

Advanced Power MOSFET

IRF650A

FEATURES

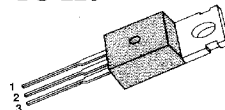
- Avalanche Rugged Technology
- Rugged Gate Oxide Technology
- Lower Input Capacitance
- Improved Gate Charge
- Extended Safe Operating Area
- Lower Leakage Current : 10 μ A (Max.) @ $V_{DS} = 200V$
- Low $R_{DS(ON)}$: 0.071 Ω (Typ.)

$$BV_{DSS} = 200 V$$

$$R_{DS(on)} = 0.085 \Omega$$

$$I_D = 28 A$$

TO-220



1. Gate 2. Drain 3. Source

Absolute Maximum Ratings

Symbol	Characteristic	Value	Units
V_{DSS}	Drain-to-Source Voltage	200	V
I_D	Continuous Drain Current ($T_C=25^\circ C$)	28	A
	Continuous Drain Current ($T_C=100^\circ C$)	17.7	
I_{DM}	Drain Current-Pulsed ①	112	A
V_{GS}	Gate-to-Source Voltage	± 30	V
E_{AS}	Single Pulsed Avalanche Energy ②	523	mJ
I_{AR}	Avalanche Current ①	28	A
E_{AR}	Repetitive Avalanche Energy ①	15.6	mJ
dv/dt	Peak Diode Recovery dv/dt ③	5.0	V/ns
P_D	Total Power Dissipation ($T_C=25^\circ C$)	156	W
	Linear Derating Factor	1.25	
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	--	0.8	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink	0.5	--	
$R_{\theta JA}$	Junction-to-Ambient	--	62.5	

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N-CHANNEL POWER MOSFET

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	200	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$\Delta BV/\Delta T_J$	Breakdown Voltage Temp. Coeff.	--	0.24	--	$V/^\circ\text{C}$	$I_D=250\mu A$ See Fig 7
$V_{GS(th)}$	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	μA	$V_{DS}=200V$
		--	--	100		$V_{DS}=160V, T_C=125^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-State Resistance	--	--	0.085	Ω	$V_{GS}=10V, I_D=14A$ ④
g_{fs}	Forward Transconductance	--	18.44	--	S	$V_{DS}=40V, I_D=14A$ ④
C_{iss}	Input Capacitance	--	2300	3000	pF	$V_{GS}=0V, V_{DS}=25V, f=1\text{MHz}$ See Fig 5
C_{oss}	Output Capacitance	--	410	475		
C_{rss}	Reverse Transfer Capacitance	--	200	230		
$t_{d(on)}$	Turn-On Delay Time	--	21	50	ns	$V_{DD}=100V, I_D=32A,$ $R_G=6.2\Omega$ See Fig 13 ④ ⑤
t_r	Rise Time	--	20	50		
$t_{d(off)}$	Turn-Off Delay Time	--	77	160		
t_f	Fall Time	--	38	90		
Q_g	Total Gate Charge	--	95	123	nC	$V_{DS}=160V, V_{GS}=10V,$ $I_D=32A$ See Fig 6 & Fig 12 ④ ⑤
Q_{gs}	Gate-Source Charge	--	18	--		
Q_{gd}	Gate-Drain("Miller") Charge	--	45.3	--		

Source-Drain Diode Ratings and Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Units	Test Condition
I_S	Continuous Source Current	--	--	28	A	Integral reverse pn-diode in the MOSFET
I_{SM}	Pulsed-Source Current ①	--	--	112		
V_{SD}	Diode Forward Voltage ④	--	--	1.5	V	$T_J=25^\circ\text{C}, I_S=28A, V_{GS}=0V$
t_{rr}	Reverse Recovery Time	--	203	--	ns	$T_J=25^\circ\text{C}, I_F=32A$
Q_{rr}	Reverse Recovery Charge	--	1.52	--	μC	$di_F/dt=100A/\mu\text{s}$ ④

Notes ;

- ① Repetitive Rating : Pulse Width Limited by Maximum Junction Temperature
- ② $L=1\text{mH}, I_{AS}=28A, V_{DD}=50V, R_G=27\Omega$, Starting $T_J=25^\circ\text{C}$
- ③ $I_{SD}\leq 32A, di/dt\leq 320A/\mu\text{s}, V_{DD}\leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$
- ④ Pulse Test : Pulse Width = 250 μs , Duty Cycle $\leq 2\%$
- ⑤ Essentially Independent of Operating Temperature

Fig 1. Output Characteristics

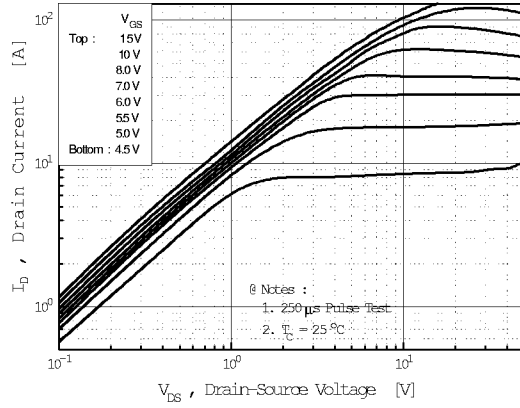


Fig 2. Transfer Characteristics

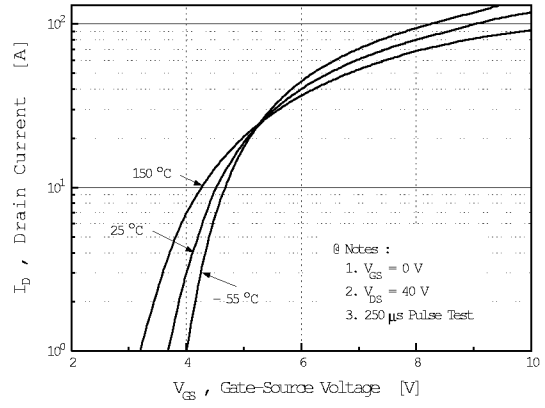


Fig 3. On-Resistance vs. Drain Current

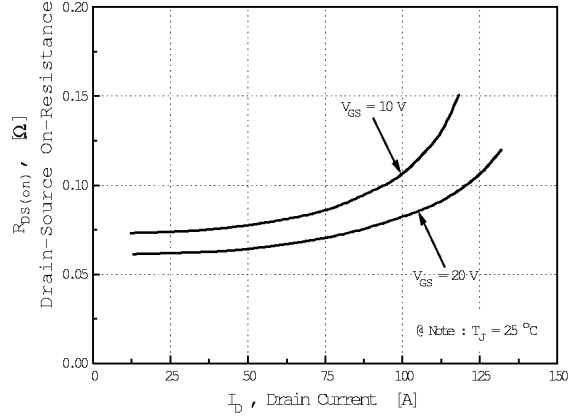


Fig 4. Source-Drain Diode Forward Voltage

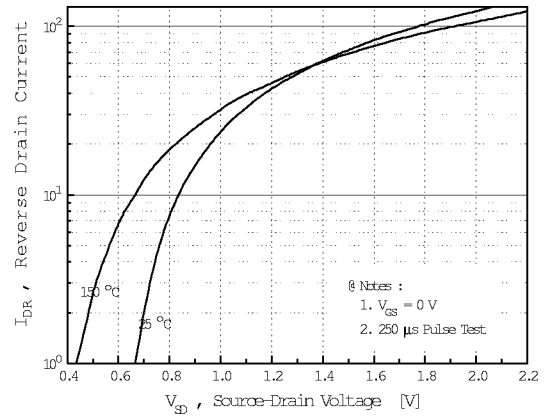


Fig 5. Capacitance vs. Drain-Source Voltage

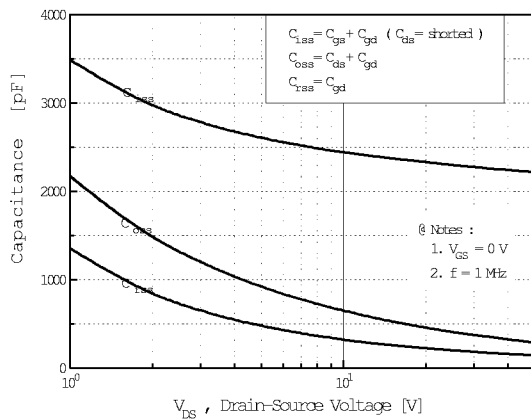
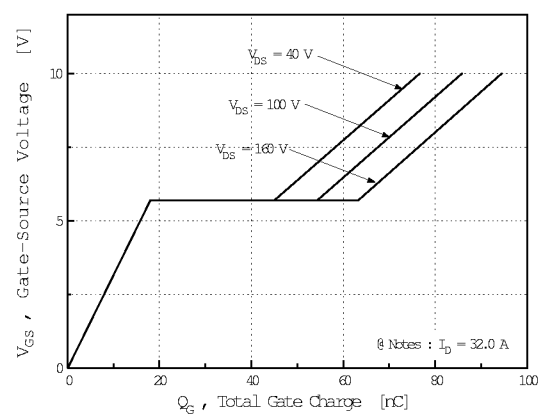


