PrimePACK™3+ B-series module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC / pre-applied thermal interface material

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 2400 A / I_{CRM} = 4800 A
  - High current density
  - Low inductive design
  - Low $V_{CE,sat}$
  - $T_{vj,op}$ = 150°C
  - Overload operation up to 175°C
  - TRENCHSTOP™ IGBT7
- Mechanical features
  - High creepage and clearance distances
  - High power density
  - Package with CTI > 400
  - Pre-applied thermal interface material

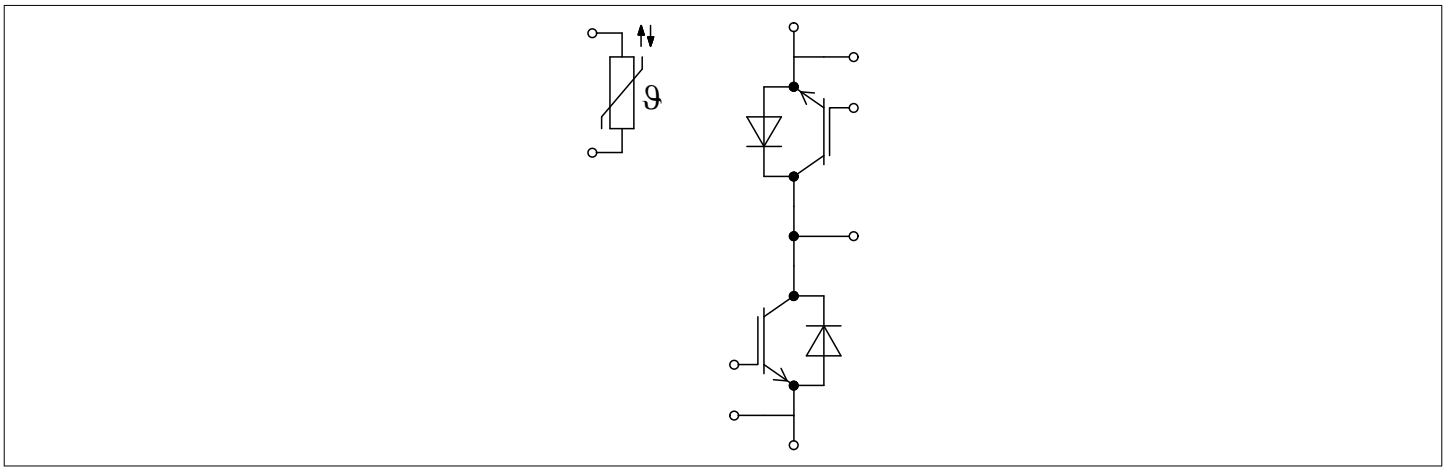
Potential applications

- Three-level applications
- Solar applications
- Energy storage 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	4.0	kV
Material of module baseplate			Cu	
Creepage distance	d_{Creep}	terminal to heatsink	36.0	mm
Creepage distance	d_{Creep}	terminal to terminal	28.0	mm
Clearance	d_{Clear}	terminal to heatsink	21.0	mm
Clearance	d_{Clear}	terminal to terminal	19.0	mm
Comparative tracking index	*CTI*		>400	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Stray inductance module	L_{sCE}				5		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H=25°C, per switch			0.045		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H=25°C, per switch			0.045		mΩ
Storage temperature	T_{stg}			-40		150	°C
Maximum baseplate operation temperature	T_{BPmax}					150	°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	M4, Screw	1.8		2.1	Nm
			M8, Screw	8		10	
Weight	*G*				1400		g

2 IGBT, 3-Level

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	1200	V
Implemented collector current	I_{CN}			2400	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_H = 30 °C	2400	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$	4800	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 = 2400 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.27	1.79	V
			T_{vj} = 125 °C		1.37	1.82	
			T_{vj} = 150 °C		1.40	1.84	
Gate threshold voltage	V_{GEth}	I_C = 48 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			38.1		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0.23		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			325		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			1.92		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			5	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				400	nA
Turn-on delay time (inductive load)	t_{don}	I_C = 2400 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.4 Ω	T_{vj} = 25 °C		0.645		µs
			T_{vj} = 125 °C		0.785		
			T_{vj} = 150 °C		0.820		
Rise time (inductive load)	t_r	I_C = 2400 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Gon} = 0.4 Ω	T_{vj} = 25 °C		0.185		µs
			T_{vj} = 125 °C		0.210		
			T_{vj} = 150 °C		0.215		
Turn-off delay time (inductive load)	t_{doff}	I_C = 2400 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		2.800		µs
			T_{vj} = 125 °C		2.900		
			T_{vj} = 150 °C		3.000		
Fall time (inductive load)	t_f	I_C = 2400 A, V_{CE} = 600 V, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω	T_{vj} = 25 °C		0.205		µs
			T_{vj} = 125 °C		0.245		
			T_{vj} = 150 °C		0.275		
Turn-on energy loss per pulse	E_{on}	I_C = 2400 A, V_{CE} = 600 V, L_σ = 50 nH, V_{GE} = ±15 V, R_{Gon} = 0.4 Ω, di/dt = 9000 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		110		mJ
			T_{vj} = 125 °C		205		
			T_{vj} = 150 °C		240		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 2400 A, V_{CE} = 600 V, L_σ = 50 nH, V_{GE} = ±15 V, R_{Goff} = 3.3 Ω, dv/dt = 1030 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		715		mJ
			T_{vj} = 125 °C		845		
			T_{vj} = 150 °C		890		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material				27.6	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: R_{thJH} max. value is valid for T_C= 110 °C.

3 Diode, 3-Level

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			2400	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		4800	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 2400 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.70	2.03	V
			T_{vj} = 125 °C		1.65	1.96	
			T_{vj} = 150 °C		1.60	1.94	
Peak reverse recovery current	I_{RM}	I_F = 2400 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 6850 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		735		A
			T_{vj} = 125 °C		885		
			T_{vj} = 150 °C		895		
Recovered charge	Q_r	I_F = 2400 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 6850 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		210		µC
			T_{vj} = 125 °C		410		
			T_{vj} = 150 °C		475		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Reverse recovery energy	E_{rec}	I_F = 2400 A, V_R = 600 V, V_{GE} = -15 V, -di$_F$/dt = 6850 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		80		mJ
			T_{vj} = 125 °C		150		
			T_{vj} = 150 °C		170		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material				46.4	K/kW
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: Dynamic data for 3-level valid in conjunction with datasheet FF1800R23IE7, version 1.0.

$T_{vj\,op}$ up to 175 °C is allowed for operations in overload conditions. For detailed specifications please refer to AN2021-11.

R_{thJH} max. value is valid for T_C= 95 °C.

4 NTC-Thermistor

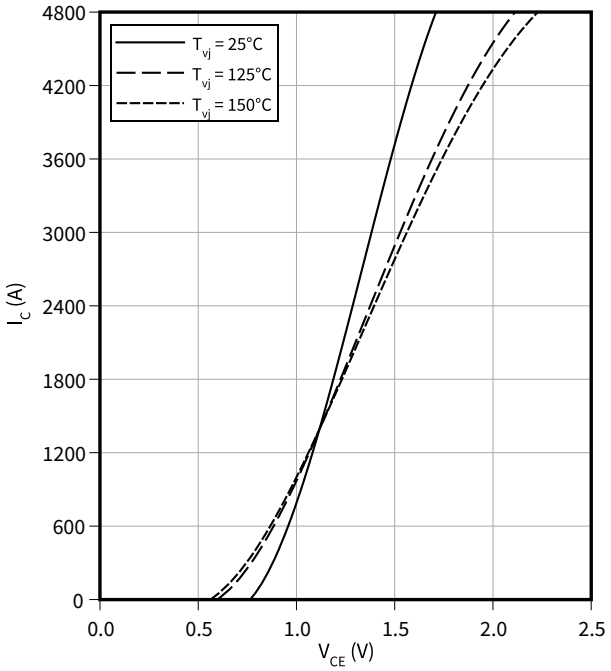
Table 7 Characteristic values

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

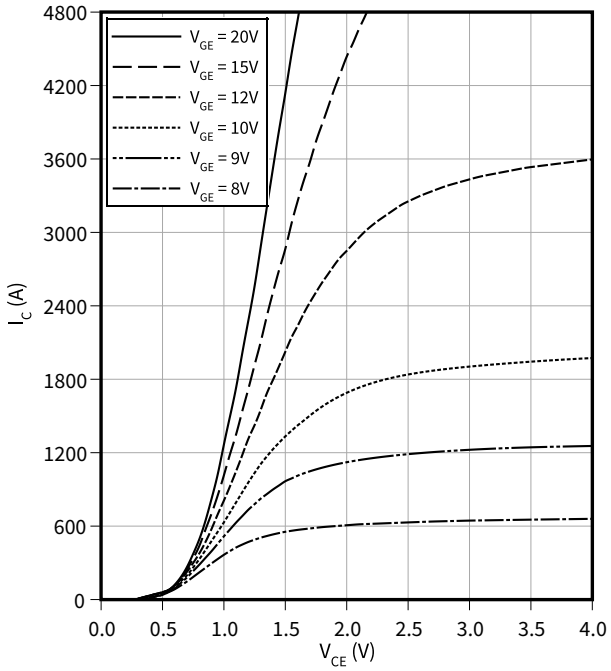
Note: For detailed specifications please refer to AN2009-10.

5 Characteristics diagrams

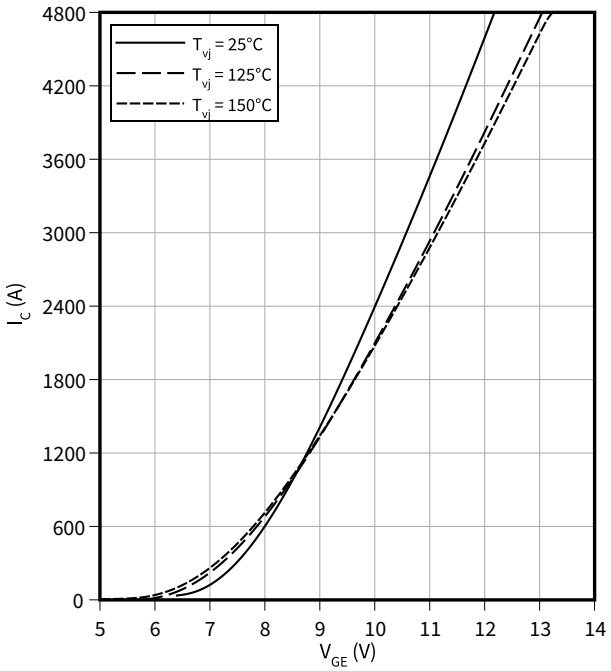
Output characteristic (typical), IGBT, 3-Level
$I_C = f(V_{CE})$
V_{GE} = 15 V



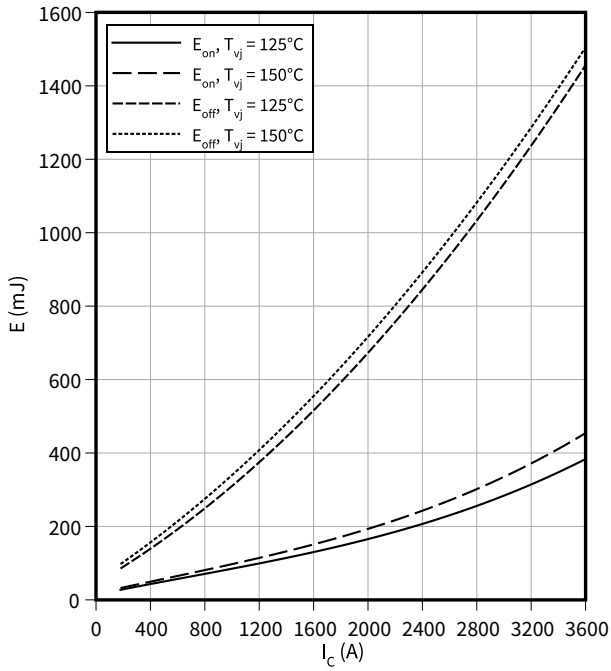
Output characteristic field (typical), IGBT, 3-Level
$I_C = f(V_{CE})$
T_{vj} = 150 °C



Transfer characteristic (typical), IGBT, 3-Level
$I_C = f(V_{GE})$
V_{CE} = 20 V



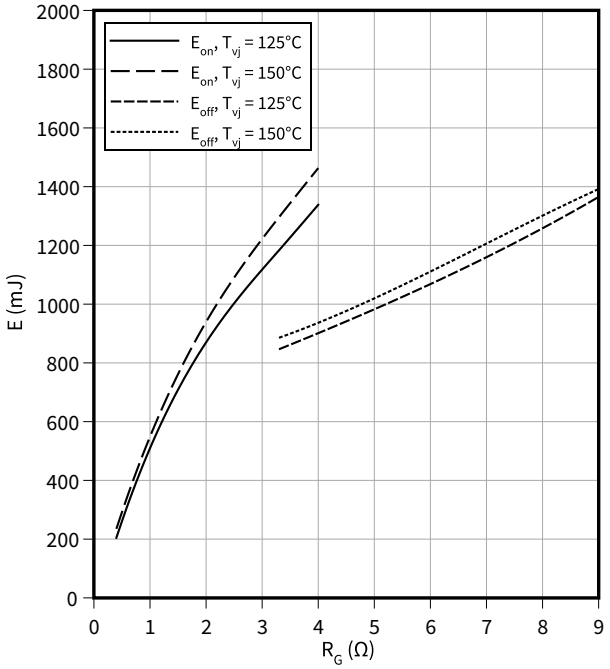
Switching losses (typical), IGBT, 3-Level
$E = f(I_C)$
R_{Goff} = 3.3 Ω, R_{Gon} = 0.4 Ω, V_{CE} = 600 V, V_{GE} = ± 15 V
Ic is limited to 3600A by FF1800R23IE7 module.



Switching losses (typical), IGBT, 3-Level

$E = f(R_G)$

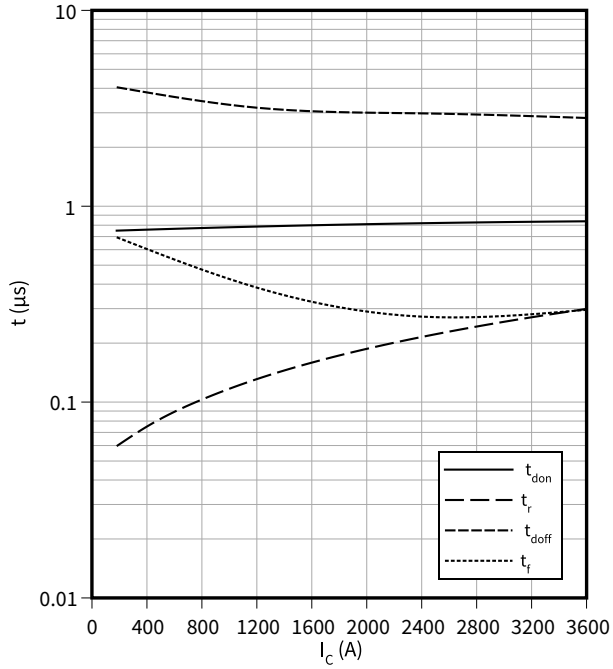
$I_C = 2400\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$



Switching times (typical), IGBT, 3-Level

$t = f(I_C)$

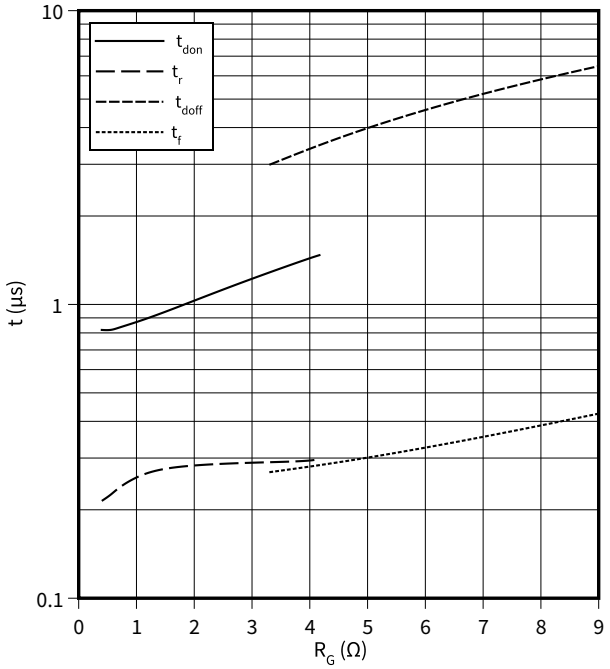
$R_{Goff} = 3.3\ \Omega$, $R_{Gon} = 0.4\ \Omega$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 150\ °C$



Switching times (typical), IGBT, 3-Level

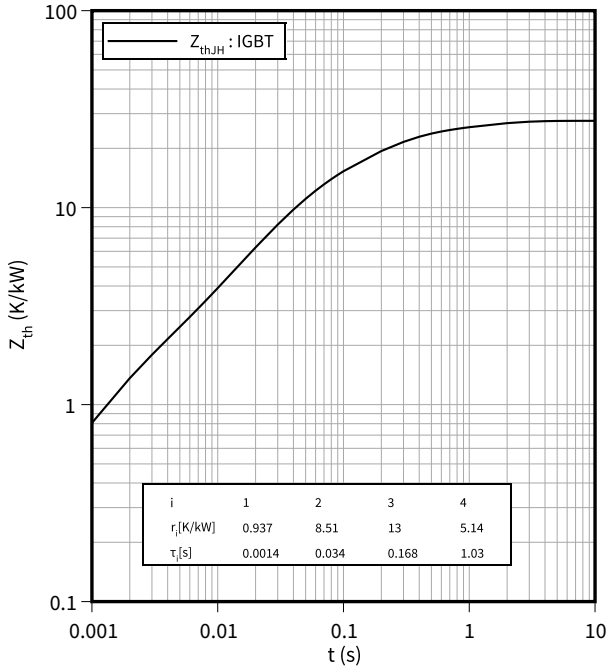
$t = f(R_G)$

$I_C = 2400\ A$, $V_{CE} = 600\ V$, $V_{GE} = \pm 15\ V$, $T_{vj} = 150\ °C$



Transient thermal impedance , IGBT, 3-Level

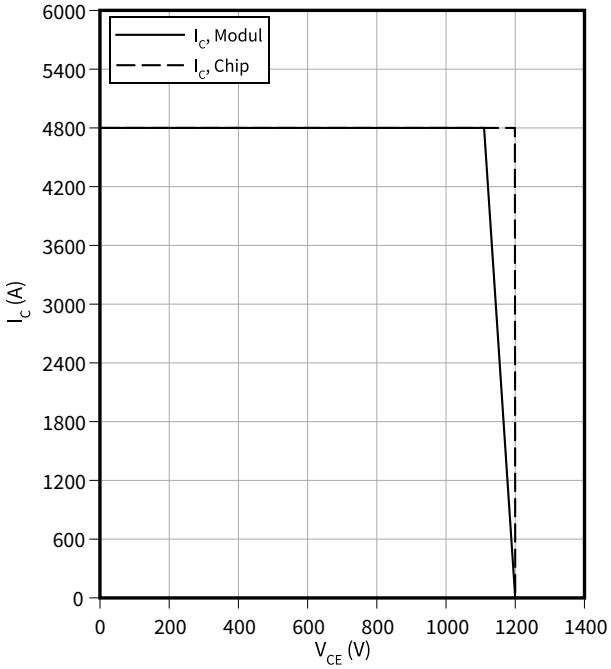
$Z_{th} = f(t)$



Reverse bias safe operating area (RBSOA), IGBT, 3-Level

$I_C = f(V_{CE})$

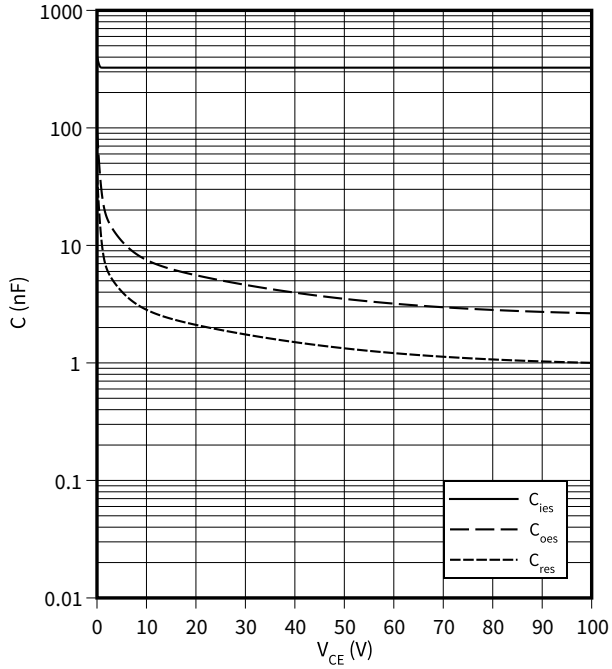
$R_{Goff} = 3.3\ \Omega$, $V_{GE} = 15$ V, $T_{vj} = 150$ °C



Capacity characteristic (typical), IGBT, 3-Level

$C = f(V_{CE})$

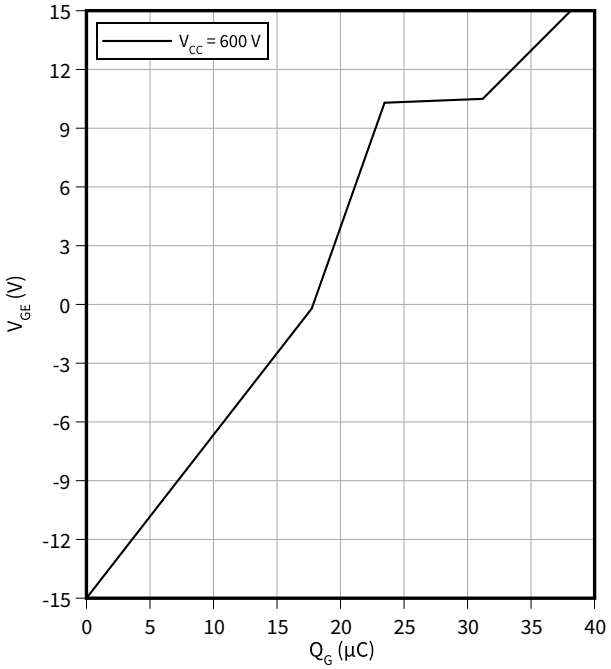
$f = 100$ kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, 3-Level

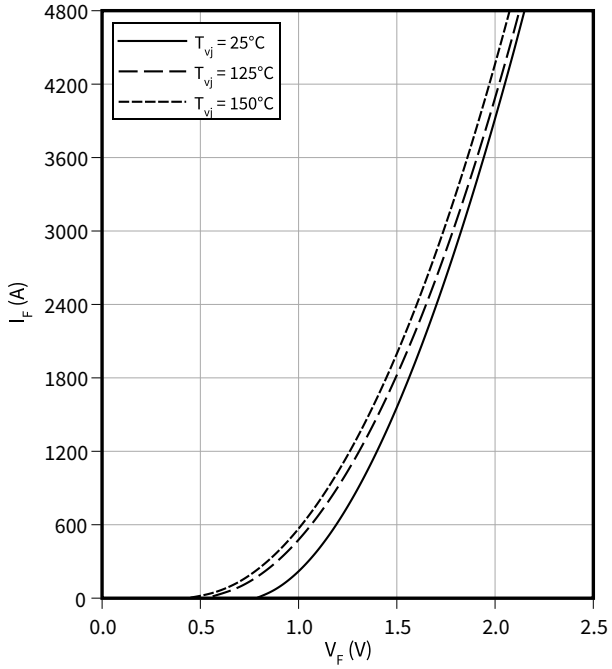
$V_{GE} = f(Q_G)$

$I_C = 2400$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, 3-Level

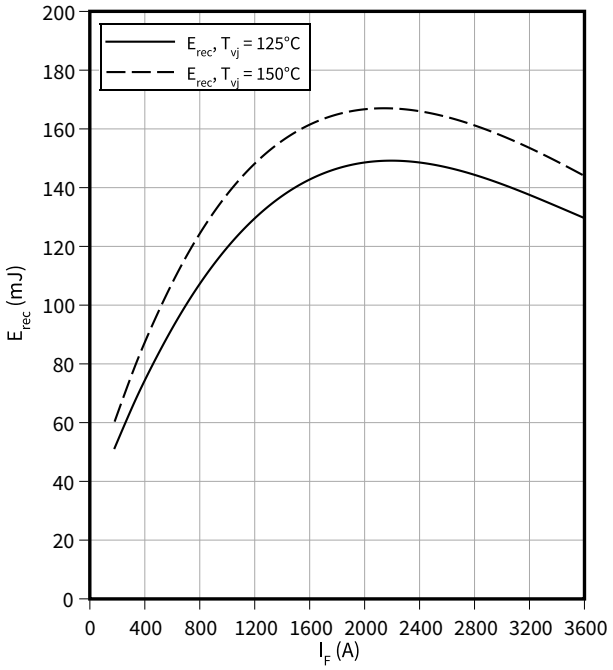
$I_F = f(V_F)$



Switching losses (typical), Diode, 3-Level

$E_{rec} = f(I_F)$

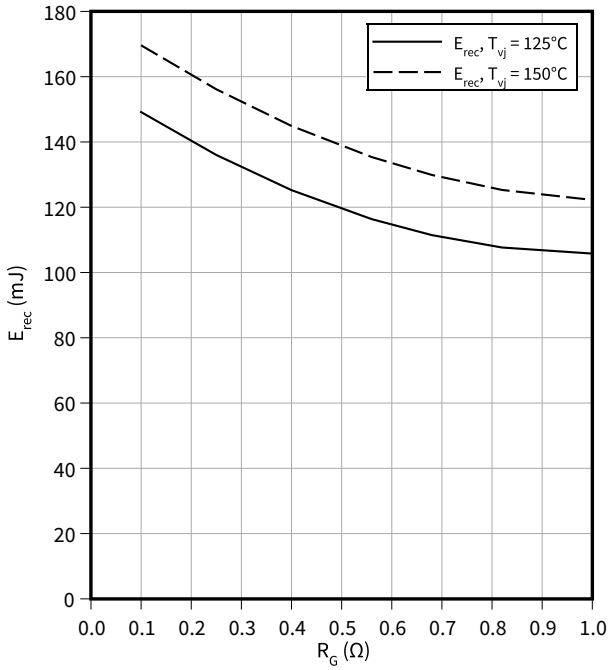
$V_{CE} = 600\ V$, $R_{Gon} = R_{Gon}(IGBT)$



Switching losses (typical), Diode, 3-Level

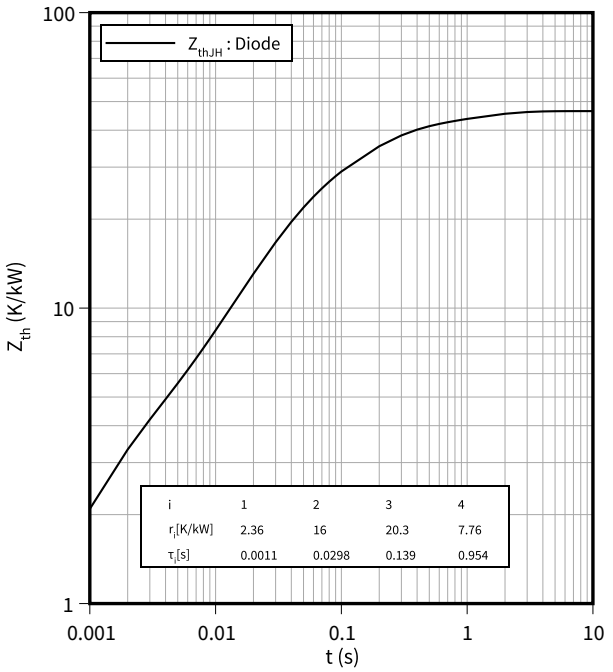
$E_{rec} = f(R_G)$

$V_{CE} = 600\ V$, $I_F = 2400\ A$



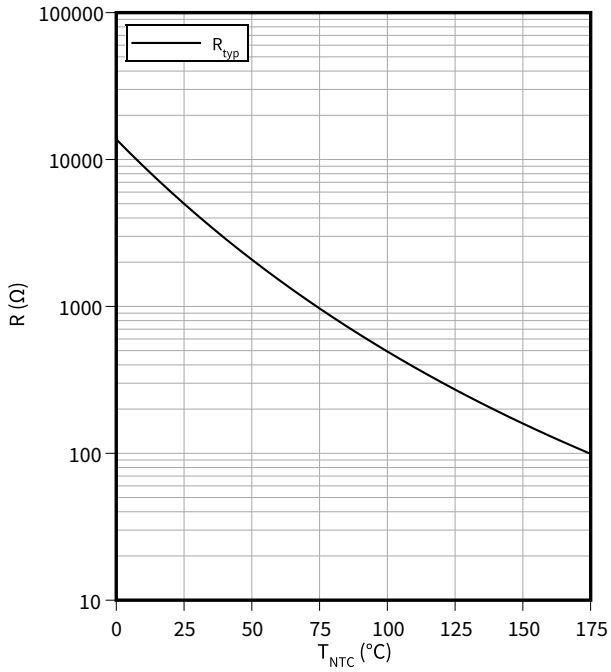
Transient thermal impedance, Diode, 3-Level

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6 Circuit diagram

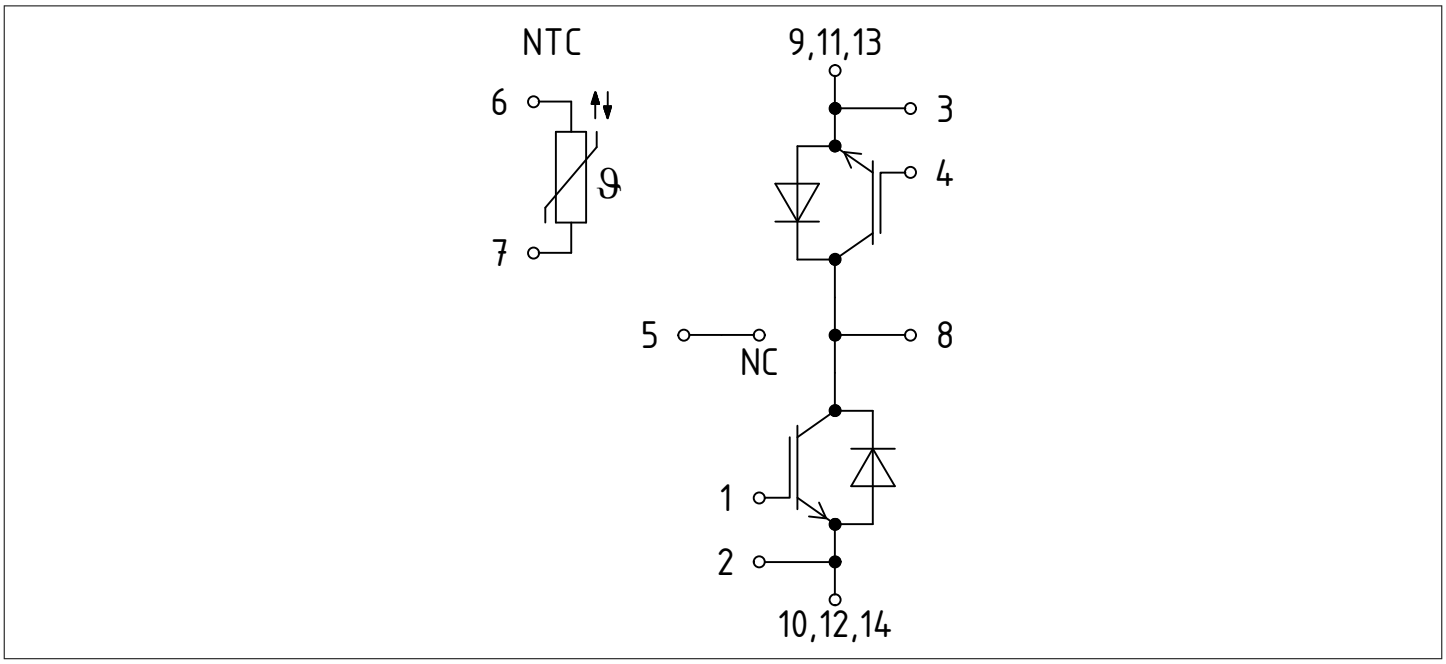


Figure 1

7 Package outlines

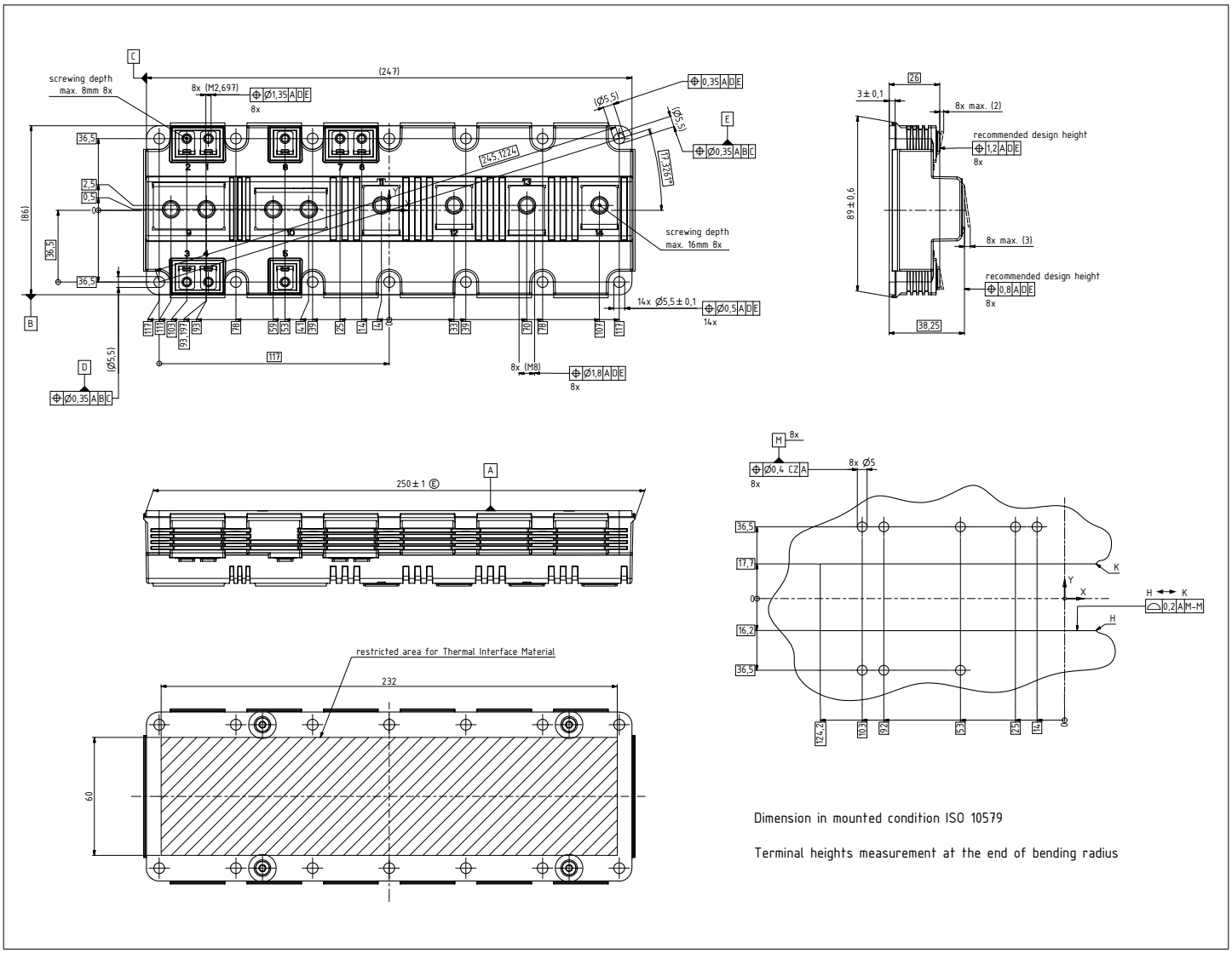


Figure 2

8 Module label code

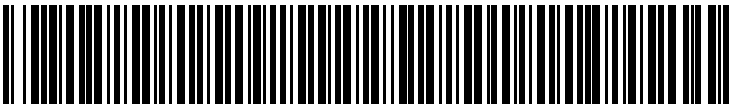
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production week)	*Digit* 1 – 5 6 - 11 12 - 19 20 – 21 22 – 23	*Example* 71549 142846 55054991 15 30
Example	 7154914284655054991530	 7154914284655054991530	

Figure 3

Revision history

Document revision	Date of release	Description of changes
1.00	2021-04-15	Final datasheet
1.10	2022-03-17	Final datasheet - update to FF1800R23IE7 Rev. 1.0; Extension of diagrams to 4800A (except of dynamic data, which is limited by FF1800R23IE7)

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Edition 2022-03-17

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-ABA765-002

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