

# MOSFET – P-Channel, POWERTRENCH<sup>®</sup>

**-20 V, -56 A, 4 mΩ**

## FDMC6686P

### General Description

This P-Channel MOSFET is produced using **onsemi's** advanced POWERTRENCH process that has been optimized for  $R_{DS(ON)}$ , switching performance and ruggedness.

### Features

- Max  $R_{DS(on)}$  = 4 mΩ at  $V_{GS} = -4.5$  V,  $I_D = -18$  A
- Max  $R_{DS(on)}$  = 5.7 mΩ at  $V_{GS} = -2.5$  V,  $I_D = -16$  A
- Max  $R_{DS(on)}$  = 11.5 mΩ at  $V_{GS} = -1.8$  V,  $I_D = -11$  A
- High Performance Trench Technology for Extremely Low  $R_{DS(on)}$
- High Power and Current Handling Capability in a Widely Used Surface Mount Package
- This Device is Pb-Free, Halide Free and is RoHS Compliant

### Applications

- Load Switch
- Battery Management
- Power Management
- Reverse Polarity Protection

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

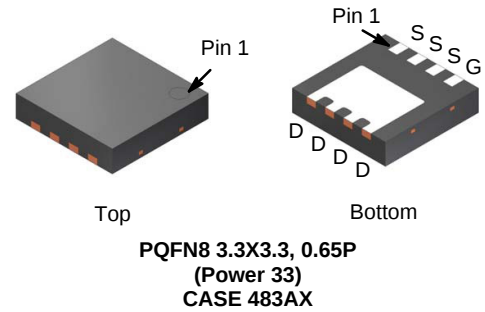
| Symbol         | Parameter                                                                                                                      | Ratings            | Unit             |
|----------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|------------------|
| $V_{DS}$       | Drain to Source Voltage                                                                                                        | -20                | V                |
| $V_{GS}$       | Gate to Source Voltage                                                                                                         | ±8                 | V                |
| $I_D$          | Drain Current<br>– Continuous $T_C = 25^\circ\text{C}$<br>– Continuous $T_A = 25^\circ\text{C}$ (Note 1a)<br>– Pulsed (Note 3) | -56<br>-18<br>-377 | A                |
| $P_D$          | Power Dissipation<br>$T_C = 25^\circ\text{C}$<br>$T_A = 25^\circ\text{C}$ (Note 1a)                                            | 40<br>2.3          | W                |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                                                                               | -55 to +150        | $^\circ\text{C}$ |

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.

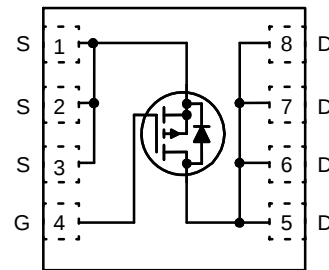
### THERMAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)

| Symbol          | Parameter                                         | Ratings | Unit               |
|-----------------|---------------------------------------------------|---------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case              | 3.1     | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 53      |                    |

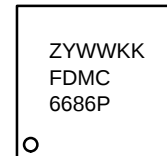
| $V_{DS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|----------|------------------|-----------|
| -20 V    | 4 mΩ @ -4.5 V    | -56 A     |
|          | 5.7 mΩ @ -2.5 V  |           |
|          | 11.5 mΩ @ -1.8 V |           |



### PIN ASSIGNMENT



### MARKING DIAGRAM



Z = Assembly Plant Code  
 YWW = Date Code (Year & Week)  
 KK = Lot Traceability Code  
 FDMC6686P = Specific Device Code

### ORDERING INFORMATION

| Device    | Package                          | Shipping <sup>†</sup> |
|-----------|----------------------------------|-----------------------|
| FDMC6686P | PQFN8<br>(Power 33)<br>(Pb-Free) | 3000 /<br>Tape & Reel |

<sup>†</sup>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.

