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May 2016

FDMD8560L

Dual N-Channel PowerTrench[®] MOSFET

Q1: 60 V, 22 A, 3.2 mΩ Q2: 60 V, 22 A, 3.2 mΩ

Features

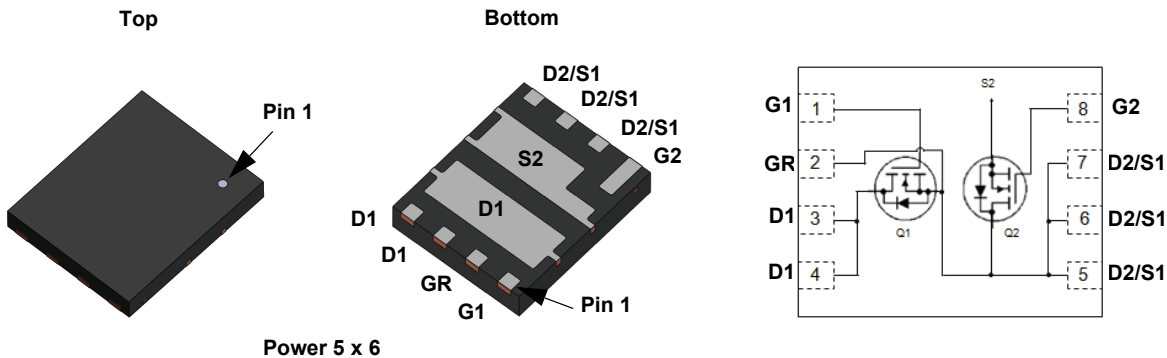
- Q1: N-Channel
- Max $r_{DS(on)}$ = 3.2 mΩ at $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$
 - Max $r_{DS(on)}$ = 5.4 mΩ at $V_{GS} = 4.5\text{ V}$, $I_D = 18\text{ A}$
- Q2: N-Channel
- Max $r_{DS(on)}$ = 3.2 mΩ at $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$
 - Max $r_{DS(on)}$ = 5.4 mΩ at $V_{GS} = 4.5\text{ V}$, $I_D = 18\text{ A}$
- Ideal for Flexible Layout in Primary Side of Bridge Topology
 - 100% UIL Tested
 - Kelvin High Side MOSFET Drive Pin-out Capability
 - RoHS Compliant

General Description

This device includes two 60V N-Channel MOSFETs in a dual power (5 mm X 6 mm) package. HS source and LS drain internally connected for half/full bridge, low source inductance package, low $r_{DS(on)}$ /Qg FOM silicon.

Applications

- Synchronous Buck: Primary Switch of Half / Full Bridge Converter for Telecom
- Motor Bridge: Primary Switch of Half / Full Bridge Converter for BLDC Motor
- MV POL: 48V Synchronous Buck Switch
- Half/Full Bridge Secondary Synchronous Rectification



MOSFET Maximum Ratings $T_A = 25\text{ °C}$ unless otherwise noted.

| Symbol | Parameter | Q1 | Q2 | Units |
|----------------|--|--------------------------------|-------------------|-------------------|
| V_{DS} | Drain to Source Voltage | 60 | 60 | V |
| V_{GS} | Gate to Source Voltage | ±20 | ±20 | V |
| I_D | Drain Current -Continuous | $T_C = 25\text{ °C}$ (Note 5) | 93 | 93 |
| | -Continuous | $T_C = 100\text{ °C}$ (Note 5) | 59 | 59 |
| | Drain Current -Continuous | $T_A = 25\text{ °C}$ | 22 ^{1a} | 22 ^{1b} |
| | -Pulsed | (Note 4) | 550 | 550 |
| E_{AS} | Single Pulse Avalanche Energy | (Note 3) | 384 | 384 |
| P_D | Power Dissipation | $T_C = 25\text{ °C}$ | 48 | 48 |
| | Power Dissipation | $T_A = 25\text{ °C}$ | 2.2 ^{1a} | 2.2 ^{1b} |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 to +150 | | °C |

Thermal Characteristics

| | | | | |
|-----------------|---|------------------|------------------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 2.6 | 2.6 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 55 ^{1a} | 55 ^{1b} | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|-----------|-------------|-----------|------------|------------|
| FDMD8560L | FDMD8560L | Power 5 x 6 | 13" | 12 mm | 3000 units |

Electrical Characteristics $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted.

| Symbol | Parameter | Test Conditions | Type | Min. | Typ. | Max. | Units |
|--------|-----------|-----------------|------|------|------|------|-------|
|--------|-----------|-----------------|------|------|------|------|-------|

Off Characteristics

| | | | | | | | |
|--------------------------------------|---|---|----------|----------|----------|------------------------|----------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$ | Q1 Q2 | 60 60 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$, referenced to $25\text{ }^\circ\text{C}$ | Q1 Q2 | | 32 32 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$ | Q1 Q2 | | | 1 1 | μA |
| I_{GSS} | Gate to Source Leakage Current | $V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$ | Q1 Q2 | | | ± 100 ± 100 | nA |

