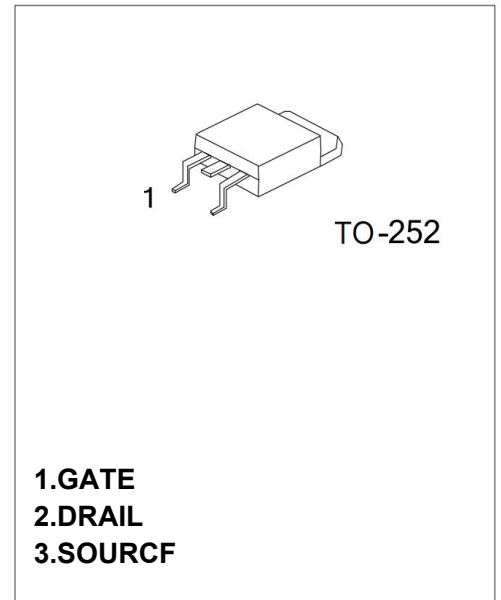


## P-Channel 60-V(D-S) Enhancement Mode Field Effect Transistor

V(BR)DSS	RDS(on)MAX	ID
-60 V	200mΩ@ -10 V	-8.8A

### Equivalent Circuit:



### General Description:

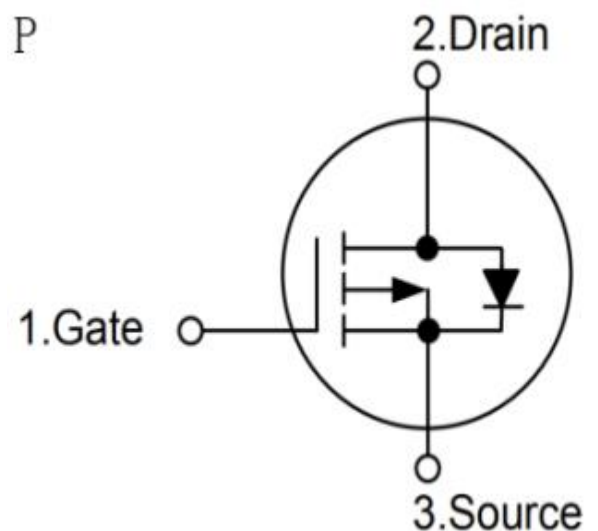
Third generation Power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The is designed for surface mounting using vapor phase, infrared, or wave soldering techniques. The straight lead version (IRFRseries) is for through-hole mounting applications. Power dissipation levels up to 1.5 W are possible in typical surface mount applications.

### FEATURE:

- ※ Surface Mount
- ※ Straight Lead
- ※ Available in Tape and Reel
- ※ Fast Switching
- ※ Repetitive Avalanche Rated
- ※ Simple Drive Requirements
- ※ Lead (Pb)-free Available.
- ※ Dynamic dV/dt Rating
- ※ Ultra Low On-Resistance

### SYMBOL :



## Maximum ratings ( Ta=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	VDS	-60	V
Gate-Source Voltage	VGS	±20	
Continuous Drain Current	ID	-8.8	A
Pulsed Diode Current	IDM	-35	
Linear Derating Factor		0.33	W/°C
Linear Derating Factor (PCB Mount)		0.02	W/°C
Power Dissipation	PD	50	W
Thermal Resistance from Junction to Ambient (t≤10s)	RθJA	45	°C/W
Single Pulse Avalanche Energy	EAS	300	mJ
Repetitive Avalanche Current	IAR	-8.8	A
Repetitive Avalanche Energy	EAR	5.0	mJ
Peak Diode Recovery dV/dt	dV/dt	-4.5	V/ns
Maximum Junction-to-Ambient	RthJA	110	°C/W
Operating Junction	TJ	150	°C
Storage Temperature	TSTG	-55~+155	

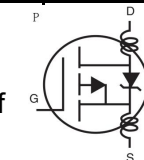
### Notes :

- 1.Repetitive rating; pulse width limited by maximum junction temperature
- 2.VDD = 25 V, starting TJ = 25 °C, L = 4.5 μH, RG = 25 Ω, IAS = -8.8 A
- 3.ISD ≤ -11 A, dI/dt ≤ 140 A/μs, VDD ≤ VDS, '
- 4.1.6 mm from case.
- 5.When mounted on 1" square PCB (FR-4 or G-10 material).

