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August 2014

FCMT199N60 — N-Channel SuperFET® II MOSFET

FCMT199N60

N-Channel SuperFET® II MOSFET

600 V, 20.2 A, 199 mΩ

Features

- 650 V @ $T_J = 150^\circ\text{C}$
- $R_{DS(on)} = 170\text{ m}\Omega$ (Typ.)
- Ultra Low Gate Charge (Typ. $Q_g = 57\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 160\text{ pF}$)
- 100% Avalanche Tested
- RoHS Compliant

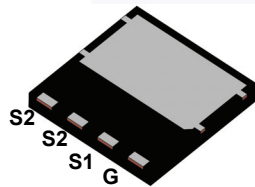
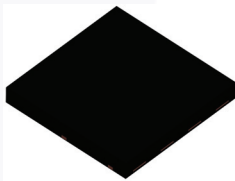
Applications

- Server and Telecom Power Supplies
- Solar Inverters
- Adaptors

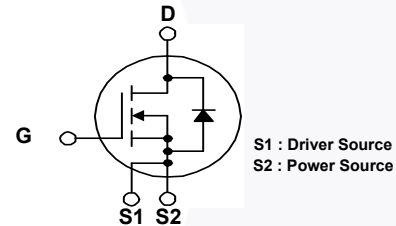
Description

SuperFET® II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET II MOSFET is very suitable for the switching power applications such as server/telecom power, adaptor and solar inverter applications.

The Power88 package is an ultra-slim surface-mount package (1 mm high) with a low profile and small footprint ($8 \times 8\text{ mm}^2$). SuperFET II MOSFET in a Power88 package offers excellent switching performance due to lower parasitic source inductance and separated power and drive sources. Power88 offers Moisture Sensitivity Level 1 (MSL 1).



Power88



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted.

| Symbol | Parameter | FCMT199N60 | Unit |
|----------------|--|---|------------------|
| V_{DSS} | Drain to Source Voltage | 600 | V |
| V_{GSS} | Gate to Source Voltage | -DC | ± 20 |
| | | -AC ($f > 1\text{ Hz}$) | ± 30 |
| I_D | Drain Current | -Continuous ($T_C = 25^\circ\text{C}$) | 20.2 |
| | | -Continuous ($T_C = 100^\circ\text{C}$) | 12.7 |
| I_{DM} | Drain Current | - Pulsed (Note 1) | 60.6 |
| E_{AS} | Single Pulsed Avalanche Energy | (Note 2) | 400 |
| I_{AR} | Avalanche Current | (Note 1) | 4.0 |
| E_{AR} | Repetitive Avalanche Energy | (Note 1) | 2.1 |
| dv/dt | Peak Diode Recovery dv/dt | (Note 3) | 20 |
| | MOSFET dv/dt | | 100 |
| P_D | Power Dissipation | ($T_C = 25^\circ\text{C}$) | 208 |
| | | - Derate above 25°C | 1.67 |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +150 | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300 | $^\circ\text{C}$ |

Thermal Characteristics

| Symbol | Parameter | FCMT199N60 | Unit |
|-----------------|--|------------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.6 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (* 1 in ² pad of 2 oz copper), Max. | 45 | |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|------------|---------|-----------|------------|----------|
| FCMT199N60 | FCMT199N60 | Power88 | - | - | 3000 |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------------|------|------|------|------|
|--------|-----------|-----------------|------|------|------|------|

Off Characteristics

| | | | | | | |
|--------------------------------|---|---|-----|------|-----------|---------------------------|
| BV_{DSS} | Drain to Source Breakdown Voltage | $V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_C = 25^\circ\text{C}$ | 600 | - | - | V |
| | | $V_{GS} = 0\text{ V}, I_D = 10\text{ mA}, T_C = 150^\circ\text{C}$ | 650 | - | - | |
| $\Delta BV_{DSS} / \Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D = 10\text{ mA}, \text{Referenced to } 25^\circ\text{C}$ | - | 0.67 | - | $\text{V}/^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | - | - | 1 | μA |
| | | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$ | - | 2.2 | - | |
| I_{GSS} | Gate to Body Leakage Current | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$ | - | - | ± 100 | nA |

On Characteristics

| | | | | | | |
|--------------|--------------------------------------|---|-----|-------|-------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$ | 2.5 | - | 3.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS} = 10\text{ V}, I_D = 10\text{ A}$ | - | 0.170 | 0.199 | Ω |
| g_{FS} | Forward Transconductance | $V_{DS} = 20\text{ V}, I_D = 10\text{ A}$ | - | 20 | - | S |

Dynamic Characteristics

| | | | | | | |
|-----------------------|-------------------------------|--|----------|------|------|----------|
| C_{iss} | Input Capacitance | $V_{DS} = 380\text{ V}, V_{GS} = 0\text{ V}$ $f = 1\text{ MHz}$ | - | 2043 | 2715 | pF |
| C_{oss} | Output Capacitance | | - | 45 | 60 | pF |
| C_{rSS} | Reverse Transfer Capacitance | | - | 7 | - | pF |
| $C_{oss\text{ eff.}}$ | Effective Output Capacitance | $V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$ | - | 160 | - | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10V | $V_{DS} = 380\text{ V}, I_D = 10\text{ A}$ $V_{GS} = 10\text{ V}$ | - | 57 | 74 | nC |
| Q_{gs} | Gate to Source Gate Charge | | - | 9 | - | nC |
| Q_{gd} | Gate to Drain "Miller" Charge | | (Note 4) | - | 21 | - |
| ESR | Equivalent Series Resistance | $f = 1\text{ MHz}$ | - | 1 | - | Ω |

Switching Characteristics

| | | | | | | | |
|--------------|---------------------|---|----------|----|----|-----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 380\text{ V}, I_D = 10\text{ A}$ $V_{GS} = 10\text{ V}, R_g = 4.7\ \Omega$ | - | 20 | 50 | ns | |
| t_r | Turn-On Rise Time | | - | 10 | 30 | ns | |
| $t_{d(off)}$ | Turn-Off Delay Time | | (Note 4) | - | 64 | 138 | ns |
| t_f | Turn-Off Fall Time | | (Note 4) | - | 5 | 20 | ns |

Drain-Source Diode Characteristics

| | | | | | | |
|----------|--|---|---|------|-----|---------------|
| I_S | Maximum Continuous Drain to Source Diode Forward Current | - | - | 20.2 | A | |
| I_{SM} | Maximum Pulsed Drain to Source Diode Forward Current | - | - | 60.6 | A | |
| V_{SD} | Drain to Source Diode Forward Voltage | $V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A}$ | - | - | 1.2 | V |
| t_{rr} | Reverse Recovery Time | $V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A}$ | - | 320 | - | ns |
| Q_{rr} | Reverse Recovery Charge | $di_F/dt = 100\text{ A}/\mu\text{s}$ | - | 5.1 | - | μC |

Notes:

1. Repetitive Rating: Pulse-width limited by maximum junction temperature.
2. $I_{AS} = 4\text{ A}, R_G = 25\ \Omega$, starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 10\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$, starting $T_J = 25^\circ\text{C}$
4. Essentially independent of operating temperature typical characteristics.

Typical Characteristics

Figure 1. On-Region Characteristics

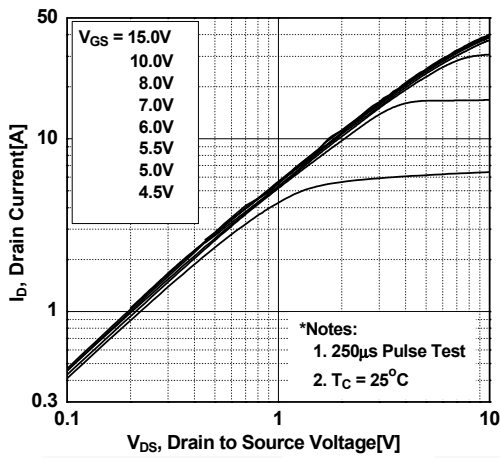


Figure 2. Transfer Characteristics

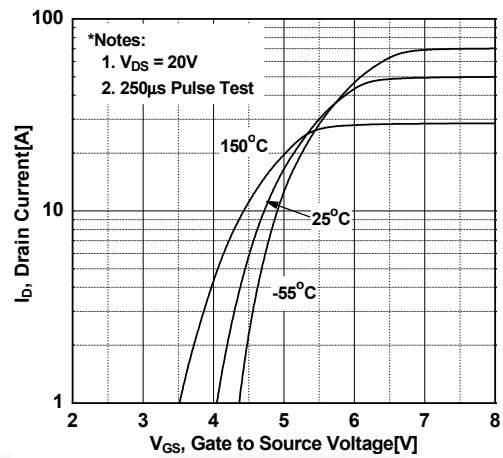


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

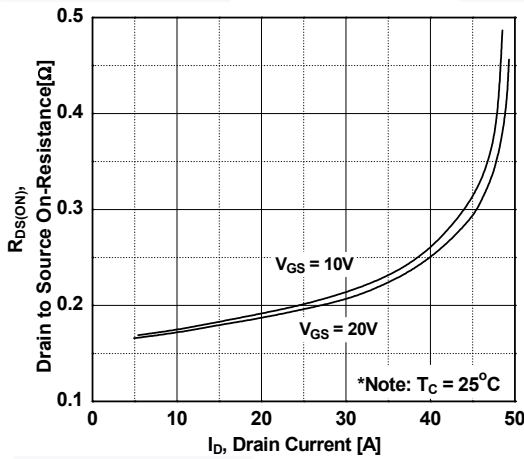


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature

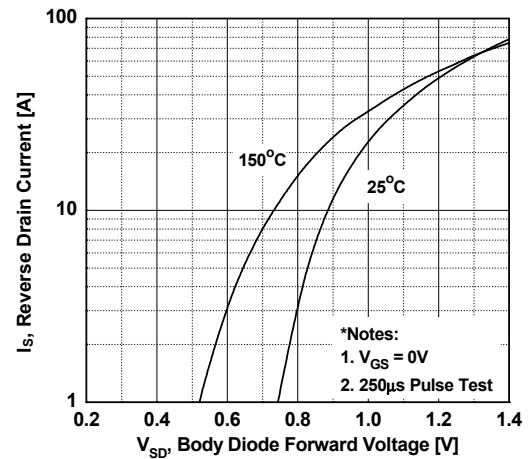


Figure 5. Capacitance Characteristics

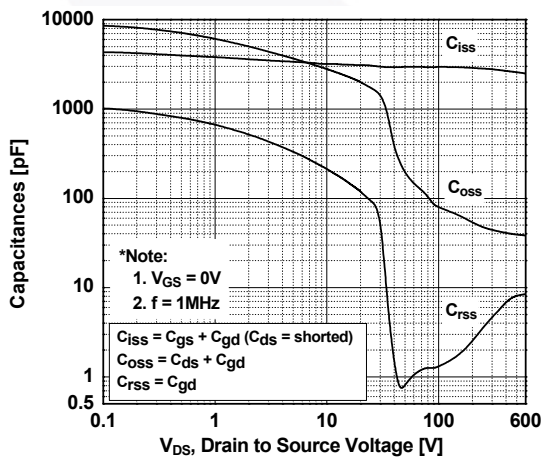
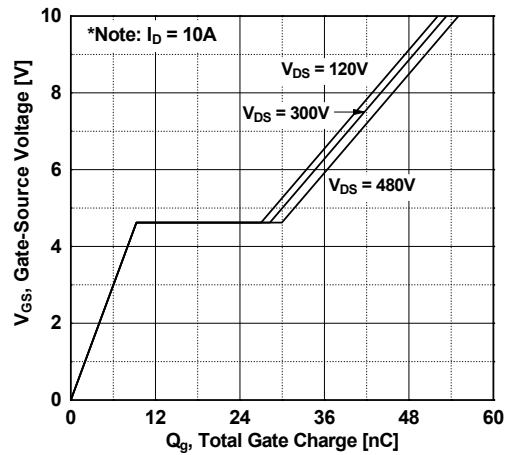


Figure 6. Gate Charge Characteristics



Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

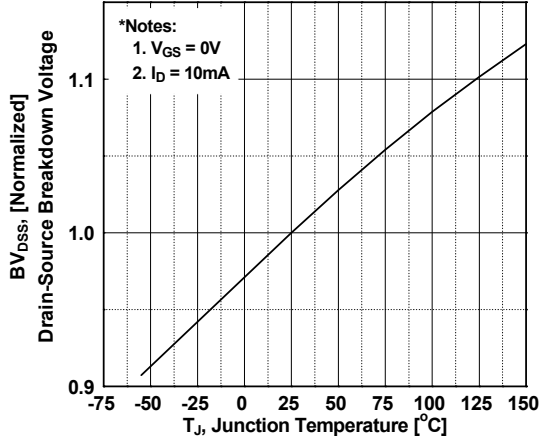


Figure 8. On-Resistance Variation vs. Temperature

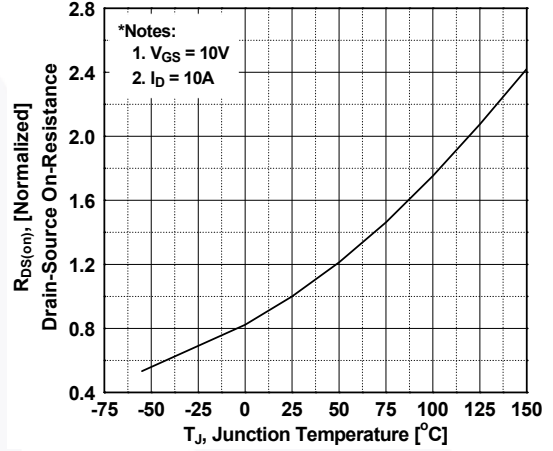


Figure 9. Maximum Safe Operating Area

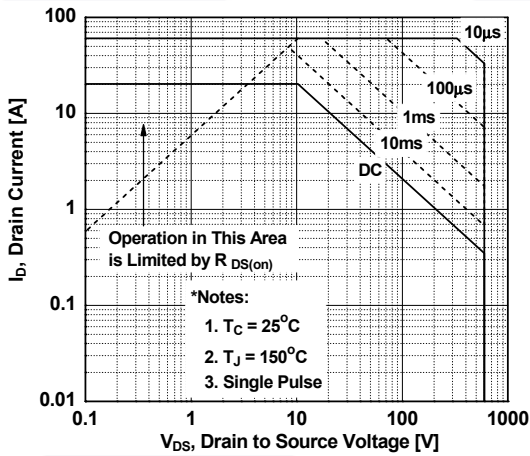


Figure 10. Maximum Drain Current vs. Case Temperature

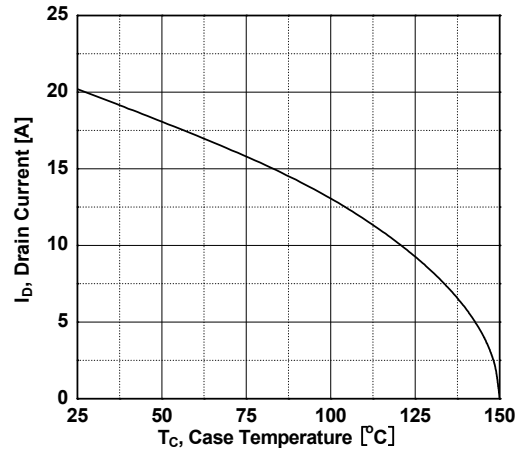
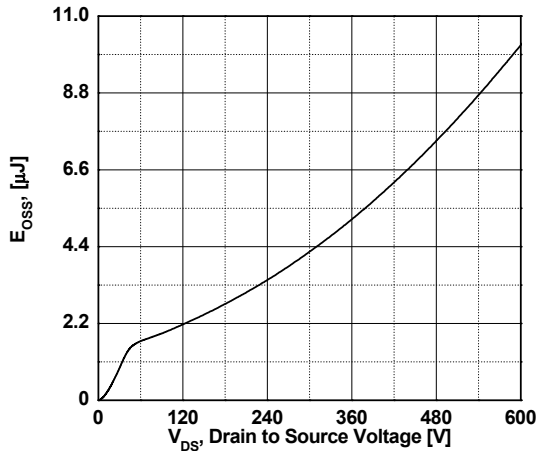
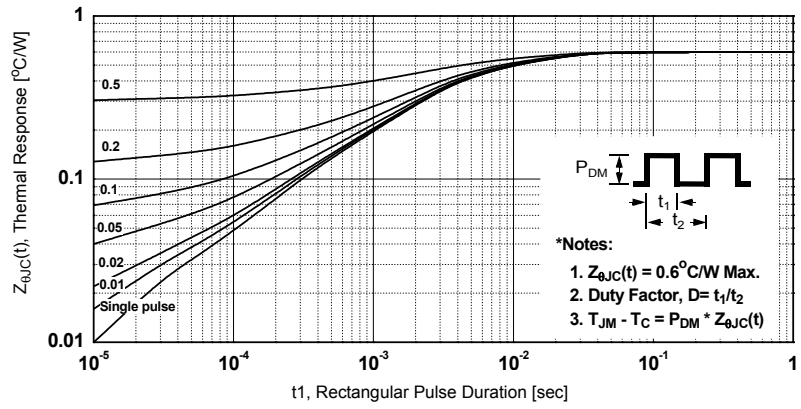


Figure 11. E_oss vs. Drain to Source Voltage Switching Capability



Typical Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



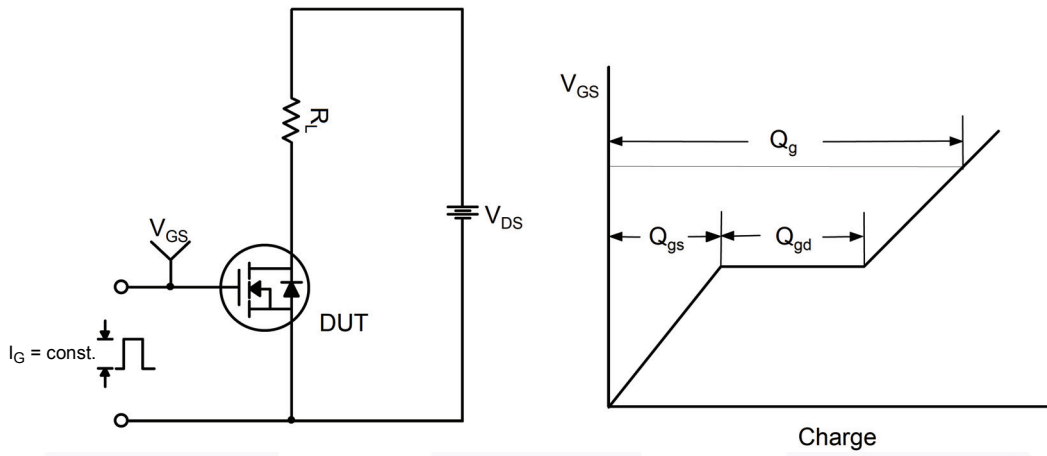


Figure 13. Gate Charge Test Circuit & Waveform

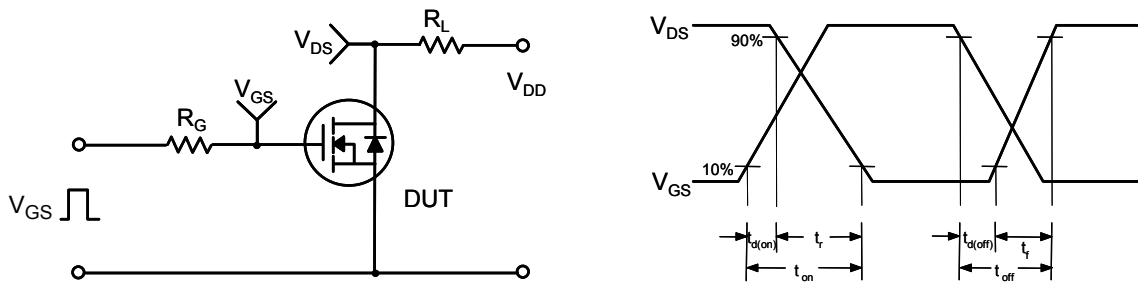


Figure 14. Resistive Switching Test Circuit & Waveforms

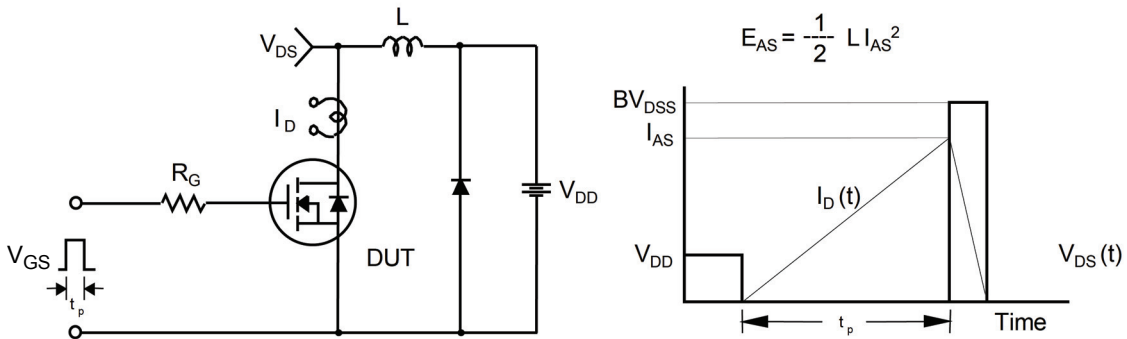
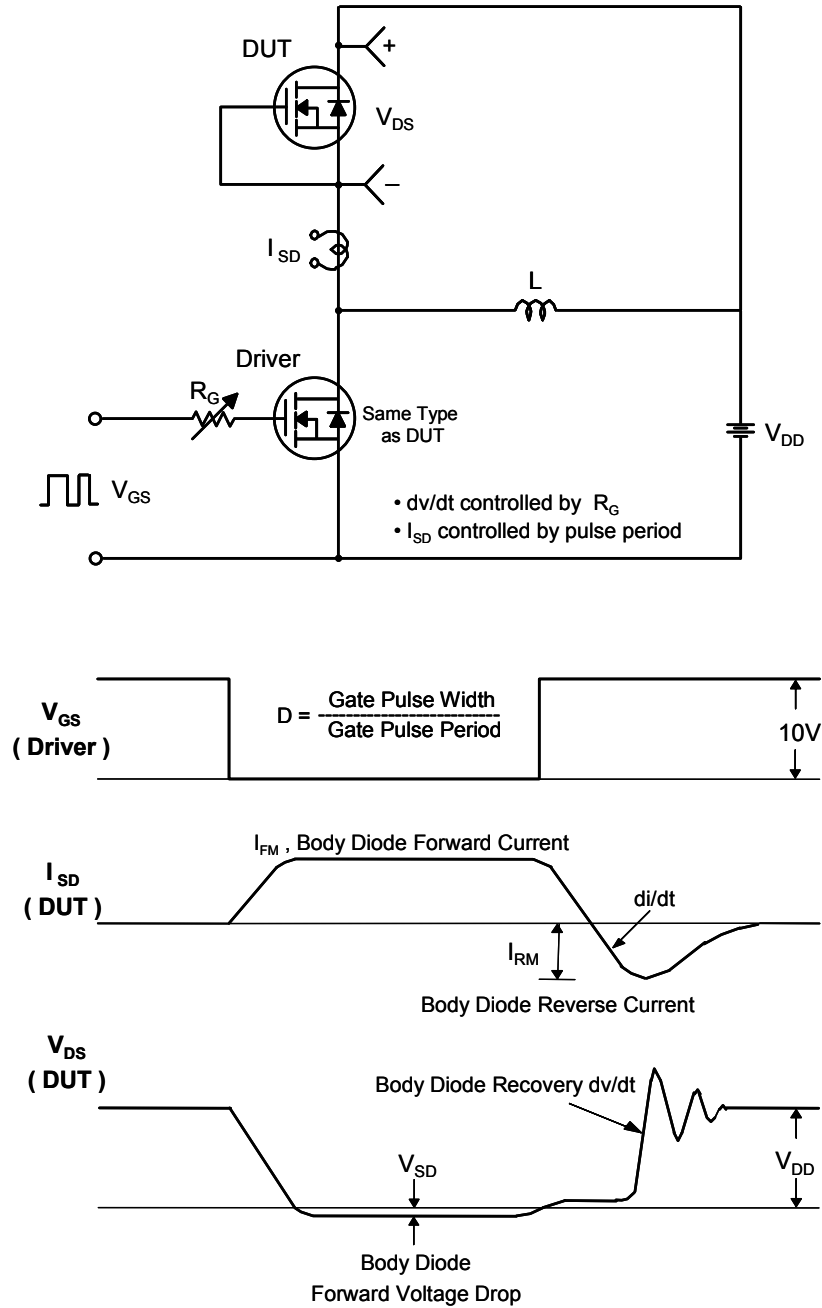


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

Figure 16. Peak Diode Recovery dv/dt Test Circuit & Waveforms



Mechanical Dimensions

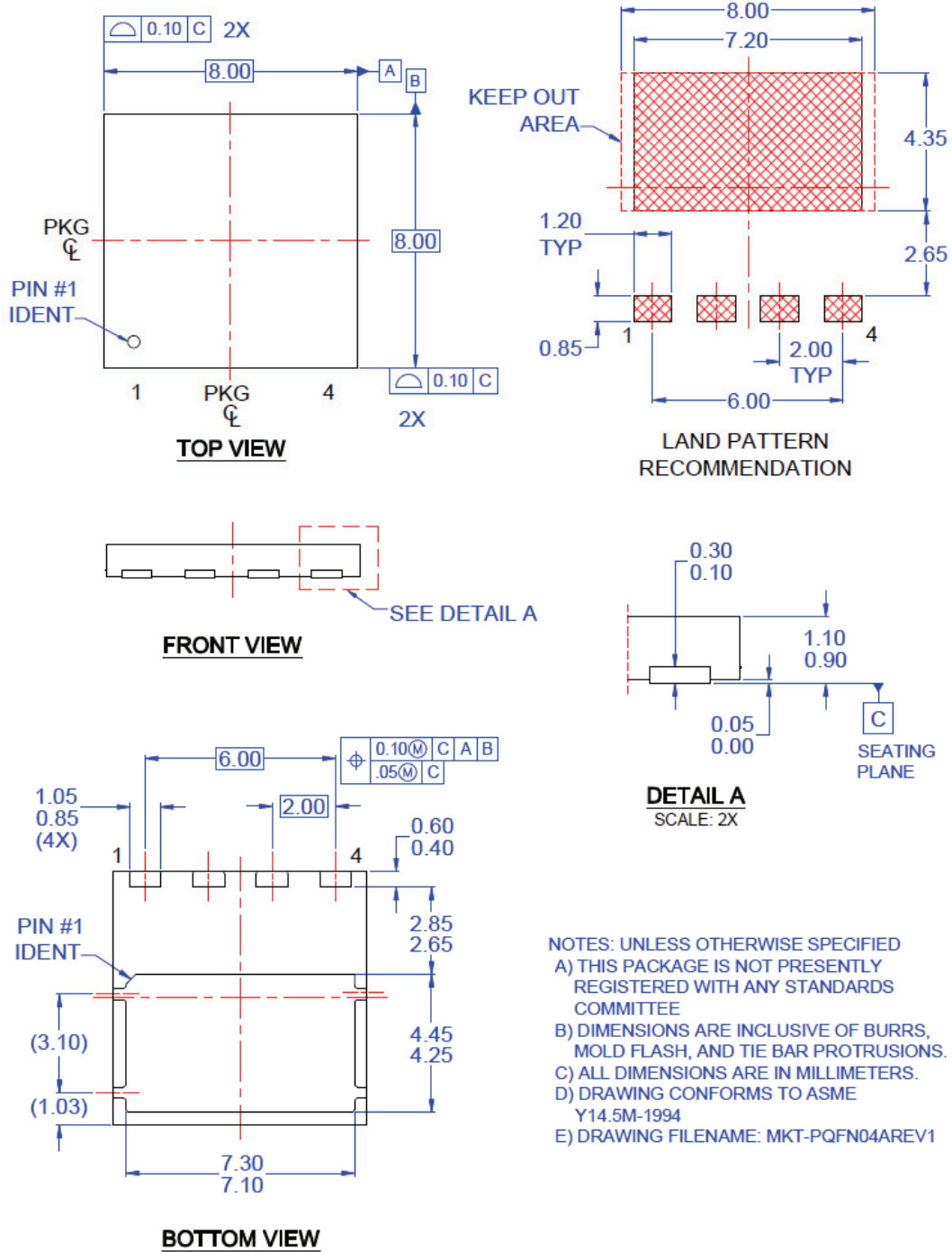


Figure 17. Molded Package, Power88, 4 Lead

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