

FEATURES

- Trench Gate IGBT
- Cu Base with Enhanced Al₂O₃ Substrates
- 10µs Short Circuit Withstand
- Compact Module

APPLICATIONS

- Motor Drives
- Power Charging Equipment
- Renewable Energy Power Conversion
- High Reliability Inverters
- Electric Vehicles

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 DIM450M1HS12-PB500 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.

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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:

DIM450M1HS12-PB500

Note: When ordering, please use the complete part number

KEY PARAMETERS

V_{CES}	1200V
$V_{CE(sat)}$ * (typ)	1.65V
I_C (max)	450A
$I_{C(PK)}$ (max)	900A

* Measured at the auxiliary terminals

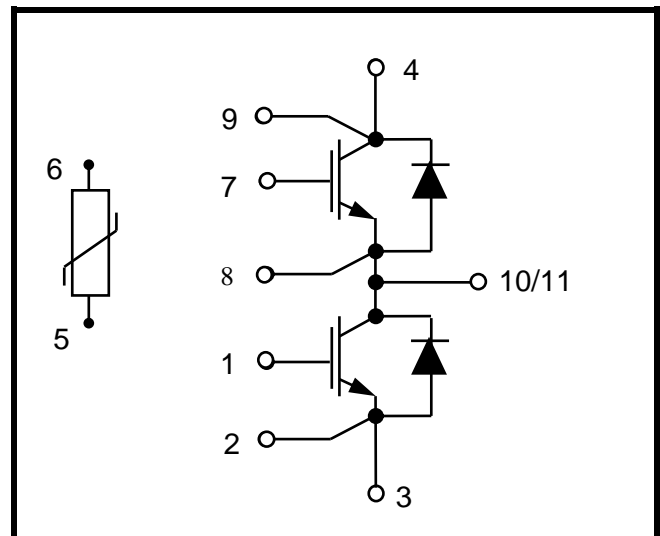


Fig. 1 Circuit configuration



Outline type code: M1

(See Fig. 16 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, T _{vjmax} = 175°C	450	A
I _{C(PK)}	Peak collector current	t _p = 1ms	900	A
P _{max}	Max. transistor power dissipation	T _C = 25°C, T _{vj} = 175°C	2.8	kW
I ² t	Diode I ² t value	V _R = 0V, t _p = 10ms, T _{vj} = 150°C	27.2	kA ² s
V _{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz	3400	V

THERMAL AND MECHANICAL RATINGS

Internal insulation material:	Al ₂ O ₃
Baseplate material:	Cu
Creepage distance – Terminal to heatsink:	15.0mm
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	-	-	52	°C/kW
R _{th(j-c)}	Thermal resistance – diode		-	-	86	°C/kW
R _{th(c-h)}	Thermal resistance – case to heatsink (IGBT)	Mounting torque 5Nm (with mounting grease 1W/m °C)	-	30	-	°C/kW
R _{th(c-h)}	Thermal resistance – case to heatsink (Diode)		-	45	-	°C/kW
T _j	Junction temperature – under switching conditions	IGBT	-40	-	150	°C
		Diode	-40	-	150	°C
T _{stg}	Storage temperature range	-	-40	-	125	°C
	Screw torque	Mounting – M5	3	-	6	Nm
		Electrical connections – M6	3	-	6	Nm

ELECTRICAL CHARACTERISTICS

$T_{case} = 25^{\circ}C$ 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}	5.3	5.9	6.5	V
V _{CE(sat)}	Collector-emitter saturation voltage	V _{GE} = 15V, I _C = 450A		1.65	2.05	V
		V _{GE} = 15V, I _C = 450A, T _j = 125°C		1.95		V
		V _{GE} = 15V, I _C = 450A, T _j = 150°C		2.0		V
I _F	Diode forward current	DC		450		A
I _{FM}	Diode maximum forward current	t _p = 1ms		900		A
V _F	Diode forward voltage	I _F = 450A		1.65	2.05	V
		I _F = 450A, T _j = 125°C		1.75		V
		I _F = 450A, T _j = 150°C		1.75		V
C _{ies}	Input capacitance	V _{CE} = 25V, V _{GE} = 0V, f = 100kHz		62		nF
Q _g	Gate charge	±15V		4.6		μC
C _{res}	Reverse transfer capacitance	V _{CE} = 25V, V _{GE} = 0V, f = 1MHz		0.82		nF
L _M	Module inductance			20		nH
R _{INT}	Internal transistor resistance			1.2		Ω
R _{CC+EE'}	Module lead resistance, terminal to chip			1.1		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* x di/dt IEC 60747-9		1900		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 R ₁₀₀	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/T ₂ - 1/(298.15K))]		3375		K
B _{25/80}		R ₂ = R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298.15K))]		3411		K
B _{25/100}		R ₂ = R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298.15K))]		3433		K

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
t _{d(off)}	Turn-off delay time	I _C = 450A V _{CE} = 600V V _{GE} = ±15V L _S ~ 35nH	R _{G(OFF)} = 2.2Ω		510		ns
t _f	Fall time				170		ns
E _{OFF}	Turn-off energy loss				37		mJ
t _{d(on)}	Turn-on delay time		R _{G(ON)} = 0.5Ω		190		ns
t _r	Rise time				50		ns
E _{ON}	Turn-on energy loss				19.0		mJ
Q _{rr}	Diode reverse recovery charge	I _F = 450A V _{CE} = 600V			45		μC
I _{rr}	Diode reverse recovery current				410		A
E _{rec}	Diode reverse recovery energy				21		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 = 450A V _{CE} = 600V V _{GE} = ±15V L _S ~ 35nH	R _{G(OFF)} = 2.2Ω		570		ns
t _f	Fall time				200		ns
E _{OFF}	Turn-off energy loss				50		mJ
t _{d(on)}	Turn-on delay time		R _{G(ON)} = 0.5Ω		200		ns
t _r	Rise time				60		ns
E _{ON}	Turn-on energy loss				31.5		mJ
Q _{rr}	Diode reverse recovery charge	I _F = 450A V _{CE} = 600V			71		μC
I _{rr}	Diode reverse recovery current				455		A
E _{rec}	Diode reverse recovery energy				36		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 = 450A V _{CE} = 600V V _{GE} = ±15V L _S ~ 35nH	R _{G(OFF)} = 2.2Ω dv/dt = 5200V/μs		580		ns
t _f	Fall time				200		ns
E _{OFF}	Turn-off energy loss				52.5		mJ
t _{d(on)}	Turn-on delay time		R _{G(ON)} = 0.5Ω di/dt = 7000A/μs		200		ns
t _r	Rise time				60		ns
E _{ON}	Turn-on energy loss				39.0		mJ
Q _{rr}	Diode reverse recovery charge	I _F = 450A V _{CE} = 600V di/dt = 7000A/μs			87		μC
I _{rr}	Diode reverse recovery current				460		A
E _{rec}	Diode reverse recovery energy				40		mJ