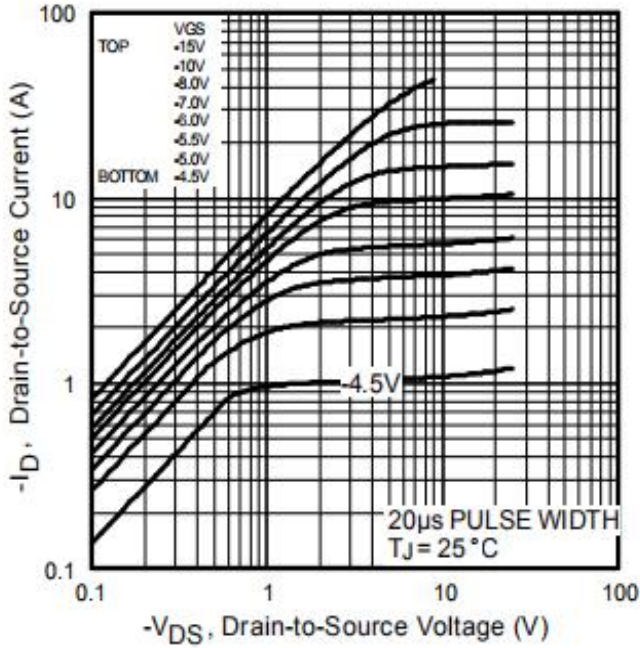
## MOSFET ELECTRICAL CHARACTERISTICS

### Static Electrical Characteristics (Ta = 25 °C Unless Otherwise Noted)

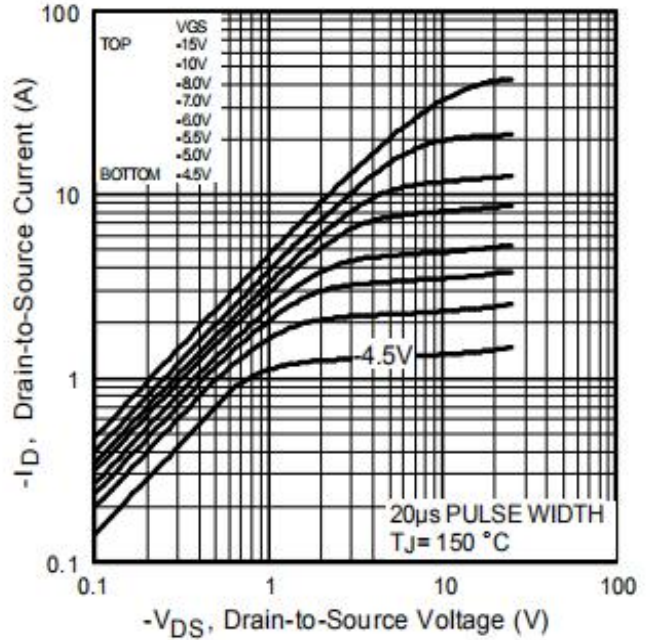
Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>Static</b>						
Drain-source breakdown voltage	<b>V(BR)DSS</b>	VGS = 0V, ID = - 250μA	<b>-60</b>			V
Gate-source threshold voltage	<b>VGS(th)</b>	VDS =VGS, ID = -250μA	<b>-2</b>		<b>-4</b>	V
Gate-source leakage	<b>IGSS</b>	VDS =0V, VGS = ±20V			<b>±100</b>	nA
Zero gate voltage drain current	<b>IDSS</b>	VDS = -60V, VGS =0V			<b>-100</b>	μA
Drain-source on-state resistancea	<b>RDS(on)</b>	VGS = -10V, ID = -5.3A		<b>75</b>	<b>200</b>	mΩ
Forward transconductancea	<b>gfs</b>	VDS = -25V, ID = -5.3A	<b>2.9</b>			S
Diode forward voltage	<b>VSD</b>	IS= -7.2A, VGS=0V			<b>-1.8</b>	V
<b>Dynamic</b>						
Input capacitance	<b>Ciss</b>	VDS = -25V, VGS = 0V, f=1MHz		<b>570</b>		pF
Output capacitance	<b>Coss</b>			<b>360</b>		pF
Reverse transfer capacitanceb	<b>Crss</b>			<b>65</b>		pF
Total gate charge	<b>Qg</b>	VDS = -48V, VGS = - 10V, ID = -11A			<b>19</b>	nC
Gate-source charge	<b>Qgs</b>				<b>5.4</b>	nC
Gate-drain charge	<b>Qgd</b>				<b>11</b>	nC
Gate resistance	<b>Rg</b>	f=1MHz				Ω
<b>Switchingb</b>						
Turn-on delay time	<b>td(on)</b>	VDD= -30V RD=3Ω, ID = -11A, VGEN= -10V,Rg= 18Ω		<b>13</b>		ns
Rise time	<b>tr</b>			<b>68</b>		ns
Turn-off delay time	<b>td(off)</b>			<b>15</b>		ns
Fall time	<b>tf</b>			<b>29</b>		ns
Internal Drain Inductance	<b>LD</b>	Between lead, 6 mm (0.25") from package and center of die contact		<b>4.5</b>		nH
Internal Source Inductance	<b>LS</b>			<b>7.5</b>		nH
<b>Drain-Source Diode Characteristics</b>						
Reverse Recovery Time	<b>trr</b>	IF= -11A, dI/dt=100A/s		<b>100</b>	<b>200</b>	ns
Reverse Recovery Charge	<b>Qrr</b>	IF= -11A, dI/dt=100A/s		<b>0.32</b>	<b>0.64</b>	μC
Continuous Source-Drain Diode Current	<b>IS</b>	MOSFET symbol showing the integral reverse p - n junction diode			<b>-8.8</b>	A
Pulsed Diode Forward Current	<b>ISM</b>				<b>-35</b>	A



