INSPIRE - 100

An Emergency Ventilator Device

Web Applications Manual

TekMedika

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Introduction

In addition to the front panel, INSPIRE-100 provides the ability to remotely monitor all ventilation sessions via a WEB dashboard. Doctors and technicians can use the dashboard to connect to any INSPIRE-100 system using a unique system ID embedded in each system. This feature is useful to enable a remote specialist to observe the key system and patient parameters during a session and suggest a course of action for the local practitioners.

A brief overview of the process is as follows.

1. There must be a Wi-Fi network at the site where the INSPIRE-100 system is deployed. If required, use a 4G/5G dongle to establish a Wi-Fi network. One dongle can serve multiple systems at the same site at the same time.
2. There must be Wi-Fi or wired internet at the monitoring site.
3. Enable WEB dashboard monitoring on the INSPIRE-100 system.
4. Allow the INSPIRE-100 system to log on to the Wi-Fi network.
5. Visit the provided URL at the monitoring site.
6. Pair the WEB dashboard at the monitoring site with the INSPIRE-100 at the deployment site using the INSPIRE-100 System Unique ID.
7. WEB Applications allows monitoring only. Remote control of the system is not permitted.

During the start-up sequence, the system gives an option to enable or disable remote monitoring for the system. Once enabled, the system guides the user to set up the remote WEB Apps.

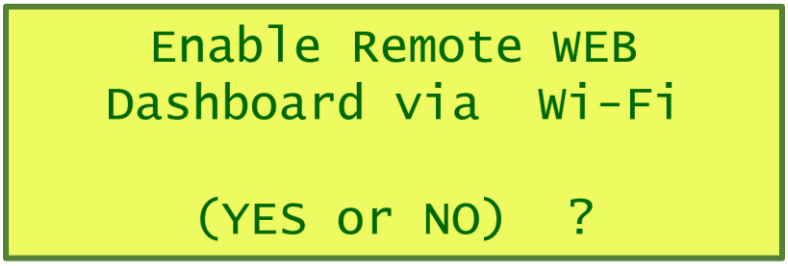


Figure 1: Enable/Disable Wi-Fi login

Setting up Wi-Fi credentials

INSPIRE-100 system remembers the history of prior Wi-Fi networks that have been used by the system. The user is provided with an option to either auto-connect to a previously known Wi-Fi network or to configure a new one. If desired, the recorded Wi-Fi history can be erased at this time.

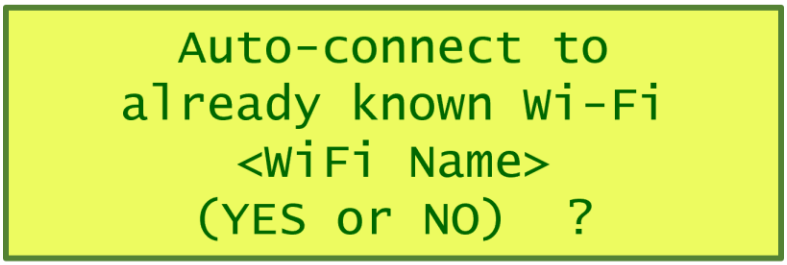


Figure 2: Wi-Fi Autoconnect

If Auto-connect is not enabled or if Auto-connect fails, the next option is to use a configuration portal to setup a new Wi-Fi network for the system to log in to. To enable login through a configuration portal, the system sets up a local, temporary Wi-Fi network named "INSPIRE-100 Wi-Fi". The user can use either a wifi-enabled laptop or a smartphone to log on to this network.

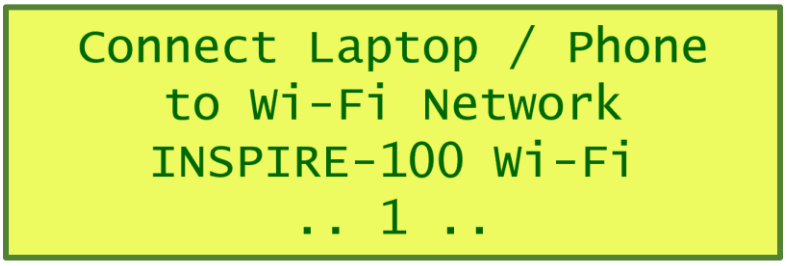


Figure 3: Connect to INSPIRE-100 Wi-Fi network

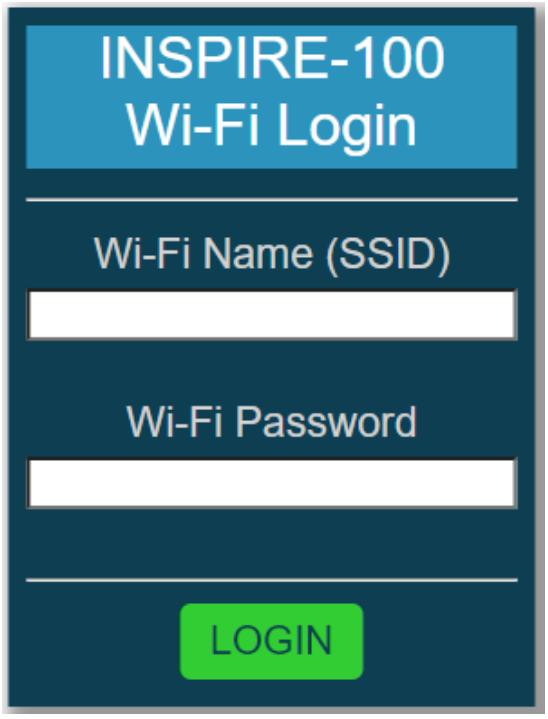


Figure 4: Wi-Fi Configuration Portal

Upon login to this “INSPIRE-100 Wi-Fi” network, a portal screen is automatically presented on the laptop or the smartphone which guides the user step-by-step to enabling system to login to a desired Wi-Fi network. The portal time out in 2 minutes if unable to log on for whatever reason. If the system times out, the user can retry as many times as desired.

In case the portal does not automatically open, open a browser and navigate to 192.168.1.4 (URL) after connecting to the “INSPIRE-100 Wi-Fi” network.

WiFi login has two options as below.

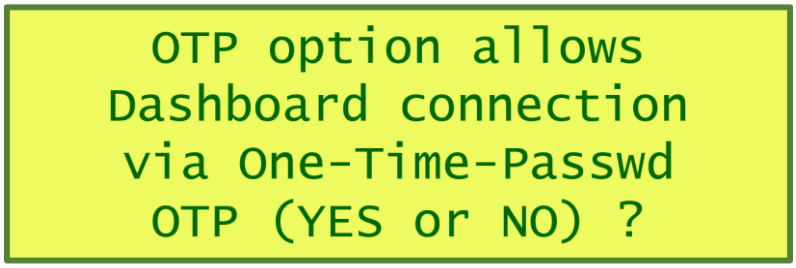


Figure 5: Login OTP Selection

1. Anonymous

   No message is sent to the Web Apps portals to announce the login. Only those browsers with prior knowledge of the particular system can connect to it. The “My Systems” page, described later, is the key for a browser to remember a particular INSPIRE-100 system.

   (See section on My Systems Table)

2. Broadcast

   A message is sent to all currently active Web Apps portals to announce the login. An OTP will be generated and displayed on the INSPIRE-100 system’s Front-panel. Only those browsers with knowledge of the OTP (One Time Password) system can connect to it.

   (See section on My Systems Table)

If the Wi-Fi login was unsuccessful, the user can still continue without enabling a WEB dashboard.

Upon a successful Wi-Fi login, the system is now ready to be connected to the WEB Apps using the unique system id (SYSUID). The SYSUID is a 20 character string starting with the prefix “UID_” followed by 16 hexadecimal digits. Another option is to connect using the OTP displayed as below. Further details can be found in the next section.

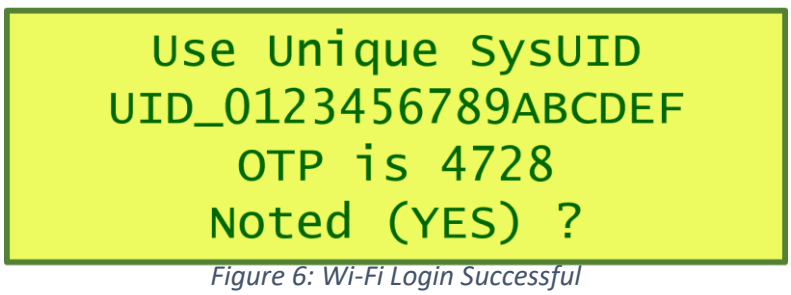


Figure 6: Wi-Fi Login Successful

Launching the WEB Apps

https://www.tekmedika.com/inspire-100

The screenshot below on the left is the main portal menu while the screenshot on the right above is the My Systems Table.

