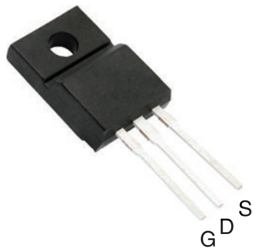
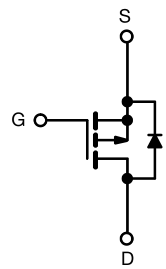
Power MOSFET

TO-220 FULLPAK





P-Channel MOSFET

FEATURES

- Isolated package
- High voltage isolation = 2.5 kV_{RMS} (t = 60 s; f = 60 Hz)
- Sink to lead creepage distance = 4.8 mm
- P-channel
- Dynamic dV/dt rating
- Low thermal resistance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

PRODUCT SUMMARY		
V_{DS} (V)	-200	
$R_{DS(on)}$ (Ω)	V_{GS} = -10 V	3.0
Q_g (Max.) (nC)	13	
Q_{gs} (nC)	3.2	
Q_{gd} (nC)	7.3	
Configuration	Single	

DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The TO-220 FULLPAK eliminates the need for additional insulating hardware in commercial-industrial applications. The molding compound used provides a high isolation capability and a low thermal resistance between the tab and external heatsink. This isolation is equivalent to using a 100 micron mica barrier with standard TO-220 product. The FULLPAK is mounted to a heatsink using a single clip or by a single screw fixing.

ORDERING INFORMATION	
Package	TO-220 FULLPAK
Lead (Pb)-free	IRFI9610GPbF

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

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-source voltage			V_{DS}	-200	V
Gate-source voltage			V_{GS}	± 20	
Continuous drain current	V_{GS} at -10 V	T_C = 25 °C	I_D	-2.0	A
		T_C = 100 °C		-1.3	
Pulsed drain current [a]			I_{DM}	-8.0	
Linear derating factor				0.22	W/°C
Single pulse avalanche energy [b]			E_{AS}	100	mJ
Repetitive avalanche current [a]			I_{AR}	-2.0	A
Repetitive avalanche energy [a]			E_{AR}	2.7	mJ
Maximum power dissipation	T_C = 25 °C		P_D	27	W
Peak diode recovery dV/dt [c]			dV/dt	-11	V/ns
Operating junction and storage temperature range			T_J, T_{stg}	-55 to +150	°C
Soldering recommendations (peak temperature) [d]	For 10 s			300	
Mounting torque	M3 screw			0.6	Nm

Notes

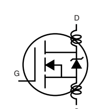
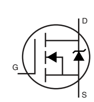
a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. Starting T_J = 25 °C, L = 51 mH, R_G = 25 Ω, I_{AS} = -2.0 A (see fig. 12)

c. $I_{SD} \leq$ -2.0 A, dI/dt $\leq$ -250 A/μs, $V_{DD} \leq V_{DS}$, $T_J \leq$ 150 °C

d. 1.6 mm from case

THERMAL RESISTANCE RATINGS				
PARAMETER	**SYMBOL**	**TYP.**	**MAX.**	**UNIT**
Maximum junction-to-ambient	R_{thJA}	-	65	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	4.6	