On Characteristics

| | | | | | | | |
|--|--|--|----------|------------|------------|------------|----------------------|
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS} = V_{DS}$, $I_D = 250\text{ }\mu\text{A}$ | Q1 Q2 | 1.0 1.0 | 1.6 1.6 | 3.0 3.0 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$, referenced to $25\text{ }^\circ\text{C}$ | Q1 Q2 | | -7 -7 | | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$ | Q1 | | 2.5 | 3.2 | m Ω |
| | | $V_{GS} = 4.5\text{ V}$, $I_D = 18\text{ A}$ | | 4.1 | 5.4 | | |
| | | $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$ | | 3.9 | 5.0 | | |
| | | $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$ | Q2 | | 2.5 | 3.2 | |
| | | $V_{GS} = 4.5\text{ V}$, $I_D = 18\text{ A}$ | | 4.1 | 5.4 | | |
| | | $V_{GS} = 10\text{ V}$, $I_D = 22\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$ | | 3.9 | 5.0 | | |
| g_{FS} | Forward Transconductance | $V_{DD} = 5\text{ V}$, $I_D = 22\text{ A}$ | Q1 Q2 | | 98 98 | | S |

Dynamic Characteristics

| | | | | | | | |
|-----------|------------------------------|--|----------|------------|--------------|----------------|----------|
| C_{iss} | Input Capacitance | $V_{DS} = 30\text{ V}$, $V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$ | Q1 Q2 | | 7420 7420 | 11130 11130 | pF |
| C_{oss} | Output Capacitance | | Q1 Q2 | | 1110 1110 | 1665 1665 | pF |
| C_{rss} | Reverse Transfer Capacitance | | Q1 Q2 | | 38 38 | 60 60 | pF |
| R_g | Gate Resistance | | Q1 Q2 | 0.1 0.1 | 1.5 1.5 | 3.0 3.0 | Ω |

Switching Characteristics

| | | | | | | | |
|--------------|-------------------------------|--|--------------------------------------|----------|----------|----------|------------|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 30\text{ V}$, $I_D = 22\text{ A}$ $V_{GS} = 10\text{ V}$, $R_{GEN} = 6\text{ }\Omega$ | Q1 Q2 | | 20 20 | 35 35 | ns |
| t_r | Rise Time | | Q1 Q2 | | 15 15 | 26 26 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | Q1 Q2 | | 57 57 | 90 90 | ns |
| t_f | Fall Time | | Q1 Q2 | | 11 11 | 20 20 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge | | $V_{GS} = 0\text{ V to }10\text{ V}$ | Q1 Q2 | | 92 92 | 128 128 |
| $Q_{g(TOT)}$ | Total Gate Charge | $V_{GS} = 0\text{ V to }4.5\text{ V}$ | Q1 Q2 | | 42 42 | 59 59 | nC |
| Q_{gs} | Gate to Source Charge | $V_{DD} = 30\text{ V}$, $I_D = 22\text{ A}$ | Q1 Q2 | | 19 19 | | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | Q1 Q2 | | 7 7 | | nC |

Electrical Characteristics $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted.

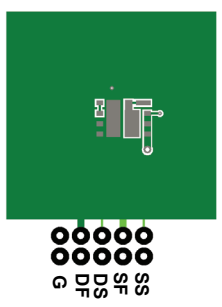
| Symbol | Parameter | Test Conditions | Type | Min. | Typ. | Max. | Units |
|--------|-----------|-----------------|------|------|------|------|-------|
|--------|-----------|-----------------|------|------|------|------|-------|

Drain-Source Diode Characteristics

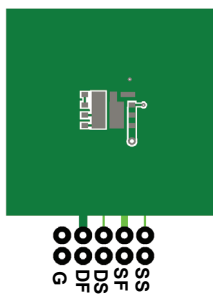
| | | | | | | | |
|----------|---------------------------------------|---|----------|--|------------|------------|----|
| V_{SD} | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 22\text{ A}$ (Note 2) | Q1 Q2 | | 0.8 0.8 | 1.3 1.3 | V |
| V_{SD} | Source to Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_S = 2\text{ A}$ (Note 2) | Q1 Q2 | | 0.7 0.7 | 1.2 1.2 | V |
| t_{rr} | Reverse Recovery Time | $I_F = 22\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$ | Q1 Q2 | | 53 53 | 84 84 | ns |
| Q_{rr} | Reverse Recovery Charge | | Q1 Q2 | | 44 44 | 70 70 | nC |

NOTES:

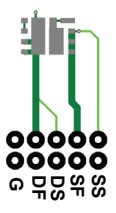
1. $R_{\theta JA}$ is determined with the device mounted on a 1 in² pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



