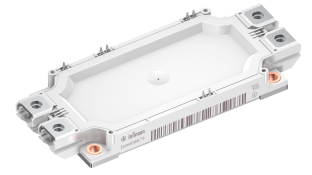


EconoDUAL™3 module with TRENCHSTOP™ IGBT7 and emitter controlled 7 diode and NTC

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{nom}} = 750\text{ A} / I_{CRM} = 1500\text{ A}$
 - Integrated temperature sensor
 - TRENCHSTOP™ IGBT7
 - $V_{CE,\text{sat}}$ with positive temperature coefficient
- Mechanical features
 - PressFIT contact technology
 - Standard housing
 - Isolated base plate
 - High power density



Potential applications

- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- UPS systems

Product validation

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

Description

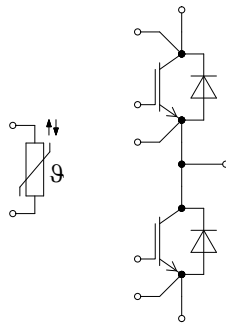


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	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	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	$R_{CC'+EE'}$	$T_C = 25^\circ\text{C}$, per switch		0.8		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}	$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175^\circ\text{C}$ $T_C = 90^\circ\text{C}$	750	A
Maximum RMS module DC-terminal current	I_{tRMS}	$T_{\text{Terminal}} = 90^\circ\text{C}$, $T_C = 90^\circ\text{C}$	580	A
		$T_{\text{Terminal}} = 105^\circ\text{C}$, $T_C = 90^\circ\text{C}$	565	

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	$t_p = 1 \text{ ms}$	1500	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	$V_{CE \text{ sat}}$	$I_C = 750 \text{ A}, V_{GE} = 15 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.50	1.75	V
			$T_{vj} = 125 \text{ °C}$	1.65		
			$T_{vj} = 175 \text{ °C}$	1.75		
Gate threshold voltage	V_{Geth}	$I_C = 15 \text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25 \text{ °C}$	5.15	5.80	6.45	V
Gate charge	Q_G	$V_{GE} = \pm 15 \text{ V}, V_{CE} = 600 \text{ V}$		12		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25 \text{ °C}$		0.5		Ω
Input capacitance	C_{ies}	$f = 100 \text{ kHz}, T_{vj} = 25 \text{ °C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		115		nF
Reverse transfer capacitance	C_{res}	$f = 100 \text{ kHz}, T_{vj} = 25 \text{ °C}, V_{CE} = 25 \text{ V}, V_{GE} = 0 \text{ V}$		0.58		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200 \text{ V}, V_{GE} = 0 \text{ V}$			45	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0 \text{ V}, V_{GE} = 20 \text{ V}, T_{vj} = 25 \text{ °C}$			100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \text{ } \Omega$	$T_{vj} = 25 \text{ °C}$	0.300		μs
			$T_{vj} = 125 \text{ °C}$	0.320		
			$T_{vj} = 175 \text{ °C}$	0.340		
Rise time (inductive load)	t_r	$I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \text{ } \Omega$	$T_{vj} = 25 \text{ °C}$	0.079		μs
			$T_{vj} = 125 \text{ °C}$	0.086		
			$T_{vj} = 175 \text{ °C}$	0.090		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.5 \text{ } \Omega$	$T_{vj} = 25 \text{ °C}$	0.470		μs
			$T_{vj} = 125 \text{ °C}$	0.550		
			$T_{vj} = 175 \text{ °C}$	0.600		
Fall time (inductive load)	t_f	$I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, R_{Goff} = 0.5 \text{ } \Omega$	$T_{vj} = 25 \text{ °C}$	0.110		μs
			$T_{vj} = 125 \text{ °C}$	0.240		
			$T_{vj} = 175 \text{ °C}$	0.350		
Turn-on energy loss per pulse	E_{on}	$I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, L_\sigma = 25 \text{ nH}, V_{GE} = \pm 15 \text{ V}, R_{Gon} = 0.5 \text{ } \Omega, di/dt = 7000 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	53		mJ
			$T_{vj} = 125 \text{ °C}$	86		
			$T_{vj} = 175 \text{ °C}$	107		

(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}	$I_C = 750\text{ A}, V_{CE} = 600\text{ V}, L_\sigma = 25\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 0.5\ \Omega, dv/dt = 3100\text{ V}/\mu\text{s} (T_{vj} = 175\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$	65		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	97.5		
			$T_{vj} = 175\text{ }^\circ\text{C}$	121		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}, V_{CC} = 800\text{ V}, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 8\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$	2900		A
			$t_p \leq 6\ \mu\text{s}, T_{vj} = 175\text{ }^\circ\text{C}$	2800		
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.0520	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1\text{ W}/(\text{m} \cdot \text{K})$		0.0260		K/W
Temperature under switching conditions	T_{vjop}		-40		175	$^\circ\text{C}$

Note: $T_{vjop} > 150\text{ }^\circ\text{C}$ is 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}	$T_{vj} = 25\text{ }^\circ\text{C}$	1200	V	
Continuous DC forward current	I_F		750	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1500	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}, V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	28700	A^2s
			$T_{vj} = 175\text{ }^\circ\text{C}$	20500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 750\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$	1.80	2.10	V
			$T_{vj} = 125\text{ }^\circ\text{C}$	1.70		
			$T_{vj} = 175\text{ }^\circ\text{C}$	1.60		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	$V_R = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 7000\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	400		A
			$T_{vj} = 125\text{ °C}$	485		
			$T_{vj} = 175\text{ °C}$	561		
Recovered charge	Q_r	$V_R = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 7000\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	48		μC
			$T_{vj} = 125\text{ °C}$	84		
			$T_{vj} = 175\text{ °C}$	131		
Reverse recovery energy	E_{rec}	$V_R = 600\text{ V}$, $I_F = 750\text{ A}$, $V_{GE} = -15\text{ V}$, $-di_F/dt = 7000\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ °C}$)	$T_{vj} = 25\text{ °C}$	20		mJ
			$T_{vj} = 125\text{ °C}$	32		
			$T_{vj} = 175\text{ °C}$	53		
Thermal resistance, junction to case	R_{thJC}	per diode			0.101	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1\text{ W}/(\text{m}^*\text{K})$		0.0380		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		175	$^{\circ}\text{C}$

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

4 NTC-Thermistor

Table 7 Characteristic values

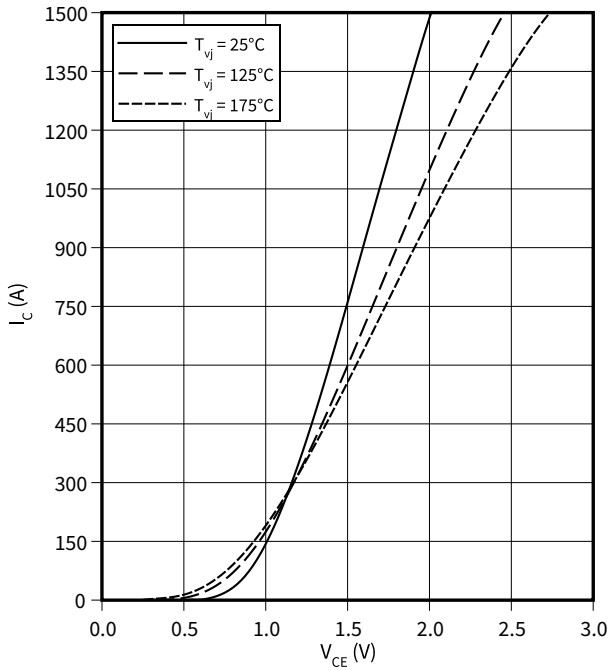
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25\text{ °C}$		5		k Ω
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100\text{ °C}$, $R_{100} = 493\text{ }\Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25\text{ °C}$			20	mW
B-value	$B_{25/50}$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

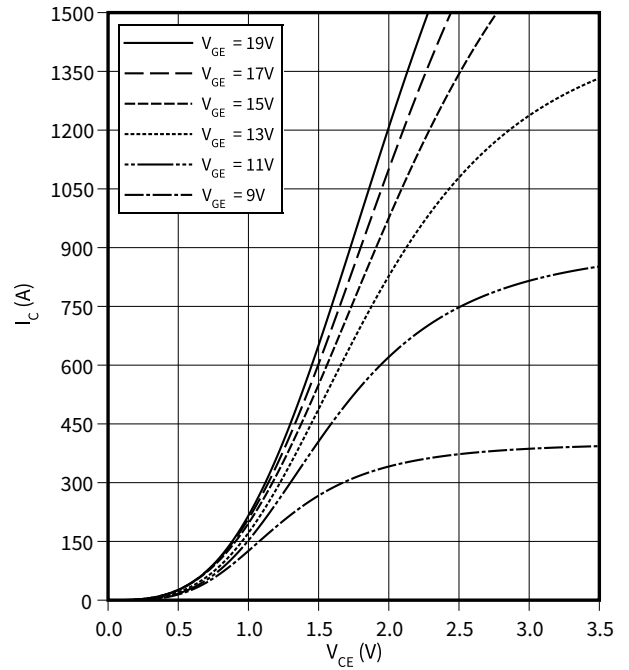
output characteristic (typical), IGBT, Inverter

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



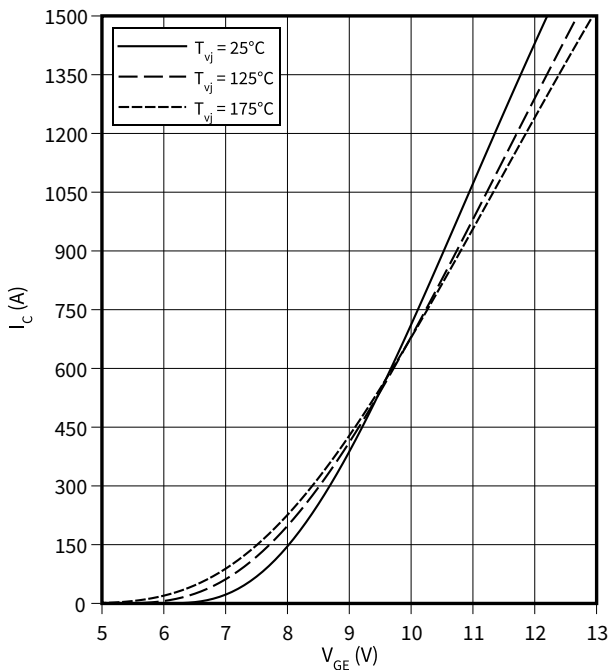
output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$
 $T_{vj} = 175\text{ °C}$



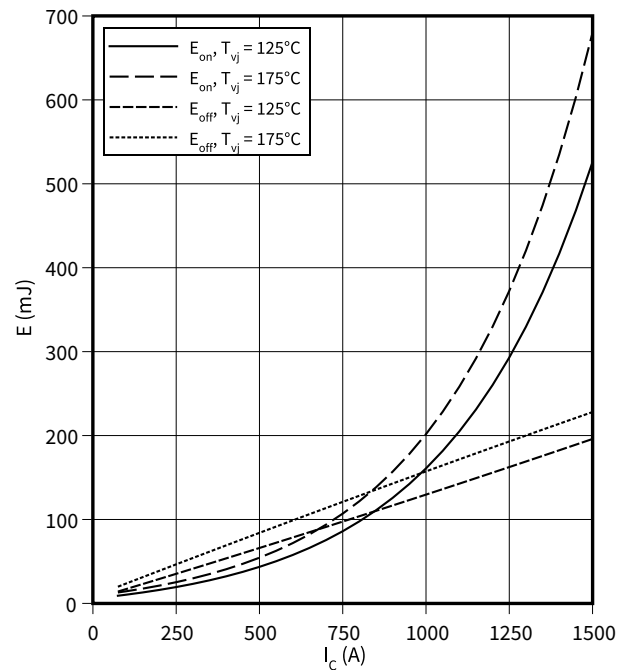
transfer characteristic (typical), IGBT, Inverter

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



switching losses (typical), IGBT, Inverter

$E = f(I_C)$
 $R_{Goff} = 0.5\ \Omega, R_{Gon} = 0.5\ \Omega, V_{CE} = 600\text{ V}, V_{GE} = -15 / 15\text{ V}$

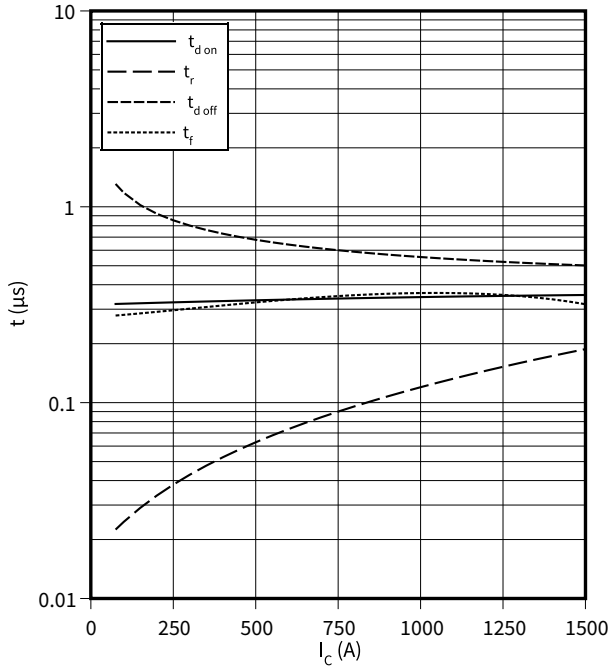


5 Characteristics diagrams

Switching times (typical), IGBT, Inverter

$t = f(I_C)$

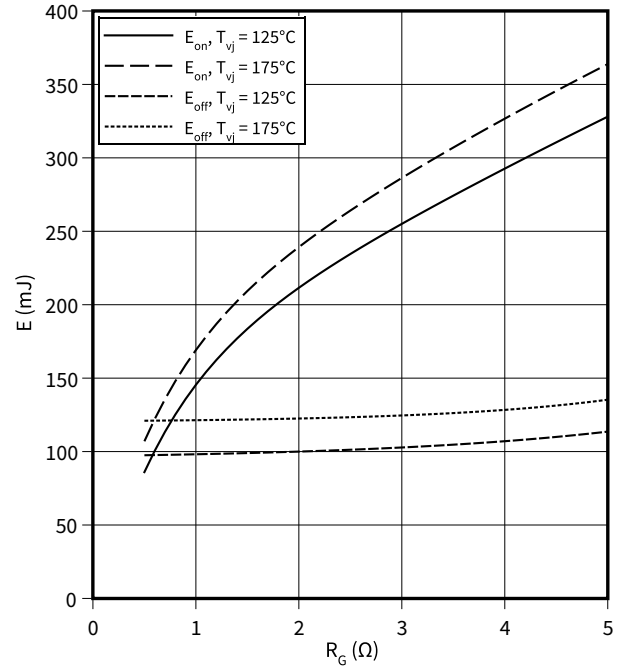
$R_{Goff} = 0.5 \Omega, R_{Gon} = 0.5 \Omega, V_{GE} = \pm 15 V, V_{CE} = 600 V, T_{vj} = 175 \text{ }^\circ\text{C}$



switching losses (typical), IGBT, Inverter

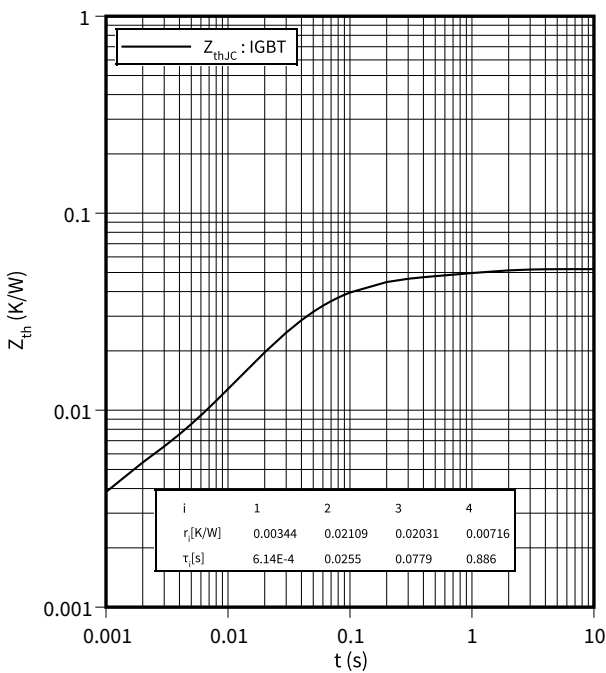
$E = f(R_G)$

$I_C = 750 A, V_{CE} = 600 V, V_{GE} = -15 / 15 V$



transient thermal impedance , IGBT, Inverter

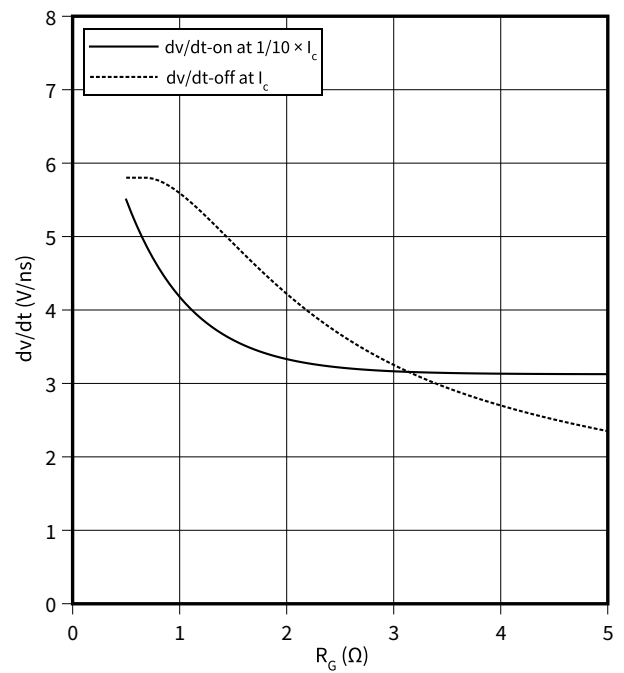
$Z_{th} = f(t)$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

$I_C = 750 A, V_{CE} = 600 V, V_{GE} = \pm 15 V, T_{vj} = 25 \text{ }^\circ\text{C}$

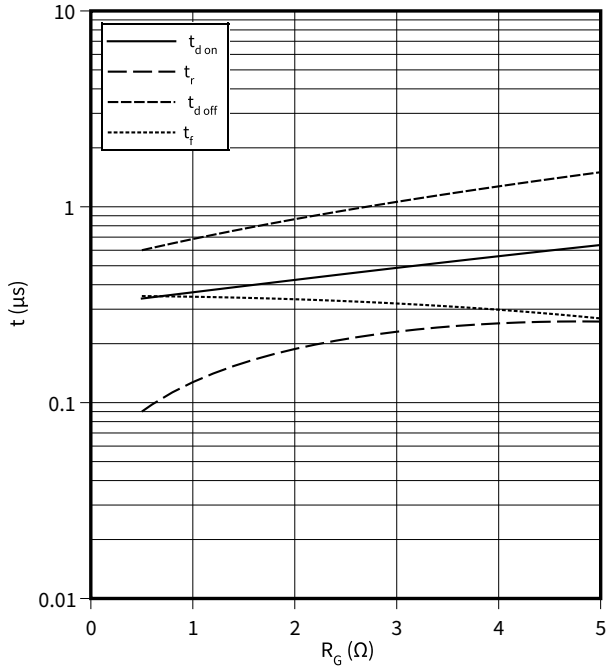


5 Characteristics diagrams

Switching times (typical), IGBT, Inverter

$t = f(R_G)$

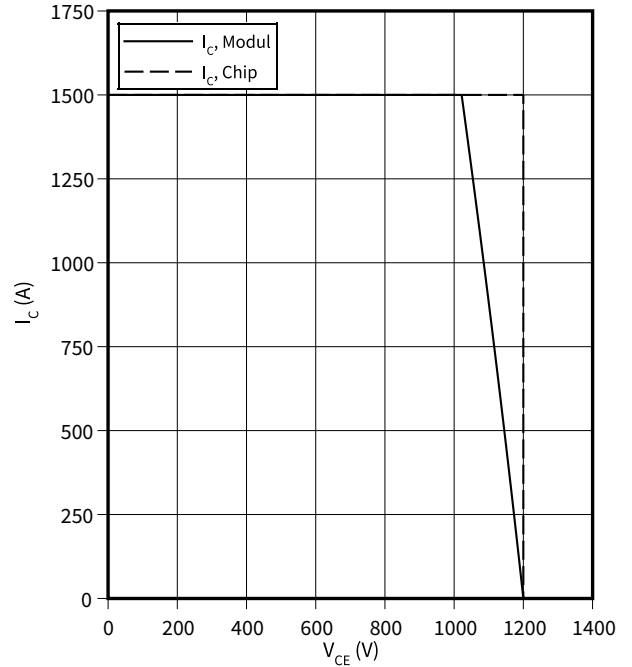
$V_{GE} = \pm 15 \text{ V}, I_C = 750 \text{ A}, V_{CE} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



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

$I_C = f(V_{CE})$

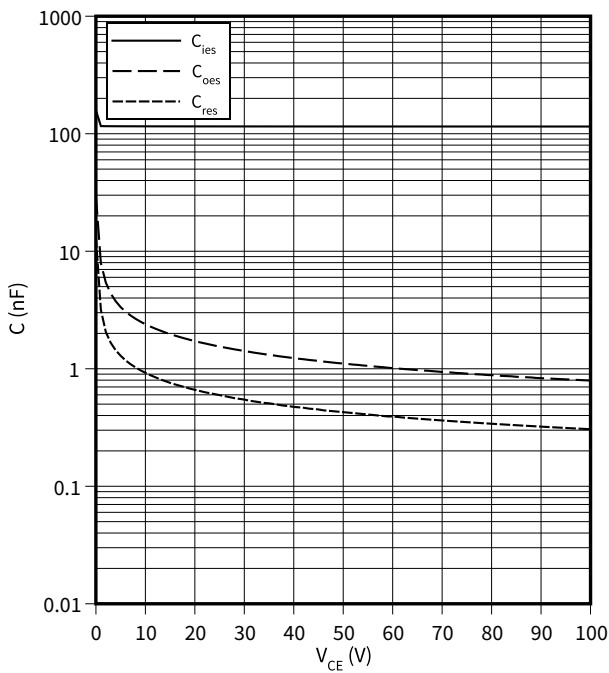
$R_{Goff} = 0.5 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

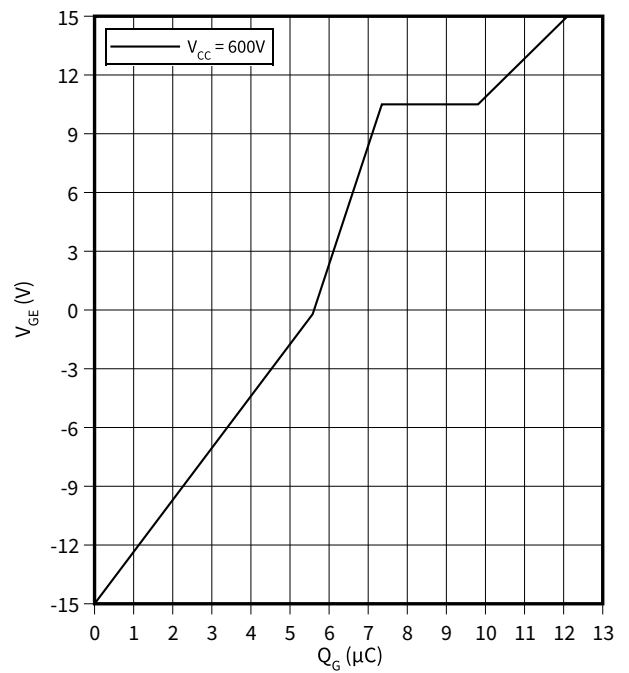
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



gate charge characteristic (typical), IGBT, Inverter

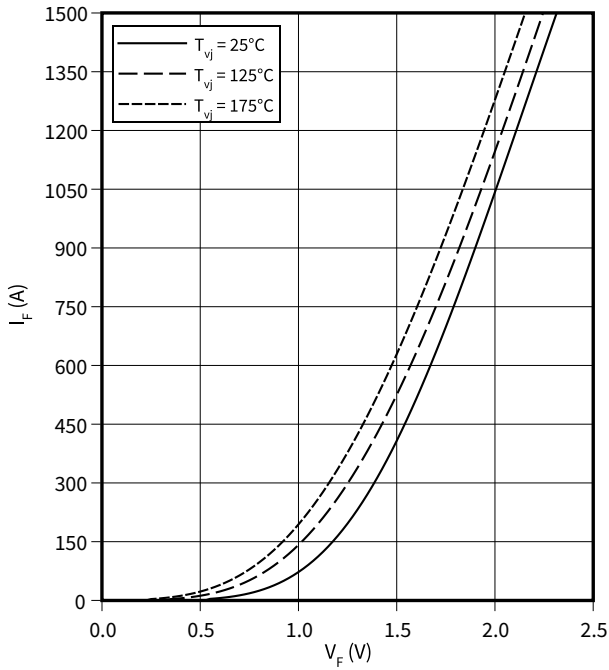
$V_{GE} = f(Q_G)$

$I_C = 750 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



forward characteristic (typical), Diode, Inverter

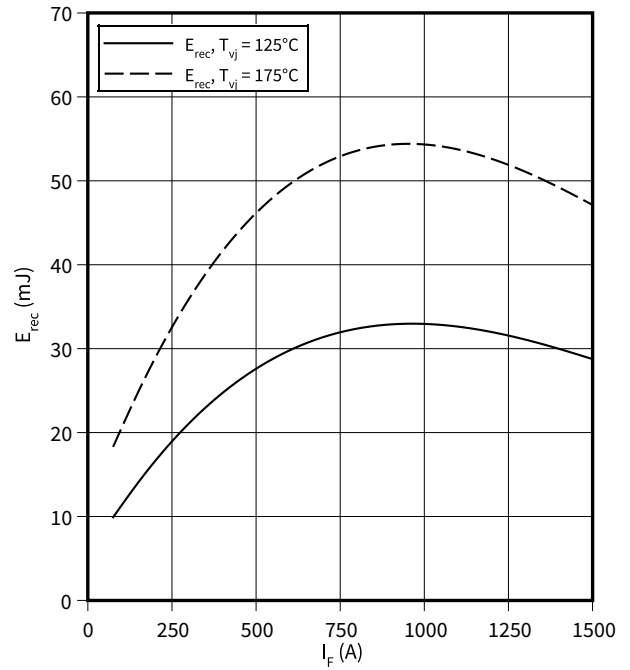
$I_F = f(V_F)$



switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

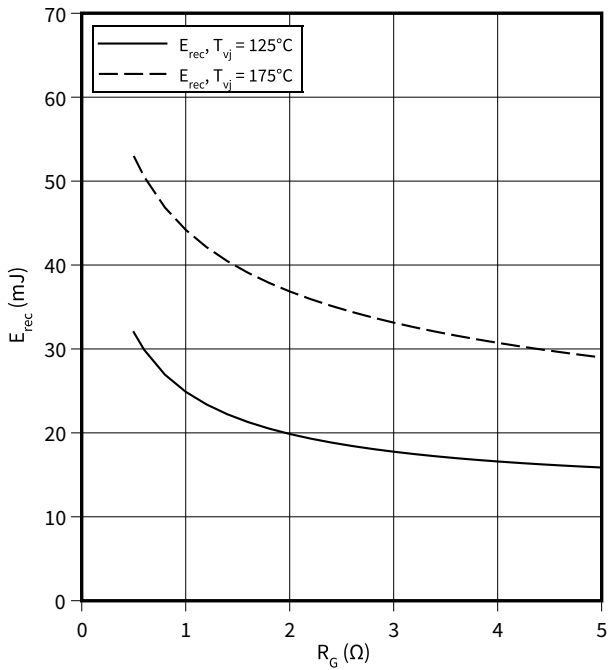
$V_{CE} = 600 \text{ V}, R_{Gon} = R_{Gon}(IGBT)$



switching losses (typical), Diode, Inverter

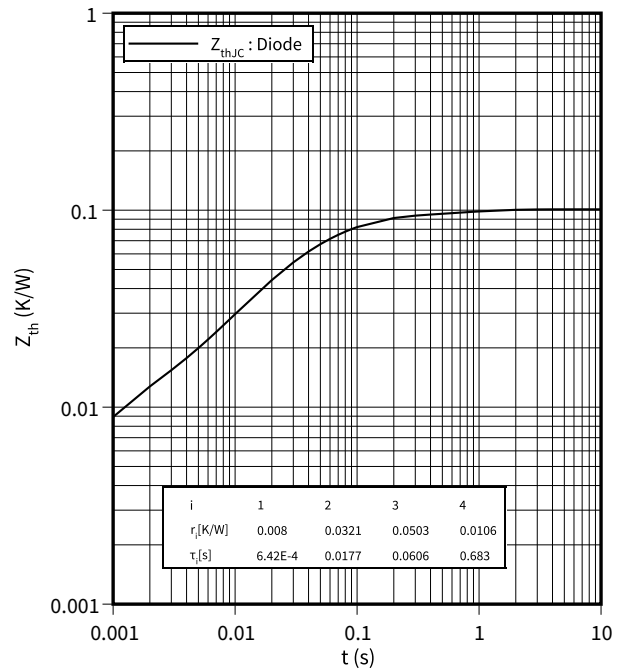
$E_{rec} = f(R_G)$

$V_{CE} = 600 \text{ V}, I_F = 750 \text{ A}$



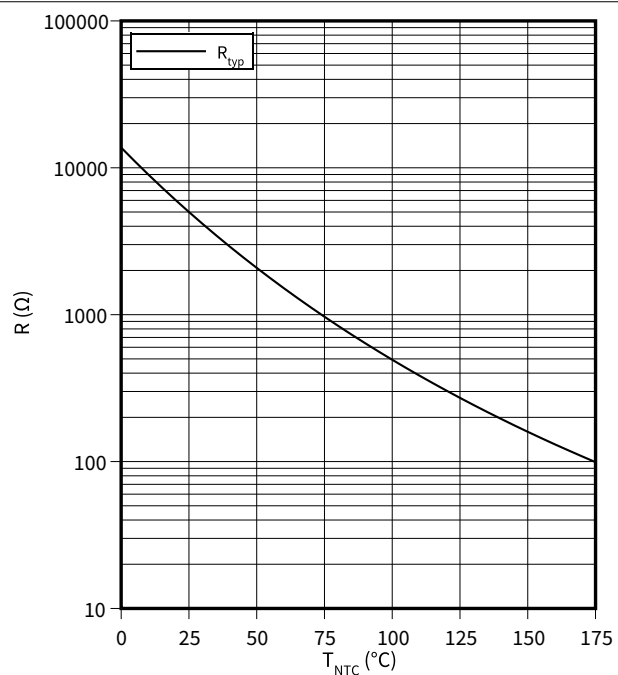
transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



temperature characteristic (typical), NTC-Thermistor

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



6 Circuit diagram

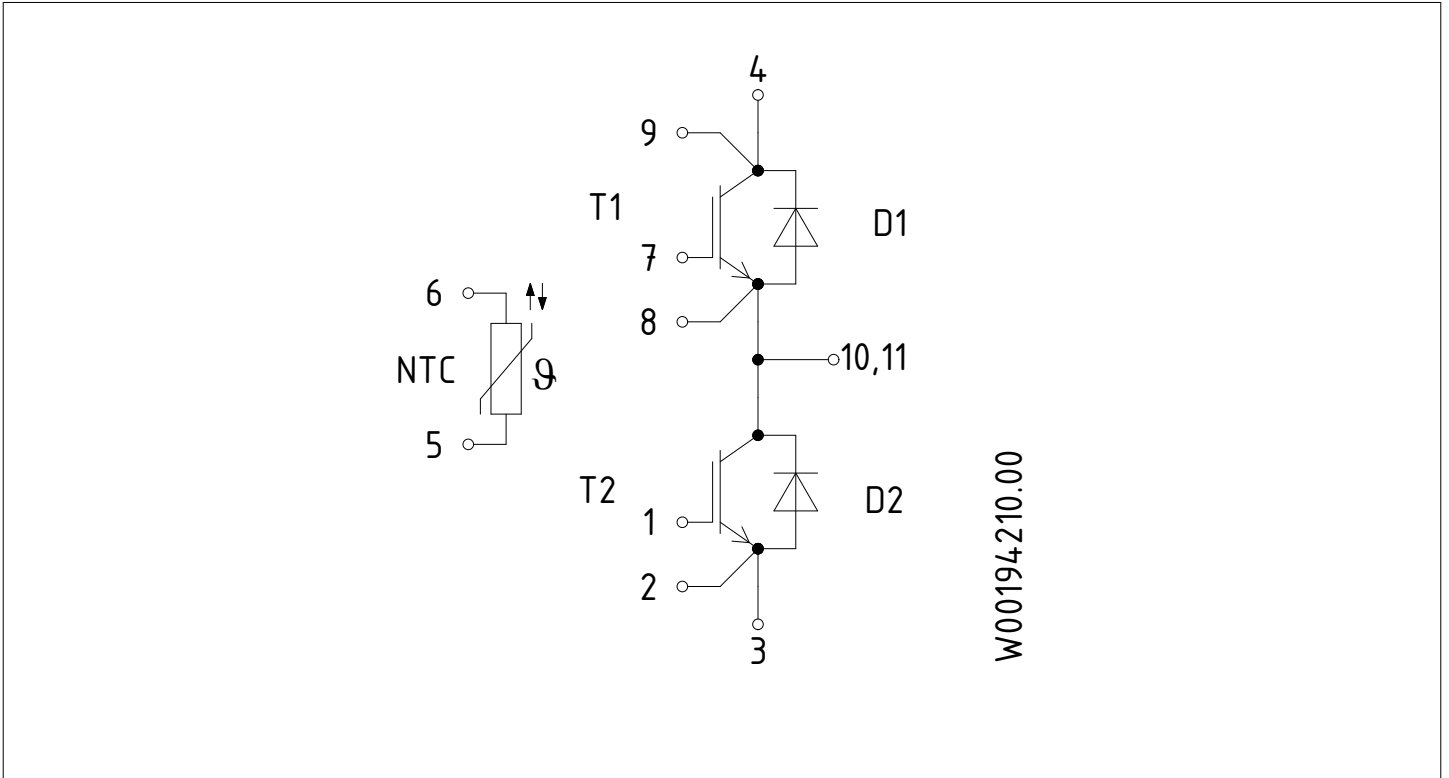


Figure 1

7 Package outlines

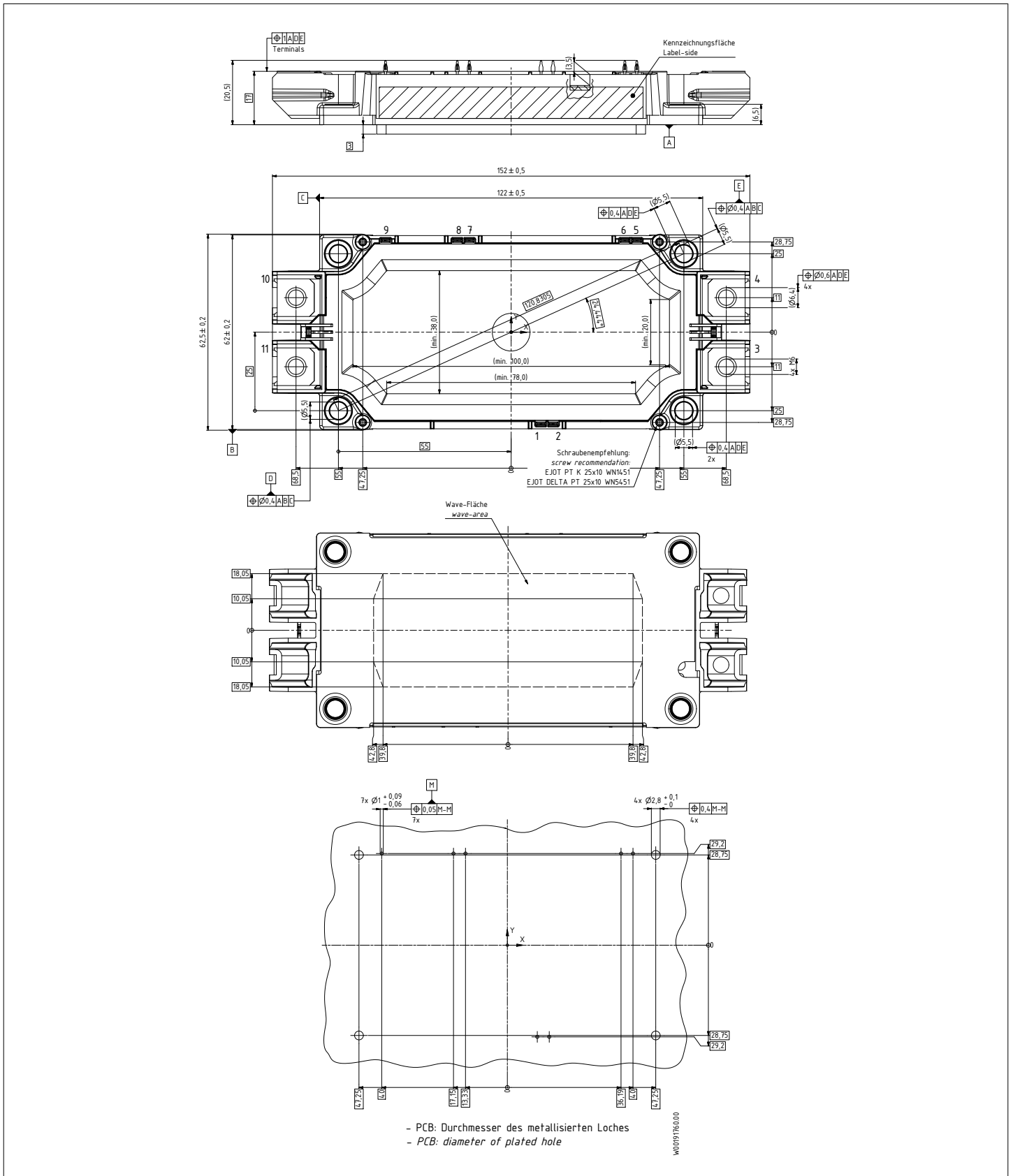


Figure 2

8 Module label code


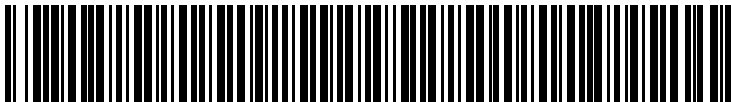
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production 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
V1.0	2019-11-06	Target datasheet
0.11	2020-11-24	Target datasheet
1.00	2021-05-27	Final datasheet
1.10	2021-10-11	Final datasheet

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