DYNEX Power through Innovation

TRENCH
Gen5 TMOS

DIM450M1HS12-PB500

Half Bridge IGBT Module

Replaces DS6279-2

DS6279-3 February 2020 (LN39598)

FEATURES

- Trench Gate IGBT
- Cu Base with Enhanced Al_2O_3 Substrates
- 10µs Short Circuit Withstand
- Compact Module

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

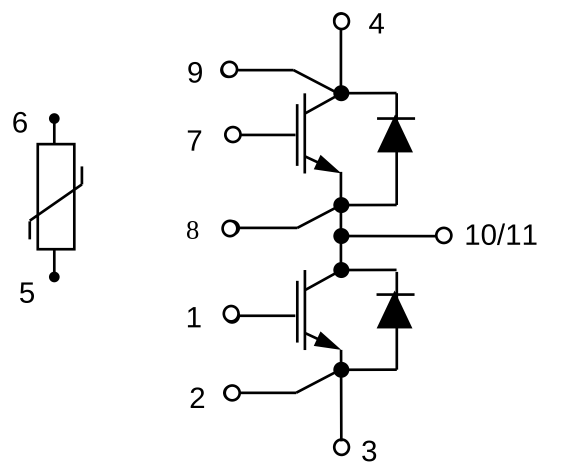


Fig. 1 Circuit configuration

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.

trench gate, insulated gate bipolar transistor (IGBT) module with enhanced field stop and implantation technology.

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.

Outline type code: M1

(See Fig. 15 for further information)

Fig. 2 Package

ORDERING INFORMATION

Order As:

DIM450M1HS12-PB500

Note: When ordering, please use the complete part number

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	450	A
$I_{C(PK)}$	Peak collector current	t_P = 1ms, T_C = 133°C	900	A
P_{max}	Max. transistor power dissipation	T_C = 25°C, T_{vj} = 175°C	2.8	kW
I^2t	Diode I^2t value	V_R = 0, t_p = 10ms, T_{vj} = 150ºC	27.2	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	-	-	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 3Nm (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	-	150	°C
	Screw torque	Mounting – M5	3	-	6	Nm
		Electrical connections – M6	3	-	6	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			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 = 450A		1.65	2.05	V
		V_{GE} = 15V, I_C = 450A, T_j = 125°C		1.95	2.35	V
		V_{GE} = 15V, I_C = 450A, T_j = 150°C		2.0	2.4	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	2.15	V
		I_F = 450A, T_j = 150°C		1.75	2.15	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			1.1		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 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 = 450A V_{CE} = 600V V_{GE} = ±15V $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 1.0Ω L_S ~ 50nH	*dv/dt* = 4500V/µs		530		ns
t_f	Fall time				260		ns
E_{OFF}	Turn-off energy loss				52		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 7000A/µs		220		ns
t_r	Rise time				70		ns
E_{ON}	Turn-on energy loss				8.3		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 450A V_{CE} = 600V *di/dt* = 7000A/µs			34		µC
I_{rr}	Diode reverse recovery current				415		A
E_{rec}	Diode reverse recovery energy				24		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 $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 1.0Ω L_S ~ 50nH	*dv/dt* = 4500V/µs		590		ns
t_f	Fall time				320		ns
E_{OFF}	Turn-off energy loss				62		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 7000A/µs		224		ns
t_r	Rise time				74		ns
E_{ON}	Turn-on energy loss				12		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 450A V_{CE} = 600V *di/dt* = 7000A/µs			77		µC
I_{rr}	Diode reverse recovery current				475		A
E_{rec}	Diode reverse recovery energy				48		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 $R_{G(OFF)}$ = 1.0Ω $R_{G(ON)}$ = 1.0Ω L_S ~ 50nH	*dv/dt* = 4500V/µs		600		ns
t_f	Fall time				330		ns
E_{OFF}	Turn-off energy loss				65		mJ
$t_{d(on)}$	Turn-on delay time		*di/dt* = 7000A/µs		226		ns
t_r	Rise time				76		ns
E_{ON}	Turn-on energy loss				13		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 450A V_{CE} = 600V *di/dt* = 7000A/µs			90		µC
I_{rr}	Diode reverse recovery current				500		A
E_{rec}	Diode reverse recovery energy				55		mJ

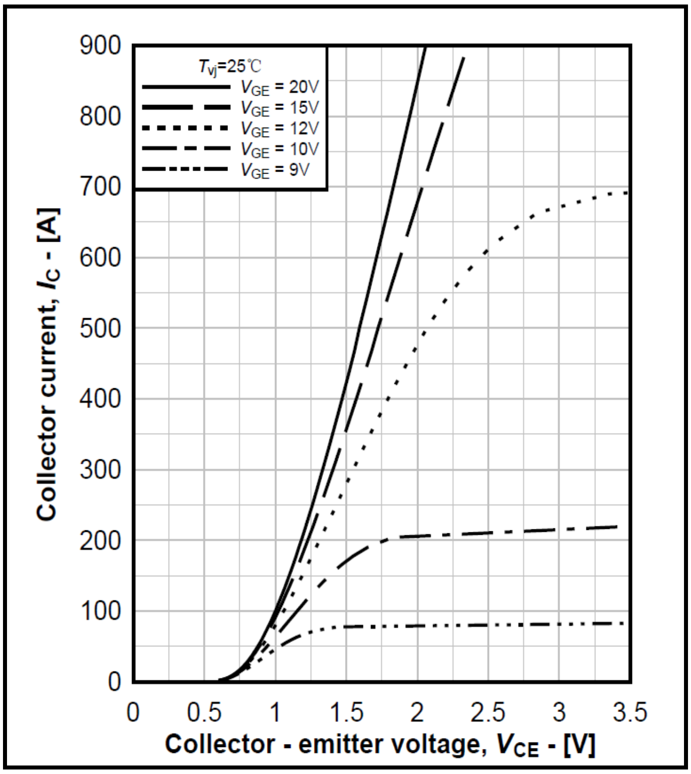


Fig. 3 Typical IGBT output characteristics, I_C = f(V_{CE})

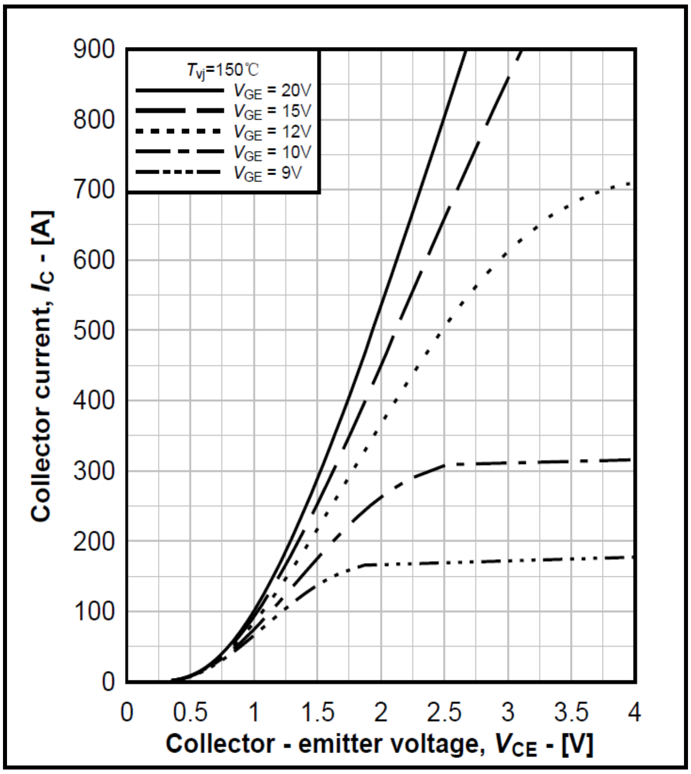


Fig. 4 Typical IGBT output characteristics, I_C = f(V_{CE})

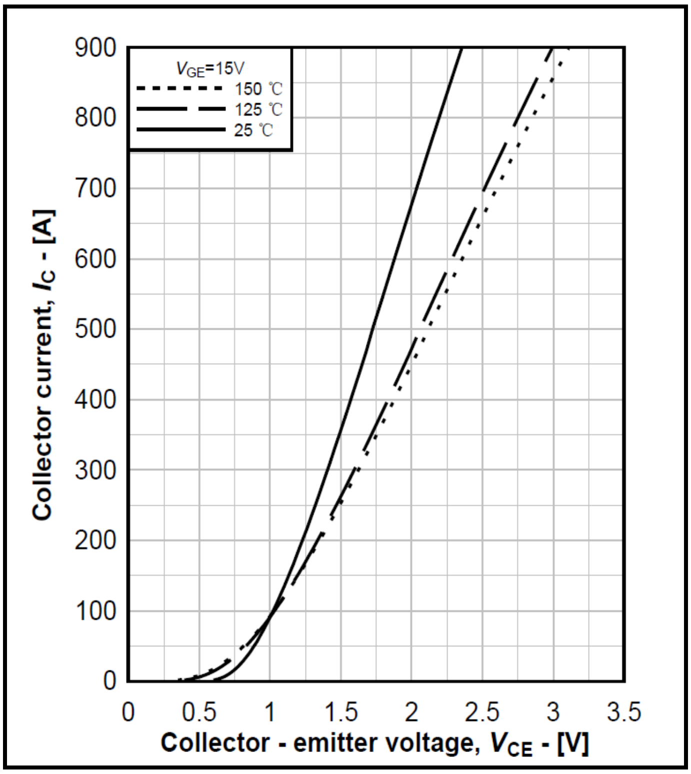


Fig. 5 Typical IGBT output characteristics, I_C = f(V_{CE})

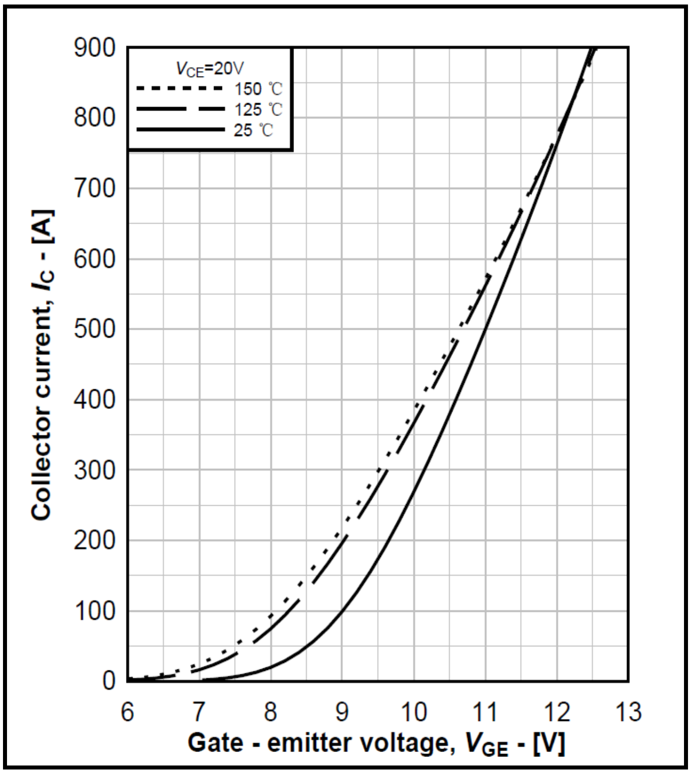


Fig. 6 Typical IGBT transfer characteristics, I_C = f(V_{GE})

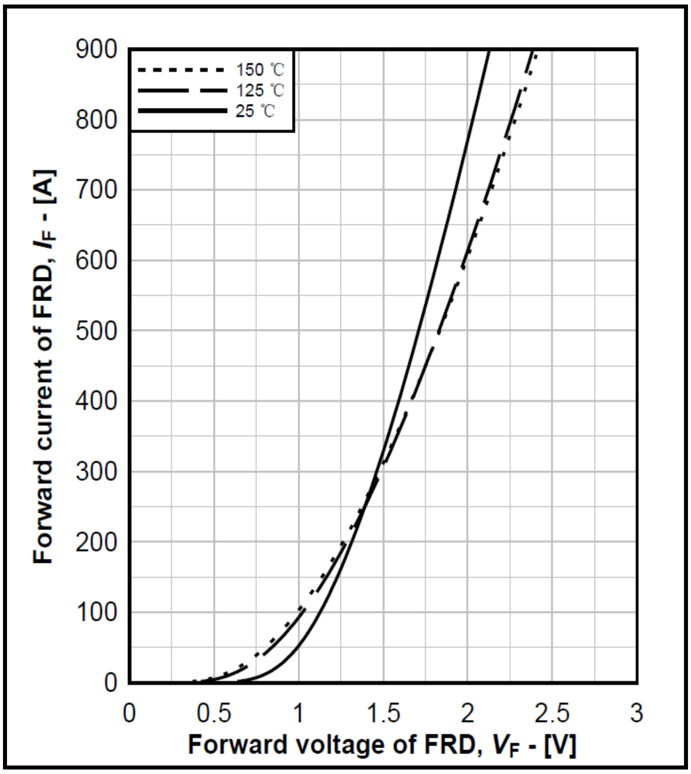


Fig. 7 Diode typical forward characteristics, $I_F = f(V_F)$

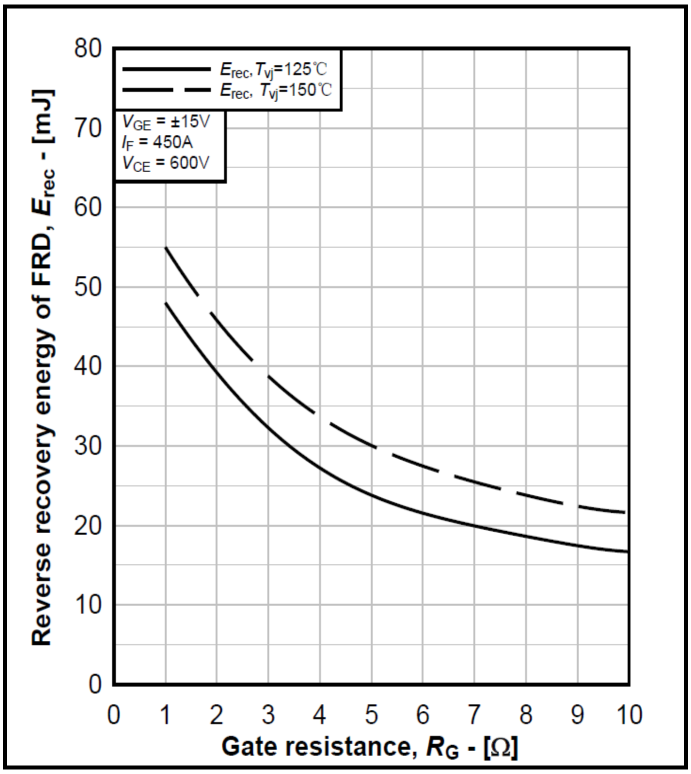


Fig. 8 Typical FRD E_{rec}, $E_{rec} = f(R_G)$

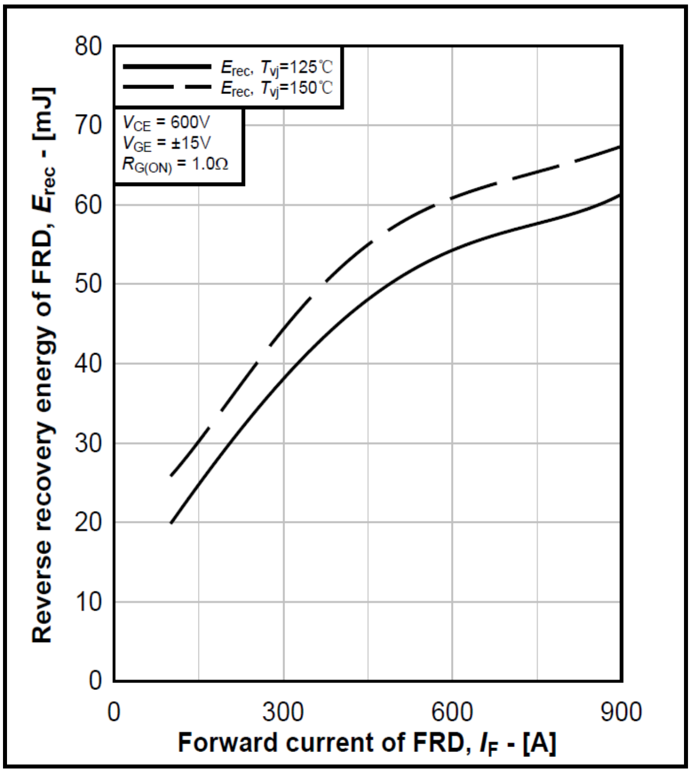


