TG600HF12M1-S3A00

Half Bridge IGBT Module

DS6250-1 August 2018 (LN36188)

FEATURES

- Cu Base with Enhanced Al_2O_3 Substrates
- 10µs Short Circuit Withstand

APPLICATIONS

- Motor Drives
- Power Charging Equipment
- Solar Power
- 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 TG600HF12M1-S3A00 is a half bridge 1200V, n-channel enhancement mode, insulated gate bipolar transistor (IGBT) module. 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:

TG600HF12M1-S3A00

Note: When ordering, please use the complete part number

KEY PARAMETERS

V_{CES}		**1200V**
$V_{CE(sat)}$ *	**(typ)**	**1.70V**
I_C	**(max)**	**600A**
$I_{C(PK)}$	**(max)**	**1200A**

* Measured at the auxiliary terminals

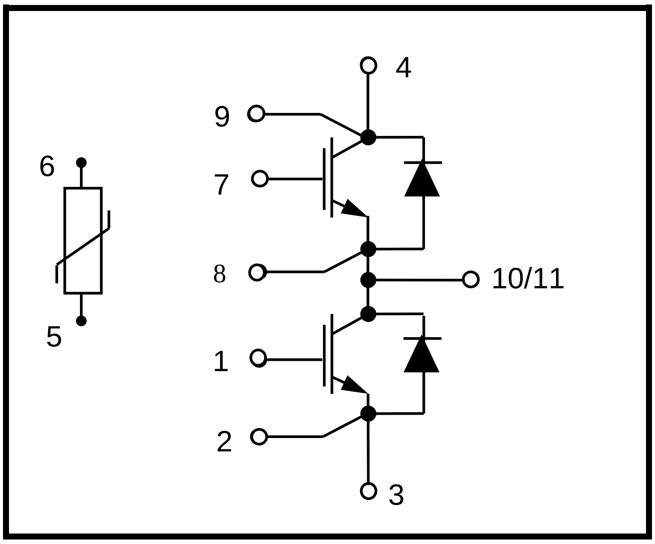


Fig. 1 Circuit configuration

Outline type code: M1

(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 = 88°C	600	A
$I_{C(PK)}$	Peak collector current	t_P = 1ms, TC = 133°C	1200	A
P_{max}	Max. transistor power dissipation	T_C = 25°C, T_{vj} = 175°C	3.0	kW
I^2t	Diode I^2t value	V_R = 0, t_p = 10ms, T_{vj} = 150ºC	28.8	kA^2s
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	2500	V

THERMAL AND MECHANICAL RATINGS

Internal insulation material:	Al_2O_3
Baseplate material:	Cu
Creepage distance – Terminal to heatsink:	14.5mm
Creepage distance – Terminal to terminal:	13.0mm
Clearance – Terminal to heatsink:	12.5mm
Clearance – Terminal to terminal:	10mm
CTI (Comparative Tracking Index):	>200

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-c)}$	Thermal resistance – IGBT	Continuous dissipation - junction to case	-	-	49	°C/kW
$R_{th(j-c)}$	Thermal resistance – diode		-	-	77	°C/kW
$R_{th(c-h)}$	Thermal resistance – case to heatsink (IGBT)	Mounting torque 5Nm (with mounting grease 1W/m °C)	-	-	34	°C/kW
$R_{th(c-h)}$	Thermal resistance – case to heatsink (Diode)		-	-	40	°C/kW
T_j	Junction temperature	IGBT	-40	-	150	°C
		Diode	-40	-	150	°C
T_{stg}	Storage temperature range	-	-40	-	150	°C
	Screw torque	Mounting – M5	3	-	6	Nm
		Electrical connections – M6	3	-	6	Nm

