Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

# NVMFS5C646NL

# Power MOSFET

## 60 V, 4.7 mΩ, 93 A, Single N−Channel

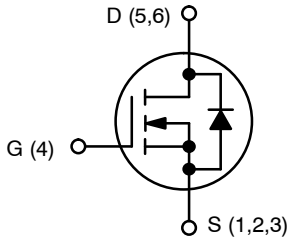
### Features

- Small Footprint (5x6 mm) for Compact Design
- Low $R_{DS(on)}$ to Minimize Conduction Losses
- Low $Q_G$ and Capacitance to Minimize Driver Losses
- NVMFS5C646NLWF − Wettable Flank Option for Enhanced Optical Inspection
- AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

**ON Semiconductor®**

www.onsemi.com

| $V_{(BR)DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 60 V | 4.7 mΩ @ 10 V | 93 A |
| | 6.3 mΩ @ 4.5 V | |




**N−CHANNEL MOSFET**

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

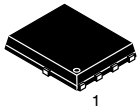
| Parameter | | | Symbol | Value | Unit |
|---|---|---|---|---|---|
| Drain−to−Source Voltage | | | $V_{DSS}$ | 60 | V |
| Gate−to−Source Voltage | | | $V_{GS}$ | ±20 | V |
| Continuous Drain Current $R_{\theta JC}$ (Notes 1, 3) | Steady State | $T_C$ = 25°C | $I_D$ | 93 | A |
| | | $T_C$ = 100°C | | 65 | |
| Power Dissipation $R_{\theta JC}$ (Note 1) | | $T_C$ = 25°C | $P_D$ | 79 | W |
| | | $T_C$ = 100°C | | 40 | |
| Continuous Drain Current $R_{\theta JA}$ (Notes 1, 2, 3) | Steady State | $T_A$ = 25°C | $I_D$ | 20 | A |
| | | $T_A$ = 100°C | | 14 | |
| Power Dissipation $R_{\theta JA}$ (Notes 1 & 2) | | $T_A$ = 25°C | $P_D$ | 3.7 | W |
| | | $T_A$ = 100°C | | 1.8 | |
| Pulsed Drain Current | $T_A$ = 25°C, $t_p$ = 10 μs | | $I_{DM}$ | 750 | A |
| Operating Junction and Storage Temperature | | | $T_J$, $T_{stg}$ | −55 to +175 | °C |
| Source Current (Body Diode) | | | $I_S$ | 100 | A |
| Single Pulse Drain−to−Source Avalanche Energy ($I_{L(pk)}$ = 5 A) | | | $E_{AS}$ | 185 | mJ |
| Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | | $T_L$ | 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**

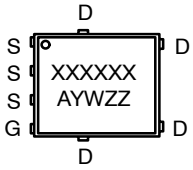
| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction−to−Case − Steady State | $R_{\theta JC}$ | 1.9 | °C/W |
| Junction−to−Ambient − Steady State (Note 2) | $R_{\theta JA}$ | 41 | |

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.




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

**MARKING DIAGRAM**




XXXXXX = 5C646L
(NVMFS5C646NL) or
646LWF
(NVMFS5C646NLWF)
A = Assembly Location
Y = Year
W = Work Week
ZZ = Lot Traceability

