

Flexim PIOX R532/R500 Process Refractometer



Transmitted Light Process Refractometer - Chemistry Design

Features

- Unique transmitted light refractometer for process analysis
- High accuracy and drift-free due to difference measurement
- Integrated fluid temperature measurement
- Internal self-diagnosis and detection of errors
- Stainless steel and carbon-fiber reinforced PTFE sensors available
- Use in chemical processes to determine the concentration and density of liquid mixtures
- Library for approx. 50 typical analysis applications available, customized fluid data sets can also be provided
- Typical analysis outputs like M%, Vol%, g/l, operating density, laboratory density selectable

Measurement principle	3
Refractive index	3
Measurement with refractometer PIOX R.	3
Measuring setup	5
Transmitter	6
Technical data	6
Dimensions	8
2" pipe mounting kit (optional)	8
Storage	8
Terminal assignment	9
Sensor	10
Technical data	10
Dimensions	11
Sensor mounting positions	12
Connection	13
Sensor order code	14
Process connection	15
Direct flange for PIOX R500-LCS4K*-****-***D	15
Process connection for PIOX R500-MCS4K*-****-***F	15
Direct flange for PIOX R500-LCTFKR-****-***D	17
Process connection for PIOX R500-MCTFKR-****-***D	17
Accessories	18

Measurement principle

Refractive index

The refractive index n of a solution is determined using transmitted light refractometry. A light beam propagates through the solution and is refracted at the interface of a prism. The angle of refraction is measured by a detector. The refractive index n of the solution is calculated from the angle of refraction using Snell's law of refraction:

$$n_i \cdot \sin\theta_i = n_t \cdot \sin\theta_t$$

where

n_i = refractive index of fluid

θ_i = angle of incidence

n_t = refractive index of prism

θ_t = angle of refraction

Measurement with refractometer PIOX R

Sensor

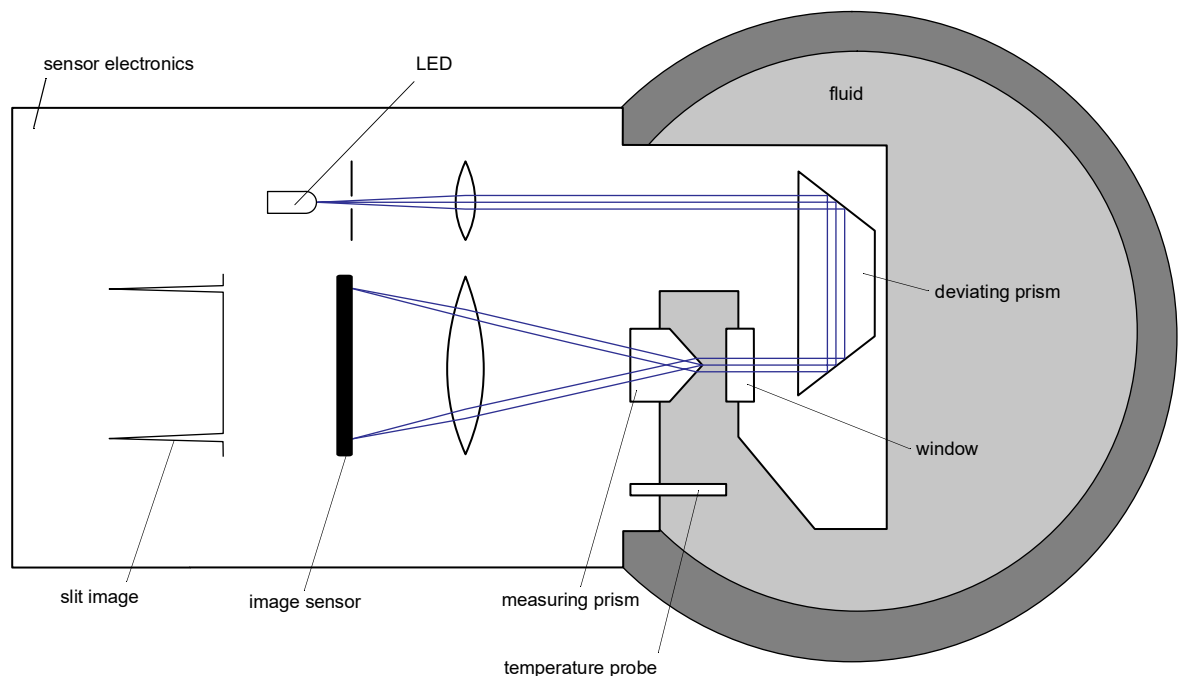
A special LED with a wave length $\lambda = 590$ nm (sodium D line) is used as the light source. The light passes through a slit, is parallelized by a lens and reversed by a deviating prism. Then it enters the fluid through a window in the sensor head. When the light beam re-enters the sensor, it is split at the apex of a measuring prism and refracted at its lateral surfaces.

The two resulting measuring beams are focused by a lens, generating sharp slit images on the image sensor.

The angle of refraction is determined from the difference between the two images of the slit. The zero point is calculated continuously in order to compensate for the influences of the process pressure and temperature.

The refractive index n_D is calculated from the angle of refraction between the measuring prism and the fluid. Furthermore, the following values can be measured:

- fluid temperature measured by the integrated temperature probe Pt1000
- diagnostic values (e.g., gain, amplitude, quality, symmetry) resulting from extended signal processing
- sensor humidity and temperature



Processing in the transmitter

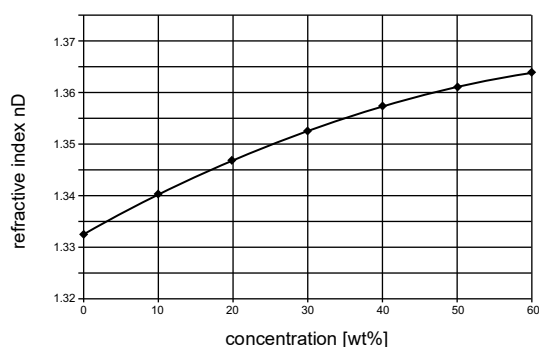
The transmitter calculates application-specific analysis quantity such as M%, Vol%, g/l, nDT (temperature-compensated refractive index), operating density, laboratory density, Brix value either with standardized fluid data sets from the library or with customized ones.

The transmitter can be equipped with electrical inputs, allowing for the input of additional available fluid quantities, e.g., sound speed, density or conductance, and using them for the measurement of three-component mixtures.

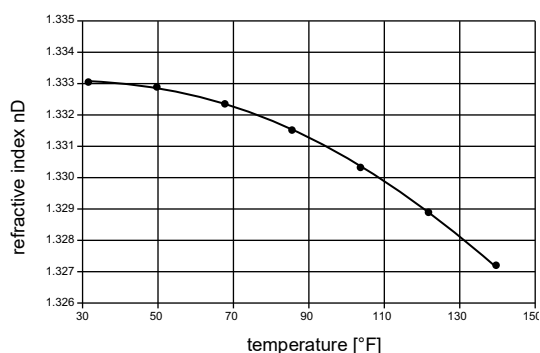
Dependence on temperature and concentration

As well as the density, the refractive index of a fluid depends on the temperature and concentration. In the majority of aqueous solutions, the refractive index increases with rising concentration (temperature = constant) and decreases with rising temperature (concentration = constant).

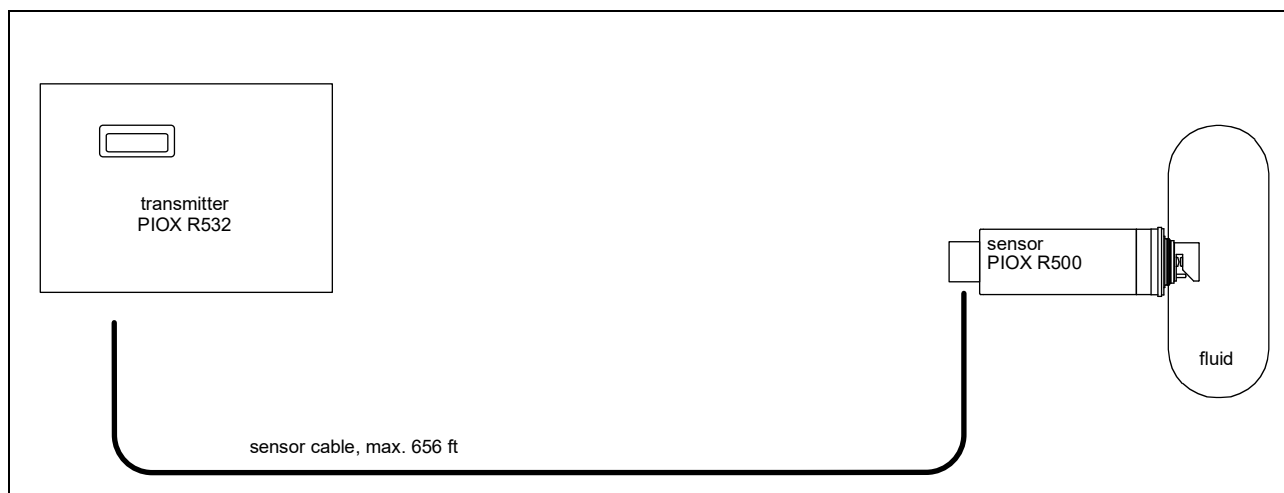
Dependence of the refractive index on the concentration (temperature = constant)



Dependence of the refractive index on the temperature (concentration = constant)




Measuring setup



Transmitter

Technical data

		PIOX R532
		
design		field device with 1 measuring channel
transmitter		
power supply		<ul style="list-style-type: none"> • 90 to 250 V/50 to 60 Hz or • 11 to 32 V DC
power consumption	W	< 10
number of measuring channels		1
damping	s	0 to 100 (adjustable)
response time	s	1
housing material		aluminum, powder coated
degree of protection		IP66
dimensions	inch	see dimensional drawing
weight	lb	7
fixation		wall mounting, optional: 2" pipe mounting
ambient temperature	°F	-4 to +140
display		128 x 64 pixels, backlight
menu language		English, German, French, Spanish, Dutch, Russian, Polish, Turkish, Italian, Chinese
measuring functions		
physical quantities		see table below
diagnostic functions		signal amplitude, sensor humidity, sensor temperature
communication interfaces		
service interfaces		measured value transmission, parametrization of the transmitter: <ul style="list-style-type: none"> • USB • LAN
process interfaces		max. 1 option: <ul style="list-style-type: none"> • Modbus RTU • HART
accessories		
data transmission kit		USB cable
software		<ul style="list-style-type: none"> • FluxDiagReader: reading of measured values and parameters, graphical representation • FluxDiag (optional): reading of measurement data, graphical representation, report generation, parametrization of the transmitter
data logger		
loggable values		all physical quantities and totalized physical quantities
capacity		max. 800 000 measured values

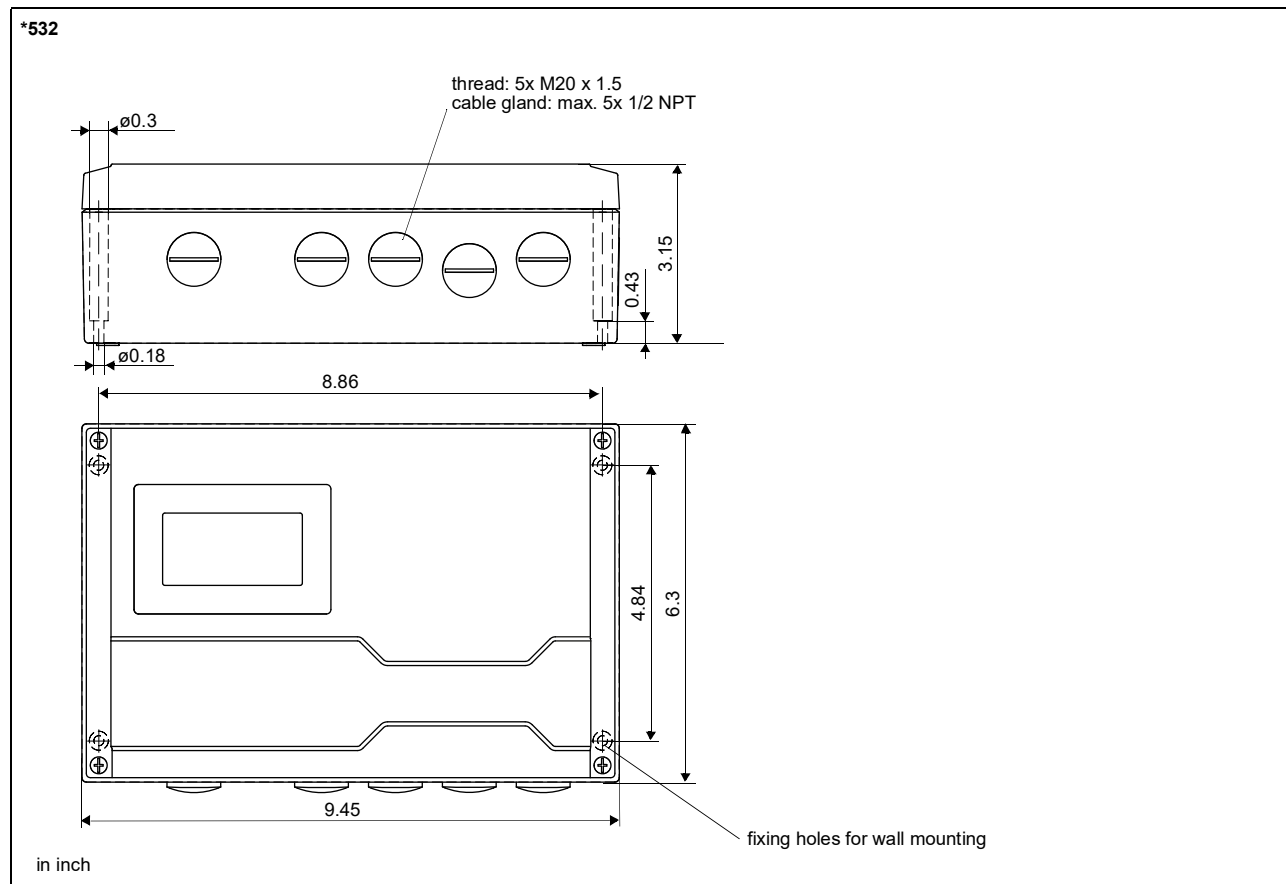
PIOX R532		
outputs		
The outputs are galvanically isolated from the transmitter.		
• switchable current output		
		configurable according to NAMUR NE 43
number		1 and optional: 1 (HART)
range	mA	4 to 20 (alarm current: 3.2 to 3.99, 20.01 to 24, hardware fault current: 3.2)
uncertainty		0.04 % of output value $\pm 3 \mu\text{A}$
active output		$R_{\text{ext}} = 250 \text{ to } 530 \Omega$, $U_{\text{opencircuit}} = 28 \text{ V DC}$
passive output		$U_{\text{ext}} = 9 \text{ to } 30 \text{ V DC}$, depending on R_{ext} ($R_{\text{ext}} < 458 \Omega$ at 20 V)
current output in HART mode		
• range	mA	4 to 20 (alarm current: 3.5 to 3.99, 20.01 to 22, hardware fault current: 3.2)
• active output		$R_{\text{ext}} = 250 \text{ to } 530 \Omega$, $U_{\text{opencircuit}} = 28 \text{ V DC}$
• passive output		$U_{\text{ext}} = 9 \text{ to } 30 \text{ V DC}$, depending on R_{ext} ($R_{\text{ext}} = 250 \text{ to } 458 \Omega$ at 20 V)
• digital output		
number		2
functions		<ul style="list-style-type: none"> • frequency output • binary output • pulse output
type		open collector (passive)
operating parameters		5 to 30 V, $I_{\text{max}} = 100 \text{ mA}$, $R_{\text{int}} = 20 \Omega$ Low: $U < 2 \text{ V}$ at $I_{\text{loop}} = 2 \text{ mA}$ ($R_{\text{ext}} = 12 \text{ k}\Omega$ at $U_{\text{ext}} = 24 \text{ V}$) High: $U > 15 \text{ V}$ ($R_{\text{ext}} = 12 \text{ k}\Omega$ at $U_{\text{ext}} = 24 \text{ V}$)
frequency output		
• range	kHz	0.002 to 10
• damping	s	0 to 999.9 (adjustable)
• pulse-to-pause ratio		1:1
binary output		
• binary output as alarm output		limit, change of flow direction or error
pulse output		
• pulse value	units	0.01 to 1000
• pulse width	ms	0.05 to 1000
• pulse rate		max. 10 000 pulses

