

# FC40SA50FK

HEXFET® Power MOSFET

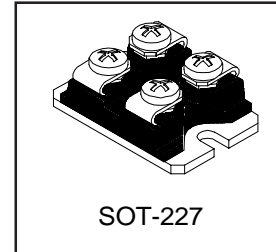
## Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

$V_{DSS}$	$R_{DS(on)}$ typ.	$I_D$
500V	0.084 $\Omega$	40A

## Benefits

- Low Gate Charge  $Q_g$  results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic  $dv/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Low  $R_{DS(on)}$
- Fully Insulated Package



## Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	40	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10\text{V}$	26	
$I_{DM}$	Pulsed Drain Current ①	160	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	430	W
	Linear Derating Factor	3.45	W/ $^\circ\text{C}$
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V
$dv/dt$	Peak Diode Recovery $dv/dt$ ③	9.0	V/ns
$T_J$ $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ\text{C}$

## Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy ②	–	1240	mJ
$I_{AR}$	Avalanche Current ②	–	40	A
$E_{AR}$	Repetitive Avalanche Energy ①	–	43	mJ

## Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	–	0.29	$^\circ\text{C/W}$
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.05	–	

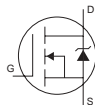
Static @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	500	–	–	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	–	0.60	–	V/ $^\circ\text{C}$	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$ ④
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	–	0.084	0.10	$\Omega$	$V_{GS} = 10V, I_D = 24A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	–	5.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	–	–	50	$\mu A$	$V_{DS} = 500V, V_{GS} = 0V$
		–	–	250		$V_{DS} = 400V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	–	–	250	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	–	–	-250		$V_{GS} = -30V$

Dynamic @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	23	–	–	S	$V_{DS} = 50V, I_D = 28A$
$Q_g$	Total Gate Charge	–	–	270	nC	$I_D = 40A$
$Q_{gs}$	Gate-to-Source Charge	–	–	84		$V_{DS} = 400V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	–	–	130		$V_{GS} = 10V$ , See Fig. 6 and 13 ④
$t_{d(on)}$	Turn-On Delay Time	–	25	–	ns	$V_{DD} = 250V$
$t_r$	Rise Time	–	140	–		$I_D = 40A$
$t_{d(off)}$	Turn-Off Delay Time	–	55	–		$R_G = 1.0\Omega$
$t_f$	Fall Time	–	74	–		$V_{GS} = 10V$ , See Fig. 10 ④
$C_{iss}$	Input Capacitance	–	8310	–	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	–	960	–		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	–	120	–		$f = 1.0\text{MHz}$ , See Fig. 5
$C_{oss}$	Output Capacitance	–	10170	–		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	–	240	–		$V_{GS} = 0V, V_{DS} = 480V, f = 1.0\text{MHz}$
$C_{oss\ eff.}$	Effective Output Capacitance	–	440	–		$V_{GS} = 0V, V_{DS} = 0V$ to 480V ⑤

## Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	–	–	40	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	–	–	160		
$V_{SD}$	Diode Forward Voltage	–	–	1	V	$T_J = 25^\circ\text{C}, I_S = 40A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	–	620	940	ns	$T_J = 25^\circ\text{C}, I_F = 47A$
$Q_{rr}$	Reverse Recovery Charge	–	14	21	$\mu C$	$di/dt = 100A/\mu s$ ④
$I_{RRM}$	Reverse Recovery Current	–	38	–	A	$T_J = 25^\circ\text{C}$
$t_{on}$	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)
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.55\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 40A$ ,  $dv/dt = 5.5V/ns$  (See Figure 12a)
- ③  $I_{SD} \leq 40A$ ,  $di/dt \leq 150A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$

- ④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

- ⑤  $C_{oss\ eff.}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$

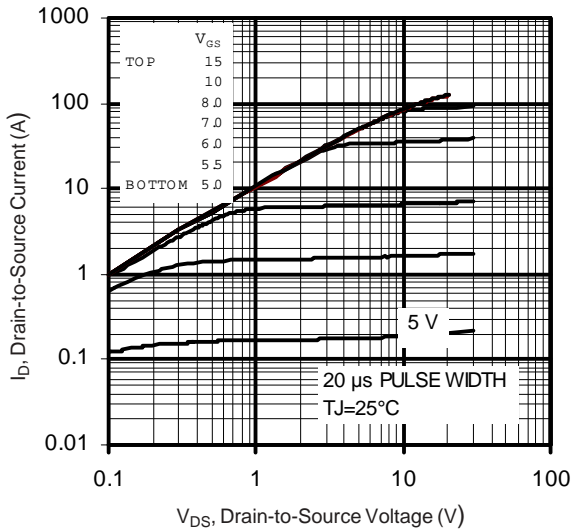


Fig 1. Typical Output Characteristics

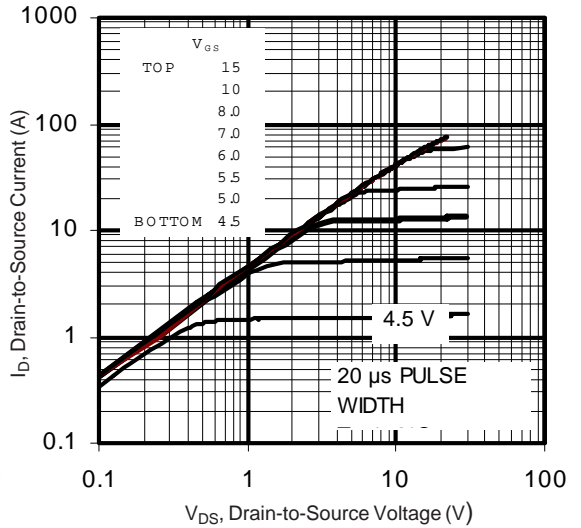


Fig 2. Typical Output Characteristics

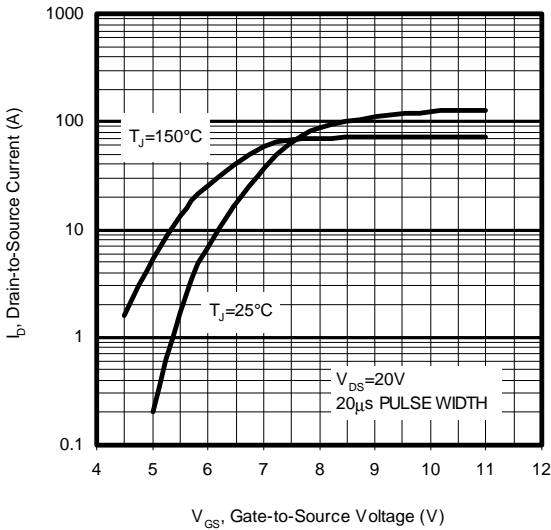


Fig 3. Typical Transfer Characteristics

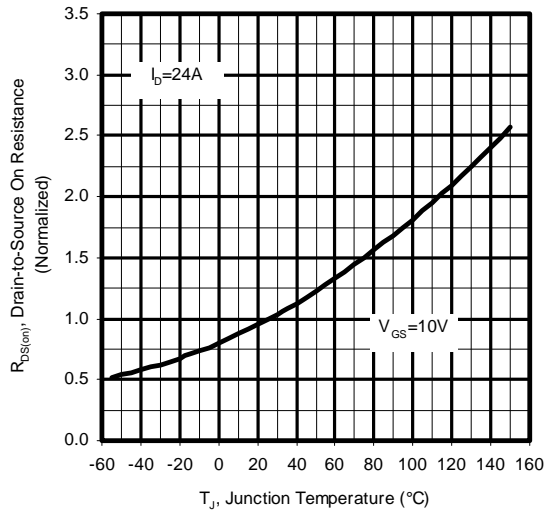
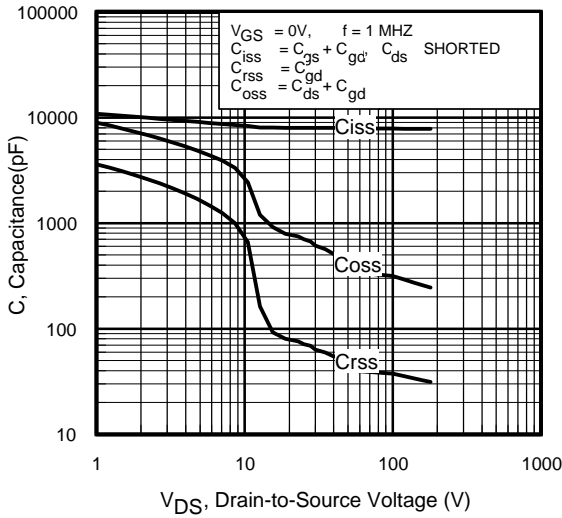
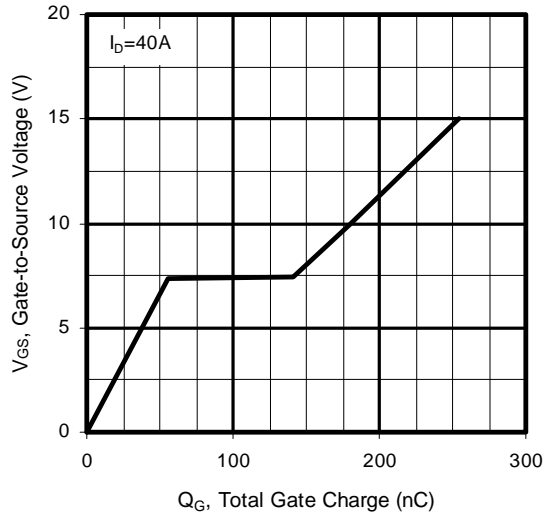


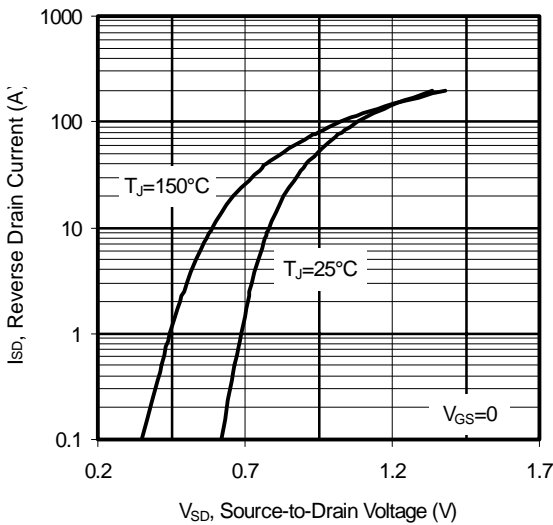
Fig 4. Normalized On-Resistance Vs. Temperature



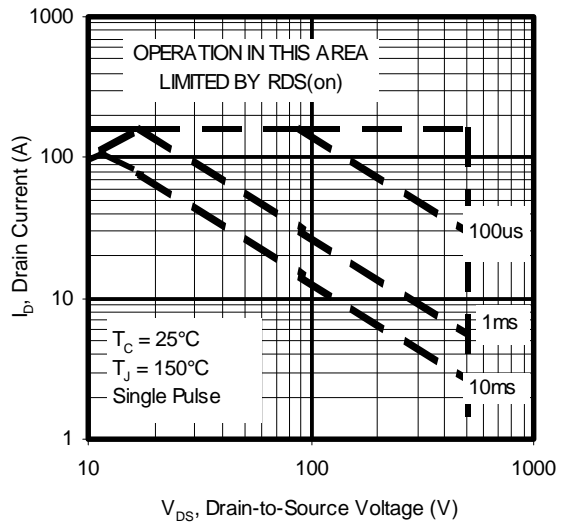
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



