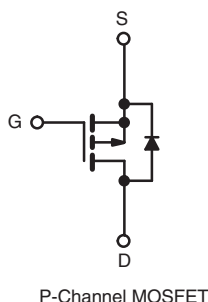
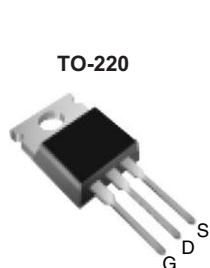


Power MOSFET

PRODUCT SUMMARY

V_{DS} (V)	- 200	
$R_{DS(on)}$ (Ω)	$V_{GS} = -10\text{ V}$	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



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 $T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise noted

PARAMETER	SYMBOL	LIMIT	UNIT
Drain-Source Voltage	V_{DS}	- 200	V
Gate-Source Voltage	V_{GS}	± 20	
Continuous Drain Current	$V_{GS} \text{ at } -10\text{ V}$	$T_C = 25$	A
		$T_C = 100$	
Pulsed Drain Current ^a	I_{DM}	- 7.0	
Linear Derating Factor		0.16	W/ $^{\circ}\text{C}$
Maximum Power Dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	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	$^{\circ}\text{C}$
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.
- $I_{SD} \leq -1.8\text{ A}$, $dI/dt \leq 70\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^{\circ}\text{C}$.
- 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 V, I _D = - 250 μA		- 200	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = - 1 mA		-	- 0.23	-	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 = -0.90 A ^b	-	-	3.0	Ω
Forward Transconductance	g _{fs}	V _{DS} = - 50 V, I _D = - 0.90 A ^b		0.90	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = - 25 V, f = 1.0 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 V	I _D = - 3.5 A, V _{DS} = - 160 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 V, I _D = - 0.90 A, R _G = 50 Ω, R _D = 110 Ω, 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 °C, I _S = - 1.8 A, V _{GS} = 0 V ^b		-	-	- 5.8	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = - 1.8 A, dI/dt = 100 A/μs ^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

