

EasyPACK™ 2B module with TRENCHSTOP™ 5 H5 IGBT and NTC

Features

- Electrical features
 - $V_{CES} = 650\text{ V}$
 - $I_{C\text{ nom}} = 35\text{ A} / I_{CRM} = 70\text{ A}$
 - Trench IGBT 5
 - Low switching losses
 - Increased blocking voltage capability up to 650 V
- Mechanical features
 - Rugged mounting due to integrated mounting clamps
 - Al_2O_3 substrate with low thermal resistance
 - Compact design
 - Solder contact technology



Typical appearance

Potential applications

- UPS systems
- DC charger for EV
- Motor drives

Product validation

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

Description

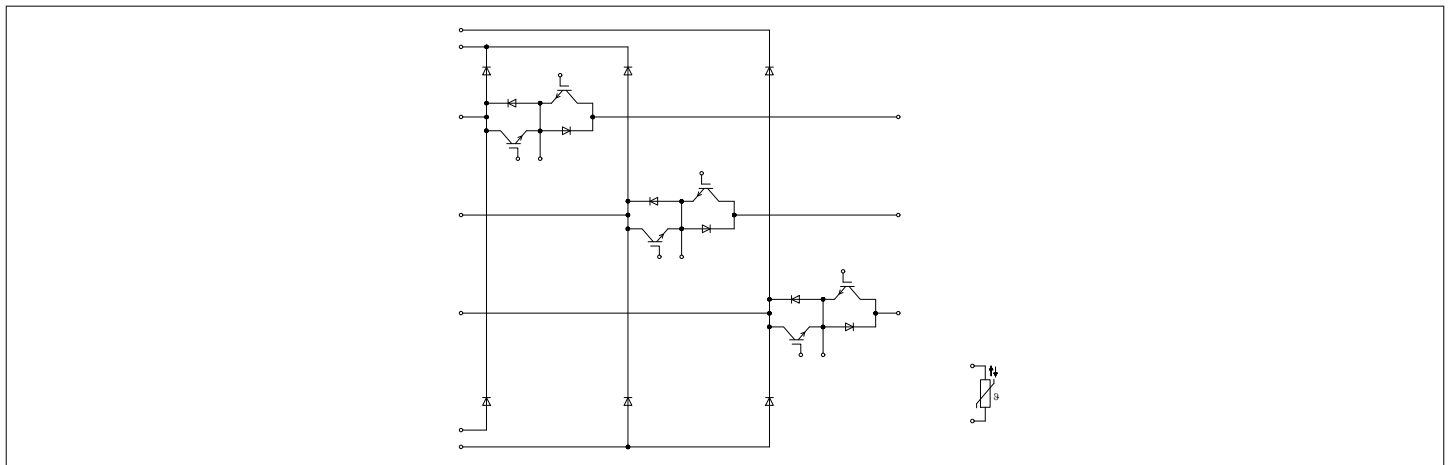


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	2.5	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
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	$R_{AA'+CC'}$	$T_H = 25 \text{ °C}$, per switch		2.4		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$, per switch		3.9		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	F		40		80	N
Weight	G			39		g

Note: The current under continuous operation is limited to 30A rms per connector pin

2 IGBT, T1-T6

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = 25 \text{ °C}$	650	V
Implemented collector current	I_{CN}			35	A
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$	$T_H = 65 \text{ °C}$	25	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$		70	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	$V_{CE\ sat}$	$I_C = 20\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.32	1.67	V
			$T_{vj} = 125\ ^\circ C$		1.39		
			$T_{vj} = 150\ ^\circ C$		1.41		
Gate threshold voltage	V_{GETh}	$I_C = 0.35\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		3.85	4.60	5.35	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CC} = 300\ V$			0.152		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			0		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			1.94		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.007		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 650\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			0.012	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}	$I_C = 20\ A, V_{CC} = 350\ V, V_{GE} = \pm 15\ V, R_{Gon} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.016		μs
			$T_{vj} = 125\ ^\circ C$		0.017		
			$T_{vj} = 150\ ^\circ C$		0.017		
Rise time (inductive load)	t_r	$I_C = 20\ A, V_{CC} = 350\ V, V_{GE} = \pm 15\ V, R_{Gon} = 6.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.004		μs
			$T_{vj} = 125\ ^\circ C$		0.005		
			$T_{vj} = 150\ ^\circ C$		0.006		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 20\ A, V_{CC} = 350\ V, V_{GE} = \pm 15\ V, R_{Goff} = 7.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.090		μs
			$T_{vj} = 125\ ^\circ C$		0.110		
			$T_{vj} = 150\ ^\circ C$		0.120		
Fall time (inductive load)	t_f	$I_C = 20\ A, V_{CC} = 350\ V, V_{GE} = \pm 15\ V, R_{Goff} = 7.5\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.018		μs
			$T_{vj} = 125\ ^\circ C$		0.052		
			$T_{vj} = 150\ ^\circ C$		0.073		
Turn-on energy loss per pulse	E_{on}	$I_C = 20\ A, V_{CC} = 350\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 6.2\ \Omega, di/dt = 2260\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.39		mJ
			$T_{vj} = 125\ ^\circ C$		0.49		
			$T_{vj} = 150\ ^\circ C$		0.507		
Turn-off energy loss per pulse	E_{off}	$I_C = 20\ A, V_{CC} = 350\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 7.5\ \Omega, dv/dt = 7200\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.14		mJ
			$T_{vj} = 125\ ^\circ C$		0.31		
			$T_{vj} = 150\ ^\circ C$		0.365		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, $\lambda_{grease} = 1\ W/(m \cdot K)$			2.12		K/W

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°C

3 Diode, D1-D6

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\,^{\circ}\text{C}$	650	V
Continuous DC forward current	I_F			30	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\,\text{ms}$		60	A
I^2t - value	I^2t	$t_P = 10\,\text{ms}, V_R = 0\,\text{V}$	$T_{vj} = 125\,^{\circ}\text{C}$	90	A^2s
			$T_{vj} = 150\,^{\circ}\text{C}$	82	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 30\,\text{A}, V_{GE} = 0\,\text{V}$		$T_{vj} = 25\,^{\circ}\text{C}$	1.60	V
				$T_{vj} = 125\,^{\circ}\text{C}$	1.55	
				$T_{vj} = 150\,^{\circ}\text{C}$	1.52	
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 1\,\text{W}/(\text{m}\cdot\text{K})$		2.48		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		150	°C

4 Diode, D7-D12

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\,^{\circ}\text{C}$	1200	V
Implemented forward current	I_{FN}			50	A
Continuous DC forward current	I_F			20	A

(table continues...)

Table 7 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$	100	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	A^2s
			$T_{vj} = 175 \text{ °C}$	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 20 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.30	1.50	V
			$T_{vj} = 125 \text{ °C}$	1.18		
			$T_{vj} = 175 \text{ °C}$	1.10		
Peak reverse recovery current	I_{RM}	$V_{CC} = 350 \text{ V}, I_F = 20 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 2260 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	40.9		A
			$T_{vj} = 125 \text{ °C}$	53.1		
			$T_{vj} = 175 \text{ °C}$	62		
Recovered charge	Q_r	$V_{CC} = 350 \text{ V}, I_F = 20 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 2260 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	2.27		μC
			$T_{vj} = 125 \text{ °C}$	4.36		
			$T_{vj} = 175 \text{ °C}$	5.6		
Reverse recovery energy	E_{rec}	$V_{CC} = 350 \text{ V}, I_F = 20 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 2260 \text{ A}/\mu\text{s} (T_{vj} = 175 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	0.5		mJ
			$T_{vj} = 125 \text{ °C}$	1.08		
			$T_{vj} = 175 \text{ °C}$	1.48		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		1.46		K/W
Temperature under switching conditions	$T_{vj op}$		-40		175	°C

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

5 NTC-Thermistor

Table 9 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}, R_{100} = 493 \text{ Ω}$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			20	mW

(table continues...)

Table 9 (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

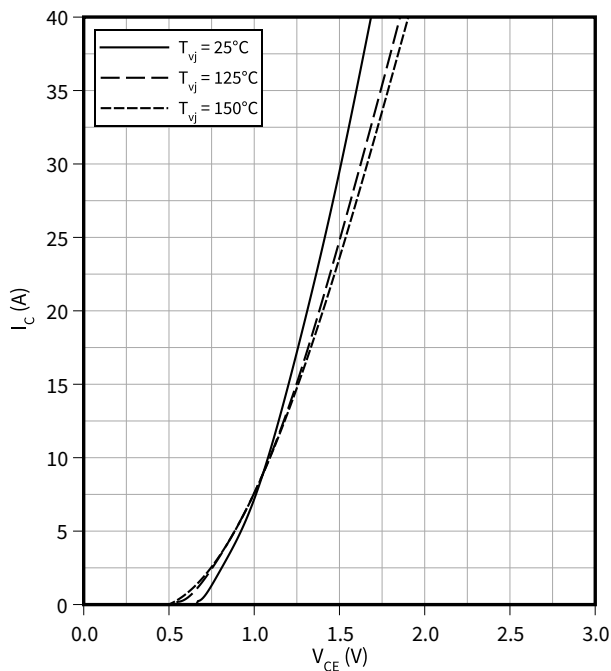
Note: Specification according to the valid application note.

6 Characteristics diagrams

Output characteristic (typical), IGBT, T1-T6

$I_C = f(V_{CE})$

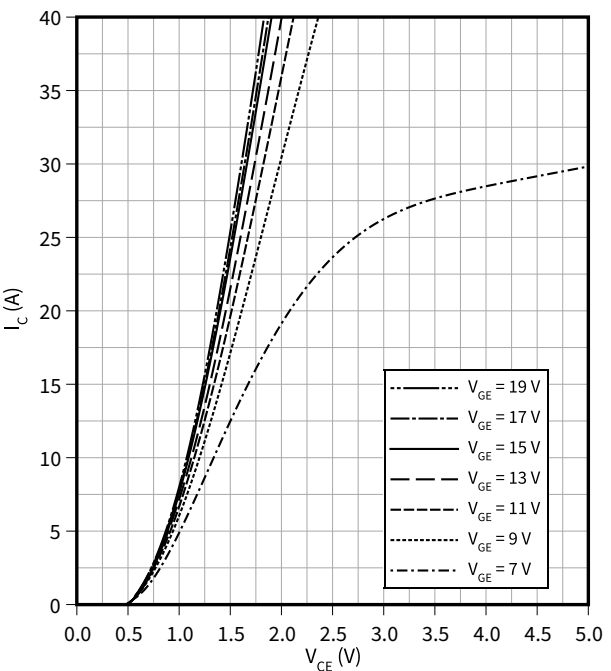
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, T1-T6

$I_C = f(V_{CE})$

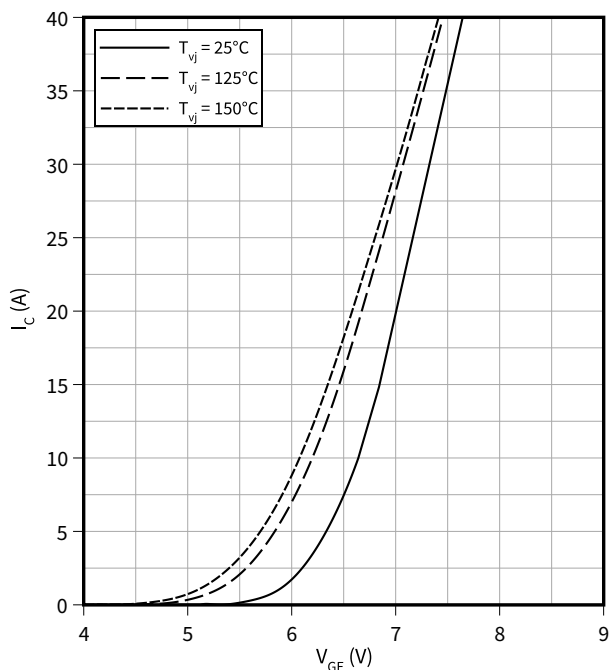
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, T1-T6

$I_C = f(V_{GE})$

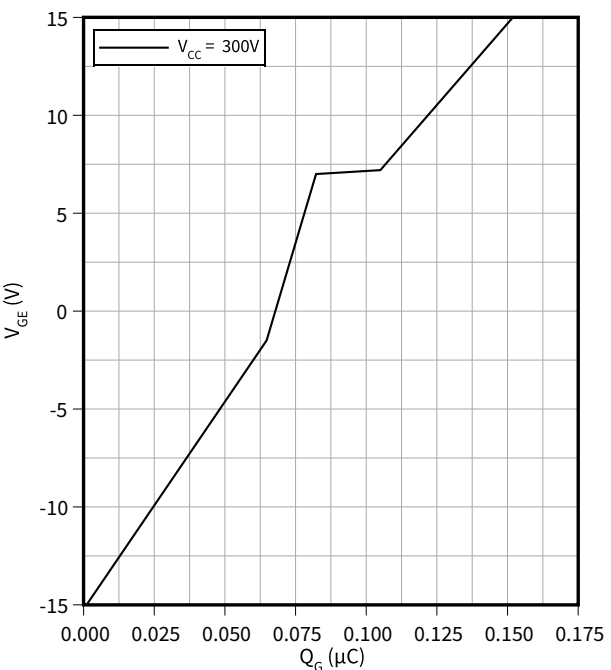
$V_{CE} = 20\text{ V}$



Gate charge characteristic (typical), IGBT, T1-T6

$V_{GE} = f(Q_G)$

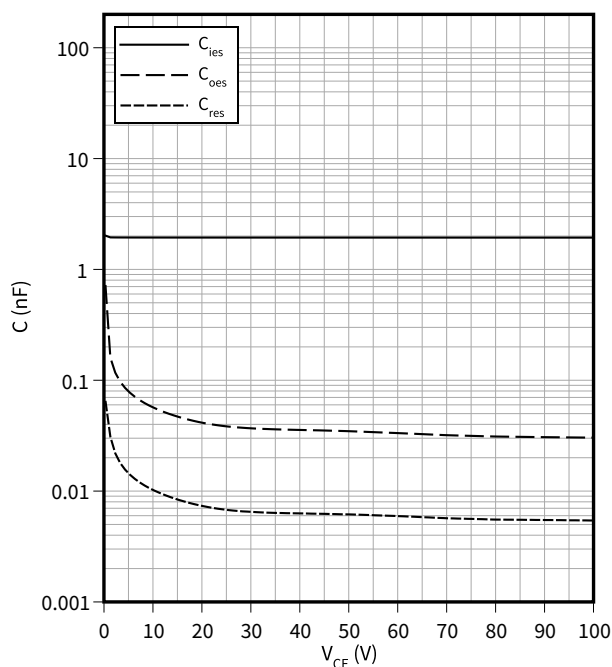
$I_C = 35\text{ A}, T_{vj} = 25\text{ °C}$



Capacity characteristic (typical), IGBT, T1-T6

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

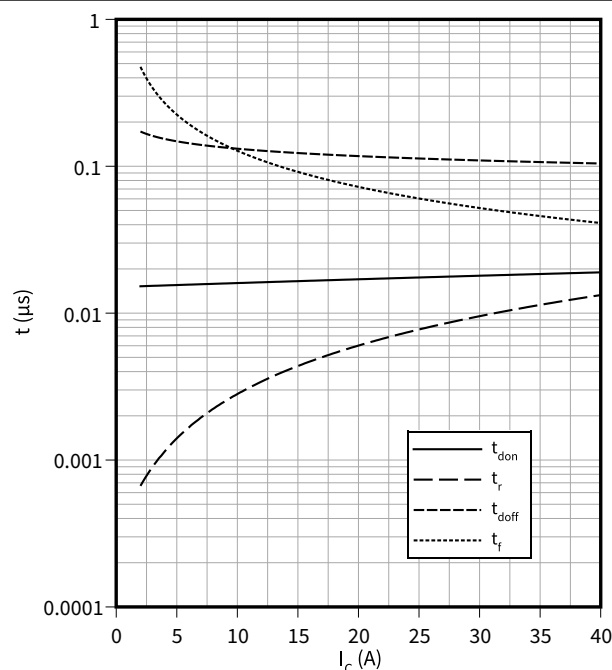
$f = 100 \text{ kHz}$, $V_{GE} = 0 \text{ V}$, $T_{vj} = 25 \text{ °C}$



Switching times (typical), IGBT, T1-T6

$$t = f(I_C)$$

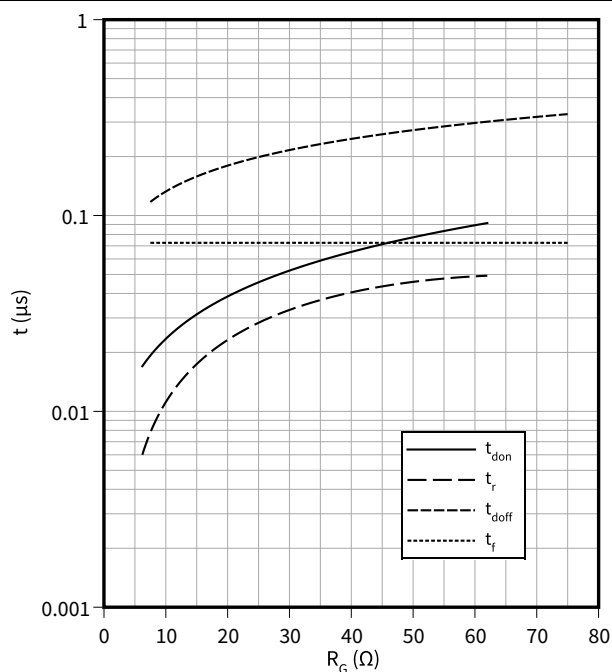
$R_{Goff} = 7.5 \text{ } \Omega$, $R_{Gon} = 6.2 \text{ } \Omega$, $V_{CC} = 350 \text{ V}$, $V_{GE} = -15 / 15 \text{ V}$, $T_{vj} = 150 \text{ °C}$



Switching times (typical), IGBT, T1-T6

$$t = f(R_G)$$

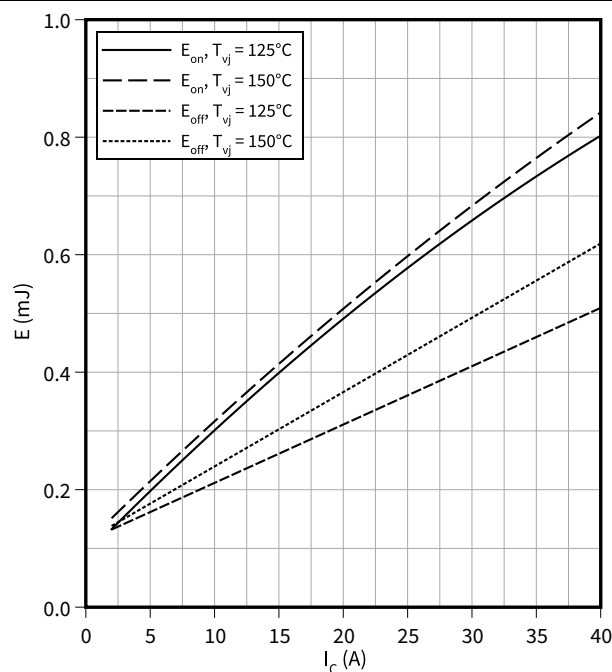
$I_C = 20 \text{ A}$, $V_{CC} = 350 \text{ V}$, $V_{GE} = -15 / 15 \text{ V}$, $T_{vj} = 150 \text{ °C}$



Switching losses (typical), IGBT, T1-T6

$$E = f(I_C)$$

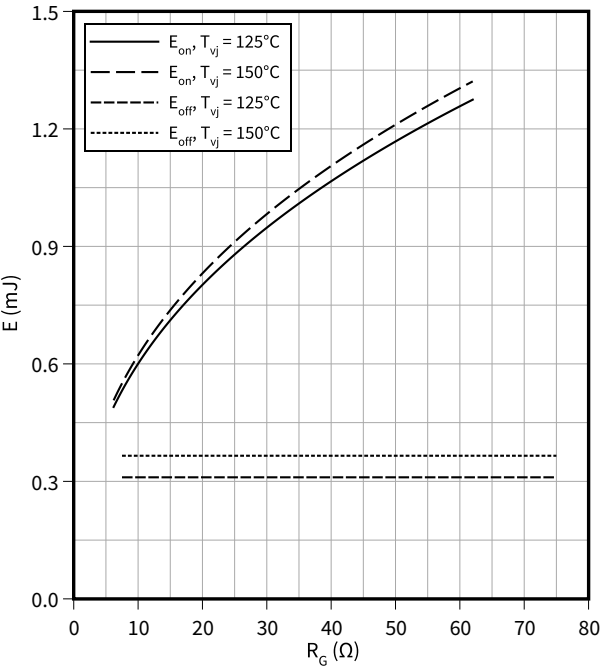
$R_{Goff} = 7.5 \text{ } \Omega$, $R_{Gon} = 6.2 \text{ } \Omega$, $V_{CC} = 350 \text{ V}$, $V_{GE} = -15 / 15 \text{ V}$



6 Characteristics diagrams

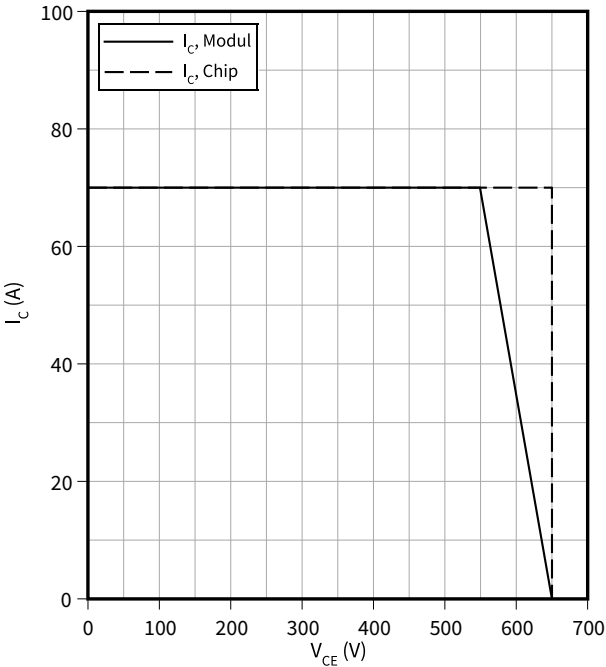
Switching losses (typical), IGBT, T1-T6

$E = f(R_G)$
 $I_C = 20\text{ A}$, $V_{CC} = 350\text{ V}$, $V_{GE} = -15 / 15\text{ V}$



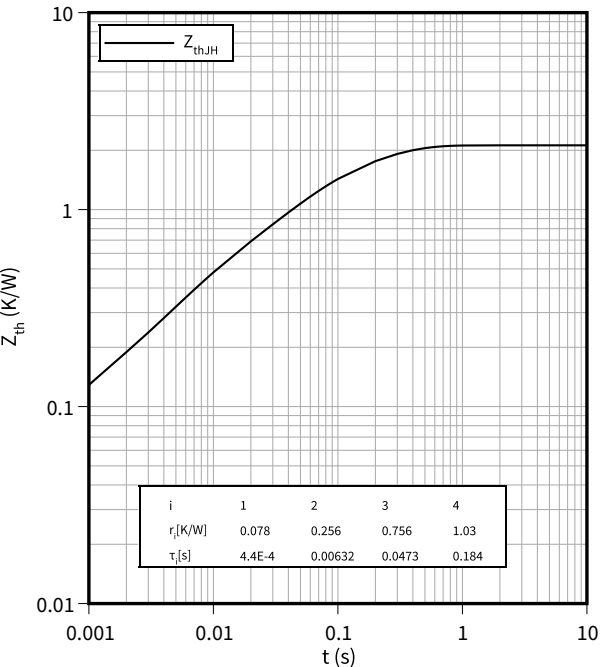
Reverse bias safe operating area (RBSOA), IGBT, T1-T6

$I_C = f(V_{CE})$
 $R_{Goff} = 7.5\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



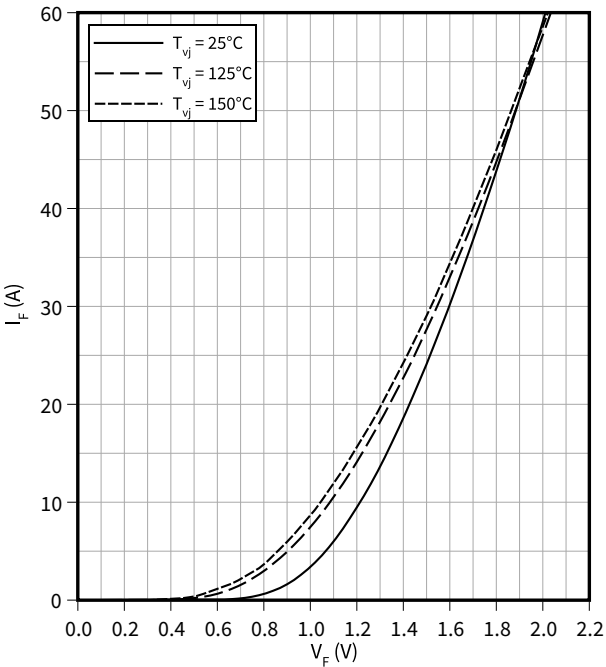
Transient thermal impedance, IGBT, T1-T6

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D1-D6

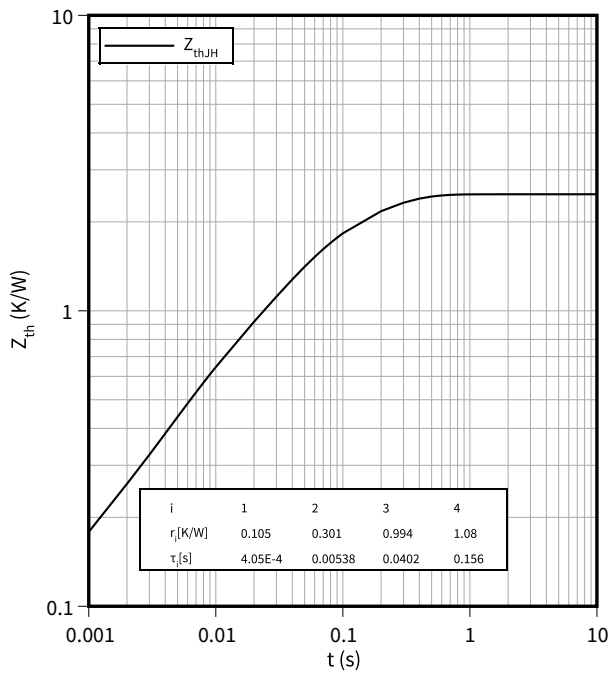
$I_F = f(V_F)$



6 Characteristics diagrams

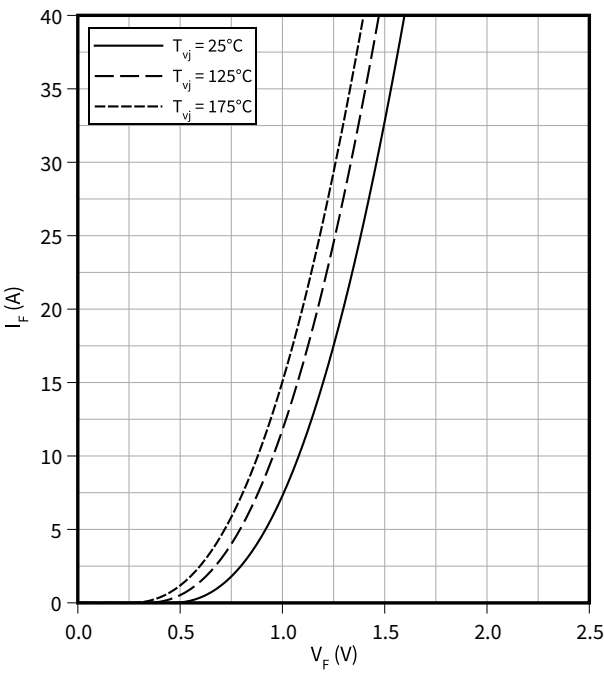
Transient thermal impedance, Diode, D1-D6

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D7-D12

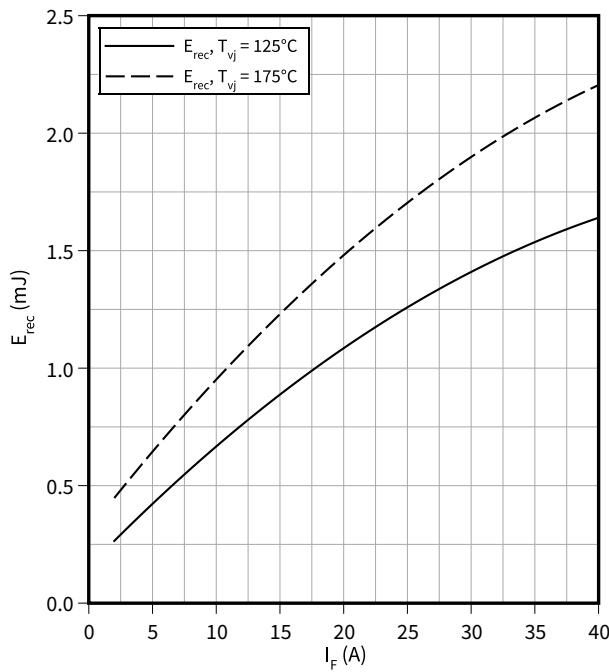
$I_F = f(V_F)$



Switching losses (typical), Diode, D7-D12

$E_{rec} = f(I_F)$

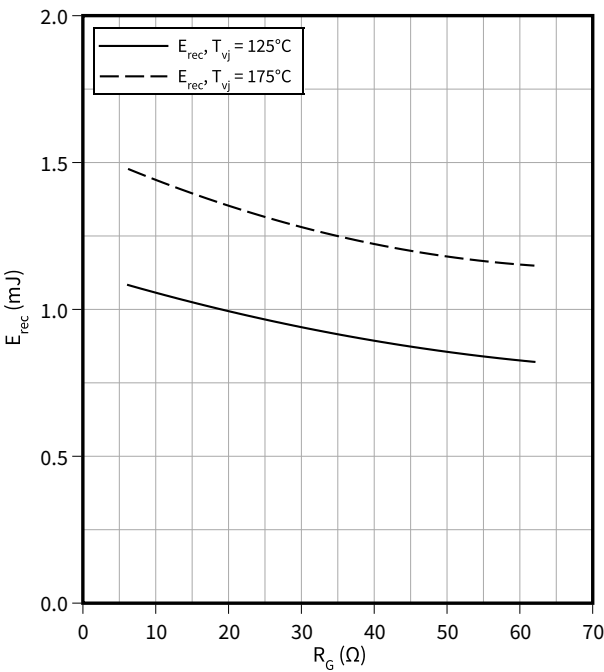
$R_{Gon} = 6.2 \Omega, V_{CC} = 350 V$



Switching losses (typical), Diode, D7-D12

$E_{rec} = f(R_G)$

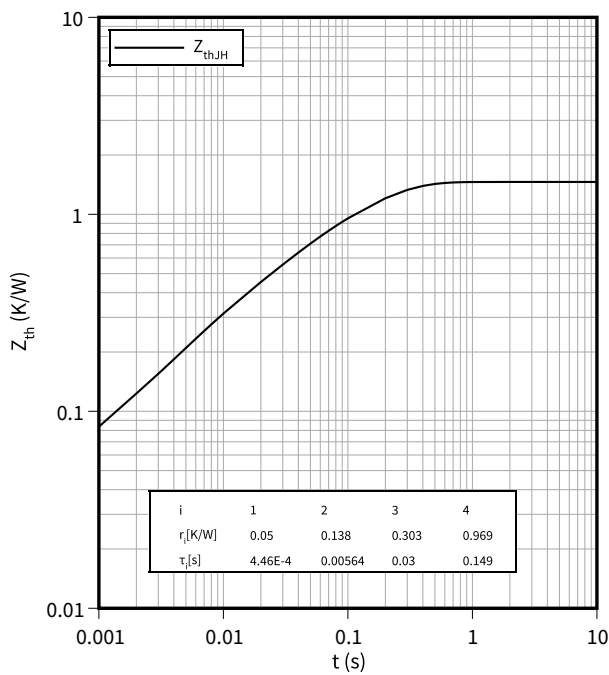
$I_F = 20 A, V_{CC} = 350 V$



6 Characteristics diagrams

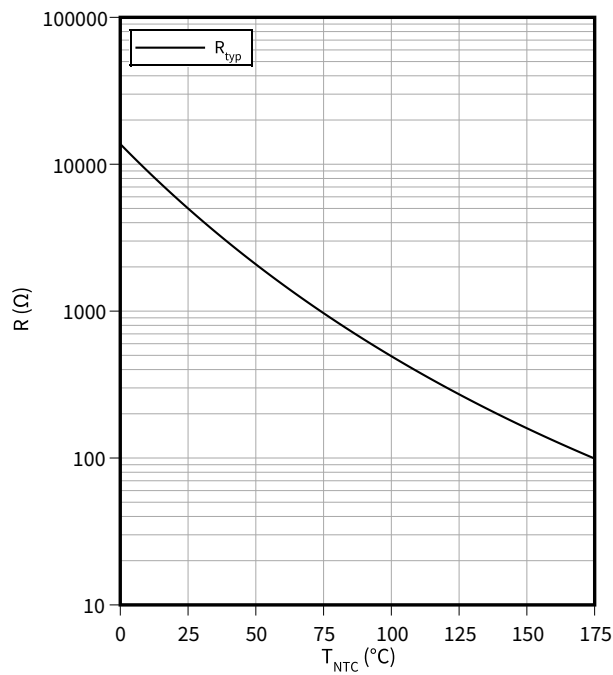
Transient thermal impedance, Diode, D7-D12

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 Circuit diagram

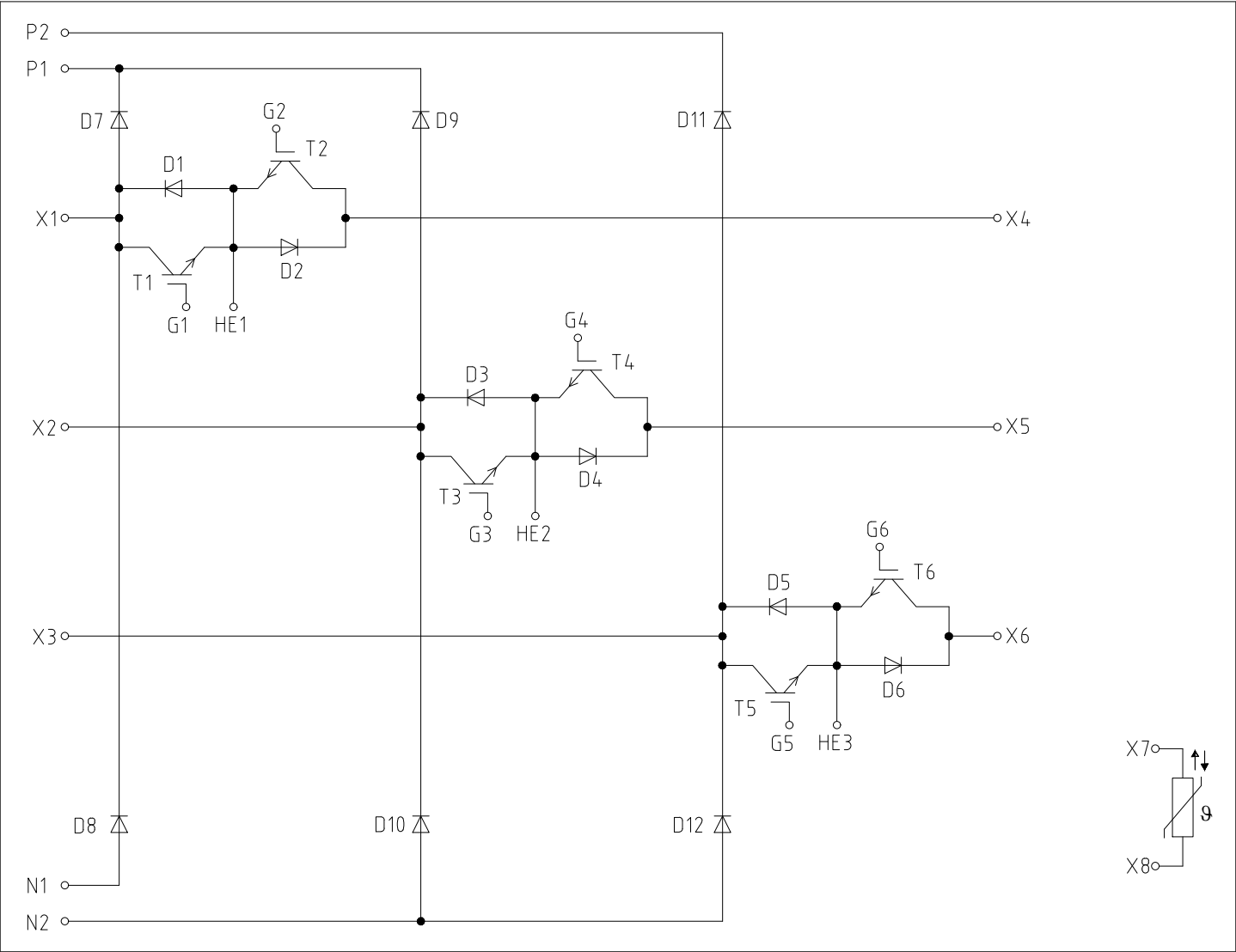


Figure 1

Package outlines

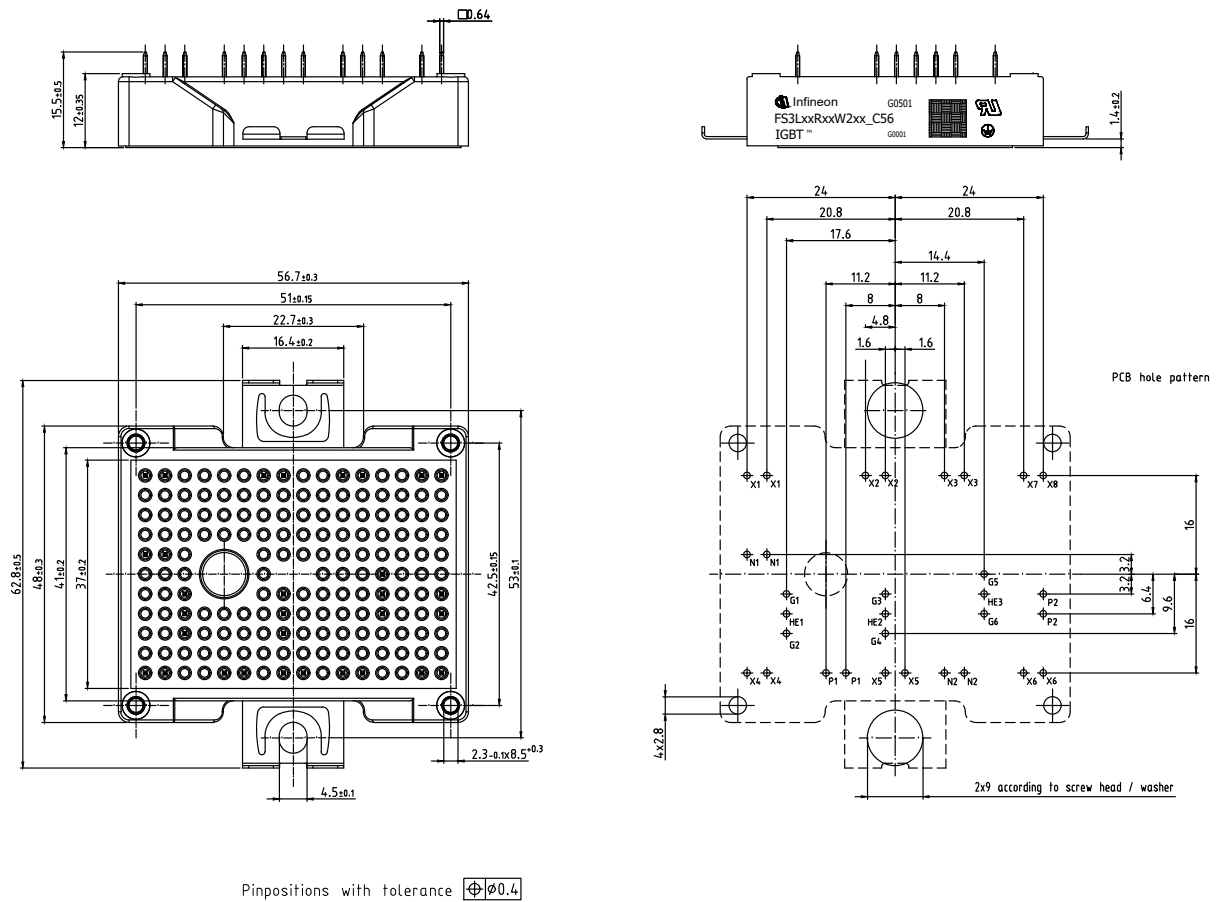


Figure 2

9 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

Revision history

Document revision	Date of release	Description of changes
1.00	2023-04-26	Initial version

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