

## 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

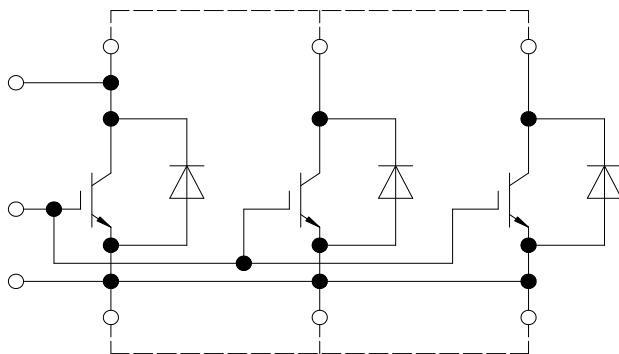
### Potential applications

- 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



external connection  
(to be done)

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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	$V_{CE(D)}$	$T_{vj}=25^{\circ}\text{C}$ , 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		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C=25^{\circ}\text{C}$ , per switch		0.095		mΩ
Storage temperature	$T_{stg}$		-40		150	°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	$I_{CDC}$	$T_{vj \text{ max}} = 150^{\circ}\text{C}$	$T_C = 105^{\circ}\text{C}$	1800	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1 \text{ ms}$		3600	A
Gate-emitter peak voltage	$V_{GES}$			-20/25	V

**Table 4**                      **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 1800\ A, V_{GE} = 25\ V$	$T_{vj} = 25\ ^\circ C$		2.15	2.60	V
			$T_{vj} = 125\ ^\circ C$		2.50	3.05	
			$T_{vj} = 150\ ^\circ C$		2.60	3.15	
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	$I_{SC}$	$V_{GE} = 15\ V, V_{CC} = 3000\ V, V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$	$t_p \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		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, $\lambda_{grease} = 1 \text{ W/(m}^2\text{K)}$		3.60		K/kW
Temperature under switching conditions	$T_{vj\text{ op}}$		-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	V
			$T_{vj} = 125 \text{ °C}$		2.50	
			$T_{vj} = 150 \text{ °C}$		2.45	
Peak reverse recovery current	$I_{RM}$	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A/μs} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		2360	A
			$T_{vj} = 125 \text{ °C}$		2600	
			$T_{vj} = 150 \text{ °C}$		2630	
Recovered charge	$Q_r$	$V_R = 2800 \text{ V}, I_F = 1800 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6500 \text{ A/μs} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		1560	μC
			$T_{vj} = 125 \text{ °C}$		3060	
			$T_{vj} = 150 \text{ °C}$		3560	

(table continues...)

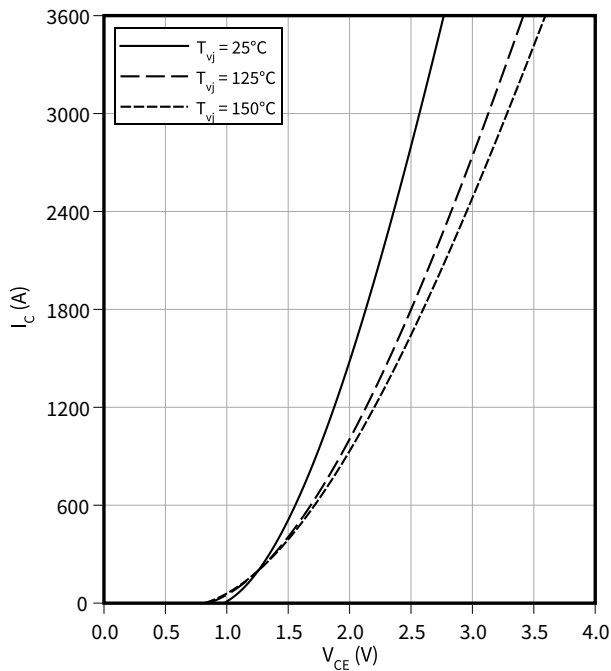
**Table 6** (continued) Characteristic values

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	$T_{vj\text{ op}}$		-40		150	$^\circ\text{C}$

