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FDD86540

N-Channel PowerTrench[®] MOSFET 60 V, 136 A, 4.1 mΩ

Features

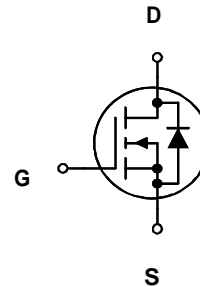
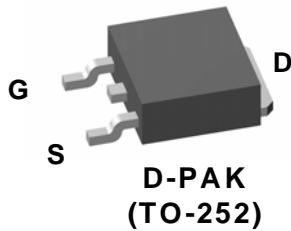
- Max $r_{DS(on)}$ = 4.1 mΩ at $V_{GS} = 10\text{ V}$, $I_D = 21.5\text{ A}$
- Max $r_{DS(on)}$ = 5 mΩ at $V_{GS} = 8\text{ V}$, $I_D = 19.5\text{ A}$
- 100% UIL tested
- RoHS Compliant

General Description

This N-Channel MOSFET has been designed specifically to improve the overall efficiency and to minimize switch node ringing of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low $r_{DS(on)}$, fast switching speed and body diode reverse recovery performance.

Applications

- Primary Switch in isolated DC-DC
- Synchronous Rectifier
- Load Switch



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

| Symbol | Parameter | Ratings | Units |
|----------------|--|--------------------------------|-------|
| V_{DS} | Drain to Source Voltage | 60 | V |
| V_{GS} | Gate to Source Voltage | ±20 | V |
| I_D | Drain Current -Continuous | $T_C = 25\text{ °C}$ (Note 5) | 136 |
| | -Continuous | $T_C = 100\text{ °C}$ (Note 5) | 86 |
| | -Continuous | $T_A = 25\text{ °C}$ (Note 1a) | 21.5 |
| | -Pulsed | (Note 4) | 240 |
| E_{AS} | Single Pulse Avalanche Energy | (Note 3) | 228 |
| P_D | Power Dissipation | $T_C = 25\text{ °C}$ | 127 |
| | Power Dissipation | $T_A = 25\text{ °C}$ (Note 1a) | 3.1 |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 to +150 | °C |

Thermal Characteristics

| | | | |
|-----------------|---|------|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 0.98 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 40 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|----------|---------------|-----------|------------|------------|
| FDD86540 | FDD86540 | D-PAK(TO-252) | 13 " | 16 mm | 2500 units |

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

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

Off Characteristics

| | | | | | | |
|--------------------------------------|---|---|----|----|-----------|----------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$ | 60 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\text{ }\mu\text{A}$, referenced to $25\text{ }^\circ\text{C}$ | | 28 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 48\text{ V}$, $V_{GS} = 0\text{ V}$ | | | 1 | μA |
| 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 | $V_{GS} = V_{DS}$, $I_D = 250\text{ }\mu\text{A}$ | 2 | 3.1 | 4 | 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 $25\text{ }^\circ\text{C}$ | | -11 | | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}$, $I_D = 21.5\text{ A}$ | | 3.4 | 4.1 | m Ω |
| | | $V_{GS} = 8\text{ V}$, $I_D = 19.5\text{ A}$ | | 4.1 | 5 | |
| | | $V_{GS} = 10\text{ V}$, $I_D = 21.5\text{ A}$, $T_J = 125\text{ }^\circ\text{C}$ | | 5.2 | 6.3 | |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{ V}$, $I_D = 21.5\text{ A}$ | | 75 | | S |

Dynamic Characteristics

| | | | | | | |
|-----------|------------------------------|--|--|------|------|----------|
| C_{iss} | Input Capacitance | $V_{DS} = 30\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1\text{ MHz}$ | | 4767 | 6340 | pF |
| C_{oss} | Output Capacitance | | | 1409 | 1880 | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 48 | 90 | pF |
| R_g | Gate Resistance | | | 0.6 | | Ω |

Switching Characteristics

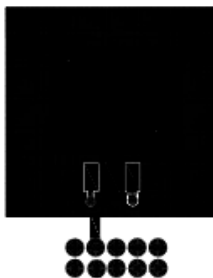
| | | | | | | |
|--------------|-------------------------------|--|---|-----|----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 30\text{ V}$, $I_D = 21.5\text{ A}$, $V_{GS} = 10\text{ V}$, $R_{GEN} = 6\text{ }\Omega$ | | 26 | 42 | ns |
| t_r | Rise Time | | | 15 | 28 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 31 | 49 | ns |
| t_f | Fall Time | | | 6.9 | 14 | ns |
| Q_g | Total Gate Charge | $V_{GS} = 0\text{ V}$ to 10 V | $V_{DD} = 30\text{ V}$, $I_D = 21.5\text{ A}$ | 65 | 90 | nC |
| Q_g | Total Gate Charge | $V_{GS} = 0\text{ V}$ to 8 V | | 54 | 75 | nC |
| Q_{gs} | Gate to Source Charge | | | 23 | | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | | 12 | | nC |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|------------------------------------|--|--|-----|-----|----|
| V_{SD} | Source-Drain Diode Forward Voltage | $V_{GS} = 0\text{ V}$, $I_S = 21.5\text{ A}$ (Note 2) | | 0.8 | 1.3 | V |
| | | $V_{GS} = 0\text{ V}$, $I_S = 2.6\text{ A}$ (Note 2) | | 0.7 | 1.2 | V |
| t_{rr} | Reverse Recovery Time | $I_F = 21.5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ | | 56 | 90 | ns |
| Q_{rr} | Reverse Recovery Charge | | | 43 | 69 | nC |

Notes:

- $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JA}$ is determined by the user's board design.



a) $40\text{ }^\circ\text{C}/\text{W}$ when mounted on a 1 in^2 pad of 2 oz copper



b) $96\text{ }^\circ\text{C}/\text{W}$ when mounted on a minimum pad

2: Pulse Test: Pulse Width < $300\text{ }\mu\text{s}$, Duty cycle < 2.0%.

3: Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 0.3\text{ mH}$, $I_{AS} = 39\text{ A}$, $V_{DD} = 54\text{ V}$, $V_{GS} = 10\text{ V}$.

4: Pulsed I_d please refer to Fig 11 SOA graph for more details.

5: Computed continuous current limited to Max Junction Temperature only, actual continuous current will be limited by thermal & electro-mechanical application board design.

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

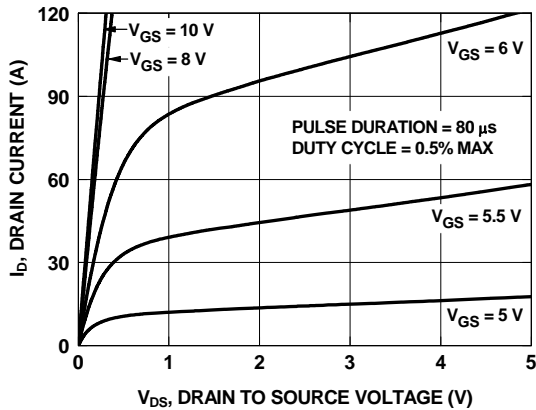


Figure 1. On-Region Characteristics

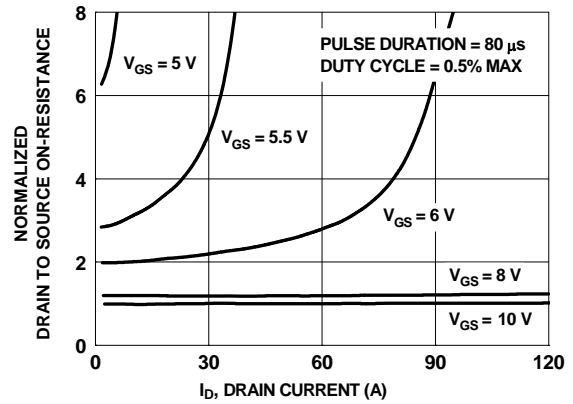


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

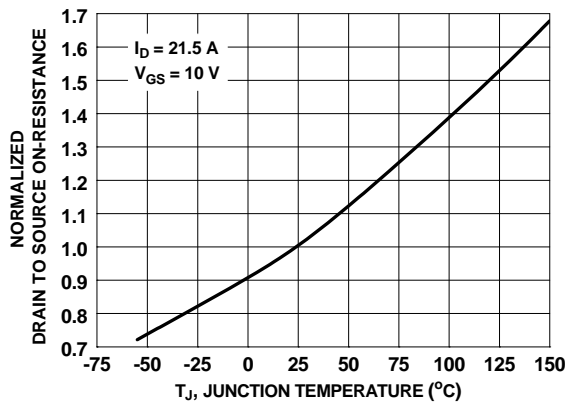


Figure 3. Normalized On-Resistance vs Junction Temperature

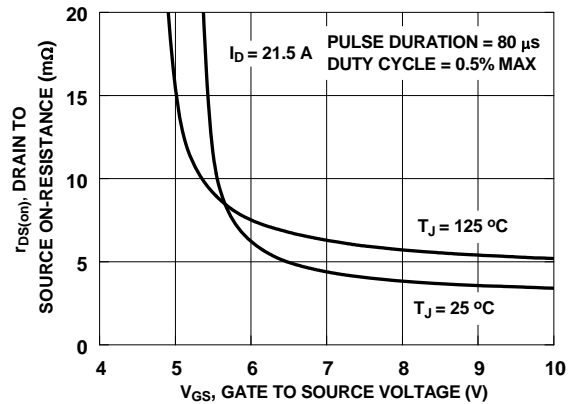


Figure 4. On-Resistance vs Gate to Source Voltage

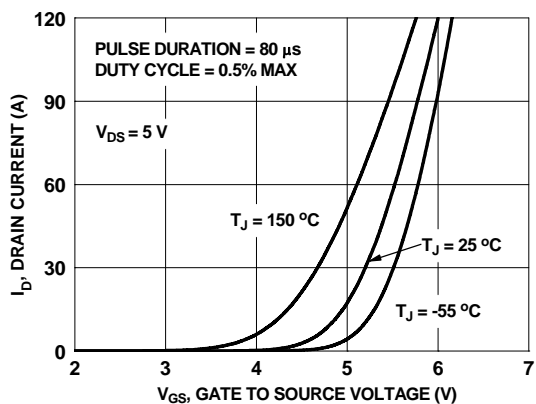


Figure 5. Transfer Characteristics

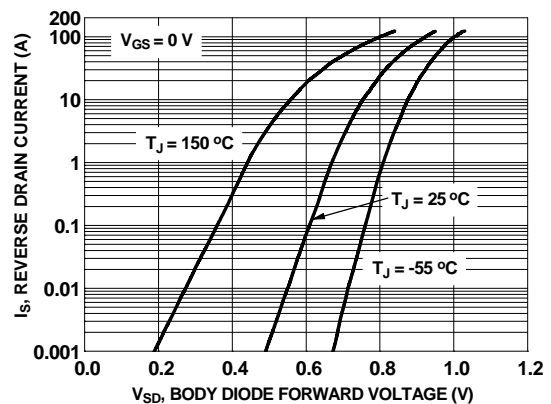


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

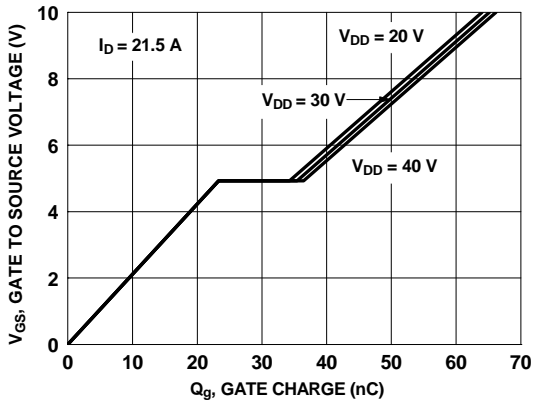


Figure 7. Gate Charge Characteristics

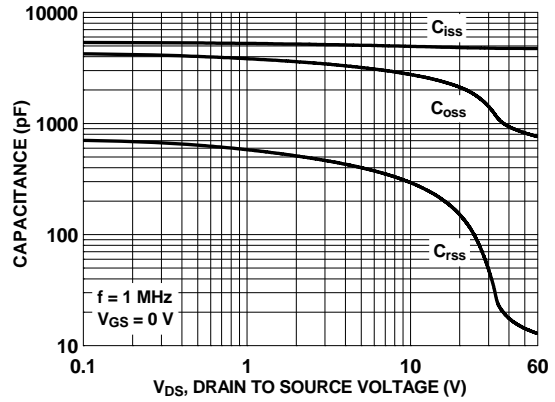


Figure 8. Capacitance vs Drain to Source Voltage

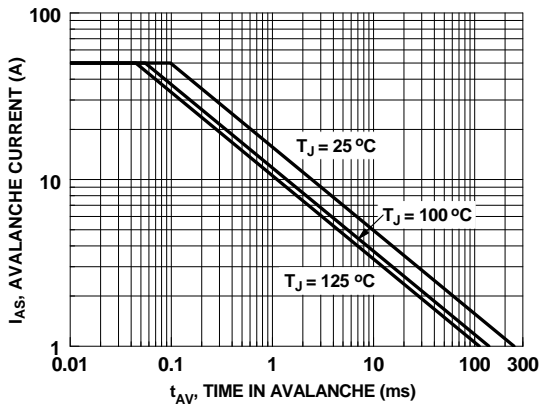


Figure 9. Unclamped Inductive Switching Capability

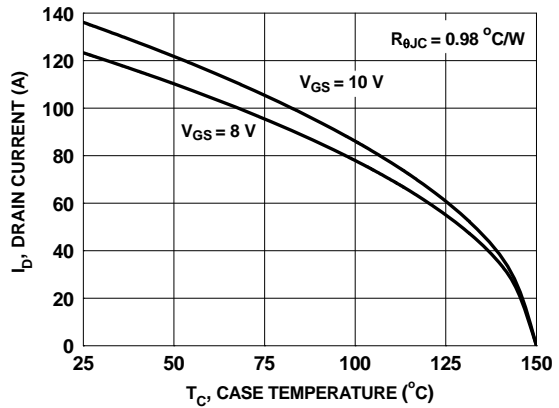


Figure 10. Maximum Continuous Drain Current vs Case Temperature

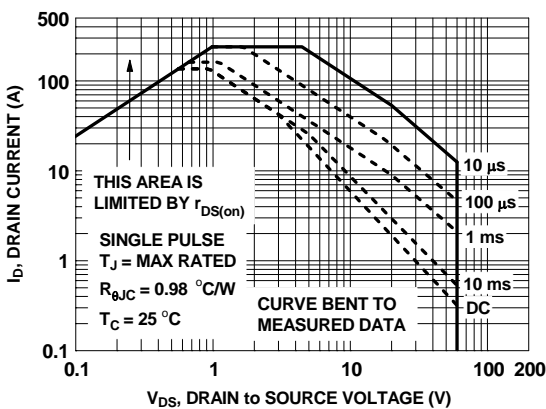


Figure 11. Forward Bias Safe Operating Area

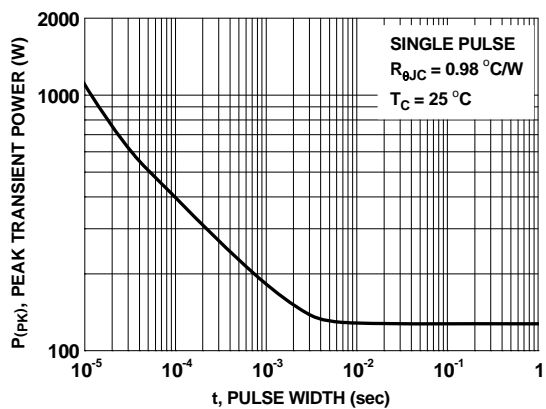


Figure 12. Single Pulse Maximum Power Dissipation

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

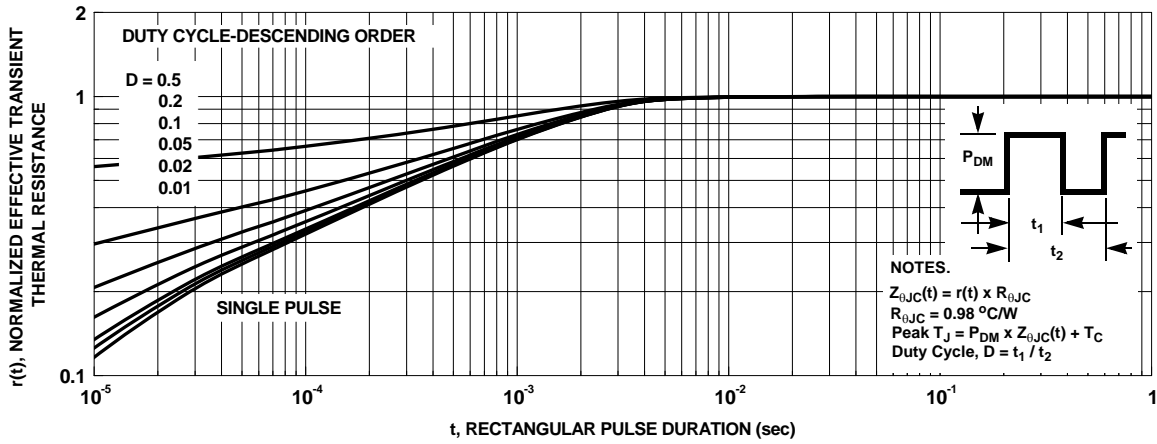


Figure 13. Junction-to-Case Transient Thermal Response Curve



NOTES: UNLESS OTHERWISE SPECIFIED
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.

B) ALL DIMENSIONS ARE IN MILLIMETERS.

C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.

D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.

E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS

F) DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH AND TIE BAR EXTRUSIONS.

G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.

H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11



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