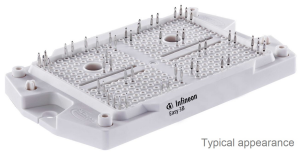
Final datasheet

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

Features


Typical appearance

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 240 A / I_{CRM} = 480 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
  - Al_2O_3 substrate with low thermal resistance
  - High current pin
  - PressFIT contact technology
  - Rugged mounting due to integrated mounting clamps

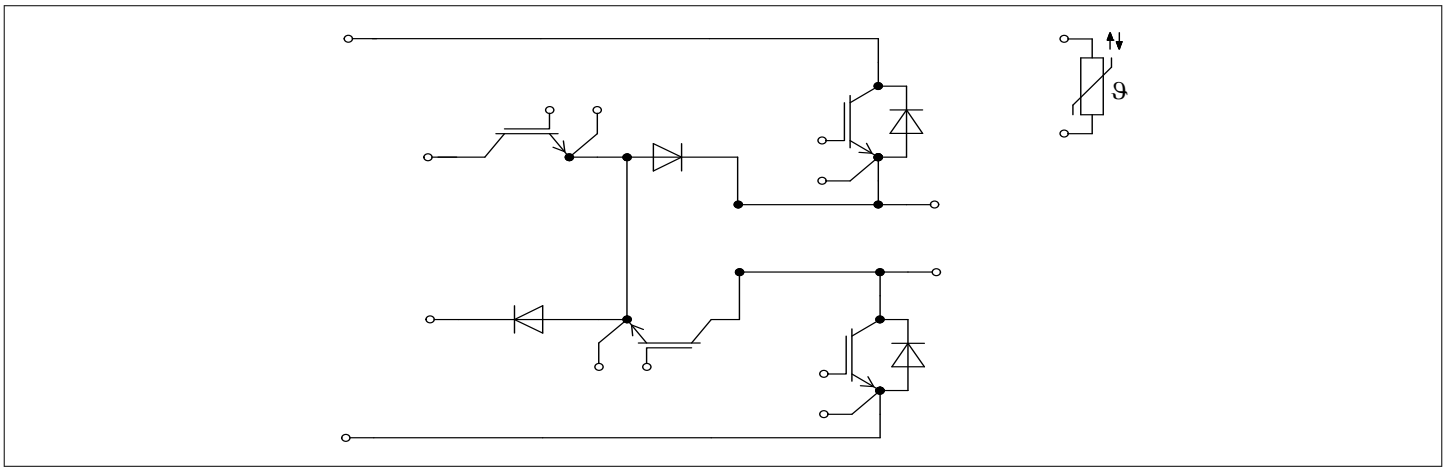
Potential applications

- Three-level applications
- Solar applications

Product validation

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

Description



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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	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}				25		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H = 25 °C, per switch			1.7		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H = 25 °C, per switch			1.2		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
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	240	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		480	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 = 240 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.47	1.80	V
			T_{vj} = 125 °C		1.58		
			T_{vj} = 175 °C		1.63		
Gate threshold voltage	V_{GEth}	I_C = 6.72 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			6.19		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			47.7		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.33		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			26	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 = 240 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω	T_{vj} = 25 °C		0.370		µs
			T_{vj} = 125 °C		0.410		
			T_{vj} = 175 °C		0.450		
Rise time (inductive load)	t_r	I_C = 240 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω	T_{vj} = 25 °C		0.024		µs
			T_{vj} = 125 °C		0.028		
			T_{vj} = 175 °C		0.030		
Turn-off delay time (inductive load)	t_{doff}	I_C = 240 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω	T_{vj} = 25 °C		1.160		µs
			T_{vj} = 125 °C		1.250		
			T_{vj} = 175 °C		1.300		
Fall time (inductive load)	t_f	I_C = 240 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω	T_{vj} = 25 °C		0.024		µs
			T_{vj} = 125 °C		0.058		
			T_{vj} = 175 °C		0.088		
Turn-on energy loss per pulse	E_{on}	I_C = 240 A, V_{CC} = 500 V, L_σ = 8 nH, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω, di/dt = 8200 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.47		mJ
			T_{vj} = 125 °C		7.15		
			T_{vj} = 175 °C		9.18		
Turn-off energy loss per pulse	E_{off}	I_C = 240 A, V_{CC} = 500 V, L_σ = 8 nH, V_{GE} = ±15 V, R_{Goff} = 8.2 Ω, dv/dt = 5200 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		6.5		mJ
			T_{vj} = 125 °C		10.1		
			T_{vj} = 175 °C		12.6		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 5 W/(m·K)			0.220		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**: $T_{vj\,op}$ > 150°C is 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			240	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		480	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	7400	A^2s
			T_{vj} = 175 °C	6500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 240 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.94	2.10	V
			T_{vj} = 125 °C		1.63		
			T_{vj} = 175 °C		1.45		
Peak reverse recovery current	I_{RM}	V_{CC} = 500 V, I_F = 240 A, V_{GE} = -15 V, -di$_F$/dt = 6500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		204		A
			T_{vj} = 125 °C		317		
			T_{vj} = 175 °C		385		
Recovered charge	Q_r	V_{CC} = 500 V, I_F = 240 A, V_{GE} = -15 V, -di$_F$/dt = 6500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		10		µC
			T_{vj} = 125 °C		23.5		
			T_{vj} = 175 °C		34.2		
Reverse recovery energy	E_{rec}	V_{CC} = 500 V, I_F = 240 A, V_{GE} = -15 V, -di$_F$/dt = 6500 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.19		mJ
			T_{vj} = 125 °C		8.19		
			T_{vj} = 175 °C		12.2		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 5 W/(m·K)			0.220		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**: $T_{vj\,op}$ > 150°C is 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	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	160	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		320	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 = 160 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.34	1.60	V
			T_{vj} = 125 °C		1.40		
			T_{vj} = 175 °C		1.43		
Gate threshold voltage	V_{GEth}	I_C = 6.72 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			6.19		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			47.7		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.3		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			92	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 = 160 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω	T_{vj} = 25 °C		0.370		µs
			T_{vj} = 125 °C		0.400		
			T_{vj} = 175 °C		0.440		

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Rise time (inductive load)	t_r	I_C = 160 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω	T_{vj} = 25 °C		0.025		µs
			T_{vj} = 125 °C		0.029		
			T_{vj} = 175 °C		0.031		
Turn-off delay time (inductive load)	t_{doff}	I_C = 160 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 6.8 Ω	T_{vj} = 25 °C		1.000		µs
			T_{vj} = 125 °C		1.100		
			T_{vj} = 175 °C		1.160		
Fall time (inductive load)	t_f	I_C = 160 A, V_{CC} = 500 V, V_{GE} = ±15 V, R_{Goff} = 6.8 Ω	T_{vj} = 25 °C		0.028		µs
			T_{vj} = 125 °C		0.052		
			T_{vj} = 175 °C		0.082		
Turn-on energy loss per pulse	E_{on}	I_C = 160 A, V_{CC} = 500 V, L_σ = 10 nH, V_{GE} = ±15 V, R_{Gon} = 0.68 Ω, di/dt = 6000 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		4.52		mJ
			T_{vj} = 125 °C		6.48		
			T_{vj} = 175 °C		7.64		
Turn-off energy loss per pulse	E_{off}	I_C = 160 A, V_{CC} = 500 V, L_σ = 10 nH, V_{GE} = ±15 V, R_{Goff} = 6.8 Ω, dv/dt = 5400 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.94		mJ
			T_{vj} = 125 °C		6.58		
			T_{vj} = 175 °C		8.24		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 5 W/(m·K)			0.220		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

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

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	1200	V
Continuous DC forward current	I_F			160	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		320	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	5500	A^2s
			T_{vj} = 175 °C	4100	

