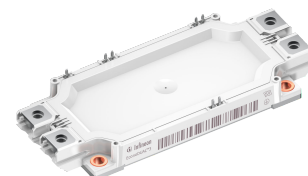


Final datasheet

EconoDUAL™3 module with Trench/Fieldstop IGBT4 and emitter controlled diode and 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
 - Standard housing
 - Isolated base plate
 - High power density



Potential applications

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

Product validation

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

Description

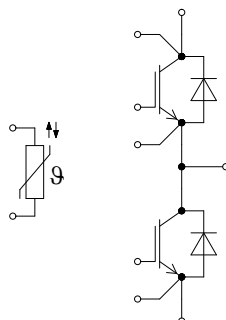


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1 Package

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
Isolation test voltage NTC	$V_{ISOL(NTC)}$	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	$d_{Creep \text{ nom}}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7	mm
Creepage distance	$d_{Creep \text{ nom}}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to baseplate, nom.	> 12.5	mm
Clearance	$d_{Clear \text{ min}}$	terminal to baseplate, min.	12.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to terminal, nom.	10.0	mm
Clearance	$d_{Clear \text{ min}}$	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	$R_{CC'+EE'}$	$T_C = 25\text{ }^{\circ}\text{C}$, 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}		$T_{vj} = 25\text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 175\text{ °C}$	$T_C = 100\text{ °C}$	600	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\text{ op}}$		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	$V_{CE\text{ sat}}$	$I_C = 600\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.75	2.10	V
			$T_{vj} = 125\text{ °C}$		2.00		
			$T_{vj} = 150\text{ °C}$		2.05		
Gate threshold voltage	V_{GETh}	$I_C = 23\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25\text{ °C}$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\text{ V}$			4.4		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			1.2		Ω
Input capacitance	C_{ies}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			37		nF
Reverse transfer capacitance	C_{res}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			2.05		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			3	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$, $T_{vj} = 25\text{ °C}$				400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1.5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.160		μs
			$T_{vj} = 125\text{ °C}$		0.210		
			$T_{vj} = 150\text{ °C}$		0.210		
Rise time (inductive load)	t_r	$I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1.5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.090		μs
			$T_{vj} = 125\text{ °C}$		0.090		
			$T_{vj} = 150\text{ °C}$		0.100		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 1.5\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.480		μs
			$T_{vj} = 125\text{ °C}$		0.610		
			$T_{vj} = 150\text{ °C}$		0.650		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 1.5 \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	0.070		μs
			$T_{vj} = 125 \text{ }^\circ\text{C}$	0.110		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	0.120		
Turn-on energy loss per pulse	E_{on}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 35 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Gon} = 1.5 \Omega$, $di/dt = 5100 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	62.5		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	83		
			$T_{vj} = 150 \text{ }^\circ\text{C}$	90		
Turn-off energy loss per pulse	E_{off}	$I_C = 600 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 35 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 1.5 \Omega$, $dv/dt = 3700 \text{ V}/\mu\text{s}$ ($T_{vj} = 150 \text{ }^\circ\text{C}$)	$T_{vj} = 25 \text{ }^\circ\text{C}$	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 case	R_{thJC}	per IGBT			0.0473	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.0304		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	$^\circ\text{C}$

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
			$T_{vj} = 150 \text{ }^\circ\text{C}$	37500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 600 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.65	2.10	V
			$T_{vj} = 125 \text{ °C}$	1.65		
			$T_{vj} = 150 \text{ °C}$	1.65		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600 \text{ V}$, $I_F = 600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5100 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	290		A
			$T_{vj} = 125 \text{ °C}$	420		
			$T_{vj} = 150 \text{ °C}$	450		
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}$, $I_F = 600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5100 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	62		μC
			$T_{vj} = 125 \text{ °C}$	115		
			$T_{vj} = 150 \text{ °C}$	130		
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}$, $I_F = 600 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 5100 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	22		mJ
			$T_{vj} = 125 \text{ °C}$	44		
			$T_{vj} = 150 \text{ °C}$	51		
Thermal resistance, junction to case	R_{thJC}	per diode			0.0767	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		0.0474		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	°C

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

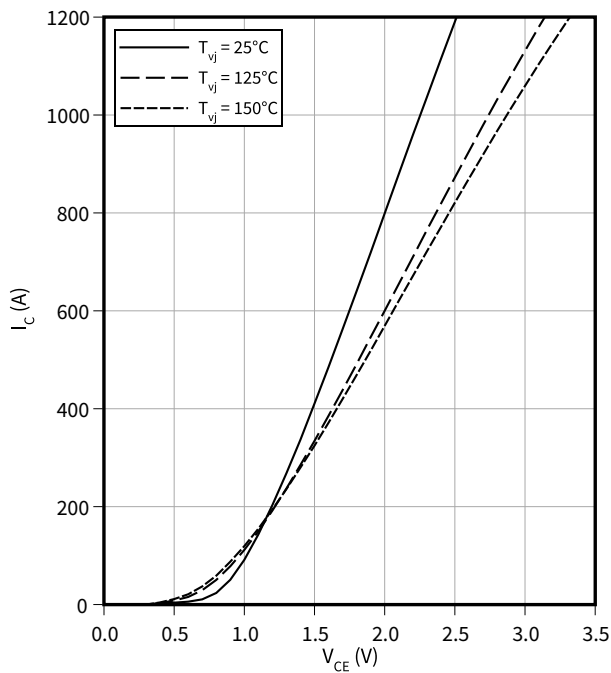
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

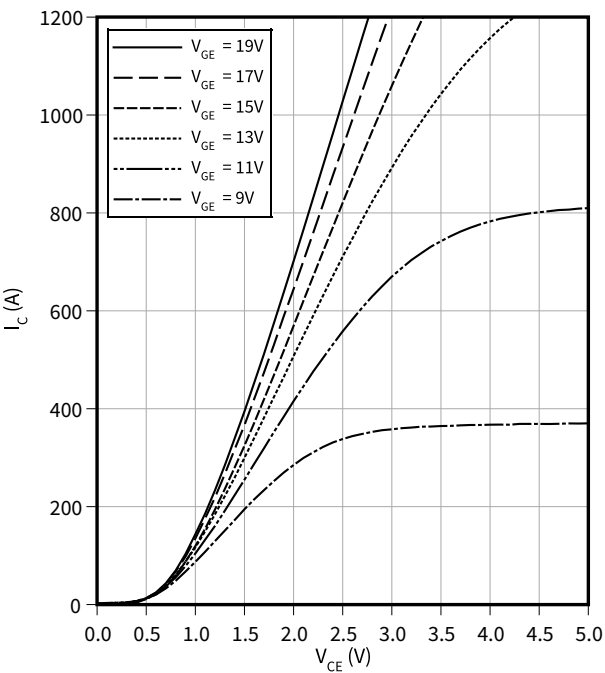
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

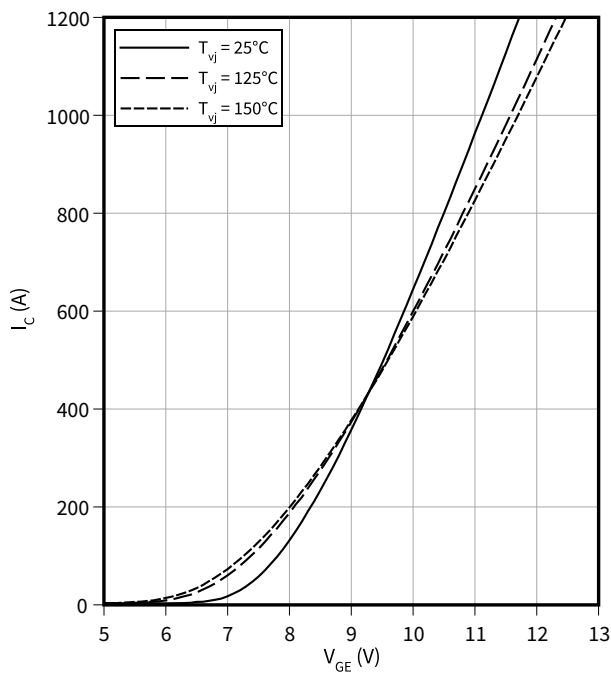
$T_{vj} = 150^\circ\text{C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

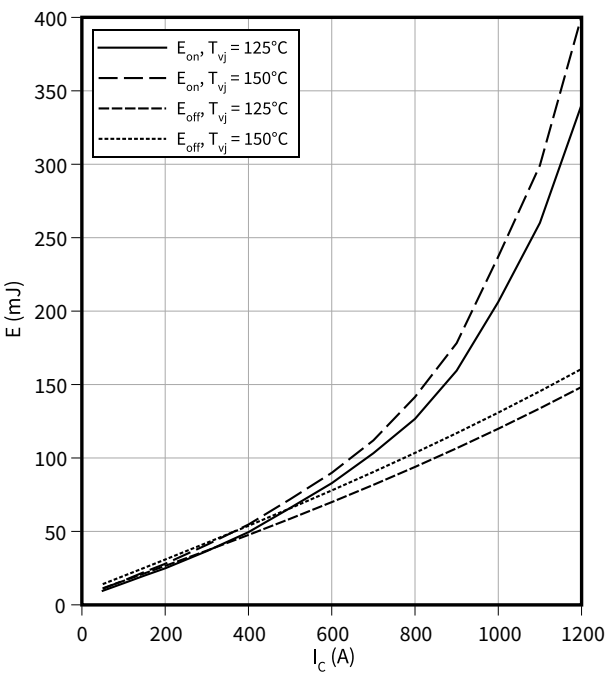
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

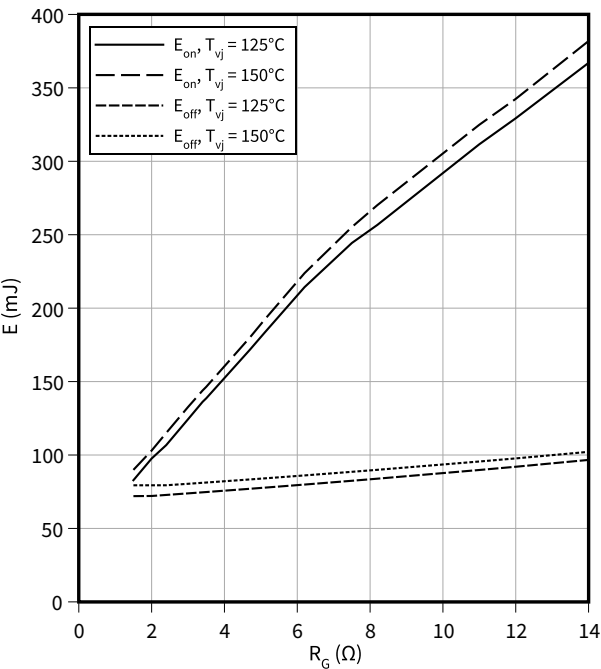
$R_{Goff} = 1.5\ \Omega$, $R_{Gon} = 1.5\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $V_{CC} = 600\text{ V}$



5 Characteristics diagrams

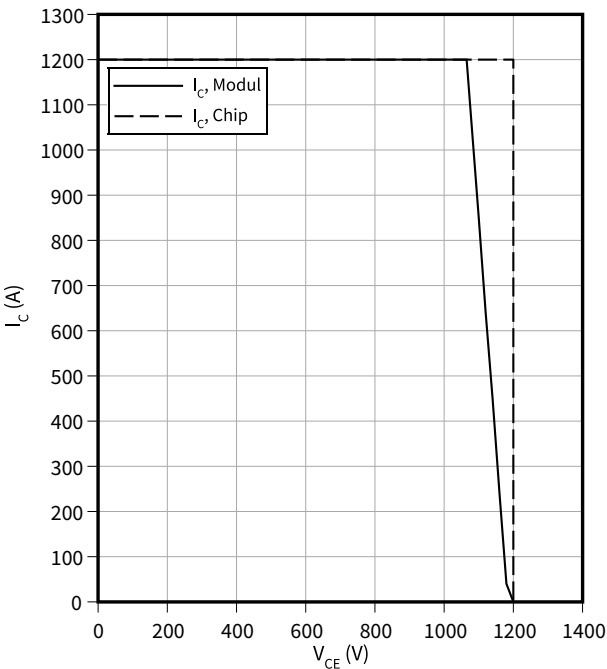
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 600\text{ A}$, $V_{CC} = 600\text{ V}$



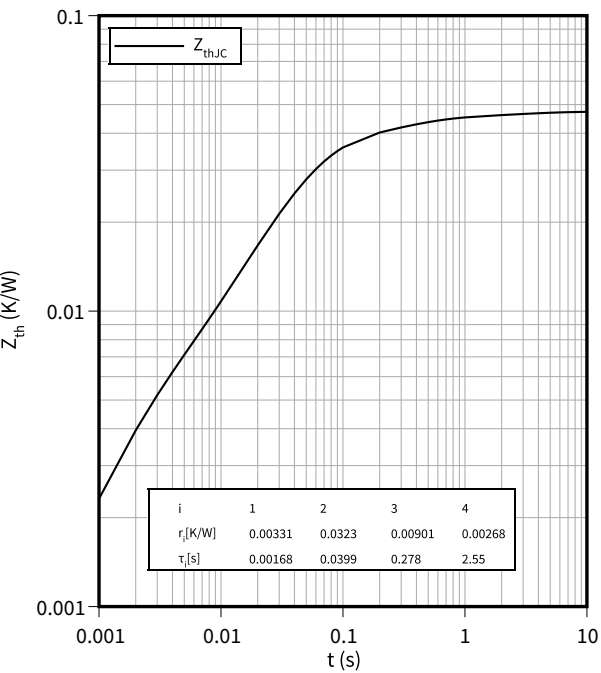
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1.5\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



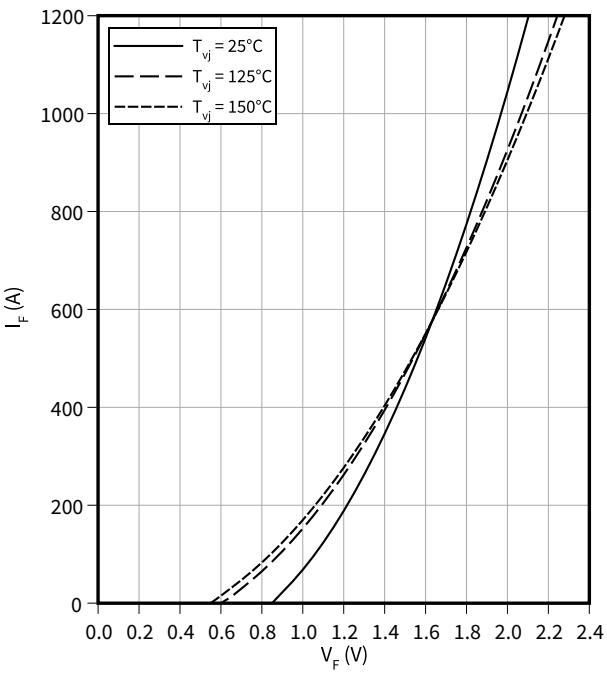
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

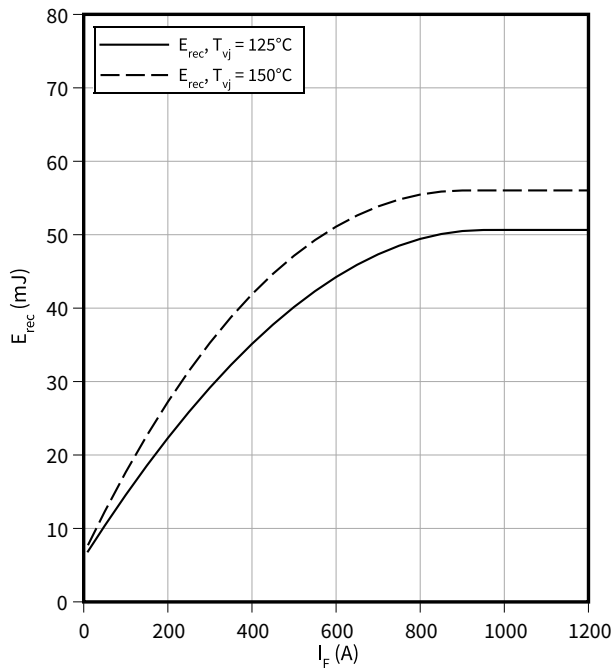
$I_F = f(V_F)$



5 Characteristics diagrams

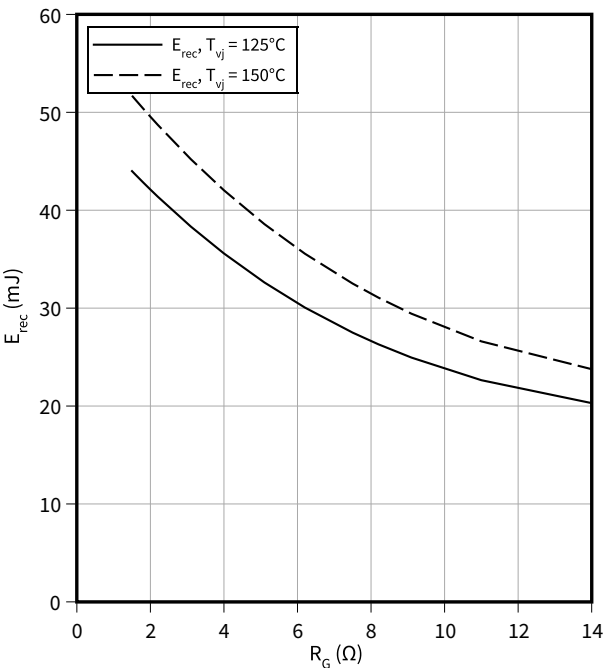
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $R_{Gon} = 1.5 \, \Omega$, $V_{CC} = 600 \, V$



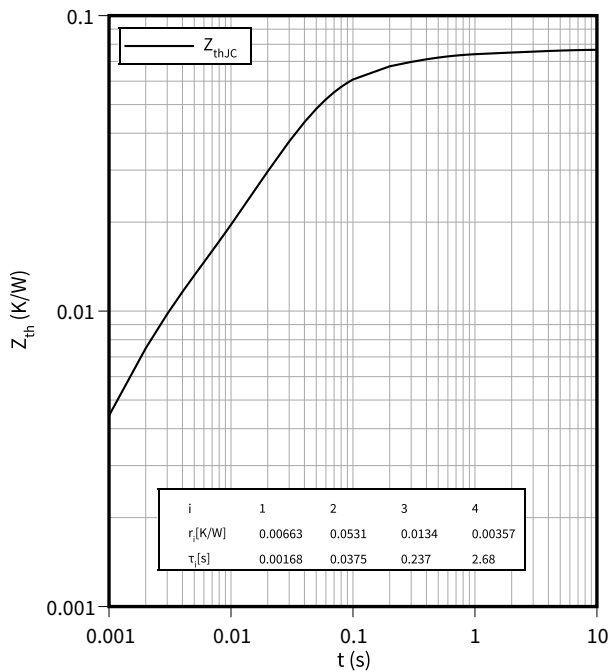
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $I_F = 600 \, A$, $V_{CC} = 600 \, V$



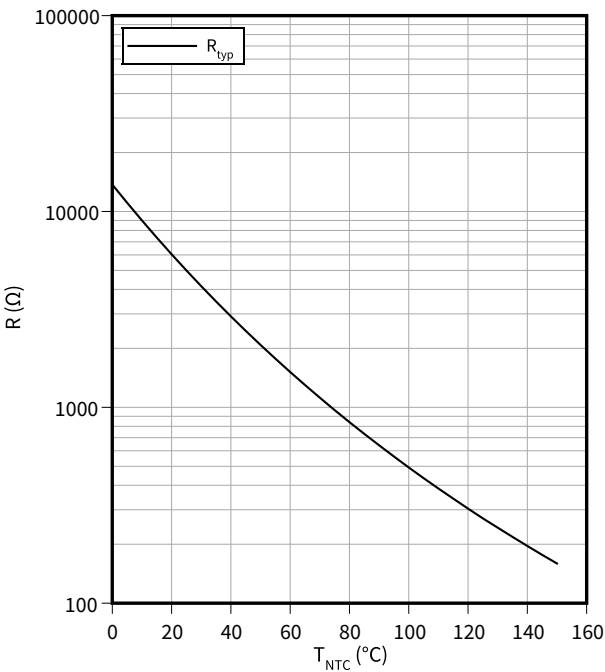
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

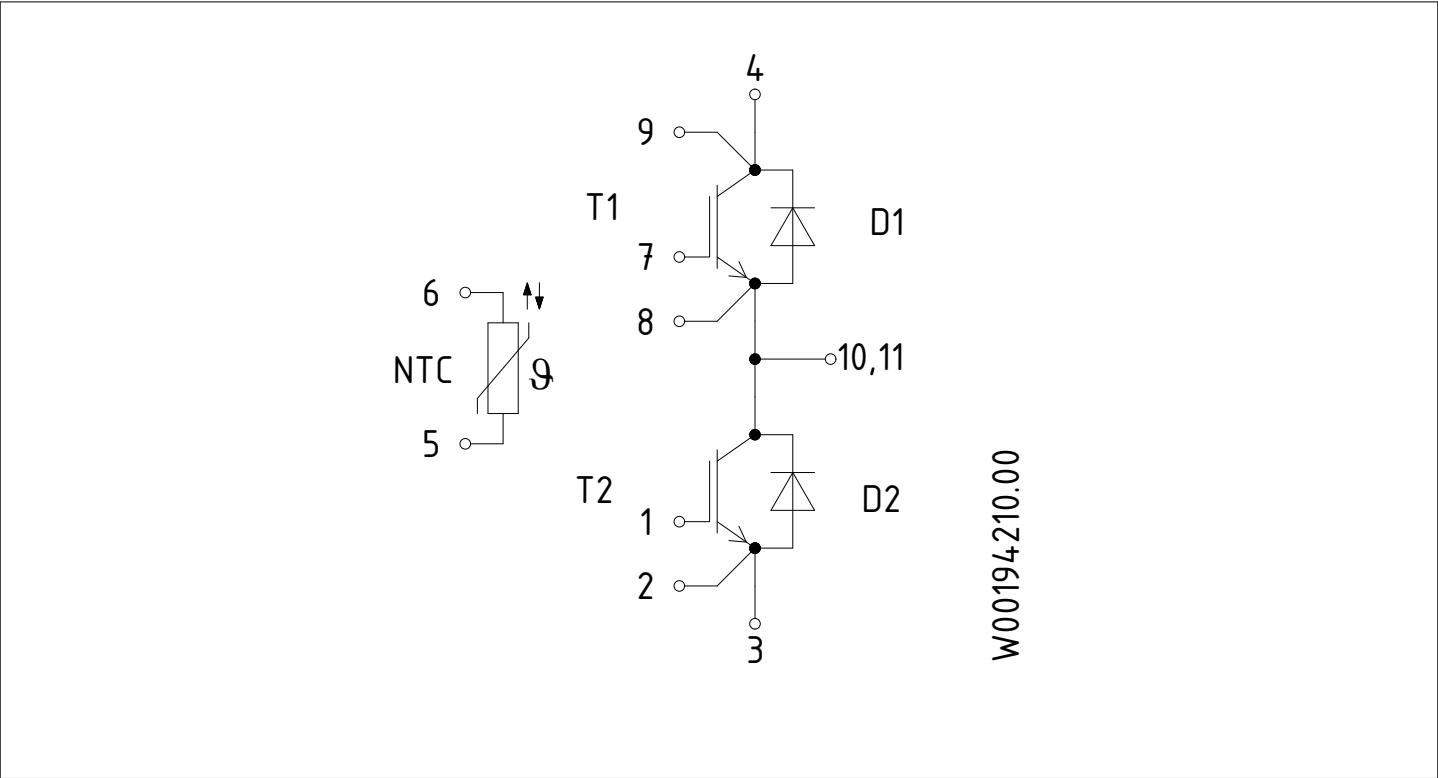


Figure 1

7 Package outlines

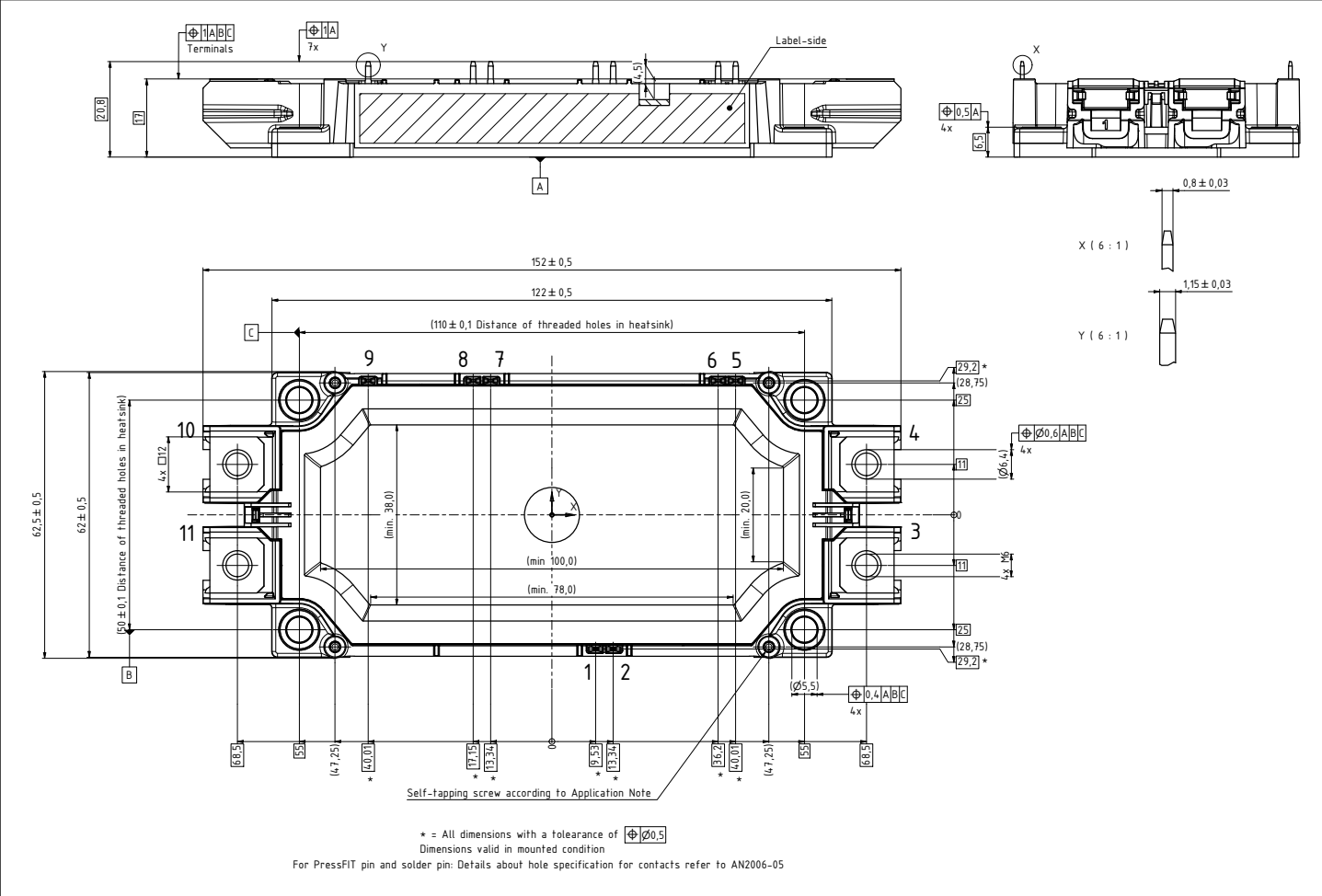


Figure 2

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	 7154914284655054991153071549142846550549911530		

Figure 3



Revision history

Revision history

Document revision	Date of release	Description of changes
V1.0	2017-06-23	Target datasheet
V3.0	2017-09-05	Final datasheet
V3.1	2019-10-10	Final 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
1.10	2024-03-18	Final datasheet

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