

$V_{DSS}$	600	V
$I_D$	7	A
$P_D(T_C=25^\circ\text{C})$	30	W
$R_{DS(ON)}$	1.10	$\Omega$

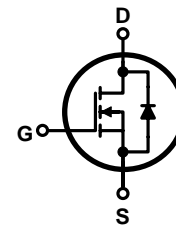
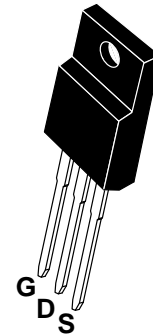
## Features

- Fast Switching
- ESD Improved Capability
- Low Gate Charge (Typical Data:21nC)
- Low Reverse transfer capacitances(Typical:15pF)
- 100% Single Pulse avalanche energy Test

## Applications

Power switch circuit of adaptor and charger.

### PIN Connection TO-220F



### Marking Diagram



Y = Year  
 A = Assembly Location  
 WW = Work Week  
 FIR8N60F = Specific Device Code

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

Symbol	Parameter	Rating	Units
$V_{DSS}$	Drain-to-Source Voltage	600	V
$I_D$	Continuous Drain Current	7	A
	Continuous Drain Current $T_C = 100^\circ\text{C}$	4.5	A
$I_{DM}^{a1}$	Pulsed Drain Current	28	A
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$E_{AS}^{a2}$	Single Pulse Avalanche Energy	550	mJ
$E_{AR}^{a1}$	Avalanche Energy ,Repetitive	54	mJ
$I_{AR}^{a1}$	Avalanche Current	10.4	A
$dv/dt^{a3}$	Peak Diode Recovery dv/dt	5.0	V/ns
$P_D$	Power Dissipation	100	W
	Derating Factor above 25°C	0.80	W/°C
$V_{ESD(G-S)}$	Gate source ESD (HBM-C= 100pF, R=1.5k $\Omega$ )	3000	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
ΔBV <sub>DSS</sub> /ΔT <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	
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> =3.5A	--	1.10	1.25	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> = 3.5A	--	6.0	--	S
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V V <sub>DS</sub> = 25V f = 1.0MHz	--	1380	--	pF
C <sub>oss</sub>	Output Capacitance		--	170	--	
C <sub>rss</sub>	Reverse Transfer Capacitance		--	15	--	

<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> = 7.0A V <sub>DD</sub> = 300V V <sub>GS</sub> = 10V R <sub>G</sub> = 4.7Ω	--	13	--	ns
t <sub>r</sub>	Rise Time		--	10	--	
t <sub>d(OFF)</sub>	Turn-Off Delay Time		--	26	--	
t <sub>f</sub>	Fall Time		--	8	--	
Q <sub>g</sub>	Total Gate Charge	I <sub>D</sub> = 7.0A V <sub>DD</sub> = 480V V <sub>GS</sub> = 10V	--	30	39	nC
Q <sub>gs</sub>	Gate to Source Charge		--	6	--	
Q <sub>gd</sub>	Gate to Drain ("Miller") Charge		--	14	--	

Source-Drain Diode Characteristics						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$I_S$	Continuous Source Current (Body Diode)		--	--	7	A
$I_{SM}$	Maximum Pulsed Current (Body Diode)		--	--	28	A
$V_{SD}$	Diode Forward Voltage	$I_S=7.0A, V_{GS}=0V$	--	--	1.5	V
$t_{rr}$	Reverse Recovery Time	$I_S=7.0A, T_j = 25^\circ C$ $dI_F/dt=100A/us,$ $V_{GS}=0V$	--	570	--	ns
$Q_{rr}$	Reverse Recovery Charge		--	4.3	--	nC
$I_{RRM}$	Reverse Recovery Current		--	12	--	A
Pulse width $t_p \leq 380\mu s, \delta \leq 2\%$						

Symbol	Parameter	Typ.	Units
$R_{\theta JC}$	Junction-to-Case	1.25	$^\circ C/W$
$R_{\theta JA}$	Junction-to-Ambient	62	$^\circ C/W$

Gate-source Zener diode						
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
$V_{GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1mA (Open Drain)$	20			V
<p>The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.</p>						

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

<sup>a2</sup>:  $L=10.0mH, I_D=7A, Start T_j=25^\circ C$

<sup>a3</sup>:  $I_{SD} = 7A, di/dt \leq 100A/us, V_{DD} \leq BV_{DS}, Start T_j=25^\circ C$

