MetriCorr

Slimline series

ICL-C & MasterLink

Operation Manual

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Contents

Revision	Date	Comments	Prepared	Review	Approval
001	2021-06-02	Review Section 7. Satellite – communication	RCH	LBT	LBT
Draft R001	2021-01-08	Operation Guide ICL-C & MasterLink. Already reviewed by LBT and FGa. This version is based on the previous ICL & MasterLink operation guide by FrB, 2018-11-14.	RCH	LBT FGa	

1 Scope

This document is a guideline for setup and operation of the datalogger model "**ICL-C & MasterLink"** from MetriCorr's Slimline series of remote monitoring equipment. Hereafter referred to as "unit".

The MetriCorr remote monitoring system uses an online WebService, where all the data from site are uploaded and stored. The unit consists of a MasterLink module and an ICL-C module, where both modules are configured and controlled from WebService.

Before you start:

- If you want to link your new unit to an existing MetriCorr WebService account, please email support@metricorr.com with the following information:
    - **Account Name** (existing or new) you wish the unit(s) to be assigned to.
    - **User email address** (for new users to log in to existing or new accounts**)**
    - **MasterLink Serial Number(s)** you wish to link to the account

- If you are a new customer or setting up a **NEW account,** please also provide details of a Primary contact person for data & administration communication with MetriCorr.
    1. Name & title / position
    2. Email address
    3. Telephone number

Once you have confirmation that the units have been assigned to the account as requested (together with login details if you have requested a new account or user), you are ready to start.

IMPORTANT: Do not disassemble the unit. If the unit is malfunctioning, please contact MetriCorr.

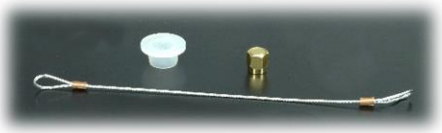
2 ICL-C & MasterLink Unit

The Slimline ICL-C measurement module is paired with a MasterLink control and communications module. They are shipped preassembled as shown:

Figure 1. ICL-C & MasterLink as shipped

Standard accessories:

- Antenna LTE with 1m wire and adhesive pad
- Protective caps for connectors
- Power cable with DC connector
- Yellow wire 1m, 4mm banana connectors
- Black wire 1m, 4mm banana connectors



2.1 MasterLink module connectors & control

The MasterLink module comes with a Status/control button, antenna, and Power supply connectors as standard. Optional interface connectors are available on-demand.

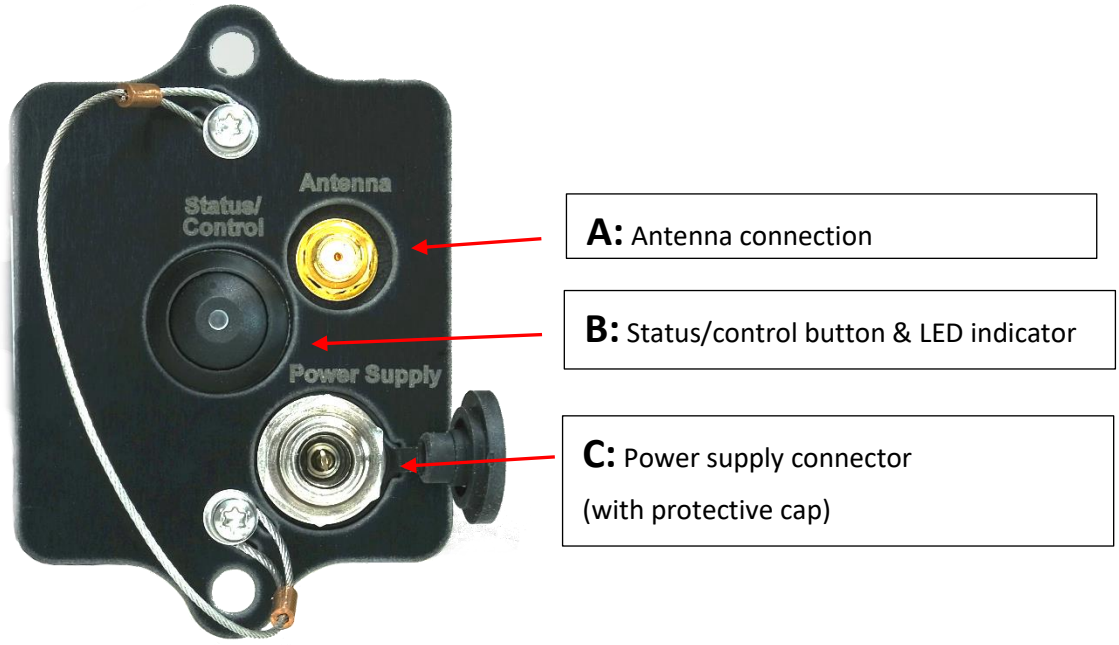


Figure 2. MasterLink module connectors & control

MasterLink – Specifications	
Battery Lifetime	+3 years @ 1h logging intervals and weekly transmissions
Casing	IP65
Humidity	0-100% RH condensing conditions
Operating conditions	-40 °C to +85 °C
Storage capacity	+200 000 readings
Logging intervals (Normal mode)	10 min → ∞, recommended 1 hour
Logging interval (Campaign mode)	1 sec in pre-defined time intervals

Table 1. MasterLink - Specifications

2.2 ICL-C module connectors

The ICL-C module's endplate consists of five connectors for the ER probe connection, Line Current Sensor, and Reference electrode to Pipe/structure measurement.

ER channel (1)	
Resistance Range	**150 mΩ**
Repeatability	**0.2 µΩ**
Precision	**0.4 µΩ**

Line Current channel (2)	
Input voltage range DC (Before clip)	**± 1.2 V**
Input voltage range AC (Before clip)	**845 mV_{RMS}**
Target input range for DC measurements	**-20 mV → +20 mV**
Resolution	**0.2 µV**
DC accuracy	**± 1 µV**
AC accuracy	**± 4 µV**
Input resistance	**33 kΩ**

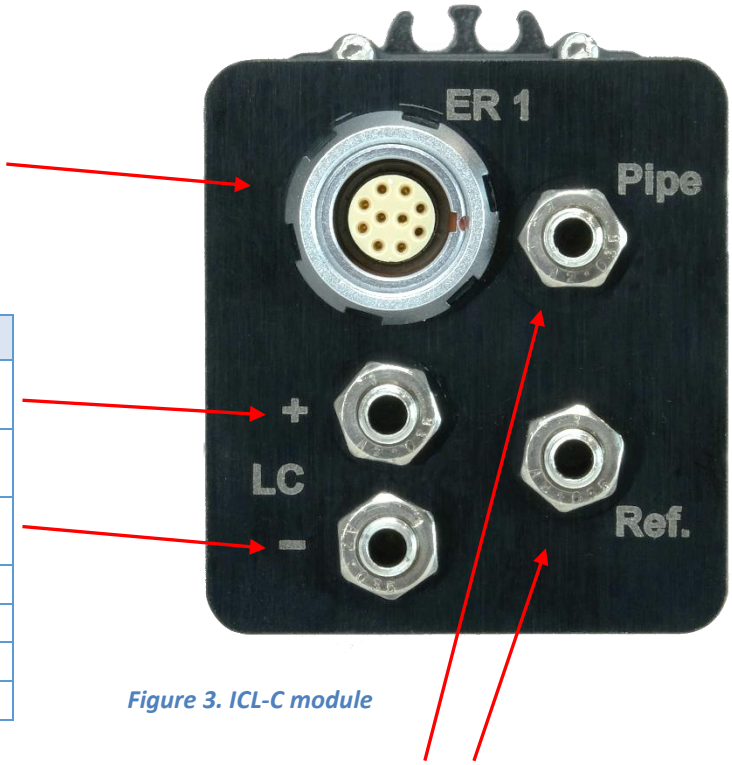


Figure 3. ICL-C module

Terminal "**Pipe**" – Pipe/structure connection
Terminal "**Ref.**" – Reference Electrode connection

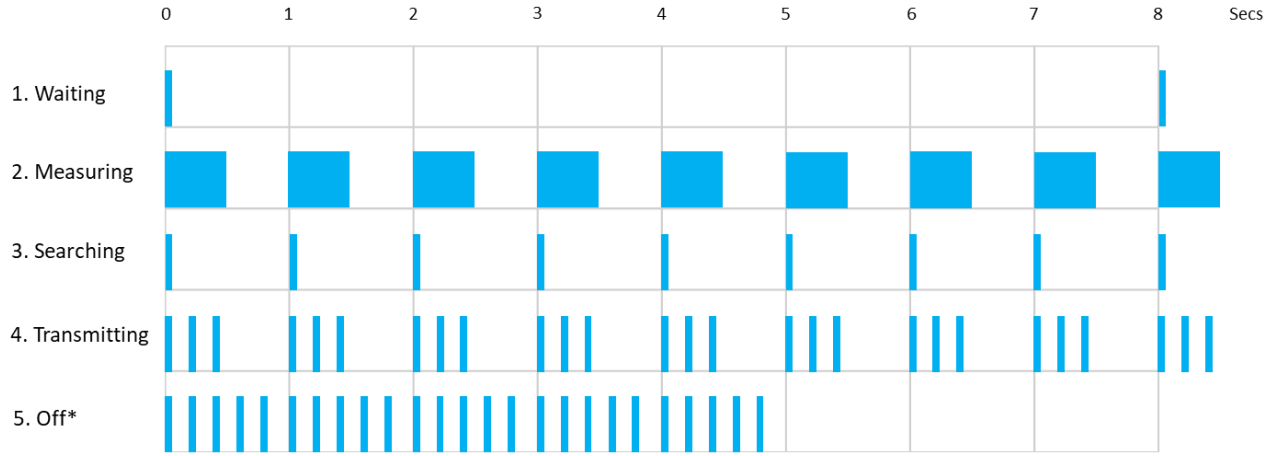
The voltage measurement between "Pipe" and "Ref." is performed by both channel 1 and channel 2.

Voltage measurement (both channels)	
Input range (voltage)	**± 100 V**
Resolution (voltage)	**1 mV**
DC accuracy (voltage)	**± 1 mV ± 0.3% reading**
AC accuracy (voltage)	**± 2 mV ± 1% reading**
ER Probe Current measurement (channel 1)	
Current range	**± 300 mA**
Resolution (current)	**0.1 µA**
AC accuracy (current)	**± 4 µA ± 1% reading**
DC accuracy (current)	**± 1 µA ± 1% reading**

3 Configuration

3.1 Switch on & Initial Communication

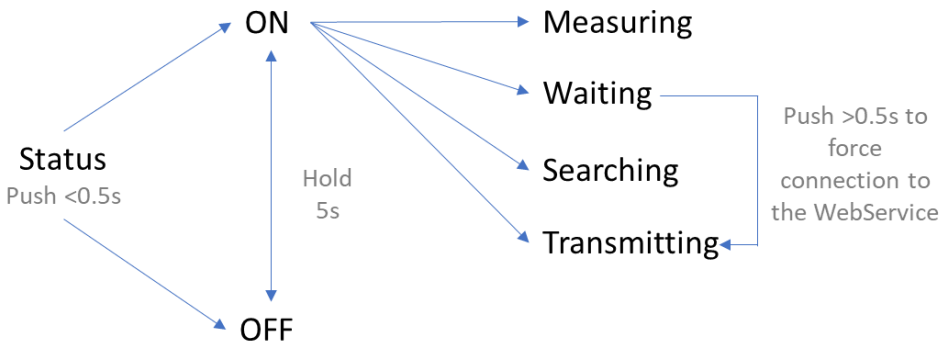
Once connected to the antenna and battery, push the **'Status/Control'** button ('E' in Figure 3) and release (<0.5s). This will indicate the unit's current status/mode with a series of flashes on the LED built into the button. Please refer to the LED flash patterns below.



The device is Off. 5 short (0.5 milliseconds) flashes per second for 5 seconds. This signal is triggered by a **short (<0.5s) push on the push-button.*

Figure 4. LED flash indication

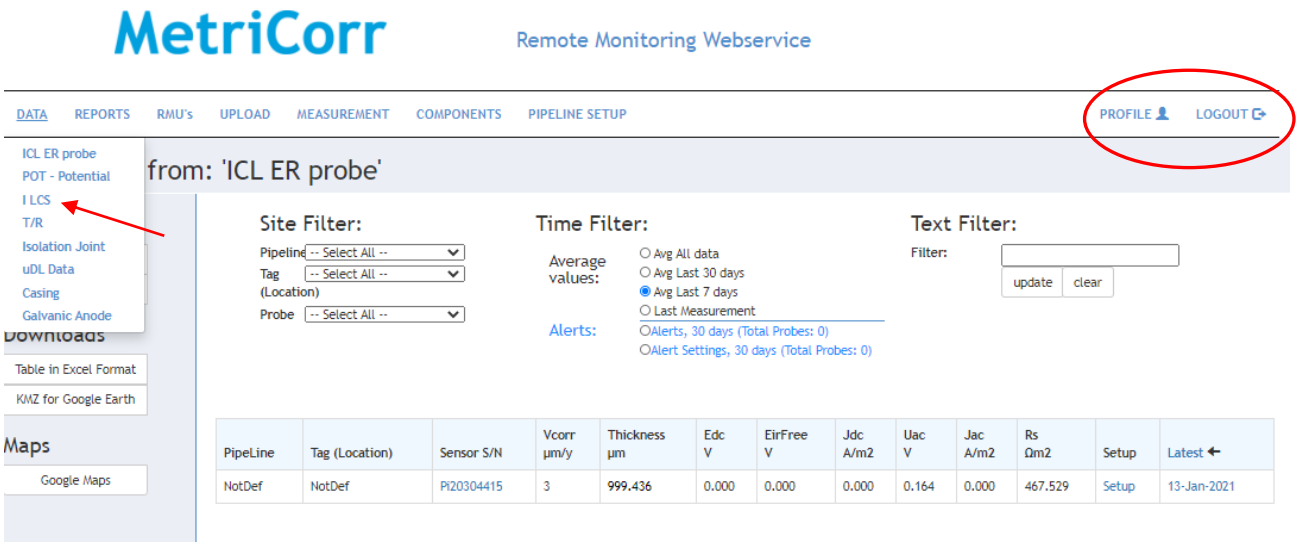
Mode / status	Description
Waiting	**The device is active and waiting for the next measurement to be performed.** Short (50 milliseconds) flash every 8 seconds
Measuring	**The device is performing a measurement**. Longer flash (0.5 seconds) repeated every second.
Searching	**The device is searching for a network**. 1 short (0.5 milliseconds) flash repeated every second.
Transmitting	**The device is transmitting data to the WebService.** 3 short (0.5 milliseconds) consecutive flashes repeated every second.
Off	**The device is Off**. 5 short (0.5 milliseconds) flashes per second for 5 seconds.



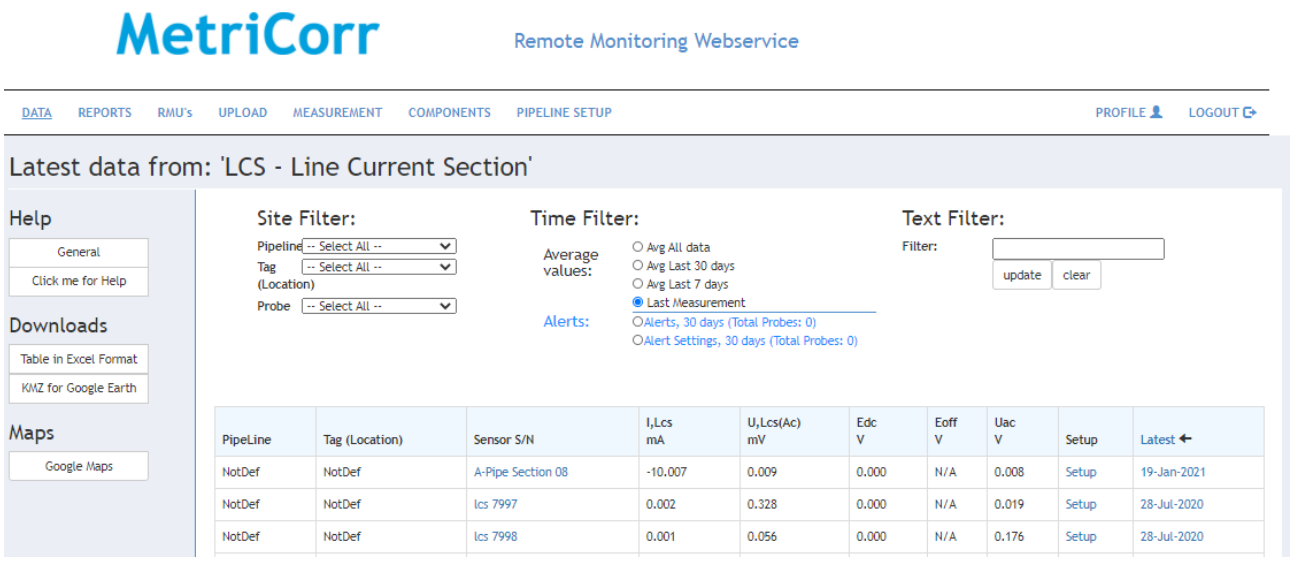
3.2 WebService - general

Log on to https://data-metricorr.com using the username and password sent to you as per Section 1. For data safety, it is recommended that your assigned password should be changed on your first login. This can be done in the '**Profile**' menu. You should also '**Logout**' when you have completed your session.

The landing page is the "ICL ER probe" page and looks like this:



Click "DATA" -> "I LCS" to show the "Line Current Section":



Click "RMU" -> "MASTERLINKS" to show the page "Your defined MasterLinks":

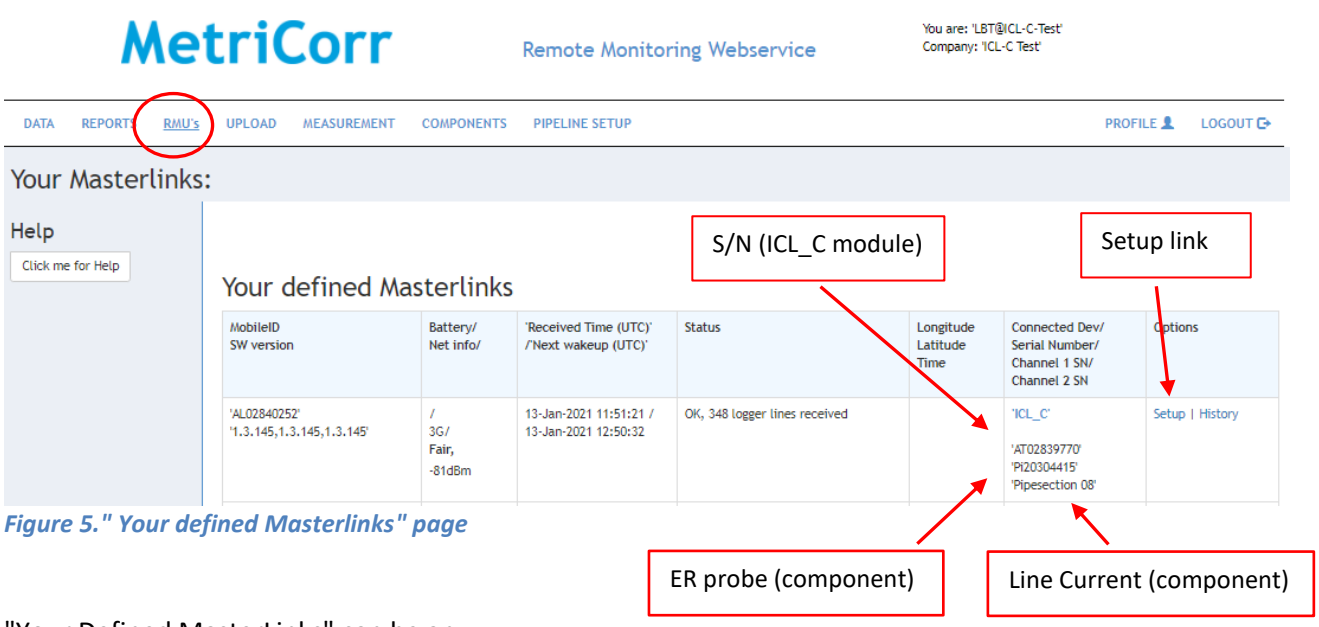


Figure 5." Your defined Masterlinks" page

"Your Defined MasterLinks" can be any

of the following types: ICL, VL100 or ICL_C

An overview of the columns in the" Your defined Masterlink" table above is described in Table 2 below:

Parameter	Data (example)	Comment
MobileID	AL02840252	MasterLink Serial number
SW version	1.3.145,1.3.145,1.3.145	Software version (MasterLink, Bluetooth, ICL-C module)
Battery	/	Not fitted with battery
Net info	3G/Fair,-81dBm	Network connection and signal strength
Received Time (UTC)	13-Jan-2021 11:51:21	UTC time stamp of LAST communication/data transfer
Next wakeup (UTC)	13-Jan-2021 12:50:32	UTC time stamp of NEXT communication attempt
Status	OK, 348 logger lines received	" OK" indicates that communication went well. " 348 logger lines received" inform amount of data received since last communication session.
Longitude	12.430468	Geographic coordinate [degrees]
Lattitude	55.695079	Geographic coordinate [degrees]
Time	11:38:57	UTC time stamp for geographic coordinate
Connected Device	ICL-C	Indicate type of logger, in example: ICL, VL-100 or ICL-C
Serial number	AT0239770	Serial number of ICL-C module
Channel 1 SN	PI20304415	Serial number of connected ER probe
Channel 2 SN	Pipesection 08	Serial number of Line Current Component, i.e. a pipe section.
Options	Setup	Link to the Setup page
	History	Link to the History page

Table 2. Your defined MasterLinks – parameter description

The 'Received Time' should be approximately that of when the unit was powered up. Status should be 'OK.'

After the unit has started communication (refer to" Figure 4. LED flash indication" flash pattern, 3rd row), it could take a few moments for the WebService to update. Refresh your browser page if it does not appear within 1 minute.

Should the unit not display on the MasterLink page, restart the unit to force new communication.

3.2.1 Setup of ICL-C & MasterLink

On the setup page in WEBService, the user shall specify the interval between measurements or a schedule for a weekly" Intensive mode" campaign.

On the" Your defined Masterlink" page, see

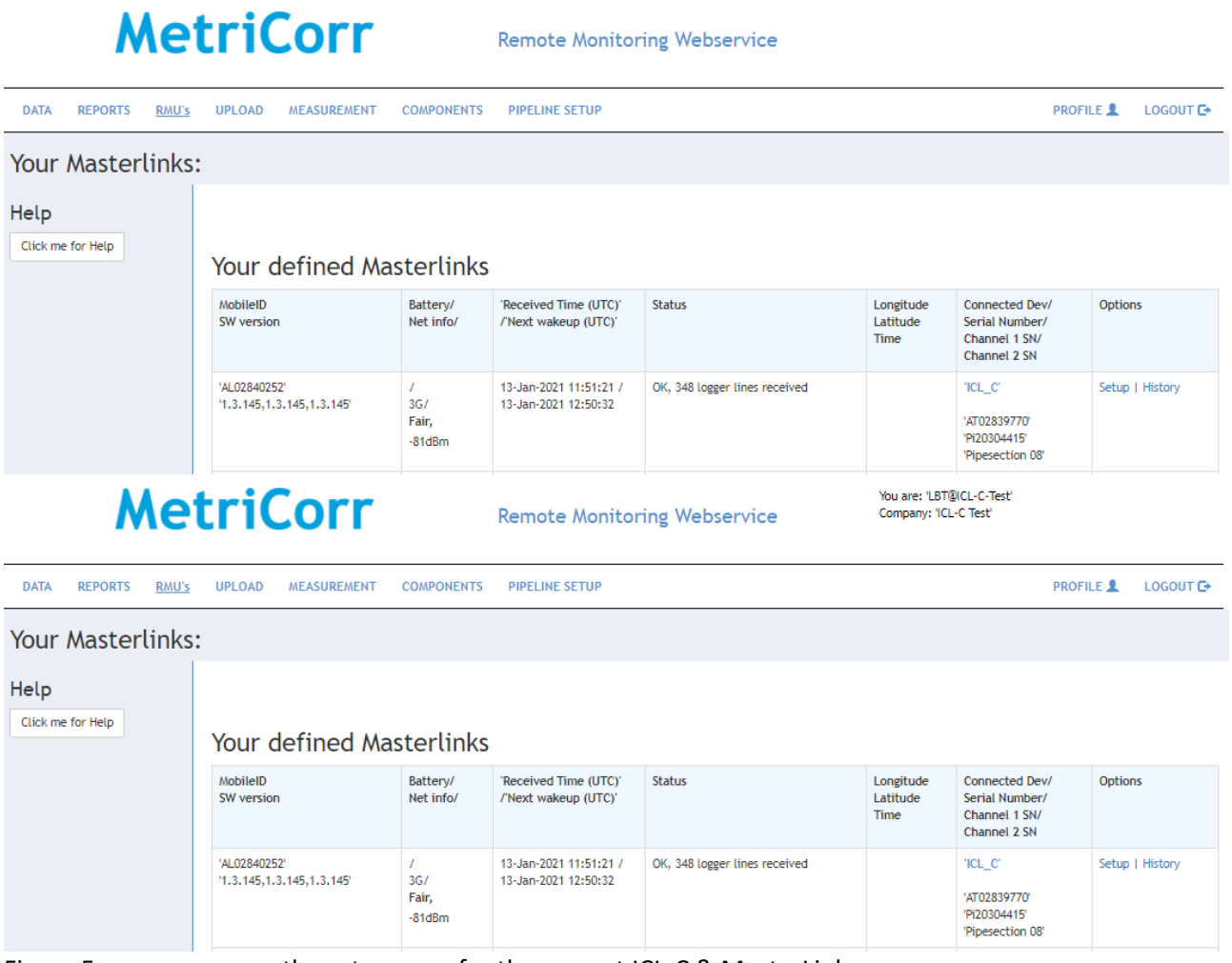
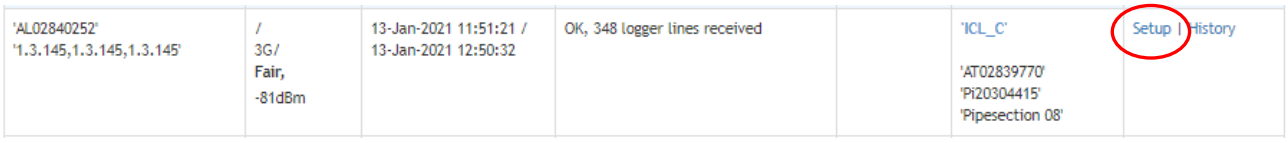
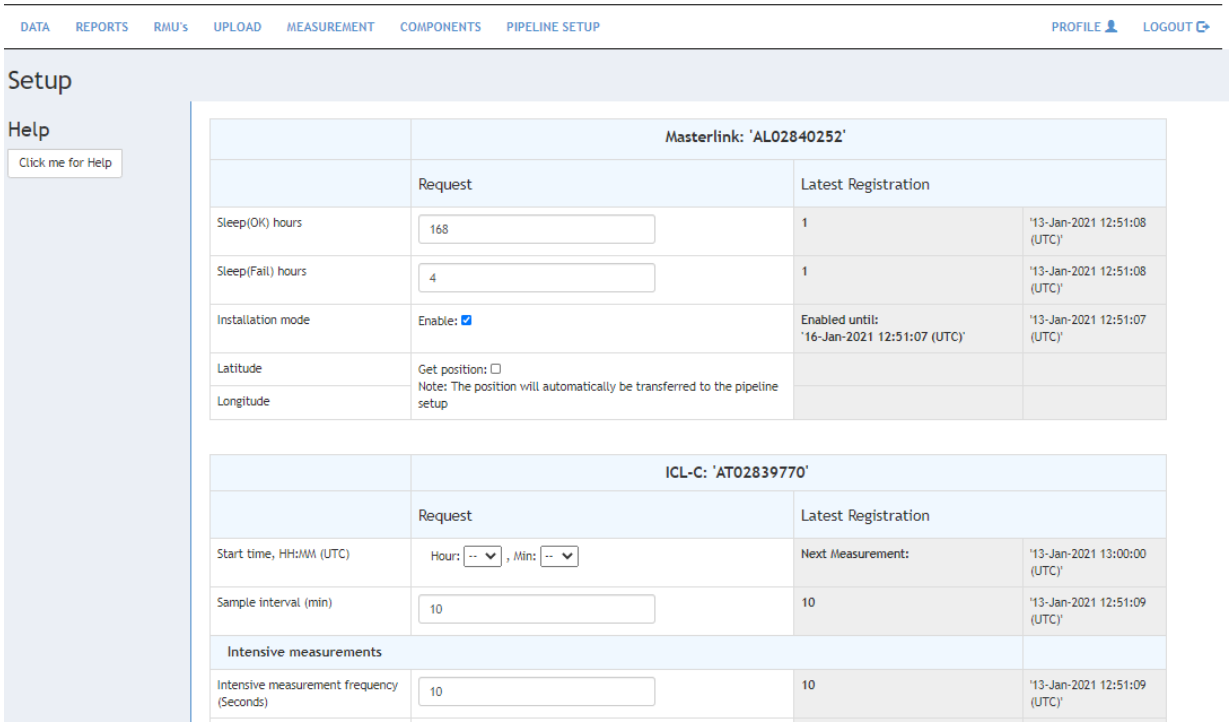


Figure 5, you can access the setup page for the current ICL-C & MasterLink:

Click' **Setup'** in the column to the right:



Now the Setup page will be shown:



In the following sections, the setup page will be described in detail.

3.2.2 Communication interval

Two parameters set the interval between MasterLink communication (wake up) with WebService:

1. **Sleep(OK) hours**. As long as communication is successful, the MasterLink goes to sleep for example, 168 hours before the next wake-up, where communication and data transfer are established again.

2. **Sleep(Fail) hours**. If communication fails, the MasterLink try to establish communication with a different interval. (I.e. 4 hours)

For battery operation, it is recommended to set the unit for a 4h sleep interval in case of a communication error (**Sleep (FAIL) hours**), and a 24h (once daily) for **normal** operation (**Sleep (OK) hours**) in order to preserve battery life.

The existing settings are shown under **'Latest Registration'.** For a new unit this will be blank.

	Masterlink: 'AL02840252'		
	Request	Latest Registration	
Sleep(OK) hours	168	1	'13-Jan-2021 12:51:08 (UTC)'
Sleep(Fail) hours	4	1	'13-Jan-2021 12:51:08 (UTC)'
Installation mode	Enable: ☑	Enabled until: '16-Jan-2021 12:51:07 (UTC)'	'13-Jan-2021 12:51:07 (UTC)'
Latitude	Get position: ☐ Note: The position will automatically be transferred to the pipeline setup		
Longitude			

Installation mode.

After initial power-up, **'Installation mode'** will be activated. Communication frequency will be forced automatic to 1h. This stated will automatically be disabled after three days and returned to recommended normal operation.

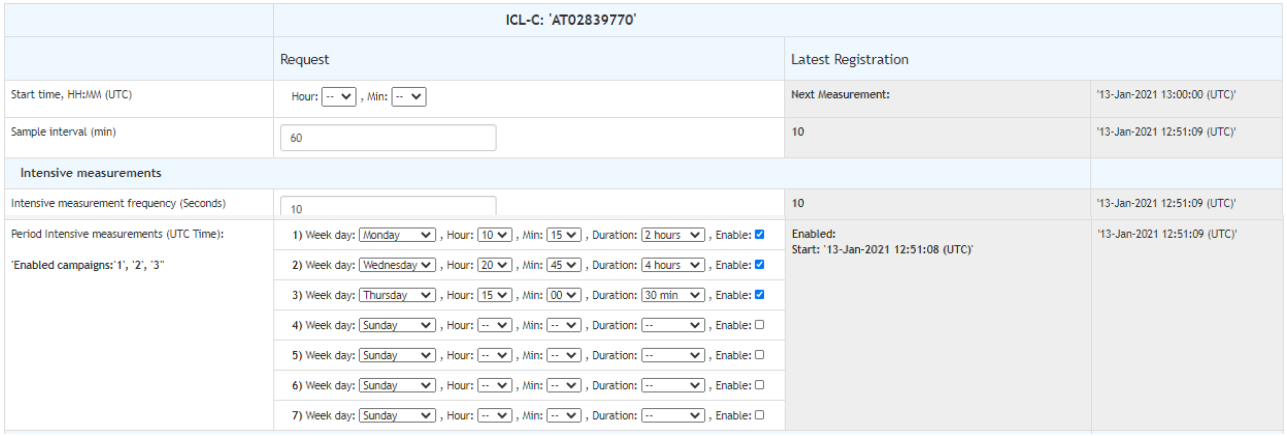
Communication frequency can configurated as desired. It is recommended to specify a 4h sleep time, in case of a communication **error** (**Sleep (FAIL)**) and a 24h (once daily) for **normal** operation (**Sleep (OK)**) to preserve battery life.

Latitude & Longitude coordinates.

You can also request the unit's position (estimated latitude, longitude by GNSS) by checking the **'Get Position'** box. The retrieved data will be displayed in the 'MasterLink' table on next scheduled 'wake up'.

3.2.3 Sample interval & Start time

The time between each measurement of ER probe, Line Current Sensor and Pipe-Ref voltage are specified as **Sample interval**, which can be set by the user according to the part of the **Setup** page shown below:



Start time, HH:MM (UTC) sets the time of the first sample to be measured.

Sample interval (min) sets the interval for the next sample to be measured. The unit will continue to perform measurements with this interval until the user stops it.

The '**Latest Registration**' text shows when the next measurement is currently due to occur. All updates will be performed at this time. This can be 'forced' by physically restarting the MasterLink. Remember to '**Save request**' beforehand.

3.2.4 Intensive measurements

There are seven individual periods available. Each of the periods specifies a measurement there will be repeated on weekly basics; all setup is in UTC Time.

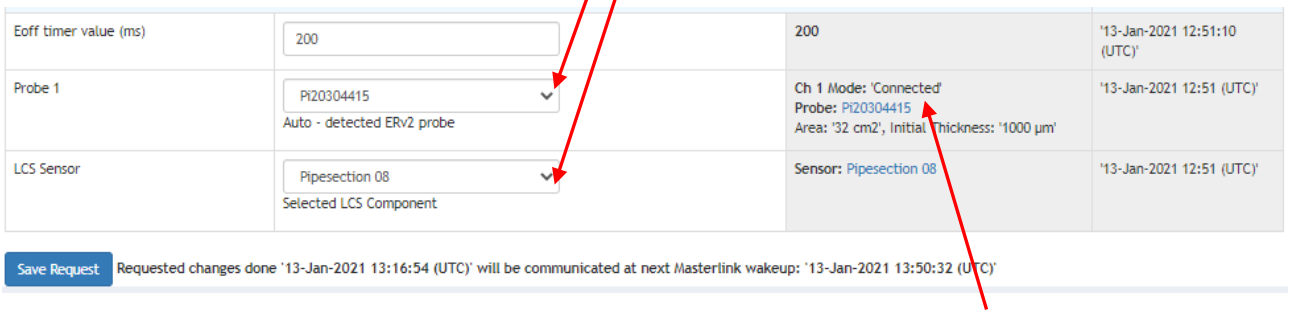
For example, three periods are enabled in the weekly schedule.

1. Every Monday, starting at 10:15 AM, for a period of 2 hours
2. Every Wednesday, starting 8:45 PM, for a period of 4 hours
3. Every Thursday, starting 3:00 AM, for a period of 30 min

3.2.5 Assigning probes/sensors/components to the ICL-C

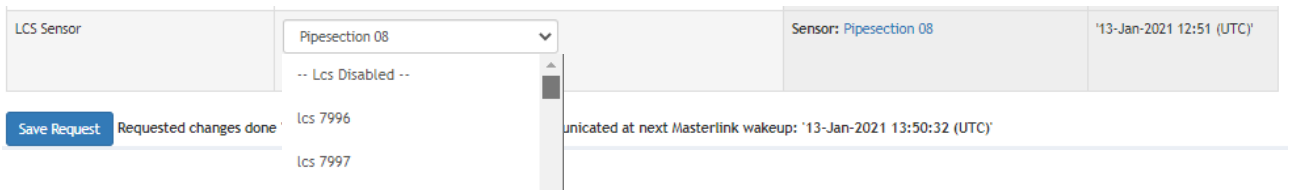
The ICL-C has two channels: Channel 1 (ER probes) and Channel 2 (Line Current Sensor).

At the bottom of the setup page, you can assign ER probes to Channel 1 **(Probe 1)** and a LCS component to Channel 2 **(LCS Sensor)** using the drop-down list of probes you have linked to your account, see the following section "4.5.1 Create Line Current Sensor".



ER probes for ICL-C will always be" Connected". Only Channel 2 on an ICL-MasterLink (a different product in the Slimline series) can be configured as" Native" via a hardware jumper inside the unit. "Connected" means that the ER probe is connected to the "Pipe" terminal. "Native" means that the ER probe is NOT connected to the "Pipe" terminal, which is used for corrosion measurements in free air.

As shown below, probes/sensors can be 'Disabled' from the drop-down list for both channels. Assigning a probe/sensor/component to a channel allows the ICL-C to take readings on that channel.



Probe 1 (ER probe)

Suppose an ERv2 probe is connected to the ICL-C. In that case, the unit will automatically detect the probe serial number and the probe certificate data, which does not need any further action once the probe serial number is displayed.

LCS sensor (LCS component)

Before you can assign an LCS sensor, you must create an LCS sensor certificate, a data-set typed in on the webpage described in section "4.5.1 Create Line Current Sensor".

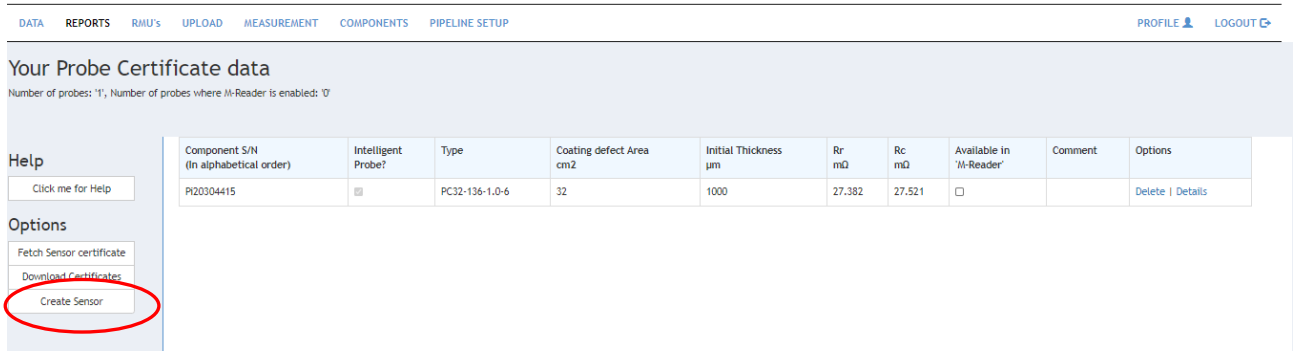
3.2.6 Linking ER probes to your account

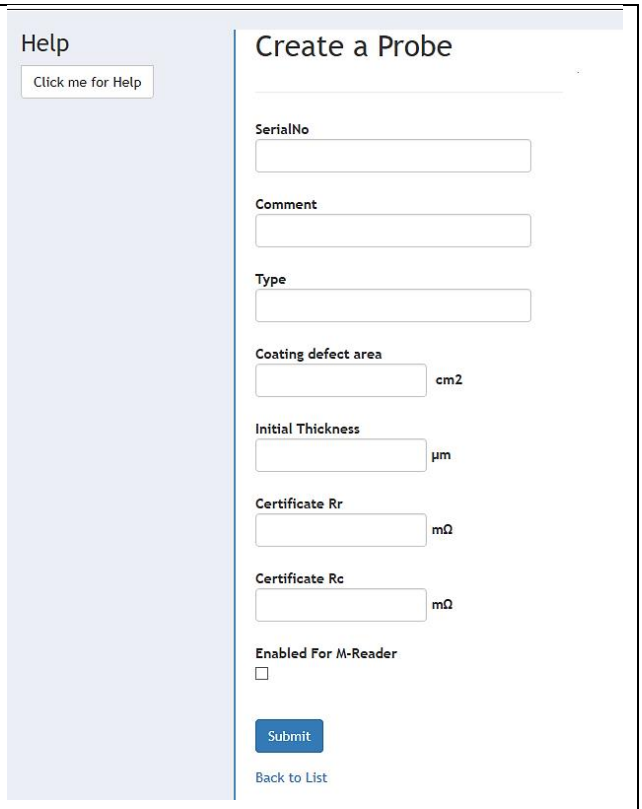
The slimline ICL automatically recognizes the new ERv2 generation probes, and the data are stored automatically. However, previous-generation probes must be configured manually:

Manual ER probe configuration

Click “Component” -> “ICL ER Probe”

The landing page will now show "Your Probe Certificate data":



Click "Create Sensor" The landing page is displayed to the right, where a new sensor/probe can be created by manually typing in the certificate data for the ER probe. The certificate is provided with each probe. If you do not have the certificate for the probe you want to upload, please email the serial number to support@metricorr.com, and we will email a copy as soon as possible.	

4 Line Current Sensor

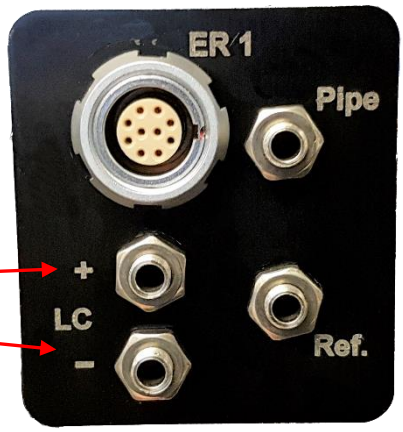
The Line Current (LC) input on the ICL-C is designed to monitor the current flowing in a steel pipe (or other structure), hereafter referred to as "pipe", by measuring the voltage drop across a certain span of the pipe.

However, it is possible to measure any voltage source connected to the LC input within the maximum limits of ± 1.2 Vdc. Data for both DC and AC voltages are accessible in WebService.

The **DC current** in the pipe is calculated by a user-defined DC resistance and displayed in WebService as a graph.

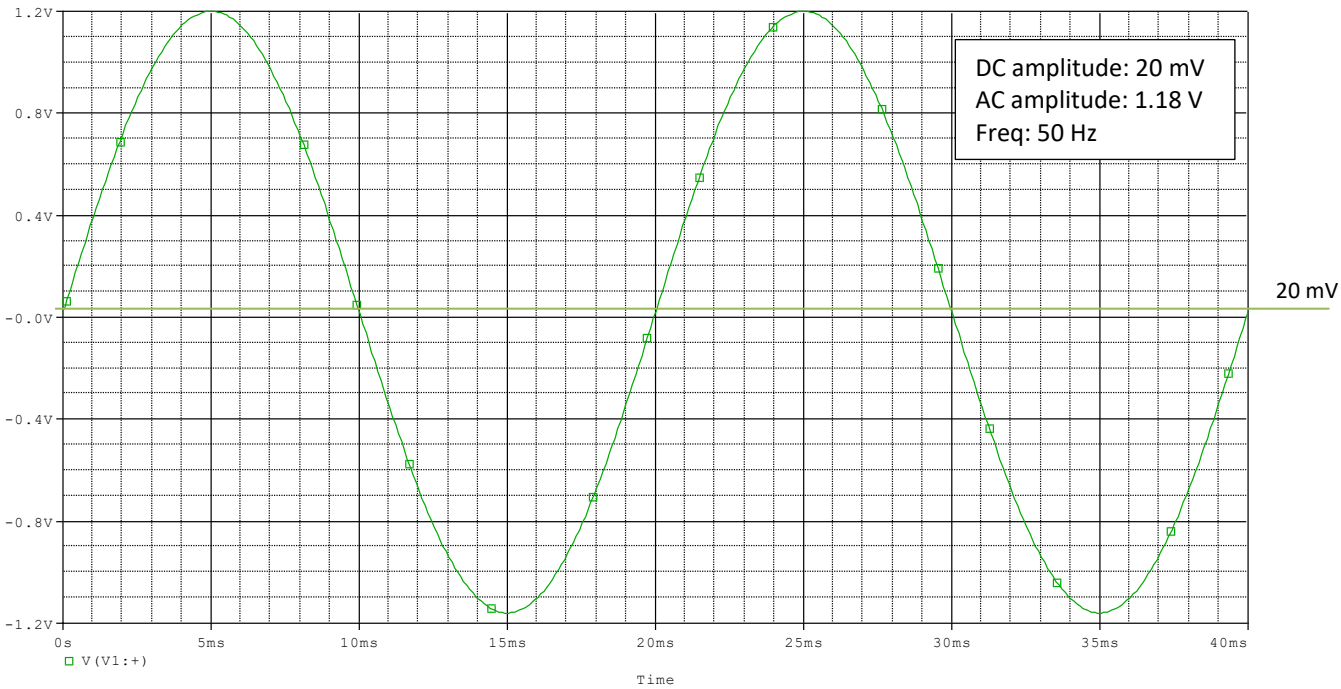
The **AC current** in the pipe depends on many fluctuating factors such as soil moisture level and is therefore not calculated in WebService.

The LC input consists of the two terminals LC+ and LC-, which are galvanically isolated from all other terminals.



4.1 LC input voltage range

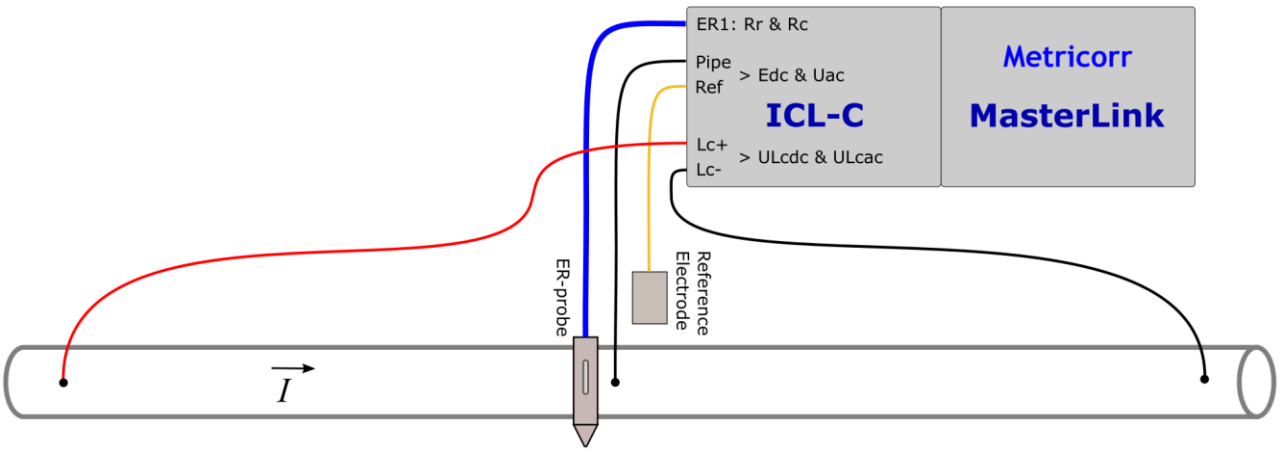
The LC input is designed to monitor signals in the µV and mV range with a maximum target DC voltage of 20 mV. However, the maximum allowable input voltage range is ± 1.2 Vdc to allow a much higher AC voltage signal without clipping the signal as illustrated in the graph below:



If the LC input voltage exceeds 1.2 V, the A/D converter will clip the signal and an error message will be shown.

4.2 Connections to steel pipe or other structure

A steel pipe is used for this illustration, where the ICL-C MasterLink is placed in the center between the two line current measuring points:



The current "I" with an arrow indicates the positive current direction.

4.3 DC resistance (LC input)

DC current in a buried steel pipe only depends on the DC resistance of a given length of the steel pipe, which is a fixed value. (Does not change with soil moisture level, etc.). Since the DC resistance of a given length of steel pipe (span) is much smaller than the AC impedance, it is recommended to select the pipe span long enough to achieve a DC voltage measurement high enough to give accurate readings.

The recommended DC target voltage is 20 mV, which gives a good resolution in the µV range while keeping a good headroom for superimposed AC voltages before clip (± 1.2 Vdc), 60 times higher than 20 mV.

Example: 12.75" steel pipe, 100-meter span

This example indicates the measured voltage range of a steel pipe with the given data:

Data for steel pipe		
Outer diameter	12.75”	324 mm
Wall thickness	0.5"	12.7 mm
DC resistance	23.3 mΩ/mi	14.5 µΩ/m

DC resistance for 100 m pipe:

$$RL_{cs,DC} = 14.5\ \mu\Omega/\mathrm{m} \cdot 100\ m = 1.45\ m\Omega$$

Voltage measurement per ampere:

$$Volts/amp = 1.45\ mV/A$$

The pipe current that results in a measured voltage of 20 mVdc across the span of the pipe (100m) is given by:

$$I_{20mV} = \frac{20\ mV}{1.45\ m\Omega} = 13.8\ A$$

Maximum peak current before clip:

$$I_{peak} = \frac{1.2\ V}{RL_{cs,DC}} = \frac{1.2\ V}{1.45\ m\Omega} = 828\ A$$

4.4 AC measurements for a steel pipe (LC input)

The LC input offers an AC voltage measurement to be displayed in Webservice.

Determining the AC current in a buried steel pipe requires advanced models to predict the AC impedance, which depends on many factors:

- Steel pipe inductance (Relative permeability of the steel type used for the pipe)
- Pipe dimensions
- Capacitance to surrounding soil (coating)
- Specific earth resistance (depends on location and soil moisture level)

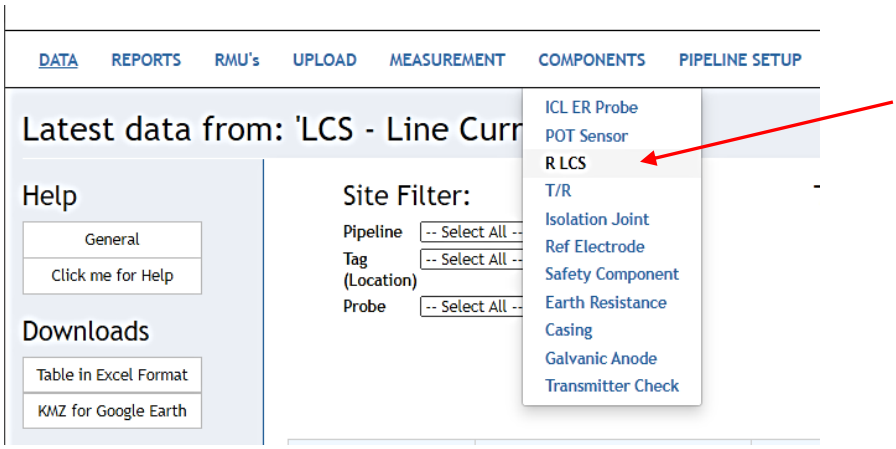
Note that the AC impedance will change according to the moisture content of the surrounding soil.

4.5 WebService - Line Current Sensor (LCS)

The "Line Current Sensor" (LCS) must be created in WebService under "Components" before the LC input can be measured. Furthermore, a DC resistance must be typed into WebService to enable calculated DC currents and graphs.

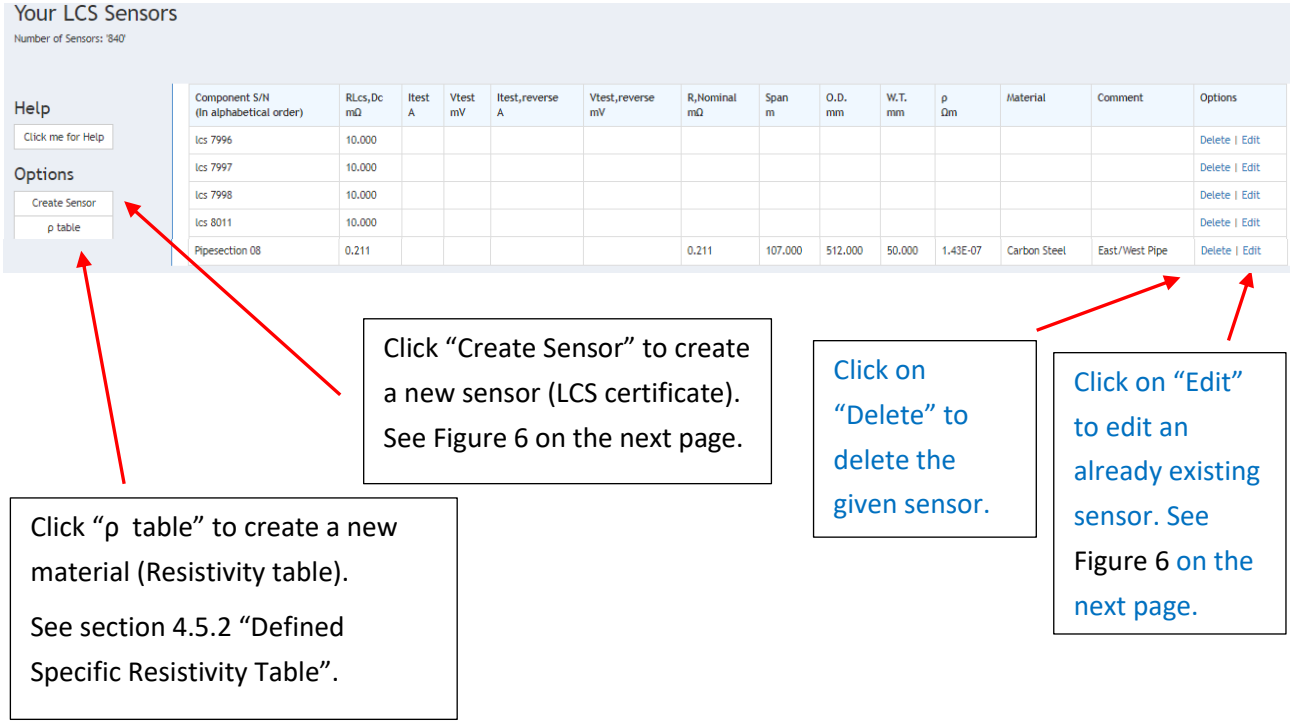
4.5.1 Create Line Current Sensor

Click on “Components” -> “R LCS”



The landing page "Your LCS Sensors" is shown below.

The list shows all your LCS Sensors. In this example, there are two LCS sensors, "LCS-FGA" and "min lcs.



Click “Create Sensor” to create a new sensor (LCS certificate). See Figure 6 on the next page.

Click on “Delete” to delete the given sensor.

Click on “Edit” to edit an already existing sensor. See Figure 6 on the next page.

Click “ρ table” to create a new material (Resistivity table).

See section 4.5.2 “Defined Specific Resistivity Table”.

