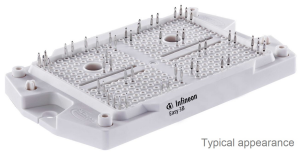
Final datasheet

EasyPACK™ module with active “Neutral Point Clamp 2” topology and PressFIT / NTC

Features


Typical appearance

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 500 A / I_{CRM} = 1000 A
  - Ultra fast IGBT chips
  - Low inductive design
  - Low switching losses
  - Low $V_{CE,sat}$
  - Suitable Infineon gate drivers can be found under https://www.infineon.com/gdfinder
- Mechanical features
  - 2.5 kV AC 1 minute insulation
  - Al_2O_3 substrate with low thermal resistance
  - High current pin
  - PressFIT contact technology
  - Rugged mounting due to integrated mounting clamps

Potential applications

- Three-level applications
- Solar applications

Product validation

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

Description

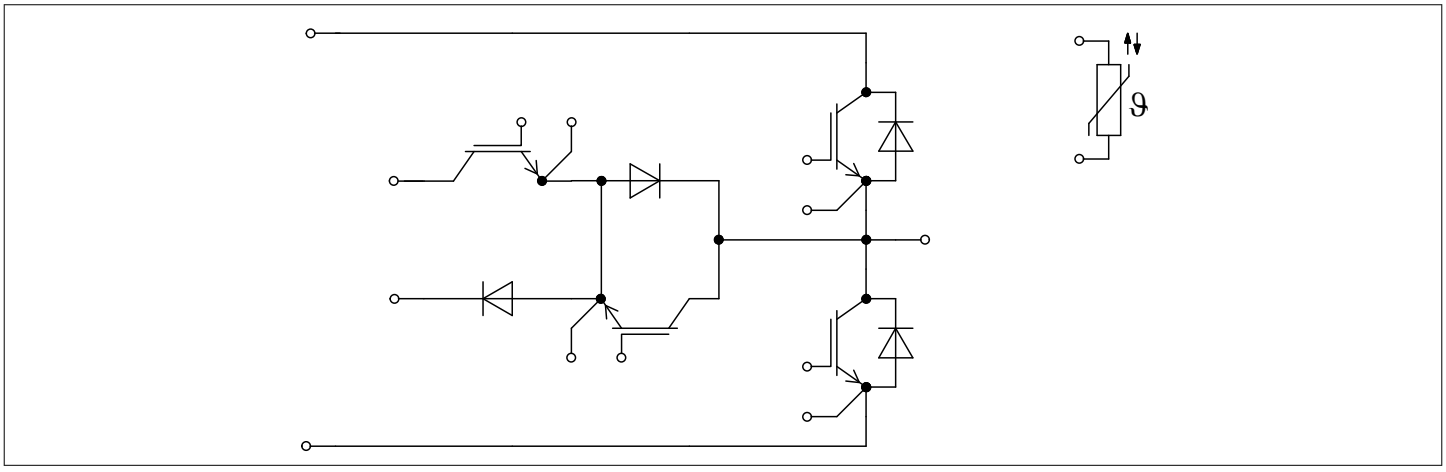


Table of contents

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	2.5	kV
Isolation test voltage NTC	$V_{ISOL(NTC)}$	RMS, f = 50 Hz, *t* = 1 min	2.5	kV
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Comparative tracking index	*CTI*		> 400	
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
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H = 25 °C, per switch		1.3		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note; M5, Screw	1.3		1.5	Nm
Weight	*G*			78		g

***Note**: The current under continuous operation is limited to 50 A rms per connector pin.*

2 IGBT, T1 / T2

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}			510	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	315	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		1020	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 = 500 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.69	2.23	V
			T_{vj} = 125 °C		1.89		
			T_{vj} = 175 °C		1.98		
Gate threshold voltage	V_{GEth}	I_C = 8.16 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		4.85	5.5	6.15	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 600 V, T_{vj} = 25 °C			7.52		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			1.7		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			57.9		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.37		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			29	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 = 500 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω	T_{vj} = 25 °C		0.430		µs
			T_{vj} = 125 °C		0.480		
			T_{vj} = 175 °C		0.530		
Rise time (inductive load)	t_r	I_C = 500 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω	T_{vj} = 25 °C		0.050		µs
			T_{vj} = 125 °C		0.056		
			T_{vj} = 175 °C		0.061		
Turn-off delay time (inductive load)	t_{doff}	I_C = 500 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 11 Ω	T_{vj} = 25 °C		1.700		µs
			T_{vj} = 125 °C		1.790		
			T_{vj} = 175 °C		1.850		
Fall time (inductive load)	t_f	I_C = 500 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 11 Ω	T_{vj} = 25 °C		0.043		µs
			T_{vj} = 125 °C		0.044		
			T_{vj} = 175 °C		0.060		
Turn-on energy loss per pulse	E_{on}	I_C = 500 A, V_{CC} = 500 V, L_σ = 10 nH, V_{GE} = ±15 V, R_{Gon} = 0.75 Ω, di/dt = 6890 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		28.2		mJ
			T_{vj} = 125 °C		30.7		
			T_{vj} = 175 °C		31.2		
Turn-off energy loss per pulse	E_{off}	I_C = 500 A, V_{CC} = 500 V, L_σ = 10 nH, V_{GE} = ±15 V, R_{Goff} = 11 Ω, dv/dt = 4270 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		20.1		mJ
			T_{vj} = 125 °C		26.1		
			T_{vj} = 175 °C		30.8		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 3.3 W/(m·K)			0.170		K/W

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Temperature under switching conditions	$T_{vj\,op}$		-40		175	°C

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

3 Diode, D1 / D2

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			400	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		800	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	19300	A^2s
			T_{vj} = 175 °C	16700	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 400 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_{CC} = 500 V, I_F = 400 A, V_{GE} = -15 V, -di$_F$/dt = 5030 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		150		A
			T_{vj} = 125 °C		252		
			T_{vj} = 175 °C		316		
Recovered charge	Q_r	V_{CC} = 500 V, I_F = 400 A, V_{GE} = -15 V, -di$_F$/dt = 5030 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		21.5		µC
			T_{vj} = 125 °C		46.3		
			T_{vj} = 175 °C		62.4		
Reverse recovery energy	E_{rec}	V_{CC} = 500 V, I_F = 400 A, V_{GE} = -15 V, -di$_F$/dt = 5030 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.13		mJ
			T_{vj} = 125 °C		16.2		
			T_{vj} = 175 °C		23.1		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 3.3 W/(m·K)			0.251		K/W

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Temperature under switching conditions	$T_{vj\,op}$		-40		175	°C

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

4 IGBT, T3 / T4

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	950	V
Implemented collector current	I_{CN}			400	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 150 °C	T_H = 65 °C	200	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		800	A
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 = 400 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.85	2.25	V
			T_{vj} = 125 °C		2.10		
			T_{vj} = 150 °C		2.15		
Gate threshold voltage	V_{GEth}	I_C = 6.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		4.35	5.1	5.85	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 600 V, T_{vj} = 25 °C			0.9		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			25.2		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.078		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 950 V, V_{GE} = 0 V	T_{vj} = 25 °C			93	µA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time (inductive load)	t_{don}	I_C = 400 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 3.6 Ω	T_{vj} = 25 °C		0.073		µs
			T_{vj} = 125 °C		0.080		
			T_{vj} = 150 °C		0.082		
Rise time (inductive load)	t_r	I_C = 400 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 3.6 Ω	T_{vj} = 25 °C		0.055		µs
			T_{vj} = 125 °C		0.057		
			T_{vj} = 150 °C		0.061		
Turn-off delay time (inductive load)	t_{doff}	I_C = 400 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 15 Ω	T_{vj} = 25 °C		0.540		µs
			T_{vj} = 125 °C		0.570		
			T_{vj} = 150 °C		0.600		
Fall time (inductive load)	t_f	I_C = 400 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 15 Ω	T_{vj} = 25 °C		0.040		µs
			T_{vj} = 125 °C		0.068		
			T_{vj} = 150 °C		0.086		
Turn-on energy loss per pulse	E_{on}	I_C = 400 A, V_{CC} = 500 V, L_σ = 40 nH, V_{GE} = ±15 V, R_{Gon} = 3.6 Ω, di/dt = 5030 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		26.4		mJ
			T_{vj} = 125 °C		29		
			T_{vj} = 150 °C		29		
Turn-off energy loss per pulse	E_{off}	I_C = 400 A, V_{CC} = 500 V, L_σ = 40 nH, V_{GE} = ±15 V, R_{Goff} = 15 Ω, dv/dt = 6220 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		12.9		mJ
			T_{vj} = 125 °C		16.8		
			T_{vj} = 150 °C		18.3		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 3.3 W/(m·K)			0.278		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

5 Diode, D3 / D4

Table 9 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	950	V
Continuous DC forward current	I_F			300	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		600	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	3590	A^2s
			T_{vj} = 150 °C	3190	

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 300 A, V_{GE} = 0 V	T_{vj} = 25 °C		2.60	2.90	V
			T_{vj} = 125 °C		2.40		
			T_{vj} = 150 °C		2.35		
Peak reverse recovery current	I_{RM}	V_{CC} = 500 V, I_F = 300 A, V_{GE}=-15 V, -di$_F$/dt = 6890 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		131		A
			T_{vj} = 125 °C		175		
			T_{vj} = 150 °C		185		
Recovered charge	Q_r	V_{CC} = 500 V, I_F = 300 A, V_{GE}=-15 V, -di$_F$/dt = 6890 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		7.5		µC
			T_{vj} = 125 °C		17.9		
			T_{vj} = 150 °C		20.5		
Reverse recovery energy	E_{rec}	V_{CC} = 500 V, I_F = 300 A, V_{GE}=-15 V, -di$_F$/dt = 6890 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1.98		mJ
			T_{vj} = 125 °C		5.11		
			T_{vj} = 150 °C		6.07		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 3.3 W/(m·K)			0.435		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

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	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3433		K

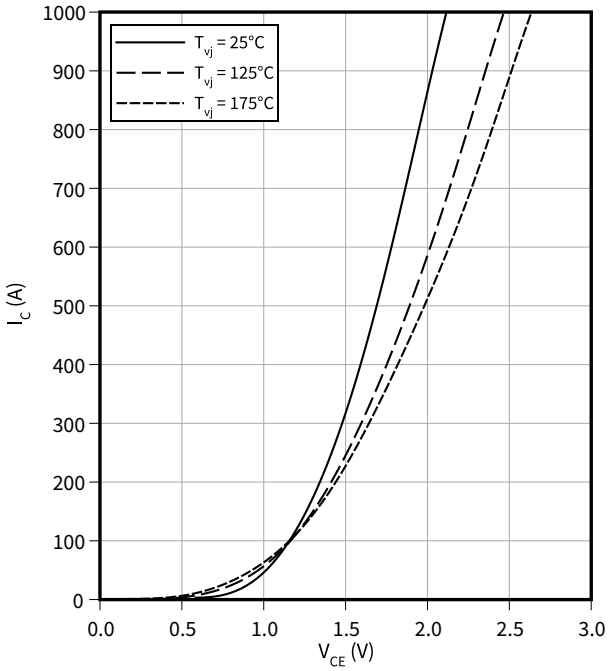
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.*

7 Characteristics diagrams

Output characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{CE})$

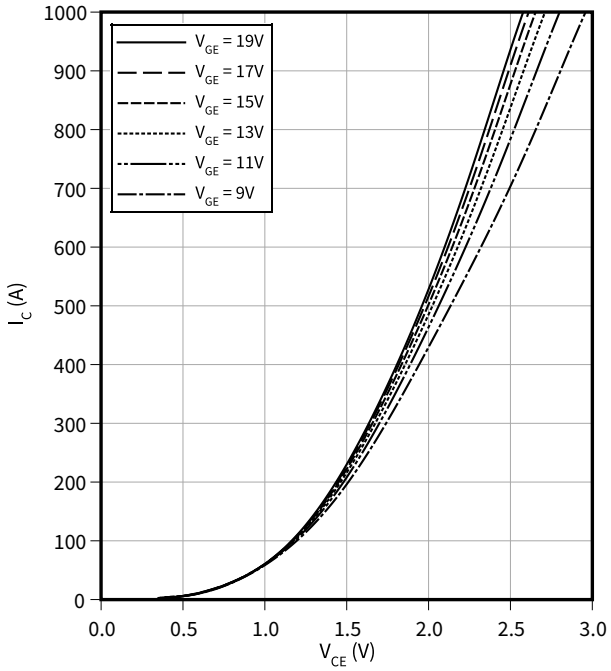
V_{GE} = 15 V



Output characteristic field (typical), IGBT, T1 / T2

$I_C = f(V_{CE})$

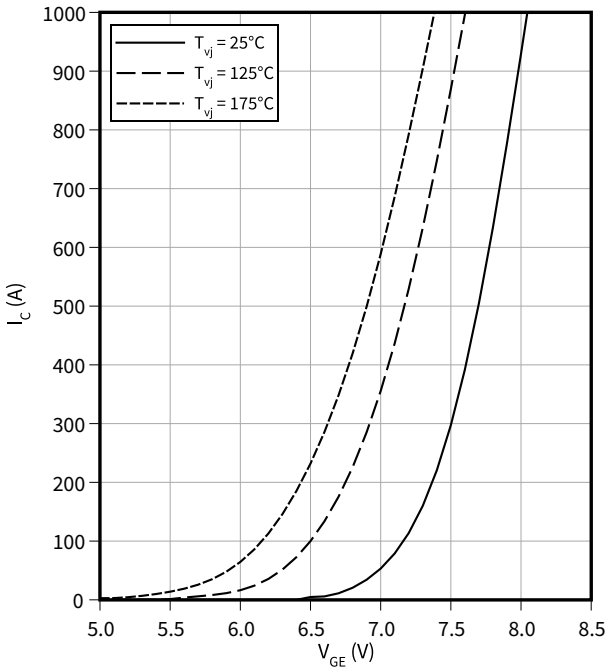
T_{vj} = 175 °C



Transfer characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{GE})$

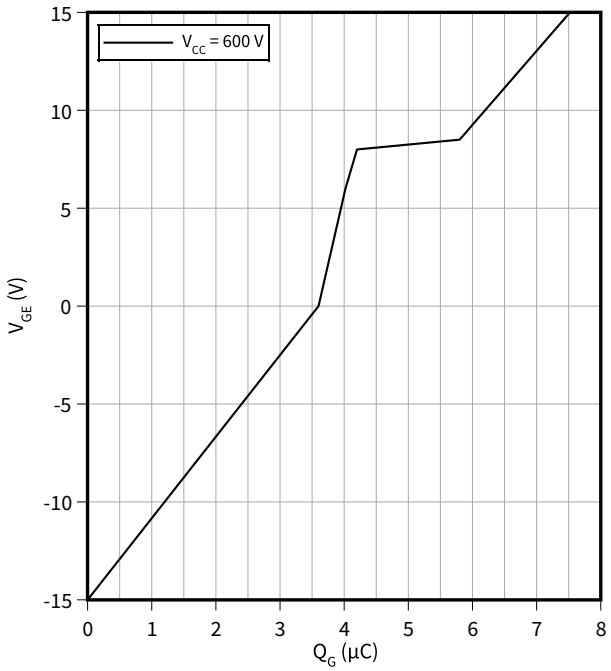
V_{CE} = 20 V



Gate charge characteristic (typical), IGBT, T1 / T2

$V_{GE} = f(Q_G)$

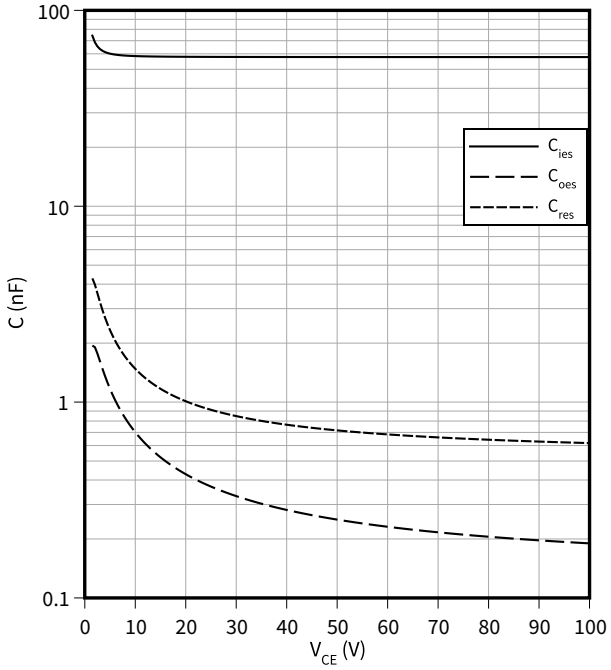
I_C = 500 A, T_{vj} = 25 °C



Capacity characteristic (typical), IGBT, T1 / T2

$C = f(V_{CE})$

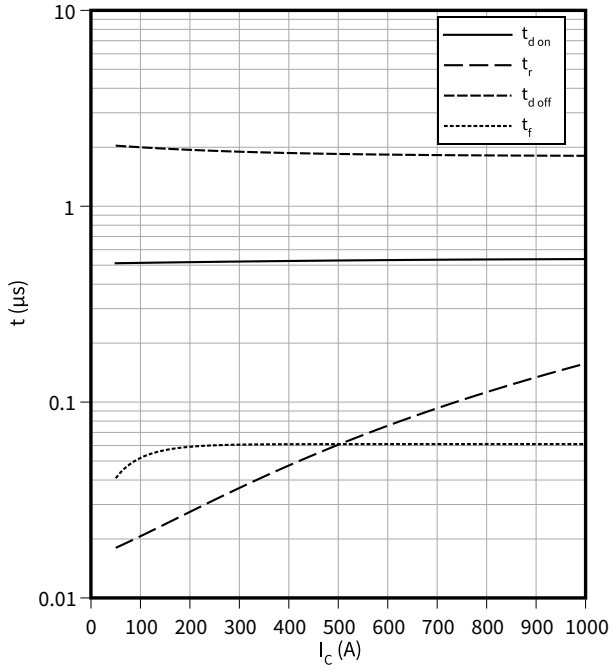
$f = 100\ kHz$, $V_{GE} = 0\ V$, $T_{vj} = 25\ °C$



Switching times (typical), IGBT, T1 / T2

$t = f(I_C)$

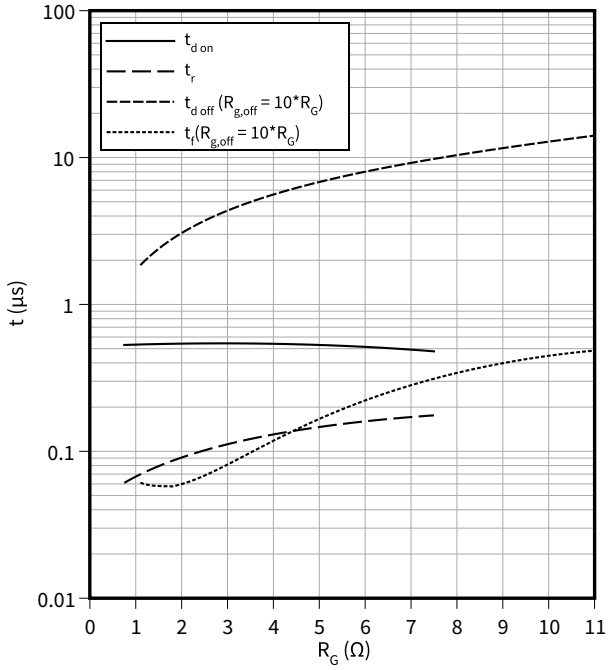
$R_{Goff} = 11\ \Omega$, $R_{Gon} = 0.75\ \Omega$, $V_{GE} = \pm 15\ V$, $V_{CC} = 500\ V$, $T_{vj} = 175\ °C$



Switching times (typical), IGBT, T1 / T2

$t = f(R_G)$

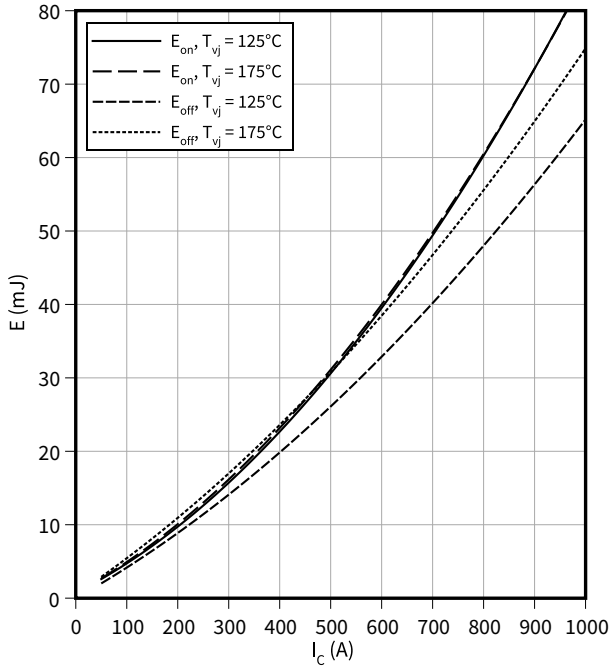
$V_{GE} = \pm 15\ V$, $I_C = 500\ A$, $V_{CC} = 500\ V$, $T_{vj} = 175\ °C$



Switching losses (typical), IGBT, T1 / T2

$E = f(I_C)$

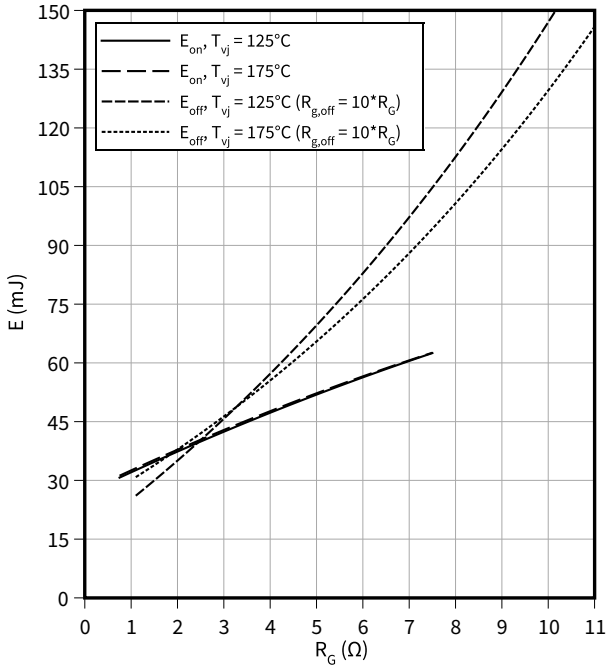
$R_{Goff} = 11\ \Omega$, $R_{Gon} = 0.75\ \Omega$, $V_{CC} = 500\ V$, $V_{GE} = \pm 15\ V$



Switching losses (typical), IGBT, T1 / T2

$E = f(R_G)$

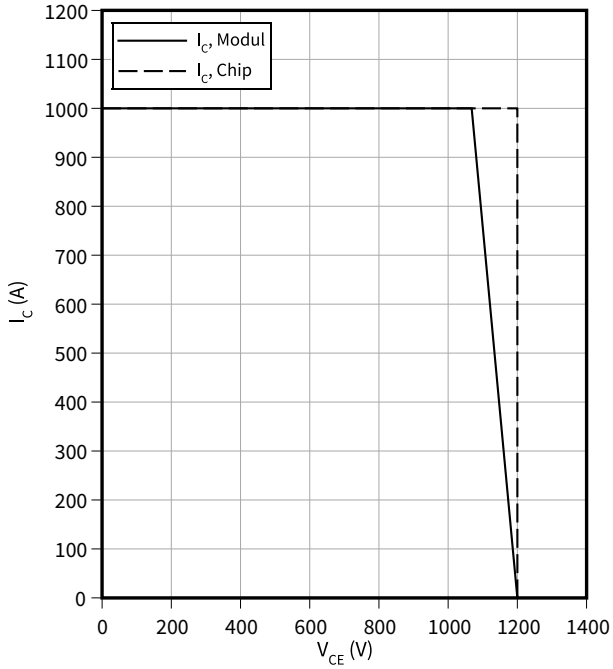
V_{CC} = 500 V, V_{GE} = ± 15 V, I_C = 500 A



Reverse bias safe operating area (RBSOA), IGBT, T1 / T2

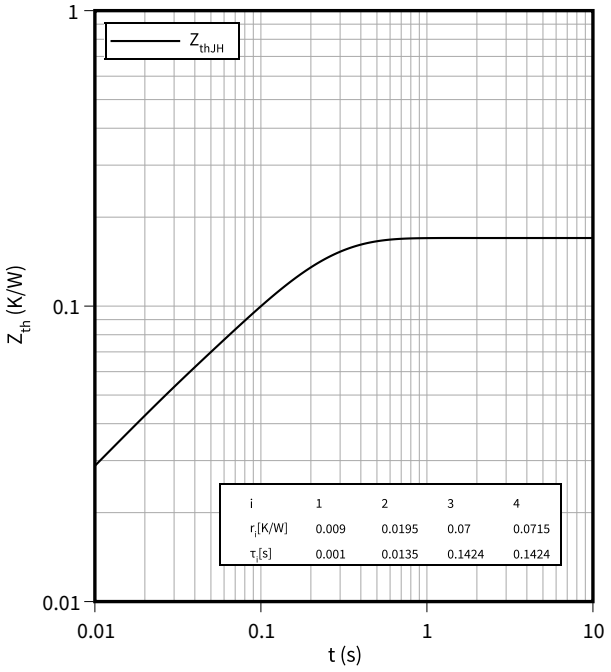
$I_C = f(V_{CE})$

R_{Goff} = 7.5 Ω, V_{GE} = ±15 V, T_{vj} = 175 °C



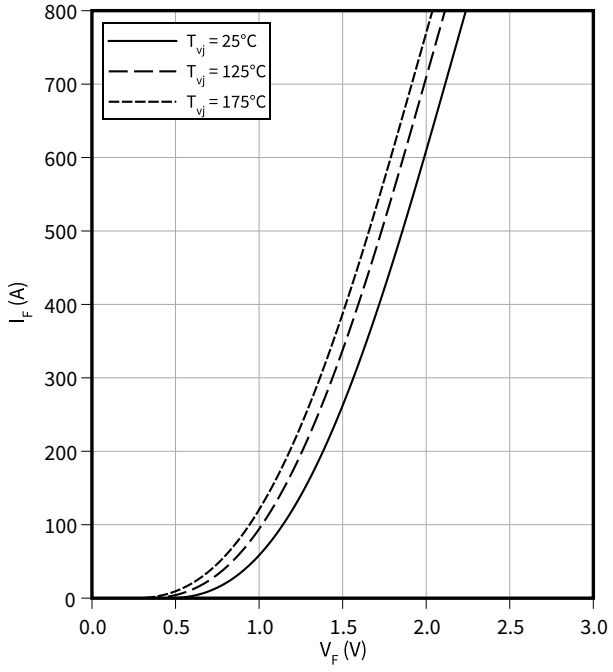
Transient thermal impedance, IGBT, T1 / T2

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D1 / D2

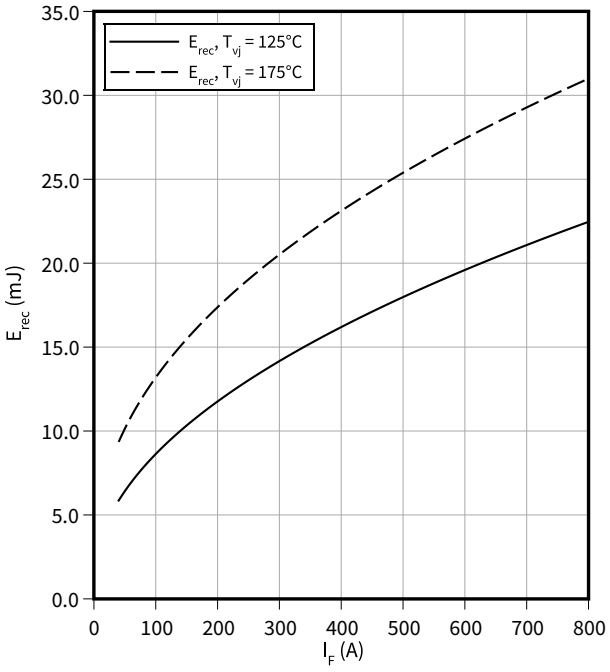
$I_F = f(V_F)$



Switching losses (typical), Diode, D1 / D2

$E_{rec} = f(I_F)$

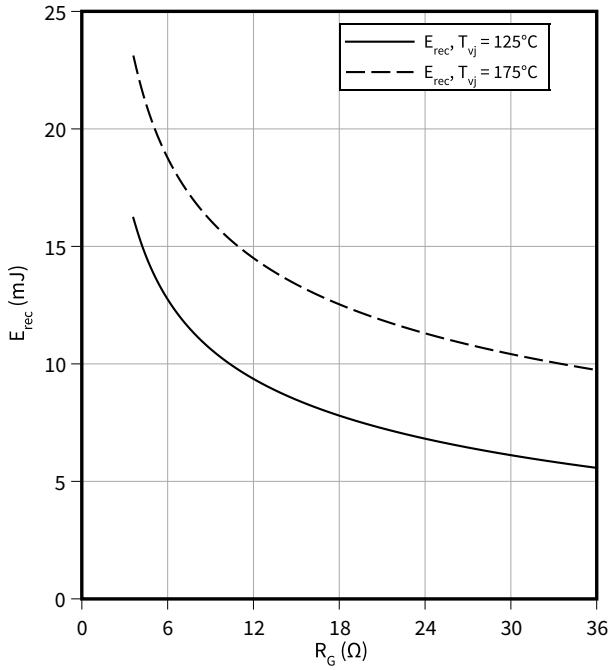
$V_{CE} = 500\ V$, $R_G = 3.6\ \Omega$



Switching losses (typical), Diode, D1 / D2

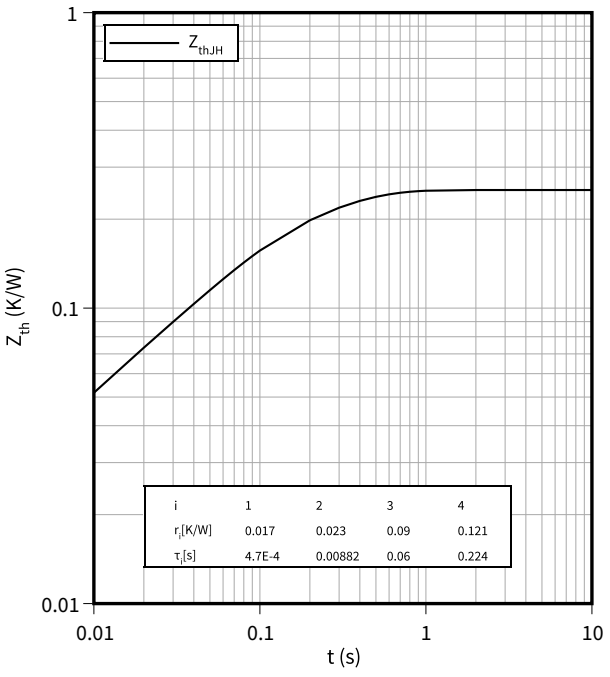
$E_{rec} = f(R_G)$

$V_{CE} = 500\ V$, $I_F = 400\ A$



Transient thermal impedance, Diode, D1 / D2

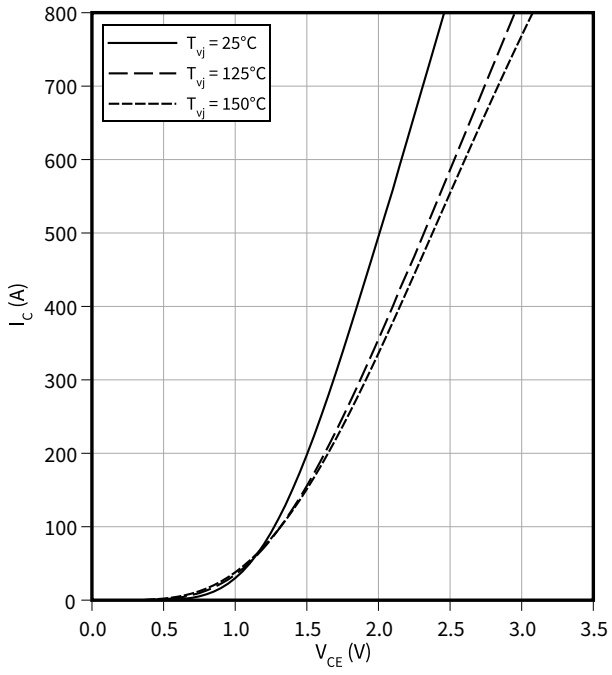
$Z_{th} = f(t)$



Output characteristic (typical), IGBT, T3 / T4

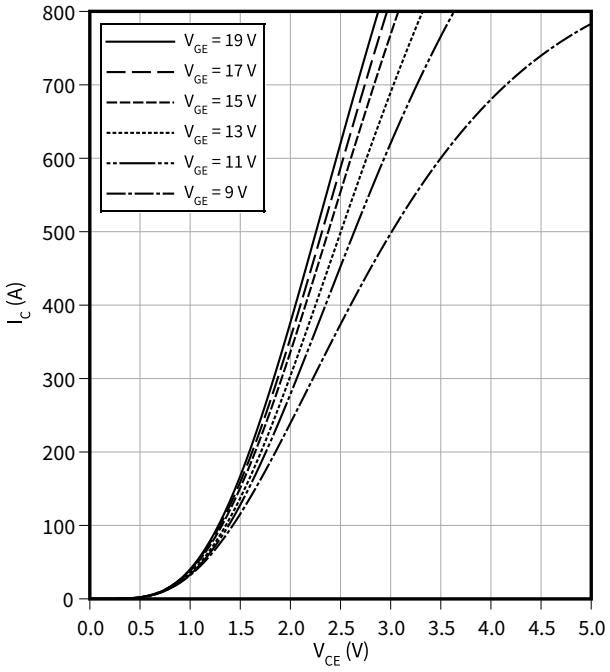
$I_C = f(V_{CE})$

$V_{GE} = 15\ V$



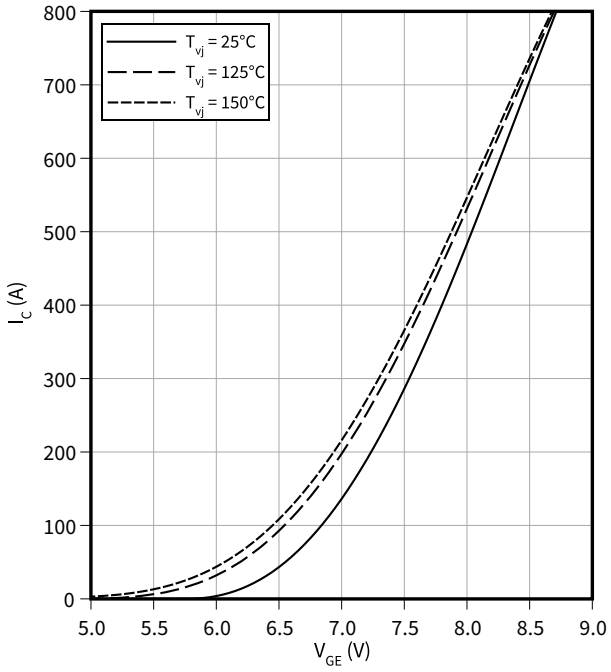
Output characteristic field (typical), IGBT, T3 / T4

$I_C = f(V_{CE})$
$T_{vj} = 150\ °C$



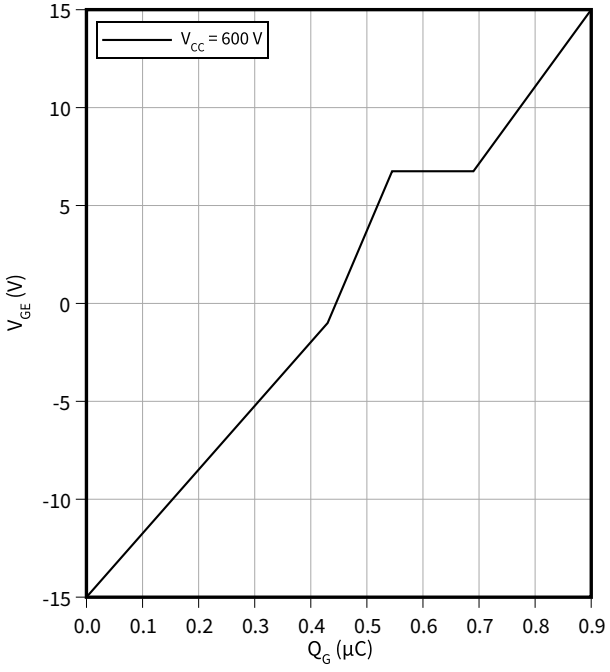
Transfer characteristic (typical), IGBT, T3 / T4

$I_C = f(V_{GE})$
$V_{CE} = 20\ V$



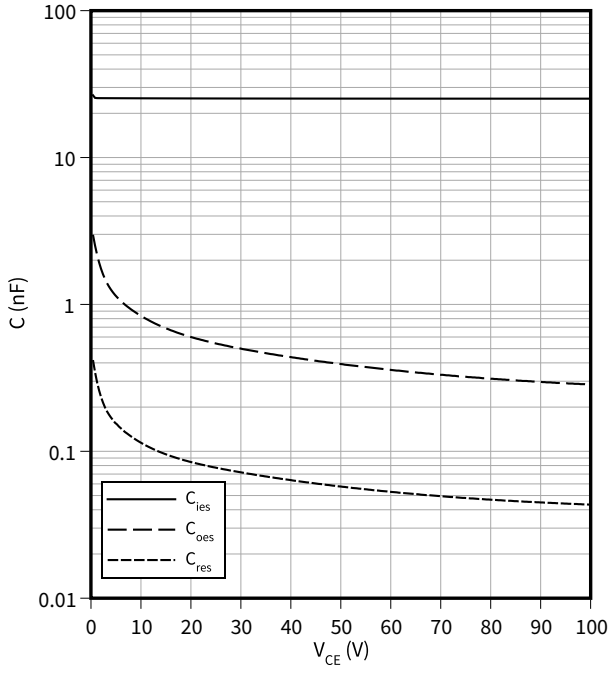
Gate charge characteristic (typical), IGBT, T3 / T4

$V_{GE} = f(Q_G)$
$I_C = 400\ A,\ T_{vj} = 25\ °C$



Capacity characteristic (typical), IGBT, T3 / T4

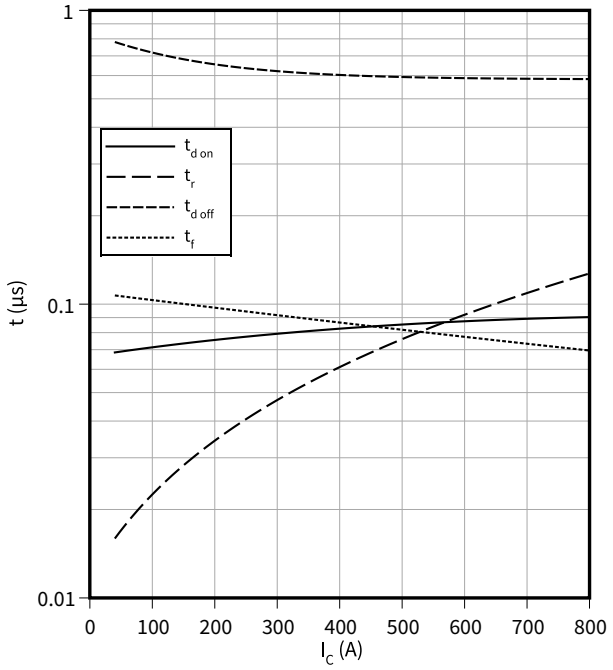
$C = f(V_{CE})$
$f = 100\ kHz,\ V_{GE} = 0\ V,\ T_{vj} = 25\ °C$



Switching times (typical), IGBT, T3 / T4

$t = f(I_C)$

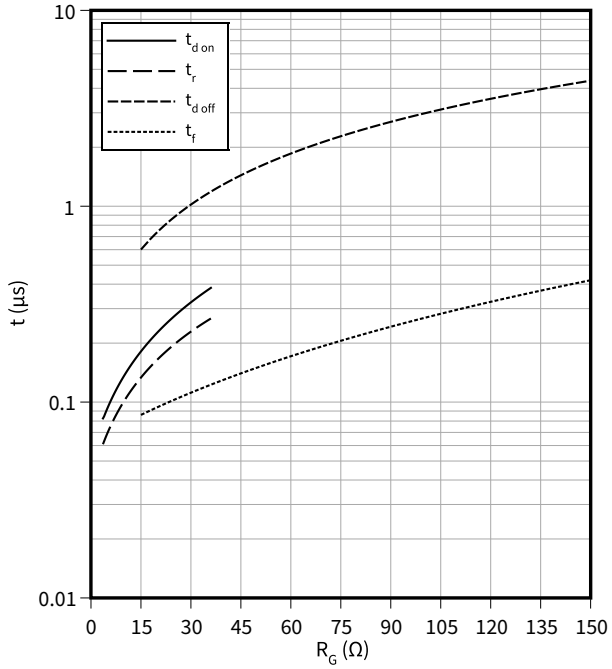
R_{Goff} = 15 Ω, R_{Gon} = 3.6 Ω, V_{CC} = 500 V, V_{GE} = ± 15 V, T_{vj} = 150 °C



Switching times (typical), IGBT, T3 / T4

$t = f(R_G)$

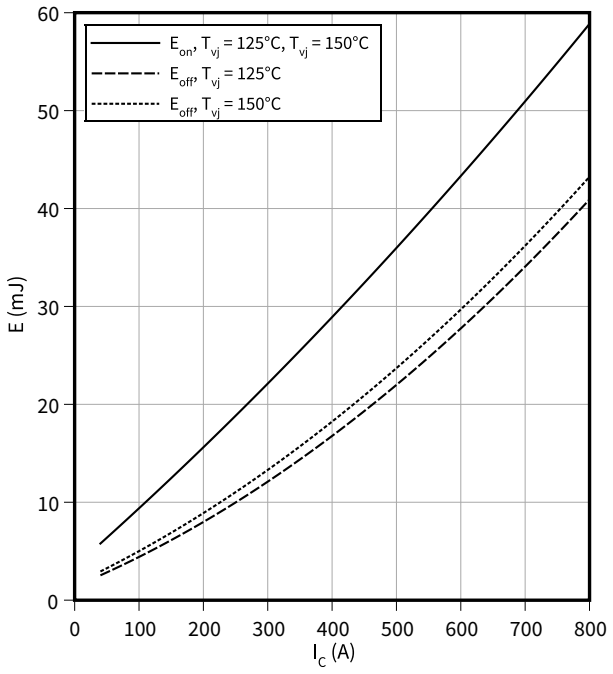
V_{GE} = ±15 V, I_C = 400 A, V_{CC} = 500 V, T_{vj} = 150 °C



Switching losses (typical), IGBT, T3 / T4

$E = f(I_C)$

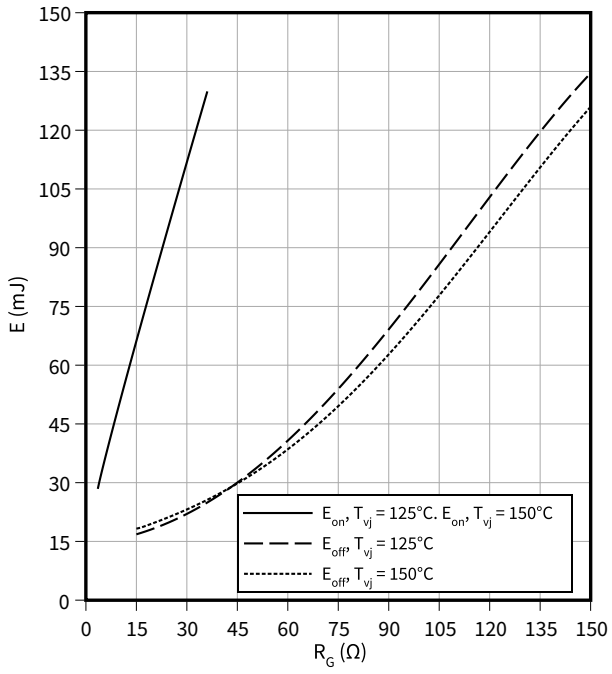
R_{Goff} = 15 Ω, R_{Gon} = 3.6 Ω, V_{CC} = 500 V, V_{GE} = ± 15 V



Switching losses (typical), IGBT, T3 / T4

$E = f(R_G)$

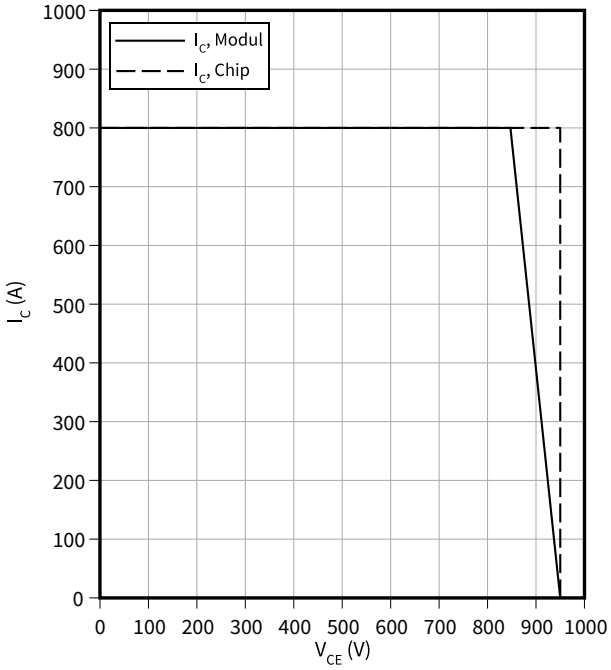
I_C = 400 A, V_{CC} = 500 V, V_{GE} = ± 15 V



Reverse bias safe operating area (RBSOA), IGBT, T3 / T4

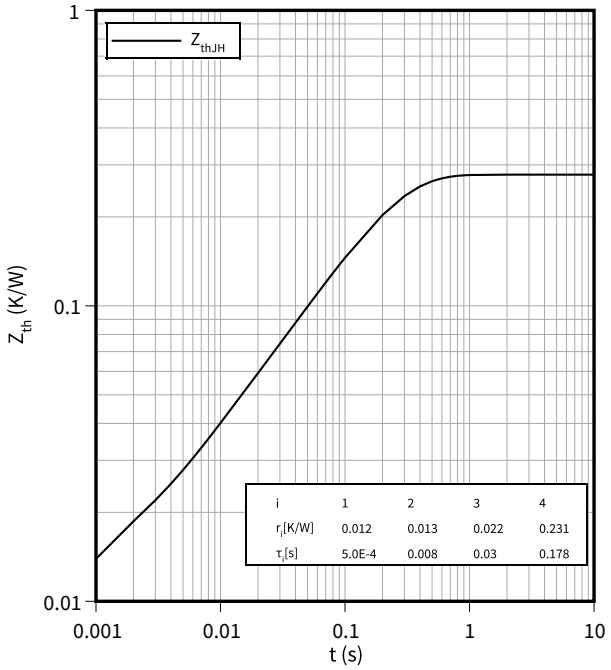
$I_C = f(V_{CE})$

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



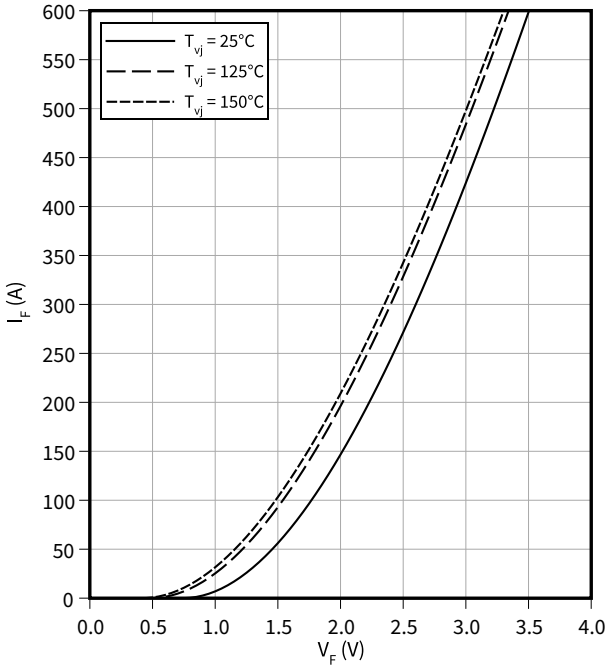
Transient thermal impedance, IGBT, T3 / T4

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D3 / D4

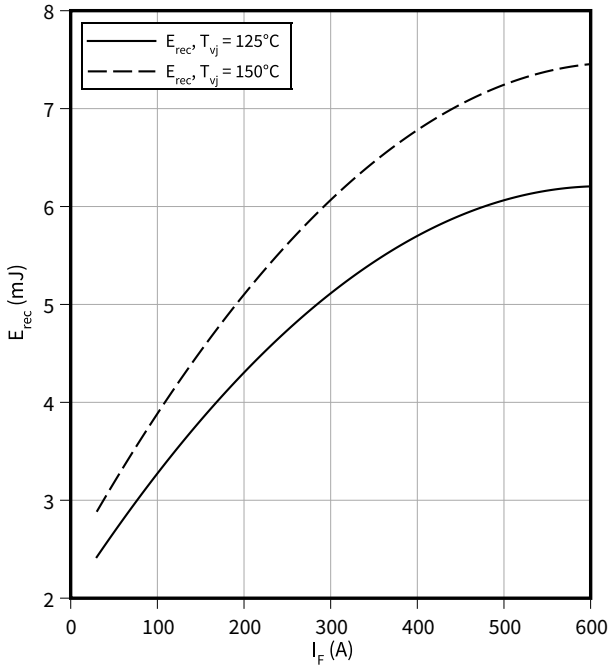
$I_F = f(V_F)$



Switching losses (typical), Diode, D3 / D4

$E_{rec} = f(I_F)$

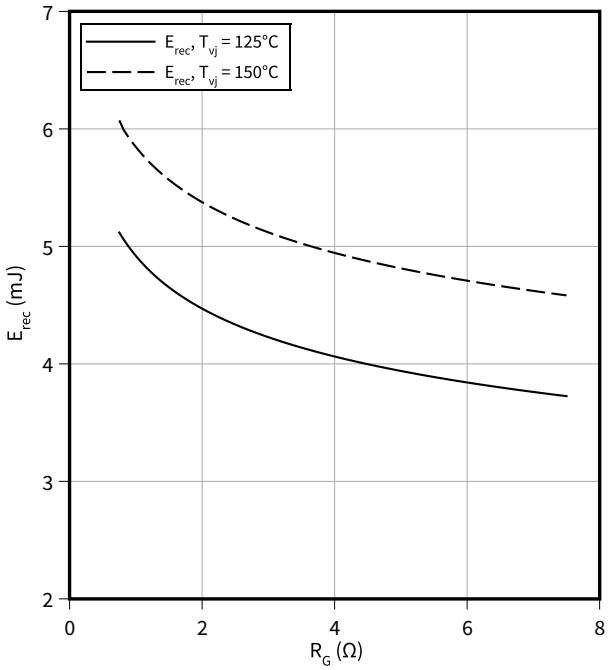
$V_{CE} = 500$ V, $R_G = 0.75\ \Omega$



Switching losses (typical), Diode, D3 / D4

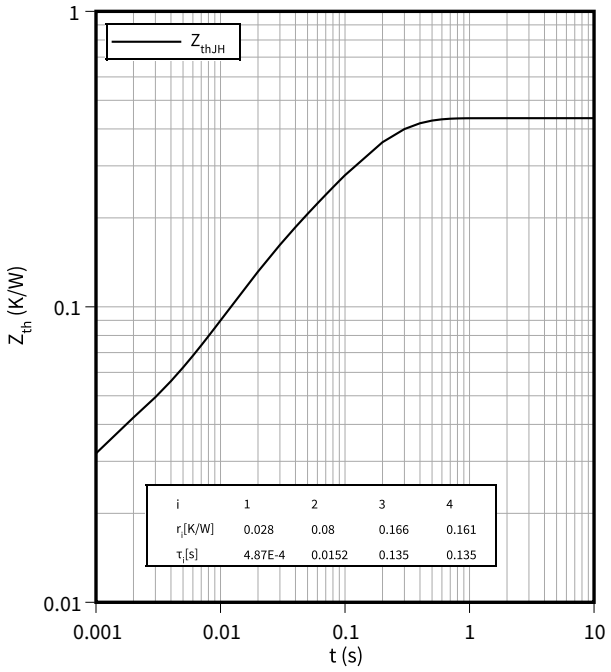
$E_{rec} = f(R_G)$

$V_{CE} = 500\ V$, $I_F = 300\ A$



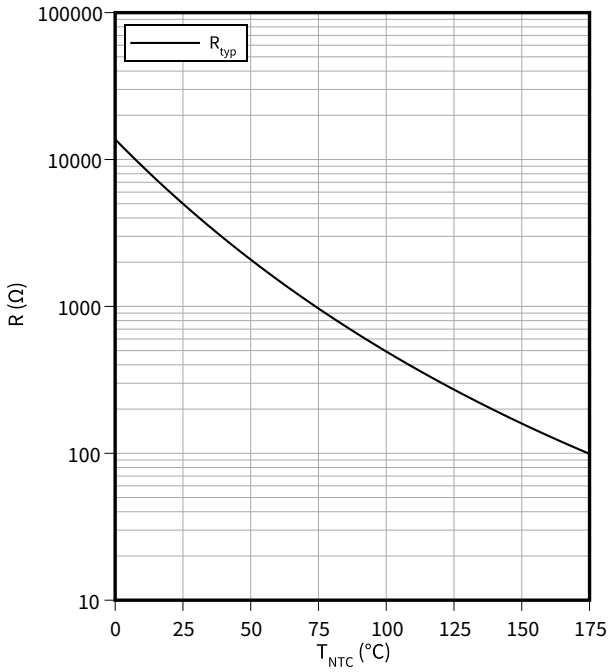
Transient thermal impedance, Diode, D3 / D4

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

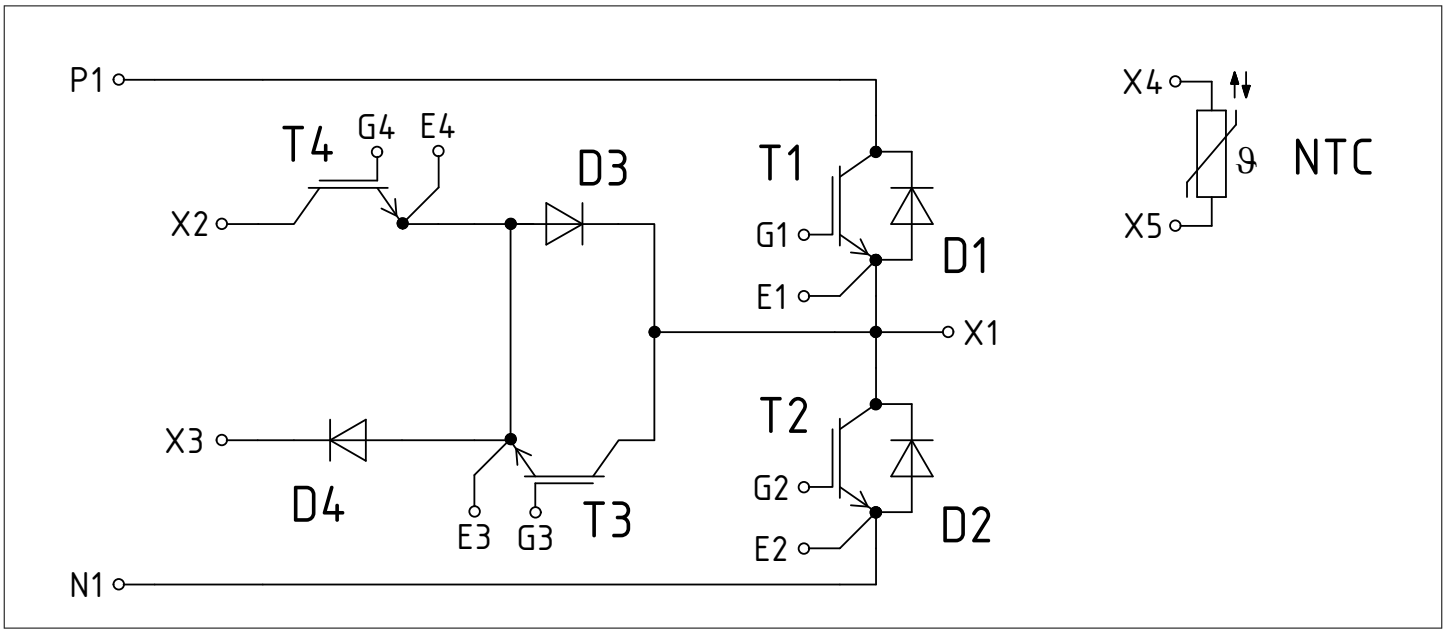


Figure 1

9 Package outlines

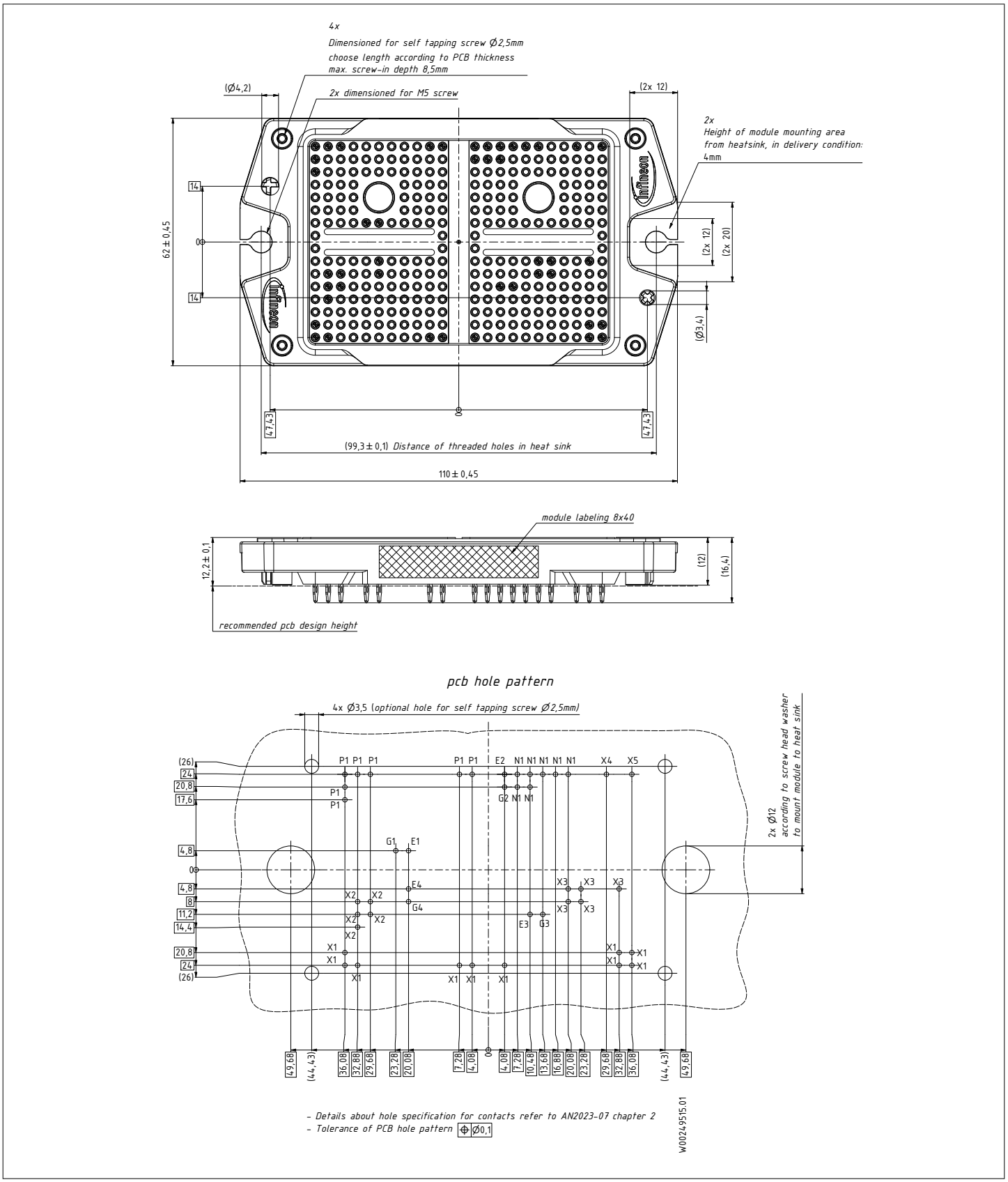


Figure 2

10 Module label code

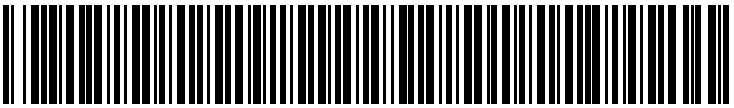
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production 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 version	Date of release	Description of changes
0.10	2024-04-15	Initial version
1.00	2024-08-30	Final datasheet

Trademarks

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

Edition 2024-08-30

Published by

Infineon Technologies AG

81726 Munich, Germany

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

Email: erratum@infineon.com

Document reference
IFX-ABJ429-002

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.