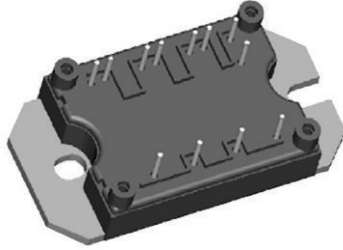



## “Half Bridge” MTP Trench IGBT, 75 A


**MTP**

### FEATURES

- Trench gate field stop technology
- Positive  $V_{CE(on)}$  temperature coefficient
- 5  $\mu$ 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?99912](http://www.vishay.com/doc?99912)


**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

### PRIMARY CHARACTERISTICS

$V_{CES}$	1200 V
$V_{CE(on)}$ typical at $I_C = 40$ A	2.24 V
$I_C$ at $T_C = 25$ °C	75 A
Speed	8 kHz to 30 kHz
Package	MTP
Circuit configuration	Half bridge

### 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	75	A
		$T_C = 102$ °C	40	
Pulsed collector current	$I_{CM}$	$T_J = 150$ °C, $t_p = 6$ ms, $V_{GE} = 15$ V	150	
Clamped inductive load current	$I_{LM}$		120	
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	305	W
		$T_C = 100$ °C	122	



<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	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 2\text{ mA}$	1200	-	-	V
Collector to emitter saturation voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$	-	2.24	2.65	V
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}$	-	2.84	-	
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	2.53	-	
		$V_{GE} = 15\text{ V}, I_C = 80\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	3.44	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$	4.6	5.9	7.6	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 2\text{ mA}$ ( $25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ )	-	-13	-	mV/ $^\circ\text{C}$
Transconductance	$g_{fe}$	$V_{CE} = 50\text{ V}, I_C = 40\text{ A}$	-	29	-	S
Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 25\text{ }^\circ\text{C}$	-	0.6	50	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.31	-	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	1.16	-	
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)	$Q_g$	$I_C = 40\text{ A}$ $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$	-	158	-	nC
Gate to emitter charge (turn-on)	$Q_{ge}$		-	17	-	
Gate to collector charge (turn-on)	$Q_{gc}$		-	85	-	
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	-	0.76	-	mJ
Turn-off switching loss	$E_{off}$		-	1.14	-	
Total switching loss	$E_{tot}$		-	1.9	-	
Turn-on switching loss	$E_{on}$		-	1.02	-	
Turn-off switching loss	$E_{off}$		-	1.83	-	
Total switching loss	$E_{tot}$	-	2.85	-		
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$ $V_{CC} = 25\text{ V}$ $f = 1.0\text{ MHz}$	-	3200	-	pF
Output capacitance	$C_{oes}$		-	220	-	
Reverse transfer capacitance	$C_{res}$		-	80	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 120\text{ A}$ $V_{CC} = 800\text{ V}, V_p = 1200\text{ V}$ $R_g = 10\text{ }\Omega, V_{GE} = +15\text{ V to }0\text{ V}$	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C},$ $V_{CC} = 600\text{ V}, V_p = 1200\text{ V}$ $V_{GE} = +15\text{ V to }0\text{ V}$	5	-	-	$\mu\text{s}$

<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	$V_{FM}$	$I_C = 40\text{ A}$	-	2.98	3.38	V
		$I_C = 80\text{ A}$	-	3.90	-	
		$I_C = 40\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.08	-	
		$I_C = 80\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	4.29	-	
		$I_C = 40\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	3.12	-	
Reverse recovery energy of the diode	$E_{rec}$	$V_{GE} = 15\text{ V}, R_g = 5\text{ }\Omega, L = 200\text{ }\mu\text{H}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $T_J = 125\text{ }^\circ\text{C}$	-	574	-	$\mu\text{J}$
Diode reverse recovery time	$t_{rr}$		-	120	-	ns
Peak reverse recovery current	$I_{rr}$		-	43	-	A



