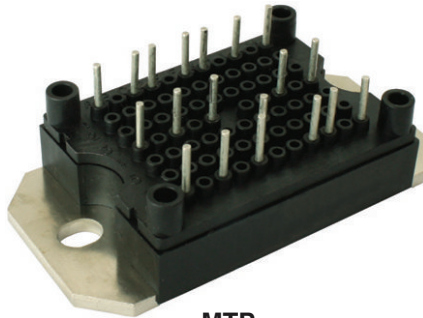



## “Full Bridge” IGBT MTP (TrenchStop IGBT), 57 A



MTP  
(Package example)

### FEATURES

- Trench and Field Stop IGBT technology
- Positive  $V_{CE(on)}$  temperature coefficient
- 10  $\mu$ 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](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT

### PRIMARY CHARACTERISTICS

$V_{CES}$	1200 V
$I_C$ at $T_C = 25\text{ }^\circ\text{C}$	57 A
$V_{CE(on)}$	1.84 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	$I_C$	$T_C = 25\text{ }^\circ\text{C}$	57	A
		$T_C = 80\text{ }^\circ\text{C}$	42	
Pulsed collector current	$I_{CM}$	$T_J = 150\text{ }^\circ\text{C}$ , $t_p = 6\text{ ms}$ , $V_{GE} = 15\text{ V}$	50	
Clamped inductive load current	$I_{LM}$		75	
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, $t = 1\text{ min}$	2500	
Maximum power dissipation (only IGBT)	$P_D$	$T_C = 25\text{ }^\circ\text{C}$	240	W
		$T_C = 80\text{ }^\circ\text{C}$	134	



<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	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}, I_C = 850\text{ }\mu\text{A}$	1200	-	-	V
Collector to emitter saturation voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}, I_C = 20\text{ A}$	-	1.84	2.16	V
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$	-	2.60	-	
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.06	-	
		$V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.19	-	
		$V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	2.12	-	
Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 850\text{ }\mu\text{A}$	4.7	5.8	6.8	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}, I_C = 0.85\text{ mA}$ ( $25\text{ }^\circ\text{C}$ to $125\text{ }^\circ\text{C}$ )	-	-12.1	-	mV/ $^\circ\text{C}$
Transconductance	$g_{fe}$	$V_{CE} = 20\text{ V}, I_C = 20\text{ A}$	-	13	-	S
Zero gate voltage collector current	$I_{CES}^{(1)}$	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 25\text{ }^\circ\text{C}$	-	1.0	200	$\mu\text{A}$
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	0.52	-	mA
		$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 150\text{ }^\circ\text{C}$	-	2.1	-	
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)	$Q_g$	$I_C = 20\text{ A}$	-	119	-	nC
Gate to emitter charge (turn-on)	$Q_{ge}$	$V_{CC} = 960\text{ V}$	-	20	-	
Gate to collector charge (turn-on)	$Q_{gc}$	$V_{GE} = 15\text{ V}$	-	57	-	
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	-	0.75	-	mJ
Turn-off switching loss	$E_{off}$		-	0.66	-	
Total switching loss	$E_{tot}$		-	1.41	-	
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	-	1.08	-	mJ
Turn-off switching loss	$E_{off}$		-	1.18	-	
Total switching loss	$E_{tot}$		-	2.26	-	
Input capacitance	$C_{ies}$	$V_{GE} = 0\text{ V}$	-	1430	-	pF
Output capacitance	$C_{oes}$	$V_{CC} = 30\text{ V}$	-	115	-	
Reverse transfer capacitance	$C_{res}$	$f = 1.0\text{ MHz}$	-	75	-	
Reverse bias safe operating area	RBSOA	$T_J = 150\text{ }^\circ\text{C}, I_C = 75\text{ A}, V_{CC} = 900\text{ V}, V_p = 1200\text{ V}, R_g = 4.7\text{ }\Omega, V_{GE} = +15\text{ V to }0\text{ V}, L = 500\text{ }\mu\text{H}$	Fullsquare			
Short circuit safe operating area	SCSOA	$T_J = 150\text{ }^\circ\text{C}, V_{CC} = 800\text{ V}, V_p = 1200\text{ V}, R_g = 5\text{ }\Omega, V_{GE} = +15\text{ V to }0\text{ V}$	-	-	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	-	
		$I_C = 20\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	2.44	-	
		$I_C = 40\text{ A}, T_J = 125\text{ }^\circ\text{C}$	-	3.45	-	
		$I_C = 20\text{ A}, T_J = 150\text{ }^\circ\text{C}$	-	2.21	-	
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	-	$\mu\text{J}$
Diode reverse recovery time	$t_{rr}$	$V_{CC} = 600\text{ V}, I_C = 20\text{ A}$	-	98	-	ns
Peak reverse recovery current	$I_{rr}$	$T_J = 125\text{ }^\circ\text{C}$	-	33	-	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	$R_{thJC}$	-	-	0.52	°C/W
	Diode		-	-	0.61	
Case to sink per module	$R_{thCS}$		-	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

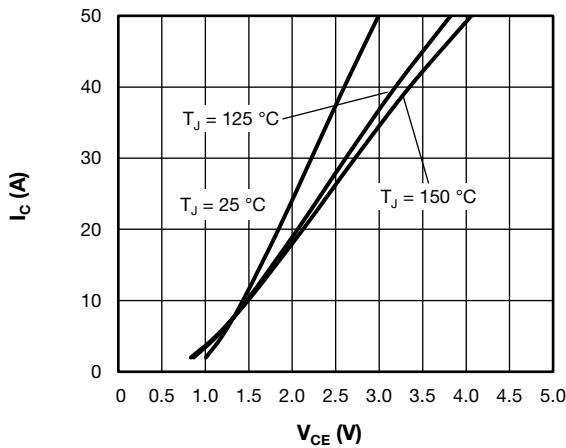


Fig. 1 - Typical Trench IGBT Output Characteristics,  $V_{GE} = 15\text{ V}$

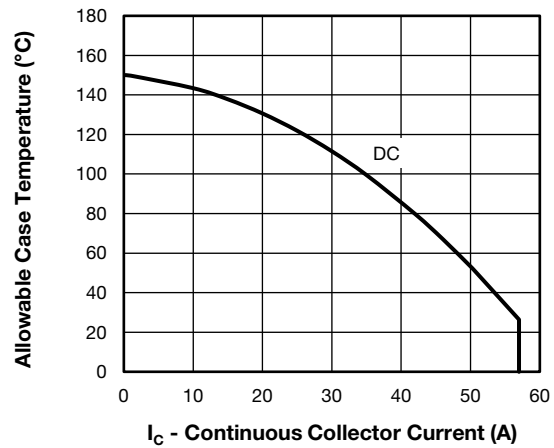


Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

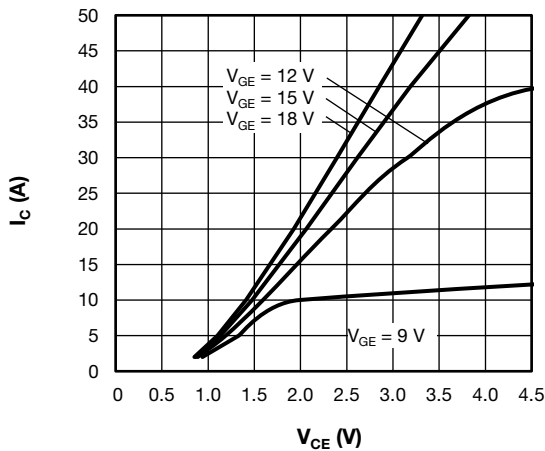


Fig. 2 - Typical Trench IGBT Output Characteristics,  $T_J = 125\text{ °C}$

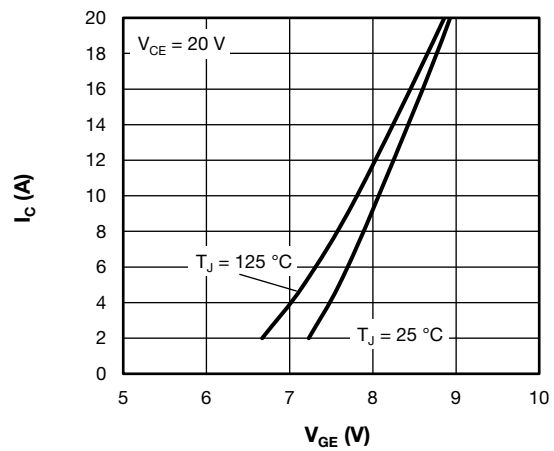


Fig. 4 - Typical Trench IGBT Transfer Characteristics

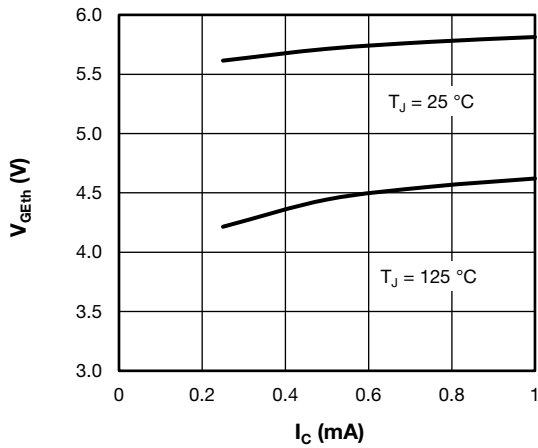


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

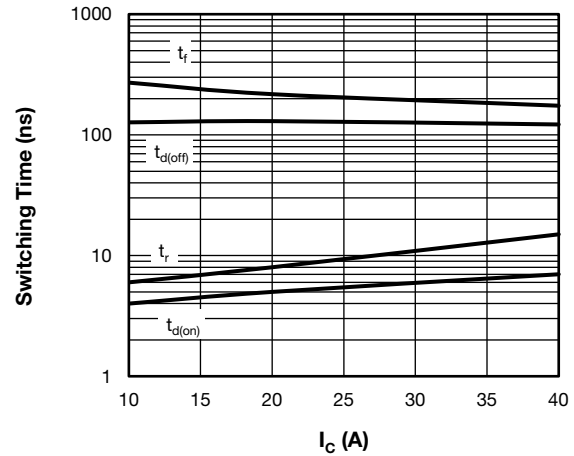


Fig. 8 - Typical Trench IGBT Switching Time vs.  $I_C$  (with Antiparallel Diode)

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

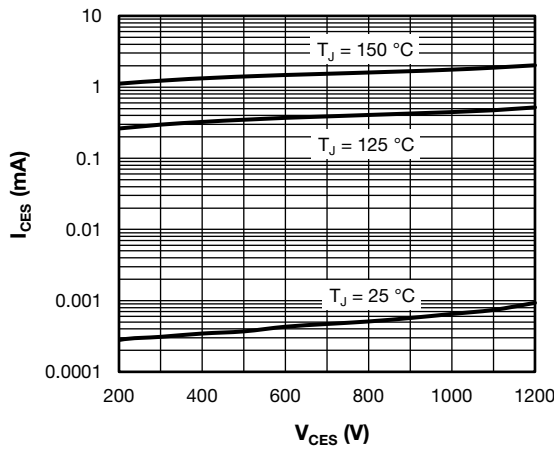


Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

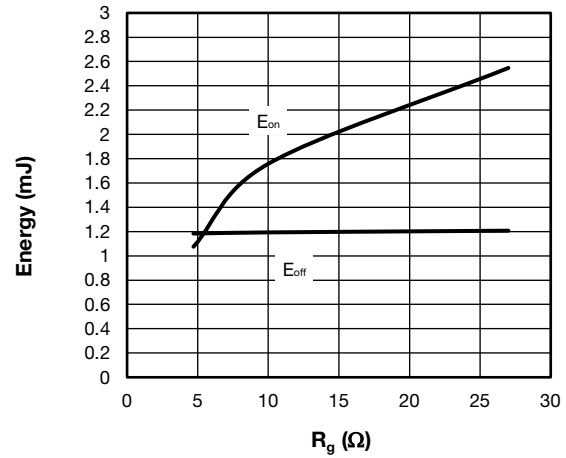


Fig. 9 - Typical Trench IGBT Energy Loss vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 20\text{ A}$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

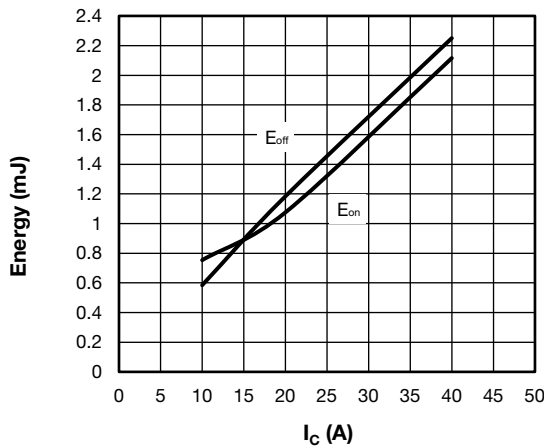


Fig. 7 - Typical Trench IGBT Energy Loss vs.  $I_C$  (with Antiparallel Diode)

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

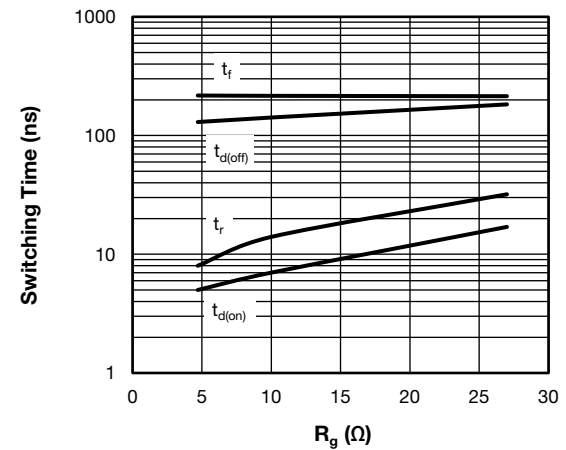


Fig. 10 - Typical Trench IGBT Switching Time vs.  $R_g$  (with Antiparallel Diode)

$T_J = 125\text{ °C}$ ,  $V_{CC} = 600\text{ V}$ ,  $I_C = 20\text{ A}$ ,  $V_{GE} = +15\text{V}/-15\text{V}$ ,  $L = 500\ \mu\text{H}$

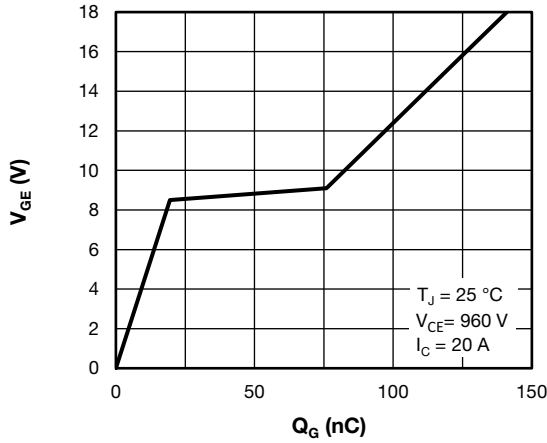


Fig. 11 - Typical Trench IGBT Gate charge vs. Gate to Emitter Voltage

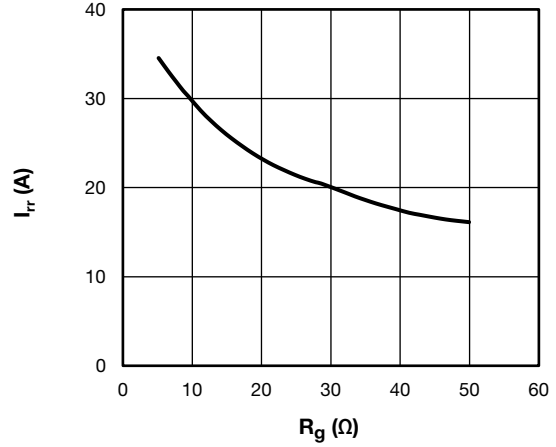


Fig. 14 - Typical Diode  $I_{rr}$  vs.  $R_g$   
 $T_J = 150\text{ }^\circ\text{C}$ ;  $I_F = 5.0\text{ A}$

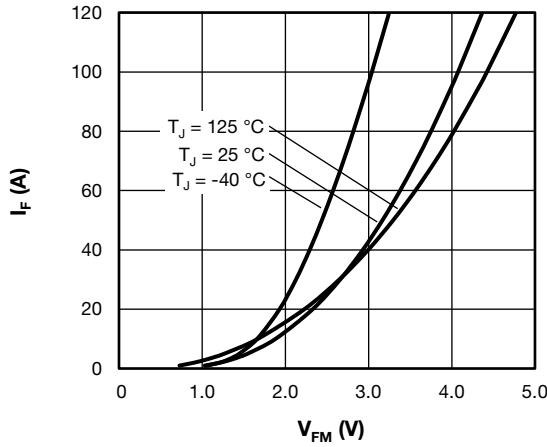


Fig. 12 - Typical Diode Forward Characteristics  
 $t_p = 80\text{ }\mu\text{s}$

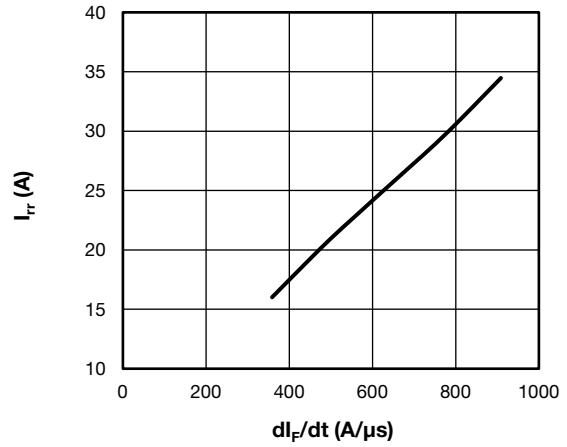


Fig. 15 - Typical Diode  $I_{rr}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $I_{CE} = 5.0\text{ A}$ ;  $T_J = 150\text{ }^\circ\text{C}$

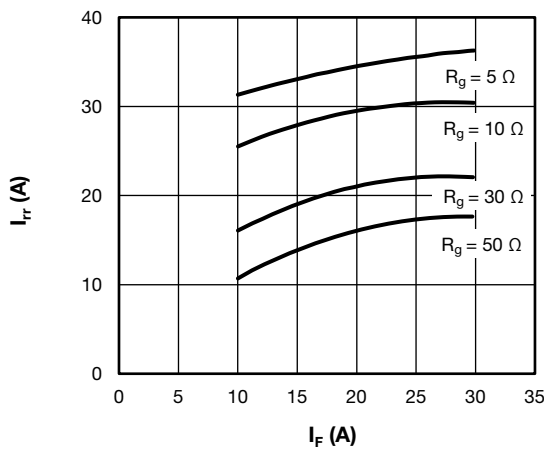


Fig. 13 - Typical Diode  $I_{rr}$  vs.  $I_F$ ,  
 $T_J = 150\text{ }^\circ\text{C}$

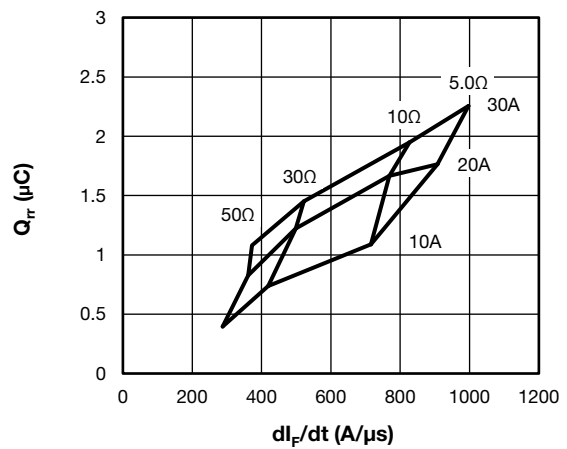


Fig. 16 - Typical Diode  $Q_{rr}$  vs.  $di_F/dt$   
 $V_{CC} = 400\text{ V}$ ;  $V_{GE} = 15\text{ V}$ ;  $T_J = 150\text{ }^\circ\text{C}$

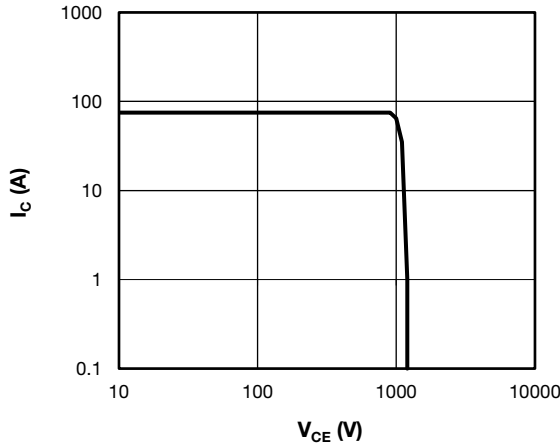


Fig. 17 - Trench IGBT Reverse BIAS SOA  
 $T_J = 150\text{ }^\circ\text{C}$ ,  $I_C = 75\text{ A}$ ,  $R_g = 4.7\ \Omega$ ,  $V_{GE} = +15\text{V}/0\text{ V}$ ,  $V_{CC} = 700\text{ V}$ ,  
 $V_p = 1200\text{ V}$

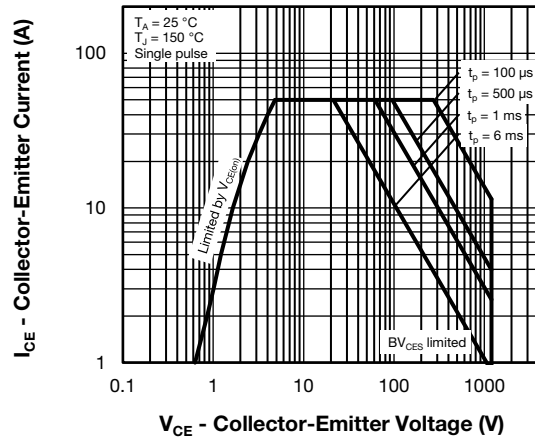


Fig. 18 - Trench IGBT Safe Operating Area

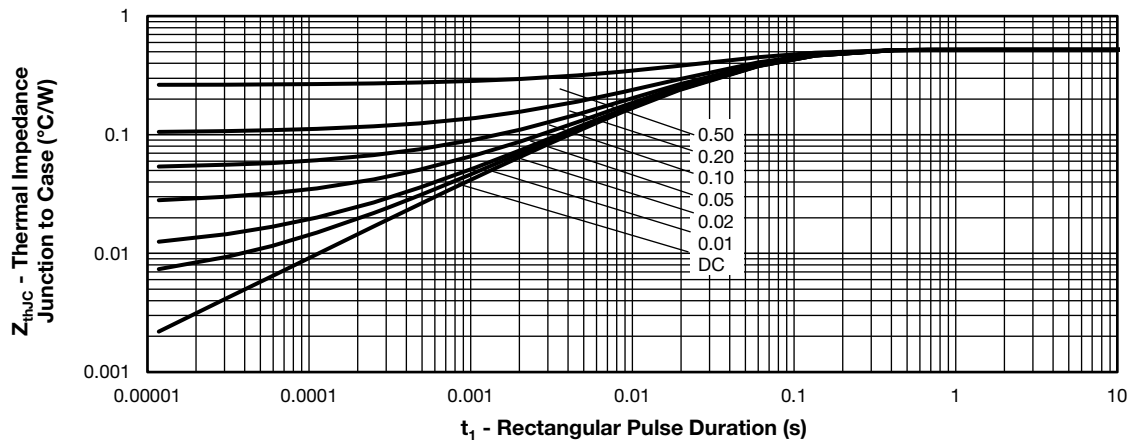


Fig. 19 - Maximum Trench IGBT Thermal Impedance  $Z_{thJC}$  Characteristics

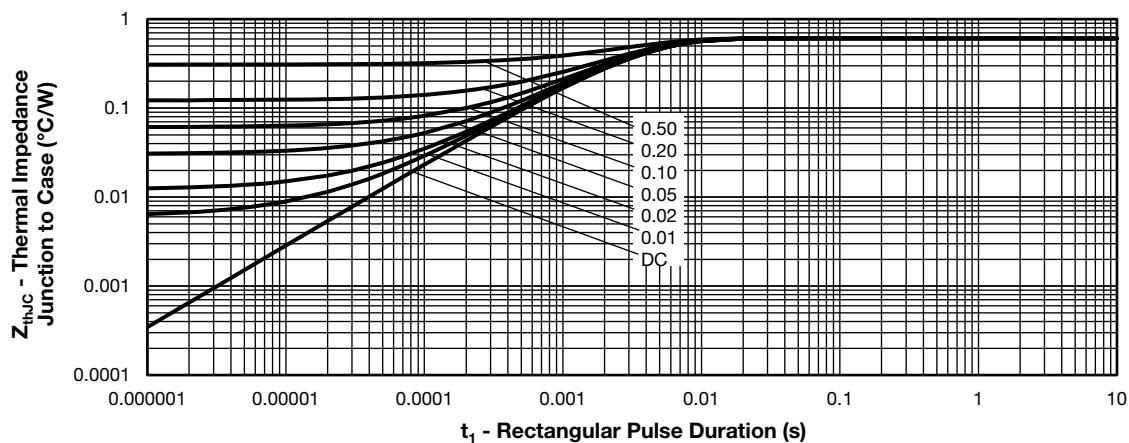


Fig. 20 - Maximum Diode Thermal Impedance  $Z_{thJC}$  Characteristics

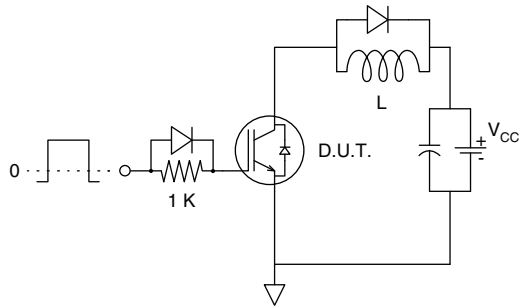


Fig. 21 - Gate Charge Circuit (Turn-Off)

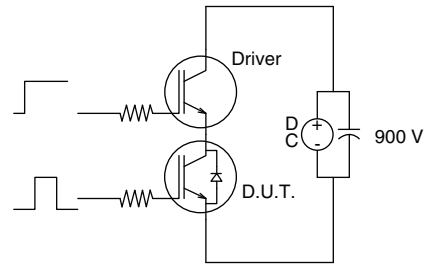


Fig. 23 - S.C. SOA Circuit

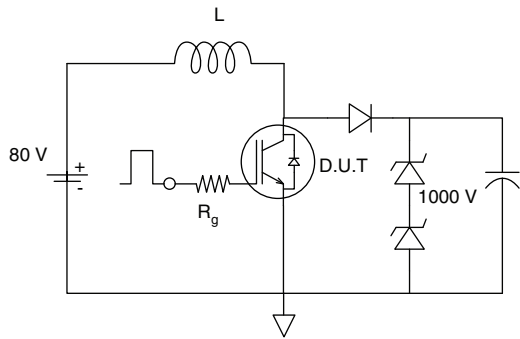


Fig. 22 - RBSOA Circuit

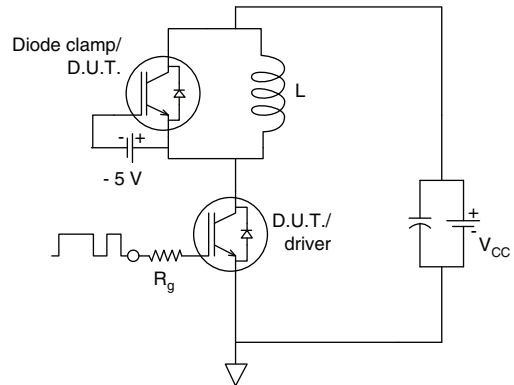


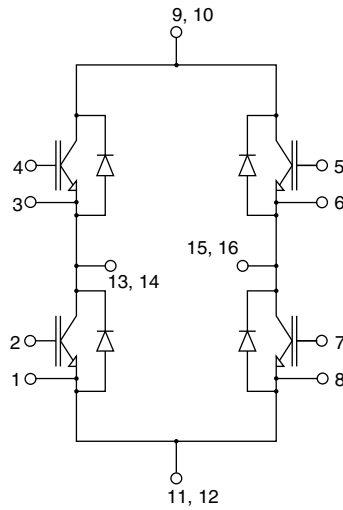
Fig. 24 - Switching Loss Circuit

**ORDERING INFORMATION TABLE**

Device code	<b>VS-</b>	<b>20</b>	<b>MT</b>	<b>120</b>	<b>P</b>	<b>F</b>	<b>P</b>
	①	②	③	④	⑤	⑥	⑦
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
	-	-	-	-	-	-	-
	Vishay Semiconductors product	Current rating (20 = 20 A)	Essential part number	Voltage code (120 = 1200 V)	Speed / type (P = Trench IGBT)	Circuit configuration (F = full bridge)	P = lead (Pb)-free



