

NTTD4401F

FETKY™ Power MOSFET and Schottky Diode

-20 V, -3.3 A P-Channel with 20 V, 1.0 A Schottky Diode, Micro8™ Package

The FETKY product family incorporates low $R_{DS(on)}$, true logic level MOSFETs packaged with industry leading, low forward drop, low leakage Schottky Barrier Diodes to offer high efficiency components in a space saving configuration. Independent pinouts for TMOS and Schottky die allow the flexibility to use a single component for switching and rectification functions in a wide variety of applications.

Features

- Low V_F and Low Leakage Schottky Diode
- Lower Component Placement and Inventory Costs along with Board Space Savings
- Logic Level Gate Drive – Can be Driven by Logic ICs
- Pb-Free Package is Available

Applications

- Buck Converter
- Synchronous Rectification
- Low Voltage Motor Control
- Load Management in Battery Packs, Chargers, Cell Phones, and other Portable Products

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

| Rating | | Symbol | Value | Unit |
|---|---------------------------|---------------------------|------------|------------------|
| Drain-to-Source Voltage | | V_{DSS} | -20 | V |
| Gate-to-Source Voltage | | V_{GS} | ± 10 | V |
| Continuous Drain Current (Note 1) | $T_A = 25^\circ\text{C}$ | I_D | -3.3 | A |
| | $T_A = 100^\circ\text{C}$ | | -2.1 | |
| Power Dissipation (Note 1) | Steady State | $T_A = 25^\circ\text{C}$ | P_D | 1.42 |
| | | $T_A = 100^\circ\text{C}$ | | |
| Continuous Drain Current (Note 2) | $T_A = 25^\circ\text{C}$ | I_D | -2.4 | A |
| | $T_A = 100^\circ\text{C}$ | | -1.5 | |
| Power Dissipation (Note 2) | Steady State | $T_A = 25^\circ\text{C}$ | P_D | 0.78 |
| | | | | |
| Pulsed Drain Current | $t = 10 \mu\text{s}$ | I_{DM} | -10 | A |
| Operating Junction and Storage Temperature | | T_J, T_{STG} | -55 to 150 | $^\circ\text{C}$ |
| Single Pulse Drain-to-Source Avalanche Energy Starting $T_A = 25^\circ\text{C}$ ($t \leq 10 \text{ s}$) | | EAS | 150 | mJ |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | | T_L | 260 | $^\circ\text{C}$ |

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).
2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.172 in sq).



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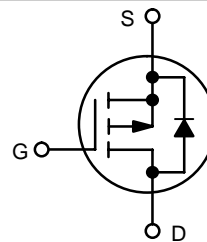
<http://onsemi.com>

MOSFET PRODUCT SUMMARY

| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP | I_D Max |
|---------------|-------------------------|-----------|
| -20 V | 70 m Ω @ -4.5 V | -3.3 A |
| | 100 m Ω @ -2.7 V | -2.7 A |

SCHOTTKY DIODE SUMMARY

| V_R Max | I_F Max | V_F Max |
|-----------|-----------|--------------------------------|
| 20 V | 2.0 A | 600 mV @ $I_F = 2.0 \text{ A}$ |

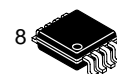


P-Channel MOSFET

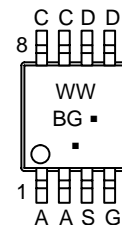


Schottky Diode

MARKING DIAGRAM & PIN ASSIGNMENT



Micro8 CASE 846A



BG = Specific Device Code
 WW = Work Week
 ■ = Pb-Free Package
 (Note: Microdot may be in either location)

ORDERING INFORMATION

| Device | Package | Shipping† |
|--------------|------------------|------------------|
| NTTD4401FR2 | Micro8 | 4000/Tape & Reel |
| NTTD4401FR2G | Micro8 (Pb-Free) | 4000/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.

