

6000W 高频开关电源选用的 SOT-227 封装四螺孔紧固连线 MOSFET 新品 FA57SA50LC

刘胜利 深圳中电公司电力所

6000W 电源全桥变换器 4 只主功率开关管、以及 Boost 两并联 MOSFET 均用 IR 公司新品：FA57SA50LC 共 6 只，均为最佳封装 SOT-227，其主要特性为：

① $V_{DSS}=500V$, $R_{DS(on)}=0.08\Omega$, $I_D=57A$ ；明显大于 36A 的 IRFP37N50A；

② 完全隔离的绝缘封装 SOT-227 型：先进的厚铜块散热层；

③ 低导通电阻 $80m\Omega$ ，优于耐压相同的著名产品：IRFP460 (0.27Ω)；36A 新品达 0.13Ω ；

④ 动态特性 dv/dt 达额定设计值；新工艺使其实现高速开关特性；

⑤ 最低栅极电荷器件，并具有低的漏极工作电容，低的内部分布电感。

作为第三代新型 HEXFET 产品，IR 公司为电源设计者提供了最佳 MOSFET，具有最好的快速开关组件，低导通电阻值、低的成本效率，器件有加固性能。在单管功耗水平接近 500W 的商业应用和工业应用中，SOT-227 封装受到普遍欢迎。它的低热阻特性被工业界广泛接受。FA57SA50LC 的极限参数、电气特性见下面表格。

表 1 FA57SA50LC 极限参数值

符号	参 数	最大值	单位
$I_D@T_C=25^\circ C$	连续的漏极工作电流, $V_{GS}=10V$	57	A
$I_D@T_C=100^\circ C$	连续的漏极工作电流, $V_{GS}=10V$	36	A
I_{DM}	脉冲状态漏极电流	228	A
$P_D@T_C=25^\circ C$	功耗	625	W
	线性减少额定值因数	5.0	W/C
V_{GS}	栅极-源极电压	± 20	V
E_{AS}	单脉冲雪崩能量	725	mJ
I_{AR}	雪崩电流	57	A
E_{AR}	重复的雪崩能量	62.5	mJ
dv/dt	峰值二极管恢复	3.0	V/ns
T_J T_{STG}	工作结温度、存储温度范围	-55 to +150	°C
V_{ISO}	绝缘耐受电压 (AC-RMS)	2.5	kV
接触热阻 (结-外壳): $R_{JC}=0.20^\circ C/W$; (外壳-散热器): $R_{CS}=0.05^\circ C/W$			

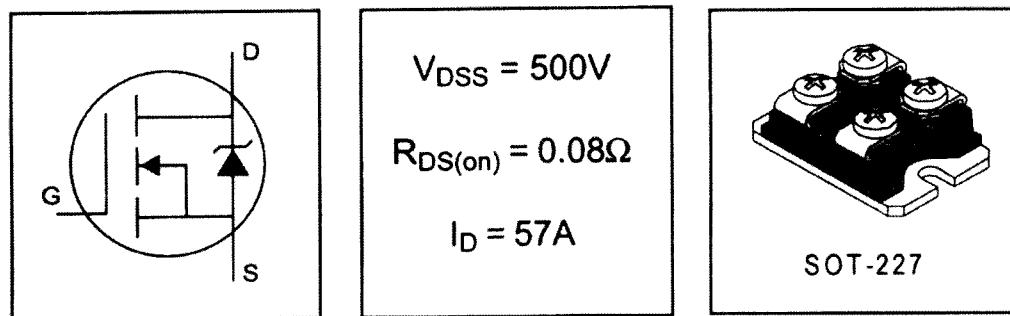


图 1 FA57SA50LC 新型 SOT-227 封装、四螺孔连线、主要电压电流

表 2 FA57SA50LC 源极-漏极额定值与特性

	参数	典型	最大	条 件
I_S	连续的源极电流 (体二极管)		57A	MOSFET 符号表明了整体 反向 P-N 结二极管
I_{SM}	脉冲源极电流 (体二极管)		228A	
V_{SD}	二极管正向电压		1.3V	$T_J=25^{\circ}\text{C}$, $I_S=57A, V_{GS}=0$
t_{rr}	反向恢复时间		901~1351ns	$T_J=25^{\circ}\text{C}$, $I_F=57A$
Q_{rr}	反向恢复电荷		15~23 μC	$dI/dt=100\text{A}/\mu\text{s}$ ④
t_{on}	正向导通时间		本征导通时间是可忽略的。导通时间由 (L_S+L_D) 支配。	

表 3 FA57SA50LC 电气特性参数 ($T_J=25^{\circ}\text{C}$)

符 号	参 数	最 小	典 型	最 大	单 位	测 量 条 件
$V_{(BR)DSS}$	漏极-源极击穿电压	500	—	—	V	$V_{GS}=0V, I_D=1.0\text{mA}$
$\Delta V_{(BR)DSS}/\Delta T_J$	击穿电压的温度系数	—	0.62	—	V/ $^{\circ}\text{C}$	参考基准为 25°C , $I_D=1\text{mA}$
$R_{DS(on)}$	静态时漏极-源极导通电阻	—	—	0.08	Ω	$V_{GS}=10V, I_D=34A$ ④
$V_{GS(th)}$	栅极门限电压	2.0	—	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$
g_{fs}	正向跨导	43	—	—	S	$V_{DS}=50V, I_D=34A$
I_{DSS}	漏极-源极漏电流	—	—	50	μA	$V_{DS}=500V, V_{GS}=0V$
		—	—	500		$V_{DS}=400V, V_{GS}=0V, T_J=125^{\circ}\text{C}$
I_{GSS}	栅极-源极正向漏电流	—	—	200	nA	$V_{GS}=20V$
	栅极-源极反向漏电流	—	—	-200		$V_{GS}=-20V$
Q_g	总的栅极电荷	—	225	338	nC	$I_D=57A$
Q_{gs}	栅极-源极电荷	—	51	77		$V_{DS}=400V$
Q_{gd}	栅极-源极 ("米勒" 电荷)	—	98	147		$V_{GS}=10V$, 见图 7 和图 15。
$t_{d(on)}$	导通延迟时间	—	32	—	ns	$V_{DD}=250V$

t_r	上升时间	—	152	—		$I_D=57A$
$t_d(\text{off})$	截止延迟时间	—	108	—		$R_G=2.0\Omega$
t_f	下降时间	—	118	—		$R_D=4.3\Omega$, 见图 11
L_s	内部源极电感量	—	5.0	—	nH	在引线之间, 管芯接点中心
C_{iss}	输入电容	—	10000	—		$V_{GS}=0V$
C_{oss}	输出电容	—	1500	—		$V_{DS}=25V$
C_{rss}	反向传输电容	—	50	—		$f=1.0\text{MHz}$, 见图 6。

