EconoPIM™2 module with TRENCHSTOP™IGBT7 and emitter controlled 7 diode and NTC

Features


Typical appearance

- Electrical features
  - V_{CES} = 1200 V
  - $I_{C\ nom}$ = 25 A / I_{CRM} = 50 A
  - TRENCHSTOP™ IGBT7
  - Overload operation up to 175°C
  - Low $V_{CE,sat}$
- Mechanical features
  - High power density
  - Compact design
  - Al_2O_3 substrate with low thermal resistance
  - 2.5 kV AC 1 minute insulation

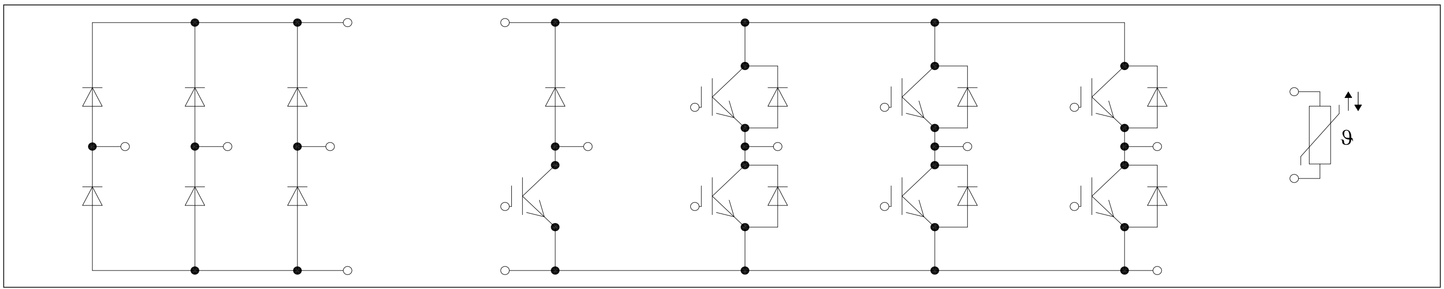
Potential applications

- Auxiliary inverters
- Air conditioning
- Motor drives

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
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	d_{Creep}	terminal to heatsink	10.0	mm
Clearance	d_{Clear}	terminal to heatsink	7.5	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}				35		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$	T_C = 25 °C, per switch			6.9		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	T_C = 25 °C, per switch			5.9		mΩ
Storage temperature	T_{stg}			-40		125	°C
Mounting torque for module mounting	*M*	- Mounting according to valid application note	M5, Screw	3		5	Nm
Weight	*G*				180		g

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

The current under continuous operation is limited to 50 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_C = 120 °C	25	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\ op}$		50	A

(table continues...)

Table 3 **(continued) Maximum rated values**

Parameter	Symbol	Note or test condition	Values	Unit
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 = 25 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 = 0.525 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			0.395		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			4.77		nF
Reverse transfer capacitance	C_{res}	f = 100 kHz, T_{vj} = 25 °C, V_{CE} = 25 V, V_{GE} = 0 V			0.017		nF
Collector-emitter cut-off current	I_{CES}	V_{CE} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.0056	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 = 25 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω	T_{vj} = 25 °C		0.040		µs
			T_{vj} = 125 °C		0.042		
			T_{vj} = 175 °C		0.043		
Rise time (inductive load)	t_r	I_C = 25 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω	T_{vj} = 25 °C		0.045		µs
			T_{vj} = 125 °C		0.048		
			T_{vj} = 175 °C		0.050		
Turn-off delay time (inductive load)	t_{doff}	I_C = 25 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		0.209		µs
			T_{vj} = 125 °C		0.325		
			T_{vj} = 175 °C		0.376		
Fall time (inductive load)	t_f	I_C = 25 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω	T_{vj} = 25 °C		0.164		µs
			T_{vj} = 125 °C		0.233		
			T_{vj} = 175 °C		0.300		
Turn-on energy loss per pulse	E_{on}	I_C = 25 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 9.1 Ω, di/dt = 640 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.29		mJ
			T_{vj} = 125 °C		3.01		
			T_{vj} = 175 °C		3.52		

(table continues...)

Table 4 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-off energy loss per pulse	E_{off}	I_C = 25 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 9.1 Ω, dv/dt = 2900 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		1.57		mJ
			T_{vj} = 125 °C		2.58		
			T_{vj} = 175 °C		3.15		
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		80		A
			t_P ≤ 7 µs, T_{vj}=175 °C		75		
Thermal resistance, junction to case	R_{thJC}	per IGBT				0.967	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.170		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.*

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			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	125	A^2s
			T_{vj} = 175 °C	95	

Table 6 **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		

(table continues...)

Table 6 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current	I_{RM}	V_{CC} = 600 V, I_F = 25 A, V_{GE} = -15 V, -di_F/dt = 640 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		17.3		A
			T_{vj} = 125 °C		22.1		
			T_{vj} = 175 °C		25.1		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 25 A, V_{GE} = -15 V, -di_F/dt = 640 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		2.01		µC
			T_{vj} = 125 °C		3.57		
			T_{vj} = 175 °C		4.72		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 25 A, V_{GE} = -15 V, -di_F/dt = 640 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.74		mJ
			T_{vj} = 125 °C		1.36		
			T_{vj} = 175 °C		1.79		
Thermal resistance, junction to case	R_{thJC}	per diode				1.43	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.182		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.*

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_C = 80 °C		70	A
Maximum RMS current at rectifier output	I_{RMSM}	T_C = 80 °C		100	A
Surge forward current	I_{FSM}	t_P = 10 ms	T_{vj} = 25 °C	560	A
			T_{vj} = 150 °C	435	
I^2t - value	I^2t	t_P = 10 ms	T_{vj} = 25 °C	1570	A^2s
			T_{vj} = 150 °C	945	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 25 A	T_{vj} = 150 °C		0.88		V
Reverse current	I_r	T_{vj} = 150 °C, V_R = 1600 V			1		mA
Thermal resistance, junction to case	R_{thJC}	per diode				0.870	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.166		K/W
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_C = 125 °C	15	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		30	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 = 15 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 = 0.553 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			0.234		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			2.82		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} = 1200 V, V_{GE} = 0 V	T_{vj} = 25 °C			0.003	mA
Gate-emitter leakage current	I_{GES}	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25 °C				100	nA

(table continues...)