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 160 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.83	2.00	V
			T_{vj} = 125 °C		1.52		
			T_{vj} = 175 °C		1.35		
Peak reverse recovery current	I_{RM}	V_{CC} = 500 V, I_F = 160 A, V_{GE} = -15 V, -di$_F$/dt = 5200 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		206		A
			T_{vj} = 125 °C		277		
			T_{vj} = 175 °C		330		
Recovered charge	Q_r	V_{CC} = 500 V, I_F = 160 A, V_{GE} = -15 V, -di$_F$/dt = 5200 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		8.1		µC
			T_{vj} = 125 °C		18		
			T_{vj} = 175 °C		27		
Reverse recovery energy	E_{rec}	V_{CC} = 500 V, I_F = 160 A, V_{GE} = -15 V, -di$_F$/dt = 5200 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.4		mJ
			T_{vj} = 125 °C		5.8		
			T_{vj} = 175 °C		8.8		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 5 W/(m·K)			0.330		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		175	°C

***Note**: $T_{vj\,op}$ > 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

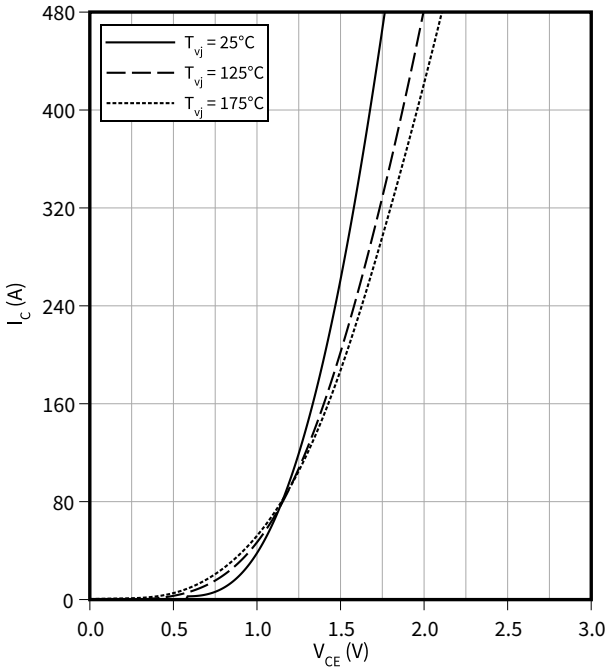
***Note**: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.*

