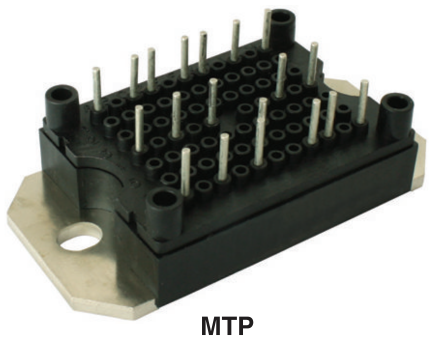
"Full Bridge" IGBT MTP (TrenchStop IGBT), 57 A



MTP
(Package example)

FEATURES

- Trench and Field Stop IGBT technology
- Positive $V_{CE(on)}$ temperature coefficient
- 10 μs 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

Pb-free

RoHS COMPLIANT

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

PRIMARY CHARACTERISTICS	
V_{CES}	1200 V
I_C at T_C = 25 °C	57 A
$V_{CE(on)}$	1.84 V
Speed	8 kHz to 30 kHz
Package	MTP
Circuit configuration	Full bridge

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	57	A
		T_C = 80 °C	42	
Pulsed collector current	I_{CM}	T_J = 150 °C, t_p = 6 ms, V_{GE} = 15 V	50	
Clamped inductive load current	I_{LM}		75	
Diode continuous forward current	I_F	T_C = 106 °C	25	
Diode maximum forward current	I_{FM}		100	
Gate to emitter voltage	V_{GE}		± 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	240	W
		T_C = 80 °C	134	

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ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Collector to emitter breakdown voltage	$V_{(BR)CES}$	V_{GE} = 0 V, I_C = 850 μA	1200	-	-	V
Collector to emitter saturation voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 20 A	-	1.84	2.16	V
		V_{GE} = 15 V, I_C = 40 A	-	2.60	-	
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C	-	2.06	-	
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C	-	3.19	-	
		V_{GE} = 15 V, I_C = 20 A, T_J = 150 °C	-	2.12	-	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 850 μA	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 mA (25 °C to 125 °C)	-	-12.1	-	mV/°C
Transconductance	g_{fe}	V_{CE} = 20 V, I_C = 20 A	-	13	-	S
Zero gate voltage collector current	I_{CES} (1)	V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 25 °C	-	1.0	200	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.52	-	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	2.1	-	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 250	nA

Note

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

SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Total gate charge (turn-on)	Q_g	I_C = 20 A V_{CC} = 960 V V_{GE} = 15 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 V, I_C = 20 A, V_{GE} = 15 V, R_g = 5 Ω, L = 1 mH, T_J = 25 °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 V, I_C = 20 A, V_{GE} = 15 V, R_g = 5 Ω, L = 1 mH, T_J = 125 °C, energy losses include tail and diode reverse recovery	-	1.08	-	
Turn-off switching loss	E_{off}		-	1.18	-	
Total switching loss	E_{tot}		-	2.26	-	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1.0 MHz	-	1430	-	pF
Output capacitance	C_{oes}		-	115	-	
Reverse transfer capacitance	C_{res}		-	75	-	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 75 A, V_{CC} = 900 V, V_p = 1200 V, R_g = 4.7 Ω, V_{GE} = + 15 V to 0 V, L = 500 μH	Fullsquare			
Short circuit safe operating area	SCSOA	T_J = 150 °C, V_{CC} = 800 V, V_p = 1200 V, R_g = 5 Ω, V_{GE} = +15 V to 0 V	-	-	10	μs

DIODE SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Diode forward voltage drop	V_{FM}	I_C = 20 A	-	2.48	2.94	V
		I_C = 40 A	-	3.28	-	
		I_C = 20 A, T_J = 125 °C	-	2.44	-	
		I_C = 40 A, T_J = 125 °C	-	3.45	-	
		I_C = 20 A, T_J = 150 °C	-	2.21	-	
Reverse recovery energy of the diode	E_{rec}	V_{GE} = 15 V, R_g = 5 Ω, L = 200 μH V_{CC} = 600 V, I_C = 20 A T_J = 125 °C	-	420	-	μJ
Diode reverse recovery time	t_{rr}		-	98	-	ns
Peak reverse recovery current	I_{rr}		-	33	-	A

