

EconoPIM™3 module with Trench/Fieldstop IGBT4 and emitter controlled 4 diode and NTC / pre-applied thermal interface material

Features

- Electrical features
 - $V_{CES} = 1200\text{ V}$
 - $I_{C\text{ nom}} = 150\text{ A} / I_{CRM} = 300\text{ A}$
 - Low $V_{CE,sat}$
 - $T_{vj,op} = 150^{\circ}\text{C}$
 - $V_{CE,sat}$ with positive temperature coefficient
- Mechanical features
 - High power density
 - Integrated NTC temperature sensor
 - Copper base plate
 - Solder contact technology
 - Standard housing
 - Pre-applied thermal interface material



Typical appearance

Potential applications

- Auxiliary inverters
- Motor drives
- Servo drives

Product validation

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

Description

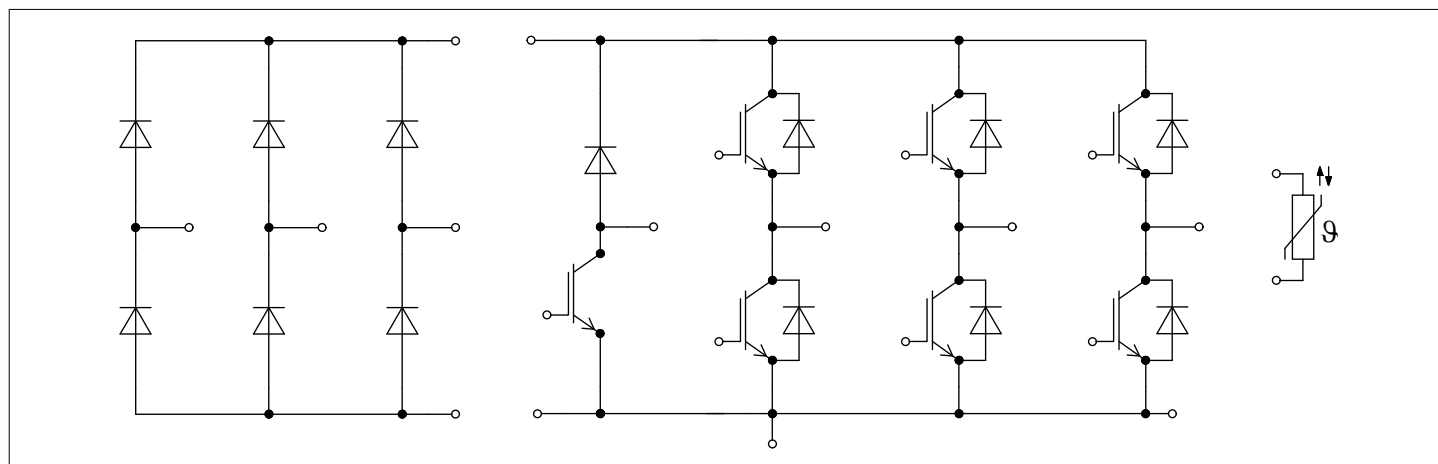


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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	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	

Table 2 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Stray inductance module	L_{sCE}			25		nH
Module lead resistance, terminals - chip	$R_{CC'+EE'}$	$T_H = 25 \text{ °C}$, per switch		1.1		mΩ
Storage temperature	T_{stg}		-40		125	°C
Maximum baseplate operation temperature	T_{BPmax}				125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M5, Screw	3	6	Nm
Weight	G			300		g

Note: Storage and shipment of modules with TIM => see AN2012-07

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}	$T_{vj \text{ max}} = 175 \text{ °C}$ $T_H = 75 \text{ °C}$	150	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj \text{ op}}$	300	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}	$I_C = 5.7\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.25	5.80	6.35	V
Gate charge	Q_G	$V_{GE} = \pm 15\ V$			1.2		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\ ^\circ C$			5		Ω
Input capacitance	C_{ies}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			9.35		nF
Reverse transfer capacitance	C_{res}	$f = 1000\ kHz, T_{vj} = 25\ ^\circ C, V_{CE} = 25\ V, V_{GE} = 0\ V$			0.41		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}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 6.8\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.160		μs
			$T_{vj} = 125\ ^\circ C$		0.190		
			$T_{vj} = 150\ ^\circ C$		0.190		
Rise time (inductive load)	t_r	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 6.8\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.070		μs
			$T_{vj} = 125\ ^\circ C$		0.080		
			$T_{vj} = 150\ ^\circ C$		0.080		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.8\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.420		μs
			$T_{vj} = 125\ ^\circ C$		0.480		
			$T_{vj} = 150\ ^\circ C$		0.530		
Fall time (inductive load)	t_f	$I_C = 150\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 6.8\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.100		μs
			$T_{vj} = 125\ ^\circ C$		0.190		
			$T_{vj} = 150\ ^\circ C$		0.220		
Turn-on energy loss per pulse	E_{on}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 6.8\ \Omega, di/dt = 1600\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		22		mJ
			$T_{vj} = 125\ ^\circ C$		28.5		
			$T_{vj} = 150\ ^\circ C$		30.5		
Turn-off energy loss per pulse	E_{off}	$I_C = 150\ A, V_{CC} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 6.8\ \Omega, dv/dt = 3600\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		9.8		mJ
			$T_{vj} = 125\ ^\circ C$		15		
			$T_{vj} = 150\ ^\circ C$		17		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} * di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		540		A

