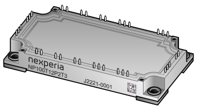


NP100T12P2T3

1200 V, 100 A, Power Integrated Module

Rev. 1 — 20 February 2024 **Product data sheet**

1. General description

IGBT power module provides ultra-low conduction loss as well as short circuit ruggedness. They are designed for applications such as inverters for motor drivers and servo drivers.

2. Features and benefits

- Low switching losses and low saturation voltage $V_{CE(sat)}$
- 10 µs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 °C
- Low stray inductance package
- Fast and soft reverse recovery anti-parallel free-wheeling diode
- RoHS compliant product
- Integrated NTC thermistor temperature sensor

3. Applications

- Inverter for motor drivers and servo drivers
- AC/DC servo drive amplifier

4. Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
NP100T12P2T3	NP2-35P	plastic house; through hole solderable pin with copper baseplate; 35 pins; 62.5 mm × 122.5 mm × 17 mm body	SOT8053-1

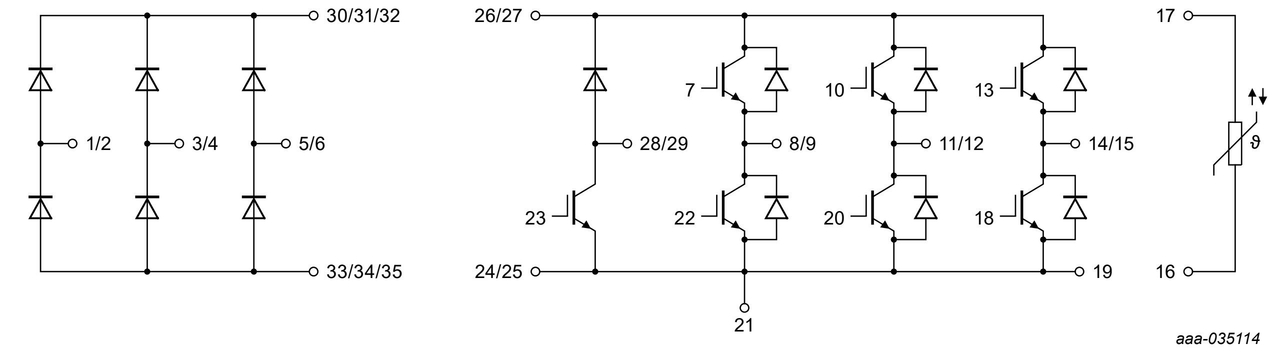


Fig. 1. Schematic diagram

5. Limiting values

Table 2. IGBT

Symbol	Parameter	Conditions	Min	Max	Unit
Inverter					
V_{CES}	collector-emitter voltage	T_j = 25 °C	-	1200	V
I_C	DC collector current	T_{case} = 100 °C; T_{jmax} = 175 °C	-	100	A
I_{CRM}	repetitive peak collector current	t_p = 1 ms	-	200	A
V_{GES}	gate to emitter voltage		-	±20	V
Brake-chopper					
V_{CES}	collector-emitter voltage	T_j = 25 °C	-	1200	V
I_C	DC collector current	T_{case} = 100 °C; T_{jmax} = 175 °C	-	50	A
I_{CRM}	repetitive peak collector current	t_p = 1 ms	-	100	A
V_{GES}	gate to emitter voltage		-	±20	V

Table 3. Diode

Symbol	Parameter	Conditions	Min	Max	Unit
Inverter					
V_{RRM}	repetitive peak reverse voltage	T_j = 25 °C	-	1200	V
I_F	continuous DC forward current	T_{case} = 100 °C; T_{jmax} = 175 °C	-	100	A
I_{FRM}	repetitive peak forward current	t_p = 1 ms	-	200	A
I^2t	I^2t-value	V_R = 0 V; t_p = 10 ms; T_j = 125 °C	-	1795	A^2s
		V_R = 0 V; t_p = 10 ms; T_j = 150 °C	-	1488	A^2s
Rectifier					
V_{RRM}	repetitive peak reverse voltage	T_j = 25 °C	-	1600	V
I_{FRMSM}	maximum RMS forward current per chip	T_{case} = 100 °C	-	100	A
I_{RMSM}	maximum RMS forward current at rectifier output	T_{case} = 100 °C	-	100	A
I_{FSM}	surge forward current	t_p = 10 ms; T_j = 25 °C	-	1272	A
		t_p = 10 ms; T_j = 150 °C	-	983	A
I^2t	I^2t-value	t_p = 10 ms; T_j = 25 °C	-	8099	A^2s
		t_p = 10 ms; T_j = 150 °C	-	4840	A^2s
Brake-chopper					
V_{RRM}	repetitive peak reverse voltage	T_j = 25 °C	-	1200	V
I_F	continuous DC forward current	T_{case} = 100 °C; T_{jmax} = 175 °C	-	50	A
I_{FRM}	repetitive peak forward current	t_p = 1 ms	-	100	A
I^2t	I^2t-value	V_R = 0 V; t_p = 10 ms; T_j = 125 °C	-	360	A^2s
		V_R = 0 V; t_p = 10 ms; T_j = 150 °C	-	336	A^2s