Fig. 9 Typical FRD E_{rec}, $E_{rec} = f(I_F)$

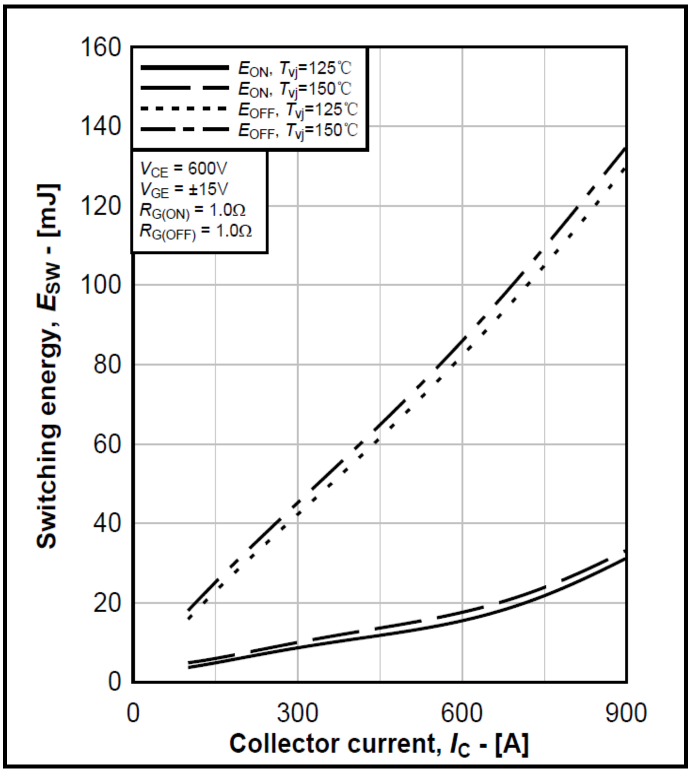


Fig. 10 Typical IGBT switching energy,
$E_{ON} = f(I_C)$, $E_{OFF} = f(I_C)$

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

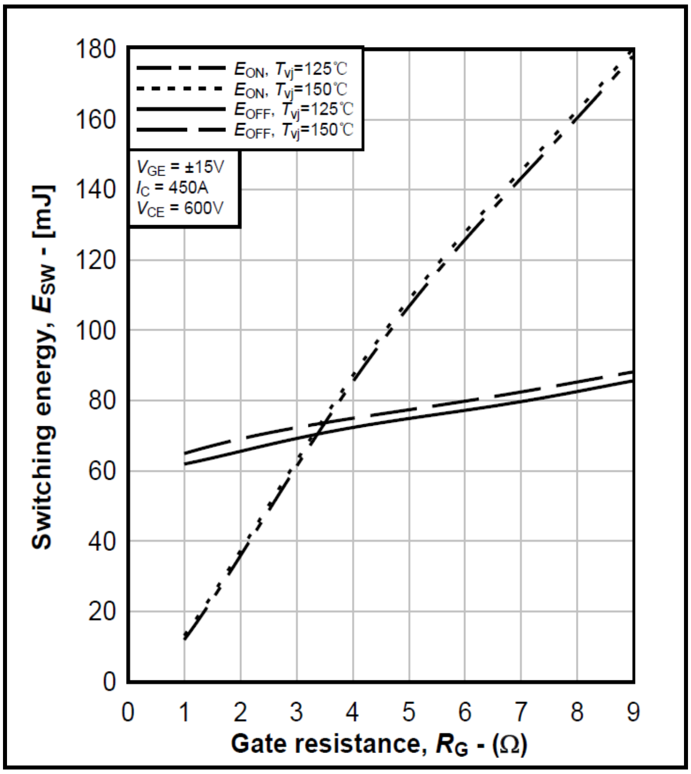


Fig. 11 Typical IGBT switching energy
$E_{ON} = f(R_G)$, $E_{OFF} = fR_G)$

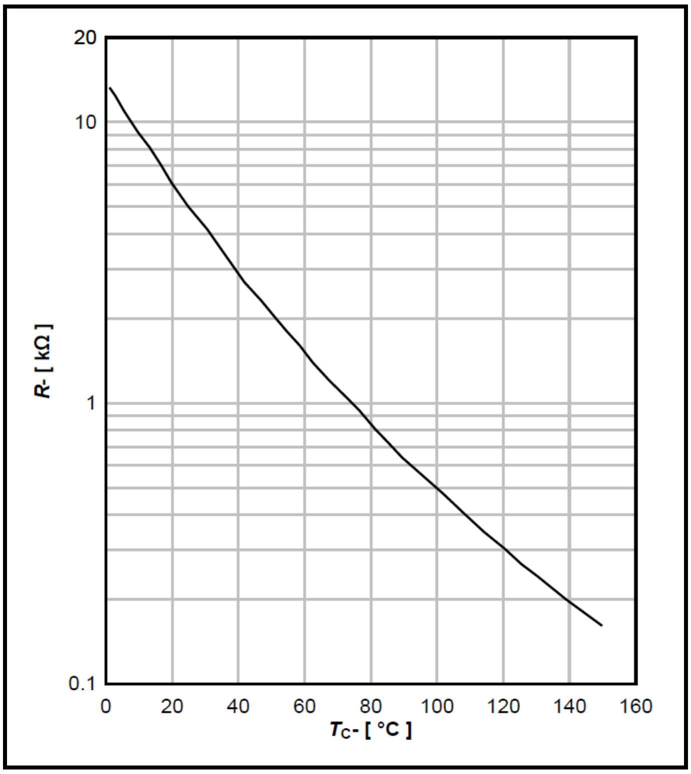


Fig. 12 Typical NTC thermistor characteristic, $R = f(T_C)$

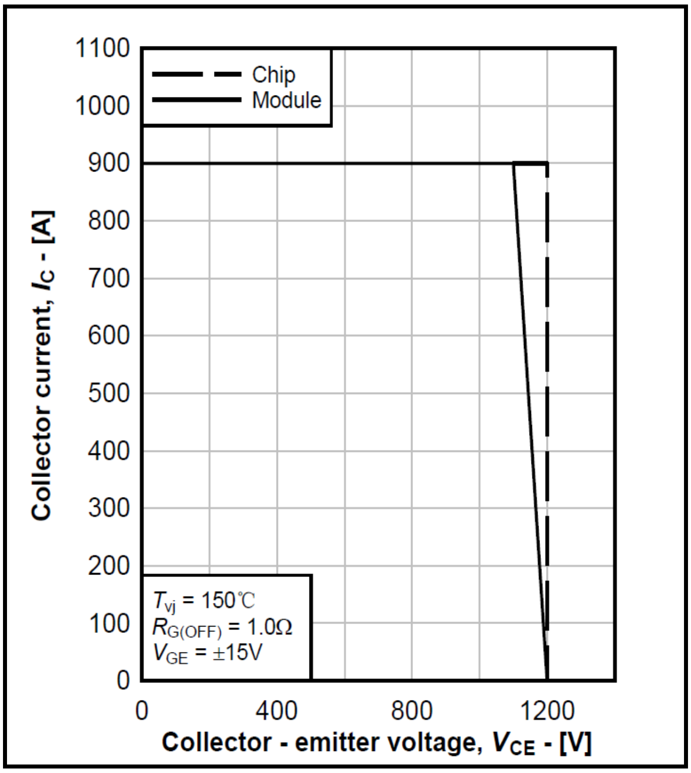


Fig. 13 Reverse bias safe operating area of IGBT,
$I_C = f(V_{CE})$

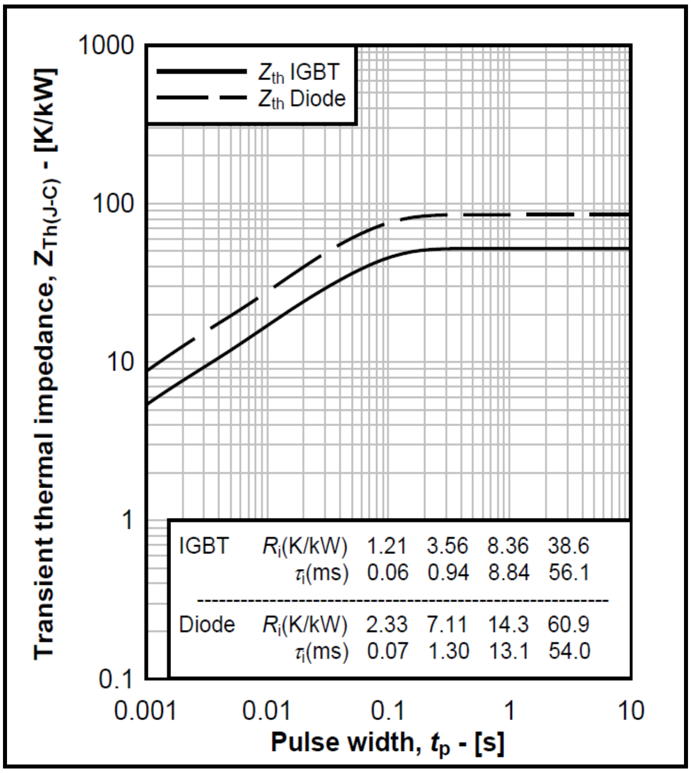
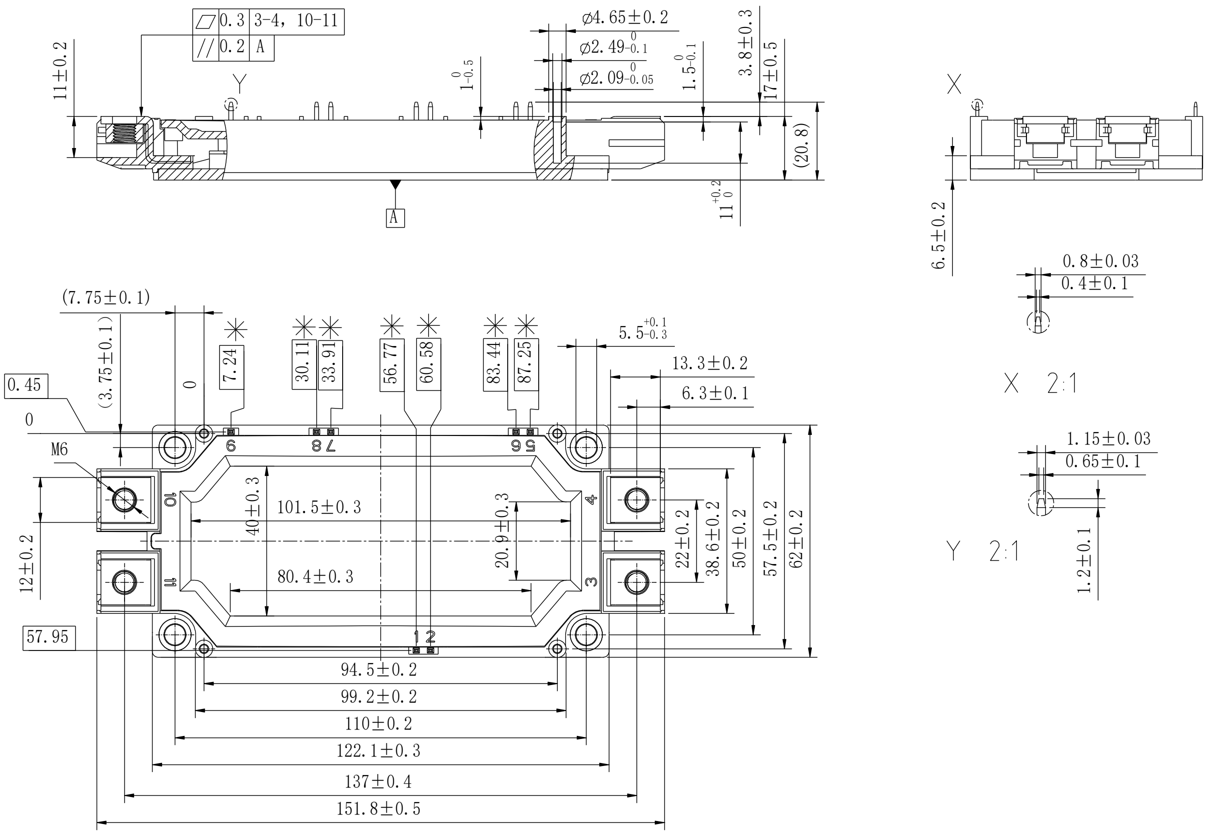


Fig. 14 Transient thermal impedance, $Z_{th}(J\text{-}C) = f(t)$

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

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

IMPORTANT INFORMATION:

This publication is provided for information only and not for resale.

The products and information in this publication are intended for use by appropriately trained technical personnel.

Due to the diversity of product applications, the information contained herein is provided as a general guide only and does not constitute any guarantee of suitability for use in a specific application. The user must evaluate the suitability of the product and the completeness of the product data for the application. The user is responsible for product selection and ensuring all safety and any warning requirements are met. Should additional product information be needed please contact Customer Service.

Although we have endeavoured to carefully compile the information in this publication it may contain inaccuracies or typographical errors. The information is provided without any warranty or guarantee of any kind.

This publication is an uncontrolled document and is subject to change without notice. When referring to it please ensure that it is the most up to date version and has not been superseded.

The products are not intended for use in applications where a failure or malfunction may cause loss of life, injury or damage to property. The user must ensure that appropriate safety precautions are taken to prevent or mitigate the consequences of a product failure or malfunction.

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.

Product Status & Product Ordering:
We annotate datasheets in the top right hand corner of the front page, to indicate product status if it is not yet fully approved for production. The annotations are as follows:-

Target Information:	This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.
Preliminary Information:	The product design is complete and final characterisation for volume production is in progress. The datasheet represents the product as it is now understood but details may change.
No Annotation:	The product has been approved for production and unless otherwise notified by Dynex any product ordered will be supplied to the **current version of the data sheet prevailing at the time of our order acknowledgement.**

All products and materials are sold and services provided subject to Dynex's conditions of sale, which are available on request.

Any brand names and product names used in this publication are trademarks, registered trademarks or trade names of their respective owners.

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