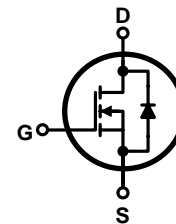
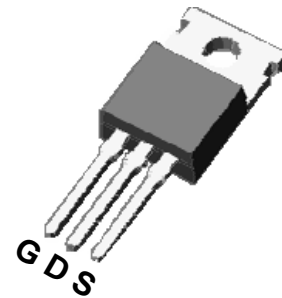


## PIN Connection TO-220

$V_{DSS}$	600	V
$I_D$	10	A
$P_D (T_C=25^\circ\text{C})$	125	W
$R_{DS(ON)}$	0.63	$\Omega$



### Marking Diagram



Y = Year  
 A = Assembly Location  
 WW = Work Week  
 FIR10N60P = Specific Device Code

## Features

- **Fast Switching**
- **ESD Improved Capability**
- **Low Gate Charge** (Typical Data:60nC)
- **Low Reverse transfer capacitances**(Typical:28pF)
- **100% Single Pulse avalanche energy Test**

## Applications

Power switch circuit of adaptor and charger.

## Absolute (Tc= 25°C unless otherwise specified)

Symbol	Parameter	Rating	Units
$V_{DSS}$	Drain-to-Source Voltage	600	V
$I_D$	Continuous Drain Current	10	A
	Continuous Drain Current $T_C = 100^\circ\text{C}$	6.4	A
$I_{DM}^{a1}$	Pulsed Drain Current	40	A
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}^{a2}$	Single Pulse Avalanche Energy	300	mJ
$E_{AR}^{a1}$	Avalanche Energy ,Repetitive	30	mJ
$I_{AR}^{a1}$	Avalanche Current	8.0	A
$dv/dt^{a3}$	Peak Diode Recovery dv/dt	5.5	V/ns
$P_D$	Power Dissipation	125	W
	Derating Factor above 25°C	1.0	W/°C
$V_{ESD(G-S)}$	Gate source ESD (HBM-C= 100pF, R=1.5k $\Omega$ )	4000	V
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	150, -55 to 150	°C
$T_L$	Maximum Temperature for Soldering	300	°C

**Electrical Characteristics** (Tc= 25°C unless otherwise specified)

<b>OFF Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V <sub>DSS</sub>	Drain to Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	600	--	--	V
Δ BV <sub>DSS</sub> / Δ T <sub>J</sub>	Bvdss Temperature Coefficient	I <sub>D</sub> =250uA, Reference 25°C	--	0.74	--	V/°C
I <sub>DSS</sub>	Drain to Source Leakage Current	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 25°C	--	--	25	μA
		V <sub>DS</sub> = 480V, V <sub>GS</sub> = 0V, T <sub>a</sub> = 125°C	--	--	250	
V <sub>GSO</sub>	Gate Source Breakdown Voltage	I <sub>GS</sub> = ±1mA (Open Drain)	±20			V
I <sub>GSS(F)</sub>	Gate to Source Forward Leakage	V <sub>GS</sub> = +20V	--	--	10	μA
I <sub>GSS(R)</sub>	Gate to Source Reverse Leakage	V <sub>GS</sub> = -20V	--	--	-10	μA

<b>ON Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
R <sub>DS(ON)</sub>	Drain-to-Source On-Resistance	V <sub>GS</sub> =10V, I <sub>D</sub> =5A	--	0.63	0.75	Ω
V <sub>GS(TH)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0	3.0	4.0	V
Pulse width tp ≤ 380μs, δ ≤ 2%						

<b>Dynamic Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
g <sub>fs</sub>	Forward Transconductance	V <sub>DS</sub> =15V, I <sub>D</sub> =5.0A	--	8.5	--	S
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	--	1430	--	pF
C <sub>oss</sub>	Output Capacitance		--	160	--	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	28	--	