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SCHOTTKY DIODE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
|--|-----------|-------|------|
| Peak Repetitive Reverse Voltage | V | 20 | V |
| Average Forward Current (Rated V_R , $T_A = 100^\circ\text{C}$) | I_O | 1.0 | A |
| Peak Repetitive Forward Current (Note 3) | I_{FRM} | 2.0 | A |
| Non-Repetitive Peak Surge Current (Note 4) | I_{FSM} | 20 | A |

THERMAL RESISTANCE RATINGS

| Rating | Symbol | FET | Schottky | Unit |
|---|-----------------|-----|----------|--------------------|
| | | Max | | |
| Junction-to-Ambient – Steady State (Note 5) | $R_{\theta JA}$ | 88 | 135 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – Steady State (Note 6) | $R_{\theta JA}$ | 160 | 250 | $^\circ\text{C/W}$ |

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

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

OFF CHARACTERISTICS

| | | | | | | |
|--|---------------|---|-----|---|-----------|---------------|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}$ | -20 | - | - | V |
| Zero Gate Voltage Drain Current (Note 7) | I_{DSS} | $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$ | - | - | -1.0 | μA |
| | | $V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}, V_{DS} = -16\text{ V}$ | - | - | -25 | |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$ | - | - | ± 100 | nA |

ON CHARACTERISTICS

| | | | | | | |
|--|------------------|---|------|-----|------|----------------------------|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$ | -0.5 | - | -1.5 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | - | - | 2.5 | - | $\text{mV}/^\circ\text{C}$ |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$ | - | 70 | 90 | $\text{m}\Omega$ |
| | | $V_{GS} = -2.5\text{ V}, I_D = -1.2\text{ A}$ | - | 100 | 150 | |
| Forward Transconductance | g_{FS} | $V_{DS} = -10\text{ V}, I_D = -2.7\text{ A}$ | - | 4.2 | - | S |

CHARGES, CAPACITANCES AND GATE RESISTANCE

| | | | | | | |
|-------------------------------|--------------|--|---|-----|-----|-------------|
| Input Capacitance | C_{ISS} | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -16\text{ V}$ | - | 550 | 750 | pF |
| Output Capacitance | C_{OSS} | | - | 200 | 300 | |
| Reverse Transfer Capacitance | C_{RSS} | | - | 50 | 175 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -16\text{ V}, I_D = -3.3\text{ A}$ | - | 10 | 18 | nC |
| Gate-to-Source Gate Charge | Q_{GS} | | - | 1.5 | 3.0 | |
| Gate-to-Drain "Miller" Charge | Q_{GD} | | - | 5.0 | 10 | |

SWITCHING CHARACTERISTICS

| | | | | | | |
|---------------------|--------------|---|---|----|----|----|
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V}, I_D = -3.3\text{ A}, R_G = 6.0\ \Omega$ | - | 11 | 20 | ns |
| Rise Time | t_r | | - | 35 | 65 | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | - | 33 | 60 | |
| Fall Time | t_f | | - | 29 | 55 | |

DRAIN-SOURCE DIODE CHARACTERISTICS

| | | | | | | |
|-------------------------|----------|--|---|-------|------|----|
| Forward Diode Voltage | V_{SD} | $V_{GS} = 0\text{ V}, I_S = -2.0\text{ A}$ | - | -0.88 | -1.0 | V |
| Reverse Recovery Time | t_{RR} | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = -3.3\text{ A}$ | - | 37 | 50 | ns |
| Charge Time | t_a | | - | 16 | - | |
| Discharge Time | t_b | | - | 21 | - | |
| Reverse Recovery Charge | Q_{RR} | - | - | 0.025 | 0.05 | nC |

3. Rated V_R , square wave, 20 kHz, $T_A = 105^\circ\text{C}$.

4. Surge applied at rated load conditions, half-wave, single phase, 60 Hz.

5. Surface-mounted on FR4 board using 1 inch sq pad size (Cu area = 1.127 in sq [1 oz] including traces).

6. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.172 in sq).

7. Body diode leakage current.

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

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit | |
|---------------------------|---------|------------------------|---------------------------|--------|-----|------------------|----|
| Reverse Breakdown Voltage | B_V | $I_R = 1.0 \text{ mA}$ | 20 | - | - | V | |
| Reverse Leakage Current | I_R | $V_R = 20 \text{ V}$ | $T_A = 25^\circ\text{C}$ | - | - | 0.05 | mA |
| | | | $T_A = 125^\circ\text{C}$ | - | - | 10 | |
| Forward Voltage | V_F | $I_F = 1.0 \text{ A}$ | $T_A = 25^\circ\text{C}$ | - | - | 0.5 | V |
| | | | $T_A = 125^\circ\text{C}$ | - | - | 0.39 | |
| | | $I_F = 2.0 \text{ A}$ | $T_A = 25^\circ\text{C}$ | - | - | 0.6 | |
| | | | $T_A = 125^\circ\text{C}$ | - | - | 0.53 | |
| Voltage Rate of Change | dV/dt | $V_R = 20 \text{ V}$ | - | 10,000 | - | V/ μs | |

TYPICAL ELECTRICAL CHARACTERISTICS

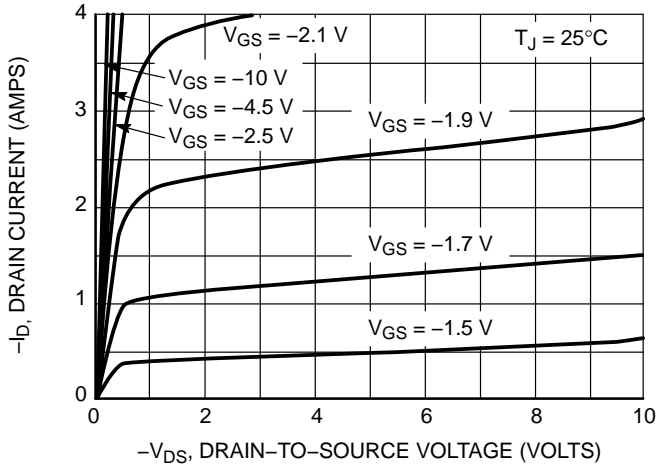


Figure 1. On-Region Characteristics

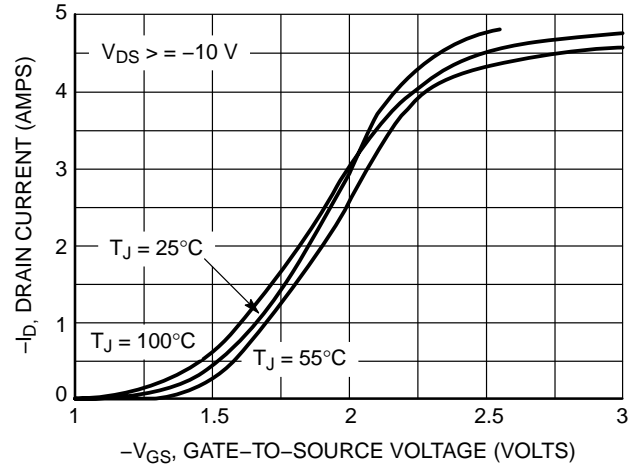


Figure 2. Transfer Characteristics

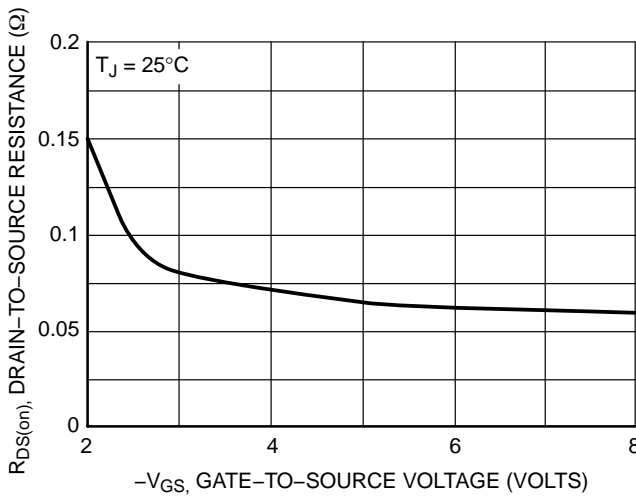


Figure 3. On-Resistance vs. Gate-to-Source Voltage

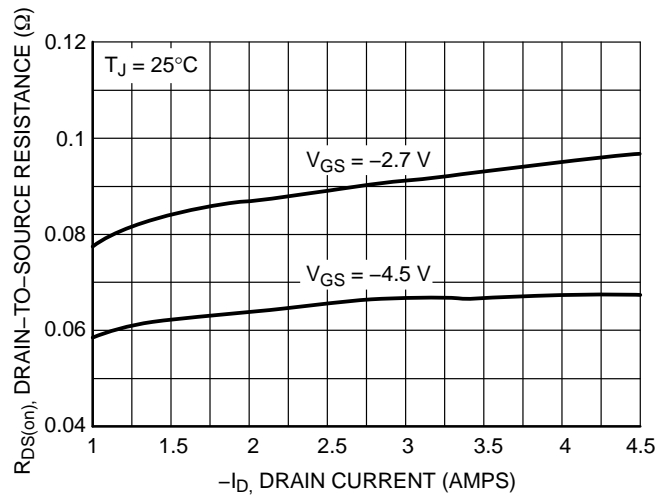


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

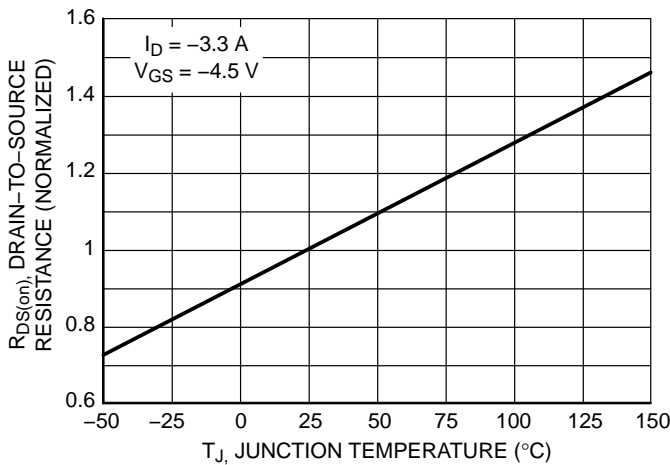


Figure 5. On-Resistance Variation with Temperature

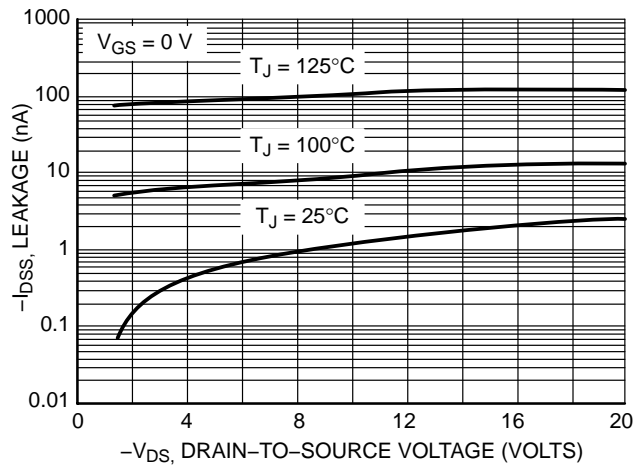


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

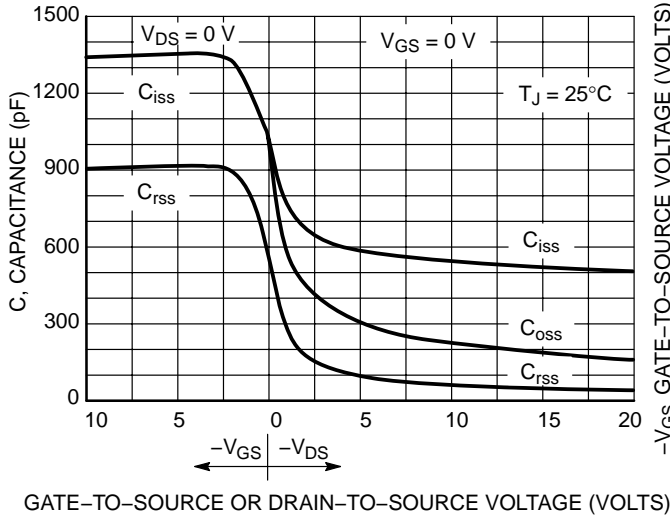


Figure 7. Capacitance Variation

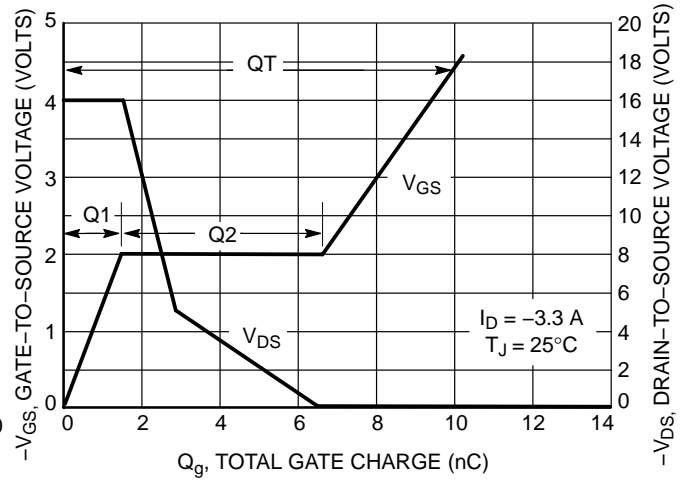


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

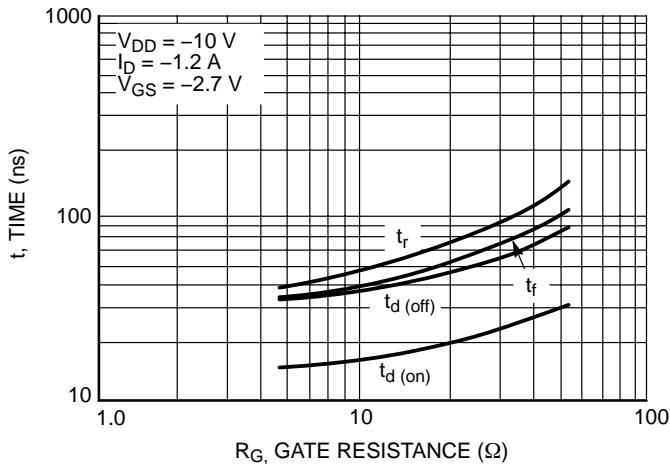


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

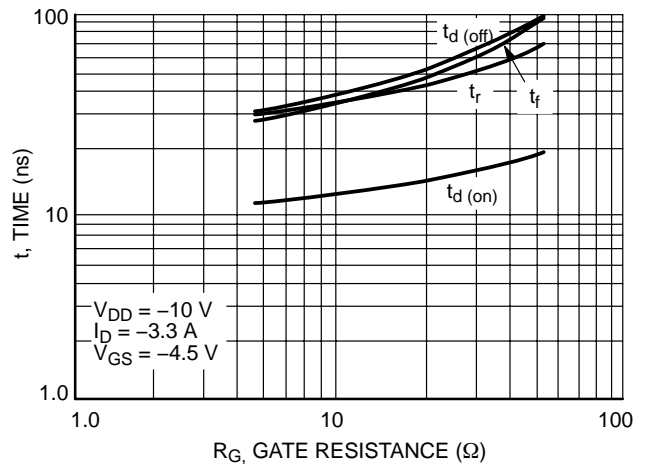


Figure 10. Resistive Switching Time Variation vs. Gate Resistance

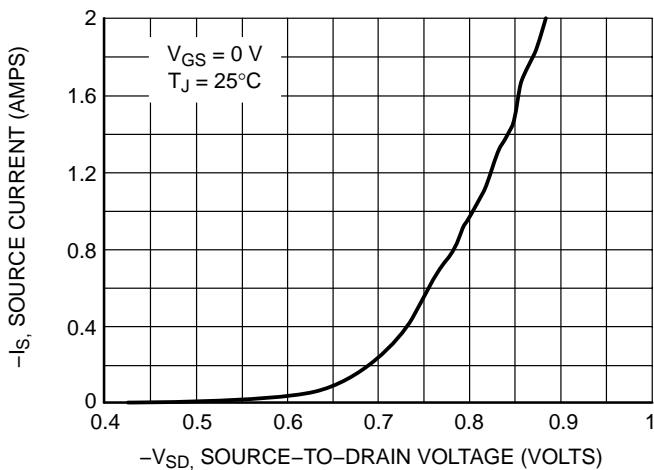


Figure 11. Diode Forward Voltage vs. Current

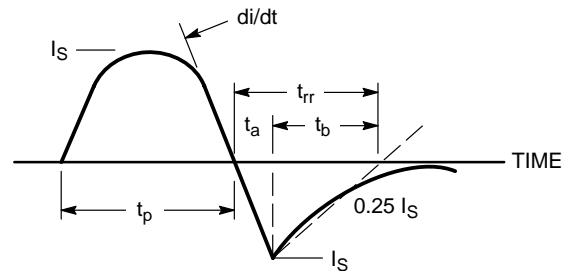


Figure 12. Diode Reverse Recovery Waveform

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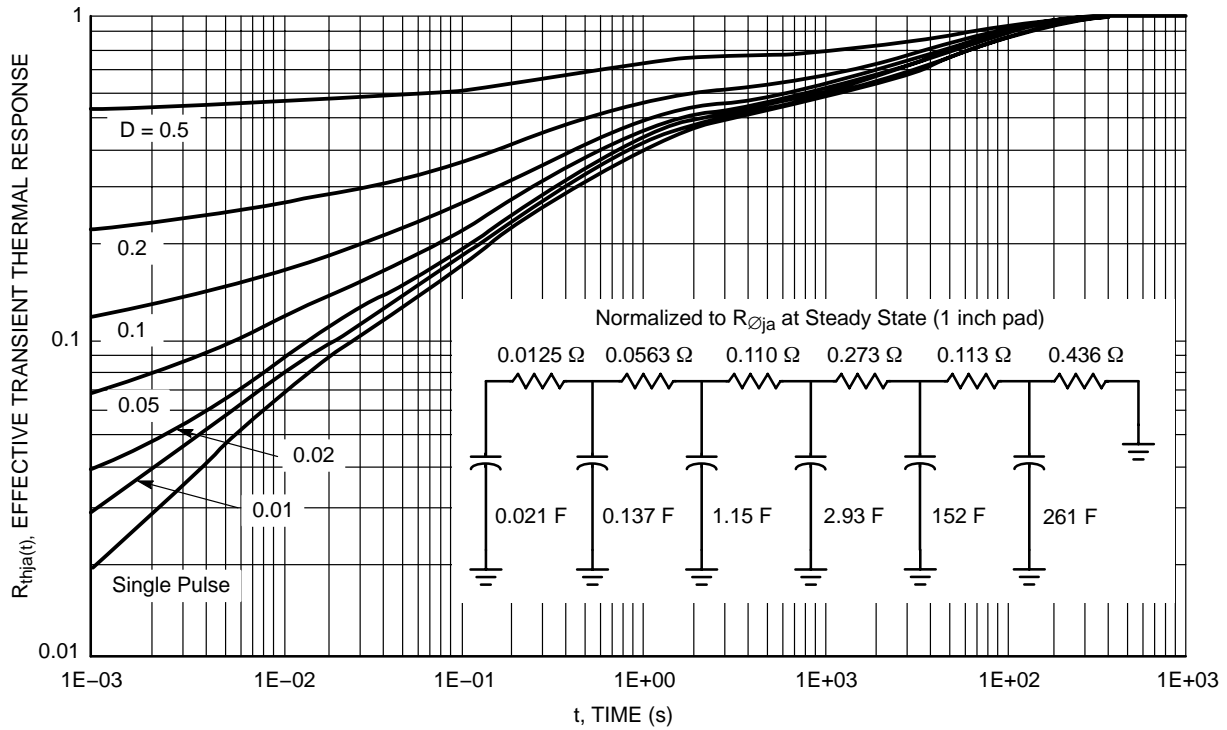


Figure 13. FET Thermal Response

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

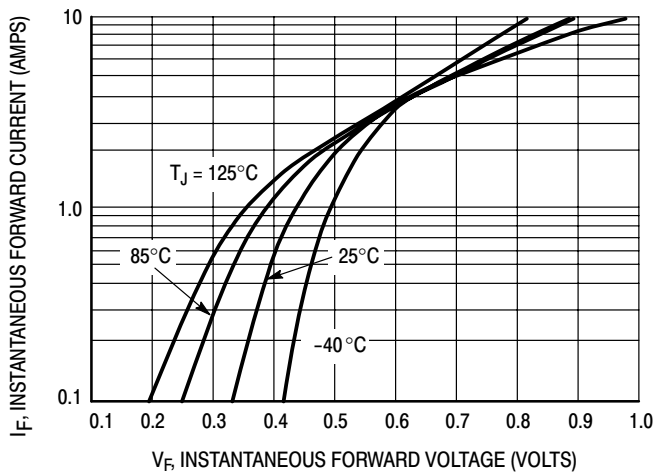


Figure 14. Typical Forward Voltage

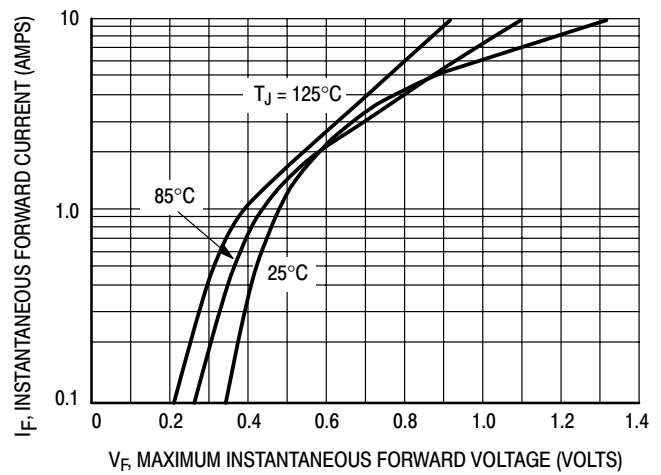


Figure 15. Maximum Forward Voltage

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

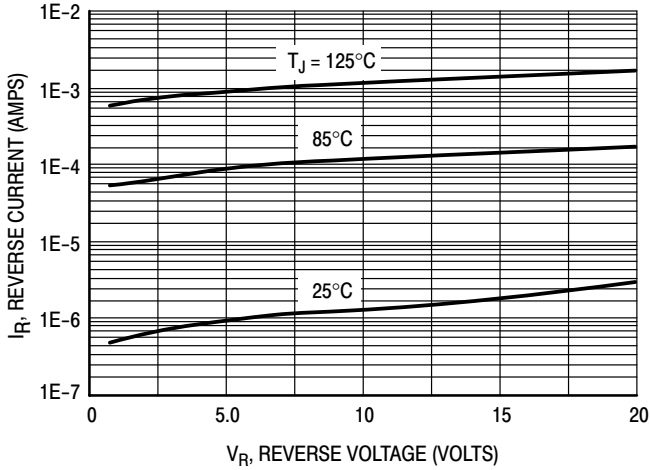


Figure 16. Typical Reverse Current

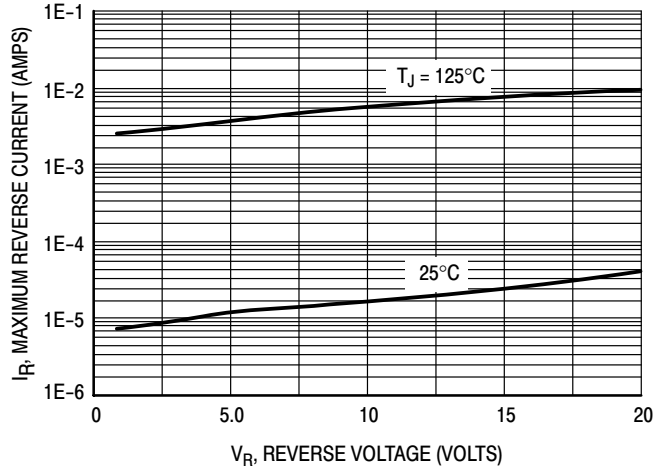


Figure 17. Maximum Reverse Current

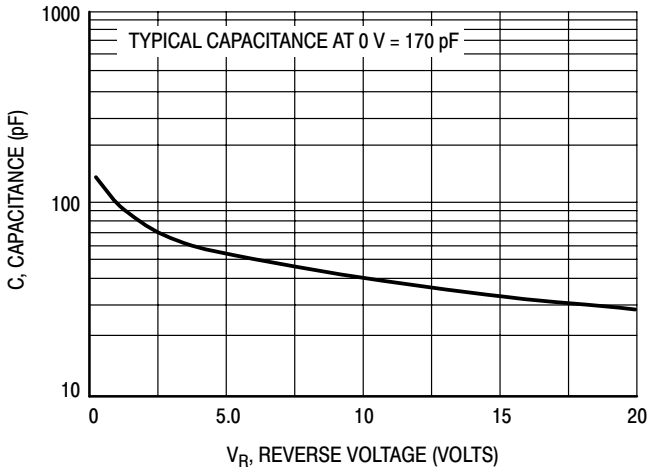


Figure 18. Typical Capacitance

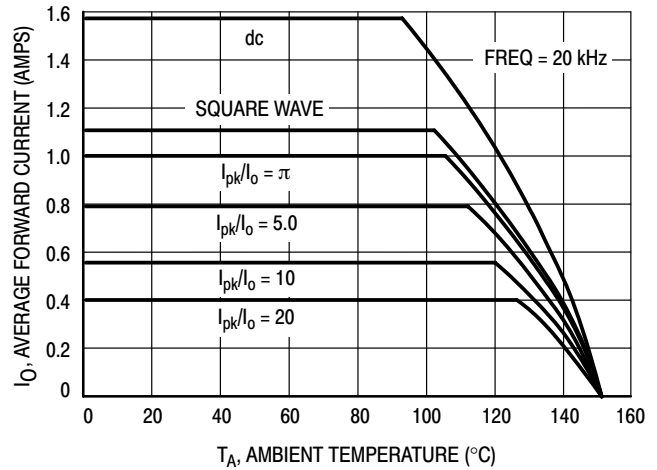


Figure 19. Current Derating

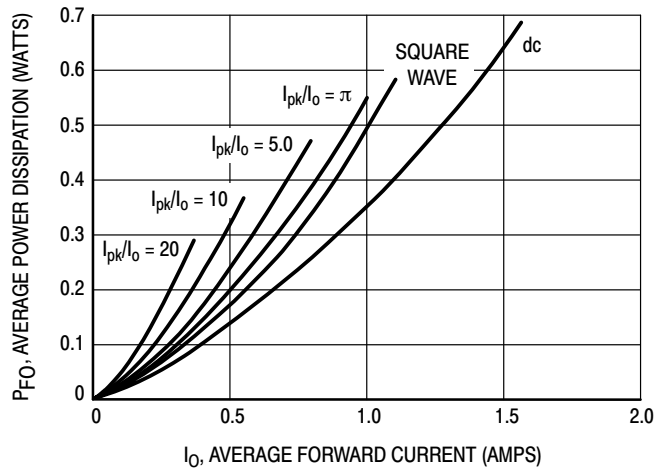
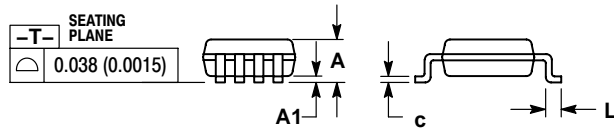
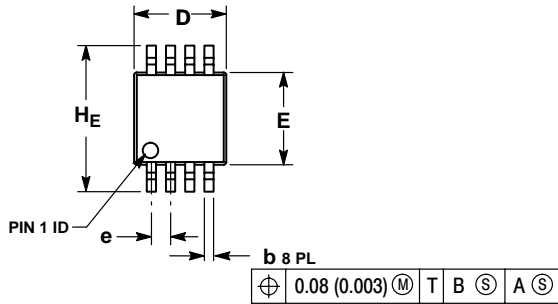


