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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

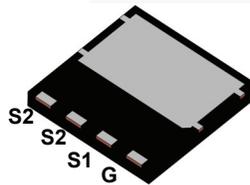
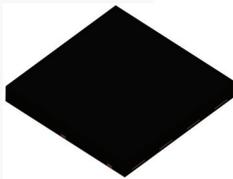
#### Applications

- Server and Telecom Power Supplies
- Solar Inverters
- Adaptors

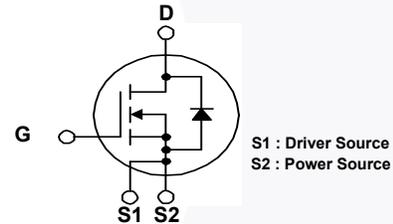
#### Description

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	$\pm 20$
		-AC ( $f > 1\text{ Hz}$ )	$\pm 30$
$I_D$	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 $25^\circ\text{C}$	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 <sup>2</sup> 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
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### 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	$I_D = 10\text{ mA}$ , Referenced to $25^\circ\text{C}$	-	0.67	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_C = 125^\circ\text{C}$	-	2.2	-	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$	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	$\Omega$
$g_{FS}$	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	-	$\Omega$

### Switching Characteristics

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

### Drain-Source Diode Characteristics

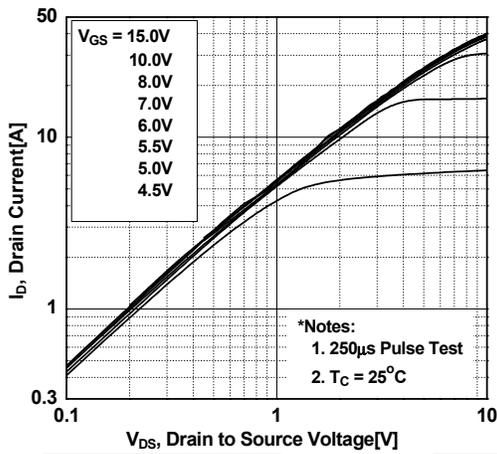
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	20.2	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	60.6	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_{SD} = 10\text{ A}$	-	-	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V},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

#### Notes:

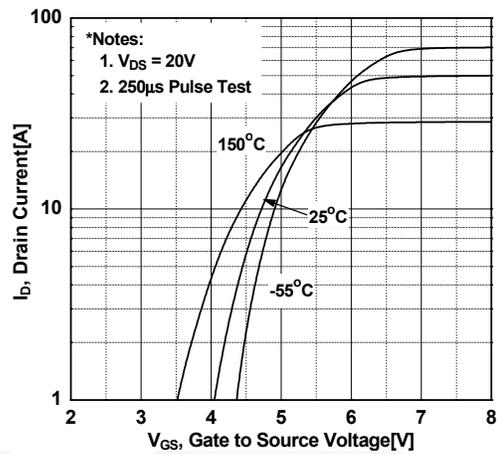
1. Repetitive Rating: Pulse-width limited by maximum junction temperature.
2.  $I_{AS} = 4\text{ A}$ ,  $R_G = 25\text{ }\Omega$ , starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 10\text{ A}$ ,  $di/dt \leq 200\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq BV_{DSS}$ , starting  $T_J = 25^\circ\text{C}$
4.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