注意: ① 重复时的额定值, 脉冲宽度受最大结温度限制; 详见后面特性曲线图 12。

② 起动时温度 $T_J=25^\circ\text{C}$, $L=446\mu\text{H}$, $R_G=25\Omega$, $I_{AS}=57\text{A}$ 。详见后面图 13。

③ $I_{SD}\leq 57\text{A}$, $dI/dt\leq 200\text{A}/\mu\text{s}$, $V_{DD}\leq V_{(BR)DSS}$, $T_J\leq 150^\circ\text{C}$ 。

④ 脉冲宽度 $\leq 300\mu\text{s}$, 占空比 $\leq 2\%$ 。

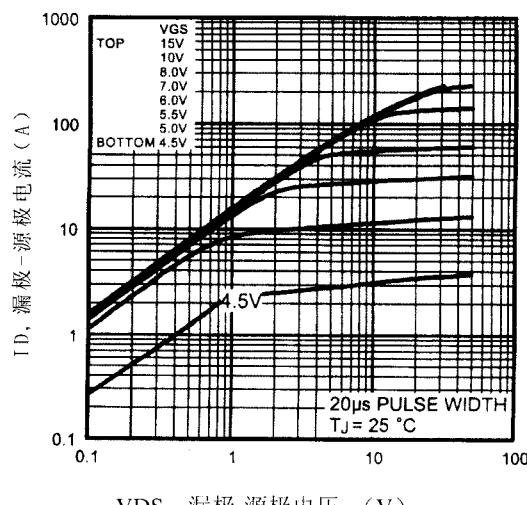


图 2 典型的输出特性 (之一)

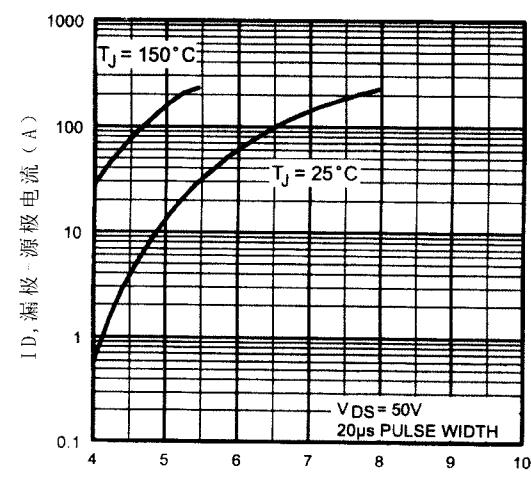


图 4 典型的传输特性

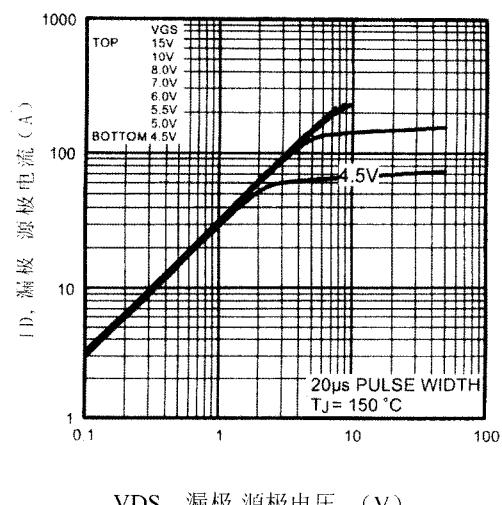


图 3 典型的输出特性 (之二)

