

# NTGD4169F

## Power MOSFET and Schottky Diode

30 V, 2.9 A, N-Channel with Schottky Barrier Diode, TSOP-6

### Features

- Fast Switching
- Low Gate Charge
- Low  $R_{DS(on)}$
- Low  $V_F$  Schottky Diode
- Independently Connected Devices to Provide Design Flexibility
- This is a Pb-Free Device

### Applications

- DC-DC Converters
- Portable Devices like PDA's, Cellular Phones, and Hard Drives

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                         |                      |                          | Symbol         | Value      | Unit             |
|-------------------------------------------------------------------|----------------------|--------------------------|----------------|------------|------------------|
| Drain-to-Source Voltage                                           |                      |                          | $V_{DS}$       | 30         | V                |
| Gate-to-Source Voltage                                            |                      |                          | $V_{GS}$       | $\pm 12$   | V                |
| N-Channel Continuous Drain Current (Note 1)                       | Steady State         | $T_A = 25^\circ\text{C}$ | $I_D$          | 2.6        | A                |
|                                                                   |                      | $T_A = 85^\circ\text{C}$ |                | 1.9        |                  |
|                                                                   | $t \leq 5 \text{ s}$ | $T_A = 25^\circ\text{C}$ |                | 2.9        |                  |
| Power Dissipation (Note 1)                                        | Steady State         | $T_A = 25^\circ\text{C}$ | $P_D$          | 0.9        | W                |
|                                                                   | $t \leq 5 \text{ s}$ |                          |                | 1.1        |                  |
| Pulsed Drain Current                                              |                      | $t_p = 10 \mu\text{s}$   | $I_{DM}$       | 8.6        | A                |
| Operating Junction and Storage Temperature                        |                      |                          | $T_J, T_{STG}$ | -25 to 150 | $^\circ\text{C}$ |
| Source Current (Body Diode)                                       |                      |                          | $I_S$          | 0.9        | A                |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                      |                          | $T_L$          | 260        | $^\circ\text{C}$ |

### SCHOTTKY MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise stated)

| Parameter                         | Symbol    | Value | Unit |
|-----------------------------------|-----------|-------|------|
| Peak Repetitive Reverse Voltage   | $V_{RRM}$ | 30    | V    |
| DC Blocking Voltage               | $V_R$     | 30    | V    |
| Average Rectified Forward Current | $I_F$     | 1     | A    |

### THERMAL RESISTANCE RATINGS

| Parameter                                           | Symbol          | Value | Unit               |
|-----------------------------------------------------|-----------------|-------|--------------------|
| Junction-to-Ambient – Steady State (Note 1)         | $R_{\theta JA}$ | 140   | $^\circ\text{C/W}$ |
| Junction-to-Ambient – $t \leq 5 \text{ s}$ (Note 1) | $R_{\theta JA}$ | 110   | $^\circ\text{C/W}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).



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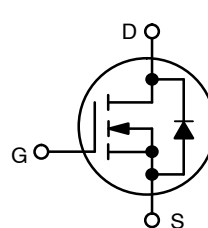
<http://onsemi.com>

### N-CHANNEL MOSFET

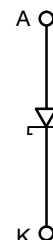
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max       | $I_D$ Max |
|---------------|------------------------|-----------|
| 30 V          | 90 m $\Omega$ @ 4.5 V  | 2.6 A     |
|               | 125 m $\Omega$ @ 2.5 V | 2.2 A     |

### SCHOTTKY DIODE

| $V_R$ Max | $V_F$ Max | $I_F$ Max |
|-----------|-----------|-----------|
| 30 V      | 0.53 V    | 1.0 A     |



