# MOSFET – Power, Single, N-Channel

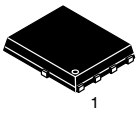
## 40 V, 270 A, 1.1 mΩ

# NTMFS5H409NL

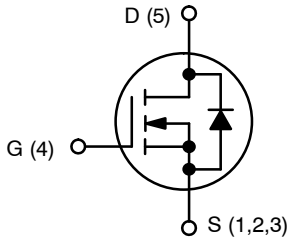
| $V_{(BR)DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 40 V | 1.1 mΩ @ 10 V | 270 A |
| | 1.6 mΩ @ 4.5 V | |

### Features

- Small Footprint (5x6 mm) for Compact Design
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low $Q_G$ and Capacitance to Minimize Driver Losses
- These Devices are Pb−Free and are RoHS Compliant




**DFN5**
**(SO−8FL)**
**CASE 488AA**
**STYLE 1**




**N−CHANNEL MOSFET**

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

| Symbol | Parameter | | | Value | Unit |
|---|---|---|---|---|---|
| $V_{DSS}$ | Drain−to−Source Voltage | | | 40 | V |
| $V_{GS}$ | Gate−to−Source Voltage | | | ±20 | V |
| $I_D$ | Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3) | Steady State | $T_C$ = 25°C | 270 | A |
| | | | $T_C$ = 100°C | 170 | |
| $P_D$ | Power Dissipation $R_{\theta JC}$ (Note 1) | | $T_C$ = 25°C | 140 | W |
| | | | $T_C$ = 100°C | 56 | |
| $I_D$ | Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3) | Steady State | $T_A$ = 25°C | 41 | A |
| | | | $T_A$ = 100°C | 26 | |
| $P_D$ | Power Dissipation $R_{\theta JA}$ (Notes 1, 2) | | $T_A$ = 25°C | 3.2 | W |
| | | | $T_A$ = 100°C | 1.3 | |
| $I_{DM}$ | Pulsed Drain Current | $T_A$ = 25°C, $t_p$ = 10 μs | | 900 | A |
| $T_J$, $T_{stg}$ | Operating Junction and Storage Temperature Range | | | −55 to +150 | °C |
| $I_S$ | Source Current (Body Diode) | | | 160 | A |
| $E_{AS}$ | Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 45 A) | | | 304 | mJ |
| $T_L$ | Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | | 260 | °C |

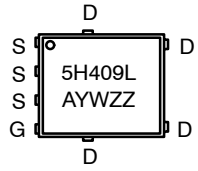
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL RESISTANCE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Junction−to−Case − Steady State | 0.9 | °C/W |
| $R_{\theta JA}$ | Junction−to−Ambient − Steady State (Note 2) | 39 | |

1. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.
2. Surface−mounted on FR4 board using a 650 $mm^2$, 2 oz. Cu pad.
3. Maximum current for pulses as long as 1 second is higher but is dependent on pulse duration and duty cycle.

### MARKING DIAGRAM




5H409L = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
ZZ = Lot Traceability

### ORDERING INFORMATION

See detailed ordering, marking and shipping information section on page 5 of this data sheet.

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

| Symbol | Parameter | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| $V_{(BR)DSS}$ | Drain−to−Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 40 | – | – | V |
| $V_{(BR)DSS}/T_J$ | Drain−to−Source Breakdown Voltage Temperature Coefficient | | | – | 19.1 | – | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0 V, $V_{DS}$ = 40 V | $T_J$ = 25 °C | – | – | 10 | μA |
| | | | $T_J$ = 125°C | – | – | 250 | |
| $I_{GSS}$ | Gate−to−Source Leakage Current | $V_{DS}$ = 0 V, $V_{GS}$ = 20 V | | – | | 100 | nA |
| **ON CHARACTERISTICS** (Note 4) | | | | | | | |
| $V_{GS(TH)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.2 | – | 2.0 | V |
| $V_{GS(TH)}/T_J$ | Threshold Temperature Coefficient | | | – | −4.8 | – | mV/°C |
| $R_{DS(on)}$ | Drain−to−Source On Resistance | $V_{GS}$ = 10 V | $I_D$ = 50 A | – | 0.85 | 1.1 | mΩ |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 50 A | – | 1.2 | 1.6 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 15 V, $I_D$ = 50 A | | – | 300 | – | S |
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 20 V | | – | 5700 | – | pF |
| $C_{OSS}$ | Output Capacitance | | | – | 1400 | – | |
| $C_{RSS}$ | Reverse Transfer Capacitance | | | – | 73 | – | |
| $Q_{G(TOT)}$ | Total Gate Charge | $V_{GS}$ = 4.5 V, $V_{DS}$ = 20 V; $I_D$ = 50 A | | – | 41 | – | nC |
| $Q_{G(TOT)}$ | Total Gate Charge | $V_{GS}$ = 10 V, $V_{DS}$ = 20 V; $I_D$ = 50 A | | – | 89 | – | |
| $Q_{G(TH)}$ | Threshold Gate Charge | $V_{GS}$ = 4.5 V, $V_{DS}$ = 20 V; $I_D$ = 50 A | | – | 8.6 | – | |
| $Q_{GS}$ | Gate−to−Source Charge | | | – | 15 | – | |
| $Q_{GD}$ | Gate−to−Drain Charge | | | – | 10 | – | |
| $V_{GP}$ | Plateau Voltage | | | – | 2.8 | – | V |
| $Q_{OSS}$ | Output Charge | $V_{GS}$ = 0 V, $V_{DS}$ = 20 V | | – | 62 | – | nC |
| **SWITCHING CHARACTERISTICS** (Note 5) | | | | | | | |
| $t_{d(ON)}$ | Turn−On Delay Time | $V_{GS}$ = 4.5 V, $V_{DS}$ = 20 V, $I_D$ = 50 A, $R_G$ = 2.5 Ω | | – | 17 | – | ns |
| $t_r$ | Rise Time | | | – | 130 | – | |
| $t_{d(OFF)}$ | Turn−Off Delay Time | | | – | 40 | – | |
| $t_f$ | Fall Time | | | – | 14 | – | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| $V_{SD}$ | Forward Diode Voltage | $V_{GS}$ = 0 V, $I_S$ = 50 A | $T_J$ = 25°C | – | 0.79 | 1.2 | V |
| | | | $T_J$ = 125°C | – | 0.64 | – | |
| $t_{RR}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $dI_S/dt$ = 100 A/μs, $I_S$ = 50 A | | – | 59 | – | ns |
| $t_a$ | Charge Time | | | – | 31 | – | |
| $t_b$ | Discharge Time | | | – | 28 | – | |
| $Q_{RR}$ | Reverse Recovery Charge | | | – | 80 | – | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
5. Switching characteristics are independent of operating junction temperatures.

## TYPICAL CHARACTERISTICS

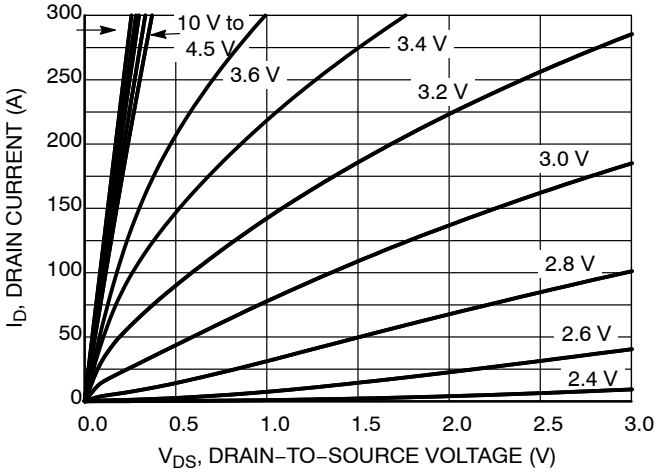



**Figure 1. On−Region Characteristics**

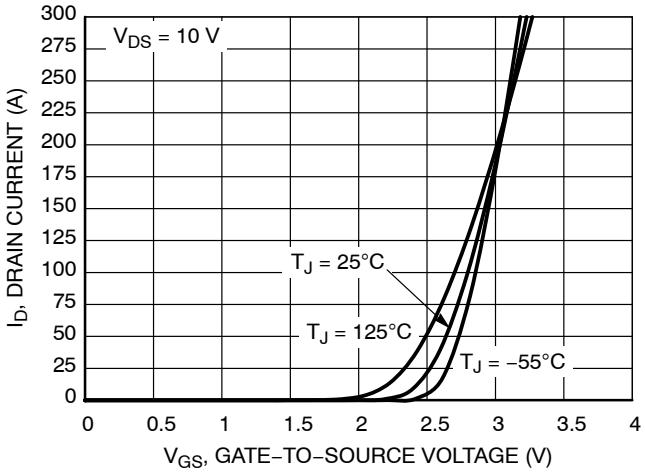



**Figure 2. Transfer Characteristics**

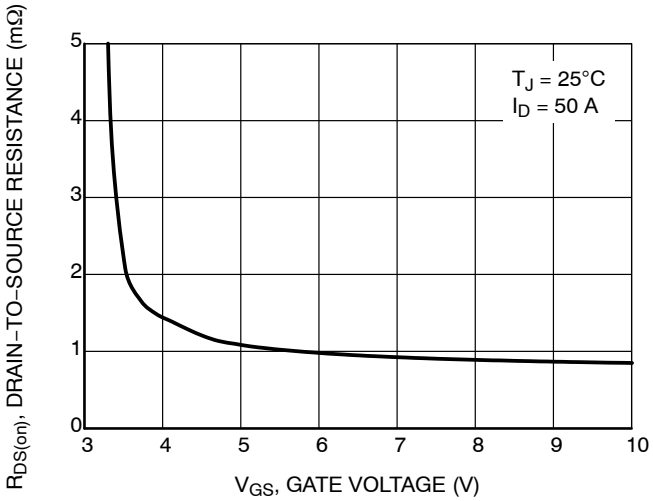



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

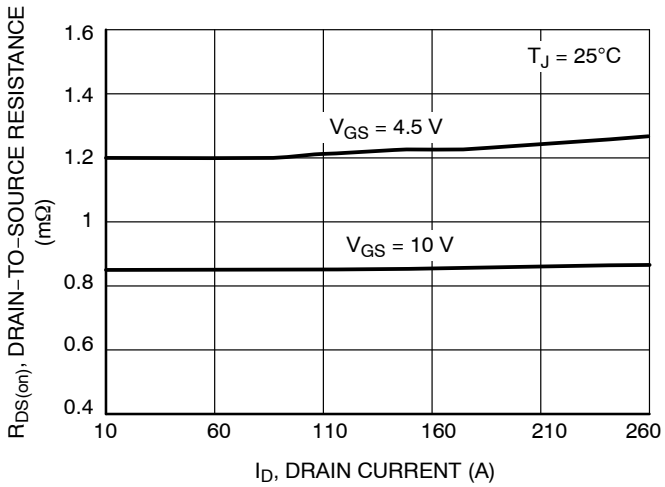



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

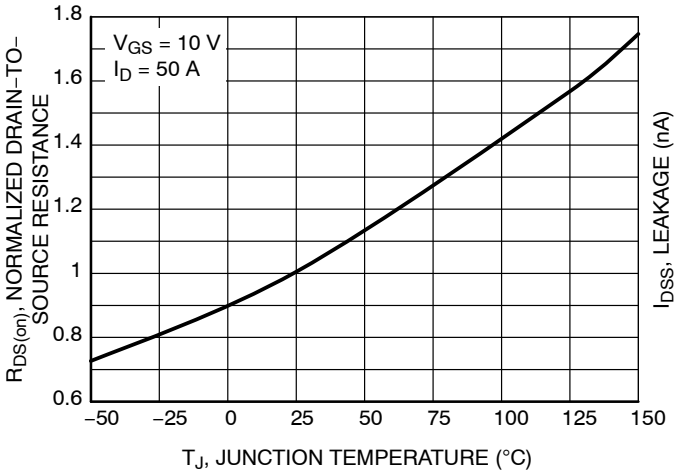



**Figure 5. On−Resistance Variation with Temperature**

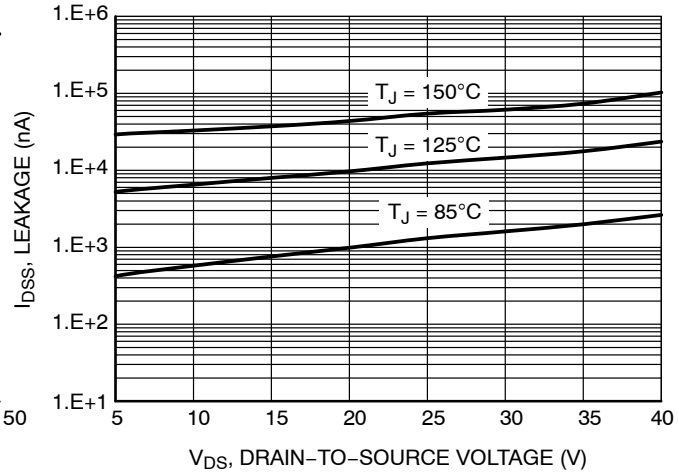



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

## TYPICAL CHARACTERISTICS (continued)

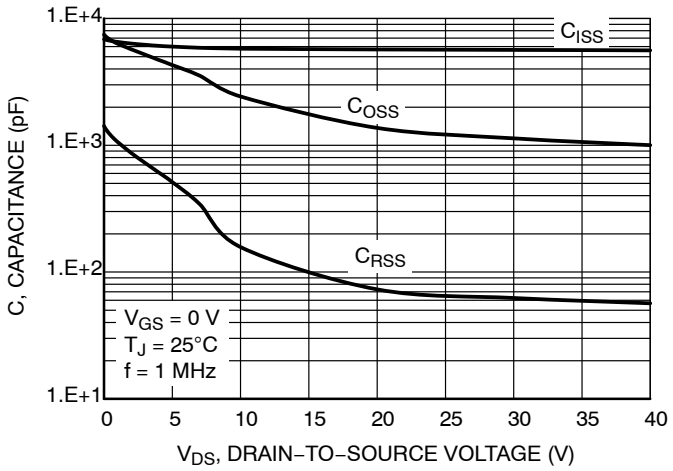



**Figure 7. Capacitance Variation**

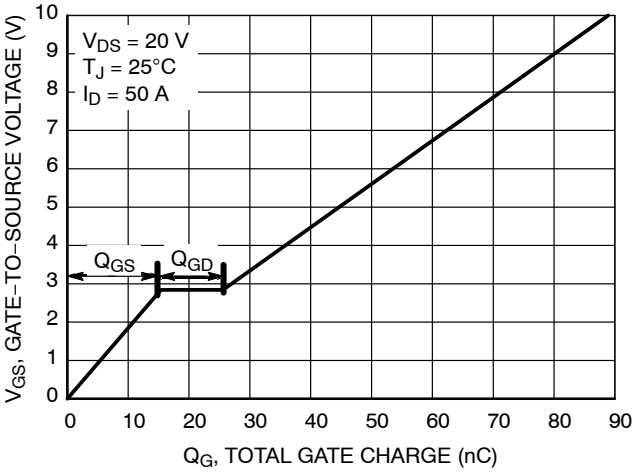



**Figure 8. Gate−to−Source vs. Total Charge**

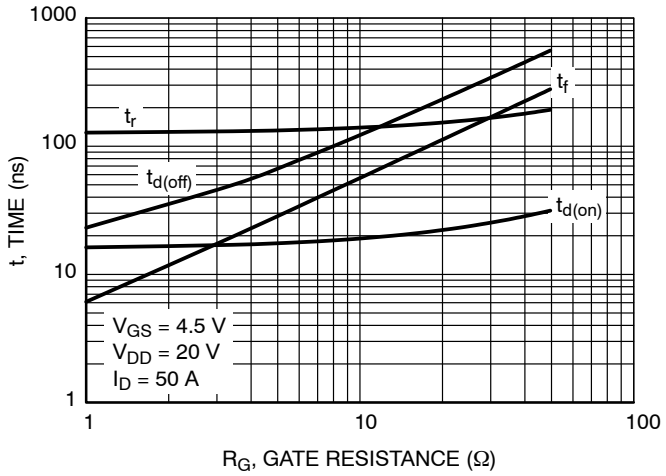



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

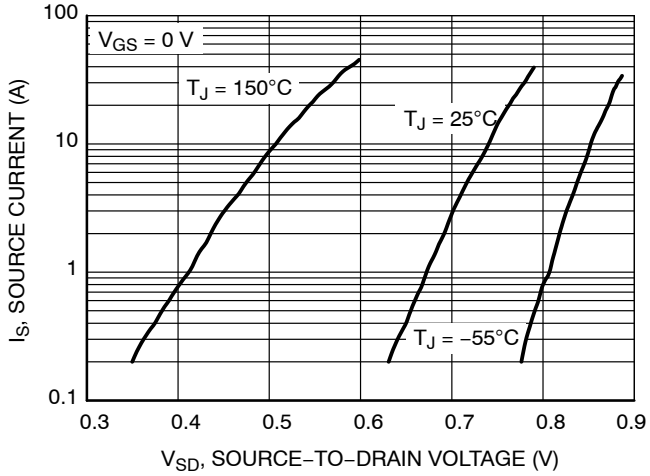



**Figure 10. Diode Forward Voltage vs. Current**

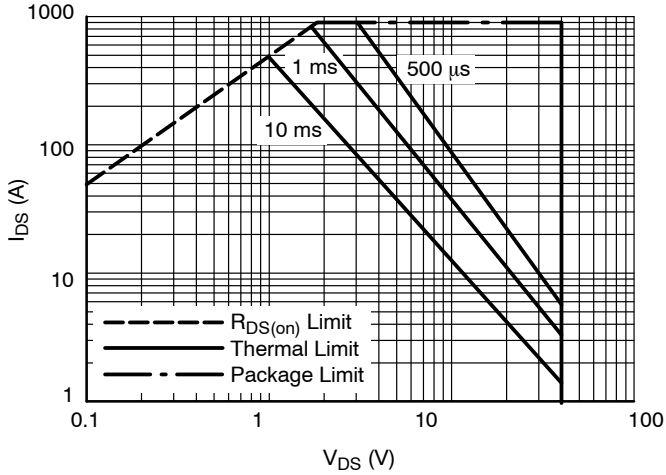



**Figure 11. Safe Operating Area**

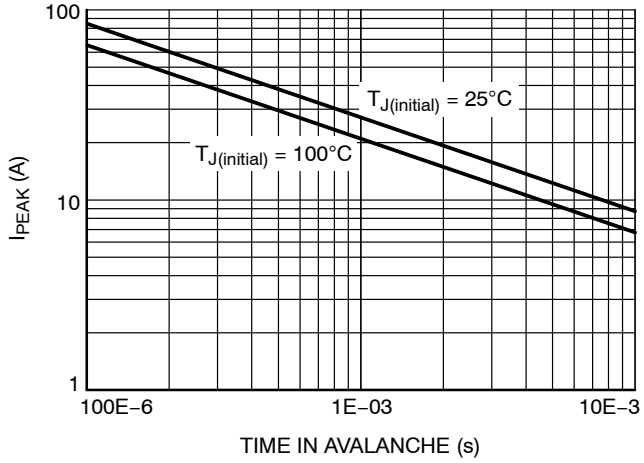



**Figure 12. $I_{PEAK}$ vs. Time in Avalanche**

## TYPICAL CHARACTERISTICS (continued)

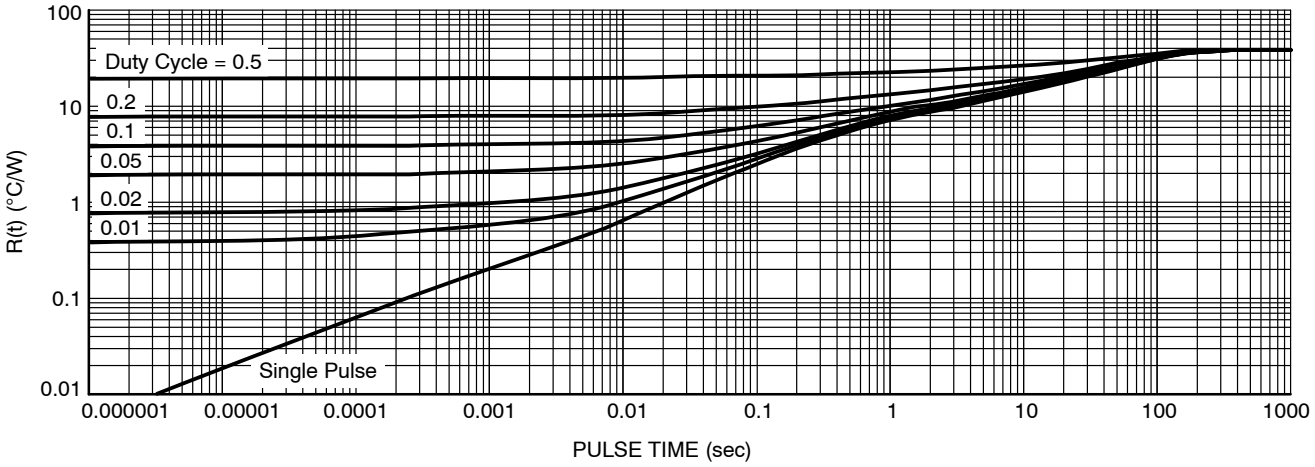
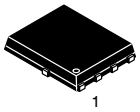



**Figure 13. Transient Thermal Impedance**

### DEVICE ORDERING INFORMATION

| Device | Marking | Package | Shipping† |
|---|---|---|---|
| NTMFS5H409NLT1G | 5H409L | DFN5<br>(Pb−Free) | 1,500 / Tape & Reel |
| NTMFS5H409NLT3G | 5H409L | DFN5<br>(Pb−Free) | 5,000 / Tape & Reel |

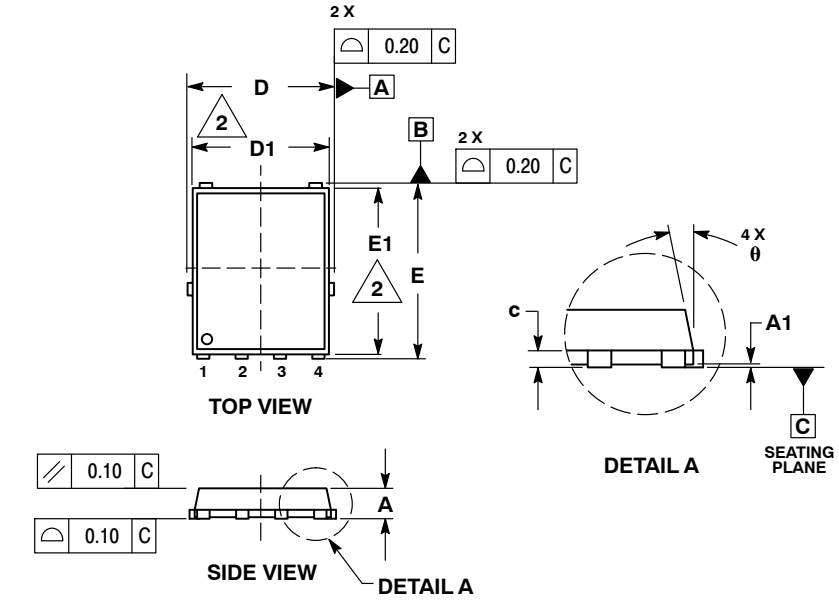
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



**SCALE 2:1**

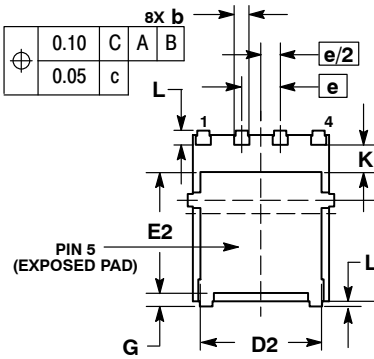
**DFN5 5x6, 1.27P**
**(SO−8FL)**
CASE 488AA
ISSUE N

DATE 25 JUN 2018

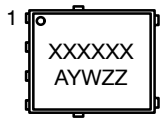



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| | MILLIMETERS | | |
|---|---|---|---|
| DIM | MIN | NOM | MAX |
| A | 0.90 | 1.00 | 1.10 |
| A1 | 0.00 | ––– | 0.05 |
| b | 0.33 | 0.41 | 0.51 |
| c | 0.23 | 0.28 | 0.33 |
| D | 5.00 | 5.15 | 5.30 |
| D1 | 4.70 | 4.90 | 5.10 |
| D2 | 3.80 | 4.00 | 4.20 |
| E | 6.00 | 6.15 | 6.30 |
| E1 | 5.70 | 5.90 | 6.10 |
| E2 | 3.45 | 3.65 | 3.85 |
| e | 1.27 BSC | | |
| G | 0.51 | 0.575 | 0.71 |
| K | 1.20 | 1.35 | 1.50 |
| L | 0.51 | 0.575 | 0.71 |
| L1 | 0.125 REF | | |
| M | 3.00 | 3.40 | 3.80 |
| θ | 0 ° | ––– | 12 ° |



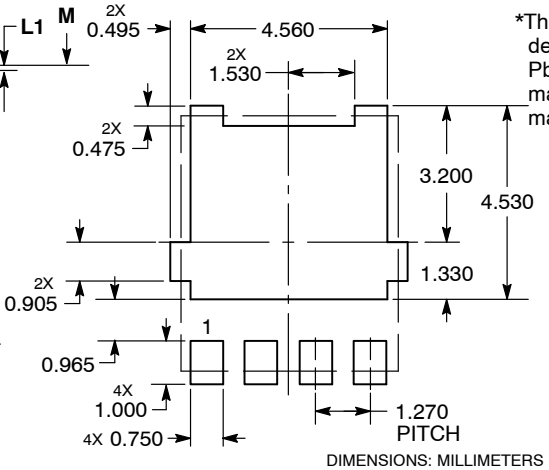

**GENERIC MARKING DIAGRAM***




XXXXXX = Specific Device Code
A = Assembly Location
Y = Year
W = Work Week
ZZ = Lot Traceability

*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. Some products may not follow the Generic Marking.

**RECOMMENDED SOLDERING FOOTPRINT***




DIMENSIONS: MILLIMETERS

STYLE 1:
PIN 1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN

STYLE 2:
PIN 1. ANODE
2. ANODE
3. ANODE
4. NO CONNECT
5. CATHODE

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

| | | | |
|---|---|---|---|
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| **DESCRIPTION:** | **DFN5 5x6, 1.27P (SO−8FL)** | | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

**TECHNICAL PUBLICATIONS**:
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