# NTHD4N02F

# Power MOSFET and Schottky Diode

## 20 V, 2.7 A, N−Channel, with 1.0 A Schottky Barrier Diode, ChipFET

ON Semiconductor®

http://onsemi.com

### Features

- Leadless SMD Package Featuring a MOSFET and Schottky Diode
- 40% Smaller than TSOP−6 Package with Better Thermals
- Super Low Gate Charge MOSFET
- Ultra Low $V_F$ Schottky
- Pb−Free Package May be Available. The G−Suffix Denotes a Pb−Free Lead Finish

### Applications

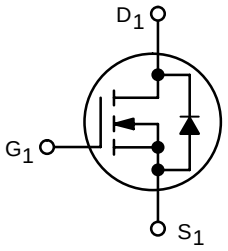
- Fast Switching, low Gate Charge for Dc to Dc Buck and Boost Converters
- Li−Ion Battery Applications in Cell Phones, PDAs, DSCs, and Media Players
- Load Side Switching

**MOSFET**

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | $I_D$ MAX |
|---|---|---|
| 20 V | 60 mΩ @ 4.5 V | 2.7 A |
| | 80 mΩ @ 2.5 V | |

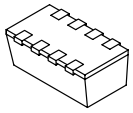
**SCHOTTKY DIODE**

| $V_R$ MAX | $V_F$ TYP | $I_F$ MAX |
|---|---|---|
| 20 V | 0.35 V | 1.0 A |



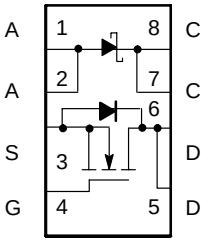

N−Channel MOSFET


SCHOTTKY DIODE



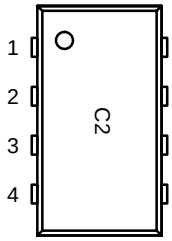
**ChipFET™**
**CASE 1206A**
**STYLE 3**

**PIN CONNECTIONS**




(Top View)

**MARKING DIAGRAM**




C2 = Specific Device Code

**MOSFET MAXIMUM RATINGS** ($T_J$ = 25°C unless otherwise noted)

| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 20 | V |
| Gate−to−Source Voltage | | | $V_{GS}$ | ±12 | V |
| Continuous Drain Current | Steady State | $T_J$=25°C | $I_D$ | 2.7 | A |
| | | $T_J$=85°C | | 1.7 | |
| Pulsed Drain Current | $t_p$=10 μs | | $I_{DM}$ | 9.0 | A |
| Power Dissipation | Steady State | $T_J$=25°C | $P_D$ | 0.91 | W |
| | | $T_J$=85°C | | 0.36 | |
| Continuous Source Current (Body Diode) | | | $I_S$ | 2.7 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{STG}$ | −55 to 125 | °C |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | | | $T_L$ | 260 | °C |

**SCHOTTKY DIODE MAXIMUM RATINGS**
($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Peak Repetitive Reverse Voltage | $V_{RRM}$ | 20 | V |
| DC Blocking Voltage | $V_R$ | 20 | V |
| Average Rectified Forward Current | $I_F$ | 2.2 | A |

**THERMAL RESISTANCE RATINGS**

| Parameter | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 110 | °C/W |
| Junction−to−Ambient – t ≤ 5 s | $R_{\theta JA}$ | 60 | °C/W |

1. Surface Mounted on FR4 Board using 1 in sq. pad size (Cu area = 1.27 in sq. [1 oz] including traces).

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NTHD4N02FT1 | ChipFET | 3000/Tape & Reel |
| NTHD4N02FT1G | ChipFET (Pb−Free) | 3000/Tape & Reel |

†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.

