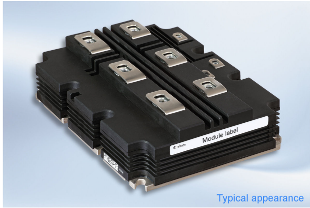
Highly insulated module with Trench/Fieldstop IGBT3 and emitter controlled 3 diode



Features

- Electrical features
  - V_{CES} = 4500 V
  - $I_{C\ nom}$ = 1200 A / I_{CRM} = 2400 A
  - High DC stability
  - High dynamic robustness
  - Low $V_{CE,sat}$
  - Trench IGBT 3
  - $V_{CE,sat}$ with positive temperature coefficient
  - High short-circuit capability
- Mechanical features
  - High creepage and clearance distances
  - AlSiC base plate for increased thermal cycling capability
  - Package with enhanced insulation of 10.4 kV AC 60 s
  - Package with CTI > 600
  - Isolated base plate

Potential applications

- High-power converters
- Medium-voltage converters
- Motor drives
- Multi-level inverter
- Traction drives

Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

Description

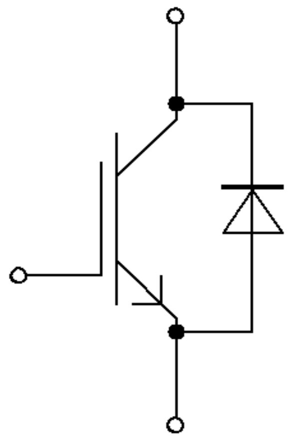


Table of contents

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 60 s	10.4	kV
Partial discharge extinction voltage	V_{isol}	RMS, f = 50 Hz, Q_{PD} ≤ 10 pC	3.5	kV
DC stability	$V_{CE(D)}$	T_{vj}=25°C, 100 Fit	3000	V
Material of module baseplate			AlSiC	
Internal isolation		basic insulation (class 1, IEC 61140)	AlN	
Creepage distance	d_{Creep}	terminal to heatsink	64.0	mm
Creepage distance	d_{Creep}	terminal to terminal	56.0	mm
Clearance	d_{Clear}	terminal to heatsink	40.0	mm
Clearance	d_{Clear}	terminal to terminal	26.0	mm
Comparative tracking index	CTI		>600	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Stray inductance module	L_{sCE}				18		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.12		mΩ
Storage temperature	T_{stg}			-55		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M6, Screw	4.25		5.75	Nm
Terminal connection torque	M	- Mounting according to valid application note	M4, Screw	1.8		2.1	Nm
			M8, Screw	8		10	
Weight	G				1400		g

Note: The maximum allowed dv/dt measured between 0,6 and 1×Vce is 2400V/µs.

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = -40 °C	4500	V
			T_{vj} = 25 °C	4500	
			T_{vj} = 125 °C	4500	

(table continues...)