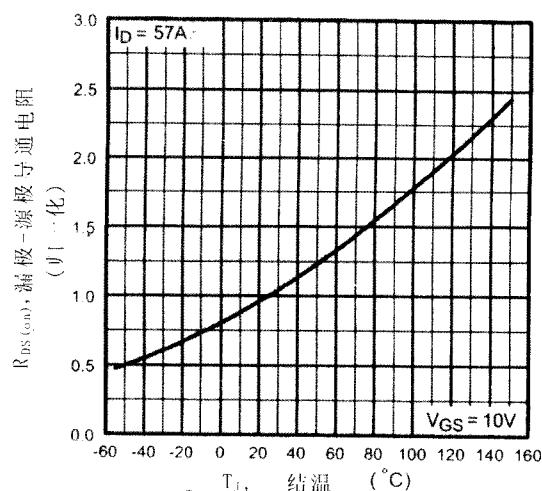


图 5 (归一化的) 导通电阻与温度关系曲线

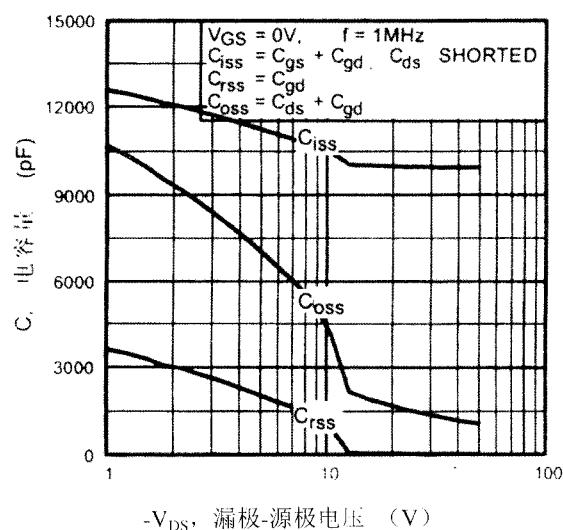


图 6 典型的电容与漏极-源极电压关系

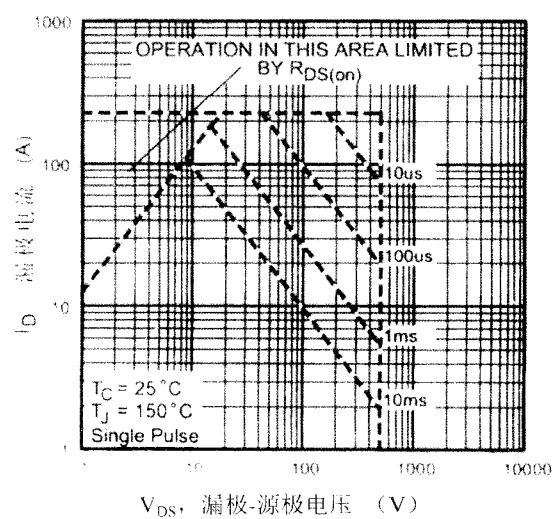


图 9 最大安全工作区

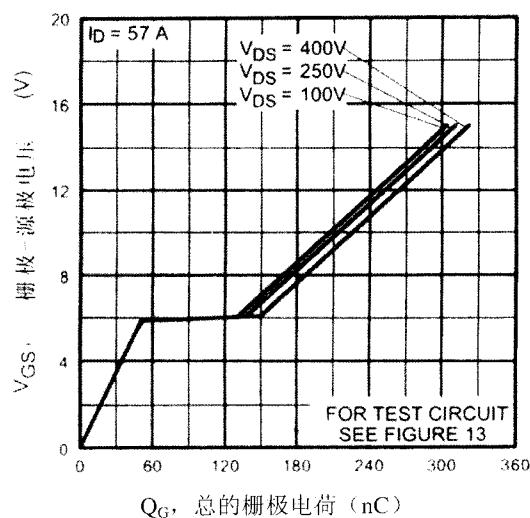


图 7 典型的栅极电荷与栅源电压关系

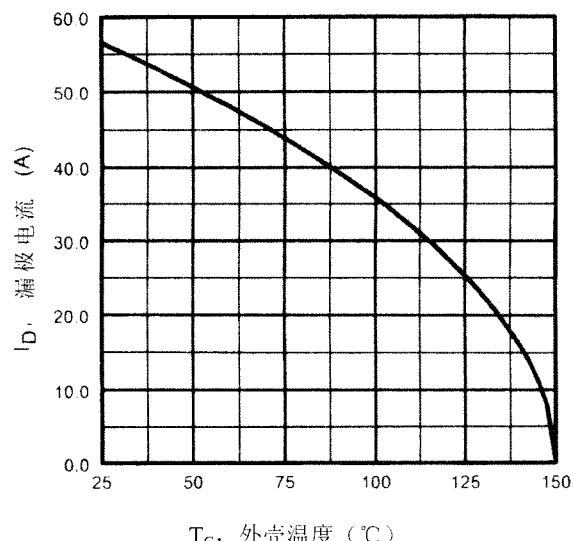


图 10 最大漏极电流与外壳温度关系

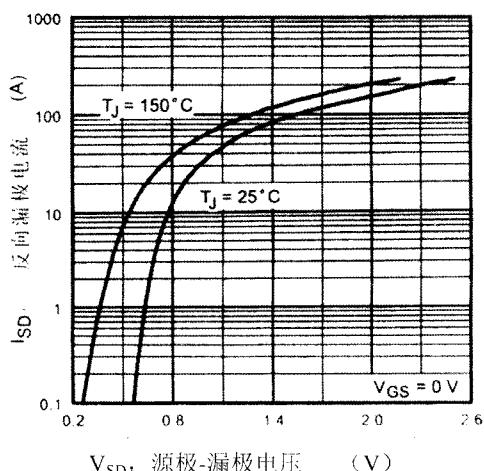


图 8 典型的源极-漏极二极管正向电压

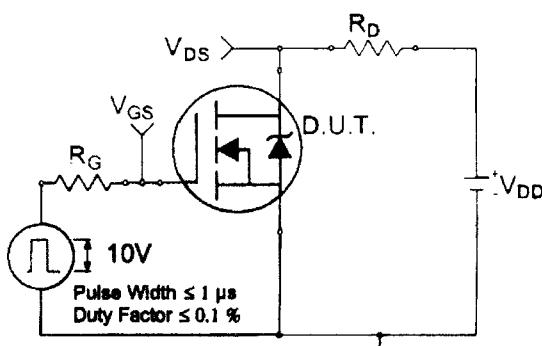


图 11 (a) 开关时间测试电路

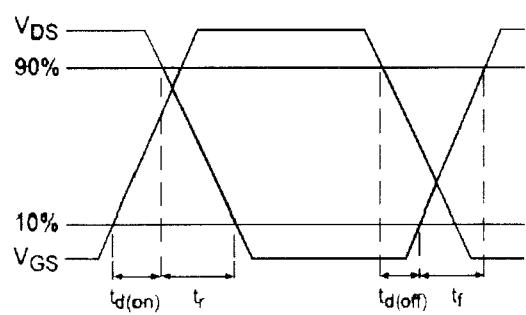


图 11 (b) 开关时间波形

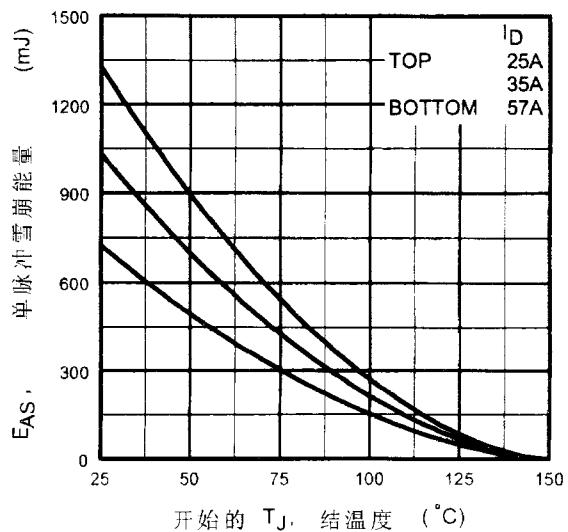


图 14 最大雪崩能量与漏极电源关系

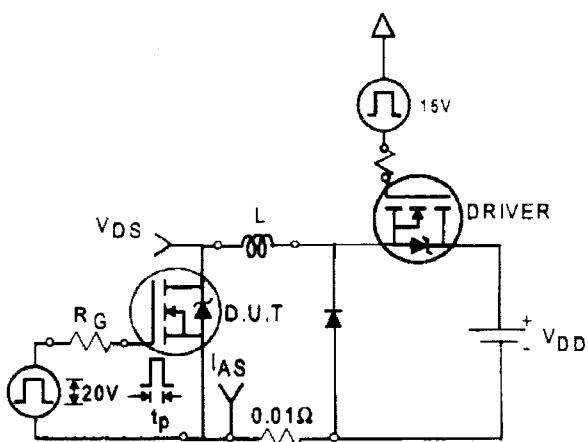


图 13 (a) 不箝位时感性测试电路

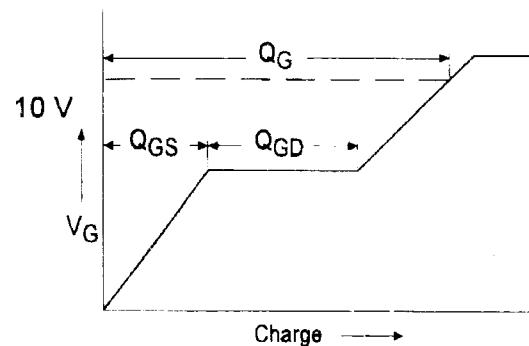


图 15 (a) 基本的栅极电荷波形

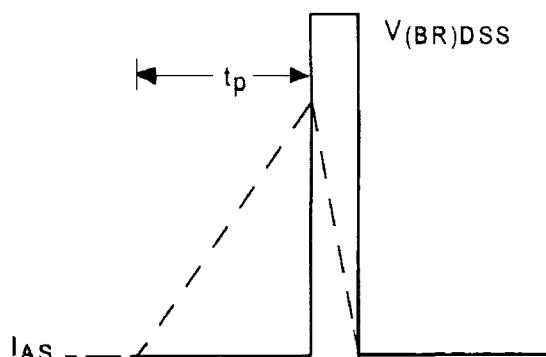


图 13 (b) 不箝位时感性波形

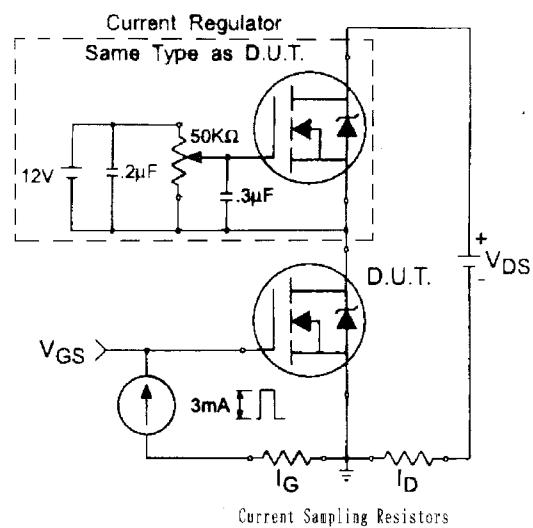
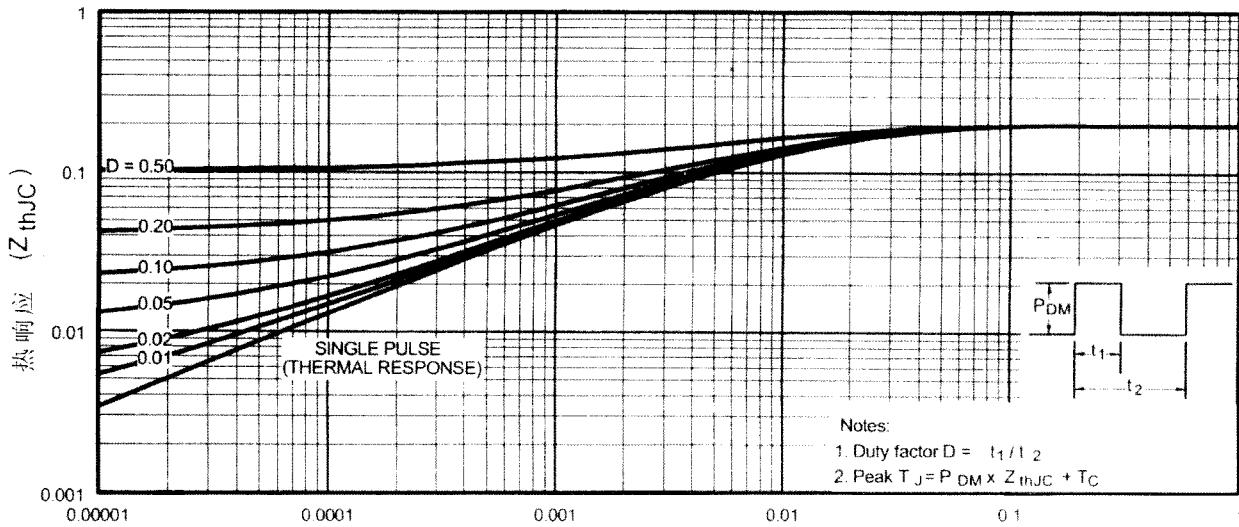


图 15 (b) 栅极电荷测试电路



t1, 矩形脉冲持续时间 (秒)
图 12 最大有效的热阻抗 (结-外壳)



电力问题

限流：这是电源供应器的一种过载保护功能。在 UPS 内部的充电器一般会设计此功能，以避免过大的充电电流对电池造成损坏，但 UPS 输出本身则较少采用此功能，仅在过载发生时跳旁路或关机。依限流的定义而言，其意思是当负载电流超过某一设定值时，会限制住此负载电流的大小。

短路：产生的原因，除了机器过于老旧而导致电子零件异常外，异物所产生的短路现象如：昆虫或是人为的不小心等，皆会造成短路现象。以计算机而言，若传输线短路，所造成的结果只是资料的流失，但若是电源部分短路，所造成的结果轻则设备损坏，重则引起电线走火，因此，在电子设备中，有保险丝或是无熔丝开关 (Breaker) 诸如此类的保护设计，其目的就是要短路的危害。

短暂的压降：通常是指短暂电压的下降，当 AC 电压低于正常标准达 1 秒时，这种情况则称之为 SAG (压降)，甚至有时候负载过大或是电力尖峰时段，电力公司供电量不足等，也会产生短暂压降的现象。

UPS

专用名词解释 (三)

瞬间电压降：有些会从数毫秒持续到数百毫秒，若电压降持续的时间或是时常发生，则会造成计算机以及电器用品的故障及寿命的降低。

突波：产生突波的现象有两种，一、自然界所产生的，如雷击；二、电子设备瞬间加入负载。突波一种瞬间的高压，这种高压从数百伏特 (安培) 到数千伏特 (安培) 或更高，持续的时间从数千分之一秒到数亿分之一秒，这对电子设备来说是一种极大的潜在危险，轻则造成资料流失或电子零件寿命减短，严重会造成设备的损坏或产生更严重的结果。因此，在现今有许多电子设备中都有突波抑制器 (Surge Suppressor)，保护设备与使用者的安全。