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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

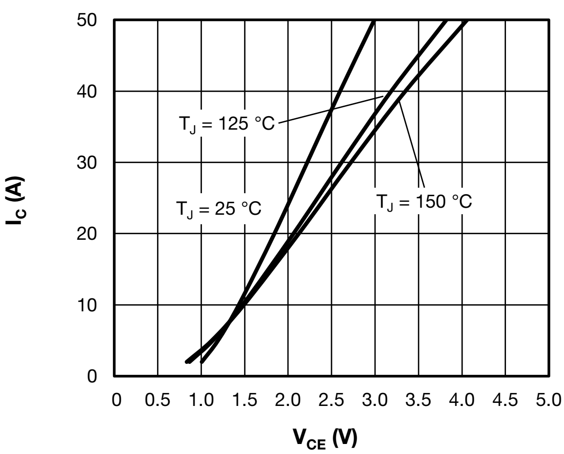

Fig. 1 - Typical Trench IGBT Output Characteristics, V_{GE} = 15 V

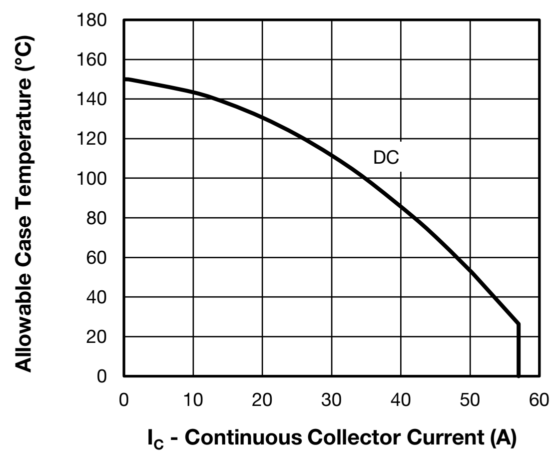

Fig. 3 - Maximum Trench IGBT Continuous Collector Current vs. Case Temperature

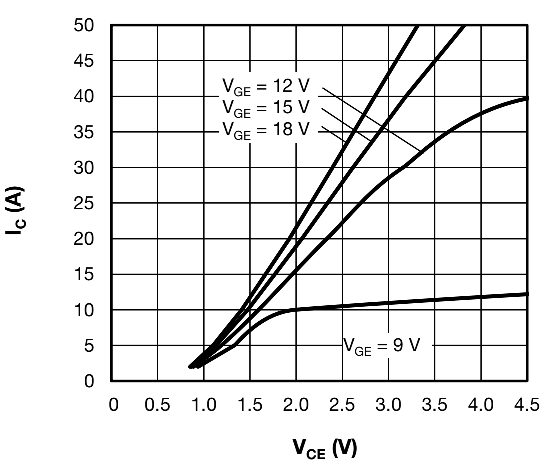

Fig. 2 - Typical Trench IGBT Output Characteristics, T_J = 125 °C

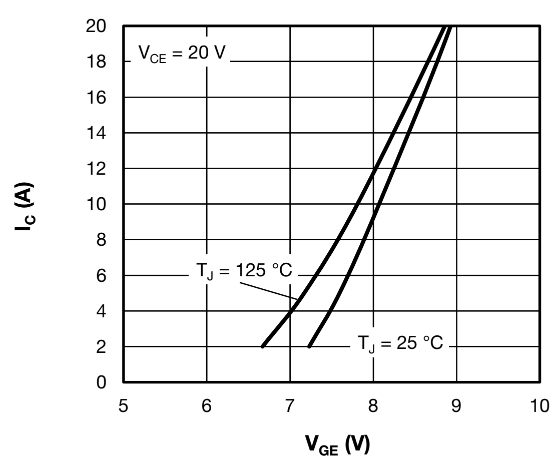

Fig. 4 - Typical Trench IGBT Transfer Characteristics