<b>Resistive Switching Characteristics</b>						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
t <sub>d(ON)</sub>	Turn-on Delay Time	I <sub>D</sub> = 10.0A V <sub>DD</sub> = 300V V <sub>GS</sub> = 10V R <sub>G</sub> = 4.7Ω	--	20	--	ns
t <sub>r</sub>	Rise Time		--	20	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	55	--	
t <sub>f</sub>	Fall Time		--	30	--	
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> = 10.0A V <sub>DD</sub> = 480V V <sub>GS</sub> = 10V	--	60	70	nC
Q <sub>gs</sub>	Gate to Source Charge		--	12	--	
Q <sub>gd</sub>	Gate to Drain ("Miller") Charge		--	28	--	

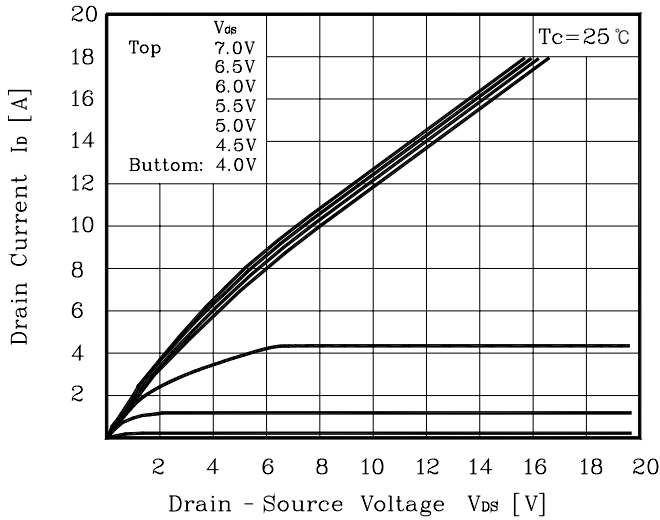
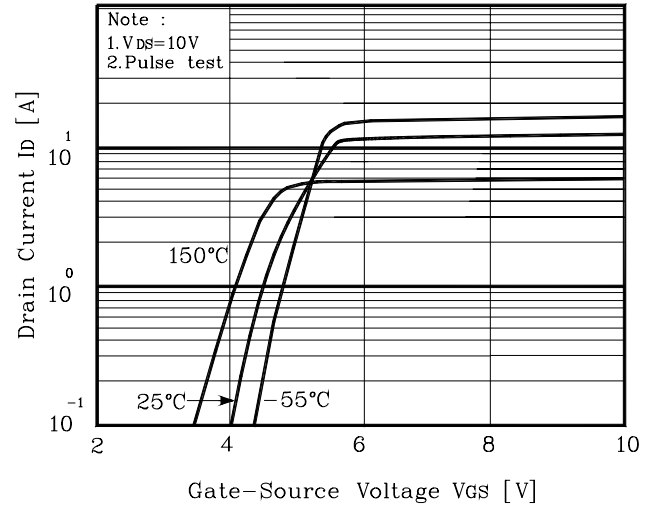
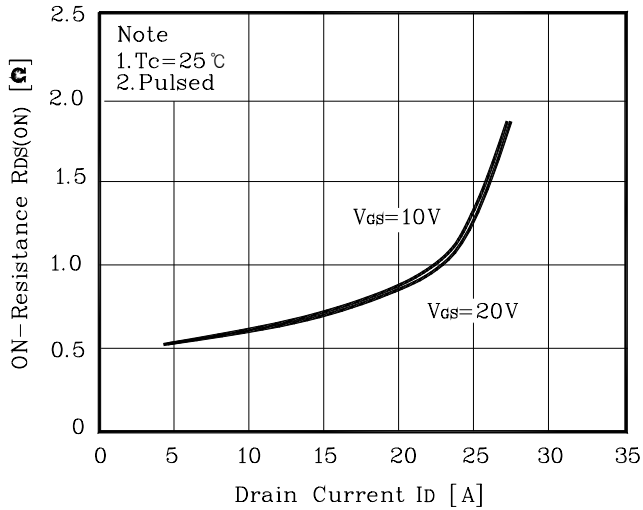
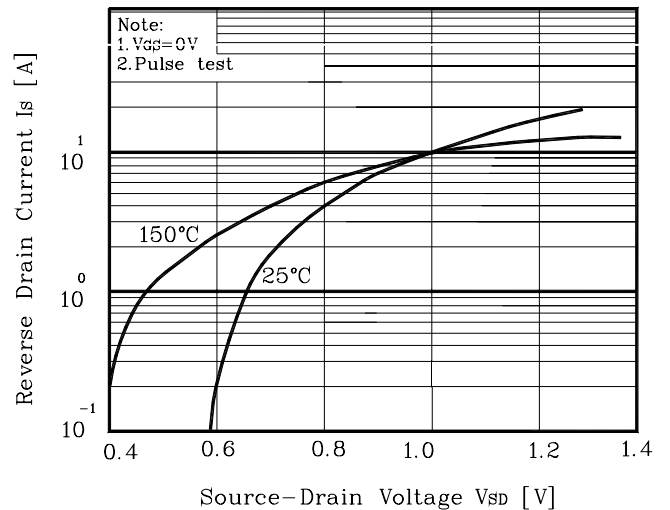
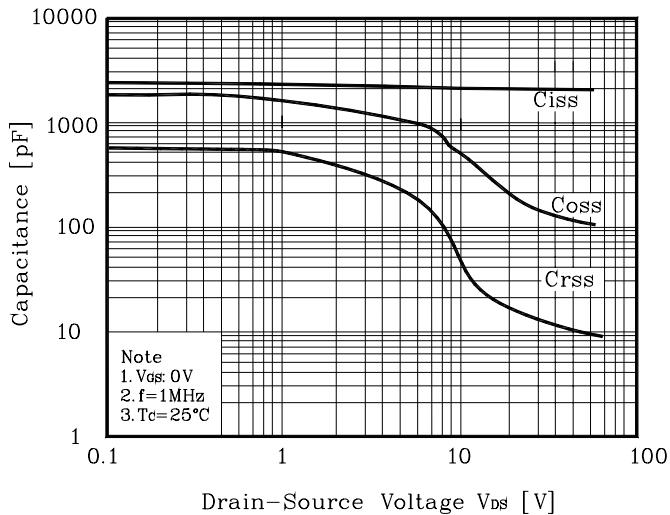
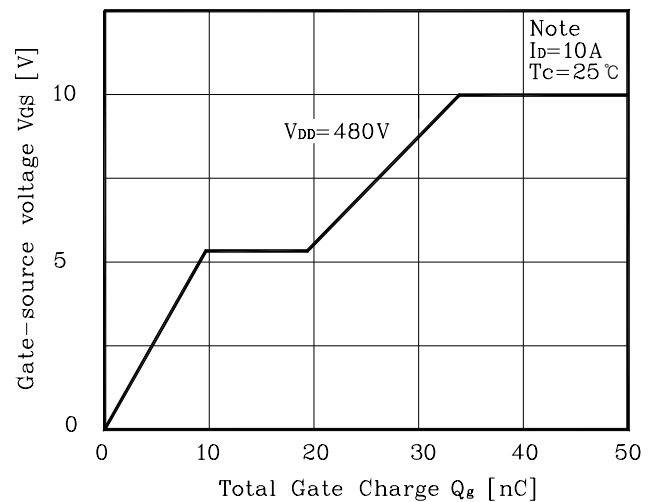
Source-Drain Diode Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$I_S$	Continuous Source Current (Body Diode)		--	--	10	A
$I_{SM}$	Maximum Pulsed Current (Body Diode)		--	--	40	A
$V_{SD}$	Diode Forward Voltage	$I_S=10.0A, V_{GS}=0V$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S=10.0A, T_j = 25^\circ C$ $dI_F/dt=100A/us,$ $V_{GS}=0V$	--	600	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	4.3	--	nC
$I_{RRM}$	Reverse Recovery Current		--	13	--	A
Pulse width $t_p \leq 380\mu s, \delta \leq 2\%$						

Symbol	Parameter	Typ.	Units
$R_{\theta JC}$	Junction-to-Case	1.0	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient	62	$^\circ C/W$

<sup>a1</sup>: Repetitive rating; pulse width limited by maximum junction temperature

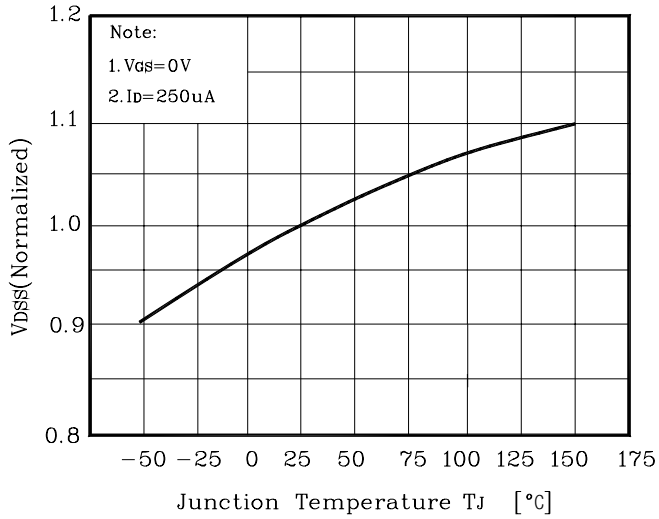
<sup>a2</sup>:  $L=10.0mH, I_P=10A, Start T_j=25^\circ C$

<sup>a3</sup>:  $I_{SD}=10A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}, Start T_j=25^\circ C$

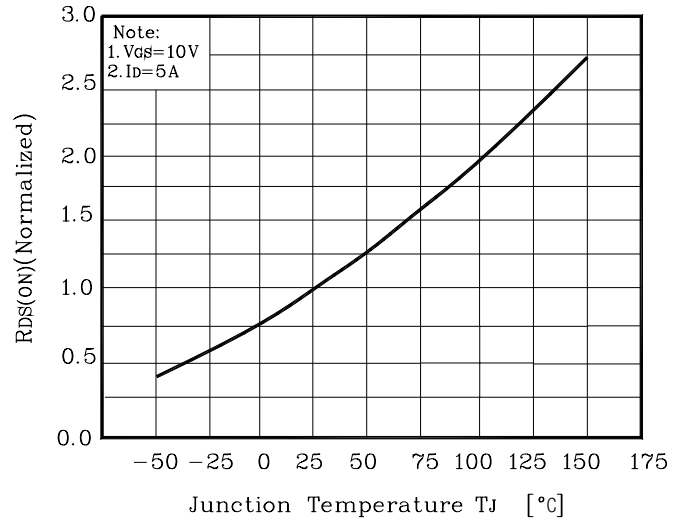
**Electrical Characteristic Curves**
**Fig. 1  $I_D - V_{DS}$** 

**Fig. 2  $I_D - V_{GS}$** 

**Fig. 3  $R_{DS(on)} - I_D$** 

**Fig. 4  $I_S - V_{SD}$** 

**Fig. 5 Capacitance -  $V_{DS}$** 

**Fig. 6  $V_{GS} - Q_G$** 


## Electrical Characteristic Curves

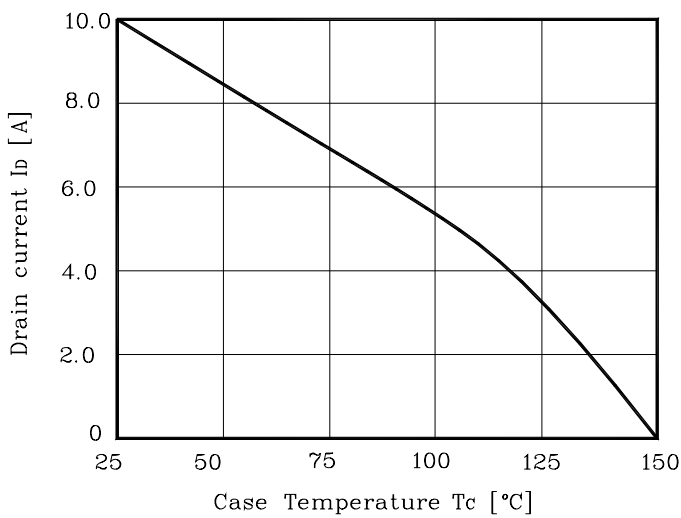
**Fig. 7  $V_{DSS} - T_J$**



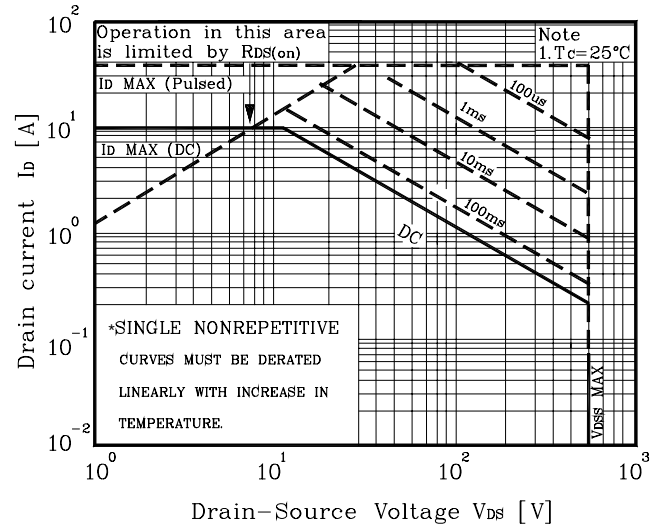
