

NTMD4184PF

Power MOSFET and Schottky Diode

-30 V, -4.0 A, Single P-Channel with 20 V, 2.2 A, Schottky Barrier Diode

Features

- FETKY™ Surface Mount Package Saves Board Space
- Independent Pin-Out for MOSFET and Schottky Allowing for Design Flexibility
- Low $R_{DS(on)}$ MOSFET and Low V_F Schottky to Minimize Conduction Losses
- Optimized Gate Charge to Minimize Switching Losses
- This is a Pb-Free Device

Applications

- Disk Drives
- DC-DC Converters
- Printers

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

| Rating | Symbol | Value | Unit |
|---|-----------|--------------------------|------------------|
| Drain-to-Source Voltage | V_{DSS} | -30 | V |
| Gate-to-Source Voltage | V_{GS} | ± 20 | V |
| Continuous Drain Current $R_{\theta JA}$ (Note 1) | I_D | $T_A = 25^\circ\text{C}$ | -3.3 |
| | | $T_A = 70^\circ\text{C}$ | -2.6 |
| Power Dissipation $R_{\theta JA}$ (Note 1) | P_D | 1.6 | W |
| Continuous Drain Current $R_{\theta JA}$ (Note 2) | I_D | $T_A = 25^\circ\text{C}$ | -2.3 |
| | | $T_A = 70^\circ\text{C}$ | -1.8 |
| Power Dissipation $R_{\theta JA}$ (Note 2) | P_D | 0.77 | W |
| Continuous Drain Current $R_{\theta JA} t < 10$ s (Note 1) | I_D | $T_A = 25^\circ\text{C}$ | -4.0 |
| | | $T_A = 70^\circ\text{C}$ | -3.2 |
| Power Dissipation $R_{\theta JA} t < 10$ s (Note 1) | P_D | 2.31 | W |
| Pulsed Drain Current | I_{DM} | -10 | A |
| Operating Junction and Storage Temperature | | T_J, T_{STG} | -55 to +150 |
| Source Current (Body Diode) | I_S | -1.3 | 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)

| Rating | Symbol | Value | Unit |
|---|-----------|--------------|------|
| Peak Repetitive Reverse Voltage | V_{RRM} | 20 | V |
| DC Blocking Voltage | V_R | 20 | V |
| Average Rectified Forward Current, (Note 1) | I_F | Steady State | 2.2 |
| | | $t < 10$ s | 3.2 |



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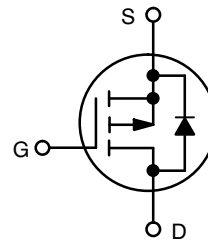
<http://onsemi.com>

P-CHANNEL MOSFET

| $V_{(BR)DSS}$ | $R_{DS(on)}$ Max | I_D Max |
|---------------|-------------------------|-----------|
| -30 V | 95 m Ω @ -10 V | -4.0 A |
| | 165 m Ω @ -4.5 V | |

SCHOTTKY DIODE

| V_R Max | V_F Max | I_F Max |
|-----------|-----------|-----------|
| 20 V | 0.58 V | 2.2 A |

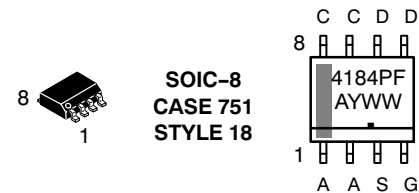


P-Channel MOSFET



Schottky Diode

MARKING DIAGRAM & PIN ASSIGNMENT



4184PF = Device Code
 A = Assembly Location
 Y = Year
 WW = Work Week
 ■ = Pb-Free Package

ORDERING INFORMATION

| Device | Package | Shipping† |
|---------------|------------------|------------------|
| NTMD4184PFR2G | SOIC-8 (Pb-Free) | 2500/Tape & Reel |

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

NTMD4184PF

THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter MOSFET & Schottky | Symbol | Max | Unit |
|---|-----------------|-----|------|
| Junction-to-Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 79 | °C/W |
| Junction-to-Ambient – $t \leq 10$ s Steady State (Note 1) | $R_{\theta JA}$ | 54 | |
| Junction-to-FOOT (Drain) Equivalent to $R_{\theta JC}$ | $R_{\theta JF}$ | 50 | |
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 163 | |

1. Surface-mounted on FR4 board using 1 inch sq pad size, 1 oz Cu.
2. Surface-mounted on FR4 board using the minimum recommended pad size.