**MOSFET ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain−to−Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 20 | 28 | | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 16 V | $T_J$ = 25°C | | | 1.0 | μA |
| | | | $T_J$ = 85°C | | | 5.0 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±12 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 2) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 0.6 | | 1.2 | V |
| Drain−to−Source On−Resistance | $R_{DS(on)}$ | $V_{GS}$ = 4.5, $I_D$ = 2.7 A | | | 0.058 | 0.080 | Ω |
| | | $V_{GS}$ = 2.5, $I_D$ = 2.3 A | | | 0.077 | 0.115 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 10 V, $I_D$ = 2.7 A | | | 6.0 | | S |
| **CHARGES AND CAPACITANCES** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1.0 MHz, $V_{DS}$ = 10 V | | | 180 | 300 | pF |
| Output Capacitance | $C_{OSS}$ | | | | 80 | 130 | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 30 | 50 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 10 V, $I_D$ = 2.7 A | | | 2.6 | 4.0 | nC |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 0.6 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 0.7 | | |
| **SWITCHING CHARACTERISTICS** (Note 3) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 4.5 V, $V_{DD}$ = 16 V, $I_D$ = 2.7 A, $R_G$ = 2.5 Ω | | | 5.0 | 10 | ns |
| Rise Time | $t_r$ | | | | 9.0 | 18 | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 10 | 20 | |
| Fall Time | $t_f$ | | | | 3.0 | 6.0 | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** (Note 2) | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 2.7 A | | | 0.8 | 1.15 | V |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, $I_S$ = 2.7 A, $dI_S/dt$ = 100 A/μs | | | 12.5 | | ns |
| Charge Time | ta | | | | 9.0 | | |
| Discharge Time | tb | | | | 3.5 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 6.0 | | nC |

**SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Maximum Instantaneous Forward Voltage | $V_F$ | $I_F$ = 0.1 A | | | 0.31 | V |
| | | $I_F$ = 1.0 A | | | 0.365 | |
| Maximum Instantaneous Reverse Current | $I_R$ | $V_R$ = 10 V | | | 0.75 | mA |
| | | $V_R$ = 20 V | | | 2.5 | |
| Non−Repetitive Peak Surge Current | $I_{FSM}$ | Halfwave, Single Pulse, 60 Hz | | | 23 | A |