N-Channel MOSFET

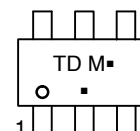


Schottky Diode



TSOP-6  
CASE 318G  
STYLE 15

### MARKING DIAGRAM



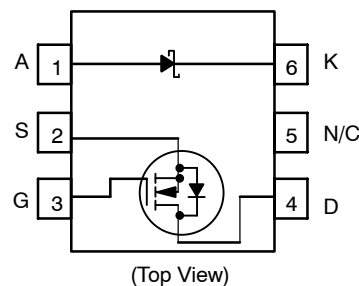
TD = Specific Device Code

M = Date Code

■ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTION



(Top View)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

# NTGD4169F

## MOSFET ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|----------------|--------|----------------|-----|-----|-----|------|
|----------------|--------|----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                           |                   |                                                     |                          |      |     |                      |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|--------------------------|------|-----|----------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 30                       |      |     | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |                          | 21.4 |     | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$         | $T_J = 25^\circ\text{C}$ |      | 1.0 | $\mu\text{A}$        |
|                                                           |                   |                                                     | $T_J = 85^\circ\text{C}$ |      | 10  |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$     |                          |      | 100 | nA                   |

### ON CHARACTERISTICS (Note 2)

|                                        |                  |                                                 |     |      |     |                      |
|----------------------------------------|------------------|-------------------------------------------------|-----|------|-----|----------------------|
| Gate Threshold Voltage                 | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 0.5 | 0.9  | 1.5 | V                    |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |     | -3.4 |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance          | $R_{DS(on)}$     | $V_{GS} = 4.5\text{ V}, I_D = 2.6\text{ A}$     |     | 52   | 90  | m $\Omega$           |
|                                        |                  | $V_{GS} = 2.5\text{ V}, I_D = 2.2\text{ A}$     |     | 67   | 125 |                      |
| Forward Transconductance               | $g_{FS}$         | $V_{DS} = 15\text{ V}, I_D = 2.6\text{ A}$      |     | 2.6  |     | S                    |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                   |  |     |     |    |
|------------------------------|--------------|-------------------------------------------------------------------|--|-----|-----|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 15\text{ V}$   |  | 295 |     | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                   |  | 48  |     |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                   |  | 27  |     |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 2.0\text{ A}$ |  | 3.7 | 5.5 | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                   |  | 0.6 |     |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                   |  | 0.9 |     |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                   |  | 0.8 |     |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |              |                                                                                            |  |     |  |    |
|---------------------|--------------|--------------------------------------------------------------------------------------------|--|-----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 1.0\text{ A}, R_G = 6.0\text{ }\Omega$ |  | 7.0 |  | ns |
| Rise Time           | $t_r$        |                                                                                            |  | 4.0 |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                            |  | 14  |  |    |
| Fall Time           | $t_f$        |                                                                                            |  | 2.0 |  |    |

### DRAIN-TO-SOURCE CHARACTERISTICS

|                       |          |                                                                               |                          |  |     |     |    |
|-----------------------|----------|-------------------------------------------------------------------------------|--------------------------|--|-----|-----|----|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 0.9\text{ A}$                                     | $T_J = 25^\circ\text{C}$ |  | 0.7 | 1.2 | V  |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 0.9\text{ A}$ |                          |  | 8.0 |     | ns |
| Charge Time           | $T_a$    |                                                                               |                          |  | 5.0 |     |    |
| Discharge Time        | $T_b$    |                                                                               |                          |  | 3.0 |     |    |
| Reverse Recovery Time | $Q_{RR}$ |                                                                               |                          |  | 3.0 |     | nC |

2. Pulse Test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

3. Switching characteristics are independent of operating junction temperatures.

# NTGD4169F

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                             | Symbol | Test Conditions      | Min | Typ  | Max  | Unit          |
|---------------------------------------|--------|----------------------|-----|------|------|---------------|
| Maximum Instantaneous Forward Voltage | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.41 | 0.45 | V             |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.46 | 0.53 |               |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 30\text{ V}$  |     | 7.3  | 20   | $\mu\text{A}$ |
|                                       |        | $V_R = 20\text{ V}$  |     | 2.5  | 8.0  |               |

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 85^\circ\text{C}$ unless otherwise noted)

| Parameter                             | Symbol | Test Conditions      | Min | Typ  | Max | Unit |
|---------------------------------------|--------|----------------------|-----|------|-----|------|
| Maximum Instantaneous Forward Voltage | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.35 |     | V    |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.41 |     |      |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 30\text{ V}$  |     | 0.4  |     | mA   |
|                                       |        | $V_R = 20\text{ V}$  |     | 0.17 |     |      |

