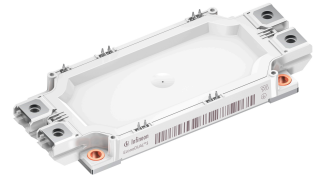


Final datasheet

EconoDUAL™3 module with Trench/Fieldstop IGBT4 and emitter controlled 3 diode

Features

- Electrical features
 - $V_{CES} = 1700\text{ V}$
 - $I_{C\text{ nom}} = 250\text{ A} / I_{CRM} = 500\text{ A}$
 - $V_{CE,sat}$ with positive temperature coefficient
 - Trench IGBT 4
 - Low $V_{CE,sat}$
 - High short-circuit capability
 - High DC stability
 - $T_{vj,op} = 150^{\circ}\text{C}$
- Mechanical features
 - Al_2O_3 substrate with low thermal resistance
 - High power density
 - Isolated base plate
 - PressFIT contact technology



Potential applications

- Wind turbines
- Medium-voltage converters
- High-power converters

Product validation

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

Description

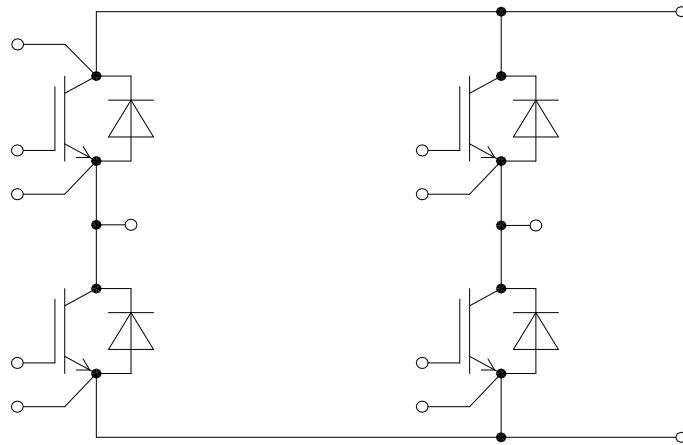




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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	3.4	kV
Material of module baseplate			Cu	
Internal isolation		basic insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance	$d_{Creep \text{ nom}}$	terminal to baseplate, nom., (PD2, IEC 60664-1, Ed. 3.0)	> 15	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to baseplate, min., (PD2, IEC 60664-1, Ed. 3.0)	14.7	mm
Creepage distance	$d_{Creep \text{ nom}}$	terminal to terminal, nom., (PD2, IEC 60664-1, Ed. 3.0)	12.1	mm
Creepage distance	$d_{Creep \text{ min}}$	terminal to terminal, min., (PD2, IEC 60664-1, Ed. 3.0)	11.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to baseplate, nom.	> 12.5	mm
Clearance	$d_{Clear \text{ min}}$	terminal to baseplate, min.	12.5	mm
Clearance	$d_{Clear \text{ nom}}$	terminal to terminal, nom.	10.0	mm
Clearance	$d_{Clear \text{ min}}$	terminal to terminal, min.	9.6	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}			26		nH
Storage temperature	T_{stg}		-40		125	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	3		6	Nm
Terminal connection torque	M	- Mounting according to valid application note	3		6	Nm
Weight	G			345		g

Note: The labels AC and DC on the housing do not have relevance.

2 IGBT, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition		Values	Unit
Collector-emitter voltage	V_{CES}		$T_{vj} = 25\text{ °C}$	1700	V
Continuous DC collector current	I_{CDC}	$T_{vj\text{ max}} = 175\text{ °C}$	$T_C = 100\text{ °C}$	250	A
Repetitive peak collector current	I_{CRM}	t_p limited by $T_{vj\text{ op}}$		500	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	$V_{CE\text{ sat}}$	$I_C = 250\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25\text{ °C}$		1.80	2.30	V
			$T_{vj} = 125\text{ °C}$		2.15		
			$T_{vj} = 150\text{ °C}$		2.30		
Gate threshold voltage	V_{GETh}	$I_C = 9.4\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25\text{ °C}$		5.20	5.80	6.40	V
Gate charge	Q_G	$V_{GE} = \pm 15\text{ V}$			2.25		μC
Internal gate resistor	R_{Gint}	$T_{vj} = 25\text{ °C}$			5.8		Ω
Input capacitance	C_{ies}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			21		nF
Reverse transfer capacitance	C_{res}	$f = 1000\text{ kHz}$, $T_{vj} = 25\text{ °C}$, $V_{CE} = 25\text{ V}$, $V_{GE} = 0\text{ V}$			0.68		nF
Collector-emitter cut-off current	I_{CES}	$V_{CE} = 1700\text{ V}$, $V_{GE} = 0\text{ V}$	$T_{vj} = 25\text{ °C}$			3	mA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = 20\text{ V}$, $T_{vj} = 25\text{ °C}$				400	nA
Turn-on delay time (inductive load)	t_{don}	$I_C = 250\text{ A}$, $V_{CC} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.360		μs
			$T_{vj} = 125\text{ °C}$		0.400		
			$T_{vj} = 150\text{ °C}$		0.400		
Rise time (inductive load)	t_r	$I_C = 250\text{ A}$, $V_{CC} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.070		μs
			$T_{vj} = 125\text{ °C}$		0.080		
			$T_{vj} = 150\text{ °C}$		0.080		
Turn-off delay time (inductive load)	t_{doff}	$I_C = 250\text{ A}$, $V_{CC} = 900\text{ V}$, $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 1\text{ }\Omega$	$T_{vj} = 25\text{ °C}$		0.630		μs
			$T_{vj} = 125\text{ °C}$		0.780		
			$T_{vj} = 150\text{ °C}$		0.820		

(table continues...)

Table 4 (continued) Characteristic values

Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Fall time (inductive load)	t_f	$I_C = 250 \text{ A}$, $V_{CC} = 900 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 1 \Omega$	$T_{vj} = 25 \text{ °C}$	0.150		μs
			$T_{vj} = 125 \text{ °C}$	0.200		
			$T_{vj} = 150 \text{ °C}$	0.210		
Turn-on energy loss per pulse	E_{on}	$I_C = 250 \text{ A}$, $V_{CC} = 900 \text{ V}$, $L_\sigma = 35 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Gon} = 1 \Omega$, $di/dt = 2700 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	77		mJ
			$T_{vj} = 125 \text{ °C}$	105		
			$T_{vj} = 150 \text{ °C}$	115		
Turn-off energy loss per pulse	E_{off}	$I_C = 250 \text{ A}$, $V_{CC} = 900 \text{ V}$, $L_\sigma = 35 \text{ nH}$, $V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 1 \Omega$, $dv/dt = 2600 \text{ V}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	79		mJ
			$T_{vj} = 125 \text{ °C}$	110		
			$T_{vj} = 150 \text{ °C}$	120		
SC data	I_{SC}	$V_{GE} \leq 15 \text{ V}$, $V_{CC} = 1000 \text{ V}$, $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt$	$t_p \leq 10 \mu\text{s}$, $T_{vj} = 150 \text{ °C}$	1300		A
Thermal resistance, junction to case	R_{thJC}	per IGBT			0.101	K/W
Thermal resistance, case to heat sink	R_{thCH}	per IGBT, $\lambda_{grease} = 1 \text{ W}/(\text{m} \cdot \text{K})$		0.0800		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}		$T_{vj} = 25 \text{ °C}$	1700	V
Continuous DC forward current	I_F			250	A
Repetitive peak forward current	I_{FRM}	$t_p = 1 \text{ ms}$		500	A
I^2t - value	I^2t	$t_p = 10 \text{ ms}$, $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	11000	A^2s
			$T_{vj} = 150 \text{ °C}$	10000	

Table 6 **Characteristic values**

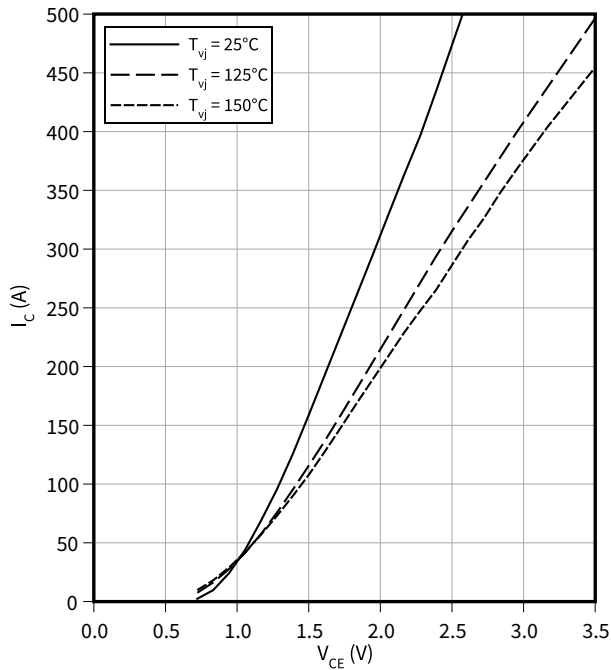
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 250 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	1.80	2.55	V
			$T_{vj} = 125 \text{ °C}$	1.85		
			$T_{vj} = 150 \text{ °C}$	1.85		
Peak reverse recovery current	I_{RM}	$V_{CC} = 900 \text{ V}$, $I_F = 250 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 2700 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	240		A
			$T_{vj} = 125 \text{ °C}$	250		
			$T_{vj} = 150 \text{ °C}$	255		
Recovered charge	Q_r	$V_{CC} = 900 \text{ V}$, $I_F = 250 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 2700 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	63		μC
			$T_{vj} = 125 \text{ °C}$	100		
			$T_{vj} = 150 \text{ °C}$	115		
Reverse recovery energy	E_{rec}	$V_{CC} = 900 \text{ V}$, $I_F = 250 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 2700 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	29.5		mJ
			$T_{vj} = 125 \text{ °C}$	52.5		
			$T_{vj} = 150 \text{ °C}$	60		
Thermal resistance, junction to case	R_{thJC}	per diode			0.215	K/W
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		0.126		K/W
Temperature under switching conditions	$T_{vj\text{ op}}$		-40		150	°C

4 Characteristics diagrams

Output characteristic (typical), IGBT, Inverter

$I_C = f(V_{CE})$

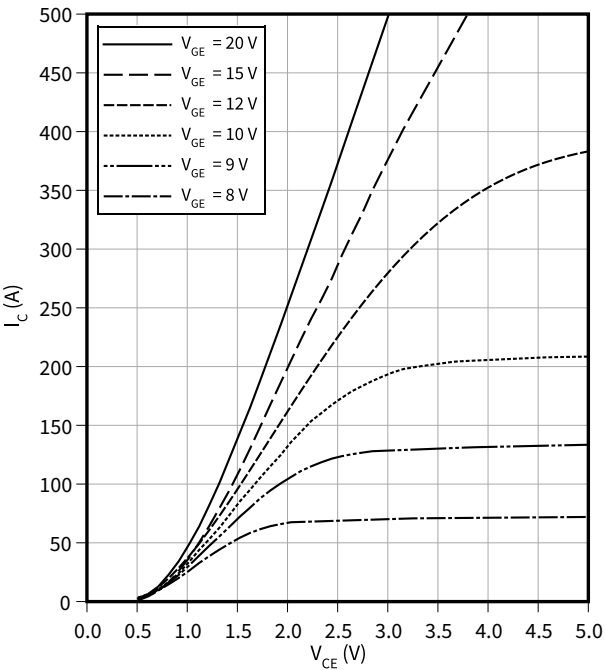
$V_{GE} = 15\text{ V}$



Output characteristic field (typical), IGBT, Inverter

$I_C = f(V_{CE})$

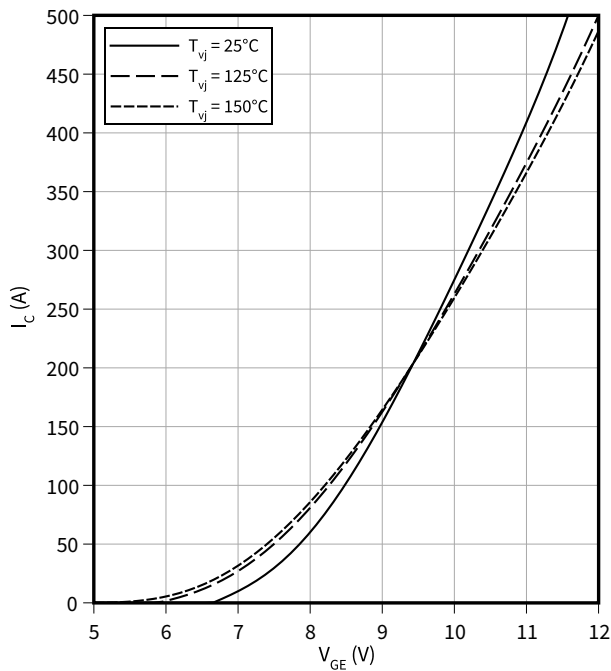
$T_{vj} = 150\text{ °C}$



Transfer characteristic (typical), IGBT, Inverter

$I_C = f(V_{GE})$

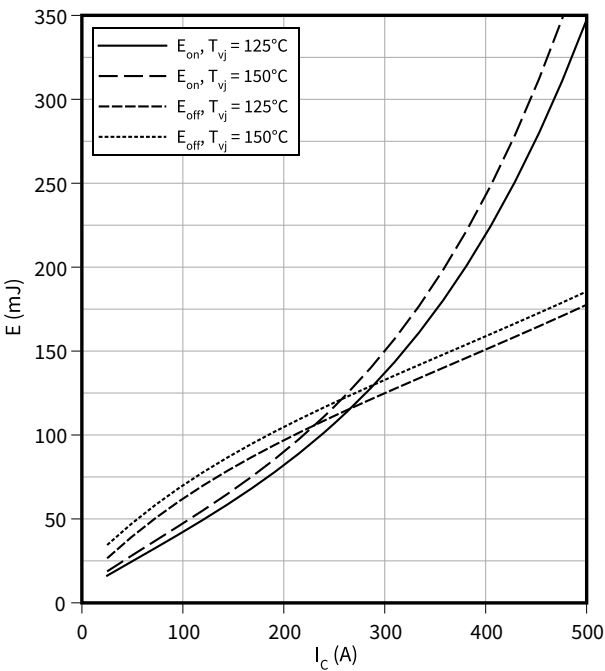
$V_{CE} = 20\text{ V}$



Switching losses (typical), IGBT, Inverter

$E = f(I_C)$

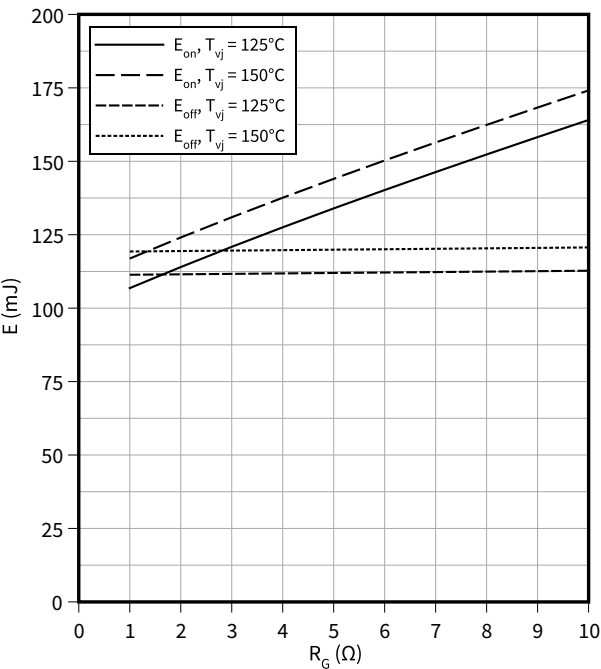
$V_{CC} = 900\text{ V}, R_{Goff} = 1\text{ }\Omega, R_{Gon} = 1\text{ }\Omega, V_{GE} = \pm 15\text{ V}$



4 Characteristics diagrams

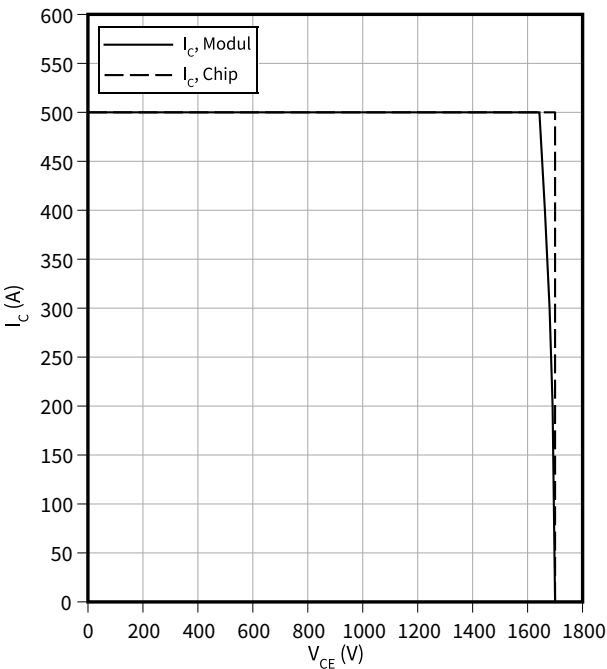
Switching losses (typical), IGBT, Inverter

$E = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 250\text{ A}$, $V_{CC} = 900\text{ V}$



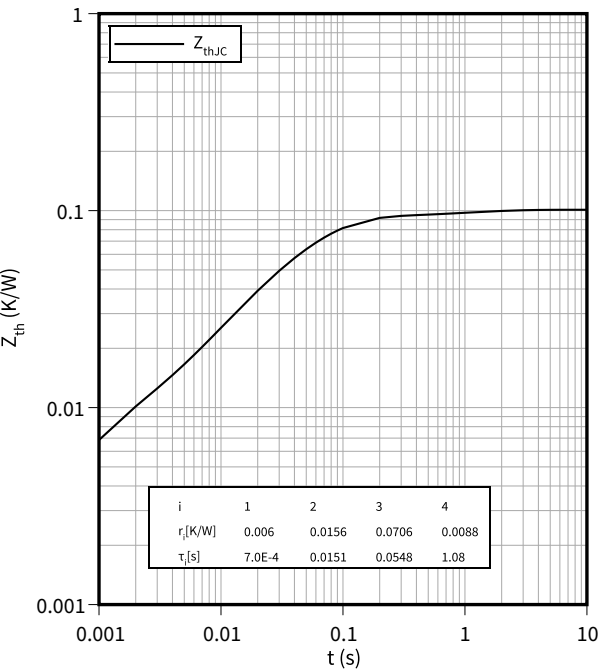
Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$
 $R_{Goff} = 1\text{ }\Omega$, $V_{GE} = \pm 15\text{ V}$, $T_{vj} = 150\text{ }^\circ\text{C}$



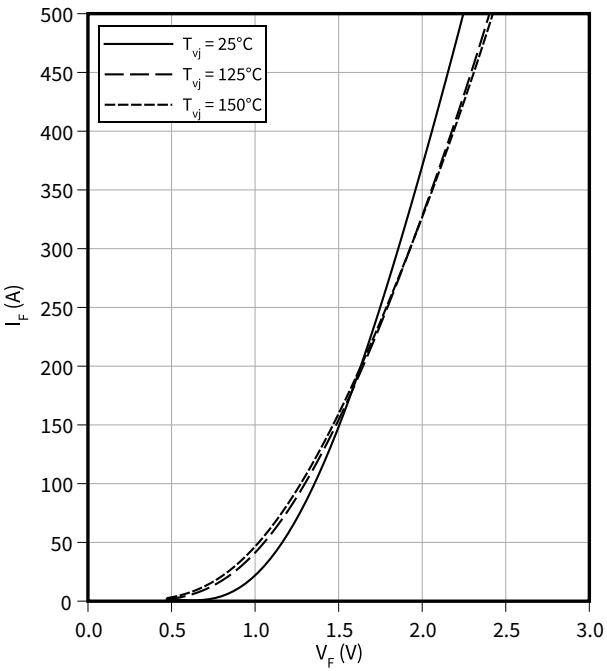
Transient thermal impedance, IGBT, Inverter

$Z_{th} = f(t)$



Forward characteristic (typical), Diode, Inverter

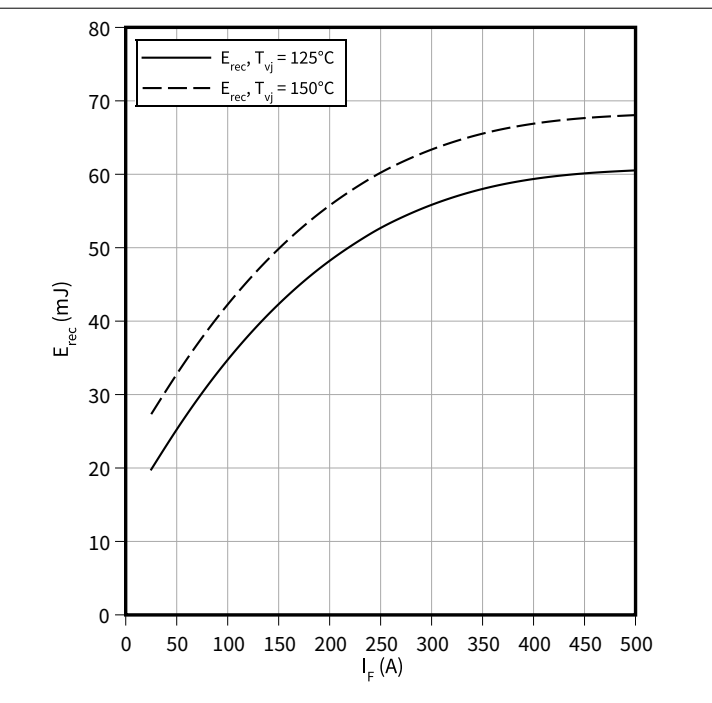
$I_F = f(V_F)$



4 Characteristics diagrams

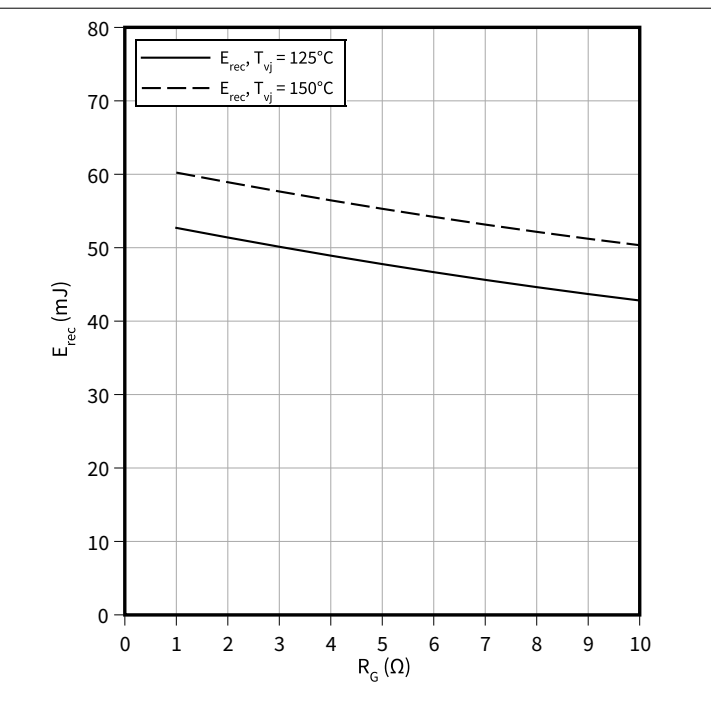
Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$
 $R_{Gon} = 1\ \Omega$, $V_{CC} = 900\ V$



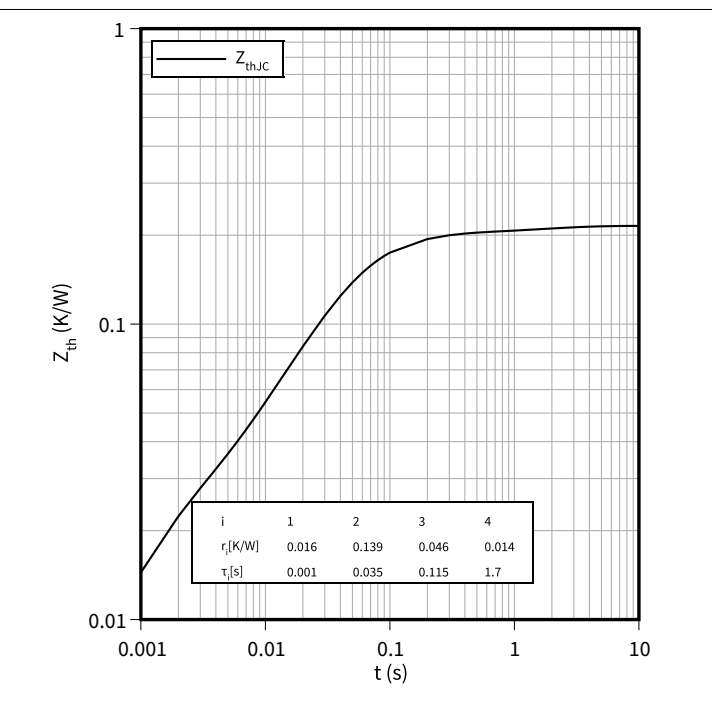
Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$
 $I_F = 250\ A$, $V_{CC} = 900\ V$



Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



5 Circuit diagram

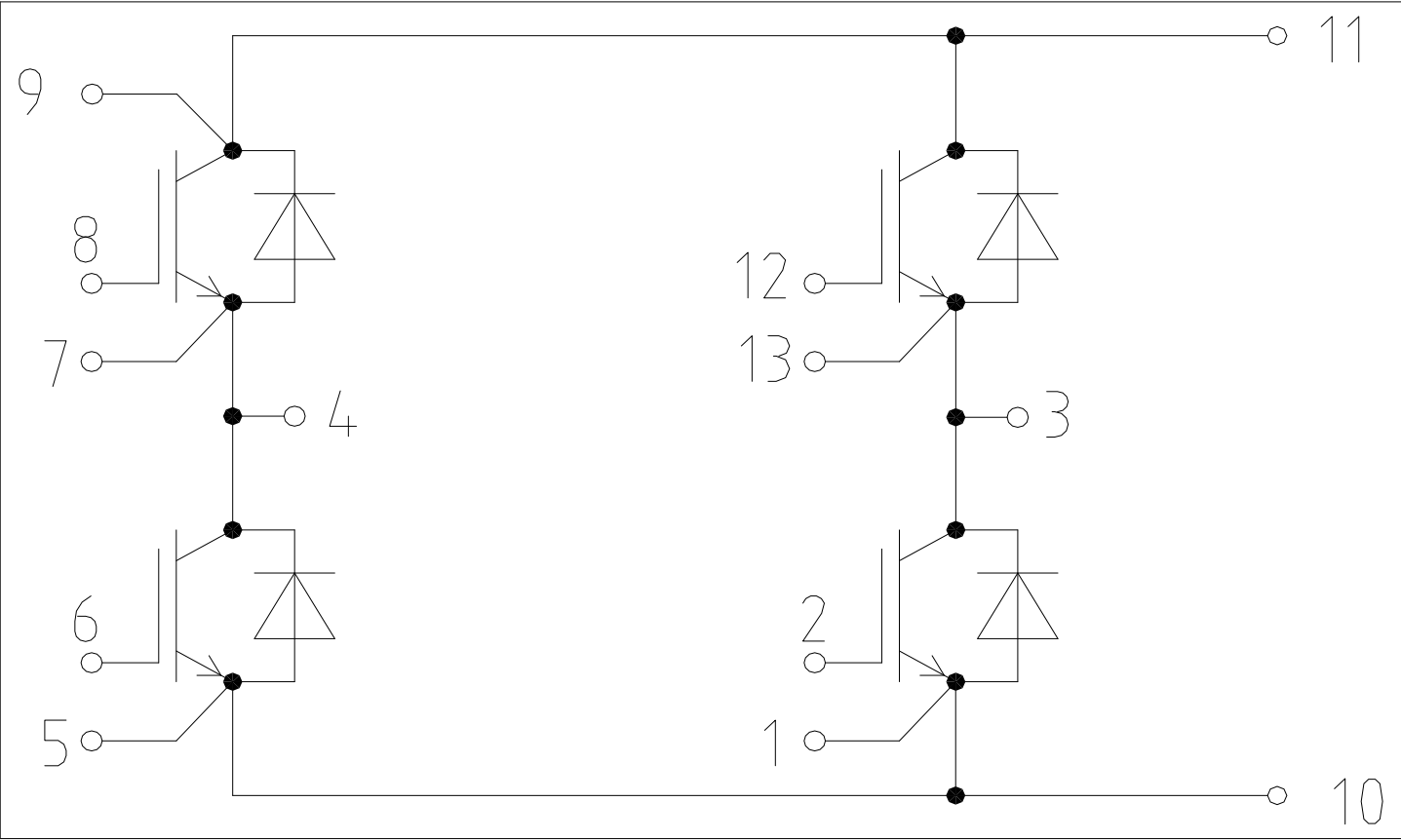


Figure 1



7 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	<i>Content</i>	<i>Digit</i>	<i>Example</i>
	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	2012-08-22	Target datasheet
V1.1	2012-12-19	Target datasheet
V1.2	2013-01-07	Target datasheet
V1.3	2014-07-22	Target datasheet
V1.4	2014-12-01	Target datasheet
V1.5	2015-12-02	Target datasheet
V3.0	2016-04-18	Final datasheet
V3.1	2017-09-07	Final datasheet
V3.2	2017-09-18	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	2024-03-18	Final datasheet

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