## Typical Characteristics

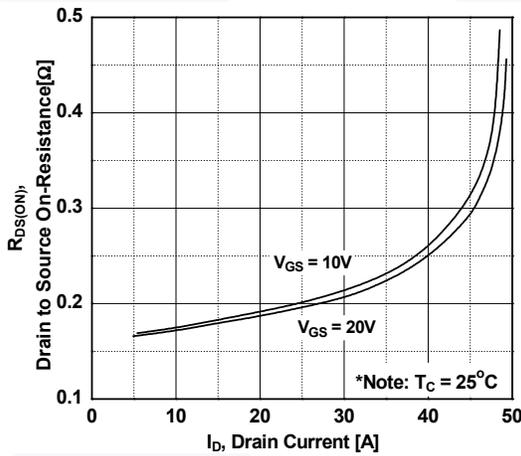
**Figure 1. On-Region Characteristics**



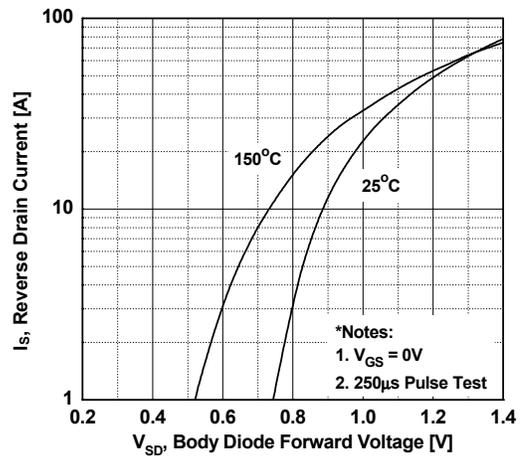
**Figure 2. Transfer Characteristics**



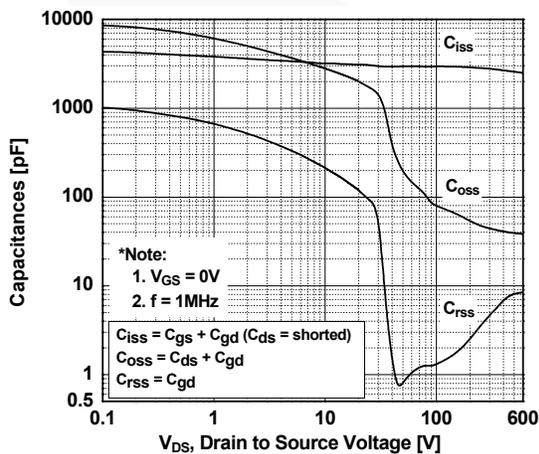
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



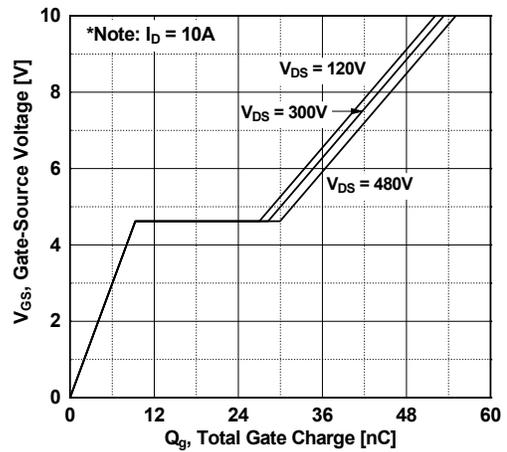
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**



