

Final datasheet

EconoPIM™3 module with fast Trench/Fieldstop IGBT4 and emitter controlled 4 diode

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 100\text{ A} / I_{CRM} = 200\text{ A}$
 - Low switching losses
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - $V_{CE,sat}$ with positive temperature coefficient
 - Low $V_{CE,sat}$
- Mechanical features
 - High power and thermal cycling capability
 - Copper base plate
 - Solder contact technology
 - Standard housing



Typical appearance

Potential applications

- Auxiliary inverters
- Medical applications
- Motor drives
- Servo drives

Product validation

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

Description

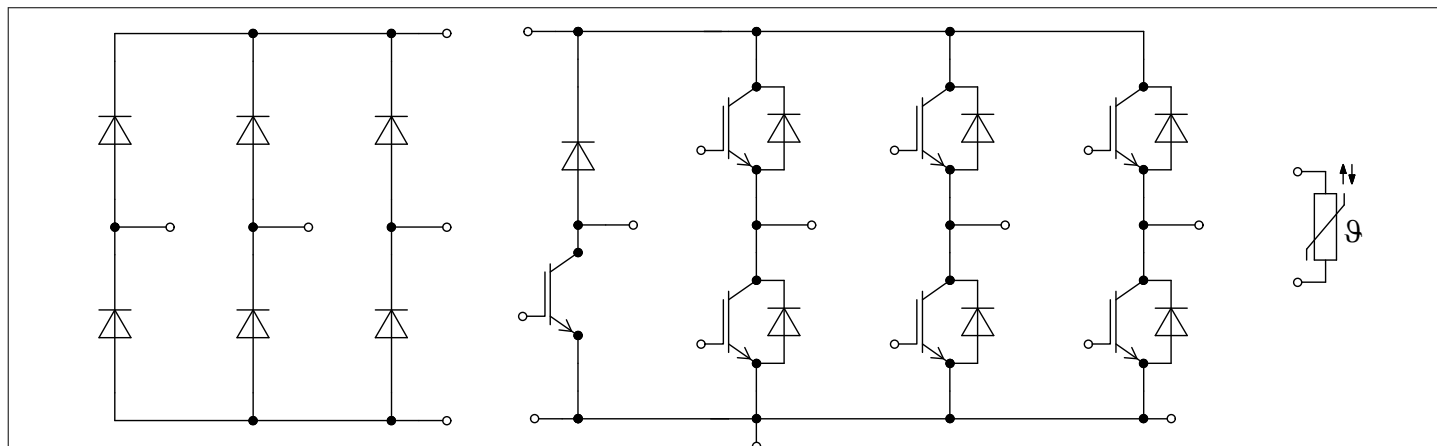


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	$t = 1 \text{ min}$	2.5	kV
Material of module baseplate			Cu	
Internal isolation			Al_2O_3	
Creepage distance	d_{Creep}		10.0	mm
Clearance	d_{Clear}		7.5	mm
Comparative tracking index	CTI		> 200	
Relative thermal index (electrical)	RTI		120	°C

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, case to heat sink	R_{thCH}	$\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.009		K/W
Stray inductance module	L_{sCE}			40		nH
Module lead resistance, terminals - chip	$R_{AA'+CC'}$			3		mΩ
Module lead resistance, terminals - chip	$R_{CC'+EE'}$			4		mΩ
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	M5	3		6	Nm
Weight	G			300		g

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Collector-emitter voltage	V_{CES}	$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_C = 95 \text{ °C}$	100	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$	200	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	$V_{CE\ sat}$	$I_C = 150\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$		2.05		
			$T_{vj} = 150\ ^\circ C$		2.10		
Gate threshold voltage	V_{GETh}	$I_C = 3.8\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V$			0.8		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			7.5		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			6.3		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.27		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\ V, V_{GE} = 0\ V$	$T_{vj} = 25\ ^\circ C$			1	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\ V, V_{GE} = 20\ V, T_{vj} = 25\ ^\circ C$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.160		μs
			$T_{vj} = 125\ ^\circ C$		0.170		
			$T_{vj} = 150\ ^\circ C$		0.170		
Rise time (inductive load)	t_r	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.030		μs
			$T_{vj} = 125\ ^\circ C$		0.040		
			$T_{vj} = 150\ ^\circ C$		0.040		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.330		μs
			$T_{vj} = 125\ ^\circ C$		0.430		
			$T_{vj} = 150\ ^\circ C$		0.450		
Fall time (inductive load)	t_f	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.080		μs
			$T_{vj} = 125\ ^\circ C$		0.150		
			$T_{vj} = 150\ ^\circ C$		0.170		
Turn-on energy loss per pulse	E_{on}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 40\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega, di/dt = 3000\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		5.5		mJ
			$T_{vj} = 125\ ^\circ C$		8.5		
			$T_{vj} = 150\ ^\circ C$		9.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 40\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega, dv/dt = 3600\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		5.5		mJ
			$T_{vj} = 125\ ^\circ C$		8.5		
			$T_{vj} = 150\ ^\circ C$		9.5		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		400		A

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.290	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.130		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	°C

3 Diode, Inverter

Table 5 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC forward current	I_F			100	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$		200	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	1550	A^2s
			$T_{vj} = 150 \text{ °C}$	1500	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 100 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.70	2.15	V
			$T_{vj} = 125 \text{ °C}$	1.65		
			$T_{vj} = 150 \text{ °C}$	1.65		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 3000 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	115		A
			$T_{vj} = 125 \text{ °C}$	125		
			$T_{vj} = 150 \text{ °C}$	130		
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 3000 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	9.5		μC
			$T_{vj} = 125 \text{ °C}$	17.5		
			$T_{vj} = 150 \text{ °C}$	20.5		
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}, I_F = 100 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 3000 \text{ A/}\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$	3.5		mJ
			$T_{vj} = 125 \text{ °C}$	6		
			$T_{vj} = 150 \text{ °C}$	7.5		

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to case	R_{thJC}	per diode			0.500	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$		0.225		K/W
Temperature under switching conditions	$T_{vj,op}$		-40		150	°C

4 Diode, Rectifier

Table 7 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ °C}$	1600	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_C = 80 \text{ °C}$		100	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_C = 80 \text{ °C}$		150	A
Surge forward current	I_{FSM}	$t_P = 10 \text{ ms}$	$T_{vj} = 25 \text{ °C}$	1150	A
			$T_{vj} = 150 \text{ °C}$	880	
I^2t - value	I^2t	$t_P = 10 \text{ ms}$	$T_{vj} = 25 \text{ °C}$	6600	A²s
			$T_{vj} = 150 \text{ °C}$	3850	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition		Values			Unit
				Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 100 \text{ A}$	$T_{vj} = 150 \text{ °C}$		1.00		V
Reverse current	I_r	$T_{vj} = 150 \text{ °C}$, $V_R = 1600 \text{ V}$			1		mA
Thermal resistance, junction to case	R_{thJC}	per diode				0.400	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W/(m}\cdot\text{K)}$			0.180		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}		$T_{vj} = 25\text{ °C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 175\text{ °C}$	$T_C = 95\text{ °C}$	50	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\text{ op}}$		100	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	$V_{CE\text{ sat}}$	$I_C = 50\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.85	2.15	V
			$T_{vj} = 125\text{ °C}$		2.15		
			$T_{vj} = 150\text{ °C}$		2.25		
Gate threshold voltage	V_{GETh}	$I_C = 1.6\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25\text{ °C}$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\text{ V}$			0.38		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			4		Ω
Input capacitance	C_{ies}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			2.8		nF
Reverse transfer capacitance	C_{res}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			0.1		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1200\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			1	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$, $T_{vj} = 25\text{ °C}$				100	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 50\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 15\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.160		μs
			$T_{vj} = 125\text{ °C}$		0.170		
			$T_{vj} = 150\text{ °C}$		0.170		
Rise time (inductive load)	t_r	$I_C = 50\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 15\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.030		μs
			$T_{vj} = 125\text{ °C}$		0.040		
			$T_{vj} = 150\text{ °C}$		0.040		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 50\text{ A}$, $V_{CC} = 600\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 15\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.330		μs
			$T_{vj} = 125\text{ °C}$		0.430		
			$T_{vj} = 150\text{ °C}$		0.450		

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$I_C = 50 \text{ A}$, $V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 15 \Omega$	$T_{vj} = 25 \text{ °C}$	0.080		μs
			$T_{vj} = 125 \text{ °C}$	0.150		
			$T_{vj} = 150 \text{ °C}$	0.170		
Turn-on energy loss per pulse	E_{on}	$I_C = 50 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 20 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Gon} = 15 \Omega$	$T_{vj} = 25 \text{ °C}$	5.7		mJ
			$T_{vj} = 125 \text{ °C}$	7.7		
			$T_{vj} = 150 \text{ °C}$	8.4		
Turn-off energy loss per pulse	E_{off}	$I_C = 50 \text{ A}$, $V_{CC} = 600 \text{ V}$, $L_\sigma = 20 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 15 \Omega$	$T_{vj} = 25 \text{ °C}$	2.8		mJ
			$T_{vj} = 125 \text{ °C}$	4.3		
			$T_{vj} = 150 \text{ °C}$	4.8		
SC data	I_{SC}	$V_{GE} \leq 15 \text{ V}$, $V_{CC} = 800 \text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 10 \mu\text{s}$, $T_{vj} = 125 \text{ °C}$	180		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.540	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.245		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	°C

6 Diode, Brake-Chopper

Table 11 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Repetitive peak reverse voltage	V_{RRM}		$T_{vj} = 25 \text{ °C}$	1200	V
Continuous DC forward current	I_F			25	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$		50	A
I^2t - value	I^2t	$t_P = 10 \text{ ms}$, $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	90	A^2s
			$T_{vj} = 150 \text{ °C}$	80	

Table 12 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 25 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.75	2.15	V
			$T_{vj} = 125 \text{ °C}$	1.75		
			$T_{vj} = 150 \text{ °C}$	1.75		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600 \text{ V}$, $I_F = 25 \text{ A}$, $-di_F/dt = 1200 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	39		A
			$T_{vj} = 125 \text{ °C}$	40		
			$T_{vj} = 150 \text{ °C}$	41		
Recovered charge	Q_r	$V_{CC} = 600 \text{ V}$, $I_F = 25 \text{ A}$, $-di_F/dt = 1200 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	2.4		μC
			$T_{vj} = 125 \text{ °C}$	4.1		
			$T_{vj} = 150 \text{ °C}$	4.4		
Reverse recovery energy	E_{rec}	$V_{CC} = 600 \text{ V}$, $I_F = 25 \text{ A}$, $-di_F/dt = 1200 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	0.9		mJ
			$T_{vj} = 125 \text{ °C}$	1.5		
			$T_{vj} = 150 \text{ °C}$	1.7		
Thermal resistance, junction to case	R_{thJC}	per diode			1.35	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		0.610		K/W
Temperature under switching conditions	$T_{vj op}$		-40		150	°C

7 NTC-Thermistor

Table 13 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Rated resistance	R_{25}	$T_{NTC} = 25 \text{ °C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100 \text{ °C}$, $R_{100} = 493 \text{ Ω}$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25 \text{ °C}$			20	mW
B-value	$B_{25/50}$			3375		K
B-value	$B_{25/80}$			3411		K
B-value	$B_{25/100}$			3433		K

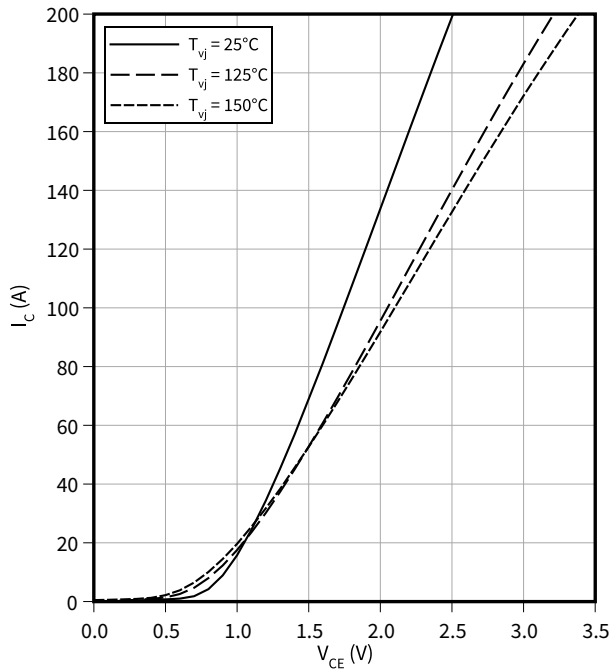
Note: Specification according to the valid application note.

8 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

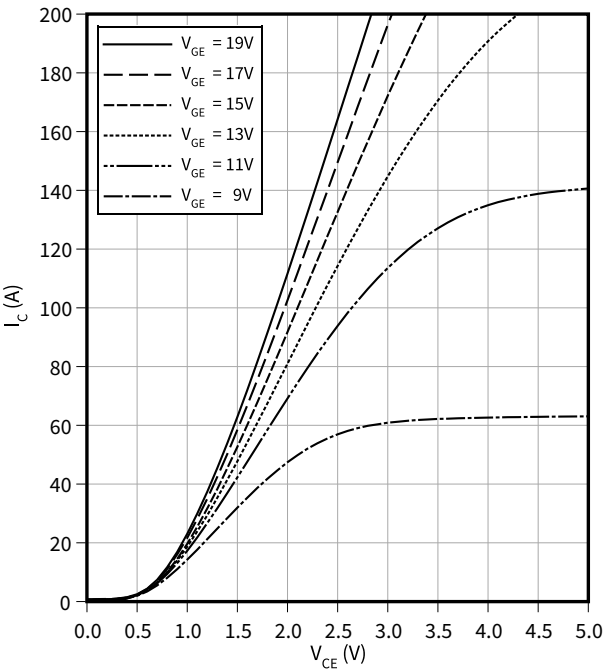
$V_{GE} \leq 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

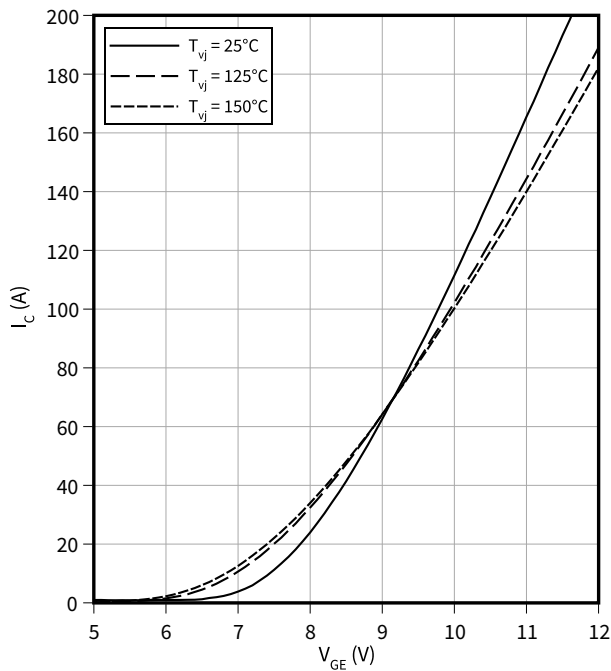
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

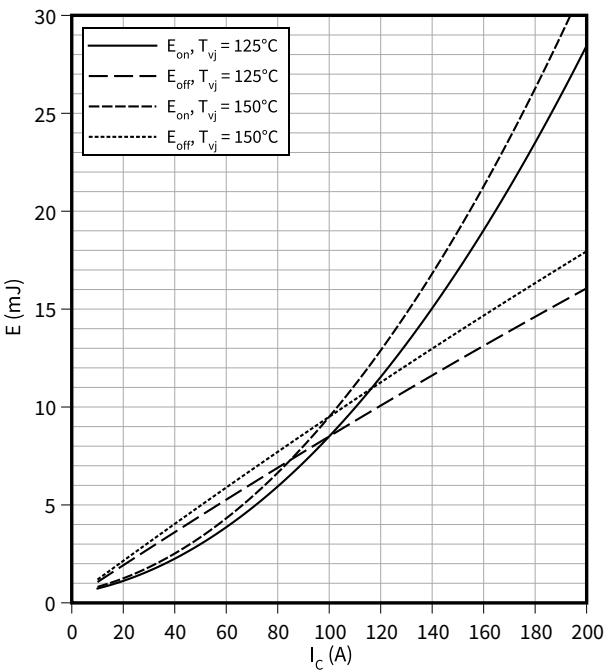
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

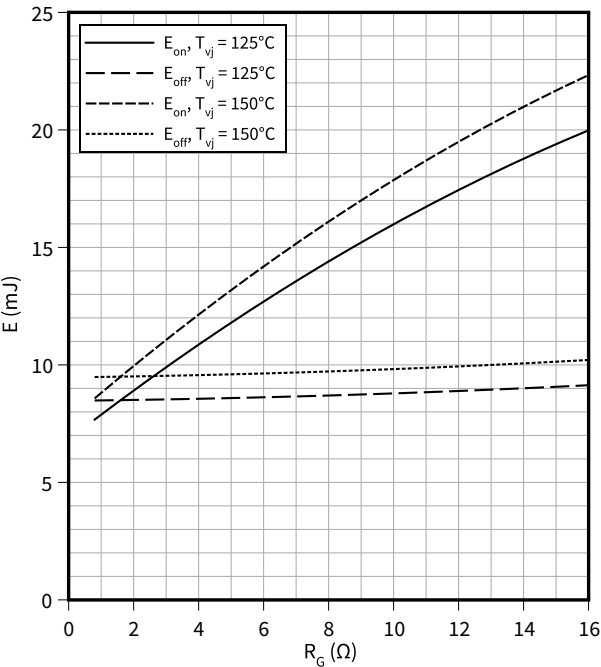
$R_{Goff} = 1.6\text{ }\Omega$, $R_{Gon} = 1.6\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $V_{CC} = 600\text{ V}$



8 Characteristics diagrams

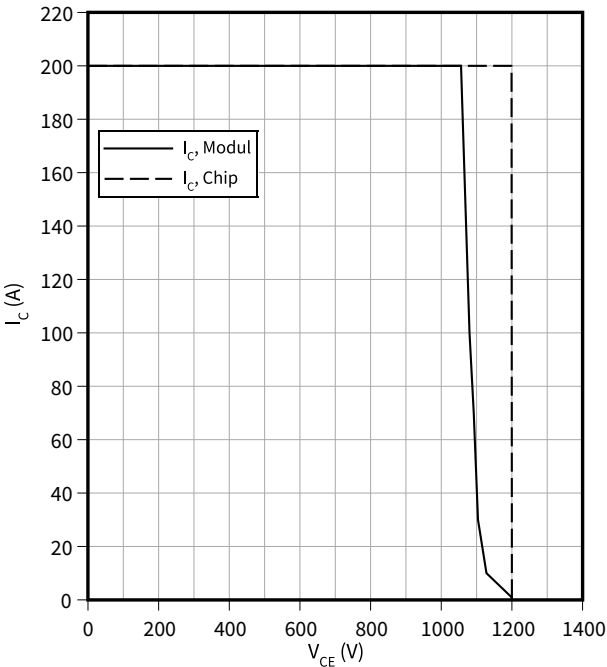
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 150\text{ A}$, $V_{CC} = 600\text{ V}$



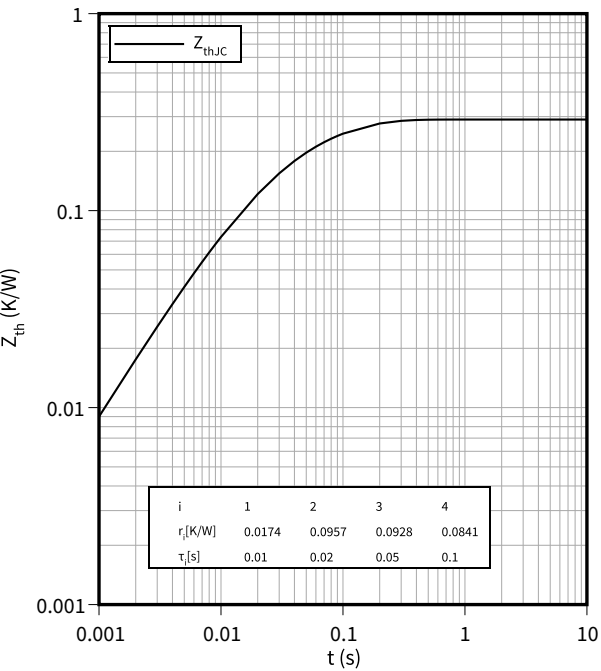
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1.6\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150^\circ\text{C}$



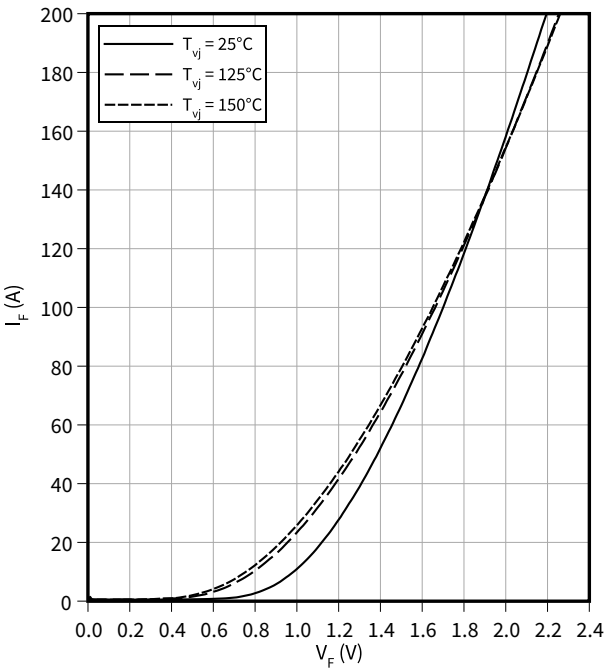
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

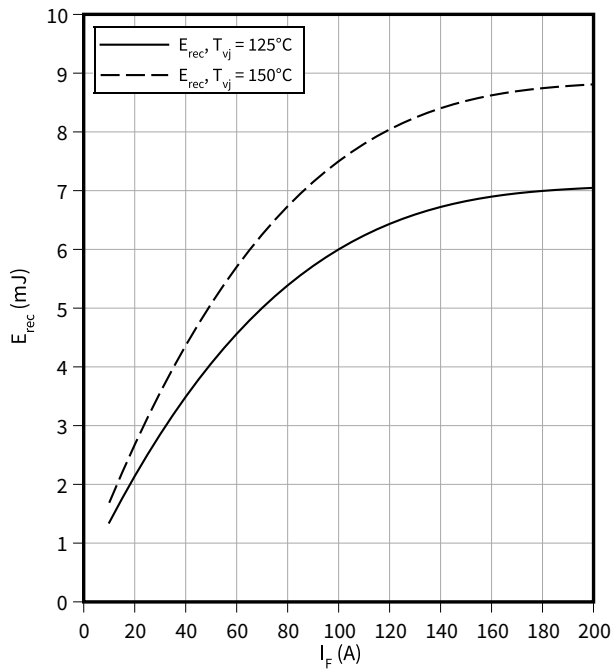
$I_F = f(V_F)$



8 Characteristics diagrams

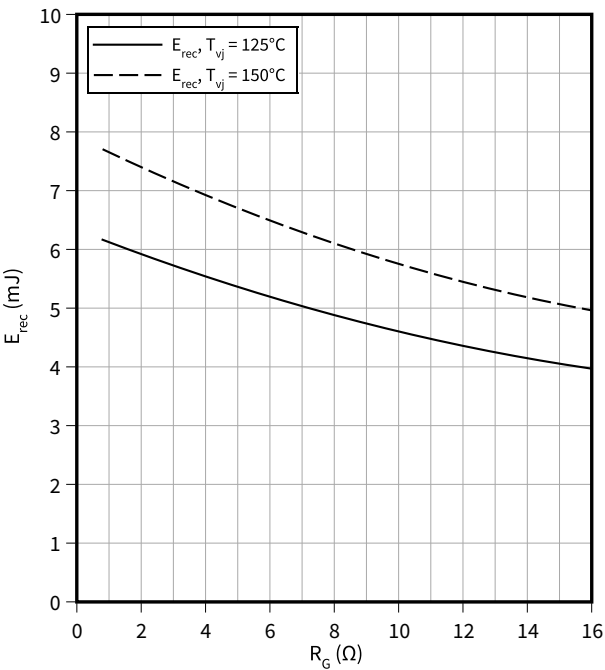
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $R_{Gon} = R_{Gon}(IGBT) , V_{CC} = 600\text{ V}$



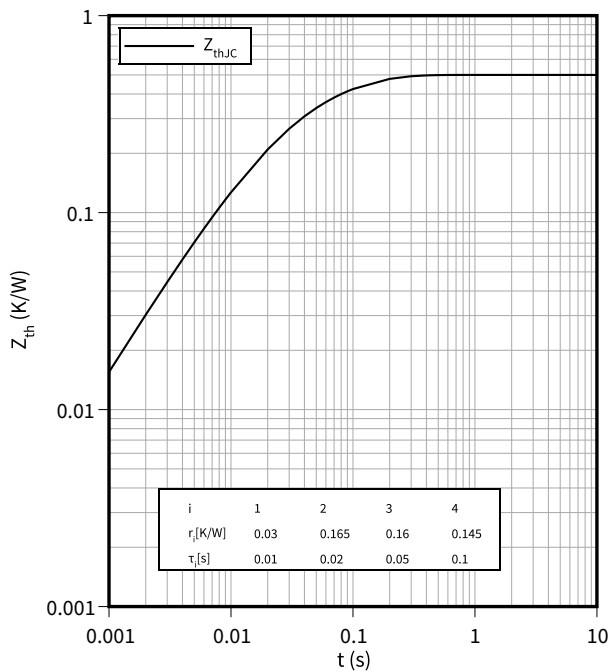
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $I_F = 100\text{ A}, V_{CC} = 600\text{ V}$



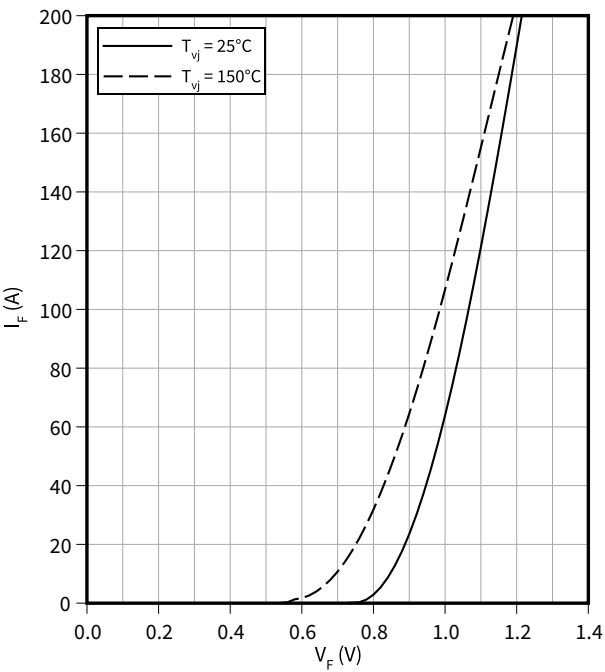
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$

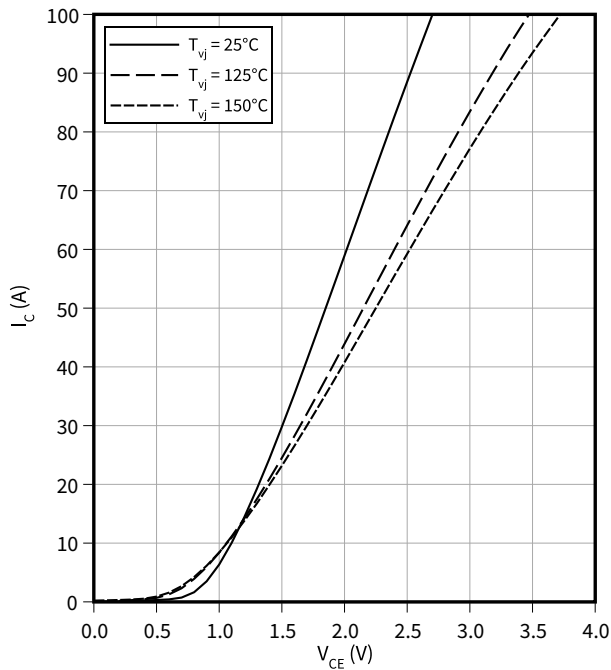


8 Characteristics diagrams

Output characteristic (typical), IGBT, Brake-Chopper

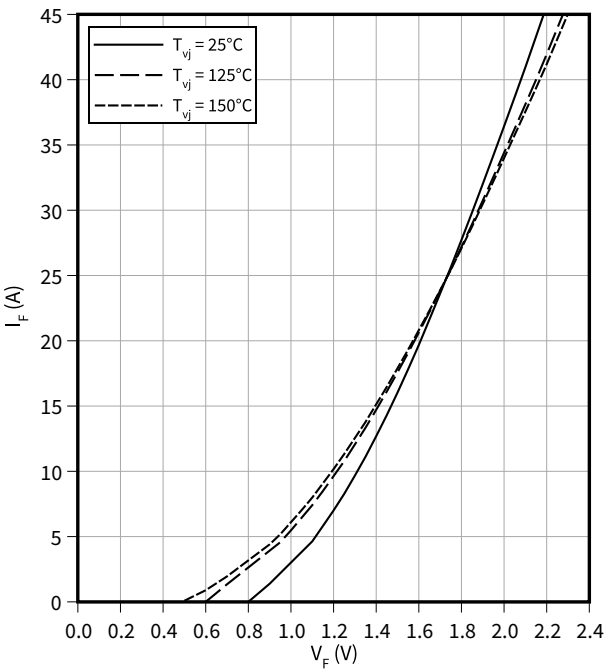
$I_C = f(V_{CE})$

$V_{GE} = 15\text{ V}$



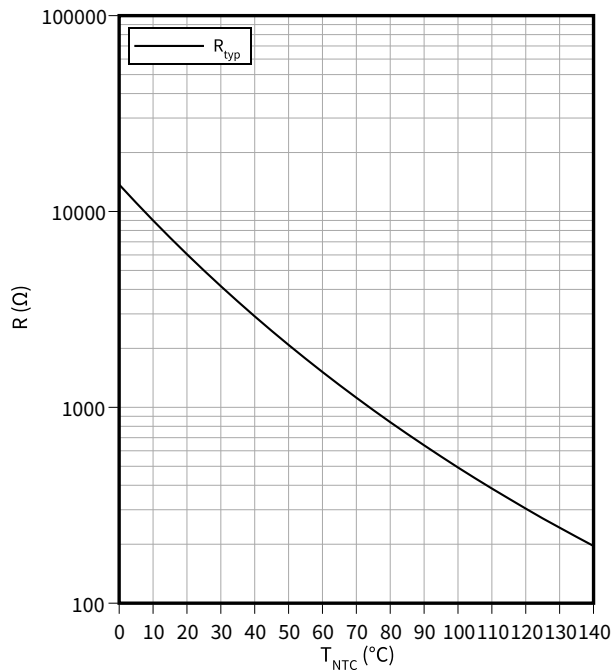
Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 **Circuit diagram**

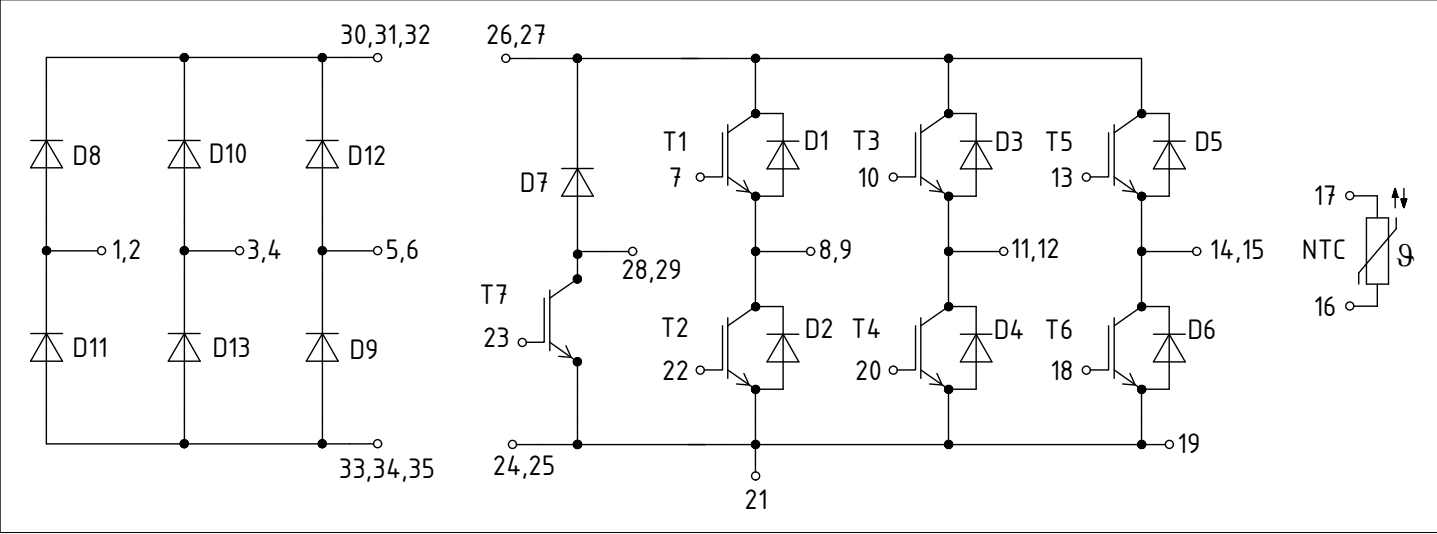


Figure 1



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	 7154914284655054991153071549142846550549911530		

Figure 3

Revision history

Revision history

Document revision	Date of release	Description of changes
V2.0	2007-11-12	Preliminary 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	2024-08-02	Final datasheet

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