HybridPACK™ 2 Module

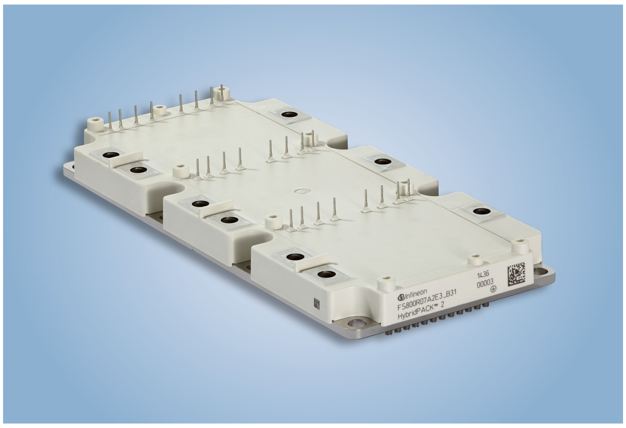
FS900R08A2P2_B31

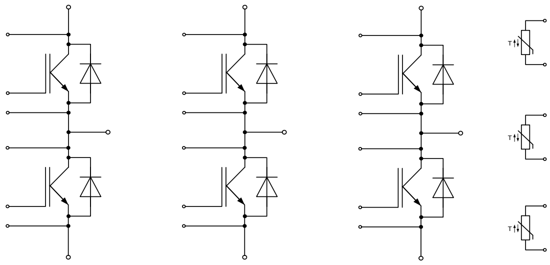
Final Data Sheet

V3.2, 2017-08-30

Automotive High Power

1 Features / Description





V_{CES} = 750V
$I_{C\ nom}$ = 900A

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

Electrical Features
- V_{CEsat} with positive Temperature Coefficient
- Low V_{CEsat}
- Low Switching Losses
- Low Qg and Cres
- Low Inductive Design
- $T_{vj\ op}$ = 150°C
- Short-time extended Operation Temperature $T_{vj\ op}$ = 175°C

Mechanical Features
- 2.5kV AC 1min Insulation
- Direct Cooled PinFin Base Plate
- High Power Density
- Integrated NTC temperature sensor
- Copper Base Plate
- Isolated Base Plate
- RoHS compliant

Product Name	Ordering Code
FS900R08A2P2_B31	-

2 IGBT,Inverter

2.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	750	V
Implemented collector current		I_{CN}	900	A
Continuous DC collector current	T_F = 105°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	550	A
Repetitive peak collector current	t_P = 1 ms	I_{CRM}	1800	A
Total power dissipation	T_F = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	1546	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 = 550 A, V_{GE} = 15 V I_C = 550 A, V_{GE} = 15 V I_C = 550 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		1.10 1.10 1.10	1.25	V
Gate threshold voltage	I_C = 13.0 mA, V_{CE} = V_{GE}	T_{vj} = 25°C	V_{GEth}	4.90	5.80	6.50	V
Gate charge	V_{GE} = -8 V ... 15 V, V_{CE} = 400V		Q_G		5.80		µC
Internal gate resistor		T_{vj} = 25°C	R_{Gint}		0.5		Ω
Input capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{ies}		105		nF
Reverse transfer capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{res}		0.50		nF
Collector-emitter cut-off current	V_{CE} = 450 V, V_{GE} = 0 V	T_{vj} = 25°C	I_{CES}			0.5	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 = 550 A, V_{CE} = 400 V V_{GE} = -8 V / +15 V R_{Gon} = 3.3 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0.39 0.39 0.39		µs
Rise time, inductive load	I_C = 550 A, V_{CE} = 400 V V_{GE} = -8 V / +15 V R_{Gon} = 3.3 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0.09 0.11 0.11		µs
Turn-off delay time, inductive load	I_C = 550 A, V_{CE} = 400 V V_{GE} = -8 V / +15 V R_{Goff} = 2.0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0.63 0.71 0.74		µs
Fall time, inductive load	I_C = 550 A, V_{CE} = 400 V V_{GE} = -8 V / +15 V R_{Goff} = 2.0 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0.06 0.08 0.08		µs
Turn-on energy loss per pulse	I_C = 550 A, V_{CE} = 400 V, L_S = 20 nH V_{GE} = -8 V / +15 V R_{Gon} = 3.3 Ω di/dt (T_{vj} = 150°C) = 4100 A/µs	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		21.0 29.0 30.5		mJ
Turn-off energy loss per pulse	I_C = 550 A, V_{CE} = 400 V, L_S = 20 nH V_{GE} = -8 V / +15 V R_{Goff} = 2.0 Ω dv/dt (T_{vj} = 150°C) = 2600 V/µs	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		27.5 36.0 38.5		mJ
SC data	V_{GE} ≤ 15 V, V_{CC} = 400 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 4 µs, T_{vj} = 150°C	I_{SC}		4500		A
Thermal resistance, junction to cooling fluid	per IGBT; ΔV/Δt = 10 dm³/min		R_{thJF}			0.097	K/W
Temperature under switching conditions	t_{op} continuous $t_{op\,max}$ 30h over life time, for 10s within period of 10min		$T_{vj\,op}$	-40 150		150 175	°C

3 Diode, Inverter

3.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	750	V
Implemented forward current		I_{FN}	860	A
Continuous DC forward current		I_F	550	A
Repetitive peak forward current	t_P = 1 ms	I_{FRM}	1720	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	19500 19000	A²s A²s

3.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Forward voltage	I_F = 550 A, V_{GE} = 0 V I_F = 550 A, V_{GE} = 0 V I_F = 550 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		1.40 1.30 1.25	1.65	V
Peak reverse recovery current	I_F = 550 A, - di_F/dt = 4100 A/µs (T_{vj} = 150°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		265 385 420		A
Recovered charge	I_F = 550 A, - di_F/dt = 4100 A/µs (T_{vj} = 150°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		23.0 49.5 58.5		µC
Reverse recovery energy	I_F = 550 A, - di_F/dt = 4100 A/µs (T_{vj} = 150°C) V_R = 400 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		7.20 15.0 17.5		mJ
Thermal resistance, junction to cooling fluid	per diode; ΔV/Δt = 10 dm³/min		R_{thJF}			0.125	K/W
Temperature under switching conditions	t_{op} continuous $t_{op\ max}$ 30h over life time, for 10s within period of 10min		$T_{vj\ op}$	-40 150		150 175	°C

4 NTC-Thermistor

Parameter	Conditions	Symbol	min.	Value (typ.)	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.

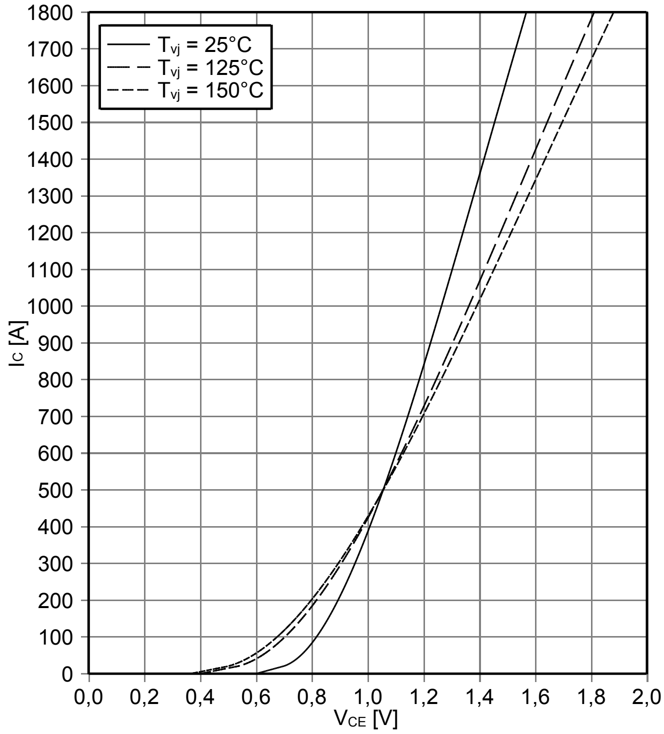
5 Module

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}		7.0 5.5		mm
Clearance	terminal to heatsink terminal to terminal	d_{Clear}		7.0 5.0		mm
Comperative tracking index		CTI		> 200		
			min.	typ.	max.	
Pressure drop in cooling circuit	$\Delta V/\Delta t$ = 10.0 dm³/min; T_F = 25°C	Δp		119		mbar
Maximum pressure in cooling circuit		p			2.5	bar
Stray inductance module		L_{sCE}		14		nH
Module lead resistance, terminals - chip	T_F = 25 °C, per switch	$R_{CC'+EE'}$		0.80		mΩ
Storage temperature		T_{stg}	-40		125	°C
Mounting torque for modul mounting	Screw M6 baseplate to heatsink	M	3.00		6.00	Nm
Terminal connection torque	Screw M6	M	2.5	-	5.0	Nm
Weight		G		1340		g

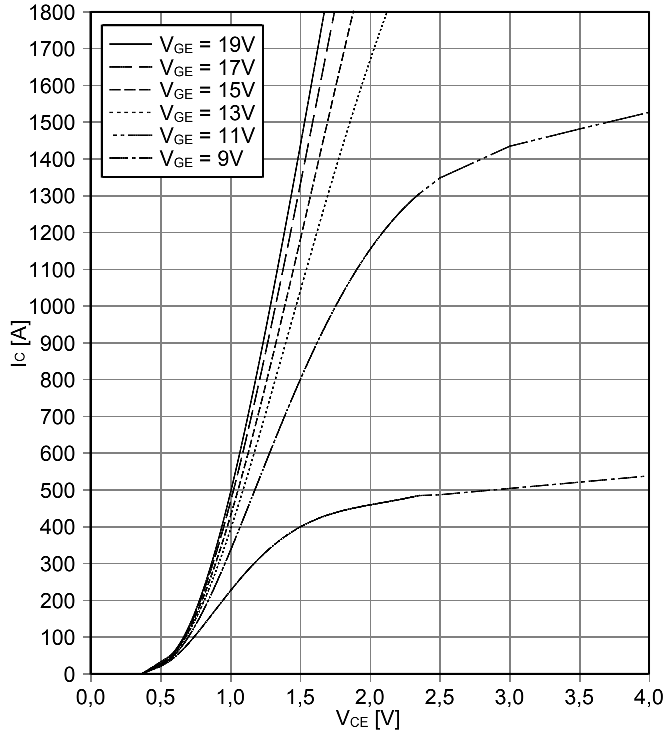
* Kühleraufbau gemäß gültiger Application Note.
* Cooler setup according to the valid application note.

6 Characteristics Diagrams

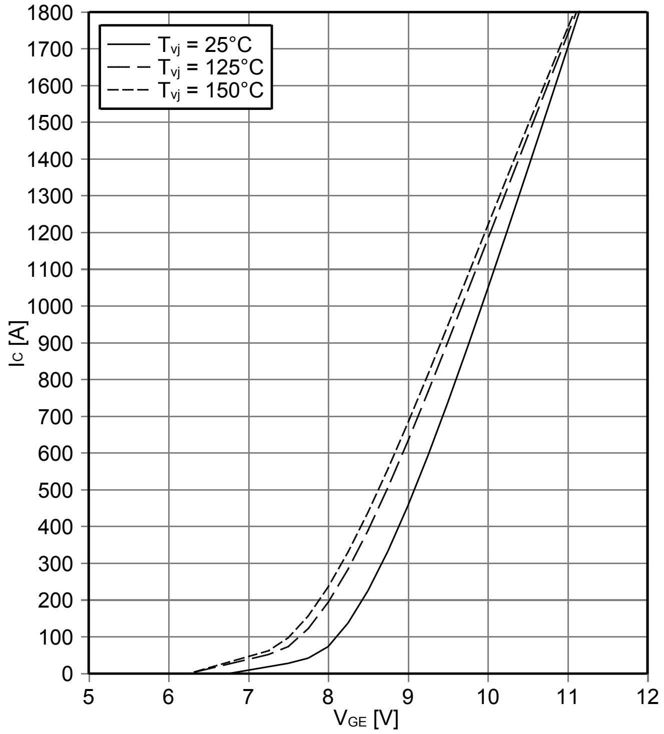
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



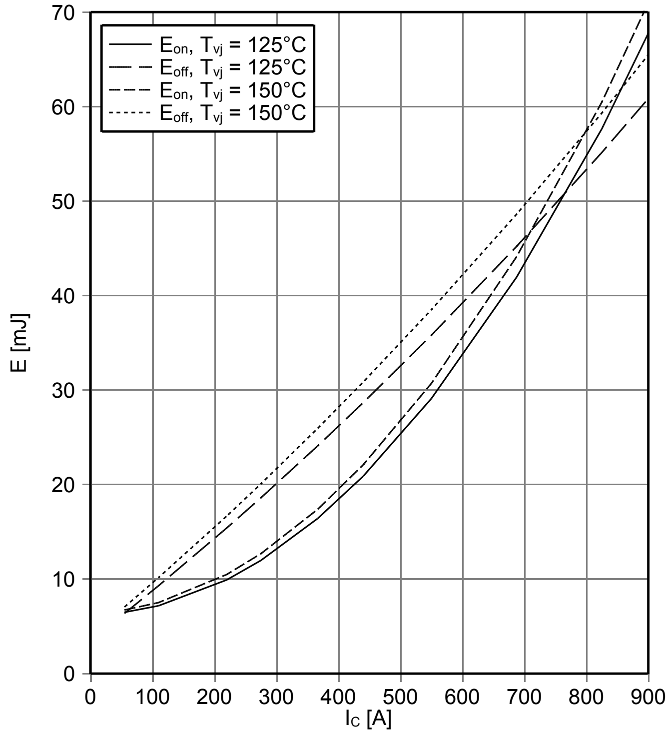
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



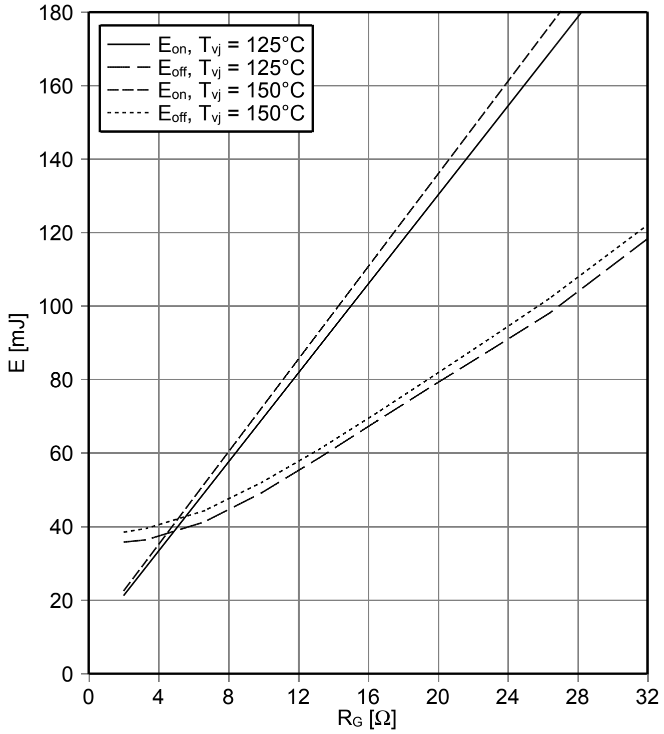
transfer characteristic IGBT,Inverter (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



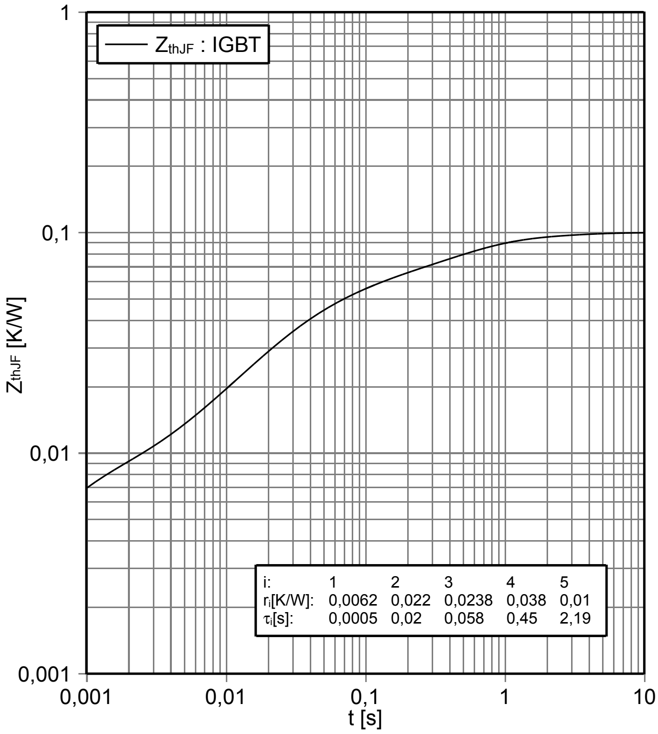
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm 15$ V, $R_{Gon} = 3.3\ \Omega$, $R_{Goff} = 2\ \Omega$, $V_{CE} = 400$ V



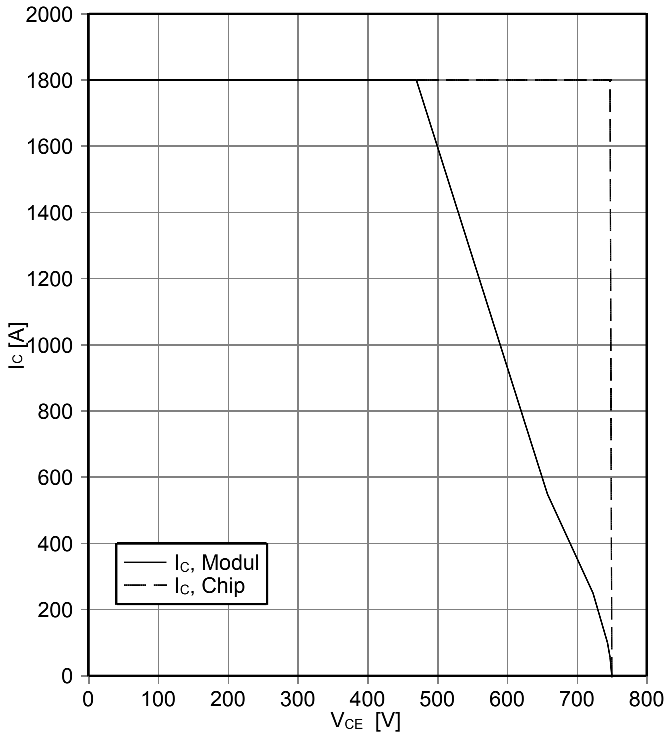
switching losses IGBT,Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = ±15 V, I_C = 550 A, V_{CE} = 400 V



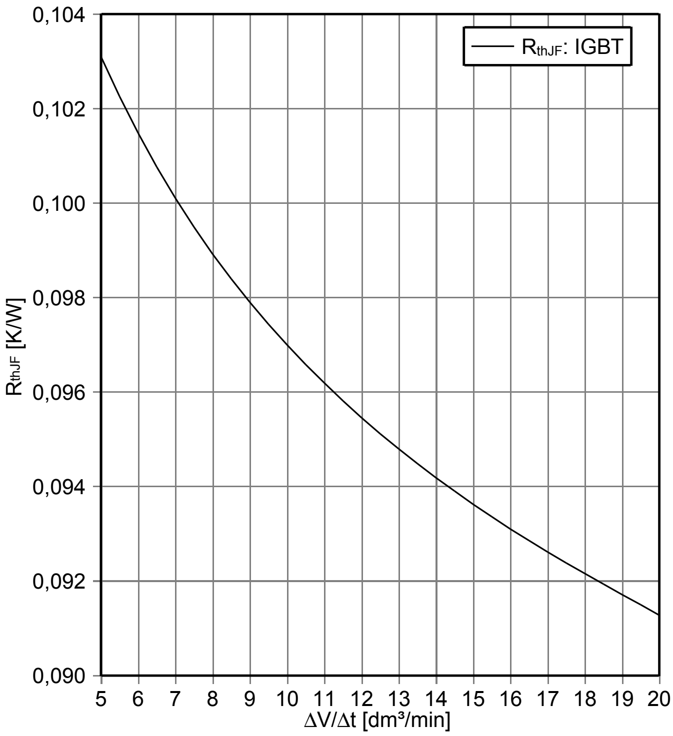
transient thermal impedance IGBT,Inverter
Z_{thJF} = f (t) (ΔV/Δt=10 dm³/min)



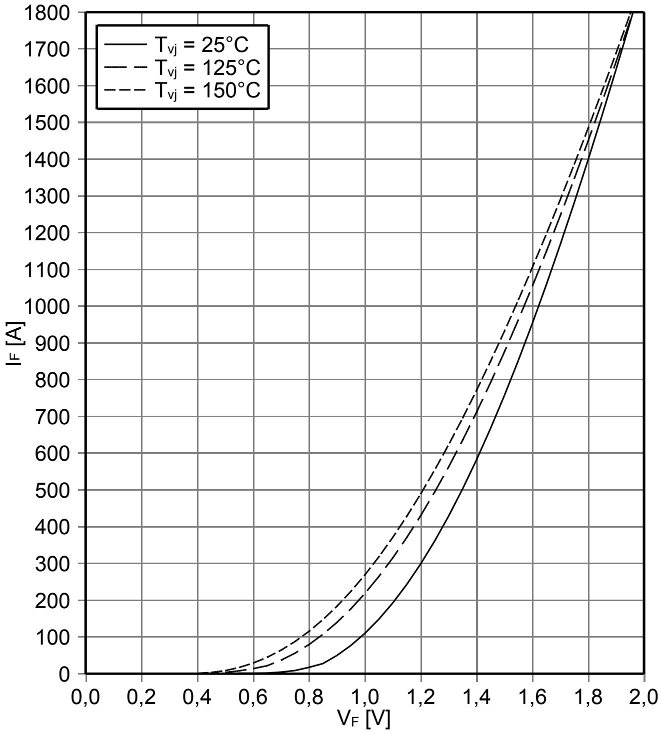
reverse bias safe operating area IGBT,Inverter (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 2 Ω, T_{vj} = 150°C



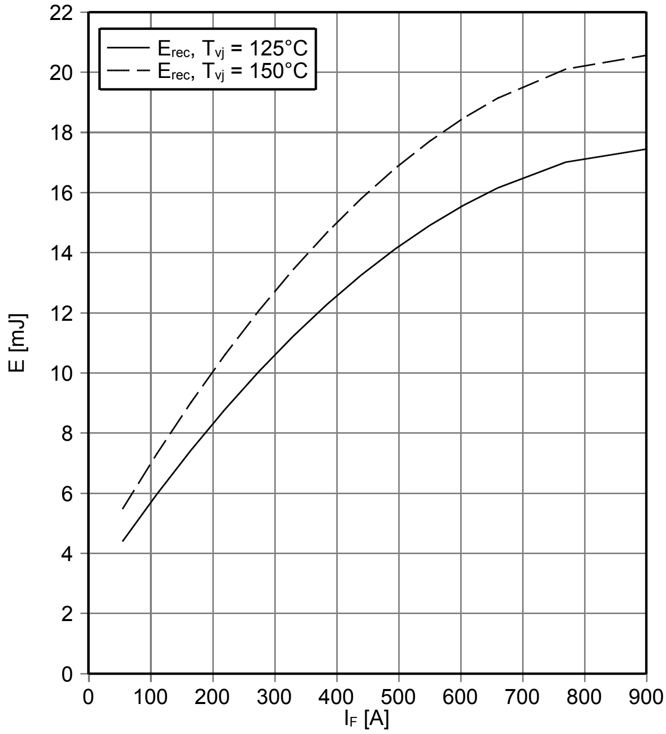
thermal impedance IGBT,Inverter
R_{thJF} = f (ΔV/Δt)
cooling fluid = 50% water/50% ethylenglycol



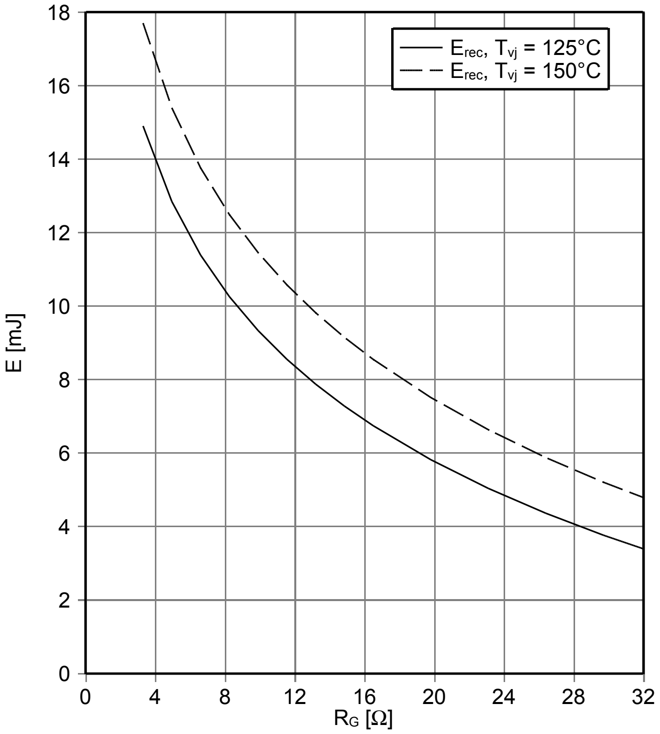
forward characteristic of Diode, Inverter (typical)
$I_F = f(V_F)$



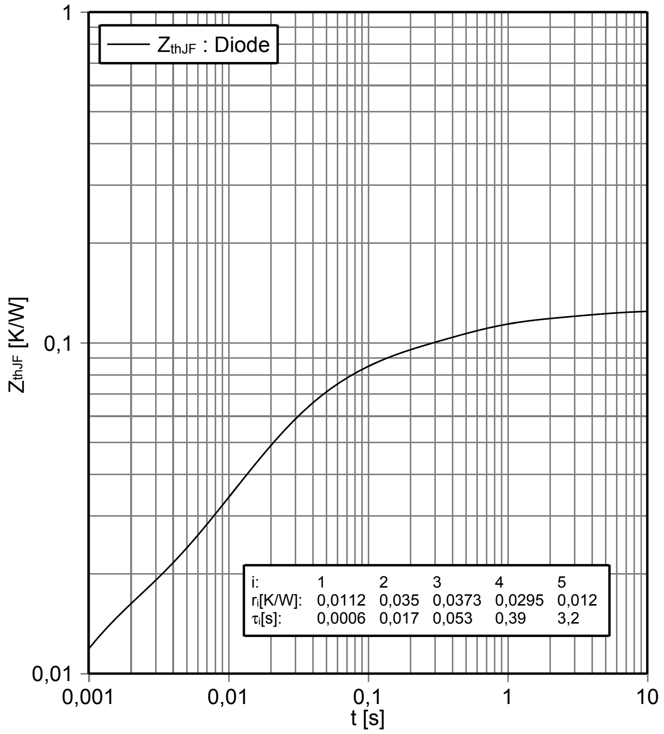
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 3.3\ \Omega$, $V_{CE} = 400$ V



switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 550$ A, $V_{CE} = 400$ V

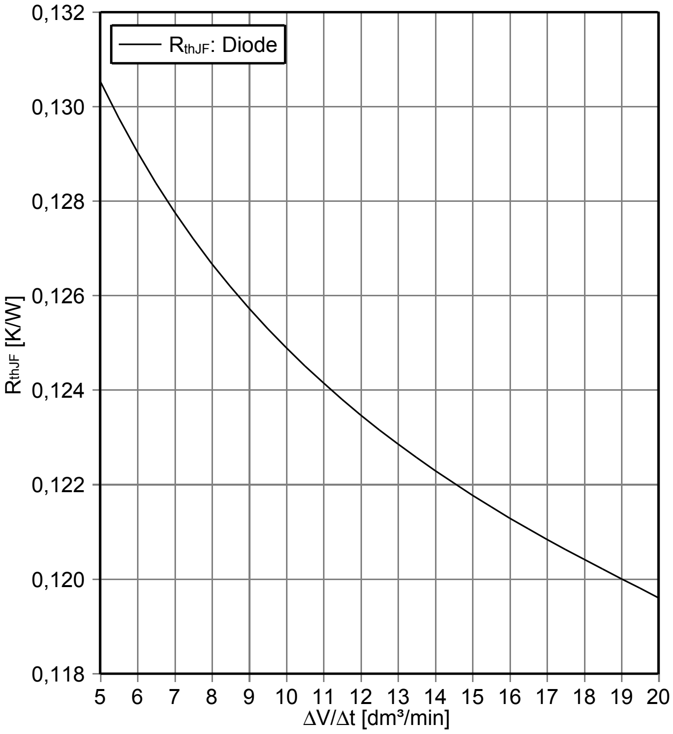


transient thermal impedance Diode, Inverter
$Z_{thJF} = f(t)$ ($\Delta V/\Delta t$=10 dm³/min)

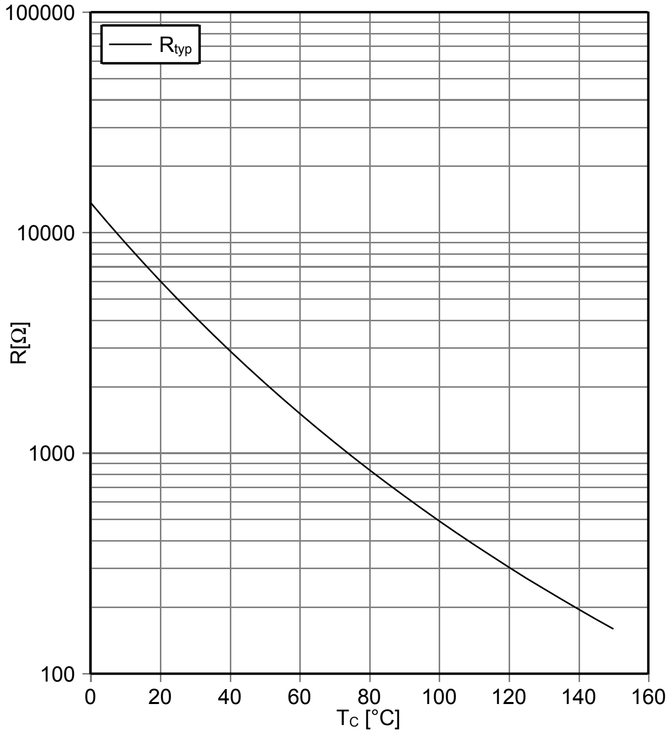


i:	1	2	3	4	5
r_i[K/W]:	0,0112	0,035	0,0373	0,0295	0,012
τ_i[s]:	0,0006	0,017	0,053	0,39	3,2

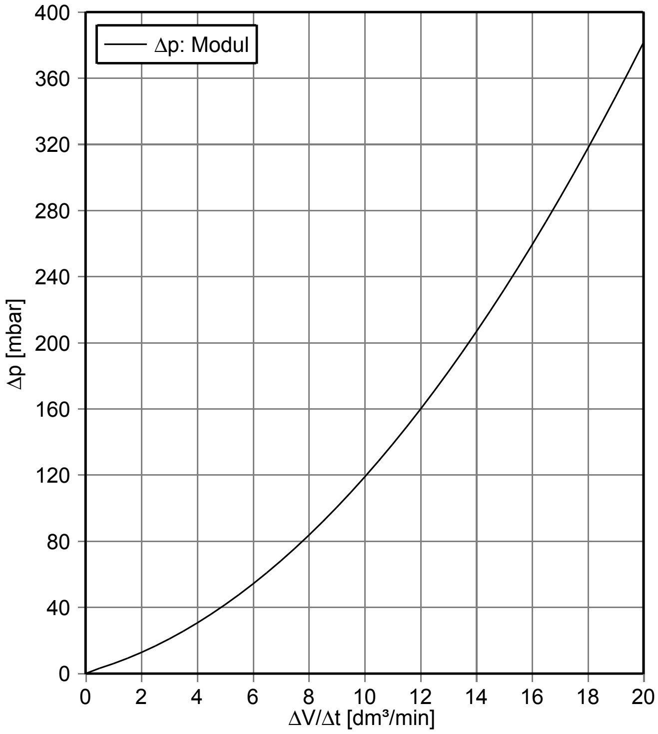
thermal impedance Diode, Inverter
$R_{thJF} = f\ (\Delta V/\Delta t)$
cooling fluid = 50% water/50% ethylenglycol



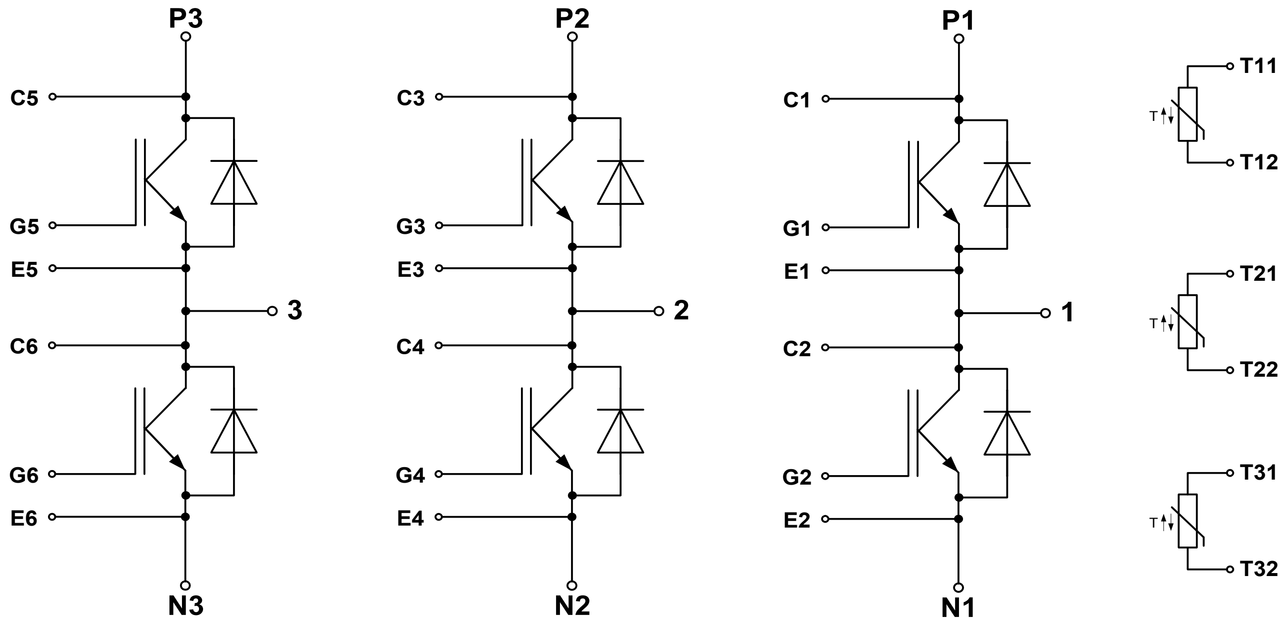
NTC-Thermistor-temperature characteristic (typical)
R = f (T)



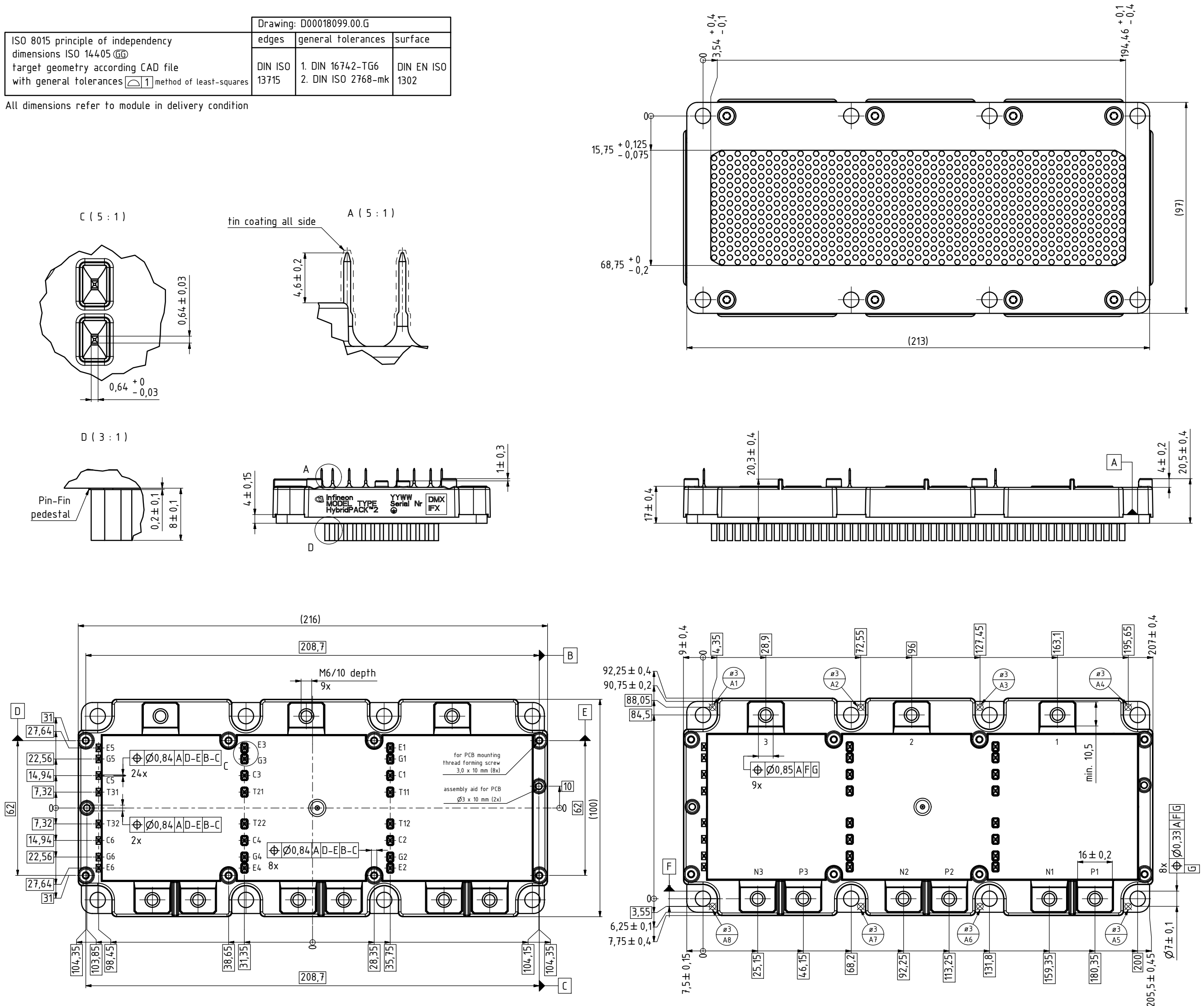
pressure drop in cooling circuit
$\Delta p = f\ (\Delta V/\Delta t)$
cooling fluid = 50% water/50% ethylenglycol, T_F = 25°C



7 Circuit diagram



8 Package outlines



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	7154914284655054991153 0		

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	2014-07-11	Initial Version
V2.0	2016-01-13	preliminary data
V2.1	2016-04-11	-
V3.0	2016-11-07	Final datasheet
V3.1	2016-11-14	-
V3.2	2017-08-30	-

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