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 | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$ | -30 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | 30 | | mV/°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 | μA |
| | | | $T_J = 125^\circ\text{C}$ | | -10 | |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$ | | | ± 100 | nA |

ON CHARACTERISTICS (Note 3)

| | | | | | | |
|--|------------------|---|------|-----|------|------------|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$ | -1.0 | | -3.0 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | 4.4 | | mV/°C |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = -10\text{ V}, I_D = -3.0\text{ A}$ | | 70 | 95 | m Ω |
| | | $V_{GS} = -4.5\text{ V}, I_D = -1.5\text{ A}$ | | 120 | 165 | |
| Forward Transconductance | g_{FS} | $V_{DS} = -1.5\text{ V}, I_D = -3.0\text{ A}$ | | 5.0 | | S |

CHARGES, CAPACITANCES AND GATE RESISTANCE

| | | | | | | |
|------------------------------|--------------|--|--|-----|-----|----|
| Input Capacitance | C_{ISS} | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -10\text{ V}$ | | 280 | 360 | pF |
| Output Capacitance | C_{OSS} | | | 80 | 110 | |
| Reverse Transfer Capacitance | C_{RSS} | | | 52 | 80 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.0\text{ A}$ | | 2.8 | 4.2 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | 0.4 | | |
| Gate-to-Source Charge | Q_{GS} | | | 1.1 | | |
| Gate-to-Drain Charge | Q_{GD} | | | 1.1 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.0\text{ A}$ | | 5.8 | 8.8 | nC |

SWITCHING CHARACTERISTICS (Note 4)

| | | | | | | |
|---------------------|--------------|--|--|-----|-----|----|
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}, I_D = -1.0\text{ A}, R_G = 6.0\ \Omega$ | | 7.2 | 15 | ns |
| Rise Time | t_r | | | 12 | 24 | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | 18 | 36 | |
| Fall Time | t_f | | | 2.6 | 6.0 | |

DRAIN-TO-SOURCE CHARACTERISTICS

| | | | | | | | |
|-----------------------|----------|--|---------------------------|------|------|------|----|
| Forward Diode Voltage | V_{SD} | $V_{GS} = 0\text{ V}, I_D = -1.3\text{ A}$ | $T_J = 25^\circ\text{C}$ | | -0.8 | -1.0 | V |
| | | | $T_J = 125^\circ\text{C}$ | | 0.7 | | |
| Reverse Recovery Time | t_{RR} | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = -1.3\text{ A}$ | | 12.8 | | ns | |
| Charge Time | t_a | | | 10 | | | |
| Discharge Time | t_b | | | 2.8 | | | |
| Reverse Recovery Time | Q_{RR} | | | 7.4 | | | nC |

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

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

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 | $I_F = 1.0\text{ A}$ | $T_J = 25^\circ\text{C}$ | | 0.43 | 0.50 | V |
| | | | $T_J = 125^\circ\text{C}$ | | 0.35 | 0.39 | |
| | | $I_F = 2.0\text{ A}$ | $T_J = 25^\circ\text{C}$ | | 0.5 | 0.58 | |
| | | | $T_J = 125^\circ\text{C}$ | | 0.45 | 0.53 | |
| Maximum Instantaneous Reverse Current | I_R | $V_R = 10\text{ V}$ | $T_J = 25^\circ\text{C}$ | | 0.001 | 0.02 | mA |
| | | | $T_J = 125^\circ\text{C}$ | | 1.2 | 14 | |
| | | $V_R = 20\text{ V}$ | $T_J = 25^\circ\text{C}$ | | 0.004 | 0.05 | |
| | | | $T_J = 125^\circ\text{C}$ | | 2.0 | 18 | |

