

# FDD6N50F / FDU6N50F

## N-Channel MOSFET

### 500V, 5.5A, 1.15Ω

#### Features

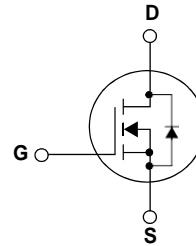
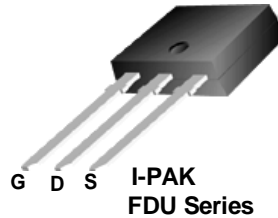
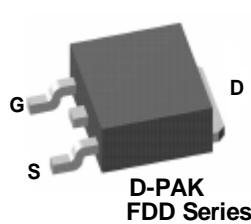
- $R_{DS(on)} = 1.0\Omega$  (Typ.) @  $V_{GS} = 10V$ ,  $I_D = 2.75A$
- Low gate charge (Typ. 15nC)
- Low  $C_{rss}$  (Typ. 6.3pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- RoHS compliant



#### Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advance technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficient switched mode power supplies and active power factor correction.



#### MOSFET Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted\*

Symbol	Parameter	Ratings	Units
$V_{DSS}$	Drain to Source Voltage	500	V
$V_{GSS}$	Gate to Source Voltage	$\pm 30$	V
$I_D$	Drain Current	- Continuous ( $T_C = 25^\circ\text{C}$ )	5.5
		- Continuous ( $T_C = 100^\circ\text{C}$ )	2.4
$I_{DM}$	Drain Current	- Pulsed (Note 1)	22
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	270
$I_{AR}$	Avalanche Current	(Note 1)	5.5
$E_{AR}$	Repetitive Avalanche Energy	(Note 1)	8.9
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	4.5
$P_D$	Power Dissipation	( $T_C = 25^\circ\text{C}$ )	89
		- Derate above $25^\circ\text{C}$	0.71
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

#### Thermal Characteristics

Symbol	Parameter	Ratings	Units
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.4	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	83	

\*When mounted on the minimum pad size recommended (PCB Mount)

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### Features

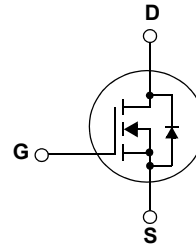
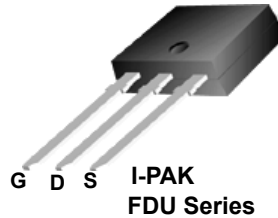
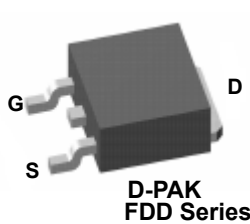
- $R_{DS(on)} = 1.0\Omega$  (Typ.) @  $V_{GS} = 10V, I_D = 2.75A$
- Low gate charge (Typ. 15nC)
- Low  $C_{RSS}$  (Typ. 6.3pF)
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$V_{DSS}$	Drain to Source Voltage	500	V
$V_{GSS}$	Gate to Source Voltage	±30	V
$I_D$	Drain Current	-Continuous ( $T_C = 25^\circ\text{C}$ )	5.5
		-Continuous ( $T_C = 100^\circ\text{C}$ )	2.4
$I_{DM}$	Drain Current	- Pulsed (Note 1)	22
$E_{AS}$	Single Pulsed Avalanche Energy	(Note 2)	270
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\*When mounted on the minimum pad size recommended (PCB Mount)

**Package Marking and Ordering Information**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FDD6N50F	FDD6N50FTM	D-PAK	380mm	16mm	2500
FDD6N50F	FDD6N50FTF	D-PAK	380mm	16mm	2000
FDU6N50F	FDU6N50FTU	I-PAK	-	-	70

**Electrical Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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**Off Characteristics**

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	500	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.15	-	$\text{V}/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$ $V_{DS} = 400\text{V}, T_C = 125^\circ\text{C}$	-	-	10 100	$\mu\text{A}$
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 2.75\text{A}$	-	1.0	1.15	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}, I_D = 2.75\text{A}$ (Note 4)	-	4.3	-	S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}, V_{GS} = 0\text{V}$ $f = 1\text{MHz}$	-	720	960	pF
$C_{oss}$	Output Capacitance		-	85	115	pF
$C_{rss}$	Reverse Transfer Capacitance		-	6.3	9.5	pF
$Q_{g(tot)}$	Total Gate Charge at 10V	$V_{DS} = 400\text{V}, I_D = 6\text{A}$ $V_{GS} = 10\text{V}$ (Note 4, 5)	-	15	19.8	nC
$Q_{gs}$	Gate to Source Gate Charge		-	4.4	-	nC
$Q_{gd}$	Gate to Drain "Miller" Charge		-	6.1	-	nC

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{V}, I_D = 6\text{A}$ $R_G = 25\Omega$ (Note 4, 5)	-	17	44	ns
$t_r$	Turn-On Rise Time		-	28.3	66.6	ns
$t_{d(off)}$	Turn-Off Delay Time		-	33.4	76.7	ns
$t_f$	Turn-Off Fall Time		-	20.5	51	ns

**Drain-Source Diode Characteristics**

$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	5.5	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	22	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 5.5\text{A}$	-	-	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 5.5\text{A}$	-	85	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	0.15	-	$\mu\text{C}$

**Notes:**

- 1: Repetitive Rating: Pulse width limited by maximum junction temperature
- 2:  $L = 16\text{mH}, I_{AS} = 5.5\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
- 3:  $I_{SD} \leq 5.5\text{A}, di/dt \leq 200\text{A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
- 4: Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$
- 5: Essentially Independent of Operating Temperature Typical Characteristics

**Package Marking and Ordering Information**  $T_C = 25^\circ\text{C}$  unless otherwise noted

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**Electrical Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
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$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}, T_J = 25^\circ\text{C}$	500	-	-	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	0.15	-	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{V}, V_{GS} = 0\text{V}$	-	-	10	$\mu\text{A}$
		$V_{DS} = 400\text{V}, T_C = 125^\circ\text{C}$	-	-	100	
$I_{GSS}$	Gate to Body Leakage Current	$V_{GS} = \pm 30\text{V}, V_{DS} = 0\text{V}$	-	-	$\pm 100$	nA

**On Characteristics**

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 250\mu\text{A}$	3.0	-	5.0	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 10\text{V}, I_D = 2.75\text{A}$	-	1.0	1.15	$\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{V}, I_D = 2.75\text{A}$ (Note 4)	-	4.3	-	S

**Dynamic Characteristics**

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**Drain-Source Diode Characteristics**

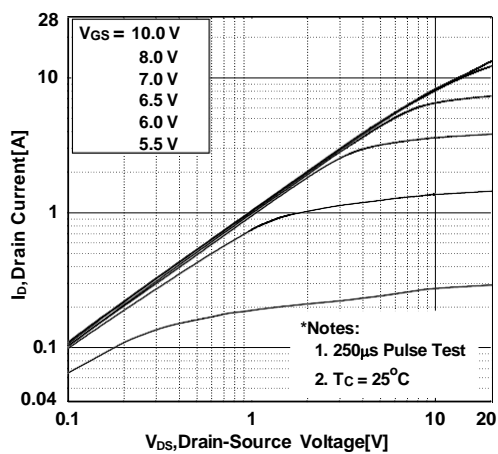
$I_S$	Maximum Continuous Drain to Source Diode Forward Current	-	-	5.5	A	
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current	-	-	22	A	
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS} = 0\text{V}, I_{SD} = 5.5\text{A}$	-	-	1.5	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{V}, I_{SD} = 5.5\text{A}$	-	85	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F/dt = 100\text{A}/\mu\text{s}$ (Note 4)	-	0.15	-	$\mu\text{C}$

**Notes:**

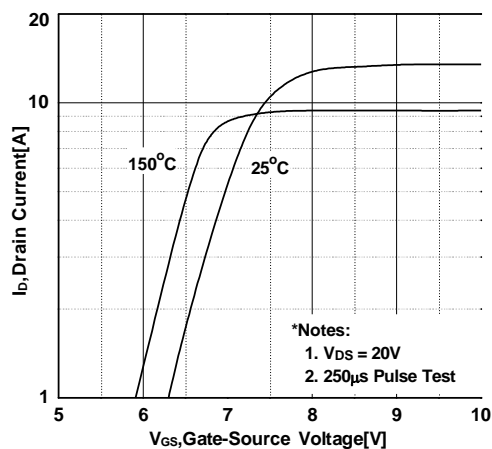
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## Typical Performance Characteristics

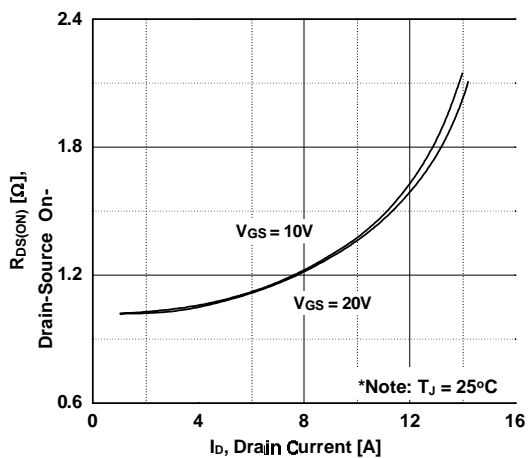
**Figure 1. On-Region Characteristics**



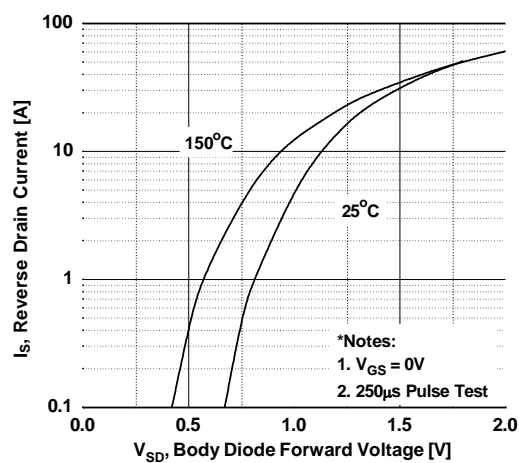
**Figure 2. Transfer Characteristics**



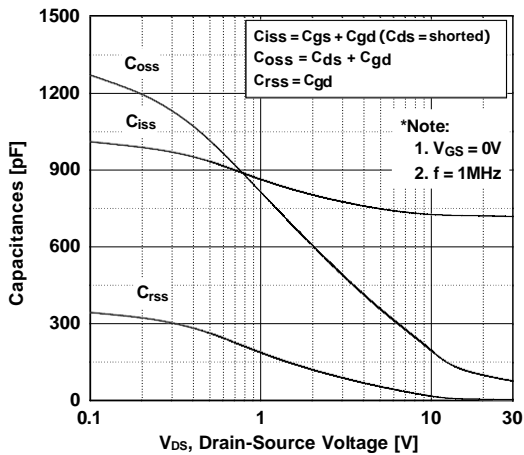
**Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage**



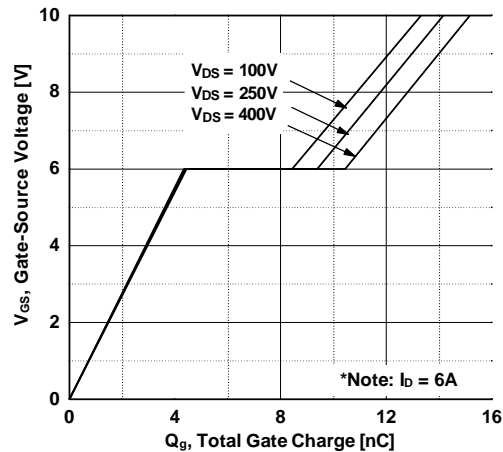
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



**Figure 5. Capacitance Characteristics**

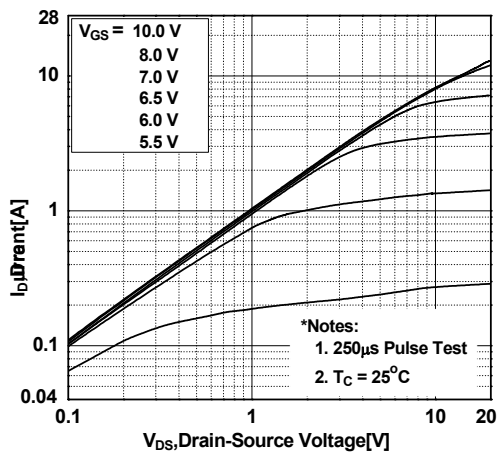


**Figure 6. Gate Charge Characteristics**

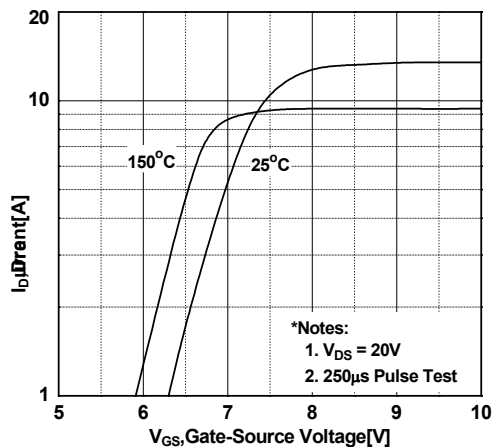


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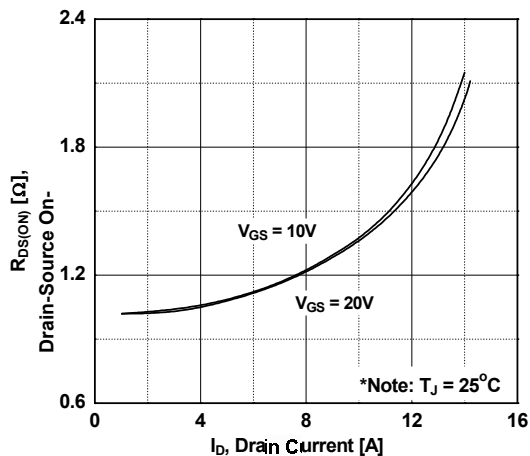
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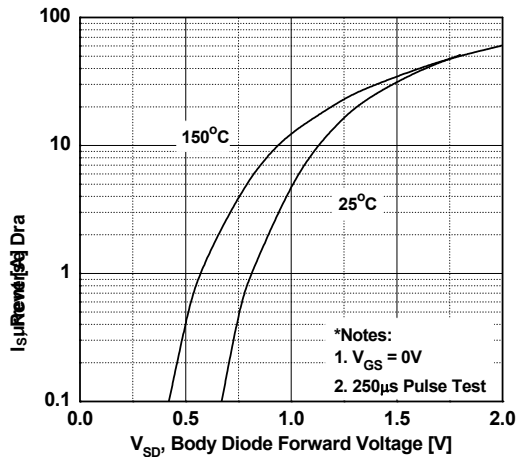
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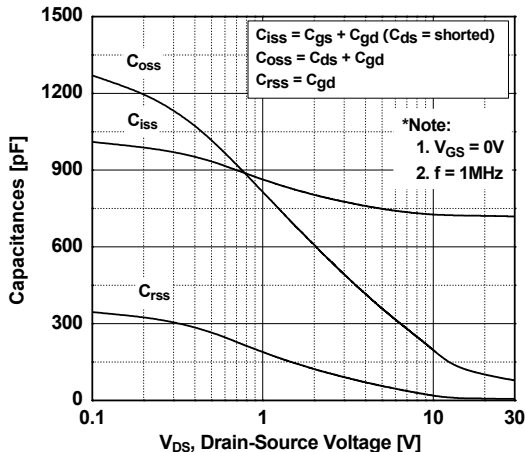
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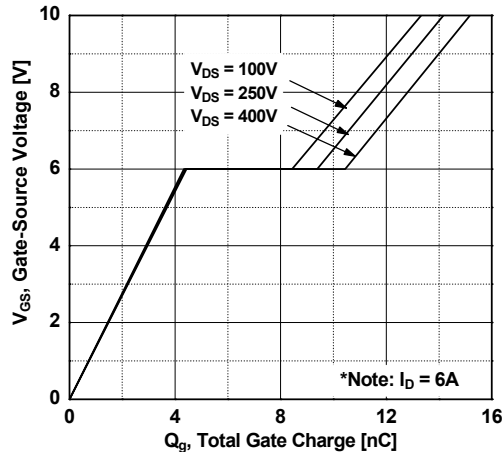
**Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature**



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Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

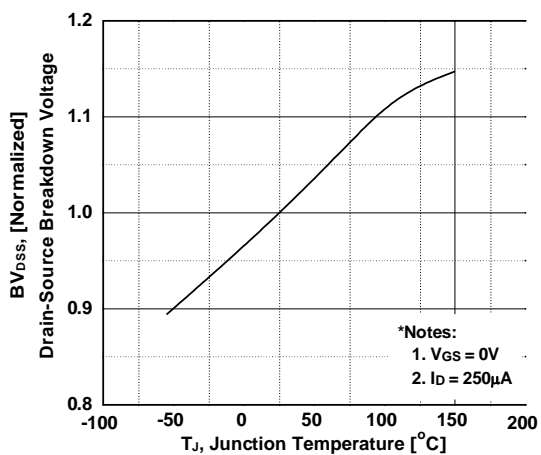


Figure 8. Maximum Safe Operating Area

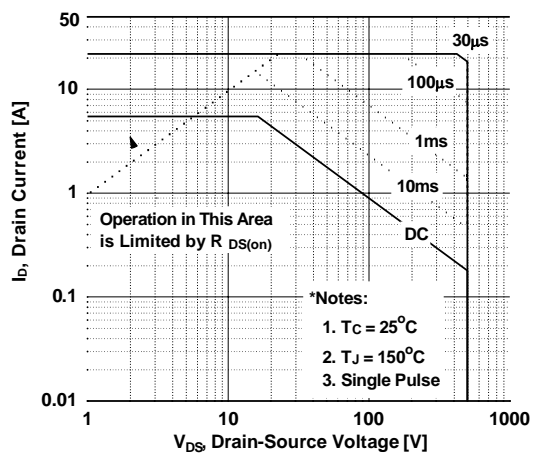


Figure 9. Maximum Drain Current vs. Case Temperature

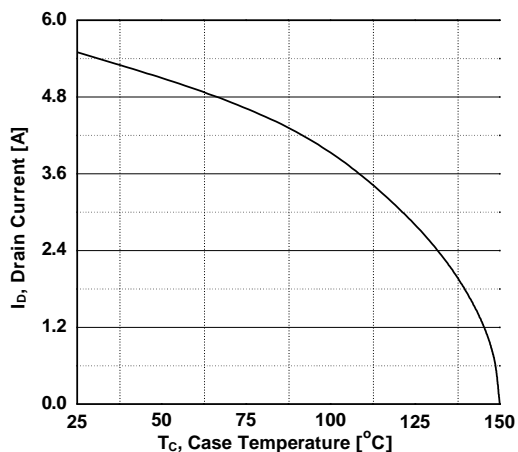
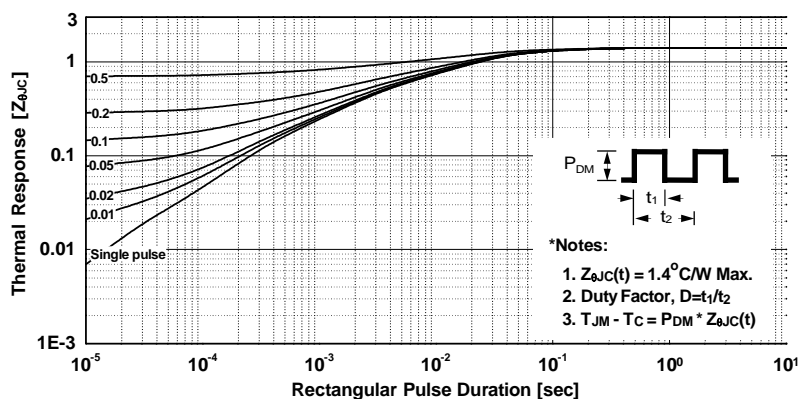


Figure 10. Transient Thermal Response Curve



Typical Performance Characteristics (Continued)

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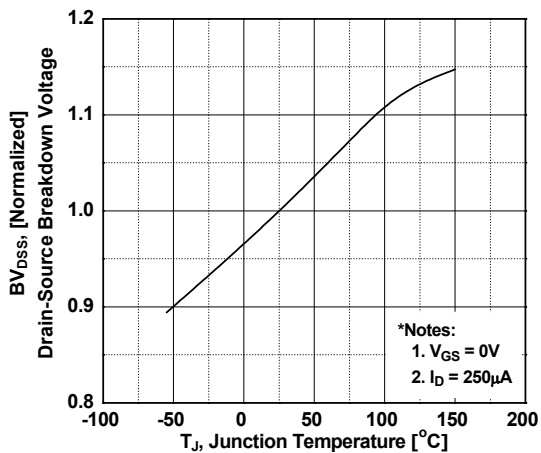


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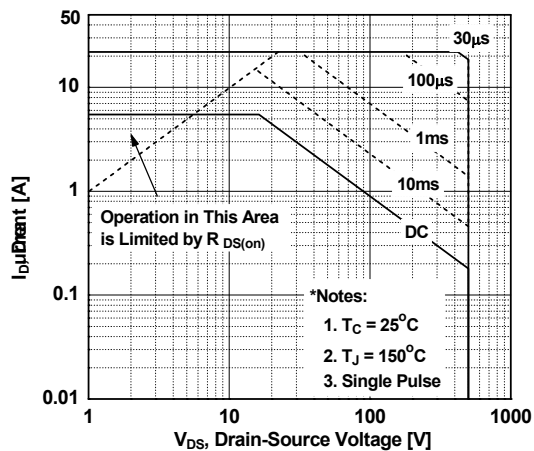