Table 10 **(continued) Characteristic values**

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Turn-on delay time (inductive load)	t_{don}	I_C = 15 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 10 Ω	T_{vj} = 25 °C		0.034		µs
			T_{vj} = 125 °C		0.035		
			T_{vj} = 175 °C		0.036		
Rise time (inductive load)	t_r	I_C = 15 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Gon} = 10 Ω	T_{vj} = 25 °C		0.053		µs
			T_{vj} = 125 °C		0.054		
			T_{vj} = 175 °C		0.055		
Turn-off delay time (inductive load)	t_{doff}	I_C = 15 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 10 Ω	T_{vj} = 25 °C		0.336		µs
			T_{vj} = 125 °C		0.534		
			T_{vj} = 175 °C		0.632		
Fall time (inductive load)	t_f	I_C = 15 A, V_{CC} = 600 V, V_{GE} = ±15 V, R_{Goff} = 10 Ω	T_{vj} = 25 °C		0.272		µs
			T_{vj} = 125 °C		0.313		
			T_{vj} = 175 °C		0.333		
Turn-on energy loss per pulse	E_{on}	I_C = 15 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Gon} = 10 Ω, di/dt = 520 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		4.57		mJ
			T_{vj} = 125 °C		5.55		
			T_{vj} = 175 °C		6.07		
Turn-off energy loss per pulse	E_{off}	I_C = 15 A, V_{CC} = 600 V, L_σ = 35 nH, V_{GE} = ±15 V, R_{Goff} = 10 Ω, dv/dt = 2100 V/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.927		mJ
			T_{vj} = 125 °C		1.49		
			T_{vj} = 175 °C		1.77		
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		48		A
			t_P ≤ 7 µs, T_{vj}=175 °C		45		
Thermal resistance, junction to case	R_{thJC}	per IGBT				1.29	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, λ_{grease} = 1 W/(m·K)			0.180		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 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			10	A
Repetitive peak forward current	I_{FRM}	t_P = 1 ms		20	A
I^2t - value	I^2t	t_P = 10 ms, V_R = 0 V	T_{vj} = 125 °C	30	A^2s
			T_{vj} = 175 °C	25	

Table 12 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F = 10 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 = 10 A, V_{GE} = -15 V, -di_F/dt = 450 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		11.2		A
			T_{vj} = 125 °C		13.4		
			T_{vj} = 175 °C		14.5		
Recovered charge	Q_r	V_{CC} = 600 V, I_F = 10 A, V_{GE} = -15 V, -di_F/dt = 450 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.95		µC
			T_{vj} = 125 °C		1.68		
			T_{vj} = 175 °C		2.05		
Reverse recovery energy	E_{rec}	V_{CC} = 600 V, I_F = 10 A, V_{GE} = -15 V, -di_F/dt = 450 A/µs (T_{vj} = 175 °C)	T_{vj} = 25 °C		0.37		mJ
			T_{vj} = 125 °C		0.66		
			T_{vj} = 175 °C		0.83		
Thermal resistance, junction to case	R_{thJC}	per diode				1.81	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, λ_{grease} = 1 W/(m·K)			0.181		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.*

7 NTC-Thermistor

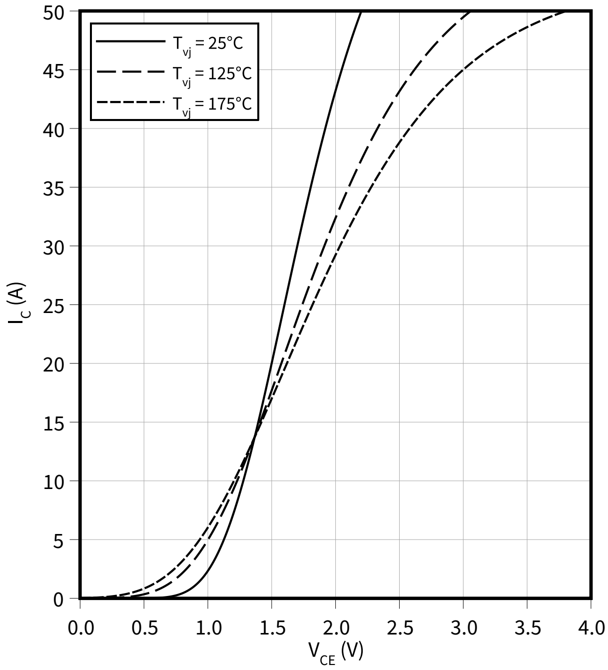
Table 13 Characteristic values

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

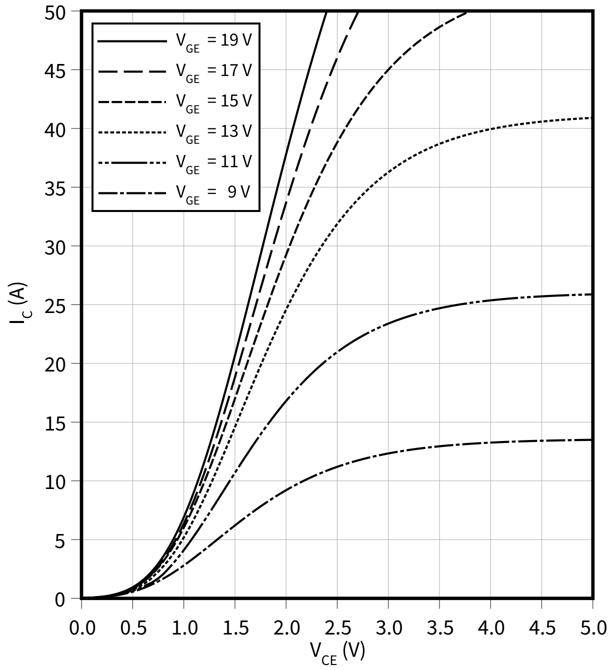
Note: Specification according to the valid application note.