谐波失真：或称谐波干扰。所谓谐波即是存在于正弦波中的奇数波 (3,5,7, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65, 67, 69, 71, 73, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111, 113, 115, 117, 119, 121, 123, 125, 127, 129, 131, 133, 135, 137, 139, 141, 143, 145, 147, 149, 151, 153, 155, 157, 159, 161, 163, 165, 167, 169, 171, 173, 175, 177, 179, 181, 183, 185, 187, 189, 191, 193, 195, 197, 199, 201, 203, 205, 207, 209, 211, 213, 215, 217, 219, 221, 223, 225, 227, 229, 231, 233, 235, 237, 239, 241, 243, 245, 247, 249, 251, 253, 255, 257, 259, 261, 263, 265, 267, 269, 271, 273, 275, 277, 279, 281, 283, 285, 287, 289, 291, 293, 295, 297, 299, 301, 303, 305, 307, 309, 311, 313, 315, 317, 319, 321, 323, 325, 327, 329, 331, 333, 335, 337, 339, 341, 343, 345, 347, 349, 351, 353, 355, 357, 359, 361, 363, 365, 367, 369, 371, 373, 375, 377, 379, 381, 383, 385, 387, 389, 391, 393, 395, 397, 399, 401, 403, 405, 407, 409, 411, 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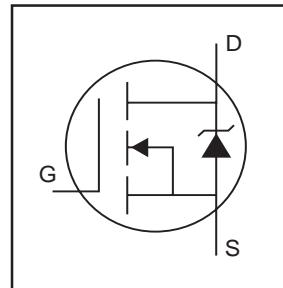
International **IR** Rectifier

PD - 91650A

FA57SA50LC

HEXFET® Power MOSFET

- Fully Isolated Package
- Easy to Use and Parallel
- Low On-Resistance
- Dynamic dv/dt Rating
- Fully Avalanche Rated
- Simple Drive Requirements
- Low Gate Charge Device
- Low Drain to Case Capacitance
- Low Internal Inductance

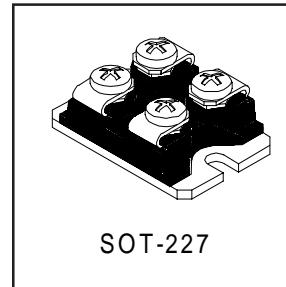


$V_{DSS} = 500V$
$R_{DS(on)} = 0.08\Omega$
$I_D = 57A$

Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The SOT-227 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 500 watts. The low thermal resistance of the SOT-227 contribute to its wide acceptance throughout the industry.



Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	57	A
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	36	
I_{DM}	Pulsed Drain Current ①	228	
$P_D @ T_C = 25^\circ C$	Power Dissipation	625	W
	Linear Derating Factor	5.0	W/C
V_{GS}	Gate-to-Source Voltage	± 20	V
E_{AS}	Single Pulse Avalanche Energy ②	725	mJ
I_{AR}	Avalanche Current ①	57	A
E_{AR}	Repetitive Avalanche Energy ①	62.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.0	V/ns
T_J	Operating Junction and	-55 to + 150	$^\circ C$
T_{STG}	Storage Temperature Range		
V_{ISO}	Insulation Withstand Voltage (AC-RMS)	2.5	kV
	Mounting torque, M4 screw	1.3	N•m

Thermal Resistance

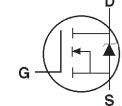
	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.20	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.05	—	$^\circ C/W$

FA57SA50LC

International
IR RectifierElectrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	500	—	—	V	$V_{GS} = 0V, I_D = 1.0\text{mA}$
$\Delta V_{(\text{BR})\text{DSS}/\Delta T_J}$	Breakdown Voltage Temp. Coefficient	—	0.62	—	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(\text{on})}$	Static Drain-to-Source On-Resistance	—	—	0.08	Ω	$V_{GS} = 10V, I_D = 34\text{A}$ ④
$V_{GS(\text{th})}$	Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$
g_{fs}	Forward Transconductance	43	—	—	S	$V_{DS} = 50V, I_D = 34\text{A}$
I_{DSS}	Drain-to-Source Leakage Current	—	—	50	μA	$V_{DS} = 500V, V_{GS} = 0V$
		—	—	500		$V_{DS} = 400V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
I_{GSS}	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{GS} = 20V$
	Gate-to-Source Reverse Leakage	—	—	-200		$V_{GS} = -20V$
Q_g	Total Gate Charge	—	225	338	nC	$I_D = 57\text{A}$
Q_{gs}	Gate-to-Source Charge	—	51	77		$V_{DS} = 400V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	98	147		$V_{GS} = 10V$, See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	—	32	—	ns	$V_{DD} = 250V$
t_r	Rise Time	—	152	—		$I_D = 57\text{A}$
$t_{d(off)}$	Turn-Off Delay Time	—	108	—		$R_G = 2.0\Omega$ (Internal)
t_f	Fall Time	—	118	—		$R_D = 4.3\Omega$, See Fig. 10 ④
L_s	Internal Source Inductance	—	5.0	—	nH	Between lead, and center of die contact
C_{iss}	Input Capacitance	—	10000	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	1500	—		$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	50	—		$f = 1.0\text{MHz}$, See Fig. 5

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	57	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	228		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}, I_S = 57\text{A}, V_{GS} = 0V$ ④
t_{rr}	Reverse Recovery Time	—	901	1351	ns	$T_J = 25^\circ\text{C}, I_F = 57\text{A}$
Q_{rr}	Reverse Recovery Charge	—	15	23	μC	$dI/dt = 100\text{A}/\mu\text{s}$ ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_s + L_D$)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

③ $I_{SD} \leq 57\text{A}$, $dI/dt \leq 200\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(\text{BR})\text{DSS}}$, $T_J \leq 150^\circ\text{C}$ ② Starting $T_J = 25^\circ\text{C}$, $L = 446\mu\text{H}$
 $R_G = 25\Omega$, $I_{AS} = 57\text{A}$. (See Figure 12)④ Pulse width $\leq 300\mu\text{s}$; duty cycle $\leq 2\%$.

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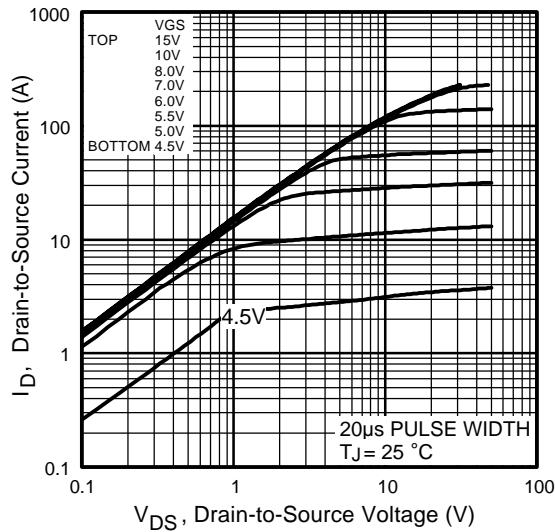


