

**General information**

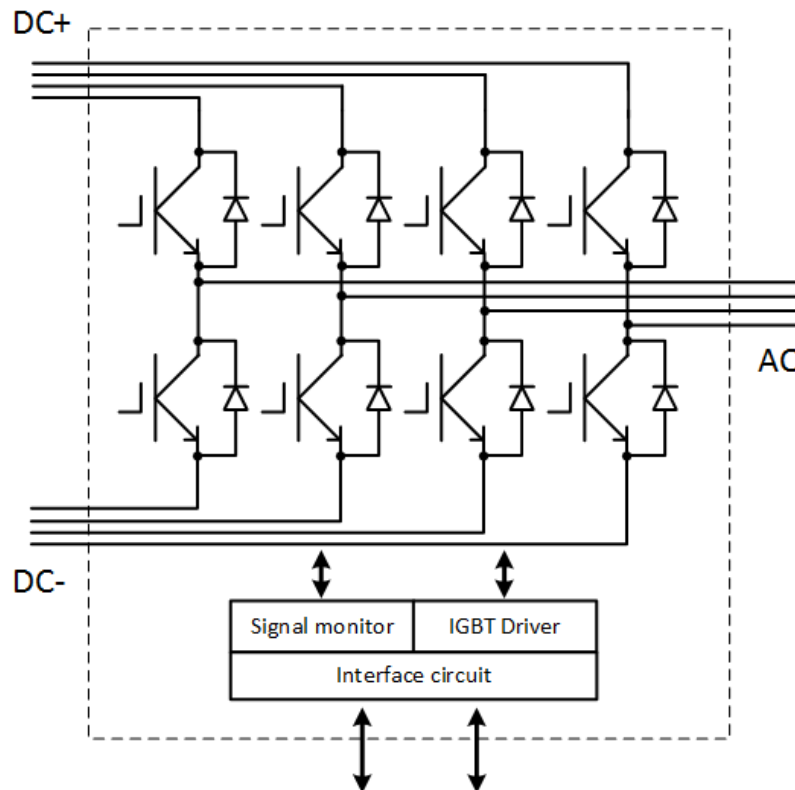
**IPM for typical voltages up to 690 V<sub>RMS</sub>**  
**Rated output current 1550 A<sub>RMS</sub>**

Features

- Integrated current, voltage and temperature measurement
- Tvjop max=150°C
- Real time Tvj simulation
- IGBT4 technology
- Smart protection
- TIM and pressfit technology
- Modbus interface
- 100% tested IPM
- ROHS compliant
- Integrated chip current : 2400A
- Integrated chip voltage: 1700V



Topology	half bridge
Application	Energy Storage, Smart Grid, Wind, Drives, Solar
Heatsink	water cooled
Implemented sensors	voltage, current, temperature
Driver signals IGBT	+15V
Approvals	UL61800-5-1
Sales - name	IFF2400P17LE440988



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Preliminary data

Characteristic values

IGBT characteristic value

			min.	typ.	max.	
Collector-emitter voltage	$I_C = 2400\text{ A}, T_{vj} = 25^\circ\text{C}$	$V_{ce\text{ sat}}$		1.95	2.30	V
	$I_C = 2400\text{ A}, T_{vj} = 150^\circ\text{C}$			2.45		V
Turn on energy loss	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 25^\circ\text{C}$	$E_{on}$		730		mJ
	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 150^\circ\text{C}$			1170		mJ
Turn off energy loss	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 25^\circ\text{C}$	$E_{off}$		460		mJ
	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 150^\circ\text{C}$			810		mJ
Thermal resistance junction to ambient for diode due diode housing	per IPM switch, flow rate: 15l/min	$R_{thja\text{ IGBT-<IGBT}}$		0.0254		K/W
Thermal resistance junction to ambient for IGBT due IGBT housing	per IPM switch, flow rate: 15l/min	$R_{thja\text{ IGBT-<diode}}$		0.0135		K/W

Notes

Cooling fluid = 48% water / 52% mono-ethylene glycol,  
For further details about the thermal resistance please refer to the handbook.

Diode characteristic value

			min.	typ.	max.	
Forward voltage	$I_C = 2400\text{ A}, T_{vj} = 25^\circ\text{C}$	$V_F$		1.80	2.20	V
	$I_C = 2400\text{ A}, T_{vj} = 150^\circ\text{C}$			1.95		V
Reverse recovery energy	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 25^\circ\text{C}$	$E_{rec}$		250		mJ
	$I_C = 2400\text{ A}, V_{DC} = 900\text{ V}, L_S = 17\text{ nH}, T_{vj} = 150^\circ\text{C}$			530		mJ
Thermal resistance junction to ambient for diode due diode housing	per IPM switch, flow rate: 15l/min	$R_{thja\text{ diode-<diode}}$		0.0358		K/W
Thermal resistance junction to ambient for IGBT due IGBT housing	per IPM switch, flow rate: 15l/min	$R_{thja\text{ diode-<IGBT}}$		0.0134		K/W

Notes

Cooling fluid = 48% water / 52% mono-ethylene glycol,  
For further details about the thermal resistance please refer to the handbook.

Absolute maximum rated values

Collector-emitter voltage	IGBT; $T_{vj} = 25^\circ\text{C}$	$V_{CES}$		1700		V
Repetitive peak reverse voltage	Diode; $T_{vj} = 25^\circ\text{C}$	$V_{RRM}$		1700		V
DC link voltage		$V_{DC}$		1450		V
Peak switching current		$I_{peak}$		4000		A
Insulation test voltage	$f = 50\text{ Hz}, t = 60\text{ s}$	$V_{ISOL}$		3.4		kV <sub>RMS</sub>
Junction temperature	under switching conditions	$T_{vjop}$		150		°C
Operational ambient temperature min.		$T_{amb}$		-40		°C
Switching frequency operation values		$f_{sw2}$		10		kHz

Notes

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Operation values

			min.	typ.	max.	
Rated continuous current	$V_{DC} = 1100\text{ V}$ , $V_{AC} = 690\text{ V}_{RMS}$ , $\cos(\varphi) = 0.85$ , $f_{AC\ sine} = 50\text{ Hz}$ , $f_{sw} = 3000\text{ Hz}$ , $T_{inlet} = 40^\circ\text{C}$ , $T_j \leq 150^\circ\text{C}$	$I_{AC}$		1550		$A_{RMS}$
Power losses	$I_{AC} = 1550\text{ A}$ , $V_{DC} = 1100\text{ V}$ , $V_{AC} = 690\text{ V}_{RMS}$ , $\cos(\varphi) = 0.85$ , $f_{AC\ sine} = 50\text{ Hz}$ , $f_{sw} = 3000\text{ Hz}$ , $T_{inlet} = 40^\circ\text{C}$ , $T_j \leq 150^\circ\text{C}$	$P_{loss}$		8900		W

Controller interface

			min.	typ.	max.	
Auxiliary voltage		$V_{aux}$	19.2	24	28.3	V
Auxiliary power requirement	$V_{aux} = 24\text{ V}$	$P_{aux}$			48	W
Digital input level		$V_{in\ low}$			2	V
		$V_{in\ high}$	8.5		16	V
Digital output level	max. 1 mA	$V_{out\ low}$			2	V
		$V_{out\ high}$	13.5	15	16.5	V
Interlock time	default value	$t_{interlock}$		4		$\mu\text{s}$
Propagation delay for PWM	default value	$t_{prop}$		4		$\mu\text{s}$
Analog output for phase current	for 1550A	$V_{lac\ ana}$		3.69		V
Over current shut down	default value, response time 15 $\mu\text{s}$	$I_{ac\ trip}$		4200		A
Analog DC link voltage sensor output	load max 5 mA, @ 1100 V	$V_{DC\ ana}$		7.86		V
Over voltage shut down	default value, response time 500 $\mu\text{s}$	$V_{dc\ trip}$		1340		V
Chip over temperature shut down	default value, response time 1000 $\mu\text{s}$	$T_{vj\ trip}$		150		$^\circ\text{C}$
Analog output for junction temperature	for 150 $^\circ\text{C}$	$V_{Tvj\ ana}$		10		V
PCB ambient over temperature shut down	default value, response time 1 s	$T_{pcb\ err}$		85		$^\circ\text{C}$
Serial BUS	Modbus, RS485			19200		Bit/s

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**Preliminary data**

**System data**

			min.	typ.	max.	
EMC robustness	according to IEC61800 at named interfaces	power	$V_{Burst}$		2	kV
		control	$V_{Burst}$		2	kV
Storage temperature		$T_{stor}$	-40		85	°C
Operational ambient temperature		$T_{op\ amb}$	-40		65	°C
Stray inductance		$L_s$		8.5		nH
Lead resistance		$R_{CC\ EE}$		1.2		mΩ
Impuls test voltage	Power to logic side, acc.IEC 61800-5-1			12		kV
Isolation test voltage	RMS, f = 50 Hz, t = 60 s	$V_{ISOL}$		3.4		kV
Creepage distance	Power side to heatsink across housing			13		mm
Clearance	Power side to heatsink			8		mm
Protection degree			IP00			
Pollution degree			2			
Dimensions	width x depth x height		215	338	115	mm
Weight				6.1		kg

**Notes**

Partical discharge test, power side to logic side, according to IEC 61800-5-1, TE > 1920V

Housing CTI > 175

For further details about the system data please refer to the handbook.

**Heatsink water cooled**

			min.	typ.	max.	
Water flow	according to coolant specification from Infineon	$\Delta V/\Delta t$		15		dm <sup>3</sup> /min
Water pressure				6	8	bar
Water pressure drop	at 15 dm <sup>3</sup> /min water flow	$\Delta p$		120		mbar
Coolant inlet temperature		$T_{inlet}$	-40		60	°C

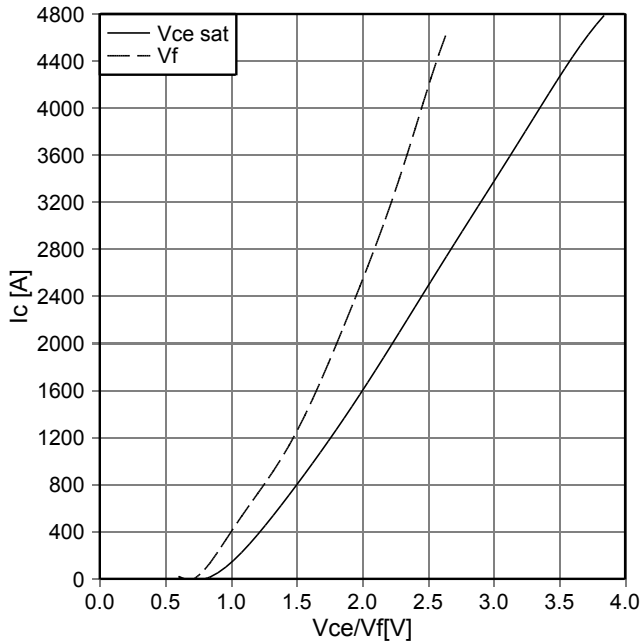
**Notes**

Cooling fluid = 48% water / 52% mone-ethylene glycol (MEG)

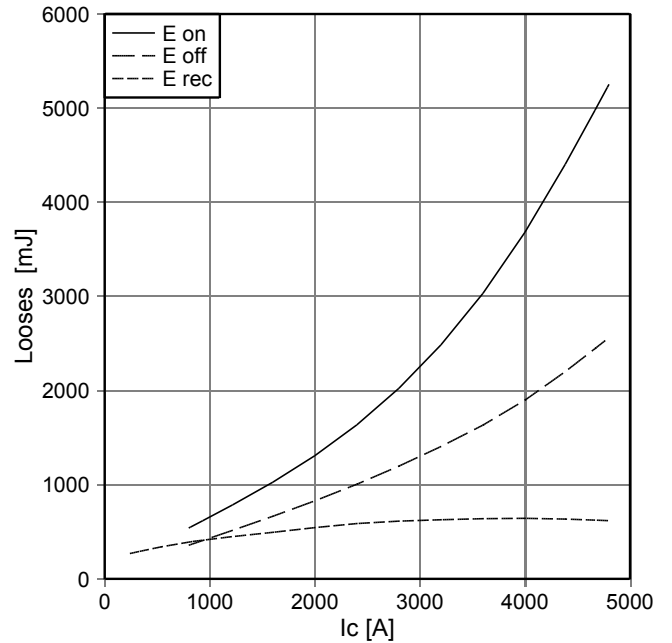
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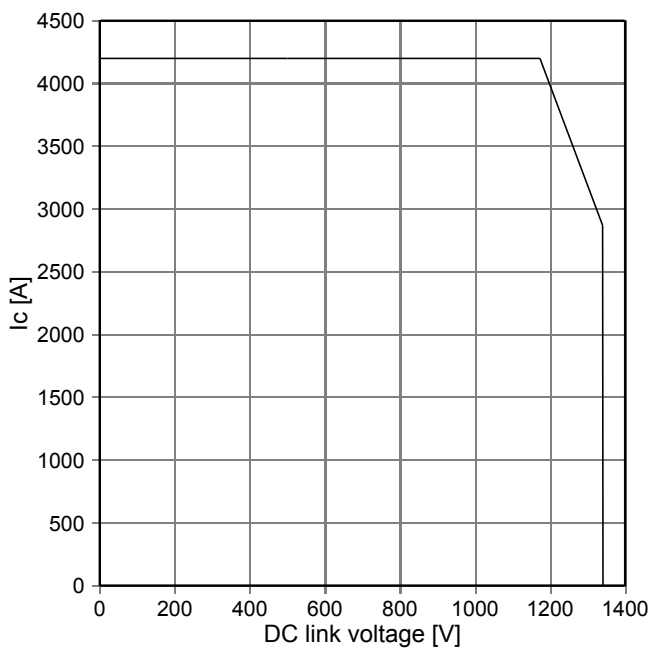
output characteristic IGBT/Diode  
 $T_{vj} = 150^{\circ}\text{C}$



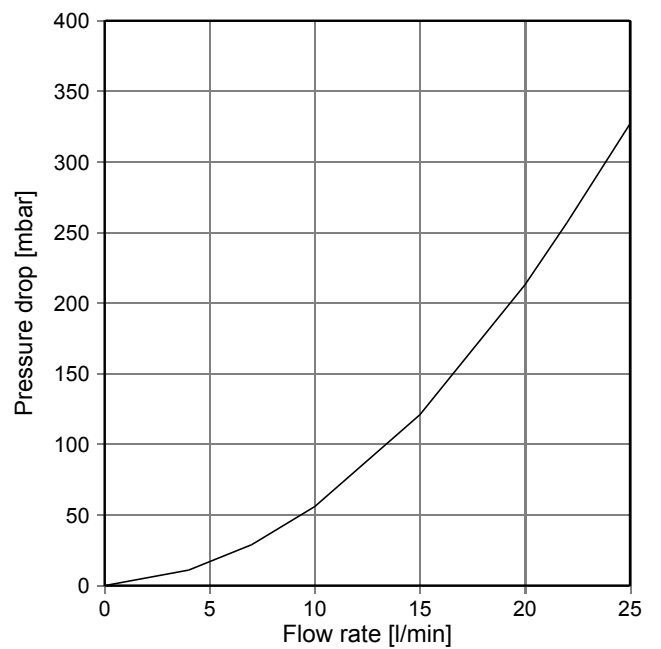
switching losses, Eon, Eoff, Erec  
 $V_{dc} 1100\text{V}, T_{vj} = 150^{\circ}\text{C}$



safe operating area



Pressure drop vs. flow rate  
 $T_{inlet} = 40^{\circ}\text{C}, 52\% \text{ water} / 48\% \text{ MEG}$

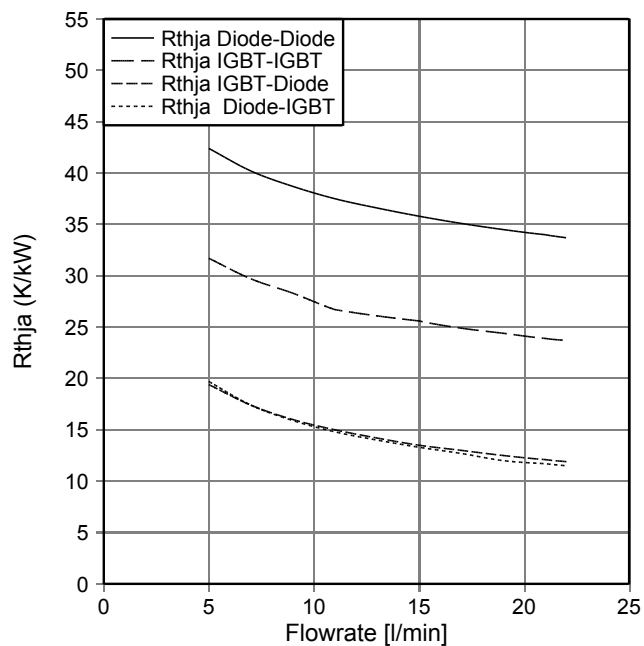


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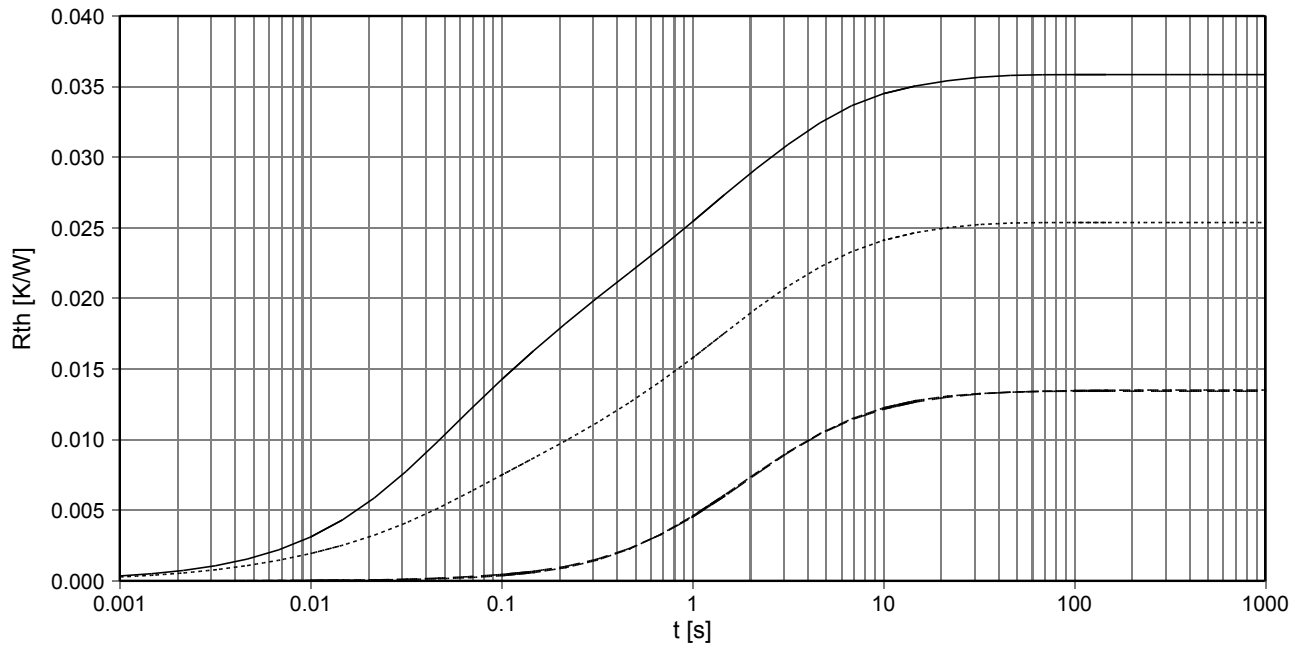
Preliminary data

Thermal resistance vs. Flow rate  
 T inlet=40°C, 48% water/ 52% MEG



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thermal impedance  
 Tinlet =40°C, 48% water/52% MEG, 15l/min



—— Rthja Diode - Diode

i:	1	2	3	4	5	6
r <sub>i</sub> [K/W]:	0.00115	0.00737	0.00818	0.0068	0.00975	0.0026
τ <sub>i</sub> [s]:	0.032	0.032	0.1165	0.625	2.615	12.1

- - - Rthja IGBT - IGBT

i:	1	2	3	4	5	6
r <sub>i</sub> [K/W]:	-0.00085	0.00117	-0.00067	0.00595	0.00565	0.00218
τ <sub>i</sub> [s]:	0.024	0.0313	0.084	1.29	3.25	13

- · - - Rthja IGB -Diode

i:	1	2	3	4	5	6
r <sub>i</sub> [K/W]:	-0.001	0.00035	0.00491	0.00605	0.00275	0.00045
τ <sub>i</sub> [s]:	0.166	0.26	1.025	2.765	7.695	40.84

····· Rthja Diode-IGBT

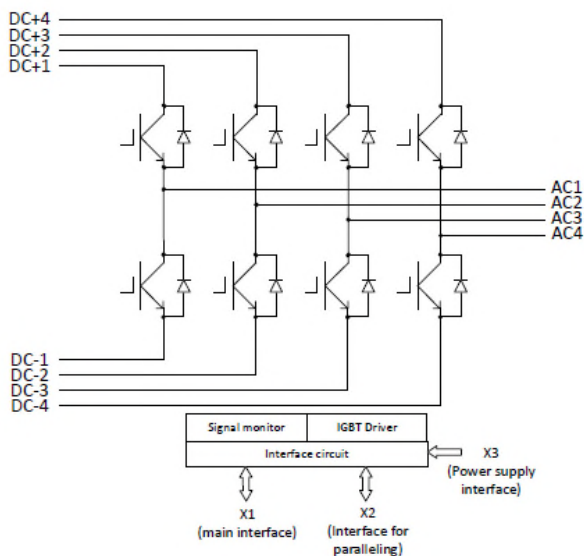
i:	1	2	3	4	5	6
r <sub>i</sub> [K/W]:	0.0008	0.0046	0.003565	0.006735	0.007075	0.0026
τ <sub>i</sub> [s]:	0.0053	0.043	0.173	0.897	2.89	10.9

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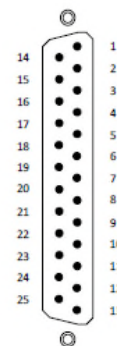
Circuit diagram



Pin configuration for X1 (main control interface)

Pin	Signal	I/O	Pin	Signal	I/O
1	24V_supply	PWR	14	GND_supply	PWR
2	24V_supply	PWR	15	GND_supply	PWR
3	+15_DC	PWR	16	GND_DC	PWR
4	Alert	OUT	17	Enable	IN
5	Fault	IN/OUT	18	Warn_OV	IN/OUT
6	ANA_Tj	ANA OUT	19	ID_det	IN/OUT
7	ANA_Vdc	ANA OUT	20	GND_ana	PWR
8	PWM_top	IN	21	PWM_bot	IN
9	Warn_OC	IN/OUT	22	GND_dig	PWR
10	ANA_lic	ANA OUT	23	Warn_OT	IN/OUT
11	TX/RX_IN+	IN/OUT	24	TX/RX_IN-	IN/OUT
12	TX/RX_Out+	IN/OUT	25	TX/RX_Out-	IN/OUT
13	Shield			Housing is shield	

Detail information for X1, X2 and X3 refer to handbook



Sub-D 25, male with UNC thread

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- the conclusion of Quality Agreements;
- to establish joint measures of an ongoing product survey, and that we may make delivery depended on the realization of any such measures.

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**Safety Instructions**

Prior to installation and operation, all safety notices and warnings and all warning signs attached to the equipment have to be carefully read. Make sure that all warning signs remain in a legible condition and that missing or damaged signs are replaced. To installation and operation, all safety notices and warnings and all warning signs attached to the equipment have to be carefully read. Make sure that all warning signs remain in a legible condition and that missing or damaged signs are replaced.

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