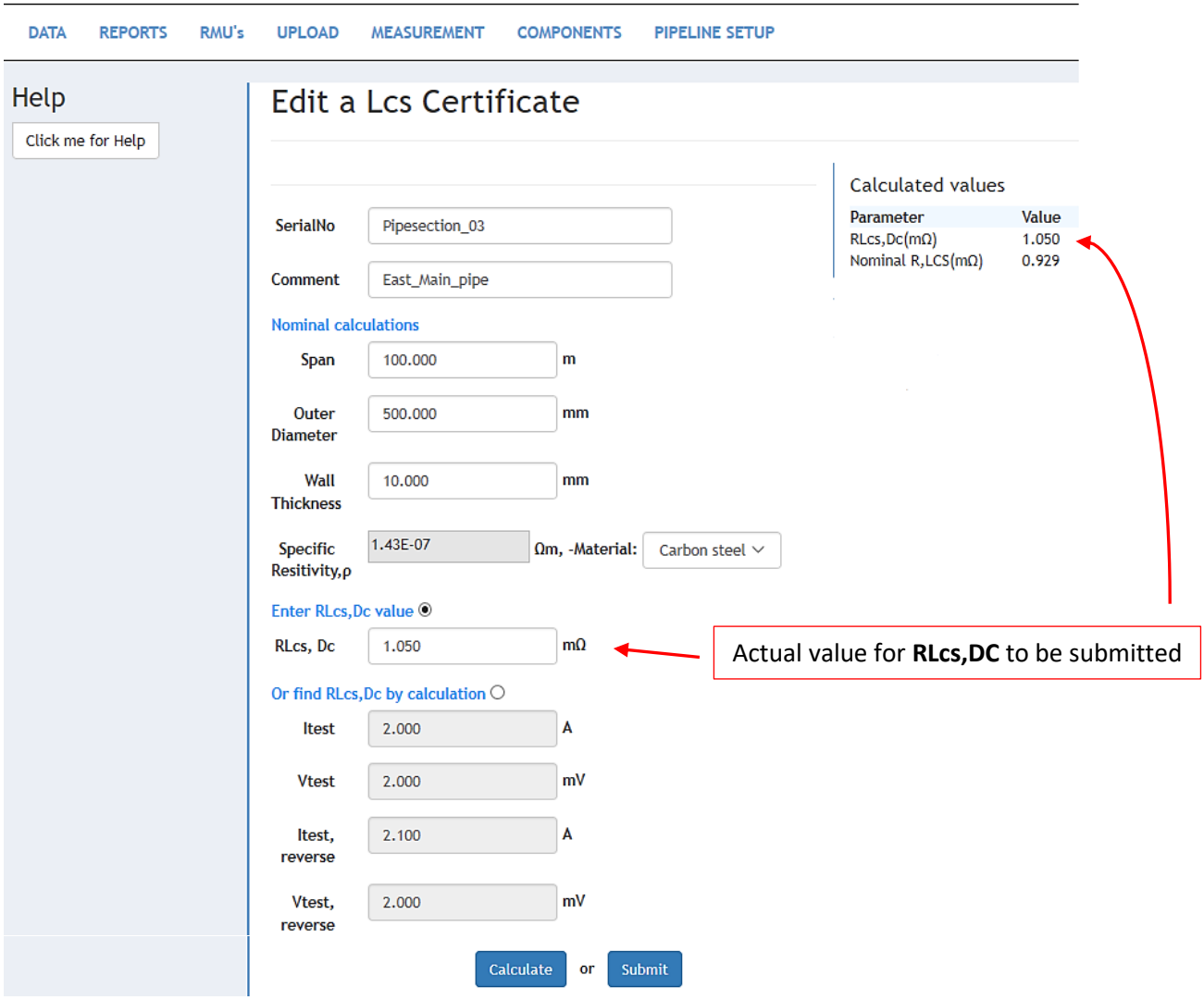


Figure 6." Edit a LCS certificate" page for typing in a value for DC resistance

Parameter	Data (example)	Comment
SerialNo	Pipesection_03	The unique name or serial number for a pipe section or part of the structure to be measured
Comment	East_Main_pipe	Any comment that describes the pipe section or part of the structure
Nominal calculations (input values for online DC resistance calculator for a steel pipe)		
Span	100 m	Span or length of the pipe section
Outer diameter	500 mm	The diameter of the pipe section
Wall Thickness	10 mm	The thickness of steel for the pipe
Specific Resistivity, ρ	1.43E-07 Ωm	Specific Resistivity for the steel. Choose from the drop-down menu. Note that you must define materials before anything shows!
Enter RLcs,DC value (Type in actual DC resistance value to be used for DC current calculation)		
RLcs,DC	2 mΩ	Type in actual DC resistance

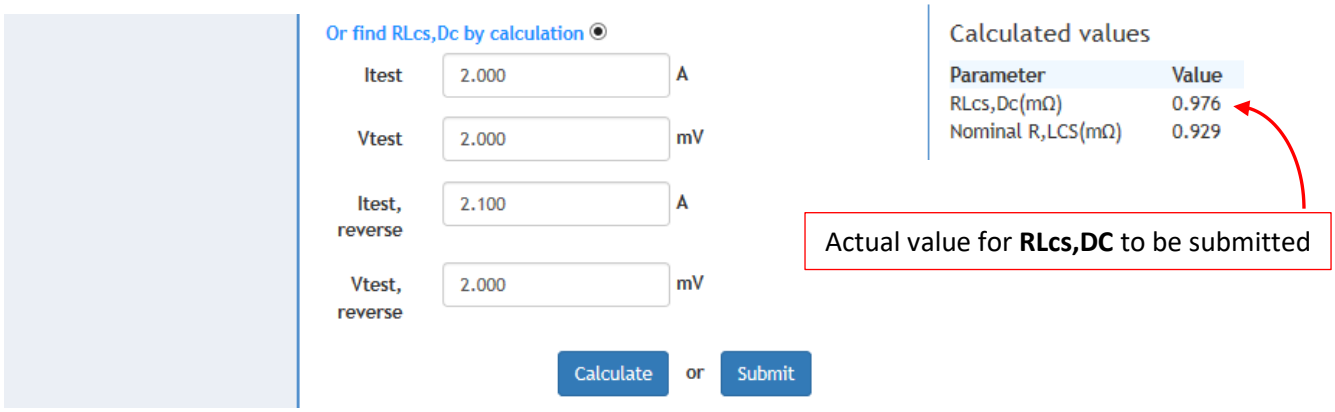
Table 3. LCS certificate - parameter description

Click **"Calculate"** and the actual and nominal values for RLcs,DC will be shown to the right.

Click **"Submit"** and the **actual** value for RLcs,DC will be submitted and used for DC current calculations.

Alternative way to calculate and submit RLcs,DC

It is also possible to enter measured DC voltage and current values for the given pipe section or structure to calculate the actual RLcs,Dc value. Check the "Or find RLcs,Dc by calculation" box:



The online calculator takes values for currents and voltages measured both ways and sets RLcs,Dc to the mean value between the forward and reverse measurements:

$$RL_{cs,DC} = ½ \cdot \left(\frac{2\ mV}{2.0\ A} + \frac{2.0\ mV}{2.1\ A}\right) = 0.976\ m\Omega$$

Click **"Calculate"** and the actual and nominal values for RLcs,DC will be shown to the right.

Click **"Submit"** and the **actual** value for RLcs,DC will be submitted and used for DC current calculations.

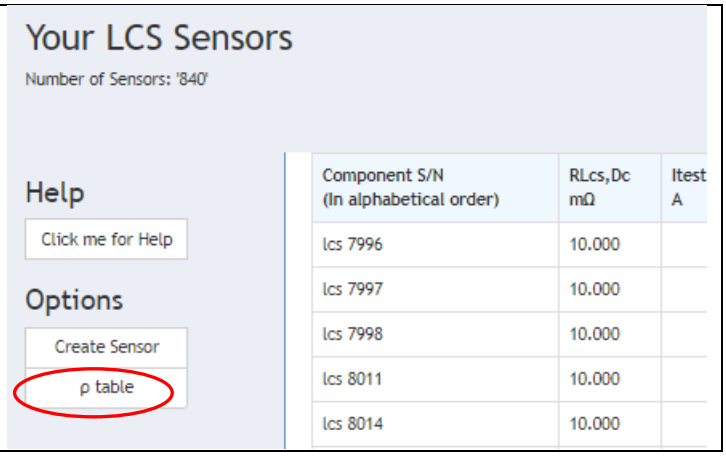
4.5.2 Defined Specific Resistivity Table

You can define your own materials with specific resistivity values in the "Rho table" described in this section. An example of different types of steel alloys.

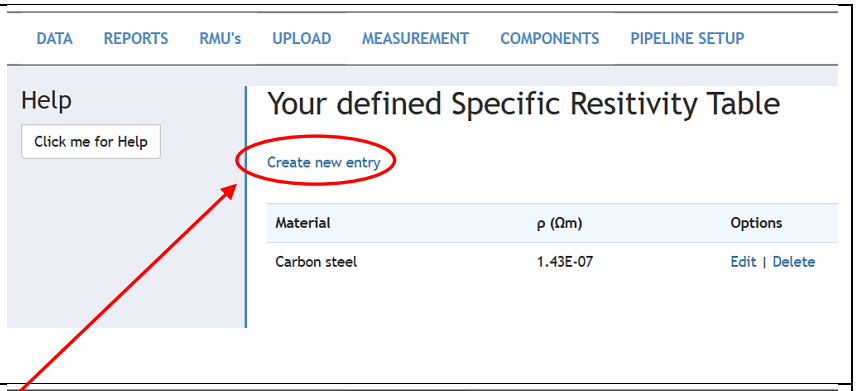
Click on “Components” -> “R LCS”

The window to the right will be shown.

Click on "Rho table."
(Specific Resistivity table)



Your defined Specific Resistivity Table will be shown.



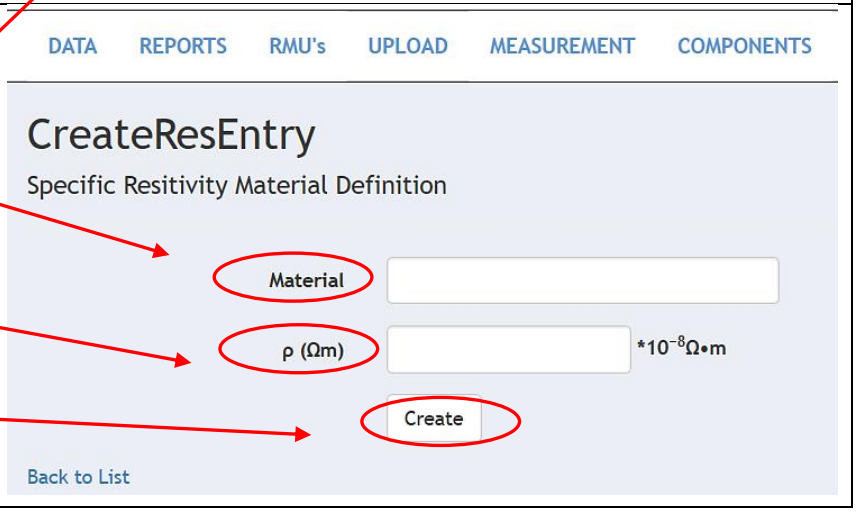
To create a new material:

Click on "Create new entry".

Type in name of material

Type in value of "Rho".
(Specific Resistivity)

Click "Create"

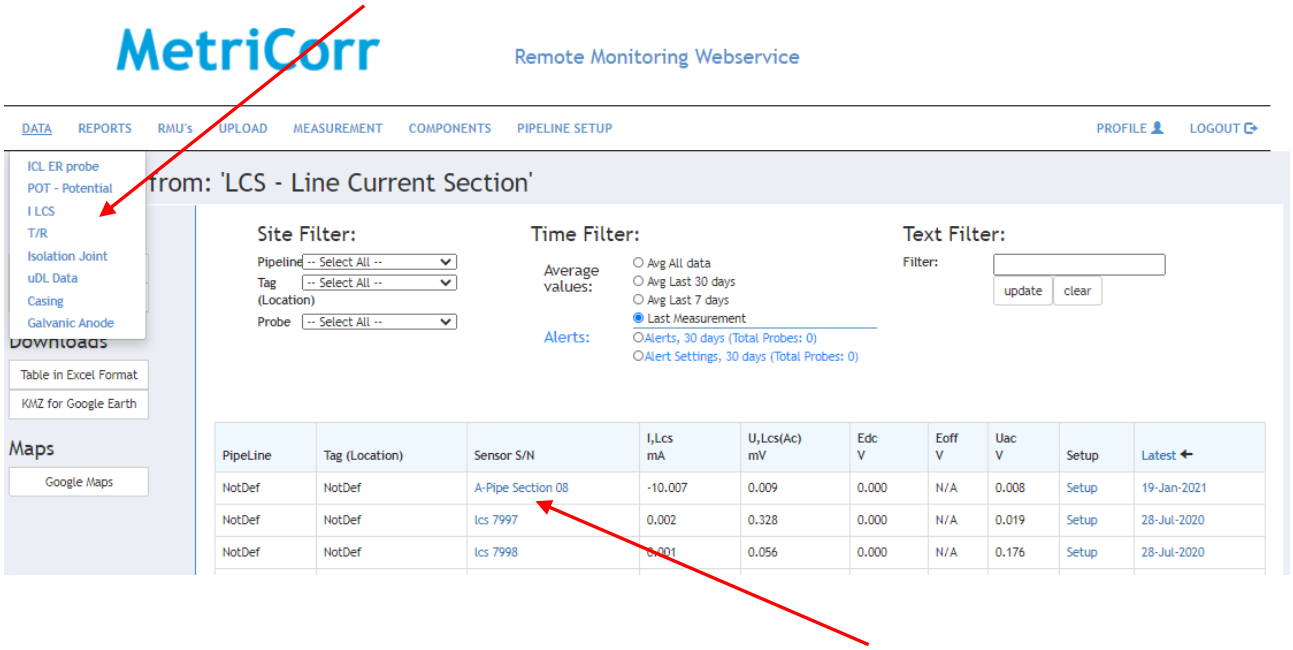


The new material will now appear in "Your defined Specific Resistivity Table" ready to be used when defining an LCS sensor certificate, see "Figure 6." Edit a LCS certificate" page for typing in a value for DC resistance."

4.5.3 Data display – Line Current Sensor (LC Sensor)

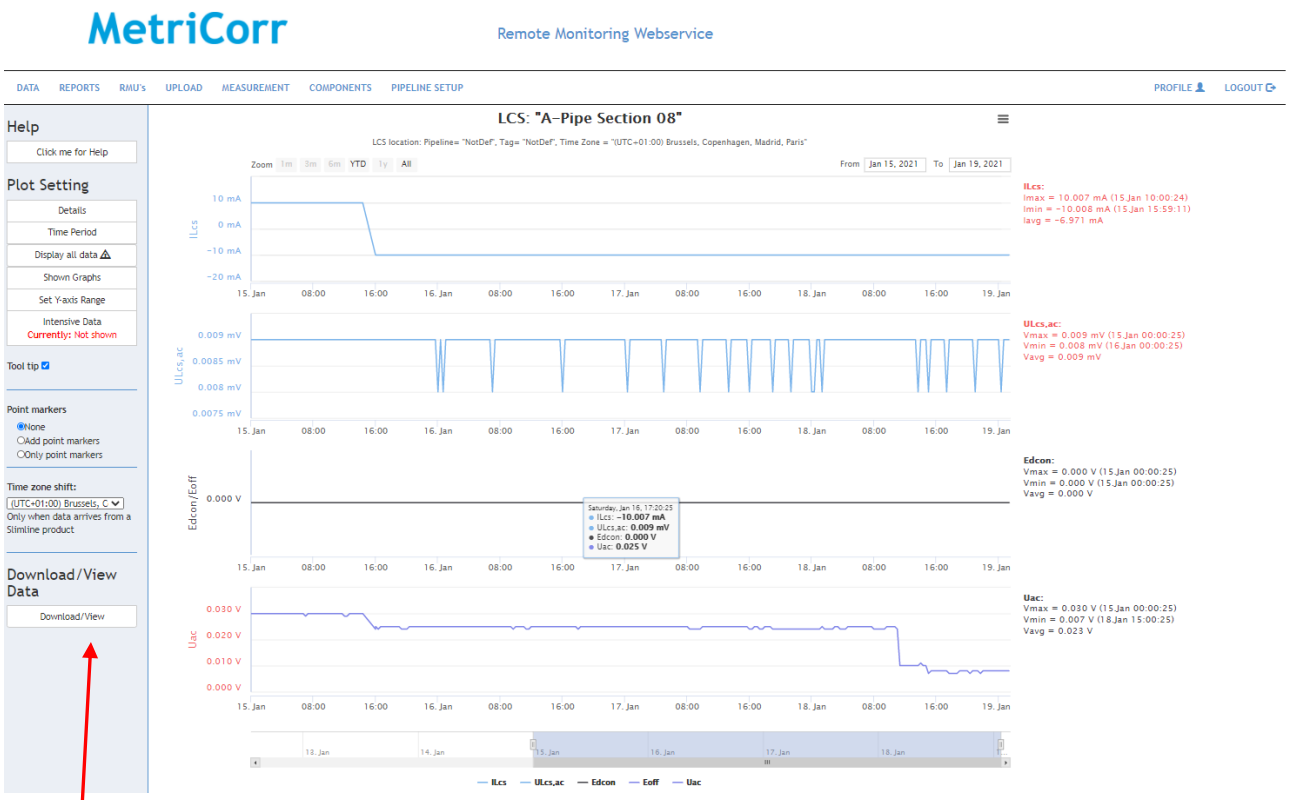
LC Sensor performs measurements of both the (LC inputs) and the (Pipe – Ref) voltage input simultaneously.

Click "DATA" -> "I LCS" to view the LCS sensors linked to your account:



To view the collected data from an LCS sensor, click on its "Sensor S/N", for example "A-Pipe Section 08".

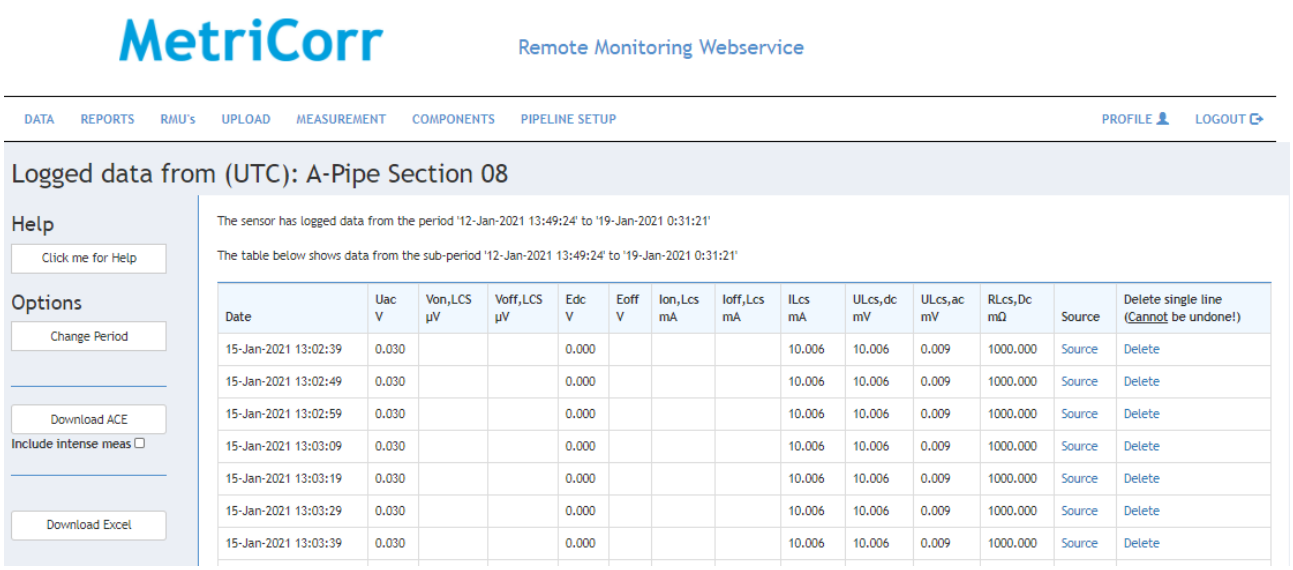
The LCS data window for the selected LCS sensor will now be shown:



Graphs:

1. **ILcs** is the Line Current measurement (LC+ and LC-)
2. **Edcon/Eoff** is the simultaneous DC voltage measurement (Pipe – Ref)
3. **Uac** is the simultaneous AC voltage measurement (Pipe – Ref)

Click "Download/View Data" to view a list of each measurement, including the (Line Current AC voltage measurement, ULcs,ac), illustrated on next page.



An overview of the columns in the" Logged data from (UTC)" table above is described in Table 4 below:

Parameter	Data (example)	Comment
Date	15-Jan-2021 13:02:39	UTC time stamp of measurement
Pipe – Ref terminals		
Uac V	0.030	AC voltage measurement in volts
Von,LCS µV		On-potential in microvolts
Voff,LCS µV		Off-potential in microvolts
Edc V	0.000	DC voltage measurement in volts
Eoff V		Off DC voltage measurement in volts
LC+ and LC- terminals		
Ion,Lcs mA		On-state current in milliamps
Ioff,Lcs mA		Off-state current in milliamps
ILcs mA	10.006	DC current in milliamps (calculated from ULcs,dc and RLcs,Dc)
ULcs,dc mV	10.006	DC voltage measurement in millivolts
ULcs,ac mV	0.009	AC voltage measurement in millivolts
RLcs,Dc mΩ	1000.00	DC resistance in milliohms (for the given pipe section)
Source	Data delivered by Masterlink with Mobile ID: AL02840252	Check which MasterLink sent the measurement
Delete		Deletes the measurement (single line). Cannot be undone!

Table 4. Logged data from (UTC): Line Current Sensor – parameter description

5 Installation

This section covers the installation of the Slimline units for different applications listed here:

1. Solar Junction box (Solar panel and Lead-acid battery 12V/12Ah)
2. Solar junction box (Satellite modem, solar panel and Lead-acid battery 12V/12Ah), see section 7.
3. Big Fink (External power required)
4. Big Fink Solar solution (Solar panel and Lead-acid battery 12V/2Ah)
5. Big Fink Battery Hat (Lithium Thionyl battery 7.2V/42Ah)

The accessories required as well as the assembly are described in the relevant sections, below.

5.1 Solar Junction Box Installation

The junction box itself can be installed on a stable wooden pole, metal tube, or test station pipe such as a big fink. The mounting should be carried out according to the mounting sketch present in Appendix 1. To the best possible extent, it is important to mount the junction box such that it is not shadowed (in any season) as the solar panel needs direct sun to recharge the battery effectively. A back-up battery for three months of operation (without solar charging) at 1-hour measurement intervals and weekly uploads is supplied with the junction box.

Once the junction box is securely mounted in place, the onsite installation/set up of the RMU can commence.

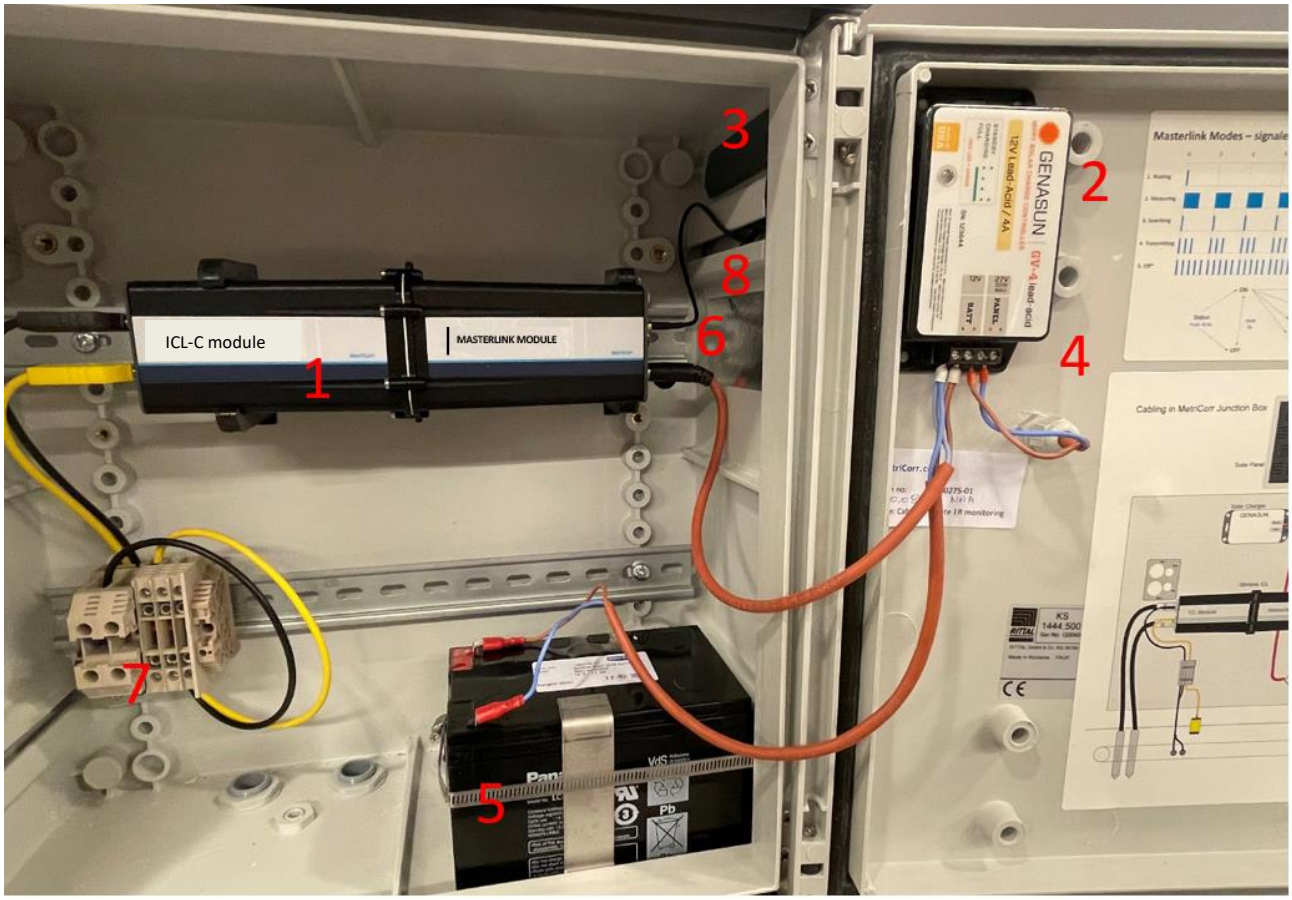


Figure 7: Interior of Solar Junction Box as Battery and solar connected.

1 – ICL-C – RMU Unit
2 – Solar Charge Controller
3 – Antenna
4 – Power from solar panel
5 - Battery
6 – Power connector to Slimline VL100
7 – Input: Pipe (**black**) & reference (**yellow**)
(Note.: Picture missing input connectors for LC + and LC -)
8 – Reflective Panel for LED

Note: ER probe cable and wires to LC input NOT shown.

Installation Steps (Solar Junction box)

1. Bring the pipe and reference electrode cables into the junction box through the glanded cable entries.

   Yellow:
   Reference electrode

   Black:
   Pipe

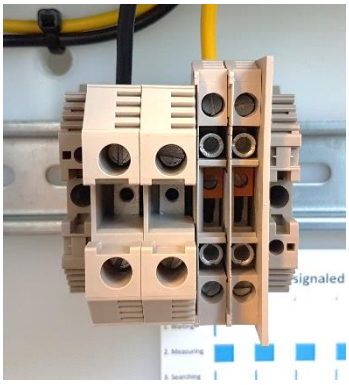


Figure 8: Pipe & Reference IN

2. Refer to Figure 8 above: plug in the supplied pipe connection (black - Top) and the reference electrode (yellow – Bottom) to the terminals "Pipe" and "Ref". Connect the pipe and reference cables from the field through the terminal block indicated above.

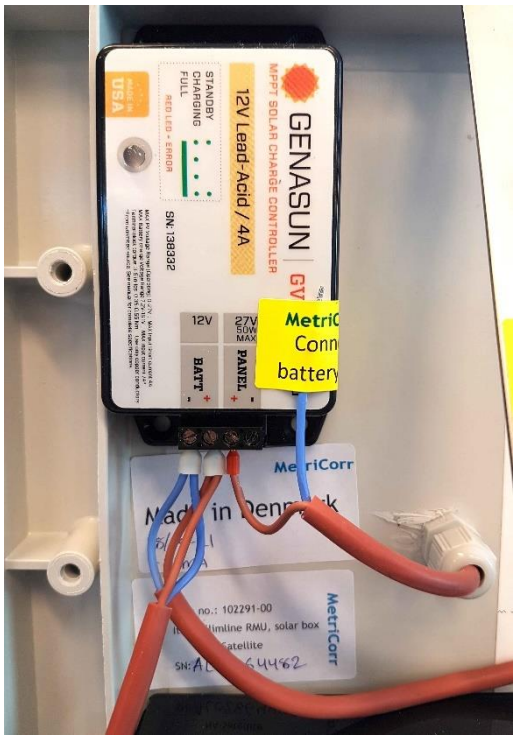
3. Installation of wires/cable to "LC+" and "LC-"shall be done according to the same procedure as for the "Pipe" and "Ref" connections. Note, Connectors for LC + and LC – not shown)

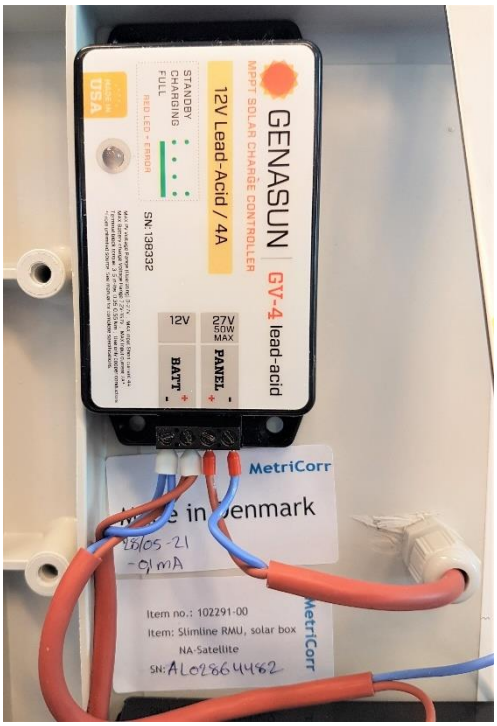
Important Please follow the sequence below exactly. Failure to do so may result in damage to the solar charge controller.

Test the charge of the battery before you head to the site. It should be above 12V. If it is not, charge the battery with a separate lead crystal battery charger (note that the battery MUST be disconnected from the solar charger during charging). Once charged, follow the steps below.

4. Remove the yellow tape from the connector (blue wire) and connect it to the (-) pole on the battery.

5. Remove yellow tape from the connector (blue wire from solar panel), insert it into the solar panel terminal marked “Panel –“ and tighten the screw terminal:





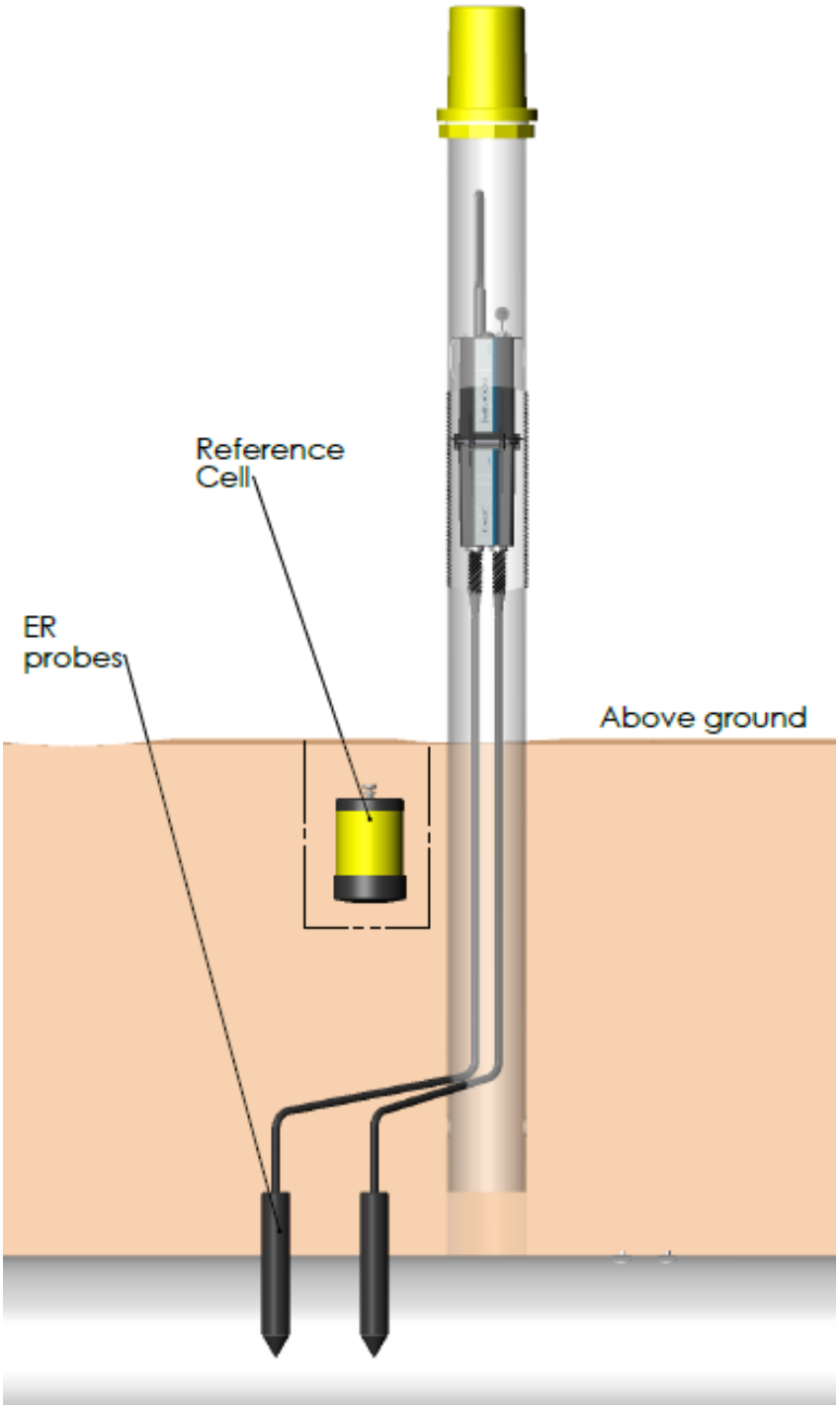
Step 5: Connect the Solar Charger to the solar panel

6. Finally, check that the circular power connector are connected to the power socket on the MasterLink module.

Figure 9: Power connector

5.2 Big Fink Installation

The Slimline loggers are designed to fit inside a Big Fink type test post, with probe or sensor as shown in the general illustration. **Please note,** the illustration below is depicted with a "ICL & MasterLink" from the slimline series with two ER probe channels



The loggers can be mounted within the test post either using factory fitted clips, or brackets depending on the Client's preference.

Installation Steps (Big Fink)

Figure 10: Left: Big Fink terminals. Right: Mounting brackets and Clips for Slimline Installation in Big Finks

1. The reference electrode cable and the pipe connection(s) should be available at the top of the Big Fink, as shown.

   NB: if installing in an existing installation, additional connections (e.g., foreign pipeline, coupon, etc.) should also be brought up so that they can be terminated correctly.

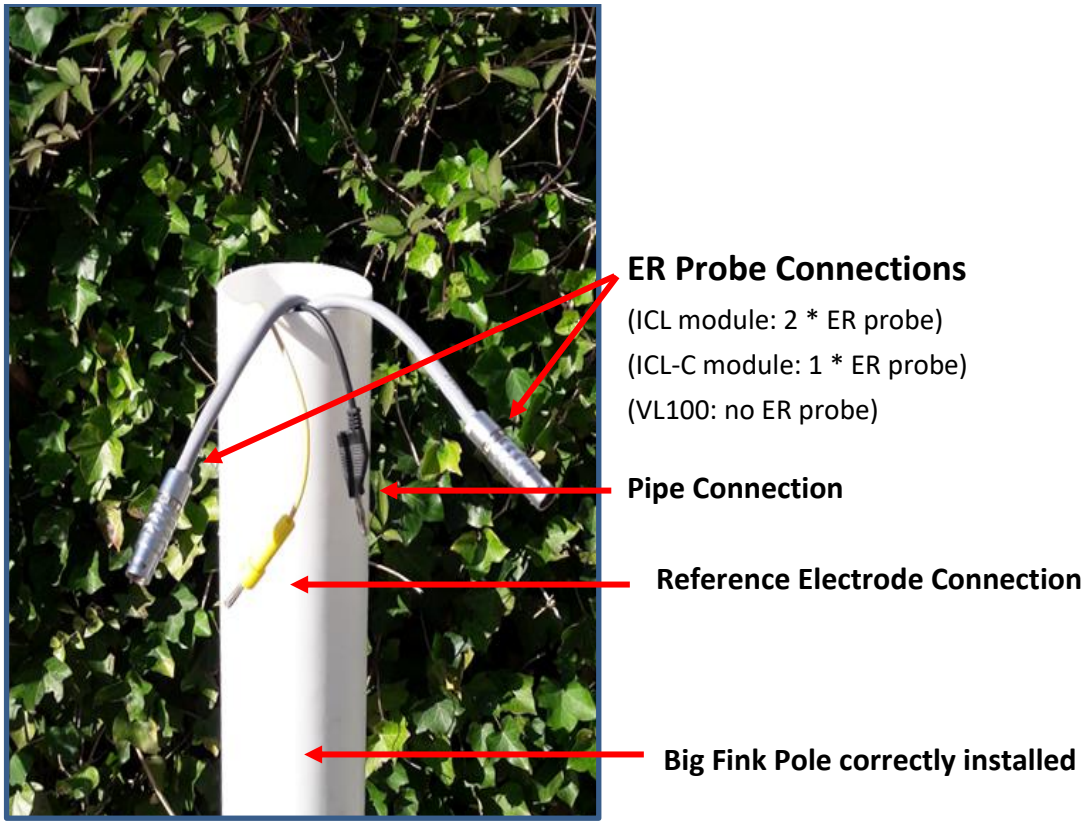
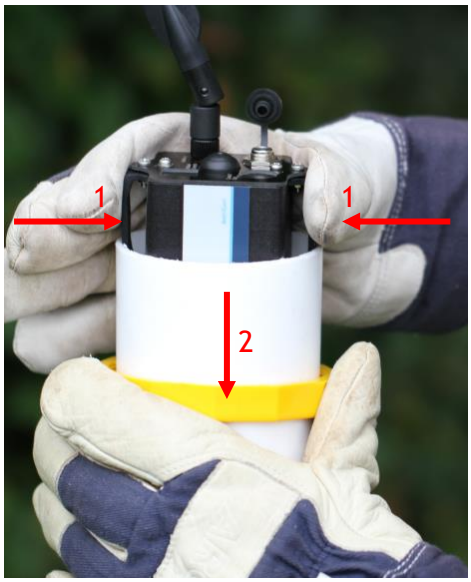


Figure 11: Big Fink Test Station ready for installation of Slimline series: "ICL & MasterLink".
Note that "ICL-C & MasterLink" only takes one ER probe, Pipe connection (black), Reference (Yellow) and two wires for pipe connections for "LC+" and "LC-".

2. **ER probes:** Connect the ODU connectors for the ER probe cables to the ER socket(s) on the ICL module or ICL-C module.
3. **"Pipe" & "Ref":** Connect the pipe and reference electrode cables to the logger. The connection should be made using banana plugs (depending on the existing setup, making-off the cable ends with banana plugs before installation of the logger may be necessary).
4. **LC input:** Connect the two wires from the pipe to "LC+" and "LC-". The connection should be made using banana plugs as for the "Pipe" & "Ref" terminals
5. **Antenna and power cable** must be connected to the MasterLink module and go through commissioning procedure to start the logger as outlined in **Section 3.**



6. **Clips**

Squeeze the clips in towards the Slimline unit and insert into the test station, pushing down such that there is room enough for the antenna beneath the Big Fink cap, ensuring the cables are not excessively bent or trapped between the logger and the side of the test post.

7. **Brackets**

The logger should be lowered until the Big Fink top attached to the bracket can be correctly seated on top of the pole. Tighten the collar nut to ensure a secure fit.

8. All additional cables should be correctly terminated on either the standard Big Fink terminal board (in the case of the Solar Hat Solution) or on the supplied modified (flat) terminal board in the case of the hat battery solution.

The modified terminal board can be supplied, if additional connections are required, e.g in test stations with the battery solution. Connections to the existing standard terminal board in the solar solution are possible.

These additional connections are NOT necessary for the installation of the Slimline ICL-C since "LC+" & "LC-", "Pipe" & "Ref" cables can be directly connected to the logger from the field without passing through the terminal board.

5.3 Big Fink Solar Solution

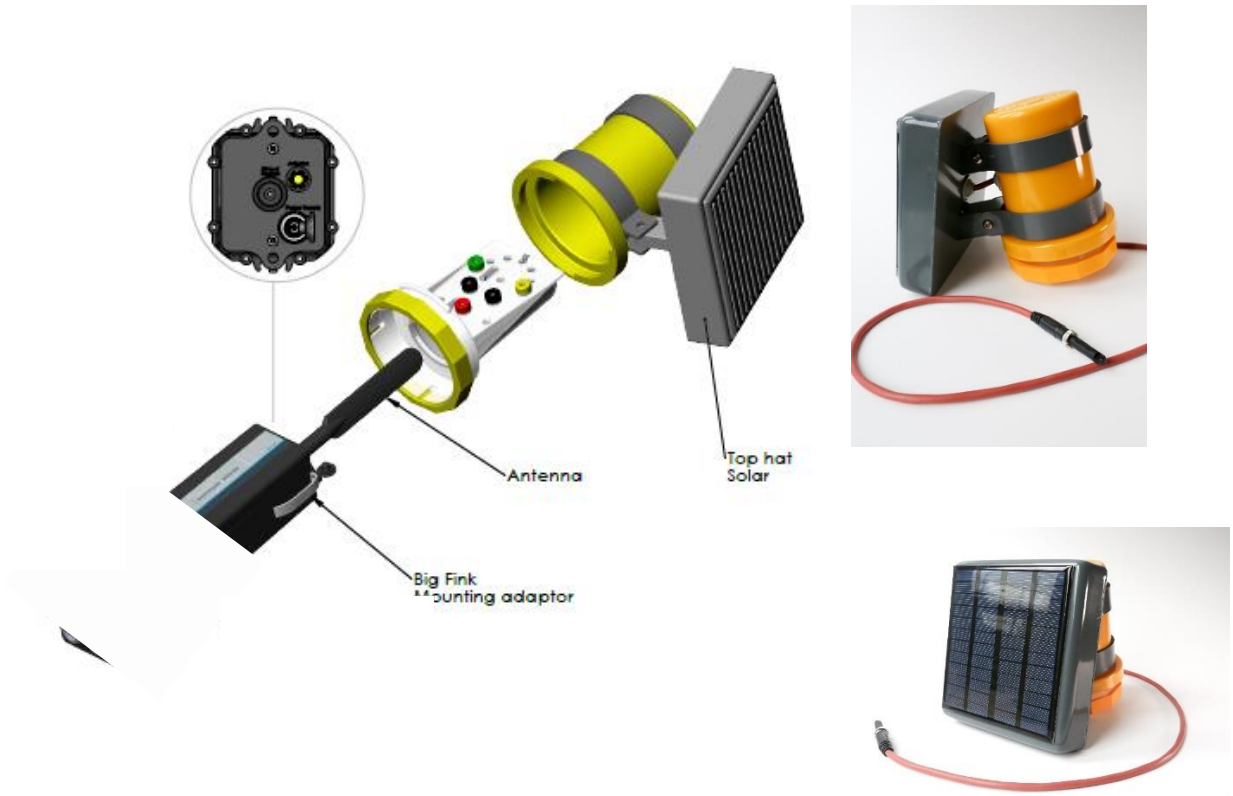


Figure 12: Big Fink Solar Hat general layout & appearance

The MetriCorr Big Fink Solar power solution requires only that the power cord is connected to the power supply socket on the MasterLink module, as per **step 5** above. Once power is connected, ensure that the logger is ON and set up correctly (**see Section 3**).

Secure the hat onto the top of the pole using the terminal board/collar and twist to lock, as you would a normal Big Fink hat, ensuring that the solar panel is facing toward the prevailing sun. There must be no shadowing of the solar panel.

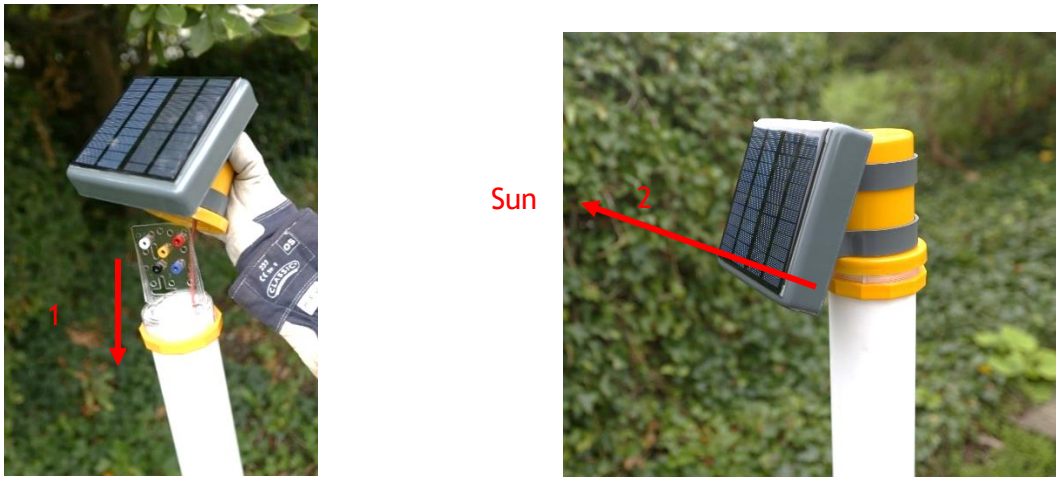


Figure 13: Securing the Big Fink Solar Hat

5.4 Battery Hat Solution

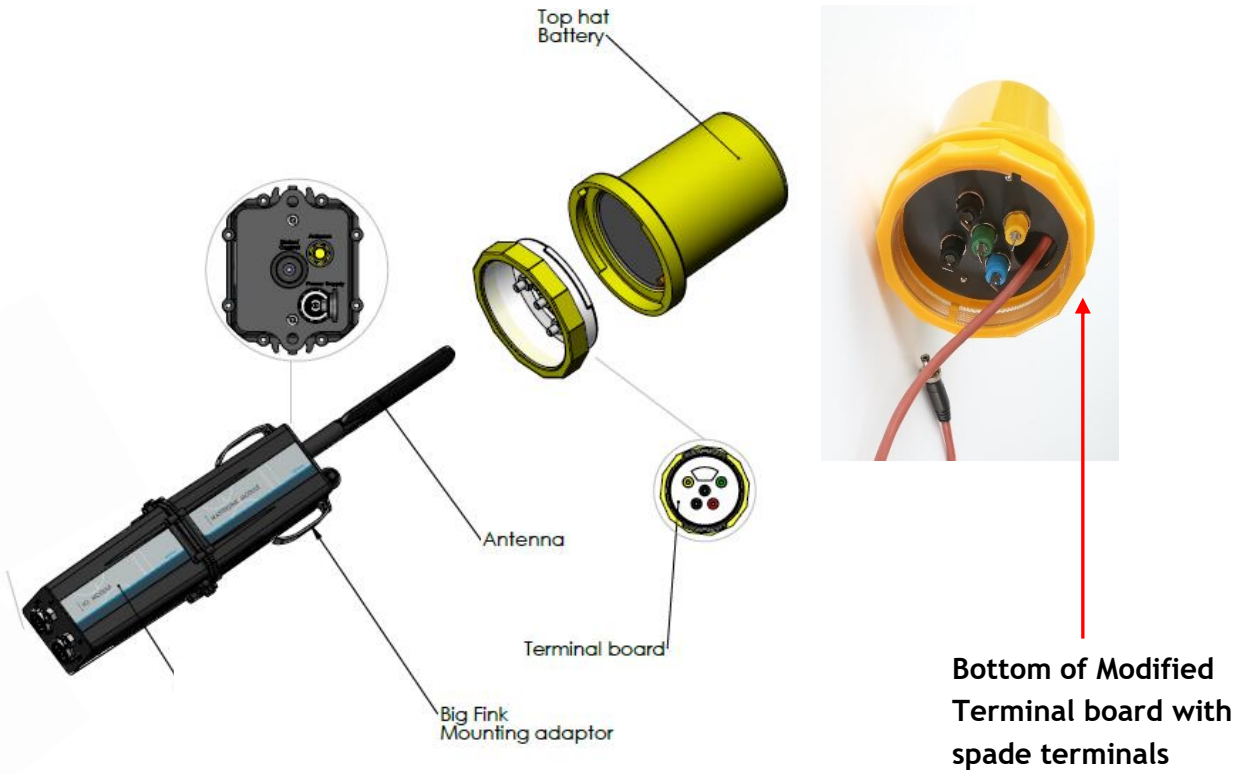


Figure 14: Big Fink Battery Hat General layout & appearance

The MetriCorr Big Fink Battery requires only that power cord connected to connector E (Figure 2), as per **step 3** above. Once power is connected, ensure that the logger is ON and set up correctly (**see Section 3**).

Secure the hat onto the top of the pole using the terminal board/collar and twist to lock, as you would a normal Big Fink hat.

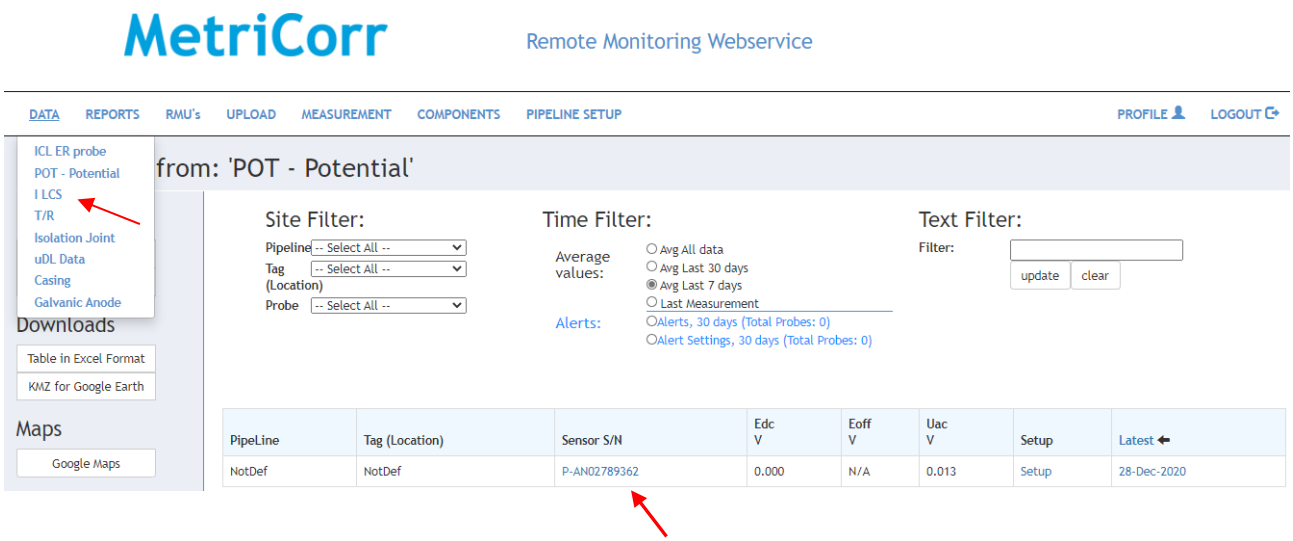
Figure 15: Securing the Big Fink Battery Hat

6 Your Data – Simple WEBservice Instructions

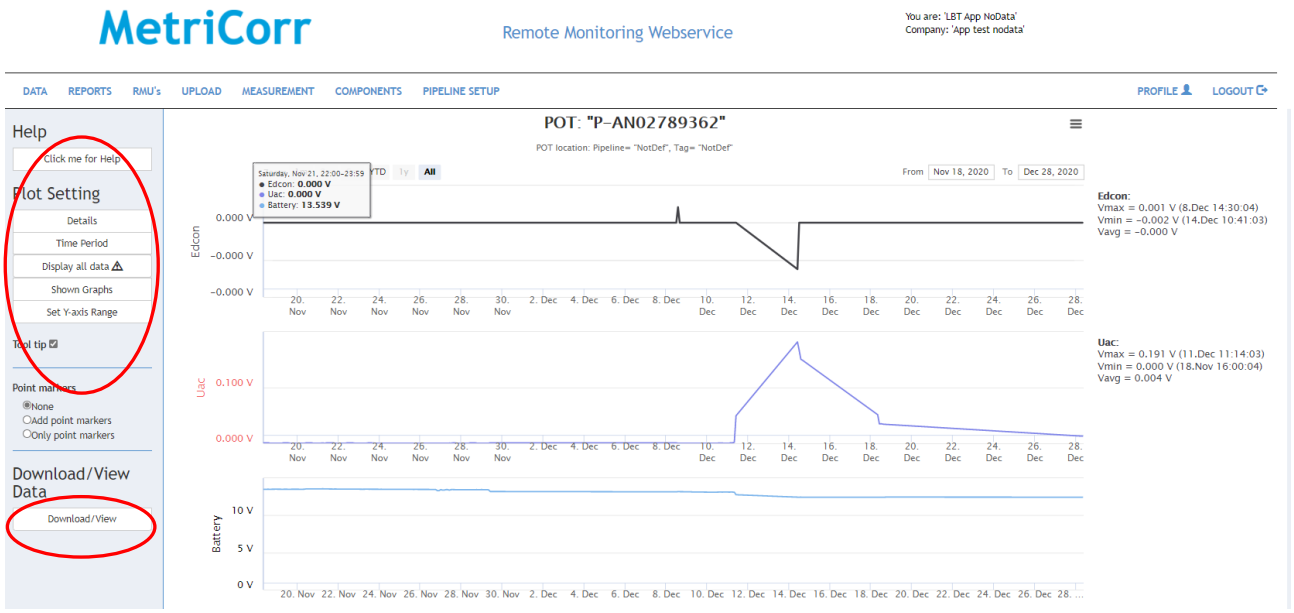
The MetriCorr WEBservice is a powerful tool that allows you to view, treat, and download data as well as associated logger and pipeline information. Here are a few tips to get you going.

6.1 View & Download Logged Data

Once your unit(s) have logged and sent the first set of data, you can view it by clicking the '**Data**' heading and selecting the type of data you wish to see (in the case of the ICL-C, this will be "**I LCS**").



This will display a table of all of your POT - sensors and the latest measurement values (average of the last seven days is the default). You can use the Site, Time, and Text filters to change the probes/sensors that are displayed. Clicking on the sensor number will display a graphical representation of the data for that probe/sensor.

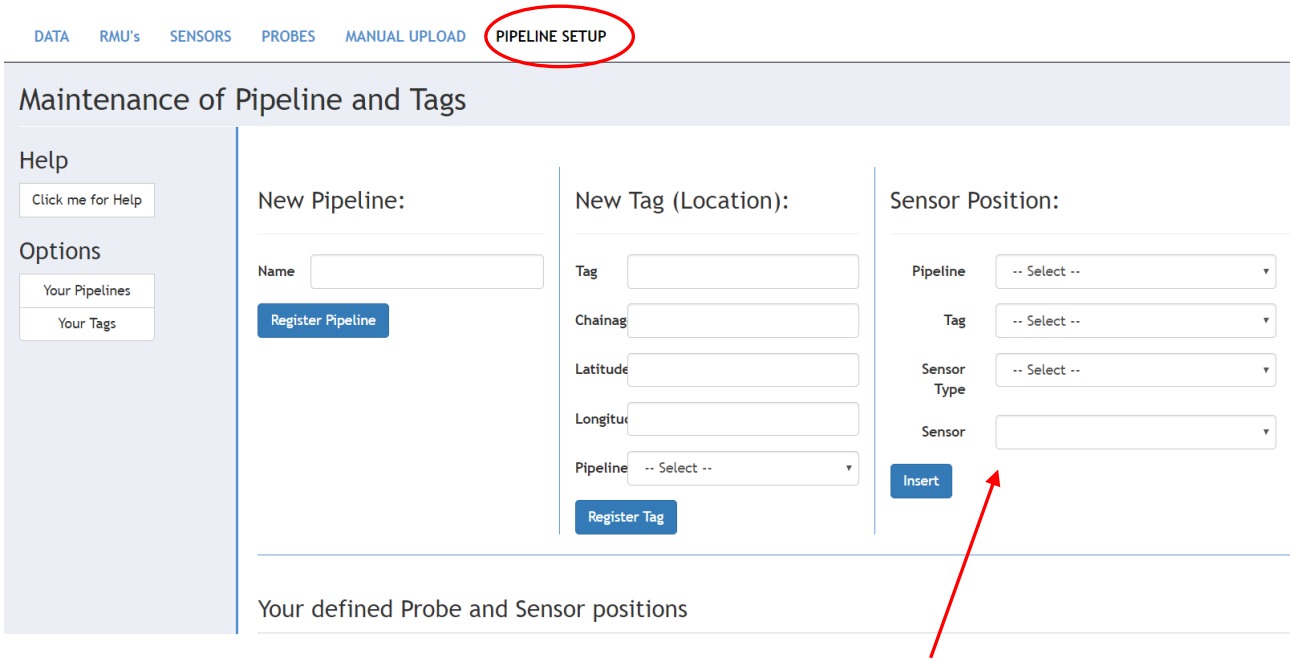


The graph appearance and the data shown can be changed by using '**Plot Settings**' and downloaded as a .jpeg etc. by clicking the three-line symbol (circled above).

Data for that probe/sensor can be downloaded in tabular form by clicking '**Download/View**'.

6.2 Unit Pipeline & Location Assignment

A sensor/probe can be assigned to a pipeline and specific tag/location for easy data identification. You can define the specific information regarding pipelines, locations etc. using the '**Pipeline Setup**' menu.



Once a pipeline and tag have been defined, you can assign the '**Sensor Position**'.

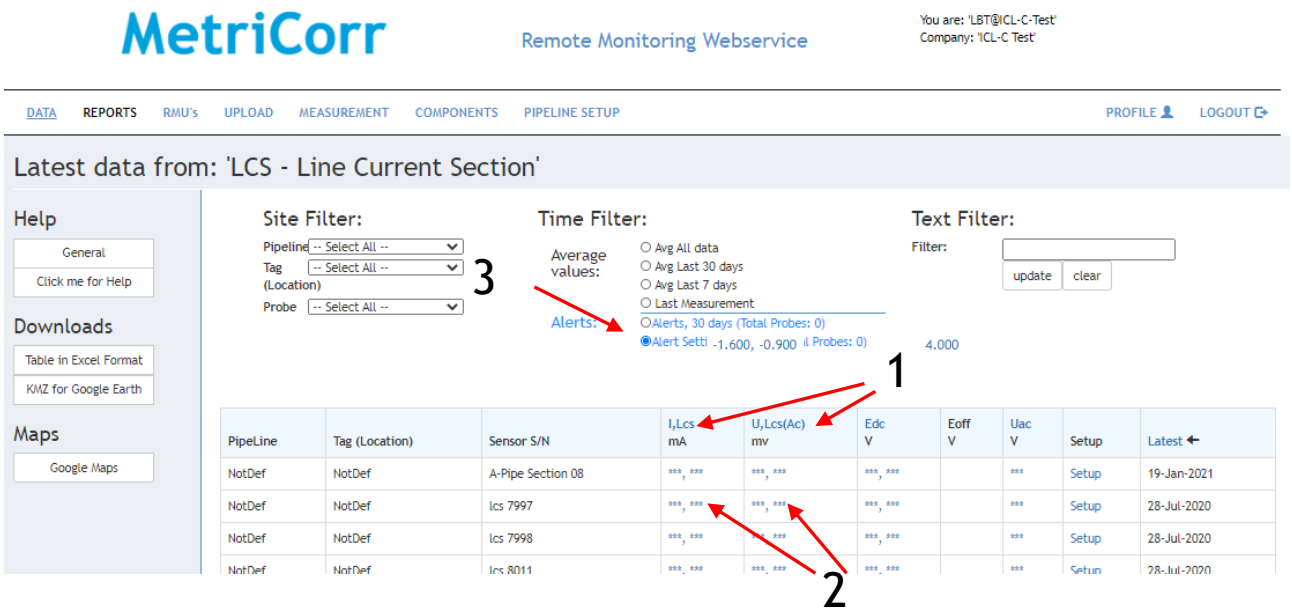
The sensor/probe's pipeline, tag and chainage will be shown in the Data table and can be filtered using the **Site**, **Time** and **Text filters** described in Section 6.1.

6.3 Alerts

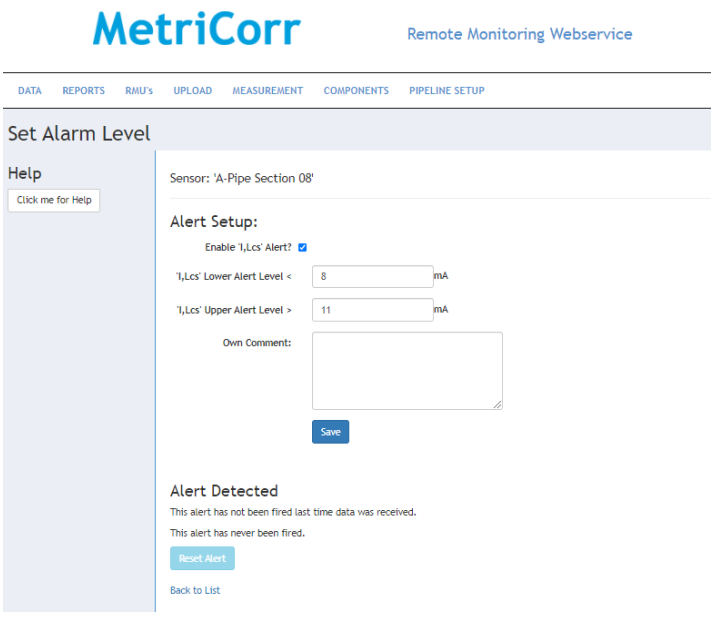
You can define alert values/ limits for specific parameters for specific probes/sensors or an entire group of sensors/probes. Found on the main '**Data**' or landing page by clicking '**Alert Settings**'.

1. Set alert for all probes shown for this parameter
2. Set Alert for this parameter for this specific probe/sensor only
3. View triggered alerts

Note, that the example below shows the" POT – Potential" data page ("Pipe"-"Ref" terminals), which all slimline loggers pr default are equipped with.

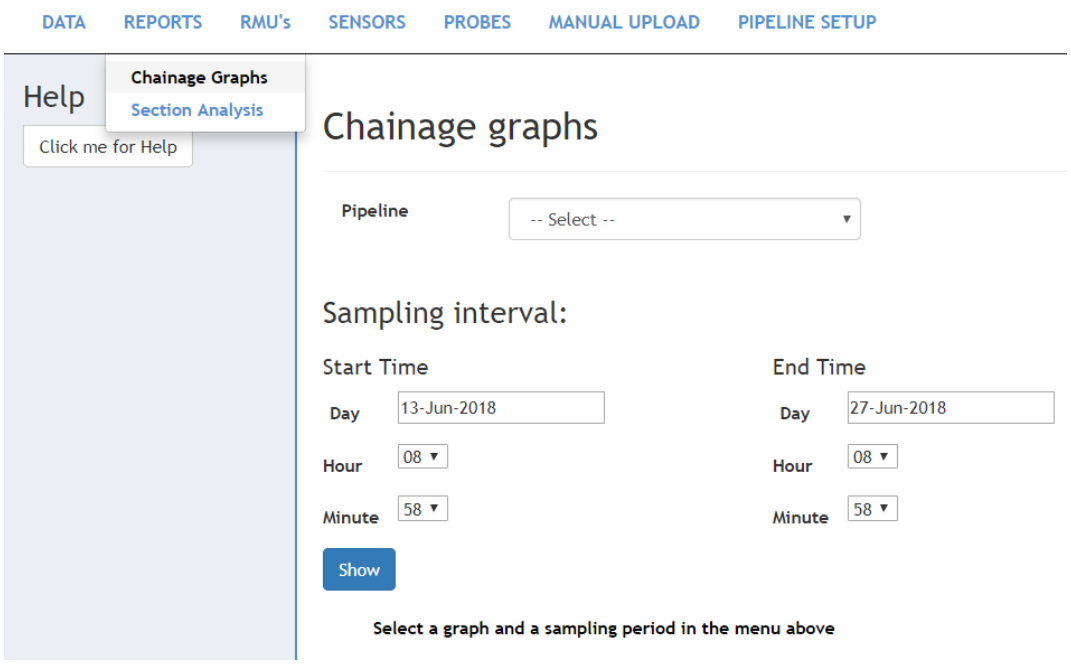


Configure and enable Alerts by selecting a specific parameter



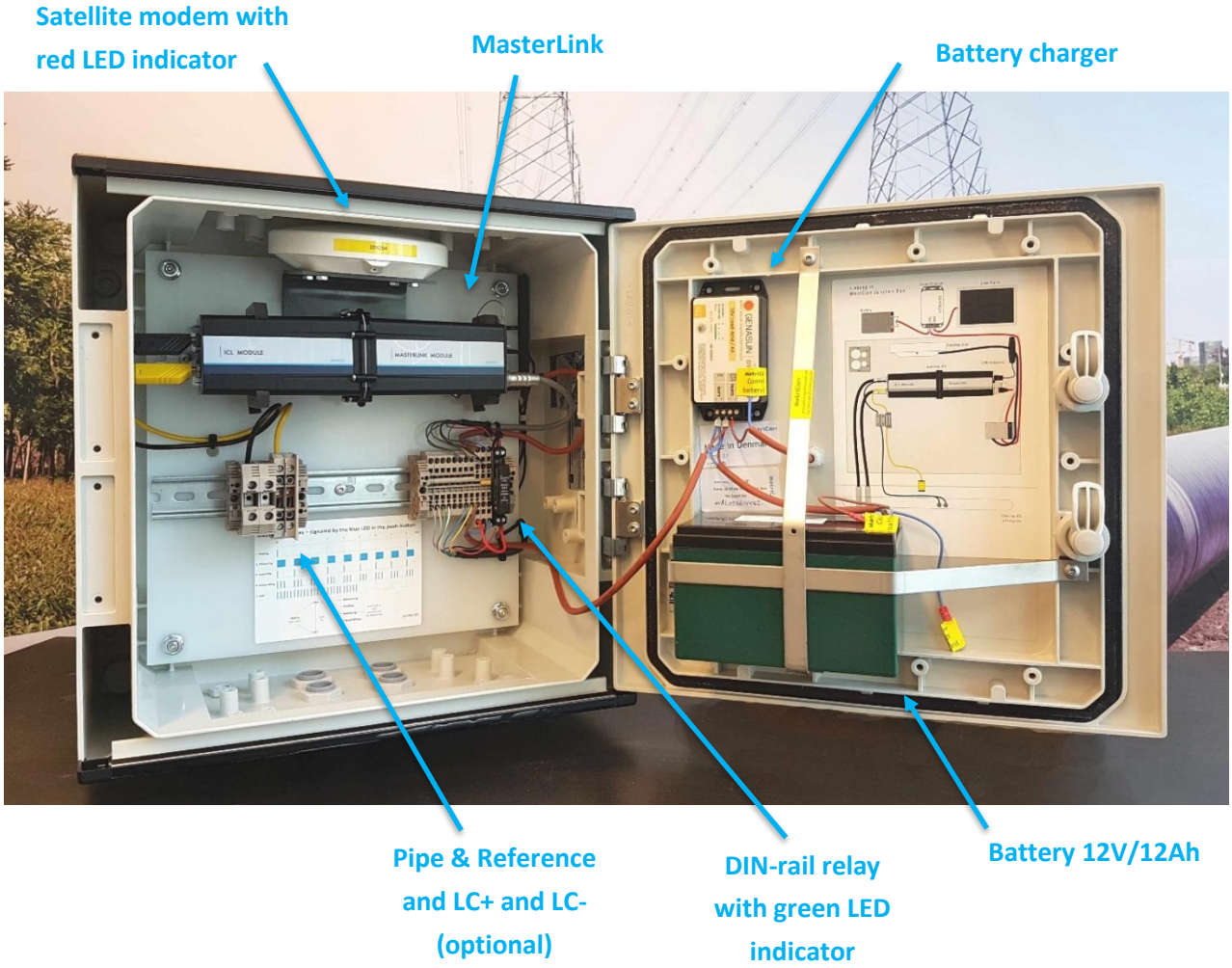
6.4 Reports

It is possible to generate a chainage graph for a specific pipeline with average, minimum, and maximum values over a specified period. in the '**Reports**' menu.



7 Satellite - communication

For areas with no GSM/LTE coverage, Metricorr offers a solution for dataloggers to transmit their measurement data to WEBservice via satellites. Our standard configuration for satellite communication is based on a solar/battery powered Masterlink-datalogger with a satellite modem; all housed in a 40cm x 40cm x 20cm cabinet as shown below. (Similar to the "Solar Junction Box" described in section 5.)



The satellite modem is mounted under the top of the cabinet and is connected to the MasterLink and battery charger via the DIN-rail terminals + relay to the right, (internal connections only). The cabinet shown also holds optional extra surge protection for areas with increased risk of surges from lightnings.

7.1 Satellite modem & placement

The installed modem used for satellite communication is the model “RockBLOCK+” produced by “RockBLOCK”, which communicates via the satellite network operator “Iridium”.

It is important to place the satellite junction box with unblocked access to the sky. We refer to the guidelines from “RockBLOCK’s” website: https://docs.rockblock.rock7.com/docs/mounting

”

Selecting a mounting location

Iridium operates in the microwave L-band and therefore requires line-of-sight communication between RockBLOCK and the satellites.

Don't install RockBLOCK inside a building.
Unlike GSM networks, the microwave L-band can't penetrate solid objects.

Operating RockBLOCK through windows not recommended.
Apart from causing long session timeouts, windows with UV protection films will also block the signal.

Comply with RF exposure limits.
We don't recommend installing RockBLOCK within 20 cm of a person.

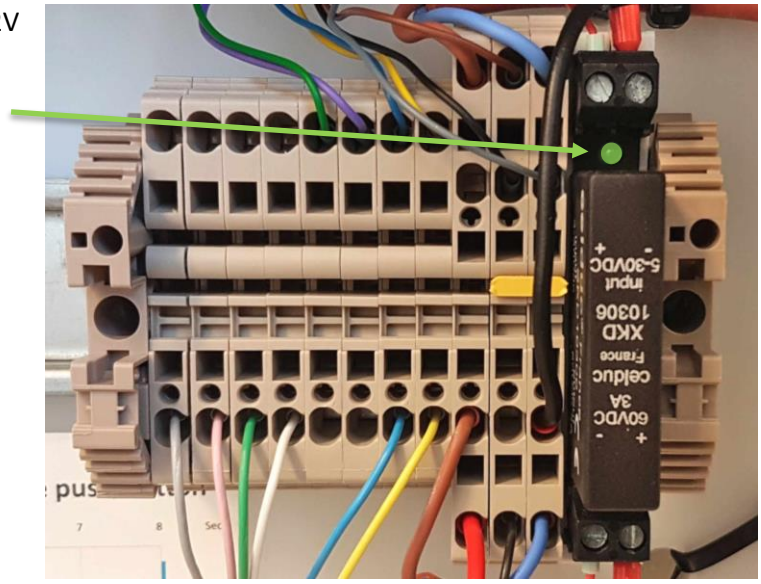
Typically, the best installation location will be on top of an asset, with a 360 degree view of the sky. Because Iridium satellites are always moving, with a sensible retry strategy it is possible to achieve good performance even with quite a restricted view of the sky.

“

7.2 Power & LED indicators

The satellite modem is powered from the 12V battery via a DIN-rail mounted relay with a green LED indicating when the satellite modem is connected to the 12V battery.

The relay is controlled by the MasterLink, which is connected directly to the 12V battery.

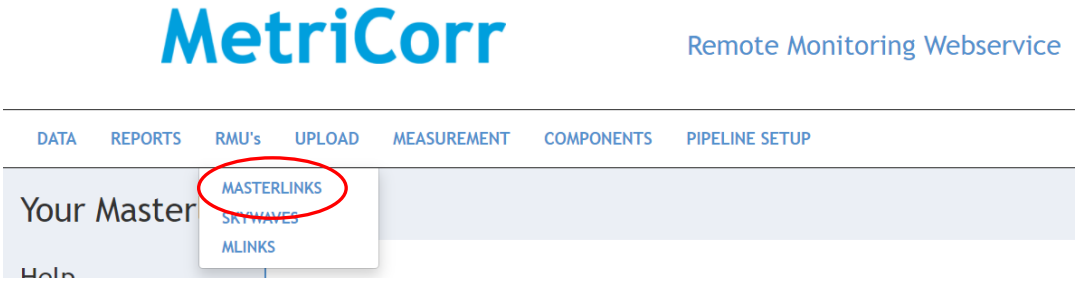


The red LED indicates the power status of the satellite modem. The red LED is located on the front of the modem.

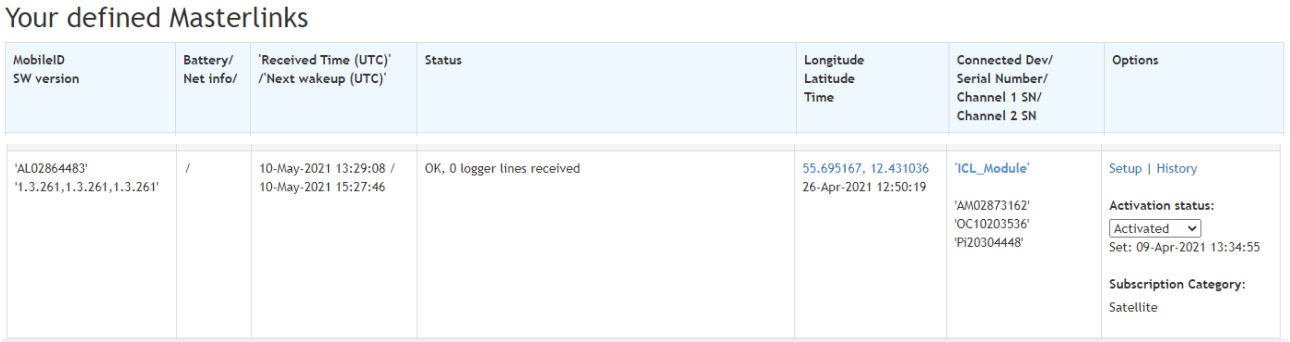
When the relay is switched on (green LED), the built-in supercapacitor in the modem must be charged before it is able to operate, which will take up to 30 seconds. The red LED on the modem will light up when it is ready to operate. When the relay is switched off, the modem will stay on (indicated by the red LED) for a while until the super capacitor has been discharged.

7.3 Webservice Subscription

In WEBservice, the subscription for satellite communication is called “Satellite”, which includes data transfer of one measurement per day. In WEBservice, press “RMU” -> “Masterlinks” in the top menu as shown below:



Your satellite-connected MasterLink will appear in the “Your defined Masterlinks” list as any other MasterLink-datalogger from Metricorr. Here, the “Subscription Category” is set to “Satellite”.



7.4 Setup in Webservice

The options for satellite connected MasterLinks are limited compared to standard GSM/LTE connected Masterlinks, since data transfer will only be sent once a day. However, the datalogger will still do measurements once an hour, which is stored in the MasterLink memory to be manually transferred using the Metricorr App.

Press “Setup” for the Masterlink you want to configure to enter the setup page shown below. Both Masterlink serial number and the unique satellite serial number and IMEI number are shown in the top right corner. The two parameters “Sleep(ok)” and “Sleep(Fall)” are set to fixed values and cannot be changed by the user.

	Masterlink: 'AL02864445' via Satellite (SN: '204256', IMEI: '300534060416500')		
	Request	Latest Registration	
Sleep(OK) hours	24	24	'31-May-2021 14:13:22 (UTC)'
Sleep(Fail) hours	4	4	'31-May-2021 14:13:22 (UTC)'
Latitude	Get position: ☐ Note: The position will automatically be transferred to the pipeline setup		
Longitude			

	Slimline ICL: 'AM02873181'		
	Request	Latest Registration	
Time for first daily returned measurement, HH:MM (UTC)	Hour: 12 , Min: 00		'01-Jun-2021 12:23:09 (UTC)'
Time between returned measurements (hours)	25		' (UTC)'
Sample interval (min)	60	60	'31-May-2021 14:13:41 (UTC)'
Eoff timer value (ms)	200	200	'31-May-2021 14:14:25 (UTC)'
Probe 1	-- Probe Disabled -- No probe selected or auto-detected	Mode: 'Connected' Probe: 'Channel disabled'	'31-May-2021 14:14 (UTC)'
Probe 2	-- Probe Disabled -- No probe selected or auto-detected	Mode: 'Connected' Probe: 'Channel disabled'	'31-May-2021 14:14 (UTC)'

Save Request

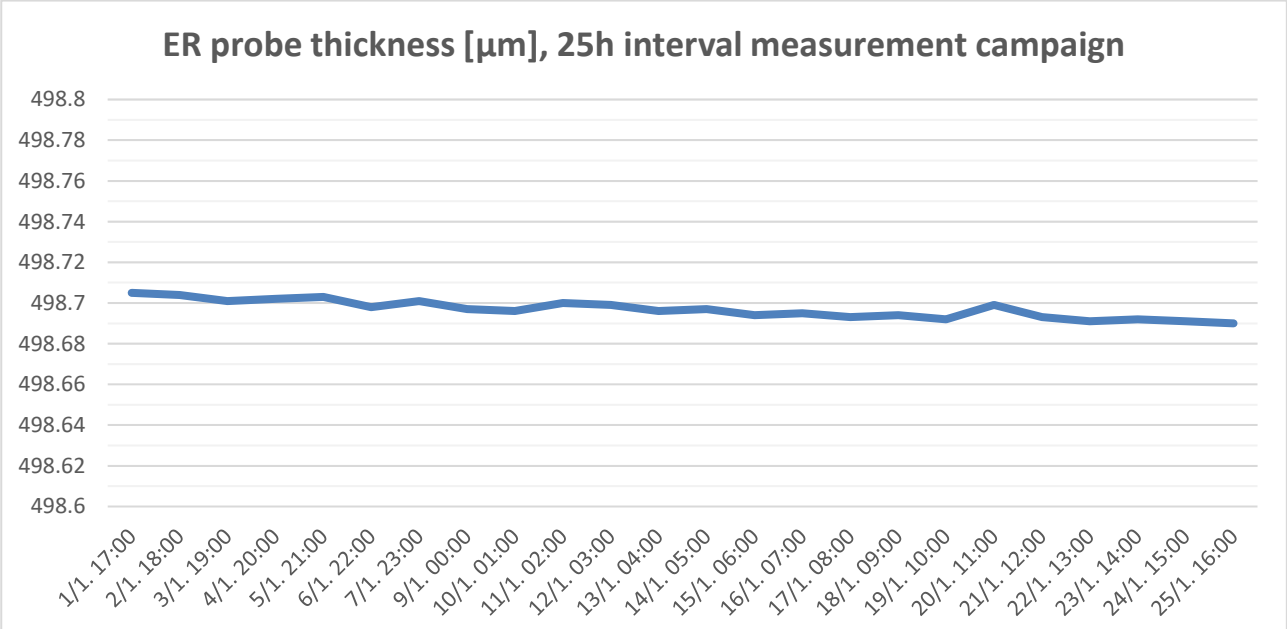
Setup page, MasterLink-ICL, satellite subscription

Setup parameters for an ICL-datalogger are shown below:

Parameter	Value	Comment
Time for first daily returned measurement, HH:MM (UTC)	12:00	Sets time for daily measurement. If the interval between measurements (set in the row below) is set to be longer than 24h, the time set here will be valid for the first measurement only.
Time between returned measurements (hours)	25	Sets interval between measurements to be transferred to WEBservice daily via satellite. 25 hours are default. 24h intervals or longer intervals are possible, see section 7.3
Sample interval (min)	60	Cannot be changed by the user. The datalogger performs measurements with 1 hour interval, which are stored in the MasterLink memory.
Eoff timer value (ms)	200	Delay for off-potential measurement. Metricorr recommends 200 ms.
Probe 1	ER-probe	Auto-detected probe by default. It is possible to select probe manually.
Probe 2	ER-probe or LC sensor	Auto-detected probe by default. It is possible to select probe manually.

7.4.1 Example: 25h interval measurement campaign

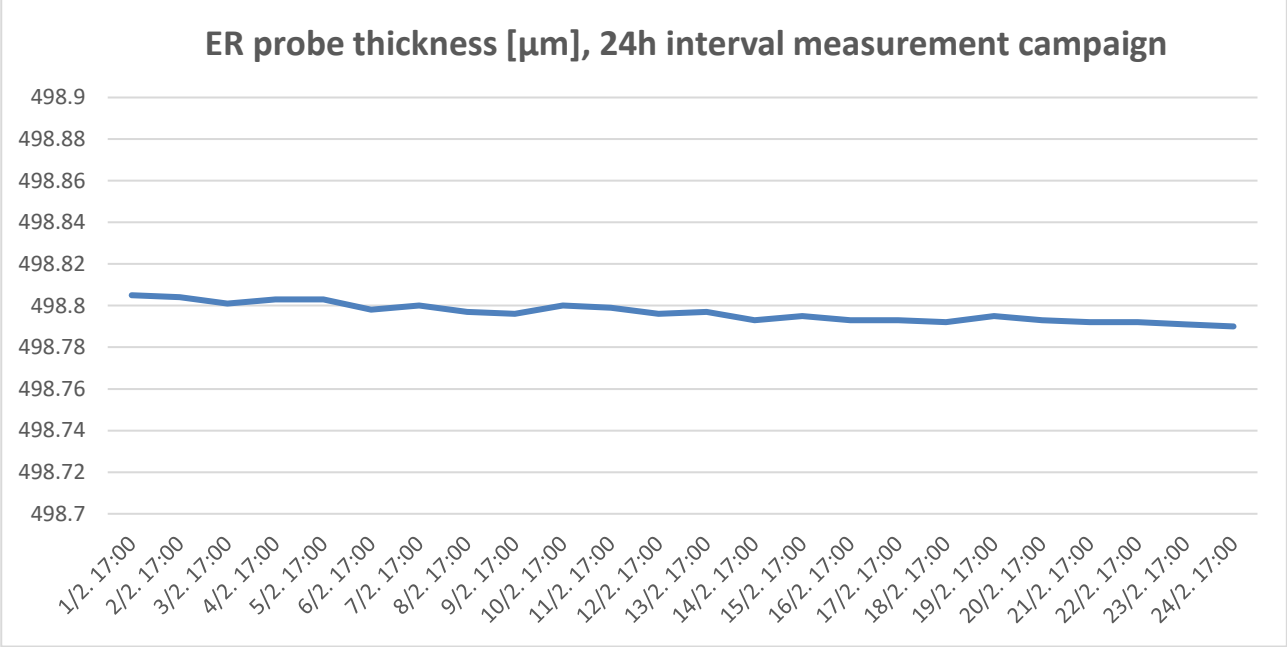
This example illustrates a measurement campaign, where measurements will be taken with 25 hours interval. Here, each transmitted measurement will be shifted one hour each day to get measurements around the clock over a 25 day period. Data will still be transmitted once a day.



7.4.2 Example: 24h interval measurement campaign

This example illustrates a 24h measurement campaign, where the daily time is set to 17:00.

Parameter	Value	Comment
Time for first daily returned measurement, HH:MM (UTC)	17:00	Measurement campaign is set to start at 17:00 o'clock.
Time between returned measurements (hours)	24	Interval between measurements transmitted to WEBservice.

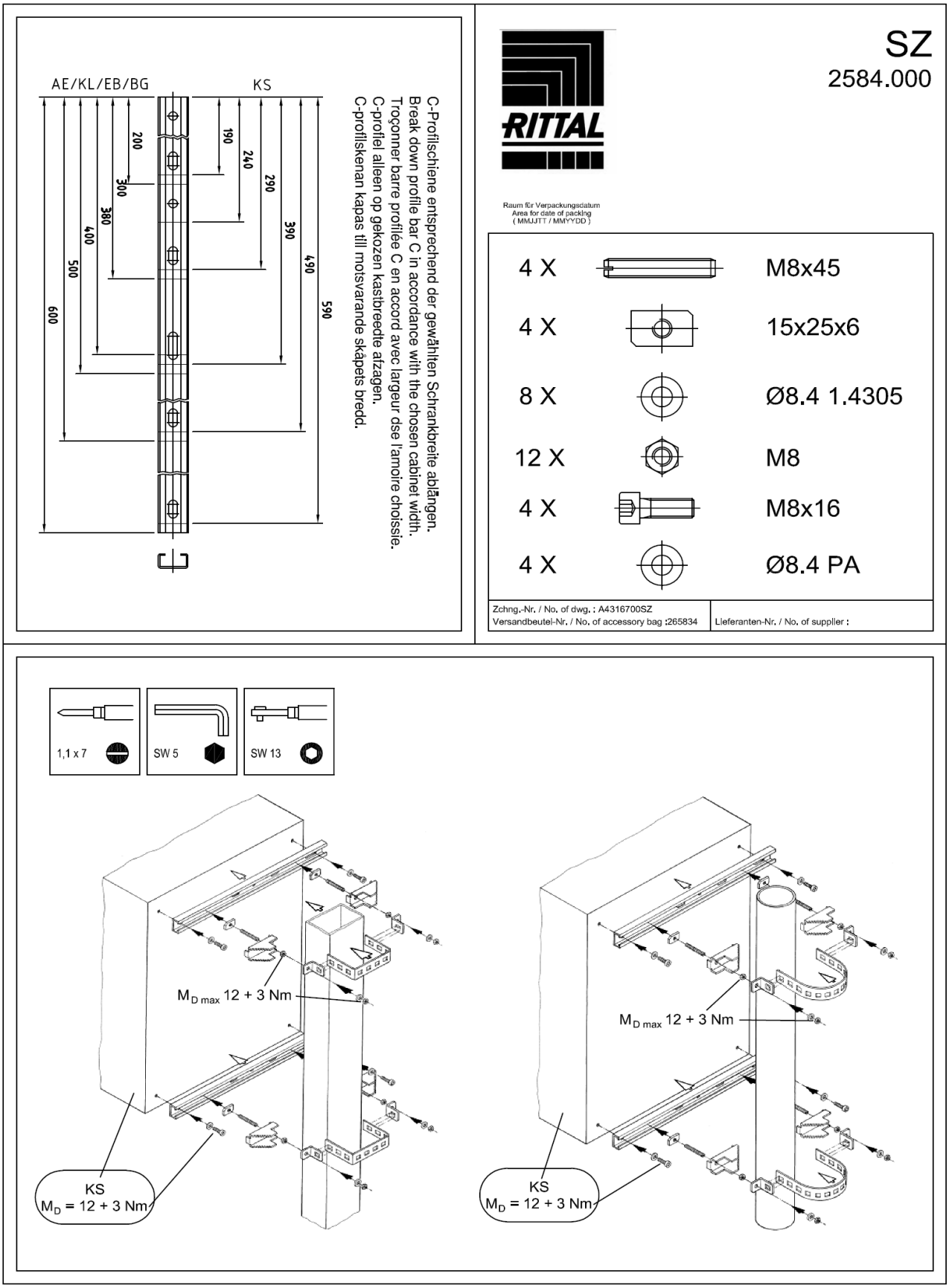


7.5 App & Data for satellite connected MasterLinks

As with any other MasterLink-dataloggers from Metricorr, satellite connected MasterLinks can be accessed on location using the Metricorr App.

The measurements transferred via satellite will provide daily measurements for monitoring to allow for immediate action, if for example the corrosion rate has accelerated. Hourly measurements can then be collected for example once a year using the Metricorr app to get a more precise picture that will reveal possible interference with trains, AC power lines, etc.

Appendix 1: Junction Box Mounting Guide



Appendix 2: Solar Charger Instructions

MetriCorr installed, Genasun models GV-4P-Pb-12V in Solar Junction Box

GENASUN **GV-4** Manual

Solar Charge Controller with Maximum Power Point Tracking

For models:

GV-4-Pb-12V:	12V Lead-Acid/AGM/Gel/Sealed/Flooded
GV-4P-Pb-12V:	12V Lead-Acid/AGM/Gel/Sealed/Flooded
GV-4-Pb-CV:	12V Custom Multi-Stage Lead-Acid/AGM/Gel/ Sealed/Flooded

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GENASUN GV-4 (ALL MODELS) MANUAL, REVISION 2.0 | 01.2018

IMPORTANT SAFETY INSTRUCTIONS | SAVE THESE INSTRUCTIONS

Safety Instructions:

This manual contains important instructions for the GV-4-Pb-12V, GV-4P-Pb-12V, and GV-4-Pb-CV solar charge controller that shall be followed during installation and maintenance.

The GV-4 is intended for charging 12V Lead-Acid, AGM, Gel, Sealed, and Flooded batteries. Consult your battery charging specifications to ensure that the GV-4 is compatible with your chosen batteries.
The GV-4 does not include a fuse. Overcurrent protection suitable for the application must be provided by the user.
WARNING: EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT WHEN ENERGIZED. DO NOT DISCONNECT WHILE THE CIRCUIT IS LIVE OR UNLESS THE AREA IS FREE OF IGNITABLE CONCENTRATIONS.
ATTENTION: RISQUE D'EXPLOSION. NE PAS CONNECTER NI DÉCONNECTER PAS LORSQU'IL EST SOUS TENSION. NE PAS CONNECTER LE CIRCUIT ALORS QUE EST VIVANT OU A MOINS QUE LA ZONE EST LIBRE DE CONCENTRATIONS IGNITAIRES.

CAUTION: INTERNAL TEMPERATURE COMPENSATION. RISK OF FIRE, USE WITHIN 0.3 m (1 ft) of BATTERIES. Lead-acid batteries can create explosive gases. Short circuits can draw thousands of amps from a battery. Carefully read and follow all instructions supplied with the battery. Use only 12V lead-acid batteries with the GV-4-Pb-12V and GV-4-Pb-CV.

DO NOT SHORT CIRCUIT the solar array when plugged into the controller. **DO NOT MEASURE SHORT CIRCUIT CURRENT** of the array while connected to the controller. This may damage the controller, and such damage will not be covered under warranty.

Grounding is not necessary for operation and is at the user's discretion. If the GV-4 is to be used with a solar array electrically connected to earth ground, please note the following: **WARNING: THIS UNIT IS NOT PROVIDED WITH A GFDI DEVICE.** Consult Article 690 of the National Electrical Code (or the standards in force at the installation location) to determine whether a GFDI is necessary for your installation.

WARNING: THIS UNIT IS NOT PROVIDED WITH DISCONNECT DEVICES. Consult Article 690 of the National Electrical Code (or the standards in force at the installation location) to determine whether disconnect devices are necessary for your installation.

Use only 12-30 AWG (3.0 mm^2 max) copper conductors suitable for a minimum of 60 degrees C. If operation at high power or at high ambient temperatures is expected, wire with a higher temperature rating may be necessary.
Recommended terminal block tightening torque: 3-5 in-lbs, 0.35-0.55 Nm.

Inspection & Maintenance

No user-serviceable parts inside.

Inspect the controller at least once per year to ensure proper performance.

- Check for animal or insect damage.
- Inspect for corrosion / water damage.
- Inspect the security of all connections.
- Ensure the solar array does not exceed the maximum input voltage.
- Repair and clean as necessary.

Installation & System Connections:

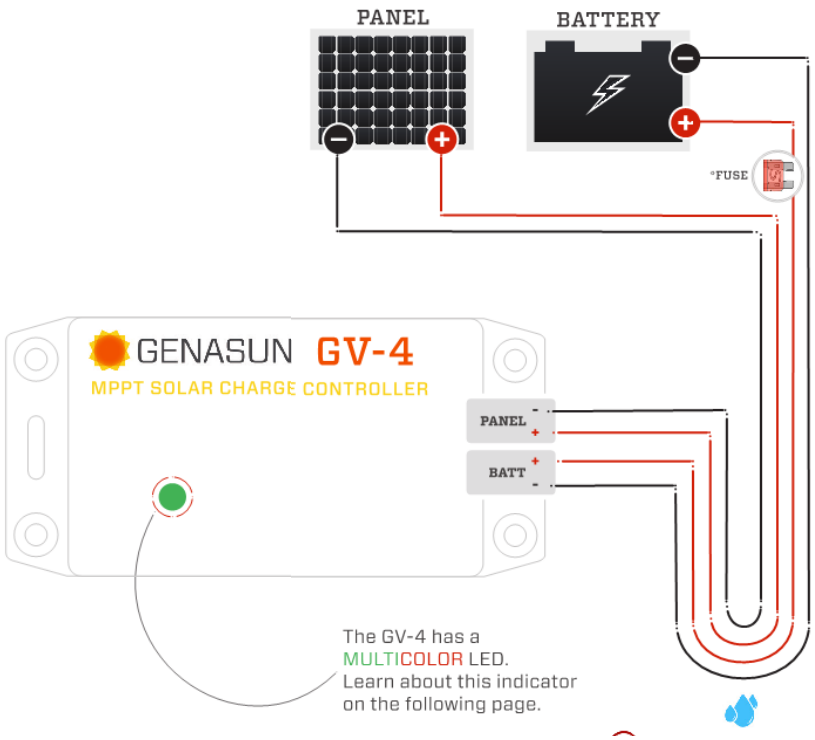
- Connections should be made according to Article 690 of the National Electrical Code (NFPA 70) or the standards in force at the installation location.
- Electrical connections may be made in any order; however the sequence below is recommended.

1 MOUNTING

Mount the controller near your battery securely using the holes provided on the enclosure's flanges or with a means appropriate to the application.

- Mount near the battery (use within 0.3 m (1 ft) of batteries. See Caution, p.2).
- The GV-4 can be mounted in any orientation on the floor or wall. We recommend a position in which all labels are clearly visible.
- Do not expose to water.
- Do not mount in direct sunlight or near a source of heat.
- Allow adequate airflow around the controller to achieve maximum output capability.
- For outdoor use, the controller must be housed in an enclosure providing protection at least equivalent to NEMA Type 3.

Note*: The positive or negative battery cable must be protected by a fast-acting fuse or circuit breaker of 10A or less, rated for the maximum battery voltage and connected close to the battery terminal or power distribution block. This fuse will protect the wiring in the event of a short circuit or controller damage.



Status Indication:

The GV-4 has a MULTICOLOR LED

LED RUN/CHARGE INDICATION

Standby: The battery is connected properly and ready to charge when solar panel power is available.

8-10 SEC. BETWEEN GREEN BLINKS

Charging (low current, less than 0.15A):

4-5 SEC. BETWEEN GREEN BLINKS

Charging (between 0.15A - 1.5A):

FAST GREEN BLINKS

Charging (high current, more than 1.5A):

LONGER, SLOWER GREEN BLINKS

Charging (current limit): charging at current limit. The GV-4 is overloaded and limiting charging current.

LONG, THEN SHORT GREEN BLINKS

Battery Charged: The battery is in the absorption or float charging stage.

SOLID GREEN LED

LED ERROR INDICATION

Overheat: The controller's internal temperature is too high.

SETS OF 2 RED BLINKS.

Overload: This could be caused by changing the solar panel connections while the controller is operating.

SETS OF 3 RED BLINKS.

Battery voltage too low: The controller cannot begin charging due to low battery voltage. If the nominal battery voltage is correct (12V), charge the battery by some other means before use.

SETS OF 4 RED BLINKS

Battery voltage too high: If the nominal battery voltage is correct (12V), check the functioning of other chargers that may be connected to the system.

SETS OF 5 RED BLINKS.

Panel voltage too high: Only 12V nominal solar panels may be used with this controller.

SETS OF 6 RED BLINKS.

Internal Error: Contact your dealer for assistance.

2 LONG BLINKS, FOLLOWED BY ANY NUMBER OF SHORT BLINKS.

Troubleshooting

If the LED Indicator will not light, or displays an indication not listed in this manual:

- Verify correct battery polarity;
- Check that there is a solid electrical connection to the battery;
- Check that battery voltage appears on the GV-4 battery terminal screws;
- Check the GV-4 terminal area for evidence of water or mechanical damage.

The GV-4 will not operate without a battery. If the system appears to be overcharging or the GV-4 will not begin charging, ensure that the solar panel is wired only to the GV-4, and in particular that the solar panel negative terminal is not connected to ground (battery negative). If the GV-4 does not appear to be charging, note that the GV-4 waits up to one minute before trying to restart if is has shut down due to lack of power from the solar panel. For more in-depth system troubleshooting, please visit the support area of our website: www.genasun.com/support/

Specifications:

	GV-4-Pb-12V
Maximum Recommended Panel Power:	50W
Rated Battery (Output) Current:	4A
Nominal Battery Voltage:	12V
Maximum Input Voltage:	27V
Recommended Max Panel Voc at STC:	22V
Minimum Battery Voltage for Operation:	7.2V
Input Voltage Range:	0-27V
Maximum Input Short Circuit Current*:	4A
Maximum Input Current**:	7A

*Panel Isc. Maximum input power and maximum input voltage requirements must also be respected. **Maximum current that the controller could draw from an unlimited source.

Specifications (cont.):

	GV-4-Pb-12V
Charge Profile:	Multi-Stage with Temperature Compensation
Absorption Voltage:	14.2V
Absorption Time:	2 Hours
Float Voltage:	13.8V
Charging Output Voltage Range:	7.2-18V
Battery Temperature Compensation:	-28mV/°C
Operating Temperature:	-40°C – 85°C
Maximum Full Power Ambient:	50°C
Electrical Efficiency:	96% - 99.85% typical
Tracking Efficiency:	99% typical
MPPT Tracking Speed:	15Hz
Operating Consumption:	0.125mA (125uA)
Night Consumption:	0.09mA (90uA)
Environmental Protection:	IP40, Nickel-Plated Brass & Stainless Hardware
Connection:	4-position terminal block for 12-30AWG wire
Weight:	2.8 oz., 80 g
Dimensions:	4.3 x 2.2 x 0.9", 11 x 5.6 x 2.5 cm
Warranty:	5 years

Certifications: