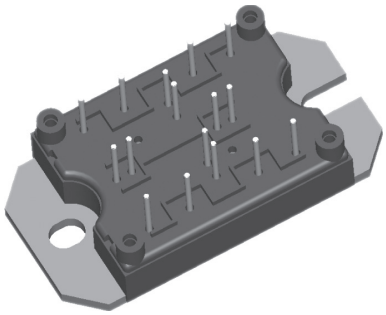
"Full Bridge" IGBT MTP (Ultrafast NPT IGBT), 20 A



MTP

FEATURES

- Ultrafast Non Punch Through (NPT) technology
- Positive $V_{CE(on)}$ temperature coefficient
- 10 µs short circuit capability
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- Low diode V_F
- Square RBSOA
- Al_2O_3 DBC substrate
- Very low stray inductance design for high speed operation
- UL approved file E78996
- Speed 8 kHz to 60 kHz
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

BENEFITS

- Optimized for welding, UPS and SMPS applications
- Rugged with ultrafast performance
- Outstanding ZVS and hard switching operation
- Low EMI, requires less snubbing
- Excellent current sharing in parallel operation
- Direct mounting to heatsink
- PCB solderable terminals
- Very low junction to case thermal resistance

PRODUCT SUMMARY	
V_{CES}	1200 V
I_C at T_C = 96 °C	20 A
$V_{CE(on)}$ (typical) at I_C = 20 A, 25 °C	3.29 V
Package	MTP
Circuit	Full bridge

ABSOLUTE MAXIMUM RATINGS				
PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter breakdown voltage	V_{CES}		1200	V
Continuous collector current	I_C	T_C = 96 °C	20	A
Pulsed collector current	I_{CM}		100	
Clamped inductive load current	I_{LM}		100	
Diode maximum forward current	I_{FM}		100	
Gate to emitter voltage	V_{GE}		± 20	V
RMS isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	
Maximum power dissipation (only IGBT)	P_D	T_C = 25 °C	240	W
		T_C = 100 °C	96	
Operating junction temperature range	T_J		-40 to +150	°C

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 250 µA	1200	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 3 mA (25 to 125 °C)	-	+ 1.3	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 20 A	-	3.29	3.59	V
		V_{GE} = 15 V, I_C = 40 A	-	4.42	4.66	
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C	-	3.87	4.11	
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C	-	5.32	5.70	
		V_{GE} = 15 V, I_C = 20 A, T_J = 150 °C	-	3.99	4.27	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 µA	4	-	6	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 3 mA (25 to 125 °C)	-	- 14	-	mV/°C
Transconductance	g_{fe}	V_{CE} = 50 V, I_C = 20 A, PW = 80 µs	-	17.5	-	S
Zero gate voltage collector current	I_{CES} (1)	V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 25 °C	-	-	250	µA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.7	3.0	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	2.9	9.0	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 250	nA

Note

(1) I_{CES} includes also opposite leg overall leakage

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Total gate charge (turn-on)	Q_g	I_C = 20 A V_{CC} = 600 V V_{GE} = 15 V	-	176	264	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	19	30	
Gate to collector charge (turn-on)	Q_{gc}		-	89	134	
Turn-on switching loss	E_{on}	V_{CC} = 600 V, I_C = 20 A, V_{GE} = 15 V, R_g = 5 Ω, L = 200 µH, T_J = 25 °C, energy losses include tail and diode reverse recovery	-	0.513	0.770	mJ
Turn-off switching loss	E_{off}		-	0.402	0.603	
Total switching loss	E_{tot}		-	0.915	1.373	
Turn-on switching loss	E_{on}	V_{CC} = 600 V, I_C = 20 A, V_{GE} = 15 V, R_g = 5 Ω, L = 200 µH, T_J = 125 °C, energy losses include tail and diode reverse recovery	-	0.930	1.395	
Turn-off switching loss	E_{off}		-	0.610	0.915	
Total switching loss	E_{tot}		-	1.540	2.310	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1.0 MHz	-	2530	3790	pF
Output capacitance	C_{oes}		-	344	516	
Reverse transfer capacitance	C_{res}		-	78	117	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 120 A V_{CC} = 1000 V, V_p = 1200 V R_g = 5 Ω, V_{GE} = + 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T_J = 150 °C V_{CC} = 900 V, V_p = 1200 V R_g = 5 Ω, V_{GE} = + 15 V to 0 V	10	-	-	µs

DIODE SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Diode forward voltage drop	V_{FM}	I_C = 20 A	-	2.48	2.94	V
		I_C = 40 A	-	3.28	3.90	
		I_C = 20 A, T_J = 125 °C	-	2.44	2.84	
		I_C = 40 A, T_J = 125 °C	-	3.45	4.14	
		I_C = 20 A, T_J = 150 °C	-	2.21	2.93	
Reverse recovery energy of the diode	E_{rec}	V_{GE} = 15 V, R_g = 5 Ω, L = 200 µH V_{CC} = 600 V, I_C = 20 A T_J = 125 °C	-	420	630	µJ
Diode reverse recovery time	t_{rr}		-	98	150	ns
Peak reverse recovery current	I_{rr}		-	33	50	A

THERMAL AND MECHANICAL SPECIFICATIONS							
PARAMETER		**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Operating junction temperature range		T_J		- 40	-	150	°C
Storage temperature range		T_{Stg}		- 40	-	125	
Junction to case	IGBT	R_{thJC}		-	0.53	0.64	°C/W
	Diode			-	0.69	0.83	
Case to sink per module		R_{thCS}	Heatsink compound thermal conductivity = 1 W/mK	-	0.06	-	
Clearance			External shortest distance in air between 2 terminals	5.5	-	-	mm
Creepage			Shortest distance along external surface of the insulating material between 2 terminals	8	-	-	
Mounting torque			A mounting compound is recommended and the torque should be checked after 3 hours to allow for the spread of the compound. Lubricated threads.	3 ± 10 %			Nm
Weight				66			g

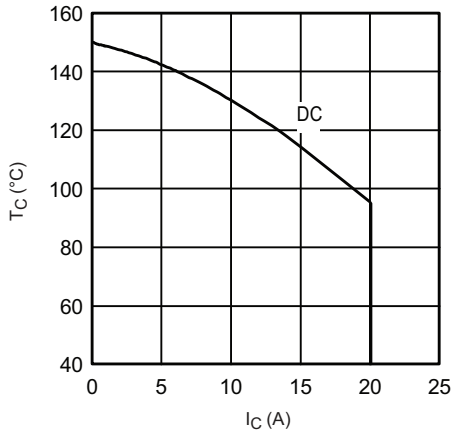


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

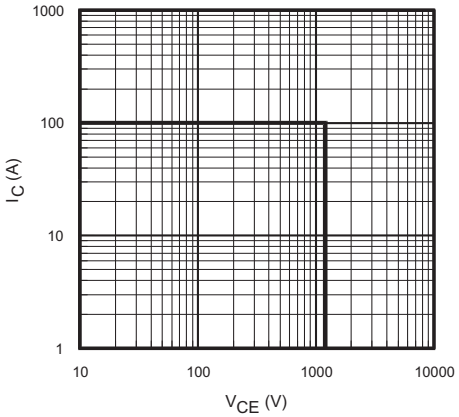


Fig. 4 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

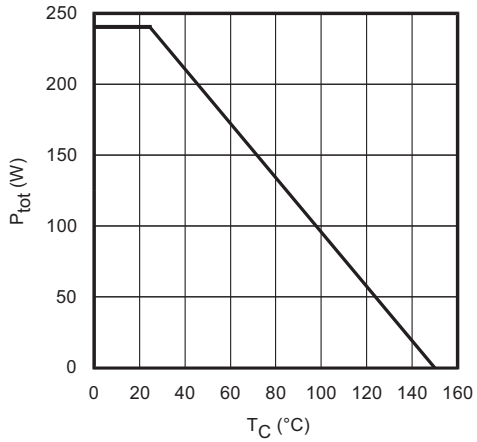


Fig. 2 - Power Dissipation vs. Case Temperature

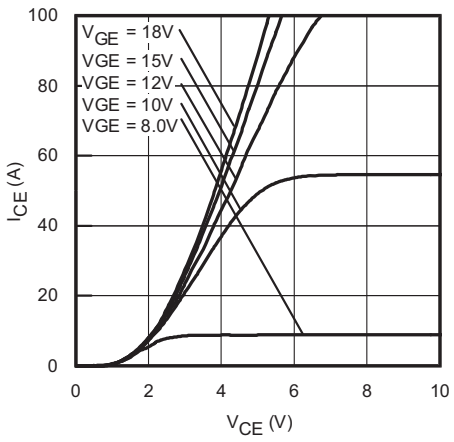


Fig. 5 - Typical IGBT Output Characteristics
T_J = - 40 °C; t_p = 80 µs

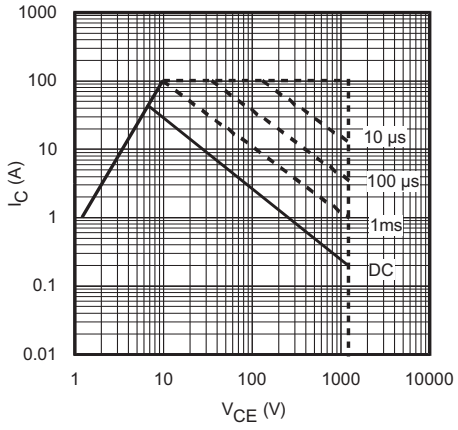


Fig. 3 - Forward SOA
T_C = 25 °C; $T_J \leq$ 150 °C

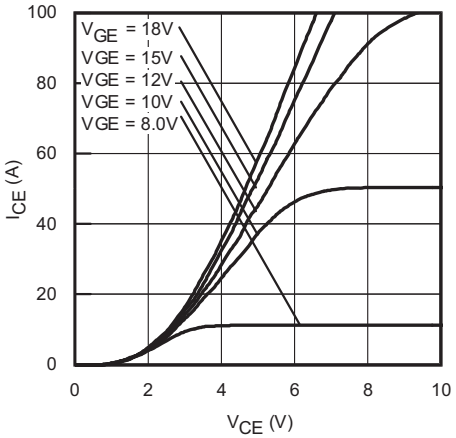


Fig. 6 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 µs

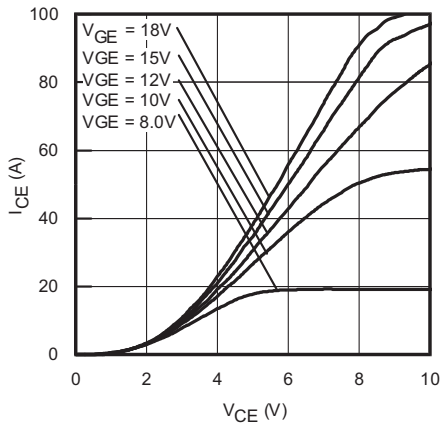


Fig. 7 - Typical IGBT Output Characteristics
T_J = 125 °C; t_p = 80 µs

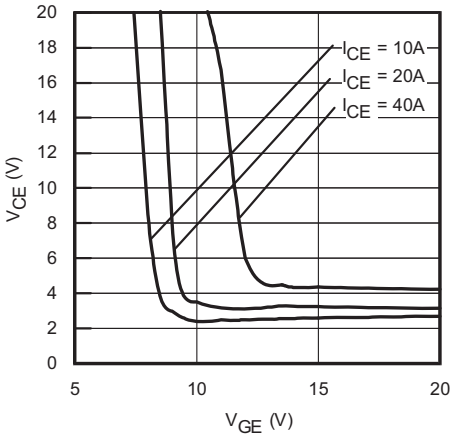


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

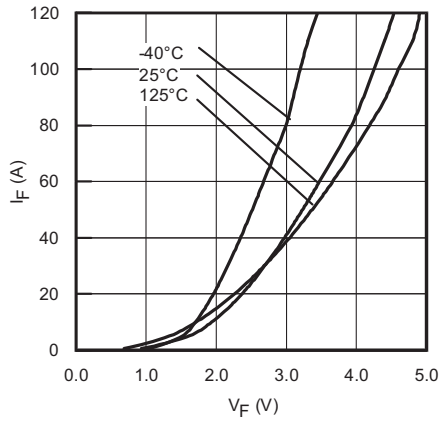


Fig. 8 - Typical Diode Forward Characteristics
t_p = 80 µs

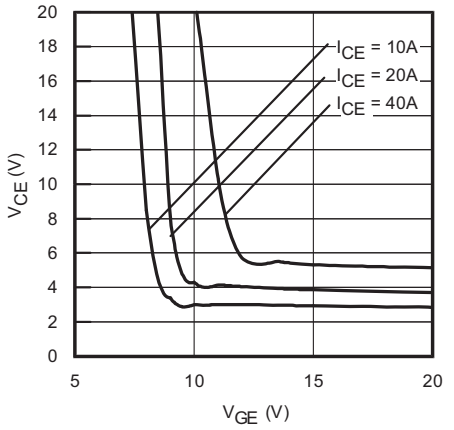


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

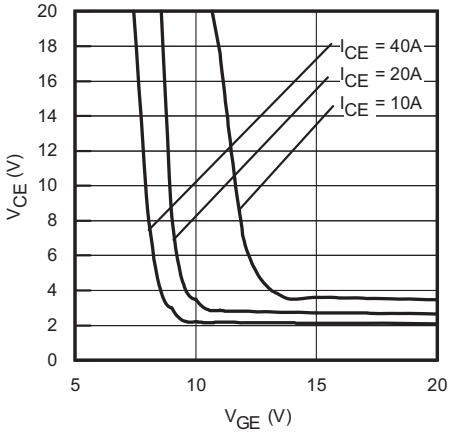


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = - 40 °C

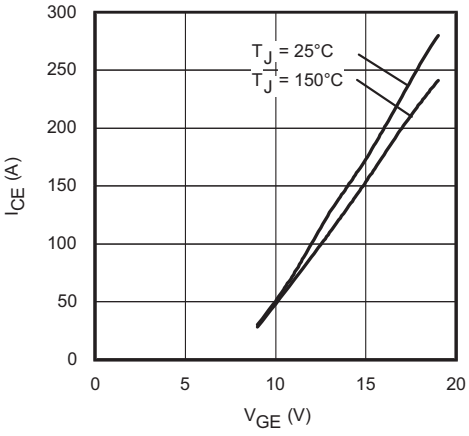


Fig. 12 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

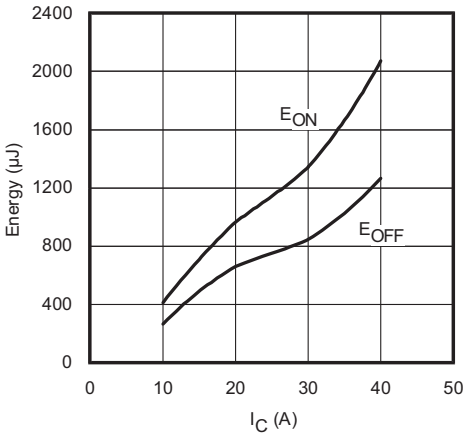


Fig. 13 - Typical Energy Loss vs. I_C
T_J = 150 °C; L = 1.4 mH; V_{CE} = 400 V
R_g = 5 Ω; V_{GE} = 15 V

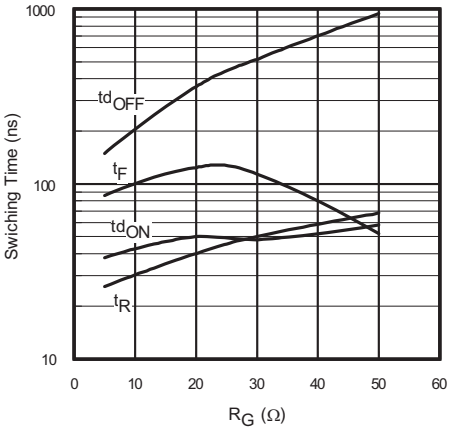


Fig. 16 - Typical Switching Time vs. R_g
T_J = 150 °C; L = 1.4 mH; V_{CE} = 400 V
I_{CE} = 5.0 A; V_{GE} = 15 V

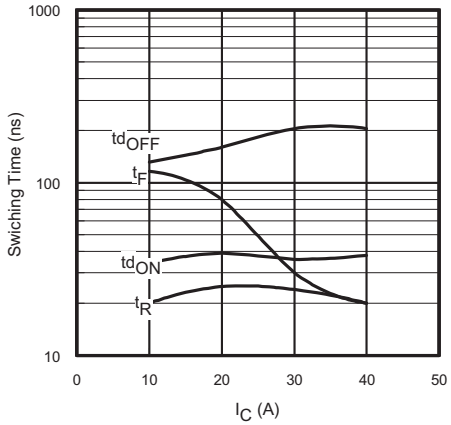


Fig. 14 - Typical Switching Time vs. I_C
T_J = 150 °C; L = 1.4 mH; V_{CE} = 400 V
R_g = 100 Ω; V_{GE} = 15 V

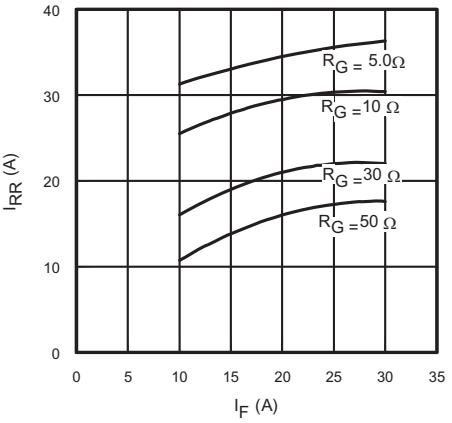


Fig. 17 - Typical Diode I_{rr} vs. I_F
T_J = 150 °C

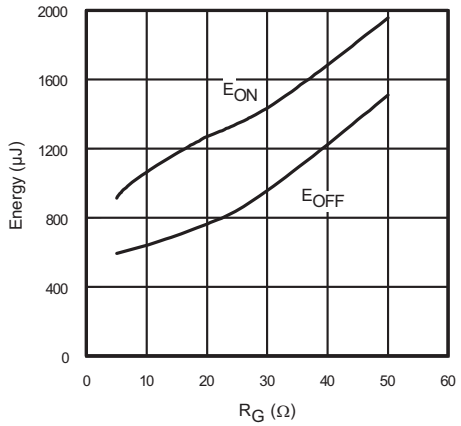


Fig. 15 - Typical Energy Loss vs. R_g
T_J = 150 °C; L = 1.4 mH; V_{CE} = 400 V
I_{CE} = 5.0 A; V_{GE} = 15 V

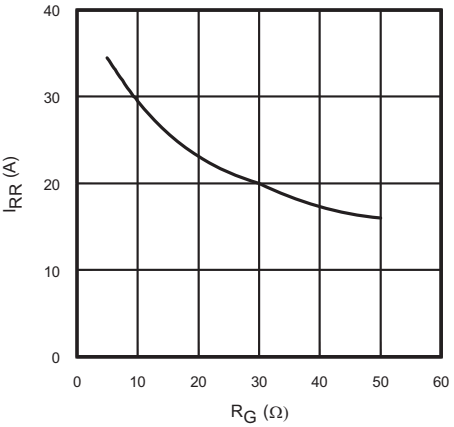


Fig. 18 - Typical Diode I_{rr} vs. R_g
T_J = 150 °C; I_F = 5.0 A

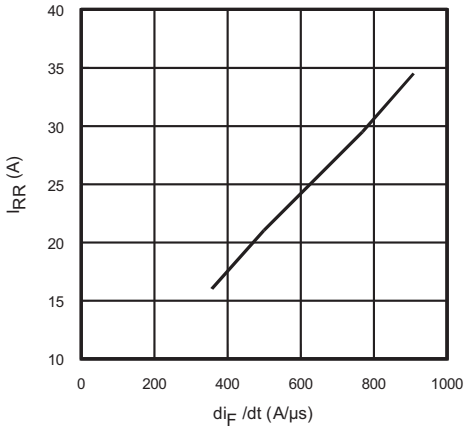


Fig. 19 - Typical Diode I_{rr} vs. dI_F/dt
V_{CC} = 400 V; V_{GE} = 15 V; I_{CE} = 5.0 A; T_J = 150 °C

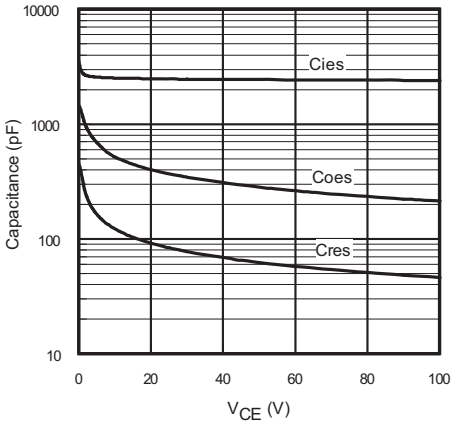


Fig. 21 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

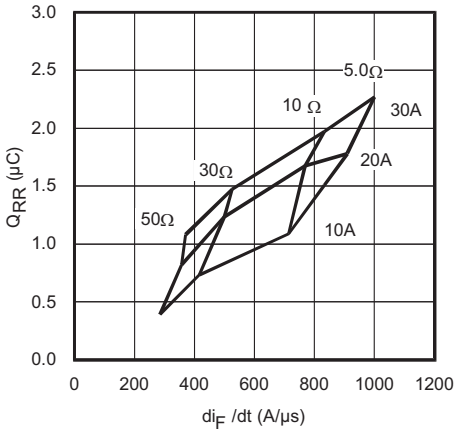


Fig. 20 - Typical Diode Q_{rr}
V_{CC} = 400 V; V_{GE} = 15 V; T_J = 150 °C

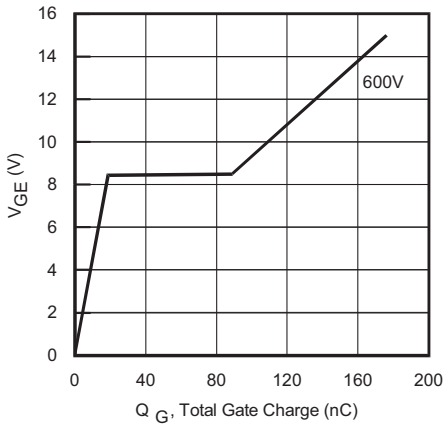


Fig. 22 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0 A; L = 600 µH

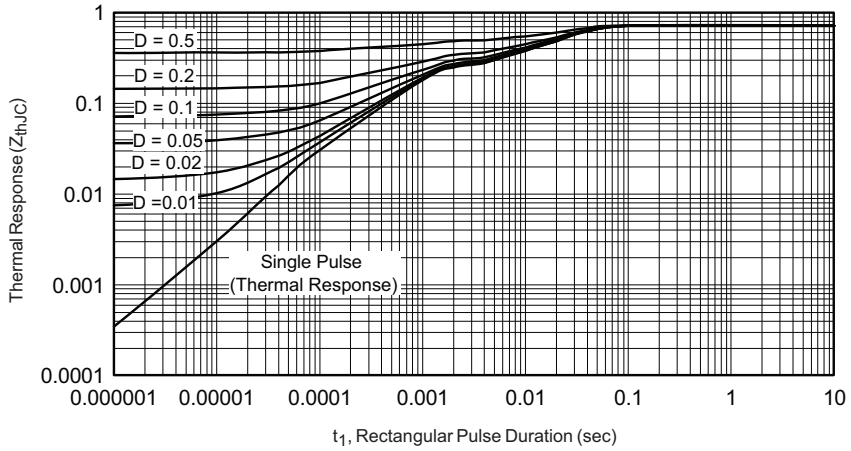


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

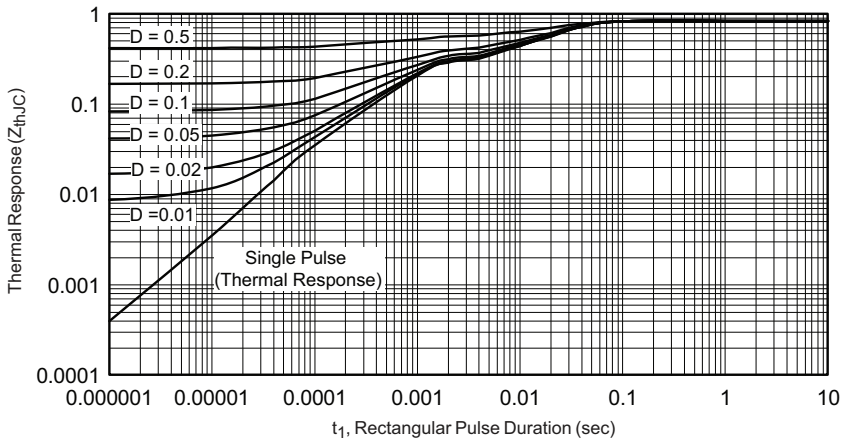


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

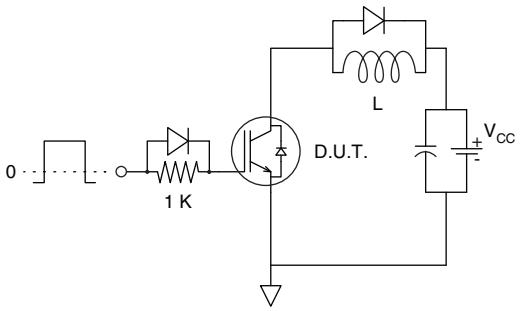


Fig. 25 - Gate Charge Circuit (Turn-Off)

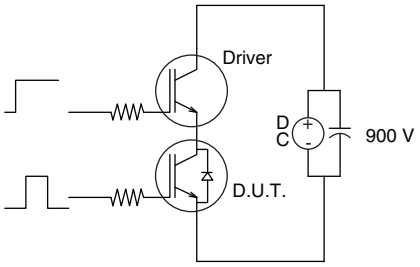


Fig. 27 - S.C. SOA Circuit

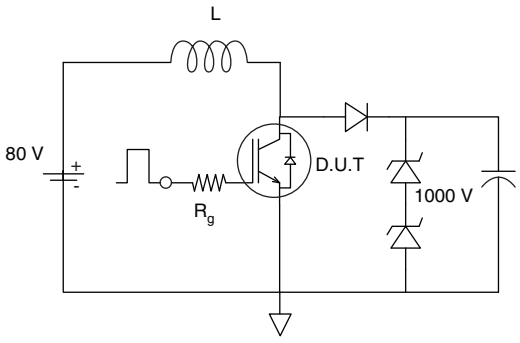


Fig. 26 - RBSOA Circuit

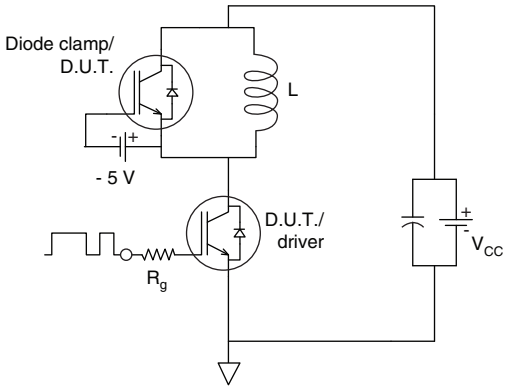


Fig. 28 - Switching Loss Circuit

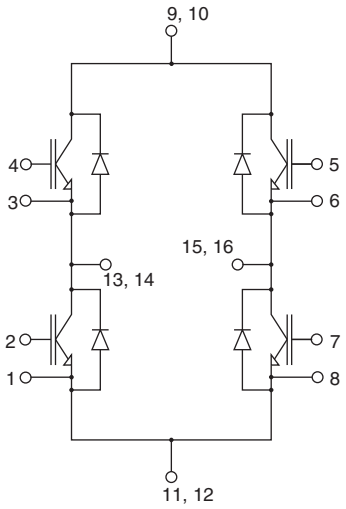


Fig. 29 - Electrical diagram

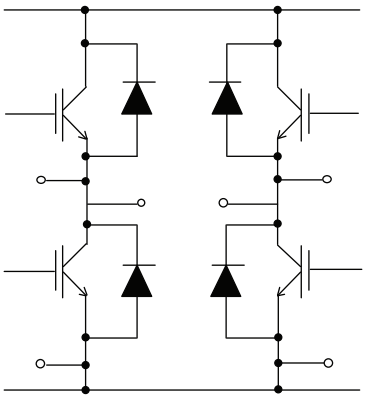
ORDERING INFORMATION TABLE

Device code

VS-	20	MT	120	U	F	A	PbF
1	2	3	4	5	6	7	8

1	-	Vishay Semiconductors product
2	-	Current rating (20 = 20 A)
3	-	Essential part number
4	-	Voltage code (120 = 1200 V)
5	-	Speed/type (U = Ultrafast IGBT)
6	-	Circuit configuration (F = Full bridge)
7	-	A = Al_2O_3 DBC substrate
8	-	Lead (Pb)-free

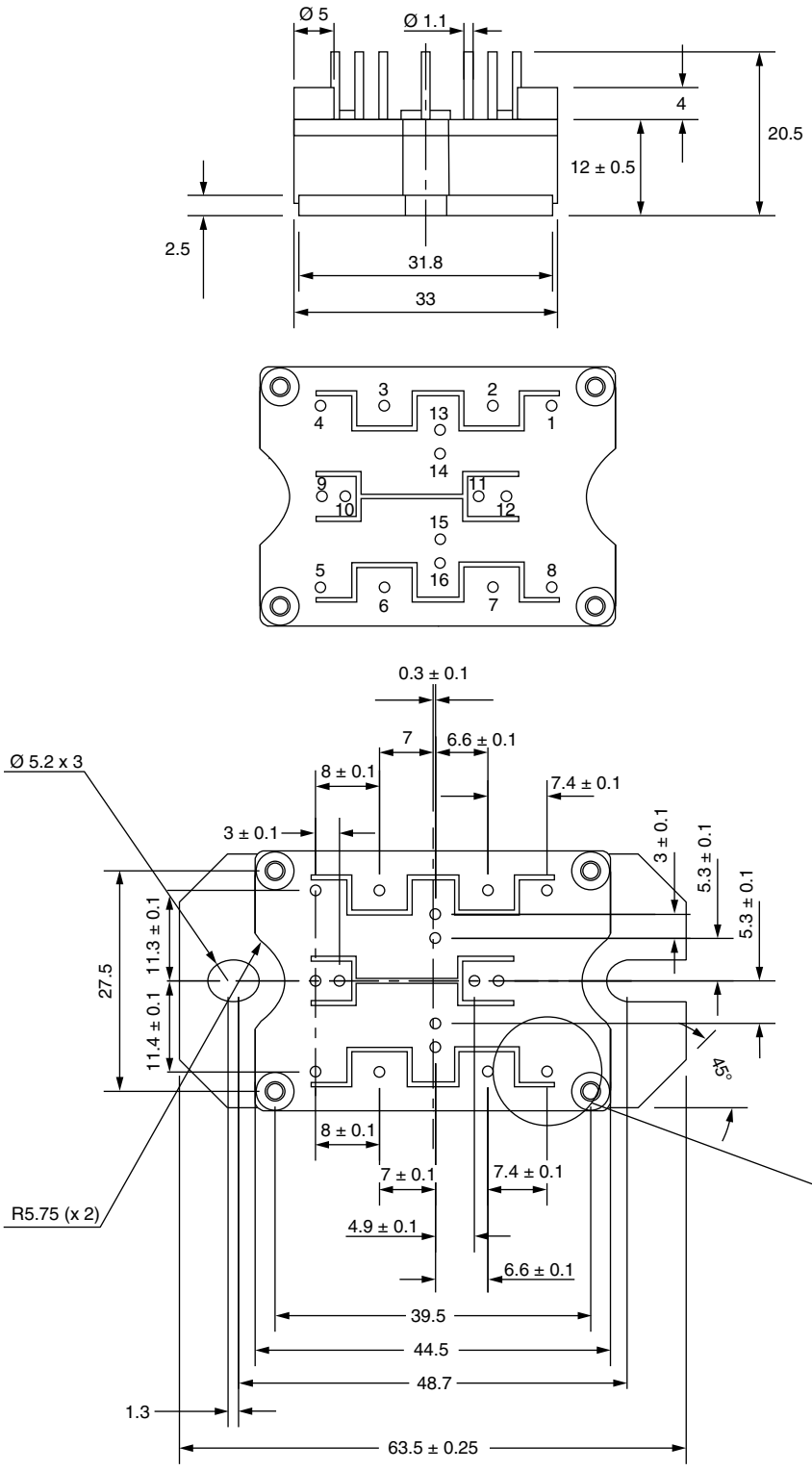
CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95245

MTP MOSFET/IGBT Full-Bridge

DIMENSIONS in millimeters



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.