4 Characteristics diagrams

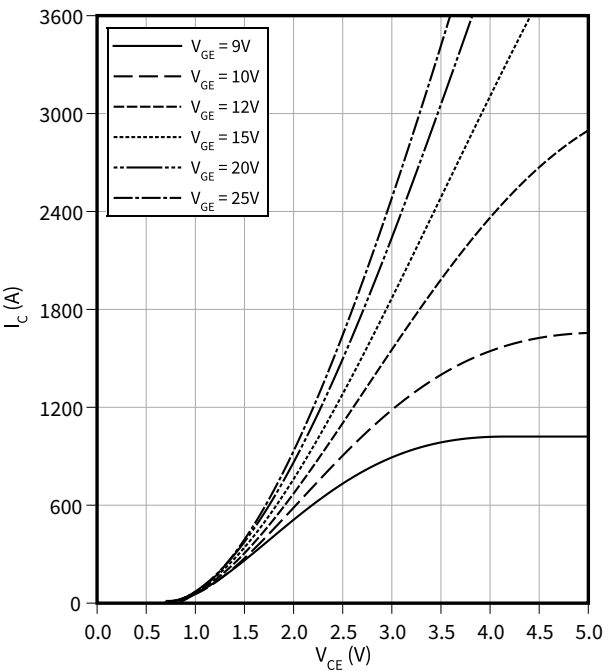
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$   
 $V_{GE} = 25\text{ V}$



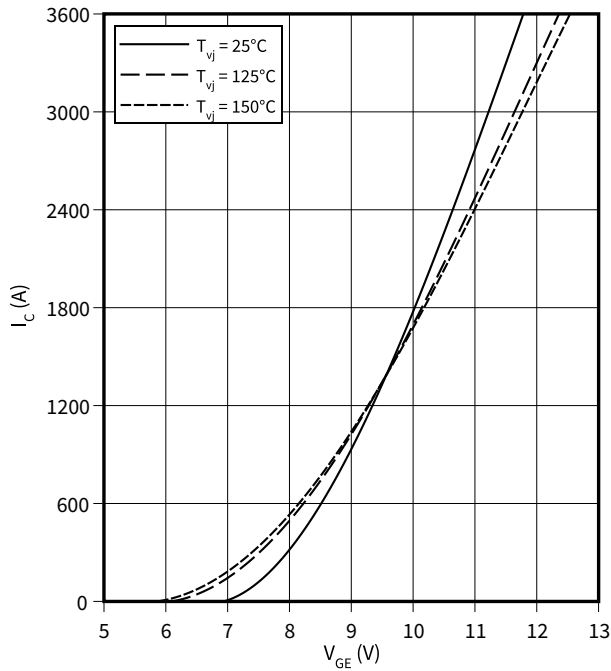
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$   
 $T_{vj} = 150\text{ °C}$



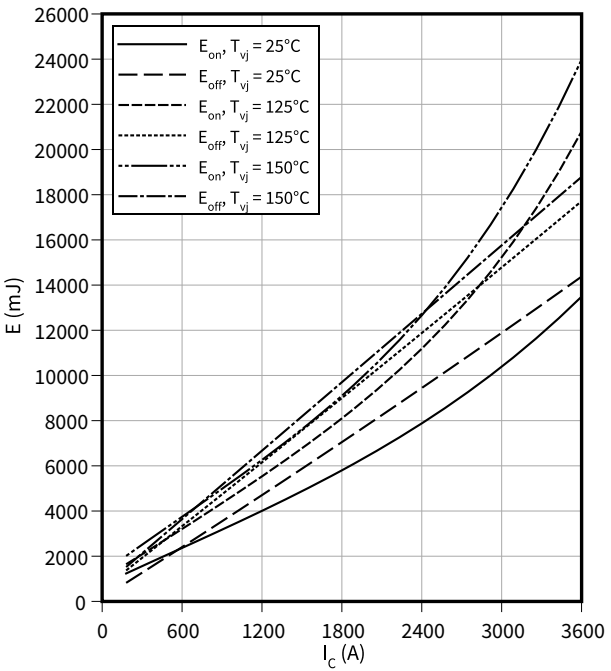
transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