7 Characteristics diagrams

Output characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{CE})$

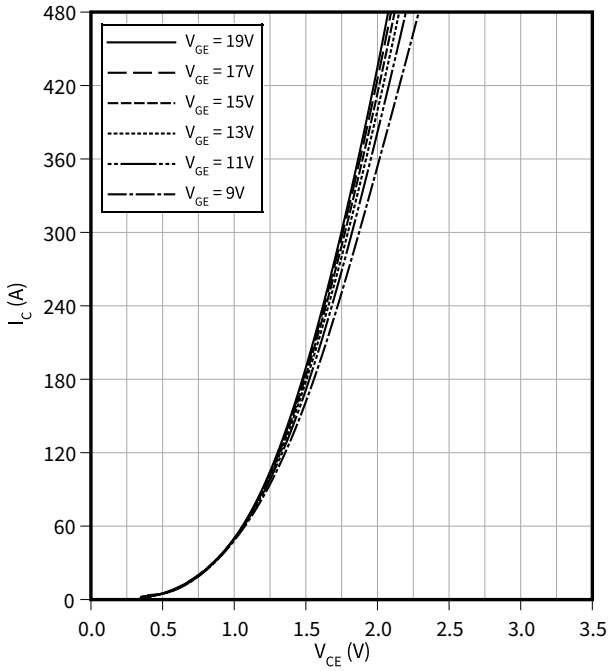
V_{GE} = 15 V



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

$I_C = f(V_{CE})$

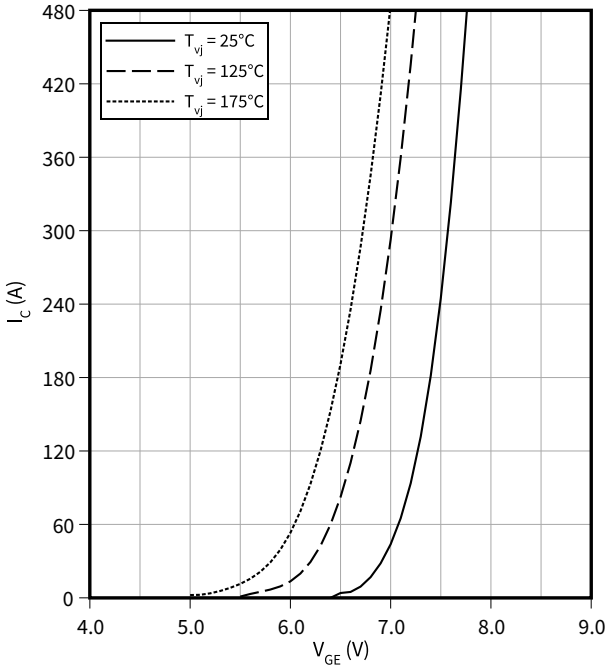
T_{vj} = 175 °C



Transfer characteristic (typical), IGBT, T1 / T2

$I_C = f(V_{GE})$

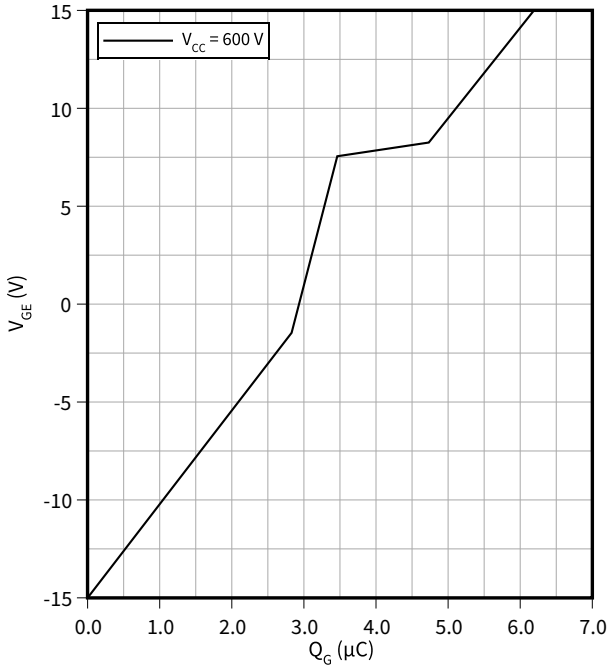
V_{CE} = 20 V



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

$V_{GE} = f(Q_G)$

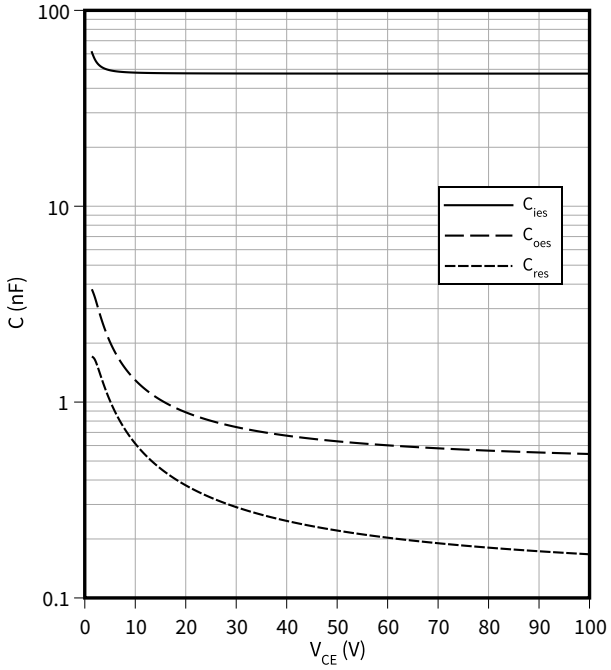
I_C = 420 A, T_{vj} = 25 °C



Capacity characteristic (typical), IGBT, T1 / T2

$C = f(V_{CE})$

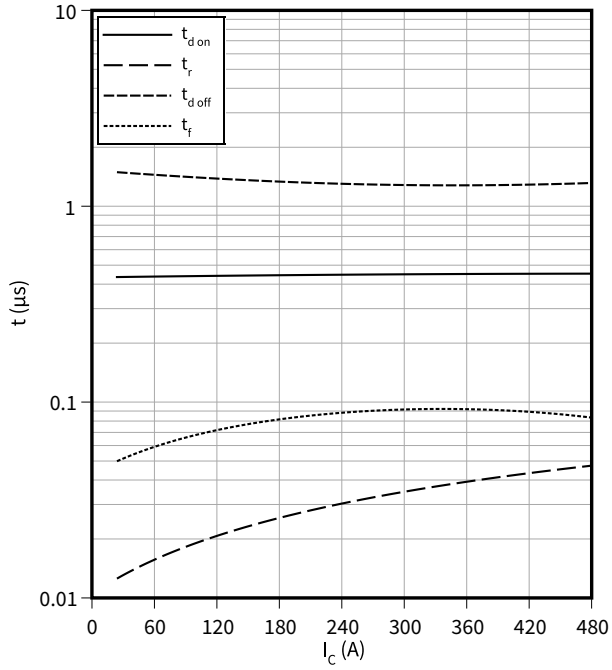
$f = 100\ kHz$, $V_{GE} = 0\ V$, $T_{vj} = 25\ °C$



Switching times (typical), IGBT, T1 / T2

$t = f(I_C)$

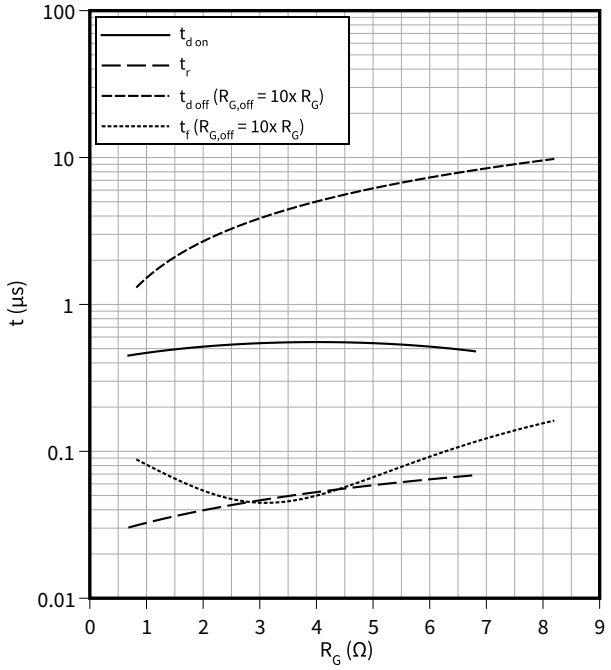
$R_{Goff} = 8.2\ \Omega$, $R_{Gon} = 0.68\ \Omega$, $V_{GE} = \pm 15\ V$, $V_{CC} = 500\ V$, $T_{vj} = 175\ °C$



Switching times (typical), IGBT, T1 / T2

$t = f(R_G)$

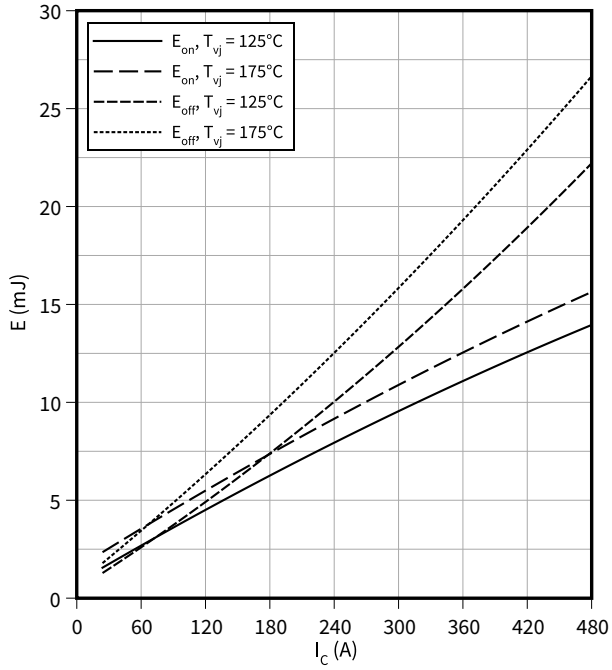
$V_{GE} = \pm 15\ V$, $I_C = 240\ A$, $V_{CC} = 500\ V$, $T_{vj} = 175\ °C$



Switching losses (typical), IGBT, T1 / T2

$E = f(I_C)$

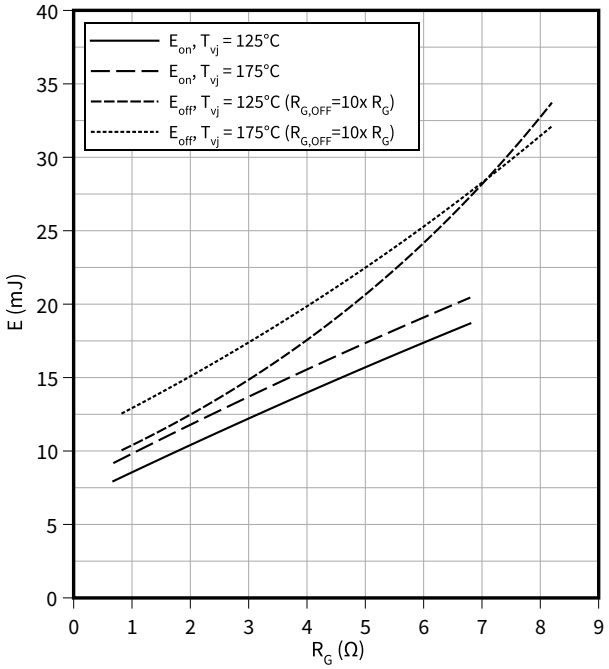
$R_{Goff} = 8.2\ \Omega$, $R_{Gon} = 0.68\ \Omega$, $V_{CC} = 500\ V$, $\pm\ 15\ V$



Switching losses (typical), IGBT, T1 / T2

$E = f(R_G)$

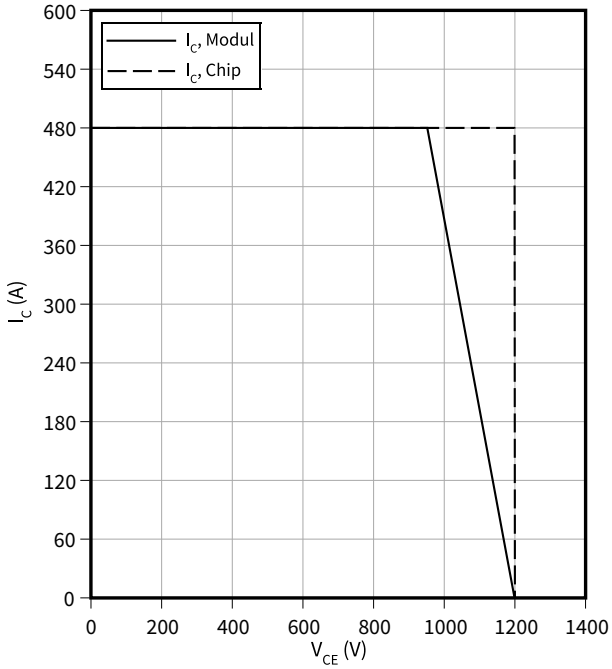
$I_C = 240\ A$, $V_{CC} = 500\ V$, ± 15 V



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

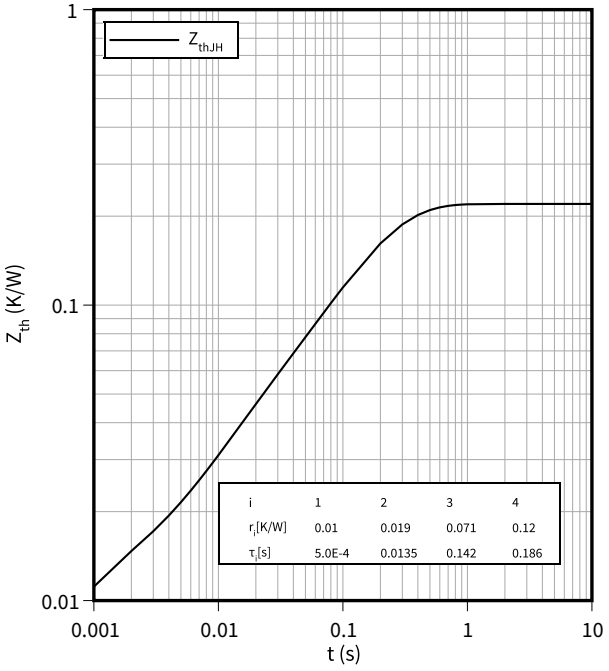
$I_C = f(V_{CE})$

$R_{Goff} = 8.2\ \Omega$, $V_{GE} = \pm 15\ V$, $T_{vj} = 175\ °C$



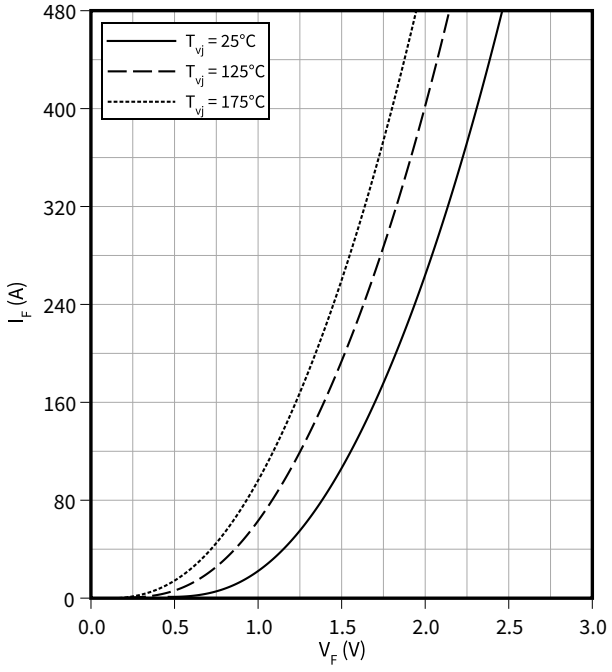
Transient thermal impedance, IGBT, T1 / T2

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D1 / D2

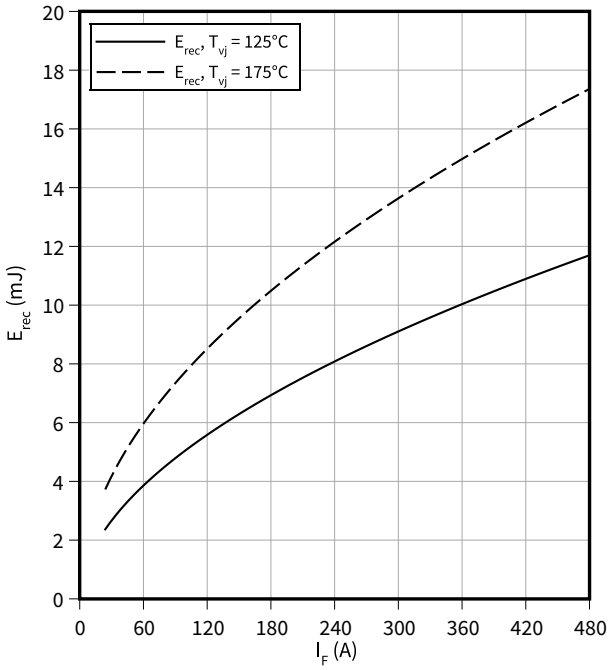
$I_F = f(V_F)$



Switching losses (typical), Diode, D1 / D2

$E_{rec} = f(I_F)$

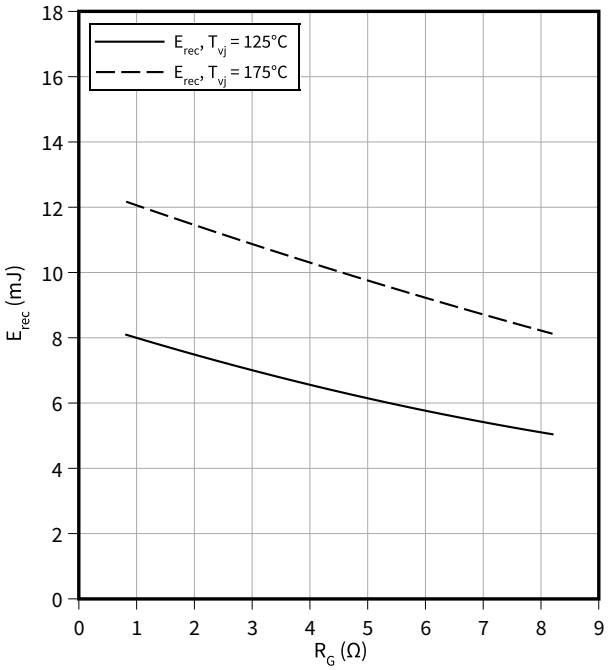
$R_{Gon} = 0.68\ \Omega$, $V_{CC} = 500$ V



Switching losses (typical), Diode, D1 / D2

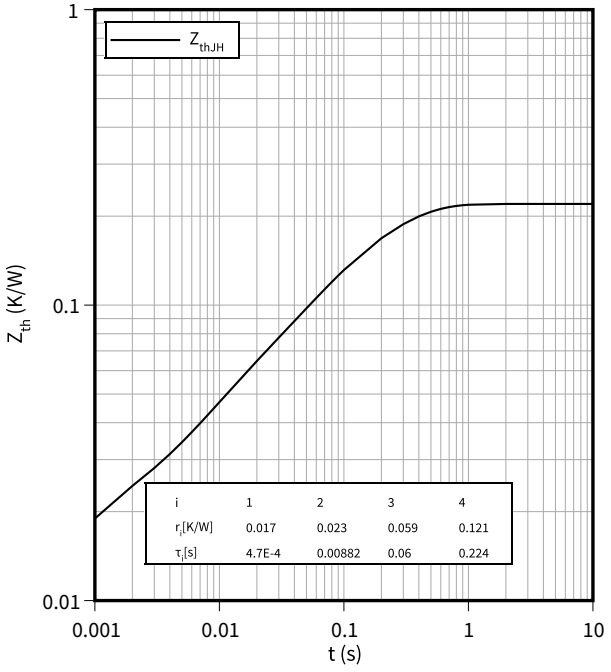
$E_{rec} = f(R_G)$

$I_F = 240$ A, $V_{CC} = 500$ V



Transient thermal impedance, Diode, D1 / D2

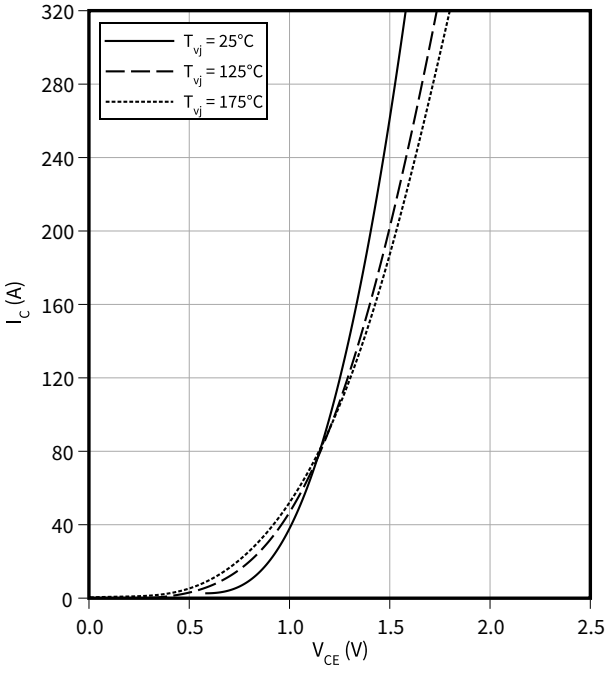
$Z_{th} = f(t)$



Output characteristic (typical), IGBT, T3 / T4

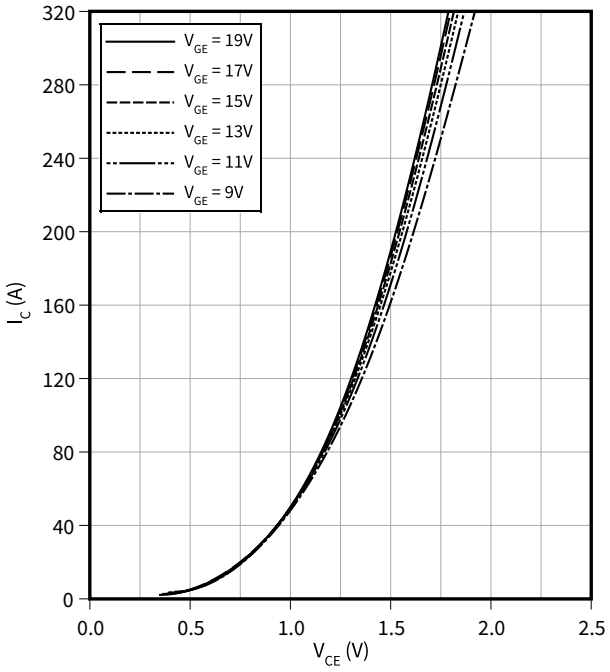
$I_C = f(V_{CE})$

$V_{GE} = 15$ V



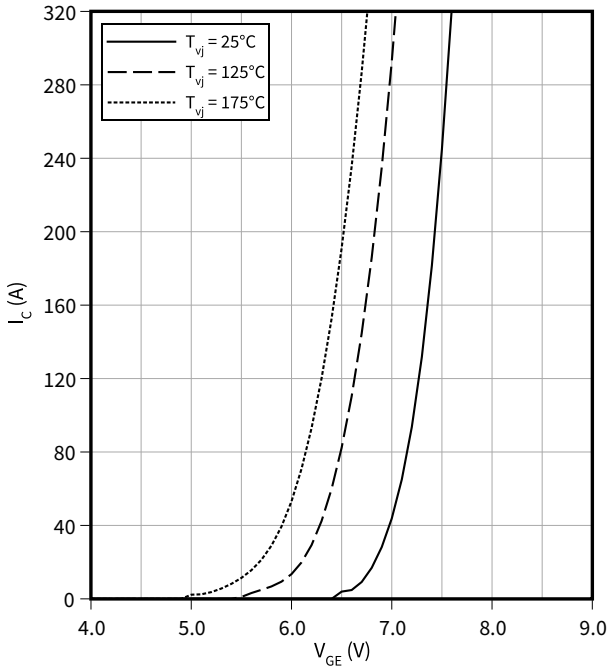
Output characteristic field (typical), IGBT, T3 / T4

$I_C = f(V_{CE})$
$T_{vj} = 175\ °C$



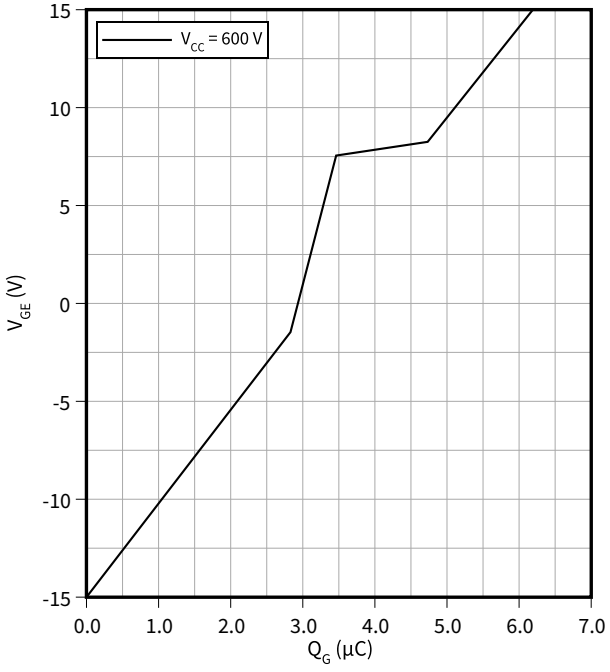
Transfer characteristic (typical), IGBT, T3 / T4

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



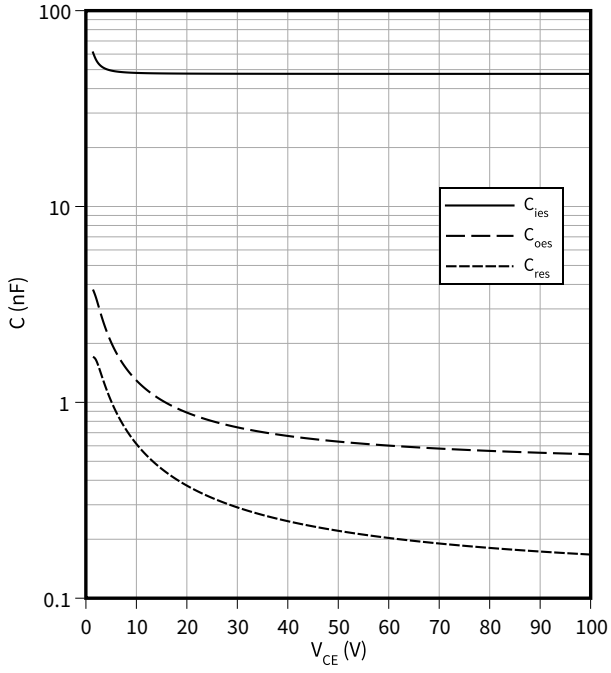
Gate charge characteristic (typical), IGBT, T3 / T4

$V_{GE} = f(Q_G)$
$I_C = 420\ A,\ T_{vj} = 25\ °C$



Capacity characteristic (typical), IGBT, T3 / T4

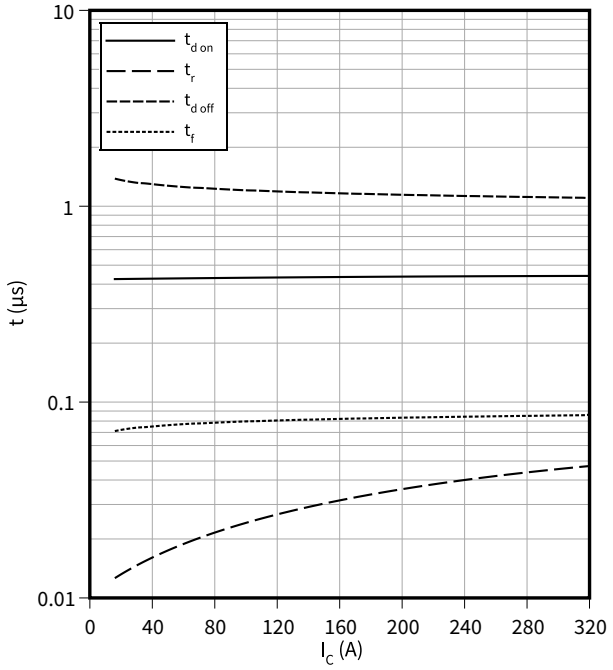
$C = f(V_{CE})$
$f = 100\ kHz,\ V_{GE} = 0\ V,\ T_{vj} = 25\ °C$



Switching times (typical), IGBT, T3 / T4

$t = f(I_C)$

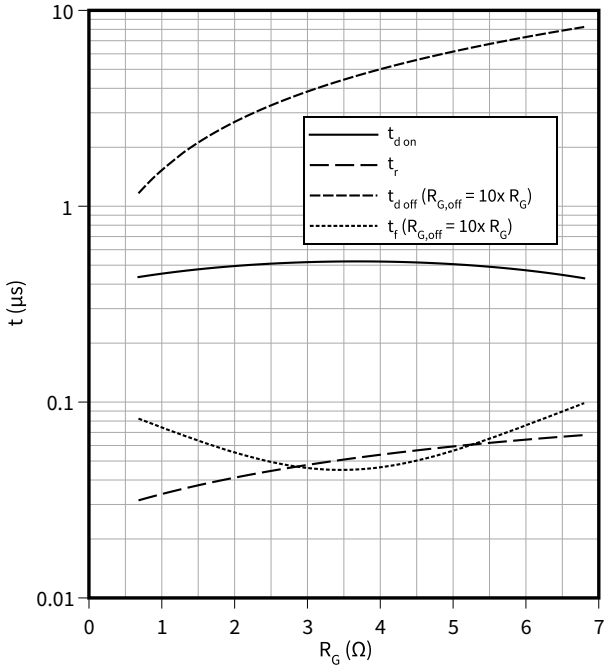
R_{Goff} = 6.8 Ω, R_{Gon} = 0.68 Ω, V_{GE} = ±15 V, V_{CC} = 500 V, T_{vj} = 175 °C



Switching times (typical), IGBT, T3 / T4

$t = f(R_G)$

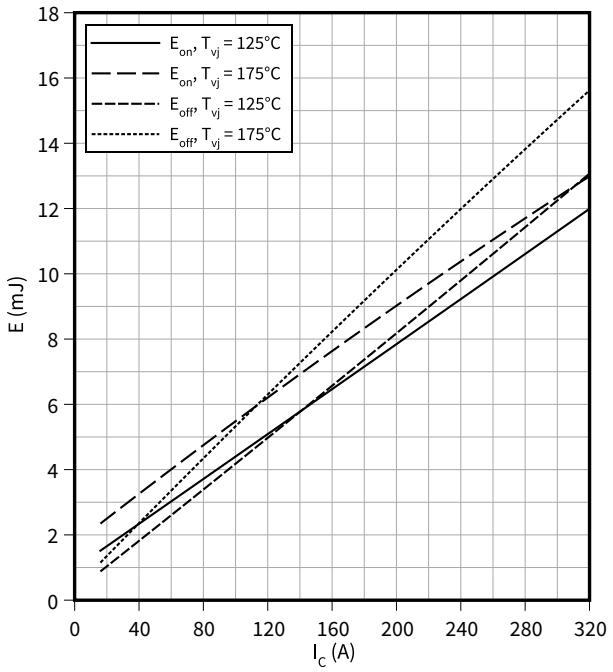
V_{GE} = ±15 V, I_C = 160 A, V_{CC} = 500 V, T_{vj} = 175 °C



Switching losses (typical), IGBT, T3 / T4

$E = f(I_C)$

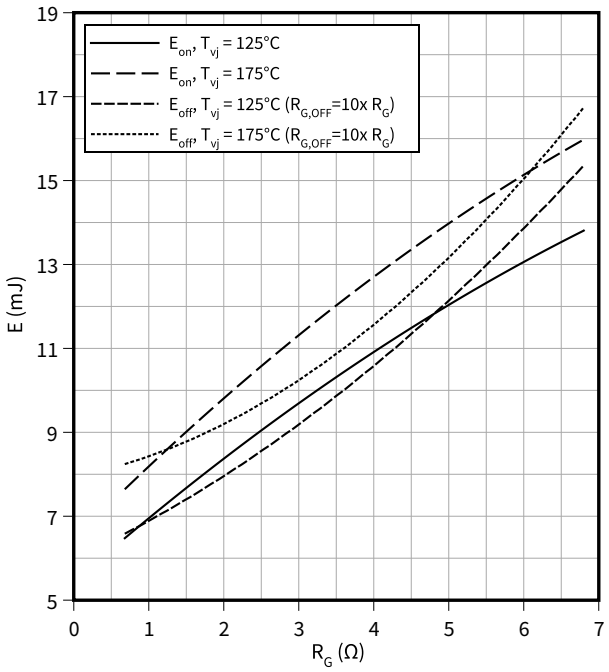
R_{Goff} = 6.8 Ω, R_{Gon} = 0.68 Ω, V_{CC} = 500 V, ± 15 V



Switching losses (typical), IGBT, T3 / T4

$E = f(R_G)$

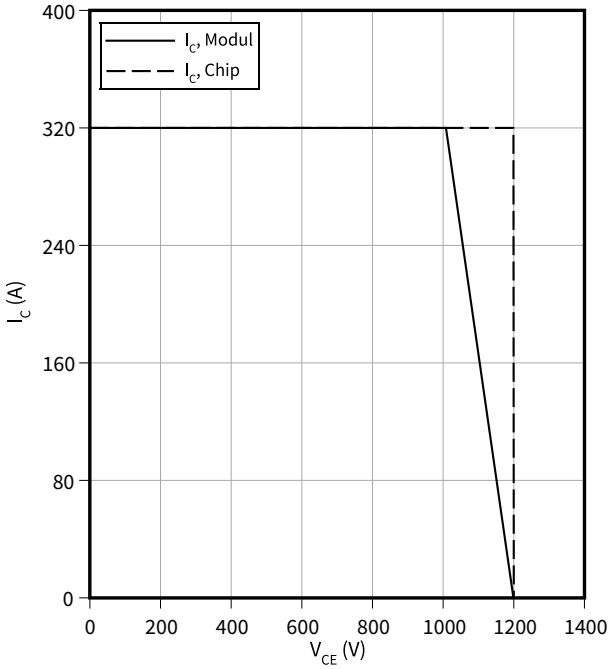
I_C = 500 A, V_{CC} = 500 V, ± 15 V



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

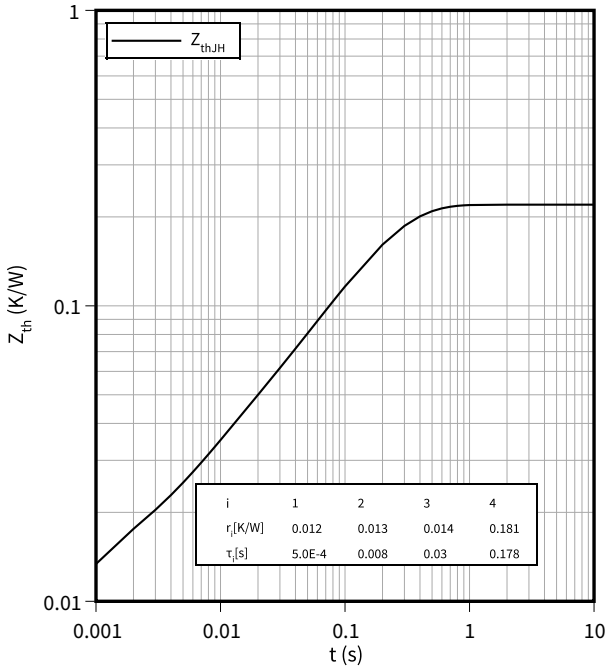
$I_C = f(V_{CE})$

$R_{Goff} = 6.8\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



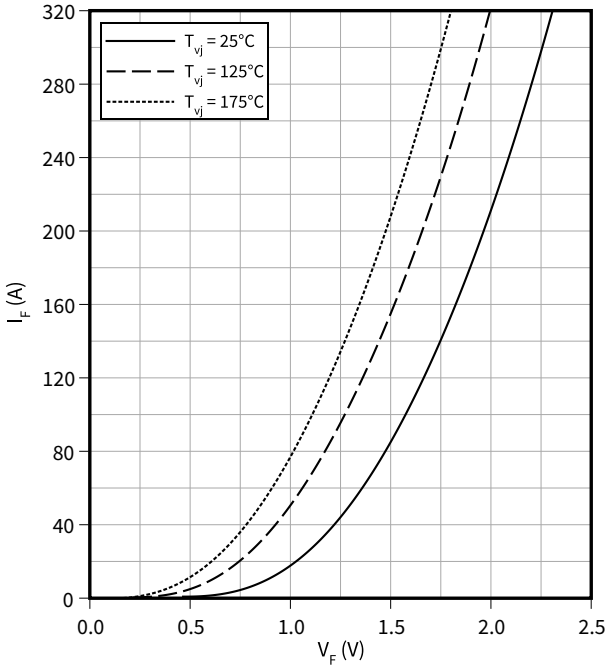
Transient thermal impedance, IGBT, T3 / T4

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D3 / D4

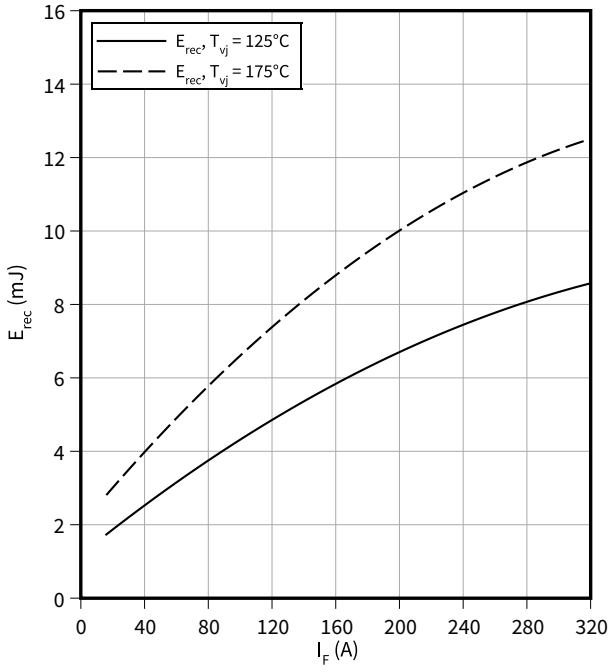
$I_F = f(V_F)$



Switching losses (typical), Diode, D3 / D4

$E_{rec} = f(I_F)$

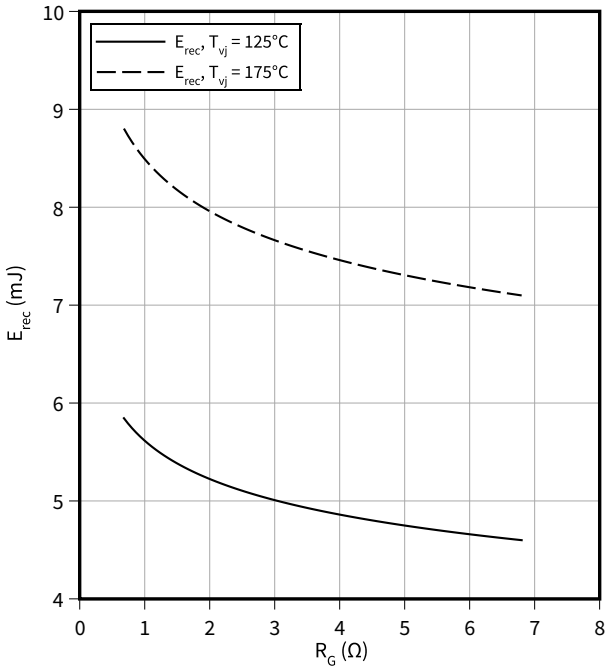
$R_{Gon} = 0.68\ \Omega$, $V_{CC} = 500$ V



Switching losses (typical), Diode, D3 / D4

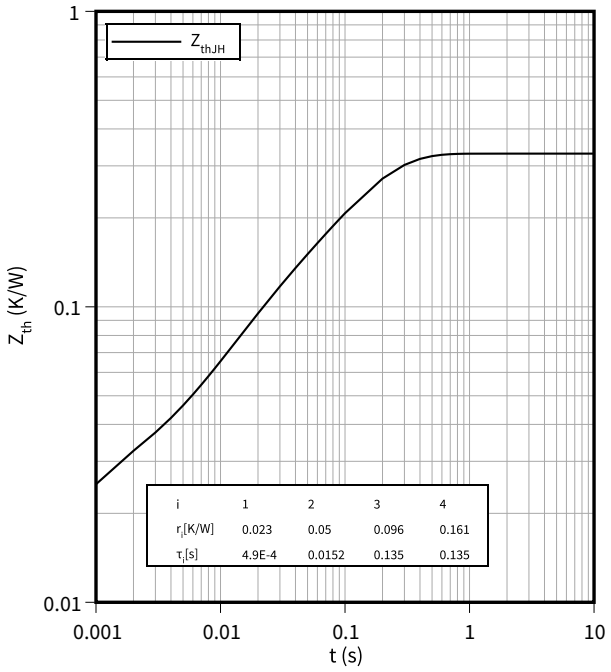
$E_{rec} = f(R_G)$

$I_F = 160\ A, V_{CC} = 500\ V$



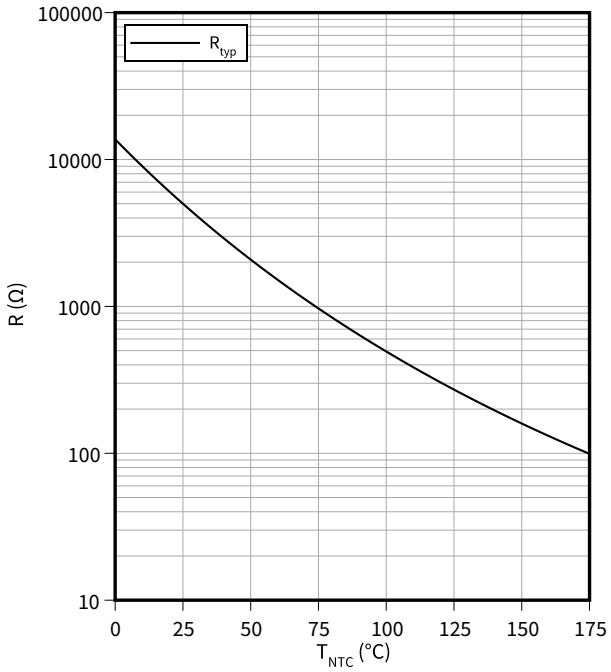
Transient thermal impedance, Diode, D3 / D4

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



8 Circuit diagram

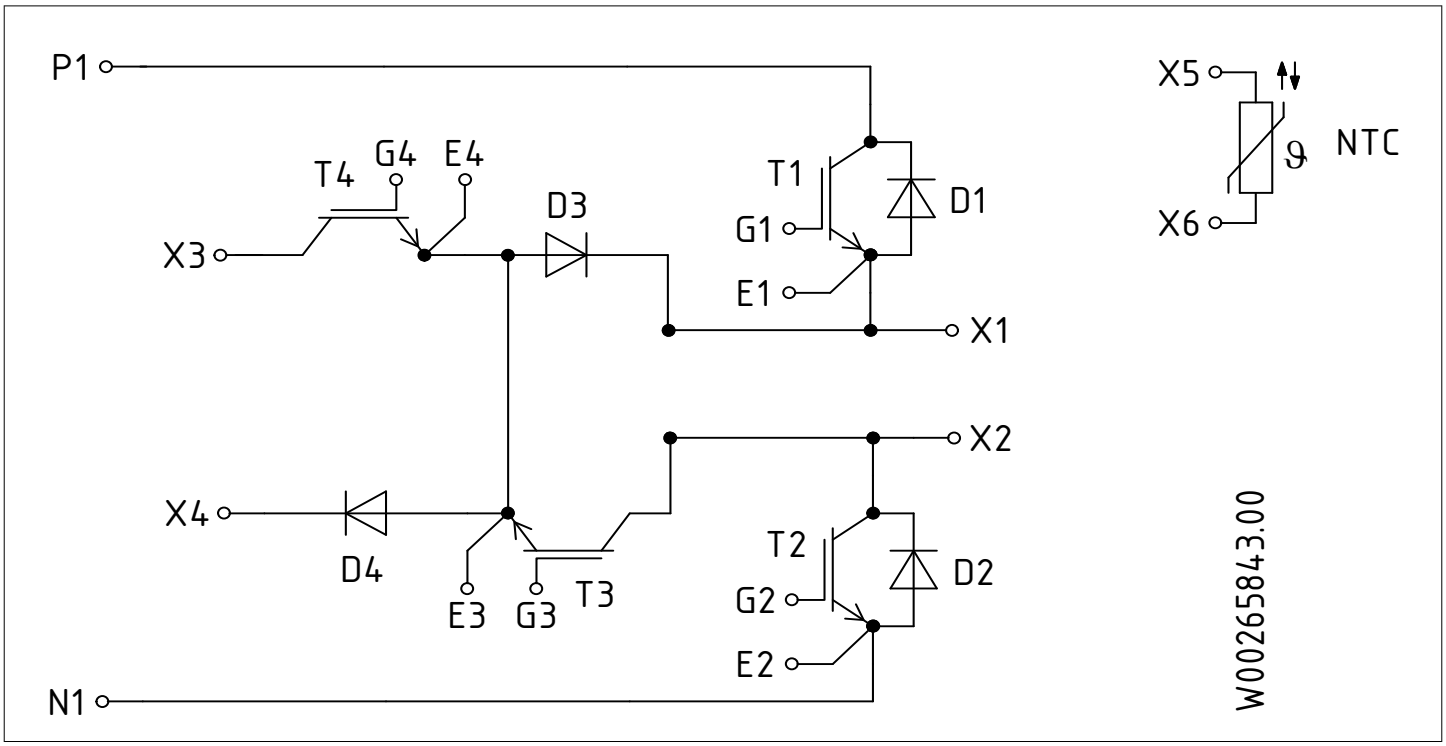


Figure 1

9 Package outlines

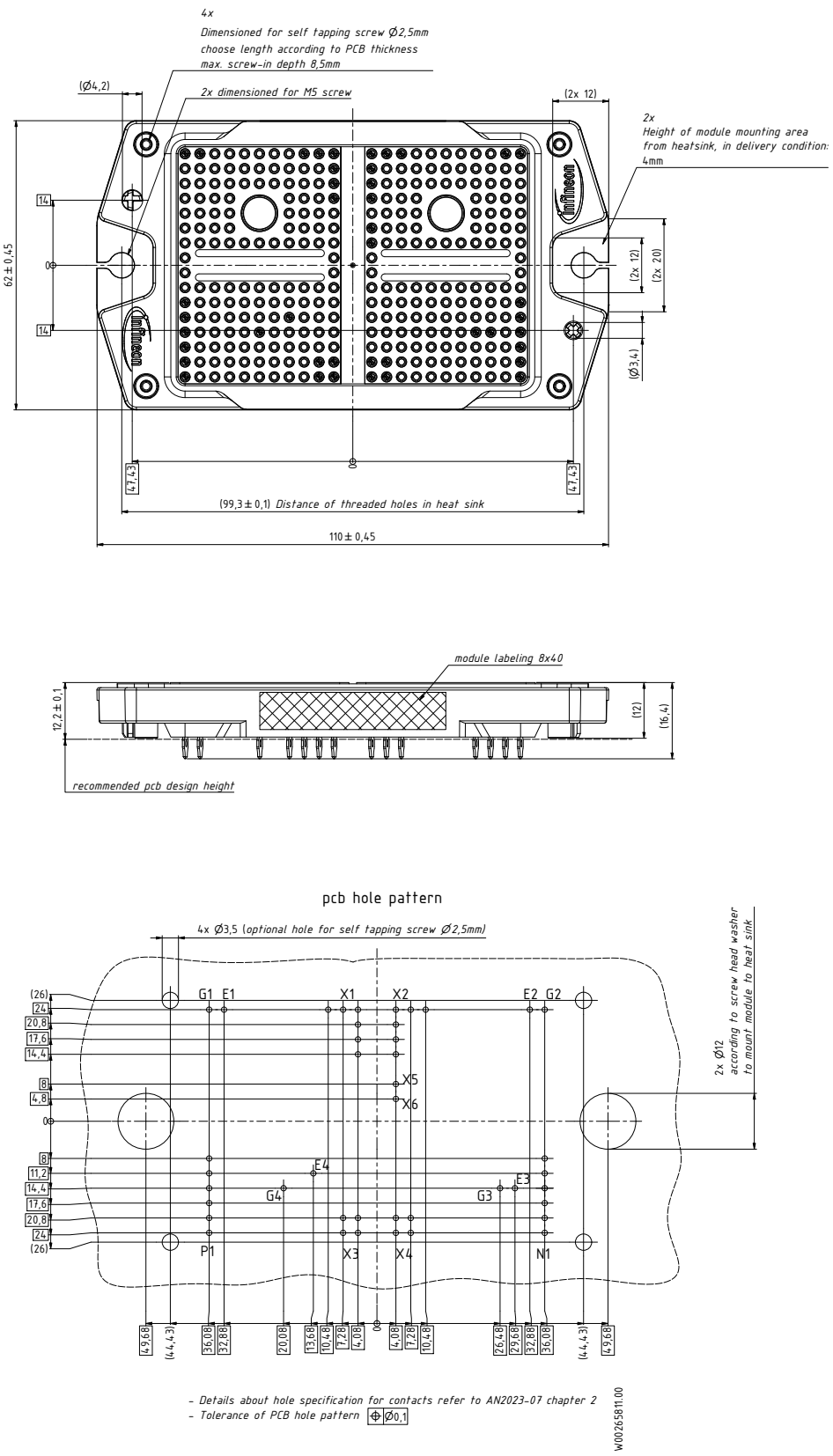


Figure 2

10 Module label code

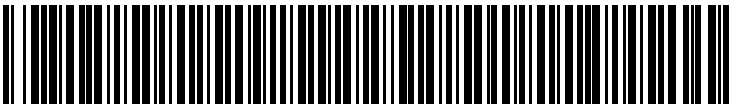
Module label code			
Code format	Data Matrix		Barcode Code128
Encoding	ASCII text		Code Set A
Symbol size	16x16		23 digits
Standard	IEC24720 and IEC16022		IEC8859-1
Code content	*Content* Module serial number Module material number Production order number Date code (production year) Date code (production 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
1.00	2025-03-11	Initial version

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