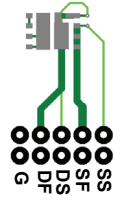
a. 55 °C/W when mounted on a 1 in² pad of 2 oz copper



b. 55 °C/W when mounted on a 1 in² pad of 2 oz copper



c. 155 °C/W when mounted on a minimum pad of 2 oz copper



d. 155 °C/W when mounted on a minimum pad of 2 oz copper

- Pulse Test: Pulse Width < 300 μs , Duty cycle < 2.0 %.
- Q1: E_{AS} of 384 mJ is based on starting $T_J = 25\text{ }^\circ\text{C}$, $L = 3\text{ mH}$, $I_{AS} = 16\text{ A}$, $V_{DD} = 60\text{ V}$, $V_{GS} = 10\text{ V}$. 100% tested at $L = 0.1\text{ mH}$, $I_{AS} = 51\text{ A}$.
- Q2: E_{AS} of 384 mJ is based on starting $T_J = 25\text{ }^\circ\text{C}$, $L = 3\text{ mH}$, $I_{AS} = 16\text{ A}$, $V_{DD} = 60\text{ V}$, $V_{GS} = 10\text{ V}$. 100% tested at $L = 0.1\text{ mH}$, $I_{AS} = 51\text{ A}$.
- Pulsed I_d please refer to Fig 11 and Fig 24 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.

