

EasyPACK™ module with TRENCHSTOP™ IGBT7 and CoolSiC™ Schottky diode and PressFIT / NTC

Features

- Electrical features
 - $V_{CES} = 950\text{ V}$
 - $I_{C\text{ nom}} = 100\text{ A} / I_{CRM} = 200\text{ A}$
 - CoolSiC™ Schottky diode gen 5
 - Low switching losses
 - TRENCHSTOP™ IGBT7
- Mechanical features
 - Al_2O_3 substrate with low thermal resistance
 - Compact design
 - Integrated NTC temperature sensor
 - PressFIT contact technology



Potential applications

- UPS systems
- Three-level applications
- Solar applications

Product validation

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

Description

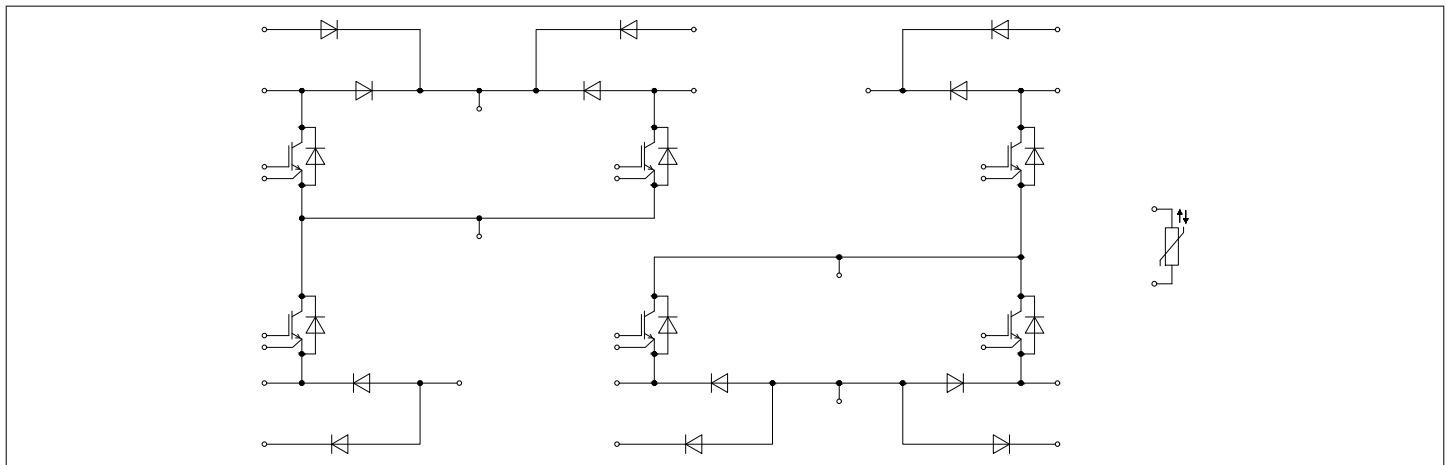


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.2	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	11.2	mm
Creepage distance	d_{Creep}	terminal to terminal	6.8	mm
Clearance	d_{Clear}	terminal to heatsink	9.4	mm
Clearance	d_{Clear}	terminal to terminal	5.5	mm
Comparative tracking index	CTI		>400	
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}			22		nH
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	1.3		1.5	Nm
Weight	G			78		g

Note: The current under continuous operation is limited to 25A rms per connector pin.

2 IGBT, Boost

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25 \text{ °C}$	950	V
Implemented collector current	I_{CN}		100	A
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_H = 65 \text{ °C}$	70	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$	200	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	$V_{CE\ sat}$	$I_C = 30\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.33	1.53	V
			$T_{vj} = 125\ ^\circ C$		1.39		
			$T_{vj} = 150\ ^\circ C$		1.40		
Gate threshold voltage	V_{GETh}	$I_C = 1.67\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		4.35	5.10	5.85	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$			0.23		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			1.5		Ω
Input capacitance	C_{ies}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			6.48		nF
Reverse transfer capacitance	C_{res}	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.02		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 950\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			0.031	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}	$I_C = 30\ A, V_{CE} = 500\ V, V_{GE} = \pm 15\ V, R_{Gon} = 10\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.060		μs
			$T_{vj} = 125\ ^\circ C$		0.060		
			$T_{vj} = 150\ ^\circ C$		0.060		
Rise time (inductive load)	t_r	$I_C = 30\ A, V_{CE} = 500\ V, V_{GE} = \pm 15\ V, R_{Gon} = 10\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.020		μs
			$T_{vj} = 125\ ^\circ C$		0.020		
			$T_{vj} = 150\ ^\circ C$		0.020		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 30\ A, V_{CE} = 500\ V, V_{GE} = \pm 15\ V, R_{Goff} = 10\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.180		μs
			$T_{vj} = 125\ ^\circ C$		0.220		
			$T_{vj} = 150\ ^\circ C$		0.240		
Fall time (inductive load)	t_f	$I_C = 30\ A, V_{CE} = 500\ V, V_{GE} = \pm 15\ V, R_{Goff} = 10\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.080		μs
			$T_{vj} = 125\ ^\circ C$		0.120		
			$T_{vj} = 150\ ^\circ C$		0.130		
Turn-on energy loss per pulse	E_{on}	$I_C = 30\ A, V_{CE} = 500\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 10\ \Omega, di/dt = 1900\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.525		mJ
			$T_{vj} = 125\ ^\circ C$		0.557		
			$T_{vj} = 150\ ^\circ C$		0.567		
Turn-off energy loss per pulse	E_{off}	$I_C = 30\ A, V_{CE} = 500\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 10\ \Omega, dv/dt = 3500\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.72		mJ
			$T_{vj} = 125\ ^\circ C$		1.21		
			$T_{vj} = 150\ ^\circ C$		1.37		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, $\lambda_{grease} = 3.3\ W/(m^*K)$			0.667		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, Boost

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25\ ^\circ\text{C}$	1200	V
Implemented forward current	I_{FN}			40	A
Continuous DC forward current	I_F			30	A
Repetitive peak forward current	I_{FRM}	$t_P = 1\ \text{ms}$		80	A
I^2t - value	I^2t	$V_R = 0\ \text{V}, t_P = 10\ \text{ms}$	$T_{vj} = 125\ ^\circ\text{C}$	200	A^2s
			$T_{vj} = 150\ ^\circ\text{C}$	111	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 30\ \text{A}, V_{GE} = 0\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$	1.29	1.63	V
			$T_{vj} = 125\ ^\circ\text{C}$	1.49		
			$T_{vj} = 150\ ^\circ\text{C}$	1.61		
Peak reverse recovery current	I_{RM}	$I_F = 30\ \text{A}, V_R = 500\ \text{V}, -di_F/dt = 1900\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	16.4		A
			$T_{vj} = 125\ ^\circ\text{C}$	16.4		
			$T_{vj} = 150\ ^\circ\text{C}$	16.4		
Recovered charge	Q_r	$I_F = 30\ \text{A}, V_R = 500\ \text{V}, -di_F/dt = 1900\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	0.74		μC
			$T_{vj} = 125\ ^\circ\text{C}$	0.74		
			$T_{vj} = 150\ ^\circ\text{C}$	0.74		
Reverse recovery energy	E_{rec}	$I_F = 30\ \text{A}, V_R = 500\ \text{V}, -di_F/dt = 1900\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	0.249		mJ
			$T_{vj} = 125\ ^\circ\text{C}$	0.249		
			$T_{vj} = 150\ ^\circ\text{C}$	0.249		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 3.3\ \text{W}/(\text{m}^2\text{K})$		0.979		K/W

(table continues...)

Table 6 (continued) Characteristic values

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

4 Bypass-diode

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25\text{ °C}$		1200	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_H = 95\text{ °C}$		50	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_H = 95\text{ °C}$		50	A
Surge forward current	I_{FSM}	$t_p = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	1070	A
			$T_{vj} = 110\text{ °C}$	957	
I^2t - value	I^2t	$t_p = 10\text{ ms}$	$T_{vj} = 25\text{ °C}$	5770	A²s
			$T_{vj} = 110\text{ °C}$	4580	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 45\text{ A}$	$T_{vj} = 110\text{ °C}$		0.88		V
Reverse current	I_r	$T_{vj} = 150\text{ °C}, V_R = 1200\text{ V}$			1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 3.3\text{ W/(m}^2\text{K)}$			0.549		K/W
Temperature under switching conditions	$T_{vj, op}$			-40		110	°C

5 Inverse-polarity protection diode A

Table 9 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = 25\text{ °C}$	1200	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_H = 95\text{ °C}$	50	A

(table continues...)

Table 9 (continued) Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Maximum RMS current at rectifier output	I_{RMSM}	$T_H = 95\text{ °C}$		50	A
Surge forward current	I_{FSM}	$t_P = 10\text{ ms}$	$T_{vj} = 125\text{ °C}$	395	A
			$T_{vj} = 150\text{ °C}$	378	
I^2t - value	I^2t	$t_P = 10\text{ ms}$	$T_{vj} = 125\text{ °C}$	780	A^2s
			$T_{vj} = 150\text{ °C}$	714	

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 30\text{ A}$	$T_{vj} = 150\text{ °C}$		0.88		V
Reverse current	I_r	$T_{vj} = 150\text{ °C}, V_R = 1200\text{ V}$			0.1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, $\lambda_{grease} = 3.3\text{ W/(m}^2\text{K)}$			0.934		K/W
Temperature under switching conditions	$T_{vj, op}$			-40		150	°C

6 NTC-Thermistor

Table 11 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
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

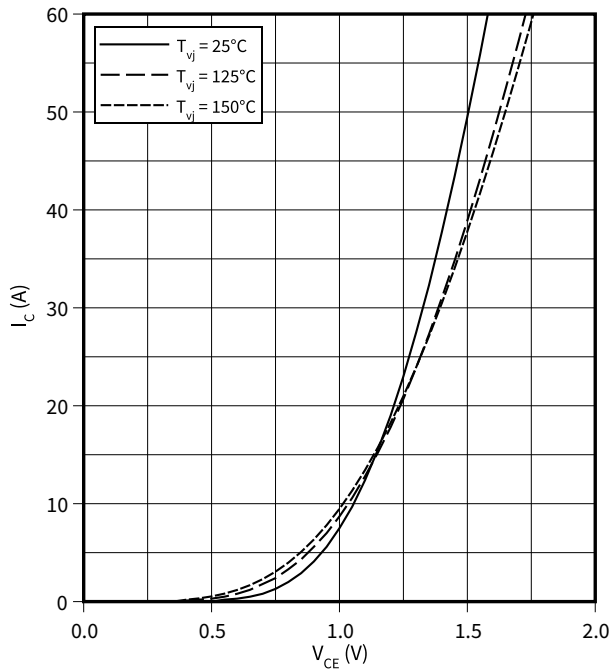
Note: Specification according to the valid application note.

7 Characteristics diagrams

Output characteristic (typical), IGBT, Boost

$I_C = f(V_{CE})$

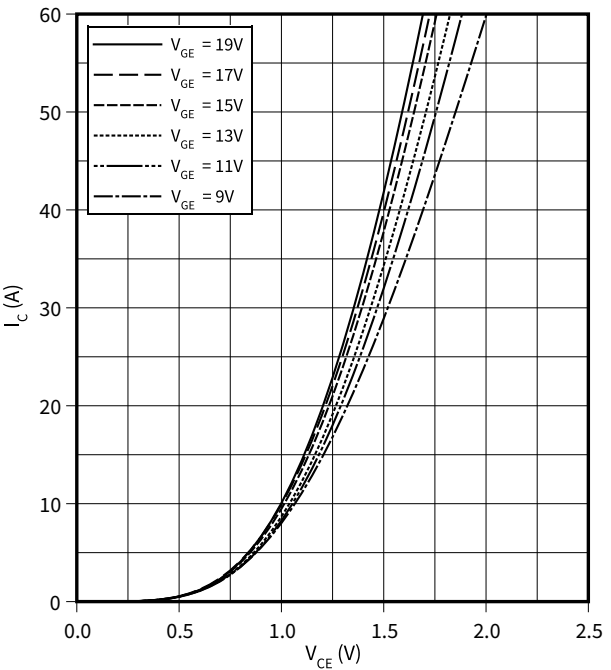
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Boost

$I_C = f(V_{CE})$

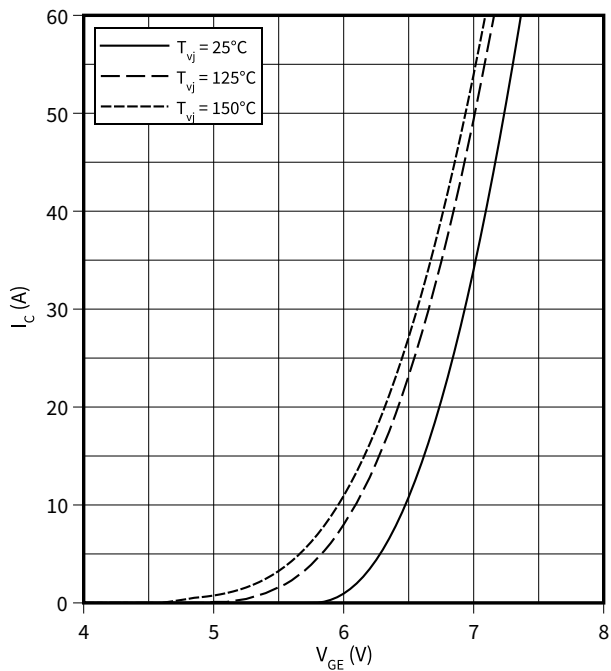
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, Boost

$I_C = f(V_{GE})$

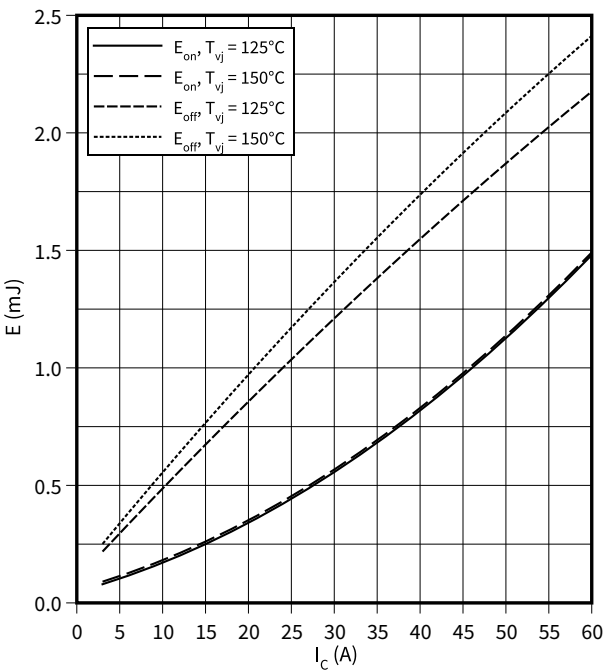
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Boost

$E = f(I_C)$

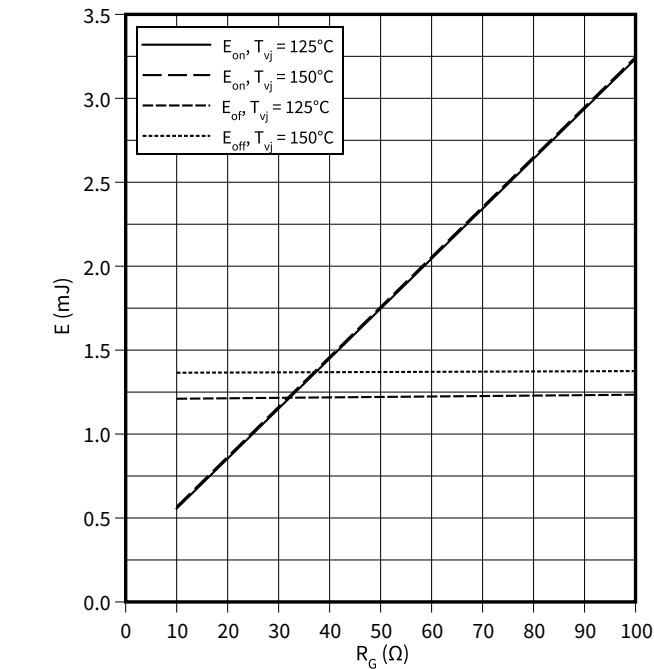
$R_{Goff} = 10\text{ }\Omega$, $R_{Gon} = 10\text{ }\Omega$, $V_{CE} = 500\text{ V}$, $V_{GE} = \pm 15\text{ V}$



7 Characteristics diagrams

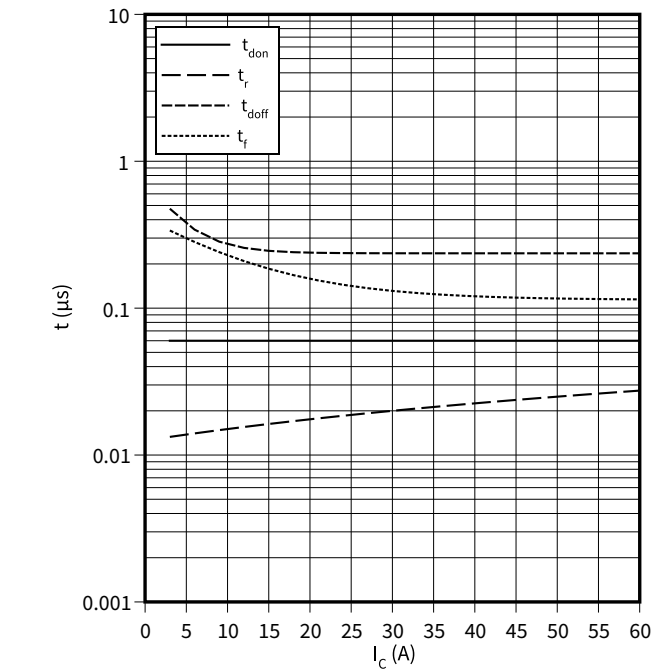
Switching losses (typical), IGBT, Boost

$E = f(R_G)$
 $I_C = 30\text{ A}$, $V_{CE} = 500\text{ V}$, $V_{GE} = \pm 15\text{ V}$



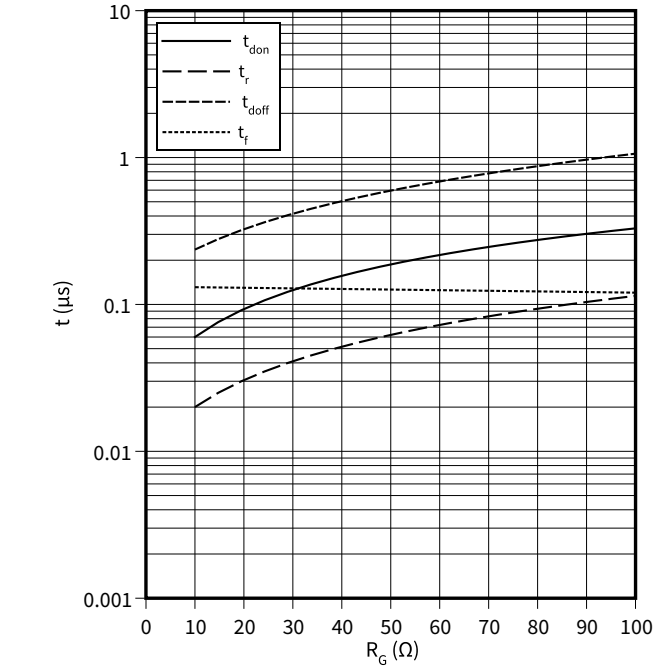
Switching times (typical), IGBT, Boost

$t = f(I_C)$
 $R_{Goff} = 10\text{ }\Omega$, $R_{Gon} = 10\text{ }\Omega$, $V_{CE} = 500\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



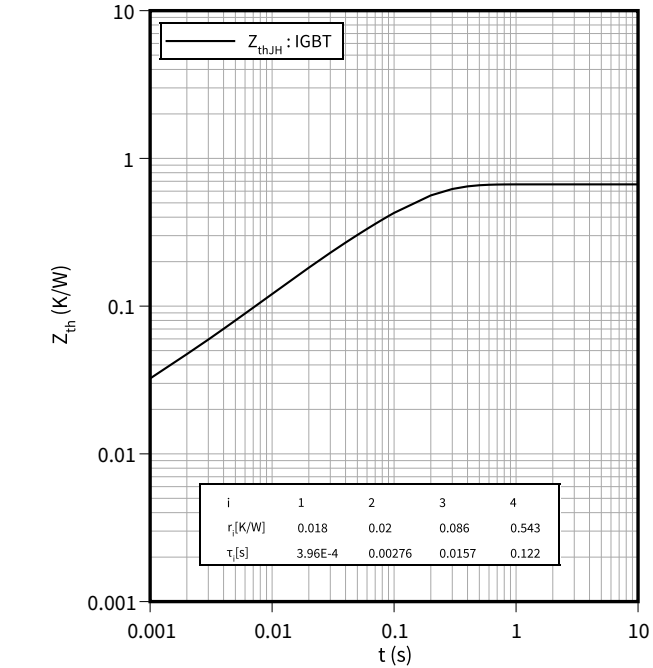
Switching times (typical), IGBT, Boost

$t = f(R_G)$
 $I_C = 30\text{ A}$, $V_{CE} = 500\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



Transient thermal impedance , IGBT, Boost

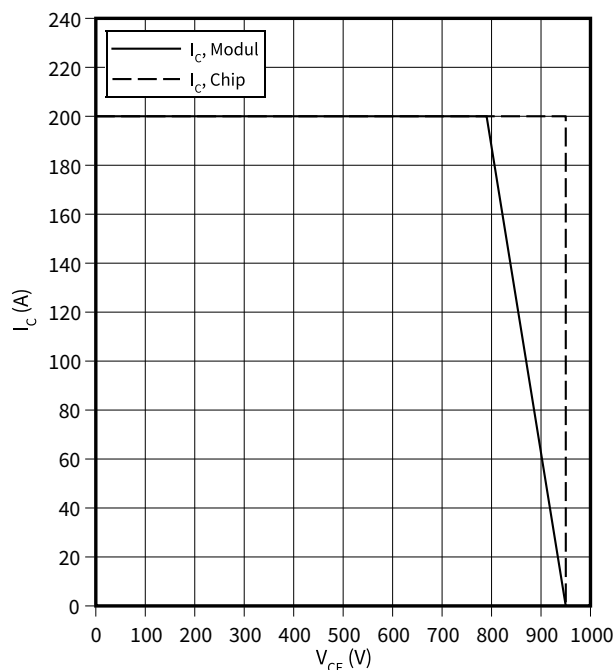
$Z_{th} = f(t)$



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

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

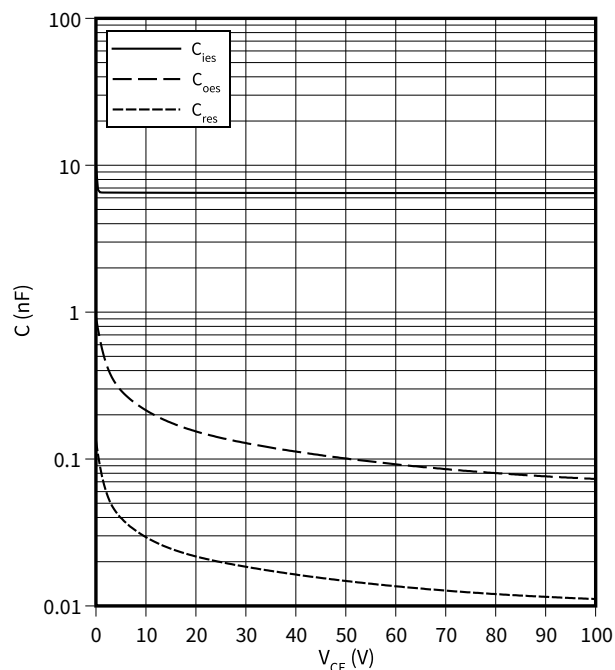
$$R_{Goff} = 10 \, \Omega, V_{GE} = \pm 15.0 \, V, T_{vj} = 150 \, ^\circ C$$



Capacity characteristic (typical), IGBT, Boost

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

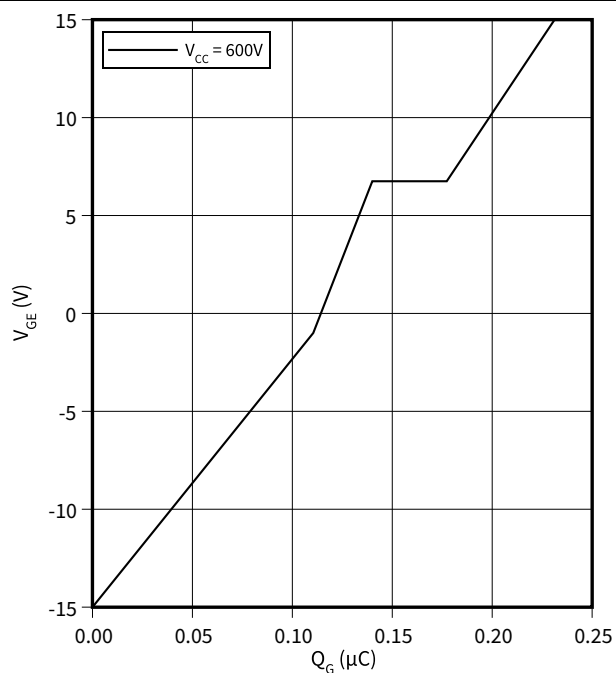
$$f = 100 \, kHz, V_{GE} = 0 \, V, T_{vj} = 25 \, ^\circ C$$



Gate charge characteristic (typical), IGBT, Boost

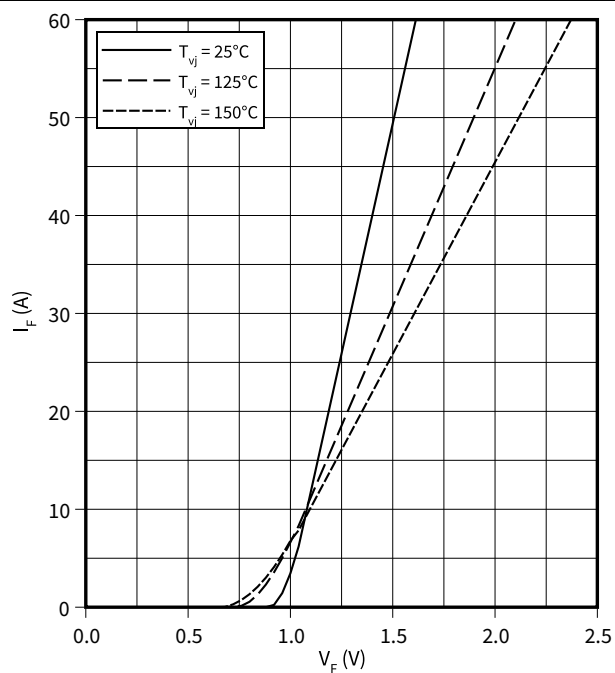
$$V_{GE} = f(Q_G)$$

$$I_C = 100 \, A, T_{vj} = 25 \, ^\circ C$$



Forward characteristic (typical), Diode, Boost

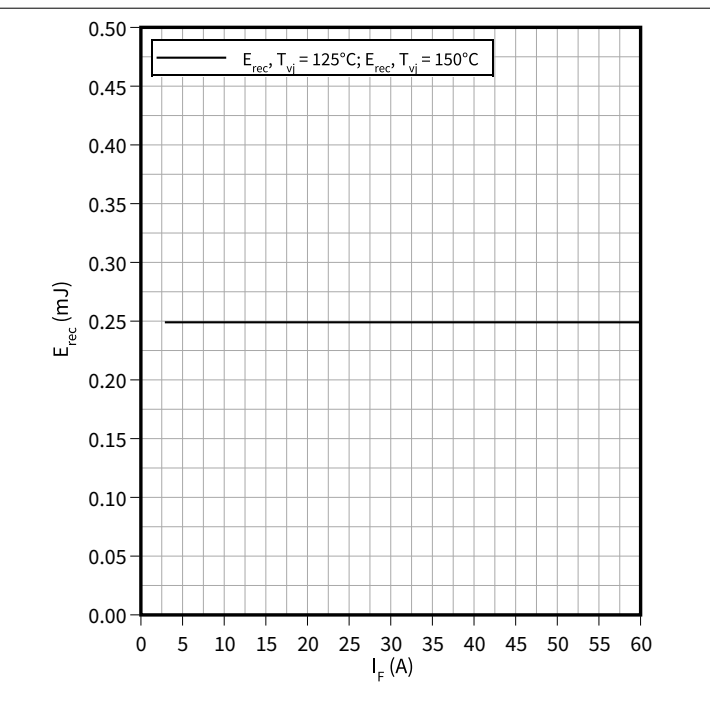
$$I_F = f(V_F)$$



7 Characteristics diagrams

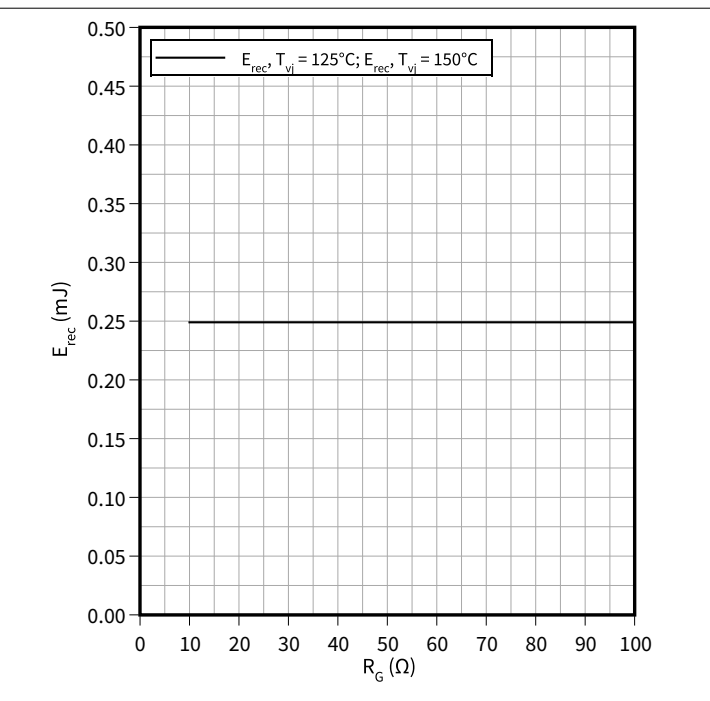
Switching losses (typical), Diode, Boost

$E_{rec} = f(I_F)$
 $R_{Gon} = 10\ \Omega, V_{CE} = 500\ V$



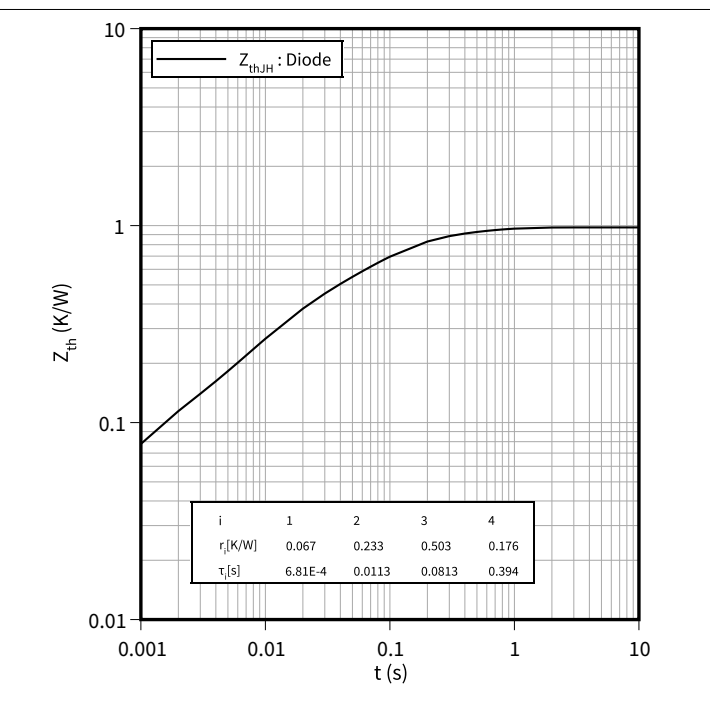
Switching losses (typical), Diode, Boost

$E_{rec} = f(R_G)$
 $V_{CE} = 500\ V, I_F = 30\ A$



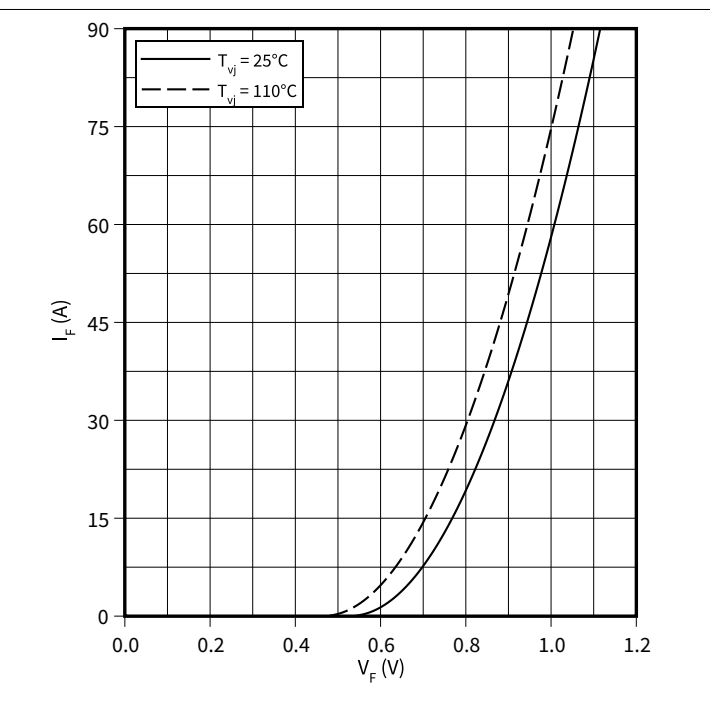
Transient thermal impedance, Diode, Boost

$Z_{th} = f(t)$



Forward characteristic (typical), Bypass-diode

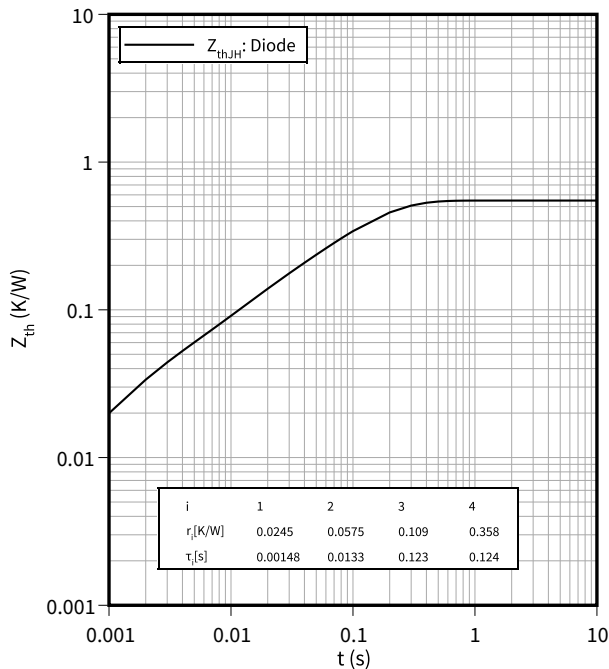
$I_F = f(V_F)$



7 Characteristics diagrams

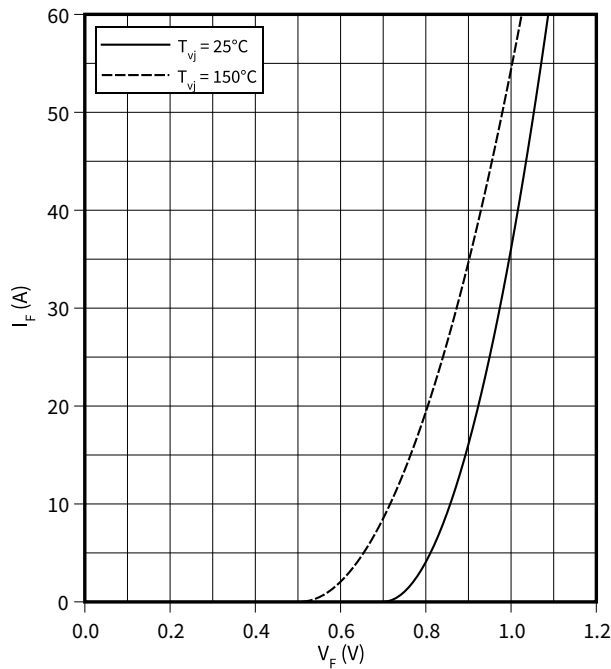
Transient thermal impedance, Bypass-diode

$Z_{th} = f(t)$



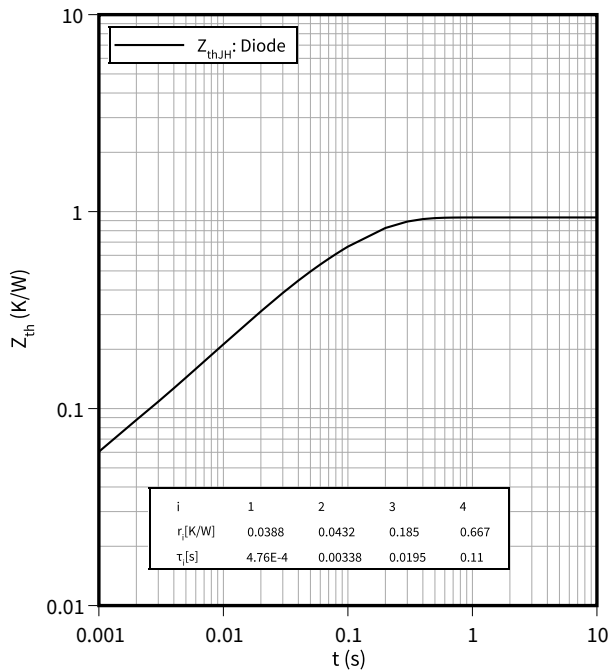
Forward characteristic (typical), Inverse-polarity protection diode A

$I_F = f(V_F)$



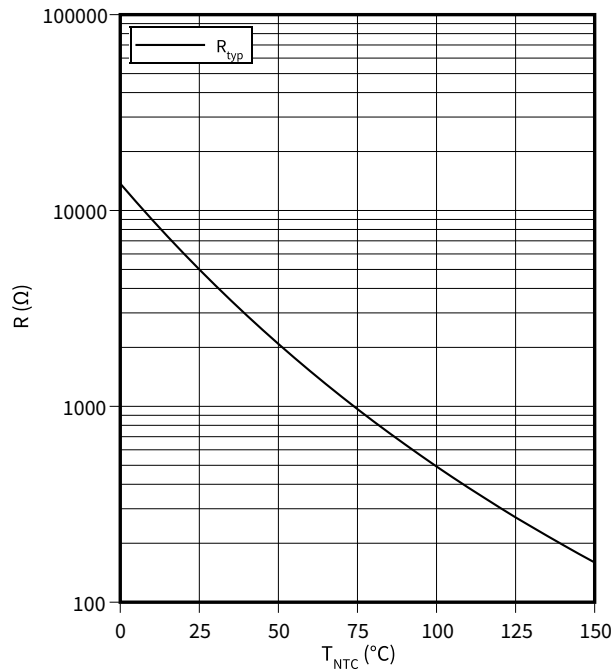
Transient thermal impedance, Inverse-polarity protection diode A

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

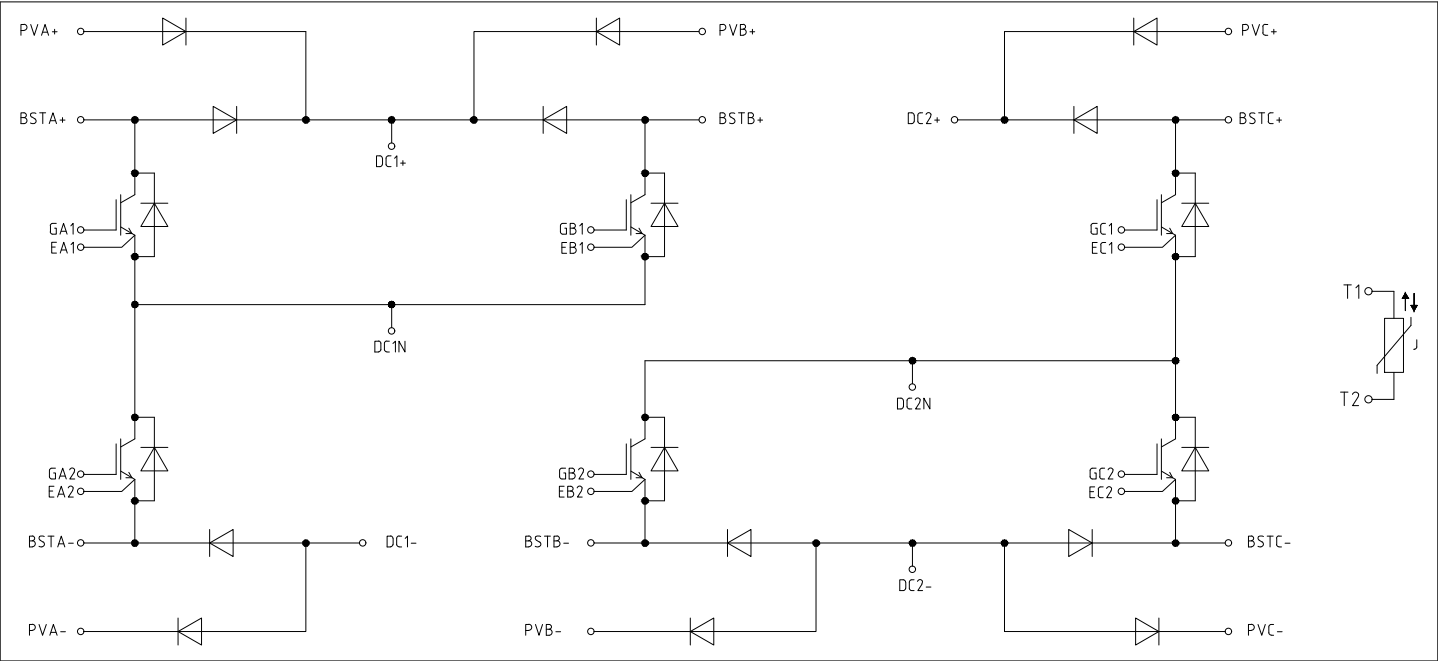


Figure 1

Figure 2

10 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
0.10	2020-12-15	
1.00	2022-02-16	Final datasheet

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