

## Final datasheet

### IHM-B module with Trench/Fieldstop IGBT4 and emitter controlled 4 diode

#### Features

- Electrical features
  - $V_{CES} = 4500\text{ V}$
  - $I_{C\text{ nom}} = 1200\text{ A} / I_{CRM} = 2400\text{ A}$
  - High DC stability
  - High short-circuit capability
  - High dynamic robustness
  - Low  $V_{CE,sat}$
  - Trench IGBT 4
  - $V_{CE,sat}$  with positive temperature coefficient
- Mechanical features
  - AlSiC base plate for increased thermal cycling capability
  - Package with CTI > 600
  - IHM B housing
  - Isolated base plate
  - Standard housing



Typical appearance

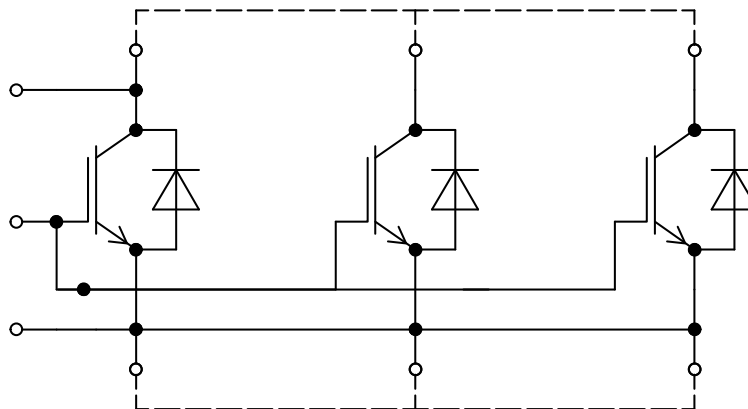
#### Potential applications

- High-power converters
- Medium-voltage converters
- Power transmission and distribution

#### Product validation

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

#### Description



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## 1 Package

**Table 1** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$	RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	6.0	kV
Partial discharge extinction voltage	$V_{isol}$	RMS, $f = 50 \text{ Hz}$ , $Q_{PD} \leq 10 \text{ pC}$	3.5	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25 \text{ }^\circ\text{C}$ , 100 Fit	2900	V
Material of module baseplate			AlSiC	
Creepage distance	$d_{Creep}$	terminal to heatsink	32.2	mm
Clearance	$d_{Clear}$	terminal to heatsink	19.1	mm
Comparative tracking index	$CTI$		> 600	

**Table 2** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Stray inductance module	$L_{sCE}$			6		nH	
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_C = 25 \text{ }^\circ\text{C}$ , per switch		0.08		m $\Omega$	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25 \text{ }^\circ\text{C}$ , per switch		0.095		m $\Omega$	
Storage temperature	$T_{stg}$		-40		150	$^\circ\text{C}$	
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	$G$			1200		g	

## 2 IGBT, Inverter

**Table 3** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Collector-emitter voltage	$V_{CES}$		$T_{vj} = -40 \text{ }^\circ\text{C}$	4300	V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	4500	
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 150 \text{ }^\circ\text{C}$	$T_C = 110 \text{ }^\circ\text{C}$	1200	A
Repetitive peak collector current	$I_{CRM}$	$t_p$ limited by $T_{vj \text{ op}}$		2400	A
Gate-emitter peak voltage	$V_{GES}$			-20/20	V

**Table 4** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 1200\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		2.30	2.75	V
			$T_{vj} = 125\ ^\circ C$		2.70	3.25	
			$T_{vj} = 150\ ^\circ C$		2.85	3.40	
Gate threshold voltage	$V_{GETh}$	$I_C = 112\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.5	6	6.5	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CC} = 2800\ V$			35		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$			0.39		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			223		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			4.1		nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 4500\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			5	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				400	nA
Turn-on delay time (inductive load)	$t_{don}$	$I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.330		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.360		
			$T_{vj} = 150\ ^\circ C$		0.370		
Rise time (inductive load)	$t_r$	$I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.260		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.270		
			$T_{vj} = 150\ ^\circ C$		0.280		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		9.300		$\mu s$
			$T_{vj} = 125\ ^\circ C$		9.800		
			$T_{vj} = 150\ ^\circ C$		9.900		
Fall time (inductive load)	$t_f$	$I_C = 1200\ A, V_{CC} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.740		$\mu s$
			$T_{vj} = 125\ ^\circ C$		1.730		
			$T_{vj} = 150\ ^\circ C$		2.040		
Turn-on time (resistive load)	$t_{on\_R}$	$I_C = 500\ A, V_{CC} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega$	$T_{vj} = 25\ ^\circ C$	1.24			$\mu s$
Turn-on energy loss per pulse	$E_{on}$	$I_C = 1200\ A, V_{CC} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.3\ \Omega, di/dt = 3700\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		4100		mJ
			$T_{vj} = 125\ ^\circ C$		5800		
			$T_{vj} = 150\ ^\circ C$		6350		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 1200\ A, V_{CC} = 2800\ V, L_\sigma = 150\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 9.1\ \Omega, dv/dt = 1000\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		5500		mJ
			$T_{vj} = 125\ ^\circ C$		6900		
			$T_{vj} = 150\ ^\circ C$		7300		

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
SC data	$I_{SC}$	$V_{GE} \leq 15 \text{ V}$ , $V_{CC} = 3000 \text{ V}$ , $V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$ $t_p \leq 10 \mu\text{s}$ , $T_{vj} = 150 \text{ }^\circ\text{C}$		6400		A
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			9.40	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		4.10		K/kW
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	$^\circ\text{C}$

### 3 Diode, Inverter

**Table 5 Maximum rated values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Repetitive peak reverse voltage	$V_{RRM}$		$T_{vj} = -40 \text{ }^\circ\text{C}$	4500		V
			$T_{vj} = 150 \text{ }^\circ\text{C}$	4500		
Continuous DC forward current	$I_F$			1200		A
Repetitive peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$		2400		A
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}$ , $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ }^\circ\text{C}$	760		kA <sup>2</sup> s
			$T_{vj} = 150 \text{ }^\circ\text{C}$	710		
Maximum power dissipation	$P_{RQM}$		$T_{vj} = 150 \text{ }^\circ\text{C}$	2400		kW
Minimum turn-on time	$t_{onmin}$			10		$\mu\text{s}$

**Table 6 Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 1200 \text{ A}$ , $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$		2.50	2.95	V
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2.40	2.85	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2.30	2.75	
Peak reverse recovery current	$I_{RM}$	$V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ , $V_{GE} = -15 \text{ V}$ , $-di_F/dt = 3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		1400		A
			$T_{vj} = 125 \text{ }^\circ\text{C}$		1640		
			$T_{vj} = 150 \text{ }^\circ\text{C}$		1750		

(table continues...)

**Table 6 (continued) Characteristic values**

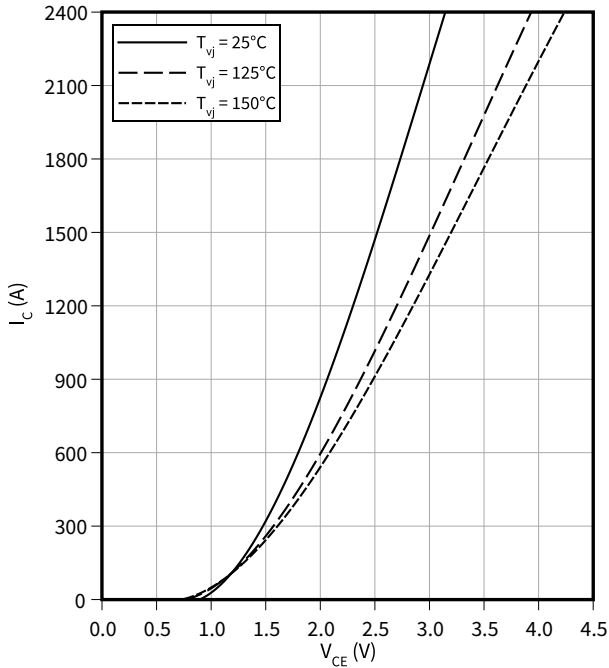
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	$Q_r$	$V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ , $V_{GE} = -15 \text{ V}$ , $-di_F/dt =$ $3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		1000	$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$		2000	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		2380	
Reverse recovery energy	$E_{rec}$	$V_{CC} = 2800 \text{ V}$ , $I_F = 1200 \text{ A}$ , $V_{GE} = -15 \text{ V}$ , $-di_F/dt =$ $3700 \text{ A}/\mu\text{s}$ ( $T_{vj} = 150 \text{ }^\circ\text{C}$ )	$T_{vj} = 25 \text{ }^\circ\text{C}$		1500	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		3300	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		4000	
Thermal resistance, junction to case	$R_{thJC}$	per diode			15.6	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		6.20		K/kW
Temperature under switching conditions	$T_{vjop}$		-40		150	$^\circ\text{C}$

## 4 Characteristics diagrams

**Output characteristic (typical), IGBT, Inverter**

$$I_C = f(V_{CE})$$

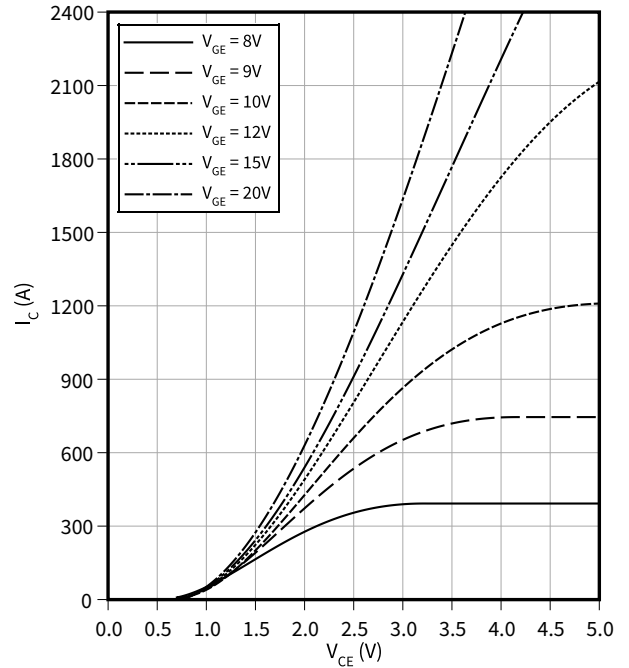
$$V_{GE} = 15 \text{ V}$$



**Output characteristic field (typical), IGBT, Inverter**

$$I_C = f(V_{CE})$$

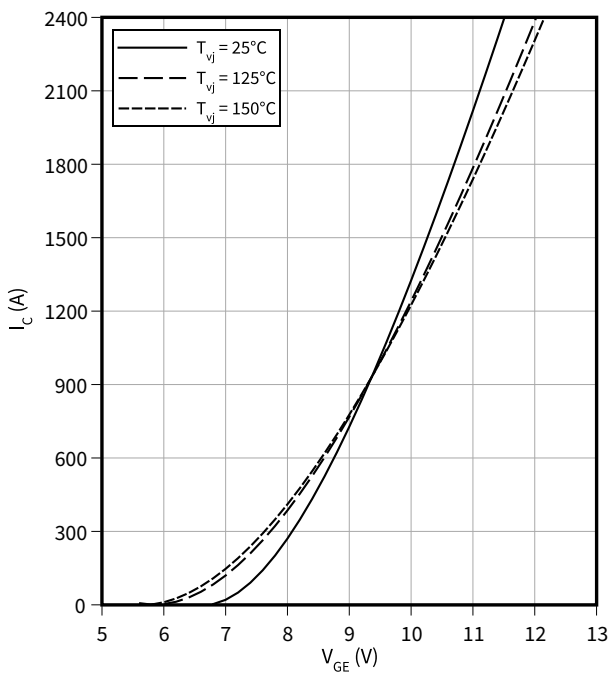
$$T_{vj} = 150 \text{ °C}$$



**Transfer characteristic (typical), IGBT, Inverter**

$$I_C = f(V_{GE})$$

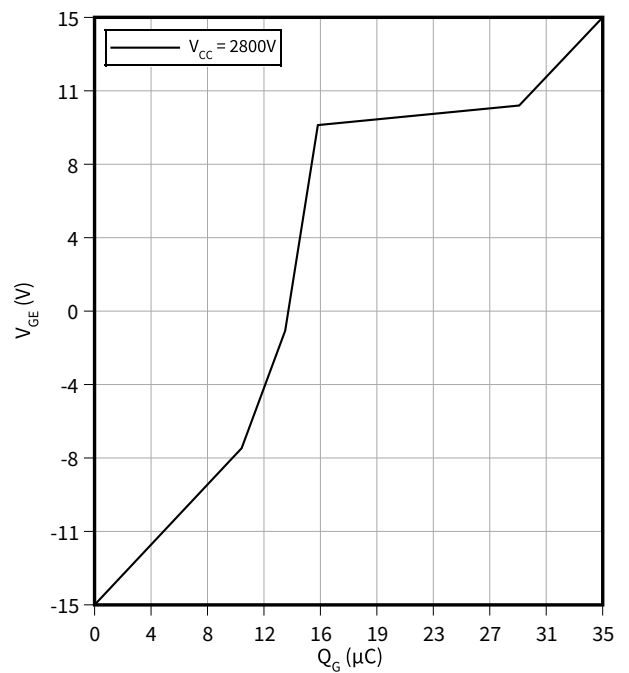
$$V_{CE} = 20 \text{ V}$$



**Gate charge characteristic (typical), IGBT, Inverter**

$$V_{GE} = f(Q_G)$$

$$I_C = 1200 \text{ A}, T_{vj} = 25 \text{ °C}$$

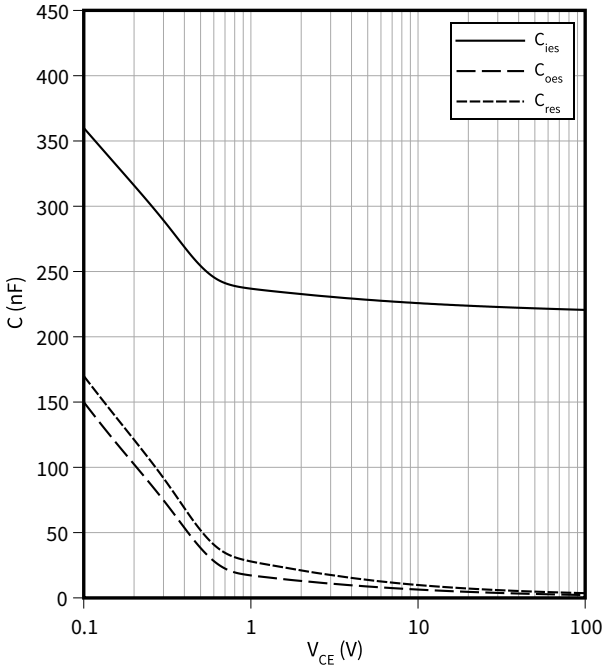


4 Characteristics diagrams

**Capacity characteristic (typical), IGBT, Inverter**

$C = f(V_{CE})$

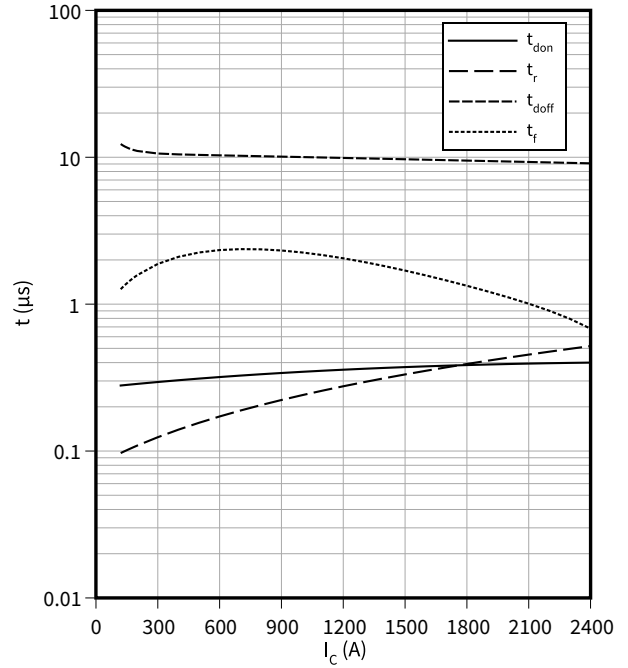
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



**Switching times (typical), IGBT, Inverter**

$t = f(I_C)$

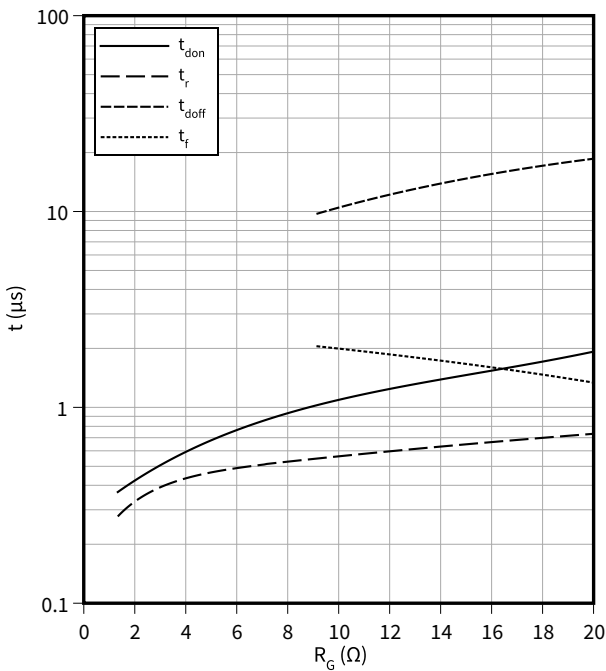
$R_{Goff} = 9.1 \text{ } \Omega, R_{Gon} = 1.3 \text{ } \Omega, V_{CC} = 2800 \text{ V}, V_{GE} = -15 \text{ V} / 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}$



**Switching times (typical), IGBT, Inverter**

$t = f(R_G)$

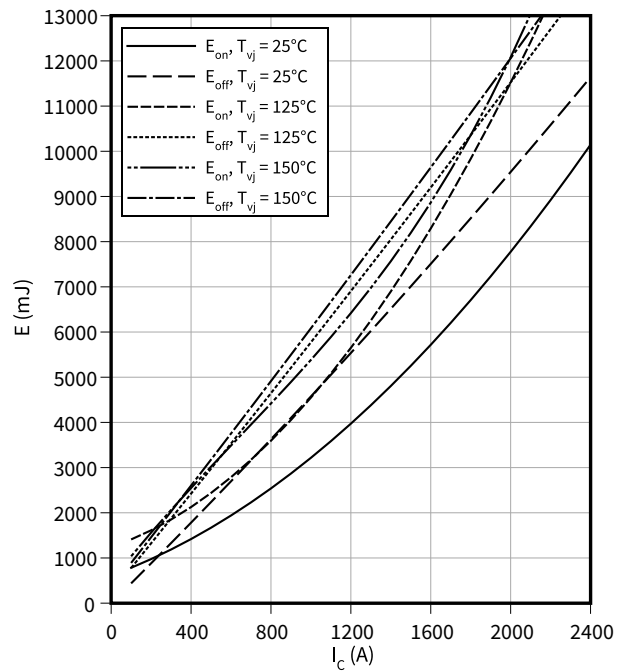
$I_C = 1200 \text{ A}, V_{CC} = 2800 \text{ V}, V_{GE} = -15 \text{ V} / 15 \text{ V}, T_{vj} = 150 \text{ }^\circ\text{C}$



**Switching losses (typical), IGBT, Inverter**

$E = f(I_C)$

$R_{Goff} = 9.1 \text{ } \Omega, R_{Gon} = 1.3 \text{ } \Omega, V_{CC} = 2800 \text{ V}, V_{GE} = -15 \text{ V} / 15 \text{ V}$



