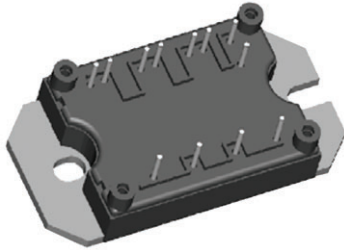



## “Half Bridge” IGBT MTP (Ultrafast NPT IGBT), 80 A


**MTP**

PRODUCT SUMMARY	
$V_{CES}$	1200 V
$V_{CE(on)}$ typical at $V_{GE} = 15$ V	3.36 V
$I_C$ at $T_C = 25$ °C	80 A
Speed	8 kHz to 30 kHz
Package	MTP
Circuit	Half bridge

### FEATURES

- Ultrafast Non Punch Through (NPT) technology
- Positive  $V_{CE(on)}$  temperature coefficient
- 10  $\mu$ s short circuit capability
- Square RBSOA
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery and low  $V_F$
- $Al_2O_3$  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?999912](http://www.vishay.com/doc?999912)


**RoHS\***  
Available

### Note

\* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details.

### BENEFITS

- Optimized for welding, UPS and SMPS applications
- Rugged with ultrafast performance
- Benchmark efficiency above 20 kHz
- 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	$I_C$	$T_C = 25$ °C	80	A
		$T_C = 104$ °C	40	
Pulsed collector current	$I_{CM}$		160	
Clamped inductive load current	$I_{LM}$		160	
Diode continuous forward current	$I_F$	$T_C = 105$ °C	21	
Diode maximum forward current	$I_{FM}$		160	
Gate to emitter voltage	$V_{GE}$		$\pm 20$	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	463	W
		$T_C = 100$ °C	185	



<b>ELECTRICAL SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified)						
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)	-	+1.1	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$	-	3.36	3.59	V
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$	-	4.53	4.91	
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	3.88	4.10	
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	5.35	5.68	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 500\text{ }\mu\text{A}$	4	-	6	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 1\text{ mA}$ (25 °C to 125 °C)	-	-12	-	mV/°C
Transconductance	$g_{fe}$	$V_{CE} = 50\text{ V}, I_C = 40\text{ A}, PW = 80\text{ }\mu\text{s}$	-	35	-	S
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 25\text{ }^\circ\text{C}$	-	-	250	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.4	1.0	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	0.2	10	
Gate to emitter leakage current	$I_{GES}$	$V_{GE} = \pm 20\text{ V}$	-	-	$\pm 250$	nA

<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)	$Q_g$	$I_C = 40\text{ A}$	-	399	599	nC
Gate to emitter charge (turn-on)	$Q_{ge}$	$V_{CC} = 600\text{ V}$	-	43	65	
Gate to collector charge (turn-on)	$Q_{gc}$	$V_{GE} = 15\text{ V}$	-	187	281	
Turn-on switching loss	$E_{on}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 200\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C},$ energy losses include tail and diode reverse recovery	-	1.14	1.71	mJ
Turn-off switching loss	$E_{off}$		-	1.35	2.02	
Total switching loss	$E_{tot}$		-	2.49	3.73	
Turn-on switching loss	$E_{on}$		$V_{CC} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 200\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C},$ energy losses include tail and diode reverse recovery	-	1.60	
Turn-off switching loss	$E_{off}$		-	1.62	2.43	
Total switching loss	$E_{tot}$		-	3.22	4.82	
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$	-	5521	8282	pF
Output capacitance	$C_{oes}$	$V_{CC} = 30\text{ V}$	-	380	570	
Reverse transfer capacitance	$C_{res}$	$f = 1.0\text{ MHz}$	-	171	257	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 160\text{ A}$ $V_{CC} = 1000\text{ V}, V_p = 1200\text{ V}$ $R_g = 5\text{ }\Omega, V_{GE} = +15\text{ V to }0\text{ V}$	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	-	-	$\mu\text{s}$



DIODE SPECIFICATIONS (T <sub>J</sub> = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Diode forward voltage drop	V <sub>FM</sub>	I <sub>C</sub> = 40 A	-	2.98	3.38	V
		I <sub>C</sub> = 80 A	-	3.90	4.41	
		I <sub>C</sub> = 40 A, T <sub>J</sub> = 125 °C	-	3.08	3.39	
		I <sub>C</sub> = 80 A, T <sub>J</sub> = 125 °C	-	4.29	4.72	
		I <sub>C</sub> = 40 A, T <sub>J</sub> = 150 °C	-	3.12	3.42	
Reverse recovery energy of the diode	E <sub>rec</sub>	V <sub>GE</sub> = 15 V, R <sub>g</sub> = 5 Ω, L = 200 μH V <sub>CC</sub> = 600 V, I <sub>C</sub> = 40 A T <sub>J</sub> = 125 °C	-	574	861	μJ
Diode reverse recovery time	t <sub>rr</sub>		-	120	180	ns
Peak reverse recovery current	I <sub>rr</sub>		-	43	65	A

THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	T <sub>J</sub>		-40	-	150	°C
Storage temperature range	T <sub>Stg</sub>		-40	-	125	
Junction to case	IGBT	R <sub>thJC</sub>	-	-	0.29	°C/W
	Diode		-	-	0.61	
Case to sink per module	R <sub>thCS</sub>	Heatsink compound thermal conductivity = 1 W/mK	-	0.06	-	
Clearance <sup>(1)</sup>		External shortest distance in air between 2 terminals	5.5	-	-	mm
Creepage <sup>(2)</sup>		Shortest distance along external surface of the insulating material between 2 terminals	8	-	-	
Mounting torque to heatsink		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

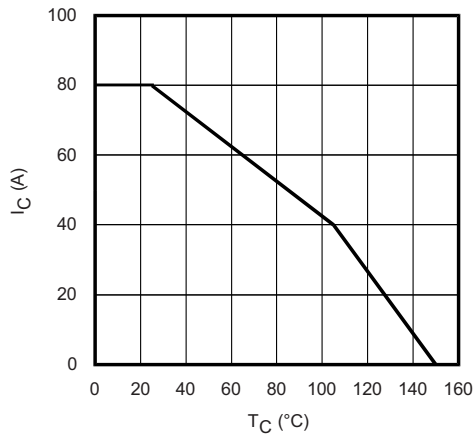


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

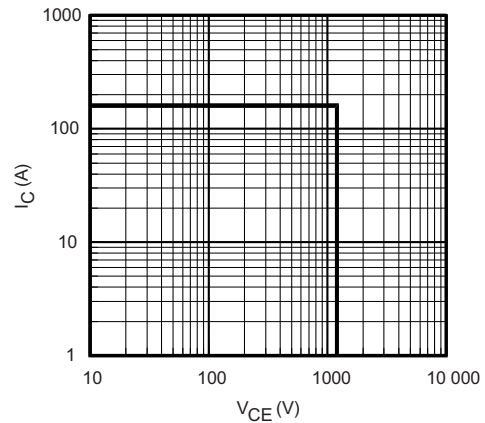


Fig. 4 - Reverse BIAS SOA  
T<sub>J</sub> = 150 °C; V<sub>GE</sub> = 15 V

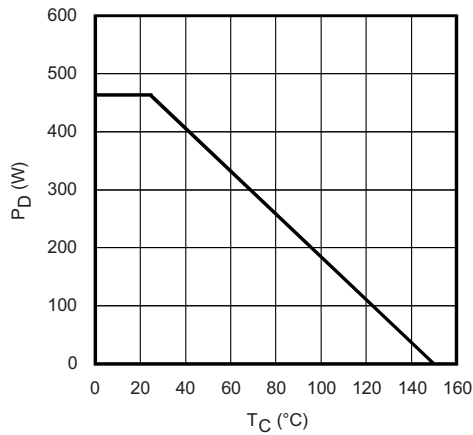


Fig. 2 - Power Dissipation vs. Case Temperature

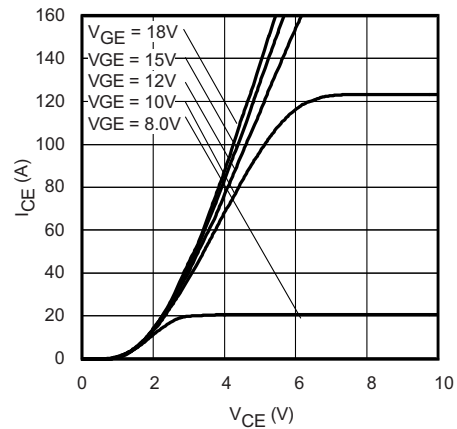


Fig. 5 - Typical IGBT Output Characteristics  
T<sub>J</sub> = - 40 °C; t<sub>p</sub> = 80 μs

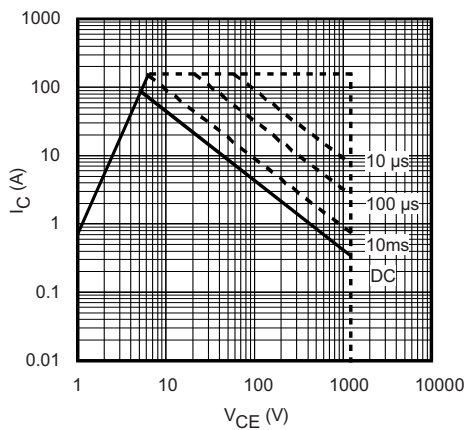


Fig. 3 - Forward SOA  
T<sub>C</sub> = 25 °C; T<sub>J</sub> ≤ 150 °C

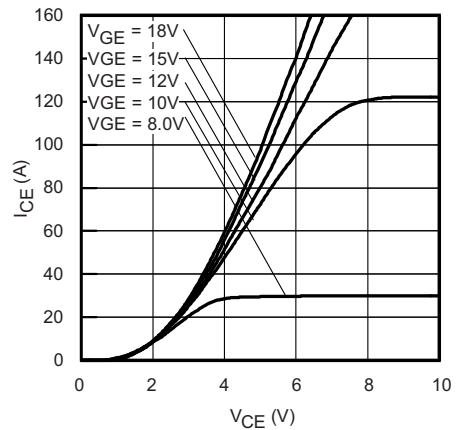


Fig. 6 - Typical IGBT Output Characteristics  
T<sub>J</sub> = 25 °C; t<sub>p</sub> = 80 μs

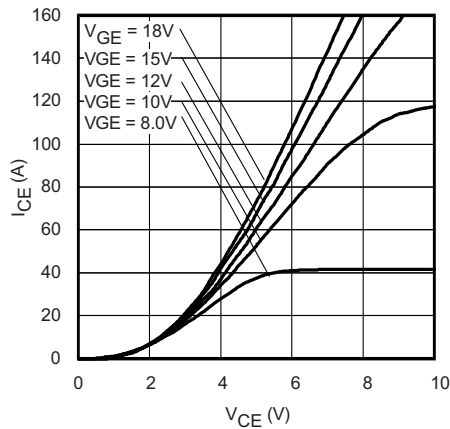


Fig. 7 - Typical IGBT Output Characteristics  
 $T_J = 125^\circ\text{C}$ ;  $t_p = 80\ \mu\text{s}$

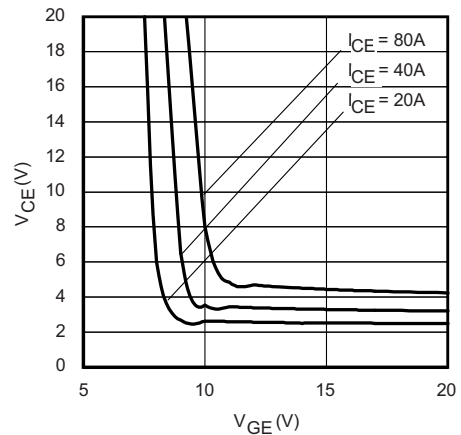


Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 25^\circ\text{C}$

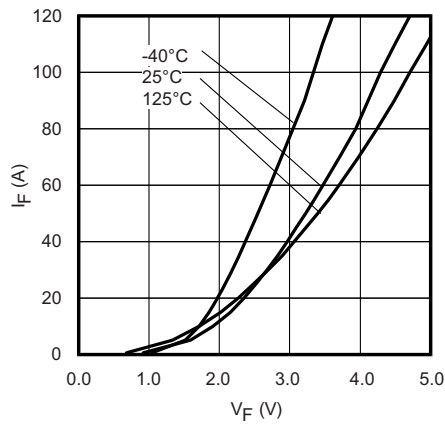


Fig. 8 - Typical Diode Forward Characteristics  
 $t_p = 80\ \mu\text{s}$

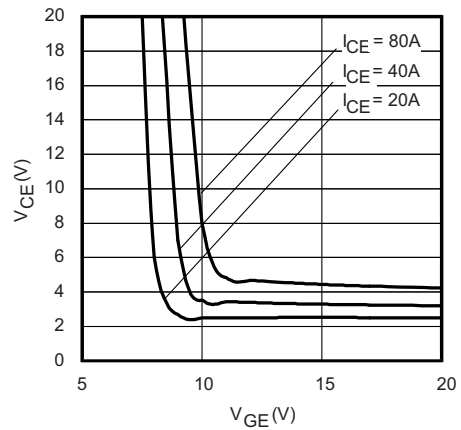


Fig. 11 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = 125^\circ\text{C}$

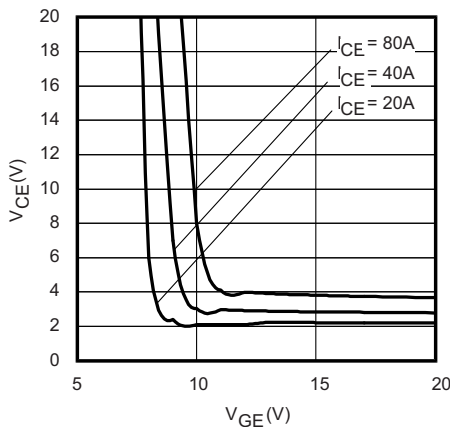


Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$   
 $T_J = -40^\circ\text{C}$

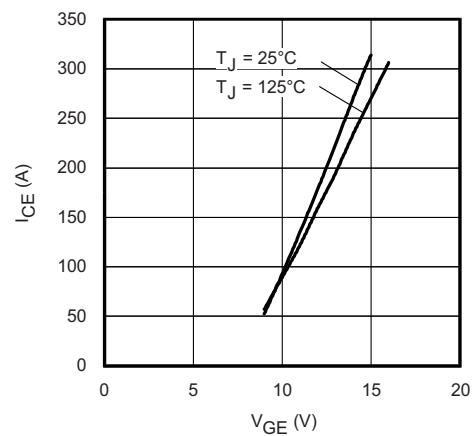


Fig. 12 - Typical Transfer Characteristics  
 $V_{CE} = 50\ \text{V}$ ;  $t_p = 10\ \mu\text{s}$

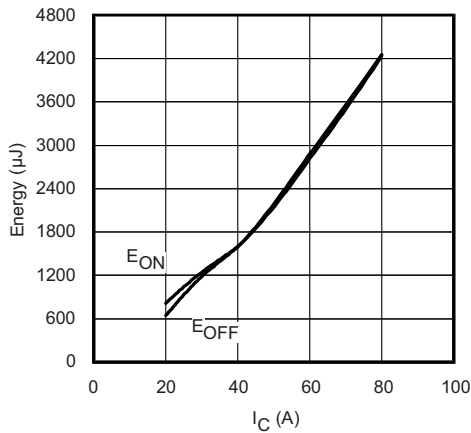


Fig. 13 - Typical Energy Loss vs. I<sub>C</sub>  
 T<sub>J</sub> = 125 °C; L = 250 μH; V<sub>CE</sub> = 400 V  
 R<sub>g</sub> = 5 Ω; V<sub>GE</sub> = 15 V

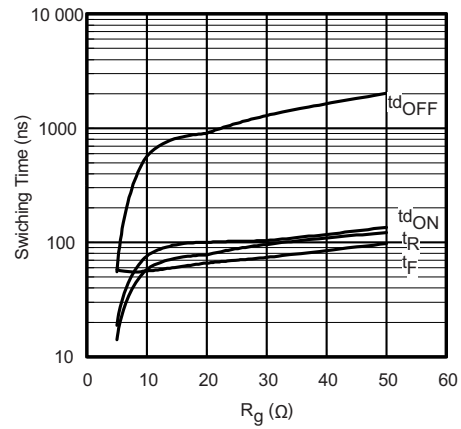


Fig. 16 - Typical Switching Time vs. R<sub>g</sub>  
 T<sub>J</sub> = 150 °C; L = 250 μH; V<sub>CE</sub> = 600 V  
 I<sub>CE</sub> = 40 A; V<sub>GE</sub> = 15 V

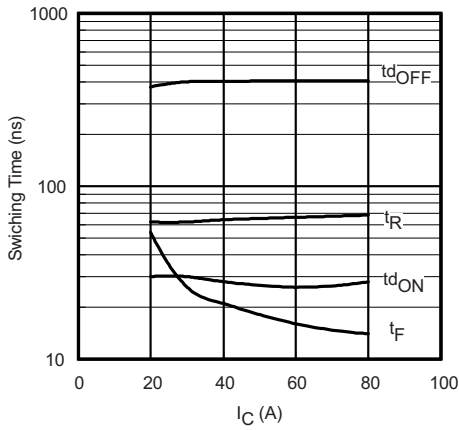


Fig. 14 - Typical Switching Time vs. I<sub>C</sub>  
 T<sub>J</sub> = 125 °C; L = 250 μH; V<sub>CE</sub> = 400 V  
 R<sub>g</sub> = 5 Ω; V<sub>GE</sub> = 15 V

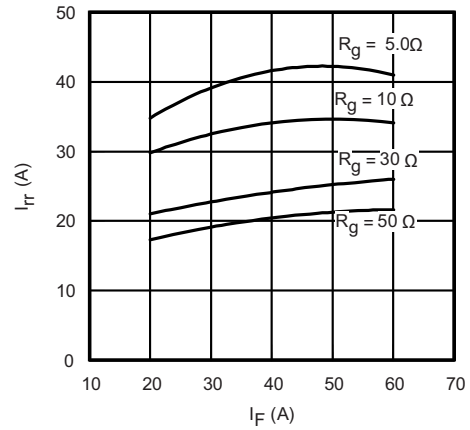


Fig. 17 - Typical Diode I<sub>rr</sub> vs. I<sub>F</sub>  
 T<sub>J</sub> = 125 °C

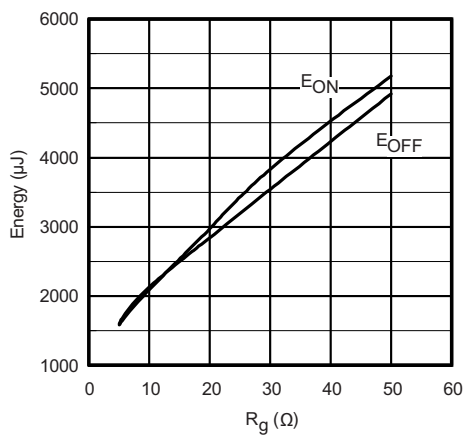


Fig. 15 - Typical Energy Loss vs. R<sub>g</sub>  
 T<sub>J</sub> = 150 °C; L = 250 μH; V<sub>CE</sub> = 600 V  
 I<sub>CE</sub> = 40 A; V<sub>GE</sub> = 15 V

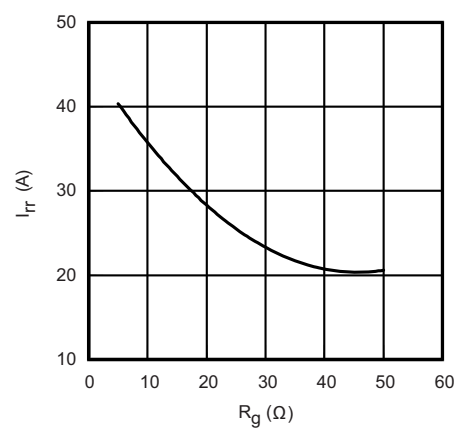


Fig. 18 - Typical Diode I<sub>rr</sub> vs. R<sub>g</sub>  
 T<sub>J</sub> = 125 °C; I<sub>F</sub> = 40 A

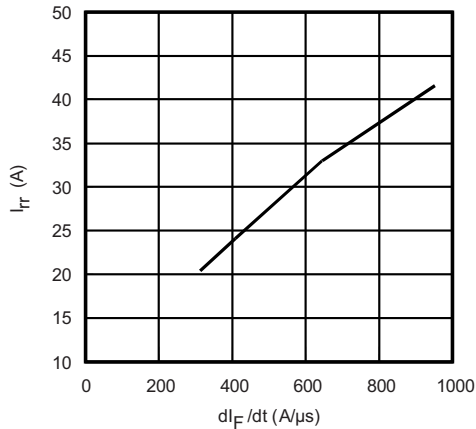


Fig. 19 - Typical Diode  $I_{rr}$  vs.  $dI_F/dt$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $I_{CE} = 40\text{ A}$ ;  $T_J = 125\text{ }^\circ\text{C}$

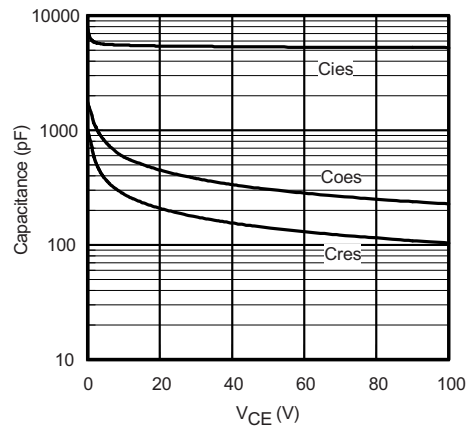


Fig. 21 - Typical Capacitance vs.  $V_{CE}$   
 $V_{GE} = 0\text{ V}$ ;  $f = 1\text{ MHz}$

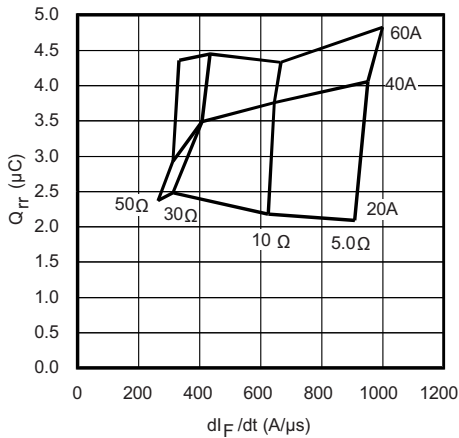


Fig. 20 - Typical Diode  $Q_{rr}$  vs.  $dI_F/dt$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $T_J = 125\text{ }^\circ\text{C}$

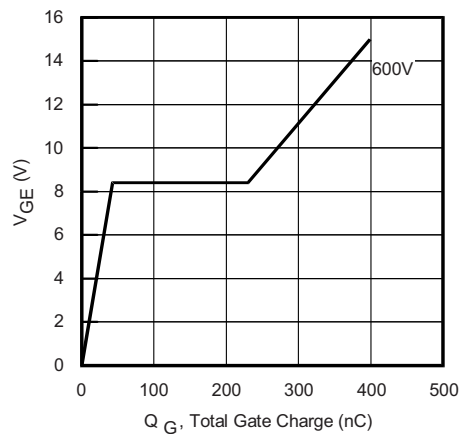


Fig. 22 - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 5.0\text{ A}$ ;  $L = 600\text{ } \mu\text{H}$

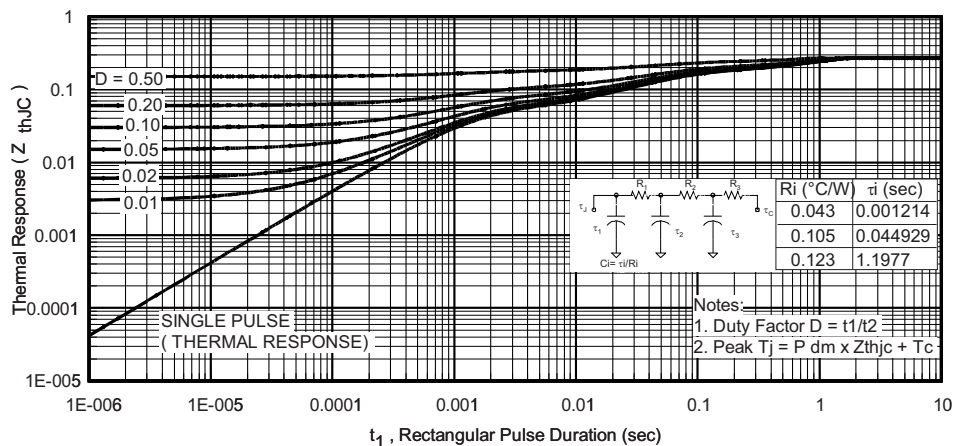


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

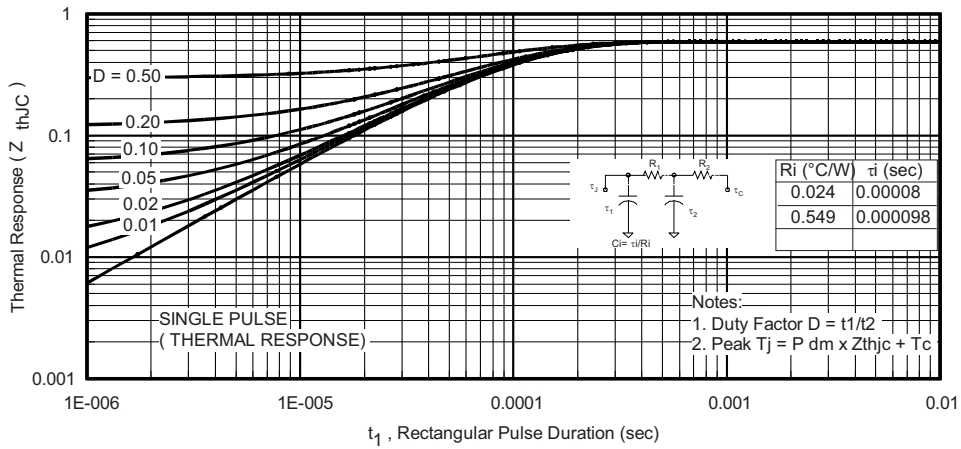


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

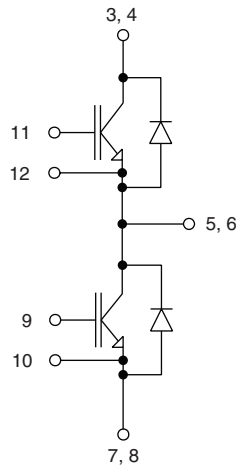


Fig. 25 - Electrical diagram



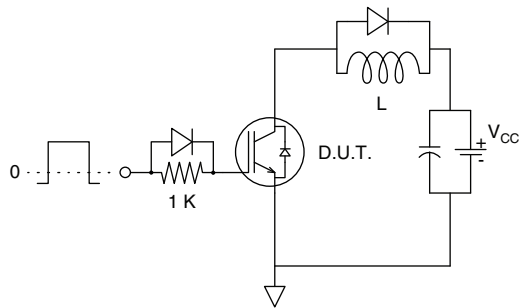


Fig. CT.1 - Gate Charge Circuit (Turn-Off)

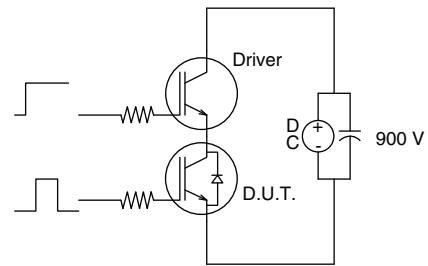


Fig. CT.3 - S.C. SOA Circuit

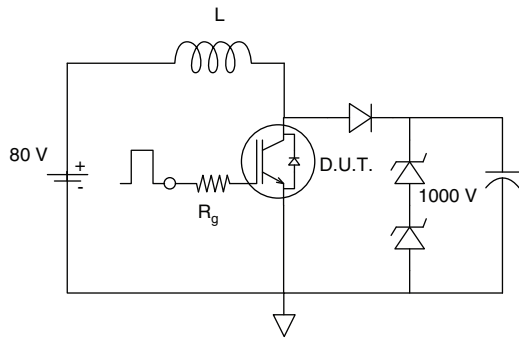


Fig. CT.2 - RBSOA Circuit

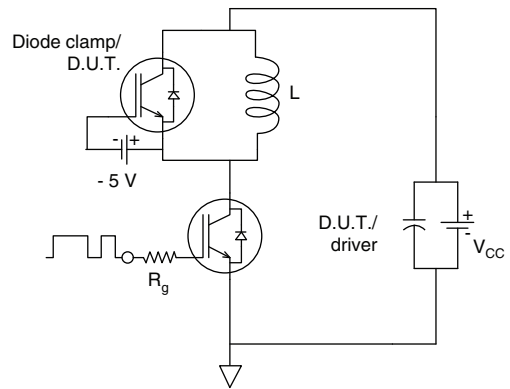


Fig. CT.4 - Switching Loss Circuit

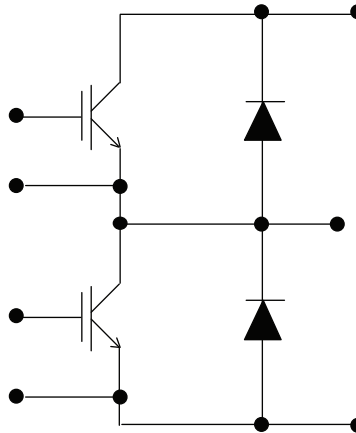


## ORDERING INFORMATION TABLE

Device code	<b>VS-</b>	<b>40</b>	<b>MT</b>	<b>120</b>	<b>U</b>	<b>H</b>	<b>A</b>	<b>PbF</b>
	①	②	③	④	⑤	⑥	⑦	⑧

- 1** - Vishay Semiconductors product
- 2** - Current rating (40 = 40 A)
- 3** - Essential part number
- 4** - Voltage code (120 = 1200 V)
- 5** - Speed/type (U = Ultrafast IGBT)
- 6** - Circuit configuration (H = Half bridge)
- 7** - A = Al<sub>2</sub>O<sub>3</sub> DBC substrate
- 8** - PbF = Lead (Pb)-free

## CIRCUIT CONFIGURATION

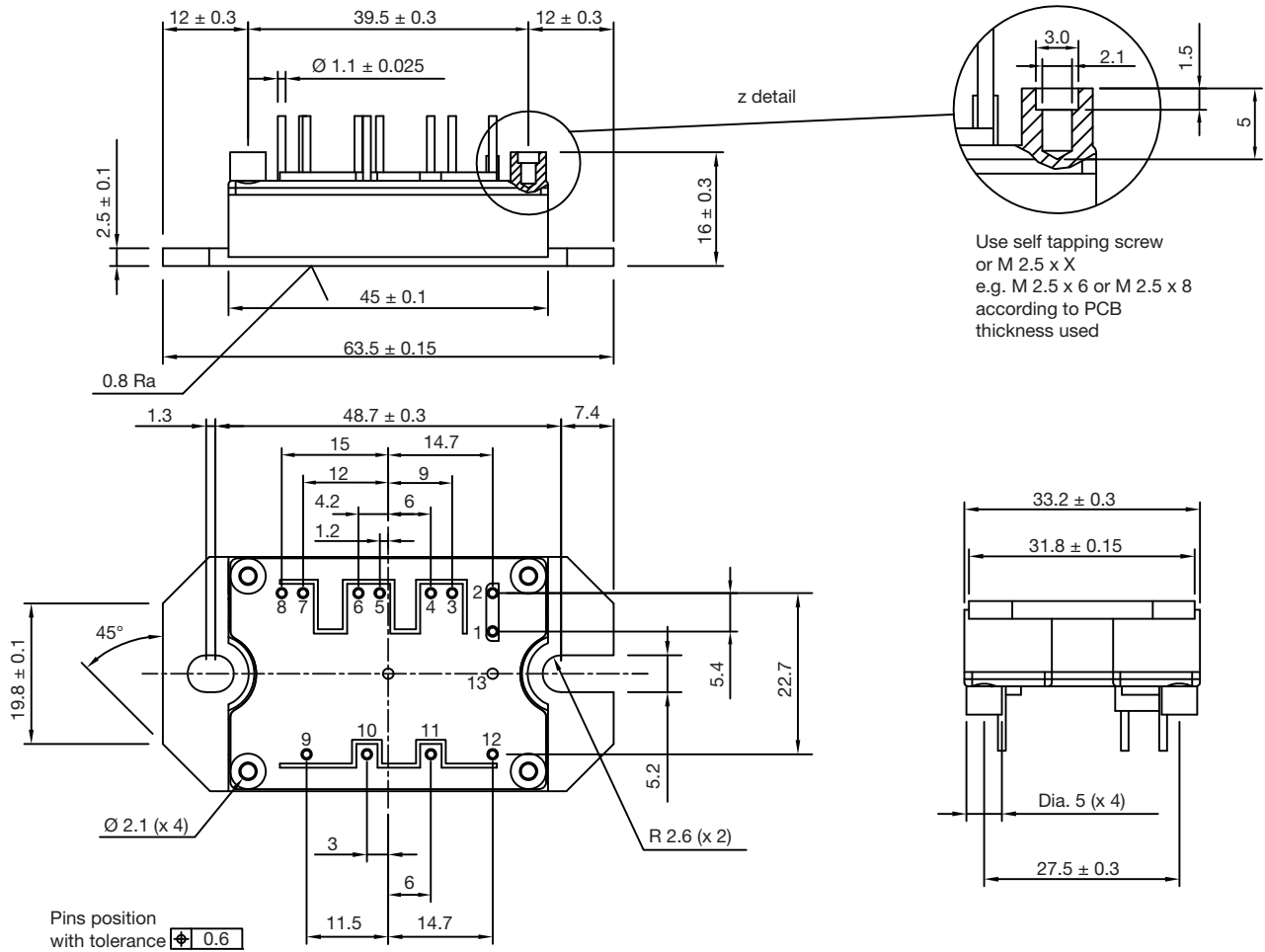


LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95175">www.vishay.com/doc?95175</a>



## MTP

**DIMENSIONS** in millimeters



Use self tapping screw or M 2.5 x X e.g. M 2.5 x 6 or M 2.5 x 8 according to PCB thickness used

### Note

- Unused terminals are not assembled in the package



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