Click to view price, real time Inventory, Delivery & Lifecycle Information ;

FS400R07A1E3

Infineon Technologies

IGBT Modules

HybridPACK™ 1 Module

FS400R07A1E3

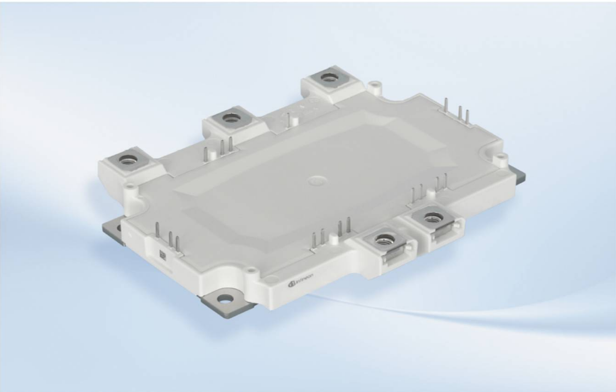
Final Data Sheet

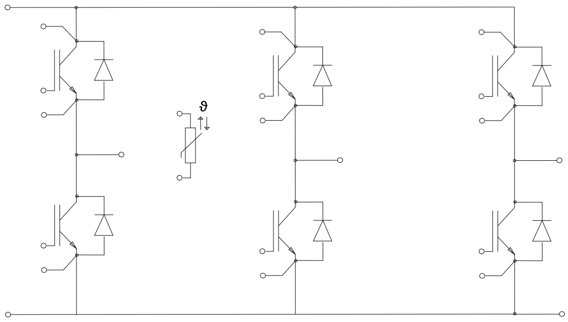
V3.3, 2017-03-07

Automotive High Power

1 Features / Description

HybridPACK™ 1 module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode and NTC





V_{CES} = 650V
$I_{C\ nom}$ = 400A / I_{CRM} = 800A

Typical Applications

- Automotive Applications
- Hybrid Electrical Vehicles (H)EV
- Commercial Agriculture Vehicles
- Motor Drives
- Optimized for automotive applications with DC link voltages up to 420 V

Electrical Features

- Low Switching Losses
- Low V_{CEsat}
- $T_{vj\ op}$ = 150°C
- V_{CEsat} with positive Temperature Coefficient

Mechanical Features

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

Description

Infineon®'s HybridPACK™ 1 is an automotive qualified power module designed for electric vehicle applications for a power range up to 20–30kW. Designed for a 150°C junction operation temperature, the module accommodates a 3-phase Six-Pack configuration of Trench-Field-Stop IGBT3 and matching emitter controlled diodes.

The HybridPACK™ 1 power module is built on Infineon's long time experience in the development of IGBT power modules, intense research efforts of new material combinations and assembly technologies. HybridPACK™ 1 is suitable for air or liquid cooling. The copper base plate combined with high-performance ceramic substrate and Infineon's enhanced wire-bonding process provides unparalleled thermal and power cycling capability and highest reliability for mild hybrid inverter or generator applications. For a compact design the driver stage PCB can easily be soldered on top of the module. All power connections are realized with screw terminals.

Product Name	Ordering Code
FS400R07A1E3	SP000663446

2 IGBT,Inverter

2.1 Maximum Rated Values

Parameter	Conditions	Symbol	Value	Unit
Collector-emitter voltage	$T_{vj} = 25°C$	V_{CES}	650	V
Continuous DC collector current	$T_C = 65°C$, $T_{vj\,max} = 175°C$ $T_C = 25°C$, $T_{vj\,max} = 175°C$	$I_{C\,nom}$ I_C	400 500	A A
Repetitive peak collector current	$t_P = 1$ ms	I_{CRM}	800	A
Total power dissipation	$T_C = 25°C$, $T_{vj\,max} = 175°C$	P_{tot}	1250	W
Gate-emitter peak voltage		V_{GES}	+/-20	V

