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User manual

SEP

Selective Electric Isotropic Triaxial Antenna

Updated to software version:
MPB SEP V 3.3
SEPcfg 1.0
Updated to firmware version:
SEP B.37
MSP430 2.09

SAFETY NOTES

Read carefully before using the product

MPB works to provide its customers with the best safety conditions available, complying with the current safety standards. The instrumentation described in this manual has been produced and tested in conditions that fully comply with the European standards. To maintain these conditions please carefully follow this manual. This product is intended for industrial environments and laboratories and should be used by authorized personnel only. MPB disclaims any responsibility for different uses of the device.

Declaration of conformity

CE

This is to certify that the product: SEP
(Selective Electric Isotropic Triaxial Antenna)

Complies with the following European Standards:
Safety: CEI EN 61010-1 (undated reference, applies to all editions)
EMC: EN 61326-1 (undated reference, applies to all editions)

This product complies with the requirements of the Low Voltage Directive 2014/35/EU, and with the EMC Directive 2014/30/EU and the RoHs directive 2011/65/EU.

MPB S.r.l.

Index

1. General information

1.1. Introduction

Figure 1

The SEP was developed to selectively monitor the electric field in a very wide range and with a dynamic that is over 80 dB typically. Moreover, its data transmission system, made of non-conductive optical fiber, increases its performances and accuracy to perform measurements. His three high sensitivity axes allow the SEP to cover different applications in the sector of electric field measurements.

1.2. System description

The SEP (Figure 1) is a small spherical measurement system, coming with three antennas of the same size arranged on measurement axes that are perpendicular to each other. It is also equipped with a non-magnetic stirrup for the fixing, a micro-USB connector and two connectors for the optical fiber.

1.3. Composition

Provided with the instrument:

- Hard Case (41 x 35 x 20 cm)
- Plexiglass support
- USB pen drive with PC utility software
- Optical fiber (10m)

- Optical interface/USB for PC connection
- USB cable
- 220V 4 x slots battery charger
- 4x Lithium battery: Panasonic model NCR18500
- Cap remover
- User Manual
- STD Calibration Certificate

1.4 Option WiFi and Bluetooth connection

For more information see APPENDIX B

1.5 SEP Overview

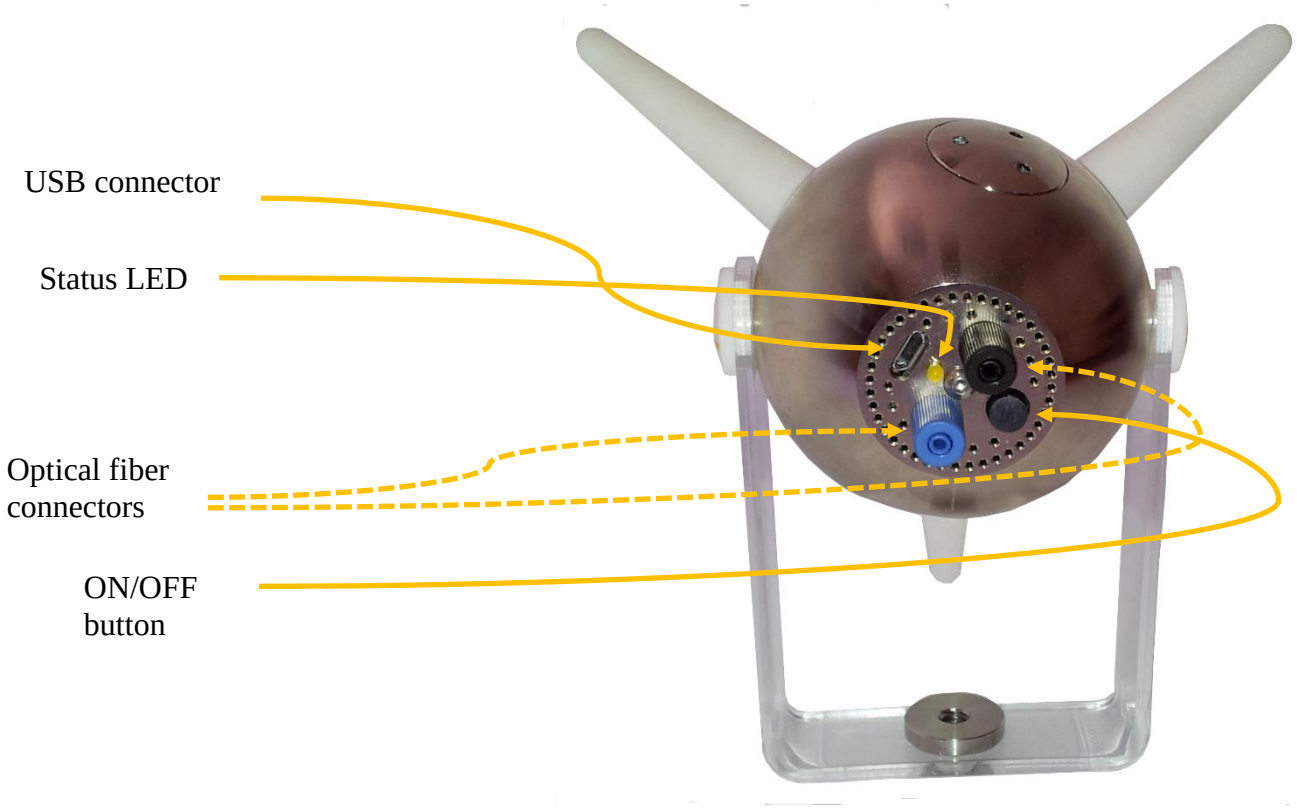


Figure 2

1.6 Technical specifications

Frequency Range	
Band1	*100 kHz to 9.999 MHz*
Band2	*10 MHz to 3.6 GHz*
Resolution	*1 kHz*
Reference Frequency	
Aging year	1 x 10 $^{-5}$
Temperature drift (0° C to + 30° C)	5 x 10 $^{-6}$
Frequency Span	
Range	100 *kHz* to full span
Step number	MIN 50; MAX 12000 (Each Axis)
Resolution Bandwidth	
Range (-3 *dB* bandwidth)	*3 kHz to 1 MHz 1/3 sequence*
Tolerance	*5%*
Spectral Purity	
SSB Phase Noise	*@ 1 GHz*
@ 3 kHz (carries)	*< -85 dBc / Hz*
@ 30 kHz (carries)	*<-90 dBc / Hz*
@ 300 kHz (carries)	*<-102 dBc /Hz*
Measurement Range	
Max Level	200 v/m @ 10 *MHz*…3.6 *GHz*
Min Level @500 *kHz*	1 v/m @ 3 *kHz* RBW HW Detector Average
Min Level @10 to 100 *MHz*	0.1 v/m @ 3 *kHz* RBW HW Detector Average
Min Level @0.1 to 2 *GHz*	0.02 v/m @ 3 *kHz* RBW HW Detector Average
Min Level @2 to 3 *GHz*	0.09 v/m @ 3 *kHz* RBW HW Detector Average
Min Level @3 to 3.6 *GHz*	0.1 v/m @ 3 *kHz* RBW HW Detector Average
Damage Level	350 v/m @ 10 *MHz*…3.6 *GHz* 750 v/m < 2 *MHz*
Dynamic Range @200 *MHz*	>80 *dB*; 85 *dB (Typ)* @ 3 *kHz* RBW HW Detector Average
Linearity Error @200 *MHz*	<± 0.5 *dB* @ 0.1…30 v/m (±0.25 *dB* Typ) <± 1 *dB* @ 0.03…100 v/m

Flatness @ 0.5 to 10 *MHz* @ 10 to 2000 *MHz* @ 2 to 3 *GHz* @ 3 to 3.6 *GHz*	 < ± 1 *dB* @ 50 v/m < ± 1 *dB* @ 6 v/m < ± 1,2 *dB* @ 6 v/m < ± 1,5 *dB* @ 6 v/m
Isotropy 500 *MHz* 1000 *MHz* 2000 *MHz* 2500 *MHz*	@6 v/m; 3 kHz RBW; HW detector Average <± 0.5 *dB* ; < ± 0.3 *dB* (Typ) < ± 0.6 *dB* (Typ) < ± 0.8 *dB* (Typ) < ± 1.3 *dB* (Typ)
Resolution Level Max Min	 0.001 v/m 0.1 v/m
Spurious Response Input related Residual @HW detector Average	 < -60 *dBc* (Typ) 0.1 v/m @ 30 *MHz*…1.5 *GHz* 0.2 v/m @ 10 *MHz*…3 *GHz*
Selectable Standards	Pre-defined
Correction Factor	Stored in EEPROM
Detectors HW	Peak, AVG and RMS
Antenna	Three-Axial X,Y and Z (identified by a led) Positioned with an axis in vertical or all the axes inclined at 54.7 degrees
I/O interface Optical Link (connector-less type) USB Bluetooth WiFi	 Plastic Fiber Cable (max length 20mt.) Micro – USB Connector Fiber/Bluetooth Adapter (distance max 20m in open air) WiFi Radio link adpter (distance max 300m in open air)
Operating Temperature	0° C to 50° C
Power Supply Rechargeable/Replaceable Batteries Operation Time Battery Charger	 Li-Ion 3.7 V 4h 4 slots battery 110…240 V
Dimensions	140 x 140 x 140 mm
Weight	370 g
Recommended Calibration Interval	24 months

Technical specifications may change without notice

1.7 Technical specifications SEP UP (only the difference with standard configuration)

Frequency Range Band	 *1 MHz to 3 GHz*
Resolution level	 <0.5 V/m
Damage Level @ 1 MHz to 3GHz	 800 V/m
Flatness @ 1 MHz to 3GHz	 *<2dB*
Measurement Range Max Min	 *350 V/m* *1 V/m*

1.8 Software Specifications

Scale	Linear or semi-logarithmic
Data Acquisition	X,Y,Z selectable
Measurements Marker Limit (Horizontal Marker) Isotropic Max Hold RMS Average Channel Power Multi-Channel Power	 Dragged marker with value V/m; W/m^2; mW/cm^2; mV/m Select the peaks over the selectable limit. Orderable in frequency/amplitude Root Mean Square value. Selects the max value of the isotropic track With selectable time (from 1 minute to 1 hour) With selectable time (from 1 minute to 1 hour) Selectable and dragged from 1 *MHz* to 20 *MHz* Multiple simultaneous channel power with value acquisition
Report	Easy screenshots of measurements with the possibility to take notes
Setup	Programmable, customizable. Saved setup can be stored
PC Requirements OS RAM Resolution	 Windows 7 – 8 – 8.1 – 10 Minimum 2 GB Minimum 800 x 600

2. Operating principle

2.1. SEP

The block diagram below in Figure 3Figure 2 represents the functioning of the SEP

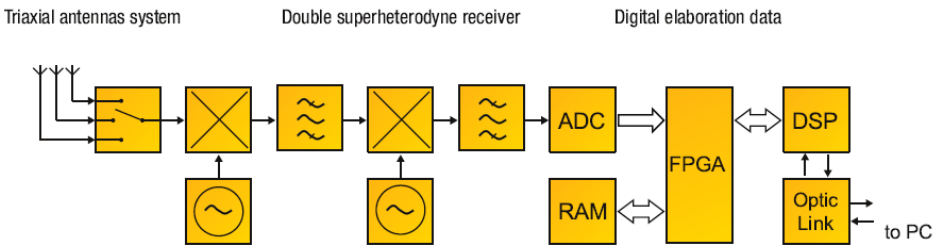


Figure 3 SEP logic scheme

The signal, received from the three dipoles (X, Y and Z), is selected by a switch that directs it at the input of the receiver; the first stage of the superheterodyne receiver converts the signal to the frequency of the first IF, where it is filtered and amplified, before being re-converted to the frequency of the second IF, which makes it downloadable from the analog to digital converter. The digital signal, as a result of numerous and complex processing, is made available to the optical interface, that transfers all the necessary data to the PC. Through the PC software MPB SEP, users will be able to view real-time data while making measurements of revealed intensity point by point, read the values integration over a frequency band and save the work session as an image or data files, for a future check.

3. SEP Use and operations

3.1. Power supply

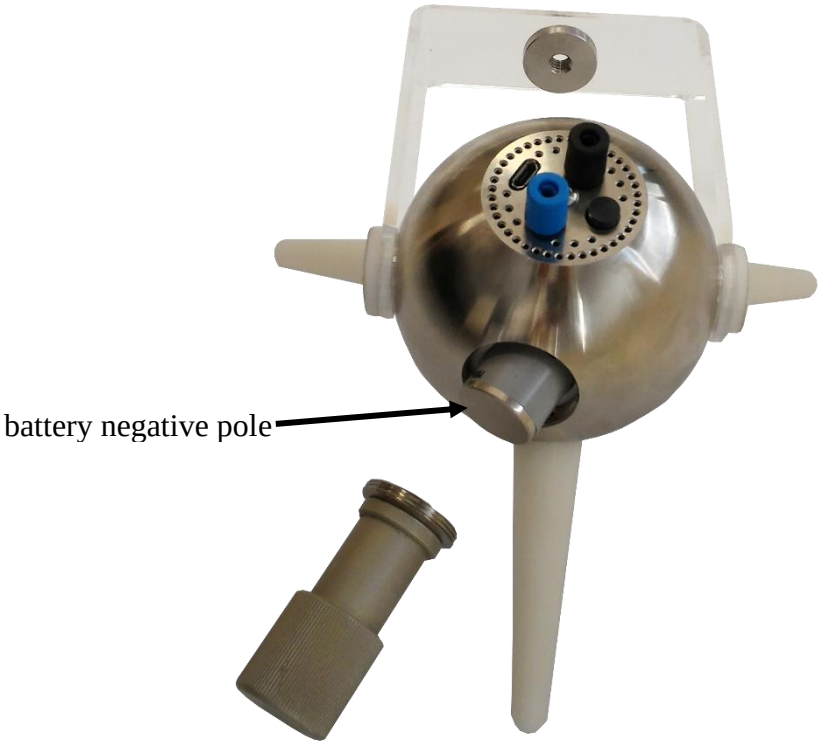


Figure 4 Cap Remover

The SEP does not need external supply. It in fact uses two 3.7V lithium batteries, 49.3 mm long and 18.4 mm of diameter. This model (NCR18500) is manufactured by Panasonic. The batteries compartments are located on the side of the device, that can be opened by the cap remover supplied with the kit, as shown in Figure 4.
The Cap remover is equipped with a magnet to help the user with the screwing operation. The batteries have to be plugged with the positive side first. For recharging, the user can

remove all the batteries and use the external 220V charger or plug the SEP micro-USB connector to a simple charger min 1 Ampere and leave the batteries inside the device.

When screwing, please make sure the cap reaches the sphere surface without tightening too much.

3.2. Placement

Before any operation, plug the plexiglass support with a tripod through the appropriate ¼“ threaded hole. In order to have a better isotropy response from the SEP, please perform the placement as in Figure 3.2. Please remember to stay away from metal objects that may cause electromagnetic reflections that may affect the measurement.

Figure 5 SEP on a tripod

3.3. Fiber Optic Plug

Insert the optical fiber in its room on the back of the SEP, as in Figure 5 SEP on a tripodbeing careful to match the optical fiber recognizable by the blue color with the color of the corresponding connector. On the side of the PC, the USB – RS232 converter must be installed with the optical link, supplied with the kit.
In this case there is only one way to connect the optical fiber
to the connector. For the installation of the converter driver

3.4. Switch On/Off

To turn on the device, press the power button ON/OFF, shown in Figure 2. To turn it off press the same button for around 4 seconds. Please remember that the SEP is not a standalone device, so it has to be plugged to a PC for programming and for real-time data visualization. To learn the software usage, please skip to Chapter 4.

4. Use and functioning of the software MPB SEP

Please note that this manual was written according to software version V 3.3

4.1. Prerequisites

The MPB SEP was developed for Windows platforms, with at least 2 GB of RAM and preferably a dedicated video memory. The compatible operating systems are the following:

- Windows 7
- Windows 8
- Windows 8.1
- Windows 10

It is also necessary the .NET Framework 4.0 (or next), that is free of charge through the Windows Update system. In case the computer in use has no internet connection, it is possible to use the installer provided in the USB key supplied with the kit, that will add the necessary inputs to execute the software. Even the USB – RS232 converter, used to connect, through the fiber optic, the SEP to the PC, can be installed through the automatic functionality of the Windows driver research or, in case of no internet connection, using the manual installation mode of the driver, also provided in the USB key supplied. If the computer meets these requirements and has installed the drivers of the converter, you can proceed with the SEP software installation.

4.2. .NET Framework 4.0 installation

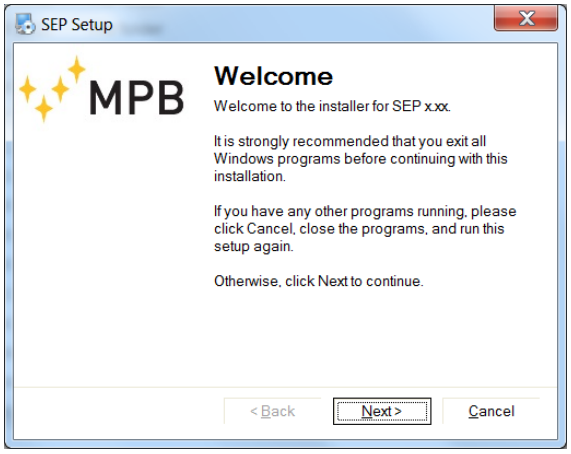
In order to verify which version of the .NET Framework is installed on the PC in use, it is sufficient to open the control panel and check the programs installed. In the Windows 7 version, if not automatically updated through Window Update, the most recent framework versions could not be installed. This is why in the USB key supplied is included the 4.0 version, that can be also installed offline. As for from Windows 8 on, this component is already part of the operating system.

4.3. FTDI driver installation

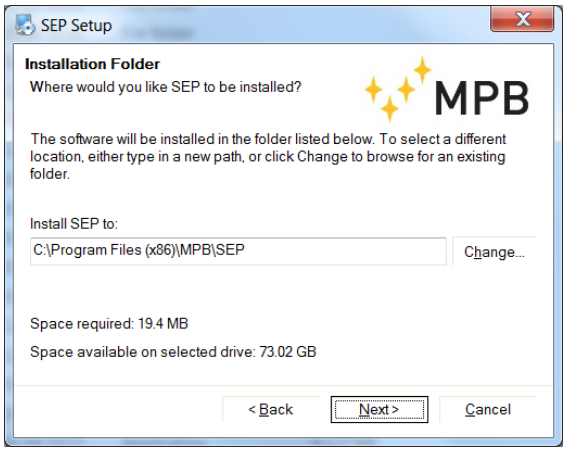
In case of no internet connection, so in case an automatic research of the update driver is not possible, the driver supplied with the USB key can be used. Please then plug the USB – RS232 converter with the optical link to the PC (in this phase it is not necessary to connect the fiber optic) and, in case the automatic installation will not work, choose the manual installation mode by selecting the driver supplied with the USB pen driver.

4.4. MPB SEP installation

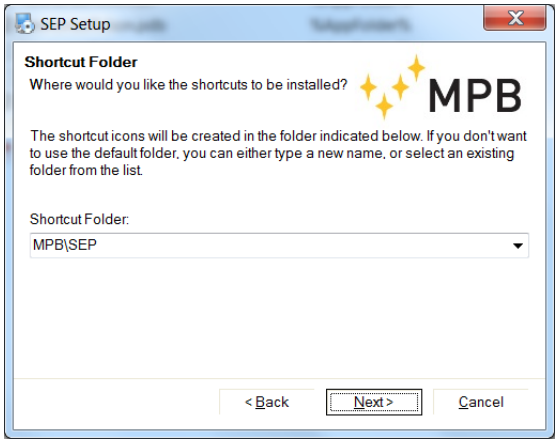
Keeping the installer provided in the USB key, or downloading the software from our website (gruppompb.uk.com), it will be possible to choose in which folder to install the applicative (Figure 6(b)), edit the position of the links in the system menu, (Figure 6(c)). In the report (Figure 6(d)) are shown all the settings before proceeding with the installation, at the end of whom the final confirmation screen of the operation will appear (Figure 6(e)). Keeping the default settings, it will be possible to find the application installed on the smart menu, in the “MPB S.r.l.” folder.



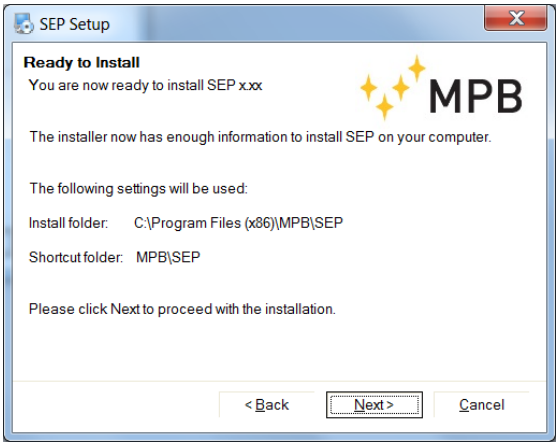
(a) Welcome



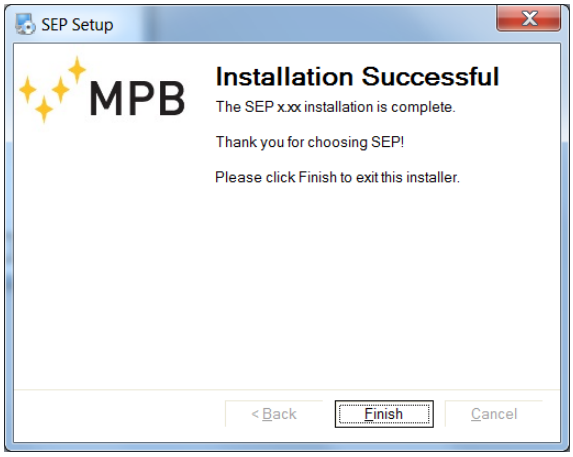
(b) Patch



(c) Link



(d) Report



(e) End

Figure 6 Installer MPB SEP

4.5. Software Home page

Figure 7 Home Page

[We recommend a screen resolution of 1920 x 1080 – with 100% screen configuration]
By pressing the "Connect" button, the software will attempt a connection with the device, automatically finding the correct COM port. In case of eventual error message, the software will warn the user asking to check the power status of the SEP or the driver installation.
Once the connection is established, a green outline will confirm that the instrument is connected and ready to make measurements. The MPB SEP will show under the "Connect" button, the device information, such as the COM port used, the FW version installed in the device, the serial number, the calibration date, the working mode and the battery level.
Now, with the SEP connected, the "Spectrum Mode" will be enabled. Please note that although the frequency range of the instrument is 100 kHz–3.6 GHz, two working bands are allowed: "Band1" [100 kHz-9.999MHz] and "Band2" [10MHz-3.6GHz]. By default, the instrument's working mode is set on "Band2". This means that working in between "Band1" and "Band2" (e.g. a start frequency set at 9 MHz and stop frequency set at 20 MHz) is not allowed. It is recommended to insert username and location in order to recall the data both on the graph and generated files.
On the left part of the panel, also three shortcuts are present:

- Website: direct link to the MPB website
- Manual: offline link to the SEP manual, added during the installation
- Video: direct link to the MPB Youtube page

From the main screen, a measuring mode and two user commodity forms are available.

4.5.1. Standards and Limits

Through this form, that can be opened even when the SEP is not connected, the user can create standard files that the software will use to set limits and make measurements according to those limits. The default standards in the software are four:

- ICNIRP 2010 Occupational
- ICNIRP 2010 General Public
- Italy CM 2003 – Attention Value
- Italy CM 2003 – Exposure Limits

Even the Standard files are exportable and importable from the pc, in order to favor the expandability and collaboration. All standards can be also renamed, edited, deleted, replaced or created from scratch.

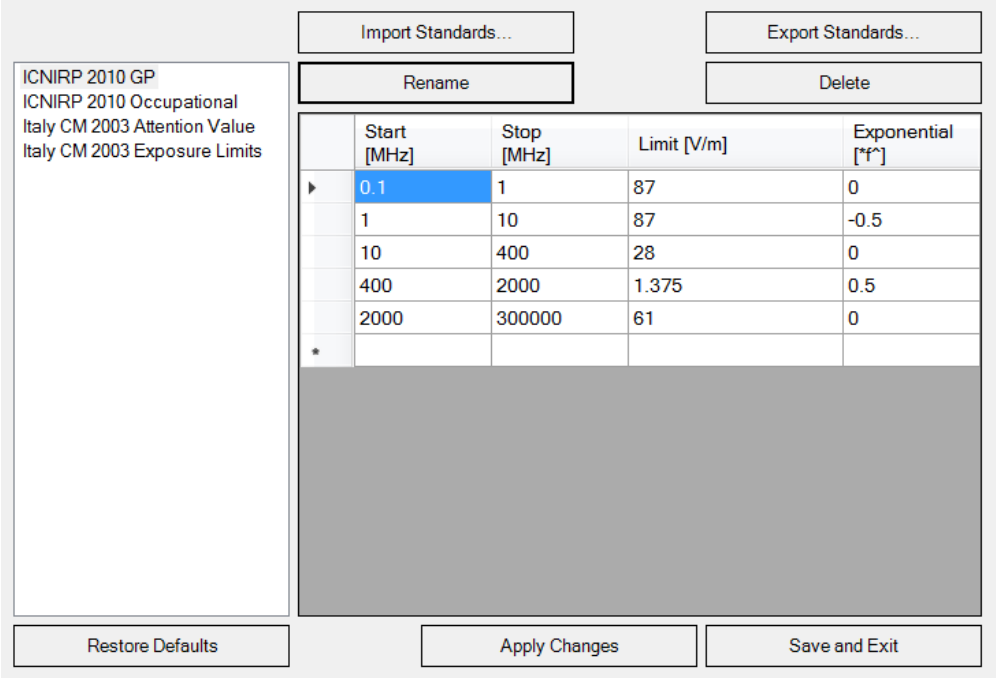


Figure 8

4.5.2. Personal Frequencies and Channels

This form allows creating files with frequencies, channels, users and locations that can then be used when performing measurements for a quick recall, to fasten the procedures. This form allows making “Single Frequencies List Files” to recall a set of interest frequencies, and “Channels List Files” in case channels are required. The procedure is the following: by pressing “Add new”, inserting the preferred name, press “OK” and the file is created. To edit the created file please select the name in the list

and the data grid view is then enabled for editing, so to write the interested frequencies. By pressing “Apply”, a confirmation message appears. In case invalid channels are set, the software will warn the user by highlighting the sets in red. From this section on, the files will be saved on the pc through the “Apply” button. Each section has its own “Apply” button.
Please note that the “Single Frequencies List Files” will be shown in the “Limit” section while “Channels List Files” will be shown in the “Multi-Channel Power” section, see related sections (4.14.2 and 4.14.3) for more information.

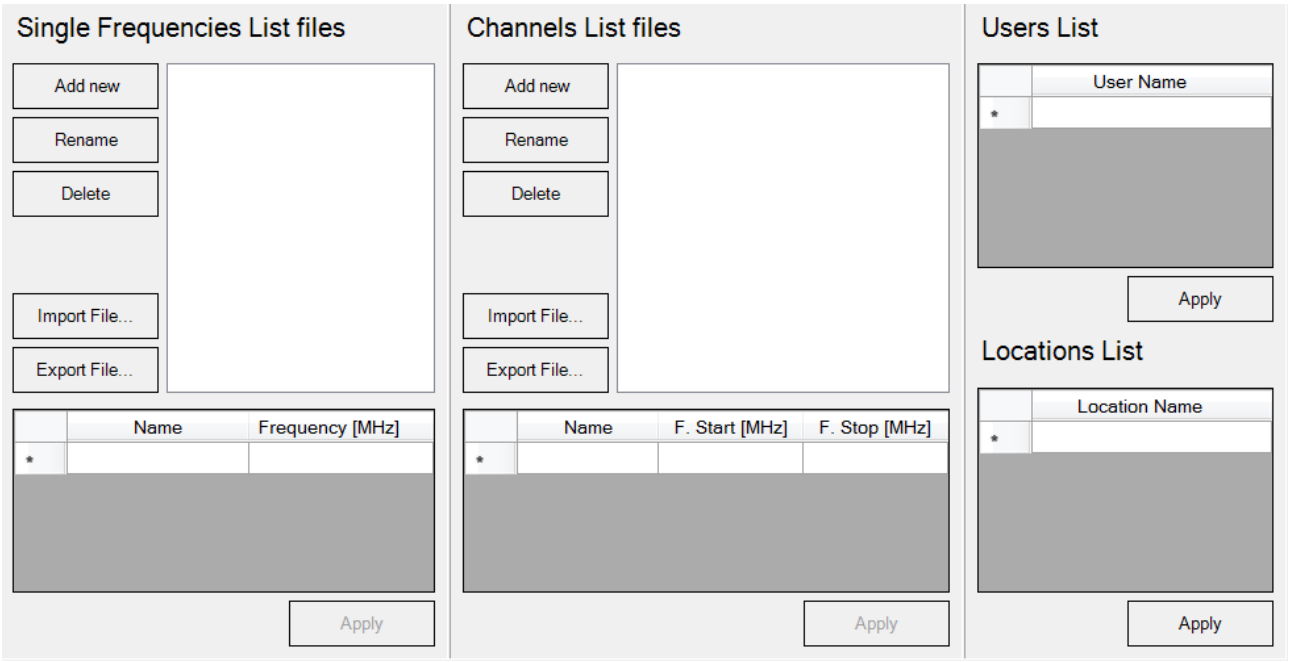


Figure 9 Persona Database

4.6. Spectrum Mode

Once the SEP is connected, by selecting the “Spectrum Mode”, the scan will begin: on top left, you will find first the MPB logo, then battery status, the voltage and fans status.

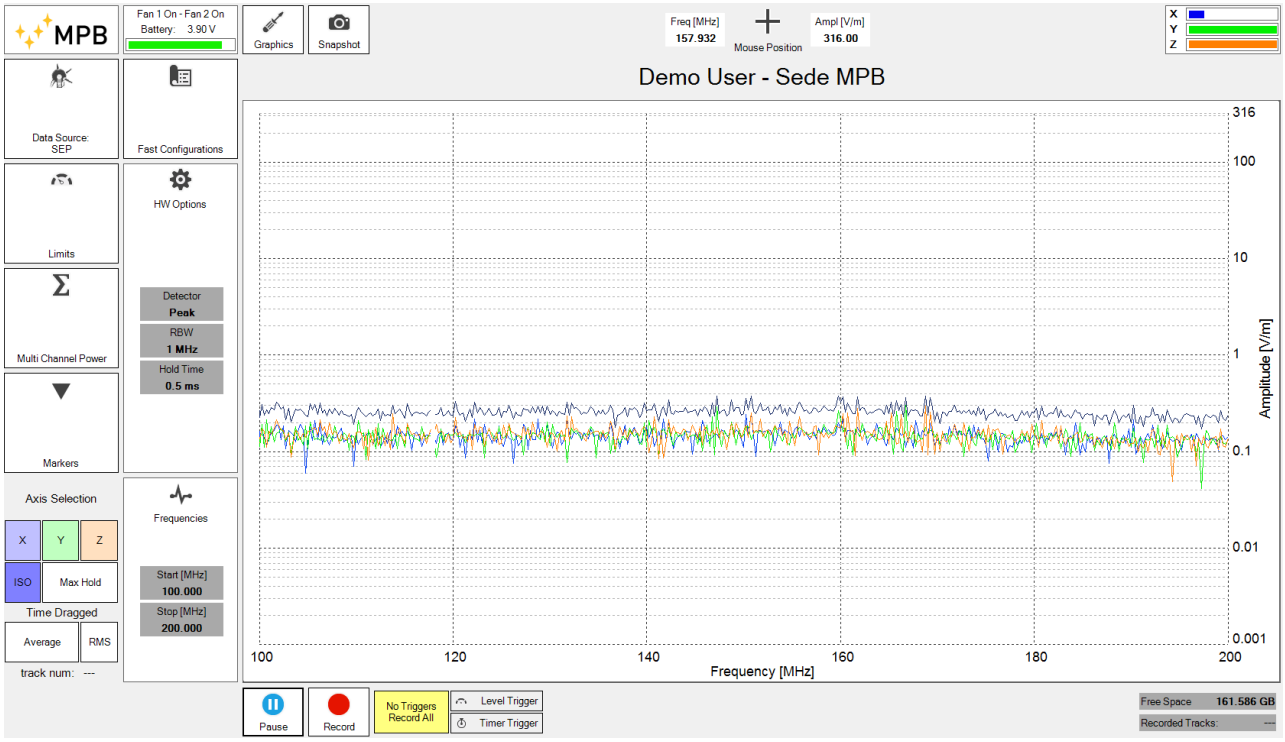


Figure 10 MPB SEP Spectrum Mode

4.6.1. Graphics

To the right of the battery indicator, the "Graphics" button is shown. By clicking "Graphics", a panel is shown (as in Figure 11 Graphics Panel) giving the user the possibility to edit the view. From the top, the "Custom Description" group is available: it firstly shows or hide (by flagging or unflagging the "Show" – related button) a default description that can be edited by the user by pressing "Edit Description", according to his needs. Then the "Default" button will restore on the top of the graph, the name and location set before. As for the x-axis, the view can be linear or logarithmic; as for the y-axis, it can be both but is also available the y-range, that represents the minimum and maximum view point.

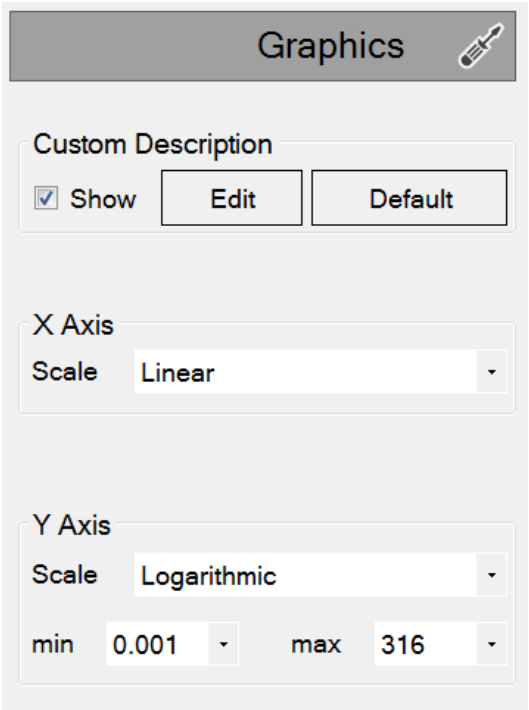


Figure 11 Graphics Panel

Note: for SEP UP configuration set min 1 V/m e max 1000 V/m

4.6.2. Snapshot

Next to “Graphics”, the “Snapshot” command is shown: in case the user presses the button during the scan, the software will wait until the ongoing track is finished. When the scan is finished, a “Save file dialog” will be shown. The suggested name and folder are used to keep chronological order for each file, but the user is free to choose both the preferred name and path.

4.6.3. Mouse Position

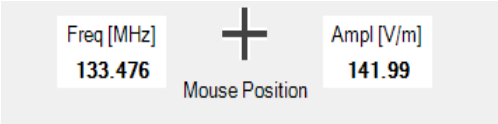


Figure 12Mouse Position

The “Mouse Position” path is not clickable but was developed for reading use only. Moving the mouse on the chart, this panel will be updated with the actual values of the pointer on the chart.

4.6.4. State of the actual data

Last on the top right, it represents the actual of the axis data, a real time indicator of the axis downloading state. (The panel moves together with the real data, so in case it will not move, it means that the scanning is not in progress. In that case the operator will have to check if he has pushed the “Pause” button).

4.7. Data Source

From this panel, the user can select which data source the software will use. During the first use, the selected data source will be the “SEP”, showing the connection status, as it is in the home page. Also as in the home page, from this tab is possible to connect or disconnect the SEP. The other selectable data source is from “Files”. By clicking on “Files”, the underlying panel will change to an explorer tab, showing all previously recorded tracks. Please note that by selecting “Files”, the command under the graph will change, enabling the user to review his recorded files.

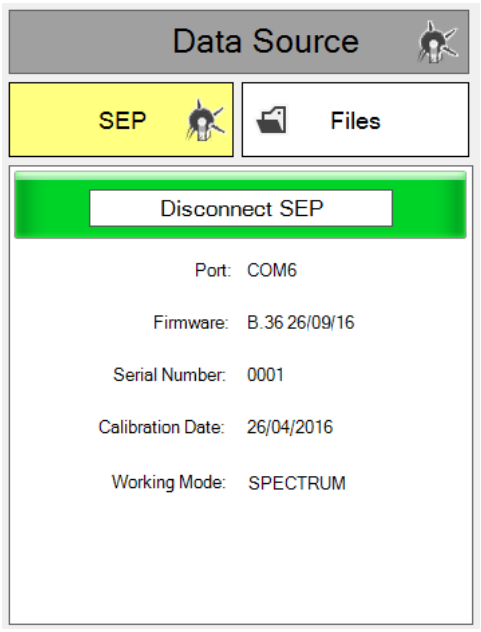


Figure 13 Data source

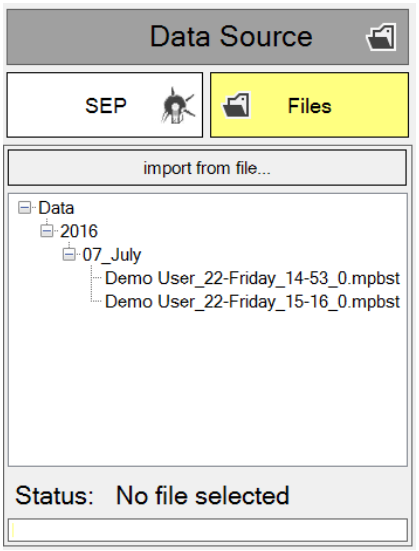


Figure 14 Data Source Files

4.8. Registration

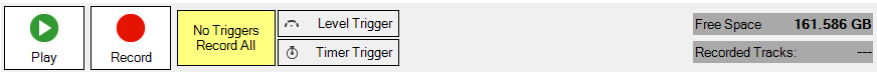


Figure 15 SEP live bar

Once the SEP is connected and operative, the lower part of the graph can be used for post processing operations. During the work session it is possible to pause the scan through the “Pause” button. The software has three record modes, that can be selected from the first panel after the record button.

- No trigger: once pressed, the user will be warned on the chart informing that recording is going on. In this mode every track downloaded by the SEP will be saved on file (in the next chapters we will see how to recall this files).

- Level trigger: this button will reveal an additional panel for the level selection so the user could set a limit over which the software will save the actual data on file.

- Time trigger: also this button reveals another panel, based on the sleeping time of the software: it is this called because the software will pause every tot seconds set by the user

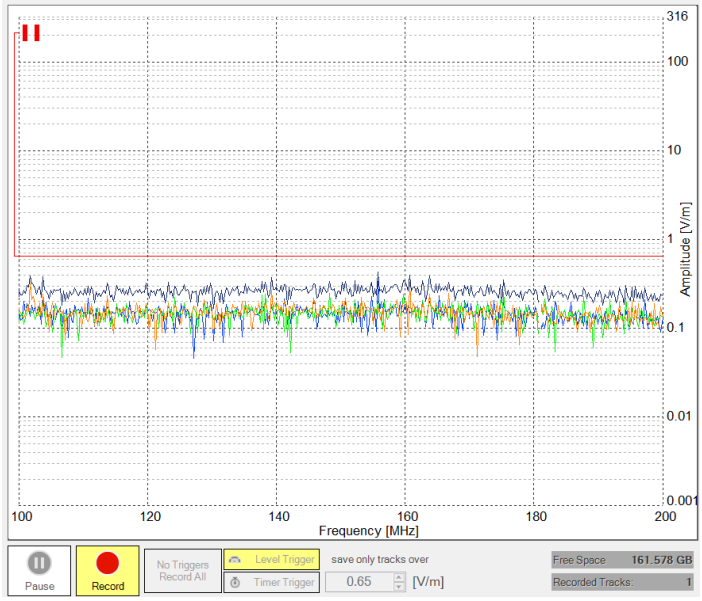


Figure 16 Level Triggered Recording

4.9. Review Stored Session Files

From the Data Source panel, select the "Files" Data Source (Shown in Figure 13 Data source). This operation will change the control bar under the chart and the "Data Source" panel will show all the recorded files on the pc. The data are automatically chronologically sorted by the software. By clicking on one of these files, the software will load the related session. Under the chart are shown date & time information for each track through a track bar screen. The user will be free to perform new measurements such as channel power, markers, dragged in a set time.

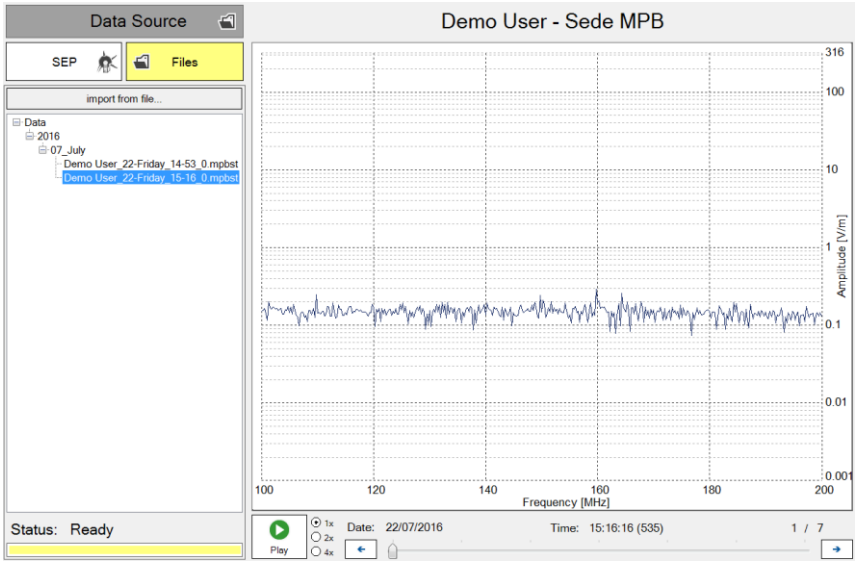


Figure 17 Stored File Processing

In the Data Source panel, by right clicking a file, a context menu will allow the user to load, export or delete each file. External files can be loaded by pressing the “Import” button over the three view tab.

4.10. Fast Configuration

Through this tab, the user is allowed to store the ongoing hardware configuration and create a set for the most used configurations. By pressing “Store actual configuration”, the software will ask for a configuration name, and will save the used hardware options and frequencies. Alternatively, for a deeper customization, all configurations can be created in the “Manage Configurations” form.

Figure 18 Fast Configuration

4.10.1. Manage Configurations

This tab “Manage Configurations”, will allow to add new fast configurations in the “Fast Configurations” tab.
The File ITA2016_FastConfiguration.mpbc contains all the information concerning the distribution of the frequencies of the TV, Radio DAB and mobile frequencies according to the operator, updated to the Software release date.
It is possible to load the configuration files (.mpbc extension) by clicking on "Fast Configuration"->Manage Configurations->Import Configurations File and by linking the preferred .mpbc followed by " Save and Exit". Also, its “Import” and “Export” functions, allow to maintain specific hardware settings and to share them with partners.
Other buttons underlying the grid are “Add new line”, for setting a new fast “Fast Configuration” line, “Sort”, that will organize all the fast configurations by category and then by name. The “Sort” method can also be organized by frequencies, by clicking on the header of the preferred column. Last, the “Save and Exit”, necessary to apply the edit.

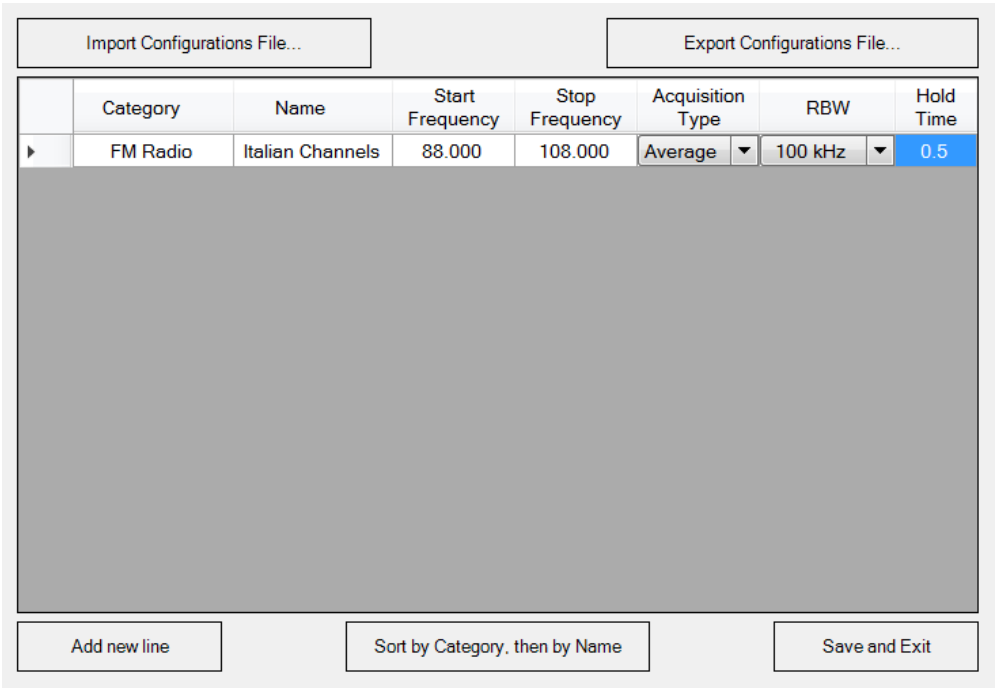
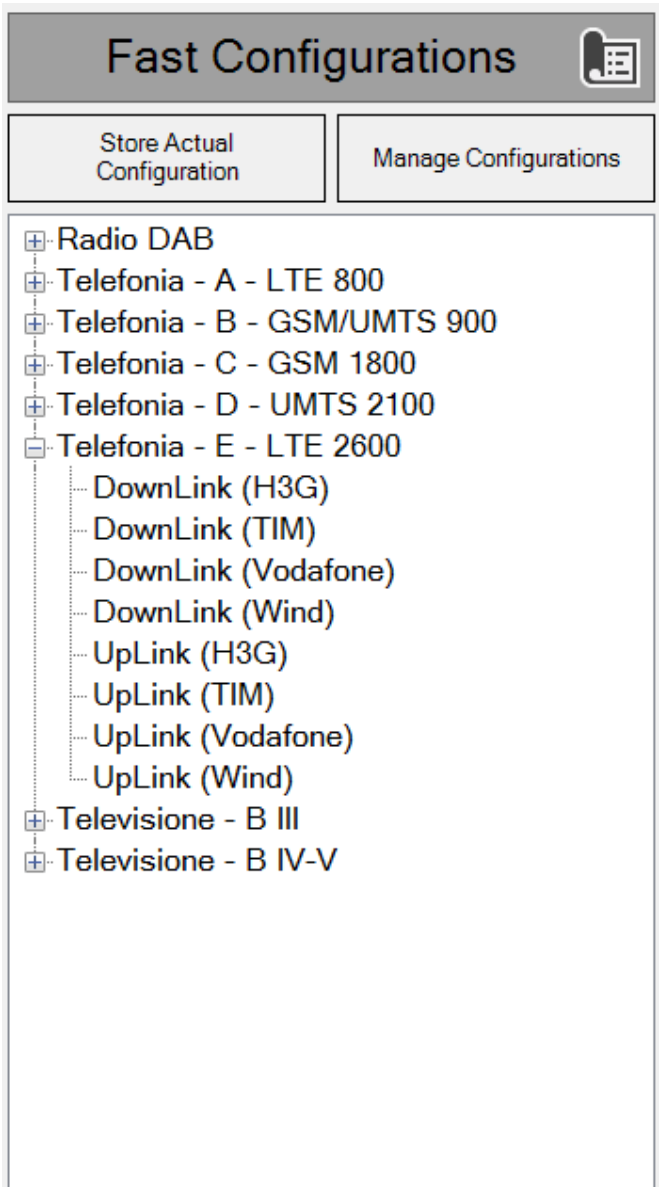


Figure 19 Manage Configurations



In the Figure 20 Fast Configurations Examplesis shown an example of a working configurations set. Stay tuned with our website for some precompiled configuration set.

Figure 20 Fast Configurations Examples

4.11. HW Options

This tab includes three different hardware options: on top, the “Resolution Bandwidth”.
The panel will show all the filters that can be chosen, according to the selected frequency range: tighter is the span and less will be the filters that can be selected. Please note that, only for “Band1”, RBW value is fixed on 3 kHz and cannot be chosen. The SEP has six different filters:

- 1 MHz

- 300 kHz
- 100 kHz
- 30 kHz
- 10 kHz
- 3 kHz

In the middle is the “Hardware Detector”: this panel allows choosing from three different modes of acquiring the single point within “Peak”, “Average” and “RMS”. In the bottom part, the “Hold Time” panel allows to choose how long (in milliseconds) it takes to consider the measure of each individual point. It can be set from a minimum of 0.1 ms to maximum of 10 ms.

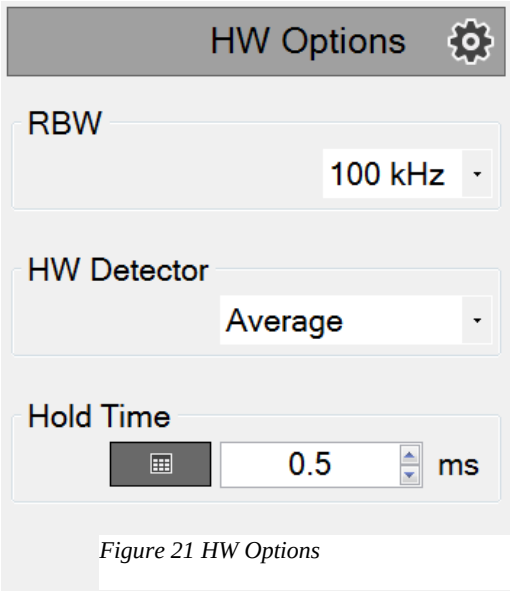


Figure 21 HW Options

4.12. Frequencies

Through this tab, the user can insert and edit specific frequencies. Four commands are available: “Start”, “Stop”, “Span”, and “Center”. By editing values in any space provided, of course different values in the other three might appear. In most of the cases however, by editing the “Center”, the span value will stay the same. Please note that through the “Start”, “Stop” and “Center” settings, it is possible to switch between “Band1” and “Band2”, and there is a dedicated label that indicates the ongoing working band chosen. Through the “Span” tab, the measurement range can be set within the selected working band (“Band1” and “Band2”). This means that is not possible through the “Span” values, to switch between “Band1” and “Band2”. Please
note that in proximity of the limits of the bands, the “Start”, “Stop” and “Span” values, could be automatically re-calculated for visu-alization purposes. Please also note that the RBW follows the “Span “settings, so by editing the span, the “RBW” value can change according to the device’s hardware features. Please note that the numeric buttons near the “Center” and the “Span” (not available in “Band1”) will change relative values and adapt others for facility.

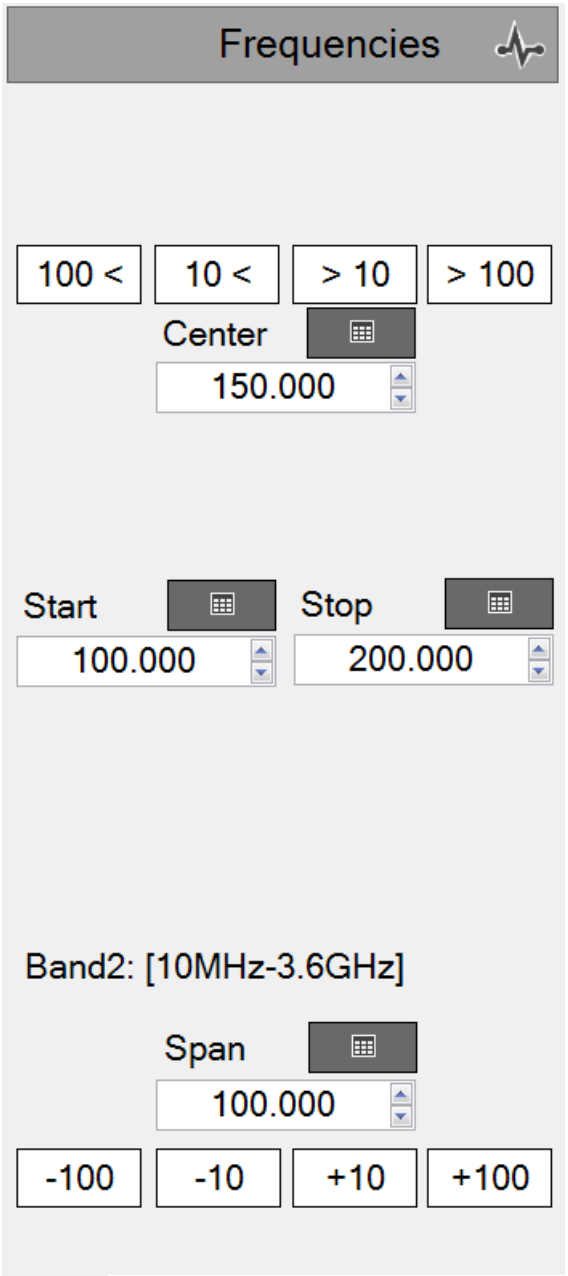


Figure 22 Frequencies

4.13. Axis Selection

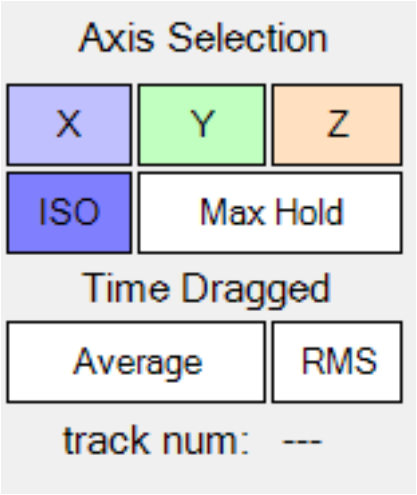


Figure 23 Axis selection

On the left of frequency tab, the "Axis Selection" is available for the user to choose which axis to view. The ongoing axis will be "colored". Please note that choosing the isotropy each axes will be enabled, even if not necessary visualized. Under the axes-related buttons that represent a real downloaded value, the ISO track will represent a virtual value measured according to the real axes values. The "Max Hold" will keep on the graph only the maximum isotropic measured values.
Bottom left, the "Time Dragged" measure is available: it allows both "Average" and "RMS" measures that are mutually exclusive. The first one is the average of the summation of different ISO tracks in a set time.

Please note that by selecting "Average", in case the user is willing to perform the dragged measure, the software will set the hardware detector according to the selection. In case he is willing instead to perform the dragged measure by using another type of detector, it will be sufficient to set it after having activated the dragged function. To select how long it will take for the software to calculate the dragged measure, just set in the specific control (shown in Figure 24 Time Dragged) under the axis selection.

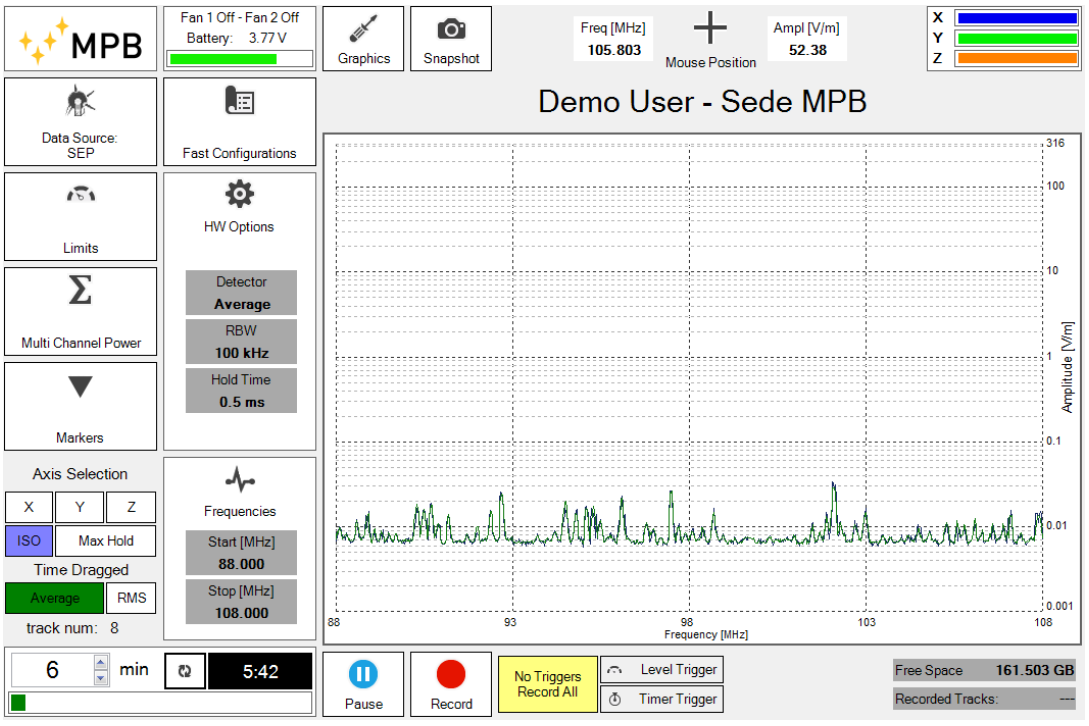


Figure 24 Time Dragged

4.14. Measurement tools

In this section will be explained how to use all measurement tools in the software. Please note that these tools will work independently from the chosen data source. (Chapter 4.7)

