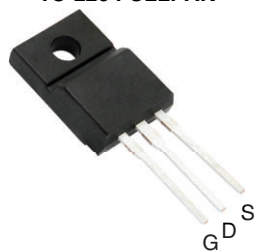


Power MOSFET

TO-220 FULLPAK


N-Channel MOSFET

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
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

APPLICATIONS

- Switch mode power supply (SMPS)
- Uninterruptible power supply
- High speed power switching
- High voltage isolation = 2.5 kV_{RMS} (t = 60 s, f = 60 Hz)

TYPICAL SMPS TOPOLOGIES

- Single transistor forward
- Active clamped forward

PRODUCT SUMMARY

V_{DS} (V)	600	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	0.75
Q_g max. (nC)	49	
Q_{gs} (nC)	13	
Q_{gd} (nC)	20	
Configuration	Single	

ORDERING INFORMATION

Package	TO-220 FULLPAK
Lead (Pb)-free	IRFIB6N60APbF

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$, unless otherwise noted)

PARAMETER				SYMBOL	LIMIT	UNIT
Drain-source voltage				V _{DS}	600	V
Gate-source voltage				V _{GS}	± 30	
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	I _D	5.5		
		T _C = 100 °C		3.5		
Pulsed drain current ^a				I _{DM}	37	
Linear derating factor					0.48	W/°C
Single pulse avalanche energy ^b				E _{AS}	290	mJ
Repetitive avalanche current ^a				I _{AR}	9.2	A
Repetitive avalanche energy ^a				E _{AR}	6.0	mJ
Maximum power dissipation		T _C = 25 °C		P _D	60	W
Peak diode recovery dV/dt ^c				dV/dt	5.0	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

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
- Starting $T_J = 25^\circ\text{C}$, $L = 6.8\text{ mH}$, $R_G = 25\ \Omega$, $I_{AS} = 9.2\text{ A}$ (see fig. 12)
- $I_{SD} \leq 9.2\text{ A}$, $dI/dt \leq 50\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150^\circ\text{C}$
- 1.6 mm from case

**THERMAL RESISTANCE RATINGS**

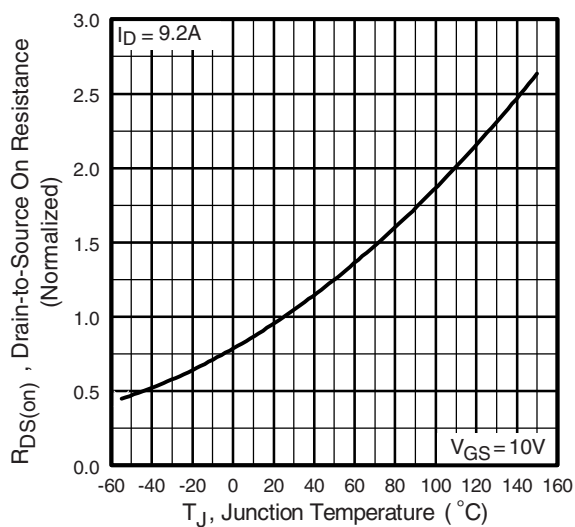
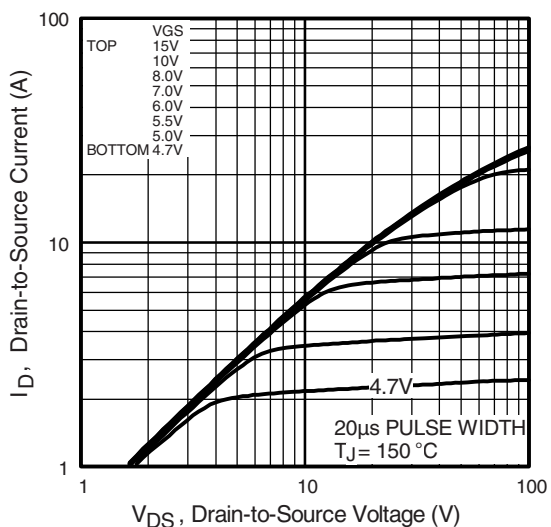
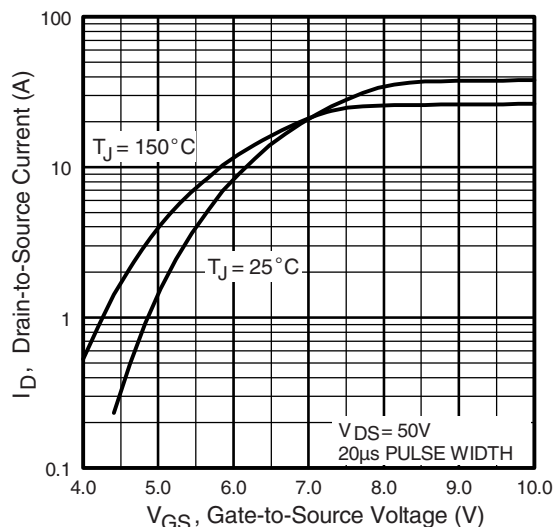
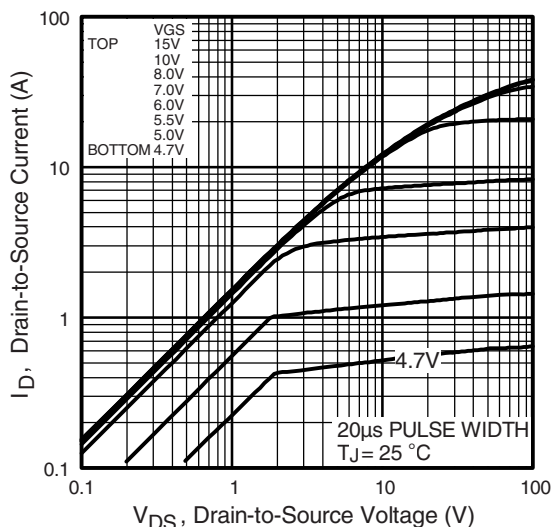
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	R_{thJA}	-	65	°C/W
Maximum junction-to-case (drain)	R_{thJC}	-	2.1	

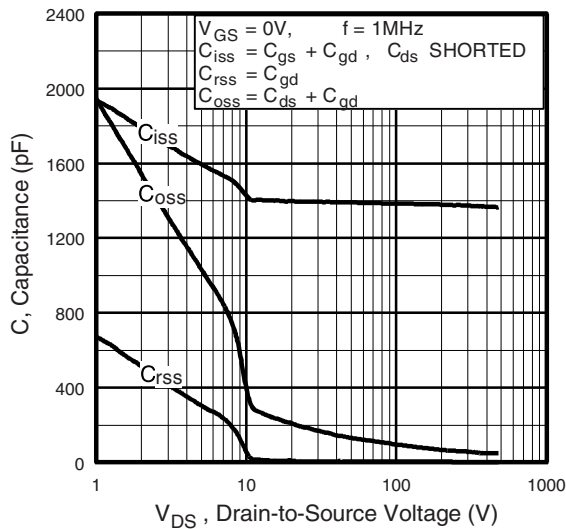
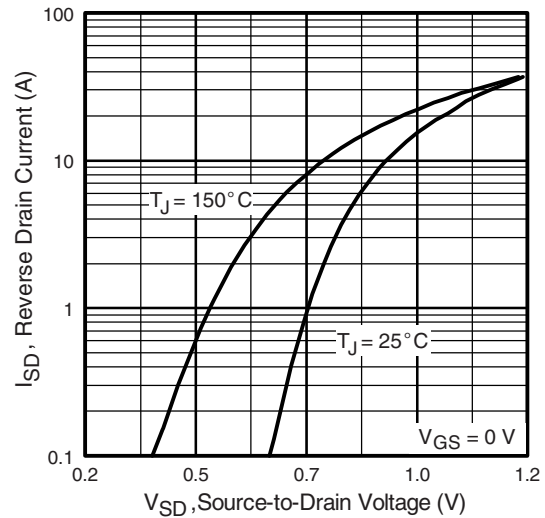
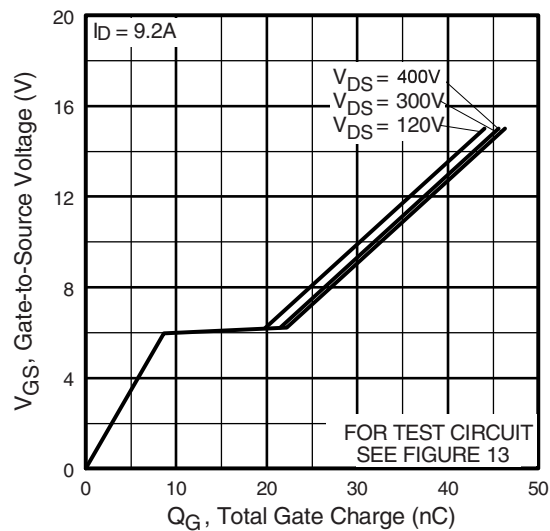
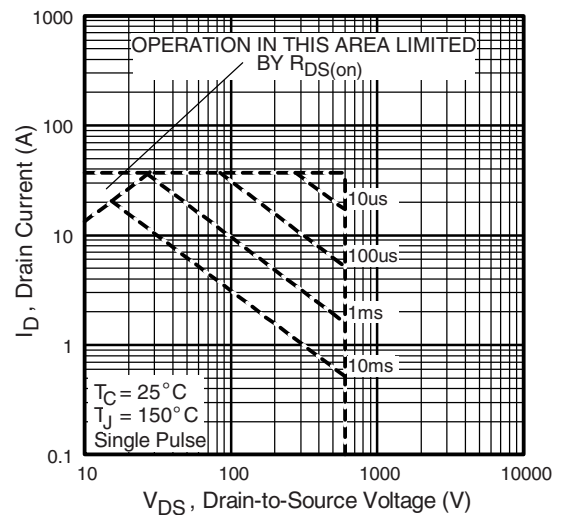
SPECIFICATIONS ($T_J = 25\text{ °C}$, unless otherwise noted)

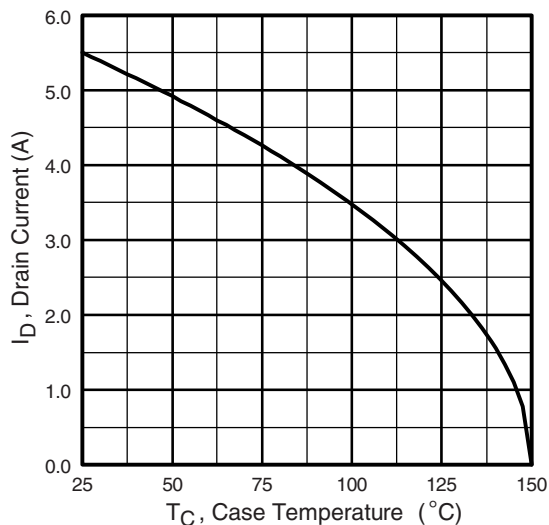
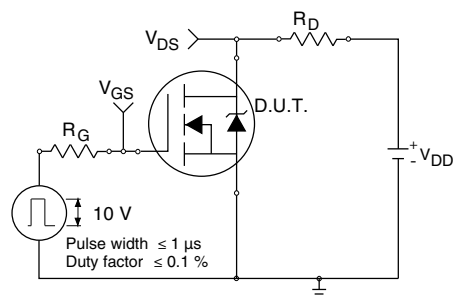
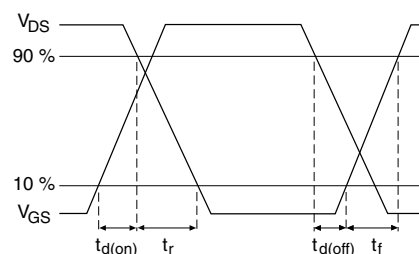
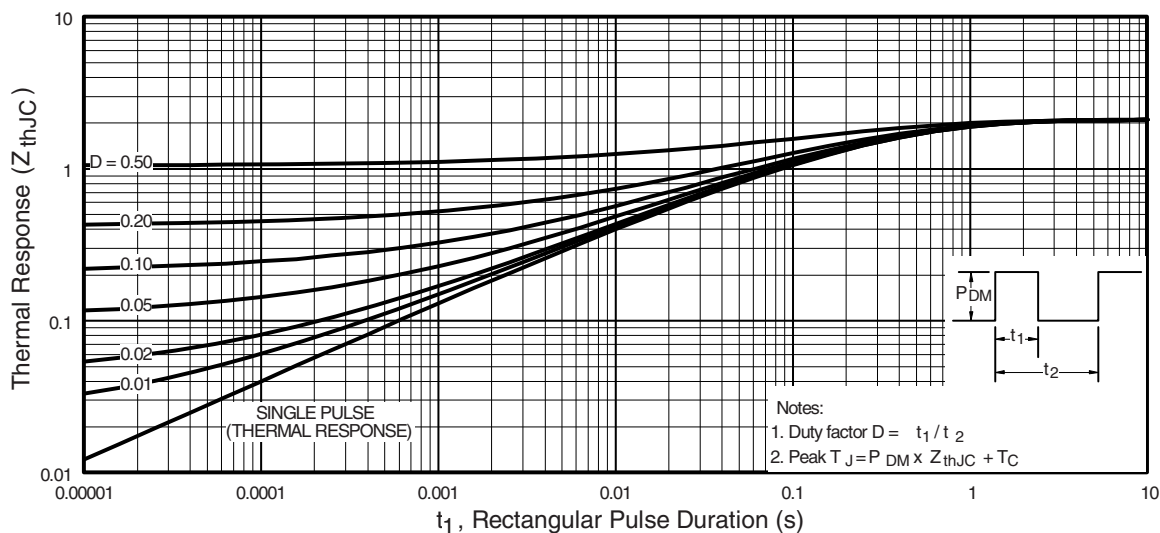
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V_{DS}	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	600	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C , $I_D = 1\text{ mA}^d$	-	660	-	mV/°C
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-source leakage	I_{GSS}	$V_{GS} = \pm 30\text{ V}$	-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 600\text{ V}$, $V_{GS} = 0\text{ V}$	-	-	25	μA
		$V_{DS} = 480\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ °C}$	-	-	250	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$, $I_D = 3.3\text{ A}^b$	-	-	0.75	Ω
Forward transconductance	g_{fs}	$V_{DS} = 25\text{ V}$, $I_D = 5.5\text{ A}$	5.5	-	-	S
Dynamic						
Input capacitance	C_{iss}	$V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1.0\text{ MHz}$, see fig. 5	-	1400	-	pF
Output capacitance	C_{oss}		-	180	-	
Reverse transfer capacitance	C_{rss}		-	7.1	-	
Output capacitance	C_{oss}	$V_{GS} = 0\text{ V}$ $V_{DS} = 1.0\text{ V}$, $f = 1.0\text{ MHz}$ $V_{DS} = 480\text{ V}$, $f = 1.0\text{ MHz}$ $V_{DS} = 0\text{ V}$ to 480 V^c	-	1957	-	
Effective output capacitance	$C_{oss\text{ eff.}}$		-	96	-	nC
Total gate charge	Q_g	$V_{GS} = 10\text{ V}$ $I_D = 9.2\text{ A}$, $V_{DS} = 400\text{ V}$, see fig. 6 and 13 ^b	-	-	49	
Gate-source charge	Q_{gs}		-	-	13	
Gate-drain charge	Q_{gd}		-	-	20	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 300\text{ V}$, $I_D = 9.2\text{ A}$, $R_G = 9.1\text{ }\Omega$, $R_D = 35.5\text{ }\Omega$, see fig. 10 ^b	-	13	-	ns
Rise time	t_r		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	30	-	
Fall time	t_f		-	22	-	
Gate input resistance	R_g	$f = 1\text{ MHz}$, open drain	0.5	-	3.2	Ω
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	5.5	A
Pulsed diode forward current ^a	I_{SM}		-	-	37	
Body diode voltage	V_{SD}	$T_J = 25\text{ °C}$, $I_S = 9.2\text{ A}$, $V_{GS} = 0\text{ V}^b$	-	-	1.5	V
Body diode reverse recovery time	t_{rr}	$T_J = 25\text{ °C}$, $I_F = 9.2\text{ A}$, $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	530	800	ns
Body diode reverse recovery charge	Q_{rr}		-	3.0	4.4	μC
Forward turn-on time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)				

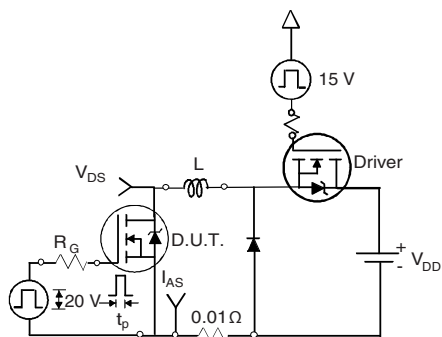
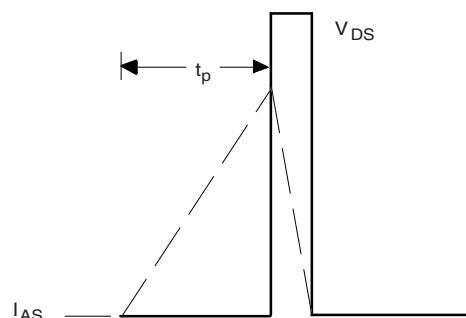
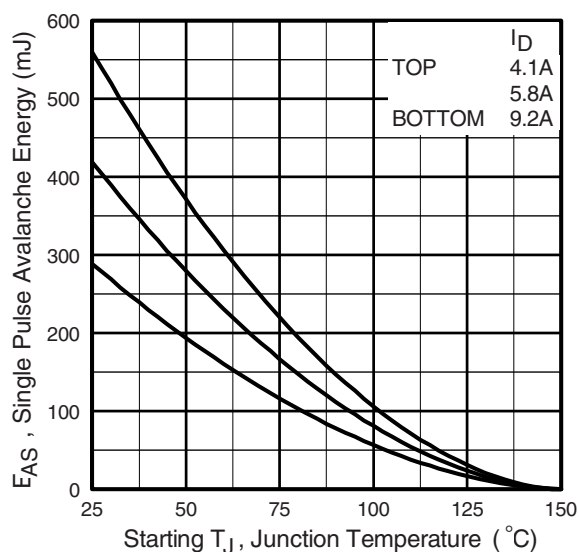
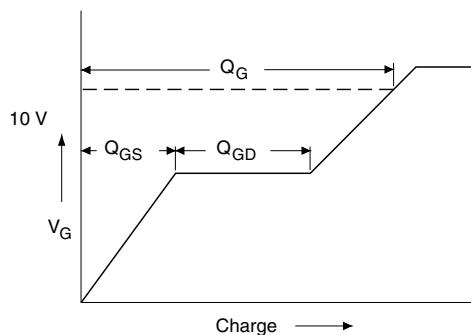
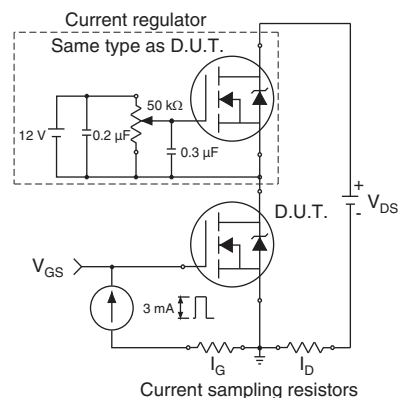
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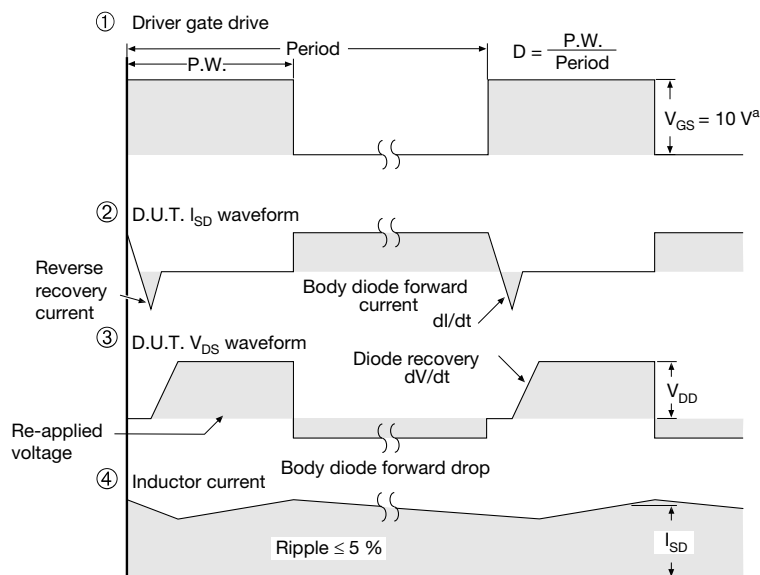
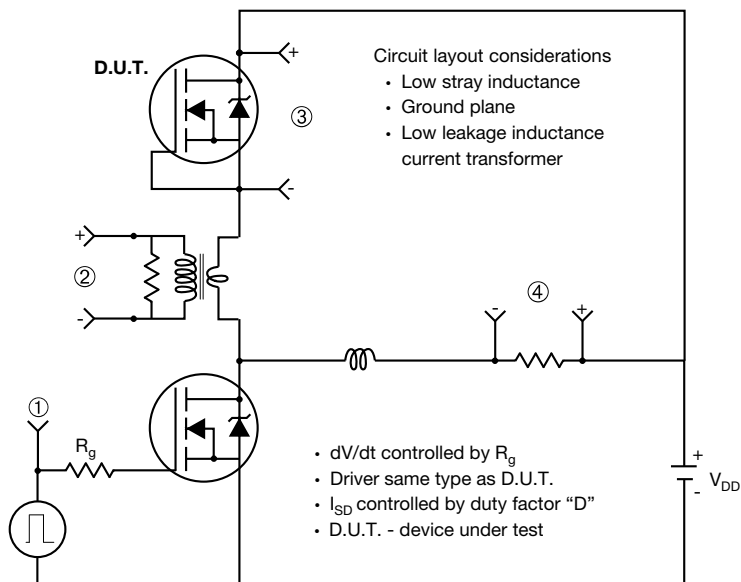
- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$
c. $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS}
d. $t = 60\text{ s}$, $f = 60\text{ Hz}$

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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

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

Fig. 14 - For N-Channel

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TO-220 FULLPAK (High Voltage)

OPTION 1: FACILITY CODE = 9



DIM.	MILLIMETERS		
	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**

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: E19-0180-Rev. D, 08-Apr-2019
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
6. Facility code will be the 1st character located at the 2nd row of the unit marking



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