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

TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

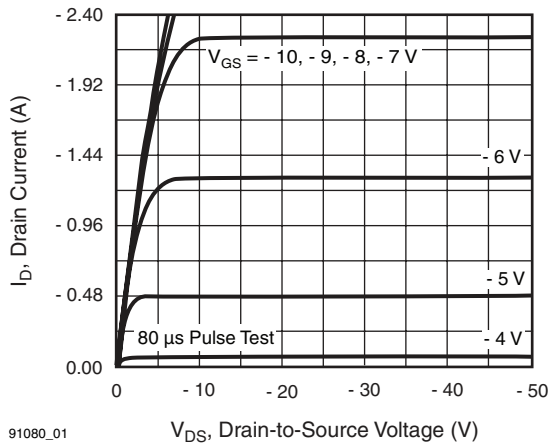


Fig. 1 - Typical Output Characteristics

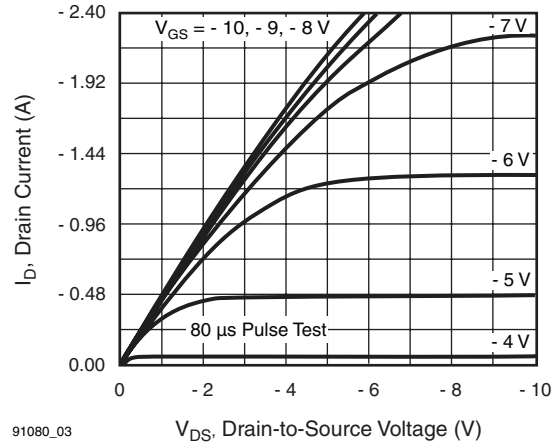


Fig. 3 - Typical Saturation Characteristics

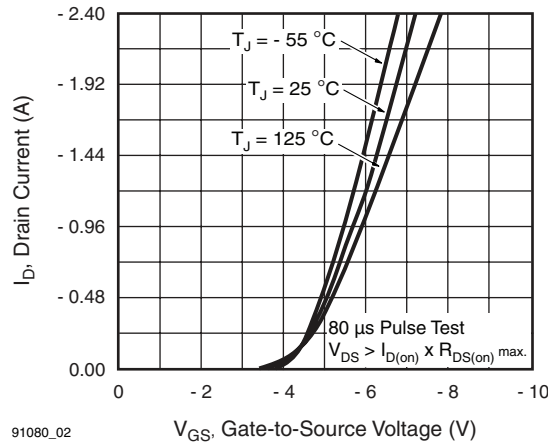


Fig. 2 - Typical Transfer Characteristics

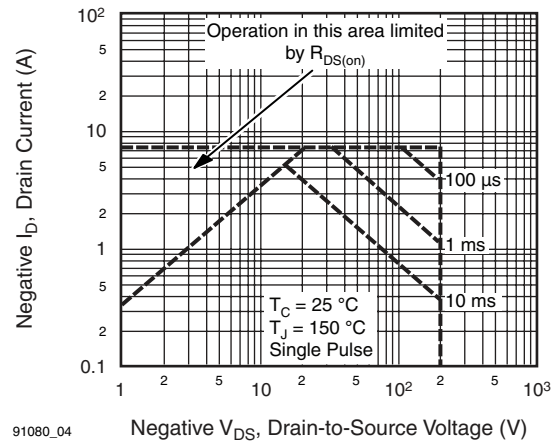


Fig. 4 - Maximum Safe Operating Area

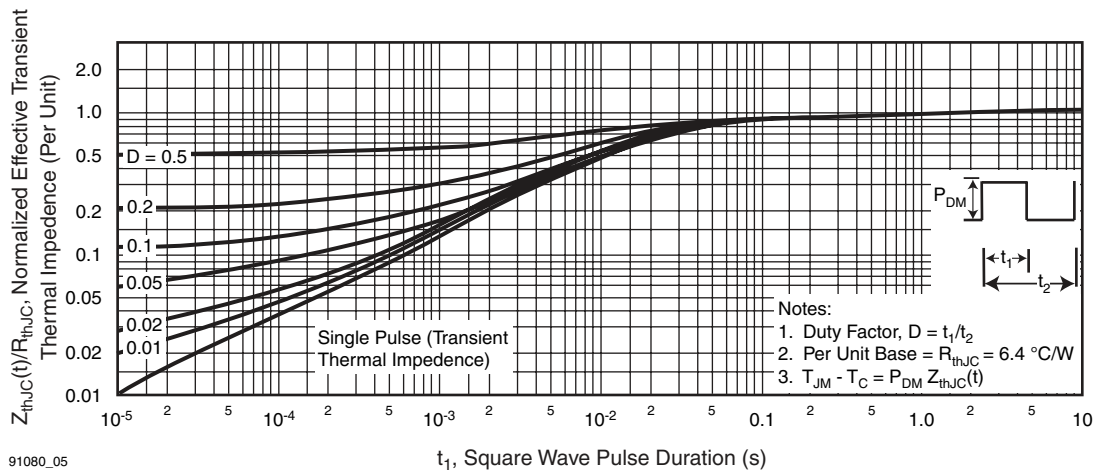


Fig. 5 - Maximum Effective Transient Thermal Impedance, Junction-to-Case vs. Pulse Duration