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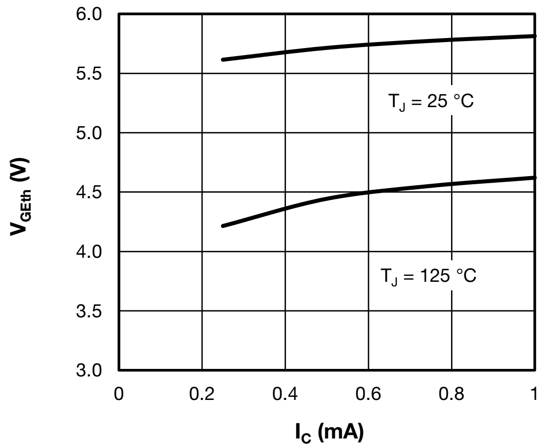

Fig. 5 - Typical Trench IGBT Gate Threshold Voltage

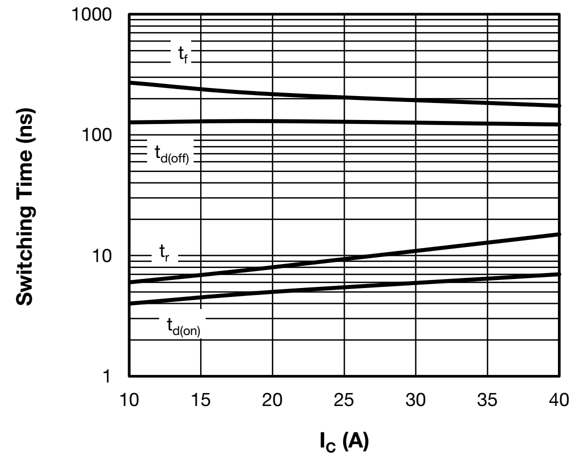

Fig. 8 - Typical Trench IGBT Switching Time vs. I_C (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = +15V/-15V, L = 500 μH

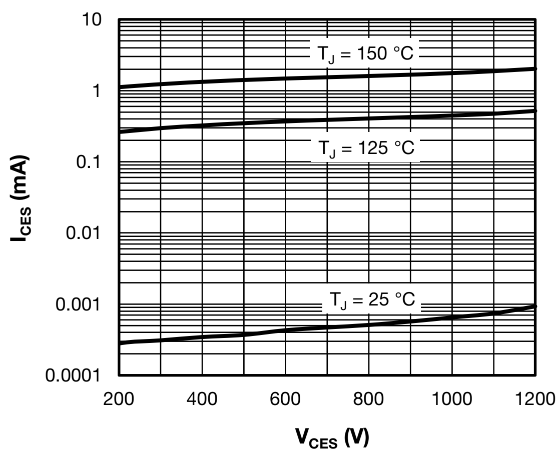

Fig. 6 - Typical Trench IGBT Zero Gate Voltage Collector Current

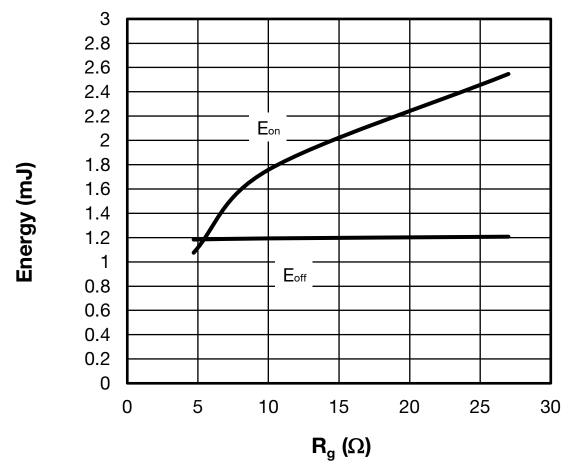

Fig. 9 - Typical Trench IGBT Energy Loss vs. R_g (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 600 V, I_C = 20 A, V_{GE} = +15V/-15V, L = 500 μH

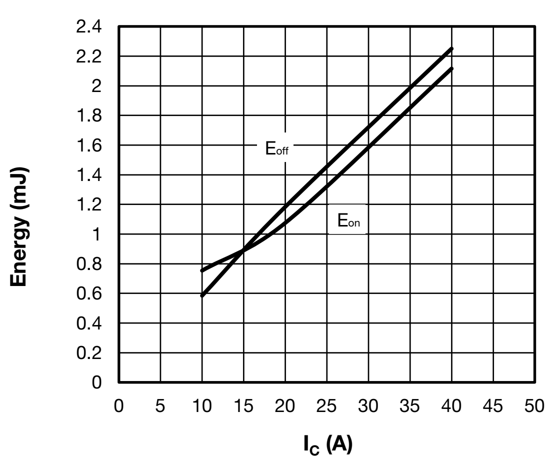

Fig. 7 - Typical Trench IGBT Energy Loss vs. I_C (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 600 V, R_g = 4.7 Ω, V_{GE} = +15V/-15V, L = 500 μH

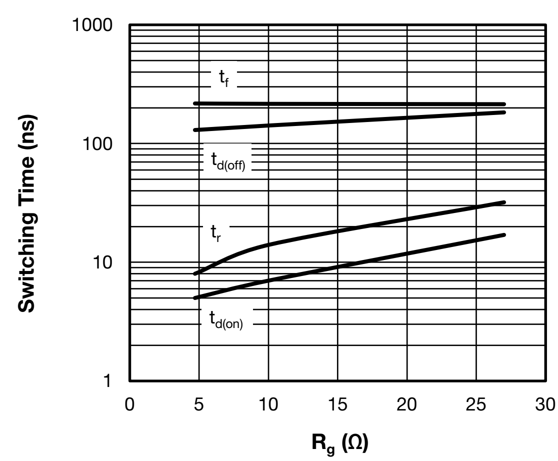

Fig. 10 - Typical Trench IGBT Switching Time vs. R_g (with Antiparallel Diode)
T_J = 125 °C, V_{CC} = 600 V, I_C = 20 A, V_{GE} = +15V/-15V, L = 500 μH

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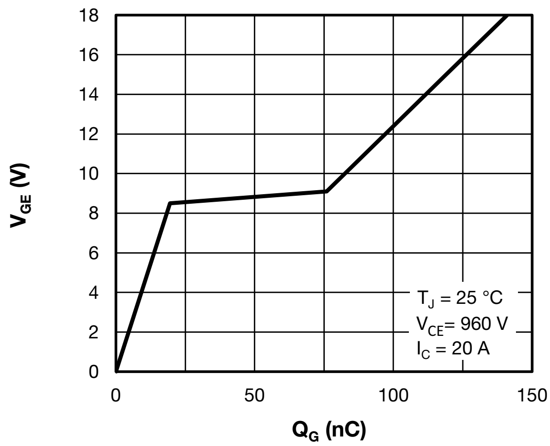

Fig. 11 - Typical Trench IGBT Gate charge vs.
Gate to Emitter Voltage

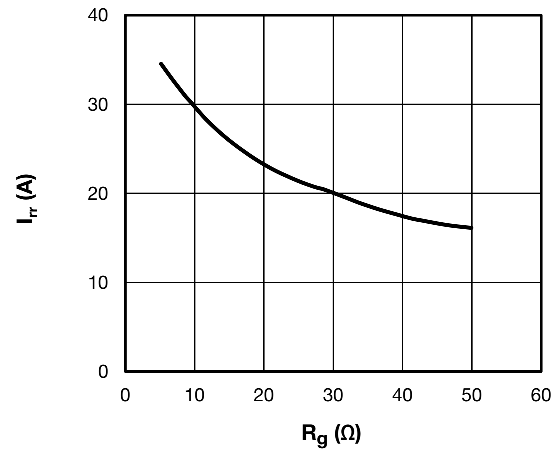

Fig. 14 - Typical Diode I_{rr} vs. R_g
T_J = 150 °C; I_F = 5.0 A

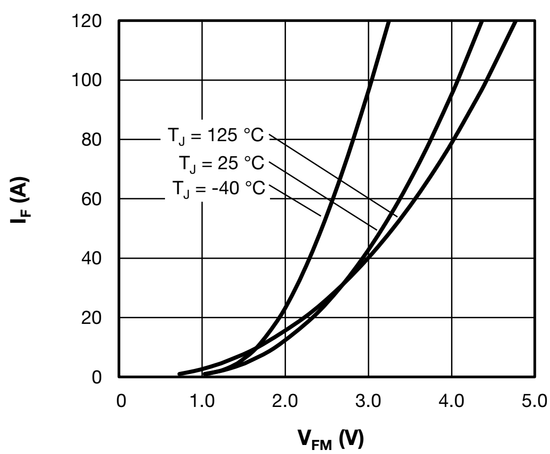

Fig. 12 - Typical Diode Forward Characteristics
t_p = 80 μs

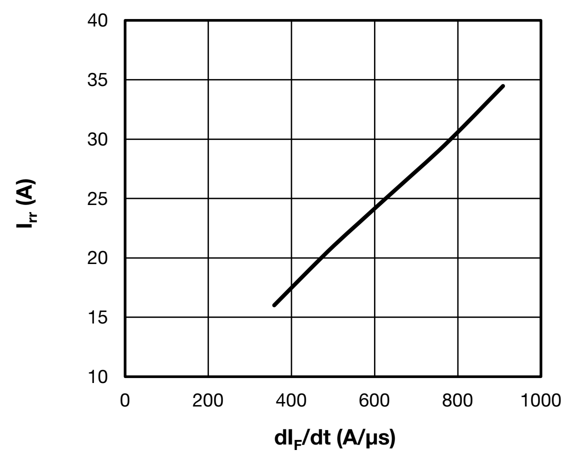

Fig. 15 - Typical Diode I_{rr} vs. dI_F/dt
V_{CC} = 400 V; V_{GE} = 15 V; I_{CE} = 5.0 A; T_J = 150 °C

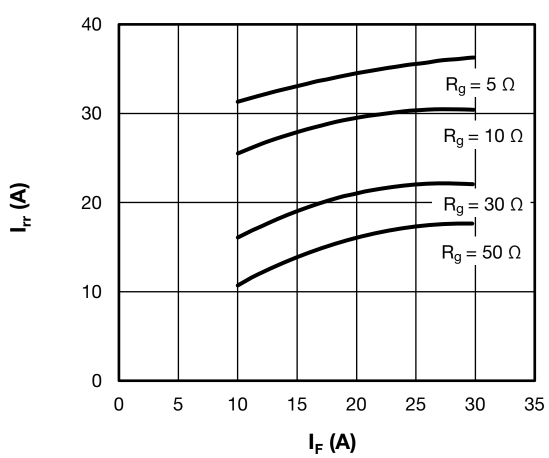

Fig. 13 - Typical Diode I_{rr} vs. I_F,
T_J = 150 °C

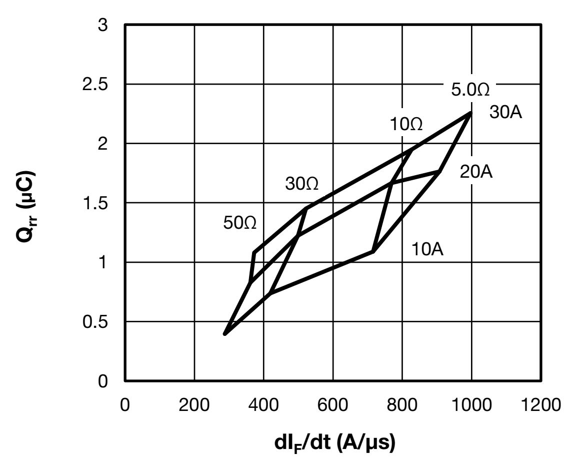

Fig. 16 - Typical Diode Q_{rr} vs. dI_F/dt
V_{CC} = 400 V; V_{GE} = 15 V; T_J = 150 °C

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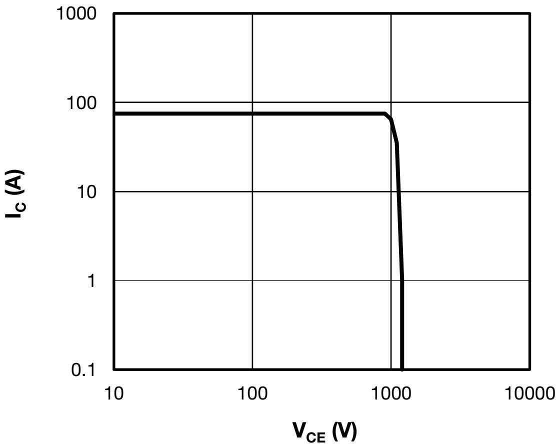

Fig. 17 - Trench IGBT Reverse BIAS SOA
T_J = 150 °C, I_C = 75 A, R_g = 4.7 Ω, V_{GE} = +15V/0 V, V_{CC} = 700 V, V_p = 1200 V

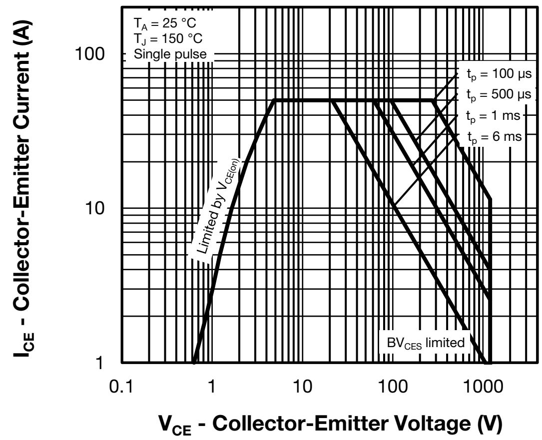

Fig. 18 - Trench IGBT Safe Operating Area

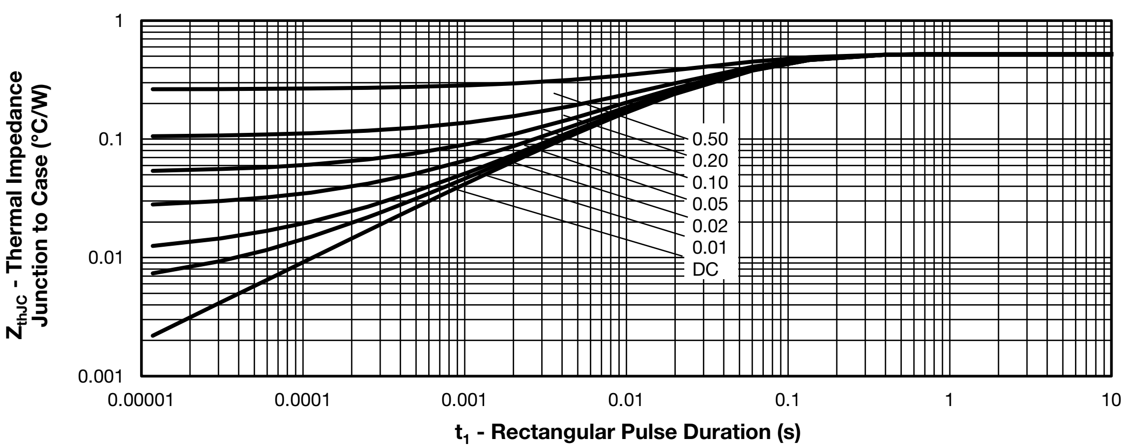

Fig. 19 - Maximum Trench IGBT Thermal Impedance Z_{thJC} Characteristics

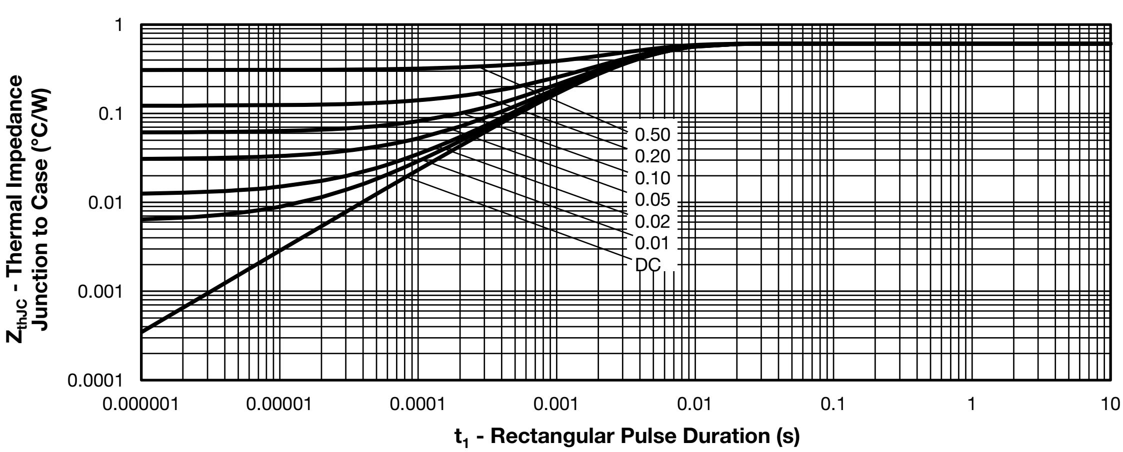

Fig. 20 - Maximum Diode Thermal Impedance Z_{thJC} Characteristics

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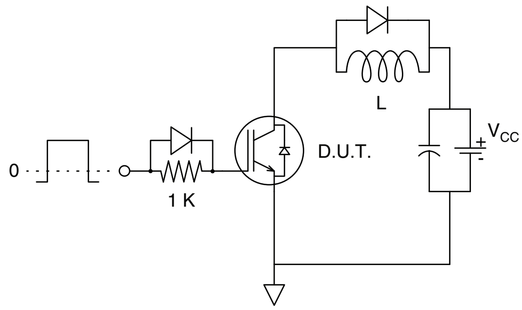

Fig. 21 - Gate Charge Circuit (Turn-Off)

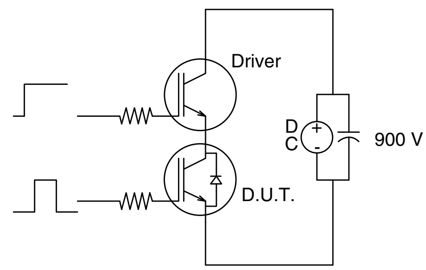

Fig. 23 - S.C. SOA Circuit

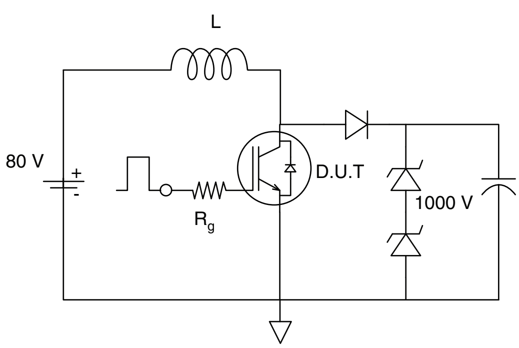

Fig. 22 - RBSOA Circuit

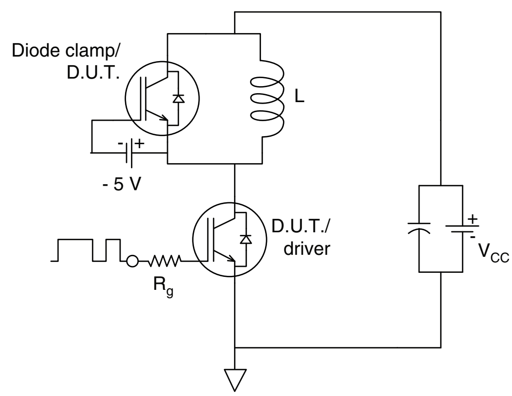

Fig. 24 - Switching Loss Circuit

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

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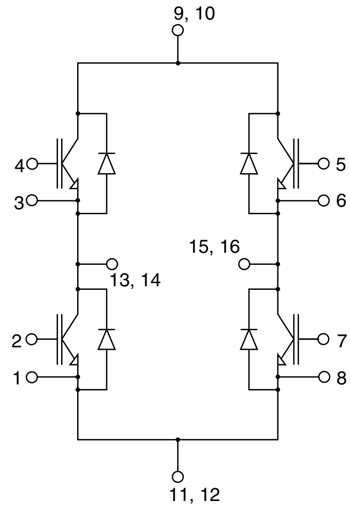
CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95245

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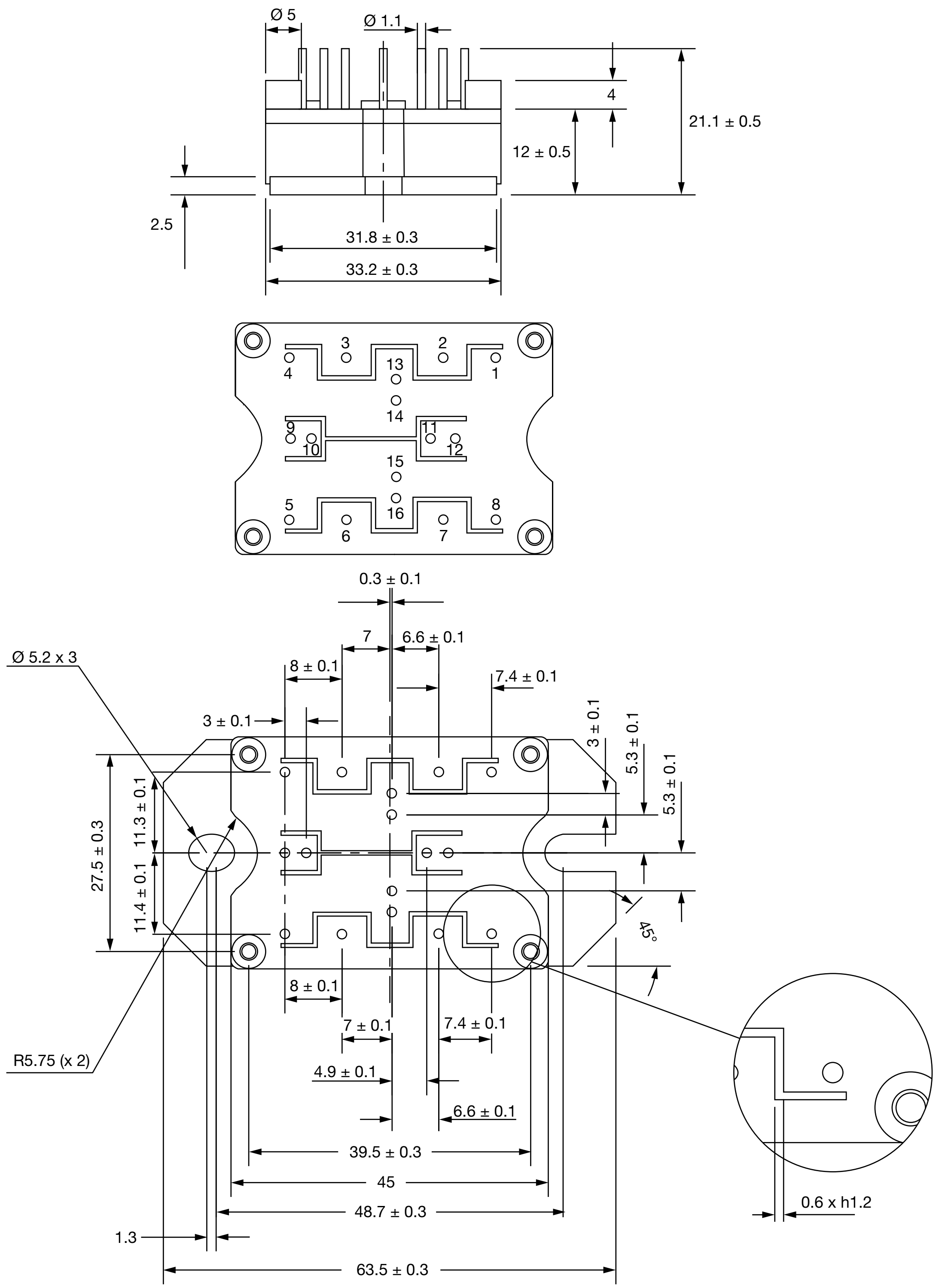
MTP MOSFET / IGBT Full-Bridge

DIMENSIONS in millimeters



Tolerance (unless other stated):
X = ± 0.3
X.X = ± 0.1
X.XX = ± 0.03

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