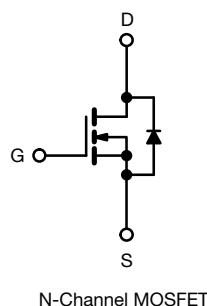
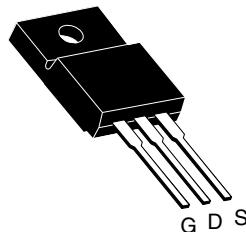


E Series Power MOSFET

TO-220 FULLPAK

PRODUCT SUMMARY

V_{DS} (V) at T_J max.	650	
$R_{DS(on)}$ max. (Ω) at 25 °C	$V_{GS} = 10$ V	0.28
Q_g max. (nC)	78	
Q_{gs} (nC)	9	
Q_{gd} (nC)	17	
Configuration	Single	

FEATURES

- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Industrial
 - Welding
 - Induction heating
 - Motor drives
 - Battery chargers
 - Renewable energy
 - Solar (PV inverters)

ORDERING INFORMATION

Package	TO-220 FULLPAK
Lead (Pb)-free	SiHF15N60E-E3
Lead (Pb)-free and Halogen-free	SiHF15N60E-GE3

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V_{DS}	600	V
Gate-Source Voltage	V_{GS}	± 30	
Continuous Drain Current ($T_J = 150$ °C) ^e	V_{GS} at 10 V	15	A
		9.6	
Pulsed Drain Current ^a	I_{DM}	39	
Linear Derating Factor		0.27	W/°C
Single Pulse Avalanche Energy ^b	E_{AS}	102	mJ
Maximum Power Dissipation	P_D	34	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +150	°C
Drain-Source Voltage Slope	$V_{DS} = 0$ V to 80 % V_{DS}	70	V/ns
Reverse Diode dV/dt ^d		7.7	
Soldering Recommendations (Peak temperature) ^c	For 10 s	300	°C
Mounting Torque	M3 screw	0.6	Nm

Notes

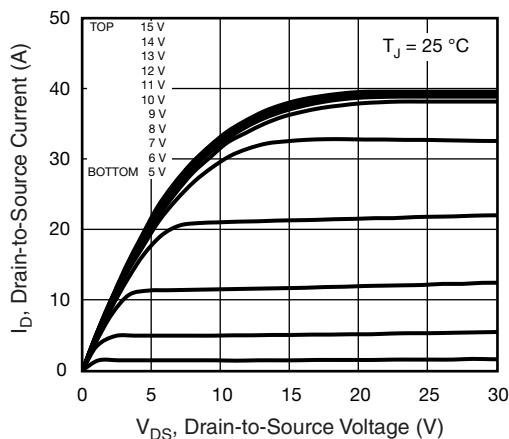
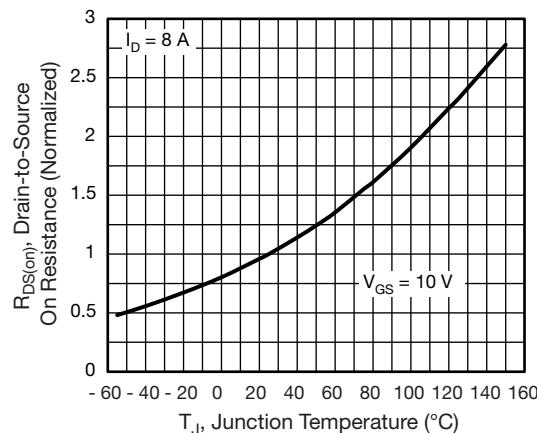
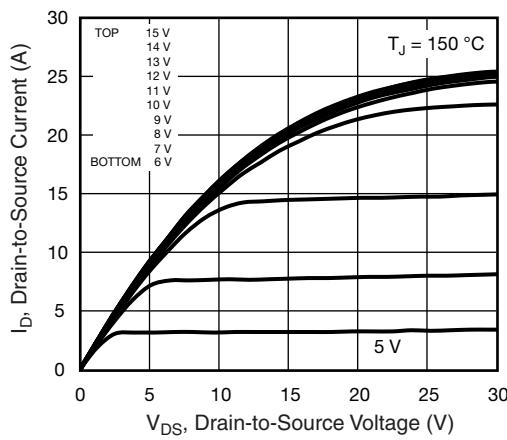
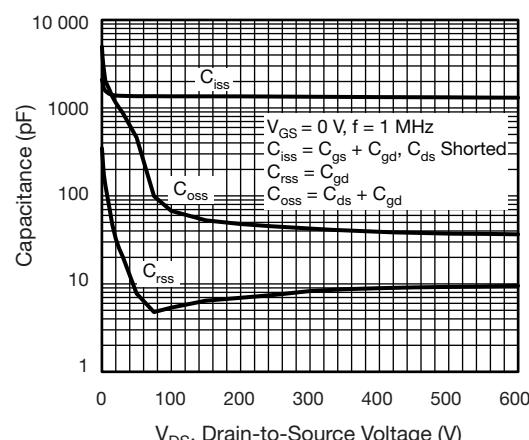
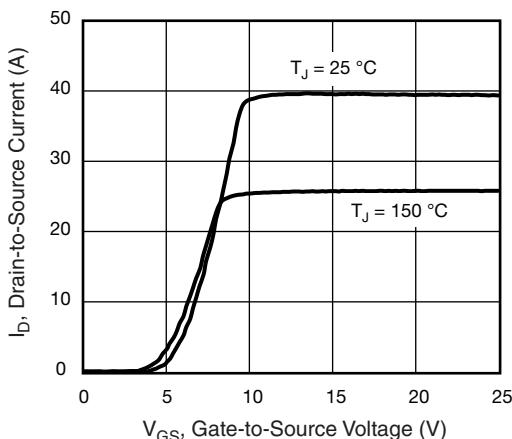
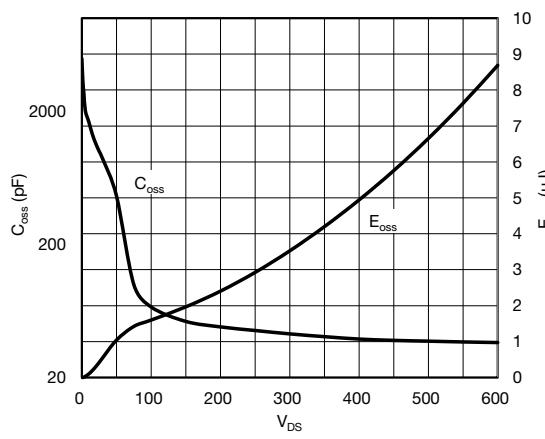
- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 11.6$ mH, $R_g = 25$ Ω, $I_{AS} = 4.2$ A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$, $dI/dt = 100$ A/μs, starting $T_J = 25$ °C.
- Limited by maximum junction temperature.

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	65	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	3.7	°C/W

SPECIFICATIONS ($T_J = 25^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0 \text{ V}$, $I_D = 250 \mu\text{A}$		600	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25°C , $I_D = 1 \text{ mA}$		-	0.71	-	$\text{V}/^\circ\text{C}$
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 250 \mu\text{A}$		2	-	4	V
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 20 \text{ V}$		-	-	± 100	nA
		$V_{GS} = \pm 30 \text{ V}$		-	-	± 1	μA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 600 \text{ V}$, $V_{GS} = 0 \text{ V}$		-	-	1	
		$V_{DS} = 480 \text{ V}$, $V_{GS} = 0 \text{ V}$, $T_J = 125^\circ\text{C}$		-	-	10	μA
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10 \text{ V}$	$I_D = 8 \text{ A}$	-	0.23	0.28	Ω
Forward Transconductance	g_{fs}	$V_{DS} = 30 \text{ V}$	$I_D = 8 \text{ A}$	-	4.6	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0 \text{ V}$, $V_{DS} = 100 \text{ V}$, $f = 1 \text{ MHz}$		-	1350	-	pF
Output Capacitance	C_{oss}			-	70	-	
Reverse Transfer Capacitance	C_{rss}			-	5	-	
Effective Output Capacitance, Energy Related ^a	$C_{o(er)}$	$V_{DS} = 0 \text{ V}$ to 480 V , $V_{GS} = 0 \text{ V}$		-	53	-	
Effective Output Capacitance, Time Related ^b	$C_{o(tr)}$			-	177	-	
Total Gate Charge	Q_g	$V_{GS} = 10 \text{ V}$	$I_D = 8 \text{ A}$, $V_{DS} = 480 \text{ V}$	-	39	78	nC
Gate-Source Charge	Q_{gs}			-	11	-	
Gate-Drain Charge	Q_{gd}			-	17	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 480 \text{ V}$, $I_D = 8 \text{ A}$, $V_{GS} = 10 \text{ V}$, $R_g = 9.1 \Omega$		-	16	32	ns
Rise Time	t_r			-	26	52	
Turn-Off Delay Time	$t_{d(off)}$			-	41	82	
Fall Time	t_f			-	22	44	
Gate Input Resistance	R_g	$f = 1 \text{ MHz}$, open drain		0.3	0.86	1.7	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	15	A
Pulsed Diode Forward Current	I_{SM}			-	-	60	
Diode Forward Voltage	V_{SD}	$T_J = 25^\circ\text{C}$, $I_S = 8 \text{ A}$, $V_{GS} = 0 \text{ V}$		-	1.0	1.2	V
Reverse Recovery Time	t_{rr}	$T_J = 25^\circ\text{C}$, $I_F = I_S = 8 \text{ A}$, $dt/dt = 100 \text{ A}/\mu\text{s}$, $V_R = 25 \text{ V}$		-	302	604	ns
Reverse Recovery Charge	Q_{rr}			-	4.0	8	μC
Reverse Recovery Current	I_{RRM}			-	24	-	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 - C_{oss} and E_{oss} vs. V_{DS}

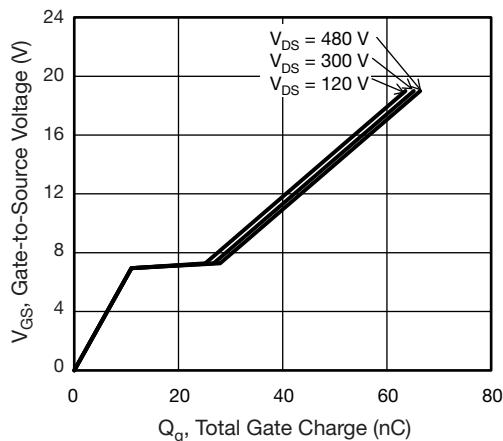


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

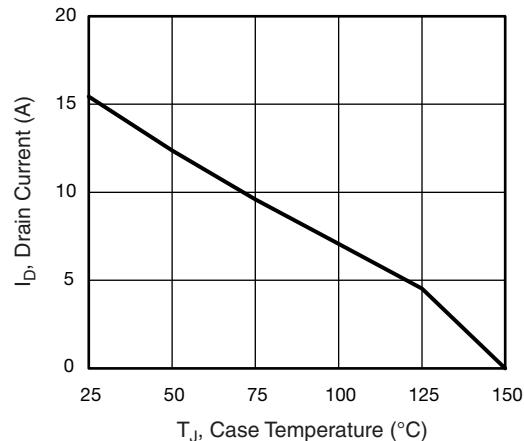


Fig. 10 - Maximum Drain Current vs. Case Temperature

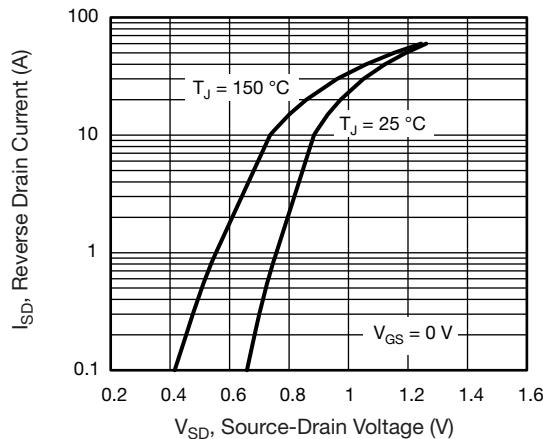


Fig. 8 - Typical Source-Drain Diode Forward Voltage

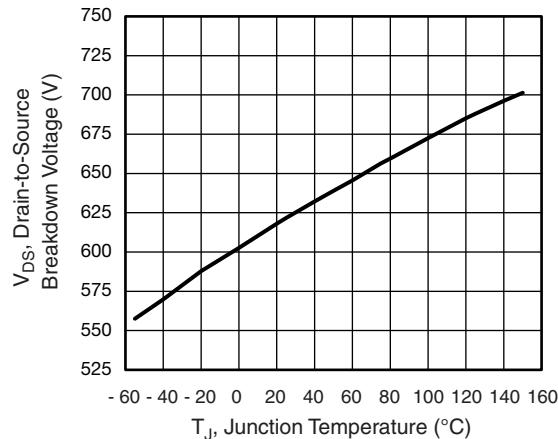


Fig. 11 - Temperature vs. Drain-to-Source Voltage

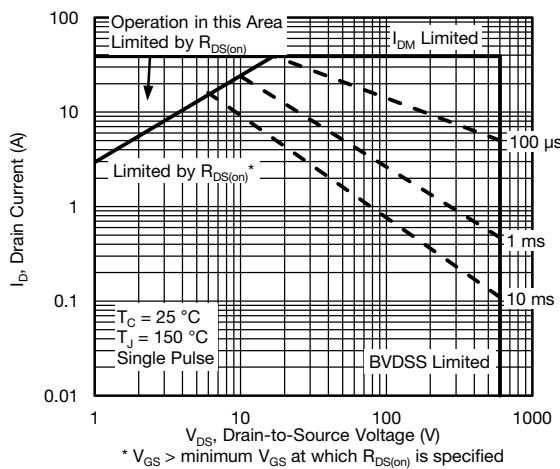


Fig. 9 - Maximum Safe Operating Area

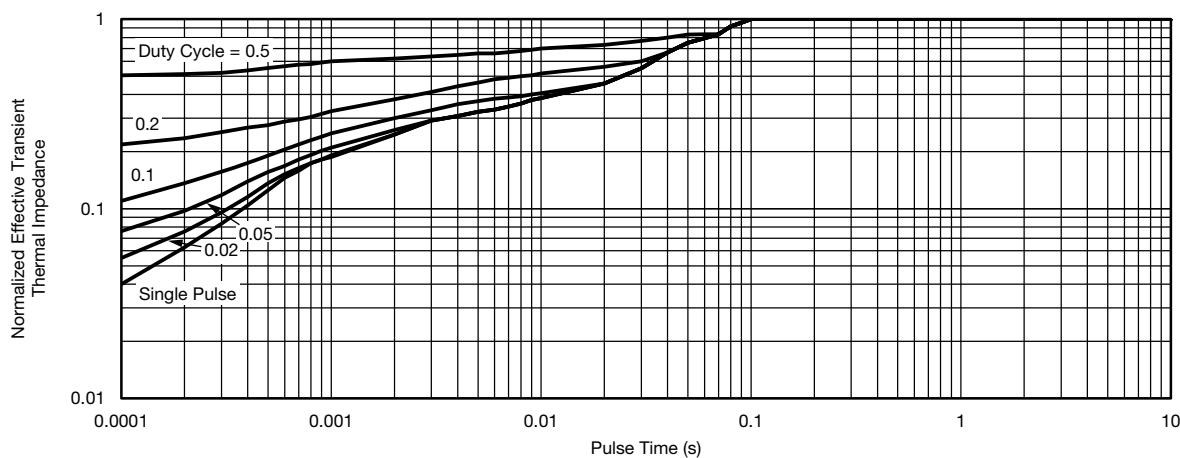


Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case

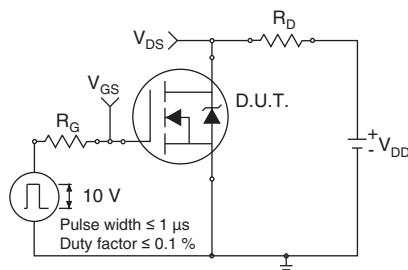


Fig. 13 - Switching Time Test Circuit

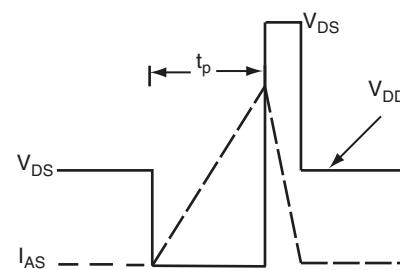


Fig. 16 - Unclamped Inductive Waveforms

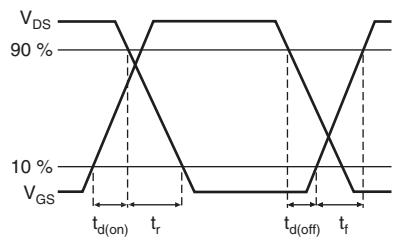


Fig. 14 - Switching Time Waveforms

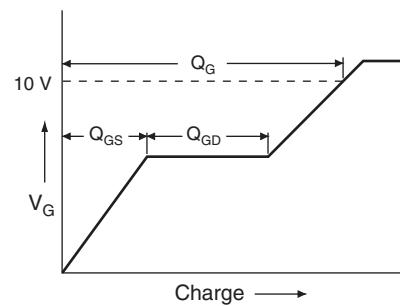


Fig. 17 - Basic Gate Charge Waveform

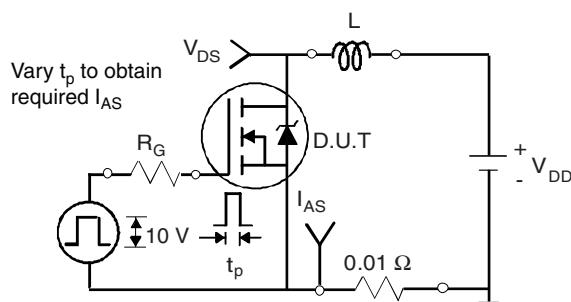


Fig. 15 - Unclamped Inductive Test Circuit

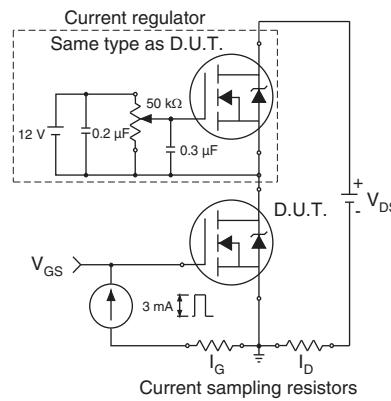
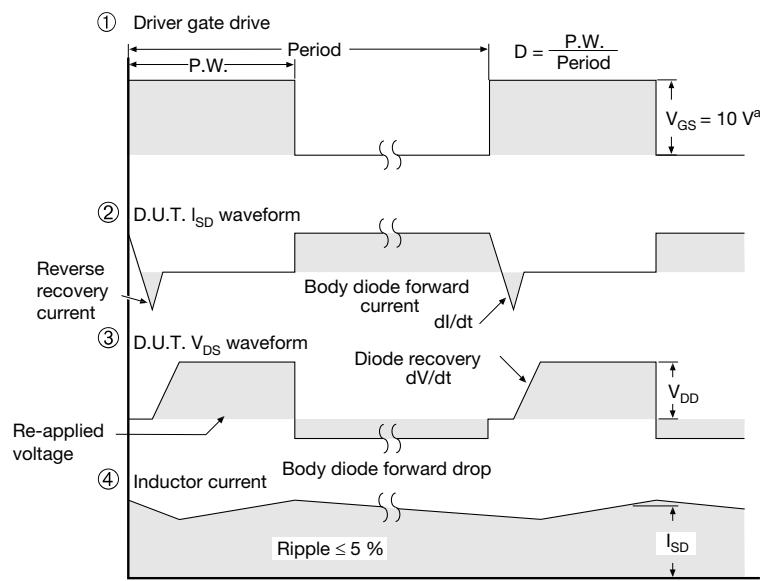
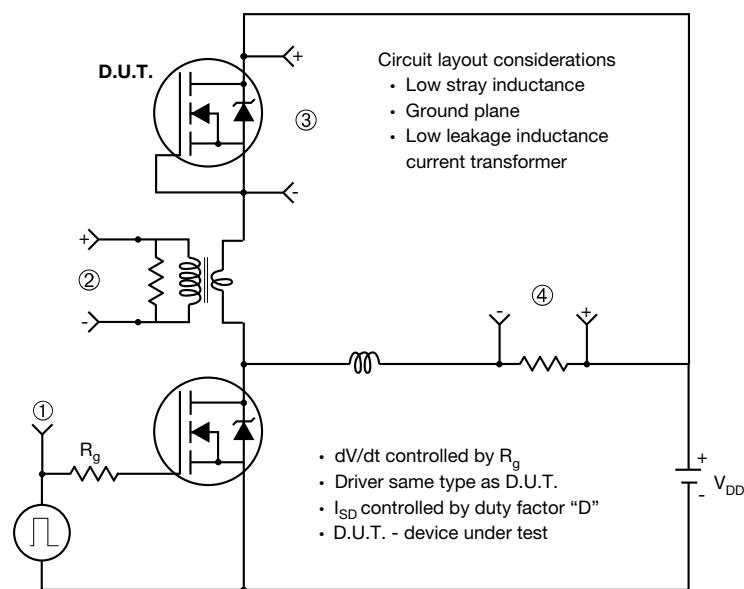