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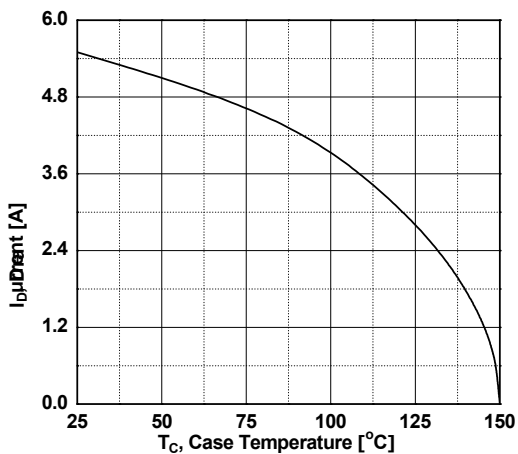
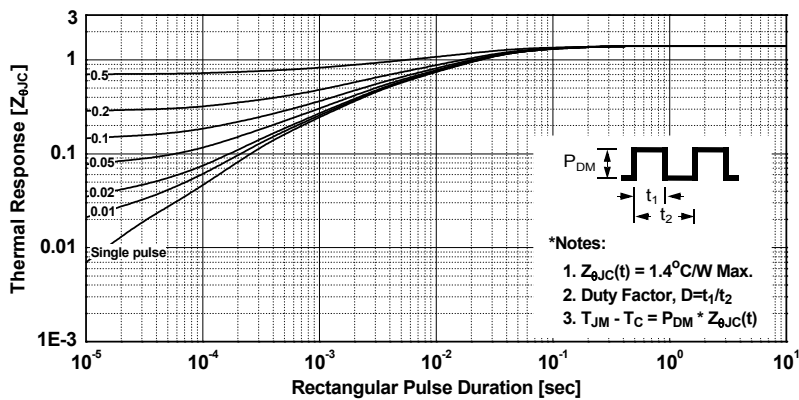
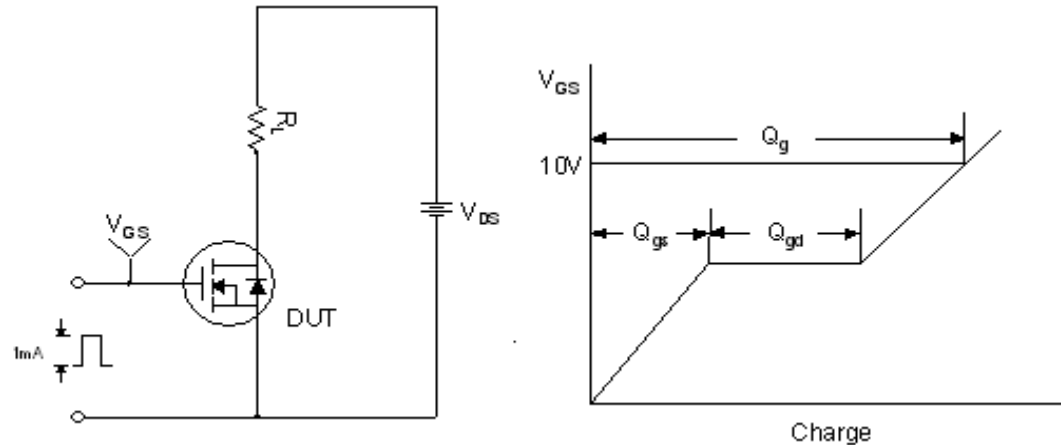


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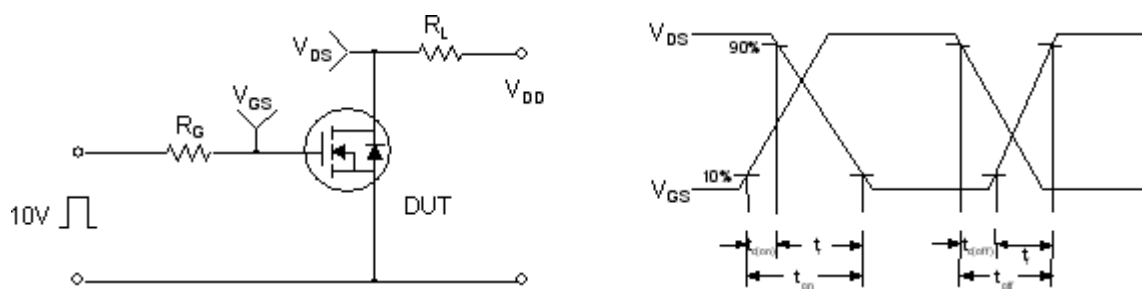




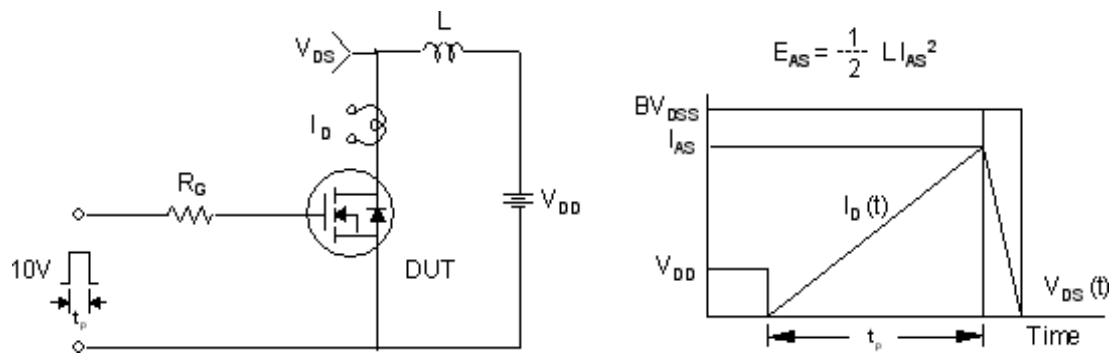
**Gate Charge Test Circuit & Waveform**



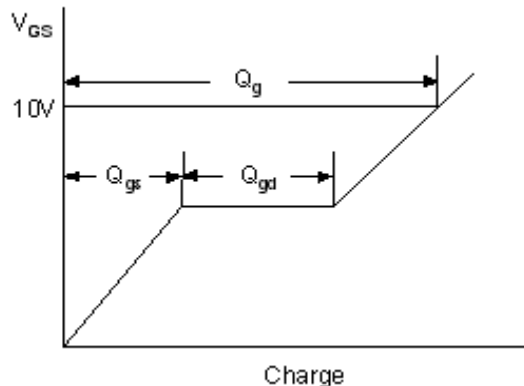
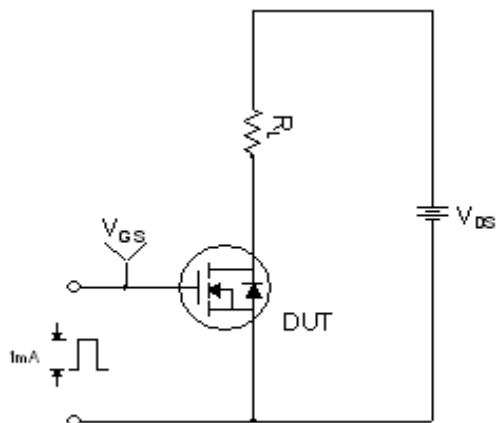
**Resistive Switching Test Circuit & Waveforms**



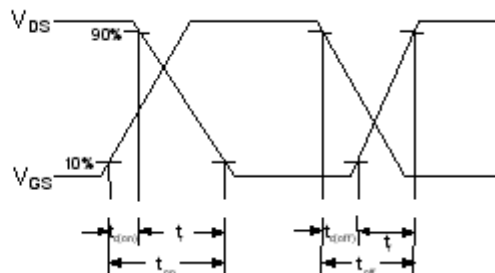
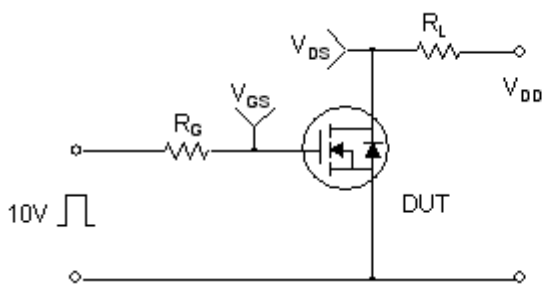
**Unclamped Inductive Switching Test Circuit & Waveforms**



