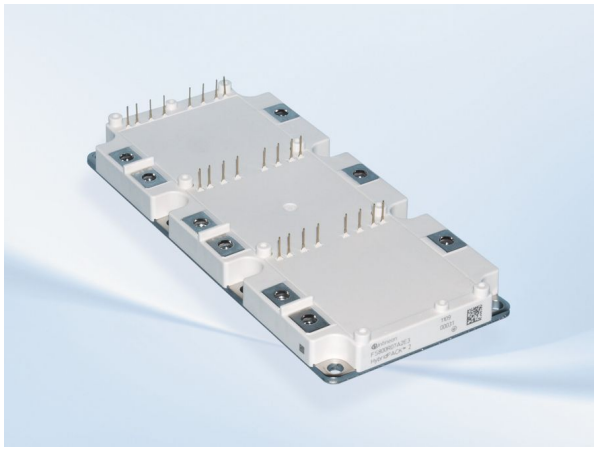
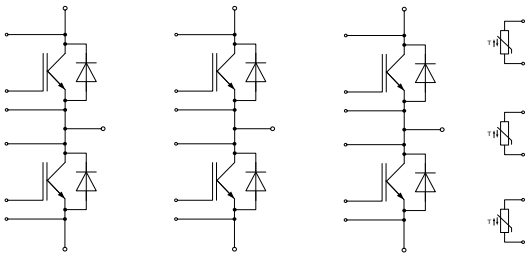
Technische Information / Technical Information

IGBT-Modul
IGBT-Module

FS800R07A2E3_B31

HybridPACK™2 Modul mit Trench/Feldstopp IGBT3 und Emitter Controlled 3 Diode und NTC
HybridPACK™2 module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode and NTC





V_{CES} = 650V
$I_{C\ nom}$ = 800A / I_{CRM} = 1600A

Typische Anwendungen
- Anwendungen im Automobil
- Hybrid-Elektrofahrzeuge (H)EV
- Hybrid-Nutzfahrzeuge
- Motorantriebe

Typical Applications
- Automotive Applications
- Hybrid Electrical Vehicles (H)EV
- Commercial Agriculture Vehicles
- Motor Drives

Elektrische Eigenschaften
- Erhöhte Sperrspannungsfestigkeit auf 650V
- Erweiterte Sperrschichttemperatur $T_{vj\ op}$
- Hohe Stromdichte
- Niederinduktives Design
- Niedrige Schaltverluste
- Niedriges V_{CEsat}
- $T_{vj\ op}$ = 150°C
- $T_{vj\ op}$ = 175°C
- Trench IGBT 3
- V_{CEsat} mit positivem Temperaturkoeffizienten

Electrical Features
- Increased blocking voltage capability to 650V
- Extended Operation Temperature $T_{vj\ op}$
- High Current Density
- Low Inductive Design
- Low Switching Losses
- Low V_{CEsat}
- $T_{vj\ op}$ = 150°C
- $T_{vj\ op}$ = 175°C
- Trench IGBT 3
- V_{CEsat} with positive Temperature Coefficient

Mechanische Eigenschaften
- 2,5 kV AC 1min Isolationsfestigkeit
- Direkt gekühlte Bodenplatte
- Hohe Leistungsdichte
- Integrierter NTC Temperatur Sensor
- Isolierte Bodenplatte

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

Module Label Code

Barcode Code 128

Sample
00000123456000000000000

DMX - Code

Content of the Code	Digit
Module Serial Number	1 - 5
Module Material Number	6 - 11
Production Order Number	12 - 19
Datecode (Production Year)	20 - 21
Datecode (Production Week)	22 - 23

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IGBT,Wechselrichter / IGBT,Inverter

Höchstzulässige Werte / Maximum Rated Values

Kollektor-Emitter-Sperrspannung Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	650	V
Implementierter Kollektor-Strom Implemented collector current		I_{CN}	800	A
Kollektor-Dauergleichstrom Continuous DC collector current	T_F = 75°C, $T_{vj\,max}$ = 175°C T_F = 25°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$ I_C	550 700	A A
Periodischer Kollektor-Spitzenstrom Repetitive peak collector current	t_P = 1 ms	I_{CRM}	1600	A
Gesamt-Verlustleistung Total power dissipation	T_F = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	1550	W
Gate-Emitter-Spitzenspannung Gate-emitter peak voltage		V_{GES}	+/-20	V

