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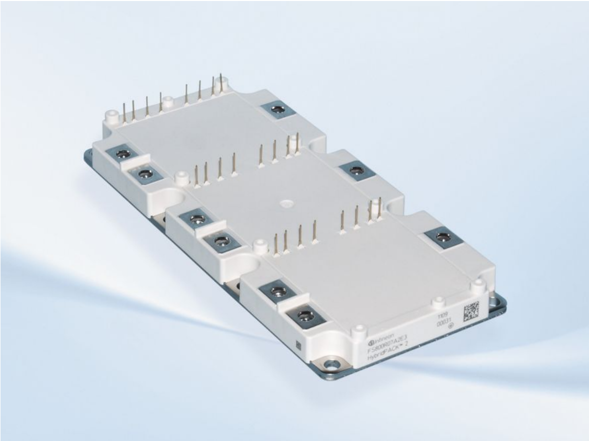
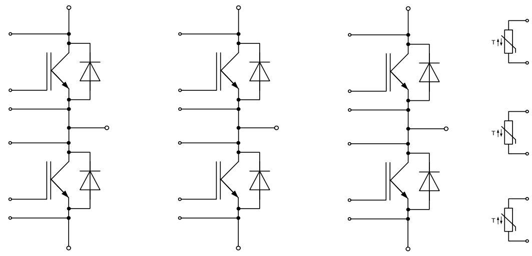
FS400R12A2T4

HybridPACK™2 Modul mit Trench/Feldstopp IGBT4 und Emitter Controlled 4 Diode und NTC
HybridPACK™2 module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode and NTC





V_{CES} = 1200V
$I_{C\ nom}$ = 400A / I_{CRM} = 800A

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

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

Elektrische Eigenschaften
- Erhöhte Zwischenkreisspannung
- Niederinduktives Design
- Niedrige Schaltverluste
- Trench IGBT 4
- $T_{vj\ op}$ = 150°C
- V_{CEsat} mit positivem Temperaturkoeffizienten

Electrical Features
- Increased DC link Voltage
- Low inductive design
- Low Switching Losses
- Trench IGBT 4
- $T_{vj\ op}$ = 150°C
- 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
- Kupferbodenplatte
- RoHS konform

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

Module Label Code

Barcode Code 128

Sample
00000123456000000000000

DMX - Code

Sample

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

prepared by: AU	date of publication: 2012-11-06	material no: 36841
approved by: MM	revision: 3.0	UL approved (E83335)

IGBT-Wechselrichter / IGBT-inverter

Höchstzulässige Werte / Maximum Rated Values

Kollektor-Emitter-Sperrspannung Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
Implementierter Kollektor-Strom Implemented collector current		I_{CN}	400	A
Kollektor-Dauergleichstrom Continuous DC collector current	T_F = 75°C, T_{vj} = 175°C T_F = 25°C, T_{vj} = 175°C	$I_{C\ nom}$ I_C	300 400	A A
Periodischer Kollektor-Spitzenstrom Repetitive peak collector current	t_P = 1 ms	I_{CRM}	800	A
Gesamt-Verlustleistung Total power dissipation	T_F = 25°C, T_{vj} = 175°C	P_{tot}	1500	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 = 300 A, V_{GE} = 15 V I_C = 300 A, V_{GE} = 15 V I_C = 300 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\ sat}$		1,55 1,75 1,80	1,85	V V V
Gate-Schwellenspannung Gate threshold voltage	I_C = 13,0 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,2	5,8	6,4	V
Gateladung Gate charge	V_{GE} = -15 V ... +15 V		Q_G		3,20		µC
Interner Gatewiderstand Internal gate resistor	T_{vj} = 25°C		R_{Gint}		1,9		Ω
Eingangskapazität Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		25,0		nF
Rückwirkungskapazität Reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{res}		1,10		nF
Kollektor-Emitter-Reststrom Collector-emitter cut-off current	V_{CE} = 1200 V, V_{GE} = 0 V, T_{vj} = 25°C		I_{CES}			1,0	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 = 300 A, V_{CE} = 500 V V_{GE} = ±15 V R_{Gon} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ on}$		0,16 0,18 0,19		µs µs µs
Anstiegszeit, induktive Last Rise time, inductive load	I_C = 300 A, V_{CE} = 500 V V_{GE} = ±15 V R_{Gon} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,05 0,05 0,06		µs µs µs
Abschaltverzögerungszeit, induktive Last Turn-off delay time, inductive load	I_C = 300 A, V_{CE} = 500 V V_{GE} = ±15 V R_{Goff} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\ off}$		0,42 0,53 0,61		µs µs µs
Fallzeit, induktive Last Fall time, inductive load	I_C = 300 A, V_{CE} = 500 V V_{GE} = ±15 V R_{Goff} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,04 0,09 0,09		µs µs µs
Einschaltverlustenergie pro Puls Turn-on energy loss per pulse	I_C = 300 A, V_{CE} = 500 V, L_S = 20 nH V_{GE} = ±15 V, di/dt = 5500 A/µs (T_{vj}=150°C) R_{Gon} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		17,0 24,0 26,0		mJ mJ mJ
Abschaltverlustenergie pro Puls Turn-off energy loss per pulse	I_C = 300 A, V_{CE} = 500 V, L_S = 20 nH V_{GE} = ±15 V, du/dt = 2550 V/µs (T_{vj}=150°C) R_{Goff} = 1,5 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		13,0 26,0 30,0		mJ mJ mJ
Kurzschlußverhalten SC data	V_{GE} ≤ 15 V, V_{CC} = 900 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 8 µs, T_{vj} = 25°C t_P ≤ 6 µs, T_{vj} = 150°C	I_{SC}		2300 2000		A A
Wärmewiderstand, Chip bis Gehäuse Thermal resistance, junction to case	pro IGBT / per IGBT cooling fluid = 50% water/50% ethylenglycol; ΔV/Δt = 10,0 dm³/min		R_{thJF}			0,10	K/W

