

## N-Channel 700 V(D-S) Power MOSFET



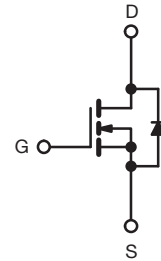
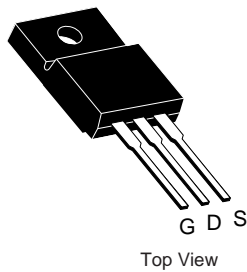
RoHS  
COMPLIANT

PRODUCT SUMMARY	
$V_{DS}$ (V)	700
$R_{DS(on)}$ max. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V   1.4
$Q_g$ Typ. (nC)	24
$Q_{gs}$ (nC)	6
$Q_{gd}$ (nC)	11
Configuration	Single

### FEATURES

- 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
- Compliant to RoHS directive 2002/95/EC

TO-220 FULLPAK




N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER		SYMBOL	LIMIT	UNIT
Drain-source voltage		$V_{DS}$	700	V
Gate-source voltage		$V_{GS}$	$\pm 30$	
Continuous drain current ( $T_J = 150$ °C) <sup>e</sup>	$V_{GS}$ at 10 V	$I_D$	$T_C = 25$ °C	7
			$T_C = 100$ °C	5
Pulsed drain current <sup>a</sup>		$I_{DM}$	18	A
Linear derating factor			0.63	
Single pulse avalanche energy <sup>b</sup>		$E_{AS}$	56	mJ
Maximum power dissipation		$P_D$	31	W
Operating junction and storage temperature range		$T_J, T_{stg}$	-55 to +150	°C
Drain-source voltage slope		$dV/dt$	$T_J = 125$ °C	37
Reverse diode $dV/dt$ <sup>d</sup>			27	
Soldering recommendations (peak temperature) <sup>c</sup>		For 10 s	300	°C
Mounting torque		M3 screw	0.6	Nm

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 28.2$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 2$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C
- Limited by maximum junction temperature

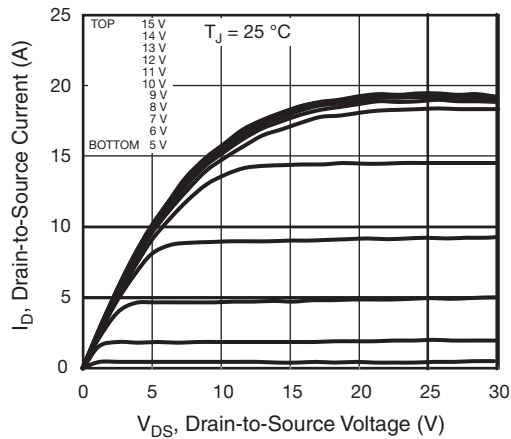
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	43	65	°C/W
Maximum junction-to-case (drain)	$R_{thJC}$	3.1	4.0	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	700	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$	-	0.73	-	V/°C
Gate-source threshold voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	2	-	4	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
		$V_{GS} = \pm 30\text{ V}$	-	-	$\pm 1$	$\mu\text{A}$
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 700\text{ V}, V_{GS} = 0\text{ V}$	-	-	1	$\mu\text{A}$
		$V_{DS} = 560\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	10	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$	-	1.36	-	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 30\text{ V}, I_D = 3\text{ A}$	-	2	-	S
<b>Dynamic</b>						
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	410	820	-	pF
Output capacitance	$C_{oss}$		20	60	-	
Reverse transfer capacitance	$C_{rss}$		2	4	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 560\text{ V}, V_{GS} = 0\text{ V}$	-	36	-	
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$		-	117	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}, V_{DS} = 520\text{ V}$	-	24	48	nC
Gate-source charge	$Q_{gs}$		-	6	-	
Gate-drain charge	$Q_{gd}$		-	11	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 560\text{ V}, I_D = 3\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$	-	14	28	ns
Rise time	$t_r$		-	12	24	
Turn-off delay time	$t_{d(off)}$		-	30	60	
Fall time	$t_f$		-	20	40	
Gate input resistance	$R_g$	$f = 1\text{ MHz}, \text{open drain}$	0.4	1.4	2.7	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>						
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	7	A
Pulsed diode forward current	$I_{SM}$		-	-	18	
Diode forward voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 3\text{ A}, V_{GS} = 0\text{ V}$	-	0.83	1.3	V
Reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 3\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 25\text{ V}$	118	237	474	ns
Reverse recovery charge	$Q_{rr}$		-	2.2	-	$\mu\text{C}$
Reverse recovery current	$I_{RRM}$		-	16	-	A

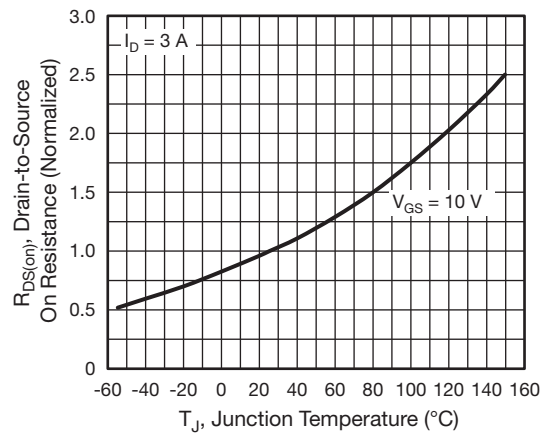
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$
- b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$

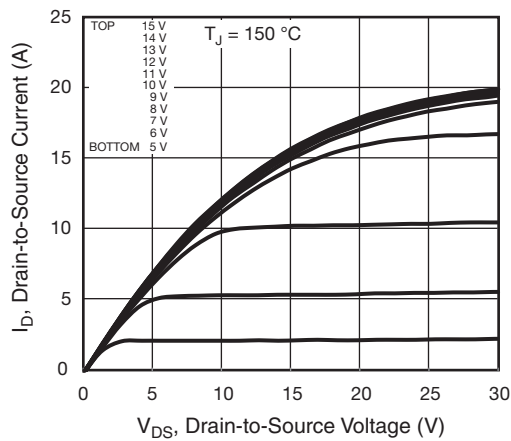
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



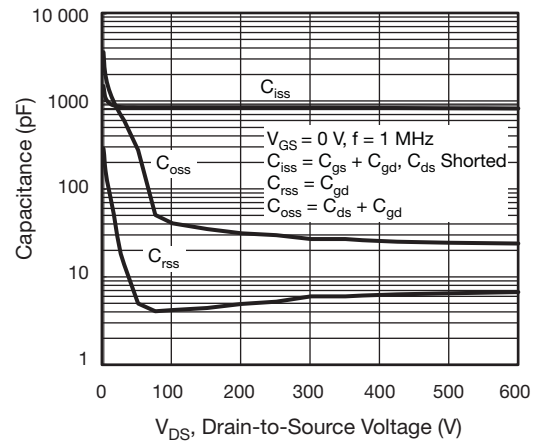
**Fig. 1 - Typical Output Characteristics**



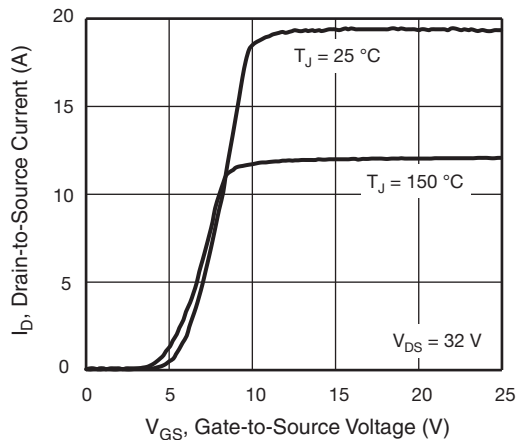
**Fig. 4 - Normalized On-Resistance vs. Temperature**



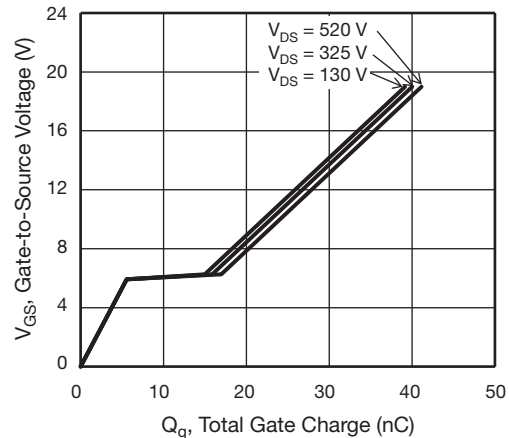
**Fig. 2 - Typical Output Characteristics**



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



**Fig. 3 - Typical Transfer Characteristics**



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

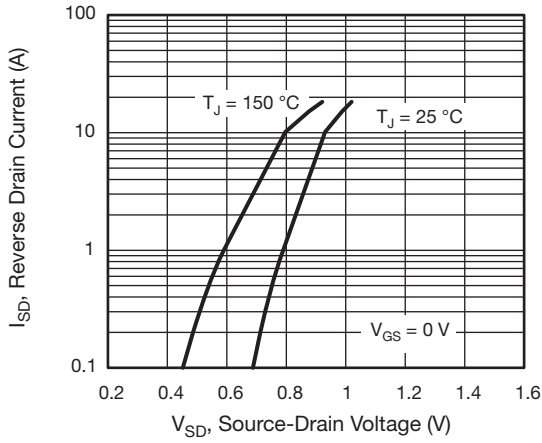


Fig. 7 - Typical Source-Drain Diode Forward Voltage

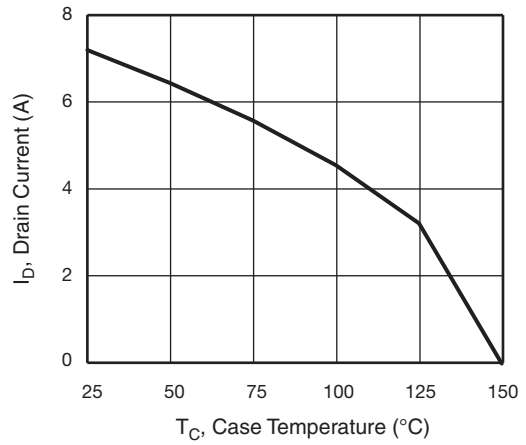


Fig. 9 - Maximum Drain Current vs. Case Temperature

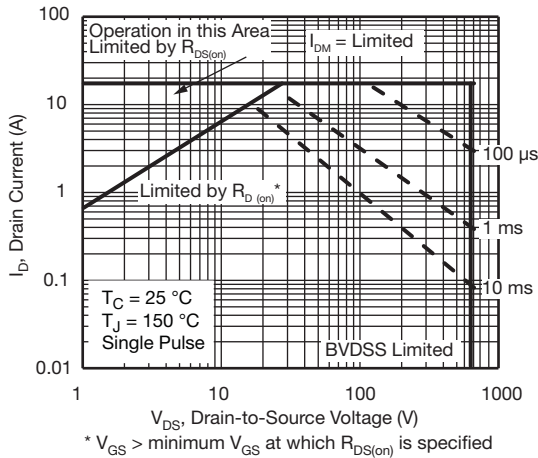


Fig. 8 - Maximum Safe Operating Area

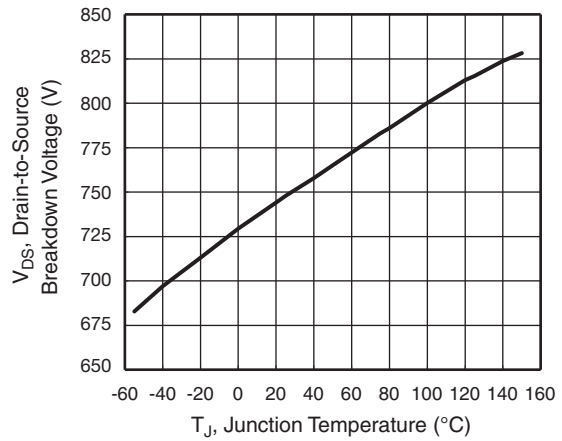


Fig. 10 - Temperature vs. Drain-to-Source Voltage

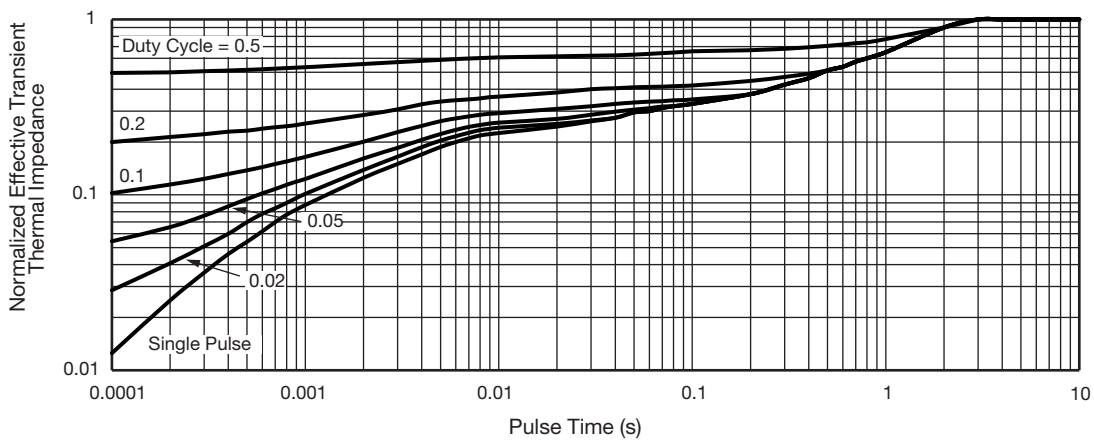


Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

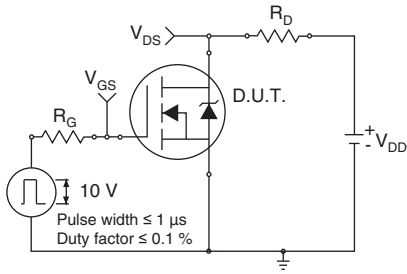


Fig. 12 - Switching Time Test Circuit

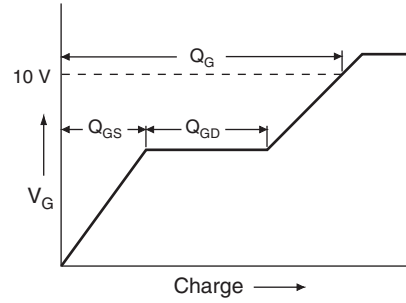


Fig. 16 - Basic Gate Charge Waveform

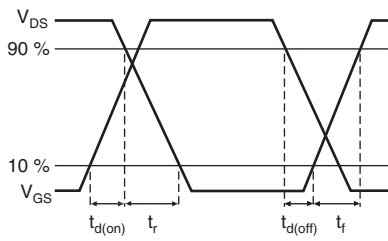


Fig. 13 - Switching Time Waveforms

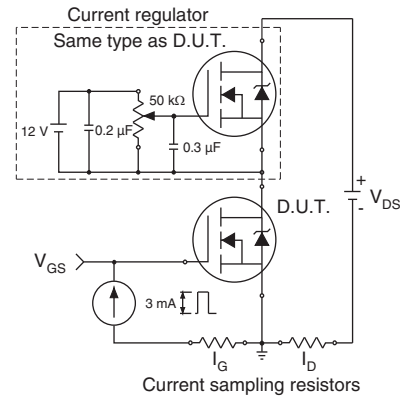


Fig. 17 - Gate Charge Test Circuit

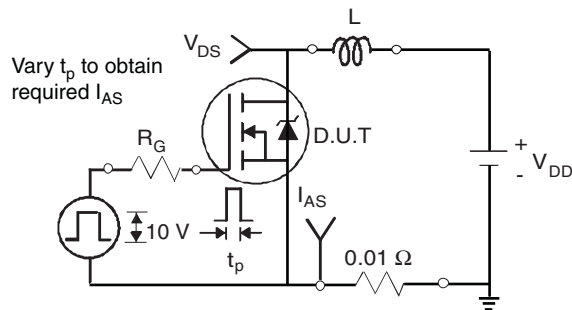


Fig. 14 - Unclamped Inductive Test Circuit

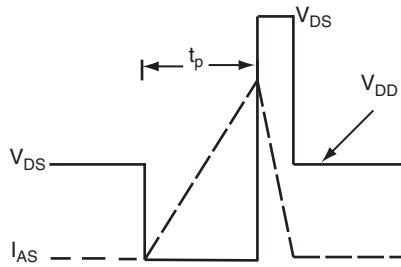
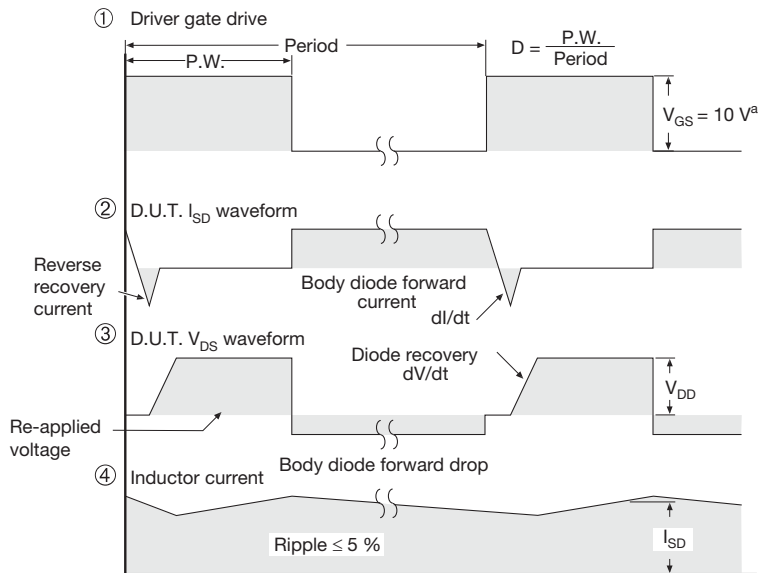
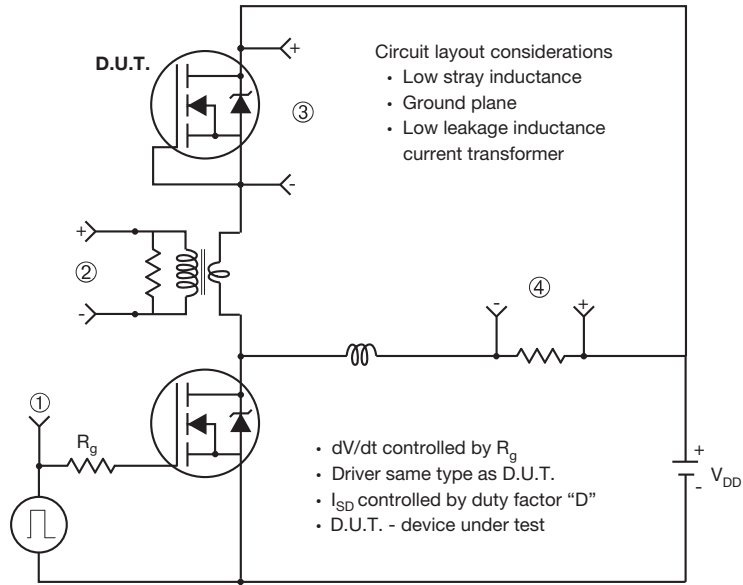


