

## N-Channel Power MOSFET

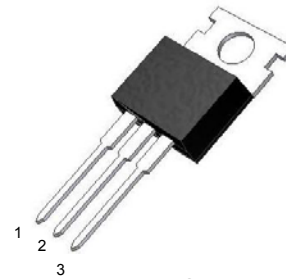
2.1A, 600V, 5.6Ω

### General Description

The N-Channel MOSFET is used an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance. This device is well suited for high efficiency switched mode power suppliers, active power factor correction, electronic lamp ballasts based half bridge topology.

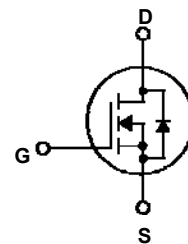
### Features

- Robust high voltage termination
- Avalanche energy specified
- Diode is characterized for use in bridge circuits
- Source to Drain diode recovery time comparable to a discrete fast recovery diode.



1 = Gate  
2 = Drain  
3 = Source

TO-220AB



### DEVICE MARKING DESIGNATION:

Line 1 = TC Brand  
Line 2 = Device Type

### ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub>=25°C, unless otherwise noted)

Symbol	Parameter	Value	Units
V <sub>DSS</sub>	Drain- Source Voltage	600	V
V <sub>GSS</sub>	Gate-Source Voltage	±30	V
I <sub>D</sub>	Drain Current	2.1	A
I <sub>DM</sub>	Drain Current Pulsed	8.4	A
P <sub>D</sub>	Power Dissipation (Note 2)	48	W
	Derating factor above 25°C	0.39	W/°C
E <sub>AS</sub>	Single Pulsed Avalanche Energy (Note 1)	180	mJ
E <sub>AR</sub>	Repetitive Avalanche Energy (Note 2)	4.8	mJ
T <sub>J</sub>	Operating Junction Temperature	150	°C
T <sub>stg</sub>	Storage Temperature Range	- 55 to +150	°C

### Notes:

1. L=75mH, I<sub>AS</sub>=2.1A, V<sub>DD</sub>=50V, R<sub>G</sub>=50Ω, Starting T<sub>J</sub>=25°C
2. Repetitive Rating: Pulse width limited by maximum junction temperature.

### THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case	2.58	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

**ELECTRICAL CHARACTERISTICS**
**Off Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 600V, V_{GS} = 0V$	--	--	10	$\mu A$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30V, V_{DS} = 0V$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30V, V_{DS} = 0V$	--	--	-100	nA

**On Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.0	--	4.0	V
$R_{DS(ON)}$	On-Resistance	$V_{GS} = 10V, I_D = 1.05A$	--	5.0	5.6	$\Omega$

**Dynamic Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input Capacitance	$V_{DS} = 25V, V_{GS} = 0V,$ $f = 1.0\text{MHz}$	--	220	320	pF
$C_{oss}$	Output Capacitance		--	32	46	pF
$C_{rss}$	Reverse Transfer Capacitance		--	8	12	pF

**Switching Characteristics**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 300V, I_D = 2.1A,$ $R_G = 25\Omega$ (Note 3 & 4)	--	12	34	nS
$t_r$	Turn-On Rise Time		--	23	56	nS
$t_{d(off)}$	Turn-Off Delay Time		--	30	70	nS
$t_r$	Turn-Off Fall Time		--	15	40	nS
$Q_g$	Total Gate Charge	$V_{DS} = 480V, I_D = 2.1A,$	--	7.6	10	nC
$Q_{gs}$	Gate-Source Charge	$V_{GS} = 10V$	--	1.3	--	nC
$Q_{gd}$	Gate-Drain Charge	(Note 3 & 4)	--	3.2	--	nC

**Drain-Source Diode Characteristics and Maximum Ratings**

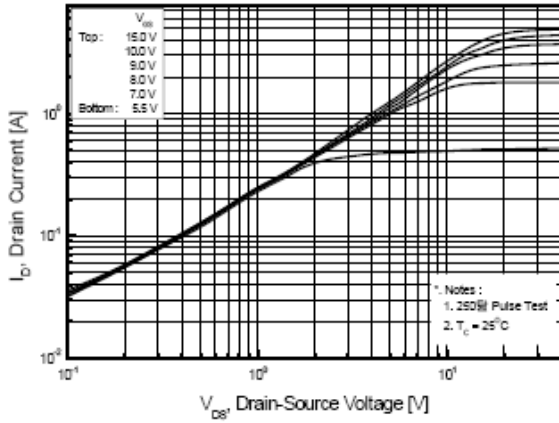
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_S$	Maximum Continuous Drain-Source Diode Forward Current		--	--	2.1	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current		--	--	8.4	A
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0V, I_S = 2.1A$	--	--	1.5	V
$T_{rr}$	Reverse Recovery Time	$V_{GS} = 0V, I_S = 2.1A,$ $dI_F / dt = 100A/\mu S$	--	590	--	nS
$Q_{rr}$	Reverse Recovery Charge	(Note 3)	--	1.0	--	$\mu C$

**Notes:**

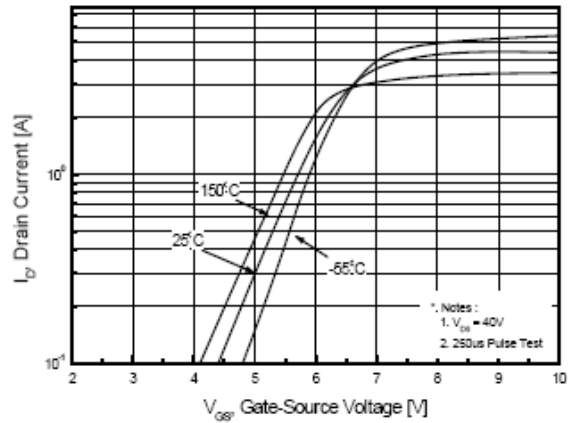
- Pulse Test: Pulse width < 300 $\mu s$ , Duty cycle  $\leq 2\%$ .
- Basically not affected by working temperature.

**TYPICAL CHARACTERISTICS**

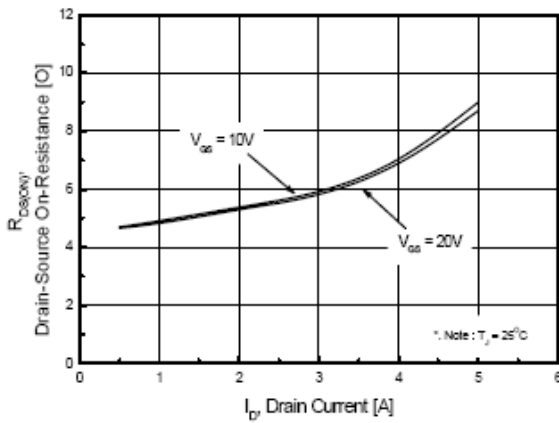
**Fig 1. On-State Characteristics**



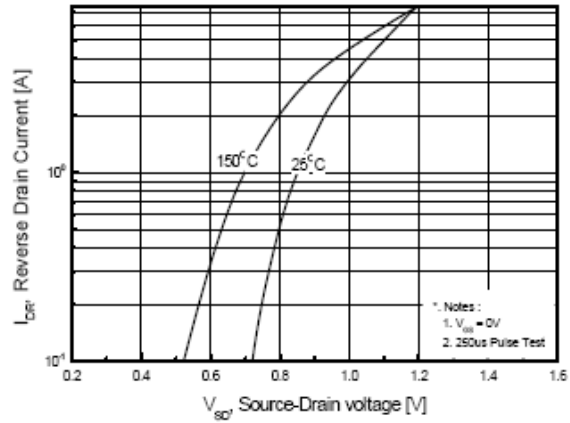
**Fig 2. Transfer Characteristics**



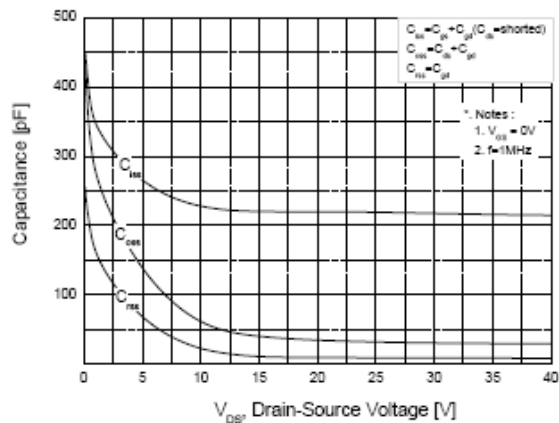
**Fig 3. On Resistance Variation vs. Drain Current and Gate Voltage**



**Fig 4. On State Current vs. Reverse Drain Current**



**Fig 5. Capacitance Characteristics (Non-Repetitive)**



**Fig 6. Gate Charge Characteristics**

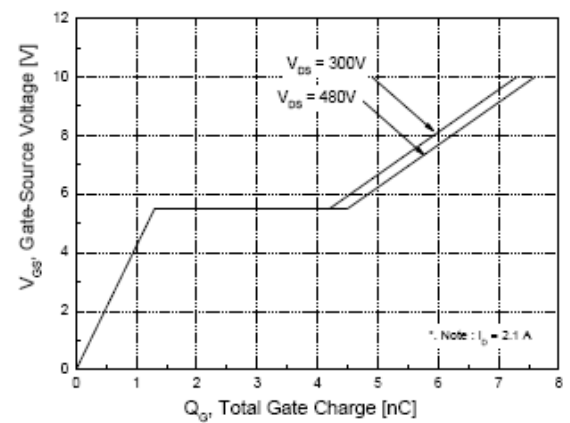


Fig 7. Breakdown Voltage Variation vs. Junction Temperature

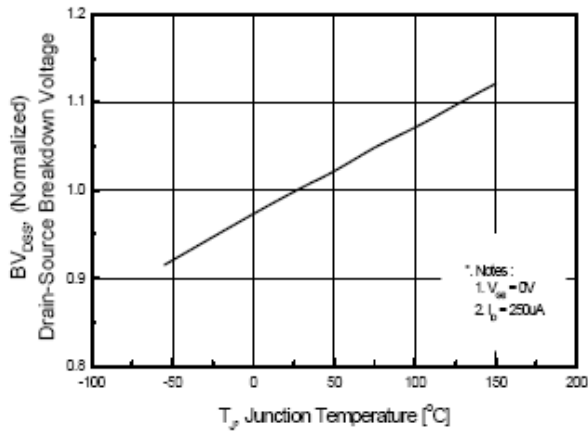


Fig 8. On-Resistance Variation vs. Junction Temperature

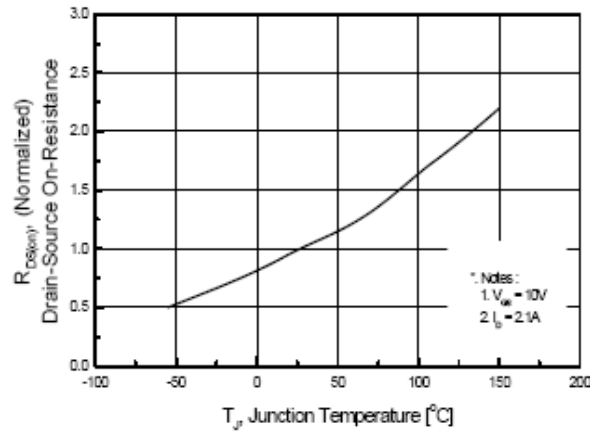


Fig 9. Maximum Safe Operating Area

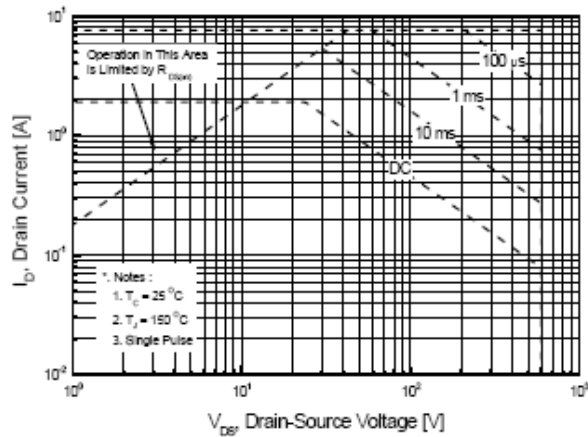


Fig 10. Maximum Drain Current vs. Case Temperature

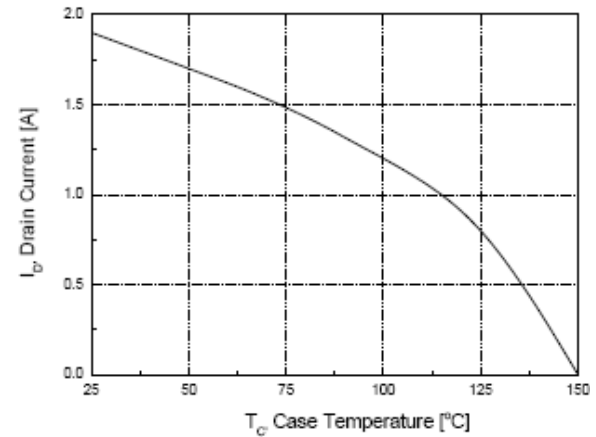
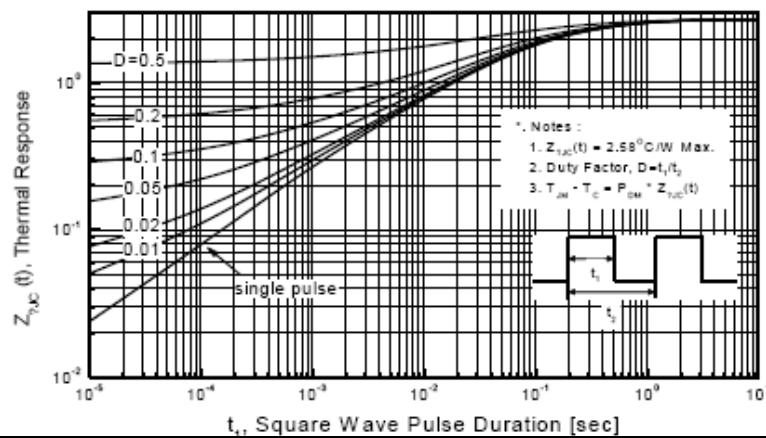


Fig 11. Transient Thermal Response Curve



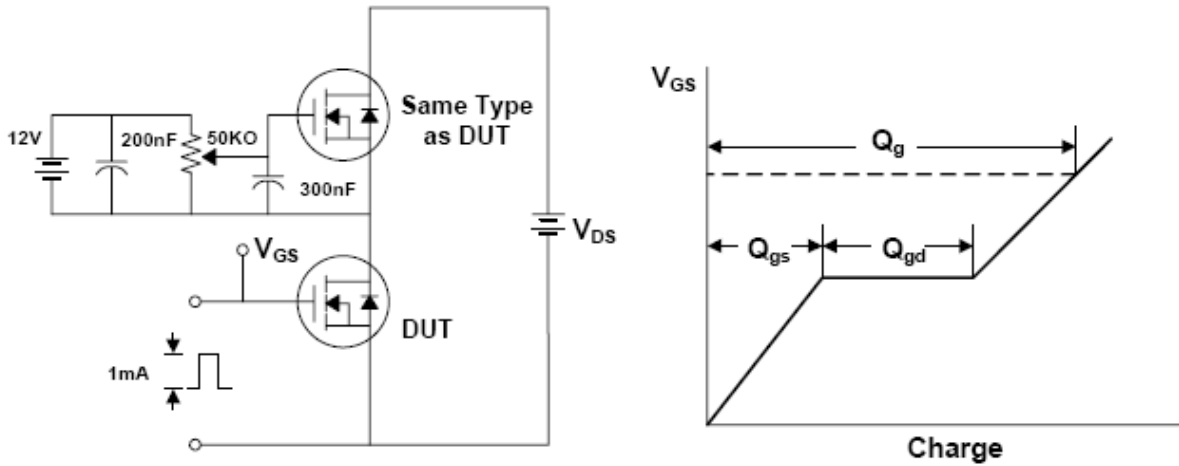
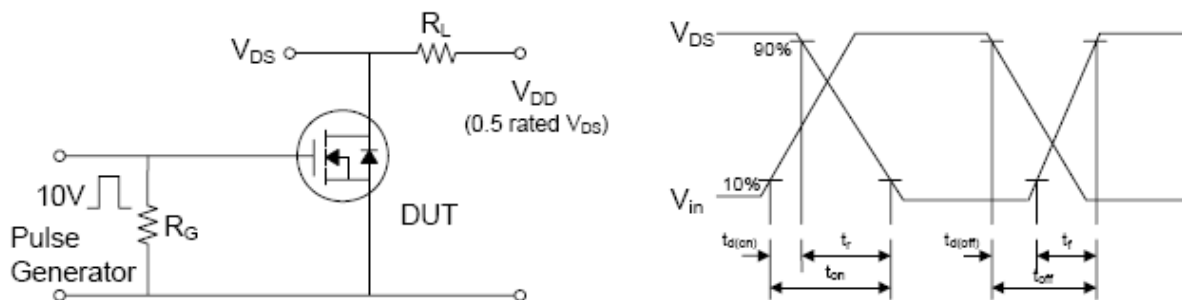
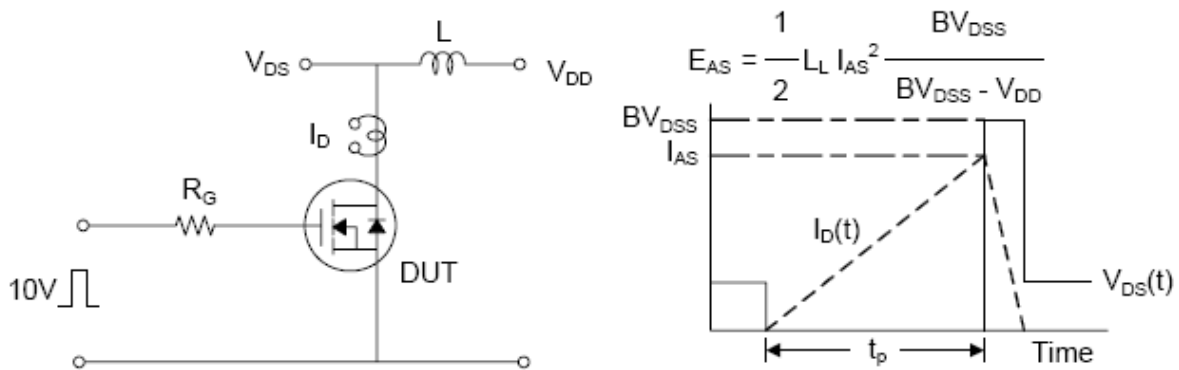
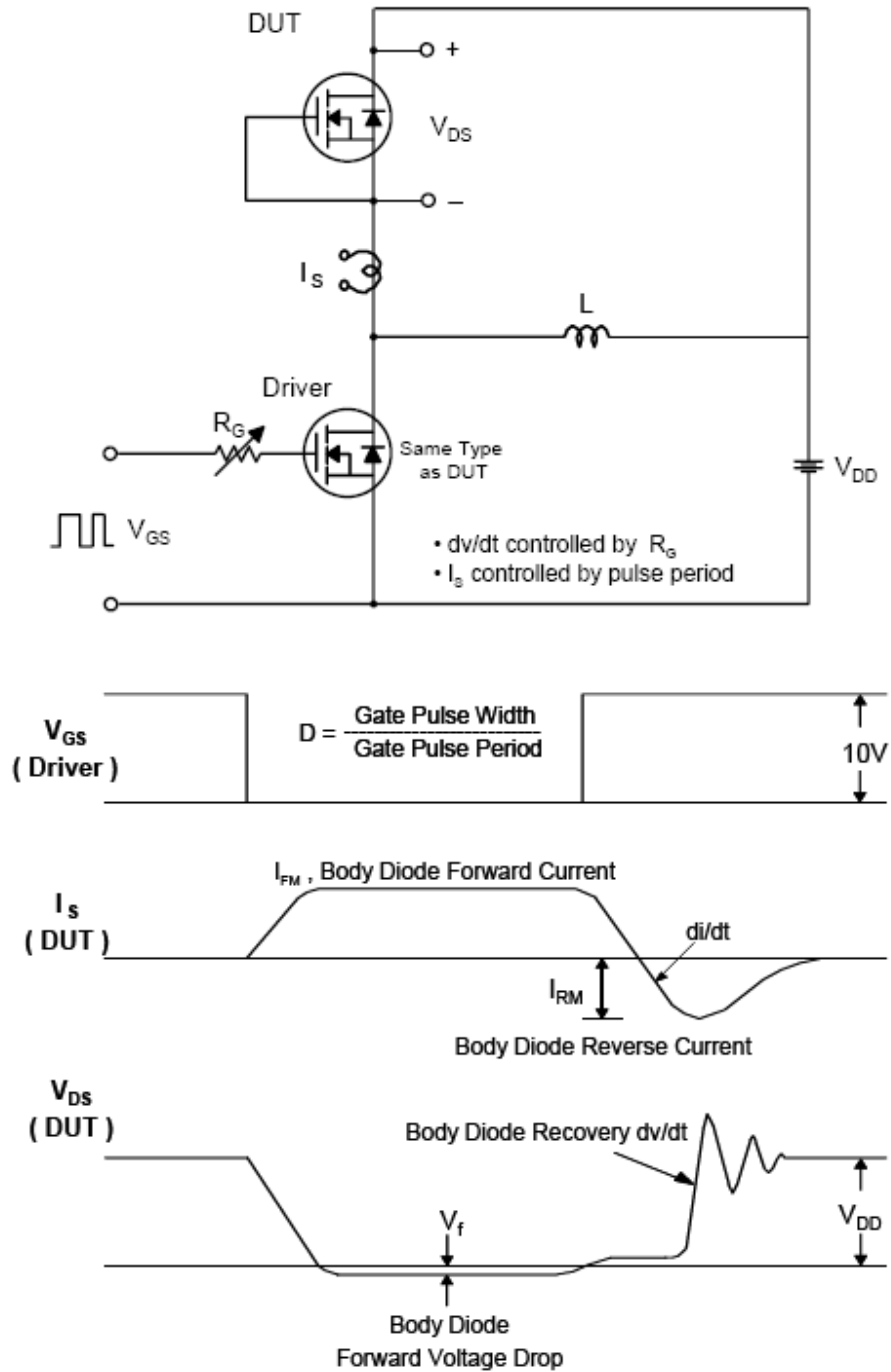
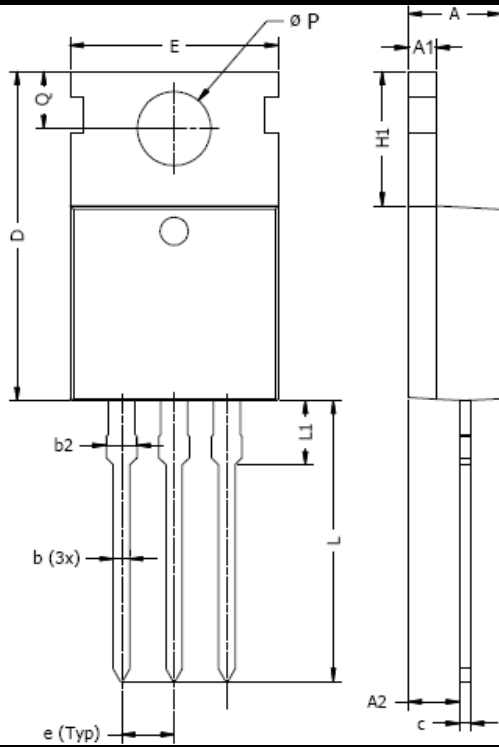
**Fig. 12. Gate Charge Test Circuit & Waveforms**

**Fig 13. Switching Time Test Circuit & Waveforms**

**Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms**


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



**TO220AB PACKAGE OUTLINE**



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	3.6	4.8	0.142	0.189
A1	1.2	1.4	0.047	0.055
A2	2.0	2.9	0.079	0.114
b	0.4	1.0	0.016	0.039
b2	1.2	1.8	0.047	0.071
c	0.36	0.6	0.014	0.024
D	14.2	16.5	0.559	0.650
e	2.34	2.74	0.092	0.108
E	9.7	10.6	0.382	0.417
H1	5.8	6.85	0.228	0.270
L	12.7	14.7	0.500	0.579
L1	2.7	3.3	0.106	0.130
ØP	3.5	4.0	0.138	0.157
Q	2.54	3.4	0.100	0.134

NOTE: Above package outline conforms to JEDEC TO-220AB

## **NOTICE**

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