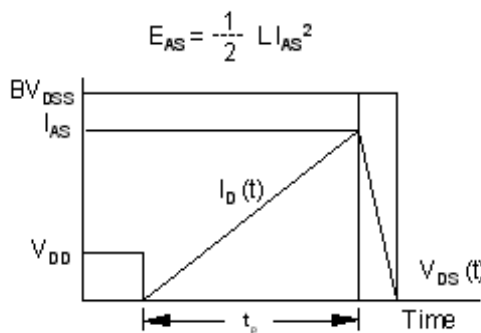
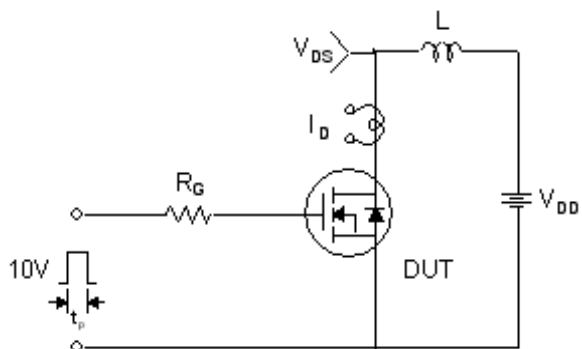
**Gate Charge Test Circuit & Waveform**



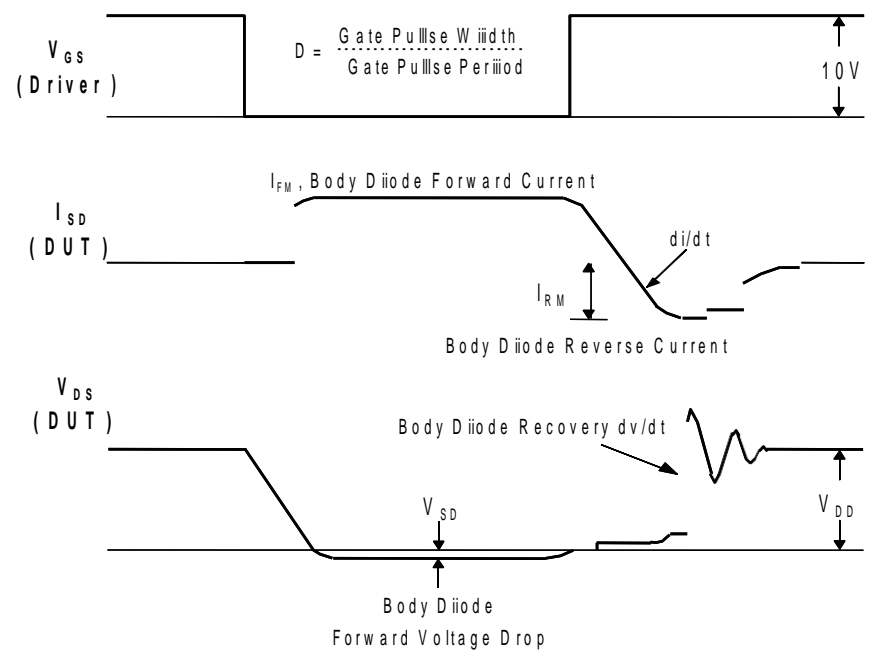
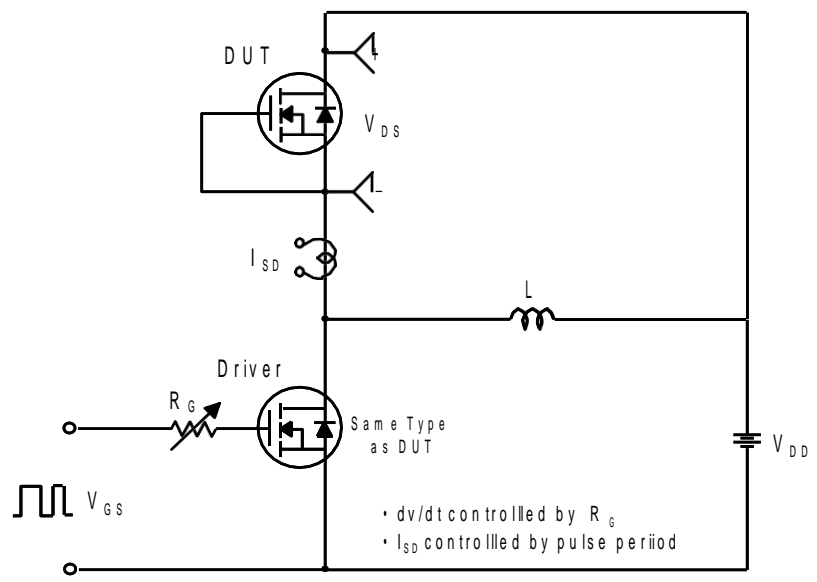
**Resistive Switching Test Circuit & Waveforms**



**Unclamped Inductive Switching Test Circuit & Waveforms**



Peak Diode Recovery dv/dt Test Circuit & Waveforms



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