SPECIFICATIONS T_J = 25 °C, unless otherwise noted							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static							
Drain-ssource breakdown voltage	V_{DS}	V_{GS} = 0 V, I_D = -250 μA		-200	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = -1 mA		-	-0.22	-	V/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, I_D = -250 μA		-2.0	-	-4.0	V
Gate-source leakage	I_{GSS}	V_{GS} = ± 20 V		-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	V_{DS} = -200 V, V_{GS} = 0 V		-	-	-100	μA
		V_{DS} = -160 V, V_{GS} = 0 V, T_J = 125 °C		-	-	-500	
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS} = -10 V	I_D = -1.2 A[b]	-	-	3.0	Ω
Forward transconductance	g_{fs}	V_{DS} = -50 V, I_D = -1.2 A[b]		0.7	-	-	S
Dynamic							
Input capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = -25 V, f = 1.0 MHz, see fig. 5		-	180	-	pF
Output capacitance	C_{oss}			-	66	-	
Reverse transfer capacitance	C_{rss}			-	12	-	
Total gate charge	Q_g	V_{GS} = -10 V	I_D = -2.0 A, V_{DS} = -160 V, see fig. 6 and 13[b]	-	-	13	nC
Gate-source charge	Q_{gs}			-	-	3.2	
Gate-drain charge	Q_{gd}			-	-	7.3	
Turn-on delay time	$t_{d(on)}$	V_{DD} = -100 V, I_D = -2.0 A, R_G = 24 Ω, V_{GS} = -10 V, see fig. 10[b]		-	12	-	ns
Rise time	t_r			-	17	-	
Turn-off delay time	$t_{d(off)}$			-	19	-	
Fall time	t_f			-	15	-	
Internal drain inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact		-	4.5	-	nH
Internal source inductance	L_S			-	7.5	-	
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	-2.0	A
Pulsed diode forward current[a]	I_{SM}			-	-	-8.0	
Body diode voltage	V_{SD}	T_J = 25 °C, I_S = -2.0 A, V_{GS} = 0 V[b]		-	-	-5.8	V
Body diode reverse recovery time	t_{rr}	T_J = 25 °C, I_F = -2.0 A, dI/dt = 100 A/μs[b]		-	130	200	ns
Body diode reverse recovery charge	Q_{rr}			-	700	1050	μC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)					

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. Pulse width ≤ 300 μs; duty cycle ≤ 2 %

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

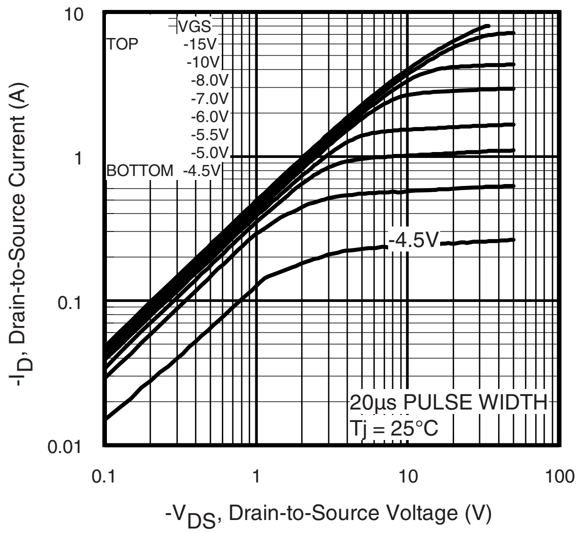


Fig. 1 - Typical Output Characteristics, T_C = 25 °C

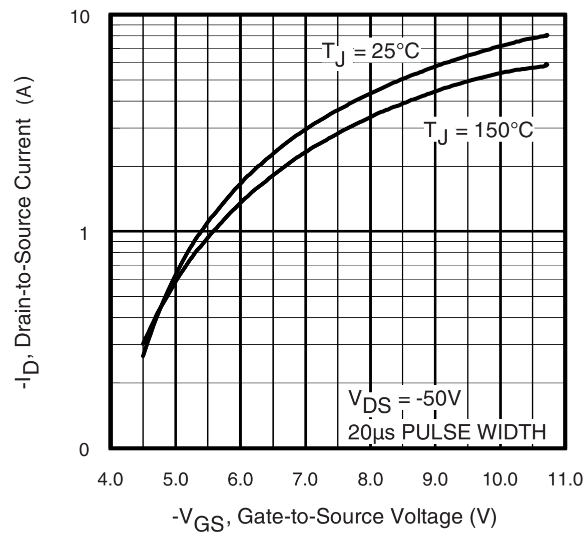


Fig. 3 - Typical Transfer Characteristics

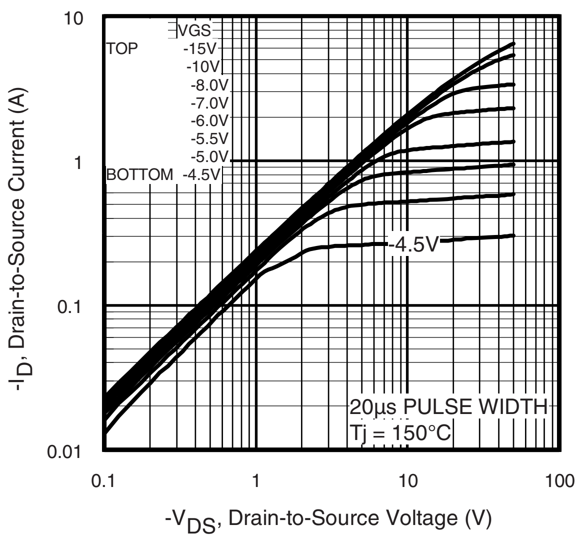


Fig. 2 - Typical Output Characteristics, T_C = 150 °C

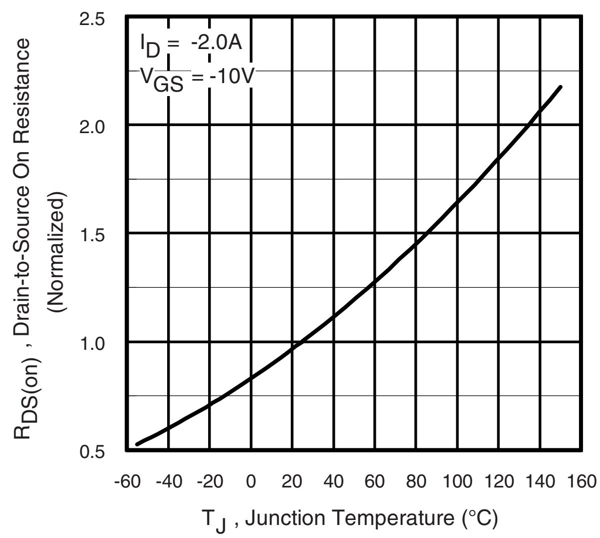


Fig. 4 - Normalized On-Resistance vs. Temperature

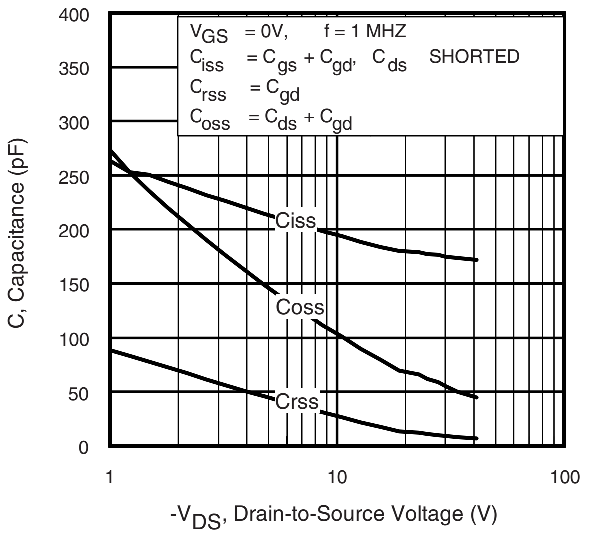


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

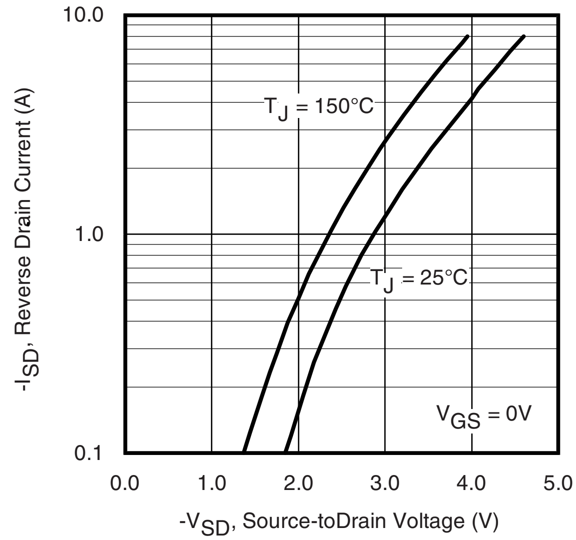


Fig. 7 - Typical Source-Drain Diode Forward Voltage

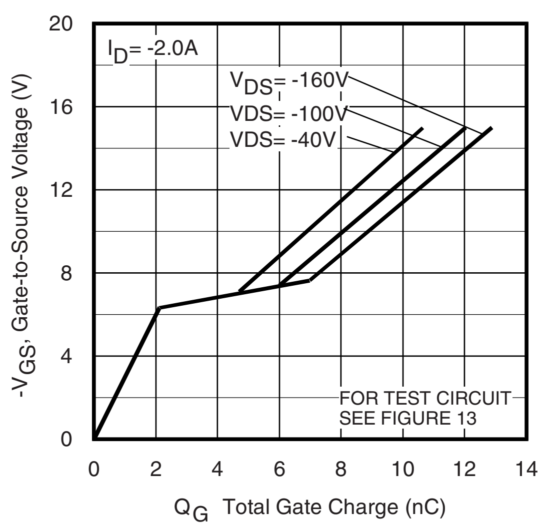


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

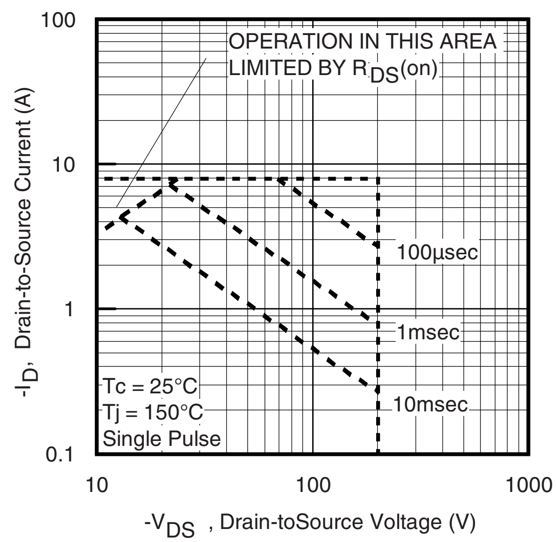


Fig. 8 - Maximum Safe Operating Area

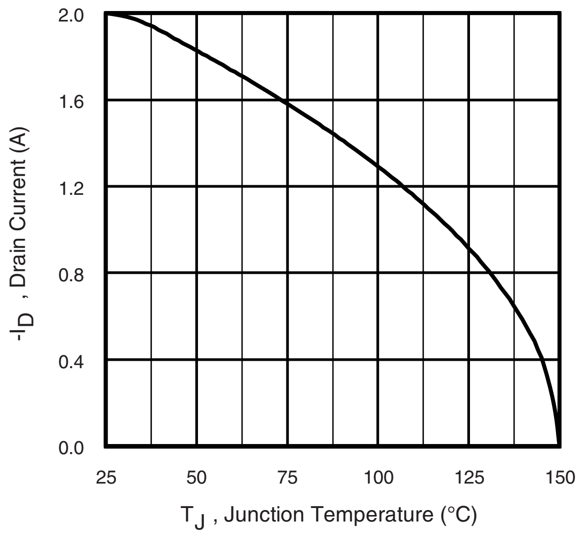


Fig. 9 - Maximum Drain Current vs. Case Temperature

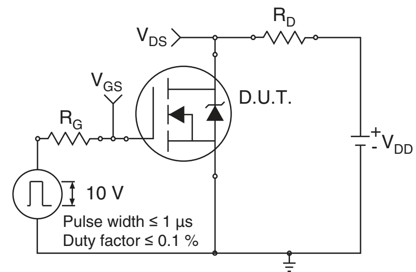


Fig. 10a - Switching Time Test Circuit

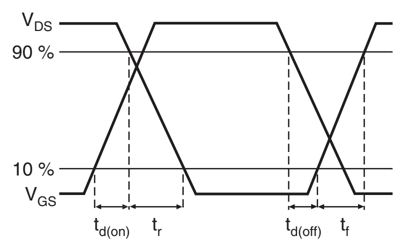


Fig. 10b - Switching Time Waveforms

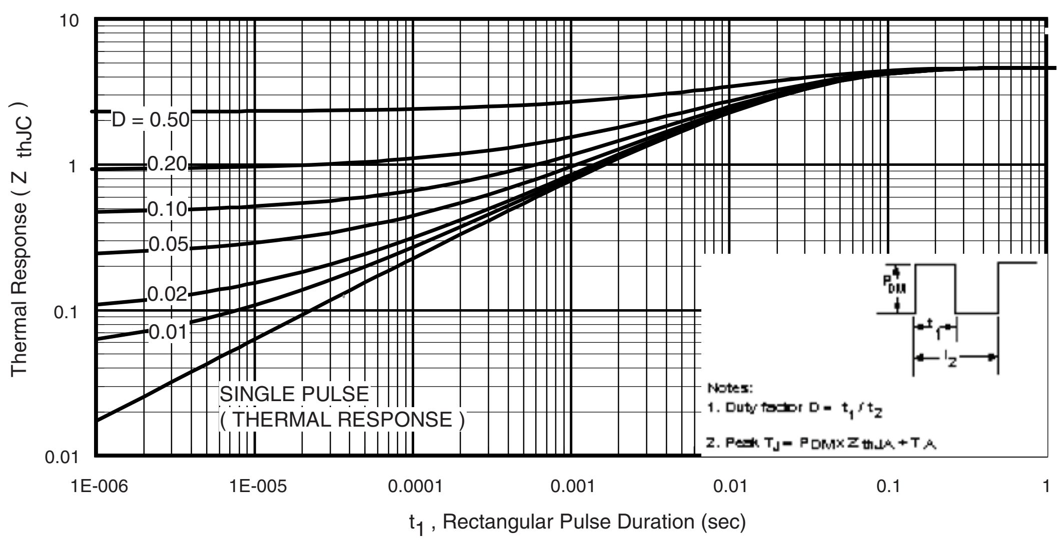


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

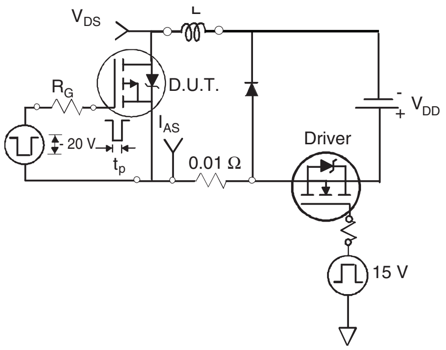


Fig. 12a - Unclamped Inductive Test Circuit

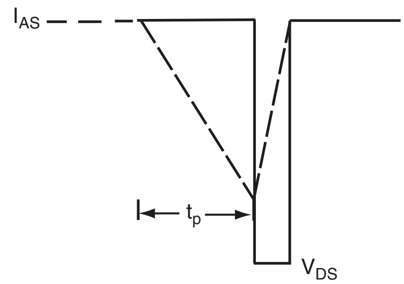


