

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

**Features**

- Electrical features
  - $V_{CES} = 4500\text{ V}$
  - $I_{C\text{ nom}} = 1800\text{ A} / I_{CRM} = 3600\text{ A}$
  - High DC stability
  - High dynamic robustness
  - High short-circuit capability
  - Low  $V_{CE,sat}$
  - Trench IGBT 4
  - $V_{CE,sat}$  with positive temperature coefficient
- Mechanical features
  - Package with CTI > 600
  - Standard housing
  - ALSiC base plate for increased thermal cycling capability
  - IHM B housing
  - Isolated base plate



Typical appearance

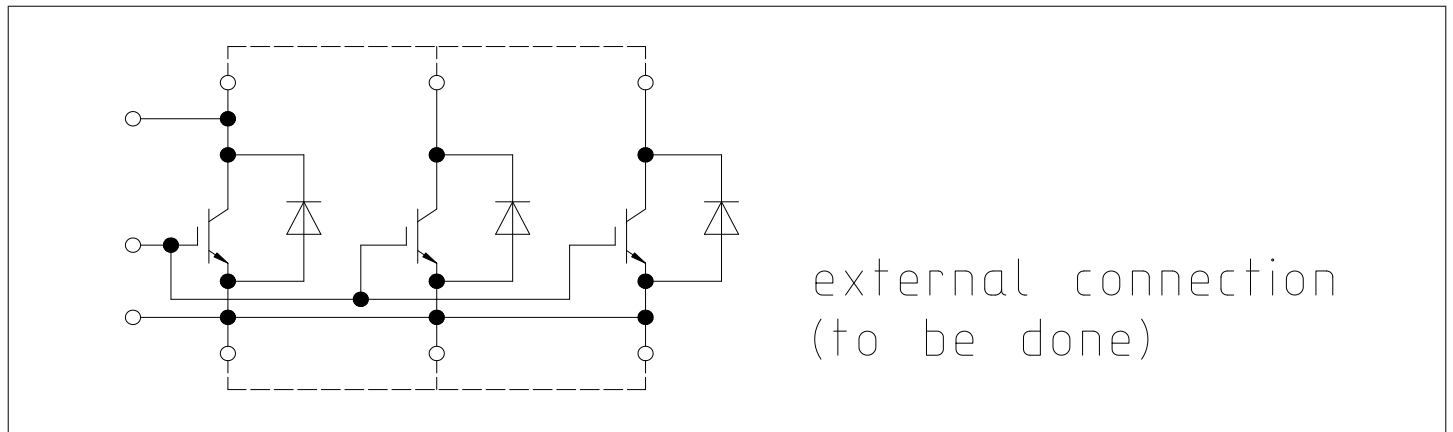
**Potential applications**

- 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, $f = 50$ Hz, $t = 1$ min	6.0	kV
Partial discharge extinction voltage	$V_{isol}$	RMS, $f = 50$ Hz, $Q_{PD} \leq 10$ pC	3.5	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25^\circ\text{C}$ , 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	$R_{AA'+CC'}$	$T_C = 25^\circ\text{C}$ , per switch		0.08		m $\Omega$	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$ , 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	$V_{CES}$		$T_{vj} = -40^\circ\text{C}$	4500	V
			$T_{vj} = 150^\circ\text{C}$	4500	
Continuous DC collector current	$I_{CDC}$	$T_{vj\ max} = 150^\circ\text{C}$	$T_C = 100^\circ\text{C}$	1800	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1$ ms		3600	A
Gate-emitter peak voltage	$V_{GES}$			$\pm 20$	V

**Table 4** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 1800\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	2.35	2.80	V
			$T_{vj} = 125\ ^\circ C$	2.85	3.40	
			$T_{vj} = 150\ ^\circ C$	2.95	3.50	
Gate threshold voltage	$V_{GEth}$	$I_C = 149\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.5	6	6.5	V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 2800\ V$		47		$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0.29		$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		297		nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		5.4		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)	$t_{don}$	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.260		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.290		
			$T_{vj} = 150\ ^\circ C$	0.310		
Rise time (inductive load)	$t_r$	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.210		$\mu s$
			$T_{vj} = 125\ ^\circ C$	0.230		
			$T_{vj} = 150\ ^\circ C$	0.230		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega$	$T_{vj} = 25\ ^\circ C$	6.930		$\mu s$
			$T_{vj} = 125\ ^\circ C$	7.320		
			$T_{vj} = 150\ ^\circ C$	7.410		
Fall time (inductive load)	$t_f$	$I_C = 1800\ A, V_{CE} = 2800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega$	$T_{vj} = 25\ ^\circ C$	1.130		$\mu s$
			$T_{vj} = 125\ ^\circ C$	2.630		
			$T_{vj} = 150\ ^\circ C$	2.850		
Turn-on time (resistive load)	$t_{on\_R}$	$I_C = 500\ A, V_{CE} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.86		$\mu s$
Turn-on energy loss per pulse	$E_{on}$	$I_C = 1800\ A, V_{CE} = 2800\ V, L_\sigma = 110\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.75\ \Omega, di/dt = 6500\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	5800		mJ
			$T_{vj} = 125\ ^\circ C$	8100		
			$T_{vj} = 150\ ^\circ C$	9100		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 1800\ A, V_{CE} = 2800\ V, L_\sigma = 110\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 4.7\ \Omega, dv/dt = 1250\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	7050		mJ
			$T_{vj} = 125\ ^\circ C$	9000		
			$T_{vj} = 150\ ^\circ C$	9700		
SC data	$I_{SC}$	$V_{GE} = 15\ V, V_{CC} = 3000\ V, V_{CEmax} = V_{CES} - L_{SCE} * di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$	8100		A

