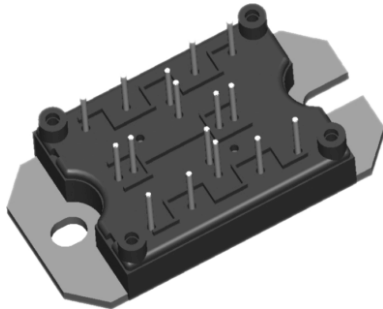



## "Full Bridge" IGBT MTP (Ultrafast NPT IGBT), 40 A



MTP

### FEATURES

- Ultrafast Non Punch Through (NPT) technology
- Positive  $V_{CE(on)}$  temperature coefficient
- 10  $\mu$ s short circuit capability
- HEXFRED<sup>®</sup> 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 
- Speed 8 kHz to 60 kHz
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


**RoHS**  
COMPLIANT

PRODUCT SUMMARY	
$V_{CES}$	1200 V
$I_C$ at $T_C = 25\text{ }^\circ\text{C}$	40 A
$V_{CE(on)}$	3.29 V

### 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	$V_{GE}$		$\pm 20$	V
RMS isolation voltage	$V_{ISOL}$	Any terminal to case, $t = 1$ minute	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	

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ 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 °C to 125 °C)	-	+ 1.3	-	V/°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 °C to 125 °C)	-	- 14	-	mV/°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	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	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	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 250$	nA

**Note**

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

<b>SWITCHING CHARACTERISTICS</b> ( $T_J = 25\text{ }^\circ\text{C}$ 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	$T_J = 150\text{ }^\circ\text{C}, I_C = 120\text{ A}$ $V_{CC} = 1000\text{ V}, V_p = 1200\text{ V}$ $R_g = 5\text{ }\Omega, V_{GE} = + 15\text{ V to } 0\text{ V}$	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}$ $V_{CC} = 900\text{ V}, V_p = 1200\text{ V}$ $R_g = 5\text{ }\Omega, V_{GE} = + 15\text{ V to } 0\text{ V}$	10	-	-	$\mu\text{s}$



<b>DIODE SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ 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	$E_{rec}$	$V_{GE} = 15\text{ V}, R_g = 5\ \Omega, L = 200\ \mu\text{H}$	-	420	630	$\mu\text{J}$
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

<b>THERMAL AND MECHANICAL SPECIFICATIONS</b>						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	$T_J$		- 40	-	150	$^\circ\text{C}$
Storage temperature range	$T_{Stg}$		- 40	-	125	
Junction to case	$R_{thJC}$	IGBT	-	0.35	0.52	$^\circ\text{C/W}$
		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

# 20MT120UFP



Vishay High Power Products "Full Bridge" IGBT MTP  
(Ultrafast NPT IGBT), 40 A

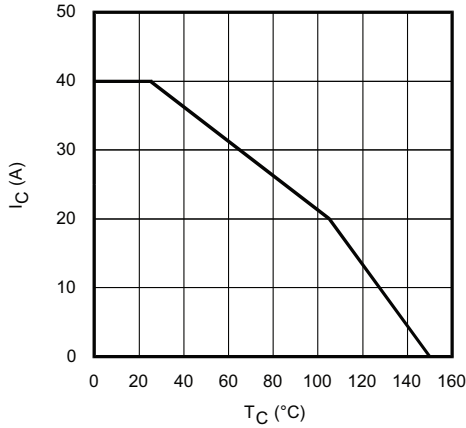


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

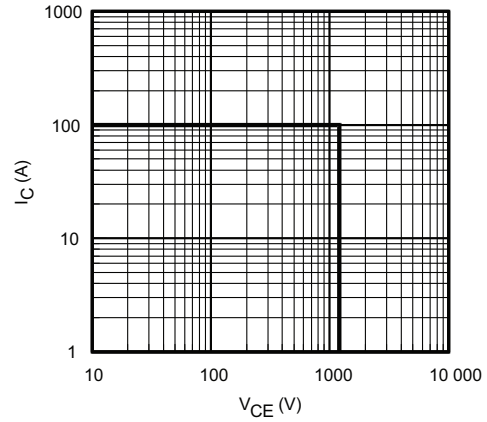


Fig. 4 - Reverse Bias SOA  
T<sub>J</sub> = 150 °C; V<sub>GE</sub> = 15 V

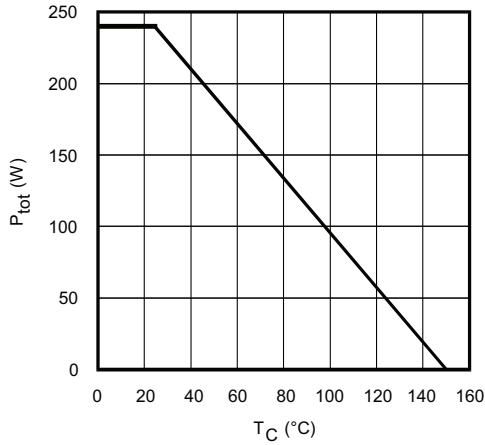


Fig. 2 - Power Dissipation vs. Case Temperature

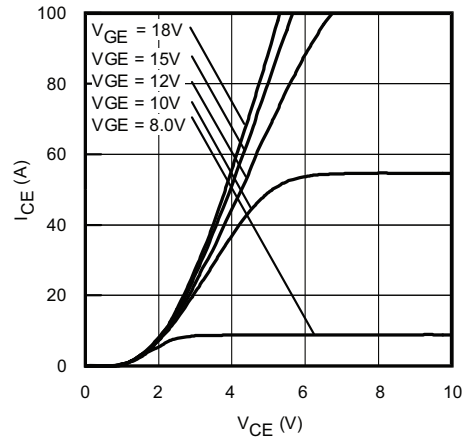


Fig. 5 - Typical IGBT Output Characteristics  
T<sub>J</sub> = - 40 °C; t<sub>p</sub> = 80 μs

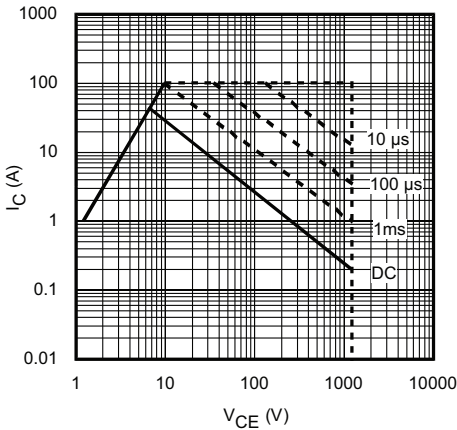


Fig. 3 - Forward SOA  
T<sub>C</sub> = 25 °C; T<sub>J</sub> ≤ 150 °C

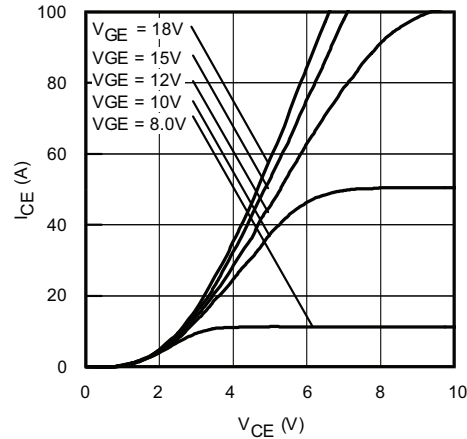


Fig. 6 - Typical IGBT Output Characteristics  
T<sub>J</sub> = 25 °C; t<sub>p</sub> = 80 μs

## "Full Bridge" IGBT MTP Vishay High Power Products (Ultrafast NPT IGBT), 40 A

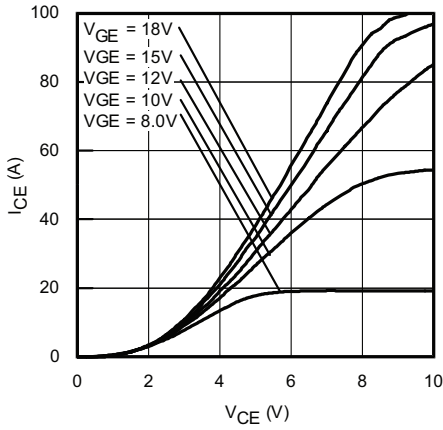


Fig. 7 - Typical IGBT Output Characteristics  
 $T_J = 125^\circ\text{C}$ ;  $t_p = 80 \mu\text{s}$

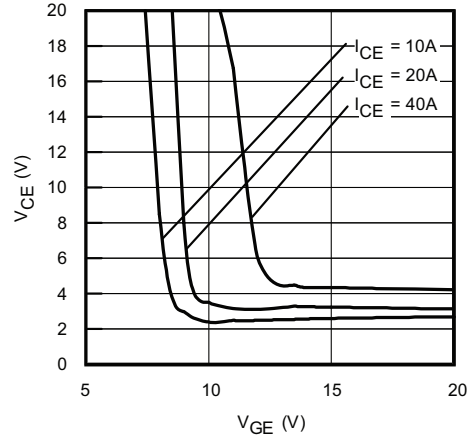


Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$

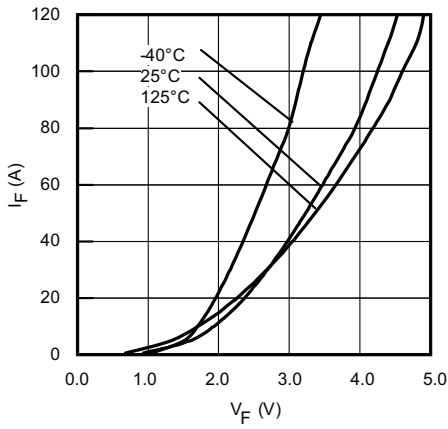


Fig. 8 - Typical Diode Forward Characteristics  
 $t_p = 80 \mu\text{s}$

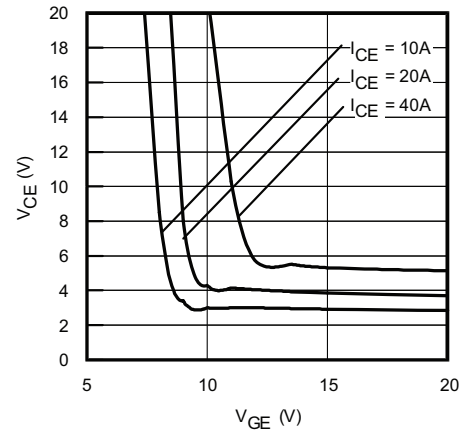


Fig. 11 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 125^\circ\text{C}$

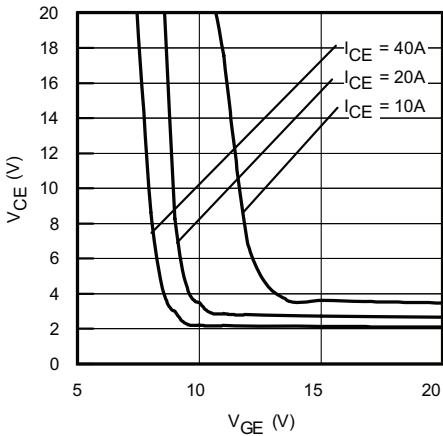


Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$

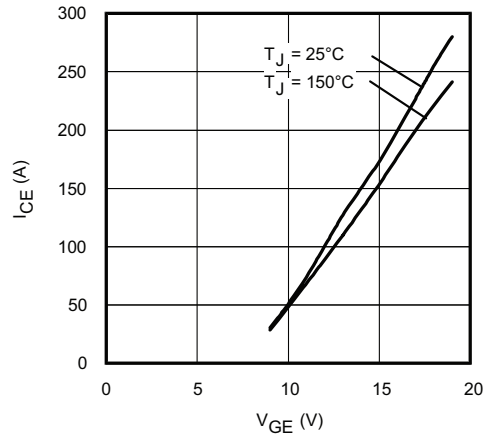


Fig. 12 - Typical Transfer Characteristics  
 $V_{CE} = 50 \text{ V}$ ;  $t_p = 10 \mu\text{s}$

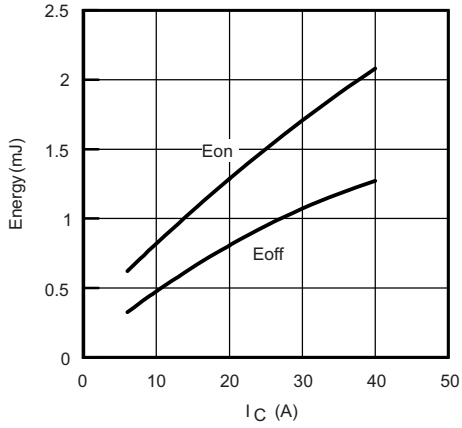


Fig. 13 - Typical Energy Loss vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 1\text{ mH}$ ;  $V_{CC} = 600\text{ V}$   
 $R_g = 5\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

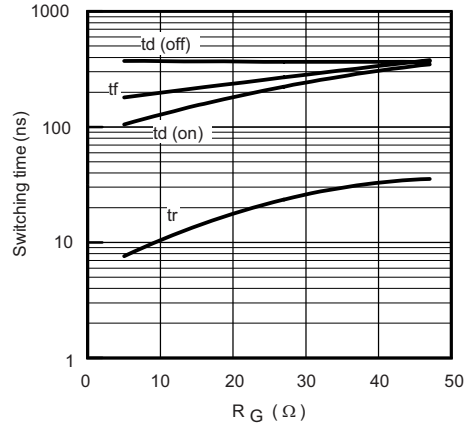


Fig. 16 - Typical Switching Time vs.  $R_g$   
 $T_J = 150\text{ }^\circ\text{C}$ ;  $L = 1\text{ mH}$ ;  $V_{CC} = 600\text{ V}$   
 $I_{CE} = 6\text{ A}$ ;  $V_{GE} = 15\text{ V}$

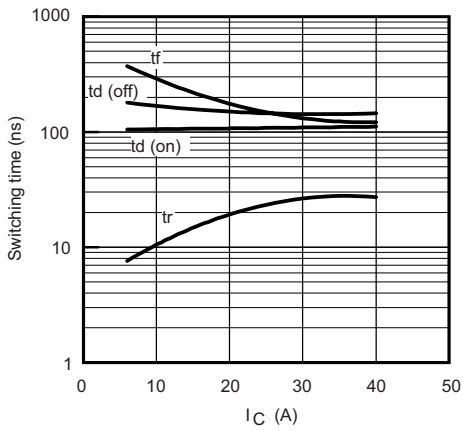


Fig. 14 - Typical Switching Time vs.  $I_C$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 1\text{ mH}$ ;  $V_{CC} = 600\text{ V}$   
 $R_g = 5\text{ }\Omega$ ;  $V_{GE} = 15\text{ V}$

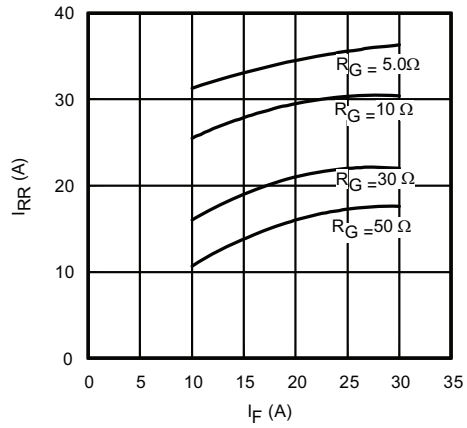


Fig. 17 - Typical Diode  $I_{rr}$  vs.  $I_F$   
 $T_J = 150\text{ }^\circ\text{C}$

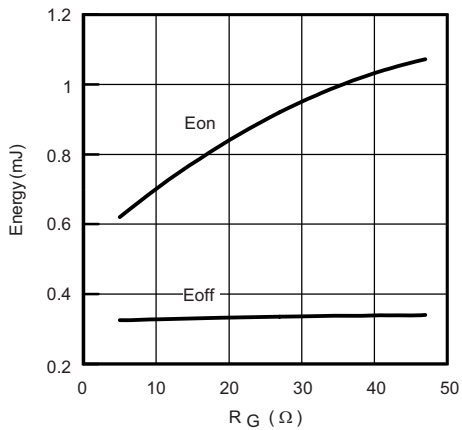


Fig. 15 - Typical Energy Loss vs.  $R_g$   
 $T_J = 125\text{ }^\circ\text{C}$ ;  $L = 1\text{ mH}$ ;  $V_{CC} = 600\text{ V}$   
 $I_{CE} = 6\text{ A}$ ;  $V_{GE} = 15\text{ V}$

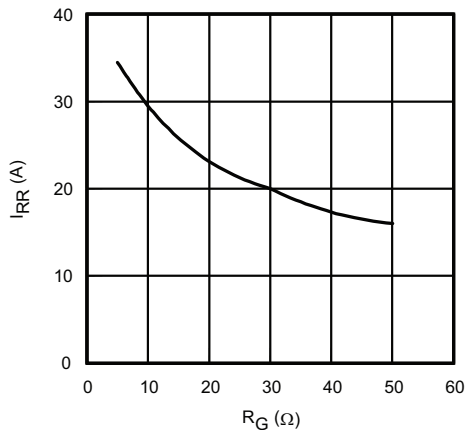


Fig. 18 - Typical Diode  $I_{rr}$  vs.  $R_g$   
 $T_J = 150\text{ }^\circ\text{C}$ ;  $I_F = 5.0\text{ A}$

# "Full Bridge" IGBT MTP Vishay High Power Products (Ultrafast NPT IGBT), 40 A

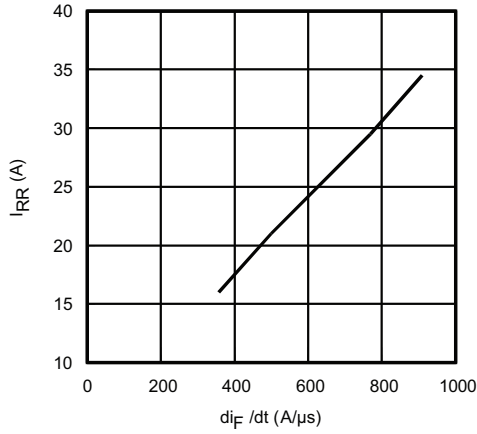


Fig. 19 - Typical Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $I_{CE} = 5.0\text{ A}$ ;  $T_J = 150\text{ }^\circ\text{C}$

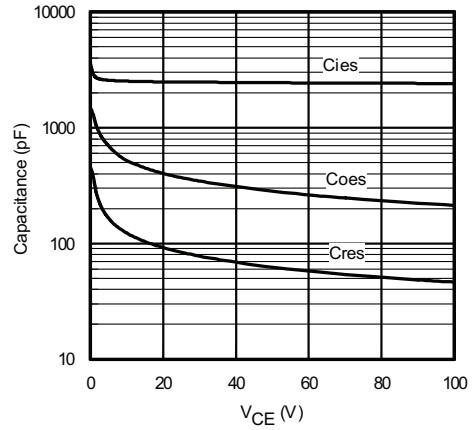


Fig. 21 - Typical Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

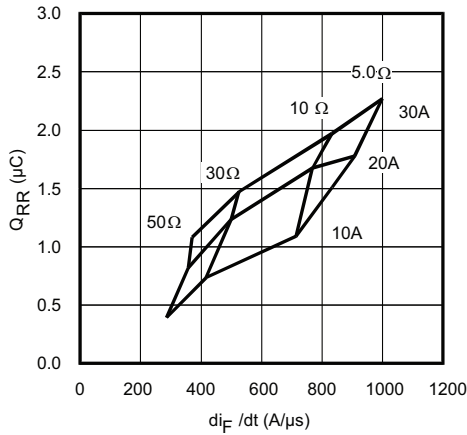


Fig. 20 - Typical Diode  $Q_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $T_J = 150\text{ }^\circ\text{C}$

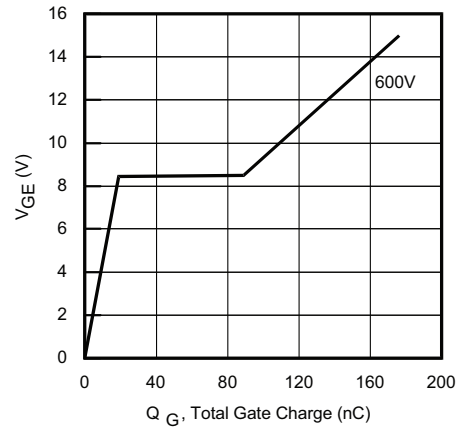


Fig. 22 - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 5.0\text{ A}$ ;  $L = 600\text{ } \mu\text{H}$

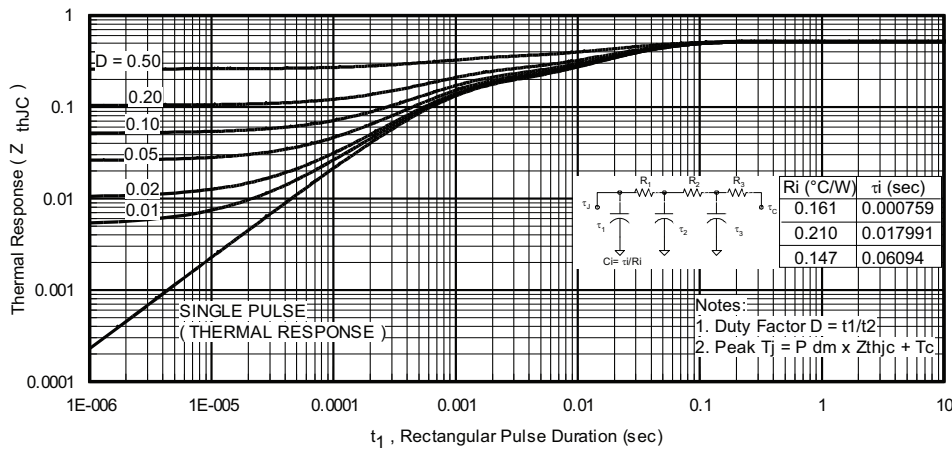


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

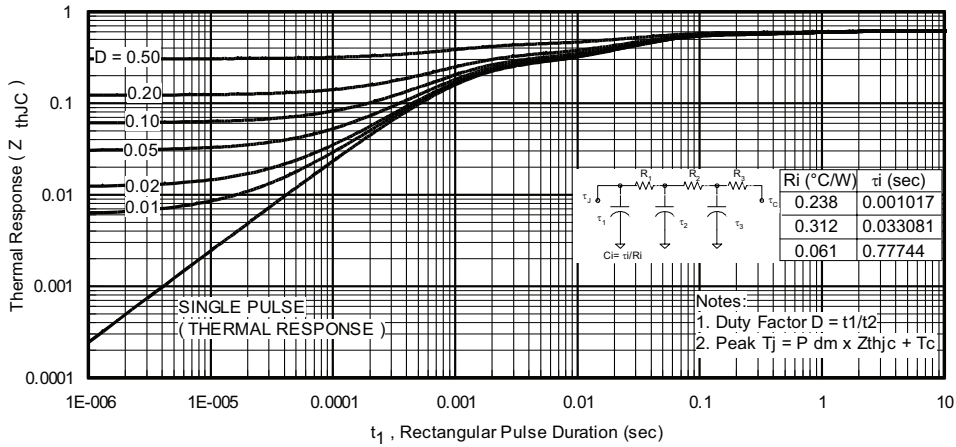


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

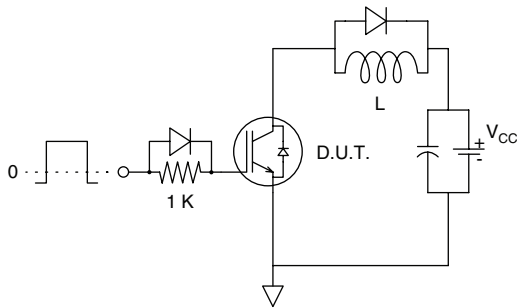


Fig. CT.1 - Gate Charge Circuit (Turn-Off)

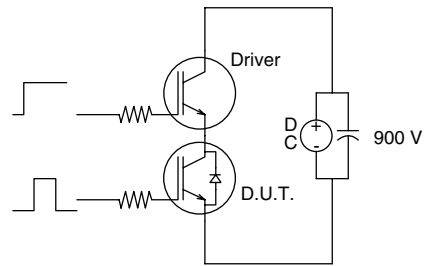


Fig. CT.3 - S.C. SOA Circuit

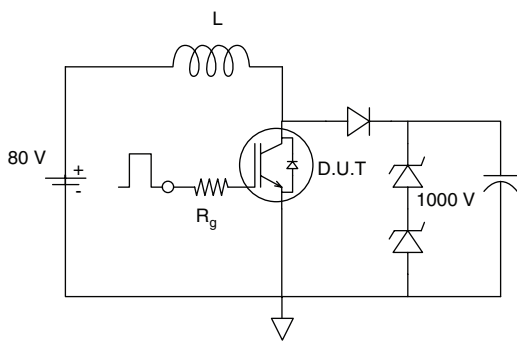


Fig. CT.2 - RBSOA Circuit

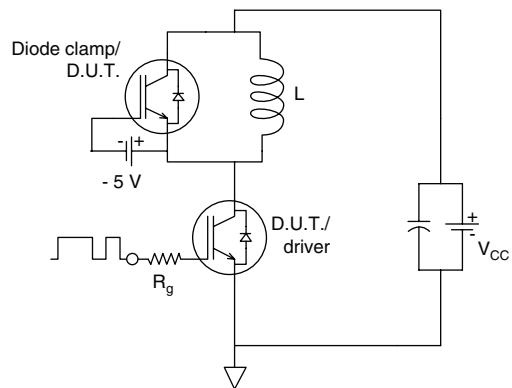


Fig. CT.4 - Switching Loss Circuit

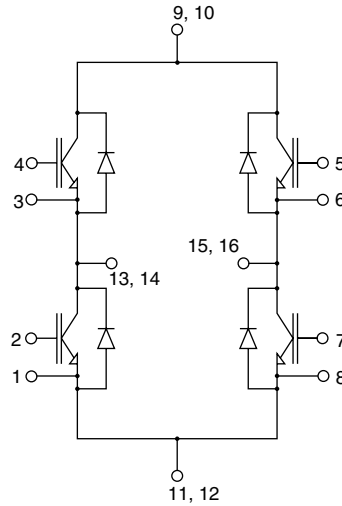
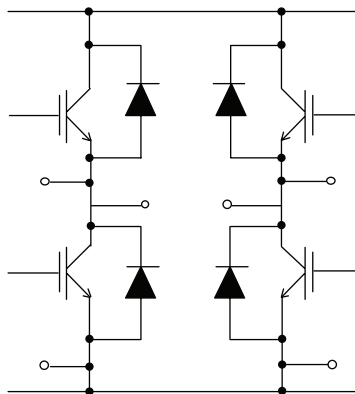


Fig. 25 - Electrical diagram

**ORDERING INFORMATION TABLE**

Device code	<b>20</b>	<b>MT</b>	<b>120</b>	<b>U</b>	<b>F</b>	<b>P</b>
	①	②	③	④	⑤	⑥
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
	-	-	-	-	-	-
	Current rating (20 = 20 A)	Essential part number	Voltage code (120 = 1200 V)	Speed/type (U = Ultrafast IGBT)	Circuit configuration (F = Full bridge)	P = Lead (Pb)-free

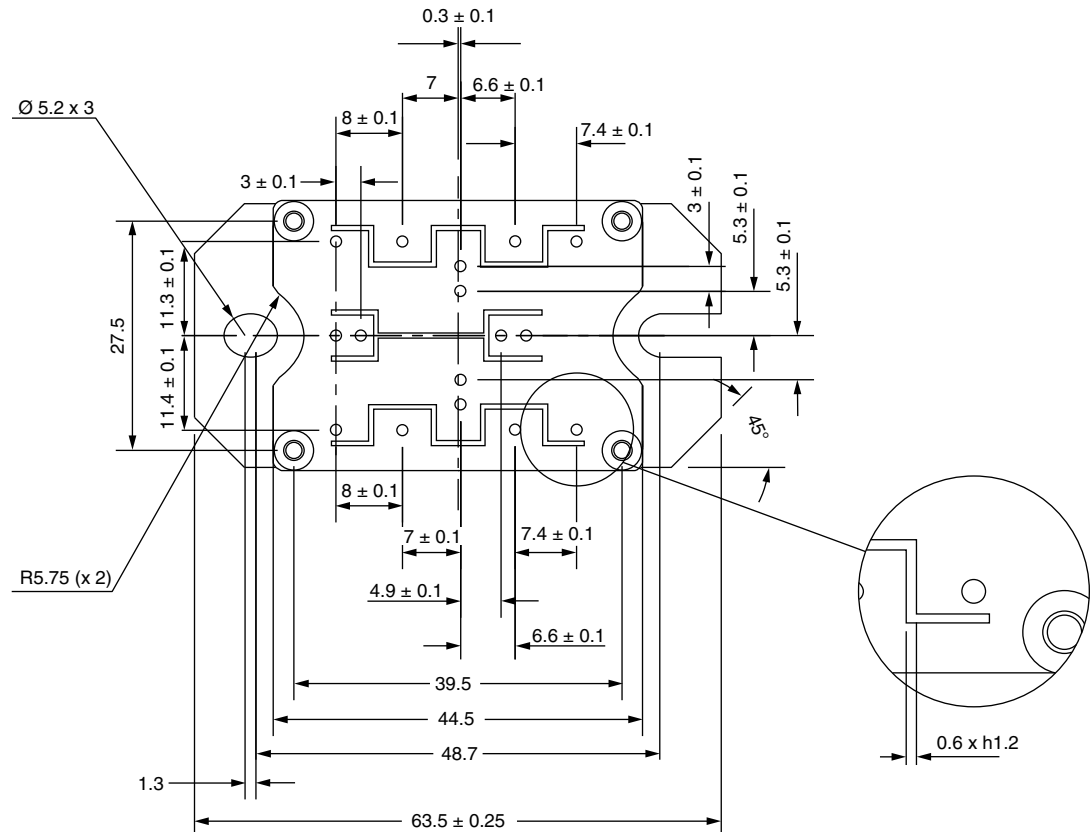
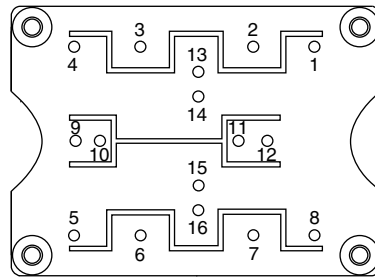
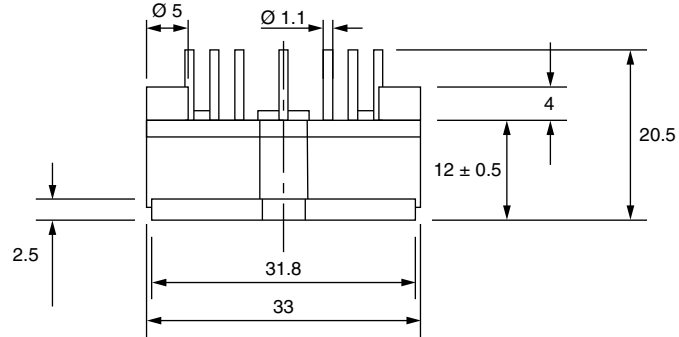
**CIRCUIT CONFIGURATION**



LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95245">www.vishay.com/doc?95245</a>

## MTP MOSFET/IGBT Full-Bridge

**DIMENSIONS** in millimeters





## Disclaimer

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## 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.**