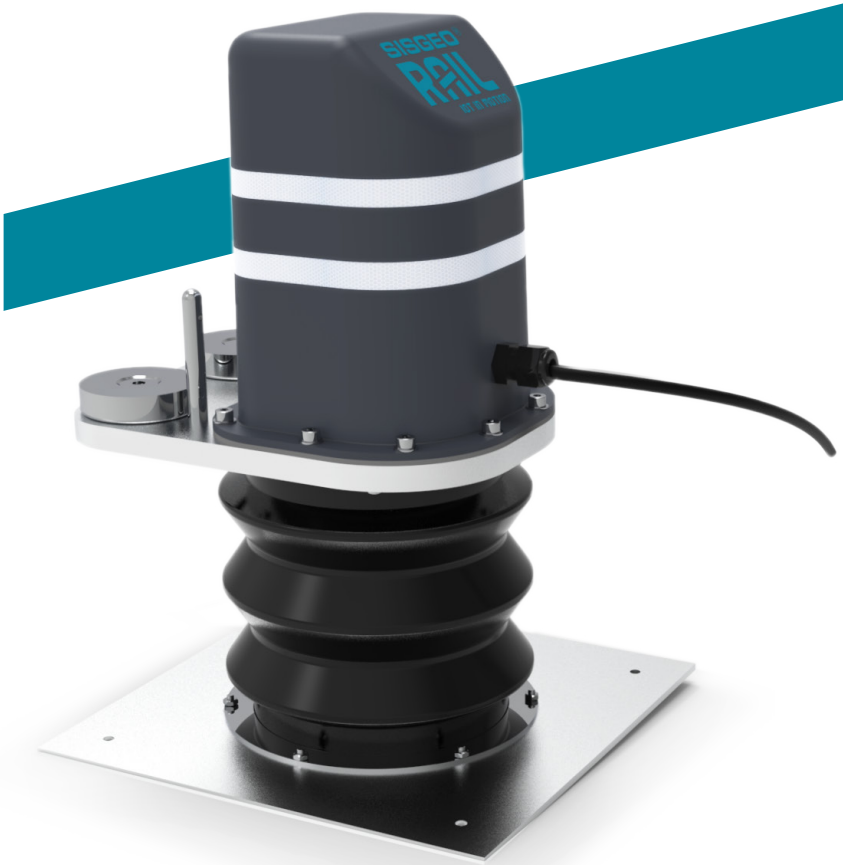
SISGEO®
RAIL
IOT IN MOTION

FLX-RAIL®

USER MANUAL



FLX-RAIL

INDEX

Notes on the use of product

For safe and efficient use of the product, please read carefully the following instructions before starting any operation.

Any use of the product other than the one described in this manual shall be considered the user's full responsibility.
The same applies for any unauthorized modifications.
In addition to the hereby listed standards, the user must comply with the provisions of the current legislation regarding personal safety and health together with all other persons in the workplace.
SISGEO is not responsible for any accident, breakdown or other problems due to lack of knowledge and / or non-compliance with the requirements contained in this manual.
Check that the product has not been damaged during the transport.
Verify that the package includes all items as well as any requested optional accessories; if anything is missing, please promptly contact SISGEO.
The user must strictly follow all the operations described in this manual.
Maintenance or repair of the device is permitted only by authorized operators.
These operators must be physically and intellectually suitable.
For information about instrument or to order spare parts, always specify the product information which can be found on the identification label.
When replacing parts, always use ORIGINAL SPARE PARTS.
The manufacturer reserves the right to make either technical and / or commercial changes without prior notice.
It is our policy to keep manuals continuously updated.

Symbols

Pay particular attention to the following instruction.

Identification

Instruments can be identified

- From a production lot number (written on the Compliance Certificate)
- From a serial number (s/n) engraved indelibly on the instrument
- From a label on the instrument
- From a label on the cable

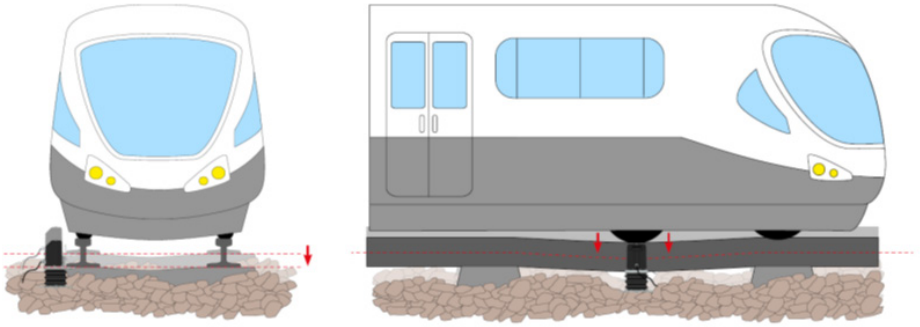
Note

The present Manual is issued by SISGEO in English Language and translated in other different languages.
In order to avoid discrepancies and disagreements on the interpretation of the meanings, Sisgeo Srl declares that English Language prevails

INTRODUCTION

The FLX-Rail® is an instrument developed to measure the maximum deflection of the track at each passage of the train. The measurement consists in reading the variation of distance between the ballast/concrete surface and the track, to which the instrument is fixed by two strong magnets.

The instrument is also equipped with SBV® technology (Start By Vibe®) in order to switch on the instrument only when the train approaches (energy saving).



In addition to the vertical measurement at each passage of the train, it is also possible to have an integrated biaxial tiltmeter and an externally attached temperature measurement through PT-100 (sensor positioned where needed within the limit of the cable length). Readings from tiltmeter and temperature gauge will be taken in static condition (no train passage) in order to do not interfer with the reading.

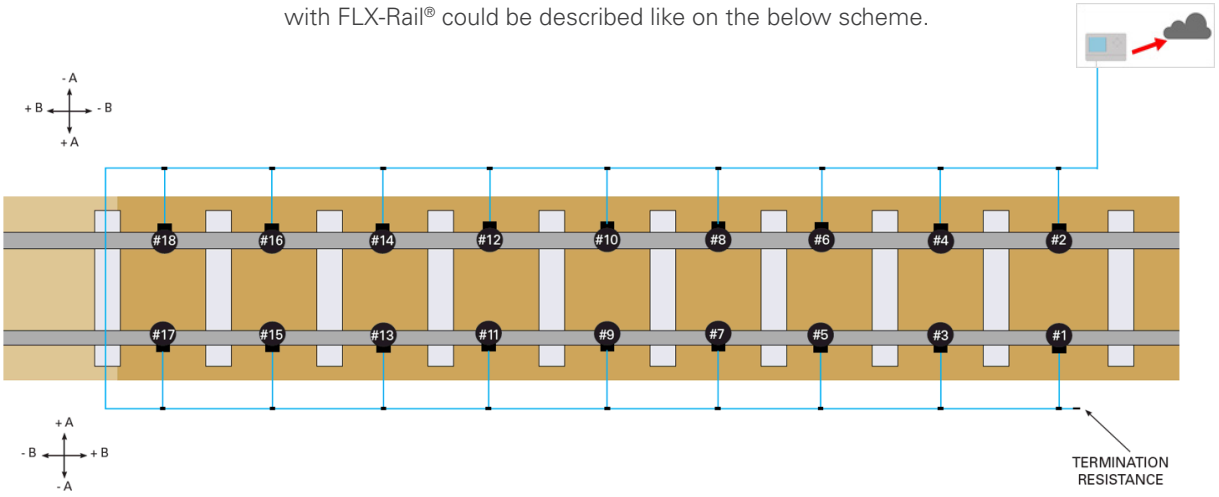
FLX-Rail® MODELS

SISGEO RAIL supplies 4 different FLX-Rail® models :

- FLX-Rail® for VERT DISPL: able to monitor the vertical deflexion of the rail
- FLX-Rail® for VERT DISPL+ TILT: able to monitor the vertical deflexion of the rail and the rail tilting
- FLX-Rail® for VERT DISPL + TEMP: able to monitor the vertical deflexion of the rail,
- and the temperature of the rail skin
- FLX-Rail® for VERT DISPL + TILT + TEMP: able to monitor the vertical deflexion of the rail, the rail tilting and the rail skin temperature

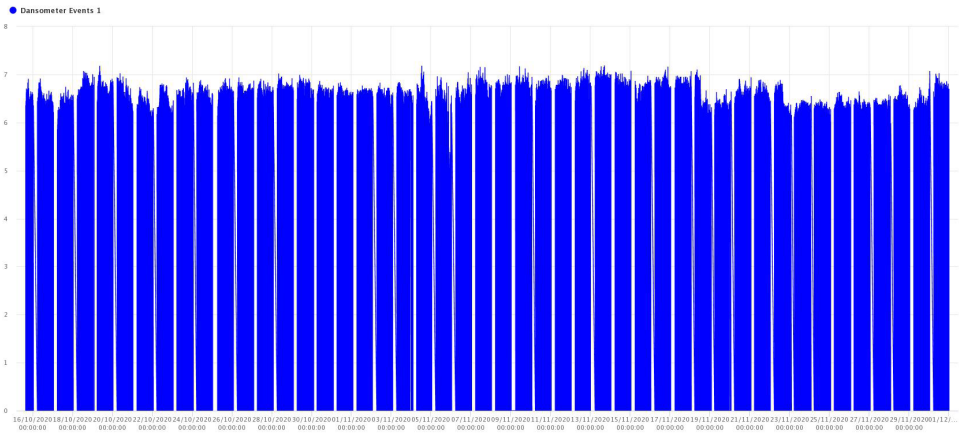
CONTEXTUAL USE OF FLX-RAIL®

As a general guidance, the installation layout of a complete monitoring survey with FLX-Rail® could be described like on the below scheme.



The system is managed by means of datalogger (e.g. OMNIAlog), coupled to W.M.S., a web-visualisation platform provided by FIELD Srl (Sisgeo Group). The local datalogger transmits datafiles to a FTP-server which integrates all data into a dedicated database in order to display, for each FLX-Rail®, the relevant parameters.

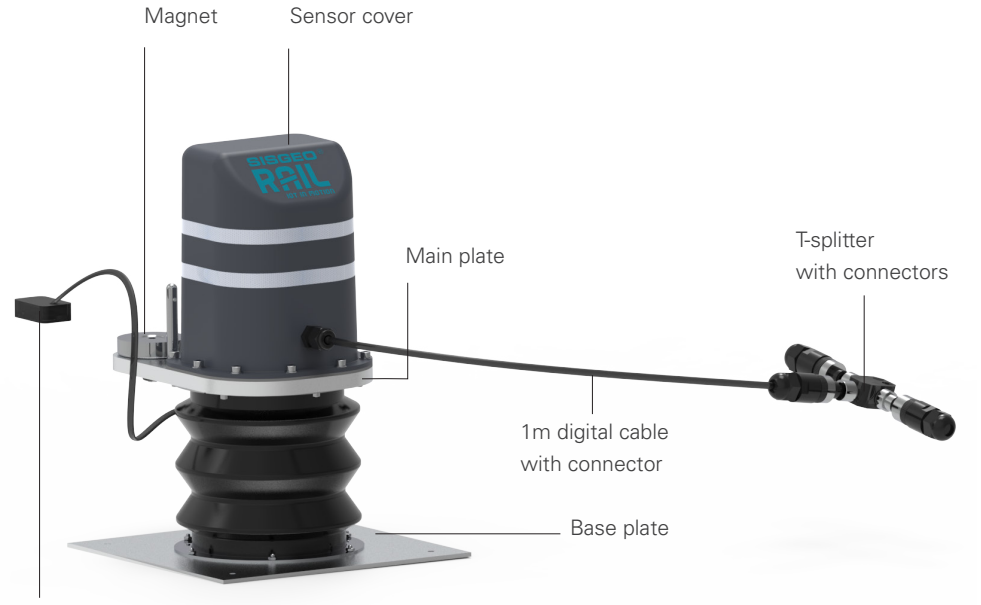
An example of histogram here below shows the evolution of the maximal deflexion for each event (train).



DESCRIPTION

The FLX-Rail® gauge is composed by:

- A main body with
  1. the sensor cover
  2. the main plate with two magnets and two rail supports
  3. the foot with a springed-leg and a steel base plate
- An optional detachable temperature sensor with integrated magnet
- A 1m-long digital cable with a T-connector and 3 connectors. The 2 connectors are supplied attached to a 5m cable each in order to build a chain of FLX-Rail®-s.



According to the needs SISGEO can therefore supply different models of FLX-Rail®.

All these models have an RS485 communication interface and standard MODBUS RTU protocol. All instruments are equipped with diagnostic sensors such as: measurement of temperature and humidity inside the instrument, measurement of the power supply voltage (of each individual instrument).

NOTE: the special RS485 Modbus protocol for FLX-Rail is not published into SISGEO website. For any clarification please contact your Sales Representative or Sisgeo Customer Care Department (assistance@sisgeo.com)

Main parameters configured at factory for each gauge:

- Serial number;
- Calibration parameters;
- RS485 address. Each FLX-Rail® has an univocal address also reported in a label on the cable.
- Powering type: always-on
- Unit of measurement
  1 - for displacement transducer, the standard output is mm.
  2 - for embedded biaxial tiltmeter version, the standard output is sinα. Upon request is possible to configure the inclination in Ksinα with K≠1 or another unit of measurement (mm/m or °). Contact SISGEO for further information
  3 - for magnet temperature gauge, the standard output is °C.

PRELIMINARY CHECKS

Useful tools :

For installation there is no specific tool needed. Nevertheless the complete installation would be performed with means of:

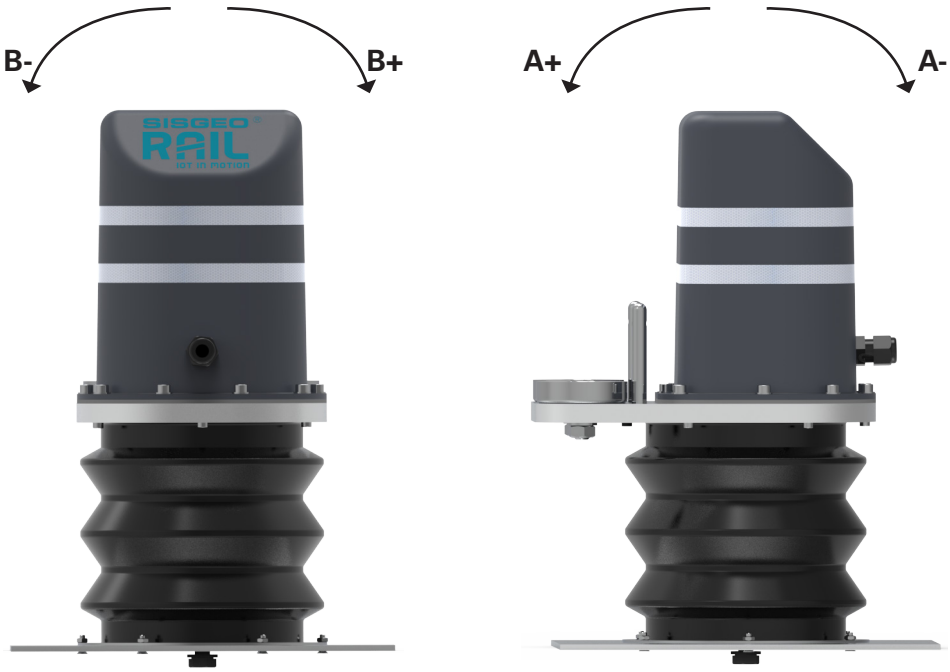
- a shovel and/or a pickaxe
- a measuring tape
- a metallic brush in case of excessive rust

Before installation it is recommended to check the compression of the instrument which must take place smoothly and without noise and to clean the magnet.

In case of re-use, it is strongly advised to clean completely the outside of the instrument, and to check the mechanical functionnality.

The provided 5m cable is shielded, not armored, it is therefore recommended to use cable ducts to protect against accidental shocks with sharp objects. A metal conduit is advised to improve the shielding against EM interference (rember that the metal conduit must be connected to a good grounding system).

Sign convention for the MEMS inclinometer



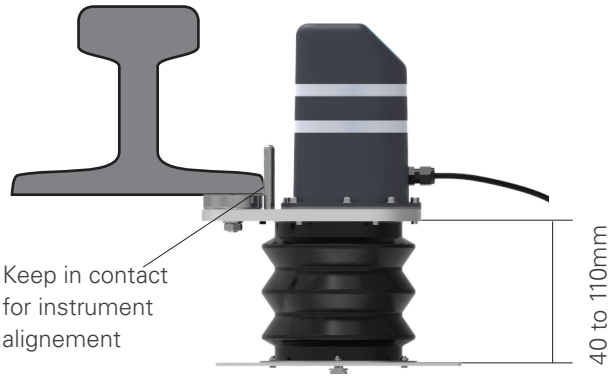
INSTALLATION

NOTE: the installation of these systems, being on a railway track, is subject to strict safety regulations. Please refer to the safety procedure issued by the relevant railway authority.

To install a FLX-Rail® unit, please follow this general guideline:

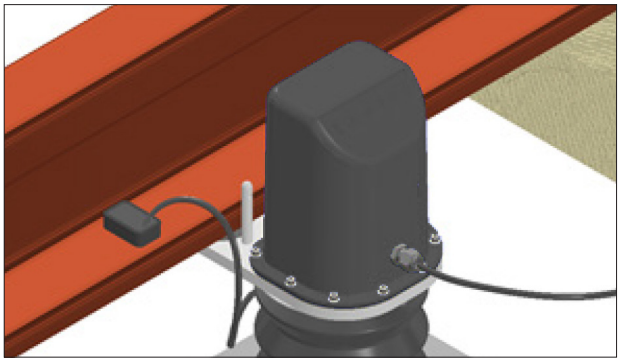
- Remove the ballast/concrete under the track and clean with brush the underside of the track where the instrument will be fixed. If the rail is over concrete, remove the concrete in the zone where the gauge will be installed.
  NOTE: Scrub off the rust from the rail in the zone where the magnets will be in connection with the rail is really important in order to have a better and stronger connection.
- Insert the instrument under the track keeping the two plates close together, taking care not to put your fingers between the upper plate of the instrument and the track, and then release them once the instrument is fixed under the track by means of the magnets.
- Check that the distance between the two plates after the installation is about 90mm: with the plates at such distance you should have an output of about 50mm (50mm in compression and 20mm in extension).

