

# NTMFS08N2D5C

## MOSFET – Power Trench, N-Channel, Shielded Gate

**80 V, 166 A, 2.7 mΩ**

### General Description

This N-Channel MV MOSFET is produced using ON Semiconductor's advanced PowerTrench process that incorporates Shielded Gate technology. This process has been optimized to minimize on-state resistance and yet maintain superior switching performance with best in class soft body diode.

### Features

- Shielded Gate MOSFET Technology
- Max  $R_{DS(on)}$  = 2.7 mΩ at  $V_{GS}$  = 10 V,  $I_D$  = 68 A
- Max  $R_{DS(on)}$  = 8 mΩ at  $V_{GS}$  = 6 V,  $I_D$  = 34 A
- 50% Lower  $Q_{rr}$  than Other MOSFET Suppliers
- Lowers Switching Noise/EMI
- MSL1 Robust Package Design
- 100% UIL Tested
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Primary DC-DC MOSFET
- Synchronous Rectifier in DC-DC and AC-DC
- Motor Drive
- Solar

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

| Symbol         | Parameter                                                                                                                                          | Value                   | Unit |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------|
| $V_{DS}$       | Drain to Source Voltage                                                                                                                            | 80                      | V    |
| $V_{GS}$       | Gate to Source Voltage                                                                                                                             | ±20                     | V    |
| $I_D$          | Drain Current:<br>Continuous, $T_C$ = 25°C (Note 5)<br>Continuous, $T_C$ = 100°C (Note 5)<br>Continuous, $T_A$ = 25°C (Note 1a)<br>Pulsed (Note 4) | 166<br>105<br>24<br>823 | A    |
| $E_{AS}$       | Single Pulse Avalanche Energy<br>(Note 3)                                                                                                          | 600                     | mJ   |
| $P_D$          | Power Dissipation:<br>$T_C$ = 25°C<br>$T_A$ = 25°C (Note 1a)                                                                                       | 138<br>2.7              | W    |
| $T_J, T_{STG}$ | Operating and Storage Junction<br>Temperature Range                                                                                                | -55 to +150             | °C   |

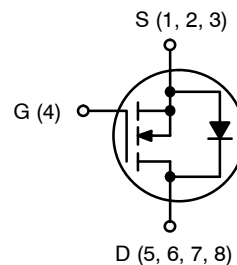
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.



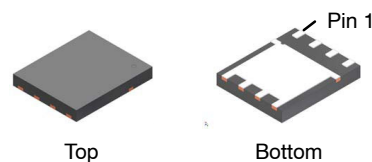
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| $V_{DS}$ | $R_{DS(on)}$ MAX            | $I_D$ MAX |
|----------|-----------------------------|-----------|
| 80 V     | 2.7 mΩ @ 10 V<br>8 mΩ @ 6 V | 166 A     |

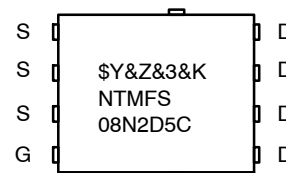


**N-CHANNEL MOSFET**



**Power 56  
(PQFN8)  
CASE 483AF**

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
NTMFS08N2D5C = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

# NTMFS08N2D5C

## THERMAL CHARACTERISTICS

| Symbol          | Parameter                                         | Value | Unit |
|-----------------|---------------------------------------------------|-------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case              | 0.9   | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 45    |      |

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

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

### OFF CHARACTERISTICS

|                                |                                           |                                                             |    |    |     |               |
|--------------------------------|-------------------------------------------|-------------------------------------------------------------|----|----|-----|---------------|
| $BV_{DSS}$                     | Drain to Source Breakdown Voltage         | $I_D = 250\ \mu\text{A}$ , $V_{GS} = 0\ \text{V}$           | 80 |    |     | V             |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$ , referenced to $25^\circ\text{C}$ |    | 62 |     | mV/°C         |
| $I_{DSS}$                      | Zero Gate Voltage Drain Current           | $V_{DS} = 64\ \text{V}$ , $V_{GS} = 0\ \text{V}$            |    |    | 1   | $\mu\text{A}$ |
| $I_{GSS}$                      | Gate to Source Leakage Current            | $V_{GS} = \pm 20\ \text{V}$ , $V_{DS} = 0\ \text{V}$        |    |    | 100 | nA            |

### ON CHARACTERISTICS

|                                  |                                                          |                                                                            |     |      |     |            |
|----------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------|-----|------|-----|------------|
| $V_{GS(th)}$                     | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}$ , $I_D = 380\ \mu\text{A}$                               | 2.0 | 2.9  | 4.0 | V          |
| $\Delta V_{GS(th)} / \Delta T_J$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 380\ \mu\text{A}$ , referenced to $25^\circ\text{C}$                |     | -8.3 |     | mV/°C      |
| $r_{DS(on)}$                     | Static Drain to Source On Resistance                     | $V_{GS} = 10\ \text{V}$ , $I_D = 68\ \text{A}$                             |     | 2.2  | 2.7 | m $\Omega$ |
|                                  |                                                          | $V_{GS} = 6\ \text{V}$ , $I_D = 34\ \text{A}$                              |     | 3.3  | 8   |            |
|                                  |                                                          | $V_{GS} = 10\ \text{V}$ , $I_D = 68\ \text{A}$ , $T_J = 125^\circ\text{C}$ |     | 3.7  | 5.4 |            |
| $g_{FS}$                         | Forward Transconductance                                 | $V_{DS} = 5\ \text{V}$ , $I_D = 68\ \text{A}$                              |     | 148  |     | S          |

### DYNAMIC CHARACTERISTICS

|           |                              |                                                                        |  |      |      |          |
|-----------|------------------------------|------------------------------------------------------------------------|--|------|------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 40\ \text{V}$ , $V_{GS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$ |  | 4455 | 7500 | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                        |  | 1480 | 2485 | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                        |  | 59   | 105  | pF       |
| $R_g$     | Gate Resistance              |                                                                        |  | 0.8  | 1.6  | $\Omega$ |

### SWITCHING CHARACTERISTICS

|              |                               |                                                                                                  |  |    |     |    |
|--------------|-------------------------------|--------------------------------------------------------------------------------------------------|--|----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = 40\ \text{V}$ , $I_D = 68\ \text{A}$ , $V_{GS} = 10\ \text{V}$ , $R_{GEN} = 6\ \Omega$ |  | 21 | 34  | ns |
| $t_r$        | Rise Time                     |                                                                                                  |  | 11 | 20  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |                                                                                                  |  | 29 | 47  | ns |
| $t_f$        | Fall Time                     |                                                                                                  |  | 7  | 13  | ns |
| $Q_g$        | Total Gate Charge             | $V_{GS} = 0\ \text{V}$ to $10\ \text{V}$ , $V_{DD} = 40\ \text{V}$ , $I_D = 68\ \text{A}$        |  | 60 | 100 | nC |
|              |                               | $V_{GS} = 0\ \text{V}$ to $6\ \text{V}$ , $V_{DD} = 40\ \text{V}$ , $I_D = 68\ \text{A}$         |  | 38 | 65  | nC |
| $Q_{gs}$     | Gate to Source Charge         | $V_{DD} = 40\ \text{V}$ , $I_D = 68\ \text{A}$                                                   |  | 19 |     | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge | $V_{DD} = 40\ \text{V}$ , $I_D = 68\ \text{A}$                                                   |  | 12 |     | nC |
| $Q_{oss}$    | Output Charge                 | $V_{DD} = 40\ \text{V}$ , $V_{GS} = 0\ \text{V}$                                                 |  | 84 |     | nC |
| $Q_{sync}$   | Total Gate Charge Sync        | $V_{DS} = 0\ \text{V}$ , $I_D = 68\ \text{A}$                                                    |  | 51 |     | nC |

# NTMFS08N2D5C

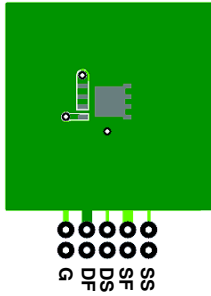
## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (continued)

| Symbol                                    | Parameter                             | Test Condition                                         | Min | Typ | Max | Unit |
|-------------------------------------------|---------------------------------------|--------------------------------------------------------|-----|-----|-----|------|
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS</b> |                                       |                                                        |     |     |     |      |
| $V_{SD}$                                  | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 2.2\text{ A}$ (Note 2)     |     | 0.7 | 1.2 | V    |
|                                           |                                       | $V_{GS} = 0\text{ V}, I_S = 68\text{ A}$ (Note 2)      |     | 0.8 | 1.3 |      |
| $t_{rr}$                                  | Reverse Recovery Time                 | $I_F = 34\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$  |     | 30  | 48  | ns   |
| $Q_{rr}$                                  | Reverse Recovery Charge               |                                                        |     | 55  | 88  | nC   |
| $t_{rr}$                                  | Reverse Recovery Time                 | $I_F = 34\text{ A}, di/dt = 1000\text{ A}/\mu\text{s}$ |     | 24  | 39  | ns   |
| $Q_{rr}$                                  | Reverse Recovery Charge               |                                                        |     | 139 | 222 | nC   |

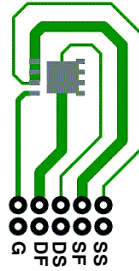
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 × 1.5 in. board of FR-4 material.  $R_{\theta CA}$  is determined by the user's board design.

### NOTES:



a)  $45^\circ\text{C}/\text{W}$  when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



b)  $115^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty cycle < 2.0%.
- $E_{AS}$  of 600 mJ is based on starting  $T_J = 25^\circ\text{C}$ ; N-ch:  $L = 3\text{ mH}$ ,  $I_{AS} = 20\text{ A}$ ,  $V_{DD} = 80\text{ V}$ ,  $V_{GS} = 10\text{ V}$ . 100% test at  $L = 0.1\text{ mH}$ ,  $I_{AS} = 63\text{ A}$ .
- Pulsed  $I_d$  please refer to Figure 11 SOA graph for more details.
- Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

## ORDERING INFORMATION

| Device       | Marking      | Package                                      | Reel Size | Tape Width | Quantity |
|--------------|--------------|----------------------------------------------|-----------|------------|----------|
| NTMFS08N2D5C | NTMFS08N2D5C | Power 56 (PQFN8)<br>(Pb-Free / Halogen Free) | 13"       | 12 mm      | 3000     |

# TYPICAL CHARACTERISTICS

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

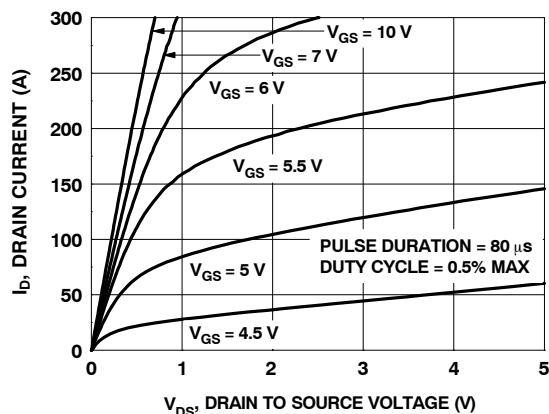


Figure 1. On Region Characteristics

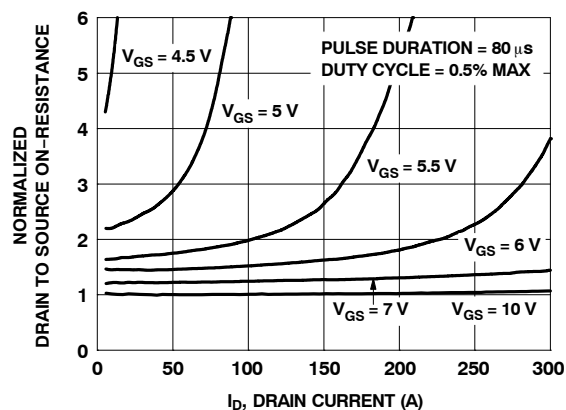


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

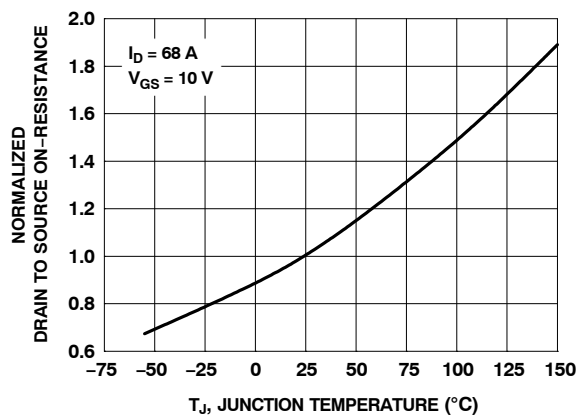


Figure 3. Normalized On-Resistance vs. Junction Temperature

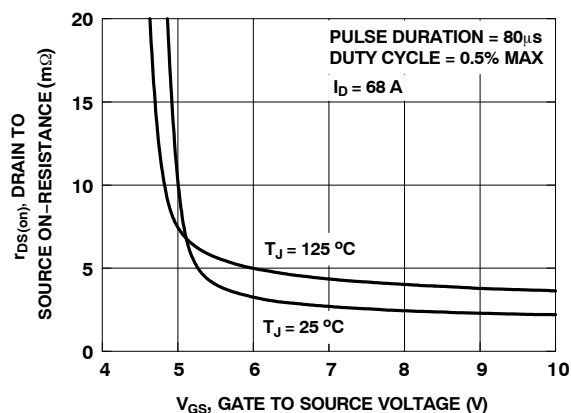


Figure 4. On-Resistance vs. Gate to Source Voltage

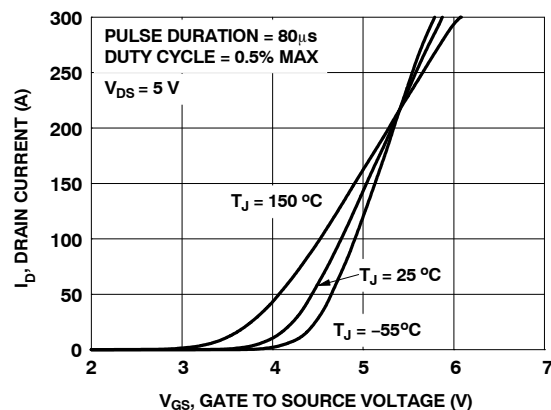


Figure 5. Transfer Characteristics

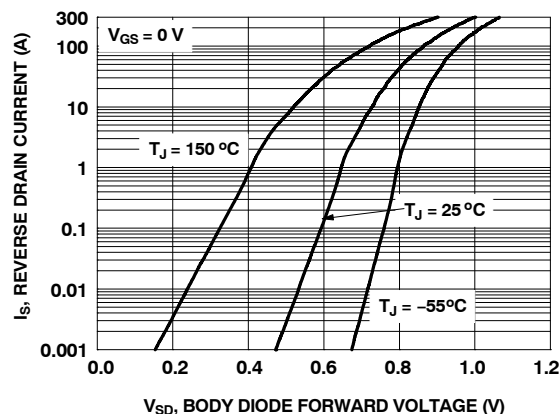


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

# NTMFS08N2D5C

## TYPICAL CHARACTERISTICS

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

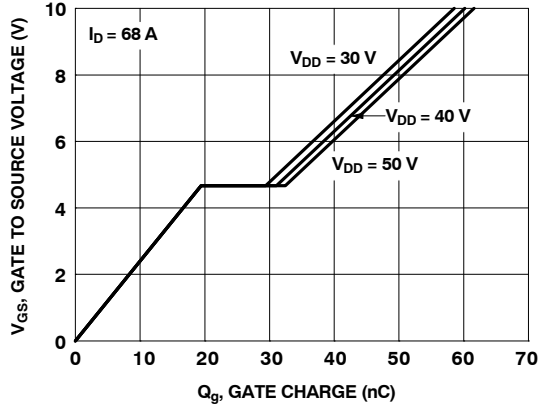


Figure 7. Gate Charge Characteristics

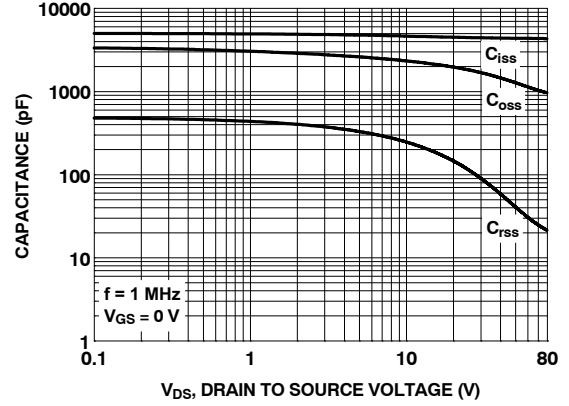


Figure 8. Capacitance vs. Drain to Source Voltage

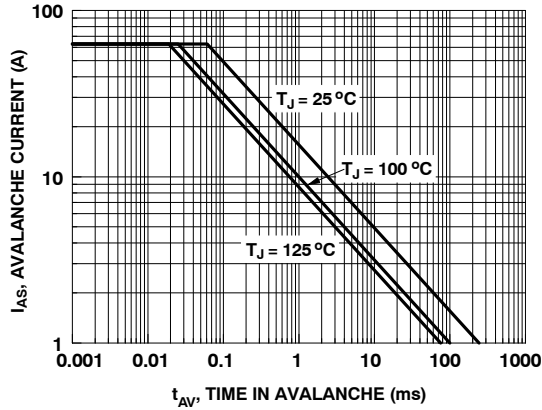


Figure 9. Unclamped Inductive Switching Capability

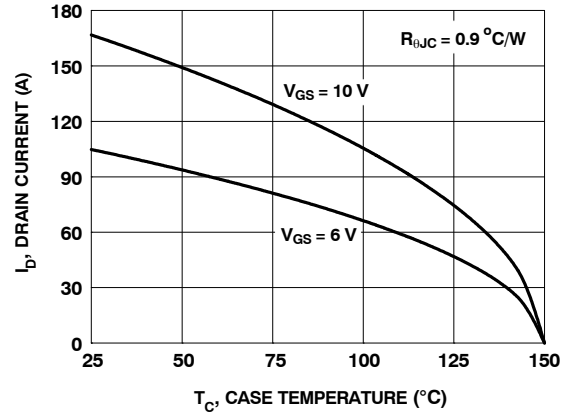


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

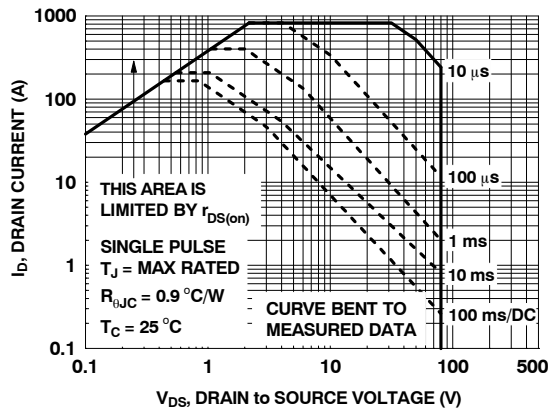


Figure 11. Forward Bias Safe Operating Area

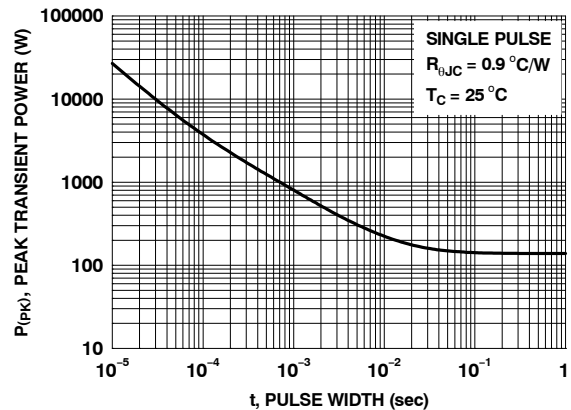


Figure 12. Single Pulse Maximum Power Dissipation

# NTMFS08N2D5C

## TYPICAL CHARACTERISTICS

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

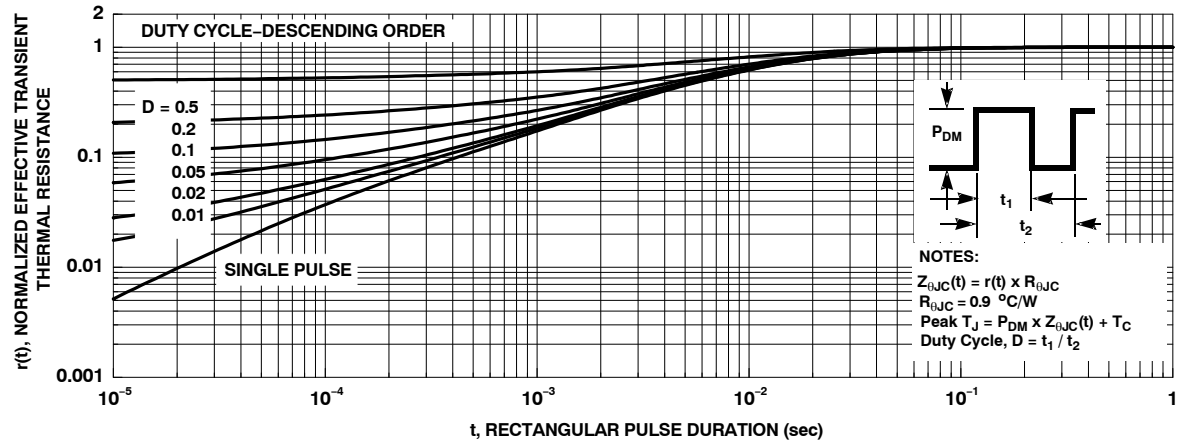
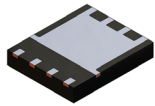


Figure 13. Junction-to-Case Transient Thermal Response Curve

# MECHANICAL CASE OUTLINE

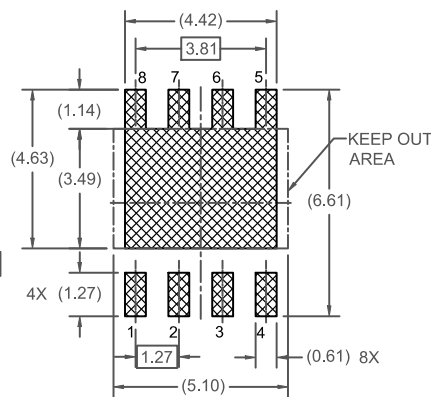
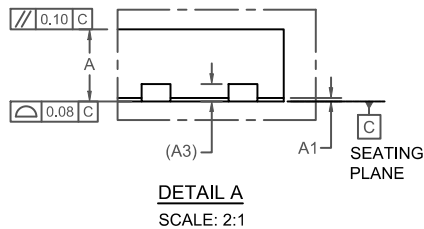
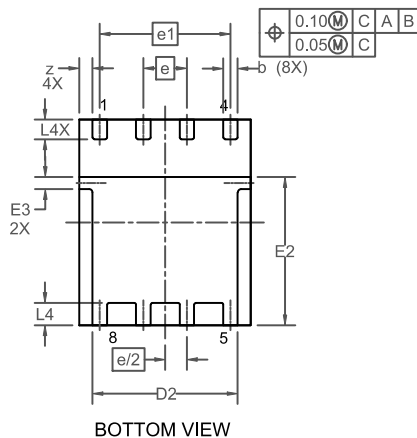
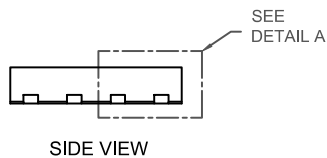
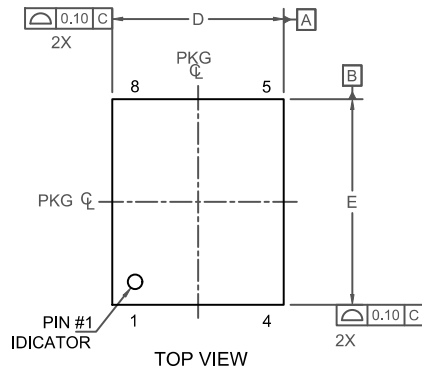
## PACKAGE DIMENSIONS

ON Semiconductor®



**PQFN8 5X6, 1.27P**  
CASE 483AF  
ISSUE A

DATE 06 JUL 2021



\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

NOTES: UNLESS OTHERWISE SPECIFIED

- A) PACKAGE STANDARD REFERENCE: JEDEC MO-240, ISSUE A, VAR. AA,
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
- D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
- E) IT IS RECOMMENDED TO HAVE NO TRACES OR VIAS WITHIN THE KEEP OUT AREA.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.90        | 1.00 | 1.10 |
| A1  | 0.00        | -    | 0.05 |
| A3  | 0.20 REF.   |      |      |
| b   | 0.37        | 0.42 | 0.47 |
| D   | 4.90        | 5.00 | 5.10 |
| D2  | 4.13        | 4.23 | 4.33 |
| E   | 5.90        | 6.00 | 6.10 |
| E2  | 4.23        | 4.33 | 4.43 |
| E3  | 0.35 REF.   |      |      |
| e   | 1.27 BSC    |      |      |
| e/2 | 0.635 BSC   |      |      |
| e1  | 3.81 BSC    |      |      |
| L   | 0.52        | 0.57 | 0.62 |
| L4  | 0.55        | 0.65 | 0.75 |
| z   | 0.38 REF    |      |      |

DOCUMENT NUMBER: 98AON13656G

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