Fig 1. Typical Output Characteristics

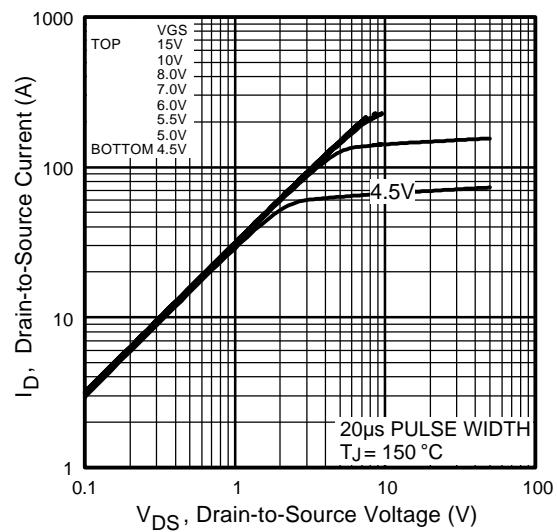


Fig 2. Typical Output Characteristics

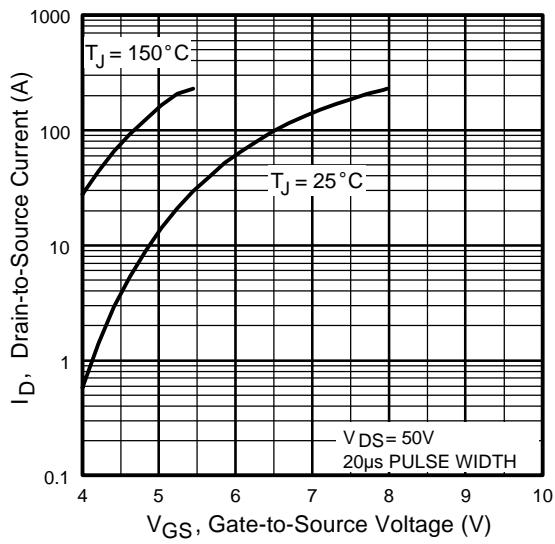


Fig 3. Typical Transfer Characteristics

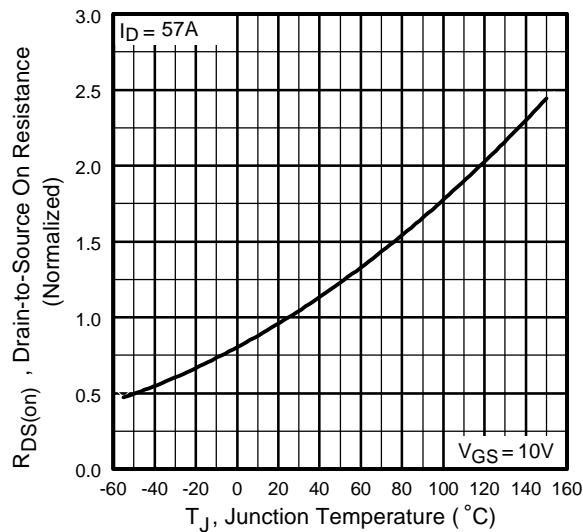


Fig 4. Normalized On-Resistance
Vs. Temperature

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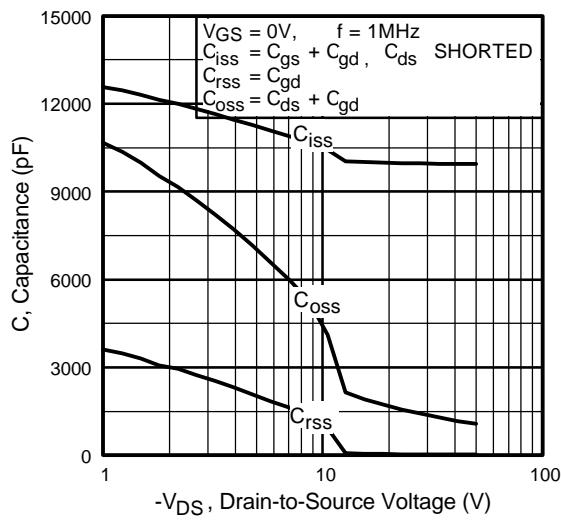


Fig 5. Typical Capacitance Vs.
Drain-to-Source Voltage

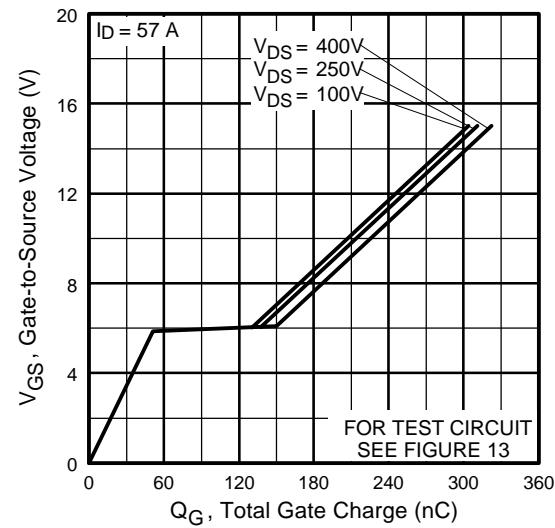


Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage

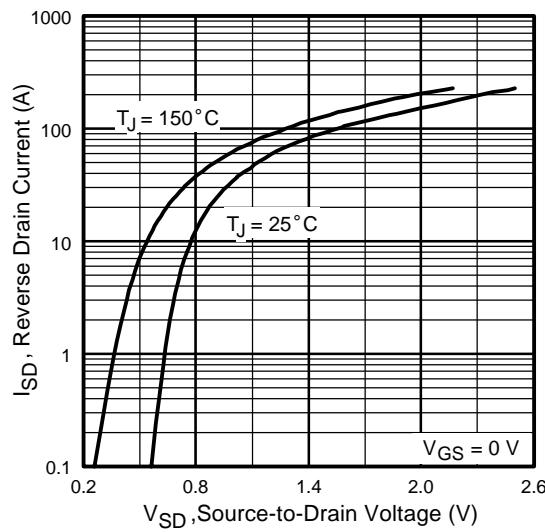


Fig 7. Typical Source-Drain Diode
Forward Voltage

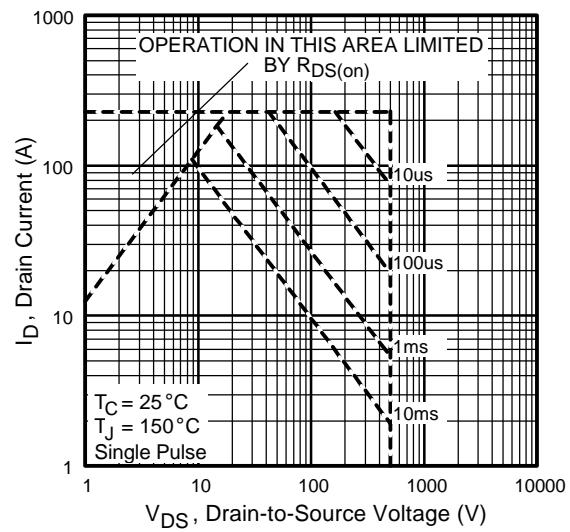


Fig 8. Maximum Safe Operating Area

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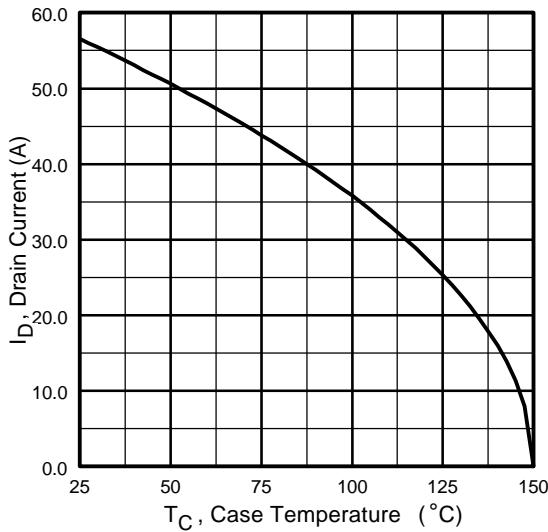


