FAIRCHILD SEMICONDUCTOR®

October 2006

# FDMC6890NZ
# Dual N-Channel PowerTrench® MOSFET
**20V, 4A, Q1:68mΩ, Q2:100mΩ**

## Features

Q1: N-Channel

- Max $r_{DS(on)}$ = 68mΩ at $V_{GS}$ = 4.5V, $I_D$ = 4A
- Max $r_{DS(on)}$ = 100mΩ at $V_{GS}$ = 2.5V, $I_D$ = 3A

Q2: N-Channel

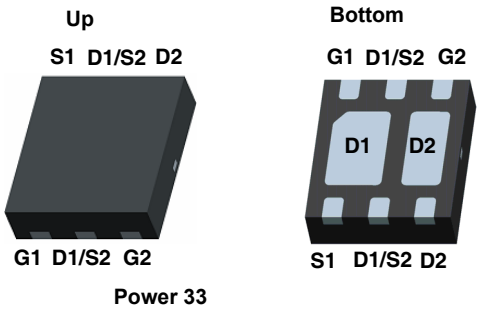
- Max $r_{DS(on)}$ = 100mΩ at $V_{GS}$ = 4.5V, $I_D$ = 4A
- Max $r_{DS(on)}$ = 150mΩ at $V_{GS}$ = 2.5V, $I_D$ = 2A
- Low gate Charge
- RoHS Compliant

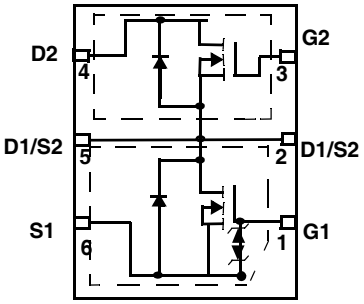
## General Description

FDMC6890NZ is a compact single package solution for DC to DC converters with excellent thermal and switching characteristics. Inside the Power 33 package features two N-channel MOSFETs with low on-state resistance and low gate charge to maximize the power conversion and switching efficiency. The Q1 switch also integrates gate protection from unclamped voltage input.

## Application

- DC - DC Conversion




## MOSFET Maximum Ratings $T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Q1 | Q2 | Units |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 20 | 20 | V |
| $V_{GS}$ | Gate to Source Voltage | ±12 | ±12 | V |
| $I_D$ | -Continuous | 4 | | A |
| | -Pulsed | 10 | | |
| $P_D$ | Power Dissipation (Steady State) Q1 (Note 1a) | 1.92 | | W |
| | Power Dissipation (Steady State) Q2 | 1.78 | | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 | | °C |

### Thermal Characteristics

| | | | |
|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient Q1 (Note 1a) | 65 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient Q2 | 70 | |

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| 6890N | FDMC6890NZ | Power 33 | 7inch | 8mm | 3000 units |

## Electrical Characteristics $T_J$ = 25°C unless otherwise noted

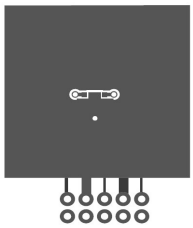
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250μA, $V_{GS}$ = 0V | Q1<br>Q2 | 20<br>20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250μA, referenced to 25°C | Q1<br>Q2 | | 13<br>12 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 16V, $V_{GS}$ = 0V | Q1<br>Q2 | | | 1<br>1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±12V, $V_{DS}$= 0V | Q1<br>Q2 | | | ±10<br>±100 | μA<br>nA |
| **On Characteristics** | | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250μA | Q1<br>Q2 | 0.6<br>0.6 | 0.9<br>1.0 | 2<br>2 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250μA, referenced to 25°C | Q1<br>Q2 | | -3<br>-3 | | mV/°C |
| $r_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 4.5V, $I_D$ = 4A<br>$V_{GS}$ = 2.5V, $I_D$ = 3A | Q1 | | 58<br>77 | 68<br>100 | mΩ |
| | | $V_{GS}$ = 4.5V, $I_D$ = 4A<br>$V_{GS}$ = 2.5V, $I_D$ = 2A | Q2 | | 67<br>102 | 100<br>150 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = V, $I_D$ =4A | Q1<br>Q2 | | 10<br>7 | | S |
| **Dynamic Characteristics** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 10V, $V_{GS}$ = 0V, f= 1MHZ | Q1<br>Q2 | | 205<br>190 | 270<br>250 | pF |
| $C_{oss}$ | Output Capacitance | | Q1<br>Q2 | | 60<br>60 | 80<br>80 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | Q1<br>Q2 | | 40<br>35 | 60<br>55 | pF |
| $R_g$ | Gate Resistance | f = 1MHz | Q1<br>Q2 | | 3.3<br>2.8 | | Ω |
| **Switching Characteristics** | | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 10V, $I_D$ = 4A, $R_{GEN}$ = 6Ω | Q1<br>Q2 | | 4<br>4 | 10<br>10 | ns |
| $t_r$ | Rise Time | | Q1<br>Q2 | | 13<br>12 | 22<br>21 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | Q1<br>Q2 | | 10<br>7 | 19<br>14 | ns |
| $t_f$ | Fall Time | | Q1<br>Q2 | | 6<br>6 | 12<br>12 | ns |
| $Q_{g(TOT)}$ | Total Gate Charge at 4.5V | $V_{GS}$ = 0V to 4.5V | Q1<br>Q2 | | 2.4<br>1.8 | 3.4<br>2.6 | nC |
| $Q_{g(2)}$ | Total Gate Charge at 2V | $V_{DD}$ = 10 V<br>$I_D$ = 4A | Q1<br>Q2 | | 1.4<br>0.6 | 1.9<br>0.8 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | Q1<br>Q2 | | 0.4<br>0.5 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | Q1<br>Q2 | | 0.9<br>0.8 | | nC |

## Electrical Characteristics $T_J$ = 25°C unless otherwise noted

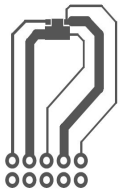
| Symbol | Parameter | Test Conditions | Type | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Drain-Source Diode Characteristics** | | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 4A | Q1<br>Q2 | | 0.94<br>0.92 | 1.25<br>1.25 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 4A, di/dt = 100A/s | Q1<br>Q2 | | 18<br>17 | 27<br>26 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | Q1<br>Q2 | | 9<br>10 | 14<br>15 | nC |

**Notes:**

**1:** $R_{\theta JA}$ is determined with the device mounted on a 1in$^2$ 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. 65°C/W when mounted on a 1 in$^2$ pad of 2 oz copper



b. 150°C/W when mounted on a minimum pad of 2 oz copper

**2:** Pulse Test: Pulse Width < 300μs, Duty cycle < 2.0%.

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted

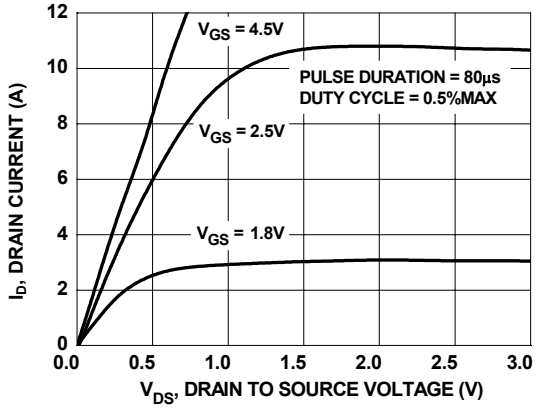



**Figure 1. On-Region Characteristics**

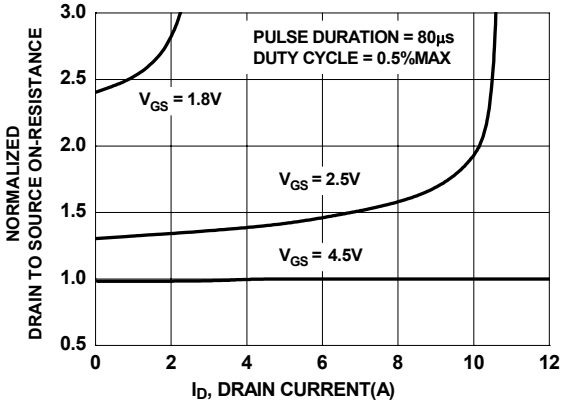



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

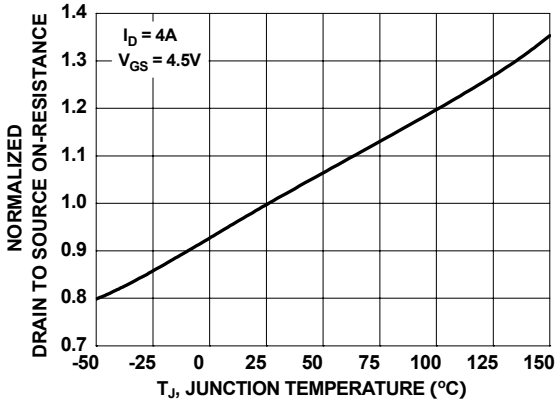



**Figure 3. Normalized On-Resistance vs Junction Temperature**

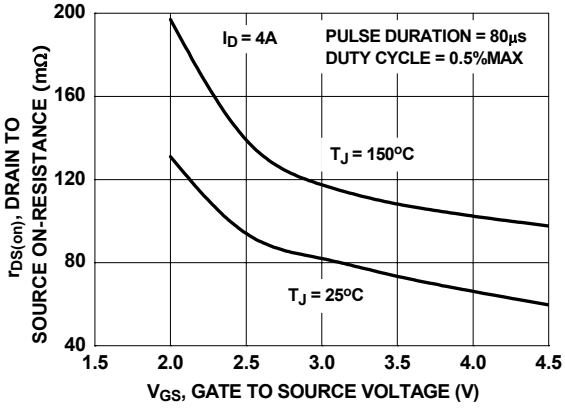



**Figure 4. On-Resistance vs Gate to Source Voltage**

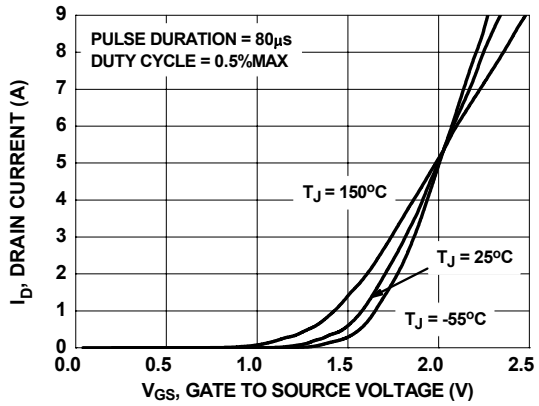



**Figure 5. Transfer Characteristics**

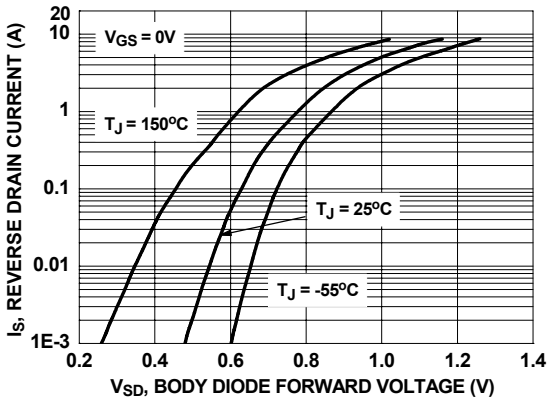



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted

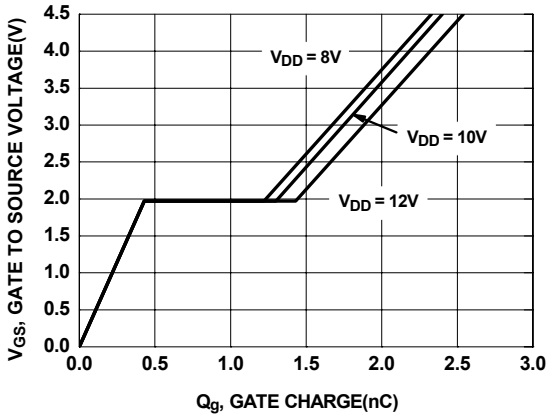



Figure 7. Gate Charge Characteristics

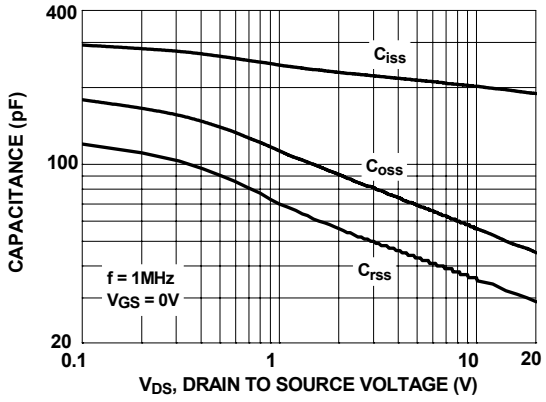



Figure 8. Capacitance vs Drain to Source Voltage

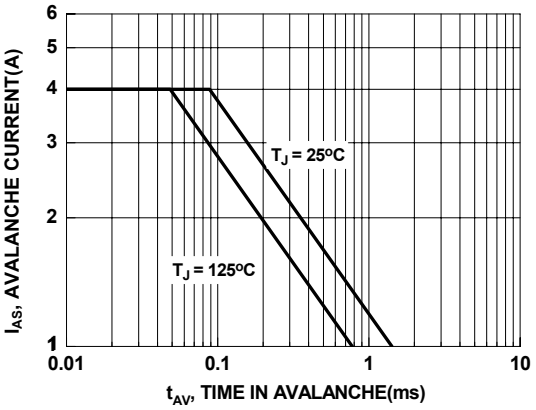



Figure 9. Unclamped Inductive Switching Capability

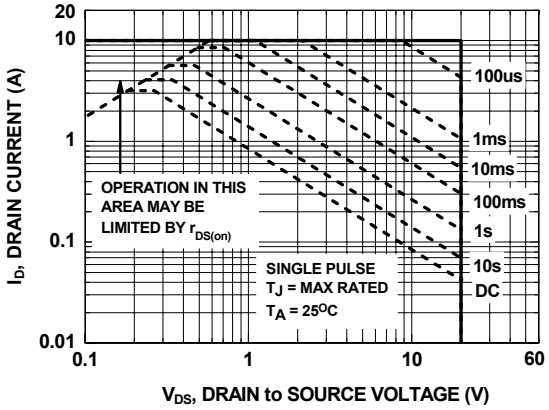



Figure 10. Forward Bias Safe Operating Area

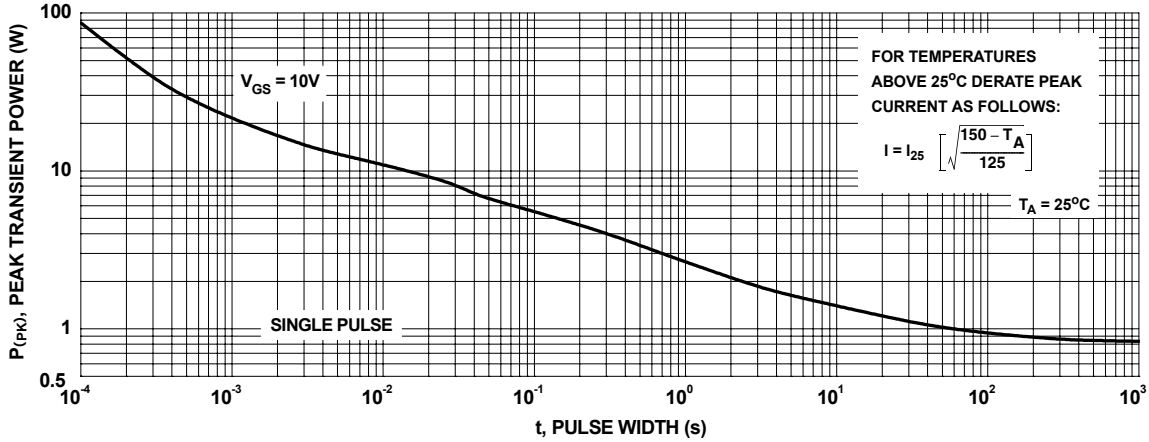



Figure 11. Single Pulse Maximum Power Dissipation

## Typical Characteristics (Q1 N-Channel) $T_J$ = 25°C unless otherwise noted

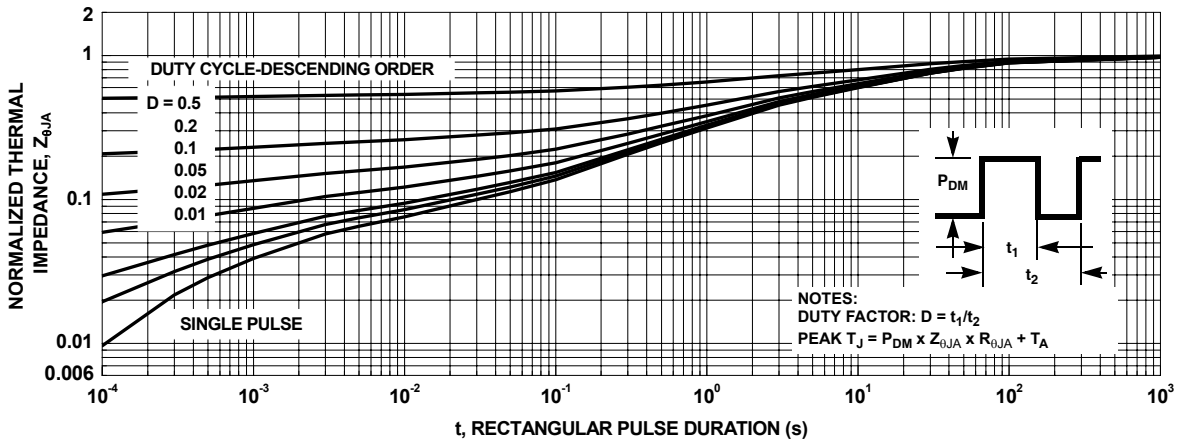



**Figure 12. Transient Thermal Response Curve**

## Typical Characteristics (Q2 N-Channel)

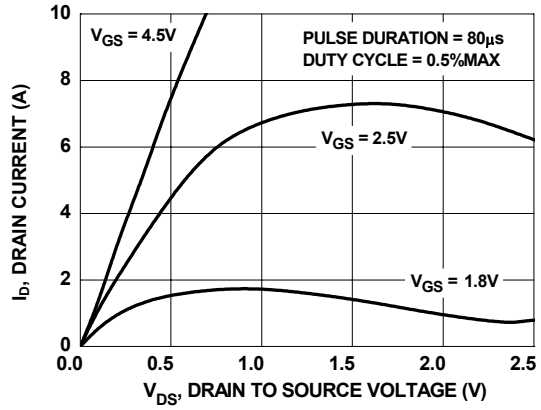



**Figure 13. On Region Characteristics**

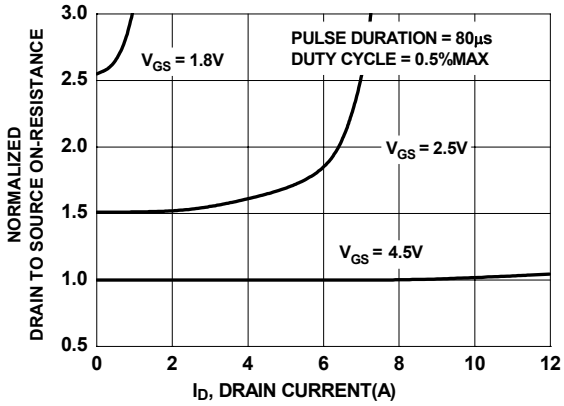



**Figure 14. Normalized on-Resistance vS Drain Current and Gate Voltage**

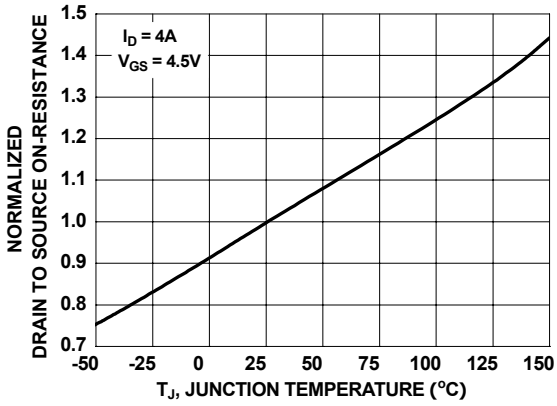



**Figure 15. Normalized On Resistance vs Junction Temperature**

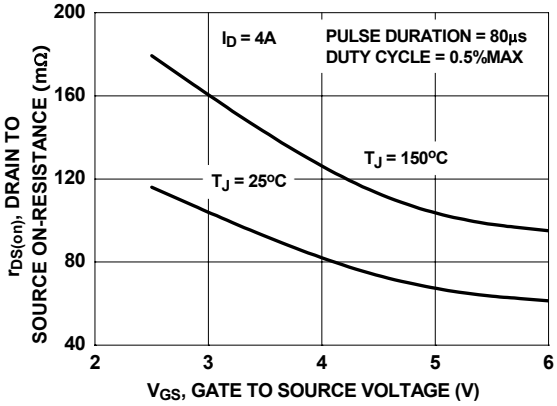



**Figure 16. On-Resistance vs Gate to Source Voltage**

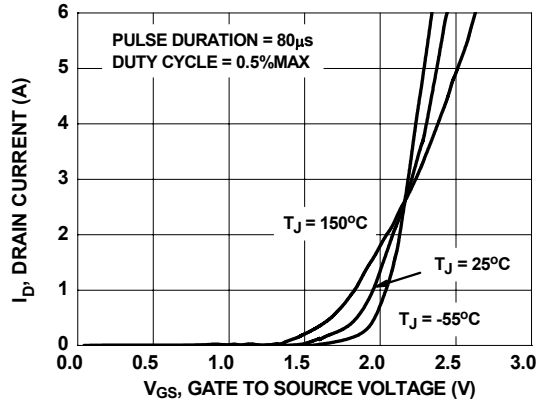



**Figure 17. Transfer Characteristics**

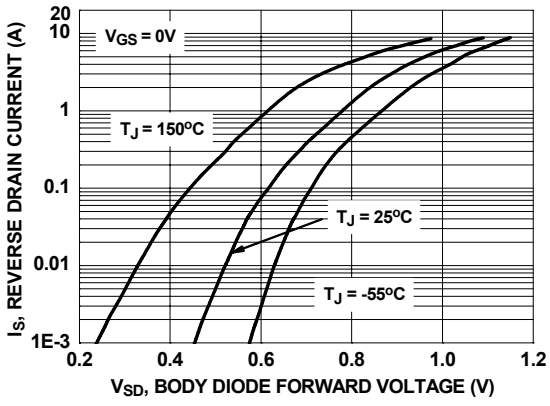



**Figure 18. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics

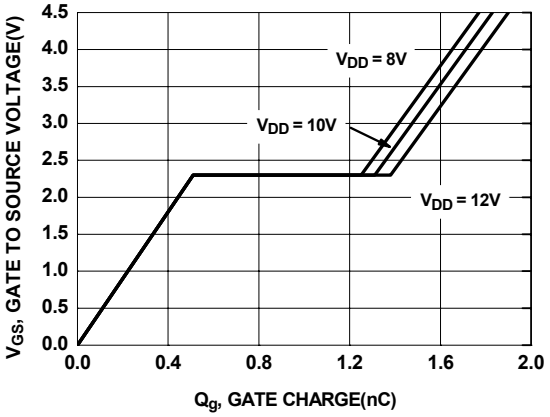



**Figure 19. Gate Charge Characteristics**

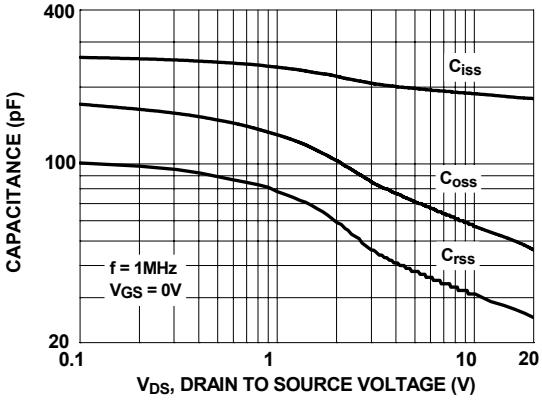



**Figure 20. Capacitance vs Drain to Source Voltage**

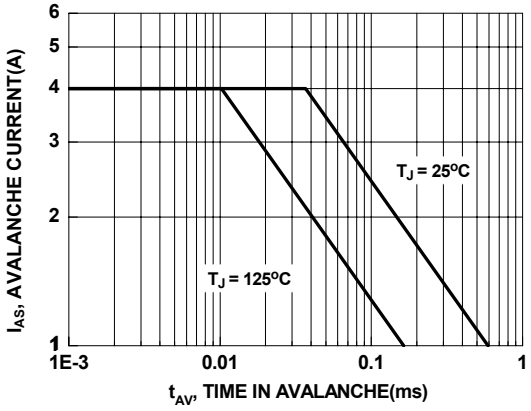



**Figure 21. Unclamped Inductive Switching Capability**

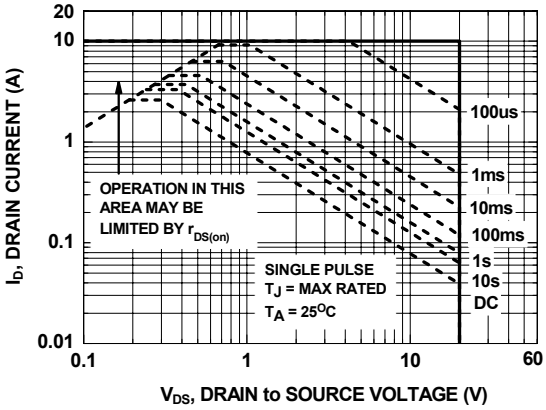



**Figure 22. Forward Bias Safe Operating Area**

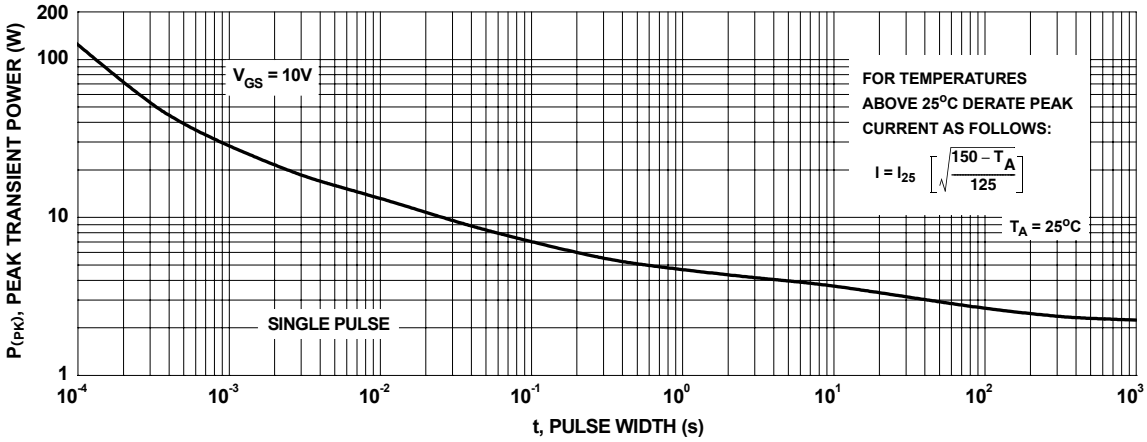



**Figure 23. Single Pulse Maximum Power Dissipation**

## Typical Characteristics

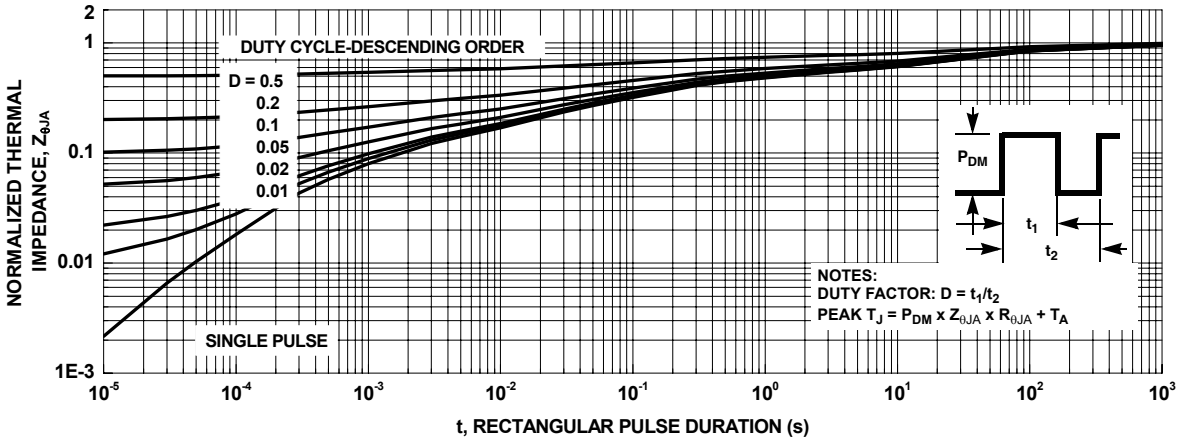
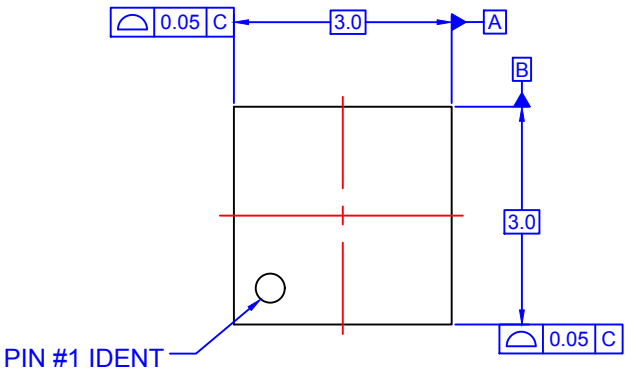
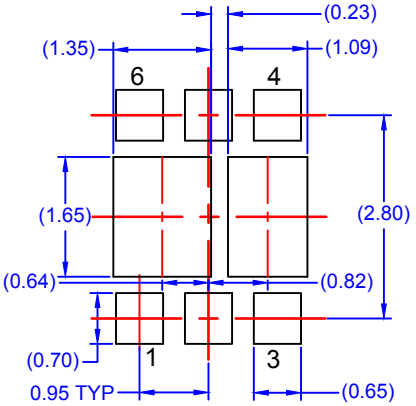


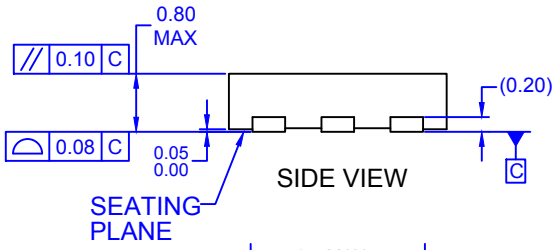

**Figure 24. Transient Thermal Response Curve**




TOP VIEW

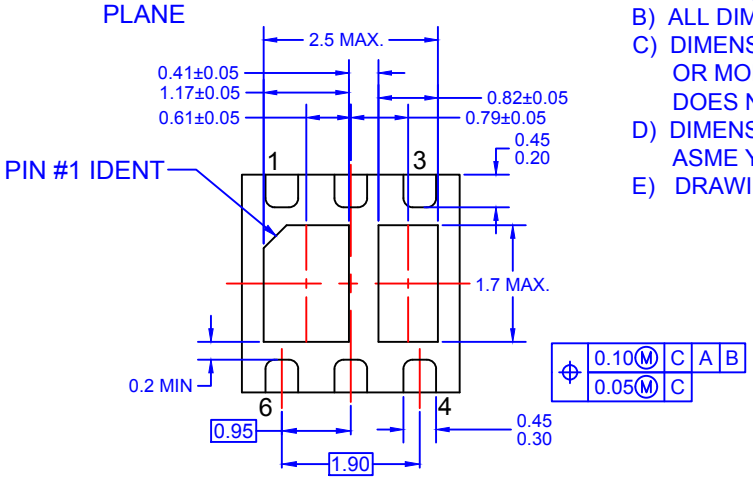



RECOMMENDED LAND PATTERN




SIDE VIEW

NOTES: UNLESS OTHERWISE SPECIFIED
A) CONFORMS TO JEDEC REGISTRATION, MO-229, VARIATION WEEA
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) DRAWING FILE NAME: MKT-MLP06HREV2




BOTTOM VIEW

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DEUXPEED®
Dual Cool™
EcoSPARK®
EfficientMax™
ESBC™
Fairchild®
Fairchild Semiconductor®
FACT Quiet Series™
FACT®
FastvCore™
FETBench™
FPS™
F-PFS™
FRFET®
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Green FPS™
Green FPS™ e-Series™
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MTx®
MVN®
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SuperSOT™-6
SuperSOT™-8
SupreMOS®
SyncFET™
Sync-Lock™
SYSTEM GENERAL®*
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TinyBuck®
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TinyLogic®
TINYOPTO™
TinyPower™
TinyPWM™
TinyWire™
TranSiC™
TriFault Detect™
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## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Terms of Use

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

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