

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

Features

- Electrical features
 - $V_{CES} = 4500\text{ V}$
 - $I_{C\text{ nom}} = 800\text{ A} / I_{CRM} = 1600\text{ A}$
 - 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

- Traction drives
- Motor drives
- Medium-voltage converters
- Chopper applications
- High-power converters

Product validation

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

Description

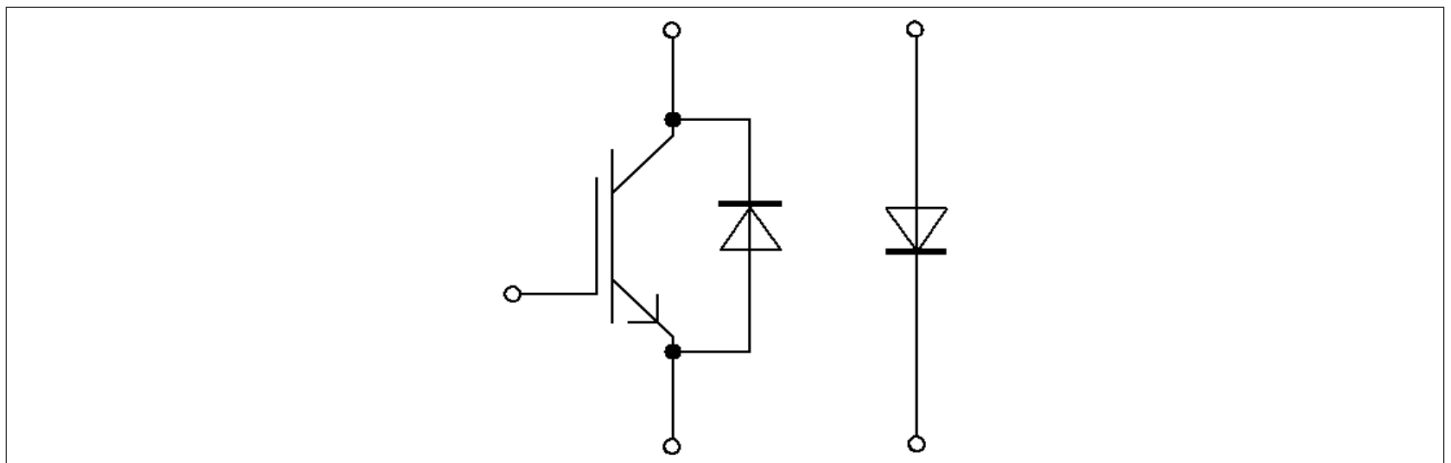


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 60 \text{ s}$	10.4	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	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	$R_{AA'+CC'}$	$T_C=25^{\circ}\text{C}$, per switch		0.18		mΩ	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_C=25^{\circ}\text{C}$, 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			1400		g	

Note: The maximum allowed dv/dt measured between 0,6 and $1 \times V_{ce}$ is $2400\text{V}/\mu\text{s}$.

2 IGBT, Brake-Chopper

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter voltage	V_{CES}		$T_{vj} = -40\text{ °C}$	4500		V
			$T_{vj} = 25\text{ °C}$	4500		
			$T_{vj} = 125\text{ °C}$	4500		
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 125\text{ °C}$	$T_C = 95\text{ °C}$	800		A
Repetitive peak collector current	I_{CRM}	$t_p = 1\text{ ms}$		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	$V_{CE\text{ sat}}$	$I_C = 800\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	2.50	2.85	V
			$T_{vj} = 125\text{ °C}$	3.10	3.70	
Gate threshold voltage	V_{GEth}	$I_C = 70.5\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25\text{ °C}$	5.40	6	6.60	V
Gate charge	Q_G	$V_{CE} = 2800\text{ V}$		26.5		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$		1.1		Ω
Input capacitance	C_{ies}	$f = 1000\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		185		nF
Reverse transfer capacitance	C_{res}	$f = 1000\text{ kHz}, T_{vj} = 25\text{ °C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		3.1		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 4500\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$		5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25\text{ °C}$			400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 800\text{ A}, V_{CE} = 2800\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.580		μs
			$T_{vj} = 125\text{ °C}$	0.600		
Rise time (inductive load)	t_r	$I_C = 800\text{ A}, V_{CE} = 2800\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.190		μs
			$T_{vj} = 125\text{ °C}$	0.220		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 800\text{ A}, V_{CE} = 2800\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 7.5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	6.600		μs
			$T_{vj} = 125\text{ °C}$	6.900		
Fall time (inductive load)	t_f	$I_C = 800\text{ A}, V_{CE} = 2800\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 7.5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.350		μs
			$T_{vj} = 125\text{ °C}$	0.450		
Turn-on time (resistive load)	t_{on_R}	$I_C = 500\text{ A}, V_{CE} = 2000\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	1.80		μs

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-on energy loss per pulse	E_{on}	$I_C = 800\text{ A}$, $V_{CE} = 2800\text{ V}$, $L_\sigma = 95\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1\ \Omega$, $di/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	3100		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	4100		
Turn-off energy loss per pulse	E_{off}	$I_C = 800\text{ A}$, $V_{CE} = 2800\text{ V}$, $L_\sigma = 95\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 7.5\ \Omega$, $dv/dt = 2000\text{ V}/\mu\text{s}$ ($T_{vj} = 125\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	2800		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	3400		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 2800\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}$, $T_{vj} \leq 125\text{ }^\circ\text{C}$	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, $\lambda_{grease} = 1\text{ W}/(\text{m} \cdot \text{K})$		13.5		K/kW
Temperature under switching conditions	$T_{vj\ op}$		-50		125	$^\circ\text{C}$

3 Diode, Brake-Chopper

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = -40\text{ }^\circ\text{C}$	4500	V
			$T_{vj} = 25\text{ }^\circ\text{C}$	4500	
			$T_{vj} = 125\text{ }^\circ\text{C}$	4500	
Continuous DC forward current	I_F		800	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1600	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	255	kA^2s
Maximum power dissipation	P_{RQM}	$T_{vj} = 125\text{ }^\circ\text{C}$	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	$I_F = 800\text{ A}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	2.50	3.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	2.50	3.00	

(table continues...)

Table 6 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ °C}$)	$T_{vj} = 25\text{ °C}$	1000		A
			$T_{vj} = 125\text{ °C}$	1150		
Recovered charge	Q_r	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ °C}$)	$T_{vj} = 25\text{ °C}$	770		μC
			$T_{vj} = 125\text{ °C}$	1400		
Reverse recovery energy	E_{rec}	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ °C}$)	$T_{vj} = 25\text{ °C}$	1200		mJ
			$T_{vj} = 125\text{ °C}$	2400		
Thermal resistance, junction to case	R_{thJC}	per diode			25.5	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$		21.0		K/kW
Temperature under switching conditions	$T_{vj\text{op}}$		-50		125	$^{\circ}\text{C}$

4 Diode, Reverse

Table 7 **Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = -40\text{ °C}$	4500	V
			$T_{vj} = 25\text{ °C}$	4500	
			$T_{vj} = 125\text{ °C}$	4500	
Continuous DC forward current	I_F		800	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1600	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ °C}$	255	kA^2s
Maximum power dissipation	P_{RQM}	$T_{vj} = 125\text{ °C}$	1600	kW	
Minimum turn-on time	t_{onmin}		10	μs	

Table 8 **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 800\text{ A}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	2.50	3.10	V
			$T_{vj} = 125\text{ °C}$	2.50	3.00	

(table continues...)

Table 8 (continued) Characteristic values

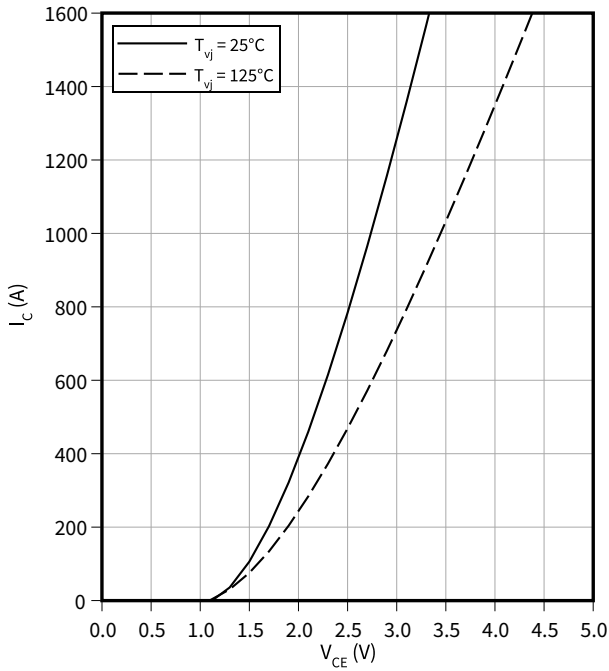
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	1000		A
			$T_{vj} = 125\text{ }^\circ\text{C}$	1150		
Recovered charge	Q_r	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	770		μC
			$T_{vj} = 125\text{ }^\circ\text{C}$	1400		
Reverse recovery energy	E_{rec}	$V_R = 2800\text{ V}$, $I_F = 800\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 3300\text{ A}/\mu\text{s}$ ($T_{vj} = 125\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	1200		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	2400		
Thermal resistance, junction to case	R_{thJC}	per diode			25.5	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$		21.0		K/kW
Temperature under switching conditions	$T_{vj\text{op}}$		-50		125	$^\circ\text{C}$

5 Characteristics diagrams

Output characteristic (typical), IGBT, Brake-Chopper

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

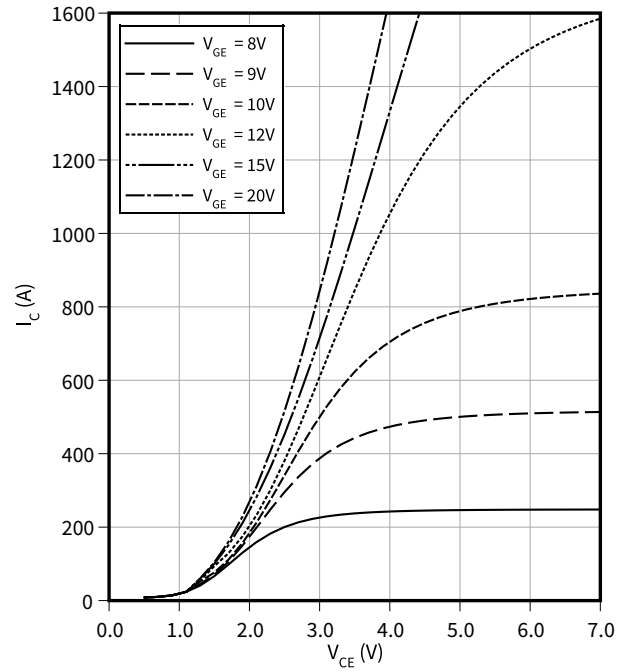
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Brake-Chopper

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

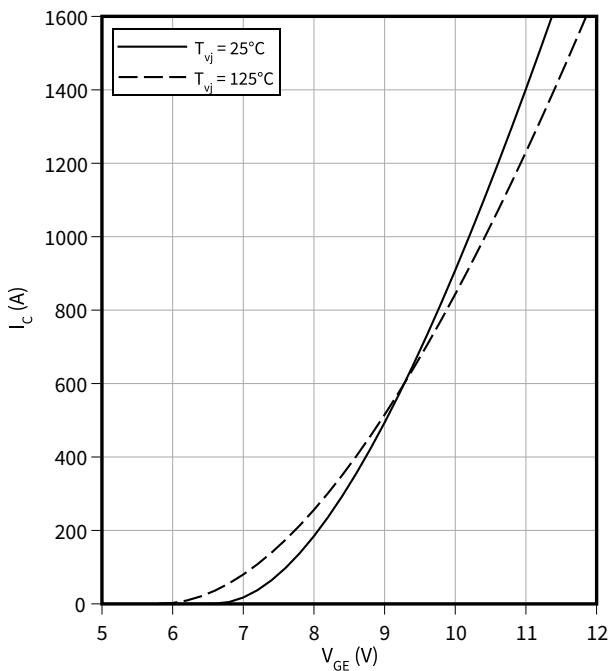
$$T_{vj} = 125 \text{ °C}$$



Transfer characteristic (typical), IGBT, Brake-Chopper

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

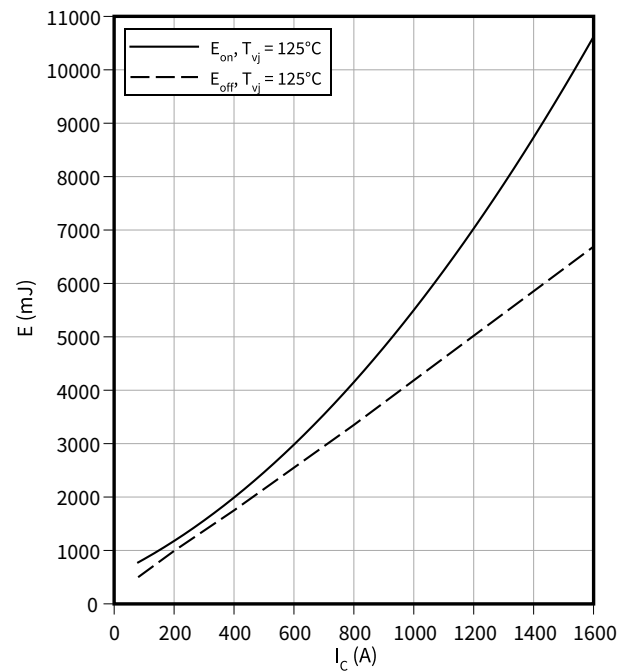
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Brake-Chopper

$$E = f(I_C)$$

$$R_{Goff} = 7.5 \text{ } \Omega, R_{Gon} = 1 \text{ } \Omega, V_{CE} = 2800 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

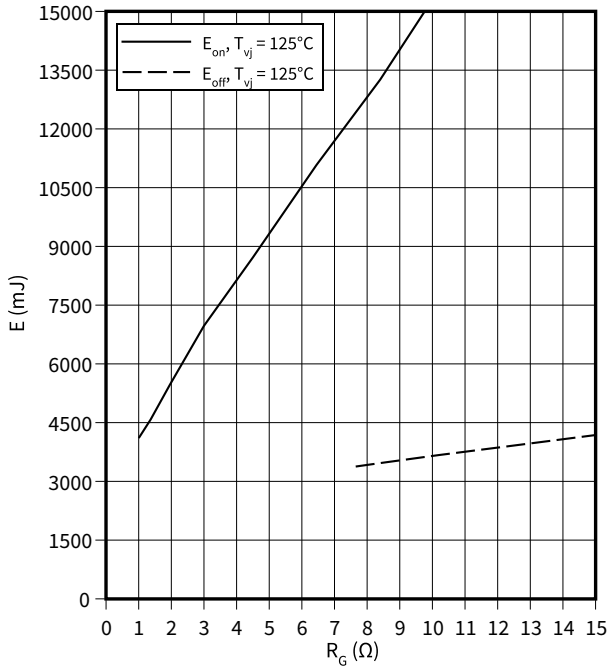


5 Characteristics diagrams

Switching losses (typical), IGBT, Brake-Chopper

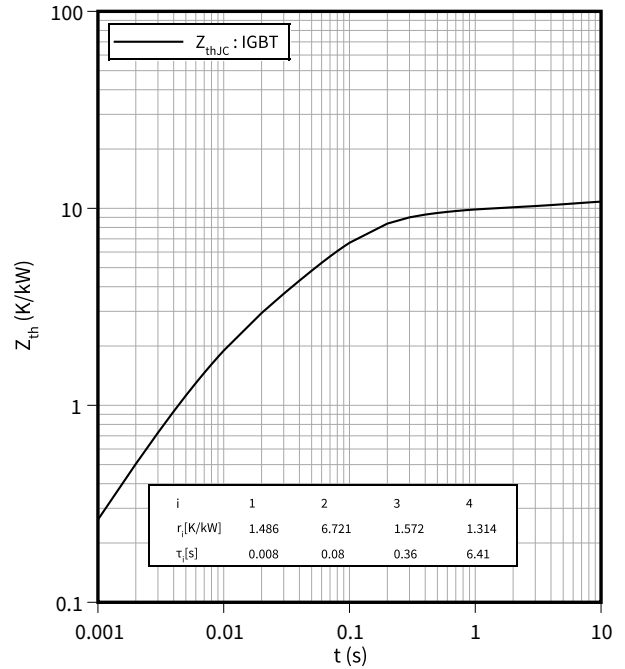
$E = f(R_G)$

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



Transient thermal impedance, IGBT, Brake-Chopper

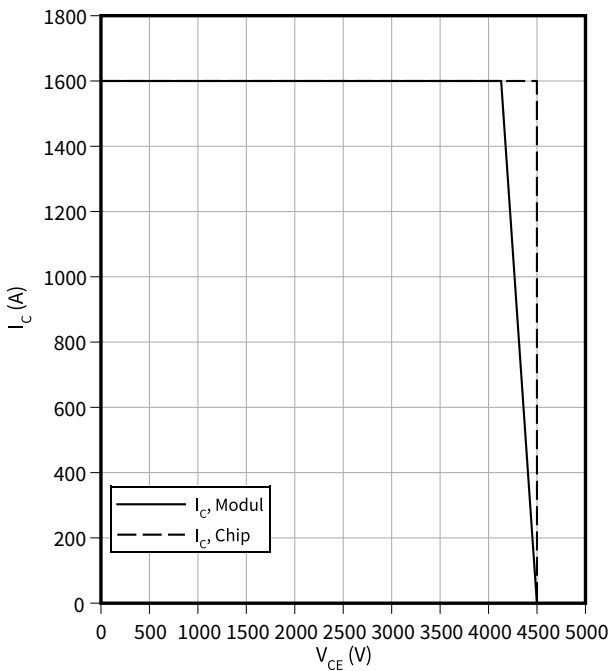
$Z_{th} = f(t)$



Reverse bias safe operating area (RBSOA), IGBT, Brake-Chopper

$I_C = f(V_{CE})$

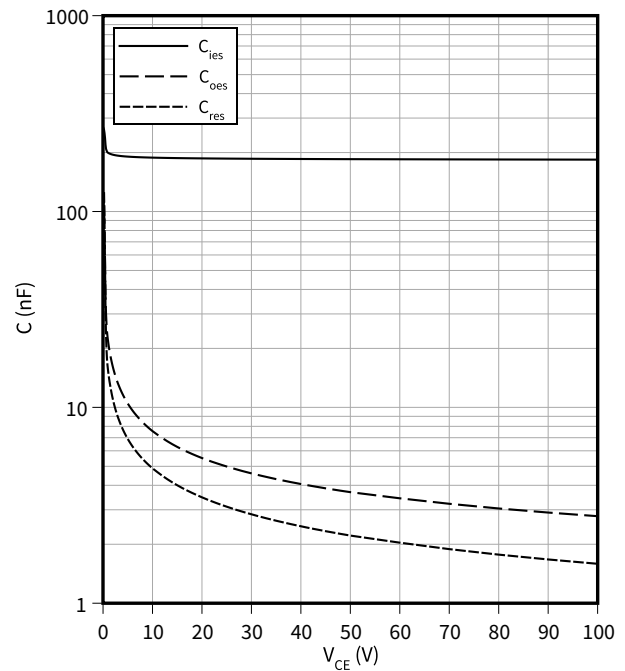
$R_{Goff} = 7.5 \Omega$, $V_{GE} = \pm 15 \text{ V}$, $T_{vj} = 125 \text{ °C}$



Capacity characteristic (typical), IGBT, Brake-Chopper

$C = f(V_{CE})$

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

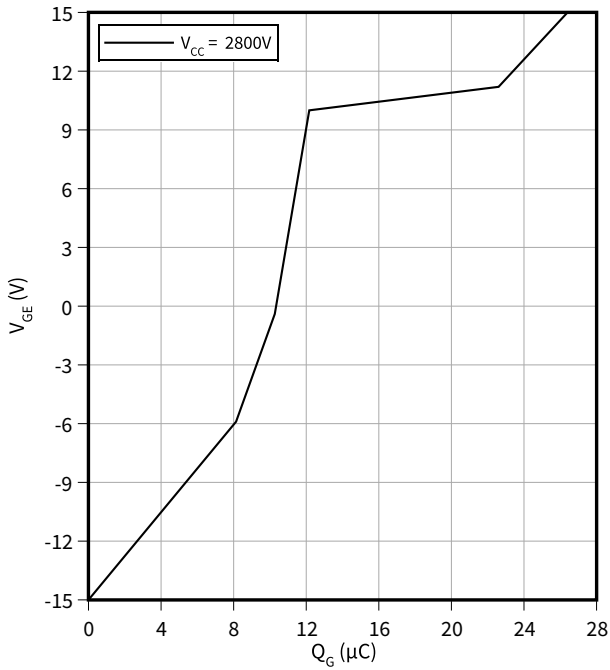


5 Characteristics diagrams

Gate charge characteristic (typical), IGBT, Brake-Chopper

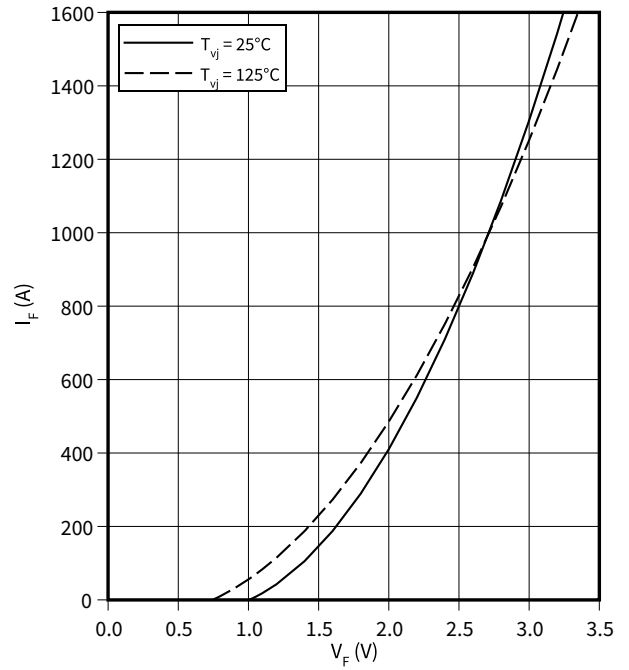
$V_{GE} = f(Q_G)$

$I_C = 800 \text{ A}$, $T_{vj} = 25 \text{ }^\circ\text{C}$



Forward characteristic (typical), Diode, Brake-Chopper

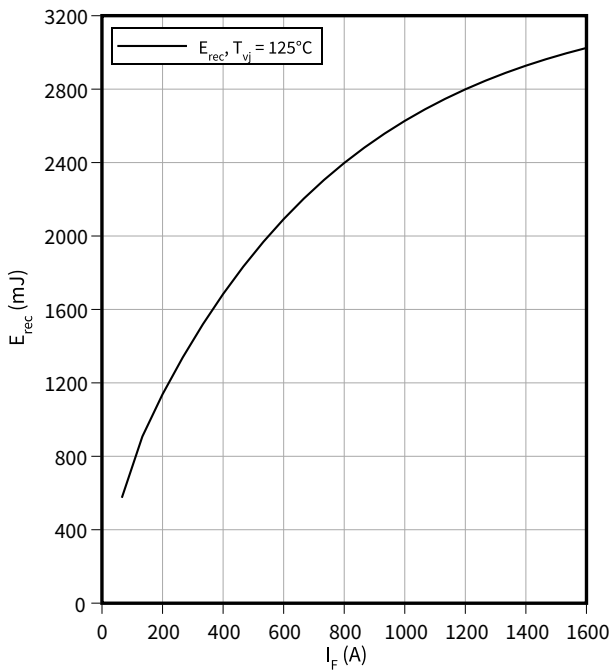
$I_F = f(V_F)$



Switching losses (typical), Diode, Brake-Chopper

$E_{rec} = f(I_F)$

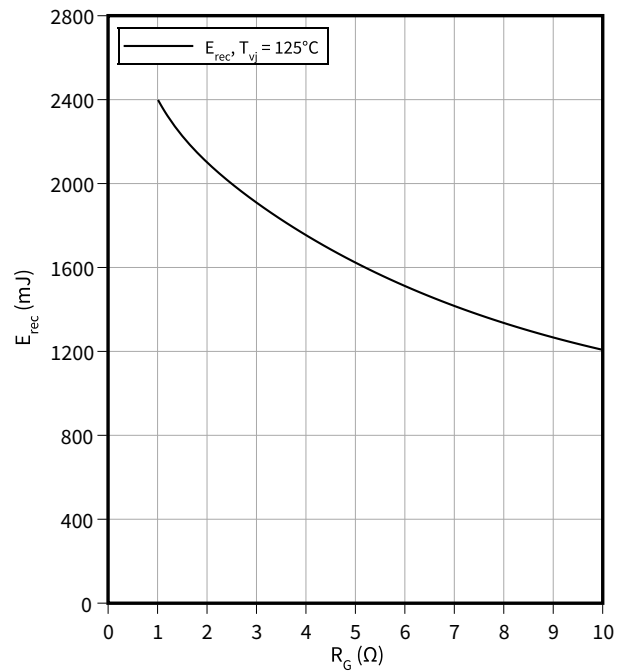
$V_{CE} = 2800 \text{ V}$, $R_{Gon} = R_{Gon}(\text{IGBT})$



Switching losses (typical), Diode, Brake-Chopper

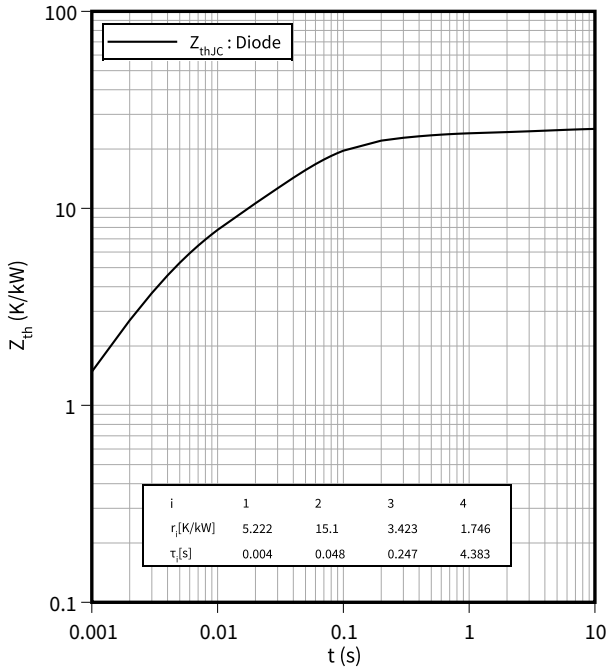
$E_{rec} = f(R_G)$

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



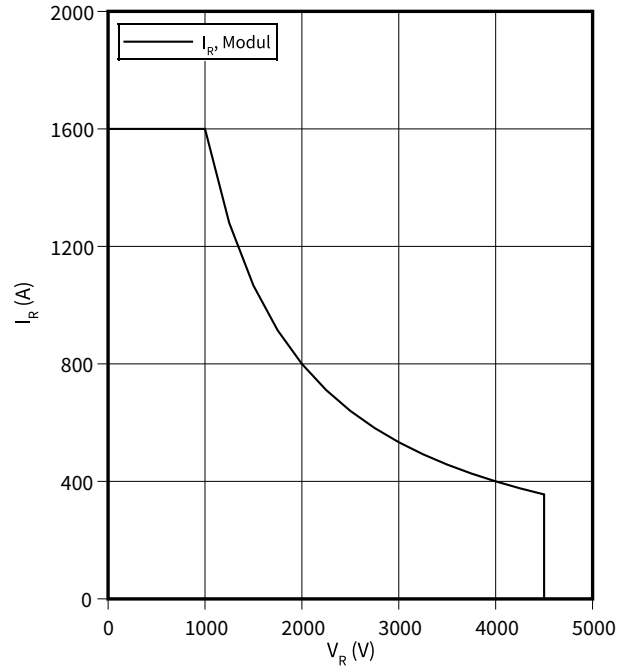
Transient thermal impedance, Diode, Brake-Chopper

$Z_{th} = f(t)$



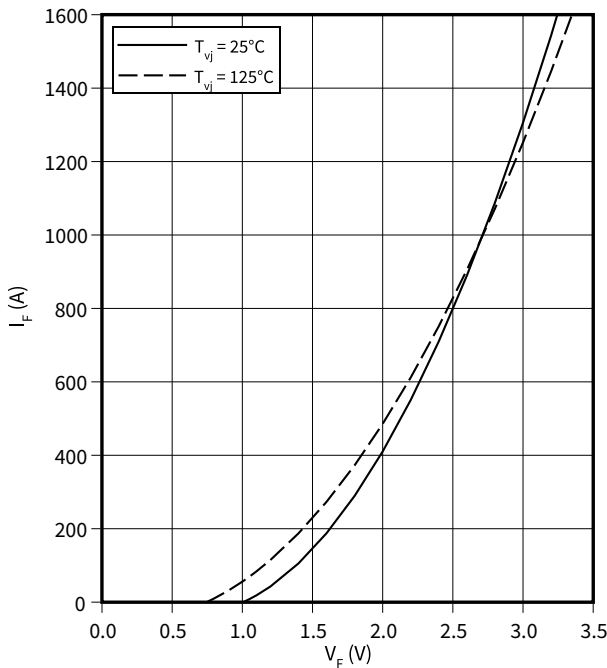
Safe operating area (SOA), Diode, Brake-Chopper

$I_R = f(V_R)$
 $T_{vj} = 125^\circ\text{C}$



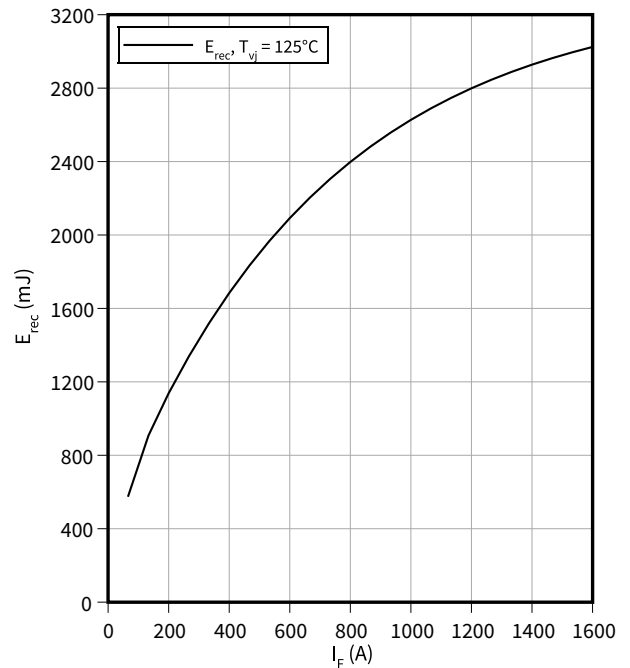
Forward characteristic (typical), Diode, Reverse

$I_F = f(V_F)$



Switching losses (typical), Diode, Reverse

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

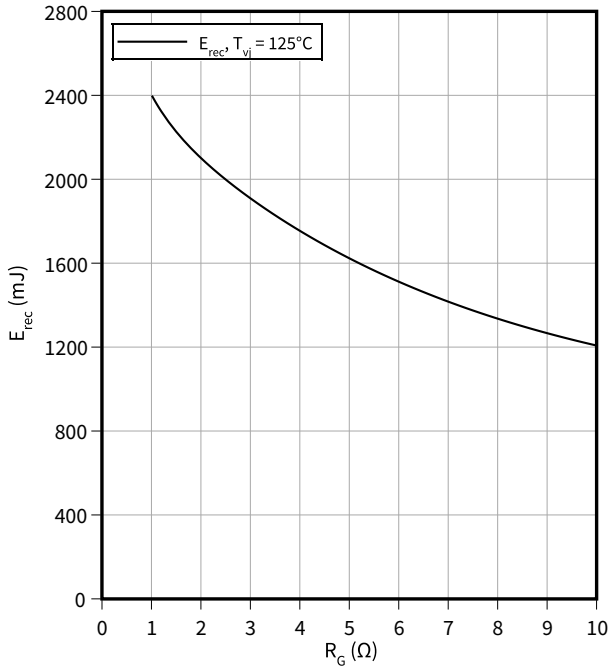


5 Characteristics diagrams

Switching losses (typical), Diode, Reverse

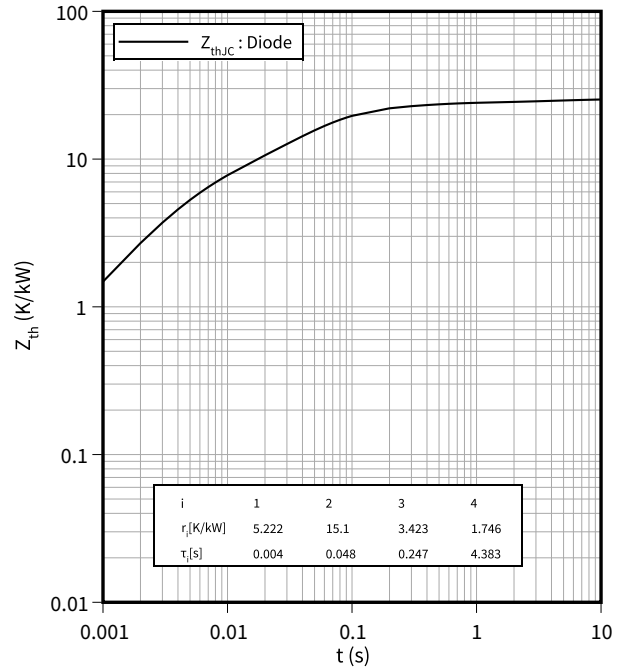
$E_{rec} = f(R_G)$

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



Transient thermal impedance, Diode, Reverse

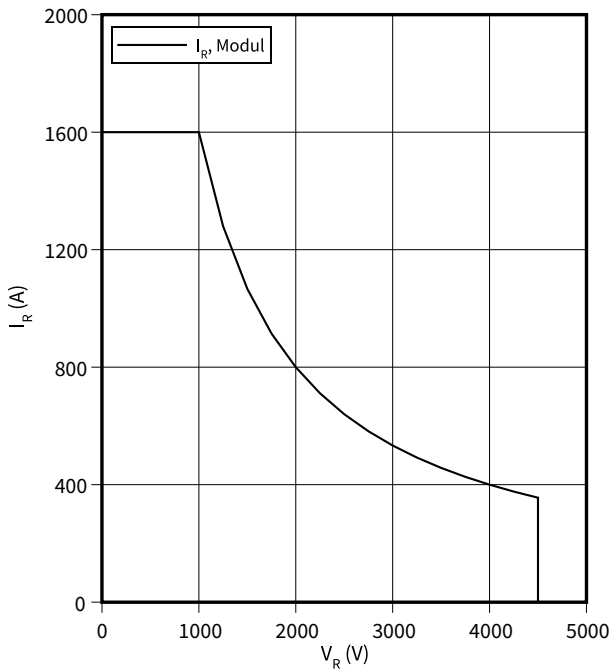
$Z_{th} = f(t)$



Safe operating area (SOA), Diode, Reverse

$I_R = f(V_R)$

$T_{vj} = 125\text{ °C}$



6 Circuit diagram

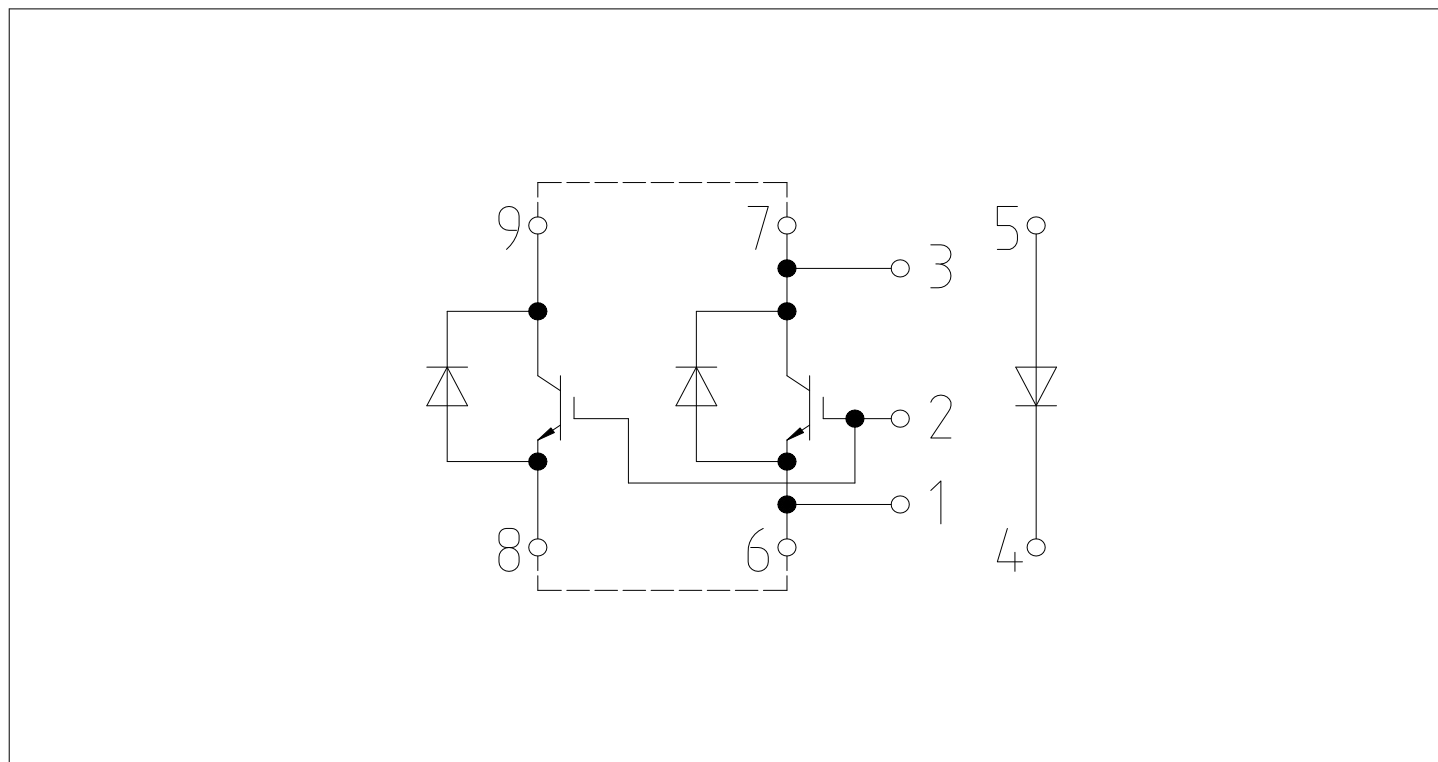


Figure 1

7 Package outlines

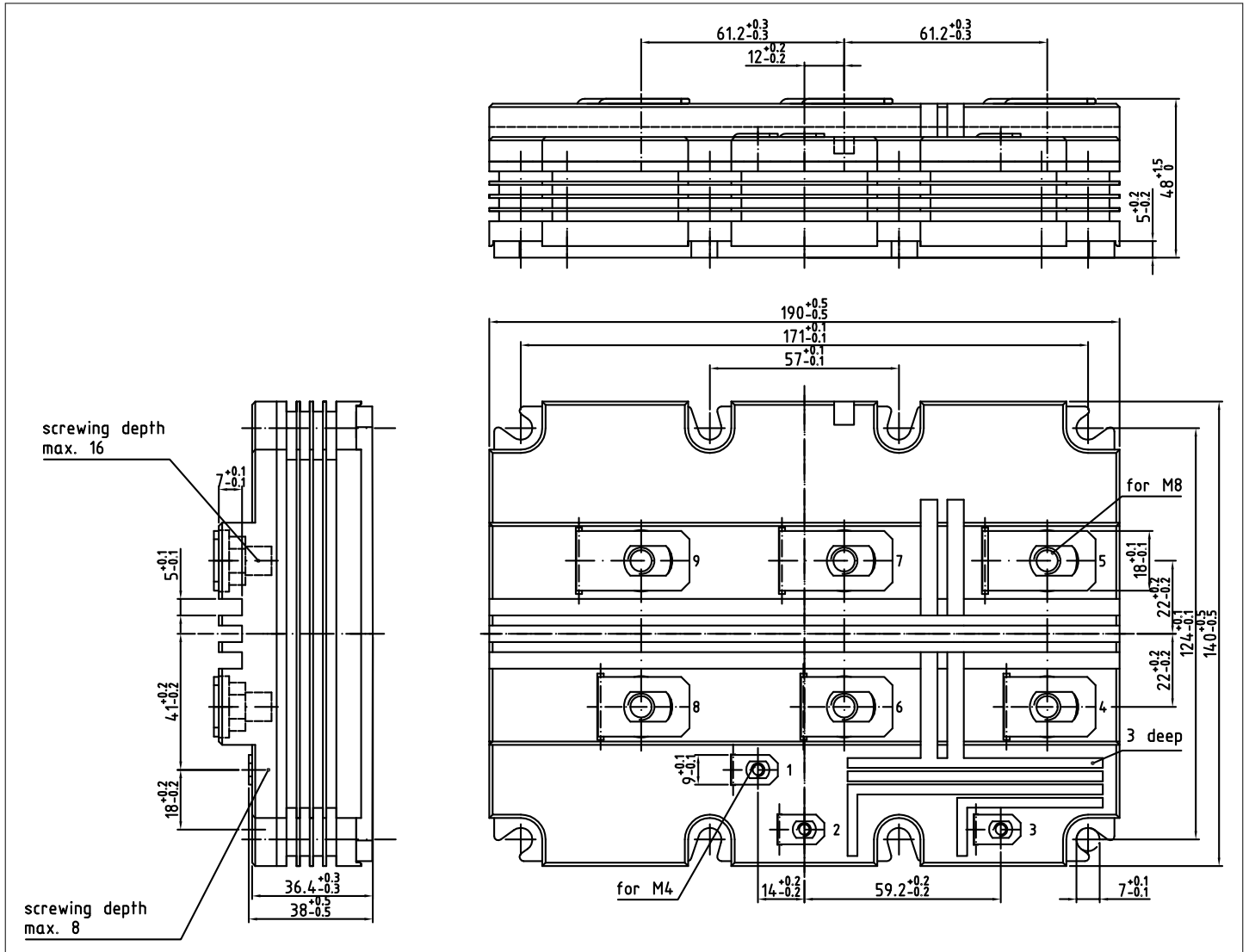


Figure 2

8 Module label code


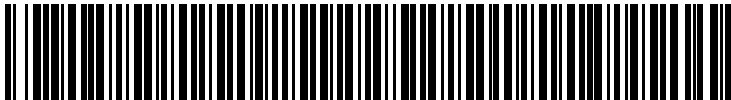
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production 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
V2.0	2015-07-08	Preliminary datasheet
V3.0	2015-09-14	Final datasheet
V3.1	2016-08-30	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	2021-12-23	Final datasheet

Trademarks

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Document reference

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