Final datasheet

EasyPACK™ 1B module with TRENCHSTOP™ 5 H5 and RAPID 1 diode and PressFIT / NTC

Features

Typical appearance

- Electrical features
  - V_{CES} = 650 V
  - $I_{C\ nom}$ = 40 A / I_{CRM} = 100 A
  - Low switching losses
  - Low inductive design
- Mechanical features
  - PressFIT contact technology
  - Integrated NTC temperature sensor
  - Rugged mounting due to integrated mounting clamps

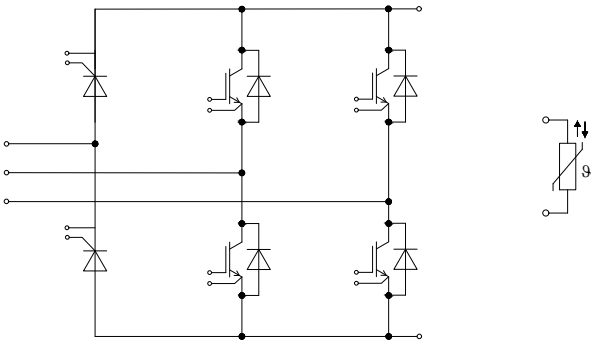
Potential applications

- Automotive applications
- DC charger for EV
- High-frequency switching application

Product validation

- Qualified according to AQG 324, release no.: 02.1/2019

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* = 60 s	2.5	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	6.2	mm
Clearance	d_{Clear}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to terminal	4.2	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}			21		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H = 25 °C, per switch		5.3		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting force per clamp	*F*		20		50	N
Weight	*G*			24		g

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

2 IGBT, T3-T6

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		T_{vj} = 25 °C	650	V
Implemented collector current	I_{CN}			50	A
Continuous DC collector current	I_{CDC}	$T_{vj\,max}$ = 175 °C	T_H = 65 °C	30	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		100	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 = 40 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.47	1.97	V
			T_{vj} = 125 °C		1.58		
			T_{vj} = 150 °C		1.61		
Gate threshold voltage	V_{GEth}	I_C = 0.5 mA, V_{CE} = V_{GE}, T_{vj} = 25 °C		3.85	4.60	5.35	V
Gate charge	Q_G	V_{GE} = ±15 V, V_{CC} = 400 V			0.217		µC
Internal gate resistor	R_{Gint}	T_{vj} = 25 °C			0		Ω
Input capacitance	C_{ies}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			2.75		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.01		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_{vj} = 25 °C			16	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 = 40 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 11 Ω	T_{vj} = 25 °C		0.038		µs
			T_{vj} = 125 °C		0.037		
			T_{vj} = 150 °C		0.037		
Rise time (inductive load)	t_r	I_C = 40 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Gon} = 11 Ω	T_{vj} = 25 °C		0.018		µs
			T_{vj} = 125 °C		0.019		
			T_{vj} = 150 °C		0.019		
Turn-off delay time (inductive load)	t_{doff}	I_C = 40 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Goff} = 10 Ω	T_{vj} = 25 °C		0.164		µs
			T_{vj} = 125 °C		0.179		
			T_{vj} = 150 °C		0.184		
Fall time (inductive load)	t_f	I_C = 40 A, V_{CC} = 400 V, V_{GE} = 0/15 V, R_{Goff} = 10 Ω	T_{vj} = 25 °C		0.023		µs
			T_{vj} = 125 °C		0.031		
			T_{vj} = 150 °C		0.032		
Turn-on energy loss per pulse	E_{on}	I_C = 40 A, V_{CC} = 400 V, L_σ = 10 nH, V_{GE} = 0/15 V, R_{Gon} = 11 Ω, di/dt = 1800 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		0.97		mJ
			T_{vj} = 125 °C		1.29		
			T_{vj} = 150 °C		1.37		
Turn-off energy loss per pulse	E_{off}	I_C = 40 A, V_{CC} = 400 V, L_σ = 10 nH, V_{GE} = 0/15 V, R_{Goff} = 10 Ω, dv/dt = 12000 V/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		0.27		mJ
			T_{vj} = 125 °C		0.37		
			T_{vj} = 150 °C		0.41		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 1 W/(m·K)			1.75		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		150	°C

3 Diode, D3-D6

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	650	V
Continuous DC forward current	I_F			40	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		80	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	133	A^2s
			T_{vj} = 150 °C	95	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 40 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.50	2.05	V
			T_{vj} = 125 °C		1.48		
			T_{vj} = 150 °C		1.47		
Peak reverse recovery current	I_{RM}	V_{CC} = 400 V, I_F = 40 A, V_{GE} = 0 V, -di$_F$/dt = 1950 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		22		A
			T_{vj} = 125 °C		31		
			T_{vj} = 150 °C		34		
Recovered charge	Q_r	V_{CC} = 400 V, I_F = 40 A, V_{GE} = 0 V, -di$_F$/dt = 1950 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		1.61		µC
			T_{vj} = 125 °C		2.84		
			T_{vj} = 150 °C		3.22		
Reverse recovery energy	E_{rec}	V_{CC} = 400 V, I_F = 40 A, V_{GE} = 0 V, -di$_F$/dt = 1950 A/µs (T_{vj} = 150 °C)	T_{vj} = 25 °C		0.25		mJ
			T_{vj} = 125 °C		0.54		
			T_{vj} = 150 °C		0.65		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 1 W/(m·K)			2.10		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		150	°C