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Junction and storage temperature range	$T_J, T_{Stg}$		-40	-	150	°C
Junction to case	IGBT	$R_{thJC}$	-	-	0.41	°C/W
	Diode		-	-	0.61	
Case to sink per module	$R_{thCS}$		-	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

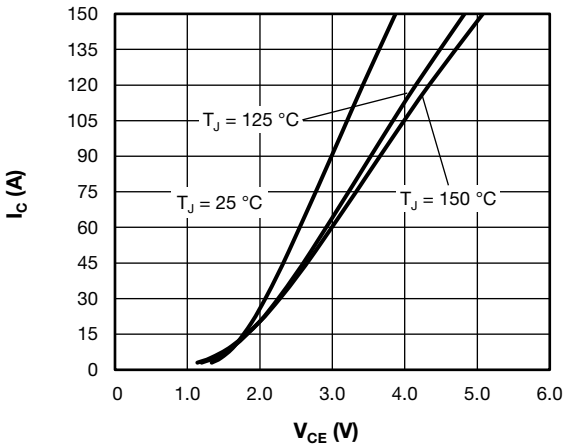


Fig. 1 - Typical Trench IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

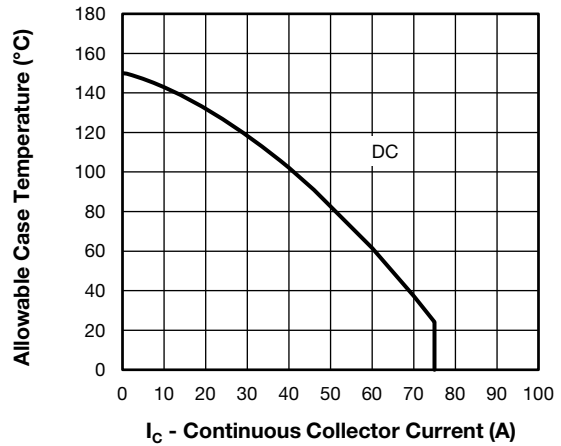


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

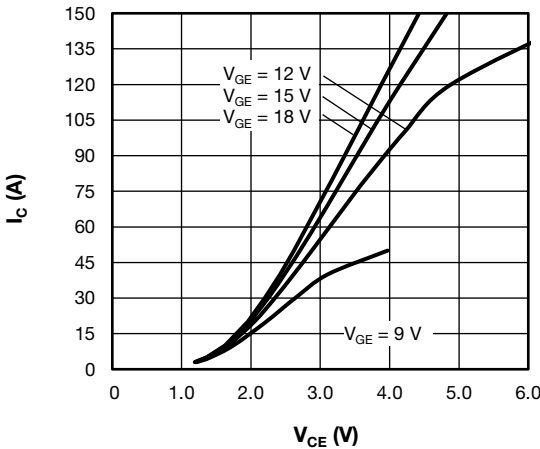


Fig. 2 - Typical Trench IGBT Output Characteristics,  $T_J = 125\text{ °C}$

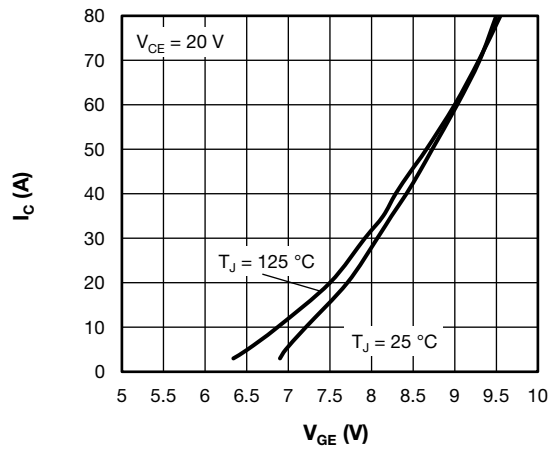


Fig. 4 - Typical Trench IGBT Transfer Characteristics

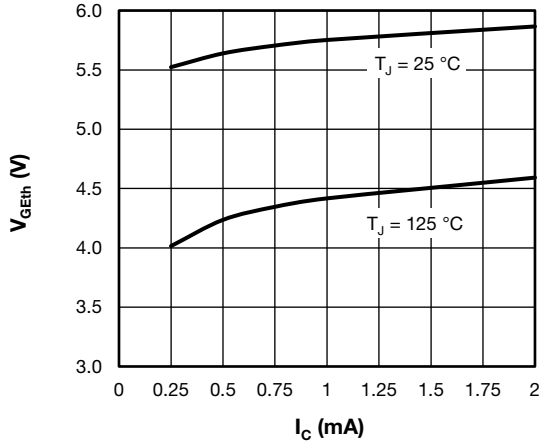


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

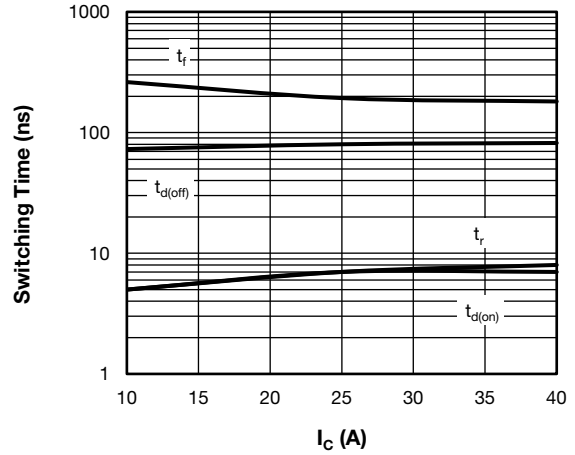


Fig. 8 - Typical Trench IGBT Switching Time vs.  $I_C$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

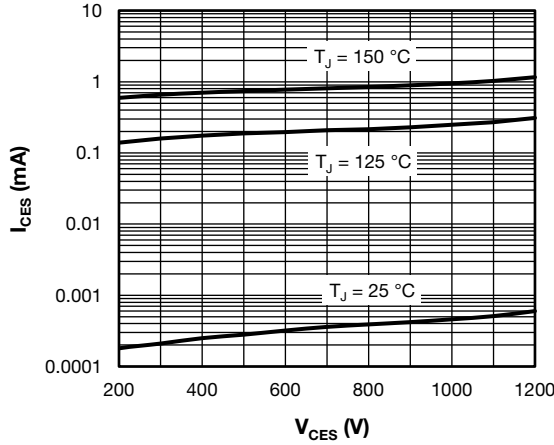


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

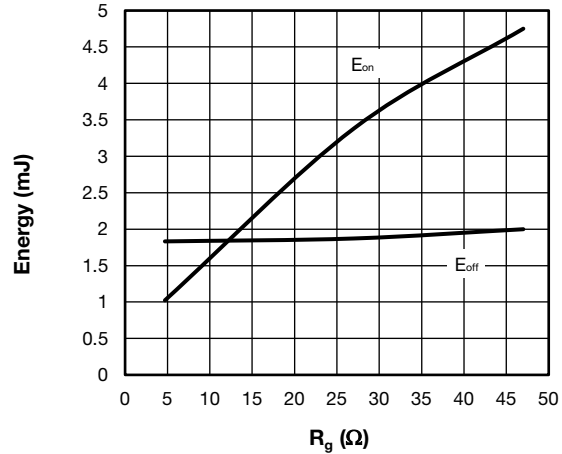


Fig. 9 - Typical Trench IGBT Energy Loss vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 40\text{ A}$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

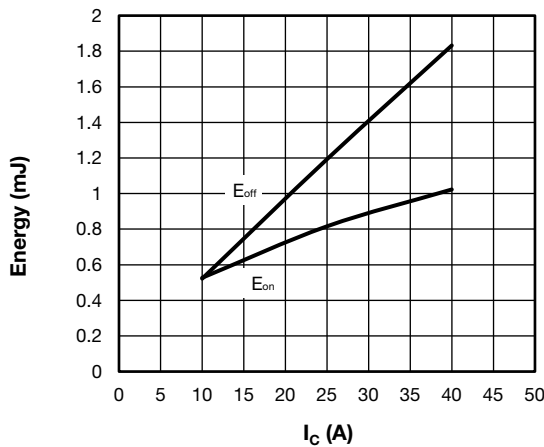


Fig. 7 - Typical Trench IGBT Energy Loss vs.  $I_C$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

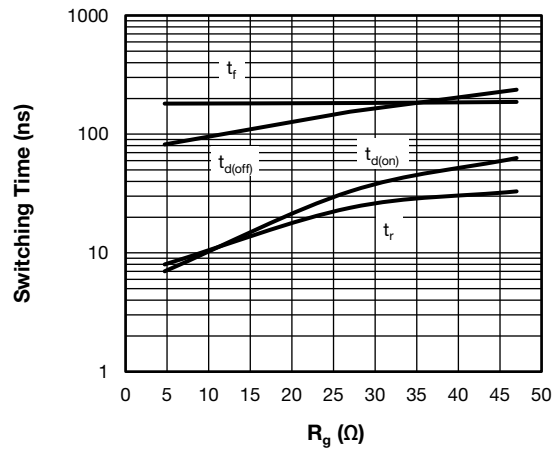


Fig. 10 - Typical Trench IGBT Switching Time vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ }^\circ\text{C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 40\text{ A}$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

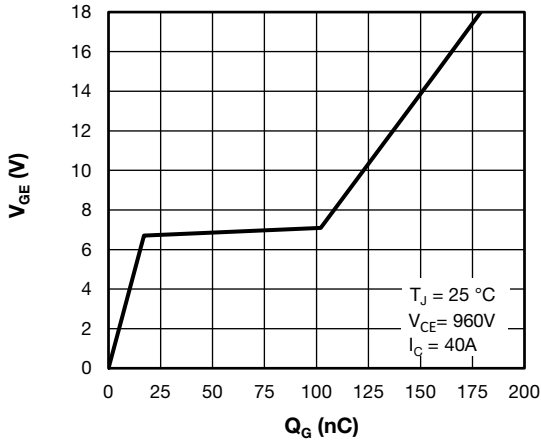


Fig. 11 - Typical Trench IGBT Gate Charge vs. Gate to Emitter Voltage

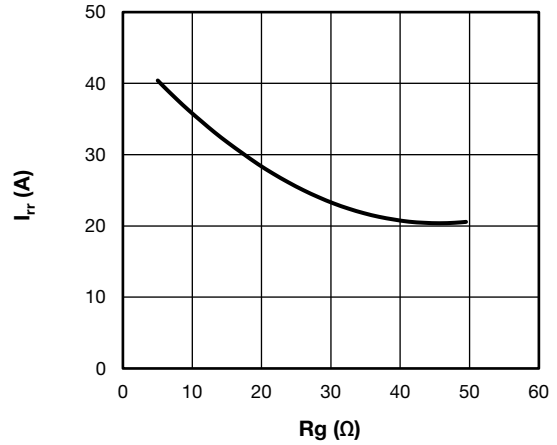


Fig. 14 - Typical Diode  $I_{rr}$  vs.  $R_g$   
 $T_J = 125\text{ °C}$ ;  $I_F = 40\text{ A}$

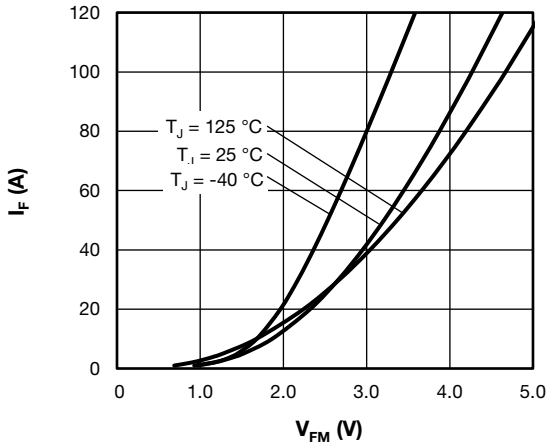


Fig. 12 - Typical Diode Forward Characteristics

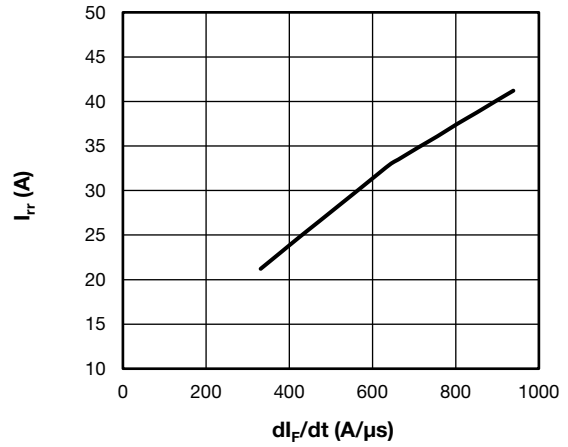


Fig. 15 - Typical Diode  $I_{rr}$  vs.  $di_F/dt$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $I_{CE} = 40\text{ A}$ ;  $T_J = 125\text{ °C}$

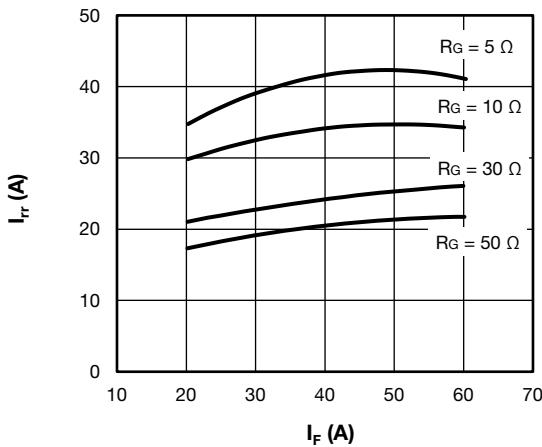


Fig. 13 - Typical Diode  $I_{rr}$  vs.  $I_F$ ,  
 $T_J = 125\text{ °C}$

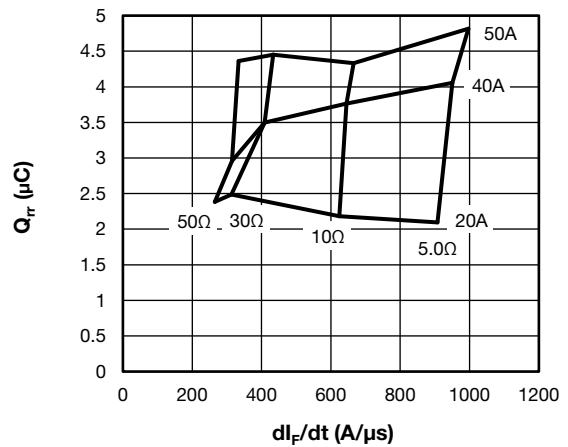


Fig. 16 - Typical Diode  $Q_{rr}$  vs.  $di_F/dt$   
 $V_{CC} = 600\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $T_J = 125\text{ °C}$

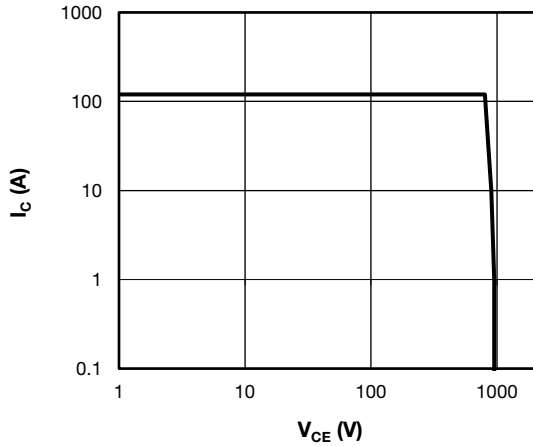


Fig. 17 - Trench IGBT Reverse BIAS SOA  
 $T_J = 150\text{ }^\circ\text{C}$ ,  $I_C = 120\text{ A}$ ,  $R_g = 10\ \Omega$ ,  $V_{GE} = +15\text{V} / 0\text{V}$ ,  $V_{CC} = 800\text{ V}$ ,  
 $V_p = 1200\text{ V}$

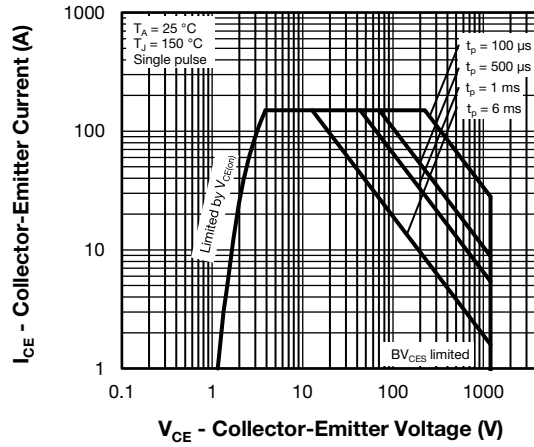


Fig. 18 - Trench IGBT Safe Operating Area

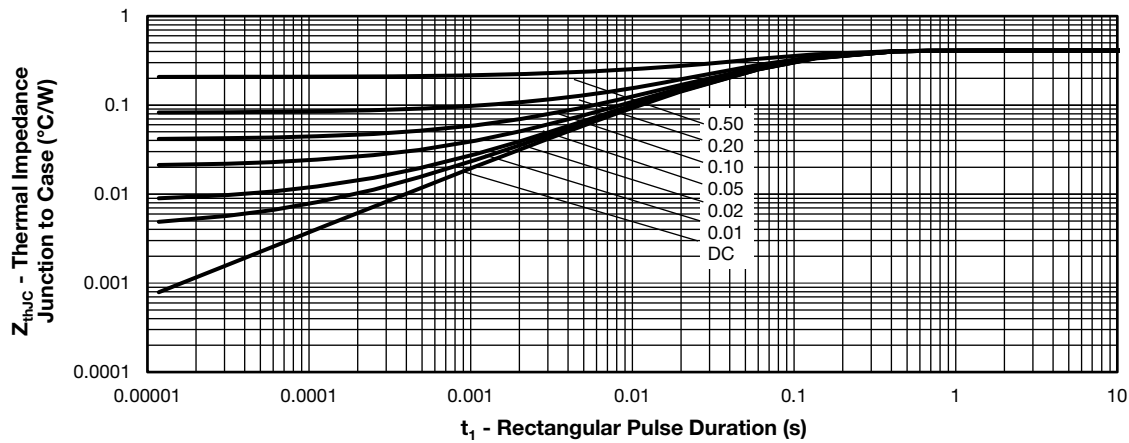


Fig. 19 - Maximum Trench IGBT Thermal Impedance  $Z_{thJC}$  Characteristics

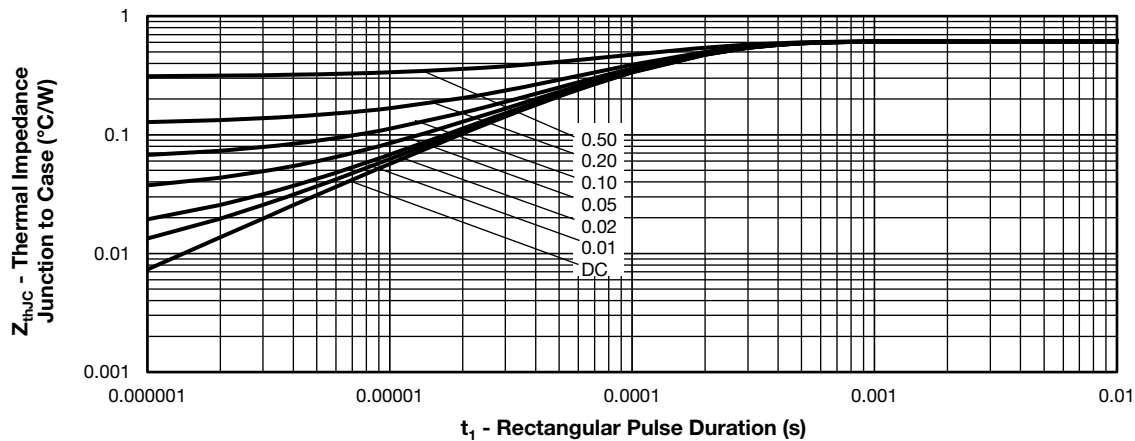


Fig. 20 - Maximum Diode Thermal Impedance  $Z_{thJC}$  Characteristics

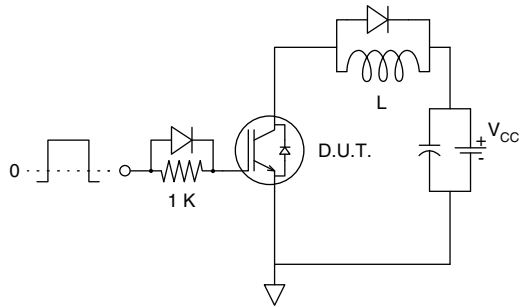


Fig. 21 - Gate Charge Circuit (Turn-Off)

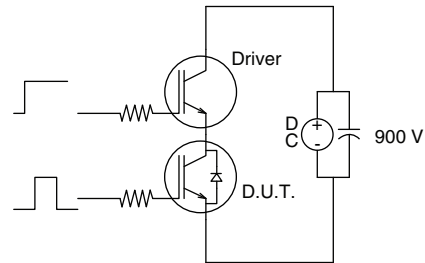


Fig. 23 - S.C. SOA Circuit

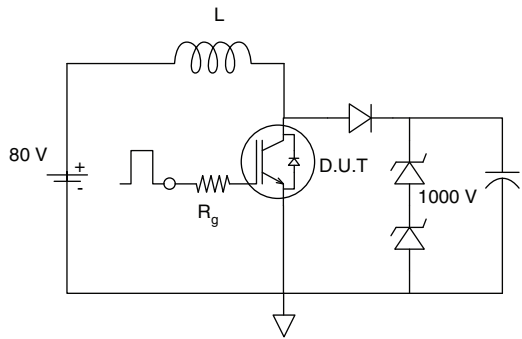


Fig. 22 - RBSOA Circuit

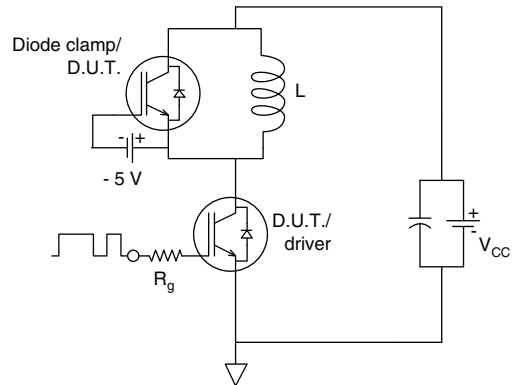


Fig. 24 - Switching Loss Circuit

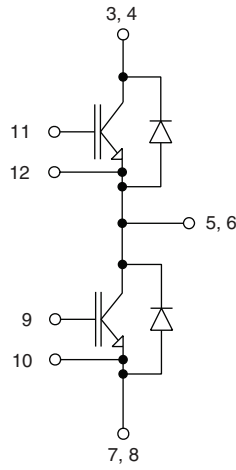
**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>40</b>	<b>MT</b>	<b>120</b>	<b>P</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 (P = trench 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

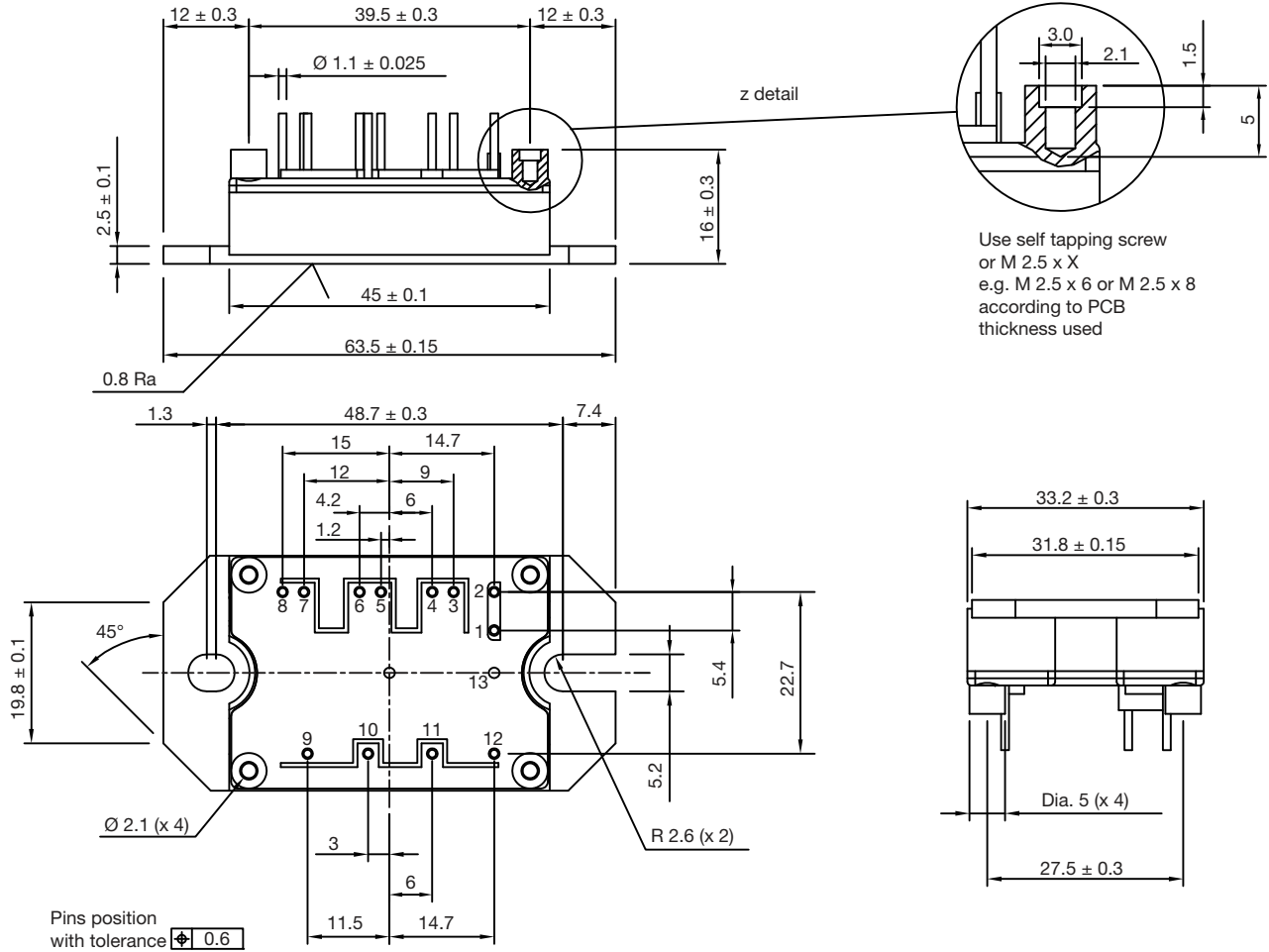
LINKS TO RELATED DOCUMENTS	
Dimensions	<a href="http://www.vishay.com/doc?95175">www.vishay.com/doc?95175</a>





### 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



## Disclaimer

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