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

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			10	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150°C			20	mA
I_{GES}	Gate leakage current	V_{GE} = ± 20V, V_{CE} = 0V			0.5	μA
$V_{GE(TH)}$	Gate threshold voltage	I_C = 15mA, V_{GE} = V_{CE}	5.0	6.0	7.0	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE} = 15V, I_C = 600A		1.7		V
		V_{GE} = 15V, I_C = 600A, T_j = 125°C		2.0		V
		V_{GE} = 15V, I_C = 600A, T_j = 150°C		2.1		V
I_F	Diode forward current	DC		600		A
I_{FM}	Diode maximum forward current	t_p = 1ms		1200		A
V_F	Diode forward voltage	I_F = 600A		1.9		V
		I_F = 600A, T_j = 125°C		2.1		V
		I_F = 600A, T_j = 150°C		2.1		V
C_{ies}	Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		57		nF
Q_g	Gate charge	±15V		6.1		μC
C_{res}	Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz		1.8		nF
L_M	Module inductance			22		nH
R_{INT}	Internal transistor resistance			1		mΩ
SC_{Data}	Short circuit current, I_{SC}	T_j = 150°C, V_{CC} = 800V t_p ≤ 10μs, V_{GE} ≤ 15V $V_{CE\,(max)} = V_{CES} - L^* \times dI/dt$ IEC 60747-9		2800		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
ΔR/R	Deviation of R100	T_C = 100°C, R_{100} = 493Ω	-5		5	%
P_{25}	Power dissipation	T_C = 25°C			20	mW
$B_{25/50}$	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 = 600A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 0.5Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 40nH	*dv/dt* = 3500V/µs		710		ns
t_f	Fall time				280		ns
E_{OFF}	Turn-off energy loss				90		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 6000A/µs		185		ns
t_r	Rise time				92		ns
E_{ON}	Turn-on energy loss				22		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 600A V_{CE} = 600V *di/dt* = 6000A/µs			52		µC
I_{rr}	Diode reverse recovery current				365		A
E_{rec}	Diode reverse recovery energy				29		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 = 600A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 0.5Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 40nH	*dv/dt* = 3500V/µs		780		ns
t_f	Fall time				400		ns
E_{OFF}	Turn-off energy loss				102		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 6000A/µs		180		ns
t_r	Rise time				98		ns
E_{ON}	Turn-on energy loss				32		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 600A V_{CE} = 600V *di/dt* = 6000A/µs			78		µC
I_{rr}	Diode reverse recovery current				420		A
E_{rec}	Diode reverse recovery energy				43		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 = 600A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 0.5Ω $R_{G(ON)}$ = 0.5Ω L_S ~ 40nH	*dv/dt* = 3500V/µs		800		ns
t_f	Fall time				430		ns
E_{OFF}	Turn-off energy loss				105		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 6000A/µs		180		ns
t_r	Rise time				100		ns
E_{ON}	Turn-on energy loss				34		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 600A V_{CE} = 600V *di/dt* = 6000A/µs			100		µC
I_{rr}	Diode reverse recovery current				450		A
E_{rec}	Diode reverse recovery energy				55		mJ

