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USERS' MANUAL

SEEPAGE MONITORING SYSTEM WITH DIGITAL SENSOR

MODEL ESM-12S

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1 INTRODUCTION

1.1 ESM-12S seepage monitoring system

The Encardio-rite model ESM-12S seepage monitoring system is designed for precision measurement and monitoring of water level in weirs, tanks and reservoirs and seepage in dams.

Quantity of water seeping through, around or under a dam is of great importance in analysing structural behaviour of a dam. For measuring seepage, the drain water is taken through collection channel(s) for discharge into the downstream of dam. The collection channel/channels are terminated in a collection chamber where the discharge is accurately measured with a 'V' notch and a water level measurement system.

In order to measure discharge over the weir accurately, the head over the weir is measured with model ESM-12S seepage monitoring system. The system mainly consists of a low range digital pressure sensor (with SDI-12 interface or Modbus output) inside a perforated pipe. The pressure sensor has a vented cable and a signal cable. The vent tube is terminated in a moisture trap. The vent being open to atmosphere helps to compensate the barometric fluctuations automatically.

To monitor water head, the pressure sensor position is kept submerged in water lower than the vertex of weir. Any change in water level results in change in water head, which is measured by the pressure sensor. To avoid water level variations caused by waves, turbulence or vibration, the water level head should be measured in a stilling well-constructed upstream of the weir in the collection channel.

The digital pressure sensor is connected to Encardio-rite model ESDL-30 datalogger directly for remote online monitoring. ESDL-30 datalogger is a compact datalogger that can be mounted easily near the sensor or in a control room in close vicinity. The system can also be directly connected to RF nodes and gateway communication network for wireless data transfer.

The configuration of the system with datalogger as well as with node and gateway is user friendly, which makes the commissioning of digital seepage monitoring system quite easy and fast. Data from the datalogger or from gateway can be transmitted remotely to a central/cloud server via mobile network.

Real-time seepage data helps in observing the behaviour of leakage in dams, especially after construction, and indicates potentially dangerous conditions that may adversely affect stability of the structure. The authorities can learn instantly from the alerts, in case any value crosses pre-defined limits. This allows one to take timely decisions, increase safety and save costs.

Encardio-rite seepage monitoring system can be supplied with a stainless steel V-notch weir, if ordered separately, to monitor rate of flow of water.

1.2 Conventions used in this manual

WARNING! Warning messages calls attention to a procedure or practice, that if not properly followed could possibly cause personal injury.

CAUTION: Caution messages calls attention to a procedure or practice, that if not properly followed may result in loss of data or damage to equipment.

NOTE: Note contains important information and is set off from regular text to draw the users' attention.

1.3 How to use this manual

This users' manual is intended to provide you with sufficient information for making optimum use of vibrating wire sensor in your application.

To make this manual more useful we invite your valuable comments and suggestions regarding any additions or enhancements. We also request you to please let us know of any errors that you may find while going through this manual.

NOTE: The installation personnel must have a background of good installation practices and knowledge of the fundamentals of geotechnics. Novices may find it very difficult to carry on installation work. The intricacies involved in installation are such that even if a single essential but apparently minor requirement is ignored or overlooked, the most reliable of instruments will be rendered useless.

A lot of effort has been made in preparing this instruction manual. However, the best of instruction manuals cannot provide for every condition in the field that may affect the performance of the sensor. In addition, blindly following the instruction manual will not guarantee success. Invariably, installation personnel depending upon field conditions will have to consciously depart from the written text and use their knowledge and common sense to find solution to a particular problem.

2 DIGITAL SEEPAGE MONITORING SYSTEM

2.1 General description

Model ESM-12S Seepage monitoring system typically consists of:

- ESM-12S/1 low range digital pressure sensor
- ESM-12S/2 perforated PVC pipe
- ESM-12S/3 Mounting plate with moisture trap and junction box
- ESDL-30 datalogger
- ESM-10 Weir (ordered separately)

The smart digital sensor makes the system very easy to install and configure. The high precision system allows long term reliable monitoring, with least maintenance cost.

2.2 Operating principle

In dams, for measuring seepage, the drain water is taken through collection channel(s) for discharge into the downstream of dam. The collection channel/channels are terminated in a collection chamber where the discharge is accurately measured with a weir ('V' notch or rectangular weir) and a water level/seepage measurement device.

In order to measure discharge over the weir accurately, the head over the weir is measured with the water level sensor. ESM-12S uses a low range high precision pressure sensor for measuring this water head. The pressure sensor is installed inside the slotted PVC pipe fixed at the required location. The sensor position is kept submerged in water, lower than the vertex of weir. Any change in water level results in change in water head, which is measured by the pressure sensor.

To compensate the barometric variation automatically, the pressure sensor is vented to the atmosphere with a vented signal cable. The vent tube is terminated in a desiccant unit with moisture trap, while the signal cable is terminated in the junction box/datalogger mounted adjacent to moisture trap.

To avoid water level variations caused by waves, turbulence or vibration, the head is normally measured in a stilling well-constructed upstream of the weir in the collection channel.

2.3 ESM-12S/1 Digital Seepage monitor sensor

Model ESM-12S/1 is a digital high precision low range level sensor with vented signal cable. The sensor has inbuilt temperature sensor. The seepage sensor is installed enclosed in a perforated PVC pipe (ESM-12S/2 desilting chamber).

The sensor has a vent tube running from inside the sensor to the outside atmosphere ensuring that sensor reading is unaffected by change in barometric pressure. The end of the vent tube terminates into a moisture trap assembly (described below) thus preventing any moisture from migrating into the vent tube.

The seepage sensors are available with digital SDI-12 and Modbus output. When used with SDI-12 output, maximum distance of datalogger from the sensor can be up to 200 m. When used with Modbus output, maximum distance of datalogger from the sensor can be 1.2 km. The bus cable is connected to the datalogger either directly, or through junction box depending on the site conditions.

2.4 Moisture trap assembly and Junction box

The digital seepage sensor is vented to atmosphere to ensure that air pressure both inside and outside the capsule are same so that any change in atmospheric pressure does not affect the reading of the sensor. When air pressure (barometric pressure) changes, the fluctuations are transmitted to the sensor through air vent tube. This results in cancelling out the effect of barometric pressure on the sensor.

The vent tube is connected to a moisture trap (with desiccant unit and hydrophobic filter), so that only dry air can enters the sensor vent line. Desiccant and hydrophobic filter ensure that the air inside the moisture trap is dry. Moisture content in air in the sensor vent line can, in course of time, coalesce to form water droplets and can damage the inside of the transducer.

The desiccant capsules contains blue colour desiccant inside them. Desiccant needs changing when it becomes pink.

The moisture trap is fixed on a wall mounting plate with the help of two clamps provided on mounting plate.

The wall mounting plate also has a junction box fixed on it. The leads from the three core cable are terminated in the terminated box, from where a three core or six core cable can be routed to the datalogger.

NOTE: Choice of cable depends on the distance between junction box and datalogger. Preferably, the datalogger should be mounted next to the mounting plate, if the location has satisfactory network (GSM/GPRS) signal.

The wall mounting plate can be fixed vertically on any vertical surface like a wall using four Hilti expandable fasteners HPS-1 5/5x25 or equivalent.

Figure 2-2 Mounting plate with moisture trap and junction box

2.5 Model ESDL-30 Datalogger

Model ESM-12S/1 seepage/water level sensor is connected to Encardio-rite model ESDL-30 datalogger for remote online monitoring. ESDL-30 datalogger is a compact datalogger that can be mounted easily near the sensor or in a control room in close vicinity.

The datalogger's configuration software is user friendly, which makes the commissioning of digital seepage monitoring system quite easy and fast. At locations covered by a mobile network, the data from the ESDL-30 datalogger can be transmitted remotely to a central/cloud server.

2.6 Model ESM-10 Weir or V-Notch

The seepage monitoring system can be supplied with a stainless steel V-notch or rectangular weir, if ordered separately.

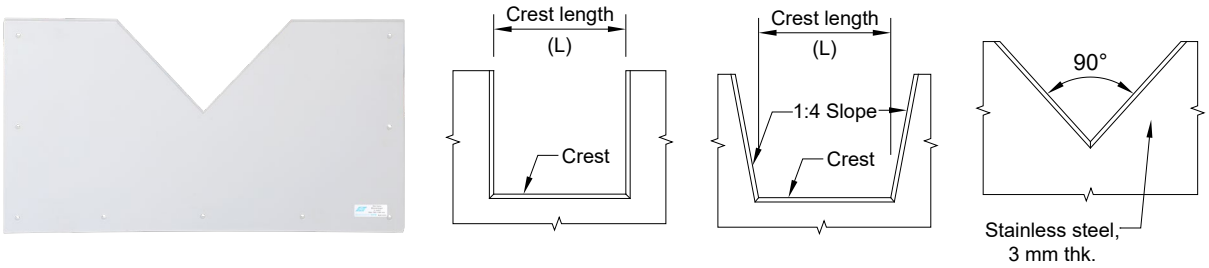


Figure 2-4 Model ESM-10 Weir - Rectangular and V-Notch type

The weir comprising of stainless steel plate, is provided in a suitable size and angle, to suit expected flow rate. The most used size is rectangular or 90° V-notch type.

Other sizes of weir can also be provided, depending on site requirements. In case of a low flow rate, a V-notch weir with an angle of less than 90° may be used. The weirs are normally manufactured as per Indian Standard IS: 9117-1979.

Sizes available: 22.5°, 45°, 90° and rectangle

Range available: 10 to 70 litres/second

3 TOOLS AND ACCESSORIES

The following tools and accessories are required for installation of the settlement monitoring system.

- Impact or percussion electric drill with 8 mm and 6 mm drill bit for drilling in concrete or masonry (for fixing fasteners)
- Cable Cutter
- Wire Stripper
- Small spirit level (preferably bubble type)
- 3½ digit digital multimeter

4 INSTALLATION PROCEDURE

4.1 Sensor check before installation

Check that the seepage sensor is functioning properly. The reading of the sensor should be zero.

4.2 Installation of V-notch and seepage sensor

- Fix the overflow plate V-notch in the concrete reservoir or channel, generally as shown in figure below. Fix the V-notch, with the help of groutable anchors, at the planned location, perpendicular to the channel, verifying with a spirit/mason's level that the plate is vertical. Ensure a complete tightness at the contact between the concrete and the plate. The tapered/chamfered edge of the V-notch should be facing the downstream side.

NOTE: A typical installation method is described here. However, suitable changes may be required, depending on site conditions.

- Install the PVC perforated pipe, with seepage sensor mounted inside it, at its planned location (as shown in figure below). Following points needs attention while selecting the mounting location for seepage sensor.