Figure 20. Forward Power Dissipation

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PACKAGE DIMENSIONS

Micro8™
CASE 846A-02
ISSUE G

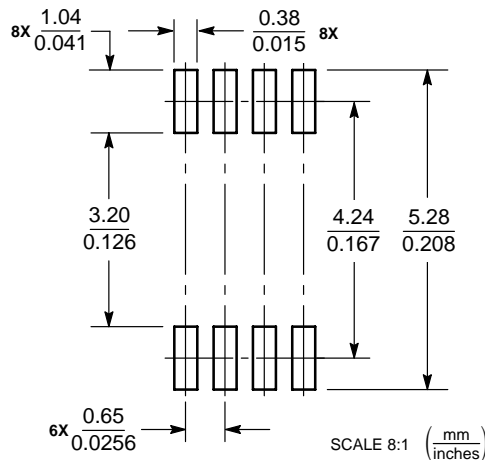


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846A-01 OBSOLETE, NEW STANDARD 846A-02.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 1.10 | --- | --- | 0.043 |
| A1 | 0.05 | 0.08 | 0.15 | 0.002 | 0.003 | 0.006 |
| b | 0.25 | 0.33 | 0.40 | 0.010 | 0.013 | 0.016 |
| c | 0.13 | 0.18 | 0.23 | 0.005 | 0.007 | 0.009 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.40 | 0.55 | 0.70 | 0.016 | 0.021 | 0.028 |
| HE | 4.75 | 4.90 | 5.05 | 0.187 | 0.193 | 0.199 |

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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