2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

## TYPICAL MOSFET PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

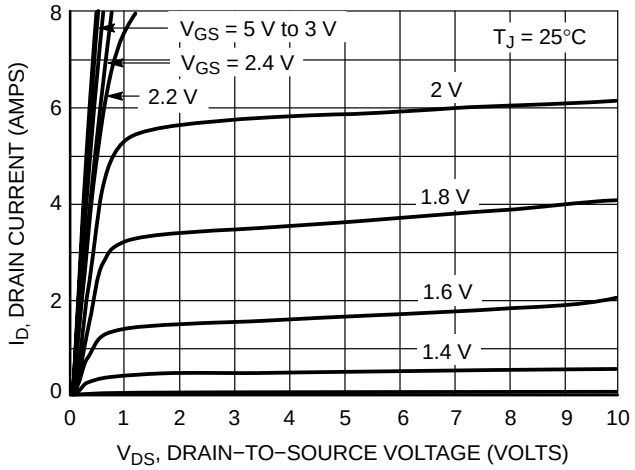



**Figure 1. On−Region Characteristics**

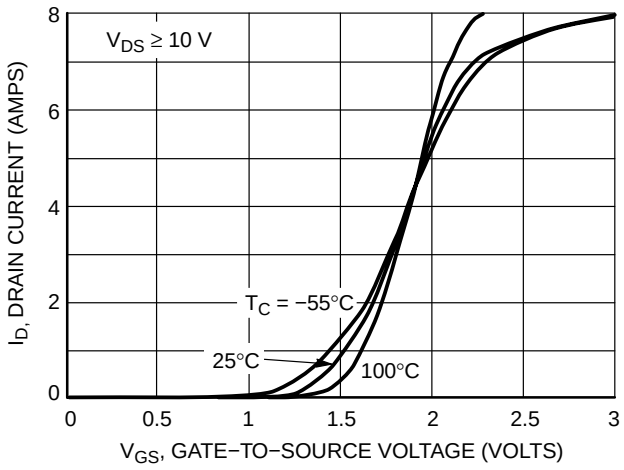



**Figure 2. Transfer Characteristics**

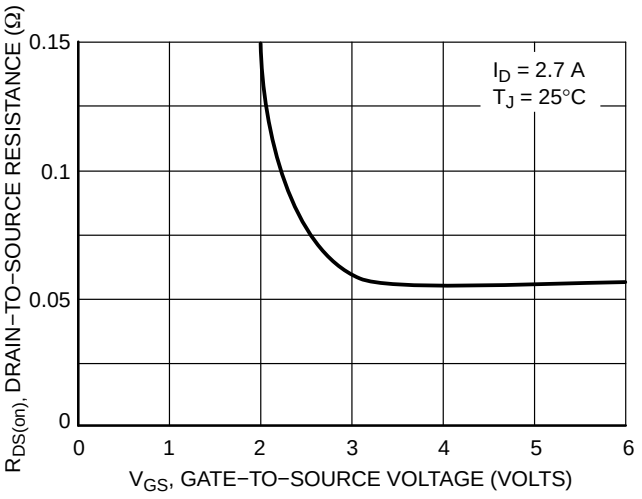



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

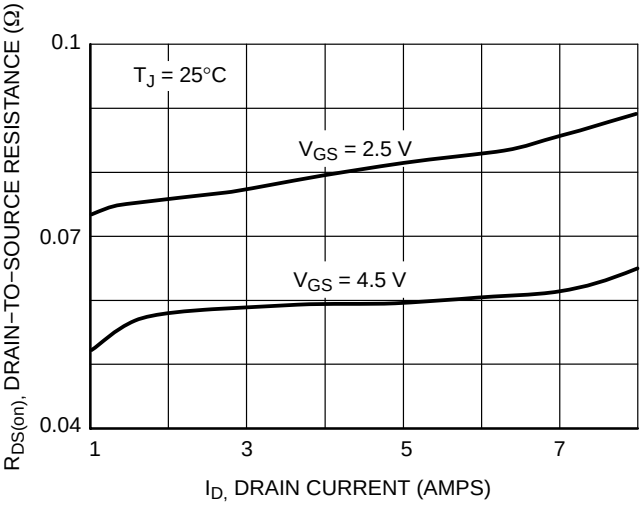