Physical quantities

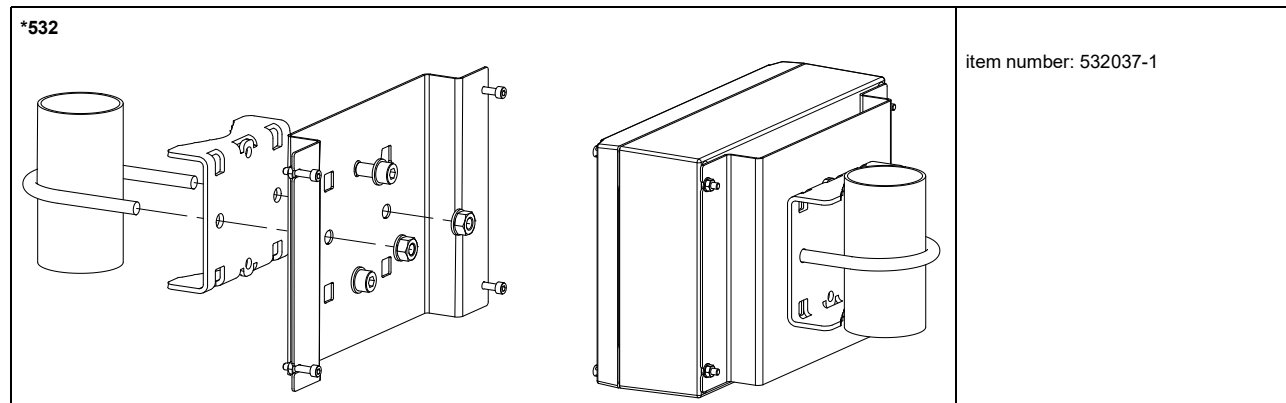
The available physical quantities depend on the fluid data set in the transmitter.

fluid data set		physical quantities	remark
	no fluid data set	refractive index, fluid temperature, °Brix	
SSF	standard fluid data set	refractive index, fluid temperature, °Brix, concentration	application-specific fluid data set from FLEXIM database
SCF	customized fluid data set	refractive index, fluid temperature, °Brix, further customized physical quantities	data set developed by FLEXIM in cooperation with the customer

Dimensions



2" pipe mounting kit (optional)

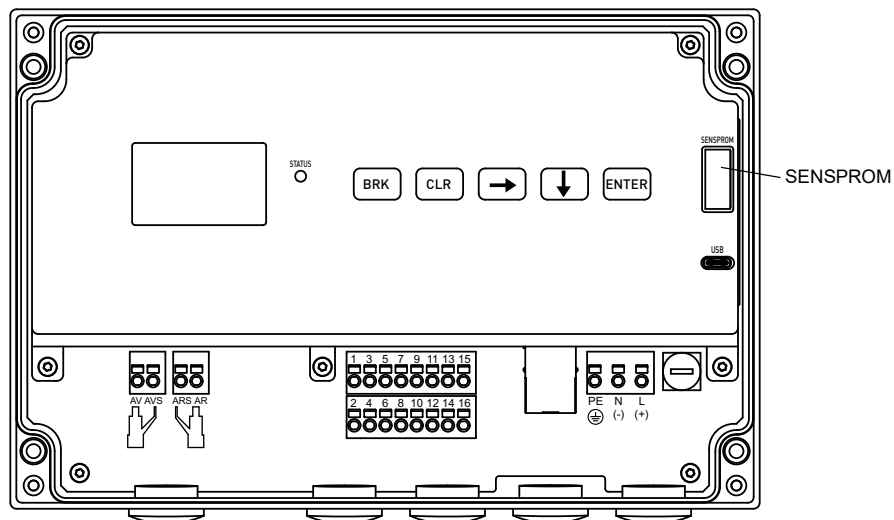


Storage

- do not store outdoors
- store within the original package
- store in a dry and dust-free place
- protect against sunlight
- keep all openings closed
- storing temperature: -4...+140 °F

Terminal assignment

*532



power supply ¹			
terminal	connection (AC)	terminal	connection (DC)
PE	protective conductor	PE	protective conductor
N	neutral conductor	(-)	-
L	line conductor	(+)	+
transducers			
terminal		transducer cable	
4		yellow	
3		green	
1		brown	
2		white	
outputs ^{1, 2}			
terminal	connection		
13+, 14-	passive current output		
13-, 14+	active current output		
9+, 10- 11+, 12-	digital output		
15+, 16-	passive current output/HART		
15-, 16+	active current output/HART		
communication interfaces			
terminal	connection	communication interface	
15	signal +	Modbus RTU ¹	
16	signal -		
USB	type C Hi-Speed USB 2.0 Device	service (FluxDiag/FluxDiagReader)	
LAN	RJ45 10/100 Mbps Ethernet	service (FluxDiag/FluxDiagReader)	

¹ cable (by customer): e.g., flexible wires, with insulated wire ferrules, wire cross-section: AWG14 to 24

² The number, type and terminal assignment are customized.

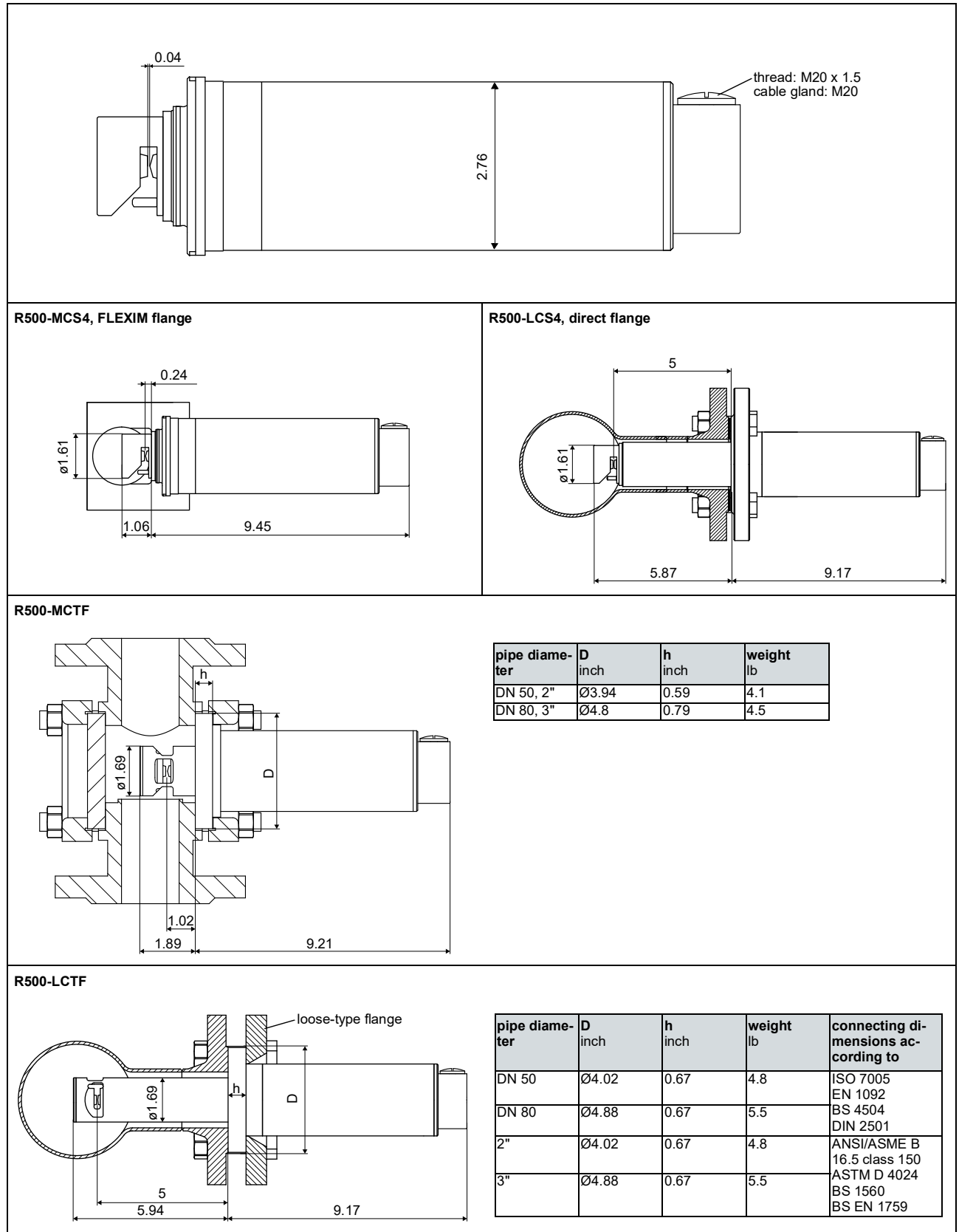
Sensor

Technical data

		R500	R500
order code		RS1-R500-*CS4KR-NN	RS1-R500-*CTFKR-NN
process parameters			
fluid		all liquids with a turbidity < 10 000 FAU	all liquids with a turbidity < 10 000 FAU
fluid temperature (depending on ambient temperature)	°F	-4 to +302 (302 °F at an ambient temperature of 68 °F)	-4 to +248
fluid pressure		PN 10, PN 16, PN 40 (on request, depending on process connection)	PN 10
measurement			
measurement principle		transmitted light refractometry	transmitted light refractometry
measuring range		nD: 1.3 to 1.7	nD: 1.3 to 1.7
accuracy (absolute)		nD: 0.000 2 (typically 0.1 wt%)	nD: 0.000 2 (typically 0.1 wt%) ¹
repeatability		nD: 0.000 02 (typically 0.01 wt%)	nD: 0.000 02 (typically 0.01 wt%)
resolution (display)		nD: 0.000 001	nD: 0.000 001
material			
housing		stainless steel 304	stainless steel 304, epoxy-powder coated
wetted parts		stainless steel 316Ti (others on request)	PTFE/carbon 25 %
gaskets		FFKM	FFKM
prism		sapphire, nD ≈ 1.76	sapphire, nD ≈ 1.76
degree of protection		IP54, wetted parts: IP67	IP54, wetted parts: IP67
flange		depending on type of construction (see sensor order code)	depending on type of construction (see sensor order code)
dimensions		see dimensional drawing	see dimensional drawing
weight	lb	min. 4.4	see dimensional drawing
ambient temperature	°F	-40 to +158	-40 to +158
temperature probe			
type		Pt1000	Pt1000
resolution	K	0.01	0.01
accuracy at 68 °F	K	0.15	0.15
response time	s	5	20

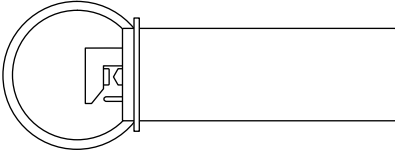
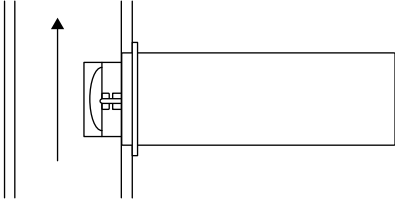
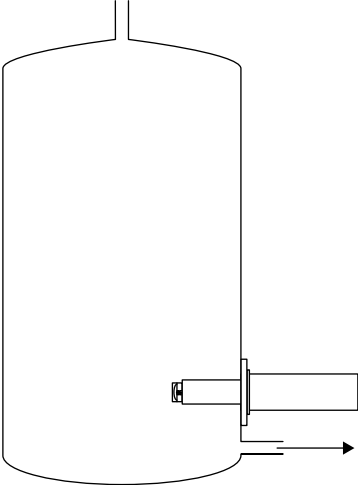
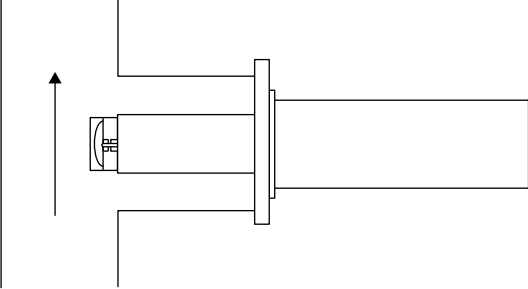
¹ R500-LCTF: depending on temperature and flow velocity:
max. 8 ft/s at 68 °F
max. 3 ft/s at 176 °F

Dimensions



in inch

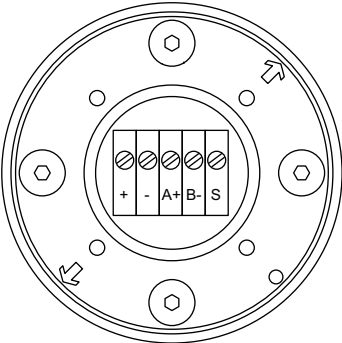
Sensor mounting positions

R500-M	
horizontal pipe 	vertical pipe ¹ 
R500-L	
vessel  installation close to the outlet	T-piece ¹ 

¹ The pipe always has to be completely filled. The preferred flow direction is upward, in exceptional cases downward.

Connection

Terminal assignment



terminal	connection
+	yellow
-	green
A+	brown
B-	white
S	shield

equipotential bonding terminal on housing cover

Sensor cable

		R500
item number		TR10126
type		LIYCY 2 x 2 x 0.75 gray
length	ft	max. 656
weight	lb/ft	approx. 0.07
ambient temperature	°F	-40 to +176
properties		flame retardant according to IEC 60332-1-2
cable jacket		
material		PVC
outer diameter	inch	0.33
color		gray
shield		x

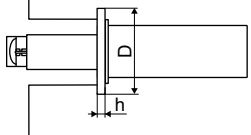
Sensor order code

1, 2	3 to 5	6	7	8, 9	10, 11	12, 13	14, 15	16 to 18	19	20 to 22	no. of character												
measurement principle	type	-	type of construction	design	material (wetted parts)	gaskets	-	explosion protection	certification	-	process pressure	flange	flange size (flange = D)	description									
R	transmitted light refractometer																						
	500	standard sensor																					
		M	long sensor																				
		L	chemistry design																				
			C	stainless steel 316Ti (1.4571)																			
				S4	PTFE																		
				TF	FFKM (standard)																		
					KR	FFKM (oleum specialized)																	
					KA	not explosion-proof																	
						NN	-																
							NN																
								P10	PN 10														
								A15	150 psi														
								P16	PN 16														
								A30	300 psi														
								P40	PN 40 (on request)														
									F	FLEXIM flange (R500-MC)													
									D	direct flange (R500-LCS4, R500-*CTF)													
										050	DN 50 (R500-LCS4)												
										080	DN 80 (R500-LCS4)												
										002	2" (R500-LCS4)												
										003	3" (R500-LCS4)												
										H50	DN 50 (loose-type flange (R500-LCTF) or sight glass fitting (R500-MCTF))												
										H80	DN 80 (loose-type flange (R500-LCTF) or sight glass fitting (R500-MCTF))												
										H02	2" (loose-type flange (R500-LCTF) or sight glass fitting (R500-MCTF))												
										H03	3" (loose-type flange (R500-LCTF) or sight glass fitting (R500-MCTF))												

Process connection

Direct flange for PIOX R500-LCS4K*-****-***D

The sensor is welded to the direct flange (EN 1092-1 type 05 or ASME B16.5 150/300 psi).

description		sensor order code	pressure rating (flange)	pipe diameter	dimensions [inch]		dimensional drawing
					D	h	
direct flange	D050	R500-LCS4K*-****-P**D050	PN 16 optional: PN 40	DN 50	ø6.5	0.71	
	D080	R500-LCS4K*-****-P16D080	PN 16	DN 80	ø7.87	0.79	
	D002	R500-LCS4K*-****-A15D002 R500-LCS4K*-****-A30D002	150 psi 300 psi	2"	ø6	0.75	
	D003	R500-LCS4K*-****-A15D003 R500-LCS4K*-****-A30D003		3"	ø7.5	0.94	

special materials on request

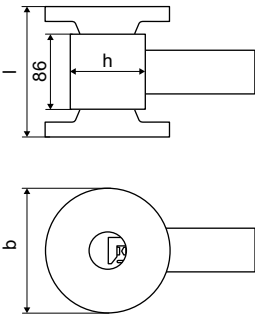
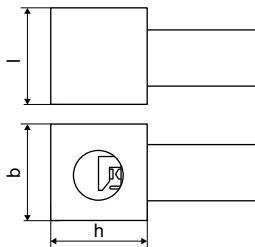
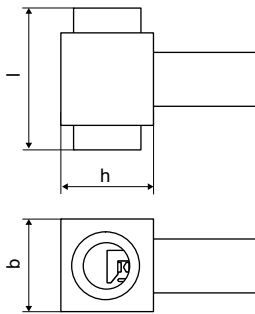
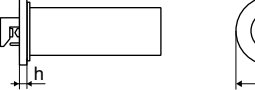

Process connection for PIOX R500-MCS4K*-****-***F

Order code

process connection	connection type	pipe diameter	explosion protection	material ¹	gaskets	pressure rating (flange) ¹	option	description
PCR								process connection
	FD							flow chamber with flanges according to EN 1092-1 type 11
	FA							flow chamber with flanges according to ASME B 16.5 150/300 psi
	FT							flow chamber with screwed connection
	FW							flow chamber with welded connection to the process pipe
	WR							round welding plate for vessel installation
	WS							square welding plate for vessel installation
		xxx						DN xxx (xxx = 015, 025, 050, 080) 1" (xxx = 001), 2" (xxx = 002), 3" (xxx = 003), 3/8" (xxx = G38), 1/2" (xxx = G12), 3/4" (xxx = G34) welding plate (xxx = T00)
			NN					not explosion-proof, zone 0/1
				S4				stainless steel 316Ti
					FE			FPM with FEP coating
						Pyy		pressure rating PN yy in bar (yy = 10, 16, on request: 40)
						Ayy		150 psi (yy = 15), 300 psi (yy = 30)
							HCL	cleaning line (PCR-F*)

¹ possible pipe diameters/materials/pressure ratings to be selected from table on page 16. Observe national regulations when selecting the flange size depending on the pressure rating.

Technical data

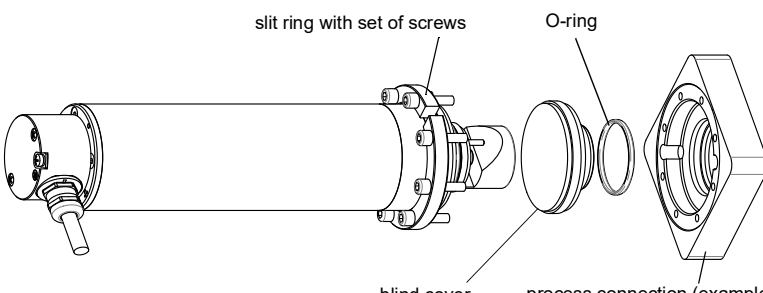
description	order code	pressure rating (flange) Pyy	pipe diameter xxx	dimensions [inch]			weight [lb]	dimensional drawing
				l	b	h		
flow chamber with flanges accessories: blind cover, sensor mounting kit optional: cleaning line ¹	PCR-FDxxx**-S4FE-P16	PN 16	DN 15	6.69	ø3.74	2.28	9.5	
			DN 25	6.93	ø4.53	2.28	11	
			DN 50	7.48	ø6.5	3.15	18.3	
	PCR-FAxxx**-S4FE-Ayy	150 psi 300 psi	DN 80	7.87	ø7.87	4.21	26.2	
			ANSI 1"	8.32	ø4.25	2.3	11.2	
			ANSI 2"	8.94	ø6	3.15	19.4	
			ANSI 3"	9.69	ø7.48	4.21	29.5	
flow chamber with screwed connection accessories: blind cover, sensor mounting kit optional: cleaning line ¹	PCR-FTxxx**-S4FE-Pyy		G 3/8"	3.94	3.94	3.94	7.3	
			G 1/2"				7.1	
			G 3/4"				7.1	
flow chamber with welded connection to the process pipe accessories: blind cover, sensor mounting kit optional: cleaning line ¹	PCR-FWxxx**-S4FE-Pyy		DN 15	3.94	3.94	2.28	6.2	
			DN 25	3.94	3.94	2.28	6	
			DN 50	3.94	3.94	3.15	9.3	
			DN 80	3.94	3.94	4.21	6.8	
			1"	3.94	3.94	2.3	6	
			2"	3.94	3.94	3.15	9.3	
			3"	3.94	3.94	4.21	6.8	
round welding plate for vessel installation accessories: blind cover, sensor mounting kit	PCR-WRT00**-S4FE-Pyy				ø3.94	0.79		
square welding plate for vessel installation accessories: blind cover, sensor mounting kit	PCR-WST00**-S4FE-Pyy			3.94	3.94	0.79		

xxx, yy - see order code
PN 40 on request

¹ cleaning connection:

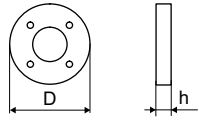
- thread: G1/4"
- cable gland
- stainless steel pipe 0.24 x 0.04 inch, length: 5.91 inch

Accessories

sensor mounting kit 											
sensor mounting kit slit ring set of screws O-ring blind cover included in supply	<table border="1"> <thead> <tr> <th>sensor mounting kit</th><th>item number</th></tr> </thead> <tbody> <tr> <td>slit ring</td><td>TR4492-SP</td></tr> <tr> <td>set of screws</td><td>8x TR4214-SP</td></tr> <tr> <td>O-ring</td><td>TR2661-SP</td></tr> <tr> <td>blind cover</td><td>TR4494-SP</td></tr> </tbody> </table>	sensor mounting kit	item number	slit ring	TR4492-SP	set of screws	8x TR4214-SP	O-ring	TR2661-SP	blind cover	TR4494-SP
sensor mounting kit	item number										
slit ring	TR4492-SP										
set of screws	8x TR4214-SP										
O-ring	TR2661-SP										
blind cover	TR4494-SP										

Direct flange for PIOX R500-LCTFKR-****-***D

The sensor is connected to the direct flange. It is fixed with a loose-type flange.

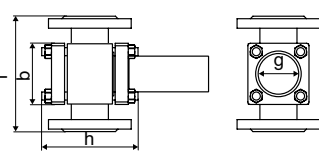
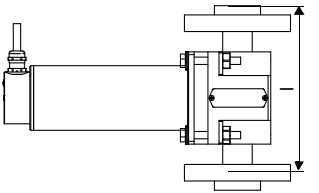
description	sensor order code	pressure rating (flange)	pipe diameter	dimensions [inch]		dimensional drawing
				D	h	
loose-type flange	DH50	R500-LCTFKR-****-P10DH50	DN 50	6.5	0.79	
	DH80	R500-LCTFKR-****-P10DH80	DN 80	7.87	0.79	
	DH02	R500-LCTFKR-****-A15DH02	150 psi	6.5	0.94	
	DH03	R500-LCTFKR-****-A15DH03	3"	7.87	1.06	

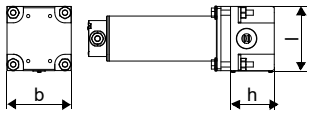
included in supply

Process connection for PIOX R500-MCTFKR-****-***D

Order code

process connection	connection type	pipe diameter	explosion protection	material (wetted parts)	gaskets	pressure rating (flange)	description
PCR							process connection
	FH						sight glass fitting
	PH						flow chamber PVDF
		xxx					DN xxx (xxx = 025, 050, 080) 1" (xxx = 001), 2" (xxx = 002), 3" (xxx = 003), 4" (xxx = 004) 3/8" (xxx = G38), 1/2" (xxx = G12), 3/4" (xxx = G34)
			NN				not explosion-proof, zone 0/1
				PF			sight glass fitting with PFA liner
				PV			PVDF
					FE		FPM with FEP coating
					NN		without gasket (self-sealing)
						Pyy	pressure rating PN yy in bar (yy = 10)
						Ayy	150 psi (yy = 15)

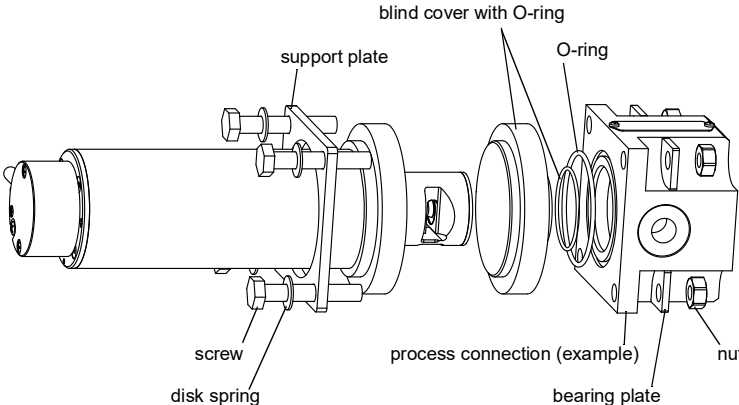
description	order code	pressure rating (flange)	pipe diameter	dimensions [inch]				dimensional drawing
				l	b	g	h	
sight glass fitting with PFA liner (self-sealing) • sensor: PIOX R500-MCTFKR-****-P10DH** (pipe diameter of sight glass fitting and sensor flange size must match each other)	PCR-FH050-**-PFNN-P10	PN 10	DN 50	9.06	4.72	ø3.15	7.28	
	PCR-FH080-**-PFNN-P10		DN 80	12.2	ø7.48	ø3.94	9.69	
	PCR-FH002-**-PFNN-A15	150 psi	2"	9.06	4.72	ø3.15	7.28	
	PCR-FH003-**-PFNN-A15		3"	12.2	ø7.48	ø3.94	9.69	
flow chamber with flanges (PVDF) • sensor: PIOX R500-MCTFKR-****-P10DH50 • gasket: TR2644-SP ¹	PCR-PH025-**-PVFE-P10	PN 10	DN 25	7.87				
	PCR-PH001-**-PVFE-A15	150 psi	1"	7.87				

description	order code	pres- sure ra- ting (flange)	pipe dia- meter	dimensions [inch]				dimensional drawing
				l	b	g	h	
flow chamber with scre- wed connection (PVDF) • sensor: PIOX R500- MCTFKR-****-P10DH50 • gasket: TR2644-SP ¹	PCR-PHG38-**-PVFE- A15	150 psi	NPT 3/8"	3.94	3.94		2.68	
	PCR-PHG12-**-PVFE- A15		NPT 1/2"					
	PCR-PHG34-**-PVFE- A15		NPT 3/4"					

¹ gasket TR2644-SP: 63.17 x 2.62 FEP (FPM), included in supply

Accessories

sensor mounting kit



blind cover with O-ring

support plate

O-ring

process connection (example)

bearing plate

nut

disk spring

screw

sensor mounting kit	item number
support plate	TR2013-SP
bearing plate	4x TR2014-SP
screw	4x TR9180-SP
nut	4x TR4294-SP
disk spring	4x TR4209-SP
O-ring	TR2644-SP
blind cover	TR3922-SP
O-ring	TR2646-SP

included in supply

For more information: **Emerson.com**

© 2025 Emerson. All rights reserved.

Emerson Terms and Conditions of Sale are available upon request.
The Emerson logo is a trademark and service mark of Emerson Electric Co. Flexim is a mark of one of the Emerson family of companies. All other marks are the property of their respective owners.