# FDMC6686P

## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

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

### OFF CHARACTERISTICS

|                                      |                                           |                                                 |     |     |      |       |
|--------------------------------------|-------------------------------------------|-------------------------------------------------|-----|-----|------|-------|
| BV <sub>DSS</sub>                    | Drain to Source Breakdown Voltage         | I <sub>D</sub> = -250 μA, V <sub>GS</sub> = 0 V | -20 | -   | -    | V     |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = -250 μA, referenced to 25°C    | -   | -15 | -    | mV/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V  | -   | -   | -1   | μA    |
| I <sub>GSS</sub>                     | Gate to Source Leakage Current            | V <sub>GS</sub> = ±8 V, V <sub>DS</sub> = 0 V   | -   | -   | ±100 | nA    |

### ON CHARACTERISTICS

|                                        |                                                          |                                                                          |      |       |      |       |
|----------------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------|------|-------|------|-------|
| V <sub>GS(th)</sub>                    | Gate to Source Threshold Voltage                         | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA             | -0.4 | -0.75 | -1   | V     |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | I <sub>D</sub> = -250 μA, referenced to 25°C                             | -    | 3     | -    | mV/°C |
| R <sub>DS(on)</sub>                    | Static Drain to Source On Resistance                     | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -18 A                         | -    | 3.3   | 4    | mΩ    |
|                                        |                                                          | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -16 A                         | -    | 4.1   | 5.7  |       |
|                                        |                                                          | V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -11 A                         | -    | 6     | 11.5 |       |
|                                        |                                                          | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -18 A, T <sub>J</sub> = 125°C | -    | 4.3   | 6.5  |       |
| g <sub>FS</sub>                        | Forward Transconductance                                 | V <sub>DS</sub> = -5 V, I <sub>D</sub> = -18 A                           | -    | 116   | -    | S     |

### DYNAMIC CHARACTERISTICS

|                  |                              |                                                           |   |      |       |    |
|------------------|------------------------------|-----------------------------------------------------------|---|------|-------|----|
| C <sub>iss</sub> | Input Capacitance            | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1 MHz | - | 8800 | 13200 | pF |
| C <sub>oss</sub> | Output Capacitance           |                                                           | - | 1520 | 2280  | pF |
| C <sub>rss</sub> | Reverse Transfer Capacitance |                                                           | - | 1340 | 2010  | pF |
| R <sub>g</sub>   | Gate Resistance              |                                                           | - | 6.2  | -     | Ω  |

### SWITCHING CHARACTERISTICS

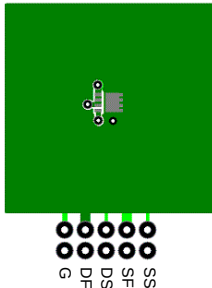
|                     |                               |                                                                                                      |   |     |     |    |
|---------------------|-------------------------------|------------------------------------------------------------------------------------------------------|---|-----|-----|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time            | V <sub>DD</sub> = -10 V, I <sub>D</sub> = -18 A,<br>V <sub>GS</sub> = -4.5 V, R <sub>GEN</sub> = 6 Ω | - | 25  | 40  | ns |
| t <sub>r</sub>      | Rise Time                     |                                                                                                      | - | 77  | 122 | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time           |                                                                                                      | - | 317 | 506 | ns |
| t <sub>f</sub>      | Fall Time                     |                                                                                                      | - | 178 | 285 | ns |
| Q <sub>g</sub>      | Total Gate Charge             | V <sub>DD</sub> = -10 V, I <sub>D</sub> = -18 A,<br>V <sub>GS</sub> = -4.5 V                         | - | 87  | 122 | nC |
| Q <sub>gs</sub>     | Gate to Source Charge         |                                                                                                      | - | 14  | -   | nC |
| Q <sub>gd</sub>     | Gate to Drain "Miller" Charge |                                                                                                      | - | 24  | -   | nC |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                       |                                                        |   |      |      |    |
|-----------------|---------------------------------------|--------------------------------------------------------|---|------|------|----|
| V <sub>SD</sub> | Source to Drain Diode Forward Voltage | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -18 A (Note 2) | - | -0.7 | -1.2 | V  |
|                 |                                       | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -2 A (Note 2)  | - | -0.6 | -1.2 |    |
| t <sub>rr</sub> | Reverse Recovery Time                 | I <sub>F</sub> = -18 A, di/dt = 100 A/μs               | - | 38   | 61   | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge               |                                                        | - | 24   | 39   | 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<sub>θJA</sub> is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. R<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design.