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

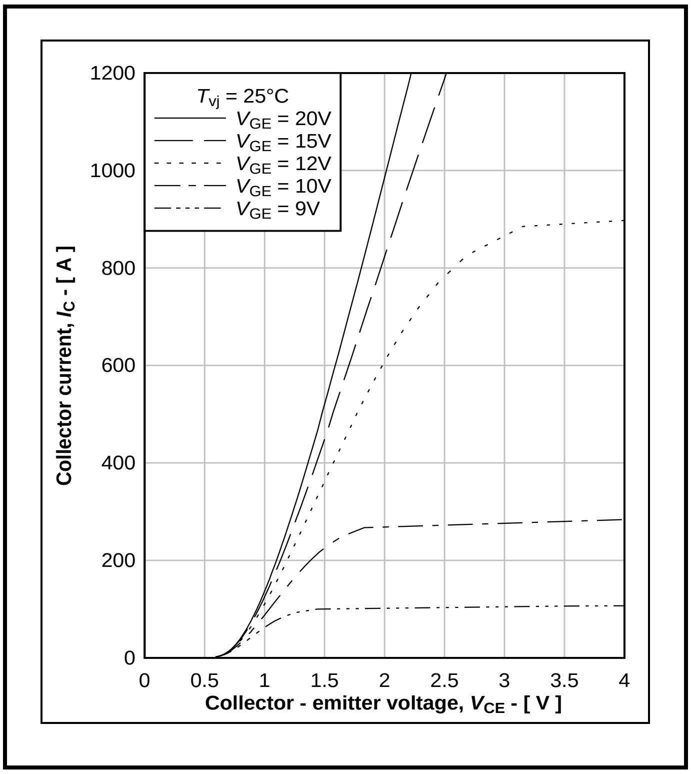


Fig. 3 Typical IGBT output characteristics, I_C = f(V_{CE})

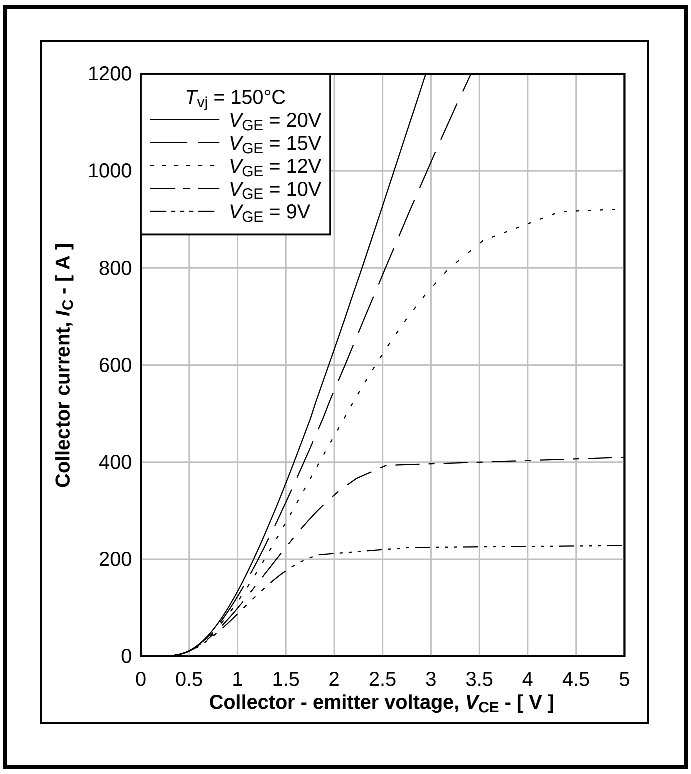


Fig. 4 Typical IGBT output characteristics, I_C = f(V_{CE})

