



Ultra-Low Power Precision Sensing & Wireless Communication

*SenScope*TM

Software Manual (V.4.4)

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I. Introduction of SenScope™

SenScope™ software is the control panel and primary user interface developed by Resensys capable of data collection, visualization, and processing. It can either work online or offline to adapt to different scenarios.

In Remote Mode, the data comes from the Resensys servers or in some cases to a remote AWS RDS read-replica and can be accessed anywhere with Internet access. Data is dumped in batches in this mode per the sampling rate of the SeniMax™, so the user should expect new data to appear once every hour in normal operation. These data packets are pushed to either resensys.net, a collection of on-premises servers owned by Resensys, or to an AWS cloud service for read-only access of the database.

In the offline mode (Live Mode or Local Mode), the data are collected on site. Therefore, the USBSink™ dongle is needed instead of the SeniMax™ and the dongle should be close enough to the device (≤ 950 meters free space).

II. Installing SenScope™

1. Locate the USBSink™ dongle and set aside; this tool will be necessary should you need to use SenScope in local or live mode.



2. Download the SenScope™ software and other required software packages from the following links.

resensys.net servers: <http://www.resensys.com/Software/SenScope/SenScope.zip>

AWS Servers: <https://www.resensys.com/Software/SenScopeAWS/SenScopeAWS.zip>

.Net framework 4.7 runtime package: <https://dotnet.microsoft.com/download/dotnet-framework-runtime>

3. Install SenScope™ and all other necessary packages.
4. Insert the USB License Dongle and the USBSink™ to the computer.
5. Install the Driver for the USBSink™. When the Internet is available, the installation should be completed by Windows automatically. If not, visit the link below to download it.

https://www.resensys.com/Software/SenScope/CP210x_VCP_Windows.zip

III. Live/Local Mode (Offline Mode)

A. Live vs. Local Mode

The only difference between live mode and the local mode is that in local mode the data (packets from SenSpot™) are stored in a local database file on the computer’s hard drive so that SenSpot™ data are accessible after SenScope™ is closed. However, in the live mode the data is deleted after the SenScope™ is closed.

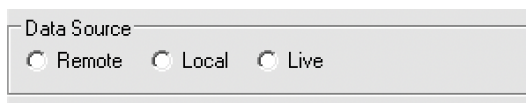
B. Viewing the data in the live/local mode

■ Opening the port

1. Open SenScope™ and switch to offline mode by pressing the middle button at the top-left corner of the window (Internet access is not required and the username and the password are not needed here).

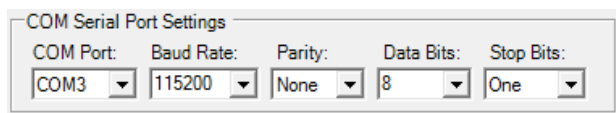


2. Select “Local” mode or “Live” mode from the “Data Source” area (top-left corner).

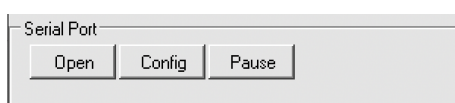


3. Switch to the “Real Time” tab in the middle left of the main window if it is not the current tab.
4. Select the COM port the USBSink™ is connected to in the “COM Serial Port Setting” area (bottom-left corner). If the port number is unknown, go to the device manager of Windows to look it up. The device name should be CP210X.

- Note: If the COM port has been assigned to the USBSink device as seen in device manager, then the corresponding COM port in SenScope should have already been selected.

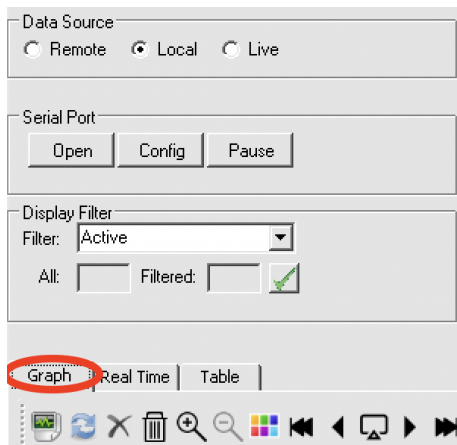


5. Make sure there is at least one working SenSpot™ or SeniMax™ near the USBSink™. Click “Open” button (top-left corner) to open the COM port. The packets should appear in the display area and the device IDs should appear in the “Sensor List” after some time (according to the transmission interval of the SenSpot™, it may take as long as 6 minutes).



- **Viewing the data and graphs in the live/local mode**

1. Switch to the “Graph” tab at the middle left of the main window.



2. Select one or several devices in the “Sensor List”.

3. Select one data type in the “Quantity” table.

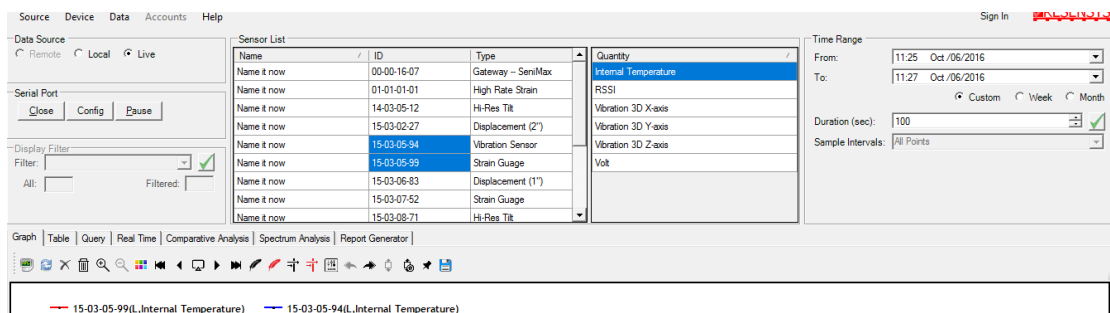






Figure 2.1 the control panel of live mode

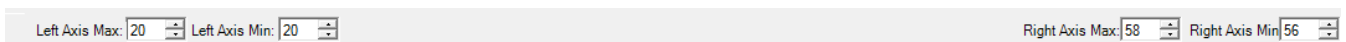
4. Click  to plot the figure.

5. The display duration can be adjusted by entering the desired time duration in







6. The Y-Axis range is automatically adjusted by default. If it's in the Manual Axis mode, click 


and it will become grey , indicating the Auto Axis mode is on. Click  to switch to Manual Axis mode and adjust the range manually by typing the range in the text boxes at the bottom side



of the window.

7. SenScope™ also supports dual Y-Axis display. The Y-Axis's position can be adjusted by using .

For example, click  and it becomes grey . At this time if  is clicked to draw a figure, the Y-Axis of the figure will be on the left side. Similarly, after clicking  the next figure's Y-axis will be on the right side. Both Y-Axis can be shown in the same figure and they can have different data types and scales.

- Click  to delete all the figures or click  to delete the figure of the currently selected item.

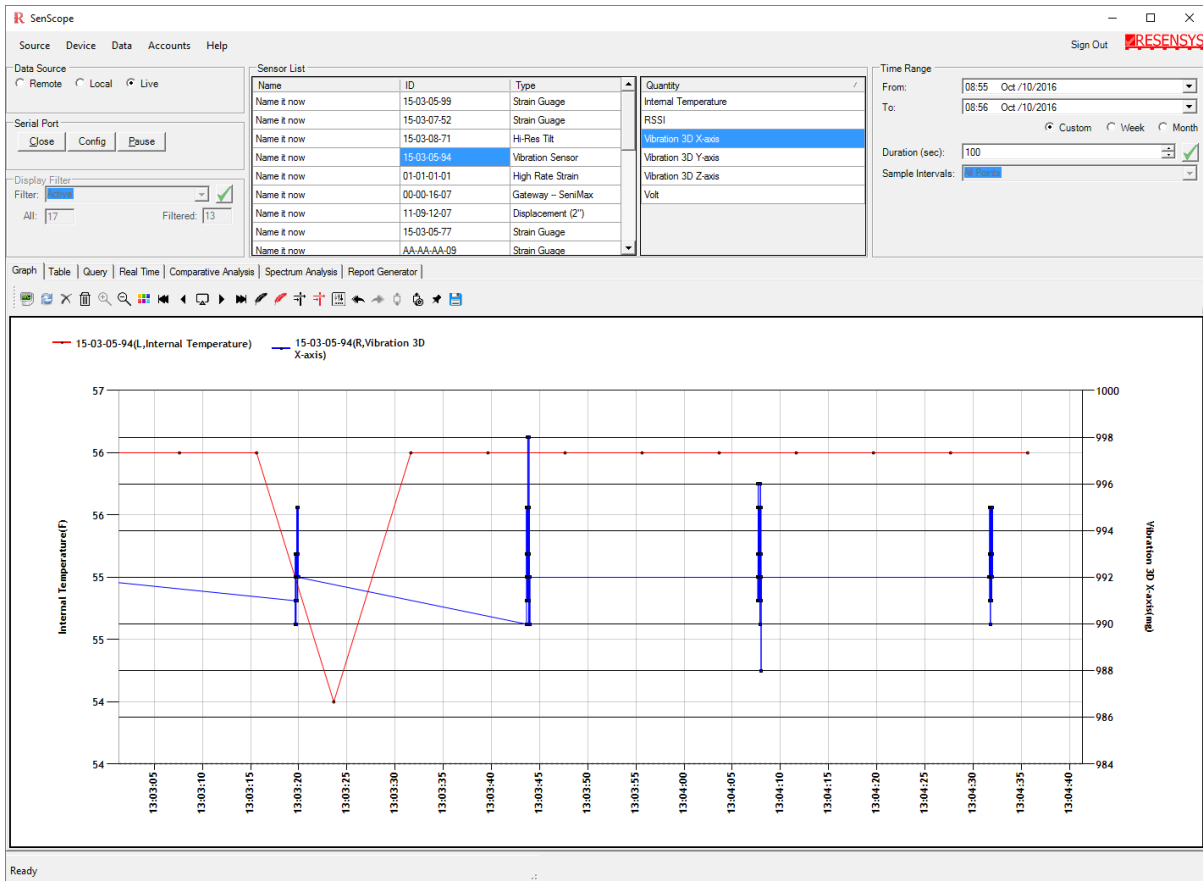


Figure 2.2 Screenshot of the live mode

C. Setting Offsets, Coefficients, and Reference

It should be noted that in order to visualize the raw data on the graph, an offset and coefficient is applied to the raw data. For each data type, there are some default values which can be changed by the user for further fine tuning. These numbers can be accessed through the Calibration tab in the Device's Properties windows (right click the device in the "Sensor List" and click "Properties". This window is shown in Figure 2.3.

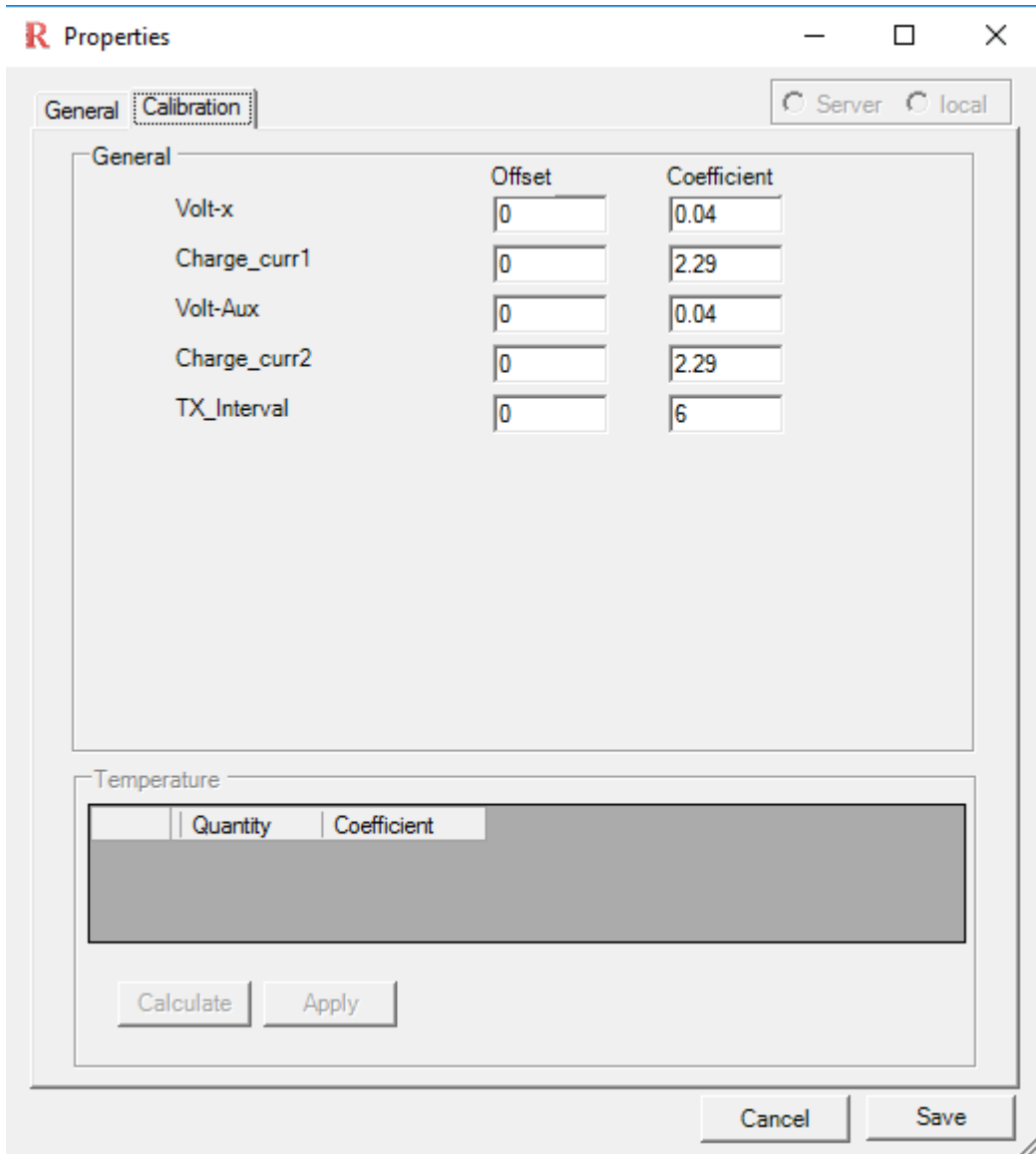


Figure 2.4 Calibration Tab

D. Air Update

▪ What's Air Update?