switching losses (typical), IGBT, Inverter

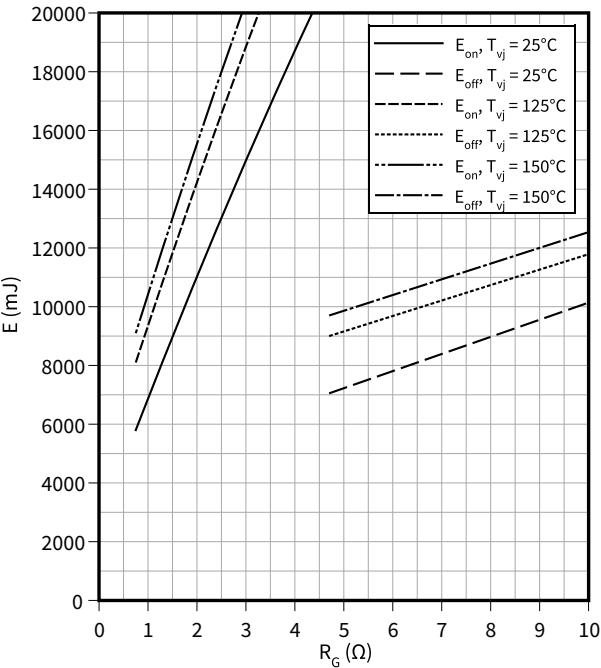
$E = f(I_C)$   
 $R_{Goff} = 4.7\text{ }\Omega$ ,  $R_{Gon} = 0.75\text{ }\Omega$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $V_{CE} = 2800\text{ V}$



4 Characteristics diagrams

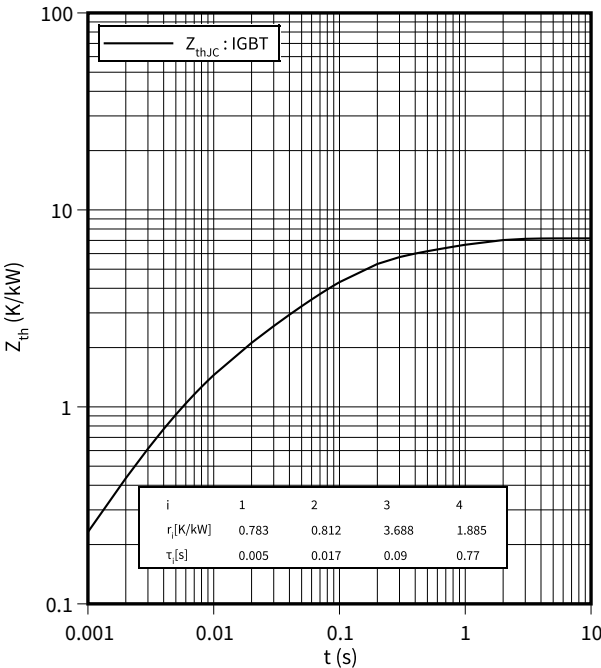
switching losses (typical), IGBT, Inverter

$E = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 1800\text{ A}$ ,  $V_{CE} = 2800\text{ V}$



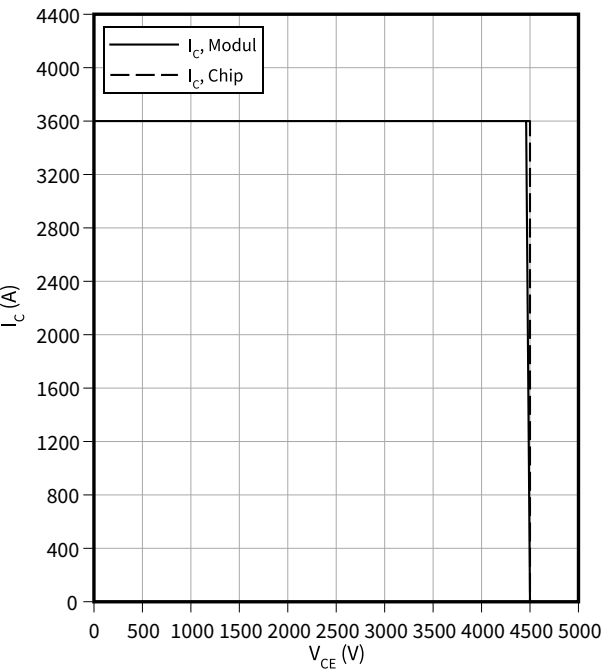
transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$



