

Electronic Expansion Valves EX4-7-...FLR Versions and M12 Connector EVC05A

Emerson Climate Technologies' EX4-7-...FLR are stepper motor driven valves for precise control of refrigerant mass flow in air conditioning, refrigeration, heat pumps, close control, and industrial process cooling applications.

Features

- Fully hermetic design
- Stepper motor driven
- Very fast full stroke time
- High resolution and excellent repeatability
- Bi-flow versions with positive shut-off in both flow directions
- Positive shut-off function to eliminate the use of an additional solenoid valve
- Linear flow capacity
- Extremely wide capacity range (10 ... 100%)
- Continuous modulation of mass flow
- Direct coupling of motor and valve for high reliability (no gear mechanism)
- Ceramic slide and port for accurate flow and minimal wear
- Corrosion resistant stainless steel body and connections
-  II 3G Ex nA IIA T3 Gc X
- The qualification /certification of EX4-7-...FLR is valid only in conjunction with EVC05A (M12 Connector)



EX4-...FLR

EX7-...FLR



EVC05A

Features EVC05A (ifm electronic GmbH)

- Vibration and shock resistance
- Protection: BVS 08 ATEX E 109 U
IECEX BVS 08.0041 U
- Marking:  II 3G Ex nA IIC Gc
 II 2D Ex tD IIIC Db IP65/ IP67

Cable and Connector Assembly

Type	Part no.	Length	Connector type to valve	Connector type to driver board or controller
EVC05A	800439	5 m	M12	Loose wires

Selection Table

Type	Part no.	Flow pattern	Nominal capacity range [kW]	Inlet connection	Outlet connection	Electrical connector
EX4-I21FLR	800430	Uni-flow	2...17	3/8" ODF	5/8" ODF	Special M12 plug
EX4-M21FLR	800431			10 mm ODF	16 mm ODF	
EX5-U21FLR	800432		5...51.6	5/8" (16 mm) ODF	7/8" (22 mm) ODF	
EX6-I21FLR	800433		12...124	7/8" ODF	1-1/8" ODF	
EX6-M21FLR	800434			22 mm ODF	28 mm ODF	
EX7-I21FLR	800440		30...340	1-1/8" ODF	1-1/8" ODF	
EX7-M21FLR	800441	28 mm ODF		28 mm ODF		
EX4-U31FLR	800435	Bi-flow (Heat pump)	2...17	5/8" (16 mm) ODF	5/8" (16 mm) ODF	
EX5-U31FLR	800436			7/8" (22 mm) ODF	7/8" (22 mm) ODF	
EX6-I31FLR	800437		1 ... 124	1-1/8" ODF	1-1/8" ODF	
EX6-M31FLR	800438			28 mm ODF	28 mm ODF	
EX7-I31FLR	800442		30...340	1-1/8" ODF	1-1/8" ODF	
EX7-M31FLR	800443			28 mm ODF	28 mm ODF	

Note: The valves are delivered without cable/connector assembly (order separately). Nominal capacity at +38°C liquid temperature, +4°C evaporating temperature and 1K subcooling. For other operating condition, see the next page.

Quick Selection (included 1.5 bar pressure drop for liquid line components and distributor)

