EasyPIM™ module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and PressFIT / NTC

Features

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 50 A / I_{CRM} = 100 A
  - TRENCHSTOP™ IGBT7
  - Overload operation up to 175°C
  - Low $V_{CE,sat}$
- Mechanical features
  - PressFIT contact technology
  - High power density
  - Package with CTI > 400
  - Compact design
  - Al_2O_3 substrate with low thermal resistance
  - 2.5 kV AC 1 minute insulation

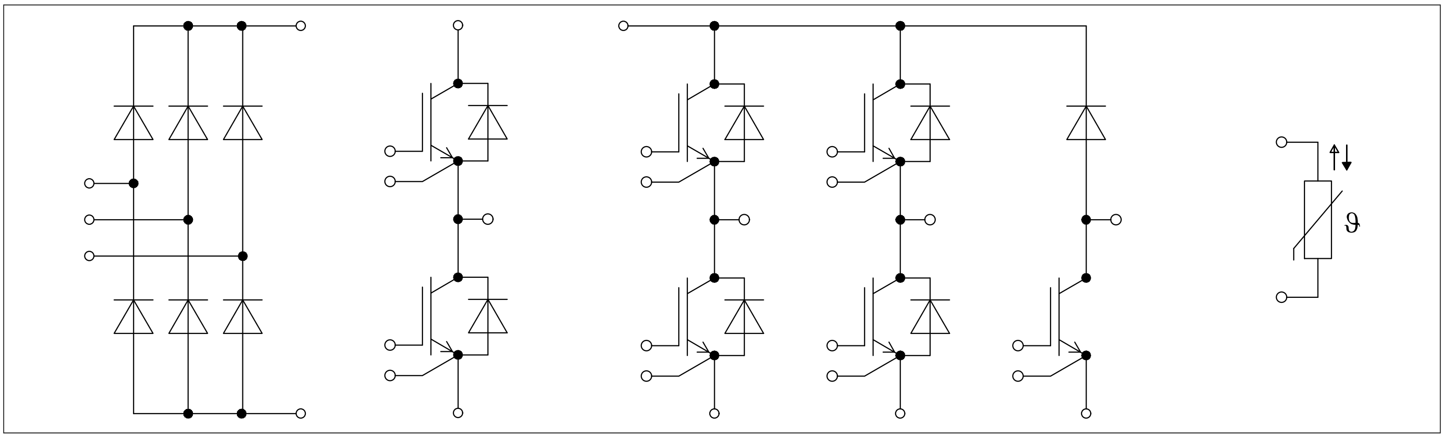
Potential applications

- Motor drives
- Air conditioning
- Auxiliary inverters

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
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	11.2	mm
Creepage distance	d_{Creep}	terminal to terminal	6.8	mm
Clearance	d_{Clear}	terminal to heatsink	9.4	mm
Clearance	d_{Clear}	terminal to terminal	5.5	mm
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}				35		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_H = 25 °C, per switch			2.8		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_H = 25 °C, per switch			2.2		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 25 A rms per connector pin.

2 IGBT, Inverter

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 = 100 °C	50	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 = 50 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.50	1.80	V
			T_{vj} = 125 °C		1.64		
			T_{vj} = 175 °C		1.72		
Gate threshold voltage	V_{GEth}	I_C = 1.28 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			0.92		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			11.1		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.039		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.013	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 = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.044		µs
			T_{vj} = 125 °C		0.046		
			T_{vj} = 175 °C		0.047		
Rise time (inductive load)	t_r	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.031		µs
			T_{vj} = 125 °C		0.036		
			T_{vj} = 175 °C		0.037		
Turn-off delay time (inductive load)	t_{doff}	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.237		µs
			T_{vj} = 125 °C		0.321		
			T_{vj} = 175 °C		0.354		
Fall time (inductive load)	t_f	I_C = 50 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.122		µs
			T_{vj} = 125 °C		0.191		
			T_{vj} = 175 °C		0.256		
Turn-on energy loss per pulse	E_{on}	I_C = 50 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω, di/dt = 1180 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		4.18		mJ
			T_{vj} = 125 °C		5.62		
			T_{vj} = 175 °C		6.55		
Turn-off energy loss per pulse	E_{off}	I_C = 50 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω, dv/dt = 2900 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		3.1		mJ
			T_{vj} = 125 °C		5.08		
			T_{vj} = 175 °C		6.22		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
SC data	I_{SC}	$V_{GE} \leq 15$ V, $V_{CC} = 800$ V, $V_{CEmax}=V_{CES}-L_{sCE}$*di/dt	$t_P \leq 8$ µs, T_{vj}=150 °C		185		A
			$t_P \leq 7$ µs, T_{vj}=175 °C		175		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 3.3 W/(m·K)			0.708		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.

3 Diode, Inverter

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			50	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		100	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	300	A^2s
			T_{vj} = 175 °C	250	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 50 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} = 600 V, I_F = 50 A, V_{GE} = -15 V, -di$_F$/dt = 1180 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		49.7		A
			T_{vj} = 125 °C		64.5		
			T_{vj} = 175 °C		74.9		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 50 A, V_{GE} = -15 V, -di_F/dt = 1180 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		4.49		µC
			T_{vj} = 125 °C		7.76		
			T_{vj} = 175 °C		10.2		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 50 A, V_{GE} = -15 V, -di_F/dt = 1180 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.75		mJ
			T_{vj} = 125 °C		3.08		
			T_{vj} = 175 °C		4.01		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 3.3 W/(m·K)			0.963		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.

4 Diode, Rectifier

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		T_{vj} = 25 °C	1600	V
Maximum RMS forward current per chip	I_{FRMSM}	T_H = 80 °C		60	A
Maximum RMS current at rectifier output	I_{RMSM}	T_H = 80 °C		100	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	450	A
			T_{vj} = 150 °C	370	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	1010	A^2s
			T_{vj} = 150 °C	685	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 35 A	T_{vj} = 150 °C		1.04		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V			1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 3.3 W/(m·K)			1.06		K/W

(table continues...)

Table 8 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Temperature under switching conditions	$T_{vj, op}$		-40		150	°C

5 IGBT, Brake-Chopper

Table 9 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 = 100 °C	35	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		70	A
Gate-emitter peak voltage	V_{GES}			±20	V

Table 10 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C = 35 A, V_{GE} = 15 V	T_{vj} = 25 °C		1.60	1.85	V
			T_{vj} = 125 °C		1.74		
			T_{vj} = 175 °C		1.82		
Gate threshold voltage	V_{GEth}	I_C = 0.75 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			0.548		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			6.62		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.023		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.0091	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 = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.041		µs
			T_{vj} = 125 °C		0.043		
			T_{vj} = 175 °C		0.044		
Rise time (inductive load)	t_r	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω	T_{vj} = 25 °C		0.038		µs
			T_{vj} = 125 °C		0.040		
			T_{vj} = 175 °C		0.041		

(table continues...)

Table 10 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time (inductive load)	t_{doff}	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.219		µs
			T_{vj} = 125 °C		0.274		
			T_{vj} = 175 °C		0.321		
Fall time (inductive load)	t_f	I_C = 35 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω	T_{vj} = 25 °C		0.077		µs
			T_{vj} = 125 °C		0.132		
			T_{vj} = 175 °C		0.181		
Turn-on energy loss per pulse	E_{on}	I_C = 35 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 5.1 Ω, di/dt = 790 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.92		mJ
			T_{vj} = 125 °C		2.85		
			T_{vj} = 175 °C		3.43		
Turn-off energy loss per pulse	E_{off}	I_C = 35 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 5.1 Ω, dv/dt = 2500 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.28		mJ
			T_{vj} = 125 °C		3.29		
			T_{vj} = 175 °C		4.25		
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		110		A
			t_P ≤ 7 µs, T_{vj}=175 °C		100		
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, λ_{grease} = 3.3 W/(m·K)			0.995		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 Diode, Brake-Chopper

Table 11 **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			25	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		50	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	72.5	A^2s
			T_{vj} = 175 °C	63	

Table 12 **Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 25 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.83	2.30	V
			T_{vj} = 125 °C		1.70		
			T_{vj} = 175 °C		1.63		
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 25 A, -di_F/dt = 580 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		36.1		A
			T_{vj} = 125 °C		49		
			T_{vj} = 175 °C		55.5		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 25 A, -di_F/dt = 580 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.93		µC
			T_{vj} = 125 °C		4.44		
			T_{vj} = 175 °C		6.5		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 25 A, -di_F/dt = 580 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.69		mJ
			T_{vj} = 125 °C		1.76		
			T_{vj} = 175 °C		2.84		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, λ_{grease} = 3.3 W/(m·K)			1.86		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.*

7 NTC-Thermistor

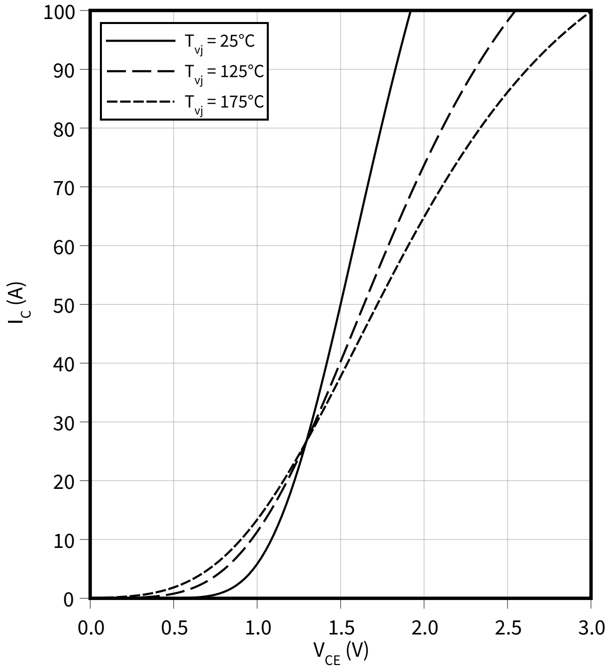
Table 13 **Characteristic values**

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

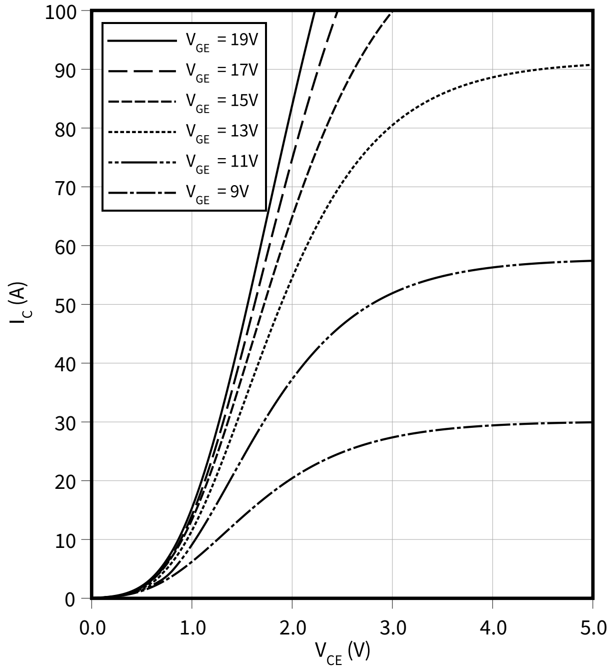
Note: *Specification according to the valid application note.*

8 Characteristics diagrams

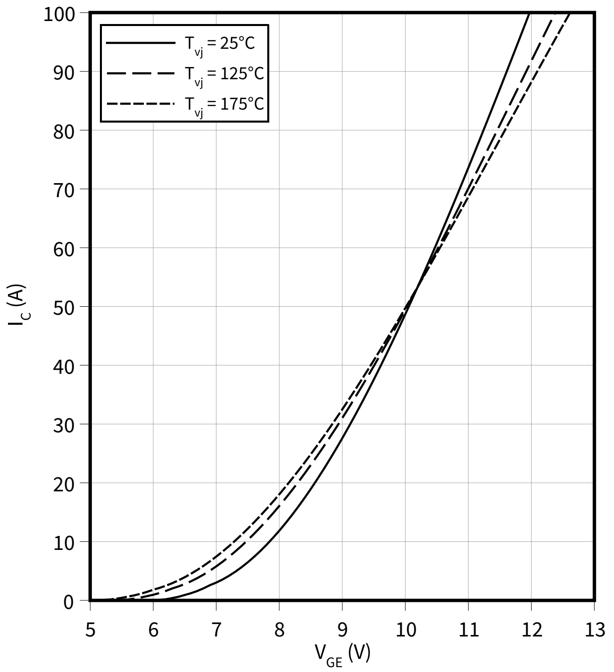
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



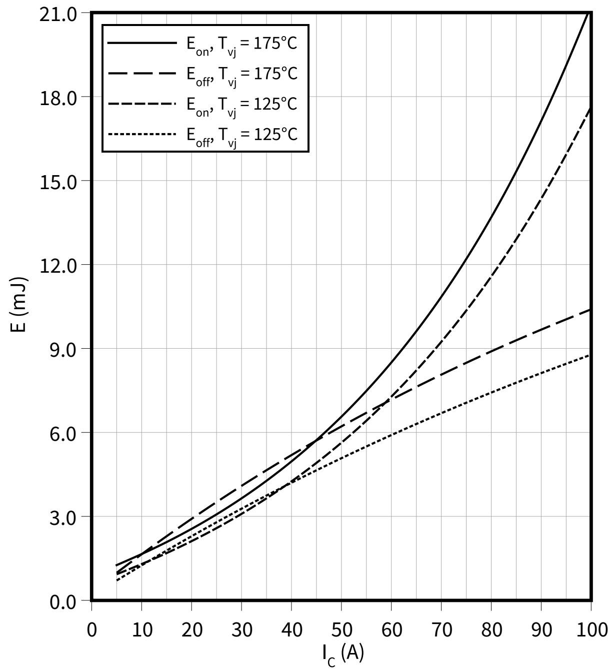
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



Transfer characteristic (typical), IGBT, Inverter
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



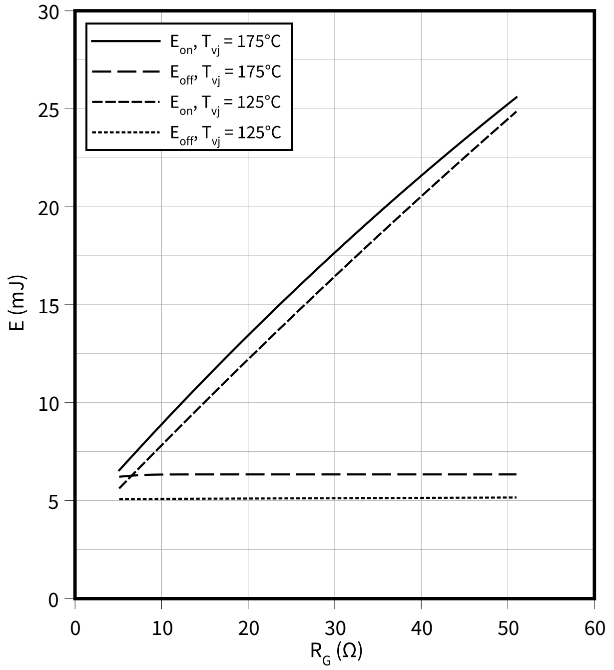
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 5.1\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CC} = 600$ V