- Pulse Test: pulse width $\leq 300\ \mu\text{s}$, duty cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

TYPICAL CHARACTERISTICS

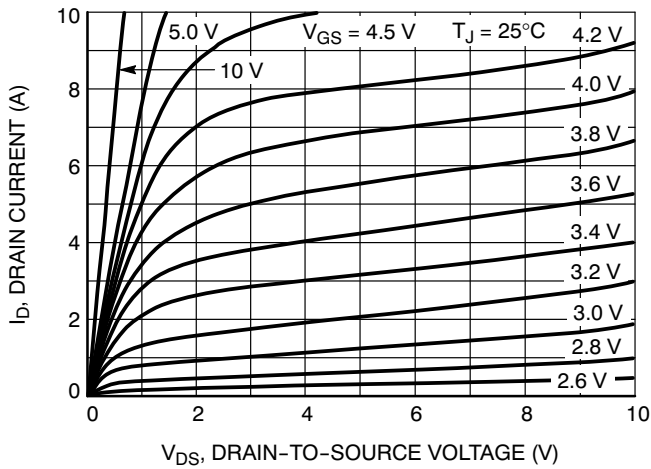


Figure 1. On-Region Characteristics

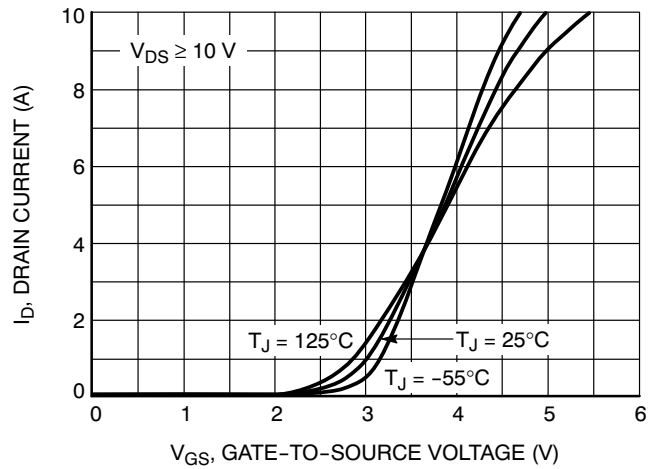


Figure 2. Transfer Characteristics

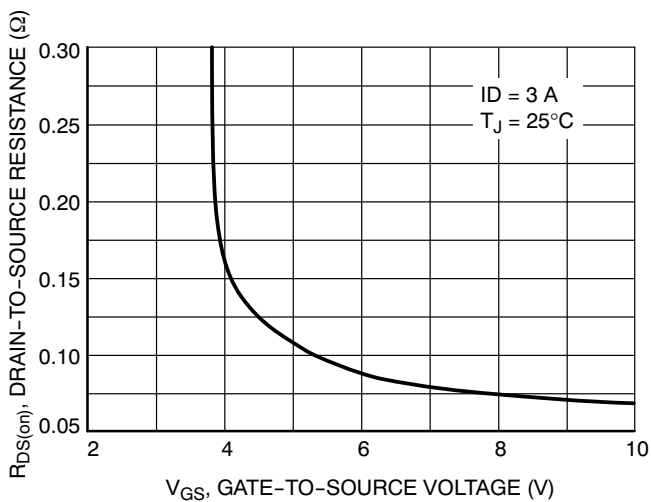


