

## Advanced Power MOSFET

## SFR/U9224

### FEATURES

- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- Lower Leakage Current : 10  $\mu$ A (Max.) @  $V_{DS} = -250V$
- Lower  $R_{DS(ON)}$  : 1.65  $\Omega$  (Typ.)

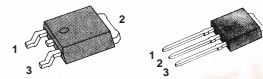
$$BV_{DSS} = -250 V$$

$$R_{DS(on)} = 2.4 \Omega$$

$$I_D = -2.5 A$$

D-PAK

I-PAK



1. Gate 2. Drain 3. Source

### Absolute Maximum Ratings

Symbol	Characteristic	Value	Units
$V_{DSS}$	Drain-to-Source Voltage	-250	V
$I_D$	Continuous Drain Current ( $T_C=25^\circ C$ )	-2.5	A
	Continuous Drain Current ( $T_C=100^\circ C$ )	-1.5	
$I_{DM}$	Drain Current-Pulsed ①	-10	A
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V
$E_{AS}$	Single Pulsed Avalanche Energy ②	156	mJ
$I_{AR}$	Avalanche Current ①	-2.5	A
$E_{AR}$	Repetitive Avalanche Energy ①	3.0	mJ
dv/dt	Peak Diode Recovery dv/dt ③	-4.8	V/ns
$P_D$	Total Power Dissipation ( $T_A=25^\circ C$ ) *	2.5	W
	Total Power Dissipation ( $T_C=25^\circ C$ )	30	W
	Linear Derating Factor	0.24	W/ $^\circ C$
$T_J, T_{STG}$	Operating Junction and Storage Temperature Range	- 55 to +150	$^\circ C$
$T_L$	Maximum Lead Temp. for Soldering Purposes, 1/8 " from case for 5-seconds	300	

### Thermal Resistance

Symbol	Characteristic	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	--	4.17	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient *	--	50	
$R_{\theta JA}$	Junction-to-Ambient	--	110	

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

Rev. B

### Electrical Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
$BV_{DSS}$	Drain-Source Breakdown Voltage	-250	--	--	V	$V_{GS}=0V, I_D=-250\mu A$
$\Delta BV/\Delta T_J$	Breakdown Voltage Temp. Coeff.	--	-0.22	--	V/ $^\circ\text{C}$	$I_D=-250\mu A$ <b>See Fig 7</b>
$V_{GS(th)}$	Gate Threshold Voltage	-2.0	--	-4.0	V	$V_{DS}=-5V, I_D=-250\mu A$
$I_{GSS}$	Gate-Source Leakage, Forward	--	--	-100	nA	$V_{GS}=-30V$
	Gate-Source Leakage, Reverse	--	--	100		$V_{GS}=30V$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	-10	$\mu A$	$V_{DS}=-250V$
		--	--	-100		$V_{DS}=-200V, T_C=125^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-State Resistance	--	--	2.4	$\Omega$	$V_{GS}=-10V, I_D=-1.3A$ ④
$g_{fs}$	Forward Transconductance	--	1.9	--	$\Omega$	$V_{DS}=-40V, I_D=-1.3A$ ④
$C_{iss}$	Input Capacitance	--	415	540	pF	$V_{GS}=0V, V_{DS}=-25V, f=1\text{MHz}$ <b>See Fig 5</b>
$C_{oss}$	Output Capacitance	--	65	95		
$C_{rss}$	Reverse Transfer Capacitance	--	24	35		
$t_{d(on)}$	Turn-On Delay Time	--	11	30	ns	$V_{DD}=-125V, I_D=-2.7A,$ $R_G=18\Omega$ <b>See Fig 13</b> ④ ⑤
$t_r$	Rise Time	--	19	50		
$t_{d(off)}$	Turn-Off Delay Time	--	34	80		
$t_f$	Fall Time	--	15	40		
$Q_g$	Total Gate Charge	--	16	20	nC	$V_{DS}=-200V, V_{GS}=-10V,$ $I_D=-2.7A$ <b>See Fig 6 &amp; Fig 12</b> ④ ⑤
$Q_{gs}$	Gate-Source Charge	--	3.3	--		
$Q_{gd}$	Gate-Drain( " Miller " ) Charge	--	7.8	--		

