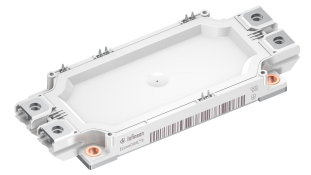


EconoDUAL™3 module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1700\text{ V}$
 - $I_{C\text{nom}} = 225\text{ A} / I_{CRM} = 450\text{ A}$
 - Integrated temperature sensor
 - High current density
 - Low $V_{CE,sat}$
 - Overload operation up to 175°C
 - TRENCHSTOP™ IGBT7
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - High power density
 - Isolated base plate
 - PressFIT contact technology
 - Standard housing



Potential applications

- High-power converters
- Medium-voltage converters
- Motor drives
- Wind turbines

Product validation

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

Description

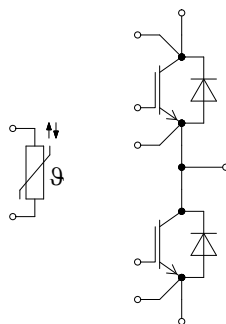


Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT, Inverter	3
3	Diode, Inverter	5
4	NTC-Thermistor	6
5	Characteristics diagrams	8
6	Circuit diagram	13
7	Package outlines	14
8	Module label code	15
	Revision history	16
	Disclaimer	17

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)	Al2O3	
Creepage distance	d_{Creep}	terminal to heatsink	15.0	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.	
Stray inductance module	L_{sCE}			20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T=25^{\circ}\text{C}$, 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}	$T_{vj} = 25^{\circ}\text{C}$	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 175^{\circ}\text{C}$ $T_C = 100^{\circ}\text{C}$	225	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\text{ op}}$	450	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	$V_{CE\ sat}$	$I_C = 225\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.70	1.85	V
			$T_{vj} = 125\ ^\circ C$		1.95		
			$T_{vj} = 150\ ^\circ C$		2.05		
			$T_{vj} = 175\ ^\circ C$		2.10		
Gate threshold voltage	V_{GEth}	$I_C = 4.62\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 900\ V$			2.1		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			1		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			22.9		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.08		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			5	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.110		μs
			$T_{vj} = 125\ ^\circ C$		0.120		
			$T_{vj} = 150\ ^\circ C$		0.125		
			$T_{vj} = 175\ ^\circ C$		0.130		
Rise time (inductive load)	t_r	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.025		μs
			$T_{vj} = 125\ ^\circ C$		0.030		
			$T_{vj} = 150\ ^\circ C$		0.032		
			$T_{vj} = 175\ ^\circ C$		0.034		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.467		μs
			$T_{vj} = 125\ ^\circ C$		0.553		
			$T_{vj} = 150\ ^\circ C$		0.570		
			$T_{vj} = 175\ ^\circ C$		0.586		
Fall time (inductive load)	t_f	$I_C = 225\ A, V_{CE} = 900\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.271		μs
			$T_{vj} = 125\ ^\circ C$		0.494		
			$T_{vj} = 150\ ^\circ C$		0.567		
			$T_{vj} = 175\ ^\circ C$		0.640		
Turn-on energy loss per pulse	E_{on}	$I_C = 225\ A, V_{CE} = 900\ V, L_\sigma = 25\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.5\ \Omega, di/dt = 5100\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		28.2		mJ
			$T_{vj} = 125\ ^\circ C$		49.4		
			$T_{vj} = 150\ ^\circ C$		55.5		
			$T_{vj} = 175\ ^\circ C$		61.5		

(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}	$I_C = 225\text{ A}, V_{CE} = 900\text{ V}, L_\sigma = 25\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 6.2\ \Omega, dv/dt = 3500\text{ V}/\mu\text{s} (T_{vj} = 175\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$		37.3	mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$		59.4	
			$T_{vj} = 150\text{ }^\circ\text{C}$		65.5	
			$T_{vj} = 175\text{ }^\circ\text{C}$		71.5	
SC data	I_{SC}	$V_{GE} = 15\text{ V}, V_{CC} = 1000\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$		870	A
			$t_p \leq 6\ \mu\text{s}, T_{vj} = 175\text{ }^\circ\text{C}$		840	
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.145	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m} \cdot \text{K})$		0.0270		K/W
Temperature under switching conditions	$T_{vj\ op}$		-40		175	$^\circ\text{C}$

Note: $T_{vj\ op} > 150\text{ }^\circ\text{C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25\text{ }^\circ\text{C}$	1700	V	
Continuous DC forward current	I_F		225	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	450	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	4660	A^2s
			$T_{vj} = 175\text{ }^\circ\text{C}$	3860	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 225 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		2.35	2.50	V
			$T_{vj} = 125 \text{ °C}$		2.25		
			$T_{vj} = 150 \text{ °C}$		2.20		
			$T_{vj} = 175 \text{ °C}$		2.10		
Peak reverse recovery current	I_{RM}	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		332		A
			$T_{vj} = 125 \text{ °C}$		356		
			$T_{vj} = 150 \text{ °C}$		360		
			$T_{vj} = 175 \text{ °C}$		363		
Recovered charge	Q_r	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		30.4		μC
			$T_{vj} = 125 \text{ °C}$		57.2		
			$T_{vj} = 150 \text{ °C}$		66		
			$T_{vj} = 175 \text{ °C}$		75.3		
Reverse recovery energy	E_{rec}	$V_R = 900 \text{ V}, I_F = 225 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6700 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		16.1		mJ
			$T_{vj} = 125 \text{ °C}$		33		
			$T_{vj} = 150 \text{ °C}$		38.7		
			$T_{vj} = 175 \text{ °C}$		44.4		
Thermal resistance, junction to case	R_{thJC}	per diode			0.237	K/W	
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}^*\text{K})$		0.0300		K/W	
Temperature under switching conditions	$T_{vj\ op}$		-40		175	°C	

Note: $T_{vj\ op} > 150 \text{ °C}$ is only allowed for operation at overload conditions. For detailed specifications please refer to AN 2018-14.

4 NTC-Thermistor

Table 7 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ }\Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			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

(table continues...)

Table 7 (continued) **Characteristic values**

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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

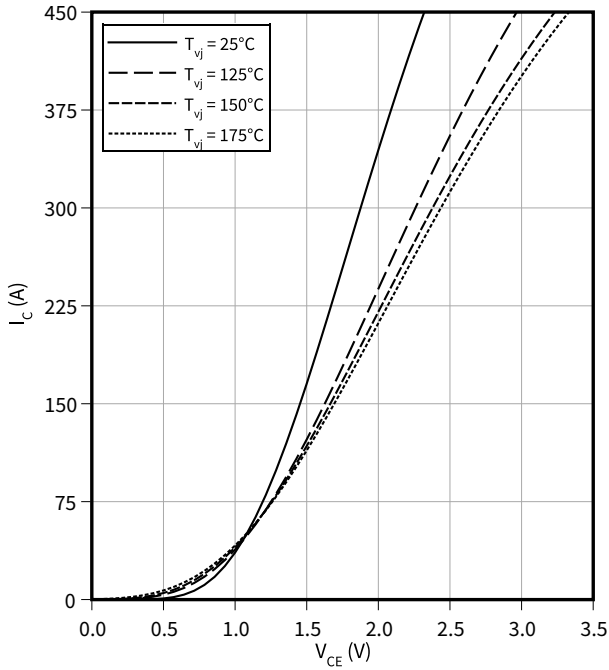
Note: Specification according to the valid application note.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

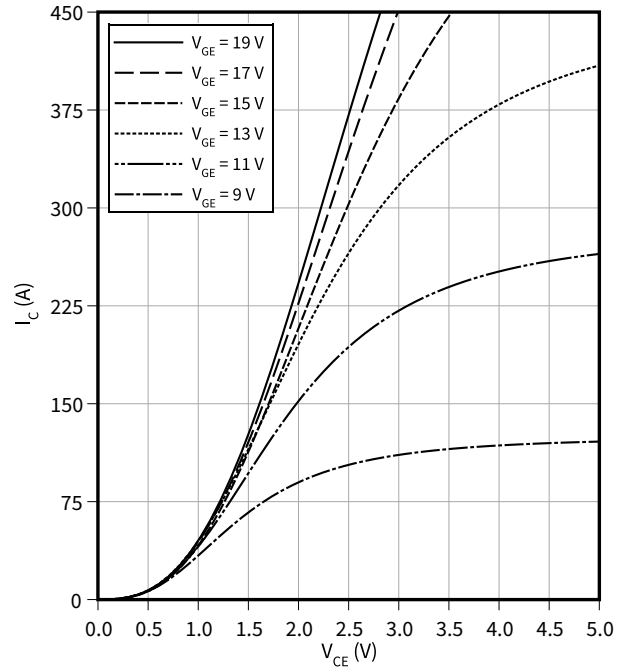
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

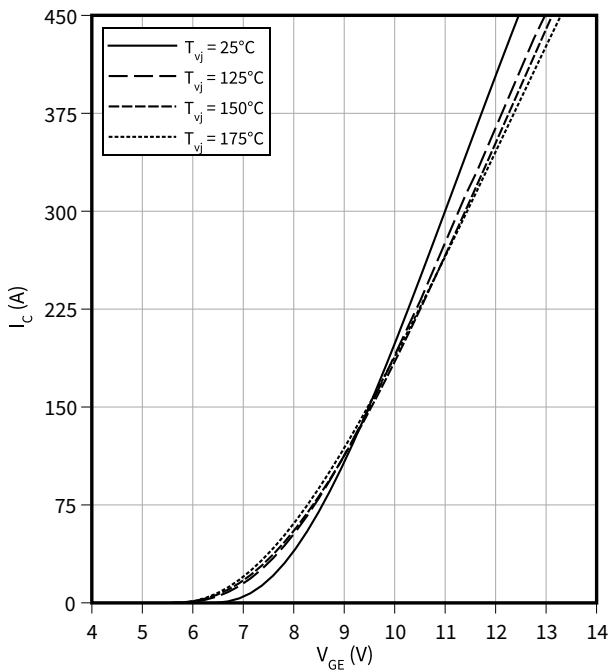
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

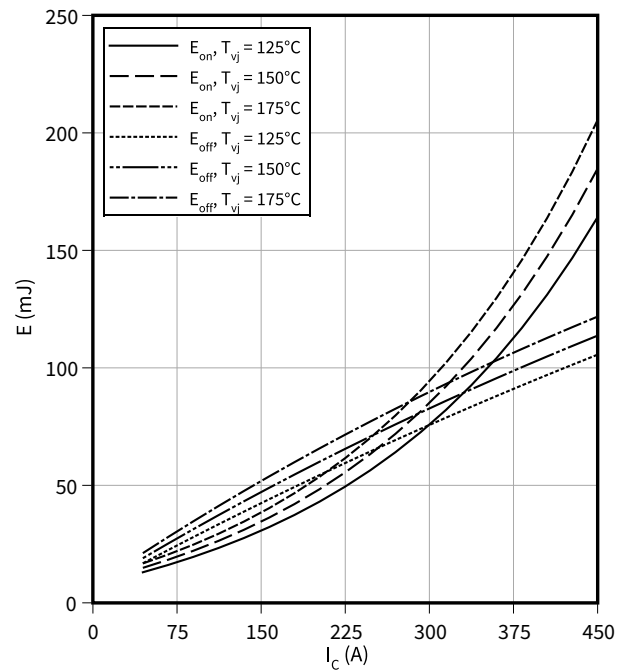
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 6.2 \text{ } \Omega, R_{Gon} = 1.5 \text{ } \Omega, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

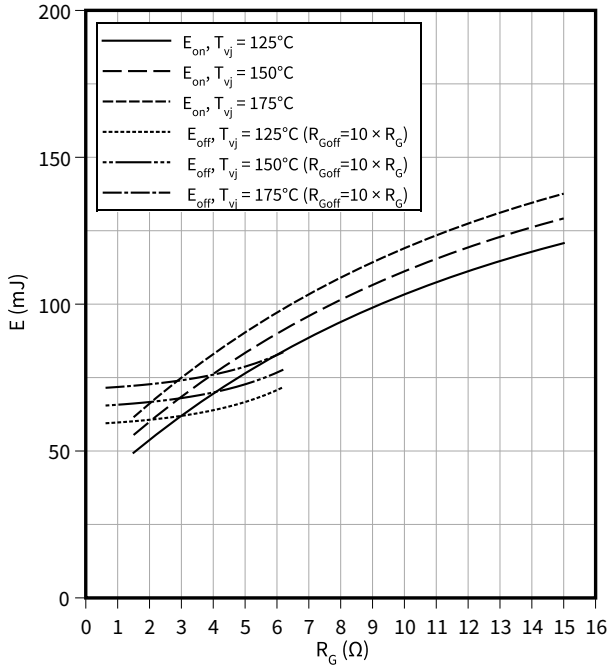


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

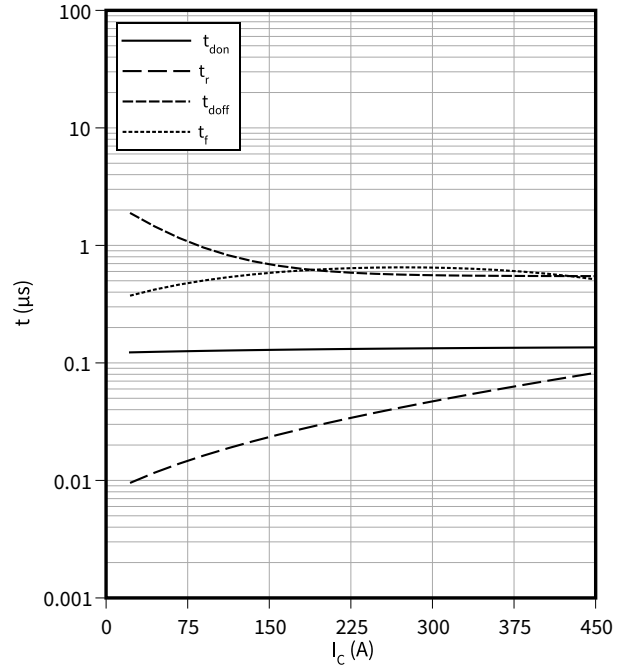
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

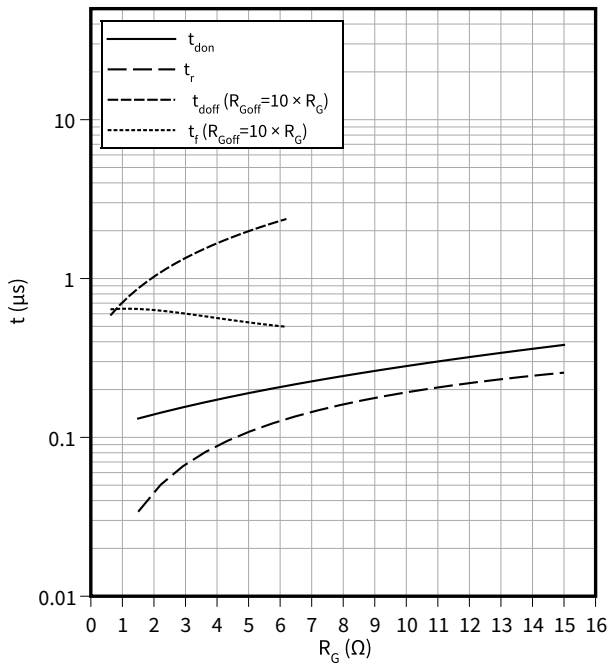
$R_{Goff} = 6.2 \Omega, R_{Gon} = 1.5 \Omega, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

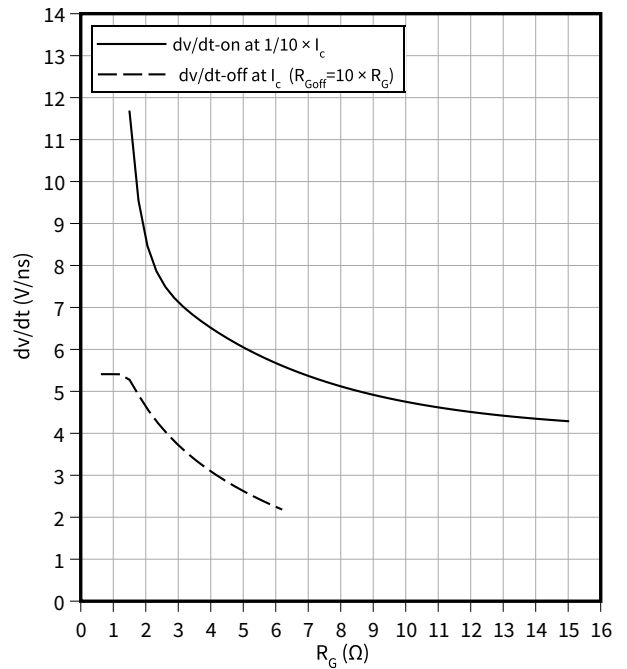
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

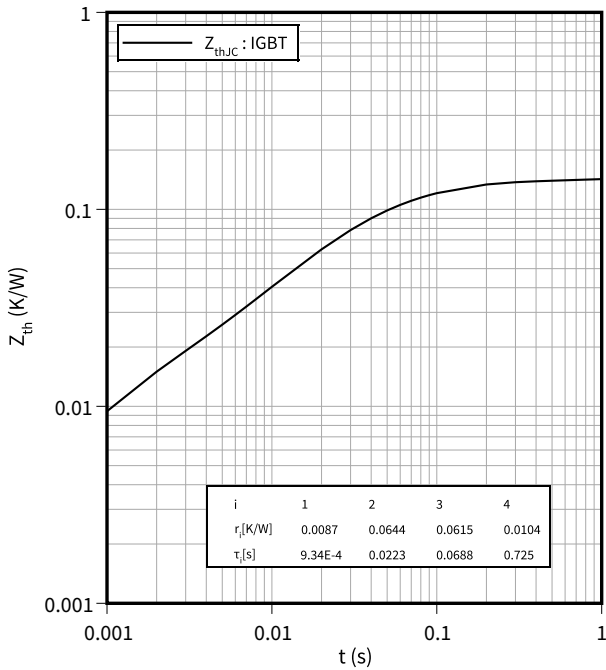
$I_C = 225 \text{ A}, V_{CE} = 900 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25 \text{ °C}$



5 Characteristics diagrams

Transient thermal impedance , IGBT, Inverter

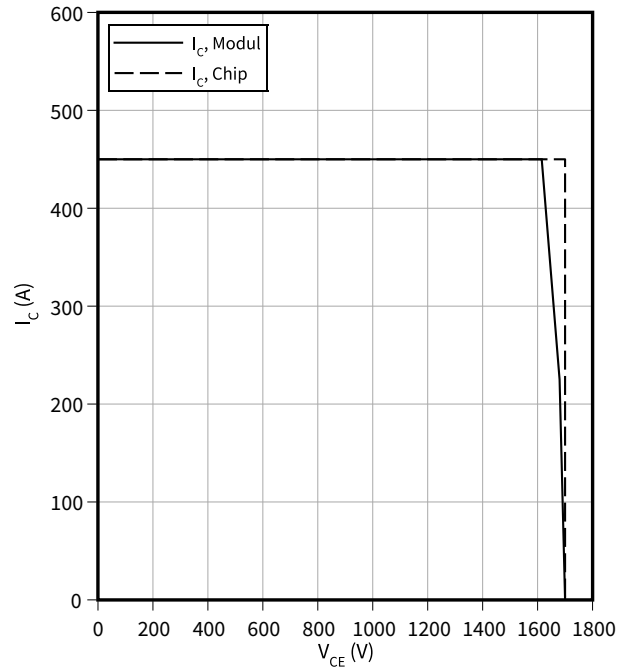
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

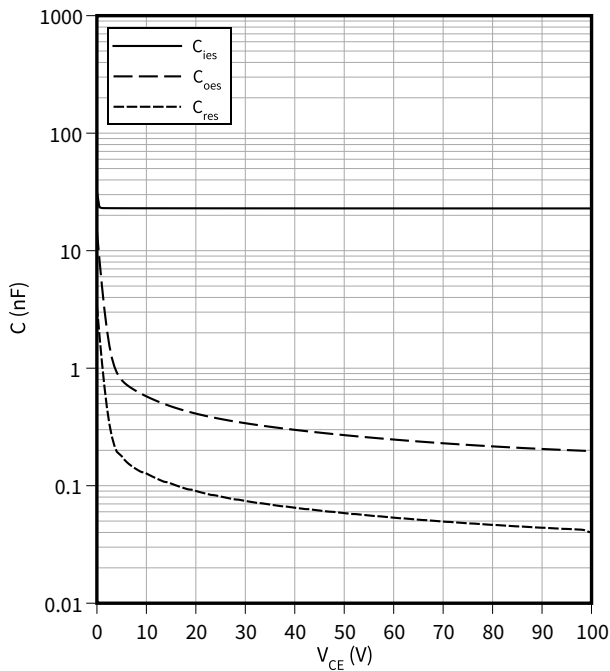
$R_{Goff} = 6.2 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

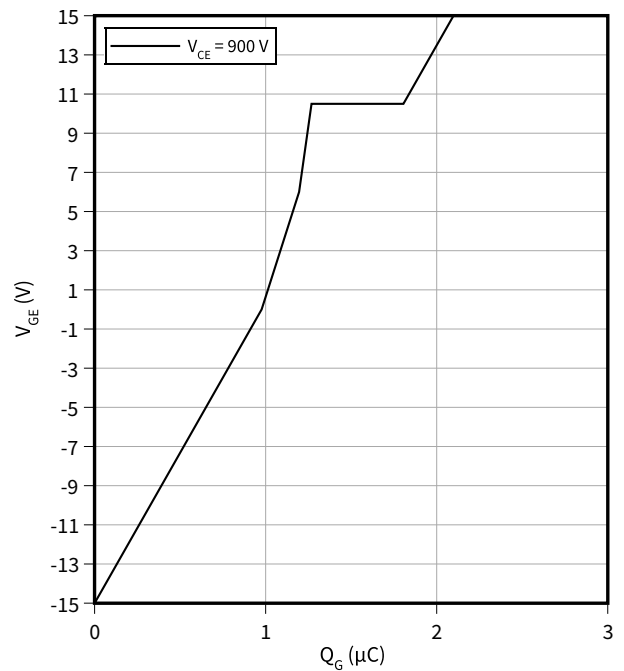
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



Gate charge characteristic (typical), IGBT, Inverter

$V_{GE} = f(Q_G)$

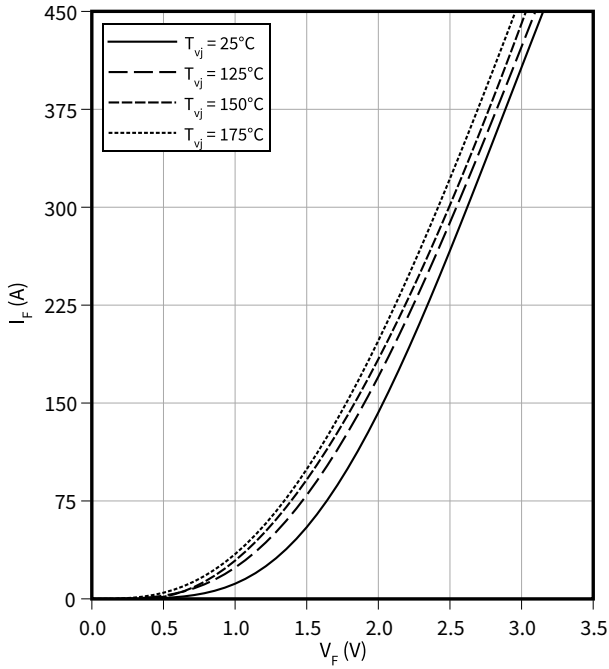
$I_C = 225 A, T_{vj} = 25 \text{ }^\circ\text{C}$



5 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

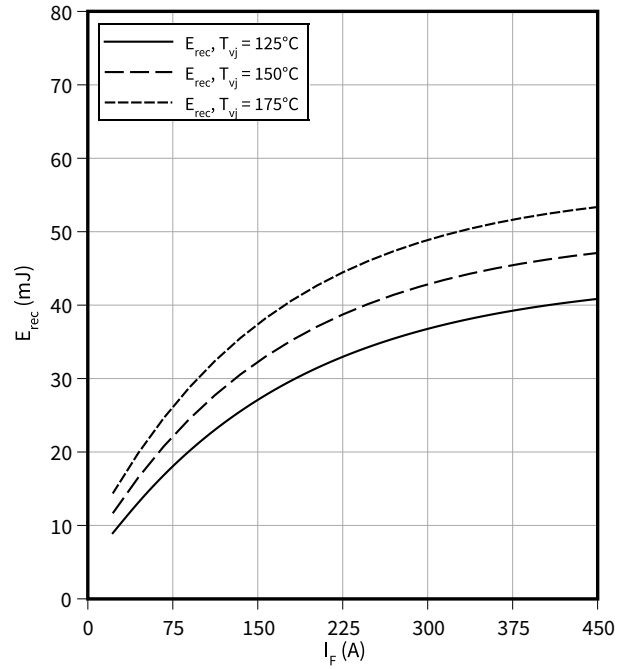
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

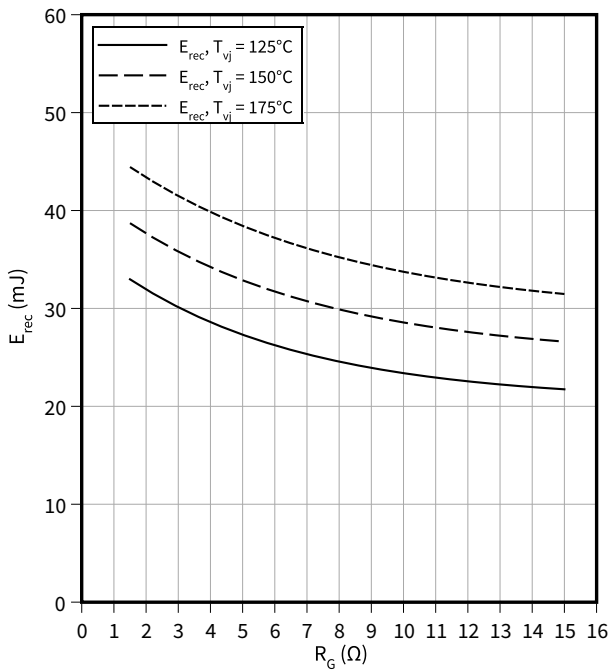
$R_{Gon} = 1.5 \Omega, V_R = 900 V$



Switching losses (typical), Diode, Inverter

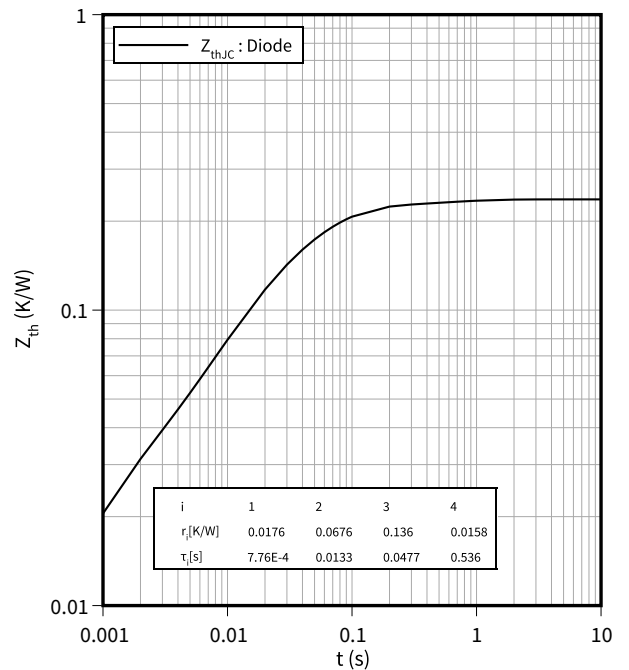
$E_{rec} = f(R_G)$

$I_F = 225 A, V_R = 900 V$



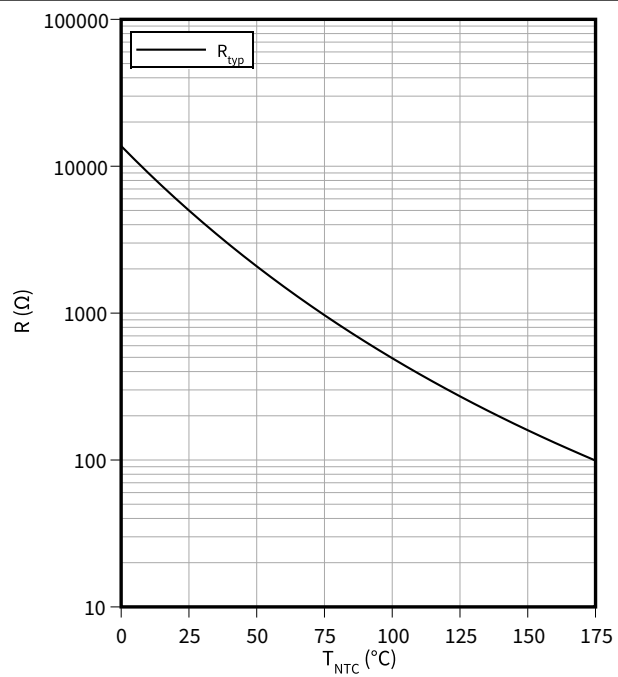
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

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



6 Circuit diagram

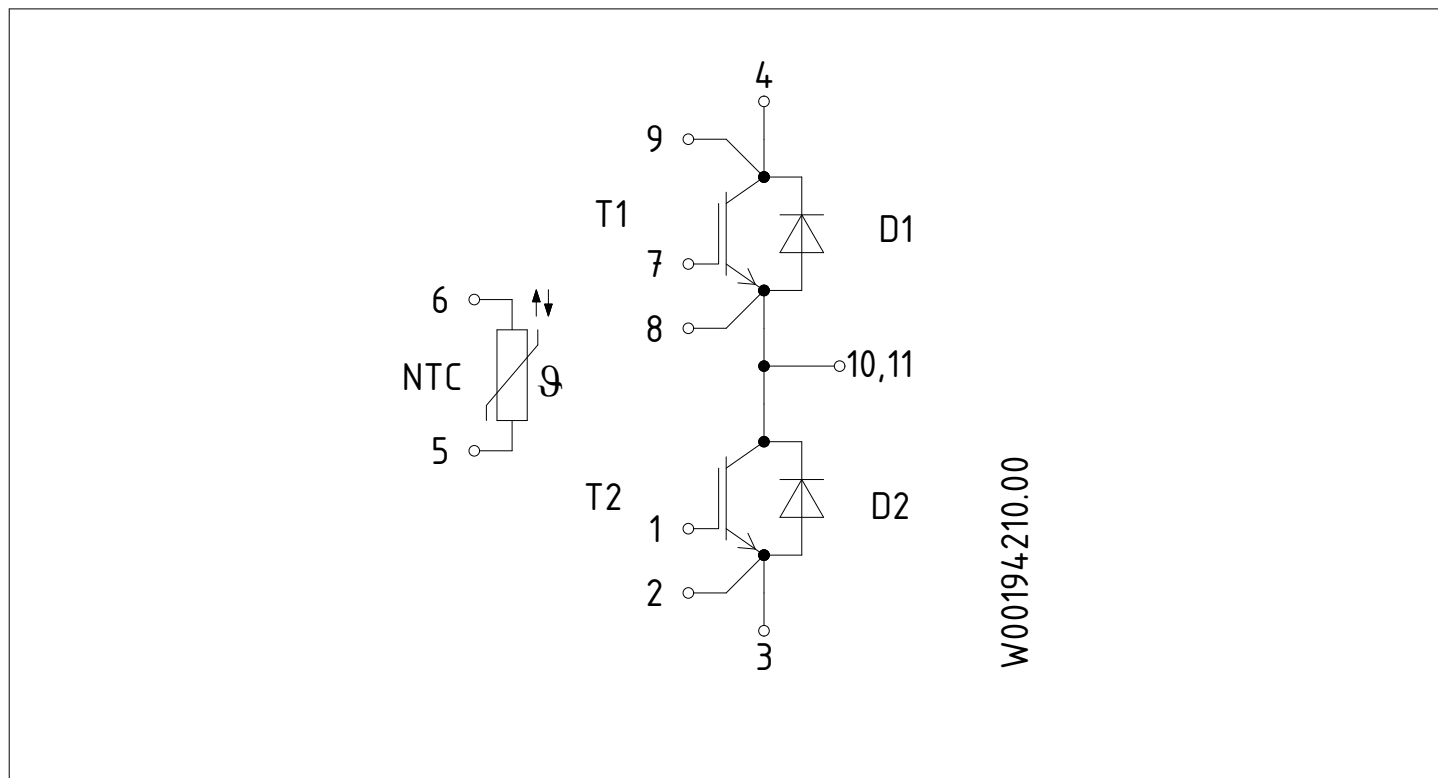


Figure 1

7 Package outlines

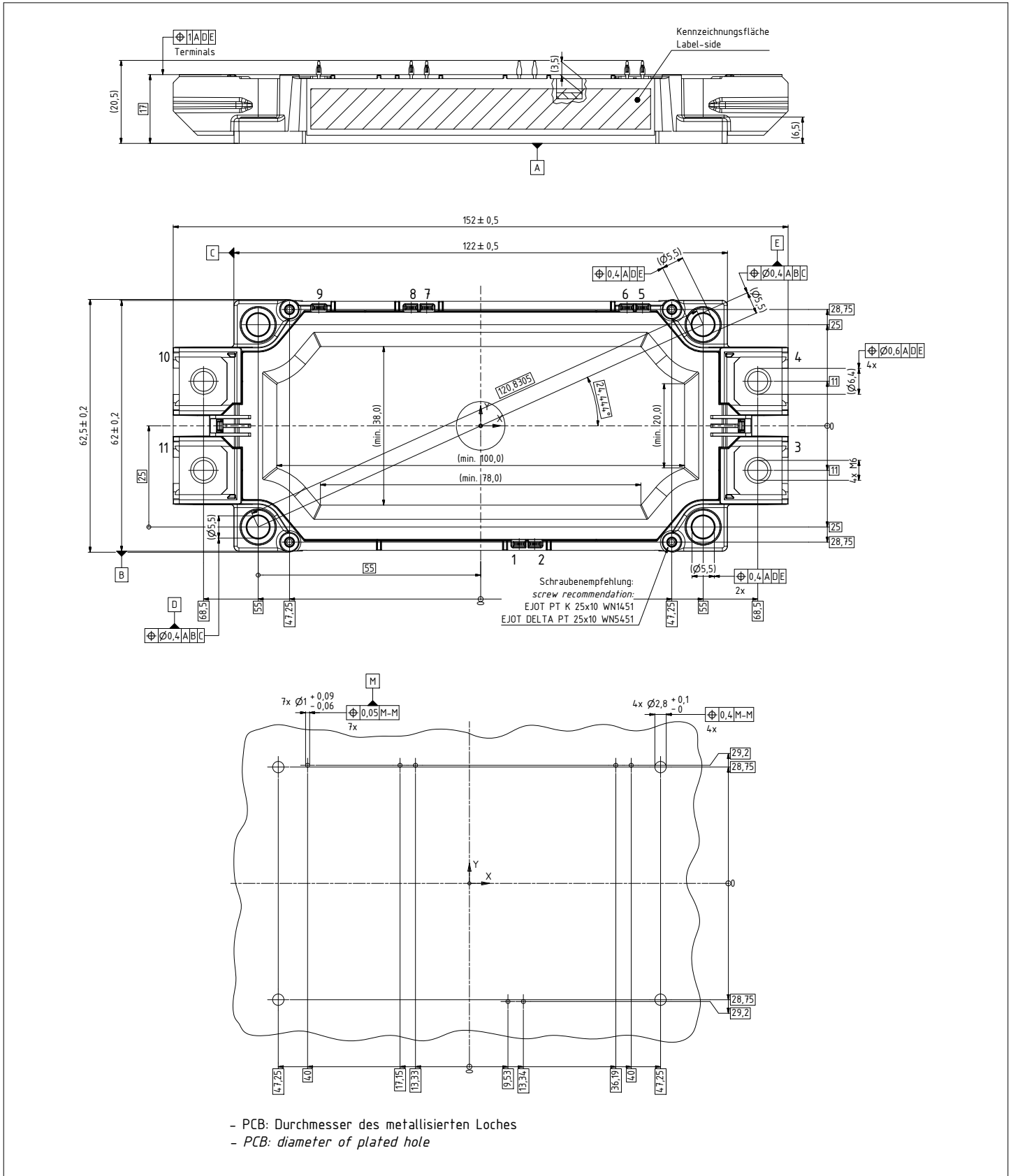


Figure 2

8 Module label code


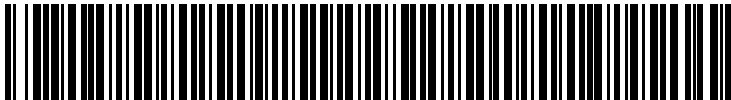
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content	Digit	Example
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 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
1.00	2022-03-10	Initial version
1.10	2022-03-18	Final datasheet

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