Figure 3. On-Resistance vs. Gate Voltage

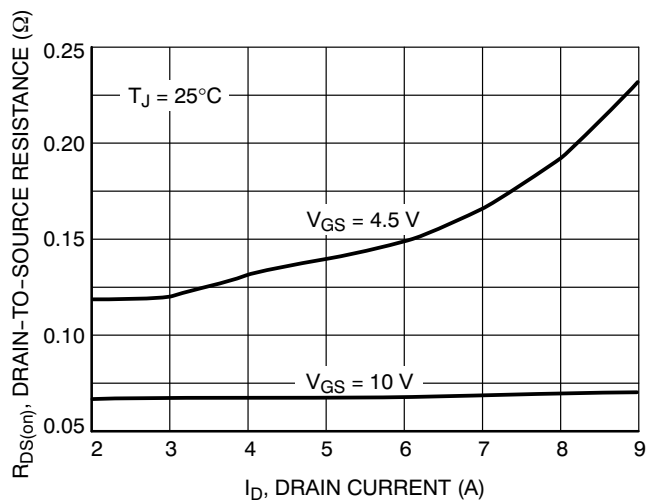


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

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TYPICAL CHARACTERISTICS

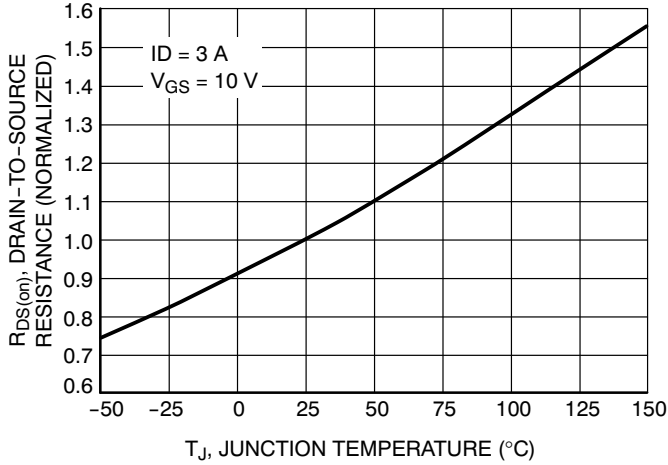


Figure 5. On-Resistance Variation with Temperature

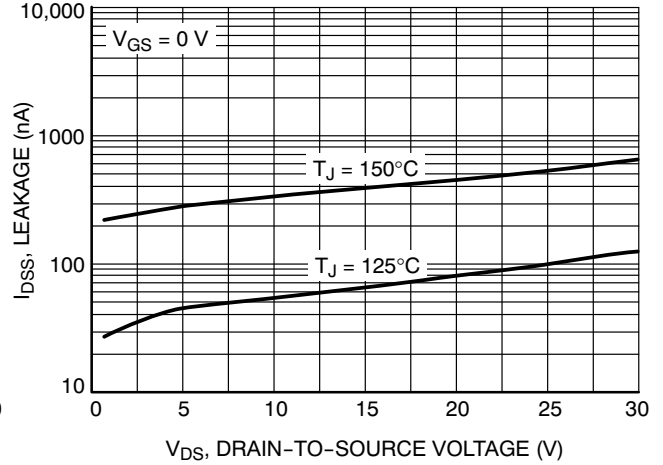


