EXTREME ENVIRONMENTS. EXTREMELY SIMPLE.

SDI-PT-KEL

SDI-12 Submersible Pressure Transducer

User Manual

For SDI-PT-SS-KEL and SDI-PT-TT-KEL

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Chapter 1 GENERAL

1.1 GENERAL DESCRIPTION

The SDI-12 Submersible Pressure Transducer (SDI-PT-KEL) is designed for freshwater level measurements. Typical applications include lakes, streams, wells, agricultural water level/flow, and tanks.

The SDI-PT-KEL can be supplied with either a stainless steel (SDI-PT-SS-KEL) or a titanium (SDI-PT-TT-KEL) case and with either a bayonet connector for use with FTS Axiom Dataloggers or with flying leads for use with other data loggers.

A vent tube incorporated in the cable vents the sensor diaphragm to the atmosphere. This eliminates the need to compensate for changes in barometric pressure. Care must be given to prevent the vent tube from being pinched or crushed which can result in erroneous readings. Ensure the cable is free from obstructions and kinks.

To prevent water vapor from entering the inner cavity of the sensor, which can cause erroneous data and damage to the sensor, the vent tube opening terminates inside a desiccated vent tube enclosure.

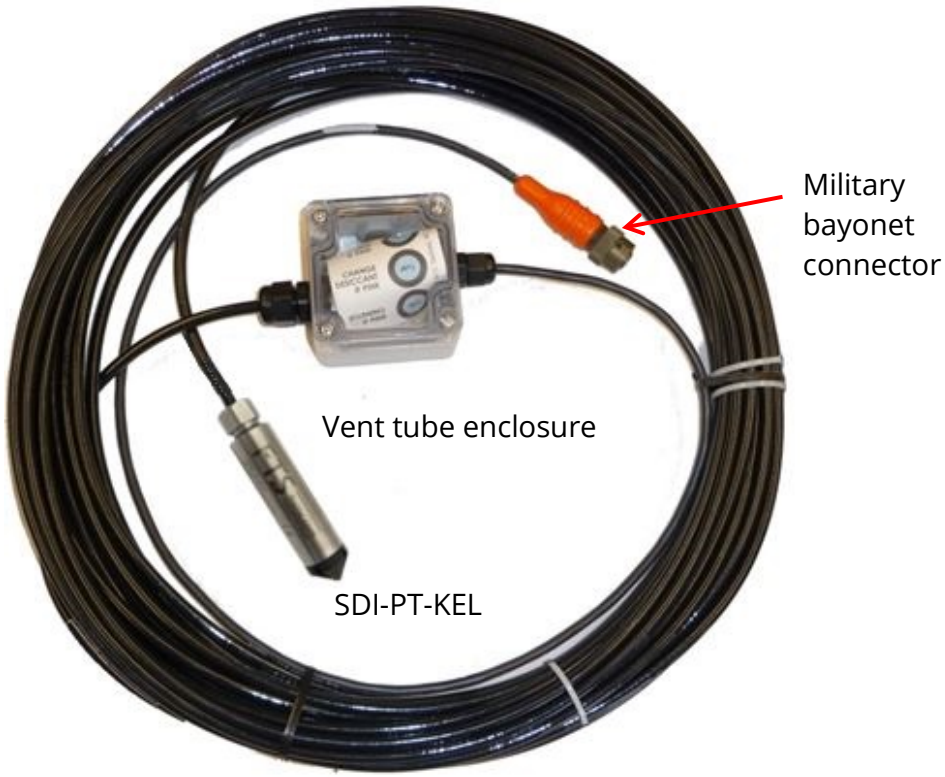
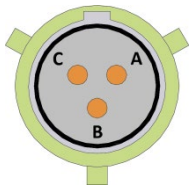


Figure 1-1: SDI-PT-KEL

1.2 WIRING

The SDI-PT-KEL can be supplied with a bayonet connector for use with FTS Axiom Dataloggers or with flying leads for use with other data loggers.

WIRE COLOUR (flying leads)	BAYONET PIN	FUNCTION
Red	A	+12 V DC power supply
White	B	Data
Black	C	Ground
Blue	N/A	RS485A
Yellow	N/A	RS485B



Bayonet connector

Braided shield wire is connected to the transducer housing. For lightning protection to function properly the shield wire must be connected to a good earth ground.

1.3 OPERATION

The SDI-PT-KEL is an SDI-12 device and is powered by the +12 V DC power supply on the SDI-12 bus. For details on the SDI commands used by the sensor, see Chapter 5 - SDI Commands.

1.4 CONFIGURATION

The SDI-PT-KEL is shipped with default address zero (0). If more than one SDI-12 sensor is on the same bus it may be necessary to change the address. Refer to Chapter 4 for instructions on the command used to set the sensor's address.

1.5 MAINTENANCE

Every visit make a visual inspection of the wiring and physical conditions looking for damage to the sensor and cable, or sensor blockages. Check the vent tube enclosure humidity monitor card to determine if the desiccant requires changing. Verify that the air inlet is free from debris.

Please contact FTS technical support (see manual front pages) if the unit ceases to operate properly.

1.5.1 Changing the Desiccant

When the humidity monitor card indicates a 40% level of humidity, the desiccant must be changed. In order to do so the vent tube enclosure must be opened using a Phillips or slot screwdriver. Only do this in a clean, dry environment.

Replace the desiccant bag and place a new humidity indicator card on top of the wiring, ensuring the 40% section of the humidity level indicator is visible. Replace the screws and hand tighten.

Desiccant bags and humidity indicator cards can be ordered through FTS:

ITEM	PART NUMBER
2 g desiccant bag	11438
Humidity indicator card	11672

1.5.2 Cleaning a Clogged Nose Cap

Erroneous readings can result from a clogged nose cap.

To clean the transducer's nose cap you will need a soap, scum and hard-water stain remover and three containers of a suitable size. Fill one container with the stain remover, another with a mixture of the cleaner and fresh water, and the third container with fresh water.

Hold the cable approximately 6 inches from the transducer and gently stir in each of the containers for 20-30 seconds in the following order: cleaning solution, cleaning solution-water mix, and finally the fresh water. Then wipe dry with a soft cloth.

> WARNING! Under no circumstances should the membrane or pressure input port be probed with any object. Damage to the sensing membrane is permanent and, in most cases, requires repair or replacement.

Chapter 2 INSTALLATION

2.1 PRIOR TO INSTALLATION

Prior to installing, inspect the SDI-PT-KEL and its cable for damage. The cable should not have any kinks or cuts as these can render the vent tube useless. Ensure the humidity monitor card in the vent enclosure box indicates low humidity levels. If not, replace the desiccant and card (see section 1.5.1)

2.2 HANDLING THE CABLE AND SENSOR

The sensor can fail if the cable is damaged so exercise care when handling the sensor and cable. The cable can also be damaged by abrasion, sharp objects and rodents so ensure it is positioned away from potential hazards and securely attached.

- Do not touch or probe the pressure sensing membrane with anything. Damage to the sensing membrane will require repair or replacement.
- Do not twist, crimp or compress the cable as this can damage the pressure tube.
    - The cable should not be bent to a radius less than 1 inch.
    - If using a compression fitting to secure the cable as it enters a junction box, do not over tighten the fitting
- Do not drop the SDI-PT-KEL, allow it to strike a hard surface forcefully, or allow it to "free fall" as this may damage the sensor.
- Do not allow the cable to drag over sharp edges or be abraded.
- Avoid contact with corrosive chemicals.
- The sensor could be damaged if encased in frozen liquid.

If the sensor is suspended, to prevent cable strain and stretch, use split mesh cable grips. This is especially important to relieve strain at the attachment point between the cable and the sensor.

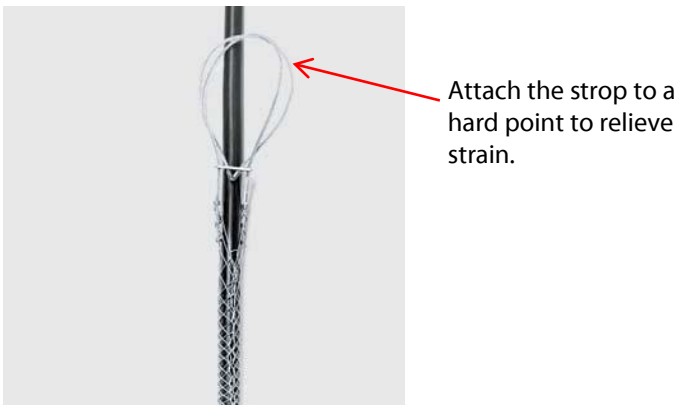


Figure 2-1: Split Mesh Cable Grip Example

2.3 SITE SELECTION

FTS recommends that the SDI-PT-KEL be installed in a stilling well or through a protective, rigid conduit to which it is attached using a conduit fitting. Ideally, there should be a solid structure (ie: bridge footing or dam face) to which the conduit can be attached.

If the installation precludes the previous installation guidelines, care should be taken to protect the cable and anchor the sensor. Select a location where the stream bed and banks are stable and are free from elements which may damage the cable (sharp protuberances, crushing hazards etc.). If the site does not have a structure which can be used, the sensor and cable should be fed through a conduit for protection and to provide a method of anchoring the sensor.

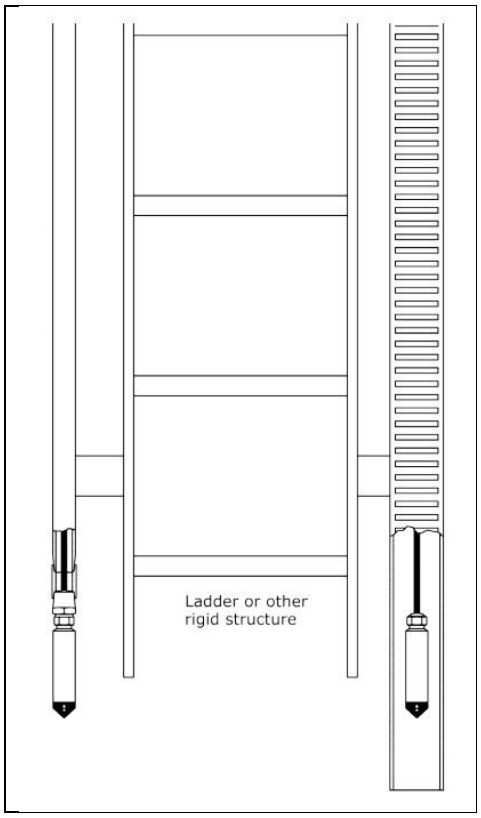
2.4 INSTALLING THE SENSOR

For best results the SDI-PT-KEL should be mounted vertically in a stilling well or attached to a rigid conduit with a conduit fitting which is integral with the transducer.

The SDI-PT-KEL should be installed at a fixed depth, mounted vertically below the lowest expected water stage. If not mounted vertically, there may be an offset. In order to compensate for the offset, measure the output with no pressure applied prior to connecting to your display, PLC, or controller. Use the measured value for your zero point.

Ensure the placement is such that potential water pressure will never exceed the sensor's pressure range, 2 times the pressure range (see Chapter 5 - Technical Specifications).

The sensor and cable should be secured to a solid and stable surface in order to maintain the desired depth and to minimize cable damage due to abrasion.



2.4.1 INSTALLATION WITH AN FTS AXIOM DATALOGGER

If installing the SDI-PT-KEL sensor with an FTS Axiom Datalogger, the sensor must be configured for the Datalogger using the Stage sensor extension. DO NOT use the SDI-PT sensor extension as that is specific to the FTS SDI-PT sensor. Refer to the Axiom Operator's Manual for details.

Chapter 3 SDI-12 COMMUNICATION

3.1 GENERAL INFORMATION

SDI-12 protocols are based on Version 1.3. [1]

All characters are printable ASCII characters except the response of an SDI-12 sensor which ends with <CR><LF>[2] and sometimes the CRC code includes a non-printable ASCII character.

The default address of an SDI-12 sensor is always '0'. The sensor's address can be changed to an address from '1' to '9', from 'A' to 'Z' or from 'a' to 'z'.

The option of continuous measurements is only supported with a specific extended command (X-command).

A <CR><LF> is returned for an R-Command or with CRC switched on. It is a<CRC> <CR><LF>, unless continuous mode is switched on and configured over the extended command aXR!

Note the following:

- the "a" in each command should be replaced with the sensor's address
- every command must terminate with an exclamation mark (!)
- the CRC[3] is added at the end of the message for commands with CRC
- the measurement command must be followed by a Send Data command (**aD0!**) to view the data

This chapter will provide basic direction on general SDI-12 Commands. Detailed direction can be found in accordance with the document found at footnote 5.

This chapter will also provide information of some useful SDI-12 commands specific to the SDI-PT-KEL. Detailed information on all SDI-12 communication protocols specific to the Keller Acculevel can be found in the Keller document, "*SDI-12 communication Protocol*"[4].

3.2 NOTATION FOR SDI-12 COMMANDS

SDI commands are strings of characters sent to the SDI sensor by a data logger, data collection platform or other SDI-12 master. The sensor takes action based on the command that was sent (ie. starting a measurement) and then replies to the command with a string of characters.

Note that as cable length increases, so do noise levels which can interfere with the digital measurement communications between the sensor and the data logger. Significant noise levels can

[1] In accordance with *"SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors ver 1.3"*. Refer to: http://www.sdi-12.org

[2] Carriage Return Line Feed

[3] Cyclic Redundancy Check

[4] https://www.kelleramerica.com/manuals-and-software/manuals/communication_protocol_SDI-12.pdf

result in excessive SDI-12 retries, incorrect data, or even no response. SDI-12 commands (like *a*MC!) which add a CRC[5] can greatly improve incorrect data issues.

The following format is used to specify the different parts of an SDI-12 command and sensor reply. Mandatory elements are in bold:

Item	Meaning	Text representation
Sensor Address	First character of a command* and response. Valid values 0-9, a-z, A-Z.	**a**
Command literal	Part of a command that must be reproduced literally as it appears;	**X**
Command parameter	Part of a command that must be filled in with an appropriate value.	***xxx***
Optional parameter	Part of a command that can be omitted if not needed. The brackets [ ] are not included in the command.	[xxx]
Floating point number	Number representing a measurement value or command parameter. If a command parameter it will be bolded and may be marked as optional.	**u.uuuuu** or [u.uuuuu]
Replies	As above but not bolded	u.uuuuu
Command Terminator	The last character of a command	**!**

* except the address query

3.3 ERROR DISPLAYS

The following error values are displayed for the D and R commands if the continuous measurement mode is switched on with the corresponding extended command.

Field	Value Displayed	Meaning
Pressure	+9999999	1) Overflow (readings +10% of the specified range) 2) Pressure element damaged
	-9999999	Underflow (readings -10% of the specified range)
Temperature	+9999999	Overflow
	-9999999	Underflow
	nan	Damaged or unreadable sensor value +9999999

[5] Cyclic Redundancy Check – an error detecting code used to detect accidental changes to raw data.

3.4 MEASUREMENT COMMANDS

The Start Measurement command triggers a measurement on the addressed sensor. The sensor will not return data, instead the sensor will return the duration of the measurement as well as the number of data points returned by the measurement. The data is read using a subsequent Request Data command (**aD0!**)

Measurement commands are in the following general format:

	String	Comment	
Cmd	**aM**[n]**!**	Start a measurement on sensor at the address indicated. [n] = optional - input the number of the measurement command for commands other than M! (ie: M1 – M4)	
Resp	**atttn**	**a**	SDI address
		ttt	measurement delay until data is ready in seconds
		n	the number of measurement values the sensor will make and return in one or more subsequent D commands; n is a single digit integer with a valid range of 1 to 9

MEASUREMENT COMMANDS

The addition of the C in the command string will include the CRC (cyclic redundancy check).

Command	Response	Values Measured (send **a**DO! command to retrieve)
aM! aMC!	a0012	After 1 second, 2 measurements available: • Pressure • Temperature
aM1! aMC1!	a0002	After 0 seconds, 2 measurements available: • Minimum Pressure in bar[1] • Maximum Pressure in bar[1]
aM2! aMC2!	a0002	After 0 seconds, 2 measurements available: • Minimum Temperature in ˚C[1] • Maximum Temperature in ˚C[1]

1 – the values for the M1 and M2 commands are always returned in the stated units of measurement regardless of the selected temperature and pressure units. These values are available directly after the command and therefore do not generate a service request.

The sensor sends a service request approximately 0.5 seconds after the 'M'-command. After this service request the measured data can be collected with the 'D0'-command.

Additionally, it is possible to read out the pressure range over the 'M1'-command as well as the temperature range over the 'M2'- command. These information values are available directly after the command and therefore do not generate a service request.

3.4.1 Concurrent Measurement Commands

Concurrent Measurement commands (C-commands) are the same as M-commands, except that no service request is generated by the C-command. Therefore, the SDI-12 master has to wait at least 1-3 seconds after the C-command to collect the data. The addition of the second C in the command string will include the CRC (cyclic redundancy check).

CONCURRENT MEASUREMENT COMMANDS		
SDI-12 Command	**Response**	**Values Measured** (send **a**DO! command to retrieve)
aC! aCC!	a00102	After 1 second, 2 measurements available: • Pressure • Temperature
aC1! aCC1!	a00002	After 0 seconds, 2 measurements available: • Minimum Pressure in bar[1] • Maximum Pressure in bar[1]
aC2! aCC2!	a00002	After 0 seconds, 32measurements available: • Minimum Temperature in °C[1] • Maximum Temperature in °C[1]

1 – the values for the C1 and C2 commands are always returned in the stated units of measurement regardless of the selected temperature and pressure units.

3.4.2 Continuous Measurement (R-Commands)

Continuous measurement must be enabled using the extended command aXR! (refer to section 3.6.2.3 for details).

The pressure and the temperature are always displayed in the unit set with the 'XP' and 'XT' command. Internally all values are calculated in bar and °C. .

The values are displayed with a polarity sign followed by a maximum of seven digits which may or may not have a decimal point (optional).

The maximum number of characters in a data value is 9 (polarity sign +7 digits + decimal point).

Calculation of the average pressure is done using the following formula:

$$Pressure_{Average\_new} = \frac{\sum_{i=1}^{Buffersize} Pressure_i}{Buffersize}$$

The response to an R-command is always **a**<CR><LF>. The values returned in response to an **a**DO! command after the R-command are as follows:

CONTINUOUS MEASUREMENT COMMANDS		
R-Command	**aDO! Response**	**Values Returned**
aR0! aRC0!	a±uu.uu±uu.uu±uu.uu±uu.uu	Mean pressure Minimum pressure Maximum pressure Temperature

3.4.3 Send Data

The **aD0!** command requests the data generated by the preceding measurement command (either **M** or **C**). The sensor sends a service request approximately 0.5 seconds after the 'M'-command. After this service request the measured data can be collected with the **aD0!** -command.

The pressure and the temperature are always displayed in the unit set in the 'XP' and 'XT' command. Internally all values are calculated in bar and °C..

	String	Note	
Cmd	**aD0!**	request data from previous measurement command	
Resp	a±u.uu±u.uu...±u.uu	**a**	sensor address
		±u.uu	first measurement value returned
		±u.uu	second measurement value returned
		±u.uu	etc.

The values are displayed with a polarity sign followed by a maximum of seven digits which may or may not have a decimal point.

The maximum number of characters in a data value is 9 (polarity sign +7 digits + decimal point).

3.5 GENERAL SDI-12 COMMANDS

General SDI-12 commands are used for housekeeping issues such as device address configuration, device identification and confirmation of device communications.

The SDI-PT-KEL supports the following measurement commands. The formats and responses will be explained in detail in the following sections:

Command	Format
Acknowledge Active	a!
Send Identification	aI!
Change Address	aAb!
Address Query	?!
Start Measurement	aM!
Send Data	aD0!.....aD4!
Additional Measurements	aM1!....aM4!
Start Verification	aV!

3.5.1 Acknowledge Active

This command queries whether a sensor is present on the SDI bus at the specified address.

	STRING	COMMENT
Cmd	**a!**	request the device at address **a** to confirm it is active
Resp	a	a device is present at address **a**

3.5.2 Send Identification

This command is used to query sensors for their SDI-12 compatibility level, model number, and firmware version number.

	STRING	COMMENT
Cmd	**aI!**	
Resp	**a13KellerAGmmmmmmvvvxx…xx**	**a** - the sensor address 13 – SDI-12 version number **KellerAG**– 8 character vendor identification, **mmmmm** - the sensor model number **vvv** – 3 character sensor version **xx..xx** – Serial number, max 13 characters.

Example response: 213KellerAG PR36X 0020000000000001

3.5.3 Change Address

This command changes a sensor's SDI address.

	STRING	NOTE
Cmd	**aAb!**	**a** = current address **b** = new address
Resp	b	response confirms new address

3.5.4 Address Query

This command requests the address of the SDI sensor.

NOTE: only one SDI device should be connected to the bus when using this command; problems arise when several devices respond on the same bus.

	STRING	NOTE
Cmd	**?!**	Request the (single) device on this bus to report its address
Resp	a	The address of the device

3.5.5 Start Verification

This command tells the sensor to return a verification in response to a subsequent D command. The format of this command is the same as the M commands. The values need to be collected with the aD0! command.

SDI-12 COMMAND	RESPONSE	VALUES MEASURED
aV!	a00102	After 1 second, 2 values are available: • ADC[6] value of Pressure • ADC value of Temperature

3.6 EXTENDED SDI-12 COMMANDS (X-COMMANDS)

This chapter provides detailed information on commonly used X-Commands specific to the SDI-PT-KEL and basic information on the less common X-Commands. Table 3-1 lists all the extended SDI-12 commands.

The format of X-commands follows the requirement for standard SDI-12 commands in that the first character of every command must be a sensor address which is then followed by the X command and terminated by an exclamation mark. Likewise, the first character of a response is also the address character.

The values are displayed with a polarity sign followed by a maximum of seven digits which may or may not have a decimal point.

The maximum number of characters in a data value is 9 (polarity sign +7 digits + decimal point). The minimum number of characters is 3 (the decimal point should always be used).

Extended SDI-12 Commands are available to configure data output and sample number.

1) the temperature units (Celsius or Fahrenheit);
2) the pressure/level units (psig, KPa, bar, feet, metre, inches, or millimetre); and
3) the sample number (and integration time) for each measurement.

To determine the sensor configuration, use the **aV!** command (see section 3.5.5).

[6] ADC = analog to digital conversion

Table 3-1 EXTENDED SDI-12 COMMANDS

This table lists the extended SDI-12 commands used by the SDI-PT-KEL (Keller Acculevel). Detailed information and instructions follow the table for the most commonly used commands which are identified in bold. Detailed information on non-bolded X-commands can be found in the Keller document, "*SDI-12 communication Protocol*[7].

Description	Command	Response
Read / write offset value for pressure	aXZZ! / aXZZ<value>!	a<value><CR><LF>
Read / write gain factor for pressure	aXZF! / aXZF<value>!	a<value><CR><LF>
Read / write pressure unit	aXP! / aXP0x!	A0x<CR><LF>
Read / write gravitational acceleration [m/s2] (default: +9.80665m/s2)	aXG! / aXG<value>!	a<value><CR><LF>
Read / write temperature unit	aXT! / aXT0x!	a0x<CR><LF>
Read / write offset value for temperature T	aXZZT! / aXZZT<value>!	a<value><CR><LF>
Read / write offset value for temperature TOB	aXZZTOB! / aXZZTOB<value>!	a<value><CR><LF>
Read / write UserID	aXI! / aXI<cccccccccccccccc>!	a<cccccccccccccccc><CR><LF>
State continuous measurement	aXR!	aXRS<tt>B<ss>RUN<CR><LF> aXRM<tt>B<ss>STOP<CR><LF>
Configuration continuous measurement	aXRS<tt>B<ss>! aXRM<tt>B<ss>!	aXRS<tt>B<ss>STOP<CR><LF> aXRM<tt>B<ss>STOP<CR><LF>
Start continuous measurement	aXRON!	aXRS<tt>B<ss>RUN<CR><LF> aXRM<tt>B<ss>STOP<CR><LF>
Stop continuous measurement	aXROFF!	aXRS<tt>B<ss>STOP<CR><LF> aXRM<tt>B<ss>STOP<CR><LF>

3.6.1 Pressure

The pressure value is scaled in the following way: value = value * gain + offset

[7] https://www.kelleramerica.com/manuals-and-software/manuals/communication_protocol_SDI-12.pdf

3.6.1.1 *Offset Value for Pressure*

Default offset = 0.000
Default offset value range = +/-2 bar

An offset programmed outside of the range results in an error and the previous offset value will still be valid.

The offset value for pressure is saved in the EEPROM and can be read and changed with this command:

Description	Command	Response
Read offset value for pressure	aXZZ! !	a<value><CR><LF>
Write offset value for pressure	aXZZ<value>!	a<value><CR><LF>

Within the transducer, the offset is laid down in bar, but it is read and displayed in the selected unit.

3.6.1.2 *Gain Value for Pressure*

The gain is always unit free regardless of selected unit.

Default gain=1.000
Gain range = 0.80-1.20

If a gain outside of range is programmed, an error occurs and the previous gain value remains valid.

The gain value for the pressure is saved in the EEPROM and can be read and changed with the command:

Description	Command	Response
Read gain value for pressure	aXZF! !	a<value><CR><LF>
Write gain value for pressure	aXZF<value>!	a<value><CR><LF>

3.6.1.3 *Pressure Unit*

Default value for g in m/s^2= 9.80665

There are six pressure units available to select. They can be selected via a table which is laid down in the internal EEPROM: (g default: 9.80665)

Number	Pressure Unit	Factor	
00	Factory	(1)	
01	Bar	1	
02	Mbar	1000	
03	mH2O,mWC	100/g	(10.1972)
04	Psi	142.2334/g	(14.5038)
05	ftWC, ftH2O	328.084/g	(33.4553)
06	inWC, inH2O	3937.008/g	(401.463)

3.6.2 Temperature

The value is scaled in the following way: value = value * gain + offset

3.6.2.1 *Offset value for Temperature*

The offset is always given in the selected unit. The internal transmitter lays it down in °C and then converts to the selected unit.

Default value = 0.000
Offset value range = +/-2°C

If an offset outside of the range is programmed, an error occurs and the previous offset value is still valid.

The offset is always given in the selected unit. The internal transducer lays it down in °C and then converts to the selected unit.

The offset value for the temperature is saved in the EEPROM and can be read and changed with the command:

Description	Command	Response
Read offset value for temperature TOB	aXZZTOB!	a<value><CR><LF>
Write offset value for temperature TOB[8]	aXZZTOB<value>!	a<value><CR><LF>

3.6.2.2 *Temperature Value*

The internal transducer always reads in °C. It is only multiplied with the "unit"-factor and added with its offset before it is given out over SDI-12 communication.

There are three different temperature units available to choose. They can be selected via a table which is laid down in the internal EEPROM:

Number	Pressure Unit	Factor	Offset
00	Factory	(1)	0
01	°C	1	0
02	°F	1.8001	32°
03	K	1	273.15°

Description	Command	Response
read temperature unit	aXT!	a0x<CR><LF>
write temperature unit	aXT0x!	a0x<CR><LF>

3.6.2.3 *Continuous Mode*

In continuous mode, the time interval and buffer size are defined. The buffer size defines the number of pressure values that are stored. After the interval time elapses the sensor wakes up from low power mode, takes a measurement, and then returns to low power mode. The pressure values are buffered in a ring buffer and it is possible to read out the average value of this buffer over an aR0! or aRC0! command.

[8] Top of Bridge – method whereby temperature is derived using a Wheatstone bridge

Configuring a Continuous Measurement+

The following command is used to configure a continuous measurement command.

Description	Command	Response
Configure Continuous command (time interval in seconds)	aXRS<tt>B<ss>!	aXRS<tt>B<ss>STOP<CR><LF>
Configure Continuous command (time interval in minutes)	aXRM<tt>B<ss>!	aXRM<tt>B<ss>STOP<CR><LF>

Command Element	Description	Units	Min	Max
S<tt>	Time Value	Seconds	04	60
M<tt>	Time Value	Minutes	01	60
B	Buffer	N/A	01	08

Continuous Measurement Commands

Description	Command	Response
State continuous measurement	aXR!	aXRS<tt>B<ss>RUN<CR><LF> aXRM<tt>B<ss>RUN<CR><LF>
Start continuous measurement	aXRON!	aXRS<tt>B<ss>RUN<CR><LF> aXRM<tt>B<ss>RUN<CR><LF>
Stop continuous measurement	aXROFF!	aXRS<tt>B<ss>STOP<CR><LF> aXRM<tt>B<ss>STOP<CR><LF>

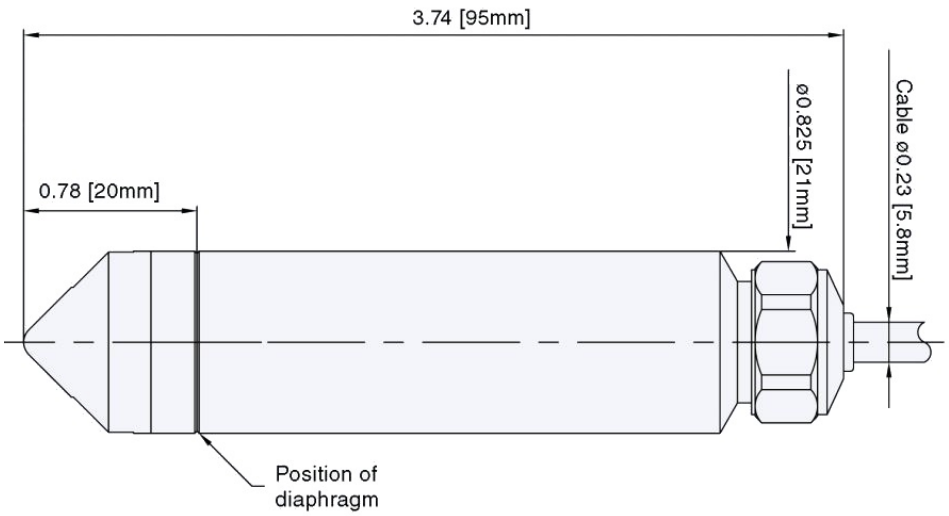
Example: To set and start a continuous measurement at 12 second intervals with a ring buffer depth of 8, sensor at address 0

Description	Enter	Response
Configure continuous command	0XRS12B08!	0XRS12B08STOP<CR><LF>
Start continuous measurement	aXRON!	0XRS12B08RUN<CR><LF>

Explanation: The continuous measurement with elements defined as stated in the example is configured and then switched on. Every 12 seconds, the transmitter wakes up and writes a pressure value to the ring buffer. Also, the temperature value is updated before the transmitter goes to low power mode again. The ring buffer has a depth of 8 pressure values. If an aR0!-command is used, the average value of the last 8 pressure values taken over the last 96 seconds is given out.

Chapter 4 TECHNICAL SPECIFICATIONS

DIMENSIONS



PRESSURE RANGES[1]	
Relative	Infinite between 0-1m through 0-274m ft water column (0-3 ft through 0-900 ft water column).
Absolute	Available on request

1 Level range may be specified in units of bar, mbar, mH2O, psi, ftWC, or inWC

ACCURACY[2,3]	
Pressure	Standard ±0.1% FS TEB Optional ±0.01 ft WC when reading ≤ 10ftWC or ±0.1% of reading >10 ftWC
Temperature	Typ. ±0.3°C

2 - Total Error Band (TEB) includes the combined effects of non-linearity, hysteresis, and non-repeatability as well as thermal dependencies, over the compensated temperature range.
3 - . Optional accuracy is written in compliance with USGS OSW specification mandates and limited to a compensated temperature range of 0-40° C.

OUTPUT[4]	
Digital	SDI-12 + RS485
Pressure Resolution	0.0005% FS
Temp. Resolution	< 0.01 °C
Comm. Protocol	SDI-12 V1.3, MODBUS RTU
Baud Rate	1200 bits/s

4 - The Submersible Pressure Transducer SDI can communicate in either SDI-12 or RS485 at any one time. By default, the Submersible Pressure Transmitter SDI will ship in SDI-12 mode. A USB Dongle is required to change to RS485 mode.

ELECTRICAL[5]	
Supply	6 to 32 VDC
Power Consumption	<0.1mA (sleep) <5.5mA (active)
Startup Time	<5 ms (interface ready)
Load Resistance (mA)	<(Supply-6V)/0.0055A
Insulation GND-CASE	>10MΩ @ 300 V
5 - Nominal values may be higher depending upon cable length. Cable resistance (~70Ω / 1000ft) adds to the supply requirement. In order to insure proper system operation, calculate the minimum required supply voltage (at the source) as follows: MINIMUM SUPPLY VOLTAGE = 6 + 0.022 (CABLE LENGTH x 0.07) VDC	
ENVIRONMENTAL	
Protection Rating	IP68
Storage Temp	-20 to 80°C (-4 to 176˚F)
Compensated Temp	Standard: -10 to 80°C (14 to 176˚F) Optional[6]: 0 to 40˚C (32 to 104°F)
6 - Optional compensated temperature range applies to transducers built to USGS OSW accuracy specification	
Wetted Materials	316L Stainless Steel Titanium optional Polyamide Fluorocarbon
Cable	Hytrel
CERTIFICATIONS	
CE	EN50081-1, EN50082-2

DOCUMENT REVISION HISTORY

Revision	Date	Description
1	27 Sep 2018	Original
2	2 Oct 2018	Minor formatting
3	22 Oct 2018	Added use of Stage sensor extension with an Axiom. SDI-PT-KEL used throughout.
4	05 Feb Jan 2020	Removed references to conductivity measurements as they are not supported(SH-98)