Electrical Characteristic Curves

Fig. 1  $I_D - V_{DS}$

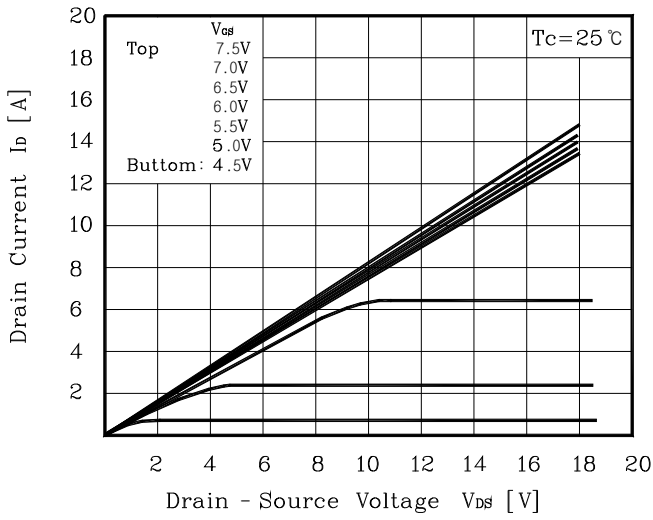


Fig. 2  $I_D - V_{GS}$

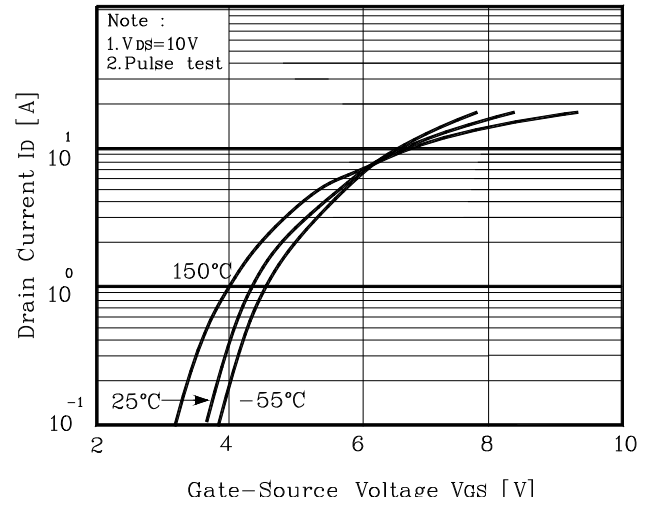


Fig. 3  $R_{DS(on)} - I_D$