Fig 9. Maximum Drain Current Vs.
Case Temperature

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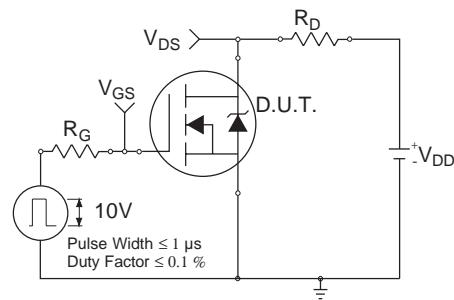


Fig 10a. Switching Time Test Circuit

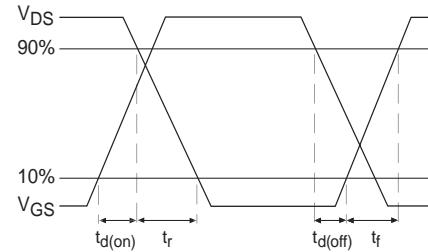


Fig 10b. Switching Time Waveforms

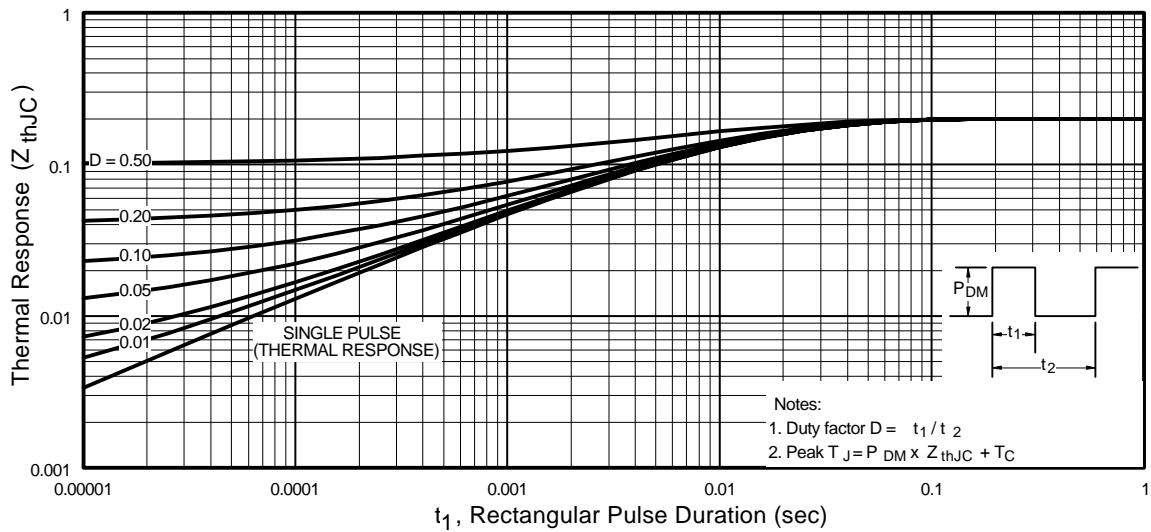


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case

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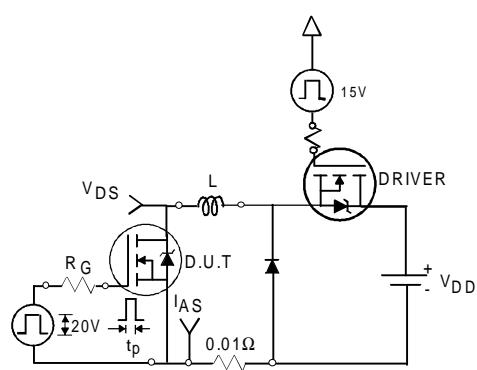