(table continues...)

**Table 4 (continued) Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	$R_{thJC}$	per IGBT			7.20	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m}^2\text{K})$		3.60		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-40		150	°C

### 3 Diode, Inverter

**Table 5 Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$		$T_{vj} = -40 \text{ °C}$	4500	V
			$T_{vj} = 150 \text{ °C}$	4500	
Continuous DC forward current	$I_F$		1800	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1 \text{ ms}$	3600	A	
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	930	kA <sup>2</sup> s
			$T_{vj} = 150 \text{ °C}$	850	
Maximum power dissipation	$P_{RQM}$	$T_{vj} = 150 \text{ °C}$	4000	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	$V_F$	$I_F = 1800 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		2.60	3.05	V
			$T_{vj} = 125 \text{ °C}$		2.50	2.95	
			$T_{vj} = 150 \text{ °C}$		2.45	2.90	
Peak reverse recovery current	$I_{RM}$	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		2360		A
			$T_{vj} = 125 \text{ °C}$		2600		
			$T_{vj} = 150 \text{ °C}$		2630		
Recovered charge	$Q_r$	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		1560		µC
			$T_{vj} = 125 \text{ °C}$		3060		
			$T_{vj} = 150 \text{ °C}$		3560		

**(table continues...)**

**Table 6 (continued) Characteristic values**

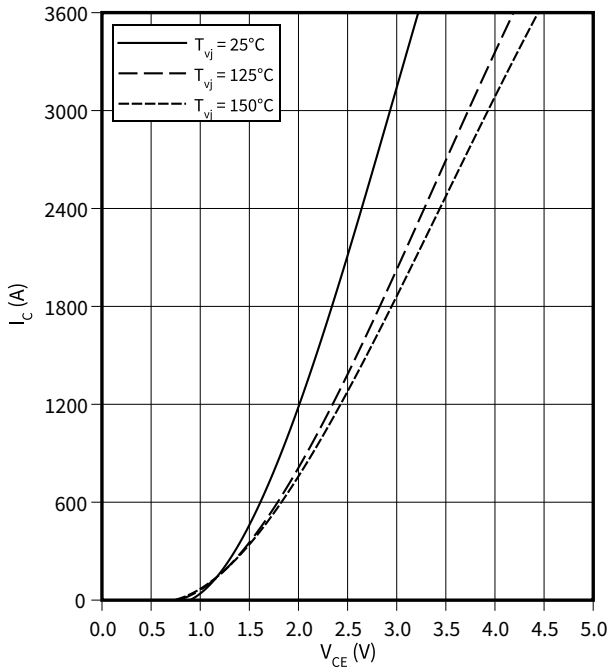
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Reverse recovery energy	$E_{rec}$	$V_R = 2800\text{ V}$ , $I_F = 1800\text{ A}$ , $V_{GE} = -15\text{ V}$ , $-di_F/dt =$ $6500\text{ A}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )	$T_{vj} = 25\text{ }^\circ\text{C}$	2340		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	5200		
			$T_{vj} = 150\text{ }^\circ\text{C}$	6100		
Thermal resistance, junction to case	$R_{thJC}$	per diode			12.7	K/kW
Thermal resistance, case to heat sink	$R_{thCH}$	per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$		5.30		K/kW
Temperature under switching conditions	$T_{vjop}$		-40		150	$^\circ\text{C}$

## 4 Characteristics diagrams

### output characteristic (typical), IGBT, Inverter

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

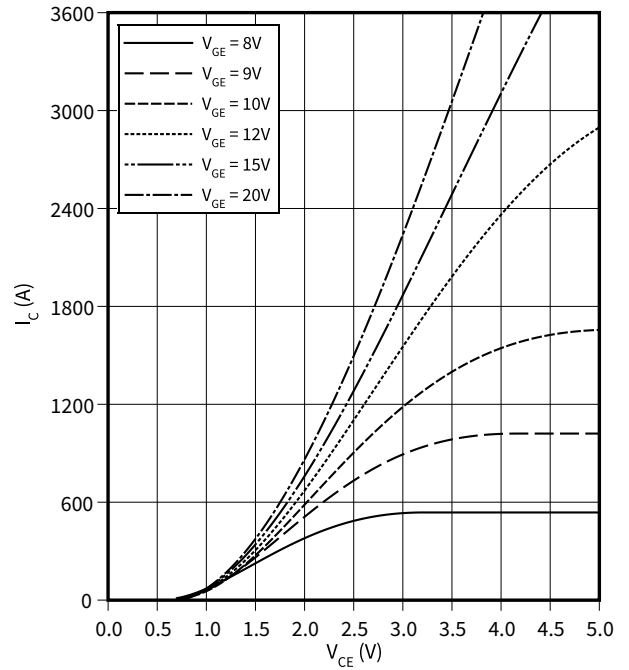
$$V_{GE} = 15 \text{ V}$$



### output characteristic (typical), IGBT, Inverter

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

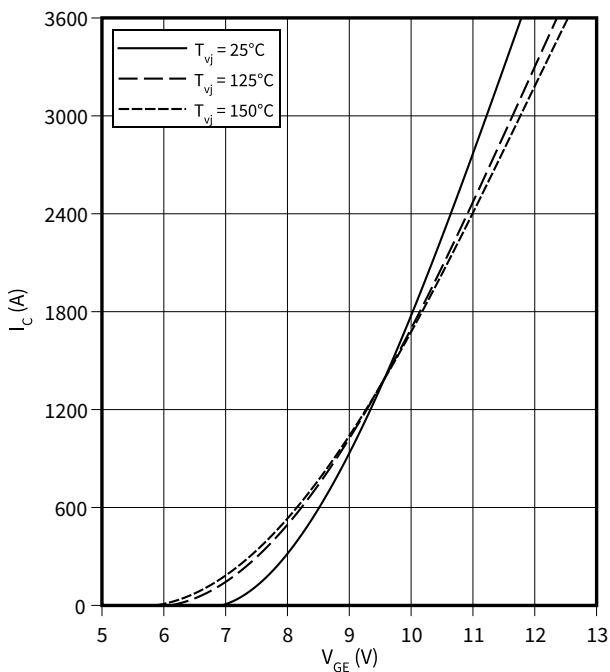
$$T_{vj} = 150 \text{ °C}$$



### transfer characteristic (typical), IGBT, Inverter

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

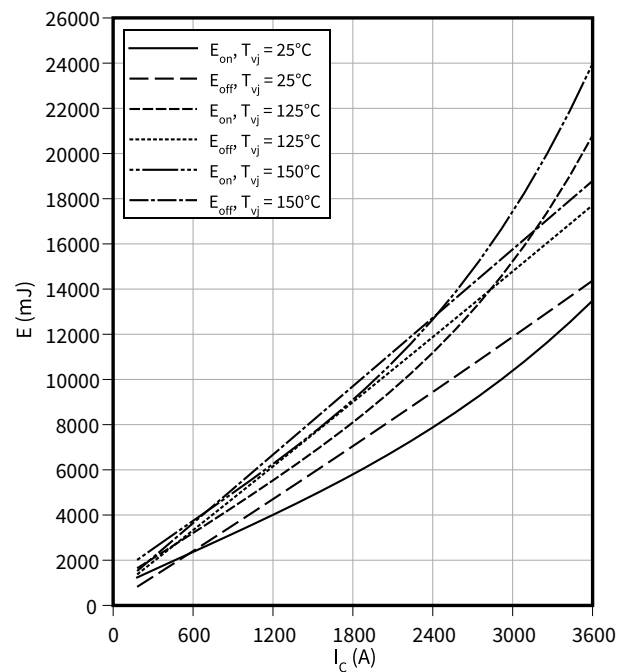
$$V_{CE} = 20 \text{ V}$$



### switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 4.7 \text{ } \Omega, R_{Gon} = 0.75 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, V_{CE} = 2800 \text{ V}$$

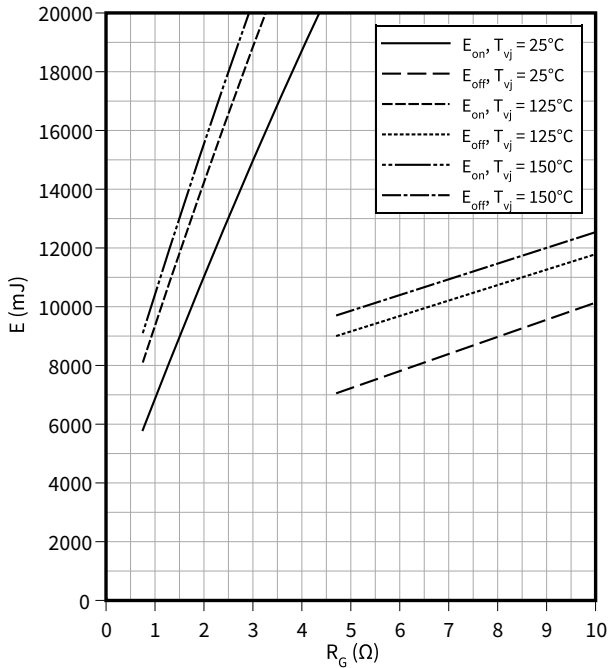


4 Characteristics diagrams

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

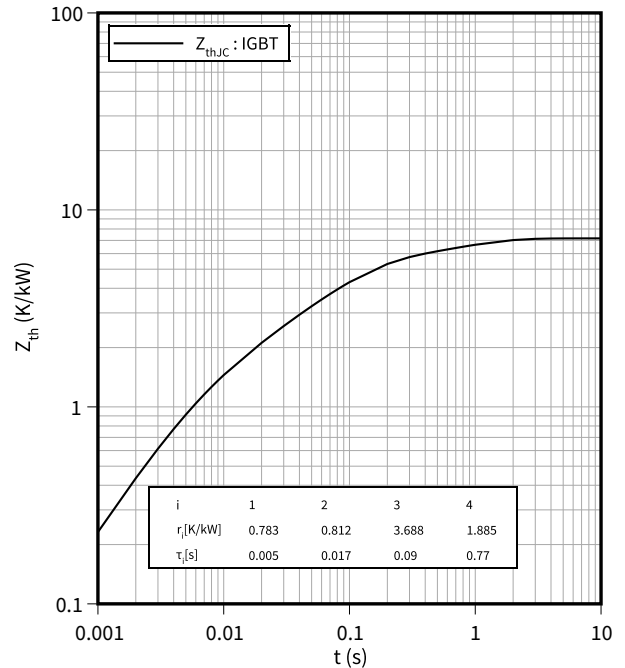
$E = f(R_G)$

$V_{GE} = \pm 15 \text{ V}$ ,  $I_C = 1800 \text{ A}$ ,  $V_{CE} = 2800 \text{ V}$



**transient thermal impedance , IGBT, Inverter**

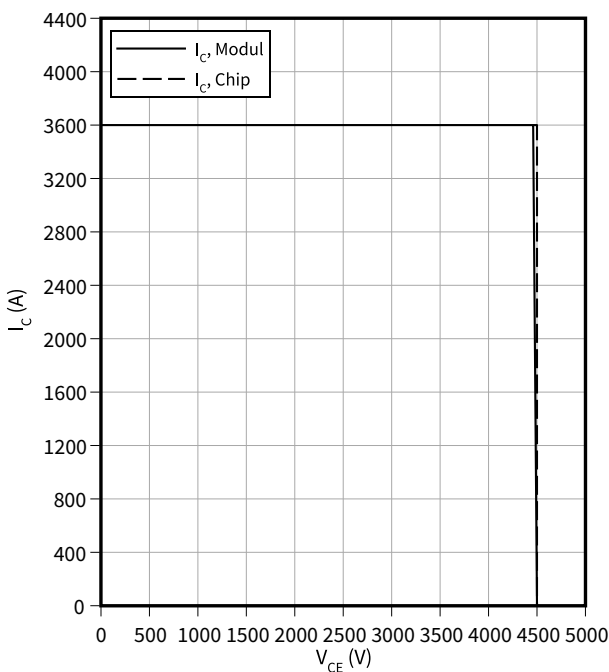
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

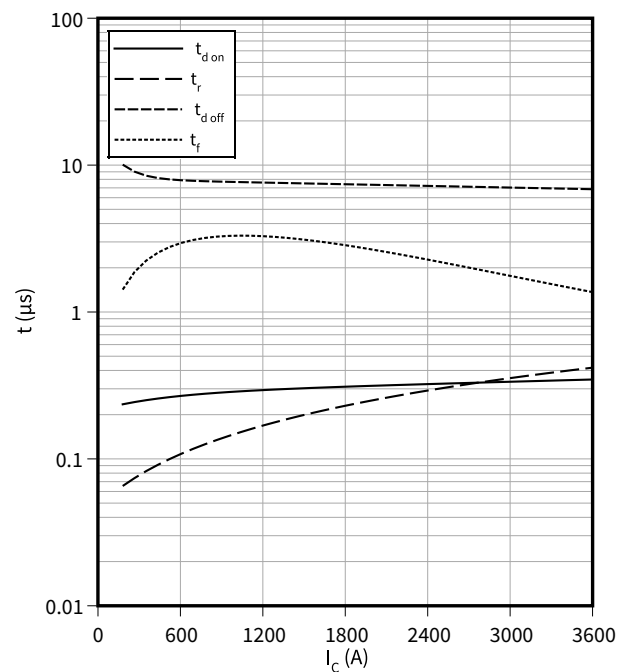
$R_{Goff} = 4.7 \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $V_{CC} \leq 3000 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$



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

$t = f(I_C)$

$V_{CE} = 2800 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$ ,  $R_{Goff} = 4.7 \Omega$ ,  $R_{Gon} = 0.75 \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$



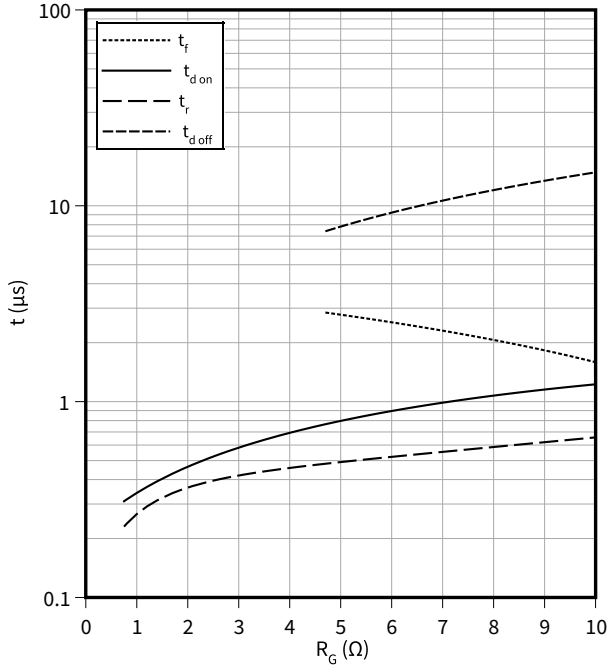


4 Characteristics diagrams

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

$t = f(R_G)$

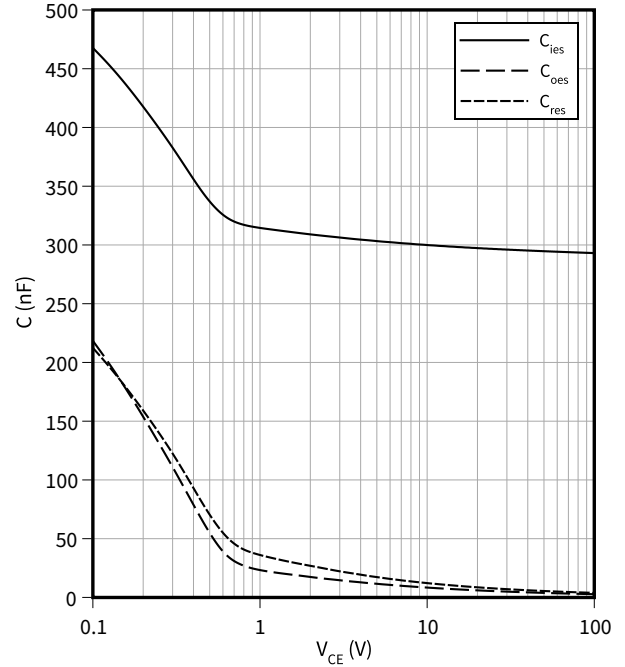
$V_{GE} = \pm 15 \text{ V}$ ,  $I_C = 1800 \text{ A}$ ,  $V_{CE} = 2800 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$



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

$C = f(V_{CE})$

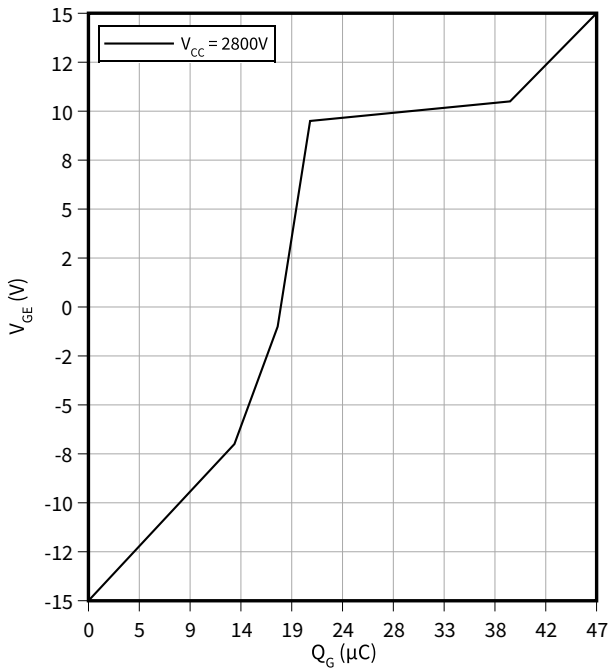
$f = 100 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$ ,  $T_{vj} = 25 \text{ }^\circ\text{C}$



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

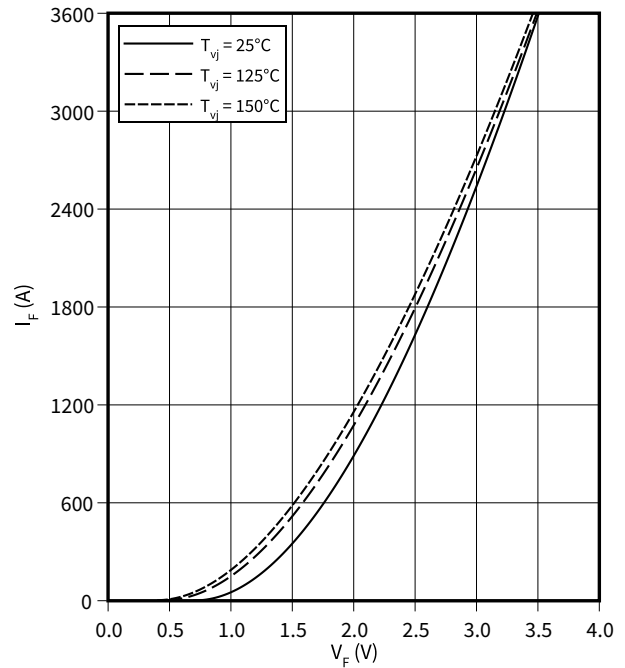
$V_{GE} = f(Q_G)$

$I_C = 1800 \text{ A}$ ,  $T_{vj} = 25 \text{ }^\circ\text{C}$



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

$I_F = f(V_F)$

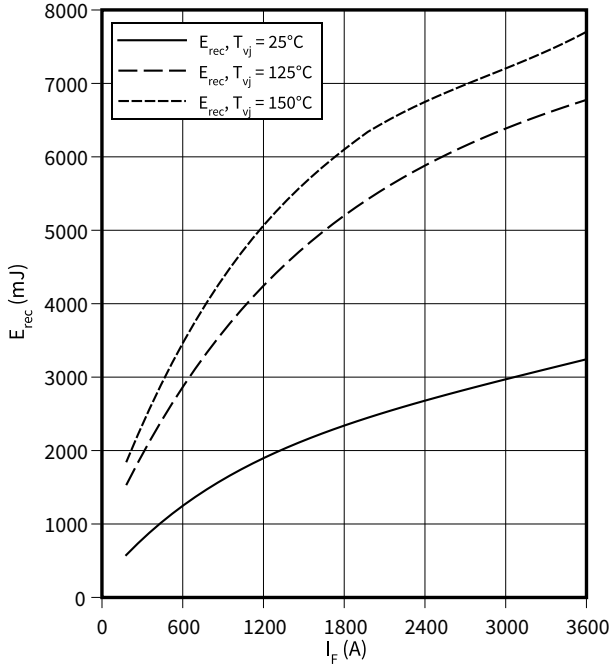


4 Characteristics diagrams

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

$E_{rec} = f(I_F)$

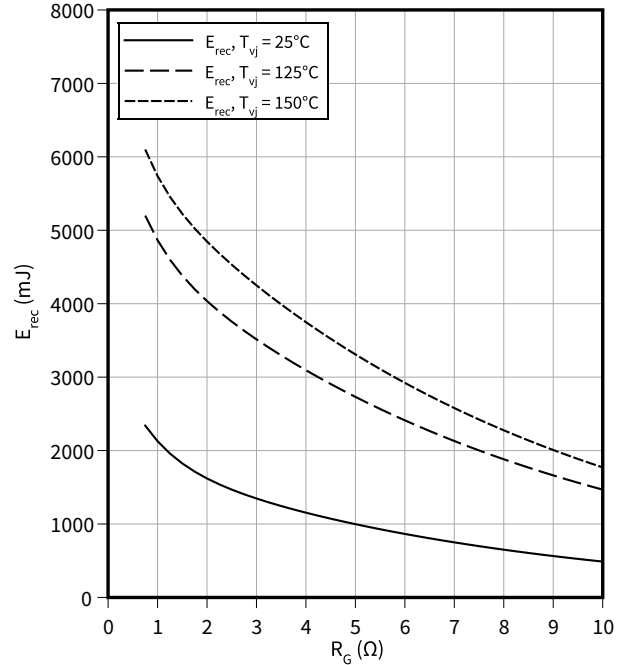
$V_{CE} = 2800\text{ V}$ ,  $R_{Gon} = R_{Gon}(IGBT)$



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

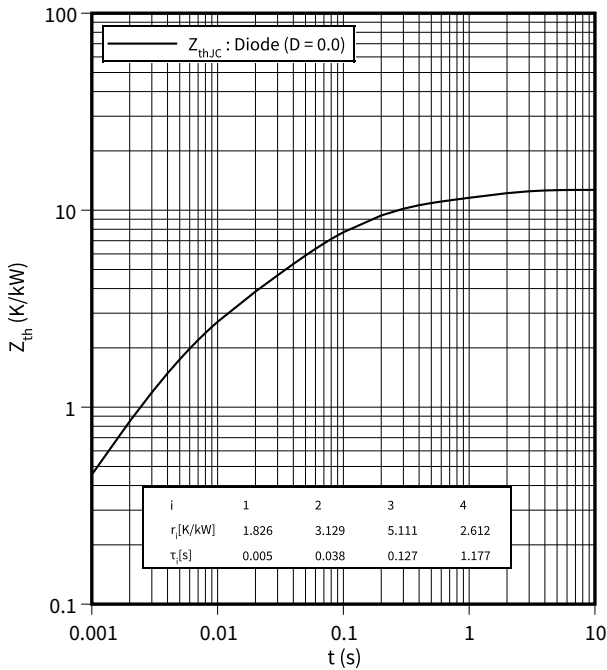
$E_{rec} = f(R_G)$

$V_{CE} = 2800\text{ V}$ ,  $I_F = 1800\text{ A}$



**transient thermal impedance , Diode, Inverter**

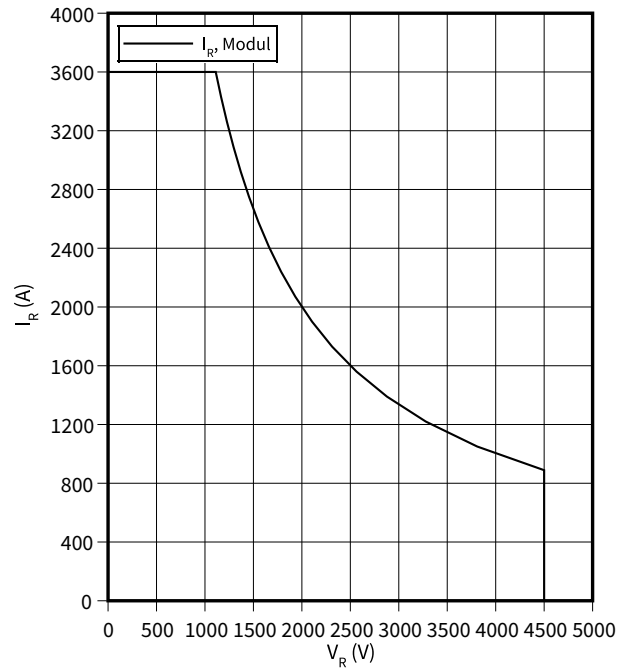
$Z_{th} = f(t)$



**safe operation area (SOA), Diode, Inverter**

$I_R = f(V_R)$

$T_{vj} = 150\text{ °C}$



## 5 Circuit diagram

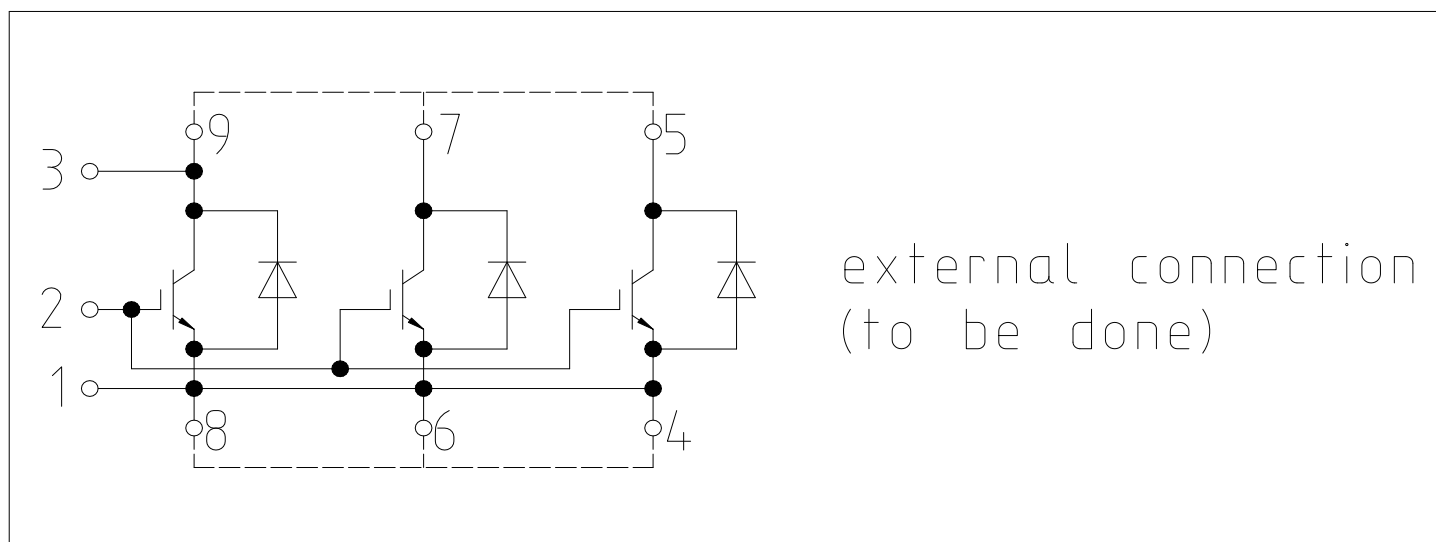


Figure 1

## 6 Package outlines

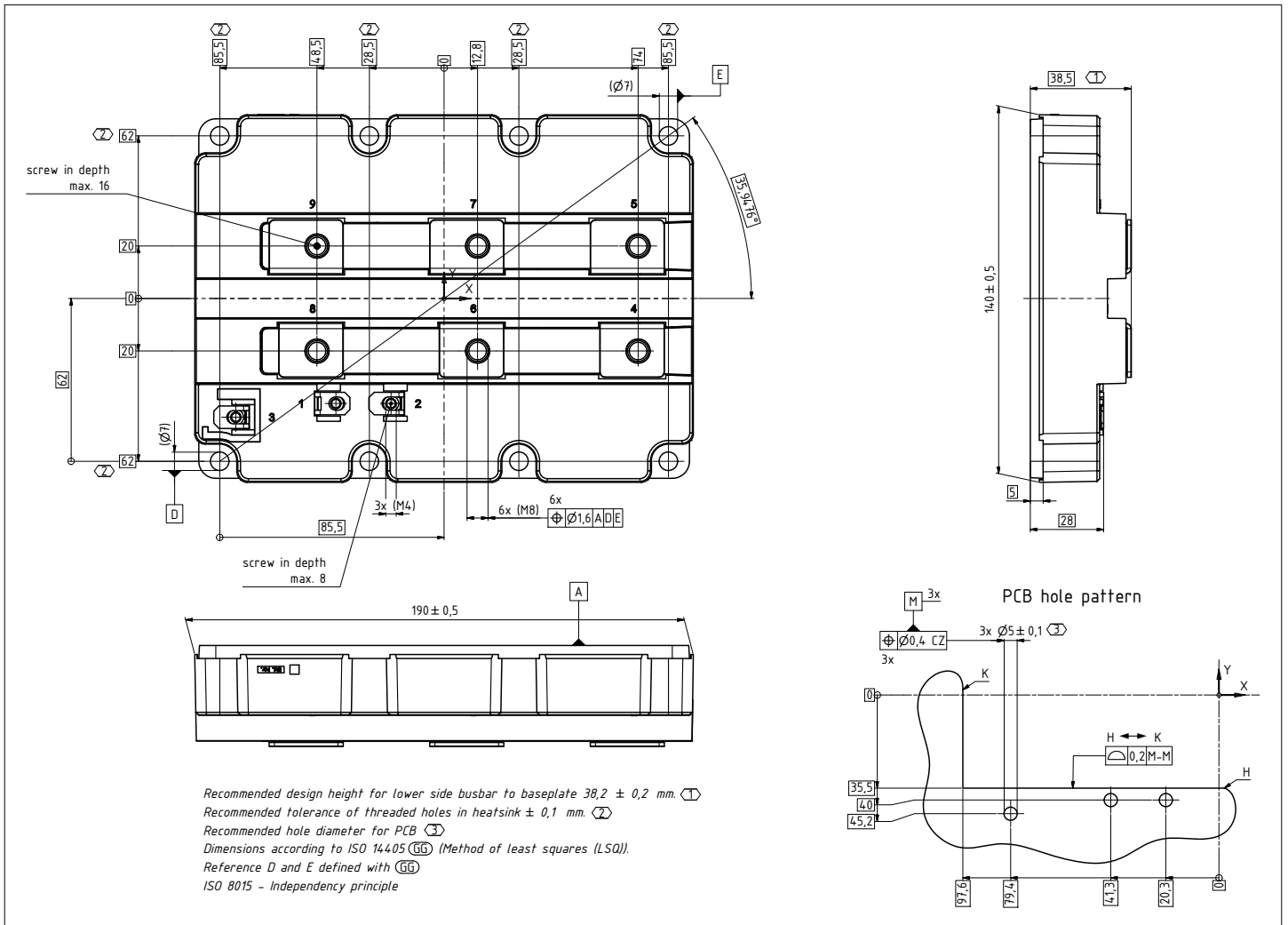




Figure 2

## 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	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	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
0.10	2020-09-18	
0.10	2020-10-05	
0.20	2021-03-25	
1.00	2021-04-16	Final
1.10	2021-10-20	Final datasheet
1.20	2021-10-26	Final datasheet

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**Document reference**

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