Air update is the utility used to change certain parameters of a SenSpot™ or SeniMax™ without reprogramming them. Air Update is only available in the live/local mode; however, similar functions can be executed server-side through remote mode of SenScope with administrator privileges.

Caution! This function is only for advanced customers. Inappropriate operations may lead to malfunction in the system. Before doing an Air Update, make sure this document is read thoroughly and the function of each parameter is understood by the user.

▪ **Air Update steps for SenSpot™**

1. Make sure SenScope™ is in the local/live mode and the COM port is opened
2. Click “Device”-> “ Air Update” in the menu bar.
3. Input the Device ID and make sure the ID is correct.
4. Check the boxes in front of the parameters that need to be updated. All the parameters without a check will remain unchanged during the update.
5. Input the value of the parameters and click apply.
6. The green ones are successfully updated. The yellow ones are being updated. The white ones are in the queue. The red ones fail the update because of timeout. The parameters with the blue bold font are the ones modified in this Air Update.
7. **Tip:** If a device is selected (highlighted) in the “Sensor List”, the parameter textboxes will show its current value when the Air Update panel is opened.

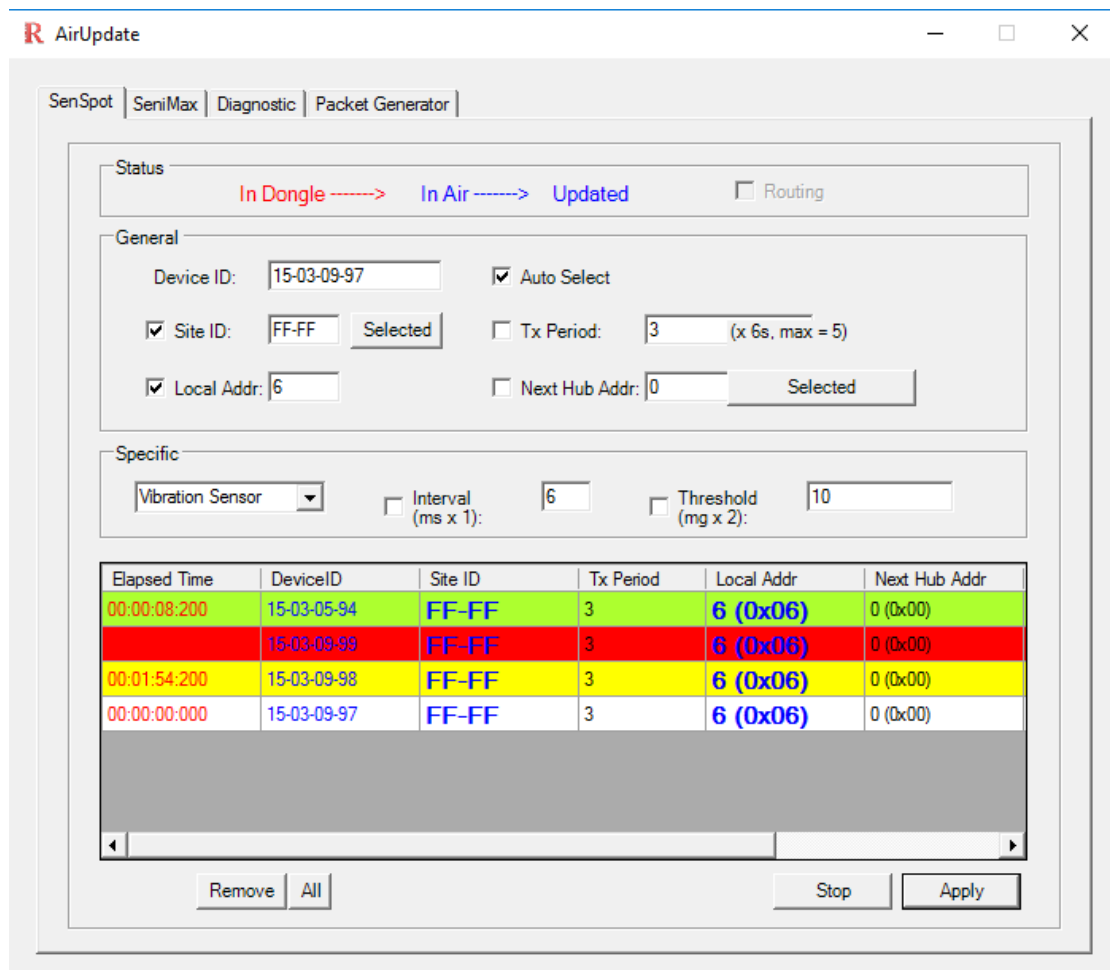


Figure 2.4 Air Update Panel: SenSpot Tab

- **Parameters and their functions for SenSpot™**

- 1. General parameters**

- Device ID (DID):** The unique identifier of each device. This serial number is printed on each SenSpot.

- Site ID (SID):** The unique identifier for each sensing system. Usually, the last four digits of the Device ID of the SeniMax™, this parameter determines which SeniMax™ is responsible to collect the data from a given SenSpot. The site ID acts as a routing parameter to point a SenSpot's wireless communication to a given internet gateway (i.e. SeniMax).

- Local Address (LA):** This parameter allows the devices which belong to the same site to get registered with the corresponding SeniMax™. In other words, to have a spot in the network to perform data transmission, each device must have a unique local address. It should be noted that although we have currently assigned a one byte length local address to each device, there is not theoretical limit on the number of devices which can be registered in a network. There is no specific way to assign a local address to a device and as long as every device has a local address, the data link is potentially created. It should be noted that the LA of SeniMax™ is conventionally assumed to be 0. Therefore, this LA is reserved and it cannot be assigned to any other devices.

- Next Hub Address:** This parameter is a special kind of local address assigned to repeaters to relay data from SenSpots to the final SeniMax gateway. In case that the span of a network is small such that each device can directly communicate with SeniMax™ the NA will be set to 0 as it is the LA of SeniMax™. However, in many cases where the span of a network is relatively large or a device's signal is blocked (e.g. thick concrete block or steel deep steel members) the use of wireless repeaters may be necessary. In such cases, a device needs to know how to reach SeniMax™ through the repeater.

- 2. Specific Parameters:** Depending on the type of SenSpot™, this field has different functions.

- Vibration SenSpot™: Interval (ms)** decide the sampling interval while **Threshold (2*mg)** determines the smallest acceleration that can be detected. The default value is Interval=20, Threshold=80. Please note that the actual Threshold is doubled ($80*2=160\text{mg}$).

- Strain Gauge SenSpot™ with event-detecting function: Threshold (4*μS)** determines how much the change in the measurement will trigger the fast sampling mode of the SenSpot™. The ACTUAL threshold equals to 4 micro-strains multiply by the number entered in this area. **Sampling Interval** determines the time interval between 2 samples in the fast sampling mode.

- **Air Update steps for SeniMax™**

- 1. Input and make sure the Device ID is correct.
 2. Choose the Connection Type (Cellular or Wi-Fi) according to the type of the SeniMax™.
 3. Just like Air Updating SenSpot™, check the boxes in front of the parameters need to be updated.

- Click “Apply” to start the Air Update.
- When **Updated** becomes red **Updated**, the Air Update is finished.

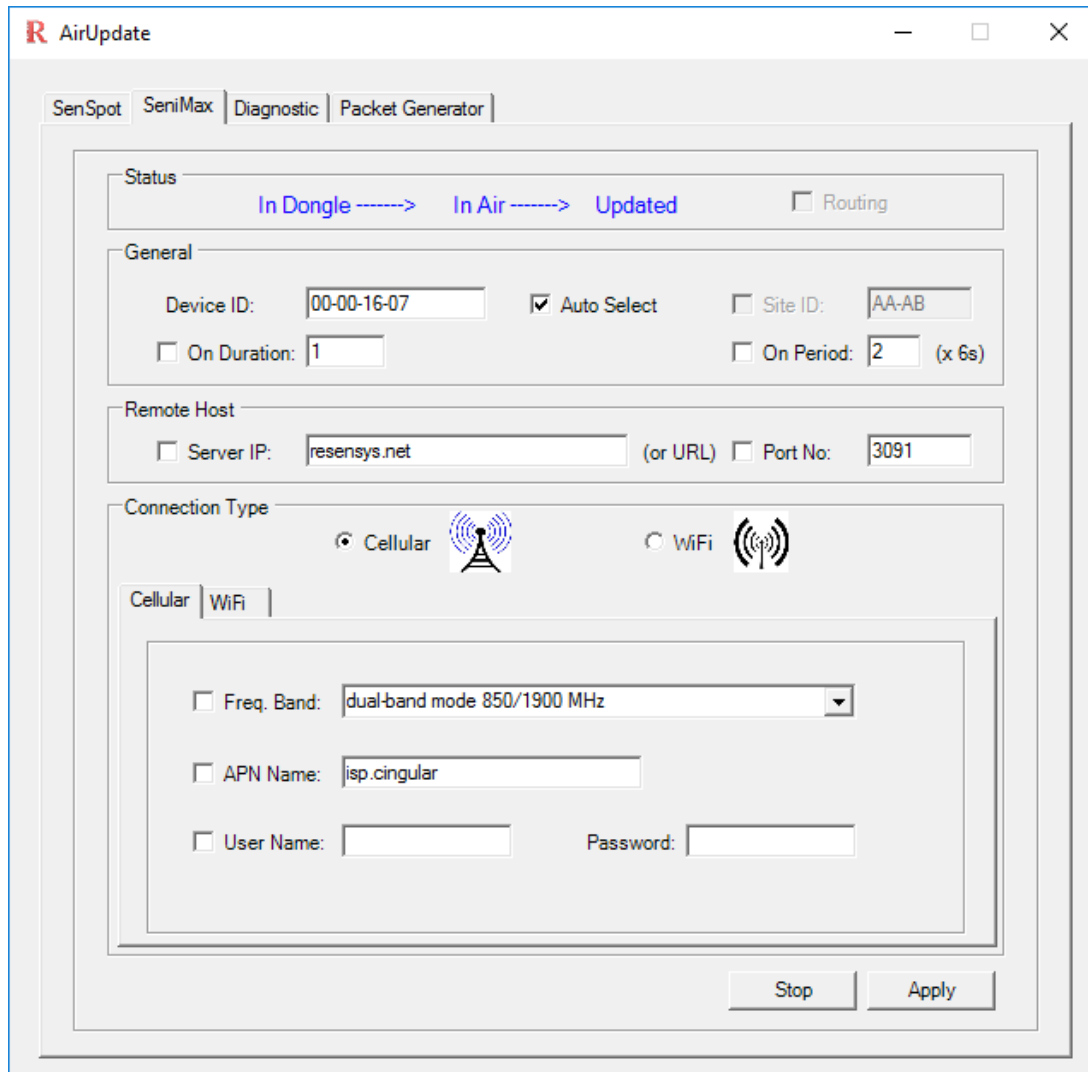


Figure 2.5 Air Update Panel: SeniMax Tab

- **Diagnostic mode**

Diagnostic is used to show the raw packets and/or their equivalent ASCII message. One use for this mode is to check whether the SeniMax™ is connected to the server rather than directly using remote mode to check the data, which can take up to an hour.