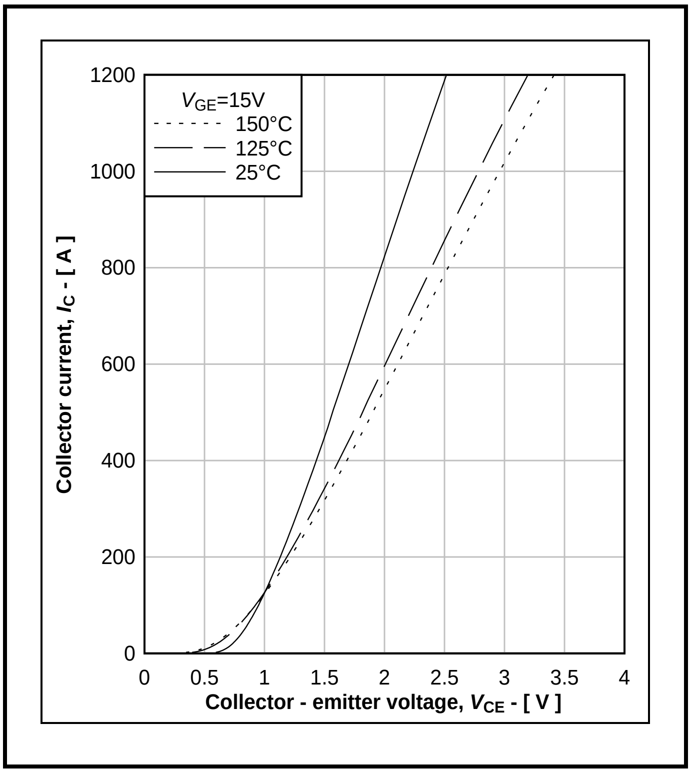


Fig. 5 Typical IGBT output characteristics, I_C = f(V_{CE})

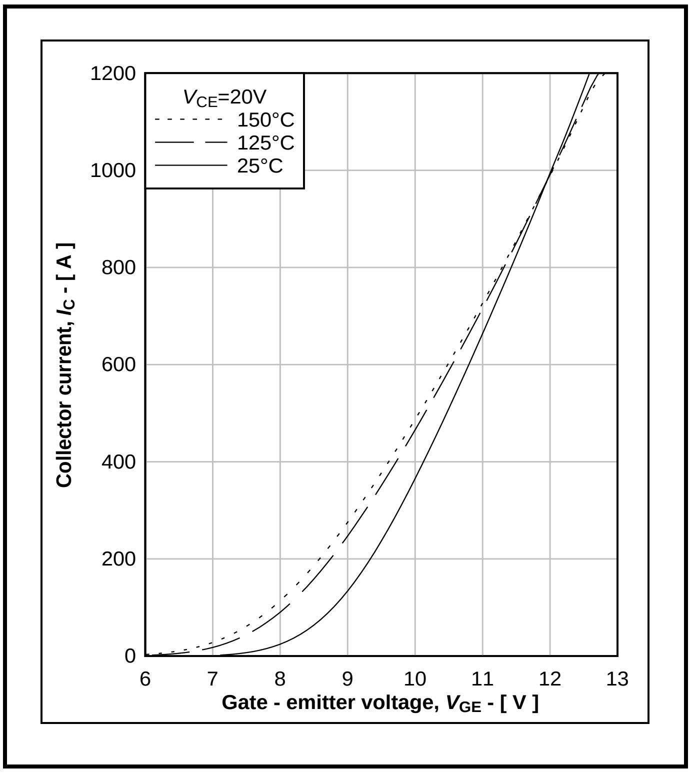


Fig. 6 Typical IGBT transfer characteristics, I_C = f(V_{GE})

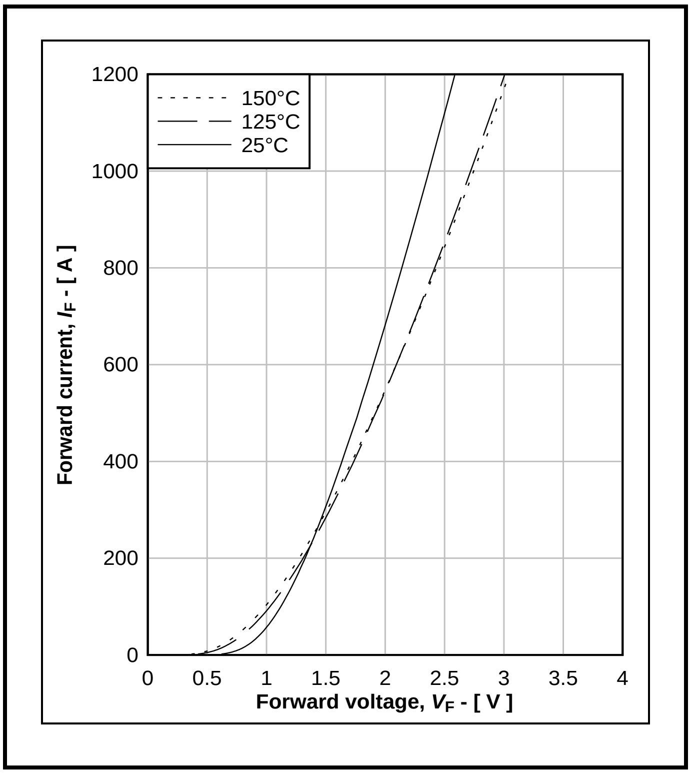


Fig. 7 Diode typical forward characteristics, I_F = f(V_F)

