

IHM-B module with fast Trench/Fieldstop IGBT3 and emitter controlled 3 diode

Features

- Electrical features
 - $V_{CES} = 3300\text{ V}$
 - $I_{C\text{ nom}} = 1500\text{ A} / I_{CRM} = 3000\text{ A}$
 - Unbeatable robustness
 - High DC stability
 - High short-circuit capability
 - Low switching losses
 - Low $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - AlSiC base plate for increased thermal cycling capability
 - Package with CTI > 600
 - IHM B housing
 - Isolated base plate



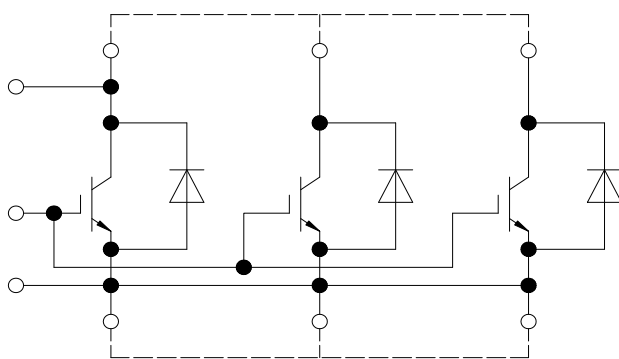
Potential applications

- Chopper applications
- Medium-voltage converters
- Motor drives
- Traction drives
- UPS systems
- Wind turbines

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, $f = 50 \text{ Hz}$, $Q_{PD} \leq 10 \text{ pC}$	2.6	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25^\circ\text{C}$, 100 Fit	2100	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	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		0.12		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}		$T_{vj} = -40^\circ\text{C}$	3300	V
			$T_{vj} = 150^\circ\text{C}$	3300	
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 150^\circ\text{C}$	$T_C = 95^\circ\text{C}$	1500	A
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$		3000	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	$V_{CE\ sat}$	$I_C = 1500\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		2.55	3.10	V
			$T_{vj} = 125\ ^\circ C$		3.00	3.45	
			$T_{vj} = 150\ ^\circ C$		3.15		
Gate threshold voltage	V_{GEth}	$I_C = 72\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 1800\ V$			42		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			0.42		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			280		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			6		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 3300\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			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}	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.47\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$		0.350		μs
			$T_{vj} = 125\ ^\circ C$		0.380		
			$T_{vj} = 150\ ^\circ C$		0.380		
Rise time (inductive load)	t_r	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.47\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$		0.350		μs
			$T_{vj} = 125\ ^\circ C$		0.380		
			$T_{vj} = 150\ ^\circ C$		0.380		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$		3.000		μs
			$T_{vj} = 125\ ^\circ C$		3.200		
			$T_{vj} = 150\ ^\circ C$		3.200		
Fall time (inductive load)	t_f	$I_C = 1500\ A, V_{CE} = 1800\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$		0.300		μs
			$T_{vj} = 125\ ^\circ C$		0.350		
			$T_{vj} = 150\ ^\circ C$		0.350		
Turn-on time (resistive load)	t_{on_R}	$I_C = 500\ A, V_{CE} = 2000\ V, V_{GE} = \pm 15\ V, R_{Gon} = 0.47\ \Omega, C_{GE} = 330\ nF$	$T_{vj} = 25\ ^\circ C$	1.32			μs
Turn-on energy loss per pulse	E_{on}	$I_C = 1500\ A, V_{CE} = 1800\ V, L_\sigma = 85\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 0.47\ \Omega, C_{GE} = 330\ nF, di/dt = 4500\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		1900		mJ
			$T_{vj} = 125\ ^\circ C$		2550		
			$T_{vj} = 150\ ^\circ C$		2900		

(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}	$I_C = 1500\text{ A}$, $V_{CE} = 1800\text{ V}$, $L_\sigma = 85\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 1.5\ \Omega$, $C_{GE} = 330\text{ nF}$, $dv/dt = 2100\text{ V}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	1600		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2100		
			$T_{vj} = 150\text{ }^\circ\text{C}$	2300		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 2500\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 10\ \mu\text{s}$, $T_{vj} = 150\text{ }^\circ\text{C}$	6400		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			7.35	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m}^2\text{K})$		10.0		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
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = -40\text{ }^{\circ}\text{C}$	3300	V
			$T_{vj} = 150\text{ }^{\circ}\text{C}$	3300	
Continuous DC forward current	I_F			1500	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\text{ ms}$		3000	A
I^2t - value	I^2t	$t_P = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^{\circ}\text{C}$	590	kA^2s
			$T_{vj} = 150\text{ }^{\circ}\text{C}$	550	
Maximum power dissipation	P_{RQM}	$T_{vj} = 150\text{ }^{\circ}\text{C}$		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	$I_F = 1500\text{ A}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	3.10	3.85	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	2.75	3.25	
			$T_{vj} = 150\text{ }^\circ\text{C}$	2.65		

(table continues...)

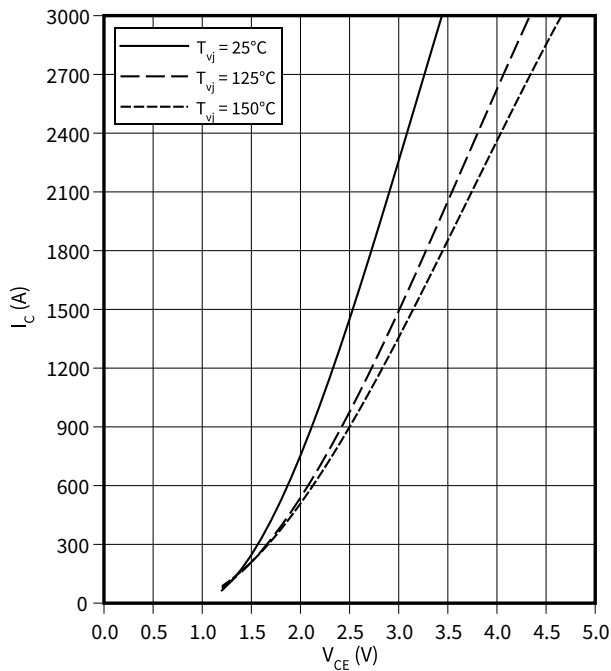
Table 6 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	$V_R = 1800\text{ V}$, $I_F = 1500\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 4500\text{ A}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	1500		A
			$T_{vj} = 125\text{ }^\circ\text{C}$	1800		
			$T_{vj} = 150\text{ }^\circ\text{C}$	1850		
Recovered charge	Q_r	$V_R = 1800\text{ V}$, $I_F = 1500\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 4500\text{ A}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	650		μC
			$T_{vj} = 125\text{ }^\circ\text{C}$	1350		
			$T_{vj} = 150\text{ }^\circ\text{C}$	1600		
Reverse recovery energy	E_{rec}	$V_R = 1800\text{ V}$, $I_F = 1500\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 4500\text{ A}/\mu\text{s}$ ($T_{vj} = 150\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	650		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	1650		
			$T_{vj} = 150\text{ }^\circ\text{C}$	1950		
Thermal resistance, junction to case	R_{thJC}	per diode			13.0	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^\circ\text{K})$		11.0		K/kW
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	$^\circ\text{C}$

4 Characteristics diagrams

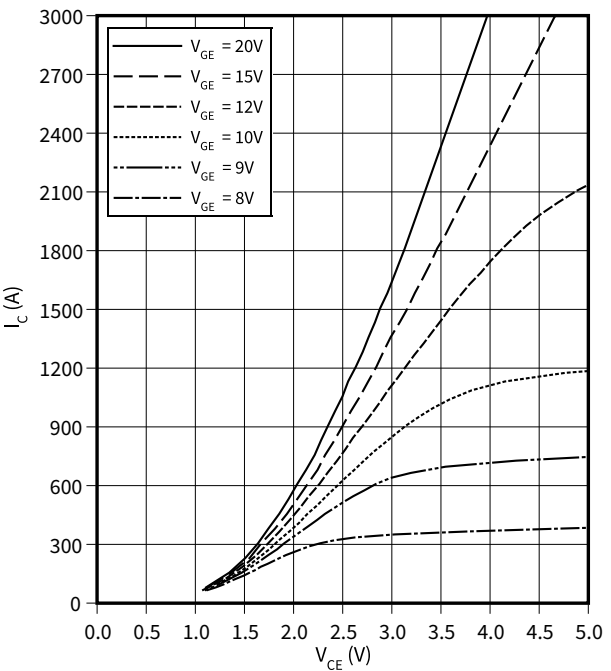
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$
 $V_{GE} = 15\text{ V}$



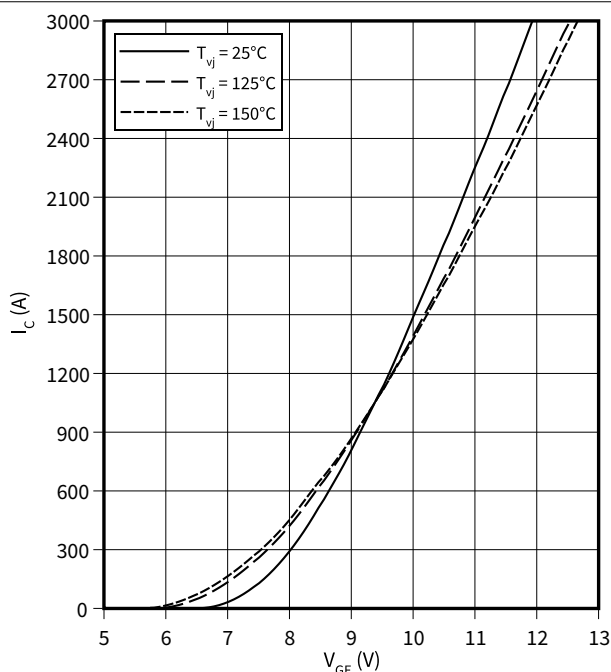
output characteristic (typical), IGBT, Inverter

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



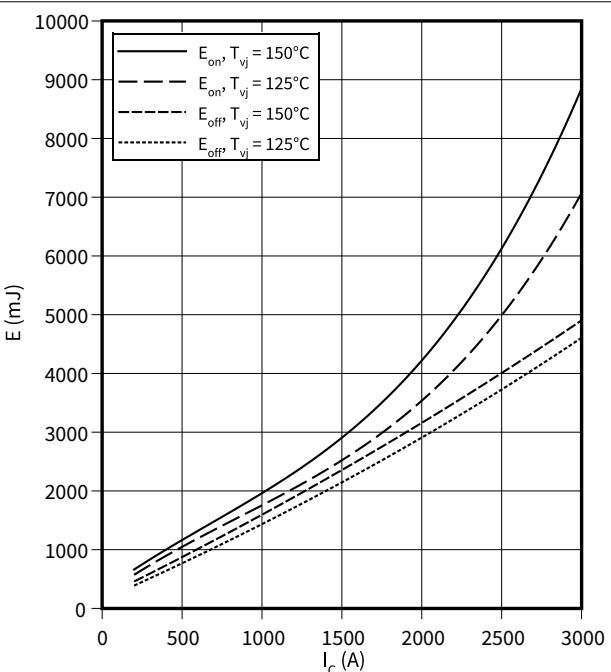
transfer characteristic (typical), IGBT, Inverter

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



switching losses (typical), IGBT, Inverter

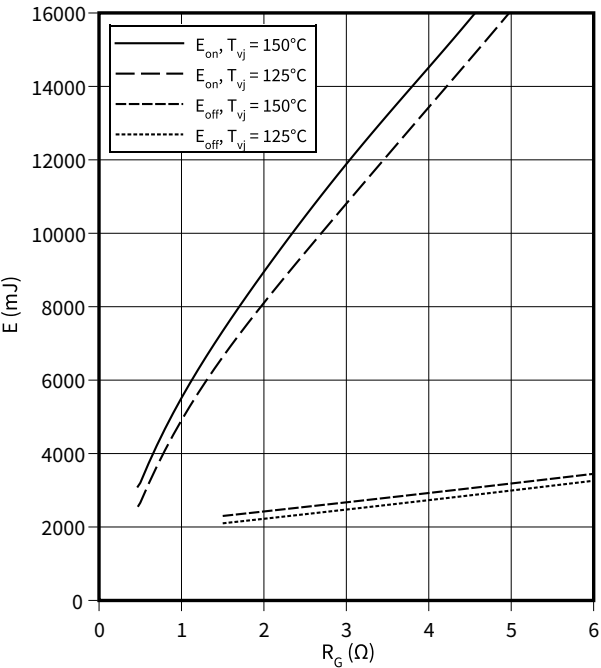
$E = f(I_C)$
 $R_{Goff} = 1.5\text{ }\Omega$, $R_{Gon} = 0.47\text{ }\Omega$, $C_{GE} = 330\text{ nF}$, $V_{CE} = 1800\text{ V}$, $V_{GE} = -15 / 15\text{ V}$



4 Characteristics diagrams

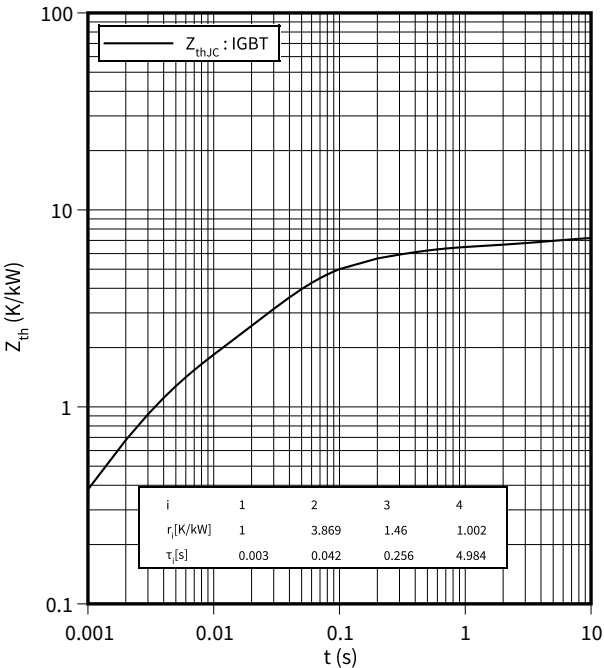
switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $I_C = 1500\text{ A}$, $C_{GE} = 330\text{ nF}$, $V_{CE} = 1800\text{ V}$, $V_{GE} = -15 / 15\text{ V}$



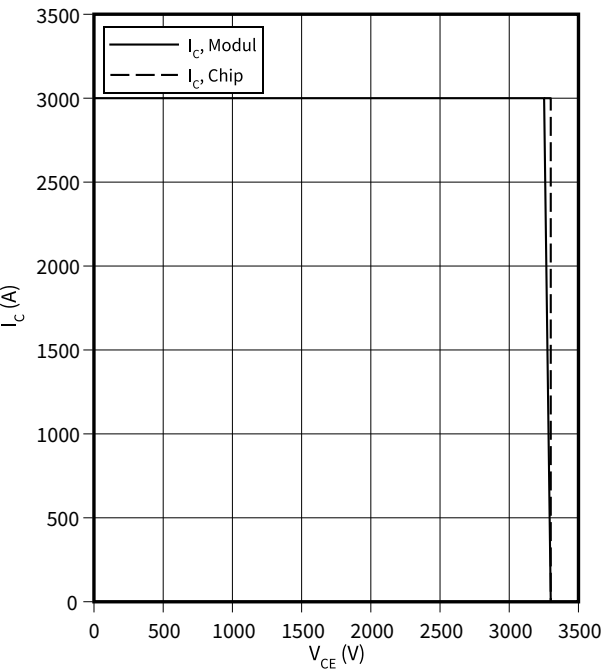
transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$



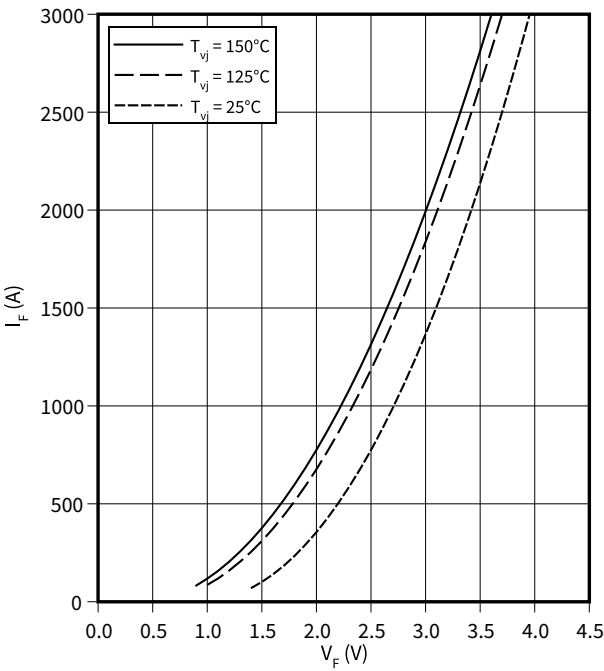
reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $C_{GE} = 330\text{ nF}$, $T_{vj} = 150\text{ °C}$, $R_{Goff} = 1.5\text{ Ω}$, $V_{GE} = \pm 15\text{ V}$



forward characteristic (typical), Diode, Inverter

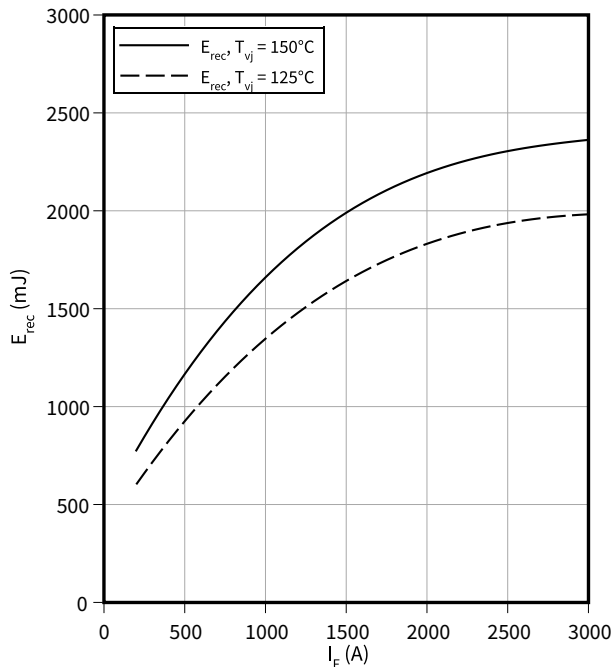
$I_F = f(V_F)$



4 Characteristics diagrams

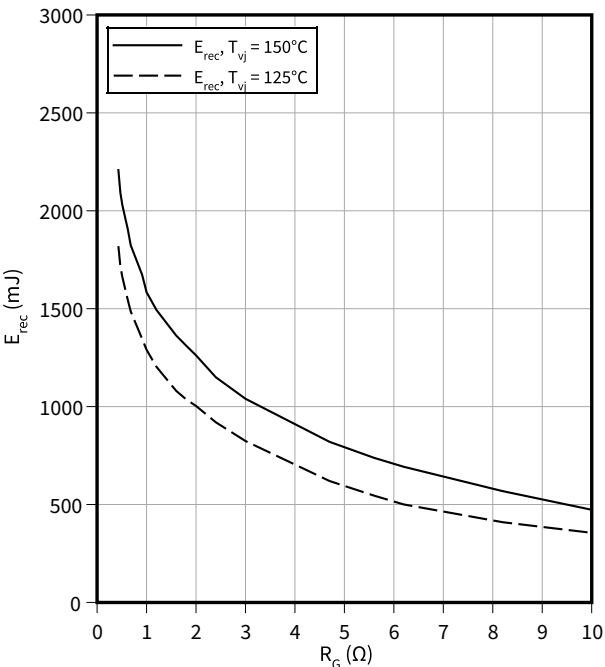
switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $V_{CE} = 1800\text{ V}, R_{Gon} = R_{Gon}(IGBT)$



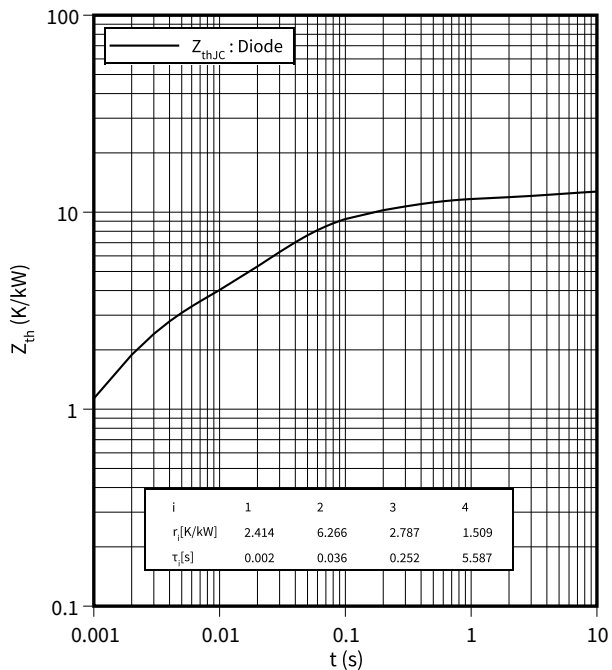
switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $V_{CE} = 1800\text{ V}, I_F = 1500\text{ A}$



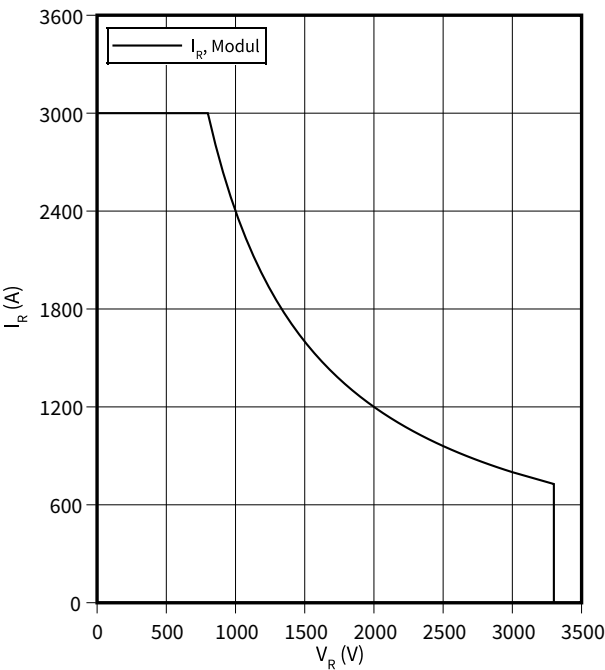
transient thermal impedance , Diode, Inverter

$Z_{th} = f(t)$



safe operation area (SOA), Diode, Inverter

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



5 **Circuit diagram**

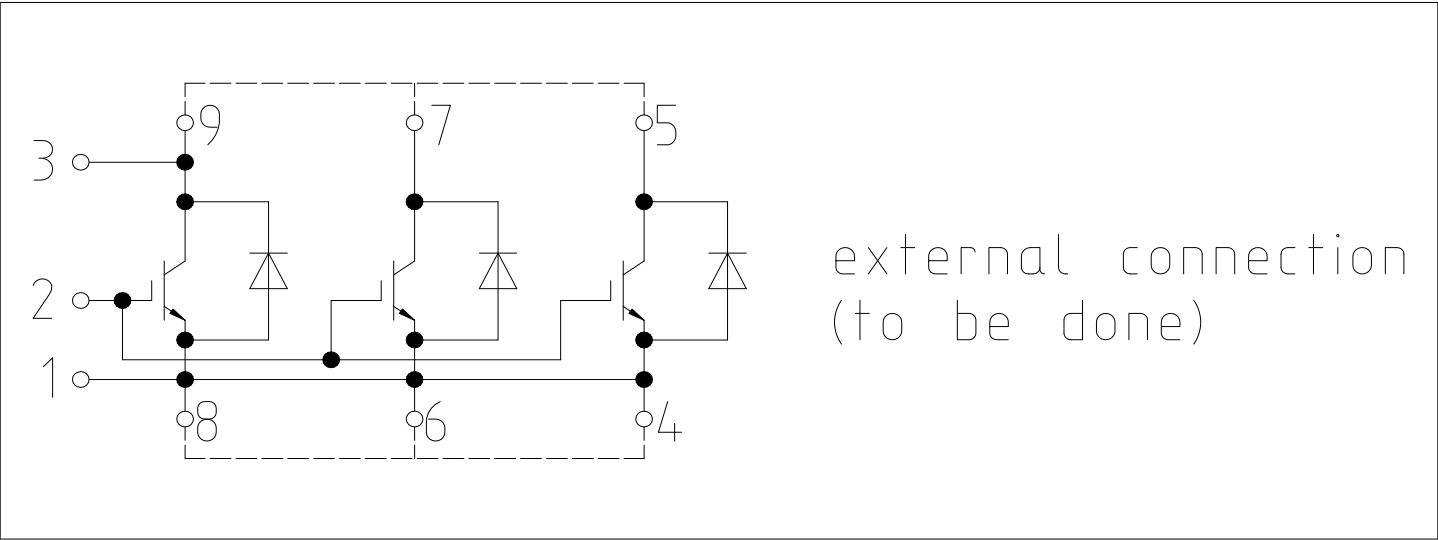


Figure 1

6 Package outlines

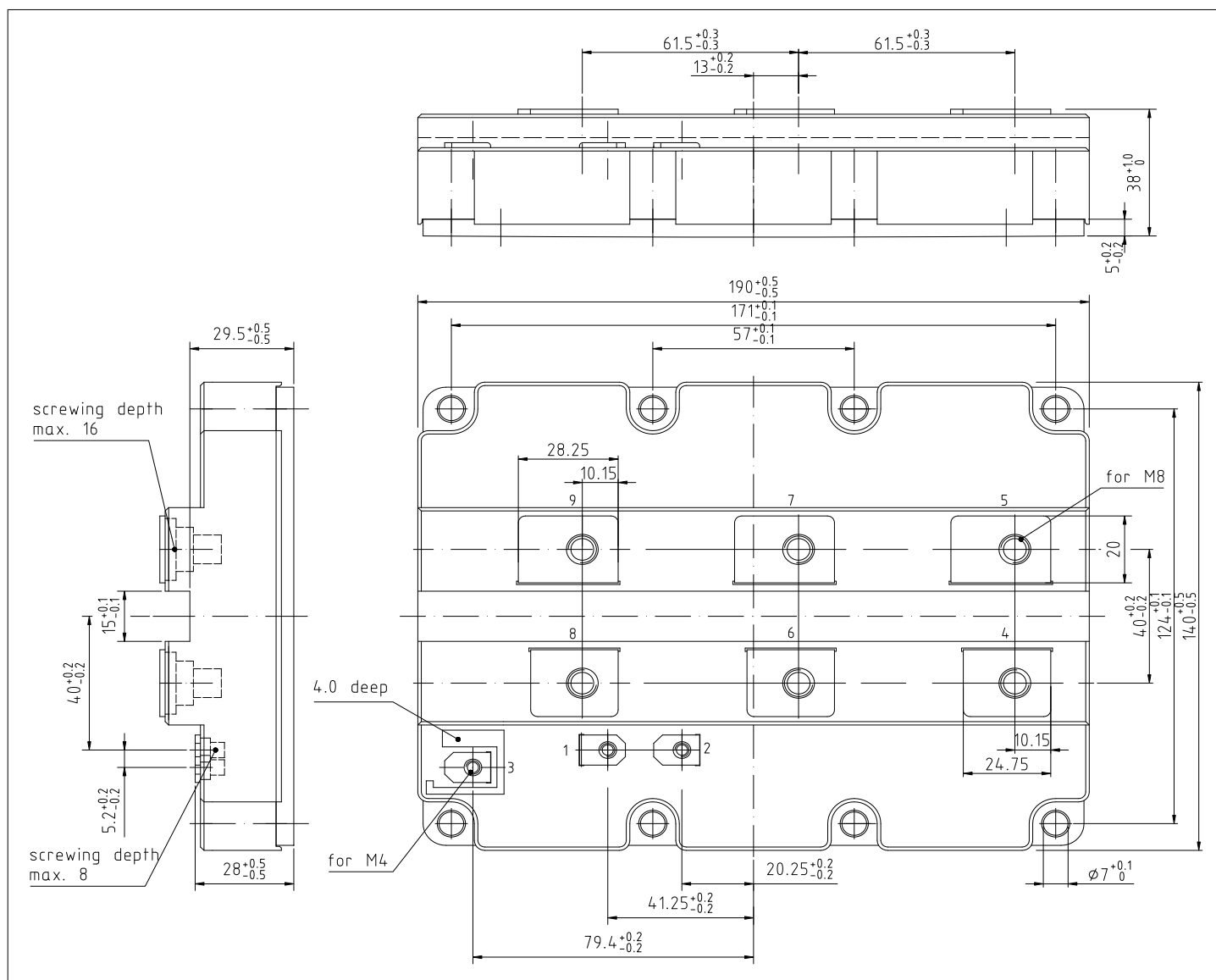


Figure 2

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	 7154914284655054991153071549142846550549911530		

Figure 3

Revision history

Document revision	Date of release	Description of changes
V2.0	2007-09-21	Preliminary datasheet
V2.1	2008-02-06	Preliminary datasheet
V2.2	2009-04-29	Preliminary datasheet
V2.3	2010-04-26	Preliminary datasheet
V2.4	2010-07-16	Preliminary datasheet
V3.0	2013-08-12	Final datasheet
V3.1	2013-12-11	Final datasheet
V3.2	2018-06-28	Final datasheet
V3.3	2019-07-24	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	2021-10-15	Final datasheet

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