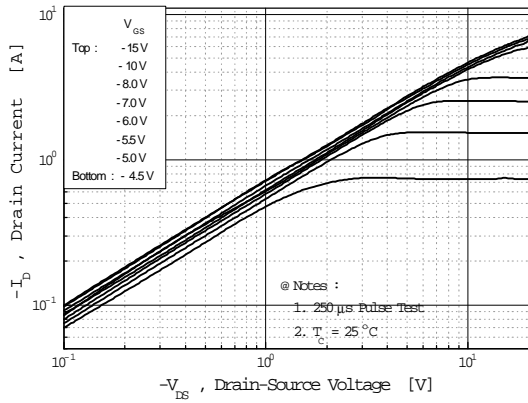
### Source-Drain Diode Ratings and Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
$I_S$	Continuous Source Current	--	--	-2.5	A	Integral reverse pn-diode in the MOSFET
$I_{SM}$	Pulsed-Source Current ①	--	--	-10		
$V_{SD}$	Diode Forward Voltage ④	--	--	-5.0	V	$T_J=25^\circ\text{C}, I_S=-2.4A, V_{GS}=0V$
$t_{rr}$	Reverse Recovery Time	--	140	--	ns	$T_J=25^\circ\text{C}, I_F=-2.7A$
$Q_{rr}$	Reverse Recovery Charge	--	0.7	--	$\mu C$	$di_F/dt=100A/\mu s$ ④

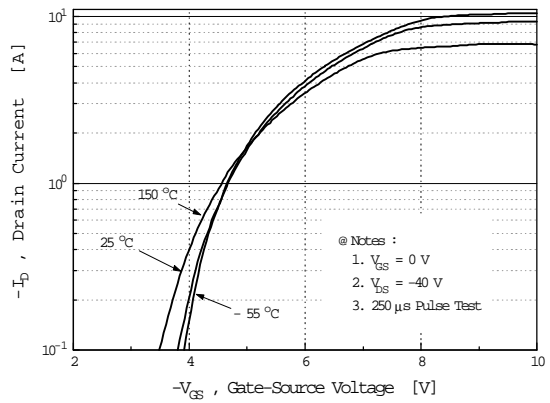
#### Notes ;

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ②  $L=40\text{mH}, I_{AS}=-2.5A, V_{DD}=-50V, R_G=27\Omega^*,$  Starting  $T_J=25^\circ\text{C}$
- ③  $I_{SD} \leq 2.7A, di/dt \leq 300A/\mu s, V_{DD} \leq BV_{DSS},$  Starting  $T_J=25^\circ\text{C}$
- ④ Pulse Test : Pulse Width = 250  $\mu s,$  Duty Cycle  $\leq 2\%$
- ⑤ Essentially Independent of Operating Temperature

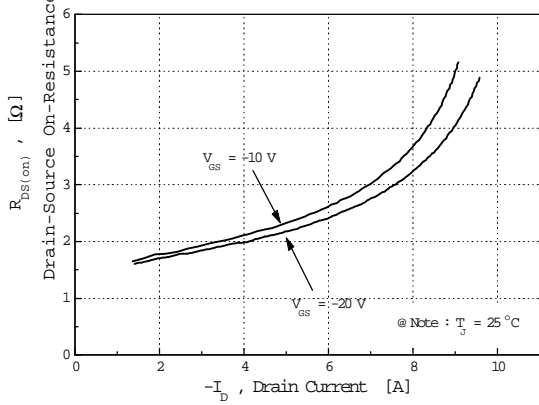
**Fig 1. Output Characteristics**



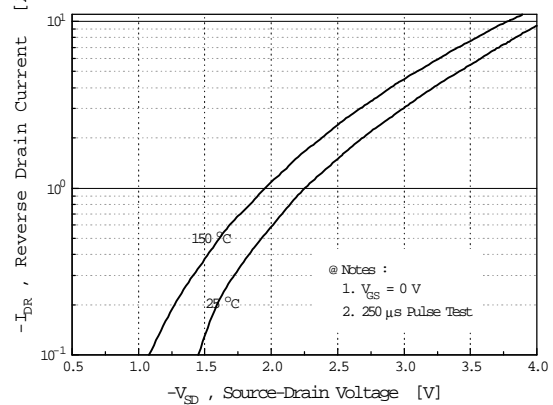
**Fig 2. Transfer Characteristics**



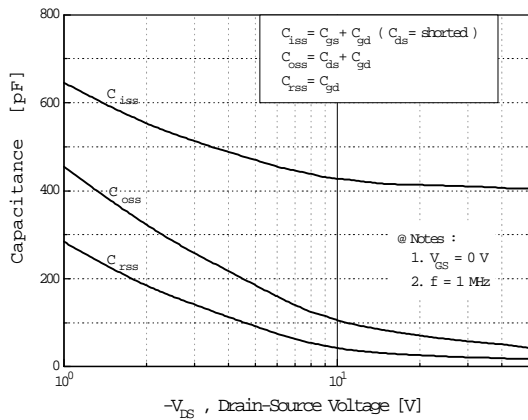
**Fig 3. On-Resistance vs. Drain Current**



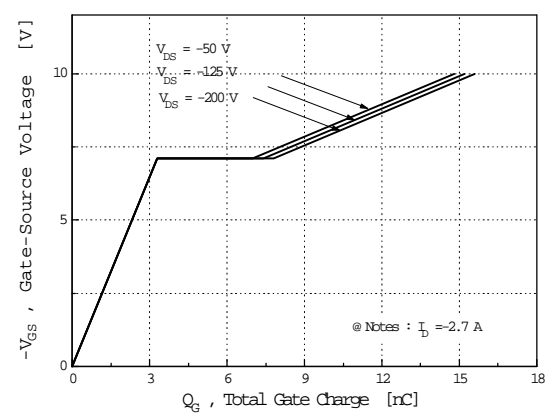
**Fig 4. Source-Drain Diode Forward Voltage**

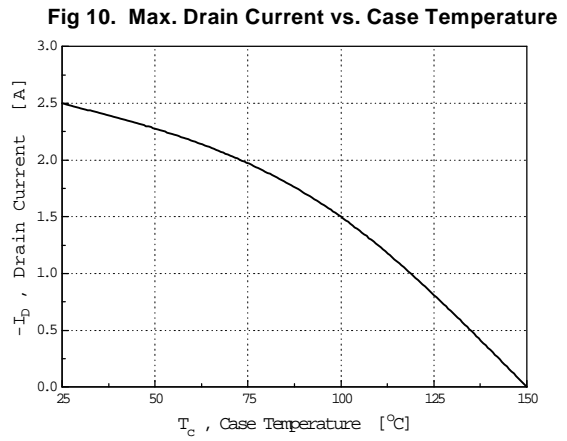
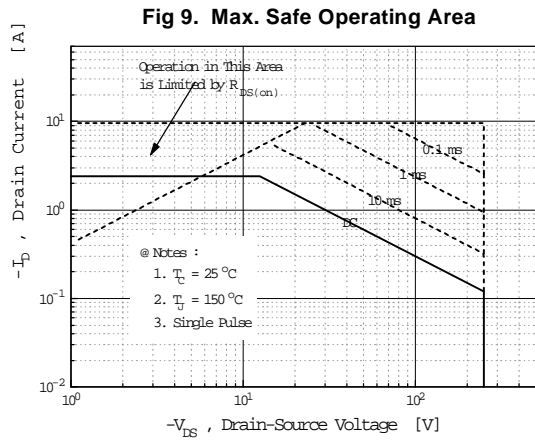
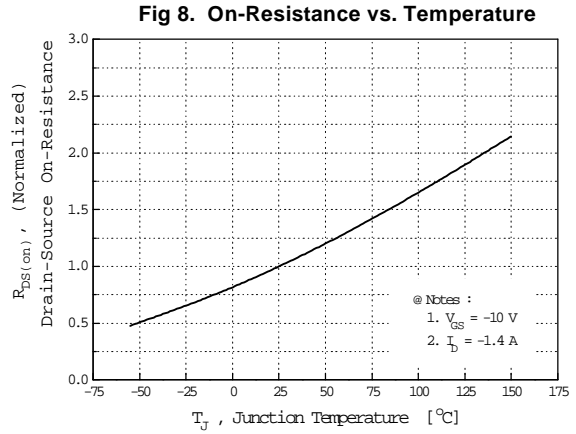
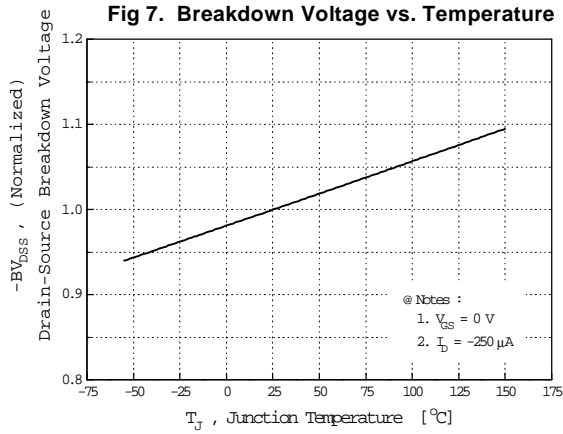