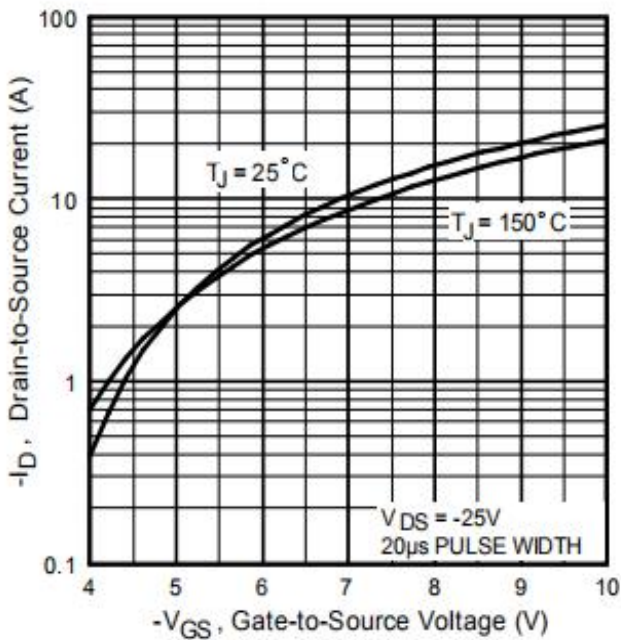
**TYPICAL CHARACTERISTICS :**



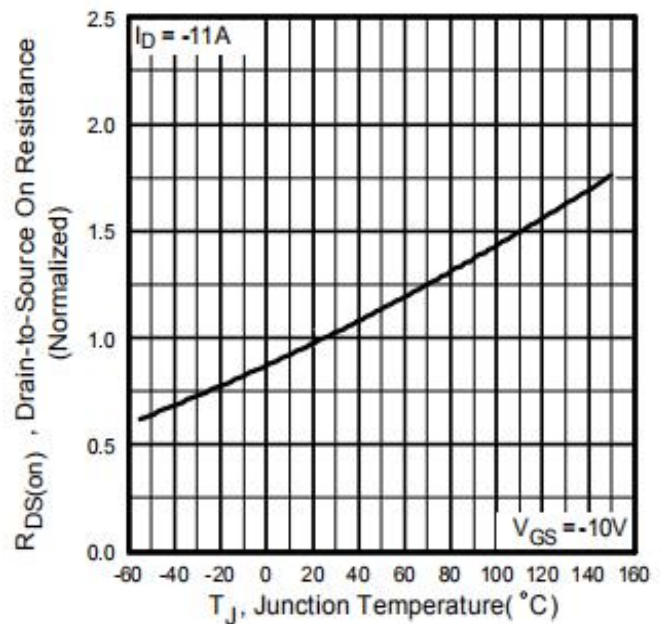
**Fig 1. Typical Output Characteristics**



