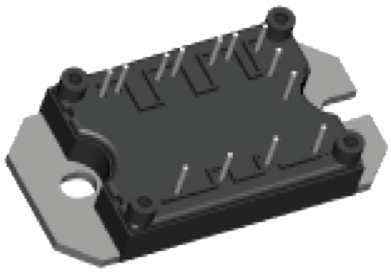
Three Phase Inverter Module in MTP Package 1200 V NPT IGBT and HEXFRED® Diodes, 5 A



MTP

PRODUCT SUMMARY	
V_{CES}	1200 V
$V_{CE(on)}$ typical at V_{GE} = 15 V	2.90 V
I_C at T_C = 100 °C	5 A
t_{sc} at T_J = 150 °C	> 10 µs
Package	MTP
Circuit	Three phase inverter

FEATURES

- Generation 5 NPT 1200 V IGBT technology
- HEXFRED® diode with ultrasoft reverse recovery
- Very low conduction and switching losses
- Optional SMT thermistor (NTC)
- Aluminum oxide DBC
- Very low stray inductance design for high speed operation
- Short circuit 10 µs
- Square RBSOA
- Operating frequencies 8 kHz to 60 kHz
- 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 inverter motor drive applications
- Low EMI, requires less snubbing
- 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 voltage	V_{CES}		1200	V
Continuous collector current	I_C	T_C = 25 °C	12	A
		T_C = 100 °C	5	
Pulsed collector current	I_{CM}		24	
Peak switching current	I_{LM}		24	
Diode continuous forward current	I_F	T_C = 100 °C	5	
Peak diode forward current	I_{FM}		12	
Gate to emitter voltage	V_{GE}		± 20	V
RMS isolation voltage	V_{ISOL}	Any terminal to case, t = 1 min	2500	
Maximum power dissipation (including diode and IGBT)	P_D	T_C = 25 °C	76	W
		T_C = 100 °C	31	

ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)						
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 $V_{(BR)CES}$	$\Delta V_{(BR)CES}/\Delta T_J$	V_{GE} = 0 V, I_C = 1 mA (25 °C to 125 °C)	-	1.14	-	V/°C
Collector to emitter voltage	$V_{CE(on)}$	V_{GE} = 15 V, I_C = 6 A	-	2.90	3.17	V
		V_{GE} = 15 V, I_C = 12 A	-	4.04	4.46	
		V_{GE} = 15 V, I_C = 6 A, T_J = 125 °C	-	3.45	3.60	
		V_{GE} = 15 V, I_C = 12 A, T_J = 125 °C	-	5.07	5.32	
Gate threshold voltage	$V_{GE(th)}$	I_C = 250 μA	4	-	6	
Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, I_C = 1 mA (25 °C to 125 °C)	-	- 10	-	mV/°C
Forward transconductance	g_{fe}	V_{CE} = 25 V, I_C = 6 A	-	3.2	-	S
Collector to emitter leaking current	I_{CES}	V_{GE} = 0 V, V_{CE} = 1200 V	-	-	250	μA
		V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 125 °C	-	-	1000	
Diode forward voltage drop	V_{FM}	I_F = 6 A, V_{GE} = 0 V	-	2.33	2.77	V
		I_F = 12 A, V_{GE} = 0 V	-	3.01	3.63	
		I_F = 6 A, V_{GE} = 0 V, T_J = 125 °C	-	2.55	2.98	
		I_F = 12 A, V_{GE} = 0 V, T_J = 125 °C	-	3.45	4.07	
Gate to emitter leakage current	I_{GES}	V_{GE} = ± 20 V	-	-	± 250	nA

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 = 6 A V_{CC} = 600 V V_{GE} = 15 V	-	27	41	nC
Gate to emitter charge (turn-on)	Q_{ge}		-	3.7	5.6	
Gate to collector charge (turn-on)	Q_{gc}		-	14	21	
Turn-on switching loss	E_{on}	I_C = 6 A, V_{CC} = 600 V, V_{GE} = 15 V R_g = 10 Ω, L = 2.0 mH, T_J = 25 °C Energy losses include tail and diode reverse recovery	-	0.606	0.909	mJ
Turn-off switching loss	E_{off}		-	0.340	0.510	
Total switching loss	E_{tot}		-	0.946	1.420	
Turn-on switching loss	E_{on}	I_C = 6 A, V_{CC} = 600 V, V_{GE} = 15 V R_g = 10 Ω, L = 2.0 mH, T_J = 125 °C Energy losses include tail and diode reverse recovery	-	0.779	1.170	mJ
Turn-off switching loss	E_{off}		-	0.403	0.605	
Total switching loss	E_{tot}		-	1.182	1.775	
Turn-on delay time	$t_{d(on)}$	I_C = 6 A, V_{CC} = 600 V, V_{GE} = 15 V L = 2.0 mH, L_S = 100 nH R_g = 10 Ω, T_J = 125 °C	-	47	71	ns
Rise time	t_r		-	17	26	
Turn-off delay time	$t_{d(off)}$		-	99	150	
Fall time	t_f		-	362	543	
Reverse BIAS safe operating area	RBSOA	T_J = 150 °C, I_C = 24 A R_g = 10 Ω, V_{GE} = 15 V to 0	Fullsquare			
Short circuit safe operating area	SCSOA	V_{CC} = 600 V, V_{GE} = + 15 V to 0 T_J = 150 °C, V_P = 1200 V, R_g = 10 Ω	10	-	-	μs
Input capacitance	C_{ies}	V_{GE} = 0 V V_{CC} = 30 V f = 1 MHz	-	369	554	pF
Output capacitance	C_{oes}		-	244	366	
Reverse transfer capacitance	C_{res}		-	12	18	
Diode reverse recovery energy	E_{rec}	I_C = 6 A, V_{CC} = 600 V, V_{GE} = 15 V L = 2.0 mH, L_S = 100 nH R_g = 10 Ω, T_J = 125 °C	-	334	-	μJ
Diode reverse recovery time	t_{rr}		-	54	-	ns
Diode peak reverse current	I_{rr}		-	17	-	A

THERMISTOR SPECIFICATIONS (T CODE ONLY)						
PARAMETER	**SYMBOL**	**TEST CONDITIONS**	**MIN.**	**TYP.**	**MAX.**	**UNITS**
Resistance	R_0 (1)	T_0 = 25 °C	-	30	-	kΩ
Sensitivity index of the thermistor material	β (1)(2)	T_0 = 25 °C T_1 = 85 °C	-	4000	-	K

Notes

(1) T_0, T_1 are thermistor´s temperatures

(2) $\frac{R_0}{R_1} = \exp\left[\beta\left(\frac{1}{T_0} - \frac{1}{T_1}\right)\right]$

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}		-	-	2.68	°C/W
	Diode			-	-	4.2	
Case to sink per module		R_{thCS}	Heatsink compound thermal conductivity = 1 W/mK	-	0.06	-	
Mounting torque				-	-	4	Nm
Weight				-	65	-	g

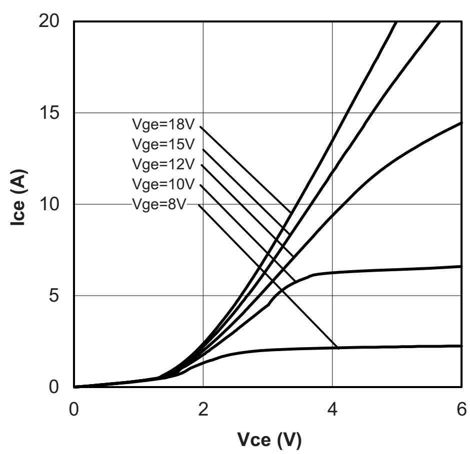


Fig. 1 - Typical Output Characteristics
T_J = 25 °C

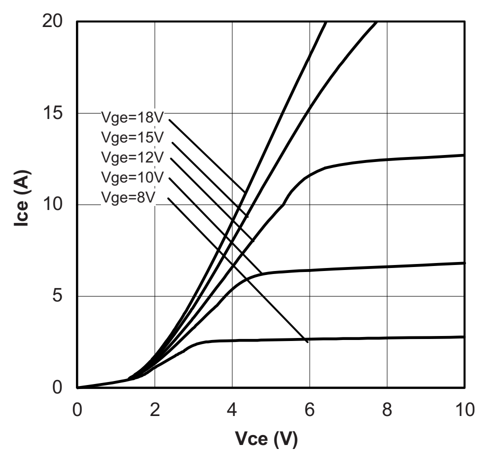


Fig. 2 - Typical Output Characteristics
T_J = 125 °C

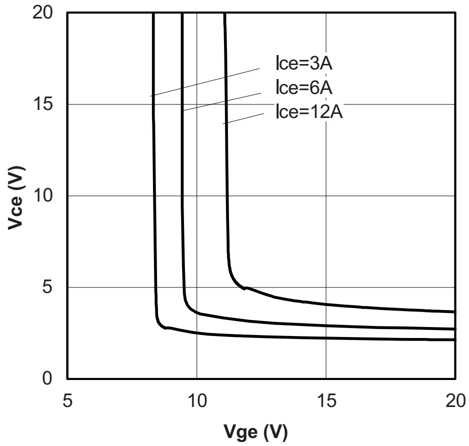


Fig. 3 - Typical V_{CE} vs. V_{GE}
T_J = 25 °C

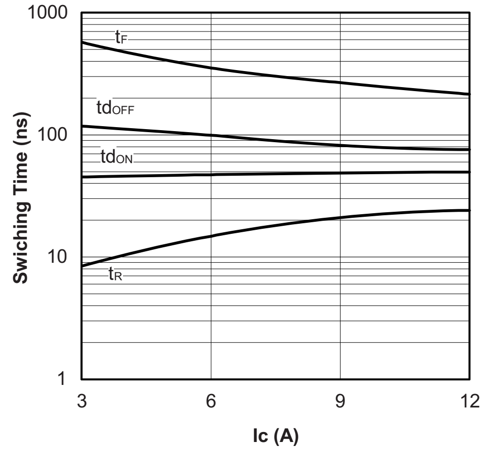


Fig. 6 - Typical Switching Time vs. I_C
T_J = 125 °C, L = 2 mH, V_{CE} = 600 V
R_g = 10 Ω; V_{GE} = 15 V

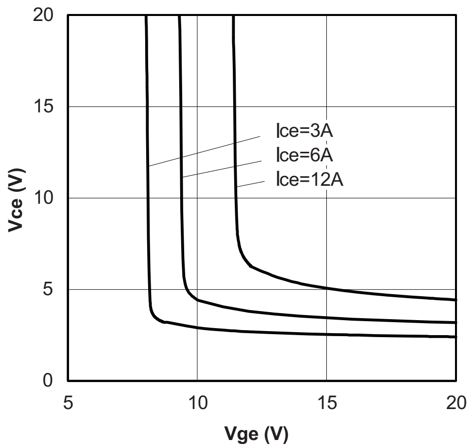


Fig. 4 - Typical V_{CE} vs. V_{GE}
T_J = 125 °C

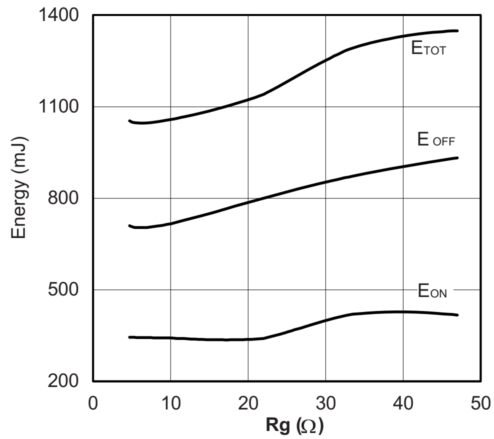


Fig. 7 - Typical Energy Loss vs. R_g
T_J = 125 °C, L = 2 mH, V_{CE} = 600 V
I_C = 6 A; V_{GE} = 15 V

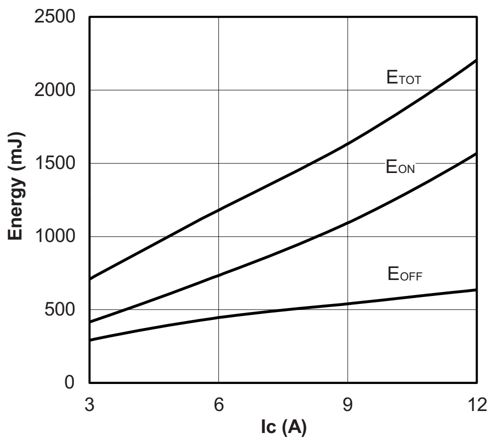


Fig. 5 - Typical Energy Loss vs. I_C
T_J = 125 °C, L = 2 mH, V_{CE} = 600 V
R_g = 10 Ω; V_{GE} = 15 V

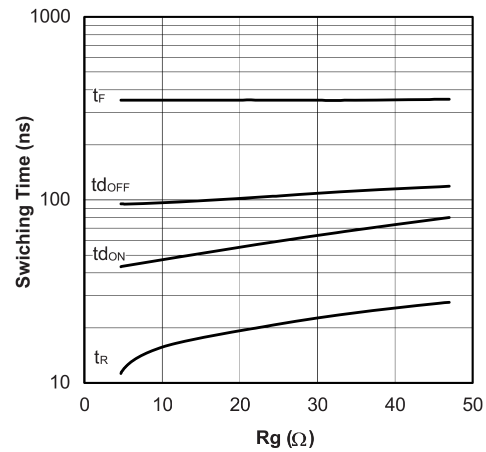


Fig. 8 - Typical Switching Time vs. R_g
T_J = 125 °C, L = 2 mH, V_{CE} = 600 V
I_C = 6 A; V_{GE} = 15 V

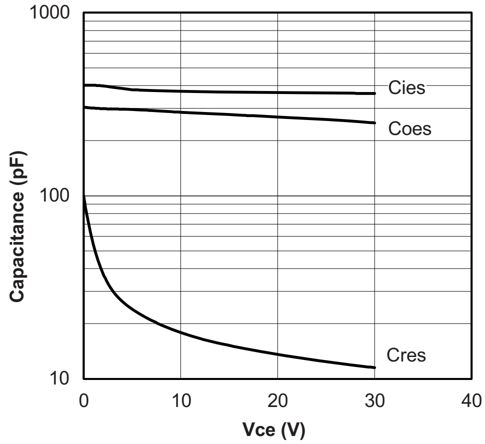


Fig. 9 - Typical Capacitance vs. V_{CE}
V_{GE} = 0 V; f = 1 MHz

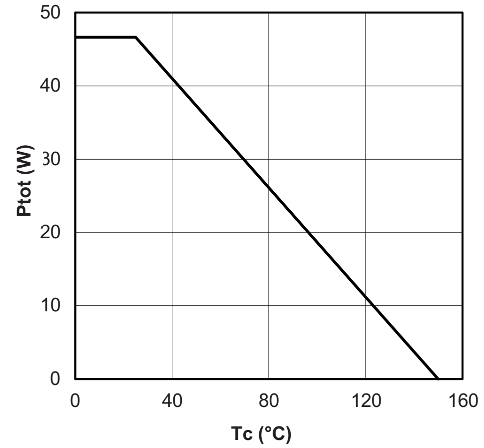


Fig. 12 - Power Dissipation vs. Case Temperature
(IGBT only)

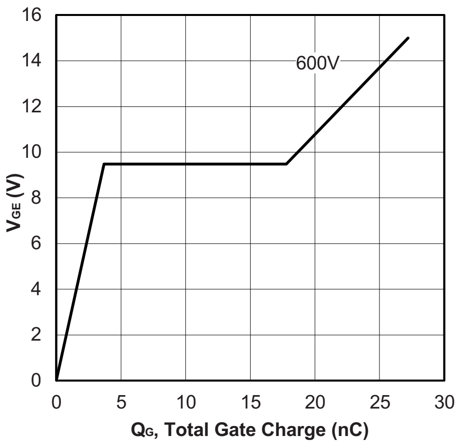


Fig. 10 - Typical Gate Charge vs. V_{GE}
I_{CE} = 5 A

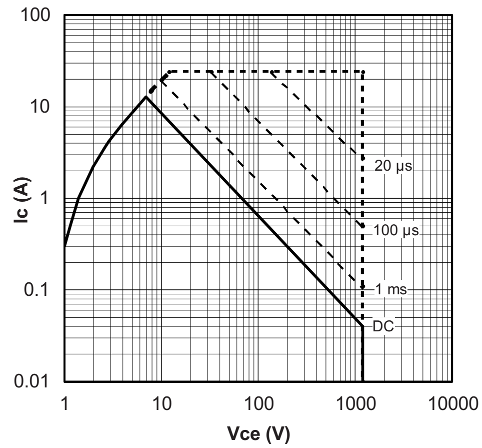


Fig. 13 - Forward SOA
T_C = 25 °C, $T_J \leq$ 150 °C

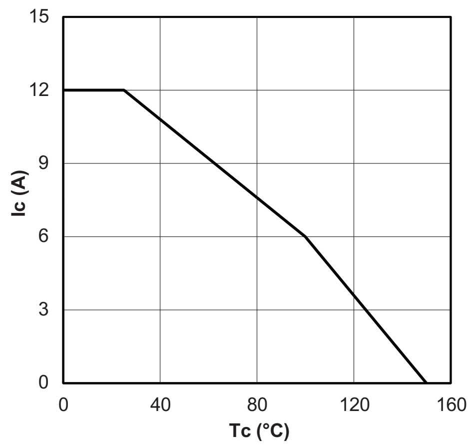


Fig. 11 - Maximum DC Collector Current vs.
Case Temperature

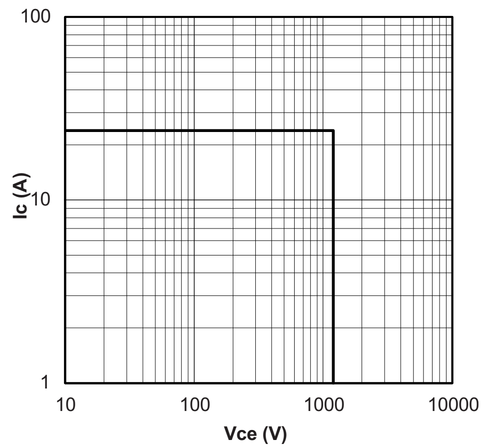


Fig. 14 - Reverse BIAS SOA
T_J = 150 °C, V_{GE} = 15 V

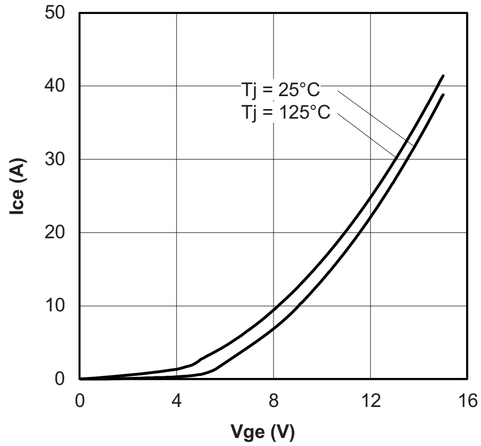


Fig. 15 - Typical Transfer Characteristics
V_{CE} = 50 V; t_p = 10 µs

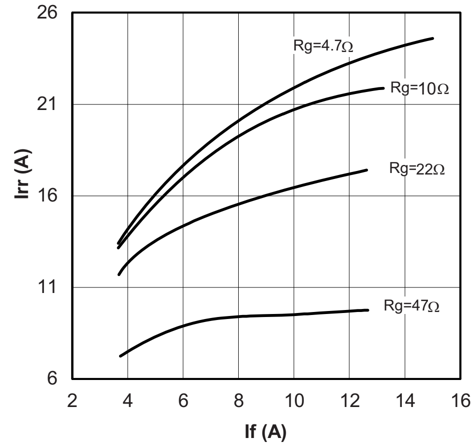


Fig. 17 - Typical Diode I_{rr} vs. I_F
T_J = 125 °C

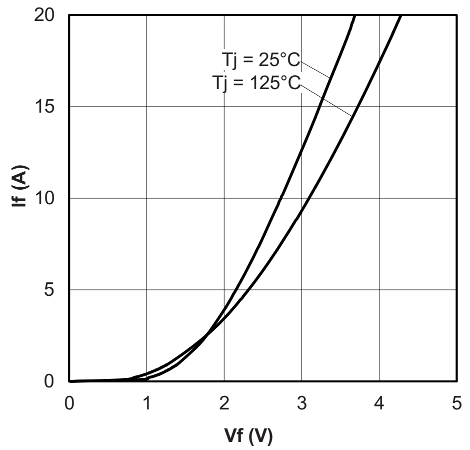


Fig. 16 - Typical Diode Forward Characteristics
t_p = 80 µs

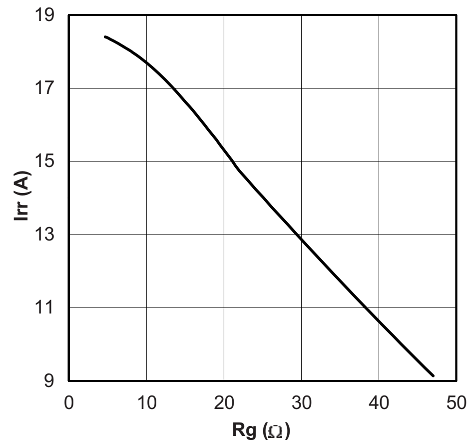


Fig. 18 - Typical Diode I_{rr} vs. R_g
T_J = 125 °C; I_F = 10 A

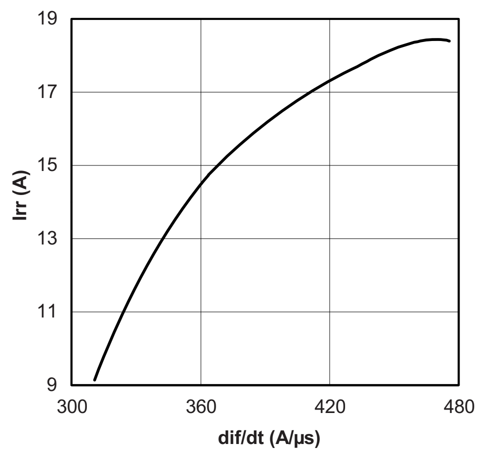


Fig. 19 - Typical Diode I_{rr} vs. dI_F/dt; V_{CC} = 600 V;
V_{GE} = 15 V; I_{CE} = 10 A, T_J = 125 °C

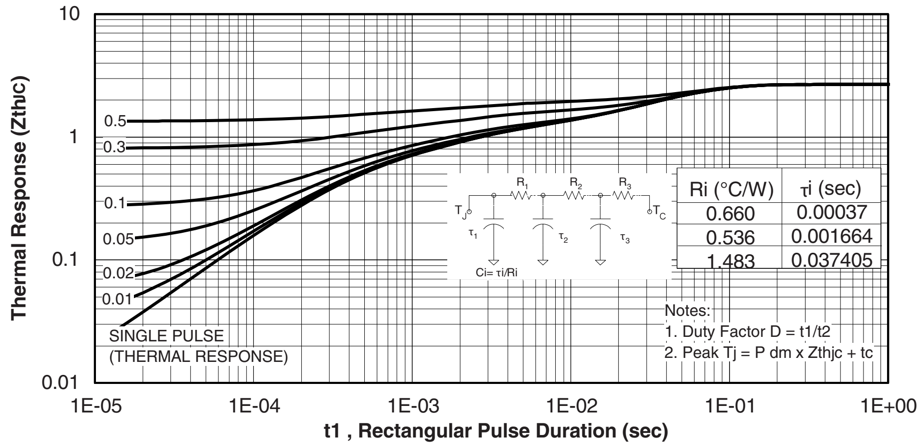


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

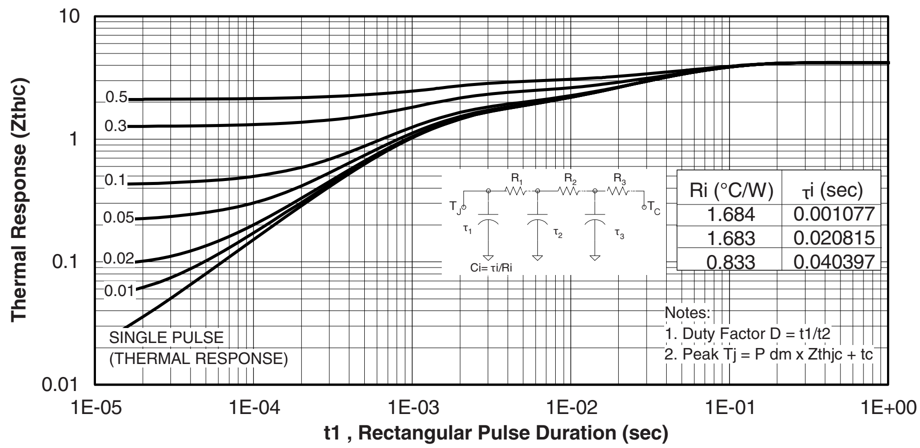


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

ORDERING INFORMATION TABLE

Device code	VS-	GB	05	XP	120	K	T	PbF
	1	2	3	4	5	6	7	8

1 - Vishay Semiconductors product

2 - IGBT module

3 - Nominal current rating (05 = 5 A)

4 - Circuit configuration (XP = Sixpack MTP package)

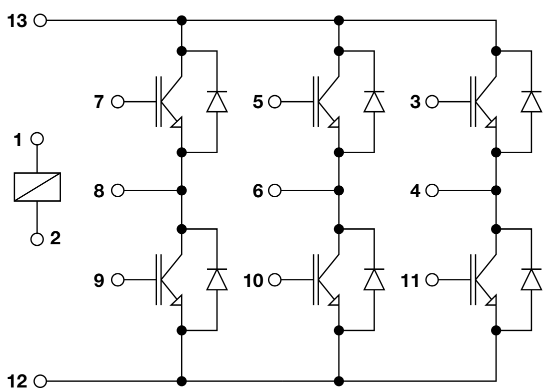
5 - Voltage code (120 = 1200 V)

6 - Speed/type (K = Ultrafast IGBT/inverter motor drive application)

7 - Special option:
- None = No special option
- T = Thermistor

8 - PbF = Lead (Pb)-free

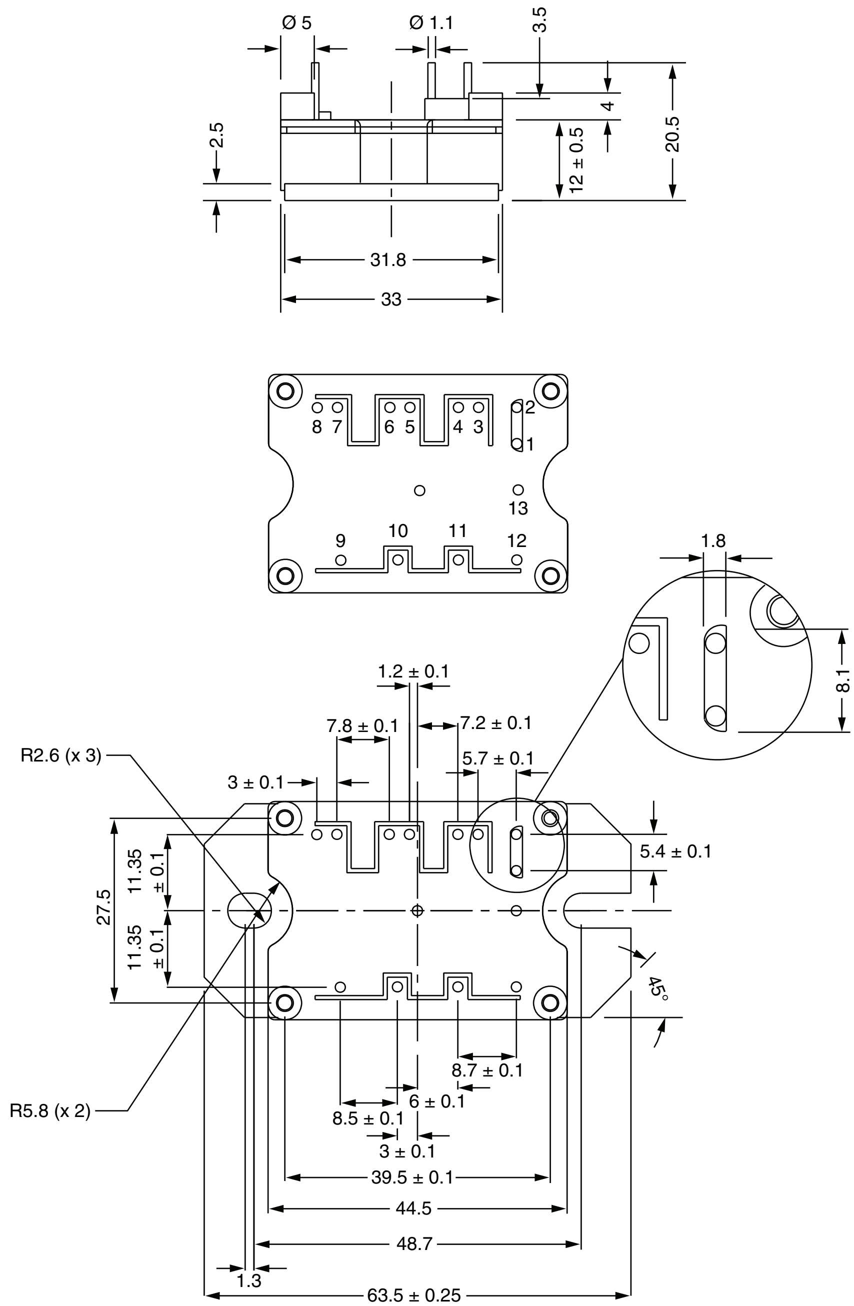
CIRCUIT CONFIGURATION



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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