ONE STOP MONITORING SOLUTIONS | HYDROLOGY | GEOTECHNICAL | STRUCTURAL | GEODETIC
Over 50 years of excellence through ingenuity

USERS' MANUAL

VERTICAL IN-PLACE INCLINOMETER SYSTEM (SDI-12 INTERFACE)

MODEL EAN-52MV

Doc # WI 6002.113 R04 | July 2019

ENCARDIO-RITE ELECTRONICS PVT. LTD.
A-7, Industrial Estate, Talkatora Road Lucknow, UP - 226011, India | P: +91 522 2661039-42 | Email: geotech@encardio.com | www.encardio.com
International: UAE | Qatar | Bahrain | Bhutan | Europe | USA
India: Lucknow | Delhi | Kolkata | Mumbai | Chennai | Bangalore | Hyderabad | J&K

Contents

1 PURPOSE

This method statement defines the procedure for long-term monitoring of lateral movement using Encardio-rite model EAN-52M vertical in-place inclinometer system in the soil, earthworks, slopes or structures like retaining/diaphragm wall, embankment or dam etc. An array of inclination measurement probes (tilt sensors) are installed inside a standard grooved inclinometer casing for real-time lateral movement monitoring in critical applications. Continuous data logging and real-time monitoring help to provide an early warning in case of an impending failure.

EAN-52M in-place inclinometer system provides significant quantitative data on the magnitude of inclination or tilt of a foundation, embankment or slope and its variations with time. It also provides the pattern of deformation, zones of potential danger and effectiveness of construction control measures undertaken. Real-time monitoring of inclination with in-place inclinometer system helps in observing the behaviour of ground movement after construction and indicates potentially dangerous conditions that may adversely affect the stability of the structure.

2 GENERAL DESCRIPTION

In-place inclinometer system consists of a string of in-place sensors (sensor model EAN-52M with SDI-12 interface, uniaxial or biaxial) installed inside standard inclinometer four grooved casing.

A series of four grooved access tubes attached to each other with fixed couplings are installed in a borehole or embedded in earth/rockfill or concrete structure during construction or fixed to the vertical face of a completed structure. One set of grooves is preferably aligned in the expected direction of movement and if this is not known, in the N-S direction.

NOTE: For instructions on installation of Encardio-rite inclinometer casing refer to Users' Manual of EAN-26M Inclinometer System (Doc. # WI 6002.104).

A string of sensors is positioned inside the inclinometer casing in a continuous array to span the movement zone. These sensors measure the tilt in successive segments to accurately monitor a change in the profile of the inclinometer casing. Refer to figure 1.a. Each in-place sensor is fitted with a pair of pivoted sprung wheels, which rests inside the grooves of the inclinometer casing. Length of spacer tubing determines the distance between each sensor i.e. length of each segment over which the tilt is monitored.

- Spacer tubing length (mm) = gauge length (mm) - 381 mm
- Outside diameter of spacer tubing = 19 mm

When ground movement occurs, it displaces the inclinometer casing, causing a change in tilt of the in-place tilt sensors. This results in a change in the output of the sensors, proportional to the tilt i.e. the angle of inclination from vertical. The sensors are connected to a data acquisition system for real-time monitoring of lateral movement. The tilt reading over gage length of each sensor (gage length is a distance between wheels) can be converted to lateral deviation by:

"L sin A" where L is gage length; A is angle of tilt from vertical

The lateral movement of the casing can be calculated by subtracting initial deviation from current deviation. Provided that one end of the casing is known to be fixed, it is possible to obtain a complete profile of the access tubing by summing readings from successive sensors. By comparing the profiles, the horizontal displacement of the gage well at different depths over a period of time may be determined.

SDI-12 is an acronym for "Serial Data Interface at 1200 Baud". It is an asynchronous ASCII, serial communications protocol. Instruments with SDI-12 interface are typically low-power (12 V), often used in remote locations, and usually, communicate with a data logger or other data acquisition device. In this master-slave configuration, the data logger or data acquisition device typically acts as the master (SDI-12 Recorder and Interrogator) to data monitoring instruments, which are the slaves (SDI-12 sensors). One master can communicate with multiple slaves; so the SDI-12 protocol requires that each device in the serial network be identified with a unique address, which is represented by a single ASCII character.

This communication is achieved by digital communication along a single serial line. The digital addressing system allows an SDI-Recorder to send out an address over a single line that is connected to sensors. Only the pre-configured sensor matching that address will respond (handshake). The other sensors on the same line will not respond until called and typically stay in "sleep mode" (low power mode), until called (often in a sequence) at a later time by the SDI-Recorder (Master).

The sensor with SDI-12 interface bears a manufacturing serial number and an identity or address can be assigned to it during the installation process. The identities are 0-9, a-z & A-Z. The sensors are provided with a pair of 3 core cable terminating at a set of male/female connectors. These connectors are water proof and are to be handled very carefully. The connectors are provided for installation of sensors in an inclinometer casing which may be filled with water.

NOTE: In an in-place inclinometer chain with SDI interface connected to one port of a datalogger IDs of the sensors cannot be repeated.

3 IN-PLACE INCLINOMETER SENSOR COMPONENTS

Figure 1.a shows an in-place inclinometer string assembly, Figure 1.b shows the sensor details and Figure 1.c shows the protective cover details. Please note the following:

- The depth of borehole and the gage length specified by the user determines the number of sensors required.
- Spacer tubing length is determined by the gage length specified.
- The depth at which first in-place sensor is to be placed from top of the borehole determines the length of the placement tube.

NOTE: Sensor used in this system is model EAN-52M with a SDI-12 interface. Sensors for both vertical and horizontal installation are available. The latter are marked with the suffix 'H' along with their serial number.

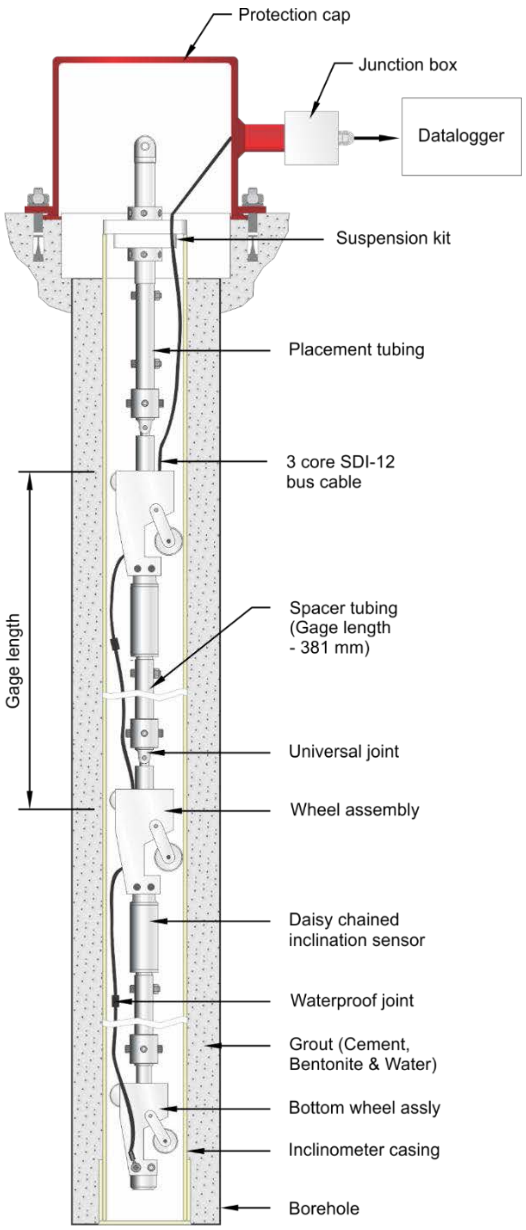


Figure 1.a: In-place Inclinometer

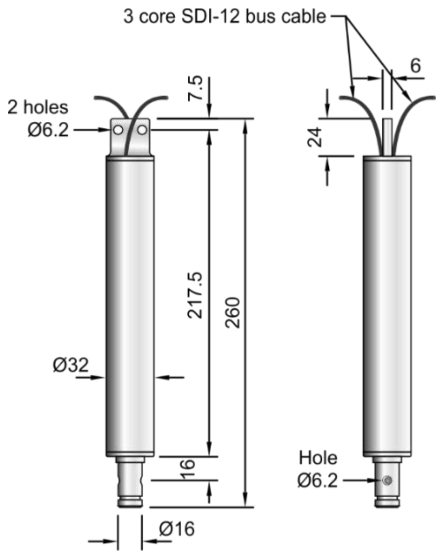


Figure 1.b: Dimensional details of sensor EAN-52M

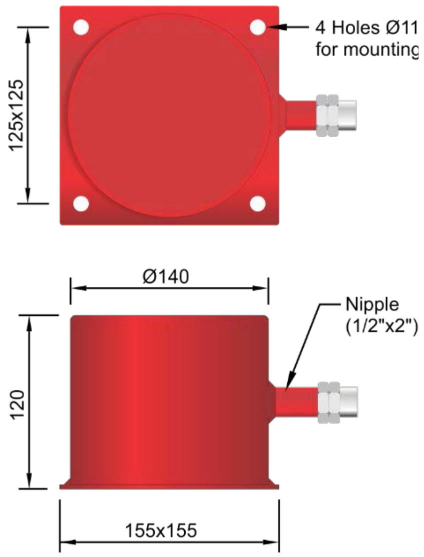


Figure 1.c: Protective

4 PREPARATION BEFORE INSTALLATION

4.1 Civil works

- Install casing as per Users' Manual - EAN-26M Inclinometer System - doc. # WI6002.104
- Make a concrete platform (refer to figure 2) such that mouth of inclinometer casing is around 25 mm below the top of the concrete platform. Inside diameter of the cavity around the top of the casing in the platform should be around 150 mm.
- Place the protective cover over the concrete platform and mark location for the Hilti HLC-M10x80 fasteners provided. Remove the cover and install the four mounting fasteners on the marked locations (for later mounting of the protective cover).

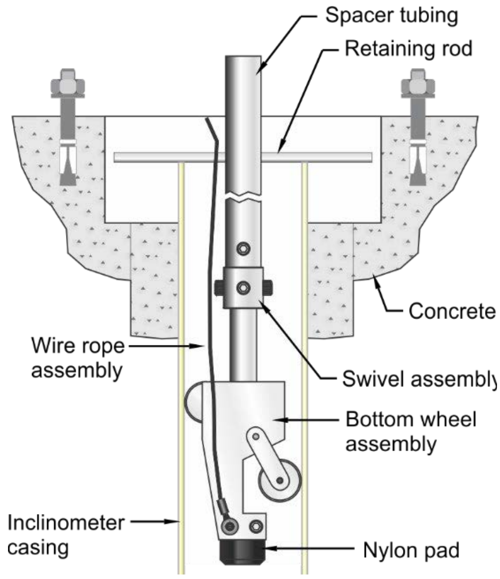


Figure 2: Concrete platform for protection

4.2 Pre-installation checks

- Check for any damage to cable/connector of each sensor.
- Each sensor bears a serial number and has two cables coming out of it.

NOTE: The bottom wheel assembly is to be considered as the reference point while analysing the monitored data.

- Identify the sensors to be lowered in order (lower most sensor to be numbered as sensor 1) and note down their serial number. Assign ID or address (0-9, a-z or A-Z). to each sensor (refer to section 5.4.2). Ensure that no sensor in the chain has the same ID.
- One end of the cable from the topmost sensor is directly terminated in a junction box at the top of the borehole. The other end has a connector which is mated with cable connector from the lower sensor.
- Locate A+ side i.e. the top wheel on all the sensors and it should be towards the expected direction of movement (refer to figure 3).

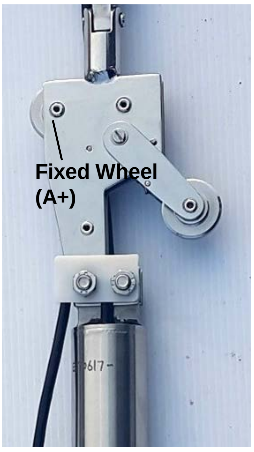


Figure 3: Top wheel

NOTE: Failure to place A+ side of each sensor of an IPI chain towards the expected direction of movement can result in misinterpretation of the data. This may have serious consequences.

Figure 4 (Bottom assembly)

4.3 Pre-assembly

4.3.1 Bottom assembly:

- The supplied wire rope assembly has two loops. Fix the smaller loop of the wire rope assembly to the lower end of the bottom wheel assembly as shown in figure 4 and figure 6.a. Other end of wire loop is fixed to any secure structure at the top of the borehole to prevent the whole assembly from dropping down accidentally into the borehole during installation/removal.
- Assemble the lower end of the spacer tubing to the bottom wheel assembly as shown in figure 6.a and figure 4.

4.3.2 Sensor assembly:

- Attach the bottom-most sensor to a wheel assembly as shown in figure 6.b.
- Fix a spacer tubing to other end of wheel assembly as shown in figure 6.b and figure 8.
- Prepare such assemblies for all the sensors except for the top most sensor.
- Spacer tubing connected to the sensors is shown in figure 5.

4.3.3 Top assembly/Suspension bracket:

- Attach a wheel assembly to the top most sensor as shown in figure 5.
- To the other end of the wheel assembly, fix the placement tube as shown in figure 6c.
- Attach suspension kit to the other end of the placement tube as shown in figure 6c.

NOTE: Required fasteners are supplied mounted on the assemblies except those used for fixing the IPI sensors to the gage tubing. These fasteners with some spares are packed separately.

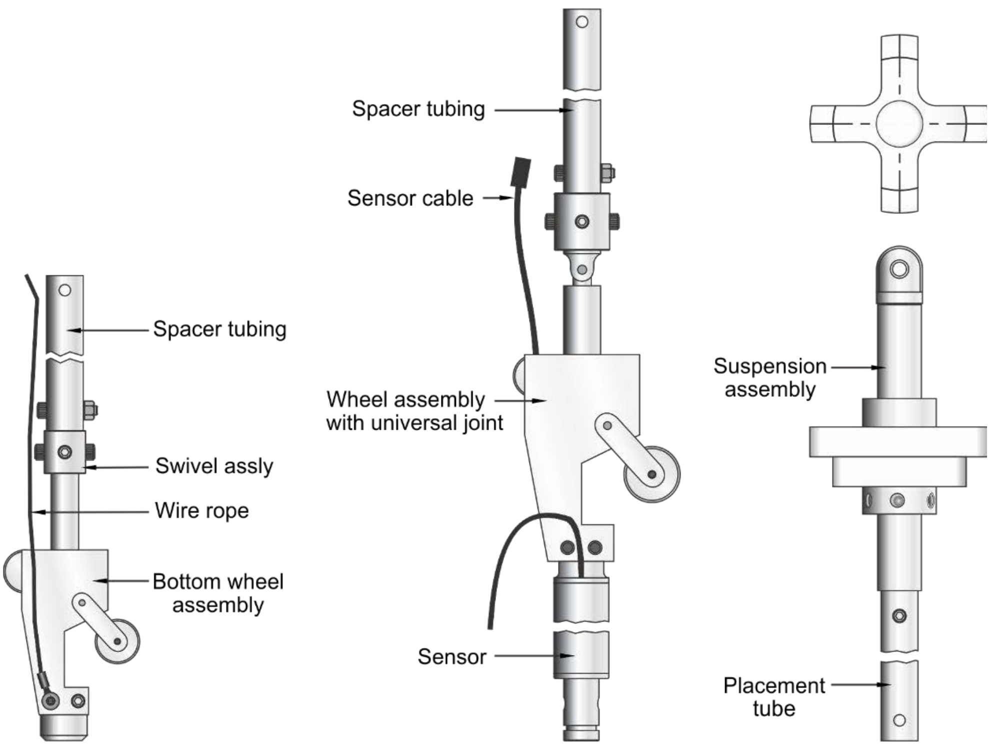


Figure 6 Sensor assembly

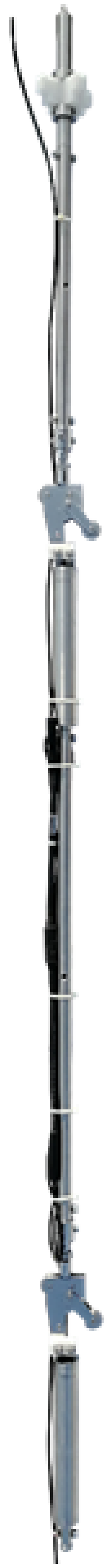


Figure 5 In-place assembly showing top suspension bracket, sensor and spacer tubing

5 INSTALLATION

- Place assemblies in side by side in the order of installation.
- Lower the bottom assembly into inclinometer casing holding the safety wire rope such that assembly does not accidentally slip down into the casing.