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material			0.250	K/W
Temperature under switching conditions	$T_{vj\ op}$		-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}		$T_{vj} = 25\ ^\circ\text{C}$	1200	V
Continuous DC forward current	I_F			150	A
Repetitive peak forward current	I_{FRM}	$t_p = 1\ \text{ms}$		300	A
I^2t - value	I^2t	$t_p = 10\ \text{ms}, V_R = 0\ \text{V}$	$T_{vj} = 125\ ^\circ\text{C}$	3050	A^2s
			$T_{vj} = 150\ ^\circ\text{C}$	2950	

Table 6 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150\ \text{A}, V_{GE} = 0\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$	1.70	2.15	V
			$T_{vj} = 125\ ^\circ\text{C}$	1.65		
			$T_{vj} = 150\ ^\circ\text{C}$	1.65		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600\ \text{V}, I_F = 150\ \text{A}, V_{GE} = -15\ \text{V}, -di_F/dt = 1600\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	57		A
			$T_{vj} = 125\ ^\circ\text{C}$	73		
			$T_{vj} = 150\ ^\circ\text{C}$	78		
Recovered charge	Q_r	$V_{CC} = 600\ \text{V}, I_F = 150\ \text{A}, V_{GE} = -15\ \text{V}, -di_F/dt = 1600\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	9.8		μC
			$T_{vj} = 125\ ^\circ\text{C}$	19.5		
			$T_{vj} = 150\ ^\circ\text{C}$	22		
Reverse recovery energy	E_{rec}	$V_{CC} = 600\ \text{V}, I_F = 150\ \text{A}, V_{GE} = -15\ \text{V}, -di_F/dt = 1600\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	2.6		mJ
			$T_{vj} = 125\ ^\circ\text{C}$	5.2		
			$T_{vj} = 150\ ^\circ\text{C}$	6.2		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			0.407	K/W

(table continues...)

Table 6 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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}		$T_{vj} = 25\,^{\circ}\text{C}$	1600	V
Maximum RMS forward current per chip	I_{FRMSM}	$T_H = 100\,^{\circ}\text{C}$		150	A
Maximum RMS current at rectifier output	I_{RMSM}	$T_H = 100\,^{\circ}\text{C}$		150	A
Surge forward current	I_{FSM}	$t_p = 10\,\text{ms}$	$T_{vj} = 25\,^{\circ}\text{C}$	1600	A
			$T_{vj} = 150\,^{\circ}\text{C}$	1400	
I^2t - value	I^2t	$t_p = 10\,\text{ms}$	$T_{vj} = 25\,^{\circ}\text{C}$	13000	A^2s
			$T_{vj} = 150\,^{\circ}\text{C}$	9800	

Table 8 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 150\,\text{A}$		$T_{vj} = 150\,^{\circ}\text{C}$	1.00	V
Reverse current	I_r	$T_{vj} = 150\,^{\circ}\text{C}$, $V_R = 1600\,\text{V}$		1		mA
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			0.356	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}		$T_{vj} = 25\,^{\circ}\text{C}$	1200	V
Continuous DC collector current	I_{CDC}	$T_{vj\,max} = 175\,^{\circ}\text{C}$	$T_H = 90\,^{\circ}\text{C}$	100	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\,op}$		200	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	$V_{CE\ sat}$	$I_C = 100\ A, V_{GE} = 15\ V$	$T_{vj} = 25\ ^\circ C$		1.75	2.10	V
			$T_{vj} = 125\ ^\circ C$		2.05		
			$T_{vj} = 150\ ^\circ C$		2.10		
Gate threshold voltage	V_{GETh}	$I_C = 3.8\ mA, V_{CE} = V_{GE}, T_{vj} = 25\ ^\circ C$		5.25	5.80	6.35	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}	$I_C = 100\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.150		μs
			$T_{vj} = 125\ ^\circ C$		0.160		
			$T_{vj} = 150\ ^\circ C$		0.160		
Rise time (inductive load)	t_r	$I_C = 100\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		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}	$I_C = 100\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.310		μs
			$T_{vj} = 125\ ^\circ C$		0.350		
			$T_{vj} = 150\ ^\circ C$		0.370		
Fall time (inductive load)	t_f	$I_C = 100\ A, V_{CC} = 600\ V, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega$	$T_{vj} = 25\ ^\circ C$		0.100		μs
			$T_{vj} = 125\ ^\circ C$		0.160		
			$T_{vj} = 150\ ^\circ C$		0.210		
Turn-on energy loss per pulse	E_{on}	$I_C = 100\ A, V_{CC} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Gon} = 1.6\ \Omega, di/dt = 2300\ A/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		6.1		mJ
			$T_{vj} = 125\ ^\circ C$		9		
			$T_{vj} = 150\ ^\circ C$		9.7		
Turn-off energy loss per pulse	E_{off}	$I_C = 100\ A, V_{CC} = 600\ V, L_\sigma = 35\ nH, V_{GE} = \pm 15\ V, R_{Goff} = 1.6\ \Omega, dv/dt = 3700\ V/\mu s (T_{vj} = 150\ ^\circ C)$	$T_{vj} = 25\ ^\circ C$		6.1		mJ
			$T_{vj} = 125\ ^\circ C$		9.2		
			$T_{vj} = 150\ ^\circ C$		10		
SC data	I_{SC}	$V_{GE} \leq 15\ V, V_{CC} = 800\ V, V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_P \leq 10\ \mu s, T_{vj} = 150\ ^\circ C$		360		A

(table continues...)

Table 10 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Thermal resistance, junction to heat sink	R_{thJH}	per IGBT, Valid with IFX pre-applied Thermal Interface Material			0.308	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}		$T_{vj} = 25\ ^\circ\text{C}$	1200	V
Continuous DC forward current	I_F			50	A
Repetitive peak forward current	I_{FRM}	$t_p = 1\ \text{ms}$		100	A
I^2t - value	I^2t	$t_p = 10\ \text{ms}, V_R = 0\ \text{V}$	$T_{vj} = 125\ ^\circ\text{C}$	560	A^2s
			$T_{vj} = 150\ ^\circ\text{C}$	475	

Table 12 Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 50\ \text{A}, V_{GE} = 0\ \text{V}$	$T_{vj} = 25\ ^\circ\text{C}$	1.70	2.15	V
			$T_{vj} = 125\ ^\circ\text{C}$	1.65		
			$T_{vj} = 150\ ^\circ\text{C}$	1.65		
Peak reverse recovery current	I_{RM}	$V_{CC} = 600\ \text{V}, I_F = 50\ \text{A}, V_{GE} = 15\ \text{V}, -di_F/dt = 2300\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	76		A
			$T_{vj} = 125\ ^\circ\text{C}$	77		
			$T_{vj} = 150\ ^\circ\text{C}$	77		
Recovered charge	Q_r	$V_{CC} = 600\ \text{V}, I_F = 50\ \text{A}, V_{GE} = 15\ \text{V}, -di_F/dt = 2300\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	5.7		μC
			$T_{vj} = 125\ ^\circ\text{C}$	9.4		
			$T_{vj} = 150\ ^\circ\text{C}$	10.5		
Reverse recovery energy	E_{rec}	$V_{CC} = 600\ \text{V}, I_F = 50\ \text{A}, V_{GE} = 15\ \text{V}, -di_F/dt = 2300\ \text{A}/\mu\text{s} (T_{vj} = 150\ ^\circ\text{C})$	$T_{vj} = 25\ ^\circ\text{C}$	2		mJ
			$T_{vj} = 125\ ^\circ\text{C}$	3.5		
			$T_{vj} = 150\ ^\circ\text{C}$	3.8		
Thermal resistance, junction to heat sink	R_{thJH}	per diode, Valid with IFX pre-applied Thermal Interface Material			0.810	K/W

(table continues...)

Table 12 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
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}	$T_{NTC} = 25\,^{\circ}\text{C}$		5		kΩ
Deviation of R_{100}	$\Delta R/R$	$T_{NTC} = 100\,^{\circ}\text{C}$, $R_{100} = 493\,\Omega$	-5		5	%
Power dissipation	P_{25}	$T_{NTC} = 25\,^{\circ}\text{C}$			20	mW
B-value	$B_{25/50}$	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15\,\text{K}))]$		3375		K
B-value	$B_{25/80}$	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15\,\text{K}))]$		3411		K
B-value	$B_{25/100}$	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15\,\text{K}))]$		3433		K

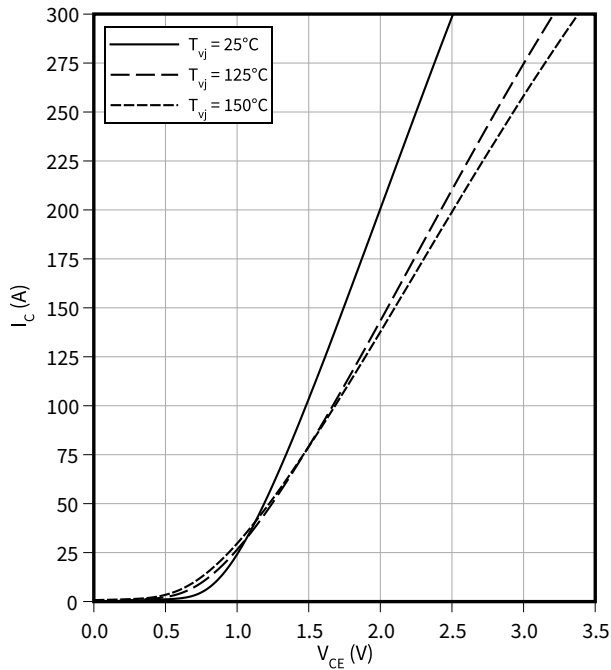
Note: Specification according to the valid application note.

8 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

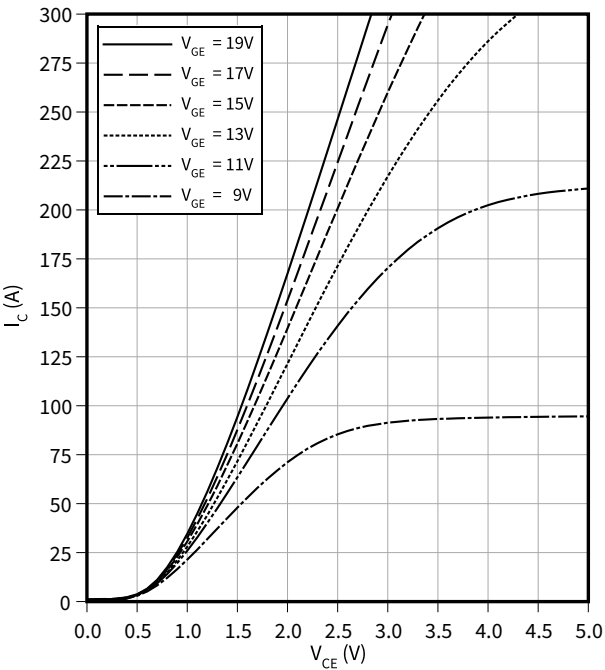
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

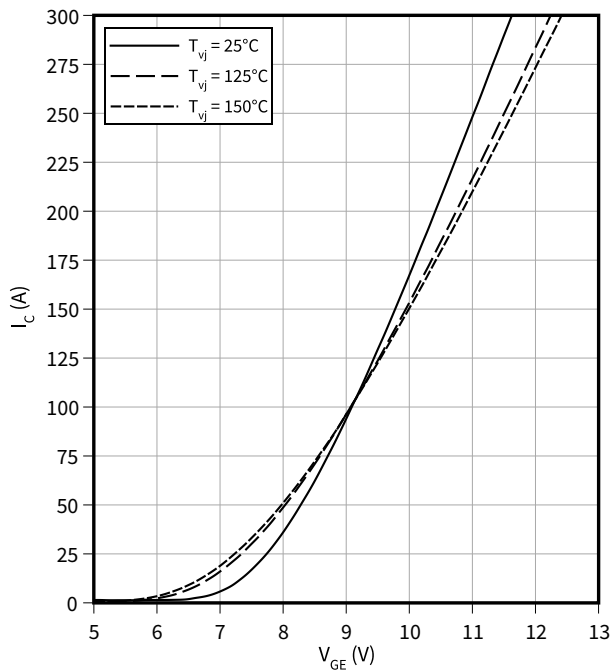
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

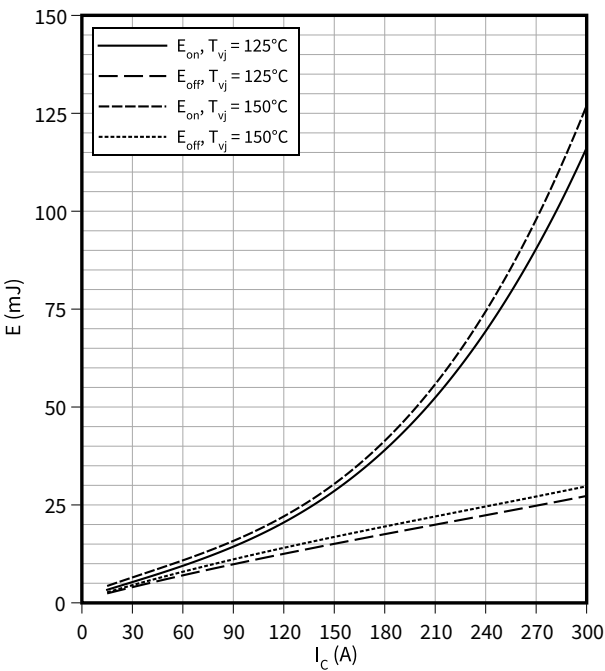
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Inverter

