Preliminary datasheet
EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC

Features

- Electrical features
  - V_{DSS} = 1200 V
  - I_{DN} = 100 A / I_{DRM} = 200 A
  - Increased DC-link voltage
  - High current density
  - Low switching losses
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - PressFIT contact technology
  - Integrated NTC temperature sensor

Potential applications

- Three-level applications
- High-frequency switching application
- Solar applications

Product validation

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

Description

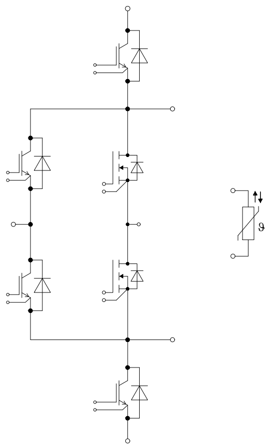


Table of contents

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	3.0	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	
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}			15		nH
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	*F*		40		80	N
Weight	*G*			39		g

Note: The current under continuous operation is limited to 25 A rms per connector pin.

2 MOSFET

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Drain-source voltage	V_{DSS}		T_{vj} = 25 °C	1200	V
Implemented drain current	I_{DN}			100	A
Continuous DC drain current	I_{DDC}	T_{vj} = 175 °C, V_{GS} = 15 V	T_H = 65 °C	85	A
Repetitive peak drain current	I_{DRM}	verified by design, t_p limited by T_{vjmax}		200	A
Gate-source voltage, max. transient voltage	V_{GS}	D < 0.01		-10/23	V

Table 4 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Drain-source on-resistance	$R_{DS(on)}$	I_D = 100 A	V_{GS} = 15 V, T_{vj} = 25 °C		11.3		mΩ
			V_{GS} = 15 V, T_{vj} = 125 °C		14.8		
			V_{GS} = 15 V, T_{vj} = 150 °C		16.5		
Gate threshold voltage	$V_{GS(th)}$	I_D = 40 mA, V_{DS} = V_{GS}, T_{vj} = 25 °C, (tested after 1ms pulse at V_{GS} = +20 V)		3.45	4.5	5.15	V
Total gate charge	Q_G	V_{DD} = 800 V, V_{GS} = -5/15 V			0.277		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			2		Ω
Input capacitance	C_{ISS}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		8.8		nF
Output capacitance	C_{OSS}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.42		nF
Reverse transfer capacitance	C_{rss}	f = 100 kHz, V_{DS} = 800 V, V_{GS} = 0 V	T_{vj} = 25 °C		0.028		nF
C_{OSS} stored energy	E_{OSS}	V_{DS} = 800 V, V_{GS} = -5/15 V, T_{vj} = 25 °C			176		µJ
Drain-source leakage current	I_{DSS}	V_{DS} = 1200 V, V_{GS} = -5 V	T_{vj} = 25 °C		0.4	380	µA
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V, T_{vj} = 25 °C	V_{GS} = 20 V			400	nA
Turn-on delay time (inductive load)	$t_{d\,on}$	I_D = 100 A, R_{Gon} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		45.1		ns
			T_{vj} = 125 °C		43.9		
			T_{vj} = 150 °C		42		
Rise time (inductive load)	t_r	I_D = 100 A, R_{Gon} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		25.5		ns
			T_{vj} = 125 °C		25.3		
			T_{vj} = 150 °C		24.4		
Turn-off delay time (inductive load)	$t_{d\,off}$	I_D = 100 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		84.2		ns
			T_{vj} = 125 °C		86.7		
			T_{vj} = 150 °C		87.5		
Fall time (inductive load)	t_f	I_D = 100 A, R_{Goff} = 3.9 Ω, V_{DD} = 600 V, V_{GS} = -5/15 V	T_{vj} = 25 °C		32.2		ns
			T_{vj} = 125 °C		35.5		
			T_{vj} = 150 °C		37.3		
Turn-on energy loss per pulse	E_{on}	I_D = 100 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -5/15 V, R_{Gon} = 3.9 Ω, di/dt = 4.5 kA/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1		mJ
			T_{vj} = 125 °C		1.15		
			T_{vj} = 150 °C		1.24		

(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_D = 100 A, V_{DD} = 600 V, L_σ = 35 nH, V_{GS} = -5/15 V, R_{Goff} = 3.9 Ω, dv/dt = 21 kV/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1.62		mJ
			T_{vj} = 125 °C		1.85		
			T_{vj} = 150 °C		1.93		
Thermal resistance, junction to heat sink	R_{thJH}	per MOSFET			0.58		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

Note: The selection of positive and negative gate-source voltages impacts losses and the long-term behavior of the MOSFET and body diode. The design guidelines described in Application Note AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

3 Body diode

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
DC body diode forward current	I_{SD}	T_{vj} = 175 °C, V_{GS} = -5 V	T_H = 20 °C	32	A

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_{SD}	I_{SD} = 100 A, V_{GS} = -5 V	T_{vj} = 25 °C		4.6	5.65	V
			T_{vj} = 125 °C		4.35		
			T_{vj} = 150 °C		4.3		

4 IGBT, 3-Level

Table 7 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}			100	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	60	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		200	A

(table continues...)

Table 7 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Gate-emitter peak voltage	V_{GES}		±20	V

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 100 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	TBD	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
Gate threshold voltage	V_{GEth}	I_C = 2.5 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			1.8		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.5		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			21.7		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.076		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.009	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 = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω	T_{vj} = 25 °C		0.153		µs
			T_{vj} = 125 °C		0.166		
			T_{vj} = 175 °C		0.174		
Rise time (inductive load)	t_r	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω	T_{vj} = 25 °C		0.033		µs
			T_{vj} = 125 °C		0.037		
			T_{vj} = 175 °C		0.040		
Turn-off delay time (inductive load)	t_{doff}	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω	T_{vj} = 25 °C		0.283		µs
			T_{vj} = 125 °C		0.368		
			T_{vj} = 175 °C		0.421		
Fall time (inductive load)	t_f	I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω	T_{vj} = 25 °C		0.149		µs
			T_{vj} = 125 °C		0.221		
			T_{vj} = 175 °C		0.273		
Turn-on energy loss per pulse	E_{on}	I_C = 100 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 1.8 Ω, di/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.75		mJ
			T_{vj} = 125 °C		9.8		
			T_{vj} = 175 °C		11.5		

(table continues...)