**Figure 6. Gate Charge Characteristics**



Typical Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

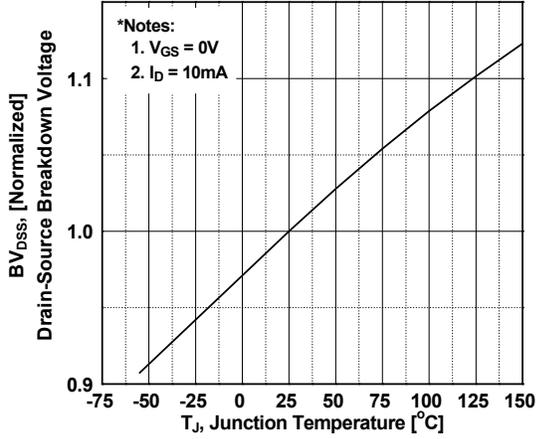


Figure 8. On-Resistance Variation vs. Temperature

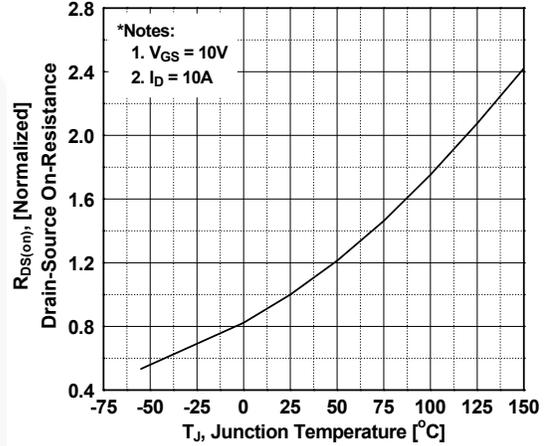


Figure 9. Maximum Safe Operating Area

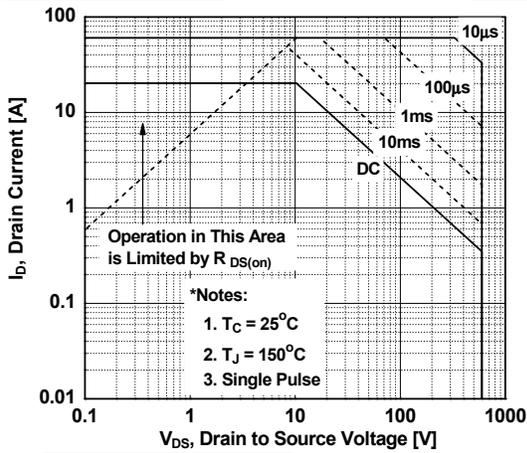


Figure 10. Maximum Drain Current vs. Case Temperature

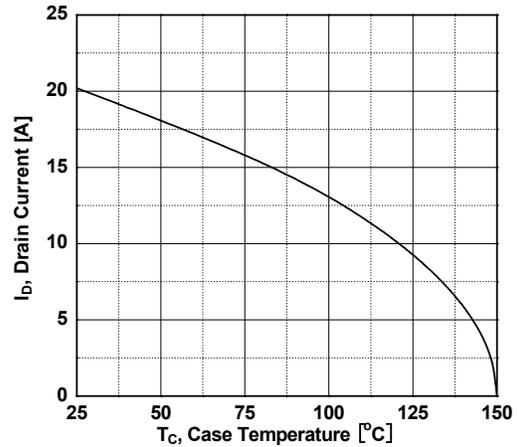
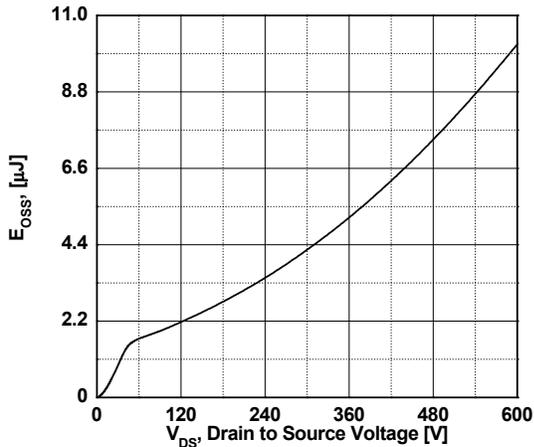
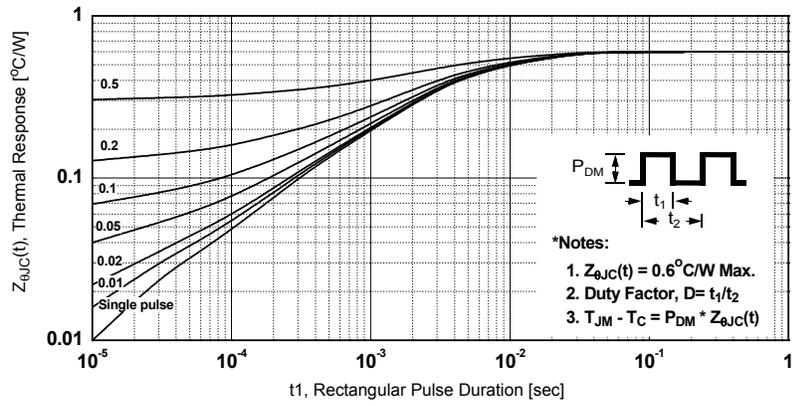


