DIM1400H1HS12-PA500

TRENCH Gen5 TMOS

Half Bridge IGBT Module

DS6317-1 February 2020 (LN39666)

FEATURES

- Trench Gate IGBT
- Cu Base with Al_2O_3 Substrates
- High Thermal Cycling Capability
- 10µs Short Circuit Withstand
- Low $V_{ce(sat)}$ Variant

APPLICATIONS

- Motor Drives
- High Power Converters
- Renewable Energy Power Conversion
- High Reliability Inverters

The Powerline range of high power modules includes half bridge, chopper, dual, single and bi-directional switch configurations covering voltages from 1200V to 6500V and currents up to 2400A.

The DIM1400H1HFS12-PA500 is a Half Bridge 1200V, trench gate, insulated gate bipolar transistor (IGBT) module with enhanced field stop and implantation technology. The IGBT has a wide reverse bias safe operating area (RBSOA) plus 10µs short circuit withstand. This device is optimised for traction drives and other applications requiring high thermal cycling capability.

The module incorporates an electrically isolated base plate and low inductance construction enabling circuit designers to optimise circuit layouts and utilise grounded heat sinks for safety.

ORDERING INFORMATION

Order As:

DIM1400H1HFS12-PA500

Note: When ordering, please use the complete part number

KEY PARAMETERS

V_{CES}		**1200V**
$V_{CE(sat)}$ *	**(typ)**	**1.8**
I_C	**(max)**	**1400A**
$I_{C(PK)}$	**(max)**	**2800A**

* Measured at the auxiliary terminals

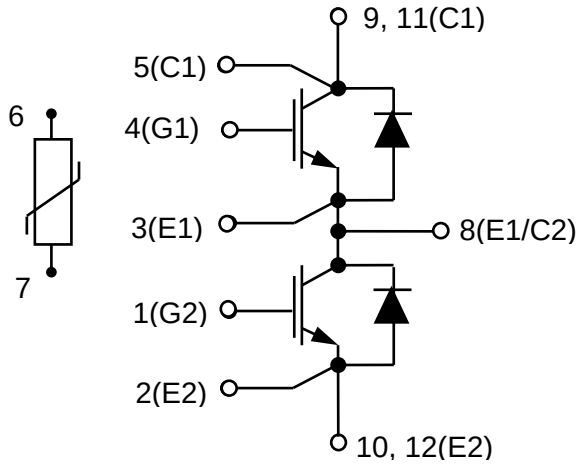
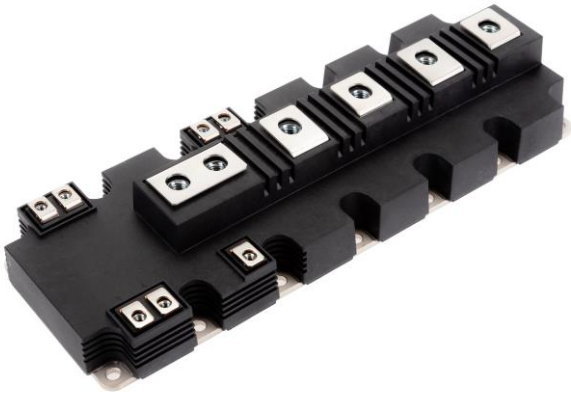


Fig. 1 Circuit configuration



Outline type code: H1

(See Fig. 15 for further information)

Fig. 2 Package

ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture of the package. Appropriate safety precautions should always be followed. Exposure to Absolute Maximum Ratings may affect device reliability.

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions	Max.	Units
V_{CES}	Collector-emitter voltage	V_{GE} = 0V, T_C = 25°C	1200	V
V_{GES}	Gate-emitter voltage	T_C = 25°C	±20	V
I_C	Continuous collector current	T_C = 100°C	1400	A
$I_{C(PK)}$	Peak collector current	t_P = 1ms,	2800	A
P_{max}	Max. transistor power dissipation	T_C = 25°C, T_{vj} = 175°C	7.5	kW
I^2t	Diode I^2t value	V_R = 0, t_p = 10ms, T_{vj} = 150ºC	172	kA^2s
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	4000	V