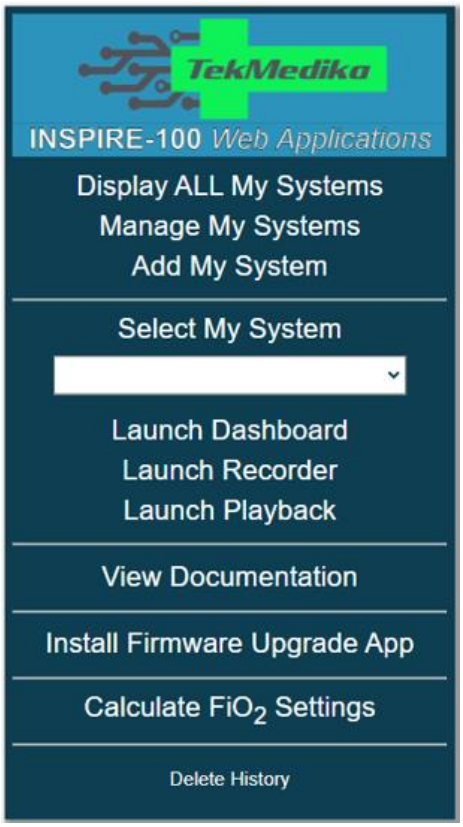


Figure 7: Web Apps Main Menu

Figure 8: INSPIRE-100 Systems Table

For Keyboard Displays

Use CTRL key and +/- keys to zoom in/out

or hold down the CTRL key and use the mouse wheel to zoom in/out

till the content fits well in the browser screen.

For Touch Displays

Use two fingers to zoom in/out

All the Web Apps communicate with a particular INSPIRE-100 system via a Unique System ID (UID). Each INSPIRE-100 system has a built-in UID which is 20 characters long (e.g. UID_AAAABBBBCCCCDDDD). This UID is displayed on the system's front panel upon a Wi-Fi login. It can also be accessed via the STANDBY menu on the system.

Each time a system logs in, the main portal page displays a popup message as below.

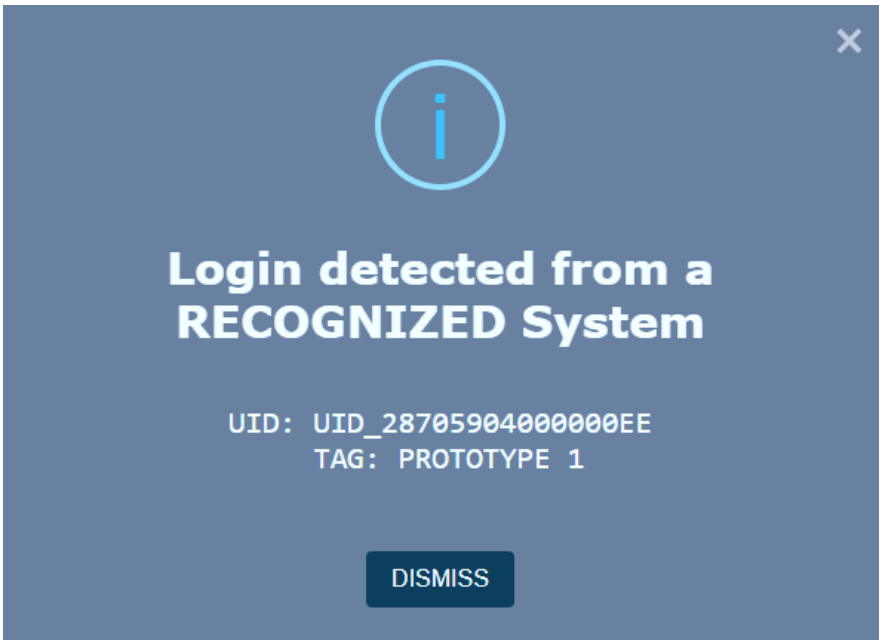


Figure 9: Login Message Popup

The main Inspire-100.com portal holds a table of the INSPIRE-100 systems it recognizes. Initially this table is empty. Once populated, it is accessible for all times after that. The table is accessed via the "Manage My Systems" button.

Each unique system id (SYSUID) of the INSPIRE-100 systems can be associated with an easy to remember name tag. The browser remembers the history of all the SYSUIDs that have been used and presents them in the dropdown list in the main menu box above.

The table of name tags and associated SYSUID (Systems Table) is accessed through the "Manage My Systems" button. The + menu button on the Systems Table adds a system. To select a system to communicate with either double click on the appropriate row or use the checkmark button against the row. A system can be removed from the table using the trash menu button in the appropriate row. The trash button on the top right removes all system information. The systems table can also be exported as a JSON file and can be imported from a JSON file by clicking the appropriate icons on the table banner. Finally, the back arrow menu button on the top left can be used to navigate back to the main menu.

There are two ways to populate the systems table.

1. If you know the UID of your system(s), simply add the information using the "Add New System" button. Each system can be assigned a tag name so that it is easy to remember and access. The popup for "Add New System" is shown below.

Figure 10: Add a new system to Systems Table

2. Every time a recognized or unrecognized system logs in, there is a message displayed on the portal web page. In case of an unrecognized system, the portal popup message provides an option to add the unrecognized system to the systems table using an OTP displayed on the system's front panel.

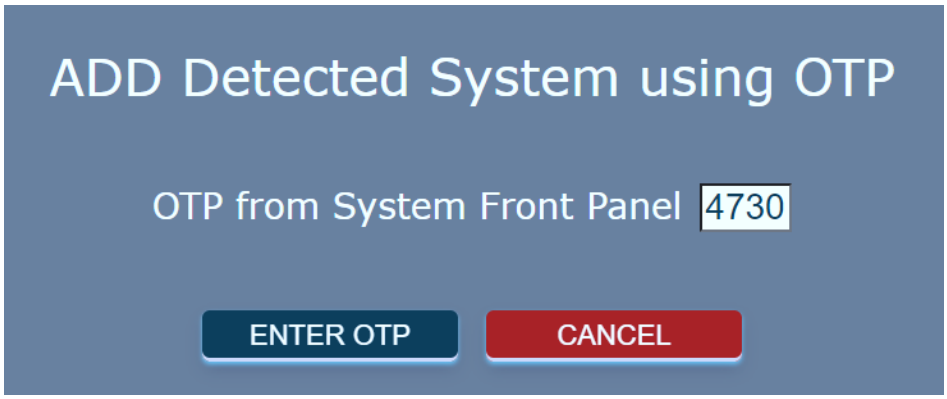


Figure 11: Add a new System using OTP

The following WebApps are available via the links on the main menu.

- ***Show ALL My Systems*** – This shows a tiled view of all systems that are entered in the "My Systems" table.

- ***Launch Dashboard*** - Monitor a session remotely. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***Launch Recorder*** – Though a recording can be done through the Dashboard App, the Recorder App is a lightweight app to record a session without all the features of a dashboard. It uses less memory. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***Launch Playback*** - Playback a previously recorded session. It requires a SysUID to be selected to determine the INSPIRE-100 system to connect to.

- ***View Documentation –*** All the pdf documents are accessible through this link. It does not require a SysUID. If a "PDF Viewer" extension is loaded in your browser the documents can be read online or else, they can be downloaded. Figure below is a screenshot of the document viewer web page.

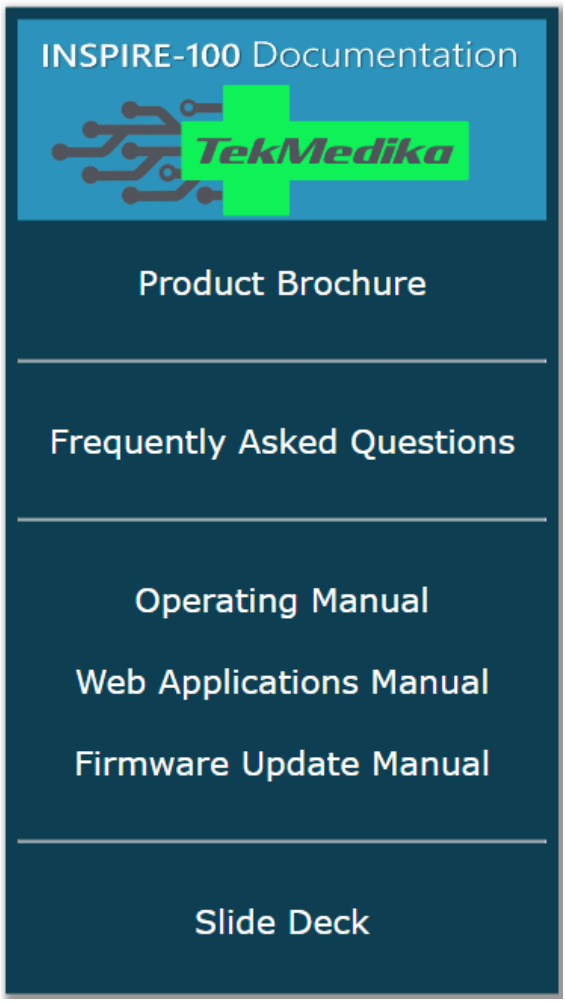


Figure 12: INSPIRE-100 Documentation

- ***Install Firmware Upgrade App –*** Download and install a WINDOWS or MACOS app on the user's laptop to enable firmware upgrades for the INSPIRE-100 system.

- ***Calculate FiO2 Settings –*** Calculate required Oxygen inflow rate. It does not require a SysUID. This app is merely an exploratory option.

Display ALL My Systems

This button presents a bird's eye view of all systems that are entered into the "My Systems" table. The view is composed of live tiles, each showing the current state of the system. Clicking on a tile launches a dashboard for that system unless one is already active. Also, Audio alarms can be turned ON or OFF. Figures below show sample screenshots of this view.

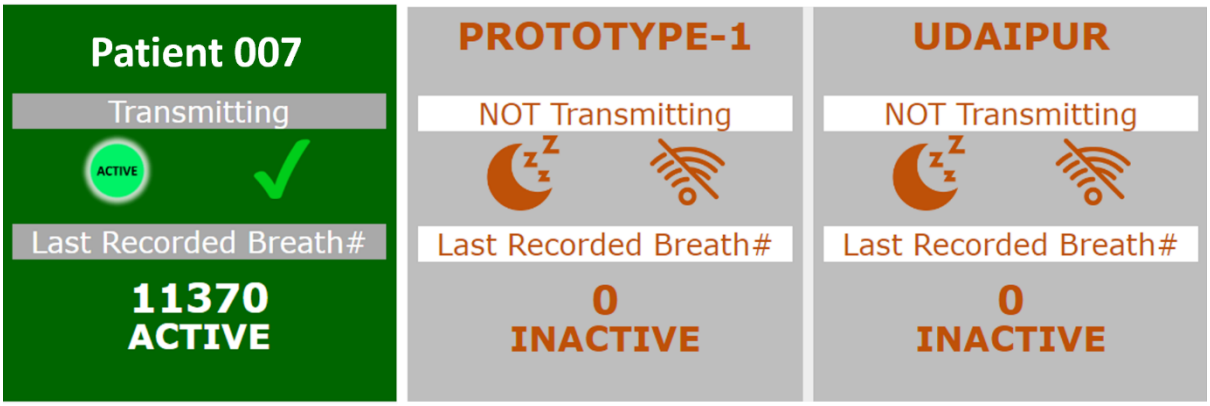


Figure 14: One System Active, Two Inactive

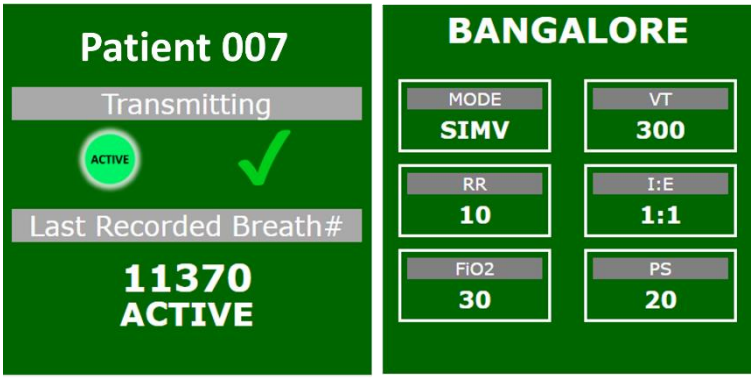
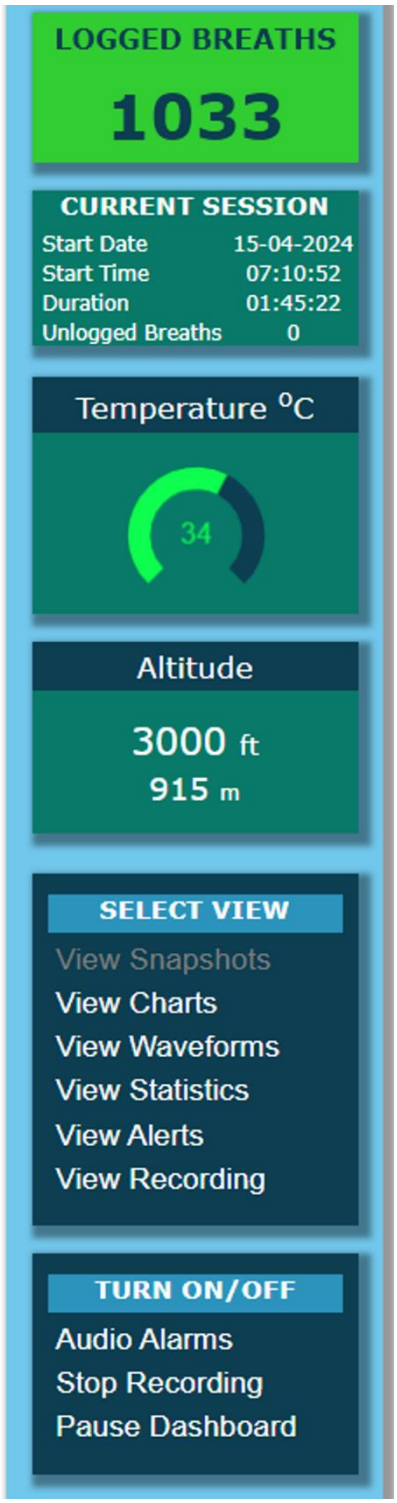


Figure 13: Alternating views of an active System

WEB Dashboard



The live WEB dashboard, when connected, offers a choice of six different views. The user can switch between these views at any time. Figure on the left shows the sidebar for the dashboard.

On the top is a display of the number of breaths that the current dashboard session has logged. In case the dashboard was launched after the system had been active for some time, it also shows the number of breaths that happened prior to the launch of the dashboard as unlogged breaths.

The next box shows some relevant summary data for the current session. It includes the start time for the Dashboard and the duration for which it has been active.

The next box allows for selecting the type of view to display. Available views are as below.

1. Snapshots view
2. Charts view
3. Statistics view
4. Alerts view
5. Breath Shapes View
6. Recording View

The next box shows the current operating temperature that the system is at. The following box is the system's deployment altitude.

The next box allows for turning on/off audio alarms, session recording and dashboard updates. Pausing dashboard updates only stops the display from updating, fresh data continues to get collected and will get displayed once the 'Pause Dashboard' is turned OFF.

Figure 15: Dashboard Menu

Dashboard Audible Alarms

By default, all audible alarms are turned ON. The audio alarms can be selectively turned ON/OFF using the “Control Audio Alarms” button.

Below is a screenshot of the Audio alarm settings.

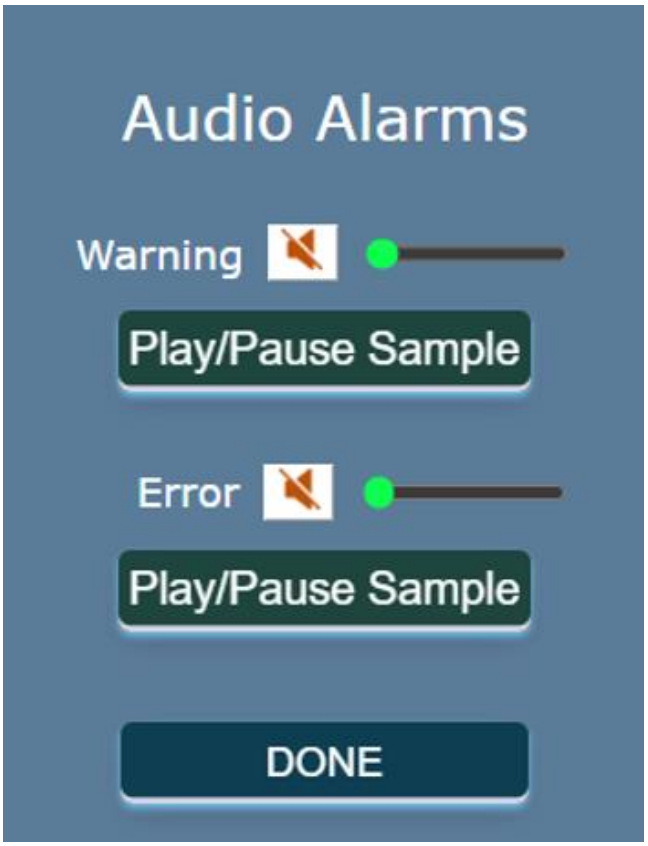


Figure 16: Setting Audio Alarms

Dashboard Snapshots View

Below is a screenshot of the WEB Dashboard “Snapshots View”. All the INSPIRE-100 parameters, both input and output, are presented on the dashboard for easy viewing as a cohesive whole.

Note that for safety reasons, the Dashboard only allows monitoring of a remote system. The dashboard cannot be used to control the remote system. That must be done using the front panel of the physical INSPIRE-100 system.

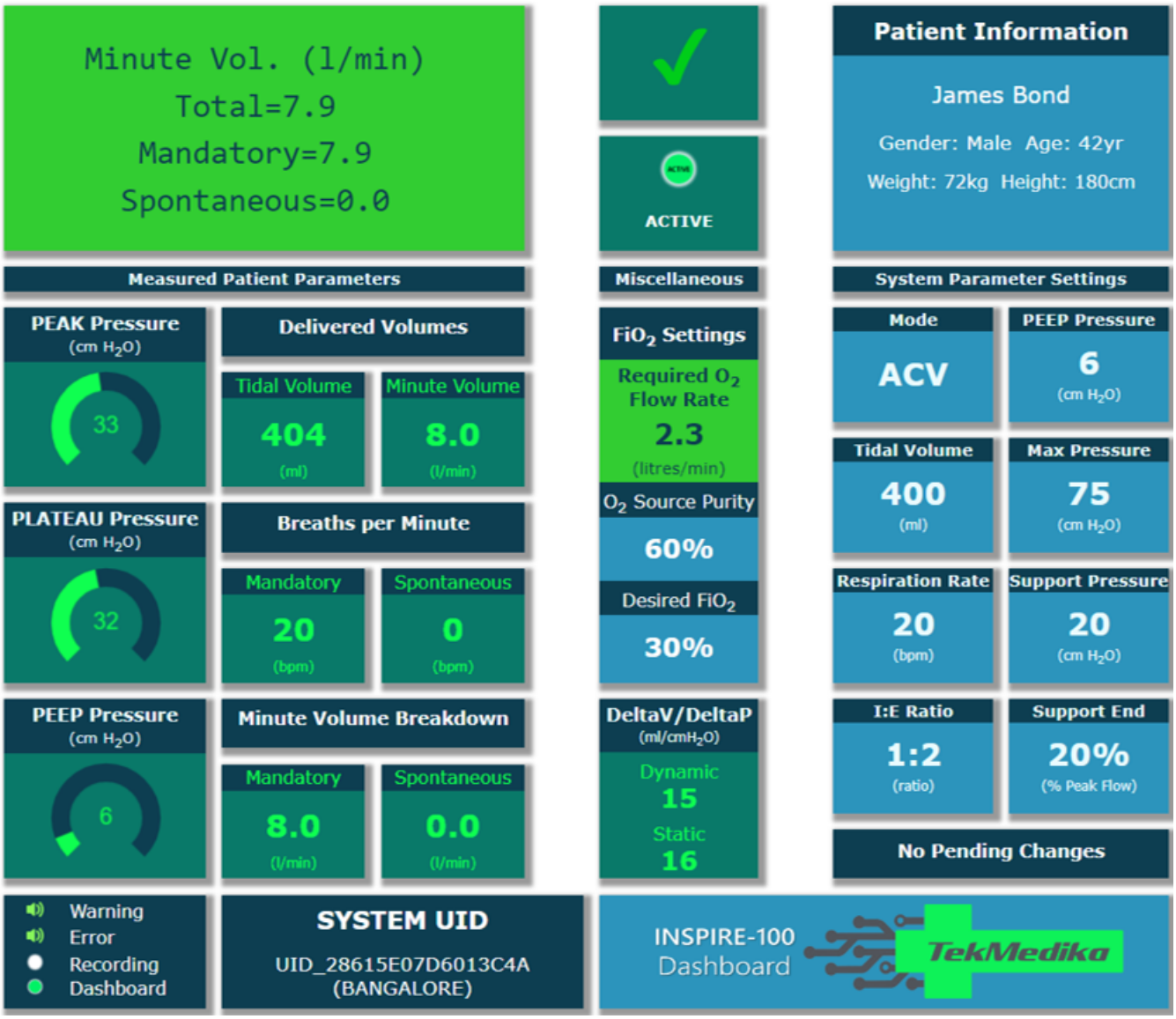


Figure 17: Dashboard Snapshots View

Dashboard Charts View

The Dashboard also provides an option for a “Charts View”. A screenshot of the charts view is shown below. This screenshot shows three chart boxes. A chart box can be added at any time using the + menu button on the top left of the chart box. Use the trash menu button on the top right to delete a chart box.

The parameters to chart can be selected using the checkboxes on the edit menu. The edit menu button is also on the top right of each chart box. The charts are updated after every breath. The X-axis can be selected as breath number or as elapsed time between breaths.

By default, the system charts the selected parameters for the past 60 breaths on a rolling basis, the charts are updated after each breath.

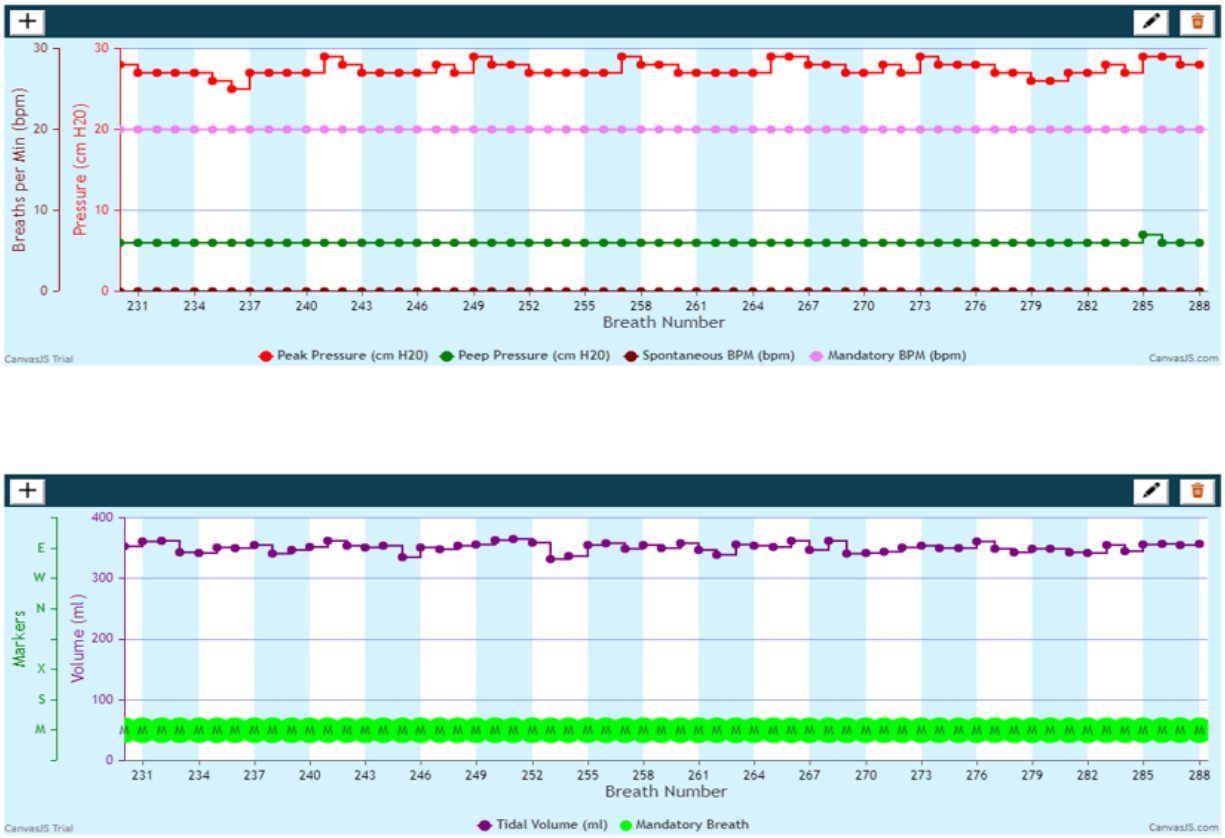


Figure 18: Dashboard Charts View

The chart box edit menu is shown below. Any collection of the shown parameters can be displayed in any chart box or in multiple chart boxes.

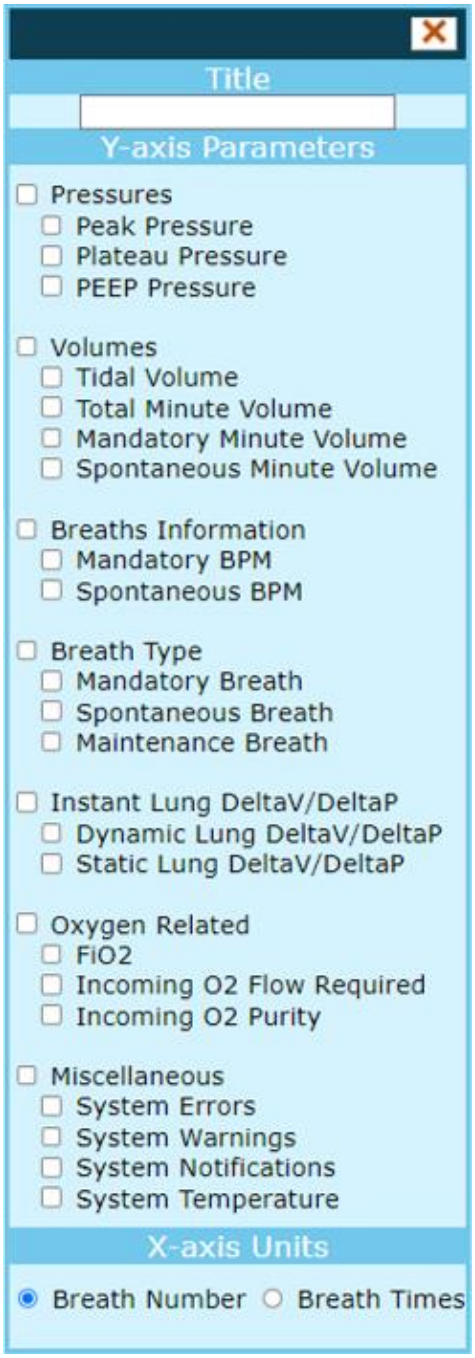


Figure 19: Charts Edit Menu

Dashboard Waveforms View

The Dashboard also provides an option to view the detailed pressure and flow waveforms for selected breaths. Figure below shows a sample of such a view.

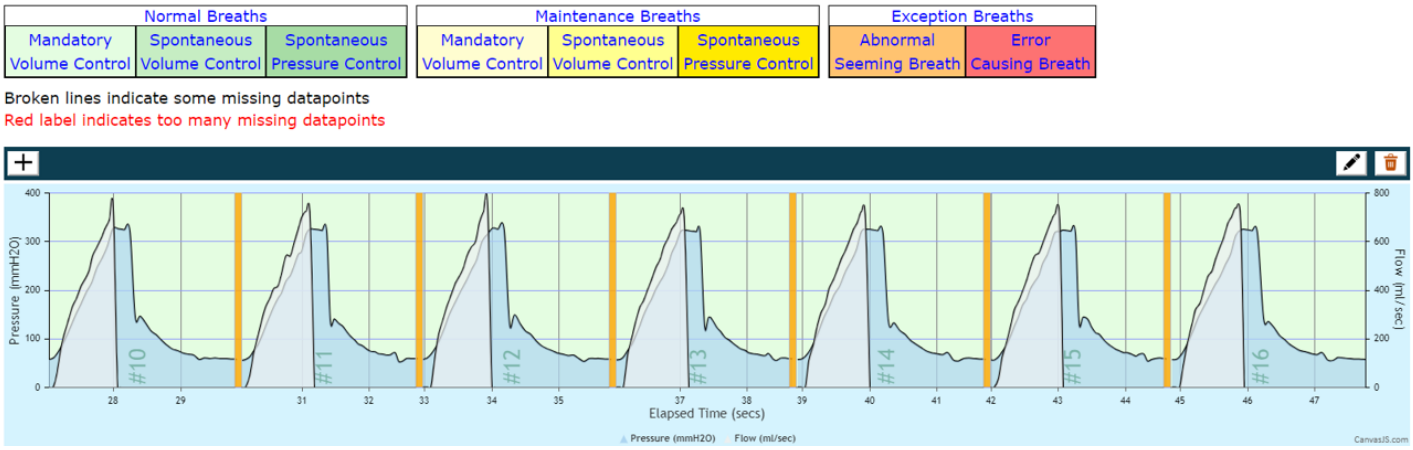


Figure 20: Breath Detailed Pressure and Flow Graphs

The EDIT icon on each box allows the selection of the kinds of breaths to display. The graphs are color coded as per the legend at the top of the page. The breath selection menu is shown in the Figure below.

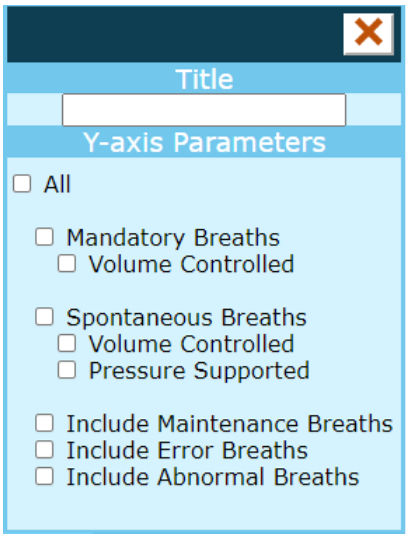
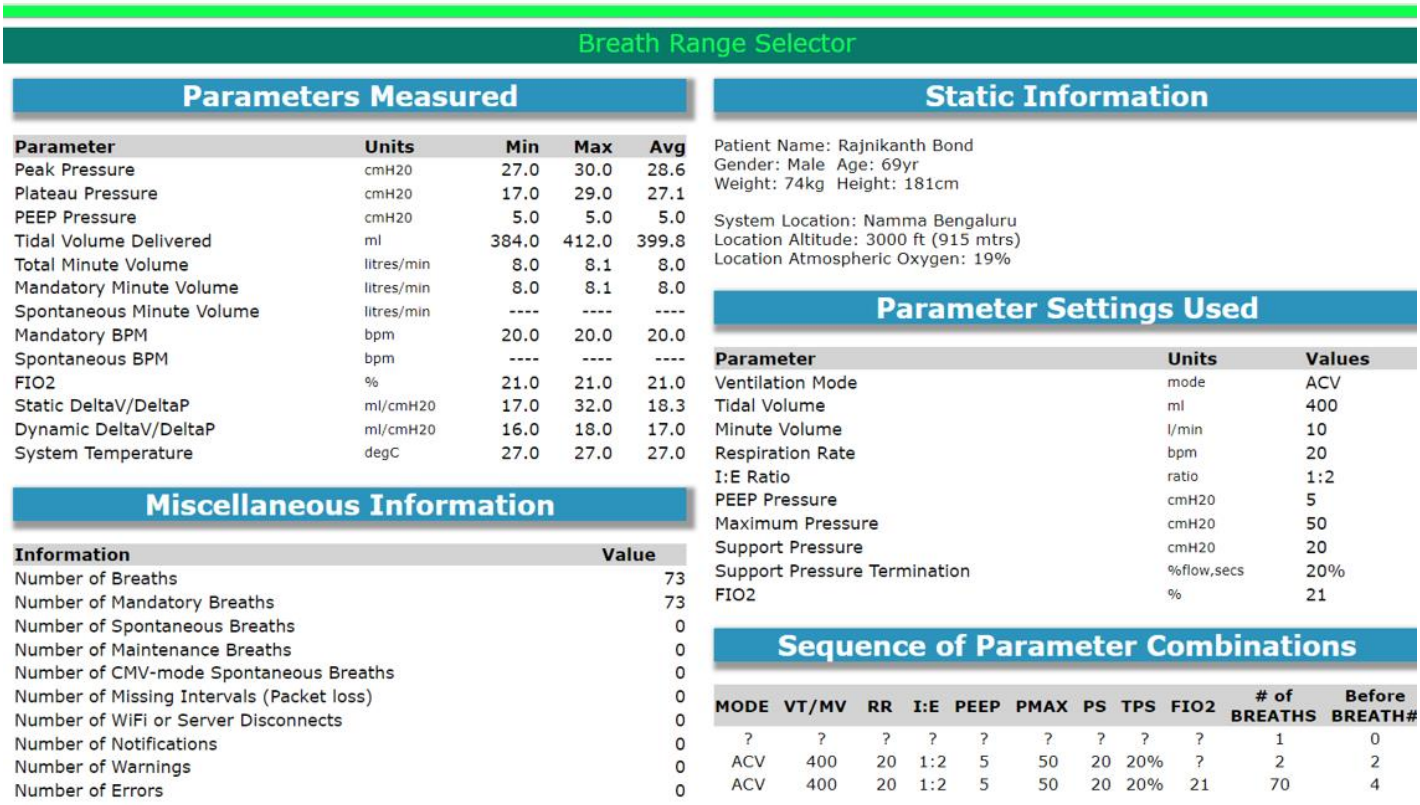


