

Power MOSFET

PRODUCT SUMMARY	
V_{DS} (V)	- 200
$R_{DS(on)}$ (Ω)	$V_{GS} = -10$ V 3.0
Q_g (Max.) (nC)	11
Q_{gs} (nC)	7.0
Q_{gd} (nC)	4.0
Configuration	Single

FEATURES

- Dynamic dV/dt Rating
- P-Channel
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Lead (Pb)-free Available

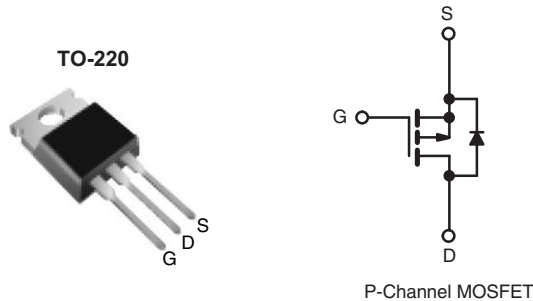


Available
RoHS*
COMPLIANT

DESCRIPTION

The Power MOSFETs technology is the key to Vishay's advanced line of Power MOSFET transistors. The efficient geometry and unique processing of the Power MOSFETs design achieve very low on-state resistance combined with high transconductance and extreme device ruggedness.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 W. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.



ORDERING INFORMATION	
Package	TO-220
Lead (Pb)-free	IRF9610PbF SiHF9610-E3
SnPb	IRF9610 SiHF9610

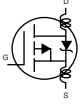
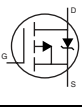
ABSOLUTE MAXIMUM RATINGS $T_C = 25$ °C, unless otherwise noted				
PARAMETER	SYMBOL		LIMIT	UNIT
Drain-Source Voltage	V_{DS}		- 200	V
Gate-Source Voltage	V_{GS}		± 20	
Continuous Drain Current	V_{GS} at - 10 V	$T_C = 25$	- 1.8	A
		$T_C = 100$	- 1.0	
Pulsed Drain Current ^a	I_{DM}		- 7.0	
Linear Derating Factor			0.16	W/°C
Maximum Power Dissipation	$T_C = 25$ °C		P_D	20
Inductive Current, Clamp	I_{LM}		- 7.0	A
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)	for 10 s		300 ^d	
Mounting Torque	6-32 or M3 screw		10	
			1.1	N · m

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 5).
- Not applicable.
- $I_{SD} \leq -1.8$ A, $dI/dt \leq 70$ A/ μ s, $V_{DD} \leq V_{DS}$, $T_J \leq 150$ °C.
- 1.6 mm from case.

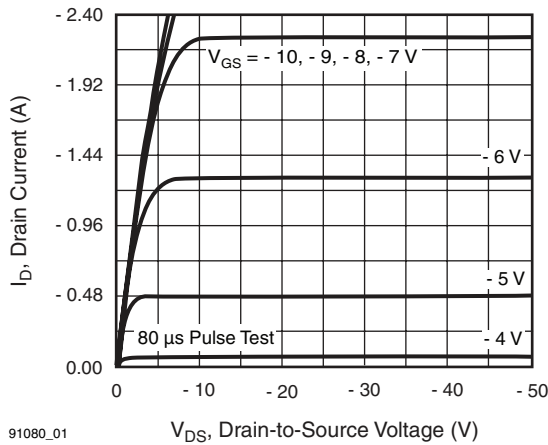
* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.50	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	6.4	

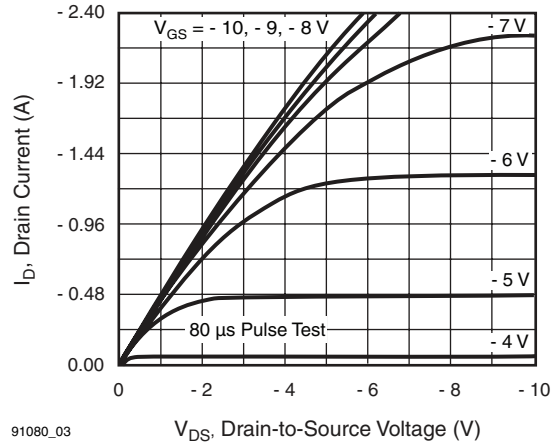
SPECIFICATIONS $T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX. UNIT	
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$		- 200	-	- V	
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = -1\text{ mA}$		-	- 0.23	- $V/^\circ\text{C}$	
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}	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100\text{ nA}$	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -200\text{ V}, V_{GS} = 0\text{ V}$		-	-	- 100 μA	
		$V_{DS} = -160\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	- 500 μA	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = -10\text{ V}$	$I_D = -0.90\text{ A}^b$	-	-	3.0 Ω	
Forward Transconductance	g_{fs}	$V_{DS} = -50\text{ V}, I_D = -0.90\text{ A}^b$		0.90	-	- S	
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = -25\text{ V},$ $f = 1.0\text{ MHz}$, see fig. 10		-	170	-	pF
Output Capacitance	C_{oss}			-	50	-	
Reverse Transfer Capacitance	C_{rss}			-	15	-	
Total Gate Charge	Q_g	$V_{GS} = -10\text{ V}$	$I_D = -3.5\text{ A}, V_{DS} = -160\text{ V},$ see fig. 11 and 18 ^b	-	-	11	nC
Gate-Source Charge	Q_{gs}			-	-	7.0	
Gate-Drain Charge	Q_{gd}			-	-	4.0	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -100\text{ V}, I_D = -0.90\text{ A},$ $R_G = 50\text{ }\Omega, R_D = 110\text{ }\Omega$, see fig. 17 ^b		-	8.0	-	ns
Rise Time	t_r			-	15	-	
Turn-Off Delay Time	$t_{d(off)}$			-	10	-	
Fall Time	t_f			-	8.0	-	
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 		-	-	- 1.8	A
Pulsed Diode Forward Current ^a	I_{SM}			-	-	- 7.0	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = -1.8\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	- 5.8	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = -1.8\text{ A}, di/dt = 100\text{ A}/\mu\text{s}^b$		-	240	360	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	1.7	2.6	μC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by L_S and L_D)					

Notes

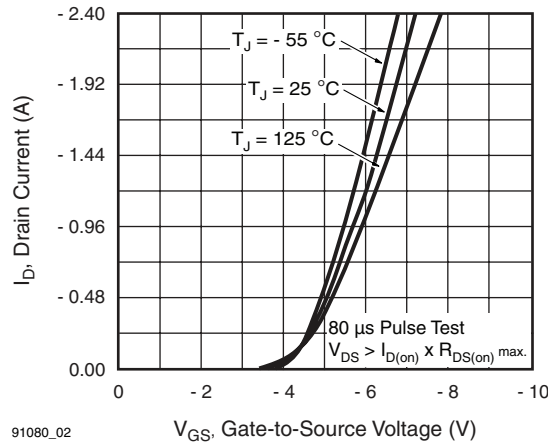
- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 5).
- Pulse width $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted


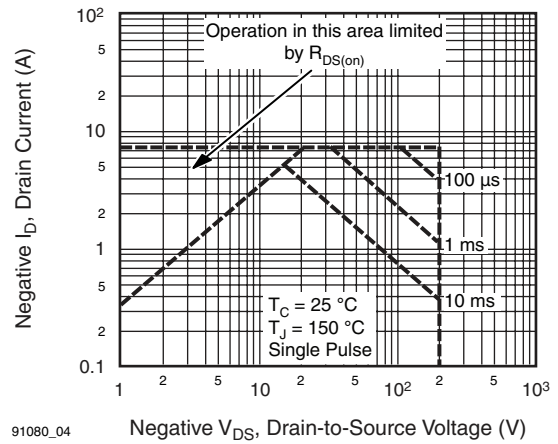
91080_01

Fig. 1 - Typical Output Characteristics


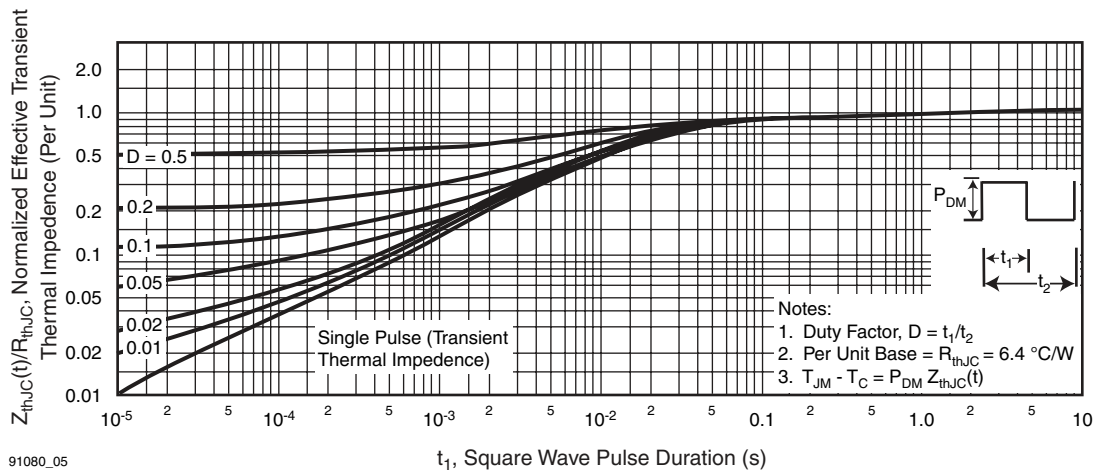
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Fig. 3 - Typical Saturation Characteristics


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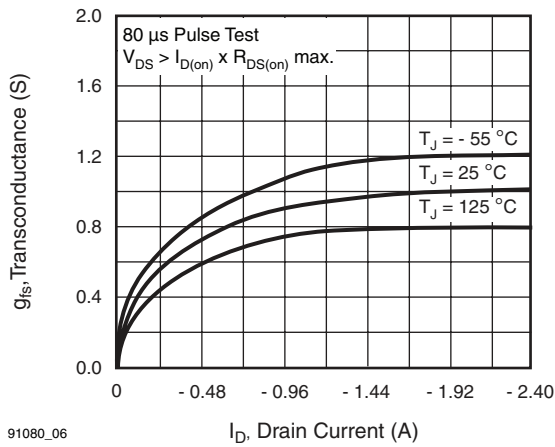
Fig. 2 - Typical Transfer Characteristics


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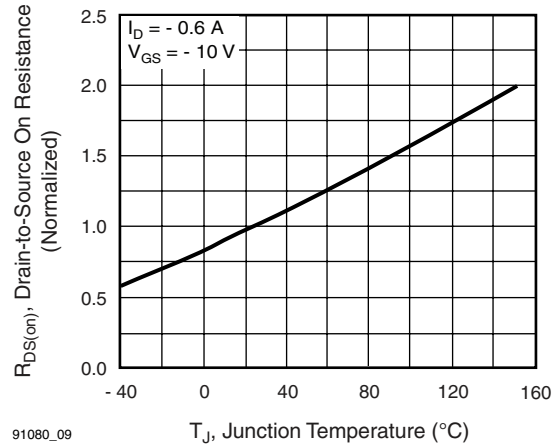
Fig. 4 - Maximum Safe Operating Area


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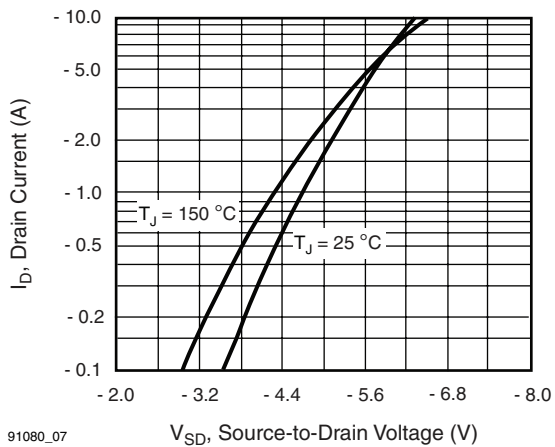
Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration



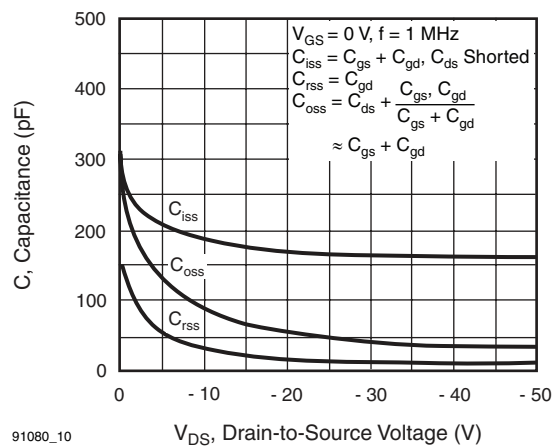
91080_06 **Fig. 6 - Typical Transconductance vs. Drain Current**



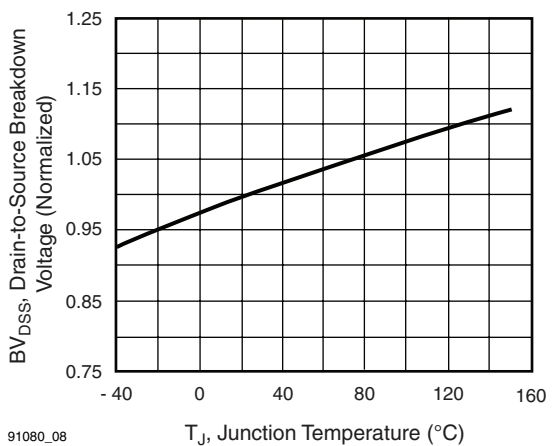
91080_09 **Fig. 9 - Normalized On-Resistance vs. Temperature**



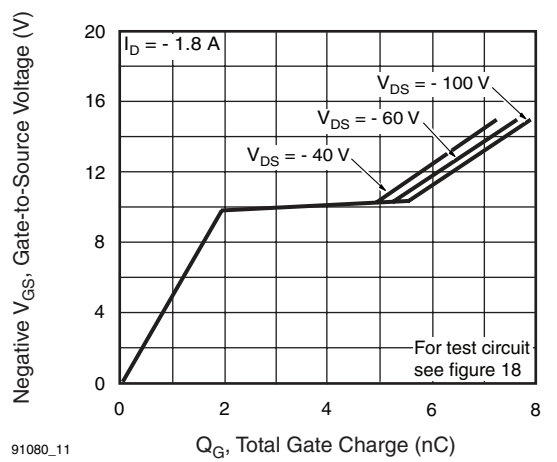
91080_07 **Fig. 7 - Typical Source-Drain Diode Forward Voltage**



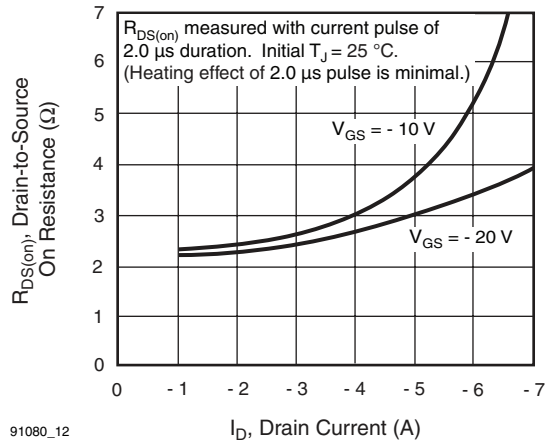
91080_10 **Fig. 10 - Typical Capacitance vs. Drain-to-Source Voltage**



91080_08 **Fig. 8 - Breakdown Voltage vs. Temperature**

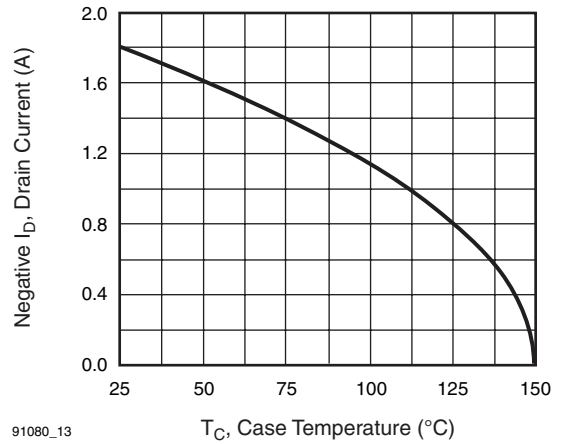


91080_11 **Fig. 11 - Typical Gate Charge vs. Gate-to-Source Voltage**



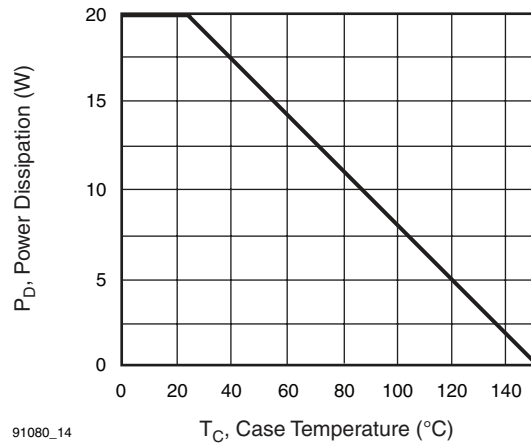
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Fig. 12 - Typical On-Resistance vs. Drain Current