**ORDERING INFORMATION**

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

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

| Parameter | Symbol | Test Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain−to−Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 60 | | | V |
| Drain−to−Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 15.5 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 60 V | $T_J$ = 25 °C | | | 10 | μA |
| | | | $T_J$ = 125°C | | | 250 | |
| Gate−to−Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±16 V | | | | ±100 | nA |
| **ON CHARACTERISTICS** (Note 4) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.2 | | 2.0 | V |
| Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | −4.9 | | mV/°C |
| Drain−to−Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 50 A | | 3.8 | 4.7 | mΩ |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 50 A | | 5.0 | 6.3 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 15 V, $I_D$ = 50 A | | | 105 | | S |
| **CHARGES, CAPACITANCES & GATE RESISTANCE** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 25 V | | | 2164 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 900 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 17 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 30 V; $I_D$ = 25 A | | | 15.7 | | nC |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 10 V, $V_{DS}$ = 30 V; $I_D$ = 25 A | | | 33.7 | | |
| Threshold Gate Charge | $Q_{G(TH)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 30 V; $I_D$ = 25 A | | | 1.5 | | |
| Gate−to−Source Charge | $Q_{GS}$ | | | | 5.6 | | |
| Gate−to−Drain Charge | $Q_{GD}$ | | | | 5.1 | | |
| Plateau Voltage | $V_{GP}$ | | | | 2.8 | | V |
| **SWITCHING CHARACTERISTICS** (Note 5) | | | | | | | |
| Turn−On Delay Time | $t_{d(ON)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 30 V, $I_D$ = 25 A, $R_G$ = 2.5 Ω | | | 10.4 | | ns |
| Rise Time | $t_r$ | | | | 14.9 | | |
| Turn−Off Delay Time | $t_{d(OFF)}$ | | | | 23.6 | | |
| Fall Time | $t_f$ | | | | 5.1 | | |
| **DRAIN−SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 50 A | $T_J$ = 25°C | | 0.88 | 1.2 | V |
| | | | $T_J$ = 125°C | | 0.78 | | |
| Reverse Recovery Time | $t_{RR}$ | $V_{GS}$ = 0 V, dIS/dt = 100 A/μs, $I_S$ = 50 A | | | 40.9 | | ns |
| Charge Time | $t_a$ | | | | 20.8 | | |
| Discharge Time | $t_b$ | | | | 20.1 | | |
| Reverse Recovery Charge | $Q_{RR}$ | | | | 32 | | nC |

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

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.