Fig. 12b - Unclamped Inductive Waveforms

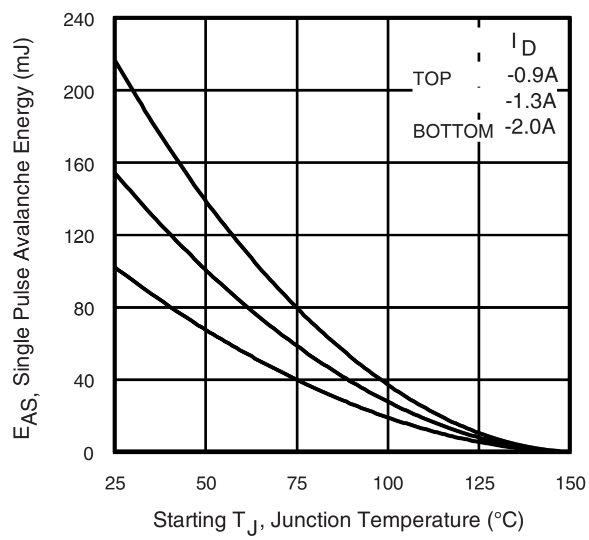


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

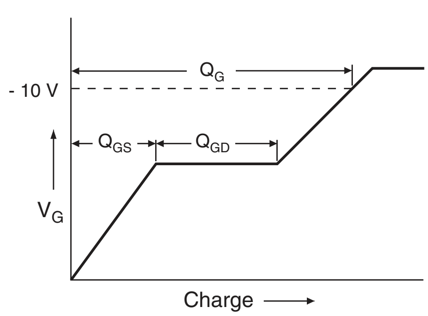


Fig. 13a - Basic Gate Charge Waveform

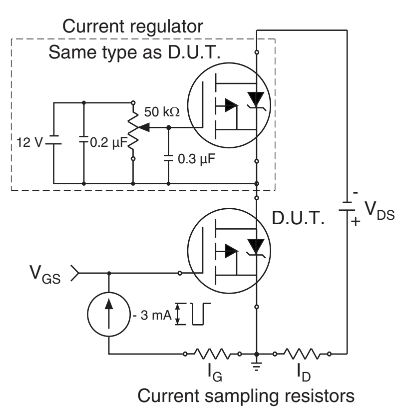
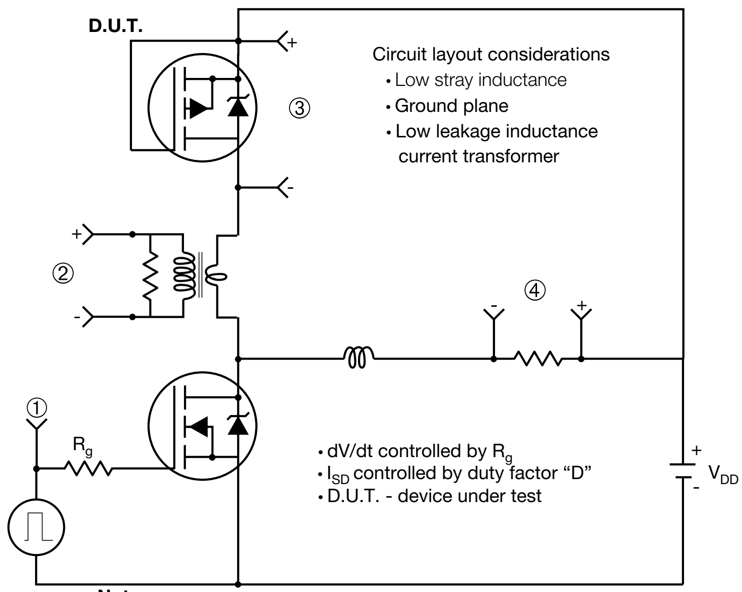
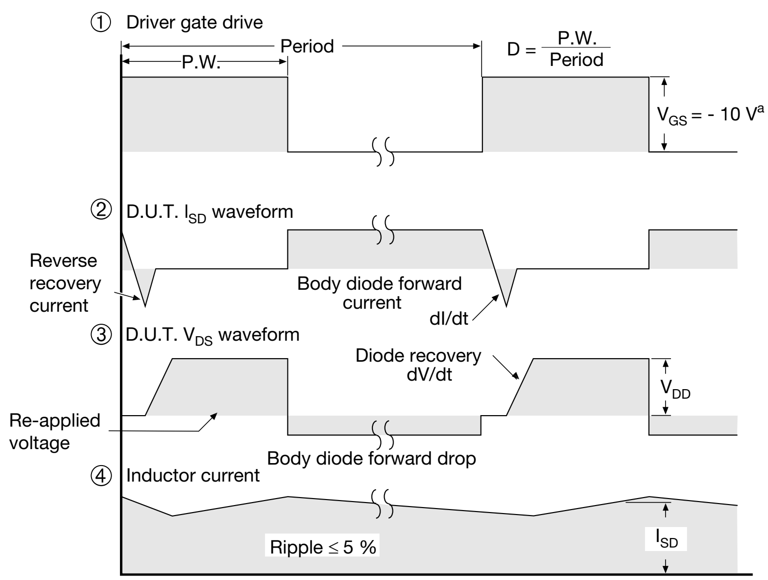


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note
• Compliment N-Channel of D.U.T. for driver

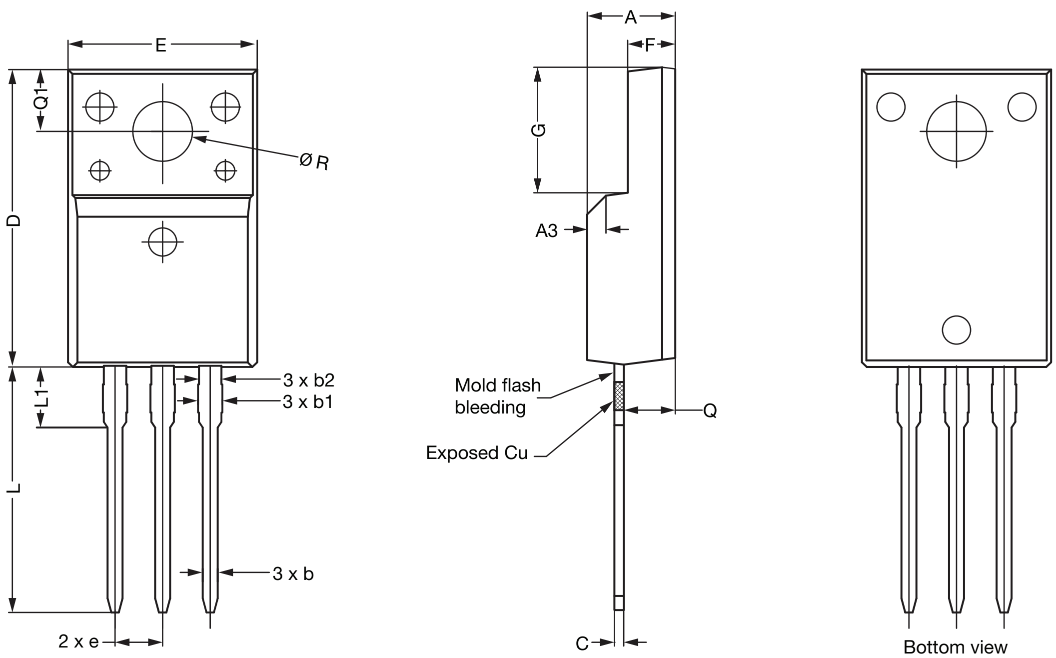


Note
a. V_{GS} = - 5 V for logic level and - 3 V drive devices

Fig. 14 - For P-Channel

TO-220 FULLPAK (High Voltage)

OPTION 1: FACILITY CODE = 9

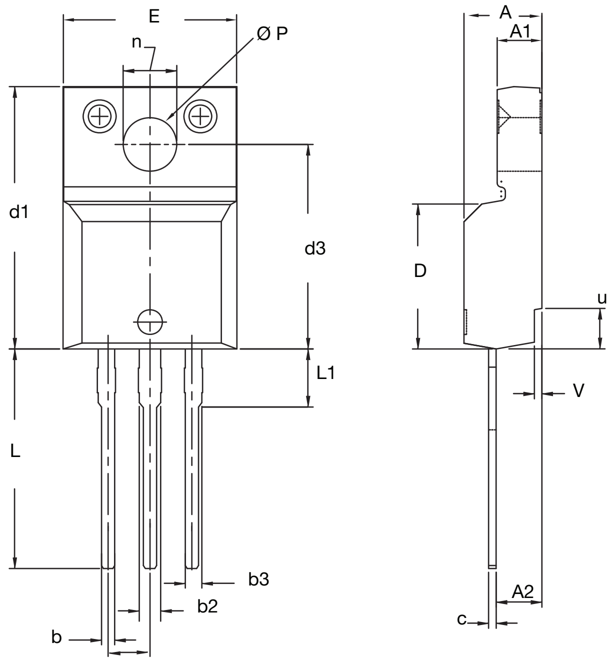


	MILLIMETERS		
DIM.	MIN.	NOM.	MAX.
A	4.60	4.70	4.80
b	0.70	0.80	0.91
b1	1.20	1.30	1.47
b2	1.10	1.20	1.30
C	0.45	0.50	0.63
D	15.80	15.87	15.97
e		2.54 BSC	
E	10.00	10.10	10.30
F	2.44	2.54	2.64
G	6.50	6.70	6.90
L	12.90	13.10	13.30
L1	3.13	3.23	3.33
Q	2.65	2.75	2.85
Q1	3.20	3.30	3.40
Ø R	3.08	3.18	3.28

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
6. Facility code will be the 1st character located at the 2nd row of the unit marking

OPTION 2: FACILITY CODE = Y



	MILLIMETERS		INCHES	
DIM.	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: E19-0180-Rev. D, 08-Apr-2019 DWG: 5972				

Notes

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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
6. Facility code will be the 1st character located at the 2nd row of the unit marking

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