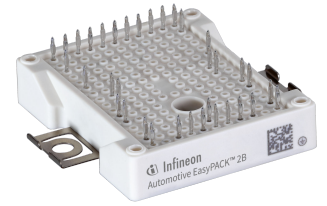


## EasyPACK™ module with EDT2 IGBT and diode and PressFIT / NTC

### Features

- Electrical features
  - Blocking voltage 750 V
  - Low  $V_{CE,sat}$
  - Low switching losses
  - Low  $Q_g$  and  $C_{rSS}$
  - Low inductive design
  - $T_{vj,op} = 150^\circ\text{C}$
- Mechanical features
  - 4.2 kV DC 1 second insulation
  - High creepage and clearance distances
  - High power density
  - Integrated NTC temperature sensor
  - PressFIT contact technology
  - RoHS compliant
  - UL 94 V0 module frame



### Potential applications

- Automotive applications
- (Hybrid) electrical vehicles (H)EV
- Motor drives

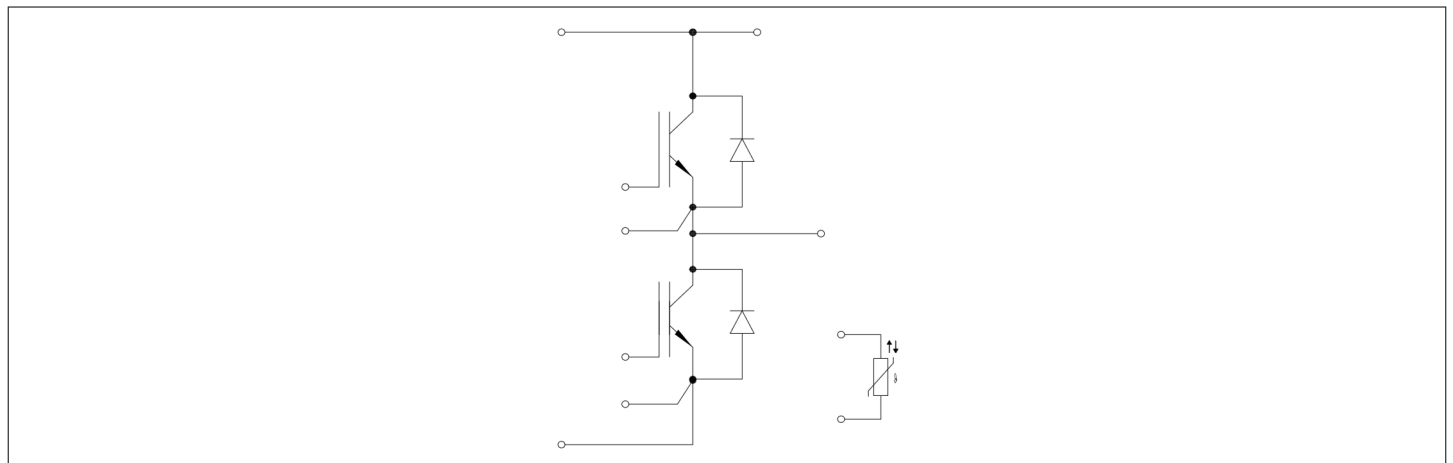
### Product validation

- Qualified according to AQG 324

### Description

The FF300R08W2P2\_B11A is a very compact and flexible product offering integrated isolation for the main inverter of hybrid and electric vehicles. The module uses the benchmark EDT2 IGBT generation allowing 750V blocking voltage and  $I_{cN}$  of 300A. The chipset has benchmark current density combined with short circuit ruggedness for reliable inverter operation under harsh environmental conditions. The EDT2 IGBTs also show excellent light load power losses, which helps to improve system efficiency over a real driving cycle. The EDT2 IGBT was optimized for applications with switching frequencies in the range of 10 kHz. The EasyPACK™ package is qualified for automotive applications and is validated according to AQG 324. Its high power cycling capability as well as the high creepage and clearance distances add to the product reliability.

The power module comes with PressFIT Pins for the signal terminals to avoid additional time consuming selective solder processes, which provides cost savings on system level and increases system reliability.



Type	Package	Marking
FF300R08W2P2_B11A	EasyPACK™ 2B Module	SP005424885

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1 Package

## 1 Package

**Table 1** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Maximum RMS module DC-terminal current <sup>1)</sup>	$I_{t,rms}$	$T_{terminal} = 105\text{ °C}$ , $T_c = 65\text{ °C}$	25	A

1)  $I_{tRMS}$ : Current per pin, continuous, steady state. Verified by characterization / design not by test

**Table 2** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$		4.2	kV
Internal isolation		basic insulation (class 1, IEC 61140)	$Al_2O_3$	
Creepage distance	$d_{creep}$	terminal to heatsink	11.5	mm
Creepage distance	$d_{creep}$	terminal to terminal	6.3	mm
Clearance	$d_{clear}$	terminal to heatsink	10.0	mm
Clearance	$d_{clear}$	terminal to terminal	5.0	mm
Comparative tracking index	$CTI$		> 200	

