


“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 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 $T_C = 25\text{ }^\circ\text{C}$	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	V
Gate to emitter voltage	V_{GE}		± 20	
RMS isolation voltage	V_{ISOL}	Any terminal to case, $t = 1\text{ min}$	2500	W
Maximum power dissipation (only IGBT)	P_D	$T_C = 25\text{ }^\circ\text{C}$	240	
		$T_C = 80\text{ }^\circ\text{C}$	134	

**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	$V_{(BR)CES}$	$V_{GE} = 0\text{ V}$, $I_C = 850\text{ }\mu\text{A}$	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	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	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}	$V_{GE} = \pm 20\text{ V}$	-	-	± 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	$I_C = 20\text{ A}$ $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$	-	119	-	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	20	-	
Gate to collector charge (turn-on)	Q_{gc}		-	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}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	-	1430	-	pF
Output capacitance	C_{oes}		-	115	-	
Reverse transfer capacitance	C_{res}		-	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 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 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	-	
		$I_C = 20\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	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}	$V_{GE} = 15\text{ V}$, $R_g = 5\text{ }\Omega$, $L = 200\text{ }\mu\text{H}$ $V_{CC} = 600\text{ V}$, $I_C = 20\text{ A}$ $T_J = 125\text{ }^{\circ}\text{C}$	-	420	-	μJ
Diode reverse recovery time	t_{rr}		-	98	-	ns
Peak reverse recovery current	I_{rr}		-	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 Diode R_{thJC}		-	-	0.52	°C/W
			-	-	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.	$3 \pm 10\%$			Nm
Weight			66			g

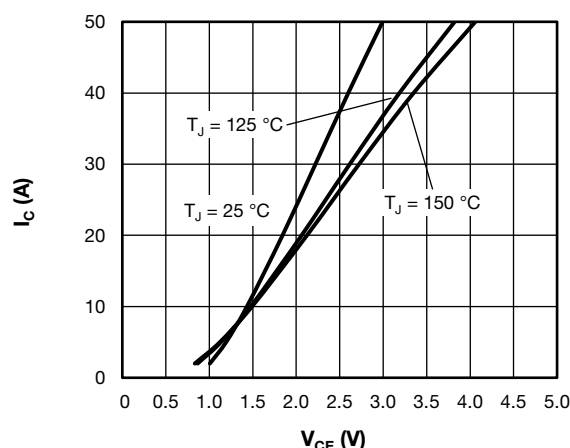
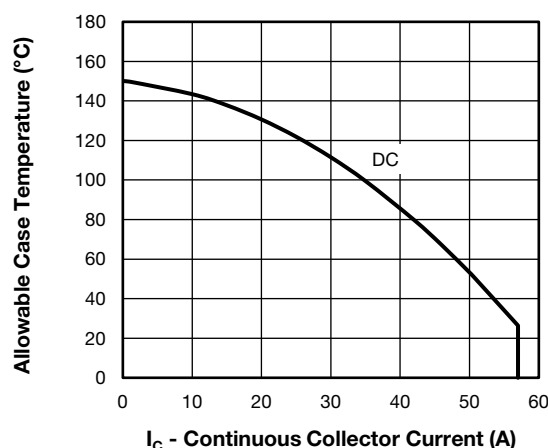

