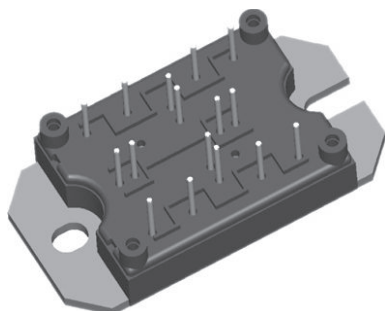


“Full Bridge” IGBT MTP (Ultrafast NPT IGBT), 40 A



MTP

FEATURES

- Ultrafast non punch through (NPT) technology
- Positive $V_{CE(on)}$ temperature coefficient
- 10 μ s short circuit capability
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- Low diode V_F
- Square RBSOA
- Aluminum nitride DBC
- Very low stray inductance design for high speed operation
- UL approved file E78996 
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912


RoHS
COMPLIANT

PRIMARY CHARACTERISTICS

V_{CES}	1200 V
I_C at $T_C = 25\text{ }^{\circ}\text{C}$	40 A
$V_{CE(on)}$	3.29 V
Speed	8 kHz to 30 kHz
Package	MTP
Circuit configuration	Full bridge

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

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter breakdown voltage	V_{CES}		1200	V
Continuous collector current	I_C	$T_C = 25\text{ }^{\circ}\text{C}$	40	A
		$T_C = 106\text{ }^{\circ}\text{C}$	20	
Pulsed collector current	I_{CM}		100	
Clamped inductive load current	I_{LM}		100	
Diode continuous forward current	I_F	$T_C = 106\text{ }^{\circ}\text{C}$	25	
Diode maximum forward current	I_{FM}		100	
Gate to emitter voltage	V_{GE}		± 20	V
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1\text{ min}$	2500	
Maximum power dissipation (only IGBT)	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	240	W
		$T_C = 100\text{ }^{\circ}\text{C}$	96	

**ELECTRICAL SPECIFICATIONS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

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

Note(1) I_{CES} includes also opposite leg overall leakage**SWITCHING CHARACTERISTICS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_g	$I_C = 20\text{ A}$ $V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}$	-	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}	$V_{CC} = 600\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_g = 5\text{ }\Omega$, $L = 1\text{ mH}$, $T_J = 25\text{ }^{\circ}\text{C}$, energy losses include tail and diode reverse recovery	-	0.92	-	mJ
Turn-off switching loss	E_{off}		-	0.46	-	
Total switching loss	E_{tot}		-	1.38	-	
Turn-on switching loss	E_{on}	$V_{CC} = 600\text{ V}$, $I_C = 20\text{ A}$, $V_{GE} = 15\text{ V}$, $R_g = 5\text{ }\Omega$, $L = 1\text{ mH}$, $T_J = 125\text{ }^{\circ}\text{C}$, energy losses include tail and diode reverse recovery	-	1.29	-	mJ
Turn-off switching loss	E_{off}		-	0.81	-	
Total switching loss	E_{tot}		-	2.1	-	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	-	2530	3790	pF
Output capacitance	C_{oes}		-	344	516	
Reverse transfer capacitance	C_{res}		-	78	117	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 120\text{ A}$ $V_{CC} = 1000\text{ V}$, $V_p = 1200\text{ V}$ $R_g = 5\text{ }\Omega$, $V_{GE} = +15\text{ V}$ to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^{\circ}\text{C}$ $V_{CC} = 900\text{ V}$, $V_p = 1200\text{ V}$ $R_g = 5\text{ }\Omega$, $V_{GE} = +15\text{ V}$ to 0 V	10	-	-	μs

DIODE SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Diode forward voltage drop	V_{FM}	$I_C = 20\text{ A}$	-	2.48	2.94	V
		$I_C = 40\text{ A}$	-	3.28	3.90	
		$I_C = 20\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.44	2.84	
		$I_C = 40\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	3.45	4.14	
		$I_C = 20\text{ A}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	2.21	2.93	
Reverse recovery energy of the diode	E_{rec}	$V_{GE} = 15\text{ V}$, $R_g = 5\text{ }\Omega$, $L = 200\text{ }\mu\text{H}$	-	420	630	μJ
Diode reverse recovery time	t_{rr}	$V_{CC} = 600\text{ V}$, $I_C = 20\text{ A}$	-	98	150	ns
Peak reverse recovery current	I_{rr}	$T_J = 125\text{ }^{\circ}\text{C}$	-	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	R_{thJC}	IGBT	-	0.35	0.52	°C/W
		Diode	-	0.40	0.61	
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.	$3 \pm 10 \%$			Nm
Weight			66			g

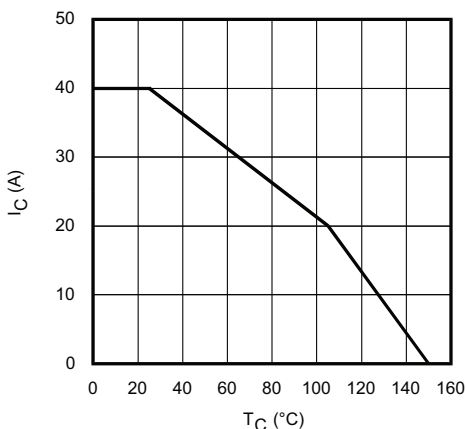


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

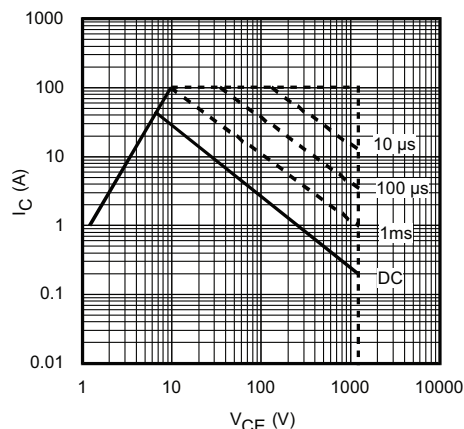
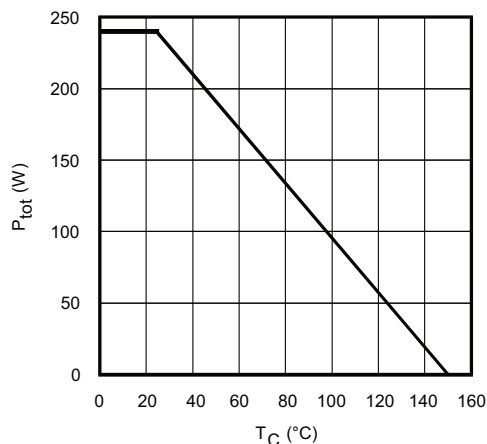
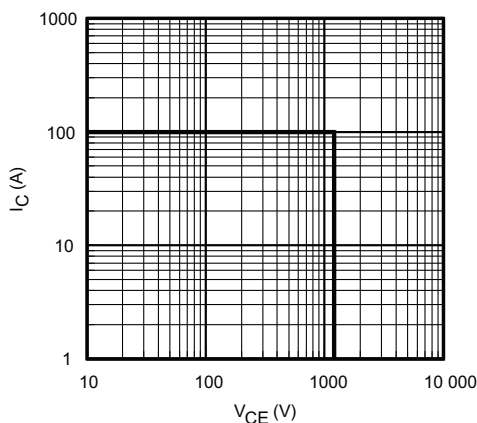

 Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$


Fig. 2 - Power Dissipation vs. Case Temperature


 Fig. 4 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{ V}$

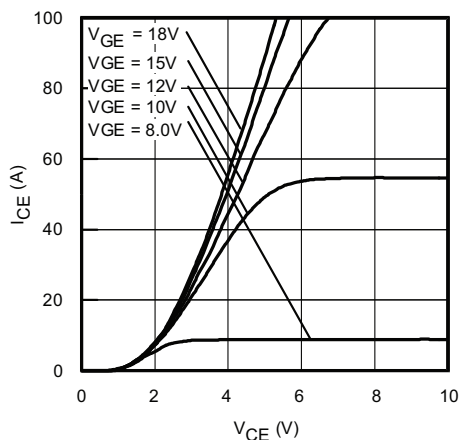


Fig. 5 - Typical IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\ \mu\text{s}$

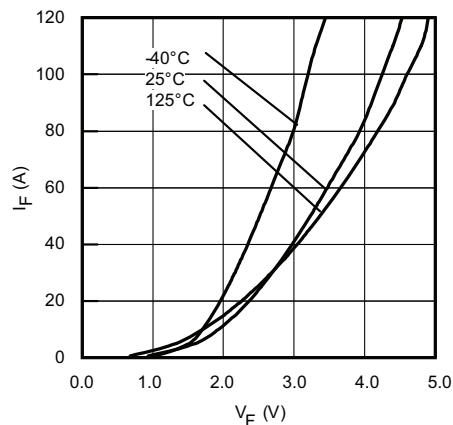


Fig. 8 - Typical Diode Forward Characteristics
 $t_p = 80\ \mu\text{s}$

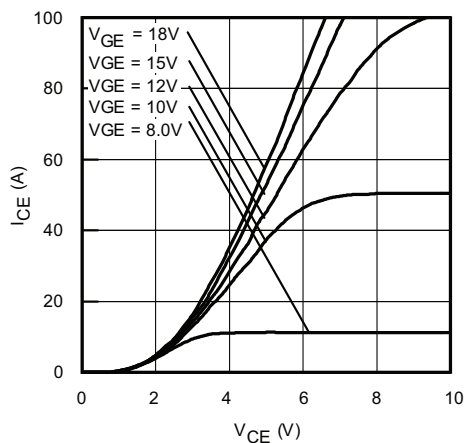


Fig. 6 - Typical IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\ \mu\text{s}$

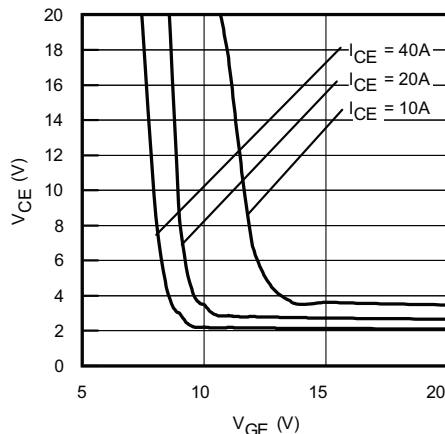


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

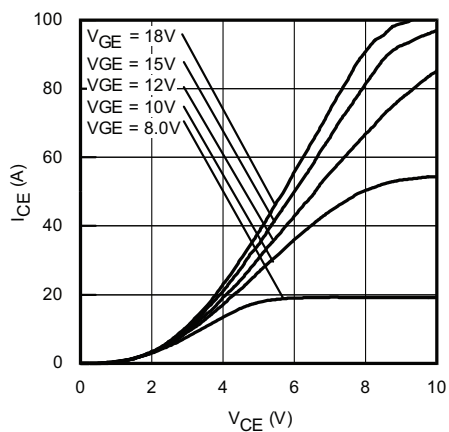


Fig. 7 - Typical IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\ \mu\text{s}$

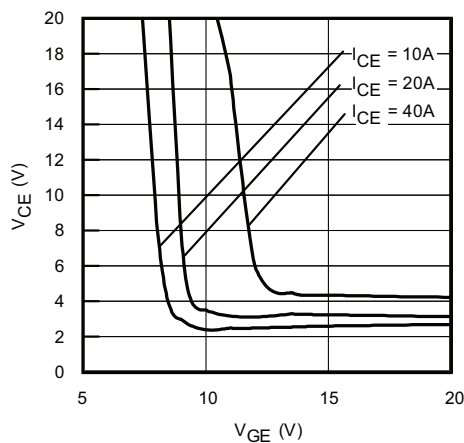


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

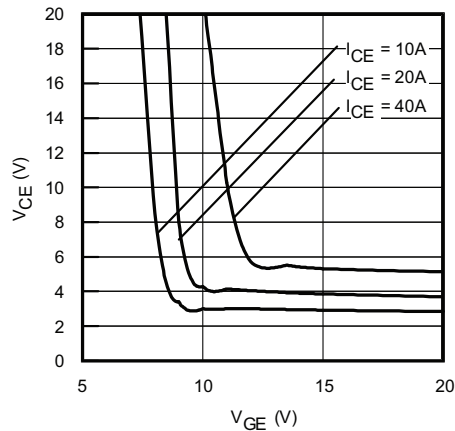


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

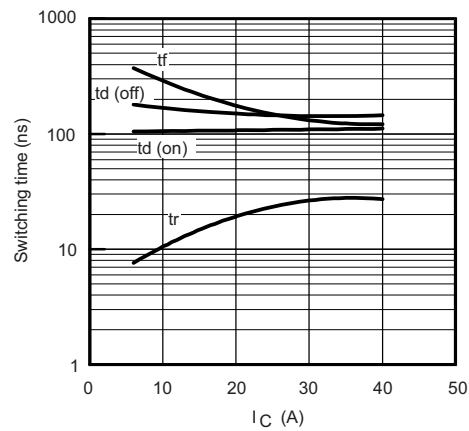


Fig. 14 - Typical Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 1\text{ mH}$; $V_{CC} = 600\text{ V}$
 $R_g = 5\ \Omega$; $V_{GE} = 15\text{ V}$

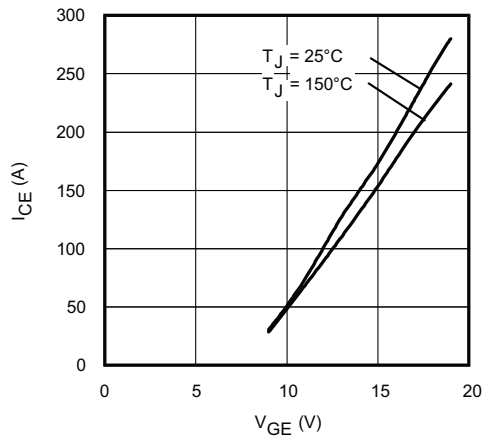


Fig. 12 - Typical Transfer Characteristics
 $V_{CE} = 50\text{ V}$; $t_p = 10\ \mu\text{s}$

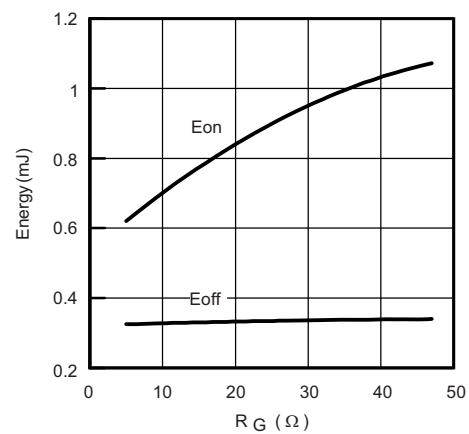


Fig. 15 - Typical Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$; $L = 1\text{ mH}$; $V_{CC} = 600\text{ V}$
 $I_{CE} = 6\text{ A}$; $V_{GE} = 15\text{ V}$

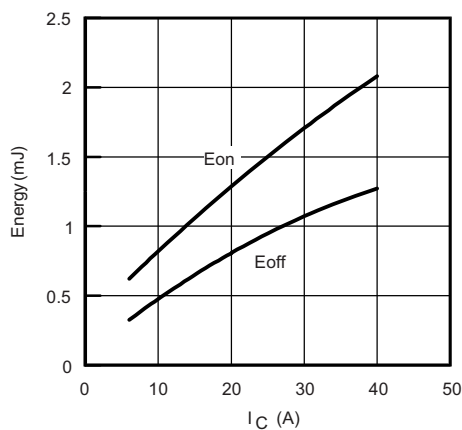


Fig. 13 - Typical Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 1\text{ mH}$; $V_{CC} = 600\text{ V}$
 $R_g = 5\ \Omega$; $V_{GE} = 15\text{ V}$

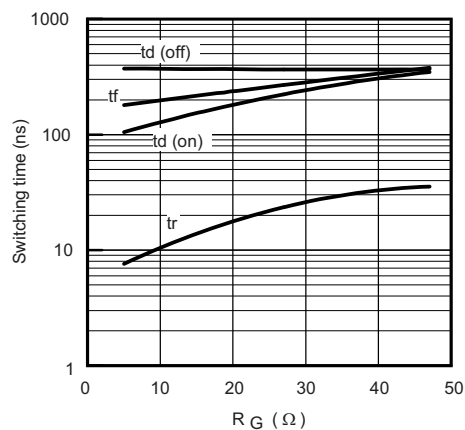


Fig. 16 - Typical Switching Time vs. R_g
 $T_J = 150^\circ\text{C}$; $L = 1\text{ mH}$; $V_{CC} = 600\text{ V}$
 $I_{CE} = 6\text{ A}$; $V_{GE} = 15\text{ V}$

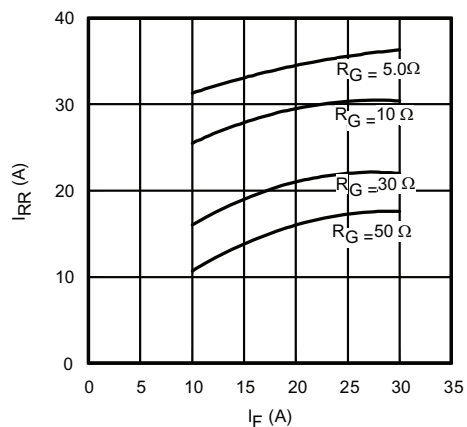


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 150\text{ }^{\circ}\text{C}$

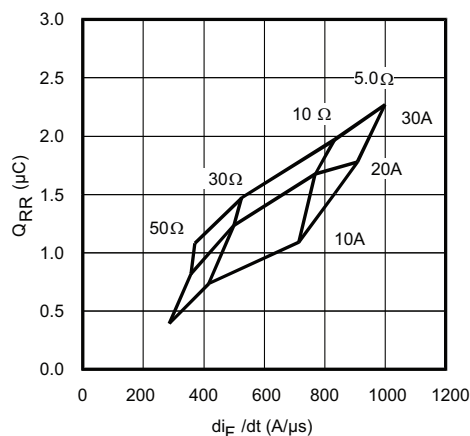


Fig. 20 - Typical Diode Q_{RR} vs. dI_F/dt
 $V_{CC} = 400\text{ V}$; $V_{GE} = 15\text{ V}$; $T_J = 150\text{ }^{\circ}\text{C}$

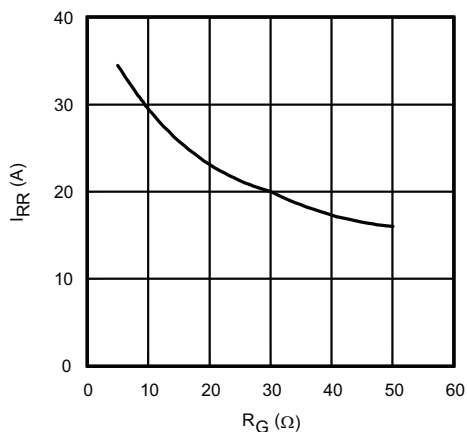


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 150\text{ }^{\circ}\text{C}$; $I_F = 5.0\text{ A}$

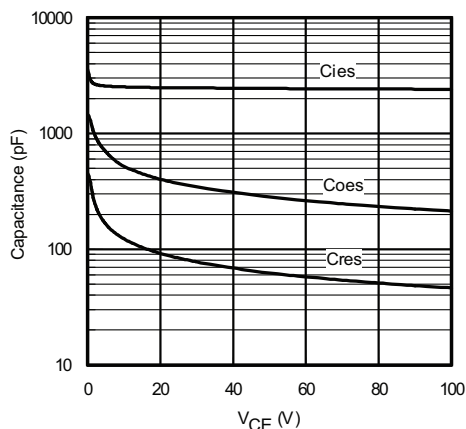


Fig. 21 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

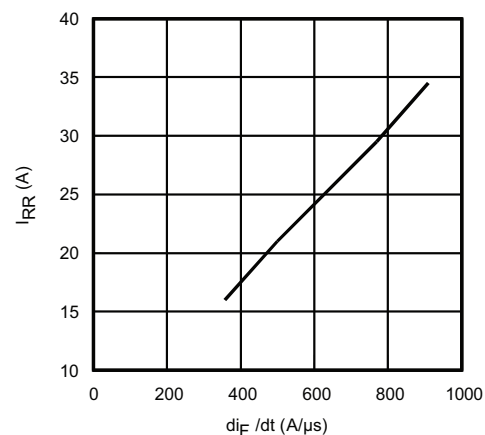


Fig. 19 - Typical Diode I_{RR} vs. dI_F/dt
 $V_{CC} = 400\text{ V}$; $V_{GE} = 15\text{ V}$; $I_{CE} = 5.0\text{ A}$; $T_J = 150\text{ }^{\circ}\text{C}$

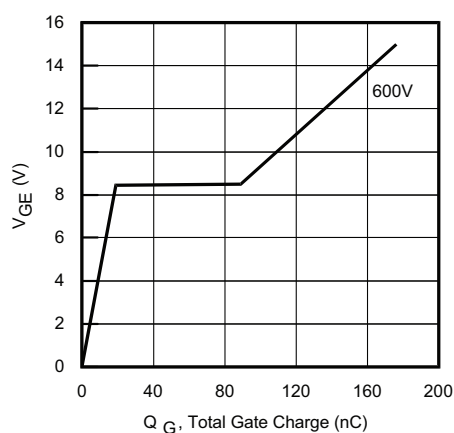


Fig. 22 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 5.0\text{ A}$; $L = 600\text{ }^{\mu}\text{H}$

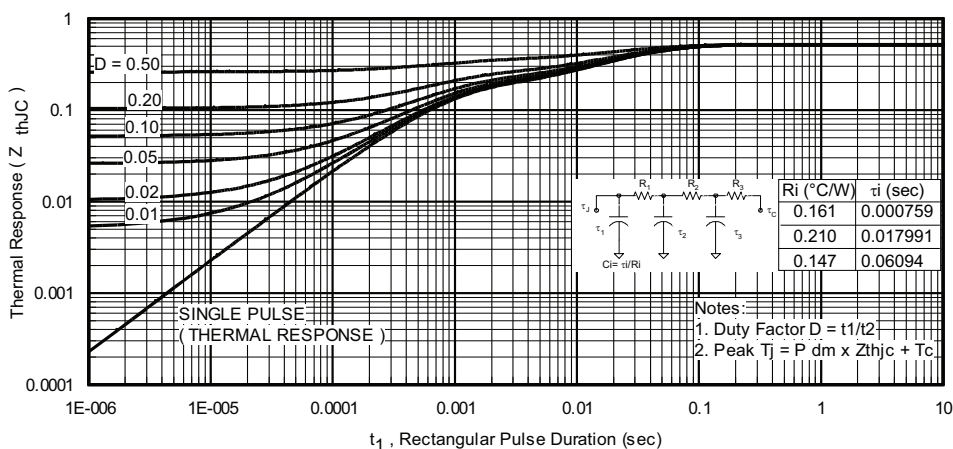


Fig. 23 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

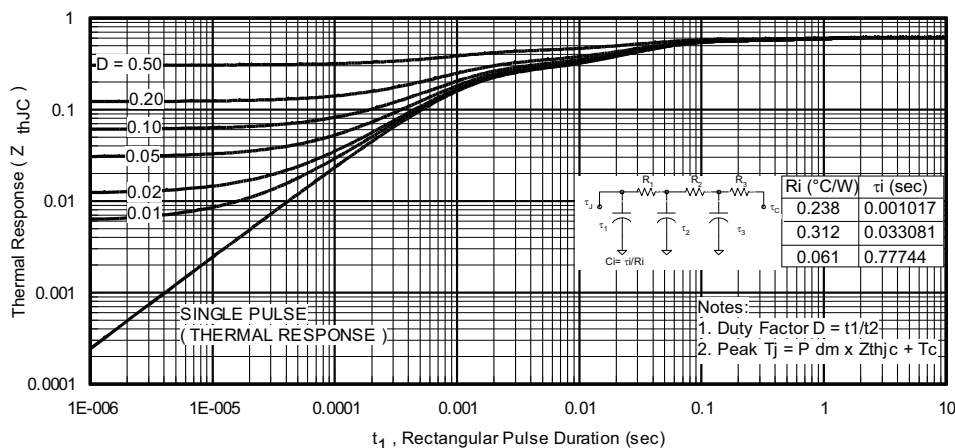


Fig. 24 - Maximum Transient Thermal Impedance, Junction-to-Case (Diode)

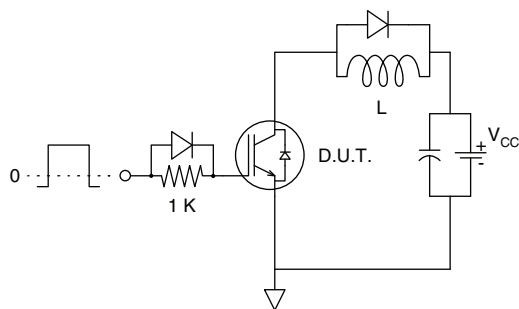


Fig. 25 - Gate Charge Circuit (Turn-Off)

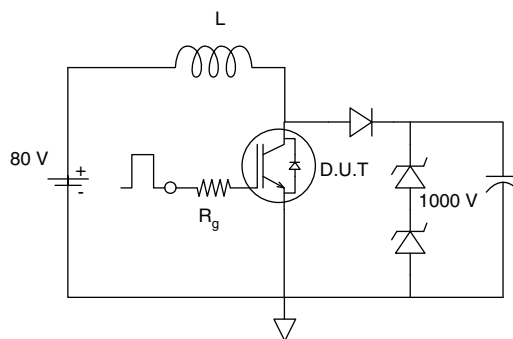


Fig. 26 - RBSOA Circuit

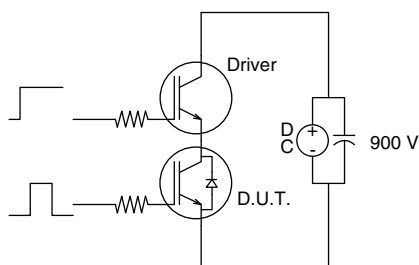


Fig. 27 - S.C. SOA Circuit

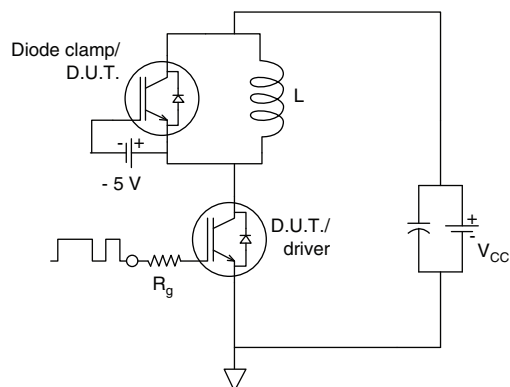


Fig. 28 - Switching Loss Circuit

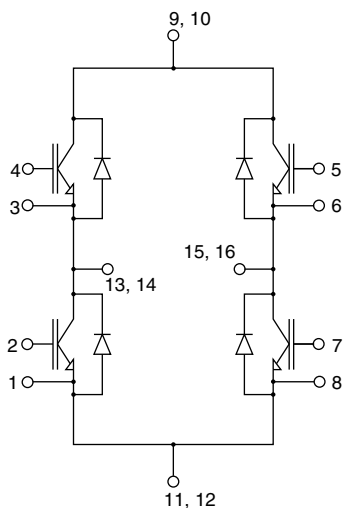


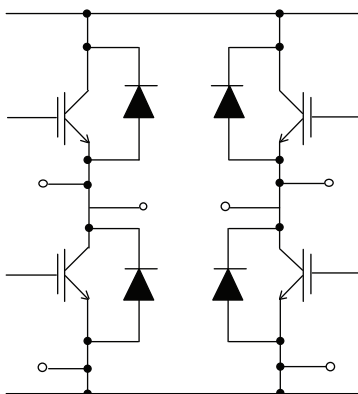
Fig. 29 - Electrical diagram

ORDERING INFORMATION TABLE

Device code	VS-	20	MT	120	U	F	P
	1	2	3	4	5	6	7
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	P = lead (Pb)-free						



CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS

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

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.

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Vishay:](#)

[VS-20MT120UFP](#)