

Power MOSFET

TO-220 FULLPAK


N-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
- Dynamic dV/dt rating
- Low thermal resistance
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

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.

PRODUCT SUMMARY

V _{DS} (V)	400	
R _{DS(on)} (Ω)	V _{GS} = 10 V	1.0
Q _g max. (nC)	38	
Q _{gs} (nC)	5.7	
Q _{gd} (nC)	22	
Configuration	Single	

ORDERING INFORMATION

Package	TO-220 FULLPAK
Lead (Pb)-free	IRFI730GPbF

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

PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-source voltage	V _{DS}	400	V	
Gate-source voltage	V _{GS}	± 20		
Continuous drain current	V _{GS} at 10 V	T _C = 25 °C	A	
		T _C = 100 °C		2.3
Pulsed drain current ^a	I _{DM}	15		
Linear derating factor		0.28	W/°C	
Single pulse avalanche energy ^b	E _{AS}	200	mJ	
Repetitive avalanche current ^a	I _{AR}	3.7	A	
Repetitive avalanche energy ^a	E _{AR}	3.5	mJ	
Maximum power dissipation	T _C = 25 °C	P _D	35	W
Peak diode recovery dV/dt ^c	dV/dt	4.0	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)
- V_{DD} = 50 V, starting T_J = 25 °C, L = 25 mH, R_g = 25 Ω, I_{AS} = 3.7 A (see fig. 12)
- I_{SD} ≤ 3.7 A, di/dt ≤ 90 A/μs, V_{DD} ≤ V_{DS}, T_J ≤ 150 °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}	-	3.6	

SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	400	-	-	V
V _{DS} temperature coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA	-	0.54	-	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} = 400 V, V _{GS} = 0 V	-	-	25	μA
		V _{DS} = 320 V, V _{GS} = 0 V, T _J = 125 °C	-	-	250	
Drain-source on-state resistance	R _{DS(on)}	V _{GS} = 10 V, I _D = 2.1 A ^b	-	-	1.0	Ω
Forward transconductance	g _{fs}	V _{DS} = 50 V, I _D = 2.1 A ^b	3.6	-	-	S
Dynamic						
Input capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1.0 MHz, see fig. 5	-	700	-	pF
Output capacitance	C _{oss}		-	170	-	
Reverse transfer capacitance	C _{rss}		-	64	-	
Drain to sink capacitance	C	f = 1.0 MHz	-	12	-	
Total gate charge	Q _g	V _{GS} = 10 V, I _D = 3.7 A, V _{DS} = 320 V, see fig. 6 and 13 ^b	-	-	38	nC
Gate-source charge	Q _{gs}		-	-	5.7	
Gate-drain charge	Q _{gd}		-	-	22	
Turn-on delay time	t _{d(on)}	V _{DD} = 200 V, I _D = 3.7 A, R _g = 12 Ω, R _D = 57 Ω, see fig. 10 ^b	-	10	-	ns
Rise time	t _r		-	15	-	
Turn-off delay time	t _{d(off)}		-	38	-	
Fall time	t _f		-	14	-	
Gate input resistance	R _g	f = 1 MHz, open drain	0.6	-	2.3	Ω
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	-	-	3.7	A
Pulsed diode forward current ^a	I _{SM}		-	-	15	
Body diode voltage	V _{SD}	T _J = 25 °C, I _S = 3.7 A, V _{GS} = 0 V ^b	-	-	1.6	V
Body diode reverse recovery time	t _{rr}	T _J = 25 °C, I _F = 3.7 A, dI/dt = 100 A/μs ^b	-	260	530	ns
Body diode reverse recovery charge	Q _{rr}		-	1.2	2.2	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)