Fig 6. Gate Charge vs. Gate-Source Voltage



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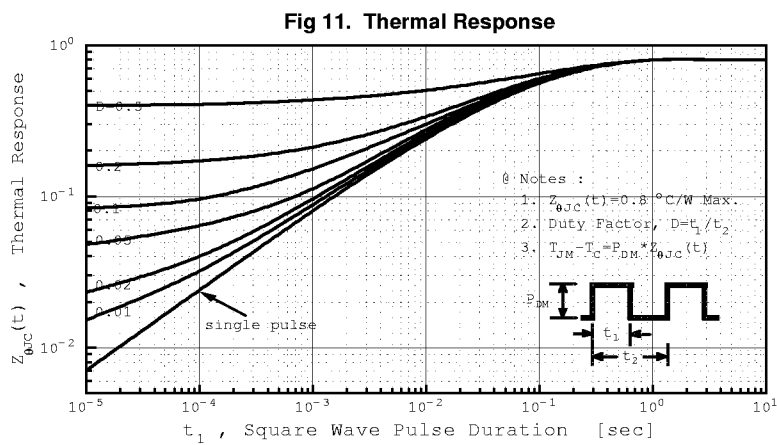
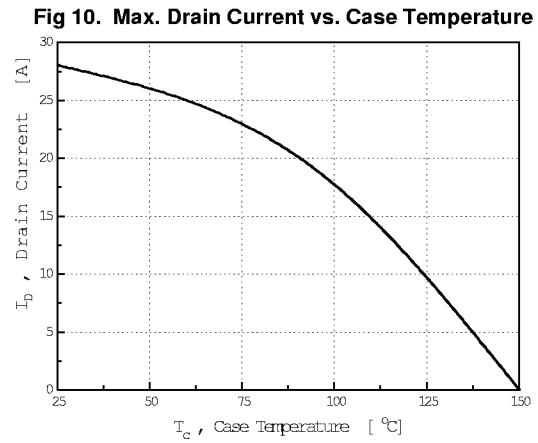
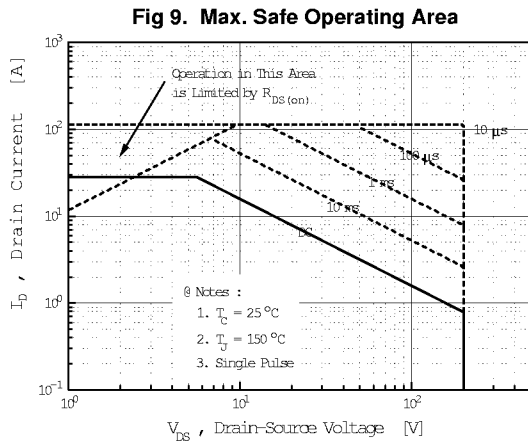
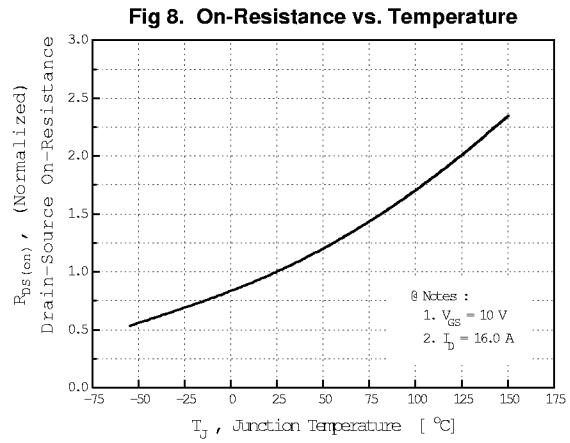
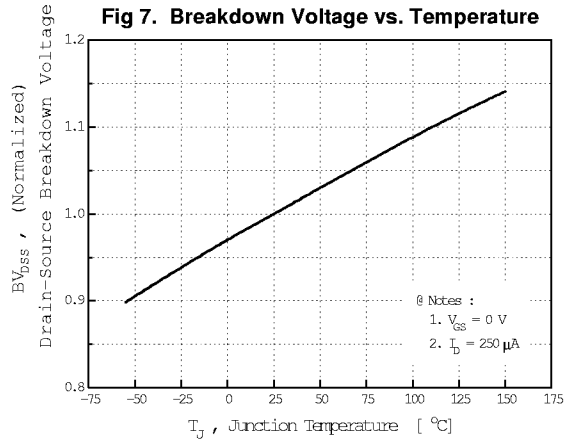


Fig 12. Gate Charge Test Circuit & Waveform

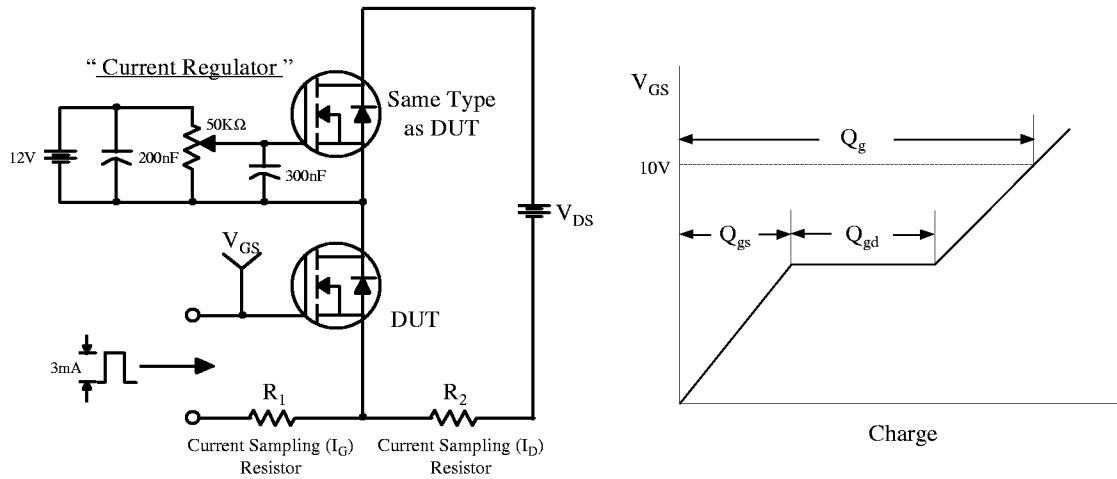


Fig 13. Resistive Switching Test Circuit & Waveforms

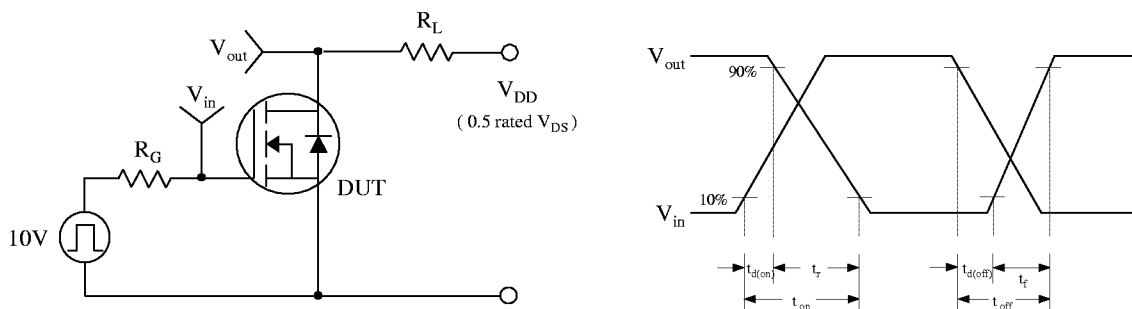


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

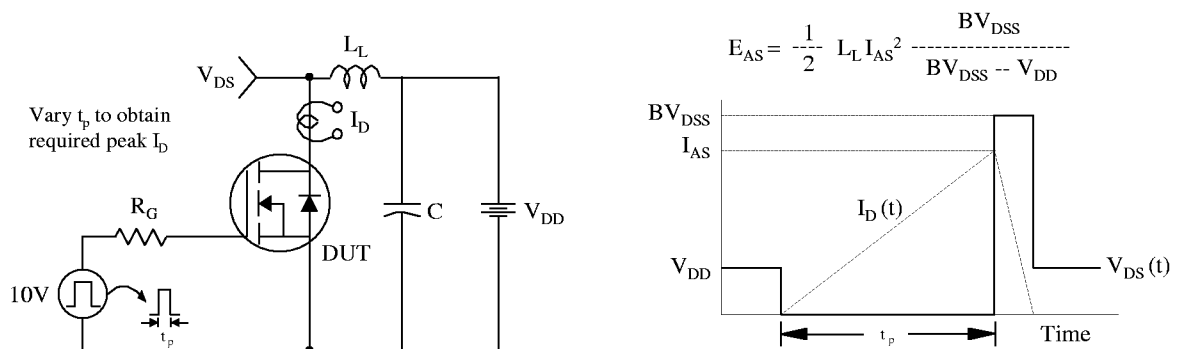
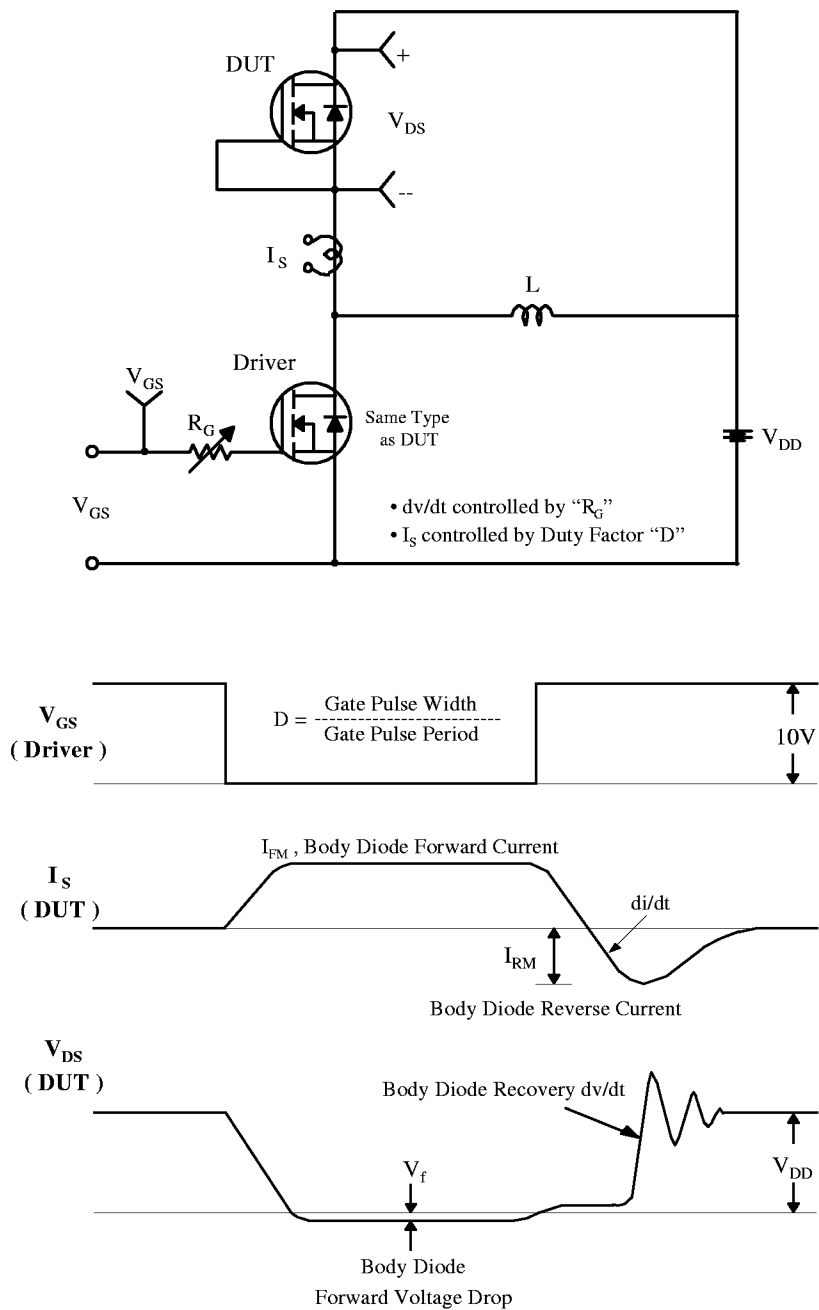
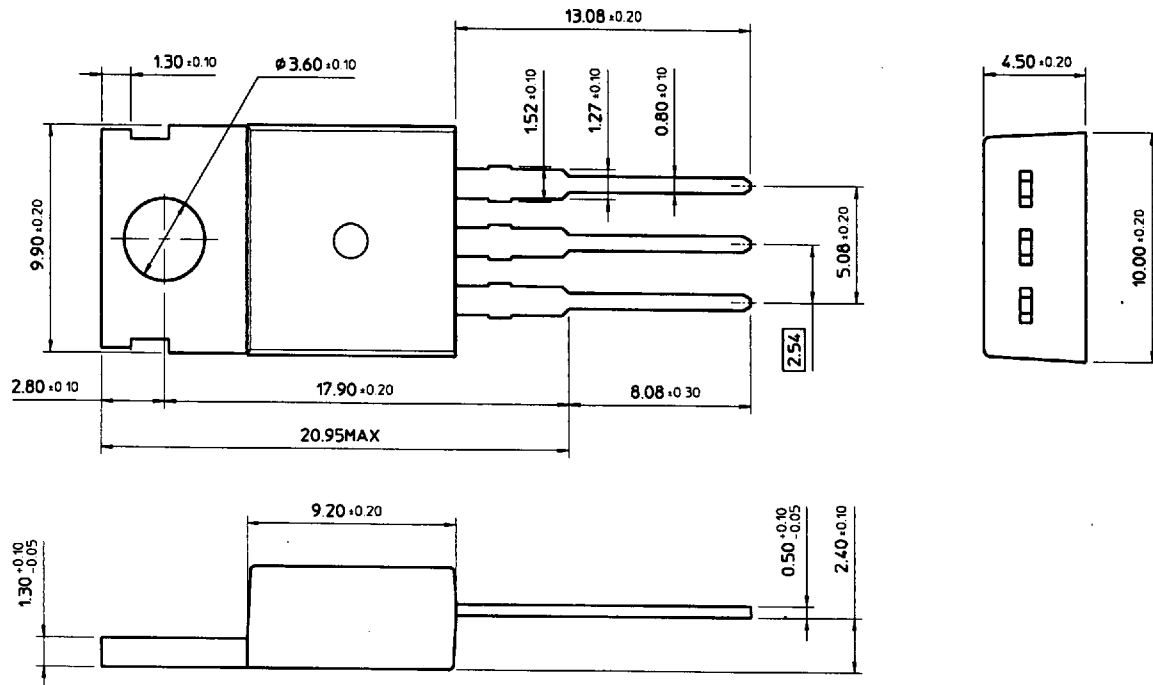


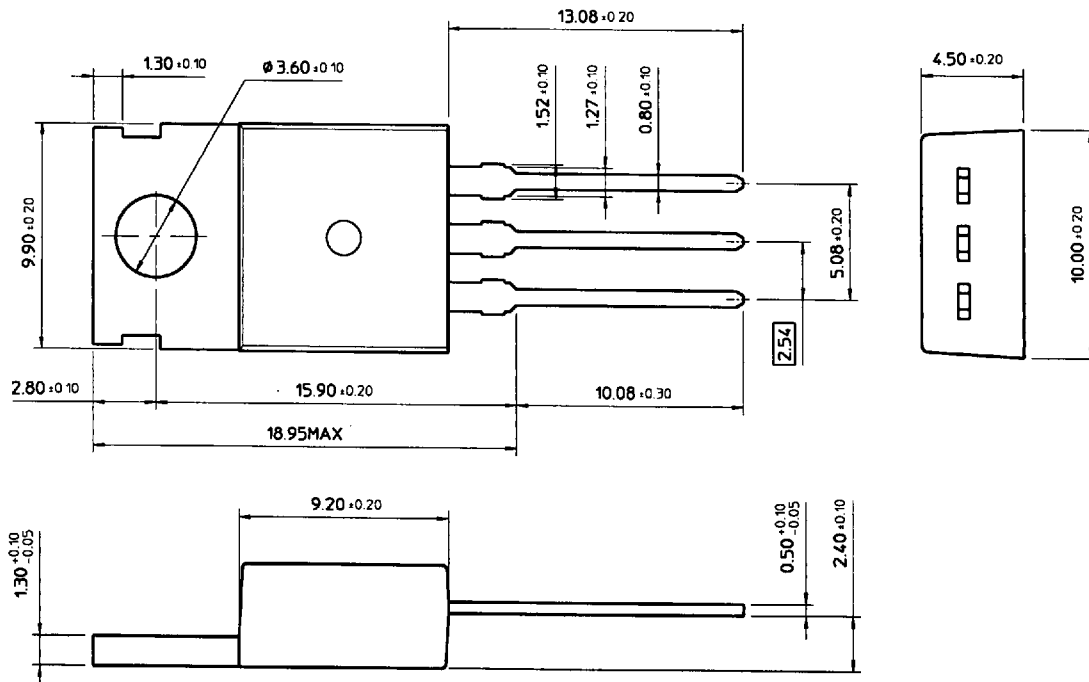
Fig 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms



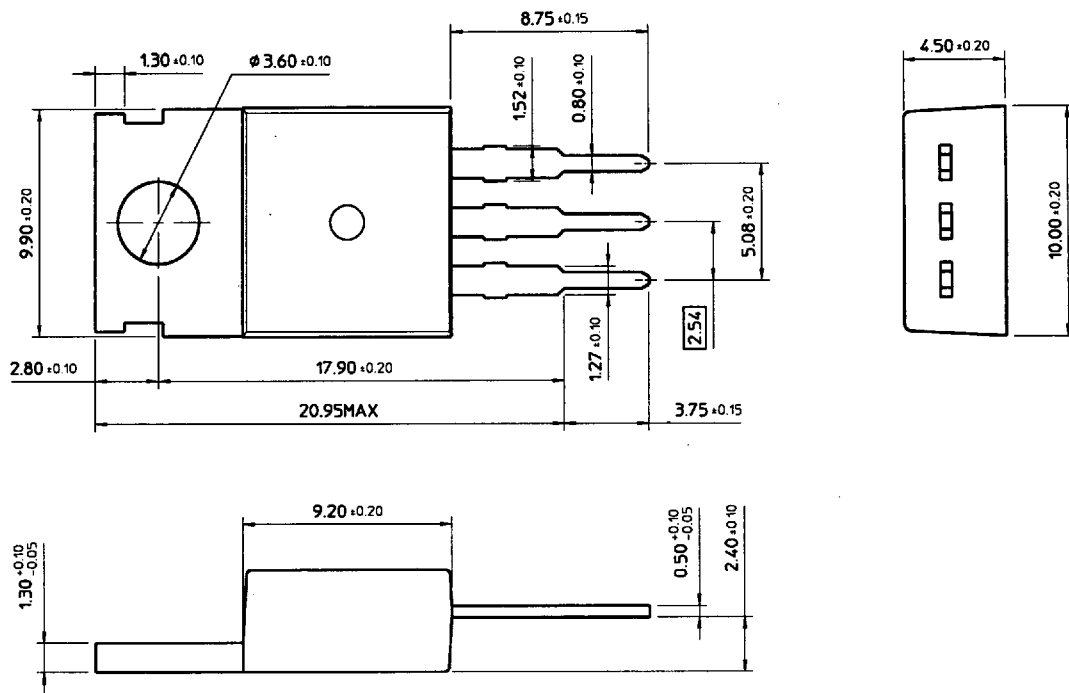
TO-220 (1)



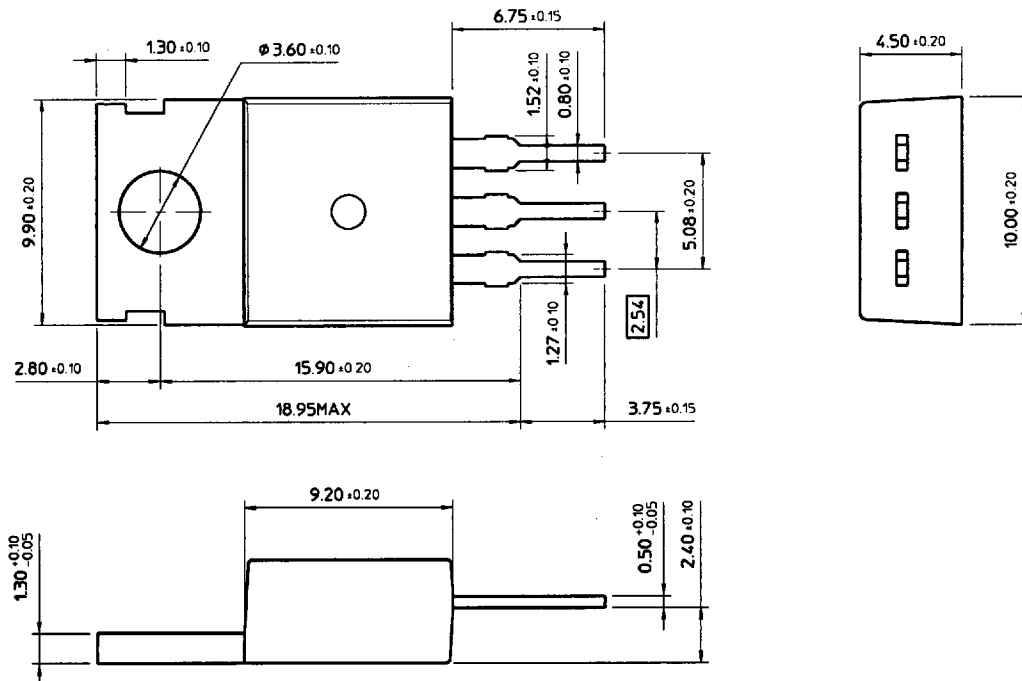
TO-220 (2)



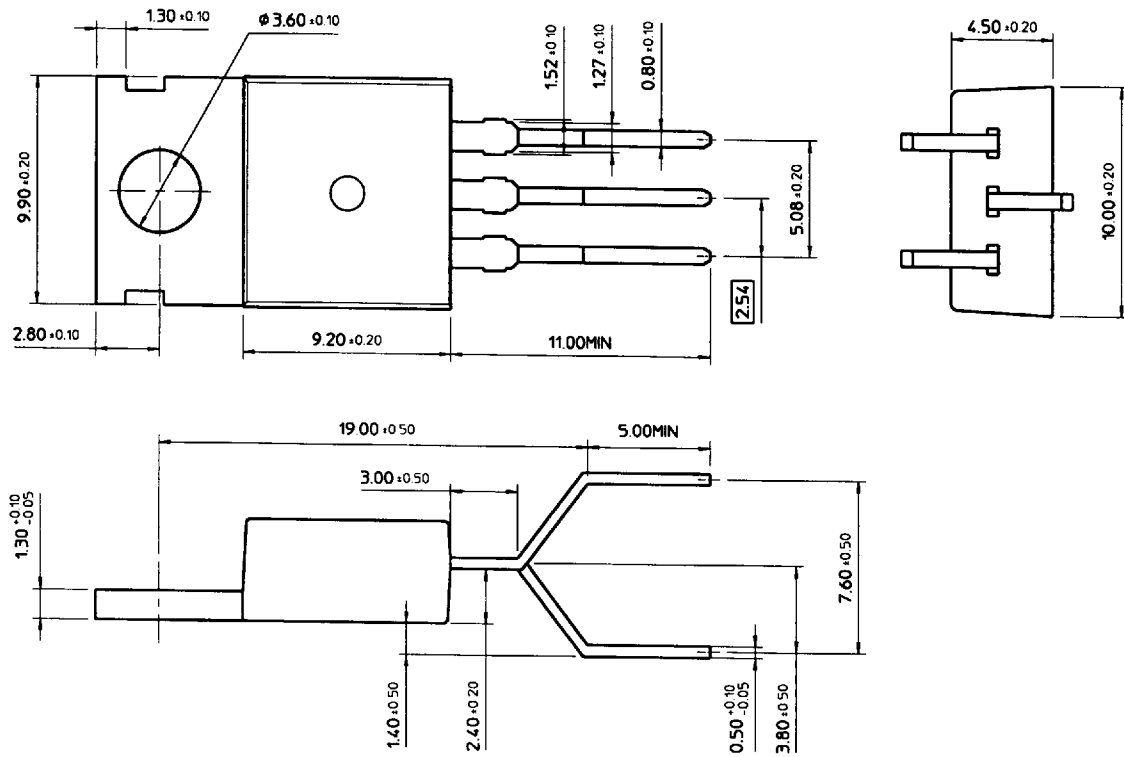
TO-220 (3)



TO-220 (4)



T0-220 (5)



NOTE