HybridPACK™ Light Module

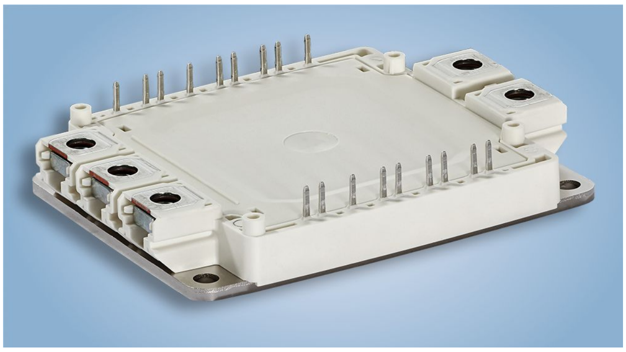
FS200R07A5E3_S6

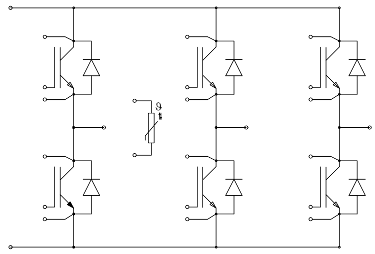
Final Data Sheet

V3.0, 2015-03-24

Automotive High Power

1 Features / Description





V_{CES} = 700V
$I_{C\,nom}$ = 200A / I_{CRM} = 400A

Typical Applications
- Hybrid Electrical Vehicles (H)EV
- Optimized for automotive applications with DC link voltages up to 450 V

Electrical Features
- Increased blocking voltage capability to 705V
- Low Switching Losses
- $T_{vj\,op}$ = 150°C
- Trench IGBT 3
- V_{CEsat} with positive Temperature Coefficient

Mechanical Features
- 2.5 kV AC 1min Insulation
- Al_2O_3 Substrate with Low Thermal Resistance
- High mechanical robustness
- Integrated NTC temperature sensor
- Copper Base Plate
- RoHS compliant

Description
The HybridPACK™ Light is a very compact six-pack module (705V/200A) targeting mild hybrid vehicles with power levels up to 20kW. The module is based on established solder and screw interconnections known from HybridPACK™ 1. Improved stray inductance and blocking voltage offer lowest conduction and switching losses especially at inverter maximum ratings.

Product Name	Ordering Code
FS200R07A5E3_S6	SP001150884

2 IGBT,Inverter

2.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	705	V
Continuous DC collector current	T_C = 75°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	200	A
Repetitive peak collector current	t_P = 1 ms	I_{CRM}	400	A
Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	630	W
Gate-emitter peak voltage		V_{GES}	+/-20	V

2.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Collector-emitter saturation voltage	I_C = 200 A, V_{GE} = 15 V I_C = 200 A, V_{GE} = 15 V I_C = 200 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		1,45 1,60 1,70	1,70	V
Gate threshold voltage	I_C = 3,20 mA, V_{CE} = V_{GE}	T_{vj} = 25°C	V_{GEth}	4,90	5,80	6,50	V
Gate charge	V_{GE} = -15 V ... 15 V		Q_G		2,15		µC
Internal gate resistor		T_{vj} = 25°C	R_{Gint}		2,0		Ω
Input capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{ies}		13,0		nF
Reverse transfer capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{res}		0,38		nF
Collector-emitter cut-off current	V_{CE} = 450 V, V_{GE} = 0 V	T_{vj} = 25°C	I_{CES}			0,1	mA
Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V	T_{vj} = 25°C	I_{GES}			400	nA
Turn-on delay time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Gon} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0,12 0,14 0,14		µs
Rise time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Gon} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,05 0,06 0,06		µs
Turn-off delay time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Goff} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0,33 0,36 0,37		µs
Fall time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = ±15 V R_{Goff} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,04 0,06 0,07		µs
Turn-on energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 25 nH V_{GE} = ±15 V, di/dt = 3500 A/µs (T_{vj} = 150°C) R_{Gon} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		2,40 3,50 3,70		mJ
Turn-off energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 25 nH V_{GE} = ±15 V, du/dt = 3500 V/µs (T_{vj} = 150°C) R_{Goff} = 2,4 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		6,20 7,50 8,00		mJ
SC data	$V_{GE} \leq$ 15 V, V_{CC} = 360 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	$t_P \leq$ 6 µs, T_{vj} = 150°C	I_{SC}		1000		A
Thermal resistance, junction to case	per IGBT		R_{thJC}			0,238	K/W
Thermal resistance, case to heatsink	per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,116		K/W
Temperature under switching conditions	t_{op} continuous		$T_{vj\,op}$	-40		150	°C

3 Diode, Inverter

3.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	705	V
Continuous DC forward current		I_F	200	A
Repetitive peak forward current	t_P = 1 ms	I_{FRM}	400	A
I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I^2t	2100 2000	A²s A²s

3.2 Characteristic Values

				min.	typ.	max.	
Forward voltage	I_F = 200 A, V_{GE} = 0 V I_F = 200 A, V_{GE} = 0 V I_F = 200 A, V_{GE} = 0 V	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 150°C	V_F		1,55 1,50 1,45	1,90	V
Peak reverse recovery current	I_F = 200 A, - di_F/dt = 3500 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 150°C	I_{RM}		99,0 135 140		A A A
Recovered charge	I_F = 200 A, - di_F/dt = 3500 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 150°C	Q_r		6,90 13,5 17,0		µC µC µC
Reverse recovery energy	I_F = 200 A, - di_F/dt = 3500 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -15 V	T_{vj} = 25 °C T_{vj} = 125 °C T_{vj} = 150°C	E_{rec}		1,80 3,40 4,20		mJ mJ mJ
Thermal resistance, junction to case	per diode		R_{thJC}			0,455	K/W
Thermal resistance, case to heatsink	per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,114		K/W
Temperature under switching conditions	t_{op} continuous		$T_{vj\ op}$	-40		150	°C

4 NTC-Thermistor

Parameter	Conditions	Symbol	Value min.	Value typ.	Value max.	Unit
Rated resistance	T_C = 25°C	R_{25}		5,00		kΩ
Deviation of R100	T_C = 100°C, R_{100} = 493 Ω	ΔR/R	5		5	%
Power dissipation	T_C = 25°C	P_{25}			20,0	mW
B-value	$R_2 = R_{25}\ exp\ [B_{25/50}(1/T_2 - 1/(298,15\ K))]$	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25}\ exp\ [B_{25/80}(1/T_2 - 1/(298,15\ K))]$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25}\ exp\ [B_{25/100}(1/T_2 - 1/(298,15\ K))]$	$B_{25/100}$		3433		K

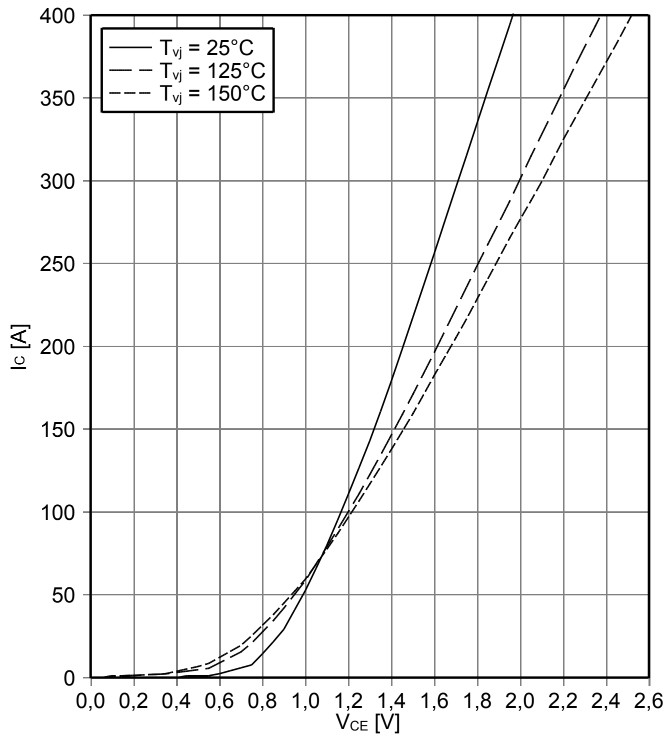
Specification according to the valid application note.

5 Module

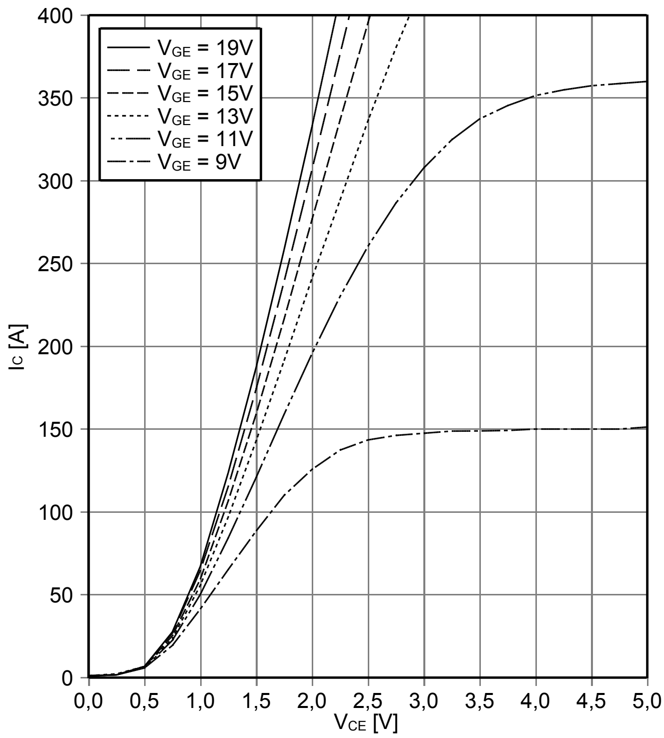
Parameter	Conditions	Symbol	Value			Unit
Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		2,5		kV
Material of module baseplate				Cu		
Internal isolation	basic insulation (class 1, IEC 61140)			Al_2O_3		
Creepage distance	terminal to heatsink terminal to terminal	d_{Creep}		12,0 6,1		mm
Clearance	terminal to heatsink terminal to terminal	d_{Clear}		12,0 6,1		mm
Comperative tracking index		CTI		> 200		
			min.	typ.	max.	
Stray inductance module		L_{sCE}		20		nH
Module lead resistance, terminals - chip	T_C = 25 °C, per switch	$R_{CC'+EE'}$		1,50		mΩ
Storage temperature		T_{stg}	-40		125	°C
Mounting torque for modul mounting	Screw M5 baseplate to heatsink	M	3,00		6,00	Nm
Terminal connection torque	Screw M6	M	3,0	-	6,0	Nm
Weight		G		340		g

6 Characteristics Diagrams

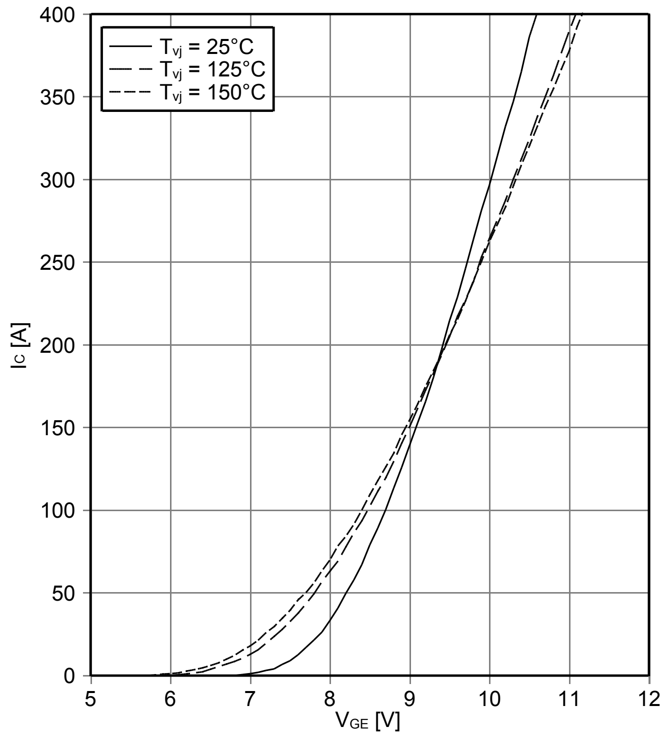
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



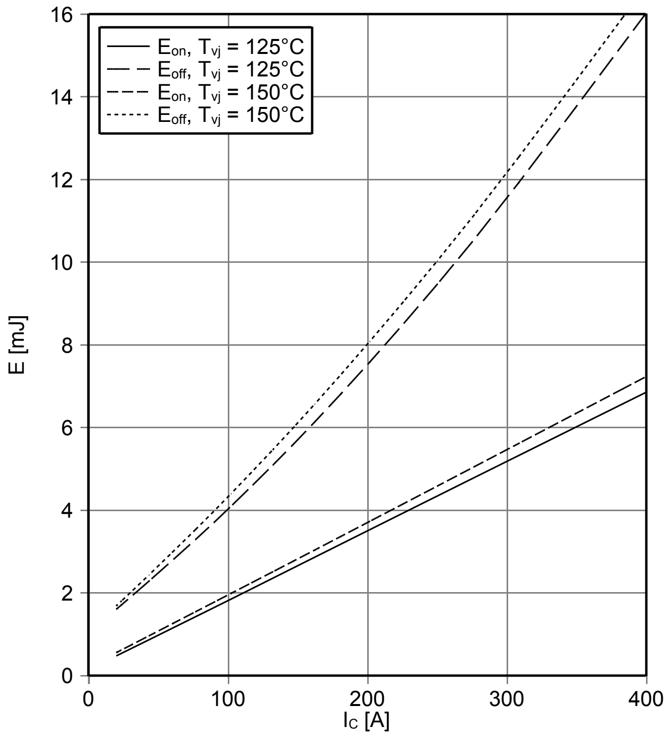
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



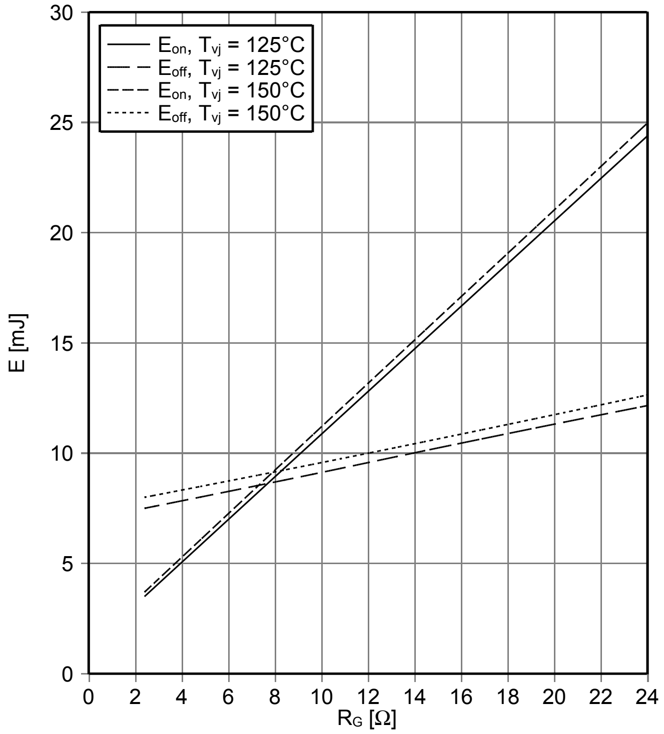
transfer characteristic IGBT,Inverter (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



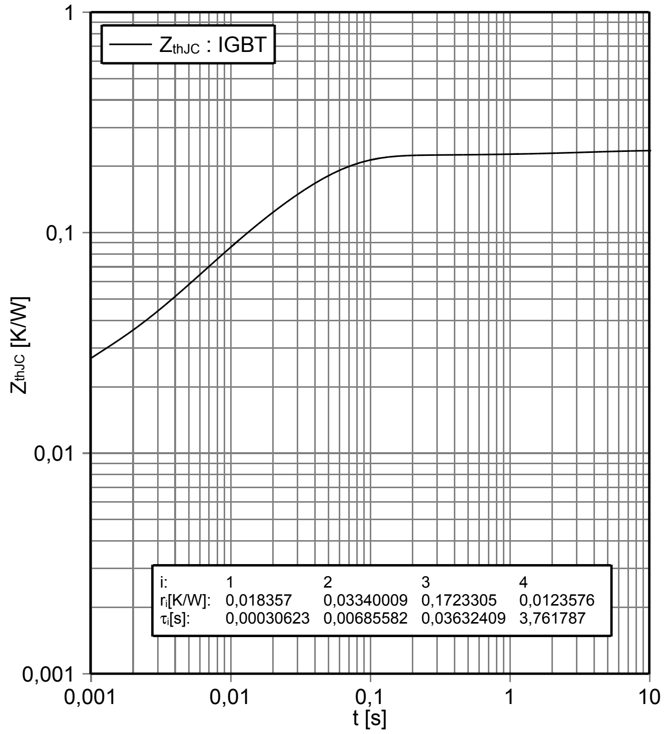
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm15$ V, $R_{Gon} = 2.4\ \Omega$, $R_{Goff} = 2.4\ \Omega$, $V_{CE} = 300$ V



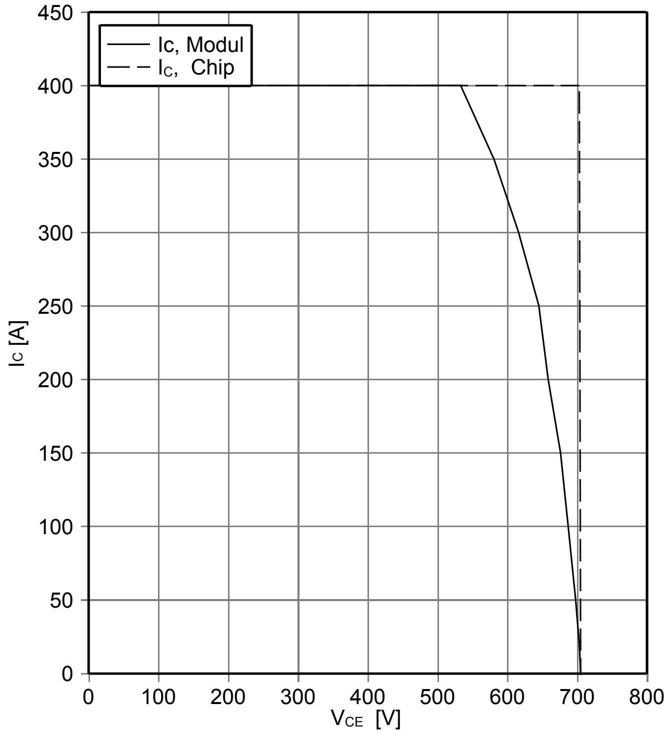
switching losses IGBT,Inverter (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
$V_{GE} = \pm 15$ V, $I_C = 200$ A, $V_{CE} = 300$ V



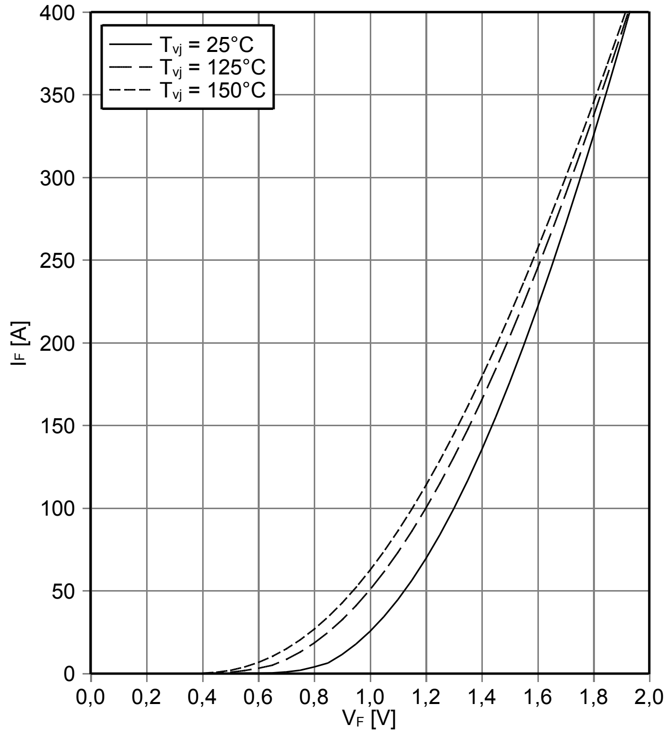
transient thermal impedance IGBT,Inverter
$Z_{thJC} = f(t)$



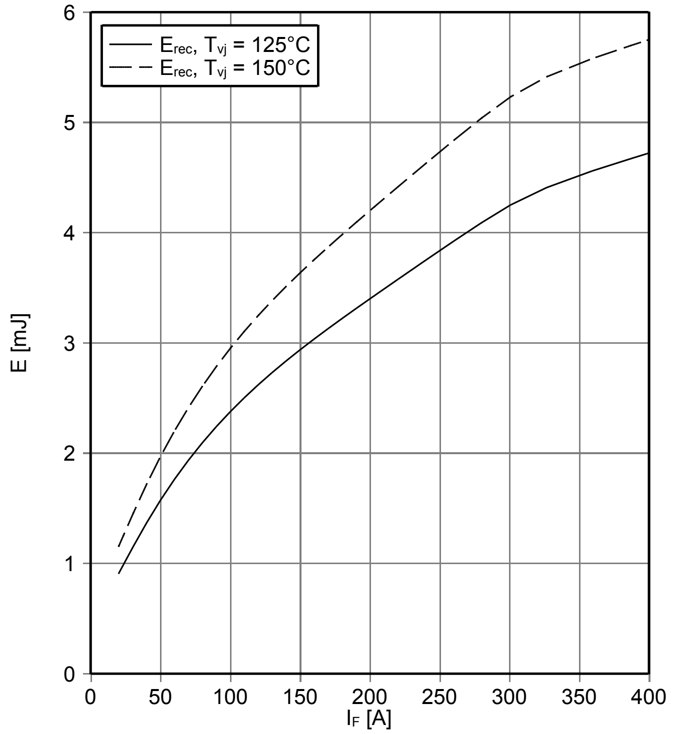
reverse bias safe operating area IGBT,Inverter (RBSOA)
$I_C = f(V_{CE})$
$V_{GE} = \pm 15$ V, $R_{Goff} = 2.4\ \Omega$, $T_{vj} = 150°C$



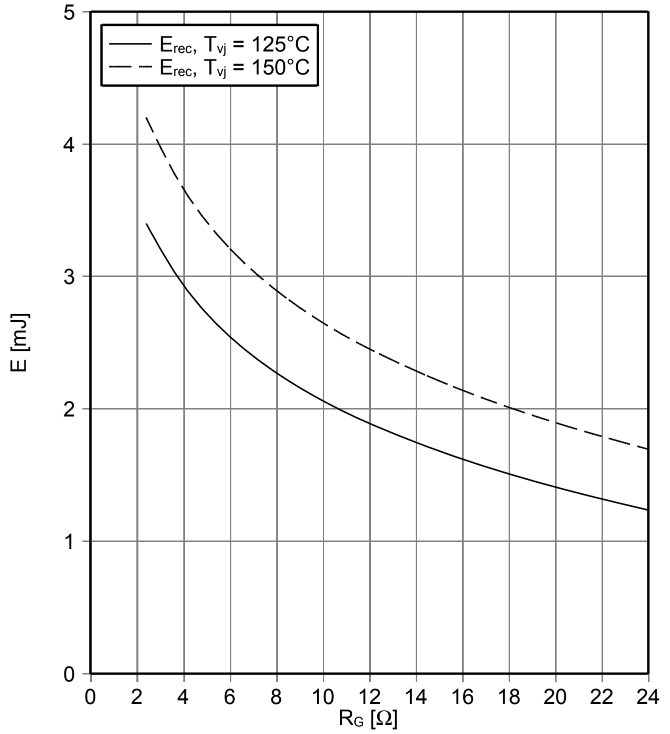
forward characteristic of Diode, Inverter (typical)
$I_F = f(V_F)$



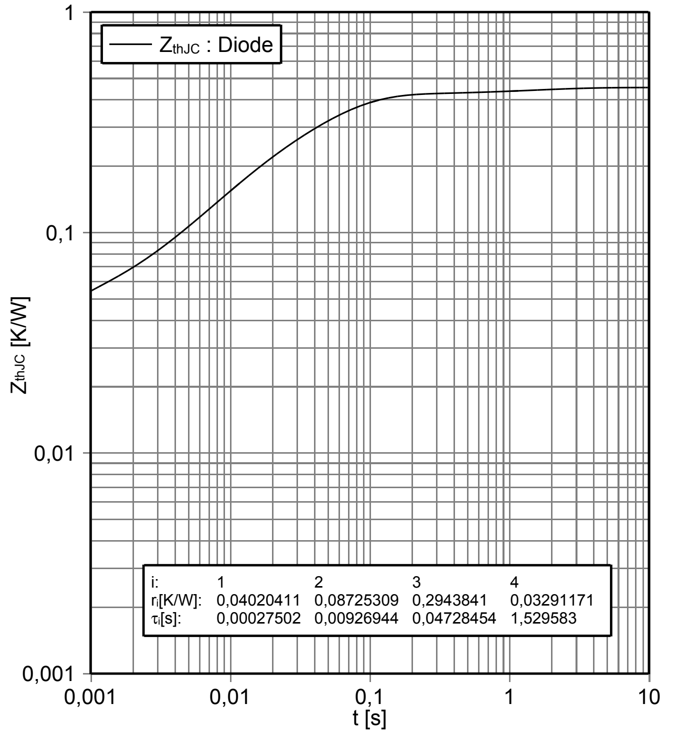
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 2.4\ \Omega$, $V_{CE} = 300$ V



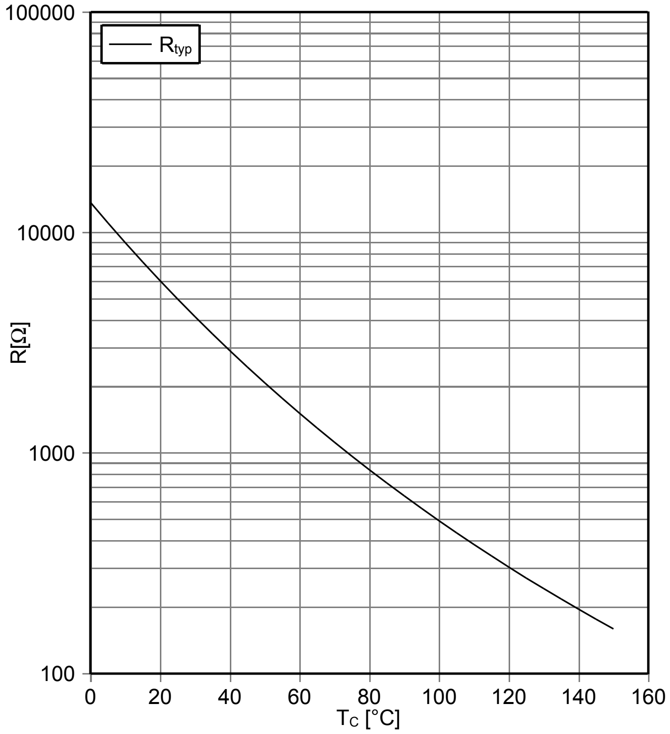
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 200$ A, $V_{CE} = 300$ V



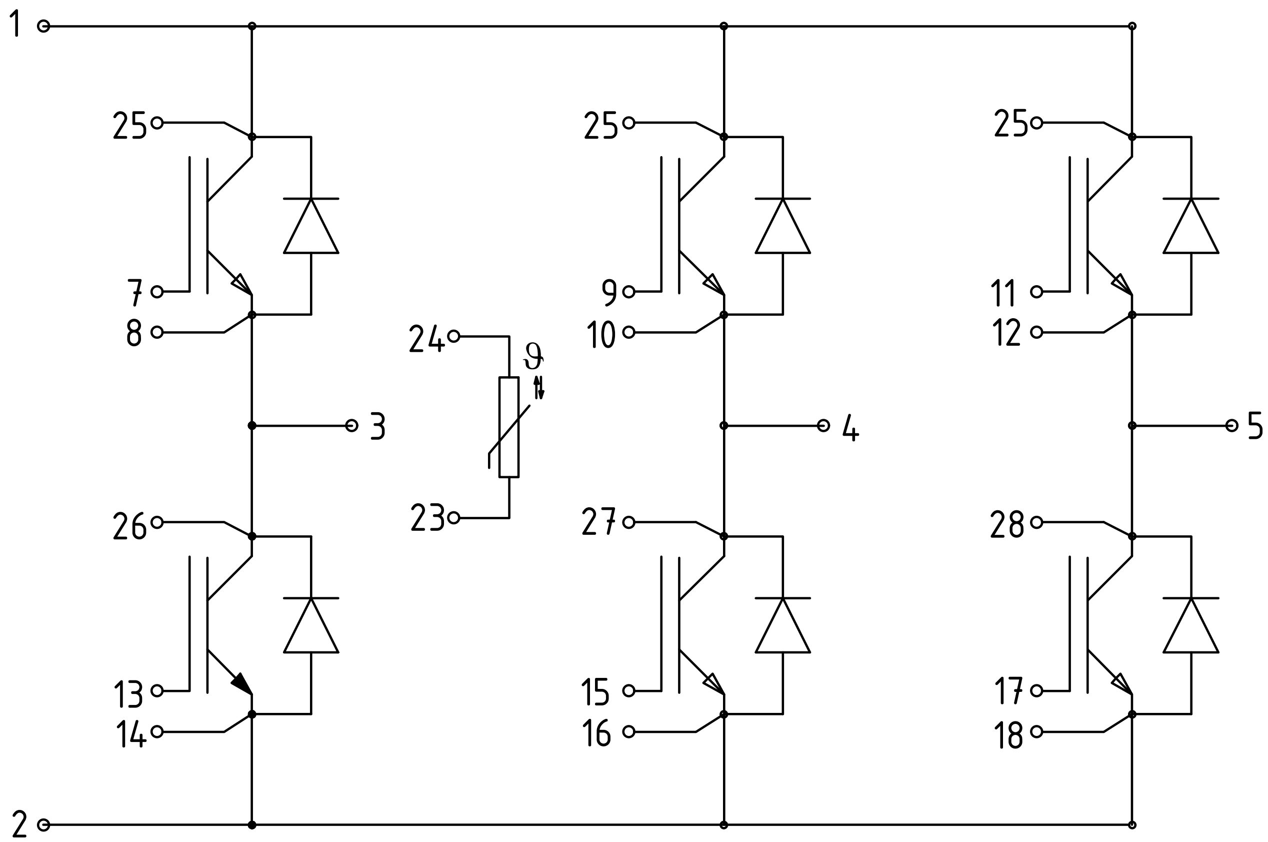
transient thermal impedance Diode, Inverter
$Z_{thJC} = f(t)$



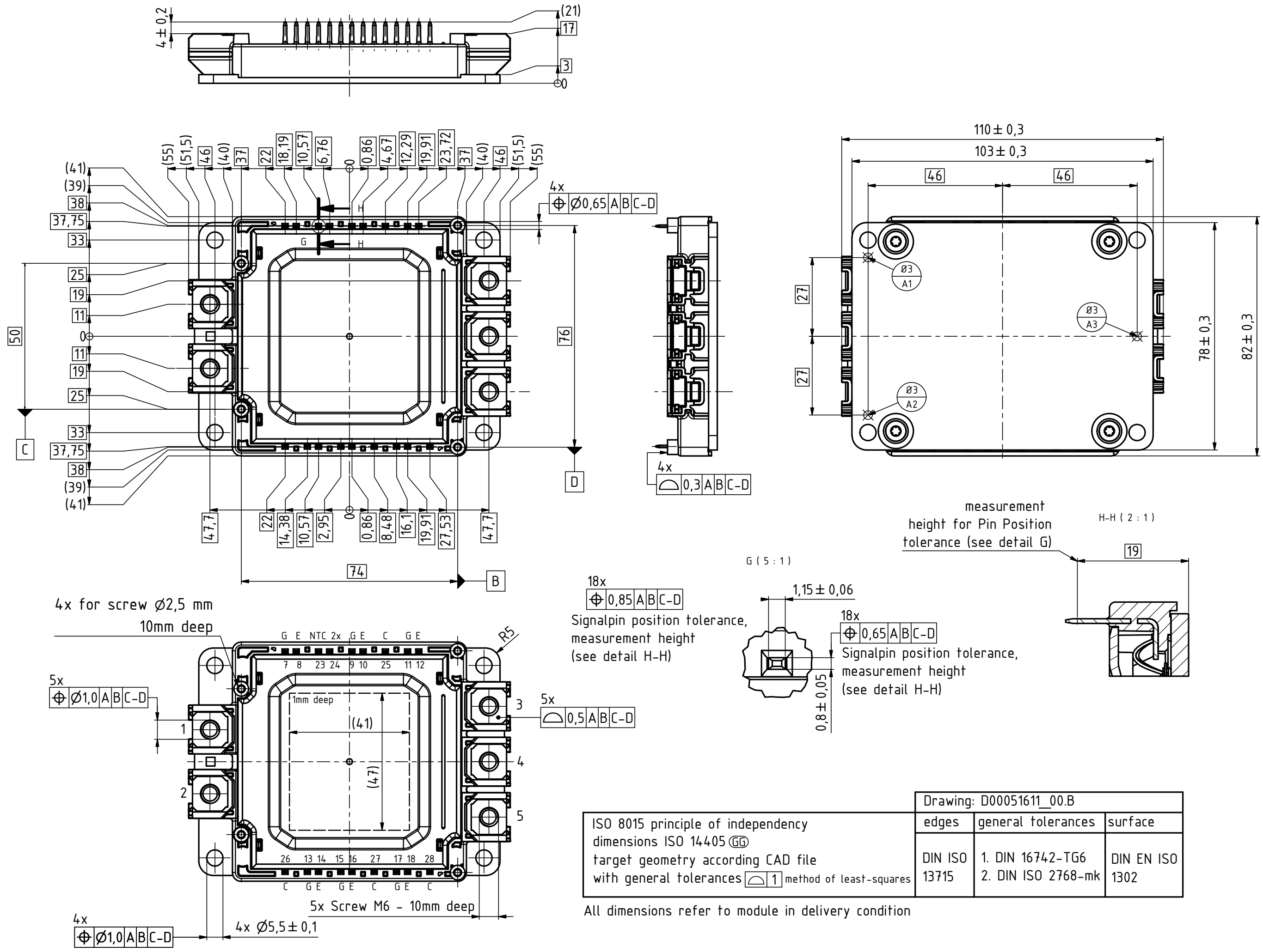
NTC-Thermistor-temperature characteristic (typical)
R = f (T)



7 Circuit diagram



8 Package outlines



ISO 8015 principle of independency dimensions ISO 14405 Ⓖⓖ target geometry according CAD file with general tolerances ⌓ 1 method of least-squares	Drawing: D00051611_00.B		
	edges	general tolerances	surface
	DIN ISO 13715	1. DIN 16742-TG6 2. DIN ISO 2768-mk	DIN EN ISO 1302

All dimensions refer to module in delivery condition

9 Label Codes

9.1 Module Code

Code Format	Data Matrix		
Encoding	ASCII Text		
Symbol Size	16x16		
Standard	IEC24720 and IEC16022		
Code Content	**Content** Module Serial Number Module Material Number Production Order Number Datecode (Production Year) Datecode (Production Week)	**Digit** 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	**Example (below)** 71549 142846 55054991 15 30
Example	71549142846550549911530		

9.2 Packing Code

Code Format	Code128			
Encoding	Code Set A			
Symbol Size	34 digits			
Standard	IEC8859-1			
Code Content	**Content** Backend Construction Number Production Lot Number Serial Number Date Code Box Quantity	**Identifier** X 1T S 9D Q	**Digit** 2 - 9 12 - 19 21 - 25 28 - 31 33 - 34	**Example (below)** 95056609 2X0003E0 754389 1139 15
Example	X950566091T2X0003E0S754389D1139Q15			

Revision History

Major changes since previous revision

Revision History		
Reference	**Date**	**Description**
V1.0	2013-09-10	Initial Version
V2.0	2014-11-01	preliminary data
V3.0	2015-03-24	final data

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