Figure 21: Breath Type Menu

Dashboard Statistics View

The Dashboard also provides an option for a “Statistics View”. A screenshot of the statistics view is shown below.

The statistics are collected for the selected range and updated after every breath by default. The range slider can be used to gather statistics for any range of breath numbers.



Breath Range Selector

Parameters Measured

Parameter	Units	Min	Max	Avg
Peak Pressure	cmH20	27.0	30.0	28.6
Plateau Pressure	cmH20	17.0	29.0	27.1
PEEP Pressure	cmH20	5.0	5.0	5.0
Tidal Volume Delivered	ml	384.0	412.0	399.8
Total Minute Volume	litres/min	8.0	8.1	8.0
Mandatory Minute Volume	litres/min	8.0	8.1	8.0
Spontaneous Minute Volume	litres/min	----	----	----
Mandatory BPM	bpm	20.0	20.0	20.0
Spontaneous BPM	bpm	----	----	----
FIO2	%	21.0	21.0	21.0
Static DeltaV/DeltaP	ml/cmH20	17.0	32.0	18.3
Dynamic DeltaV/DeltaP	ml/cmH20	16.0	18.0	17.0
System Temperature	degC	27.0	27.0	27.0

Miscellaneous Information

Information	Value
Number of Breaths	73
Number of Mandatory Breaths	73
Number of Spontaneous Breaths	0
Number of Maintenance Breaths	0
Number of CMV-mode Spontaneous Breaths	0
Number of Missing Intervals (Packet loss)	0
Number of WiFi or Server Disconnects	0
Number of Notifications	0
Number of Warnings	0
Number of Errors	0

Static Information

Patient Name: Rajnikanth Bond
Gender: Male Age: 69yr
Weight: 74kg Height: 181cm

System Location: Namma Bengaluru
Location Altitude: 3000 ft (915 mtrs)
Location Atmospheric Oxygen: 19%

Parameter Settings Used

Parameter	Units	Values
Ventilation Mode	mode	ACV
Tidal Volume	ml	400
Minute Volume	l/min	10
Respiration Rate	bpm	20
I:E Ratio	ratio	1:2
PEEP Pressure	cmH20	5
Maximum Pressure	cmH20	50
Support Pressure	cmH20	20
Support Pressure Termination	%flow,secs	20%
FIO2	%	21

Sequence of Parameter Combinations

MODE	VT/MV	RR	I:E	PEEP	PMAX	PS	TPS	FIO2	# of BREATHS	Before BREATH#
?	?	?	?	?	?	?	?	?	1	0
ACV	400	20	1:2	5	50	20	20%	?	2	2
ACV	400	20	1:2	5	50	20	20%	21	70	4

Figure 22: Dashboard Statistics View

Dashboard Alerts View

The Dashboard also provides an option for a “Alerts View”. A screenshot of the alerts view is shown below. By default, it displays the complete history of errors and warnings encountered within the selected range of breaths.

Figure 23: Dashboard Alerts View

Dashboard Recording

The Dashboard also provides an option to record any part of the current session using the “Start Recording” menu button on the sidebar menu. The recoding can be paused at any time causing that paused window to not be recorded. The Recording at the bottom left of the Snapshots view indicates whether the recording is currently active.

The recording is stored in a JSON database on the disk of the laptop or the desktop that the browser is running on. This recording can be played back and analysed at any future time using the Playback WebApp. A screenshot of the recording view is shown below.

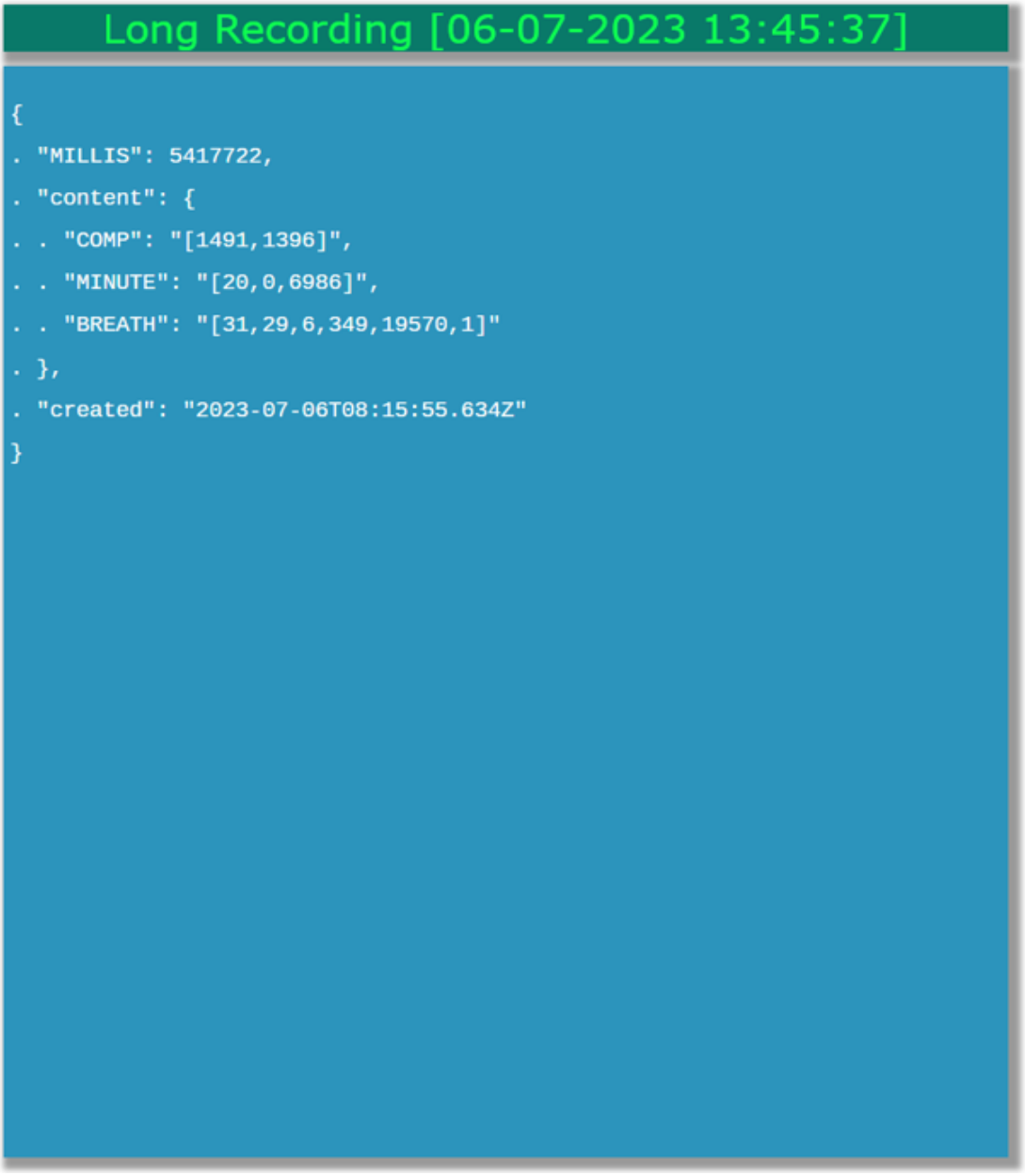


Figure 24: Dashboard Recording View

Breath Range Selector

The fundamental premise for data selection is as below.

1. All data search and selection are with reference to breaths.
2. Each breath can be classified as one of the two below.
    a. MANDATORY (ventilator-initiated). These breaths are always Volume-controlled.
    b. SPONTANEOUS (patient-initiated). SPONTANEOUS breaths could further be classified as one of two below.
        i. Volume-controlled
        ii. Pressure Supported
3. Each breath can be uniquely identified by one of the two parameters below.
    a. BREATH_NUMBER (starting from 1 as the first logged breath).
    b. BREATH_START_TIME (wall clock time as per the local time-zone).

Each dashboard and playback view (except for the Snapshots View) is controlled by a range selector as shown in the Figure below.

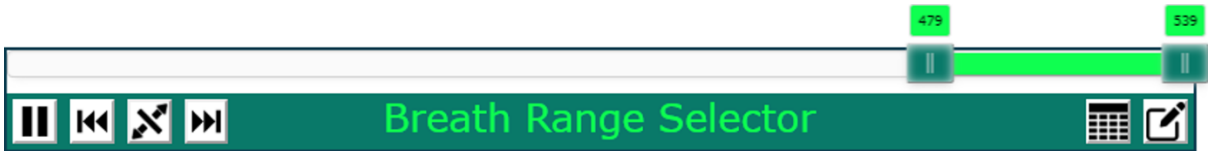


Figure 25: Breath Range Selector

Basic Operation

The slider has two handles to manually set the range. The range limits are shown above the handles. Each handle can be grabbed and moved to the required position. In addition, the green bar connected to the handles can be grabbed and moved so that the entire range moves to a different position. All the breaths contained within the range are referred to as range SPAN.

Range Selector Modes

The range selector has two operating modes as described below.

PLAY Mode – In this mode the range selection adjusts automatically as each new breath is recorded. The entire range SPAN scrolls by one breath to the right. By default, the range selector is set to “PLAY” mode.

PAUSE Mode – In this mode, the range selection is frozen to the currently selected range till manually moved.

Range Selector Controls

The range selector provides a set of buttons for control. These buttons are described below.

PLAY/PAUSE: These buttons enable the toggling between PLAY and PAUSE modes. They can be manually toggled. In addition, some other controls also toggle these modes as described below. If in PAUSE mode, the PLAY button blinks orange.

FORWARD/REWIND: These buttons move the entire range one SPAN forward or backwards. The range selector is set to PAUSE mode.

EXPAND: This button expands the range selection to the maximum available at the current time. The range selector is set to PAUSE mode.

TABLE: This button displays the currently selected range as a table shown below. The range selector is set to PAUSE mode.

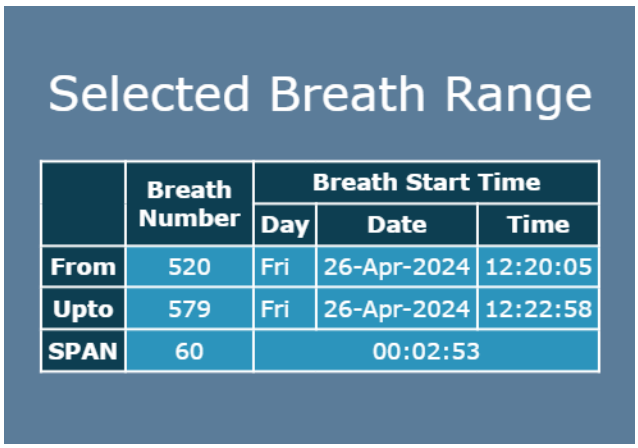


Figure 26: Breath Range Table

EDIT: This button enables a manual entry of range limits. The range limits can be selected using BREATH_NUMBERs or BREATH_START_TIMEs.

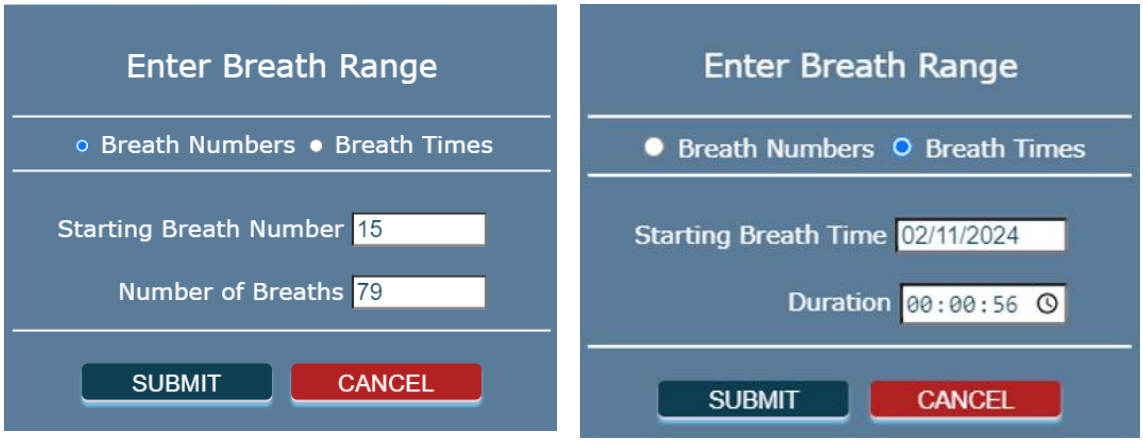


Figure 27: Breath Range Manual Edit

The entry by BREATH_NUMBERs is self-explanatory.

The entry using BREATH_START_TIMEs is slightly more complex because a ventilation session may stretch over multiple days and the entry necessarily requires entry of both date and time.

Clicking on "Starting Breath Time" field brings up a calendar which is constrained to the range of date and times for which the breaths have been logged.

The Duration can be entered as hours, minutes and seconds. Clicking on the clock icon brings up a GUI time selector to do the same.

Figure 28: Breath Time Selection

Example Usage

The Breath Range Selector is a simple but powerful tool for visualization. Its use is limited only by the user's imagination.

Let's take an example. Let's say you want to check how the patient-initiated (SPONTANEOUS) breaths have progressed over the course of the ventilation session. Below is an example of steps to determine that.

1. Navigate to the "Statistics View"
2. Click on the EDIT button on the Breath Range Selector.
3. Select the "Breath Times" option.
4. Enter the Starting Time as the beginning of the session.
5. Enter the Duration as 1 hour (or whatever is appropriate).

6. Check the “Number of Spontaneous Breaths” or “Spontaneous BPM” in the Statistics tables. These numbers are for the selected range of breaths.
7. Now click on the FORWARD button on the Breath Range Selector. This will move the selector to the next 1 hour of the session.
8. The Statistics table will now show the numbers for the new time range.
9. Or else, you can simply grab the range bar (the green bar connecting the two handles) and slide it back and forth to see the statistical numbers change.
10. And so on.

WEB Recorder

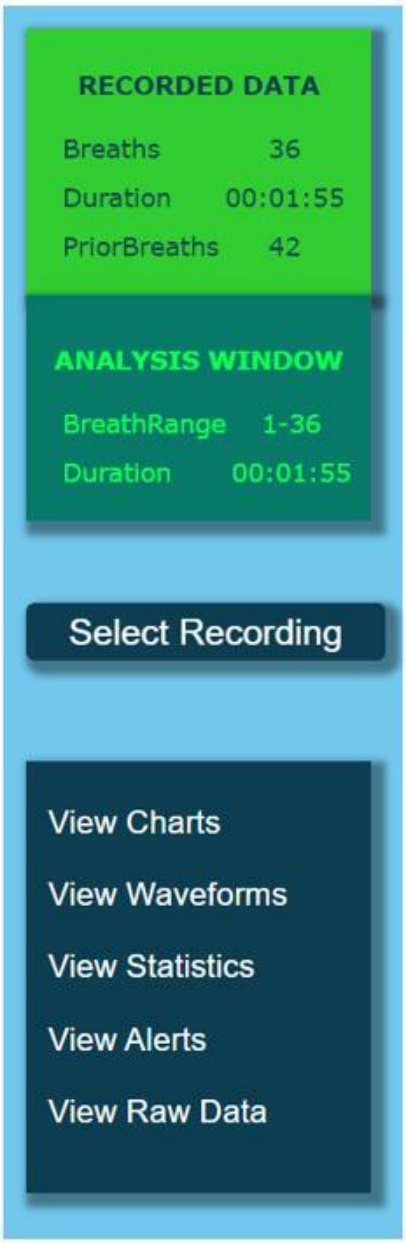
Though the Dashboard also allows recording of the current session being monitored, the stand-alone Recorder allows the same while consuming much less system memory. This is useful if the full-featured Dashboard is not required.

