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MOSFET – Power, Single, N-Channel

60 V, 4.7 mΩ, 93 A

NTMFS5C646NL

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, Halogen Free/BFR Free and are RoHS Compliant

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ 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 _{θJC} (Notes 1, 3) | Steady State | T _C = 25°C | I _D | 93 | A |
| | | T _C = 100°C | | 65 | |
| Power Dissipation R _{θJC} (Note 1) | | T _C = 25°C | P _D | 79 | W |
| | | T _C = 100°C | | 40 | |
| Continuous Drain Current R _{θJA} (Notes 1, 2, 3) | Steady State | T _A = 25°C | I _D | 20 | A |
| | | T _A = 100°C | | 14 | |
| Power Dissipation R _{θJA} (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 |

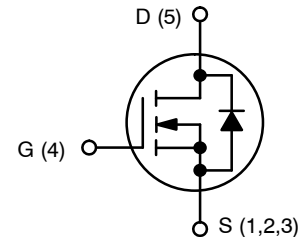
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

THERMAL RESISTANCE MAXIMUM RATINGS

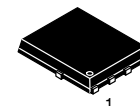
| Parameter | Symbol | Value | Unit |
|---|-----------------|-------|--------------------|
| Junction-to-Case – Steady State | $R_{\theta JC}$ | 1.9 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 41 | |

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 mm², 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.

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

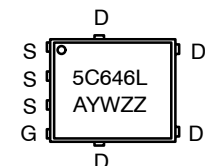


N-CHANNEL MOSFET



DFN5
(SO-8FL)
CASE 488AA
STYLE 1

MARKING DIAGRAM



5C646L = Specific Device Code
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.

NOTE: Some of the device on this data sheet have been **DISCONTINUED**. Please refer to the table on page 5.

NTMFS5C646NL

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

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

OFF CHARACTERISTICS

| | | | | | | |
|---|-------------------|---|----------------------------------|------|-----|----------------------|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 60 | | | V |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | 15.5 | | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{GS} = 0\text{ V}, V_{DS} = 60\text{ V}$ | $T_J = 25\text{ }^\circ\text{C}$ | | 10 | μA |
| | | | $T_J = 125^\circ\text{C}$ | | 250 | |
| Gate-to-Source Leakage Current | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$ | | | 100 | nA |

ON CHARACTERISTICS (Note 4)

| | | | | | | |
|-----------------------------------|------------------|--|-----|------|-----|----------------------|
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = 80\text{ }\mu\text{A}$ | 1.2 | | 2.0 | V |
| Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | -4.9 | | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}, I_D = 50\text{ A}$ | | 3.8 | 4.7 | $\text{m}\Omega$ |
| | | $V_{GS} = 4.5\text{ V}, I_D = 50\text{ A}$ | | 5.0 | 6.3 | |
| Forward Transconductance | g_{FS} | $V_{DS} = 15\text{ V}, I_D = 50\text{ A}$ | | 105 | | S |

CHARGES, CAPACITANCES & GATE RESISTANCE

| | | | | | | |
|------------------------------|--------------|--|--|------|--|-------------|
| Input Capacitance | C_{ISS} | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 25\text{ V}$ | | 2164 | | pF |
| Output Capacitance | C_{OSS} | | | 900 | | |
| Reverse Transfer Capacitance | C_{RSS} | | | 17 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}; I_D = 25\text{ A}$ | | 15.7 | | nC |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 30\text{ V}; I_D = 25\text{ A}$ | | 33.7 | | |
| Threshold Gate Charge | $Q_{G(TH)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}; I_D = 25\text{ A}$ | | 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 | $t_{d(ON)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 30\text{ V}, I_D = 25\text{ A}, R_G = 2.5\text{ }\Omega$ | | 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} | $V_{GS} = 0\text{ V}, I_S = 50\text{ A}$ | $T_J = 25^\circ\text{C}$ | | 0.88 | 1.2 | V |
| | | | $T_J = 125^\circ\text{C}$ | | 0.78 | | |
| Reverse Recovery Time | t_{RR} | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = 50\text{ A}$ | | | 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 $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.

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

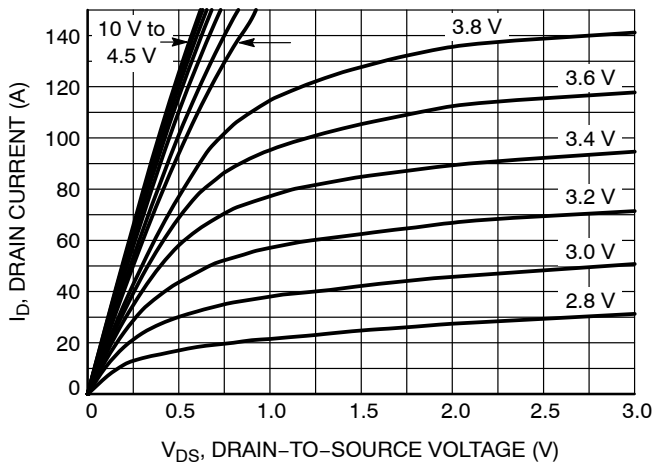


Figure 1. On-Region Characteristics

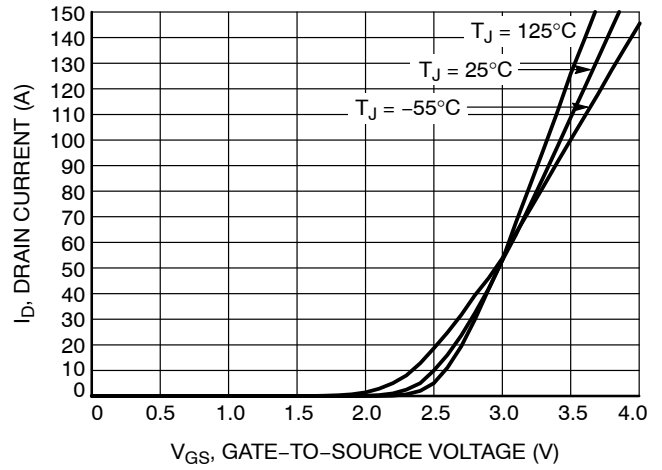


Figure 2. Transfer Characteristics

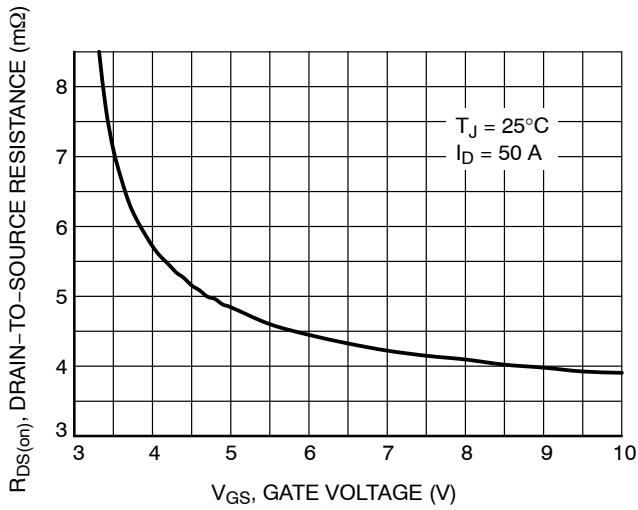


Figure 3. On-Resistance vs. Gate-to-Source Voltage

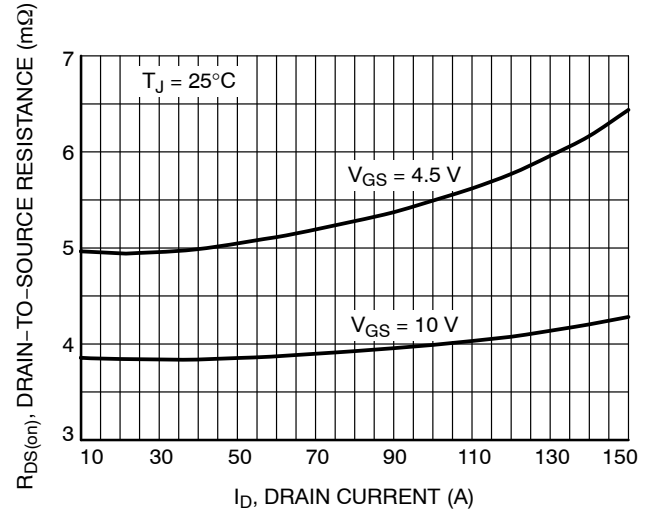


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

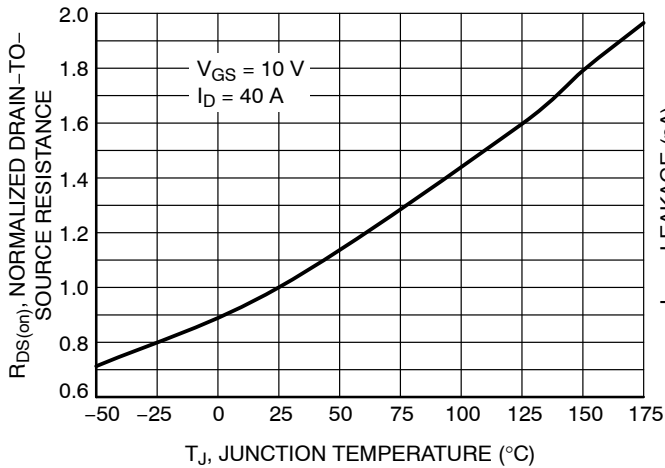


Figure 5. On-Resistance Variation with Temperature

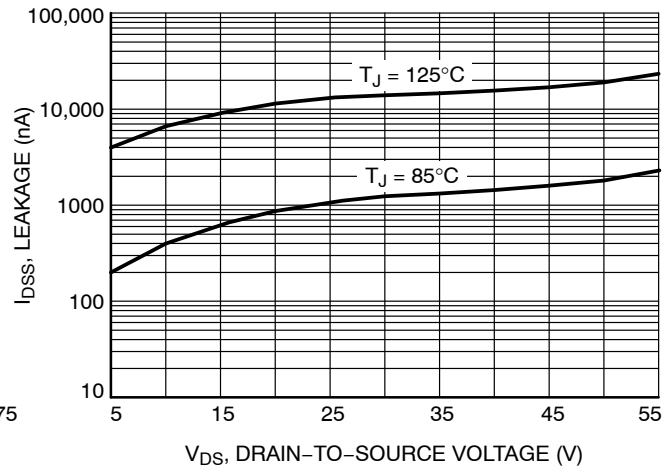


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL CHARACTERISTICS

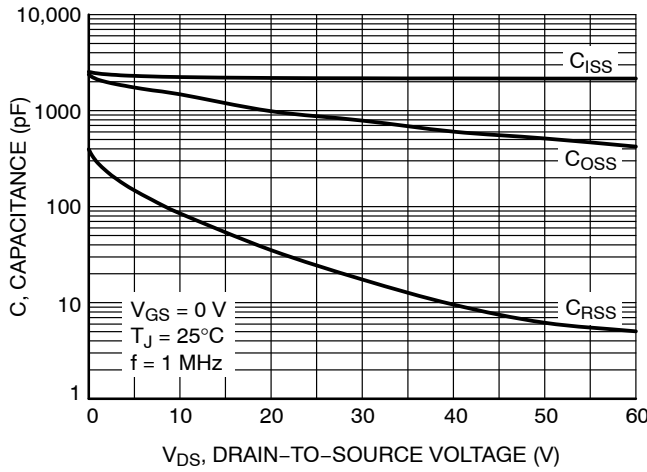


Figure 7. Capacitance Variation

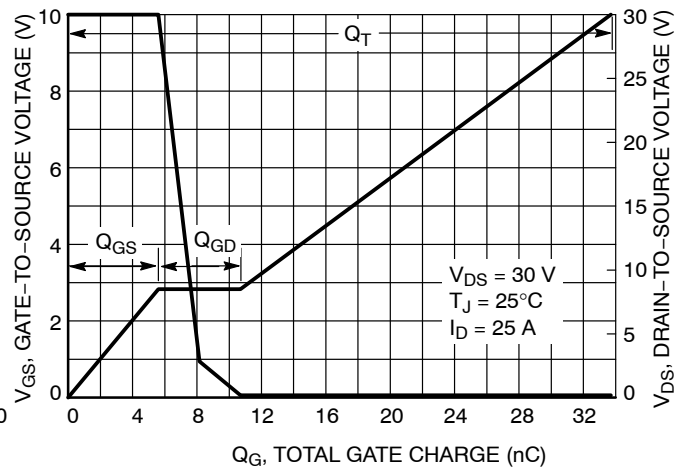


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

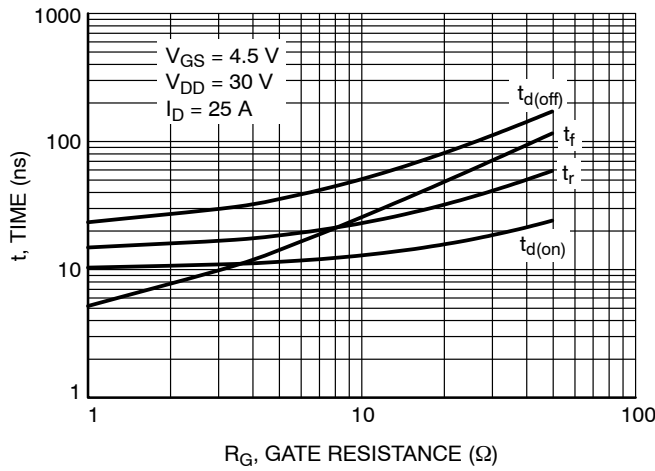


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

