Double Side Cooled Module

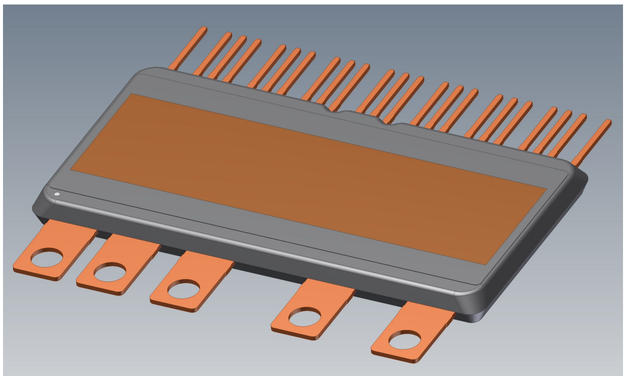
FS200R07A02E3_S6

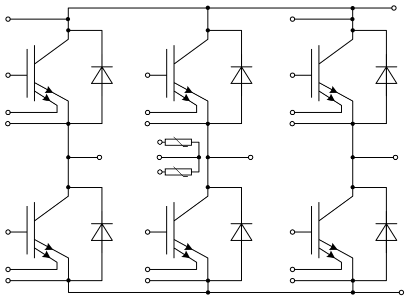
Final Data Sheet

V3.1, 2019-10-11

Automotive High Power

1 Features / Description





V_{CES} = 700 V
I_C = 200 A

Typical Applications
- Automotive Applications
- Hybrid Electrical Vehicles (H)EV

Electrical Features
- Increased Blocking Voltage Capability to 700V
- Integrated Current Sensor
- Low Inductive Design
- $T_{vj\ op}$ = 150°C

Mechanical Features
- 2.5kV AC 1min Insulation
- Double sided cooling
- Compact design
- RoHS compliant
- Integrated NTC temperature sensor

Description
The HybridPACK™ DSC L is a very compact six-pack module targeting hybrid and electric vehicles.
The module is based on Infineon's long-term experience developing IGBT power modules and Trench-Field-Stop IGBTs including matching diodes with enhanced softness. Additionally, on-die integrated current sensors and module temperature sensors (2 x NTC) support to monitor the IGBT state. These features enable enhanced short-circuit protection and intelligent control of the system.

The extreme compact package is realized by using Double Sided Cooling (DSC). This new assembly technology enables enhanced thermal and electrical performance at high reliability and mechanical robustness.

Furthermore, this module allows combination with other existing Double Sided Cooling packages (e.g. HybridPACK™ DSC S) to extend the single inverter to a dual inverter configuration.

Product Name	Ordering Code
FS200R07A02E3_S6	SP001661220

2 IGBT,Inverter

2.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	700	V
Continuous DC collector current	T_C = 65°C, $T_{vj\,max}$ = 150°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, $T_{vj\,max}$ = 150°C	P_{tot}	694	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	2.25	V
Gate threshold voltage	I_C = 3.70 mA, V_{CE} = V_{GE}	T_{vj} = 25°C	V_{GEth}	5.00	5.80	6.50	V
Gate charge	V_{GE} = -15 V ... 15 V		Q_G		2.20		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}		13.5		nF
Reverse transfer capacitance	f = 1 MHz, V_{CE} = 25 V, V_{GE} = 0 V	T_{vj} = 25°C	C_{res}		0.36		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} = -8/+15 V R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0.13 0.14 0.15		µs
Rise time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = -8/+15 V R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0.07 0.07 0.07		µs
Turn-off delay time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = -8/+15 V R_{Goff} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0.48 0.52 0.53		µs
Fall time, inductive load	I_C = 200 A, V_{CE} = 300 V V_{GE} = -8/+15 V R_{Goff} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0.03 0.04 0.04		µs
Turn-on energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 25 nH V_{GE} = -8/+15 V, di/dt = 3000 A/µs (T_{vj} = 150°C) R_{Gon} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		3.90 4.90 5.10		mJ
Turn-off energy loss per pulse	I_C = 200 A, V_{CE} = 300 V, L_S = 25 nH V_{GE} = -8/+15 V, du/dt = 2500 V/µs (T_{vj} = 150°C) R_{Goff} = 3.6 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		6.80 8.20 8.50		mJ
SC data	V_{GE} ≤ 15 V, V_{CC} = 360 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 6 µs, T_{vj} = 150°C	I_{SC}		1700		A
Thermal resistance, junction to case	per IGBT Clamping Force F = 700N		R_{thJC}			0.180[1)]	K/W
Thermal resistance, case to heatsink	per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K) Clamping Force F = 700N		R_{thCH}		0.170[1)]		K/W
Temperature under switching conditions	t_{op} continuous		$T_{vj\,op}$	-40		150	°C

[1)] with double sided cooling, evaluation according to HybridPack[TM] DSC application note

3 Diode, Inverter

3.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	700	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	I²t	1800	A²s

3.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
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		1.60 1.50 1.50	2.55	V
Peak reverse recovery current	I_F = 200 A, - di_F/dt = 2900 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		96.0 130 140		A
Recovered charge	I_F = 200 A, - di_F/dt = 2900 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		7.20 13.5 16.0		µC
Reverse recovery energy	I_F = 200 A, - di_F/dt = 2900 A/µs (T_{vj} = 150°C) V_R = 300 V V_{GE} = -8 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		1.70 3.30 3.80		mJ
Thermal resistance, junction to case	per diode Clamping Force F = 700N		R_{thJC}			0.280[1)]	K/W
Thermal resistance, case to heatsink	per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K) Clamping Force F = 700N		R_{thCH}		0.270[1)]		K/W
Temperature under switching conditions	t_{op} continuous		$T_{vj\,op}$	-40		150	°C

4 Module

Parameter	Conditions	Symbol		Value		Unit
Isolation test voltage	RMS, f = 50 Hz, t = 1min	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}		2.8		mm
Clearance	terminal to heatsink terminal to terminal	d_{Clear}		2.4		mm
Comperative tracking index		CTI		> 600		
			min.	typ.	max.	
Stray inductance module		L_{sCE}		20		nH
Storage temperature		T_{stg}	-40		125	°C
Terminal connection torque	Screw M5	M		-		Nm
Mounting force per clamp		F	400	-	750	N
Weight		G		72		g

5 Current Sensor

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output voltage	V_{CE} = 1.95 V, I_C = 400 A R_{sense} = 1.60 Ω, T_{vj} = 25°C VGE=15V	V_{sense}		0.26		V

[1)] with double sided cooling, evaluation according to HybridPack™ DSC application note

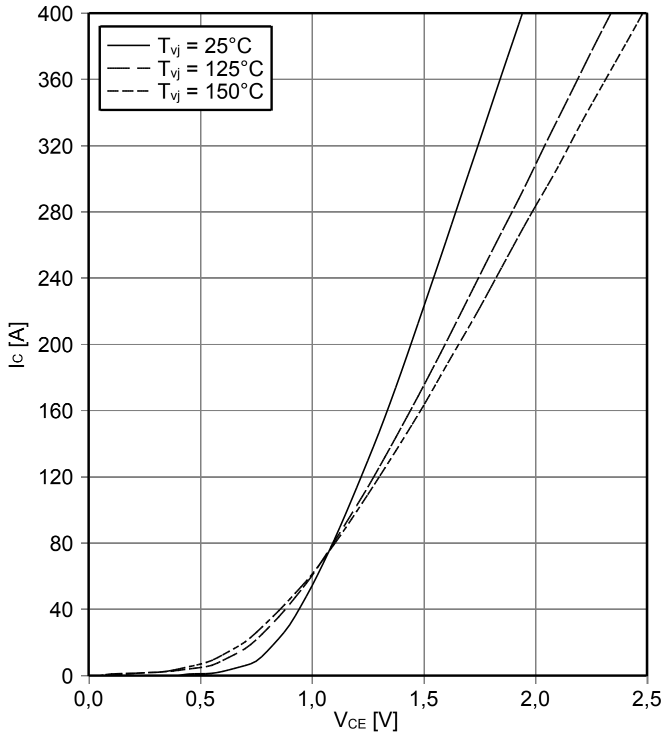
6 NTC-Thermistor

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

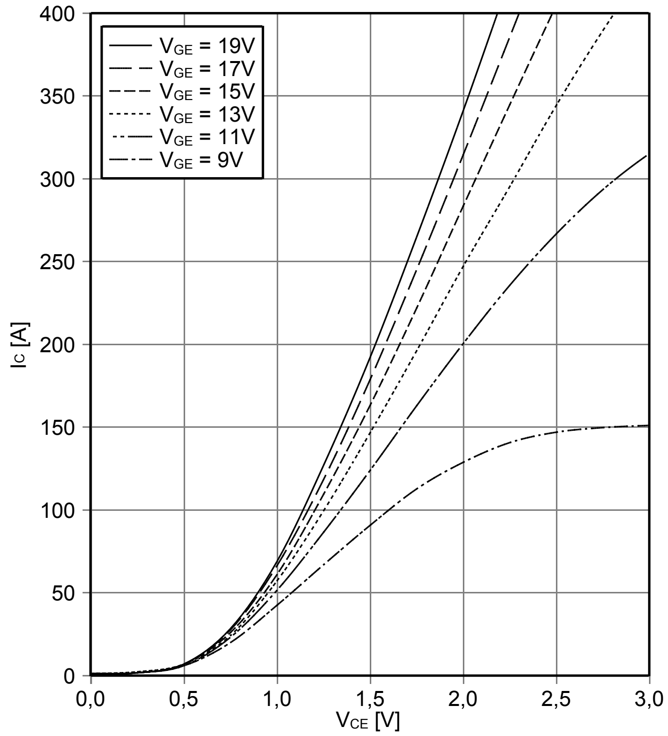
Specification according to the valid application note.

7 Characteristics Diagrams

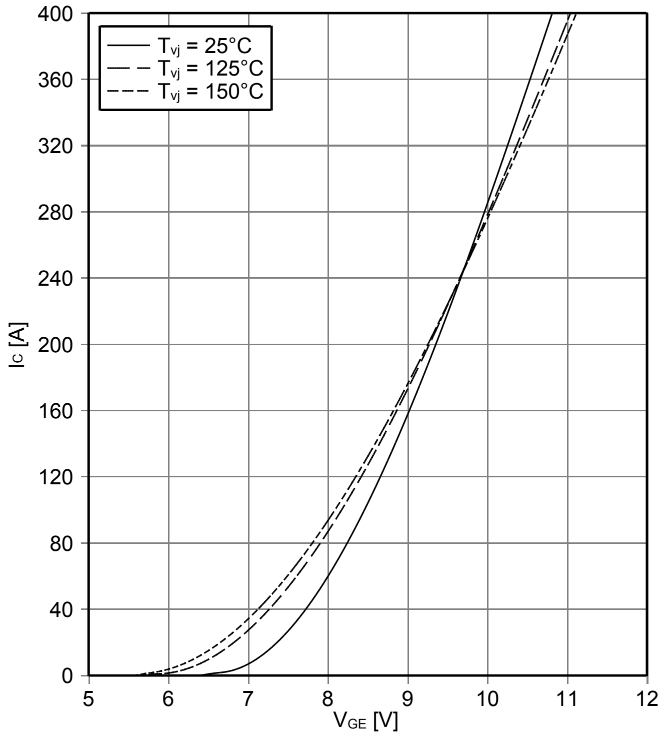
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



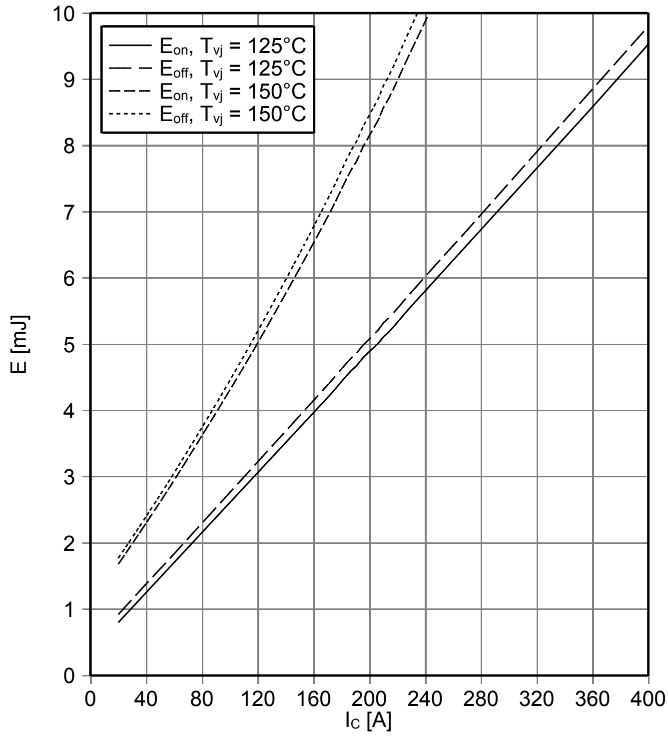
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



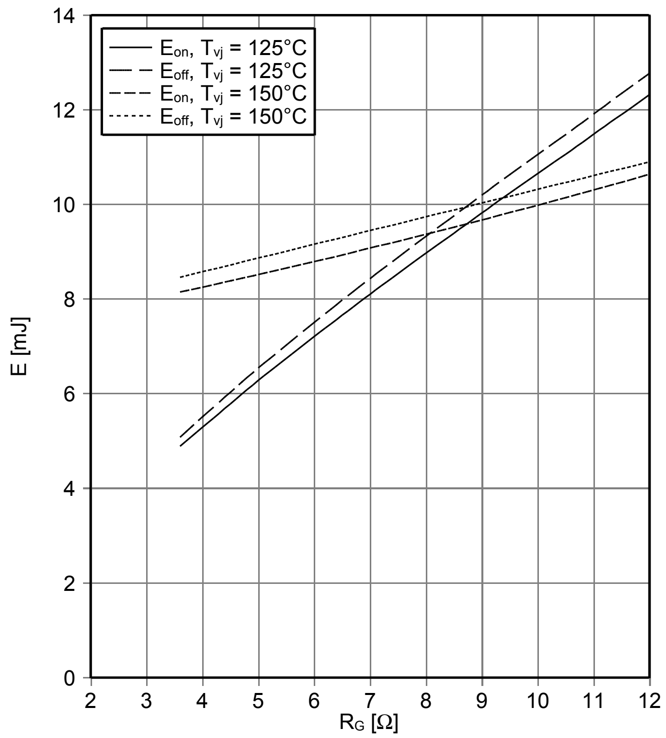
transfer characteristic IGBT,Inverter (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



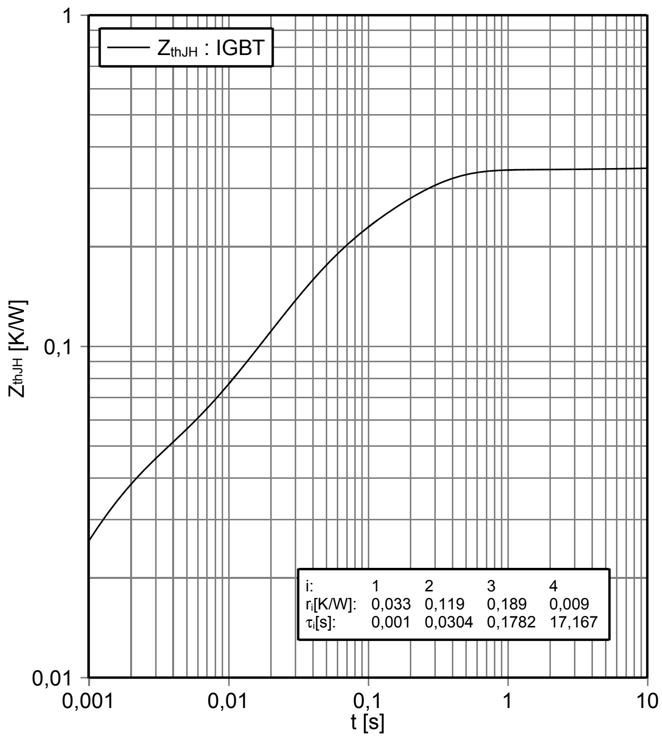
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = -8$ V / +15 V, $R_{Gon} = 3.6\ \Omega$, $R_{Goff} = 3.6\ \Omega$, $V_{CE} = 300$ V



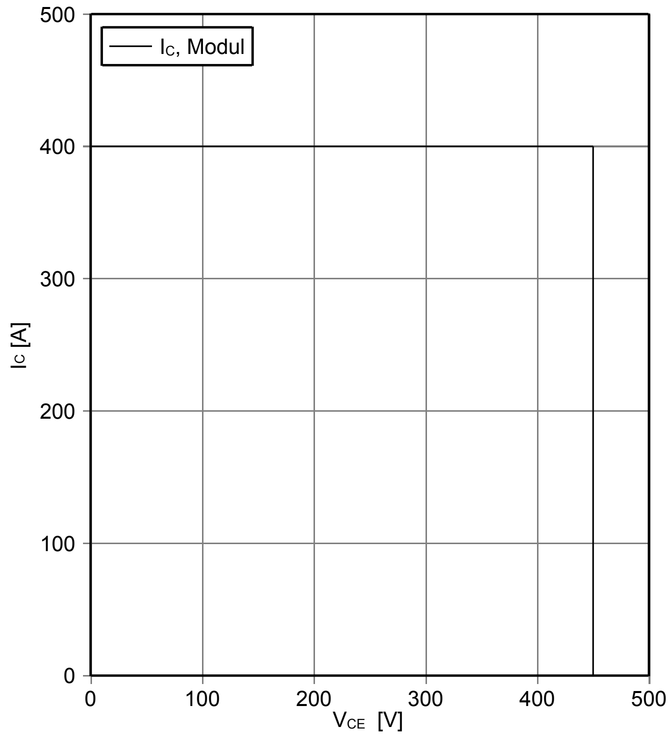
switching losses IGBT,Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = -8 / +15 V, I_C = 200 A, V_{CE} = 300 V



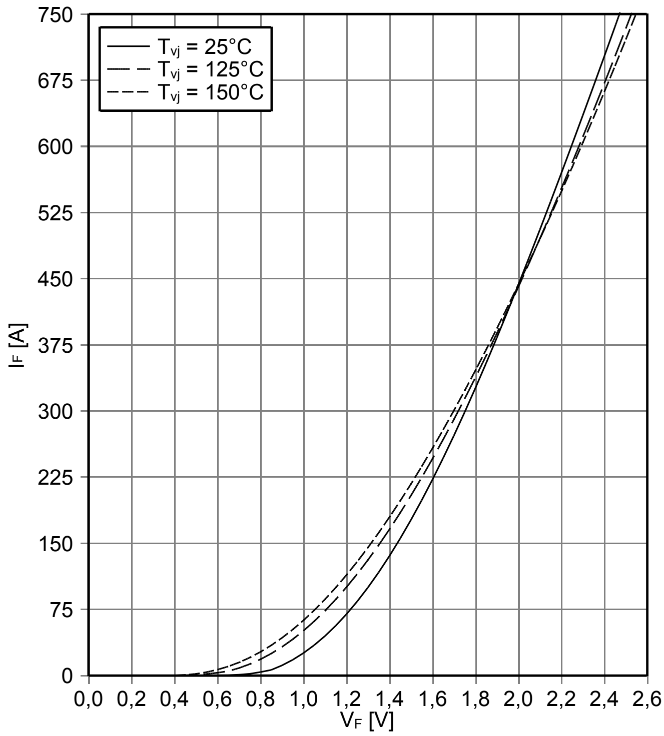
transient thermal impedance IGBT,Inverter
Z_{thJH} = f (t)



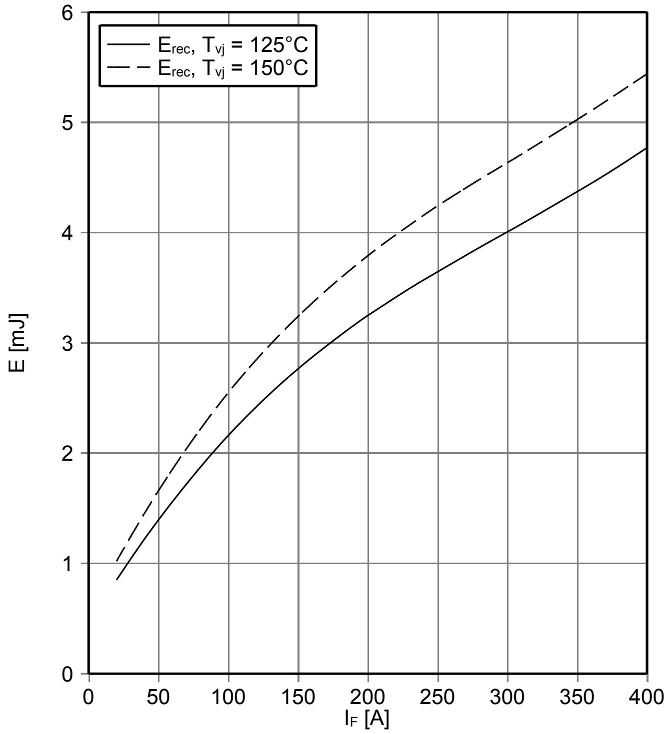
reverse bias safe operating area IGBT,Inverter (RBSOA)
I_C = f (V_{CE})
V_{GE} = -8 / +15 V, R_{Goff} = 3.6 Ω, T_{vj} = 150°C



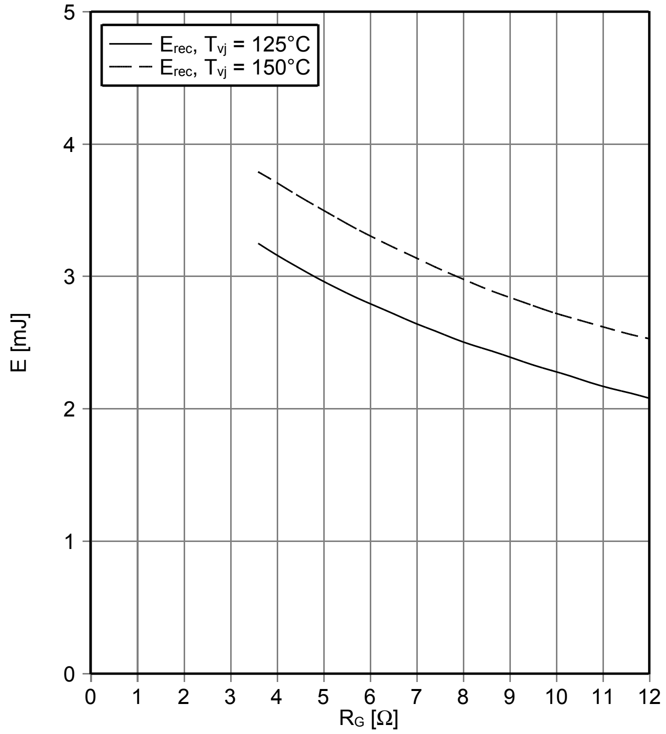
forward characteristic of Diode, Inverter (typical)
I_F = f (V_F)



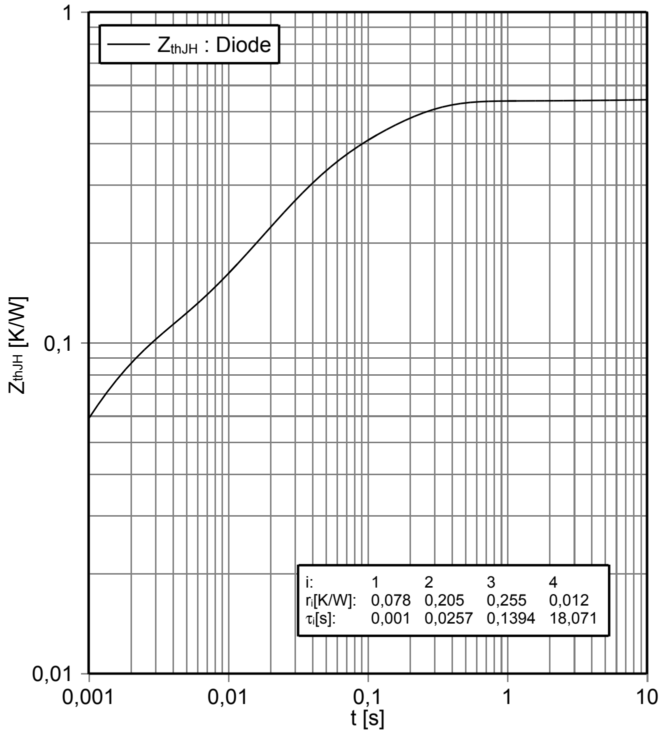
switching losses Diode, Inverter (typical)
$E_{rec} = f\,(I_F)$
R_{Gon} = 3.6 Ω, V_{CE} = 300 V



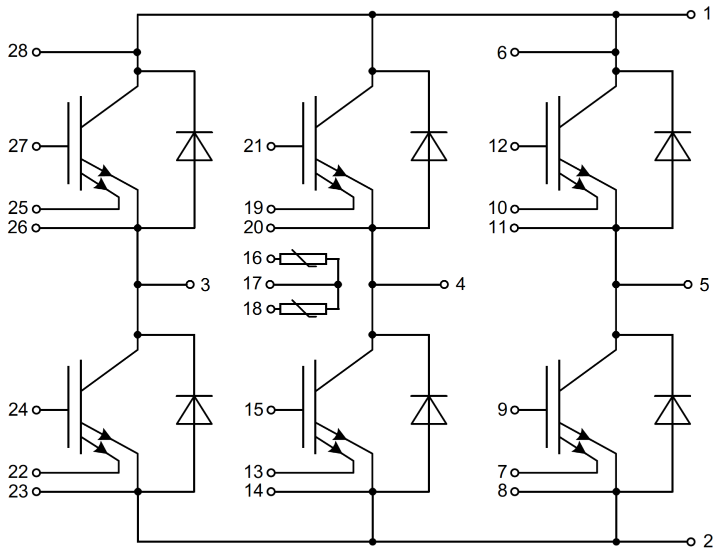
switching losses Diode, Inverter (typical)
$E_{rec} = f\,(R_G)$
I_F = 200 A, V_{CE} = 300 V



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

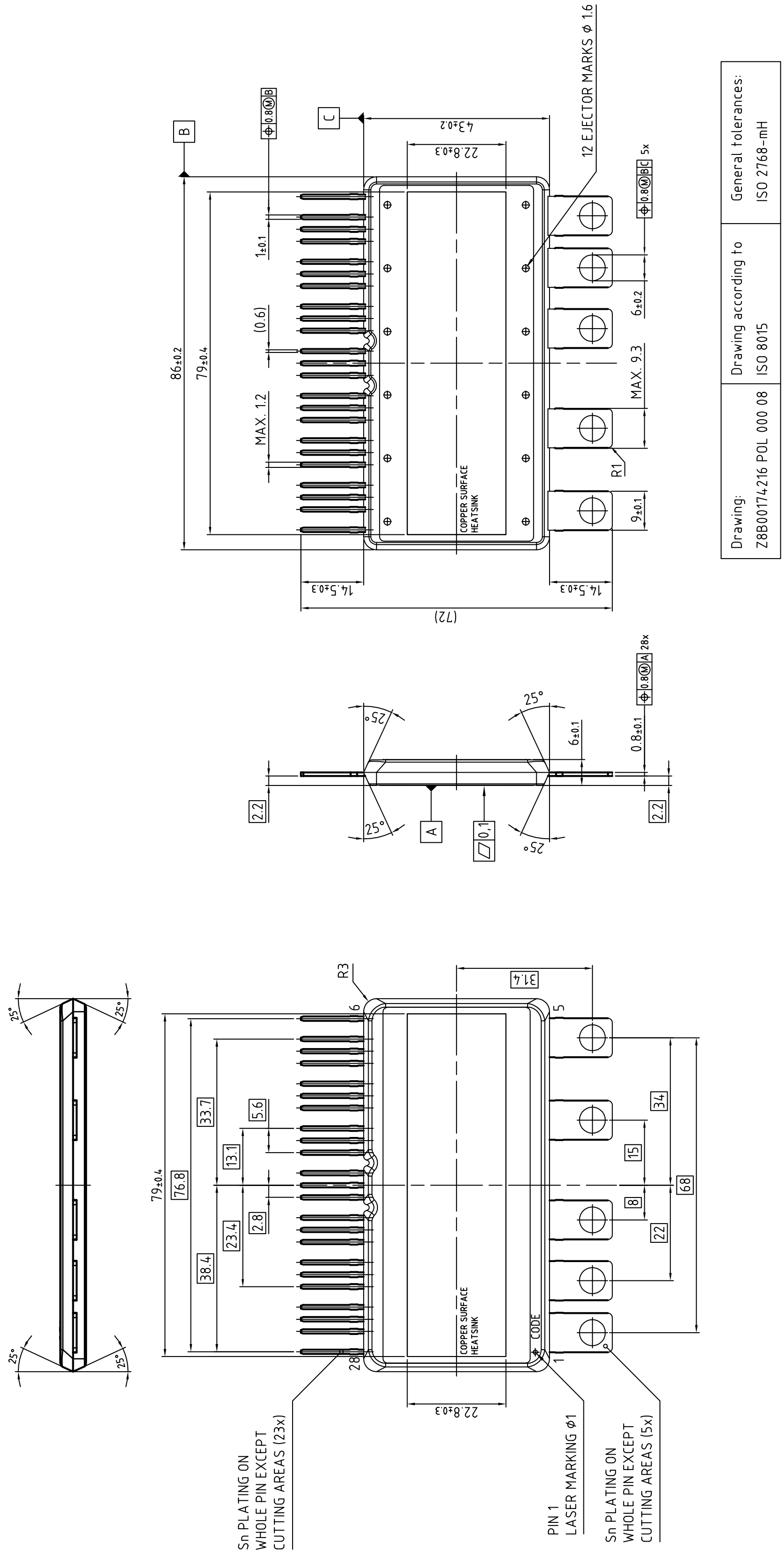


8 Circuit diagram



Pin Number	Symbol	I/O	Function
1	P	DC Supply (+)	Positive Supply
2	N	DC Supply (-)	Negative Supply
3	U	AC Output	U Phase Output
4	V	AC Output	V Phase Output
5	W	AC Output	W Phase Output
6	PS	Output	P Terminal Voltage Sensing (IGBT Collector)
7	CS6	Output	IGBT Current Sensor System 6
8	E6	Output	IGBT Emitter Output System 6
9	G6	Input	Gate Input System 6
10	CS5	Output	IGBT Current Sensor System 5
11	E5	Output	IGBT Emitter Output System 5
12	G5	Input	Gate Input System 5
13	CS4	Output	IGBT Current Sensor System 4
14	E4	Output	IGBT Emitter Output System 4
15	G4	Input	Gate Input System 4
16	T1	Output	NTC 1 +(Bottom DCB)
17	TG	Ground	NTC Ground
18	T2	Output	NTC 2 +(Top DCB)
19	CS3	Output	IGBT Current Sensor System 3
20	E3	Output	IGBT Emitter Output System 3
21	G3	Input	Gate Input System 3
22	CS2	Output	IGBT Current Sensor System 2
23	E2	Output	IGBT Emitter Output System 2
24	G2	Input	Gate Input System 2
25	CS2	Output	IGBT Current Sensor System 1
26	E1	Output	IGBT Emitter Output System 1
27	G1	Input	Gate Input System 1
28	PS	Output	P Terminal Voltage Sensing (IGBT Collector)

9 Package outlines



10 Label Codes

10.1 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		

10.2 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	2015-07-31	-
V3.0	2016-12-13	final datasheet
V3.1	2019-10-11	Change of ordering code number

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