Table 8 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 100 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 1.8 Ω, dv/dt = 2700 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.6		mJ
			T_{vj} = 125 °C		10.2		
			T_{vj} = 175 °C		12.7		
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		370		A
			t_P ≤ 7 µs, T_{vj} ≤ 175 °C		350		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT			0.920		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*

5 Diode, 3-Level

Table 9 **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			100	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		200	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	970	A^2s
			T_{vj} = 175 °C	860	

Table 10 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 100 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.72	TBD	V
			T_{vj} = 125 °C		1.59		
			T_{vj} = 175 °C		1.52		

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 100 A, V_{GE} = -15 V, -di_F/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		95.5		A
			T_{vj} = 125 °C		119		
			T_{vj} = 175 °C		134		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 100 A, V_{GE} = -15 V, -di_F/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		8.64		µC
			T_{vj} = 125 °C		15.1		
			T_{vj} = 175 °C		20		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 100 A, V_{GE} = -15 V, -di_F/dt = 2400 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.13		mJ
			T_{vj} = 125 °C		5.83		
			T_{vj} = 175 °C		7.58		
Thermal resistance, junction to heat sink	R_{thJH}	per diode			1.03		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.*

6 NTC-Thermistor

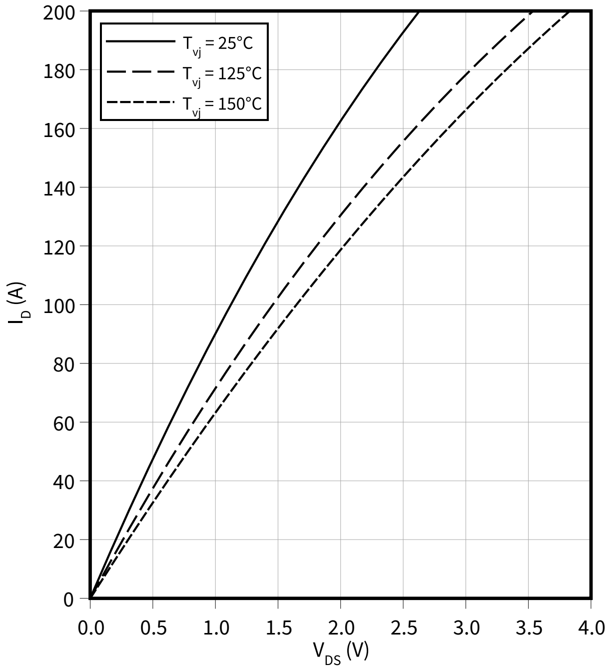
Table 11 Characteristic values

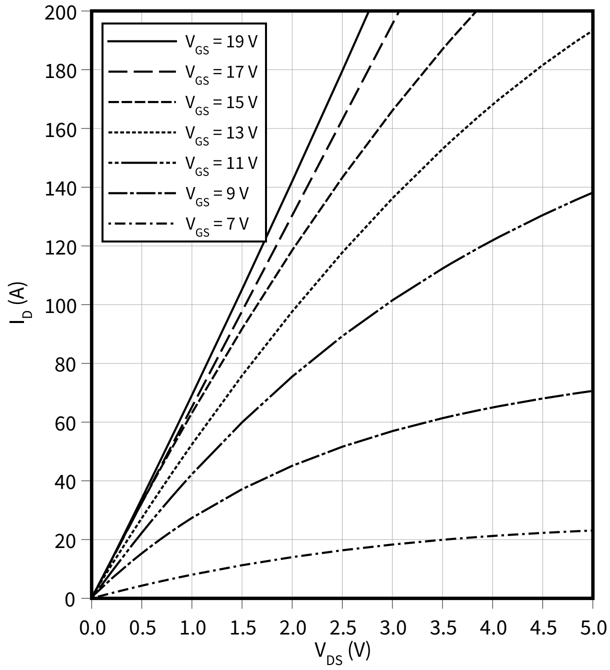
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C		5		kΩ
Deviation of R_{100}	$\Delta R/R$	T_{NTC} = 100 °C, R_{100} = 493 Ω	-5		5	%
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2-1/(298,15\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

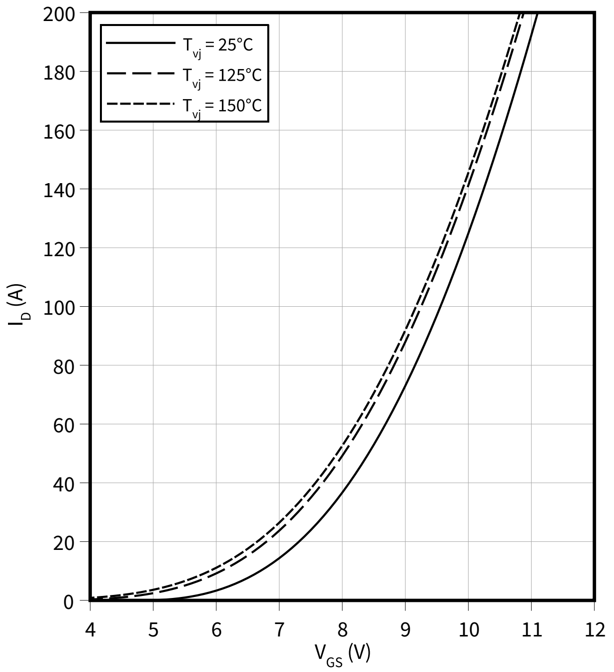
7 Characteristics diagrams

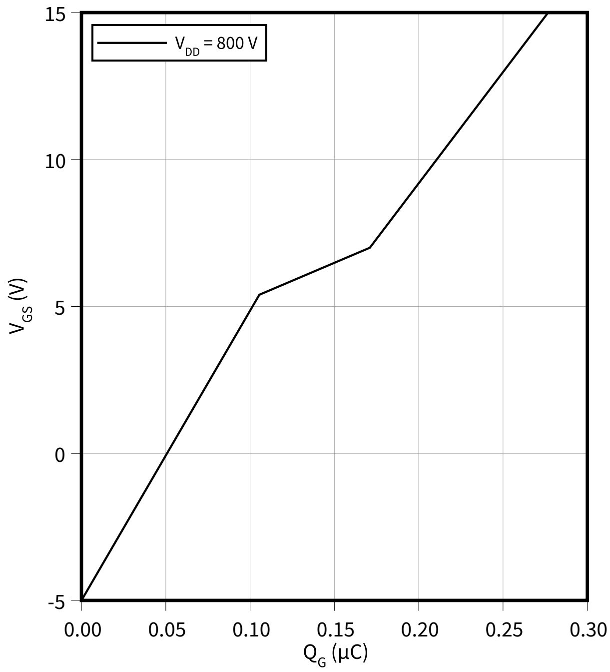
Output characteristic (typical), MOSFET	Output characteristic field (typical), MOSFET
$I_D = f(V_{DS})$	$I_D = f(V_{DS})$
$V_{GS} = 15$ V	$T_{vj} = 150$ °C





Transfer characteristic (typical), MOSFET	Gate charge characteristic (typical), MOSFET
$I_D = f(V_{GS})$	$V_{GS} = f(Q_G)$
$V_{DS} = 20$ V	$I_D = 100$ A, $T_{vj} = 25$ °C