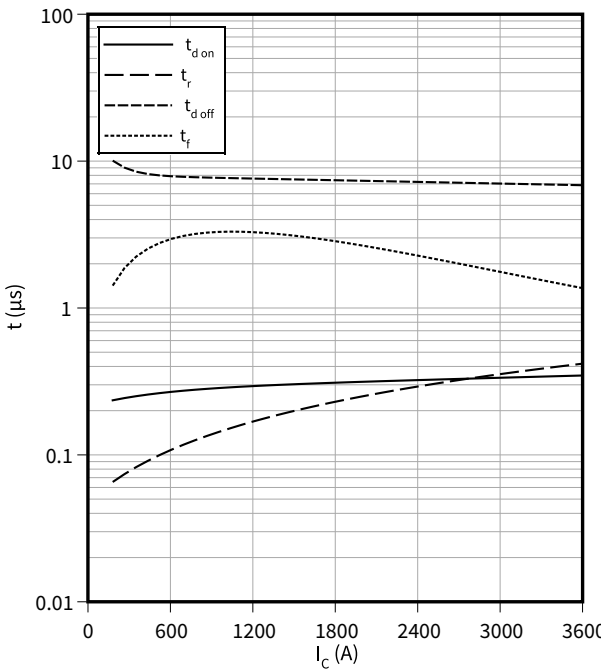
reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$   
 $V_{CC} \leq 3200\text{ V}$ ,  $T_{vj} = 150^\circ\text{C}$ ,  $R_{Goff} = 4.7\ \Omega$ ,  $V_{GE} = \pm 15\text{ V}$