6. Thermal characteristics

Table 4. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$R_{th(j-c)}$	thermal resistance from junction to case	per IGBT	inverter	-	-	0.26	K/W
			brake-chopper	-	-	0.48	K/W
		per diode	inverter	-	-	0.45	K/W
			rectifier	-	-	0.36	K/W
			brake-chopper	-	-	1.2	K/W

7. Electrical characteristics

Table 5. IGBT

T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Inverter							
BV_{CES}	collector-emitter breakdown voltage	V_{GE} = 0 V; I_C = 1 mA		1200	-	-	V
I_{CES}	collector-emitter cutoff current	V_{GE} = 0 V; V_{CE} = V_{CES}		-	-	1	mA
I_{GES}	gate leakage current	V_{CE} = 0 V; V_{GE} = V_{GES}		-	-	±500	nA
$V_{GE(th)}$	gate emitter threshold voltage	V_{CE} = 10 V; I_C = 3.8 mA		5	6.0	6.8	V
R_G	internal gate resistor	f = 1 MHz		-	9.1	-	Ω
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 100 A; V_{GE} = 15 V	T_j = 25°C	-	1.65	1.95	V
			T_j = 125°C	-	1.8	-	V
			T_j = 150°C	-	1.85	-	V
C_{ies}	input capacitance	V_{GE} = 0 V; V_{CE} =25 V; f = 100 kHz		-	8.2	-	nF
C_{oes}	output capacitance			-	1.51	-	nF
C_{res}	reverse transfer capacitance			-	0.29	-	nF
Q_g	total gate charge	V_{CC} = 960 V; I_C = 100 A; V_{GE} = ±15 V		-	0.57	-	μC
$t_{d(on)}$	turn-on delay time	V_{CC} = 600 V; I_C = 100 A; V_{GE} = ±15 V; R_{Gon} = 1.5 Ω; R_{Goff} = 1.5 Ω; L_S = 50 nH	T_j = 25°C	-	122	-	ns
			T_j = 125°C	-	129	-	ns
			T_j = 150°C	-	136	-	ns
t_r	rise time		T_j = 25°C	-	23	-	ns
			T_j = 125°C	-	25	-	ns
			T_j = 150°C	-	26	-	ns
$t_{d(off)}$	turn-off delay time		T_j = 25°C	-	231	-	ns
			T_j = 125°C	-	288	-	ns
			T_j = 150°C	-	304	-	ns
t_f	fall time		T_j = 25°C	-	134	-	ns
			T_j = 125°C	-	215	-	ns
			T_j = 150°C	-	216	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
E_{on}	turn-on switching loss	V_{CC} = 600 V; I_C = 100 A; V_{GE} = ±15 V; R_{Gon} = 1.5 Ω; L_S = 50 nH; dI/dt = 4500 A/µs	T_j = 25°C	-	5.3	-	mJ
			T_j = 125°C	-	8.7	-	mJ
			T_j = 150°C	-	10	-	mJ
E_{off}	turn-off switching loss	V_{CC} = 600 V; I_C = 100 A; V_{GE} = ±15 V; R_{Goff} = 1.5 Ω; L_S = 50 nH; du/dt = 5790 V/µs	T_j = 25°C	-	5.1	-	mJ
			T_j = 125°C	-	7.7	-	mJ
			T_j = 150°C	-	8.8	-	mJ
I_{sc}	short circuit data	V_{GE} = 15 V; V_{CC} = 800 V; T_j = 150 °C; t_p ≤ 10 µs	T_j = 150°C	-	397	-	A
$R_{th(j-c)}$	thermal resistance, junction to case	per IGBT		-	-	0.26	K/W
T_{jop}	operating junction temperature			-40	-	150	°C
Brake-chopper							
BV_{CES}	collector-emitter breakdown voltage	V_{GE} = 0 V; I_C = 1 mA		1200	-	-	V
I_{CES}	collector-emitter cutoff current	V_{GE} = 0 V; V_{CE} = V_{CES}		-	-	1	mA
I_{GES}	gate leakage current	V_{CE} = 0 V; V_{GE} = V_{GES}		-	-	±500	nA
$V_{GE(th)}$	gate emitter threshold voltage	V_{CE} = 10 V; I_C = 1.7 mA		5	6.0	6.8	V
R_G	internal gate resistor	f = 1 MHz		-	7.1		Ω
$V_{CE(sat)}$	collector-emitter saturation voltage	I_C = 50 A; V_{GE} = 15 V	T_j = 25°C	-	1.65	1.95	V
			T_j = 125°C	-	1.8	-	V
			T_j = 150°C	-	1.85	-	V
C_{ies}	input capacitance	V_{GE} = 0 V; V_{CE} =25 V; f = 100 kHz		-	3.65	-	nF
C_{oes}	output capacitance			-	0.72	-	nF
C_{res}	reverse transfer capacitance			-	0.12	-	nF
Q_g	total gate charge	V_{CC} = 960 V; I_C = 50 A; V_{GE} = ±15 V		-	0.26	-	µC
$t_{d(on)}$	turn-on delay time	V_{CC} = 600 V; I_C = 50 A; V_{GE} = ±15 V; R_{Gon} = 15 Ω; R_{Goff} = 15 Ω; L_S = 50 nH	T_j = 25°C	-	64	-	ns
			T_j = 125°C	-	65	-	ns
			T_j = 150°C	-	67	-	ns
t_r	rise time		T_j = 25°C	-	31	-	ns
			T_j = 125°C	-	66	-	ns
			T_j = 150°C	-	68	-	ns
$t_{d(off)}$	turn-off delay time		T_j = 25°C		147		ns
			T_j = 125°C	-	178	-	ns
			T_j = 150°C	-	187	-	ns
t_f	fall time		T_j = 25°C	-	144	-	ns
			T_j = 125°C	-	196	-	ns
			T_j = 150°C	-	213	-	ns

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
E_{on}	turn-on switching loss	V_{CC} = 600 V; I_C = 50 A; V_{GE} = ±15 V; R_{Gon} = 15 Ω; L_S = 50 nH; dI/dt = 1590 A/μs	T_j = 25°C	-	5.1	-	mJ
			T_j = 125°C	-	7.2	-	mJ
			T_j = 150°C	-	8.2	-	mJ
E_{off}	turn-off switching loss	V_{CC} = 600 V; I_C = 50 A; V_{GE} = ±15 V; R_{Goff} = 15 Ω; L_S = 50 nH; dV/dt = 6040 V/μs	T_j = 25°C	-	1.93	-	mJ
			T_j = 125°C	-	2.59	-	mJ
			T_j = 150°C	-	2.81	-	mJ
I_{sc}	short circuit data	V_{GE} = 15 V; V_{CC} = 800 V; T_j = 150 °C; t_p ≤ 10 μs		-	167	-	A
$R_{th(j-c)}$	thermal resistance, junction to case	per IGBT		-	-	0.48	K/W
T_{jop}	operating junction temperature			-40	-	150	°C

Table 6. Diode

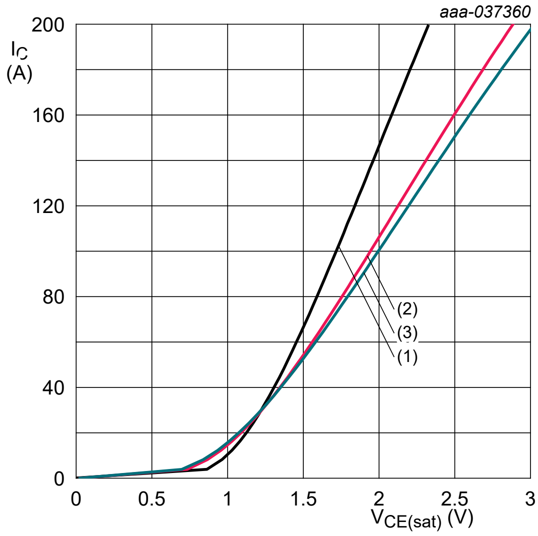
T_j = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Inverter							
V_F	forward voltage	I_F = 100 A	T_j = 25°C	-	1.7	2.1	V
			T_j = 125°C	-	1.7	-	V
			T_j = 150°C	-	1.7	-	V
I_{rr}	peak reverse recovery current	I_F = 100 A; V_R = 600 V ; -dI_F/dt = 2630 A/us; V_{GE} = -15 V	T_j = 25°C	-	126	-	A
			T_j = 125°C	-	130	-	A
			T_j = 150°C	-	132	-	A
Q_{rr}	reverse recovery charge	I_F = 100 A; V_R = 600 V ; -dI_F/dt = 2630 A/us; V_{GE} = -15 V	T_j = 25°C	-	6.48	-	μC
			T_j = 125°C	-	12.8	-	μC
			T_j = 150°C	-	15.4	-	μC
t_{rr}	reverse recovery time	I_F = 100 A; V_R = 600 V ; -dI_F/dt = 2630 A/us; V_{GE} = -15 V	T_j = 25°C	-	344	-	ns
			T_j = 125°C	-	515	-	ns
			T_j = 150°C	-	538	-	ns
E_{rec}	reverse recovery energy	I_F = 100 A; V_R = 600 V ; -dI_F/dt = 2630 A/us; V_{GE} = -15 V	T_j = 25°C	-	1.75	-	mJ
			T_j = 125°C	-	4.3	-	mJ
			T_j = 150°C	-	5.2	-	mJ
$R_{th(j-c)}$	thermal resistance, junction to case	per diode		-	-	0.45	K/W
T_{jop}	operating junction temperature			-40	-	150	°C
Rectifier							
V_F	forward voltage	I_F = 100 A	T_j = 150°C	-	0.99	-	V
I_R	reverse current	V_R = 1600 V	T_j = 150°C	-	1.5	-	A
$R_{th(j-c)}$	Thermal resistance, junction to case	per diode		-	-	0.36	K/W
T_{jop}	operating junction temperature			-40	-	150	°C

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Brake-chopper							
V_F	forward voltage	I_F = 50 A	T_j = 25°C	-	1.74	2.1	V
			T_j = 125°C	-	1.88	-	V
			T_j = 150°C	-	1.86	-	V
I_{rr}	peak reverse recovery current	I_F = 50 A; V_R = 600 V ; -dI_F/dt = 1510 A/us; V_{GE} = -15 V	T_j = 25°C	-	17	-	A
			T_j = 125°C	-	20	-	A
			T_j = 150°C	-	20	-	A
Q_{rr}	reverse recovery charge	I_F = 50 A; V_R = 600 V ; -dI_F/dt = 1510 A/us; V_{GE} = -15 V	T_j = 25°C	-	3.04	-	μC
			T_j = 125°C	-	5.52	-	μC
			T_j = 150°C	-	6.29	-	μC
t_{rr}	reverse recovery time	I_F = 50 A; V_R = 600 V ; -dI_F/dt = 1510 A/us; V_{GE} = -15 V	T_j = 25°C	-	363	-	ns
			T_j = 125°C	-	536	-	ns
			T_j = 150°C	-	616	-	ns
E_{rec}	reverse recovery energy	I_F = 50 A; V_R = 600 V ; -dI_F/dt = 1510 A/us; V_{GE} = -15 V	T_j = 25°C	-	0.747	-	mJ
			T_j = 125°C	-	1.65	-	mJ
			T_j = 150°C	-	1.94	-	mJ
$R_{th(j-c)}$	thermal resistance, junction to case	per diode		-	-	1.2	K/W
T_{jop}	operating junction temperature			-40	-	150	°C

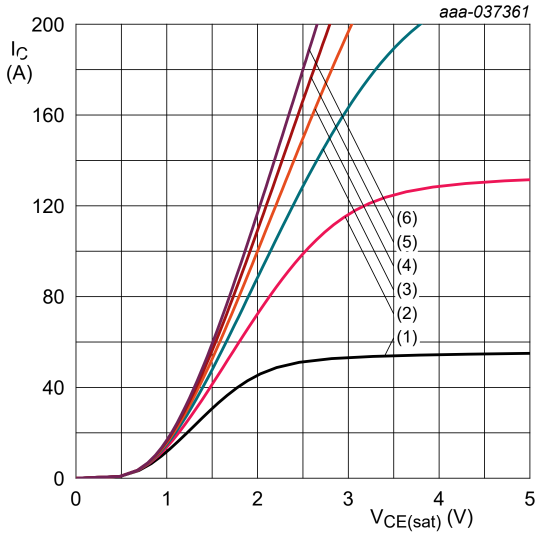
7.1. Waveforms and output characteristics

Table 7.



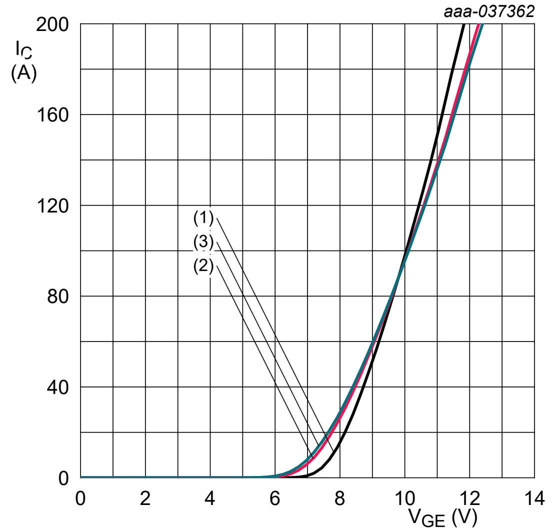
V_{GE} = 15 V
(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

Fig. 2. IGBT inverter collector current as a function of collector-emitter saturation voltage



T_j = 150 °C
(1) V_{GE} = 9 V
(2) V_{GE} = 11 V
(3) V_{GE} = 13 V
(4) V_{GE} = 15 V
(5) V_{GE} = 17 V
(6) V_{GE} = 19 V

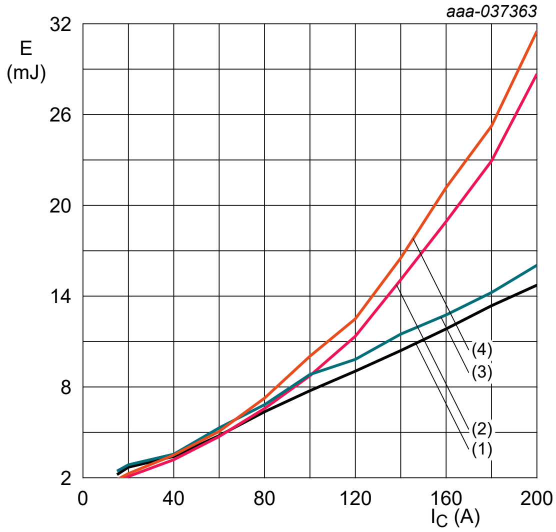
Fig. 3. IGBT inverter collector current as a function of collector-emitter saturation voltage



V_{CE}= 20 V

(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

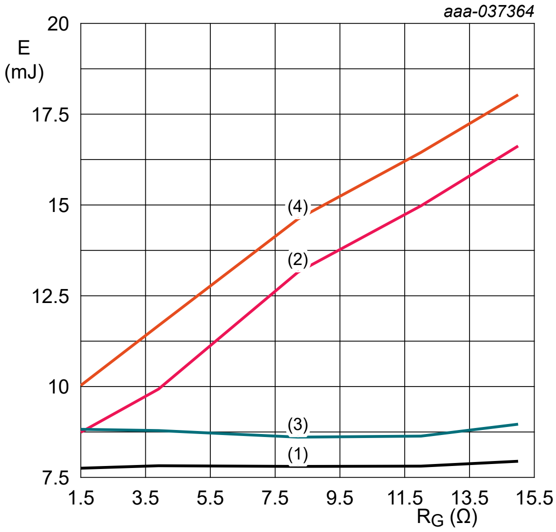
Fig. 4. IGBT inverter collector current as a function of gate-emitter voltage



V_{GE} = ±15 V, R_G = 1.5 Ω, V_{CE} = 600 V

(1) E_{off} at 125 °C
(2) E_{on} at 125 °C
(3) E_{off} at 150 °C
(4) E_{on} at 150 °C

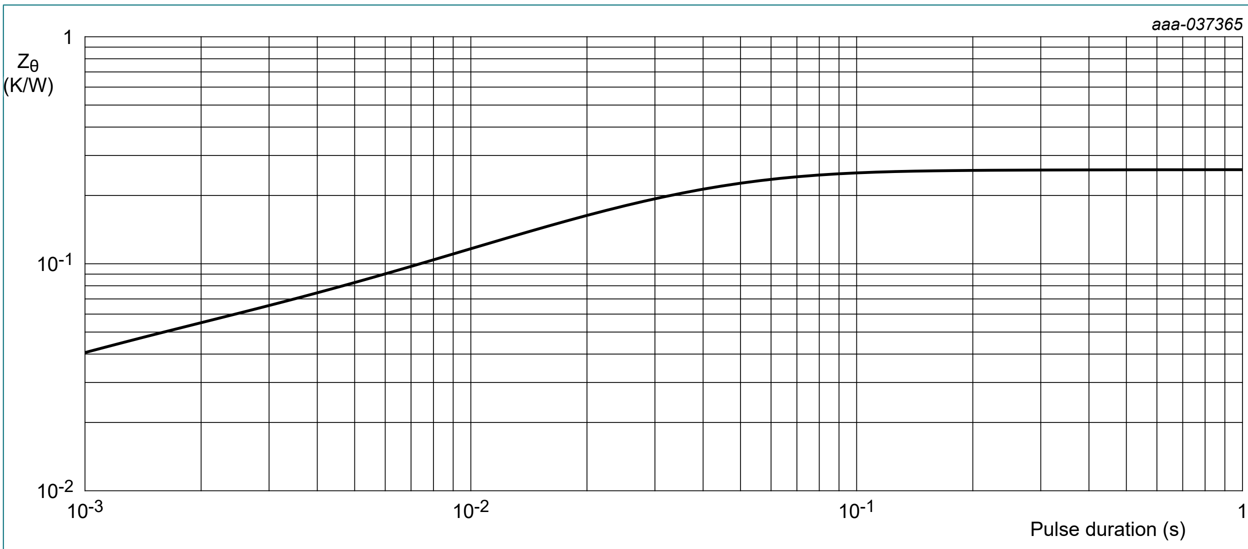
Fig. 5. IGBT inverter switching losses as a function of collector current



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

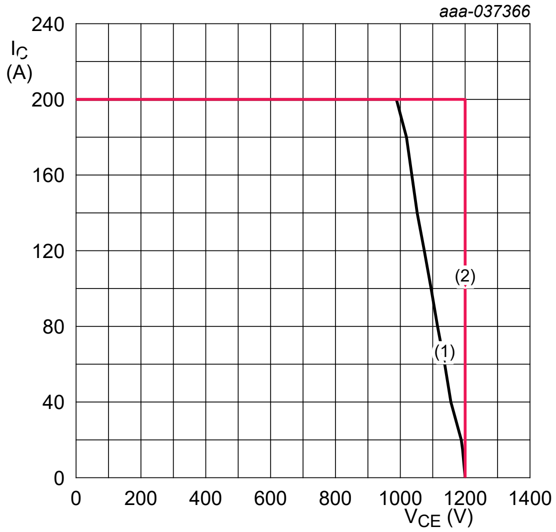
(1) E_{off} at 125 °C
(2) E_{on} at 125 °C
(3) E_{off} at 150 °C
(4) E_{on} at 150 °C

Fig. 6. IGBT inverter switching losses as a function of gate resistance



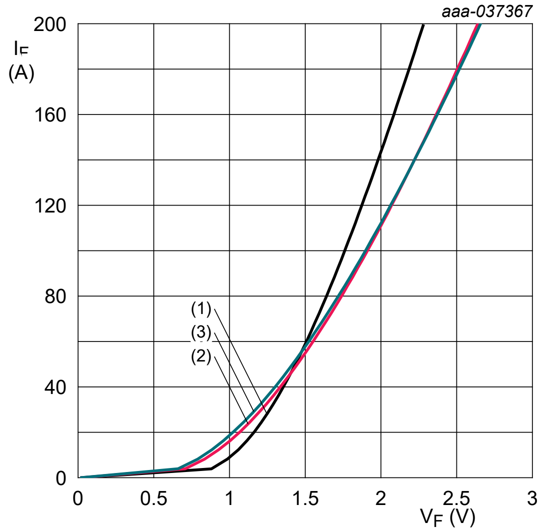
	1	2	3	4
r_i [K/W]	0.0355	0.0218	0.192	0.0108
τ [s]	0.00056	0.0063	0.0251	0.124

Fig. 7. Transient thermal impedance of IGBT inverter as a function of pulse duration



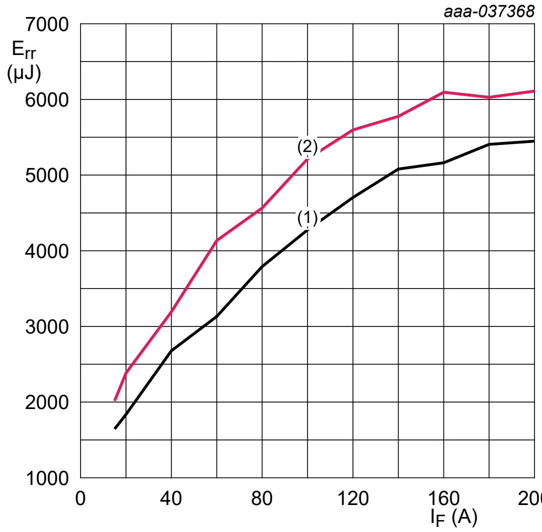
V_{GE} = ±15 V, R_G = 1.5 Ω, T_j = 150 °C
(1) Module
(2) Chip

Fig. 8. Collector current as a function of collector-emitter voltage



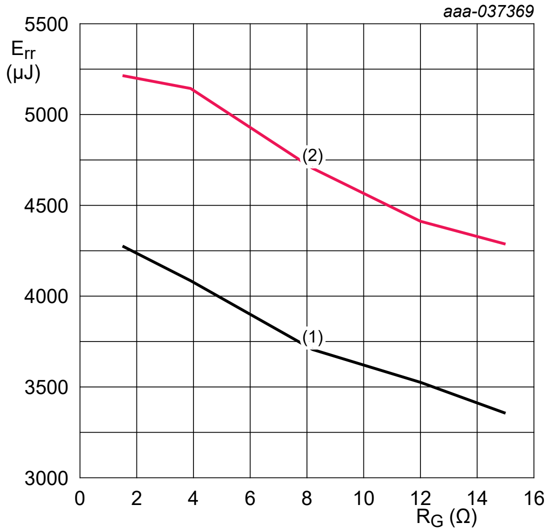
(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

Fig. 9. Diode inverter forward current as a function of forward voltage



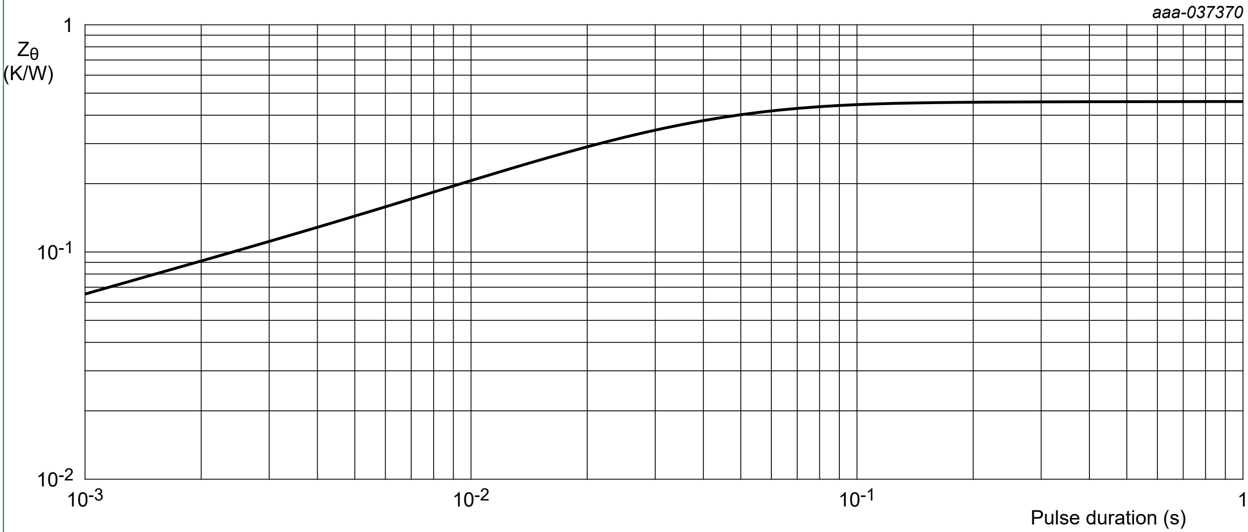
R_G = 1.5 Ω, V_{CE} = 600 V
(1) T_j = 25 °C
(2) T_j = 150 °C

Fig. 10. Diode inverter reverse recovery energy as a function of forward current



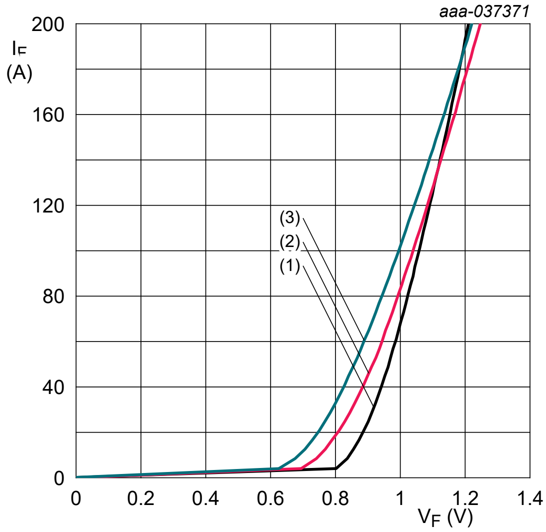
V_{GE} = ±15 V, I_F = 100 A, V_{CE} = 600 V
(1) T_j = 125 °C
(2) T_j = 150 °C

Fig. 11. Diode inverter reverse recovery energy as a function of gate resistance



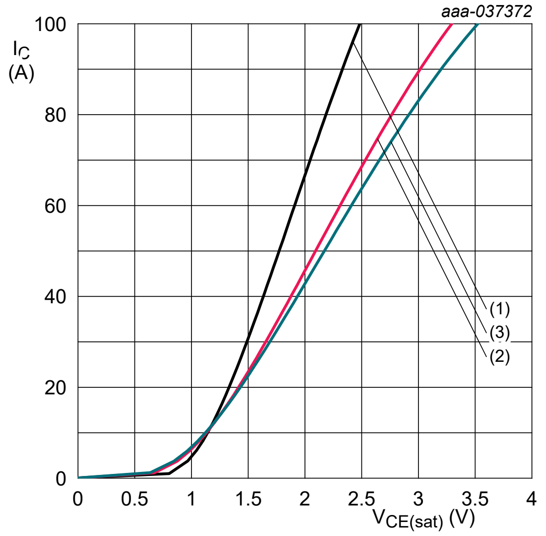
	1	2	3	4
r_i [K/W]	0.0506	0.0411	0.0345	0.0227
τ [s]	0.00055	0.00466	0.024	0.109

Fig. 12. Transient thermal impedance of diode inverter as a function of pulse duration



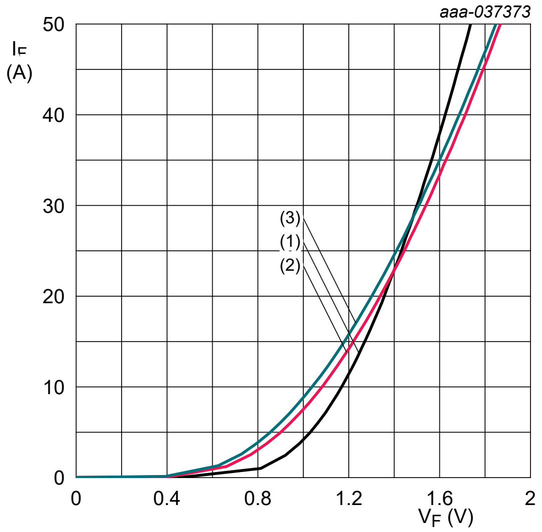
(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

Fig. 13. Diode rectifier forward current as a function of forward voltage



V_{GE} = 15 V
(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

Fig. 14. IGBT brake collector current as a function of collector-emitter saturation voltage



(1) T_j = 25 °C
(2) T_j = 125 °C
(3) T_j = 150 °C

Fig. 15. Diode brake forward current as a function of forward voltage

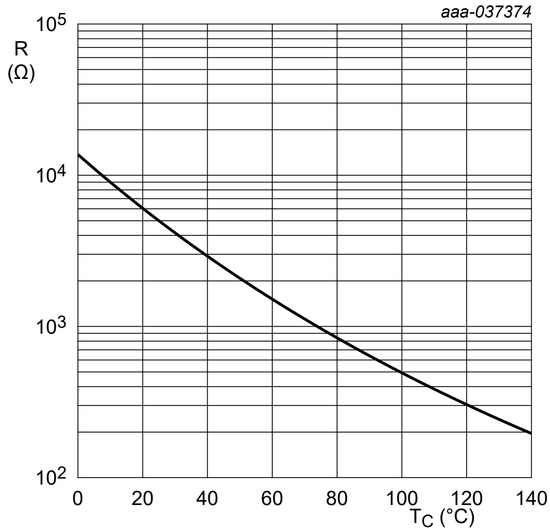


Fig. 16. NTC thermistor resistance as a fucntion of temperature

8. NTC thermistor

Table 8. NTC thermistor

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{25}	rated resistance	T_{TNTC} = 25 °C	-	5	-	kΩ
ΔR/R	deviation of R100	T_{TNTC} = 100 °C; R_{100} = 493 Ω	-10	-	10	%
P_{25}	power dissipation	T_{TNTC} = 25 °C	-	-	20	mW
$B_{25/50}$	B-value		-	3375	-	K
$B_{25/80}$	B-value		-	3414	-	K
$B_{25/100}$	V-value		-	3436	-	K

9. Module characteristics

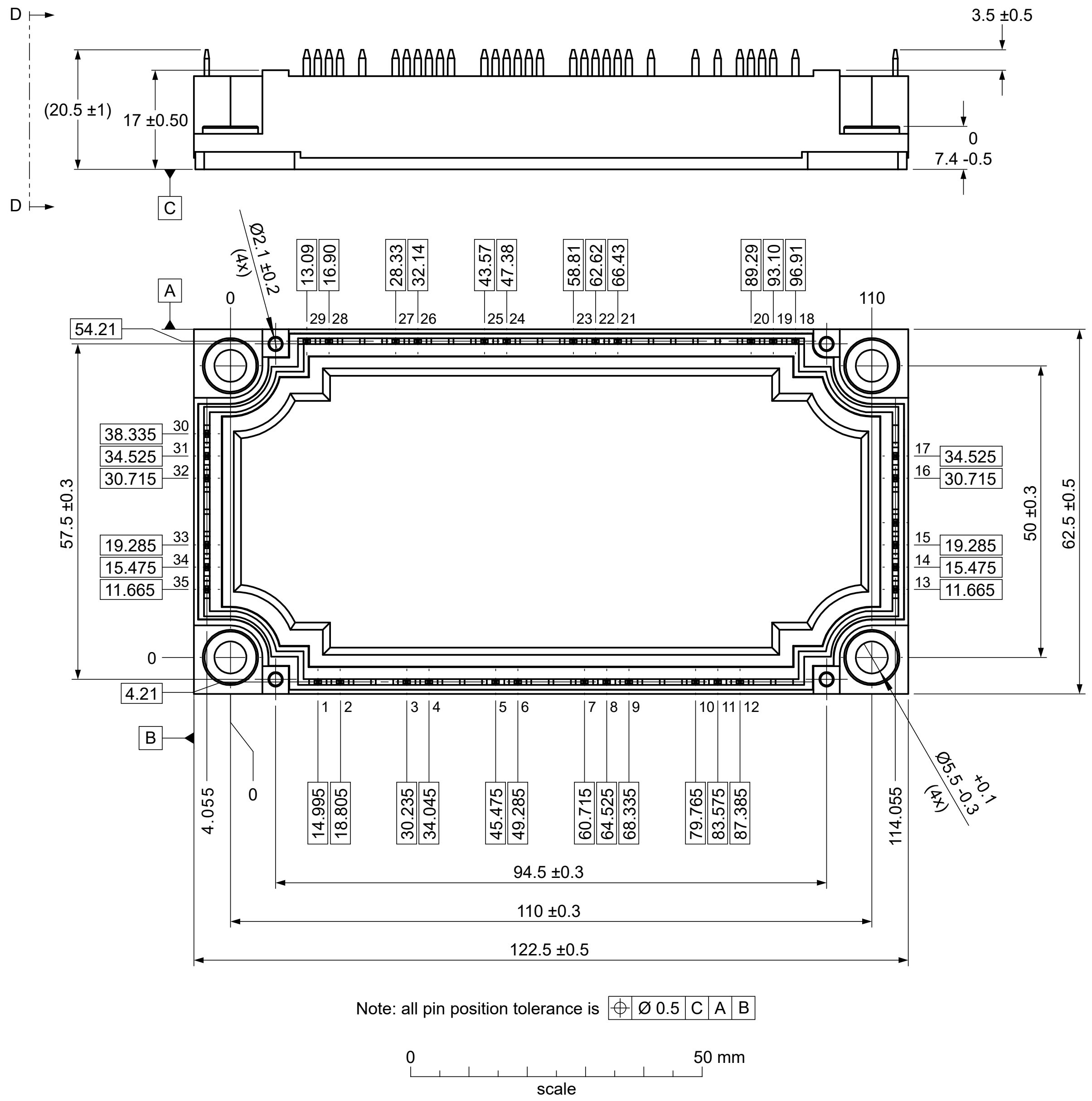
Table 9. Module characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{ISOL}	isolation test voltage	RMS; f = 50 Hz, t = 1 min	2.5	-	-	kV
	creepage distance	terminal to heat sink	-	10	-	mm
		terminal to terminal				mm
	clearance	terminal to heat sink	-	7.5	-	mm
		terminal to terminal				mm
CTI	comparative tracking index		-	>200	-	
L_{sCE}	stray inductance		-	35	-	nH
$R_{CC'+ EE'}$	module lead resistance, terminal-chip	T_C = 25 °C per switch	-	1.2	-	mΩ
M	mounting torque for module mounting		-	-	-	Nm
G	weight		-	307	-	g
T_{stg}	storage temperature		-40	-	125	°C

10. Package outline drawing

NP2-35P: plastic house, through hole solderable pin with copper baseplate, 35 pins; 62.5 mm x 122.5 mm x 17 mm body

SOT8053-1



Dimensions (mm are the original dimensions)

sot8053-1_po

Outline version	References				European projection	Issue date
	IEC	JEDEC	EIAJ			
SOT8053-1						~~22-05-25~~ 22-05-30

Fig. 17. Preliminary package outline drawing

11. Revision history

Table 10. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NP100T12P2T3 v. 1	20240220	Product data sheet	-	-

12. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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