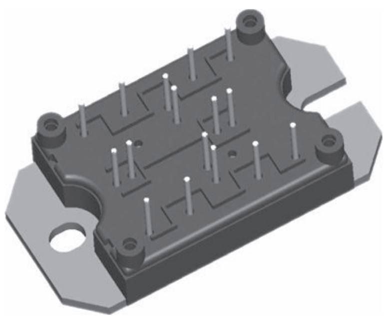
“Full Bridge” IGBT MTP (Ultrafast NPT IGBT), 40 A



MTP

PRODUCT SUMMARY	
V_{CES}	1200 V
I_C at T_C = 25 °C	40 A
$V_{CE(on)}$	3.29 V
Speed	8 kHz to 30 kHz
Package	MTP
Circuit	Full bridge

FEATURES

Pb-free
RoHS COMPLIANT

- Ultrafast Non Punch Through (NPT) 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

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 °C	40	A
		T_C = 106 °C	20	
Pulsed collector current	I_{CM}		100	
Clamped inductive load current	I_{LM}		100	
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 = 100 °C	96	

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 = 250 μA	1200	-	-	V
Temperature coefficient of breakdown voltage	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 3 mA (25 °C to 125 °C)	-	+ 1.3	-	V/°C
Collector to emitter saturation voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 20 A	-	3.29	3.59	V
		V_{GE} = 15 V, I_C = 40 A	-	4.42	4.66	
		V_{GE} = 15 V, I_C = 20 A, T_J = 125 °C	-	3.87	4.11	
		V_{GE} = 15 V, I_C = 40 A, T_J = 125 °C	-	5.32	5.70	
		V_{GE} = 15 V, I_C = 20 A, T_J = 150 °C	-	3.99	4.27	
Gate threshold voltage	$V_{GE(th)}$	V_{CE} = V_{GE}, I_C = 250 μA	4	-	6	
Temperature coefficient of threshold voltage	$V_{GE(th)}/\Delta T_J$	V_{CE} = V_{GE}, I_C = 3 mA (25 °C to 125 °C)	-	- 14	-	mV/°C
Transconductance	g_{fe}	V_{CE} = 50 V, I_C = 20 A, PW = 80 μs	-	17.5	-	S
Zero gate voltage collector current	I_{CES} (1)	V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 25 °C	-	-	250	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	0.7	3.0	mA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 150 °C	-	2.9	9.0	
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} = 600 V V_{GE} = 15 V	-	176	264	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	19	30	
Gate to collector charge (turn-on)	Q_{gc}		-	89	134	
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	-	0.92	-	mJ
Turn-off switching loss	E_{off}		-	0.46	-	
Total switching loss	E_{tot}		-	1.38	-	
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	-	1.29	-	
Turn-off switching loss	E_{off}		-	0.81	-	
Total switching loss	E_{tot}		-	2.1	-	
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1.0 MHz	-	2530	3790	pF
Output capacitance	C_{oes}		-	344	516	
Reverse transfer capacitance	C_{res}		-	78	117	
Reverse bias safe operating area	RBSOA	T_J = 150 °C, I_C = 120 A V_{CC} = 1000 V, V_p = 1200 V R_g = 5 Ω, V_{GE} = + 15 V to 0 V	Fullsquare			
Short circuit safe operating area	SCSOA	T_J = 150 °C V_{CC} = 900 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	3.90	
		I_C = 20 A, T_J = 125 °C	-	2.44	2.84	
		I_C = 40 A, T_J = 125 °C	-	3.45	4.14	
		I_C = 20 A, T_J = 150 °C	-	2.21	2.93	
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	630	µJ
Diode reverse recovery time	t_{rr}		-	98	150	ns
Peak reverse recovery current	I_{rr}		-	33	50	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	IGBT	R_{thJC}		-	0.35	0.52	°C/W
	Diode			-	0.40	0.61	
Case to sink per module		R_{thCS}	Heatsink compound thermal conductivity = 1 W/mK	-	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

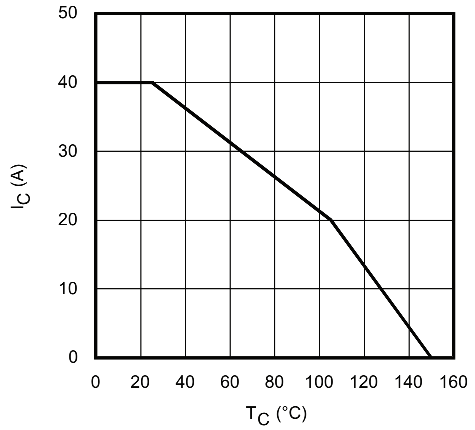


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

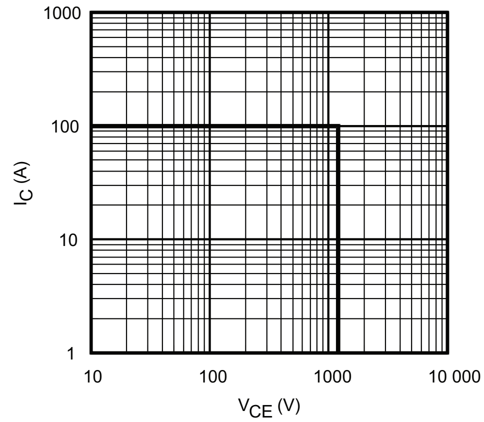


Fig. 4 - Reverse Bias SOA
T_J = 150 °C; V_{GE} = 15 V

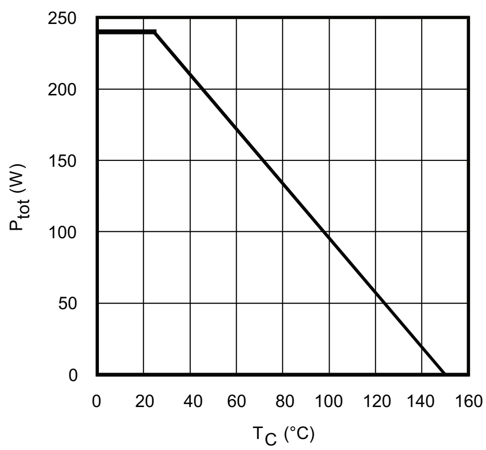


Fig. 2 - Power Dissipation vs. Case Temperature

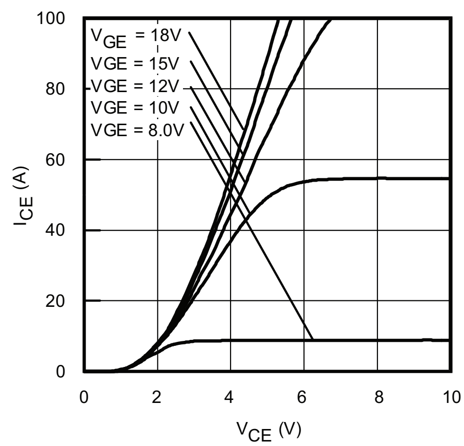


Fig. 5 - Typical IGBT Output Characteristics
T_J = - 40 °C; t_p = 80 µs

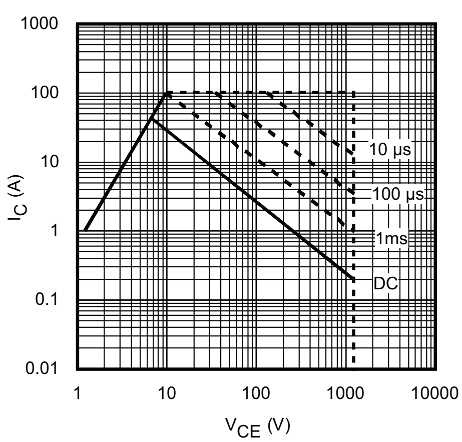


Fig. 3 - Forward SOA
T_C = 25 °C; $T_J \leq$ 150 °C

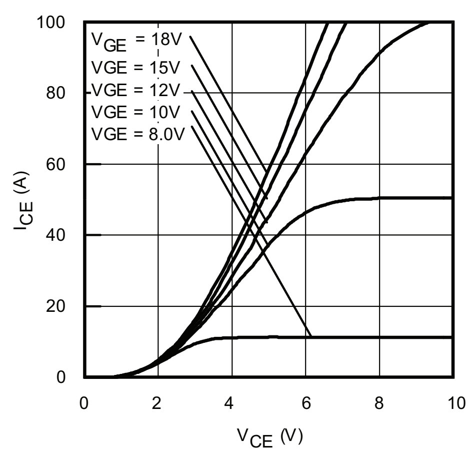


Fig. 6 - Typical IGBT Output Characteristics
T_J = 25 °C; t_p = 80 µs

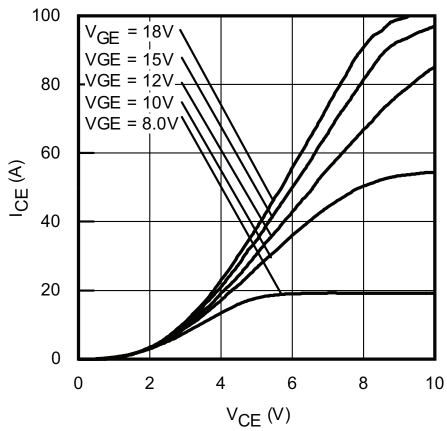


Fig. 7 - Typical IGBT Output Characteristics
T_J = 125 °C; t_p = 80 µs

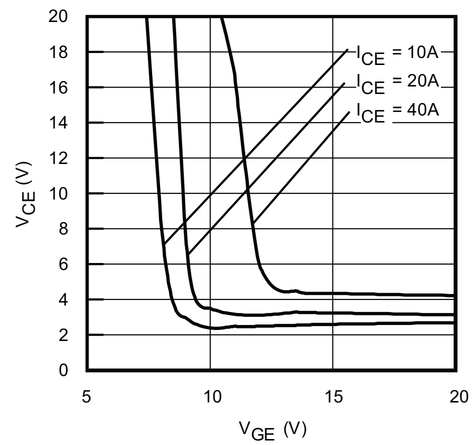


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

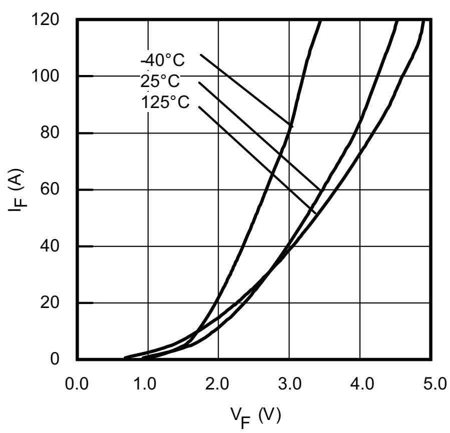


Fig. 8 - Typical Diode Forward Characteristics
t_p = 80 µs

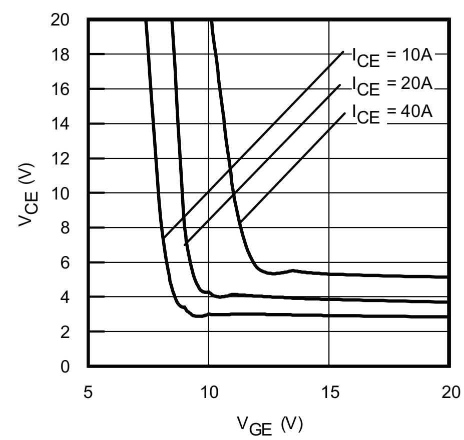


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

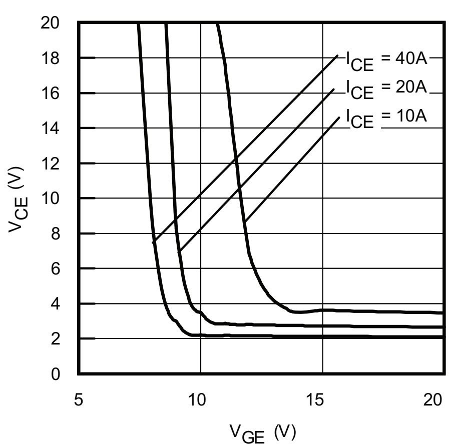


Fig. 9 - Typical V_{CE} vs. V_{GE}
T_J = - 40 °C

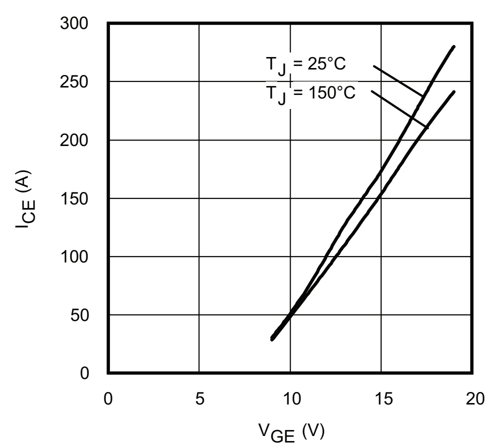


Fig. 12 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

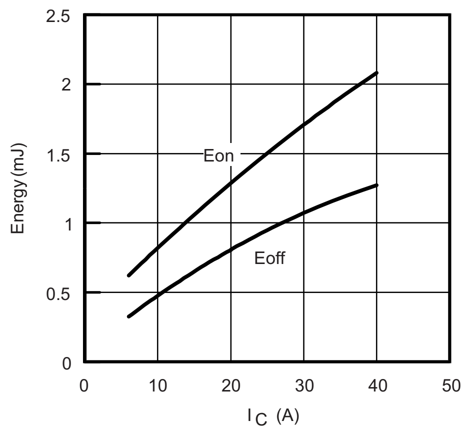


Fig. 13 - Typical Energy Loss vs. I_C
T_J = 125 °C; L = 1 mH; V_{CC} = 600 V
R_g = 5 Ω; V_{GE} = 15 V

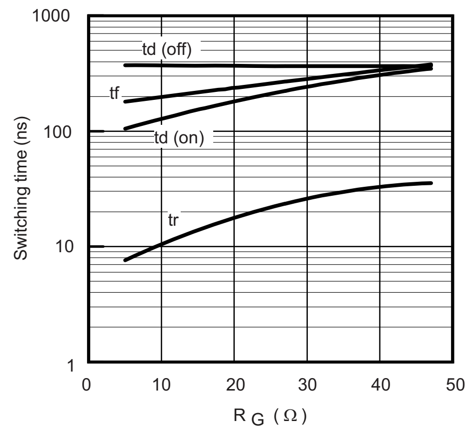


Fig. 16 - Typical Switching Time vs. R_g
T_J = 150 °C; L = 1 mH; V_{CC} = 600 V
I_{CE} = 6 A; V_{GE} = 15 V

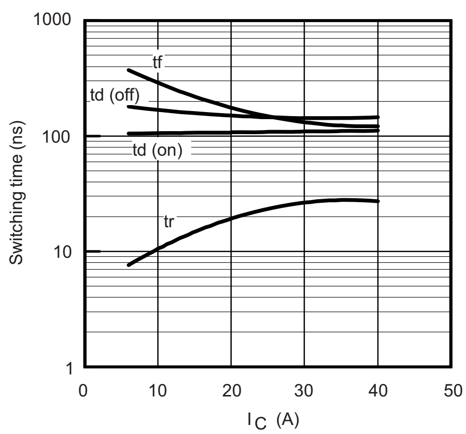


Fig. 14 - Typical Switching Time vs. I_C
T_J = 125 °C; L = 1 mH; V_{CC} = 600 V
R_g = 5 Ω; V_{GE} = 15 V

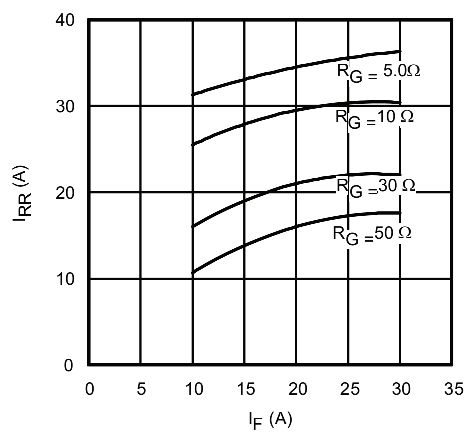


Fig. 17 - Typical Diode I_{rr} vs. I_F
T_J = 150 °C

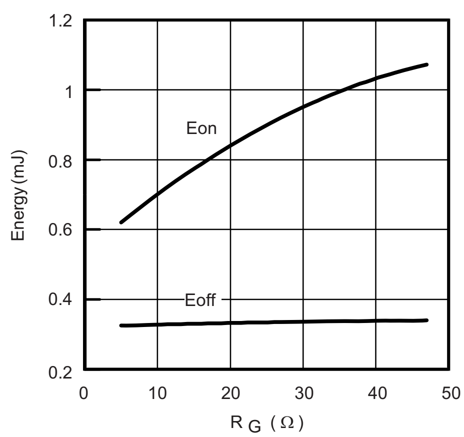


Fig. 15 - Typical Energy Loss vs. R_g
T_J = 125 °C; L = 1 mH; V_{CC} = 600 V
I_{CE} = 6 A; V_{GE} = 15 V

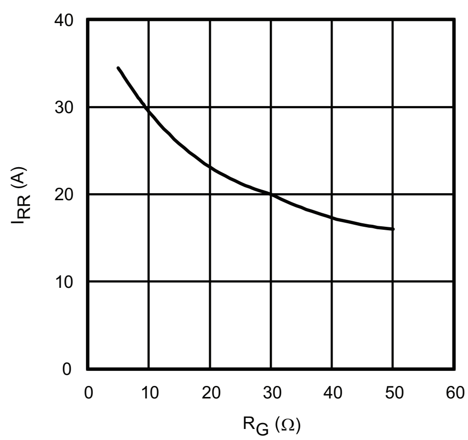


Fig. 18 - Typical Diode I_{rr} vs. R_g
T_J = 150 °C; I_F = 5.0 A

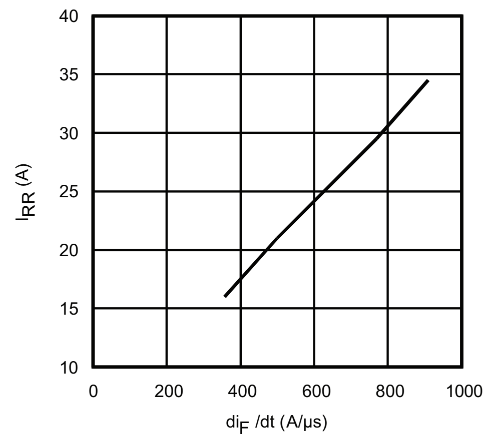


Fig. 19 - Typical Diode I_{rr} vs. dI_F/dt
V_{CC} = 400 V; V_{GE} = 15 V; I_{CE} = 5.0 A; T_J = 150 °C

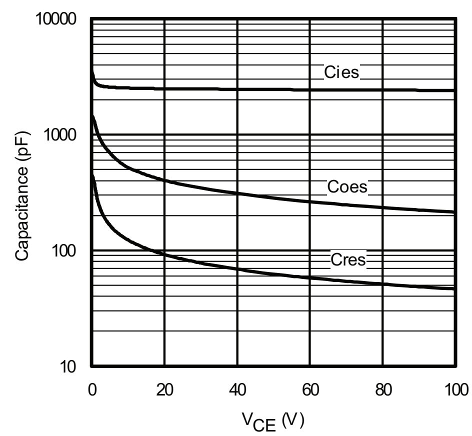


Fig. 21 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

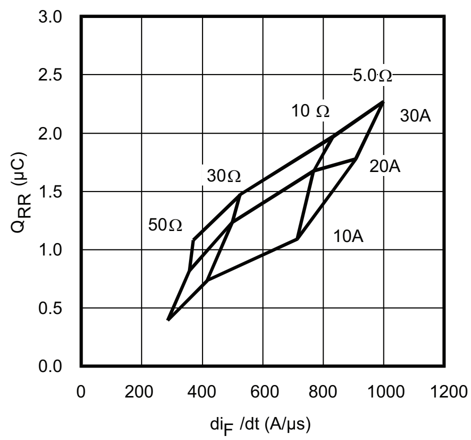


Fig. 20 - Typical Diode Q_{rr} vs. dI_F/dt
V_{CC} = 400 V; V_{GE} = 15 V; T_J = 150 °C

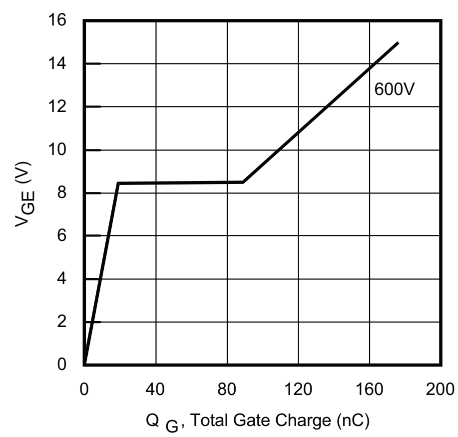


Fig. 22 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5.0 A; L = 600 µH

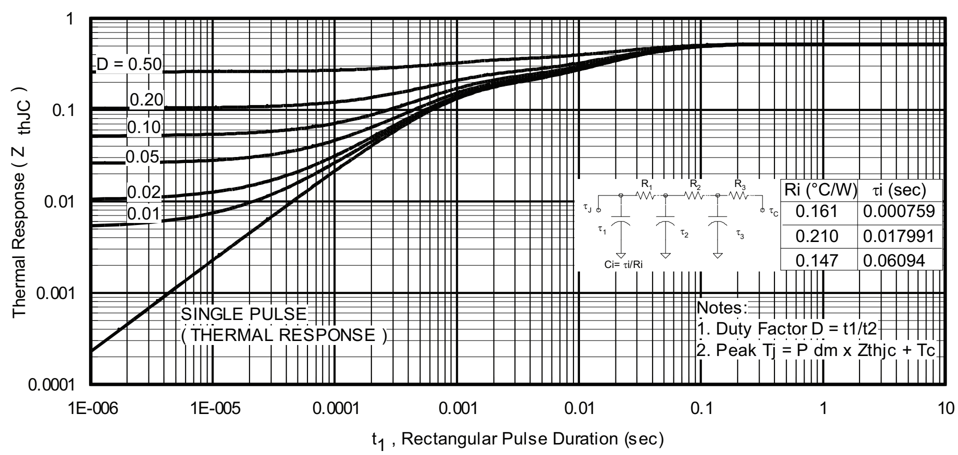


Fig. 23 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

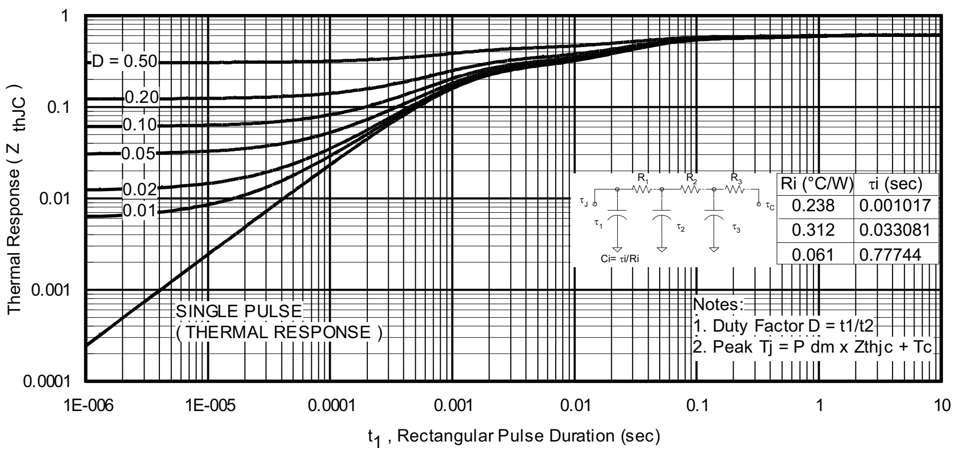


Fig. 24 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

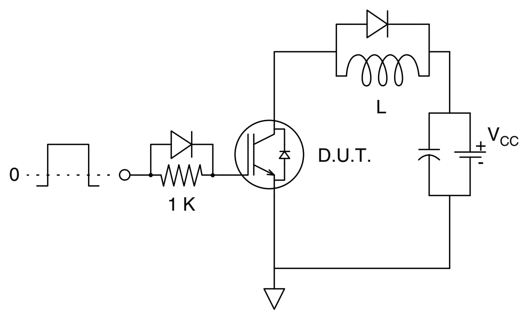


Fig. 25 - Gate Charge Circuit (Turn-Off)

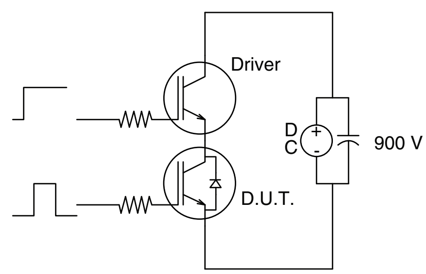


Fig. 27 - S.C. SOA Circuit

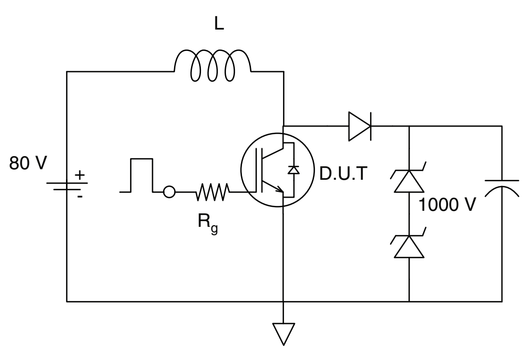


Fig. 26 - RBSOA Circuit

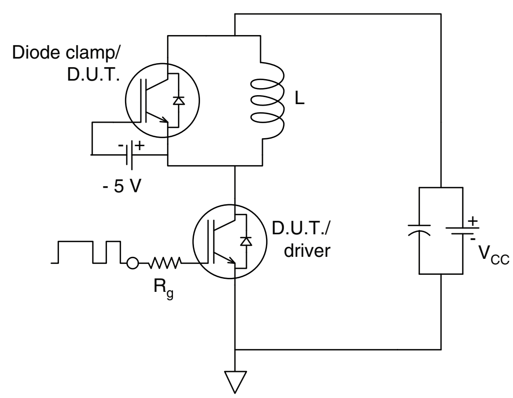


Fig. 28 - Switching Loss Circuit

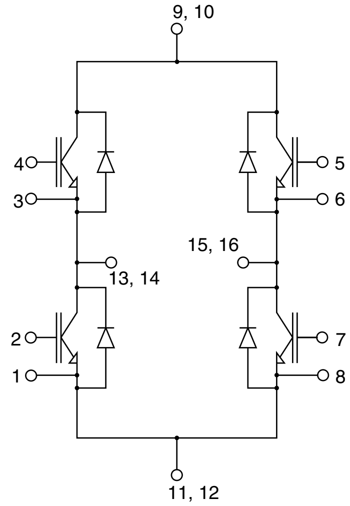


Fig. 29 - Electrical diagram

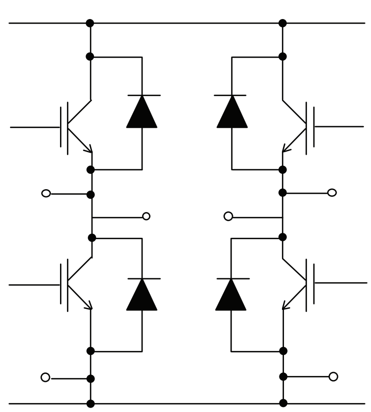
ORDERING INFORMATION TABLE

Device code

VS-	20	MT	120	U	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 (U = Ultrafast IGBT)
6 - Circuit configuration (F = Full bridge)
7 - P = Lead (Pb)-free

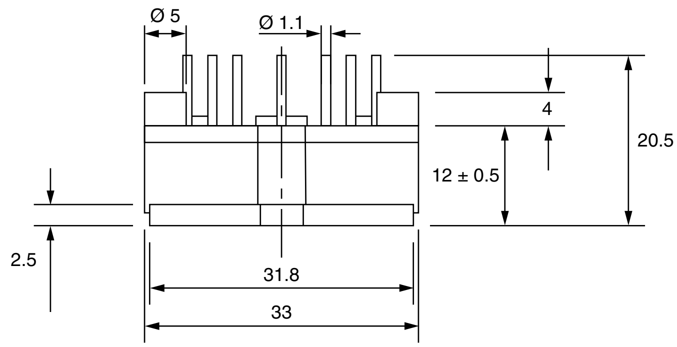
CIRCUIT CONFIGURATION

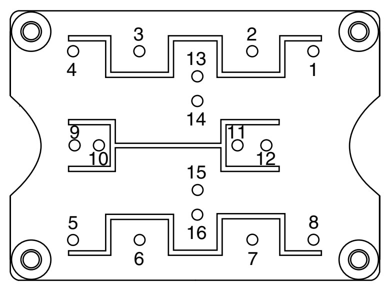


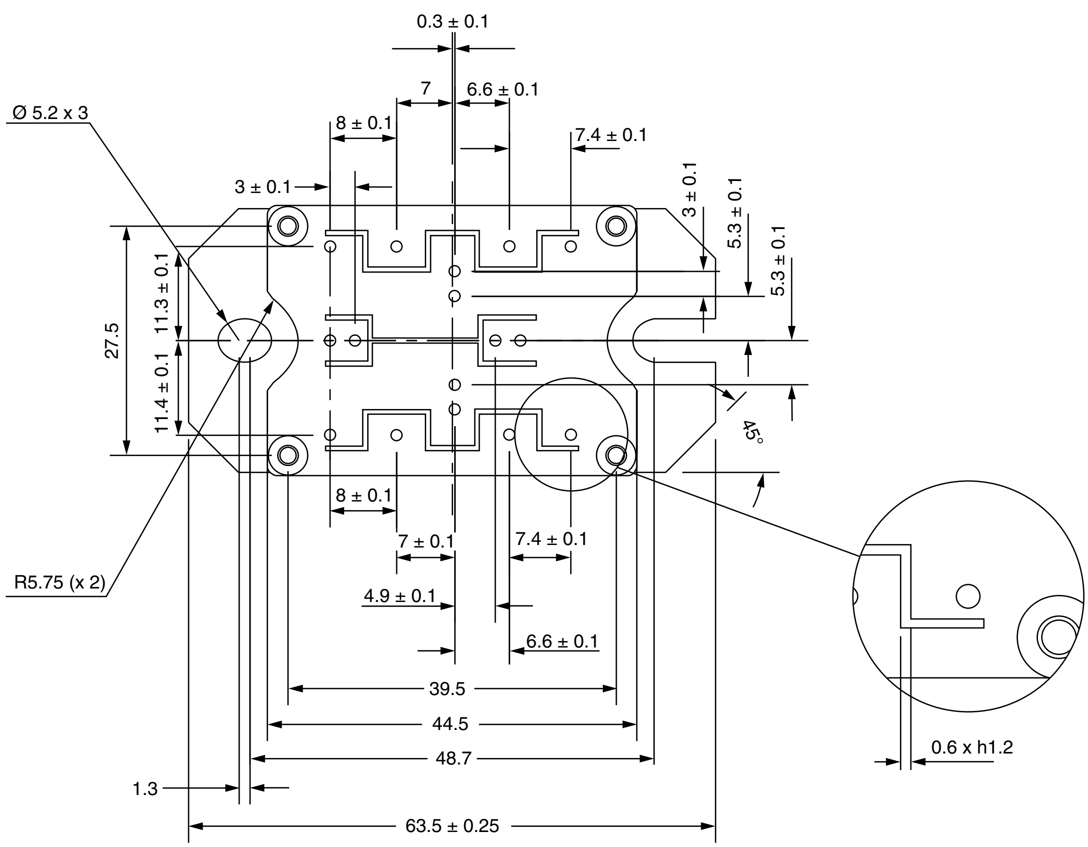
LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95245

MTP MOSFET/IGBT Full-Bridge

DIMENSIONS in millimeters







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