4.14.1. Markers

The “Markers” tab contains all the controls to move the graphic markers and read the corresponding values for each track

In the tab is present a combobox, labelled “Amplitude Unit”, that will edit the units of measure of the detected values. From the panel it is possible to set units of measure and choose the preferred frequency from the dedicated space or directly from the graph for each marker. It is also possible from the graph to move the first marker by left clicking and the second one by right clicking. In case of default the tab will include the value of the X,Y and Z axes and the Isotropic one. If in the session the user has enabled the “Max Hold” (4.13) visualization and/or the “Average” acquisition mode, the “Markers” panel will also show the values added in the session. The next units of measure are available:

- V/m
- mV/m
- W/m^2
- mW/cm^2

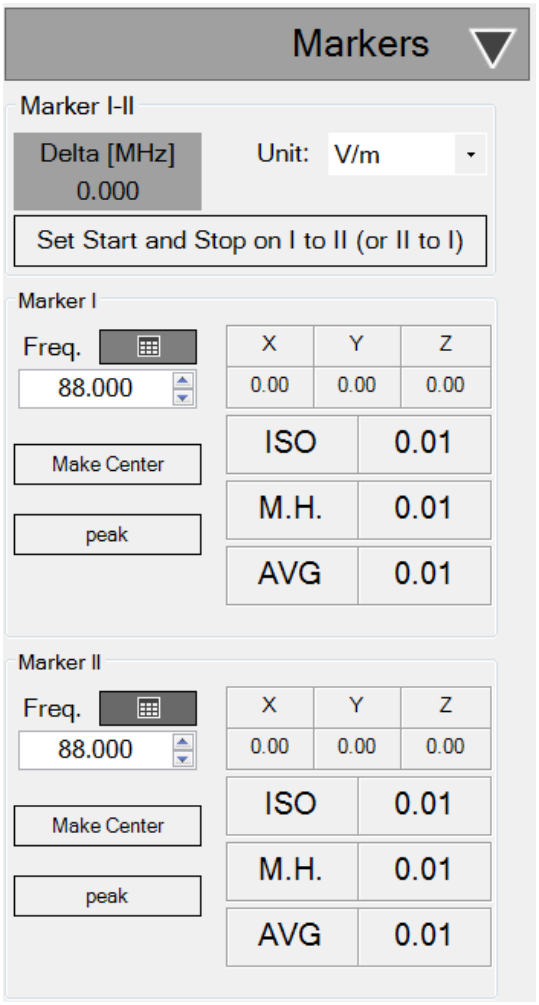


Figure 25Marker tab

The “Peak” button will move the marker to the highest point of the track, the “Make Center” will move the session frequency according to the marker position.

4.14.2. Multi Channel Power – Only in Band2

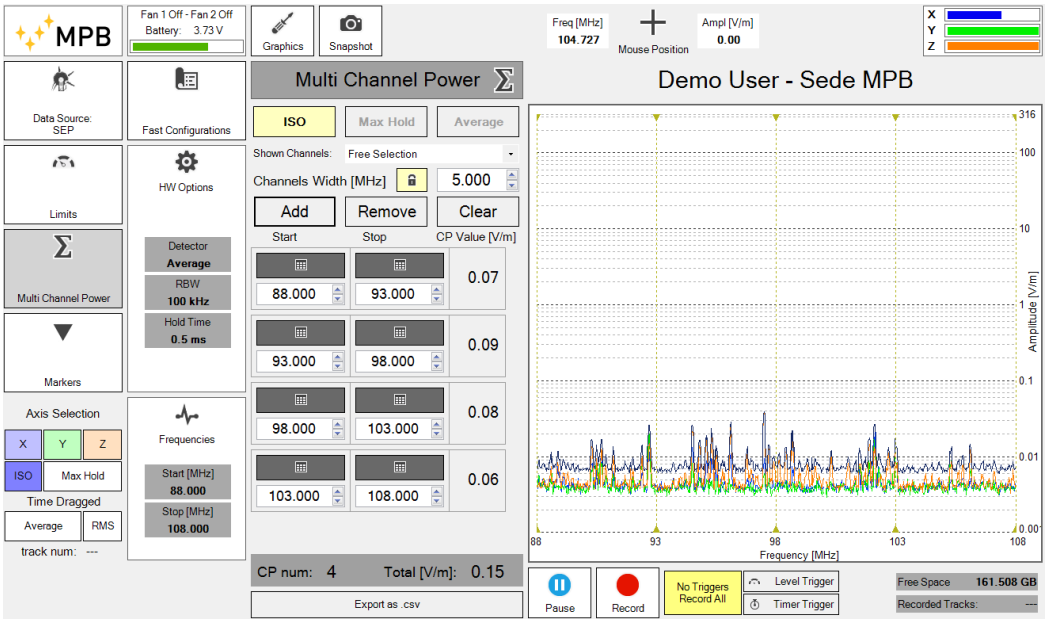


Figure 26 Multi Channel Power(1)

The “Multi Channel Power (MCP)” allows performing the calculation of the values of the integrated field of more frequency ranges at once. In the current software version are allowed up to 50 channel powers in the same scansion. The user can enable or disable the calculation, set the center of the range to be measured, the width (from a minimum of 1 kHz up to 20 MHz) and read the corresponding value in V/m. Please note that this function is allowed only in “Band2”. On the top of the panel, the user can choose on which track to perform the MCP measurement. The “Max Hold”, “Average” and “RMS” measurement can be enabled only if they were enabled in the axis selection. Besides the axis selection, a combobox is present with a “Shown Channels” dropdown list: by default a “Free Selection” mode is enabled: the dropdown will be populated with the name of the preferred personal channel list, that will be calculated only in case the selected frequencies belong to the appearing frequency range: the calculation will be performed only for the channel powers inside the spectrum, otherwise the value will be zero (see 4.5.2). By selecting in the dropdown a file name, the software will try to adapt available channels in the ongoing scan. The “Channels width”, establishes the default width of each added channel power. Near the numeric selection, there is a lock button; if enabled, the software will try to keep the channel width chosen. Therefore, for example by changing a single channel start, the stop will keep the selected width. Please note that with the lock unchecked, the user will be free to edit starts and stops individually. About Figure 26 Multi Channel Power(1)please note “Add”, “Remove” and “Clear” buttons and the room to insert the bandwidth. By pushing the “Add” button, the MCP calculation will be automatically enabled, and will set the start of the first CP on the start frequency of the session and the stop on the frequency resulting from adding

the start to the bandwidth, set in the top part of the control. The CP later added will start from the stop of the previous one. Assuming the case where the *span* of the scansion is of 40 MHz, and the width of the CP to add is 80 MHz, only by activating 5 CP it will be possible to divide the whole scansion in 5 measuring bands. Reached the end of the scan, the software will not add further CP. It is however possible to edit the modification of the single start and stop from every CP. In the bottom of the panel, the number of the created CP components is available, together with the RMS of each measured value for each channel. The last button on the bottom is the "Export as .csv": the software will prompt for a "Save file dialog", so the user can select the file name and the path preferred. In this files will be stored all channels' information and the total value. Please remember that the MCP total is the RMS summation of all the CP.

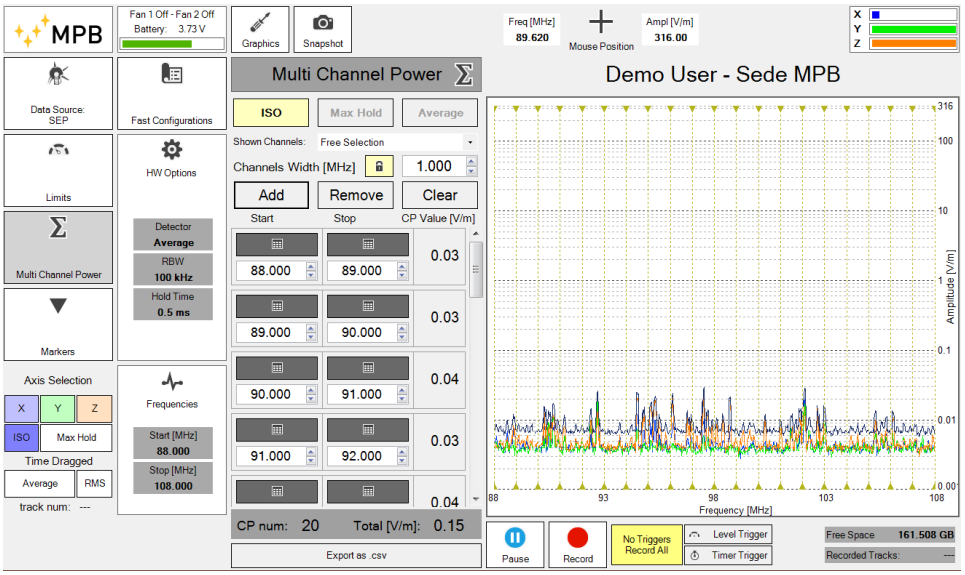


Figure 27 Limits

Also in the "Limit" tab as in the "MCP" one, the "Max Hold", "Average" and "RMS" measurements can be enabled only if they were enabled in the axis selection. The "Shown Values" (please note that in the current Software version are allowed up to 30 values in the same scansion) combobox will be by default set on "Over limits": it means that the software will list all peak values for CW signal over the selected limits. For wide-band signal the software will provide the central frequency and the channel power measurement. The total contribution to the electric field in the environment is also evaluated according to the formula: $\sum_{tot} = \sqrt{\sum_i E_i^2}$

The "Shown Values" will be also populated with the "Single frequencies list" created by the user through the "Personal DB form" (see 4.5.2). The dropdown will be populated with the name of the preferred "Single Frequencies list files", that will be calculated only in case the selected frequency belongs to the appearing frequency range: the calculation will be performed only for the frequencies inside the spectrum,

otherwise the value will be zero. Under the "Shown Values" command, there is the "Standard" field: by default the software will select "Flat Selectable Limit", giving the user an additional control to define the amplitude limit. Moreover, the "Limit" tab can show on the graph the limits required by the different ongoing standards. By default, the software allows to load four different standards:

- ICNIRP 2010 General Public
- ICNIRP 2010 Occupational
- Italy CM 2003 Attention Value
- Italy CM 2003 Exposure Limits

The values obtained can be printed in the three following units of measure:

- V/m
- W/m^2
- Mw/cm^2
- % (percentage value related to the limit according to the frequency)

The values will be updated at the end of the scansion. Moreover, the values can be shown ordered by "Frequency" or "Amplitude" only by clicking on the preferred label button. The "Limit" tab allows the user to export the measured values in .csv, and a commodity form to calculate the conformity reduction factors.

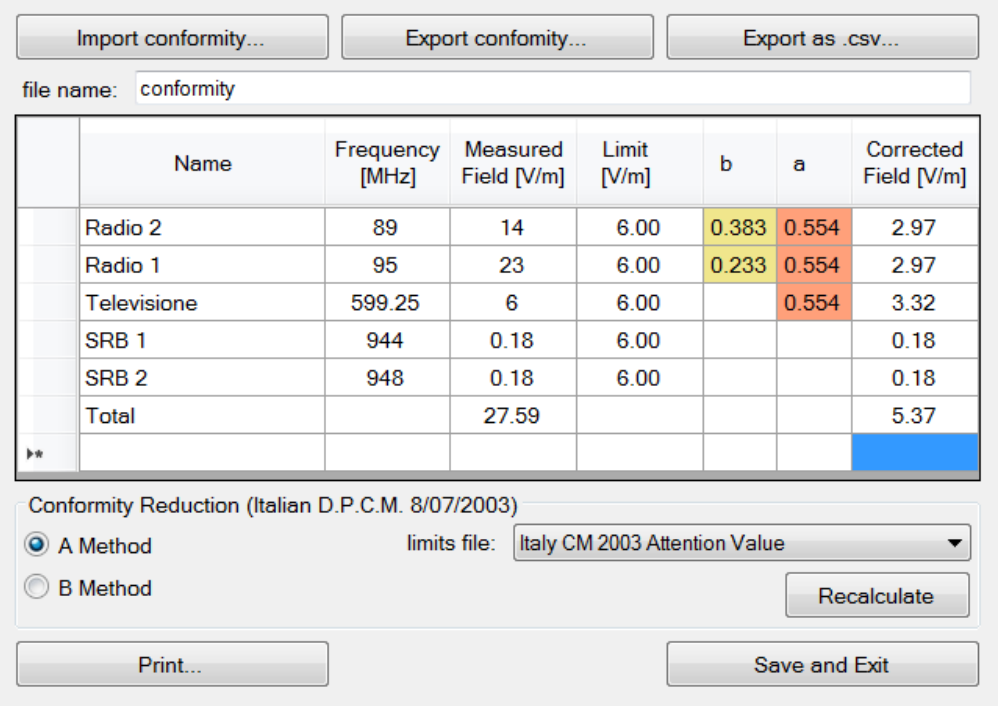


Figure 28 Conformity

The aim of this *form* is a calculation of the contribution of each source with respect to the applicable limits, described in the Italian D.P.C.M. of 07/08/2013, regarding the conformity reduction in accordance with the broadcast stations.
The contribution is described by the following formula:

$$C_i = \frac{E_i^2}{L_i^2}$$

So that the broadcasting station is within the limits, the following condition must occur:

$$\sum_{i=0}^{n} C_1 \leq 1$$

The values to be entered in the table are the frequency, the level and, optionally, the name associated. In the lower panel the user can select in relation to which standard to use the calculation of the contributions. By pressing the " Recalculate" button, the limits by frequency will be recalculated, and if the station in question does not adhere to the limits selected, will be identified the multiplication factors for the reduction in compliance. The factor β applies to all sources that individually exceed the limit. If despite the first reduction, the sum of the contribution is still over the limit, the second reduction is applied through the multiplication factor α to all the sources. For a more detailed description, please see Annex C of the D.P.C.M. of 08/07/2013.
To further simplify the data loading, please note that the "Conformity Reduction" button, in the "Limit" tab (Figure 27 Limits) will load all the frequencies and associated detected values, updating the frequency values if already present or adding new lines in the spreadsheet.

5. APPENDIX A – Auxiliary Communication Protocol

Software communicates with hardware through a proprietary protocol. To allow technicians to perform calibration an auxiliary protocol has been developed. It's not intended to use device as a probe.
In any case it's possible to launch some sweep from a serial terminal and receive measures. The speed and the number of points will be not the same achievable with the software.

Applicable with the versions below or following:
- ver. FW B.37
- ver. FPGA 0x14
- ver. MSP 430 2.09

Protocol is implemented on RS232 set as follows:
- Baud Rate **115200**
- 1 Start Bit
- 1 Stop Bit
- No Parity

Note: The auxiliary protocol is enabled at the boot. So, if you have already connected it to the software, turn off and on to reboot the device.

Request commands are made of ASCII string terminated with <CR><LF> (\r\n)
Below here a description of auxiliary protocol:

5.1. Basic commands

5.1.1. IDN query

Commands	Response
*IDN?	Gives back version and date of the firmware release of DSP.
Example: Sent ➔ *IDN?<0D><0A> Received ➔ IDN=SEP-FW - B.37 21/07/17 <0A><0A><0D>	

5.1.2. FWRQ query

Commands	Response
*FWRQ?	Gives back version of the firmware release of optical interface.
Example: Sent ➔ *FWRQ?<0D><0A> Received ➔ SEP_OP_INT_FW_VER_2.09*<0D><0A>	

5.1.3. CFG query

Commands	Response
*CFG?	Gives back serial number and calibration date.
Example: Sent ➔ *CFG?<0D><0A> Received ➔ CFA=0,(xxx_ddmmyy)<0D> Where: xxx ➔ serial number ddmmyy ➔ *ddmmyy* calibration date	

5.1.4. STA query

Commands	Response
*STA?	Gives back the status of the machine.

Example:

Sent ➔ *STA?<0D><0A>

Received ➔ Vbat 3764mV;TBD;TBD;TBD;Ric 0;USB 0;Temp 38gr;Fun f<0D><0A>

Where:

Vbat **xxxx**mV; => xxxx represent the voltage of the apparatus' internal batteries
TBD => for future expansions
Ric **n** => n is charging status of batteries if = 0 => not recharging
if = 1 => recharging
USB **n** => n is USB cable connection status if = 0 => not connected
if = 1 => connected
Temp x**x**gr => xx is the internal temperature in °C
Fun **c** => c is the fan status according to the following bit coding:
// ---1 if(**c** && 0x01) => Fun1, active; otherwise not active
// --1- if(**c** && 0x02) => Fun1, rotating; otherwise still
// -1-- if(**c** && 0x04) => Fun2, active; otherwise not active
// 1--- if(**c** && 0x08) => Fun2, rotating; otherwise still

5.2. Settings and data request commands

This commands are structured into multiple levels separated by "**:**" and followed by CR (= 0x1Dh = <0D>=\r) and LF (= 0x0Ah =<0A>=\n).

Syntax:

<level1>:<level2>:…:<leveln>\r\n

Es.

SENS:FREQ:STAR:150e3\r\n

5.2.1. Start Frequency setting

Commands	Response
SENS:FREQ:STAR:value\r\n	Gives back "ART=OK" if command is well formatted and the value is in the permitted range.
Note: value must be expressed in exponential notation in Hz.	
Example: Setting start frequency to 140 MHz Sent ➔ SENS:FREQ:STAR:140.0e6*<0D><0A> received ➔ ART=OK<0D> If value is not in the permitted range Received ➔ ART=SERR<0D>	

5.2.2. Stop Frequency setting

Commands	Response
SENS:FREQ:STOP:value\r\n	Gives back "AOP=OK" if command is well formatted and the value is in the permitted range.
Note: value must be expressed in exponential notation in Hz.	
Example: Setting stop frequency to 160MHz Sent ➔ SENS:FREQ:STOP:160.0e6*<0D><0A> Received ➔ AOP=OK<0D> If value is not in the permitted range Received ➔ AOP=SERR<0D>	

Note: The stop frequency must be greater than start frequency +100 KHz, being 100 KHz the minimum settable span.

Note: If the start frequency we are trying to set is above the current stop frequency hardware will give back "SERR". The same thing will happen if we will try to set a stop frequency below current start frequency.

Note: As stated above working frequency is split in two bands: "Band1" [100 kHz-9.999MHz] and "Band2" [10MHz-3.6GHz]. It's not possible to set a frequency range that sweep between the two bands. If necessary, split measurement in two separated sweeps.

5.2.3. Resolution bandwidth setting

Commands	Response
SENS:BAND:value\r\n	Gives back "RBW=OK" if command is well formatted and the value is one of the permitted.
Note: value must be one of the following strings: ⇨ "AUTO" ⇨ "1MHz" ⇨ "300 kHz" ⇨ "100 kHz" ⇨ "30 kHz" ⇨ "10 kHz" ⇨ "3 kHz"	
Example: Setting bandwidth resolution to 1 MHz Sent ➔ SENS:BAND:1 MHz*<0D><0A> Received ➔ RBW=OK<0D> If bad cmd Received ➔ AOP=SERR<0D>	

Note: In 0 it is explained how much point are sampled on the base of band settings.

5.2.4. Detector setting

Commands	Response
SENS:DETE:value\r\n	Gives back "ADT=OK" if command is well formatted and the value is in the permitted range.
Note: value must be one of the following strings: ⇨ "PEAK" ⇨ "AVG" ⇨ "RMS"	
Example: Setting detector to peak Sent ➔ SENS:DETE:PEAK*<0D><0A> received ➔ ADT=OK<0D> If wrong cmd Received ➔ ADT=SERR<0D>	

5.2.5. Hold time setting

Commands	Response
SENS:HOLD:value\r\n	Gives back "AHT=OK" if command is well formatted and the value is in the permitted range.
Note: value must be expressed in ms. The value can be set between minimum of 10 ad maximum of 10000.	
Example: Setting hold time to 10ms. Sent ➔ SENS:HOLD:10*<0D><0A> received ➔ AHT=OK<0D> If wrong cmd Received ➔ AHT=SERR<0D>	

5.2.6. Axis setting

Commands	Response
SENS:AXIS:value\r\n	Gives back "AXx=OK" (x= axis set) if command is well formatted and the value is in the permitted range.
Note: value must be be one of the following strings: ⇨ "X" ⇨ "Y" ⇨ "Z"	
Example: Setting axis to "Z" Sent ➔ SENS:AXIS:Z*<0D><0A> received ➔ AXZ=OK<0D>	

5.2.7. Data request

Commands	Response
DATA:ISTA:VERB\r\n	Gives back acquisition data based on previously set config.

After received the cmd, the optical interface will launch one sweep over the aselected axis. The response will be structured with a header, samples data and an end-of acquisition string as it follow:

Fstart **<start_value>** Hz,Fstop **<stop_value>** Hz,Fstep **<step_value>** Hz,N level **<levnum>**<0D><0A>
Freq = **<freq1>** MHz ==> Level = **<value1>** V/m<0D><0A>
Freq = **<freq2>** MHz ==> Level = **<value2>** V/m<0D><0A>
…
Freq = **<freqn>** MHz ==> Level = **<valuen>** V/m<0D><0A>
End of Axis<0D><0A>

Where:

<start_value> => Value in [Hz] of the start frequency
<stop_value> => Value in [Hz] of the stop frequency
<step_value> => Value in [Hz] of the step between samples
<lev_num> => Number of samples that wil be transmitted below
<freqx> => String containing the MHz value of the frequency
<valuen> => Value in [V/m] of the sample

Example: Starting data acquisition

Send ➔ DATA:ISTA:VERB*<0D><0A>
Received
➔ Fstart 1.400e+08 Hz,Fstop 1.600e+08 Hz,Fstep 2.500e+05 Hz,N level 81.0000<0D><0A>
Freq = 140.00 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 140.25 MHz ==> Level = 0.05 V/m<0D><0A>
Freq = 140.50 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 140.75 MHz ==> Level = 0.05 V/m<0D><0A>
…
Freq = 159.75 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 160.00 MHz ==> Level = 0.07 V/m<0D><0A>
End of Axis<0D><0A>

Note: The auxiliary protocol converts native data before sending it over the optical interface; The optical interface uC it's not as powerful as DSP is. If data (from DSP) are sent to fast (hold time very small and or a lot of points set (see 0)), rx buffer (of optical interface) will be saturated quickly, than it will overflow and data output will be unpredictable.

5.2.8. Stop sampling

Commands	Response
DATA:INSTA:PAUS\r\n	Gives back “STP=OK”
Example: Stop sampling Send ➔ DATA:ISTA:PAUS*<0D><0A> Received ➔ STP=OK<0D>	

5.3. Acquisition Example

In the example below a sweep will be launch between 140 and 150MHz with a resolution filter of 1MHz, peak detector type and hold time of 10ms over the three axis. To do this, the first step is to set all sweep parameters.
Note: the “*IDN?” “*FWRQ?” “*CFG?” “*STA?” queries are redundant.
Note: In black the cmd sent to SEP.

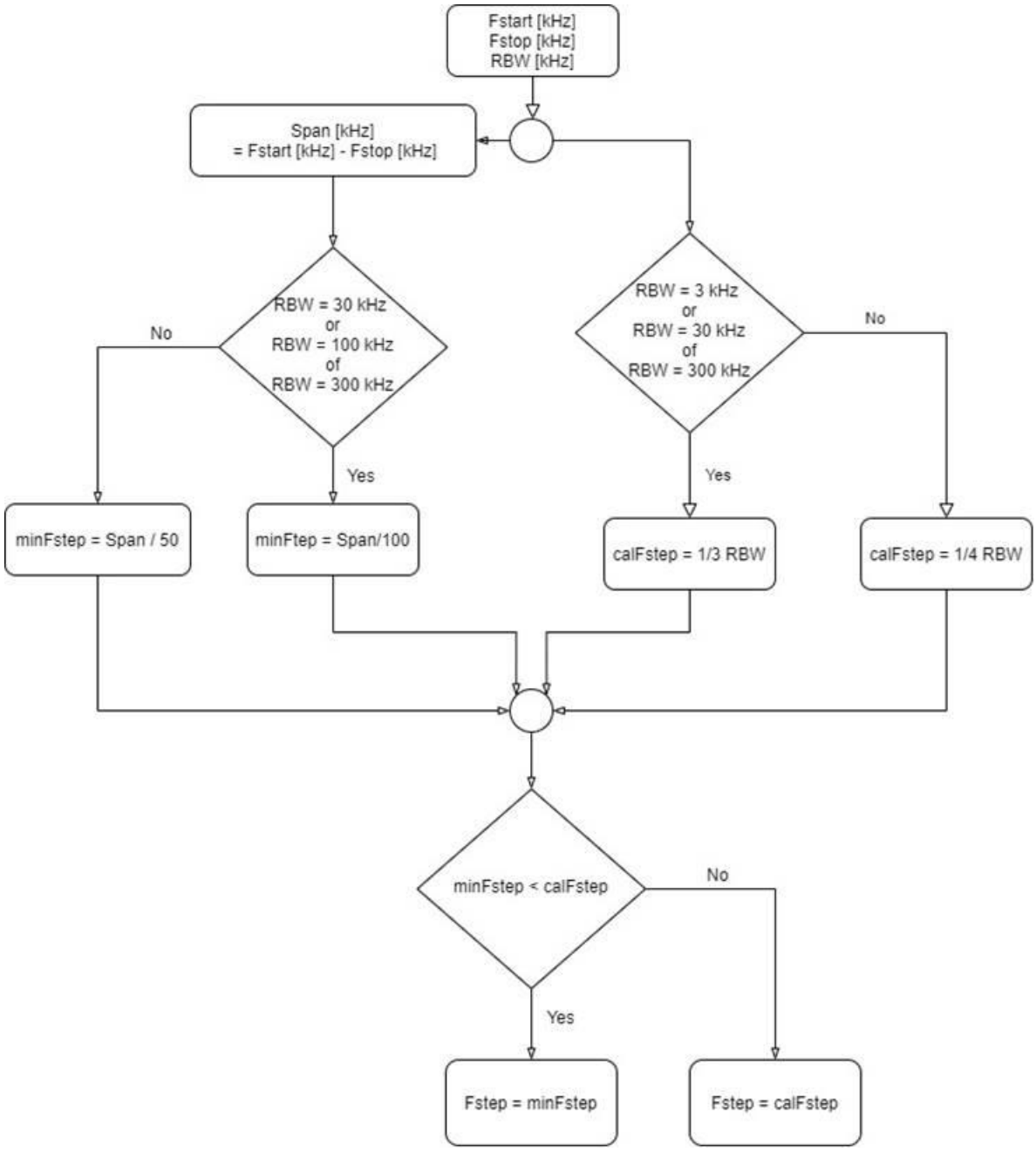
```
*IDN?<0D><0A>
IDN=SEP-FW -  B.37 21/07/17<0A><0A><0D>
*FWRQ?<0D><0A>
SEP_OP_INT_FW_VER_2.09*<0D><0A>
*CFG?<0D><0A>
CFA=0,(028_021220)<0D>
*STA?<0D><0A>
Vbat 3732mV;TBD;TBD;TBD;Ric 0;USB 0;Temp 37gr;Fun f<0D><0A>
SENS:FREQ:STOP:150.0e6*<0D><0A>
AOP=OK<0D>
SENS:FREQ:STAR:140.0e6*<0D><0A>
ART=OK<0D>
SENS:BAND:1 MHz*<0D><0A>
RBW=OK<0D>
SENS:DETE:PEAK*<0D><0A>
ADT=OK<0D>
SENS:HOLD:100*<0D><0A>
AHT=OK<0D>
SENS:AXIS:g*<0D><0A>
AXX=OK<0D>
DATA:ISTA:VERB*<0D><0A>
Fstart 1.400e+08 Hz,Fstop 1.500e+08 Hz,Fstep 2.000e+05 Hz,N level 51.000000<0D><0A>
Freq = 140.00 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 140.20 MHz ==> Level = 0.08 V/m<0D><0A>
Freq = 140.40 MHz ==> Level = 0.07 V/m<0D><0A>
…
Freq = 149.60 MHz ==> Level = 0.05 V/m<0D><0A>
Freq = 149.80 MHz ==> Level = 0.08 V/m<0D><0A>
Freq = 150.00 MHz ==> Level = 0.06 V/m<0D><0A>
End of Axis<0D><0A>
SENS:AXIS:Y*<0D><0A>
AXY=OK<0D>
DATA:ISTA:VERB*<0D><0A>
Fstart 1.400e+08 Hz,Fstop 1.500e+08 Hz,Fstep 2.000e+05 Hz,N level 51.000000<0D><0A>
Freq = 140.00 MHz ==> Level = 0.03 V/m<0D><0A>
Freq = 140.20 MHz ==> Level = 0.08 V/m<0D><0A>
Freq = 140.40 MHz ==> Level = 0.05 V/m<0D><0A>
…
Freq = 149.60 MHz ==> Level = 0.08 V/m<0D><0A>
Freq = 149.80 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 150.00 MHz ==> Level = 0.07 V/m<0D><0A>
End of Axis<0D><0A>
```

```
SENS:AXIS:Z*<0D><0A>
AXZ=OK<0D>
DATA:ISTA:VERB*<0D><0A>
Fstart 1.400e+08 Hz,Fstop 1.500e+08 Hz,Fstep 2.000e+05 Hz,N level 51.000000<0D><0A>
Freq = 140.00 MHz ==> Level = 0.06 V/m<0D><0A>
Freq = 140.20 MHz ==> Level = 0.09 V/m<0D><0A>
Freq = 140.40 MHz ==> Level = 0.11 V/m<0D><0A>
…
Freq = 149.60 MHz ==> Level = 0.10 V/m<0D><0A>
Freq = 149.80 MHz ==> Level = 0.09 V/m<0D><0A>
Freq = 150.00 MHz ==> Level = 0.09 V/m<0D><0A>
End of Axis<0D><0A>
```

5.4. How to determine the frequency distance between two successive points

To know the frequency distance between two successive points of the spectrogram have to applicate the following diagram.

For calculate the distance in frequency have to know:
Fstart (kHz) = value of first point in frequency set up in SEP
Fstop (kHz) = value of last point in frequency set up in SEP
RBW (kHz) = value of RBW set up in SEP



Following in the table ad examples of calculation

Fstart (MHz)	Fstop (MHz)	RBW (kHz)	Span (kHz)	minFstep (kHz)	calFstep (kHz)	Fstep (kHz)
102.5	97.5	**3**	5000	100	1	**1**
102.5	97.5	**10**	5000	100	2.5	**2.5**
102.5	97.5	**30**	5000	50	10	**10**
102.5	97.5	**100**	5000	50	25	**25**
102.5	97.5	**300**	5000	50	100	**50**
102.5	97.5	**1000**	5000	100	250	**100**

If you know the distance between two successive points, can also estimate the number of level transmitted by command SENS:DATA:VERB.
The number of level transmitted are calculate by :

Number of level = [(Fstop – Fstert) / Fstep * 4]

The number of level are calculate by estimate the distance between start and stop and divide by the distance of single point and multiplied by 4, because 4 values are transmitted for each point.

6. Appendix B - Optical interface Firmware update

To upgrade the firmware of the optical interface it's necessary to follow some steps; first you need to download and install the update utility from our web site, download the new firmware, enable the boot loader and than flash the firmware.

6.1. Notes

Upgrade operation could be dangerous: If something go wrong you will no longer be able to restart the device. You will have to send it back to manufacturer.
Some advices:

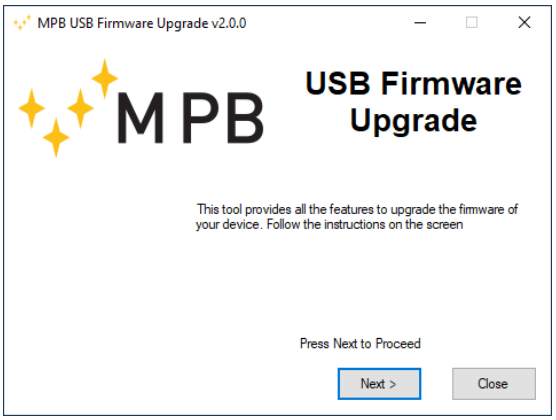
- Close all programs no necessary to perform firmware upgrade.
- Run firmware updater as admin.
- Use an UPS.

6.2. Download and install utility

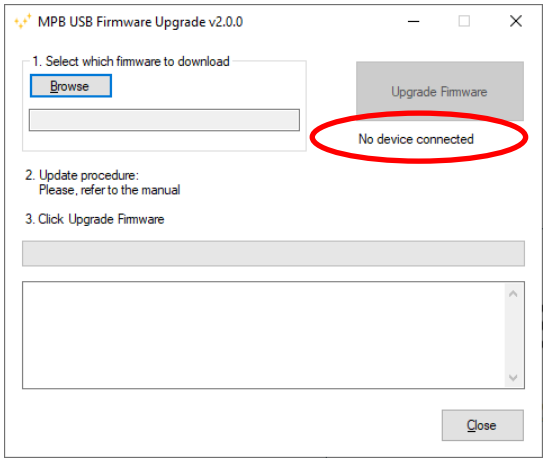
- Go to MPB web site on download section (http://www.gruppompb.uk.com/download.asp#mpb)
- Download the new release of firmware
- Download USB Firmware Updater
- Install USB Firmware

6.3. Upgrade firmware

- Connect the device to a USB port with a micro usb cable.
- If present disconnect the SEP from the optical interface.
- Open USB Firmware Upgrade.

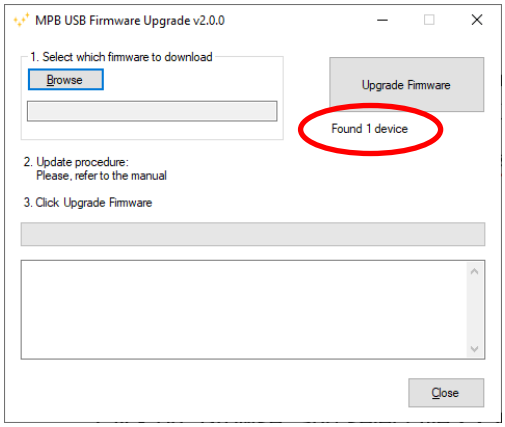


- Click next

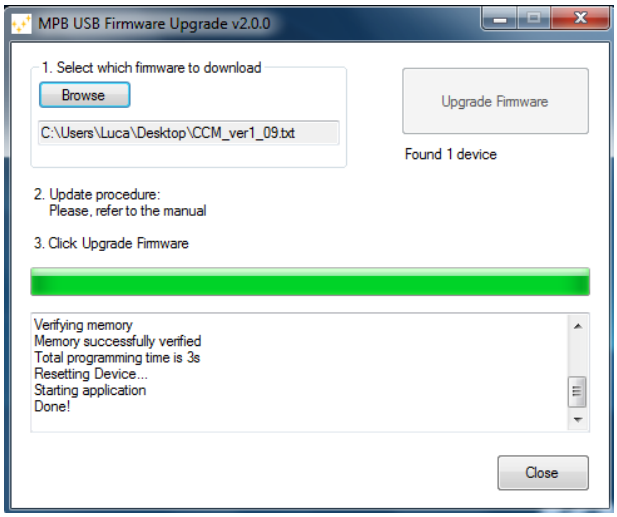


There will be no device connected

- Open a serial terminal over the COM port were the USB is connected. (use the same parameter of connection specified in chapter 5).
- Send “#V*#V*#V*”
- The sep will responde with “VaaaannX.XX*” with X.XX in the current version of firmware.
- Send “#u*#u*#u*”
- Sep will disconnect from serial port and reconnect in bootloader mode. If audio is enable you can listen the “dongle”. You will see that the updater found the device and enable the update button.



- Click “Browse” and select the file which contains the new firmware.
- Click “Update Firmware”



- Wait for the completion of upgrading operation
- Disconnect the device
- Turn off and on the device.

7. APPENDIX C WiFi and Bluetooth connection

Figure 29

With the SEP it is possible to make remote measurements, via communication protocol (see APPENDIX A), and the use of the WiFi or bluetooth

Option SEP_WLD:

- Device SEP_WLD-WHD
- Bluetooth Antenna C14
- Power connector
- USB key includes user manual

Option SEP_WHD:

- Device SEP_WHD-WHD
- router WiFi Master (1 pcs)
- router WiFi Slave (1 pcs)
- 2 power supply (220 Vac) (2 pcs)

- WiFi antenna (2 pcs)
- RS232 USB converter with CD Driver
- serial cable RS232 (f-f) 3m
- serial cable RS232 (f-f) 20 cm
- power connector (with 3-way terminal block 2 pcs)
- Optical fiber (3m)
- 2 antennas for WiFi
- USB key includes user manual

7.1. WiFi connection (mod. SEP-WHD):

- Turn on both devices
- Connect USB – serial adapter to PC
- Wait for green led named “Ready” and WLAN. The 4 green leds indicate the level of radio WiFi signal. (see Figure 30)
- Run MPB-SEP program and select “*connect to device*”.

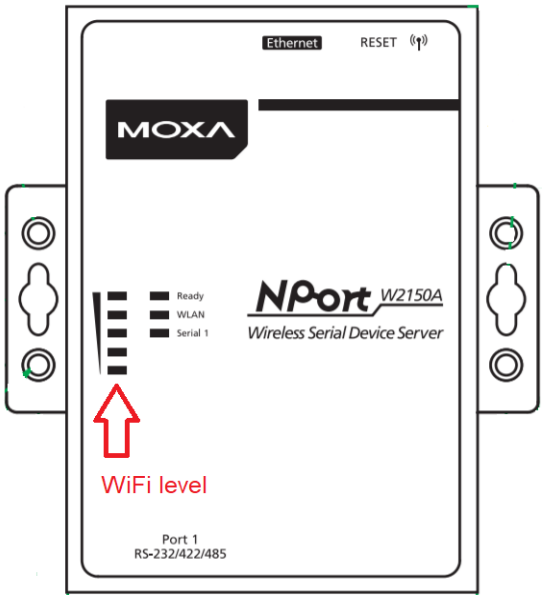


Figure 30

7.2. Bluetooth connection (mod. SEP-WLD):

In the bar status, select "*Bluetooth and other devices*"

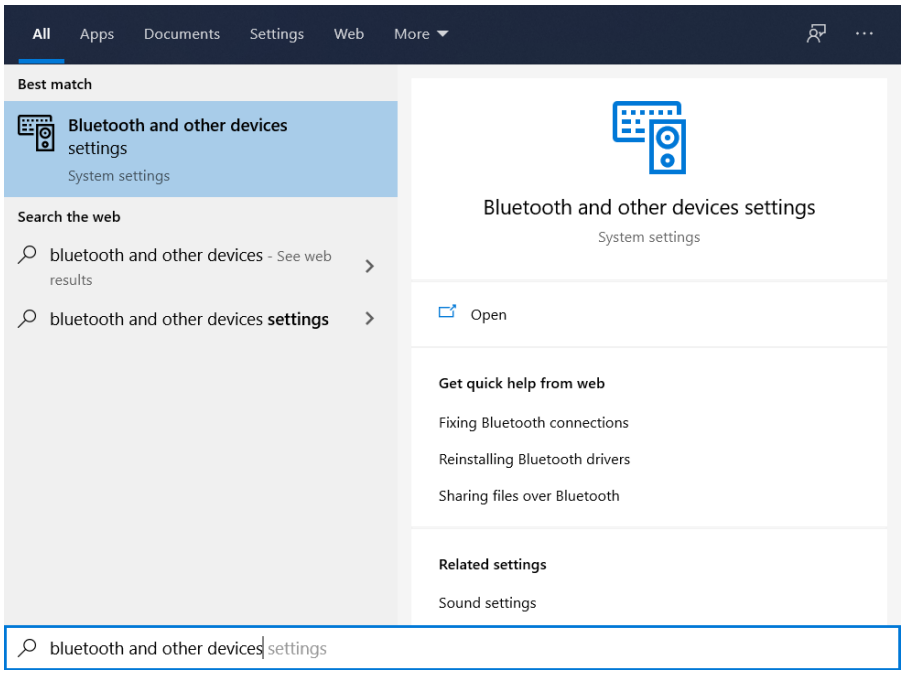


Figure 31

Then, "Add Bluetooth *or other device*":

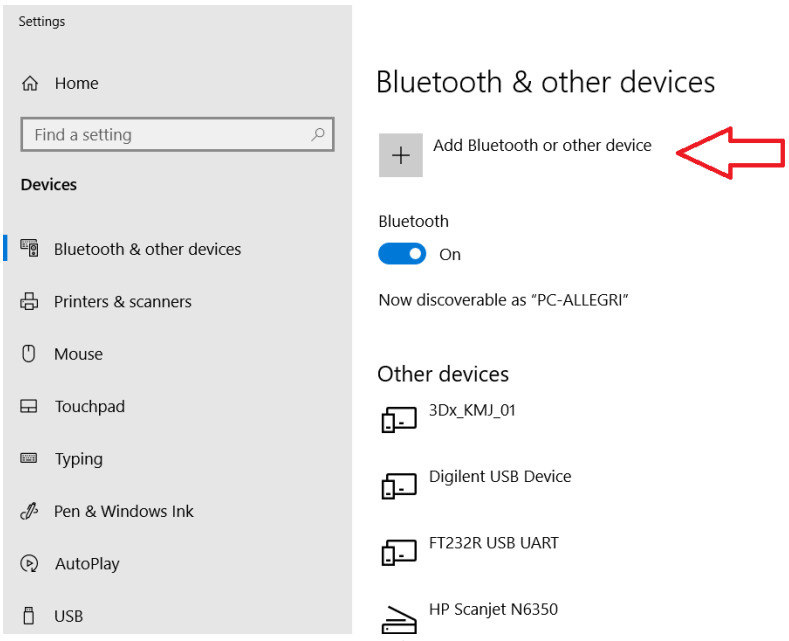


Figure 32

Select *Add a device Bluetooth*

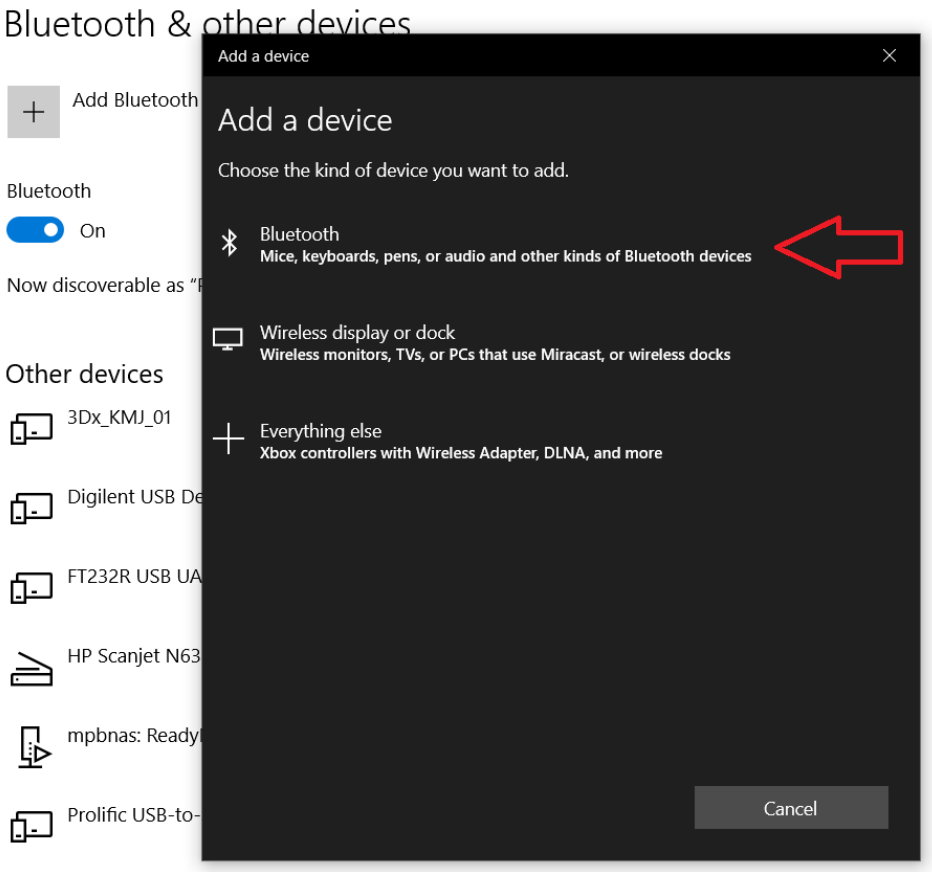


Figure 33

Select "*RNBT-xxxx*":

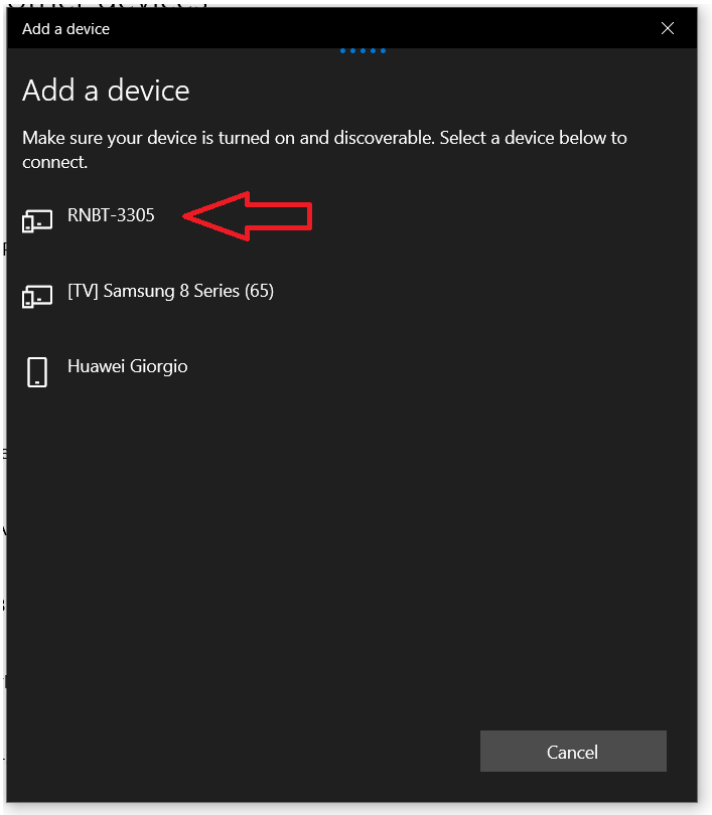


Figure 34

Accept the bluetooth association by clicking on "*connect*":

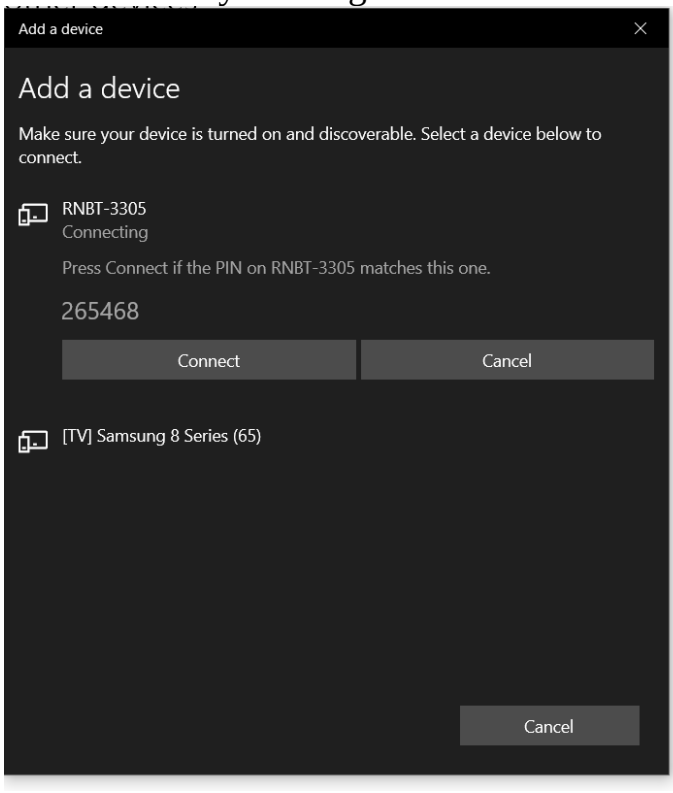


Figure 35

"*ready for use*" message is shown:

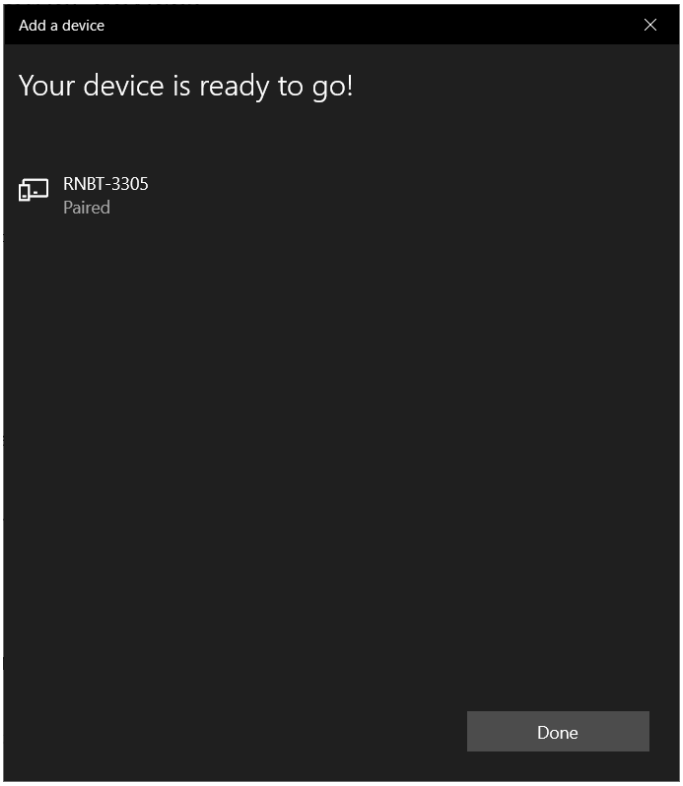


Figure 36

7.3. How to verify serial port

In bluetooth setting: a) click on "*RNBT-xxxx*" devices, b) click on "*other Bluetooth option*", c) click on "*port com*", d) read the COM number (e.g. COM7) with description "*on OUT*"

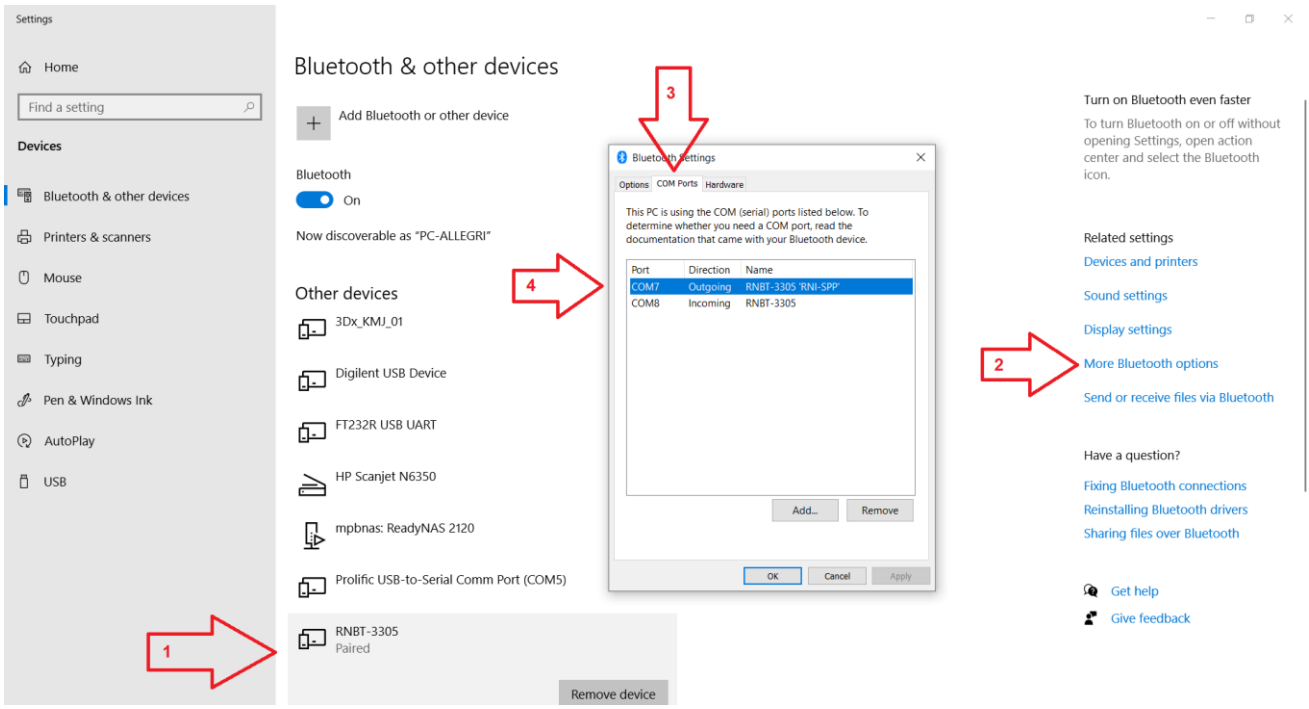
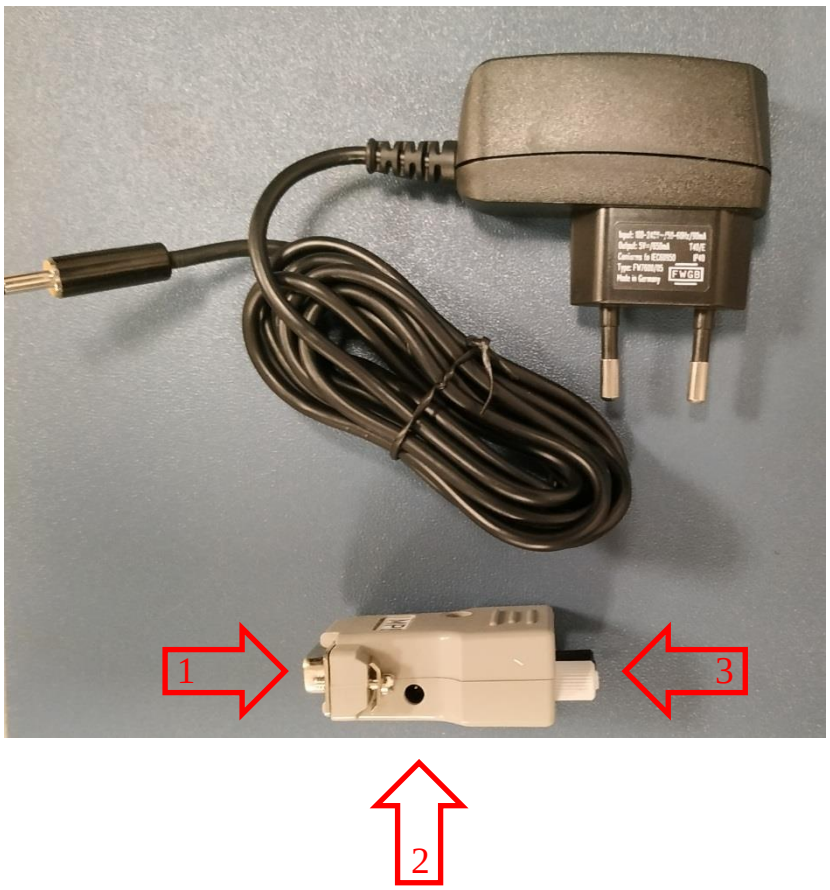

Settings
Home
Find a setting
Devices
Bluetooth & other devices
Printers & scanners
Mouse
Touchpad
Typing
Pen & Windows Ink
AutoPlay
USB
Bluetooth & other devices
Add Bluetooth or other device
Bluetooth
On
Now discoverable as "PC-ALLEGRI"
Other devices
3Dx_KMJ_01
Digilent USB Device
FT232R USB UART
HP Scanjet N6350
mpbnas: ReadyNAS 2120
Prolific USB-to-Serial Comm Port (COM5)
RNBT-3305
Paired
Remove device
1
2
3
4
Bluetooth Settings
Options
COM Ports
Hardware
This PC is using the COM (serial) ports listed below. To determine whether you need a COM port, read the documentation that came with your Bluetooth device.
Port
Direction
Name
COM7
Outgoing
RNBT-3305 'RNI-SPP'
COM8
Incoming
RNBT-3305
Add...
Remove
OK
Cancel
Apply
Turn on Bluetooth even faster
To turn Bluetooth on or off without opening Settings, open action center and select the Bluetooth icon.
Related settings
Devices and printers
Sound settings
Display settings
More Bluetooth options
Send or receive files via Bluetooth
Have a question?
Fixing Bluetooth connections
Reinstalling Bluetooth drivers
Sharing files over Bluetooth
Get help
Give feedback

Figure 37

8. APPENDIX D serial connection

8.1 Fiber optic / serial

The SEP can be connected to the PC via a fiber optic / serial connection



1: serial port

2: power connector (the adapter must always be powered during use)

3: optical fiber

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Phone +39 06 41200744