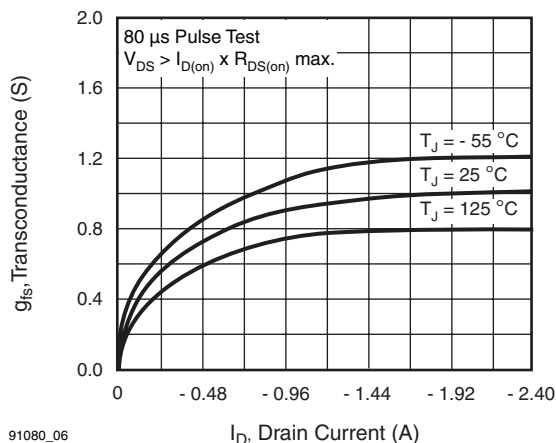


Fig. 6 - Typical Transconductance vs. Drain Current

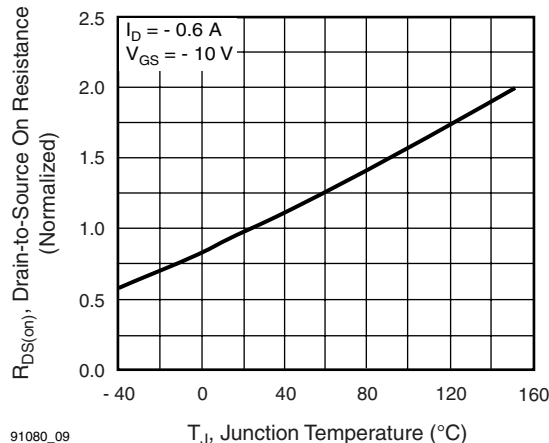


Fig. 9 - Normalized On-Resistance vs. Temperature

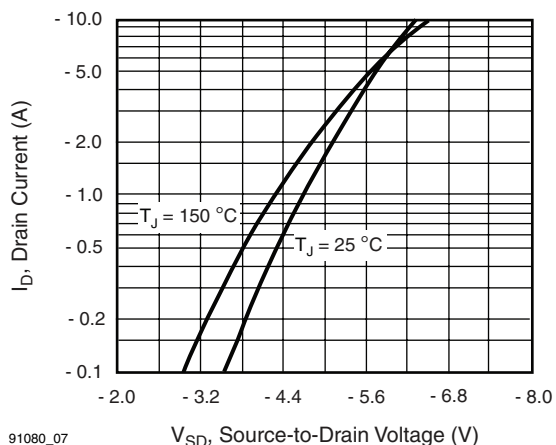


Fig. 7 - Typical Source-Drain Diode Forward Voltage

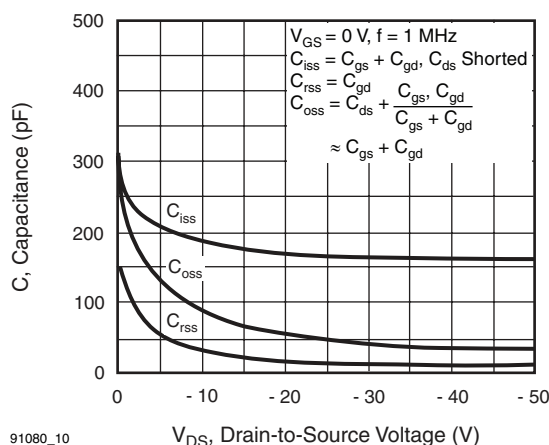


Fig. 10 - Typical Capacitance vs. Drain-to-Source Voltage

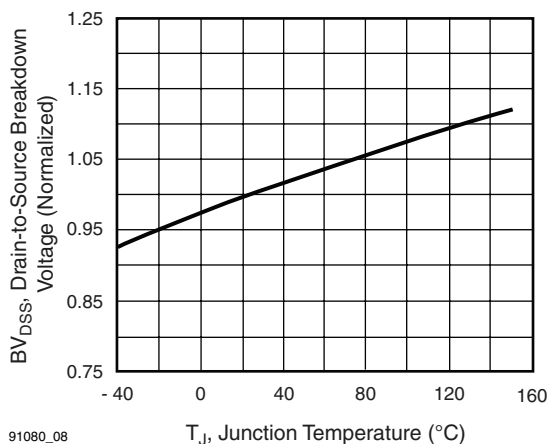


Fig. 8 - Breakdown Voltage vs. Temperature

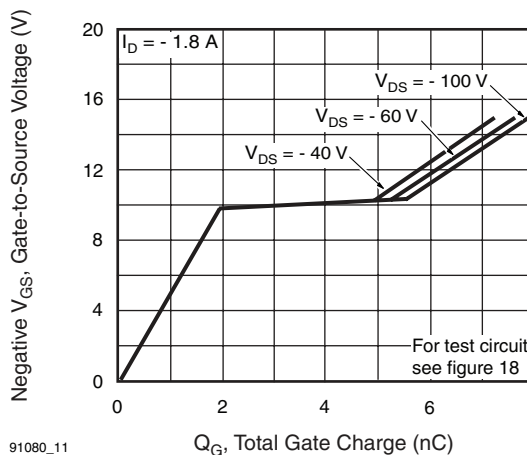


Fig. 11 - Typical Gate Charge vs. Gate-to-Source Voltage

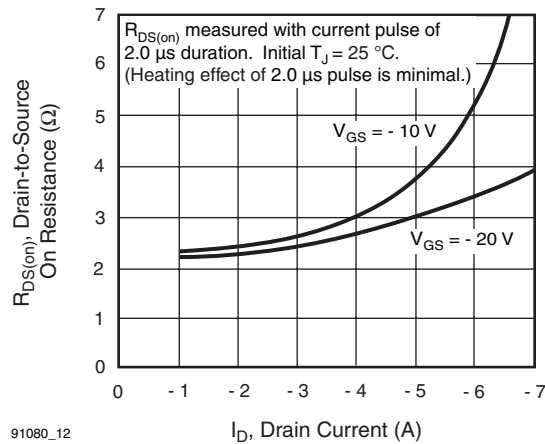


Fig. 12 - Typical On-Resistance vs. Drain Current

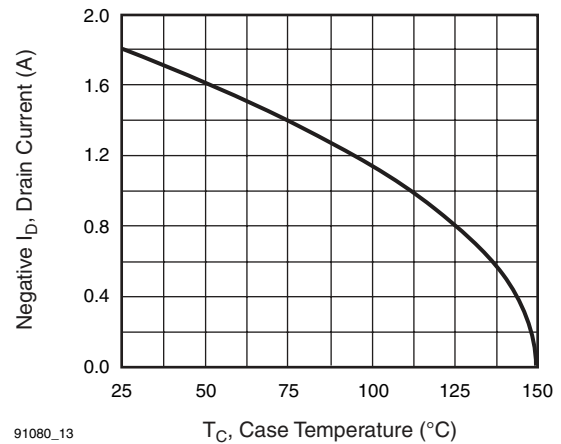


Fig. 13 - Maximum Drain Current vs. Case Temperature

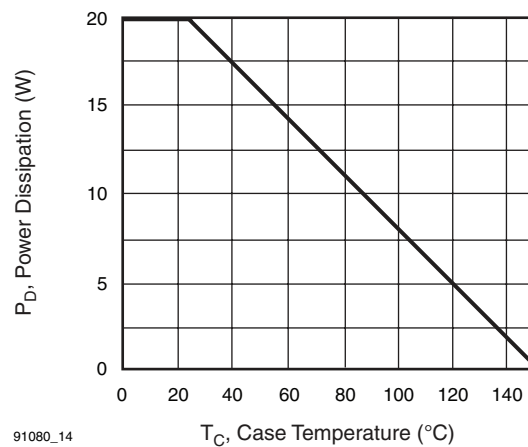


Fig. 14 - Power vs. Temperature Derating Curve