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

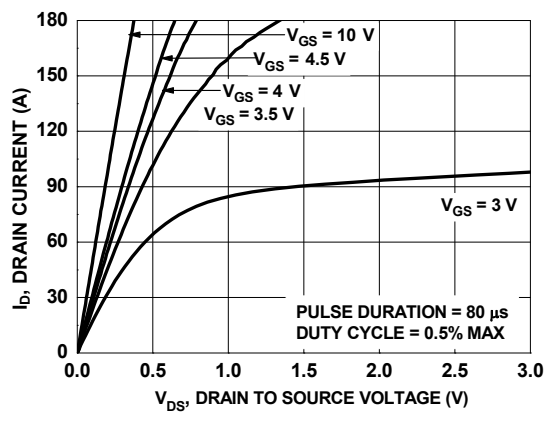


Figure 1. On Region Characteristics

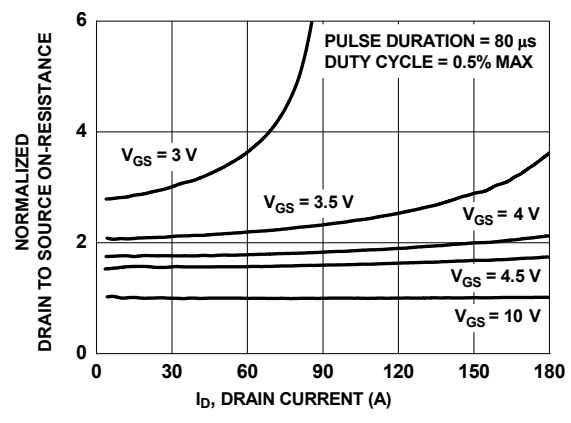


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

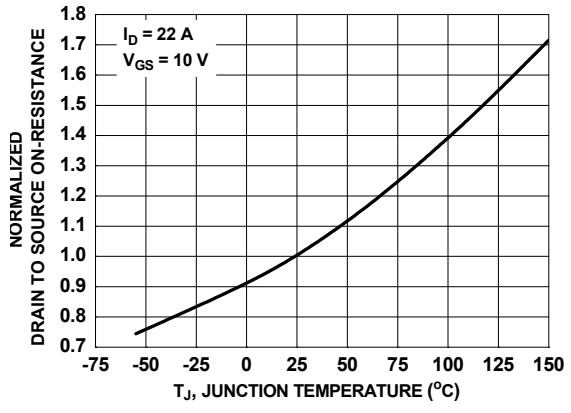


Figure 3. Normalized On Resistance vs. Junction Temperature

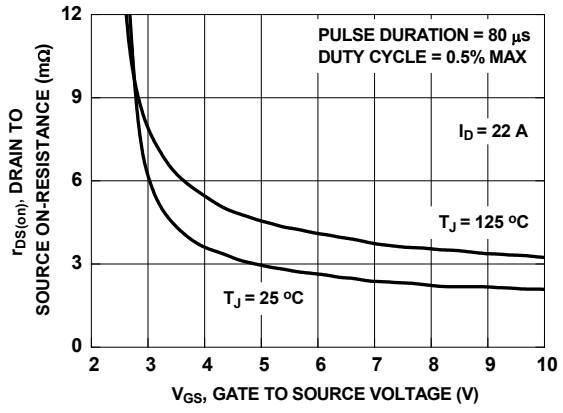


Figure 4. On-Resistance vs. Gate to Source Voltage

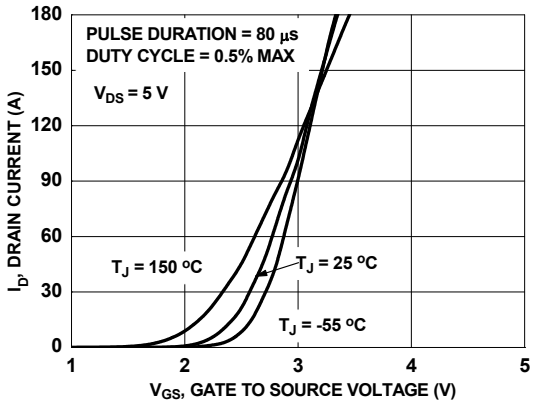


Figure 5. Transfer Characteristics

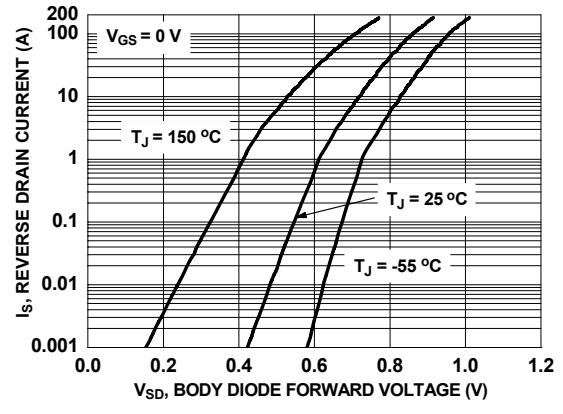


Figure 6. Source to Drain Diode Forward Voltage vs. Source Current

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

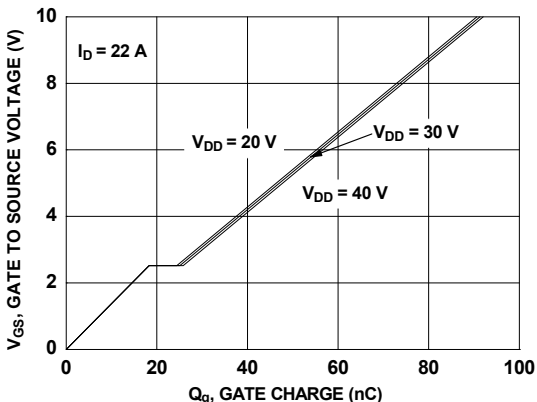


Figure 7. Gate Charge Characteristics

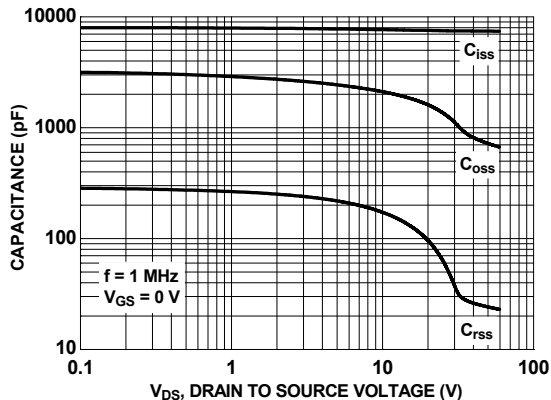


Figure 8. Capacitance vs. Drain to Source Voltage

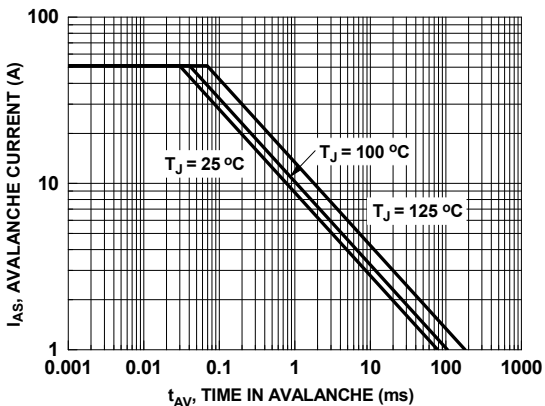


Figure 9. Unclamped Inductive Switching Capability

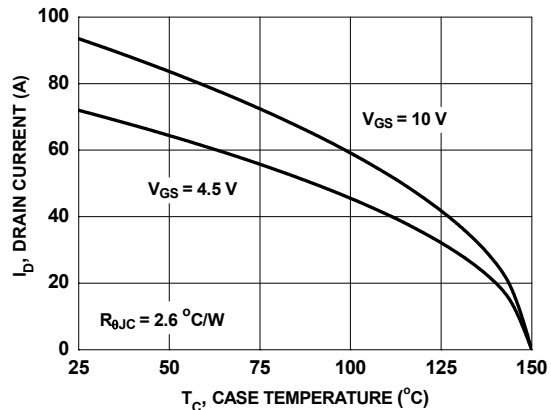


Figure 10. Maximum Continuous Drain Current vs. Case Temperature

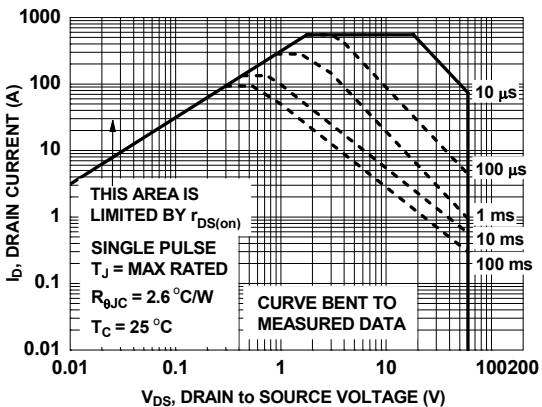


Figure 11. Forward Bias Safe Operating Area

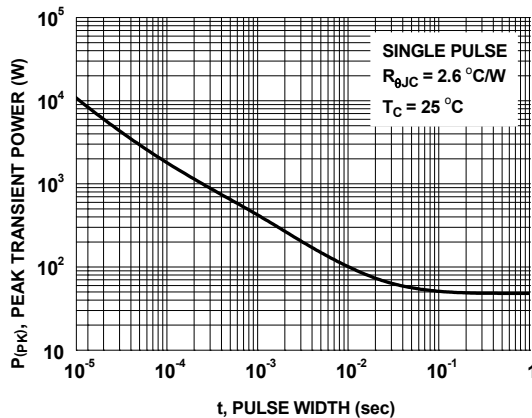


Figure 12. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q1 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