## TYPICAL CHARACTERISTICS

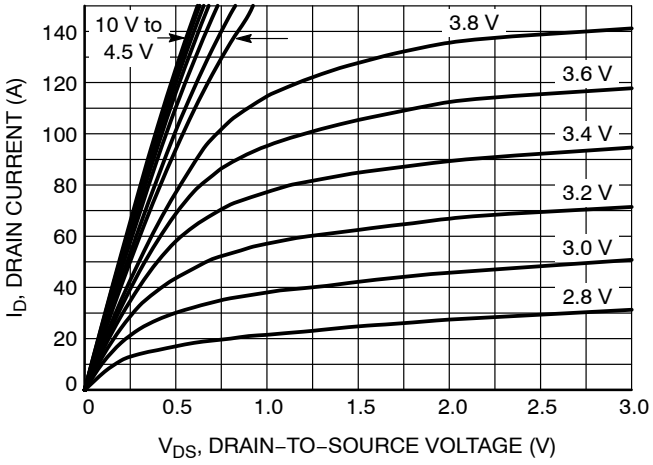



**Figure 1. On−Region Characteristics**

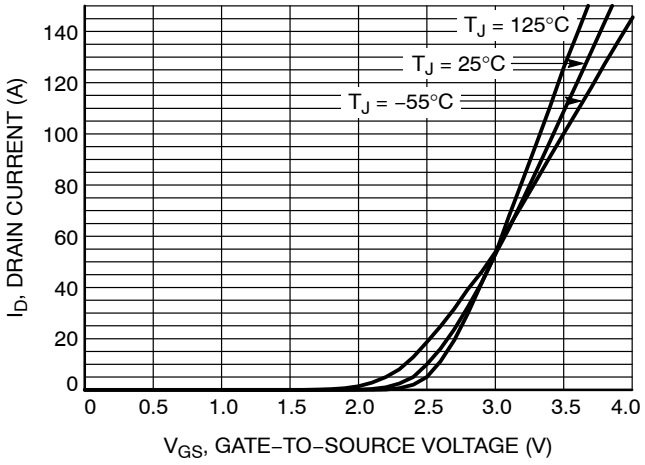



**Figure 2. Transfer Characteristics**

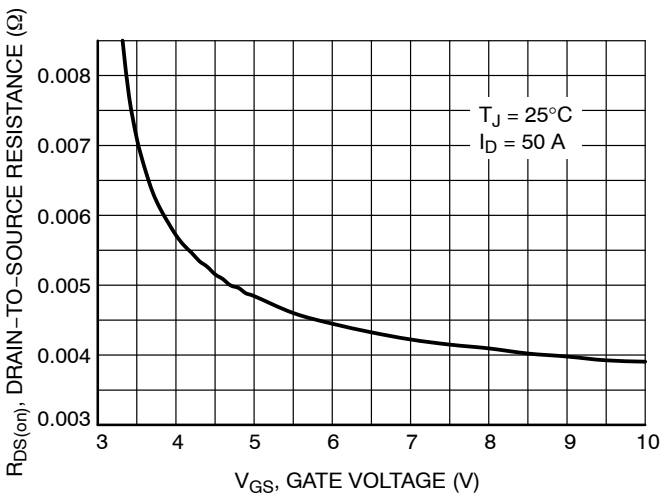



**Figure 3. On−Resistance vs. Gate−to−Source Voltage**

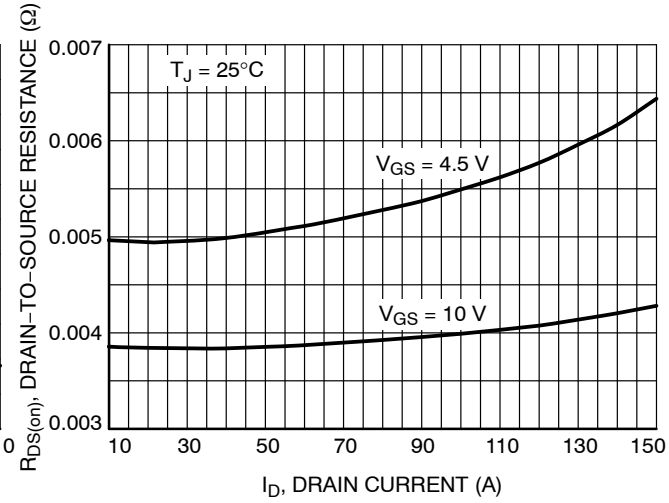



**Figure 4. On−Resistance vs. Drain Current and Gate Voltage**

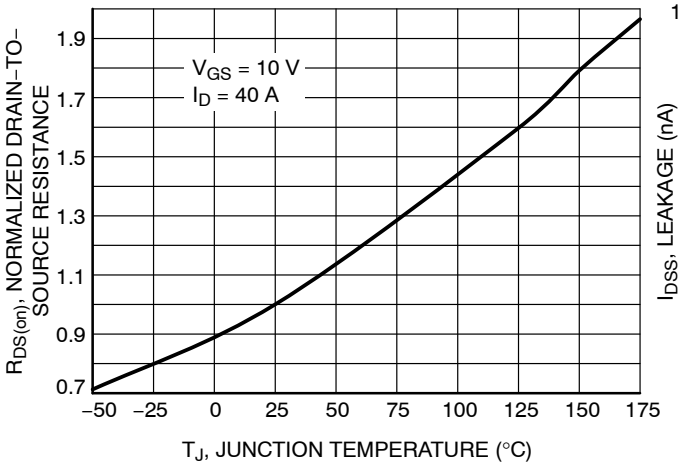



**Figure 5. On−Resistance Variation with Temperature**

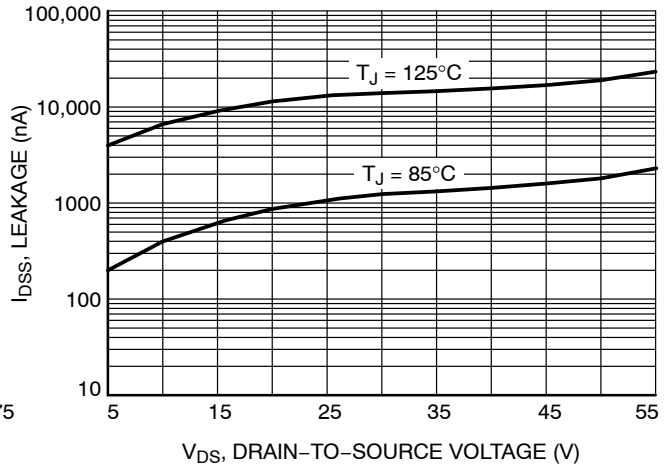



**Figure 6. Drain−to−Source Leakage Current vs. Voltage**

## TYPICAL CHARACTERISTICS

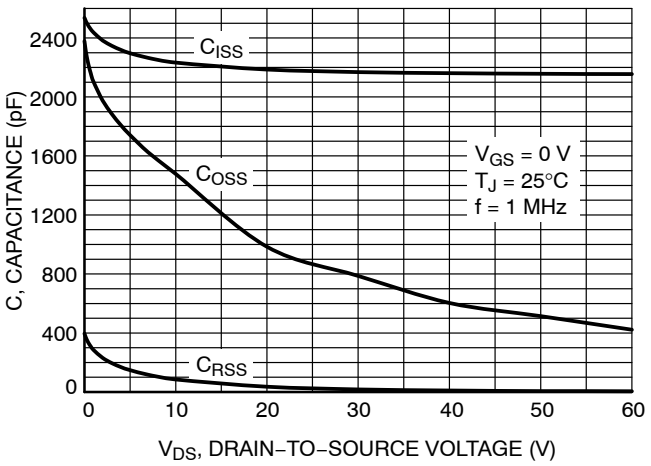



**Figure 7. Capacitance Variation**

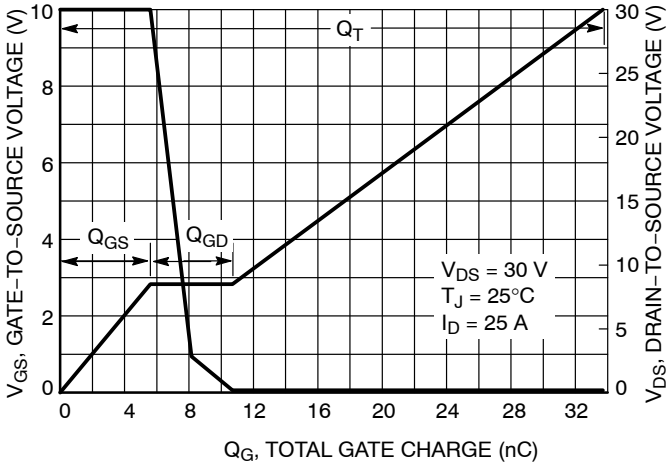



**Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge**

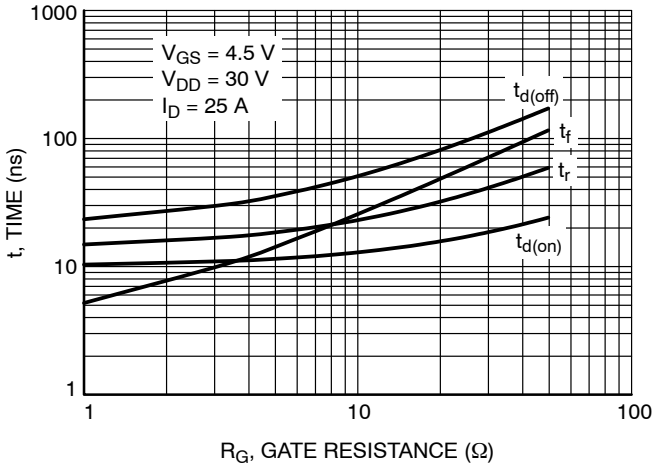



**Figure 9. Resistive Switching Time Variation vs. Gate Resistance**

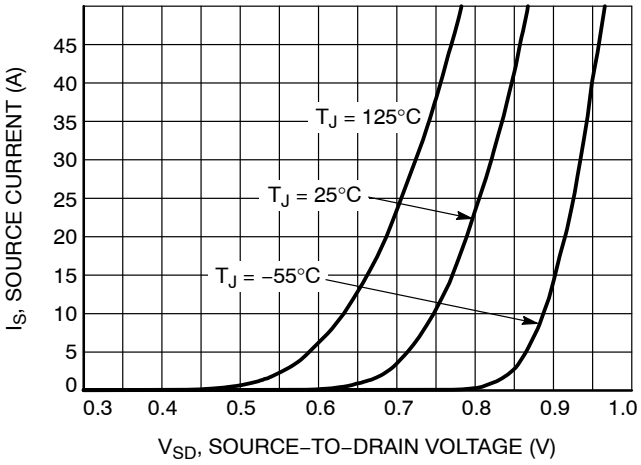



**Figure 10. Diode Forward Voltage vs. Current**

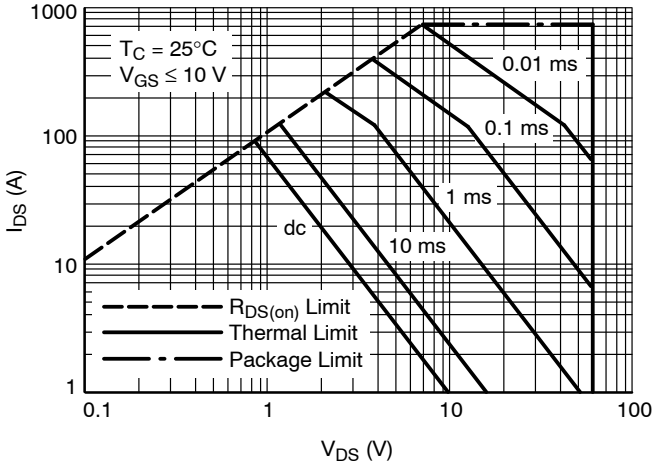



**Figure 11. Safe Operating Area**

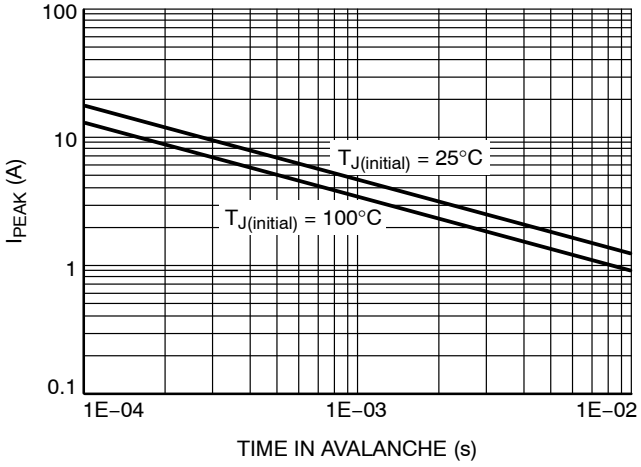



**Figure 12. $I_{PEAK}$ vs. Time in Avalanche**

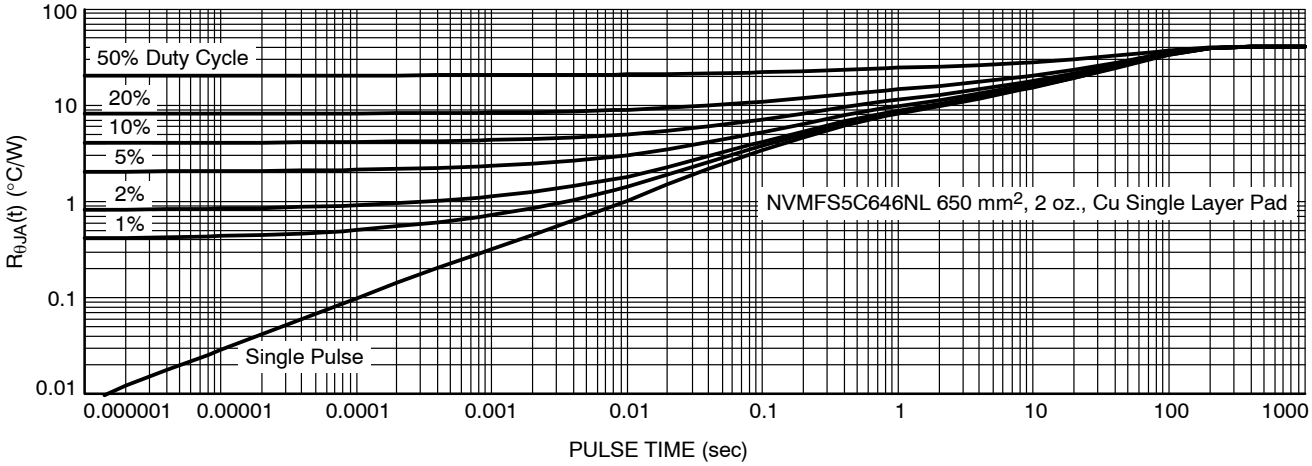



**Figure 13. Thermal Characteristics**

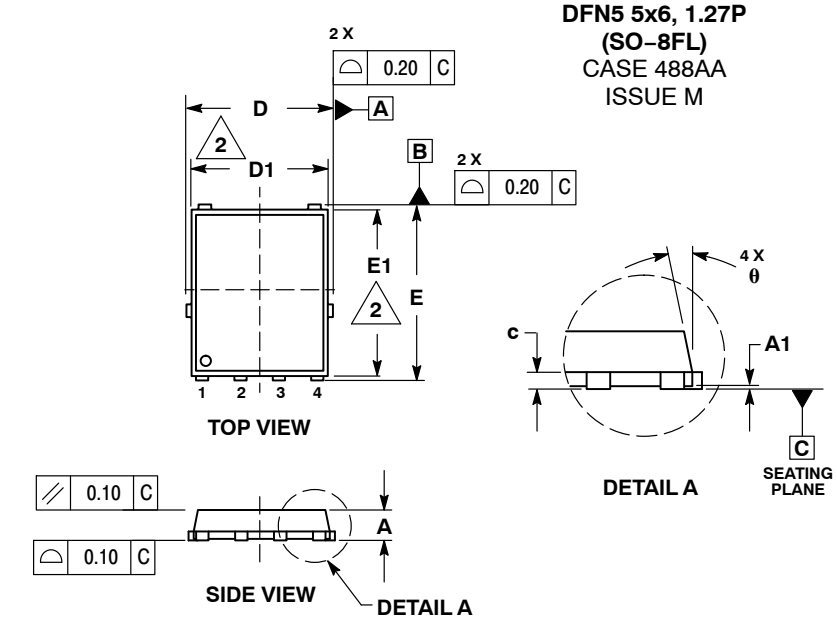
## DEVICE ORDERING INFORMATION

| Device | Marking | Package | Shipping† |
|---|---|---|---|
| NVMFS5C646NLT1G | 5C646L | DFN5 (Pb−Free) | 1500 / Tape & Reel |
| NVMFS5C646NLWFT1G | 646LWF | DFN5 (Pb−Free, Wettable Flanks) | 1500 / Tape & Reel |
| NVMFS5C646NLT3G | 5C646L | DFN5 (Pb−Free) | 5000 / Tape & Reel |
| NVMFS5C646NLWFT3G | 646LWF | DFN5 (Pb−Free, Wettable Flanks) | 5000 / Tape & Reel |
| NVMFS5C646NLAFT1G | 5C646L | DFN5 (Pb−Free) | 1500 / Tape & Reel |
| NVMFS5C646NLWFAFT1G | 646LWF | DFN5 (Pb−Free, Wettable Flanks) | 1500 / 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.

## PACKAGE DIMENSIONS

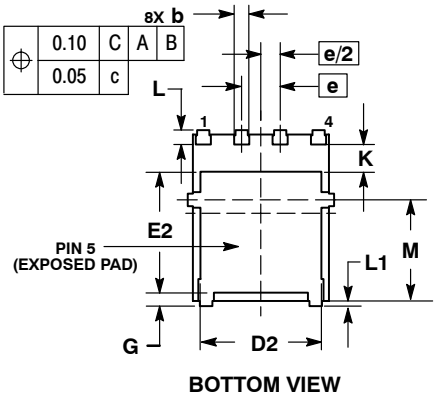
**DFN5 5x6, 1.27P**
**(SO−8FL)**
CASE 488AA
ISSUE M



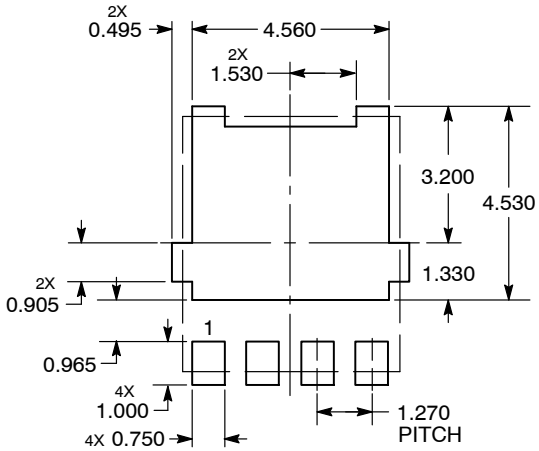

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| | 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 ° |

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




**RECOMMENDED SOLDERING FOOTPRINT***




DIMENSIONS: MILLIMETERS

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



## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
**Phone**: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
**Fax**: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
**Email**: orderlit@onsemi.com

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
**Europe, Middle East and Africa Technical Support:**
Phone: 421 33 790 2910
**Japan Customer Focus Center**
Phone: 81−3−5817−1050

**ON Semiconductor Website**: **www.onsemi.com**

**Order Literature**: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative