

EconoDUAL™3 module with Trench/Fieldstop IGBT4 and emitter controlled diode and PressFIT / NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{nom}} = 600\text{ A} / I_{CRM} = 1200\text{ A}$
 - LOW $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - Direct-cooled base plate
 - Isolated base plate
 - High power density
 - Standard housing

Potential applications

- High-power converters
- Motor drives
- Servo drives
- UPS systems
- Wind turbines

Product validation

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

Description



Typical appearance

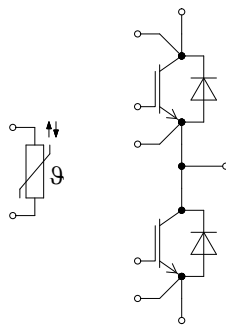


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	14.5	mm
Creepage distance	d_{Creep}	terminal to terminal	13.0	mm
Clearance	d_{Clear}	terminal to heatsink	12.5	mm
Clearance	d_{Clear}	terminal to terminal	10.0	mm
Comparative tracking index	CTI		> 200	
Relative thermal index (electrical)	RTI	housing	140	°C

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Pressure drop in cooling circuit	Δp	$\Delta V/\Delta t = 10.0 \text{ dm}^3/\text{min}$, 50% water / 50% ethylen glycol, $T_F = 60 \text{ °C}$		65		mbar	
Maximum pressure in cooling circuit	p				3	bar	
Stray inductance module	L_{SCE}			20		nH	
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_F = 25 \text{ °C}$, per switch		1		mΩ	
Storage temperature	T_{stg}		-40		125	°C	
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	3		6	Nm
Terminal connection torque	M	- Mounting according to valid application note	M6, Screw	3		6	Nm
Weight	G			345		g	

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_F = 45 \text{ °C}$	600	A

(table continues...)
 Datasheet

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$	1200	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	$V_{CE\ sat}$	$I_C = 600\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$	1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$	2.00		
			$T_{vj} = 150\ ^\circ C$	2.05		
Gate threshold voltage	V_{GEth}	$I_C = 22.8\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$		4.4		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$		1.2		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		37		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		2.05		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V$			3	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}	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.160		μs
			$T_{vj} = 125\ ^\circ C$	0.210		
			$T_{vj} = 150\ ^\circ C$	0.210		
Rise time (inductive load)	t_r	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.090		μs
			$T_{vj} = 125\ ^\circ C$	0.090		
			$T_{vj} = 150\ ^\circ C$	0.100		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.480		μs
			$T_{vj} = 125\ ^\circ C$	0.610		
			$T_{vj} = 150\ ^\circ C$	0.650		
Fall time (inductive load)	t_f	$I_C = 600\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$	0.070		μs
			$T_{vj} = 125\ ^\circ C$	0.110		
			$T_{vj} = 150\ ^\circ C$	0.120		
Turn-on energy loss per pulse	E_{on}	$I_C = 600\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega, di/dt = 5100\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$	62.5		mJ
			$T_{vj} = 125\ ^\circ C$	83		
			$T_{vj} = 150\ ^\circ C$	90		

(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}	$I_C = 600\text{ A}, V_{CE} = 600\text{ V}, L_\sigma = 35\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 1.5\ \Omega, dv/dt = 3700\text{ V}/\mu\text{s} (T_{vj} = 150\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		47	mJ	
			$T_{vj} = 125\text{ }^\circ\text{C}$		72		
			$T_{vj} = 150\text{ }^\circ\text{C}$		79.5		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}, V_{CC} = 800\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$		2400	A	
Thermal resistance, junction to cooling fluid ¹⁾	R_{thJF}	per IGBT, $\Delta V/\Delta t = 10\text{ dm}^3/\text{min}$, cooling fluid = 50% water / 50% ethylen glycol, $T_f = 60\text{ }^\circ\text{C}$			0.0848	K/W	
Temperature under switching conditions	T_{vjop}				-40	150	$^\circ\text{C}$

1) Typical R_{thJF} value using the heat sink described in the relevant application note.

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25\text{ }^\circ\text{C}$	1200	V	
Continuous DC forward current	I_F		600	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1200	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	40000	A^2s
			$T_{vj} = 150\text{ }^\circ\text{C}$	37600	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 600\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1.65	2.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$		1.65		
			$T_{vj} = 150\text{ }^\circ\text{C}$		1.65		
Peak reverse recovery current	I_{RM}	$V_R = 600\text{ V}, I_F = 600\text{ A}, V_{GE} = -15\text{ V}, -di_F/dt = 5100\text{ A}/\mu\text{s} (T_{vj} = 150\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		290	A	
			$T_{vj} = 125\text{ }^\circ\text{C}$		420		
			$T_{vj} = 150\text{ }^\circ\text{C}$		450		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	Q_r	$V_R = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5100 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		62	μC
			$T_{vj} = 125 \text{ }^\circ\text{C}$		115	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		130	
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, I_F = 600 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 5100 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ }^\circ\text{C})$	$T_{vj} = 25 \text{ }^\circ\text{C}$		22	mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$		44	
			$T_{vj} = 150 \text{ }^\circ\text{C}$		51	
Thermal resistance, junction to cooling fluid ¹⁾	R_{thJF}	per diode, $\Delta V/\Delta t = 10 \text{ dm}^3/\text{min}$, cooling fluid = 50% water / 50% ethylenglycol, $T_f = 60 \text{ }^\circ\text{C}$		0.124		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	$^\circ\text{C}$

1) Typical R_{thJF} value using the heat sink described in the relevant application note.

4 NTC-Thermistor

Table 7 Characteristic values

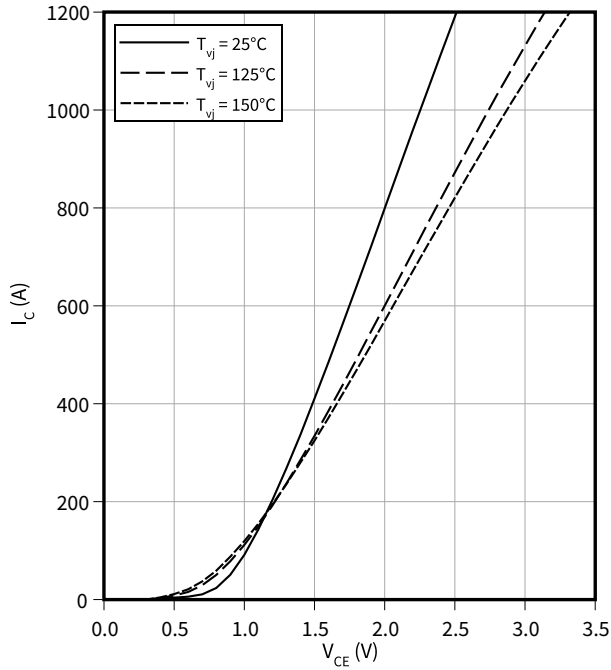
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}, R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ }^\circ\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K

Note: Specification according to the valid application note.

5 Characteristics diagrams

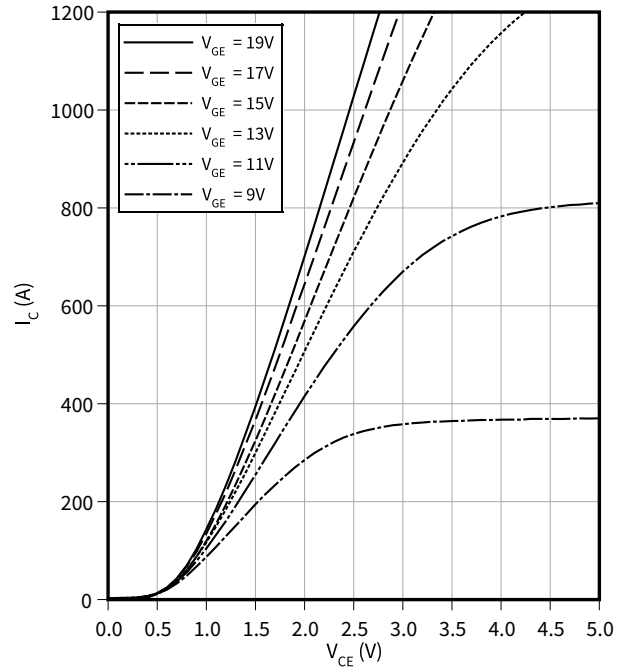
Output characteristic (typical), IGBT, Inverter

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



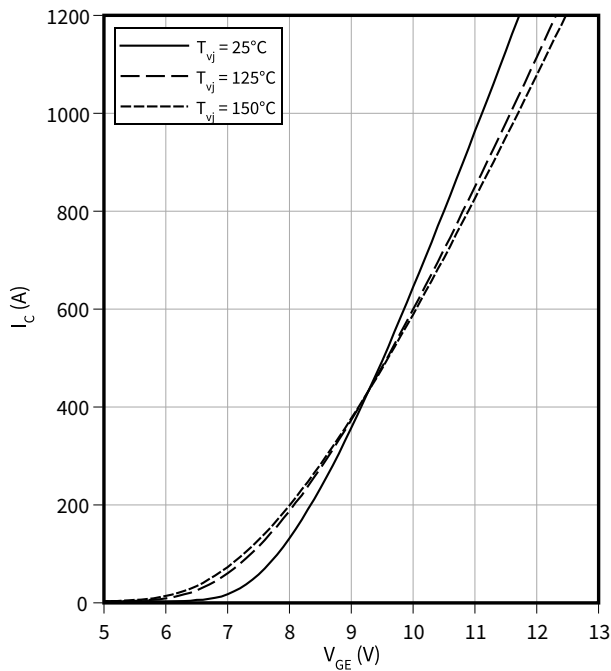
Output characteristic field (typical), IGBT, Inverter

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



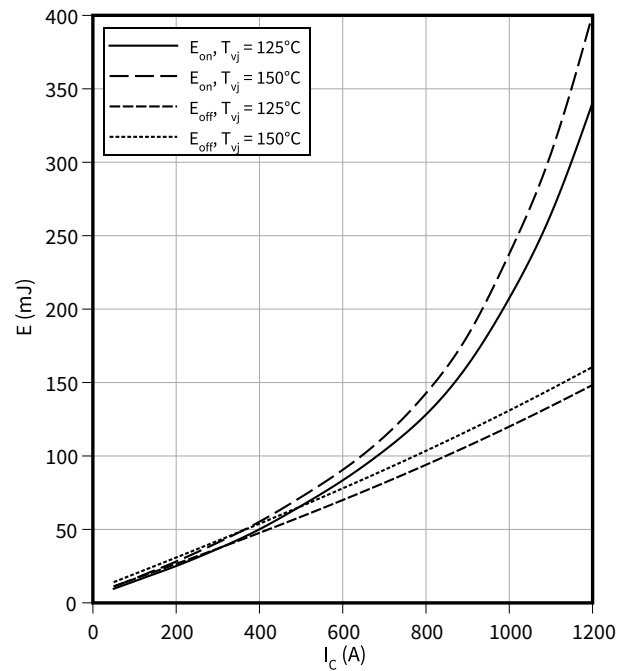
Transfer characteristic (typical), IGBT, Inverter

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



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$
 $R_{Goff} = 1.5 \text{ } \Omega$, $R_{Gon} = 1.5 \text{ } \Omega$, $V_{GE} = \pm 15 \text{ V}$, $V_{CE} = 600 \text{ V}$

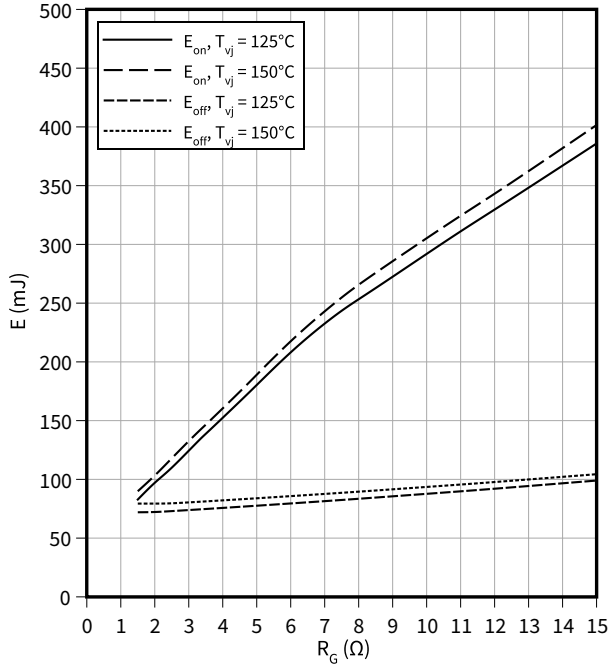


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

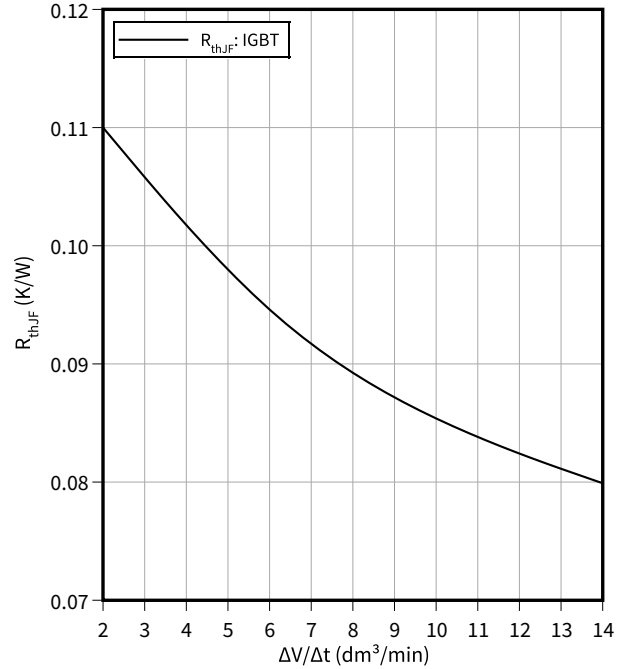
$E = f(R_G)$

$V_{GE} = \pm 15 \text{ V}, I_C = 600 \text{ A}, V_{CE} = 600 \text{ V}$



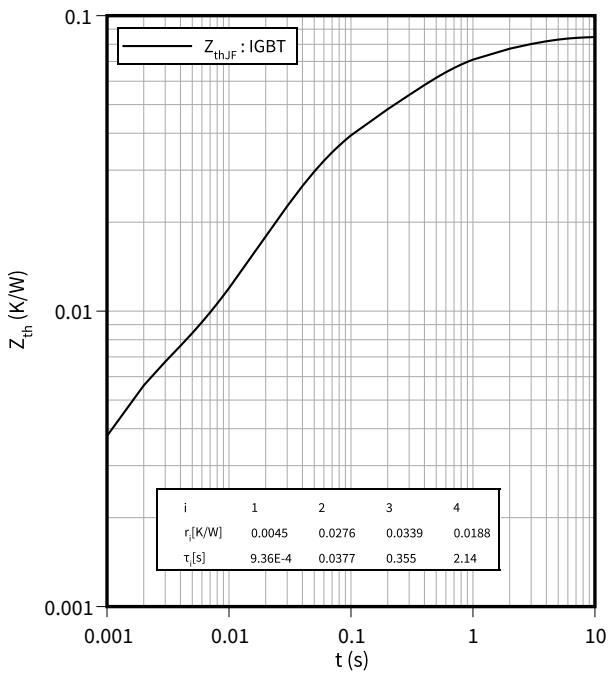
Thermal impedance, IGBT, Inverter

$R_{thJF} = f(\Delta V/\Delta t)$



Transient thermal impedance, IGBT, Inverter

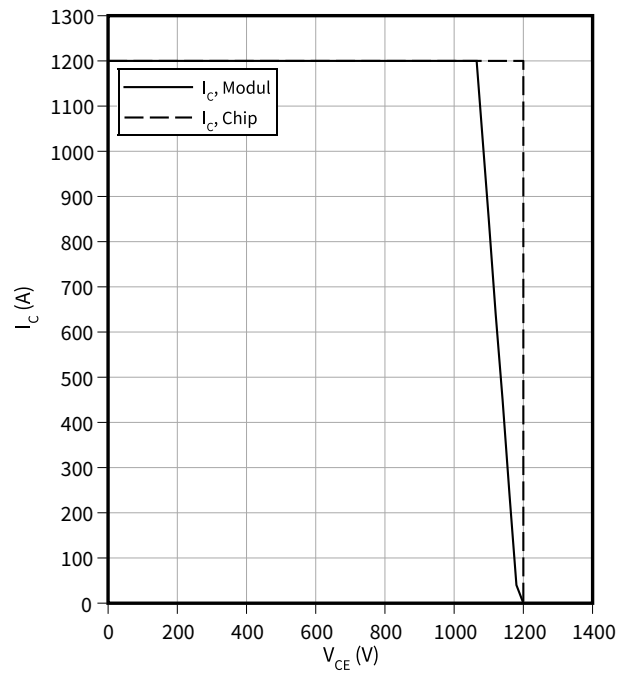
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

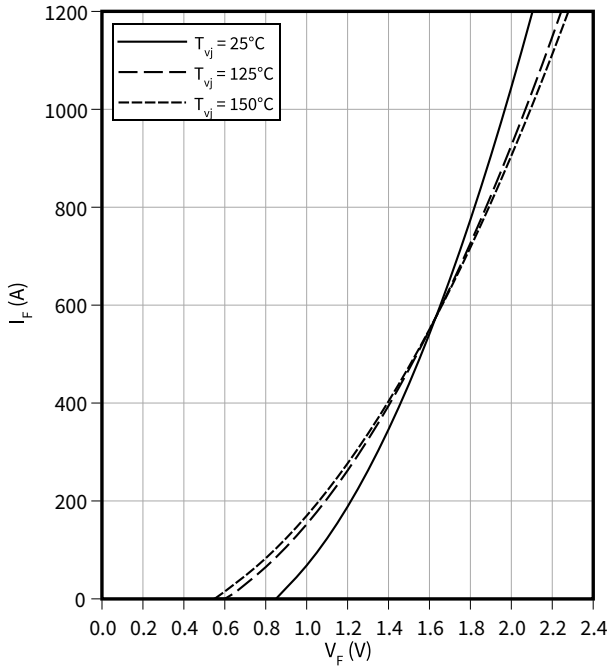
$R_{Goff} = 1.5 \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 150 \text{ °C}$



5 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

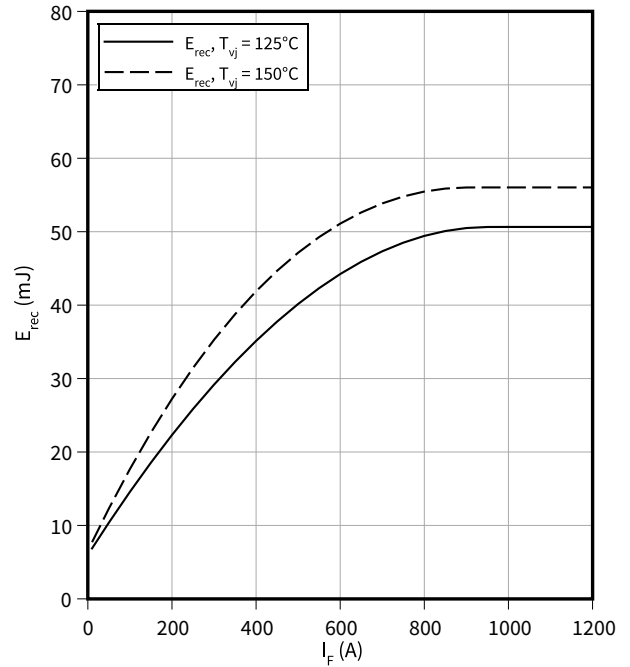
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

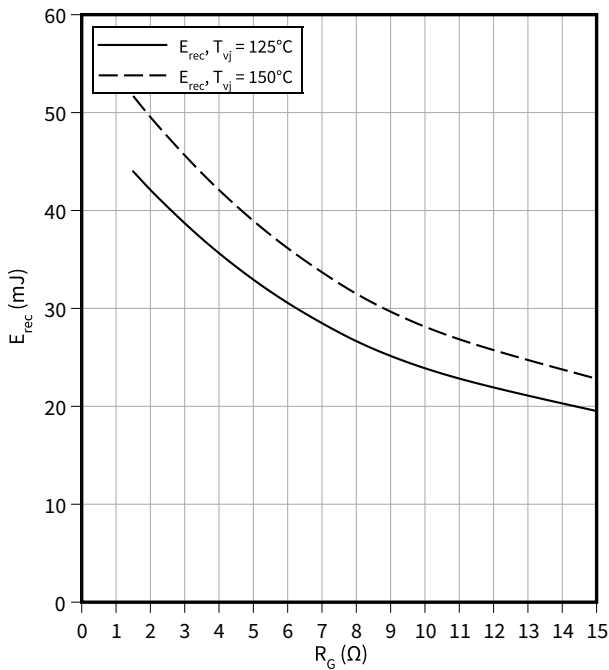
$V_{CE} = 600\text{ V}, R_{Gon} = 1.5\ \Omega$



Switching losses (typical), Diode, Inverter

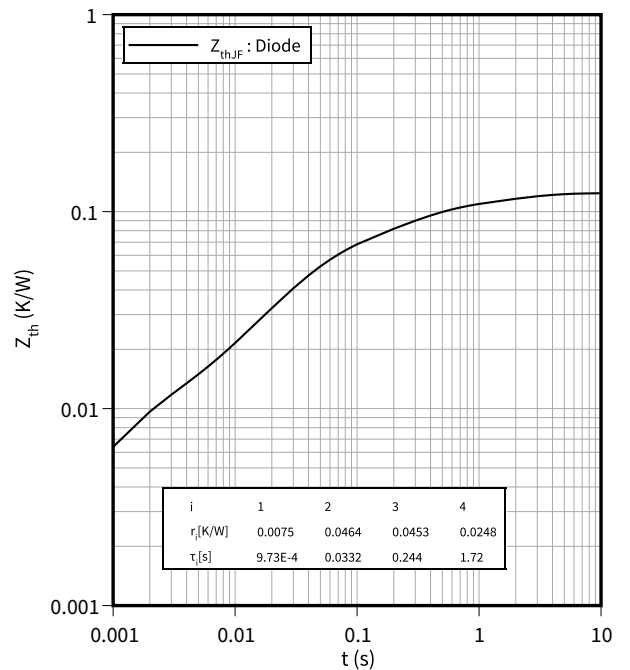
$E_{rec} = f(R_G)$

$V_{CE} = 600\text{ V}, I_F = 600\text{ A}$



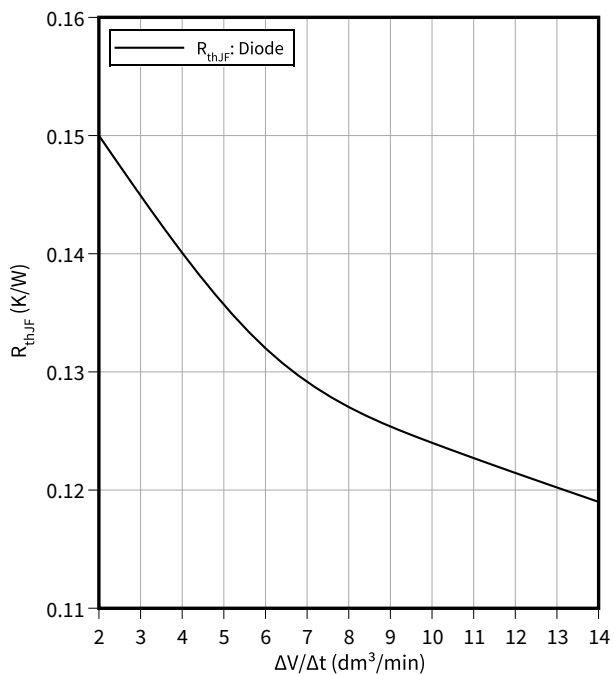
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



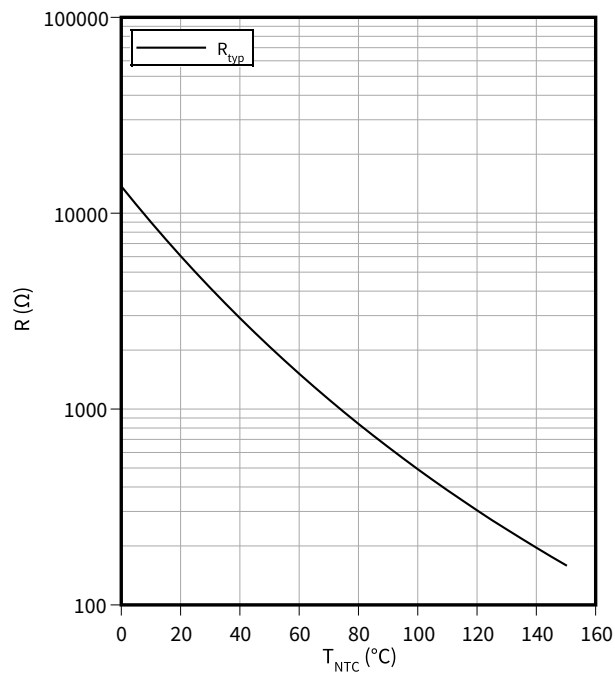
Thermal impedance, Diode, Inverter

$$R_{thJF} = f(\Delta V/\Delta t)$$



Temperature characteristic (typical), NTC-Thermistor

$$R = f(T_{NTC})$$



6 Circuit diagram

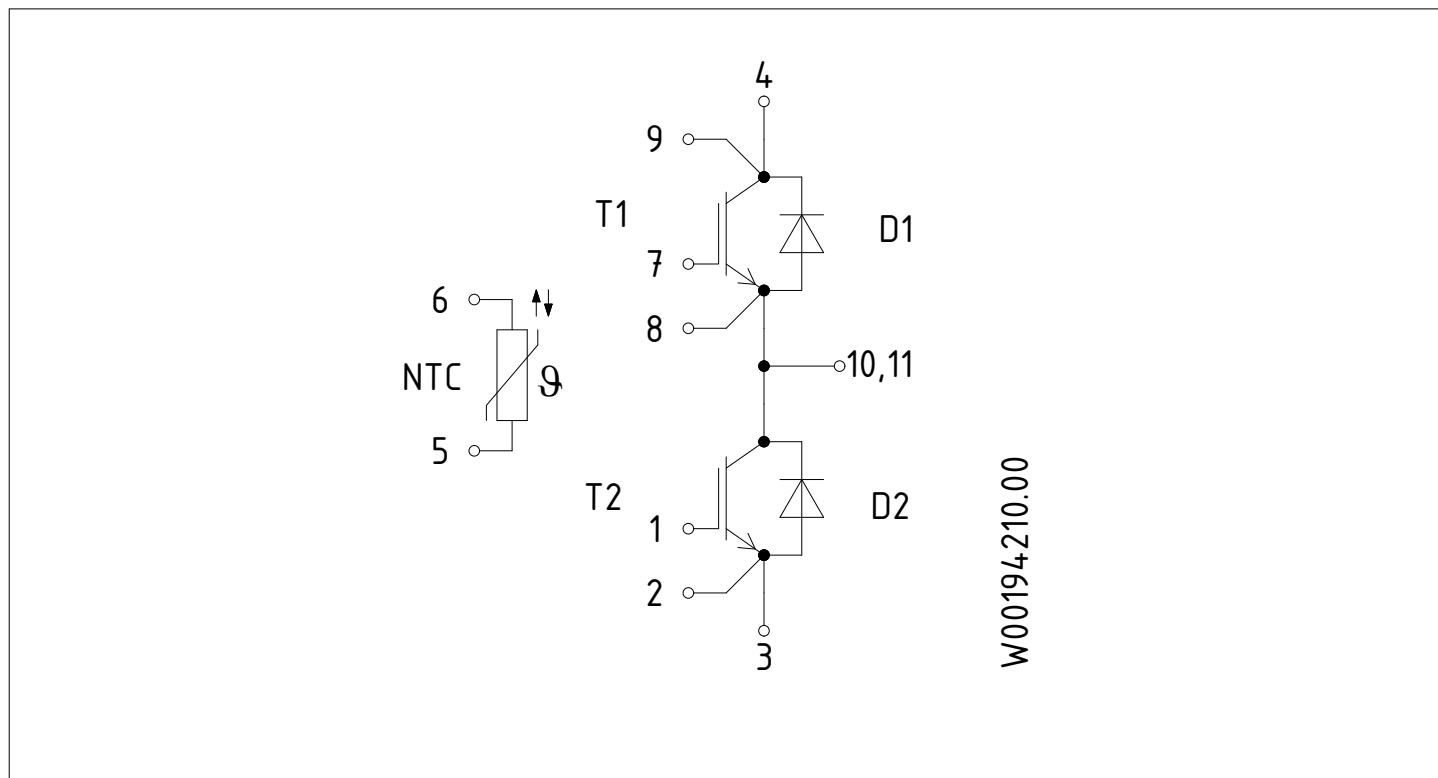


Figure 1

7 Package outlines

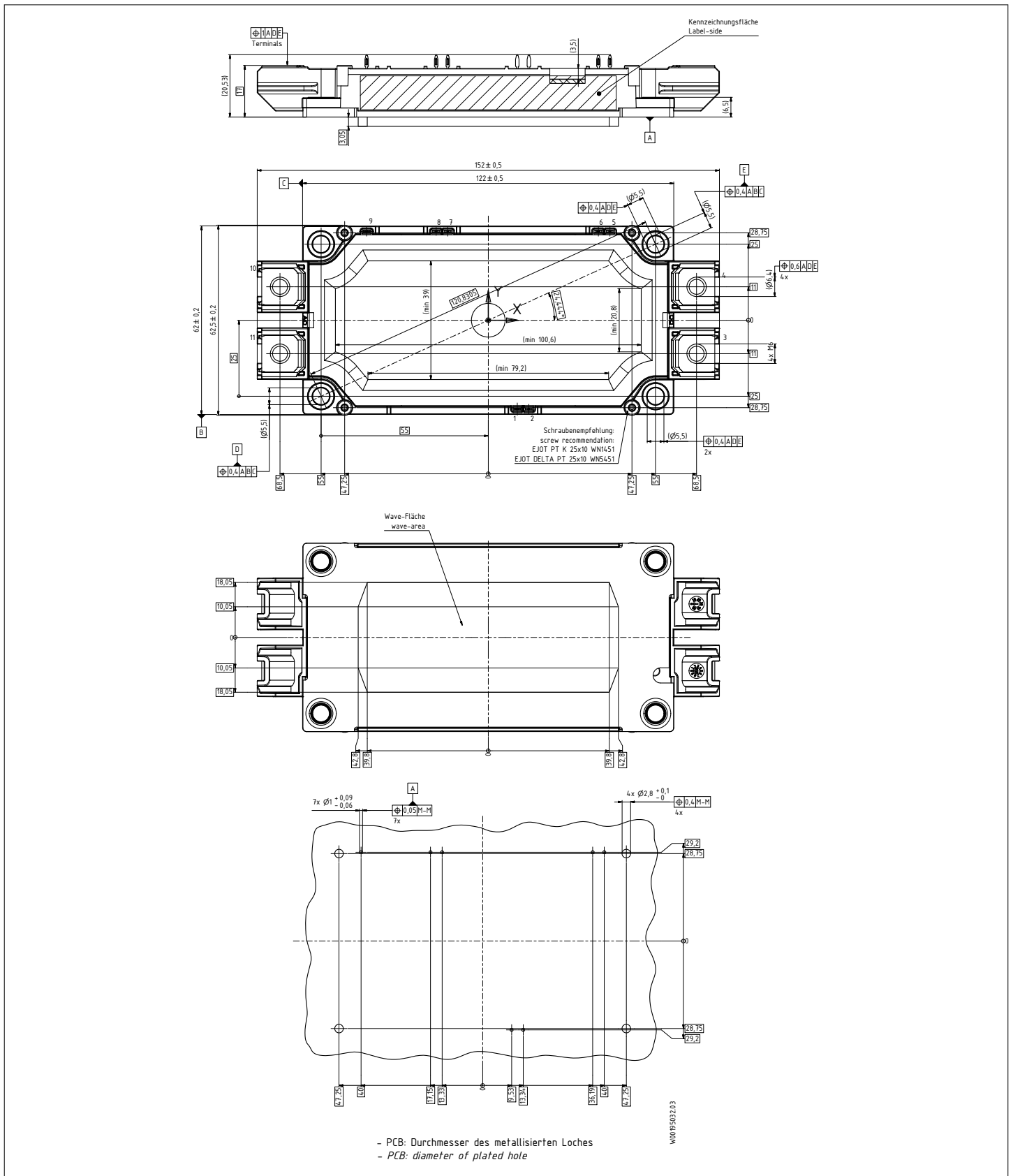


Figure 2

8 Module label code


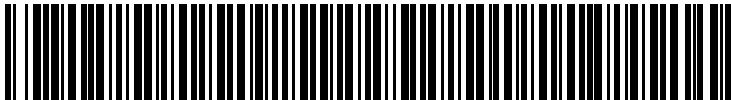
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	<i>Content</i> Module serial number Module material number Production order number Date code (production year) Date code (production week)	<i>Digit</i> 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	<i>Example</i> 71549 142846 55054991 15 30
Example	 		<p>71549142846550549911530</p> <p>71549142846550549911530</p>

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-11-26	Target 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
0.10	2021-08-30	Target datasheet
1.00	2022-04-01	Final datasheet

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