2.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Collector-emitter saturation voltage	$I_C = 400$ A, $V_{GE} = 15$ V $I_C = 400$ A, $V_{GE} = 15$ V $I_C = 400$ 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	1.90	V
Gate threshold voltage	$I_C = 6.40$ 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		4.30		µC
Internal gate resistor		$T_{vj} = 25°C$	R_{Gint}		1.0		Ω
Input capacitance	f = 1 MHz, $V_{CE} = 25$ V, $V_{GE} = 0$ V	$T_{vj} = 25°C$	C_{ies}		26.0		nF
Reverse transfer capacitance	f = 1 MHz, $V_{CE} = 25$ V, $V_{GE} = 0$ V	$T_{vj} = 25°C$	C_{res}		0.76		nF
Collector-emitter cut-off current	$V_{CE} = 650$ V, $V_{GE} = 0$ V	$T_{vj} = 25°C$	I_{CES}			1.0	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	$I_C = 400$ A, $V_{CE} = 300$ V $V_{GE} = ±15$ V $R_{Gon} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	$t_{d\,on}$		0.10 0.11 0.12		µs
Rise time, inductive load	$I_C = 400$ A, $V_{CE} = 300$ V $V_{GE} = ±15$ V $R_{Gon} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	t_r		0.08 0.08 0.08		µs
Turn-off delay time, inductive load	$I_C = 400$ A, $V_{CE} = 300$ V $V_{GE} = ±15$ V $R_{Goff} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	$t_{d\,off}$		0.46 0.50 0.50		µs
Fall time, inductive load	$I_C = 400$ A, $V_{CE} = 300$ V $V_{GE} = ±15$ V $R_{Goff} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	t_f		0.05 0.07 0.08		µs
Turn-on energy loss per pulse	$I_C = 400$ A, $V_{CE} = 300$ V, $L_S = 25$ nH $V_{GE} = ±15$ V, di/dt = 5500 A/µs ($T_{vj} = 150°C$) $R_{Gon} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	E_{on}		2.90 4.20 4.50		mJ
Turn-off energy loss per pulse	$I_C = 400$ A, $V_{CE} = 300$ V, $L_S = 25$ nH $V_{GE} = ±15$ V, du/dt = 3000 V/µs ($T_{vj} = 150°C$) $R_{Goff} = 1.8$ Ω	$T_{vj} = 25°C$ $T_{vj} = 125°C$ $T_{vj} = 150°C$	E_{off}		13.0 16.0 17.0		mJ
SC data	$V_{GE} \leq 15$ V, $V_{CC} = 360$ V $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 8$ µs, $T_{vj} = 25°C$ $t_P \leq 6$ µs, $T_{vj} = 150°C$	I_{SC}		2800 2000		A
Thermal resistance, junction to case	per IGBT		R_{thJC}			0.120	K/W
Thermal resistance, case to heatsink	per IGBT $\lambda_{Paste} = 1$ W/(m·K) / $\lambda_{grease} = 1$ W/(m·K)		R_{thCH}		0.0800		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}	650	V
Continuous DC forward current		I_F	400	A
Repetitive peak forward current	t_P = 1 ms	I_{FRM}	800	A
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	8800 8500	A^2s A^2s

3.2 Characteristic Values

Parameter	Conditions		Symbol	min.	typ.	max.	Unit
Forward voltage	I_F = 400 A, V_{GE} = 0 V I_F = 400 A, V_{GE} = 0 V I_F = 400 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	1.95	V
Peak reverse recovery current	I_F = 400 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}		210 280 300		A
Recovered charge	I_F = 400 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		18.0 30.0 34.0		µC
Reverse recovery energy	I_F = 400 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}		3.60 7.25 8.30		mJ
Thermal resistance, junction to case	per diode		R_{thJC}			0.200	K/W
Thermal resistance, case to heatsink	per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0.0850		K/W
Temperature under switching conditions	t_{op} continuous		$T_{vj\,op}$	-40		150	°C

4 NTC-Thermistor

Parameter	Conditions	Symbol	min.	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.

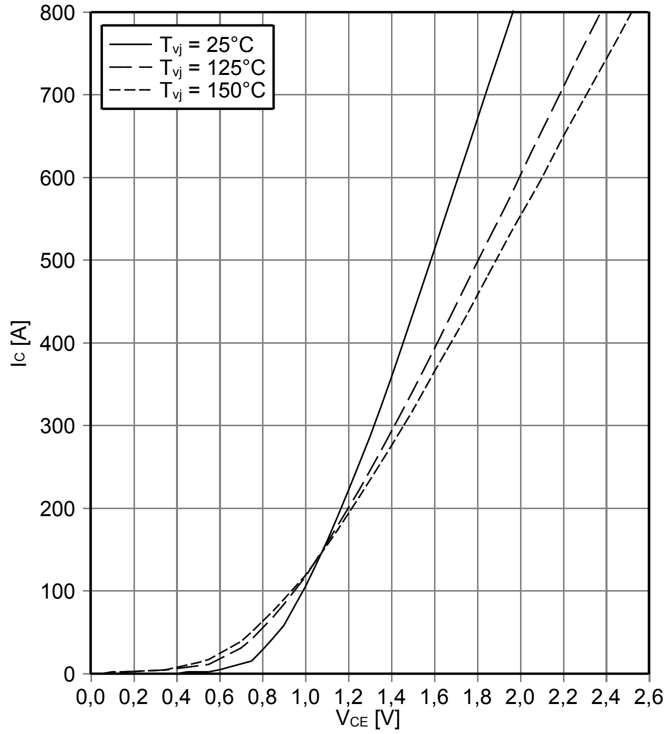
5 Module

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}		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}		30		nH
Module lead resistance, terminals - chip	T_C = 25 °C, per switch	$R_{CC'+EE'}$		1.00		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		485		g

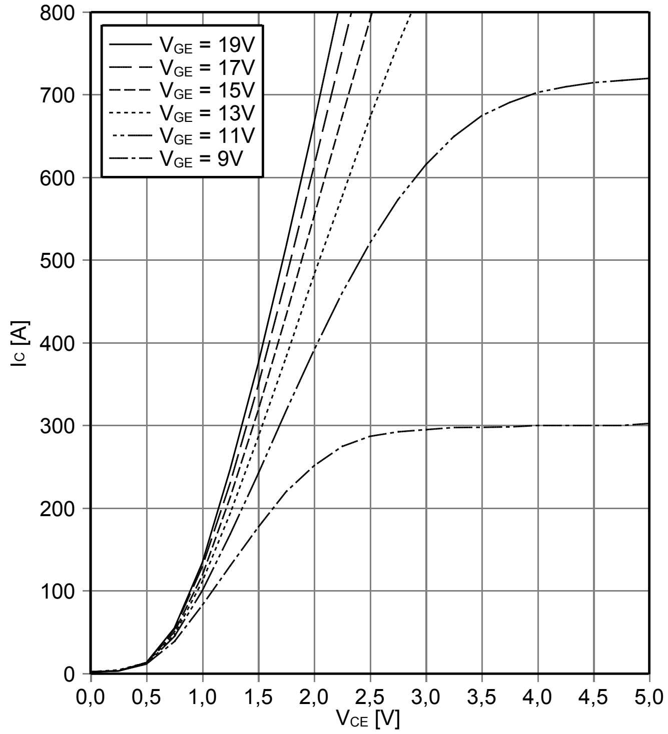
Der Kollektor-Dauergleichstrom / Dioden-Dauergleichstrom ist durch die Lastanschlüsse begrenzt.
DC-collector current / diode forward current limited by power terminals.

6 Characteristics Diagrams

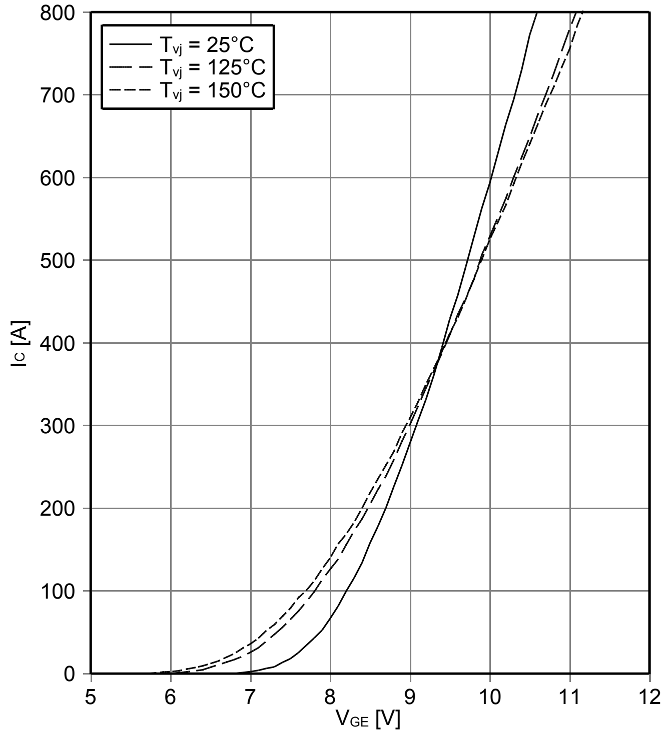
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



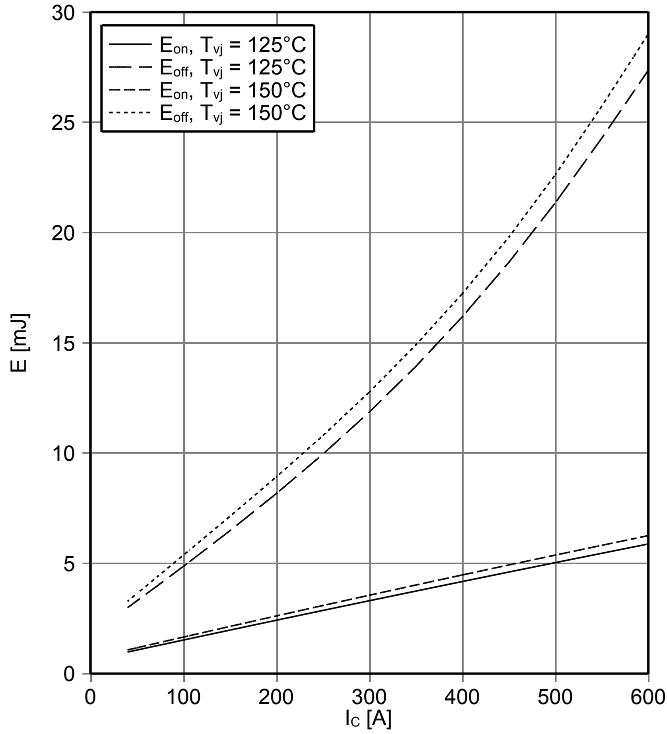
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



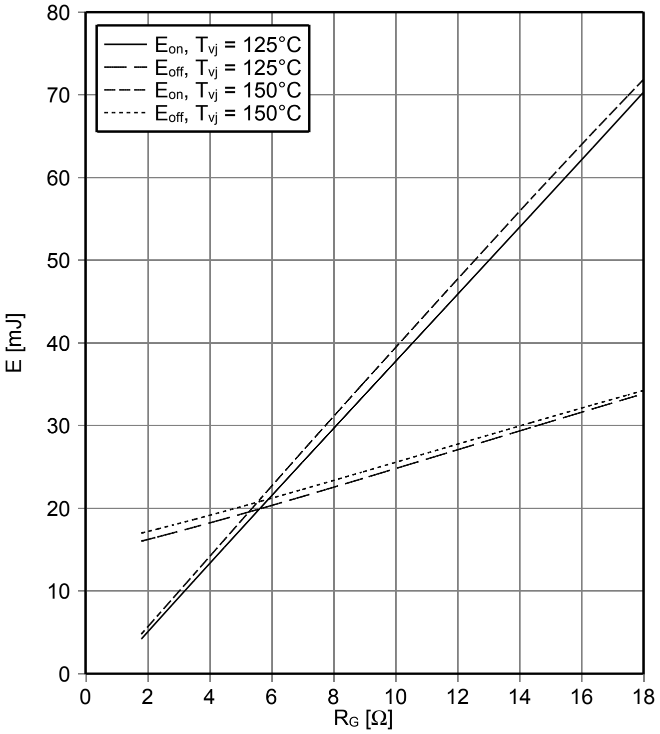
transfer characteristic IGBT,Inverter (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



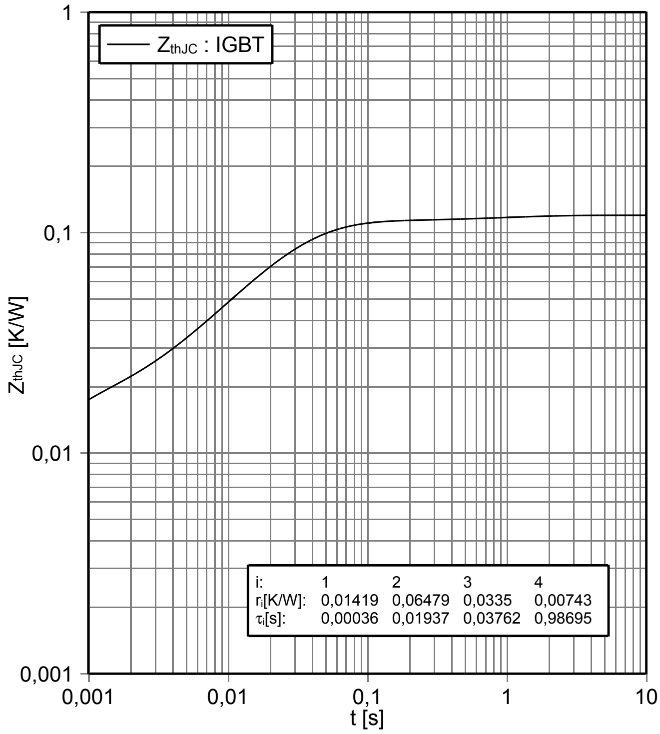
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm 15$ V, $R_{Gon} = 1.8\ \Omega$, $R_{Goff} = 1.8\ \Omega$, $V_{CE} = 300$ V



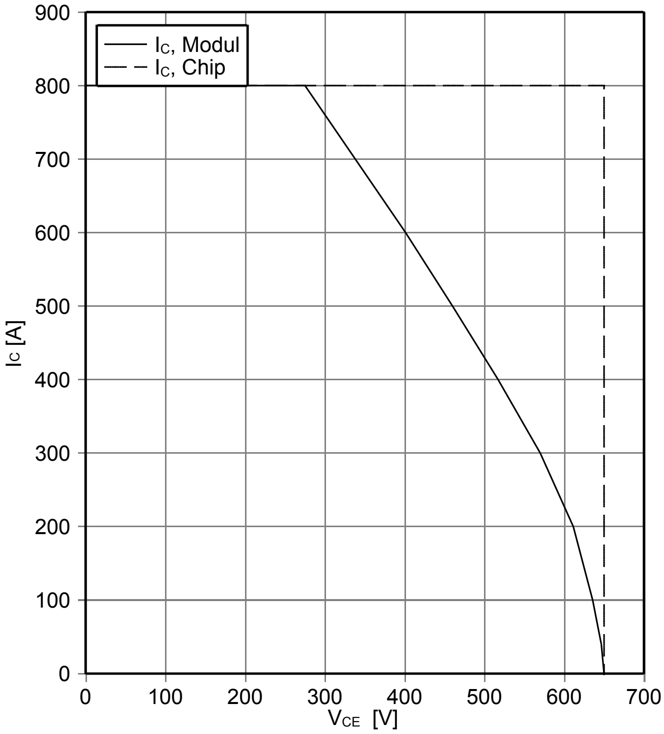
switching losses IGBT,Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = ±15 V, I_C = 400 A, V_{CE} = 300 V



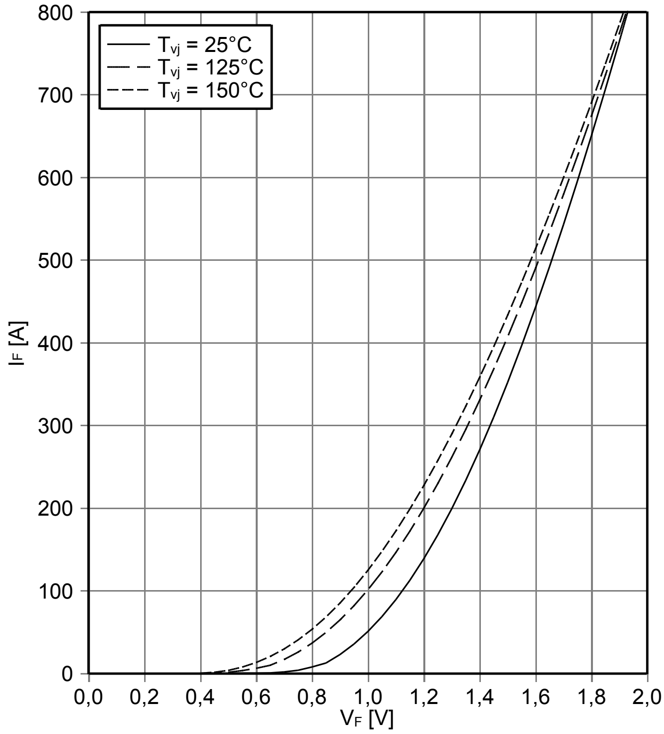
transient thermal impedance IGBT,Inverter
Z_{thJC} = f (t)



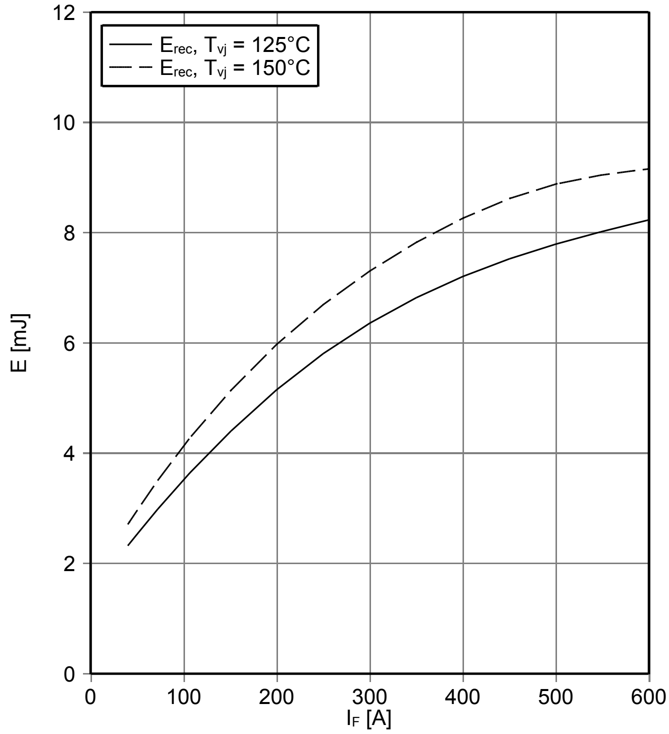
reverse bias safe operating area IGBT,Inverter (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 1.8 Ω, T_{vj} = 150°C



