



# Improved, Quad, SPST Analog Switches

**DG444/DG445**

## 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 (10pC max), low power consumption (35 $\mu$ W max), and an electrostatic discharge (ESD) tolerance of 2000V (min) per Method 3015.7. The new design offers lower off-leakage current over temperature (less than 5nA at +85°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 250ns for  $t_{ON}$  and less than 70ns for  $t_{OFF}$ . Operation is from a single +10V to +30V supply, or bipolar  $\pm 4.5V$  to  $\pm 20V$  supplies. Maxim's improved DG444/DG445 continue to be fabricated with a 44V 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             |

*Rail-to Rail is a registered trademark of Nippon Motorola, Ltd.*

## New Features

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

## Existing Features

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

## Ordering Information

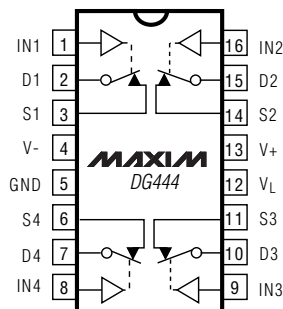
| PART     | TEMP. RANGE    | PIN-PACKAGE    |
|----------|----------------|----------------|
| DG444CJ  | 0°C to +70°C   | 16 Plastic DIP |
| DG444CY  | 0°C to +70°C   | 16 Narrow SO   |
| DG444C/D | 0°C to +70°C   | Dice*          |
| DG444DJ  | -40°C to +85°C | 16 Plastic DIP |
| DG444DY  | -40°C to +85°C | 16 Narrow SO   |

**Ordering Information continued at end of data sheet.**

\*Contact factory for dice specifications.

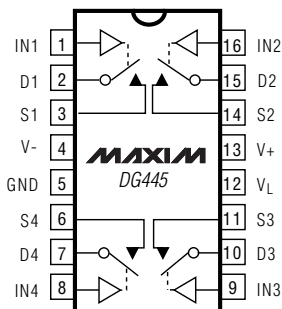
## Pin Configurations/Functional Diagrams/Truth Tables

TOP VIEW



DIP/SO

| DG444 |        |
|-------|--------|
| LOGIC | SWITCH |
| 0     | ON     |
| 1     | OFF    |



DIP/SO

| DG445 |        |
|-------|--------|
| LOGIC | SWITCH |
| 0     | OFF    |
| 1     | ON     |

SWITCHES SHOWN FOR LOGIC "0" INPUT

*Pin Configurations continued at end of data sheet.*



Maxim Integrated Products 1

**For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).**

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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)

|                                                |                 |
|------------------------------------------------|-----------------|
| 16-Pin PDIP (derate 10.53mW/°C above +70°C)    | 842mW           |
| 6-Pin Narrow SO (derate 8.70mW/°C above +70°C) | 696mW           |
| 16-Pin QFN (derate 19.2mW/°C above +70°C)      | 1538mW          |
| 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 |
|--------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------|----------|------|-----|-------|
| SWITCH                                           |                                                |                                                                                                          |                                                       |                                |          |      |     |       |
| Analog Signal Range                              | V <sub>ANALOG</sub>                            | (Note 3)                                                                                                 |                                                       | -15                            |          | 15   | V   |       |
| Drain-Source<br>On-Resistance                    | r <sub>DS(ON)</sub>                            | V <sub>+</sub> = 13.5V, V <sub>-</sub> = -13.5V,<br>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<br>Between Channels (Note 4) | Δr <sub>DS(ON)</sub>                           | V <sub>D</sub> = ±10V,<br>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,<br>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<br>(Note 5)               | I <sub>S(OFF)</sub>                            | V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V,<br>V <sub>D</sub> = ±15.5V,<br>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<br>(Note 5)            | I <sub>D(OFF)</sub>                            | V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V,<br>V <sub>D</sub> = ±15.5V,<br>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<br>(Note 5)             | I <sub>D(ON)</sub><br>or<br>I <sub>S(ON)</sub> | V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V,<br>V <sub>D</sub> = ±15.5V,<br>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       |      |     |       |
| INPUT                                            |                                                |                                                                                                          |                                                       |                                |          |      |     |       |
| Input Current with<br>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<br>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<sub>+</sub> = 15V, V<sub>-</sub> = -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 |
|----------------------------------------|---------|-----------------------------------------------------------------|-------------------|------|-----------------|-------|-------|
| SWITCH                                 |         |                                                                 |                   |      |                 |       |       |
| 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     |       |
| INPUT                                  |         |                                                                 |                   |      |                 |       |       |
| 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

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

| PARAMETER                     | SYMBOL  | CONDITIONS                                         |                   | MIN  | TYP<br>(Note 2) | MAX  | UNITS |
|-------------------------------|---------|----------------------------------------------------|-------------------|------|-----------------|------|-------|
| SWITCH                        |         |                                                    |                   |      |                 |      |       |
| Analog Signal Range           | VANALOG | (Note 3)                                           |                   | 0    |                 | 12   | V     |
| Drain-Source<br>On-Resistance | rDS(ON) | V+ = 10.8V; VL = 5.25V;<br>VD = 3V, 8V; IS = -10mA | TA = +25°C        | 100  | 160             | Ω    |       |
|                               |         |                                                    | TA = TMIN to TMAX |      | 200             |      |       |
| SUPPLY                        |         |                                                    |                   |      |                 |      |       |
| Power-Supply Range            | V+, V-  |                                                    |                   | 10.8 |                 | 24.0 | V     |
| Power-Supply Current          | I+      | All channels on or off,<br>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,<br>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,<br>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,<br>VIN = 0V or 5V          | TA = +25°C        | -1   | -0.0001         | 1    | μA    |
|                               |         |                                                    | TA = TMIN to TMAX | -5   |                 | 5    |       |
| DYNAMIC                       |         |                                                    |                   |      |                 |      |       |
| Turn-On Time                  | tON     | VS = 8V, Figure 2                                  | TA = +25°C        | 300  |                 | 400  | ns    |
| Turn-Off Time                 | tOFF    | VS = 8V, Figure 2                                  | TA = +25°C        | 60   |                 | 200  | ns    |
| Charge Injection (Note 3)     | Q       | CL = 1nF, VGEN = 0,<br>RGEN = 0Ω, Figure 3         | TA = +25°C        | 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.

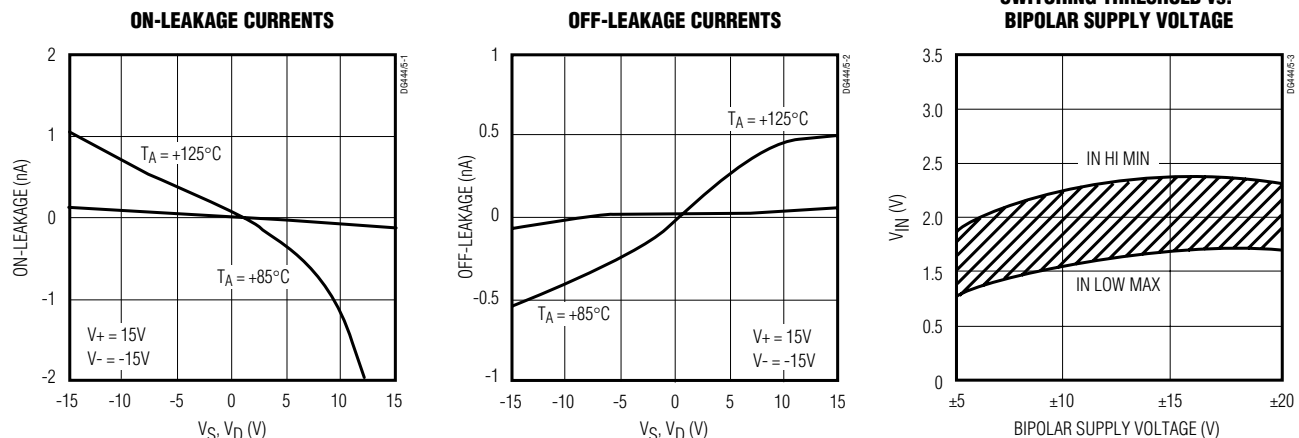
**Note 5:** Leakage parameters  $I_{\text{S(OFF)}}$ ,  $I_{\text{D(OFF)}}$ ,  $I_{\text{D(ON)}}$ , and  $I_{\text{S(ON)}}$  are 100% tested at the maximum rated hot temperature and guaranteed at  $+25^\circ\text{C}$ .

**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

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



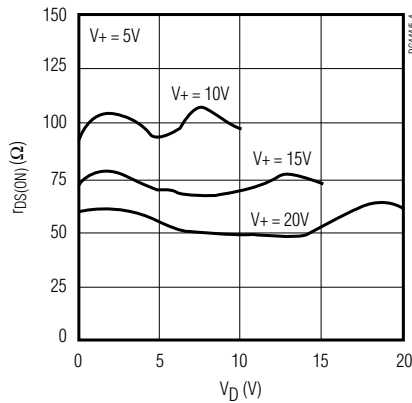
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## Typical Operating Characteristics

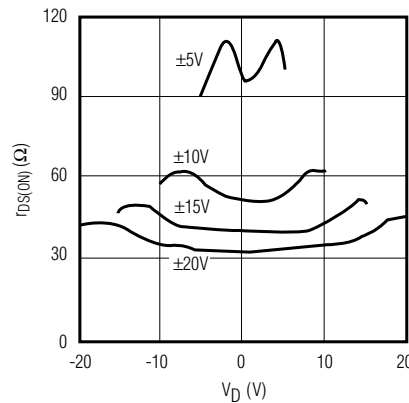
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

DG4444/DG4445

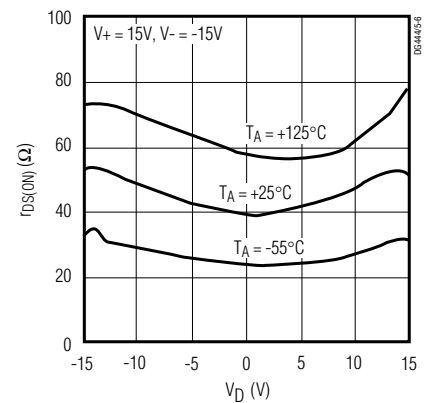
**ON-RESISTANCE vs.  $V_D$  AND UNIPOLAR-SUPPLY VOLTAGE**



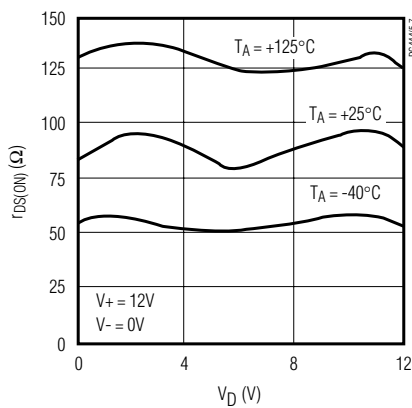
**ON-RESISTANCE vs.  $V_D$  AND BIPOLAR-SUPPLY VOLTAGE**



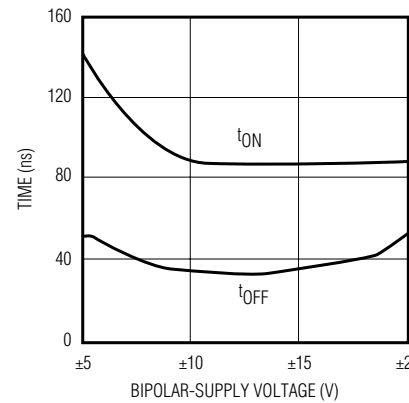
**ON-RESISTANCE vs.  $V_D$ , BIPOLAR-SUPPLY VOLTAGE AND TEMPERATURE**



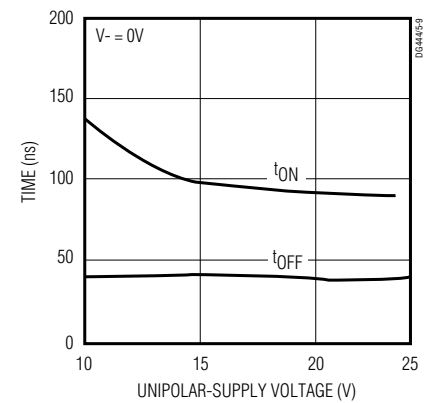
**ON-RESISTANCE vs.  $V_D$ , UNIPOLAR-SUPPLY VOLTAGE AND TEMPERATURE**



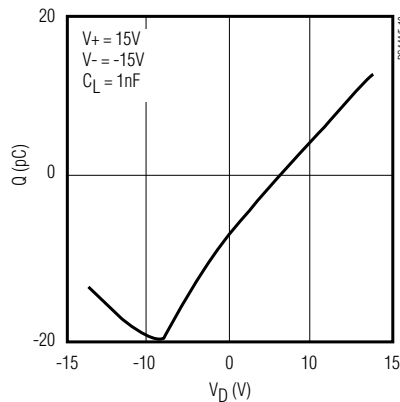
**SWITCHING TIME vs. BIPOLAR-SUPPLY VOLTAGE**



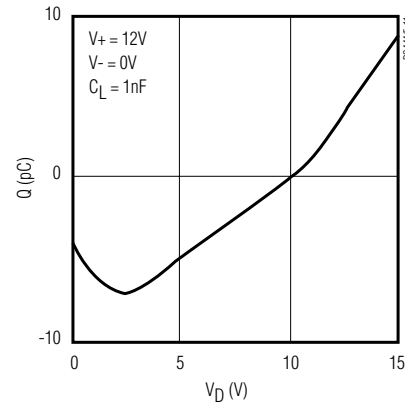
**SWITCHING TIME vs. UNIPOLAR-SUPPLY VOLTAGE**



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



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



# Improved, Quad, SPST Analog Switches

## Pin Description

| PIN          |              | NAME           | FUNCTION                                             |
|--------------|--------------|----------------|------------------------------------------------------|
| DIP/SO       | 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           | V <sub>L</sub> | Logic-Supply Voltage Input                           |
| 13           | 11           | V+             | Positive-Supply-Voltage Input—Connected to Substrate |

## 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 operate 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. V<sub>L</sub> 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 V<sub>L</sub>, 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.

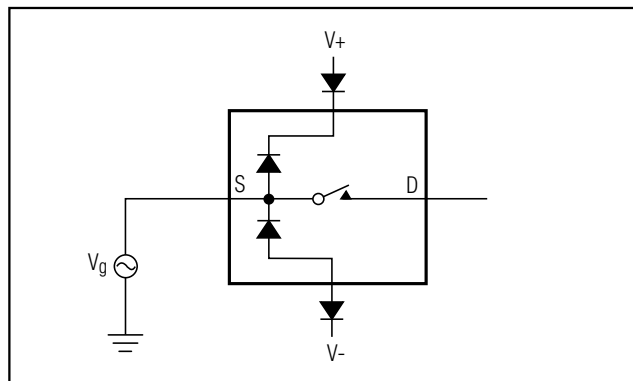


Figure 1. Overvoltage Protection Using External Blocking Diodes

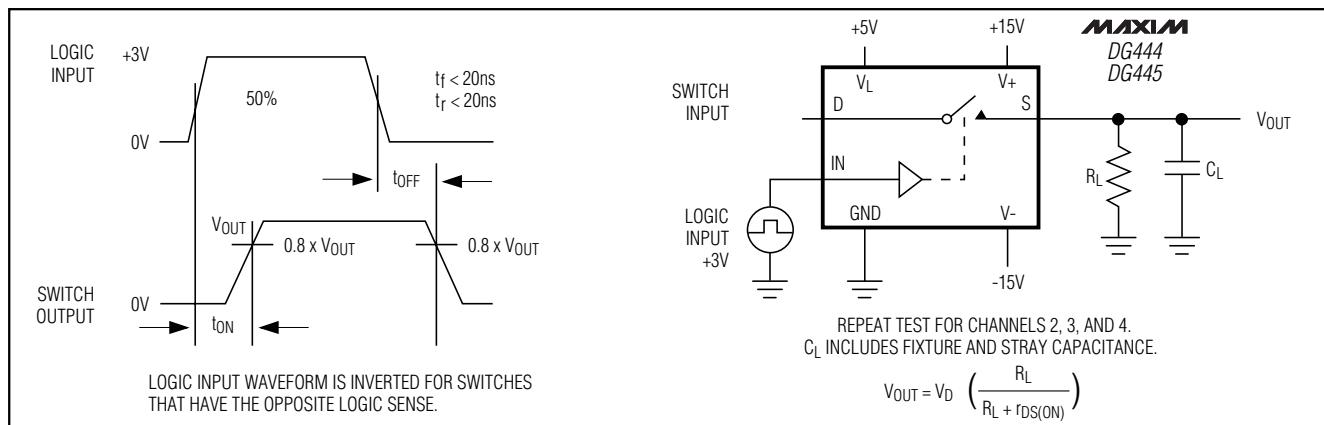


Figure 2. Switching Time

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DG444/DG445

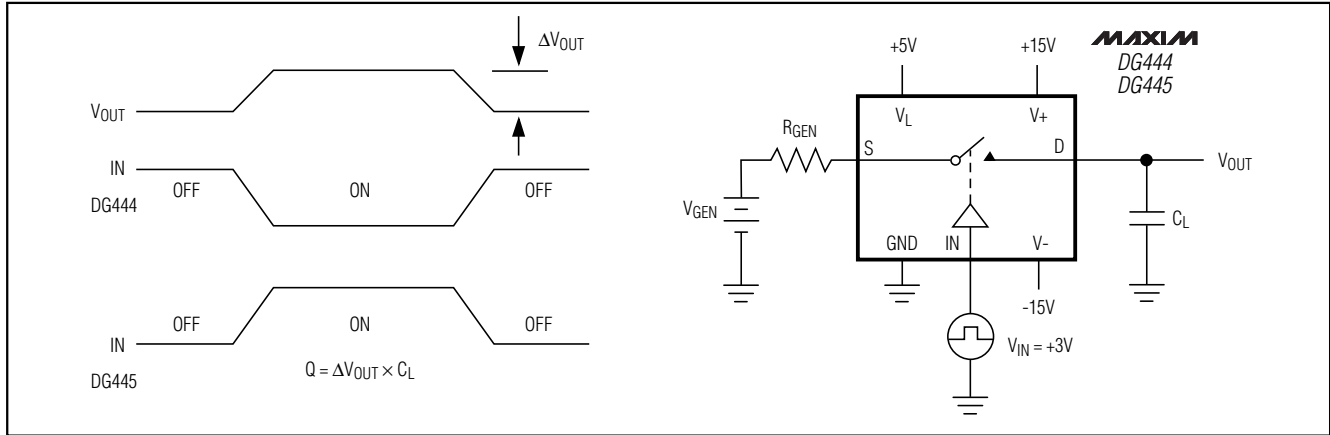


Figure 3. Charge Injection

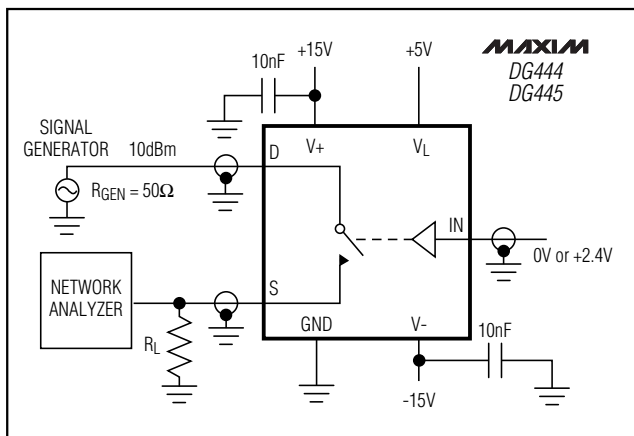


Figure 4. Off-Isolation Rejection Ratio

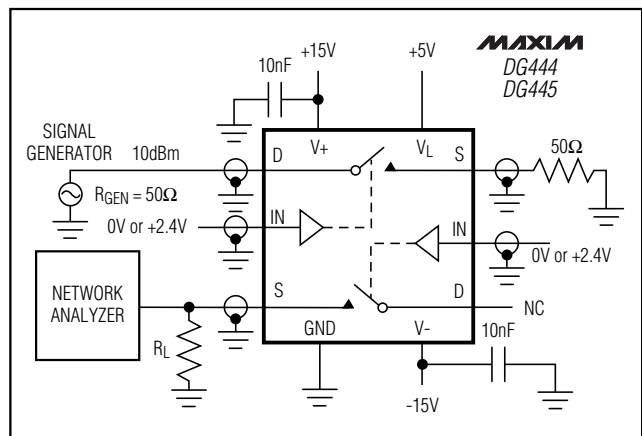


Figure 5. Crosstalk

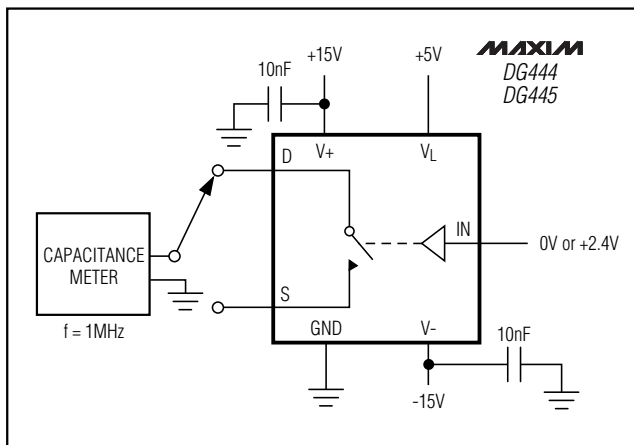


Figure 6. Source/Drain Off-Capacitance

