

## 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



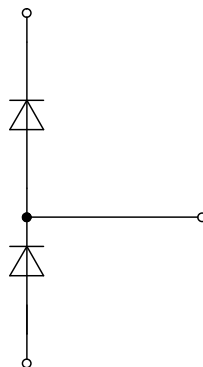
### Potential applications

- 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, $f = 50$ Hz, $t = 1$ min	10.4	kV
Partial discharge extinction voltage	$V_{isol}$	RMS, $f = 50$ Hz, $Q_{PD}$ typ. 10 pC	5.1	kV
DC stability	$V_{CE(D)}$	$T_{vj} = 25$ °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	$R_{AA'+CC'}$	$T_C = 25$ °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	$V_{RRM}$		$T_{vj} = -40$ °C	4500	V
			$T_{vj} = 150$ °C	4500	
Continuous DC forward current	$I_F$		450	A	
Repetitive peak forward current	$I_{FRM}$	$t_p = 1$ ms	900	A	

(table continues...)

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

Parameter	Symbol	Note or test condition	Values	Unit	
$I^2t$ - value	$I^2t$	$t_p = 10 \text{ ms}, V_R = 0 \text{ V}$	$T_{vj} = 125 \text{ °C}$	87.4	$\text{kA}^2\text{s}$
			$T_{vj} = 150 \text{ °C}$	79.9	
Maximum power dissipation	$P_{RQM}$		$T_{vj} = 150 \text{ °C}$	1500	kW
Minimum turn-on time	$t_{onmin}$			10	$\mu\text{s}$

**Table 4 Characteristic values**

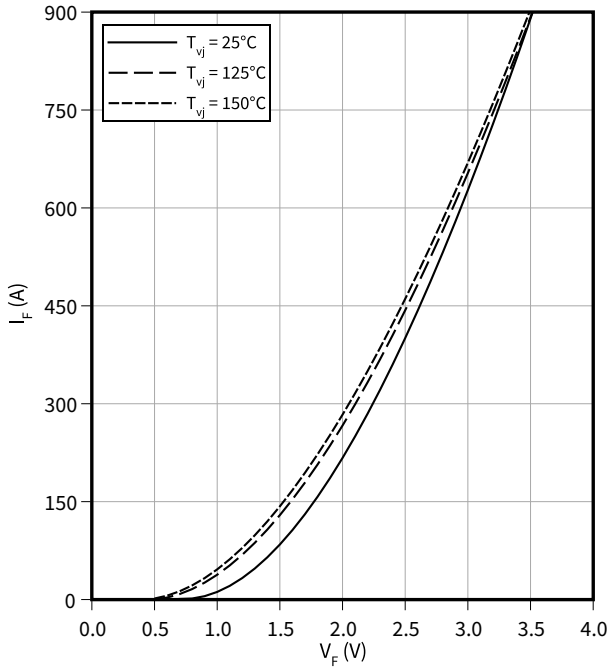
Parameter	Symbol	Note or test condition	Values			Unit	
			Min.	Typ.	Max.		
Forward voltage	$V_F$	$I_F = 450 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25 \text{ °C}$		2.60	3.05	V
			$T_{vj} = 125 \text{ °C}$		2.50	2.95	
			$T_{vj} = 150 \text{ °C}$		2.45	2.90	
Peak reverse recovery current	$I_{RM}$	$V_{CC} = 2800 \text{ V}, I_F = 450 \text{ A}, V_{GE} = -15 \text{ V}, -di_F/dt = 4900 \text{ A}/\mu\text{s} (T_{vj} = 150 \text{ °C})$	$T_{vj} = 25 \text{ °C}$		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		$\mu\text{C}$
			$T_{vj} = 125 \text{ °C}$		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**

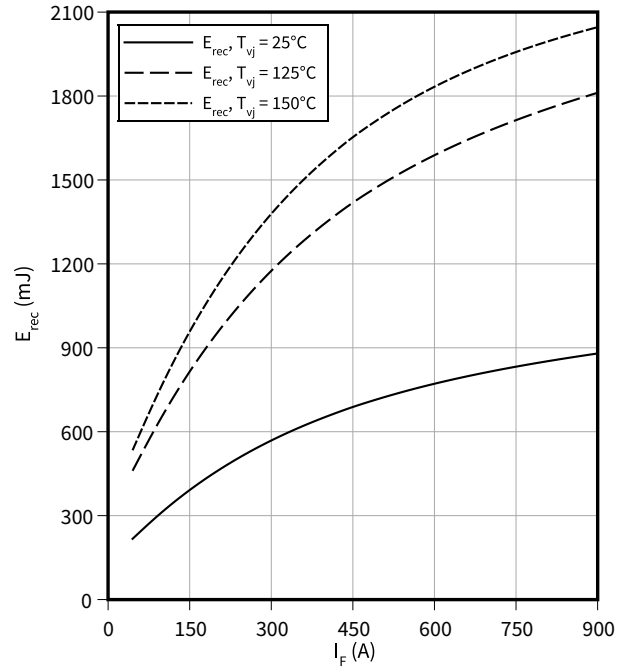
$I_F = f(V_F)$



**Switching losses (typical), Diode, Inverter**

$E_{rec} = f(I_F)$

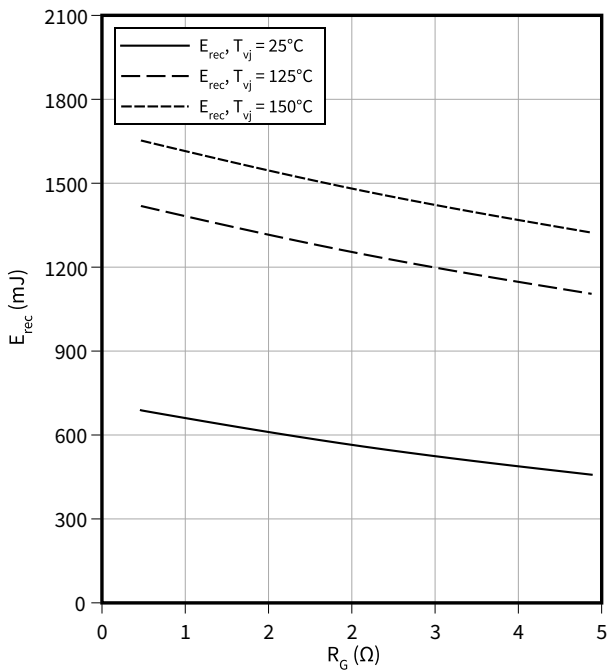
$R_{Gon} = 0.39 \Omega, V_{CE} = 2800 \text{ V}$



**Switching losses (typical), Diode, Inverter**

$E_{rec} = f(R_G)$

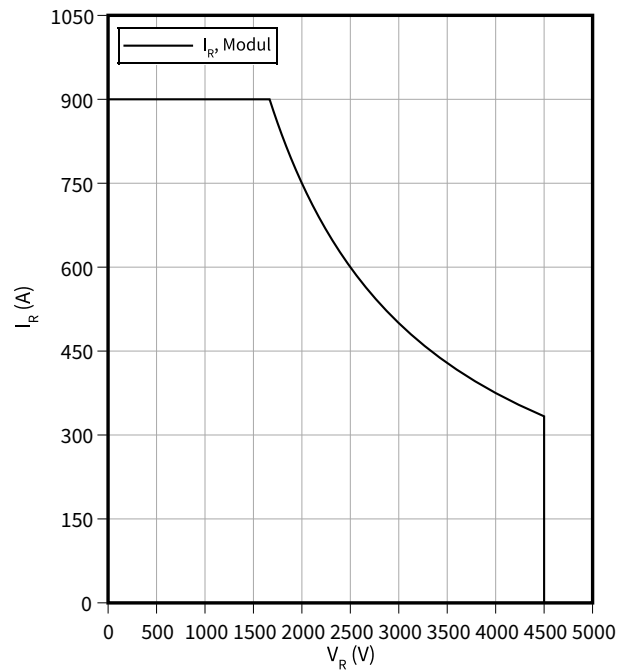
$V_{CE} = 2800 \text{ V}, I_F = 450 \text{ A}$



**Safe operating area (SOA), Diode, Inverter**

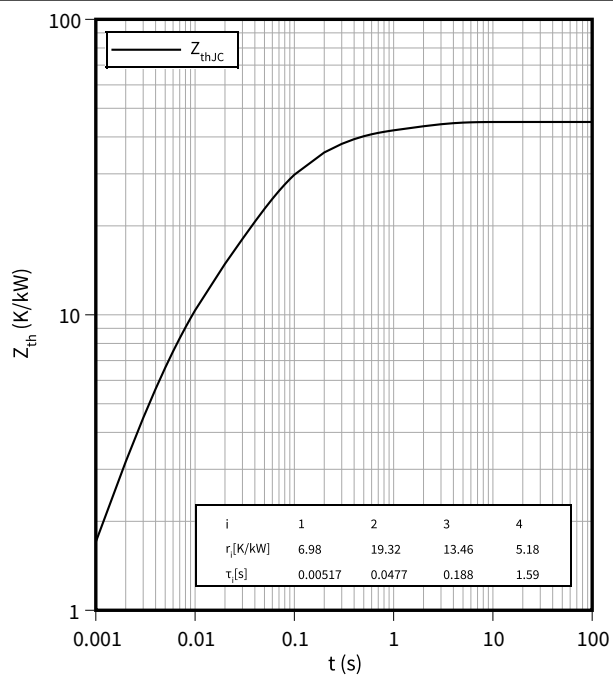
$I_R = f(V_R)$

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



**Transient thermal impedance, Diode, Inverter**

$Z_{th} = f(t)$



## 4 Circuit diagram

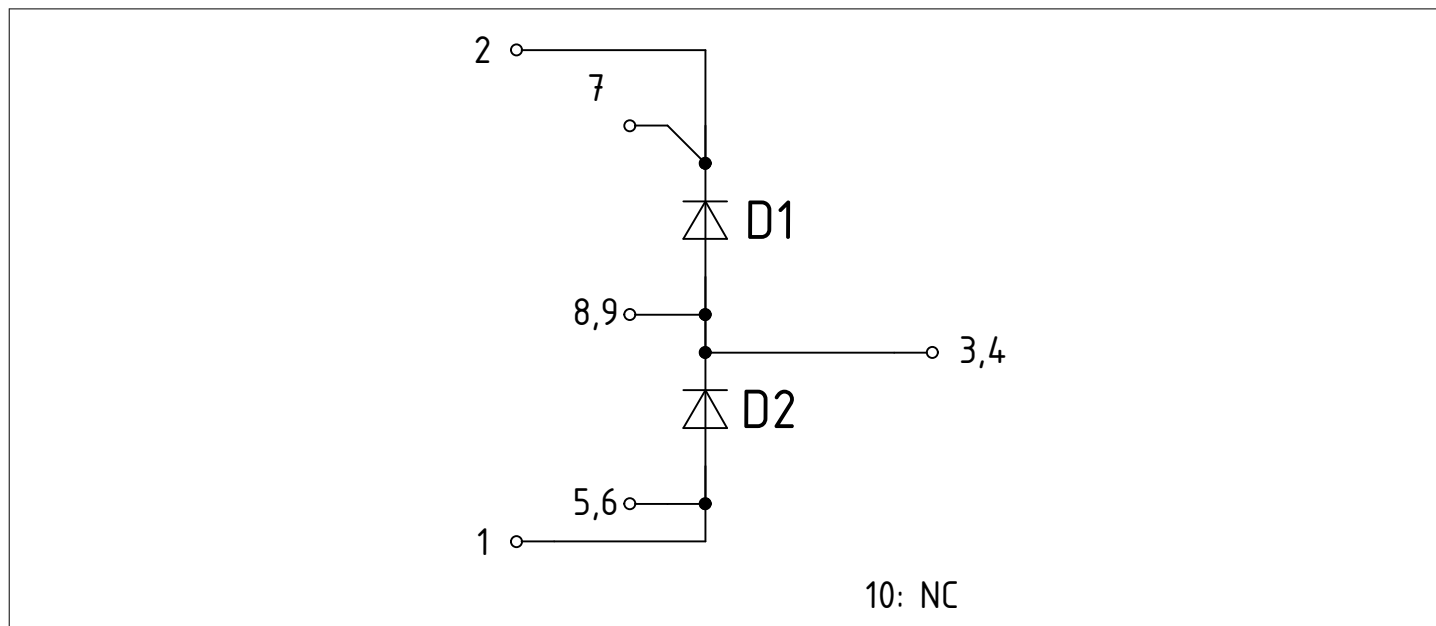


Figure 1

## 5 Package outlines

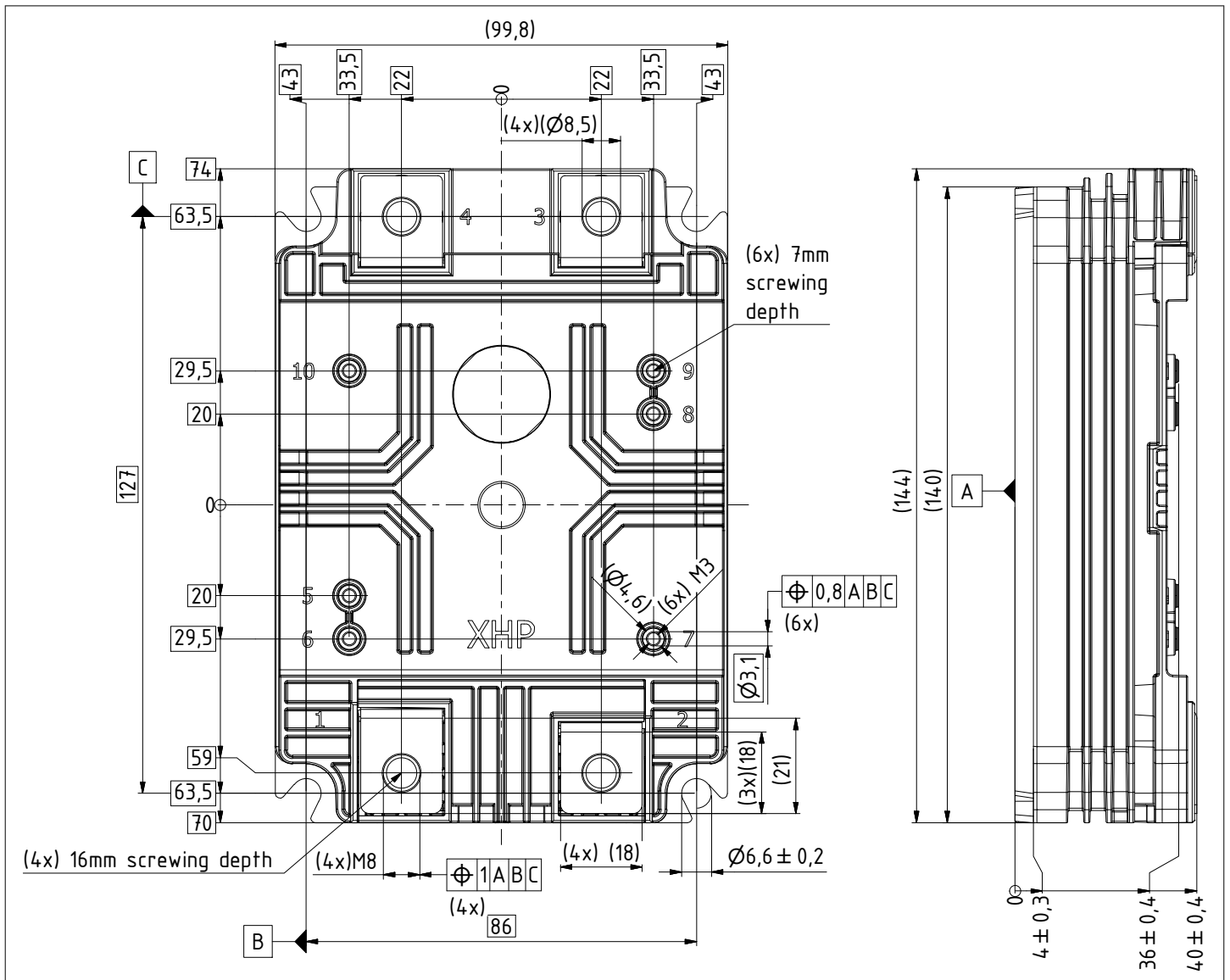

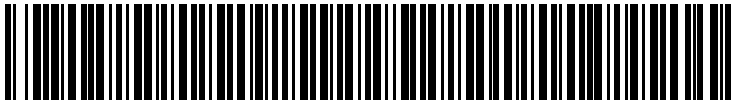


Figure 2



## 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> Module serial number Module material number Production order number Date code (production year) Date code (production week)	<i>Digit</i> 1 - 5 6 - 11 12 - 19 20 - 21 22 - 23	<i>Example</i> 71549 142846 55054991 15 30
Example	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">   71549142846550549911530 </div> <div style="text-align: center;">   71549142846550549911530 </div> </div>		

**Figure 3**

## Revision history

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

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**Document reference**

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