Switching losses (typical), IGBT, Inverter

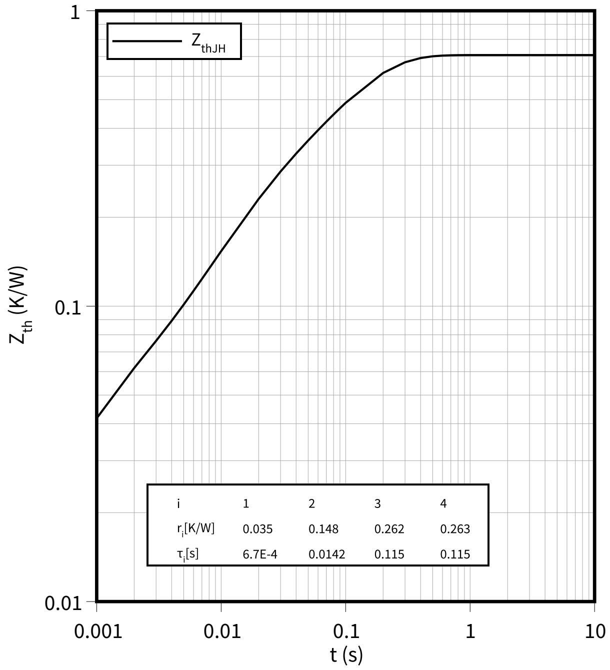
$E = f(R_G)$

$V_{GE} = \pm 15$ V, $I_C = 50$ A, $V_{CC} = 600$ V



Transient thermal impedance , IGBT, Inverter

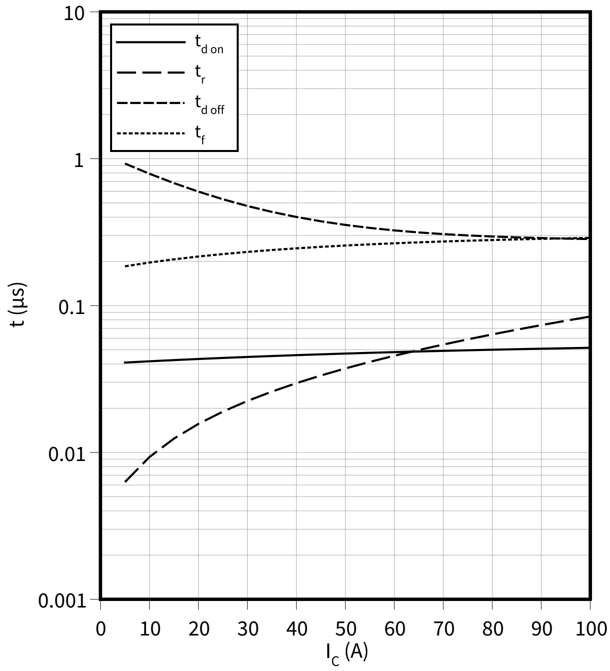
$Z_{th} = f(t)$



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

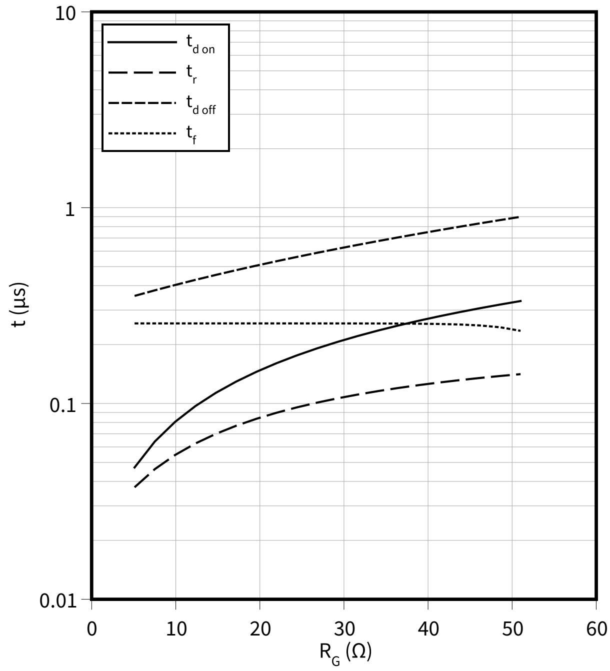
$R_{Goff} = 5.1\ \Omega$, $R_{Gon} = 5.1\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



Switching times (typical), IGBT, Inverter

$t = f(R_G)$

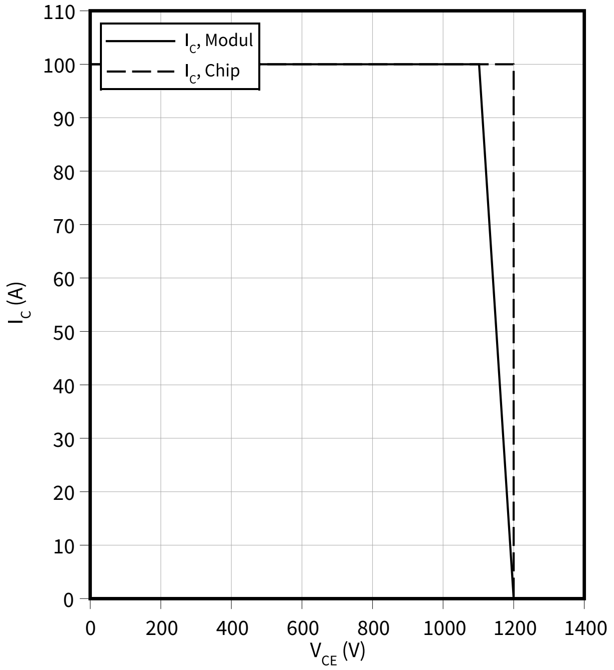
$V_{GE} = \pm 15$ V, $I_C = 50$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$

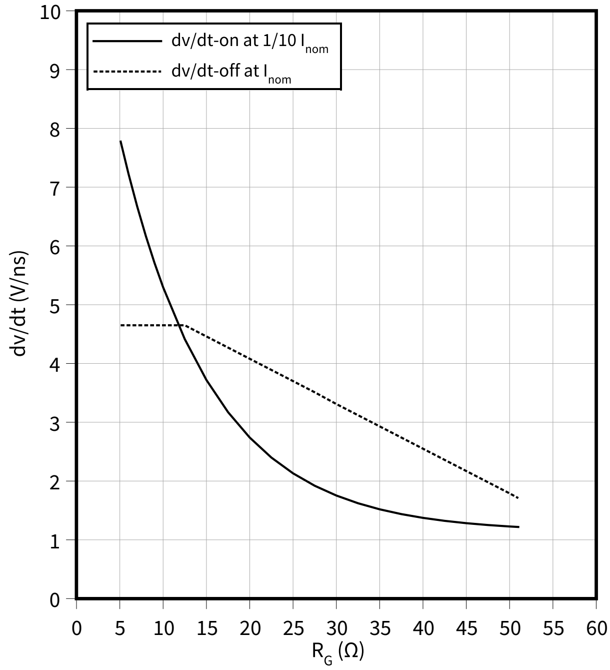
$R_{Goff} = 5.1\ \Omega$, $V_{GE} = \pm 15$ V, $T_{vj} = 175$ °C



Voltage slope (typical), IGBT, Inverter

$dv/dt = f(R_G)$

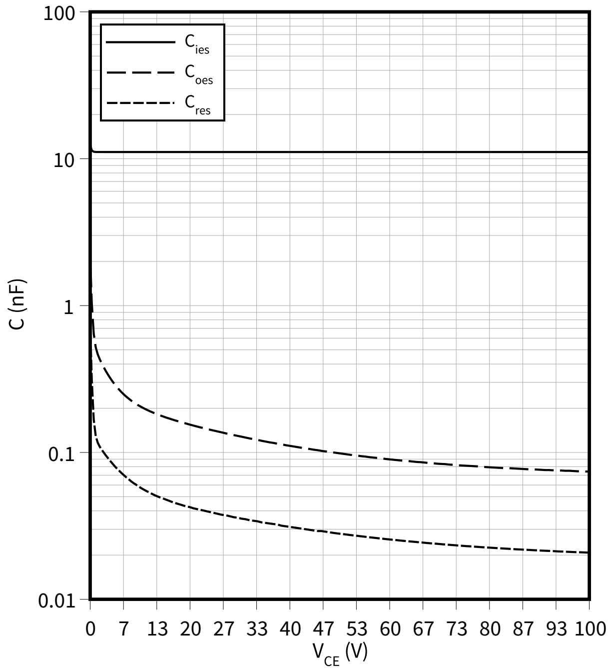
$I_C = 50$ A, $V_{CC} = 600$ V, $V_{GE} = \pm 15$ V, $T_{vj} = 25$ °C



Capacity characteristic (typical), IGBT, Inverter

$C = f(V_{CE})$

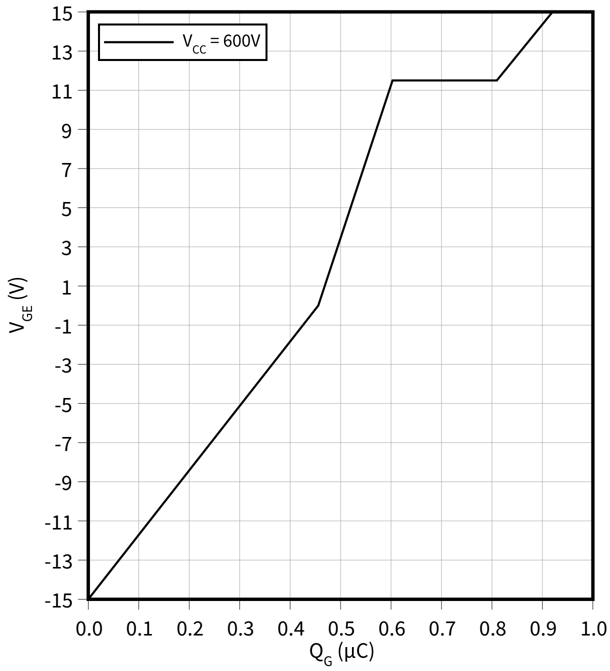
f = 100 kHz, $V_{GE} = 0$ V, $T_{vj} = 25$ °C



Gate charge characteristic (typical), IGBT, Inverter

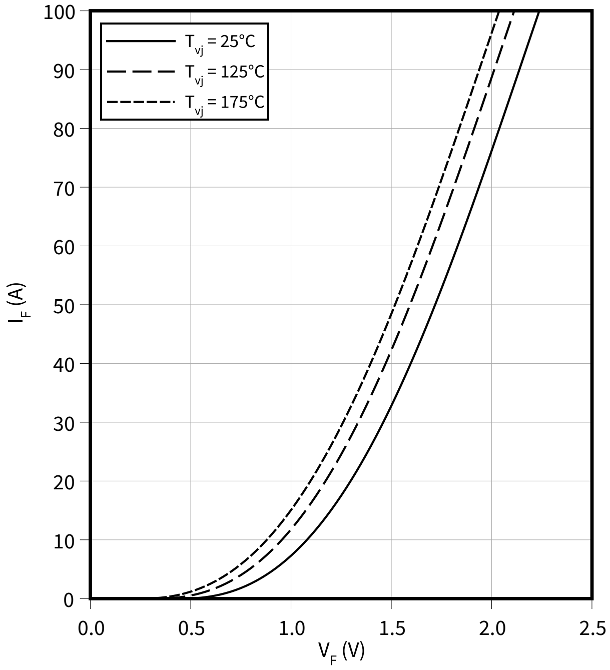
$V_{GE} = f(Q_G)$

$I_C = 50$ A, $T_{vj} = 25$ °C



Forward characteristic (typical), Diode, Inverter

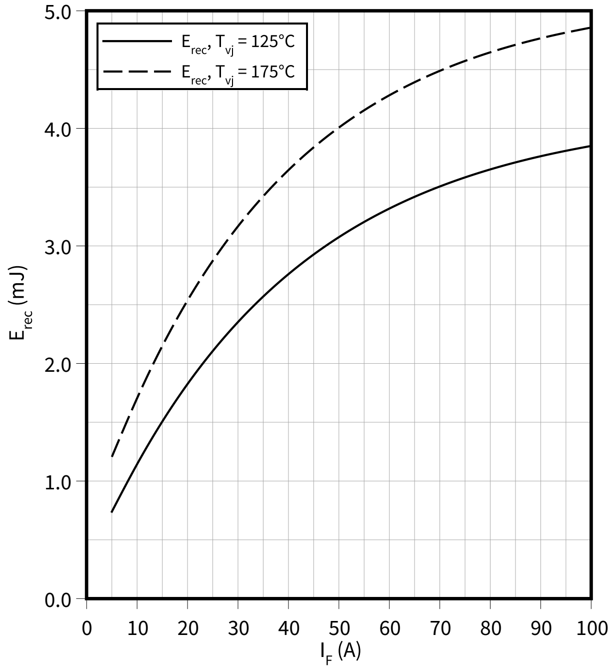
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

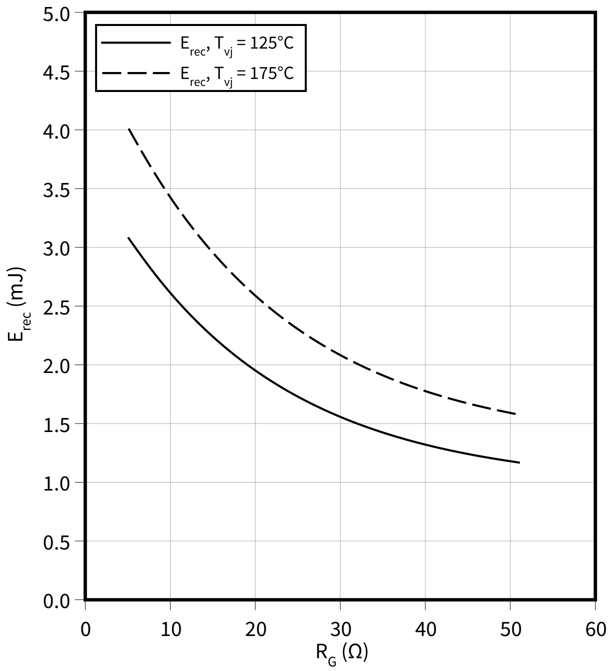
$R_{Gon} = 5.1$, $V_{CC} = 600$ V



Switching losses (typical), Diode, Inverter

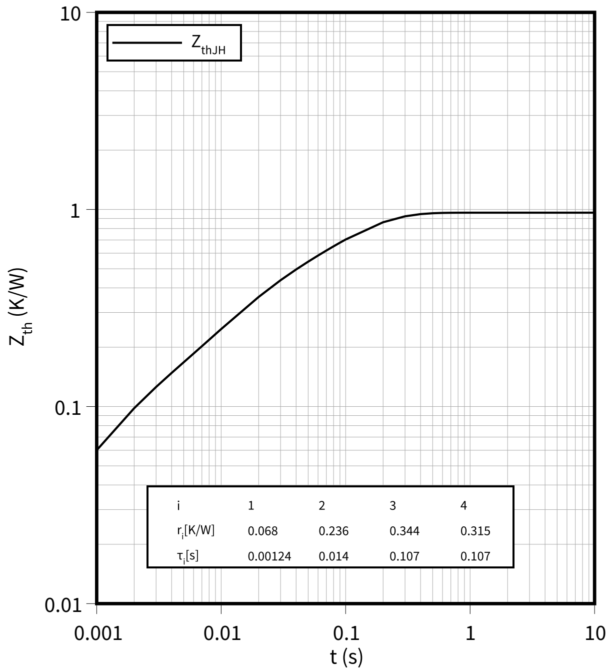
$E_{rec} = f(R_G)$

$I_F = 50$ A, $V_{CC} = 600$ V



Transient thermal impedance, Diode, Inverter

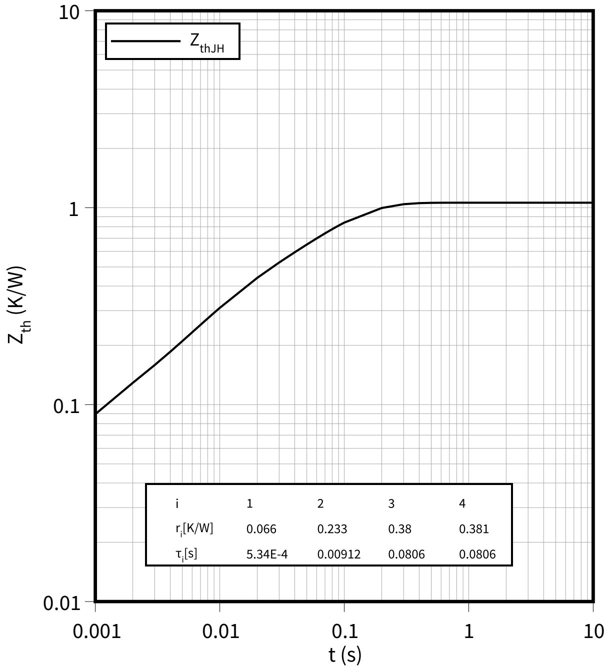
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.068	0.236	0.344	0.315
τ_i[s]	0.00124	0.014	0.107	0.107

Transient thermal impedance, Diode, Rectifier

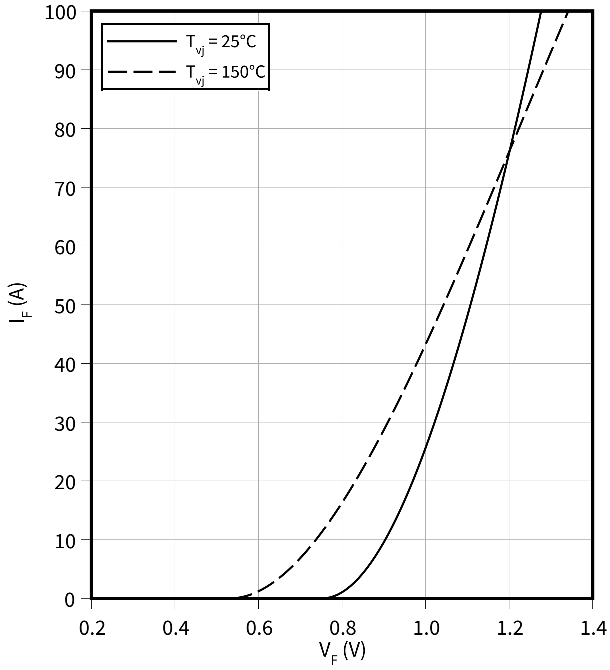
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.066	0.233	0.38	0.381
τ_i[s]	5.34E-4	0.00912	0.0806	0.0806

Forward characteristic (typical), Diode, Rectifier

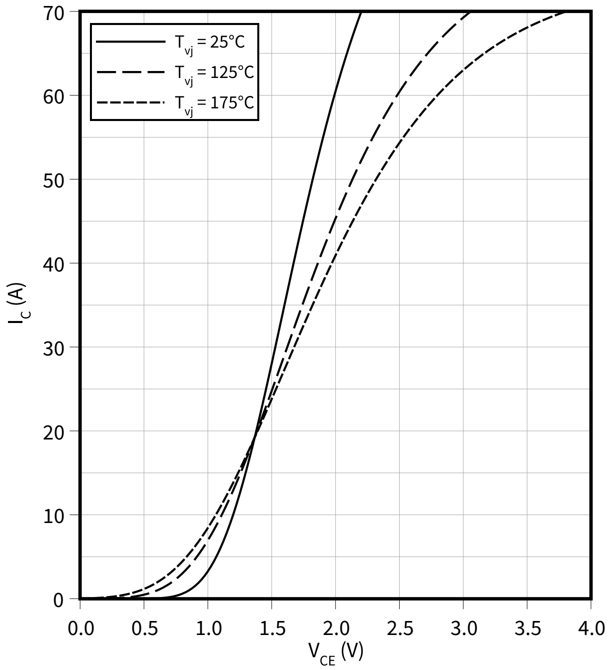
$I_F = f(V_F)$



Output characteristic (typical), IGBT, Brake-Chopper

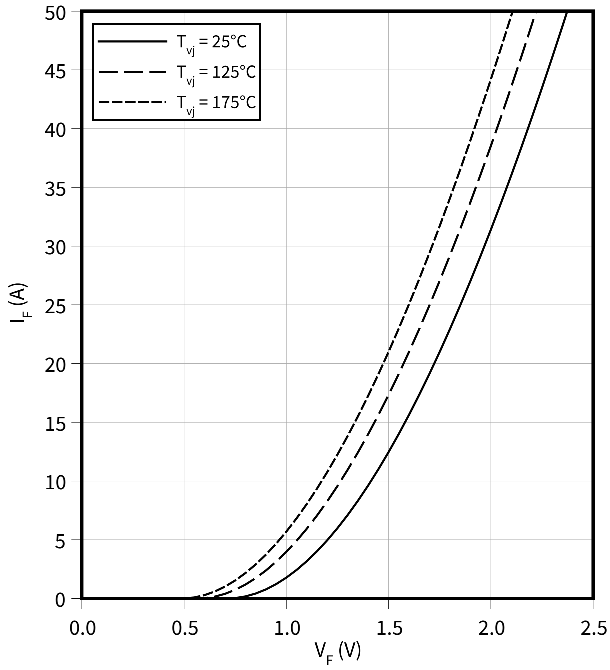
$I_C = f(V_{CE})$

$V_{GE} = 15$ V

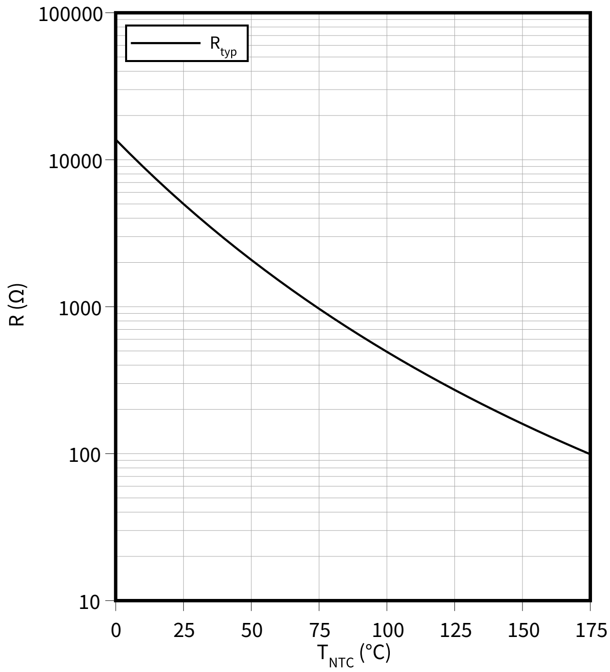


Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



Temperature characteristic (typical), NTC-Thermistor
$R = f(T_{NTC})$



9 Circuit diagram

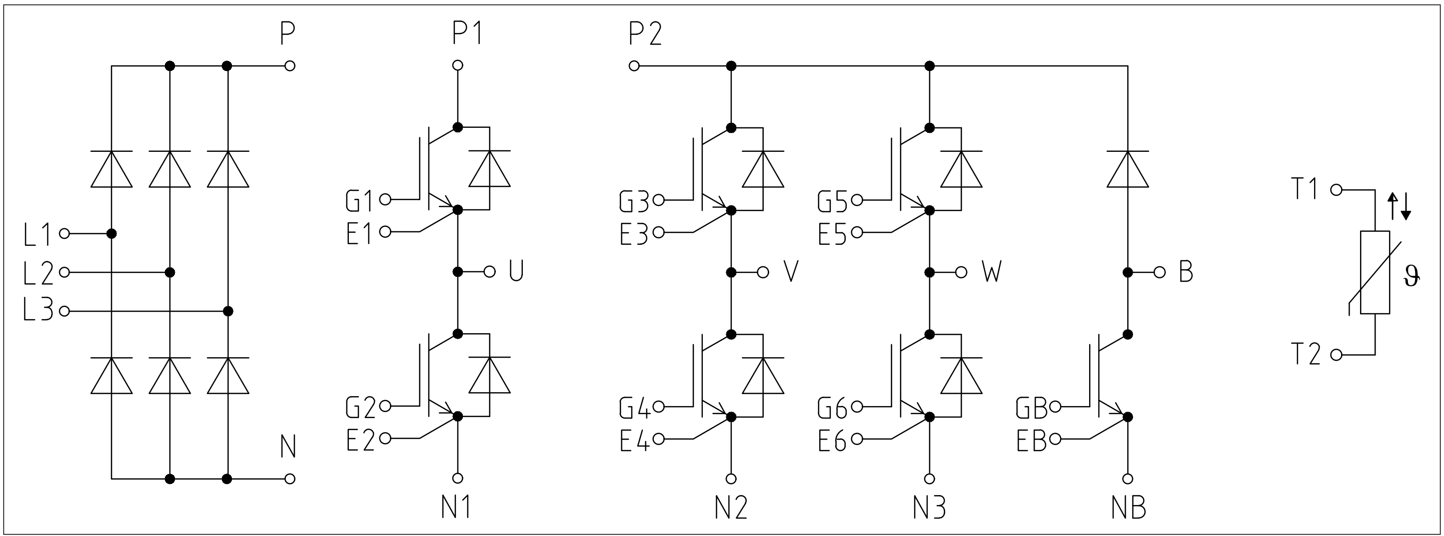


Figure 1

10 Package outlines

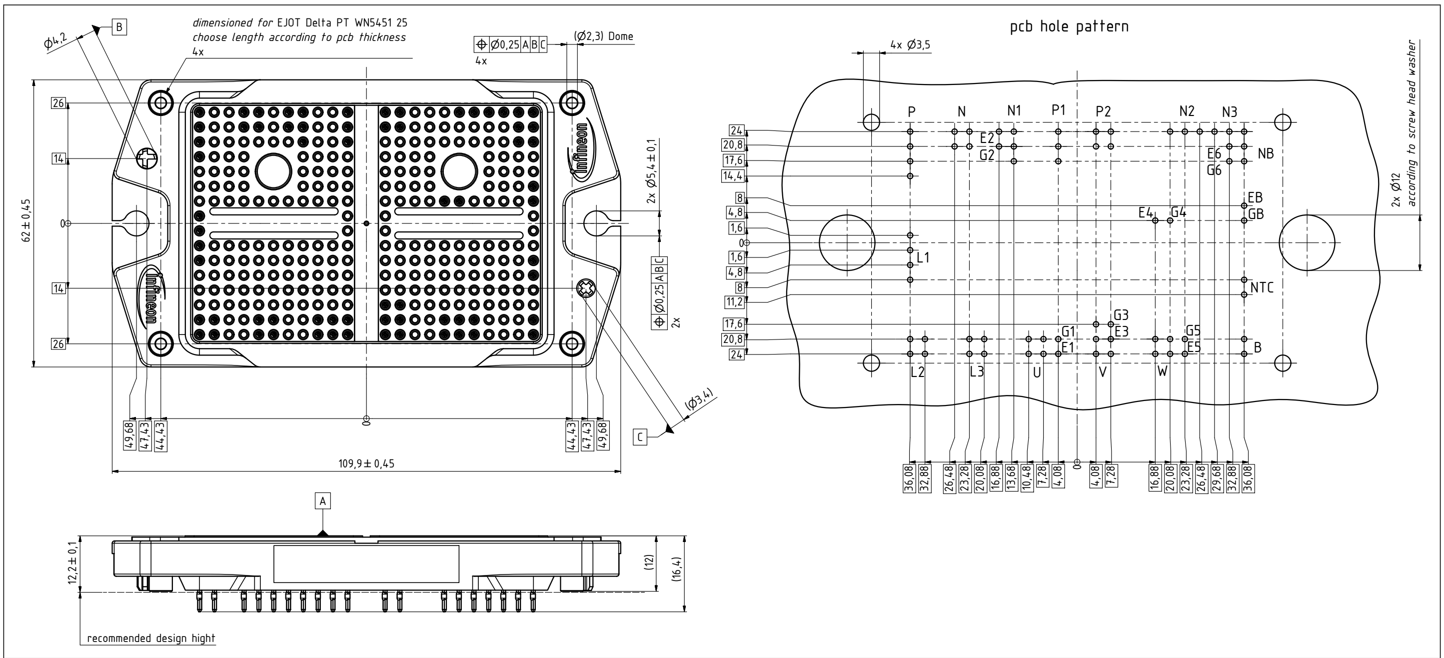


Figure 2

11 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	2020-08-20	Target 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
1.00	2022-09-27	Final datasheet
1.10	2022-12-13	Final datasheet

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