4 Thyristor, T1 / T2

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	1200	V
Repetitive peak off-state voltage	V_{DRM}		T_{vj} = 25 °C	1200	V
Maximum RMS current at rectifier output	I_{RMSmax}	T_H = 65 °C		60	A
Maximum RMS forward current per chip	I_{FRMSM}	T_H = 65 °C		60	A
Surge forward current	I_{FSM}	V_R = 0 V, t_P = 10 ms	T_{vj} = 125 °C	415	A
			T_{vj} = 150 °C	323	
I^2t - value	I^2t	V_R = 0 V, t_P = 10 ms	T_{vj} = 125 °C	861	A^2s
			T_{vj} = 150 °C	522	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_T	I_T = 65 A	T_{vj} = 25 °C			1.39	V
Gate trigger current	I_{gt}	V_D = 6 V	T_{vj} = -40 °C			80	mA
			T_{vj} = 25 °C			50	
Gate trigger voltage	V_{gt}	V_D = 6 V	T_{vj} = -40 °C			1.6	V
			T_{vj} = 25 °C			1.5	
Gate non-trigger current	I_{gd}	V_D/V_{DRM} = 0.67	T_{vj} = 150 °C			3.0	mA
Gate non-trigger voltage	V_{gd}	V_D/V_{DRM} = 0.67	T_{vj} = 25 °C			0.2	V
Holding current	I_H	V_D = 6 V	T_{vj} = 25 °C			120	mA
Reverse current	I_r		T_{vj} = 25 °C, V_R = 1200 V			0.5	mA
Thermal resistance, junction to heat sink	R_{thJH}	per Thyristor			1.08		K/W
Temperature under switching conditions	$T_{vj\,op}$			-40		125	°C
Temperature under overload switching conditions	$T_{vj\,over}$	Overload, cumulative max. 100 h				140	°C

5 NTC-Thermistor

Table 9 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_{NTC} = 25 °C	9.7	10	10.3	kΩ
Power dissipation	P_{25}	T_{NTC} = 25 °C			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2\text{-}1/(298{,}15\ K))]$		3447		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2\text{-}1/(298{,}15\ K))]$		3487		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2\text{-}1/(298{,}15\ K))]$		3510		K

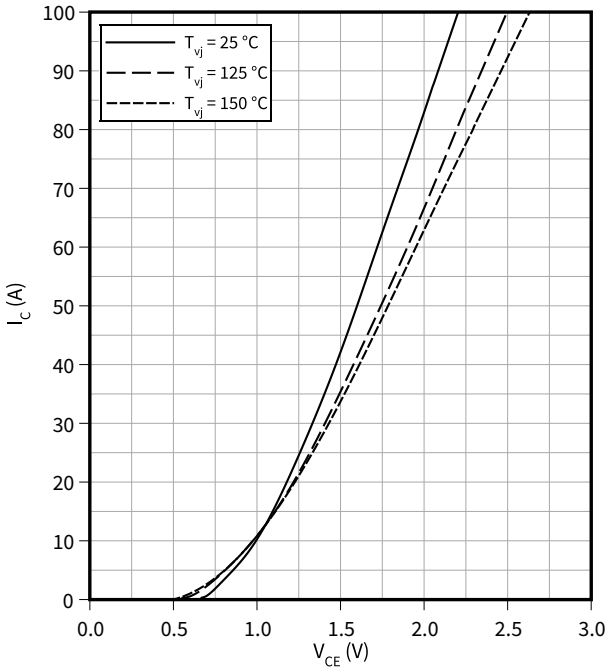
Note: For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4