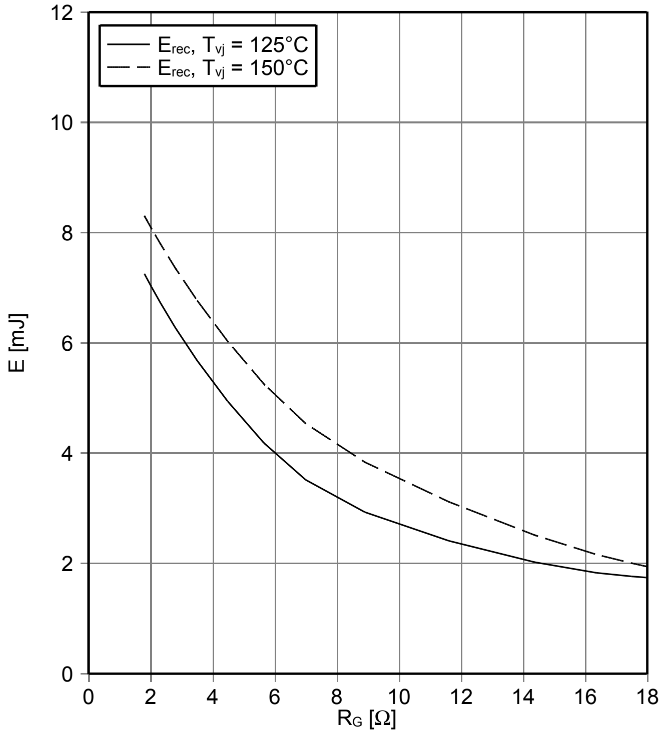
forward characteristic of Diode, Inverter (typical)
I_F = f (V_F)



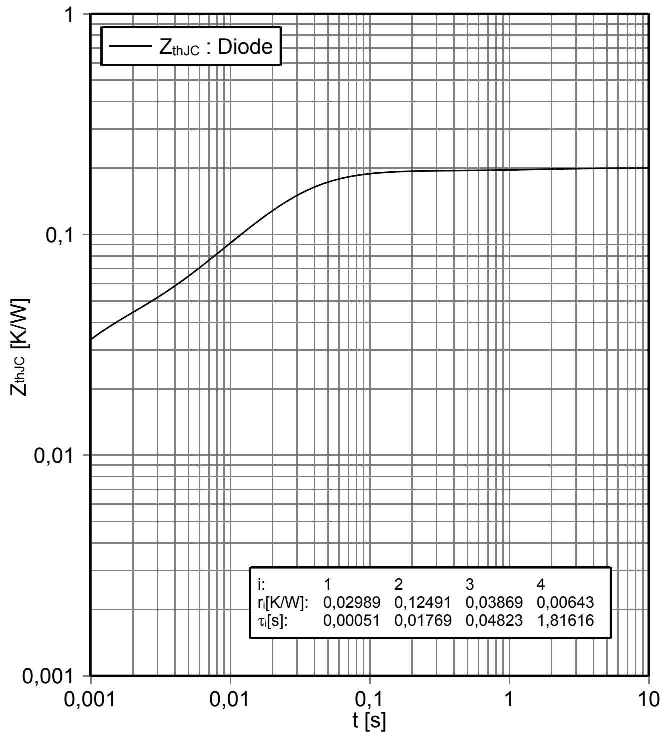
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 1.8\ \Omega$, $V_{CE} = 300$ V



switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 400$ A, $V_{CE} = 300$ V

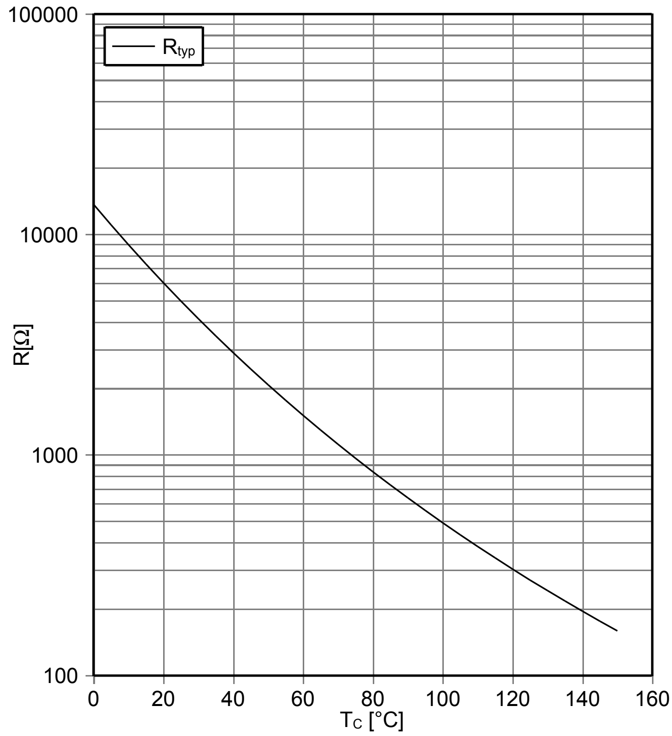


transient thermal impedance Diode, Inverter
$Z_{thJC} = f(t)$

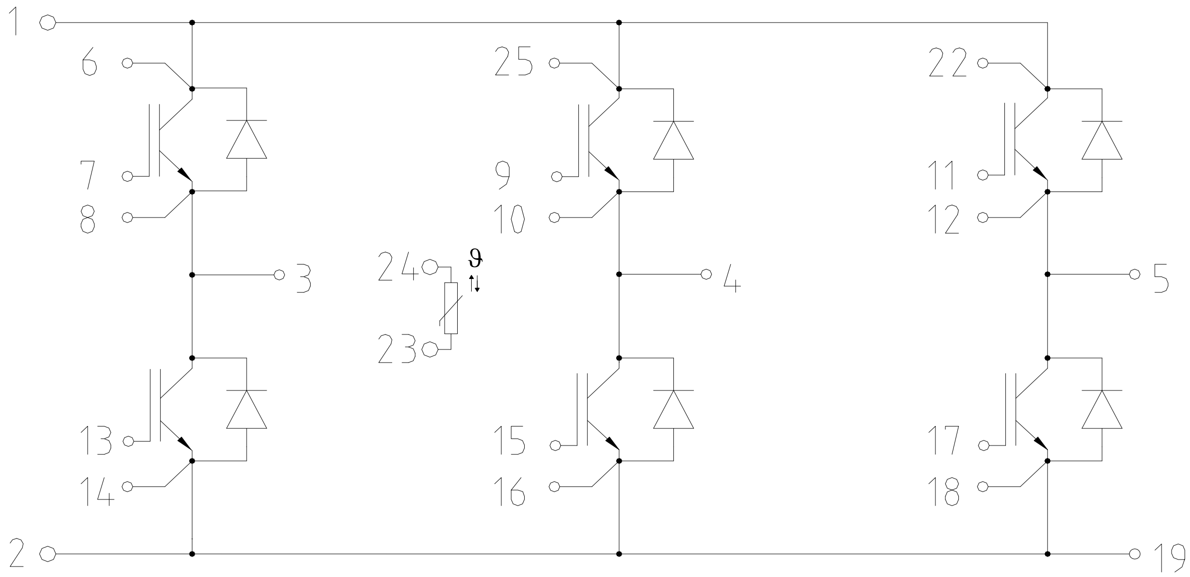


i:	1	2	3	4
r_i[K/W]:	0,02989	0,12491	0,03869	0,00643
τ_i[s]:	0,00051	0,01769	0,04823	1,81616

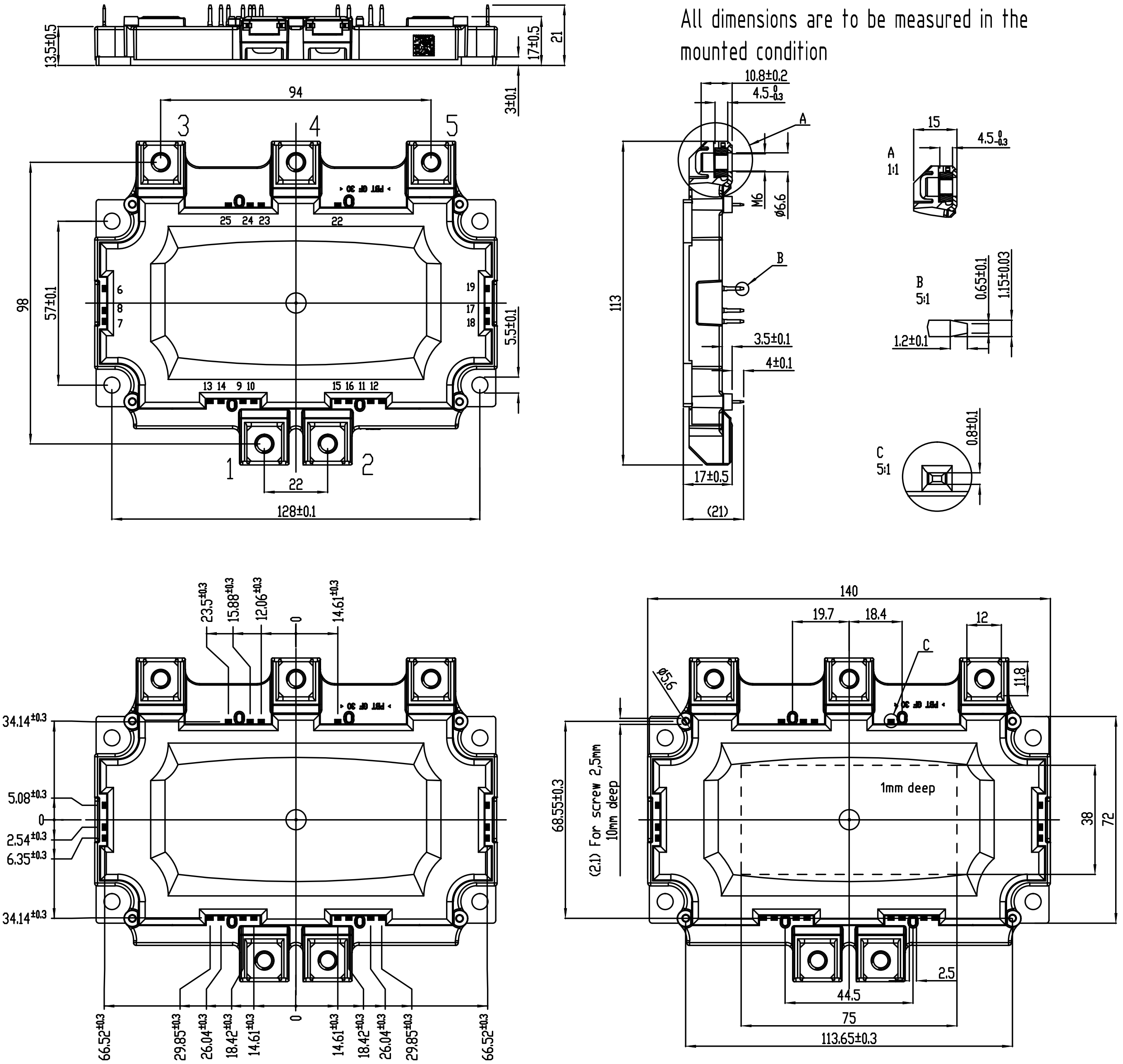
NTC-Thermistor-temperature characteristic (typical)
$R = f(T)$



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	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	2009-08-26	Initial Version
V1.1	2009-10-14	target data
V2.0	2009-11-19	preliminary data
V3.0	2010-04-21	final data
V3.1	2012-02-29	final data
V3.2	2016-11-08	new datasheet format
V3.3	2017-03-07	-

Terms & Conditions of usage

Edition 2014-05-30

Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer
The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information
For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (http://www.infineon.com)

Warnings
Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.
Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

Trademarks

Trademarks of Infineon Technologies AG

AURIX™, C166™, CanPAK™, CIPOS™, CIPURSE™, EconoPACK™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPIM™, EconoPACK™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, I²RF™, ISOFACE™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OptiMOS™, ORIGA™, POWERCODE™, PRIMARION™, PrimePACK™, PrimeSTACK™, PRO-SIL™, PROFET™, RASIC™, ReverSave™, SatRIC™, SIEGET™, SINDRION™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Other Trademarks

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, KEIL™, PRIMECELL™, REALVIEW™, THUMB™, µVision™ of ARM Limited, UK. AUTOSAR™ is licensed by AUTOSAR development partnership. Bluetooth™ of Bluetooth SIG Inc. CAT-iq™ of DECT Forum. COLOSSUS™, FirstGPS™ of Trimble Navigation Ltd. EMV™ of EMVCo, LLC (Visa Holdings Inc.). EPCOS™ of Epcos AG. FLEXGO™ of Microsoft Corporation. FlexRay™ is licensed by FlexRay Consortium. HYPERTERMINAL™ of Hilgraeve Incorporated. IEC™ of Commission Electrotechnique Internationale. IrDA™ of Infrared Data Association Corporation. ISO™ of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB™ of MathWorks, Inc. MAXIM™ of Maxim Integrated Products, Inc. MICROTEC™, NUCLEUS™ of Mentor Graphics Corporation. MIPI™ of MIPI Alliance, Inc. MIPS™ of MIPS Technologies, Inc., USA. muRata™ of MURATA MANUFACTURING CO., MICROWAVE OFFICE™ (MWO) of Applied Wave Research Inc., OmniVision™ of OmniVision Technologies, Inc. Openwave™ Openwave Systems Inc. RED HAT™ Red Hat, Inc. RFMD™ RF Micro Devices, Inc. SIRIUS™ of Sirius Satellite Radio Inc. SOLARIS™ of Sun Microsystems, Inc. SPANSION™ of Spansion LLC Ltd. Symbian™ of Symbian Software Limited. TAIYO YUDEN™ of Taiyo Yuden Co. TEAKLITE™ of CEVA, Inc. TEKTRONIX™ of Tektronix Inc. TOKO™ of TOKO KABUSHIKI KAISHA TA. UNIX™ of X/Open Company Limited. VERILOG™, PALLADIUM™ of Cadence Design Systems, Inc. VLYNQ™ of Texas Instruments Incorporated. VXWORKS™, WIND RIVER™ of WIND RIVER SYSTEMS, INC. ZETEX™ of Diodes Zetex Limited.

Last update	2011-11-11

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG