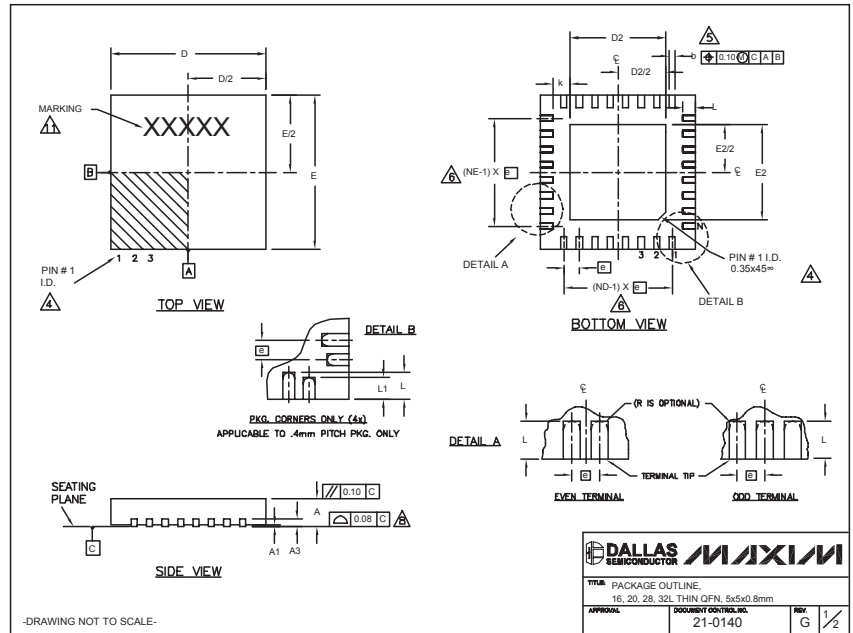
DG444/DG445



# Improved, Quad, SPST Analog Switches

## Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



| COMMON DIMENSIONS |           |      |      |           |      |      |           |      |      |           |      |      |
|-------------------|-----------|------|------|-----------|------|------|-----------|------|------|-----------|------|------|
| PKG. SYMBOL       | 16L 5x5   |      |      | 20L 5x5   |      |      | 28L 5x5   |      |      | 32L 5x5   |      |      |
|                   | MIN.      | NOM. | MAX. | MIN.      | NOM. | MAX. | MIN.      | NOM. | MAX. | MIN.      | NOM. | MAX. |
| A                 | 0.70      | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 | 0.70      | 0.75 | 0.80 |
| A1                | 0         | 0.02 | 0.05 | 0         | 0.02 | 0.05 | 0         | 0.02 | 0.05 | 0         | 0.02 | 0.05 |
| A3                | 0.20 REF. |      |      | 0.20 REF. |      |      | 0.20 REF. |      |      | 0.20 REF. |      |      |
| b                 | 0.25      | 0.30 | 0.35 | 0.25      | 0.30 | 0.35 | 0.20      | 0.25 | 0.30 | 0.20      | 0.25 | 0.30 |
| D                 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 |
| E                 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 | 4.90      | 5.00 | 5.10 |
| e                 | 0.80 BSC. |      |      | 0.65 BSC. |      |      | 0.50 BSC. |      |      | 0.50 BSC. |      |      |
| k                 | 0.25      | -    | -    | 0.25      | -    | -    | 0.25      | -    | -    | 0.25      | -    | -    |
| L                 | 0.30      | 0.40 | 0.50 | 0.45      | 0.55 | 0.65 | 0.45      | 0.55 | 0.65 | 0.30      | 0.40 | 0.50 |
| L1                | -         | -    | -    | -         | -    | -    | -         | -    | -    | -         | -    | -    |
| N                 | 16        |      |      | 20        |      |      | 28        |      |      | 32        |      |      |
| ND                | 4         |      |      | 5         |      |      | 7         |      |      | 8         |      |      |
| NE                | 4         |      |      | 5         |      |      | 7         |      |      | 8         |      |      |
| JEDEC             | WHHB      |      |      | WHHC      |      |      | WHHD-1    |      |      | WHHD-2    |      |      |

| EXPOSED PAD VARIATIONS |      |      |      |      |      |      |      |                    |       |  |  |
|------------------------|------|------|------|------|------|------|------|--------------------|-------|--|--|
| PKG. CODES             | D2   |      |      | E2   |      |      | L    | DOWN BONDS ALLOWED |       |  |  |
|                        | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |      |                    | ±0.15 |  |  |
| T1655-1                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T1655-2                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | YES                |       |  |  |
| T1655N-1               | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T2055-2                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T2055-3                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | YES                |       |  |  |
| T2055-4                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T2055-5                | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | 0.40 | Y                  |       |  |  |
| T2855-1                | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | **   | NO                 |       |  |  |
| T2855-2                | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 | **   | NO                 |       |  |  |
| T2855-3                | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | **   | YES                |       |  |  |
| T2855-4                | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 | **   | YES                |       |  |  |
| T2855-5                | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 | **   | NO                 |       |  |  |
| T2855-6                | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | **   | NO                 |       |  |  |
| T2855-7                | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 | **   | YES                |       |  |  |
| T2855-8                | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | 0.40 | Y                  |       |  |  |
| T2855N-1               | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 | **   | N                  |       |  |  |
| T3255-2                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T3255-3                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | YES                |       |  |  |
| T3255-4                | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |
| T3255N-1               | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 | **   | NO                 |       |  |  |

\*\*SEE COMMON DIMENSIONS TABLE

NOTES:  
 1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.  
 2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.  
 3. N IS THE TOTAL NUMBER OF TERMINALS.  
 4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JEDEC 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.  
 5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.  
 6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.  
 7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.  
 8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.  
 9. DRAWING CONFORMS TO JEDEC MO220, EXCEPT EXPOSED PAD DIMENSION FOR T2855-1, T2855-3 AND T2855-6.  
 10. WARPAGE SHALL NOT EXCEED 0.10 mm.  
 11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.  
 12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.



PACKAGE OUTLINE  
16, 20, 28, 32L THIN QFN, 5x5x0.8mm  
21-0140

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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