Charakteristische Werte / Characteristic Values

			min.	typ.	max.	
Kollektor-Emitter-Sättigungsspannung Collector-emitter saturation voltage	I_C = 550 A, V_{GE} = 15 V T_{vj} = 25°C I_C = 550 A, V_{GE} = 15 V T_{vj} = 125°C I_C = 550 A, V_{GE} = 15 V T_{vj} = 150°C	$V_{CE\,sat}$		1,30 1,35 1,40	1,50	V V V
Gate-Schwellenspannung Gate threshold voltage	I_C = 13,0 mA, V_{CE} = V_{GE}, T_{vj} = 25°C	V_{GEth}	4,9	5,8	6,5	V
Gateladung Gate charge	V_{GE} = -15 V ... +15 V	Q_G		8,60		µC
Interner Gatewiderstand Internal gate resistor	T_{vj} = 25°C	R_{Gint}		0,5		Ω
Eingangskapazität Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V	C_{ies}		52,0		nF
Rückwirkungskapazität Reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V	C_{res}		1,50		nF
Kollektor-Emitter-Reststrom Collector-emitter cut-off current	V_{CE} = 650 V, V_{GE} = 0 V, T_{vj} = 25°C	I_{CES}			5,0	mA
Gate-Emitter-Reststrom Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25°C	I_{GES}			400	nA
Einschaltverzögerungszeit, induktive Last Turn-on delay time, inductive load	I_C = 550 A, V_{CE} = 300 V T_{vj} = 25°C V_{GE} = ±15 V T_{vj} = 125°C R_{Gon} = 1,8 Ω T_{vj} = 150°C	$t_{d\,on}$		0,12 0,12 0,13		µs µs µs
Anstiegszeit, induktive Last Rise time, inductive load	I_C = 550 A, V_{CE} = 300 V T_{vj} = 25°C V_{GE} = ±15 V T_{vj} = 125°C R_{Gon} = 1,8 Ω T_{vj} = 150°C	t_r		0,10 0,10 0,10		µs µs µs
Abschaltverzögerungszeit, induktive Last Turn-off delay time, inductive load	I_C = 550 A, V_{CE} = 300 V T_{vj} = 25°C V_{GE} = ±15 V T_{vj} = 125°C R_{Goff} = 0,75 Ω T_{vj} = 150°C	$t_{d\,off}$		0,51 0,53 0,55		µs µs µs
Fallzeit, induktive Last Fall time, inductive load	I_C = 550 A, V_{CE} = 300 V T_{vj} = 25°C V_{GE} = ±15 V T_{vj} = 125°C R_{Goff} = 0,75 Ω T_{vj} = 150°C	t_f		0,04 0,06 0,07		µs µs µs
Einschaltverlustenergie pro Puls Turn-on energy loss per pulse	I_C = 550 A, V_{CE} = 300 V, L_S = 20 nH T_{vj} = 25°C V_{GE} = ±15 V, di/dt = 5500 A/µs (T_{vj} = 150°C) T_{vj} = 125°C R_{Gon} = 1,8 Ω T_{vj} = 150°C	E_{on}		10,5 12,0 12,5		mJ mJ mJ
Abschaltverlustenergie pro Puls Turn-off energy loss per pulse	I_C = 550 A, V_{CE} = 300 V, L_S = 20 nH T_{vj} = 25°C V_{GE} = ±15 V, du/dt = 2700 V/µs (T_{vj} = 150°C) T_{vj} = 125°C R_{Goff} = 0,75 Ω T_{vj} = 150°C	E_{off}		21,0 25,0 26,0		mJ mJ mJ
Kurzschlußverhalten SC data	V_{GE} ≤ 15 V, V_{CC} = 360 V t_P ≤ 8 µs, T_{vj} = 25°C V_{CEmax} = V_{CES} -L_{sCE} ·di/dt t_P ≤ 6 µs, T_{vj} = 150°C	I_{SC}		5600 4000		A A
Wärmewiderstand, Chip bis Kühl-Flüssigkeit Thermal resistance, junction to cooling fluid	pro IGBT / per IGBT cooling fluid = 50% water/50% ethylenglycol; ΔV/Δt = 10,0 dm³/min	R_{thJF}			0,097	K/W
Temperatur im Schaltbetrieb Temperature under switching conditions		$T_{vj\,op}$	-40		150	°C

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Diode, Wechselrichter / Diode, Inverter

Höchstzulässige Werte / Maximum Rated Values

Periodische Spitzensperrspannung Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	650	V
Dauergleichstrom Continuous DC forward current		I_F	550	A
Periodischer Spitzenstrom Repetitive peak forward current	t_P = 1 ms	I_{FRM}	1600	A
Grenzlastintegral 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	I²t	15000 14500	A²s A²s

Charakteristische Werte / Characteristic Values

			min.	typ.	max.	
Durchlassspannung 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 1,35 1,30	1,75	V V V
Rückstromspitze Peak reverse recovery current	I_F = 550 A, - di_F/dt = 5500 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}		200 330 360		A A A
Sperrverzögerungsladung Recovered charge	I_F = 550 A, - di_F/dt = 5500 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		17,0 40,0 45,0		µC µC µC
Abschaltenergie pro Puls Reverse recovery energy	I_F = 550 A, - di_F/dt = 5500 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}		4,00 9,50 11,5		mJ mJ mJ
Wärmewiderstand, Chip bis Kühl-Flüssigkeit Thermal resistance, junction to cooling fluid	pro Diode / per diode cooling fluid = 50% water/50% ethylenglycol; $\Delta V/\Delta t$ = 10,0 dm³/min		R_{thJF}			0,135	K/W
Temperatur im Schaltbetrieb Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

NTC-Widerstand / NTC-Thermistor

Charakteristische Werte / Characteristic Values

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

Angaben gemäß gültiger Application Note.
Specification according to the valid application note.

Modul / Module

Isolations-Prüfspannung Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		2,5		kV
Material Modulgrundplatte Material of module baseplate				Cu		
Innere Isolation Internal isolation	Basisisolierung (Schutzklasse 1, EN61140) basic insulation (class 1, IEC 61140)			Al_2O_3		
Kriechstrecke Creepage distance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal			7,0 5,5		mm
Luftstrecke Clearance	Kontakt - Kühlkörper / terminal to heatsink Kontakt - Kontakt / terminal to terminal			7,0 5,0		mm
Vergleichszahl der Kriechwegbildung Comperative tracking index		CTI		> 200		
			min.	typ.	max.	
Druckabfall im Kühlkreislauf* Pressure drop in cooling circuit*	$\Delta V/\Delta t$ = 10,0 dm³/min; T_F = 25°C cooling fluid = 50% water/50% ethylenglycol	Δp		119		mbar
Höchstzulässiger Druck im Kühlkreislauf Maximum pressure in cooling circuit		p			2,5	bar
Modulstreuinduktivität Stray inductance module		L_{sCE}		14		nH
Modulleitungswiderstand, Anschlüsse - Chip Module lead resistance, terminals - chip	T_F = 25°C, pro Schalter / per switch	$R_{CC'+EE'}$		0,80		mΩ
Lagertemperatur Storage temperature		T_{stg}	-40		125	°C
Anzugsdrehmoment f. Modulmontage Mounting torque for modul mounting	Schraube M6 - Montage gem. gültiger Applikationsschrift Screw M6 - Mounting according to valid application note	M	3,00	-	6,00	Nm
Anzugsdrehmoment f. elektr. Anschlüsse Terminal connection torque	Schraube M6 - Montage gem. gültiger Applikationsschrift Screw M6 - Mounting according to valid application note	M	2,5	-	5,0	Nm
Gewicht Weight		G		1340		g

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

Kundenspezifisch / Customized

			min.	typ.	max.	
Collector-emitter voltage (tested end of line)	T vj = 25°C	Vces	680			V
Temperature under switching conditions	Max. 30h over life time inverter / brake-chopper for 10s within period of 10min	T vj op			175	°C
Short circuit ruggedness specified at 150°C	s. IGBT characteristic values					

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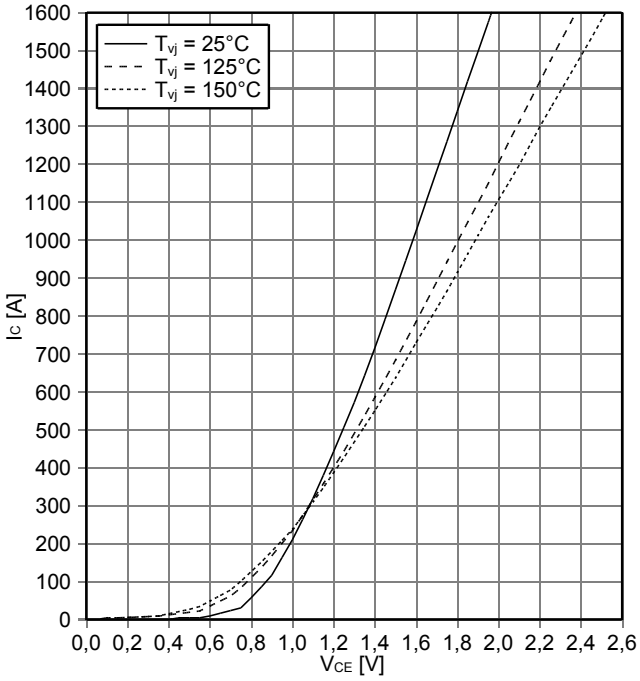
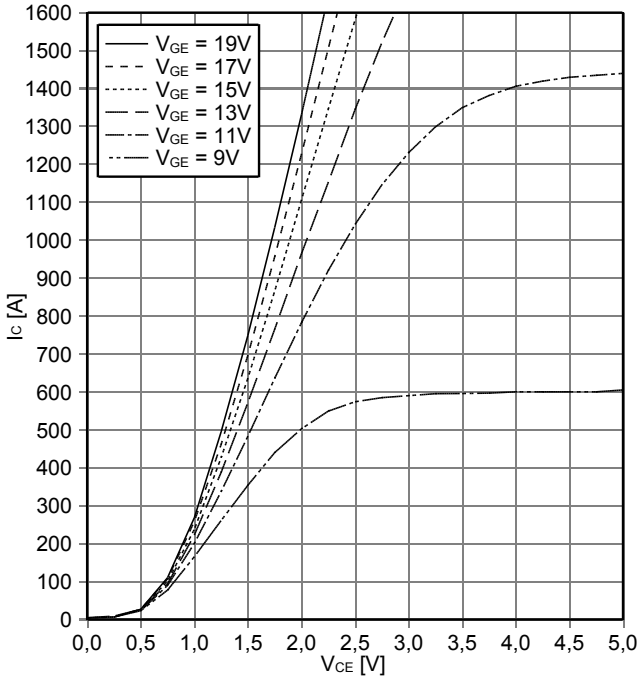
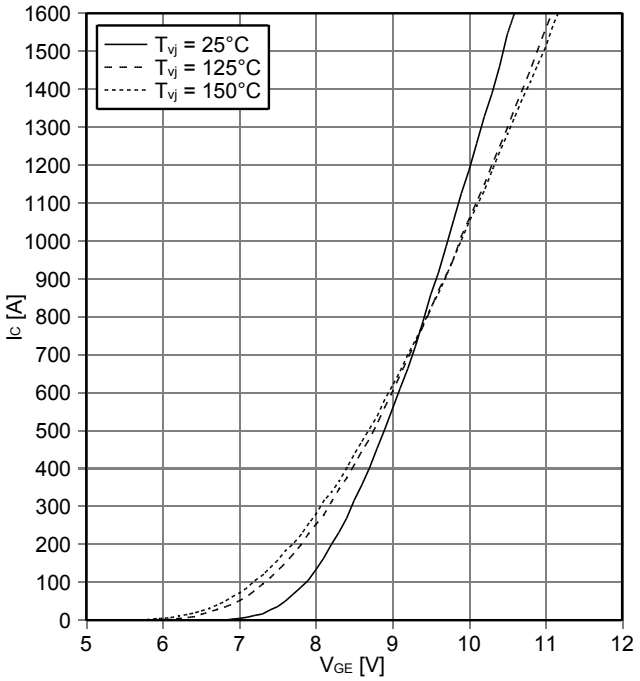
Ausgangskennlinie IGBT,Wechselrichter (typisch)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
V_{GE} = 15 V



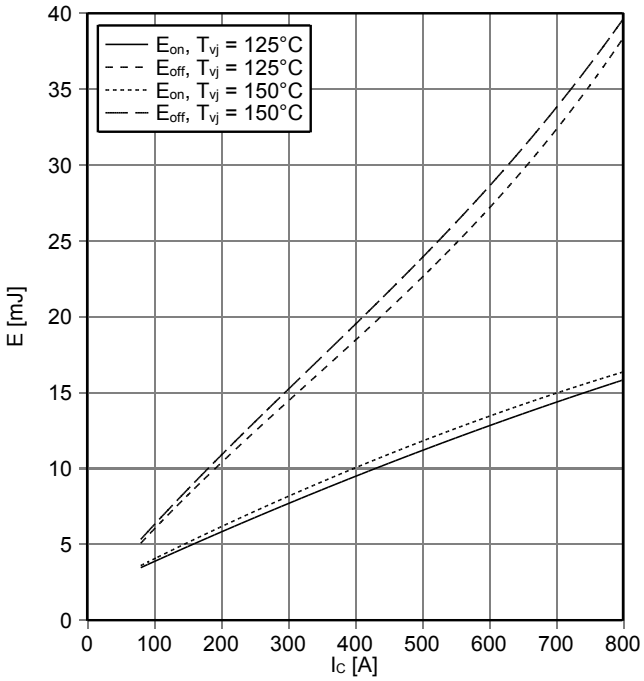
Ausgangskennlinienfeld IGBT,Wechselrichter (typisch)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
T_{vj} = 150°C



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



Schaltverluste IGBT,Wechselrichter (typisch)
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
V_{GE} = ±15 V, R_{Gon} = 1.8 Ω, R_{Goff} = 0.75 Ω, V_{CE} = 300 V



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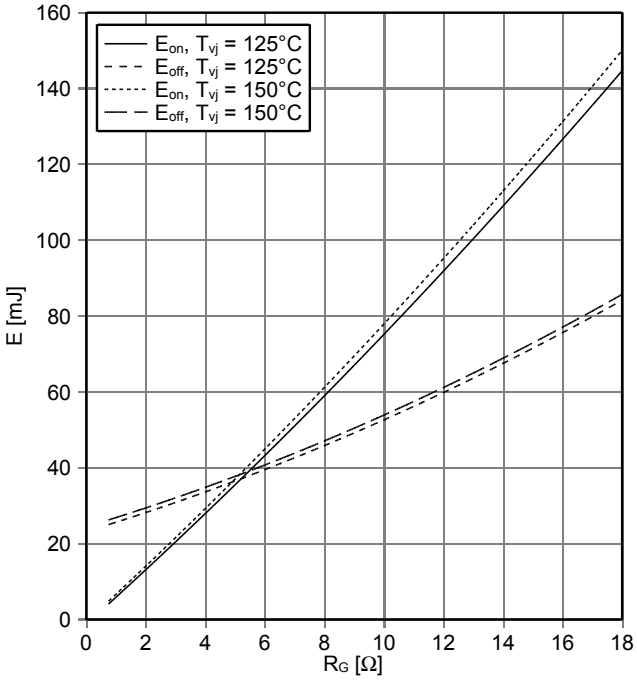
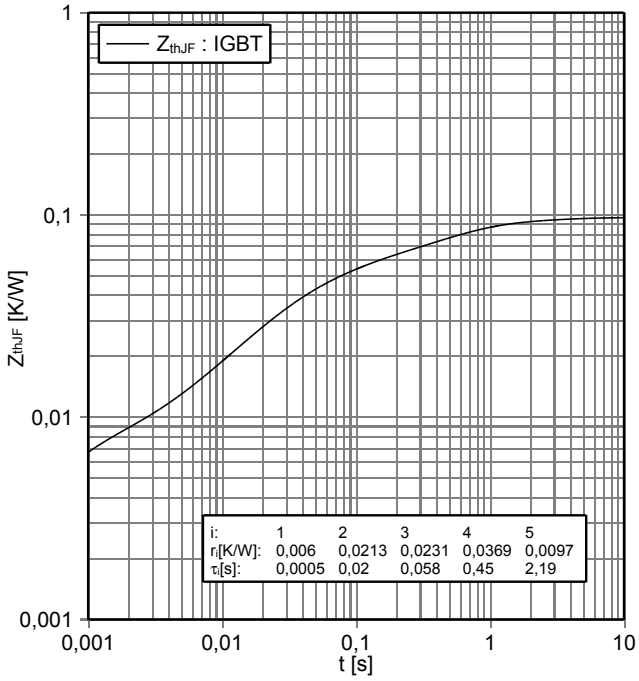
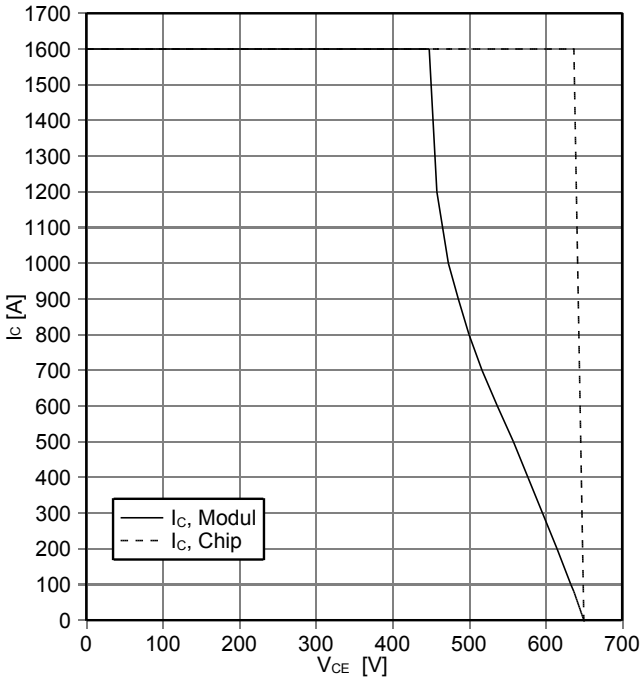
Schaltverluste IGBT,Wechselrichter (typisch)
switching losses IGBT,Inverter (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
V_{GE} = ±15 V, I_C = 550 A, V_{CE} = 300 V



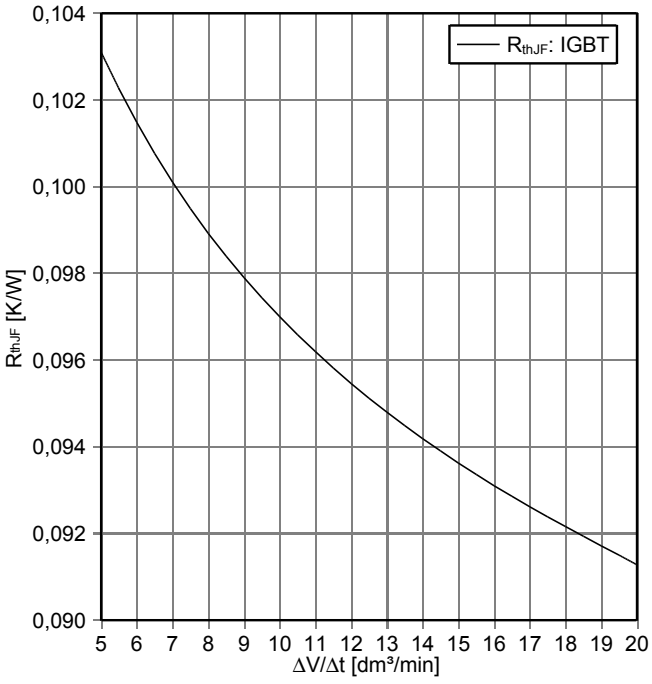
Transienter Wärmewiderstand IGBT,Wechselrichter
transient thermal impedance IGBT,Inverter
$Z_{thJF} = f(t)$ ($\Delta V/\Delta t$=10 dm³/min)



Sicherer Rückwärts-Arbeitsbereich IGBT,Wechselrichter (RBSOA)
reverse bias safe operating area IGBT,Inverter (RBSOA)
$I_C = f(V_{CE})$
V_{GE} = ±15 V, R_{Goff} = 0.75 Ω, T_{vj} = 150°C



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



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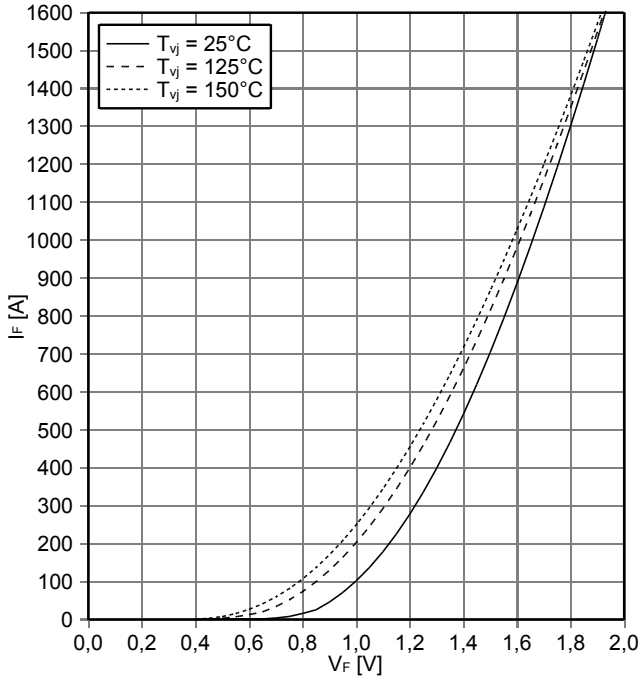
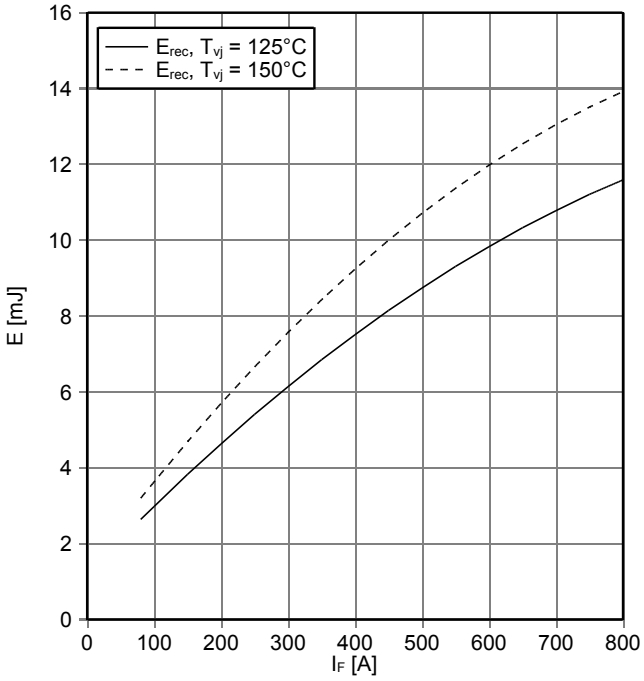
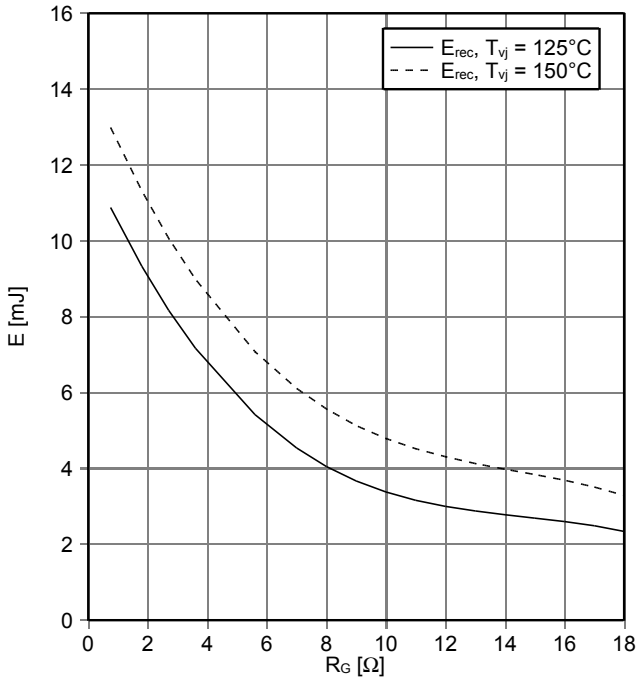
Durchlasskennlinie der Diode, Wechselrichter (typisch)
forward characteristic of Diode, Inverter (typical)
$I_F = f(V_F)$



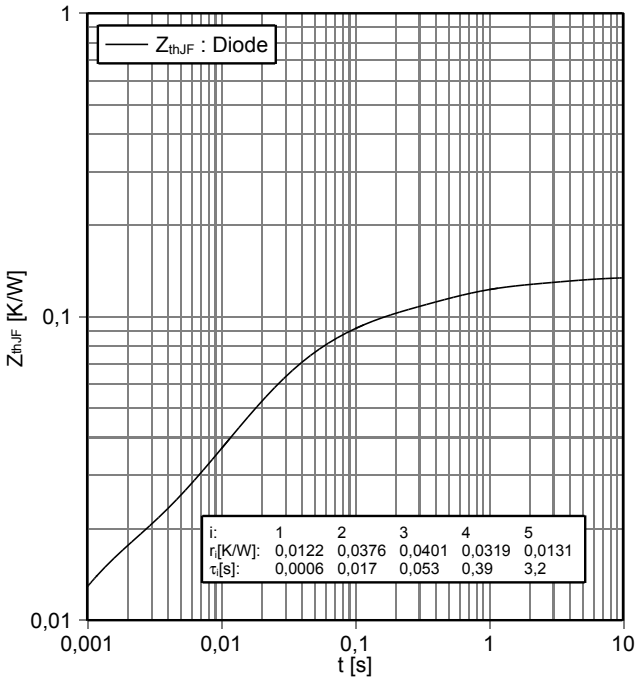
Schaltverluste Diode, Wechselrichter (typisch)
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 1.8\ \Omega$, $V_{CE} = 300$ V



Schaltverluste Diode, Wechselrichter (typisch)
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 550$ A, $V_{CE} = 300$ V



Transienter Wärmewiderstand Diode, Wechselrichter
transient thermal impedance Diode, Inverter
$Z_{thJF} = f(t)$ $(\Delta V/\Delta t = 10\ dm^3/min)$



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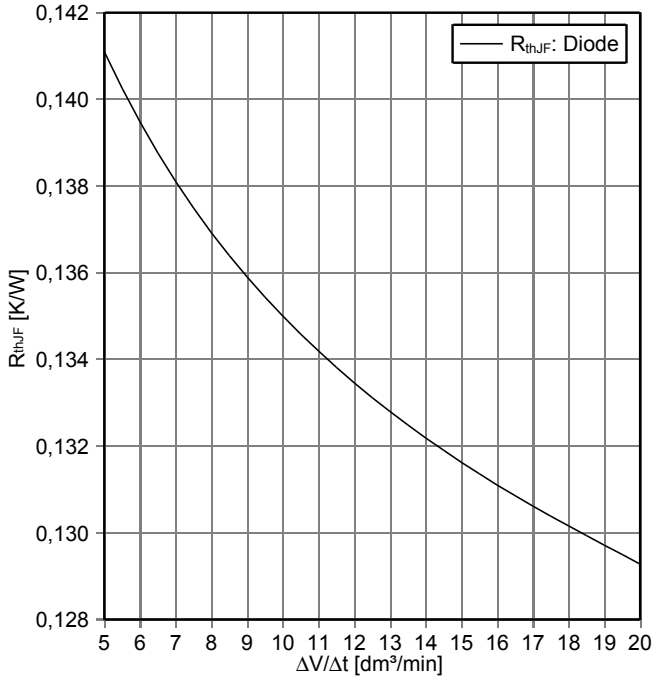
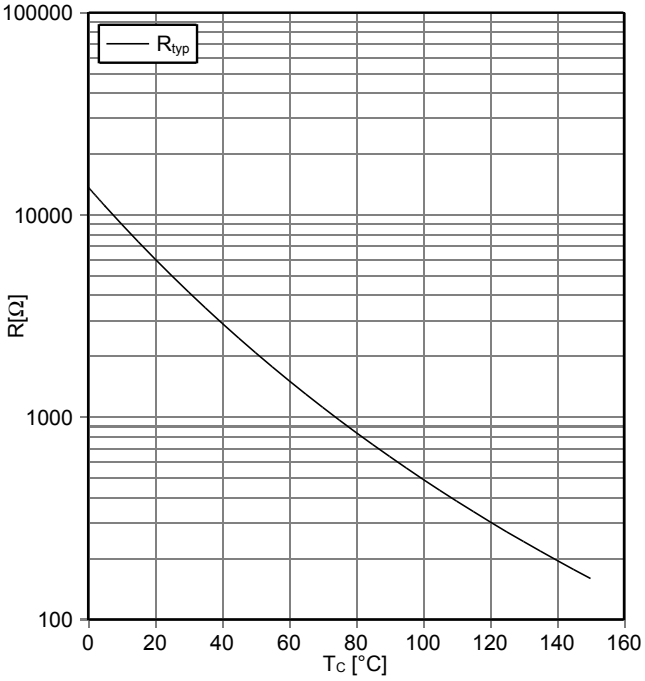
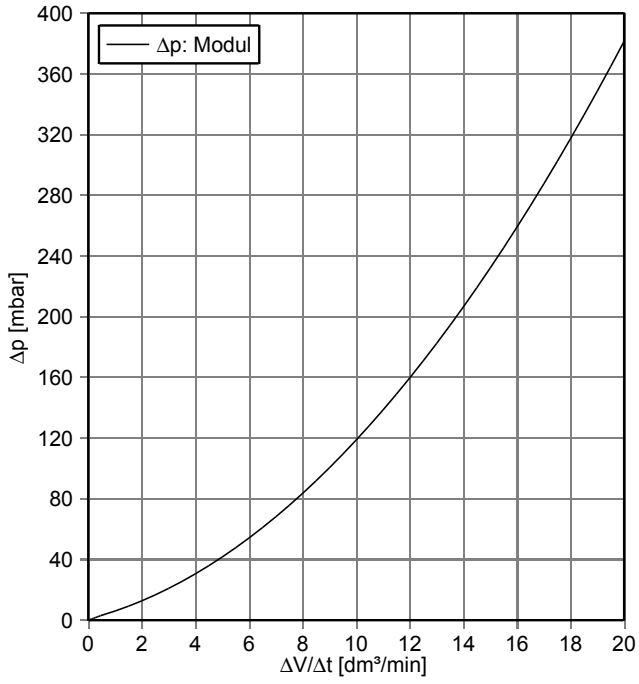
Wärmewiderstand Diode, Wechselrichter
thermal impedance Diode, Inverter
$R_{thJF} = f(\Delta V/\Delta t)$
cooling fluid = 50% water/50% ethylenglycol



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



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



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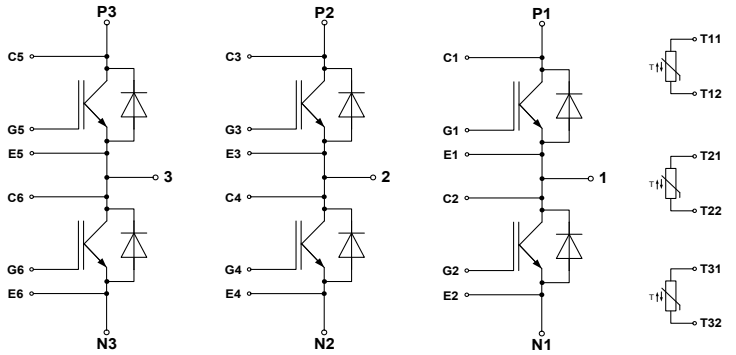
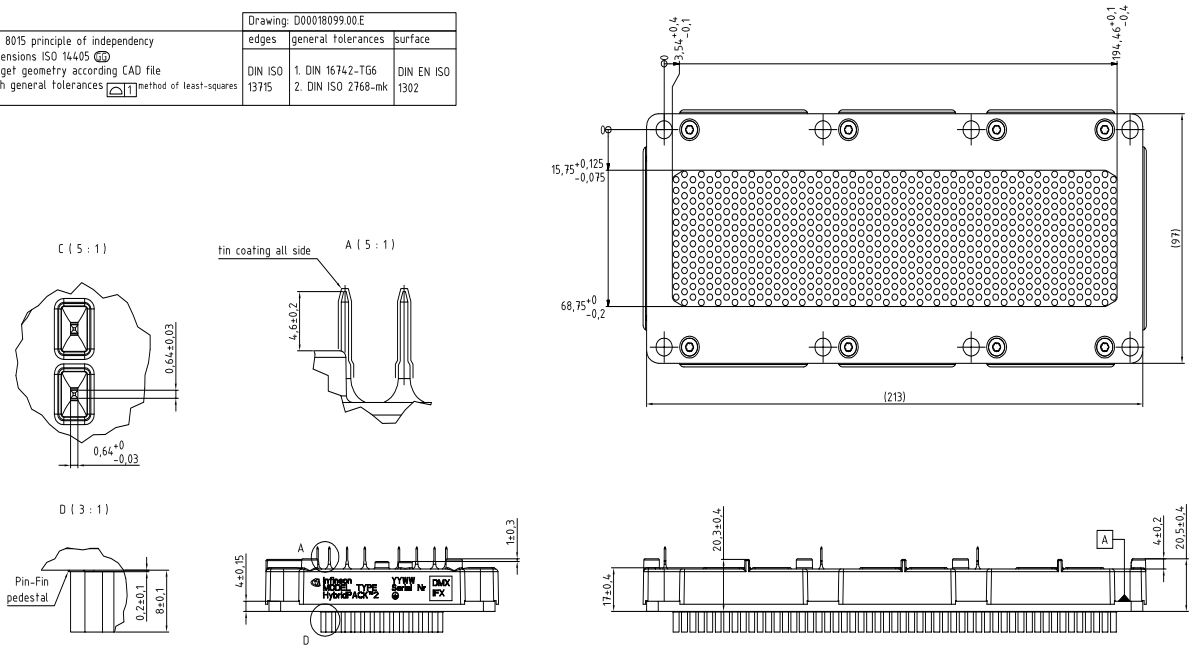
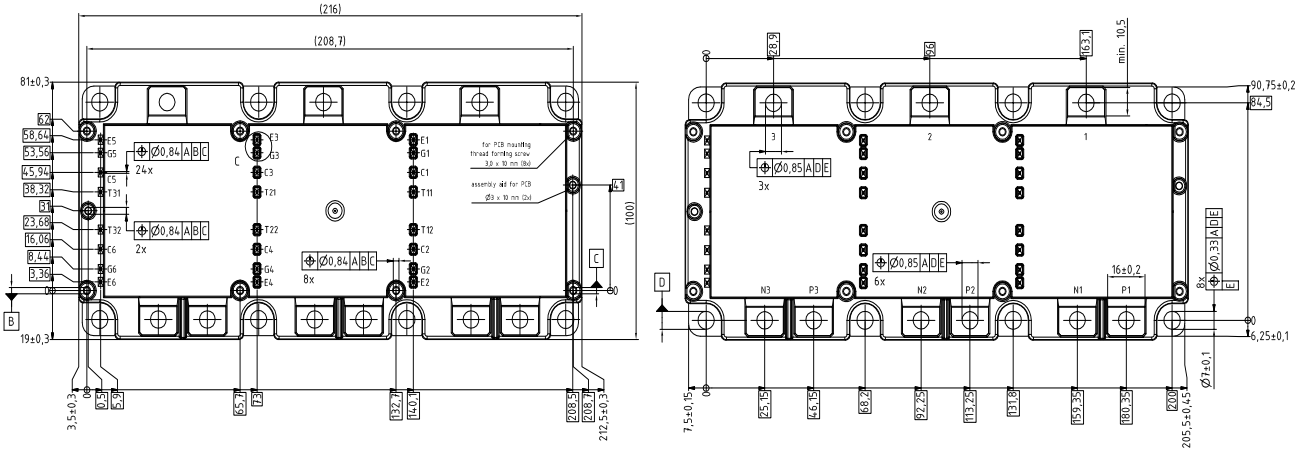
Schaltplan / circuit_diagram_headline



Gehäuseabmessungen / package outlines

	Drawing: D00018099.00.E		
ISO 8015 principle of independency dimensions ISO 14405 target geometry according CAD file with general tolerances method of least-squares	edges	general tolerances	surface
	DIN ISO 13715	1. DIN 16742-TG6 2. DIN ISO 2768-mk	DIN EN ISO 1302





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