Fig 12a. Unclamped Inductive Test Circuit

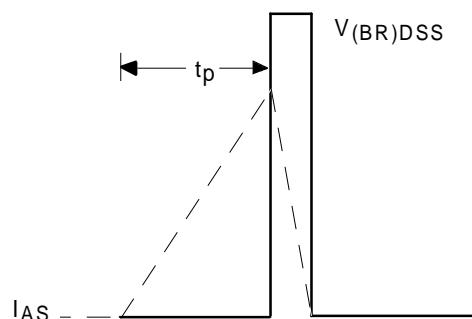


Fig 12b. Unclamped Inductive Waveforms

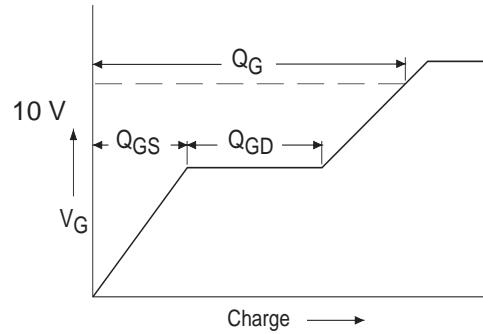


Fig 13a. Basic Gate Charge Waveform

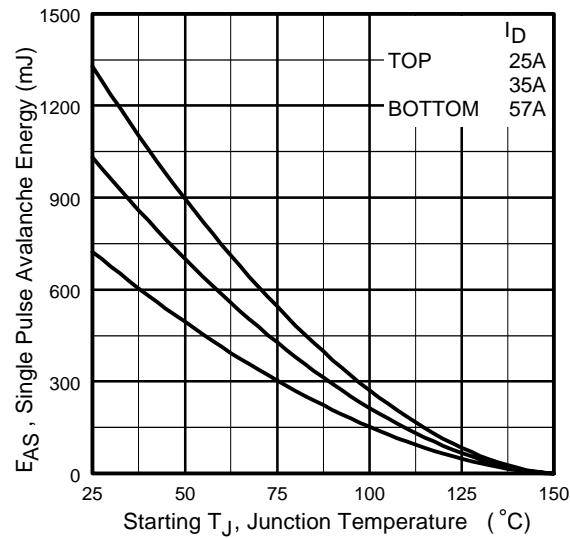


Fig 12c. Maximum Avalanche Energy Vs. Drain Current

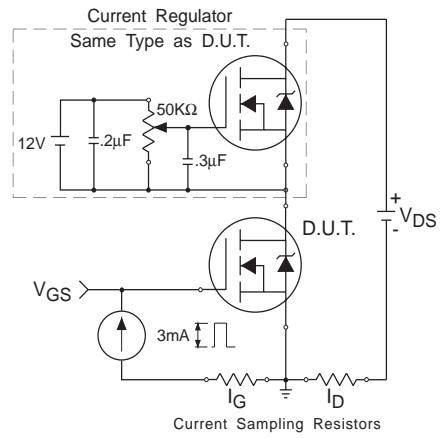
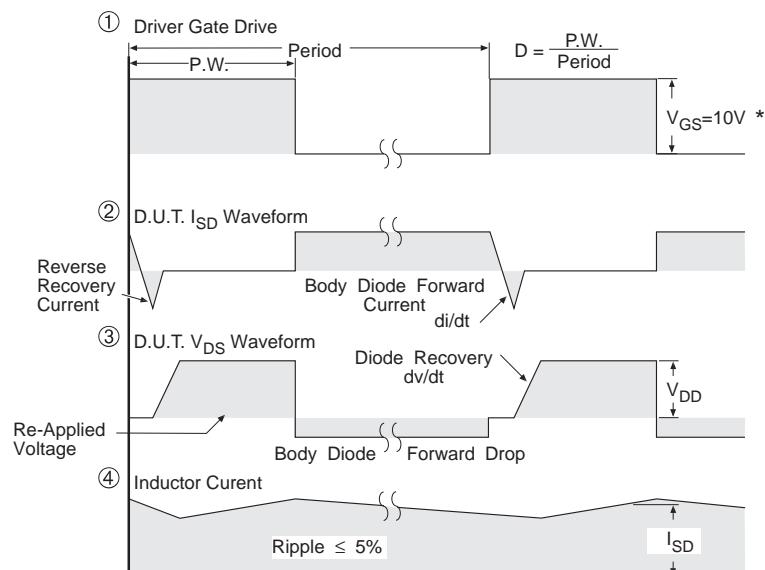
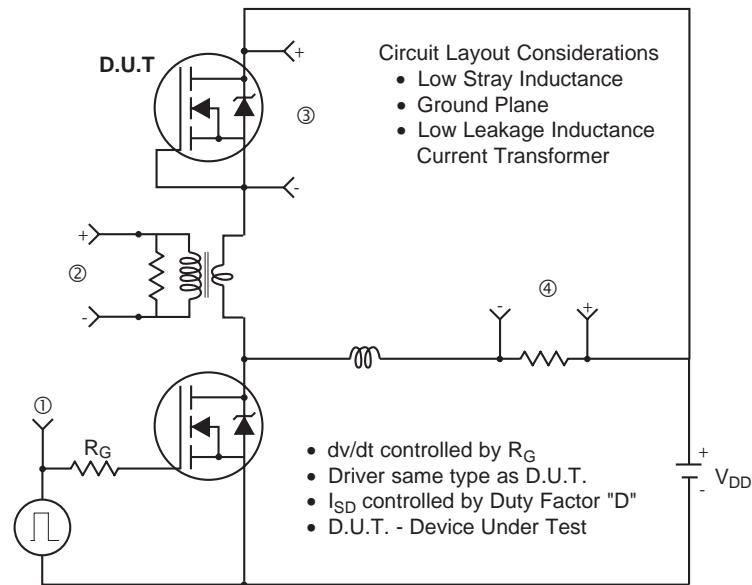


Fig 13b. Gate Charge Test Circuit

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Peak Diode Recovery dv/dt Test Circuit



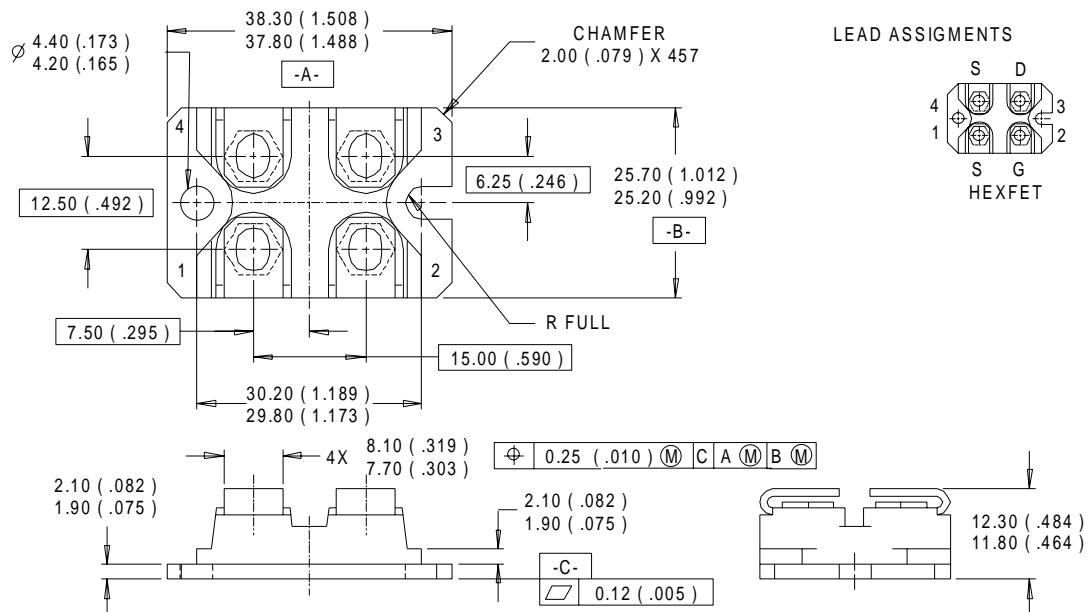
* $V_{GS} = 5V$ for Logic Level Devices

Fig 14. For N-Channel HEXFETs

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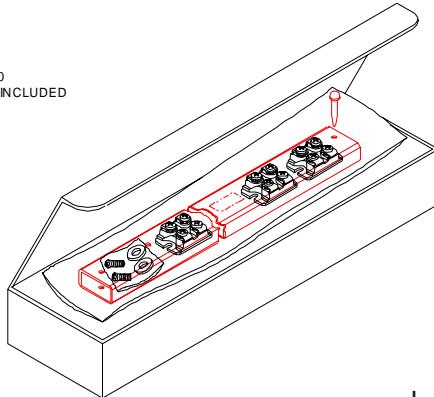
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SOT-227 Package Details



Tube

QUANTITY PER TUBE IS 10
M4 SCREW AND WASHER INCLUDED



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WORLD HEADQUARTERS: 233 Kansas St., El Segundo, California 90245, Tel: (310) 322 3331
IR GREAT BRITAIN: Hurst Green, Oxted, Surrey RH8 9BB, UK Tel: ++ 44 1883 732020

IR CANADA: 15 Lincoln Court, Brampton, Ontario L6T3Z2, Tel: (905) 453 2200

IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590

IR ITALY: Via Liguria 49, 10071 Borgaro, Torino Tel: ++ 39 11 451 0111

IR FAR EAST: K&H Bldg., 2F, 30-4 Nishi-Ikebukuro 3-Chome, Toshima-Ku, Tokyo Japan 171 Tel: 81 3 3983 0086

IR SOUTHEAST ASIA: 1 Kim Seng Promenade, Great World City West Tower, 13-11, Singapore 237994 Tel: ++ 65 838 4630

IR TAIWAN: 16 Fl. Suite D. 207, Sec. 2, Tun Haw South Road, Taipei, 10673, Taiwan Tel: 886-2-2377-9936

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