NOTE: Align wheels in casing grooves such that top/fixed wheel points towards the expected direction of movement.

- Insert a retaining rod (figure 7) in the hole at the top end of the spacer tubing and rest assembly on the casing's top with the help of the retaining rod.

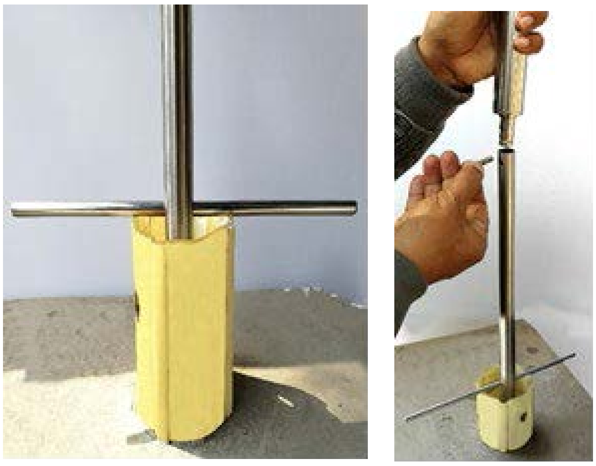


Figure 7: Inserting retaining rod in the spacer tubing

- Fix first (bottom-most) sensor assembly to the lower most spacer tubing (refer to figure 8). Use cable ties to tie the signal cable of sensor and wire rope neatly to the spacer tubing.
- Remove retaining rod, lower assembly into borehole, fix next sensor assembly to the lower most sensor's spacer tubing.
- Fix the connector of the lower sensor to the next one tightly using the hands only (refer to figure 10) and insert retaining rod in hole of next spacer tubing.

Figure 8: Fixing sensor to spacer tubing

Figure 9: Lowering of assembly

NOTE: Care should be taken during fixing of the connectors.

- Repeat above procedure for all sensors taking care of orientation of wheels as mentioned above (refer figure 9) till suspension kit of the top assembly rests on the mouth of the inclinometer casing (refer figure 11).

Figure 10: Connecting connectors of different sensors

Figure 11: Fixing Top assembly

NOTE: 1. While lowering assemblies make sure to use the retaining rod in every spacer tubing to prevent assemblies accidentally falling in to the borehole.

2. Take care of the sequence of sensors from bottom to top. Note the manufacturing serial and address of the sensors during assembly.

3. Prevent twisting of installed sensors during tightening of fasteners as this can damage the wheels and push them out of the grooves of inclinometer casing.

6 TAKING READINGS

6.1 Wiring details

Colour coding of the cable coming out from the top most IPI sensor is given below:

Colour	Description
Red	+ 12V DC
Black	0 V
Green	Output

The SDI-12 sensors are connected in a bus chain through waterproof connectors.

For extending cable from the top of an IPI chain, a junction box is required. Mounting details of the standard junction box from Encardio-rite are provided in figure 12. If it is required to connect IPI sensor chains installed in two or more boreholes, a special junction box is required as shown in figure 12 (right).

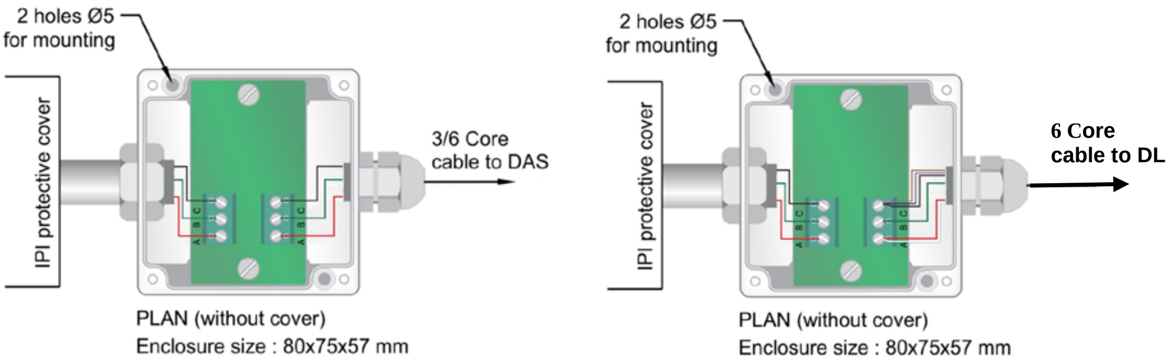


Figure 12 Junction Box

From IPI 3 core cable	Description	JB terminal	Output 6-core cable (Encardio-rite CS-0703)
Red	+12 V	A	Red, White
Green	Output	B	Green
Black	0 V	C	Black, Blue, & Brown

6.2 Sign convention

Carefully orient the sensor during installation. Make a note of the orientation. A "+" is marked on each sensor along the A-axis.

A-axis measures tilt in the plane of wheels. B-axis is at 90 degrees to A-axis. Uniaxial sensor measures tilt only along axis 'A'.

Figure 13 shows a view from top and also convention used for assessing direction of movement for data interpretation.

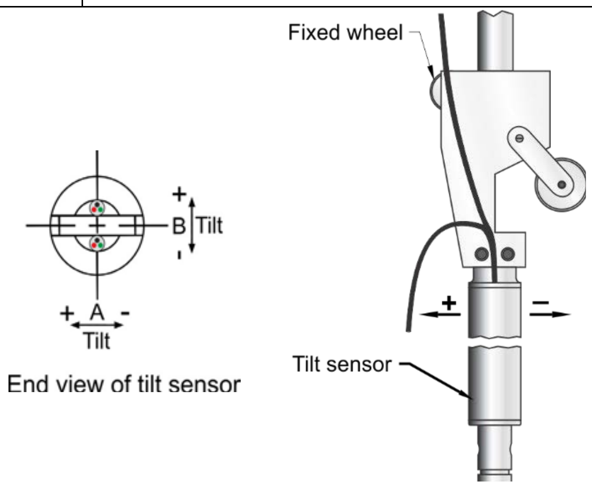


Figure 13: Sign convention

6.3 Maintenance of IPI Sensors

The in-place inclinometer requires careful maintenance after dismantling if the whole set needs to be reused in another borehole in the future. Please implement the following maintenance steps:

- Wheel assemblies, springs, pivots and axles should be cleaned and dried after dismantling the IPI chain using compressed air.
- Oiling of the wheels, springs, pivots and axles to be performed subsequently.
- Connectors should be cleaned and dried. These should be free of any cuts.
- As the dismantled IPI sensors were in use, there would be a zero offset for each sensor. It should be removed before reusing. It is recommended that the sensors should be sent back to the factory for recalibration.

7 CONNECTING SENSOR TO DATA ACQUISITION SYSTEM

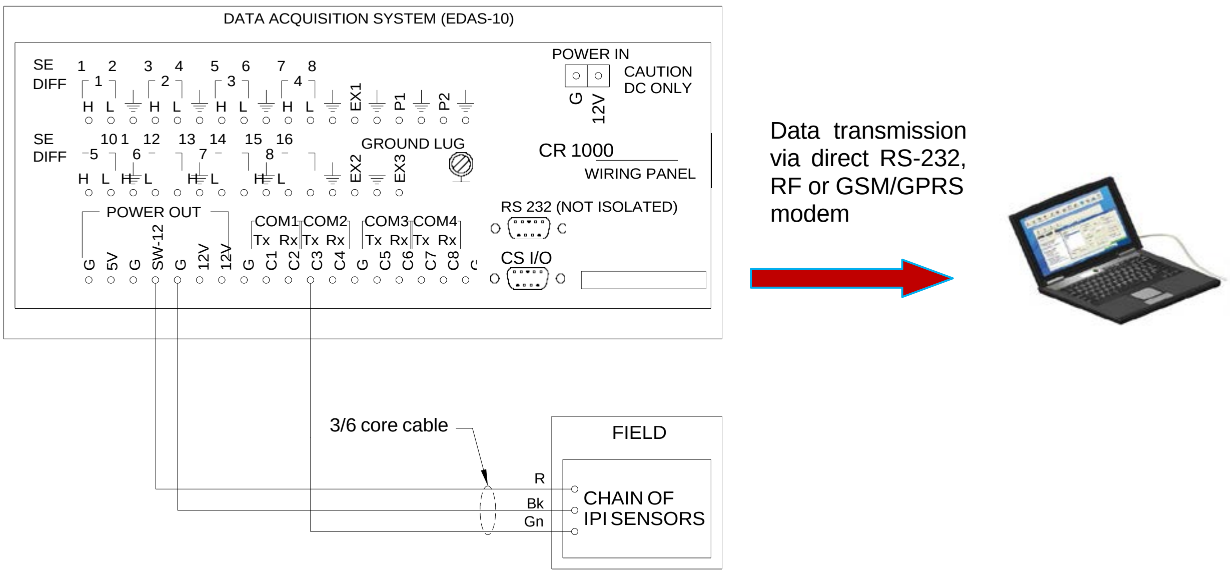
7.1 With EDAS-10 data acquisition system

Model EAN-52M (sensor used in IPI chain) sensors having SDI-12 interface require a power source of 12V DC which is provided by the EDAS-10 data acquisition system through Encardio-rite power supply model EBP-127AH. Since the SDI-12 network is connected in a bus mode, only a three core cable is routed to the data acquisition system. A six core cable can also be used for the connection. Depending upon the application, the data acquisition system can be based on Campbell measurement and control modules CR1000, CR800 or CR200.

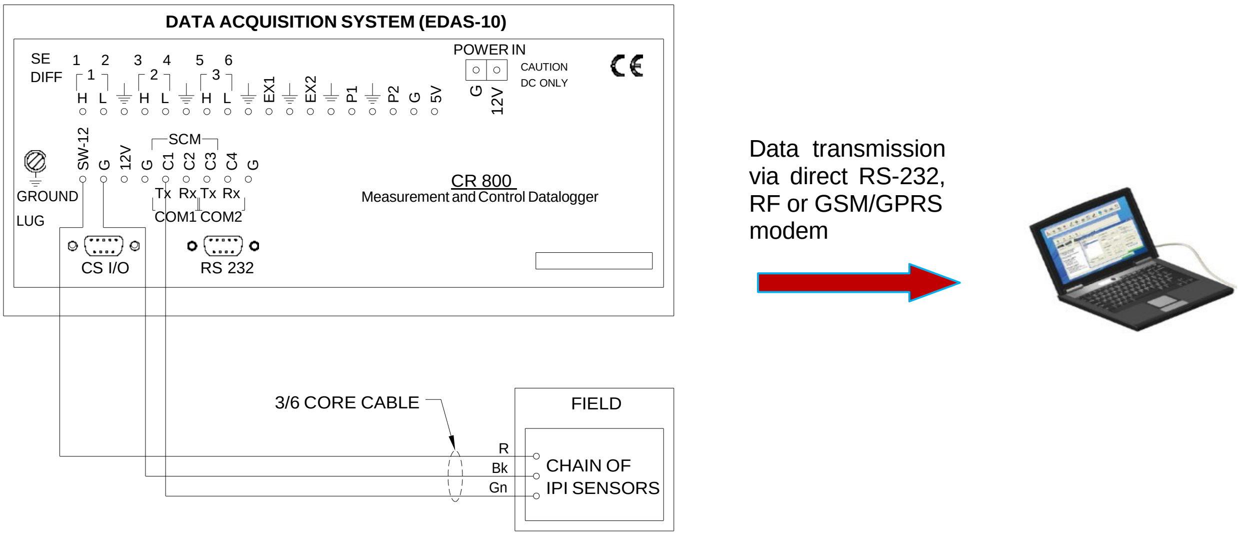
NOTE: For detailed instructions on configuration of Encardio-rite model EDAS-10 data acquisition systems based on measurement and control modules CR 1000/CR 800/CR 200, refer to Campbell Scientific's relevant Users' Manal.

Typical wiring/connection of in-place inclinometer system to CR1000, CR800 or CR200 based data acquisition systems are shown in the figures on the next page. In case data is to be transmitted via GSM/GPRS or RF modem only the CR 1000 or CR 800 based data acquisition system can be used. The CR 200 does not support transmission of data by GSM/GPRS or RF modem.

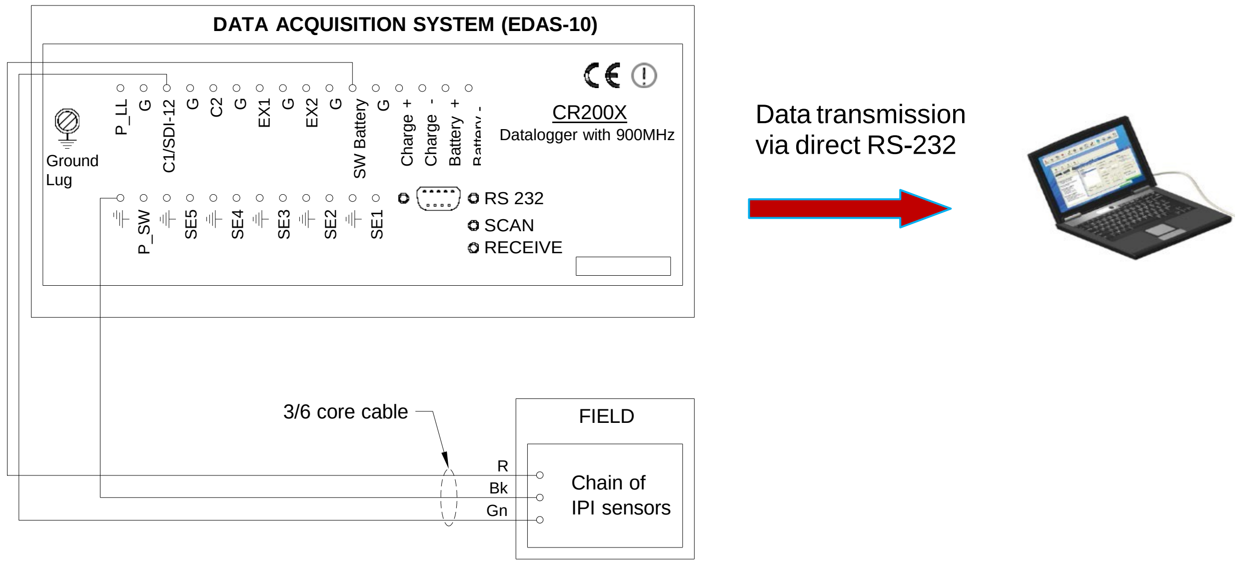
1) IPI with CR1000 System



2) IPI with CR800 System

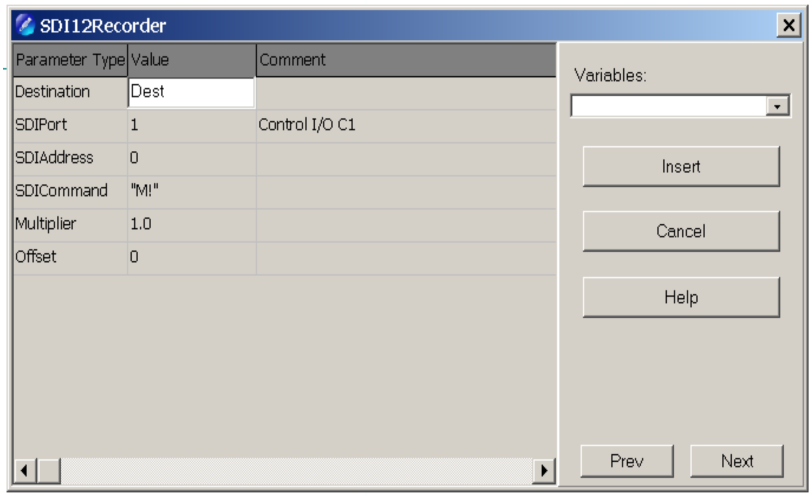


3) IPI with CR200 System



7.1.1 Program for SDI-12 sensor

Encardio-rite can supply a program for monitoring in-place inclinometer system based on information provided by customer. For details, contact Encardio-rite's head office in India.



SDI12 Recorder- The SDI12 Recorder instruction is used to retrieve the results from an SDI-12 sensor.

Syntax- SDI12 Recorder (Dest, SDIPORT, SDI Address, SDI Command, Multiplier, Offset)

Where Destination is the defined address for storage, SDIPORT is the control port connected to sensor, SDI Address is the defined address of the connected sensor, SDI Command is taken as "M!" The Multiplier and Offset have purpose as per the name suggested.

The SDI-12 Command basically has three components i.e. ***aM1!***. An active sensor responds to each command.

Sensor address (a) – a single character, and is the first character of the command.

Command body (e.g., M1) – an upper case letter (the "command") followed by alphanumeric qualifiers.

Command termination (!) – Command terminates with an exclamation mark.

SDI12 Sensor address change:

To change a sensor's address we need to send a command as given below. Command: **0A2!**

(Previous_AddressANew_Address!) Note: Here "2=Previous_Address" and "b= New_Address"

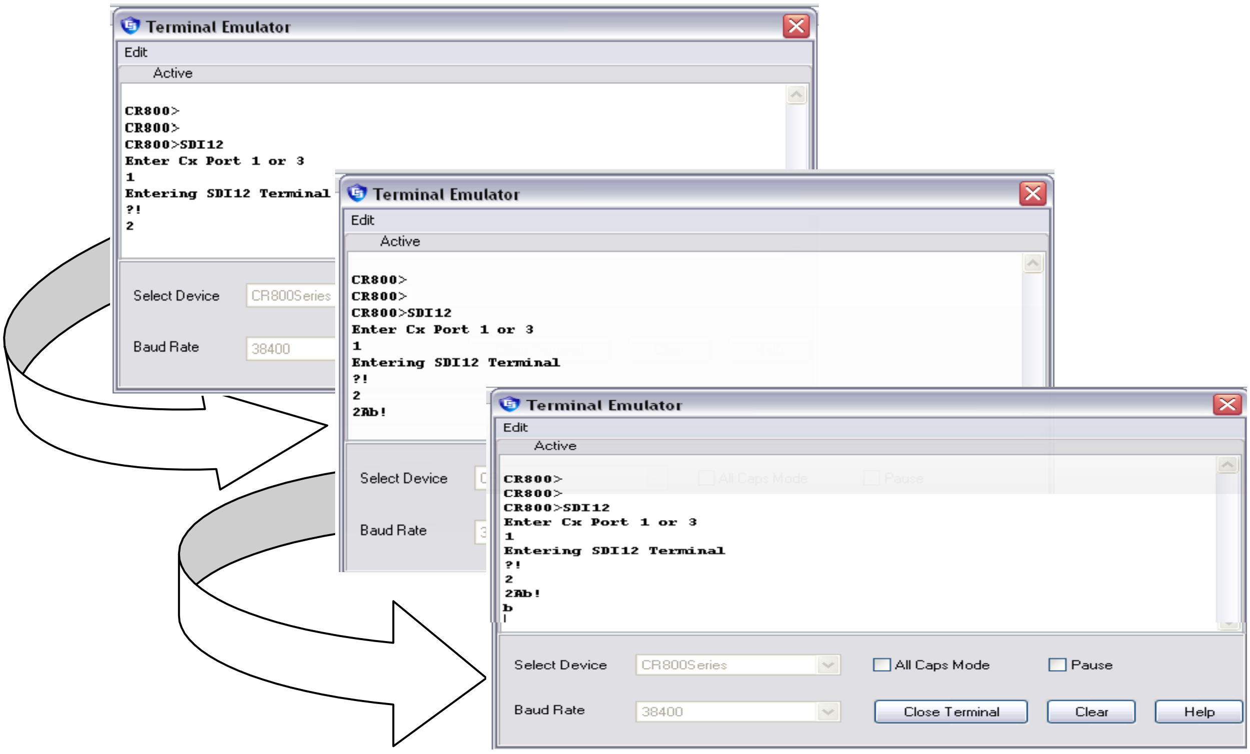


Figure 14: Sensor address change

7.1.2 Typical programming for reading one SDI-12 sensor using CRBasic

The IPI sensor response can be checked before installation at site with the help of simple program module as shown in picture 7.

```
'' SDI-12 Sensor measurements with CR1000 Series Datalogger
'Declare Public Variables
Public batt_volt
Public PTemp
Public Results(6)
Public Sensor_ID(2)
Public watchdog

'Declare Other Variables --Sensor name can be changed as required
Alias Results(1)=Sensor_1
Alias Results(4)=sensor_2

'Define Data Tables
DataTable (SDI_DATA,True,-1)
        DataInterval (0,5,min,0)
        Sample (1,batt_volt,FP2)
        Sample (1,PTemp,FP2)
        Sample (1,Sensor_1,IEEE4)
        Sample (1,Sensor_2, IEEE4)
        Sample (1,watchdog,FP2)
EndTable

'Main Program
BeginProg
    watchdog=0
        Scan (10,sec,1,0) ' Scanning Interval Can be changed
        PanelTemp (PTemp,250)
        Battery (batt_volt)
        'Sensor_ID()=value
        Sensor_ID(1)=0     'for connected sensor
        Sensor_ID(2)=1
'SW12(1)
Delay(0,3,sec)

' SDI-12 Sensor measurements
SDI12Recorder  (Results(1),3,Sensor_ID(1),"M!",1.0,0)
SDI12Recorder  (Results(4),3,Sensor_ID(2),"M!",1.0,0)
Delay(0,5,sec)
If watchdog = 0 Then
    watchdog = 10
    EndIf
        CallTable(SDI_Data)
    NextScan
EndProg
```

7.1.3 Typical programming for reading one SDI-12 sensor using Terminal Emulator

Terminal Emulator emulates a terminal connected to a datalogger or communications device. On selecting a device and baud rate and clicking Open Terminal causes PC400 to attempt to connect with that device. If the device is a datalogger, PC400 will call the datalogger over whatever communications link has been established and will attempt to get a prompt from that datalogger. The data response through emulator is as per figure 15.

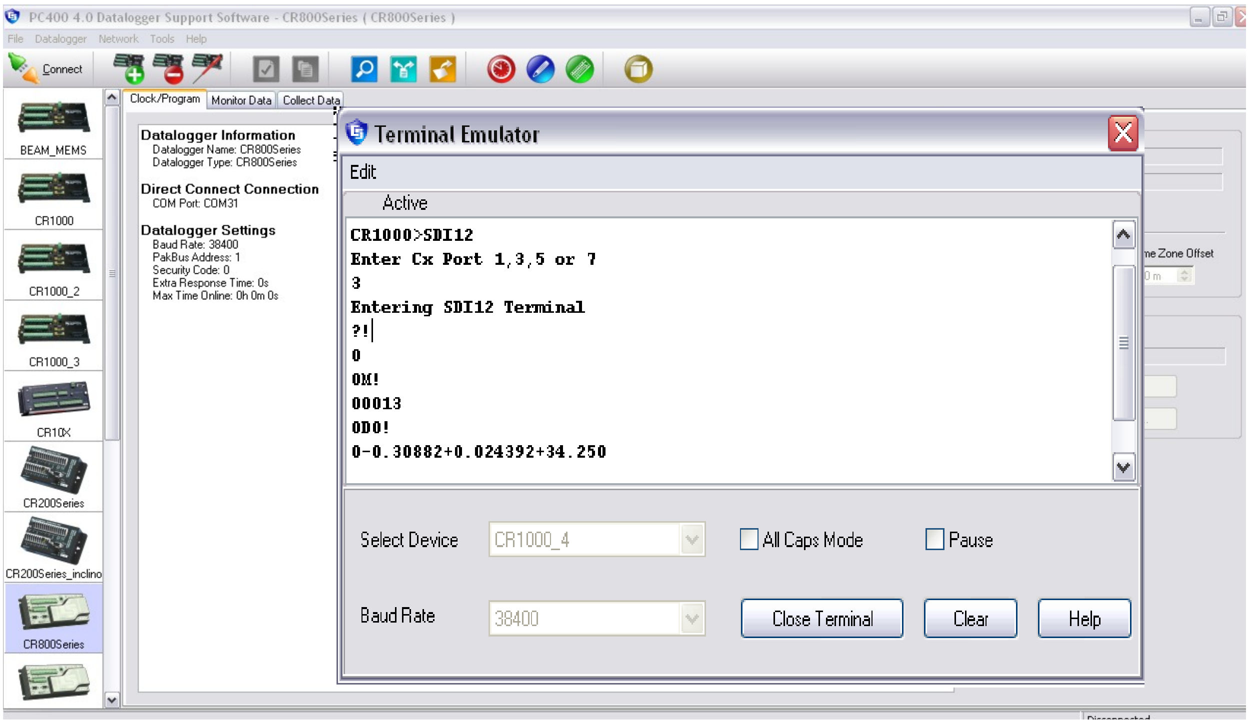


Figure 15: Terminal Emulator

7.2 With ESDL-30 Data acquisition system

ESDL-30 datalogger is designed to record data from the sensors connected to SDI-12 bus. The datalogger is having 3 SDI-12 ports (channels). Sensors having SDI-12 interface can be connected on a common SDI-12 bus. This bus can be connected to any SDI-12 port of the datalogger. 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.

These data files can be downloaded to PC using Configuration Manager software by connecting logger with data cable or Bluetooth. The downloaded readings get stored in the PC's Home Directory in CSV format. The downloaded files can be transferred to FTP server using internet connection. It can be processed on any commonly available spreadsheet like Microsoft-Excel.

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.

SDI-12 inputs should have a unique ID (0-9, a-z or A-Z). So one needs to set ID of sensors having SDI-12 output. 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.

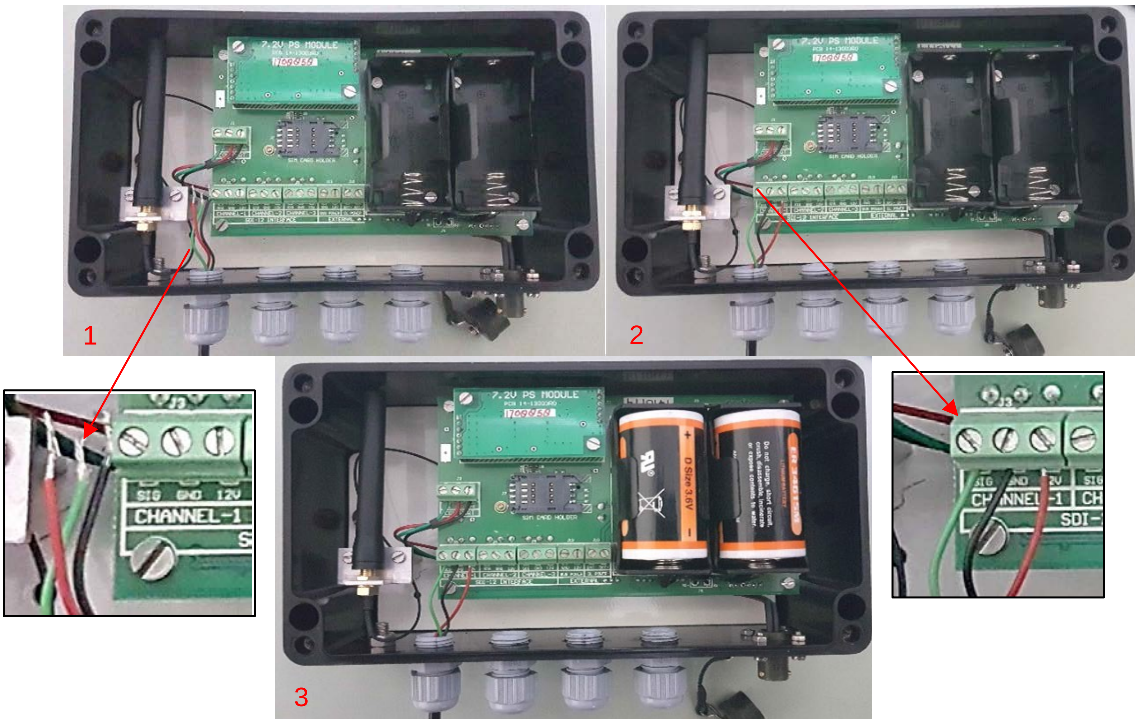


Figure 16: Connection of IPI with ESDL-30 Datalogger: 1- Datalogger shown without the IPI connection; 2- Datalogger shown with the IPI connection without internal batteries; 3- Batteries to be inserted after the IPI connection

7.2.1 Sensor Configuration with ESDL-30

1 Double click the SDI-12 Universal datalogger software icon on the Desktop. Then click "File" followed by "Create Site" as shown in figure 17 below:

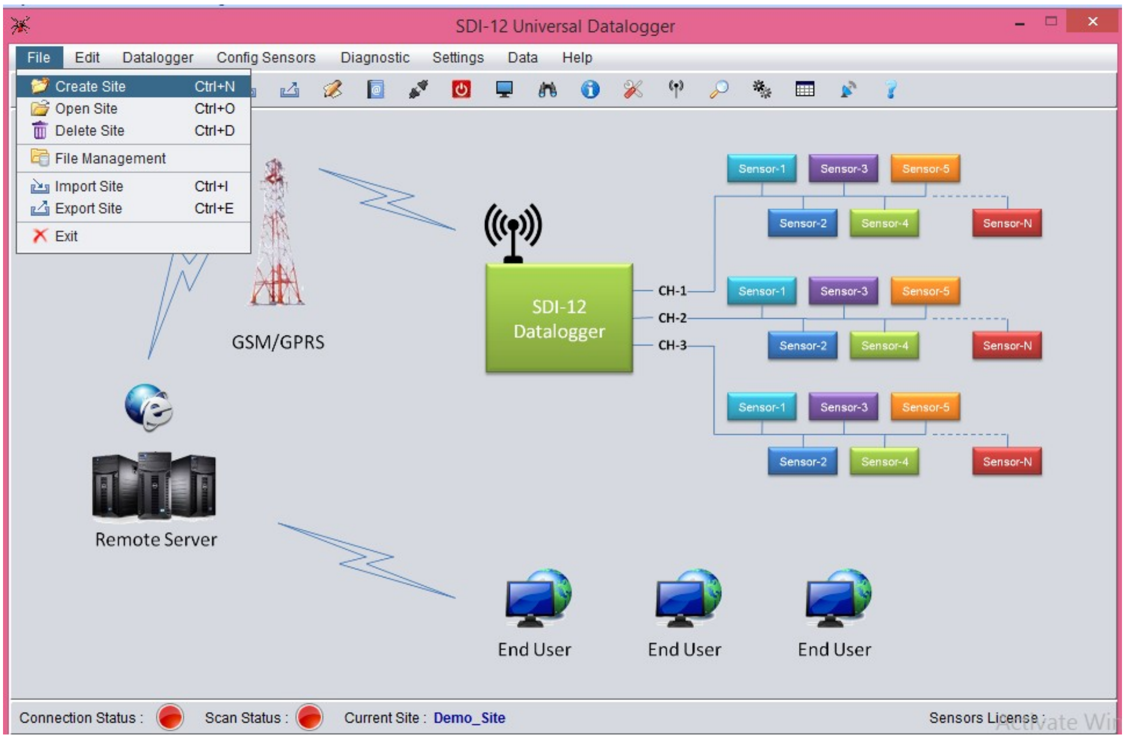


Figure 17 Home screen of EDSL-30UNI Configuration Manger Software

2 After clicking "Create Site", a "Create Site" window will appear as shown in figure 18 below. Enter "Site Name" and "Site Description". Then click "Save" button.