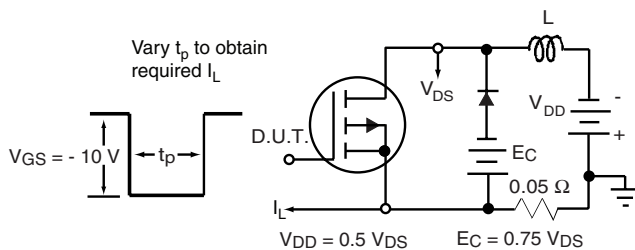


Fig. 15 - Clamped Inductive Test Circuit

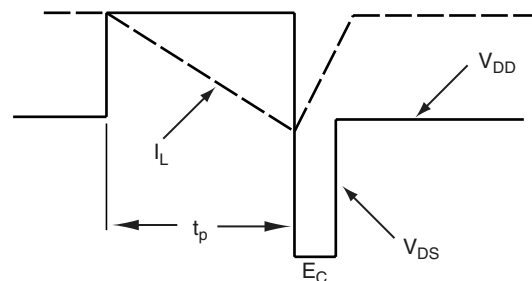


Fig. 16 - Clamped Inductive Waveforms

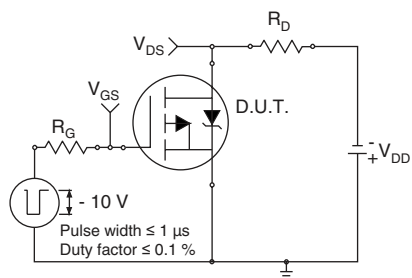


Fig. 17a - Switching Time Test Circuit

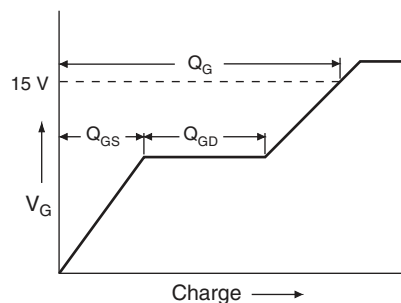


Fig. 18a - Basic Gate Charge Waveform

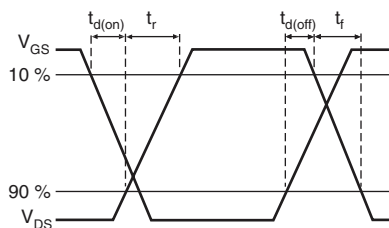


Fig. 17b - Switching Time Waveforms

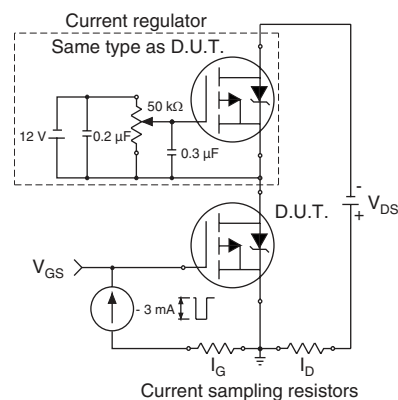
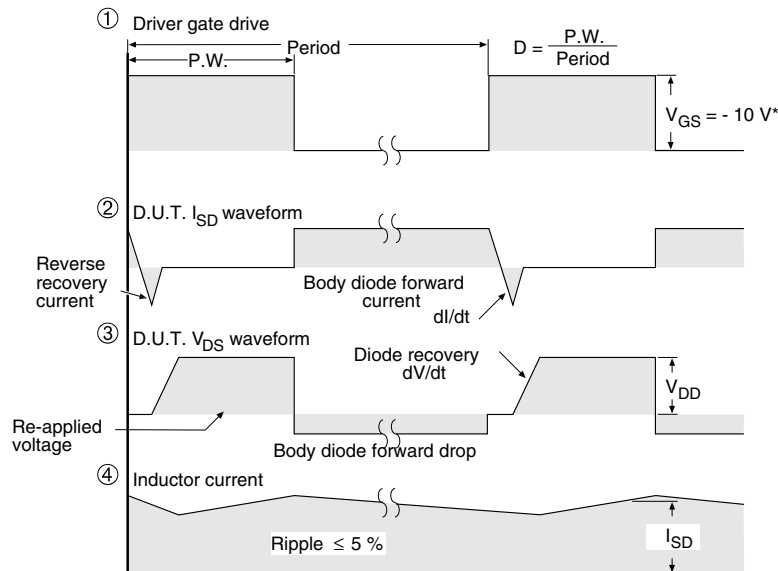
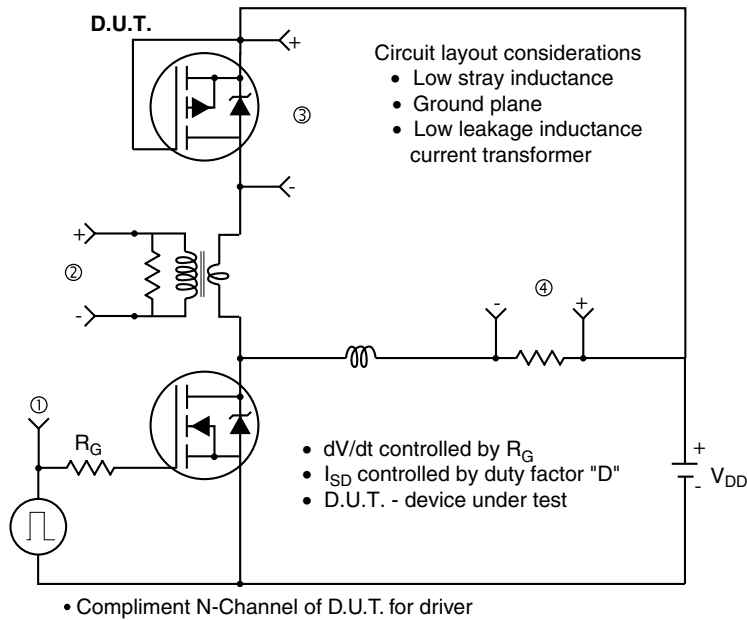


Fig. 18b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit



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

Fig. 19 - For P-Channel



TO-220-1



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.14	4.70	0.163	0.185
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	14.32	15.86	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	0.51	1.40	0.020	0.055
H(1)	6.10	6.70	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	4.05	0.131	0.159
Ø P	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: X15-0339-Rev. B, 02-Nov-15
DWG: 6031

Note

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





Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and/or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.

Material Category Policy

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.

Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as Halogen-Free follow Halogen-Free requirements as per JEDEC JS709A standards. Please note that some Vishay documentation may still make reference to the IEC 61249-2-21 definition. We confirm that all the products identified as being compliant to IEC 61249-2-21 conform to JEDEC JS709A standards.