THERMAL AND MECHANICAL RATINGS

Internal insulation material: Al_2O_3

Baseplate material: Cu

Creepage distance: 33mm

Clearance: 19mm

CTI (Comparative Tracking Index): >400

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-c)}$	Thermal resistance – transistor	Continuous dissipation - junction to case	-	-	20	°C/kW
$R_{th(j-c)}$	Thermal resistance – diode	Continuous dissipation - junction to case	-	-	35.5	°C/kW
$R_{th(c-h)}$ IGBT	Thermal resistance – case to heatsink (IGBT)	Mounting torque 5Nm (with mounting grease: 1W/mK)	-	-	9.5	°C/kW
$R_{th(c-h)}$ Diode	Thermal resistance – case to heatsink (Diode)	Mounting torque 5Nm (with mounting grease: 1W/mK)	-	-	17	°C/kW
T_j	Junction temperature – under switching conditions	Transistor	-40	-	150	°C
		Diode	-40	-	150	°C
T_{stg}	Storage temperature range	-	-40	-	150	°C
	Screw torque	Mounting – M5	3	-	6	Nm
		Electrical connections – M8	8	-	10	Nm

ELECTRICAL CHARACTERISTICS

T_{case} = 25°C unless stated otherwise.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_{CES}	Collector cut-off current	V_{GE} = 0V, V_{CE} = V_{CES}			1	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125°C			15	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150°C			30	mA
I_{GES}	Gate leakage current	V_{GE} = ± 20V, V_{CE} = 0V			0.5	µA
$V_{GE(TH)}$	Gate threshold voltage	I_C = 30mA, V_{GE} = V_{CE}	5.0	6.0	7.0	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15V, I_C = 1400A		1.8	2.2	V
		V_{GE} = 15V, I_C = 1400A, T_j = 125°C		2.15	2.55	V
		V_{GE} = 15V, I_C = 1400A, T_j = 150°C		2.25	2.65	V
I_F	Diode forward current	DC		1400		A
I_{FM}	Diode maximum forward current	t_p = 1ms		2800		A
V_F	Diode forward voltage	I_F = 1400A		1.9	2.3	V
		I_F = 1400A, T_j = 125°C		2.1	2.5	V
		I_F = 1400A, T_j = 150°C		2.1	2.5	V
C_{ies}	Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		118		nF
Q_g	Gate charge	±15V		13		µC
C_{res}	Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		3.2		nF
L_M	Module inductance			10		nH
R_{INT}	Internal transistor resistance			0.2		mΩ
SC_{Data}	Short circuit current, I_{SC}	T_j = 150°C, V_{CC} = 800V t_p ≤ 10µs, V_{GE} ≤ 15V $V_{CE\ (max)}$ = V_{CES} – L* x dI/dt IEC 60747-9		5800		A

Note:
* L is the circuit inductance + L_M

NTC-Thermistor Data

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
R_{25}	Rated resistance	T_C = 25°C		5		kΩ
Δ*R*/R	Deviation of R100	T_C = 100°C, R_{100} = 493Ω	-5		5	%
P_{25}	Power dissipation	T_C = 25°C			20	m/W
$B_{25/50}$	B-value	R_2 = R_{25}exp [$B_{25/50}$(1/T2 – 1/(298.15K))]		3375		K
$B_{25/80}$		R_2 = R_{25}exp [$B_{25/80}$(1/T2 – 1/(298.15K))]		3411		K
$B_{25/100}$		R_2 = R_{25}exp [$B_{25/100}$(1/T2 – 1/(298.15K))]		3433		K

ELECTRICAL CHARACTERISTICS

T_{case} = 25°C unless stated otherwise

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1400A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 25nH	*dv/dt* = 2100V/µs		1120		ns
t_f	Fall time				230		ns
E_{OFF}	Turn-off energy loss				245		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 8500A/µs		320		ns
t_r	Rise time				165		ns
E_{ON}	Turn-on energy loss				160		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1400A V_{CE} = 600V *di/dt* = 8500A/µs			92		µC
I_{rr}	Diode reverse recovery current				580		A
E_{rec}	Diode reverse recovery energy				41		mJ

T_{case} = 125°C unless stated otherwise

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1400A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 25nH	*dv/dt* = 2100V/µs		1160		ns
t_f	Fall time				320		ns
E_{OFF}	Turn-off energy loss				276		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 8500A/µs		300		ns
t_r	Rise time				180		ns
E_{ON}	Turn-on energy loss				196		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1400A V_{CE} = 600V *di/dt* = 8500A/µs			200		µC
I_{rr}	Diode reverse recovery current				697		A
E_{rec}	Diode reverse recovery energy				90		mJ

T_{case} = 150°C unless stated otherwise

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Units
$t_{d(off)}$	Turn-off delay time	I_C = 1400A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 25nH	*dv/dt* = 2100V/µs		1200		ns
t_f	Fall time				340		ns
E_{OFF}	Turn-off energy loss				285		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 8500A/µs		290		ns
t_r	Rise time				195		ns
E_{ON}	Turn-on energy loss				208		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 1400A V_{CE} = 600V *di/dt* = 8500A/µs			236		µC
I_{rr}	Diode reverse recovery current				765		A
E_{rec}	Diode reverse recovery energy				102		mJ

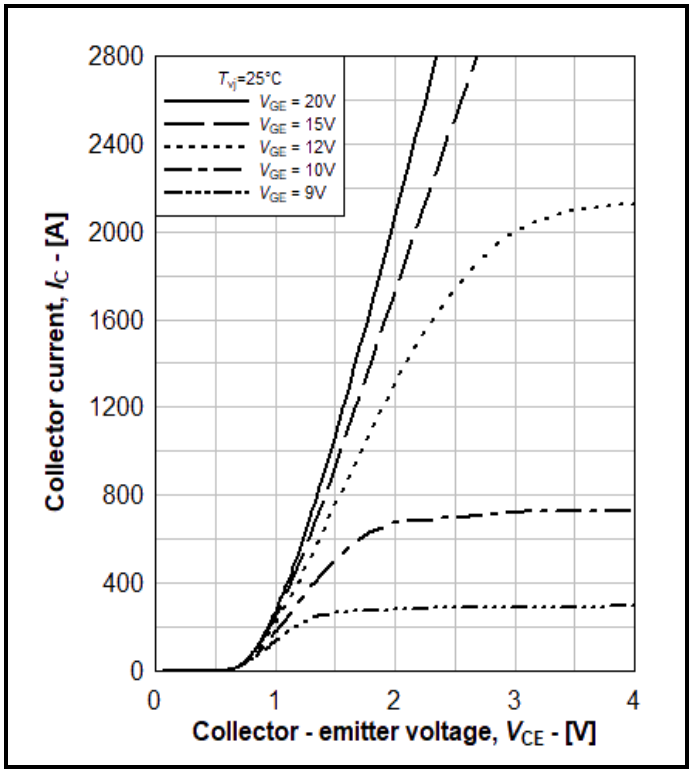


Fig. 3 Typical IGBT output characteristics, $I_C = f(V_{CE})$

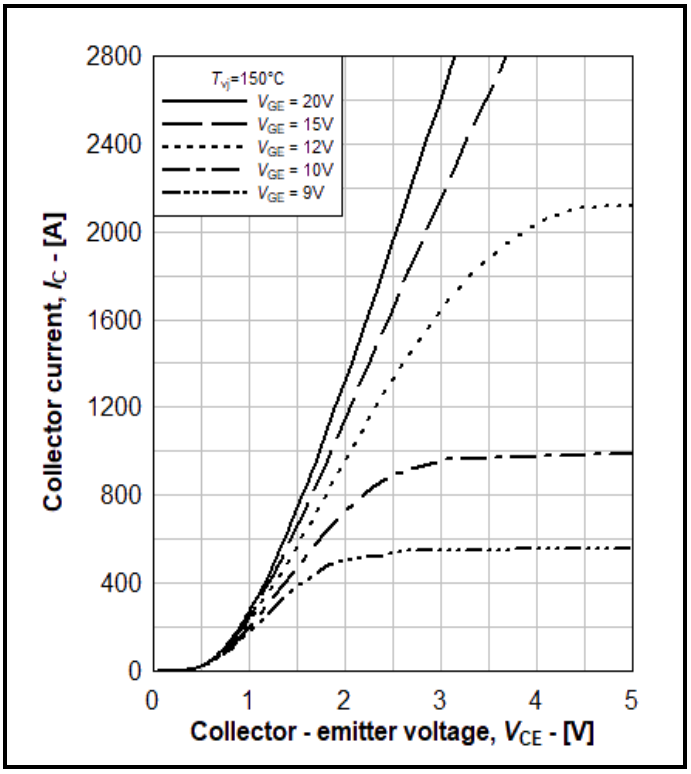


Fig. 4 Typical IGBT output characteristics, $I_C = f(V_{CE})$

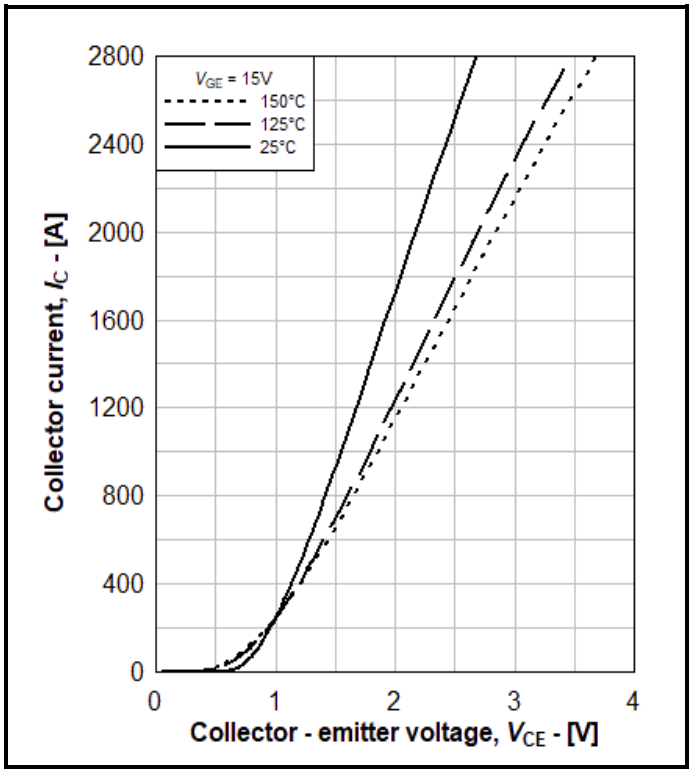


Fig. 5 Typical IGBT output characteristics, $I_C = f(V_{CE})$

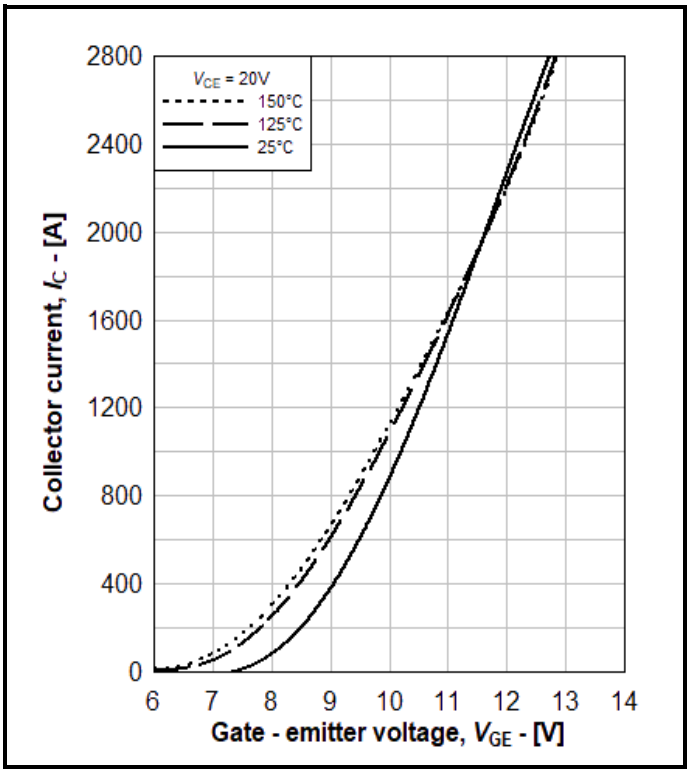


Fig. 6 Typical IGBT transfer characteristics, $I_C = f(V_{GE})$

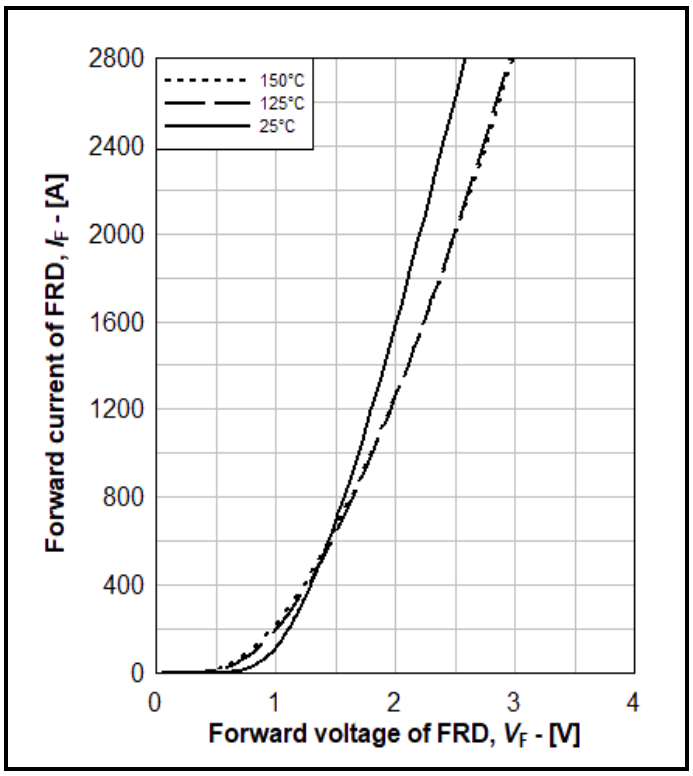


Fig. 7 Diode typical forward characteristics, $I_F = f(V_F)$

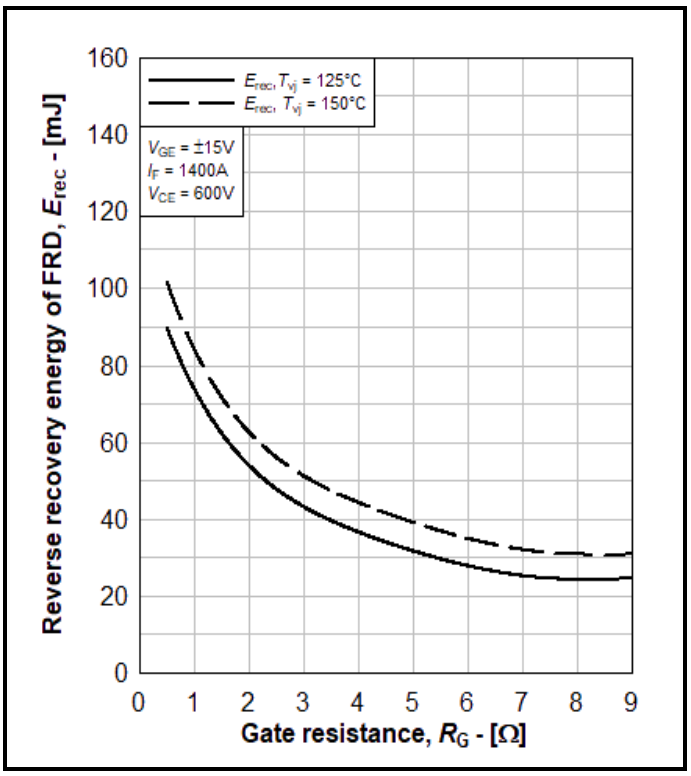


Fig. 8 Typical FRD E_{rec}, $E_{rec} = f(R_G)$

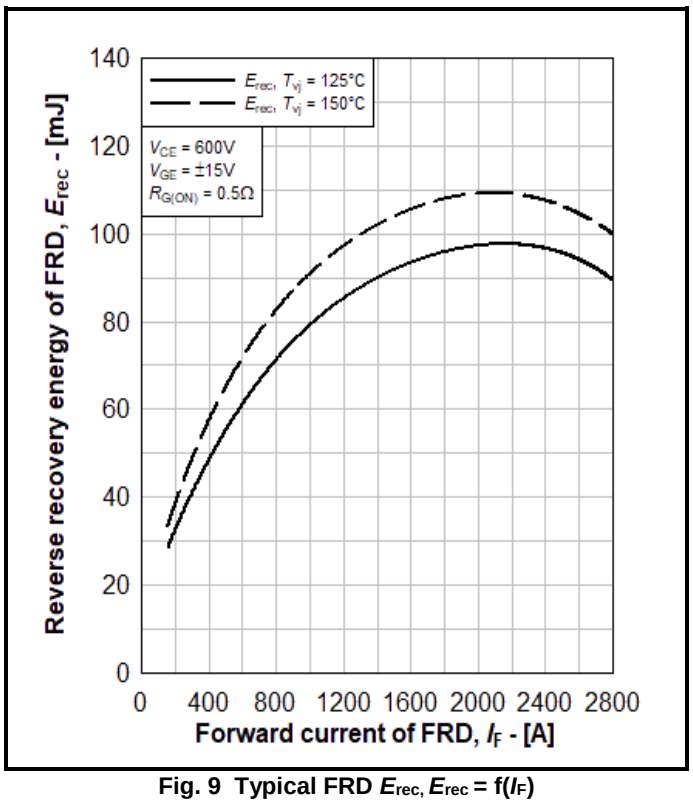


Fig. 9 Typical FRD E_{rec}, $E_{rec} = f(I_F)$

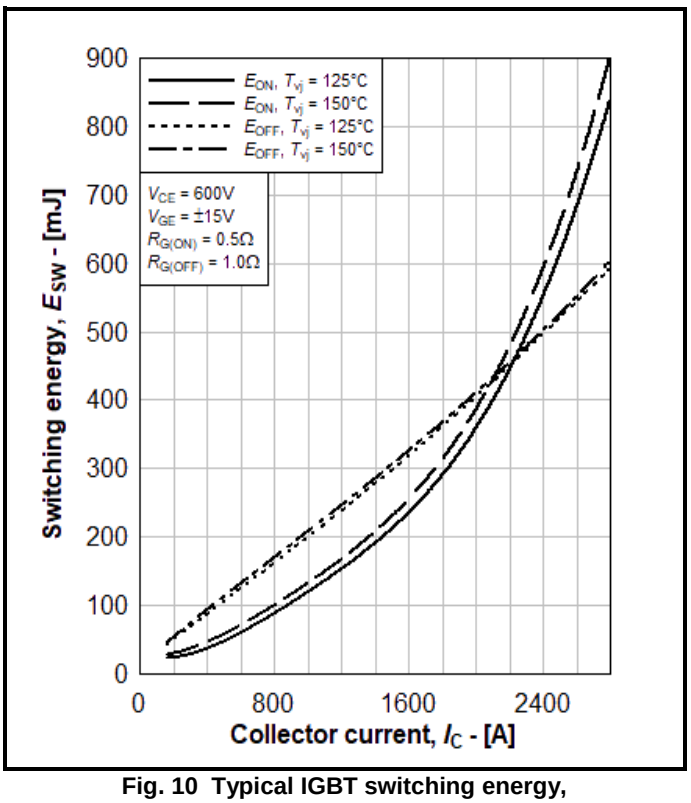


Fig. 10 Typical IGBT switching energy,
$E_{ON} = f(I_C)$, $E_{OFF} = f(I_C)$

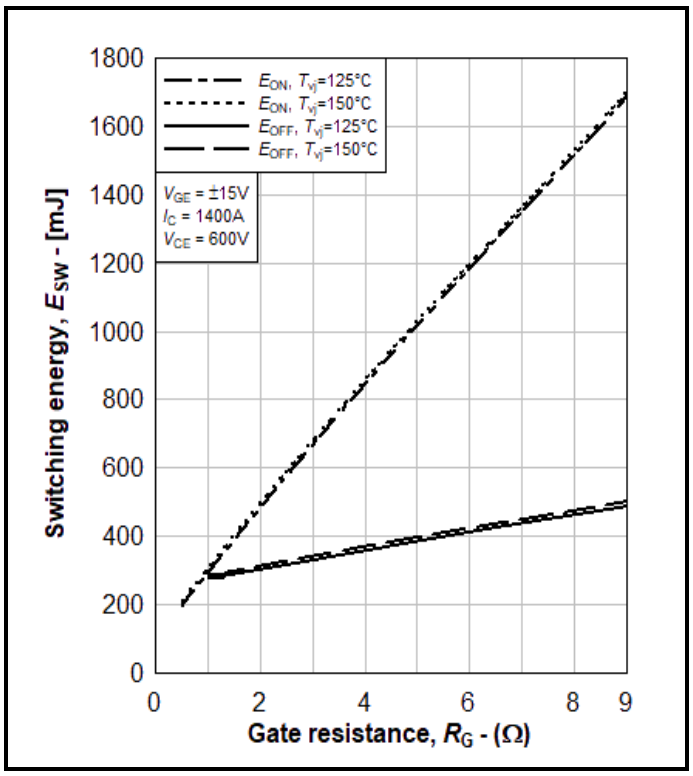


Fig. 11 Typical IGBT switching energy
E_{ON} = f(R_G), E_{OFF} = fR_G)

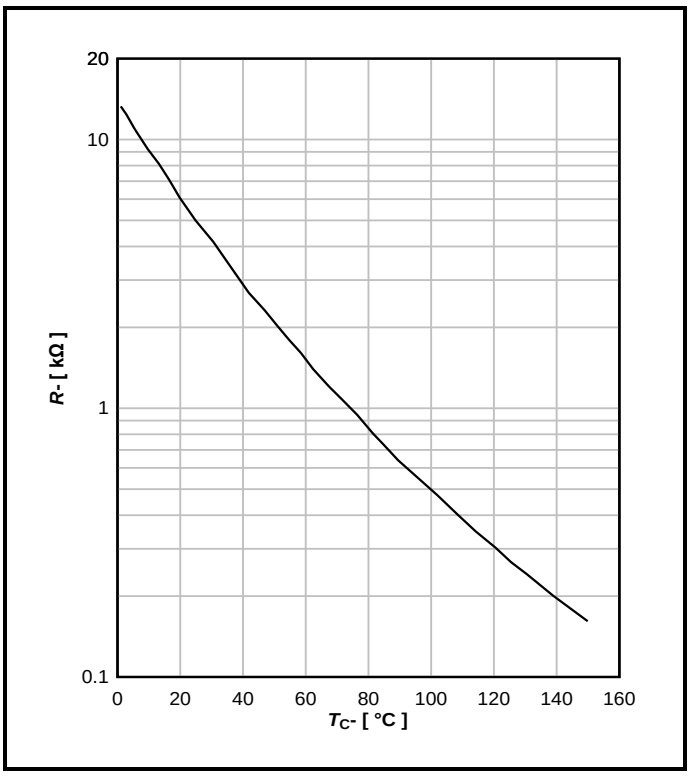


Fig. 12 Typical NTC thermistor characteristic, R = f(T_C)

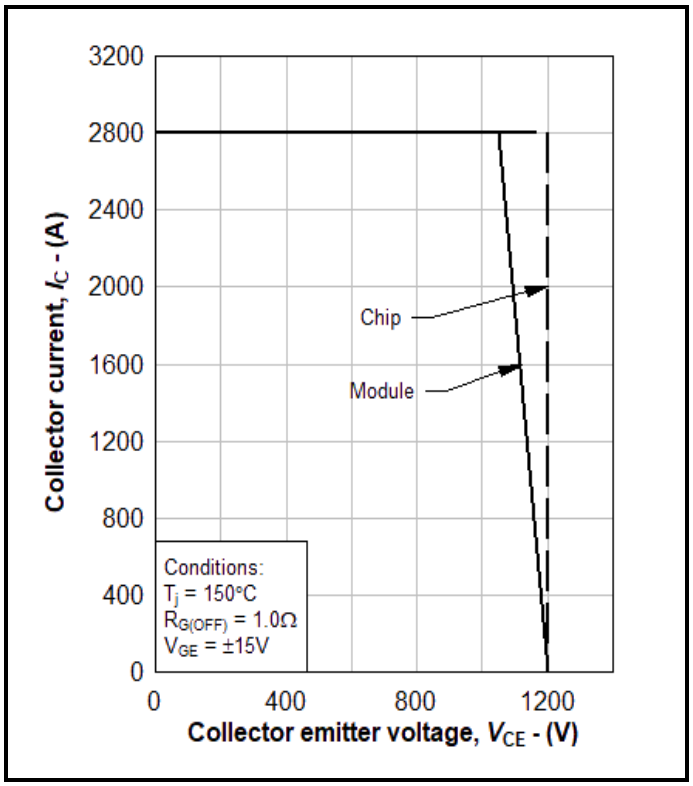


Fig. 13 Reverse bias safe operating area of IGBT,
I_C = f(V_{CE})

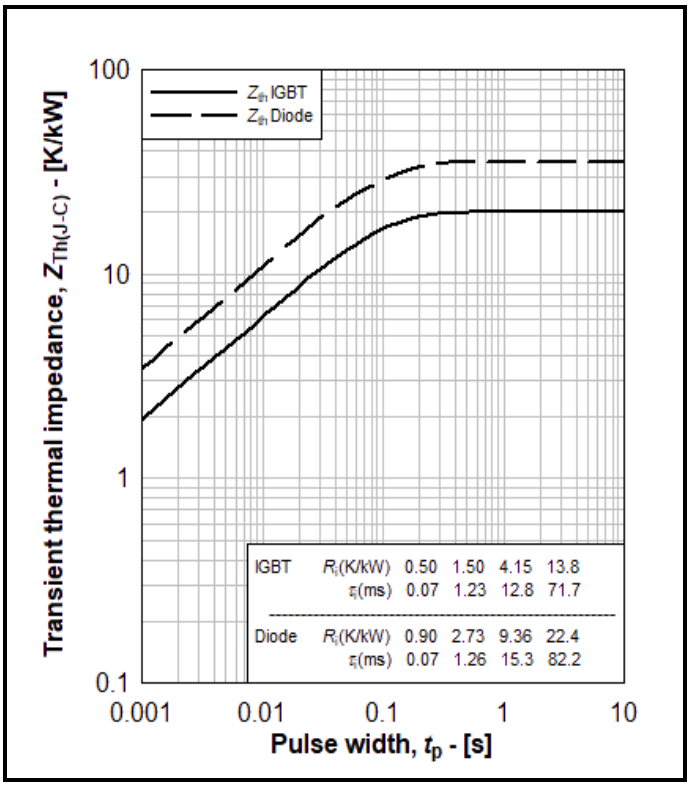
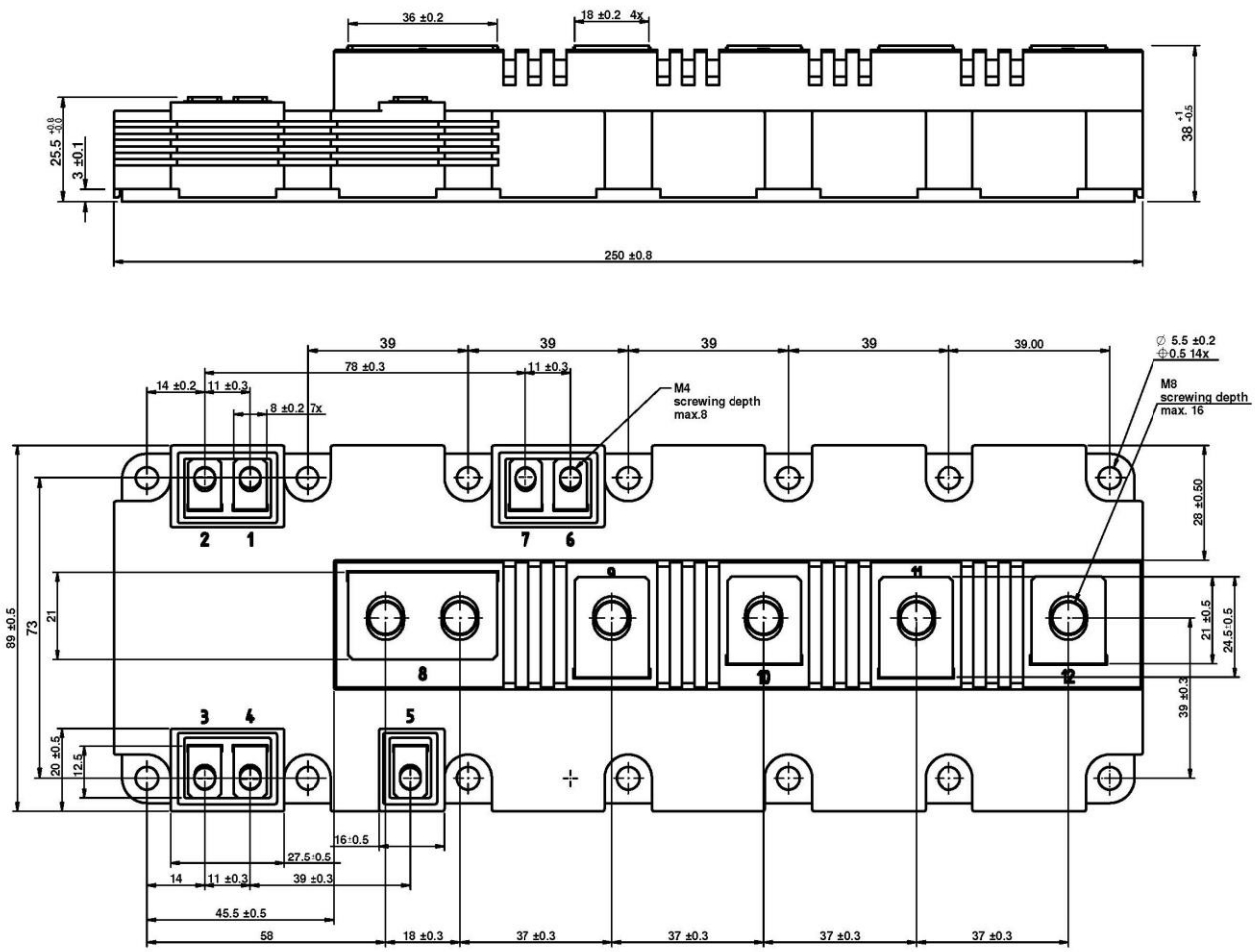


Fig. 14 Transient thermal impedance, $Z_{th(J-C)}$ = f(t)

PACKAGE DETAILS

For further package information, please visit our website or contact Customer Services.
All dimensions in mm, unless stated otherwise.
DO NOT SCALE.



Nominal Weight: 1200g

Module Outline Type Code: H1

Fig. 15 Module outline drawing

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The products must not be touched when operating because there is a danger of electrocution or severe burning. Always use protective safety equipment such as appropriate shields for the product and wear safety glasses. Even when disconnected any electric charge remaining in the product must be discharged and allowed to cool before safe handling using protective gloves.

Extended exposure to conditions outside the product ratings may affect reliability leading to premature product failure. Use outside the product ratings is likely to cause permanent damage to the product. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture, a large current to flow or high voltage arcing, resulting in fire or explosion. Appropriate application design and safety precautions should always be followed to protect persons and property.

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