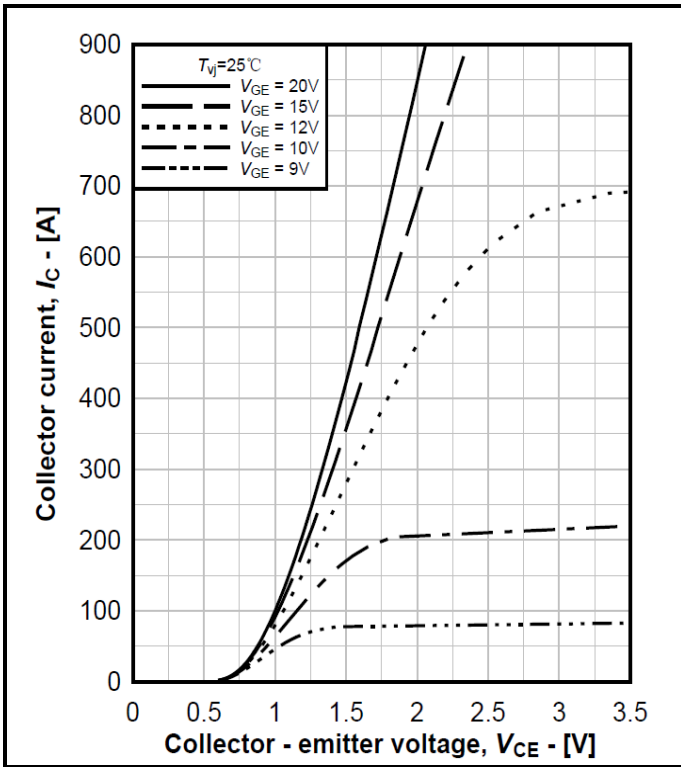


Fig. 3 Typical IGBT output characteristics, $I_C = f(V_{CE})$

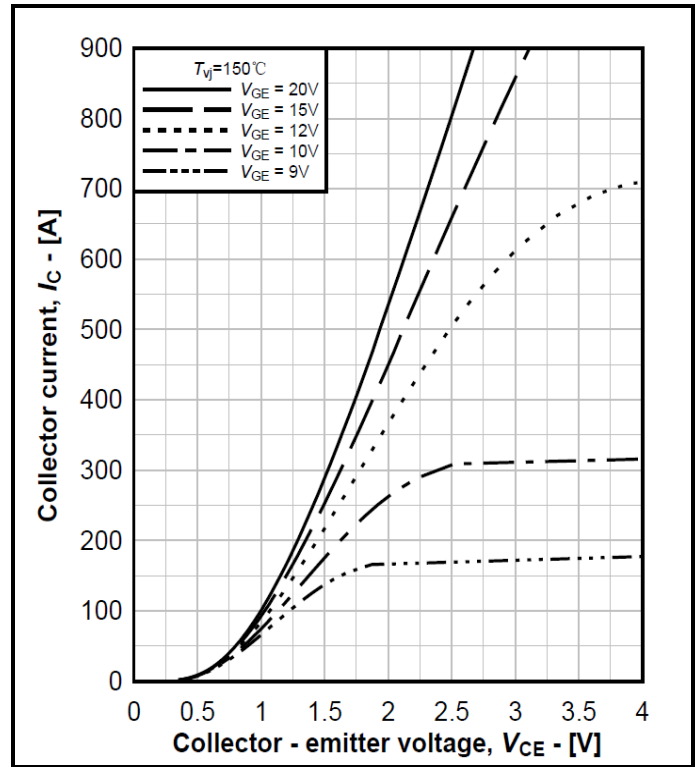


Fig. 4 Typical IGBT output characteristics, $I_C = f(V_{CE})$

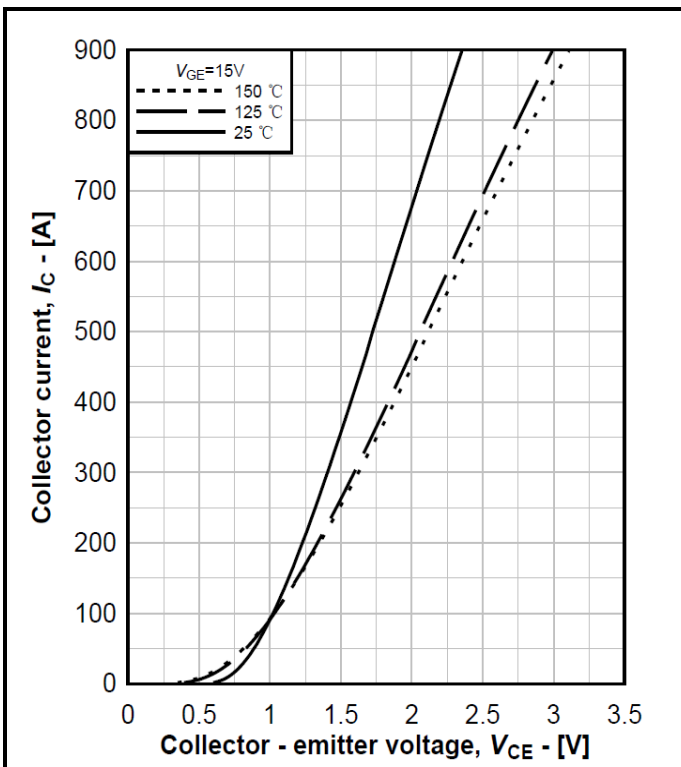


Fig. 5 Typical IGBT output characteristics, $I_C = f(V_{CE})$

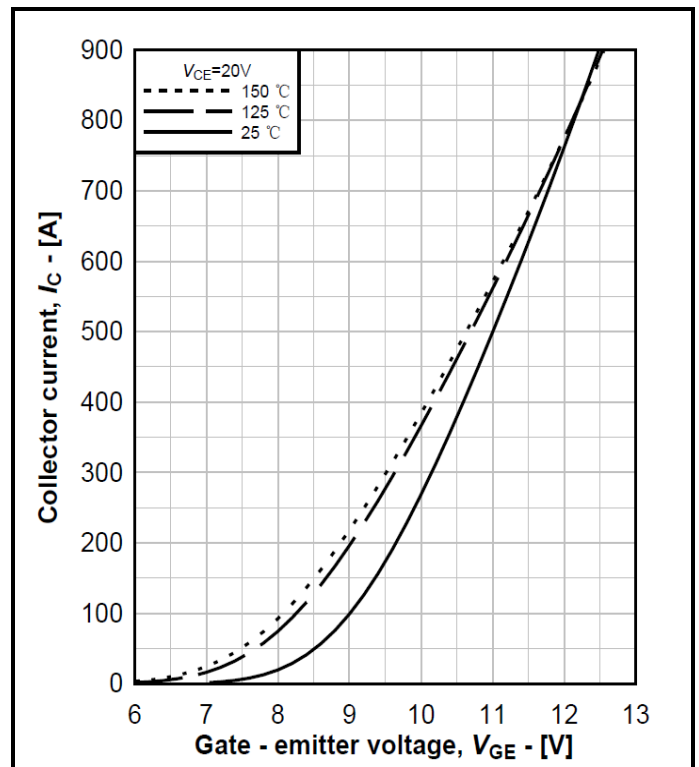


Fig. 6 Typical IGBT transfer characteristics, $I_C = f(V_{GE})$

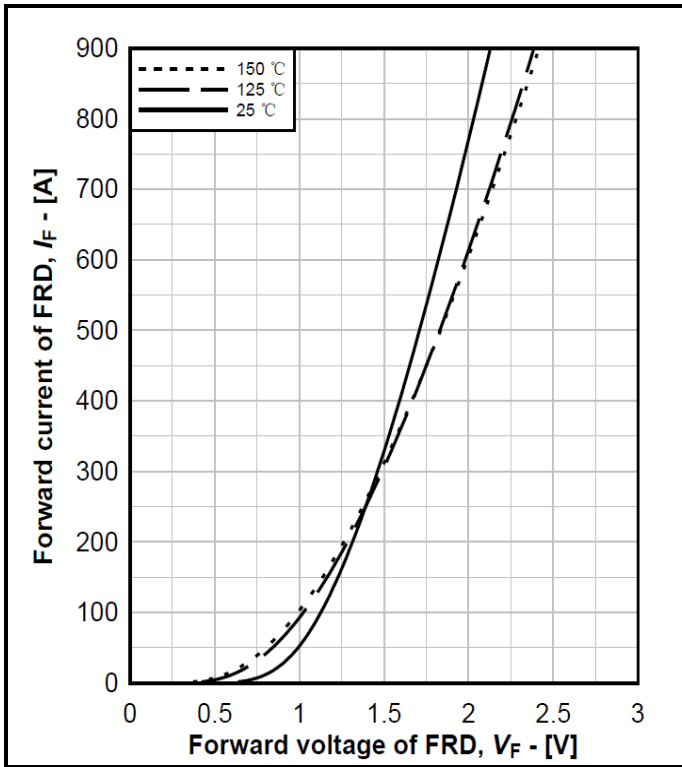


Fig. 7 Diode typical forward characteristics, $I_F = f(V_F)$

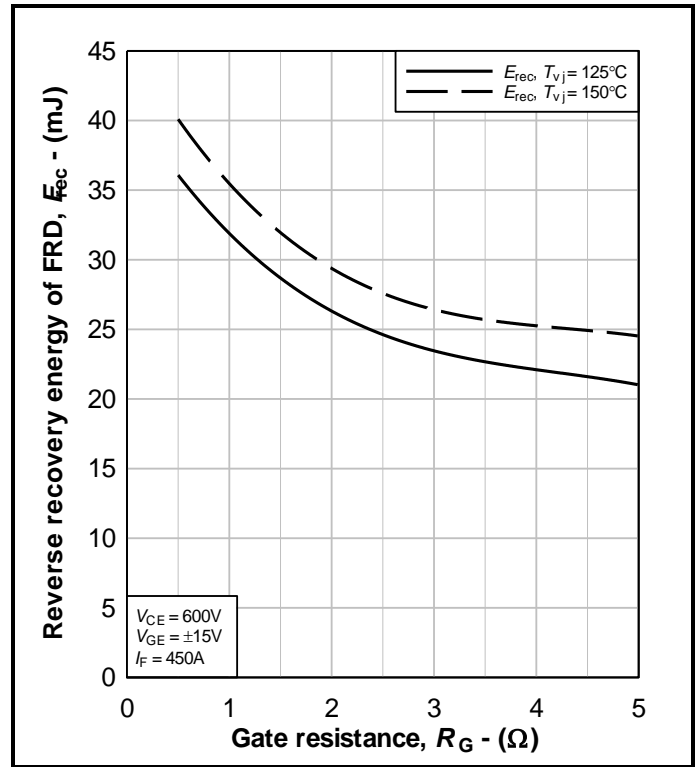


Fig. 8 Typical FRD E_{rec} , $E_{rec} = f(R_G)$

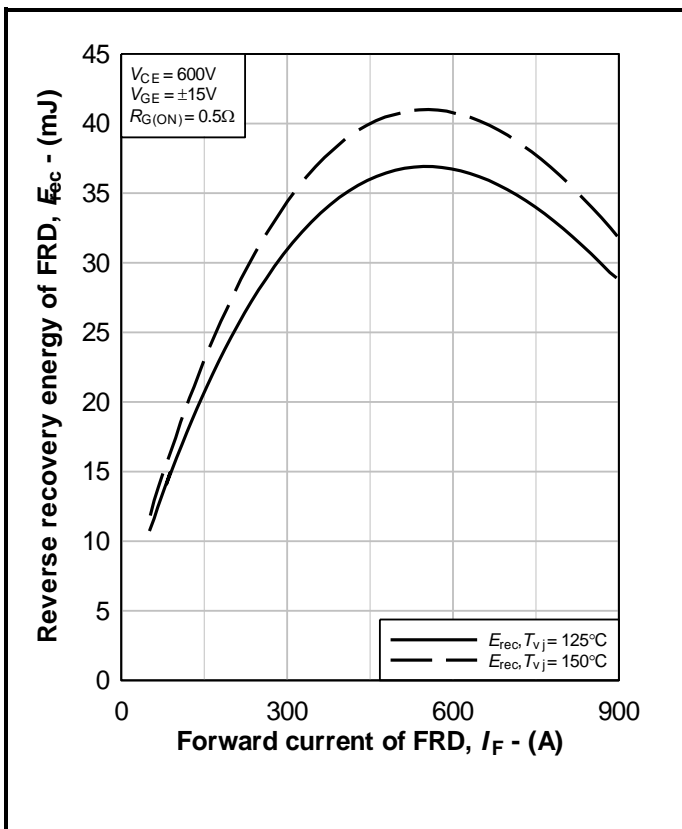


Fig. 9 Typical FRD E_{rec} , $E_{rec} = f(I_F)$

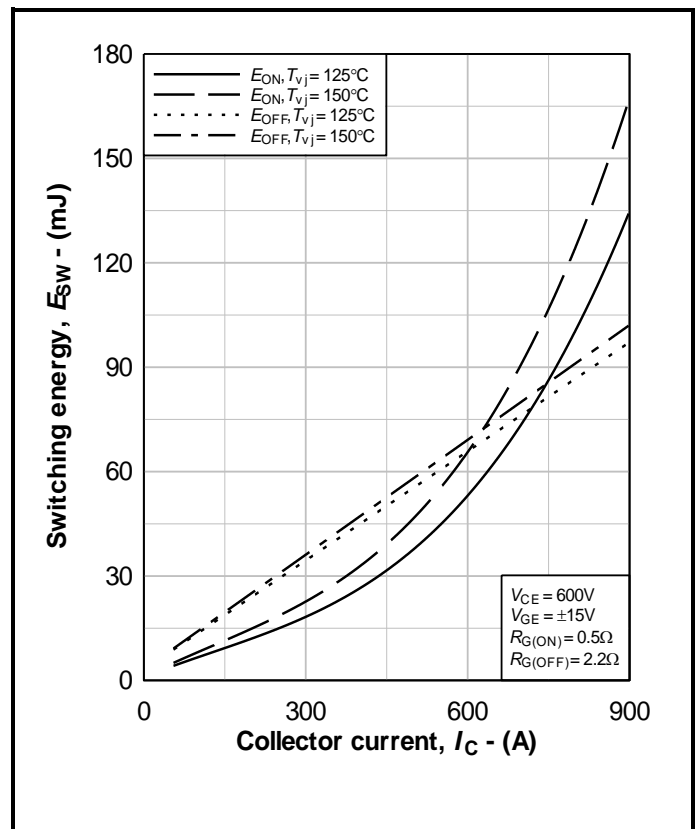


Fig. 10 Typical IGBT switching energy, $E_{ON} = f(I_C)$, $E_{OFF} = f(I_C)$

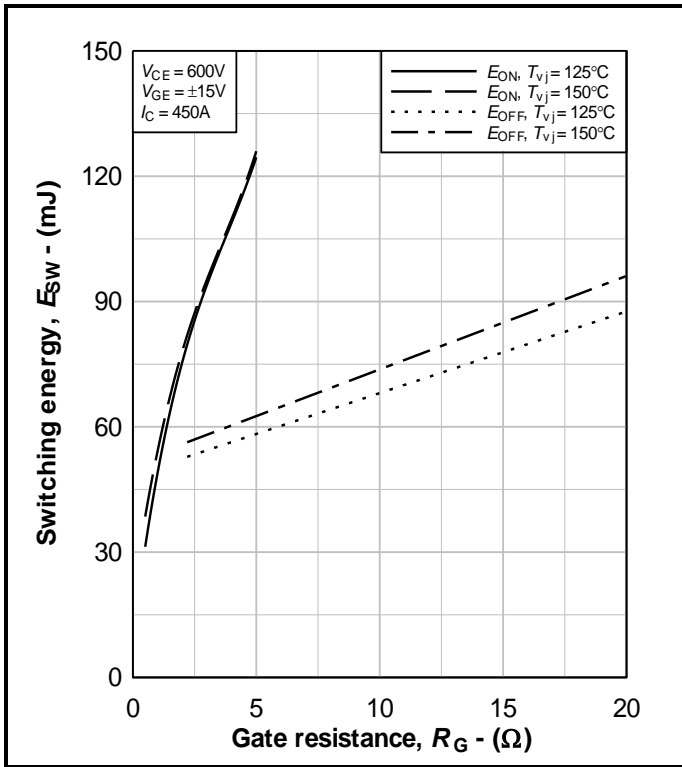


Fig. 11 Typical IGBT switching energy
 $E_{ON} = f(R_G)$, $E_{OFF} = f(R_G)$

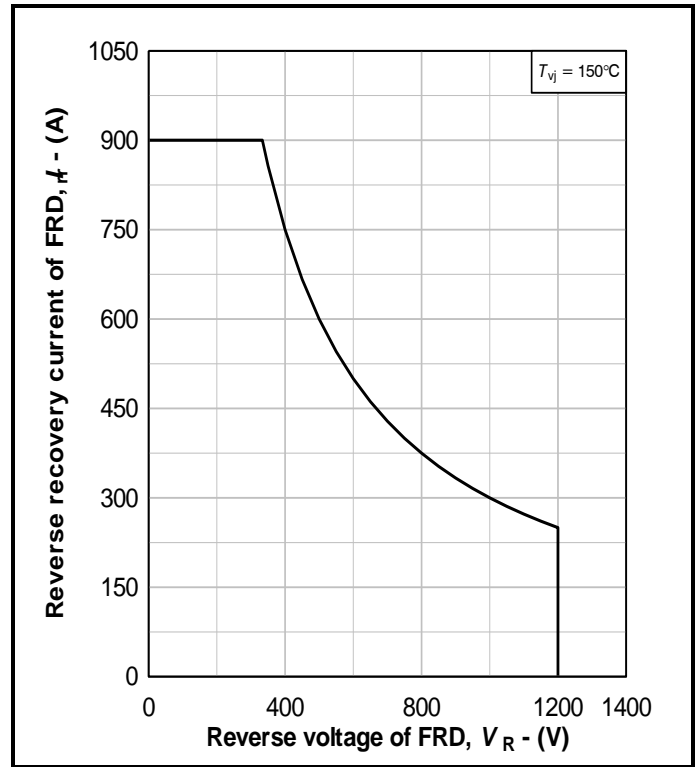


Fig. 12 Diode reverse bias safe operating area

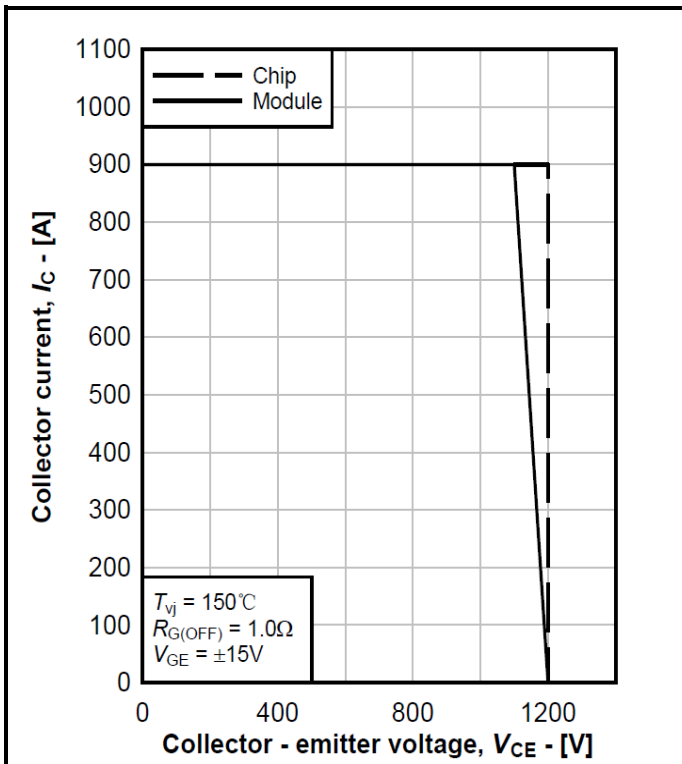


Fig. 13 Reverse bias safe operating area of IGBT,
 $I_C = f(V_{CE})$

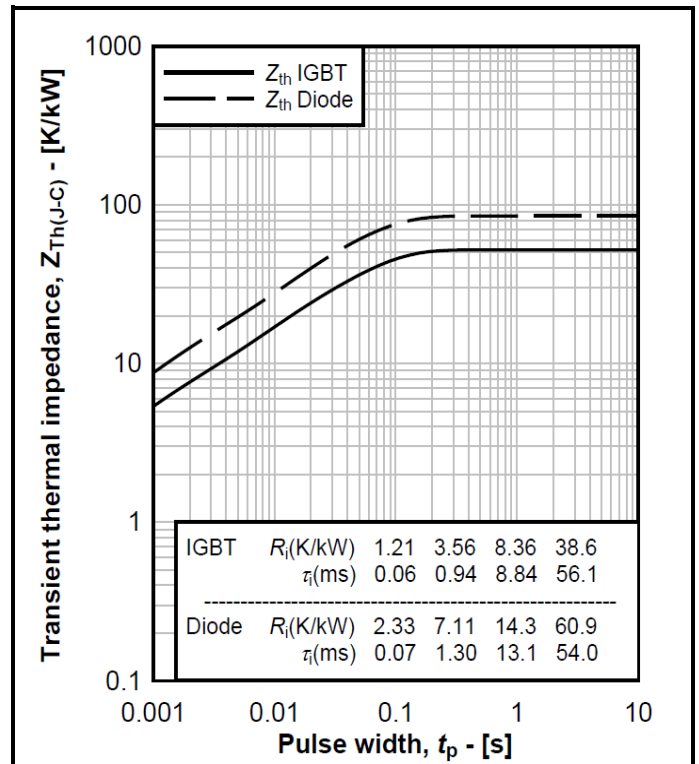


Fig. 14 Transient thermal impedance, $Z_{th(J-C)} = f(t)$

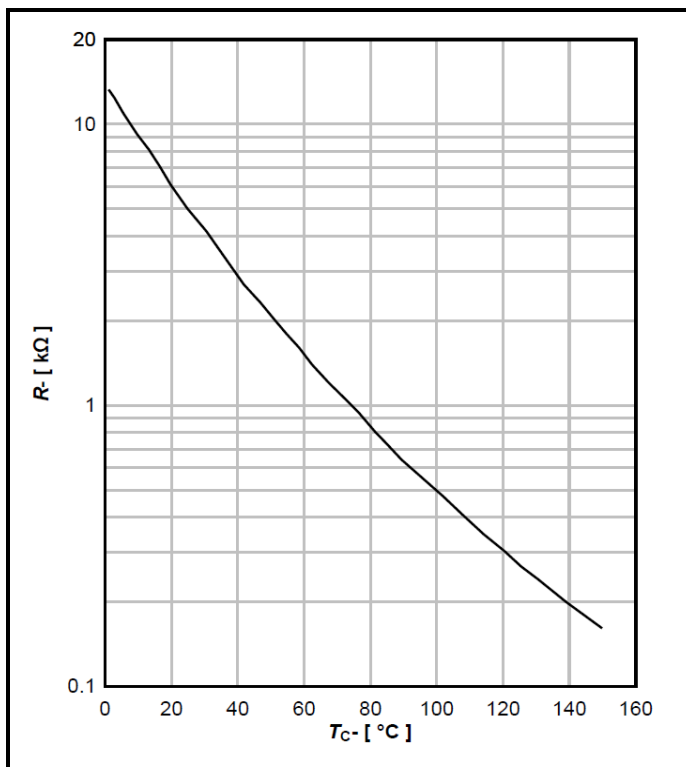


Fig. 15 Typical NTC thermistor characteristic, $R = f(T_c)$

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HEADQUARTERS OPERATIONS

DYNEX SEMICONDUCTOR LTD

Doddington Road, Lincoln, Lincolnshire, LN6 3LF,
United Kingdom

Tel: +44(0)1522 500500

Web: <http://www.dynexsemi.com>

CUSTOMER SERVICE

DYNEX SEMICONDUCTOR LTD

Doddington Road, Lincoln, Lincolnshire, LN6 3LF,
United Kingdom

Tel: +44(0)1522 502753 / 502901

Email: powersolutions@dynexsemi.com

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