**Fig 2. Typical Output Characteristics**

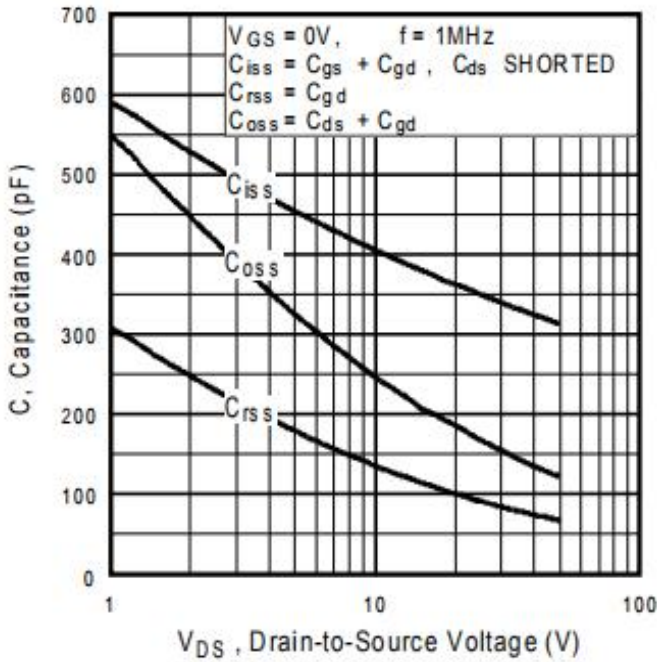


**Fig 3. Typical Transfer Characteristics**

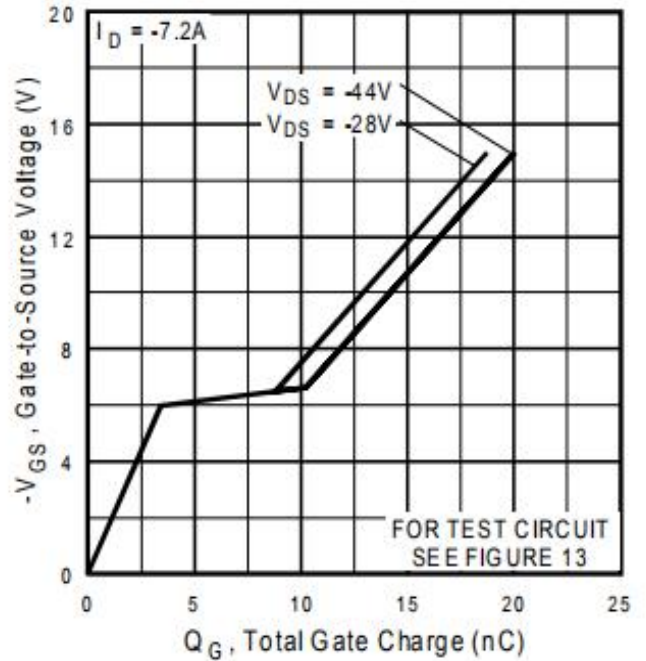


**Fig 4. Normalized On-Resistance Vs. Temperature**

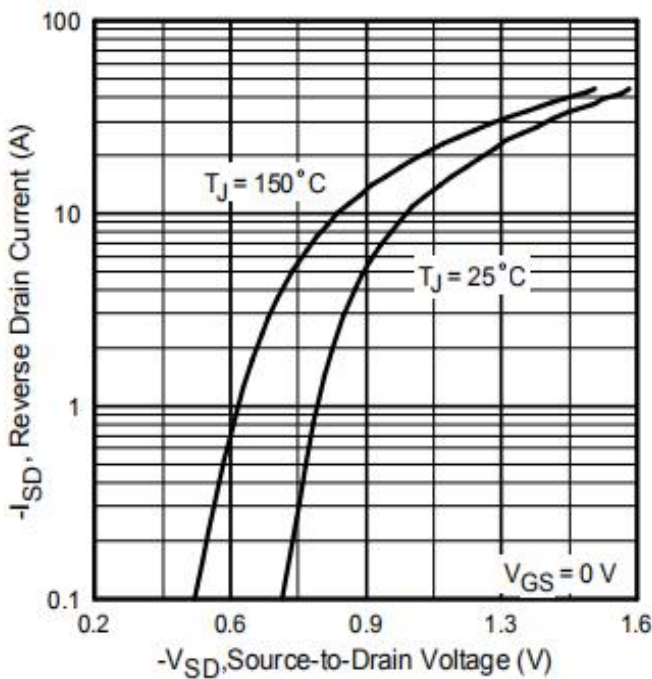
**TYPICAL CHARACTERISTICS :**



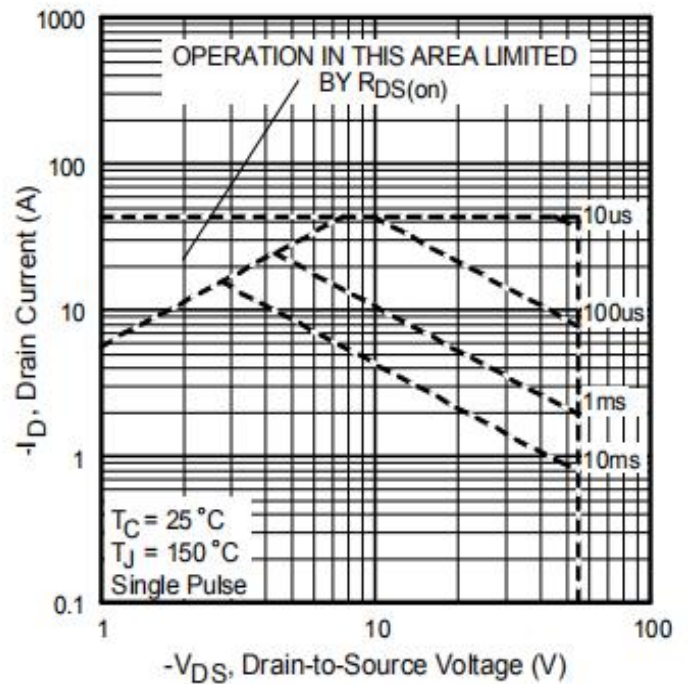
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage

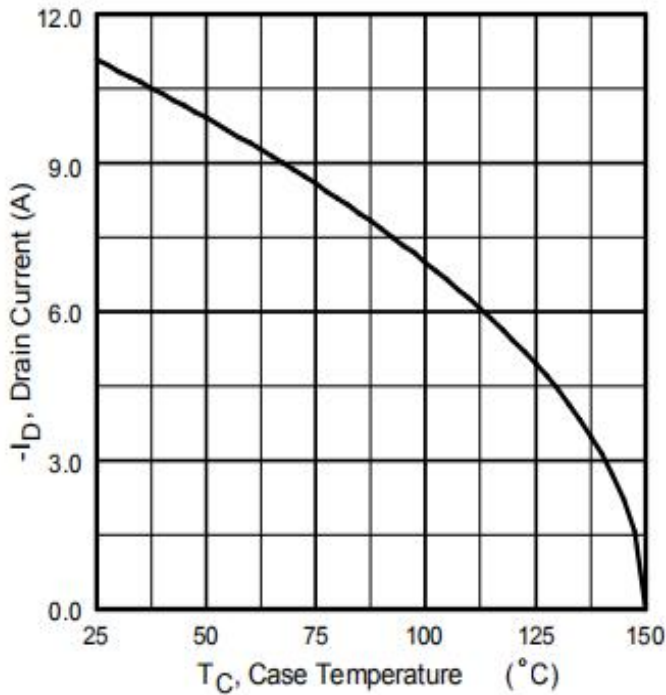


**Fig 7.** Typical Source-Drain Diode Forward Voltage

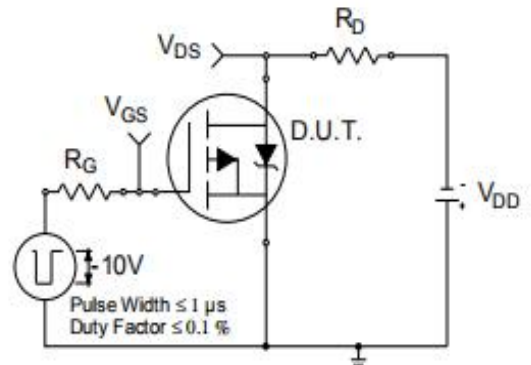


**Fig 8.** Maximum Safe Operating Area

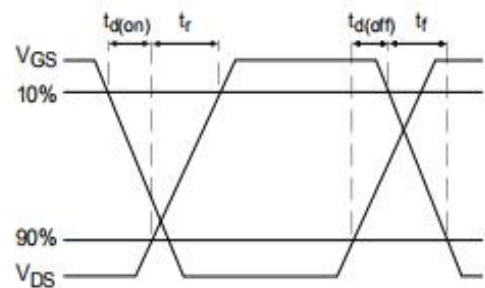
**TYPICAL CHARACTERISTICS :**



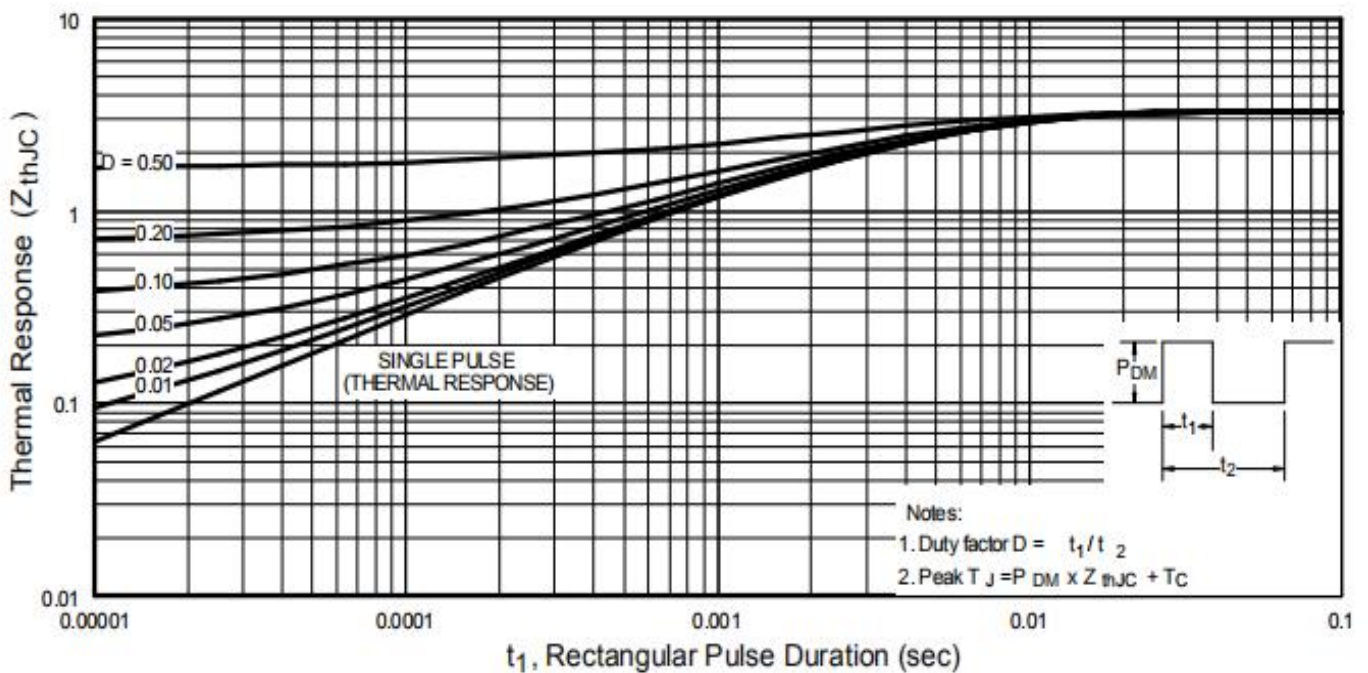
**Fig 9.** Maximum Drain Current Vs. Case Temperature