**Table 3** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	$L_{s,CE}$			8.0		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T = 25\text{ °C}$ , per switch		4.00		mΩ
Storage temperature	$T_{stg}$		-40		125	°C
Weight	$G$			41		g

## 2 IGBT, Inverter

**Table 4** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	$V_{CES}$	$T_{vj} = 25\text{ °C}$	750	V
Implemented collector current	$I_{CN}$		300	A
Continuous DC collector current	$I_{C,nom}$	$T_{vj,max} = 150\text{ °C}$ $T_h = 65\text{ °C}$	200	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1\text{ ms}$	600	A
Gate-emitter peak voltage	$V_{GES}$		±20	V

**Table 5** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	$V_{CE,sat}$	$I_C = 200\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$	1.00	1.18	V	
			$T_{vj} = 125\text{ °C}$	0.99			
			$T_{vj} = 150\text{ °C}$	0.98			
Gate threshold voltage	$V_{GE,th}$	$I_C = 6.4\text{ mA}, V_{CE} = V_{GE}$	$T_{vj} = 25\text{ °C}$	4.9	5.8	6.5	V
Gate charge	$Q_G$	$V_{GE} = 15\text{ V}, V_{CE} = 400\text{ V}$		2.9			$\mu\text{C}$
Internal gate resistor	$R_{G,int}$		$T_{vj} = 25\text{ °C}$	1.1			$\Omega$
Input capacitance	$C_{ies}$	$f = 1\text{ MHz}, V_{CE} = 50\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	53.0			nF
Output capacitance	$C_{oes}$	$f = 1\text{ MHz}, V_{CE} = 50\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	0.7			nF
Reverse transfer capacitance	$C_{res}$	$f = 1\text{ MHz}, V_{CE} = 50\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$	0.20			nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 750\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			1.0	mA
Gate-emitter leakage current	$I_{GES}$	$V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			10	nA
Turn-on delay time, inductive load	$t_{d,on}$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}, R_{G,on} = 2.4\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.21		$\mu\text{s}$	
			$T_{vj} = 125\text{ °C}$	0.23			
			$T_{vj} = 150\text{ °C}$	0.24			
Rise time, inductive load	$t_r$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}, R_{G,on} = 2.4\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.03		$\mu\text{s}$	
			$T_{vj} = 125\text{ °C}$	0.04			
			$T_{vj} = 150\text{ °C}$	0.04			
Turn-off delay time, inductive load	$t_{d,off}$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}, R_{G,off} = 5.1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.70		$\mu\text{s}$	
			$T_{vj} = 125\text{ °C}$	0.80			
			$T_{vj} = 150\text{ °C}$	0.80			
Fall time, inductive load	$t_f$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}, R_{G,off} = 5.1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	0.06		$\mu\text{s}$	
			$T_{vj} = 125\text{ °C}$	0.10			
			$T_{vj} = 150\text{ °C}$	0.10			
Turn-on energy loss per pulse	$E_{on}$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, L_\sigma = 20\text{ nH}, V_{GE} = 15\text{ V}, R_{G,on} = 2.4\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	4.4		mJ	
			$T_{vj} = 125\text{ °C}$	7.0			
			$T_{vj} = 150\text{ °C}, di/dt = 6360\text{ A}/\mu\text{s}$	7.6			
Turn-off energy loss per pulse	$E_{off}$	$I_C = 200\text{ A}, V_{CE} = 400\text{ V}, L_\sigma = 20\text{ nH}, V_{GE} = 15\text{ V}, R_{G,off} = 5.1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$	7.3		mJ	
			$T_{vj} = 125\text{ °C}$	10.7			
			$T_{vj} = 150\text{ °C}, du/dt = 2530\text{ V}/\mu\text{s}$	11.5			

**Table 5** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
SC data	$I_{SC}$	$V_{CC} = 400\text{ V}, V_{GE} = 15\text{ V}$	$t_p \leq 6.0\ \mu\text{s},$ $T_{vj} = 25\text{ }^\circ\text{C}$		3800		A
			$t_p \leq 4.0\ \mu\text{s},$ $T_{vj} = 150\text{ }^\circ\text{C}$		3000		
Thermal resistance, junction to case	$R_{th,j-c}$	per IGBT		0.09		K/W	
Thermal resistance, junction to heatsink	$R_{th,j-h}$	per IGBT, $\lambda_{paste} = 3\text{ W}/(\text{m}^2\text{K}) / \lambda_{grease} = 3\text{ W}/(\text{m}^2\text{K})$		0.25		K/W	
Temperature under switching conditions	$T_{vj,op}$		-40		150	$^\circ\text{C}$	

### 3 Diode, Inverter

**Table 6** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25\text{ }^\circ\text{C}$	750	V	
Implemented forward current	$I_{FN}$		300	A	
Continuous DC forward current	$I_{F,nom}$		200	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	600	A	
$I^2t$ - value	$I^2t$	$V_R = 400\text{ V}, t_p = 50\text{ ms}$	$T_{vj} = 125\text{ }^\circ\text{C}$	15770	$\text{A}^2\text{s}$
			$T_{vj} = 150\text{ }^\circ\text{C}$	13180	

**Table 7** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 200\text{ A}$	$T_{vj} = 25\text{ }^\circ\text{C}$		1.30	1.47	V
			$T_{vj} = 125\text{ }^\circ\text{C}$		1.20		
			$T_{vj} = 150\text{ }^\circ\text{C}$		1.15		
Peak reverse recovery current	$I_{rm}$	$I_F = 200\text{ A}, V_{CE} = 400\text{ V}, V_{GE} = -8\text{ V}$	$T_{vj} = 25\text{ }^\circ\text{C}$		200		A
			$T_{vj} = 125\text{ }^\circ\text{C}$		294		
			$T_{vj} = 150\text{ }^\circ\text{C},$ $-di_F/dt = 7250\text{ A}/\mu\text{s}$		321		

**Table 7** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Recovered charge	$Q_r$	$I_F = 200 \text{ A}, V_{CE} = 400 \text{ V}, V_{GE} = -8 \text{ V}$	$T_{vj} = 25 \text{ }^\circ\text{C}$	11.0		$\mu\text{C}$
			$T_{vj} = 125 \text{ }^\circ\text{C}$	24.0		
			$T_{vj} = 150 \text{ }^\circ\text{C}, -di_F/dt = 7250 \text{ A}/\mu\text{s}$	29.0		
Reverse recovery energy	$E_{rec}$	$I_F = 200 \text{ A}, V_{CE} = 400 \text{ V}, V_{GE} = -8 \text{ V}, R_G = 2.4 \text{ } \Omega$	$T_{vj} = 25 \text{ }^\circ\text{C}$	3.34		mJ
			$T_{vj} = 125 \text{ }^\circ\text{C}$	7.02		
			$T_{vj} = 150 \text{ }^\circ\text{C}, -di_F/dt = 7250 \text{ A}/\mu\text{s}$	8.51		
Thermal resistance, junction to case	$R_{th,j-c}$	per diode		0.17		K/W
Thermal resistance, junction to heatsink	$R_{th,j-h}$	per diode, $\lambda_{paste} = 3 \text{ W}/(\text{m}^*\text{K}) / \lambda_{grease} = 3 \text{ W}/(\text{m}^*\text{K})$		0.36		K/W
Temperature under switching conditions	$T_{vj,op}$		-40		150	$^\circ\text{C}$

## 4 NTC-Thermistor

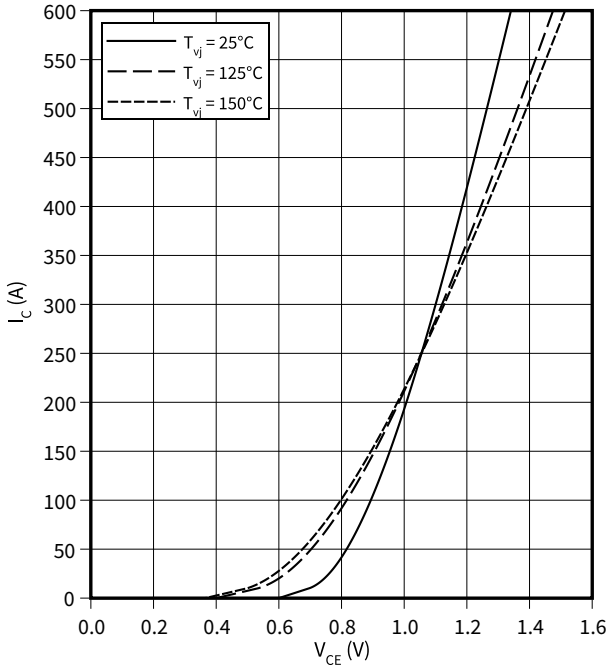
**Table 8** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	$R_{25}$	$T_{NTC} = 25 \text{ }^\circ\text{C}$		5		k $\Omega$
Deviation of $R_{100}$	$\Delta R/R$	$T_{NTC} = 100 \text{ }^\circ\text{C}, R_{100} = 493 \text{ } \Omega$	-5		5	%
Power dissipation	$P_{25}$	$T_{NTC} = 25 \text{ }^\circ\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$		3433		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$		3411		K

## 5 Characteristics diagrams

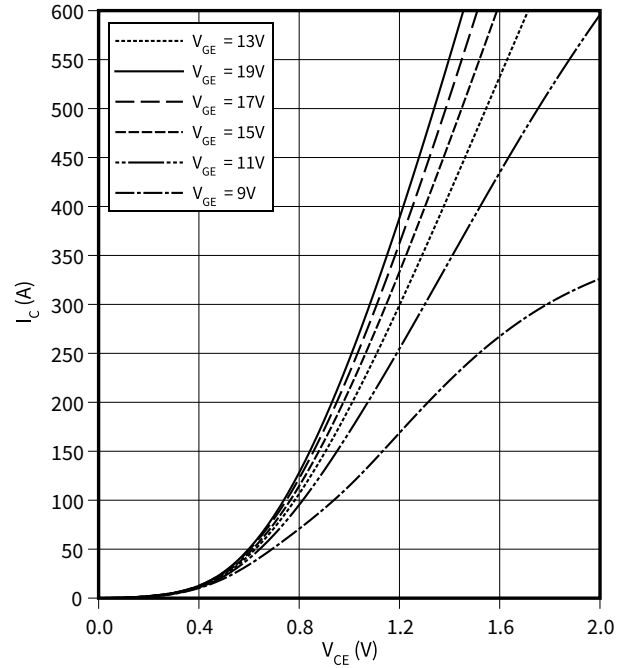
### output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$   
 $V_{GE} = -8\text{ V} / +15\text{ V}$



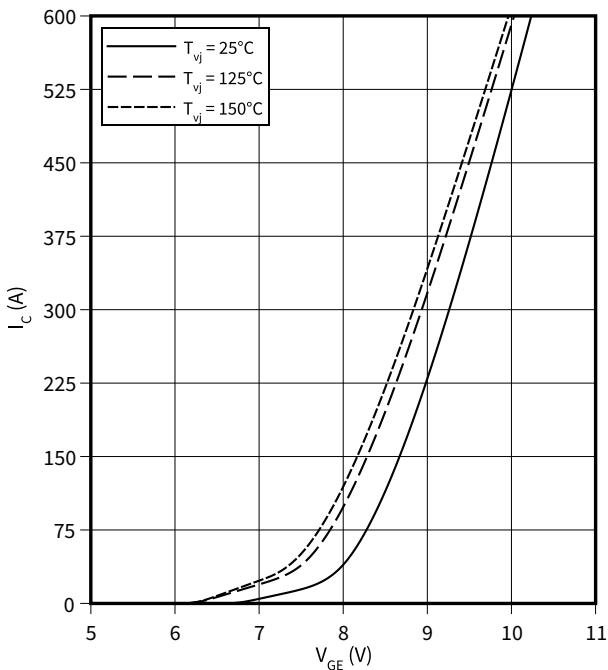
### output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$   
 $T_{vj} = 25^\circ\text{C}$



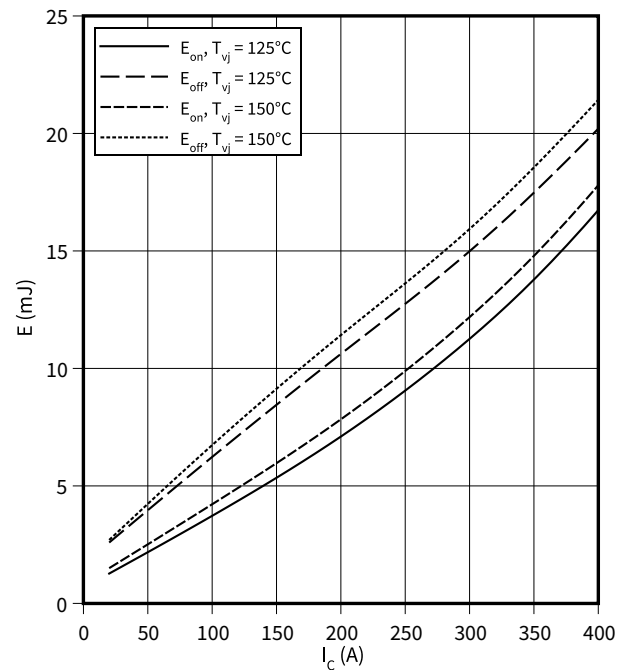
### transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$   
 $V_{CE} = 20\text{ V}$



### switching losses (typical), IGBT, Inverter

$E = f(I_C)$   
 $R_{G,off} = 5.1\ \Omega$ ,  $R_{G,on} = 2.4\ \Omega$ ,  $V_{CE} = 400\text{ V}$ ,  $V_{GE} = -8\text{ V} / +15\text{ V}$

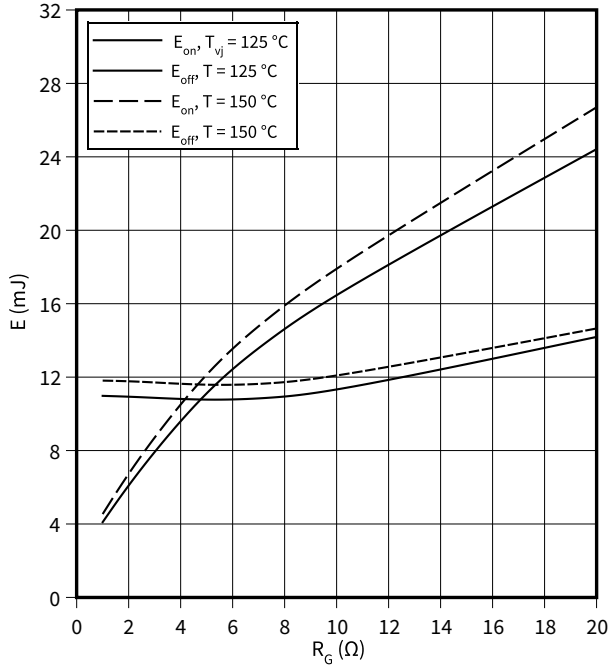


5 Characteristics diagrams

**Switching losses (typical), IGBT, Inverter**

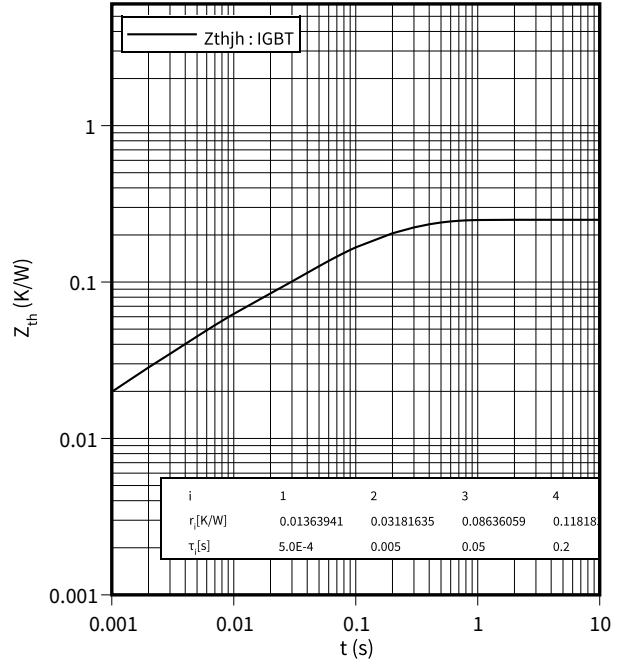
$E = f(R_G)$

$V_{CE} = 400\text{ V}, V_{GE} = -8\text{ V} / +15\text{ V}, I_C = 200\text{ A}$



**transient thermal impedance, IGBT, Inverter**

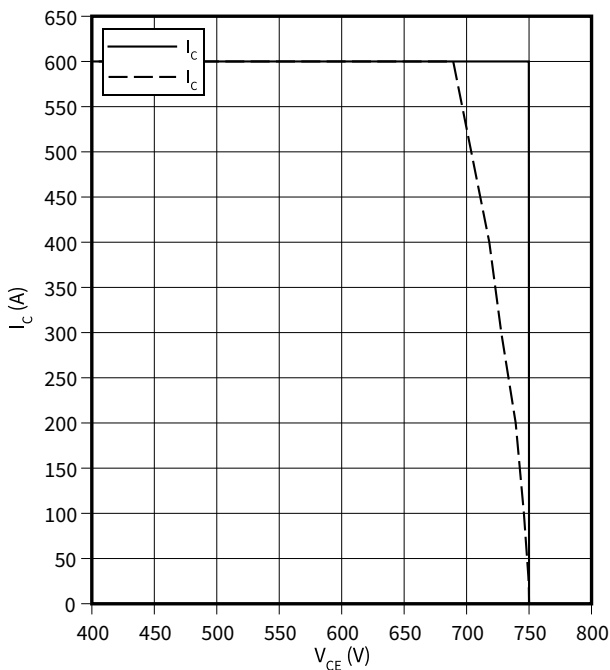
$Z_{th} = f(t)$



**Reverse bias safe operating area (RBSOA), IGBT, Inverter**

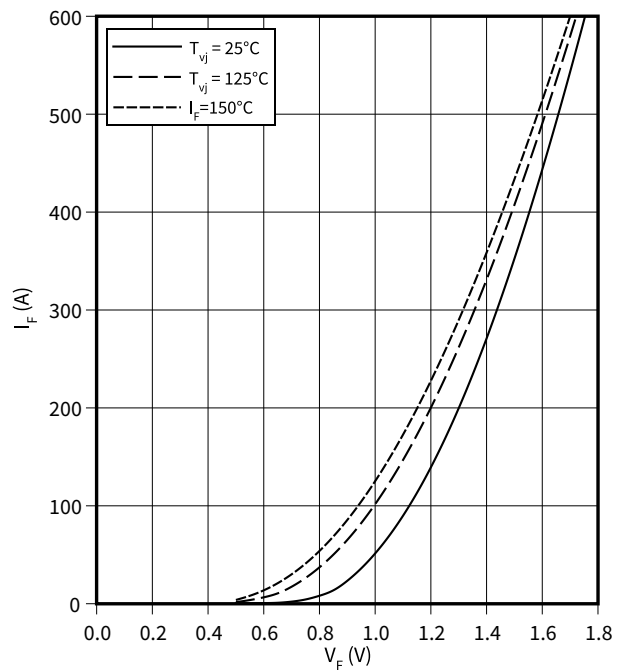
$I_C = f(V_{CE})$

$T_{vj} = 150\text{ °C}, R_{G,off} = 5.1\text{ } \Omega, V_{GE} = -8\text{ V} / +15\text{ V}$