Condensing temperature °C	R290 Capacity in kW											Valve type
	Evaporating temperature °C											
	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	
75	17	17	16,9	16,6	16,4	16	15,6	15,2	14,8	14,3	13,8	EX4...FLR
	52	52	51	51	50	49	47	46	45	43	42	EX5...FLR
	124	124	123	121	119	117	114	111	108	104	100	EX6...FLR
	342	341	338	333	328	321	313	305	296	286	276	EX7...FLR
70	17,6	17,7	17,6	17,5	17,2	17	16,7	16,3	15,9	15,4	15	EX4...FLR
	54	54	53	53	52	52	51	49	48	47	45	EX5...FLR
	128	129	128	127	126	124	121	119	116	112	109	EX6...FLR
	353	354	352	350	345	340	334	326	318	309	300	EX7...FLR
65	17,9	18	18,1	18	17,9	17,7	17,4	17,1	16,7	16,4	15,9	EX4...FLR
	54	55	55	55	54	54	53	52	51	50	48	EX5...FLR
	130	131	132	131	130	129	127	125	122	119	116	EX6...FLR
	358	361	362	361	358	354	349	342	335	327	319	EX7...FLR
60	17,8	18,1	18,3	18,3	18,2	18,1	17,9	17,7	17,4	17	16,7	EX4...FLR
	54	55	55	56	55	55	54	54	53	52	51	EX5...FLR
	130	132	133	133	133	132	131	129	127	124	121	EX6...FLR
	357	363	366	366	365	363	359	354	348	341	334	EX7...FLR
55	17,5	17,9	18,2	18,3	18,4	18,3	18,2	18	17,8	17,5	17,2	EX4...FLR
	53	54	55	56	56	56	55	55	54	53	52	EX5...FLR
	127	130	132	134	134	134	133	131	130	128	125	EX6...FLR
	350	359	364	367	368	367	365	361	357	351	344	EX7...FLR
50	16,9	17,5	17,9	18,1	18,3	18,4	18,3	18,2	18	17,8	17,5	EX4...FLR
	51	53	54	55	56	56	56	55	55	54	53	EX5...FLR
	123	127	130	132	133	134	133	133	131	130	128	EX6...FLR
	338	350	358	363	367	368	367	365	361	356	351	EX7...FLR
45	15,9	16,7	17,3	17,7	18	18,2	18,2	18,2	18,1	17,9	17,7	EX4...FLR
	48	51	53	54	55	55	55	55	55	54	54	EX5...FLR
	116	122	126	129	131	132	133	132	132	130	129	EX6...FLR
	318	335	346	355	360	364	365	364	362	358	354	EX7...FLR
40	14,6	15,6	16,4	17	17,5	17,7	17,9	17,9	17,9	17,8	17,7	EX4...FLR
	44	47	50	52	53	54	54	54	54	54	54	EX5...FLR
	106	114	120	124	127	129	130	131	130	130	129	EX6...FLR
	292	313	329	341	350	355	358	359	359	357	353	EX7...FLR
35	12,8	14,2	15,3	16,1	16,7	17,1	17,4	17,5	17,6	17,6	17,5	EX4...FLR
	39	43	46	49	51	52	53	53	53	53	53	EX5...FLR
	93	104	111	117	122	125	127	128	128	128	127	EX6...FLR
	256	285	306	322	334	343	348	351	352	352	350	EX7...FLR
30	10,3	12,3	13,8	14,9	15,7	16,2	16,7	16,9	17,1	17,1	17,1	EX4...FLR
	31	37	42	45	48	49	51	51	52	52	52	EX5...FLR
	75	90	100	108	114	118	121	123	124	125	125	EX6...FLR
	206	247	276	298	314	325	333	339	342	343	343	EX7...FLR
20		5,3	8,7	10,7	12,1	13,1	13,8	14,3	14,7	14,9	15,1	EX4...FLR
		16	26	32	37	40	42	44	45	45	46	EX5...FLR
		39	63	78	88	95	101	104	107	109	110	EX6...FLR
		107	174	214	242	262	277	287	295	299	302	EX7...FLR

Select the valve type from tables for capacity value corresponding to system (evaporator) cooling capacity.

Technical Data EX4-7-...FLR Valves

MOPD (maximum operating pressure differential)	30 bar
Max. working pressure, PS	35 bar
Max. system test pressure	38.5 bar
Ambient temperature	-20...+60°C
Storage temperature	-40...+70°C
Medium inlet temperature	
Bi-flow version:	TS: -40...+80°C
Uni-flow version:	TS: -50...+100°C
Vibration for non-connected and fastened valve	4 g (0 to 1000 Hz, 1 octave /min.)
Material	stainless steel body and fittings
Marking	 acc. to directive 94/9/EC  II 3G Ex nA IIA T3 Gc X

Protection accordance to IEC 529, DIN 40050	IP67 with M12 Connector EVC05A
Humidity	5 to 95% r.H.
Connections	ODF stainless steel fittings
Shock	20 g at 11 ms 80 g at 1 ms
Net weight (kg)	0.5 kg (EX4), 0.52 kg (EX5), 0.60 kg (EX6), 1.1 kg (EX7)
Package and delivery (individual)	without electrical connector
Accessories	M12 Connector EVC05A

Electrical Data EX4-7-...-FLR Valves

Stepper motor type	Bi-polar, phase current by chopper control (constant current)
Electrical connection	4 pin terminal via plug
Nominal supply voltage to the valve U	24 VDC
Driver supply voltage range	18 ... 36 VDC
Phase current, operating	EX4-6-...FLR: 500 mA EX7-...FLR: 750 mA
Holding current	EX4-6-...FLR: 100 mA EX7-...FLR: 250 mA

Step mode	2 phase full step, half step or microstep
Step angle	1.8° per step ±8%
Stepping rate	500 Hz
Total number of steps	EX4-6-...FLR: 750 full steps EX7-...FLR: 1600 full steps
Winding resistance per phase	EX4-6-...FLR: 13 Ohm ±10% EX7-...FLR: 8 Ohm ±10%
Full travel time	EX4-6-...FLR: 1.5 seconds EX7-...FLR: 3.2 seconds
Reference position	Mechanical stop at fully closed position

Technical Data EVC05A (ifm electronic GmbH)

Operating voltage	36 VDC in conjunction with EX4-7-...FLR
Current rating	800 mA in conjunction with EX4-7-...FLR
Design	angled
Ambient temperature	-20...+60°C
Protection	IP 67
Approval	BVS 08 ATEX E 109 U IECEX BVS 08.0041 U

Material body	housing: TPU orange; sealing: Viton
Material nut	Stainless steel 316L / 1.4404
Tightening torque for knurled nut	1.2...1.5 Nm
Weight	0.18 Kg
Connection	PUR cable / 5 m; 4 x 0.34 mm ² (42 x Ø 0.1 mm); Ø 4.9 mm; halogen-free
Marking	 II 3G Ex nA IIC Gc  II 2D Ex tD IIIC Db IP65/IP67

General Information

EX4-7-...-FLR are stepper motor driven valves for precise control of refrigerant mass flow, released for R290 in refrigeration, air conditioning, heat pumps, industrial cooling process and close control systems.

Warning

The qualification /certification of EX4-7-...-FLR is valid only in conjunction with EVC05A (Plug & Cable assembly).

The listed products are electrical devices and are in compliance with EN60079-0/-15 and directive 94/9/EC therefore rated / marked as:

 II 3G Ex nA IIA T3 Gc X

Safety Instructions

- Read operating instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.
- According to EN 13313 it is intended for use by persons having the appropriate knowledge and skill.
- R290 requires special handling and care due to its flammability. Good ventilation is required during service of the system. Contact with rapidly expanding gases can cause frostbite and eye damage. Proper protective equipment (gloves, eye protection, etc.) has to be used.
- In a severely contaminated system, avoid breathing acid vapors and avoid contact with skin from contaminated refrigerant / lubricants. Failure to do so could result in injury.
- Ensure that the system is correctly labeled with applied refrigerant type and a warning for explosion risk.
- Before opening any system make sure pressure in system is brought to and remains at atmospheric pressure.
- Do not release any refrigerant into the atmosphere!
- Ensure that the system piping is grounded.
- Do not exceed the specified maximum ratings for pressure, temperature, voltage and current.
- Do not operate valve connected directly to supply voltage. Use suitable stepper motor driver.
- Do not operate system before all cable connections are completed.
- Do not operate the valve when the compressor is not running.
- Do not operate the valve when system is under vacuum except for closure of valve before refrigerant charging.
- Before installation or service disconnect all voltages from system and device.
- Do not use any other fluid media without prior approval of Emerson.
- Ensure that design, installation and operation are according to European and national standards/regulations.

Mounting Location

- The motor needs to be pointed downward or sideways (Fig. 1).
- For best result, locate the valve as close as possible to the distributor or inlet of evaporator.

Installation

- Direction of refrigerant flow must match with arrow on the label (except bi-flow valves).
- Check for sufficient refrigerant charge/subcooling and make sure no flash gas is present at the inlet of valve before attempting to check valve operation.
- Install an Emerson sight glass MIA...-FLR and an ADK....-FLR filter before the valve.

Warning

- All valves are delivered at half open. Do not charge system before closure of valve. See operating instructions of used driver/controller.
- The interior parts of valve must be protected against moisture and water at any time. It is not permitted to use water, steam or any other solvent to the inside of valve for cleaning purpose.

Recommended external pipe connection:

Nominal pipe connection	Outside diameter	
	Min. (mm)	Max. (mm)
3/8"	9.47	9.55
5/8" / 16 mm	15.80	16.05
7/8" / 22 mm	21.95	22.25
1-1/8"	28.50	28.63
10 mm	9.95	10.05
28 mm	27.95	28.05

Brazing (Fig. 2)

- Perform and consider the brazing joint as per EN 14324.
- Before and after brazing clean tubing and brazing joints.
- Minimize vibrations in the piping lines by appropriate solutions.
- **Do not exceed the max. body temperature of 120 °C!**
- Use flux and silver rod having a minimum of 30% silver.

Pressure Test

- After completion of installation, a pressure test must be carried out according to EN 378 for systems which must comply with European pressure equipment directive 97/23/EC.
- Max. system test pressure: 38.5 bar

Warning

- Failure to do so could result in loss of refrigerant and personal injury.
- The pressure test must be conducted by skilled persons with due respect regarding the danger related to pressure.

Tightness Test

- Conduct a tightness test according to EN 378-2 with appropriate equipment and method to identify leakages of external joints. The allowable leakage rate must be according system manufacturer's specification.

Electrical Connection:

Warning

- Entire electrical connections have to comply with local regulations.
- Improper wiring will result wrong direction of rotation, no rotation of stepper motor or controller malfunction.

Wiring / Mounting of Plug: (Fig. 4-6)

- 2 = White, 4 = Black, 3 = Blue, 1 = Brown
- Use only ATEX approved prewired M12 Connector assembly EVC05A for connection to the valve.
- **See also EVC05A operating instructions for plug mounting and required protection.**
- There is no specific requirement for positioning of plug on pins (see Fig. 5).
- **Ensure that the cables are mounted without tension; always leave the cable a bit loose.**
- **Ensure that cables are not mounted near sharp edges.**
- **Do not bend or mechanically stress the cable outlet, maintain a clearance of 20 mm to neighboring parts.**
- **During operation the connector EVC05A must be protected by an appropriate housing against external mechanical damage or shock (min. required protection up to a mechanical action of 7 J - in accordance with EN60079-0).**
- **Cable end of EVC05A must be connected to a driver/controller which is ATEX approved or located out of hazard zone.**
 - If driver/controller is located out of hazard zone, appropriate ATEX approved cable gland shall be used in boundary of hazard zone and out of hazard zone.
 - If the cable needs to be extended in hazard zone, it is mandatory to use ATEX approved type coupling or junction box.
- **Supply voltage to the valve shall never exceed 36 VDC at any time.**

Wiring / Mounting to Driver / Controller

- See the wiring diagram of used driver or controller.

Operation

- See operating instructions of used electronic driver/controller.
- **Perform a functional test of electrical circuit before charging the system with refrigerant.**

Service / Maintenance

- Defective EX4-7-...FLR valves must be replaced, they cannot be repaired.
- **Disconnect electrical power to driver/controller before service.**
- **Before any debrazing ensure that the flammable refrigerant is pumped out of the system and the room around the system is well vented so no refrigerant left.**
- For motor check:
 - Remove cable plug from valve under no voltage.
 - Use an Ohm meter with suitable range.
 - Measure windings resistance per phase at opposite placed pins acc. Fig. 6 and data as in the table below.
- **The lowest pressure inside system must be at least 0.4 bar higher than ambient pressure at any time. Failure to do so could accumulate air inside the system and create an explosive mixture over time.**

Technical Data

Type	EX4-6-...FLR	EX7-...FLR
Max. allowable working pressure PS	35 bar	
Operating temp. at motor	Uni-flow versions: -50°C...+100°C Bi-flow versions: -40°C...+80°C	
Connection	see Fig. 3	
Refrigerant: R290	✓	✓
Nominal Supply Voltage to the valve U	24 VDC	24 VDC
Max. Current I _{max}	0.5 A	0.75 A
Winding resistance per phase	13 Ω ± 10%	8 Ω ± 10%
CE Marking acc. to directive 94/9/E	Yes	Yes

Fig. 1

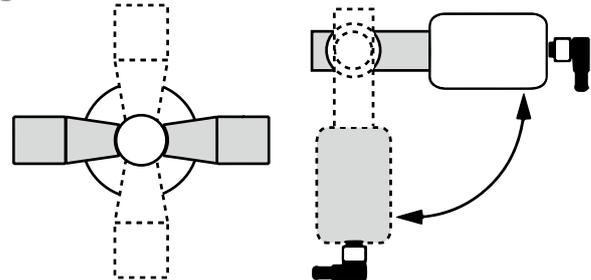
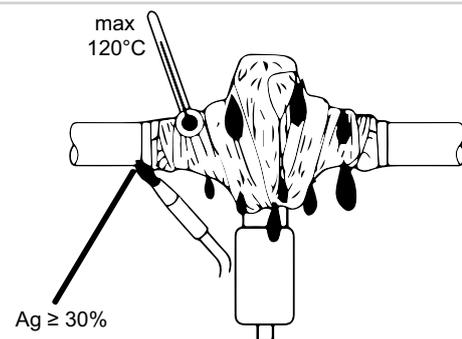
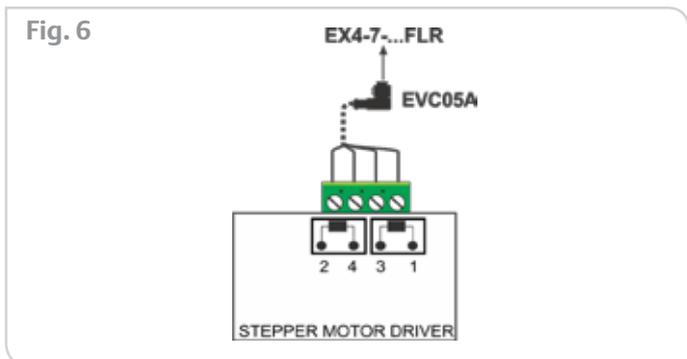
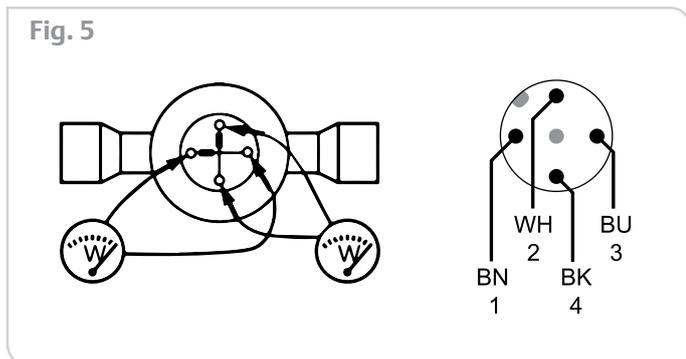
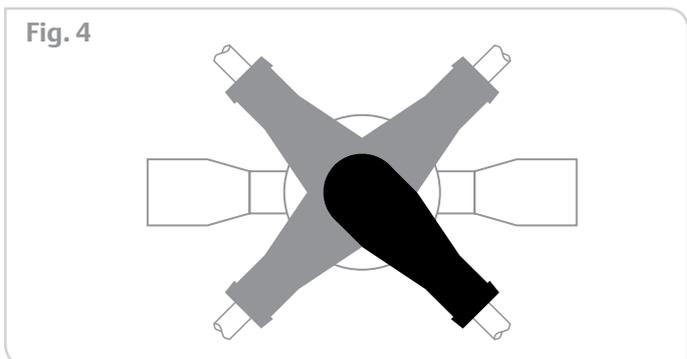
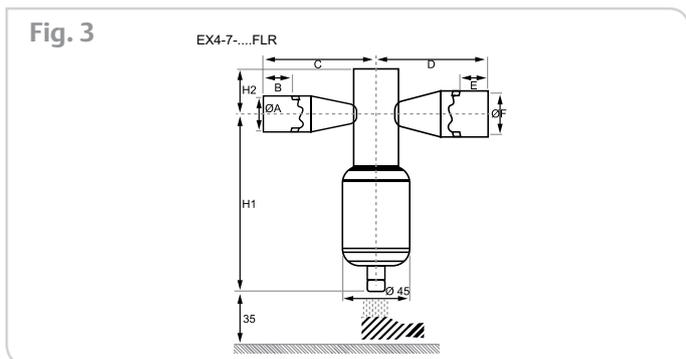