Figure 6. Drain-to-Source Leakage Current vs. Voltage

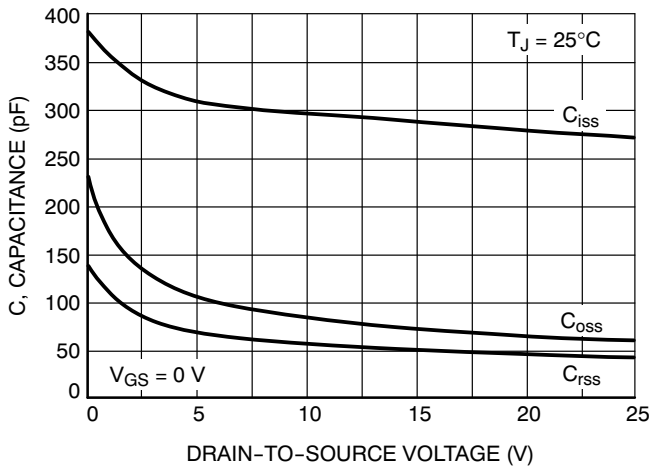


Figure 7. Capacitance Variation

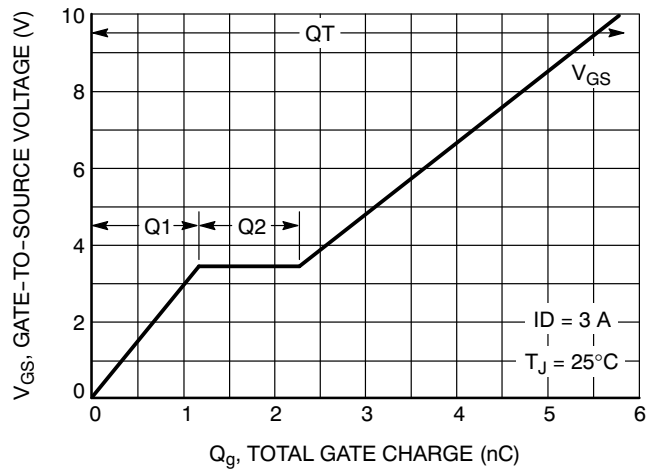


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

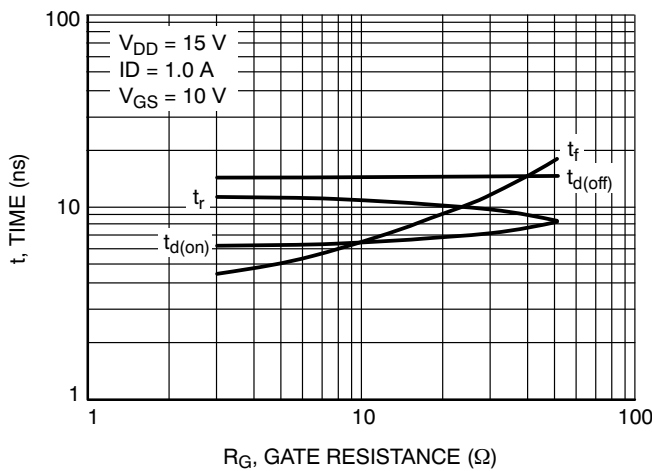


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

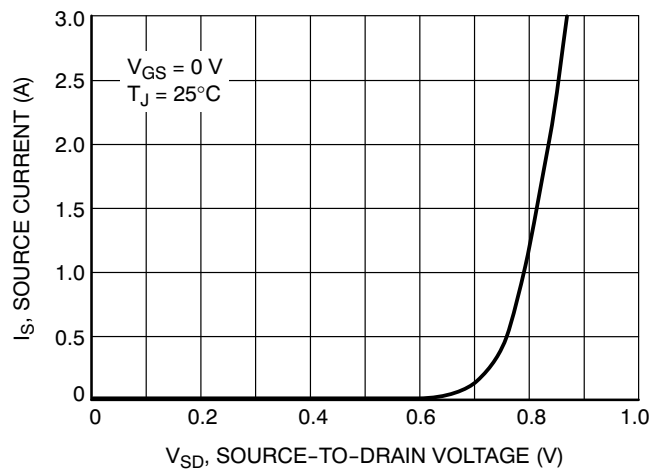


Figure 10. Diode Forward Voltage vs. Current

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TYPICAL CHARACTERISTICS

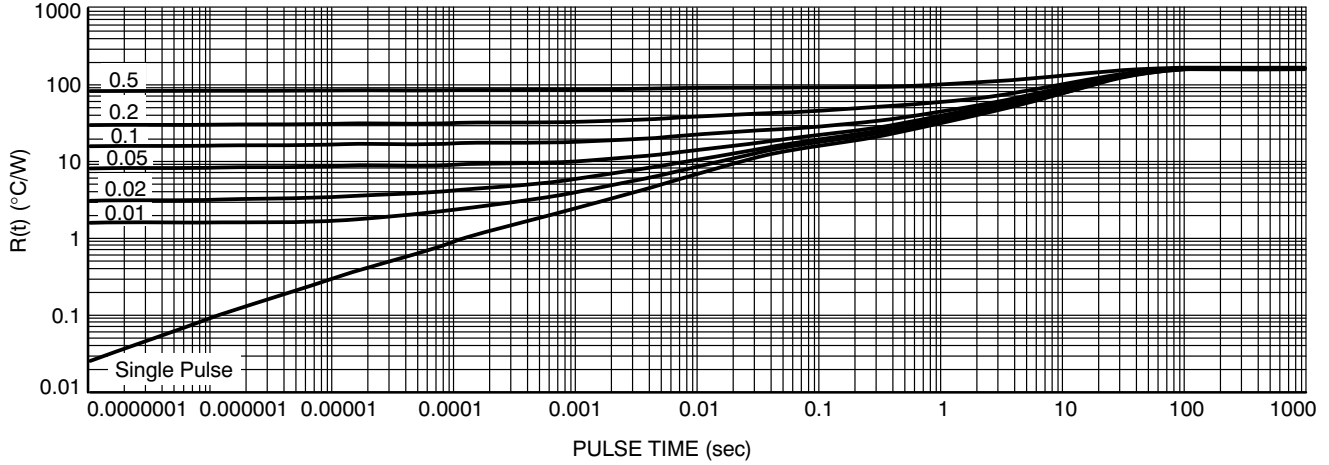


Figure 11. Thermal Response - $R_{\theta JA}$ at Steady State (min pad)

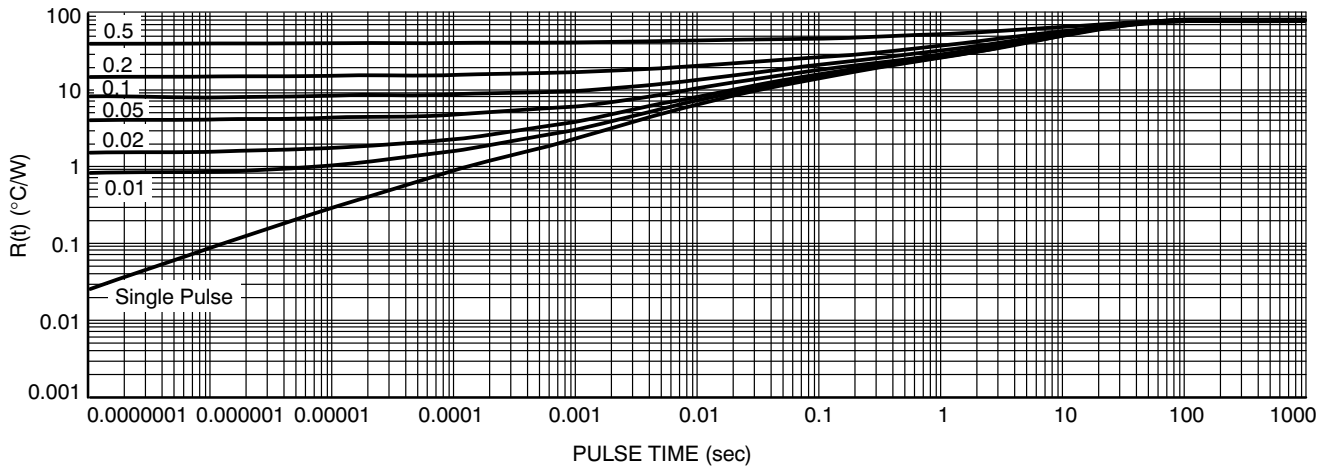


Figure 12. Thermal Response - $R_{\theta JA}$ at Steady State (1 inch sq pad)

