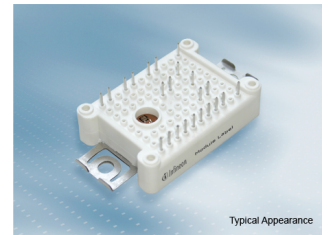


## Preliminary datasheet

### EasyPIM™ module with TRENCHSTOP™ IGBT7 and Emitter Controlled 7 diode and NTC

#### Features

- Electrical features
  - Low  $V_{CEsat}$
  - Overload operation up to 175°C
  - TRENCHSTOP™ IGBT7
- Mechanical features
  - Solder contact technology
  - Compact design
  - High power density
  - Al<sub>2</sub>O<sub>3</sub> substrate with low thermal resistance
  - 2.5 kV AC 1 min insulation



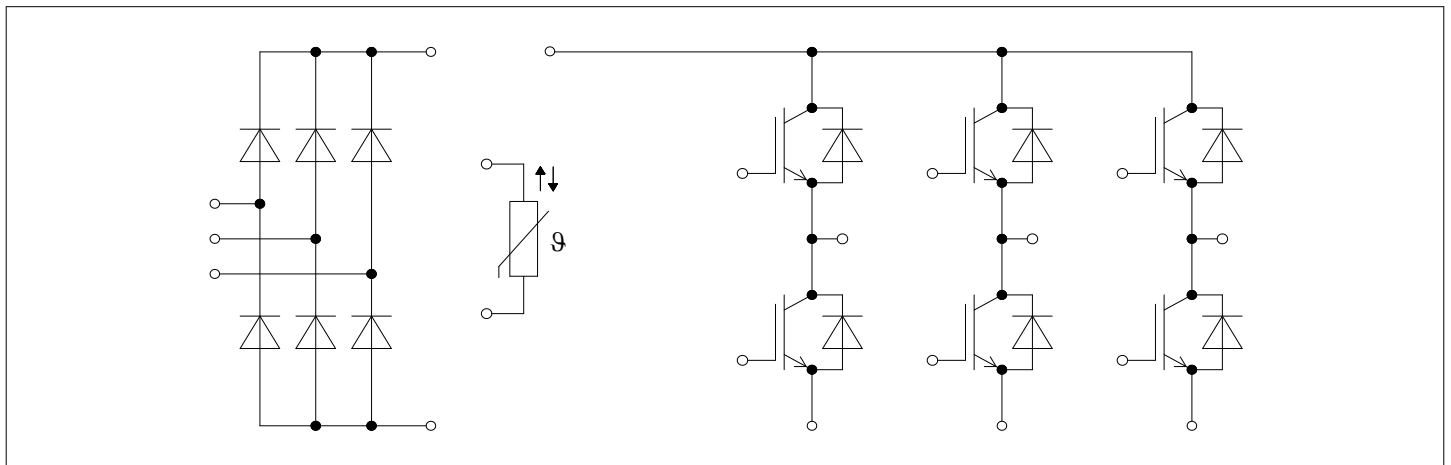
#### Potential applications

- Air conditioning
- Auxiliary inverters
- Motor drives

#### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

#### Description



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## 1 Package

**Table 1** Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	$V_{ISOL}$	RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$	2.5	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	
RTI Elec.	$RTI$	housing	140	°C

**Table 2** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	$L_{SCE}$			30		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	$T_H = 25^\circ\text{C}$ , per switch		6		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25^\circ\text{C}$ , per switch		8		mΩ
Storage temperature	$T_{stg}$		-40		125	°C
Mounting force per clamp	$F$		20		50	N
Weight	$G$			24		g

Note: The current under continuous operation is limited to 30A rms per connector pin.

## 2 IGBT, Inverter

**Table 3** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	$V_{CES}$	$T_{vj} = 25^\circ\text{C}$	1200	V
Continuous DC collector current	$I_{CDC}$	$T_{vj \text{ max}} = 175^\circ\text{C}$ $T_H = 100^\circ\text{C}$	10	A
Repetitive peak collector current	$I_{CRM}$	$t_p = 1 \text{ ms}$	20	A
Gate-emitter peak voltage	$V_{GES}$		±20	V

**Table 4** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Collector-emitter saturation voltage	$V_{CE\ sat}$	$I_C = 10\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.60	TBD	V
			$T_{vj} = 125\ ^\circ C$		1.74		
			$T_{vj} = 175\ ^\circ C$		1.82		
Gate threshold voltage	$V_{GEth}$	$I_C = 0.22\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$	5.15	5.80	6.45		V
Gate charge	$Q_G$	$V_{GE} = \pm 15\ V, V_{CE} = 600\ V$		0.157			$\mu C$
Internal gate resistor	$R_{Gint}$	$T_{vj} = 25\ ^\circ C$		0			$\Omega$
Input capacitance	$C_{ies}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		1.89			nF
Reverse transfer capacitance	$C_{res}$	$f = 100\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$		0.0066			nF
Collector-emitter cut-off current	$I_{CES}$	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			0.0045	mA
Gate-emitter leakage current	$I_{GES}$	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	$t_{don}$	$I_C = 10\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 8.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.023		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.025		
			$T_{vj} = 175\ ^\circ C$		0.026		
Rise time (inductive load)	$t_r$	$I_C = 10\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 8.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.014		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.017		
			$T_{vj} = 175\ ^\circ C$		0.019		
Turn-off delay time (inductive load)	$t_{doff}$	$I_C = 10\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 8.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.124		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.157		
			$T_{vj} = 175\ ^\circ C$		0.176		
Fall time (inductive load)	$t_f$	$I_C = 10\ A, V_{CE} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 8.2\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.227		$\mu s$
			$T_{vj} = 125\ ^\circ C$		0.347		
			$T_{vj} = 175\ ^\circ C$		0.422		
Turn-on energy loss per pulse	$E_{on}$	$I_C = 10\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 8.2\ \Omega, di/dt = 550\ A/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.73		mJ
			$T_{vj} = 125\ ^\circ C$		0.94		
			$T_{vj} = 175\ ^\circ C$		1.13		
Turn-off energy loss per pulse	$E_{off}$	$I_C = 10\ A, V_{CE} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 8.2\ \Omega, dv/dt = 2700\ V/\mu s (T_{vj} = 175\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		0.623		mJ
			$T_{vj} = 125\ ^\circ C$		0.97		
			$T_{vj} = 175\ ^\circ C$		1.17		
SC data	$I_{SC}$	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_p \leq 8\ \mu s, T_{vj} = 150\ ^\circ C$		32		A
			$t_p \leq 7\ \mu s, T_{vj} = 175\ ^\circ C$		30		

**Table 4** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heatsink	$R_{thJH}$	per IGBT		2.05		K/W
Temperature under switching conditions	$T_{vj\,op}$		-40		175	°C

Note:  $T_{vj\,op} > 150^{\circ}\text{C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

### 3 Diode, Inverter

**Table 5** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25^{\circ}\text{C}$	1200	V	
Continuous DC forward current	$I_F$		10	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1\text{ ms}$	20	A	
$I^2t$ - value	$I^2t$	$V_R = 0\text{ V}, t_p = 10\text{ ms}$	$T_{vj} = 125^{\circ}\text{C}$	27.5	$\text{A}^2\text{s}$
			$T_{vj} = 175^{\circ}\text{C}$	24	

**Table 6** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 10\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$		1.72	TBD	V
			$T_{vj} = 125^{\circ}\text{C}$		1.59		
			$T_{vj} = 175^{\circ}\text{C}$		1.52		
Peak reverse recovery current	$I_{RM}$	$I_F = 10\text{ A}, V_R = 600\text{ V}, V_{GE} = -15\text{ V}, -di_F/dt = 550\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$		10.5		A
			$T_{vj} = 125^{\circ}\text{C}$		15.3		
			$T_{vj} = 175^{\circ}\text{C}$		17.5		
Recovered charge	$Q_r$	$I_F = 10\text{ A}, V_R = 600\text{ V}, V_{GE} = -15\text{ V}, -di_F/dt = 550\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$		0.97		$\mu\text{C}$
			$T_{vj} = 125^{\circ}\text{C}$		1.7		
			$T_{vj} = 175^{\circ}\text{C}$		2.2		
Reverse recovery energy	$E_{rec}$	$I_F = 10\text{ A}, V_R = 600\text{ V}, V_{GE} = -15\text{ V}, -di_F/dt = 550\text{ A}/\mu\text{s} (T_{vj} = 175^{\circ}\text{C})$	$T_{vj} = 25^{\circ}\text{C}$		0.24		mJ
			$T_{vj} = 125^{\circ}\text{C}$		0.51		
			$T_{vj} = 175^{\circ}\text{C}$		0.72		

**Table 6** Characteristic values (continued)

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heatsink	$R_{thJH}$	per diode		2.45		K/W
Temperature under switching conditions	$T_{vj,op}$		-40		175	°C

Note:  $T_{vj,op} > 150^{\circ}\text{C}$  is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.

## 4 Diode, Rectifier

**Table 7** Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit	
Repetitive peak reverse voltage	$V_{RRM}$	$T_{vj} = 25^{\circ}\text{C}$	1600	V	
Maximum RMS forward current per chip	$I_{FRMSM}$	$T_H = 100^{\circ}\text{C}$	25	A	
Maximum RMS current at rectifier output	$I_{RMSM}$	$T_H = 100^{\circ}\text{C}$	25	A	
Surge forward current	$I_{FSM}$	$t_p = 10\text{ ms}$	$T_{vj} = 25^{\circ}\text{C}$	300	A
			$T_{vj} = 150^{\circ}\text{C}$	245	
$I^2t$ - value	$I^2t$	$t_p = 10\text{ ms}$	$T_{vj} = 25^{\circ}\text{C}$	450	$\text{A}^2\text{s}$
			$T_{vj} = 150^{\circ}\text{C}$	300	

**Table 8** Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	$V_F$	$I_F = 10\text{ A}$ $T_{vj} = 150^{\circ}\text{C}$		0.80		V
Reverse current	$I_r$	$T_{vj} = 150^{\circ}\text{C}$ , $V_R = 1600\text{ V}$		1		mA
Thermal resistance, junction to heatsink	$R_{thJH}$	per diode		1.54		K/W
Temperature under switching conditions	$T_{vj,op}$		-40		150	°C

## 5 NTC-Thermistor

**Table 9** Characteristic values

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

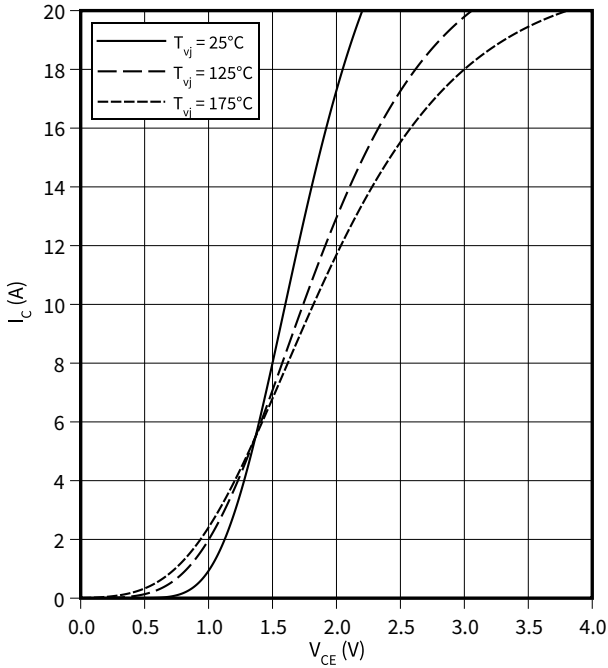
Note: Specification according to the valid application note.

## 6 Characteristics diagrams

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

$$I_C = f(V_{CE})$$

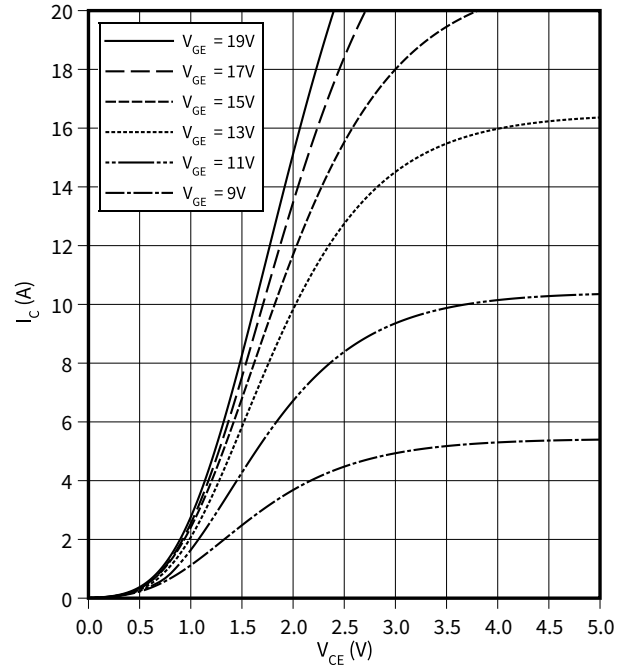
$$V_{GE} = 15 \text{ V}$$



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

$$I_C = f(V_{CE})$$

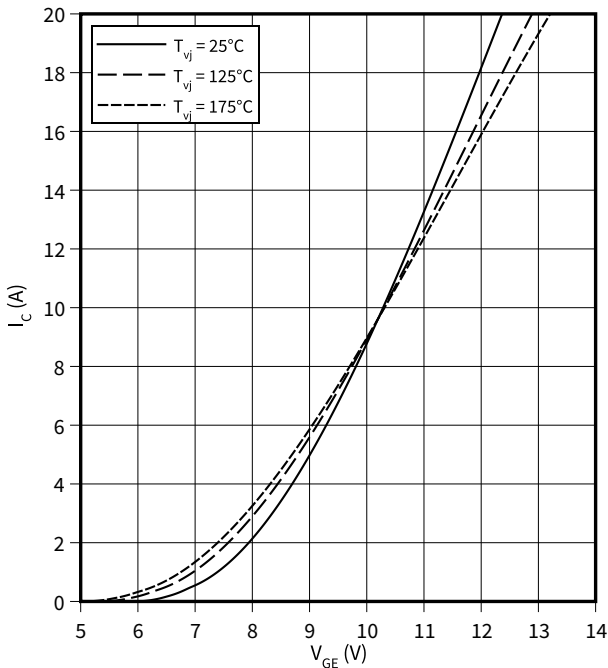
$$T_{vj} = 175 \text{ °C}$$



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

$$I_C = f(V_{GE})$$

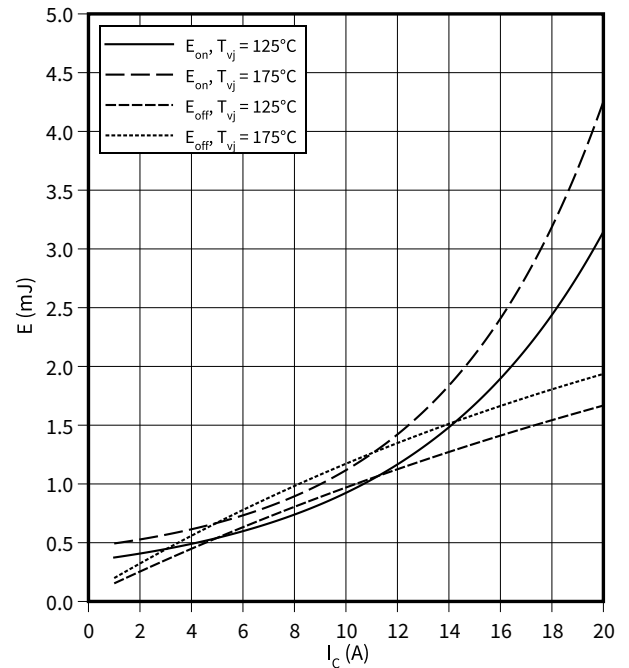
$$V_{CE} = 20 \text{ V}$$



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

$$E = f(I_C)$$

$$R_{Goff} = 8.2 \text{ } \Omega, R_{Gon} = 8.2 \text{ } \Omega, V_{CE} = 600 \text{ V}, V_{GE} = \pm 15 \text{ V}$$



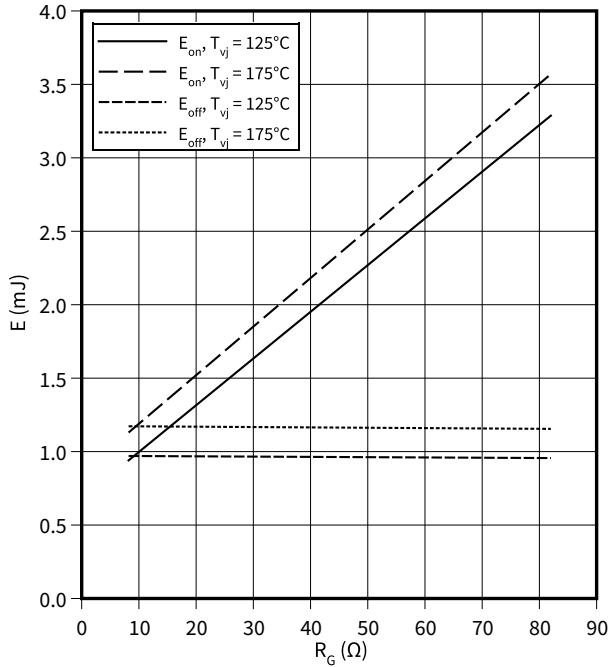


6 Characteristics diagrams

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

$E = f(R_G)$

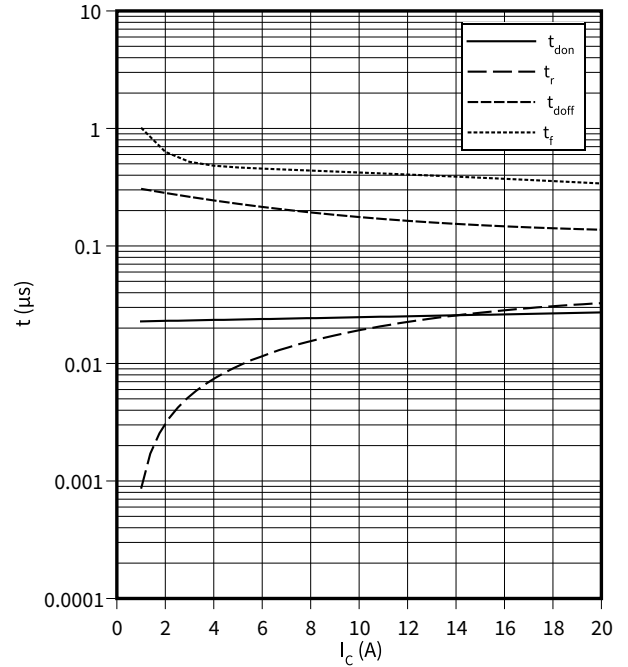
$I_C = 10\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}$



**switching times (typical), IGBT, Inverter**

$t = f(I_C)$

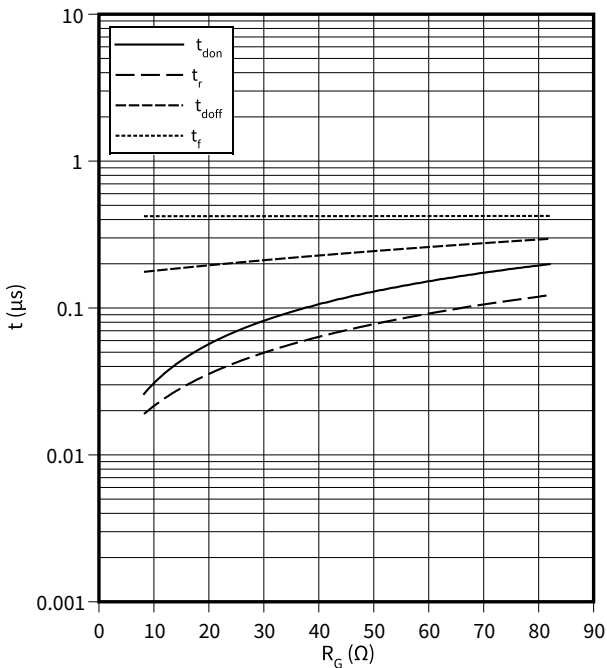
$R_{Goff} = 8.2\ \Omega, R_{Gon} = 8.2\ \Omega, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}$



**switching times (typical), IGBT, Inverter**

$t = f(R_G)$

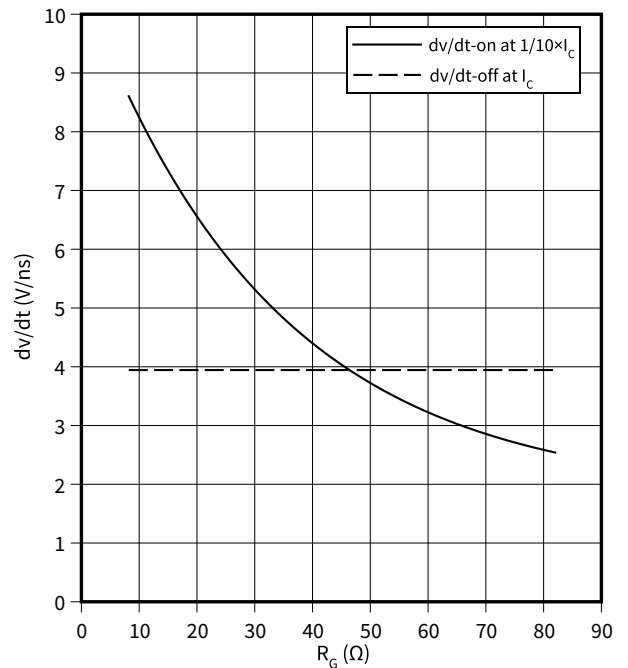
$I_C = 10\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, T_{vj} = 175\text{ }^\circ\text{C}$



**dv/dt (typical), IGBT, Inverter**

$dv/dt = f(R_G)$

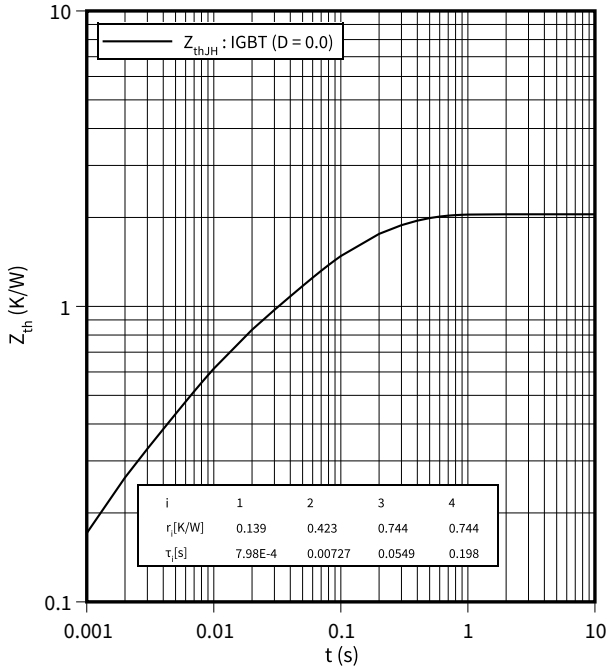
$I_C = 10\text{ A}, V_{CE} = 600\text{ V}, V_{GE} = \pm 15\text{ V}, T_{vj} = 25\text{ }^\circ\text{C}$



6 Characteristics diagrams

**transient thermal impedance , IGBT, Inverter**

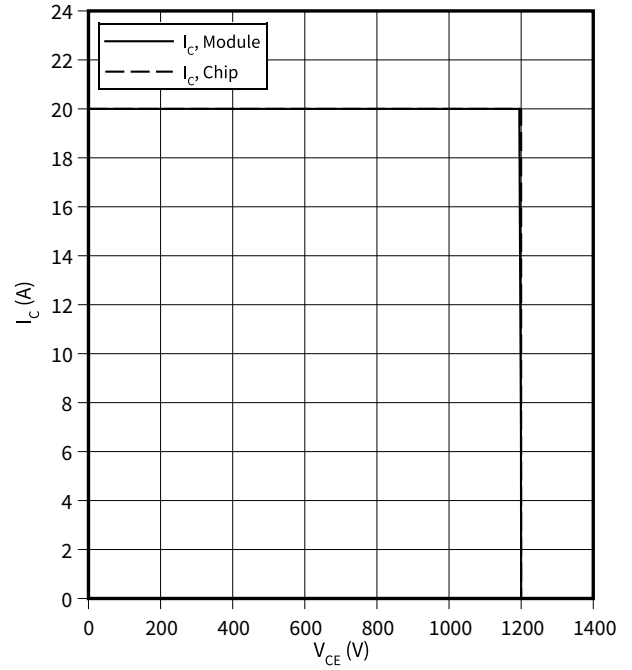
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

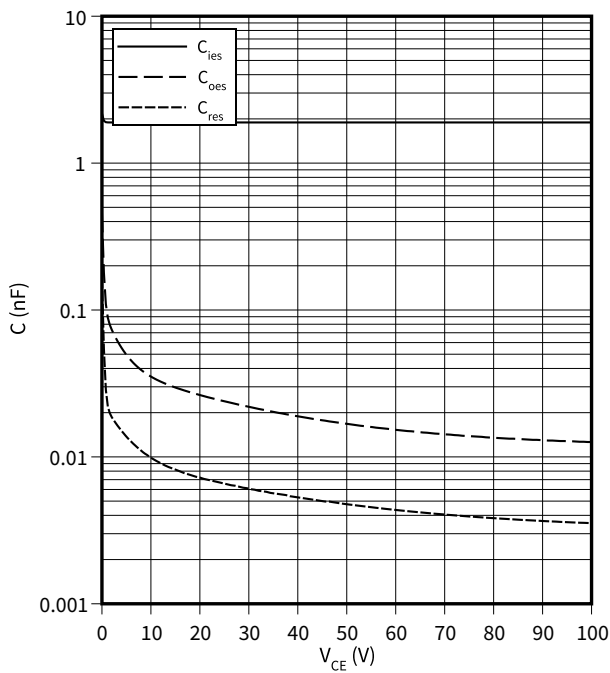
$R_{Goff} = 8.2 \Omega, V_{GE} = \pm 15 V, T_{vj} = 175 \text{ }^\circ\text{C}$



**capacity characteristic (typical), IGBT, Inverter**

$C = f(V_{CE})$

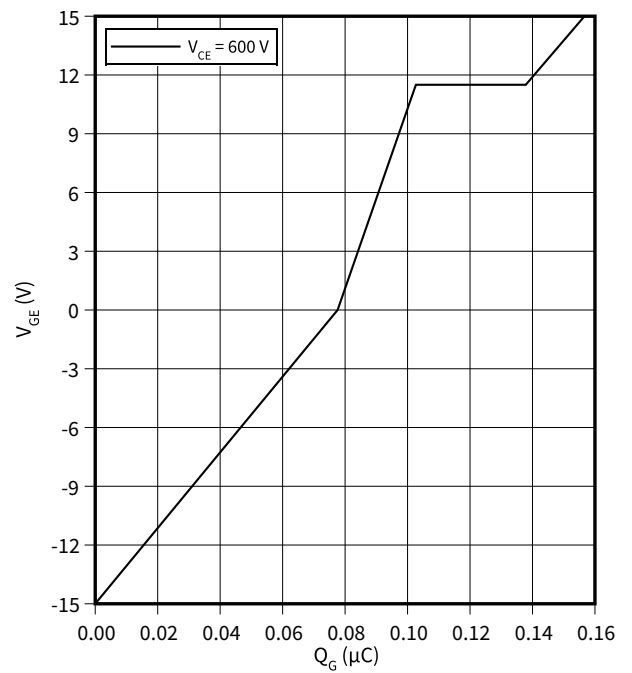
$f = 100 \text{ kHz}, V_{GE} = 0 V, T_{vj} = 25 \text{ }^\circ\text{C}$



**gate charge characteristic (typical), IGBT, Inverter**

$V_{GE} = f(Q_G)$

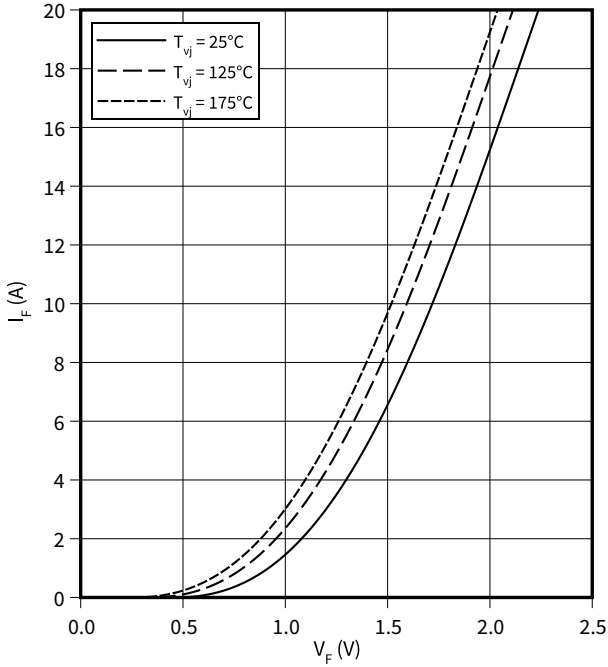
$I_C = 10 A, T_{vj} = 25 \text{ }^\circ\text{C}$



6 Characteristics diagrams

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

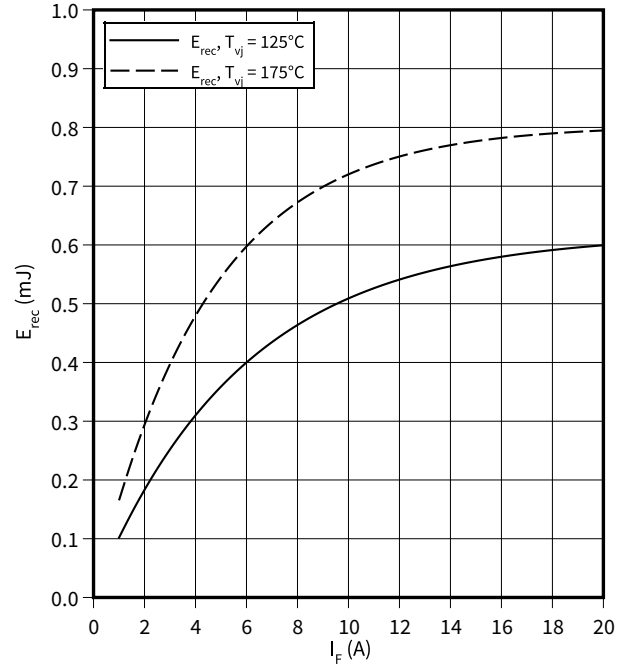
$I_F = f(V_F)$



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

$E_{rec} = f(I_F)$

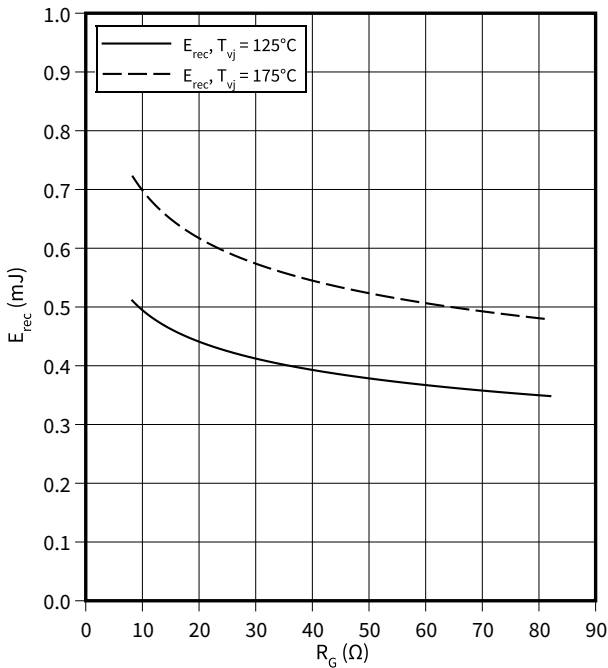
$R_{Gon} = 8.2 \Omega, V_{CE} = 600 \text{ V}$



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

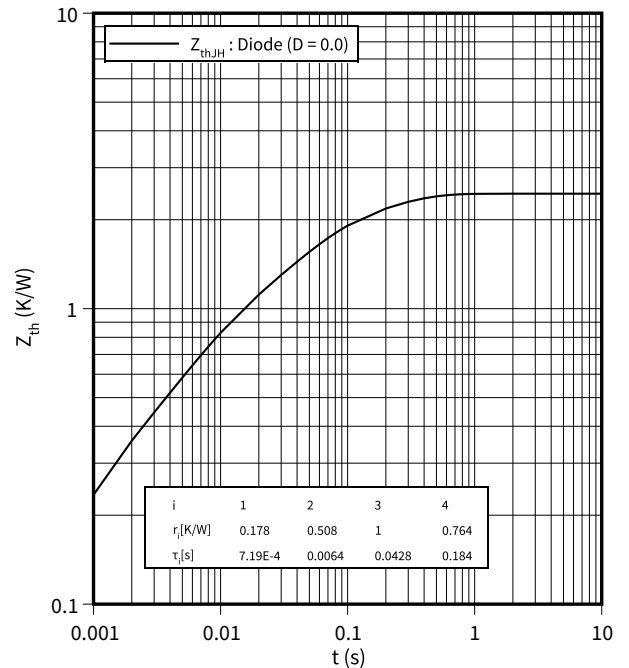
$E_{rec} = f(R_G)$

$V_{CE} = 600 \text{ V}, I_F = 10 \text{ A}$



**transient thermal impedance, Diode, Inverter**

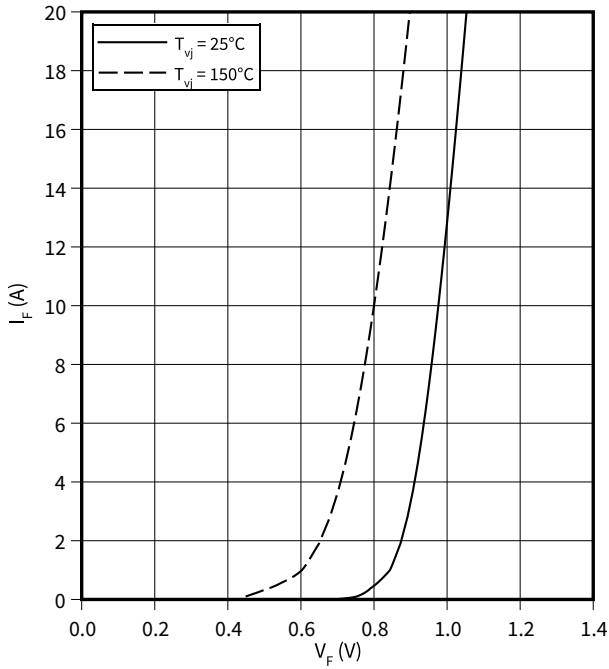
$Z_{th} = f(t)$



6 Characteristics diagrams

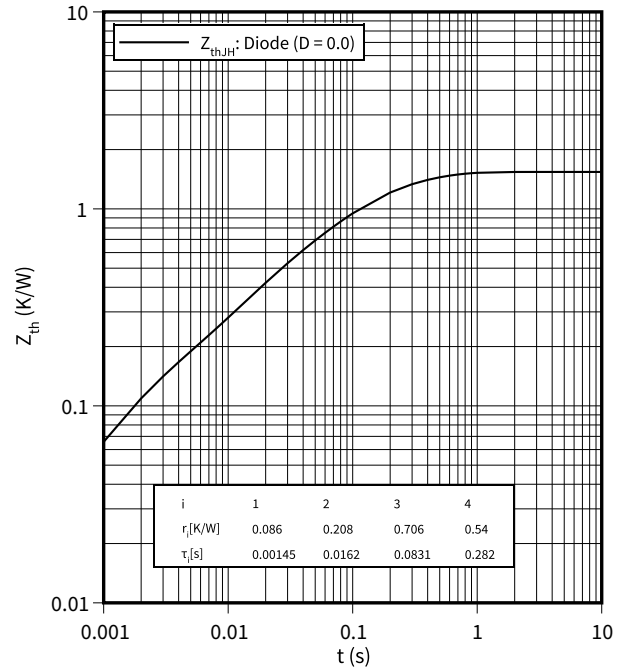
**forward characteristic (typical), Diode, Rectifier**

$I_F = f(V_F)$



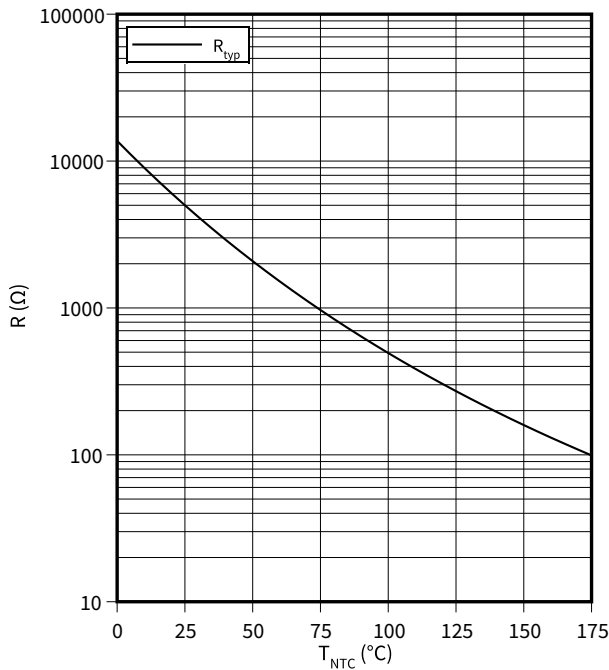
**transient thermal impedance, Diode, Rectifier**

$Z_{th} = f(t)$



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

$R = f(T_{NTC})$



## 7 Circuit diagram

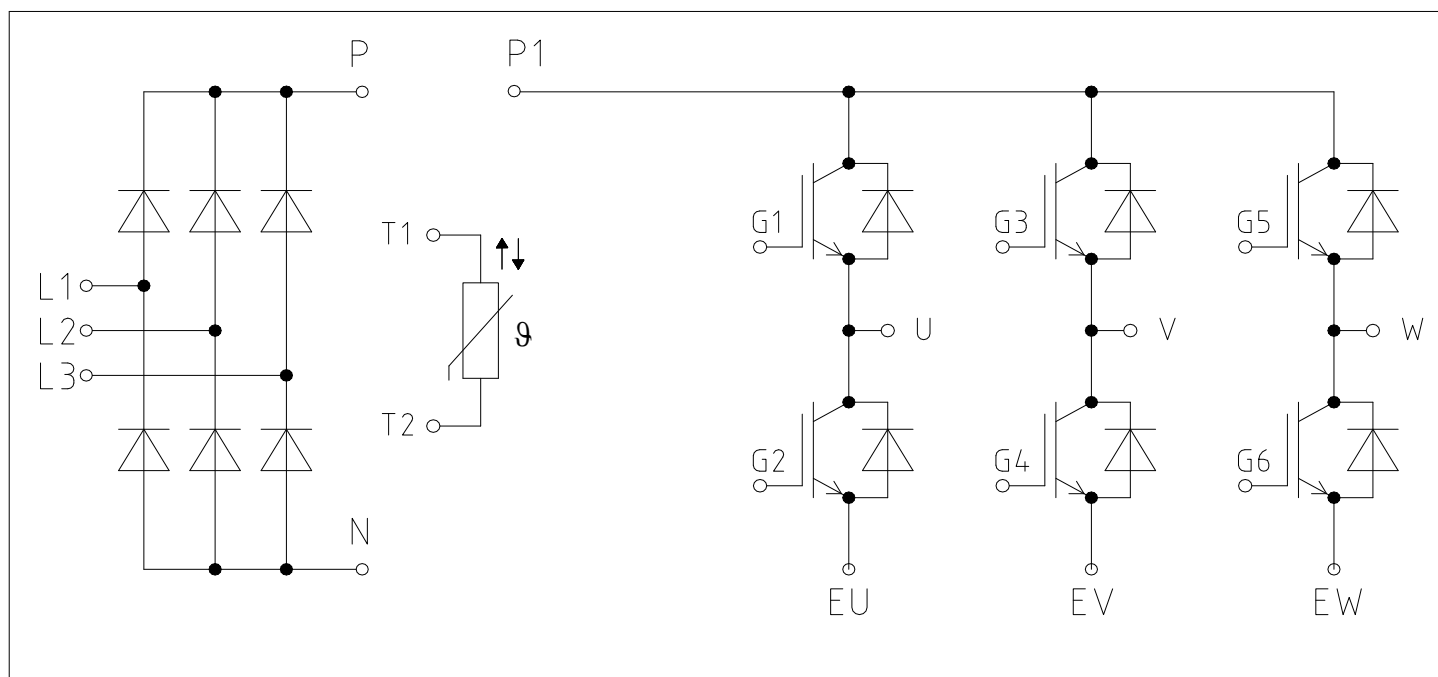


Figure 2

8 Package outlines

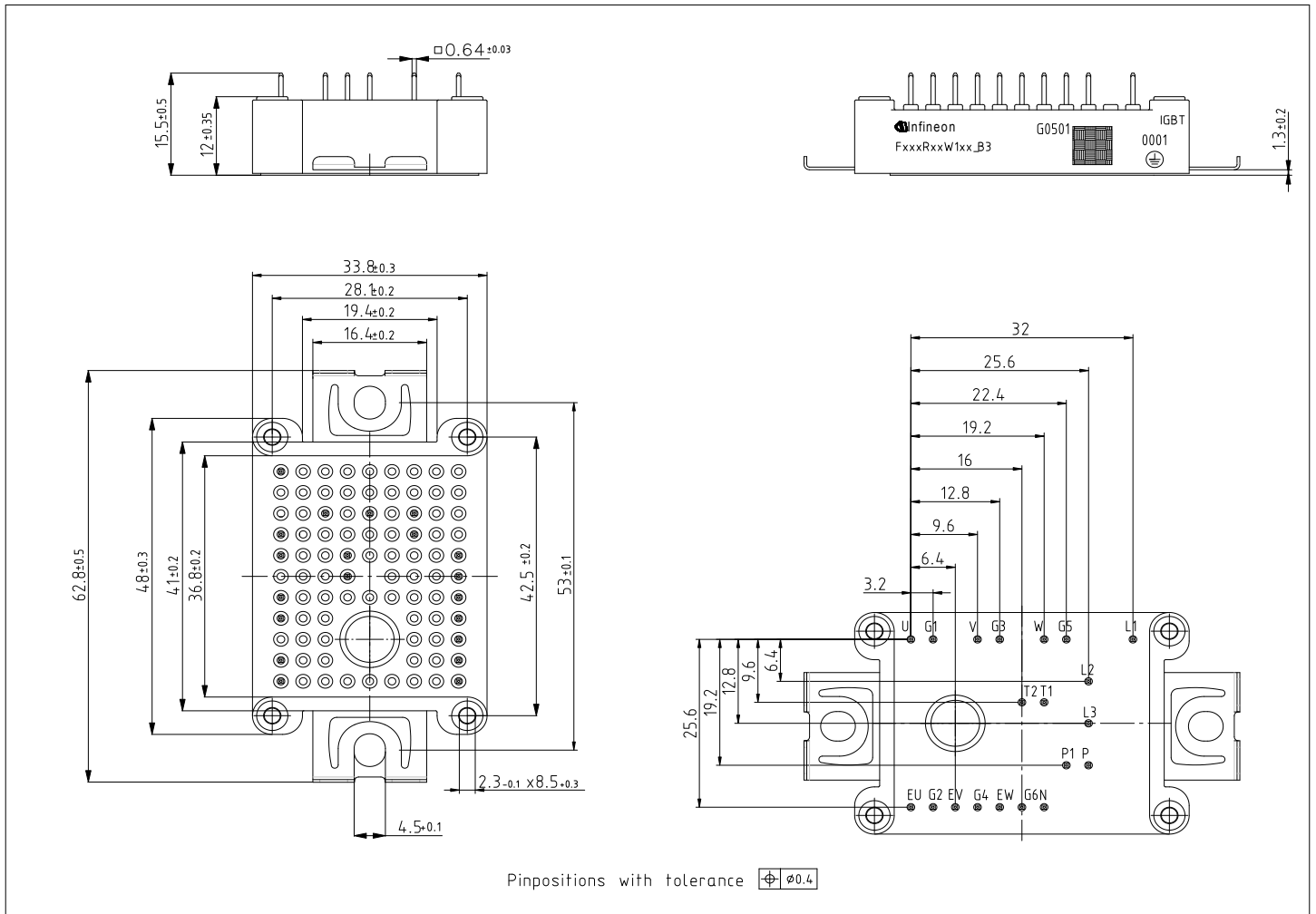


Figure 3

## 9 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

Figure 4

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