    1. The distance of seepage sensor from V-notch must be at least **four times the maximum head (upstream) on the weir i.e. height of notch**. Verify the verticality of the seepage sensor with spirit/mason's level during installation.\

    2. The seepage sensor position **should be kept submerged in water, lower than the vertex of weir**. Any change in water level results in change in water head, which is measured by the pressure sensor.

3. The perforated PVC pipe of the sensor assembly is provided with two ring markings (for minimum and maximum water level). The sensor assembly will have to be mounted such that expected maximum and minimum water level is always between these marked rings.

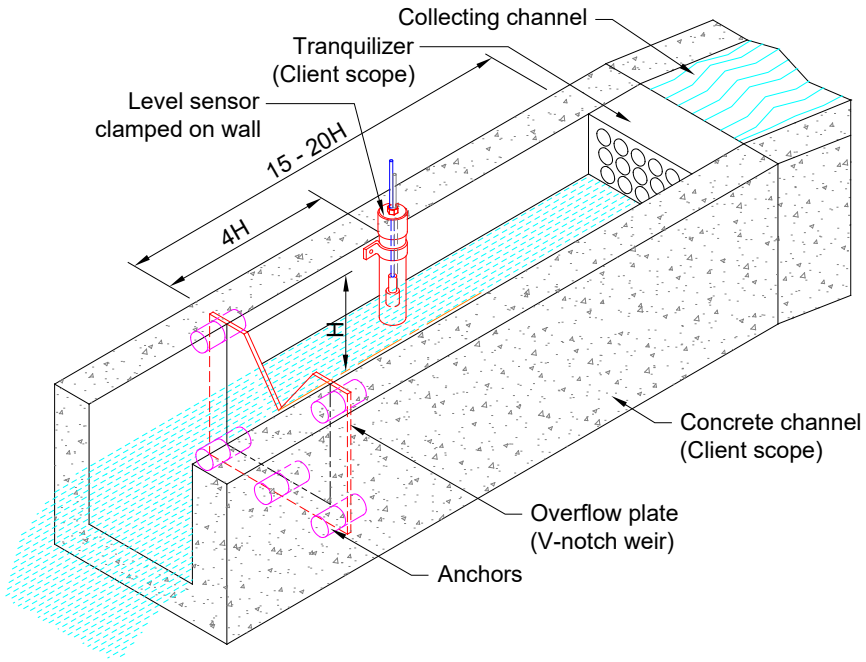


Figure 4-1 Typical installation scheme for EPS-12S seepage monitoring system in open channel with weir

- Two clamps with expandable fasteners are provided to fix the PVC perforated pipe on the wall. Mark position of holes on the clamps for expandable anchors at the selected installation location. Drill 8 mm diameter holes 75 mm deep to fix the PVC perforated pipe with clamps, using Hilti M8x75 mm expandable anchors or equivalent, as shown in figure 4-2.
- There should not be any perceptible fluctuations in the free surface of the flowing water. If necessary, tranquilize the flow in the channel by introducing a **tranquilizer** upstream (client's scope) from the measurement device in the direction of the flow.

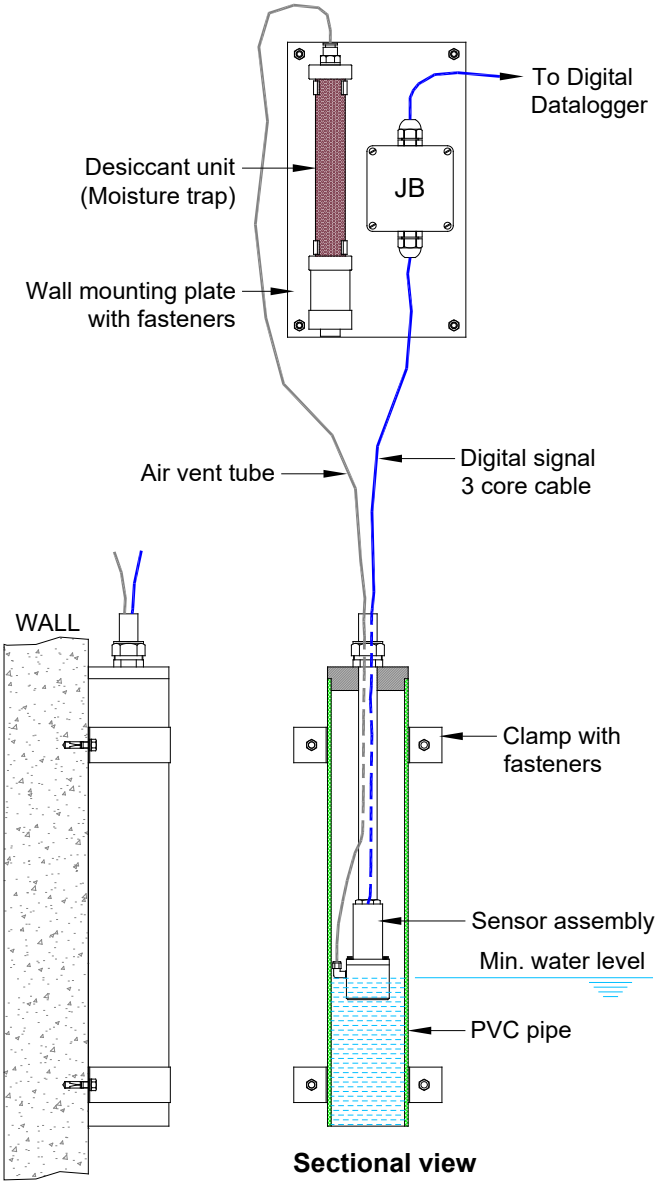


Figure 4-2 Typical installation of model ESM-12S/1 digital seepage monitoring sensor

4.2.1 Points to be considered while installation of V notch and seepage sensor

- Use sealing compound to make junction box watertight.
- The upstream face of the weir plate should be smooth and in a vertical plane perpendicular to the axis of the channel.
- The distance from the bottom of the approach channel (weir pool) to the crest should preferably be at least twice the depth of water above the crest, but not less than 30 cm.

- The distance from the sides of the weir to the sides of the approach channel should preferably be at least twice the depth of water above the crest, but not less than 30 cm.
- The overflow sheet (nappe) should touch only the upstream edges of the notch.
- The maximum water level in downstream pool should be at least 6 cm below crest elevation.
- The head on the weir should be taken as the difference in elevation between the crest and the weir surface at a point upstream from the weir.
- The seepage sensor should be located at a sufficient distance upstream from the weir because the flow at the brink of the weir is sloping down and curvilinear in nature. This curved surface/draw down extends upstream a short distance from the weir notch. The head needs to be measured at a point, beyond the effect of draw down. This distance must be at least four times the maximum head on the weir. Thus, the seepage sensor is installed at a distance of 4~5 times the height of notch.
- The seepage sensor position should be kept submerged in water, lower than the vertex of weir.

4.3 Installation of moisture trap assembly and junction box

As described earlier, moisture trap and junction box are supplied mounted on a wall mounting plate. This assembly is installed near seepage sensor location.

- Fix the wall mounting plate on a vertical surface/wall, near the sensor location, by means of the two Hilti expandable fasteners HPS-1 5/5x25 or equivalent (see figure 4-2 and 4-3).
- Check colour of desiccant in desiccant capsule. It should be blue. It needs changing if it is pink in color.
- Remove cap from cable vent tube and plug from quick connect coupling at top of moisture trap assembly. Insert cable capillary tube in quick connect coupling to make a secure connection.
- Turn vent screw at bottom of moisture trap assembly to open it to the atmosphere. Ensure connectivity between the vent tube running from inside the sensor to the outside atmosphere such that sensor reading is unaffected by any change in barometric pressure (there should not be any sharp bend).

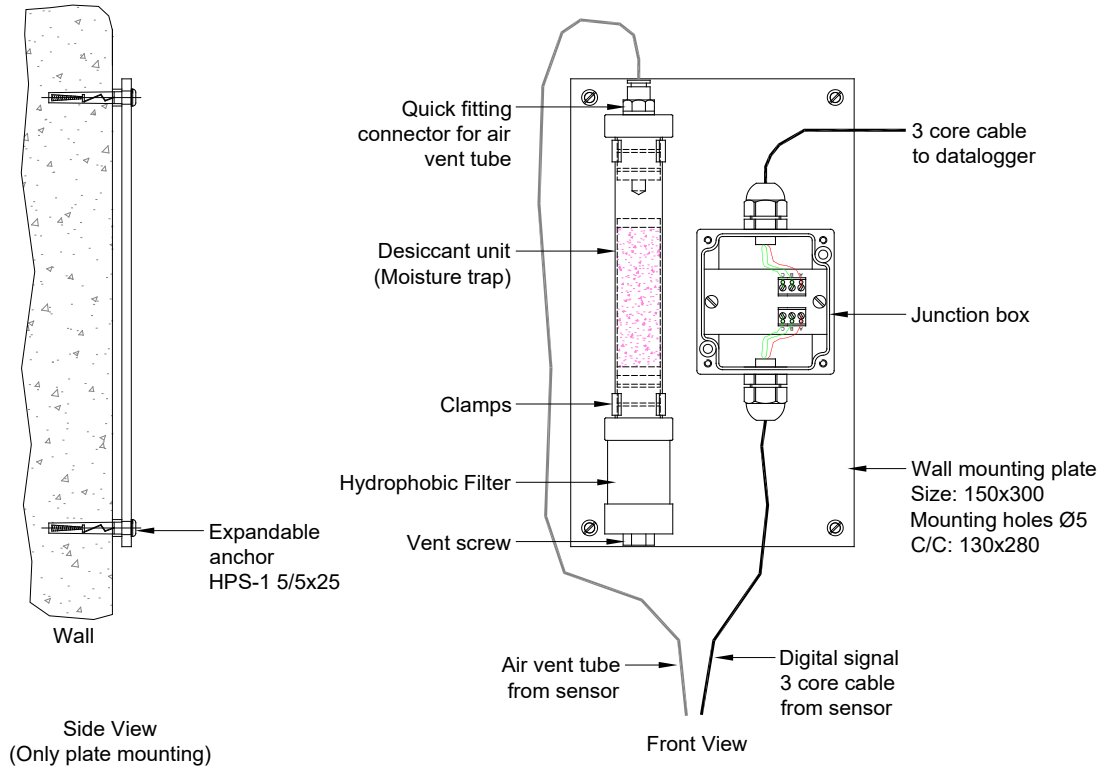


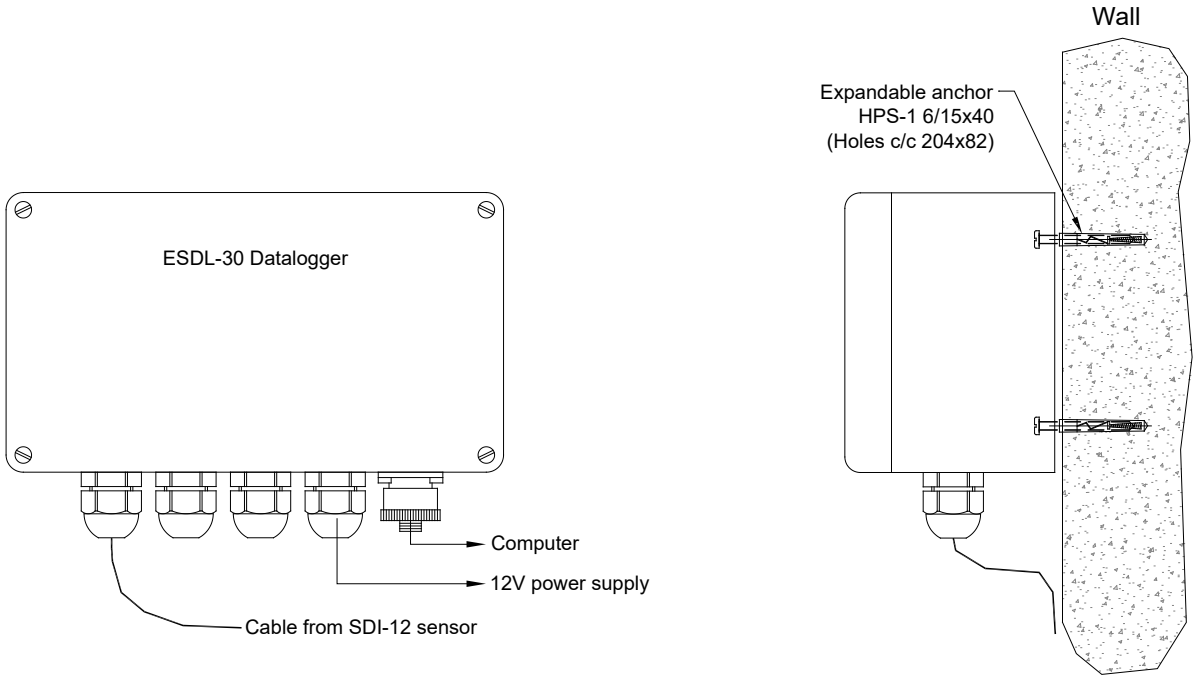
Figure 4-3 Wall mounting plate with moisture trap and junction box

4.4 Installation of datalogger

The ESDL-30 datalogger can be mounted near the seepage sensor i.e. near moisture trap. In this case, the sensor cable can be terminated directly to the datalogger, instead of junction box.

The datalogger can also be installed in the monitoring room. Depending on the distance from seepage sensor location to datalogger location, a 3 core or 6 core cable will be used from junction box to datalogger.

The mounting detail for installing datalogger on a vertical surface or wall is shown in figure 4-4. Mark the position of fasteners. Drill 6 mm dia x 40 mm deep hole. Fix the datalogger using Hilti HPS-1 6/15x40 fasteners provided.



5 CONNECTING EPS-12S TO ESDL-30 DATALOGGER

Encardio-rite model ESDL-30 datalogger is designed to record data from the digital sensors with SDI-12 interface output. It can also be used with Modbus sensors with an additional Modbus card, if specifically ordered. However, maximum limit of Modbus sensors that can be connected to this ESDL-30 datalogger version is seven.

Model ESDL-30 datalogger

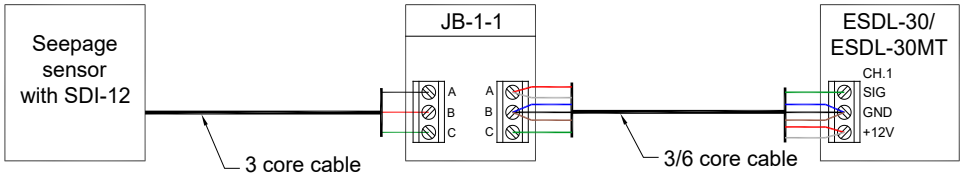
The datalogger is very easy to configure. It provides data directly in engineering units. Each reading is stamped with date and time at which the measurement was taken. It has a non-volatile flash memory to store up to 2 million data points. The data files from the datalogger can be downloaded to PC using Configuration Manager Software by connecting logger with data cable or Bluetooth.

ESDL-30 with built in GSM/GPRS modem has capability to upload data records directly to remote FTP server. Upload schedule can be programmed in the datalogger using the software for automatic data upload to FTP server. Schedule can be set as fast as 5 minutes.

Sensor cable can be directly terminated in the datalogger, in case datalogger is installed near monitoring sensor. In case the datalogger is installed at a distance (control room) from seepage monitoring location, a junction box is used to terminate sensor cable. A 3 core or 6 core bus cable is routed from junction box to datalogger.

5.1 Wiring details for sensors with SDI-12 output

Terminate leads from sensor 3-core core cable in the junction box as shown in figure 5-1. Connection details for cable from junction box to datalogger is also shown in figure 5-1, both for a 3 core or 6 core bus cable.



WIRING DIAGRAM			
JB Terminal tag	SDI-12 bus cable: 3 core cable	6 core cable	Datalogger ESDL-30
A	+12V (Red)	+12V (Red, White)	+12V
B	GND (Black)	GND (Black, Blue, Brown)	GND
C	SIG (Green)	SIG (Green)	SIG

ESDL-30 datalogger has three SDI-12 ports (channels). Sensors with SDI-12 serial interface can be connected on a common SDI-12 bus. This bus can be connected to any SDI-12 port of the datalogger. Connection detail is shown in figure below. Battery should be placed in the datalogger after the connections have been successfully done.

SDI-12 inputs have a unique ID (0-9, a-z or A-Z). Thus, the ID of sensors having SDI-12 output have to be set accordingly. Each of the 3 channels of the datalogger can have 61 sensors with ID 1-9 (ID 0 is used for factory purposes, hence not available for use), a-z or A-Z. For a given channel each sensor should have a different ID.

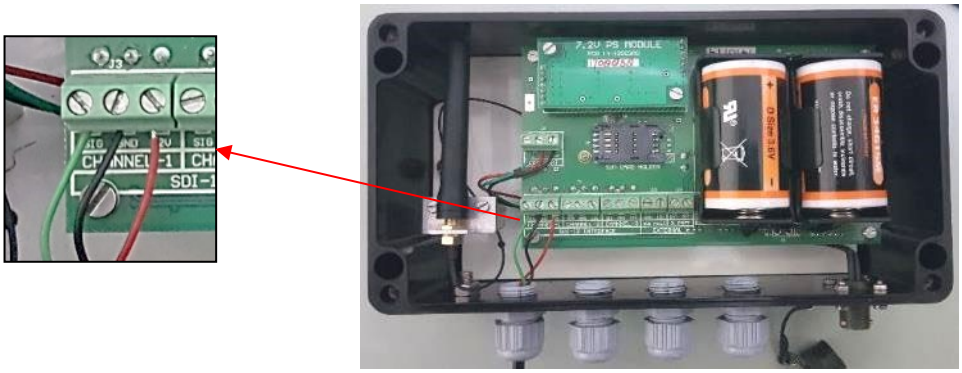


Figure 5-2 Connection of SDI-12 three-core bus cable to ESDL-30 datalogger

5.2 Wiring details for sensors with Modbus (RS-485) output

When specifically ordered for Modbus sensors, ESDL-30 datalogger is supplied with an interface card to connect Modbus (RS-485) sensors. For ESM-12S seepage monitoring systems, Modbus option can be used in case datalogger is mounted at a distance more than 200 m.

Sensors with Modbus (RS-485) output can be connected to the datalogger as shown in figure below. This will utilize one of the three SDI-12 port of the datalogger, Remaining two SDI-12 ports can be used to connect SDI-12 sensors, if required. Battery should be placed in the datalogger after the connections have been successfully done.

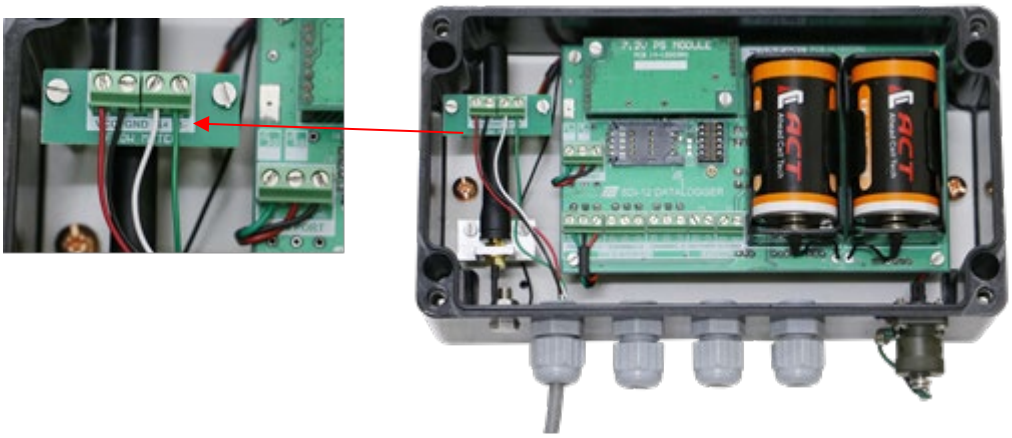


Figure 5-3 Connection of Modbus (RS-485) four-core bus cable to ESDL-30 datalogger

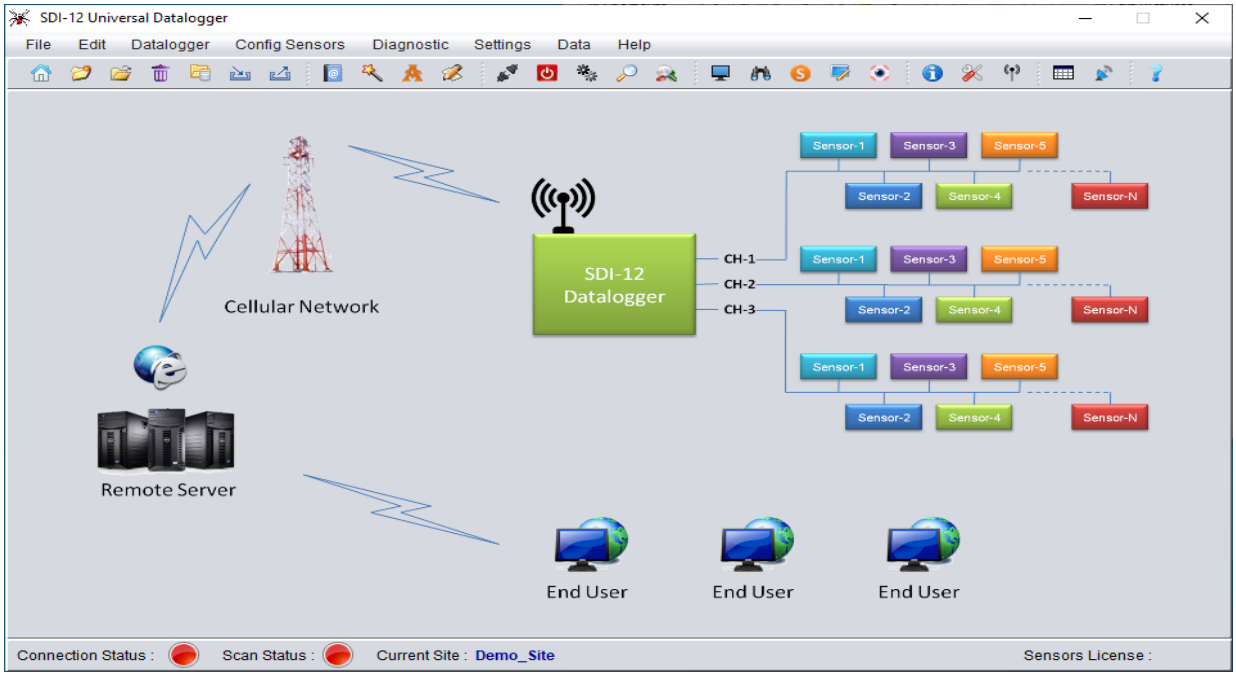
6 CONFIGURATION WITH ESDL-30 DATALOGGER

6.1 Configuration of ESDL-30 datalogger with ESM-12S sensor with SDI-12 output

NOTE: For details on operation of model ESDL-30 datalogger, please refer to **Users' Manual # WI6002.111.1 on "Operation" of ESDL-30 datalogger.** For details of configuration with model ESDL-30 datalogger, please refer to **Users' Manual WI6002.111.2 on "Configuration Manager for Windows" of ESDL-30 datalogger.**

A brief on connection and configuration for model ESM-12S sensor with SDI-12 output is given below.

1. Double click the ESDL-30 datalogger software icon on the Desktop. The main screen of the application appears as displayed in figure below



2. Connecting Datalogger: Click "Datalogger" followed by "Connect/Disconnect Datalogger". A "Connection" window will appear as shown below. Select the usable "Com port" and then click "Connect". The progress bar appears on the screen as the application takes few seconds to get connected.

3. After successful connection, information message pops up on the screen confirming successful connection. Press "OK" to proceed. This will change "Connection Status", at the left bottom, from Red to Green.

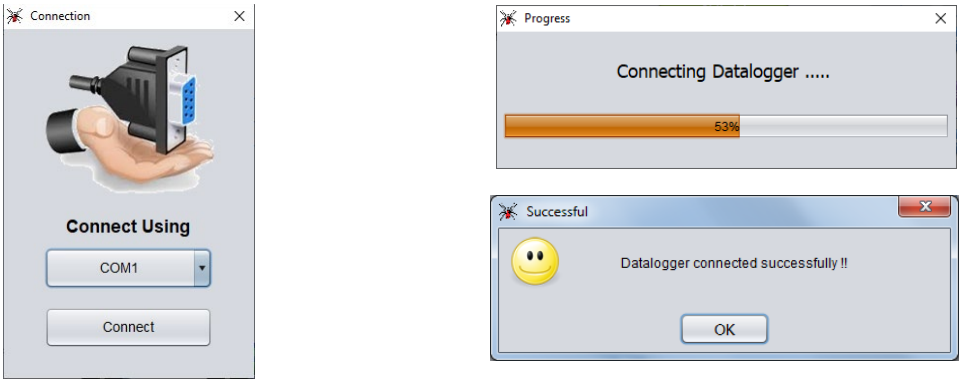
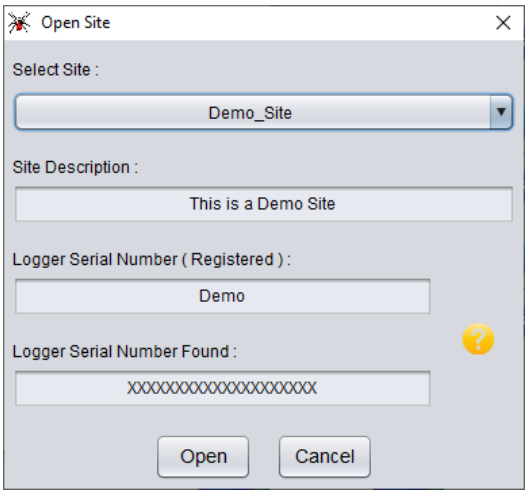
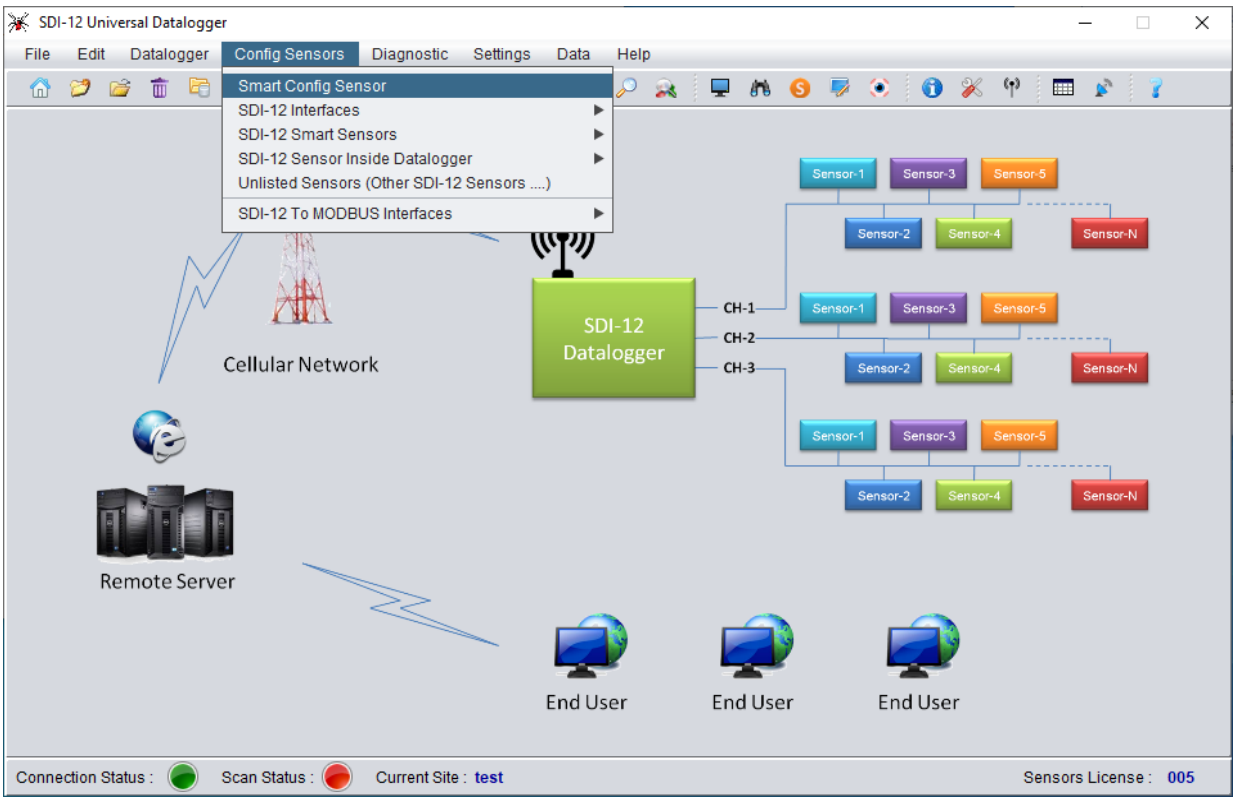


Figure 6-2 Connection

4. Application will display "Open site" window to select the site. Select the required site from "Select Site" dropdown menu. Click on "Open" button to open the site for Datalogger. You can choose "Demo site" for first time.



5. Click on "Config Sensors" tab and the select "Smart Config Sensor" as shown in figure below.



6. The screen as shown in figure 6-5 will appear. Select channel number at which the sensor is connected. Select the sensor's address and click on "Search" button to find the sensor on SDI-12 Bus. It will show the sensor details as shown in figure 6-6. Press on "Open sensor configuration window" to open configuration screen.

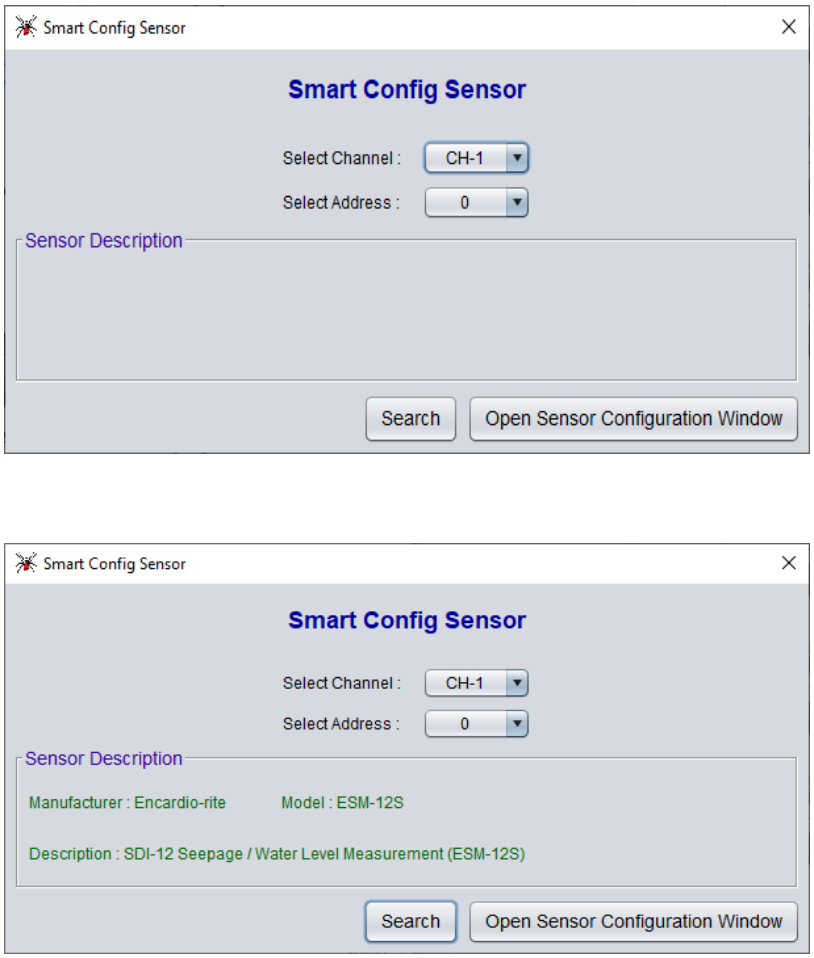


Figure 6-6 Smart config sensor screen

7. Screen as shown in figure 6-7 will appear. Press "Read" button. The application will fetch the information stored in the sensor as shown in figure 6-8.

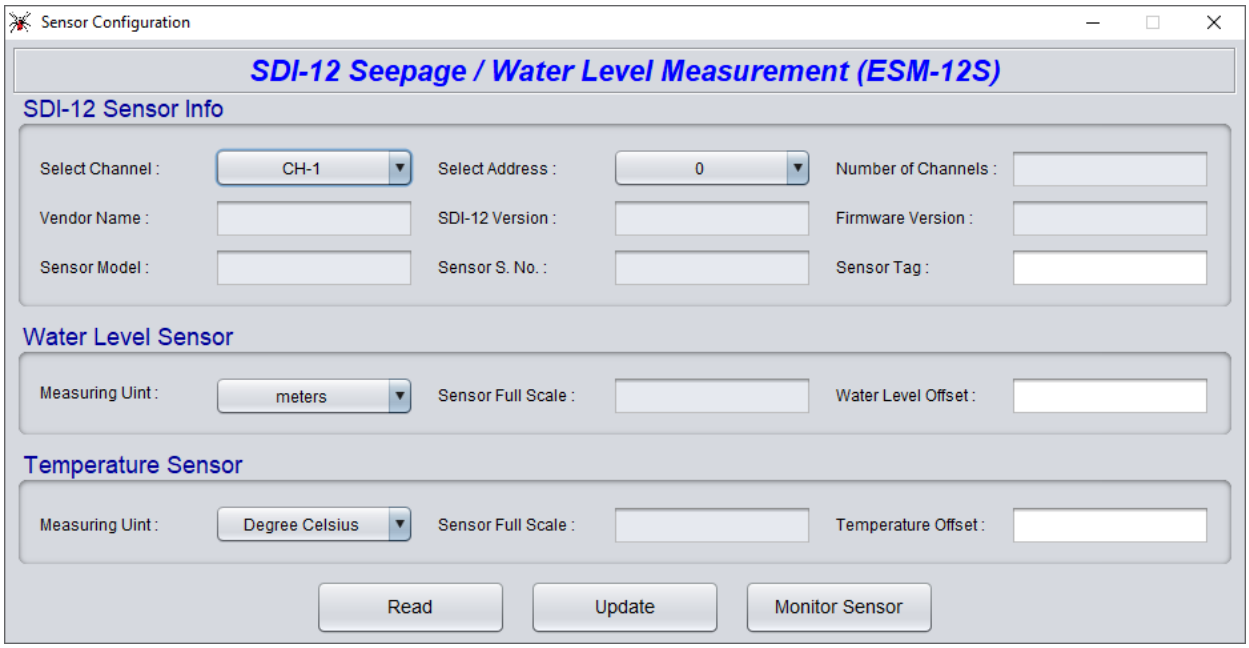


Figure 6-7

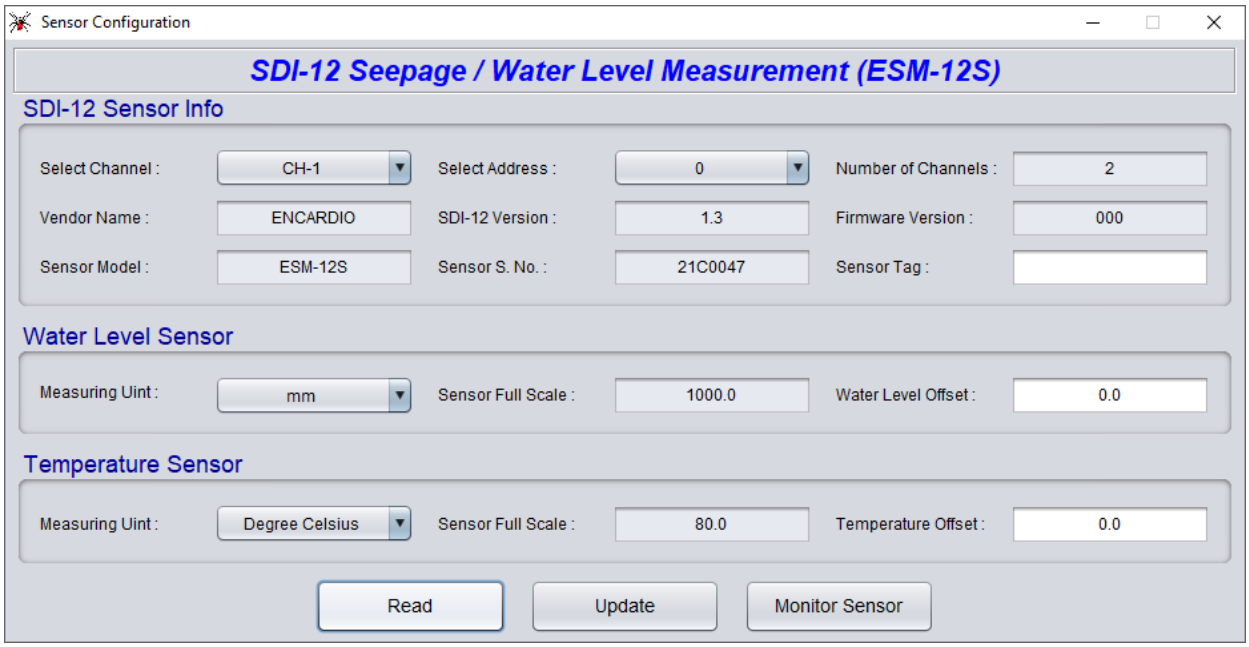


Figure 6-8 ESM-12S sensor details

8. Press "Monitor Sensor" button. The screen as shown in figure 6-9 will appear, showing the values of settlement reading (Parameter 1) and temperature reading (parameter 2) of the sensor.

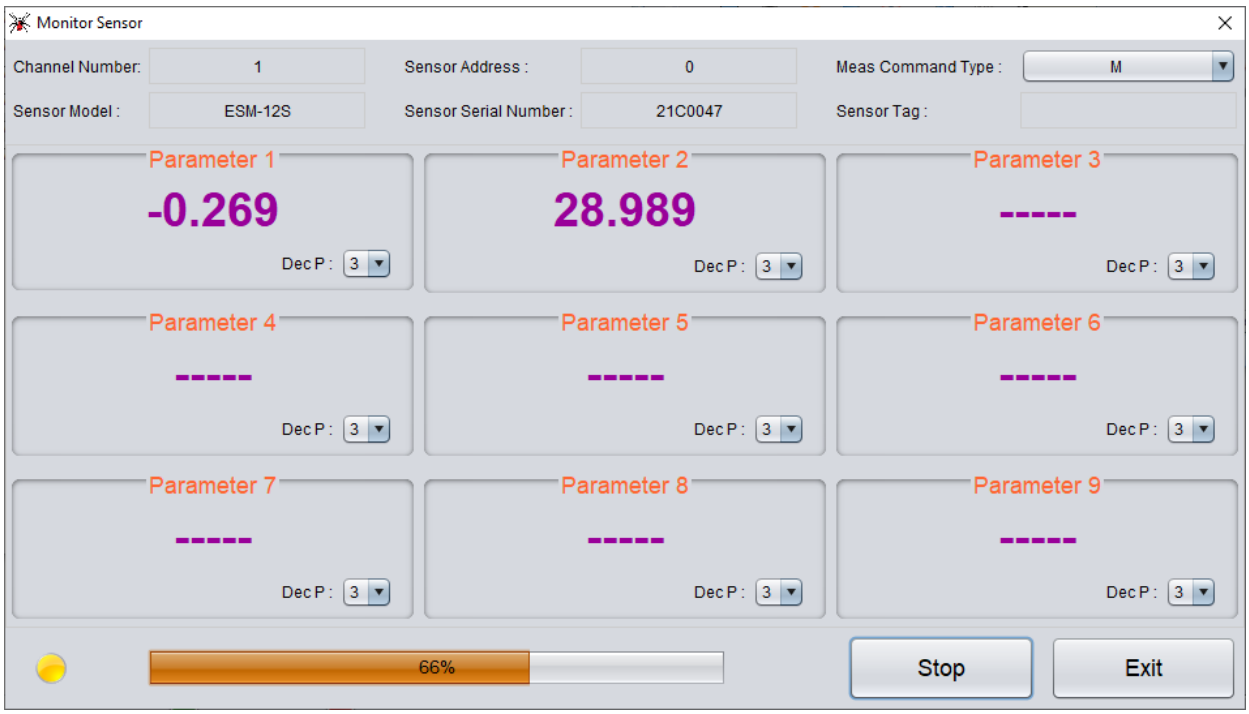


Figure 6-9 ESM-12S sensor readings

6.2 Configuration of ESDL-30 datalogger with ESM-12S sensor with Modbus output

Default Settings for ESM-12S sensor with Modbus output

Sensor default settings are given below

Device address	0x01
Baud rate	115200
Data	8-bit
Stop bit	1
Parity	None
Endian	Big Endian Atomic 16
Measuring time	1 Sec

A brief on connection and configuration for model ESM-12S sensor with SDI-12 output is given below.

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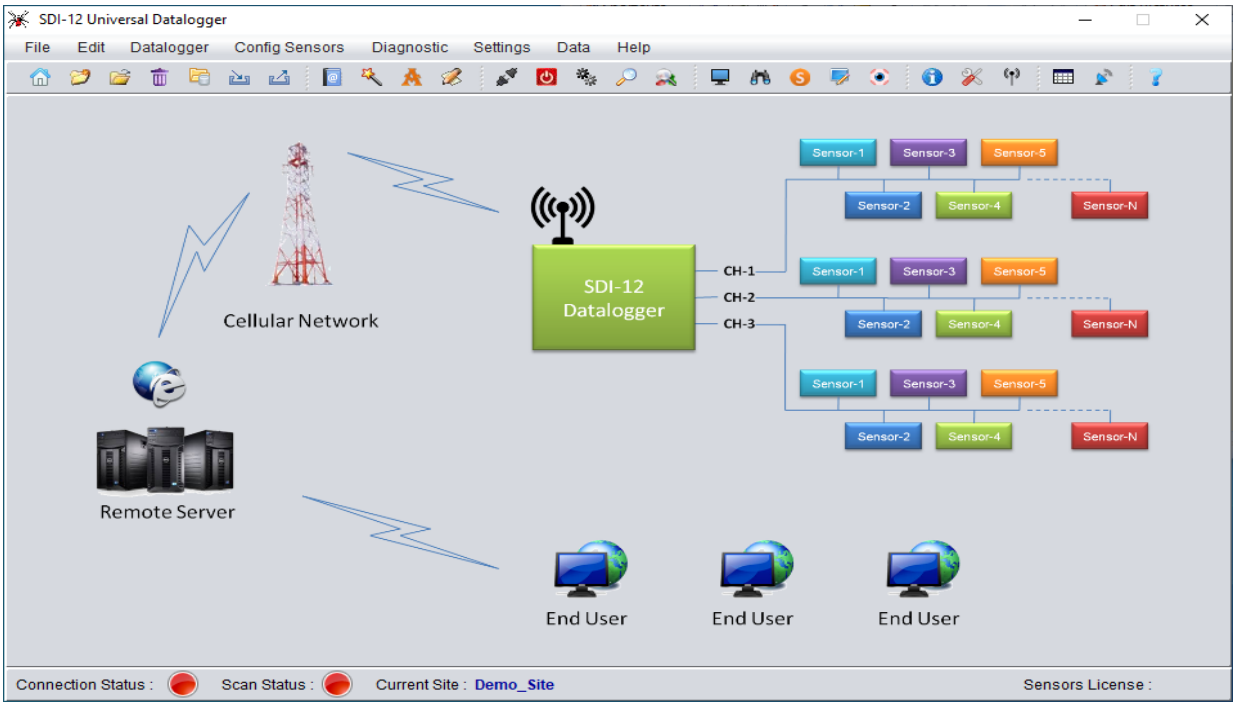

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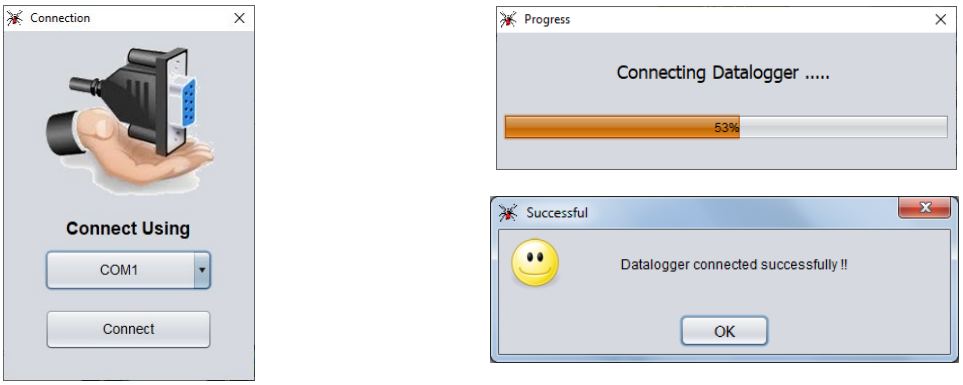
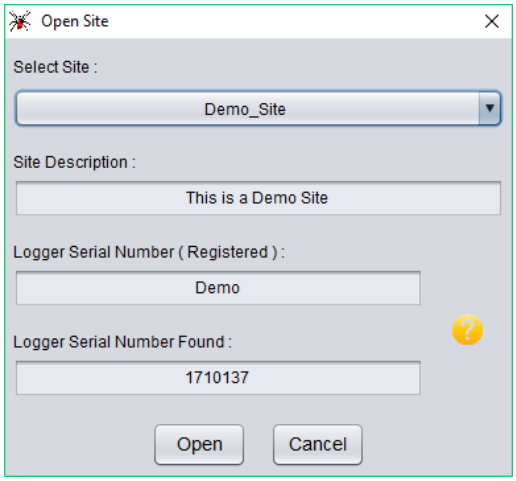
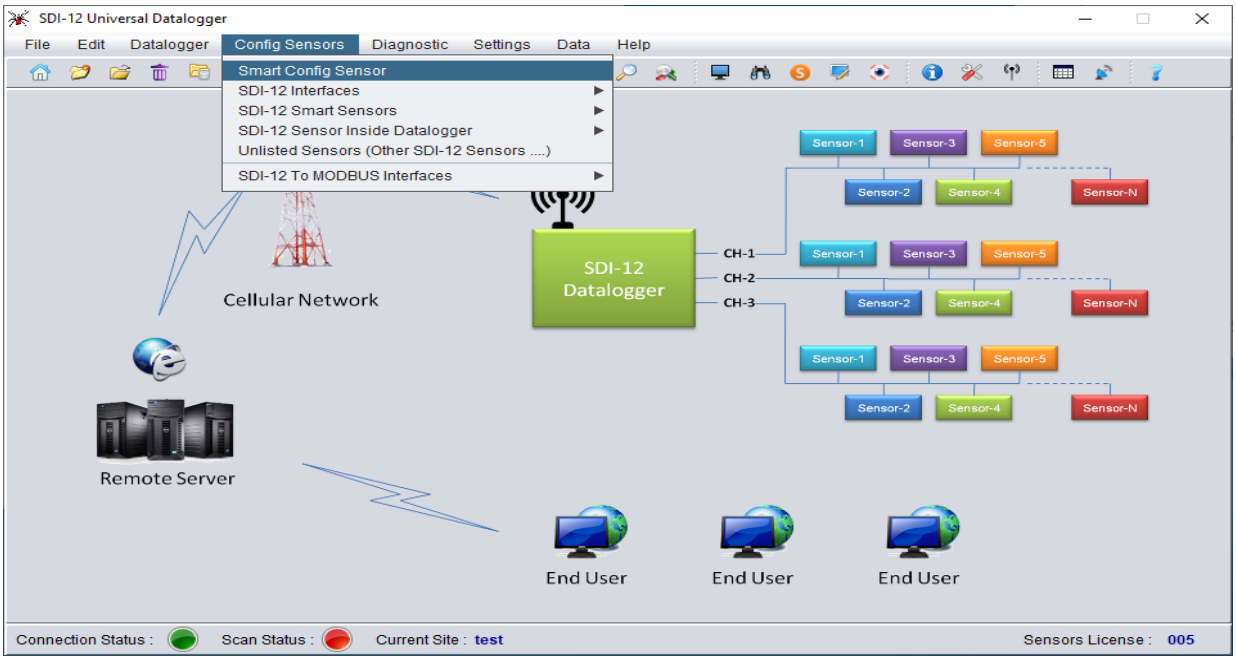


Figure 6-11 Connection

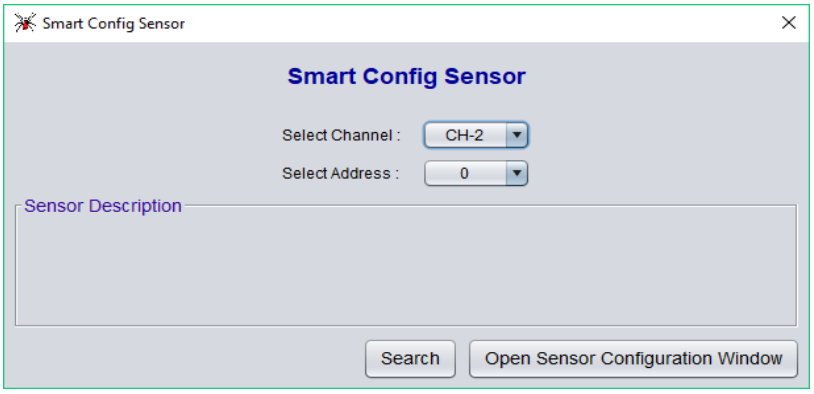
4. Application will display "Open site" window to select the site. Select the required site from "Select Site" dropdown menu. Click on "Open" button to open the site for Datalogger. You can choose "Demo site" for first time.

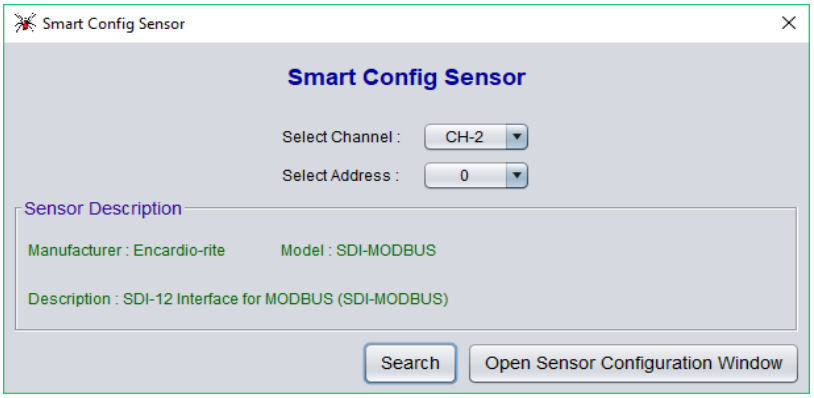


5. Click on "Config Sensors" tab and the select "Smart Config Sensor" as shown in figure below.

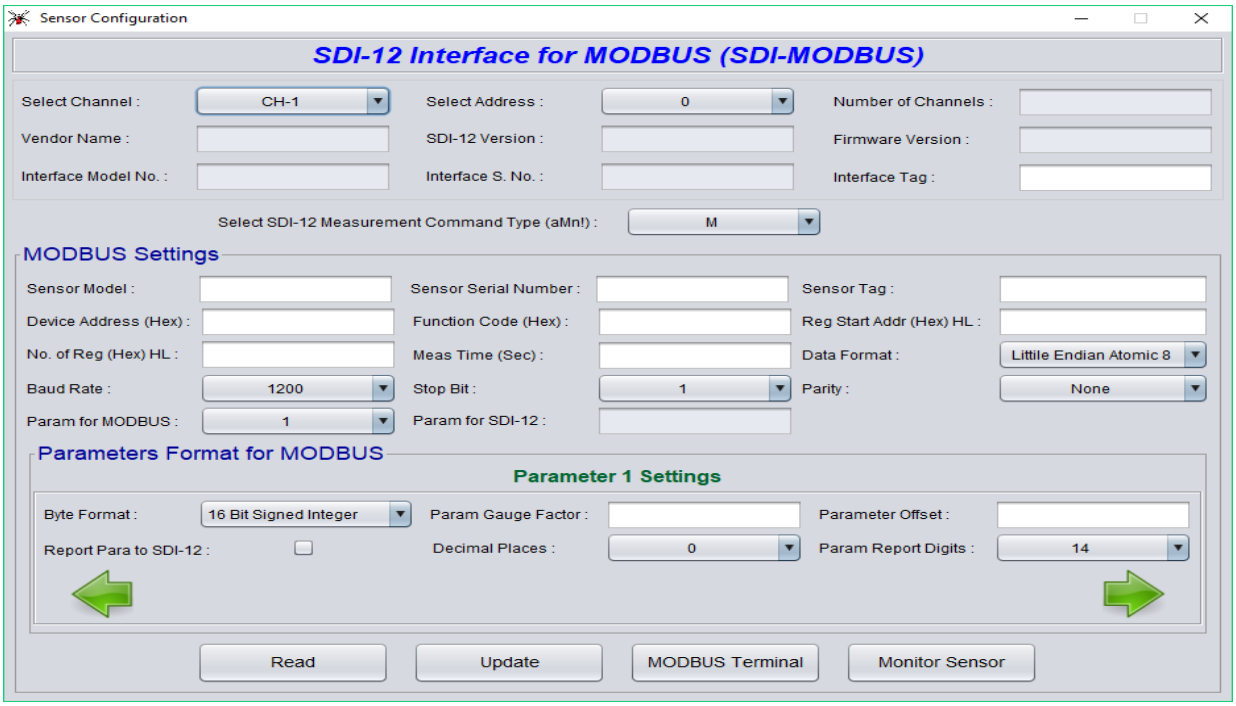


6. The screen as shown in figure 6-14 will appear. Select channel number at which the sensor is connected. Select the sensor's address and click on "Search" button to find the sensor on SDI-12 Bus. It will show the sensor details as shown in figure 6-15. Press on "Open sensor configuration window" to open configuration screen.

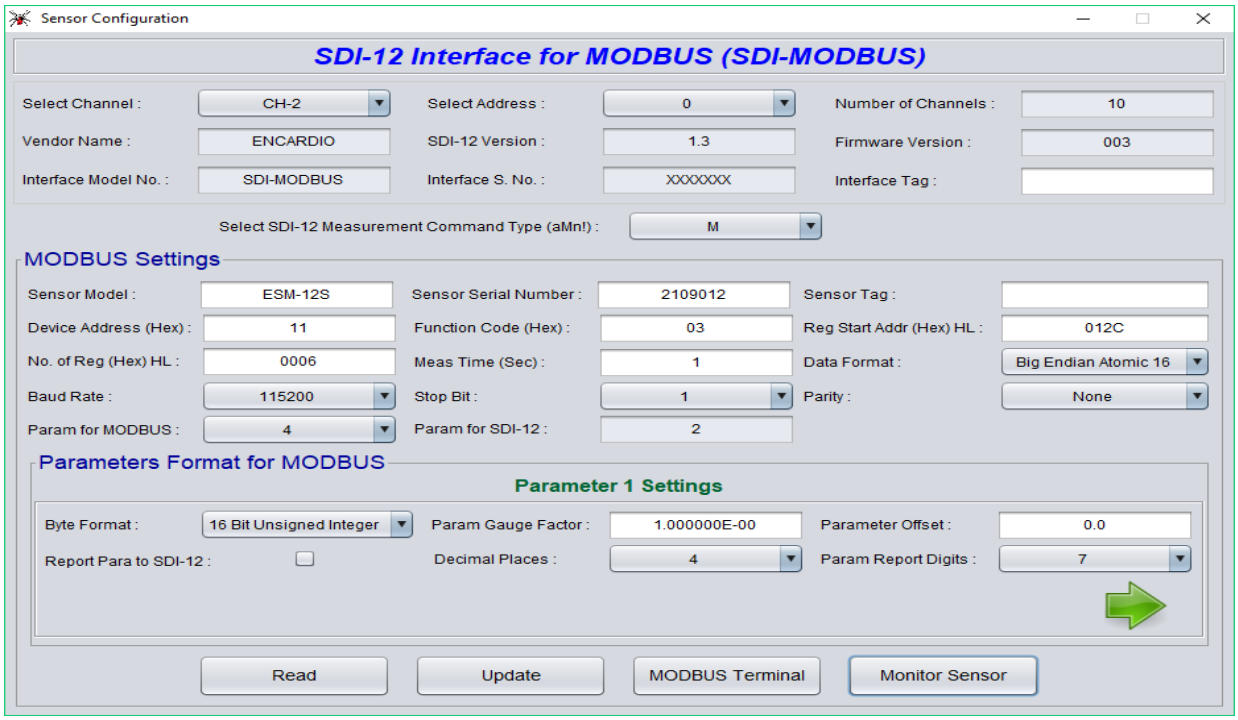


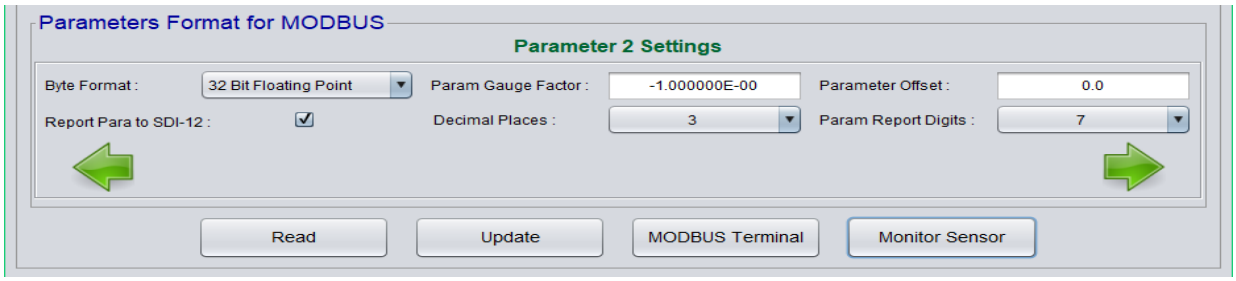


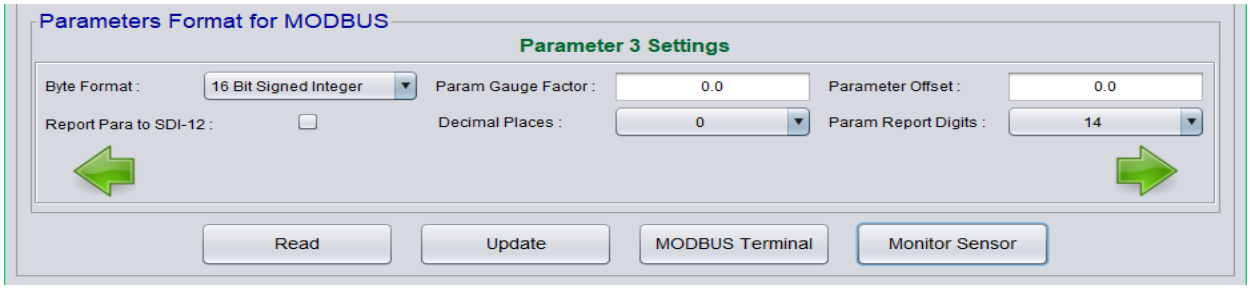
7. Screen as shown in figure 6-16 will appear. Press "Read" button.

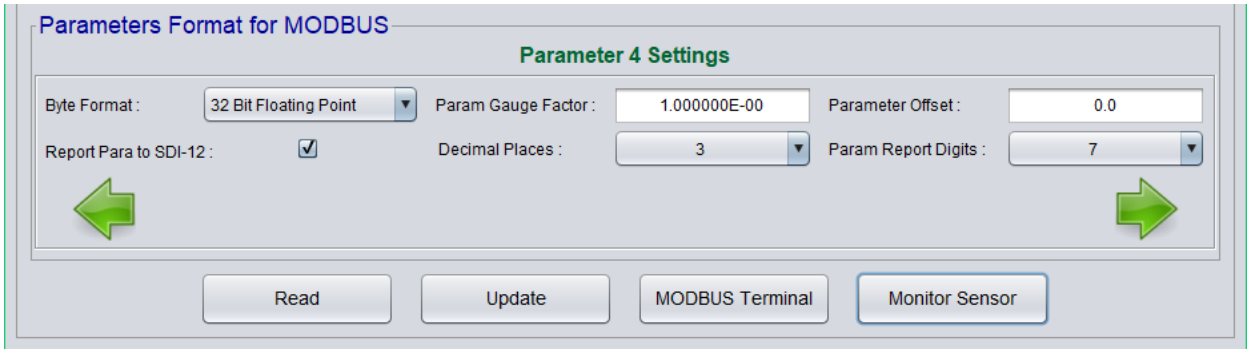


8. The application will fetch the information stored in the sensor as shown in figure 6-17 (image 1). Pressing the green arrow, one can check the parameter settings for all parameters as shown in the four images of figure 6-17.

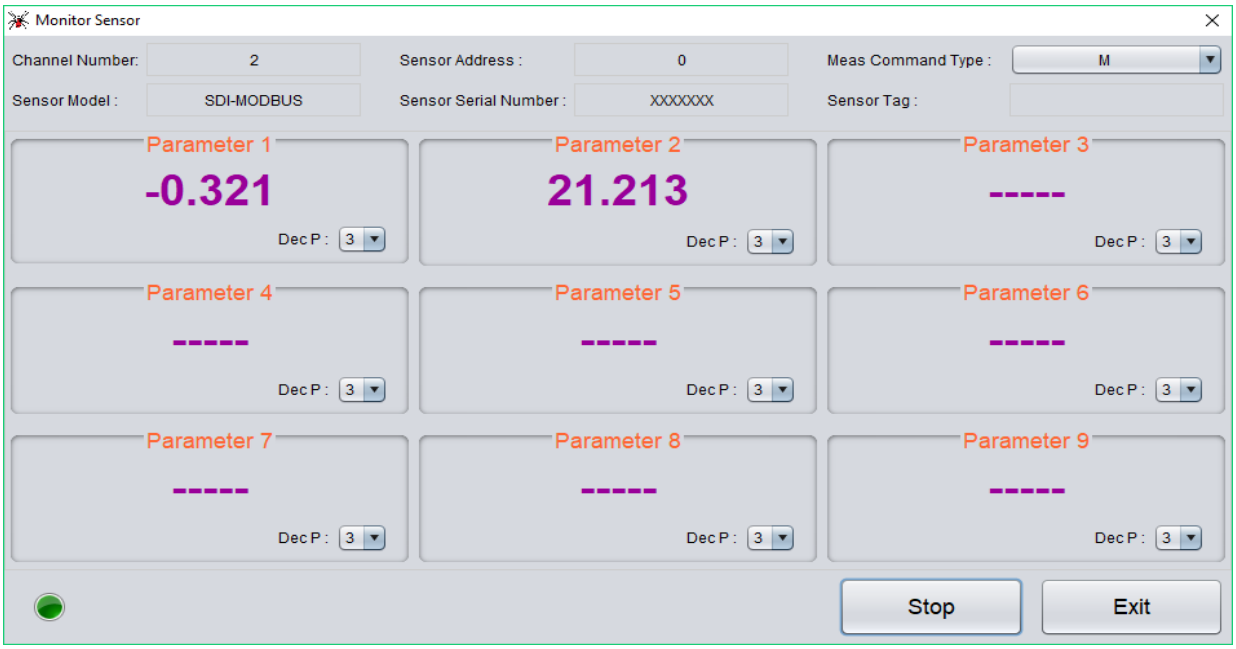








9. Press "Monitor Sensor" button. The screen as shown in figure 6-18 will appear, showing the values of settlement reading (Parameter 1) and temperature reading (parameter 2) of the sensor.



7 CONNECTING EPS-12S TO OTHER MODBUS DATALOGGERS

7.1 Introduction

Encardio-rite model ESM-12S seepage monitoring system use the industry standard Modbus Remote Terminal Unit (RTU) protocol to communicate with dataloggers. As the name suggests, Modbus was designed to work on what is known as a bus network, meaning that every device receives every message which passes across the network. Model ESM-12S uses the RS-485 electrical interface to communicate over long distance cables up to 1200 meters.

7.2 Device connection

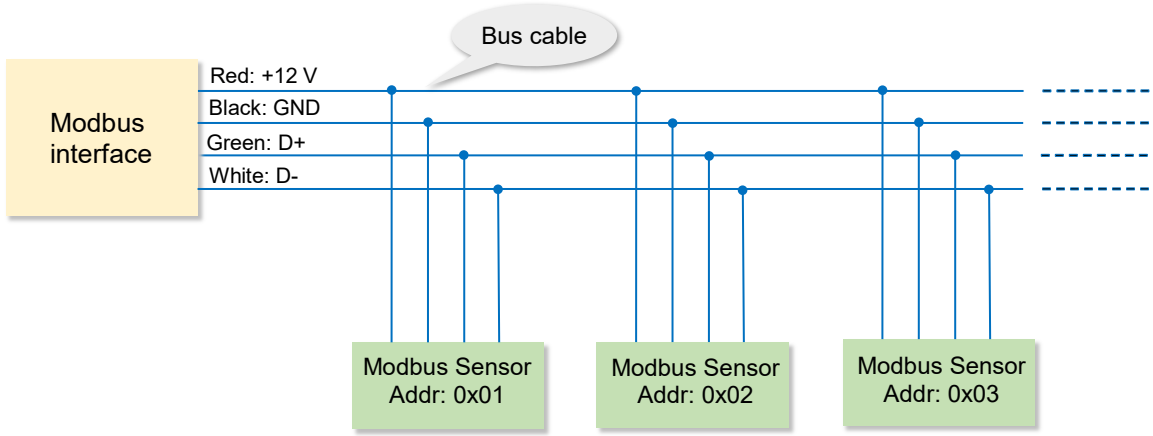


Figure 7-1 Wiring details to connect ESM-12S sensor with Modbus output to suitable datalogger

7.3 Modbus details for connection to datalogger

7.3.1 Modbus RTU overview

The Modbus RTU protocol uses packets (messages made up of multiple sections) to communicate and transfer data between devices on the network. The general format of these packets is as follows:

1. Modbus Address (1 byte) – The address of the specific device on the bus.
2. Function Code (1 byte) – The action to be carried out by the server device.
3. Data (multi-byte) – The payload of the function code being sent.
4. Cyclic Redundancy Check or CRC (2 bytes) – A 16-bit data integrity check calculated over the other byes in the packet.

7.3.2 Function code

The Modbus RTU protocol uses following Function codes:

Function Code	Description
03	Read Holding Registers
06	Write Single Register

7.3.3 Modbus register table

Modbus tables (maps) define the memory locations within each ESM-12S sensor interface and what information they contain. For example, the most recent sensor reading is stored in a table. This reading is presented in different formats in different sections of the table. The register location and size of these variables is detailed in the table below.

Modbus Register	Name	Data Length	Data Type	Description
0x00D8	Temperature Unit	2-bytes	16-bit Unsigned Integer	0 = deg C 1 = deg F
0x00D9	Parameter Unit	2-bytes	16-bit Unsigned Integer	0 = meters, 1 = mm 2= feet, 3=inches
0x00DA	Average Samples	2-bytes	16-bit Unsigned Integer	1 - 255
0x00DB	Settling Time	2-bytes	16-bit Unsigned Integer	0 – 255 seconds
0x00DD	Address of the Device	2-bytes	16-bit Unsigned Integer	0 - 247
0x00DE	Baud Rate	4-bytes	32-bit Unsigned Integer	1200, 2400, 4800, 9600, 19200, 38400, 115200
0x00E0	Endian Type	2-bytes	16-bit Unsigned Integer	0 = Little Endian Atomic 8 1 = Little Endian Atomic 16 2= Big Endian Atomic 8 3 = Big Endian Atomic 16
0x012C	Ch-1 Status	2-bytes	16-bit Unsigned Integer	0 = Measurement Ready 1 = Busy in measurement
0x012D	Parameter Value	4-bytes	32-bit float	0 – 1000 mm
0x012F	Ch-2 Status	2-bytes	16-bit Unsigned Integer	0 = Measurement Ready 1 = Busy in measurement
0x0130	Temperature	4-bytes	32-bit float	-20 to +80 deg C

7.4 Default settings

Sensor default settings are given below

Device Address	0x01
Baud Rate	115200
Data	8-bit
Stop Bit	1
Parity	None
Endian	Big Endian Atomic 16
Measuring Time	1 Sec

7.5 Modbus command format

Followings are some examples of Holding Registers Read and single register write.

- Reading Holding Registers (Ex: Reading sensor data)

BYTE	REQUEST	BYTE	ANSWER
(Hex)	Field name	(Hex)	Field name
02	Device address	02	Device address
03	Functional code	03	Functional code
01	Address of the first register Hi bytes	0C	Number of bytes more
2C	Address of the first register Lo bytes	00 00	Register value Ch-1 Status 16-bit un-signed
00	Number of registers Hi bytes	3B 21 3E 1B	Register value Parameter 32-bit Float (0.002460)
06	Number of registers Lo bytes	00 00	Register value Ch-2 Status 16-bit un-signed
05	Checksum CRC	41 DB E3 36	Register value Temperature 32-bit Float (27.485)
CE	Checksum CRC	B1	Checksum CRC
		82	Checksum CRC

- Write Single Register (Ex: Changing device address from 0x0001 to 0x0002)

BYTE	REQUEST	BYTE	ANSWER
(Hex)	Field name	(Hex)	Field name
01	Device address	01	Device address
06	Functional code	06	Functional code
00	Address of the Register Hi bytes	00	Address of the Register Hi bytes
DD	Address of the Register Lo bytes	DD	Address of the Register Lo bytes
00	Data (write) Hi bytes	00	Data (value) Hi bytes
02	Data (write) Lo bytes	02	Data (value) Lo bytes
98	Checksum CRC	98	Checksum CRC
31	Checksum CRC	31	Checksum CRC

8 CONNECTING TO NODE & GATEWAY

Wireless sensor network are becoming vital in civil engineering and geotechnical field. Encardio-rite offers an innovative wireless solution that allows real-time monitoring of geotechnical and structural sensors in challenging construction projects, with reliable data transfer over long distances without any delay.

The digital sensors (with SDI-12 or Modbus (RS-485) output) are interfaced with the long range, low power wireless network through model EWN-01D **digital node** that allows sensors to send recorded data to the model EWG-01 **gateway** with over 99% reliability, eliminating the need for running lengthy cables. The gateway then uploads all the collected sensor data to the central/cloud server.

Figure 10-1 Digital Node and Gateway

The digital node consists of a radio-transceiver with an antenna, a microcontroller, sensor module that reads the sensor; a wireless communication module that transmits the digital data to the gateway, and a processor that controls the two modules. It is a highly reliable integrated system, which is capable of collecting data from digital sensors and reporting measurements through RF wireless communication network to the gateway.

The node is housed in a rugged enclosure designed for use in harsh environments with wide temperature tolerance with resistance to moisture and humidity.

A cloud-hosted data management and configuration software can be used to manage the network. The configuration can be done with an easy to use smartphone application that comes free with the system.

The system can generate automatic reports and provide automated alerts over SMS or email for any reading crossing the pre-defined alert levels.

8.1 Sensors with SDI-12 output option

The sensor with SDI-12 output will be connected to the "SDI" port (right-most) of the digital node as shown in figure below.

Figure 10-2 Connection of digital sensor with SDI-12 output to digital node

8.2 Sensors with Modbus (RS-485) output option

The sensor with Modbus (RS-485) output will be connected to the "RS485" port (center one) of the digital node as shown in figure below.

Figure 10-3 Connection of digital sensor with Modbus (RS-485) output to digital node

For details on connection to Nodes and Gateway and their configuration, please refer to Users' Manual # WI6002.139 on Wireless (RF) Nodes and Gateway.

9 SAMPLE TEST CERTIFICATE

Test Certificate

Date: 30.06.2021
Temperature: 28^0C

Item : Water level sensor (low range pressure sensor)

Model : ESM-12S

Serial no. : ----------

Full Scale Value : 1000 mm

Observation Table :

Marking on Standard Tape (mm)	Reading Observed by Automatic level sensor (mm)	Error (mm)
0	0.00	0.10
200.00	200.10	0.25
400.00	400.25	0.25
600.00	600.25	0.15
800.00	800.15	0.25
1000.00	1000.25	0.10

Maximum Error (% FS) : 0.03

Wiring colour code:

Wire colour	Signal
Red	+ 12 V (supply)
Black	0 V (supply)
Green	Output signal

Note: The Offset value should be observed at site and fed with opposite sign in the datalogger to obtain the output in mm.

Tested by:

10 WARRANTY

The Company warrants its products against defective workmanship or material for a period of 12 months from date of receipt or 13 months from date of dispatch from the factory, whichever is earlier. The warranty is however void in case the product shows evidence of being tampered with or shows evidence of damage due to excessive heat, moisture, corrosion, vibration or improper use, application, specifications or other operating conditions not in control of Encardio-Rite. The warranty is limited to free repair/replacement of the product/parts with manufacturing defects only and does not cover products/parts worn out due to normal wear and tear or damaged due to mishandling or improper installation. This includes fuses and batteries

If any of the products does not function or functions improperly, it should be returned freight prepaid to the factory for our evaluation. In case it is found defective, it will be replaced/repaired free of cost.

A range of technical/scientific instruments are manufactured by Encardio-rite, the improper use of which is potentially dangerous. Only qualified personnel should install or use the instruments. Installation personnel must have a background of good installation practices as intricacies involved in installation are such that even if a single essential but apparently minor requirement is ignored or overlooked, the most reliable of instruments will be rendered useless.

The warranty is limited to as stated herein. Encardio-rite is not responsible for any consequential damages experienced by the user. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and of fitness for a particular purpose. Encardio-rite is not responsible for any direct, indirect, incidental, special or consequential damage or loss caused to other equipment or people that the purchaser may experience as a result of installation or use of the product. The buyer's sole remedy for any breach of this agreement or any warranty by Encardio-rite shall not exceed the purchase price paid by the purchaser to Encardio-rite. Under no circumstances will Encardio-rite reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

A lot of effort has been made and precaution for accuracy taken in preparing instruction manuals and software. However best of instruction manuals and software cannot provide for each and every condition in field that may affect performance of the product. Encardio-rite neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damage or loss that results from use of Encardio-rite products in accordance with the information contained in the manuals or software.

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