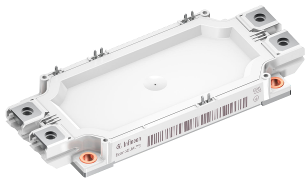
FF450R12ME7
EconoDUAL™3 module

Final datasheet
EconoDUAL™3 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC



Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 450 A / I_{CRM} = 900 A
  - $V_{CE,sat}$ with positive temperature coefficient
  - TRENCHSTOPTM IGBT7
  - Integrated temperature sensor
  - Suitable Infineon gate drivers can be found under https://www.infineon.com/gdfinder
- Mechanical features
  - High power density
  - Isolated base plate
  - Solder contact technology
  - Standard housing

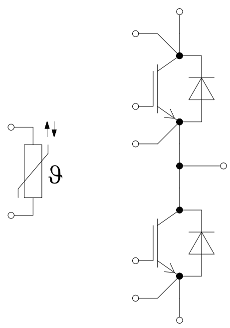
Potential applications

- Commercial agriculture vehicles
- High-power converters
- Motor drives
- Servo drives
- UPS systems

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 Hz, t = 1 min	3.4	kV
Isolation test voltage NTC	$V_{ISOL(NTC)}$	RMS, f = 50 Hz, t = 1 min	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	$d_{Creep\ nom}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15	mm
Creepage distance	$d_{Creep\ min}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7	mm
Creepage distance	$d_{Creep\ nom}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1	mm
Creepage distance	$d_{Creep\ min}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5	mm
Clearance	$d_{Clear\ nom}$	terminal to baseplate, nom.	> 12.5	mm
Clearance	$d_{Clear\ min}$	terminal to baseplate, min.	12.5	mm
Clearance	$d_{Clear\ nom}$	terminal to terminal, nom.	10.0	mm
Clearance	$d_{Clear\ min}$	terminal to terminal, min.	9.6	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}				20		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C = 25 °C, per switch			0.8		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
Terminal connection torque	*M*	- Mounting according to valid application note	M6, Screw	3		6	Nm
Weight	*G*				345		g

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 = 90 °C	450	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		900	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 = 450 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	1.75	V
			T_{vj} = 125 °C		1.65		
			T_{vj} = 175 °C		1.75		
Gate threshold voltage	V_{GEth}	I_C = 9 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_{CC} = 600 V			7.2		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.8		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			69		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.35		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			31	µA
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 = 450 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.6 Ω	T_{vj} = 25 °C		0.250		µs
			T_{vj} = 125 °C		0.270		
			T_{vj} = 175 °C		0.290		
Rise time (inductive load)	t_r	I_C = 450 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.6 Ω	T_{vj} = 25 °C		0.057		µs
			T_{vj} = 125 °C		0.065		
			T_{vj} = 175 °C		0.068		
Turn-off delay time (inductive load)	t_{doff}	I_C = 450 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 0.6 Ω	T_{vj} = 25 °C		0.390		µs
			T_{vj} = 125 °C		0.470		
			T_{vj} = 175 °C		0.510		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Fall time (inductive load)	t_f	I_C = 450 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 0.6 Ω	T_{vj} = 25 °C		0.140		µs
			T_{vj} = 125 °C		0.270		
			T_{vj} = 175 °C		0.360		
Turn-on energy loss per pulse	E_{on}	I_C = 450 A, V_{CC} = 600 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Gon} = 0.6 Ω, di/dt = 6400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		25		mJ
			T_{vj} = 125 °C		43		
			T_{vj} = 175 °C		53		
Turn-off energy loss per pulse	E_{off}	I_C = 450 A, V_{CC} = 600 V, L_σ = 25 nH, V_{GE} = ±15 V, R_{Goff} = 0.6 Ω, dv/dt = 3100 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		35		mJ
			T_{vj} = 125 °C		57		
			T_{vj} = 175 °C		69		
SC data	I_{SC}	V_{GE} ≤ 15 V, V_{CC} = 800 V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt	t_P ≤ 8 µs, T_{vj}=150 °C		2000		A
			t_P ≤ 6 µs, T_{vj}=175 °C		1900		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.0875	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.0186		K/W
Temperature under switching conditions	$T_{vj\ op}$			-40		175	°C