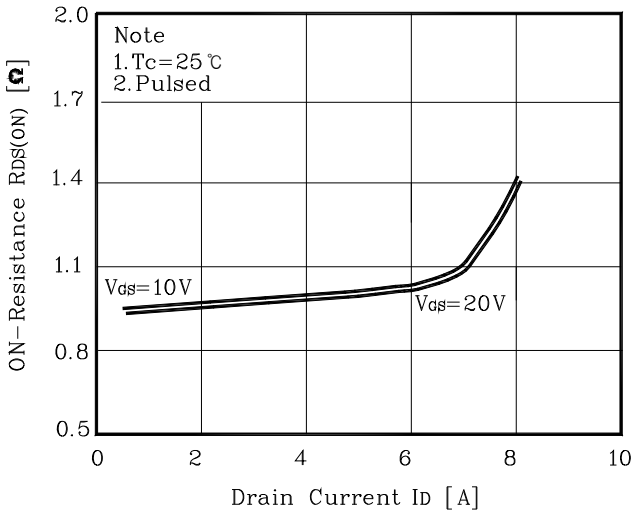


Fig. 4  $I_S - V_{SD}$

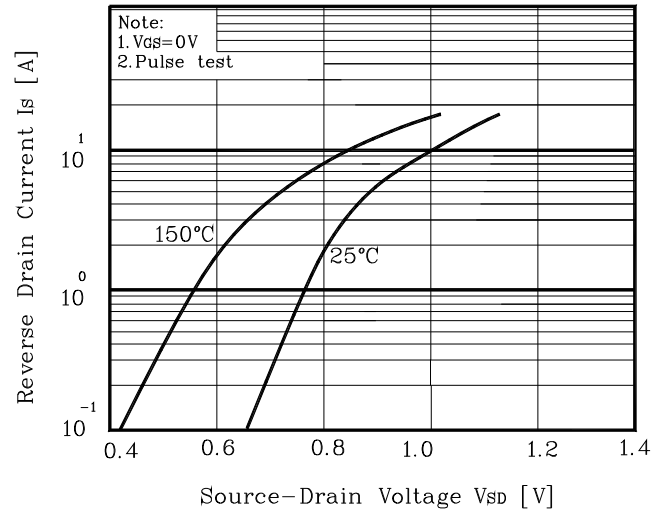


Fig. 5 Capacitance -  $V_{DS}$

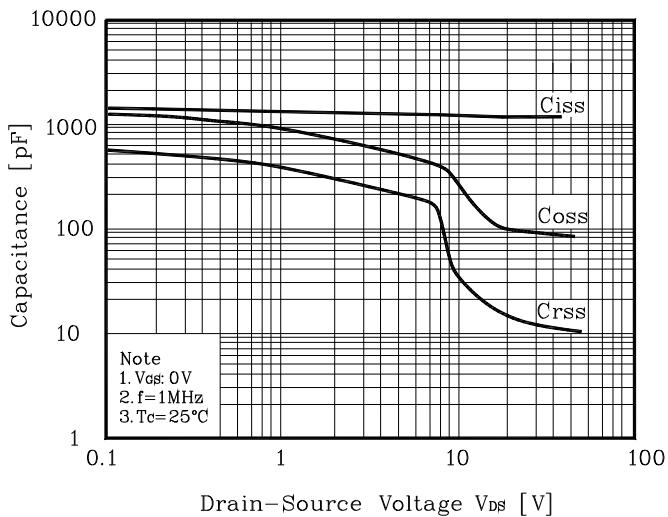
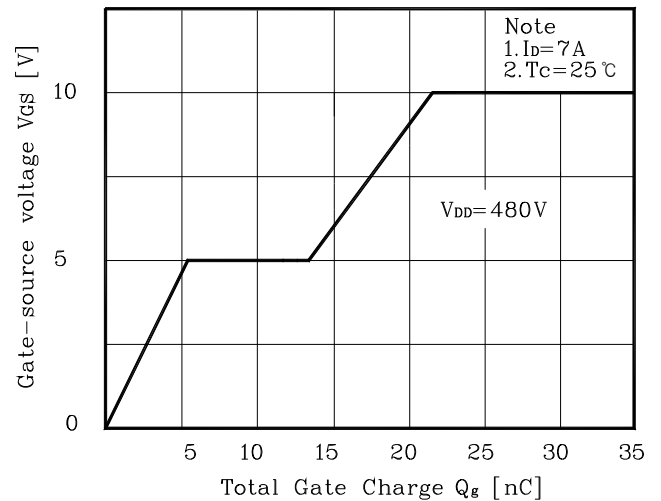
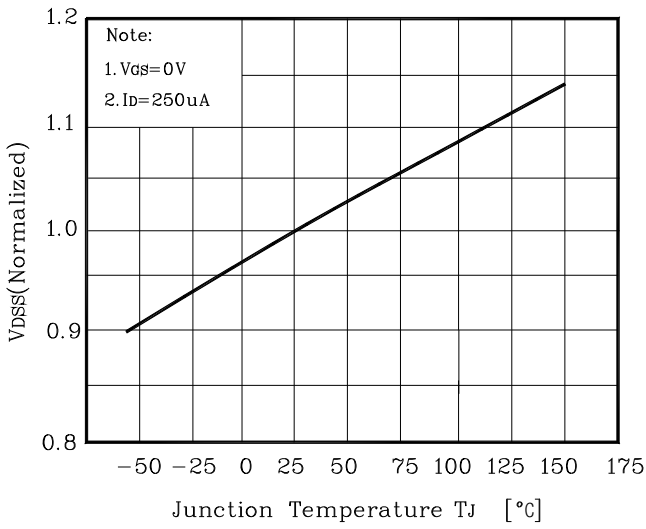
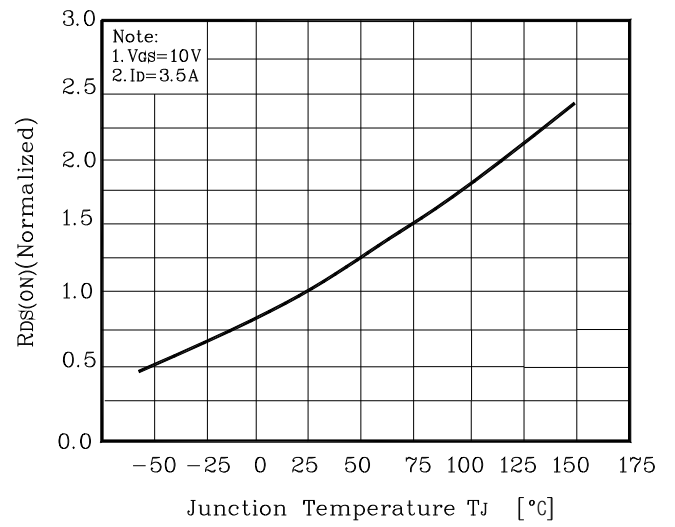
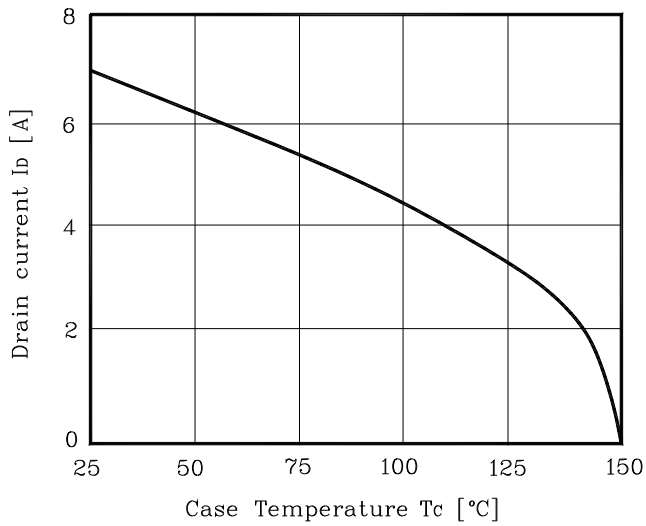
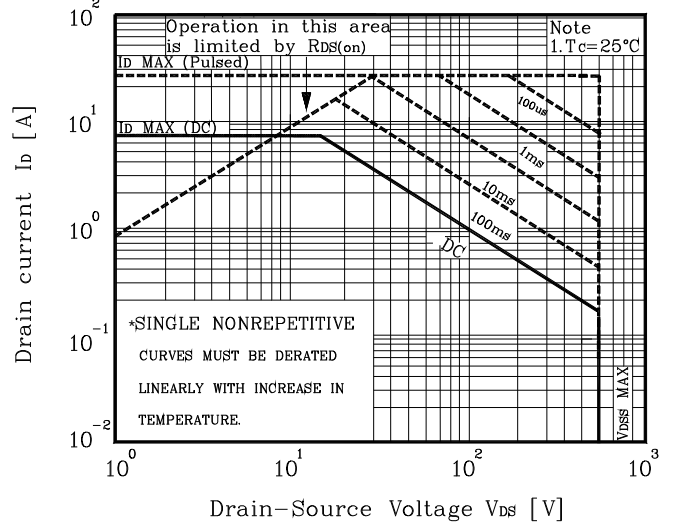
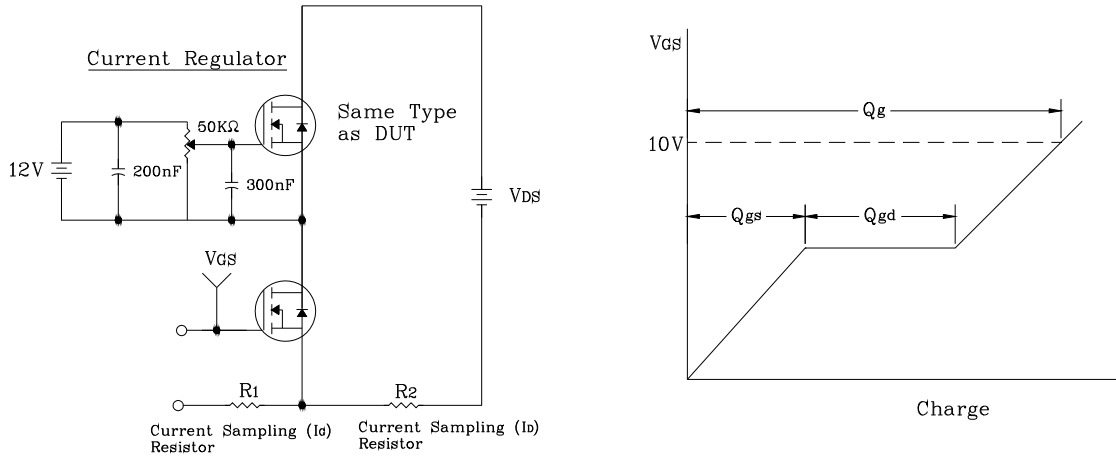


Fig.6  $V_{GS} - Q_G$

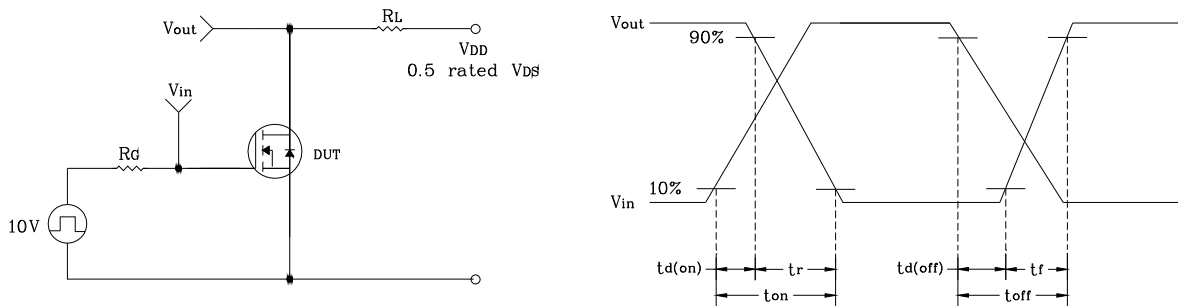


**Electrical Characteristic Curves**
**Fig. 7  $V_{DSS} - T_J$** 

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

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

**Fig. 10 Safe Operating Area**


**Fig. 11 Gate Charge Test Circuit & Waveform**



**Fig. 12 Resistive Switching Test Circuit & Waveform**



**Fig. 13 E<sub>AS</sub> Test Circuit & Waveform**

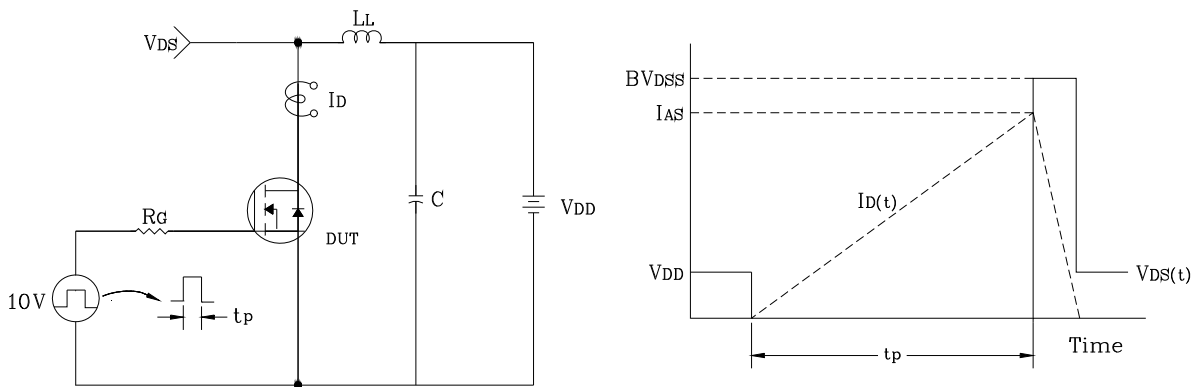
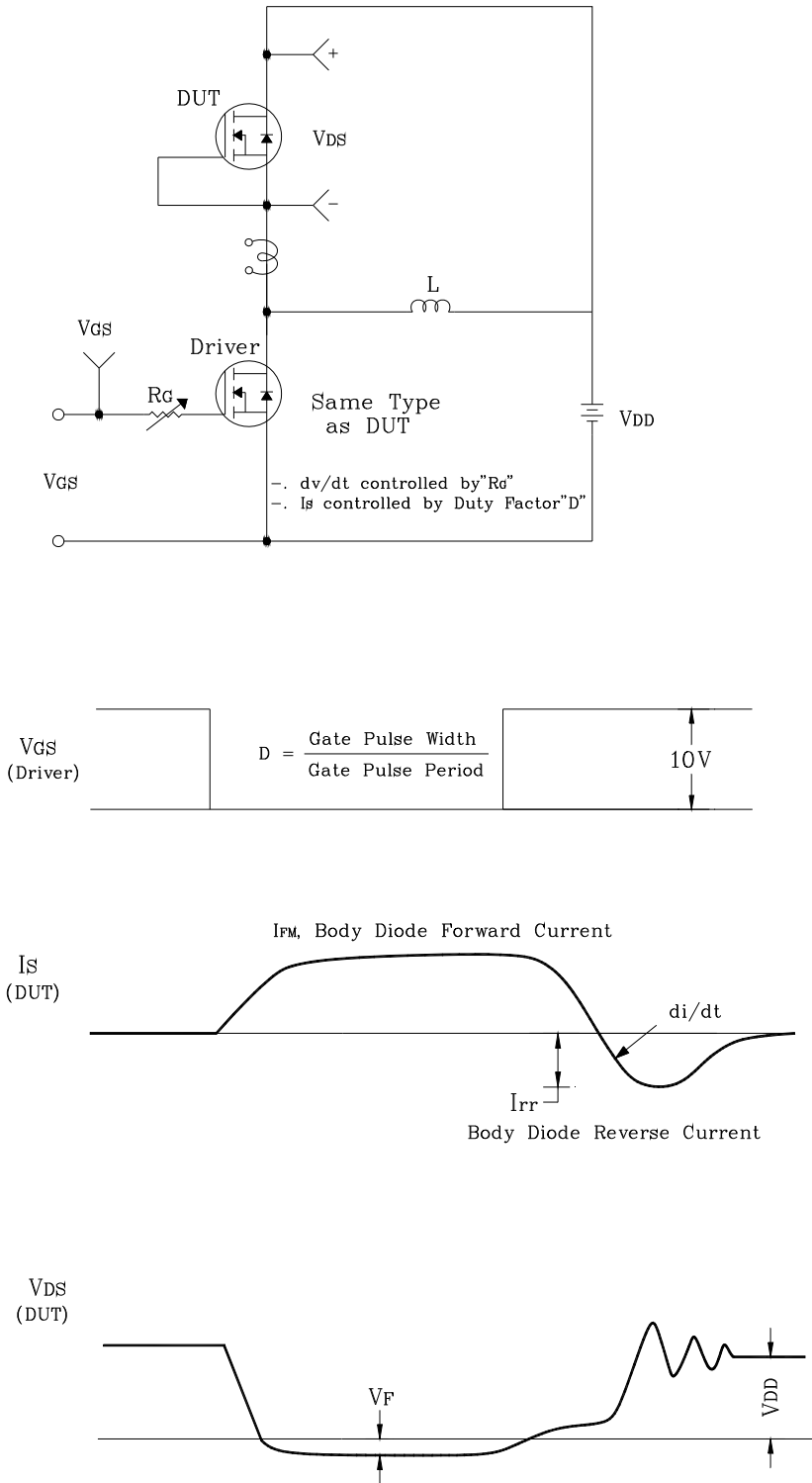
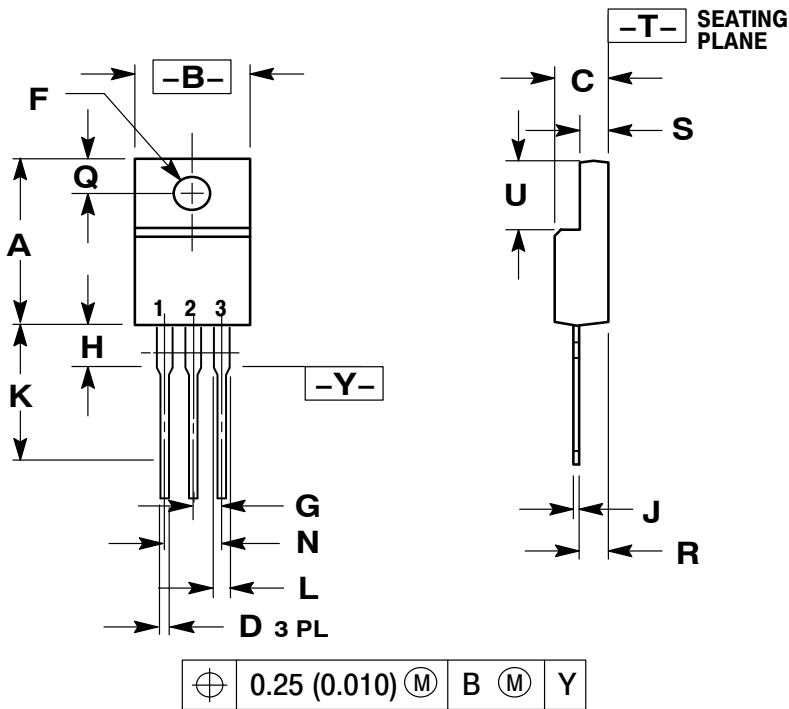


Fig. 14 Diode Reverse Recovery Time Test Circuit & Waveform



## Package Dimensions

### TO-220F



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88