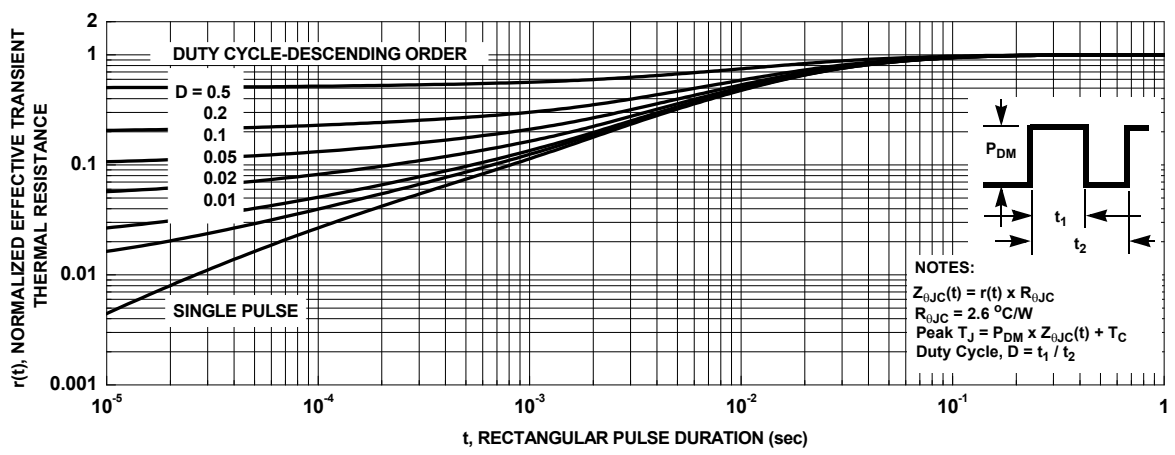


Figure 13. Junction-to-Case Transient Thermal Response Curve

Typical Characteristics (Q2 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

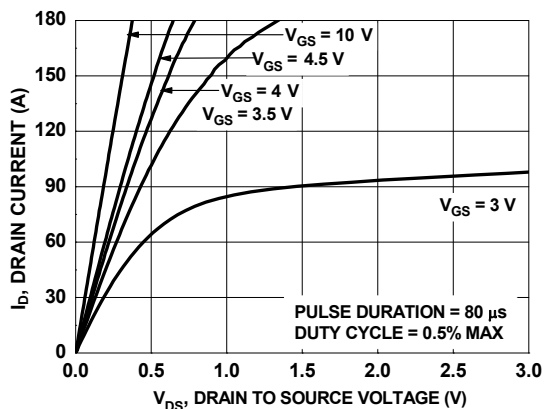


Figure 14. On-Region Characteristics

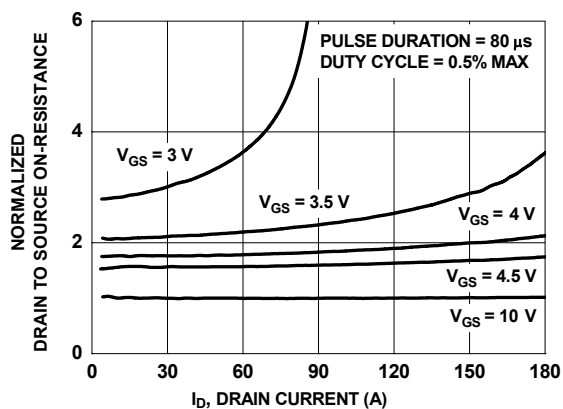


Figure 15. Normalized on-Resistance vs. Drain Current and Gate Voltage

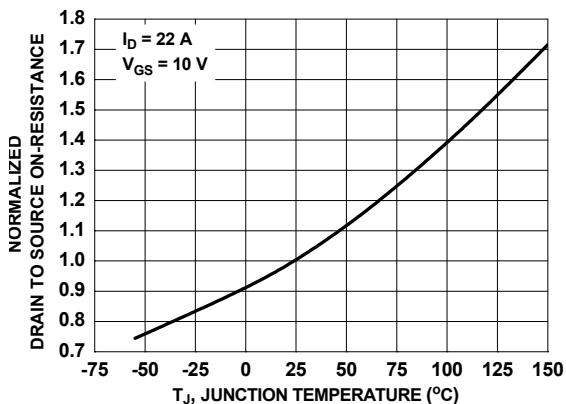


Figure 16. Normalized On-Resistance vs. Junction Temperature

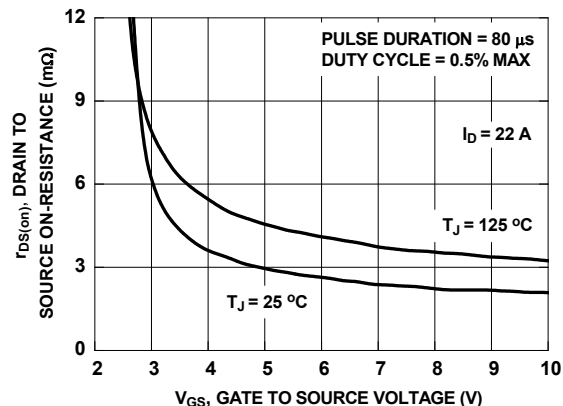


Figure 17. On-Resistance vs. Gate to Source Voltage

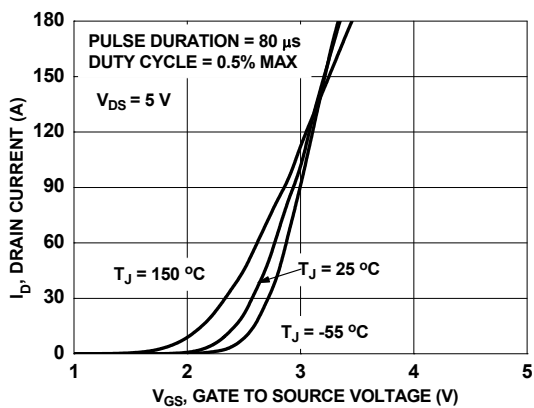


Figure 18. Transfer Characteristics

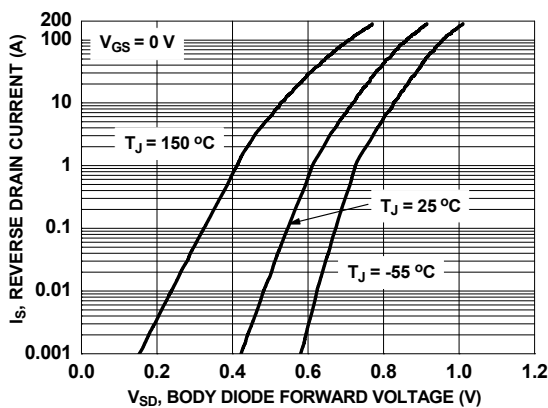


Figure 19. Source to Drain Diode Forward Voltage vs. Source Current

Typical Characteristics (Q2 N-Channel) $T_J = 25^\circ\text{C}$ unless otherwise noted.

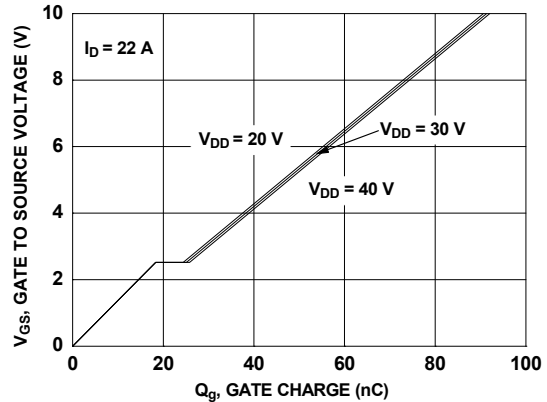


Figure 20. Gate Charge Characteristics

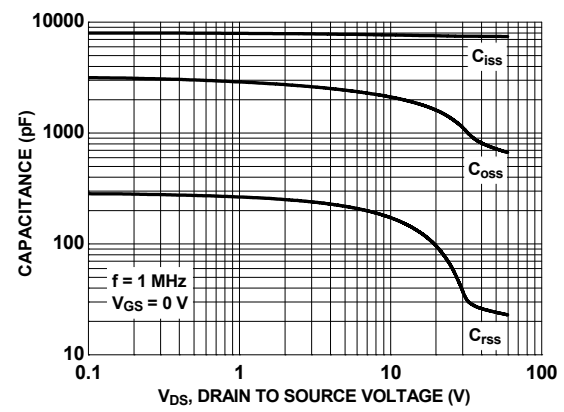


Figure 21. Capacitance vs. Drain to Source Voltage

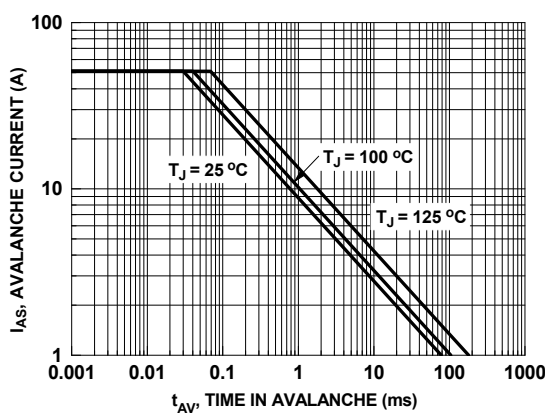


Figure 22. Unclamped Inductive Switching Capability

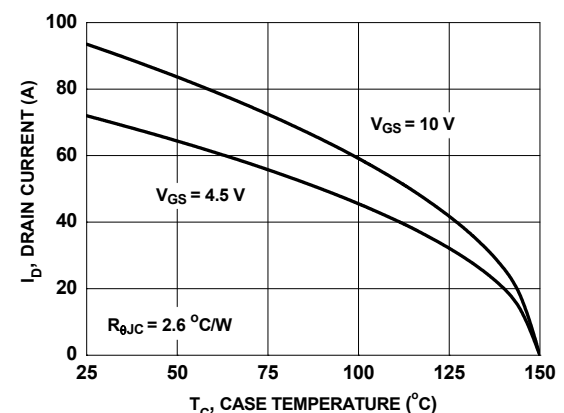


Figure 23. Maximum Continuous Drain Current vs. Case Temperature

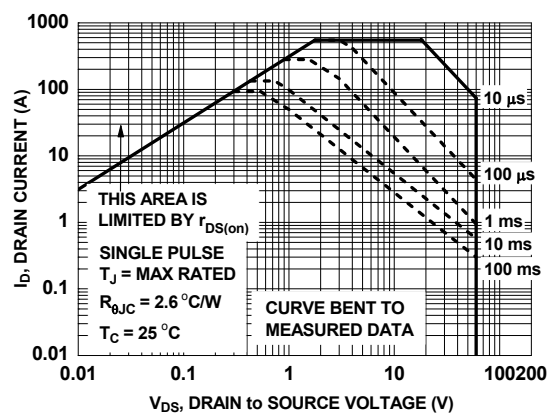


Figure 24. Forward Bias Safe Operating Area

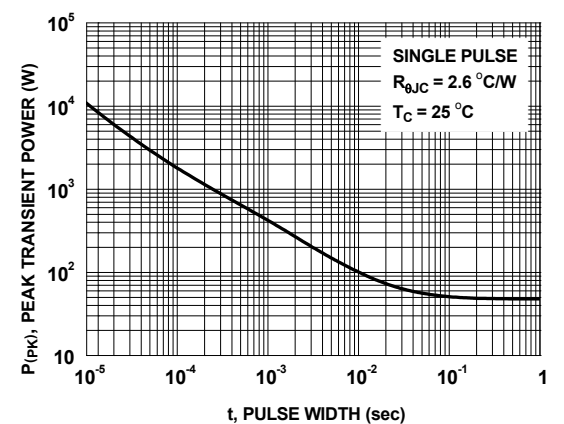


Figure 25. Single Pulse Maximum Power Dissipation

Typical Characteristics (Q2 N-Channel) $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted.

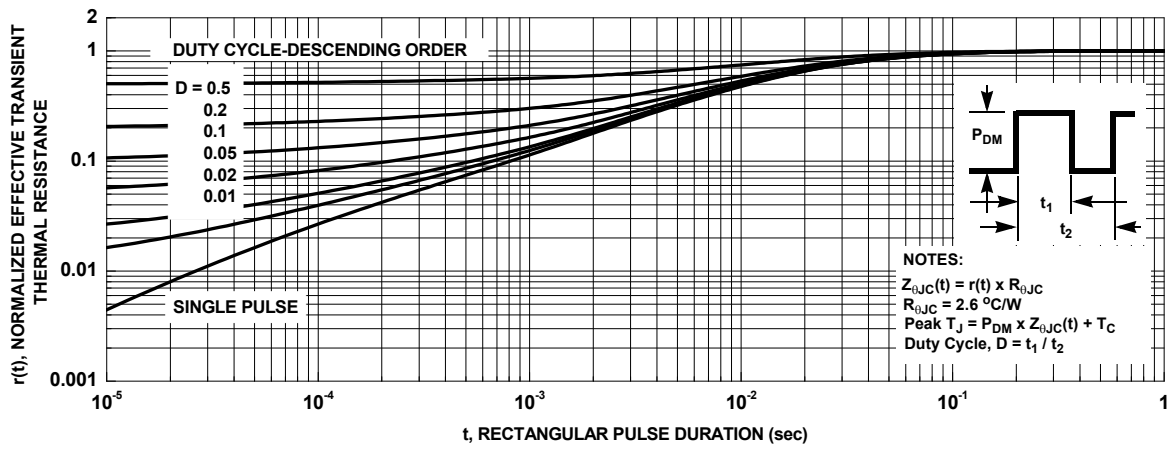
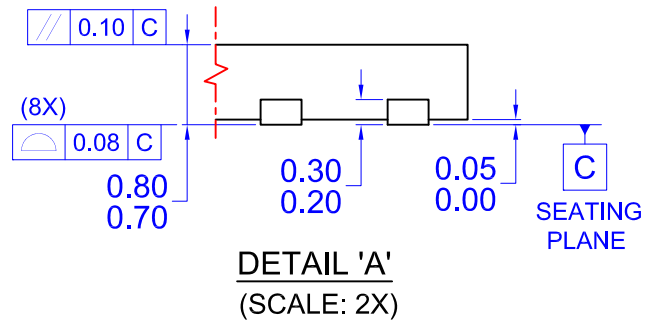
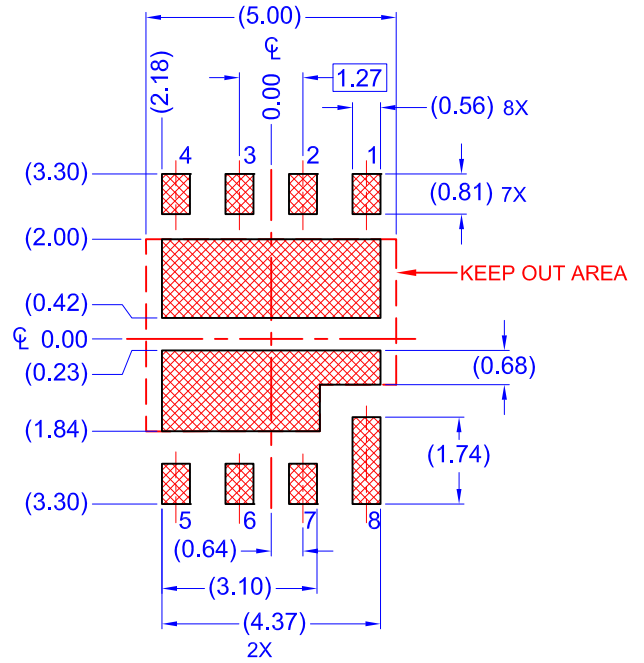
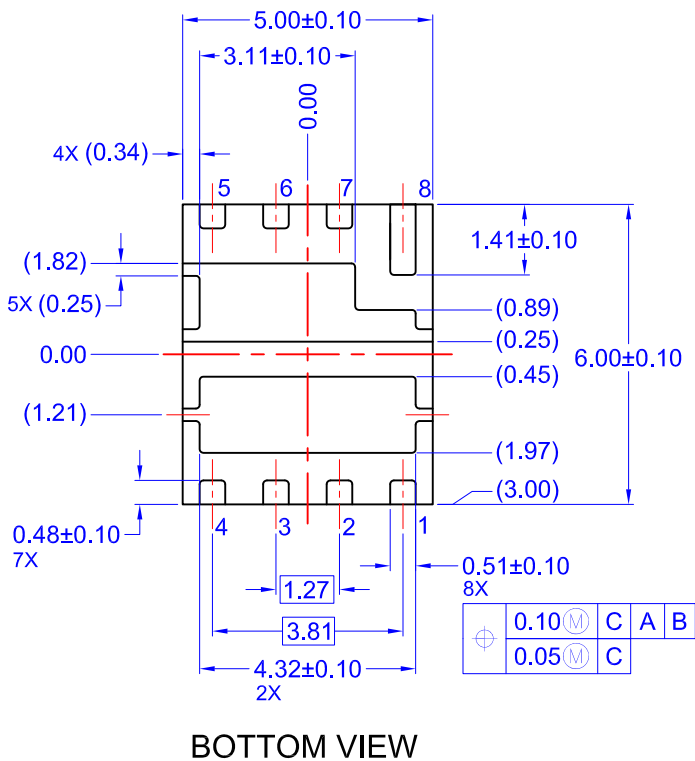
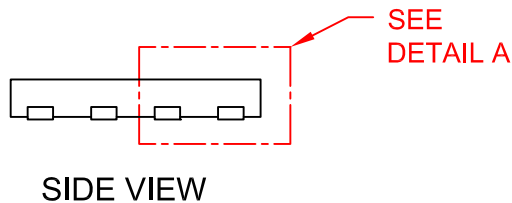
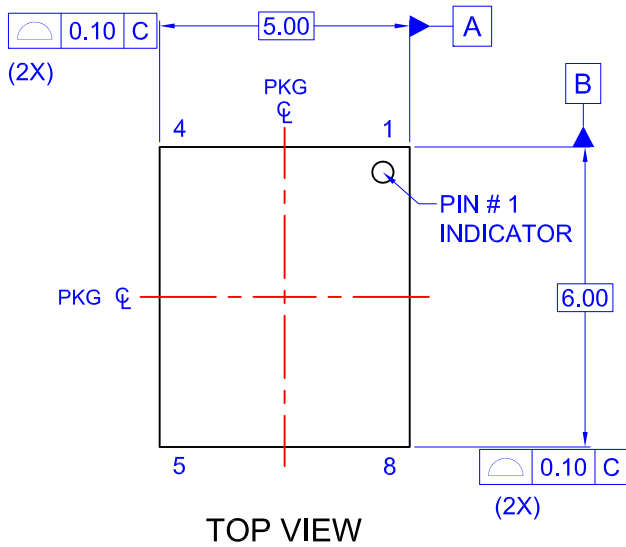


Figure 26. Junction-to-Case Transient Thermal Response Curve



- NOTES: UNLESS OTHERWISE SPECIFIED
- A) PACKAGE STANDARD REFERENCE: JEDEC REGISTRATION, MO-240, VARIATION 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.
 - F) DRAWING FILE NAME: MKT-PQFN08QREV2



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