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 125^\circ\text{C}$ unless otherwise noted)

| Parameter                             | Symbol | Test Conditions      | Min | Typ  | Max | Unit |
|---------------------------------------|--------|----------------------|-----|------|-----|------|
| Maximum Instantaneous Forward Voltage | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.31 |     | V    |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.39 |     |      |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 30\text{ V}$  |     | 4.4  |     | mA   |
|                                       |        | $V_R = 20\text{ V}$  |     | 1.6  |     |      |

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter   | Symbol | Test Conditions                            | Min | Typ | Max | Unit |
|-------------|--------|--------------------------------------------|-----|-----|-----|------|
| Capacitance | C      | $V_R = 10\text{ V}$ , $f = 1.0\text{ MHz}$ |     | 28  |     | pF   |

## ORDERING INFORMATION

| Device       | Package             | Shipping <sup>†</sup> |
|--------------|---------------------|-----------------------|
| NTGD4169FT1G | TSOP-6<br>(Pb-Free) | 3000 / Tape & Reel    |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

TYPICAL CHARACTERISTICS N-CHANNEL

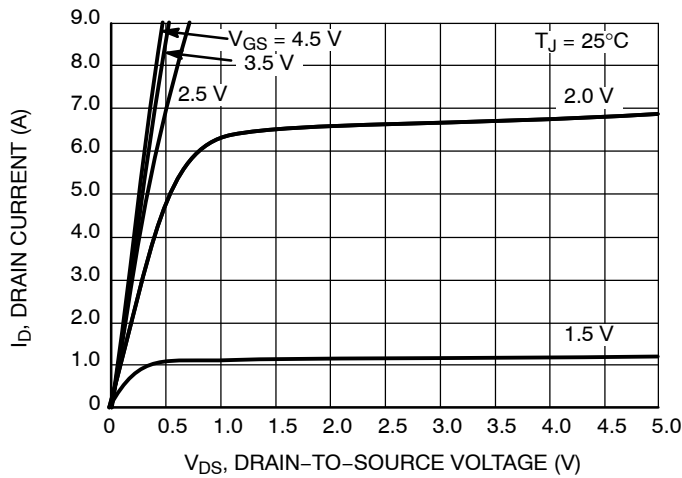


Figure 1. On-Region Characteristics

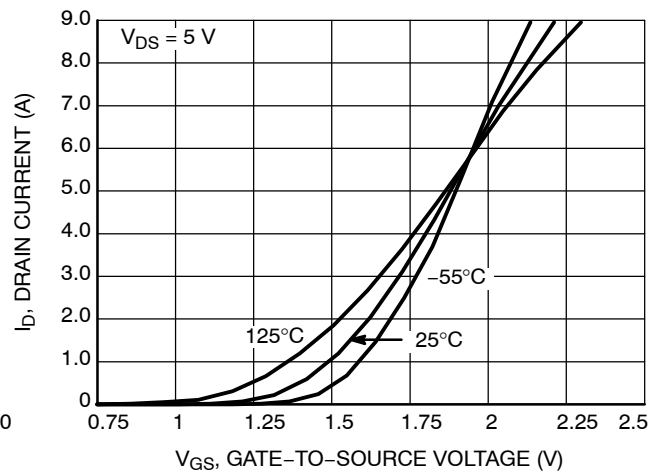


Figure 2. Transfer Characteristics

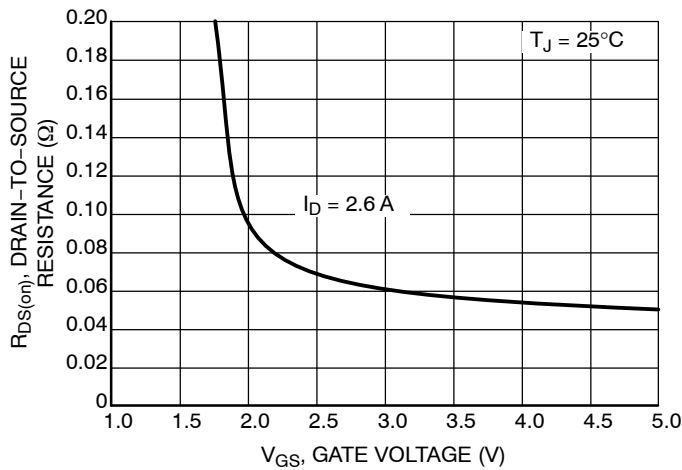


Figure 3. On-Region vs. Gate-To-Source Voltage

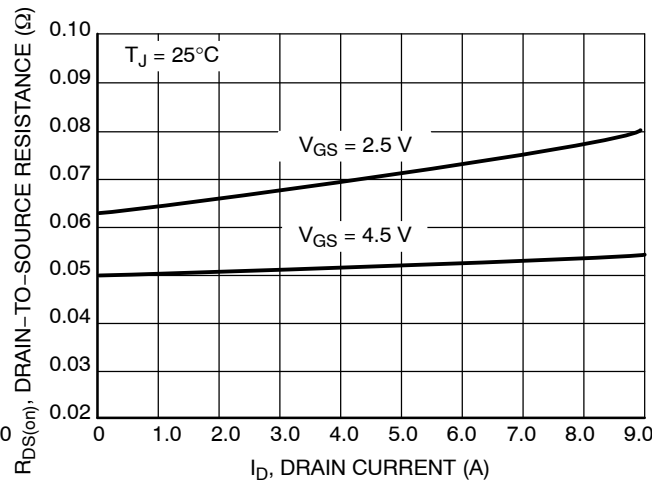


Figure 4. On-Resistance vs. Drain Current and Temperature

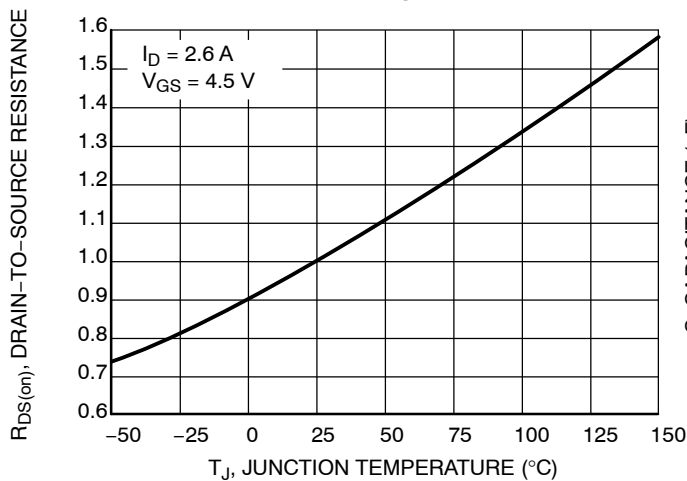


Figure 5. On-Resistance Variation with Temperature

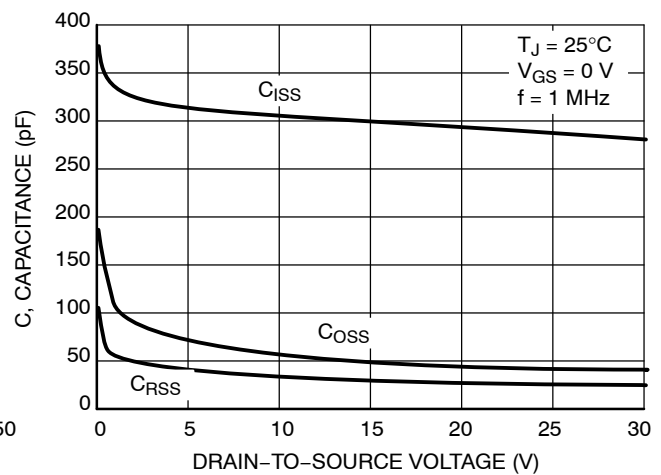
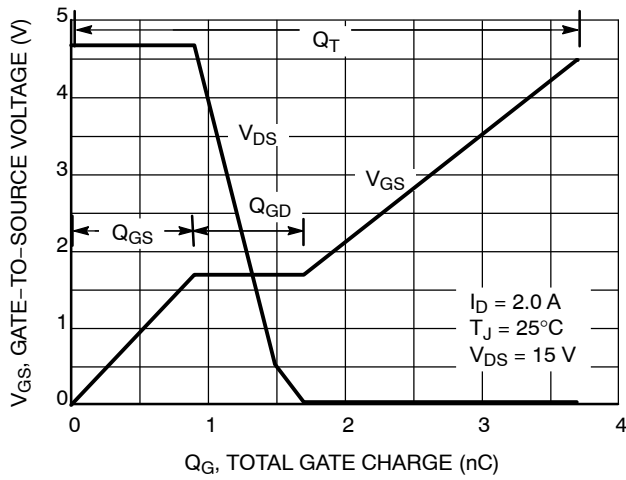
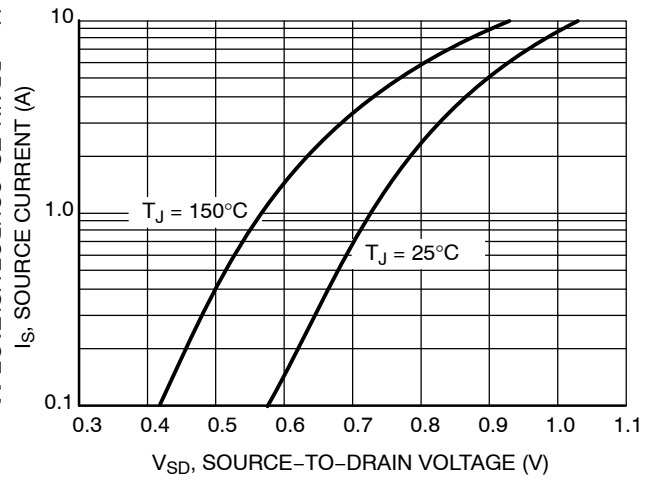


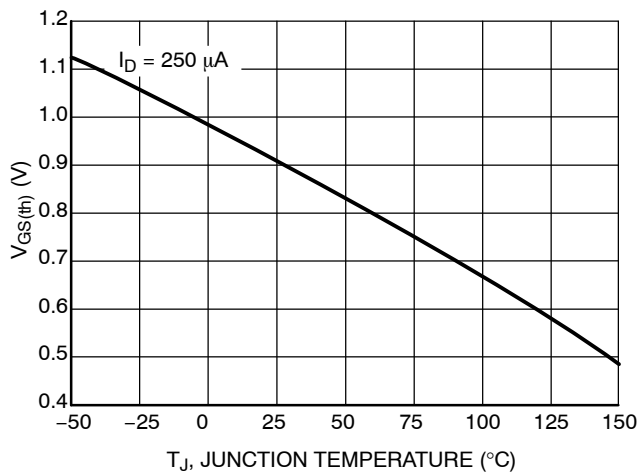
Figure 6. Capacitance Variation



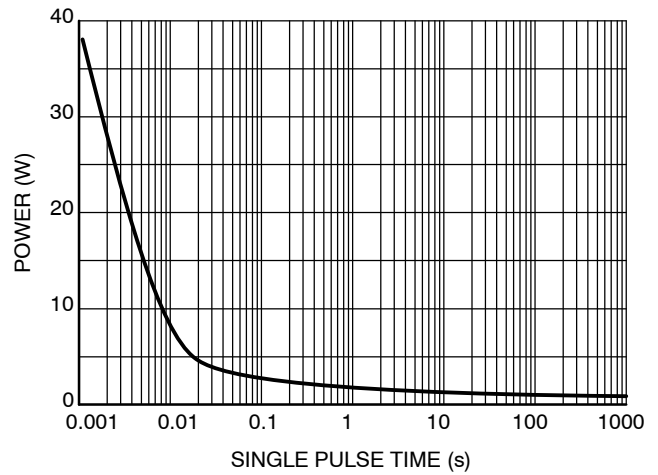
**Figure 7. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



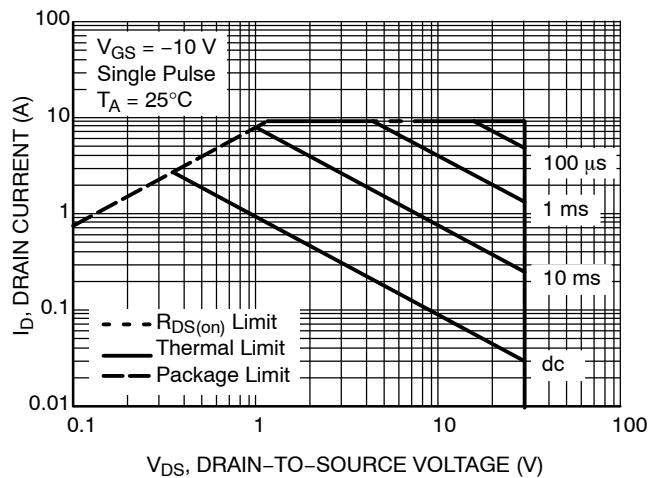
**Figure 8. Diode Forward Voltage versus Current**



**Figure 9. Threshold Voltage**



**Figure 10. Single Pulse Maximum Power Dissipation**



**Figure 11. Maximum Rated Forward Biased Safe Operating Area**

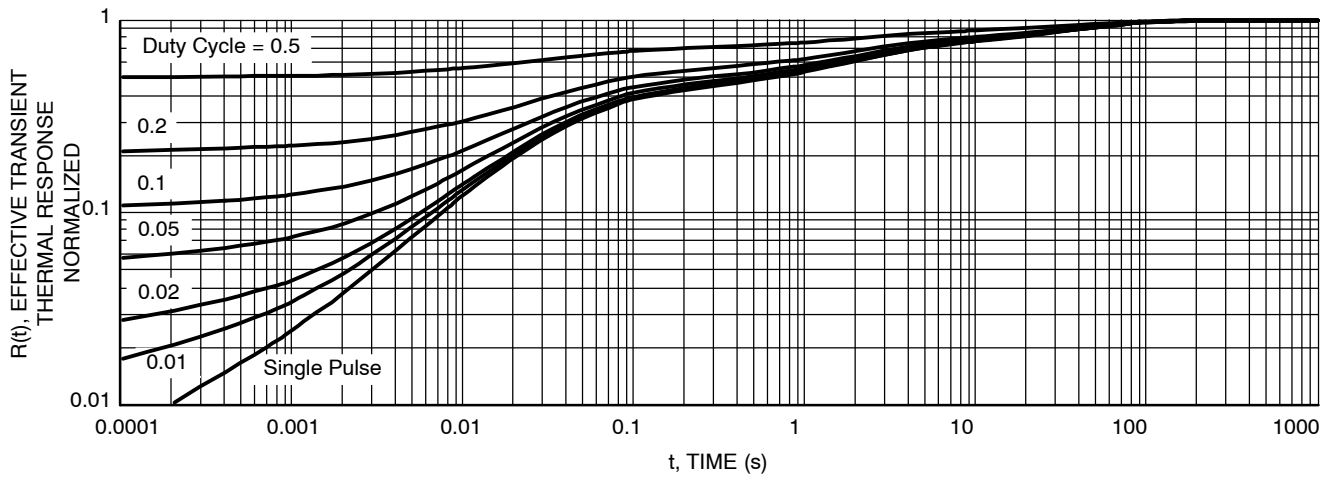


Figure 12. FET Thermal Response

### TYPICAL CHARACTERISTICS SCHOTTKY

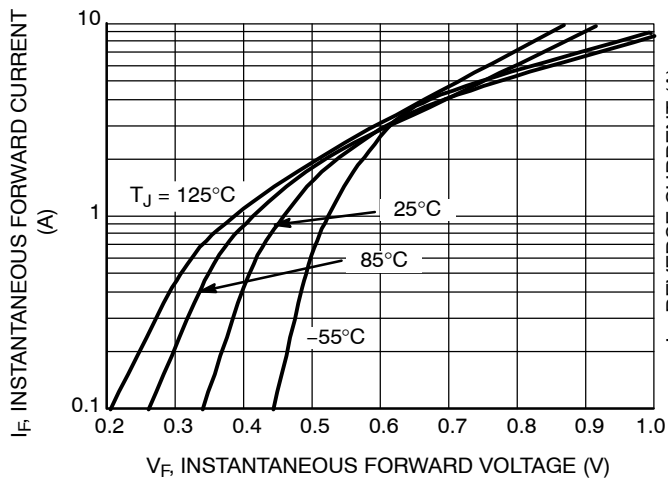


Figure 13. Typical Forward Voltage

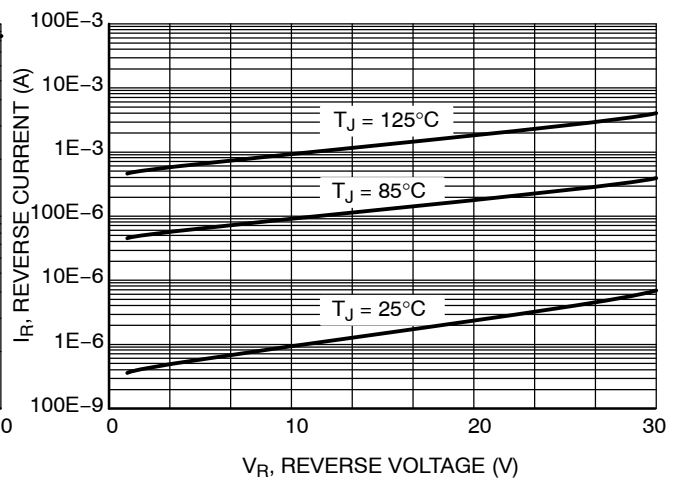


Figure 14. Typical Reverse Current

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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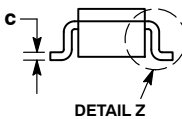
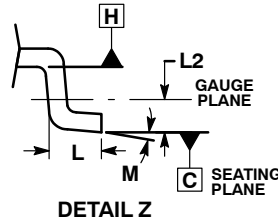
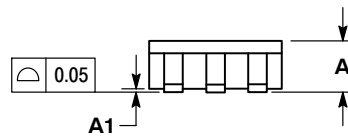
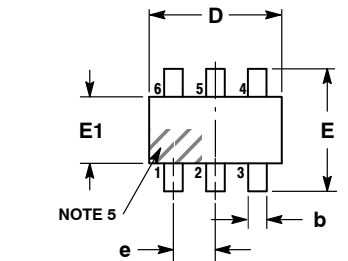
SCALE 2:1

### TSOP-6

#### CASE 318G-02

#### ISSUE V

DATE 12 JUN 2012



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
5. PIN ONE INDICATOR MUST BE LOCATED IN THE INDICATED ZONE.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN         | NOM  | MAX  |
| A   | 0.90        | 1.00 | 1.10 |
| A1  | 0.01        | 0.06 | 0.10 |
| b   | 0.25        | 0.38 | 0.50 |
| c   | 0.10        | 0.18 | 0.26 |
| D   | 2.90        | 3.00 | 3.10 |
| E   | 2.50        | 2.75 | 3.00 |
| E1  | 1.30        | 1.50 | 1.70 |
| e   | 0.85        | 0.95 | 1.05 |
| L   | 0.20        | 0.40 | 0.60 |
| L2  | 0.25 BSC    |      |      |
| M   | 0°          | —    | 10°  |

#### STYLE 1:

- PIN 1. DRAIN
- PIN 2. DRAIN
- PIN 3. GATE
- PIN 4. SOURCE
- PIN 5. DRAIN
- PIN 6. DRAIN

#### STYLE 2:

- PIN 1. EMITTER 2
- PIN 2. BASE 1
- PIN 3. COLLECTOR 1
- PIN 4. EMITTER 1
- PIN 5. BASE 2
- PIN 6. COLLECTOR 2

#### STYLE 3:

- PIN 1. ENABLE
- PIN 2. N/C
- PIN 3. R BOOST
- PIN 4. Vz
- PIN 5. V in
- PIN 6. V out

#### STYLE 4:

- PIN 1. N/C
- PIN 2. V in
- PIN 3. NOT USED
- PIN 4. GROUND
- PIN 5. ENABLE
- PIN 6. LOAD

#### STYLE 5:

- PIN 1. EMITTER 2
- PIN 2. BASE 2
- PIN 3. COLLECTOR 1
- PIN 4. EMITTER 1
- PIN 5. BASE 1
- PIN 6. COLLECTOR 2

#### STYLE 6:

- PIN 1. COLLECTOR
- PIN 2. COLLECTOR
- PIN 3. BASE
- PIN 4. EMITTER
- PIN 5. COLLECTOR
- PIN 6. COLLECTOR

#### STYLE 7:

- PIN 1. COLLECTOR
- PIN 2. COLLECTOR
- PIN 3. BASE
- PIN 4. N/C
- PIN 5. COLLECTOR
- PIN 6. EMITTER

#### STYLE 8:

- PIN 1. Vbus
- PIN 2. D(in)
- PIN 3. D(in)+
- PIN 4. D(out)+
- PIN 5. D(out)
- PIN 6. GND

#### STYLE 9:

- PIN 1. LOW VOLTAGE GATE
- PIN 2. DRAIN
- PIN 3. SOURCE
- PIN 4. DRAIN
- PIN 5. DRAIN
- PIN 6. HIGH VOLTAGE GATE

#### STYLE 10:

- PIN 1. D(OUT)+
- PIN 2. GND
- PIN 3. D(OUT)-
- PIN 4. D(IN)-
- PIN 5. VBUS
- PIN 6. D(IN)+

#### STYLE 11:

- PIN 1. SOURCE 1
- PIN 2. DRAIN 2
- PIN 3. DRAIN 2
- PIN 4. SOURCE 2
- PIN 5. GATE 1
- PIN 6. DRAIN 1/GATE 2

#### STYLE 12:

- PIN 1. I/O
- PIN 2. GROUND
- PIN 3. I/O
- PIN 4. I/O
- PIN 5. VCC
- PIN 6. I/O

#### STYLE 13:

- PIN 1. GATE 1
- PIN 2. SOURCE 2
- PIN 3. GATE 2
- PIN 4. DRAIN 2
- PIN 5. SOURCE 1
- PIN 6. DRAIN 1

#### STYLE 14:

- PIN 1. ANODE
- PIN 2. SOURCE
- PIN 3. GATE
- PIN 4. CATHODE/DRAIN
- PIN 5. CATHODE/DRAIN
- PIN 6. CATHODE/DRAIN

#### STYLE 15:

- PIN 1. ANODE
- PIN 2. SOURCE
- PIN 3. GATE
- PIN 4. DRAIN
- PIN 5. N/C
- PIN 6. CATHODE

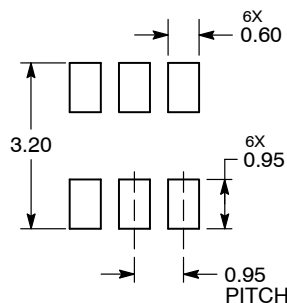
#### STYLE 16:

- PIN 1. ANODE/CATHODE
- PIN 2. BASE
- PIN 3. EMITTER
- PIN 4. COLLECTOR
- PIN 5. ANODE
- PIN 6. CATHODE

#### STYLE 17:

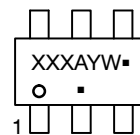
- PIN 1. EMITTER
- PIN 2. BASE
- PIN 3. ANODE/CATHODE
- PIN 4. ANODE
- PIN 5. CATHODE
- PIN 6. COLLECTOR

### RECOMMENDED SOLDERING FOOTPRINT\*

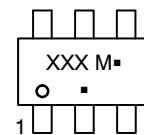


DIMENSIONS: MILLIMETERS

### GENERIC MARKING DIAGRAM\*



IC



STANDARD

XXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

|                  |             |                                                                                                                                                                                  |
|------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| DESCRIPTION:     | TSOP-6      | PAGE 1 OF 1                                                                                                                                                                      |

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