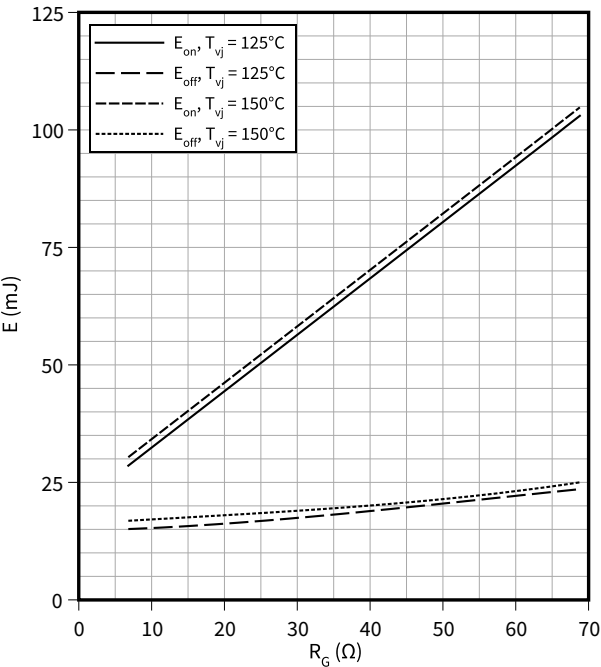
$E = f(I_C)$

$V_{CC} = 600\text{ V}, R_{Goff} = 6.8\text{ }\Omega, R_{Gon} = 6.8\text{ }\Omega, V_{GE} = \pm 15\text{ V}$



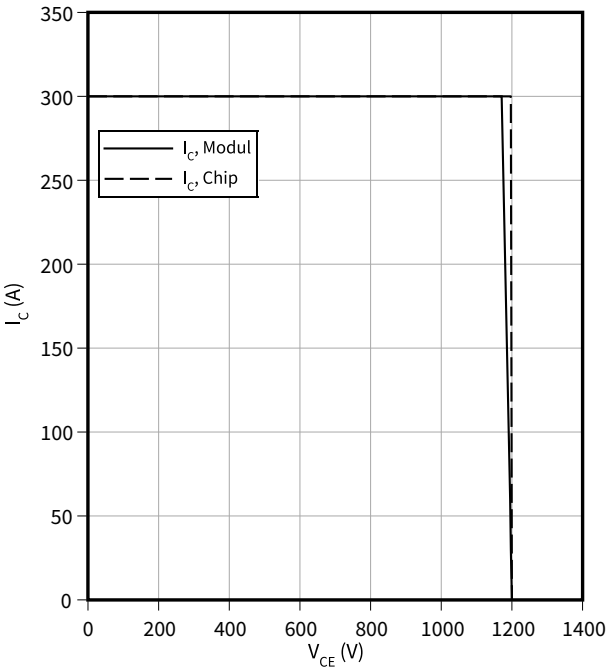
Switching losses (typical), IGBT, Inverter

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



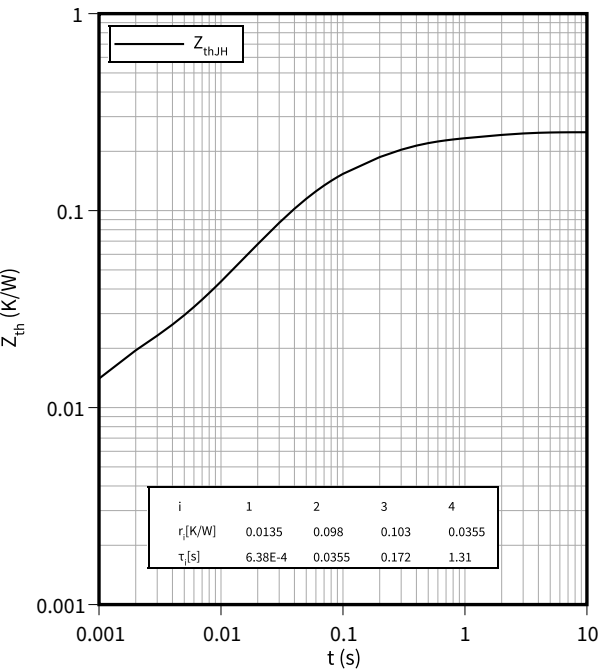
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 6.8\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