6 Characteristics diagrams

Output characteristic (typical), IGBT, T3-T6

$I_C = f(V_{CE})$

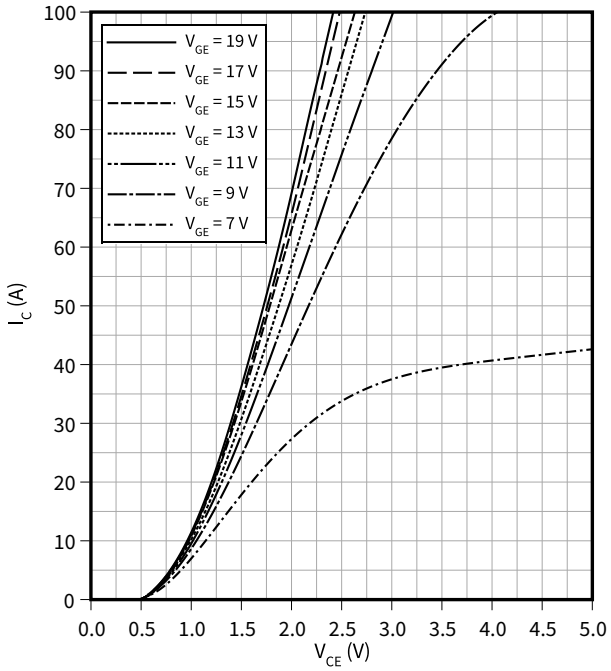
V_{GE} = 15 V



Output characteristic field (typical), IGBT, T3-T6

$I_C = f(V_{CE})$

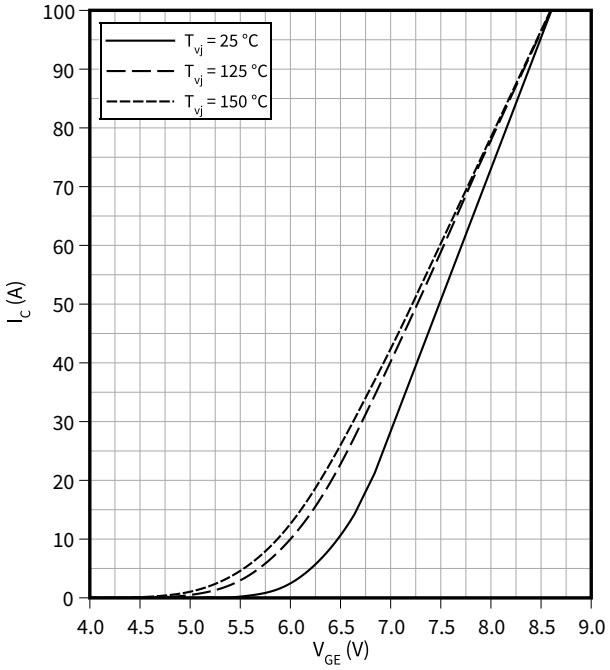
T_{vj} = 150 °C



Transfer characteristic (typical), IGBT, T3-T6

$I_C = f(V_{GE})$

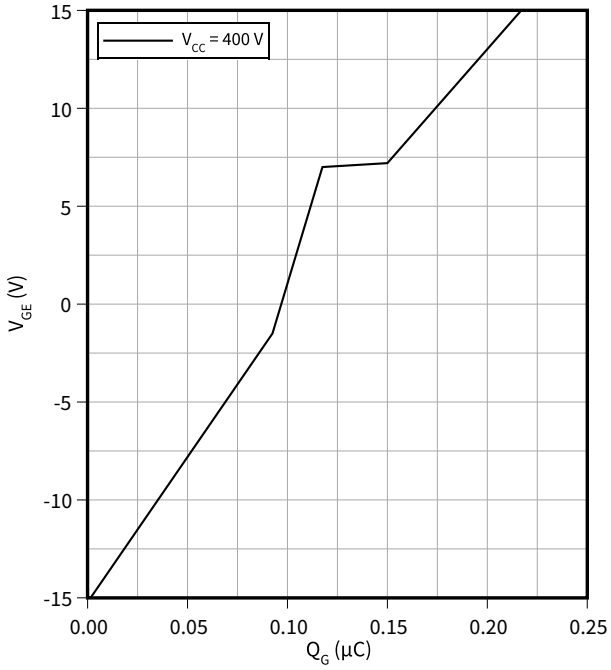
V_{CE} = 20 V



Gate charge characteristic (typical), IGBT, T3-T6

$V_{GE} = f(Q_G)$

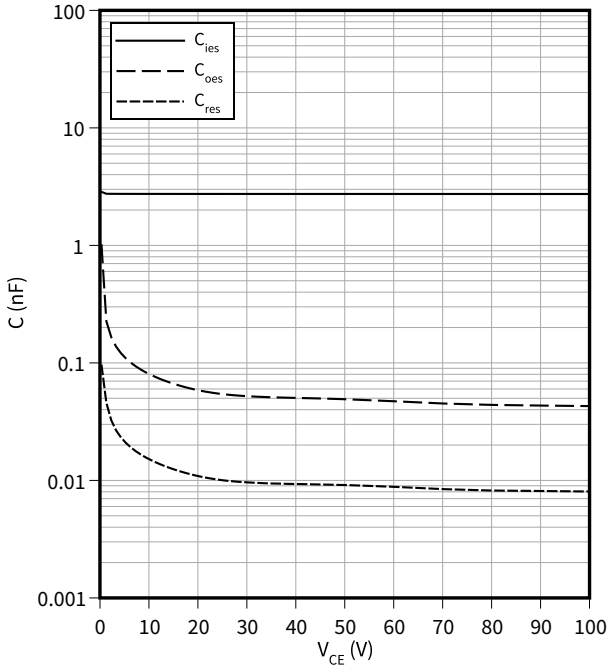
I_C = 40 A, T_{vj} = 25 °C



Capacity characteristic (typical), IGBT, T3-T6

$C = f(V_{CE})$

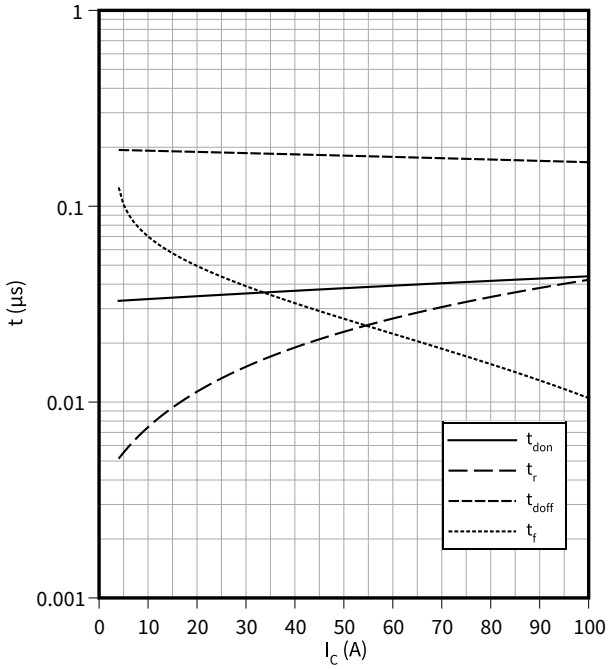
$f = 100\ kHz$, $V_{GE} = 0\ V$, $T_{vj} = 25\ °C$



Switching times (typical), IGBT, T3-T6

$t = f(I_C)$

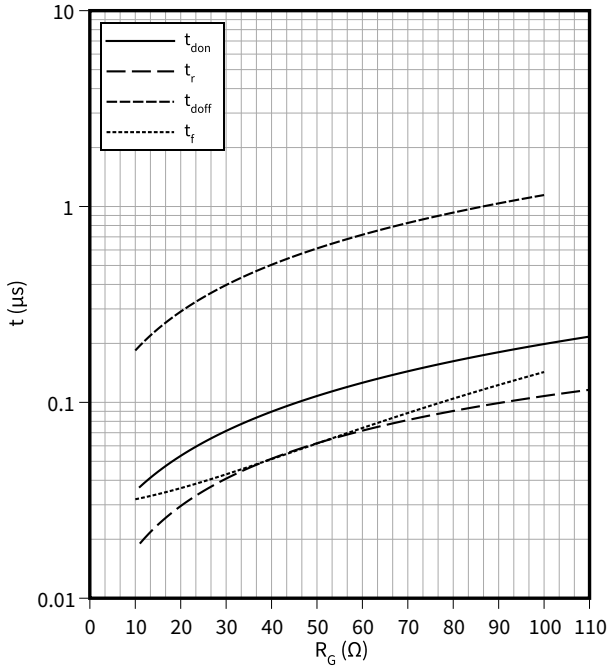
$R_{Goff} = 10\ \Omega$, $R_{Gon} = 11\ \Omega$, $V_{GE} = 0/15\ V$, $V_{CC} = 400\ V$, $T_{vj} = 150\ °C$



Switching times (typical), IGBT, T3-T6

$t = f(R_G)$

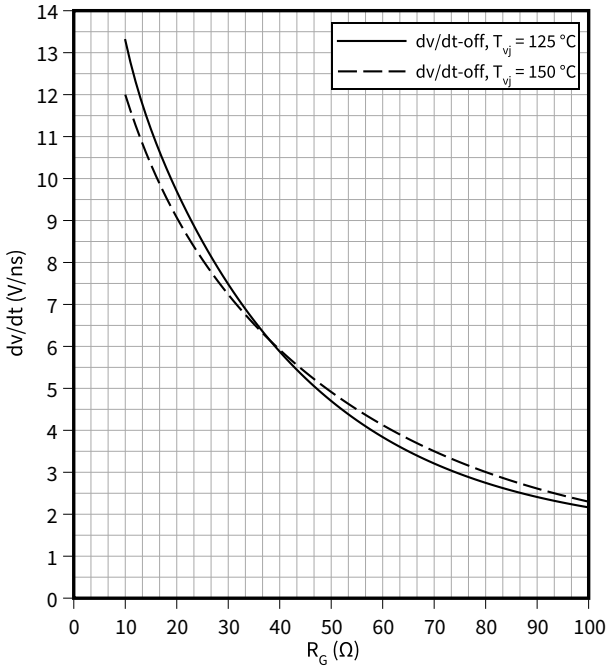
$V_{GE} = 0/15\ V$, $I_C = 40\ A$, $V_{CC} = 400\ V$, $T_{vj} = 150\ °C$



Voltage slope (typical), IGBT, T3-T6

$dv/dt = f(R_G)$

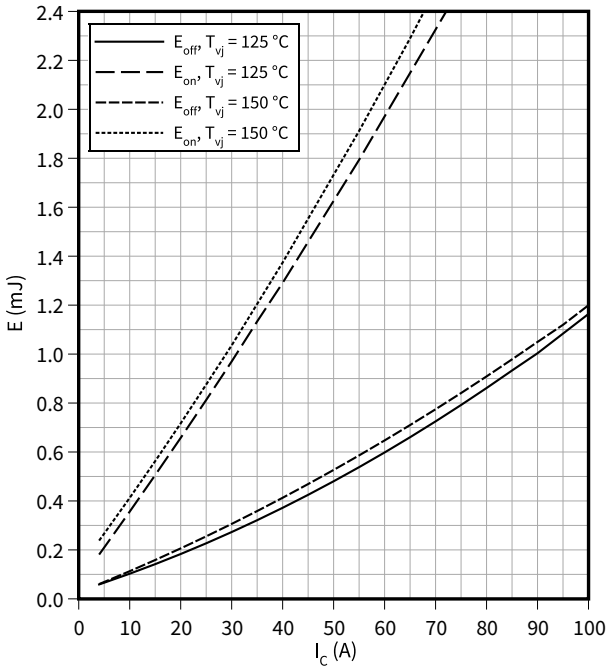
$I_C = 40\ A$, $V_{CC} = 400\ V$, $V_{GE} = 0/15\ V$



Switching losses (typical), IGBT, T3-T6

$E = f(I_C)$

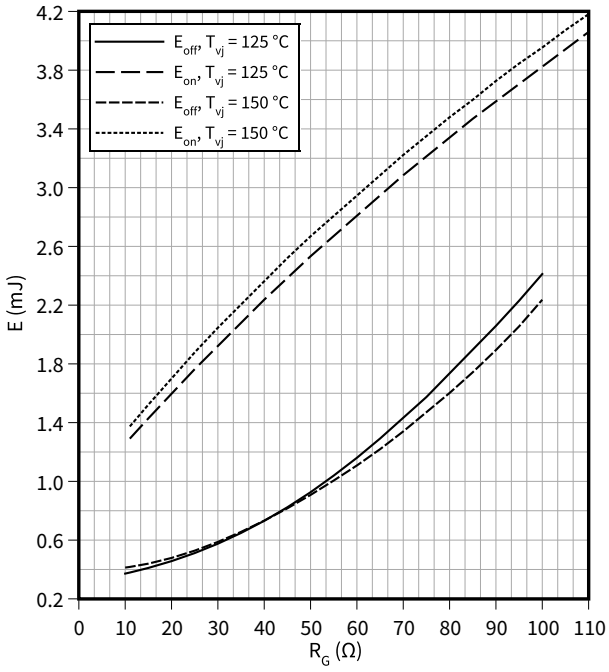
$R_{Goff} = 10\ \Omega$, $R_{Gon} = 11\ \Omega$, $V_{GE} = 0/15\ V$, $V_{CC} = 400\ V$



Switching losses (typical), IGBT, T3-T6

$E = f(R_G)$

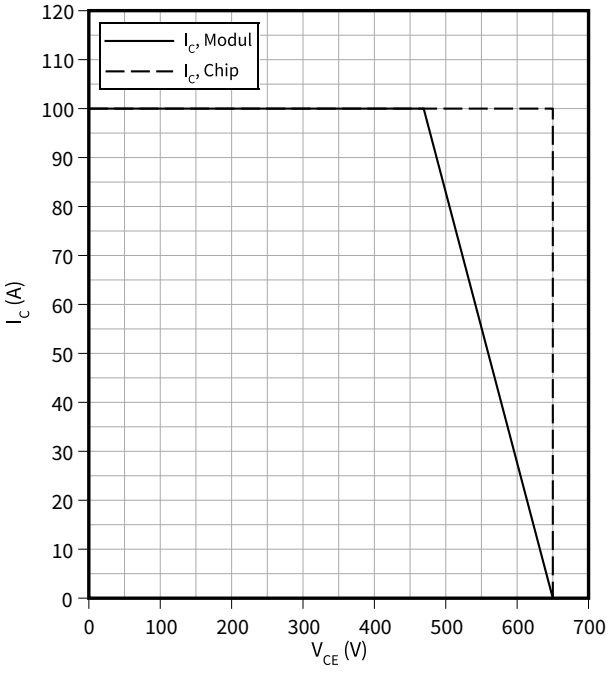
$V_{GE} = 0/15\ V$, $I_C = 40\ A$, $V_{CC} = 400\ V$



Reverse bias safe operating area (RBSOA), IGBT, T3-T6

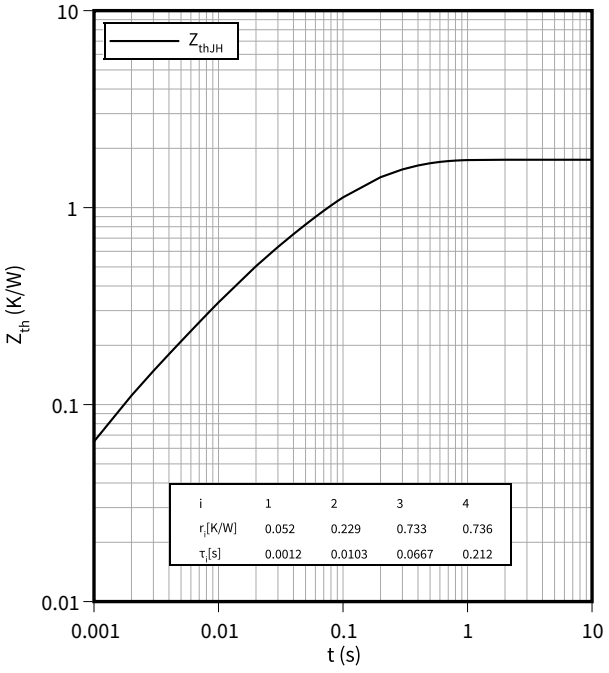
$I_C = f(V_{CE})$

$R_{Goff} = 10\ \Omega$, $V_{GE} = 0/15\ V$, $T_{vj} = 150\ °C$



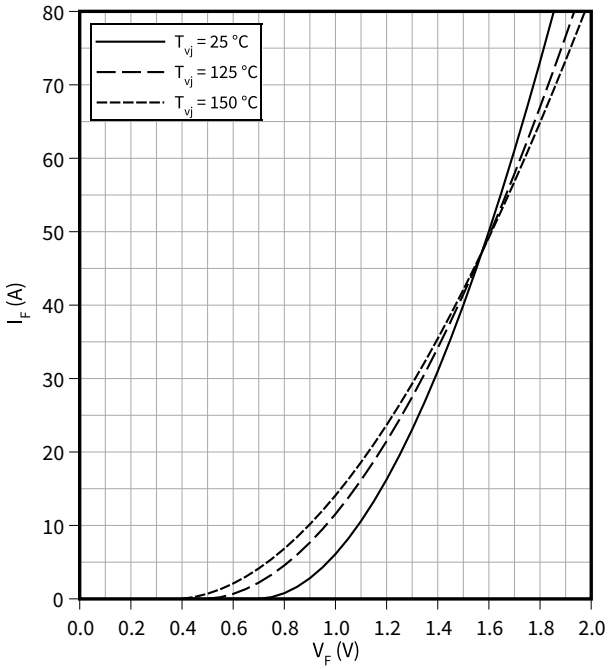
Transient thermal impedance, IGBT, T3-T6

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, D3-D6

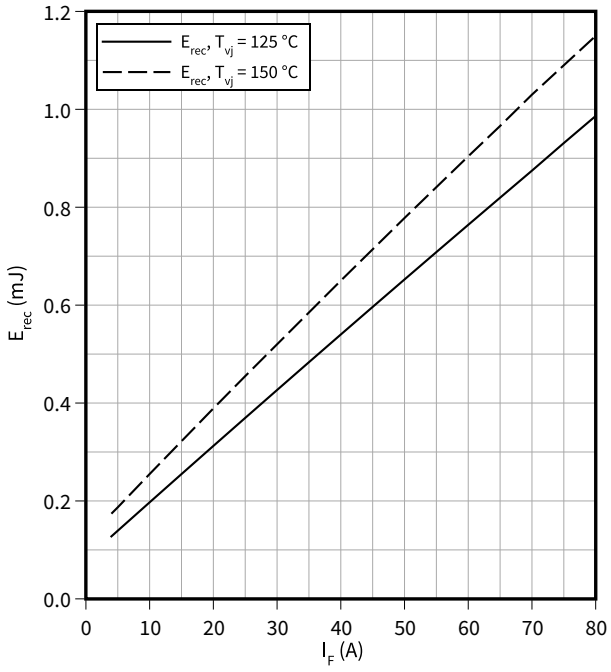
$I_F = f(V_F)$



Switching losses (typical), Diode, D3-D6

$E_{rec} = f(I_F)$

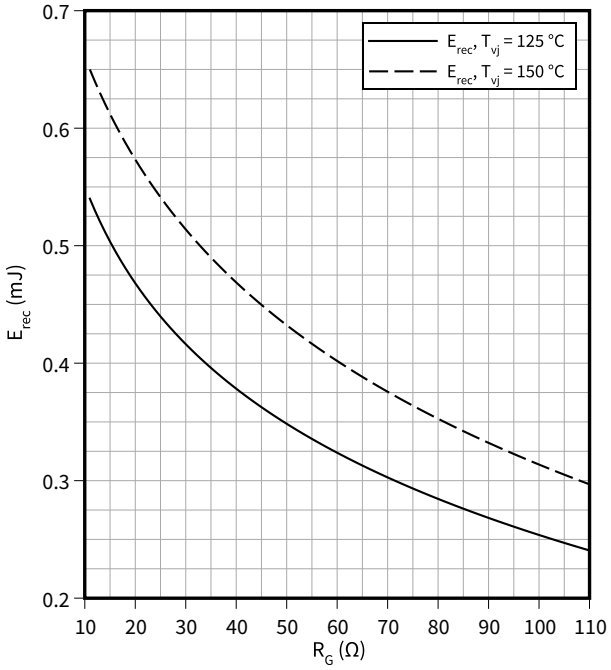
$R_G = 11\ \Omega$, $V_{CC} = 400\ V$



Switching losses (typical), Diode, D3-D6

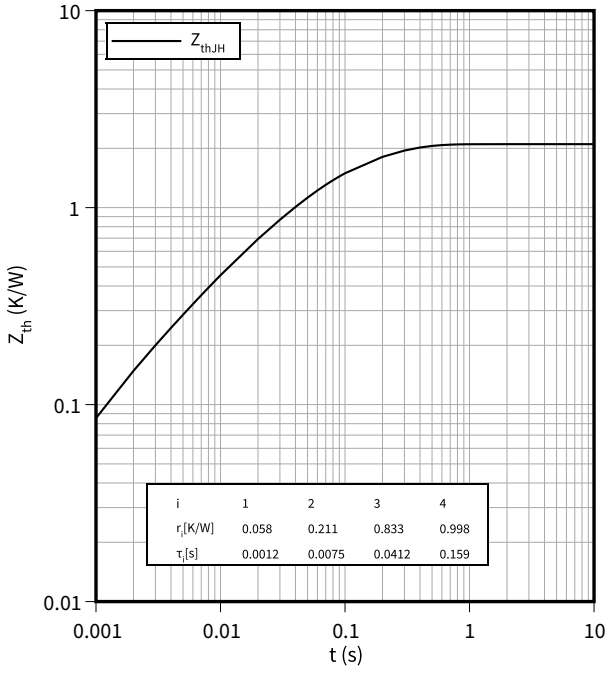
$E_{rec} = f(R_G)$

$I_F = 40\ A$, $V_{CC} = 400\ V$



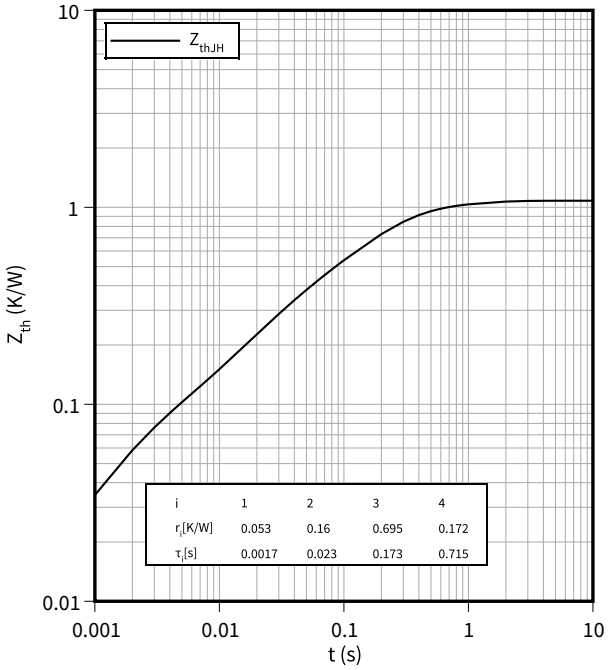
Transient thermal impedance, Diode, D3-D6

$Z_{th} = f(t)$



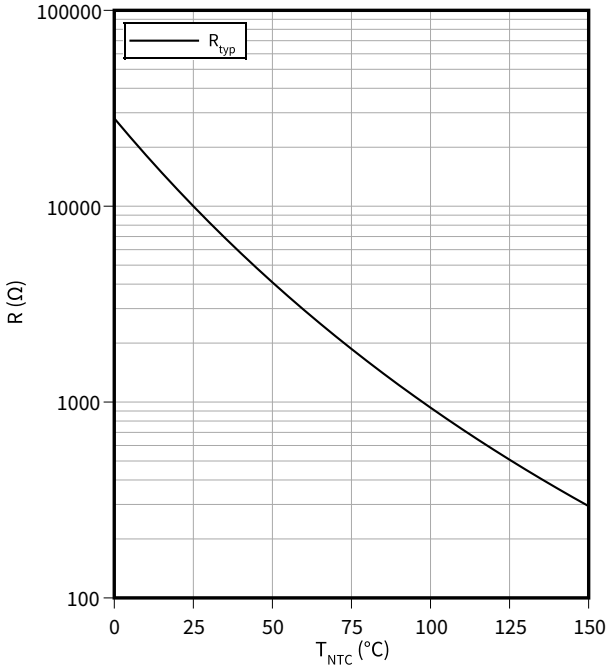
Transient thermal impedance, Thyristor, T1 / T2