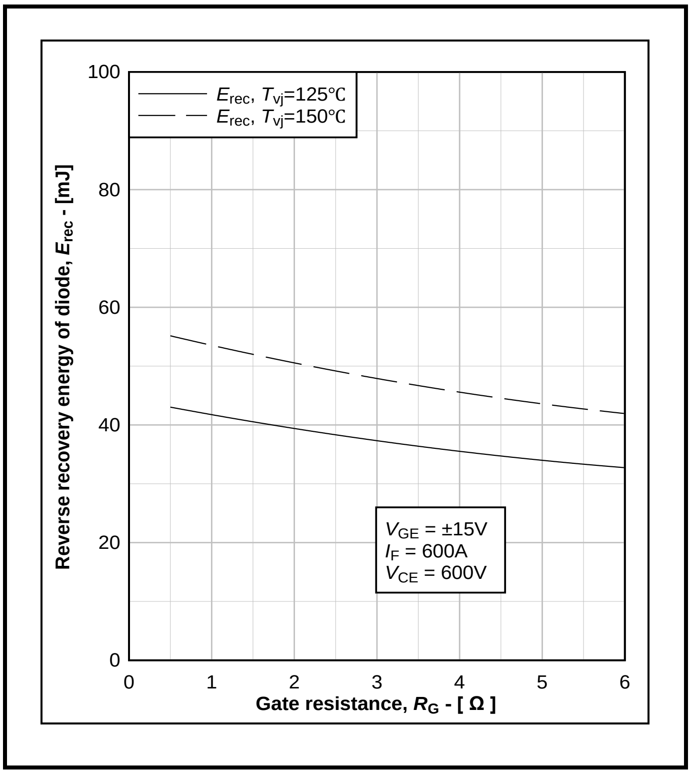


Fig. 8 Typical FRD E_{rec}, E_{rec} = f(R_G)

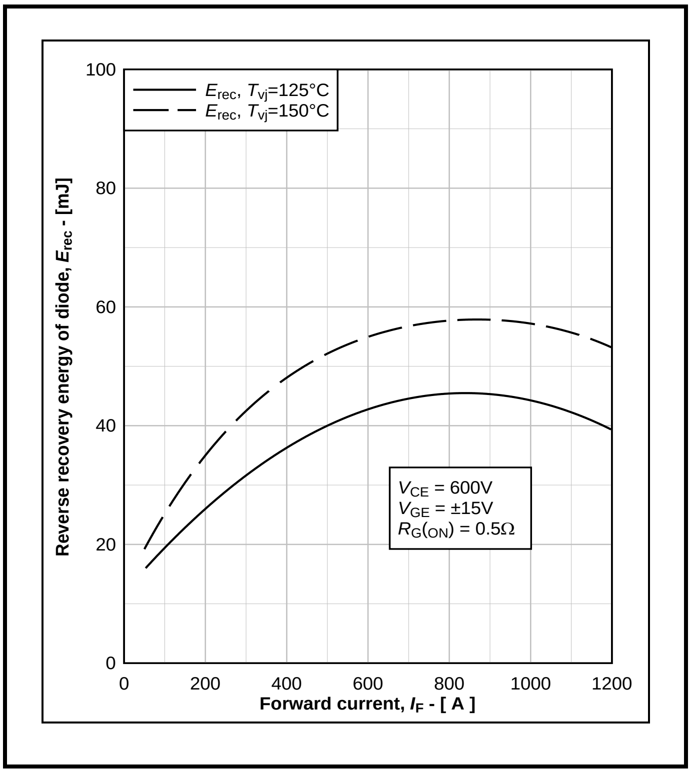


Fig. 9 Typical FRD E_{rec}, E_{rec} = f(I_F)

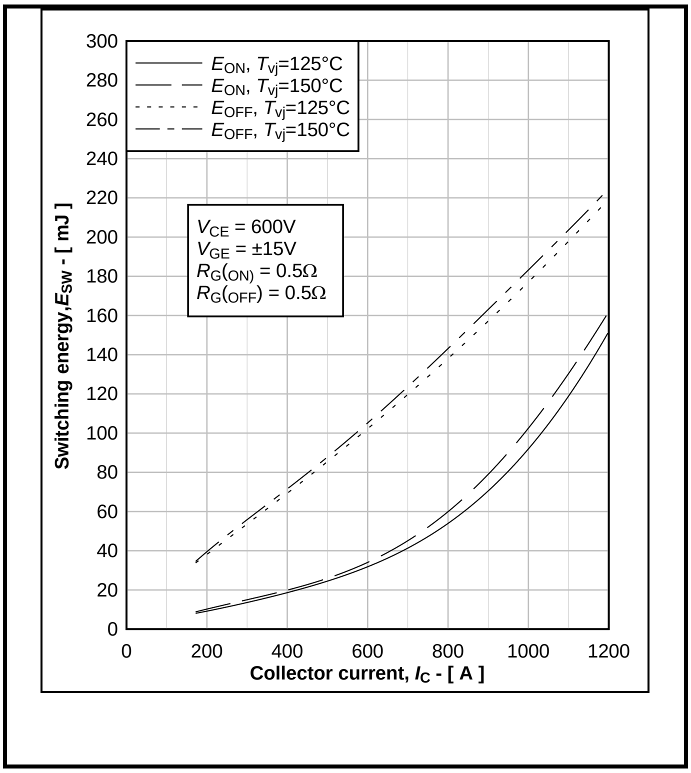


Fig. 10 Typical IGBT switching energy,
E_{ON} = f(I_C), E_{OFF} = f(I_C)

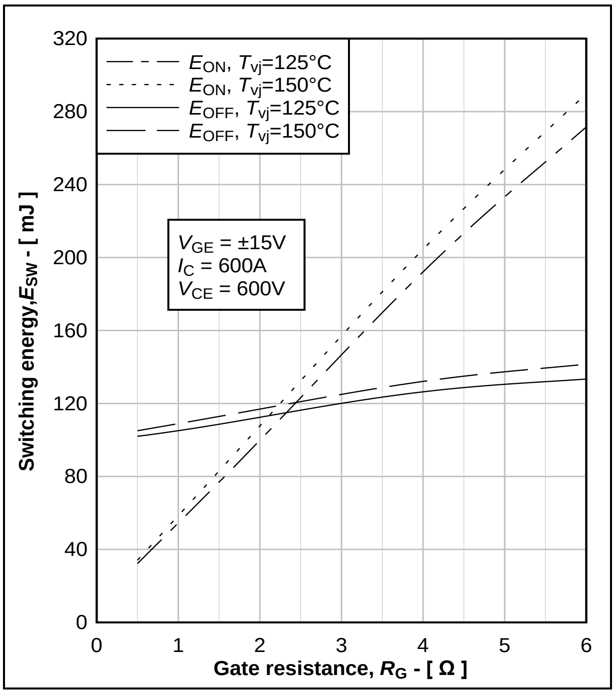


Fig. 11 Typical IGBT switching energy
E_{ON} = f(R_G), E_{OFF} = fR_G)

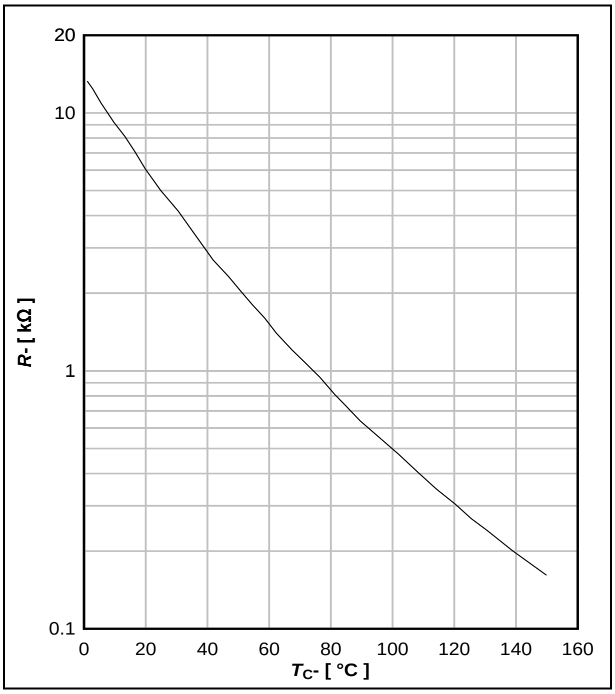


Fig. 12 Typical NTC thermistor characteristic, R = f(T_C)

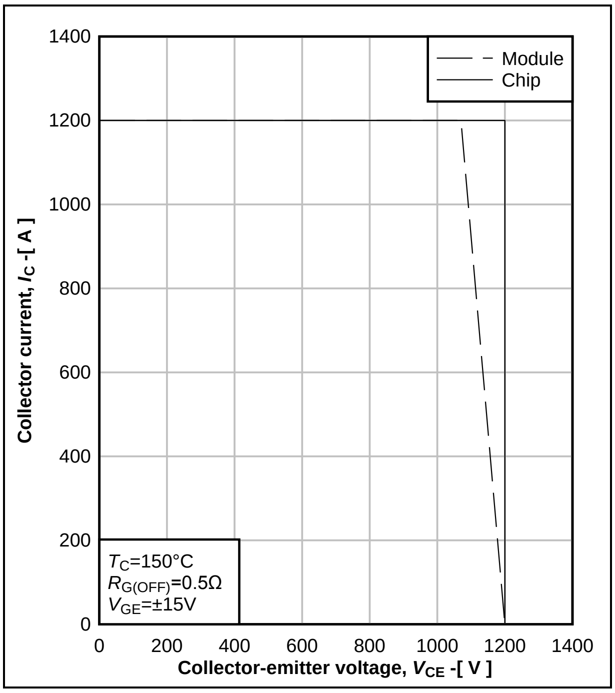


Fig. 13 Reverse bias safe operating area of IGBT,
I_C = f(V_{CE})

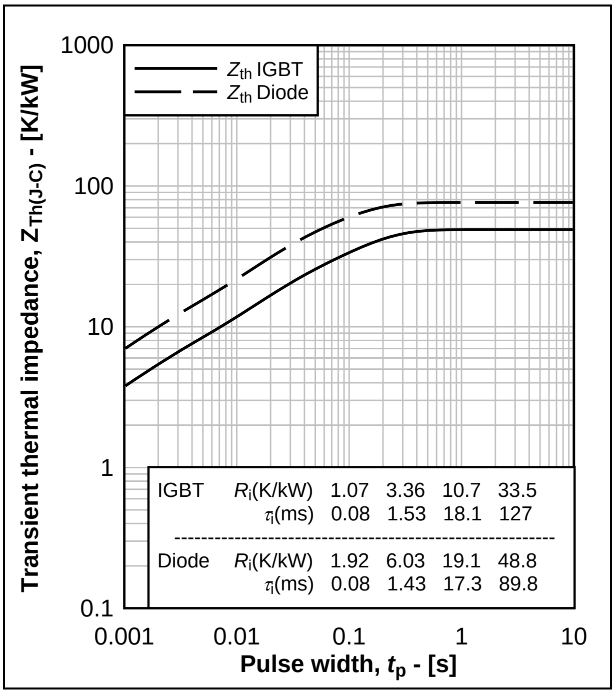
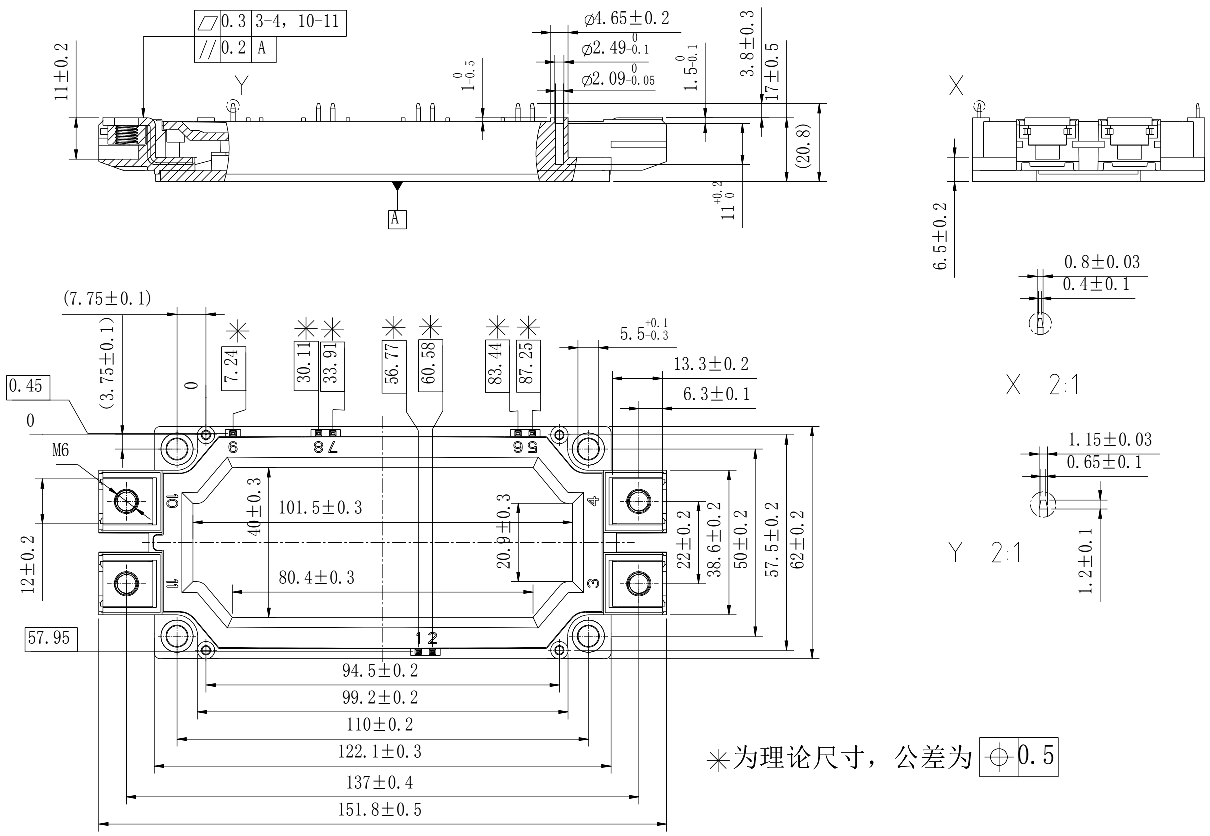


Fig. 14 Transient thermal impedance, $Z_{th(J-C)}$ = f(t)

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: 345g

Module Outline Type Code: M1

Fig. 15 Module outline drawing

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