a. 53°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper



b. 125°C/W when mounted on a minimum pad of 2 oz copper

2. Pulse Test: Pulse Width < 300 μs, Duty cycle < 2.0%.
3. Pulse Id refers to Forward Bias Safe Operation Area.

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

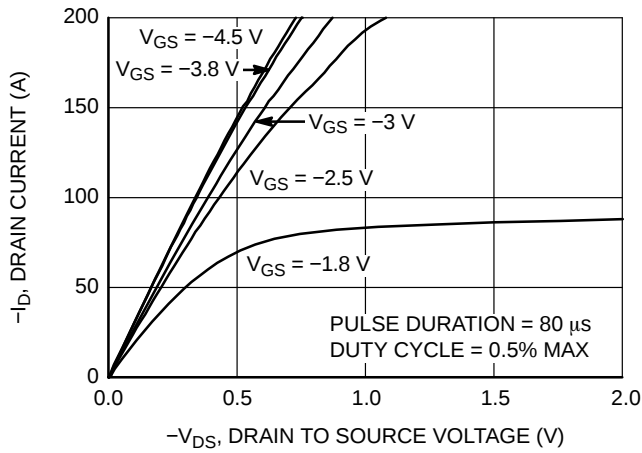


Figure 1. On-Region Characteristics

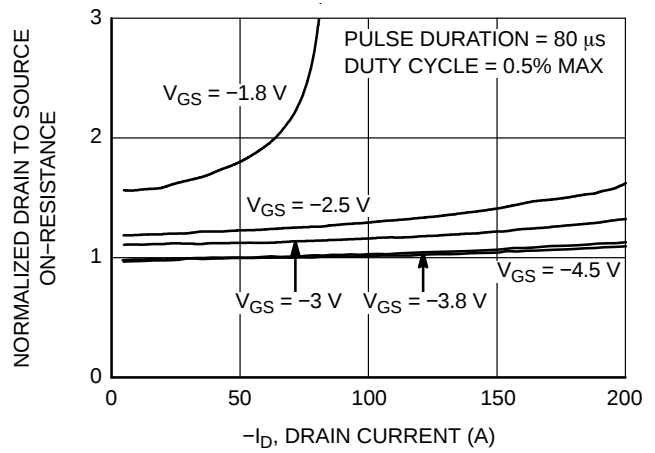


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

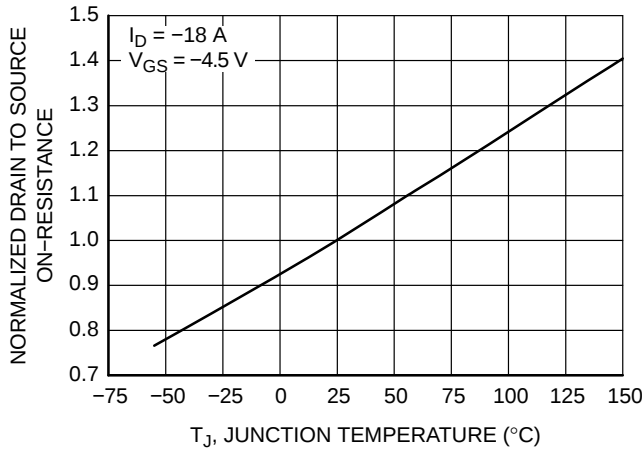


Figure 3. Normalized On-Resistance vs. Junction Temperature

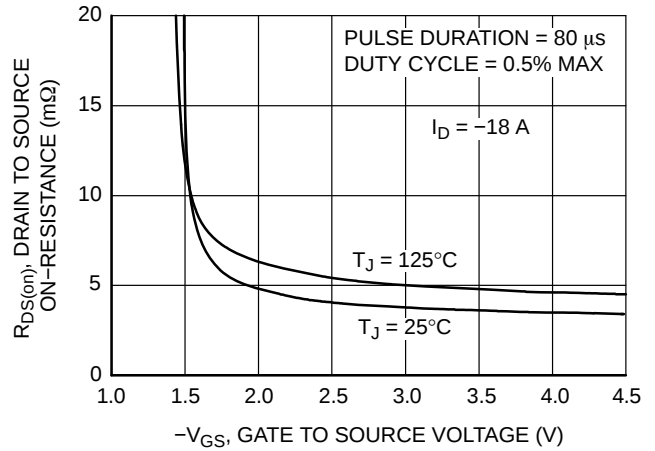


Figure 4. On-Resistance vs. Gate to Source Voltage

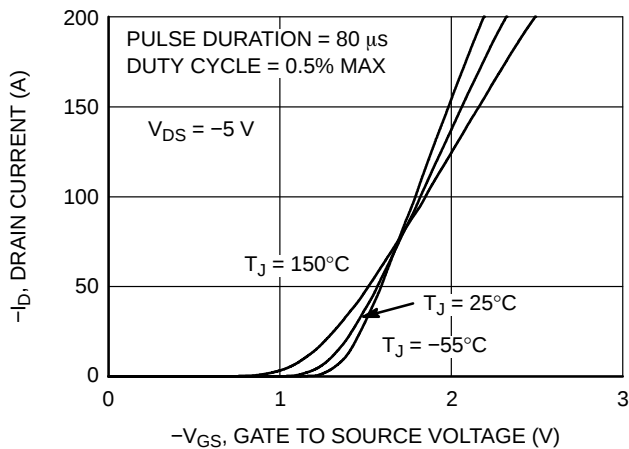


Figure 5. Transfer Characteristics

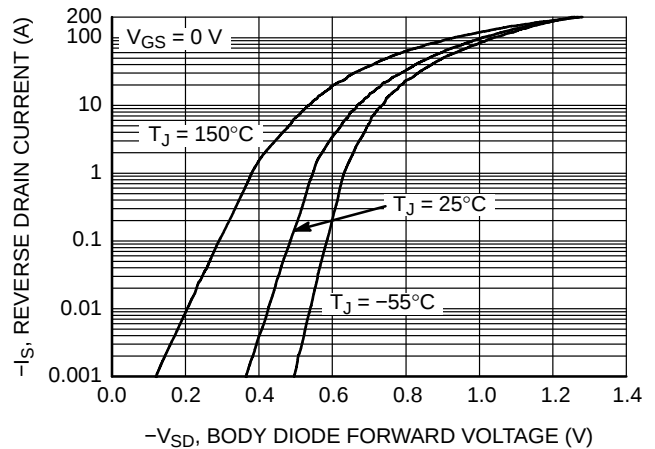


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

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

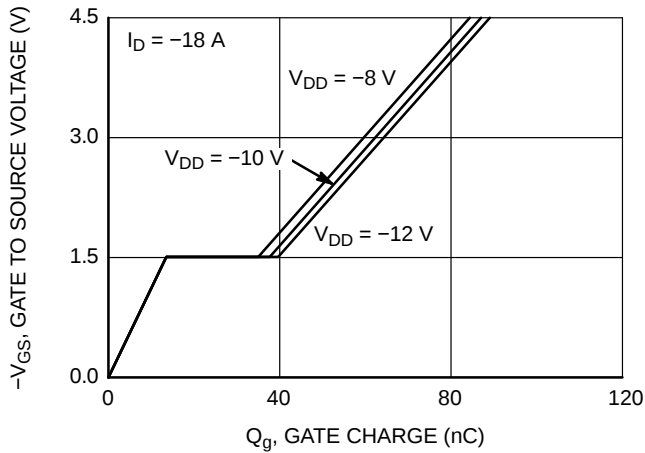


Figure 7. Gate Charge Characteristics

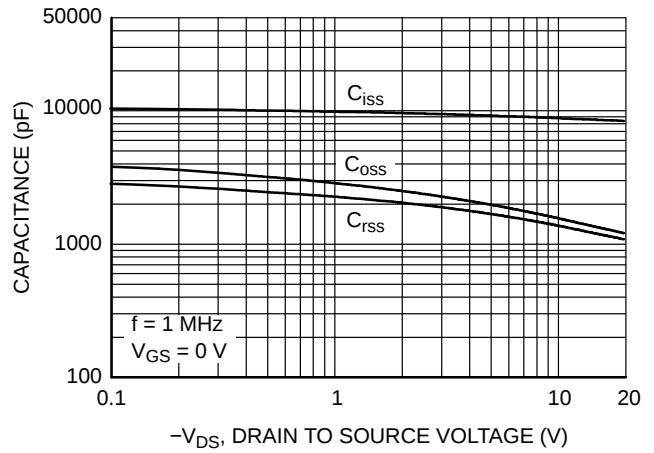


Figure 8. Capacitance vs. Drain to Source Voltage

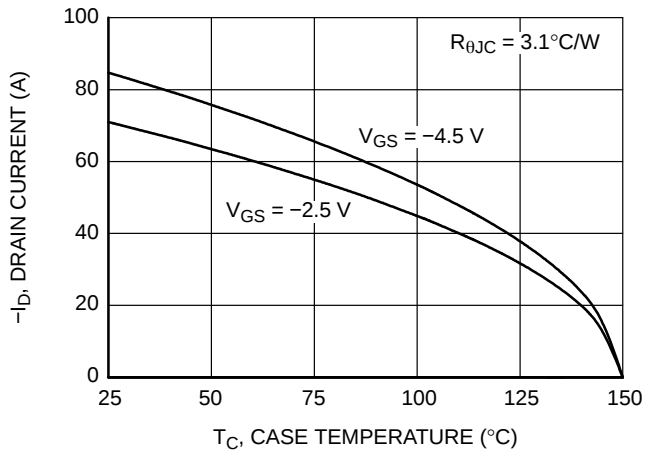


Figure 9. Maximum Continuous Drain Current vs. Case Temperature

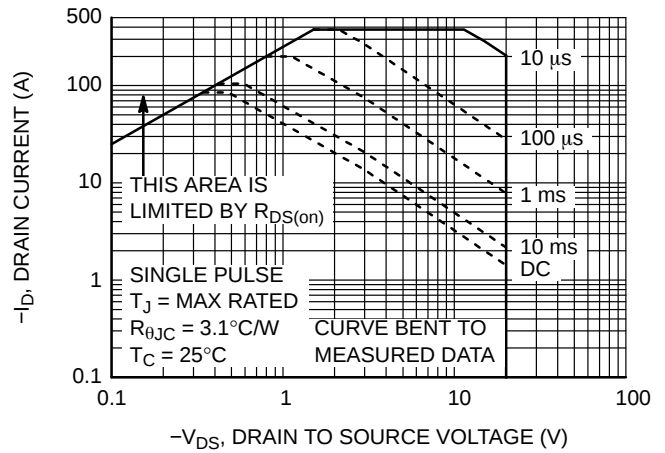


Figure 10. Forward Bias Safe Operating Area

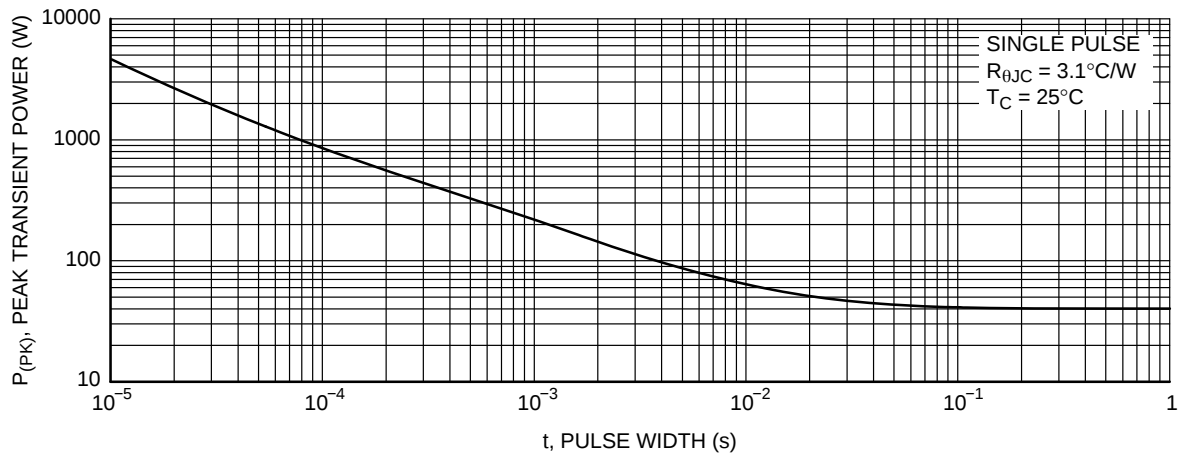
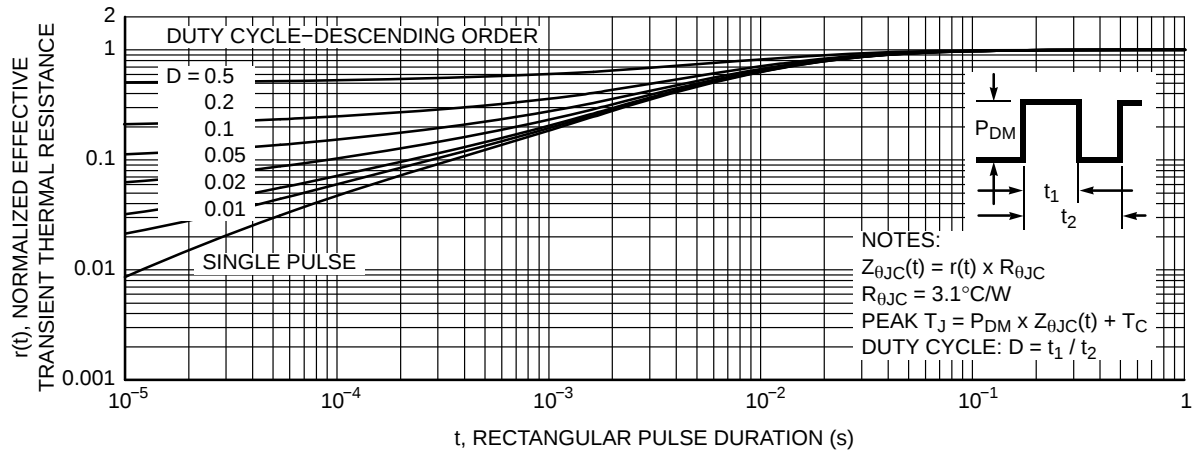
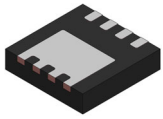


Figure 11. Single Pulse Maximum Power Dissipation

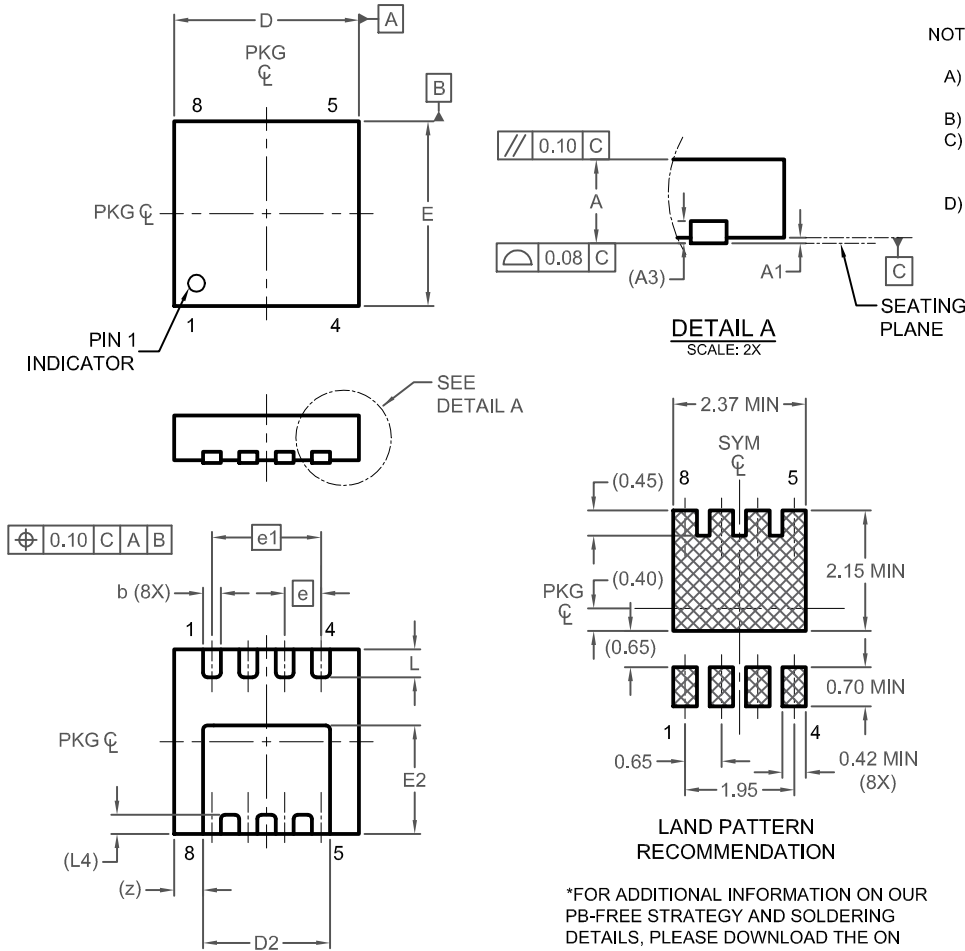
TYPICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ , unless otherwise noted) (continued)





**PQFN8 3.3X3.3, 0.65P**  
**CASE 483AX**  
**ISSUE B**

DATE 24 JUN 2022



NOTES: UNLESS OTHERWISE SPECIFIED

- A) PACKAGE STANDARD REFERENCE:  
 JEDEC MO-240, ISSUE A, VAR. BA,  
 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.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.70        | 0.75 | 0.80 |
| A1  | 0.00        | -    | 0.05 |
| A3  | 0.20 REF    |      |      |
| b   | 0.27        | 0.32 | 0.37 |
| D   | 3.20        | 3.30 | 3.40 |
| D2  | 2.17        | 2.27 | 2.37 |
| E   | 3.20        | 3.30 | 3.40 |
| E2  | 1.84        | 1.94 | 2.04 |
| e   | 0.65 BSC    |      |      |
| e1  | 1.95 BSC    |      |      |
| L   | 0.40        | 0.50 | 0.60 |
| L4  | 0.34 REF    |      |      |
| z   | 0.52 REF    |      |      |

\*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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