DIM2400ESM17-RT500

Single Switch IGBT Module

TRENCH
Gen5 TMOS

DS6434-1 February 2024 (LN43151)

KEY PARAMETERS

V_{CES}		1700V
$V_{CE(sat)}$	(typ)	1.8V
I_C	(max)	2400A
$I_{C(PK)}$	(max)	4800A

FEATURES

- 10µs Short Circuit Withstand
- High Thermal Cycling Capability
- High Current Density
- Isolated AlSiC Base with AlN Substrates
- Pre-applied Thermal Interface Material

APPLICATIONS

- High Reliability Inverters
- Motor Controllers
- Smart Grid
- Traction Drives

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 DIM2400ESM17-RT500 is a single switch 1700V, 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.

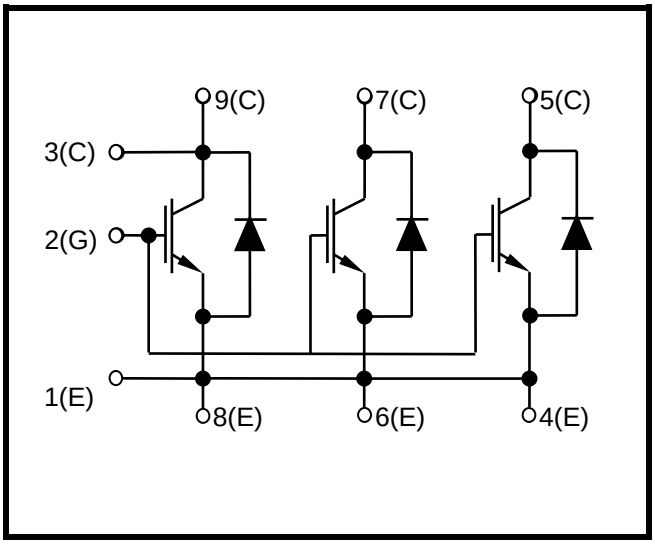


Fig. 1 Circuit configuration

Outline type code: E

(See Fig. 11 for further information)

Fig. 2 Package

ORDERING INFORMATION

Order As:

DIM2400ESM17-RT500

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	1700	V
V_{GES}	Gate-emitter voltage		±20	V
I_C	Continuous collector current	T_c = 95°C, T_{vj} max = 175°C	2400	A
$I_{C(RM)}$	Peak collector current	t_p = 1ms,	4800	A
P_{max}	Max. transistor power dissipation	T_c = 25°C, T_{vj} = 175°C	18.3	kW
I^2t	Diode I^2t value	V_R = 0, t_p = 10ms, T_{vj} = 150°C	1240	kA^2s
V_{isol}	Isolation voltage – per module	Commoned terminals to base plate. AC RMS, 1 min, 50Hz, T_c = 25°C	4000	V
Q_{PD}	Partial discharge – per module	IEC1287, V_1 = 1800V, V_2 = 1300V, 50Hz RMS	10	pC

THERMAL AND MECHANICAL RATINGS

Internal insulation material:	AlN
Baseplate material:	AlSiC
Creepage distance: Terminal to heatsink	33mm
Creepage distance: Terminal to terminal	34mm
Clearance: Terminal to heatsink	20mm
Clearance: Terminal to terminal	20mm
CTI (Comparative Tracking Index):	>600

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Units
$R_{th(j-hs)}$	Thermal resistance, junction to heatsink – IGBT	TIM mounting torque 5Nm, with pre-applied TIM	-	-	11.1	°C/kW
$R_{th(j-hs)}$	Thermal resistance, junction to heatsink – diode	TIM mounting torque 5Nm, with pre-applied TIM	-	-	12.9	°C/kW
T_j	Operating junction temperature	IGBT	-40	-	150	°C
		Diode	-40	-	150	°C
T_{stg}	Storage temperature range	-	-40	-	150	°C
	Screw torque	Mounting – M6	-	-	5	Nm
		Electrical connections – M4	-	-	2	Nm
		Electrical connections – M8	-	-	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_{vj} = 125°C			40	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150°C			70	mA
I_{GES}	Gate leakage current	V_{GE} = ± 20V, V_{CE} = 0V			1	µA
$V_{GE(TH)}$	Gate threshold voltage	I_C = 90mA, V_{GE} = V_{CE}	5.60	6.20	6.80	V
$V_{CE(sat)}$**	Collector-emitter saturation voltage	V_{GE} = 15V, I_C = 2400A		1.80	2.20	V
		V_{GE} = 15V, I_C = 2400A, T_{vj} = 125°C		2.20		V
		V_{GE} = 15V, I_C = 2400A, T_{vj} = 150°C		2.30		
I_F	Diode forward current	DC		2400		A
I_{FM}	Diode maximum forward current	t_p = 1ms		4800		A
V_F	Diode forward voltage	I_F = 2400A		1.75	2.20	V
		I_F = 2400A, T_{vj} = 125°C		1.80		V
		I_F = 2400A, T_{vj} = 150°C		1.80		
C_{ies}	Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		381		nF
Q_g	Gate charge	±15V		28.4		µC
C_{res}	Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		1.2		nF
L_M	Module inductance			6		nH
R_{CC+EE}	Module lead resistance, terminal - chip			55		µΩ
R_{INT}	Internal transistor resistance			1		Ω
SC_{Data}	Short circuit current, I_{SC}	T_j = 150°C, V_{CC} = 1000V t_p ≤ 10µs, V_{GE} ≤ 15V $V_{CE\ (max)}$ = V_{CES} – L* x di/dt IEC 60747-9		10800		A

Note:
* L is the circuit inductance + L_M
** indicates it is given at chip level

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 = 2400A V_{GE} = ±15V V_{CE} = 900V L_S ~ 60nH	$R_{G(OFF)}$ = 0.9Ω dv/dt = 2400V/µs		1870		ns
t_f	Fall time				280		ns
E_{OFF}	Turn-off energy loss				870		mJ
$t_{d(on)}$	Turn-on delay time		$R_{G(ON)}$ = 0.9Ω di/dt = 7000A/µs		1135		ns
t_r	Rise time				295		ns
E_{ON}	Turn-on energy loss				570		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V dI_F/dt = 7000A/µs			500		µC
I_{rr}	Diode reverse recovery current				1400		A
E_{rec}	Diode reverse recovery energy				295		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 = 2400A V_{GE} = ±15V V_{CE} = 900V L_S ~ 60nH	$R_{G(OFF)}$ = 0.9Ω dv/dt = 2400V/µs		2050		ns
t_f	Fall time				430		ns
E_{OFF}	Turn-off energy loss				1090		mJ
$t_{d(on)}$	Turn-on delay time		$R_{G(ON)}$ = 0.9Ω di/dt = 7000A/µs		1235		ns
t_r	Rise time				295		ns
E_{ON}	Turn-on energy loss				910		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V dI_F/dt = 7000A/µs			900		µC
I_{rr}	Diode reverse recovery current				1700		A
E_{rec}	Diode reverse recovery energy				640		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 = 2400A V_{GE} = ±15V V_{CE} = 900V L_S ~ 60nH	$R_{G(OFF)}$ = 0.9Ω dv/dt = 2400V/µs		2100		ns
t_f	Fall time				470		ns
E_{OFF}	Turn-off energy loss				1110		mJ
$t_{d(on)}$	Turn-on delay time		$R_{G(ON)}$ = 0.9Ω di/dt = 7000A/µs		1255		ns
t_r	Rise time				300		ns
E_{ON}	Turn-on energy loss				930		mJ
Q_{rr}	Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V dI_F/dt = 7000A/µs			1100		µC
I_{rr}	Diode reverse recovery current				1830		A
E_{rec}	Diode reverse recovery energy				675		mJ

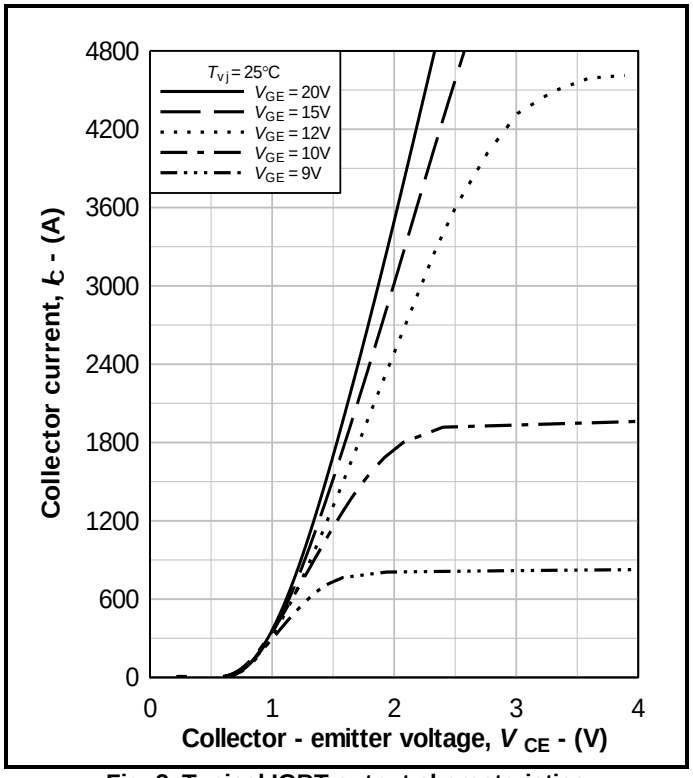


Fig. 3 Typical IGBT output characteristics

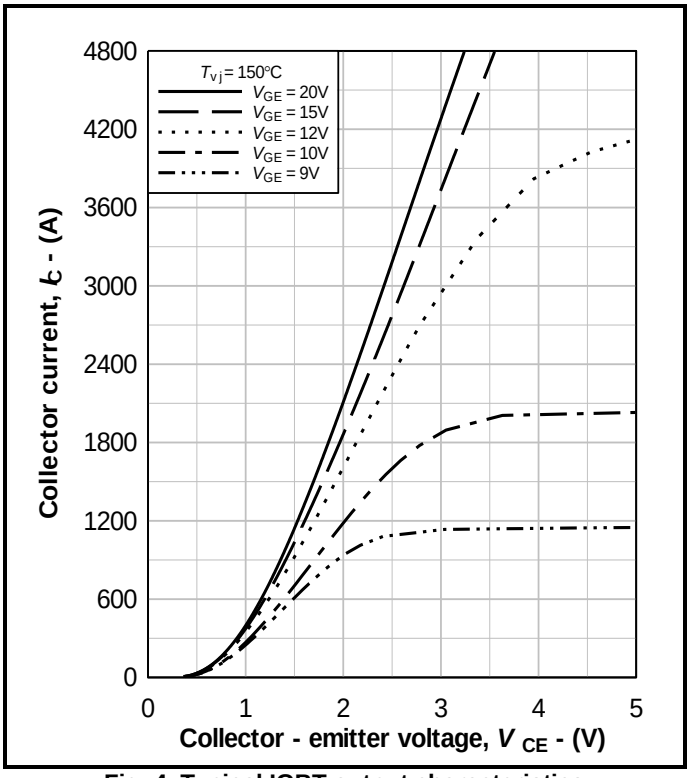


Fig. 4 Typical IGBT output characteristics

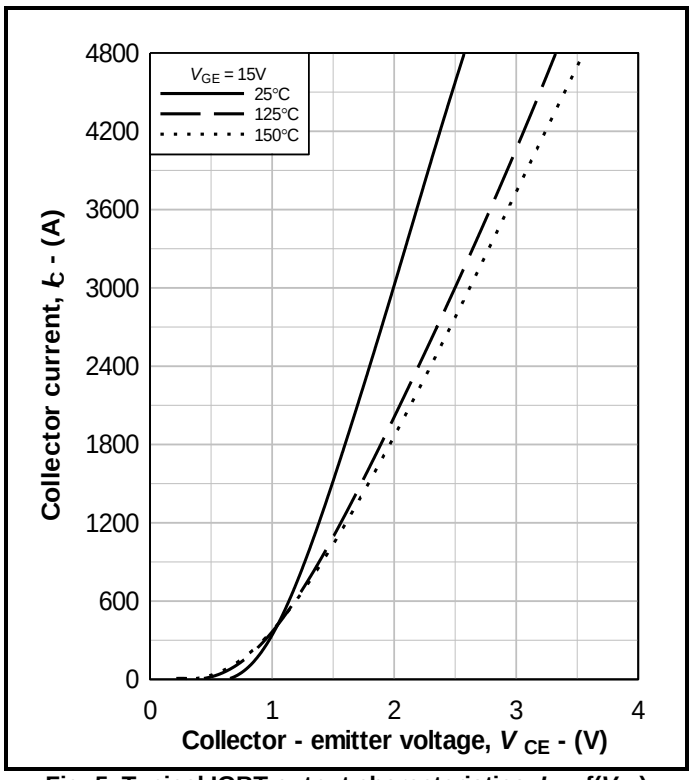


Fig. 5 Typical IGBT output characteristics, $I_C = f(V_{CE})$

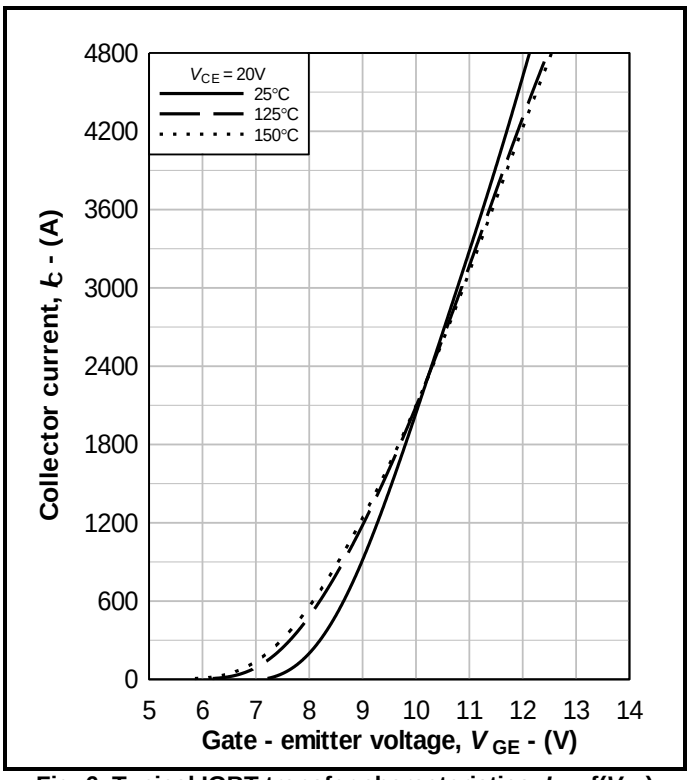


Fig. 6 Typical IGBT transfer characteristics, $I_C = f(V_{GE})$

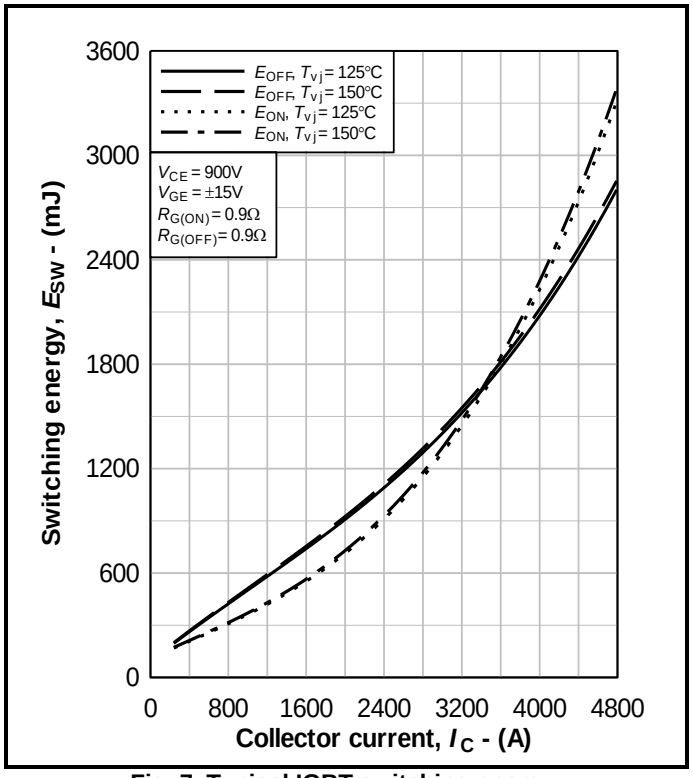


Fig. 7 Typical IGBT switching energy,
E_{ON} = f(I_C), E_{OFF} = f(I_C)

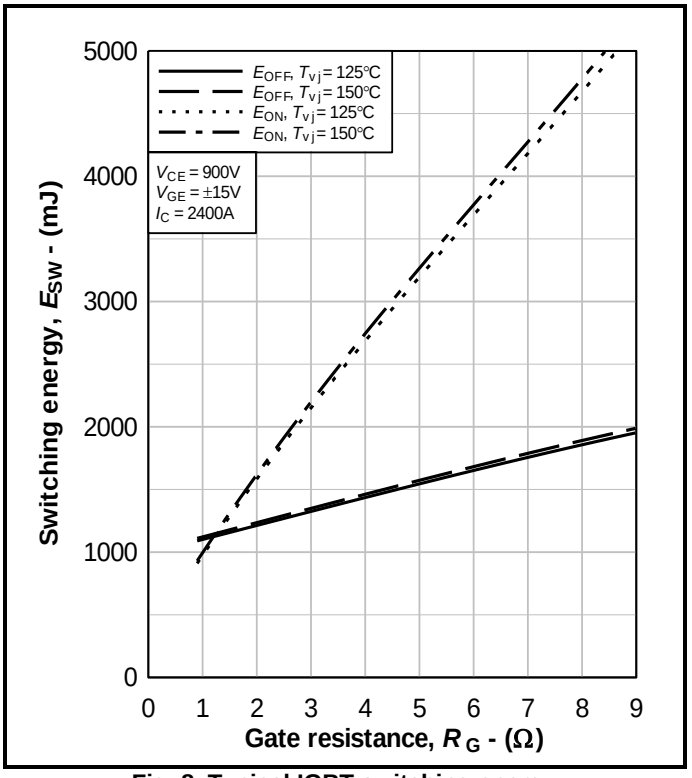


Fig. 8 Typical IGBT switching energy
E_{ON} = f(R_G), E_{OFF} = fR_G)

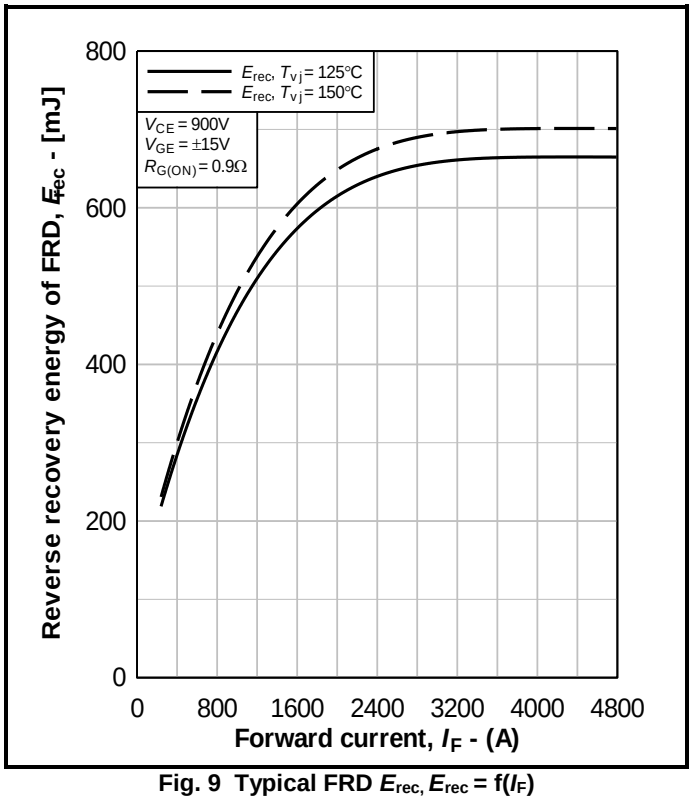


Fig. 9 Typical FRD E_{rec}, E_{rec} = f(I_F)

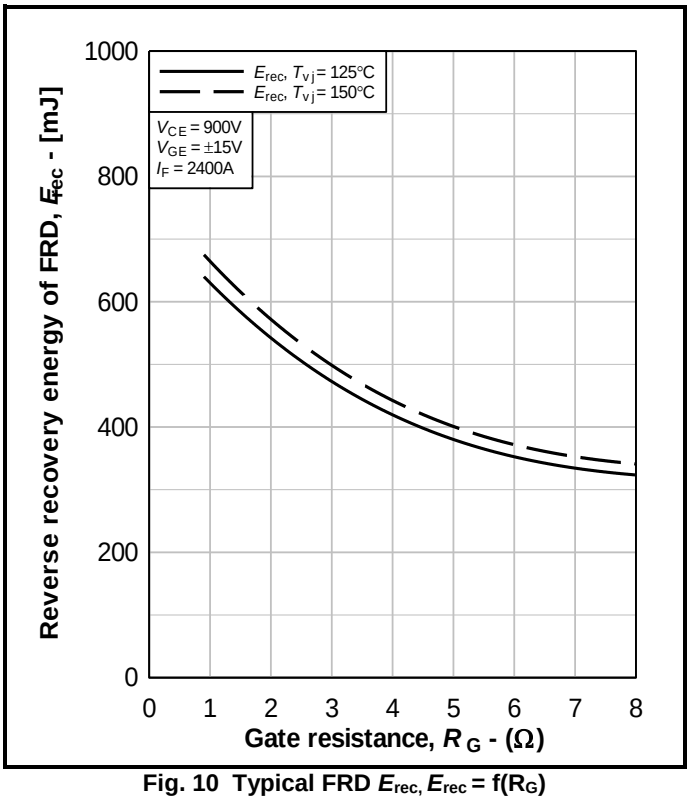


Fig. 10 Typical FRD E_{rec}, E_{rec} = f(R_G)

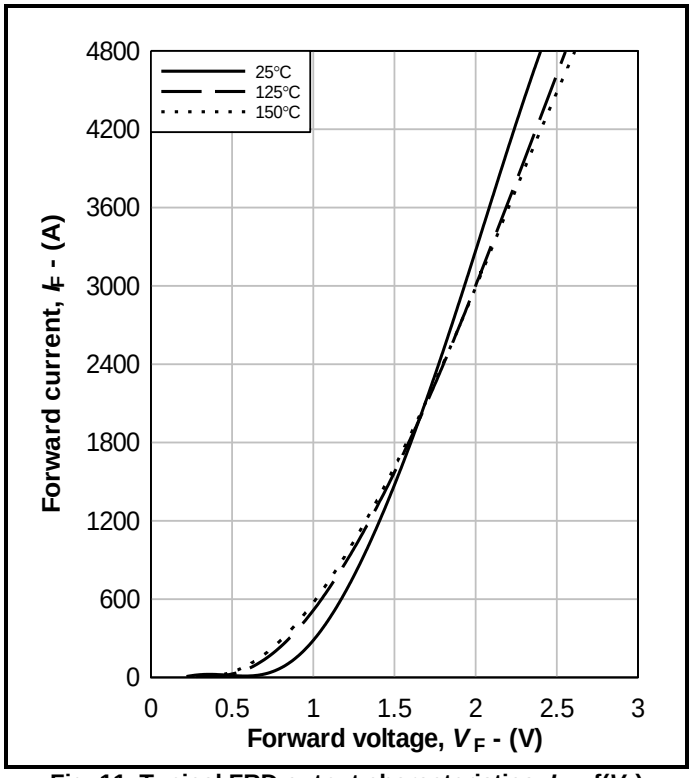


Fig. 11 Typical FRD output characteristics, $I_F = f(V_F)$

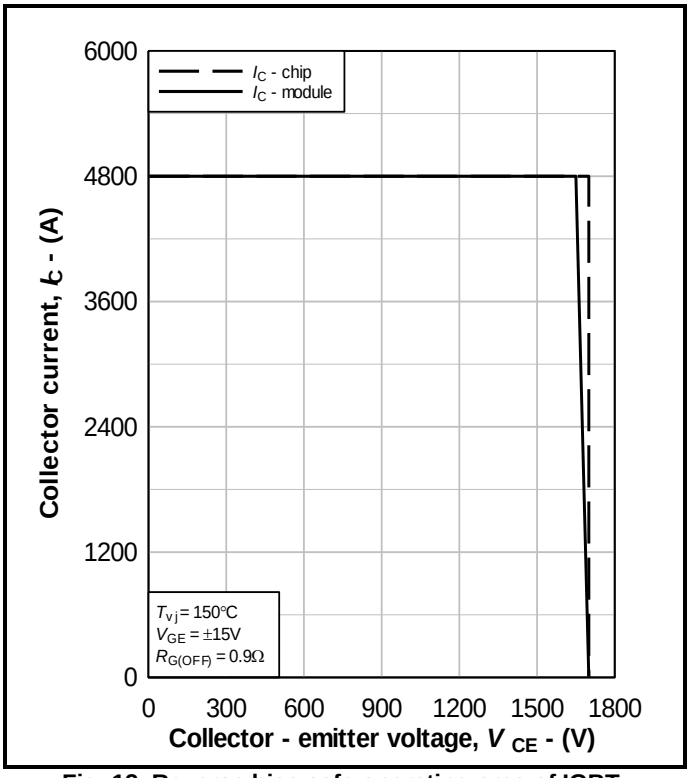


Fig. 12 Reverse bias safe operating area of IGBT, $I_C = f(V_{CE})$

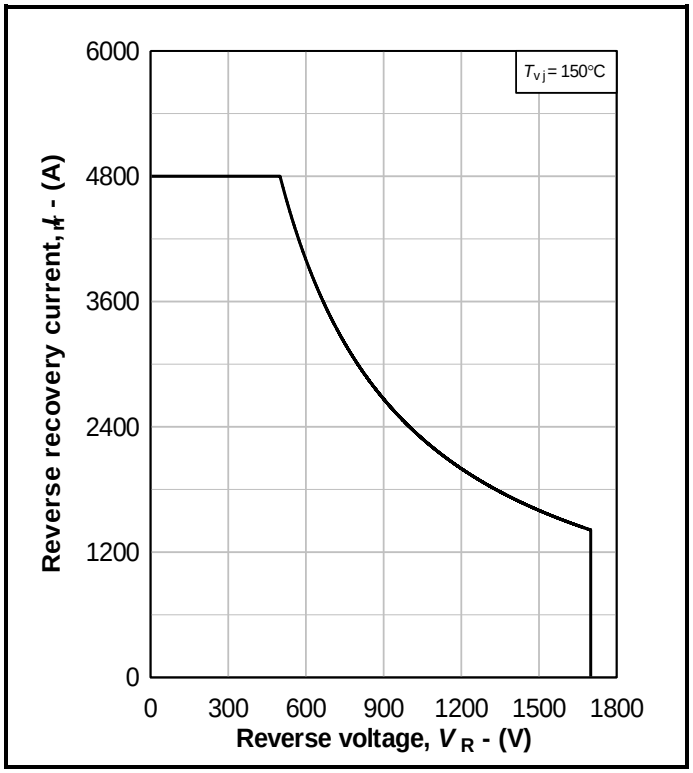


Fig. 13 Diode reverse bias safe operating area

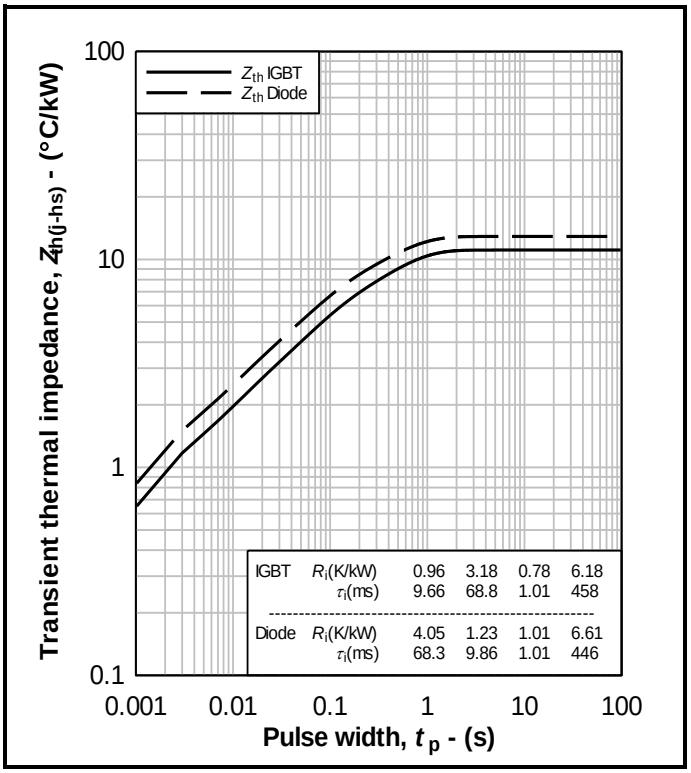


Fig. 14 Transient thermal impedance, $Z_{th(J-hs)} = f(t)$

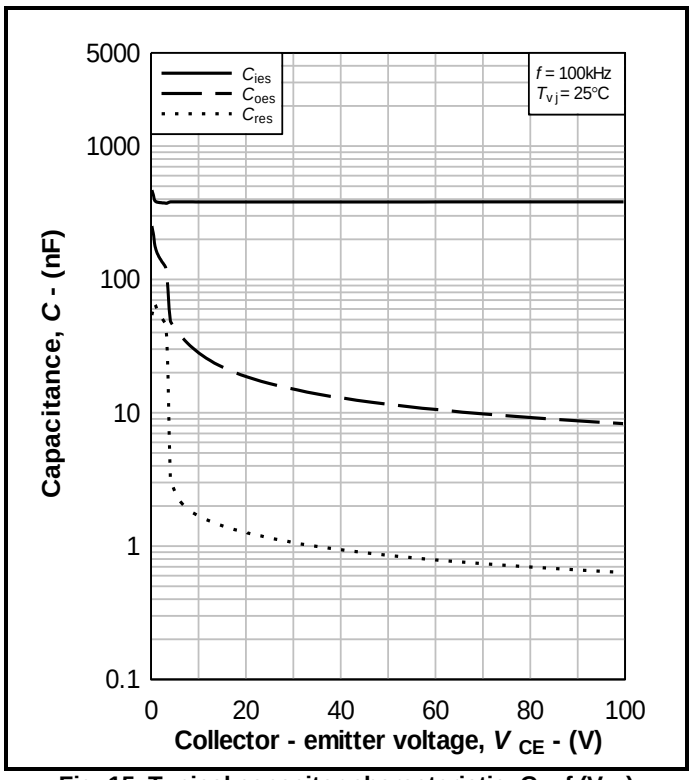


Fig. 15 Typical capacitor characteristic, C = f (V_{CE})

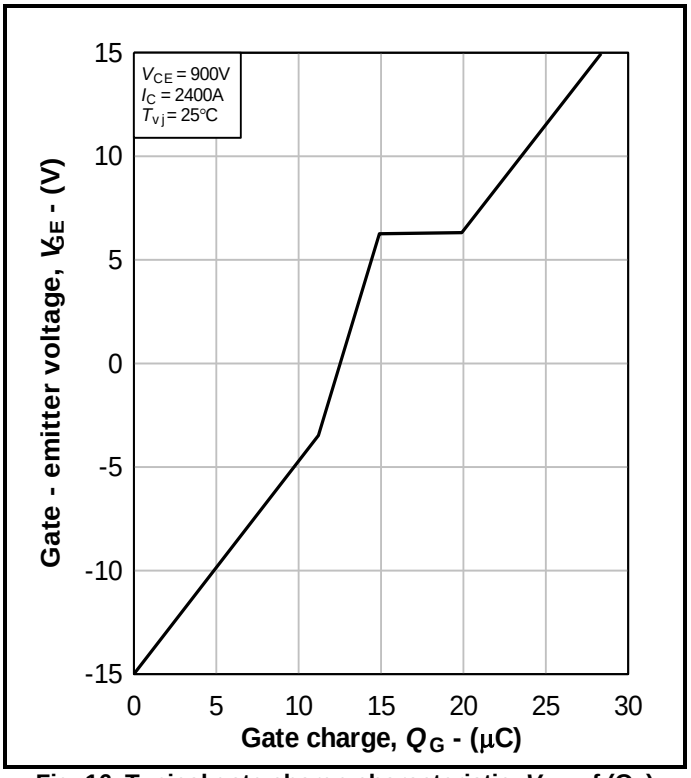
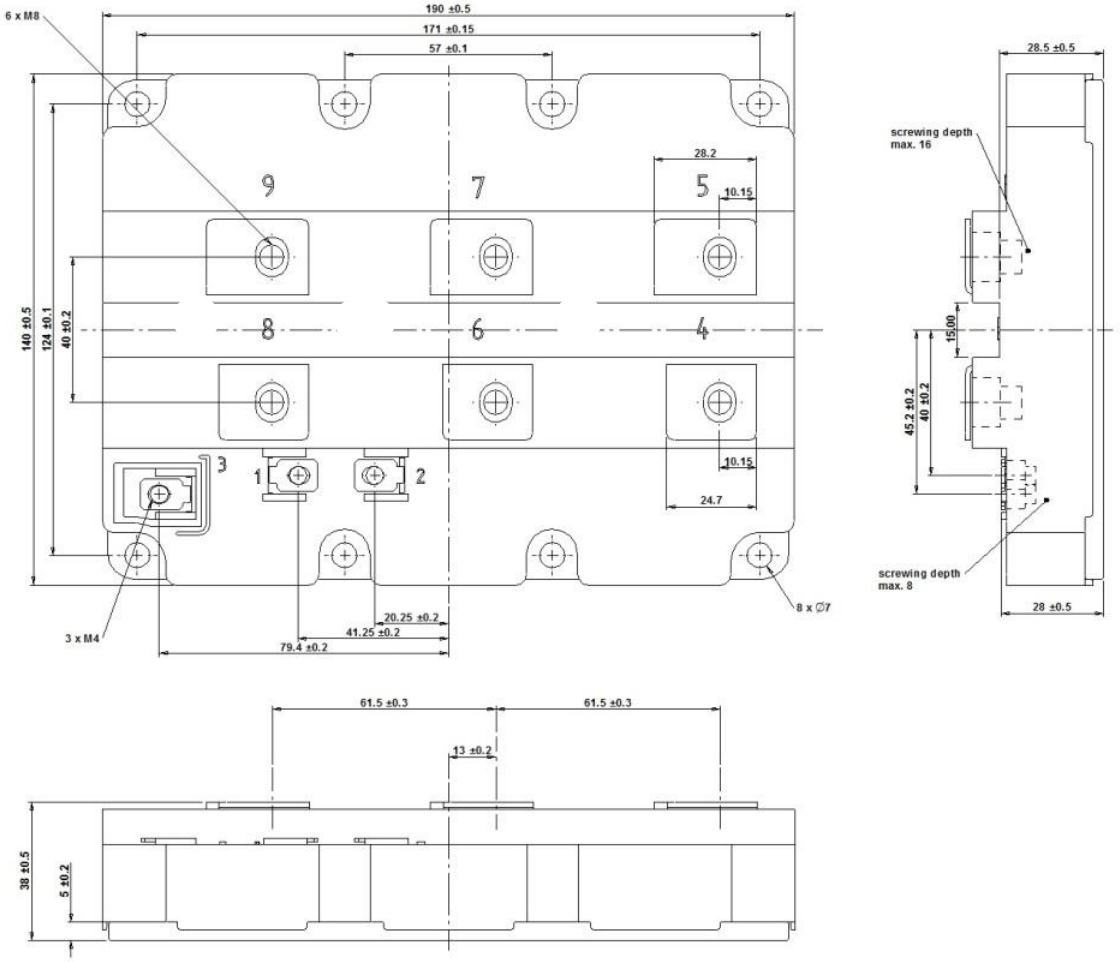


Fig. 16 Typical gate charge characteristic, V_{GE} = f (Q_G)

ACKAGE 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: 1070g

Module Outline Type Code: E

Fig. 17 Module outline drawing

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