

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

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{nom}} = 900\text{ A} / I_{CRM} = 1800\text{ A}$
 - Integrated temperature sensor
 - TRENCHSTOP™ IGBT7
 - $V_{CE,\text{sat}}$ with positive temperature coefficient
- Mechanical features
 - High power density
 - Isolated base plate
 - PressFIT contact technology
 - Standard housing
 - Direct-cooled base plate



Potential applications

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

Product validation

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

Description

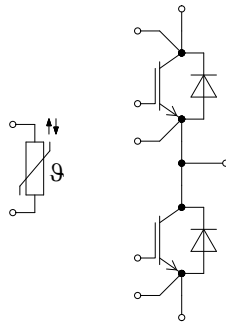


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 60 \text{ s}$	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.		
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		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}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_F = 25 \text{ °C}$	890	A

(table continues...)
Datasheet

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Maximum RMS module DC-terminal current	I_{TRMS}		$T_{\text{Terminal}} = 90\text{ °C}$, $T_{\text{C}} = 90\text{ °C}$	580	A
			$T_{\text{Terminal}} = 105\text{ °C}$, $T_{\text{C}} = 90\text{ °C}$	565	
Repetitive peak collector current	I_{CRM}	t_{p} limited by $T_{\text{vj op}}$	1800	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	$V_{\text{CE sat}}$	$I_{\text{C}} = 900\text{ A}$, $V_{\text{GE}} = 15\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$	1.50	1.80	V
			$T_{\text{vj}} = 125\text{ °C}$	1.65		
			$T_{\text{vj}} = 175\text{ °C}$	1.75		
Gate threshold voltage	V_{GEth}	$I_{\text{C}} = 18\text{ mA}$, $V_{\text{CE}} = V_{\text{GE}}$, $T_{\text{vj}} = 25\text{ °C}$	5.15	5.80	6.45	V
Gate charge	Q_{G}	$V_{\text{GE}} = \pm 15\text{ V}$, $V_{\text{CE}} = 600\text{ V}$		14.3		μC
Internal gate resistor	R_{Gint}	$T_{\text{vj}} = 25\text{ °C}$		0.5		Ω
Input capacitance	C_{ies}	$f = 100\text{ kHz}$, $T_{\text{vj}} = 25\text{ °C}$, $V_{\text{CE}} = 25\text{ V}$, $V_{\text{GE}} = 0\text{ V}$		122		nF
Reverse transfer capacitance	C_{res}	$f = 100\text{ kHz}$, $T_{\text{vj}} = 25\text{ °C}$, $V_{\text{CE}} = 25\text{ V}$, $V_{\text{GE}} = 0\text{ V}$		0.72		nF
Collector-emitter cut-off current	I_{CES}	$V_{\text{CE}} = 1200\text{ V}$, $V_{\text{GE}} = 0\text{ V}$	$T_{\text{vj}} = 25\text{ °C}$		0.1	mA
Gate-emitter leakage current	I_{GES}	$V_{\text{CE}} = 0\text{ V}$, $V_{\text{GE}} = 20\text{ V}$, $T_{\text{vj}} = 25\text{ °C}$			100	nA
Turn-on delay time (inductive load)	t_{don}	$I_{\text{C}} = 900\text{ A}$, $V_{\text{CE}} = 600\text{ V}$, $V_{\text{GE}} = \pm 15\text{ V}$, $R_{\text{Gon}} = 0.51\text{ Ω}$	$T_{\text{vj}} = 25\text{ °C}$	0.410		μs
			$T_{\text{vj}} = 125\text{ °C}$	0.460		
			$T_{\text{vj}} = 175\text{ °C}$	0.490		
Rise time (inductive load)	t_{r}	$I_{\text{C}} = 900\text{ A}$, $V_{\text{CE}} = 600\text{ V}$, $V_{\text{GE}} = \pm 15\text{ V}$, $R_{\text{Gon}} = 0.51\text{ Ω}$	$T_{\text{vj}} = 25\text{ °C}$	0.100		μs
			$T_{\text{vj}} = 125\text{ °C}$	0.110		
			$T_{\text{vj}} = 175\text{ °C}$	0.120		
Turn-off delay time (inductive load)	t_{doff}	$I_{\text{C}} = 900\text{ A}$, $V_{\text{CE}} = 600\text{ V}$, $V_{\text{GE}} = \pm 15\text{ V}$, $R_{\text{Goff}} = 0.51\text{ Ω}$	$T_{\text{vj}} = 25\text{ °C}$	0.550		μs
			$T_{\text{vj}} = 125\text{ °C}$	0.630		
			$T_{\text{vj}} = 175\text{ °C}$	0.690		
Fall time (inductive load)	t_{f}	$I_{\text{C}} = 900\text{ A}$, $V_{\text{CE}} = 600\text{ V}$, $V_{\text{GE}} = \pm 15\text{ V}$, $R_{\text{Goff}} = 0.51\text{ Ω}$	$T_{\text{vj}} = 25\text{ °C}$	0.110		μs
			$T_{\text{vj}} = 125\text{ °C}$	0.230		
			$T_{\text{vj}} = 175\text{ °C}$	0.330		

(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}	$I_C = 900\text{ A}$, $V_{CE} = 600\text{ V}$, $L_\sigma = 25\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.51\ \Omega$, $di/dt = 6200\text{ A}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	89		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	138		
			$T_{vj} = 175\text{ }^\circ\text{C}$	170		
Turn-off energy loss per pulse	E_{off}	$I_C = 900\text{ A}$, $V_{CE} = 600\text{ V}$, $L_\sigma = 25\text{ nH}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 0.51\ \Omega$, $dv/dt = 3000\text{ V}/\mu\text{s}$ ($T_{vj} = 175\text{ }^\circ\text{C}$)	$T_{vj} = 25\text{ }^\circ\text{C}$	89		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	130		
			$T_{vj} = 175\text{ }^\circ\text{C}$	158		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 800\text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 8\ \mu\text{s}$, $T_{vj} = 150\text{ }^\circ\text{C}$	3200		A
			$t_p \leq 6\ \mu\text{s}$, $T_{vj} = 175\text{ }^\circ\text{C}$	3000		
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% ethylenglycol, $T_f = 60\text{ }^\circ\text{C}$		0.0837		K/W
Temperature under switching conditions	T_{vjop}		-40		175	$^\circ\text{C}$

1) Typical R_{thJF} value using the heat sink described in AN-2022-05

Note: $T_{vjop} > 150\text{ }^\circ\text{C}$ 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}	$T_{vj} = 25\text{ }^\circ\text{C}$	1200	V	
Continuous DC forward current	I_F		900	A	
Repetitive peak forward current	I_{FRM}	$t_p = 1\text{ ms}$	1800	A	
I^2t - value	I^2t	$t_p = 10\text{ ms}$, $V_R = 0\text{ V}$	$T_{vj} = 125\text{ }^\circ\text{C}$	35000	A^2s
			$T_{vj} = 175\text{ }^\circ\text{C}$	30000	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V_F	$I_F = 900 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		1.80	2.05	V
			$T_{vj} = 125 \text{ °C}$		1.70		
			$T_{vj} = 175 \text{ °C}$		1.65		
Peak reverse recovery current	I_{RM}	$V_R = 600 \text{ V}, I_F = 900 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6200 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		389		A
			$T_{vj} = 125 \text{ °C}$		511		
			$T_{vj} = 175 \text{ °C}$		578		
Recovered charge	Q_r	$V_R = 600 \text{ V}, I_F = 900 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6200 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		65		μC
			$T_{vj} = 125 \text{ °C}$		127		
			$T_{vj} = 175 \text{ °C}$		171		
Reverse recovery energy	E_{rec}	$V_R = 600 \text{ V}, I_F = 900 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 6200 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		29		mJ
			$T_{vj} = 125 \text{ °C}$		52		
			$T_{vj} = 175 \text{ °C}$		68		
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% ethylen glycol, $T_f = 60 \text{ °C}$			0.132		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$			-40		175	°C

1) Typical R_{thJF} value using the heat sink described in AN-2022-05

Note: $T_{vj\text{ op}} > 150 \text{ °C}$ 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
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

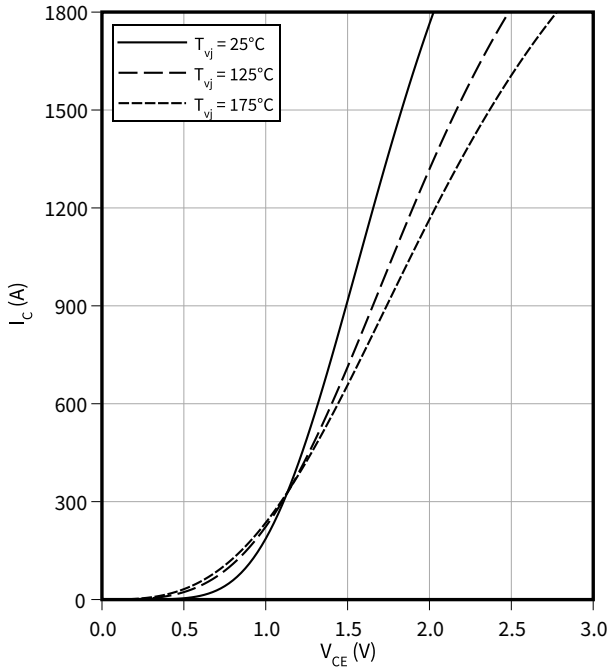
Note: Specification according to the valid application note.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

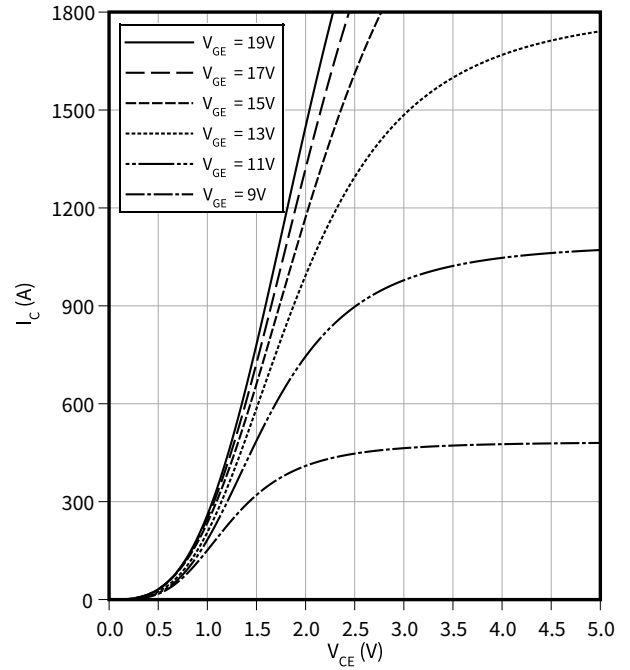
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

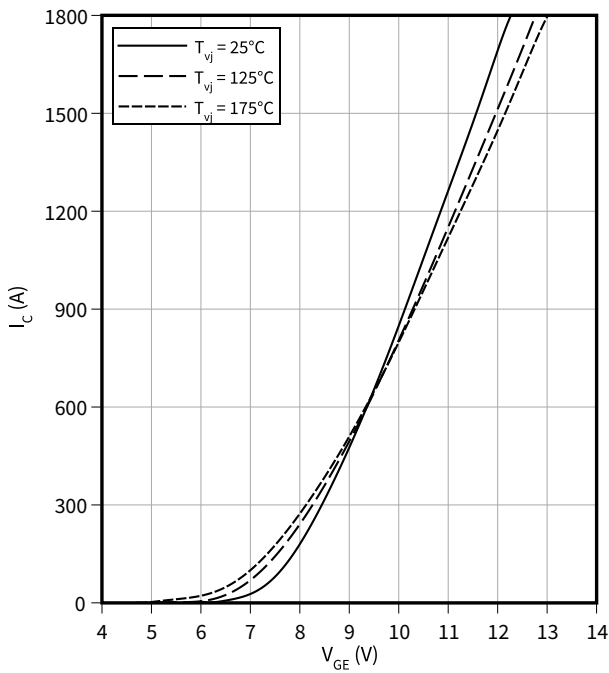
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

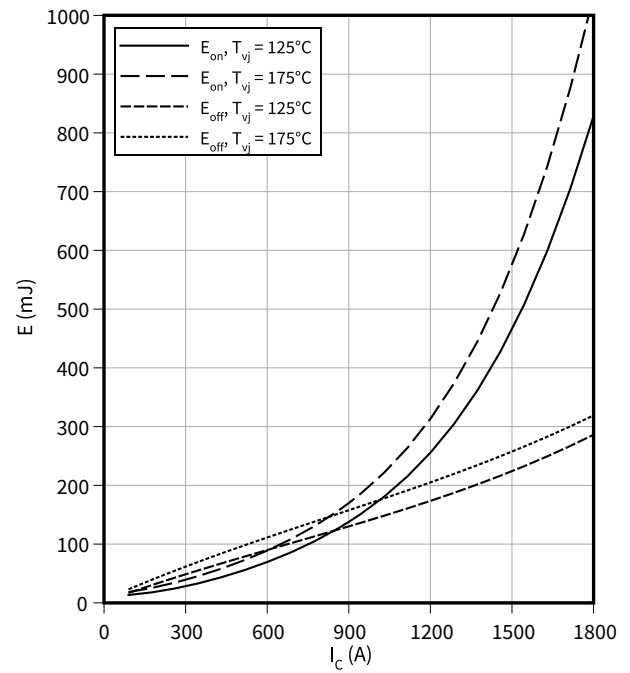
$$V_{CE} = 20 \text{ V}$$



Switching losses (typical), IGBT, Inverter

$$E = f(I_C)$$

$$R_{Goff} = 0.51 \text{ } \Omega, R_{Gon} = 0.51 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$

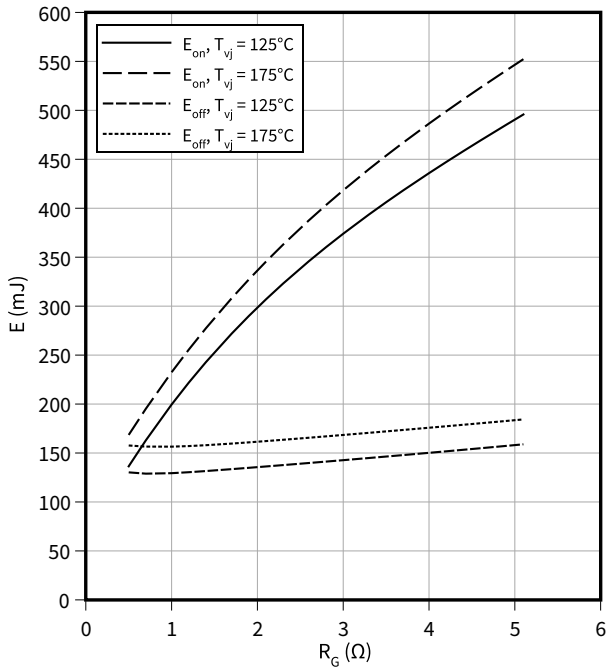


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

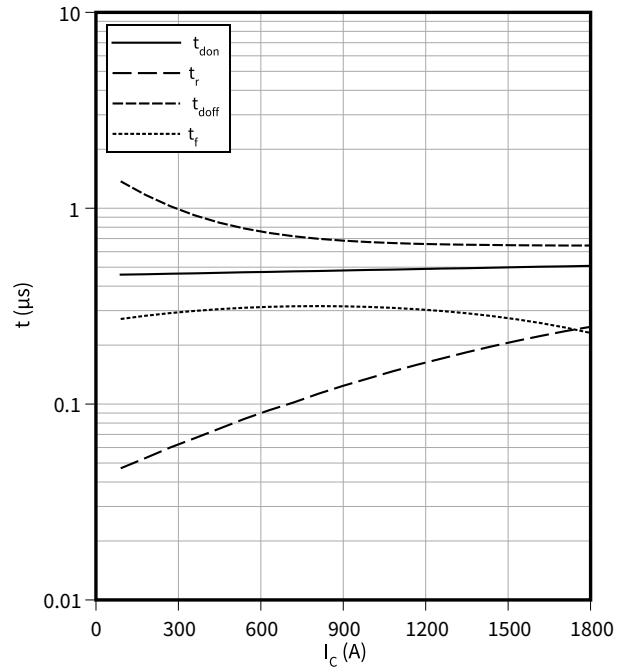
$I_C = 900 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

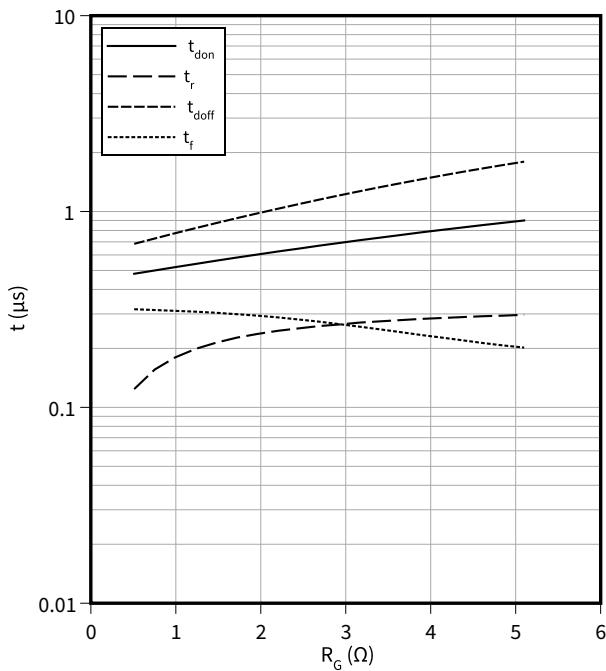
$R_{Goff} = 0.51 \Omega, R_{Gon} = 0.51 \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 175 \text{ °C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

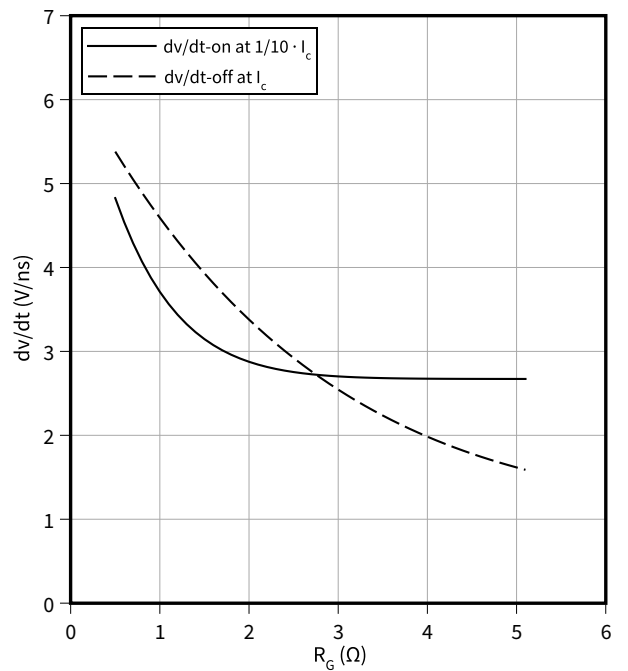
$I_C = 900 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

$I_C = 900 \text{ A}, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}, T_{vj} = 25 \text{ °C}$

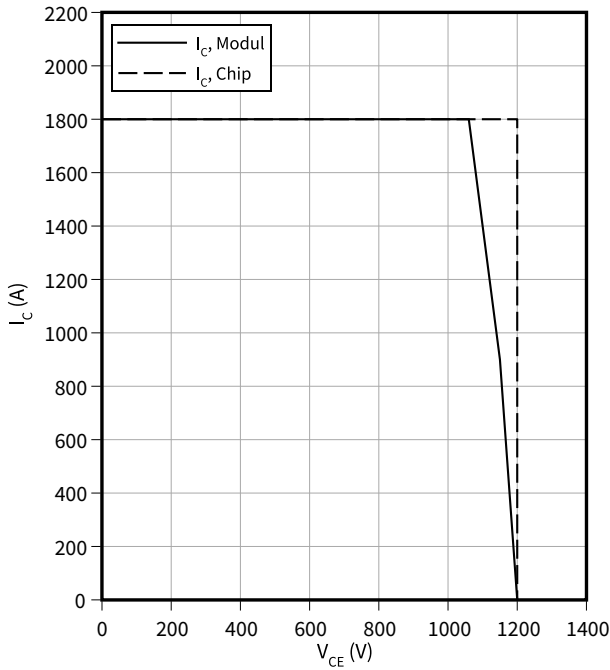


5 Characteristics diagrams

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

$I_C = f(V_{CE})$

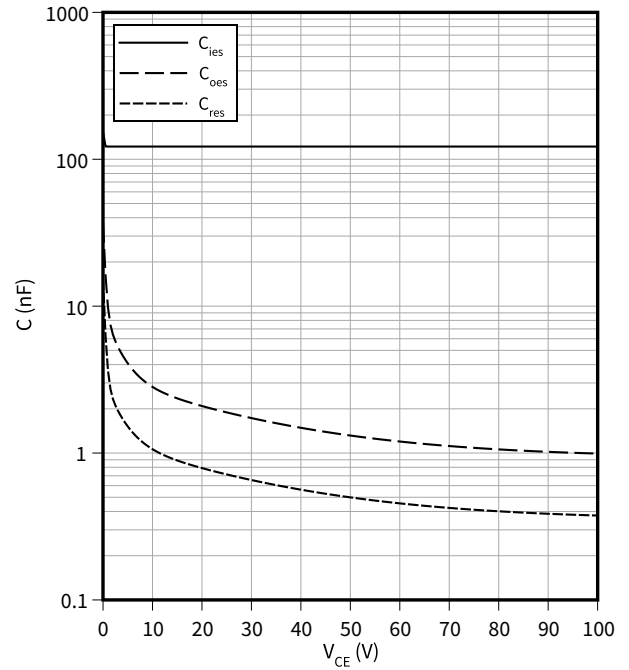
$R_{Goff} = 0.51 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

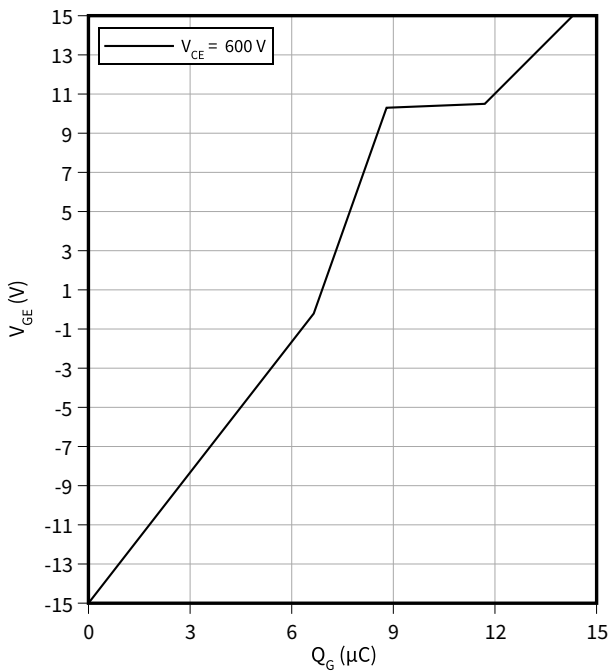
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



Gate charge characteristic (typical), IGBT, Inverter

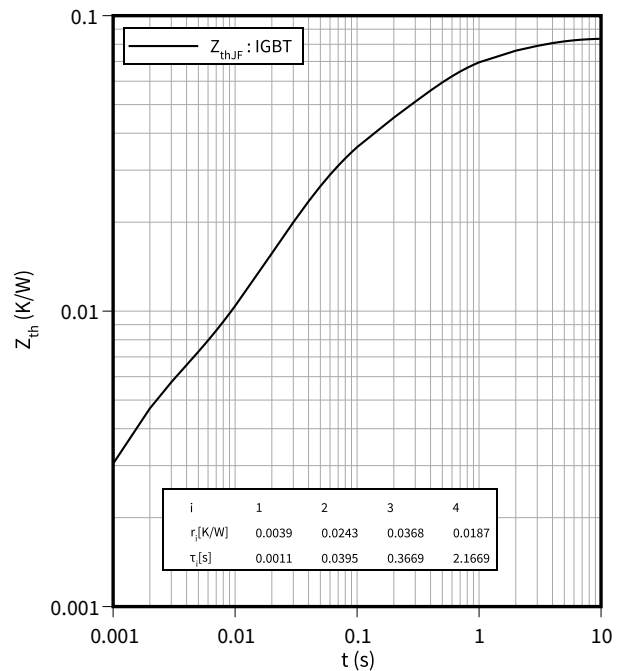
$V_{GE} = f(Q_G)$

$I_C = 900 \text{ A}, T_{vj} = 25 \text{ }^\circ\text{C}$



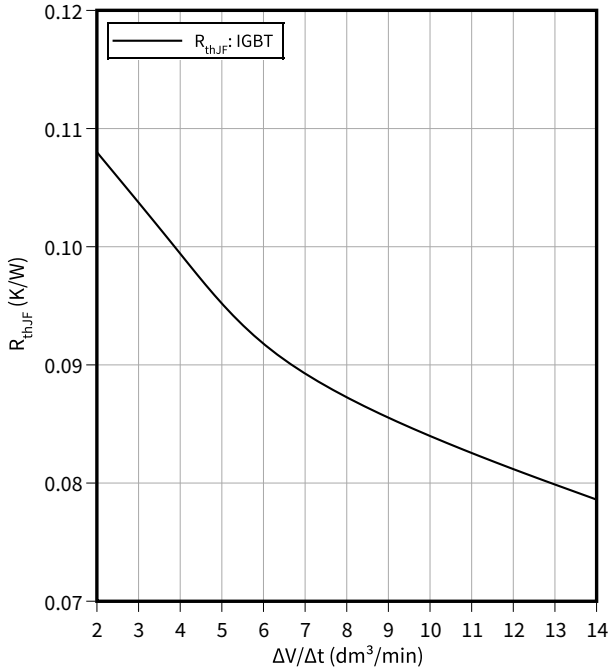
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



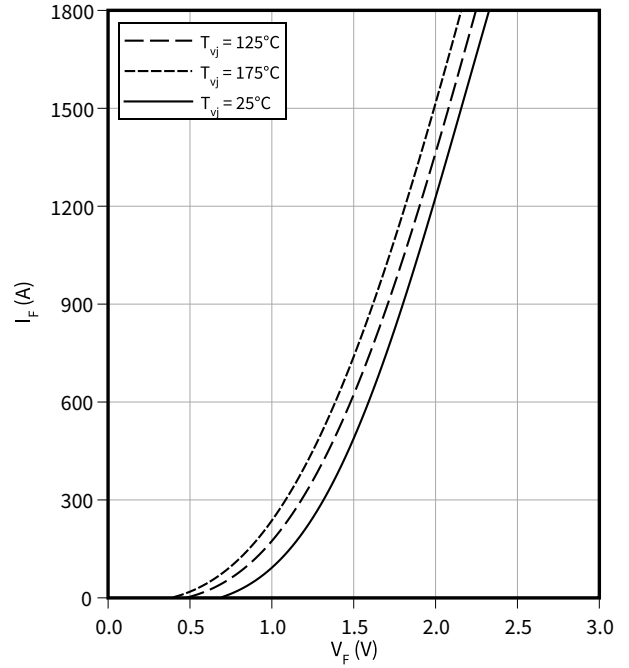
Thermal impedance, IGBT, Inverter

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



Forward characteristic (typical), Diode, Inverter

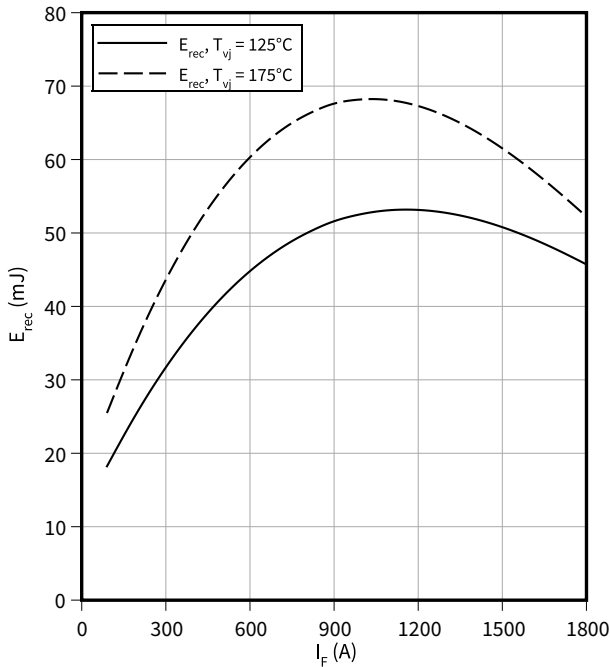
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

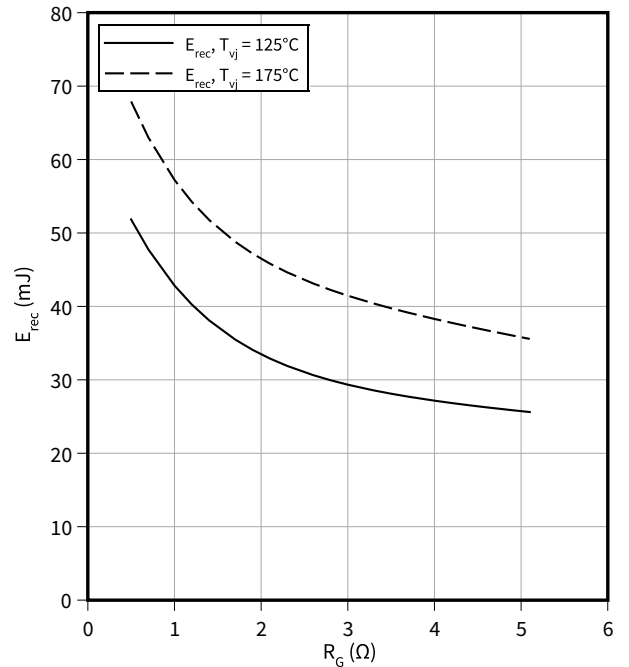
$R_{Gon} = 0.51 \Omega, V_{CE} = 600 V$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

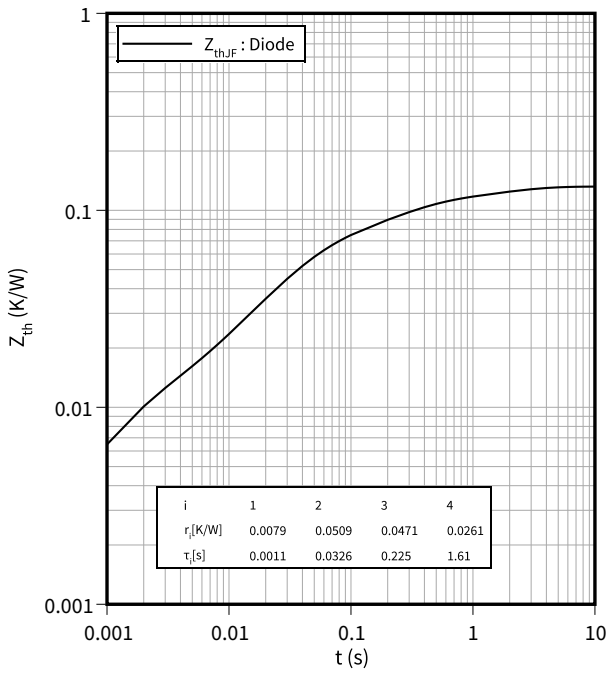
$V_{CE} = 600 V, I_F = 900 A$



5 Characteristics diagrams

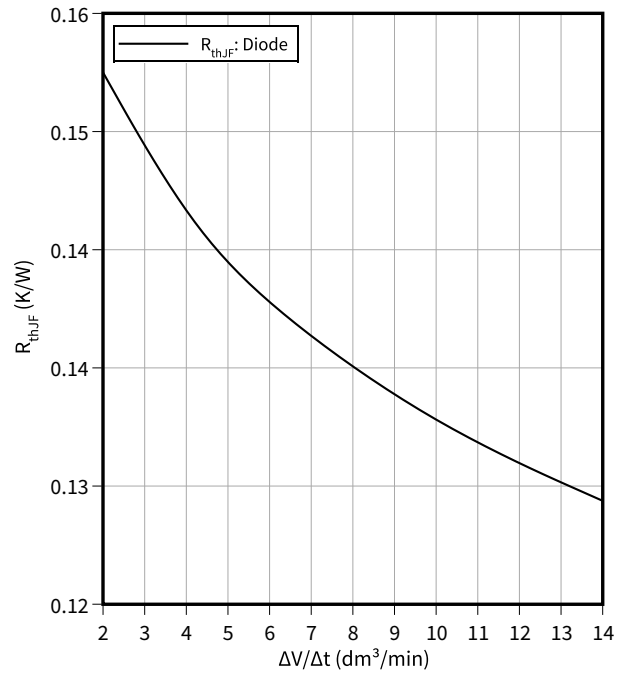
Transient thermal impedance, Diode, Inverter

$$Z_{th} = f(t)$$



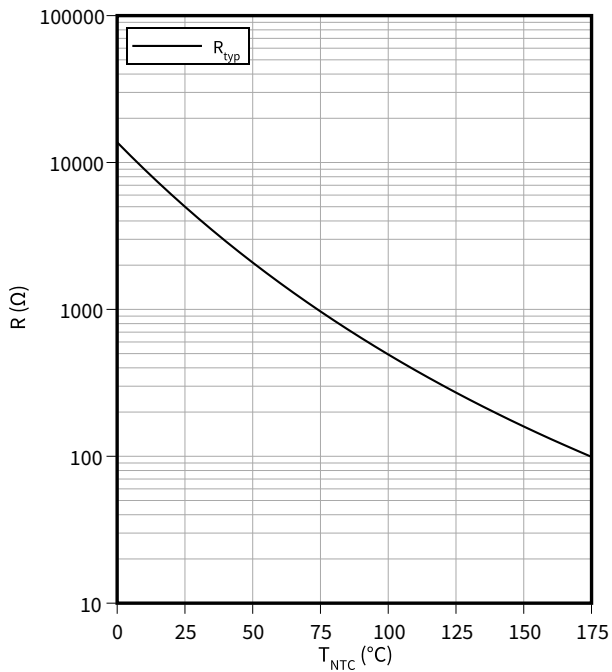
Thermal impedance, Diode, Inverter

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



Temperature characteristic (typical), NTC-Thermistor

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



6 Circuit diagram

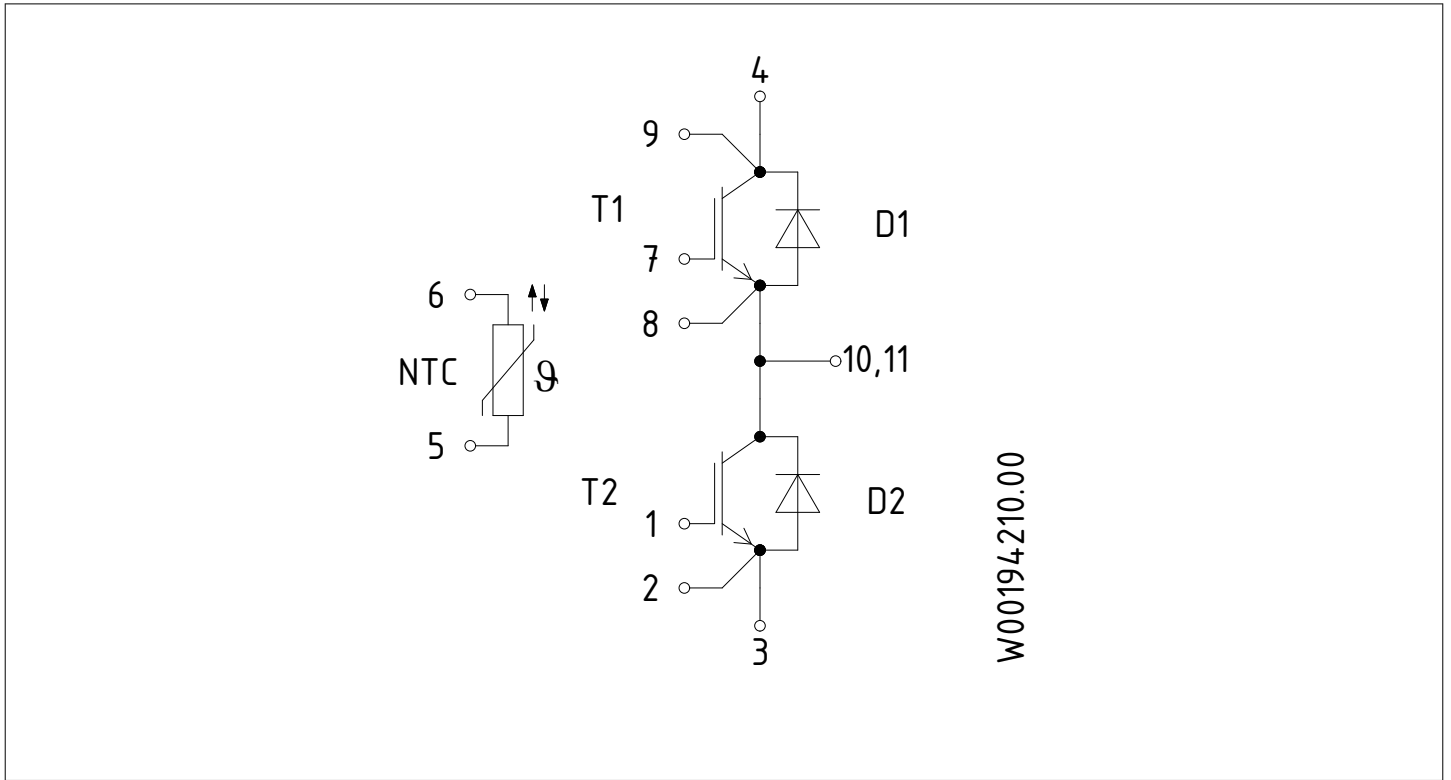


Figure 1

7 Package outlines

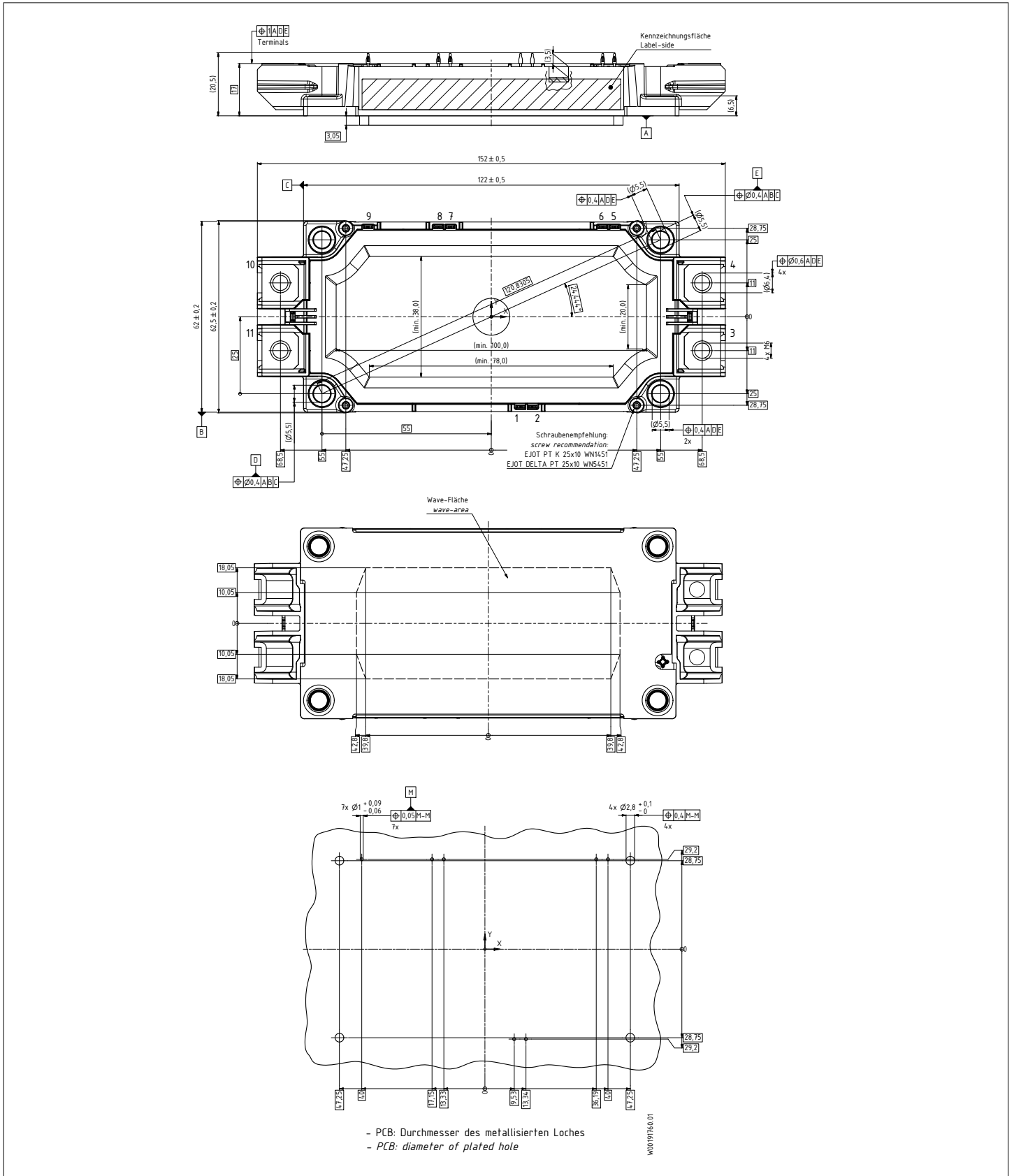


Figure 2

8 Module label code


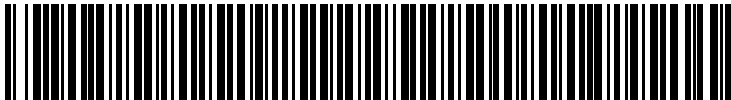
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production 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	2020-06-09	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	2021-07-08	Target datasheet
1.00	2022-04-01	Final datasheet

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