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

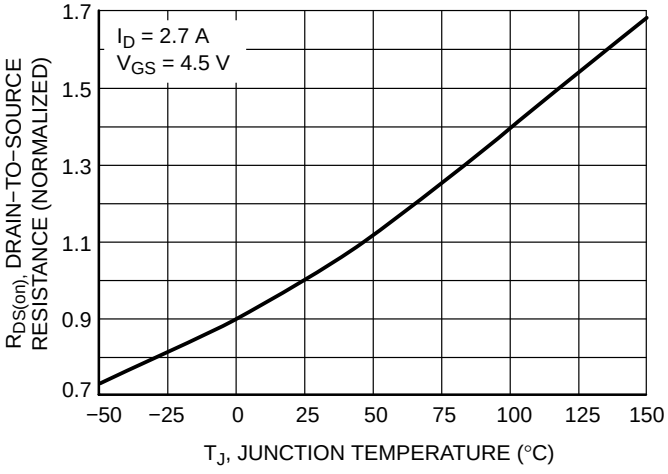



**Figure 5. On−Resistance Variation with Temperature**

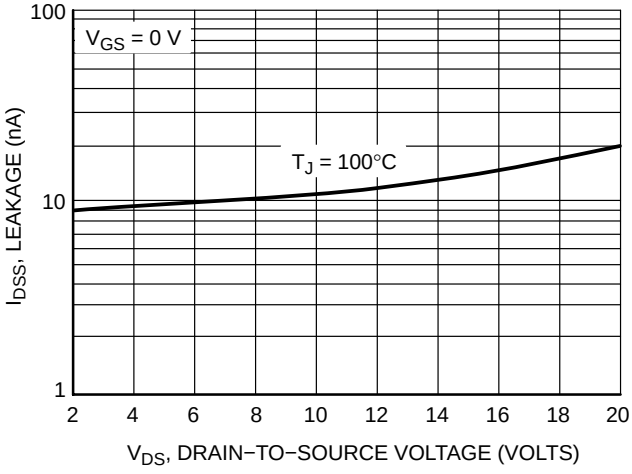



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

## TYPICAL MOSFET PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

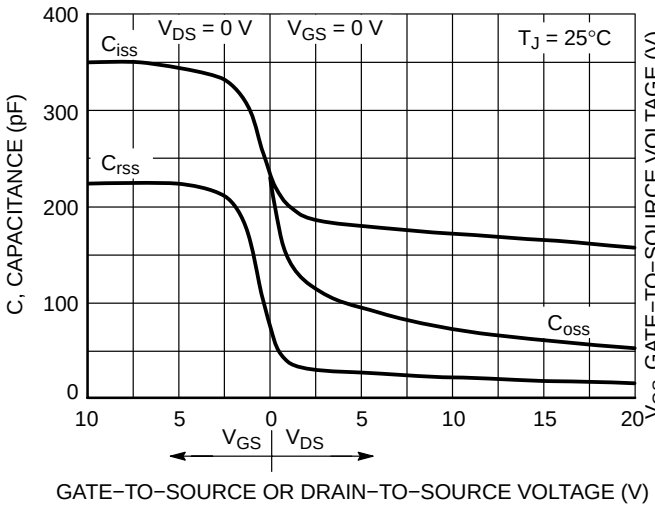



**Figure 7. Capacitance Variation**

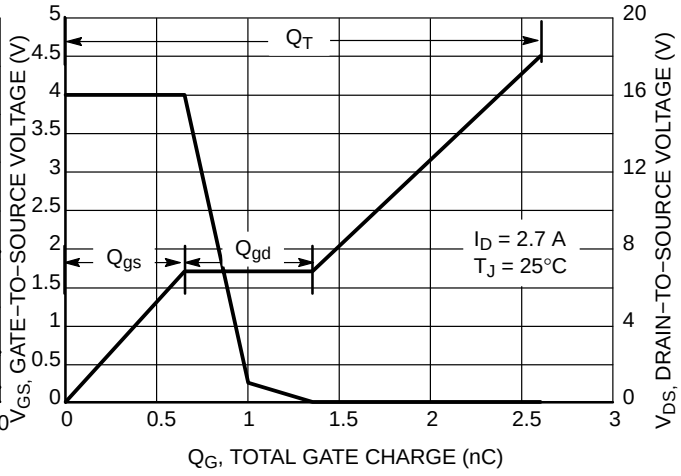



**Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge**

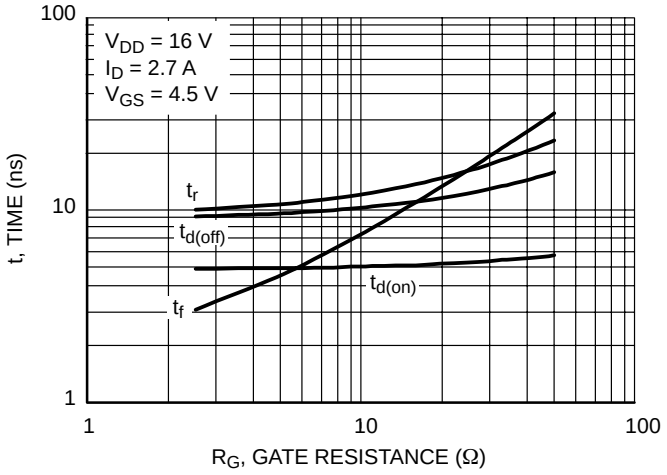



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

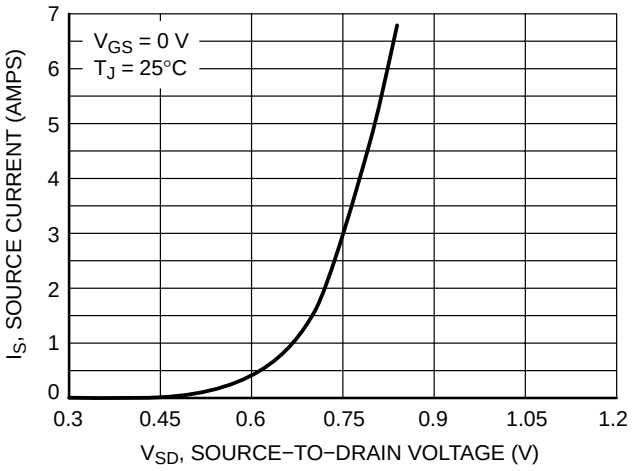



**Figure 10. Diode Forward Voltage vs. Current**

## TYPICAL SCHOTTKY PERFORMANCE CURVES ($T_J$ = 25°C unless otherwise noted)

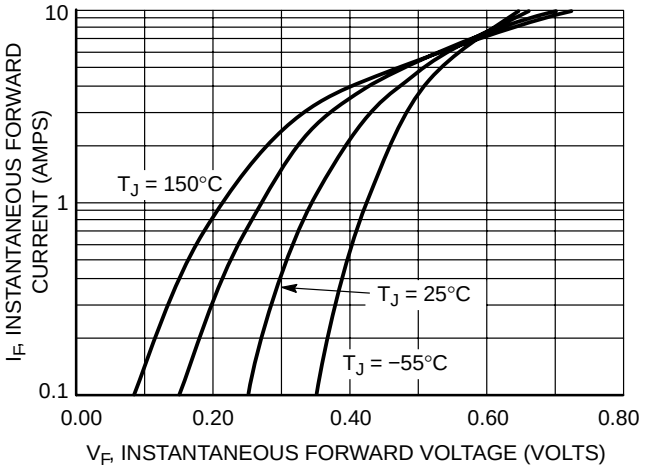