Fig. 1 - Typical Trench IGBT Output Characteristics, $V_{GE} = 15\text{ V}$


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

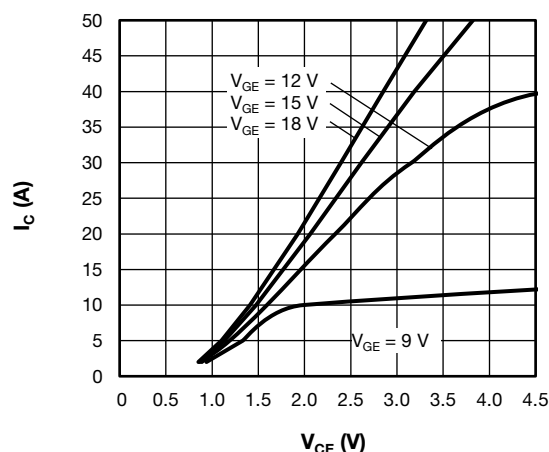
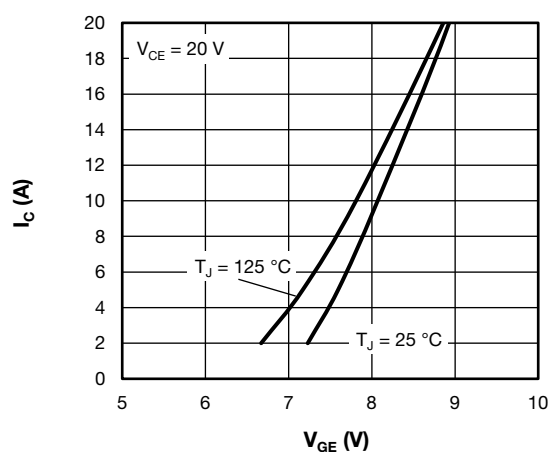

Fig. 2 - Typical Trench IGBT Output Characteristics, $T_J = 125\text{ °C}$


Fig. 4 - Typical Trench IGBT Transfer Characteristics

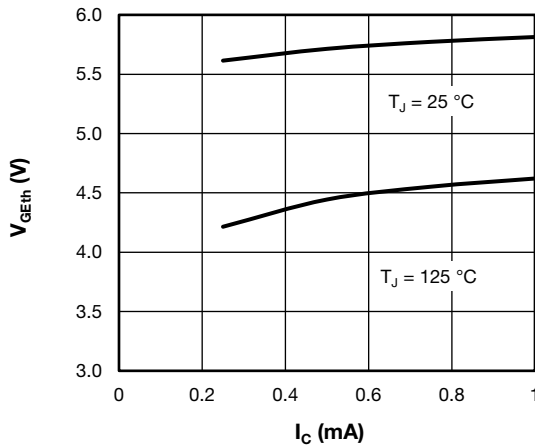
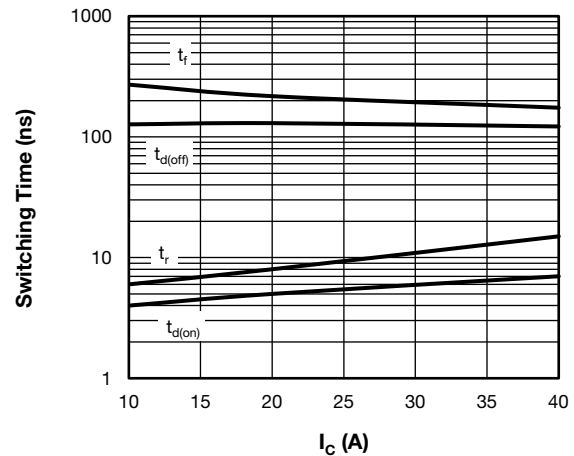


Fig. 5 - Typical Trench IGBT Gate Threshold Voltage


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

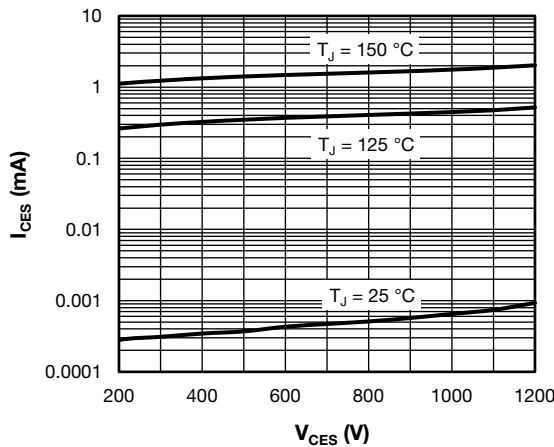
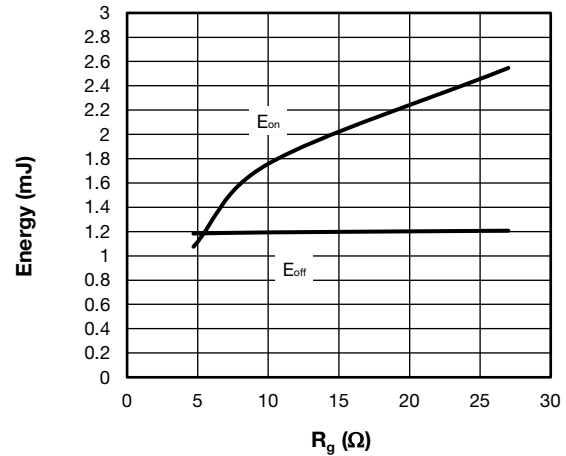
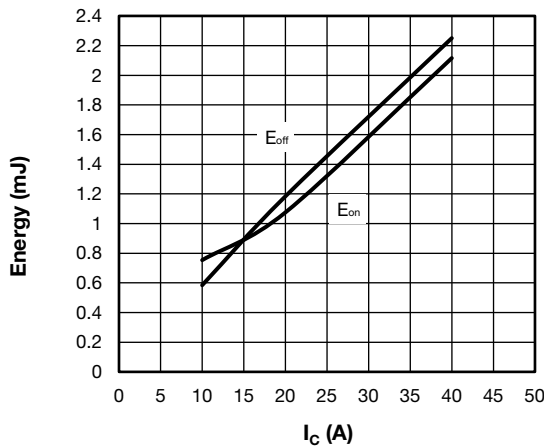
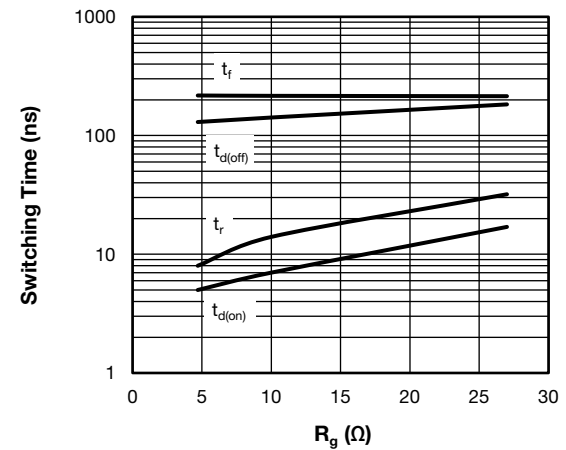
 $T_J = 125\text{ °C}$, $V_{CC} = 600\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{V}/-15\text{V}$, $L = 500\text{ }\mu\text{H}$


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


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

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

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

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

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

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

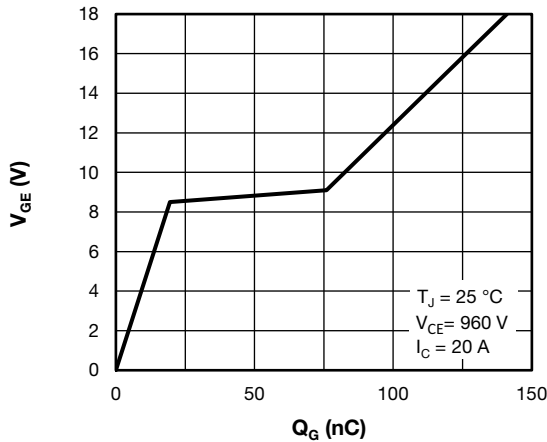


Fig. 11 - Typical Trench IGBT Gate charge vs. Gate to Emitter Voltage

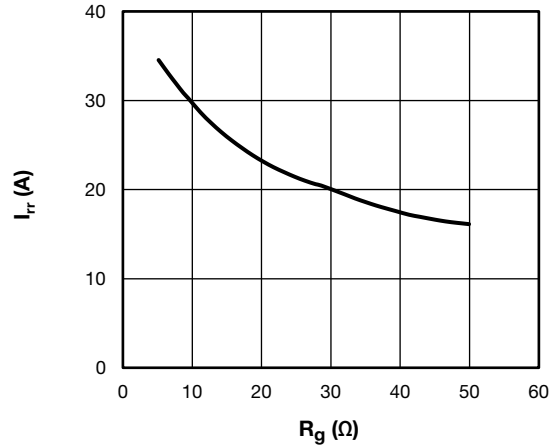


Fig. 14 - Typical Diode I_{rr} vs. R_g
 $T_J = 150\text{ °C}$; $I_F = 5.0\text{ A}$

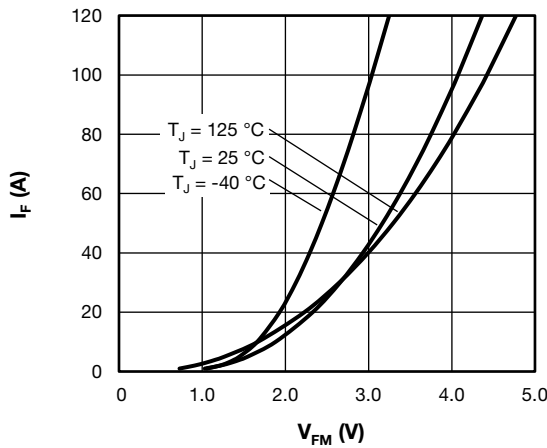


Fig. 12 - Typical Diode Forward Characteristics
 $t_p = 80\text{ }\mu\text{s}$

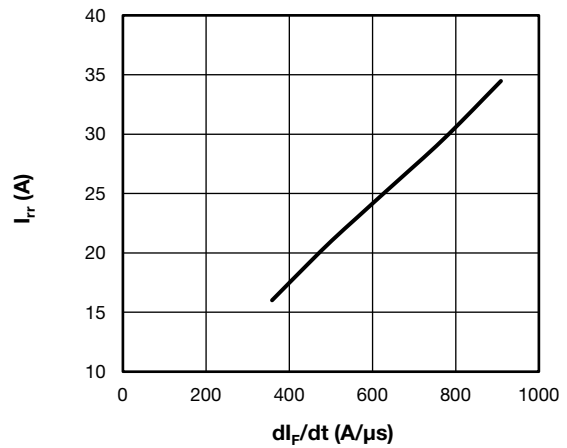


Fig. 15 - Typical Diode I_{rr} vs. di_F/dt
 $V_{CC} = 400\text{ V}$; $V_{GE} = 15\text{ V}$; $I_{CE} = 5.0\text{ A}$; $T_J = 150\text{ °C}$

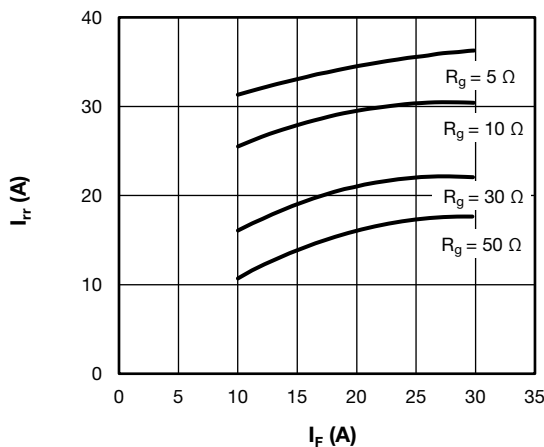


Fig. 13 - Typical Diode I_{rr} vs. I_F ,
 $T_J = 150\text{ °C}$

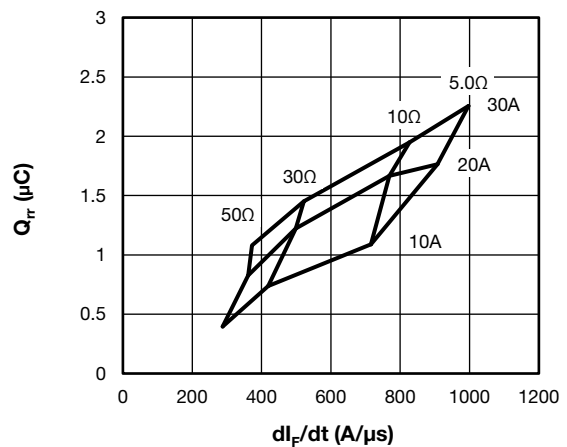


Fig. 16 - Typical Diode Q_{rr} vs. di_F/dt
 $V_{CC} = 400\text{ V}$; $V_{GE} = 15\text{ V}$; $T_J = 150\text{ °C}$

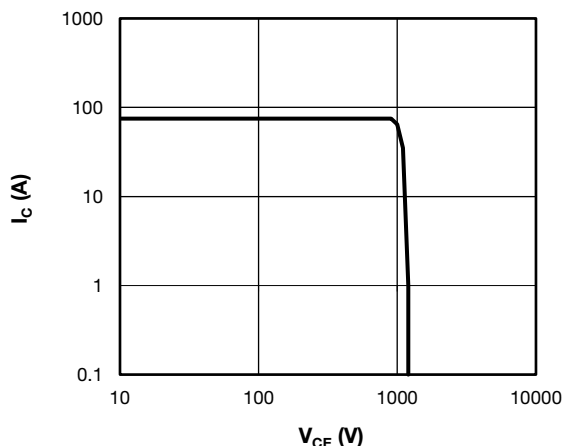


Fig. 17 - Trench IGBT Reverse BIAS SOA
 $T_J = 150\text{ }^{\circ}\text{C}$, $I_C = 75\text{ A}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = +15\text{V}/0\text{ V}$, $V_{CC} = 700\text{ V}$,
 $V_p = 1200\text{ V}$

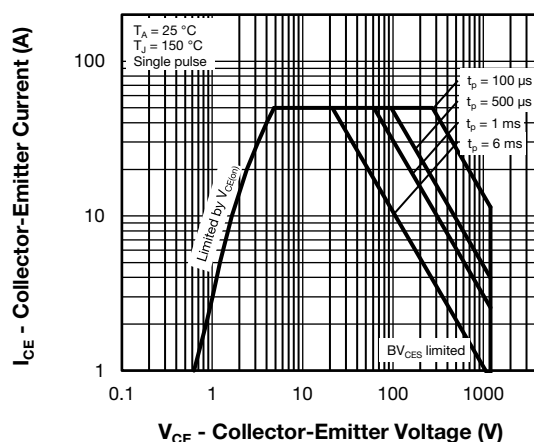


Fig. 18 - Trench IGBT Safe Operating Area

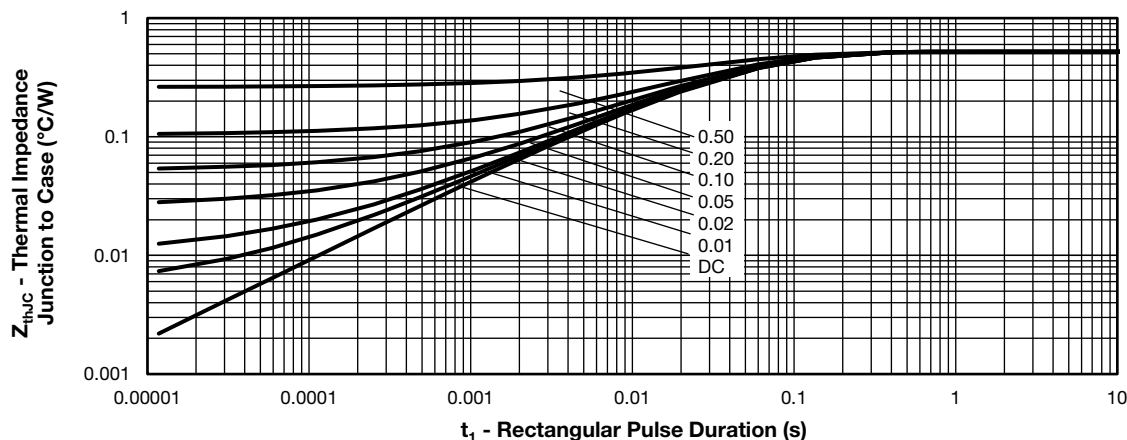


Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

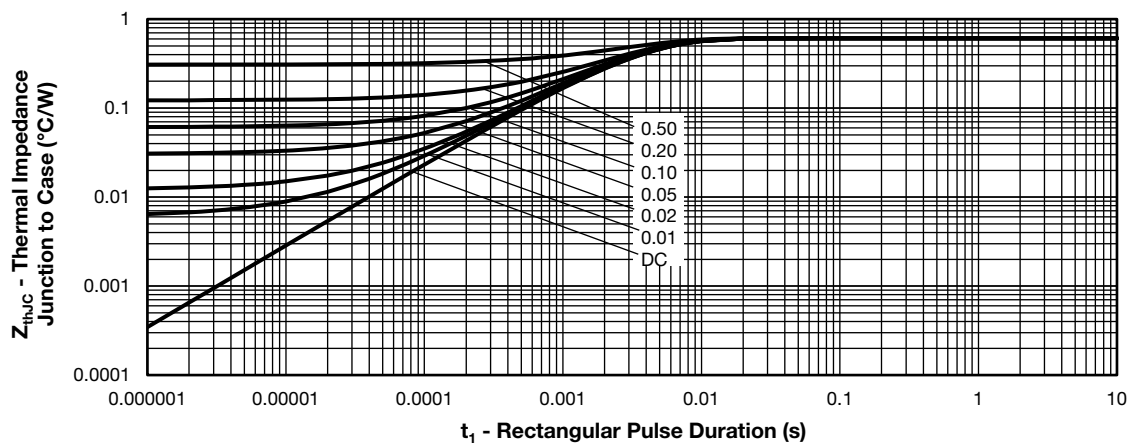


Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

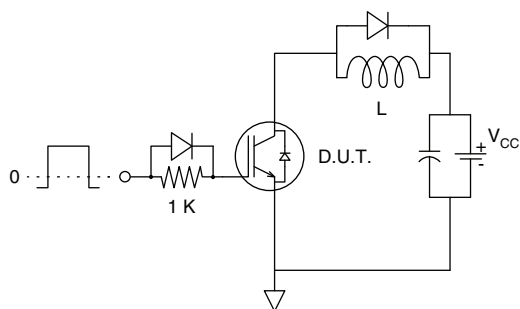


Fig. 21 - Gate Charge Circuit (Turn-Off)

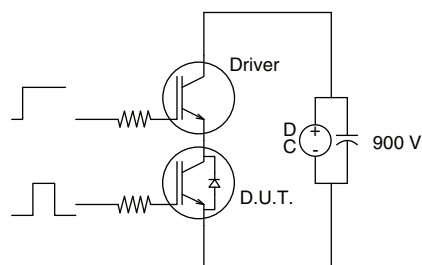


Fig. 23 - S.C. SOA Circuit

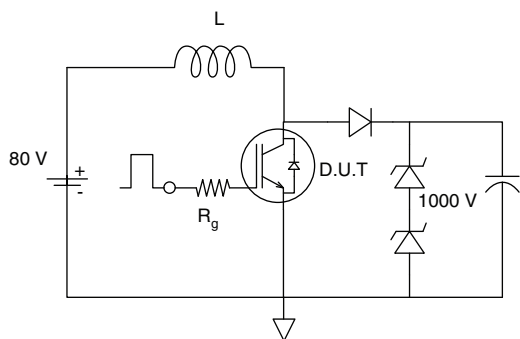


Fig. 22 - RBSOA Circuit

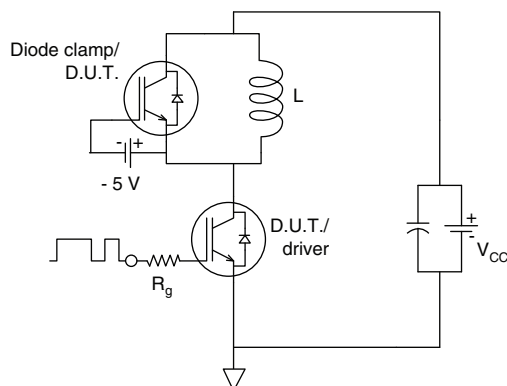


Fig. 24 - Switching Loss Circuit

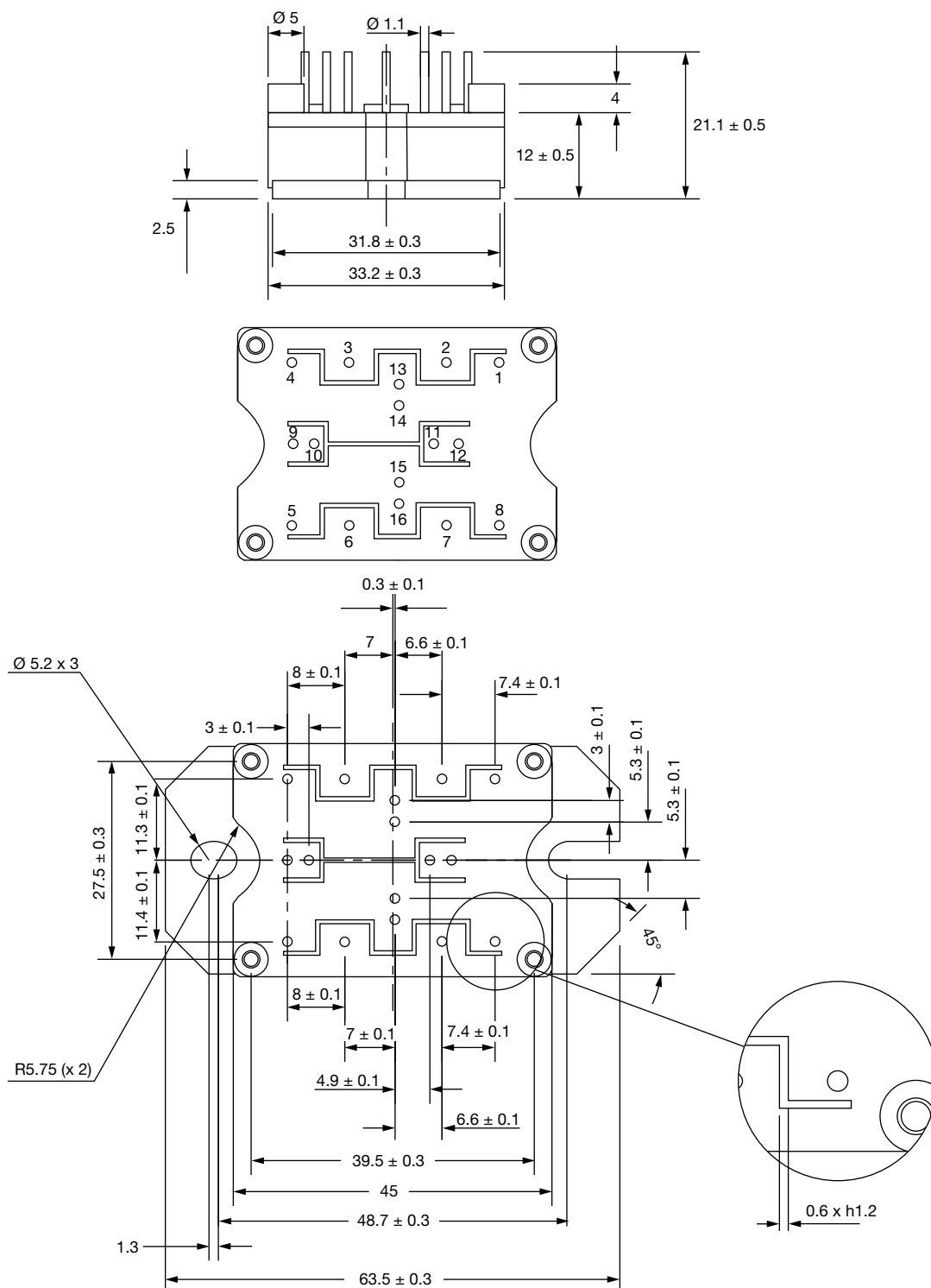
ORDERING INFORMATION TABLE

Device code	VS-	20	MT	120	P	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 (P = Trench IGBT)						
6	Circuit configuration (F = full bridge)						
7	P = lead (Pb)-free						



MTP MOSFET / IGBT Full-Bridge

DIMENSIONS in millimeters



Tolerance (unless other stated):

X = ± 0.3

X.X = ± 0.1

X.XX = ± 0.03



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