## CIRCUIT CONFIGURATION



### LINKS TO RELATED DOCUMENTS

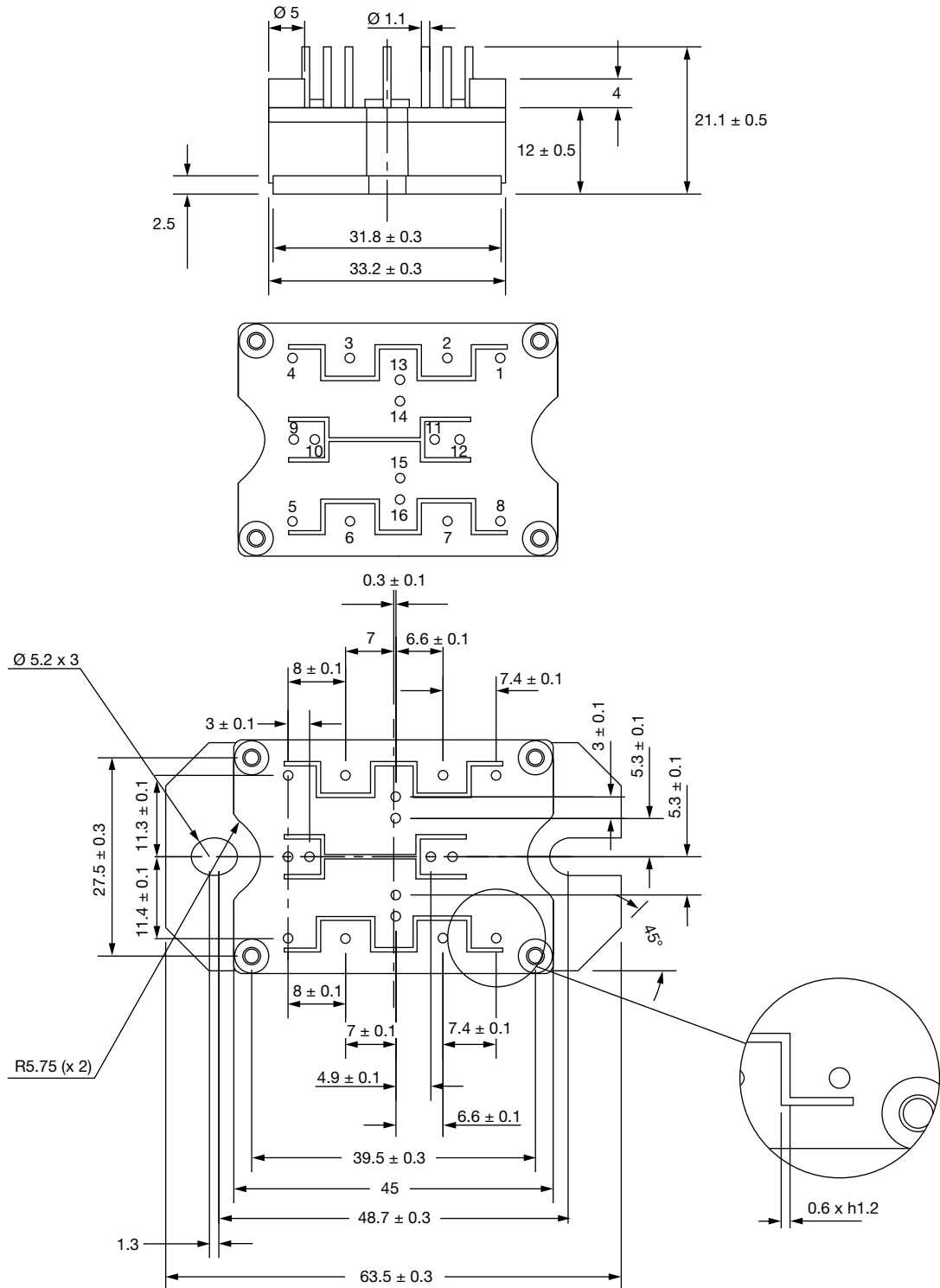
Dimensions	<a href="http://www.vishay.com/doc?95245">www.vishay.com/doc?95245</a>
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## MTP MOSFET / IGBT Full-Bridge

**DIMENSIONS** in millimeters



Tolerance (unless other stated):

X =  $\pm 0.3$

X.X =  $\pm 0.1$

X.XX =  $\pm 0.03$



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