- Open the Air Update panel and switch to the “Diagnostic” tab.
- Input the device ID
- Click “Tune”
- Check the box in front of the “Text”. Check the box in front of the “Hex” if raw data is also needed.

5. Now reset the SeniMax™.
6. It's very likely that random characters show up in the display area. Keep searching the stream and some readable text can be found (like the text in the red circles in Figure 5).
7. If some message like "OOK OOK OOK" (double circled part in Figure 5) appears, the SeniMax™ has successfully connected to the server.
8. If the "OOK" cannot be found, please verify the network settings again and reset the SeniMax™. If the problem still exists, please record the information in the display area and contact Resensys.
- 9.

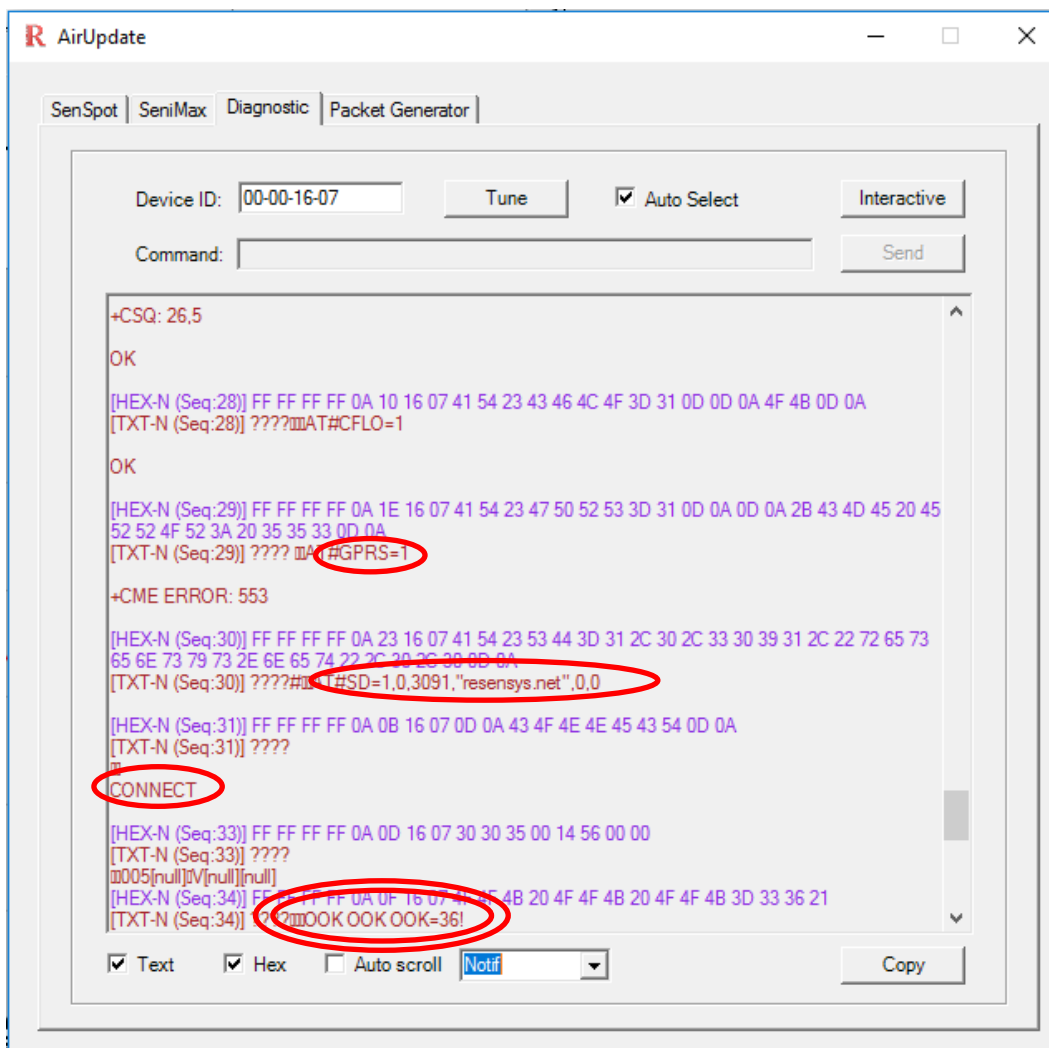


Figure 2.6: Diagnostic

- **Packet Generator and Fast sampling mode**

Packet Generator can send specific packets at a fixed rate. Like diagnostic mode, it is used mostly for debugging. An application for this function is to make the SeniMax™ enter the fast-sampling mode in which the transmission interval (of the SenSpot™) can be shortened to a desired value to show the data more frequently. This mode is useful during a deployment and live load testing to verify the connection between the SenSpot™ and the SeniMax™.

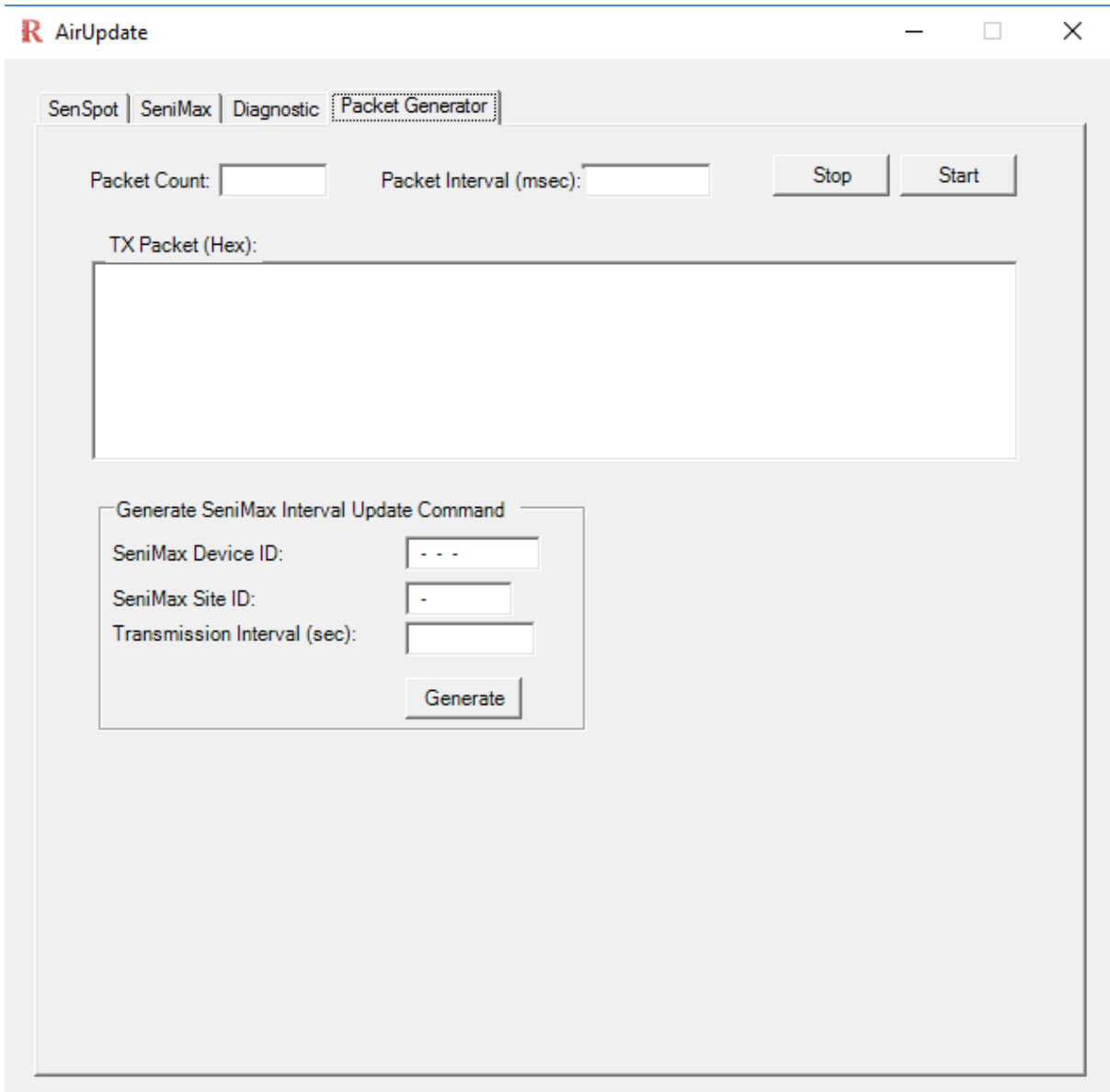
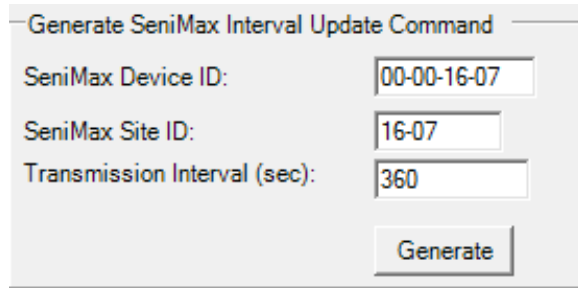


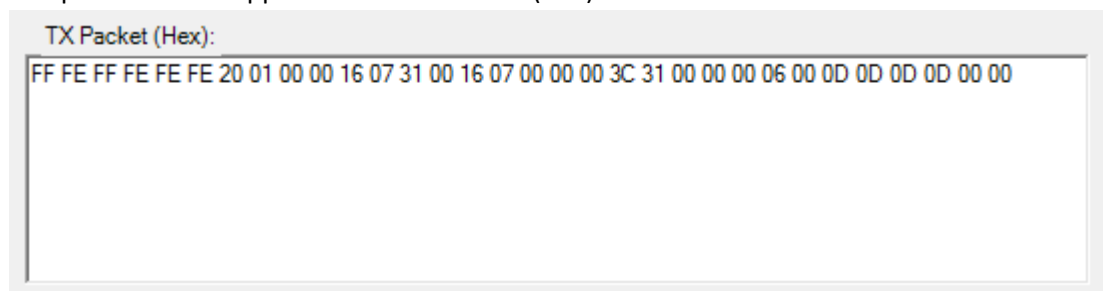
Figure 2.7: Packet generator panel

1. Open the “Packet Generator” tab in the Air Update panel.
2. Clear the “TX Packet (Hex)” area (choose any contents and hit “delete” on the keyboard).
3. Input the Device ID, Site ID and the new transmission interval. **The interval should be a multiple**

of 6 seconds and the minimum is 18 seconds! The interval of 30s is recommended if there is no specific requirement from the customer.

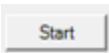



4. Click "Generate" button to generate the command packet.
5. The packet should appear in the "TX Packet (Hex)" box.



6. Input the packet count and the packet interval. These parameters determine the command packets' number and frequency sent from the computer. It is recommended that the packet count be some large number (like 2000) and the packet interval be 500ms.



7. Click  and plot the quantity "Tx Interval" of the SeniMax™ in the live mode. Please refer to the SenScope™ User Manual for how to show the data in the SenScope™.
8. Check the "Tx Interval". As soon as the "Tx Interval" changed to the desired value, click .
9. After finishing the test, remember to change the "Tx Interval" back to normal value since the power consumption of the SenSpot™ is high in fast sampling mode.

E. Data Menu

In the "Data" menu there are three options will allow the user to manipulate the collected data in the memory. In the following, these options are explained. Please note that this function is available both in Remote Mode and Live/Local mode.