Fig. 15 - Unclamped Inductive Waveforms

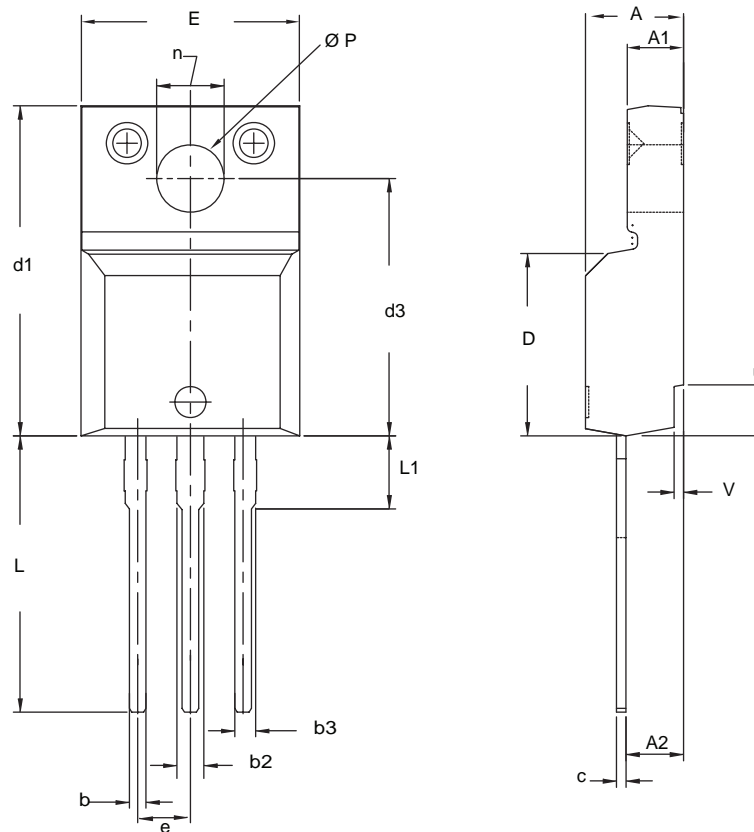
**Peak Diode Recovery dV/dt Test Circuit**



**Note**

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 18 - For N-Channel**

**TO-220 FULLPAK (HIGH VOLTAGE)**

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.570	4.830	0.180	0.190
A1	2.570	2.830	0.101	0.111
A2	2.510	2.850	0.099	0.112
b	0.622	0.890	0.024	0.035
b2	1.229	1.400	0.048	0.055
b3	1.229	1.400	0.048	0.055
c	0.440	0.629	0.017	0.025
D	8.650	9.800	0.341	0.386
d1	15.88	16.120	0.622	0.635
d3	12.300	12.920	0.484	0.509
E	10.360	10.630	0.408	0.419
e	2.54 BSC		0.100 BSC	
L	13.200	13.730	0.520	0.541
L1	3.100	3.500	0.122	0.138
n	6.050	6.150	0.238	0.242
Ø P	3.050	3.450	0.120	0.136
u	2.400	2.500	0.094	0.098
v	0.400	0.500	0.016	0.020

ECN: X09-0126-Rev. B, 26-Oct-09  
DWG: 5972

**Notes**

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet  $C_{pk} > 1.33$ .
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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