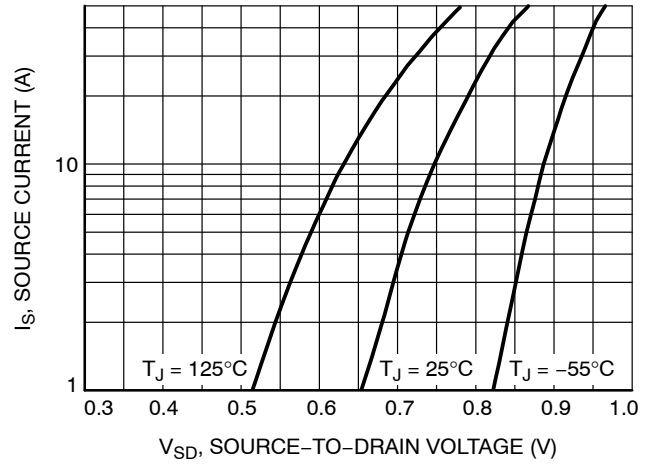


Figure 10. Diode Forward Voltage vs. Current

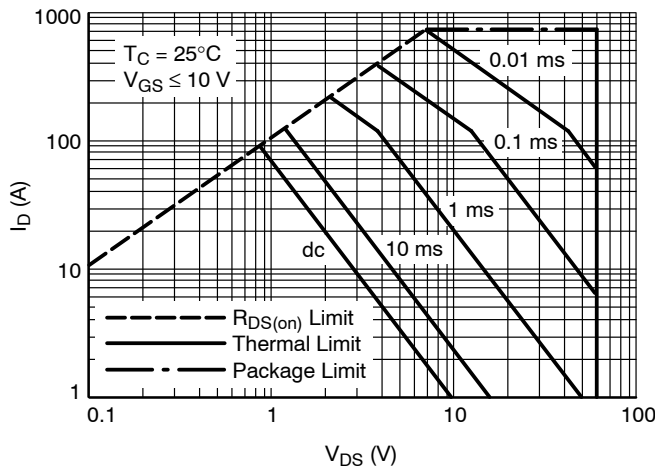


Figure 11. Safe Operating Area

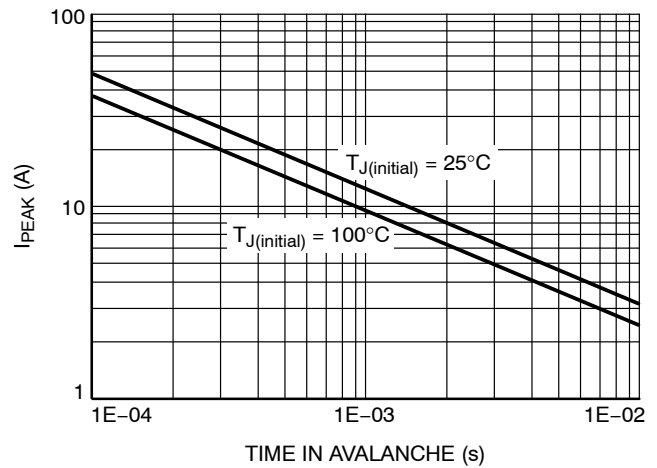


Figure 12. I_{PEAK} vs. Time in Avalanche

NTMFS5C646NL

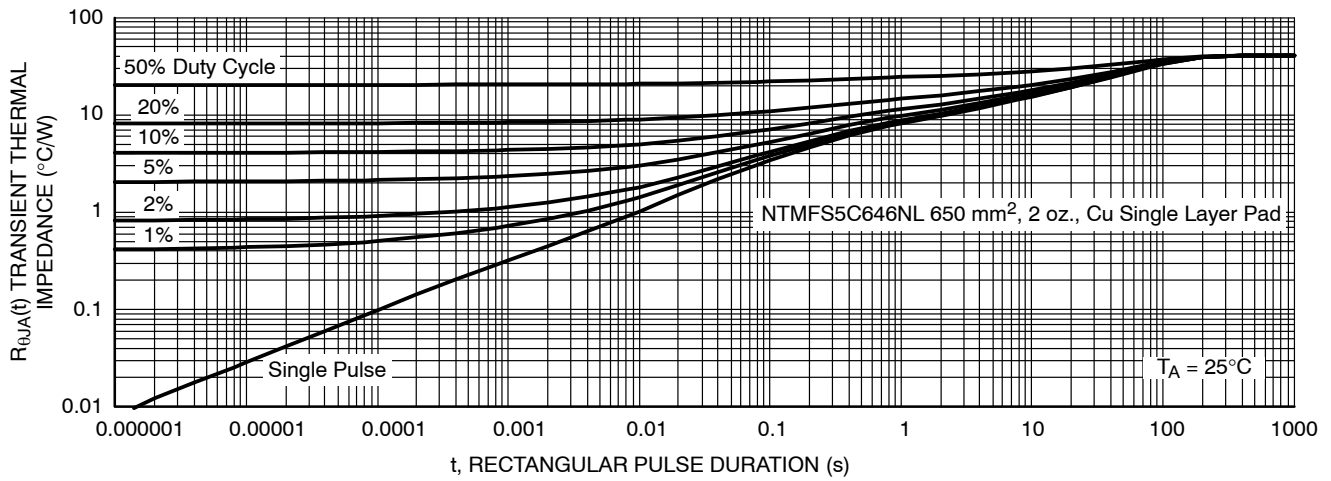


Figure 13. Thermal Response

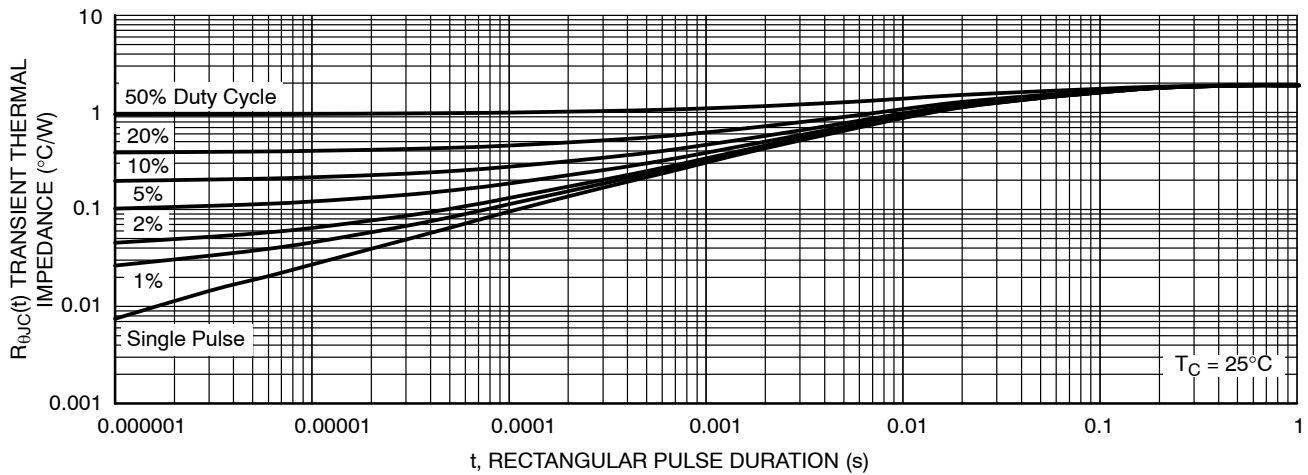


Figure 14. Thermal Response

ORDERING INFORMATION

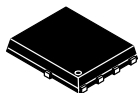
| Device | Marking | Package | Shipping [†] |
|-----------------|---------|-------------------|-----------------------|
| NTMFS5C646NLT1G | 5C646L | DFN5 (Pb-Free) | 1500 / Tape & Reel |

DISCONTINUED (Note 6)

| | | | |
|-----------------|--------|-------------------|--------------------|
| NTMFS5C646NLT3G | 5C645L | DFN5 (Pb-Free) | 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](#).

6. **DISCONTINUED:** This device is not recommended for new design. Please contact your **onsemi** representative for information. The most current information on this device may be available on www.onsemi.com.



SCALE 2:1

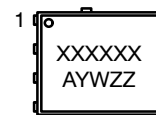
DFN5 5x6, 1.27P
(SO-8FL)
CASE 488AA
ISSUE N

DATE 25 JUN 2018

NOTES:

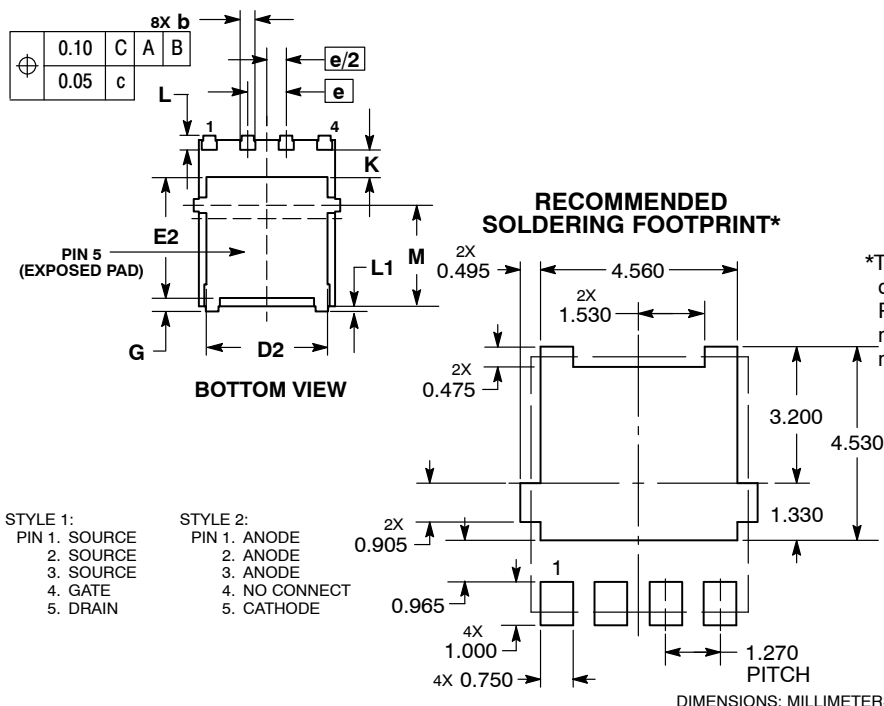
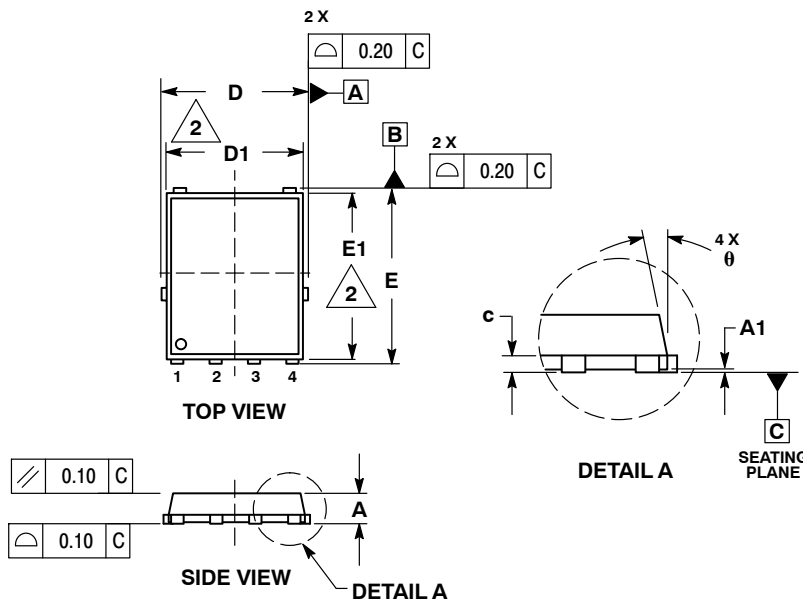
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION D1 AND E1 DO NOT INCLUDE MOLD FLASH PROTRUSIONS OR GATE BURRS.

| DIM | MILLIMETERS | | |
|-----|-------------|-------|------|
| | 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.



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 |

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