Figure 11. E\_oss vs. Drain to Source Voltage Switching Capability



Typical Characteristics (Continued)

Figure 12. Transient Thermal Response Curve



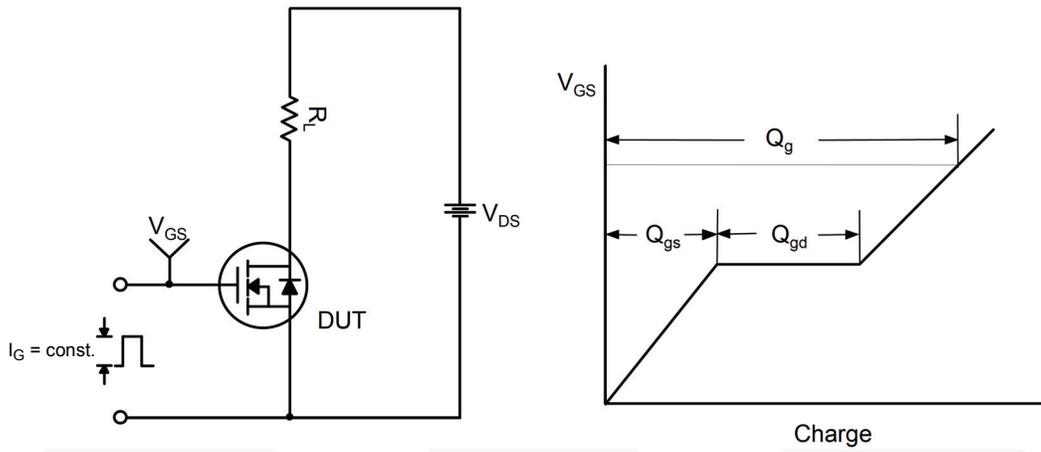


Figure 13. Gate Charge Test Circuit & Waveform

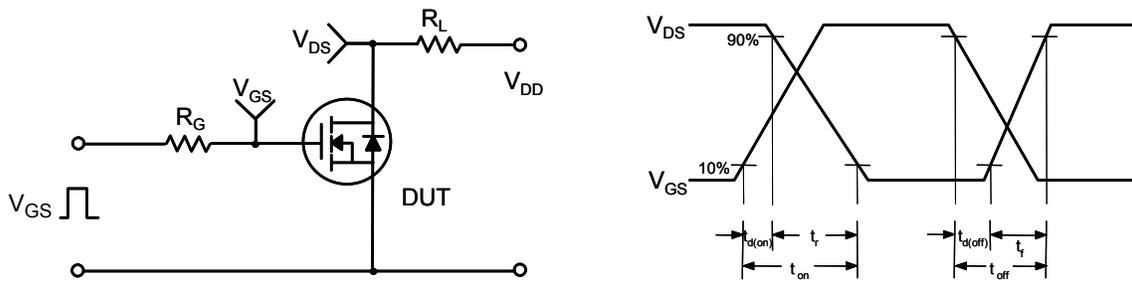


Figure 14. Resistive Switching Test Circuit & Waveforms

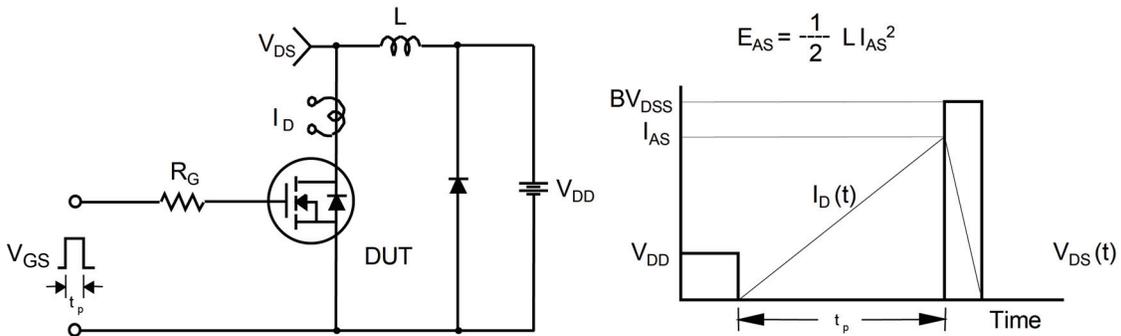
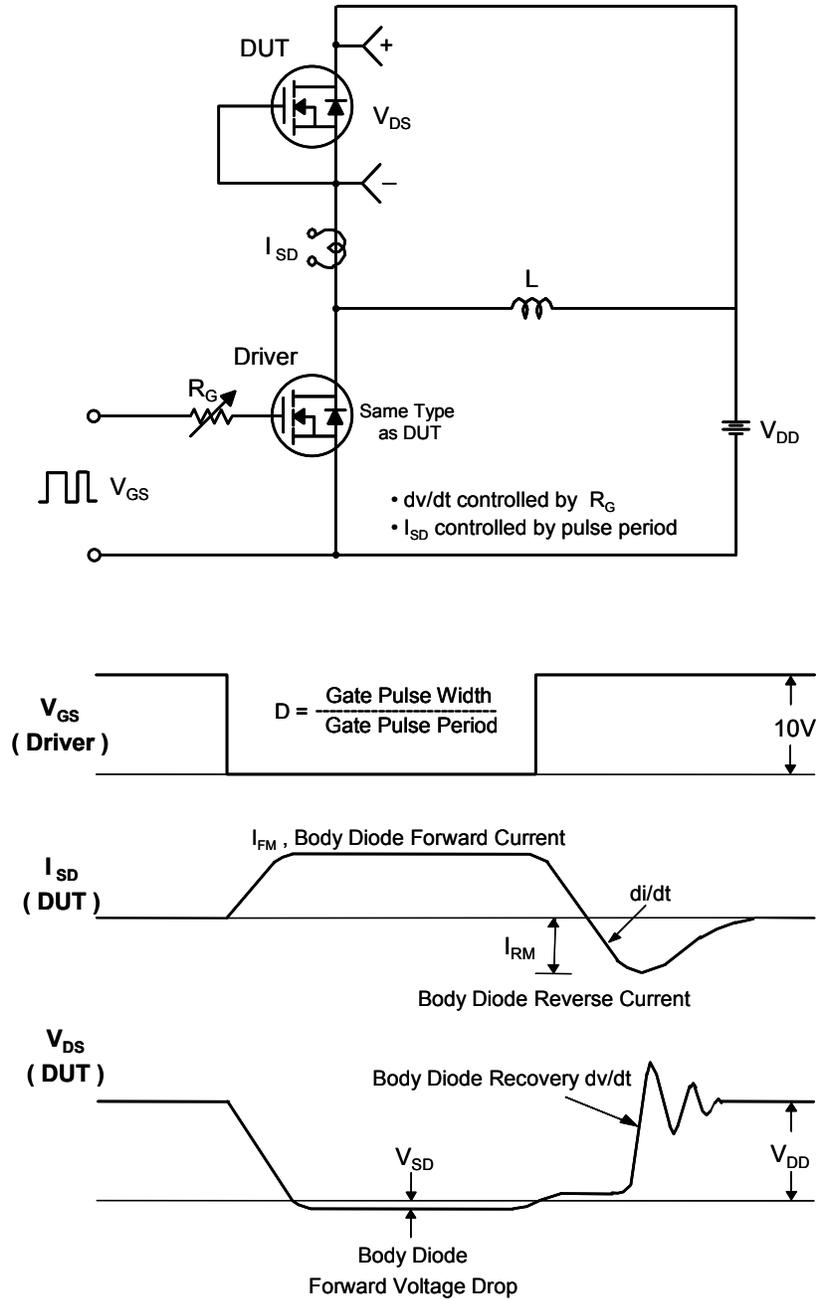
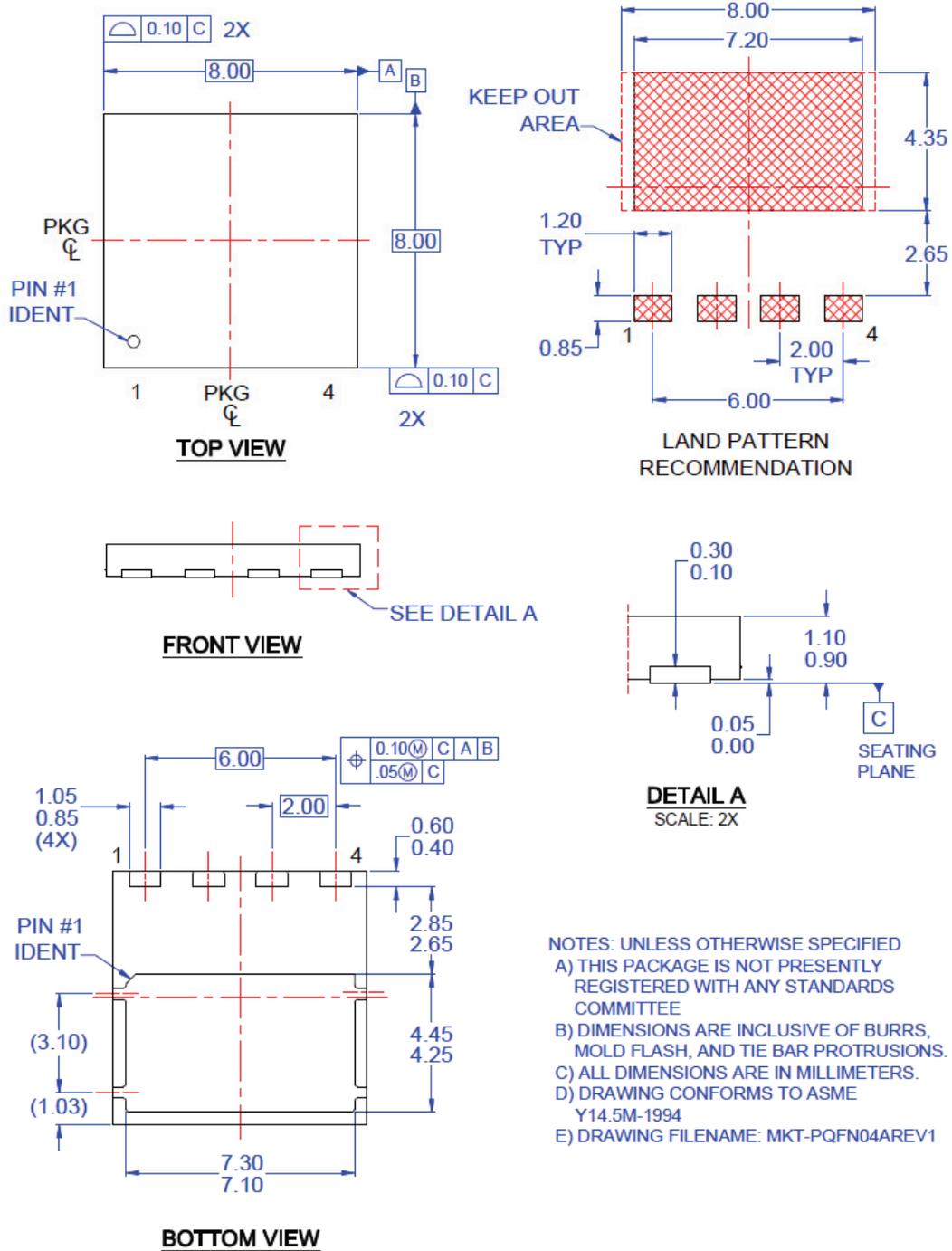


Figure 15. Unclamped Inductive Switching Test Circuit & Waveforms

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



### Mechanical Dimensions



**Figure 17. Molded Package, Power88, 4 Lead**

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