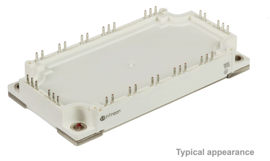
EconoPACK™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC



Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 200 A / I_{CRM} = 400 A
  - Low $V_{CE,sat}$
  - Overload operation up to 175°C
  - TRENCHSTOP™ IGBT7
- Mechanical features
  - Integrated NTC temperature sensor
  - High power and thermal cycling capability
  - Solder contact technology
  - Al_2O_3 substrate with low thermal resistance
  - Copper base plate

Potential applications

- Motor drives
- Auxiliary inverters
- Servo drives

Product validation

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

Description

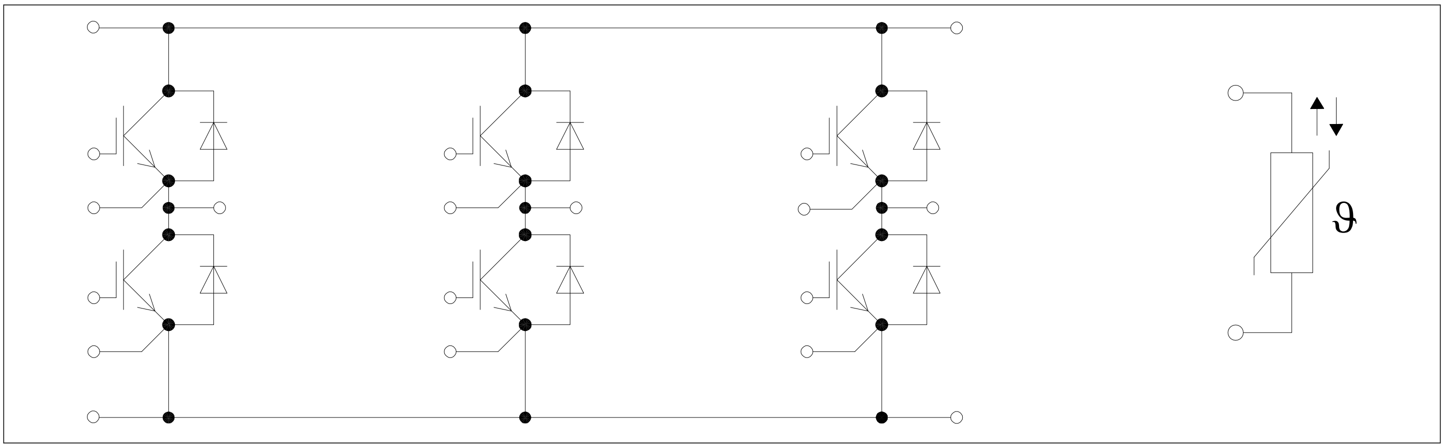


Table of contents

1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, f = 50 Hz, t = 1 min	2.5	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to heatsink	7.5	mm
Comparative tracking index	CTI		>200	
Relative thermal index (electrical)	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	$R_{CC'+EE'}$	T_C=25°C, per switch			1.5		mΩ
Storage temperature	T_{stg}			-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	3		6	Nm
Weight	G				300		g

Note: The current under continuous operation is limited to 50 A 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 °C	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_C = 75 °C	200	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		400	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 = 200 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.55	1.80	V
			T_{vj} = 125 °C		1.69		
			T_{vj} = 175 °C		1.77		
Gate threshold voltage	V_{GEth}	I_C = 4.6 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		5.15	5.80	6.45	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CE} = 600 V			3.34		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.75		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			40.3		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.14		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.016	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3 Ω	T_{vj} = 25 °C		0.172		µs
			T_{vj} = 125 °C		0.184		
			T_{vj} = 175 °C		0.192		
Rise time (inductive load)	t_r	I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 3 Ω	T_{vj} = 25 °C		0.063		µs
			T_{vj} = 125 °C		0.073		
			T_{vj} = 175 °C		0.074		
Turn-off delay time (inductive load)	t_{doff}	I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3 Ω	T_{vj} = 25 °C		0.352		µs
			T_{vj} = 125 °C		0.442		
			T_{vj} = 175 °C		0.486		
Fall time (inductive load)	t_f	I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3 Ω	T_{vj} = 25 °C		0.092		µs
			T_{vj} = 125 °C		0.190		
			T_{vj} = 175 °C		0.254		
Turn-on energy loss per pulse	E_{on}	I_C = 200 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 3 Ω, di/dt = 2300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		25.5		mJ
			T_{vj} = 125 °C		30.3		
			T_{vj} = 175 °C		32.8		
Turn-off energy loss per pulse	E_{off}	I_C = 200 A, V_{CE} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 3 Ω, dv/dt = 3100 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		13.6		mJ
			T_{vj} = 125 °C		20.6		
			T_{vj} = 175 °C		26.7		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
SC data	I_{SC}	$V_{GE} \leq 15$ V, $V_{CC} = 800$ V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	$t_P \leq 8$ µs, $T_{vj}=150$ °C		640		A
			$t_P \leq 7$ µs, $T_{vj}=175$ °C		600		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.231	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease}= 1 W/(m*K)			0.0690		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

Note: *$T_{vj\ op}$ > 150 °C is only 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}		$T_{vj} = 25$ °C	1200	V
Continuous DC forward current	I_F			200	A
Repetitive peak forward current	I_{FRM}	$t_P = 1$ ms		400	A
I²t - value	I^2t	$t_P = 10$ ms, $V_R = 0$ V	$T_{vj} = 125$ °C	5190	A²s
			$T_{vj} = 175$ °C	4690	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 200$ A, $V_{GE} = 0$ V	$T_{vj} = 25$ °C		1.72	2.10	V
			$T_{vj} = 125$ °C		1.59		
			$T_{vj} = 175$ °C		1.52		
Peak reverse recovery current	I_{RM}	$V_R = 600$ V, $I_F = 200$ A, $V_{GE} = -15$ V, -di$_F$/dt = 2300 A/µs ($T_{vj} = 175$ °C)	$T_{vj} = 25$ °C		92.5		A
			$T_{vj} = 125$ °C		134		
			$T_{vj} = 175$ °C		149		

(table continues...)

Table 6 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	V_R = 600 V, I_F = 200 A, V_{GE} = -15 V, -di_F/dt = 2300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		13		µC
			T_{vj} = 125 °C		27.3		
			T_{vj} = 175 °C		36.5		
Reverse recovery energy	E_{rec}	V_R = 600 V, I_F = 200 A, V_{GE} = -15 V, -di_F/dt = 2300 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.65		mJ
			T_{vj} = 125 °C		8.94		
			T_{vj} = 175 °C		11.8		
Thermal resistance, junction to case	R_{thJC}	per diode				0.376	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease}= 1 W/(m*K)			0.0680		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

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

4 NTC-Thermistor

Table 7 **Characteristic values**

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

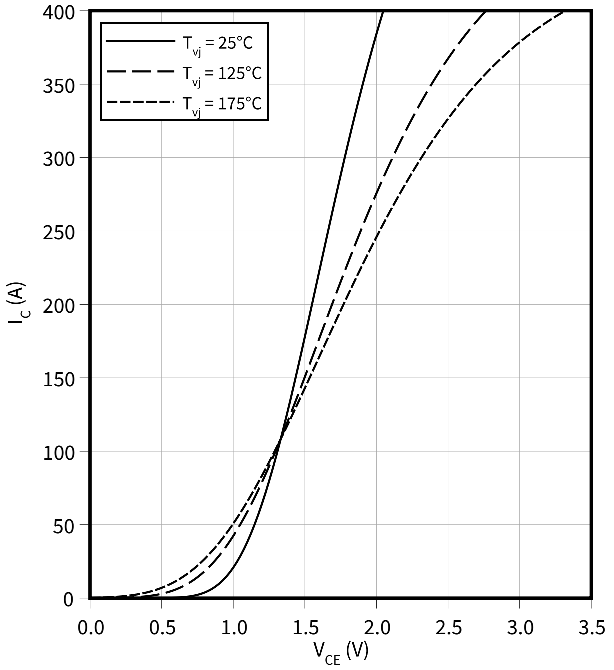
Note: *Specification according to the valid application note.*

5 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

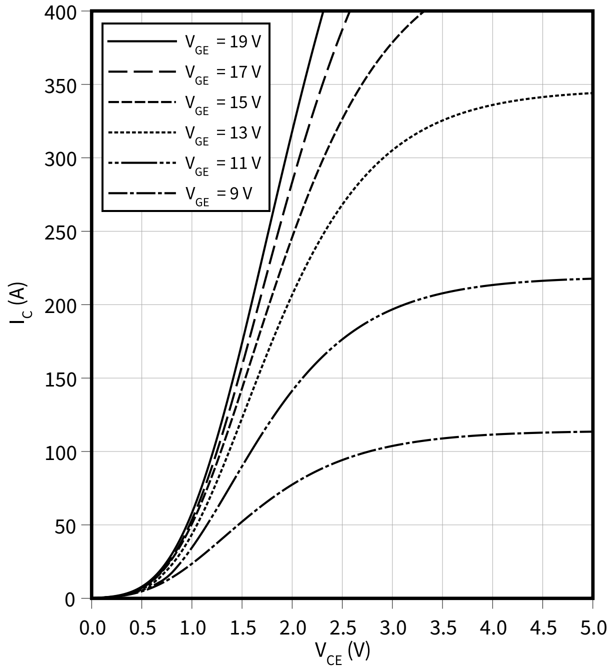
$V_{GE} = 15$ V



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

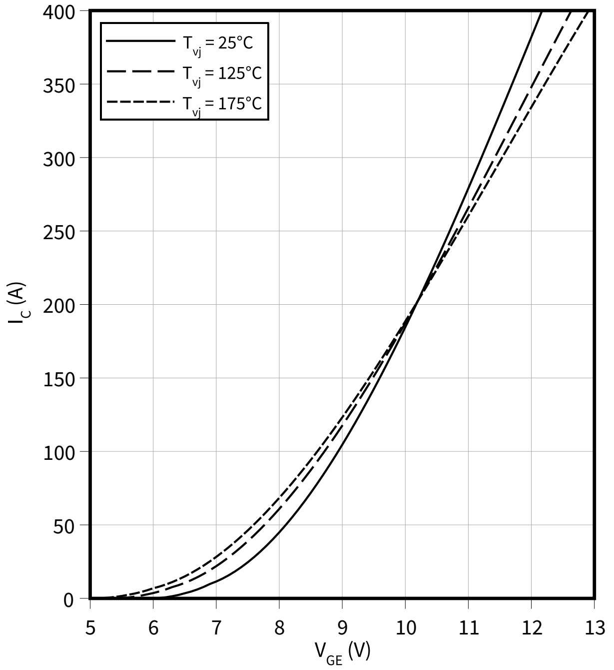
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

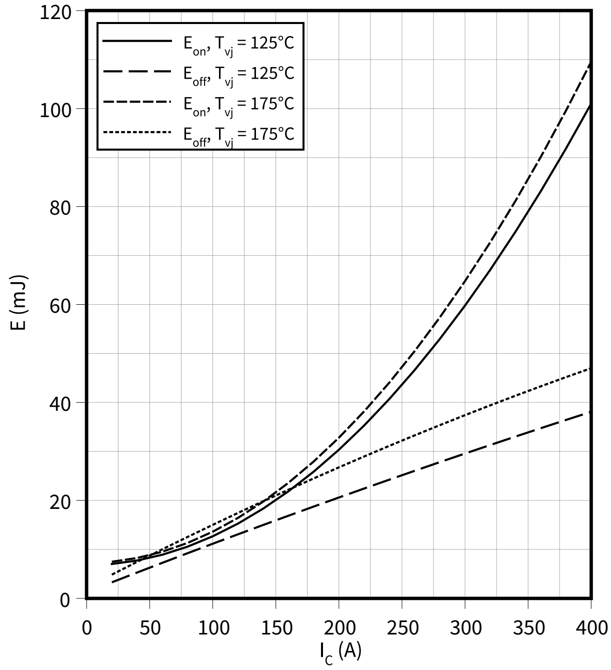
$V_{CE} = 20$ V



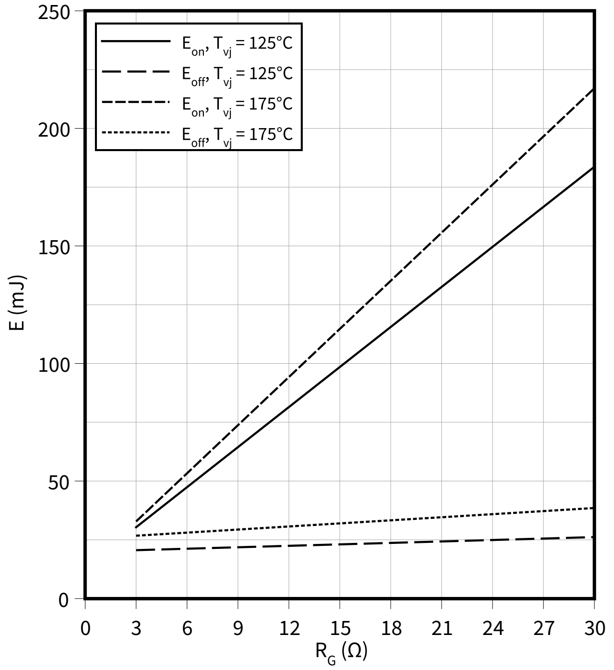
Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

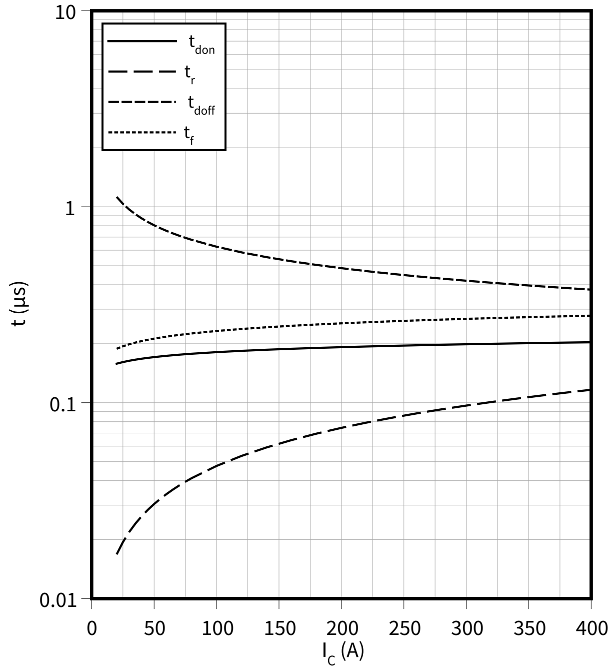
$R_{Goff} = 3.0\ \Omega$, $R_{Gon} = 3.0\ \Omega$, $V_{CE} = 600$ V, $V_{GE} = \pm 15$ V



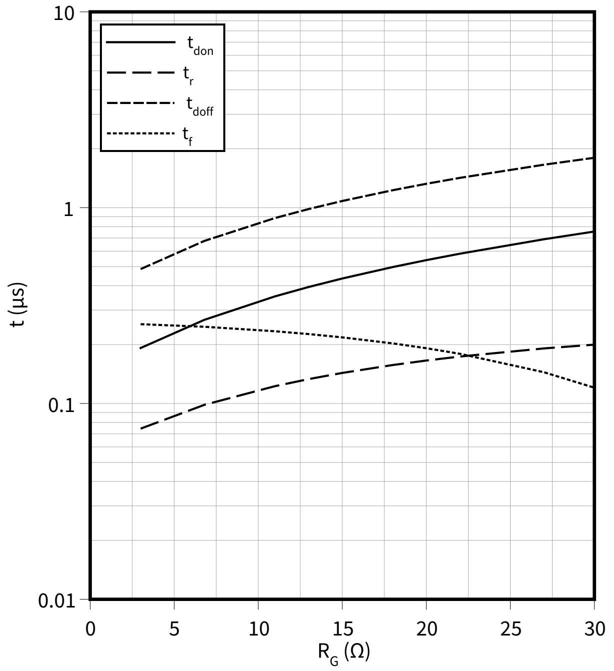
Switching losses (typical), IGBT, Inverter
$E = f(R_G)$
I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V



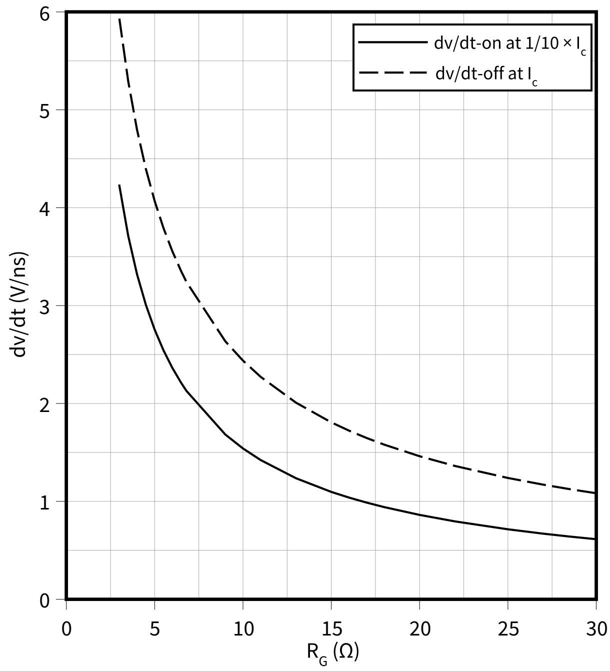
Switching times (typical), IGBT, Inverter
$t = f(I_C)$
R_{Goff} = 3.0 Ω, R_{Gon} = 3.0 Ω, V_{CE} = 600 V, V_{GE} = ±15 V, T_{vj} = 175 °C



Switching times (typical), IGBT, Inverter
$t = f(R_G)$
I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, T_{vj} = 175 °C

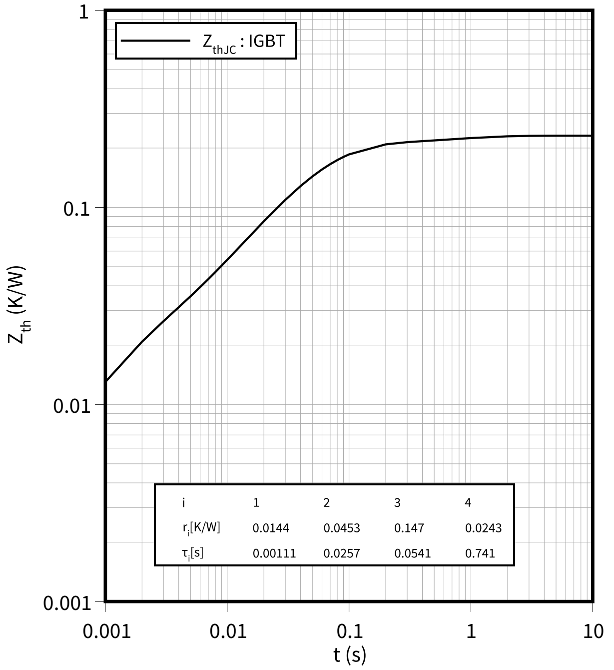


Voltage slope (typical), IGBT, Inverter
$dv/dt = f(R_G)$
I_C = 200 A, V_{CE} = 600 V, V_{GE} = ±15 V, T_{vj} = 25 °C



Transient thermal impedance , IGBT, Inverter

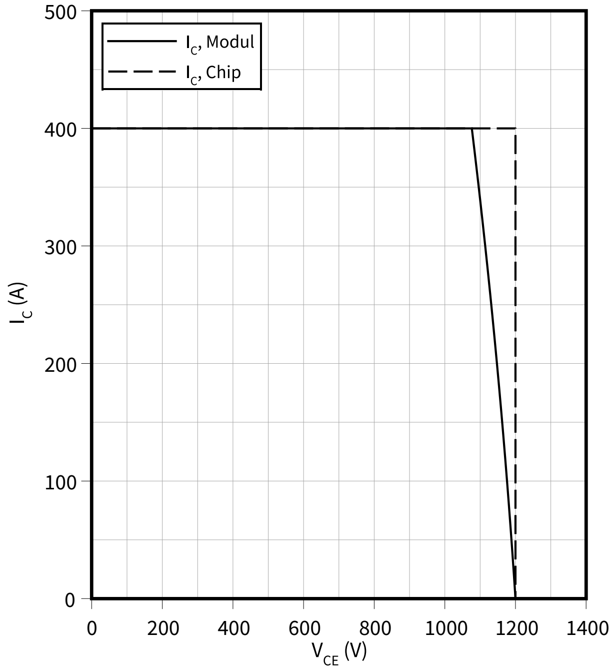
$Z_{th} = f(t)$



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

$I_C = f(V_{CE})$

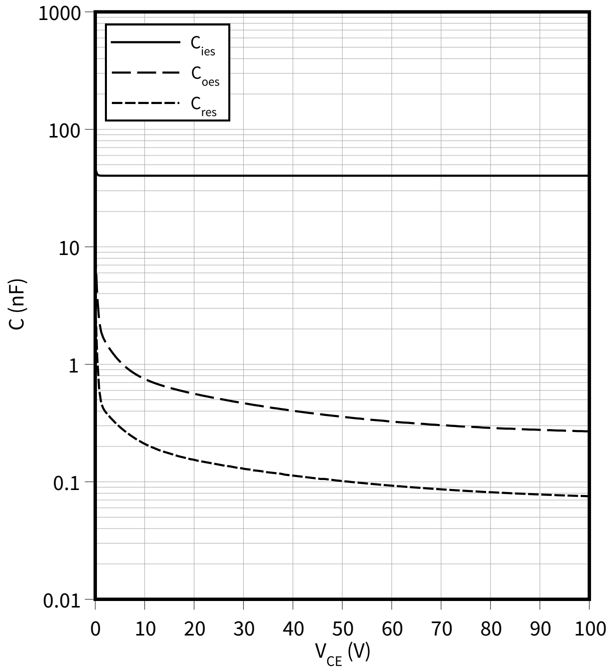
$T_{vj} = 175$ °C, $R_{Goff} = 3.0\ \Omega$, $V_{GE} = \pm 15$ V



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

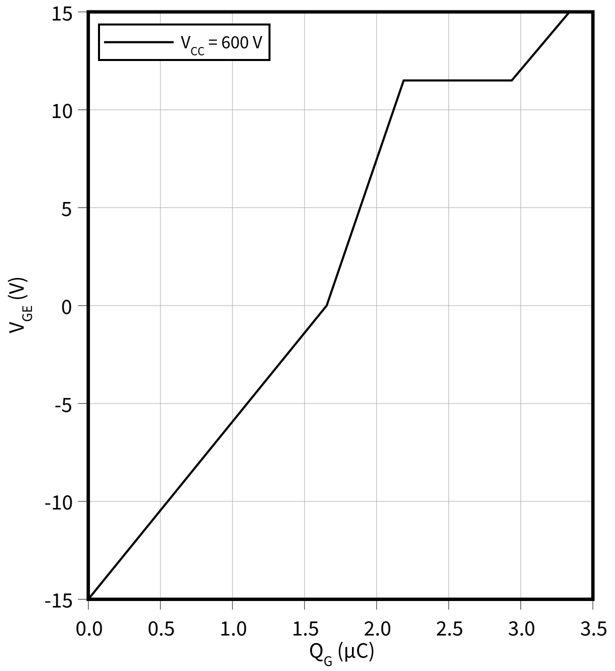
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

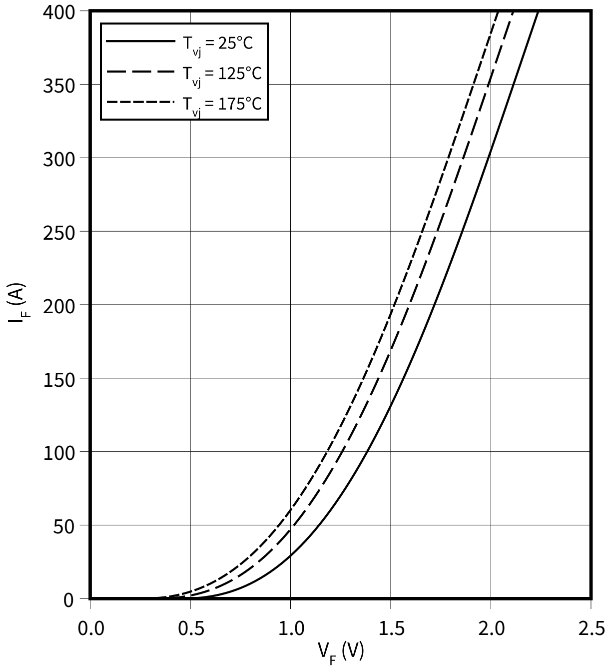
$V_{GE} = f(Q_G)$

$I_C = 200$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

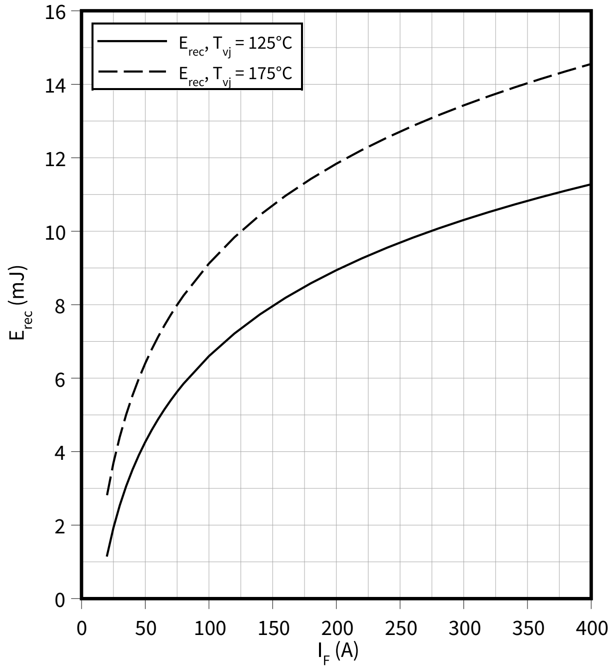
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

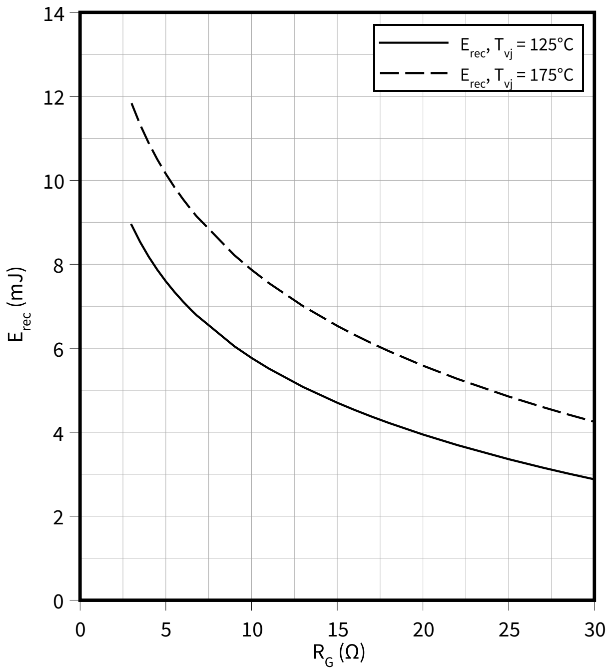
$R_{Gon} = 3.0\ \Omega$, $V_R = 600$ V



Switching losses (typical), Diode, Inverter

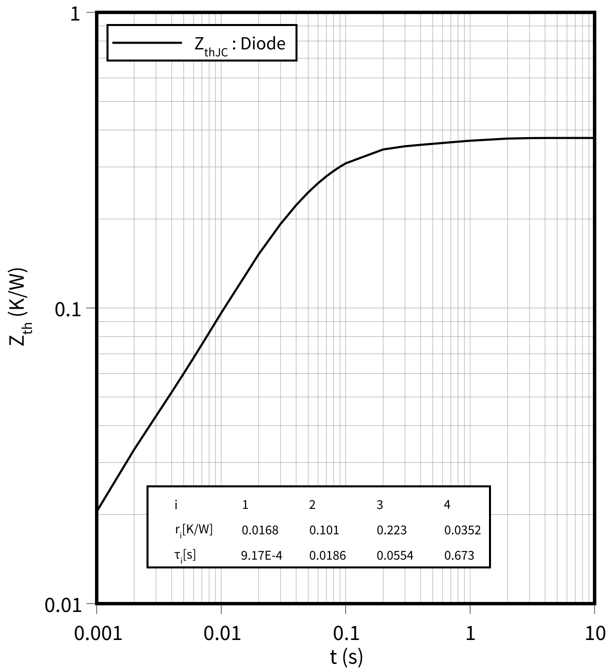
$E_{rec} = f(R_G)$

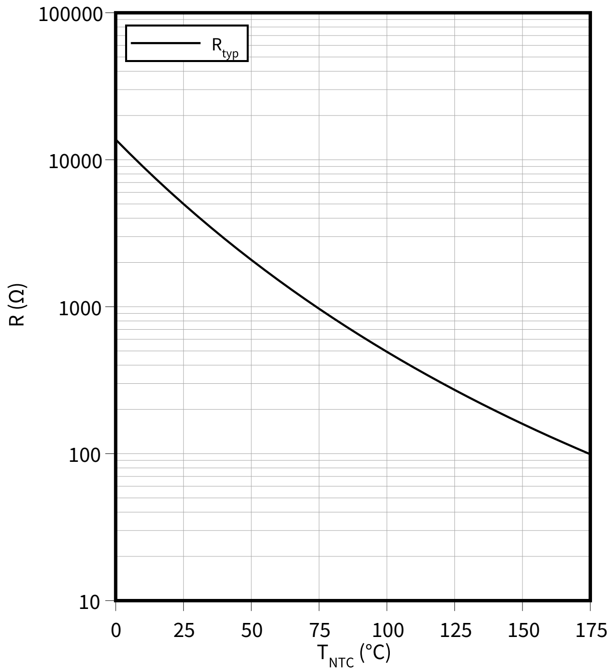
$I_F = 200$ A, $V_R = 600$ V



Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor $R = f(T_{NTC})$	
	

6 Circuit diagram

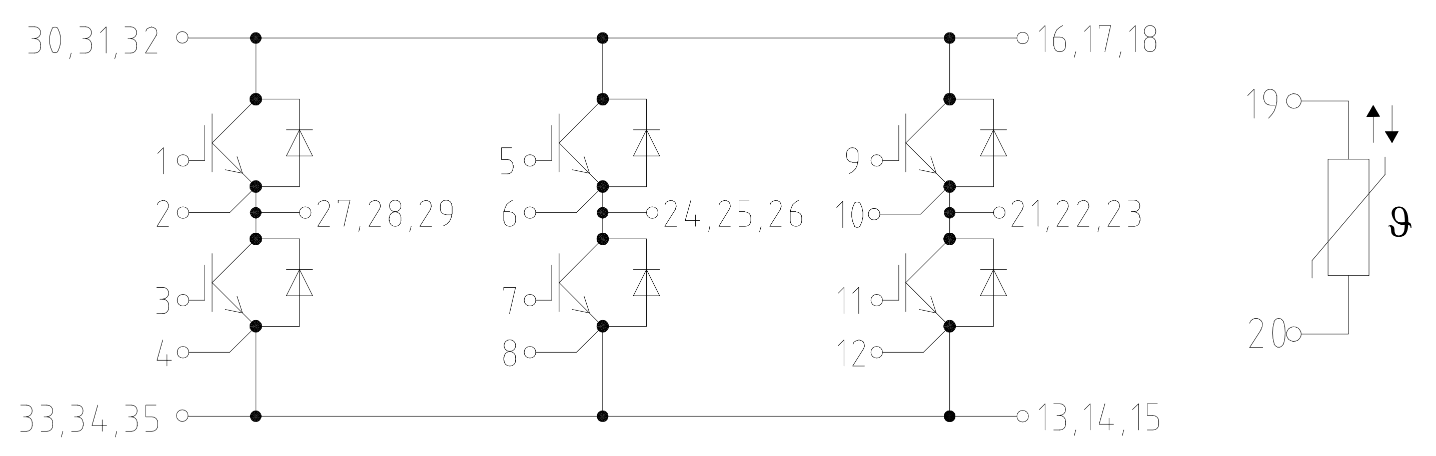


Figure 1

7 Package outlines

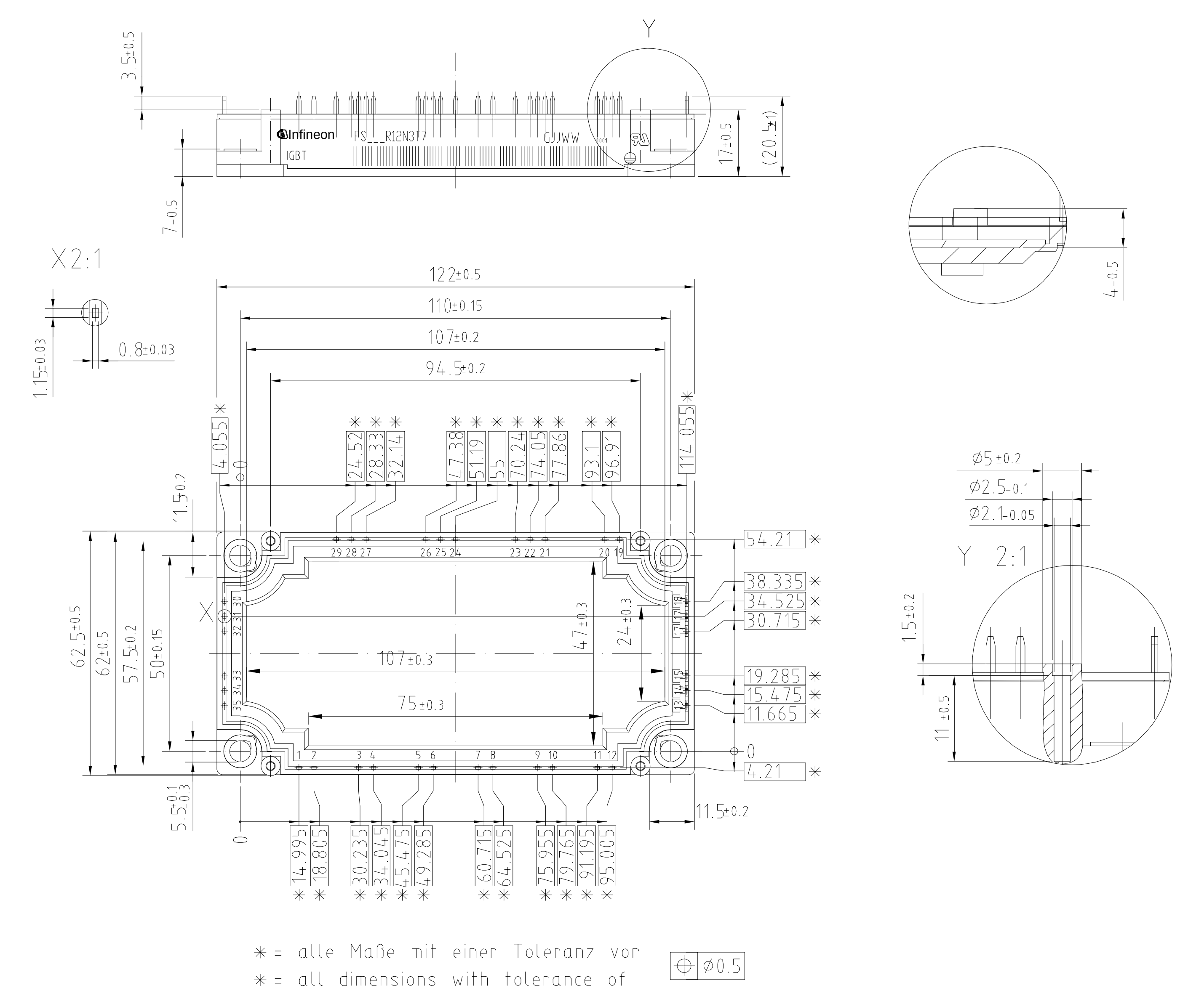


Figure 2

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	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	71549142846550549911530		71549142846550549911530

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-09-11	Target datasheet
n/a	2020-09-01	Datasheet migrated to a new system with a new layout and new revision number schema: target or preliminary datasheet = 0.xy; final datasheet = 1.xy
1.00	2022-03-02	Final datasheet

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Edition 2022-03-02

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-AAY224-002

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