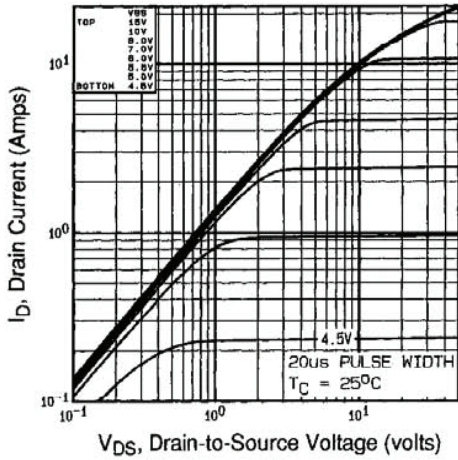


Fig. 1 - Typical Output Characteristics, $T_C = 25^\circ\text{C}$

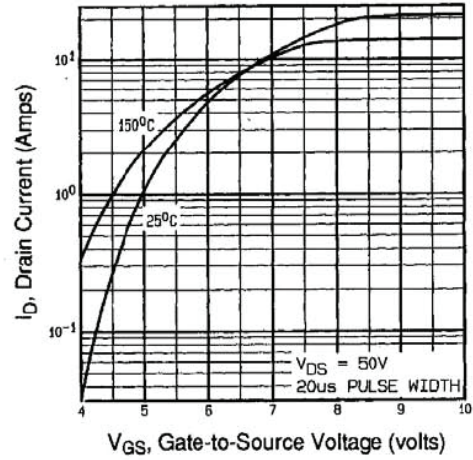


Fig. 3 - Typical Transfer Characteristics

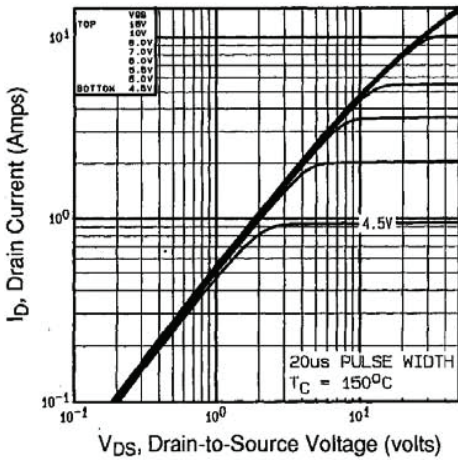


Fig. 2 - Typical Output Characteristics, $T_C = 150^\circ\text{C}$

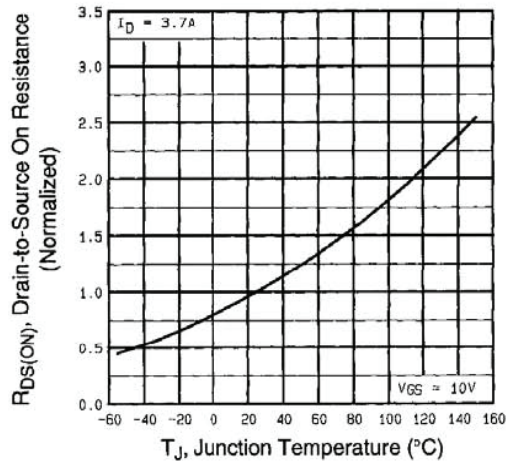


Fig. 4 - Normalized On-Resistance vs. Temperature

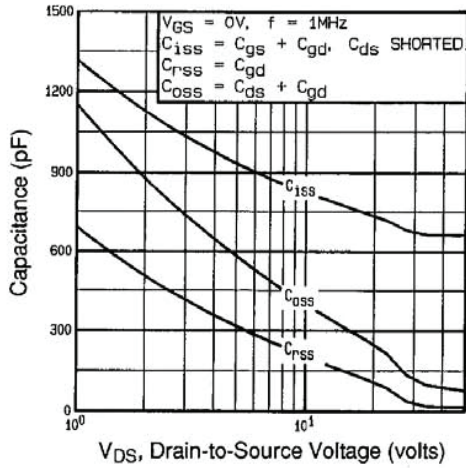


Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

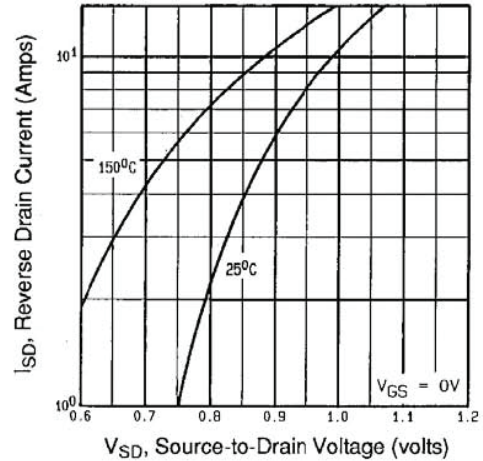


Fig. 7 - Typical Source-Drain Diode Forward Voltage

