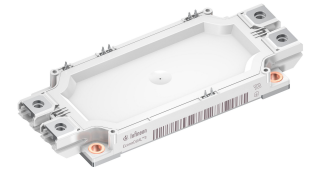


Final datasheet

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
 - $V_{CE,sat}$ 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

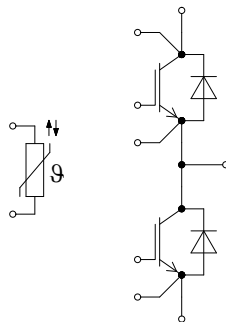


Table of contents

	Description	1
	Features	1
	Potential applications	1
	Product validation	1
	Table of contents	2
1	Package	3
2	IGBT, Inverter	4
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
			Min.	Typ.	Max.	
Isolation test voltage	V_{ISOL}	RMS, $f = 50$ Hz, $t = 1$ min	3.4			kV
Material of module baseplate			Cu			
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3			
Creepage distance	$d_{Creep\ nom}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15			mm
Creepage distance	$d_{Creep\ min}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7			mm
Creepage distance	$d_{Creep\ nom}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1			mm
Creepage distance	$d_{Creep\ min}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5			mm
Clearance	$d_{Clear\ nom}$	terminal to baseplate, nom.	> 12.5			mm
Clearance	$d_{Clear\ min}$	terminal to baseplate, min.	12.5			mm
Clearance	$d_{Clear\ nom}$	terminal to terminal, nom.	10.0			mm
Clearance	$d_{Clear\ min}$	terminal to terminal, min.	9.6			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	$R_{CC'+EE'}$	$T_C = 25$ °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
			Min.	Typ.	Max.	
Collector-emitter voltage	V_{CES}	$T_{vj} = 25\text{ °C}$		1200		V
Continuous DC collector current	I_{CDC}	$T_{vj\ max} = 175\text{ °C}$ $T_C = 90\text{ °C}$		750		A
Maximum RMS module DC-terminal current	I_{tRMS}	$T_{Terminal} = 90\text{ °C}$, $T_C = 90\text{ °C}$		580		A
			$T_{Terminal} = 105\text{ °C}$, $T_C = 90\text{ °C}$		565	
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		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	$V_{CE\ sat}$	$I_C = 750\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		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	$V_{GE} = \pm 15\text{ V}$, $V_{CC} = 600\text{ V}$		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}	$V_{CE} = 1200\text{ V}$, $V_{GE} = 0\text{ V}$ $T_{vj} = 25\text{ °C}$			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}	$I_C = 750\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.5\text{ Ω}$	$T_{vj} = 25\text{ °C}$		0.300		μs
			$T_{vj} = 125\text{ °C}$		0.320		
			$T_{vj} = 175\text{ °C}$		0.340		
Rise time (inductive load)	t_r	$I_C = 750\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 0.5\text{ Ω}$	$T_{vj} = 25\text{ °C}$		0.079		μs
			$T_{vj} = 125\text{ °C}$		0.086		
			$T_{vj} = 175\text{ °C}$		0.090		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Turn-off delay time (inductive load)	t_{doff}	$I_C = 750\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 0.5\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C}$	0.470		μs
			$T_{vj} = 125\text{ }^\circ\text{C}$	0.550		
			$T_{vj} = 175\text{ }^\circ\text{C}$	0.600		
Fall time (inductive load)	t_f	$I_C = 750\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 0.5\ \Omega$	$T_{vj} = 25\text{ }^\circ\text{C}$	0.110		μs
			$T_{vj} = 125\text{ }^\circ\text{C}$	0.240		
			$T_{vj} = 175\text{ }^\circ\text{C}$	0.350		
Turn-on energy loss per pulse	E_{on}	$I_C = 750\text{ A}, V_{CC} = 600\text{ V}, L_\sigma = 25\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Gon} = 0.5\ \Omega, di/dt = 7000\text{ A}/\mu\text{s} (T_{vj} = 175\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$	53		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	86		
			$T_{vj} = 175\text{ }^\circ\text{C}$	107		
Turn-off energy loss per pulse	E_{off}	$I_C = 750\text{ A}, V_{CC} = 600\text{ V}, L_\sigma = 25\text{ nH}, V_{GE} = \pm 15\text{ V}, R_{Goff} = 0.5\ \Omega, dv/dt = 3100\text{ V}/\mu\text{s} (T_{vj} = 175\text{ }^\circ\text{C})$	$T_{vj} = 25\text{ }^\circ\text{C}$	65		mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$	97.5		
			$T_{vj} = 175\text{ }^\circ\text{C}$	121		
SC data	I_{SC}	$V_{GE} \leq 15\text{ V}, V_{CC} = 800\text{ V}, V_{CEmax} = V_{CES} - L_{SCE} * di/dt$	$t_p \leq 8\ \mu\text{s}, T_{vj} = 150\text{ }^\circ\text{C}$	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

(table continues...)

Table 5 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
I ² t - value	I ² t	t _p = 10 ms, V _R = 0 V	T _{vj} = 125 °C	28700		A ² s
			T _{vj} = 175 °C	20500		

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	V _F	I _F = 750 A, V _{GE} = 0 V	T _{vj} = 25 °C		1.80	2.10	V
			T _{vj} = 125 °C		1.70		
			T _{vj} = 175 °C		1.60		
Peak reverse recovery current	I _{RM}	V _{CC} = 600 V, I _F = 750 A, V _{GE} = -15 V, -di _F /dt = 7000 A/μs (T _{vj} = 175 °C)	T _{vj} = 25 °C		400		A
			T _{vj} = 125 °C		485		
			T _{vj} = 175 °C		561		
Recovered charge	Q _r	V _{CC} = 600 V, I _F = 750 A, V _{GE} = -15 V, -di _F /dt = 7000 A/μs (T _{vj} = 175 °C)	T _{vj} = 25 °C		48		μC
			T _{vj} = 125 °C		84		
			T _{vj} = 175 °C		131		
Reverse recovery energy	E _{rec}	V _{CC} = 600 V, I _F = 750 A, V _{GE} = -15 V, -di _F /dt = 7000 A/μs (T _{vj} = 175 °C)	T _{vj} = 25 °C		20		mJ
			T _{vj} = 125 °C		32		
			T _{vj} = 175 °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, λ _{grease} = 1 W/(m·K)		0.0380		K/W	
Temperature under switching conditions	T _{vj op}		-40		175	°C	

Note: T_{vj op} > 150 °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 °C		5		kΩ
Deviation of R ₁₀₀	ΔR/R	T _{NTC} = 100 °C, R ₁₀₀ = 493 Ω	-5		5	%
Power dissipation	P ₂₅	T _{NTC} = 25 °C			20	mW

(table continues...)

Table 7 (continued) **Characteristic values**

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

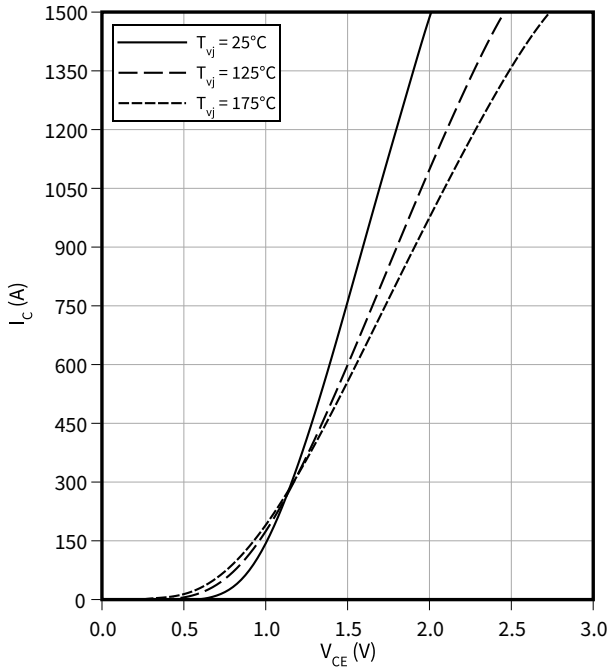
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

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

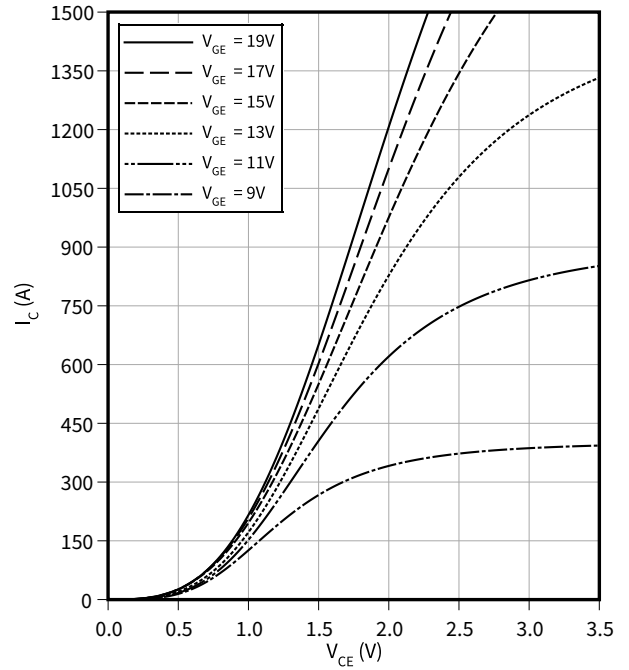
$$V_{GE} = 15 \text{ V}$$



Output characteristic field (typical), IGBT, Inverter

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

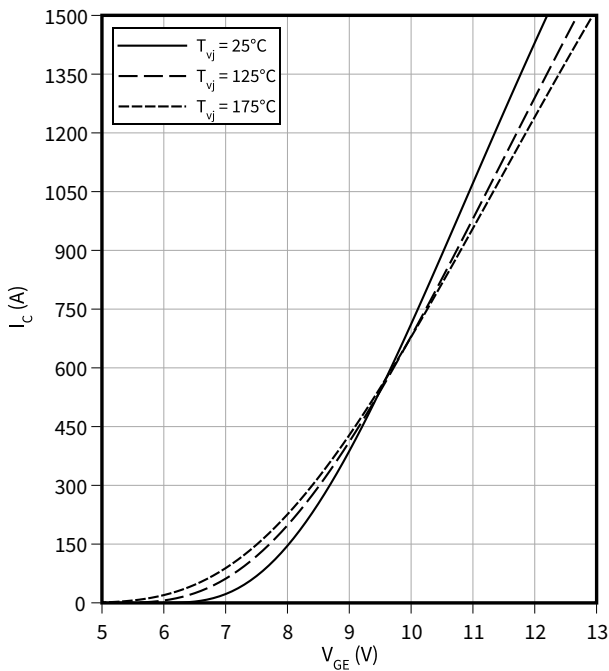
$$T_{vj} = 175 \text{ °C}$$



Transfer characteristic (typical), IGBT, Inverter

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

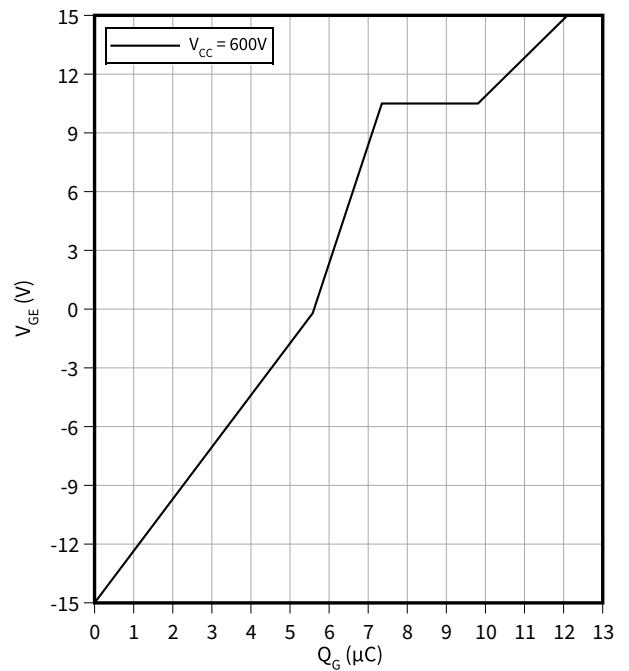
$$V_{CE} = 20 \text{ V}$$



Gate charge characteristic (typical), IGBT, Inverter

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

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

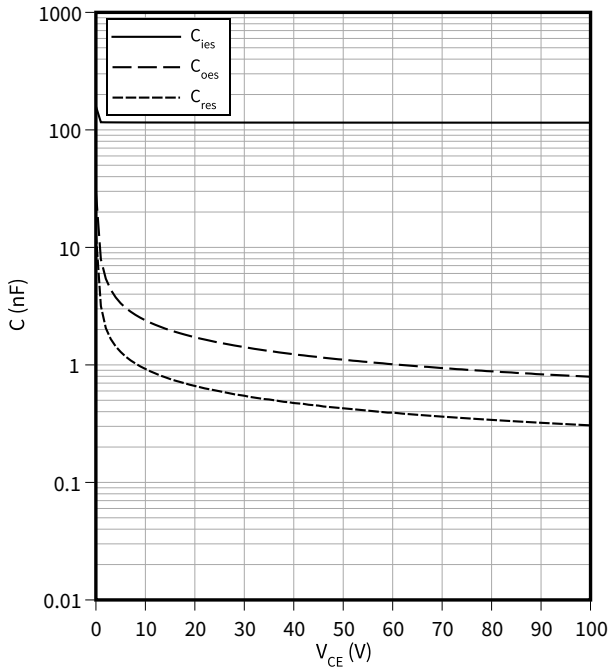


5 Characteristics diagrams

Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

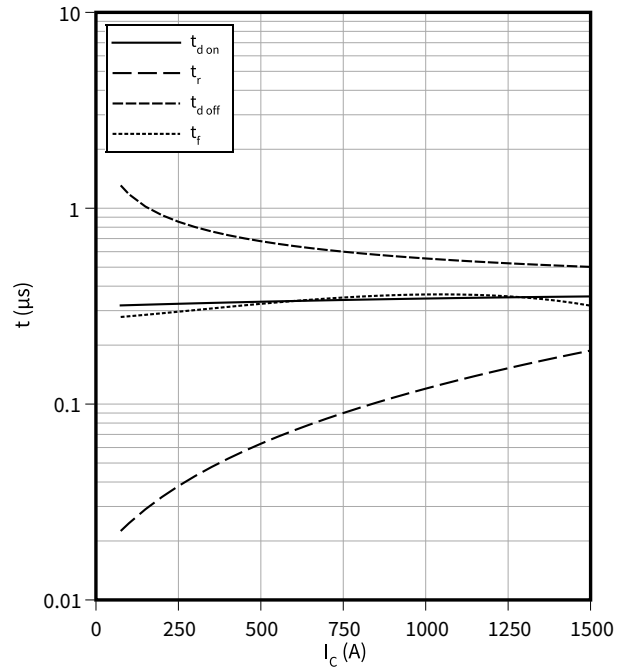
$f = 100 \text{ kHz}, V_{GE} = 0 \text{ V}, T_{vj} = 25 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(I_c)$

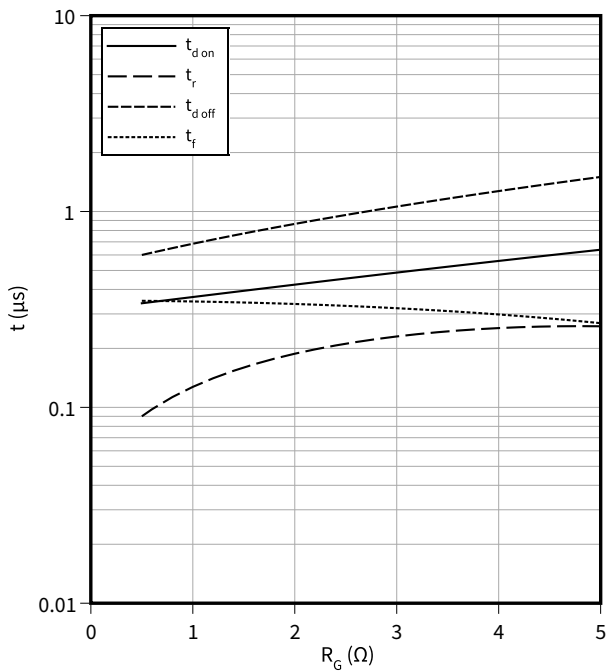
$R_{Goff} = 0.5 \text{ } \Omega, R_{Gon} = 0.5 \text{ } \Omega, V_{GE} = \pm 15 \text{ V}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

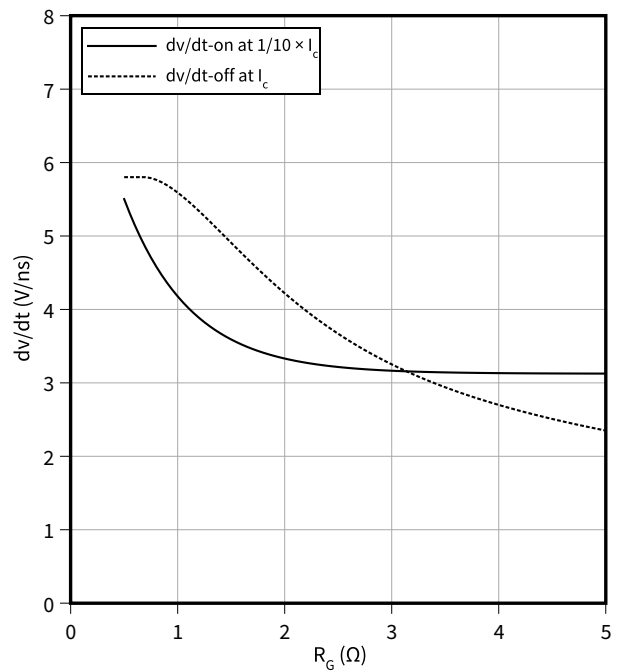
$V_{GE} = \pm 15 \text{ V}, I_c = 750 \text{ A}, V_{CC} = 600 \text{ V}, T_{vj} = 175 \text{ }^\circ\text{C}$



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

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

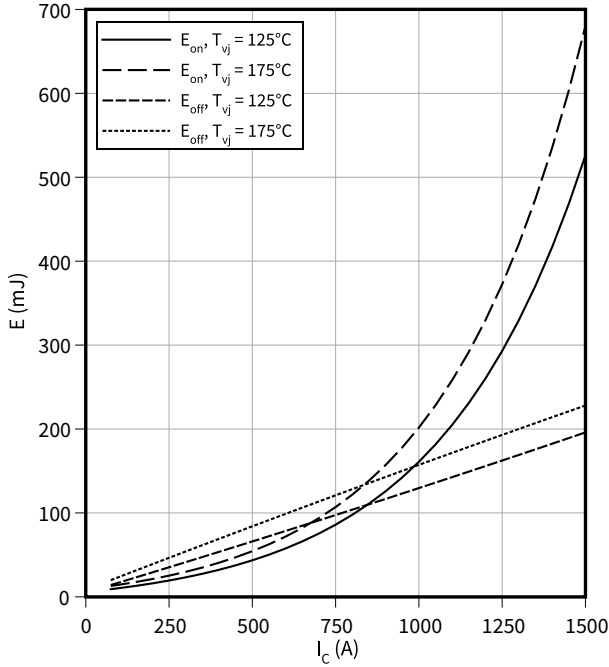


5 Characteristics diagrams

Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

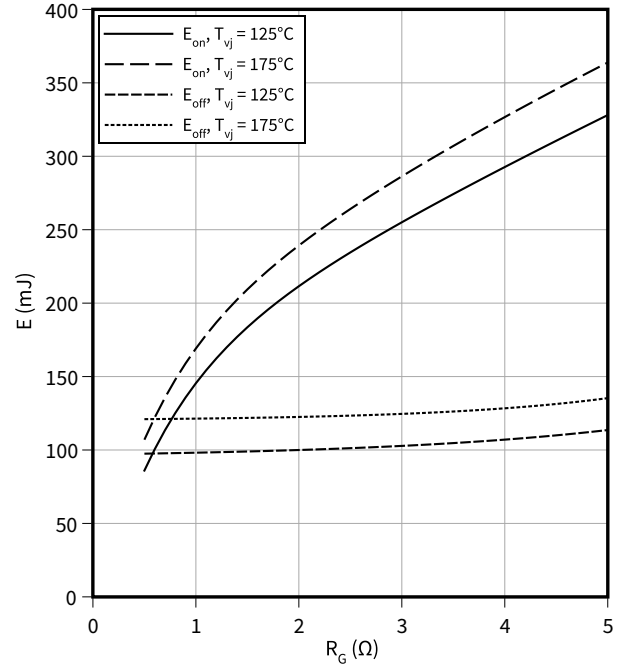
$R_{Goff} = 0.5 \Omega$, $R_{Gon} = 0.5 \Omega$, $V_{CC} = 600 \text{ V}$, $V_{GE} = -15 / 15 \text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

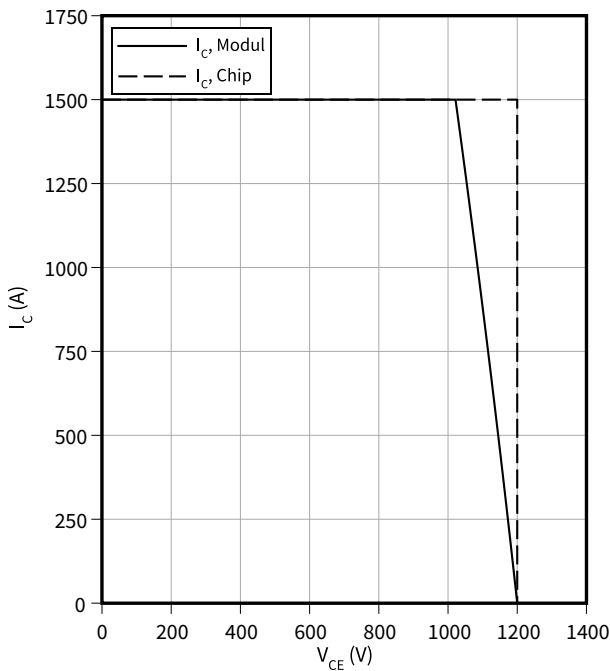
$I_C = 750 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = -15 / 15 \text{ V}$



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

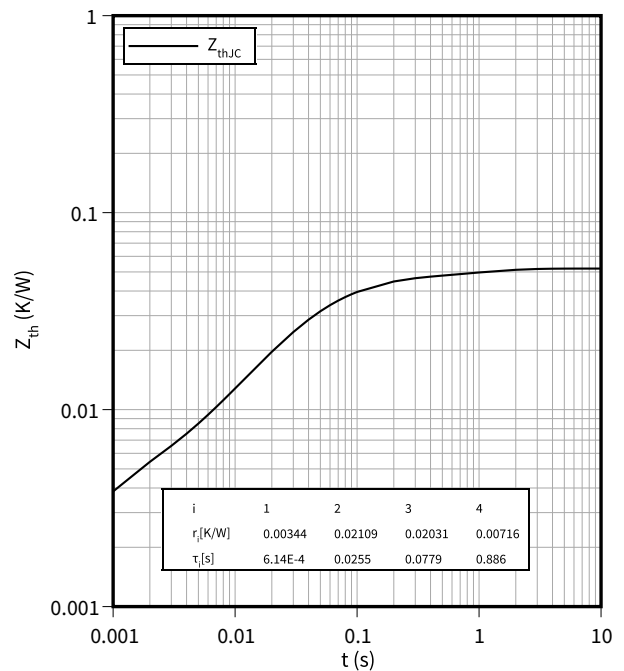
$I_C = f(V_{CE})$

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



Transient thermal impedance, IGBT, Inverter

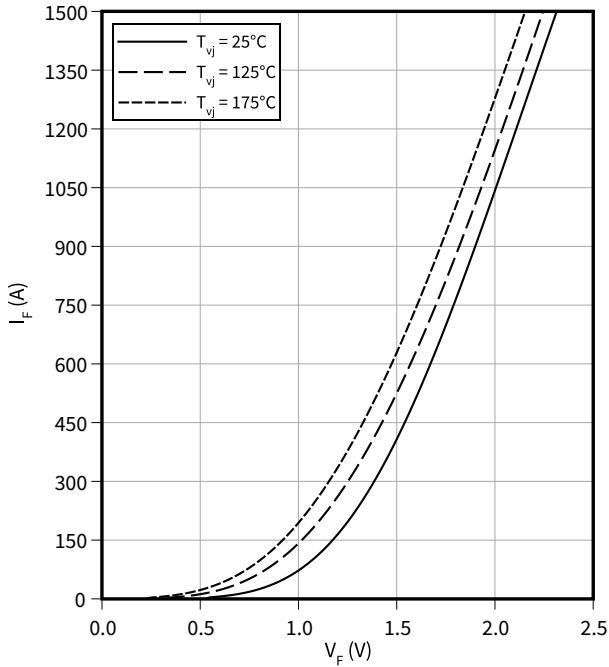
$Z_{th} = f(t)$



5 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

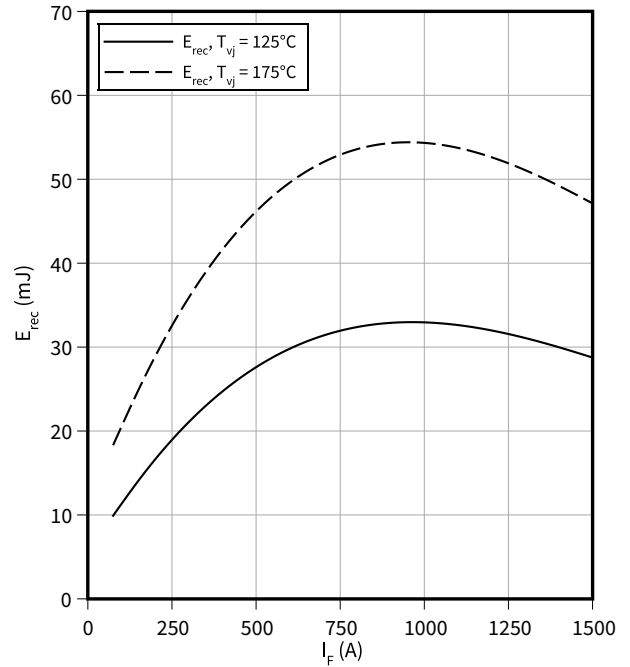
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

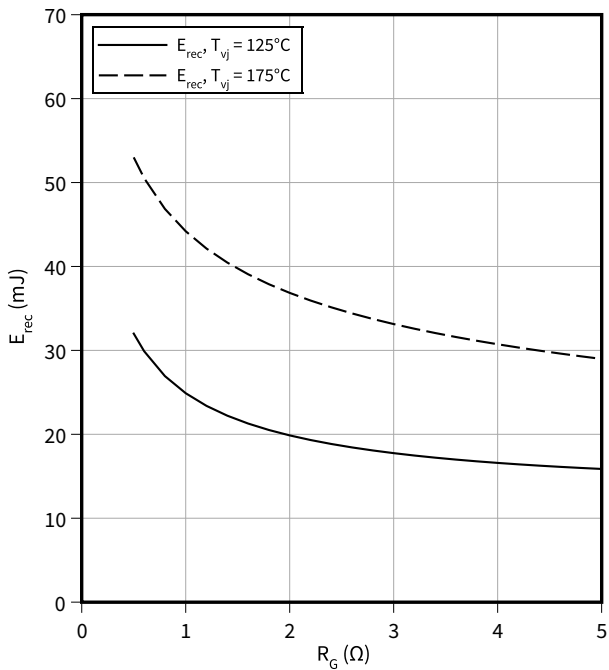
$R_{Gon} = R_{Gon}(IGBT), V_{CC} = 600\text{ V}$



Switching losses (typical), Diode, Inverter

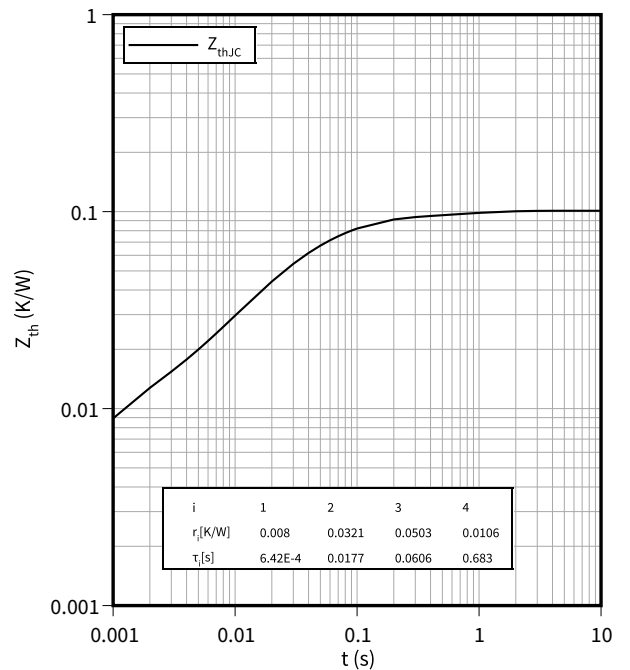
$E_{rec} = f(R_G)$

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



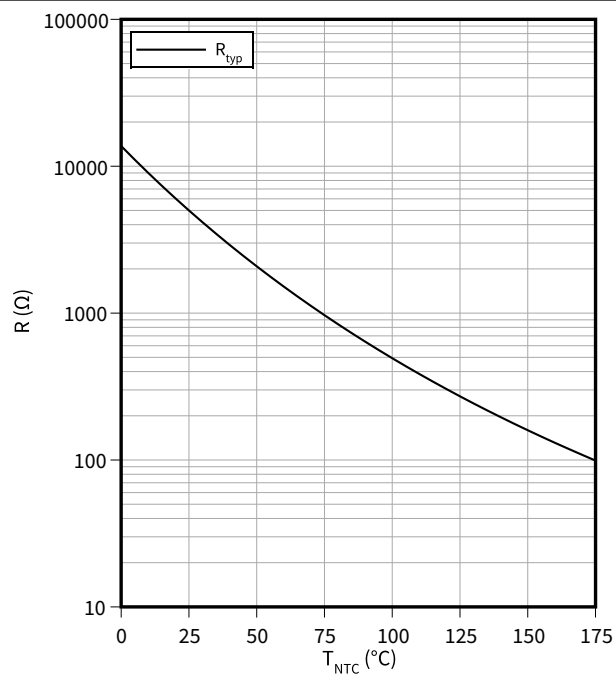
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

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



6 Circuit diagram

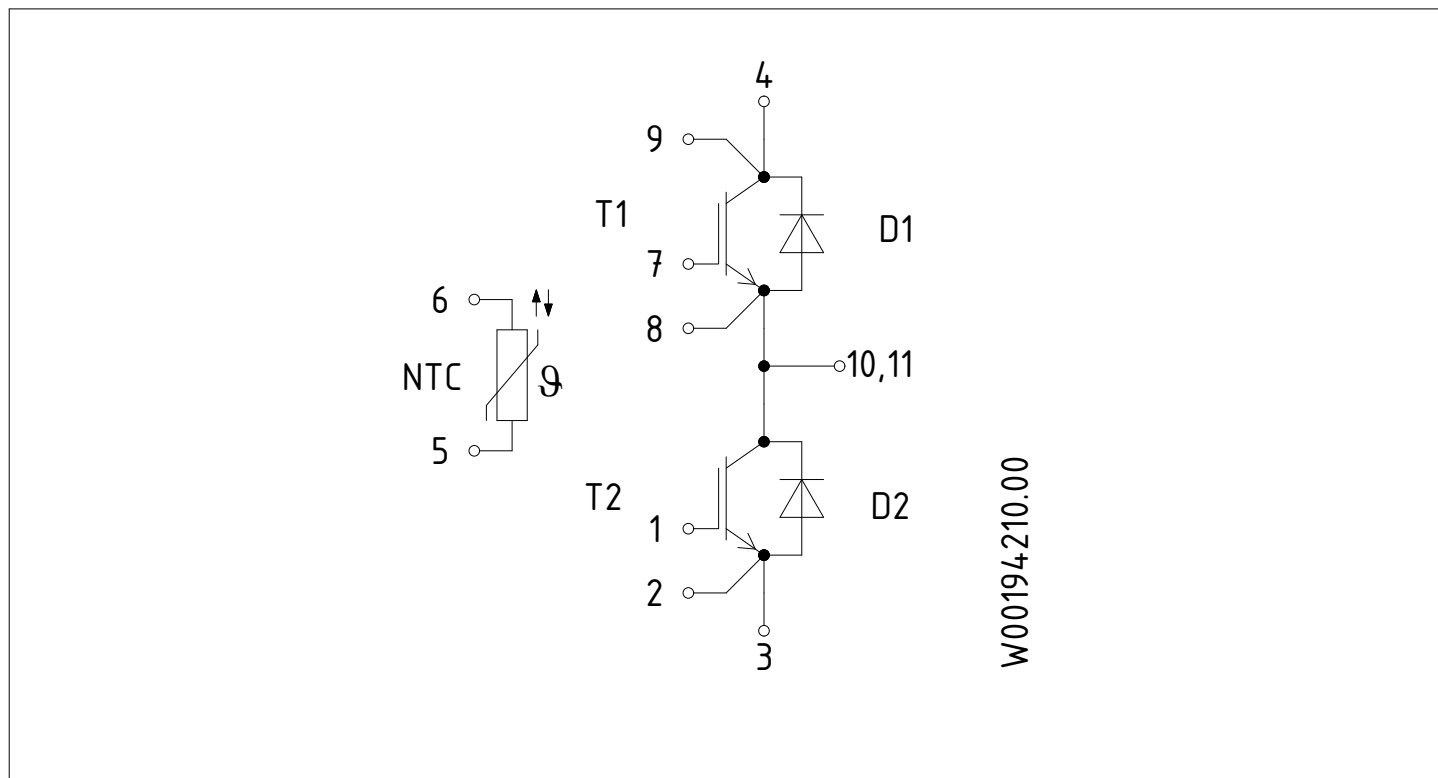


Figure 1

7 Package outlines

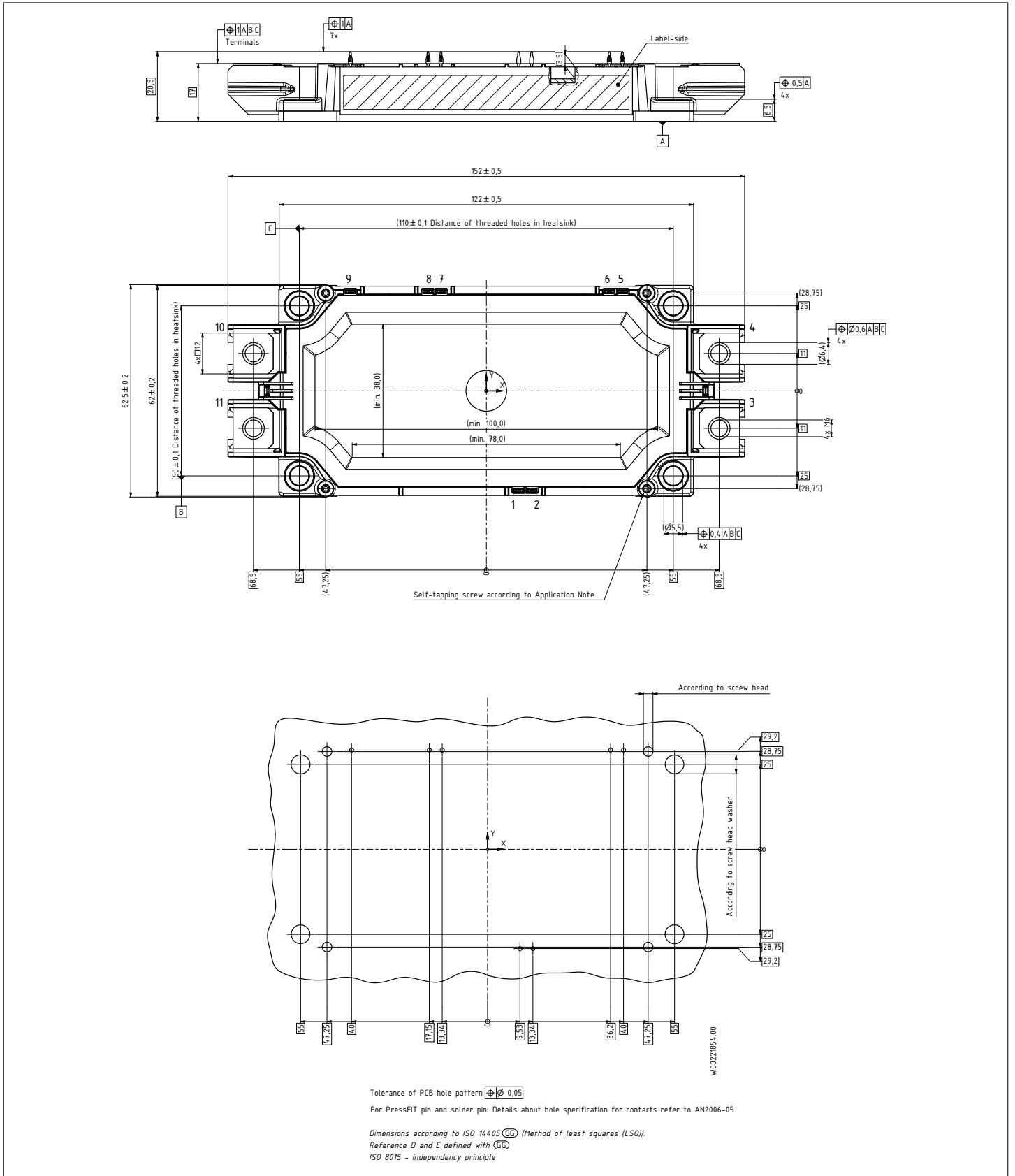


Figure 2

8 Module label code


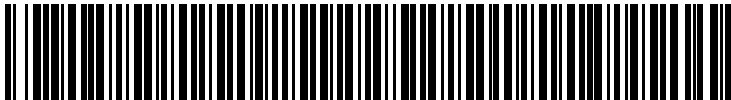
Module label code			
Code format	Data Matrix	Barcode Code128	
Encoding	ASCII text	Code Set A	
Symbol size	16x16	23 digits	
Standard	IEC24720 and IEC16022	IEC8859-1	
Code content	Content	Digit	Example
	Module serial number	1 - 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 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
V1.0	2019-11-06	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
0.11	2020-11-24	Target datasheet
1.00	2021-05-27	Final datasheet
1.10	2021-10-11	Final datasheet
1.20	2024-03-08	Final datasheet

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