

XHP™3 module with Emitter Controlled 4 diode**Features**

- Electrical features
 - $V_R = 4500\text{ V}$
 - $I_F = 450\text{ A}$, $I_{FRM} = 900\text{ A}$
 - High dynamic robustness
- Mechanical features
 - Package with CTI > 600
 - AlSiC base plate for increased thermal cycling capability
 - High creepage and clearance distances
 - Housing material compliant with the classification R23 (HL3) of the EN45545-2 “Fire protection of railway vehicles”
 - Package with enhanced insulation of 10.4 kV AC 60 s

**Potential applications**

- Traction drives
- Medium-voltage converters

Product validation

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

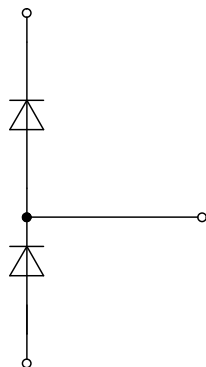
Description

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1 Package

Table 1 Insulation coordination

Parameter	Symbol	Note or test condition	Values	Unit
Isolation test voltage	V_{ISOL}	RMS, $f = 50 \text{ Hz}$, $t = 1 \text{ min}$	10.4	kV
Partial discharge extinction voltage	V_{isol}	RMS, $f = 50 \text{ Hz}$, $Q_{PD} \text{ typ. } 10 \text{ pC}$	5.1	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25 \text{ °C}$, 100 Fit	2900	V
Material of module baseplate			AlSiC	
Creepage distance	d_{Creep}	terminal to heatsink	53.0	mm
Creepage distance	d_{Creep}	terminal to terminal	53.0	mm
Clearance	d_{Clear}	terminal to heatsink	36.0	mm
Clearance	d_{Clear}	terminal to terminal	26.0	mm
Comparative tracking index	CTI		> 600	

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	$R_{AA'+CC'}$	$T_C = 25 \text{ °C}$, per switch		0.33		mΩ
Storage temperature	T_{stg}		-40		150	°C
Mounting torque for module mounting	M	- Mounting according to valid application note	M6, Screw	4.25	5.75	Nm
Terminal connection torque	M	- Mounting according to valid application note	M3, Screw	0.9	1.1	Nm
			M8, Screw	8	10	
Weight	G			700		g

2 Diode, Inverter

Table 3 Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
Repetitive peak reverse voltage	V_{RRM}	$T_{vj} = -40 \text{ °C}$	4500	V
		$T_{vj} = 150 \text{ °C}$	4500	
Continuous DC forward current	I_F		450	A
Repetitive peak forward current	I_{FRM}	$t_P = 1 \text{ ms}$	900	A

(table continues...)

Table 3 (continued) Maximum rated values

Parameter	Symbol	Note or test condition	Values	Unit
I^2t - value	I^2t	$t_p = 10 \text{ ms}$, $V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	kA^2s
			$T_{vj} = 150 \text{ °C}$	
Maximum power dissipation	P_{RQM}	$T_{vj} = 150 \text{ °C}$	1500	kW
Minimum turn-on time	t_{onmin}		10	μs

Table 4 Characteristic values

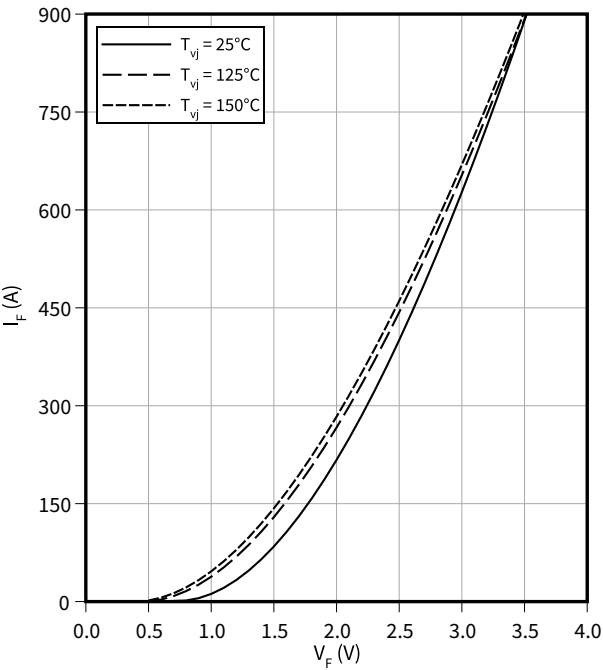
Parameter	Symbol	Note or test condition	Values			Unit
			Min.	Typ.	Max.	
Forward voltage	V_F	$I_F = 450 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$	2.60	3.05	V
			$T_{vj} = 125 \text{ °C}$	2.50	2.95	
			$T_{vj} = 150 \text{ °C}$	2.45	2.90	
Peak reverse recovery current	I_{RM}	$V_{CC} = 2800 \text{ V}$, $I_F = 450 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 4900 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	925		A
			$T_{vj} = 125 \text{ °C}$	920		
			$T_{vj} = 150 \text{ °C}$	920		
Recovered charge	Q_r	$V_{CC} = 2800 \text{ V}$, $I_F = 450 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 4900 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	405		μC
			$T_{vj} = 125 \text{ °C}$	780		
			$T_{vj} = 150 \text{ °C}$	900		
Reverse recovery energy	E_{rec}	$V_{CC} = 2800 \text{ V}$, $I_F = 450 \text{ A}$, $V_{GE} = -15 \text{ V}$, $-di_F/dt = 4900 \text{ A}/\mu\text{s}$ ($T_{vj} = 150 \text{ °C}$)	$T_{vj} = 25 \text{ °C}$	690		mJ
			$T_{vj} = 125 \text{ °C}$	1400		
			$T_{vj} = 150 \text{ °C}$	1650		
Thermal resistance, junction to case	R_{thJC}	per diode			44.9	K/kW
Thermal resistance, case to heat sink	R_{thCH}	per diode, $\lambda_{grease} = 1 \text{ W}/(\text{m}\cdot\text{K})$		19.8		K/kW
Temperature under switching conditions	$T_{vj op}$		-40		150	$^{\circ}\text{C}$

Note: Dynamic data valid in conjunction with FF450R45T3E4_B5 module

3 Characteristics diagrams

Forward characteristic (typical), Diode, Inverter

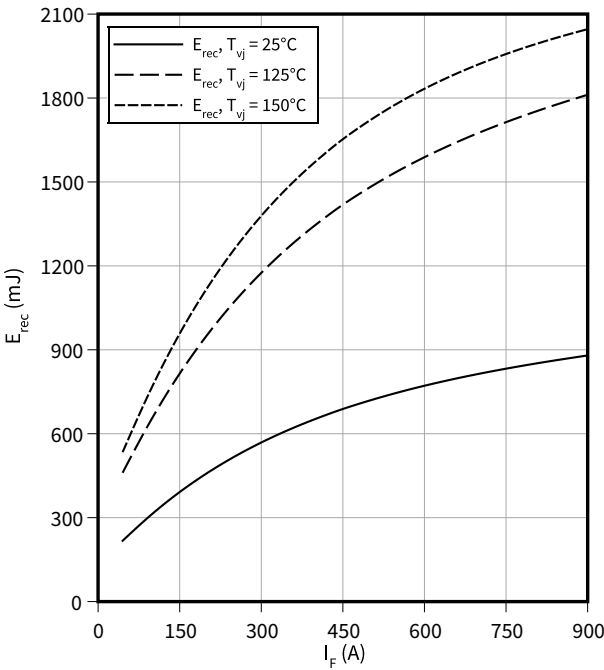
$I_F = f(V_F)$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(I_F)$

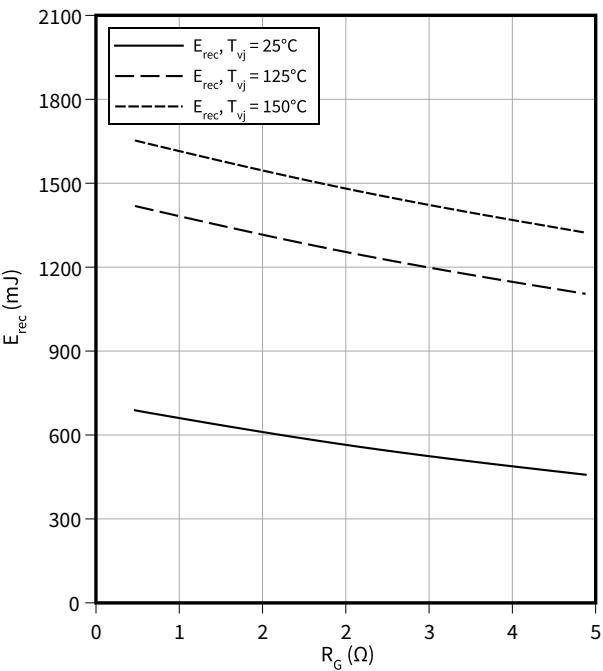
$R_{Gon} = 0.39 \Omega, V_{CE} = 2800 \text{ V}$



Switching losses (typical), Diode, Inverter

$E_{rec} = f(R_G)$

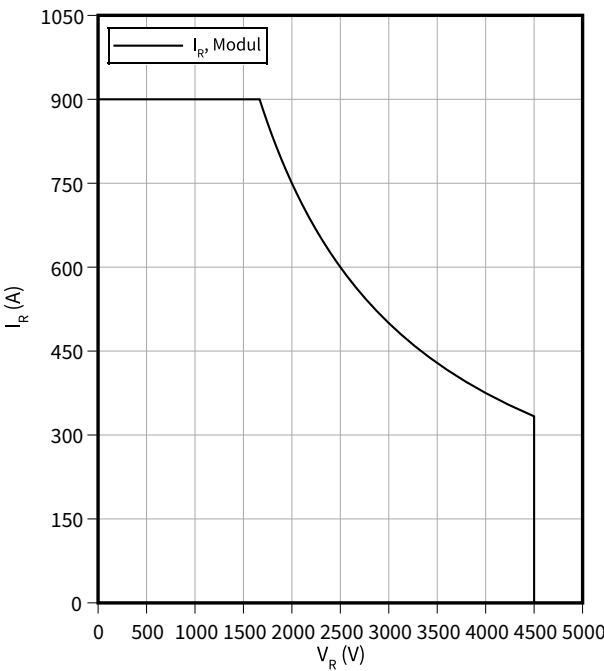
$V_{CE} = 2800 \text{ V}, I_F = 450 \text{ A}$



Safe operating area (SOA), Diode, Inverter

$I_R = f(V_R)$

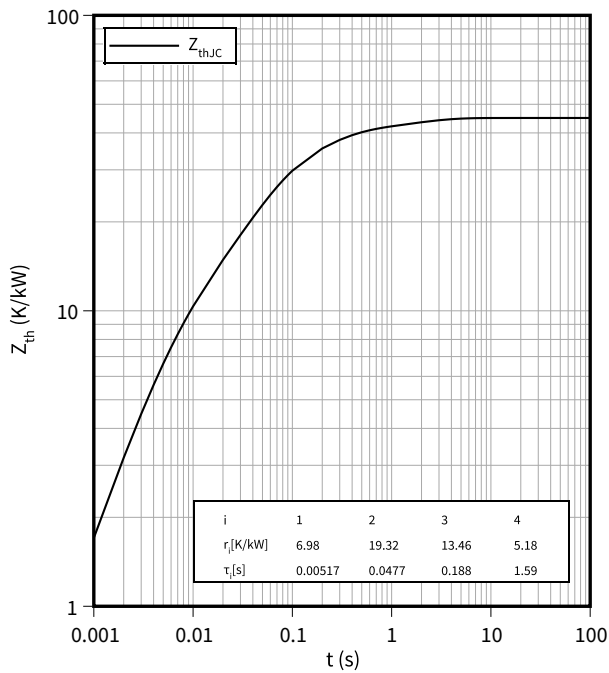
$T_{vj} = 150^\circ\text{C}$



3 Characteristics diagrams

Transient thermal impedance, Diode, Inverter

$Z_{th} = f(t)$



4 **Circuit diagram**

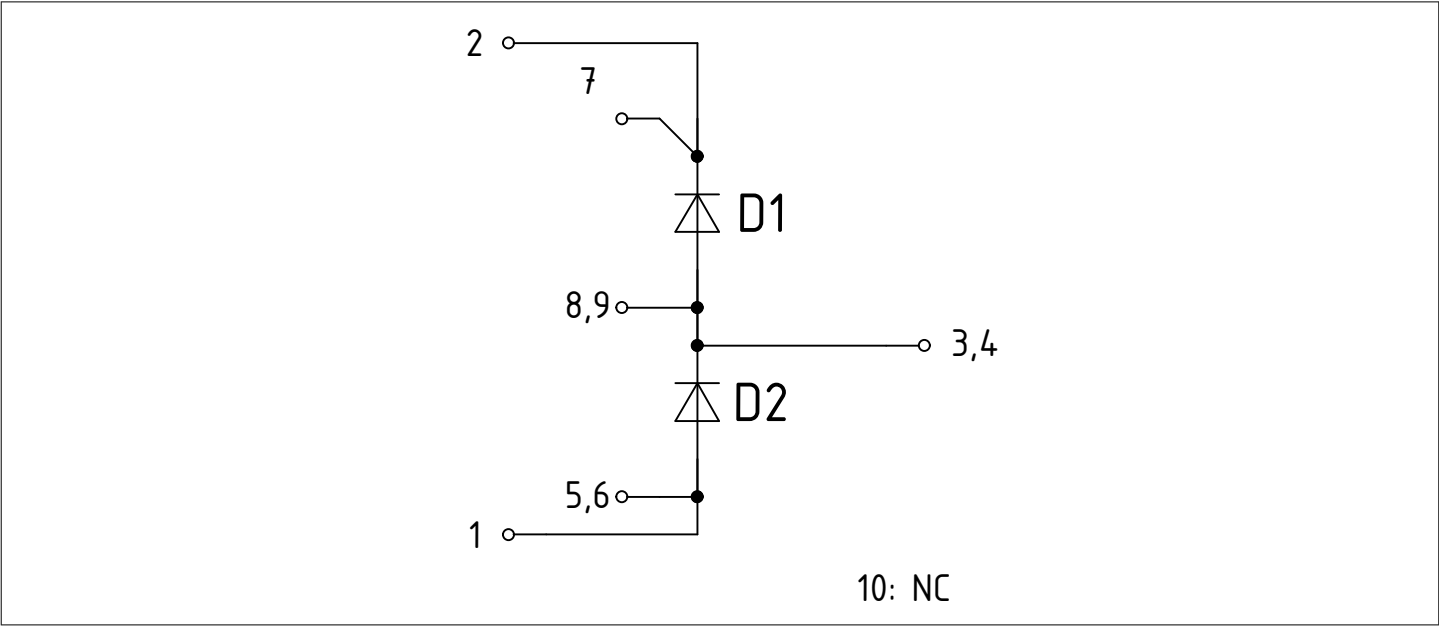


Figure 1

6 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

Revision history

Document revision	Date of release	Description of changes
1.00	2023-06-15	Initial version

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