8 Characteristics diagrams

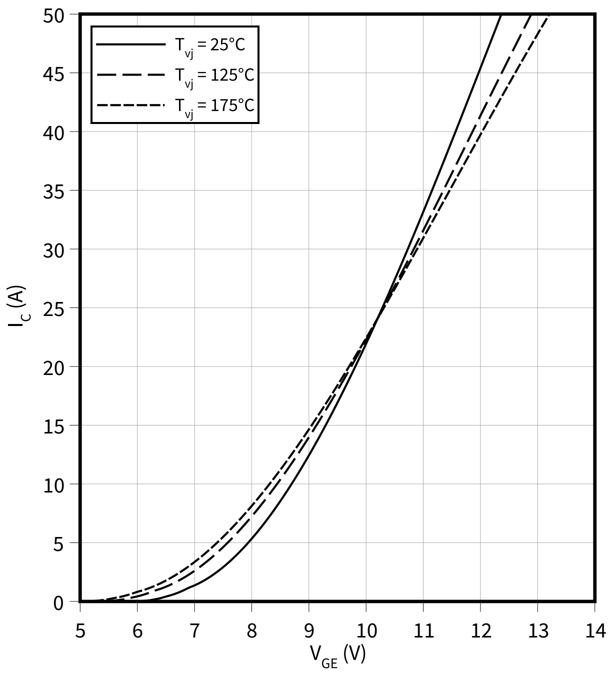
Output characteristic (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



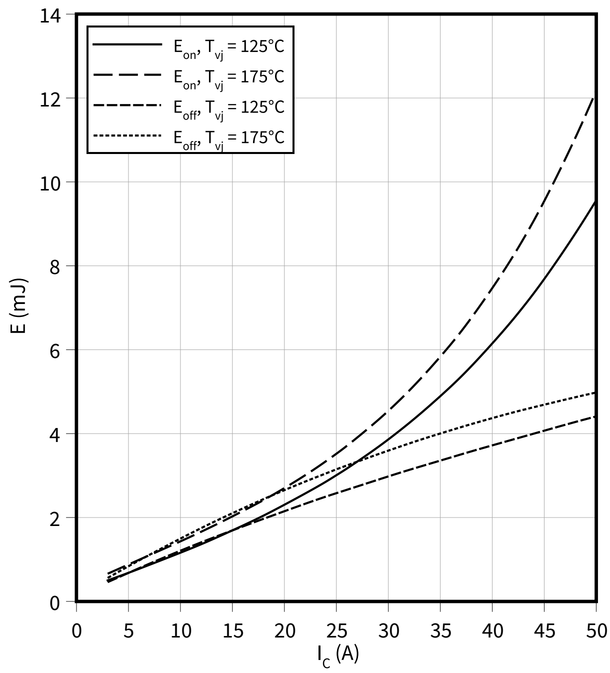
Output characteristic field (typical), IGBT, Inverter
$I_C = f(V_{CE})$
$T_{vj} = 175$ °C



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



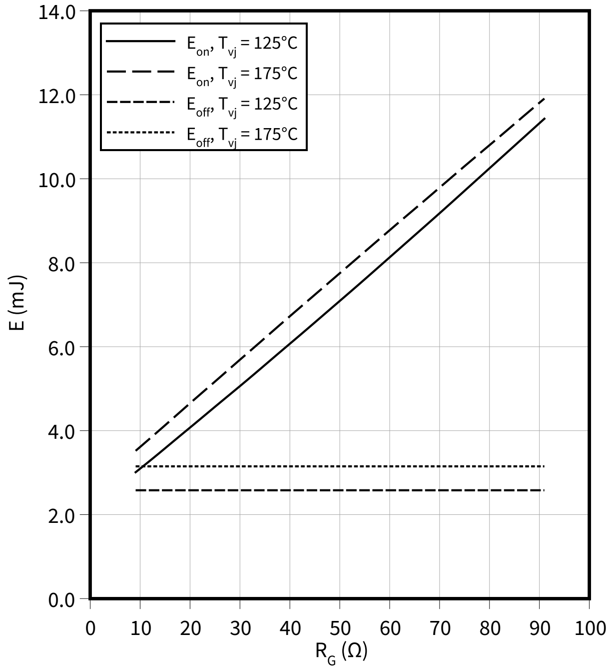
Switching losses (typical), IGBT, Inverter
$E = f(I_C)$
$R_{Goff} = 9.1\ \Omega$, $R_{Gon} = 9.1\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CC} = 600$ V



Switching losses (typical), IGBT, Inverter

$E = f(R_G)$

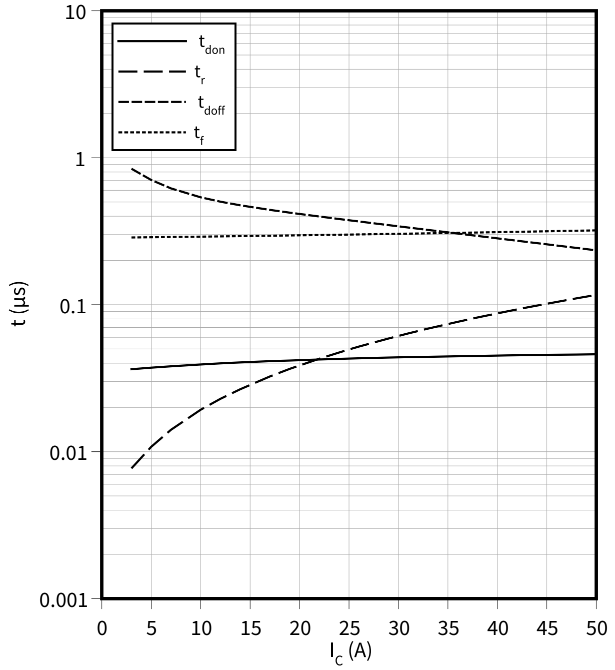
$V_{GE} = \pm 15$ V, $I_C = 25$ A, $V_{CC} = 600$ V



Switching times (typical), IGBT, Inverter

$t = f(I_C)$

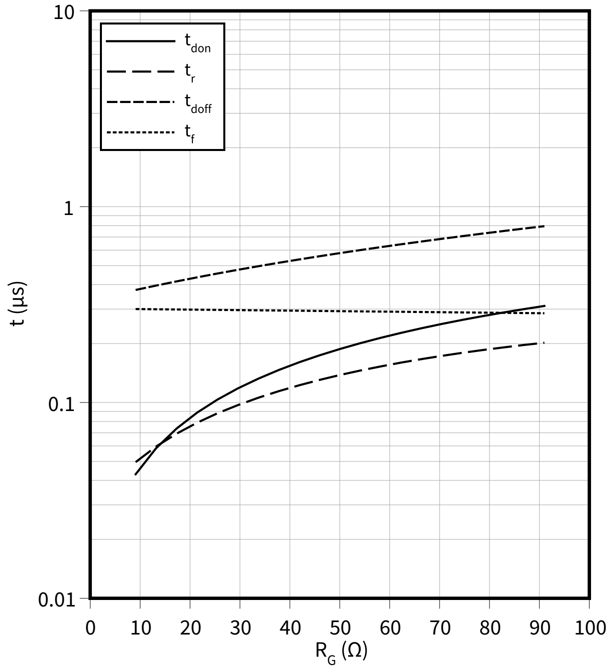
$R_{Goff} = 9.1\ \Omega$, $R_{Gon} = 9.1\ \Omega$, $V_{GE} = \pm 15$ V, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



Switching times (typical), IGBT, Inverter

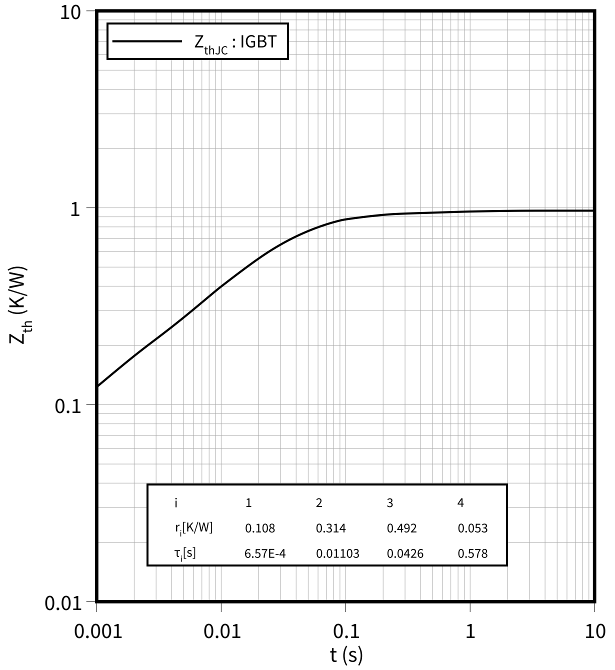
$t = f(R_G)$

$V_{GE} = \pm 15$ V, $I_C = 25$ A, $V_{CC} = 600$ V, $T_{vj} = 175$ °C



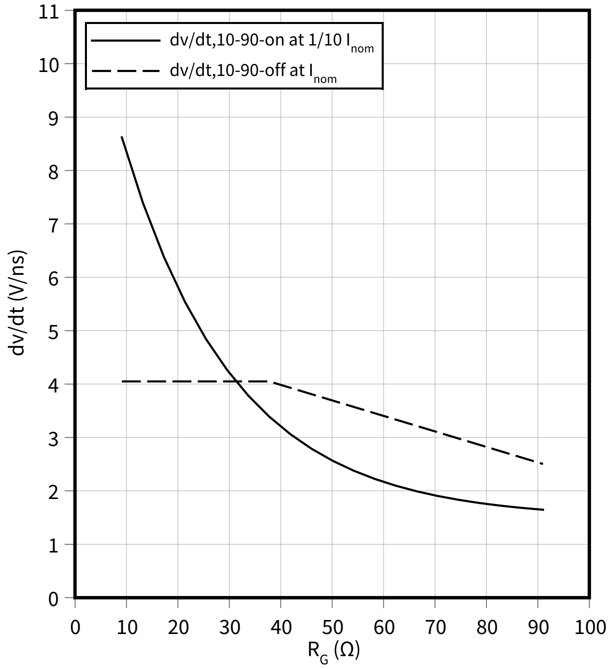
Transient thermal impedance , IGBT, Inverter

$Z_{th} = f(t)$

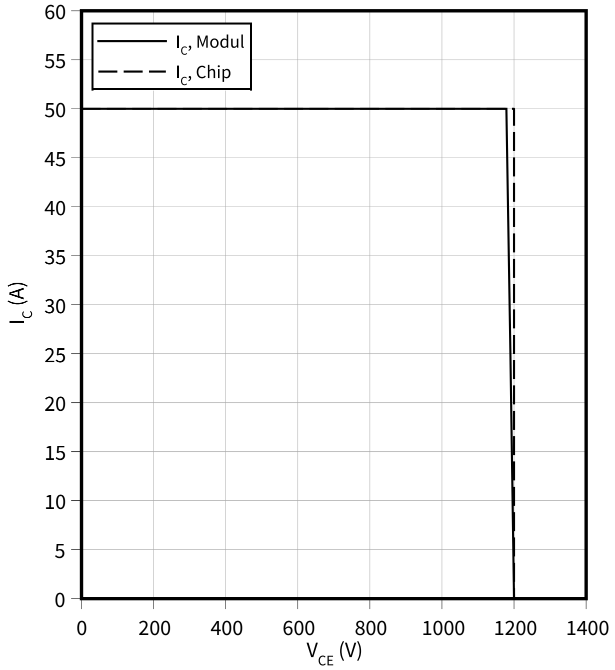


i	1	2	3	4
r_i[K/W]	0.108	0.314	0.492	0.053
τ_i[s]	6.57E-4	0.01103	0.0426	0.578

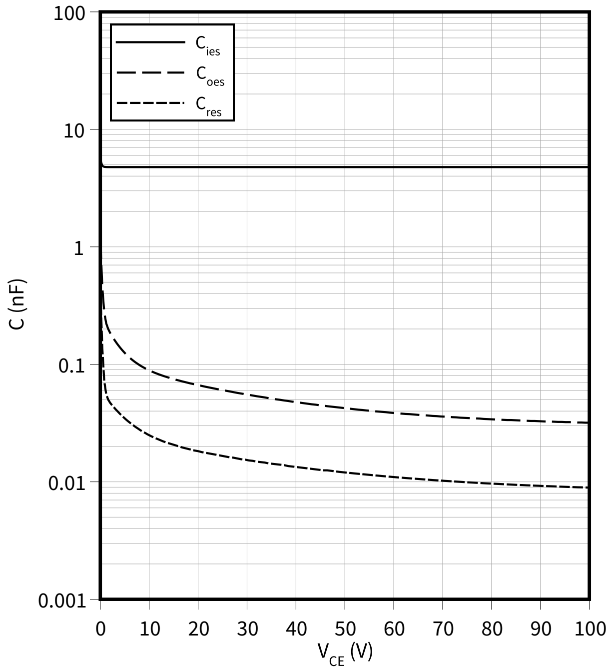
Voltage slope (typical), IGBT, Inverter
dv/dt = f(R_G)
I_C = 25 A, V_{CC} = 600 V, V_{GE} = ±15 V, T_{vj} = 25 °C



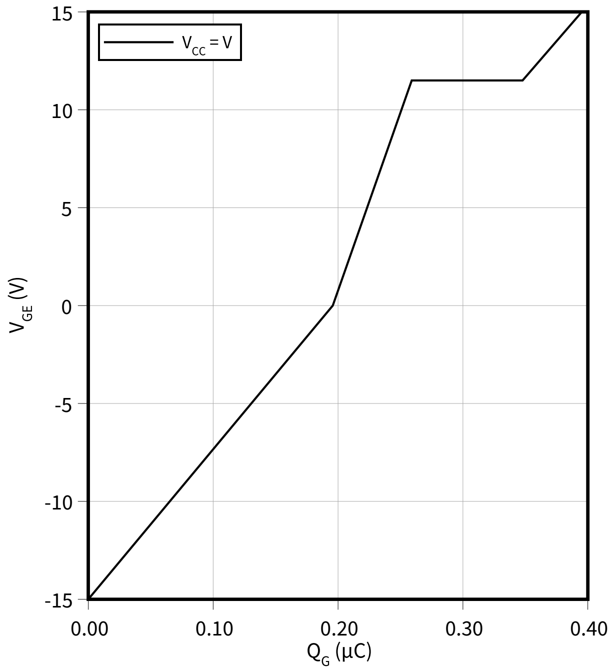
Reverse bias safe operating area (RBSOA), IGBT, Inverter
I_C = f(V_{CE})
R_{Goff} = 9.1 Ω, V_{GE} = ±15 V, T_{vj} = 175 °C



Capacity characteristic (typical), IGBT, Inverter
C = f(V_{CE})
f = 100 kHz, V_{GE} = 0 V, T_{vj} = 25 °C



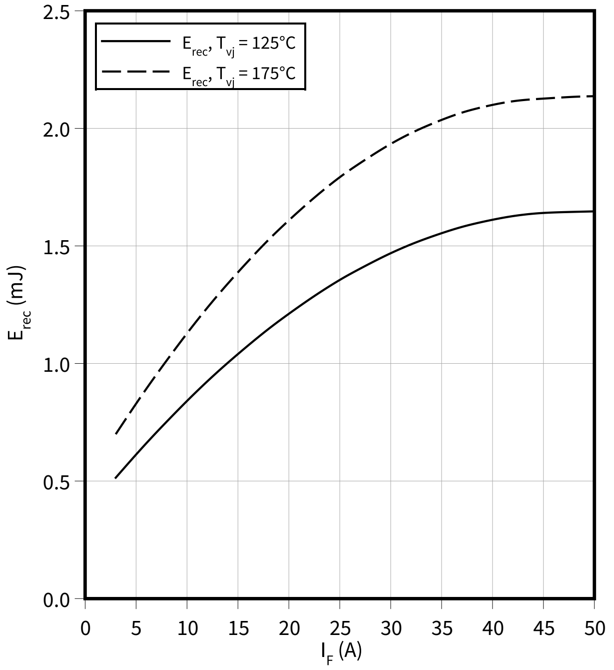
Gate charge characteristic (typical), IGBT, Inverter
V_{GE} = f(Q_G)
I_C = 25 A, T_{vj} = 25 °C



Switching losses (typical), Diode, Inverter

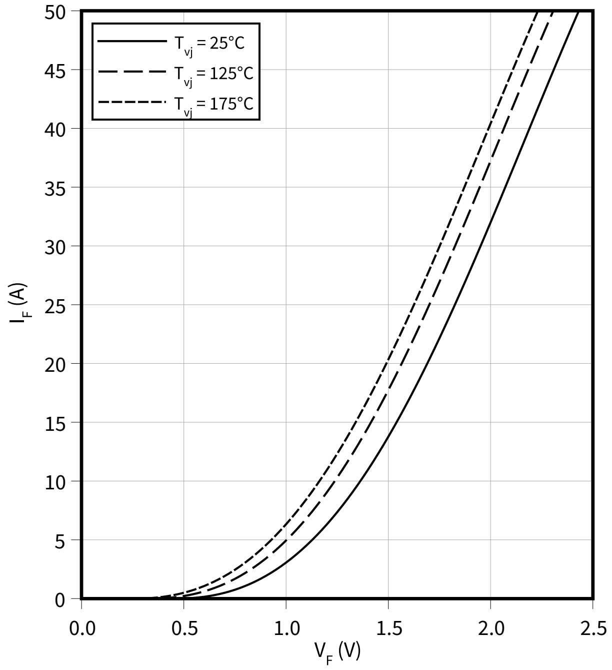
$E_{rec} = f(I_F)$

$R_{Gon} = 9.1$, $V_{CC} = 600$ V



Forward characteristic (typical), Diode, Inverter

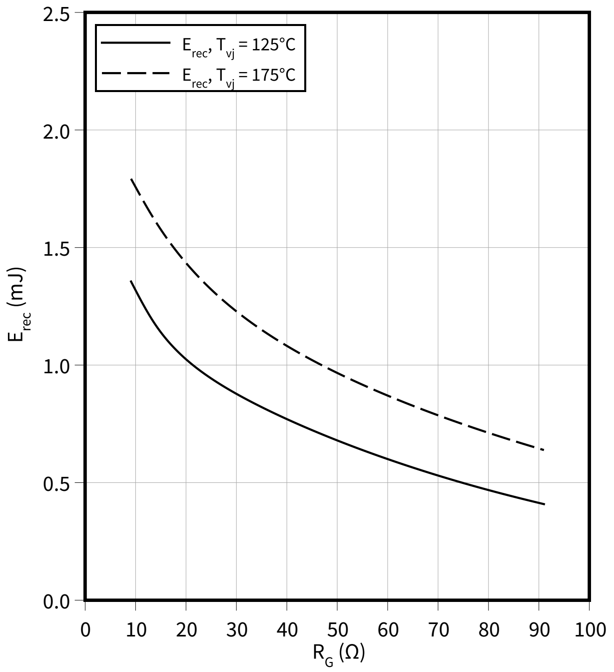
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

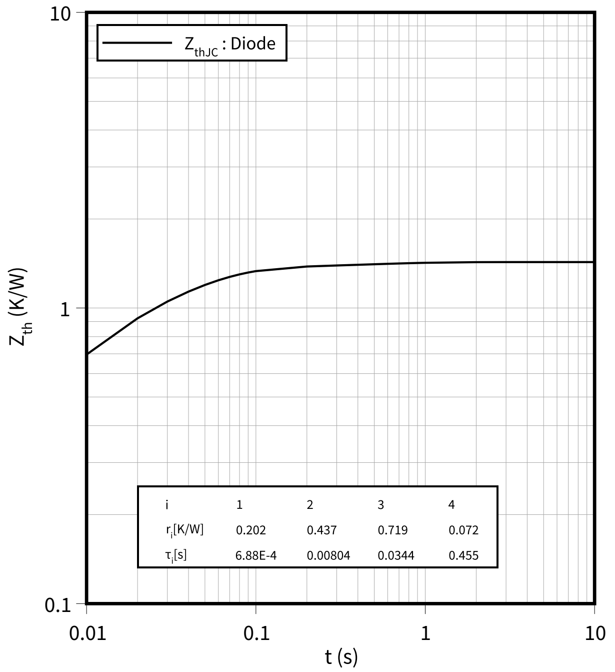
$E_{rec} = f(R_G)$

$I_F = 25$ A, $V_{CC} = 600$ V



Transient thermal impedance, Diode, Inverter

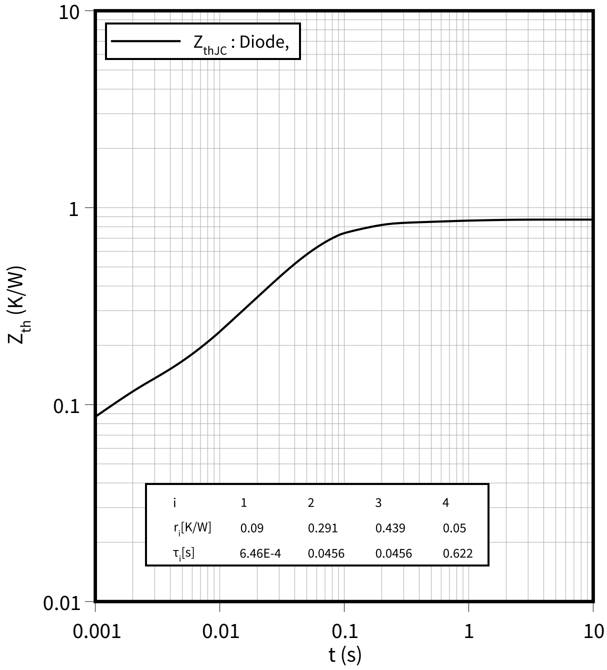
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.202	0.437	0.719	0.072
τ_i[s]	6.88E-4	0.00804	0.0344	0.455

Transient thermal impedance, Diode, Rectifier

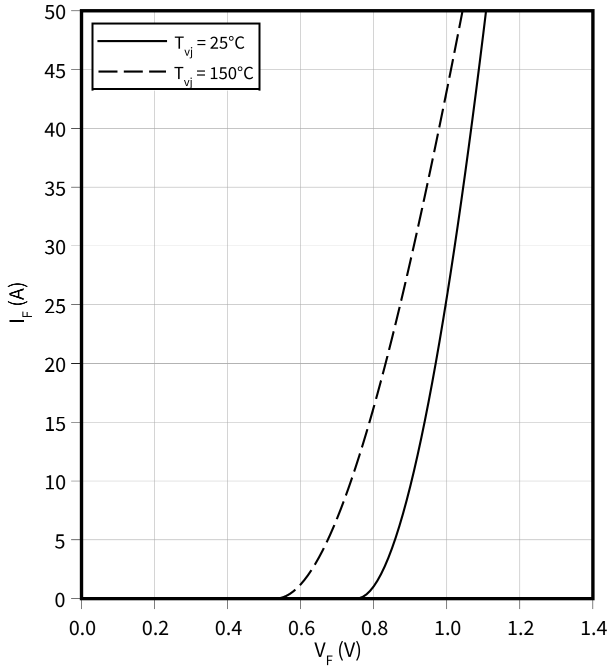
$Z_{th} = f(t)$



i	1	2	3	4
r_i[K/W]	0.09	0.291	0.439	0.05
τ_i[s]	6.46E-4	0.0456	0.0456	0.622

Forward characteristic (typical), Diode, Rectifier

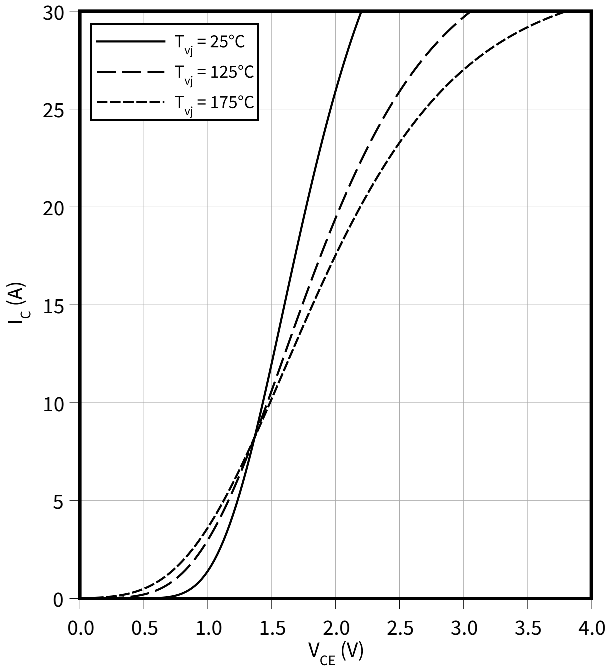
$I_F = f(V_F)$



Output characteristic (typical), IGBT, Brake-Chopper

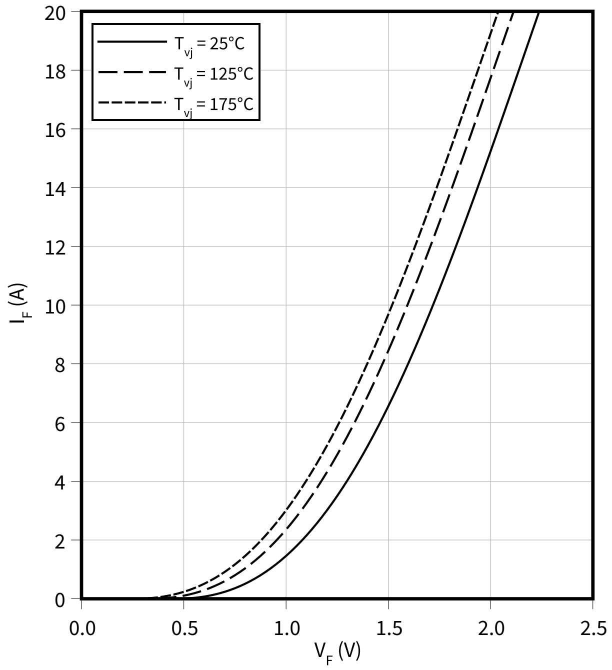
$I_C = f(V_{CE})$

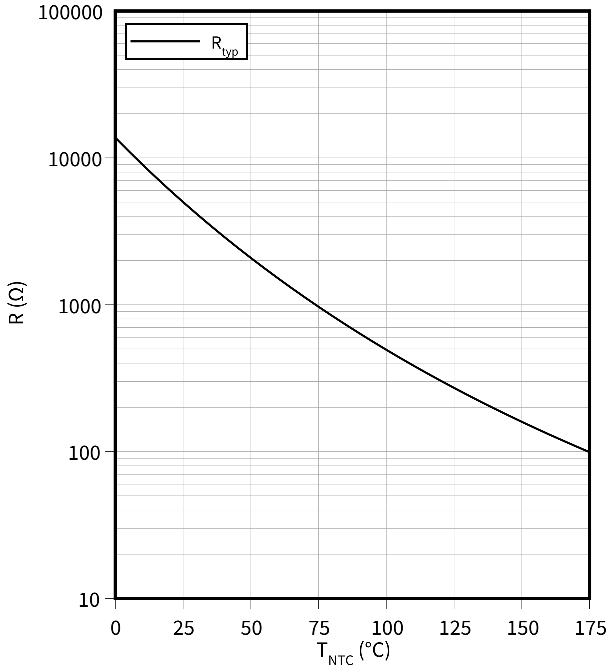
$V_{GE} = 15$ V



Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



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

9 Circuit diagram

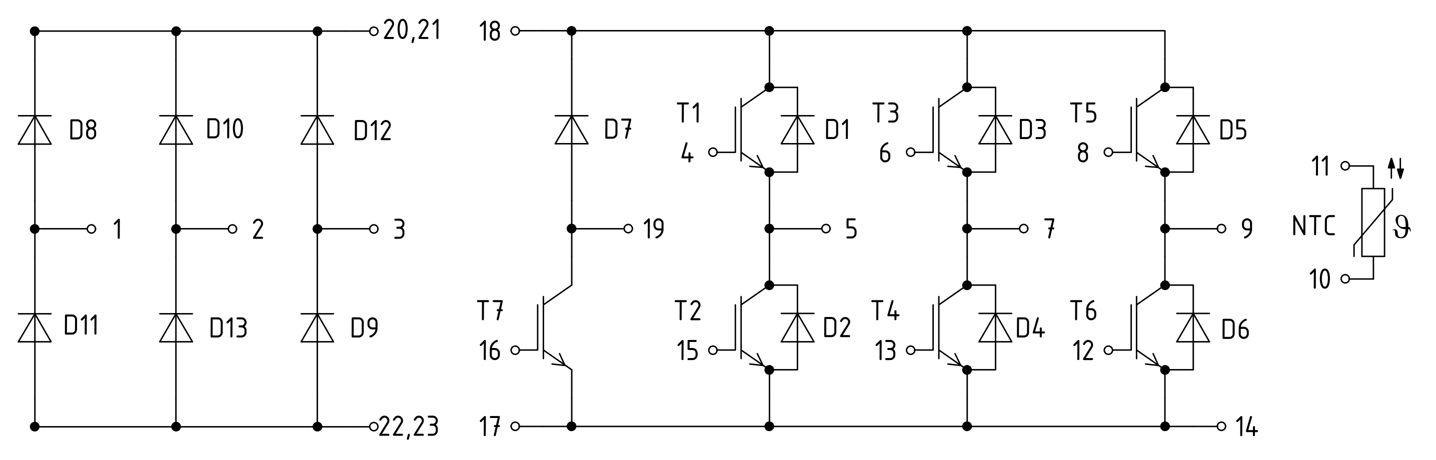
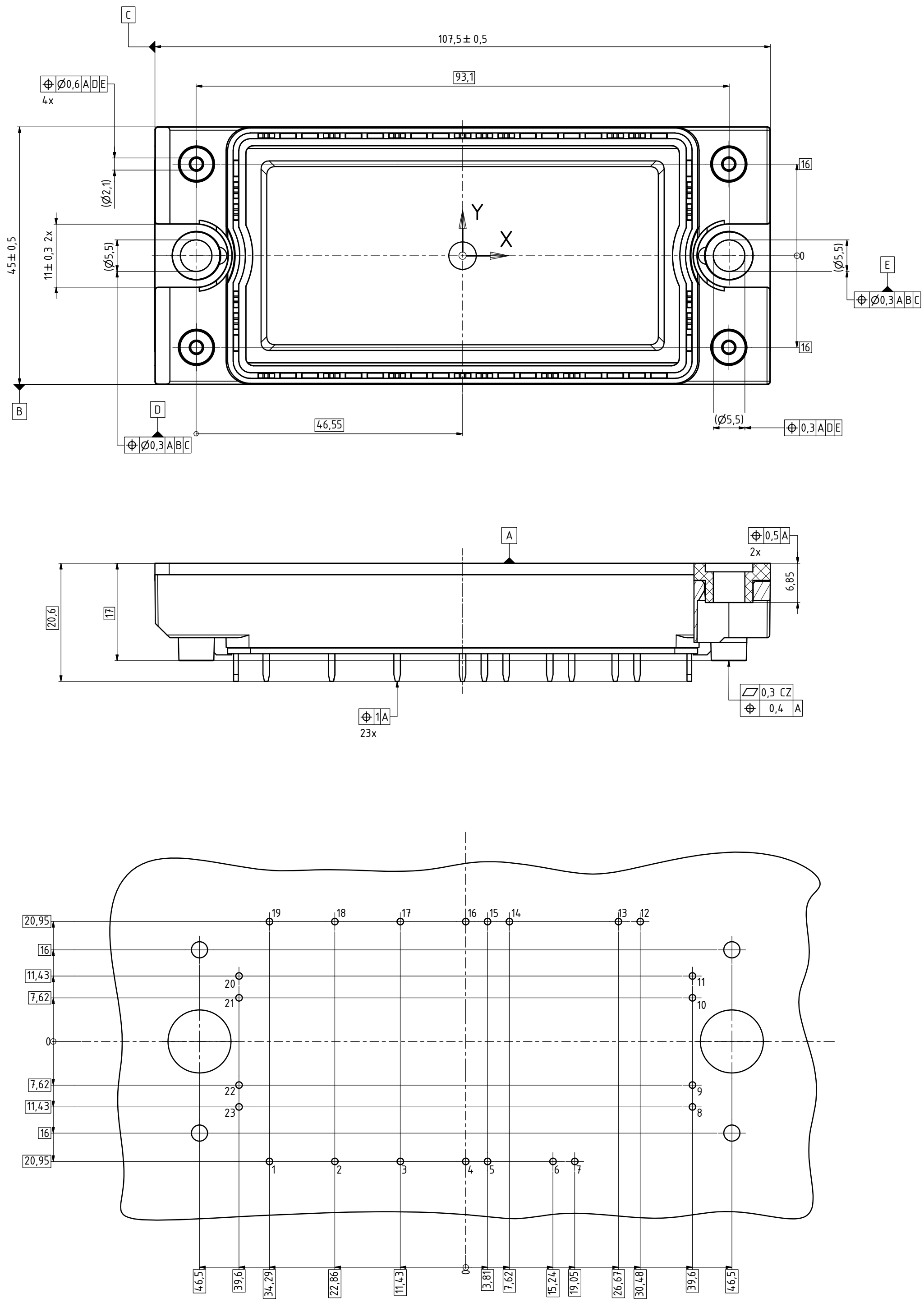


Figure 1

10 Package outlines



For PressFIT pin: Details about hole specification for contacts refer to AN2007-09
For Solderpin: Details about hole specification for contacts refer to AN2017-03

Recommended tolerance of threaded holes in heatsink ± 0,1 mm.
Dimensions according to ISO 14405 (GG) (Method of least squares (LSQ)).
Reference D and E defined with (GG)
ISO 8015 - Independency principle

W00213332.00

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*	*Digit*	*Example*
	Module serial number	1 – 5	71549
	Module material number	6 - 11	142846
	Production order number	12 - 19	55054991
	Date code (production year)	20 – 21	15
	Date code (production week)	22 – 23	30
Example	71549142846550549911530		71549142846550549911530

Figure 3

Revision history

Document revision	Date of release	Description of changes
V1.0	2019-11-14	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	2022-11-28	Final datasheet

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