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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}	1200	V
Implementierter Durchlassstrom Implemented forward current		I_{FN}	400	A
Dauergleichstrom Continuous DC forward current		I_F	300	A
Periodischer Spitzenstrom Repetitive peak forward current	t_P = 1 ms	I_{FRM}	800	A
Grenzlastintegral I^2t - 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	13000 15000	A²s A²s

Charakteristische Werte / Characteristic Values

				min.	typ.	max.	
Durchlassspannung Forward voltage	I_F = 300 A, V_{GE} = 0 V I_F = 300 A, V_{GE} = 0 V I_F = 300 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	1,80	V V V
Rückstromspitze Peak reverse recovery current	I_F = 300 A, - di_F/dt = 3150 A/µs (T_{vj}=150°C) V_R = 500 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		315 400 400		A A A
Sperrverzögerungsladung Recovered charge	I_F = 300 A, - di_F/dt = 3150 A/µs (T_{vj}=150°C) V_R = 500 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		27,0 52,0 60,0		µC µC µC
Abschaltenergie pro Puls Reverse recovery energy	I_F = 300 A, - di_F/dt = 3150 A/µs (T_{vj}=150°C) V_R = 500 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		7,00 18,0 21,0		mJ mJ mJ
Wärmewiderstand, Chip bis Gehäuse 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}			0,13	K/W

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	$\Delta R/R$	-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.

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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		100		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
Höchstzulässige Sperrschichttemperatur Maximum junction temperature	Wechselrichter, Brems-Chopper / Inverter, Brake-Chopper	$T_{vj\,max}$			175	°C
Temperatur im Schaltbetrieb Temperature under switching conditions	Wechselrichter, Brems-Chopper / Inverter, Brake-Chopper	$T_{vj\,op}$	-40		150	°C
Lagertemperatur Storage temperature		T_{stg}	-40		125	°C
Anzugsdrehmoment f. Modulmontage Mounting torque for modul mounting	Schraube M6 - Montage gem. gültiger Applikation Note 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 Applikation Note screw M6 - mounting according to valid application note	M	2,5	-	5,0	Nm
Gewicht Weight		G		1250		g

* Kühleraufbau gemäß gültiger Application Note.
* Cooler setup according to the valid application note.
* According to IEC 60664 (Materialgroup IIIa and PD2) the max. DC link voltage should be restricted to 550V

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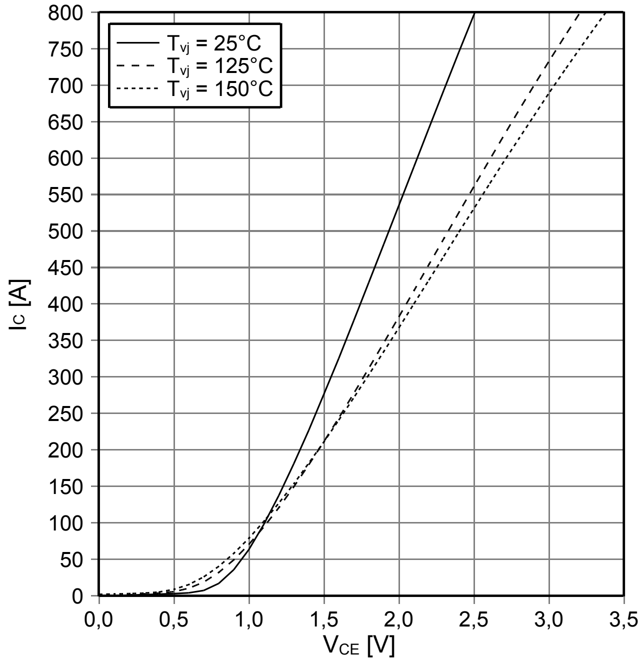
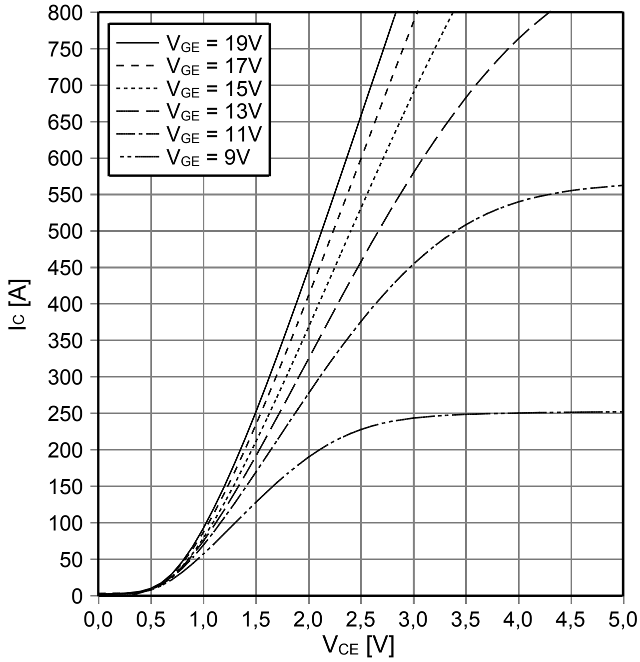
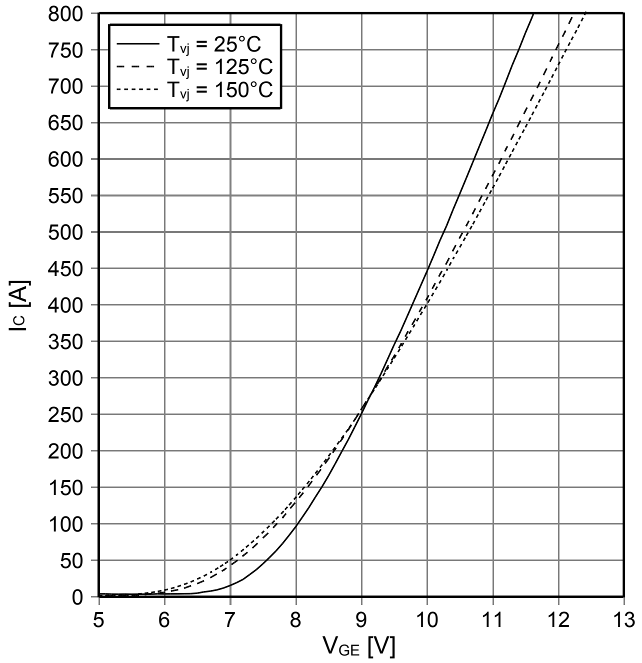
Ausgangskennlinie IGBT-Wechselr. (typisch)
output characteristic IGBT-inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



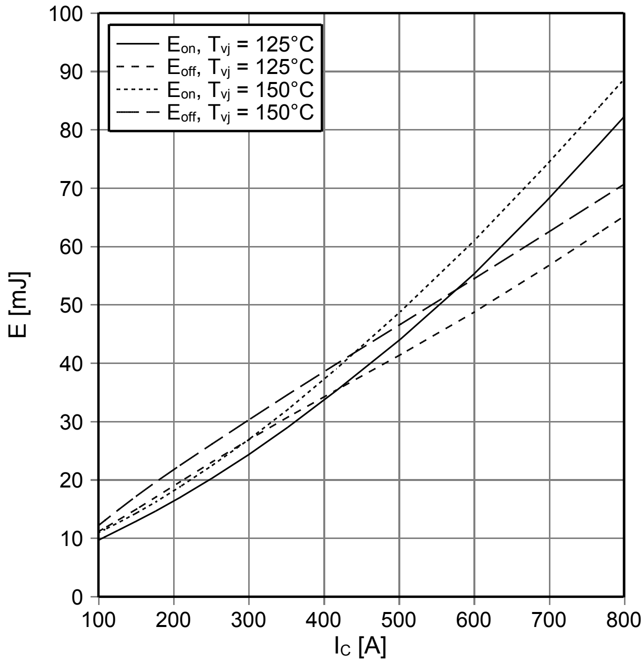
Ausgangskennlinienfeld IGBT-Wechselr. (typisch)
output characteristic IGBT-inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



Übertragungscharakteristik IGBT-Wechselr. (typisch)
transfer characteristic IGBT-inverter (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



Schaltverluste IGBT-Wechselr. (typisch)
switching losses IGBT-inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = ±15$ V, $R_{Gon} = 1.5$ Ω, $R_{Goff} = 1.5$ Ω, $V_{CE} = 500$ V



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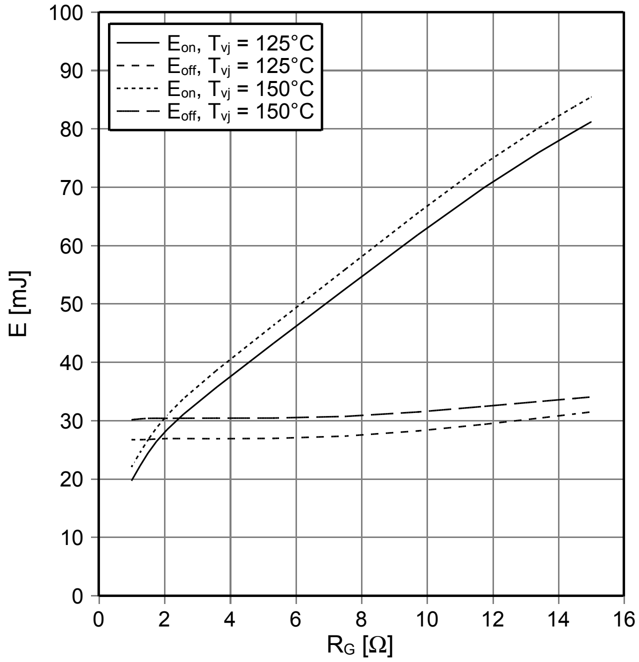
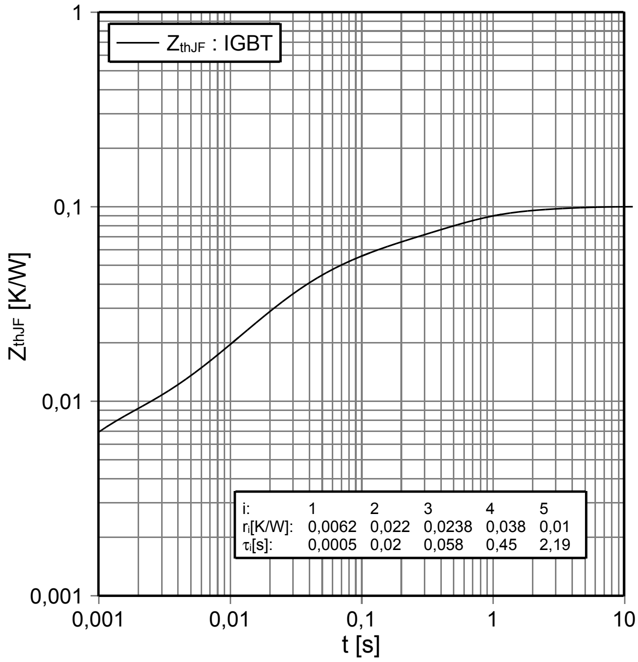
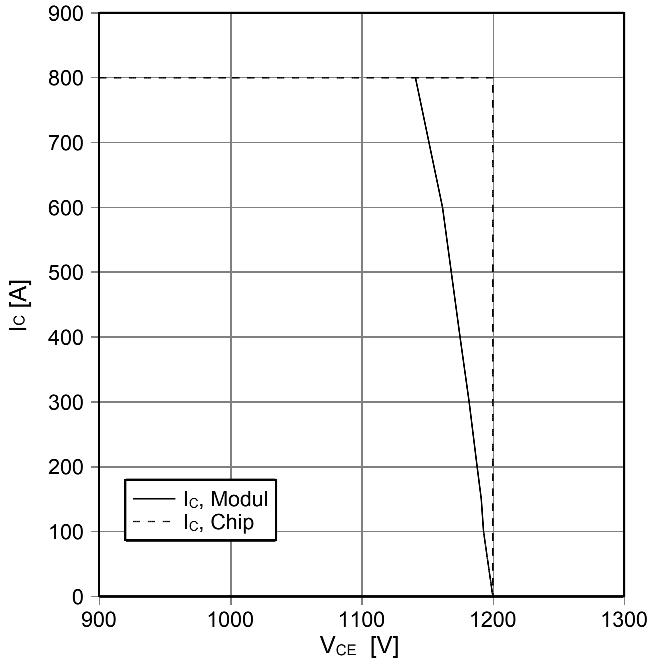
Schaltverluste IGBT-Wechselr. (typisch)
switching losses IGBT-Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = ±15 V, I_C = 300 A, V_{CE} = 500 V



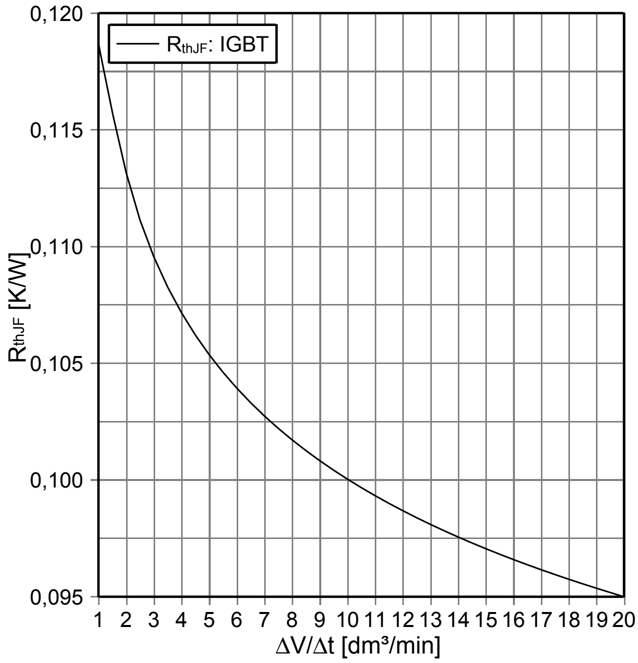
Transienter Wärmewiderstand IGBT-Wechselr.
transient thermal impedance IGBT-inverter
Z_{thJF} = f (t)   (ΔV/Δt=10 dm³/min)



Sicherer Rückwärts-Arbeitsbereich IGBT-Wr. (RBSOA)
reverse bias safe operating area IGBT-inv. (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 1.5 Ω, T_{vj} = 150°C



Wärmewiderstand IGBT-Wechselr.
thermal impedance IGBT-inverter
R_{thJF} = f (ΔV/Δt)
cooling fluid = 50% water/50% ethylenglycol



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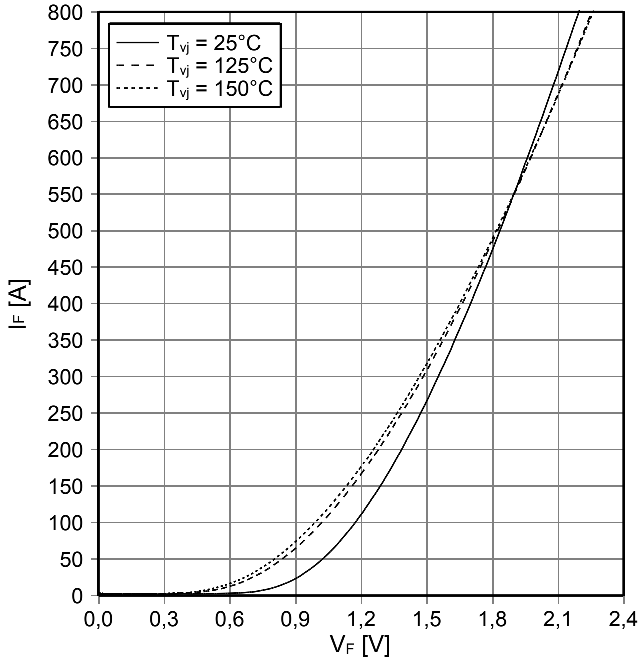
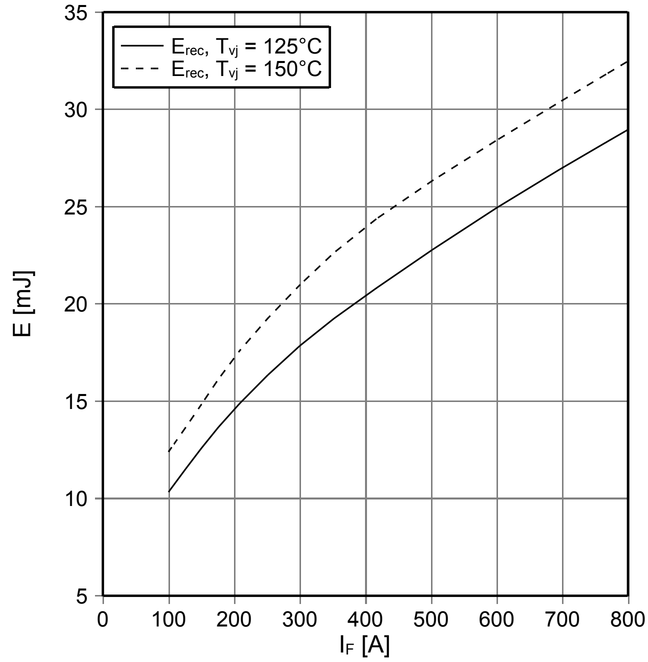
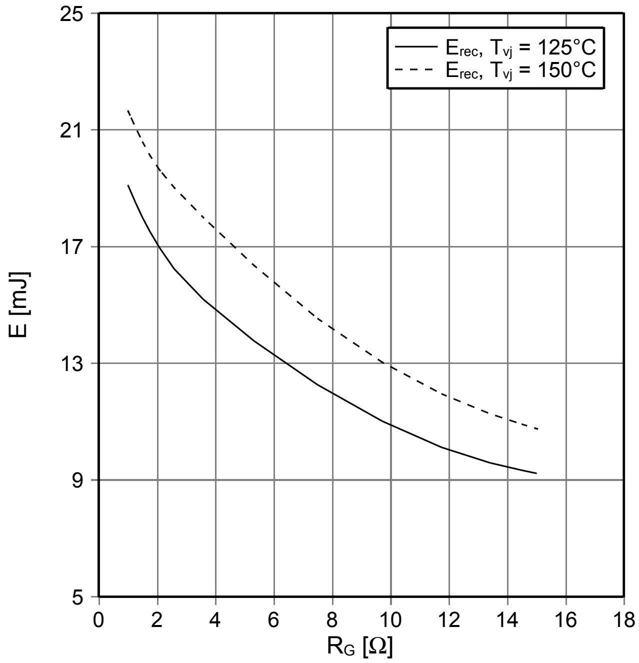
Durchlasskennlinie der Diode-Wechselr. (typisch)
forward characteristic of diode-inverter (typical)
$I_F = f(V_F)$



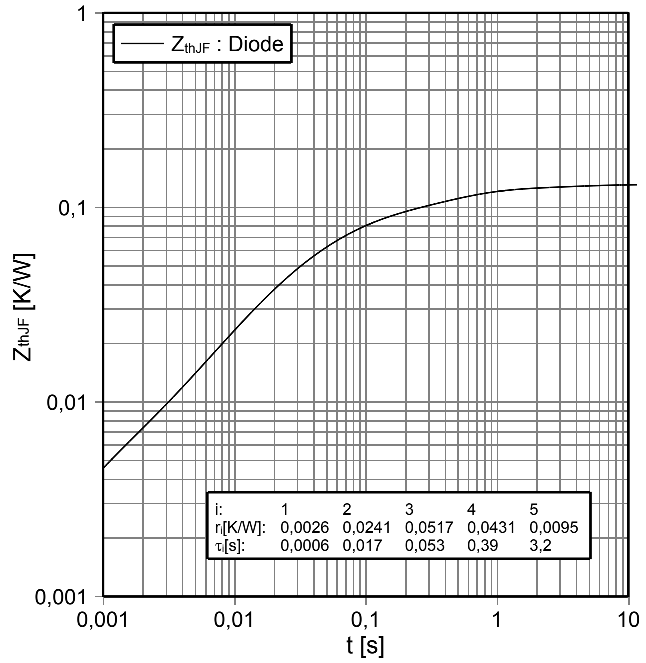
Schaltverluste Diode-Wechselr. (typisch)
switching losses diode-inverter (typical)
$E_{rec} = f(I_F)$
R_{Gon} = 1.5 Ω, V_{CE} = 500 V



Schaltverluste Diode-Wechselr. (typisch)
switching losses diode-inverter (typical)
$E_{rec} = f(R_G)$
I_F = 300 A, V_{CE} = 500 V



Transienter Wärmewiderstand Diode-Wechselr.
transient thermal impedance diode-inverter
$Z_{thJF} = f(t)$ (ΔV/Δt=10 dm³/min)



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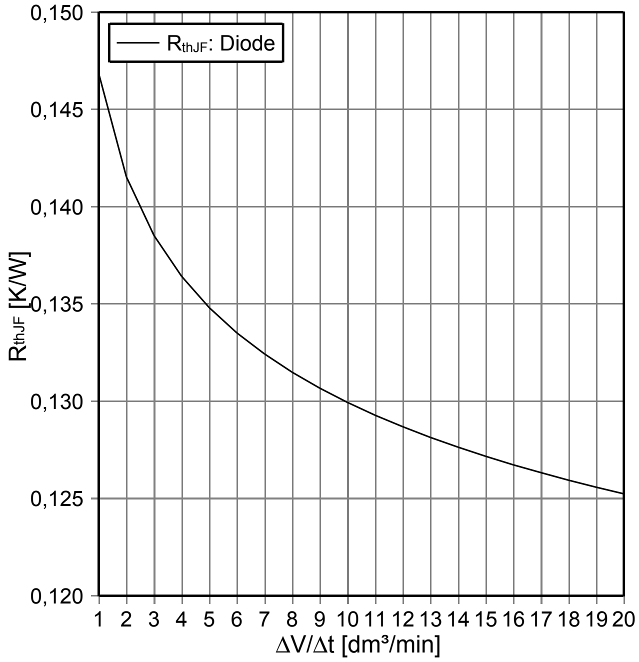
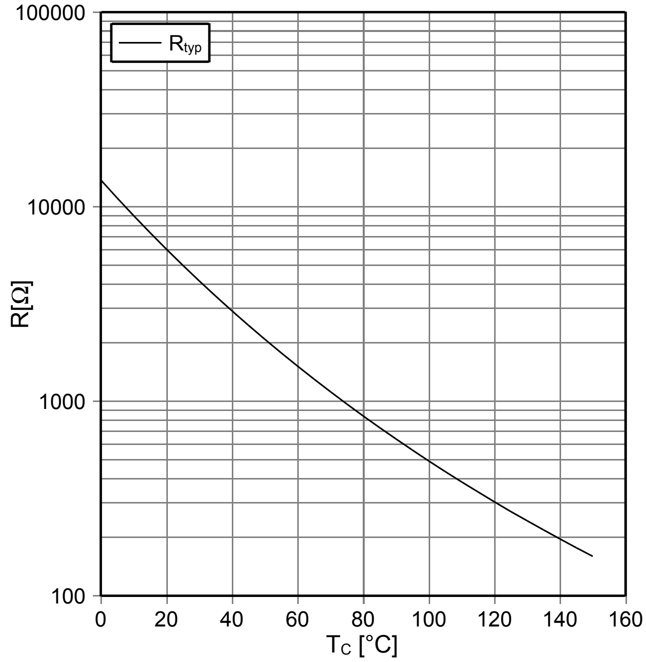
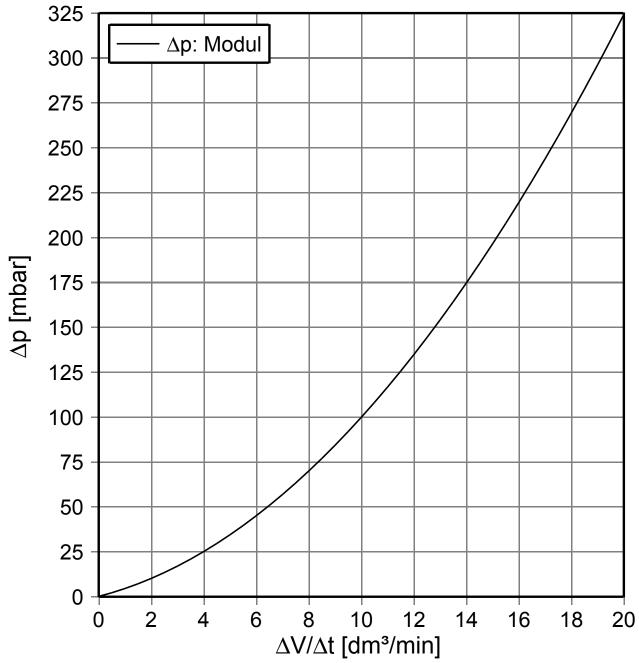
Wärmewiderstand Diode-Wechselr.
thermal impedance diode-inverter
R_{thJF} = f (ΔV/Δt)
cooling fluid = 50% water/50% ethylenglycol



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



Druckabfall im Kühlkreislauf*
pressure drop in cooling circuit*
Δp = f (ΔV/Δt)
cooling fluid = 50% water/50% ethylenglycol, T_F = 25°C



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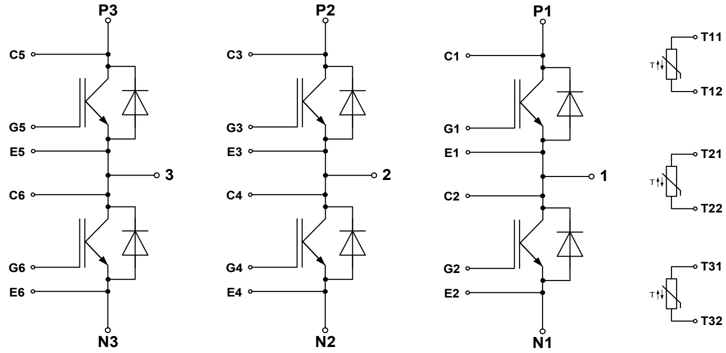
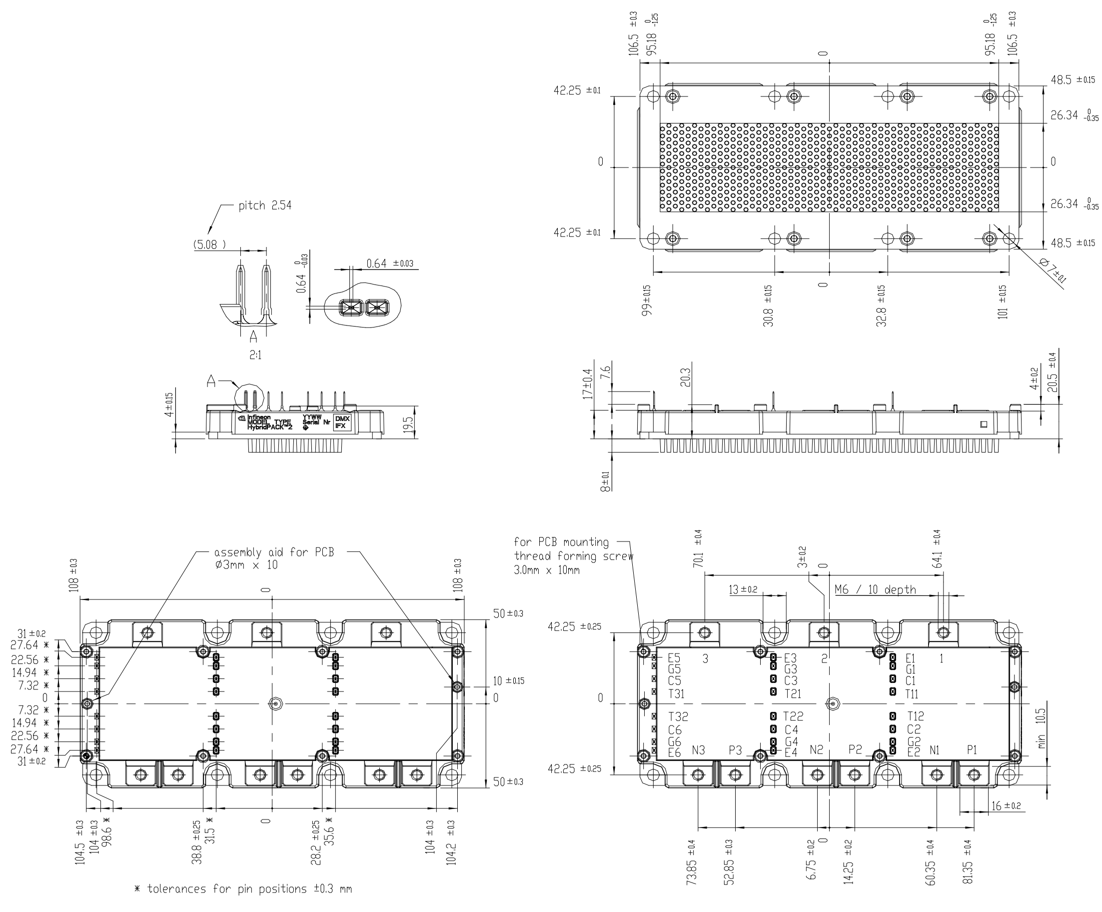
Schaltplan / circuit diagram



Gehäuseabmessungen / package outlines



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Sollten Sie beabsichtigen, das Produkt in Anwendungen der Luftfahrt, in gesundheits- oder lebensgefährdenden oder lebenserhaltenden Anwendungsbereichen einzusetzen, bitten wir um Mitteilung. Wir weisen darauf hin, dass wir für diese Fälle
- **die gemeinsame Durchführung eines Risiko- und Qualitätsassessments;**
- **den Abschluss von speziellen Qualitätssicherungsvereinbarungen;**
- **die gemeinsame Einführung von Maßnahmen zu einer laufenden Produktbeobachtung dringend empfehlen und gegebenenfalls die Belieferung von der Umsetzung solcher Maßnahmen abhängig machen.**

Soweit erforderlich, bitten wir Sie, entsprechende Hinweise an Ihre Kunden zu geben.

Inhaltliche Änderungen dieses Produktdatenblatts bleiben vorbehalten.

Terms & Conditions of usage

The data contained in this product data sheet is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to such application.

This product data sheet is describing the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively pursuant the terms and conditions of the supply agreement. There will be no guarantee of any kind for the product and its characteristics. The information in the valid application- and assembly notes of the module must be considered.

Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of our product, please contact the sales office, which is responsible for you (see www.infineon.com, sales&contact). For those that are specifically interested we may provide application notes.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the Product in aviation applications, in health or live endangering or life support applications, please notify. Please note, that for any such applications we urgently recommend
- **to perform joint Risk and Quality Assessments;**
- **the conclusion of Quality Agreements;**
- **to establish joint measures of an ongoing product survey, and that we may make delivery depended on the realization of any such measures.**

If and to the extent necessary, please forward equivalent notices to your customers.

Changes of this product data sheet are reserved.

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