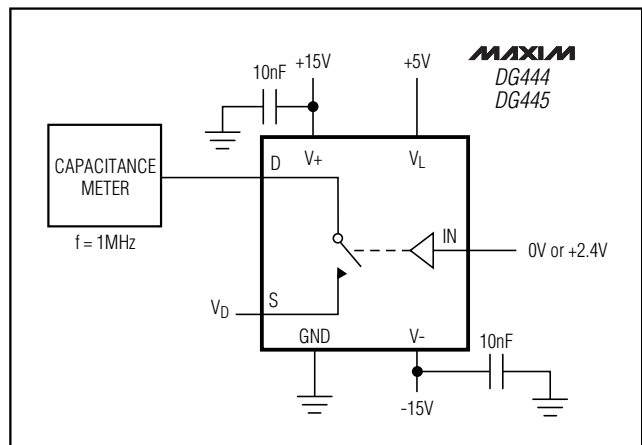


Figure 7. Source/Drain On-Capacitance

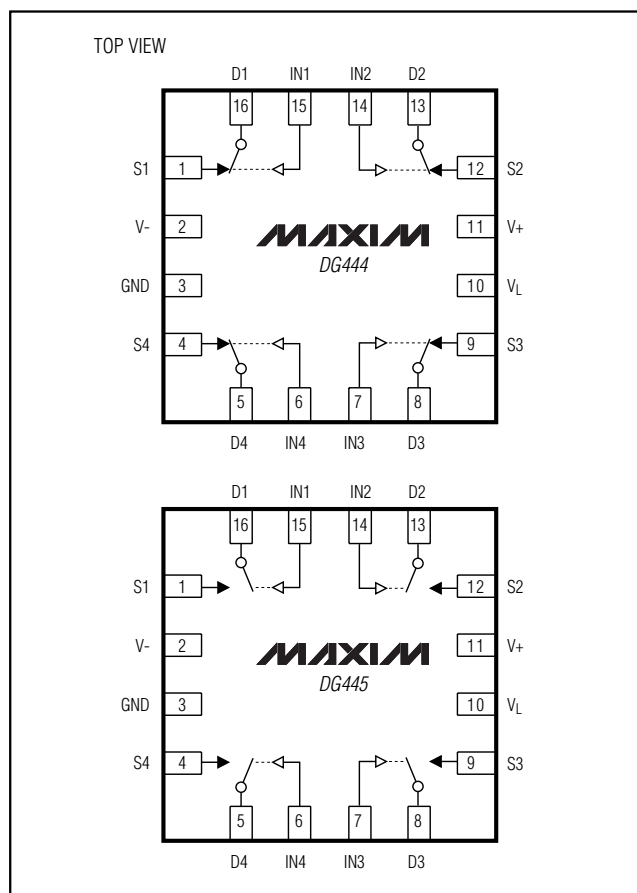
# Improved, Quad, SPST Analog Switches

## Ordering Information (continued)

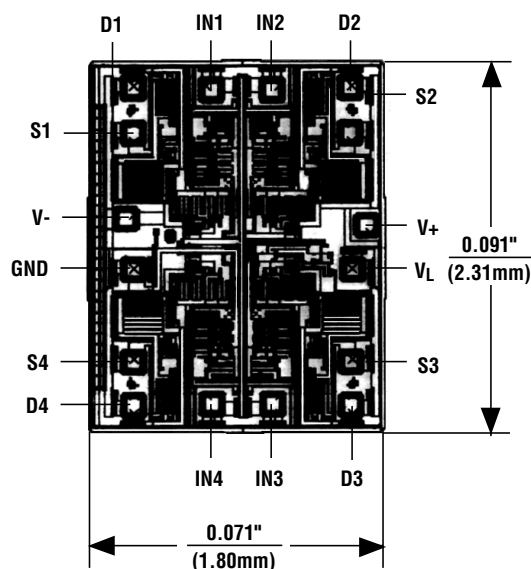
| PART           | TEMP. RANGE    | PIN-PACKAGE    |
|----------------|----------------|----------------|
| DG444EGE       | -40°C to +85°C | 16 QFN         |
| <b>DG445CJ</b> | 0°C to +70°C   | 16 Plastic DIP |
| DG445CY        | 0°C to +70°C   | 16 Narrow SO   |
| DG445C/D       | 0°C to +70°C   | Dice*          |
| DG445DJ        | -40°C to +85°C | 16 Plastic DIP |
| DG445DY        | -40°C to +85°C | 16 Narrow SO   |
| DG445EGE       | -40°C to +85°C | 16 QFN         |

\*Contact factory for dice specifications.

## Pin Configurations/Functional Diagrams (continued)



## Chip Topography



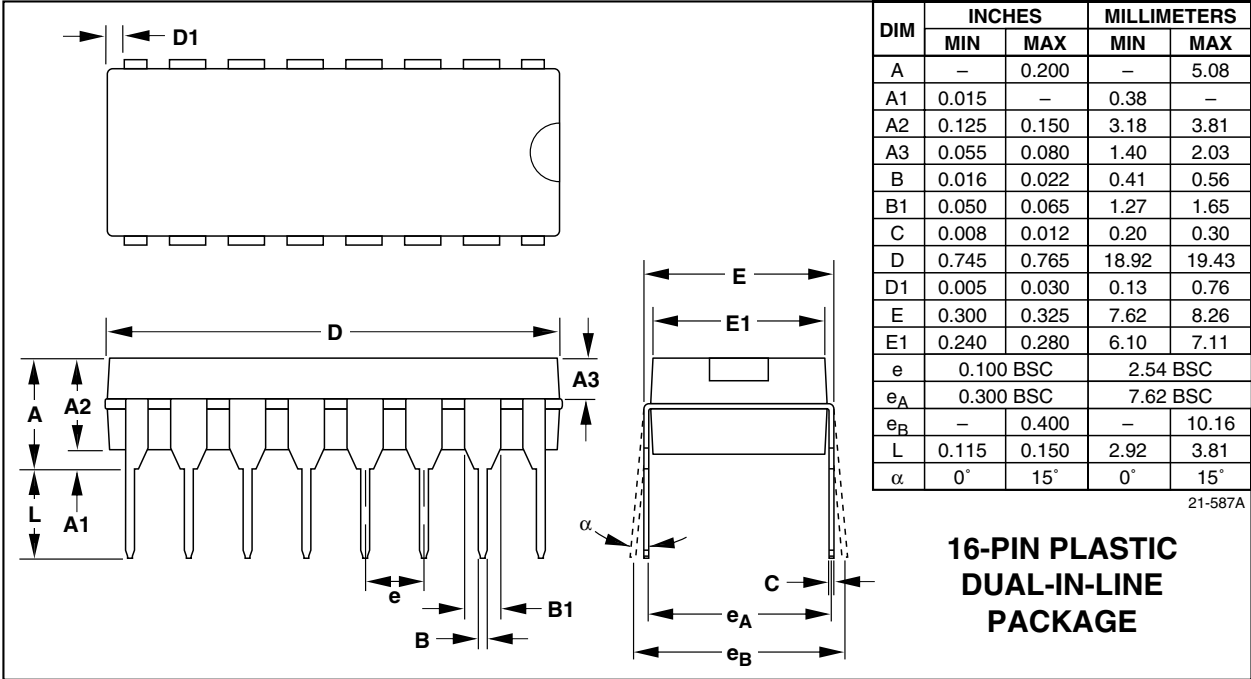
TRANSISTOR COUNT: 126  
SUBSTRATE CONNECTED TO V+



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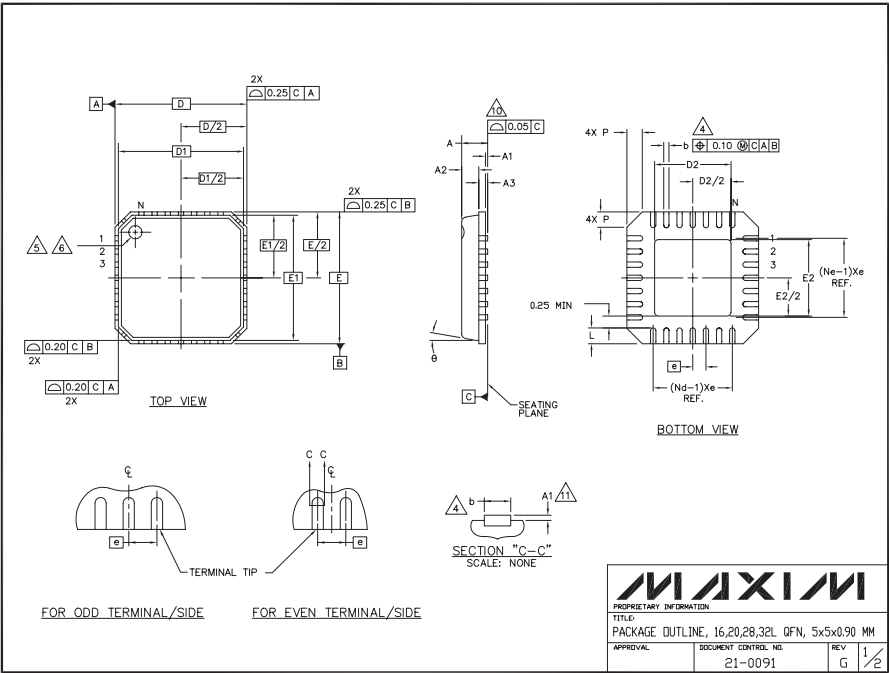
## Package Information

DG444/DG445



Improved, Quad, SPST Analog Switches

Package Information (continued)



- NOTES:
1. DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
  2. DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. - 1994.
  3. N IS THE NUMBER OF TERMINALS.  
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION &  
Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
  4. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
  5. THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/ LASER MARKED.
  6. EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
  7. ALL DIMENSIONS ARE IN MILLIMETERS.
  8. PACKAGE WARPAGE MAX 0.05mm.
  9. APPLIED FOR EXPOSED PAD AND TERMINALS.  
EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
  10. MEETS JEDEC MO220.
  11. THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES) AND TO SAW SINGULATION (STRAIGHT SIDES) QFN STYLES.

|    | COMMON DIMENSIONS |      |      | NOM. REF. |
|----|-------------------|------|------|-----------|
|    | MIN.              | NOM. | MAX. |           |
| A  | 0.80              | 0.90 | 1.00 |           |
| A1 | 0.00              | 0.01 | 0.05 |           |
| A2 | 0.00              | 0.65 | 1.00 |           |
| A3 | 0.20 REF.         |      |      |           |
| D  | 5.00 BSC          |      |      |           |
| D1 | 4.75 BSC          |      |      |           |
| E  | 5.00 BSC          |      |      |           |
| E1 | 4.75 BSC          |      |      |           |
| θ  | 0°                |      | 12°  |           |
| P  | 0                 |      | 0.60 |           |
| D2 | 1.25              |      | 3.25 |           |
| E2 | 1.25              |      | 3.25 |           |

| PITCH VARIATION B |      |      |      | PITCH VARIATION B |      |      |      | PITCH VARIATION C |      |      |      | PITCH VARIATION D |      |      |      |
|-------------------|------|------|------|-------------------|------|------|------|-------------------|------|------|------|-------------------|------|------|------|
| MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      |
| 0.80 BSC          |      |      |      | 0.65 BSC          |      |      |      | 0.50 BSC          |      |      |      | 0.50 BSC          |      |      |      |
| N                 | 16   |      |      | N                 | 20   |      |      | N                 | 28   |      |      | N                 | 32   |      |      |
| Ne                | 4    |      |      | Ne                | 5    |      |      | Ne                | 7    |      |      | Ne                | 8    |      |      |
| L                 | 0.35 | 0.55 | 0.75 | L                 | 0.35 | 0.55 | 0.75 | L                 | 0.35 | 0.55 | 0.75 | L                 | 0.30 | 0.40 | 0.50 |
| b                 | 0.28 | 0.33 | 0.40 | b                 | 0.23 | 0.28 | 0.35 | b                 | 0.18 | 0.23 | 0.30 | b                 | 0.18 | 0.23 | 0.30 |

| PITCH VARIATION B |      |      |      | PITCH VARIATION B |      |      |      | PITCH VARIATION C |      |      |      | PITCH VARIATION D |      |      |      |
|-------------------|------|------|------|-------------------|------|------|------|-------------------|------|------|------|-------------------|------|------|------|
| MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      | MIN.              | NOM. | MAX. |      |
| 0.80 BSC          |      |      |      | 0.65 BSC          |      |      |      | 0.50 BSC          |      |      |      | 0.50 BSC          |      |      |      |
| N                 | 16   |      |      | N                 | 20   |      |      | N                 | 28   |      |      | N                 | 32   |      |      |
| Ne                | 4    |      |      | Ne                | 5    |      |      | Ne                | 7    |      |      | Ne                | 8    |      |      |
| L                 | 0.35 | 0.55 | 0.75 | L                 | 0.35 | 0.55 | 0.75 | L                 | 0.35 | 0.55 | 0.75 | L                 | 0.30 | 0.40 | 0.50 |
| b                 | 0.28 | 0.33 | 0.40 | b                 | 0.23 | 0.28 | 0.35 | b                 | 0.18 | 0.23 | 0.30 | b                 | 0.18 | 0.23 | 0.30 |

**MAXIM**

PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM

APPROVAL: DOCUMENT CONTROL NO. 21-0091 REV G 2/2

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