Switching times (typical), IGBT, Inverter

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



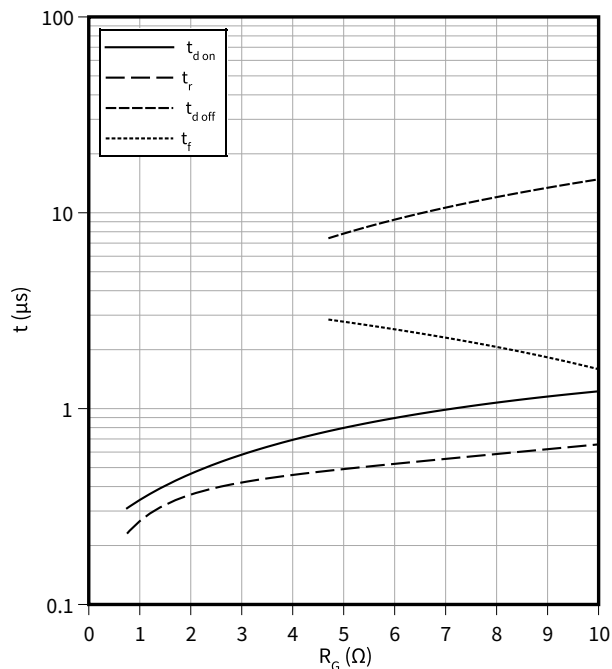


4 Characteristics diagrams

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

$$t = f(R_G)$$

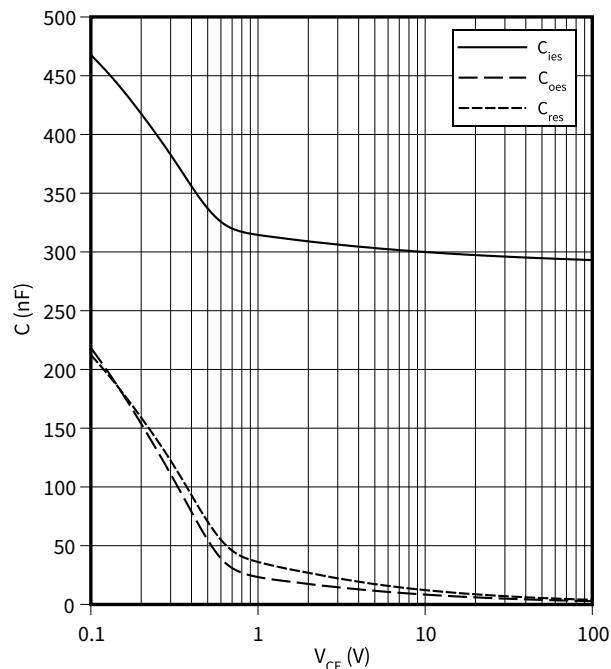
$V_{GE} = \pm 15 \text{ V}$ ,  $I_C = 1800 \text{ A}$ ,  $V_{CE} = 2800 \text{ V}$ ,  $T_{vj} = 150 \text{ }^\circ\text{C}$



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

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

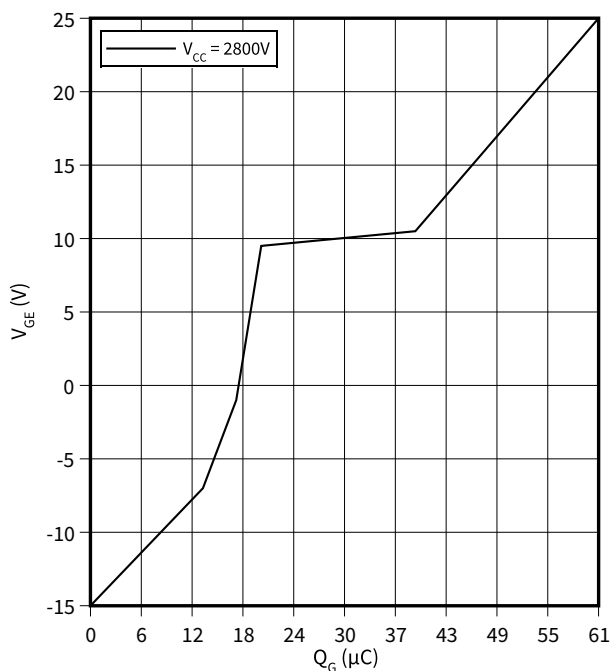
$f = 100 \text{ kHz}$ ,  $V_{GE} = 0 \text{ V}$ ,  $T_{vj} = 25 \text{ }^\circ\text{C}$



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

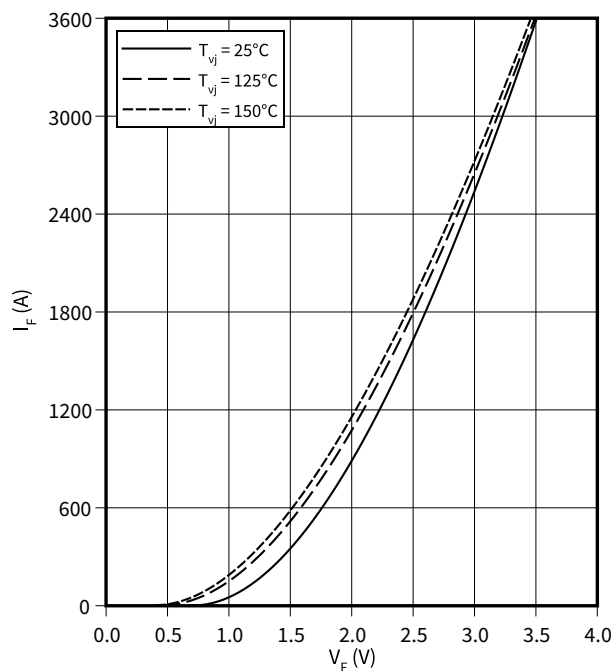
$$V_{GE} = f(Q_G)$$

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



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

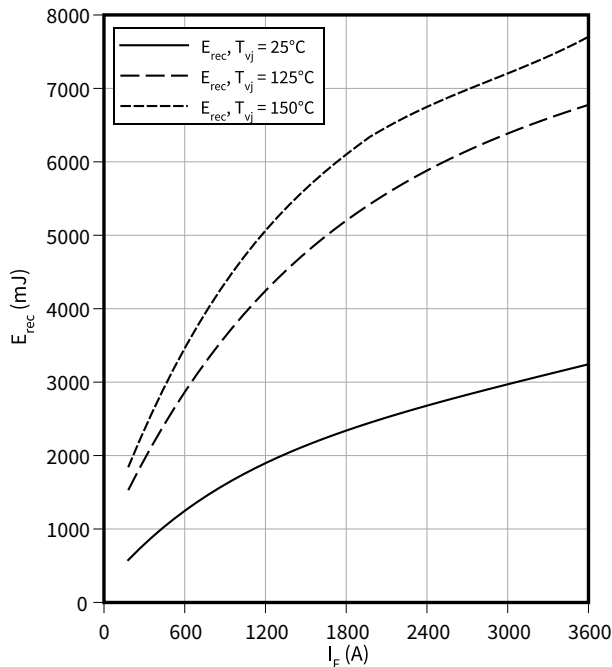
$$I_F = f(V_F)$$



4 Characteristics diagrams

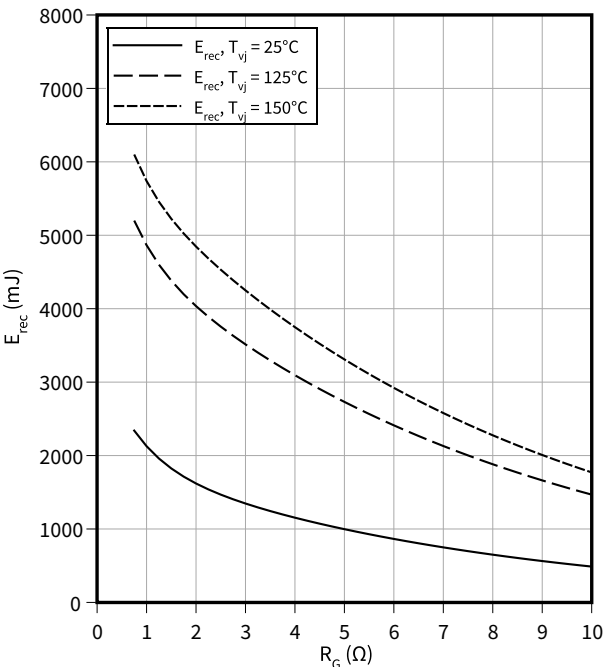
switching losses (typical), Diode, Inverter

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



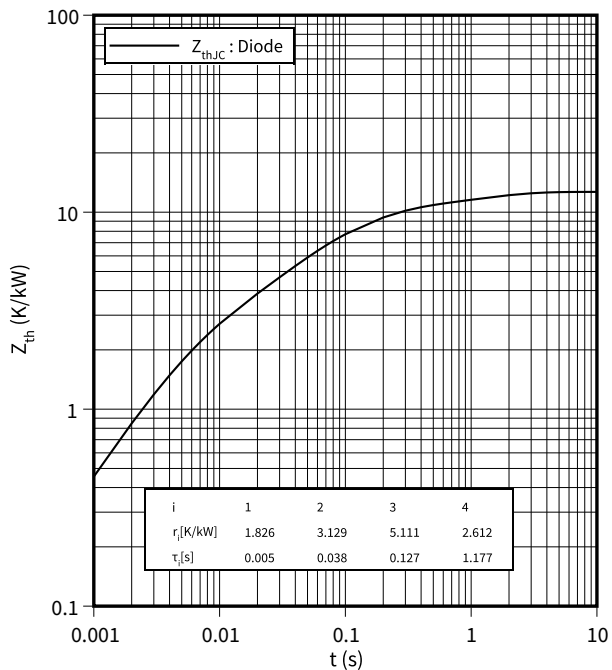
switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$   
 $V_{CE} = 2800\text{ V}, I_F = 1800\text{ A}$



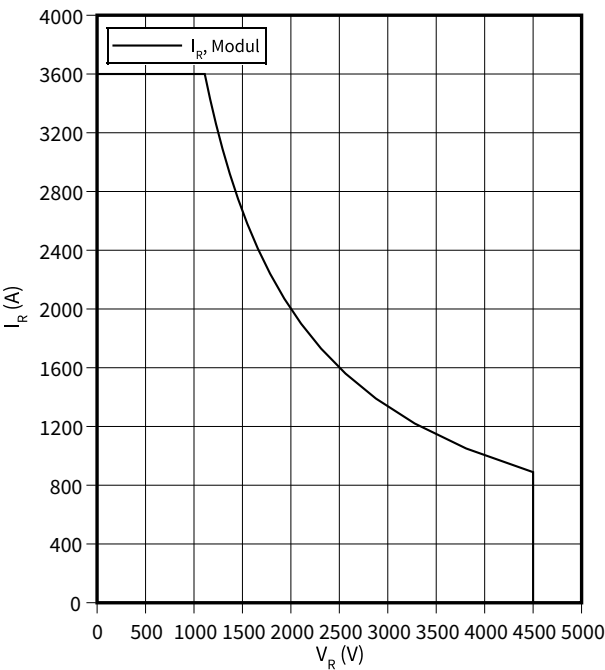
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$

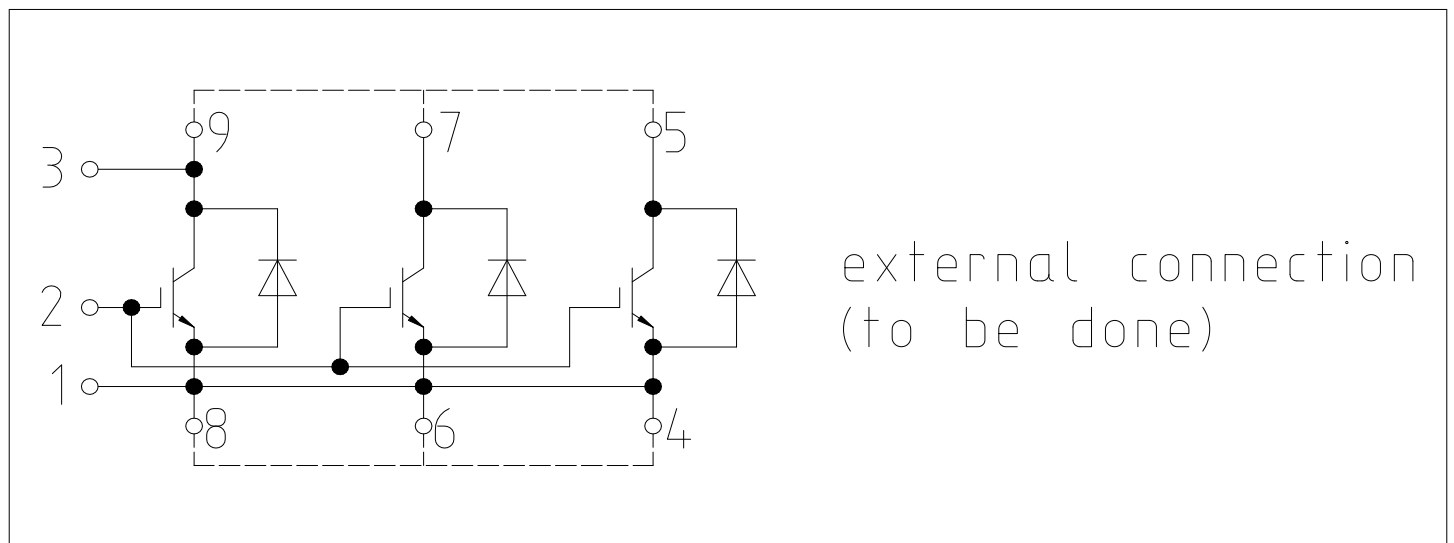


safe operation area (SOA), Diode, Inverter

$I_R = f(V_R)$   
 $T_{vj} = 150\text{ °C}$



## 5 Circuit diagram



### Figure 1

## 6



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
0.20	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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