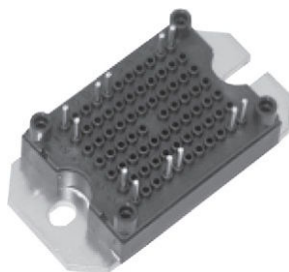


MTP IGBT Power Module Primary Dual Forward



MTP
(Package example)

PRIMARY CHARACTERISTICS

IGBT, $T_J = 150\text{ }^{\circ}\text{C}$	
V_{CES}	600 V
$V_{CE(on)}$ at $25\text{ }^{\circ}\text{C}$ at 80 A	2.11 V
I_C at $80\text{ }^{\circ}\text{C}$	96 A
FRED Pt® AP DIODE, $T_J = 150\text{ }^{\circ}\text{C}$	
V_{RRM}	600 V
$I_{F(DC)}$ at $80\text{ }^{\circ}\text{C}$	11 A
V_F at $25\text{ }^{\circ}\text{C}$ at 5 A	1.1 V
FRED Pt® CHOPPER DIODE, $T_J = 150\text{ }^{\circ}\text{C}$	
V_R	600 V
$I_{F(DC)}$ at $80\text{ }^{\circ}\text{C}$	22 A
V_F at $25\text{ }^{\circ}\text{C}$ at 60 A	2.07 V
Speed	30 kHz to 150 kHz
Package	MTP
Circuit configuration	Dual forward

FEATURES

- Buck PFC stage with warp 3 IGBT and FRED Pt® hyperfast diode
- Integrated thermistor
- Isolated baseplate
- UL approved file E78996 
- Very low stray inductance design for high speed operation
- Ultrafast switching IGBT
- Designed and qualified for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

BENEFITS

- Lower conduction losses and switching losses
- Optimized for welding, UPS, and SMPS applications
- PCB solderable terminals
- Direct mounting to heatsink

ABSOLUTE MAXIMUM RATINGS

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
IGBT	Collector to emitter voltage	V_{CES}		600	V
	Gate to emitter voltage	V_{GE}		± 20	V
	Maximum continuous collector current at $V_{GE} = 15\text{ V}$, $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_C	$T_C = 25\text{ }^{\circ}\text{C}$	138	A
			$T_C = 80\text{ }^{\circ}\text{C}$	96	
	Pulse collector current	$I_{CM}^{(1)}$		330	
	Clamped inductive load current	I_{LM}		330	
Antiparallel diode	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	543	W
	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current $T_J = 150\text{ }^{\circ}\text{C}$ maximum	$I_{F(DC)}$	$T_C = 25\text{ }^{\circ}\text{C}$	17	A
			$T_C = 80\text{ }^{\circ}\text{C}$	11	
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ }^{\circ}\text{C}$	60	
	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	24	W

**ABSOLUTE MAXIMUM RATINGS**

	PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Chopper diode	Repetitive peak reverse voltage	V_{RRM}		600	V
	Maximum continuous forward current $T_J = 150\text{ }^{\circ}\text{C}$ maximum	I_F	$T_C = 25\text{ }^{\circ}\text{C}$	33	A
			$T_C = 80\text{ }^{\circ}\text{C}$	22	
	Maximum non-repetitive peak current	I_{FSM}	10 ms sine or 6 ms rectangular pulse, $T_J = 25\text{ }^{\circ}\text{C}$	135	
	Maximum power dissipation	P_D	$T_C = 25\text{ }^{\circ}\text{C}$	57	W
	Maximum operating junction temperature	T_J		150	$^{\circ}\text{C}$
	Storage temperature range	T_{Stg}		-40 to +150	
	Isolation voltage	V_{ISOL}	$T_J = 25\text{ }^{\circ}\text{C}$, all terminals shorted, $f = 50\text{ Hz}$, $t = 1\text{ s}$	3500	V

Notes

- Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur

(1) $V_{CC} = 300\text{ V}$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$, $R_g = 4.7\text{ }\Omega$, $T_J = 150\text{ }^{\circ}\text{C}$

ELECTRICAL SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
IGBT	Collector to emitter breakdown voltage	BV_{CES}	$V_{GE} = 0\text{ V}$, $I_C = 1.5\text{ mA}$	600	-	-	V
	Temperature coefficient of breakdown voltage	$\Delta V_{BR(CES)}/\Delta T_J$	$I_C = 1.0\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	0.6	-	V/ $^{\circ}\text{C}$
	Collector to emitter voltage	$V_{CE(on)}$	$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$	-	2.11	2.48	V
			$V_{GE} = 15\text{ V}$, $I_C = 80\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	2.43	-	
	Gate threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 750\text{ }\mu\text{A}$	3.2	4.4	6.2	V
	Temperature coefficient of threshold voltage	$\Delta V_{GE(th)}/\Delta T_J$	$V_{CE} = V_{GE}$, $I_C = 1.0\text{ mA}$ ($25\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$)	-	-12	-	mV/ $^{\circ}\text{C}$
	Forward transconductance	g_{fe}	$V_{CE} = 20\text{ V}$, $I_C = 80\text{ A}$	-	97	-	S
	Transfer characteristics	V_{GE}	$V_{CE} = 20\text{ V}$, $I_C = 80\text{ A}$	-	6.6	-	V
	Collector to emitter leakage current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$	-	8	100	μA
			$V_{GE} = 0\text{ V}$, $V_{CE} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	0.1	-	mA
	Gate to emitter leakage	I_{GES}	$V_{GE} = \pm 20\text{ V}$	-	-	± 250	nA
AP diode	Blocking voltage	BV_{RRM}	$I_R = 100\text{ }\mu\text{A}$	600	-	-	V
	Forward voltage drop	V_{FM}	$I_F = 5\text{ A}$	-	1.1	1.27	V
			$I_F = 5\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	0.96	-	
Chopper diode	Forward voltage drop	V_{FM}	$I_F = 60\text{ A}$	-	2.07	2.53	V
			$I_F = 60\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	1.87	-	
	Blocking voltage	BV_{RM}	$I_R = 100\text{ }\mu\text{A}$	600	-	-	μA
	Reverse leakage current	I_{RM}	$V_{RRM} = 600\text{ V}$	-	2	70	
			$V_{RRM} = 600\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	12	-	

**SWITCHING CHARACTERISTICS** ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
PFC IGBT	Total gate charge (turn-on)	Q_g	$I_C = 60\text{ A}$ $V_{CC} = 400\text{ V}$ $V_{GE} = 15\text{ V}$	-	540	-	nC
	Gate to emitter charge (turn-on)	Q_{ge}		-	84	-	
	Gate to collector charge (turn-on)	Q_{gc}		-	192	-	
	Turn-on switching loss	E_{on}	$I_C = 150\text{ A}$, $V_{CC} = 300\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 4.7\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 25\text{ }^\circ\text{C}^{(1)}$	-	0.51	-	mJ
	Turn-off switching loss	E_{off}		-	2.66	-	
	Total switching loss	E_{tot}		-	3.17	-	
	Turn-on delay time	$t_{d(on)}$		-	173	-	ns
	Rise time	t_r		-	79	-	
	Turn-off delay time	$t_{d(off)}$		-	374	-	
	Fall time	t_f		-	66	-	
	Turn-on switching loss	E_{on}	$I_C = 150\text{ A}$, $V_{CC} = 300\text{ V}$, $V_{GE} = 15\text{ V}$, $R_g = 4.7\text{ }\Omega$, $L = 500\text{ }\mu\text{H}$, $T_J = 125\text{ }^\circ\text{C}^{(1)}$	-	0.66	-	mJ
	Turn-off switching loss	E_{off}		-	2.75	-	
	Total switching loss	E_{tot}		-	3.41	-	
	Turn-on delay time	$t_{d(on)}$		-	167	-	ns
	Rise time	t_r		-	80	-	
	Turn-off delay time	$t_{d(off)}$		-	389	-	
	Fall time	t_f		-	69	-	
	Input capacitance	C_{ies}	$V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$	-	14 020	-	pF
	Output capacitance	C_{oes}		-	1010	-	
	Reverse transfer capacitance	C_{res}		-	174	-	
		Reverse bias safe operating area	RBSOA	$I_C = 330\text{ A}$, $V_{CC} = 300\text{ V}$, $V_P = 600\text{ V}$, $R_g = 4.7\text{ }\Omega$, $V_{GE} = 15\text{ V}$, $L = 500\text{ }\mu\text{H}$, $T_J = 150\text{ }^\circ\text{C}$	Full square		

Note

⁽¹⁾ Energy losses include “tail” and diode reverse recovery

RECOVERY PARAMETER ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

	PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
AP diode	Peak reverse recovery current	I_{rr}	$I_F = 10\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$	-	10	-	A
	Reverse recovery time	t_{rr}		-	104	-	ns
	Reverse recovery charge	Q_{rr}		-	537	-	nC
Chopper diode	Peak reverse recovery current	I_{rr}	$I_F = 50\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$	-	4.7	-	A
	Reverse recovery time	t_{rr}		-	73	-	ns
	Reverse recovery charge	Q_{rr}		-	171	-	nC
	Peak reverse recovery current	I_{rr}	$I_F = 50\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $V_{rr} = 200\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$	-	10.3	-	A
	Reverse recovery time	t_{rr}		-	140	-	ns
	Reverse recovery charge	Q_{rr}		-	716	-	nC

THERMISTOR ELECTRICAL CHARACTERISTICS ($T_J = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Resistance	R	$T_J = 25\text{ }^{\circ}\text{C}$	-	30 000	-	Ω
B value	B	$T_J = 25\text{ }^{\circ}\text{C}/T_J = 85\text{ }^{\circ}\text{C}$	-	4000	-	K


THERMAL AND MECHANICAL SPECIFICATIONS

	PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS
IGBT	Junction to case IGBT thermal resistance		-	-	0.23	
AP FRED Pt	Junction to case diode thermal resistance	R_{thJC}	-	-	5.1	°C/W
FRED Pt	Junction to case diode thermal resistance		-	-	2.2	
	Case to sink, flat, greased surface per module	R_{thCS}	-	0.06	-	°C/W
	Mounting torque $\pm 10\%$ to heatsink ⁽¹⁾		-	-	4	Nm
	Approximate weight		-	65	-	g

Note

- ⁽¹⁾ A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound

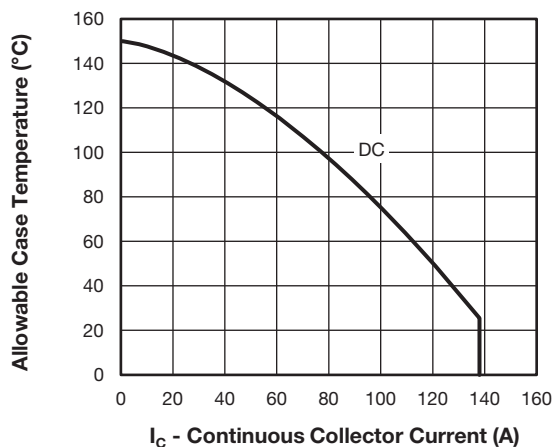


Fig. 1 - Allowable Case Temperature vs. Continuous Collector Current (Maximum IGBT Continuous Collector Current vs. Case Temperature)

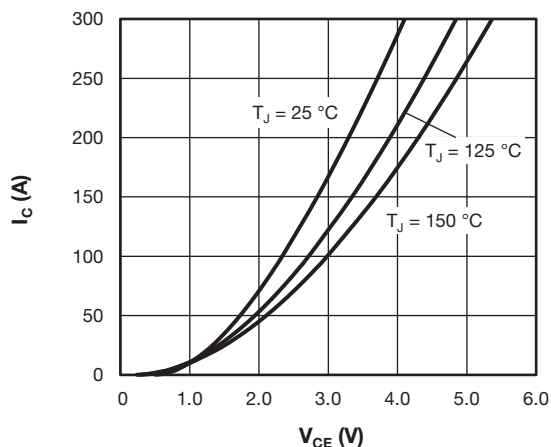


Fig. 3 - I_C vs. V_{CE}
(Typical IGBT Output Characteristics, $V_{GE} = 15\text{ V}$)

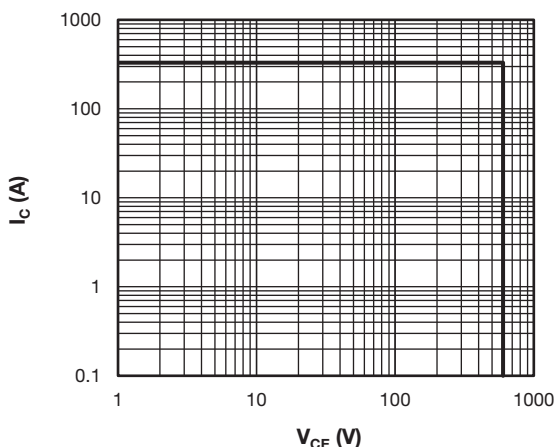


Fig. 2 - I_C vs. V_{CE}
(IGBT Reverse BIAS SOA, $T_J = 150\text{ °C}$, $V_{GE} = 15\text{ V}$)

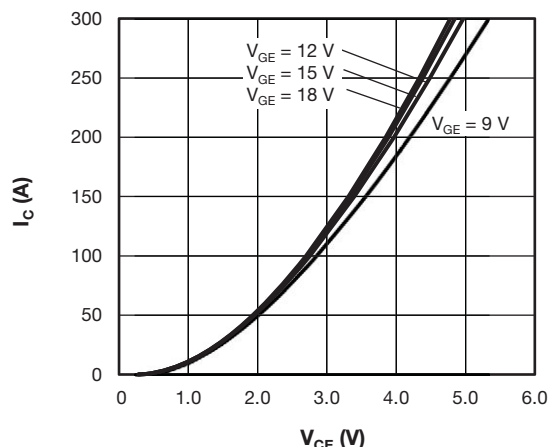


Fig. 4 - I_C vs. V_{CE}
(Typical IGBT Output Characteristics, $T_J = 125\text{ °C}$)

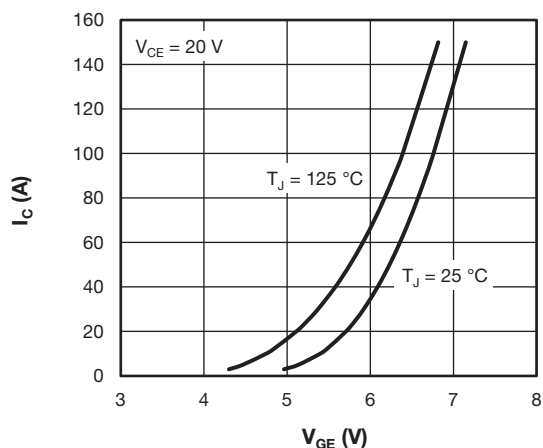


Fig. 5 - I_C vs. V_{GE}
(Typical IGBT Transfer Characteristics)

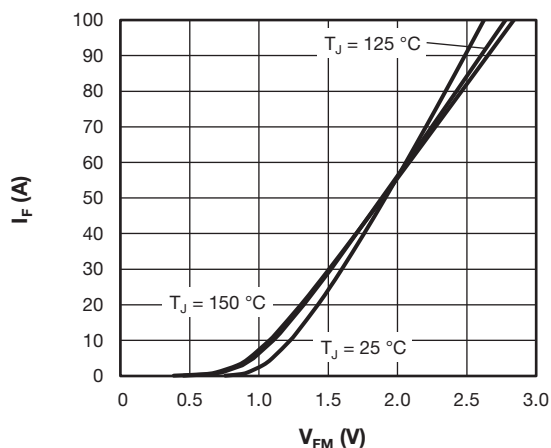


Fig. 8 - I_F vs. V_{FM}
(Typical Antiparallel Diode Forward Characteristics)

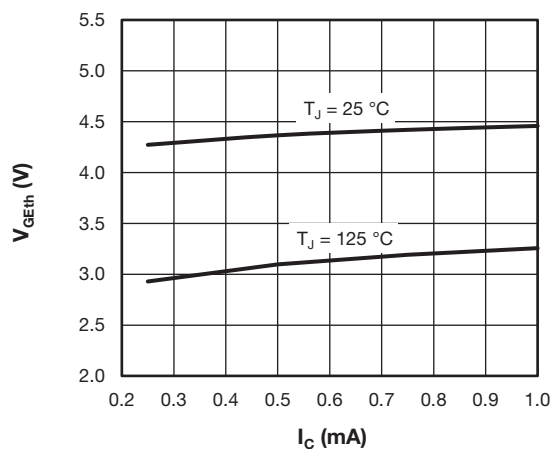


Fig. 6 - V_{GEth} vs. I_C
(Typical IGBT Gate Threshold Voltage)

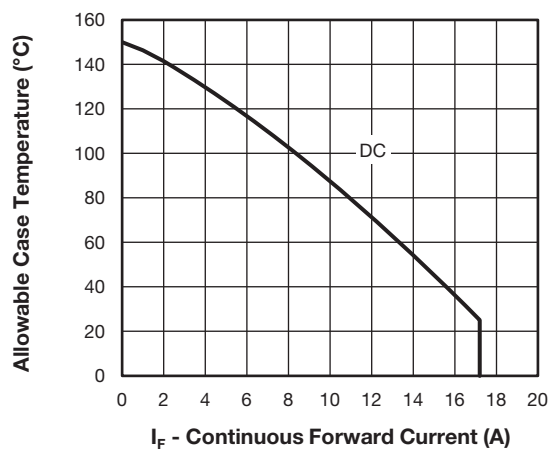


Fig. 9 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Antiparallel Diode Continuous Forward Current vs. Case Temperature)

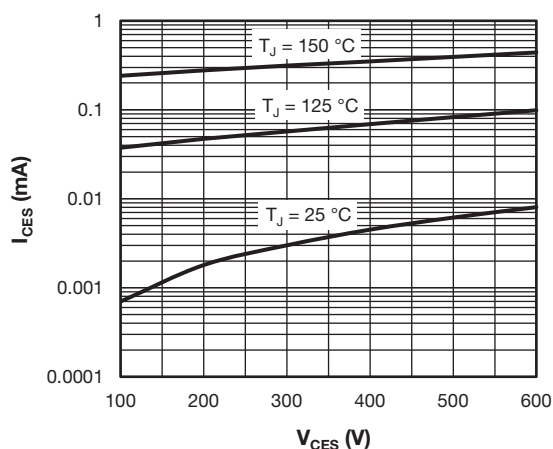


Fig. 7 - I_{CES} vs. V_{CES}
(Typical IGBT Zero Gate Voltage Collector Current)

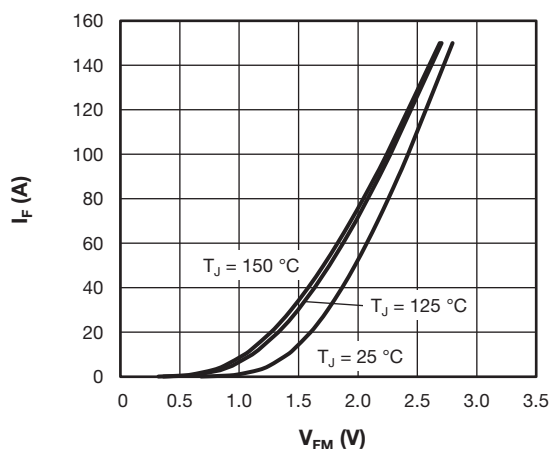


Fig. 10 - I_F vs. V_{FM}
(Typical Chopper Diode Forward Characteristics)

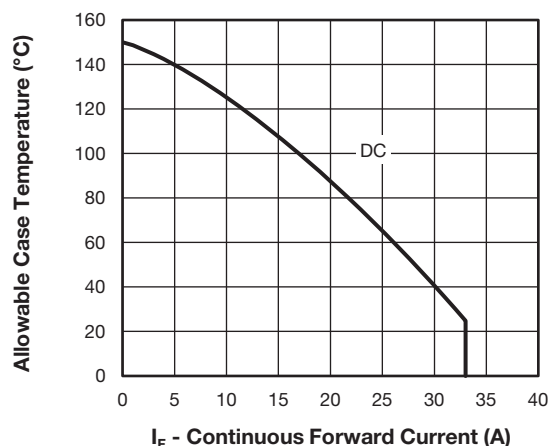


Fig. 11 - Allowable Case Temperature vs. Continuous Forward Current (Maximum Chopper Diode Continuous Forward Current vs. Case Temperature)

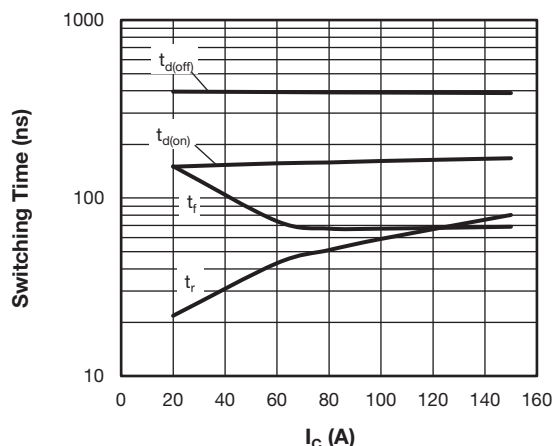


Fig. 14 - Switching Time vs. I_C
(Typical IGBT Switching Time vs. I_C)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

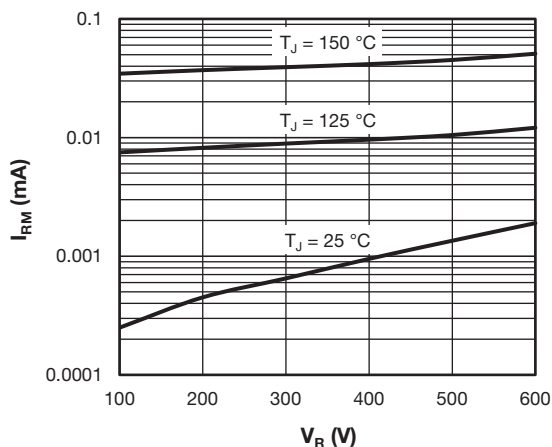


Fig. 12 - I_{RM} vs. V_R
(Typical Chopper Diode Reverse Leakage Current)

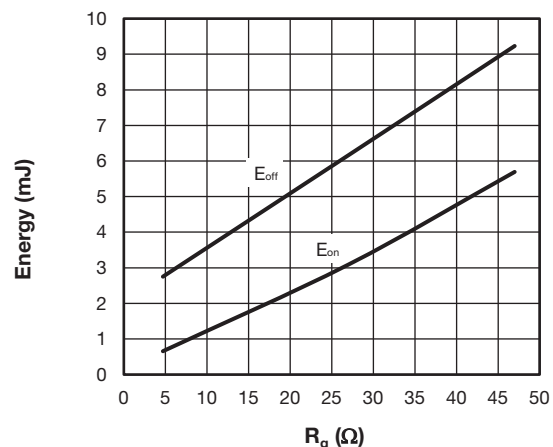


Fig. 15 - Energy Loss vs. R_g
(Typical IGBT Energy Loss vs. R_g)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 150\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

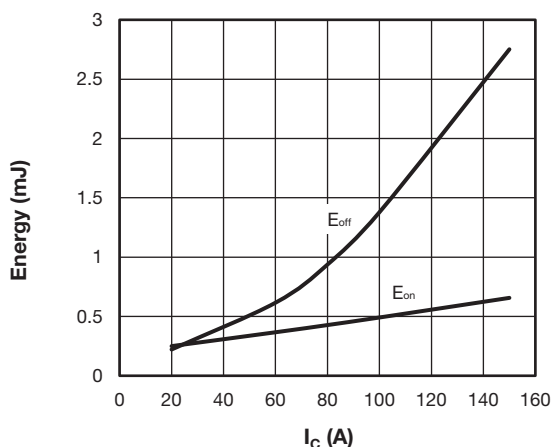


Fig. 13 - Energy Loss vs. I_C
(Typical IGBT Energy Loss vs. I_C)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $R_g = 4.7\ \Omega$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

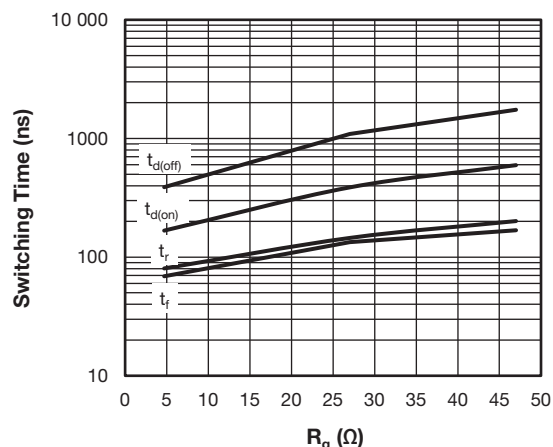


Fig. 16 - Switching Time vs. R_g
(Typical IGBT Switching Time vs. R_g)
 $T_J = 125^\circ\text{C}$, $V_{CC} = 300\text{ V}$, $I_C = 150\text{ A}$, $V_{GE} = 15\text{ V}$, $L = 500\ \mu\text{H}$

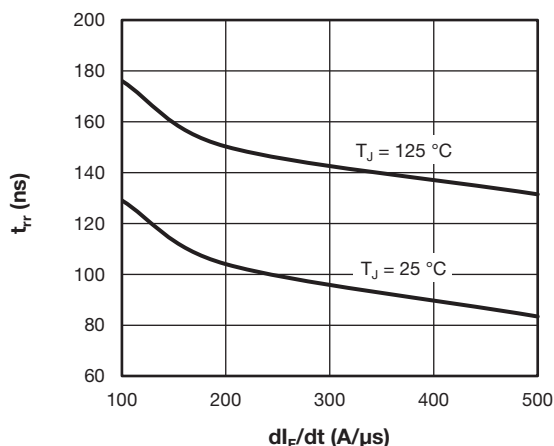


Fig. 17 - t_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Time vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

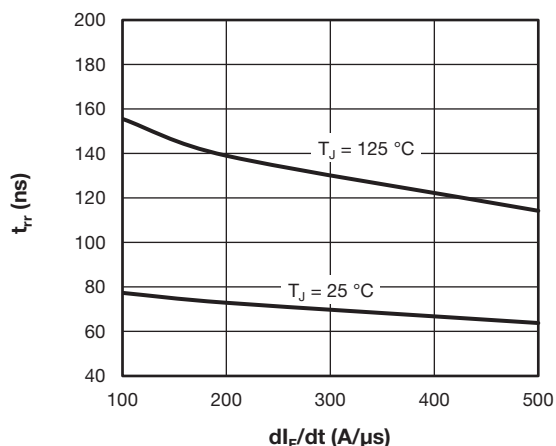


Fig. 20 - t_{rr} vs. dl_F/dt
(Typical Chopper Diode Reverse Recovery Time vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

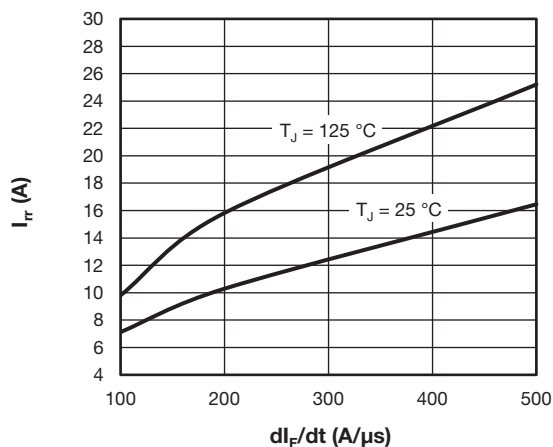


Fig. 18 - I_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Current vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

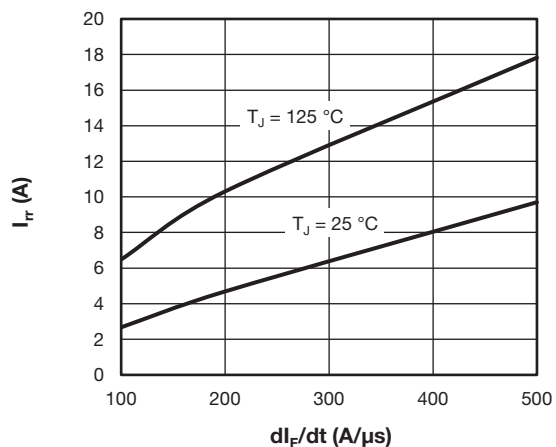


Fig. 21 - I_{rr} vs. dl_F/dt
(Typical Chopper Diode Reverse Recovery Current vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

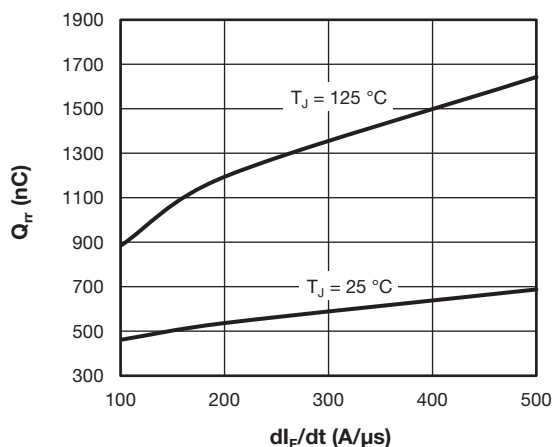


Fig. 19 - Q_{rr} vs. dl_F/dt
(Typical Antiparallel Diode Reverse Recovery Charge vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 10\text{ A}$

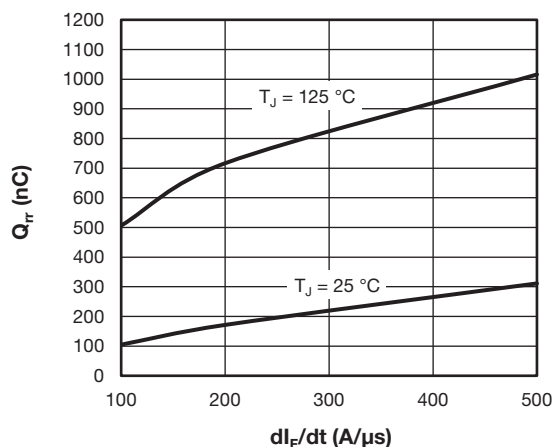


Fig. 22 - Q_{rr} vs. dl_F/dt
(Typical Chopper Diode Reverse Recovery Charge vs. dl_F/dt)
 $V_{rr} = 200\text{ V}$, $I_F = 50\text{ A}$

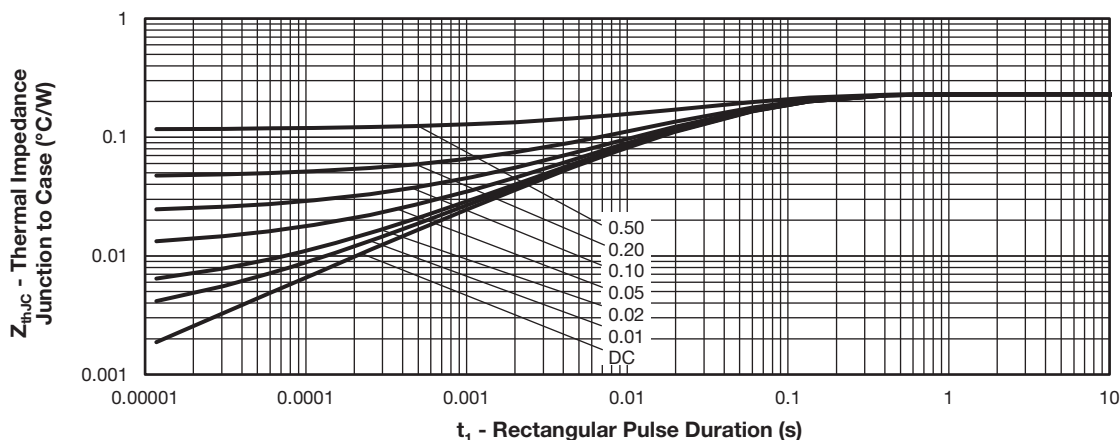


Fig. 23 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (IGBT))

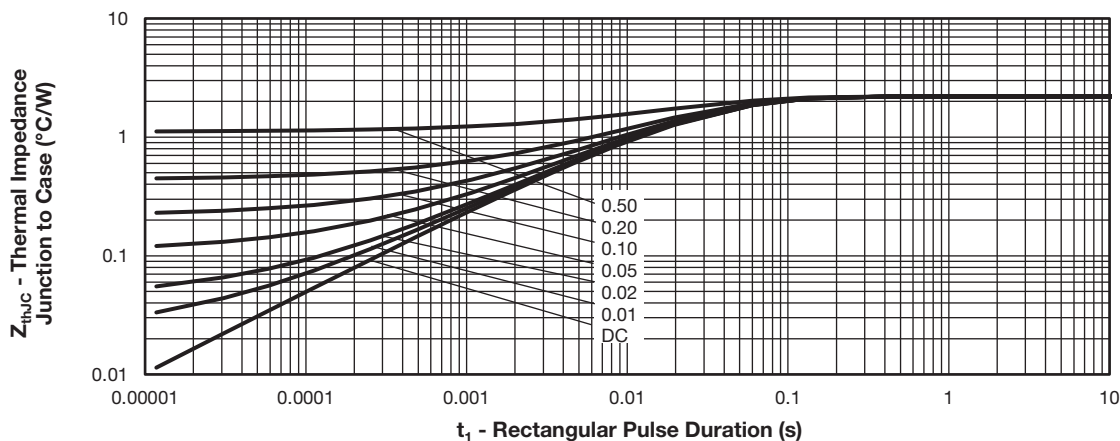
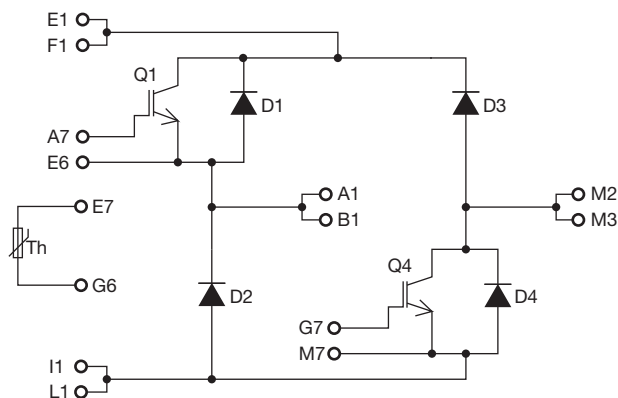


Fig. 24 - Z_{thJC} vs. t_1 Rectangular Pulse Duration
(Maximum Thermal Impedance Z_{thJC} Characteristics - (Chopper Diode))

CIRCUIT CONFIGURATION



ORDERING INFORMATION TABLE

Device code	VS-	150	MT	060	W	DF
	1	2	3	4	5	6

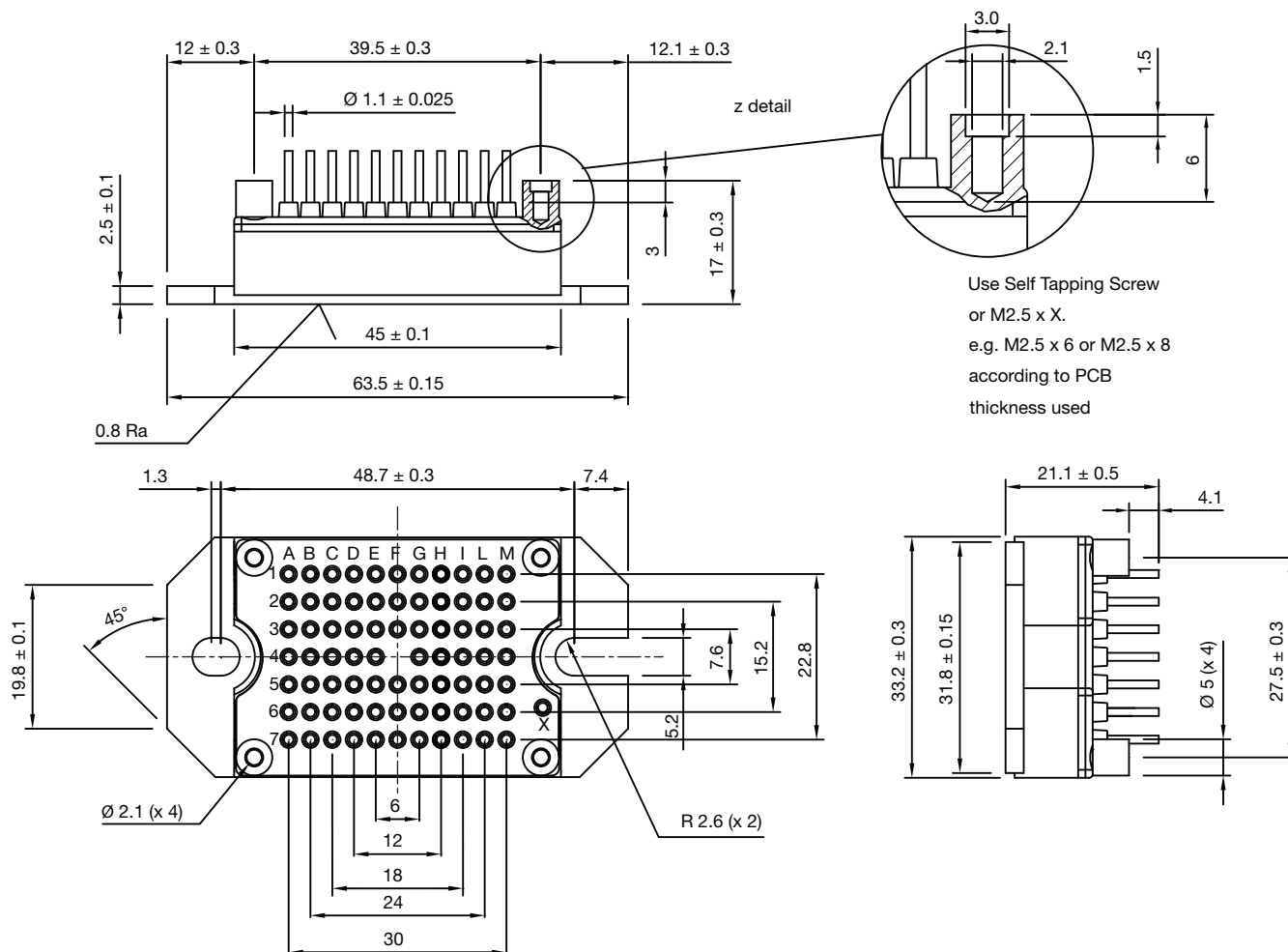
- 1** - Vishay Semiconductors product
- 2** - Current rating (150 = 150 A)
- 3** - Essential part number (MT = MTP package)
- 4** - Voltage code x 10 = voltage rating (example: 060 = 600 V)
- 5** - Die IGBT technology (W = warp speed IGBT)
- 6** - Circuit configuration (DF = dual forward)

LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95383



MTP - Full Pin

DIMENSIONS in millimeters



PINS POSITION
WITH TOLERANCE $\varnothing 0.6$



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