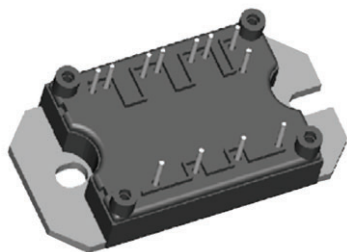


“Half Bridge” IGBT MTP (Ultrafast NPT IGBT), 80 A



MTP

FEATURES

- Ultrafast non punch through (NPT) technology
- Positive $V_{CE(on)}$ temperature coefficient
- 10 μ 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


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 $V_{GE} = 15$ V	3.36 V
I_C at $T_C = 25$ °C	80 A
Speed	8 kHz to 30 kHz
Package	MTP
Circuit 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	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}		± 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	

**ELECTRICAL SPECIFICATIONS** ($T_J = 25\text{ }^{\circ}\text{C}$ 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	$\Delta V_{(BR)CES}/\Delta T_J$	$V_{GE} = 0\text{ V}$, $I_C = 3\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	+1.1	-	V/ $^{\circ}\text{C}$
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	$V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 1\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-12	-	mV/ $^{\circ}\text{C}$
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	μA
		$V_{GE} = 0\text{ V}$, $V_{CE} = 1200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	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}	$V_{GE} = \pm 20\text{ V}$	-	-	± 250	nA

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	$I_C = 40\text{ A}$ $V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}$	-	399	599	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	43	65	
Gate to collector charge (turn-on)	Q_{gc}		-	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	2.40	mJ
Turn-off switching loss	E_{off}		-	1.62	2.43	
Total switching loss	E_{tot}		-	3.22	4.82	
Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$	-	5521	8282	pF
Output capacitance	C_{oes}		-	380	570	
Reverse transfer capacitance	C_{res}		-	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 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 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}	$I_C = 40\text{ A}$	-	2.98	3.38	V
		$I_C = 80\text{ A}$	-	3.90	4.41	
		$I_C = 40\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	3.08	3.39	
		$I_C = 80\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	4.29	4.72	
		$I_C = 40\text{ A}$, $T_J = 150\text{ }^{\circ}\text{C}$	-	3.12	3.42	
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	861	μJ
Diode reverse recovery time	t_{rr}		-	120	180	ns
Peak reverse recovery current	I_{rr}		-	43	65	A



THERMAL AND MECHANICAL SPECIFICATIONS						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating junction temperature range	T_J		-40	-	150	°C
Storage temperature range	T_{Stg}		-40	-	125	
Junction to case	R_{thJC}	IGBT	-	-	0.29	°C/W
		Diode	-	-	0.61	
Case to sink per module	R_{thCS}	Heatsink compound thermal conductivity = 1 W/mK	-	0.06	-	
Clearance ⁽¹⁾		External shortest distance in air between 2 terminals	5.5	-	-	mm
Creepage ⁽²⁾		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.	$3 \pm 10 \%$			Nm
Weight			66			g

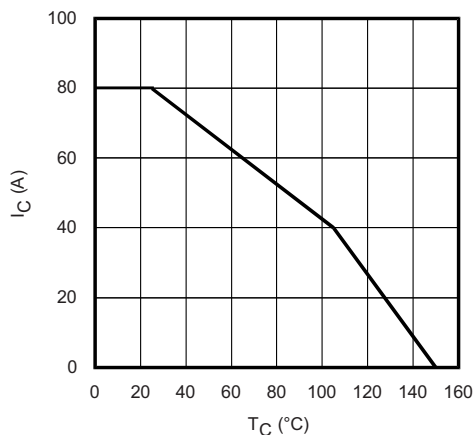


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

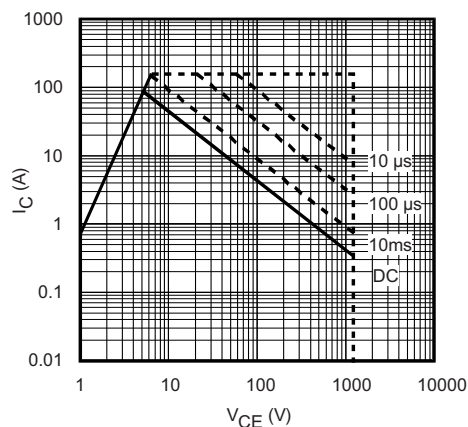
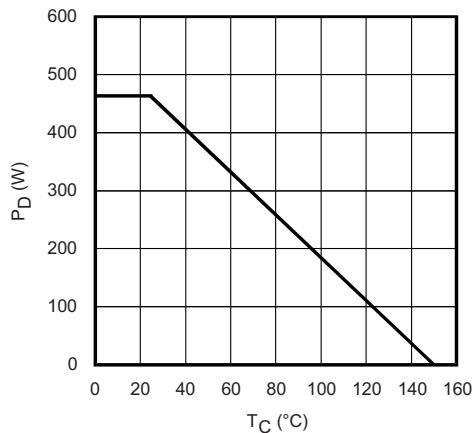
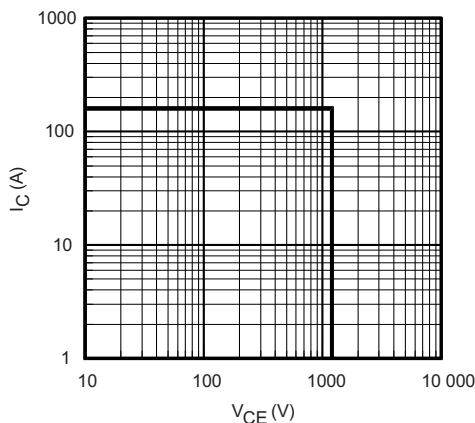

Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}$; $T_J \leq 150^\circ\text{C}$


Fig. 2 - Power Dissipation vs. Case Temperature


Fig. 4 - Reverse BIAS SOA
 $T_J = 150^\circ\text{C}$; $V_{GE} = 15\text{ V}$

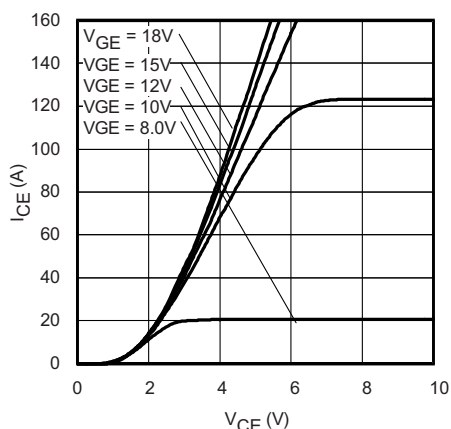


Fig. 5 - Typical IGBT Output Characteristics
 $T_J = -40\text{ }^{\circ}\text{C}$; $t_p = 80\text{ }\mu\text{s}$

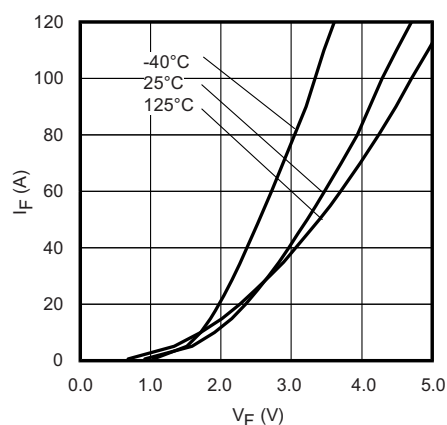


Fig. 8 - Typical Diode Forward Characteristics
 $t_p = 80\text{ }\mu\text{s}$

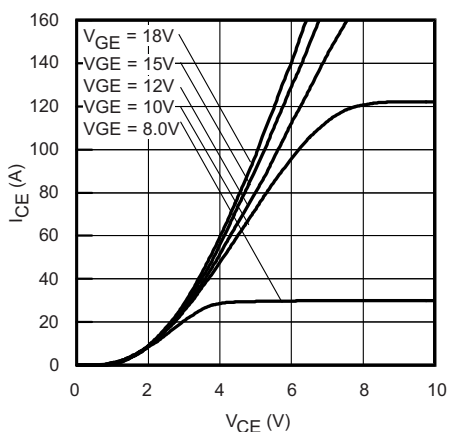


Fig. 6 - Typical IGBT Output Characteristics
 $T_J = 25\text{ }^{\circ}\text{C}$; $t_p = 80\text{ }\mu\text{s}$

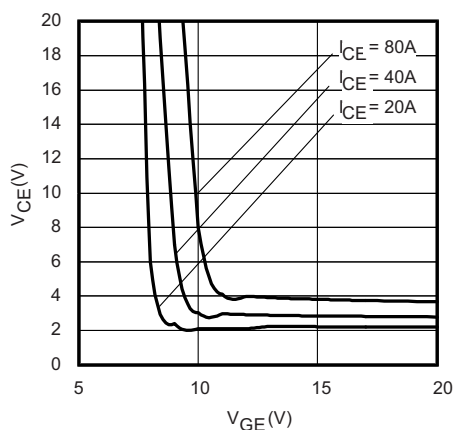


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40\text{ }^{\circ}\text{C}$

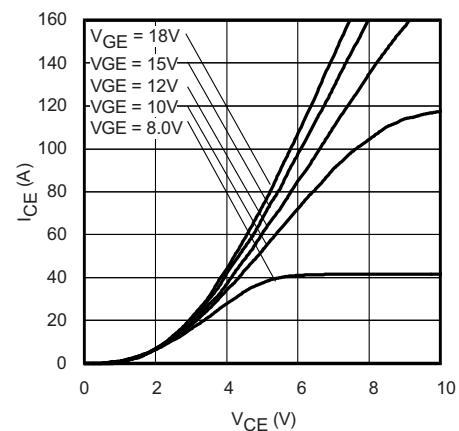


Fig. 7 - Typical IGBT Output Characteristics
 $T_J = 125\text{ }^{\circ}\text{C}$; $t_p = 80\text{ }\mu\text{s}$

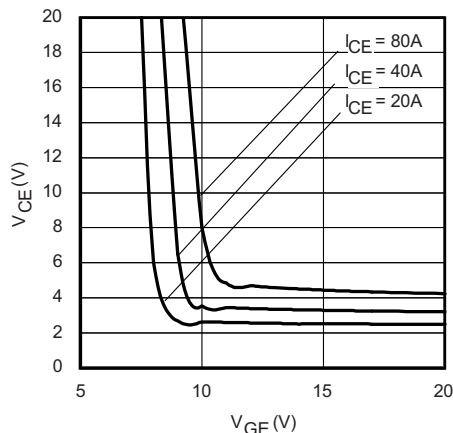


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25\text{ }^{\circ}\text{C}$

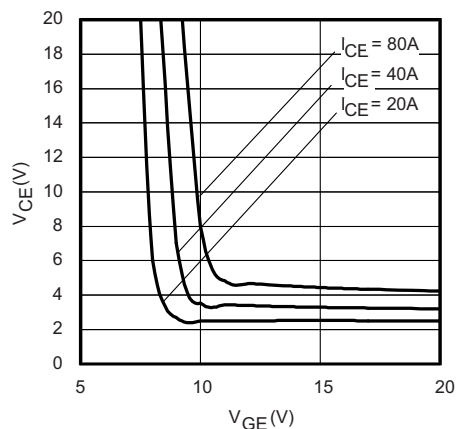


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

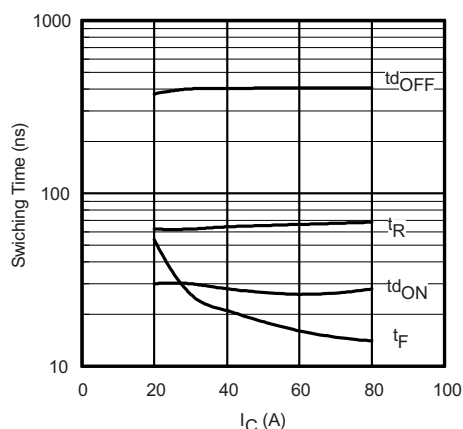


Fig. 14 - Typical Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 250\ \mu\text{H}$; $V_{CE} = 400\ \text{V}$
 $R_g = 5\ \Omega$; $V_{GE} = 15\ \text{V}$

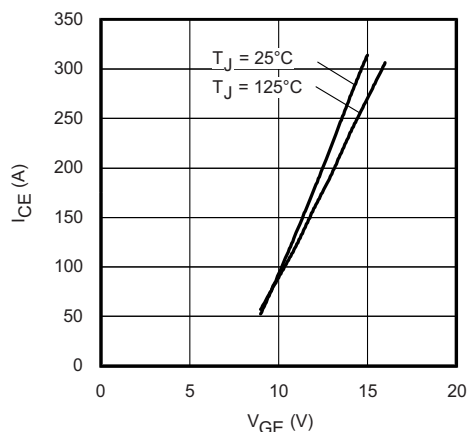


Fig. 12 - Typical Transfer Characteristics
 $V_{CE} = 50\ \text{V}$; $t_p = 10\ \mu\text{s}$

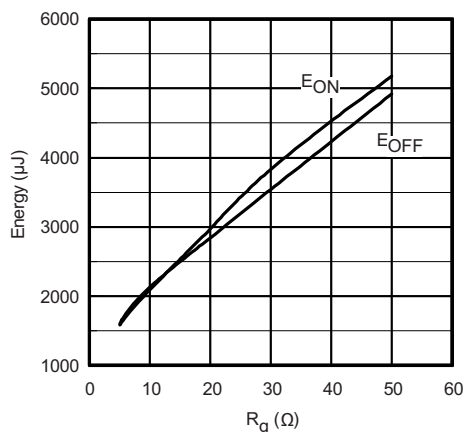


Fig. 15 - Typical Energy Loss vs. R_g
 $T_J = 150^\circ\text{C}$; $L = 250\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$
 $I_{CE} = 40\ \text{A}$; $V_{GE} = 15\ \text{V}$

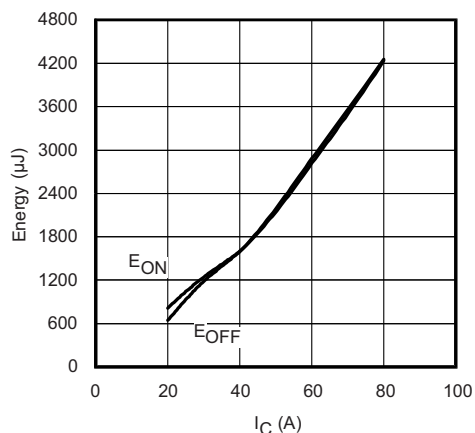


Fig. 13 - Typical Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L = 250\ \mu\text{H}$; $V_{CE} = 400\ \text{V}$
 $R_g = 5\ \Omega$; $V_{GE} = 15\ \text{V}$

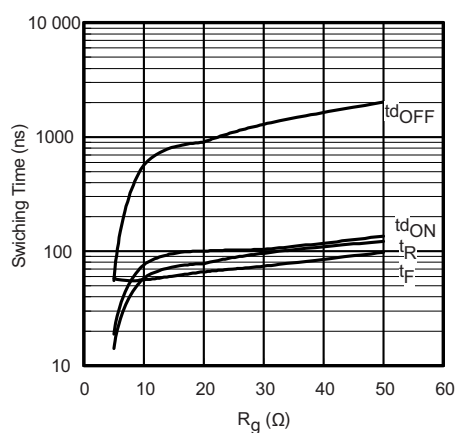


Fig. 16 - Typical Switching Time vs. R_g
 $T_J = 150^\circ\text{C}$; $L = 250\ \mu\text{H}$; $V_{CE} = 600\ \text{V}$
 $I_{CE} = 40\ \text{A}$; $V_{GE} = 15\ \text{V}$

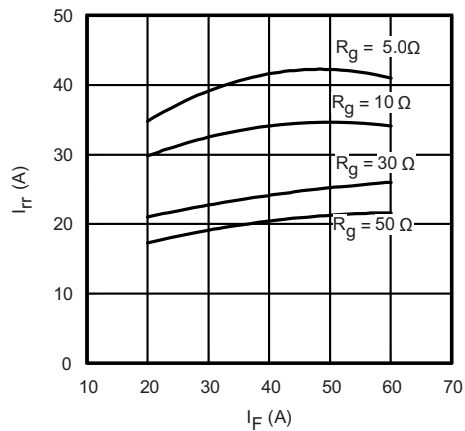


Fig. 17 - Typical Diode I_{rr} vs. I_F
 $T_J = 125\text{ }^{\circ}\text{C}$

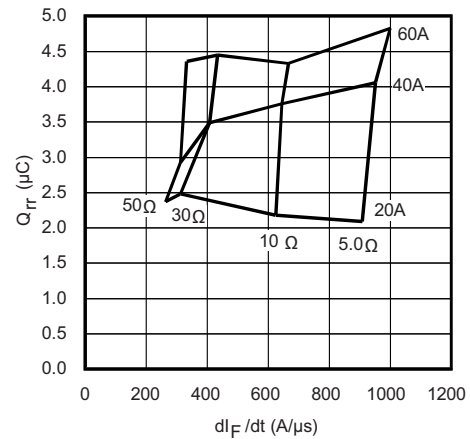


Fig. 20 - Typical Diode Q_{rr} vs. dI_F/dt
 $V_{CC} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $T_J = 125\text{ }^{\circ}\text{C}$

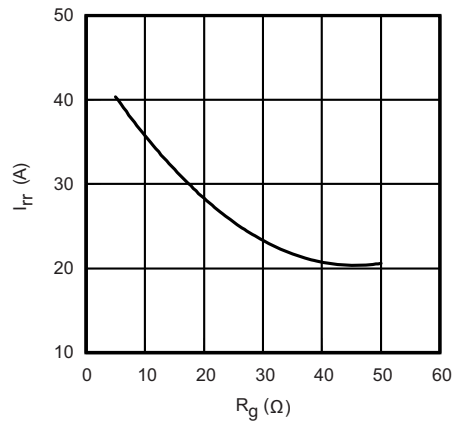


Fig. 18 - Typical Diode I_{rr} vs. R_g
 $T_J = 125\text{ }^{\circ}\text{C}$; $I_F = 40\text{ A}$

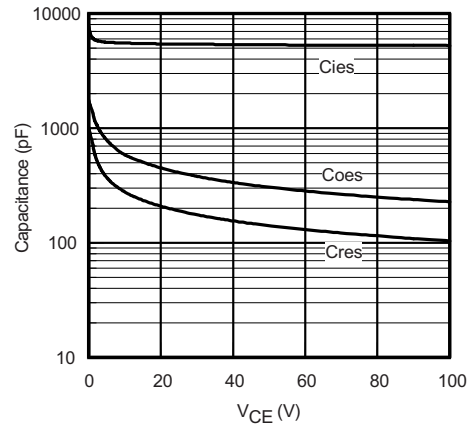


Fig. 21 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

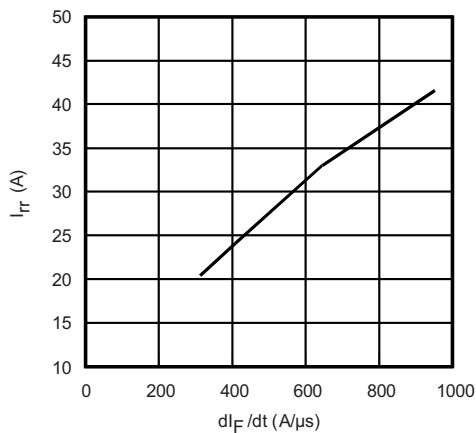


Fig. 19 - Typical Diode I_{rr} vs. dI_F/dt
 $V_{CC} = 600\text{ V}$; $V_{GE} = 15\text{ V}$; $I_{CE} = 40\text{ A}$; $T_J = 125\text{ }^{\circ}\text{C}$

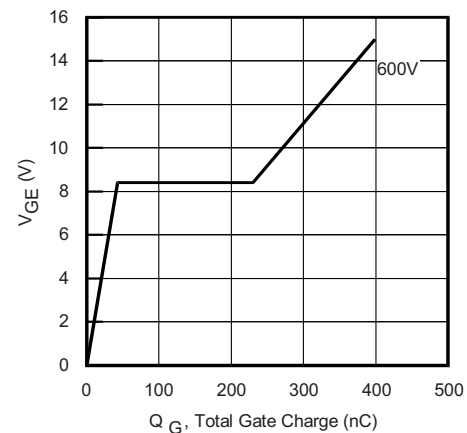


Fig. 22 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 5.0\text{ A}$; $L = 600\text{ }^{\mu}\text{H}$

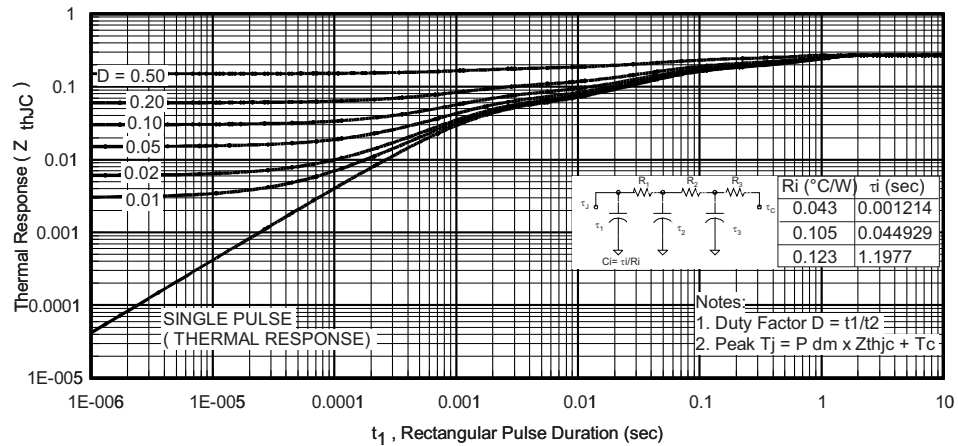


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

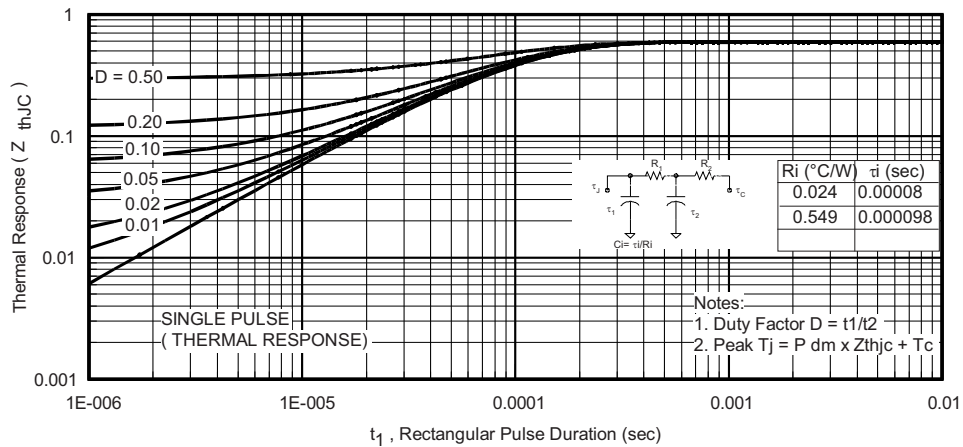


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

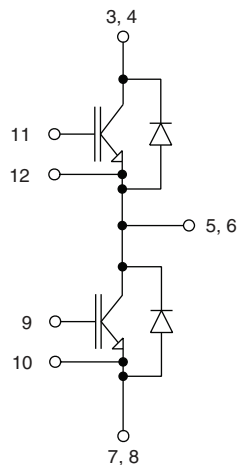


Fig. 25 - Electrical diagram

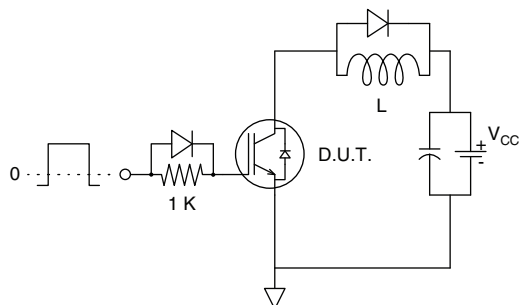


Fig. CT.1 - Gate Charge Circuit (Turn-Off)

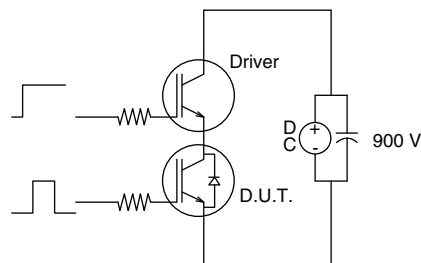


Fig. CT.3 - S.C. SOA Circuit

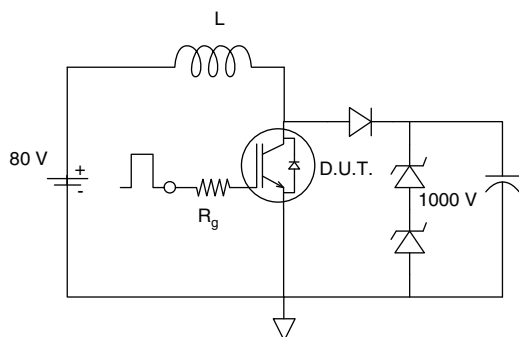


Fig. CT.2 - RBSOA Circuit

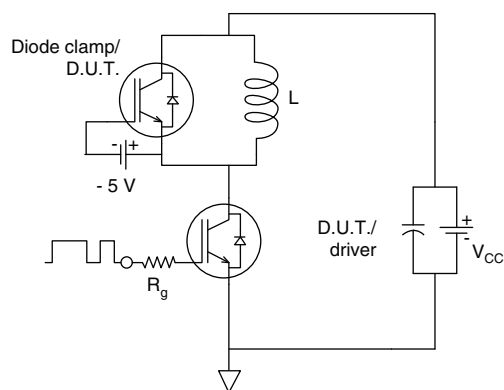


Fig. CT.4 - Switching Loss Circuit

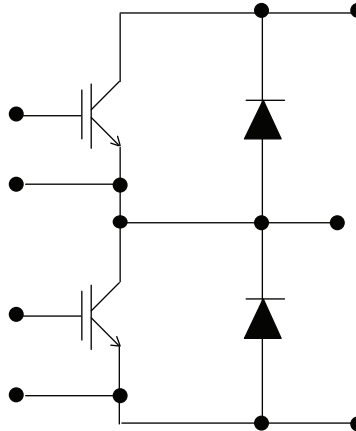
ORDERING INFORMATION TABLE

Device code	VS-	40	MT	120	U	H	A	PbF
	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 = Al₂O₃ DBC substrate
- 8** - PbF = lead (Pb)-free



CIRCUIT CONFIGURATION

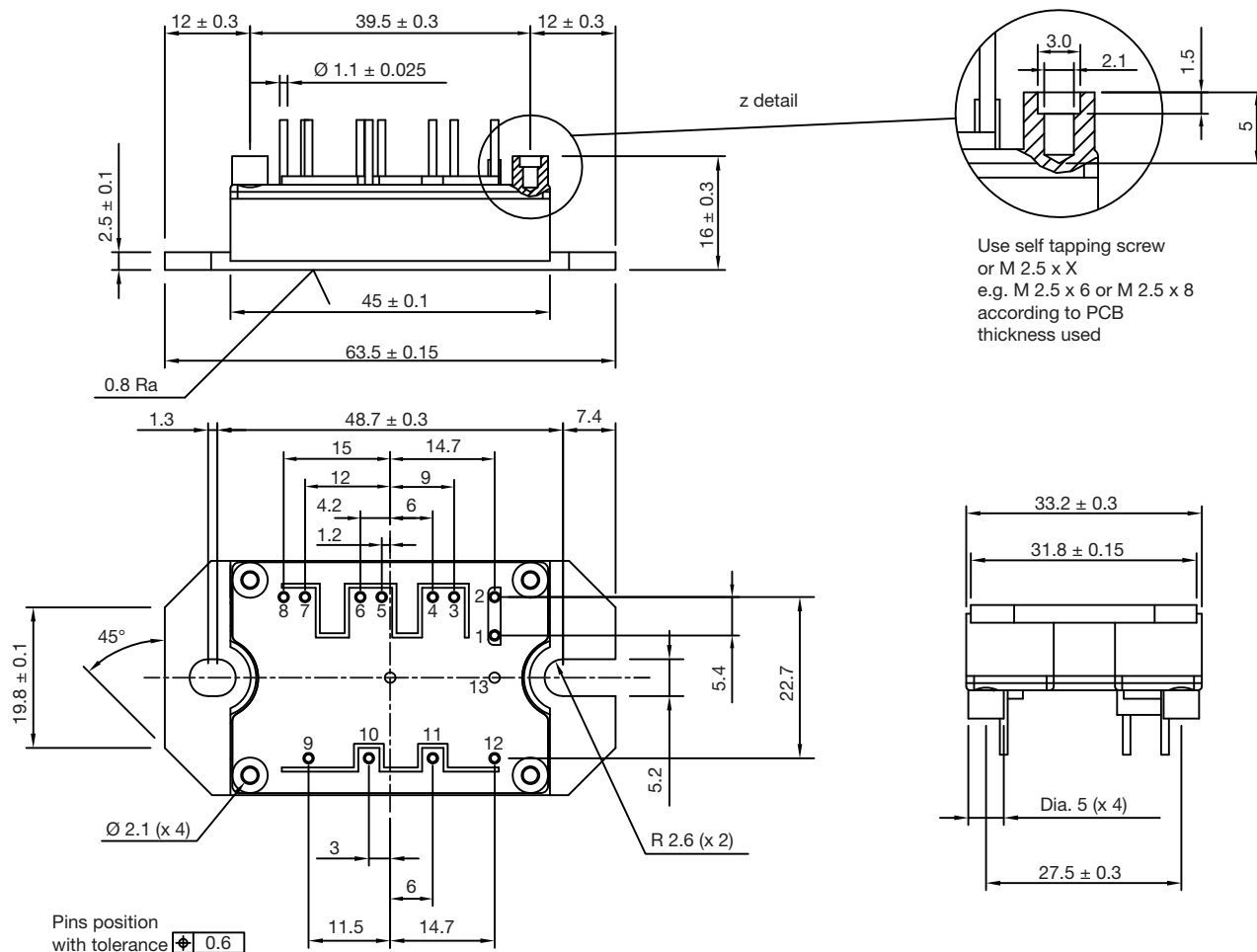


LINKS TO RELATED DOCUMENTS

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95175

MTP

DIMENSIONS in millimeters



Note

- Unused terminals are not assembled in the package



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