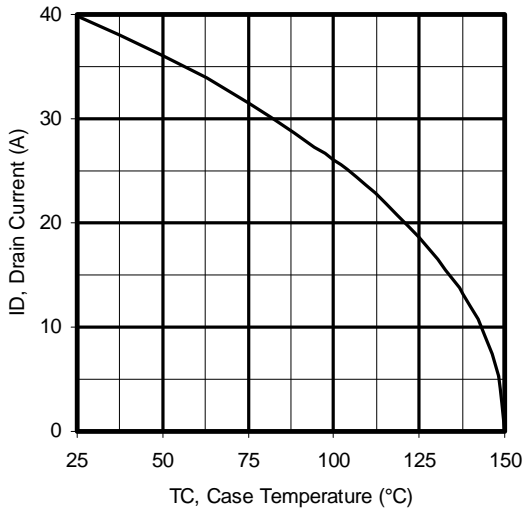
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



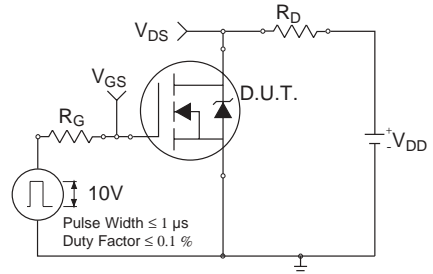
**Fig 7.** Typical Source-Drain Diode Forward Voltage



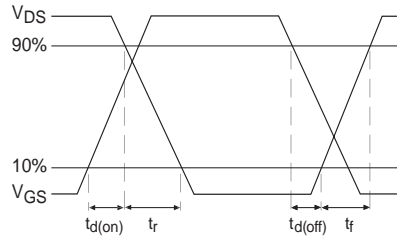
**Fig 8.** Maximum Safe Operating Area



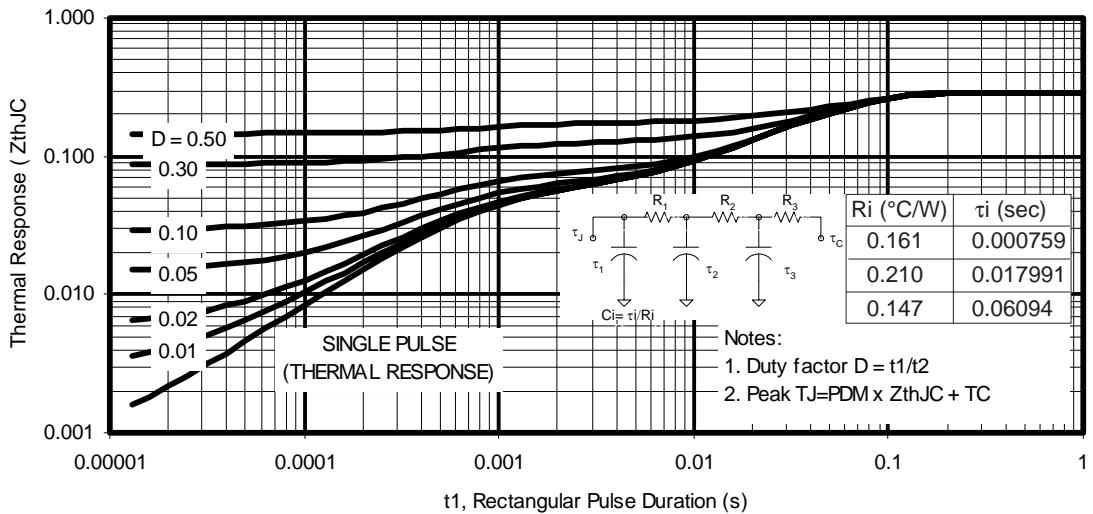
**Fig 9.** Maximum Drain Current Vs. Case Temperature