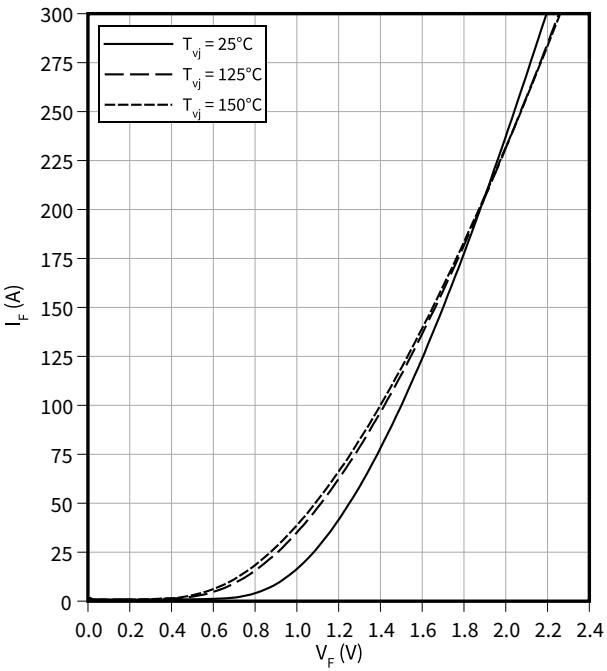
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

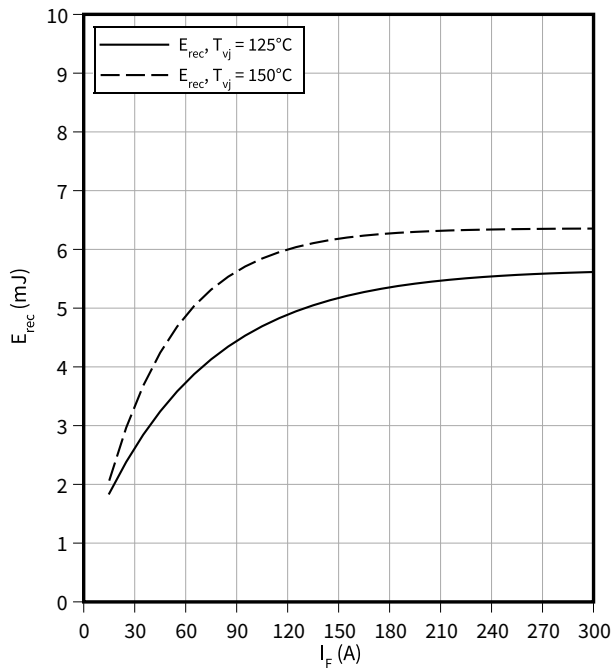
$I_F = f(V_F)$



8 Characteristics diagrams

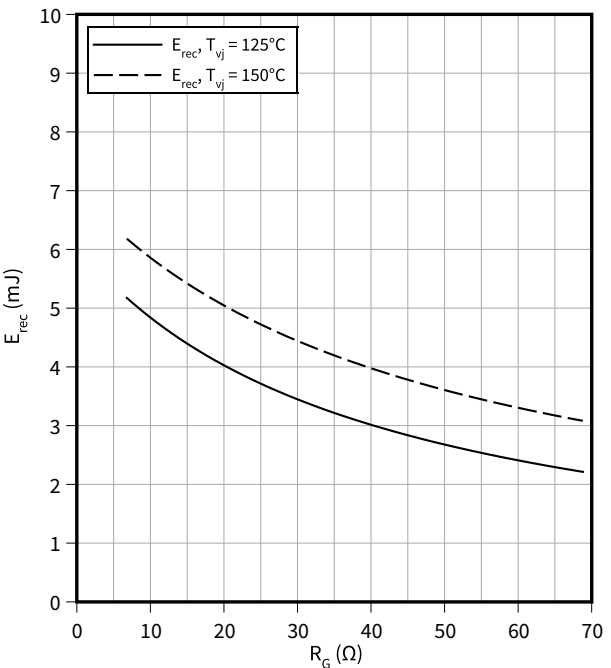
Switching losses (typical), Diode, Inverter

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



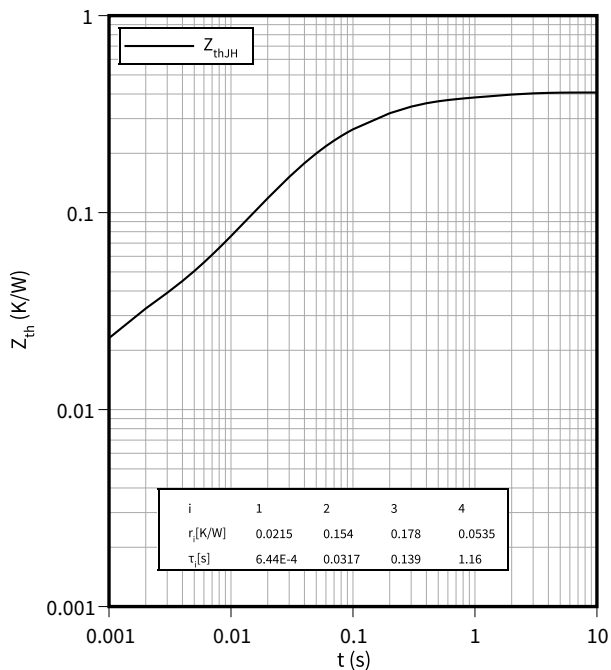
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $V_{CE} = 600\text{ V}, I_F = 150\text{ A}$



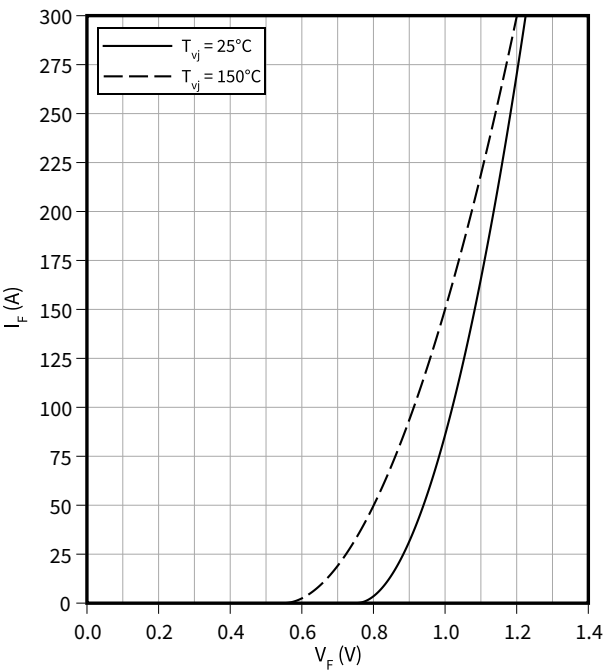
Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Rectifier

$I_F = f(V_F)$

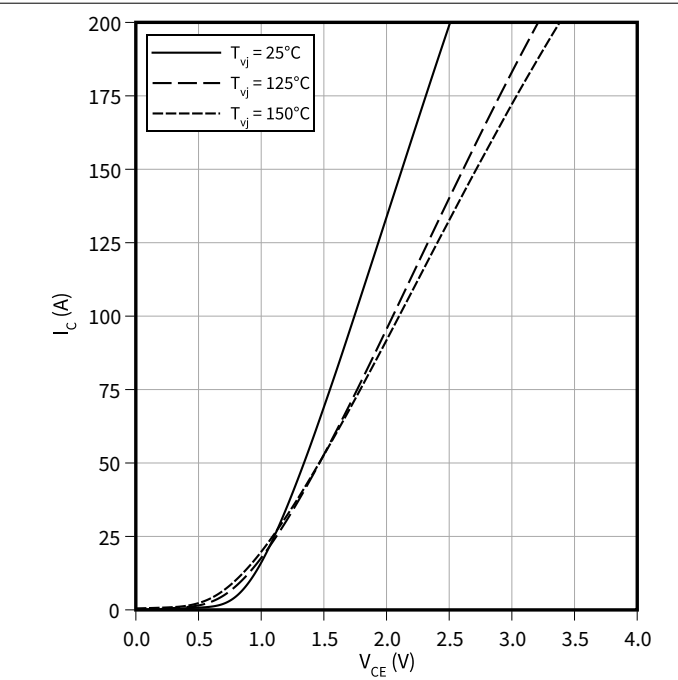


8 Characteristics diagrams

Output characteristic (typical), IGBT, Brake-Chopper

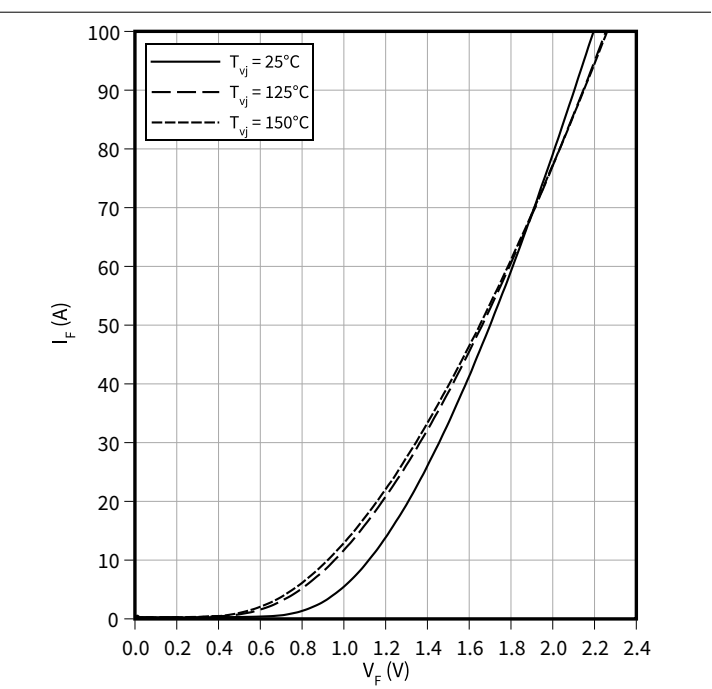
$I_C = f(V_{CE})$

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



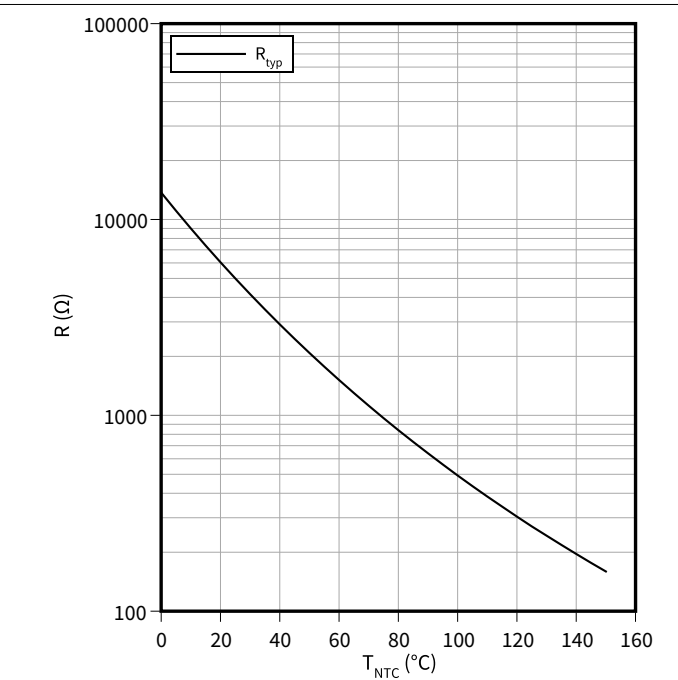
Forward characteristic (typical), Diode, Brake-Chopper

$I_F = f(V_F)$



Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



9 Circuit diagram

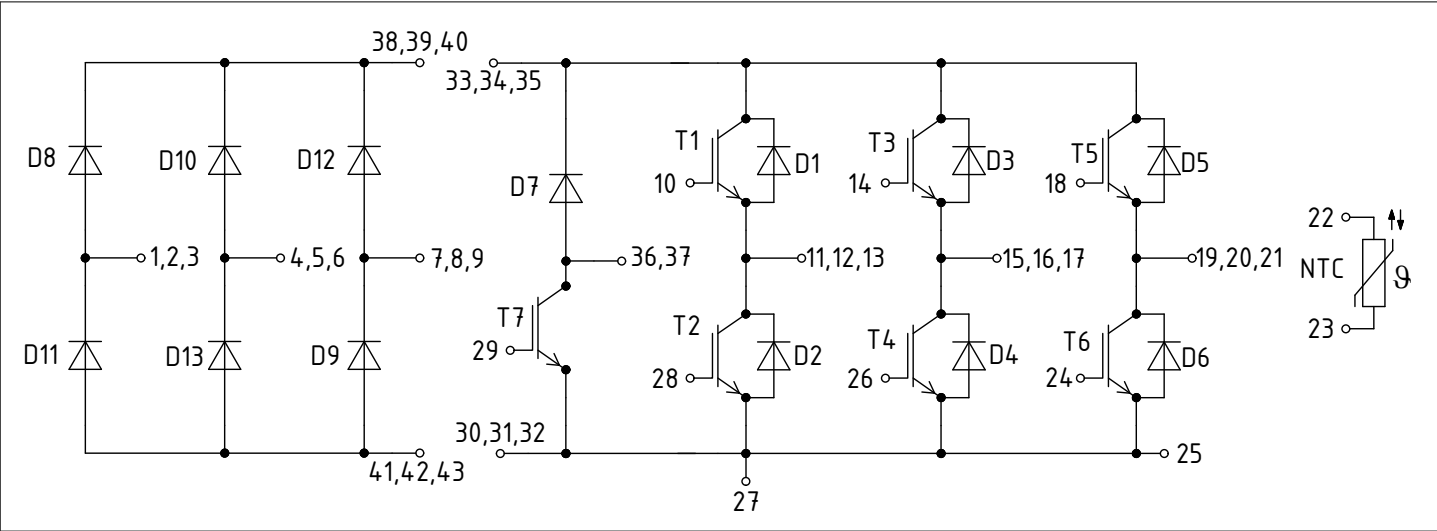


Figure 1

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	 7154914284655054991153071549142846550549911530		

Figure 3



Revision history

Revision history

Document revision	Date of release	Description of changes
V3.0	2017-04-21	Final datasheet
V3.1	2017-08-21	Final 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
1.10	2024-08-27	Final datasheet

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