**Figure 11. Typical Forward Voltage**

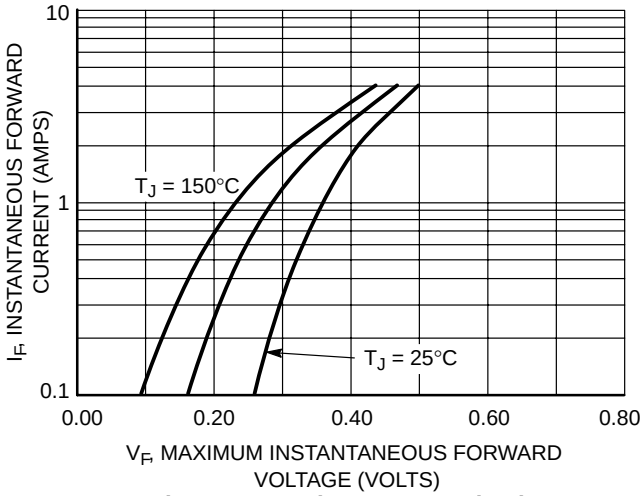



**Figure 12. Maximum Forward Voltage**

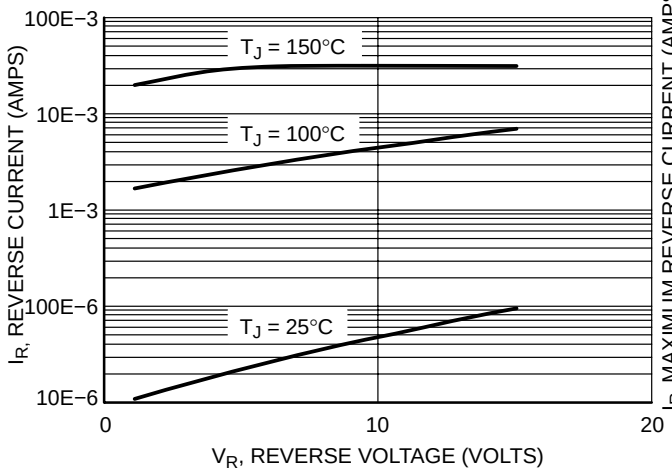



**Figure 13. Typical Reverse Current**

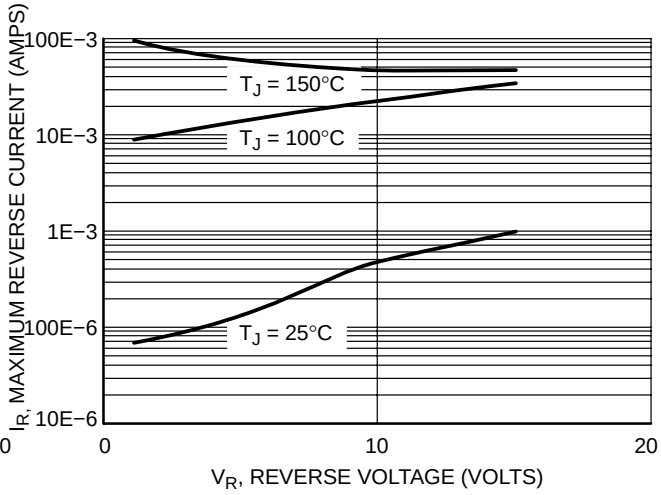



**Figure 14. Maximum Reverse Current**

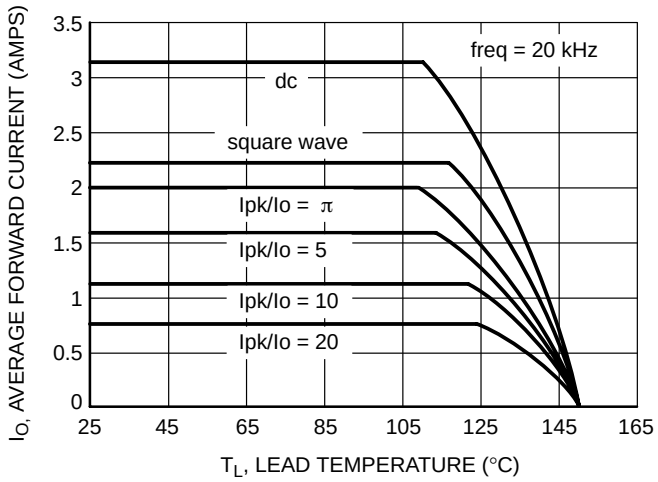



**Figure 15. Current Derating**

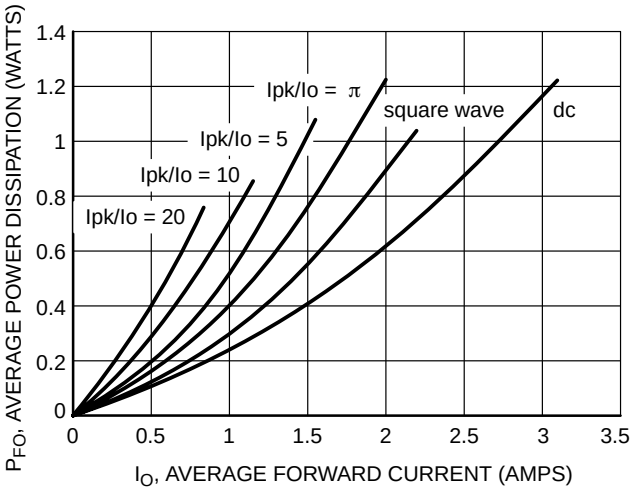
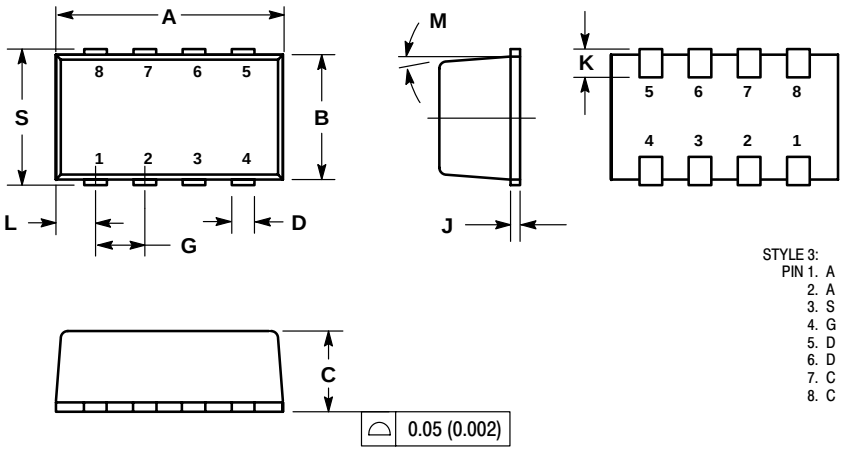



**Figure 16. Forward Power Dissipation**

## PACKAGE DIMENSIONS

**ChipFET**
CASE 1206A−03
ISSUE E




STYLE 3:
PIN 1. A
2. A
3. S
4. G
5. D
6. D
7. C
8. C

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.13 MM PER SIDE.
4. LEADFRAME TO MOLDED BODY OFFSET IN HORIZONTAL AND VERTICAL SHALL NOT EXCEED 0.08 MM.
5. DIMENSIONS A AND B EXCLUSIVE OF MOLD GATE BURRS.
6. NO MOLD FLASH ALLOWED ON THE TOP AND BOTTOM LEAD SURFACE.
7. 1206A−01 AND 1206A−02 OBSOLETE. NEW STANDARD IS 1206A−03.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 2.95 | 3.10 | 0.116 | 0.122 |
| B | 1.55 | 1.70 | 0.061 | 0.067 |
| C | 1.00 | 1.10 | 0.039 | 0.043 |
| D | 0.25 | 0.35 | 0.010 | 0.014 |
| G | 0.65 BSC | | 0.025 BSC | |
| J | 0.10 | 0.20 | 0.004 | 0.008 |
| K | 0.28 | 0.42 | 0.011 | 0.017 |
| L | 0.55 BSC | | 0.022 BSC | |
| M | 5 ° NOM | | 5 ° NOM | |
| S | 1.80 | 2.00 | 0.072 | 0.080 |

## SOLDER FOOTPRINTS*

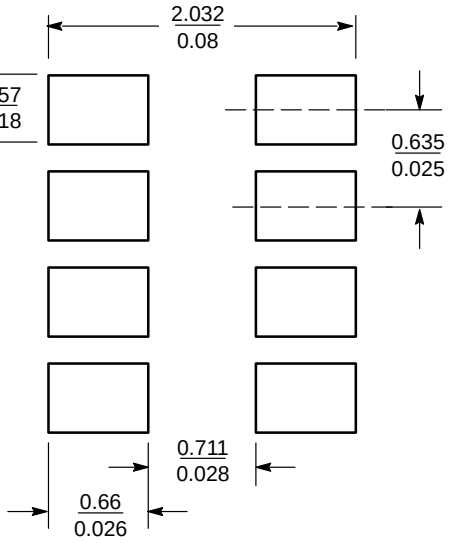



**Figure 17. Basic**

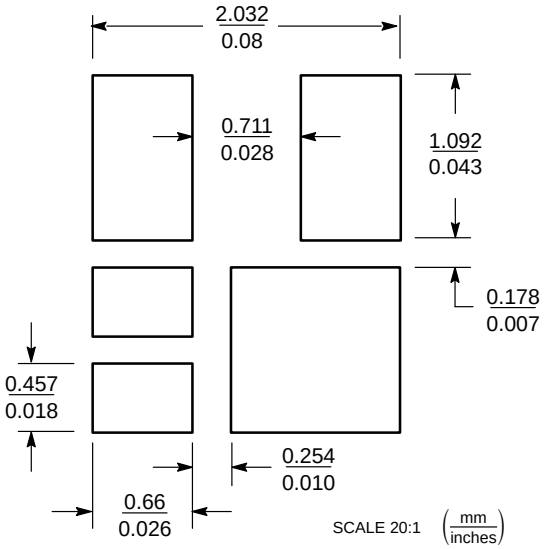



**Figure 18. Style 3**

*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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