

## Series 23SX

High-precision piezoresistive pressure transmitters

### Features

- RS485 interface can be combined with an analog interface
- Analog interface can be ranged via RS485 (turn-down)
- Modbus RTU protocol for process values and configuration
- Excellent long-term stability

### Technology

- Insulated and encapsulated piezoresistive pressure sensor
- Fully welded construction without internal seals
- High-quality pressure transducers and proven mathematical compensation
- Based on technology from the well-known 33X series with the highest level of accuracy

### Typical applications

- Engine test benches
- Industrial applications
- Automation technology
- Mobile hydraulics

#### Accuracy

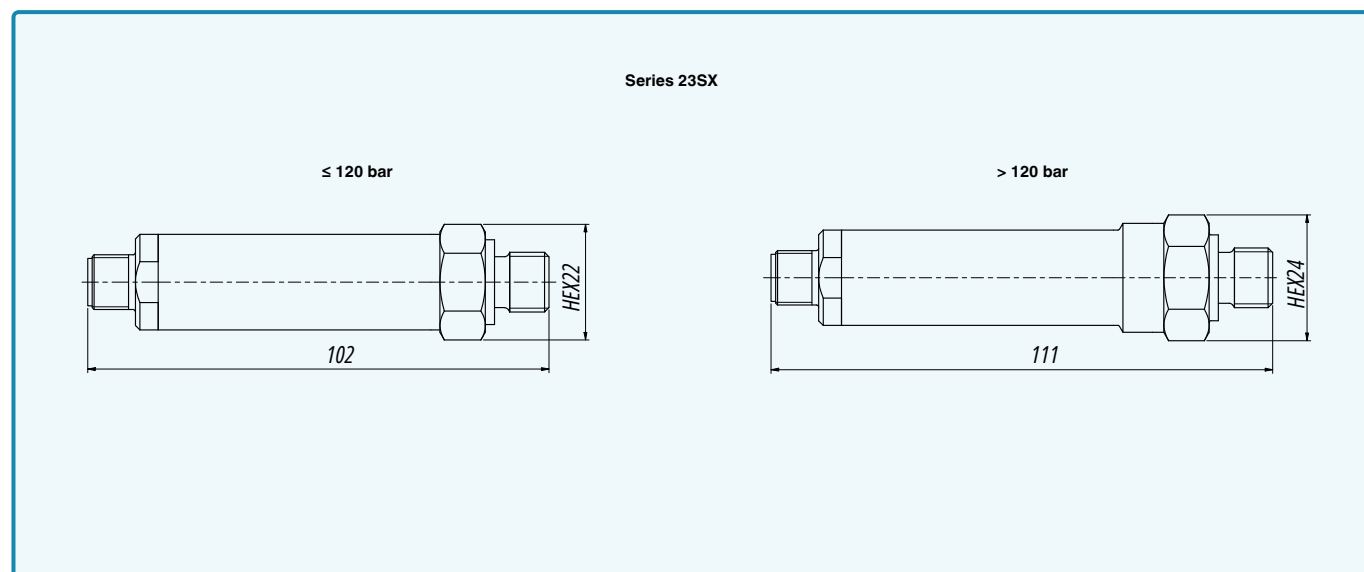
± 0,1 %FS

#### Total error band

± 0,25 %FS @ -10...80 °C

#### Pressure ranges

0...0,16 to 0...1000 bar



## Series 23SX – Specifications

### Standard pressure ranges

| Relative pressure<br>PR                |              | Proof pressure              |
|----------------------------------------|--------------|-----------------------------|
| 0...0,16                               | -0,16...0,16 | 3                           |
| 0...0,25                               | -0,25...0,25 |                             |
| 0...0,4                                | -0,4...0,4   |                             |
| 0...0,6                                | -0,6...0,6   |                             |
| 0...1                                  | -1...0       |                             |
|                                        | -1...1       | 9                           |
| 0...1,6                                | -1...1,6     |                             |
| 0...2,5                                | -1...2,5     |                             |
| 0...4                                  | -1...4       | 12                          |
| 0...6                                  | -1...6       | 18                          |
| 0...10                                 | -1...10      | 30                          |
| 0...16                                 | -1...16      | 48                          |
| 0...25                                 | -1...25      | 75                          |
| bar rel.                               |              | bar                         |
| Reference pressure at ambient pressure |              | Based on reference pressure |

| Absolute pressure<br>PAA                  | Absolute pressure<br>PA          | Proof pressure              |
|-------------------------------------------|----------------------------------|-----------------------------|
| 0,5...1,1                                 |                                  | 3                           |
| 0...1                                     |                                  |                             |
| 0...1,6                                   |                                  | 9                           |
| 0...2,5                                   |                                  |                             |
| 0...4                                     | 0...4                            | 12                          |
| 0...6                                     | 0...6                            | 18                          |
| 0...10                                    | 0...10                           | 30                          |
| 0...16                                    | 0...16                           | 48                          |
| 0...25                                    | 0...25                           | 75                          |
| 0...40                                    | 0...40                           | 120                         |
| 0...60                                    | 0...60                           | 180                         |
| 0...100                                   | 0...100                          | 300                         |
| 0...160                                   | 0...160                          | 500                         |
| 0...250                                   | 0...250                          |                             |
| 0...400                                   | 0...400                          | 800                         |
| 0...600                                   | 0...600                          | 1200                        |
| 0...1000                                  | 0...1000                         |                             |
| bar abs.                                  | bar                              | bar                         |
| Reference pressure at 0 bar abs. (vacuum) | Reference pressure at 1 bar abs. | Based on reference pressure |

### Performance

#### Pressure

|                                |                                                                                                                                                                 |                                                                                                                                                                                                                           |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accuracy @ RT (20...25 °C)     | $\leq \pm 0,1 \text{ \%FS}$                                                                                                                                     | Non-linearity (best fitted straight line BFSL), pressure hysteresis, non-repeatability, zero point deviation and amplification deviation                                                                                  |
| Total error band (-10...80 °C) | $\leq \pm 0,25 \text{ \%FS}$                                                                                                                                    | Max. deviation within the compensated pressure and temperature range. Experience shows that, outside the compensated temperature range, the total error band is expanded by 0,1 %FS within the ambient temperature range. |
| Compensated temperature range  | -10...80 °C                                                                                                                                                     | Other temperature ranges within -40...125 °C possible as an option.                                                                                                                                                       |
| Long-term stability            | $\leq \pm 0,15 \text{ \%FS}$                                                                                                                                    | Per year under reference conditions, yearly recalibration recommended.                                                                                                                                                    |
| Position dependency            | $\leq \pm 1,5 \text{ mbar}$                                                                                                                                     | Calibrated in vertical installation position with pressure connection facing downwards.                                                                                                                                   |
| Resolution                     | 0,002 %FS                                                                                                                                                       | Digital                                                                                                                                                                                                                   |
| Signal stability               | 0,01 %FS                                                                                                                                                        | Digital noise-free                                                                                                                                                                                                        |
| Internal measurement rate      | $\geq 1800 \text{ Hz}$                                                                                                                                          | For version «3-wire + digital (0...10 V. 0...5 V)» > 6000 Hz.                                                                                                                                                             |
| Pressure range reserve         | $\pm 10 \text{ \%}$                                                                                                                                             | Outside the pressure range reserve, +Inf / -Inf is displayed. If there is an error in the device, NaN is displayed.                                                                                                       |
| Vacuum resistance              | For operating pressures $\leq 0,1 \text{ bar abs.}$ , a vacuum-optimised version is recommended.                                                                |                                                                                                                                                                                                                           |
| Note                           | For pressure ranges < 1 bar, accuracy, total error band and long-term stability for 1 bar full-scale (FS) range apply.<br>Higher accuracy available on request. |                                                                                                                                                                                                                           |

#### Temperature

|                           |                         |                                                                                                                                                                                          |
|---------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Accuracy                  | $\leq \pm 2 \text{ °C}$ | The temperature is measured on the pressure sensor (silicon chip) that sits behind the metallic separating diaphragm. The specifications apply within the compensated temperature range. |
| Resolution                | $\leq 0,01 \text{ °C}$  |                                                                                                                                                                                          |
| Internal measurement rate | > 10 Hz                 |                                                                                                                                                                                          |

## Series 23SX – Specifications

### Electrical data

| Connectivity                              | digital                                                                                                                                                                                  | 2-wire + digital | 3-wire + digital |            |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|------------|
| Analog interface                          |                                                                                                                                                                                          | 4...20 mA        | 0...10 V         | 0...5 V    |
| Digital interface                         | RS485                                                                                                                                                                                    | RS485            | RS485            | RS485      |
| Power supply                              | 3,2...32 VDC                                                                                                                                                                             | 8...32 VDC       | 13...32 VDC      | 8...32 VDC |
| Power consumption (without communication) | < 8 mA                                                                                                                                                                                   | 3,5...22,5 mA    | < 8 mA           | < 8 mA     |
| RS485 voltage insulation                  | ± 32 VDC                                                                                                                                                                                 | ± 18 VDC         | ± 32 VDC         | ± 32 VDC   |
| Note                                      | Disturbance of the 4...20 mA signal occurs during communication through the digital interface. 3-wire types are suitable for simultaneous operation of the analog and digital interface. |                  |                  |            |

|                                             |                   |
|---------------------------------------------|-------------------|
| Start-up time (power supply ON)             | < 250 ms          |
| Overvoltage protection and reverse polarity | ± 32 VDC          |
| GND case insulation                         | > 10 MΩ @ 300 VDC |

#### Analog interface

|                    |                                                    |                          |
|--------------------|----------------------------------------------------|--------------------------|
| Load resistance    | < (U - 8 V) / 25 mA                                | 2-wire 3-wire 2-wire 3-  |
|                    | > 5 kΩ                                             | wire (0...10 V, 0...5 V) |
| Limiting frequency | ≥ 300 Hz                                           |                          |
|                    | ≥ 1000 Hz                                          |                          |
| Note               | Filter properties can be adjusted by the customer. |                          |

#### Digital interface

|                         |                        |                                                                                                               |
|-------------------------|------------------------|---------------------------------------------------------------------------------------------------------------|
| Type                    | RS485                  | Half-duplex                                                                                                   |
| Communication protocols | Modbus RTU             |                                                                                                               |
|                         | KELLER bus protocol    | Proprietary                                                                                                   |
| Identification          | Class.Group: 5.24      | Standard settings:<br>bus address 1,<br>baud rate 9600 bit/s.                                                 |
| Unit of pressure        | bar                    |                                                                                                               |
| Unit of temperature     | °C                     | Other default settings<br>available on request. Can be<br>reconfigured via software by<br>the customer later. |
| Data type               | Float32 and Int32      |                                                                                                               |
| Baud rates              | 9600 and 115'200 bit/s |                                                                                                               |
| Lines                   | up to 1,2 km           |                                                                                                               |

#### Electrical connection

|                        |                        |                     |                                    |
|------------------------|------------------------|---------------------|------------------------------------|
| Standard plug          | Round plug             | M12 x 1             | DIN EN 61076-2-101, A-coded, 5-pin |
|                        | Round plug 423-723-425 | M16 x 0,75          | DIN EN 61076-2-106, 5-pin          |
| Alternative plug       | Valve plug             | Form A (18 mm)      | DIN EN 175301-803-A (DIN 43650)    |
| Cable                  | ø 5,8 mm, PE sheath    | 5-wire, cable gland |                                    |
| Standard cable lengths | 2m, 5m                 | Other on request    |                                    |

#### Electromagnetic compatibility

|                                       |                                                                                                               |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------|
| CE conformity as per 2014/30/EU (EMC) | EN IEC 61326-1 / EN IEC 61326-2-3 / EN IEC 61000-6-1 / EN IEC 61000-6-2 / EN IEC 61000-6-3 / EN IEC 61000-6-4 |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------|

## Series 23SX – Specifications

### Mechanical data

Materials in contact with media

|                                          |                                    |                                                                                                                  |
|------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Pressure connection                      | Stainless steel AISI 316L          | ≤ 400 bar                                                                                                        |
|                                          | Stainless steel AISI 318LN, 1.4462 | > 400 bar                                                                                                        |
| Pressure transducer separating diaphragm | Stainless steel AISI 316L          |                                                                                                                  |
| Pressure transducer seal (internal)      | None                               |                                                                                                                  |
| Pressure connection seal (external)      | FKM (75 Shore)<br>-20...200 °C     | For media temperatures < -20 °C wird FVMQ (70 Shore, -60...175 °C) is used.<br><br>Optional: EPDM (-40...150 °C) |

Other materials

|                                 |              |                    |
|---------------------------------|--------------|--------------------|
| Pressure transducer oil filling | Silicone oil | Others on request. |
|---------------------------------|--------------|--------------------|

Further details

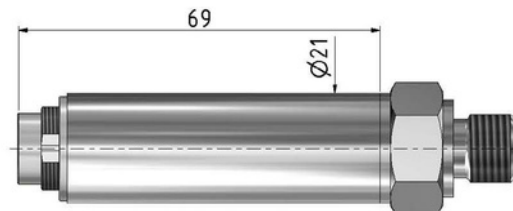
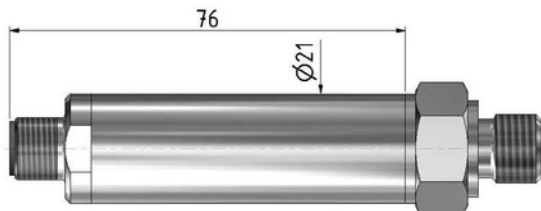
|                          |                             |                             |
|--------------------------|-----------------------------|-----------------------------|
| Pressure connection      | G1/4 male 1/4-18NPT male    | See Dimensions and options. |
|                          | ø 21 mm x approx. 115 mm    |                             |
| Diameter x length        | approx. 130 g approx. 200 g |                             |
| Weight (excluding cable) |                             | Low pressure                |
|                          |                             | High pressure               |

### Ambient conditions

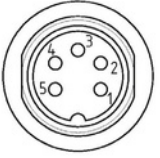
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|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------------------------|
| Media temperature range              | -40...125 °C                                                                                                                                                                                                                                              |                                        | Icing not permitted.                                          |
| Ambient temperature range            | -20...85 °C                                                                                                                                                                                                                                               | Optional: -40...85 °C                  |                                                               |
| Storage temperature range            | -20...85 °C                                                                                                                                                                                                                                               | Optional: -40...85 °C                  |                                                               |
| Protection                           | IP67                                                                                                                                                                                                                                                      | Round plug M12 x 1                     | For relative pressure IP54.                                   |
|                                      | IP67                                                                                                                                                                                                                                                      | Round plug 423 - 723 - 425, M16 x 0,75 | For relative pressure, use a cable with integrated capillary. |
|                                      | IP65                                                                                                                                                                                                                                                      | Valve plug Form A (18 mm)              |                                                               |
|                                      | IP68                                                                                                                                                                                                                                                      | Cable gland                            | For relative pressure, cable with integrated capillary.       |
| Notes                                | <ul style="list-style-type: none"> <li>Protection ratings are valid with the corresponding mating plug.</li> <li>The design implementation of the ventilation for relative pressure versions can be found in the respective technical drawing.</li> </ul> |                                        |                                                               |
| Vibration resistance                 | 10 g, 10...2000 Hz, ± 10 mm                                                                                                                                                                                                                               | IEC 60068-2-6                          |                                                               |
| Shock resistance                     | 50 g, 11 ms                                                                                                                                                                                                                                               | IEC 60068-2-27                         |                                                               |
| Pressure endurance @ RT (20...25 °C) | > 10 million pressure cycles                                                                                                                                                                                                                              | 0...100 %FS                            |                                                               |

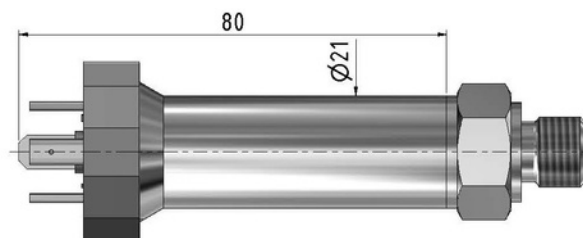
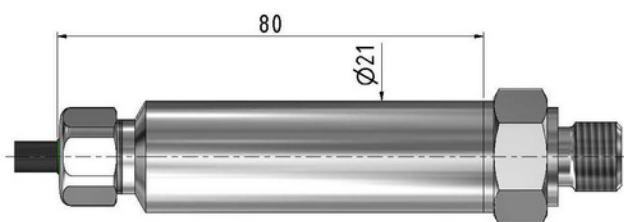
## Series 23SX – Dimensions and options

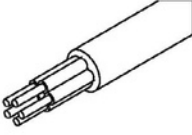
### Electrical connections



| Round plug                                                                        | 2-wire    | 3-wire        |
|-----------------------------------------------------------------------------------|-----------|---------------|
| M12 × 1                                                                           | 4...20 mA | 0...max. 10 V |
|  | 1 OUT/GND | 1 GND         |
|                                                                                   | 2 n.c.    | 2 +OUT        |
|                                                                                   | 3 +Vs     | 3 +Vs         |
|                                                                                   | 4 RS485A  | 4 RS485A      |
|                                                                                   | 5 RS485B  | 5 RS485B      |

| Round plug                                                                         | 2-wire    | 3-wire        |
|------------------------------------------------------------------------------------|-----------|---------------|
| M16 × 0,75                                                                         | 4...20 mA | 0...max. 10 V |
|  | 1 OUT/GND | 1 GND         |
|                                                                                    | 2 n.c.    | 2 +OUT        |
|                                                                                    | 3 +Vs     | 3 +Vs         |
|                                                                                    | 4 RS485A  | 4 RS485A      |
|                                                                                    | 5 RS485B  | 5 RS485B      |



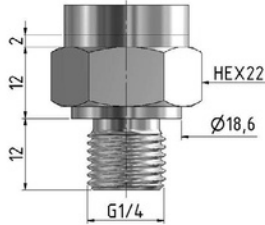
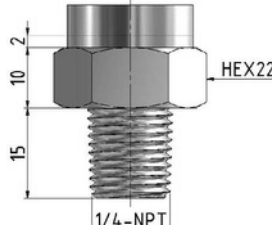
| Cable gland                                                                         | 2-wire         | 3-wire         |
|-------------------------------------------------------------------------------------|----------------|----------------|
| Cable ø 5,8                                                                         | 4...20 mA      | 0...max. 10 V  |
|  | WH. OUT/GND    | WH. GND        |
|                                                                                     | RD n.c.        | RD +OUT        |
|                                                                                     | BK +Vs         | BK +Vs         |
|                                                                                     | BU RS485A      | BU RS485A      |
|                                                                                     | YE RS485B      | YE RS485B      |
|                                                                                     | Shield on CASE | Shield on CASE |

| Valve plug                                                                           | 2-wire    |          | 3-wire        |   |          |
|--------------------------------------------------------------------------------------|-----------|----------|---------------|---|----------|
| Form A (18 mm)                                                                       | 4...20 mA |          | 0...max. 10 V |   |          |
|  |           | Standard | Alternative   |   | Standard |
|                                                                                      | 1         | OUT/GND  | n.c.          | 1 | GND      |
|                                                                                      | 2         | n.c.     | OUT/GND       | 2 | +OUT     |
|                                                                                      | 3         | +Vs      | +Vs           | 3 | +Vs      |
|                                                                                      | ⬇         | CASE     | CASE          | ⬇ | CASE     |

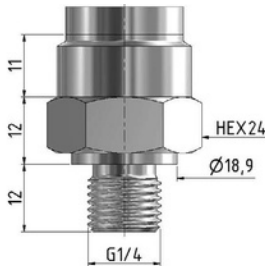
## Series 23SX – Dimensions and options

### Available pressure connections

For pressure range  $\leq 120$  bar

| G1/4                                                                              | 1/4-18NPT                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|  |  |
| DIN EN ISO 1179-2                                                                 | ASME/ANSI B 120.1                                                                 |

For pressure range  $> 120$  bar

| G1/4                                                                               | 1/4-18NPT                                                                          |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
|  |  |
| DIN EN ISO 1179-2                                                                  | ASME/ANSI B 120.1                                                                  |

Other pressure connections available on request.

### Other customer-specific options

- Other compensated pressure ranges
- Other compensated temperature ranges within  $-40 \dots 125$  °C
- Other electrical connections
- Parts that come into contact with media made from Hastelloy C-276, Inconel 718 or titanium
- O-Rings made of other materials
- Other oil filling types for pressure transducers
- Vacuum-optimised version for operating pressures  $\leq 0.1$  bar abs.
- Integration of application-specific calculations
- Modifications to customer-specific applications
- Higher accuracy

### Examples of related products

- Series 23SXc: Pressure transmitters with CANopen interface
- Series 33X: Pressure transmitters with accuracy up to 0,01 %FS
- OEM series: Pressure transducer with electronics (e.g. series 9LX or 20SX with thread) for integration in one's own systems

## Series 23SX – Software, scope of delivery and accessories

### Modbus interface

The X-line products have a digital interface (RS485 half-duplex), which supports the MODBUS RTU and KELLER bus protocols. Details of the communication protocols can be found at [www.keller-druck.com](http://www.keller-druck.com). Documentation, a Dynamic Link Library (DLL) and various programming examples are available for integrating the communication protocol into your own software.

### Interface converters

The connection to a computer is established via an RS485-USB interface converter. To ensure smooth operation, we recommend the K-114 with the corresponding mating plug, robust driver module, fast RX/TX switching and connectable bias and terminating resistors.

### «CCS30» software

The free licence software CCS30 is used to carry out configurations and record measured values.

#### Measurement collection

- Live visualisation
- Adjustable measuring and storage interval
- Export function
- Parallel recording in bus operation
- Up to 100 measured values per second

#### Configuration

- Call up of information (pressure and temperature range, software version, serial number etc.)
- Readjustment of zero point and amplification
- Rescaling of analog output (unit, pressure range)
- Adjustment of low-pass filter
- Selection of instrument address and baud rate

### Scope of delivery

| Calibration certificate                                                             | Mating plug to round plug<br>423 - 723 - 425, IP67                                  | Mating plug to valve plug<br>form A                                                 |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |

### Accessories

| Calibration certificate<br>with 5 measuring points                                  | Calibration certificate<br>with 11 measuring points                                 | Calibration certificate                                                                                                   | Interface converter                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                        | Mating plug to<br>round plug                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  |  |                                        |                                                                                                                                                                                  |                                                                                                                                   |                                                                                                                                                                                       |
| Deviation at room temperature. Issued by KELLER.                                    | Deviation at room temperature with hysteresis. Issued by KELLER.                    | Issued by the external calibration laboratory of the German accreditation body DAkkS or the Swiss accreditation body SAS. | <b>K-114</b> <ul style="list-style-type: none"> <li>• Analog measurement 0...10 V and 4...20 mA</li> <li>• 12 V measuring device supply via USB</li> <li>• USB interface electrically isolated</li> <li>• Bias and terminating resistors can be activated</li> </ul> | <b>Connection options</b> <ul style="list-style-type: none"> <li>• E.g. K-114-B with cable outlet instead of screw-type terminals for Binder series 723 (5-pin)</li> <li>• Various adapter cables available</li> </ul> | <ul style="list-style-type: none"> <li>• Angled socket, cable 5 m<br/>PN 602515.0093</li> <li>• Angled socket, cable 2 m<br/>PN 602515.0094</li> <li>• Female connector, cable 5 m<br/>PN 602515.0095</li> <li>• Female connector, cable 2 m<br/>PN 602515.0096</li> </ul> |