**Fig.8  $R_{DS(on)} - T_J$**



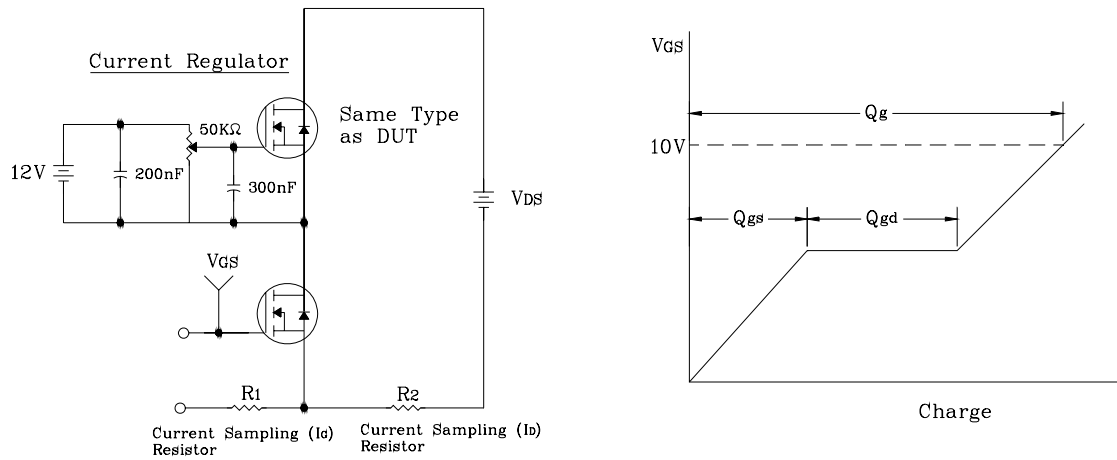
**Fig. 9  $I_D - T_C$**



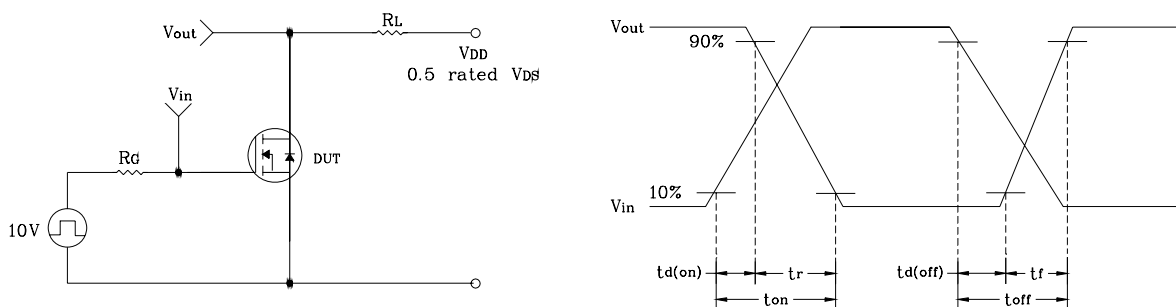
**Fig. 10 Safe Operating Area**



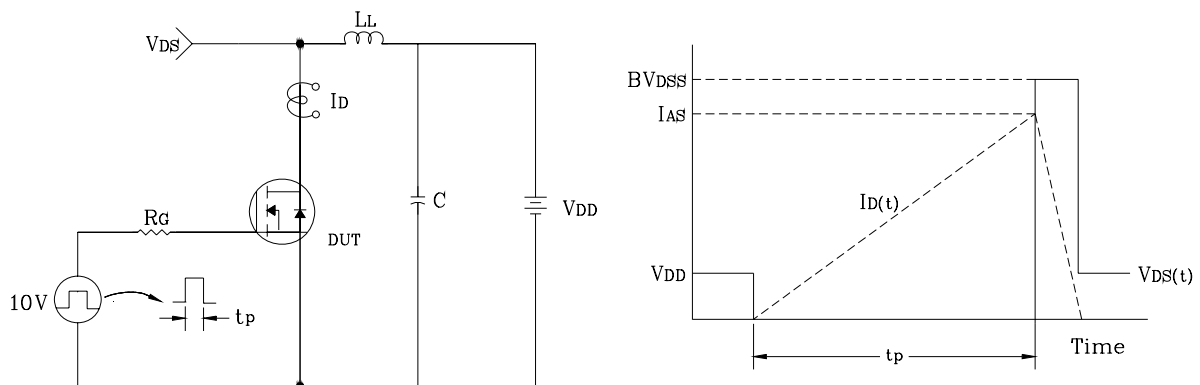
**Fig. 10 Gate Charge Test Circuit & Waveform**



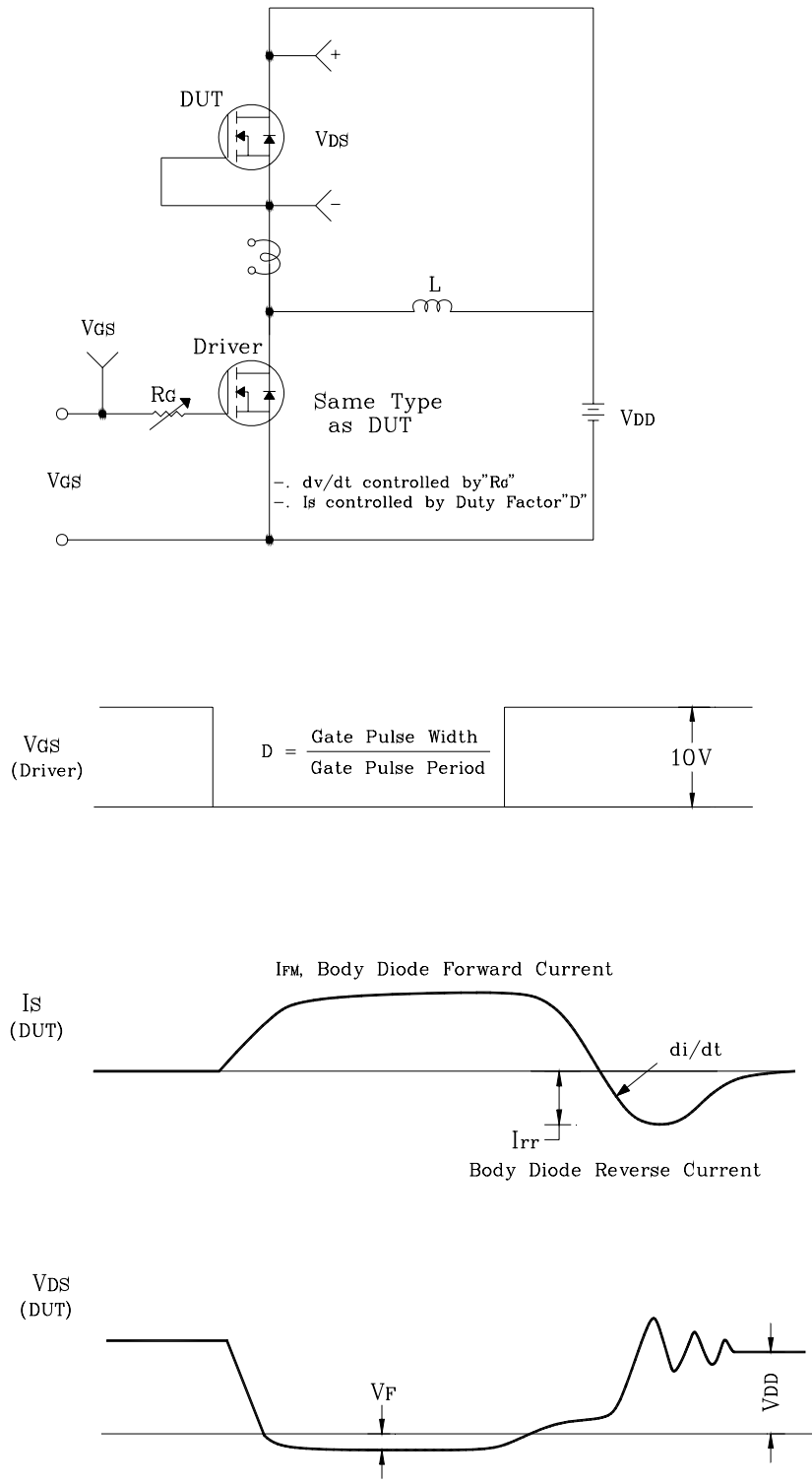
**Fig. 11 Resistive Switching Test Circuit & Waveform**



**Fig. 12 EAS Test Circuit & Waveform**

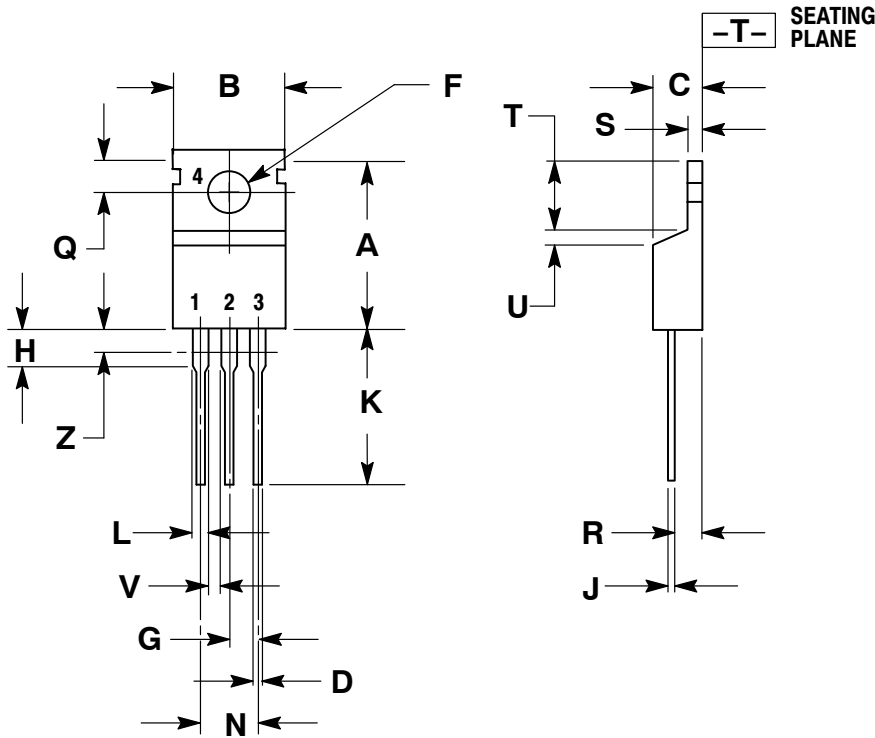


**Fig. 13 Diode Reverse Recovery Time Test Circuit & Waveform**



## Package Dimensions

### TO-220



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.161	3.61	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.014	0.025	0.36	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	---	1.15	---
Z	---	0.080	---	2.04

**STYLE 6:**

- PIN 1. ANODE
- 2. CATHODE
- 3. ANODE
- 4. CATHODE