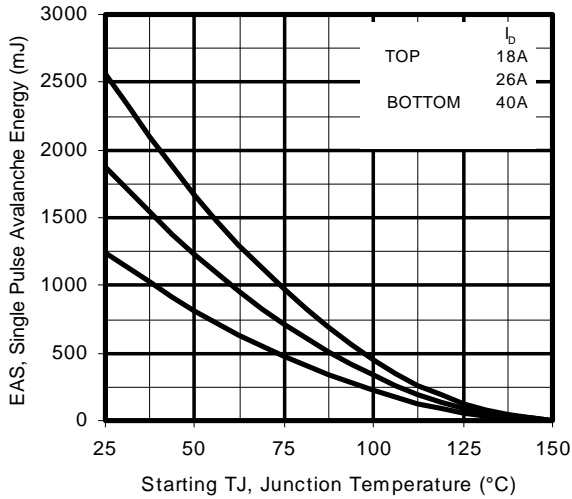
**Fig 10a.** Switching Time Test Circuit



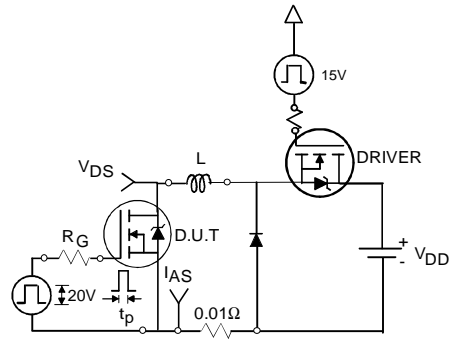
**Fig 10b.** Switching Time Waveforms



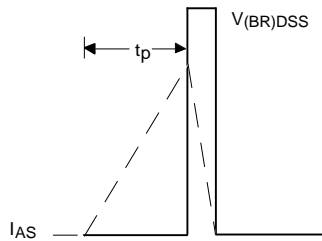
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



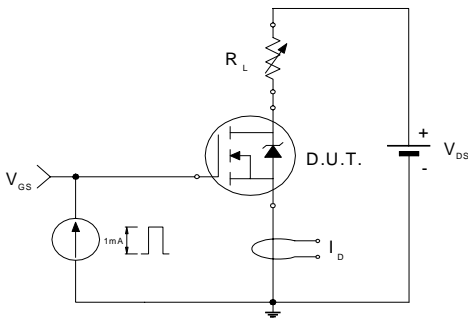
**Fig 12a.** Maximum Avalanche Energy Vs. Drain Current



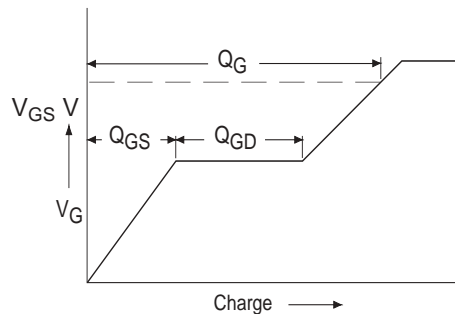
**Fig 12c.** Unclamped Inductive Test Circuit