**Fig 10a.** Switching Time Test Circuit

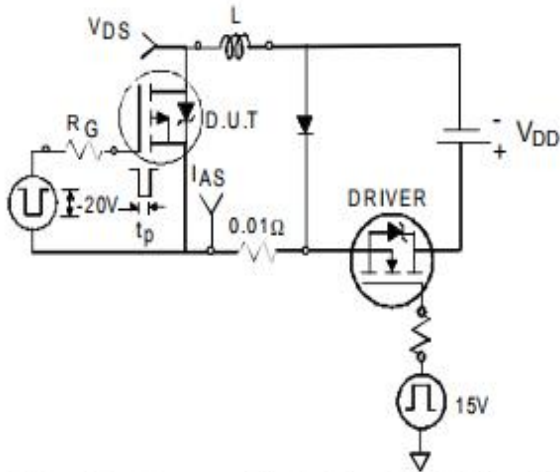


**Fig 10b.** Switching Time Waveforms

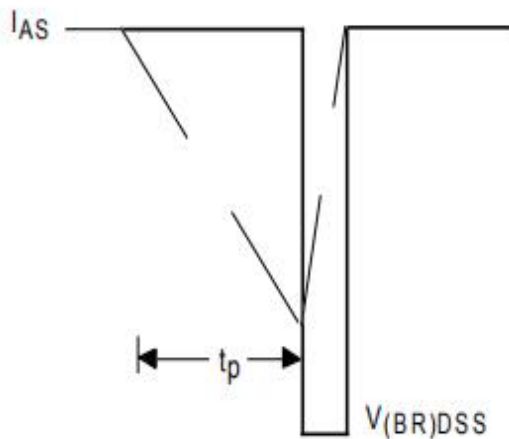


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

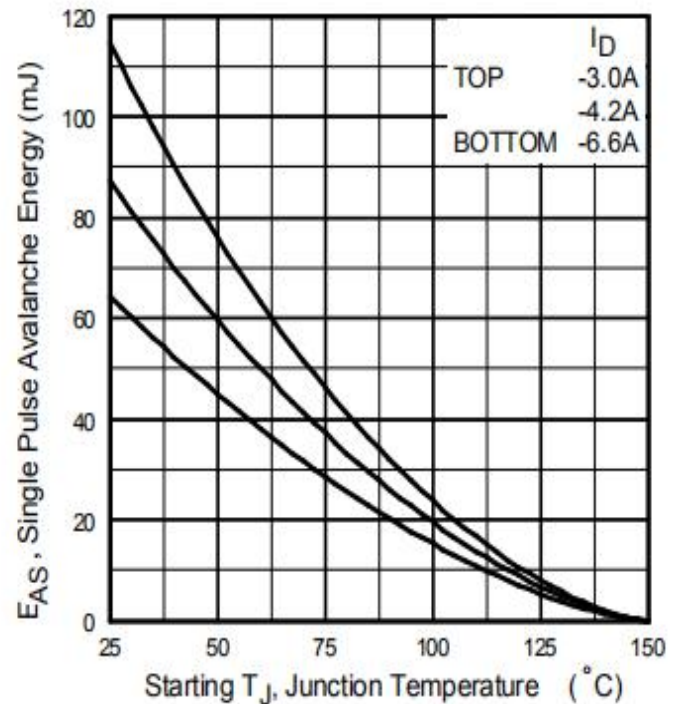
**TYPICAL CHARACTERISTICS :**



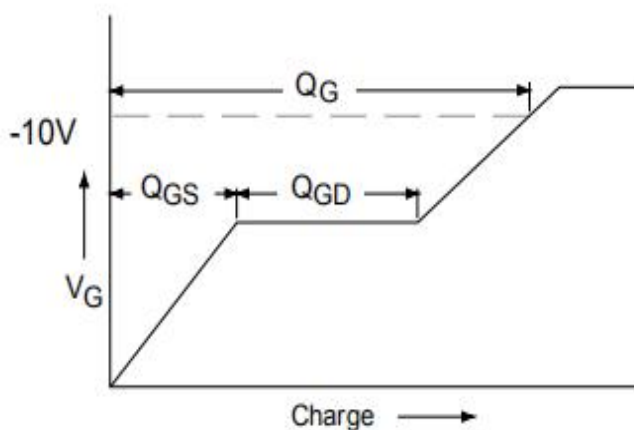
**Fig 12a.** Unclamped Inductive Test Circuit



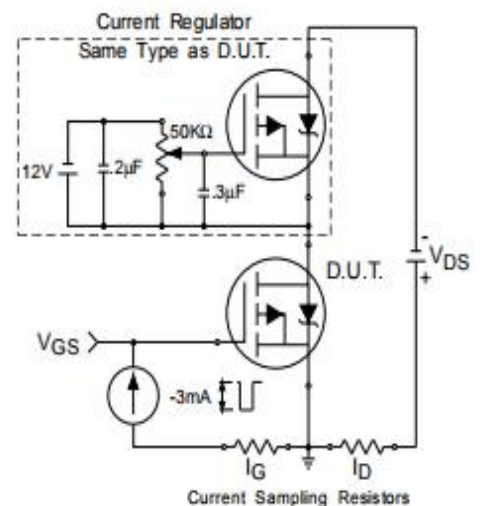
**Fig 12b.** Unclamped Inductive Waveforms



**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



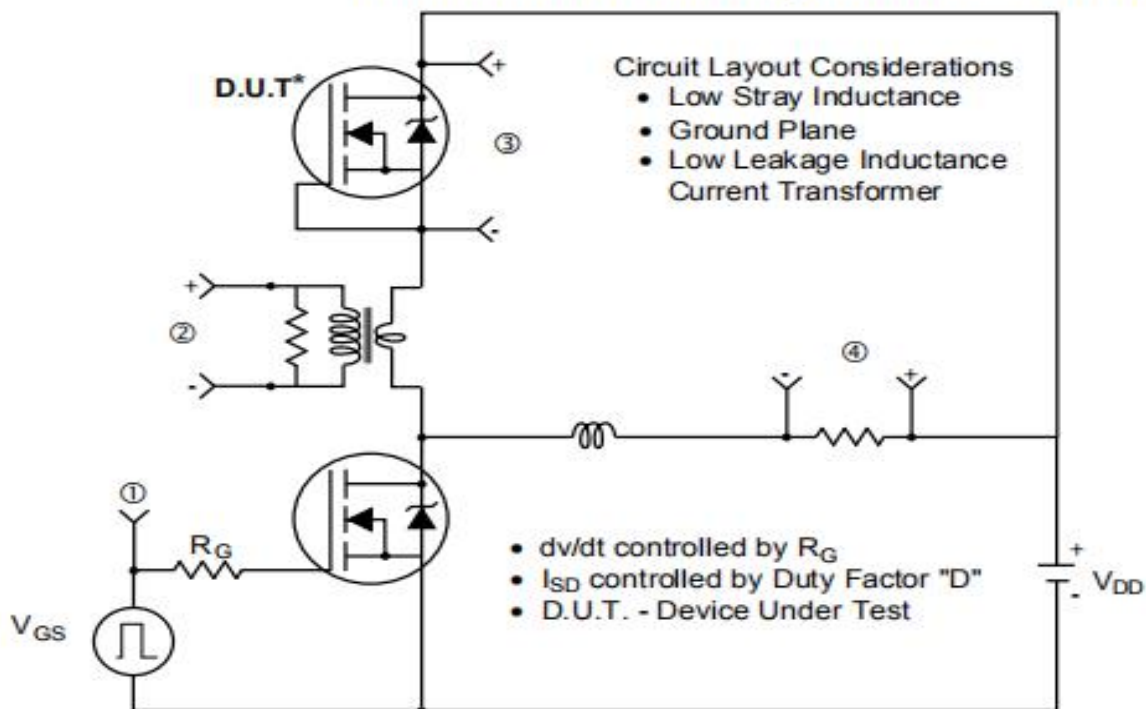
**Fig 13a.** Basic Gate Charge Waveform



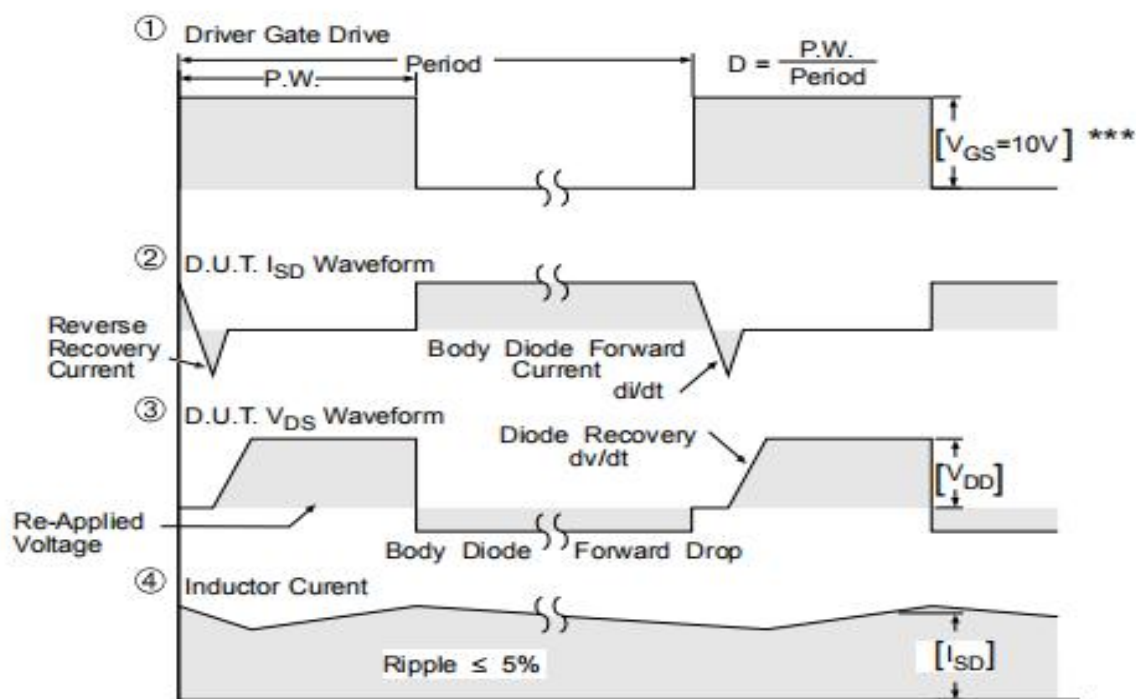
**Fig 13b.** Gate Charge Test Circuit

**TYPICAL CHARACTERISTICS :**

**Peak Diode Recovery dv/dt Test Circuit**



\* Reverse Polarity of D.U.T for P-Channel

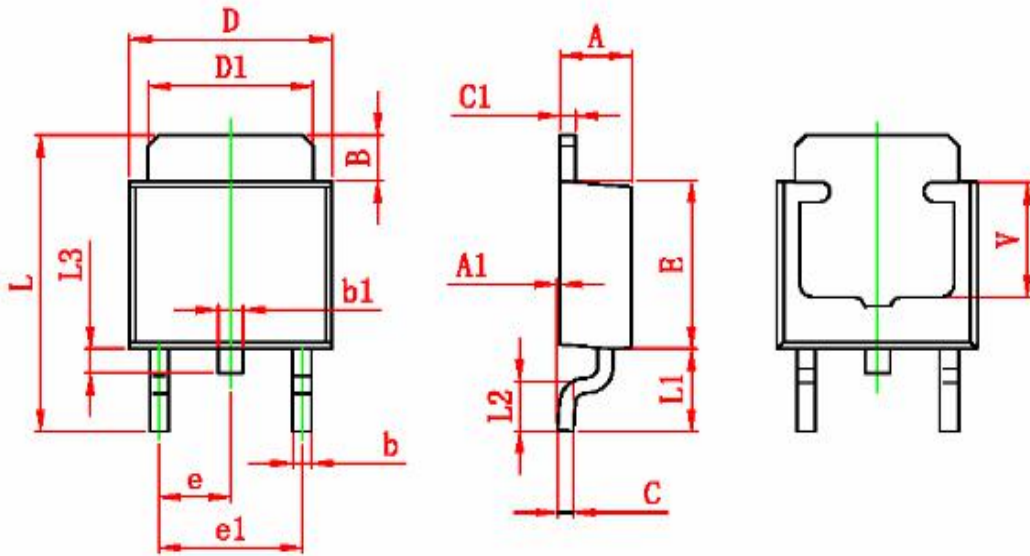


\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

**Fig 14. For P-Channel HEXFETS**



**PACKAGE OUTLINE DIMENSIONS :**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.500	0.700	0.020	0.028
b1	0.700	0.900	0.028	0.035
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.350	6.650	0.250	0.262
D1	5.200	5.400	0.205	0.213
E	5.400	5.700	0.213	0.224
e	2.300 TYP		0.091 TYP	
e1	4.500	4.700	0.177	0.185
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.350	0.650	0.014	0.026
V	3.80 REF		0.150 REF	