**forward characteristic of (typical), Diode, Inverter**

$I_F = f(V_F)$



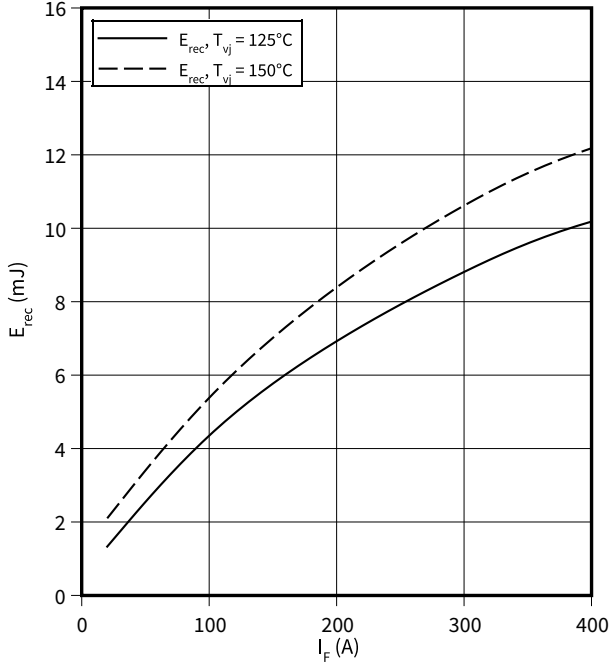


5 Characteristics diagrams

**switching losses (typical), Diode, Inverter**

$E_{rec} = f(I_F)$

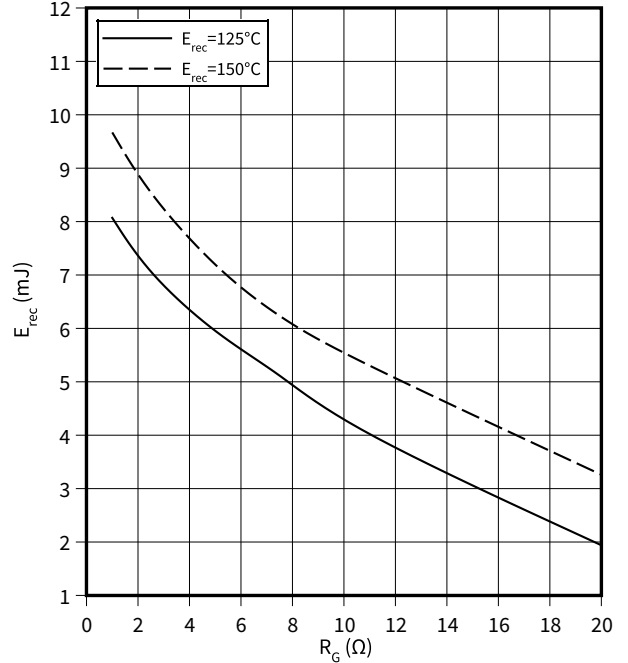
$R_{Gon} = R_{Gon}(IGBT), V_{CE} = 400 V$



**Switching losses (typical), Diode, Inverter**

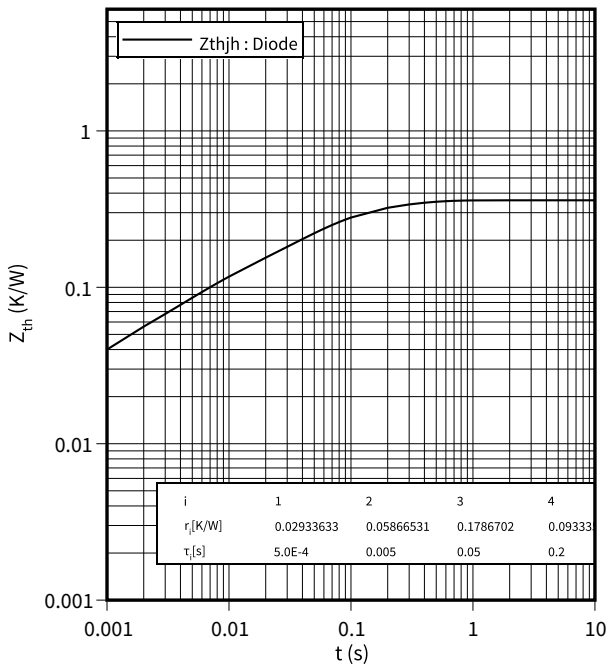
$E_{rec} = f(R_G)$

$V_{CE} = 400 V, I_F = 200 A$



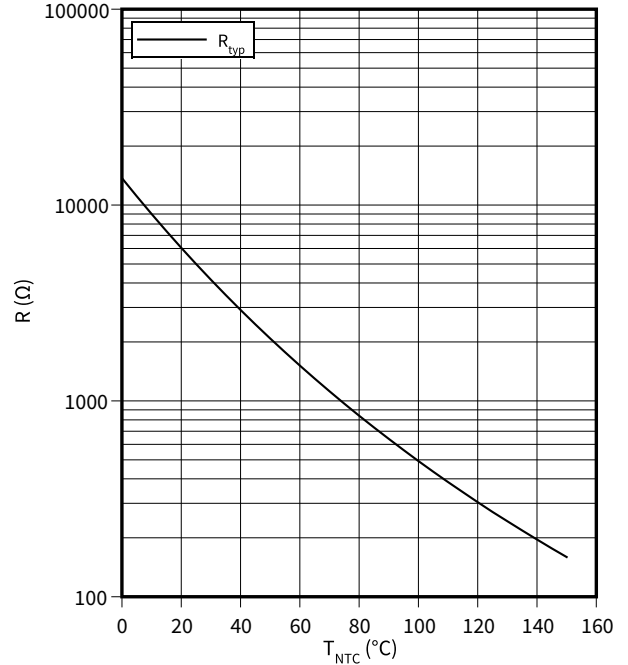
**transient thermal impedance , Diode, Inverter**

$Z_{th} = f(t)$



**temperature characteristic (typical), NTC-Thermistor**

$R = f(T_{NTC})$



## 6 Circuit diagram

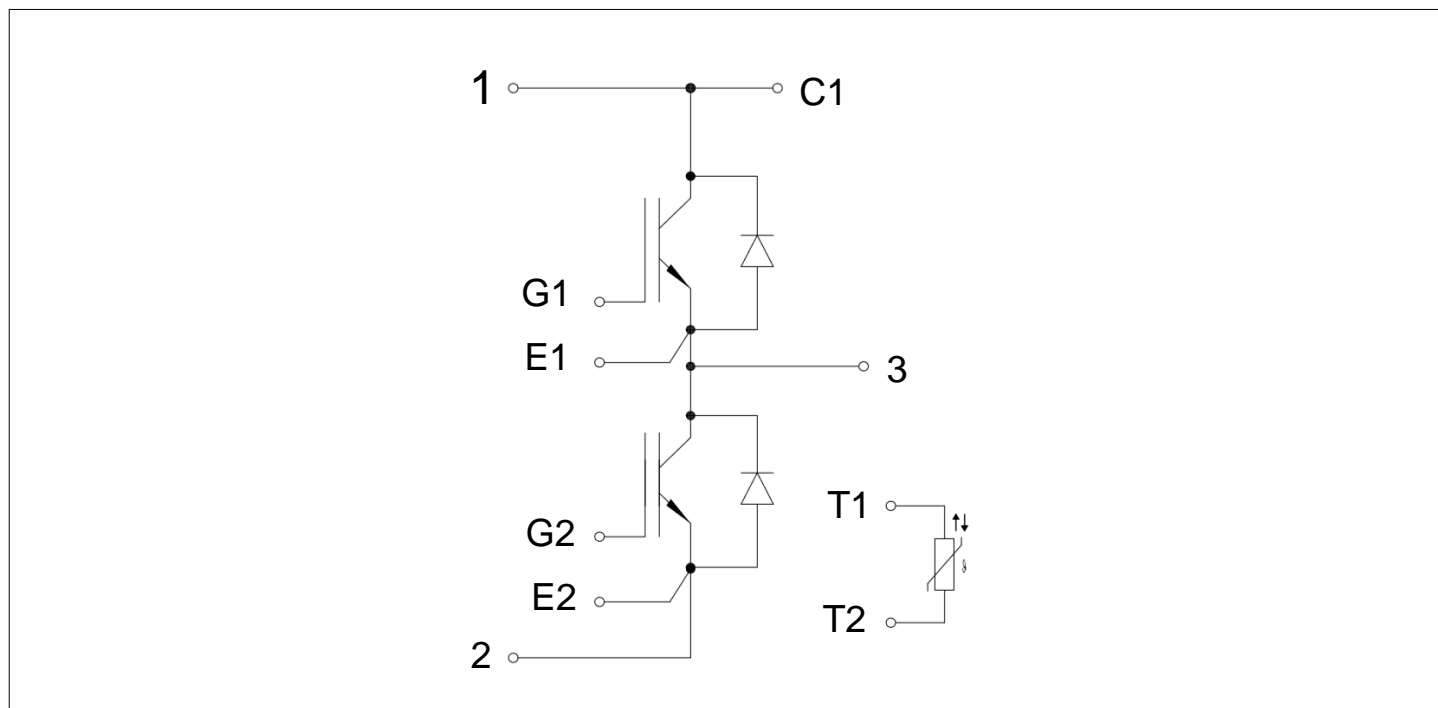


Figure 2

7 Package outlines

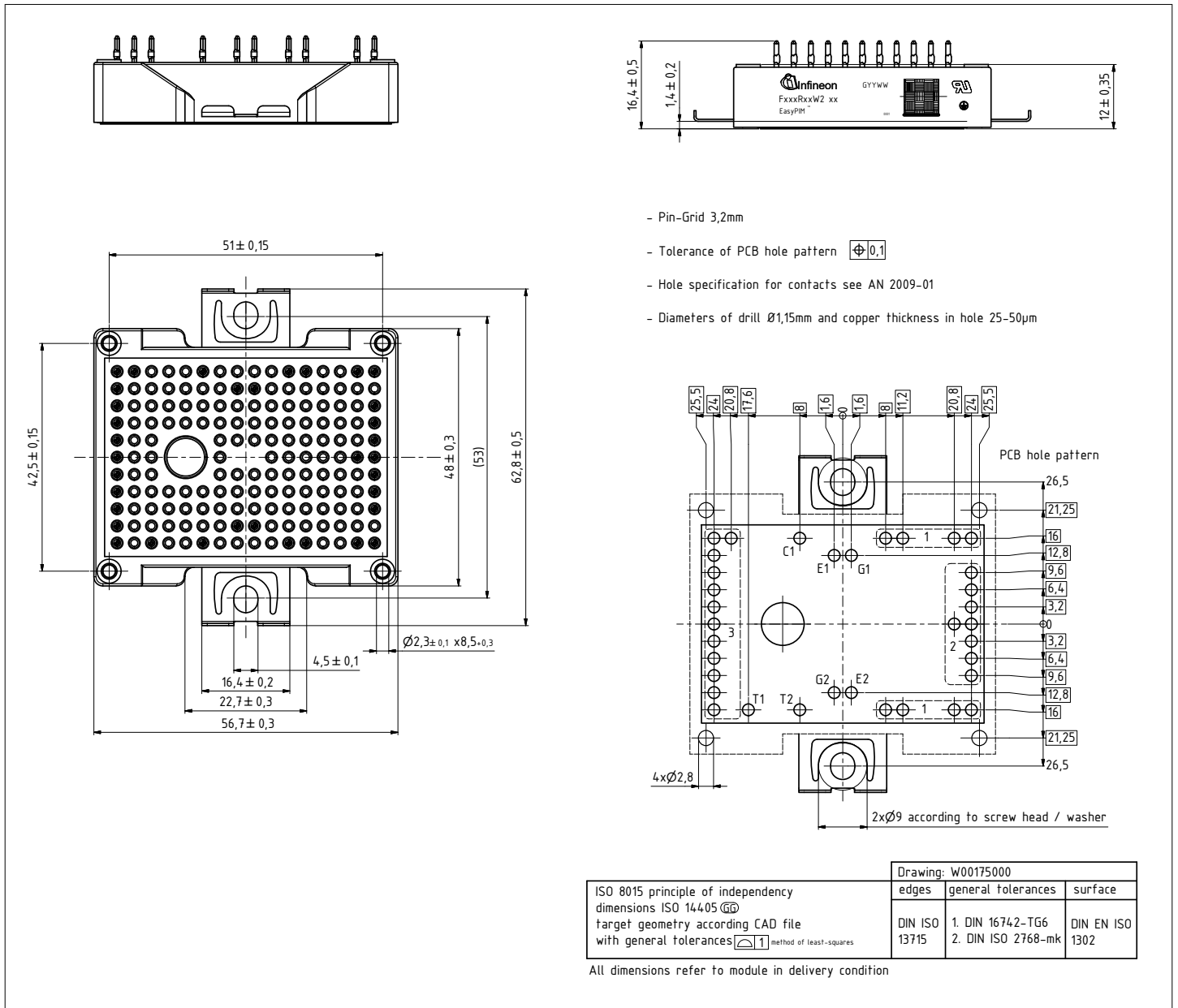


Figure 3

## 8 Module label code


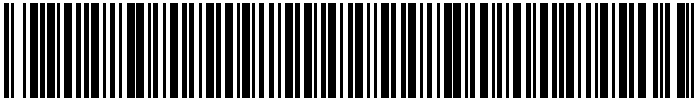
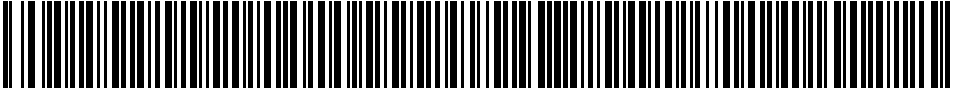
Module label code				
Code format	Data Matrix	Barcode Code128		
Encoding	ASCII text	Code Set A		
Symbol size	16x16	23 digits		
Standard	IEC24720 and IEC16022	IEC8859-1		
Code content	<i>Content</i>	<i>Digit</i>	<i>Example</i>	
	Module serial number	1 - 5	71549	
	Module material number	6 - 11	142846	
	Production order number	12 - 19	55054991	
	Date code (production year)	20 - 21	15	
	Date code (production week)	22 - 23	30	
Example	 71549142846550549911530		 71549142846550549911530	
Packing label code				
Code format	Barcode Code128			
Encoding	Code Set A			
Symbol size	34 digits			
Standard	IEC8859-1			
Code content	<i>Content</i>	<i>Identifier</i>	<i>Digit</i>	<i>Example</i>
	Module serial number	X	2 - 9	95056609
	Module material number	1T	12 - 19	2X0003E0
	Production order number	S	21 - 25	754389
	Date code (production year)	9D	28 - 31	1139
	Date code (production week)	Q	33 - 34	15
Example	 X950566091T2X0003E0S754389D1139Q15			

Figure 4

---

Revision history

## Revision history

<b>Document revision</b>	<b>Date of release</b>	<b>Description of changes</b>
V1.0	2020-07-24	Target Datasheet
1.00	2021-07-29	Final datasheet
1.01	2021-09-13	Layout correction

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**Document reference**

**IFX-AAK248-003**

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