***Note**: Tvj op > 150°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 °C	1200	V
Continuous DC forward current	I_F			450	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		900	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	17500	A^2s
			T_{vj} = 175 °C	12000	

Table 6 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 450 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.80	2.10	V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.60		
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 6400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		306		A
			T_{vj} = 125 °C		407		
			T_{vj} = 175 °C		464		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 6400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		30.5		µC
			T_{vj} = 125 °C		60		
			T_{vj} = 175 °C		82.5		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 450 A, V_{GE} = -15 V, -di_F/dt = 6400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		13.5		mJ
			T_{vj} = 125 °C		27.5		
			T_{vj} = 175 °C		37.5		
Thermal resistance, junction to case	R_{thJC}	per diode				0.164	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.0214		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

***Note**: Tvj op > 150°C is allowed for operation at overload conditions. For detailed specifications, please refer to AN 2018-14.*

4 NTC-Thermistor

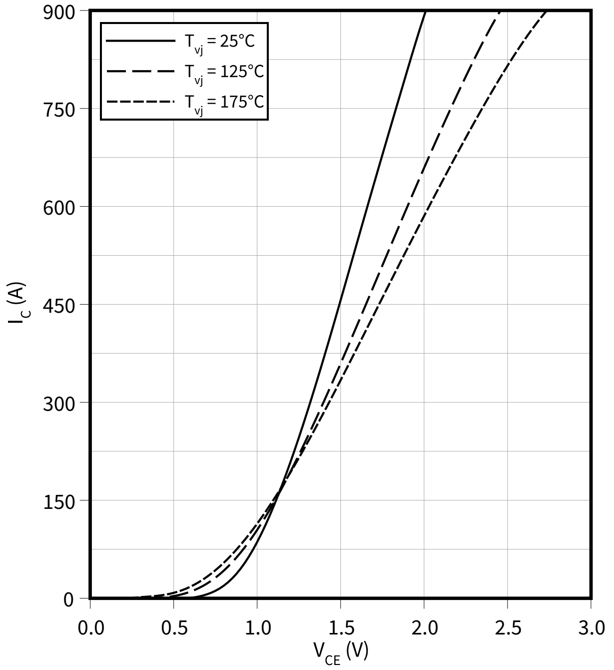
Table 7 **Characteristic values**

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

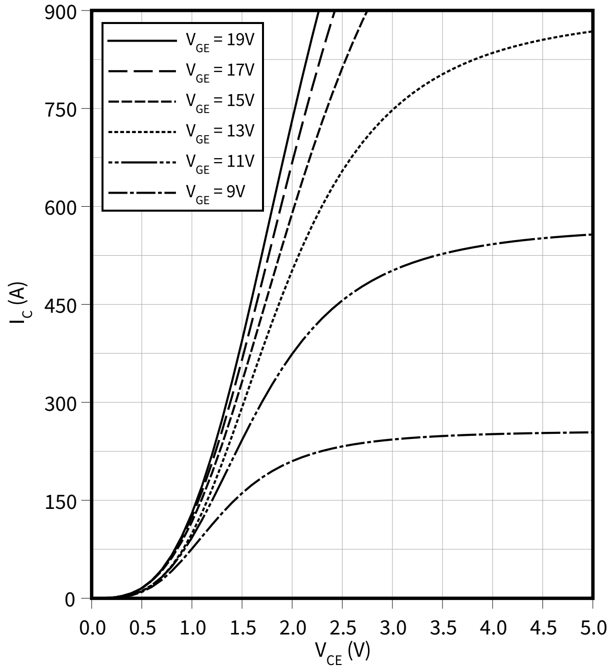
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.*

5 Characteristics diagrams

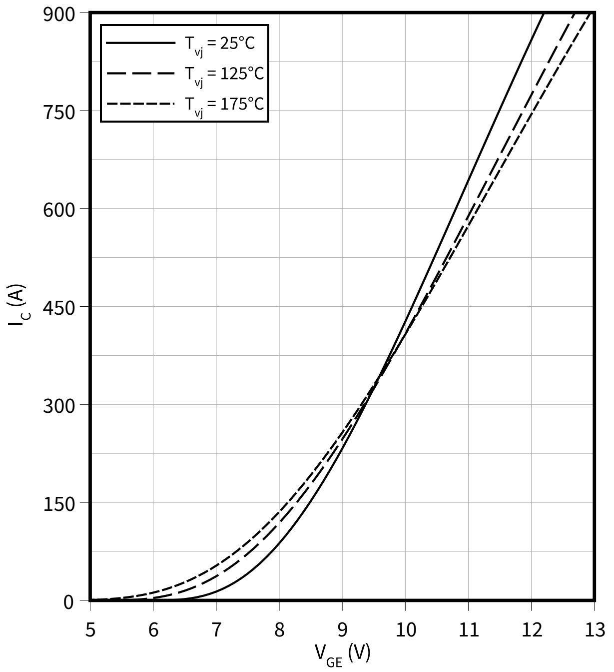
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15\ V$



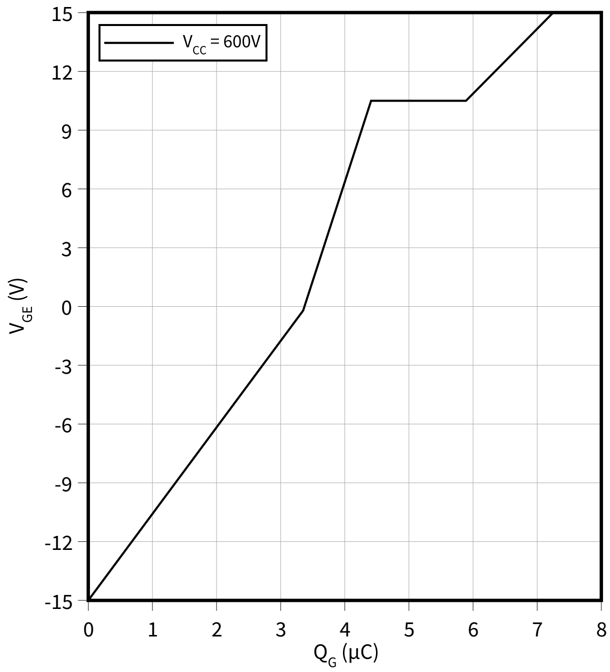
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



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



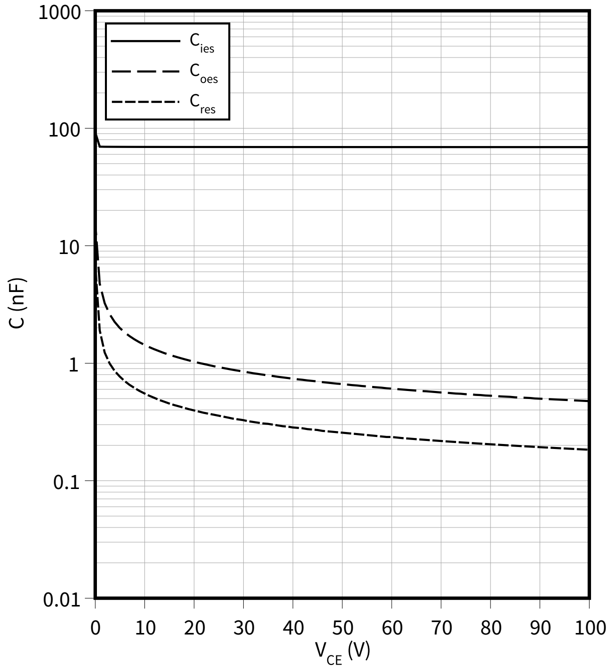
Gate charge characteristic (typical), IGBT, Inverter
$V_{GE} = f(Q_G)$
$I_C = 450\ A,\ T_{vj} = 25\ °C$



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

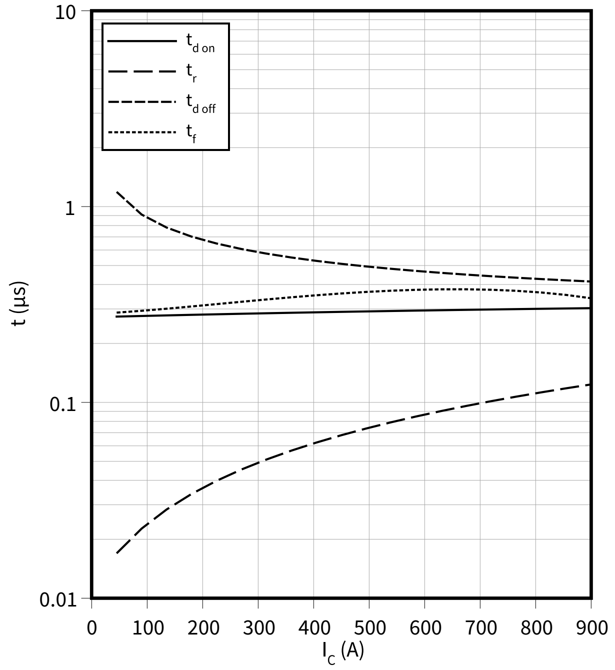
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

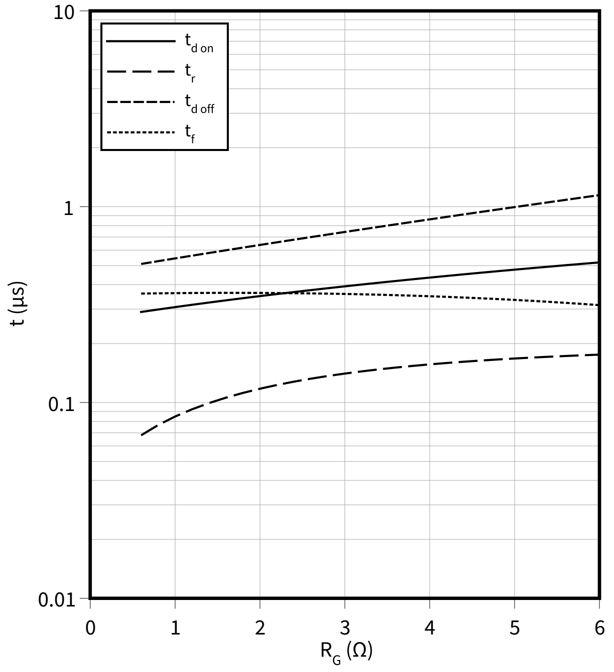
$V_{CC} = 600$ V, $R_{Goff} = 0.6$ Ω, $R_{Gon} = 0.6$ Ω, $V_{GE} = \pm15$ V, $T_{vj} = 175$ °C



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

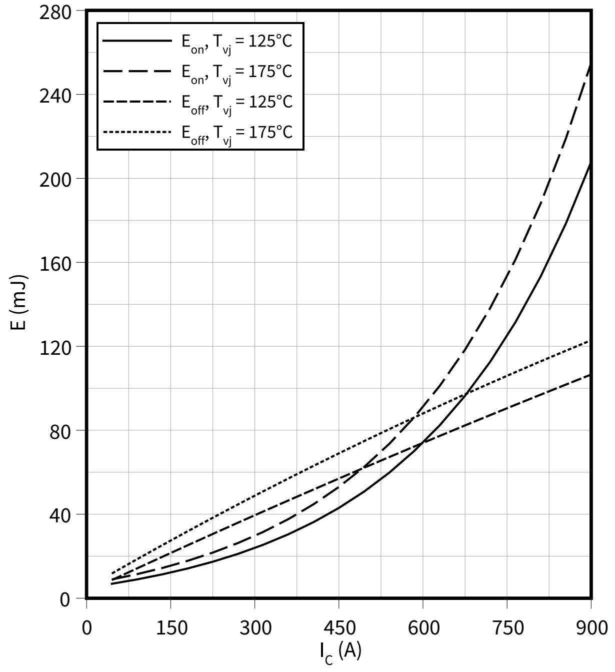
$V_{GE} = \pm15$ V, $I_C = 450$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

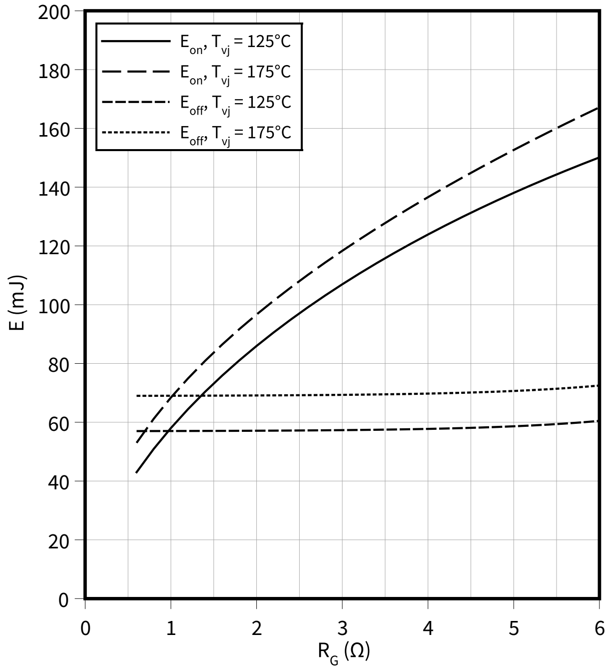
$V_{CC} = 600$ V, $R_{Goff} = 0.6$ Ω, $R_{Gon} = 0.6$ Ω, $V_{GE} = \pm15$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

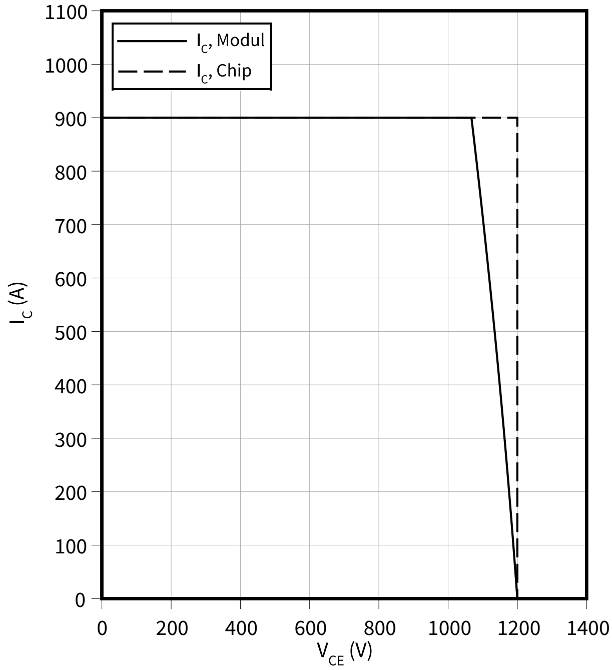
$V_{GE} = \pm15$ V, $I_C = 450$ A, $V_{CC} = 600$ V



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

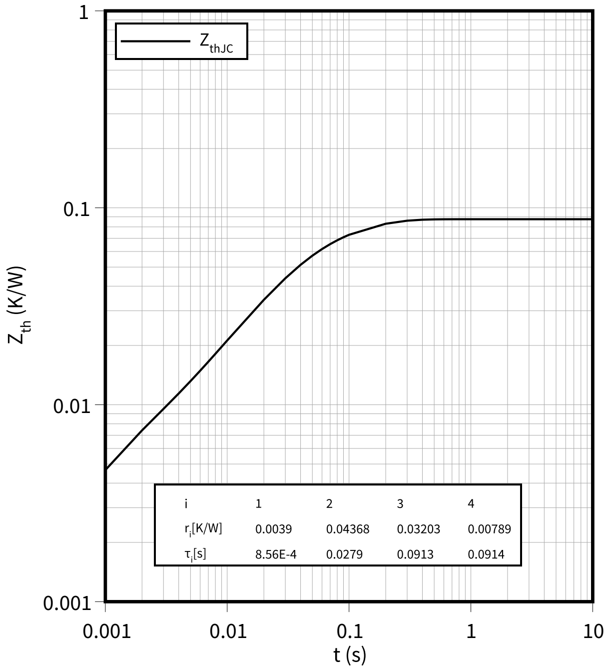
$I_C = f(V_{CE})$

$T_{vj} = 175$ °C, $R_{Goff} = 0.6$ Ω, $V_{GE} = \pm15$ V



Transient thermal impedance, IGBT, Inverter

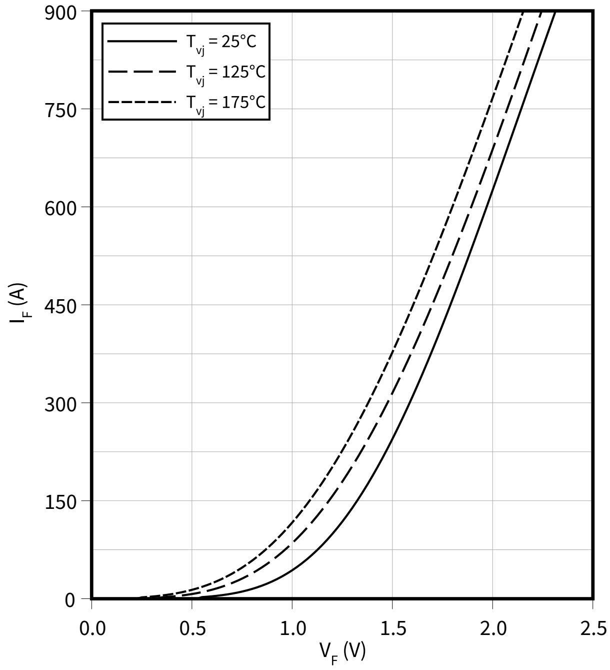
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.0039	0.04368	0.03203	0.00789
τ_i[s]	8.56E-4	0.0279	0.0913	0.0914

Forward characteristic (typical), Diode, Inverter

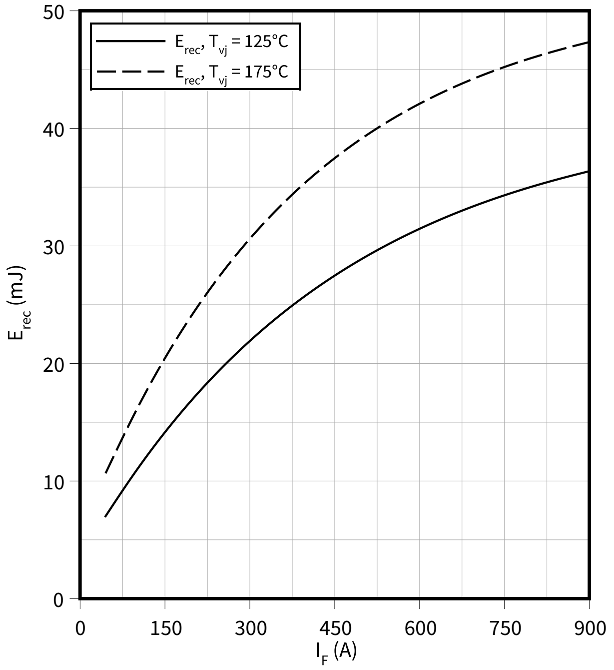
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

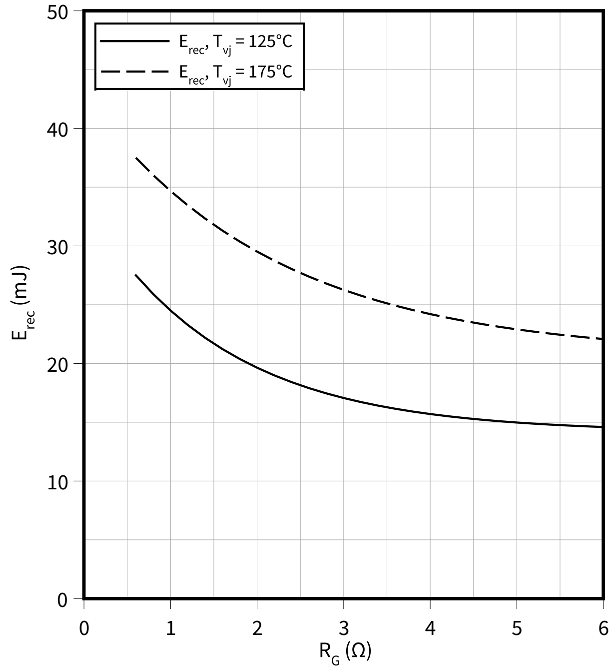
$R_{Gon} = 0.6\ \Omega$, $V_{CE} = 600$ V



Switching losses (typical), Diode, Inverter

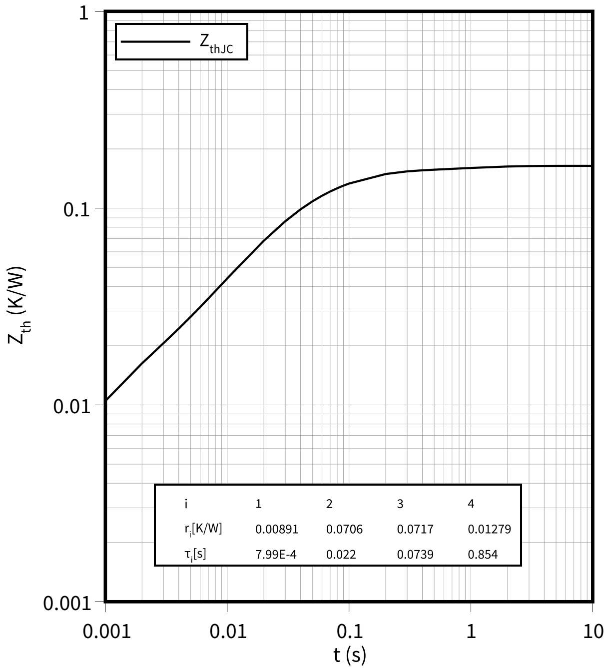
$E_{rec} = f(R_G)$

$V_{CE} = 600$ V, $I_F = 450$ A



Transient thermal impedance, Diode, Inverter

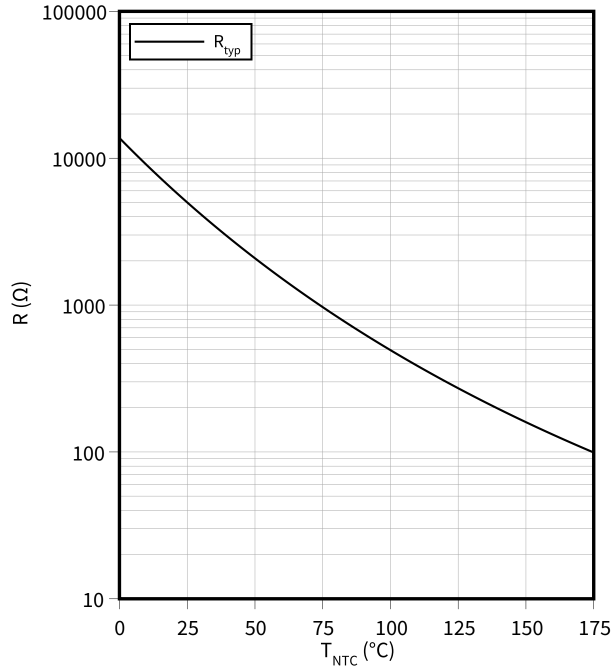
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.00891	0.0706	0.0717	0.01279
τ_i[s]	7.99E-4	0.022	0.0739	0.854

Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

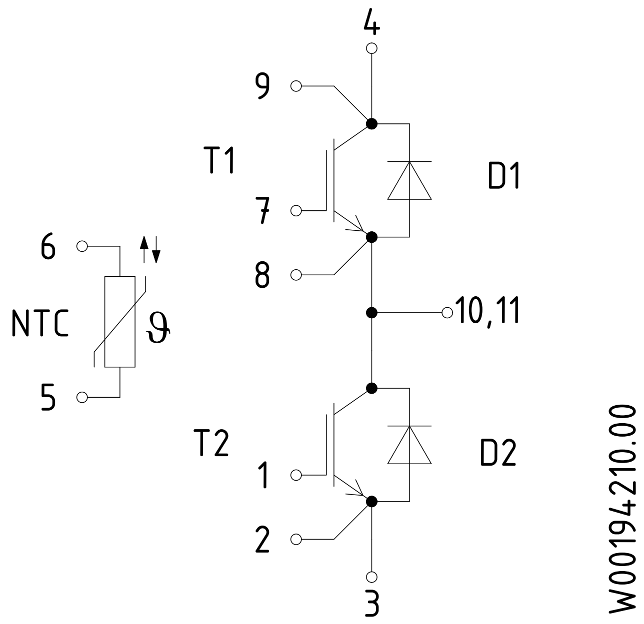


Figure 1

7 Package outlines

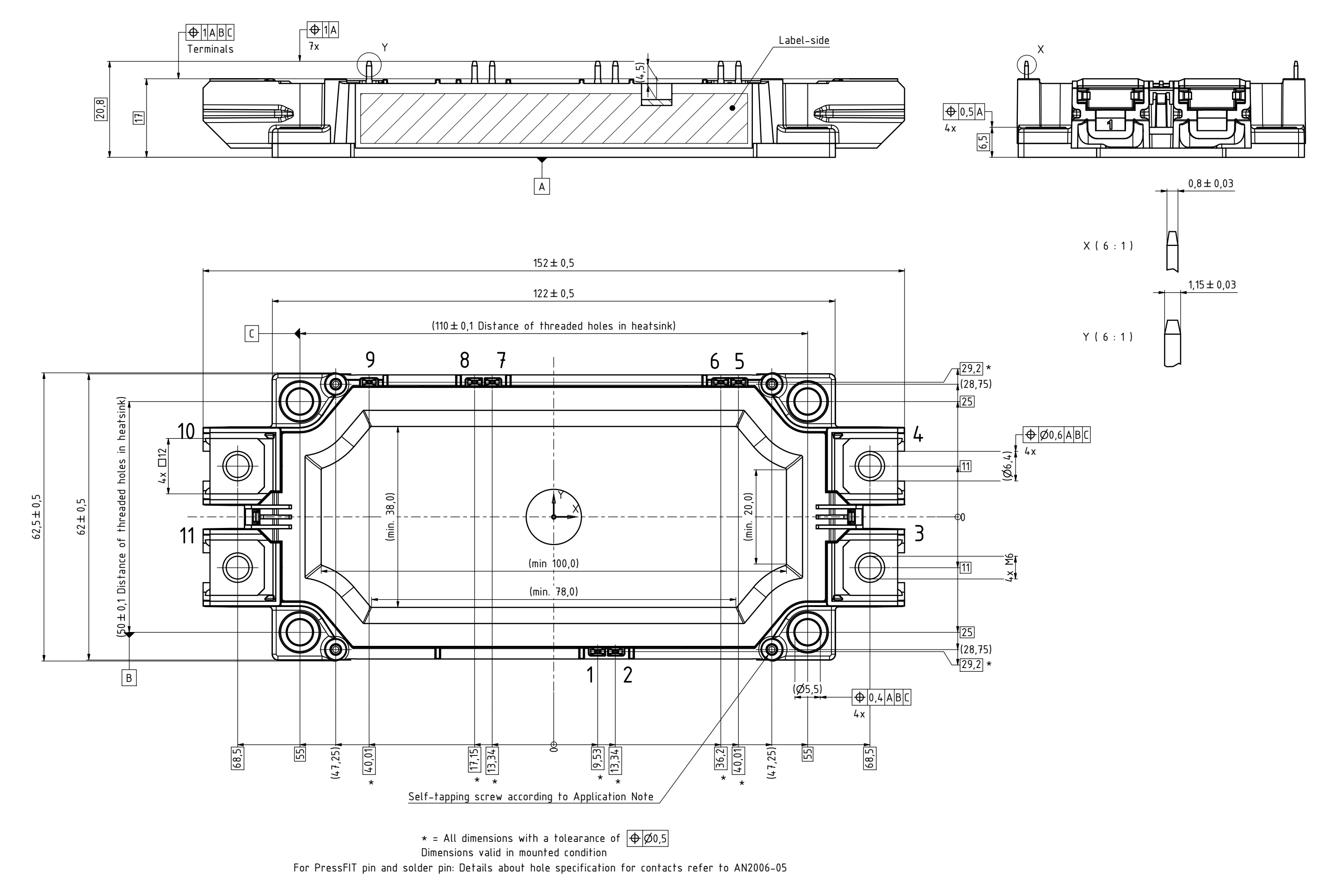


Figure 2

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
1.00	2023-11-16	Initial version
1.10	2024-03-04	Final datasheet

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Edition 2024-03-04

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-ABI645-002