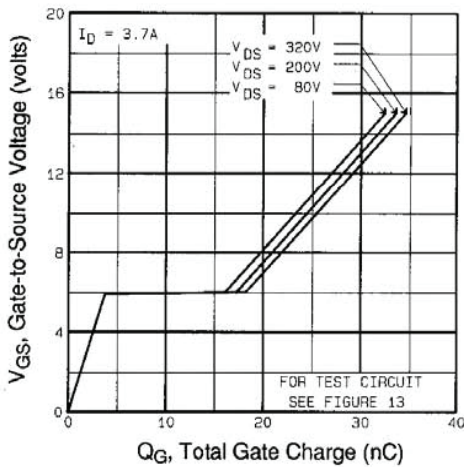


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage

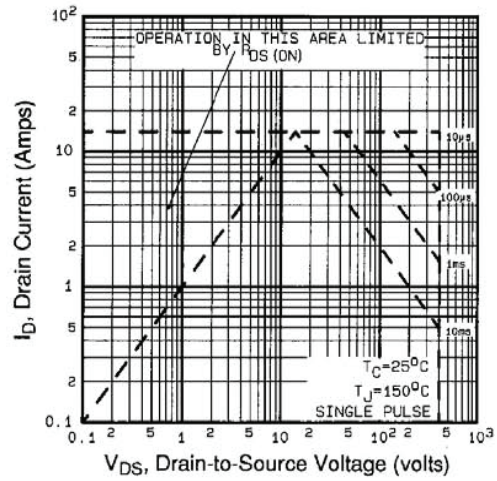


Fig. 8 - Maximum Safe Operating Area

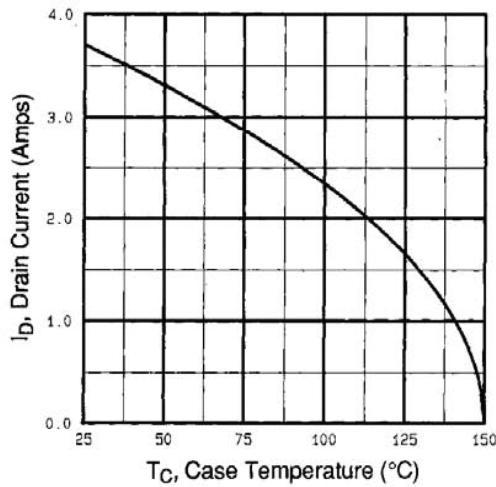


Fig. 9 - Maximum Drain Current vs. Case Temperature

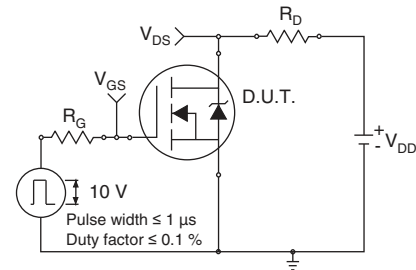


Fig. 10a - Switching Time Test Circuit



Fig. 10b - Switching Time Waveforms

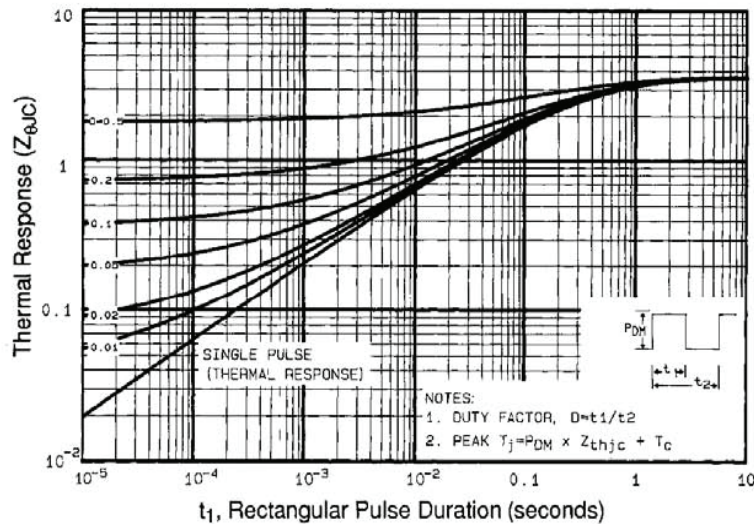


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

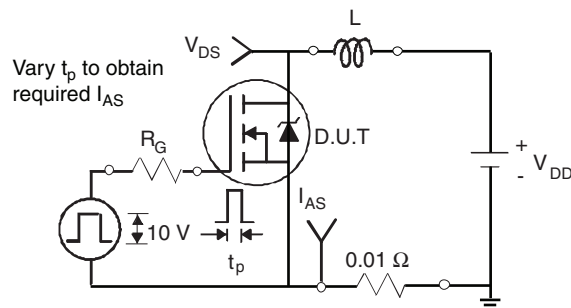


Fig. 12a - Unclamped Inductive Test Circuit

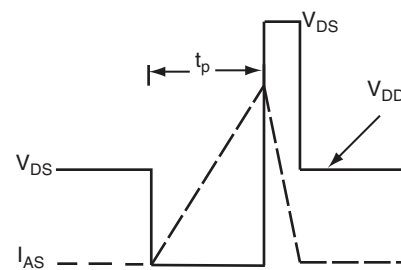


Fig. 12b - Unclamped Inductive Waveforms

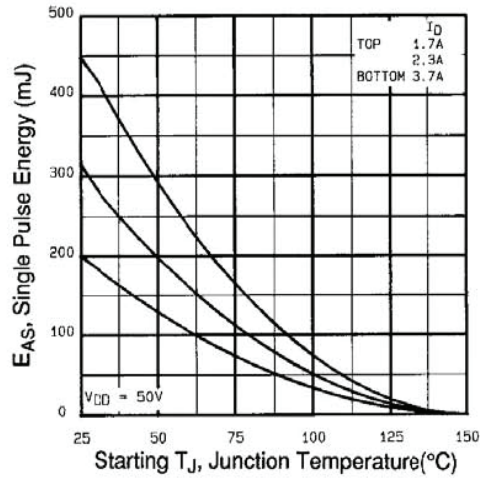


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

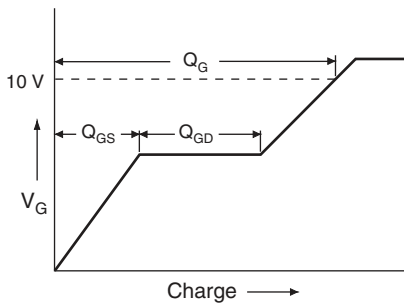


Fig. 13a - Basic Gate Charge Waveform

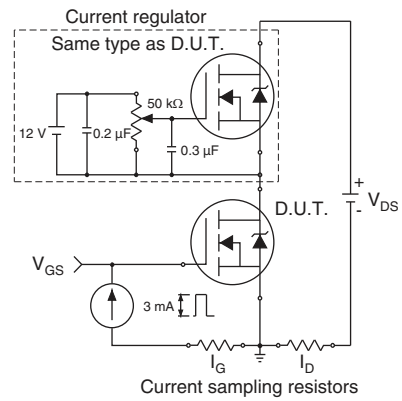
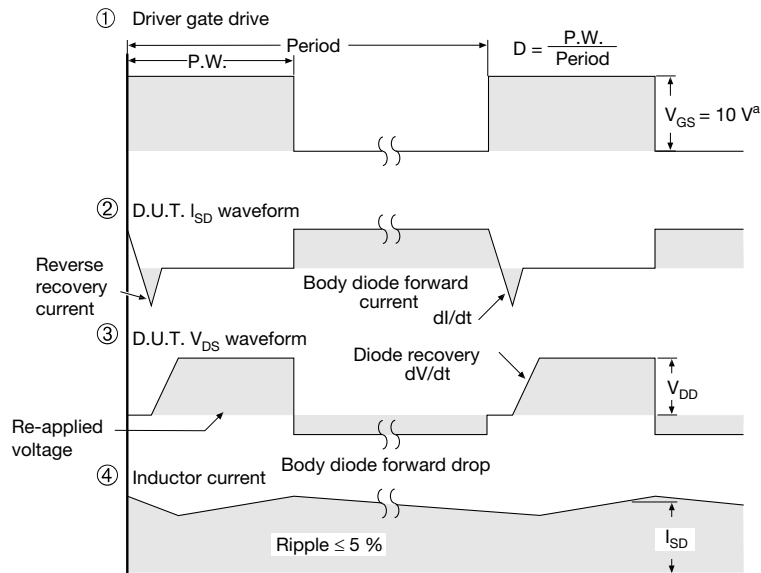
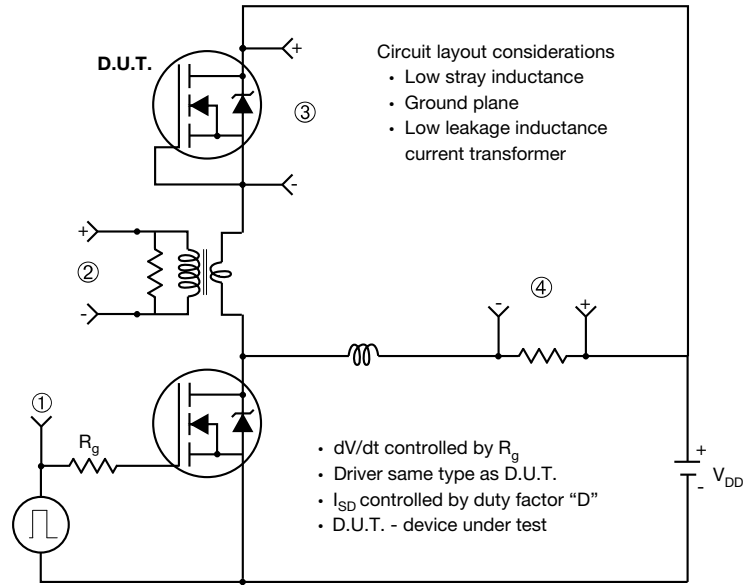


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



Note
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
$\varnothing R$	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

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