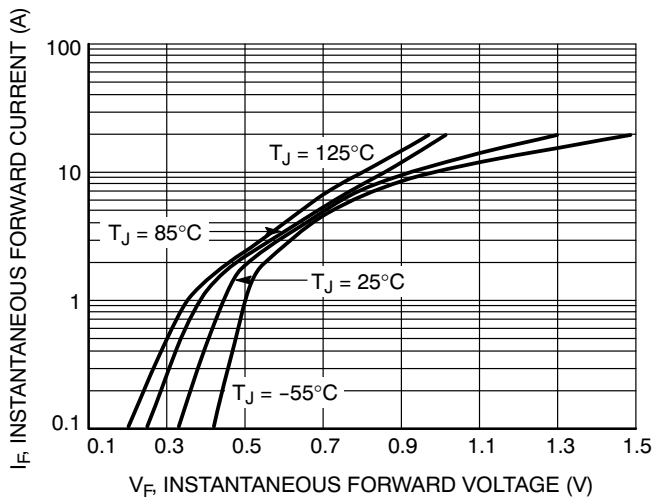


Figure 13. Typical Forward Voltage

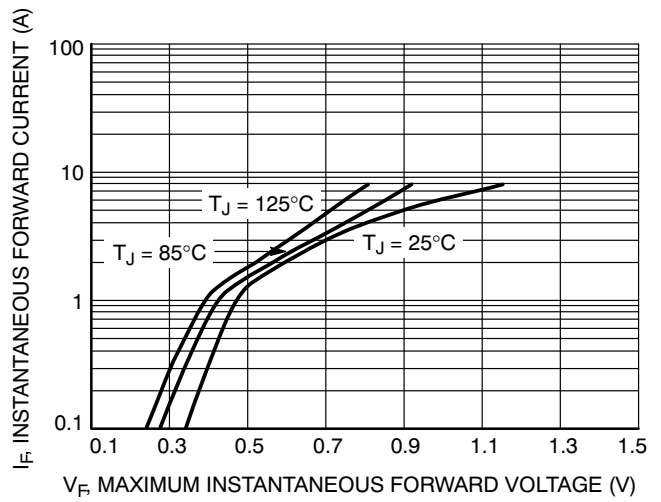


Figure 14. Maximum Forward Voltage

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TYPICAL CHARACTERISTICS

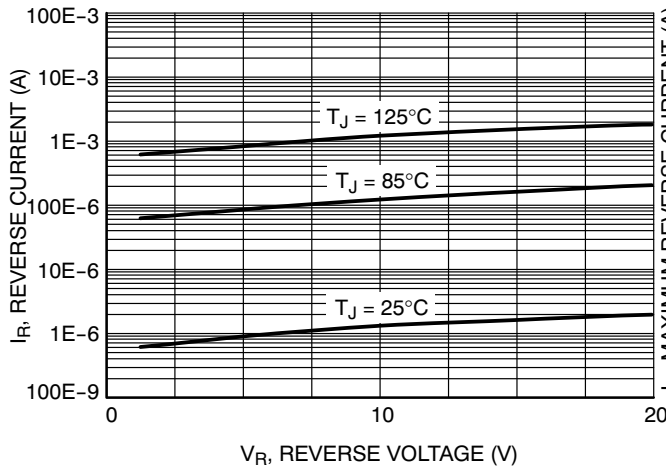


Figure 15. Typical Reverse Current

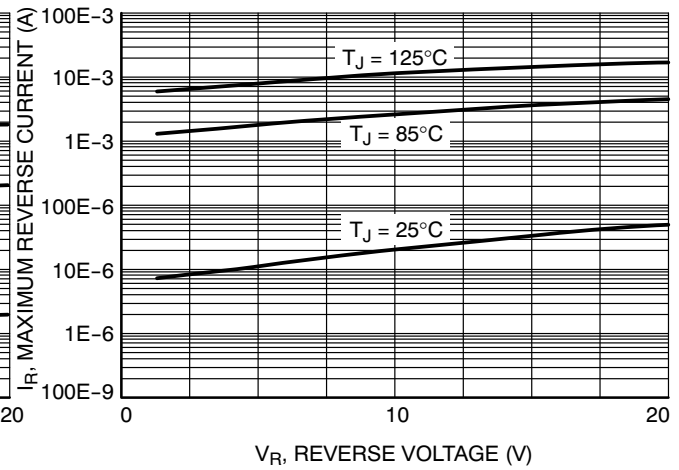


Figure 16. Maximum Reverse Current

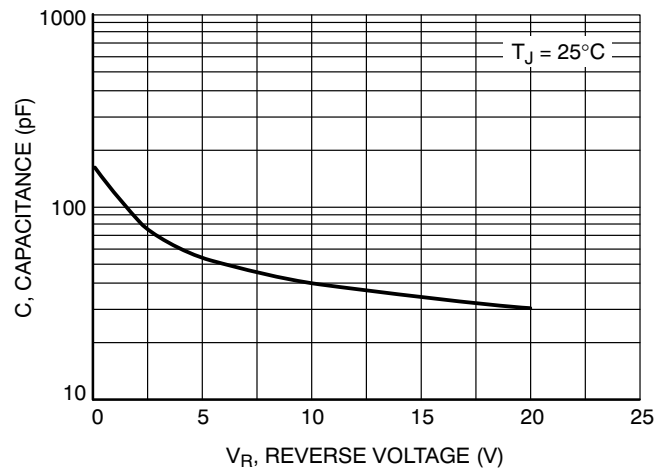
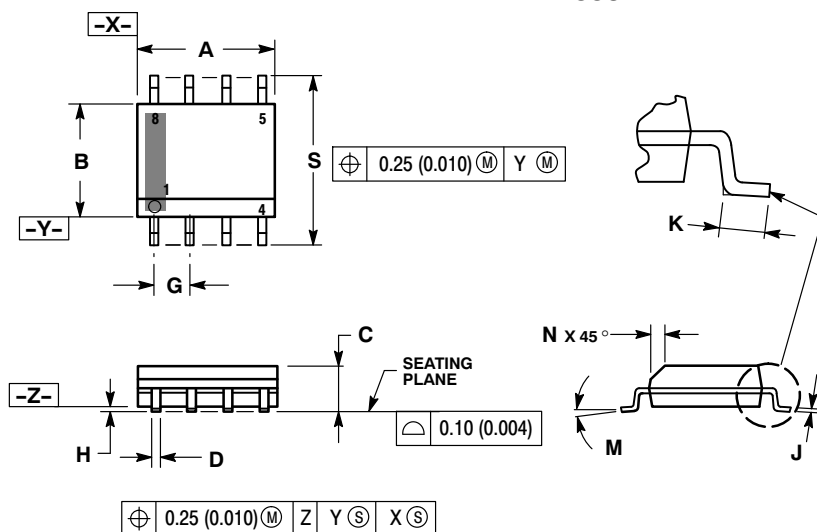


Figure 17. Capacitance

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PACKAGE DIMENSIONS

SOIC-8 NB
CASE 751-07
ISSUE AH

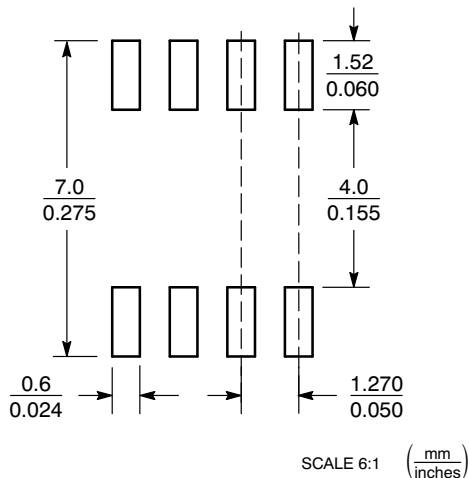


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0° | 8° | 0° | 8° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

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.

STYLE 18:

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

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