Fig. 18 - Gate Charge Test Circuit

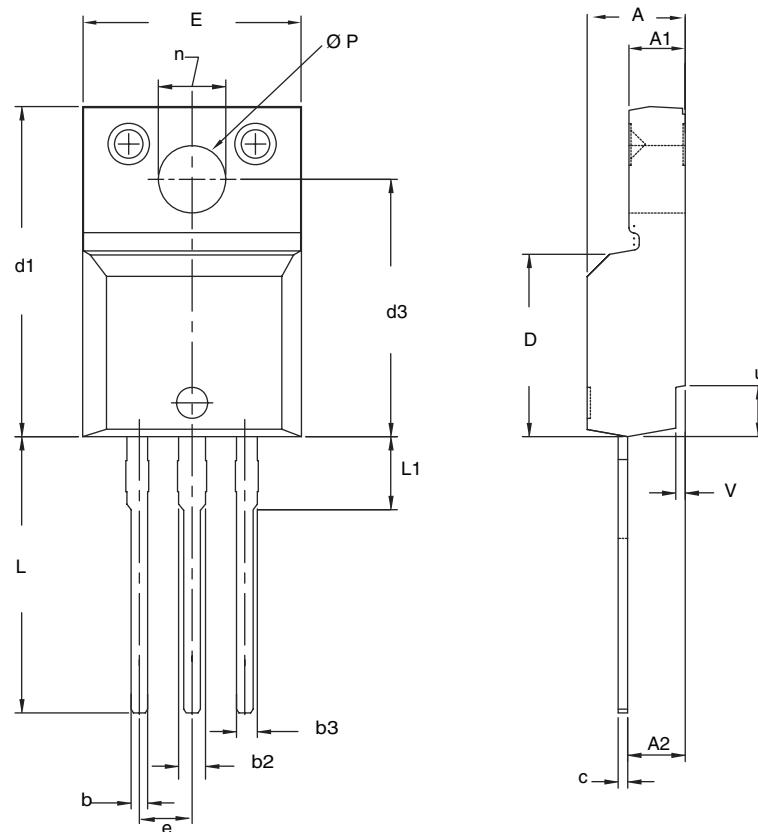
Peak Diode Recovery dV/dt Test Circuit

Note

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

Fig. 19 - For N-Channel

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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
ØP	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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