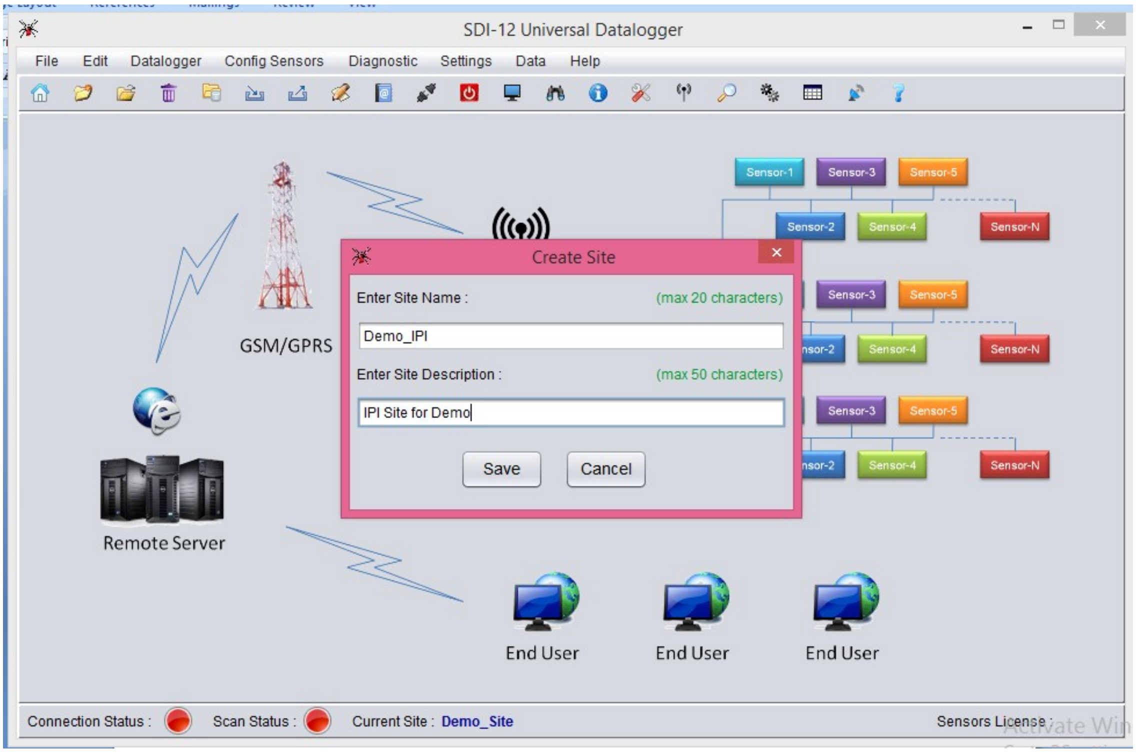


Figure 18 Create site window of EDSL-30UNI Configuration Manger Software

3 Then click "Datalogger" followed by "Connect/Disconnect Datalogger" as shown in figure 19 below.

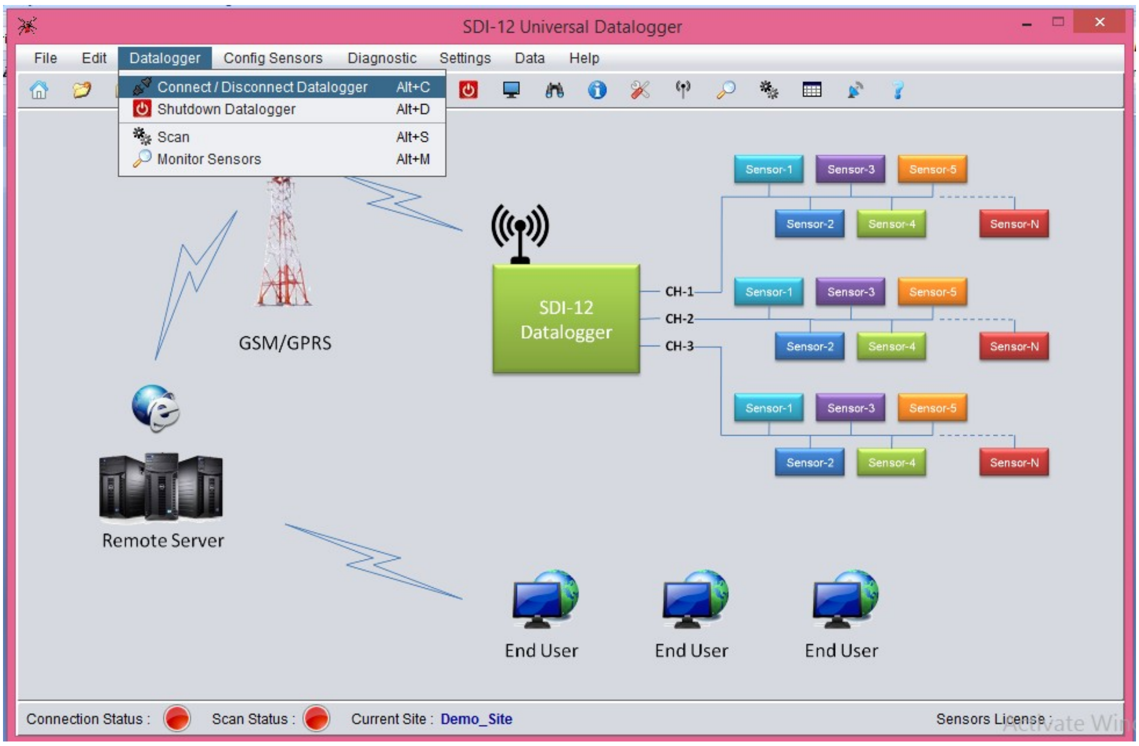


Figure 19 Datalogger menu of EDSL-30UNI Configuration Manger Software

4 After clicking "Connect/Disconnect Datalogger", a "Connection" window will appear as shown below. Select the usable "Com port" and then click "Connect" (figure 20).

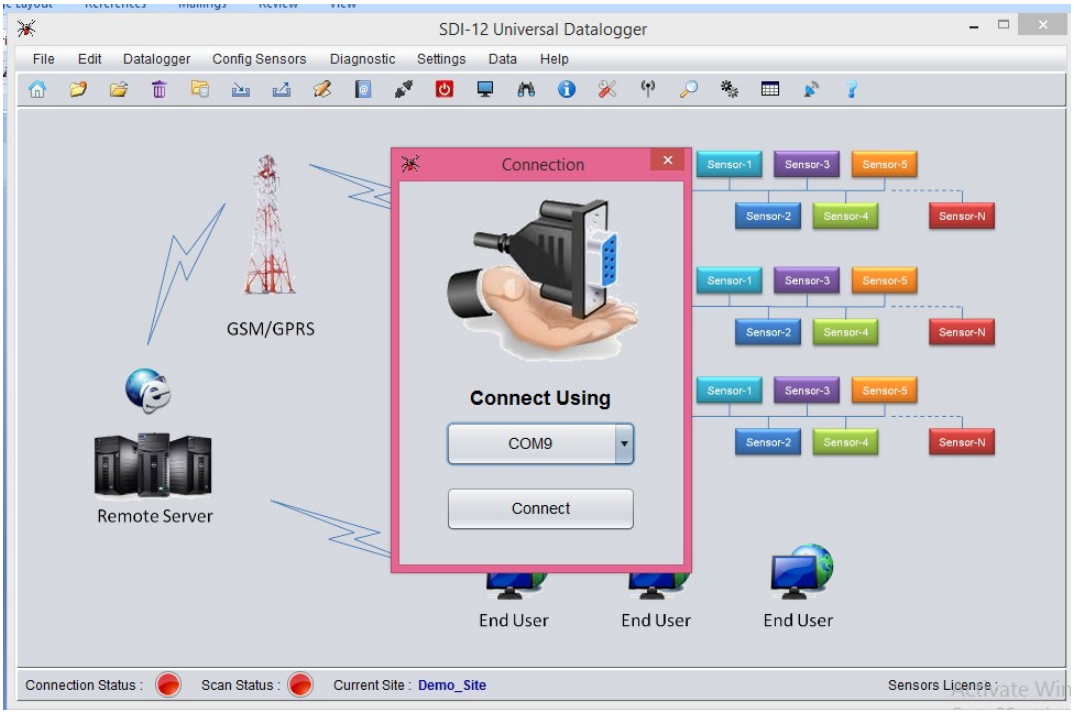


Figure 20 Dalalogger connection window of EDSL-30UNI Configuration Manger Software

5 Confirmation window showing Datalogger connection status will appear. Then click "OK" button. This will change the "Connection Status" from Red to Green (displayed at the bottom left in figure 21 below).

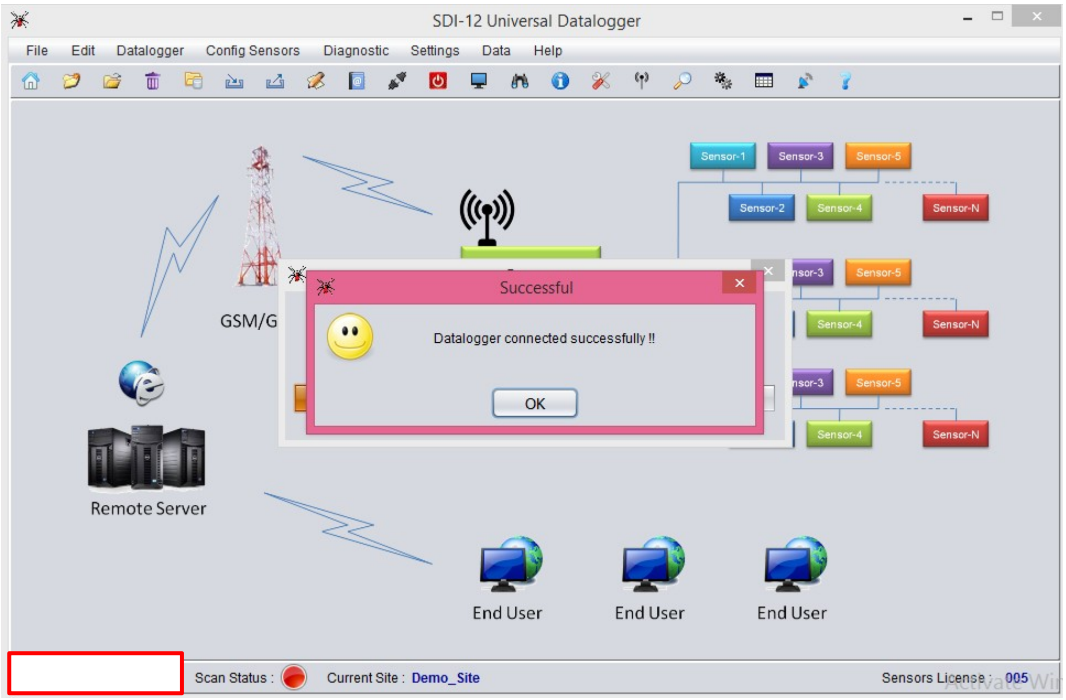


Figure 21 Datalogger connection status on EDSL-30UNI Configuration Manger Software

6 Then the Open Site window will appear automatically. Choose the created site file from "Select Site" dropdown menu and click "Open" (figure 22 and figure 23)

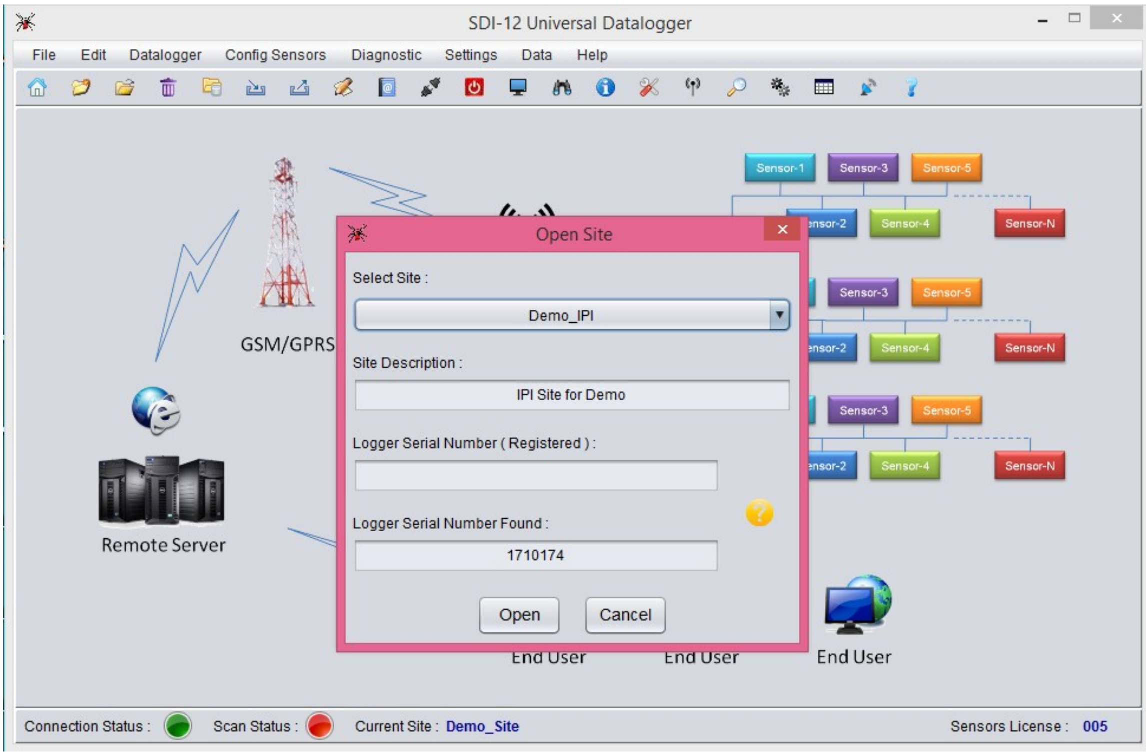


Figure 22 Open site window of EDSL-30UNI Configuration Manger Software

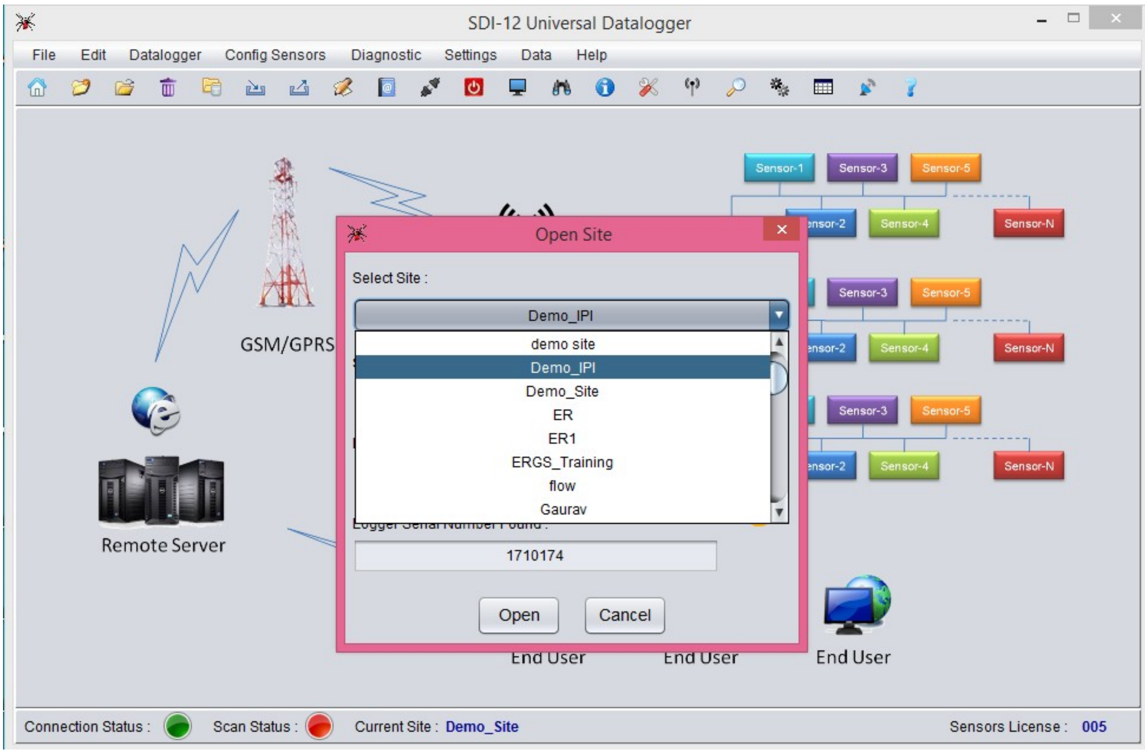


Figure 23 Open site window with dropdown list of sites of EDSL-30UNI Configuration Manger Software

7 Connect a single sensor to any Channel of the Datalogger physically. Click "Diagnostic" followed by "SDI-12 Terminal" to the set the ID of the sensor as shown in figure 24 below.

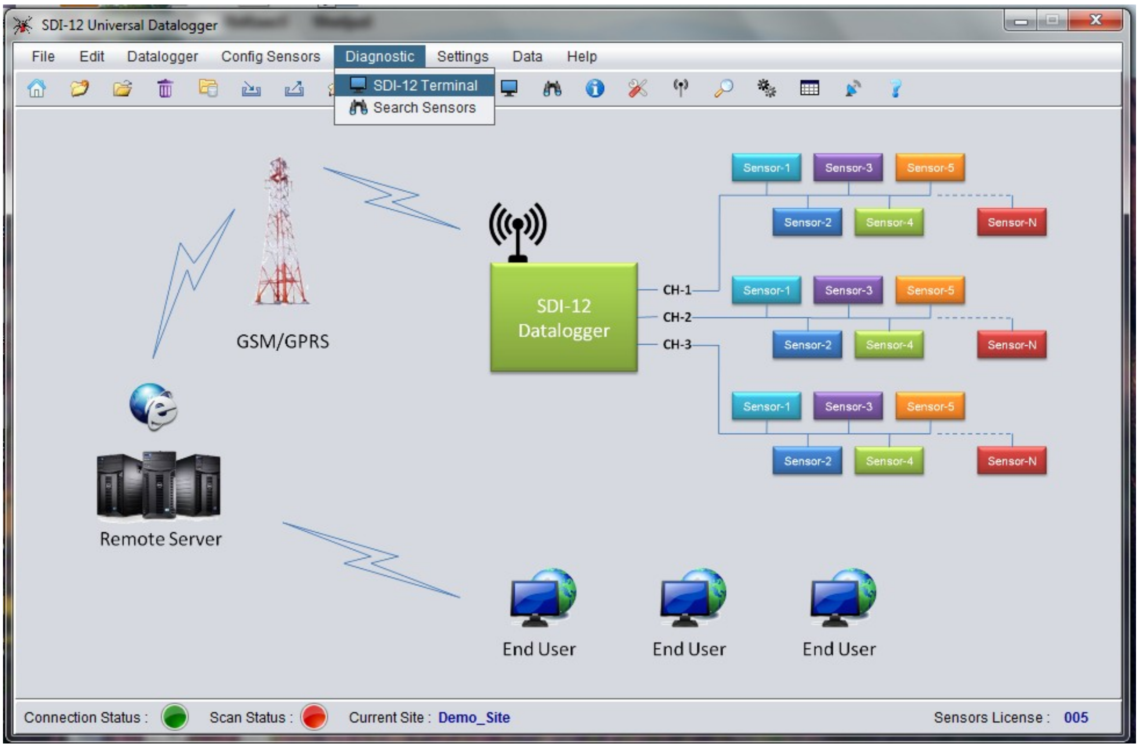


Figure 24 Assigning ID to SDI-12 sensor

8 In "SDI-12 Terminal" window (figure 25), select appropriate Channel number from the drop down list and then click "Update".

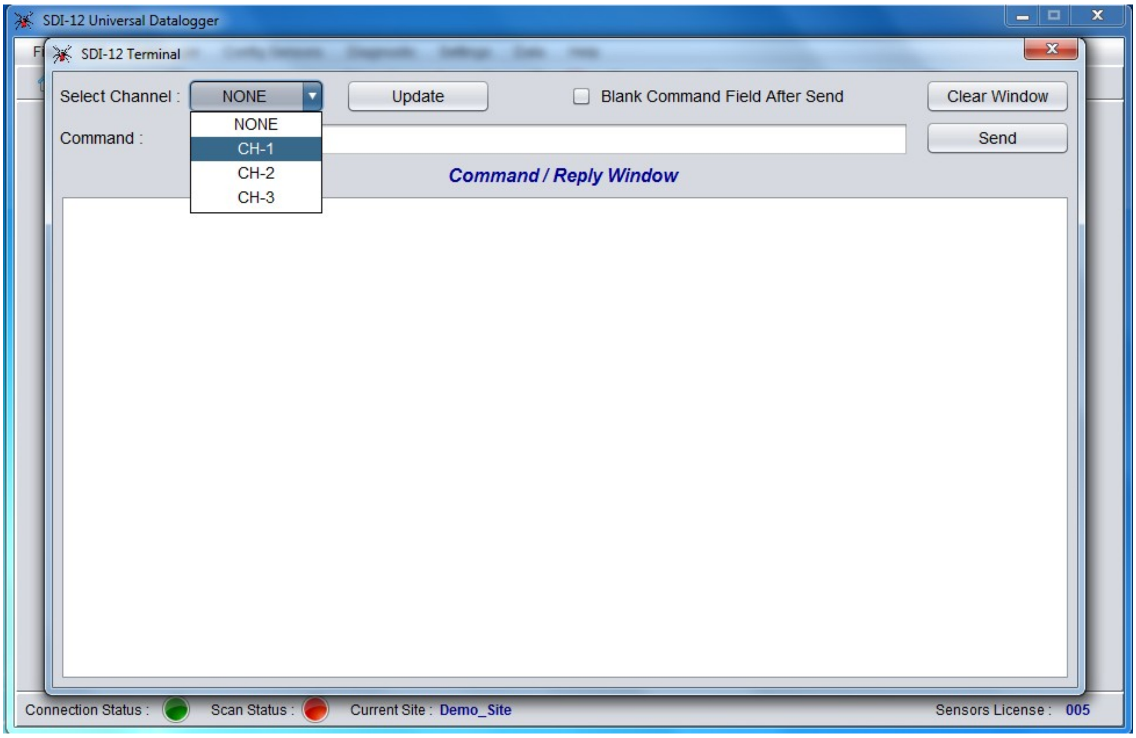


Figure 25 SDI-12 Terminal Window

9 Now type "?!" on the "Command" bar and click "Send" to read the sensor's present address (figure 26).

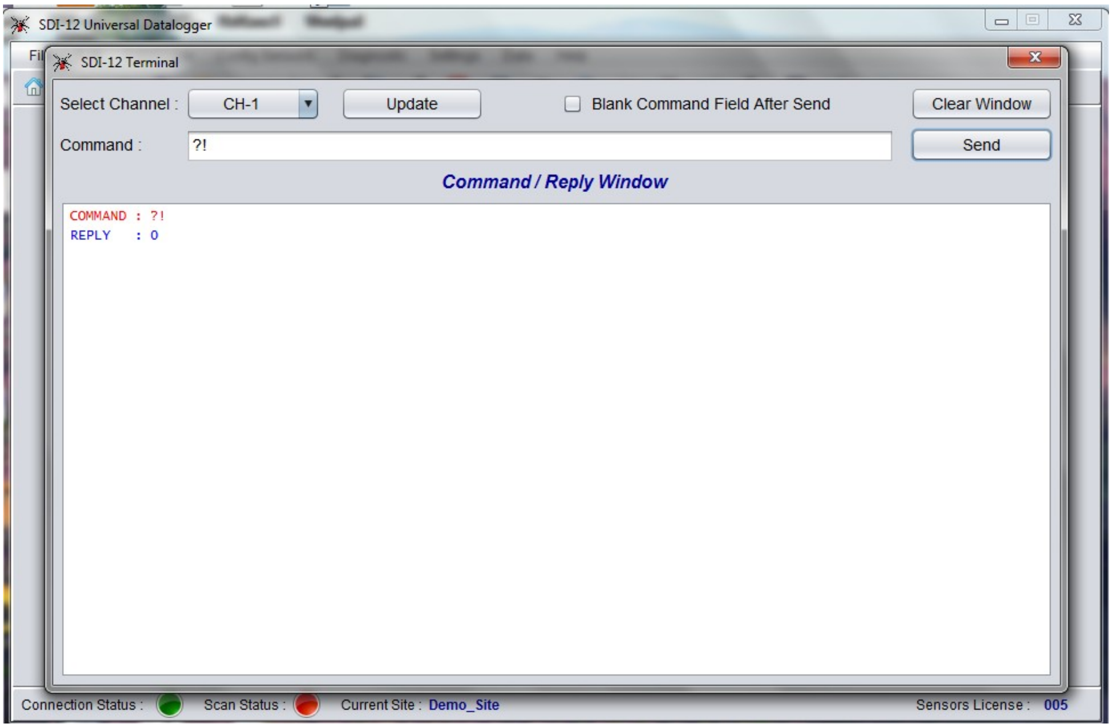


Figure 26 Command/Reply Window

10 To change the sensor address, type "oldaddr A newaddr !" then click "Send" as shown in figure 27 below. Now connect other sensors to the datalogger one by one and repeat the same procedure.

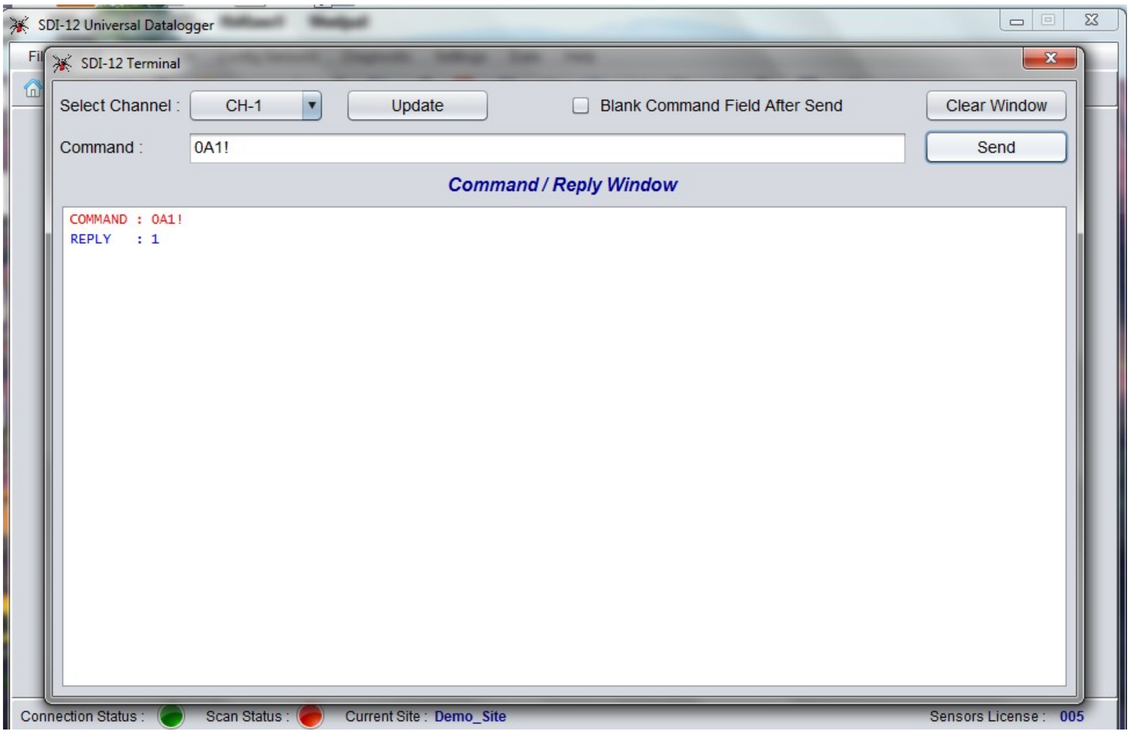


Figure 27: Command/Reply Window showing change in address

11 Click "Diagnostic" followed by "Search Sensors" to search the sensors connected with the Datalogger as shown in figure 28 below.

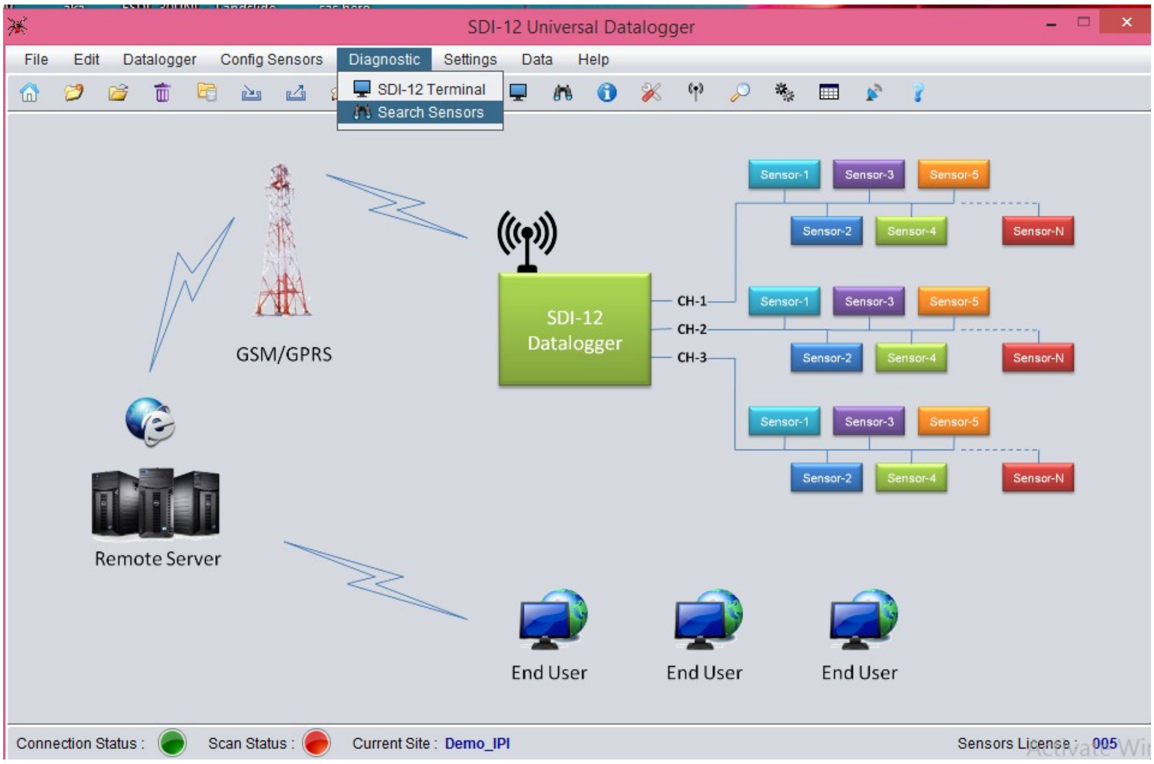


Figure 28 Diagnostic menu of EDSL-30UNI Configuration Manger Software

12 Click "Search Sensors" button to search all the sensors connected to the Datalogger (figure 29).

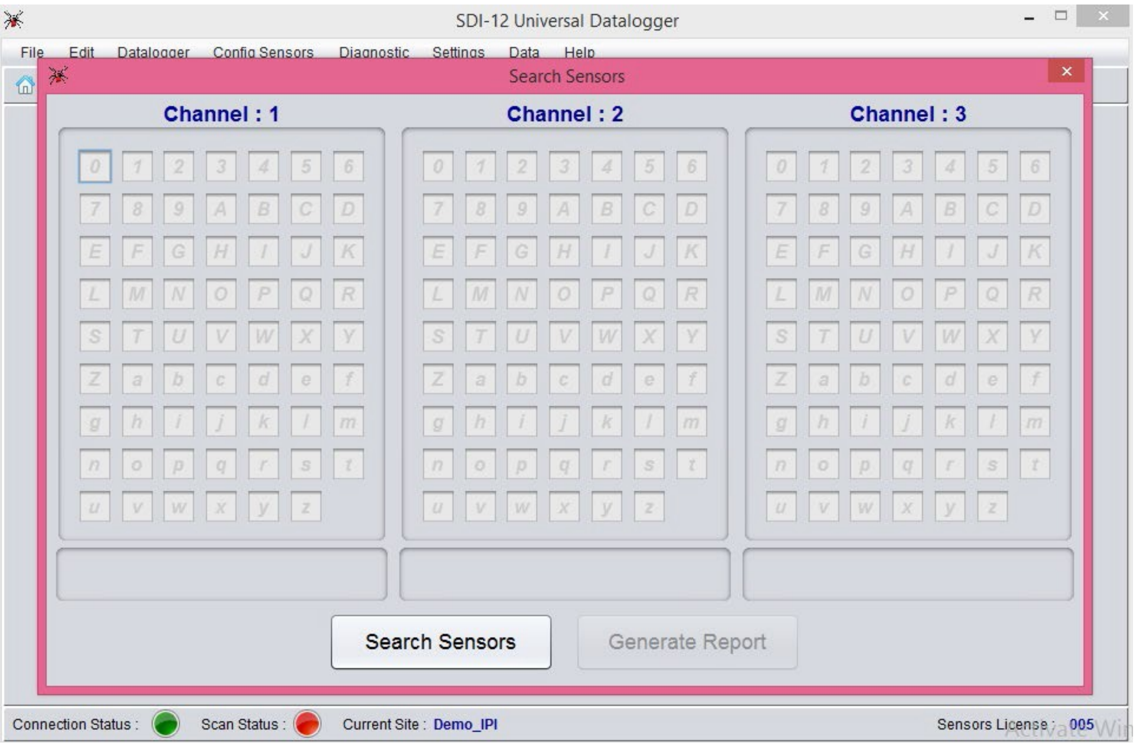


Figure 29 Search sensor window of EDSL-30UNI Configuration Manger Software

13 A message box showing progress of search will appear as shown in figure 30 below:

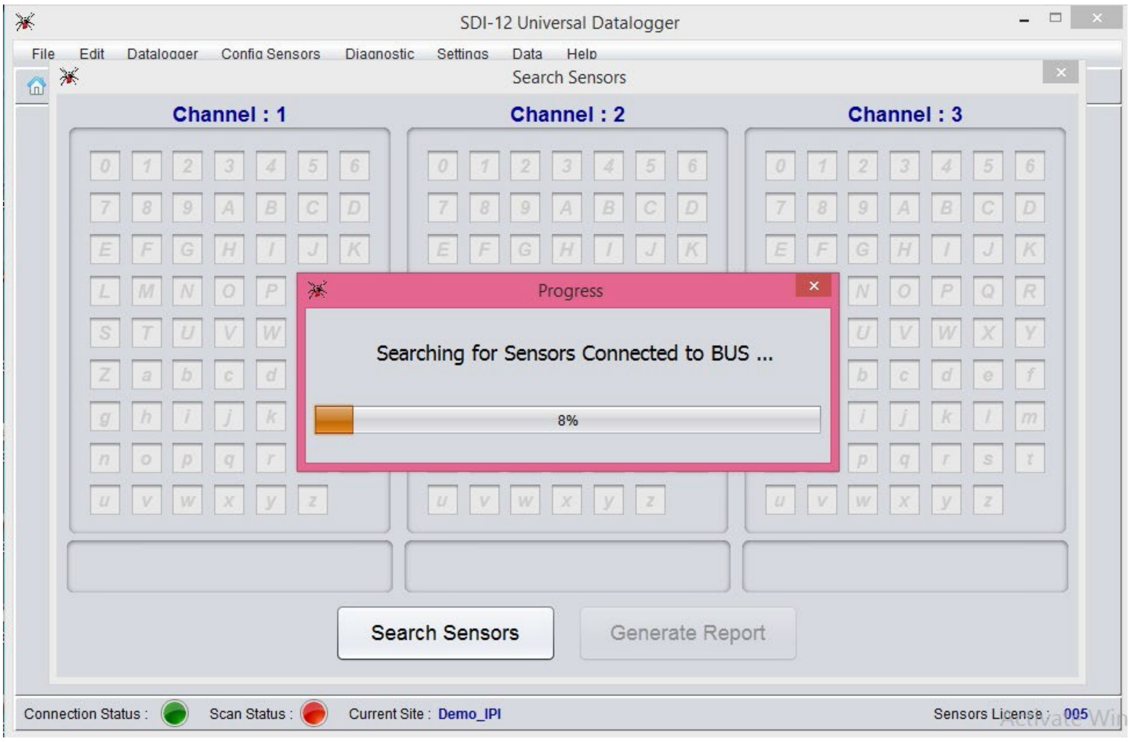


Figure 30 Message box showing sensor scan progress

14 On completion of search progress, addresses of sensor will be displayed (figure 31). Note down/generate report for later usage. Close "Search Sensors" window after use.

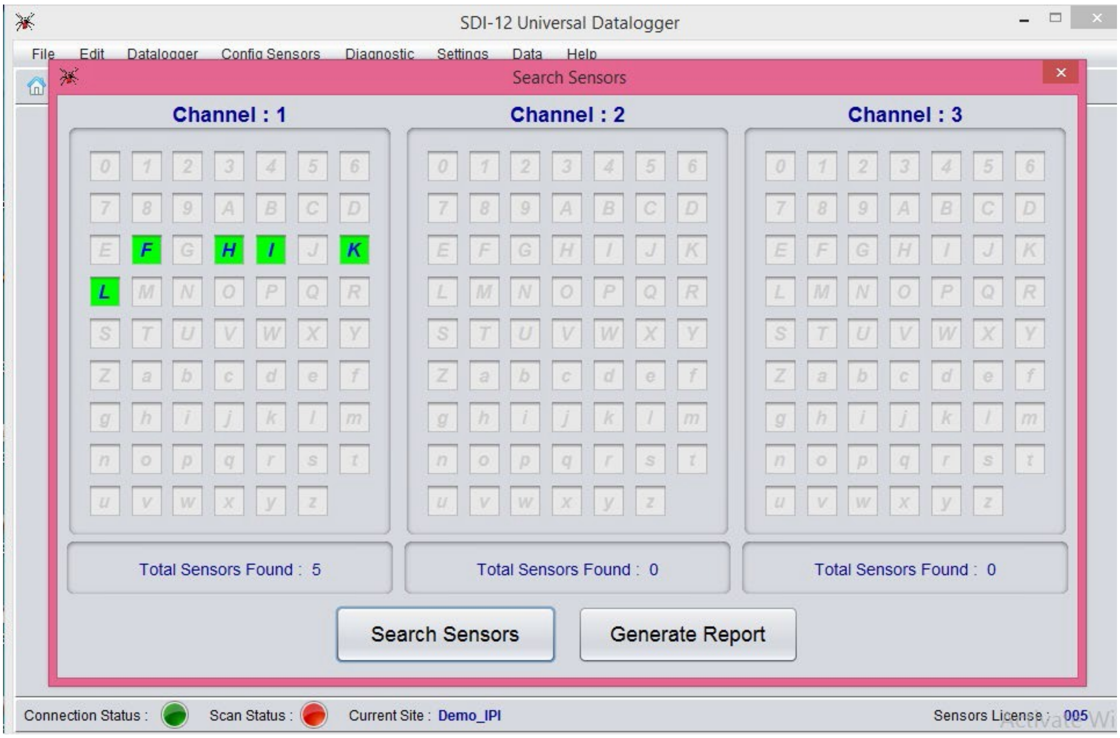


Figure 31 Search sensor window showing the detected sensors

15 Click "Edit" menu followed by "Sensor Table" as shown in figure 32 below to define the parameter name & unit of each sensor

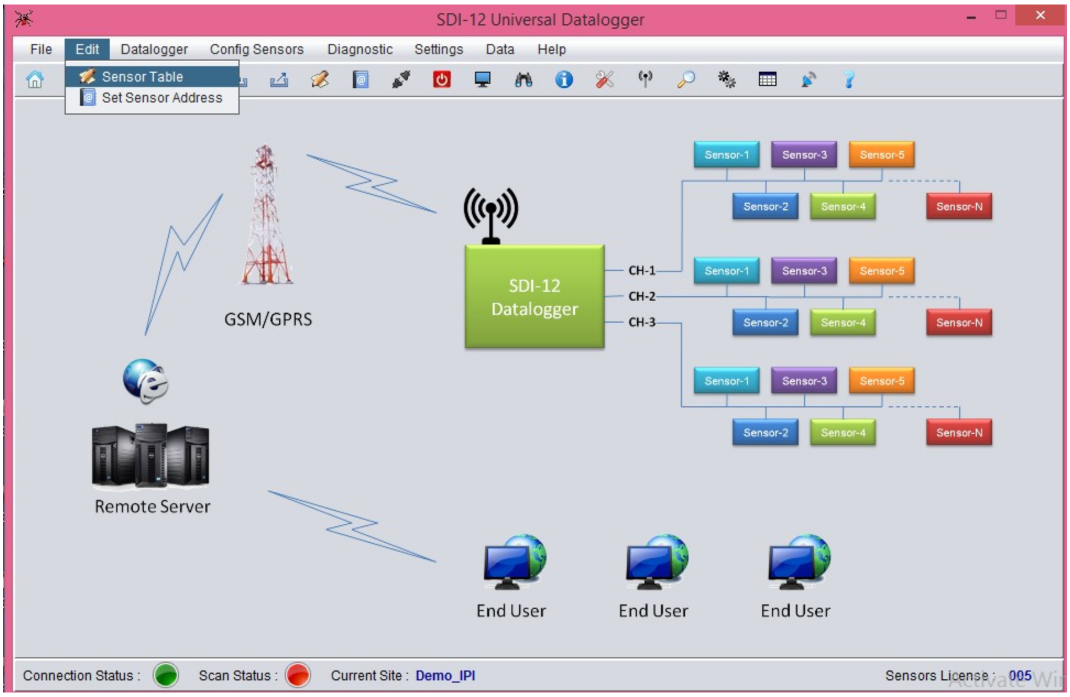


Figure 32 Edit menu with sensor table option of EDSL-30UNI Configuration Manger Software

16 In the "Sensor Table" window shown in figure 33 below, select appropriate channel from "Select Channel" & address from "Sensor Address" to which the sensor is connected. Then select the "Measurement Command Type" which is "M!" by default and "Select Number of Parameters" to be measured. Then click on "Edit Parameter Units"

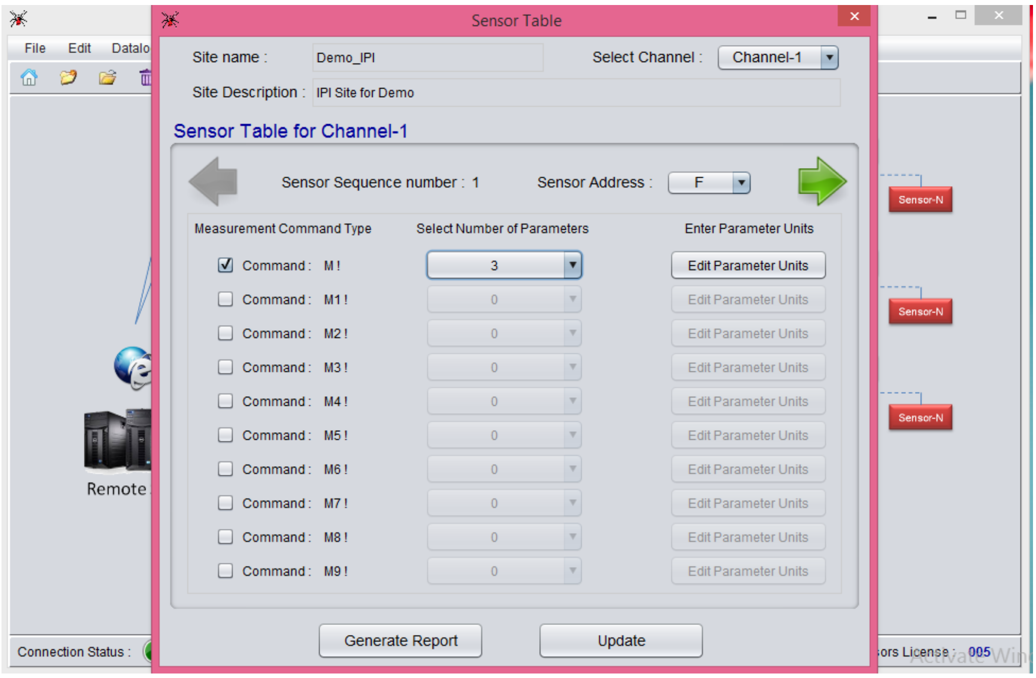


Figure 33 Sensor table window of EDSL-30UNI Configuration Manger Software

17 "Parameter Units" window will appear as shown in figure 34 below. Enter the required "Parameter Name" & "Parameter Unit". Then click "Exit"

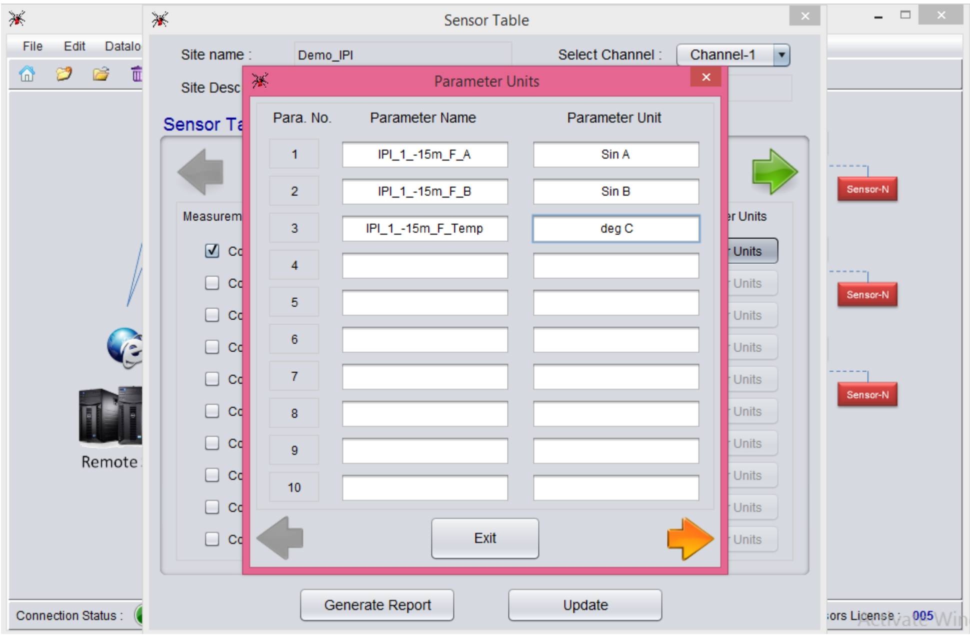


Figure 34 Paramaters unit window of EDSL-30UNI Configuration Manger Software

18 Click  (figure 35) to define the parameters of next sensor connected and repeat the steps mentioned in Point no. 13 & 14 and so on. After defining parameters for all the sensors connected to the Datalogger, click "Update" button.

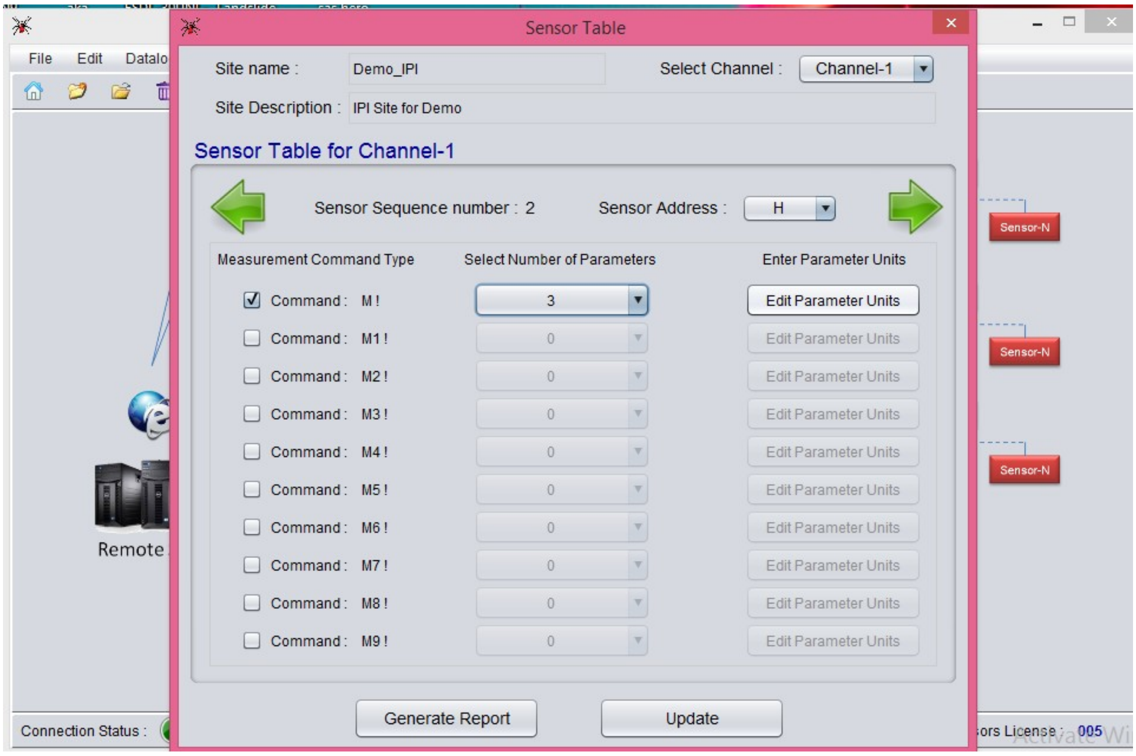


Figure 35 Selecting next sensor to be programmed in Sensor Table window

19 "Warning" message window will appear (figure 36). Click "Yes"

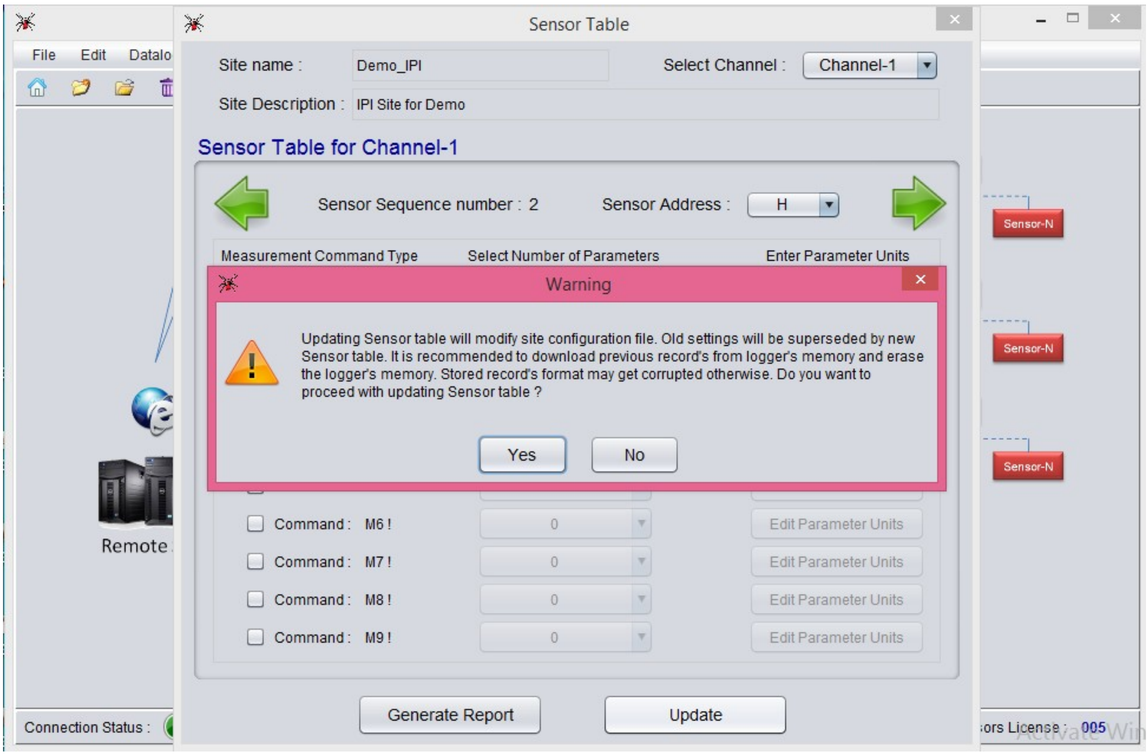


Figure 36 Warning message window appearing upon update of sensor table window

20 Now "Erase Memory" window will appear (figure 37). Click "Yes".

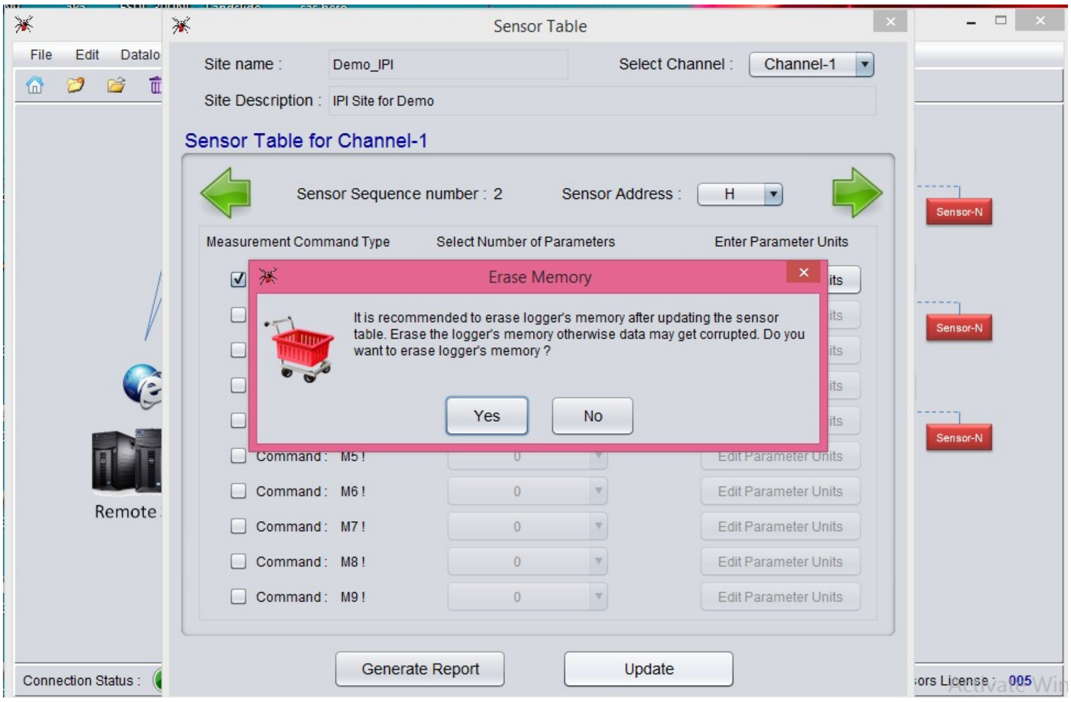


Figure 37 Esase memory window appearing upon update of sensor table window

21 Click on "Datalogger" menu followed by "Monitor Sensors" as shown in figure 38 below:

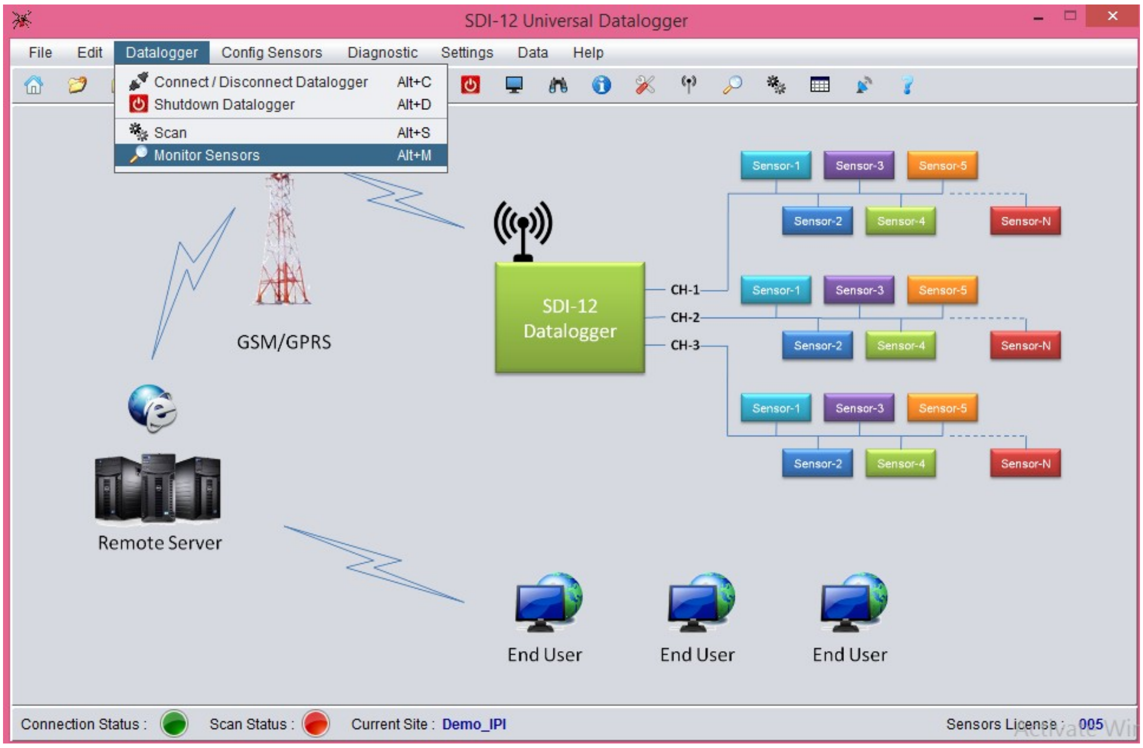


Figure 38 Monitor sensors option inside Datalogger manu

22 After clicking "Monitor Sensor" tab, a window will appear as shown in figure 39 below. Select appropriate Channel and click "Start" Button for sensor readings in Real Time

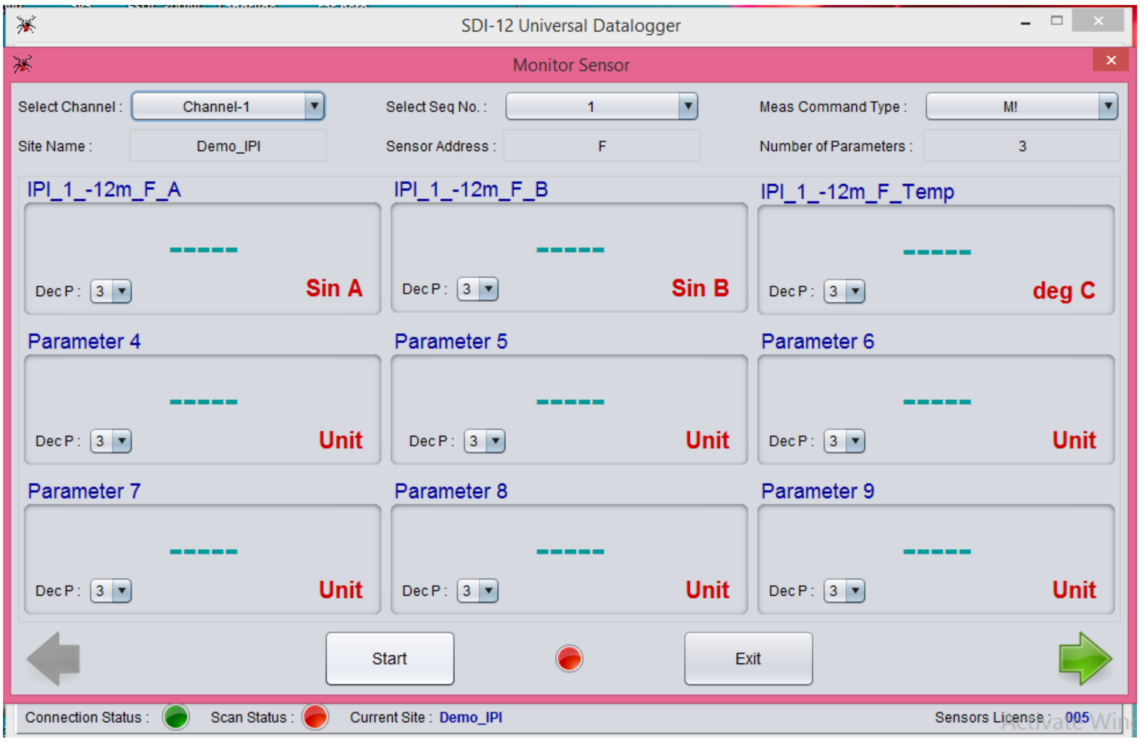


Figure 39 Monitor sensor window

23 Sensor readings for selected "Channel" & "Sequence no." will be displayed as shown in figure 40 below. Click "Exit" button to close this window.

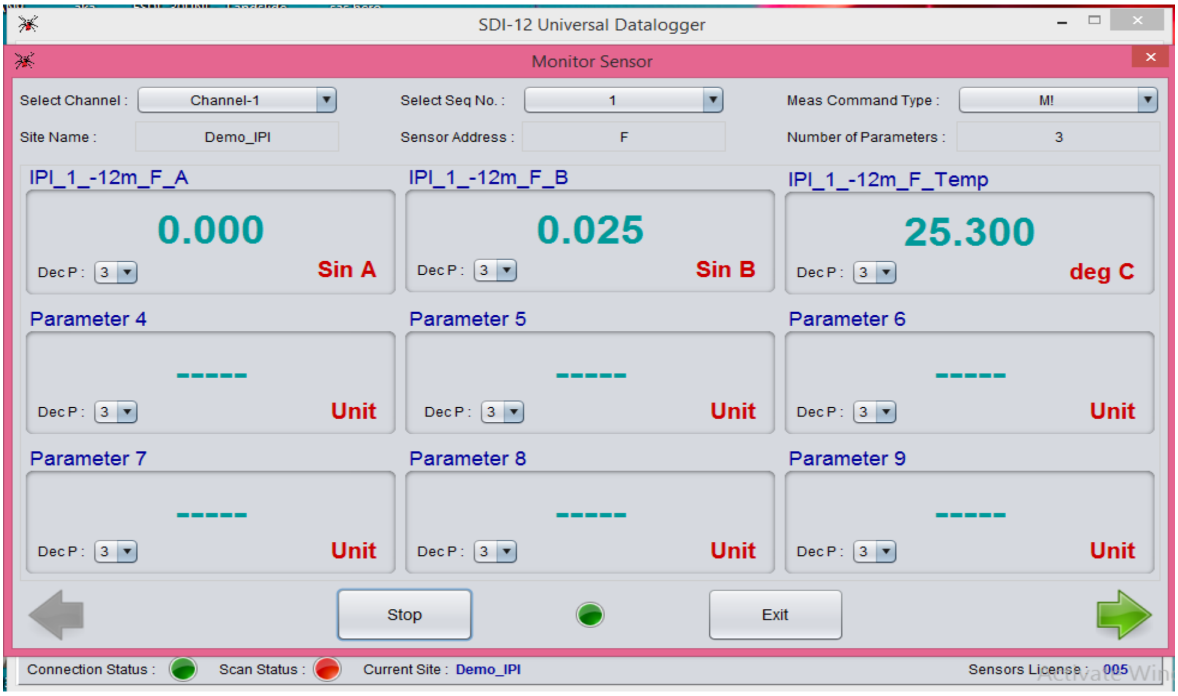


Figure 40 Measured sensor values appearing in Monitor Sensor window

24 Click "Settings" followed by "GPRS Modem" (figure 41) to configure FTP settings.

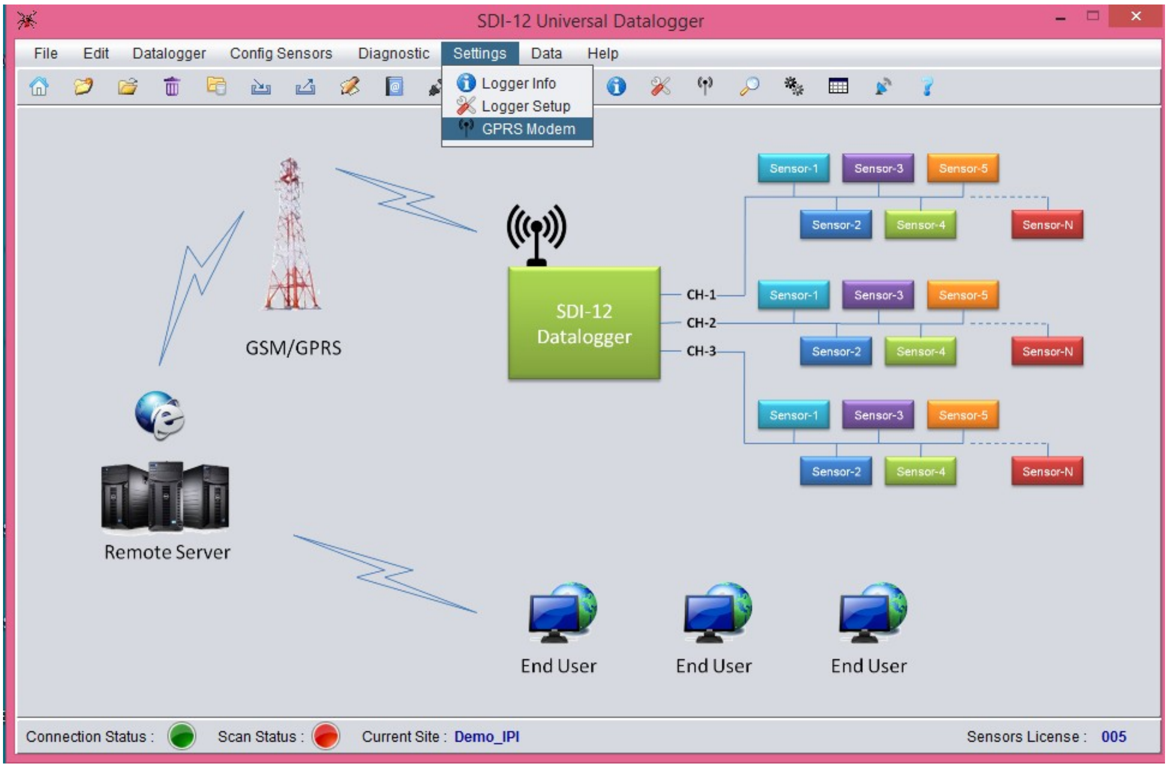


Figure 41 GPRS Modem option under Settings menu

25 Enter appropriate FTP credentials and click "Update". Then, set "Upload Time" as required and click update (figure 42).

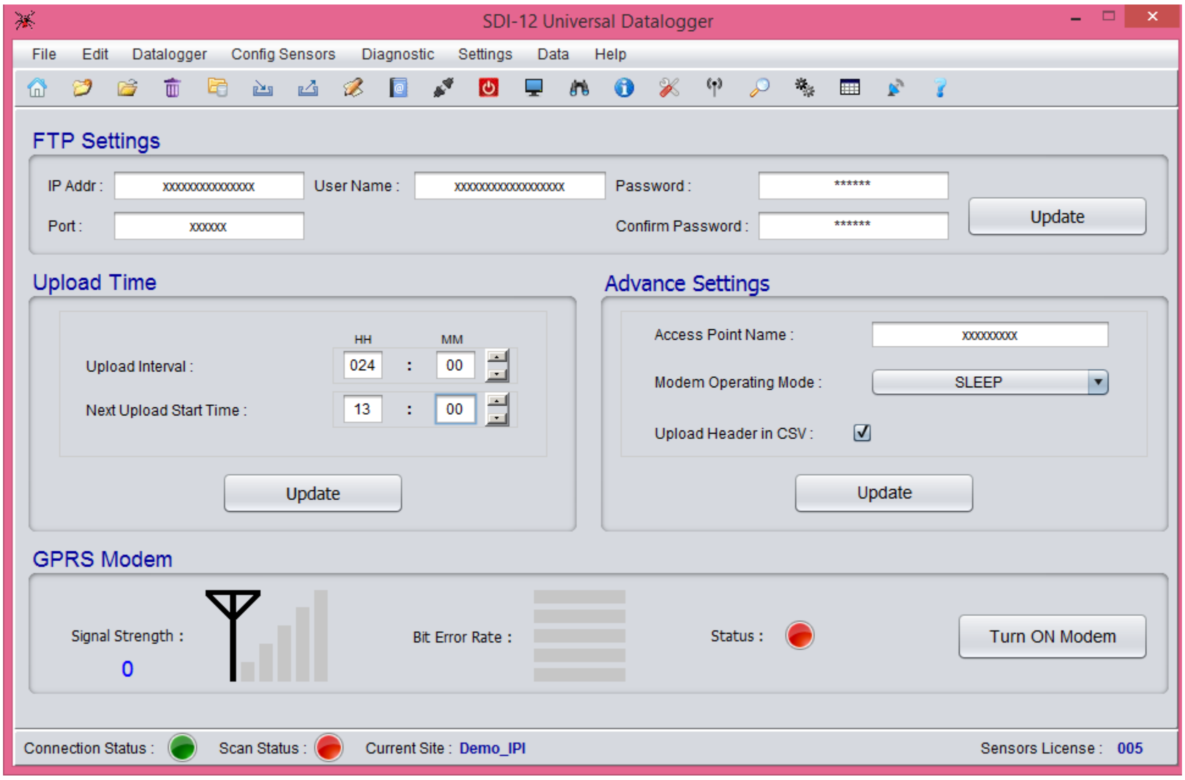


Figure 42 FTP settings window

26 After completing GPRS modem settings, click "Datalogger" followed by "Scan" to set the Datalogger Scan interval (figure 43):

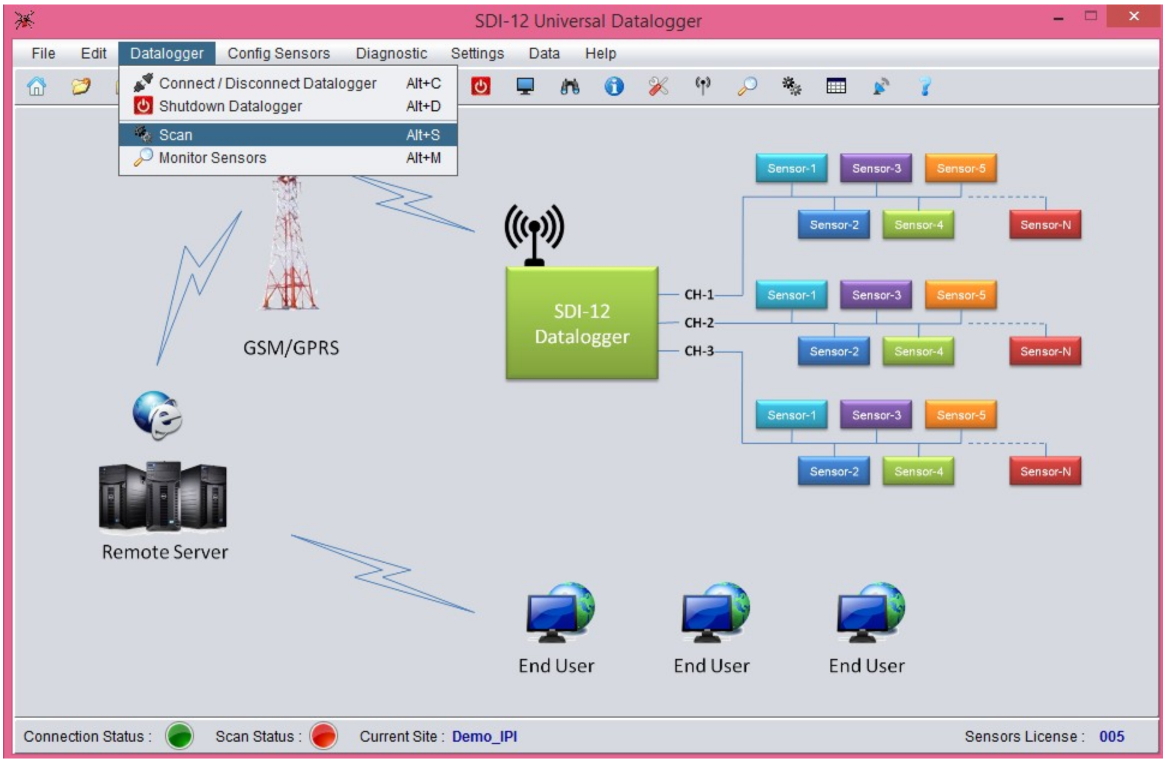


Figure 43 Scan option under Datalogger menu

1. Set "Scan Option" as required and click "Update" (figure 44)

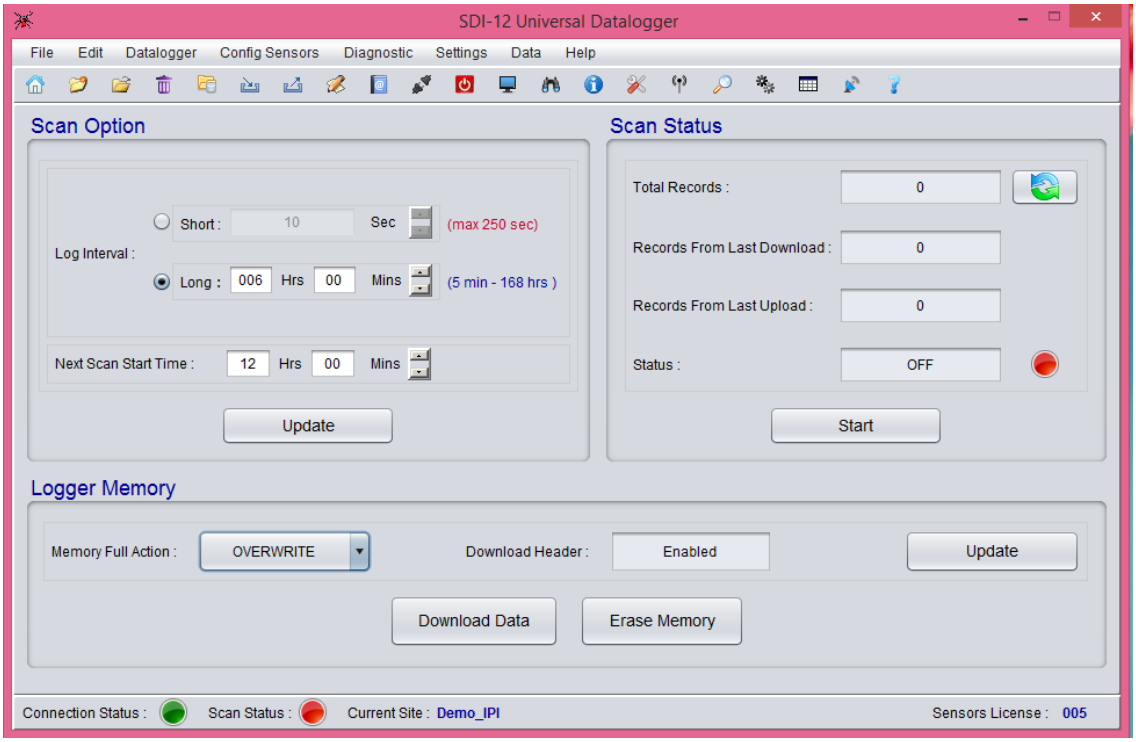


Figure 44 Configuring scan setting in Scan window

2. After updating, colour of "Scan Status" will change from Red to Green (as displayed at the bottom left corner of figure 45 below). Now click "Datalogger" followed by "Connect/Disconnect Datalogger"

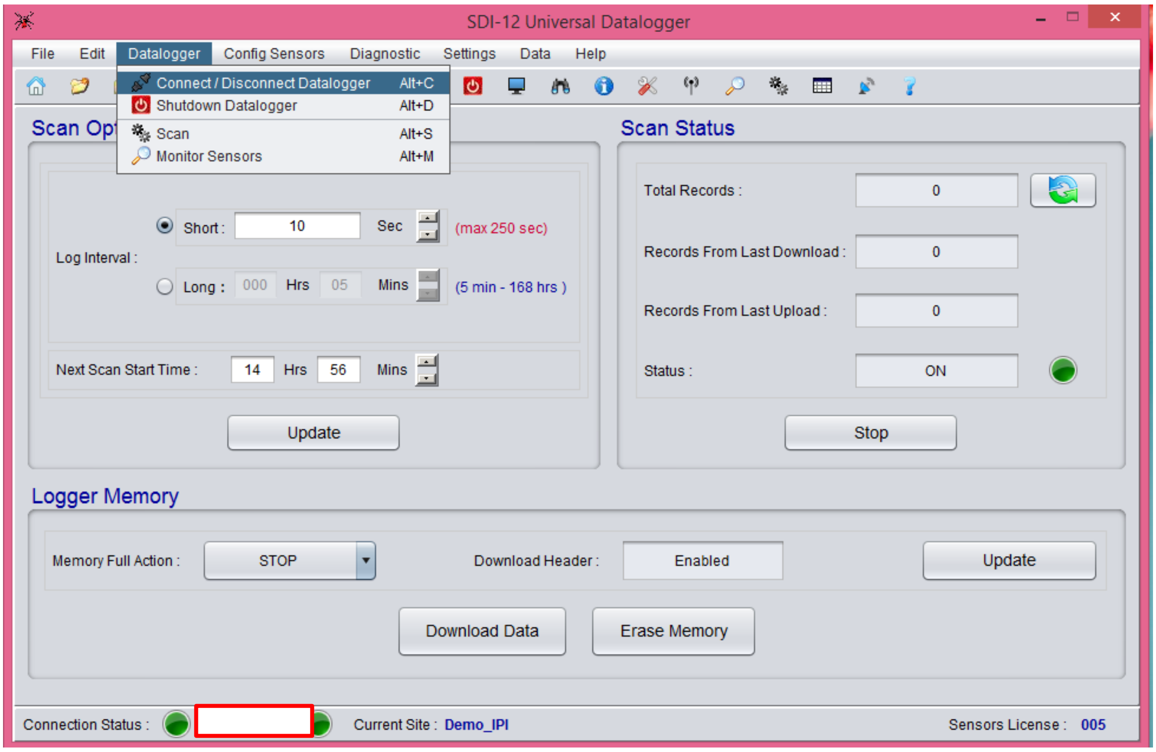


Figure 45 Scan status indicator in Scan window

3. Click "Disconnect" button to disconnect the Datalogger from Computer/ Laptop (figure 46).

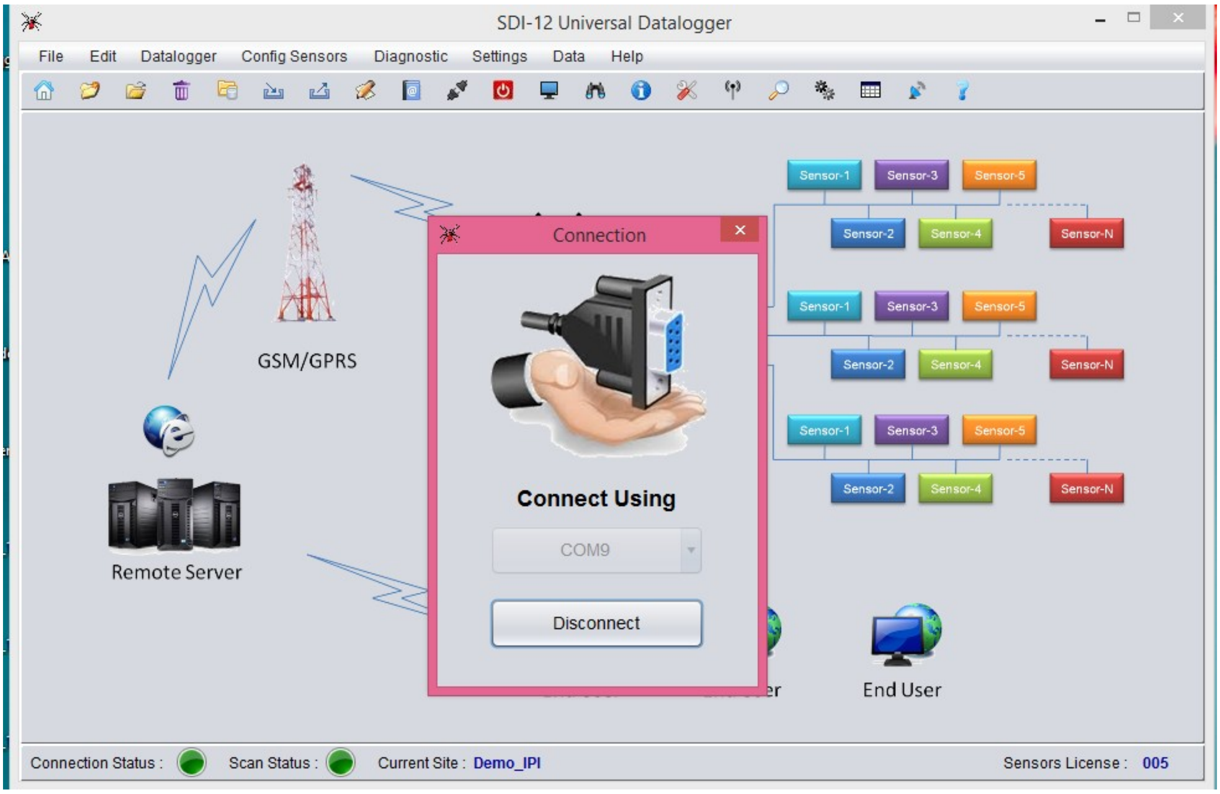


Figure 46 Disconnecting datalogger rom PC

8 SAMPLE TEST CERTIFICATES

TEST CERTIFICATE
(for 'A' axis calibration)

Item	:	Inplace Inclinometer tilt Sensor	Date	: 20.04.2017
Model	:	EAN-52M-B IPI	Temperature	: 21 ºC
Range	:	±15º		
Serial No.	:	E160180		

Next calibration due on :19.04.2018

Test data

Test position Arc degrees (A)	Corrosponding SinA	Observed SinA A' axis	Offset corrected SinA A' axis	Non-conformance (% fs) 'A' axis
15	0.2588	0.2584	0.2589	0.0197
12	0.2079	0.2074	0.2079	0.0153
9	0.1564	0.1559	0.1564	0.0315
6	0.1045	0.1039	0.1043	0.0763
3	0.0523	0.0519	0.0524	0.0120
0	0.0000	-0.0004	0.0000	0.0000
-3	-0.0523	-0.0525	-0.0521	0.0858
-6	-0.1045	-0.1046	-0.1042	0.1238
-9	-0.1564	-0.1566	-0.1561	0.1149
-12	-0.2079	-0.2081	-0.2077	0.0857
-15	-0.2588	-0.2591	-0.2587	0.0645

Max non-conformance (% fs) : 0.12

Calculation of tilt value (arc degree) :

$$A = \sin^{-1}(\text{observed output})$$

Wiring colour code :

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

Checked by   Tested by

TEST CERTIFICATE
(for 'B' axis calibration)

Item	:	Inplace Inclinometer tilt Sensor	Date	: 20.04.2017
Model	:	EAN-52M-B IPI	Temperature	: 21 ºC
Range	:	±15º		
Serial No.	:	E160180		

Next calibration due on :19.04.2018

<u>Test data</u>

Test position Arc degrees (B)	Corrosponding SinA	Observed SinB B' axis	Offset corrected SinB B' axis	Non-conformance (% fs) 'B' axis
15	0.2588	0.2584	0.2585	0.1078
12	0.2079	0.2075	0.2077	0.0741
9	0.1564	0.1561	0.1563	0.0520
6	0.1045	0.1043	0.1044	0.0342
3	0.0523	0.0522	0.0524	0.0132
0	0.0000	-0.0002	0.0000	0.0000
-3	-0.0523	-0.0523	-0.0521	0.0803
-6	-0.1045	-0.1044	-0.1042	0.1115
-9	-0.1564	-0.1563	-0.1561	0.1176
-12	-0.2079	-0.2079	-0.2077	0.0934
-15	-0.2588	-0.2590	-0.2588	0.0035

Max non-conformance (% fs) : 0.12

Calculation of tilt value (arc degree) :

$$B = Sin^{-1}(\text{observed output})$$

Wiring colour code :

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

Checked by

Tested by