Table 3 **(continued) Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Continuous DC collector current	I_{CDC}	$T_{vj\,max} = 150\ °C$	$T_C = 80\ °C$	1200	A
Repetitive peak collector current	I_{CRM}	$t_P = 1$ ms		2400	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 4 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\,sat}$	$I_C = 1200$ A, $V_{GE} = 15$ V	$T_{vj} = 25\ °C$		2.50	2.85	V
			$T_{vj} = 125\ °C$		3.10	3.70	
Gate threshold voltage	V_{GEth}	$I_C = 105$ mA, $V_{CE} = V_{GE}$, $T_{vj} = 25\ °C$		5.40	6	6.60	V
Gate charge	Q_G	$V_{GE} = ±15$ V, $V_{CE} = 2800$ V			39.5		µC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ °C$			0.75		Ω
Input capacitance	C_{ies}	$f = 1000$ kHz, $T_{vj} = 25\ °C$, $V_{CE} = 25$ V, $V_{GE} = 0$ V			280		nF
Reverse transfer capacitance	C_{res}	$f = 1000$ kHz, $T_{vj} = 25\ °C$, $V_{CE} = 25$ V, $V_{GE} = 0$ V			4.7		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 4500$ V, $V_{GE} = 0$ V	$T_{vj} = 25\ °C$			5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0$ V, $V_{GE} = 20$ V, $T_{vj} = 25\ °C$				400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 1200$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Gon} = 0.68\ Ω$	$T_{vj} = 25\ °C$		0.580		µs
			$T_{vj} = 125\ °C$		0.600		
Rise time (inductive load)	t_r	$I_C = 1200$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Gon} = 0.68\ Ω$	$T_{vj} = 25\ °C$		0.190		µs
			$T_{vj} = 125\ °C$		0.220		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1200$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Goff} = 5.1\ Ω$	$T_{vj} = 25\ °C$		6.600		µs
			$T_{vj} = 125\ °C$		6.900		
Fall time (inductive load)	t_f	$I_C = 1200$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Goff} = 5.1\ Ω$	$T_{vj} = 25\ °C$		0.350		µs
			$T_{vj} = 125\ °C$		0.450		
Turn-on time (resistive load)	t_{on_R}	$I_C = 500$ A, $V_{CE} = 2000$ V, $V_{GE} = ±15$ V, $R_{Gon} = 0.68\ Ω$	$T_{vj} = 25\ °C$	1.73			µs
Turn-on energy loss per pulse	E_{on}	$I_C = 1200$ A, $V_{CE} = 2800$ V, $L_σ = 110$ nH, $V_{GE} = ±15$ V, $R_{Gon} = 0.68\ Ω$, di/dt = 5000 A/µs ($T_{vj} = 125\ °C$)	$T_{vj} = 25\ °C$		4600		mJ
			$T_{vj} = 125\ °C$		6150		
Turn-off energy loss per pulse	E_{off}	$I_C = 1200$ A, $V_{CE} = 2800$ V, $L_σ = 110$ nH, $V_{GE} = ±15$ V, $R_{Goff} = 5.1\ Ω$, dv/dt = 2000 V/µs ($T_{vj} = 125\ °C$)	$T_{vj} = 25\ °C$		4200		mJ
			$T_{vj} = 125\ °C$		5100		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
SC data	I_{SC}	$V_{GE} \leq 15$ V, $V_{CC} = 2800$ V, $V_{CEmax}=V_{CES}-L_{sCE}*di/dt$	$t_P \leq 10$ µs, T_{vj}=125 °C		6900		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				7.40	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)			9.00		K/kW
Temperature under switching conditions	$T_{vj\ op}$			-50		125	°C

3 Diode, Inverter

Table 5 **Maximum rated values**

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = -40 °C	4500	V
			T_{vj} = 25 °C	4500	
			T_{vj} = 125 °C	4500	
Continuous DC forward current	I_F			1200	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		2400	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	570	kA^2s
Maximum power dissipation	P_{RQM}	T_{vj} = 125 °C		2400	kW
Minimum turn-on time	t_{onmin}			10	µs

Table 6 **Characteristic values**

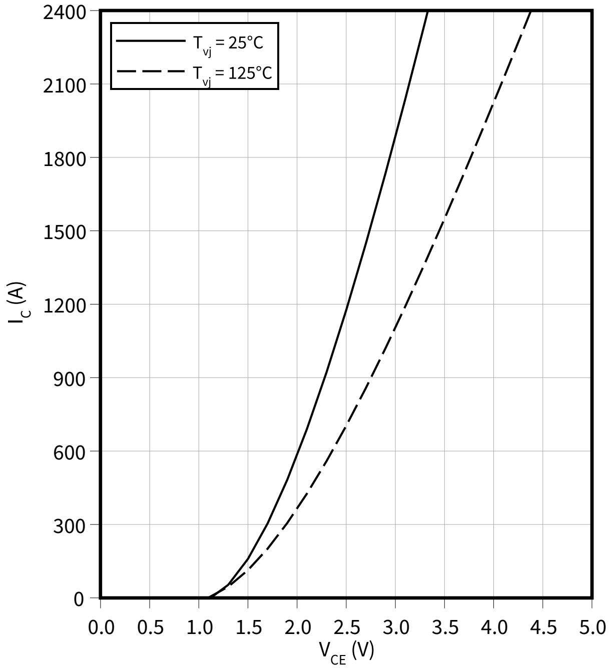
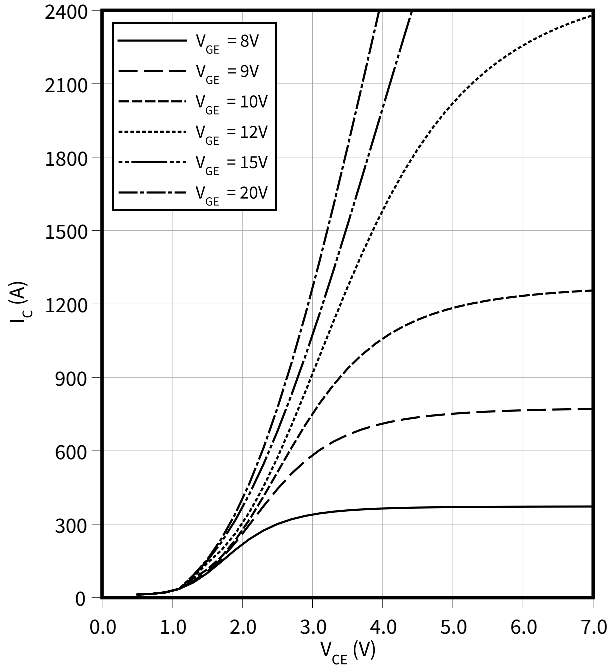
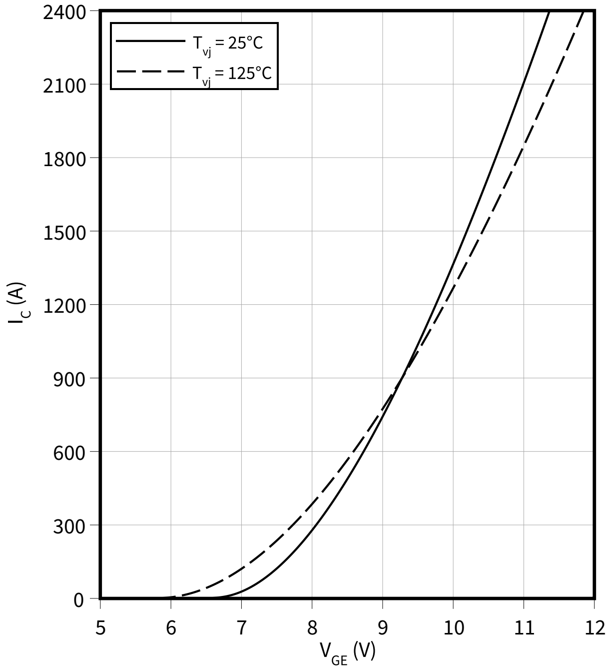
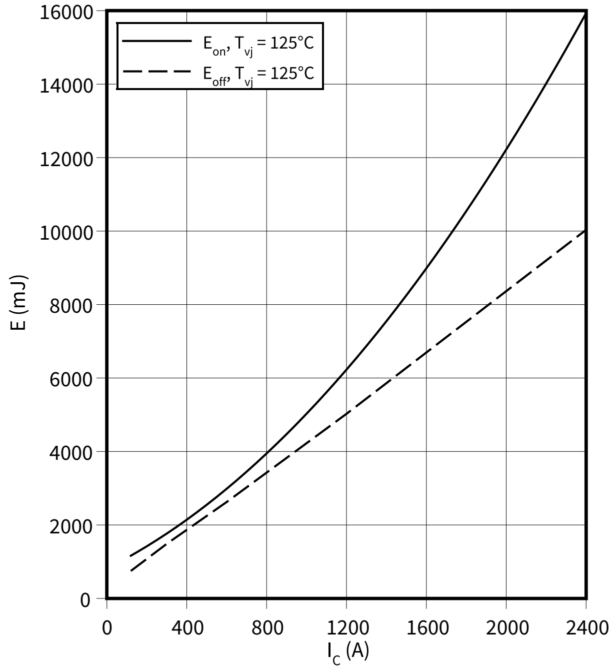
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 1200 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.50	3.10	V
			T_{vj} = 125 °C		2.50	3.00	
Peak reverse recovery current	I_{RM}	V_R = 2800 V, I_F = 1200 A, V_{GE} = -15 V, -di_F/dt = 5000 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1500		A
			T_{vj} = 125 °C		1700		
Recovered charge	Q_r	V_R = 2800 V, I_F = 1200 A, V_{GE} = -15 V, -di_F/dt = 5000 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1150		µC
			T_{vj} = 125 °C		2100		

(table continues...)

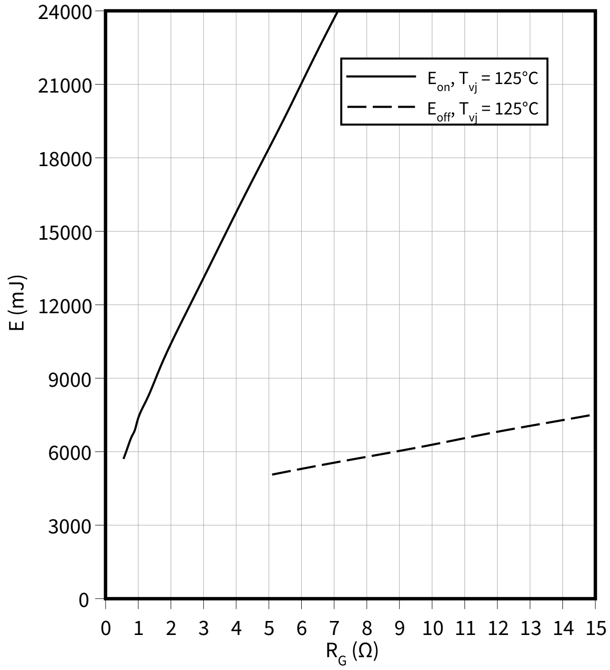
Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Reverse recovery energy	E_{rec}	V_R = 2800 V, I_F = 1200 A, V_{GE} = -15 V, -di_F/dt = 5000 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1750		mJ
			T_{vj} = 125 °C		3550		
Thermal resistance, junction to case	R_{thJC}	per diode				17.0	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)			14.0		K/kW
Temperature under switching conditions	$T_{vj\,op}$			-50		125	°C

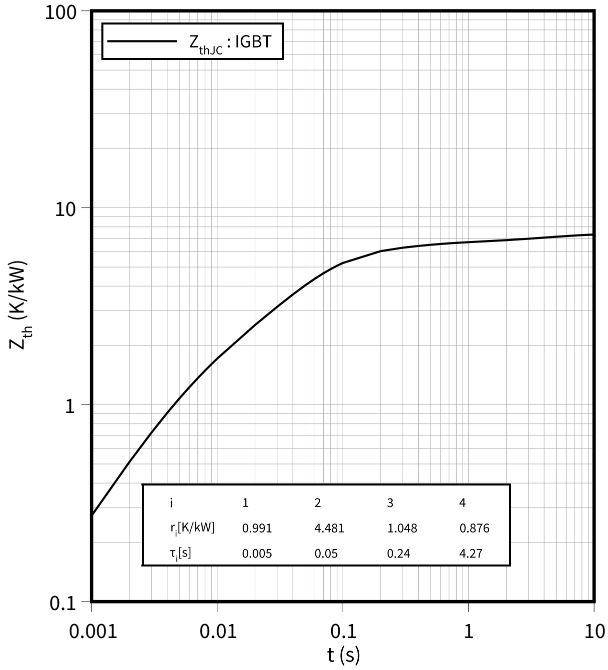
4 Characteristics diagrams

output characteristic (typical), IGBT, Inverter $I_C = f(V_{CE})$ $V_{GE} = 15$ V	**output characteristic (typical), IGBT, Inverter** $I_C = f(V_{CE})$ $T_{vj} = 125$ °C
	
transfer characteristic (typical), IGBT, Inverter $I_C = f(V_{GE})$ $V_{CE} = 20$ V	**switching losses (typical), IGBT, Inverter** $E = f(I_C)$ $V_{CE} = 2800$ V, $R_{Goff} = 5.1$ Ω, $R_{Gon} = 0.68$ Ω, $V_{GE} = -15$ / 15 V
	

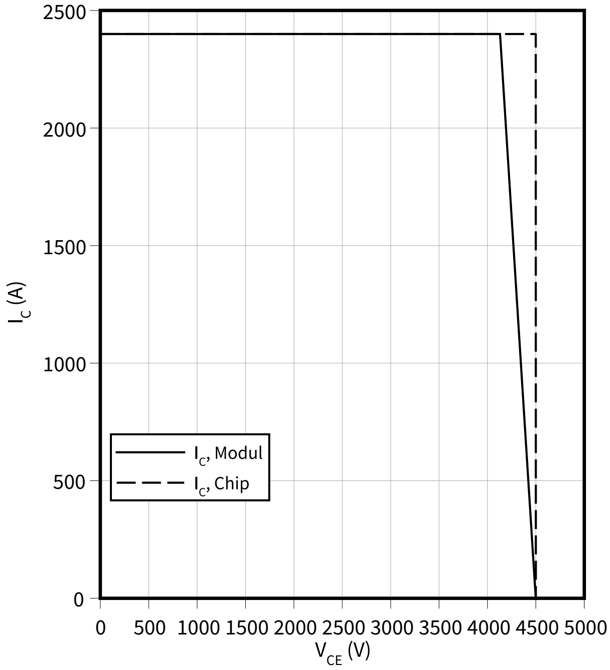
switching losses (typical), IGBT, Inverter
$E = f(R_G)$
$I_C = 1200$ A, $V_{CE} = 2800$ V, $V_{GE} = -15$ / 15 V



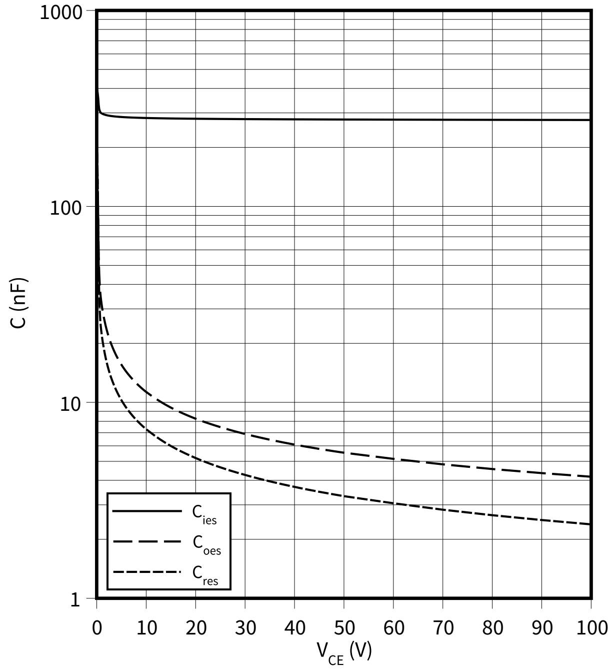
transient thermal impedance , IGBT, Inverter
$Z_{th} = f(t)$



reverse bias safe operating area (RBSOA), IGBT, Inverter
$I_C = f(V_{CE})$
$R_{Goff} = 5.1$ Ω, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



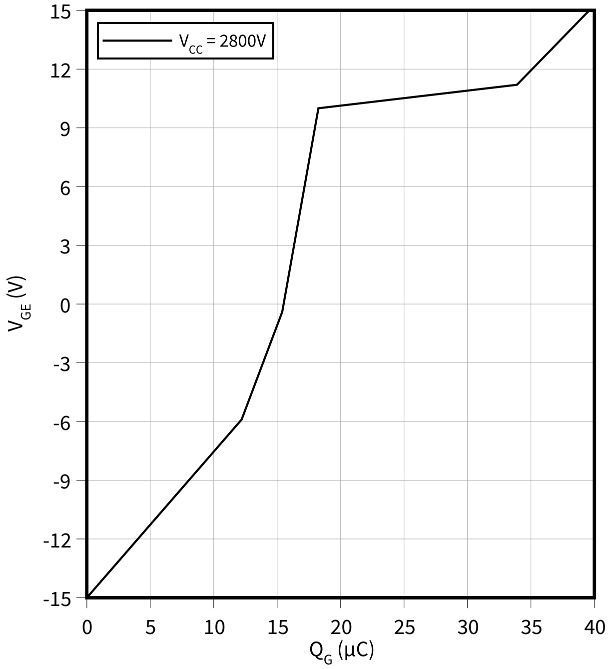
capacity characteristic (typical), IGBT, Inverter
$C = f(V_{CE})$
f = 1000 kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



gate charge characteristic (typical), IGBT, Inverter

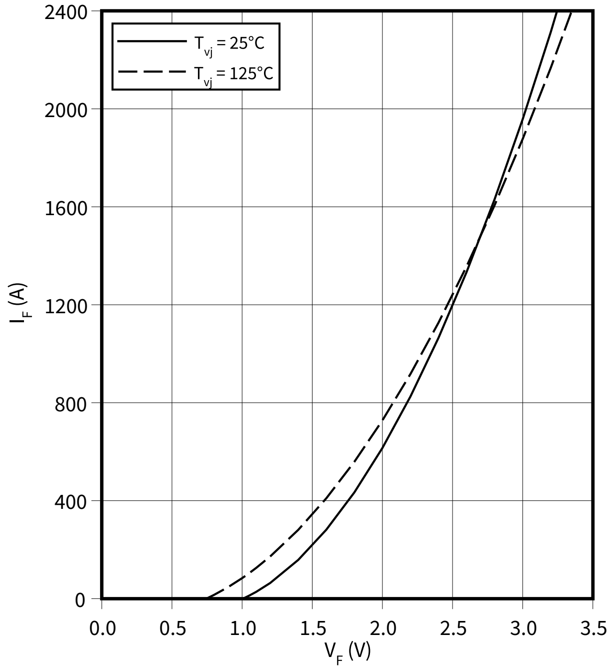
$V_{GE} = f(Q_G)$

$I_C = 1200\ A$, $T_{vj} = 25\ °C$



forward characteristic (typical), Diode, Inverter

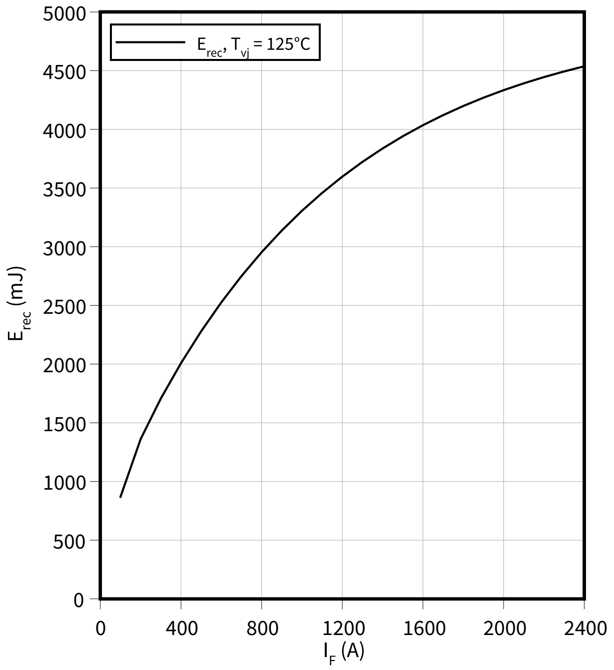
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

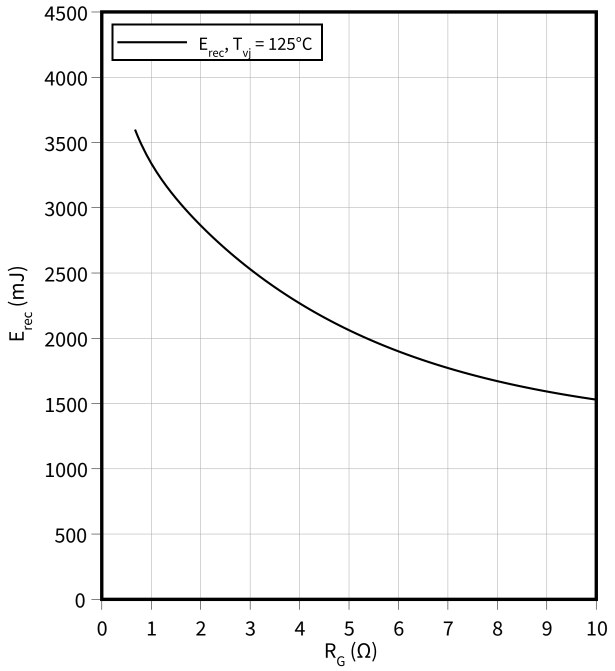
$V_{CE} = 2800\ V$, $R_{Gon} = R_{Gon}(IGBT)$



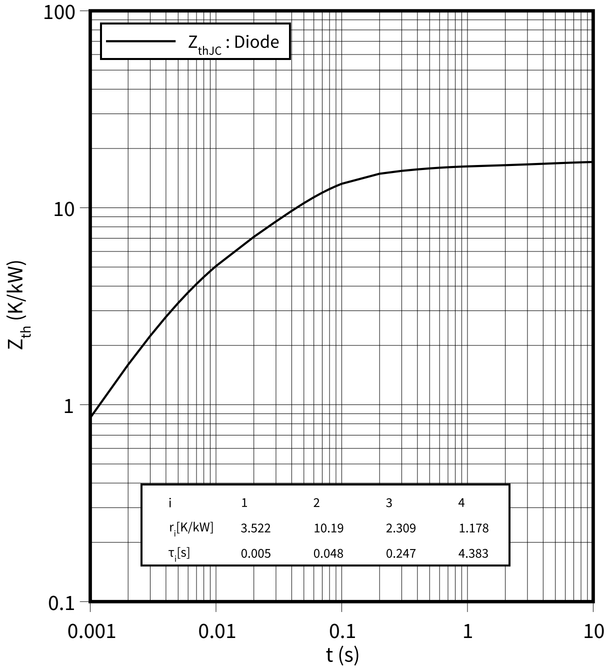
switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

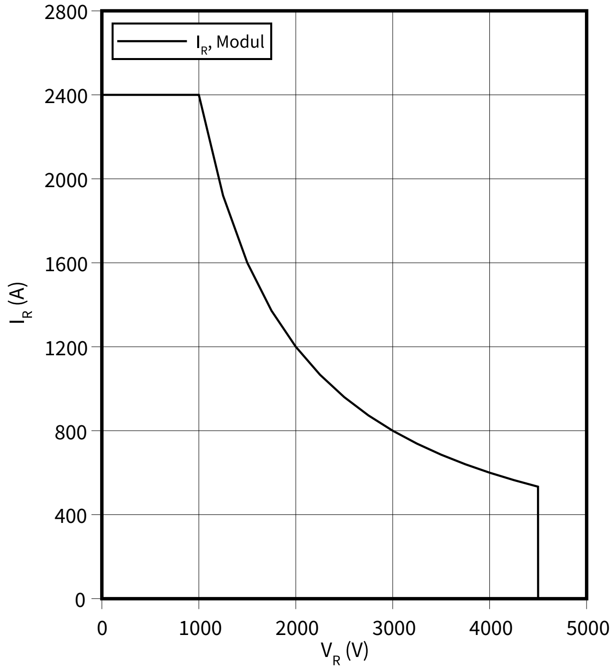
$V_{CE} = 2800\ V$, $I_F = 1200\ A$



transient thermal impedance , Diode, Inverter
$Z_{th} = f(t)$



safe operation area (SOA), Diode, Inverter
$I_R = f(V_R)$
$T_{vj} = 125\ °C$



5 Circuit diagram

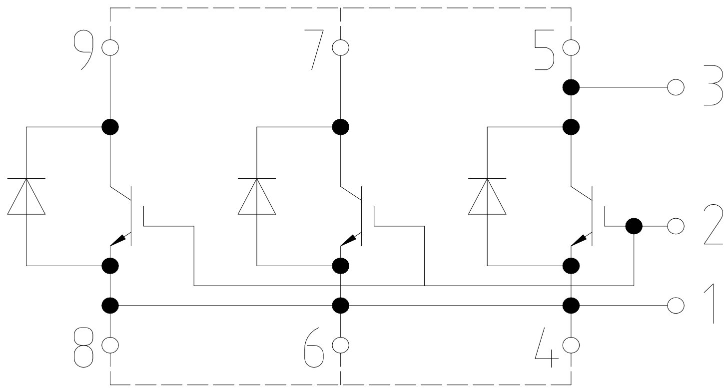


Figure 1

6 Package outlines

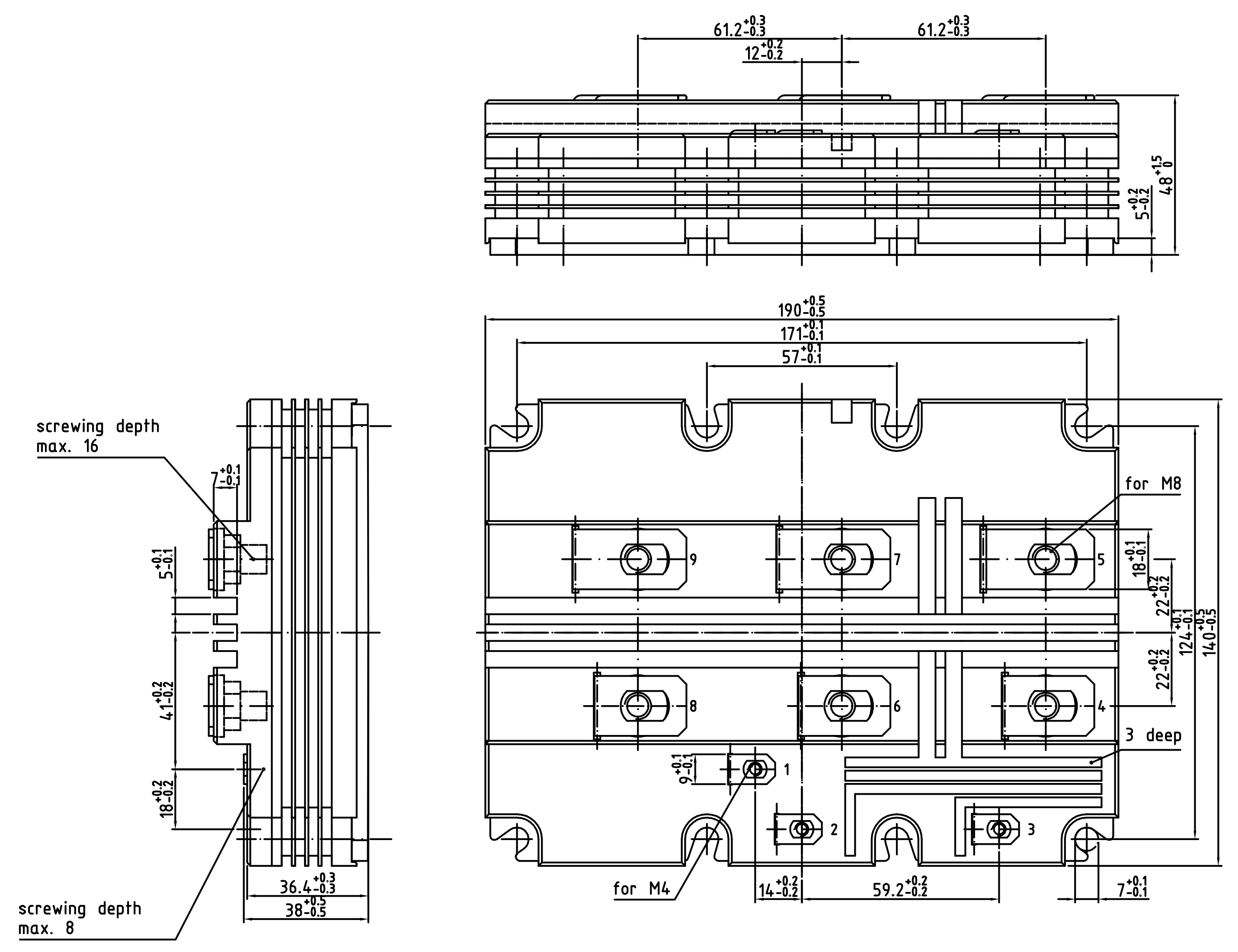


Figure 2

7 Module label code

Module label code		
Code format	Data Matrix	Barcode Code128
Encoding	ASCII text	Code Set A
Symbol size	16x16	23 digits
Standard	IEC24720 and IEC16022	IEC8859-1

Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	71549142846550549911530	71549142846550549911530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2011-07-15	Target datasheet
V1.1	2011-10-10	Target datasheet
V1.2	2011-10-21	Target datasheet
V1.3	2012-05-24	Target datasheet
V1.4	2012-06-14	Target datasheet
V1.5	2012-09-07	Target datasheet
V2.0	2013-04-02	Preliminary datasheet
V3.0	2013-05-27	Final datasheet
V3.1	2016-08-30	Final datasheet
V3.2	2018-01-15	Final datasheet
V3.3	2019-08-23	Final datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.10	2021-10-27	Final datasheet

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