NOTE: with the plates at a distance of 40mm, the output is around 0mm; with the plates at a distance of 110mm, the output is around 70mm.
NOTE: Make sure that the two "rail supports" are in contact with the rail in order to guarantee the alignment of the instrument.



ATTENTION: Pay maximum attention to the very strong magnets.
Be careful not to let your fingers between the instrument and the steel rail.

If present, the external temperature sensor is fixed to the rail through its integrated magnet.



CONNECTION AND RANGE CONTROL TEST

In order to control the position of displacement sensor at the correct installation range, it is avised to use the datalogger. With OMNIAlog, the function TEST MEASURE will be used. This function simply scans all channels configured in OMNIAlog without saving their values.

Even if powered, the instruments are, in the absence of events, in sleep mode and therefore not reachable. It will therefore be necessary to simulate an event to wake up the instrument and be able to read it.

Therefore it will be necessary to proceed as follows (refer also to OMNIAlog manual and video tutorials on www.sisgeo.com):

1. Install all the FLX-Rail® with the two plates at the appropriate inter-distance, checking with a measuring tape (if the plates are at a distance of 90mm, you will have about 50mm in compression and 20mm in extension)
2. Inter-connect all gauges with the supplied cables and T-connectors

NOTE: The connectors must NEVER be in contact with the track. The metal parts of the connectors are joined to the cable shield and could therefore create a short circuit between the two rails.

3. Connect the end-resistance on the farthest gauge (refer to "TAKING EASUREMENTS"), and connect the main cable to the nearest gauge from the datalogger
4. Connect the main cable to the RS485 input (refer to "TAKING MEASUREMENTS")
5. Log in to OMNIAlog on the MEASURE MONITOR page. If not already done, configure all the instruments in the OMNIAlog DIGITAL SENSOR page. For any other operation on OMNIAlog datalogger, refer to dedicated manual downloadable at this page: https://www.sisgeo.com/downloads-en/manuals.html
6. Compress, one after the other, all installed FLX-Rail® to wake them up by simulating an event. Pay attention to let them at the desired position along the rail.
7. Wait 1 minute, then on OMNIAlog's WEB page press TEST MEASURE to acquire the event readings, stored in each instrument

The value to be checked is the **AVERAGE MEASURE** value in millimeters, present among the acquired values, which must report an installation measurement of around 50mm.

TAKING MEASUREMENTS

The last FLX-Rail® of every chain (the farthest from the logger) must have a termination resistance with value as for the following table. A spare kit of ending resistance is available (product code 0ERESIKIT00 including one 120 Ohm, two 240 Ohm, three 360 Ohm and four 480 Ohm resistances).

Chains connected to the same logger	Resistance value
1	120Ω
2	240Ω
3	360Ω
4	480Ω

FLX-Rail® digital chain is read connecting the terminal cable to a RS485 wiring panel (master unit) according to the following table.
NOTE: to perform this connection, one connector of the provided shielded cable has to be cut. With MIND readout is possible to connect directly the readout to the instrument.

	Function	Standard cable 0DFLXS5MCAB
Digital cable (5 pins connector)	+Vdc	Brown
	GND or -Vdc	Black
	Data + (RS485 A)	Blue
	Data - (RS485 B)	White
	Grounding	Grey

To cover a greater distance than 5m between the datalogger and the first sensor, please assemble several 5m shielded cables 0DFLXS5MCAB together, using their mating connectors.

USING OMNIA series DATALOGGER (refer to the dedicated manuals/tutorials)

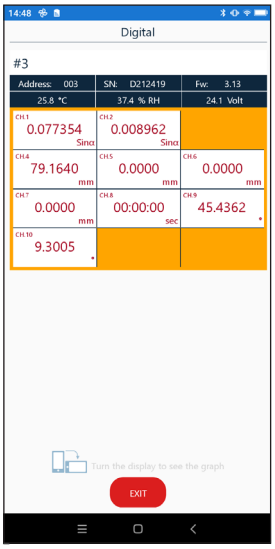
By acquiring the FLX-Rail®s with OMNIAlog/miniOMNIAlog, the entire reading process is already natively integrated into the data logger.

The user must therefore follow a few simple steps:
1. Select the correct FLX-Rail® model
2. Indicate the correct RS-485 addresses according to the connected instruments
3. Verify that the acquisition rate is set to 5 minutes
4. Configure the FTP sending of data to allow the data processing software to receive the acquisitions.

A maximum of 50 FLX-Rail®-s can be connected to OMNIAlog, while a maximum of 25 FLX-Rail®-s can be connected to miniOMNIAlog.

USING MIND READOUT (refer to the dedicated manual)

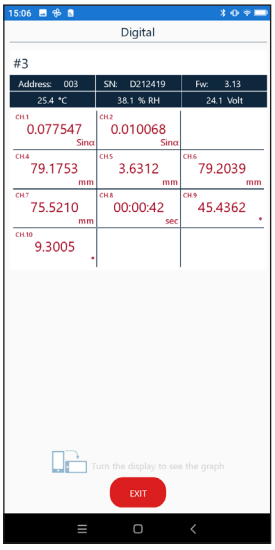
FLX-Rail®s can be read for chacking purposes with MIND readout.
In order to read single FLX-Rail® proceed as here following described:
- connect MIND Readout to FLX-Rail® using the digital flying cable supplied with the readout
- open MIND app on your mobile and switch-on the readout
- select "QUICK MEASURE" --> "DIGITAL" --> "SINGLE SENSOR"
- now on the display select "ALWAYS ON" and check "AUTO" , select NEXT
- select your MIND readout and wait for the connection with the sensor. At the end the common "SYSTEM INFO" will be displayed. Select NEXT
- some FLX-Rail® parameters will be read by MIND.



In the picture is displayed the reading of a FLX-Rail with tiltmeter sensor. For different FLX-Rail model, the view could change.

CH 1: Channel A of the tilt meter (INCL_A)
CH 2: Channel B of the tilt meter (INCL_B)
CH 3: void
CH 4: static position reading (AVERAGEMEAS)
CH 5: minimum reading during the event (MINMEASURE)
CH 6: maximum reading during the event (MAXMEASURE)
CH 7: difference from previous average static reading and minimum reading during the event (LASTEVENT)
CH 8: time from the event expressed in seconds (LASTTIMEEVENT)
CH 9: longitude position given by device's GPS (LONGITUDE)
CH10: latitude position given by device's GPS (LATITUDE)

To activate the reading of the optical displacement transducer (CH 5, CH 6, CH 7, CH 8), push the FLX-Rail® gauge 3-4 times and let the displacement movement activate the reading: now all FLX-Rail® parameters are visible on the display.



NOTE: After 6 minutes from the event, FLX-Rail will enter in sleep mode, also with MIND connected

DATA MANAGEMENT

PRINCIPLE OF OPERATION

The FLX-Rail®, in its most complete version, is able to provide 3 different types of measurements:

- maximum deflexion of the rail (VERT DISP)
- bi-axial inclination of the track (TILT)
- rail skin temperature (TEMP)

The FLX-Rail® is able to detect in real time the passage of a train and to read during its passage the maximum deflexion; after train passage and without vibrations, it can detect the temperature of the track and its inclination on two axis (option).
The FLX-Rail® is constantly powered and is listening in a low power consumption mode. A sensor inside the FLX-Rail® identifies the approach of the train a few seconds before its actual passage, and starts the dynamic acquisition of the rail movement. To make this measurement, 350 measurements are made per second and, once the train has passed, the maximum deflexion value of the track is saved. At the end of the passage, when the instrument detects the rail to be in a quiet state, the temperature and the inclination (if these sensors are present) are measured .
The data therefore remains available to be read by a data logger (MODBUS master) for 6 minutes.

The datalogger must be programmed to perform a specific sequence of operations.
If OMNIAlog or miniOMNIAlog is used as datalogger, this procedure is already integrated.

NOTE: A dedicated OMNIAlog/miniOMNIAlog firmware is needed to manage a FLX-Rail® system, specified by an "f" at the end of FW version (i.e. OMNIAlog FW 26.70.20f or miniOMNIAlog FW 12.70.07f)

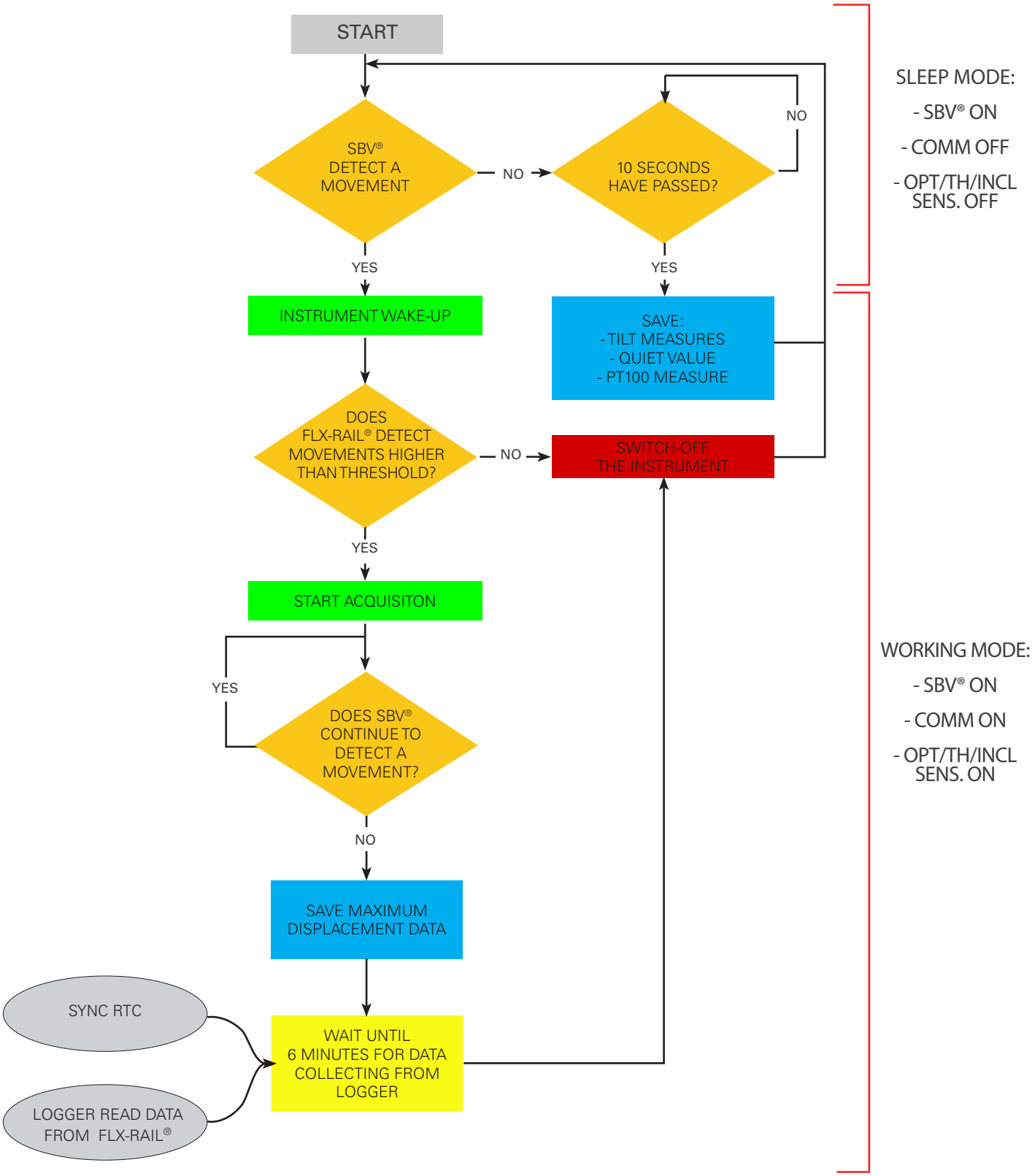
NOTE: OMNIAlog/miniOMNIAlog with dedicated FLX-Rail firmware will be able to read data from FLX-Rail gaugea only. No other gauge can be read (analogue nor digital)

The datalogger must be set to scan the FLX-Rail® gauges with a reading frequency of less than 6 minutes (we recommends 5 minutes). In this way, no events will be missed (assuming there is not more than one train passing in the 5 min interval).

NOTE: OMNIAlog and miniOMNIAlog with FLX-Rail dedicated Firmware have data acquisition frequency LOCKED at 5 minutes in order to do not lost any reading. If another logger is used, the data acquisition frequency MUST be set at 5 minutes.

If the instrument is read by the datalogger, it is switched off automatically (even if 6 minutes have not passed). If, on the other hand, the instrument is not called and therefore not even turned off by the datalogger, after 6 minutes the instrument switches off automatically to optimize consumption.

In the next page you can find a block diagram that explains how it works.


START
SBV® DETECT A MOVEMENT
NO
10 SECONDS HAVE PASSED?
NO
YES
YES
INSTRUMENT WAKE-UP
SAVE:
- TILT MEASURES
- QUIET VALUE
- PT100 MEASURE
DOES FLX-RAIL® DETECT MOVEMENTS HIGHER THAN THRESHOLD?
NO
SWITCH-OFF THE INSTRUMENT
YES
START ACQUISITON
YES
DOES SBV® CONTINUE TO DETECT A MOVEMENT?
NO
SAVE MAXIMUM DISPLACEMENT DATA
SYNC RTC
WAIT UNTIL 6 MINUTES FOR DATA COLLECTING FROM LOGGER
LOGGER READ DATA FROM FLX-RAIL®
SLEEP MODE:
- SBV® ON
- COMM OFF
- OPT/TH/INCL SENS. OFF
WORKING MODE:
- SBV® ON
- COMM ON
- OPT/TH/INCL SENS. ON

AVAILABLE CHANNELS

Depending on the FLX-Rail® model in use, various MODBUS measurement channels will be available. Below is the diagram of the active channels divided by model:

FLX-Rail®: will read the following channels:

CHANNEL	MEANING
A	AVERAGEMEAS
B	MINMEASURE
C	MAXMEASURE
D	LASTEVENT
E	LASTTIMEEVENT
HUM	HUMIDITY
VOLT	VOLTAGE
T	TEMPERATURE

FLX-Rail® +TEMP: will read the following registers:

CHANNEL	MEANING
A	TH
B	AVERAGEMEAS
C	MINMEASURE
D	MAXMEASURE
E	LASTEVENT
F	LASTTIMEEVENT
HUM	HUMIDITY
VOLT	VOLTAGE
T	TEMPERATURE

FLX-Rail® +TILT: will read the following channels:

CHANNEL	MEANING
A	INCL_A
B	INCL_B
C	AVERAGEMEAS
D	MINMEASURE
E	MAXMEASURE
F	LASTEVENT
G	LASTTIMEEVENT
HUM	HUMIDITY
VOLT	VOLTAGE
T	TEMPERATURE

FLX-Rail® +TILT +TEMP: will read the following channels:

CHANNEL	MEANING
A	INCL_A
B	INCLI_B
C	TH
D	AVERAGEMEAS
E	MINMEASURE
F	MAXMEASURE
G	LASTEVENT
H	LASTTIMEEVENT
HUM	HUMIDITY
VOLT	VOLTAGE
T	TEMPERATURE

If the FLX-Rail® is read by OMNIAlog/miniOMNIAlog data logger, the following channels will not be exported to the measurements file in columns but only to the measurements file in log format as they are considered diagnostic channels that can be used to better understand any anomalous situations:

MINMEASURE
MAXMEASURE
GPS1
GPS2
HUMIDITY
VOLTAGE

CHANNELS INTERPRETATION

The meaning of each individual channel is described below:

- **INCL_A and INCL_B**: report the inclination values in Sin α of the FLX-Rail® and therefore of the monitored track. The value is to be considered absolute from the vertical.

NOTE: different units of measurement (e.g. ° or mm / m) could be requested when ordering before production

- **TH**: reports the rail skin temperature expressed directly in degrees Celsius (° C)
- **AVERAGEMEAS**: returns the average measure of the rail static position (no train). It is the reference measure from which the displacement of the rail during the passage of a train is calculated. Its value is expressed in millimeters.
- **MINMEASURE**: returns the minimum value reached during the event. It is the value that together with the AVERAGEMEAS value is used by FLX-Rail® to calculate the maximum displacement at the end of the event.
- **MAXMEASURE:** reports the maximum value reached during the event. The value should be very similar to the AVEREGEMES value, but may be slightly higher if the track "bounces" upwards during the event.

- **LASTEVENT**: is the register in which the maximum displacement value obtained is saved at the end of each event. It is the useful measure for track monitoring.
- **LAST TIMEEVENT**: it is the time expressed in seconds in which the event occurred. This parameter must be used to calculate the exact moment d and passage of the train and then the event itself . It is expressed in seconds passed from 00:00:00 - 01/01/1970.

NOTE: in case it is not necessary to a precise calculation of the time ; when the event took place is possible to use the acquisition time of OMNIAlog / miniOMNIAlog. The maximum difference will be 5 minutes.

- **TEMPERATURE:** is the measurement of the internal temperature of the FLX-Rail® instrument.
- **HUMIDITY**: is the measurement of the internal humidity of the FLX-Rail® instrument. Too high values or large variations may indicate water infiltration inside the device.
- **VOLTAGE**: is the power supply value detected by the instrument itself. This parameter can be used as a diagnostic in case of abnormal measurements or sensor malfunctions.

EVENT TIME CALCULATION

Once the data has been received from the OMNIAlog / miniOMNIAlog data logger, it will be necessary to reconstruct the date and time when the event occurred.
The **LASTTIMEEVENT** channel is expressed in seconds from 00:00:00 on 01/01/1970. Therefore, by using a data management software or a spreadsheet it will be necessary to convert the number expressed in seconds into date and time.

For example, if the **LASTTIMEEVENT** channel reports 1611248400 (seconds) converting to date and time it would be 21/01/2021 17:00:00 GMT.
Conversely, if an event occurred on 10/01/2021 at 12:01:23 GMT in the channel the value 1610280083 will be found .
In this way it is possible to know the exact moment in which the event occurred (passage of the train)

RTC (Real Time Clock) SYNCHRONIZATION

FLX-Rail® does not have its own internal buffer battery. Therefore its internal clock is reset every time the power is removed.
OMNIAlog/miniOMNIAlog sends to the instrument, at the end of each measurement cycle, a synchronization command with the data logger time so that an accurate time is associated with each event.
Sending the synchronization at each acquisition ensures that the FLX-Rail® always has the correct time and that in case of momentary power failure the time is updated correctly.

NOTE: keep in mind that the first event generated and read by the data logger will not have the correct date and time as the synchronization will take place only after the first reading of the instrument by the data logger. SISGEO therefore recommends not considering this acquisition.

MEMORY MANAGEMENT OF THE OMNIAlog and miniOMNIAlog DATALOGGER

By default, the OMNIAlog/miniOMNIAlog memory is set cyclically every 90 days. In this way it is guaranteed that even with a large amount of data the data logger will never stop its acquisitions due to the maximum memory limit being reached.

The operation of the cyclic memory is based on the whole day, that is, on the ninety-first day the logs of day 1 will be deleted, on the ninety-second day the logs of day 2 will be deleted and so on.

WARNING: once the logs have been deleted there is no way to recover them However, this value can be set on the data logger page.

WARNING: carefully consider which parameter to set. Incorrectly increasing the buffer days could mean that in the presence of many instruments the data to be downloaded from the data logger is a large number with a consequent increase in export times and generation of very large files. If this may not be a problem for the data logger, file management becomes .csv created using classical spreadsheet software (eg Microsoft Excel).

OMNIAlog/miniOMNIAlog on-board memory must be considered as backup memory in case of failure to connect to the FTP server. Therefore, setting an adequate number of days - without exceeding - will allow faster data download during maintenance interventions in the field.

NOTE: we suggest to do not have much more than 10-days data if the reading shall be downloaded directly from OMNIA/miniOMNIA and to do so in short time.

The computation is performed when the RUN button is pressed.
If an OMNIALog/miniOMNIAlog, after a period of acquisition, is disconnected and deposited pending future use, take into consideration that when RUN is pressed, the past days to be kept in memory will be calculated and this, in particular conditions, could lead to the loss. of all data on board.

Example : An OMNIAlog/miniOMNIAlog is used for 15 days of monitoring and then is disconnected and put on stand-by for 6 months. After six months when the datalogger will be installed again, when RUN is pressed the datalogger will check the previous 90 days and delete all the data prior to these 90 days. In this particular condition it will therefore totally erase the memory.

ATTENTION: For the above it is therefore important to always set the data logger to STOP before placing it in a possible period of inactivity. In this way, when it is switched on again, it will be possible to download the old data before pressing RUN.

NOTE CONCERNING BI-AXIAL TILMETER DATA

In its dedicated version, the digital FLX-Rail® gauge gives tilt reading directly in engineering units (sin alpha, degrees or mm/m).

The relative reading refered to the reference measurement can be calculated with the following formula:

$$\Delta L = L_i - L_0$$

where:

ΔL = relative reading
L_0 = Reference reading
L_i = Follow up reading

NOTE: Please refer to APPENDIX 1 for the definition of "Reference measurement"

NOTE: Reference reading (or reference measurement) shall be taken carefully once the installation is performed, after the stabilization and baseline period, and the instrument is in operating conditions.

TROUBLESHOOTING

Problem	Possible cause	Solution
No gauge is read by Modbus master	Modbus master configuration	Verify the right Modbus master configuration (RS485 interface included)
	Wrong power supply	Verify the correct power and power supply according to the RDS gauge quantities (see F.A.Q.#073 on Sisgeo web site)
	High power cables installed near the instruments or the signal cables	Shut down the power source and/or protect the signal cable from EM interferences.
Only one gauge cannot be read from Modbus master	Modbus master configuration	Verify the right Modbus master configuration (RS485 interface included)
	Electronic board problems	Check the gauge with a SISGEO portable datalogger. Contact SISGEO assistance for replacement if problem persist.
Unstable measure	Sensor powering not correct	Check that the voltage value supplied should be between 8 - 28V DC
Tracks show short circuit problem	The metal parts of the connectors are in contact with the track.	Isolate the connectors from the track.

SYSTEM SENSITIVITY

After the installation, the following anomalous situations may occur:

1. train passage not detected : real events would therefore be lost.
2. event detected even without the passage of the train: false non-significant events would be identified (e.g. passage of the train on an adjacent track)
3. awakening of the instrument without detection of any event: there would be an unnecessary awakening of the instrument (there being no event)

To avoid the three situations described above, there are some parameters that can be adjusted ad-hoc (only by SISRAIL technicians).

- **SBV® THRESHOLD** for sensor activation
- **MINIMUM MOVEMENT THRESHOLD** for event saving
- **EVENT DURATION**

The **SBV® THRESHOLD** is a parameter that allows you to set the awakening sensitivity. This can for example be raised if there is an area subject to vibrations to discriminate the real passage of the train from a possible disturbance (train passage nearby, operating machines in progress, etc.).
By acting on this parameter it is possible to solve the problem described in point 1 if the SBV® threshold is too high and therefore the awakening is not activated or point 3 where the SBV® threshold is too low and the instrument wakes up without a valid reason.
The **MINIMUM DISPLACEMENT THRESHOLD**, on the other hand, intervenes after the

sensor activation and allows the event to be saved only if the minimum variation exceeds a certain threshold, this is to prevent micro-movements from being recorded as track movements, generating unnecessary or insignificant acquisitions.
By acting on this parameter, it is possible to solve the situation described in point 2 if the threshold is too low or to solve point 3 if the threshold is too high.
NOTE: SISRAIL has identified optimal values for most installations (test fields).
However, it may be necessary to make changes to these parameters. In this case you should contact our Customer Care.

ACQUISITION DURING SLEEP STATE

In the case where the datalogger, at one of its programmed acquisition, detects an instrument in « off-mode », a MODBUS communication error is generated and the relative acquisition cycle will therefore not have valid values. If OMNIAlog or miniOMNIAlog is used as data logger, a MODBUS TIMEOUT alarm will be generated and the acquisition will result with NAN (Not A Number) instead od numeric values.
These measures must therefore be ignored in post processing by the user.

MAINTENANCE

FLX-Rail is an instrument designed for the railway environment. Anyway some extraordinary or particular local events could affect the proper functioning of the instrument.
SISGEO suggests a periodic visual inspection of the instruments installed to verify that:
- the magnet-track contact is maintained and therefore the instruments are connected and aligned correctly to the track;
- check that the cable protection conduits and the other parts of the system are in good condition.

If the track displacement data are blocked (unchanged values), we suggest removing the instrument and trying to move it to check the proper functioning of the internal sensor.
SISGEO suggests having a suitable number of FLX-Rail as spare parts in case the replacement of a tool is required for maintenance.

If the FLX-Rail needs to be repaired or need a new calibration, please contact the Customer Care Department, that is in charge for calibrations, maintenance and repairs
The authorization for shipment shall be activated by requesting an RMA ticket (Return Manufacturer Authorization). Please create your account and then fill in the RMA form clicking on:

https://support.sisgeo.com/

Please read carefully the instruction published on Sisgeo's web site.
Send back the instrument/equipment with the complete accessories, using suitable packaging, or, even better, the original ones.
The shipping costs shall be covered by the sender.
Please return to the following address with correct delivery documentation reporting the RMA code received:

SISGEO S.r.l.
Via F.Serpero, 4/F1
20060 MASATE (MI)

Customer Care Department e-mail: **assistance@sisgeo.com**

RELATED LINKS

Please refer to the following F.A.Q. on SISGEO website (https://www.sisgeo.com/products/faq.html):

- FAQ#110 - What's the purpose of the linear and polynomial factors written in the Calibration Reports?
- FAQ#077 - Which are the maximum cable lengths from instrument to datalogger?
- FAQ#076 - Why it is necessary add a termination resistor to the last digitized sensor of each RS-485 chain?
- FAQ#075 - Which parameters are save into SISGEO digitized sensors?

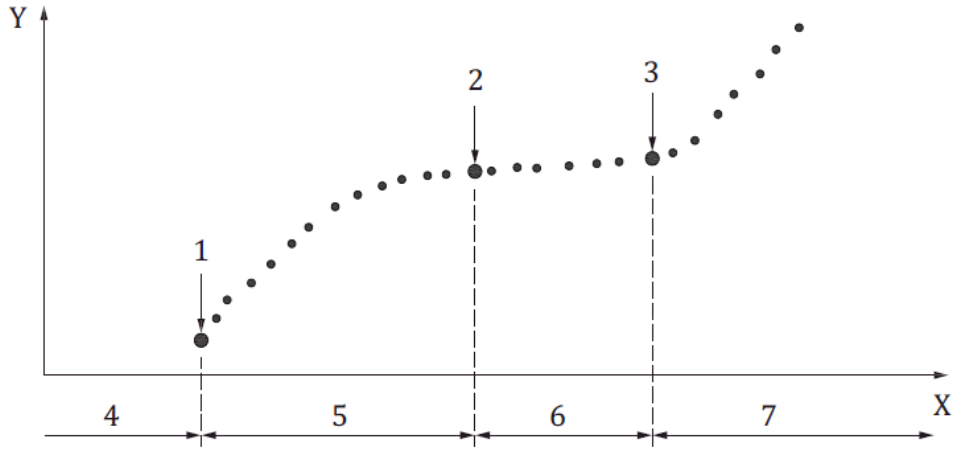
Following video tutorials will be helpful (https://www.youtube.com/user/SISGEOsrl):

- OMNIAlog tutorial: upload measure on FTP after acquisition

APPENDIX 1

DEFINITION OF DISTINCT MEASURING POINTS DURING A GEOTECHNICAL MONITORING PROJECT AS FOR ISO 18674-1

The standard ISO 18674-1 well describe the various measuring points distributed along the project timing. Here below are the description and definition as for the standard:



1 - Initial measurement: it is the first measurement after installation.

2 - Zero measurement: it is the measurement carried out after stabilization of installation effects.
The zero measurement is often taken as reference for subsequent measurements, as it is commonly related to local space and time coordinates.
The zero measurement is commonly carried out with increased measuring effort, e.g. repetition of measurements, to provide a reliable datum for subsequent measurements.

3 - Reference measurement: it is a measurement which serves as reference base for previous and subsequent measurements.
The reference measurement is also known as datum measurement.
A new reference measurement is often used for a new construction phase.
The reference measurement is often derived from several measurements.

4 - Installation period

5 - Stabilization period

6 - Period of baseline measurements: measurements carried out, subsequent to the zero measurement, over a period of time before any construction starts, to help in the definition of changes that occur from causes other than construction.
EXAMPLE Seasonal changes in groundwater levels, tidal and moisture content changes, climatic changes such as temperature, and incidence of sunlight.

7 - Construction period

X - time
Y - reading