**Fig 12d.** Unclamped Inductive Waveforms

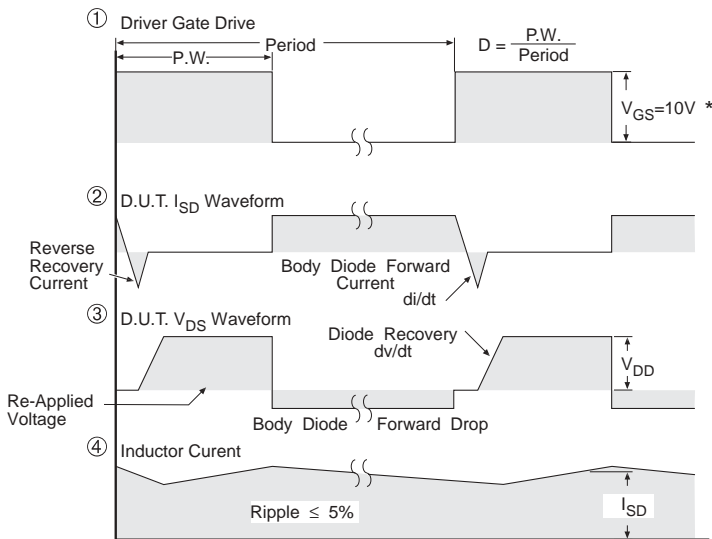
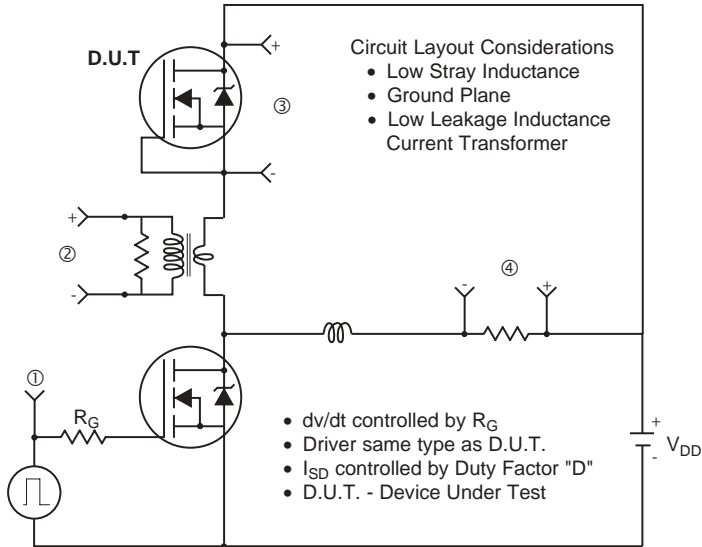


**Fig 13a.** Gate Charge Test Circuit



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

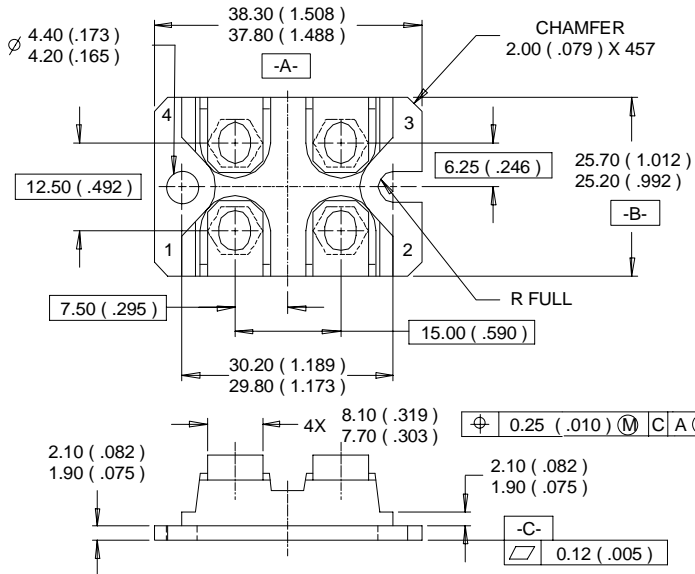
### Peak Diode Recovery dv/dt Test Circuit



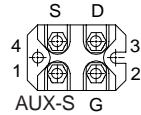
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 14.** For N-Channel HEXFET<sup>®</sup> Power MOSFETs

**SOT-227 Package Details**



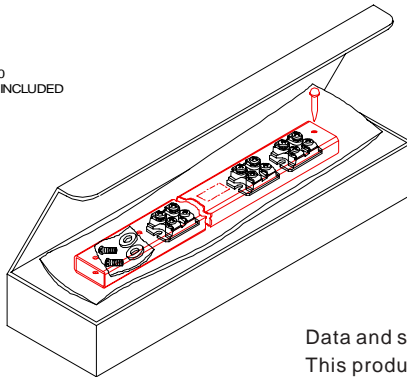
**LEAD ASSIGNMENTS**



**HEXFET**

Note :  
 AUX-S is a low current input  
 intended for driving purpose only

QUANTITY PER TUBE IS 10  
 M4 SCREW AND WASHER INCLUDED



Data and specifications subject to change without notice.  
 This product has been designed and qualified for Industrial  
 Level.