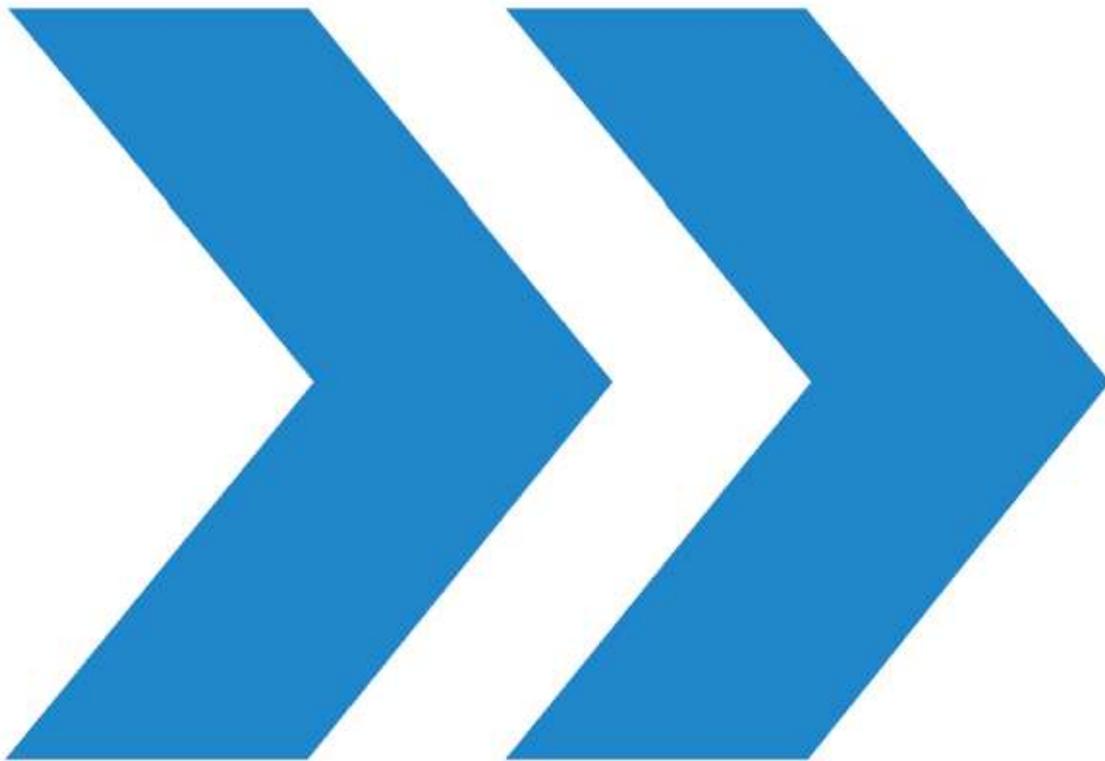




TX5001 | TX5002 | TX5003

RockMonitor XR System



User Manual

RockMonitor XR

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1 General Description

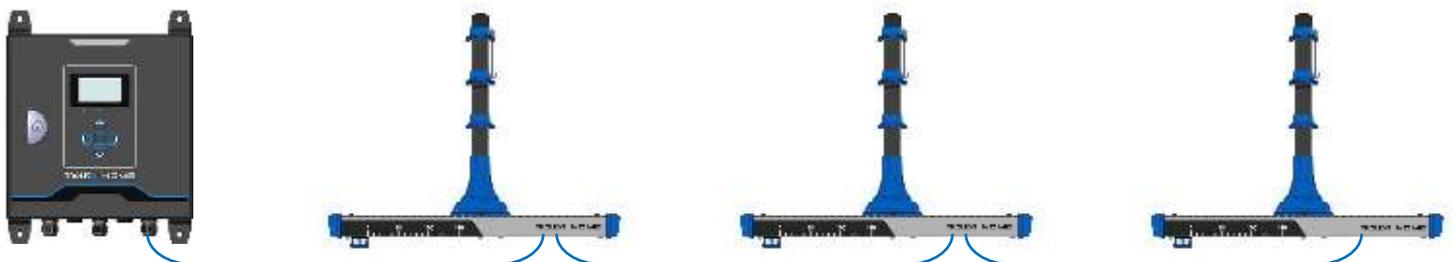
The Trolex RockMonitor XR is an intrinsically safe system primarily designed to monitor the condition of roof-bolted underground roadway strata. It offers a fully networked solution for measuring displacement of tunnel strata, allowing geotechnical engineers and mine operators to continually monitor and assess critical information regarding the safety and effectiveness of roadway support structures.

Electronic extensometers (hereafter referred to as telltales) give local visual indication combined with electronic displacement measurement to provide continuous information regarding strata condition. Spring anchors are used to locate a set of wires at different heights inside a borehole. The wires are connected to both the visual indicator and electronic measurement mechanism. Any dilation or bed separation of the strata will appear to pull the indicators along their axis showing how much each anchor has moved (relative to roadway roof) with the electronic measurement data being sent back to a controller that then communicates with application software running on a surface PC or server. Regular data analysis allows monitoring of strata condition/dilation and hence the safety and effectiveness of the roof-bolting arrangement.

A typical RockMonitor XR system consists of multiple telltale devices connected to a fixed controller. Power is provided to the controller via a suitable intrinsically safe power supply with the controller communicating to application software installed on a surface PC via an appropriate communications barrier. A portable reader is also available for system diagnostics.

Telltales can be installed at varying intervals in the sides as well as the roof of a tunnel and are designed to be plug and play with new instruments automatically configuring themselves once connected to the controller. Up to 150 telltales can be connected via 3-core wire in a daisy chain or spur configuration allowing for flexible system layouts over distances up to 6km. Once configured the controller then begins polling the telltales in sequence to obtain readings, pushing the data via RS485 or Ethernet to application software installed on a surface PC. The application software can easily export data to site SCADA systems to facilitate continuous monitoring of the strata condition.

The system is designed to be progressively configurable in an advancing roadway driveage. Telltales can be added and removed from the network seamlessly with the controller dynamically reconfiguring the telltale network as the number and position of devices changes.



RockMonitor XR Controller and Telltales

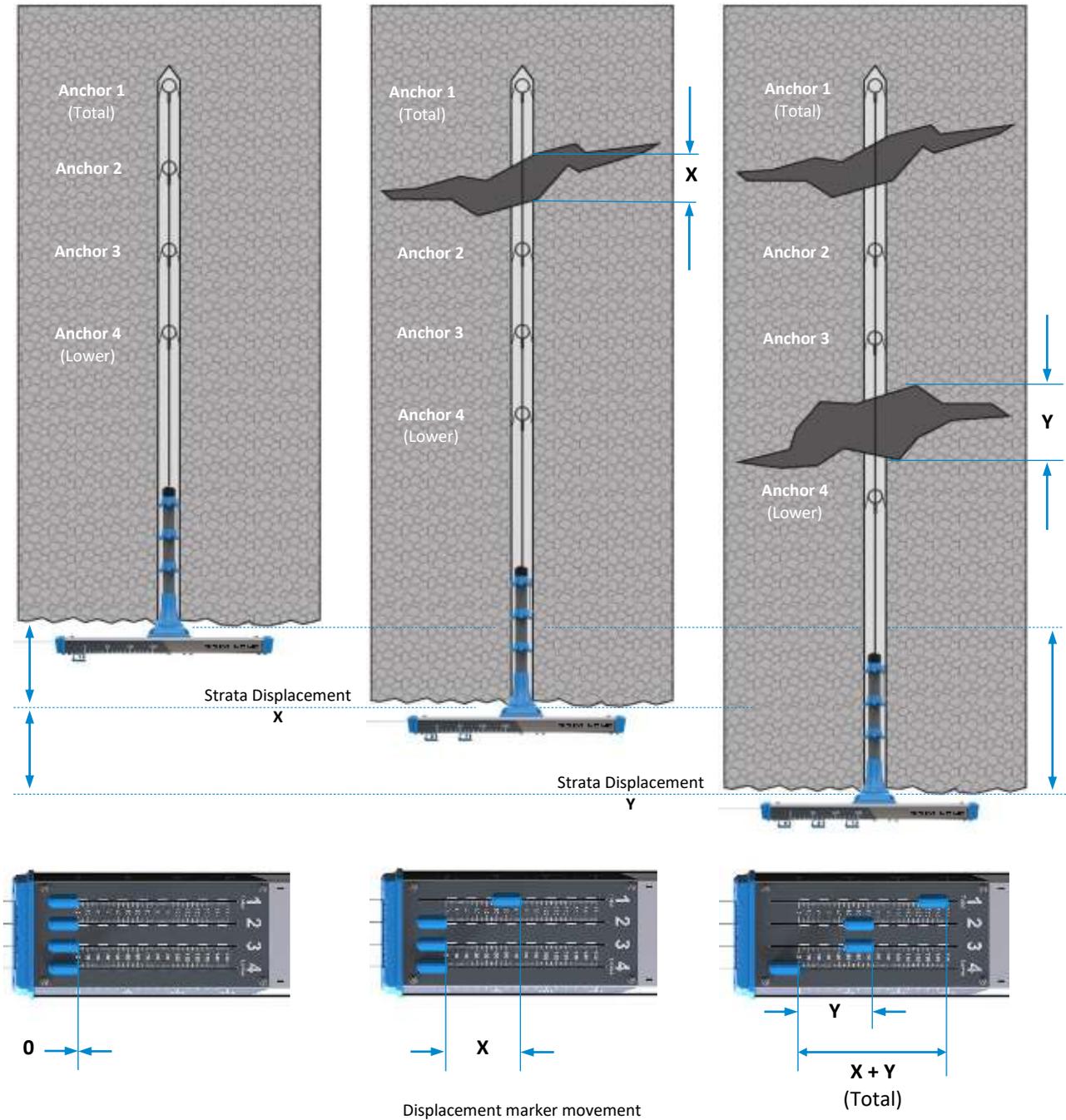
1.1 Main features

- Continuous monitoring of strata displacement
- Strata displacement measurement up to 150mm (without reset)
- Resettable height measurement for movement in excess of 150mm
- Two or four monitoring points (anchor heights) between 0.6m and 16m
- Monitor tunnels over distances of up to 6km with a single system
- Connect up to 150 telltale devices per controller
- Flexible topology, configurable as either spur or daisy chain
- Fully customizable alarm settings including rate of movement and absolute displacement
- Automated notifications via software or e-mail
- Highly visible display of displacement on-device
- Plug and play Installation
- Detailed monitoring and display of data using powerful application software
- Integration with SCADA systems

1.2 Theory of operation

The RockMonitor XR Telltales can be configured with either two or four measurement channels. Anchor wires are inserted into a borehole drilled either in the roof or side wall of a roadway and secured into position using spring anchors connected to the ends of the wires. The tube section of the telltale is then inserted into the borehole with securing features automatically gripping the sides of the borehole and keeping the telltale in position in the tunnel roof or side wall. Any displacement of the strata occurring within the height of the anchors will cause the body of the RockMonitor XR Telltale to move relative to the anchor. The anchor wires connect the anchor points to electro-mechanical measurement units housed within the body of the telltale. Movements are then shown visually on-device whilst also being communicated back to the network controller which transmits the data back to a surface computer.

The use of multiple anchor points allows more detailed insight into where the strata displacement is occurring. A typical installation would use a minimum of two anchors, placing one above the bolted height and one within the bolted height. This can provide valuable insight into the effectiveness of the chosen support strategy. The four-anchor version provides even more data with which to optimise bolting strategies.



Displacement measurement

Installation position. No strata movement indicated – all displacement markers read 0mm on the measurement scale.

Displacement occurs between anchor 1 and 2 as shown by 'X'. Anchor 1 displacement marker moves to indicate the amount displacement.

Second displacement occurs between anchors 3 and 4 as shown by 'Y'. Anchor 2 and 3 displacement markers move to represent displacement figure 'Y', whilst anchor 1 displacement marker moves to represent a total distance of 'X + Y'.

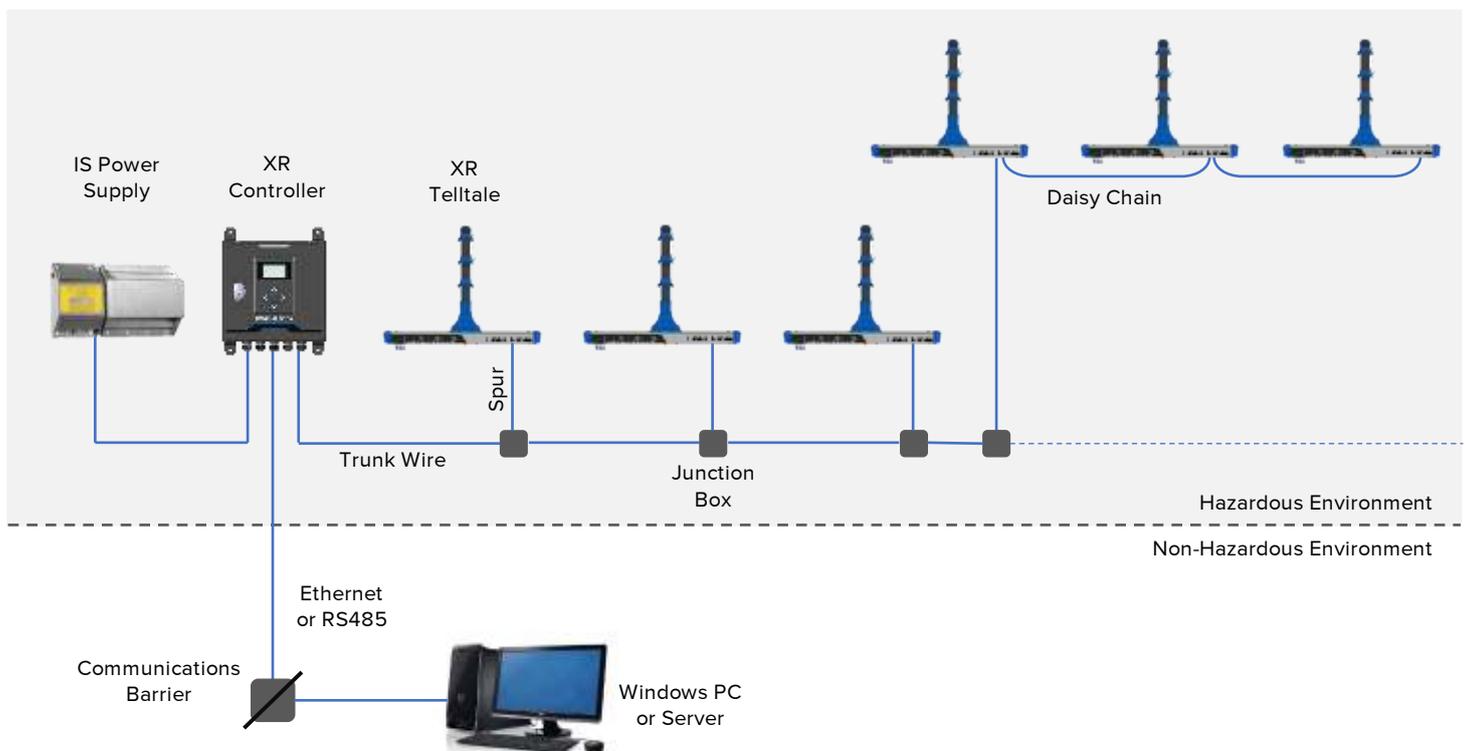
2 System Components

The RockMonitor XR System typically consists of multiple telltales connected to a single controller. Additional peripheral components are required to power the controller and provide a safe communication barrier between the controller and a surface computer running the accompanying Trolex|Core software. A portable reader is also available to aid installation and maintenance.

The RockMonitor XR Telltale (TX5001), RockMonitor XR Controller (TX5002), RockMonitor XR Reader (TX5003), and Trolex|Core software are specifically designed to work in conjunction with each other using custom protocols and design features. The system has however been designed to support 3rd party power supplies and communications barriers.

The list below shows the set of components that comprise a complete system. Further details regarding each component are given throughout this section.

- RockMonitor XR Telltale (TX5001)
- RockMonitor XR Controller (TX5002)
- RockMonitor XR Reader (TX5003)
- I.S. power supply
- RS485/Ethernet barrier
- Windows PC or server
- Trolex|Core software

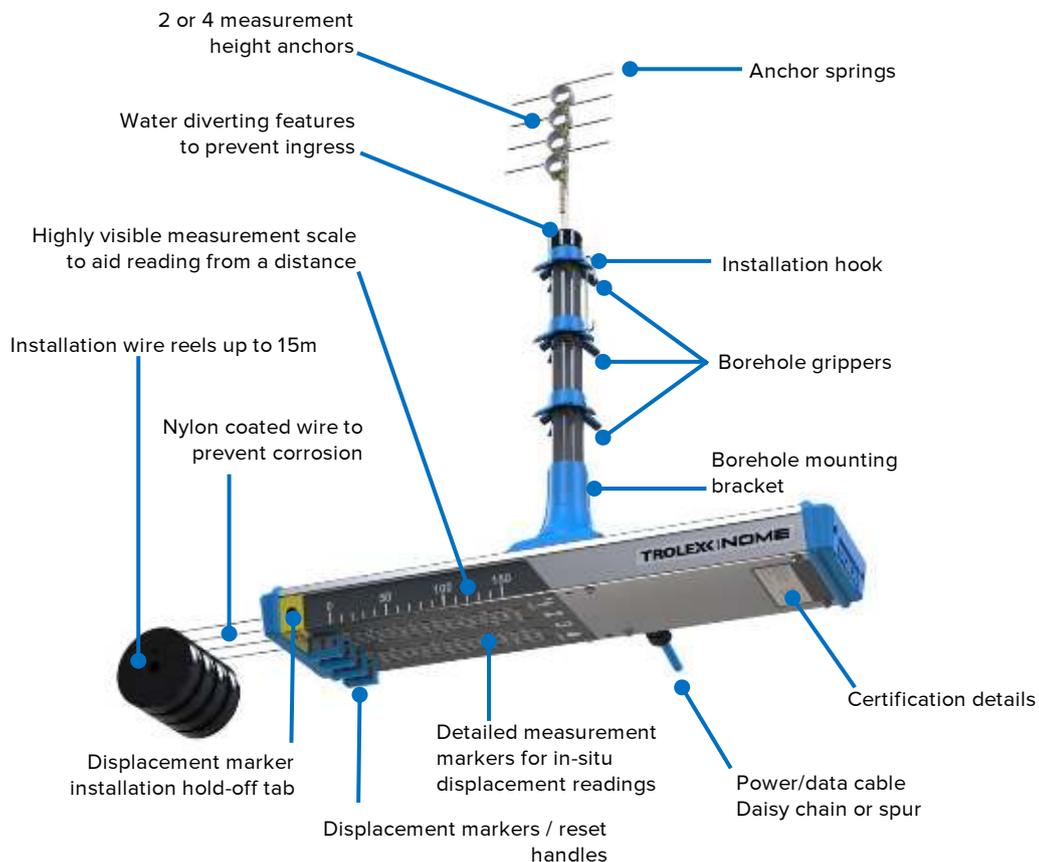


Example system configuration

2.1 RockMonitor XR Telltale – TX5001

The electro-mechanical measurement system is housed within a robust stainless-steel enclosure that remains visible after installation in the tunnel roof. Anchor springs fix the anchor wires into the borehole whilst the vertical tube is secured into the borehole by the three borehole grippers, allowing the stainless-steel body of the device to maintain a low profile to the roof or side wall. As displacement occurs, the anchor wires pull a metal tube through a coil of wire causing the inductance to change. The change in inductance is measured and converted into a value for displacement which is then communicated back to the controller. The anchor wires are secured to the measurement mechanism using clamping devices with a spring providing tension on the wires to ensure accurate measurement.

The figure below shows an individual telltale with four anchors (note that the full lengths of the anchor wires are not shown).



RockMonitor XR Telltale

Measurement indicators give easily visible local information regarding displacement of each individual anchor. A 3-core cable provides power to the device and allows communication with the RockMonitor XR Controller.

The telltales operate in low power receive mode to limit the power consumption of the network. The controller polls each telltale individually, cycling through the entire networking until all readings have been taken. Once the telltale receives its wake command it wakes up and sends the displacement data to the controller. It takes between 5 and 10 minutes to cycle through a network of 150 devices.

2.2 RockMonitor XR Controller – TX5002

The RockMonitor XR Controller is designed to be simple and rugged, supporting plug and play installation and setup of the telltale network. The controller automatically detects and configures new telltales added to the network and periodically polls all the connected telltales to collect measurement data and device information. This information is then transmitted via an RS485 or Ethernet connection to a surface computer running the Trolex|Core application software.

The controller is designed to be Intrinsically Safe and works specifically with RockMonitor XR Telltales. The control circuits are housed in a lockable, IP65 rated steel enclosure. Information and settings can be accessed using the keypad and display located on the front of the unit.

RockMonitor XR Controller key functions:

- 1) Provide power to RockMonitor XR Telltales
- 2) Communicate with RockMonitor XR Telltales to record displacement readings
- 3) Transmit displacement readings to a surface computer
- 4) Provide local support for system installation and maintenance
- 5) Provide information on system status

The controller can be powered by a range of external power supplies including power supplies incorporating battery backup (Uninterruptable Power Supply – UPS). Selection of specific power supplies can impact the number of telltale devices that the network can support. Please refer to the power supply section for further information.

The figure below shows the location of the navigation buttons, display screen and screen and status LEDs. Power and network connections enter the controller housing via cable entry glands located on the bottom of the unit along with the cable connecting the telltale network. The unit is mounted via mounting brackets.



RockMonitor XR Controller

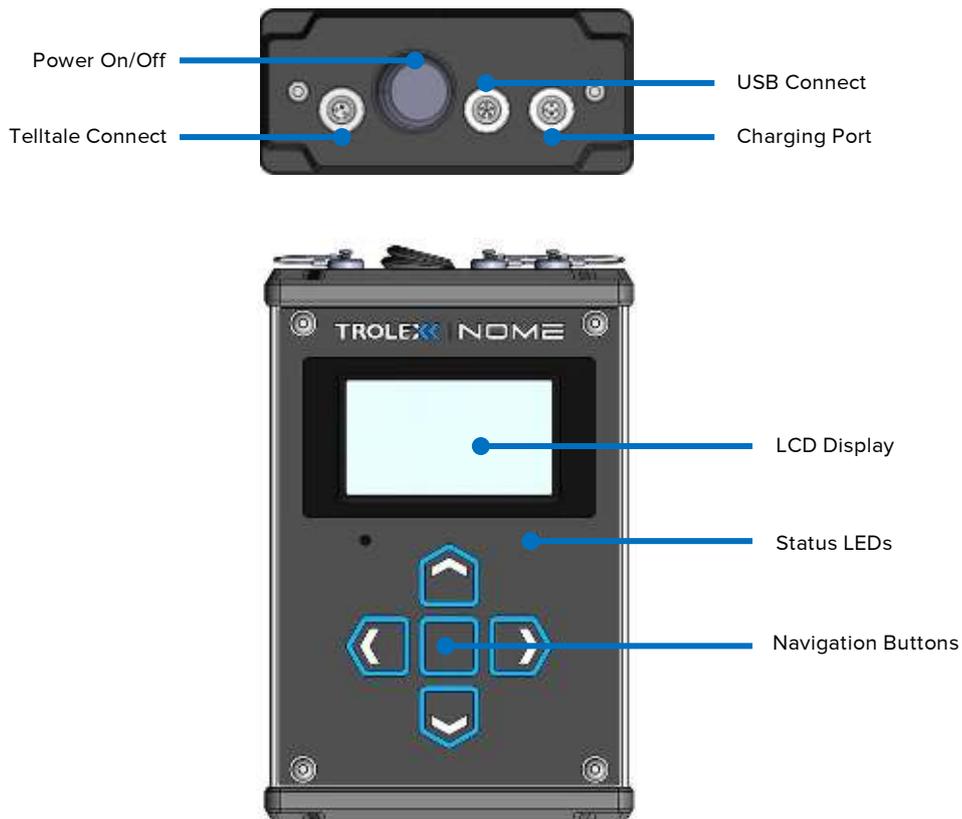
2.3 RockMonitor XR Reader – TX5003

The RockMonitor XR Reader is a portable unit to provide diagnostics information during installation and maintenance of the telltale network. The reader is battery powered and can be used to provide a limited amount of power to a single telltale or network of telltales. The reader is designed to be Intrinsically Safe with the control circuits housed in an IP65 rated stainless steel enclosure that is protected and stored using the leather carry case provided. The reader must be housed in the leather carry case when being used in potentially explosive atmospheres.

RockMonitor XR Reader key functions:

- 1) Provide local power to RockMonitor XR Telltales
- 2) Installation, commissioning, and fault finding

The figure below shows the location of the navigation buttons, display screen and screen and status LEDs. Power and network connections enter the reader housing via connectors located on the top of the unit which are exposed when opening the leather carry case.



RockMonitor XR Reader

2.4 Peripherals & accessories

2.4.1 Power supply

The RockMonitor XR must only be connected to an approved Intrinsically Safe (IS) 12 V DC power supply approved for use in hazardous locations.

2.4.2 Ethernet barrier

Use of an approved Intrinsically Safe isolating Ethernet barrier is required to connect a RockMonitor XR Controller operating in the hazardous area to the mine Ethernet network. Suitable hardware can be provided on request.

2.4.3 RS485 Barrier

Use of an Intrinsically Safe isolating RS485 barrier is required to connect a RockMonitor XR Controller operating in the hazardous area to the mine network. Converters are also available to allow integration with Ethernet communications. Suitable hardware can be provided on request.

2.4.4 Cable

Used in a daisy-chain configuration, RockMonitor XR Telltales can be linked together using the captive input and output cables provided. The cable comprises three cores and is covered by blue PVC.

Additional approved cable is available from Trolex.

2.4.5 Telltale Installation Rods

Extendable installation rods can be provided on request to support the insertion of anchor springs and wires into the borehole. A simple adapter at the end of the rod holds the spring ensuring the anchor can be easily guided along the length of the borehole until it is positioned in the desired location.

2.4.6 Windows PC or Server

A Windows PC or server is required to run the Trolex|Core application software (required to collect and process data from the telltale network). Depending on site IT restrictions this can run on dedicated hardware or installed on a Virtual Machine (VM). Minimum system requirements are detailed in a separate Trolex|Core user manual. Suitable hardware can be provided on request.

2.4.7 Trolex|Core Application Software

Data transmitted to a surface PC or server is collected, stored and processed using the Trolex|Core application software. The RockMonitor XR Controller communicates with the Trolex|Core software using a proprietary protocol. Operating instructions for the Trolex|Core application software are provided in a separate user manual. Trolex|Core can interface with SCADA packages.

3 Certification and Conformity

	<p>IECEX (International) certification for use in underground mines in Australia (including Queensland) and New Zealand.</p>
	<p>Standards: IEC 60079-0:2017 Edition 7.0 IEC 60079-11:2011 Edition 6.0 IEC 60079-25:2010 Edition: 2.0</p>

	<p>ATEX certification for use in underground mines in European Union.</p>
	<p>Complies with the following EU Directives:</p>
	<p>ATEX Directive 2014/34/EU - EN IEC 60079-0:2018 - EN 60079-11:2012 - EN 50303:2000</p>
	<p>EMC Directive 2014/30/EU - EN 61326-1:2013 - EN 61000-6-2:2019 - EN 61000-6-3:2007+A1:2011</p>
	<p>RoHS Directive 2011/65/EU</p> <p>System and Installation - EN 60079-25:2010 - EN 50628:2016</p>

3.1 Underground mines

Equipment / Product Code	Ex Certificate Number	Ex Certification Code
RockMonitor XR Telltale TX5001.06(.XX...)	IECEX ExTC 18.0022X	Ex ia I Ma -20 °C □ Ta □ +50 °C
RockMonitor XR Controller TX5002.06(.XX...)	IECEX ExTC 18.0030X	Ex ia I Ma -20 °C □ Ta □ +50 °C
RockMonitor XR Reader TX5003.06(.XX...)	IECEX ExTC 18.0031X	Ex ia I Ma -20 °C □ Ta □ +50 °C

Equipment / Product Code	Ex Certificate Number	Ex Certification Code
RockMonitor XR Telltale TX5001.19(.XX...)	TÜV 19 ATEX 8457 X IECEX ExTC 18.0022X	I M1 Ex ia I Ma -20 °C ≤ Ta ≤ +50 °C
RockMonitor XR Controller TX5002.19(.XX...)	TÜV 19 ATEX 8458 X IECEX ExTC 18.0030X	I M1 Ex ia I Ma -20 °C ≤ Ta ≤ +50 °C
RockMonitor XR Reader TX5003.19(.XX...)	TÜV 19 ATEX 8459 X IECEX ExTC 18.0031X	I M1 Ex ia I Ma -20 °C ≤ Ta ≤ +50 °C

Equipment	Ex Certificate Number	Ex Certification Code
RockMonitor XR System	IECEX ExTC 19.0008X TÜV 19 ATEX 8460 X	I M1 Ex ia I Ma -20 °C ≤ Ta ≤ +50 °C

3.2 Conditions of Use:

3.2.1 TX5001 Conditions of Use

The following Special Conditions for Safe Use and Specific Conditions of Use apply to the ATEX and IECEX certificates for TX5001 RockMonitor XR Telltale (TÜV 19 ATEX 8457 X and IECEX ExTC 18.0022X)

The equipment has the following parameters which shall be observed when connecting in an intrinsically safe circuit:

Supply or HART/FSK wrt 0 V	
U _i	17.64 V
C _i	Negligible
L _i	0 μH
U _o	9.5 V
I _o	0 A
C _o	1000 μF
L _o	200 mH

The equipment is provided with one or two integral cables (each 3 core) with the following maximum capacitance (C_c) and inductance to resistance (L_c/R_c) ratio per cable:

$$C_c = 200 \text{ pF/m}$$

$$L_c/R_c = 30 \text{ μH/Ω}$$

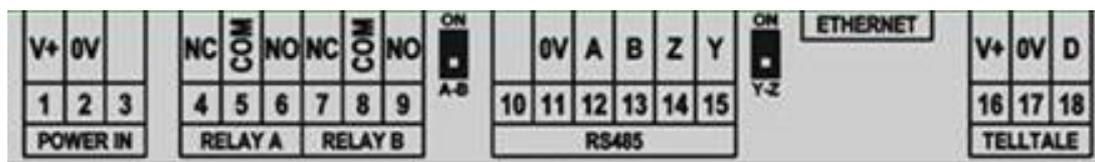
3.2.2 TX5002 Conditions of Use

The following Special Conditions for Safe Use and Specific Conditions of Use apply to the ATEX and IECEx certificates for TX5002 RockMonitor XR Controller (TÜV 19 ATEX 8458 X and IECEx ExTC 18.0030X)

The following parameters shall be observed when connecting to separately certified intrinsically safe equipment:

	Conn. P4 (Supply to TX5002)	Conn. P8 (Relay contacts – Relay A and relay B)	Conn. P7 (RS485 - parameters for individual lines)	Conn. J1 (Ethernet – all lines combined)	Conn. P5 (Telltale)
Terminal No.	1 w.r.t. 2	4, 5, 6, 7, 8, 9	12, 13, 14, 15 w.r.t. 11		16, 18 w.r.t. 17
Ui	16 V or 14.4 V (as marked on the equipment)	30 V	8.4 V	17.64 V	17.64 V
Ii	3.33 A	0.32 A			
Pi		530 mW			
Ci	4 µF	0 µF	0 µF	0.48 µF	Negligible
Li	0 µH	0 µH	0 µH	0 µH	30 µH
Uo		0 V	5.88 V	0 V dc	17.64 V
Io		0 A	66 mA	0 A dc	2.03 A
Po			97 mW	0 W dc	4.16 W
Co			1000 µF	1000 µF	10.53 µF
Lo			26 mH	97 µH	83 µH
Lo/Ro				145 µH/□	48 µH/□

Refer below for example terminal number identification:



3.2.3 TX5003 Conditions of Use

The following Special Conditions for Safe Use and Specific Conditions of Use apply to the ATEX and IECEx certificates for TX5003 RockMonitor XR Reader (TÜV 19 ATEX 8459 X and IECEx ExTC 18.0031X)

The following parameters must be observed when connecting the equipment:

Telltale cable connector		Charge cable connector		USB cable connector	
U _o	17.64 V	U _m	26.66 V	U _m	8.1V
I _o	2.03A				
P _o	4.16 W				
C _o	10.64 μ F				
L _o	83 μ H				
L _o /R _o	48 μ H/ \square				
U _i	17.64 V				
C _i	Negligible				
L _i	30 μ H				

The charge and USB connectors are only used when the equipment is in a non-hazardous area.

The TX5003 RockMonitor XR Reader shall only be used when in the leather pouch provided.

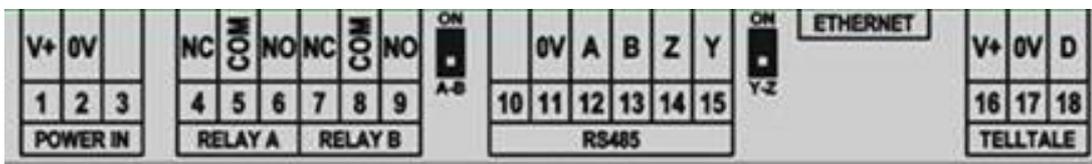
3.2.4 RockMonitor XR System Conditions of Use

The following Special Conditions for Safe Use and Specific Conditions of Use apply to the ATEX and IECEx certificates for RockMonitor XR System certification (TÜV 19 ATEX 8460 X and IECEx ExTC 19.0008X)

The parameters listed below are for external connection to the TX5002 RockMonitor XR Controller for the connection of associated apparatus not specifically covered in the system block diagram (drawings P5625.129.IECEx and P5625.129.ATEX) and must be considered in conjunction with the requirements shown in these drawings:

	Conn. P4 (Supply to TX5002)	Conn. P8 (Relay contacts – Relay A and relay B)	Conn. P7 (RS485 - parameters for individual lines)	Conn. J1 (Ethernet – all lines combined)
Terminal No.	1 w.r.t. 2	4, 5, 6, 7, 8, 9	12, 13, 14, 15 w.r.t. 11	
Ui	16 V or 14.4 V (as marked on the equipment)	30 V	8.4 V	17.64 V
Ii	3.33 A	0.32 A		
Pi		530 mW		
Ci	4 µF	0 µF	0 µF	0.48 µF
Li	0 µH	0 µH	0 µH	0 µH
Uo		0 V	5.88 V	0 V dc
Io		0 A	66 mA	0 A dc
Po			97 mW	0 W dc
Co			1000 µF	1000 µF
Lo			26 mH	97 µH
Lo/Ro				145 µH/□

Refer below for example terminal number identification. The connector “Telltale” shown in the example below may only be connected to the TX5001 RockMonitor XR Telltale units:



The Controller outer chassis shall be connected to Earth when installed.

Conditions of Use applicable to each separately certified equipment comprising the system shall be observed – refer to sub-sections 3.2.1 to 3.2.3.

4 Technical Information

4.1 Product options

TX5001 RockMonitor XR Telltale

Product Options:

TX5001											
Certification	# of Anchors	Anchor Height	Topology	Cable Length	Termination						
IECEX (AUS) Group I	06	Two Height	02	In 1m increments up to 30m*	xx	Spur	01	In 1m increments up to 30m*	xx	Strip + Tin	01
ATEX/IECEX Group I	19	Four Height	04	E.G 15 = 15m**		Daisy Chain	02	E.G 13 = 13m**		Connector	02
				*Please select maximum Anchor Height required. All Anchors will be supplied to this length plus an additional 1.5m installation aid.						*A single cable of specified length will be supplied for Spur topology. Two cables of the same length will be supplied for Daisy Chain topology.	
				**Standard Length 15 meters						**Standard Length 13 meters	

TX5002 RockMonitor XR Controller

Product Options:

TX5002		
Certification	Communications	
IECEX (AUS) Group I	Ethernet	01
ATEX/IECEX Group I	RS485	02

TX5003 RockMonitor XR Reader

Product Options:

TX5003	
Certification	
IECEX (AUS) Group I	06
ATEX/IECEX Group I	19

4.2 Product Specifications

4.2.1 RockMonitor XR System

Operating range:	Up to 10 km (See section 9.1)
Number of telltales:	Up to 150 per controller
System refresh rate (150 Telltales):	15 mins
Ambient temperature:	0 °C to +50 °C
Humidity:	10 to 98%

4.2.2 TX5001 RockMonitor XR Telltale

Ambient temperature:	0 °C to +50 °C
Storage temperature:	-20 °C to +50 °C
Humidity:	10 to 98%
Protection classification:	Dust and waterproof to IP54
Housing materials:	SS316, PC/ABS
Net weight:	2.1kg
Measurement points:	2 or 4
Borehole diameter:	35 to 45 mm
Measurement range:	0 to 150 mm (without reset)
Accuracy:	<1.0mm
Repeatability:	<0.1mm
Certification:	See section 3

4.2.3 TX5002 RockMonitor XR Controller

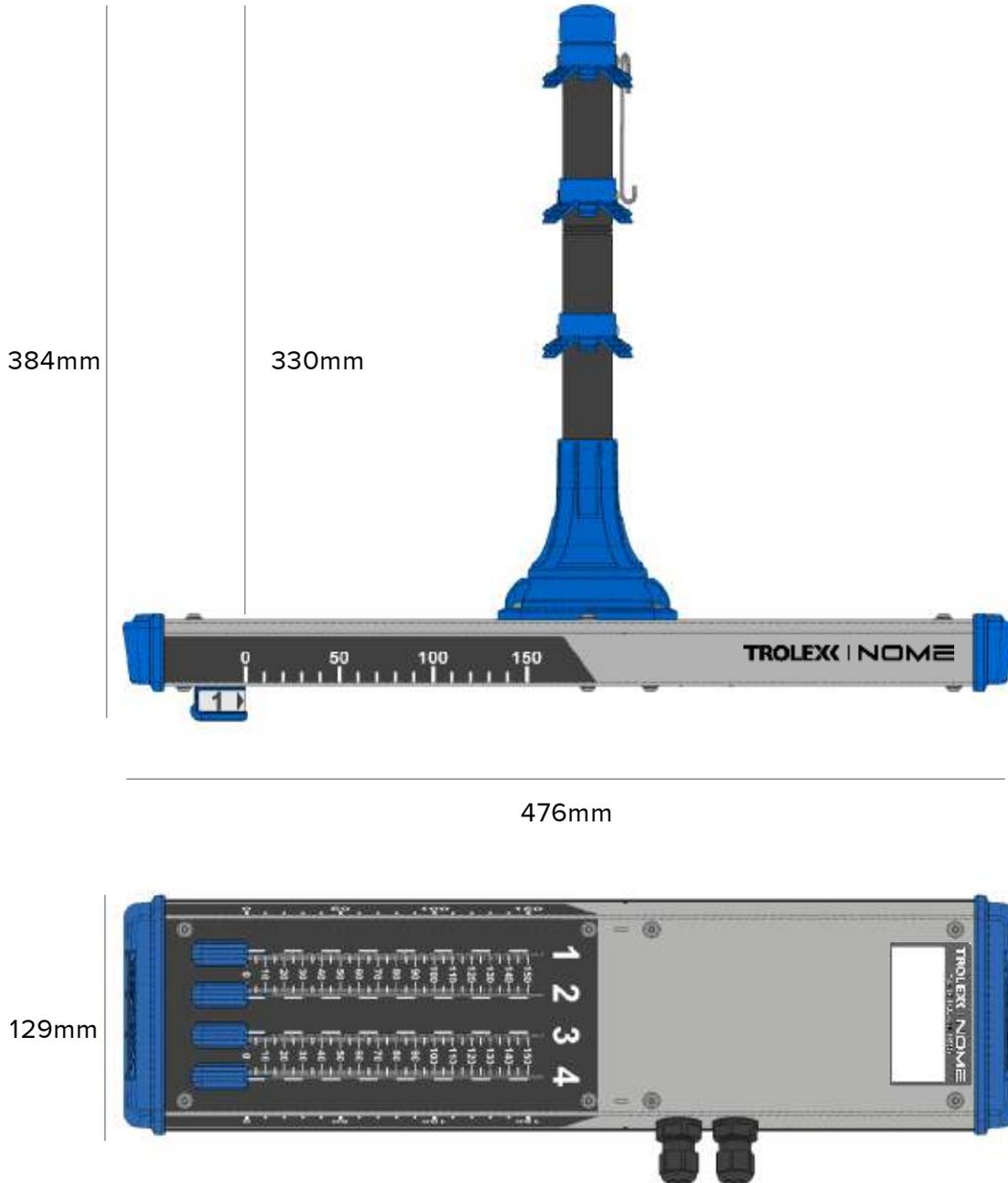
Ambient temperature:	0 °C to +50 °C
Storage temperature:	-20 °C to +50 °C
Humidity:	10 to 98%
Protection classification:	Dust and waterproof to IP66
Housing materials:	Coated Steel
Net weight:	6.8 kg
Nominal power supply requirements:	12V, 500mA
Minimum supply input	9.8V
Max peak supply current (150 Telltales):	425mA
Display:	128 x 64 pixels LCD with backlight illumination
Communications:	RS485 data output or Ethernet
System data refresh:	3-10 minutes (dynamic depending on system size)
Certification:	See section 3

4.2.4 TX5003 Reader

Ambient temperature:	0 °C to +50 °C
Storage temperature:	-20 °C to +50 °C
Humidity:	10 to 98%
Protection classification:	Dust and waterproof to IP54
Housing materials:	SS316, Acetyl, (contained in a leather pouch)
Net weight:	1.1 kg no pouch, 1.4 kg with pouch
Battery:	NiMH
Battery run time:	Up to 12 hours
Battery charge time:	6 hours
Display:	128 x 64 pixels LCD with backlight illumination
Certification:	See section 3

4.3 Product Dimensions

4.3.1 TX5001 RockMonitor XR Telltale



4.3.2 TX5002 RockMonitor XR Controller



4.3.3 TX5003 RockMonitor XR Reader



5 Hardware Installation

The RockMonitor XR has been designed to be as simple to install and commission as possible. Nevertheless, installation in underground environments can be challenging and correct set up is critical to the function of the system.

RockMonitor XR Telltales are plug and play such that they can be installed as a network in advance of connection to a RockMonitor XR Controller or they can be dynamically added to an existing network without the need to remove power from the controller. Once connected to the network and power applied, the controller automatically configures the network. Telltales added to an existing system will be automatically set up without the need to reconfigure the entire system. Once configured, the controller will start polling immediately, communicating with each telltale device to start recording displacement measurements.

To set up the RockMonitor XR Controller the user must provide power and a connection to the communications network. Aside from selecting the appropriate IP/COM port little or no user interaction is required to configure the network and have the controller send data back to the surface PC

Installation can be considered in two parts:

1. Installation of the RockMonitor XR Telltales and wired connection to the controller
2. Installation of the RockMonitor XR Controller and its communications link to the surface PC

The system must be installed as detailed in Section 3. In addition, the installation work must comply with the conditions of safe use as detailed in section [3.1.2](#) and [3.1.3](#) as well as the appropriate national installation requirements.

Peripheral components such as the power supply and communications barrier must be installed according to the manufacturer's instructions and the mine's prevailing statutory regulations.

The installation of the product must only be carried out by competent personnel. Each installation needs to be considered with reference to the local safety regulations and authorities. Refer to the following standards for additional guidance:

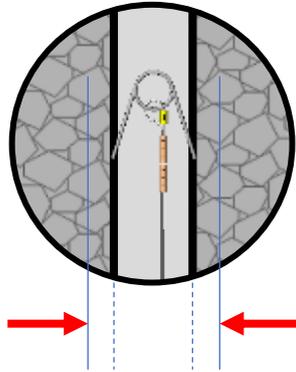
- IEC/EN 60079-14
- IEC/EN 60079-25
- EN 50628:2016

Refer to the Certification Section of this User Manual and to the relevant certificates for any installation parameters and special conditions of safe use.

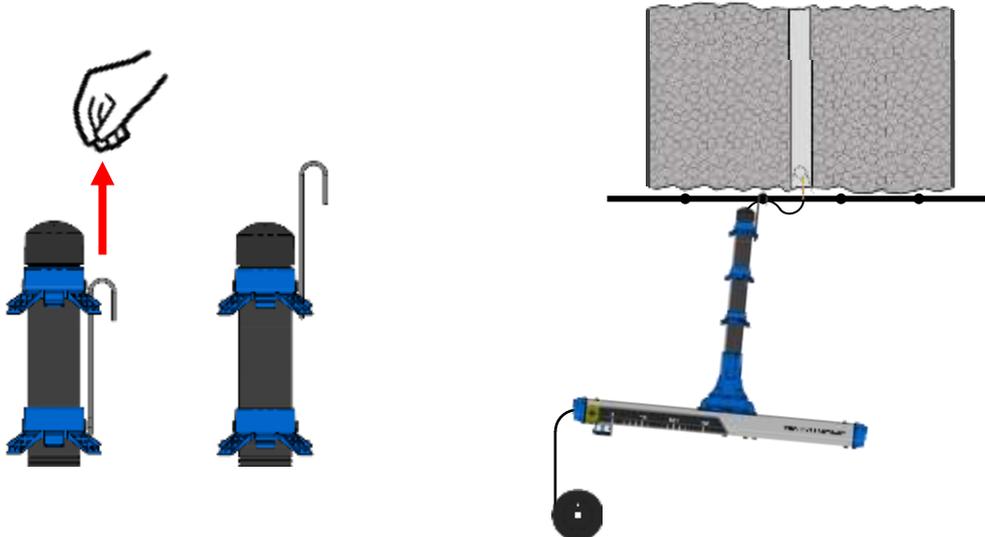
5.1 Telltale Installation

To install a RockMonitor XR Telltale into a tunnel roof or sidewall, follow the procedure below:

1. Drill a 35mm-45mm bore hole to the height required for the top most anchor.

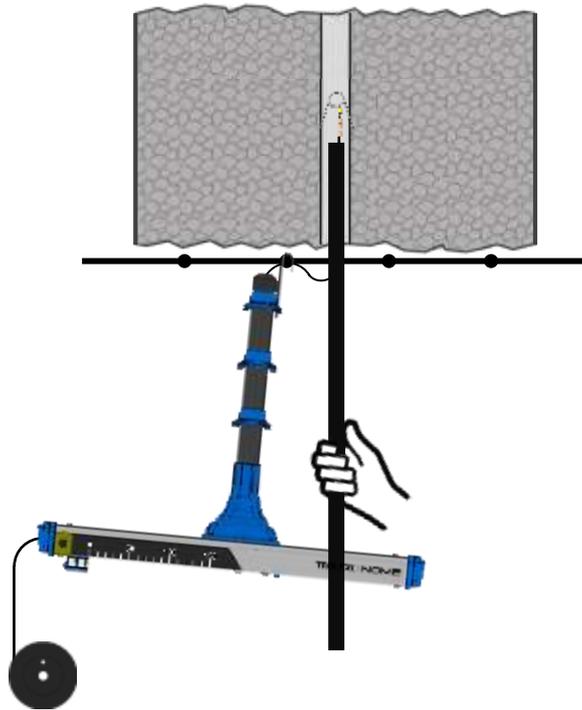


2. Cut a hole in the roof mesh large enough to ensure there is no interference to the telltale body once installed.
3. Using the integrated installation hook located in the top anchor, hang the device off the roof mesh as close to the bore hole opening as possible. Ensure the yellow installation hold-off tab is left in place.

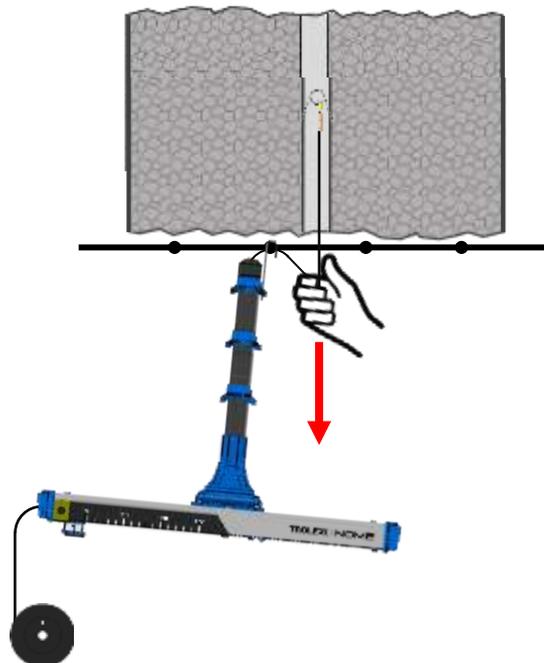


4. Remove the wire reel for anchor 1 and allow to unspool.

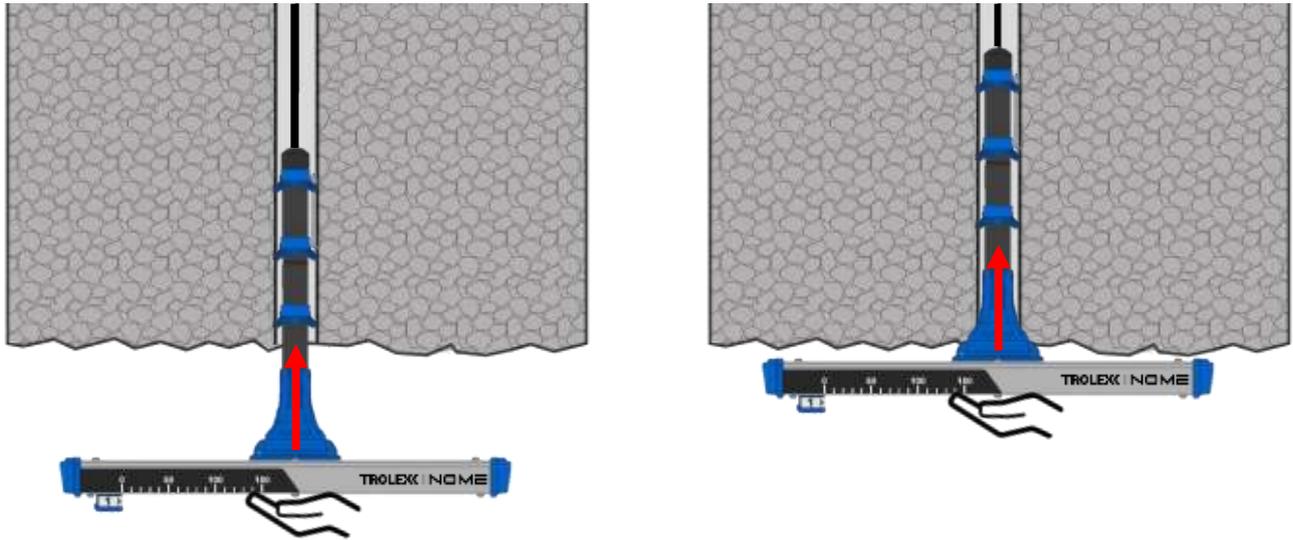
- Using an installation rod push anchor 1 up the bore hole to the required height. Repeat these steps for heights 2, 3 and 4.



- Pull down on each wire placed into the bore hole to ensure the spring anchors find a lie within the hole.



- Unhook the device from the mesh and push the device as far as it will go into the bore hole taking care to push from the centre of the device body.

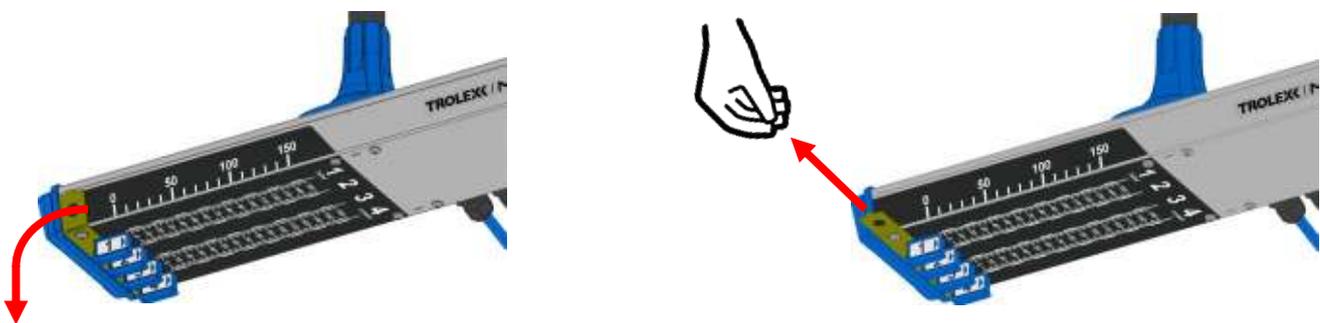


- Pull the slack cable through the device from the back end as you do this.

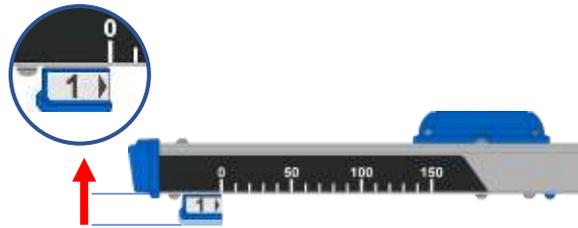


- Device orientation will be dependent on local strata conditions and should be determined on a case by case basis. However, use of the side scale for viewing at distance requires the telltale to be mounted perpendicular to the direction of travel.

- Remove the handle installation hold-off tab (the yellow plastic strip).



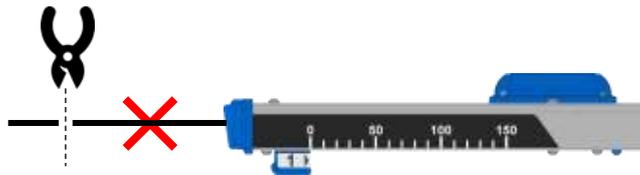
11. Ensure all marker handles sit flush against the device and are not stuck in the down position.



12. Pull on each cable coming out of the device to remove slack in the line.

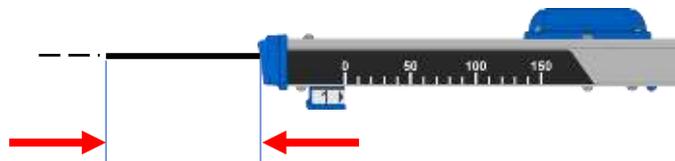


13. Excess cable can be removed with wire cutters. However, care must be taken to ensure there is enough cable to allow for potential resetting of anchors.



14. It is recommended that a suitable amount of cable remains after cutting to allow for any number of anchor height resets. Each reset requires 150mm of cable, plus 100m of remaining cable to allow for tensioning and to prevent the end of the cable being lost inside the device.

Please calculate the cable trim length based on your system requirements.



15. Connect the blue power/data cable to the rest of the network in the required manner.

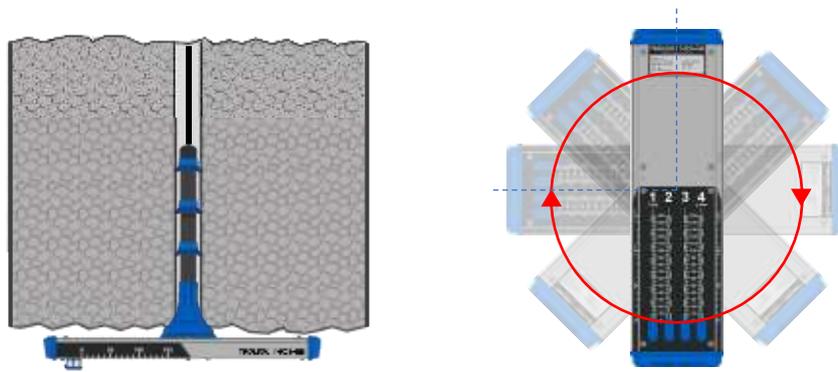
Note: the RockMonitor XR Telltale has two configuration options; daisy-chain or spur. In a daisy-chain configuration it is possible to connect the blue power/data cables directly between telltales, connecting the output from one to the input of the next using crimps or a junction box. In a spur configuration, the power/data cables are typically connected to the main trunk line via a junction box.

Telltale Orientation

It is important to consider the appropriate installation orientation of individual Telltales when fitting or expanding a RockMonitor XR system. Telltale devices have been designed to allow for various installation options when mounting into a mine roof or sidewall whilst offering the maximum protection from unnecessary ingress. Please follow the orientation installation guide below.

5.1.1 Roof Mounting

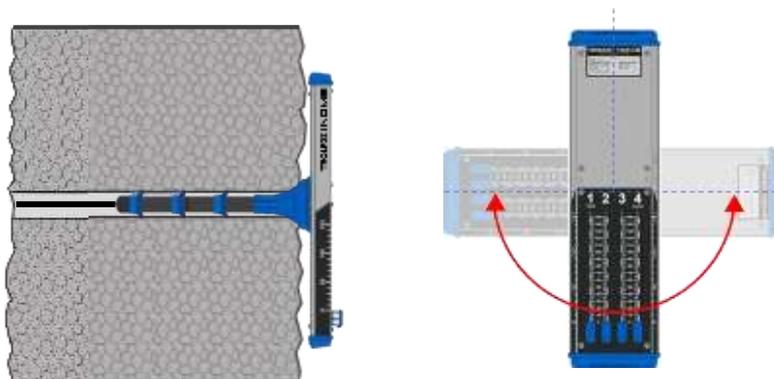
A device can be mounted directly into the mine roof with the Telltale body being positioned in any degree of angle about the bore hole centre. It is recommended to orientate the device so that it is perpendicular with the walls of the roadway. This will allow for the side scales on the device and the anchor indicators to be viewable down the roadway from both sides.



Roof Mounting Orientation

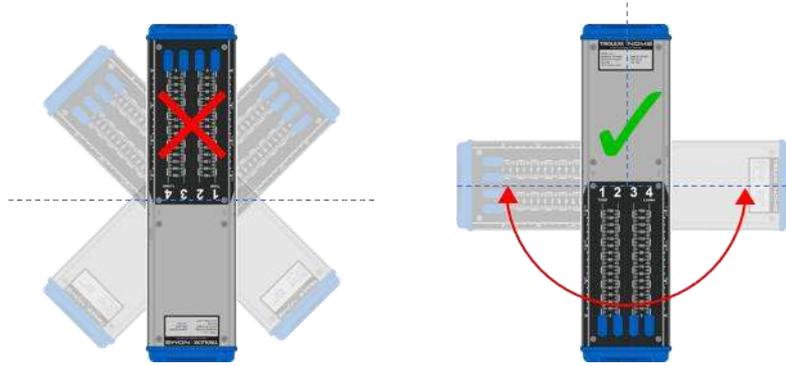
5.1.2 Sidewall Mounting

A device can be mounted directly into a mine sidewall with the Telltale body being positioned in a fixed orientation about a 180-degree angle around the bore hole centre. It is recommended to orientate the device so that the scale label is on or below a horizontal installation position to ensure suitable in-situ ingress draining takes place.



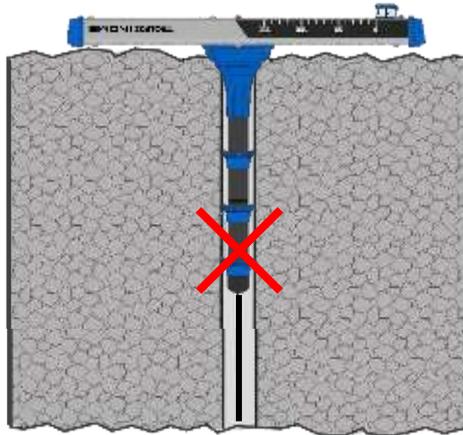
Sidewall Mounting Orientation

During sidewall mounting, the device should never be installed with the scale label positioned above the horizontal installation level.



Incorrect sidewall Telltale mounting

Telltales must never be installed with the bore tube pointing down.



Inverted device mounting

5.2 Controller Installation

The location of the RockMonitor XR Controller is the prerogative of the mine. The system has been designed to support operation over long distances thus giving as much flexibility as possible for where to locate the controller. It is possible to position the controller several kilometres from the first telltale in the network. Typically, consideration will be given to the location of a suitable power supply, access to the communication network and the protection of cabling from damage.

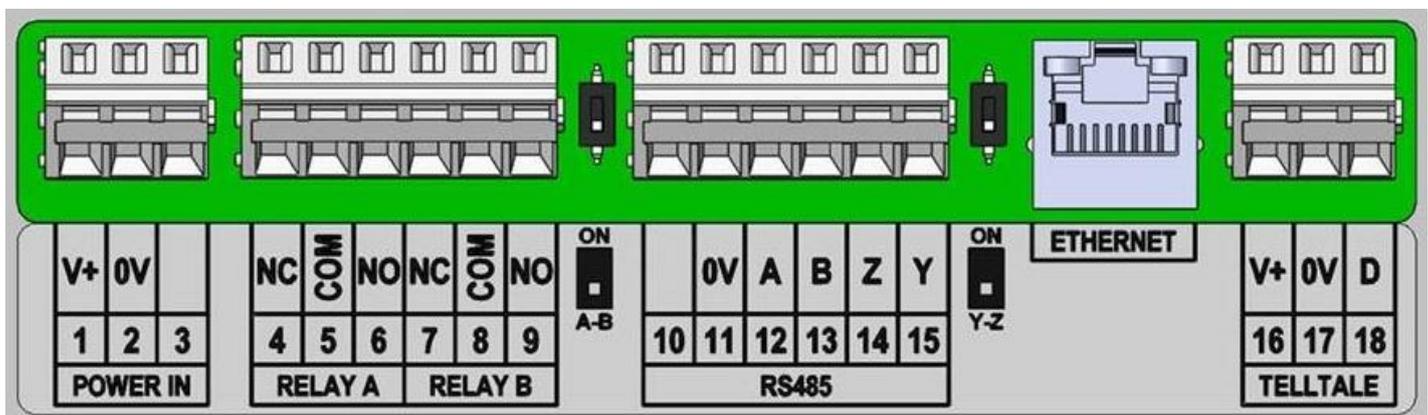
1. Secure the controller to a suitable mounting surface using the mounting brackets provided.
2. Unlock and open the enclosure door to access the internals of the controller.
3. Run the required cables through the cable glands provided in the bottom of the enclosure.
4. Wire the cables into the relevant terminals on the internal plate.
5. Tighten the cable gland against the cable to ensure an IP seal.
6. Close and lock the door after use to maintain IP rating of the enclosure.

Note 1: Only one controller shall be used to power a single telltale network

Note 2: When the door is open the unit is susceptible to ingress so care must be taken to ensure the location is clean during installation.

5.2.1 Connections

The figure below shows the connections available internally in the controller. The connections can be accessed by opening the front housing of the controller using the supplied key. The connections are clearly labelled on the internal metal plate. Wires are inserted into the connector terminals by first using a small flat head screwdriver inserted into the small recess above the appropriate terminal. Pushing the screwdriver down into the mechanism opens the connector terminal allowing the wire to be inserted into the opening. Before placing the wire into the connector, ensure that the wire has been stripped back sufficiently to allow a good electrical connection. Once the wire has been sufficiently pushed into the terminal, remove the screwdriver to allow the mechanism to clamp the bare wire end. Give a gentle tug on the wire to make sure it has been clamped sufficiently by the connector. Details of the connections are given in Tables 1 and 2.



Controller connections

Tables 1 and 2 below give full descriptions of the terminal connections shown in the figure above. The pin connections listed in Table 2 for the Ethernet connector are not labelled in the figure but relate to the internal connections of the RJ45 connector with Pin 1 on the left up to Pin 8 on the right. The switches shown either side of the RS485 terminals in the figure allow the line to be terminated. The RockMonitor controller currently only uses half duplex mode, pins 11, 14 and 15.

Power In		Relay Connections		RS485 Communication	
1	Supply voltage	4	Relay A: Normally Closed	10	No connection
2	0V return	5	Relay A: Common	11	RS485 0V
3	No connection	6	Relay A: Normally Open	12	RS485 A (R+) (not half duplex)
		7	Relay B: Normally Closed	13	RS485 B (R-) (not half duplex)
		8	Relay B: Common	14	RS485 Z (T-) (half duplex = B)
		9	Relay B: Normally Open	15	RS485 Y (T+) (half duplex = A)

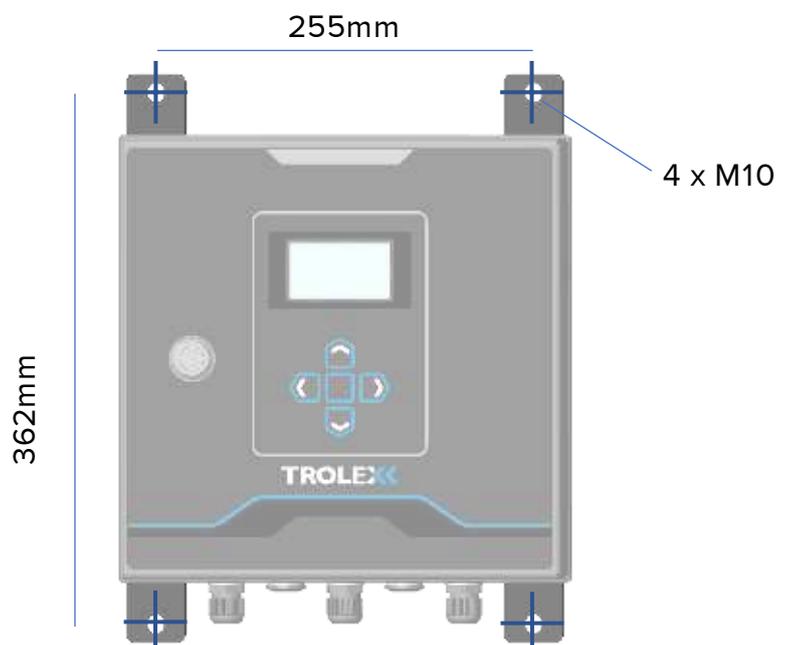
Table 1: Power, relay and RS485 terminal connections

Ethernet	Telltale Network	
Pin 1: TX+	16	Supply voltage
Pin 2: TX-	17	0V
Pin 3: RX+	18	Data communication
Pin 4: No connection		
Pin 5: No connection		
Pin 6: RX-		
Pin 7: No connection		
Pin 8: No connection		

Table 2: Ethernet and telltale network connections

5.2.2 Mounting Details

Ensure the RockMonitor XR Controller is mounted vertically during installation.



6 System Commissioning

The RockMonitor XR System is designed to be plug and play. Once the network of RockMonitor XR Telltales is connected to the RockMonitor XR Controller and power applied, the controller will automatically configure the connected devices. On connection to the communications network, the controller will start sending data to the Trolex|Core application software.

6.1 First Power On

Prior to commissioning and first use, the product should be inspected for any visible damages and integrity of the enclosure. Never use the product that has damaged housing in hazardous locations.

1. Ensure that the telltale network is correctly installed and connected to the controller.
2. Apply power to the controller.
3. The loading screen will display for several seconds until the user is presented with boot options.
4. The user will be presented with two options; Discover telltales; Controller setup only.

Note: If it is not the first time the unit has been powered with the telltale network connected then the controller will give the option to 'Load previous setup'. Choosing this option will load the previous network configuration. Any new devices connected to the network will be automatically added and configured within a few minutes.

5. Controller setup only; selecting this option will ensure that the power to the telltale network remains off and allows the user to change controller settings e.g. display brightness. This would typically be used when the telltale network is not yet installed but the user would like to configure the controller and check the communications network.
6. Discover telltales; selecting this option will trigger the controller to search for all connected telltale devices.
7. Once discover telltales has been selected the user is presented with the option to select the number of expected telltales on the network. This is to allow the optimisation of the setup time, reducing the amount of time the user must wait for the network to configure.
 - 50 or less
 - More than 50
 - More than 100

Note: if the user selects the incorrect value then the controller will still configure the network, but it will take longer than if the correct option had been selected.

8. The screen will then display the number of telltale devices found, automatically incrementing every time a new device is located on the network. This may take several minutes.
9. Once the controller has discovered all telltales the screen will display the number of connected telltales. It will also automatically countdown the number of telltales waiting to be configured.

10. Once all telltales have been configured, the telltales network is fully initialised and will automatically start collecting data.

6.2 Network Connection

1. Once the communications network is connected and power applied to the controller (and the appropriate serial port opened at the PC or server) the controller will automatically connect within approximately 10 seconds and start communicating with the Trolex|Core application software.
2. The controller will repeatedly attempt to connect, so if Trolex|Core has not yet been installed then the controller will continue to try until the software becomes available.
3. Once a connection to the Trolex|Core software has been established, the controller will start transmitting data acquired from the telltale network.

6.3 Application Software

Installation and commissioning of the Trolex|Core application software is covered in the Trolex|Core user manual.

6.4 Meter Marks

If the user would like to set the metre mark (positioning identifier indicating distance along a roadway) for each telltale, this can be done via the menu on the controller.

1. Hold the centre button to access the main menu
2. Select 'Telltale manager'
3. Select 'Telltale info'
4. Navigate to the telltale you would like to edit using the next and previous buttons
5. Select 'Config'
6. Select 'Edit metre mark'
7. Enter the metre mark
8. Select 'Set'
9. Repeat this for all telltales

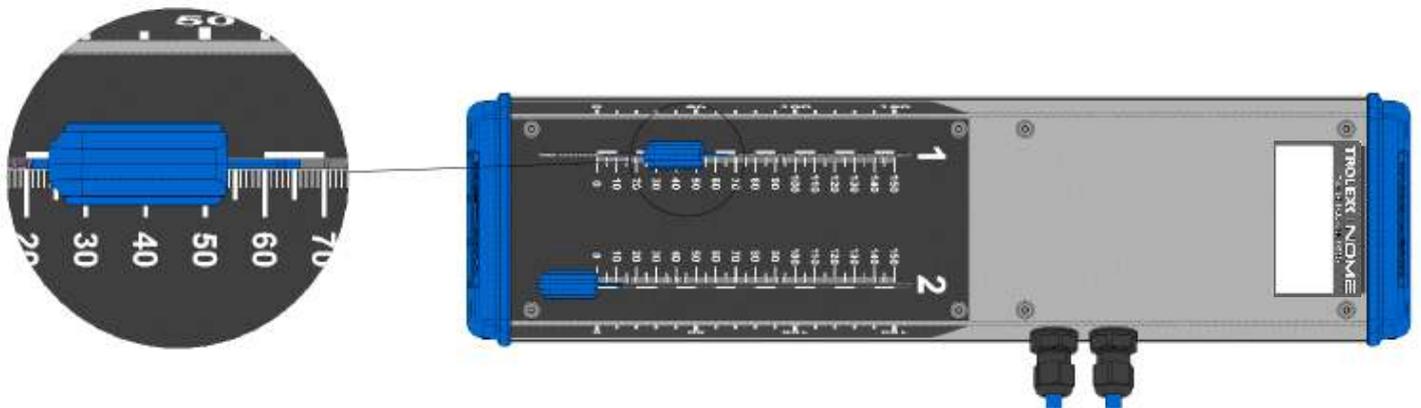
7 General Operation

7.1 Telltale

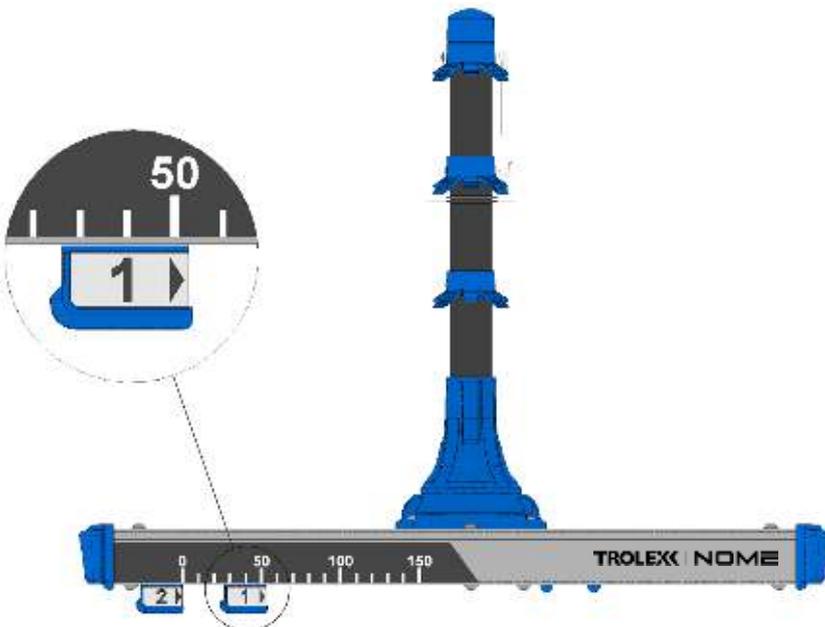
7.1.1 Measuring Displacement

The Telltale provides local indication of displacement by way of linear scales on the device. These are provided as general indication only and it is recommended that the supporting Trolex|Core application software is used to obtain accurate measurement readings. There are two types of visual scale on the device:

1. A fine scale on the underside of the device which provides measurement of displacement to the millimetre. The scale should be read from the leading (front) face of the anchor indicators.



2. A course scale on the sides of the device. These are intended to provide general indication of displacement from a distance in increments of 10mm. Viewing of the side scale from any angle other than perpendicular will result in an inability to judge displacement with any accuracy.



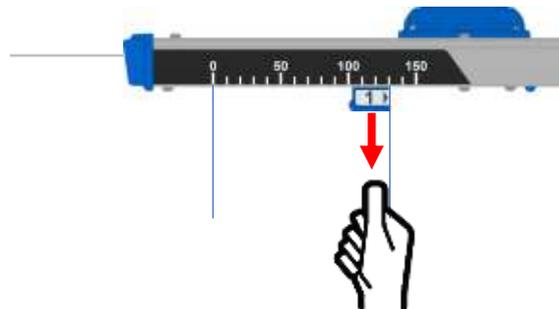
7.1.2 Extending the Measurement Range

The Telltale has a measurement range of 0 to 150mm, however this range can be extended if required. There is facility to manually reset the anchor indicators back to 0 to allow for further travel whilst maintaining the current readings. To reset the telltale, follow the procedure below:

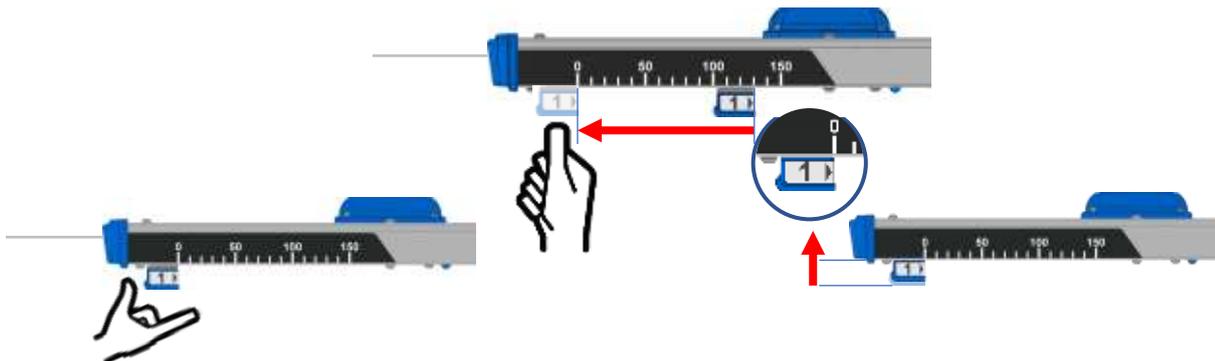
1. On the RockMonitor XR Controller, navigate to [Settings Menu > Telltale Manager > Telltale info.](#)
2. Navigate to the telltale to be reset using [Next /Prev.](#)
3. Select [Config](#), followed by [Reset w/ offset](#). Follow the instructions on screen to confirm the reset.

Note: Depending on how the alarms have been configured, this action may trigger an alarm until the telltale is mechanically reset.

4. The telltale will now use the current readings as an offset for all future readings.
5. On the telltale itself, pull the reset handle down



6. Whilst holding the handle down, slide the handle back to the zero position on the scale.



7. Release the handle. Ensure the handle snaps upwards against the device and is not stuck in the down position.
8. Pull on each cable coming out of the device to remove slack in the line.



To remove the offset:

1. Repeat steps 1 and 2 above.
2. Select [Config](#), followed by [Remove offset](#).
3. Follow the instructions on screen to confirm.

7.2 Controller

7.2.1 Auto-Detect Telltale Network

As described in the commissioning section 6.1 First Power On, the controller will automatically detect and configure any new telltales connector to the controller whether a single device or multiple devices. Even if newly installed telltales are connected to an existing network of telltales that has already been configured and is recording data, the new devices will be automatically detected and configured by the controller.

7.2.2 Adding New Telltales

- Telltales can be plugged in live – no need to disconnect power from the telltale network.
- The controller will automatically discover new devices and configure them.
- The controller can also configure multiple telltales dropped on to the system simultaneously.
- Set metre marks as described in section 6.4.

7.2.3 Removing Telltales

- Telltales can either be physically removed or remove via the menu system on the controller [Main menu > Telltale manager > Telltale info > Navigate > Config > Remove](#).
- If a unit is physically removed having been previously detected and configured by the controller, the telltale will appear as inactive. It can then be removed on the controller via the first step above.

Note: If a telltale is incorrectly removed via the controller, the user must tell the controller to rediscover the whole network in order to reinstate the incorrectly removed telltale.

7.2.4 View Live Data

- From the default screen press the right arrow to show displacement readings as well as telltale information such as serial number, metre mark, status.
- Pressing right again will show telltale supply voltage, current consumption and temperature as well as any error information.
- By default, the system will automatically scroll through the network, displaying information for each telltale one device at a time.
- The up and down key can be used to quickly navigate to a particular telltale. Pressing of the up down button will pause the auto-scroll feature for 30 seconds to allow the user to navigate to the desired telltale.

7.2.5 Power Outages and Recovery

- If power to the controller is disconnected, then the telltale network will also lose power.
- On reconnection of power to the controller, the controller will boot as normal and default to 'Load previous setup' if the network has previously been configured.
- There is an automatic time-out to ensure that this option is selected if no user is present.
- If there hasn't been a previous setup then the controller will automatically discover the telltale network.

7.2.6 Menu Navigation

- Hold the centre button to access the main menu.
- Up/down/left/right for navigation and changing values or options.
- Centre button to select menu options.

7.2.7 RS485 Communication

- To view the connection status on the controller display, press left twice from the default screen.
- Must use Trolex|Core to communicate between PC and controller (custom protocol).
- Baud fixed at 9600.

7.2.8 Ethernet Communication

- Supports DHCP or static configuration [main menu > communications > ethernet > IP assignment](#)
- If static enabled a separate screen appears to allow configuration IP address
- Must use Trolex|Core to communicate between PC and controller (custom protocol).
- Requires user name and pass to login to Trolex|Core

Note: only accessible if Ethernet option enabled in the device config

7.2.9 LCD Settings

- Ability to set display contrast, brightness [main menu > display](#)
- Ability to also set auto-scrolling functionality including time delay, live update, or disabled

7.2.10 Time and Date

- Can view by pressing left once from the default screen
- To change select [main menu > date & time > set automatically](#) (if connected to Trolex|Core) or set manually using the buttons and on-screen options

7.3 Portable Reader

7.3.1 Power on and off

The Reader has a rocker switch on the top cap to allow the device to be powered on and off to save battery life. Switch this to the ON position to use the Reader and to the OFF position to power down the device when not in use.

7.3.2 Charging

A charging adapter is provided with each reader. The charger connects to the reader via the charging connector located on the top of the device. Charging may only take place in a non-hazardous location. Charging the device fully when the battery is fully discharged can take up to eight hours.

7.3.3 Power Saving Mode

The unit will automatically shut off the screen and turn itself off after five minutes of inactivity to conserve power. The unit can be woken up with a button press.

7.3.4 Commission and Debugging Tool

The portable reader is primarily a commissioning and debugging tool to aid with installation of the telltale network and help fault find if the network becomes inactive. Using the reader to check individual telltales on installation ensures that the devices are working correctly prior to connection to the controller. The reader also provides a convenient way to set the telltale metre mark when in-situ, ensuring accurate set up of the network and helping to avoid errors. Primary functions:

- Check line voltage
- Check network current
- Edit metre mark

7.3.5 Display and Buttons

The display and buttons used are common between the controller and reader allowing familiar navigation and screen layouts. The buttons are large and designed to be suitable for use with gloves.

7.3.6 Safety Information

The following precautions are necessary to ensure safe use of the device in hazardous areas and ensure compliance with certification requirements:

- Do not plug the reader into a network with a controller or reader already connected.
- Do not remove from the leather pouch whilst in the hazardous area.
- Do not attempt to charge the reader in the hazardous area
- Ensure that the integrity of the housing is maintained, checking regularly for dents in the metal and cracks in the plastics as well as any other visual anomalies.

8 Maintenance

The maintenance of the product must only be carried out by competent personnel. Maintenance shall to be considered with reference to the local safety regulations and authorities. Refer to the following standards for additional guidance:

- IEC/EN 60079-17

The product shall only be serviced and repaired by Trolex Ltd., or a local Trolex service agent approved by Trolex Ltd. in order to maintain the certification of the product.

8.1 Visual Checks

Periodical visual checks should be carried out to assess if there are any issues arising with the Telltales. Check for:

1. Labels on the device are still in place and are not peeling or discolouring. Ensure all labels are clean by following 8.2 below.
2. Check for any damage to the device. Plastic parts should not be cracked or broken which could affect IP rating of the device. The metal housing should not be dented or bent which could cause issues with the mechanical mechanism.
3. Check that the device is still fitted tight against the roof and has not slipped down in the bore hole.

8.2 Cleaning Labels

It is recommended to clean the device periodically to ensure linear scales and indicators are clean and readable. The product should only be cleaned with a damp cloth.

8.3 Check Mechanism for Seizure or Jamming

Periodically check that the spring mechanisms on the displacement indicators are able to move freely. This can be done by pushing each indicator forward a little and releasing. The indicator should slide back freely to its original position and not stick in place.

8.4 Inactive Telltales

Inactive instruments can be viewed either via the Trolex|Core application software or directly on the controller. If an inactive instrument cannot be recovered, then it should be removed from the network.

8.5 Replacing Telltales

The telltale is designed to be a one-time fit into the bore hole, due to the retention required to hold the device in place. If a faulty instrument does need to be removed from a bore hole, then this is possible, but it would require a high degree of force to extract. Take any relevant precautions when doing this to minimise the risk of injury.

9 System Troubleshooting and Diagnosis

9.1 Faulty Telltales

- Telltale devices displaying faults will either appear as inactive on the controller or not appear at all.
- If a device displays as inactive or cannot be found, try disconnecting and reconnecting the telltale to the network.
- The portable reader can also be used to connect directly to telltale, allowing checking of the voltage and input current to ensure they are within acceptable limits.
- If disconnecting and reconnecting of the telltale does not solve the issue, then please contact Trolex for technical support.

9.2 Short Circuit (Telltale Network)

- If a short circuit is detected by the controller, the screen will display 'short circuit detected' and automatically disconnect power to the telltale network.
- Depending on the option selected in [main menu > system > short circuit reset](#), the controller will either display 'Power will auto-reset' and attempt to automatically recover periodically or display 'Power latched off' and give the user the option to attempt to recover the network.
- If short circuit detection is set to latching, the controller will turn off power to the network and remain off until an operator manually power cycles the controller.
- If the short circuit has been successfully resolved, then the controller will resume with the previous configuration.

9.3 Reset Handle

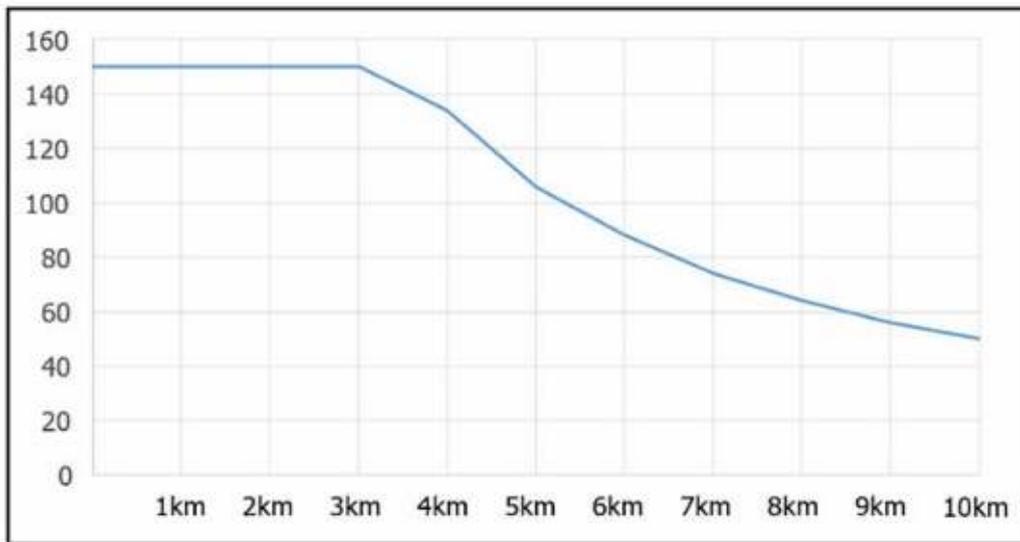
The reset handle is part of a spring-loaded mechanism designed for releasing the handle from the anchor wire to allow it to be moved back to zero.

- If the reset handle is difficult to pull down it is not recommended to apply too much force to pull it. Use one hand to brace against the metal body of the device and another to pull the handle down.
- If the handle does not snap back into the up position it could also be due to dust ingress. Do not leave the handles stuck in the down position as this means the anchor wire may not be clamped and displacement may not be measured. The handles can be pushed up manually if required, once they are against the body of the device the anchor wire will be clamped.

9.4 Cable Length Too Long / Too Many Instruments on the Line

The RockMonitor XR system is designed to work over long distances with many telltale instruments connected in a single system. However, system performance and the ability to support multiple instruments reduces rapidly over extended cable runs. The system protects itself via an undervoltage lockout mechanism implemented in the controller. If the too much current is drawn, and the voltage drops below the defined threshold then the controller will turn-off power to the telltale network.

The graph and table below show how many telltales can be supported at a given distance.



Distance	# Telltales
10km	50
9km	56
8km	64
7km	74
6km	88
5km	106
4km	134
3km	150
2km	150
1km	150

If the number of telltales required for the application exceeds the values shown above, it may be feasible to install a second controller and split the network to reduce the load on the first.

10 Disclaimer

The information and instructions contained in this manual are for guidance. Trolex Ltd. has used its reasonable endeavours to make them clear. The goods should be installed and operated by a competent person. If you are in any doubt whatsoever concerning the installation or use you should seek the advice of Trolex before proceeding further. All goods are supplied subject to Trolex's General Conditions for the Supply of Goods, a copy of which is available on request. Users should note that Trolex's liability for failure to follow these or any other instructions issued by Trolex is limited as set out in those conditions.

11 Revision History

Description	Date	Initials	Change Number
Initial Release	24 th April 2019	AR/JD/MK/KH	N/A
Certification Updates	26 th July 2019	KH	4867
Certification Updates	28 th October 2019	AH	4990
Certification Updates	16 th January 2020	AH	5005
Certification Updates	18 th February 2020	AH	5030