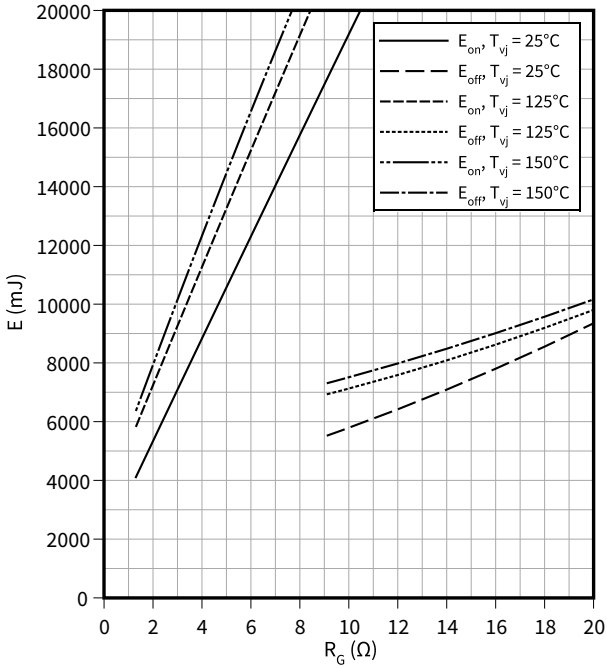


**4 Characteristics diagrams**

**Switching losses (typical), IGBT, Inverter**

$E = f(R_G)$

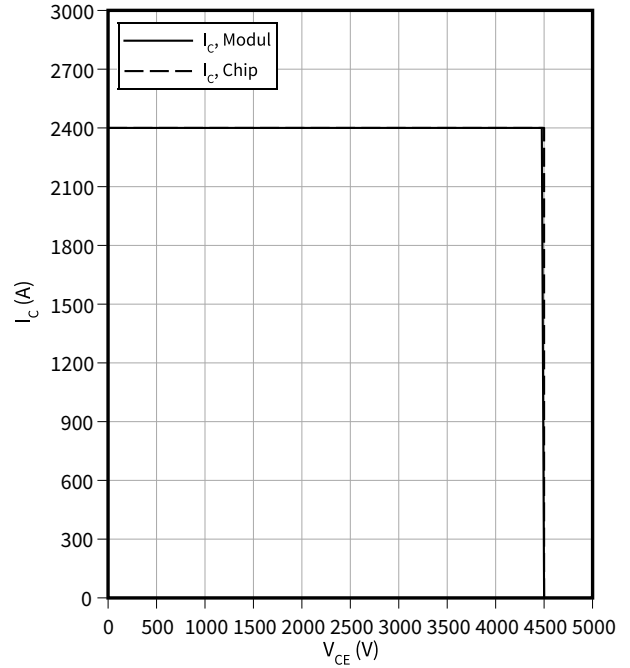
$I_C = 1200 \text{ A}$ ,  $V_{CC} = 2800 \text{ V}$ ,  $V_{GE} = -15 / 15 \text{ V}$



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

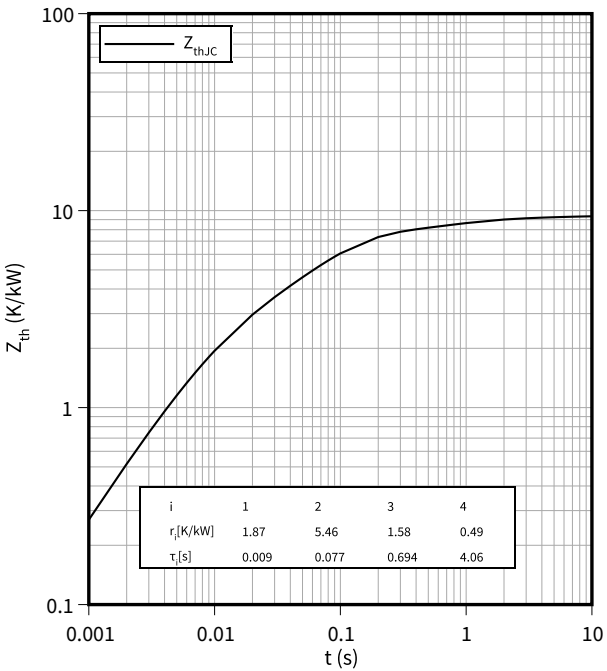
$I_C = f(V_{CE})$

$R_{Goff} = 9.1 \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $V_{CC} \leq 3200 \text{ V}$ ,  $T_{vj} = 150 \text{ °C}$



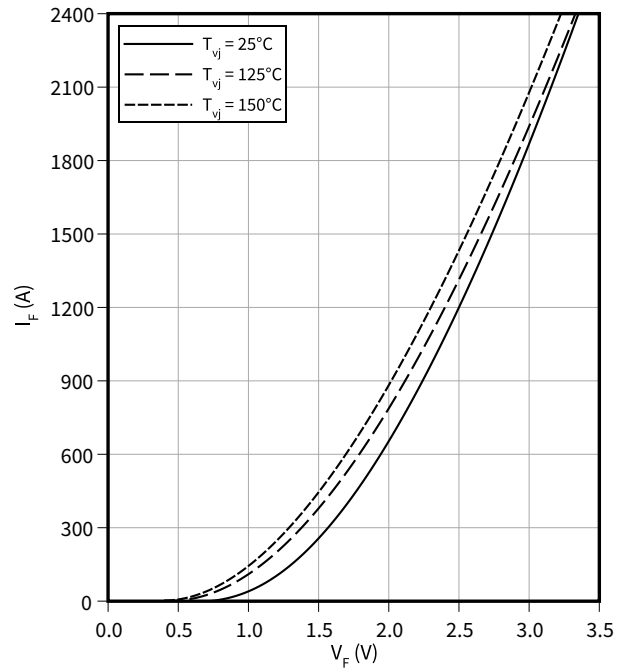
**Transient thermal impedance, IGBT, Inverter**

$Z_{th} = f(t)$



**Forward characteristic (typical), Diode, Inverter**

$I_F = f(V_F)$

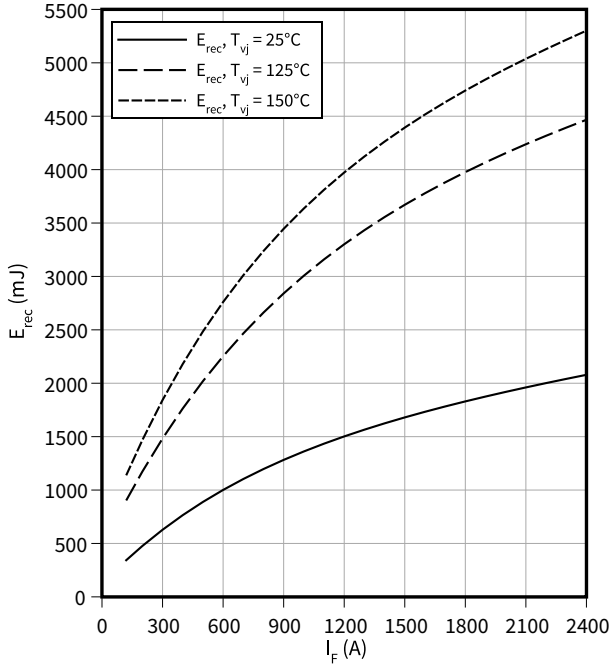


4 Characteristics diagrams

**Switching losses (typical), Diode, Inverter**

$E_{rec} = f(I_F)$

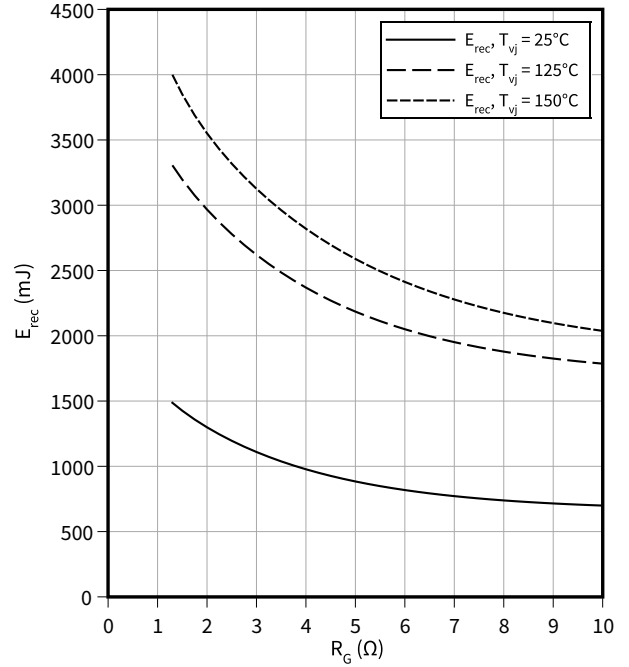
$R_{Gon} = R_{Gon}(IGBT), V_{CC} = 2800 V$



**Switching losses (typical), Diode, Inverter**

$E_{rec} = f(R_G)$

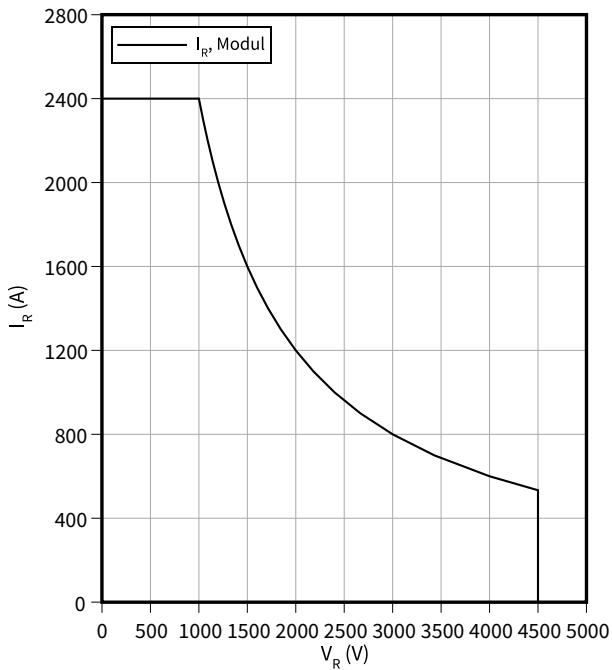
$I_F = 1200 A, V_{CC} = 2800 V$



**Safe operating area (SOA), Diode, Inverter**

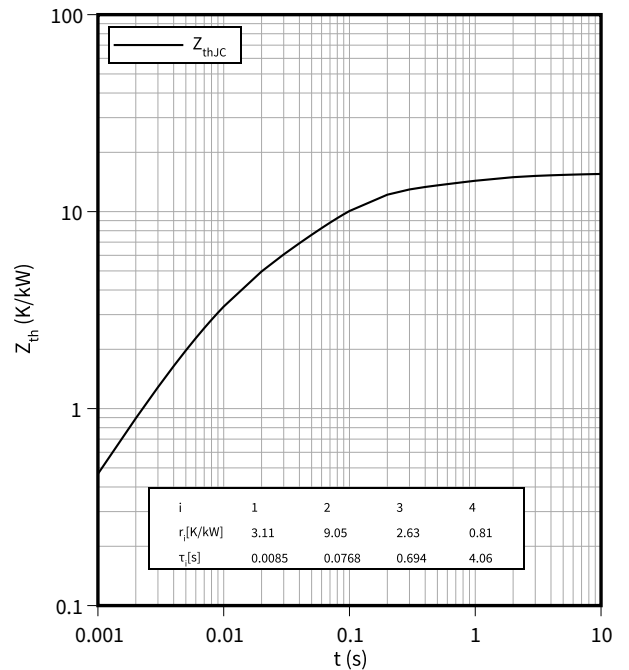
$I_R = f(V_R)$

$T_{vj} = 150 °C$



**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$



## 5 Circuit diagram

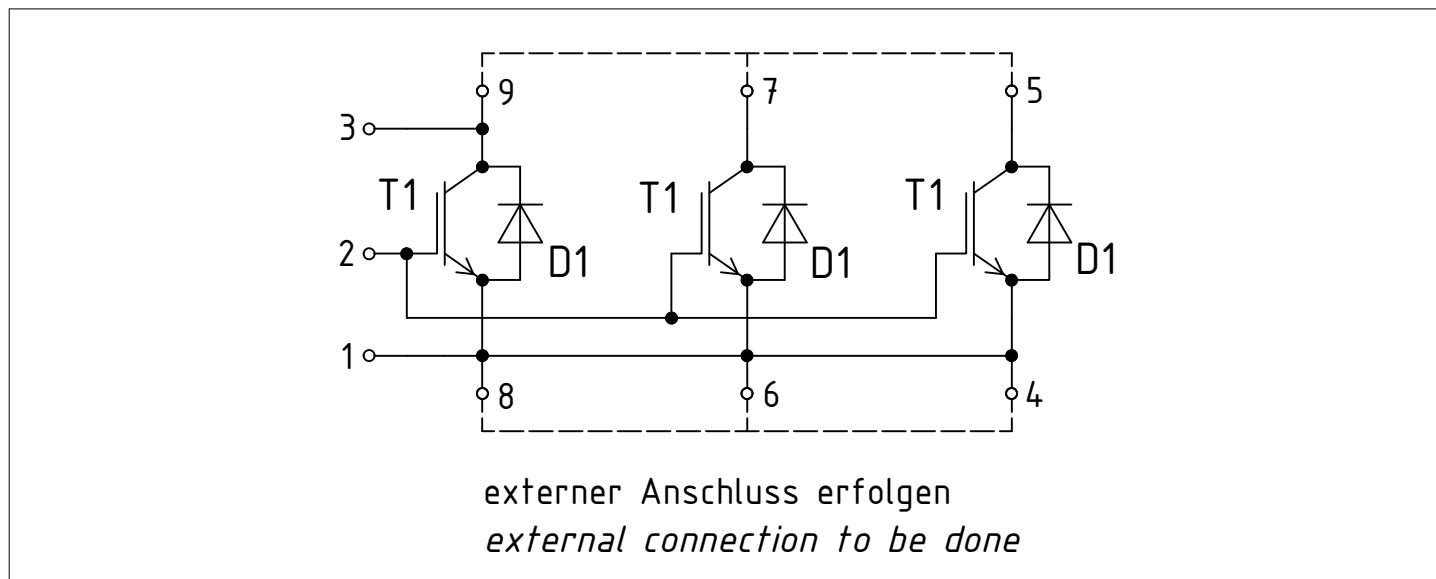


Figure 1

## 6 Package outlines

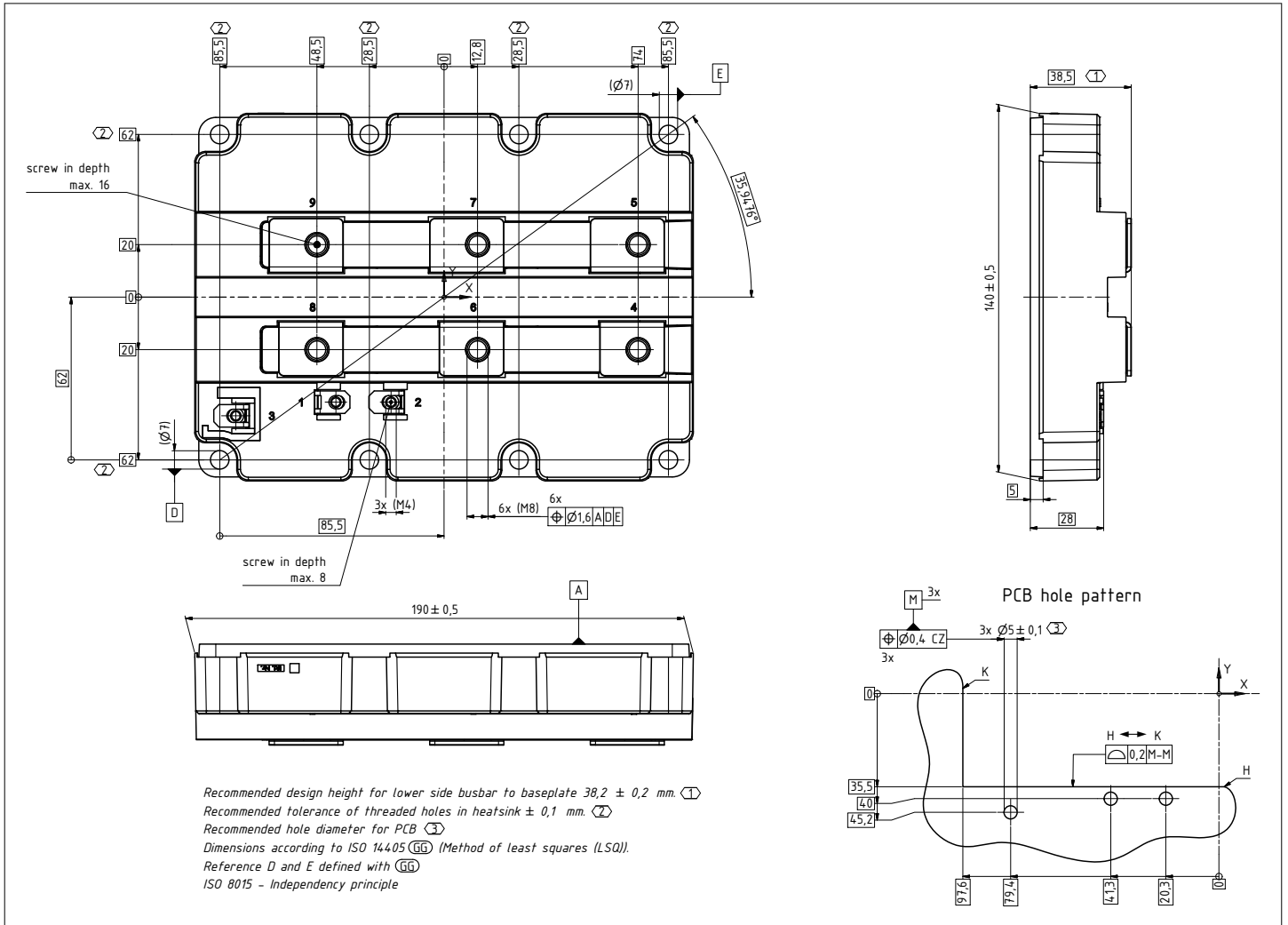

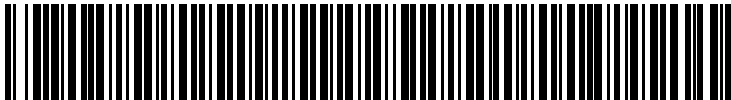


Figure 2

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

**Figure 3**

## Revision history

Document revision	Date of release	Description of changes
1.00	2023-12-14	Initial version

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[FF150R12KE3G](#) [FF200R06KE3](#) [FF200R06YE3](#) [FF300R06KE3\\_B2](#) [FF600R12IP4V](#) [FF800R17KP4\\_B2](#) [FF900R12IE4V](#)  
[FP06R12W1T4\\_B3](#) [FP100R07N3E4](#) [FP100R07N3E4\\_B11](#) [FP10R06W1E3\\_B11](#) [FP10R12W1T4\\_B11](#) [FP10R12YT3](#) [FP15R12W2T4](#)  
[FP15R12YT3](#) [FP20R06W1E3](#) [FP30R06W1E3](#) [FP40R12KT3G](#) [FP75R06KE3](#) [FS10R12YE3](#) [FS150R07PE4](#) [FS150R12PT4](#)  
[FS150R17N3E4\\_B11](#) [FS20R06W1E3\\_B11](#) [FS30R06W1E3\\_B11](#) [FS75R12KE3G](#) [FS75R12W2T4\\_B11](#) [FZ1600R17HP4\\_B2](#)  
[FZ300R12KE3G](#) [FZ400R17KE3](#) [FZ400R17KE4](#) [FZ600R65KE3](#) [DF1000R17IE4D\\_B2](#) [APTGT75DA60T1G](#) [DZ800S17K3](#) [F12-](#)  
[25R12KT4G](#) [F3L200R12W2H3\\_B11](#) [F3L300R12ME4\\_B22](#) [F3L75R07W2E3\\_B11](#) [F4-150R12KS4](#) [F475R07W1H3B11ABOMA1](#)  
[FD1400R12IP4D](#) [FD400R12KE3\\_B5](#)