Fig. 2





EXV	Flow pattern	Part. no.	Ø A x Ø F(ODF)	B	C	D	E	H1	H2
EX4-I21FLR	Uni-flow	800430	3/8" x 5/8"	8	45	55	11	113	25
EX4-M21FLR		800431	10 x 16 mm	8	45	55	11	113	25
EX5-U21FLR		800432	5/8" x 7/8" (16 x 22 mm)	11	55	65	16	113	25
EX6-I21FLR		800433	7/8" x 1-1/8"	16	65	75	19	113	25
EX6-M21FLR		800434	22 x 28 mm	16	65	75	19	113	25
EX7-I21FLR		800440	1-1/8" x 1-1/8"	20	78	83	20	158	42
EX7-M21FLR		800441	28 x 28 mm	20	78	83	20	158	42
EX4-U31FLR	Bi-flow	800435	16 x 16 mm (5/8" x 5/8")	11	55	55	11	113	25
EX5-U31FLR		800436	7/8" x 7/8" (22 x 22 mm)	16	65	65	16	113	25
EX6-I31FLR		800437	1-1/8" x 1-1/8"	19	75	75	19	113	25
EX6-M31FLR		800438	28 x 28 mm	19	75	75	19	113	25
EX7-I31FLR		800442	1-1/8" x 1-1/8"	20	83	83	20	158	42
EX7-M31FLR		800443	28 x 28 mm	20	83	83	20	158	42

Sequence for driving of stepper motor and valve

Direction	Reverse direction	Number of steps	Identification code of pins for electrical connections to third party drivers/controllers				
			2	4	3	1	
Current direction							
Valve is opening ↓	Valve is closing ↑	Step 1	+	-	+	-	
		Step 2	-	+	+	-	
		Step 3	-	+	-	+	
		Step 4	+	-	-	+	
		Remark	The sequence is repeated from step 5 to 8 similar to step 1 to 4				
		Step 5	+	-	+	-	
		Step 6	-	+	+	-	
		Step 7	-	+	-	+	
		Step 8	+	-	-	+	
		Remark	The sequence is repeated from step 9 to 12 similar to step 1 to 4				
↓	↓	↓	↓				

Functions and Features

- Use in hazardous areas according to the classification

II3G (Group II, category 3G, apparatus for gas atmosphere).
Complies with the requirements of the standard EN 60079-15.

- Use in hazardous areas according to the classification

II3G (Group II, category 20, apparatus for dust atmosphere). Complies with the requirements of the standards IEC 60079-0 and IEC 60079-31.

- EC component certificate: BVS 08ATEX E 109 U
- IEC Ex component certificate: IECEx BVS 08.0041 U
- Marking:

Ex II3G Ex nA IIC Gc (see table Operating temperature range)

Ex II20 Ex tb IIIC Db IP65/IP67

Operating temperature range

-20...+60°C

for connection cables and jumpers with angled M12 plug and angled M12 sockets

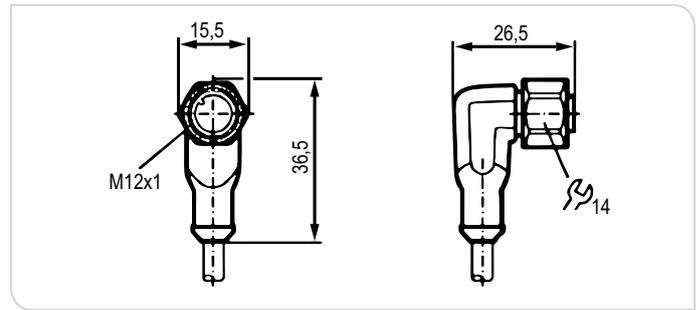
Installation / Set-up

The M12 connectors must only be installed connected and set up by qualified staff. The qualified staff must have knowledge of protection classes, regulations- and provisions for apparatus in hazardous areas.

Check whether the classification (see “Marking” above and marking on the M12 connector) is suitable for the application.

Installation Remarks / Installation

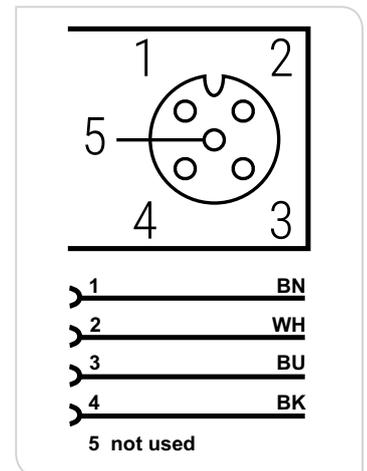
- Adhere to the relevant national regulations and provisions.
- Avoid electrostatic charging on plastic units and cables.
- Protect the M12 connectors efficiently against damage.
- The cables must be firmly laid and effectively protected against damage.
- The relevant installation regulations must be adhered to.
- For the technical data please refer to the data sheet. (see Technical Bulletin EX4-7-...-FLR).
- Avoid direct radiation with high UV components (sunlight); mount the unit in a protected place.
- M12 plugs may only be opened or closed in a sufficiently clean environment.
- Connectors must always be closed with a counterpart. They may be left open in the field only briefly for servicing purposes.



Wiring

Core colors

- BK black
- BN brown
- BU blue
- WH white



Caution: Not for interrupting current!

Special Conditions for Safe Operation

- The M12 connectors were tested in accordance with table 8 of EN 60079-0/table 5 of EN 61241-0 for group II and for a low mechanical risk with impact energy of 4 joules.
- Do not separate the connectors when energized.
- Secure the connector by tightening the nut sufficiently. Tightening torque approx. 1.2 Nm to 1.5 Nm. This tightening torque is ensured as follows:
 - Hand-fasten the coupling nut (0.4 to 0.5 Nm).
 - Then turn by 3 notches using a screwdriver across the flats 14.
- The connector conforms to the requirements for an M12 connector in EN 61076-2-101. The counterpart must also conform to this standard.
- Always refer to the operating-instructions as space restrictions may not allow markings to be applied to the unit.

Maintenance / Repair

The unit must not be modified nor can it be repaired. In case of a fault please contact the manufacturer.

The data sheets, the EC component certificates or IEC Ex component certificates are available from the manufacturer on request.