

# NTGD3147F

## Power MOSFET and Schottky Diode

–20 V, –2.5 A, P-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                                           |              |                                                      | $V_{DS}$       | –20          | V                |
| Gate-to-Source Voltage                                            |              |                                                      | $V_{GS}$       | $\pm 12$     | V                |
| Continuous Drain Current (Note 1)                                 | Steady State | $T_A = 25^\circ\text{C}$<br>$T_A = 85^\circ\text{C}$ | $I_D$          | –2.2<br>–1.6 | A                |
|                                                                   | $t \leq 5$ s | $T_A = 25^\circ\text{C}$                             |                | –2.5         |                  |
| Power Dissipation (Note 1)                                        | Steady State | $T_A = 25^\circ\text{C}$                             | $P_D$          | 1.0<br>1.3   | W                |
|                                                                   | $t \leq 5$ s |                                                      |                |              |                  |
| Pulsed Drain Current                                              |              | $t_p = 10$ $\mu\text{s}$                             | $I_{DM}$       | –7.5         | A                |
| Operating Junction and Storage Temperature                        |              |                                                      | $T_J, T_{STG}$ | –25 to 150   | $^\circ\text{C}$ |
| Source Current (Body Diode)                                       |              |                                                      | $I_S$          | –0.8         | 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   | $V_{RRM}$ | 20    | V    |
| DC Blocking Voltage               | $V_R$     | 20    | V    |
| Average Rectified Forward Current | $I_F$     | 1     | A    |

### THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol          | Value | Unit                      |
|---------------------------------------------|-----------------|-------|---------------------------|
| Junction-to-Ambient – Steady-State (Note 1) | $R_{\theta JA}$ | 125   | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient – $t \leq 5$ s (Note 1) | $R_{\theta JA}$ | 100   | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient Steady-State (Note 2)   | $R_{\theta JA}$ | 235   | $^\circ\text{C}/\text{W}$ |

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 [2 oz] including traces).
2. Surface Mounted on FR4 Board using the minimum recommended pad size (Cu area = 30 mm<sup>2</sup> [2 oz] including traces).



ON Semiconductor®

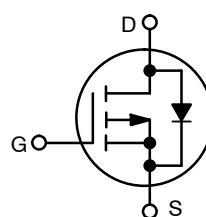
<http://onsemi.com>

### P-CHANNEL MOSFET

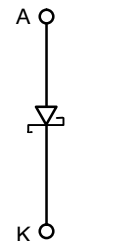
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max        | $I_D$ Max |
|---------------|-------------------------|-----------|
| –20 V         | 145 m $\Omega$ @ –4.5 V | –2.2 A    |
|               | 200 m $\Omega$ @ –2.5 V | –1.6 A    |

### SCHOTTKY DIODE

| $V_R$ Max | $V_F$ Max | $I_F$ Max |
|-----------|-----------|-----------|
| 20 V      | 0.45 V    | 1.0 A     |



P-Channel MOSFET

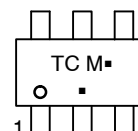


Schottky Diode



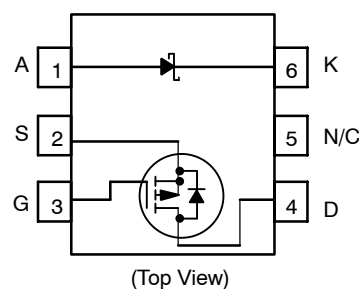
TSOP–6  
CASE 318G  
STYLE 15

### MARKING DIAGRAM



TC = Specific Device Code  
M = Date Code  
■ = Pb-Free Package  
(Note: Microdot may be in either location)

### PIN CONNECTION



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

# NTGD3147F

## 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                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | -20 |      |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |     | 14.2 |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$        |     |      | -1.0      | $\mu\text{A}$        |
|                                                           |                   | $T_J = 85^\circ\text{C}$                            |     |      | -10       |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 12\text{ V}$     |     |      | $\pm 100$ | nA                   |

### ON CHARACTERISTICS (Note 3)

|                                        |                  |                                                  |      |       |      |                      |
|----------------------------------------|------------------|--------------------------------------------------|------|-------|------|----------------------|
| Gate Threshold Voltage                 | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\text{ }\mu\text{A}$ | -0.5 | -0.95 | -1.5 | V                    |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                  |      | 3.0   |      | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance          | $R_{DS(on)}$     | $V_{GS} = -4.5\text{ V}, I_D = -2.2\text{ A}$    |      | 90    | 145  | m $\Omega$           |
|                                        |                  | $V_{GS} = -2.5\text{ V}, I_D = -1.6\text{ A}$    |      | 140   | 200  |                      |
| Forward Transconductance               | $g_{FS}$         | $V_{DS} = -5.0\text{ V}, I_D = -2.2\text{ A}$    |      | 4.5   |      | S                    |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                      |  |     |     |    |
|------------------------------|--------------|----------------------------------------------------------------------|--|-----|-----|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -10\text{ V}$     |  | 400 |     | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                      |  | 75  |     |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                      |  | 40  |     |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -2.2\text{ A}$ |  | 3.8 | 5.5 | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                      |  | 0.5 |     |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                      |  | 0.9 |     |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                      |  | 1.0 |     |    |

### SWITCHING CHARACTERISTICS (Note 4)

|                     |              |                                                                                               |  |      |  |    |
|---------------------|--------------|-----------------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -1.0\text{ A}, R_G = 6.0\text{ }\Omega$ |  | 7.5  |  | ns |
| Rise Time           | $t_r$        |                                                                                               |  | 6.2  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                               |  | 14.5 |  |    |
| Fall Time           | $t_f$        |                                                                                               |  | 18.4 |  |    |

### DRAIN-TO-SOURCE CHARACTERISTICS

|                       |          |                                                                                |                          |  |      |     |    |
|-----------------------|----------|--------------------------------------------------------------------------------|--------------------------|--|------|-----|----|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_D = -0.8\text{ A}$                                     | $T_J = 25^\circ\text{C}$ |  | -0.8 | 1.2 | V  |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = -0.8\text{ A}$ |                          |  | 12   |     | ns |
| Charge Time           | $T_a$    |                                                                                |                          |  | 8.0  |     |    |
| Discharge Time        | $T_b$    |                                                                                |                          |  | 4.0  |     |    |
| Reverse Recovery Time | $Q_{RR}$ |                                                                                |                          |  | 4.0  |     | nC |

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

4. Switching characteristics are independent of operating junction temperatures.

# NTGD3147F

## 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 | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.32 | 0.4  | V    |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.36 | 0.45 |      |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 10\text{ V}$  |     | 0.04 | 1.0  | mA   |
|                                       |        | $V_R = 20\text{ V}$  |     | 0.21 | 5.0  |      |

## SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ( $T_J = 75^\circ\text{C}$ unless otherwise noted)

| Parameter                             | Symbol | Test Conditions      | Min | Typ  | Max | Unit |
|---------------------------------------|--------|----------------------|-----|------|-----|------|
| Maximum Instantaneous Forward Voltage | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.27 |     | V    |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.31 |     |      |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 10\text{ V}$  |     | 0.77 |     | mA   |
|                                       |        | $V_R = 20\text{ V}$  |     | 2.65 |     |      |

## 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 | $V_F$  | $I_F = 0.5\text{ A}$ |     | 0.22  |     | V    |
|                                       |        | $I_F = 1.0\text{ A}$ |     | 0.27  |     |      |
| Maximum Instantaneous Reverse Current | $I_R$  | $V_R = 10\text{ V}$  |     | 8.75  |     | mA   |
|                                       |        | $V_R = 20\text{ V}$  |     | 37.37 |     |      |

TYPICAL PERFORMANCE CHARACTERISTICS

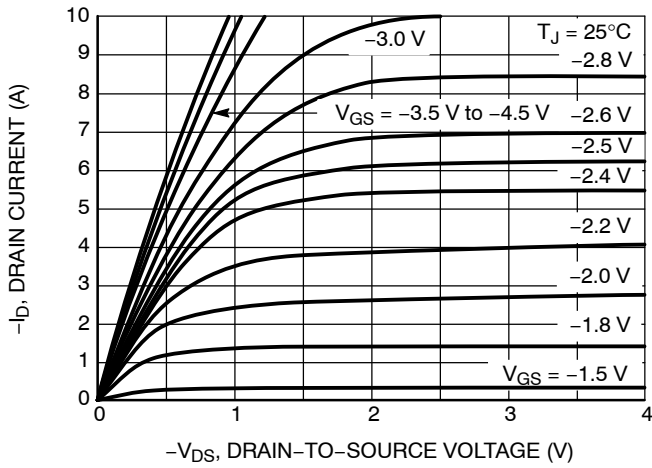


Figure 1. On-Region Characteristics

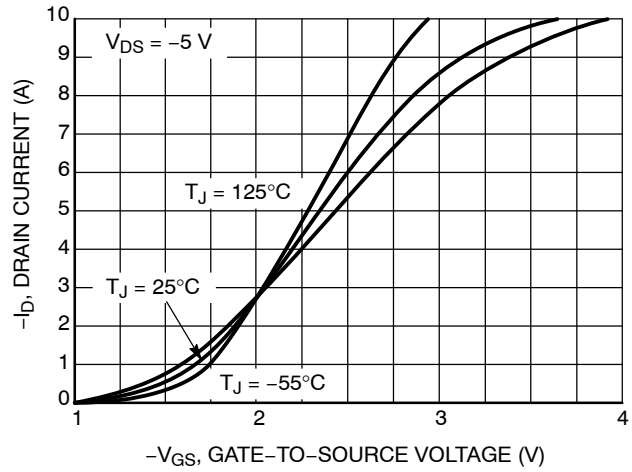


Figure 2. Transfer Characteristics

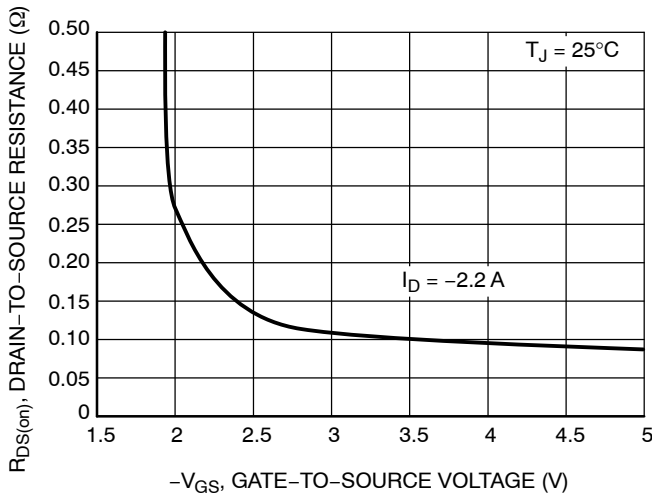


Figure 3. On-Resistance versus Gate-to-Source Voltage

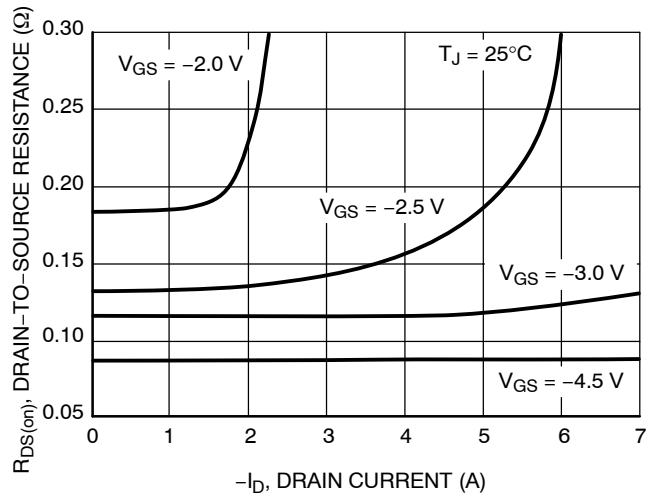


Figure 4. On-Resistance versus Drain Current and Gate Voltage

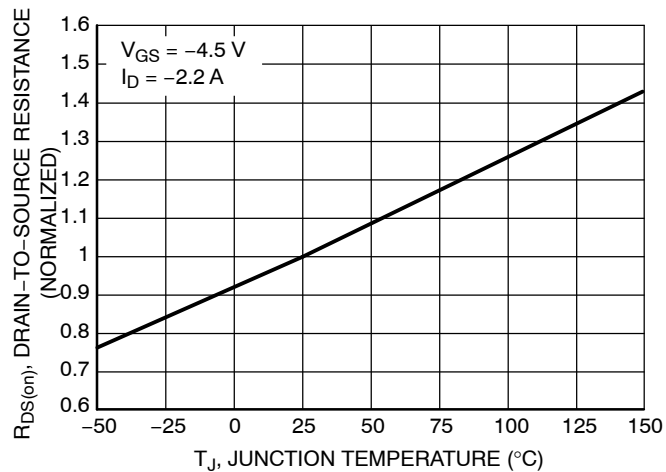


Figure 5. On-Resistance Variation with Temperature

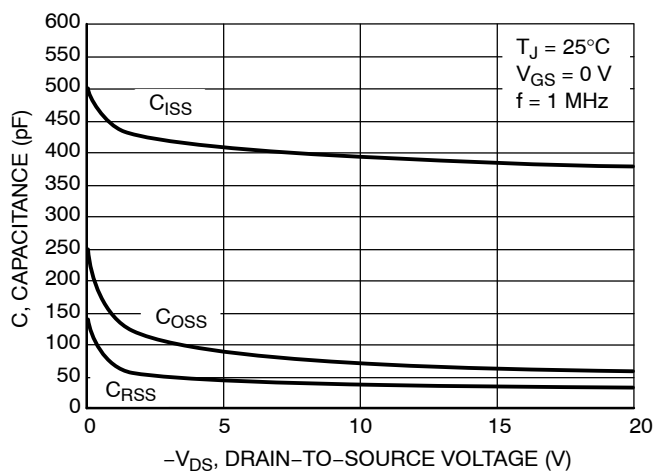


Figure 6. Capacitance Variation

TYPICAL PERFORMANCE CHARACTERISTICS

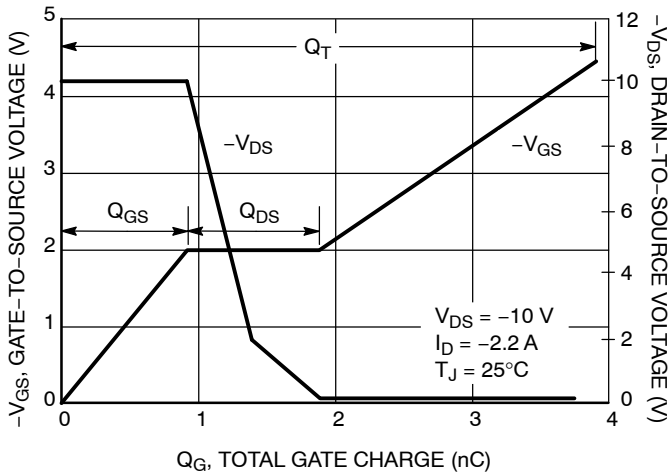


Figure 7. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

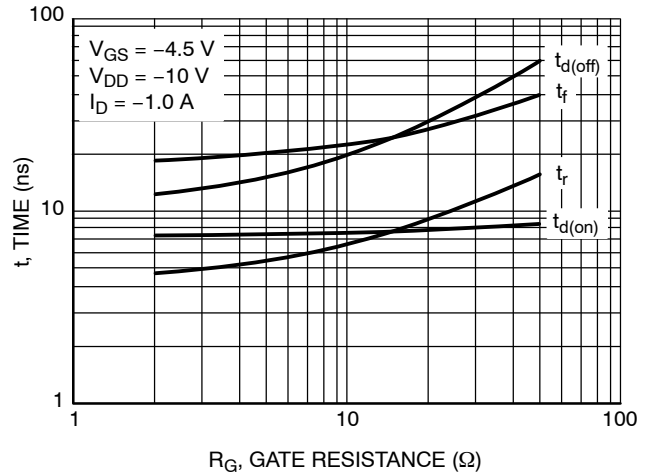


Figure 8. Resistive Switching Time Variation versus Gate Resistance

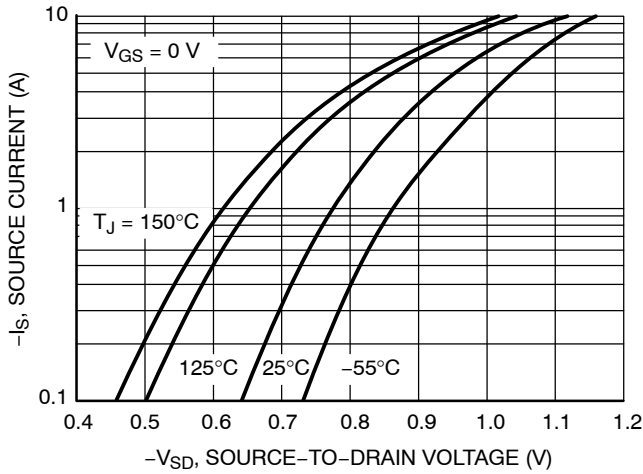


Figure 9. Diode Forward Voltage versus Current

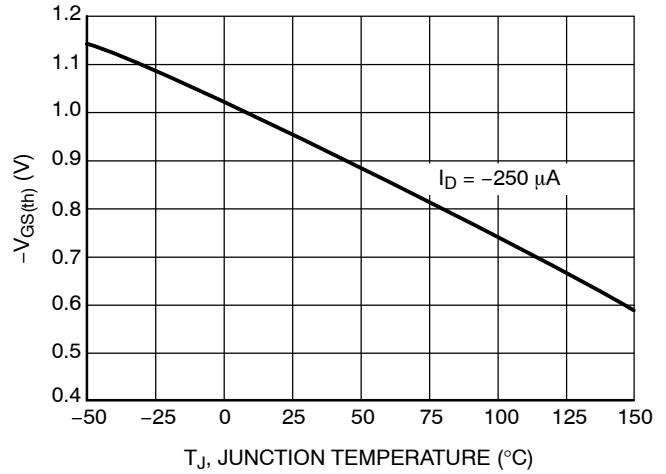


Figure 10. Threshold Voltage

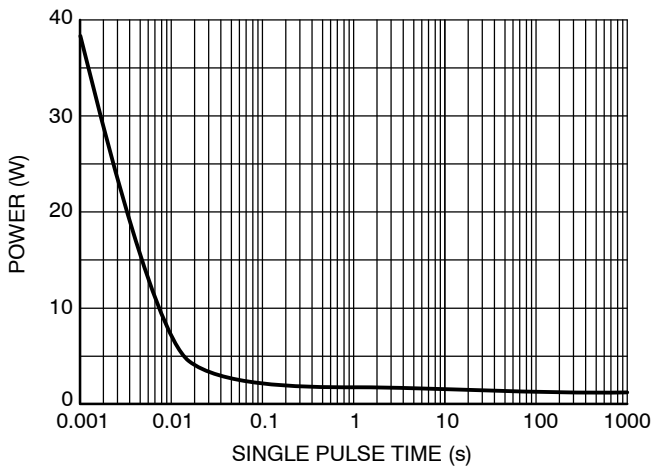


Figure 11. Single Pulse Maximum Power Dissipation

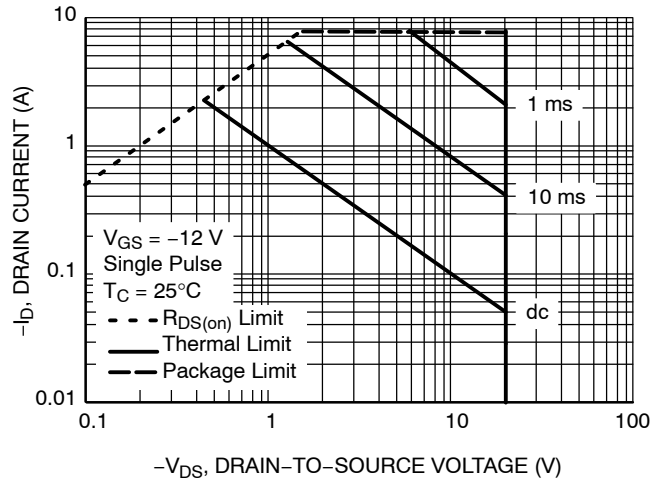


Figure 12. Maximum Rated Forward Biased Safe Operating Area

# NTGD3147F

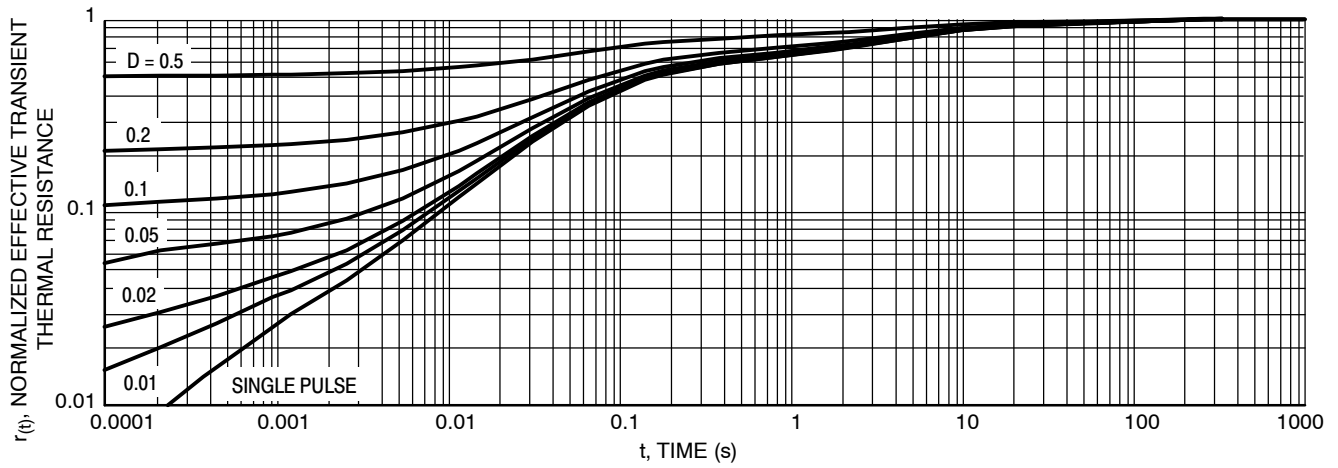


Figure 13. Thermal Response

## TYPICAL SCHOTTKY CHARACTERISTICS

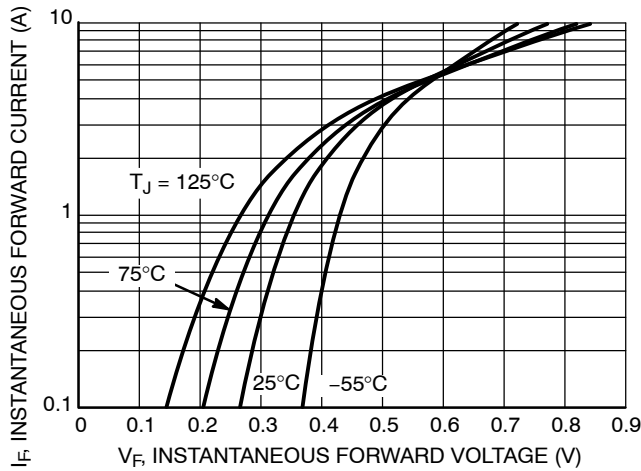


Figure 14. Typical Forward Voltage

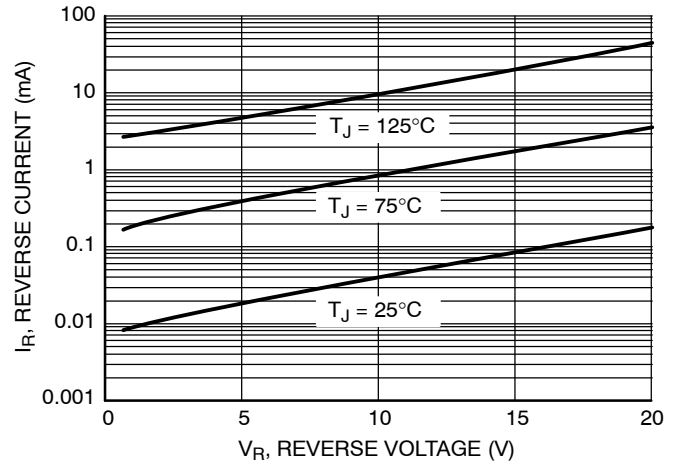


Figure 15. Typical Reverse Current

## ORDERING INFORMATION

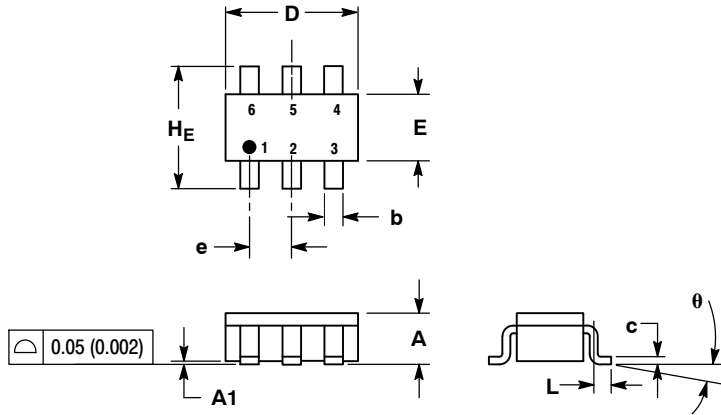
| Device       | Package             | Shipping <sup>†</sup> |
|--------------|---------------------|-----------------------|
| NTGD3147FT1G | TSOP-6<br>(Pb-Free) | 3000 / Tape & Reel    |

<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.

# NTGD3147F

## PACKAGE DIMENSIONS

### TSOP-6 CASE 318G-02 ISSUE S



#### NOTES:

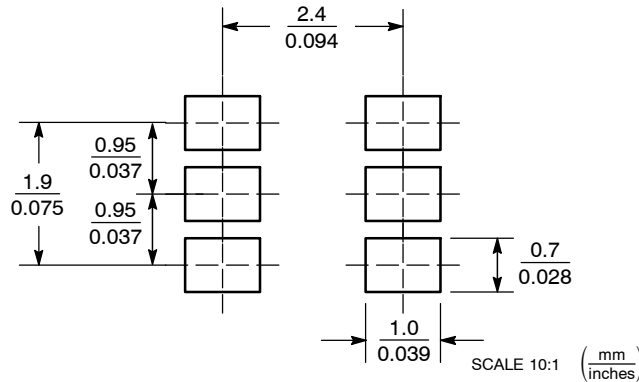
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.90        | 1.00 | 1.10 | 0.035  | 0.039 | 0.043 |
| A1  | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b   | 0.25        | 0.38 | 0.50 | 0.010  | 0.014 | 0.020 |
| c   | 0.10        | 0.18 | 0.26 | 0.004  | 0.007 | 0.010 |
| D   | 2.90        | 3.00 | 3.10 | 0.114  | 0.118 | 0.122 |
| E   | 1.30        | 1.50 | 1.70 | 0.051  | 0.059 | 0.067 |
| e   | 0.85        | 0.95 | 1.05 | 0.034  | 0.037 | 0.041 |
| L   | 0.20        | 0.40 | 0.60 | 0.008  | 0.016 | 0.024 |
| HE  | 2.50        | 2.75 | 3.00 | 0.099  | 0.108 | 0.118 |
| θ   | 0°          | —    | 10°  | 0°     | —     | 10°   |

#### STYLE 15:

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

## SOLDERING FOOTPRINT\*



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

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