Download

User can export data to ‘*.xlsx’ format which can be opened using Microsoft Excel. In order to do so, the user may select (highlight) several devices by holding ctrl and clicking on the device name and choosing Download->Excel->Selected or can export all devices’ data using Download->Excel->All. In either case, the data is exported from the memory and stored in the format of *.xlsx in the directory: SenScope\Data\Log. **Alternately, right click on the plotted graph and choose “Export Graph to file” to export the data.**

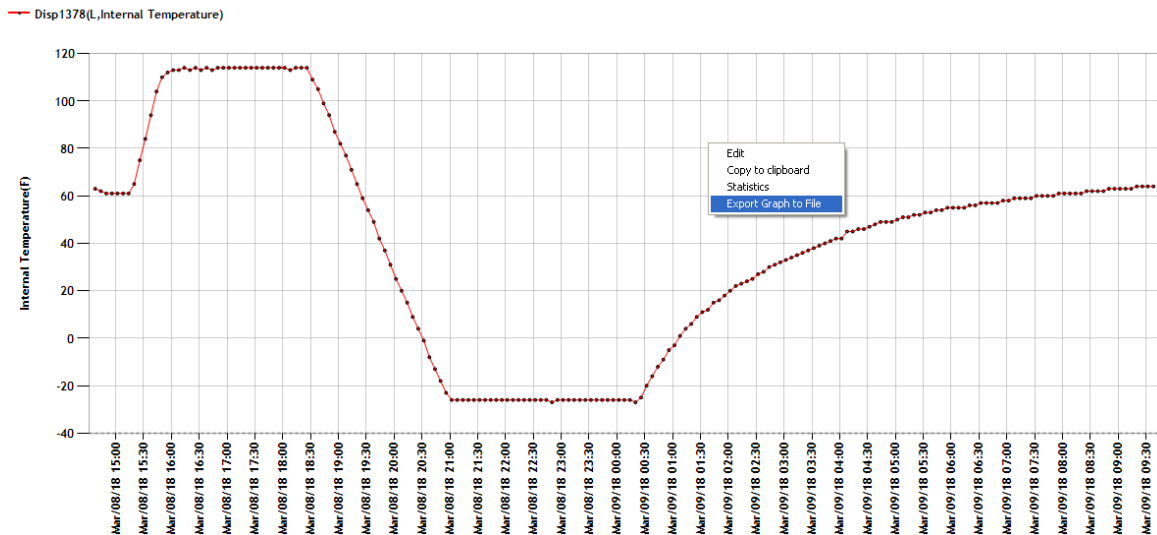


Figure 2.8: Exporting data into an Excel sheet

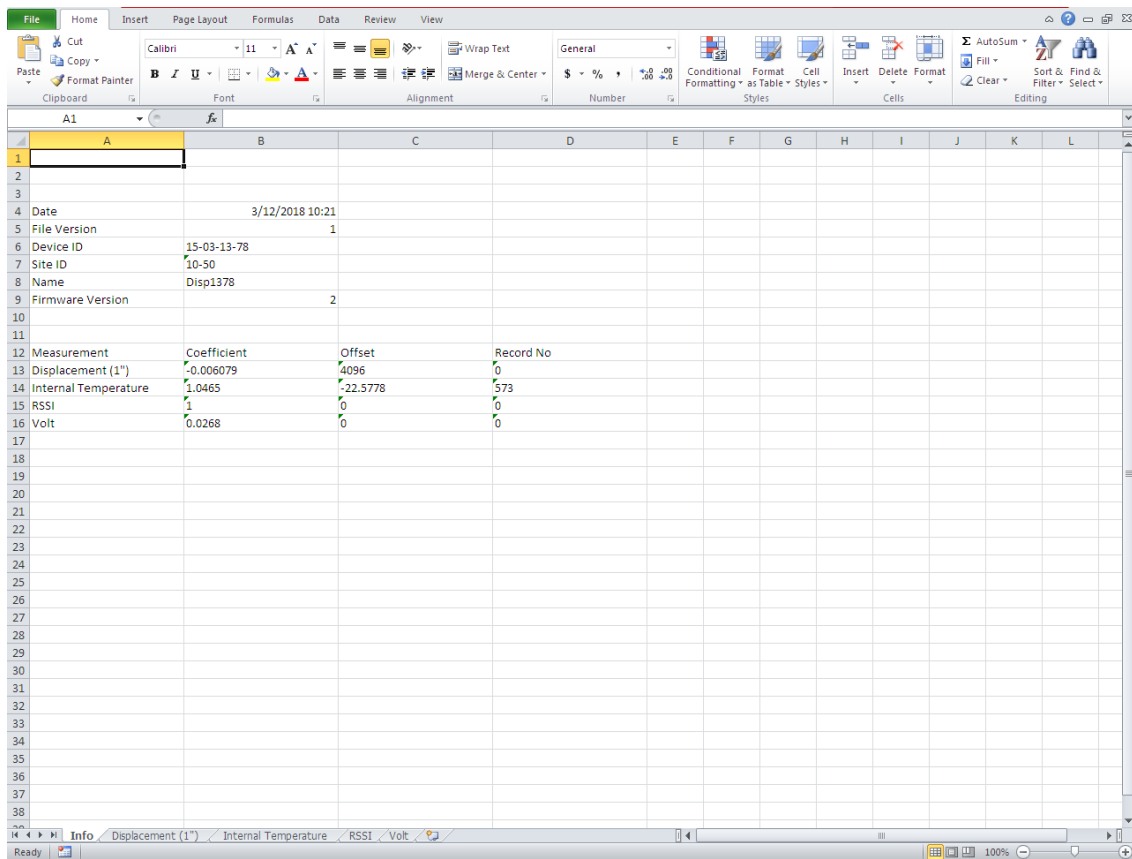


Figure 2.9: Exported data in an Excel sheet

Figure 2.9 shows a sample exported file from a device which has the ID of 15-03-13-78. The first sheet of the log file is named “Info” and it contains some information about the device from which the data is collected. For example, in addition to the date and time that the file is created, file version, Device ID, Site ID, customized name of the device, firmware version and measurement of the device are shown in this sheet. It also contains the calibration offsets and coefficients of the measurements. The number of records which have been collected by the time of exportation is shown under “Record No” for each measurement.

The detailed collected data for each measurement is stored in other sheets. For example in the above sample file, the Displacement (1”), RSSI, Volt and Internal Temperature are stored in the corresponding sheets. Figure 2.10 shows the logged internal temperature data for the same device. The table consists of three columns and multiple rows depending on the number of samples exist. The first column “A” is a one byte data which shows the sequence number of the data packet which contains the sample. This number varies from 0 to 255. The second column “B” is the time at which the sample is collected or the time of the machine at the packet arrival time and the third column “C” contain the raw data. In order to calculate the actual value of the sample the following equation can be used.

$$RealValue = (RawData - DataOffset) * DataCoefficient$$

It should be noted that the offsets and coefficients of the measurements can be found in the Info sheet.

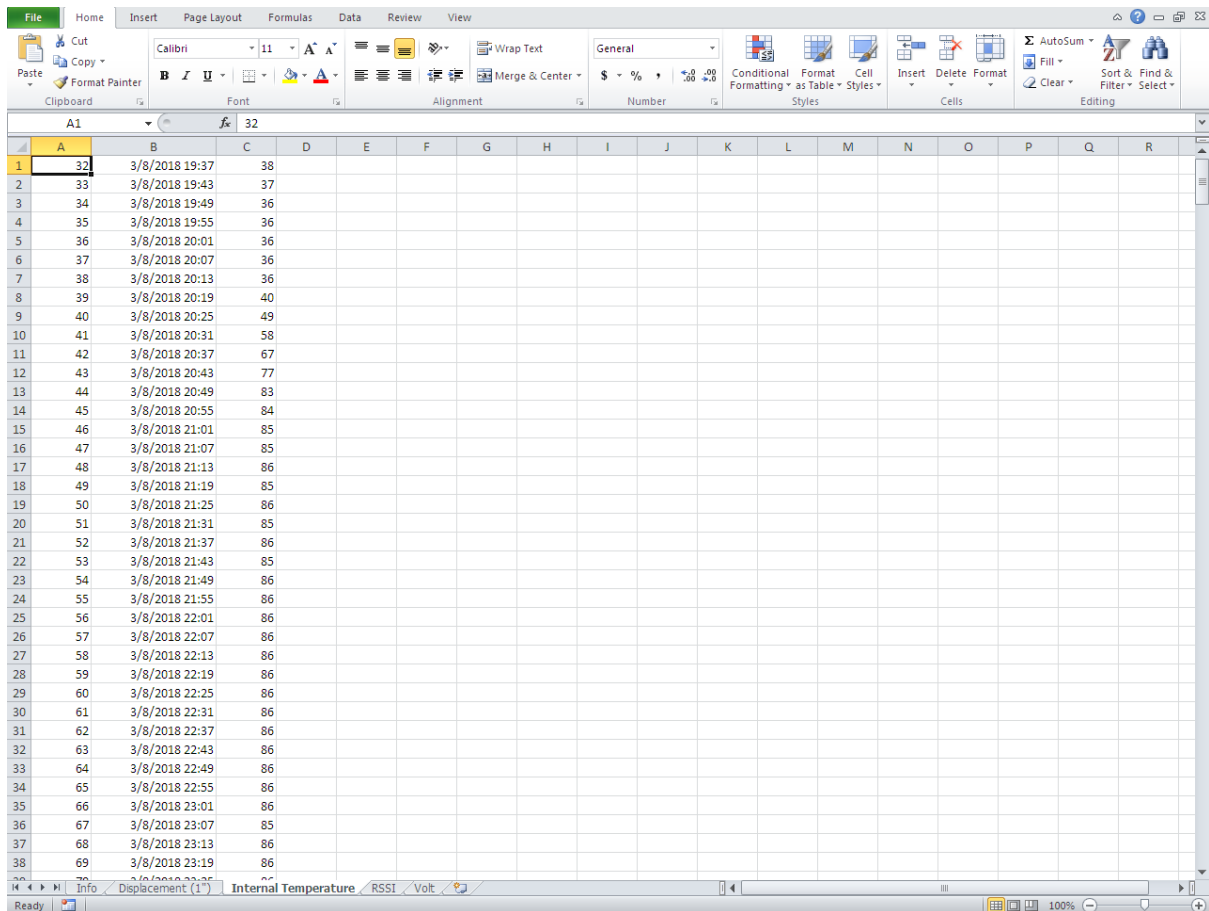


Figure 2.10: Showing the data in an excel sheet

- **Delete**

In order to delete all data received from one device, the device ID must be highlighted from the “Sensor List” and then the “Delete One” option from the “Data” menu is selected. To delete the data received from all devices shown in the sensor list the user needs to click on button “Delete All”.

- **Table**

This option can be used to quickly fetch data from the memory or the server for a selected device in the given “Time Range”. For this purpose, after highlighting the device name “Table” can be chosen from the “Data” menu. To retrieve data from memory the user needs to select “In Memory” and to do that from the server “Server Query” needs to be selected. An example of each is shown in Figure 2.11 and 2.12. To copy data to clipboard the corresponding buttons should be selected.

The screenshot shows the RESENSYS software interface. At the top, there is a menu bar with 'Source', 'Device', 'Data', 'Accounts', and 'Help'. The 'Data' menu is open, showing options like 'Download', 'Upload', 'Delete', and 'Table'. The 'Table' option is selected, and a sub-menu 'Server Query' is highlighted. Below the menu, there is a 'Sensor List' table with columns for Name, ID, Type, and Quantity. The 'Quantity' column is expanded to show 'Displacement (1")', 'Internal Temperature', 'RSSI', and 'Volt'. To the right, there are 'Time Range' settings for 'From' and 'To' dates, and 'Duration (sec)' and 'Sample Intervals' options.

Below the menu and settings, there is a 'Report' section. It shows '192 row(s) were returned for this query' and a 'None' dropdown. There are 'Clear' and 'Refresh' buttons. The main area contains a data table with the following columns: Time, SeqNo, Value, and Optional.

Time	SeqNo	Value	Optional
3/8/2018 7:37 PM	32	38	30030
3/8/2018 7:43 PM	33	37	30030
3/8/2018 7:49 PM	34	36	30030
3/8/2018 7:55 PM	35	36	30030
3/8/2018 8:01 PM	36	36	30030
3/8/2018 8:07 PM	37	36	30030
3/8/2018 8:13 PM	38	36	30030
3/8/2018 8:19 PM	39	40	30030
3/8/2018 8:25 PM	40	49	30030
3/8/2018 8:31 PM	41	59	30030
3/8/2018 8:37 PM	42	67	30030
3/8/2018 8:43 PM	43	77	30030
3/8/2018 8:49 PM	44	83	30030
3/8/2018 8:55 PM	45	84	30030
3/8/2018 9:01 PM	46	85	30030
3/8/2018 9:07 PM	47	85	30030
3/8/2018 9:13 PM	48	86	30030
3/8/2018 9:19 PM	49	85	30030
3/8/2018 9:25 PM	50	86	30030
3/8/2018 9:31 PM	51	85	30030
3/8/2018 9:37 PM	52	86	30030
3/8/2018 9:43 PM	53	85	30030
3/8/2018 9:49 PM	54	86	30030

Figure 2.11: Showing the data from the server in a table

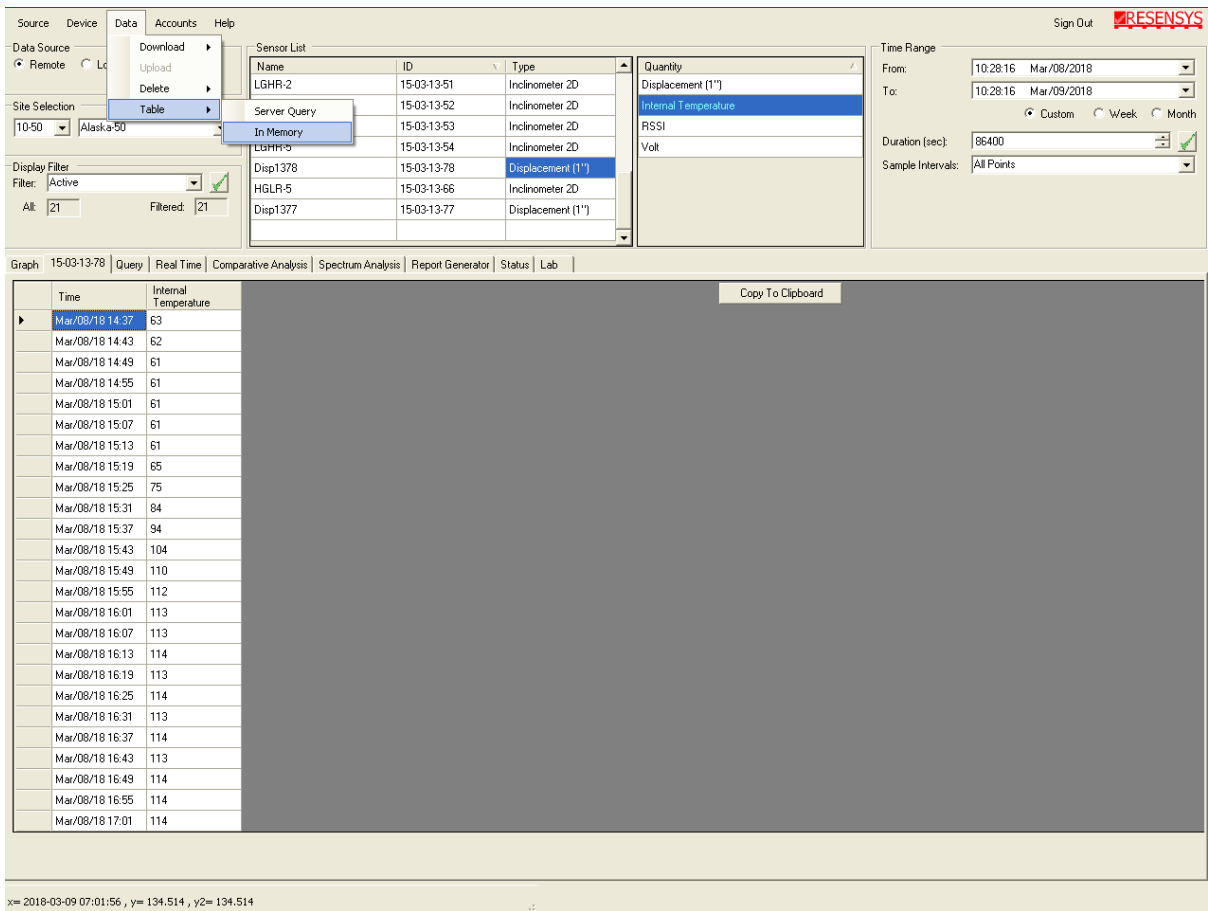


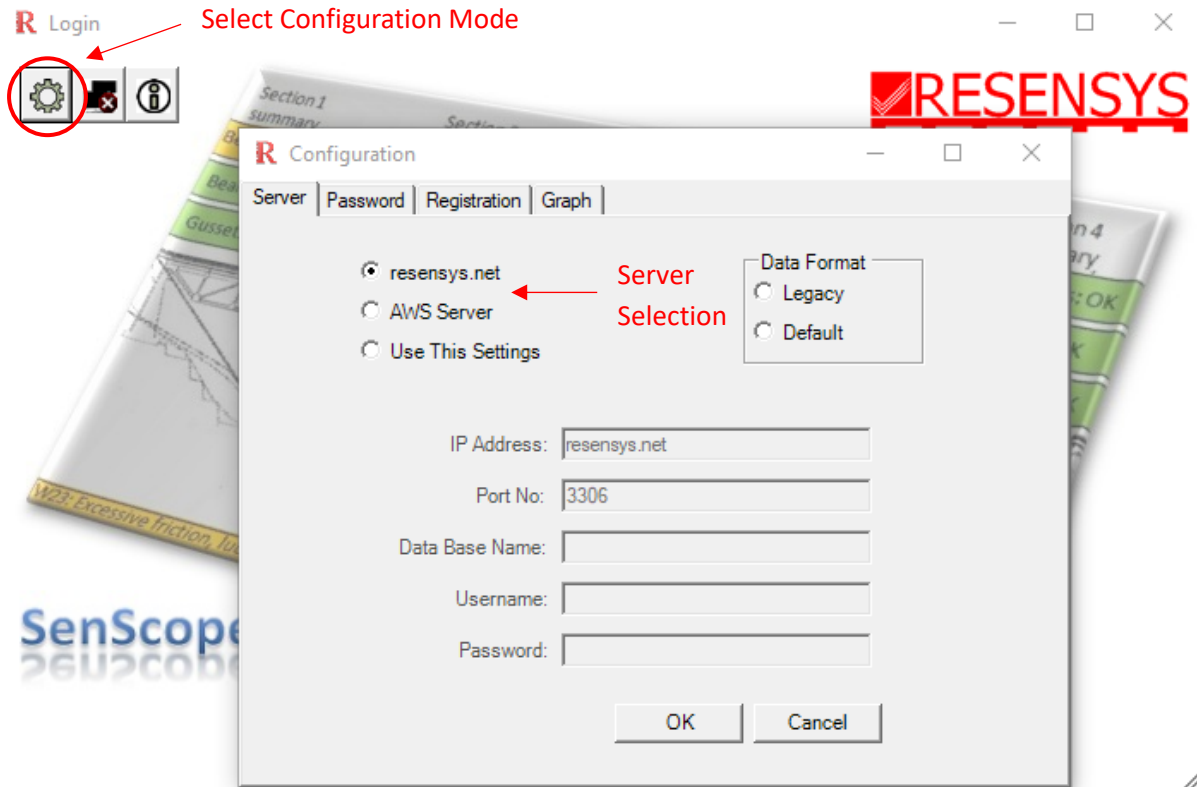
Figure 2.12: Showing the data from the memory in a table

IV. Remote Mode (Online Mode)

A. What is the remote mode?

Remote mode is for viewing the data from the remote server rather than from the local devices. Therefore, Internet access is necessary. Also, the username and the password are needed. Should the user not have them, please contact Resensys.

Note: New users should be sure to point SenScope to the correct database for data retrieval. In most cases, the user will be pointed to “resensys.net” by default. For systems configured to point to Amazon Web Services (AWS), user should be sure to select the “AWS Server” option from the configuration menu on the initial login window (see below).



B. Viewing the data in the remote mode

1. Enter the username and the password provided by Resensys then click “OK”.
2. Choose the “Remote” mode in the “Data Source” area
3. Select the desired Site ID from the drop down menu.
4. In the Time range area, enter the time period of the data.
5. Select the devices and the data type to create a figure similar to the Live/Local Mode.

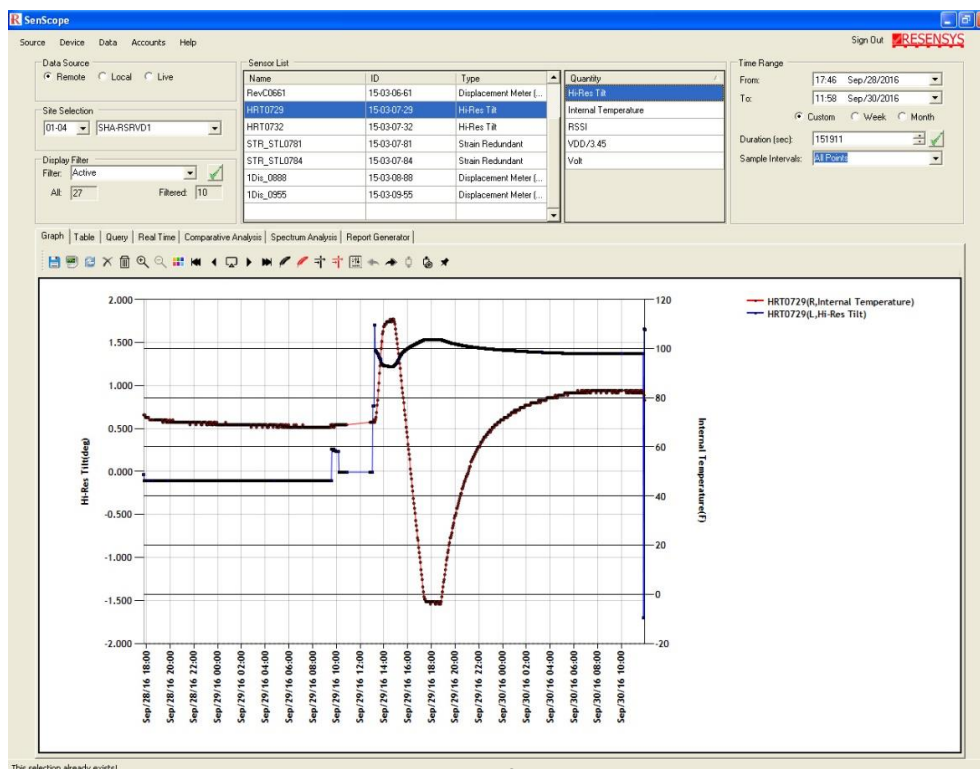


Figure 3.1 Screenshot of the remote mode

6. Remember to click “Refresh”  after changing the time period to apply it.

C. Modifying the figure

Usually the data from a long period of time consists of a trend and some fluctuations or spikes. SenScope™ provides several functions to smoothen or sharpen the figure according to the user's needs. Figure 3.2, which is the original figure, is used as an example to show different effects of these functions.

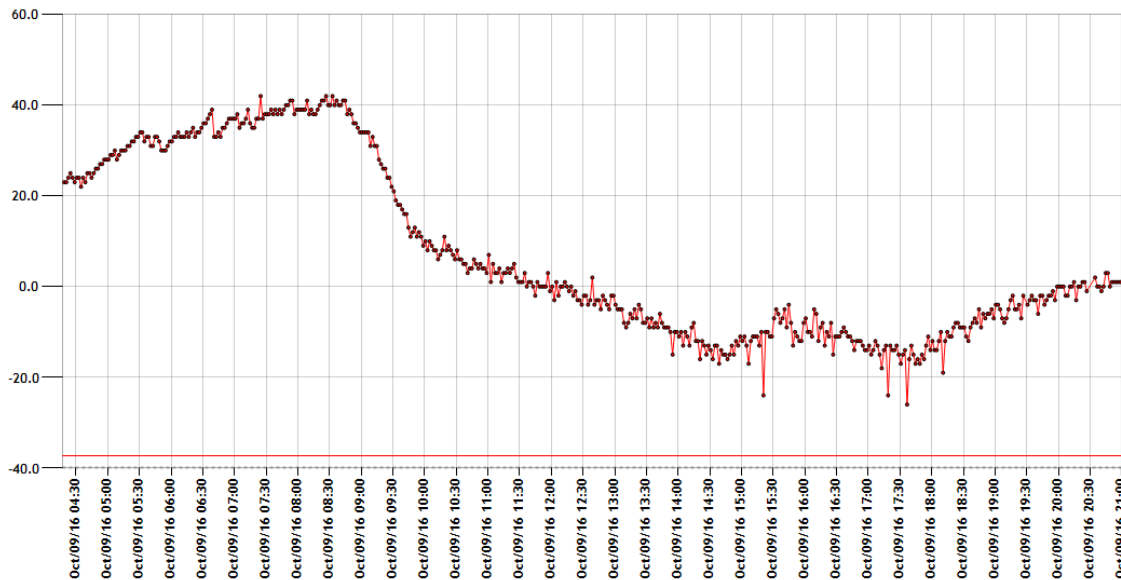



Figure 3.2 the original figure

- **Removing spikes**

By clicking  "Remove Spikes" (the icon is black), all the data points that drop far from the main trend will be removed. However, small fluctuations will be kept unchanged.

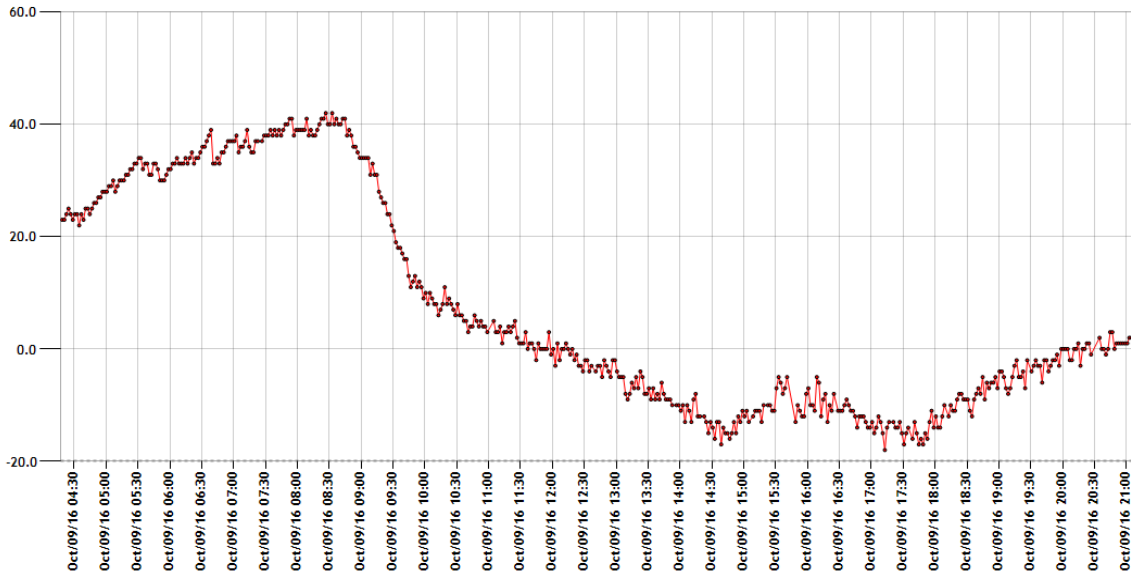



Figure 3.3 the figure after using “Remove Spikes”

- Showing spikes only

By clicking  “Show Spikes” (the icon is red), ONLY the data points that drop outside the main trend will be shown.

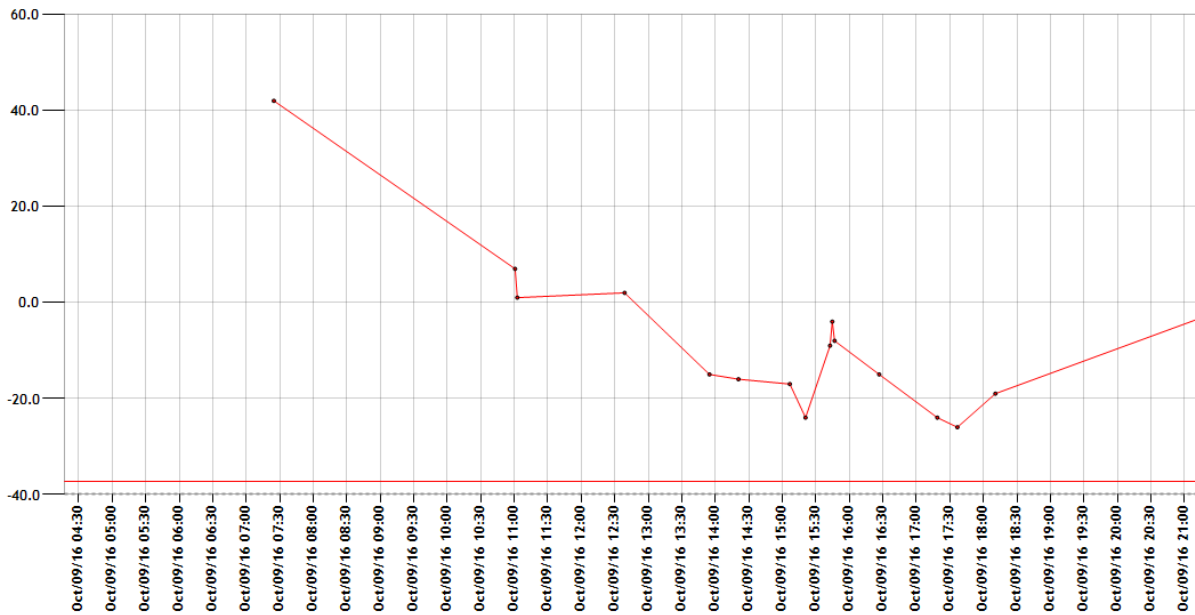



Figure 3.4 the figure after using “Show Spikes”

- **Applying a filter**

By clicking  "Apply Filter" (the icon is black), the figure is further smoothed. Only the main trend will be shown.

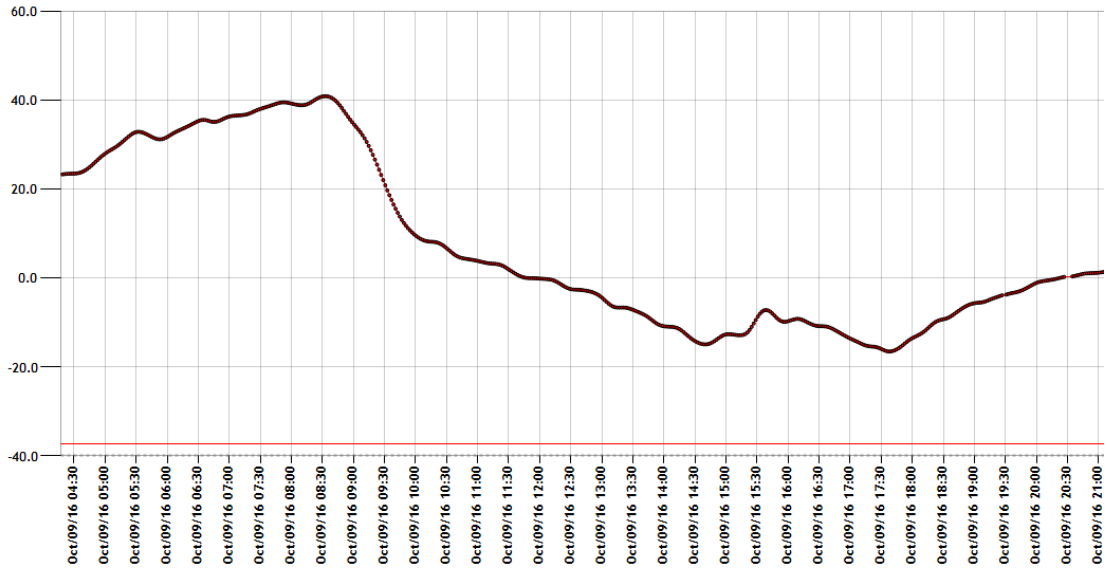



Figure 3.5 the figure after using "Apply Filter"

- **Removing the trend**

By clicking  "Remove trend" (the icon is red), ONLY the fluctuations and the spikes are shown.

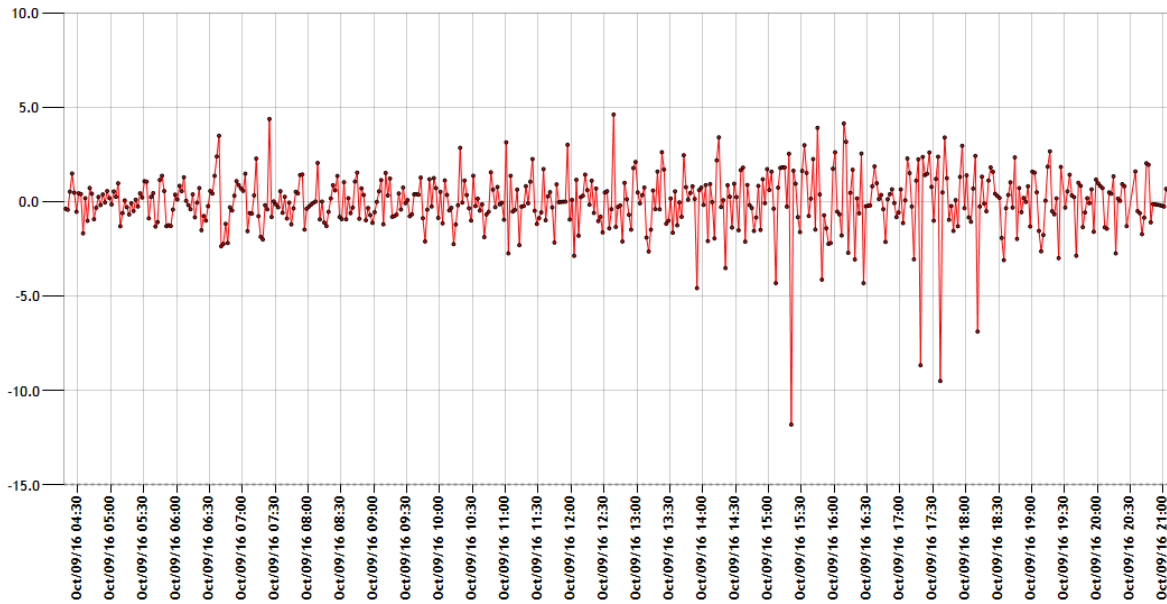



Figure 3.6 the figure after using "Apply Filter"

- **Returning to the original figure**

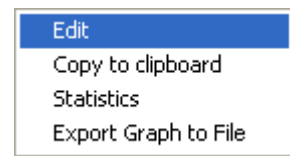
Just click  "Refresh".

- **Customizing the filter**

The parameters of the filter can be customized in the  "Filter Options". Make sure the function of each parameter is well-known by the user before changing any of them.

- **Change the properties of the figure**

1. Right click the figure area and select "Edit".



2. The style (color, font, etc.) of the figures can be changed on the panel shown below.

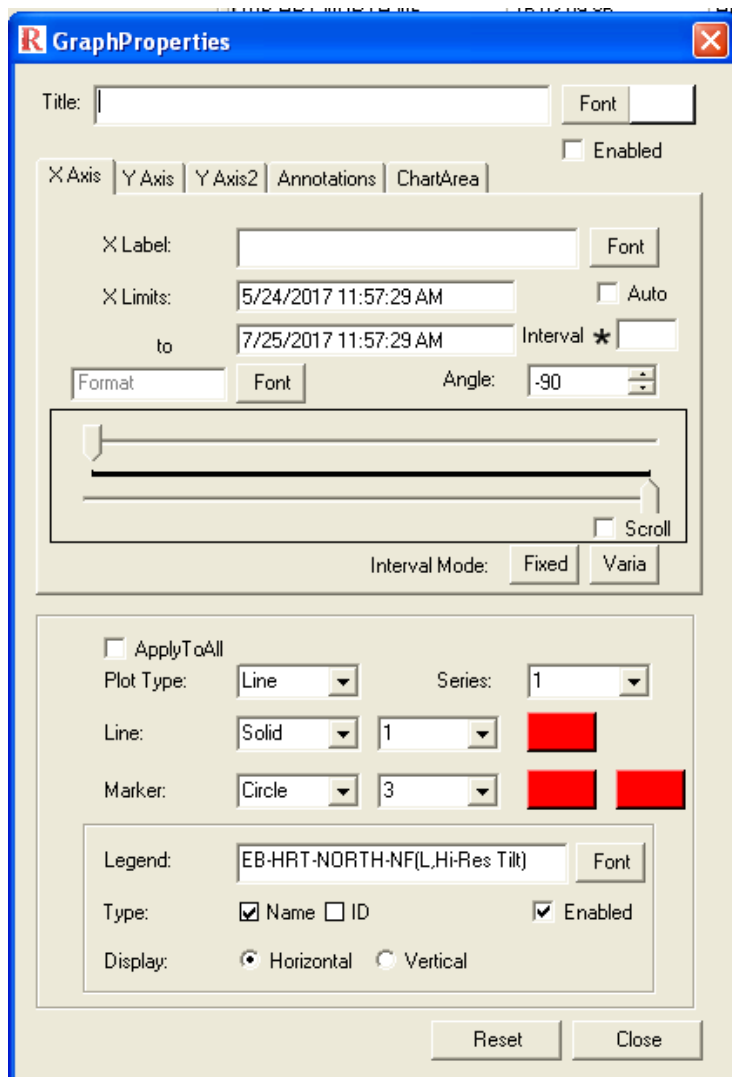
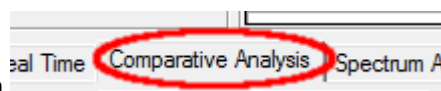


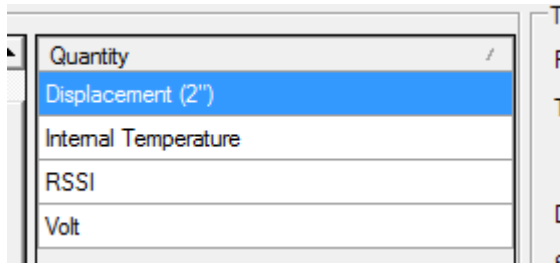
Figure 3.7 Graph Properties panel

D. Comparative Analysis

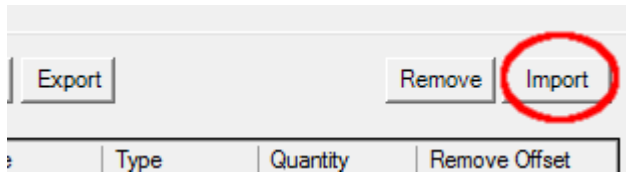
Comparative Analysis is the best way to show the statistical relationship between different quantities. To start a comparative analysis, the data must be imported.

1. Click the “Comparative Analysis” tab under the “Devices” area.
2. Select the quantity that needs to be analyzed.





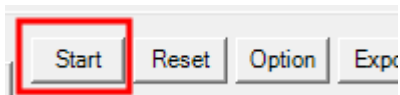
And click "Import":



3. The imported quantity will appear in the list below. Import all the quantities needed.
4. Select all the quantities needed to be analyzed by checking the box in front of them (usually 2 quantities).

	ID	Name	Type
<input checked="" type="checkbox"/>	15-03-08-88	2"_1D_Dis_...	Disp
<input checked="" type="checkbox"/>	15-03-08-88	2"_1D_Dis_...	Disp

5. Click "Start" to start analysis.



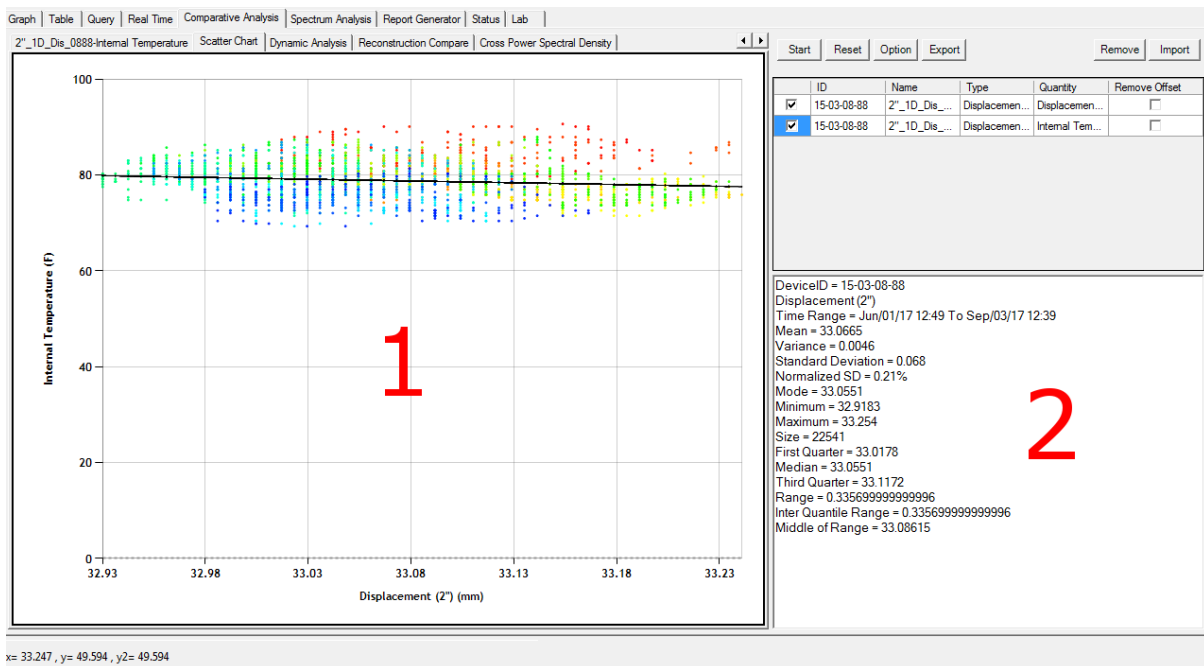


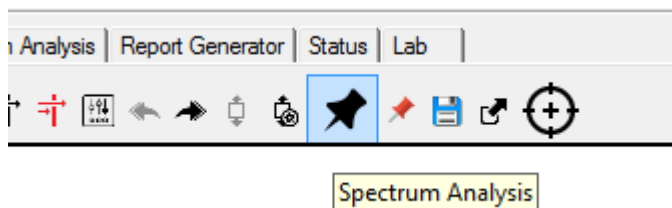
Figure 3.8 the Comparative Analysis tab

- See the figure in the plotting plain (area 1) by selecting a tab and see the statistical data in the bottom-right area (area 2). For Scattered Chart, the data points marked with blue are most recent while the red ones are the oldest.

E. Spectrum analysis

Spectrum analysis consists of applying a Fast Fourier Transform to a given acceleration signal in the time domain to the corresponding signal in the frequency domain. In this way the natural frequency can be clearly shown in the figure.

To begin, plot the data over a period of time for which a Fourier analysis will be necessary. Next, click the “Spectrum Analysis” button in the toolbar.



After the icon is selected, drag the selection box to cover all the data points that need to be analyzed. To do this you might need to do some zoom-ins and/or zoom-outs.

Then the spectrum of the data will be shown in the plotting area like this:

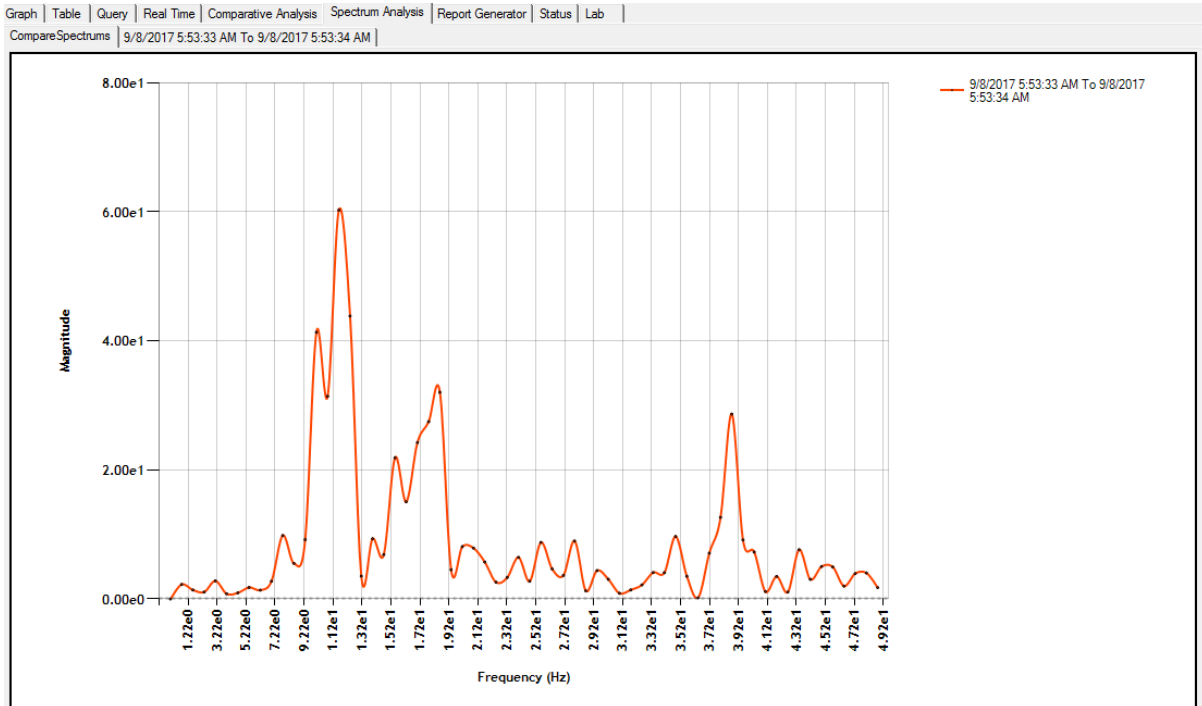


Figure 3.9 the Spectrum Analysis Result

F. Registration

Caution! This function is only for advanced customers. Inappropriate operations may lead to malfunction in the measurement of the system. Furthermore, if you are accessing data through an RDS read-replica, then this utility cannot be used. Please contact Resensys before modifying the registration of your system.


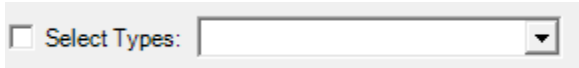
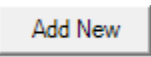
▪ Adding a device using the “Clone” function

1. Click “Device”->” Registration” in the menu bar. And the following panel will appear.

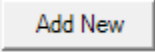
The screenshot shows the 'Registration' window with the following details:

- Options:** Clone, Blank
- Clone:** Type Device ID: 15-03-09-40, Go button, Select Types: [dropdown]
- Sensor Profile:** Device ID: 15-03-09-40, Site ID: 3E-0A, Title: Temp0940, Description: [empty], Type: Temp, Pfil: [empty], Status: 1, Version: 1
- Settings:**
 - Measurements:** M1: Temperature Probe, M2: Internal Temperature, M3: RSSI, M4: Volt, M5: [dropdown], M6: [dropdown], M7: [dropdown], M8: [dropdown]
 - Data Offsets:** DOF1: 0, DOF2: -11, DOF3: 0, DOF4: 0, DOF5: 0, DOF6: 0, DOF7: 0, DOF8: 0. Includes a Reset button.
 - Coefficients:** COF1: 1, COF2: 1, COF3: 1, COF4: 0.0268, COF5: 1, COF6: 1, COF7: 0.003583, COF8: 1. Includes a Reset button.
- Bottom Buttons:** Modify, Add New, Cancel

Figure 3.13 the Registration panel


2. Select “Clone” in the “Options” area (top-left corner of the panel).
3. Get a “Clone” by inputting the Device ID of a device of the same type in  and hit “Go”. Or alternately, check the box in front of the drop down menu  and select a type in the drop down menu.
4. Modify the information in the “Sensor Profile” area. Make sure both the “Device ID” and the “Site ID” are correct. Then please check the “Status” box. Make sure the value is 1 (“Active”) unless it is desired to be inactive.
5. Input them the data offsets and/or the coefficients if known. Otherwise, leave them as default.
6. Click  to add the device.

▪ **Adding a Device into SenScope Account**

1. Click “Device”->”Registration” in the menu bar.
2. Select “Blank” in the “Options” area (top-left corner of the panel).
3. Input the information in the “Sensor Profile” area. The “Device ID” and the “Site ID” are mandatory, the rest are optional. The “Status” should be “1” (“Active”) if the new device should be seen in the “Sensor List”.
4. Select appropriate data types from the drop down menus in the “Measurement” area and input the “Offset” and the “Coefficient”.
5. Click  to add the device.

▪ **Modifying an existing device**

1. Click “Device”->”Registration” in the menu bar.
2. Select “Clone” in the “Options” area (top-left corner of the panel).

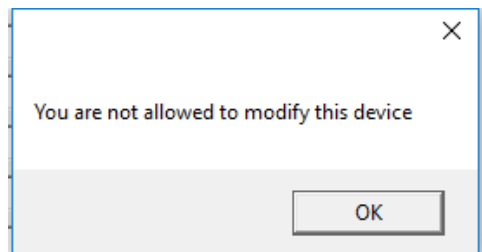
3. Input the Device ID of the device and click go 

7. INPUT the Device ID and the Site ID (the new one if modified) in the “Sensor Profile”.

4. Modify the other information if needed.

5. Click  to apply the changes.

6. If you see the following dialog please check if the Device ID and the Site ID have been correctly typed in.



▪ **Modifying parameters without using registration**

Right click any device in the Sensor List and click “Properties”. Modify the parameters and click “Save” to confirm the change which is the same as the live/local mode.

▪ **Refresh to see the changes**

Every time after changing any setting in the registration, re-select the site ID to refresh the display so that the change can be seen.

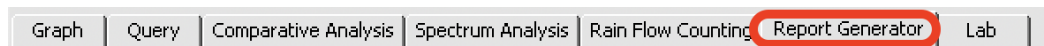
G. Exporting Data


Exporting the data can be done in the same way as in the Live/Local mode. Please refer to the previous sections for the information.

▪ Report Generator

For periodic reporting, it is necessary to export the same data for a collection of devices in a semi-automatic manner. For this purpose, you can use the “report generator” tool within remote mode of SenScope. Simply import a JSON formatted collection of devices and corresponding quantities and start exporting data for your next report.

1. Navigate to the “Report Generator” tab in the main SenScope window.

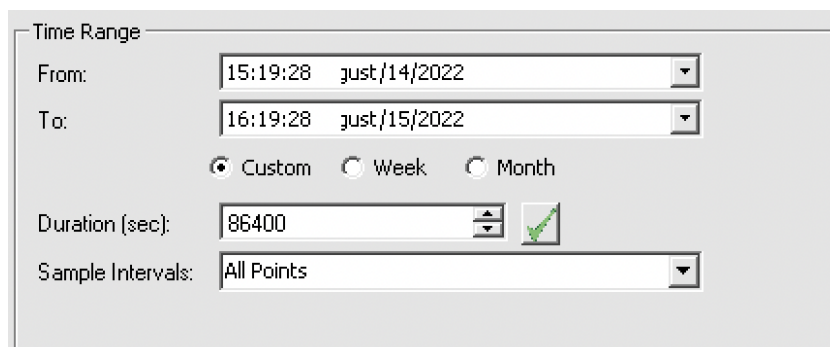


2. Next, select each device and corresponding quantity from the sensor list above and click  to add this field to a running list of device-quantity pairs to be exported to excel.

- **Note:** Be sure to adjust the quantity for each drop down in the accumulated list within the report generator tab.

	Name 1	ID 1	Quantity 1	Name 2	ID 2	
<input checked="" type="checkbox"/>	SG-FB-3-BF	15-03-42-59	Strain-Triggered-Burst	SG-FB-3-BF	15-03-42-59	Ir
<input checked="" type="checkbox"/>	SG-FB-4-TF	15-03-42-60	Volt	SG-FB-4-TF	15-03-42-60	Ir
			Strain-Triggered-Burst Internal Temperature RSSI Volt Strain-xx-high_rate InfoField3			
	note	DeviceID	Size	Mean		

3. After adding each device and quantity pair to the list, be sure to adjust the time range in the top right of the SenScope window to specify over what period of time to export data.




A screenshot of the 'Time Range' dialog box in SenScope. It contains the following fields: 'From:' with a dropdown menu showing '15:19:28 just/14/2022'; 'To:' with a dropdown menu showing '16:19:28 just/15/2022'; three radio buttons for 'Custom' (selected), 'Week', and 'Month'; 'Duration (sec):' with a numeric input field containing '86400' and a green checkmark icon; and 'Sample Intervals:' with a dropdown menu showing 'All Points'.

4. Check the boxes for each of the device-quantity pairs to be exported to excel.

	Name 1	ID 1	Quantity 1	Name 2	ID 2	Quantity 2	From	To	Interval	Filter 1	Filter 2	Graph Type
<input checked="" type="checkbox"/>	SG-FB-3-BF	15-03-42-59	Strain-Triggered-Burst	SG-FB-3-BF	15-03-42-59	Internal Temperature	8/14/2022 10:19:28 PM	8/15/2022 10:19:28 PM	All Points	No Filter	No Filter	Linear Graph
<input checked="" type="checkbox"/>	SG-FB-4-TF	15-03-42-60	Volt	SG-FB-4-TF	15-03-42-60	Internal Temperature	8/14/2022 10:19:28 PM	8/15/2022 10:19:28 PM	All Points	No Filter	No Filter	Linear Graph

5. Check any of the three boxes that appear in the report generator tab for export options

Save Excel Data
 Show Graph
 Sync Timestamps

6. Click  "Start Exporting" to export the selected data to excel workbooks; after being prompted to select a directory to store these data, a green progress bar will appear in the lower left of the screen showing the progress of the data export.
7. To save the selected device-quantity pair table created, you can save the configuration to JSON by clicking  "Export Exporting List to File"; simply save the configuration .json file to your PC and retrieve the same exporting list table in report generator later by importing via  "Import Exporting List from File."

Using this tool in combination with a saved .json configuration file, the user can periodically export the same data for weekly, bi-weekly, or monthly reporting tasks.

H. Alert Management

Resensys provides a comprehensive alert management service to notify users when unusual measurements or data loss are observed. The user should contact Resensys first to set up the service (because not all users require this service). Then the alerts can be managed by the user with the following steps.

- **Introduction of the alert management panel**

In remote mode, click on the “Device” Tab in the menu and then click on “Alert Generation”. Then you should see the Alert Management panel as shown in Figure 3.14.

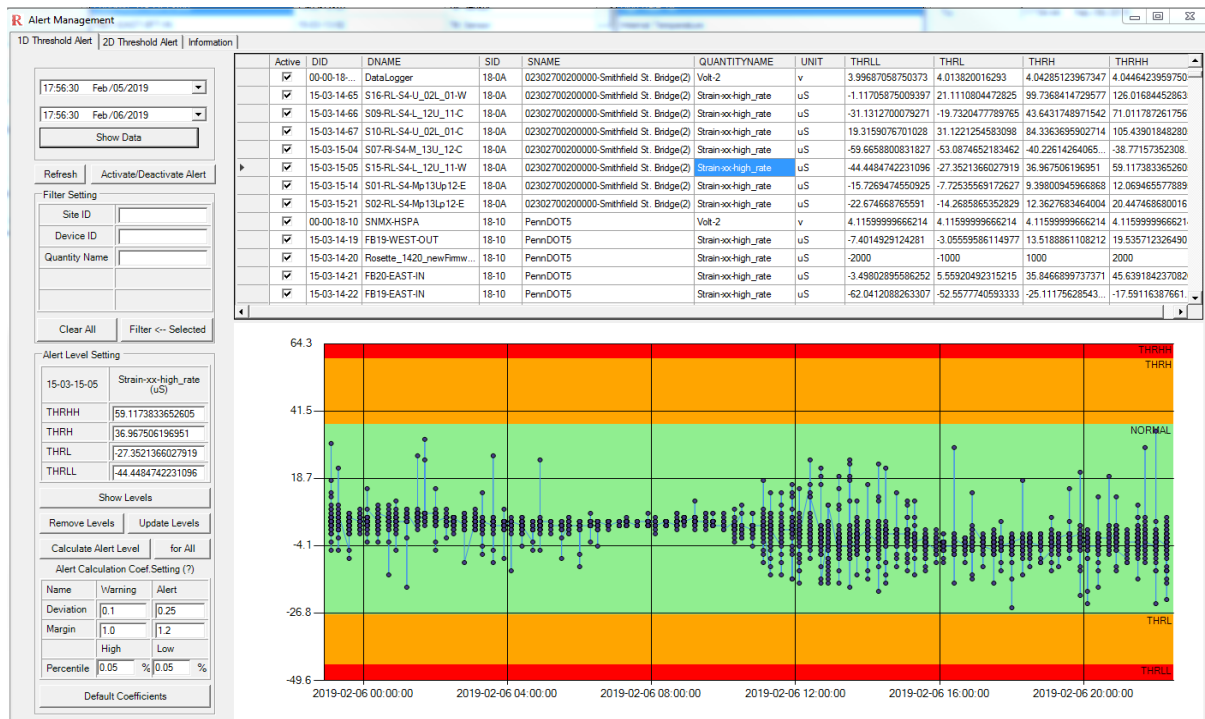
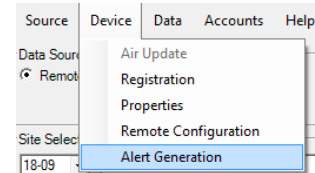


Figure 3.14 the Alert Management panel

The panel consists of 3 tabs. The first one is for configuring single-quantity-alerts (1D Threshold Alert). The second tab is for dual-quantity-alerts (2D Threshold Alert) and the last one is for changing the E-mail addresses that the alert will be sent to. All these tabs will be introduced separately in the following section.

▪ **1D Threshold Alert**

This kind of alerts only monitor one quantity per alert and trigger warning when the corresponding measurement drops out of the normal range defined by the thresholds. There are four thresholds per alert. Low Measurement Warning or THRL means the measurement is low enough to pay attention to but not seriously off the normal range. Low Measurement Alert or THRL means the measurement is too low and actions should be taken immediately. Similarly, High Measurement Warning (THRH) and High Measurement Alert (THRHH) are the high-measurement notifications respectively.

Alert Level Setting	
15-03-15-05	Strain-xx-high_rate (uS)
THRHH	59.1173833652605
THRH	36.967506196951
THRL	-27.3521366027919
THRL	-44.4484742231096
Show Levels	
Remove Levels	Update Levels

Adjust thresholds

To adjust the alarm thresholds (there should be preset thresholds already), just change the numbers in the “thresholds area” (shown on the right) and click “Update Alert Levels” above it. However, this is only feasible when the user clearly know the value of thresholds needed. If the user is not aware of the preferred thresholds, there is a more intuitive way available as well. Simply follow the following steps:

1. Pick the data used as the reference for setting the thresholds with the time range adjusting tool.
2. Choose a device. Then click on “Show Data” button to plot the data. Some figure like the one shown in Figure 3.14 should appear.
3. The user can change the thresholds manually by input numbers into the textboxes.
4. If it is difficult to find good thresholds, click on “Calculate Alert Level” button below “Show Data” and suggested levels will be calculated for all selected quantities.
5. The automated alert level calculation is done as listed below:

15:26:31	Nov/18/2018
15:26:31	Nov/19/2018

$$THRHH = [DataAverage + DataStandardDeviation * Deviation(Alert) + Margin(Alert) * (AdjustedDataMax - DataAverage) - CalibOffset] * CalibCoef$$

$$THRH = [DataAverage + DataStandardDeviation * Deviation(Warning) + Margin(Warning) * (AdjustedDataMax - DataAverage) - CalibOffset] * CalibCoef$$

$$THRL = [DataAverage + DataStandardDeviation * Deviation(Warning) + Margin(Warning) * (DataAverage - AdjustedDataMin) - CalibOffset] * CalibCoef$$

$$THRL = [DataAverage + DataStandardDeviation * Deviation(Alert) + Margin(Alert) * (DataAverage - AdjustedDataMin) - CalibOffset] * CalibCoef$$

Explanation:

The “Deviation” and “Margin” are listed in the textboxes respectively.

The “DataAverage” is the average of all the measurement values within the time range.

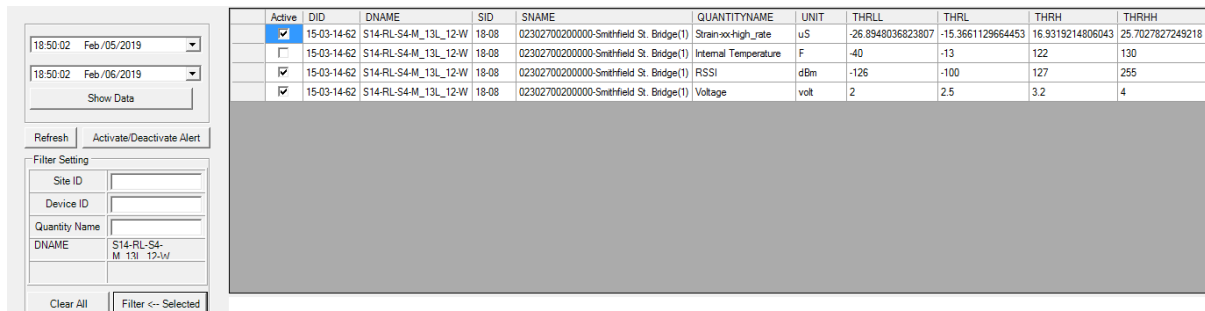
The “DataStandardDeviation” is the standard deviation of all the measurement values within the time range.

AdjustedDataMax/Min are the measurement values whose percentile rank matches the ones in the “Percentile” textbox.

6. The calculated levels will be marked in the bold-orange font.
7. After changing the thresholds levels (either with manual input or suggest levels), click on “Show Levels” in the thresholds area to replot the figure. The new ranges will be shown. The red areas are the alert ranges while the amber areas are the warning ranges.
8. If the user is unsatisfied with the thresholds, fine tuning and replotting can be done as many times as needed by using the manual input textboxes.
9. After finishing the adjustment, click on “Update Alert Levels” to save the change to the server. Make sure the ones need to be updated are selected.

Screening alerts

In Alert management panel, all the alerts of the devices which the user has access to will be listed. The user can either manually input the parameters in the “Filter Setting” area or click on “Filter<--Selected”



The screenshot shows a web interface for alert management. On the left is a 'Filter Setting' sidebar with fields for Site ID, Device ID, Quantity Name, and DNAME. The DNAME field is populated with 'S14-RL-S4-M_13L_12-W'. Below the fields are 'Clear All' and 'Filter <-- Selected' buttons. The main area contains a table of alerts with columns: Active, DID, DNAME, SID, SNAME, QUANTITYNAME, UNIT, THRL, THRL, THRH, and THRH. The table shows three rows of data, with the first and third rows selected (checked in the Active column).

Active	DID	DNAME	SID	SNAME	QUANTITYNAME	UNIT	THRL	THRL	THRH	THRH
<input checked="" type="checkbox"/>	15-03-14-62	S14-RL-S4-M_13L_12-W	18-08	02302700200000-Smithfield St. Bridge(1)	Strain-ox-high_rate	uS	-26.8948036823807	-15.3661129664453	16.9319214806043	25.7027827249218
<input type="checkbox"/>	15-03-14-62	S14-RL-S4-M_13L_12-W	18-08	02302700200000-Smithfield St. Bridge(1)	Internal Temperature	F	-40	-13	122	130
<input checked="" type="checkbox"/>	15-03-14-62	S14-RL-S4-M_13L_12-W	18-08	02302700200000-Smithfield St. Bridge(1)	RSSI	dBm	-126	-100	127	255
<input checked="" type="checkbox"/>	15-03-14-62	S14-RL-S4-M_13L_12-W	18-08	02302700200000-Smithfield St. Bridge(1)	Voltage	volt	2	2.5	3.2	4

Figure 3.15 Filter Setting and the filtered result

after selecting a cell in the table to filter the result. For example, to check the alerts for a single device, choose one of the device ID (DID) and click on “Filter<--Selected”. In this way only the alerts related to the chosen device will be listed.

Activate/Deactivate alerts

Select multiple cells (or rows) and click on “Activate/Deactivate Alert”. After confirmation, the status of all selected alerts will be toggled.