$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



7 Circuit diagram

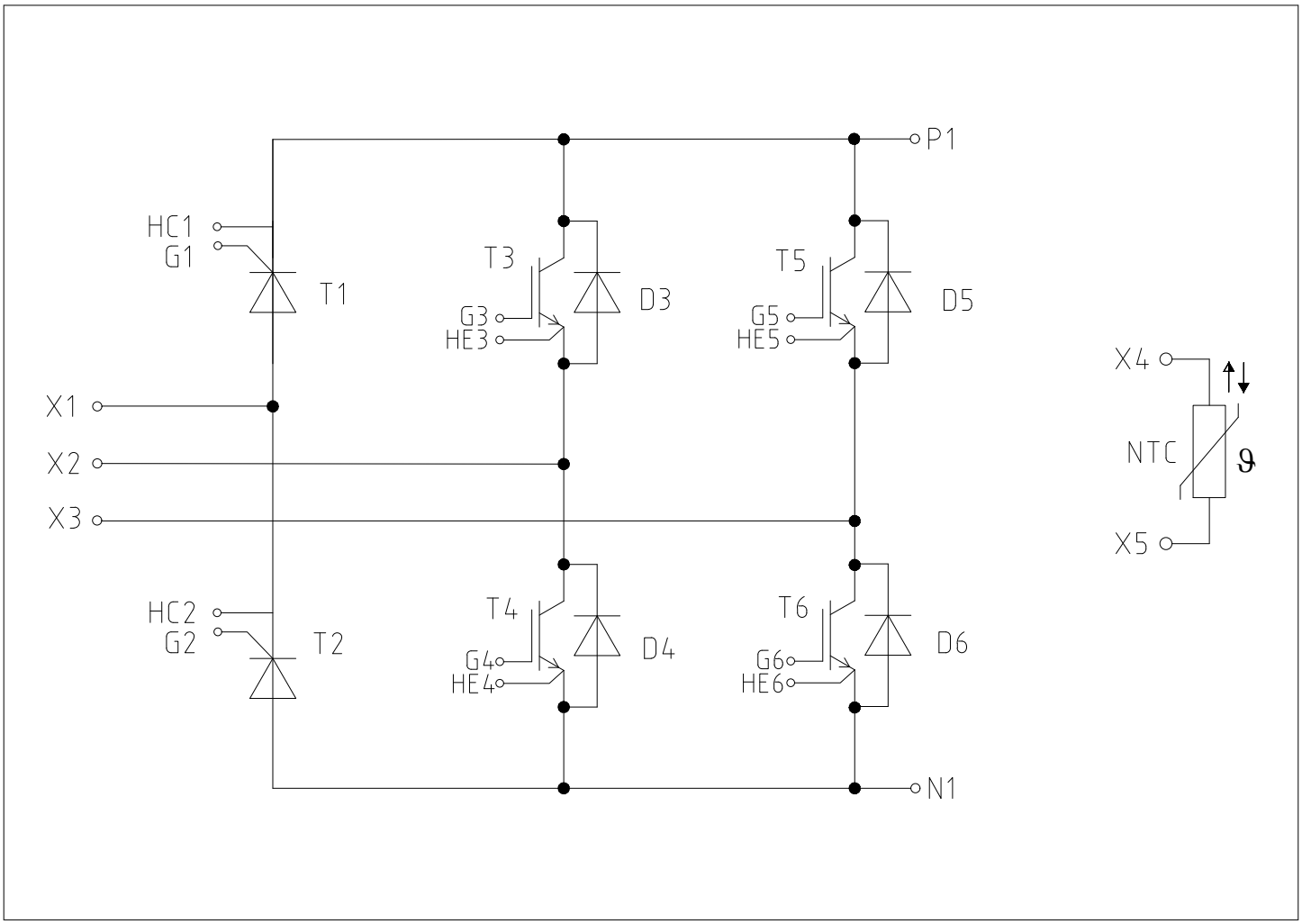


Figure 1

8 Package outlines

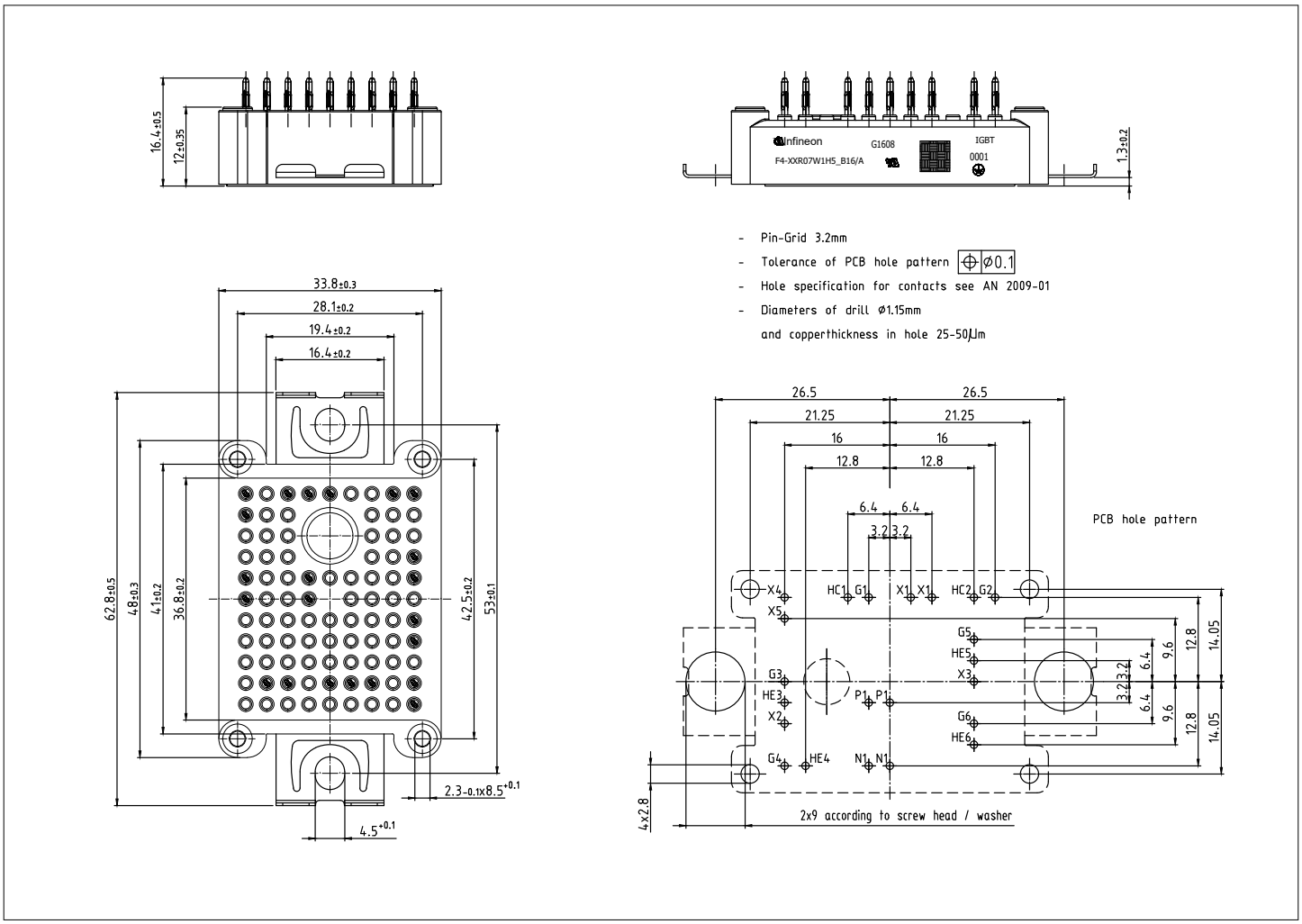


Figure 2

9 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
0.10	2022-07-04	Initial version
1.00	2022-09-01	Final datasheet
1.10	2023-08-22	10424AERRA

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