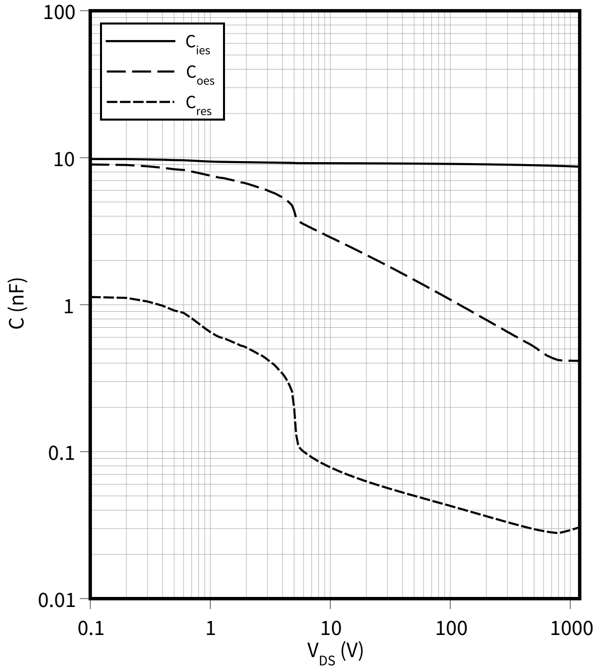




Capacity characteristic (typical), MOSFET

$C = f(V_{DS})$

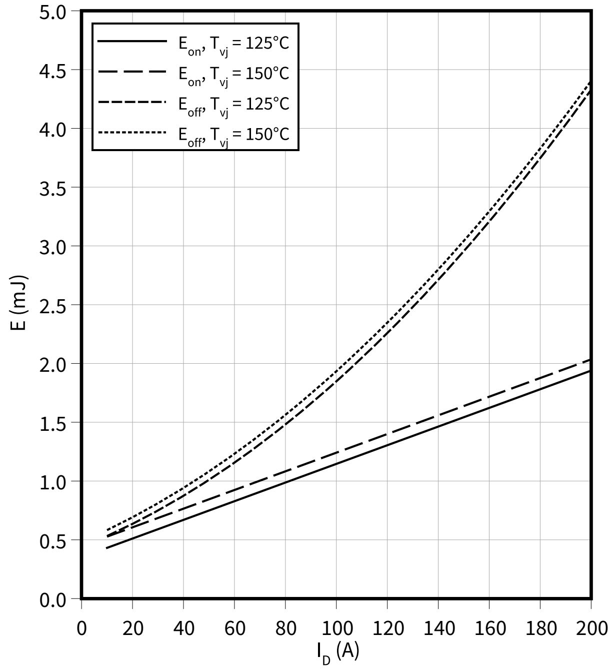
$f = 100$ kHz, $T_{vj} = 25$ °C, $V_{GS} = 0$ V



Switching losses (typical), MOSFET

$E = f(I_D)$

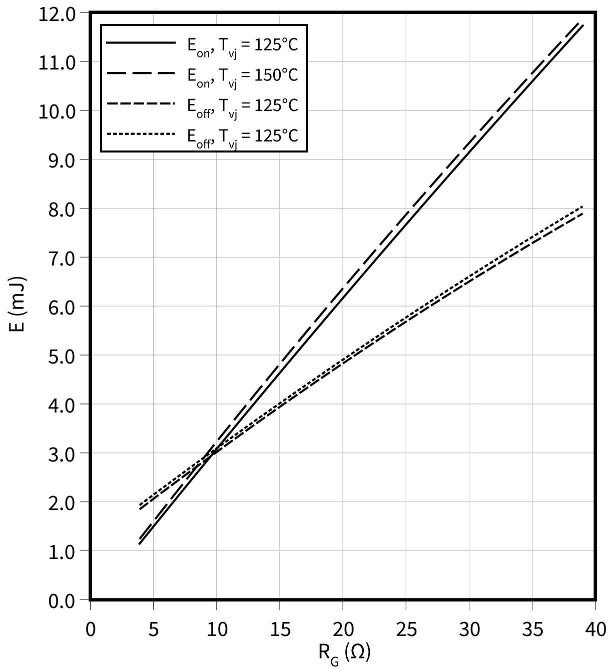
$R_{Goff} = 3.9\ \Omega$, $R_{Gon} = 3.9\ \Omega$, $V_{DS} = 600$ V, $V_{GS} = -5/15$ V



Switching losses (typical), MOSFET

$E = f(R_G)$

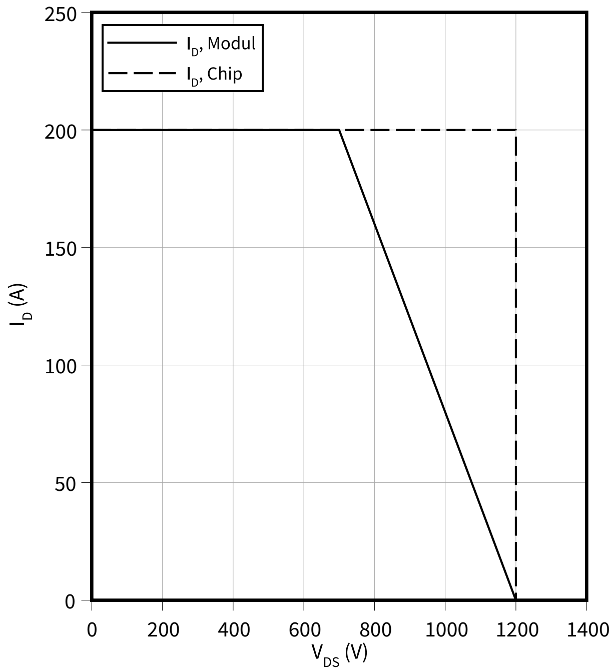
$V_{DS} = 600$ V, $I_D = 100$ A, $V_{GS} = -5/15$ V



Reverse bias safe operating area (RBSOA), MOSFET

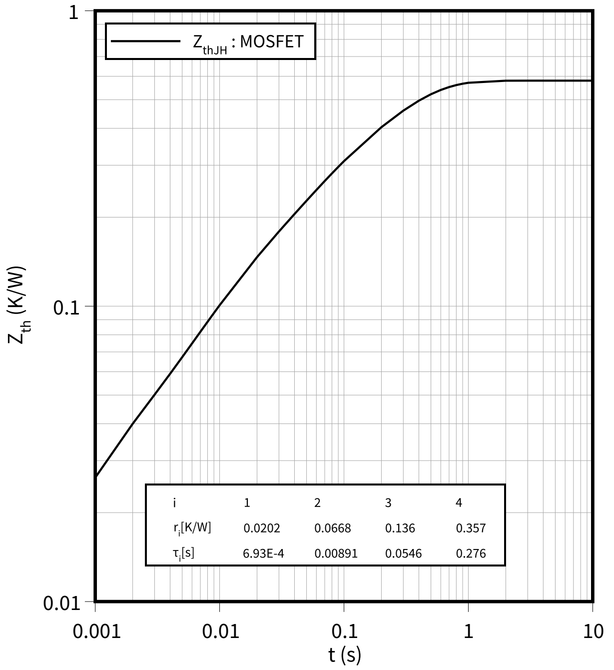
$I_D = f(V_{DS})$

$R_{Goff} = 3.9\ \Omega$, $T_{vj} = 150$ °C, $V_{GS} = -5/15$ V



Transient thermal impedance , MOSFET

$Z_{th} = f(t)$

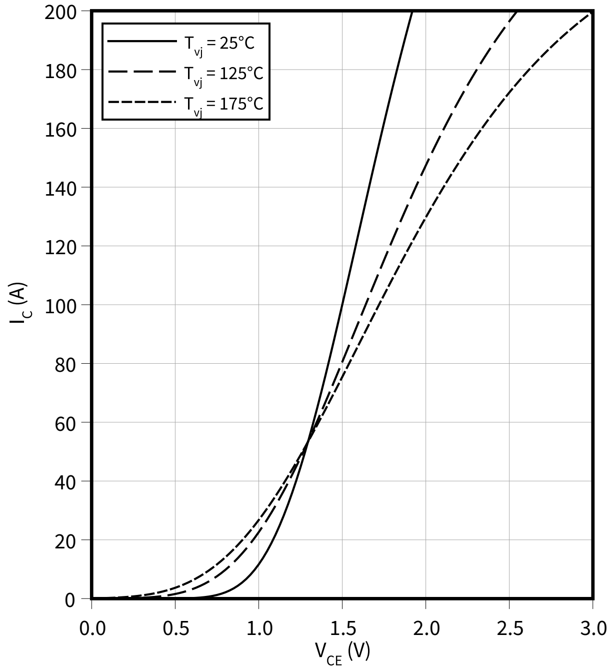


i	1	2	3	4
r_i[K/W]	0.0202	0.0668	0.136	0.357
τ_i[s]	6.93E-4	0.00891	0.0546	0.276

Output characteristic (typical), IGBT, 3-Level

$I_C = f(V_{CE})$

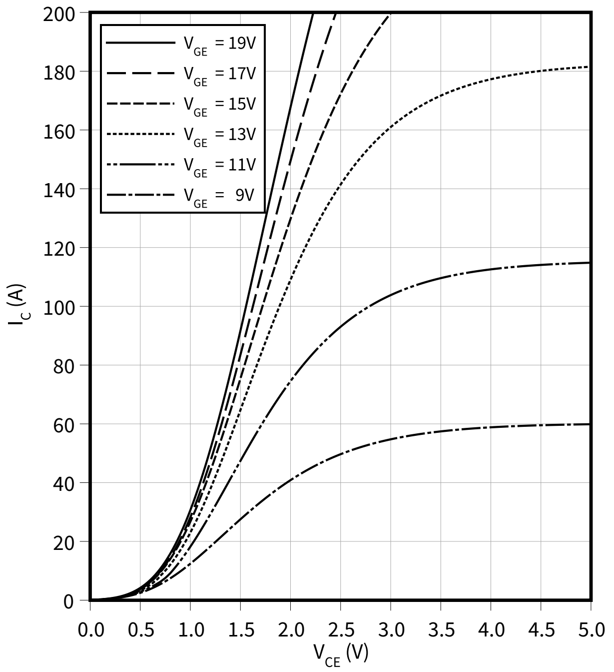
$V_{GE} = 15$ V



Output characteristic field (typical), IGBT, 3-Level

$I_C = f(V_{CE})$

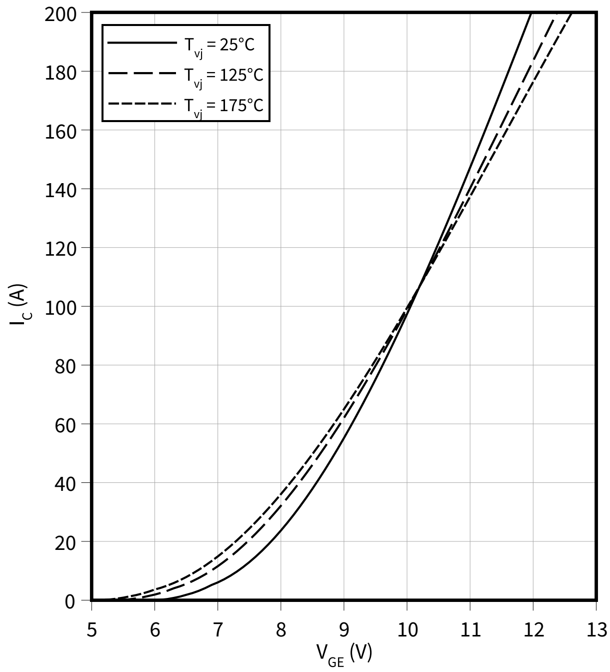
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, 3-Level

$I_C = f(V_{GE})$

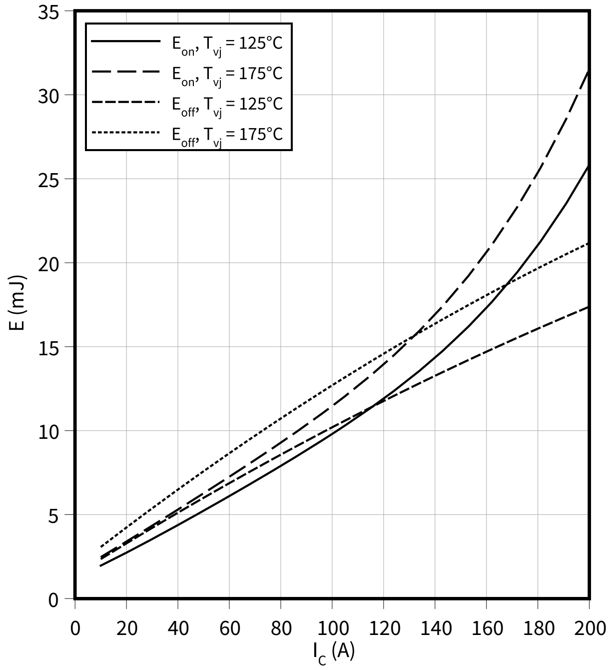
$V_{CE} = 20$ V



Switching losses (typical), IGBT, 3-Level

$E = f(I_C)$

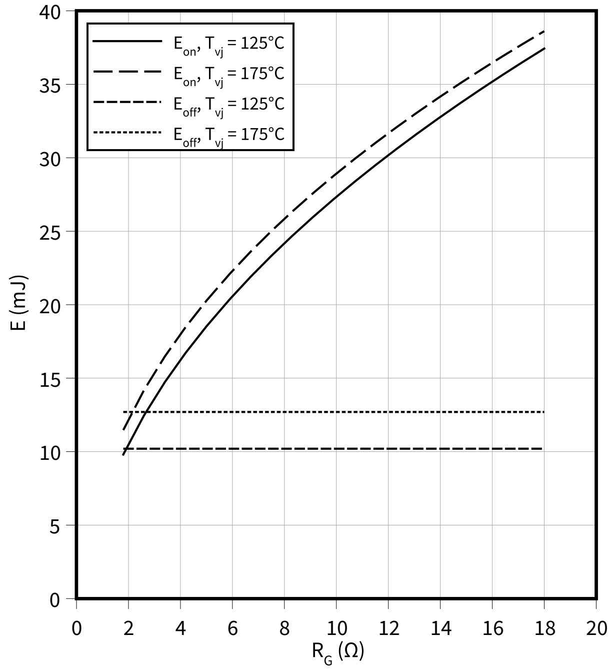
R_{Goff} = 1.8 Ω, R_{Gon} = 1.8 Ω, V_{CC} = 600 V, V_{GE} = ± 15 V



Switching losses (typical), IGBT, 3-Level

$E = f(R_G)$

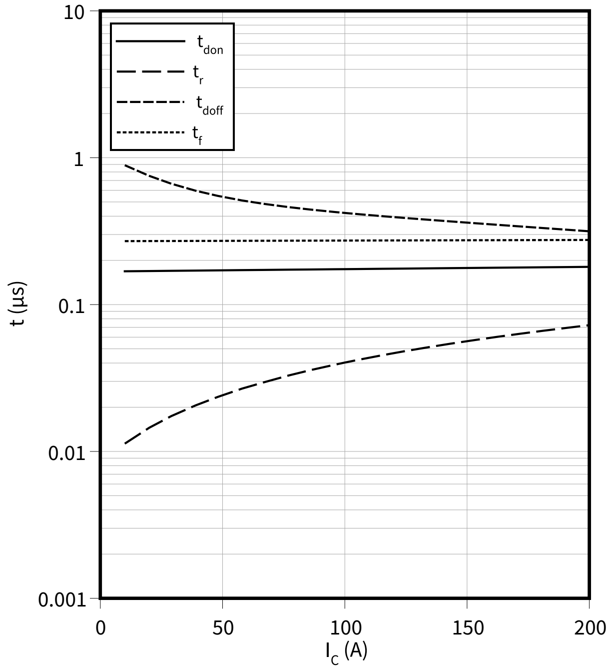
I_C = 100 A, V_{CC} = 600 V, V_{GE} = ± 15 V



Switching times (typical), IGBT, 3-Level

$t = f(I_C)$

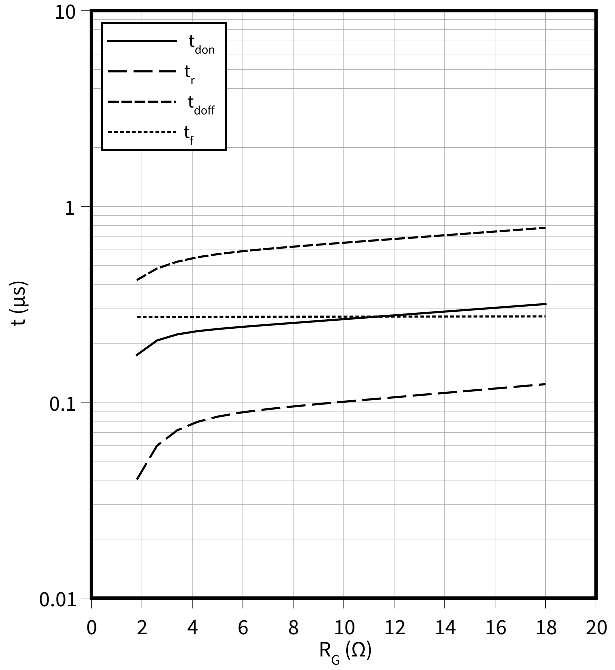
R_{Goff} = 1.8 Ω, R_{Gon} = 1.8 Ω, V_{CC} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



Switching times (typical), IGBT, 3-Level

$t = f(R_G)$

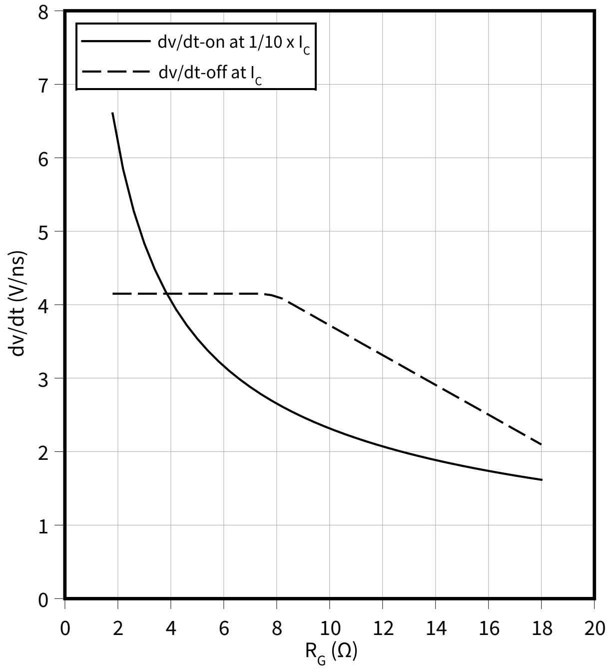
I_C = 100 A, V_{CC} = 600 V, V_{GE} = ± 15 V, T_{vj} = 175 °C



Voltage slope (typical), IGBT, 3-Level

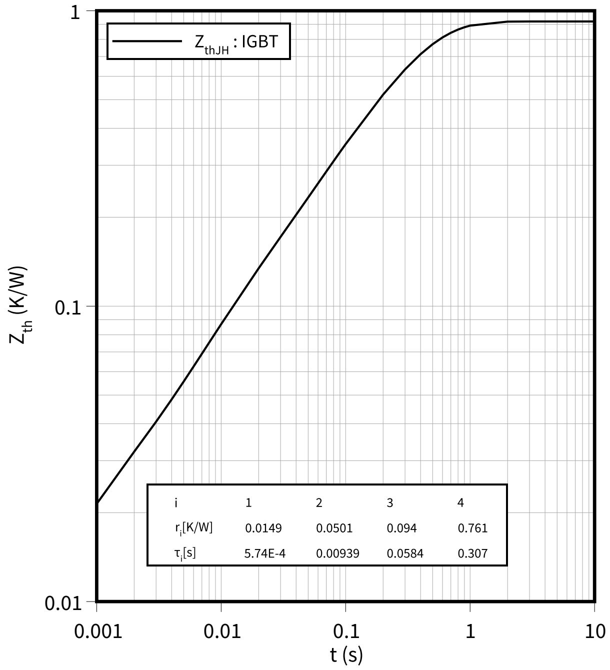
dv/dt = f(R_G)

I_C = 100 A, V_{CC} = 600 V, V_{GE} = ±15 V, T_{vj} = 25 °C



Transient thermal impedance , IGBT, 3-Level

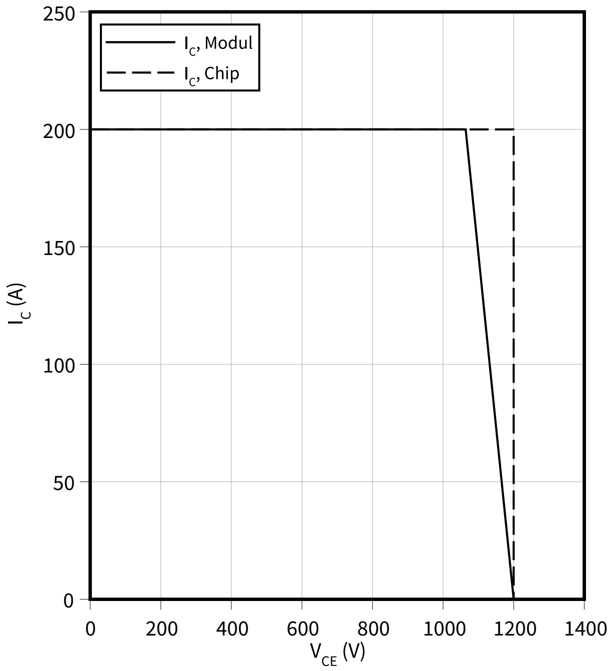
Z_{th} = f(t)



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

I_C = f(V_{CE})

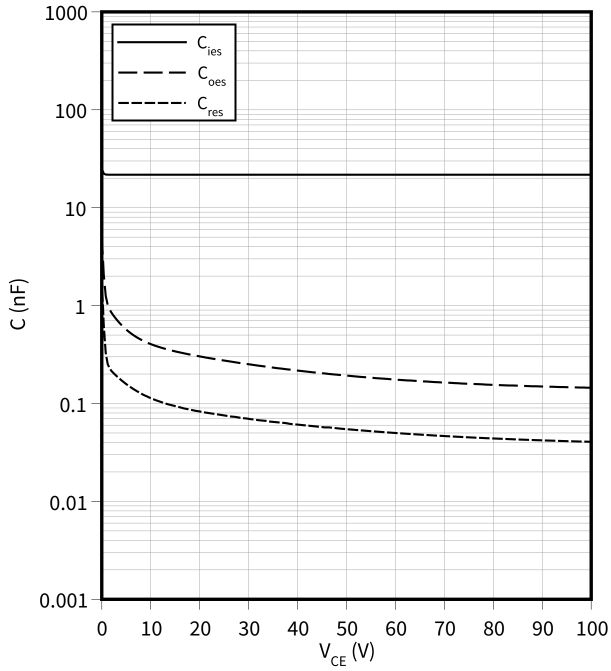
R_{Goff} = 1.8 Ω, V_{GE} = ±15 V, T_{vj} = 175 °C



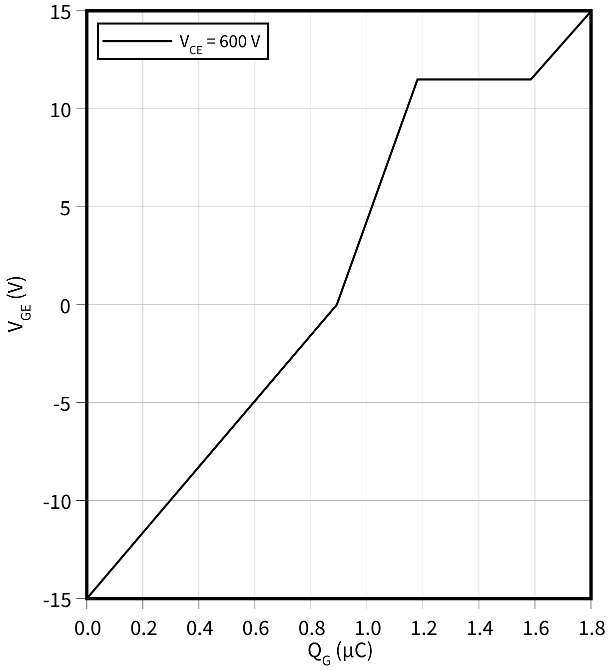
Capacity characteristic (typical), IGBT, 3-Level

C = f(V_{CE})

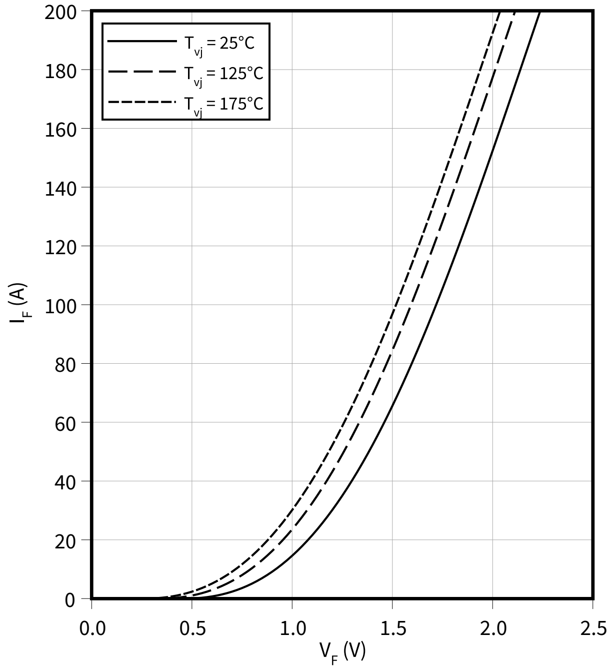
f = 100 kHz, V_{GE} = 0 V, T_{vj} = 25 °C



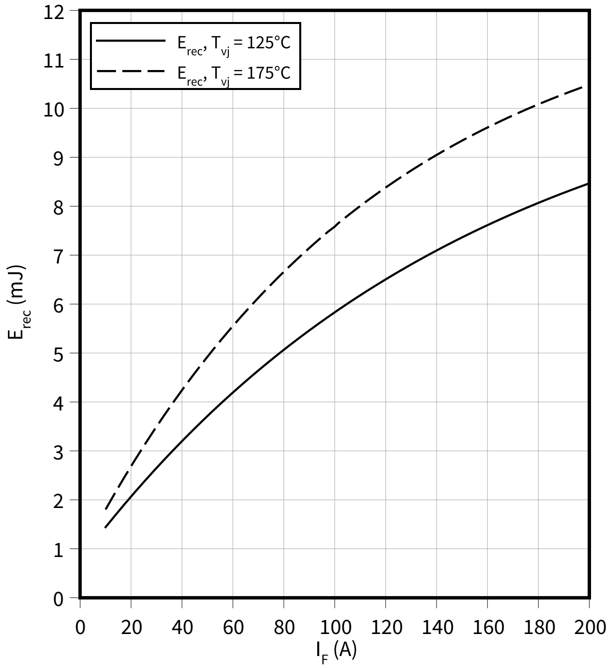
Gate charge characteristic (typical), IGBT, 3-Level
$V_{GE} = f(Q_G)$
$I_C = 100$ A, $T_{vj} = 25$ °C



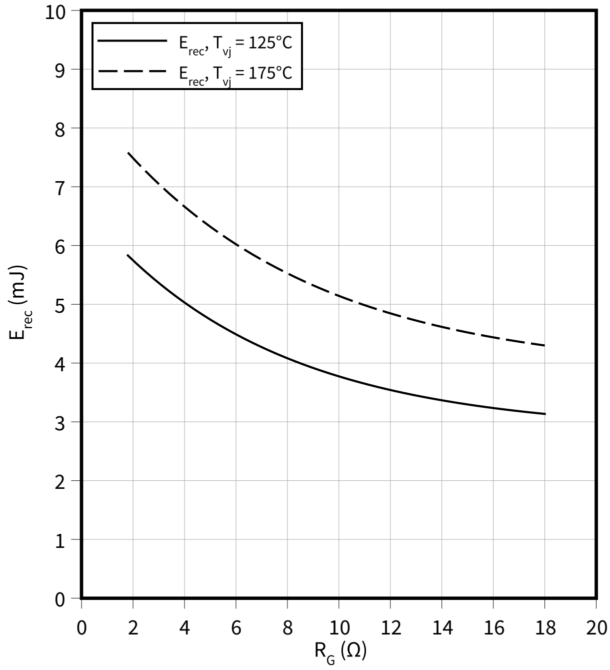
Forward characteristic (typical), Diode, 3-Level
$I_F = f(V_F)$



Switching losses (typical), Diode, 3-Level
$E_{rec} = f(I_F)$
$R_{Gon} = 1.8\ \Omega$, $V_{CC} = 600$ V

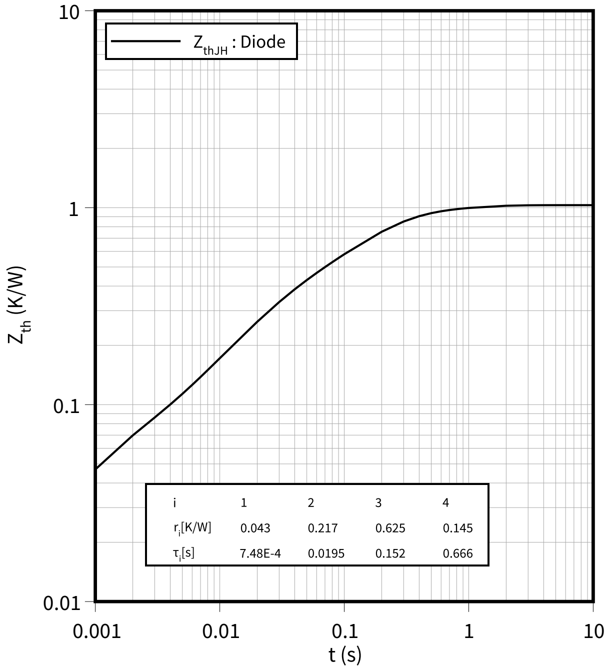


Switching losses (typical), Diode, 3-Level
$E_{rec} = f(R_G)$
$I_F = 100$ A, $V_{CC} = 600$ V



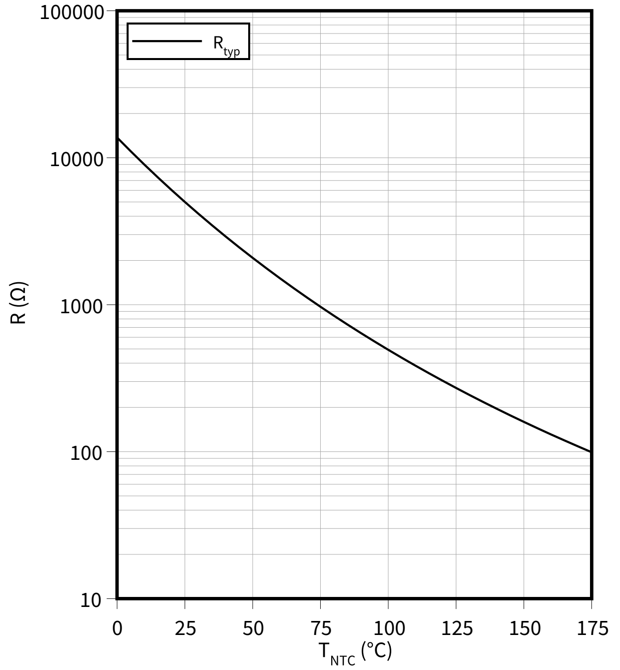
Transient thermal impedance, Diode, 3-Level

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

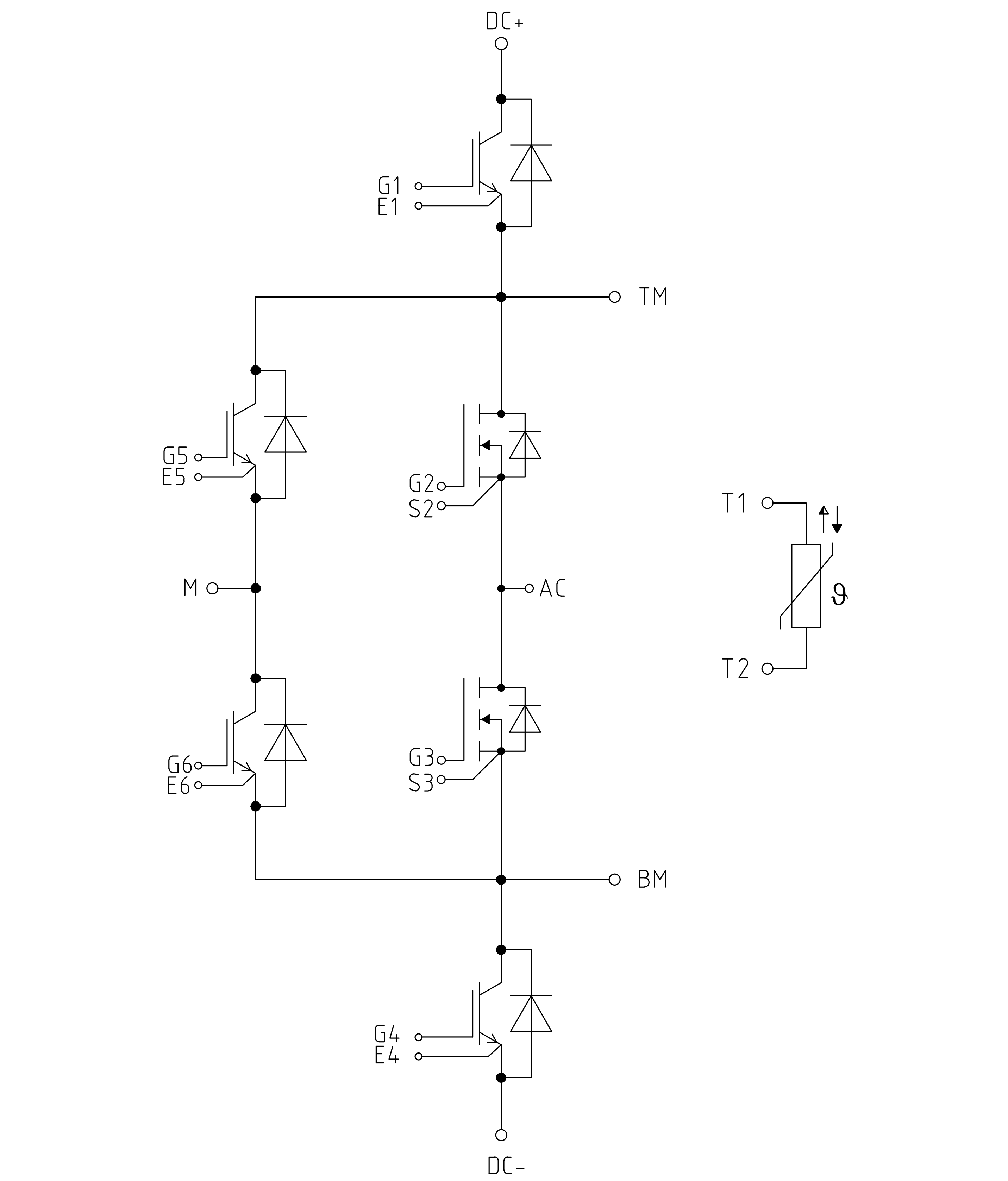


Figure 1

9 Package outlines

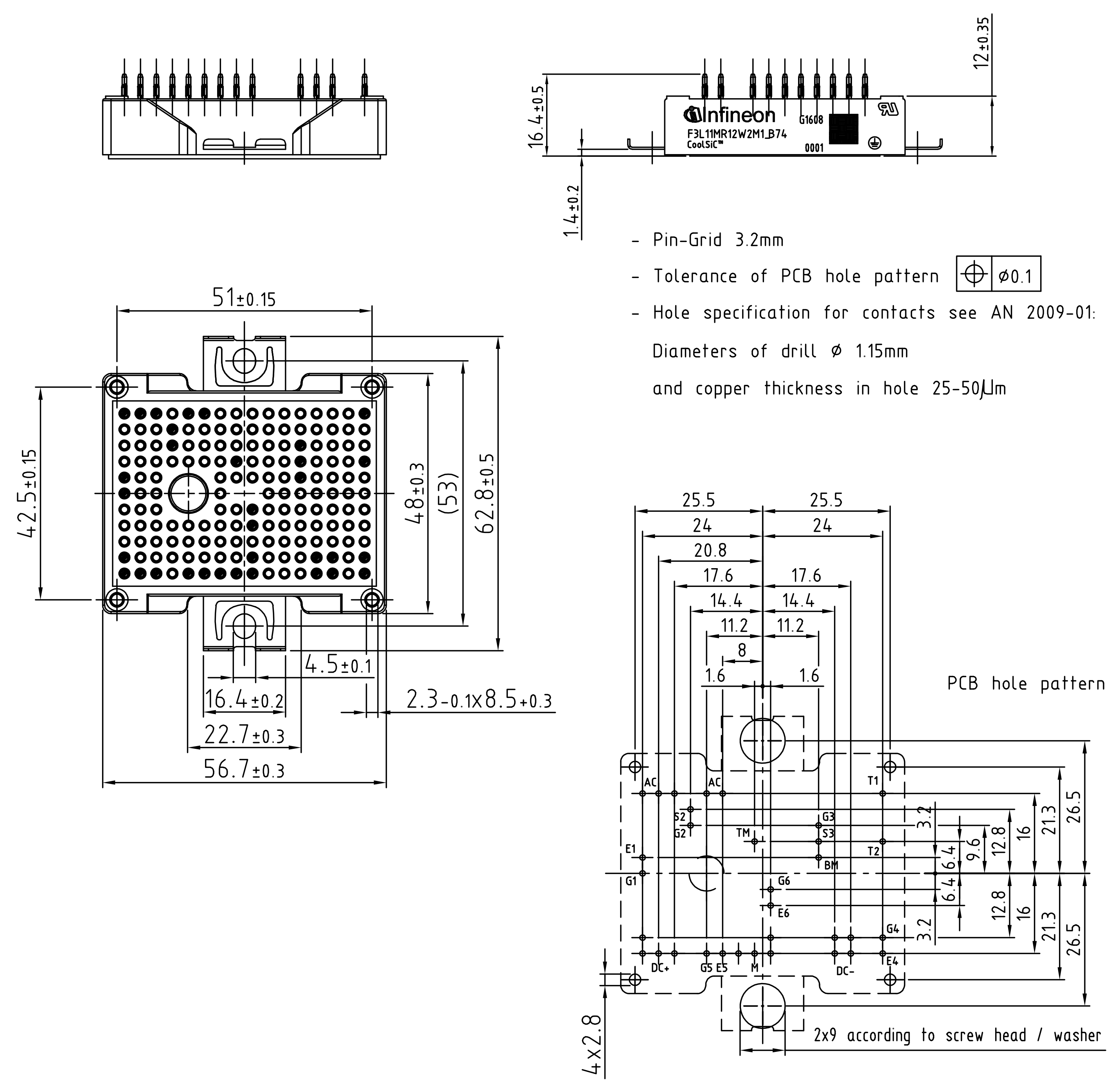


Figure 2

10 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	2020-05-29	Target datasheet
V2.0	2020-09-04	Preliminary 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
0.20	2022-05-25	Preliminary datasheet

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2022-05-25

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2022 Infineon Technologies AG

All Rights Reserved.

Do you have a question about any aspect of this document?

Email: erratum@infineon.com

Document reference
IFX-AAJ559-003

Important notice

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer's products and any use of the product of Infineon Technologies in customer's applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

Warnings

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.