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

Features

- Electrical features
  - V_{CES} = 4500 V
  - $I_{C\ nom}$ = 800 A / I_{CRM} = 1600 A
  - High DC stability
  - High dynamic robustness
  - High short-circuit capability
  - Low $V_{CE,sat}$
  - Trench IGBT 3
  - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - High creepage and clearance distances
  - Isolated base plate
  - Package with CTI > 600
  - Package with enhanced insulation of 10.4 kV AC 60 s

Potential applications

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

Product validation

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

Description

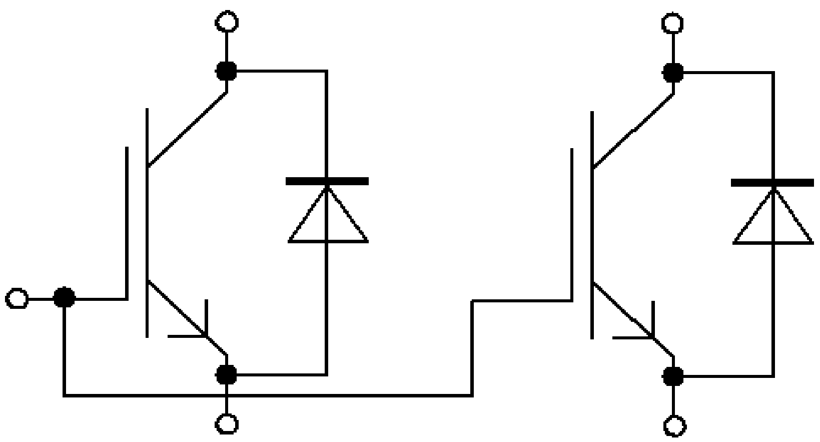


Table of contents

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, $Q_{PD} \leq 10$ 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}				20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C=25°C, per switch			0.18		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				1000		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}	$T_{vj\ max} = 150\ °C$	$T_C = 80\ °C$	800	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		1600	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	$V_{CE\ sat}$	$I_C = 800$ 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}	$I_C = 70.5$ 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			26.5		µC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ °C$			1.1		Ω
Input capacitance	C_{ies}	$f = 1000$ kHz, $T_{vj} = 25\ °C$, $V_{CE} = 25$ V, $V_{GE} = 0$ V			185		nF
Reverse transfer capacitance	C_{res}	$f = 1000$ kHz, $T_{vj} = 25\ °C$, $V_{CE} = 25$ V, $V_{GE} = 0$ V			3.1		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}	$I_C = 800$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Gon} = 1\ Ω$	$T_{vj} = 25\ °C$		0.580		µs
			$T_{vj} = 125\ °C$		0.600		
Rise time (inductive load)	t_r	$I_C = 800$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Gon} = 1\ Ω$	$T_{vj} = 25\ °C$		0.190		µs
			$T_{vj} = 125\ °C$		0.220		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 800$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Goff} = 7.5\ Ω$	$T_{vj} = 25\ °C$		6.600		µs
			$T_{vj} = 125\ °C$		6.900		
Fall time (inductive load)	t_f	$I_C = 800$ A, $V_{CE} = 2800$ V, $V_{GE} = ±15$ V, $R_{Goff} = 7.5\ Ω$	$T_{vj} = 25\ °C$		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, $R_{Gon} = 1\ Ω$	$T_{vj} = 25\ °C$	1.80			µs
Turn-on energy loss per pulse	E_{on}	$I_C = 800$ A, $V_{CE} = 2800$ V, $L_σ = 95$ nH, $V_{GE} = ±15$ V, $R_{Gon} = 1\ Ω$, di/dt = 3300 A/µs ($T_{vj} = 125\ °C$)	$T_{vj} = 25\ °C$		3100		mJ
			$T_{vj} = 125\ °C$		4100		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 800 A, V_{CE} = 2800 V, L_σ = 95 nH, V_{GE} = ±15 V, R_{Goff} = 7.5 Ω, dv/dt = 2000 V/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		2800		mJ
			T_{vj} = 125 °C		3400		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 2800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 10 µs, T_{vj} ≤ 125 °C		4600		A
Thermal resistance, junction to case	R_{thJC}	per IGBT				11.1	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT			13.5		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			800	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		1600	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	255	kA^2s
Maximum power dissipation	P_{RQM}		T_{vj} = 125 °C	1600	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 = 800 A, V_{GE} = -15 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 = 800 A, V_{GE} = -15 V, -di_F/dt = 3300 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1000		A
			T_{vj} = 125 °C		1150		

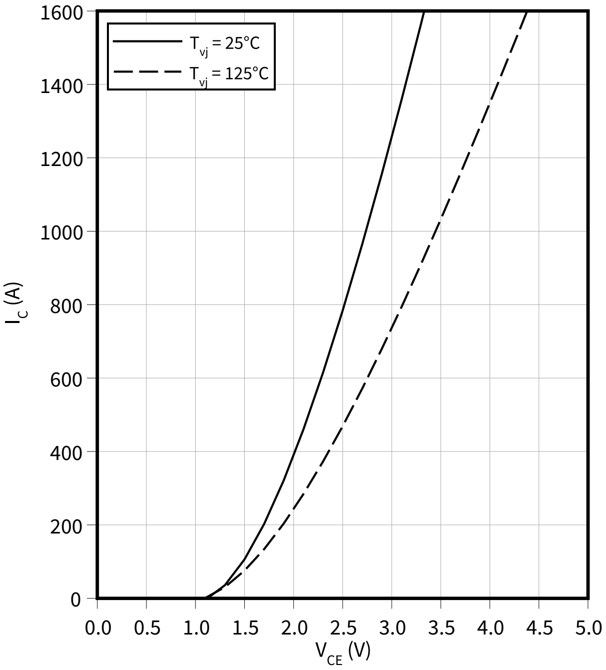
(table continues...)

Table 6 (continued) Characteristic values

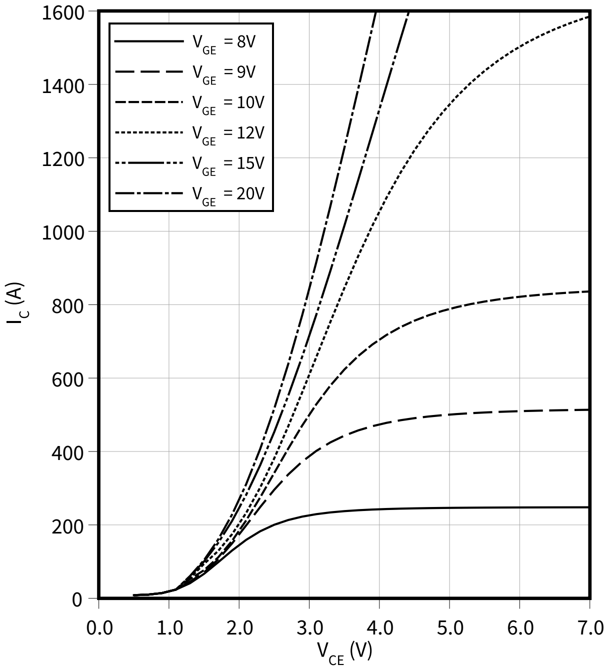
Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	V_R = 2800 V, I_F = 800 A, V_{GE} = -15 V, -di$_F$/dt = 3300 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		770		µC
			T_{vj} = 125 °C		1400		
Reverse recovery energy	E_{rec}	V_R = 2800 V, I_F = 800 A, V_{GE} = -15 V, -di$_F$/dt = 3300 A/µs (T_{vj} = 125 °C)	T_{vj} = 25 °C		1200		mJ
			T_{vj} = 125 °C		2400		
Thermal resistance, junction to case	R_{thJC}	per diode				25.5	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode			21.0		K/kW
Temperature under switching conditions	$T_{vj\ op}$			-50		125	°C

4 Characteristics diagrams

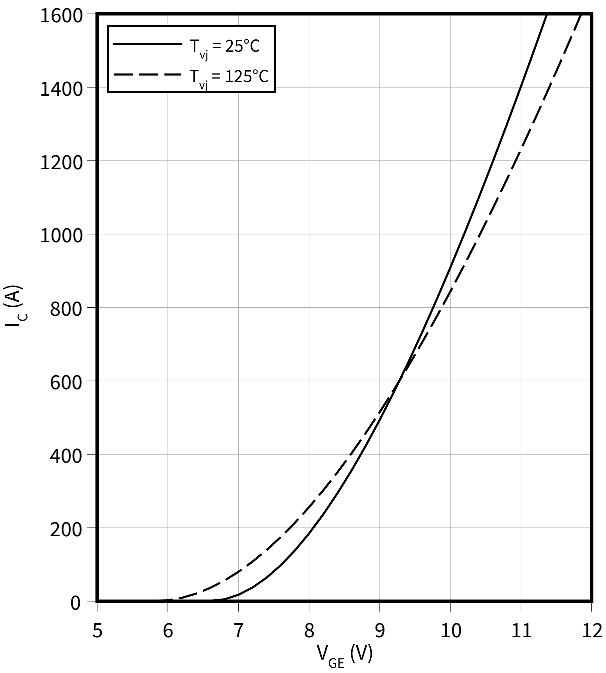
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



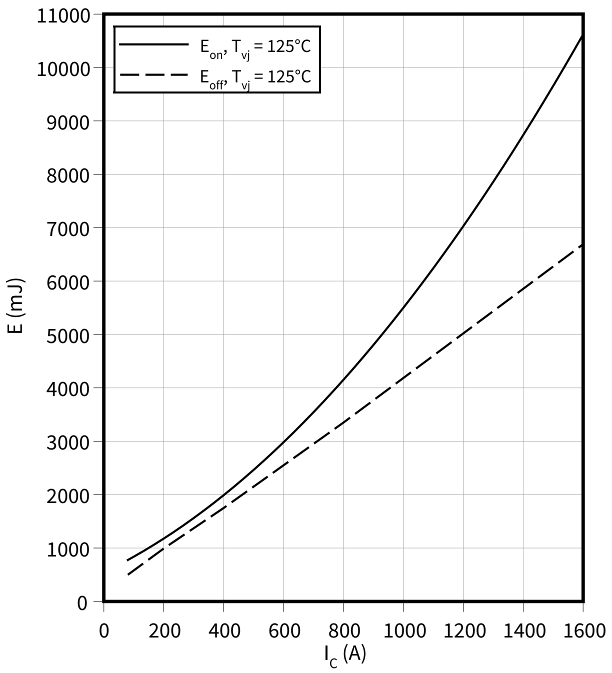
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 125$ °C



Transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



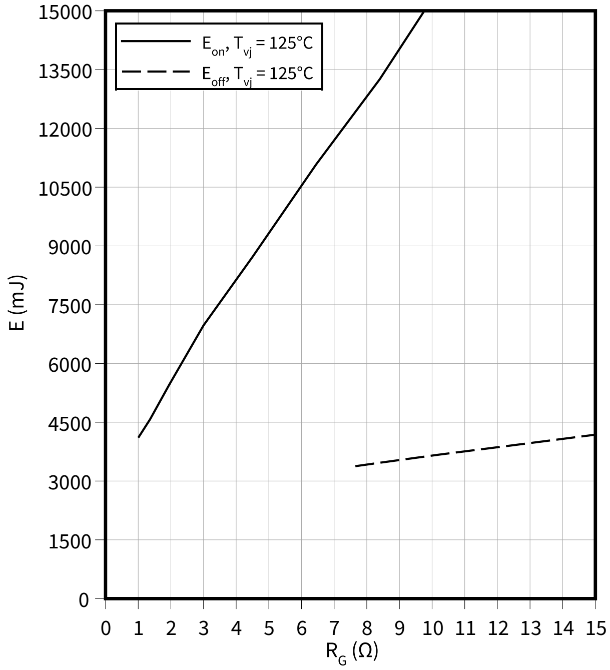
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 7.5\ \Omega$, $R_{Gon} = 1\ \Omega$, $V_{CE} = 2800$ V, $V_{GE} = \pm 15$ V



Switching losses (typical), IGBT, Inverter

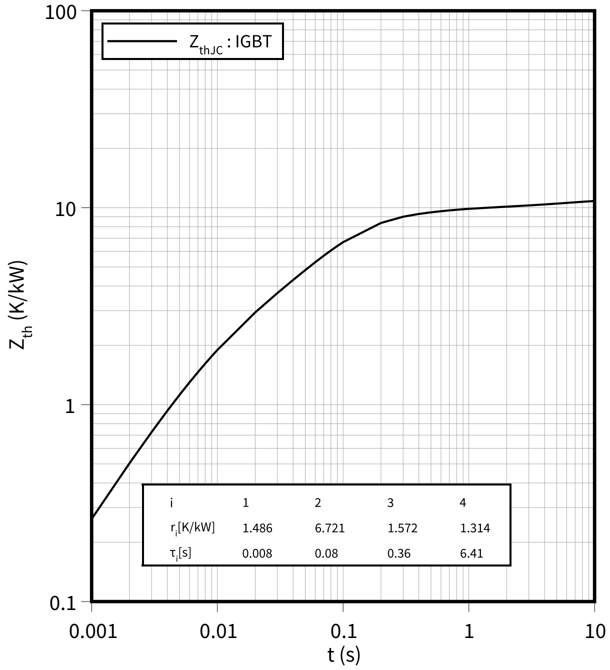
$E = f(R_G)$

$I_C = 800$ A, $V_{CE} = 2800$ V, $V_{GE} = \pm 15$ V



Transient thermal impedance , IGBT, Inverter

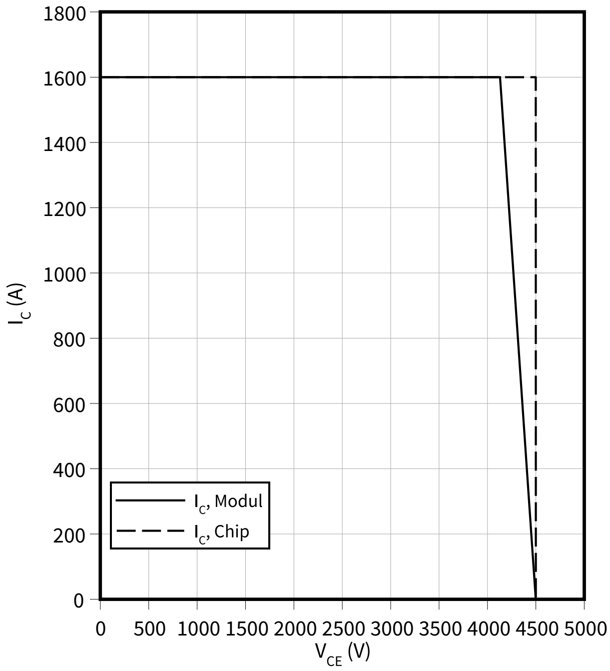
$Z_{th} = f(t)$



Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$

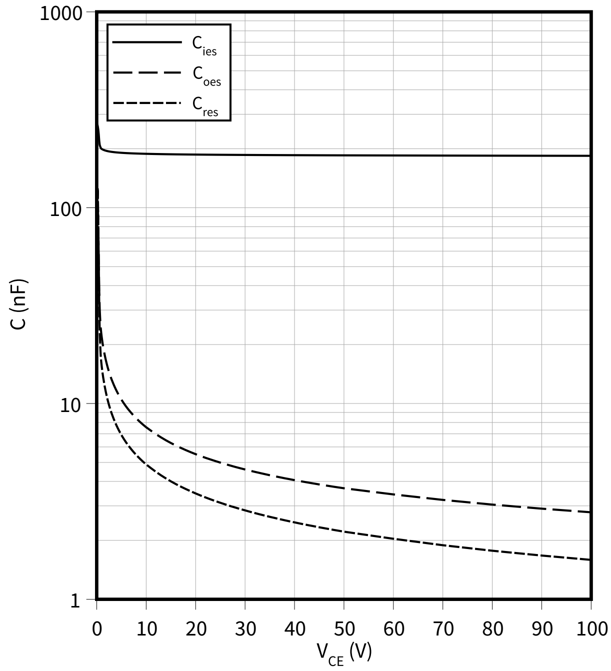
$R_{Goff} = 7.5\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 125$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

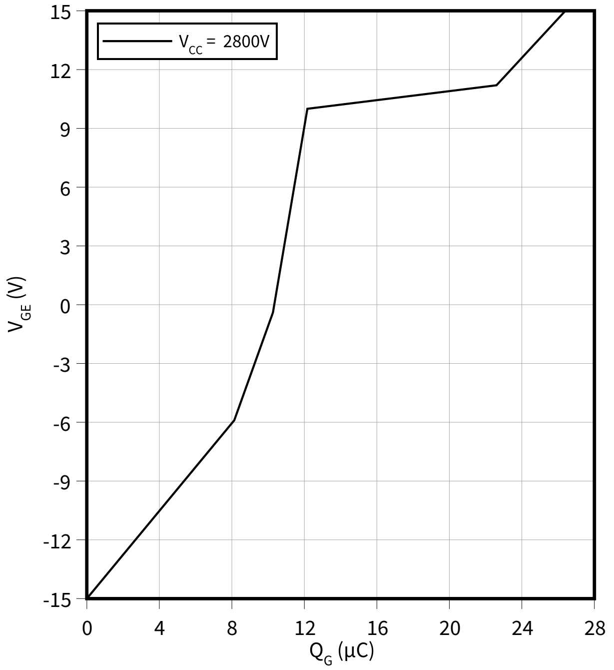
$f = 1000$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

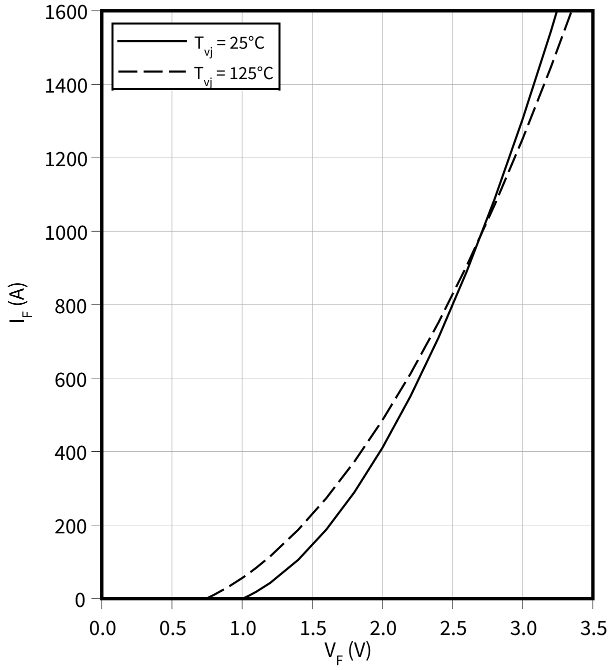
$V_{GE} = f(Q_G)$

$T_{vj} = 25\ °C$, $I_C = 800\ A$



Forward characteristic (typical), Diode, Inverter

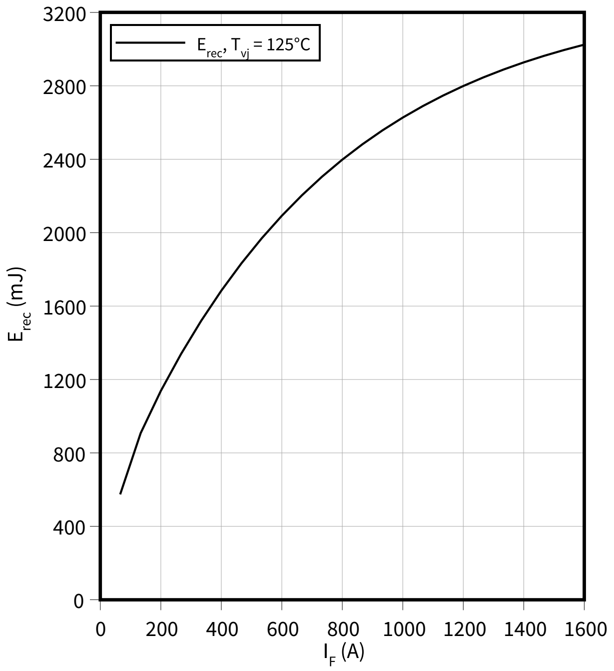
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

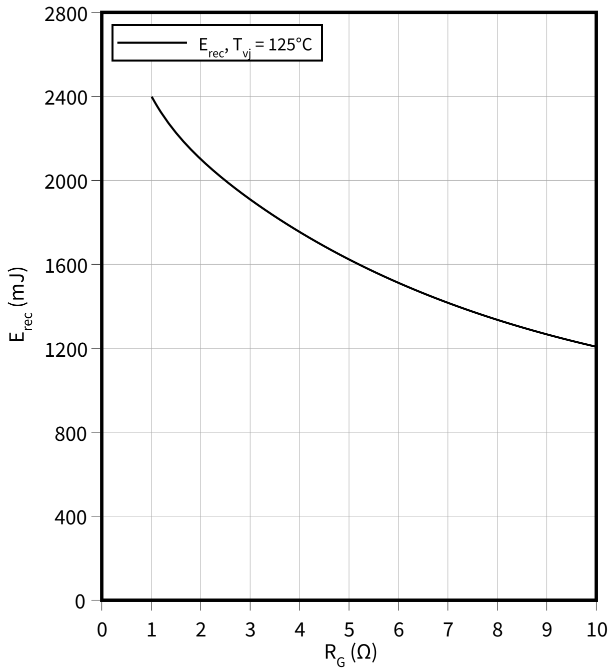
$V_{CE} = 2800\ V$, $R_{Gon} = R_{Gon}(IGBT)$



Switching losses (typical), Diode, Inverter

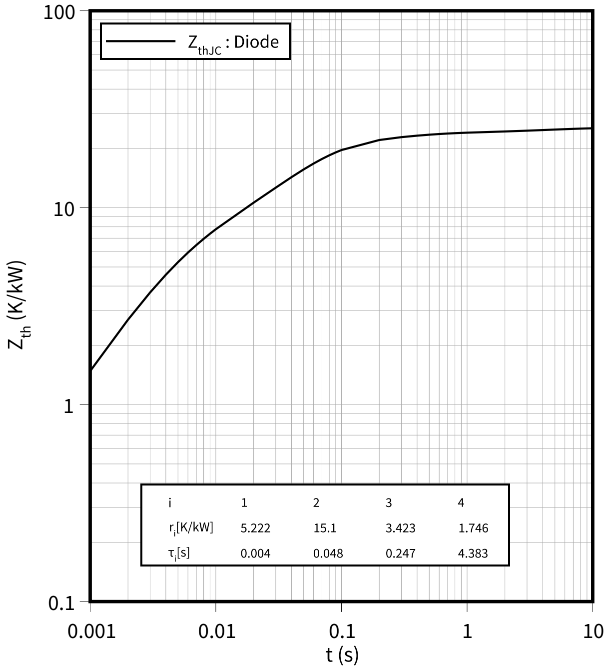
$E_{rec} = f(R_G)$

$V_{CE} = 2800\ V$, $I_F = 800\ A$



Transient thermal impedance, Diode, Inverter

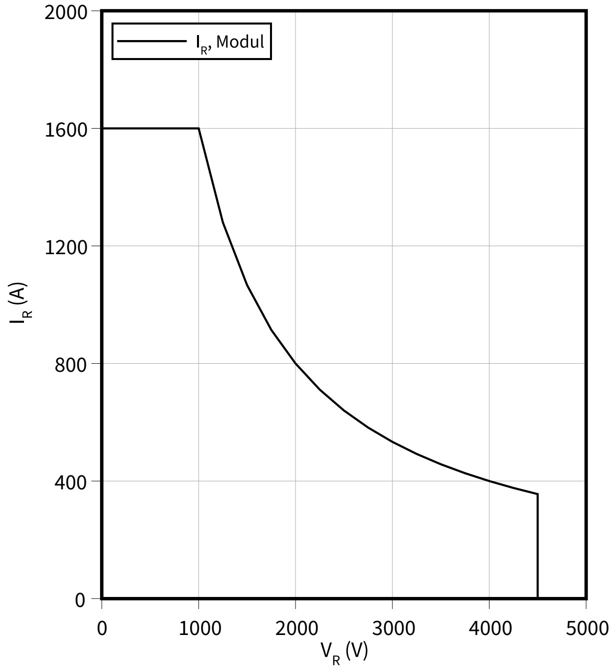
$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$

$T_{vj} = 125\ °C$



5 Circuit diagram

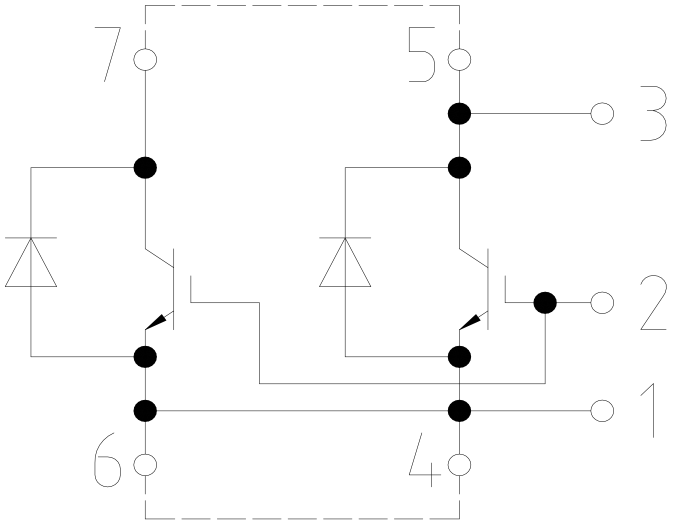


Figure 1

6 Package outlines

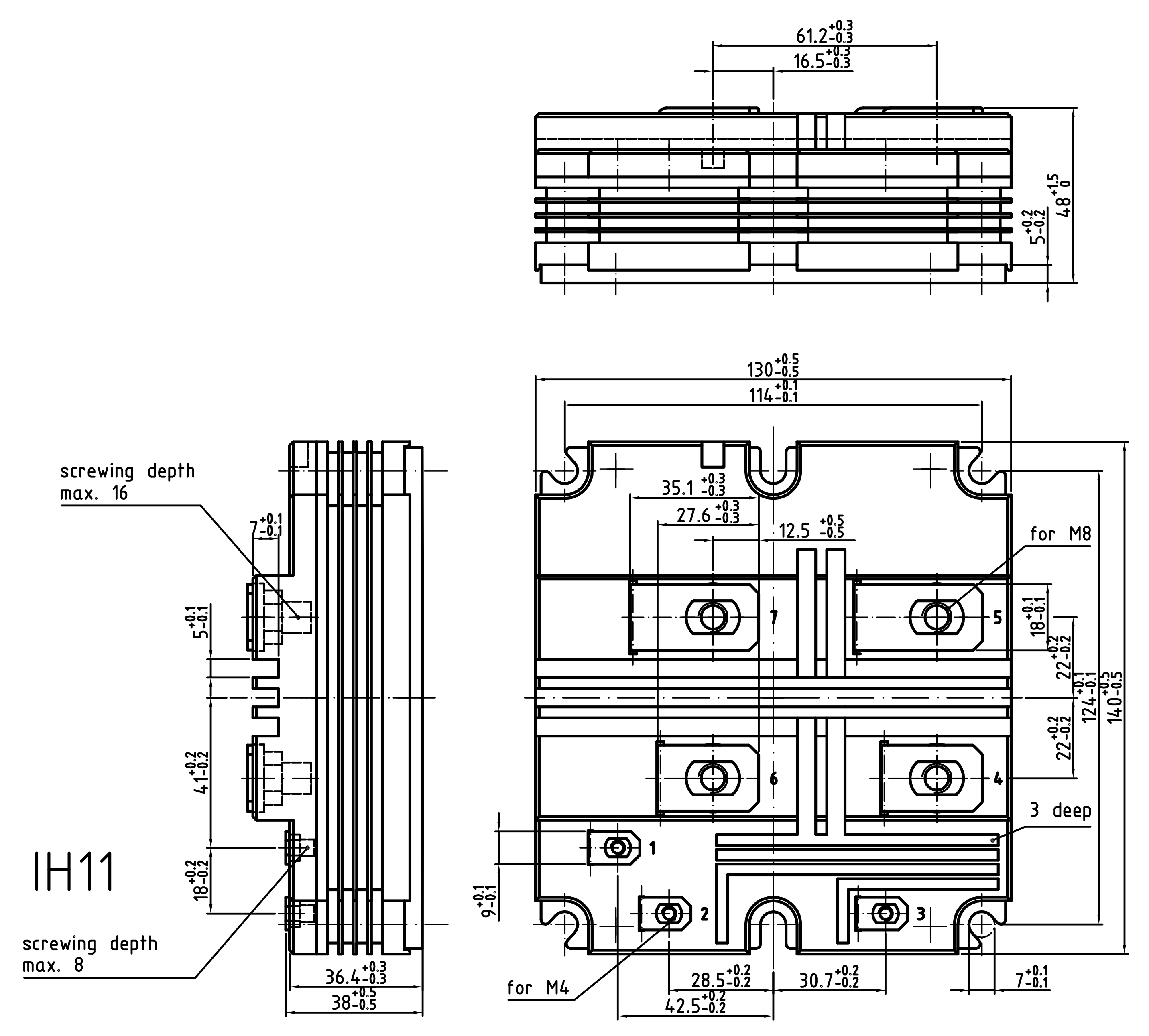


Figure 2

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	2011-10-21	Target datasheet
V1.1	2012-09-07	Target datasheet
V2.0	2013-05-27	Preliminary datasheet
V3.0	2013-05-27	Final datasheet
V3.1	2013-05-28	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	2021-10-25	Final datasheet
1.20	2022-07-17	Final datasheet

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