91080_13

Fig. 13 - Maximum Drain Current vs. Case Temperature



91080_14

Fig. 14 - Power vs. Temperature Derating Curve

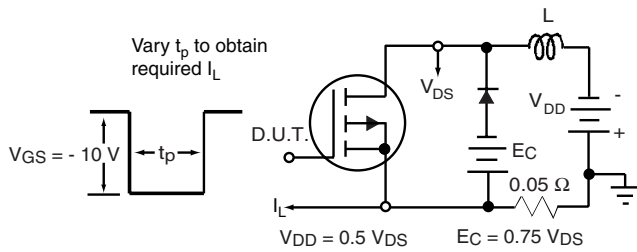


Fig. 15 - Clamped Inductive Test Circuit

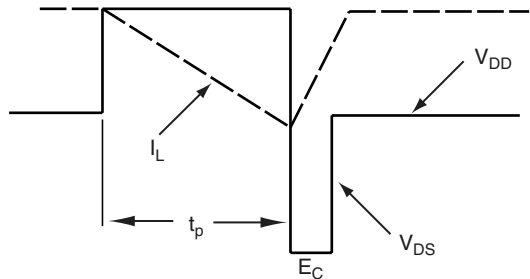


Fig. 16 - Clamped Inductive Waveforms

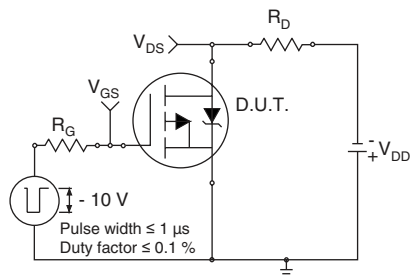


Fig. 17a - Switching Time Test Circuit

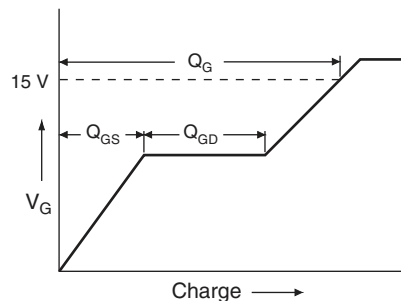


Fig. 18a - Basic Gate Charge Waveform

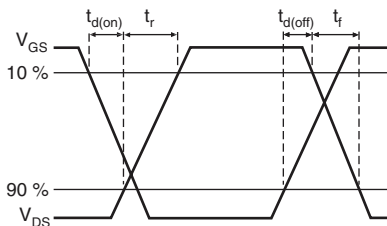


Fig. 17b - Switching Time Waveforms

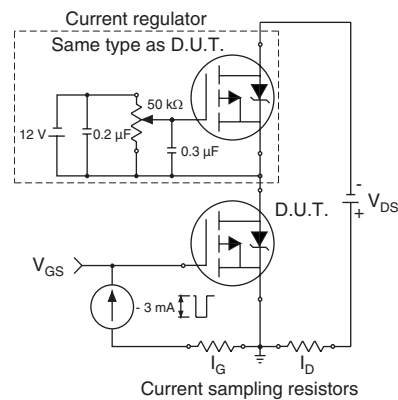
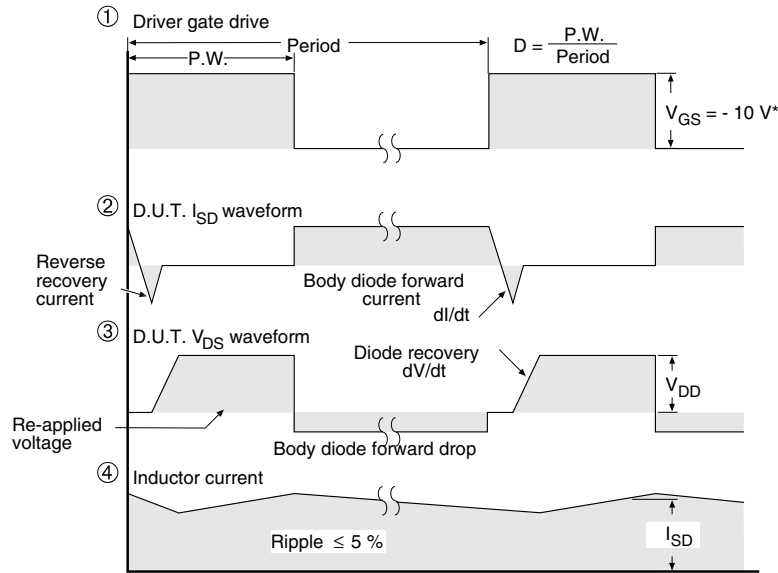
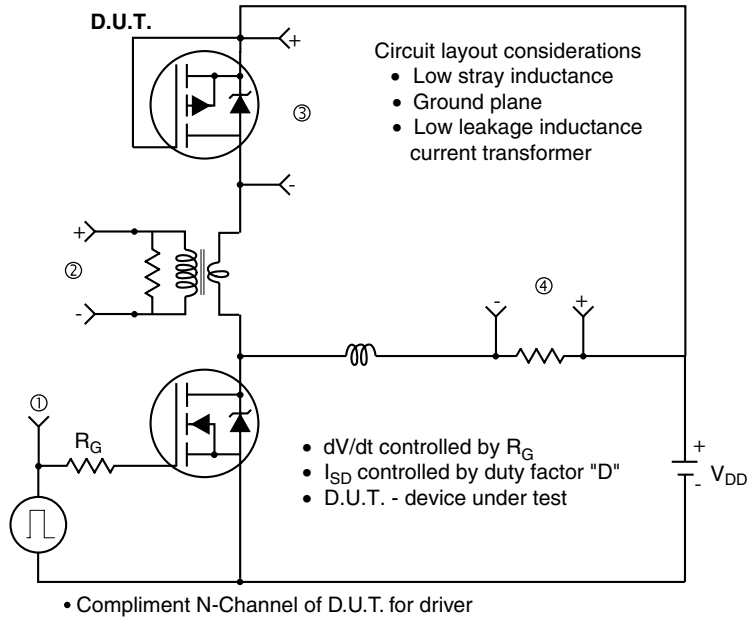


Fig. 18b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

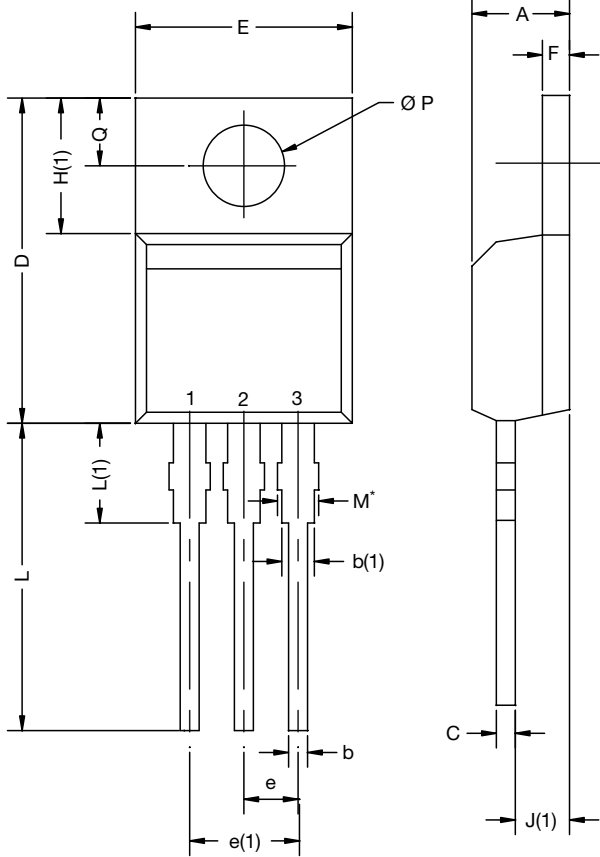


* $V_{GS} = -5V$ for logic level and $-3V$ drive devices

Fig. 19 - For P-Channel

Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see www.vishay.com/ppg?91080.

TO-220-1



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
Ø P	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: X15-0364-Rev. C, 14-Dec-15
DWG: 6031

Note

- M* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM





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