**Fig 5. Capacitance vs. Drain-Source Voltage**



**Fig 6. Gate Charge vs. Gate-Source Voltage**





**Fig 11. Thermal Response**

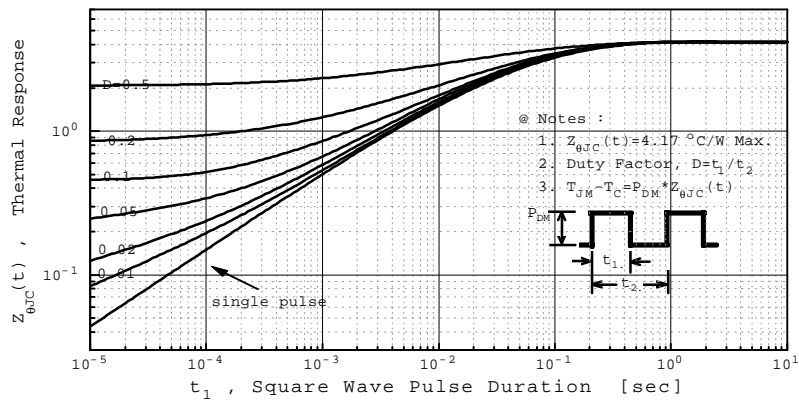


Fig 12. Gate Charge Test Circuit & Waveform

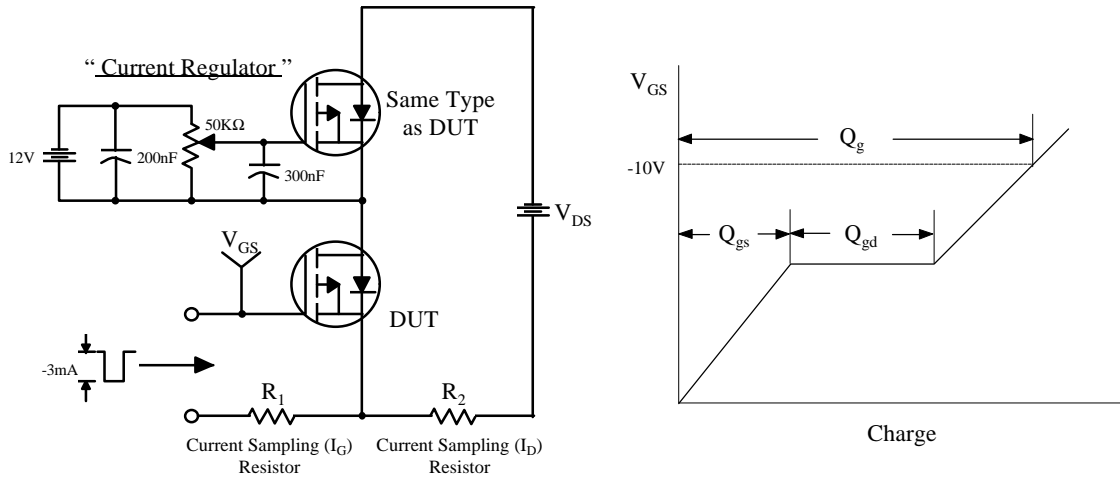


Fig 13. Resistive Switching Test Circuit & Waveforms

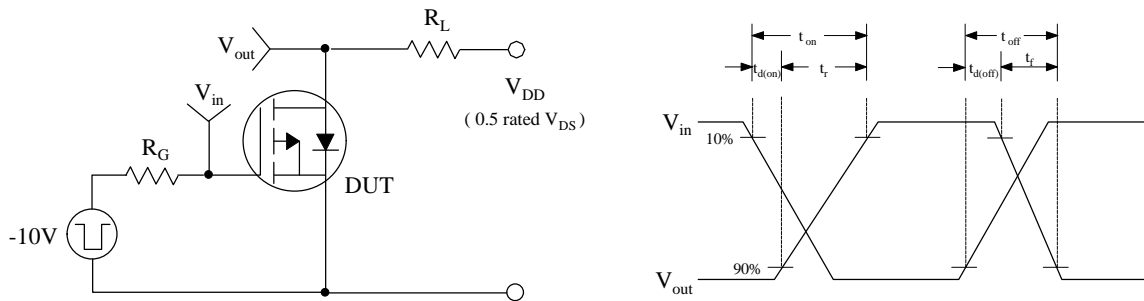


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

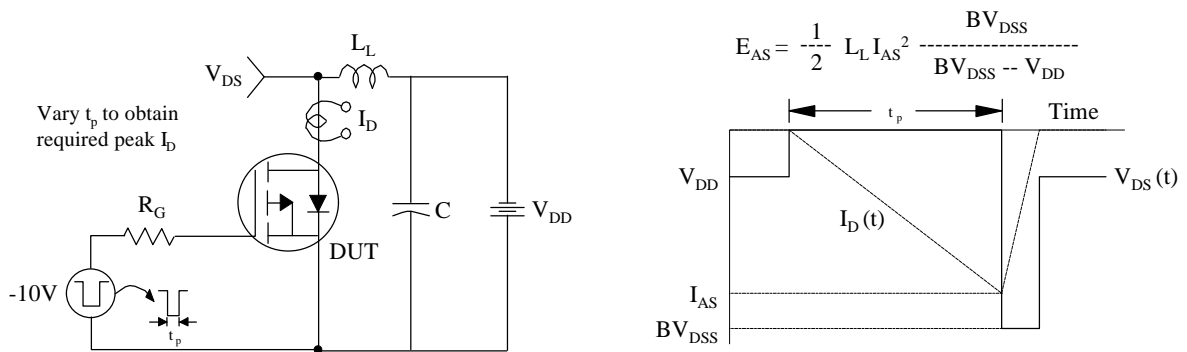
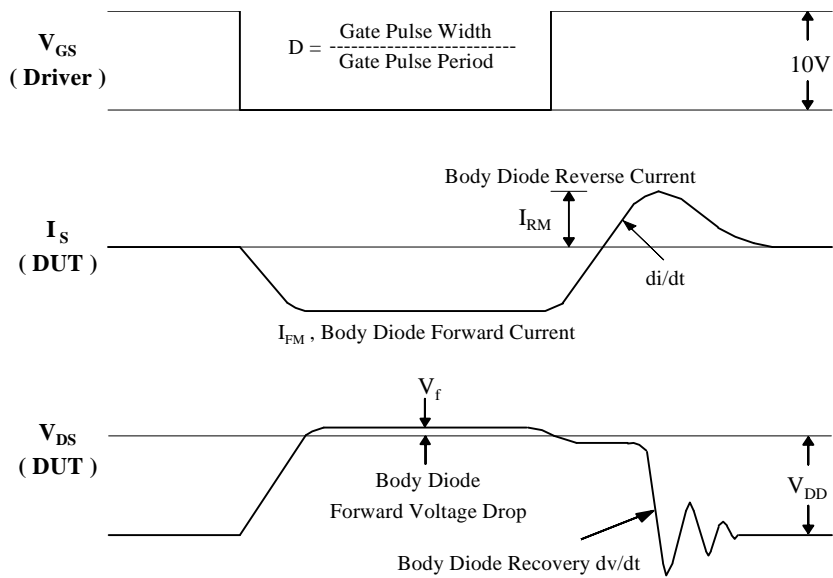
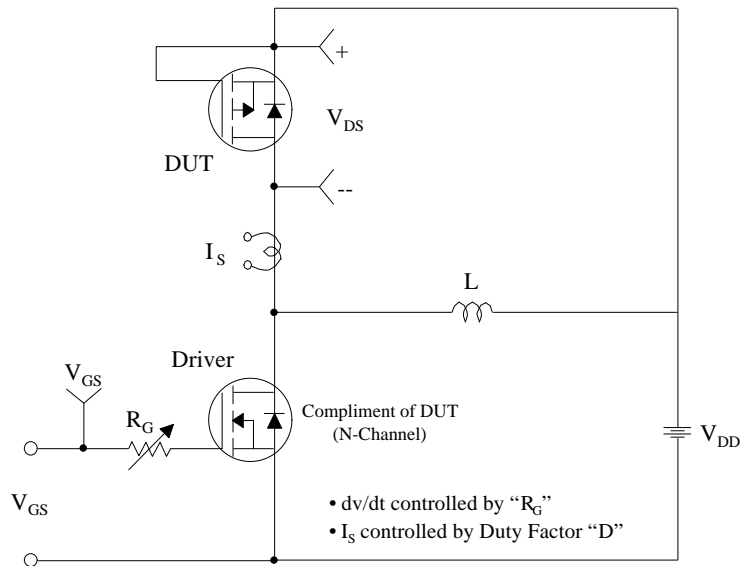


Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



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