The use interface is very simple – namely START/STOP/PAUSE recording.

Figure 29: Web Recorder

WEB Playback

The Playback App enables the playback and analysis of a previously recorded session with a patient. The process starts with selecting a session recording to playback.



Playback Sidebar Menu

The main menu for the Playback is presented as a sidebar menu as shown in the Figure on the left.

The box on the top provides a summary of the currently selected recording for playback.

The next box is a button to select a particular recording for playback.

The last box holds all the buttons to do the various types of playback and analysis. The views are the same as the ones available on the Dashboard.

Figure 30: Playback Sidebar Menu

Playback Recording Selector

Each previously recorded session is presented in a Selector table. Select a recording for playback either by double-clicking on a row or using the appropriate checkmark menu button.

After a database is selected, a summary of the recording data is displayed in the top box of the sidebar and the selected table row is highlighted.

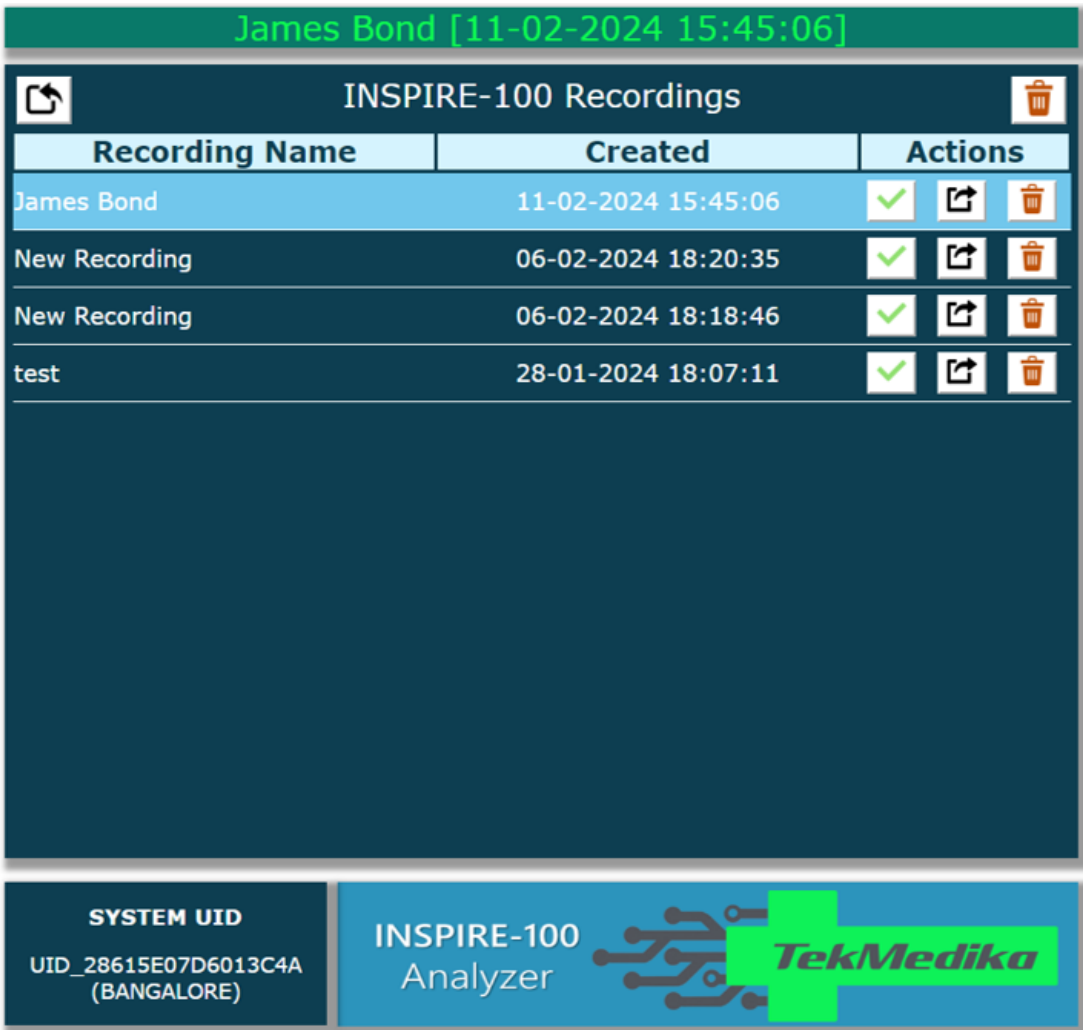


Figure 31: Playback Selector Table

Playback Recording Import Export

The EXPORT menu button on each row enables the user to export the database to a text file that can be sent to others for playback and analysis. The IMPORT button on the top left allows the user to import a previously exported text file as a new session available for playback. Below is a screenshot of the Import screen.

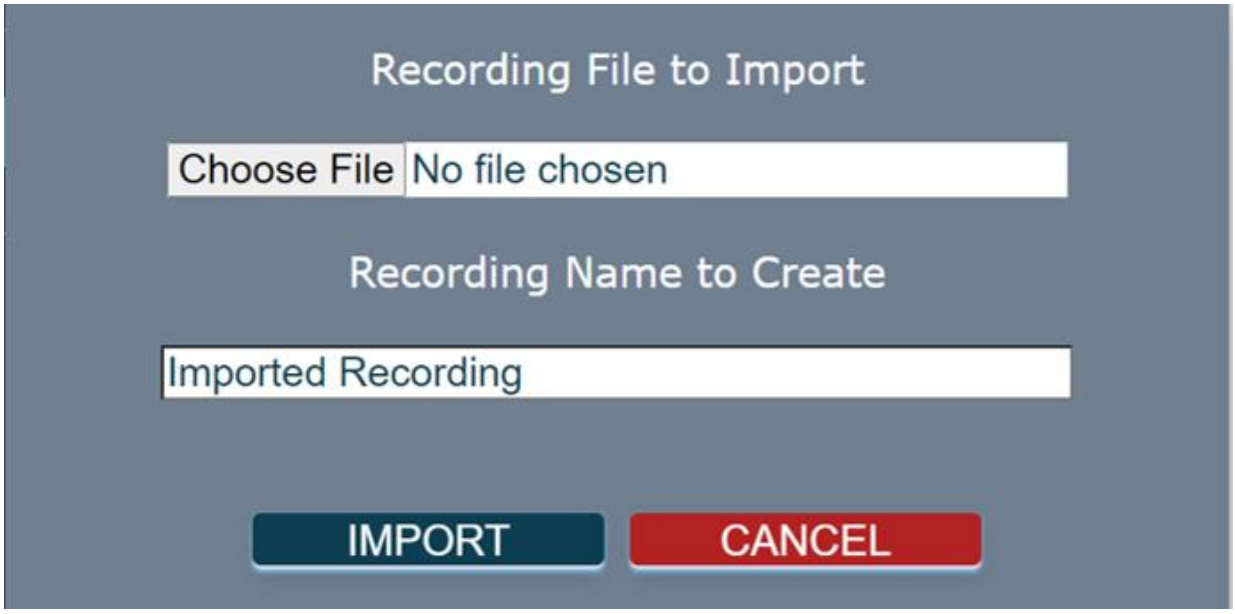


Figure 32: Playback Import View

Playback Charts, Statistics, Breath Waveforms and Alerts Views

Finally, the Charts, Statistics, Breath Shapes and Alerts views work in the same fashion as described in the Dashboard section above. Also, the Breath Range Selector works the same way as described in the Dashboard section.

Install Firmware Upgrade App

Occasionally the system may need to be upgraded in the field for new features or bugs. The new firmware releases are made available on the web for downloading and installing.

A local App must be installed on the user's laptop to enable installation of new firmware for the INSPIRE-100 system. Clicking on this button downloads the appropriate app depending on the operating system of the laptop (WINDOWS or MACOS).

For further details refer to the "Firmware Upgrade Manual".

FiO_2 Calculator

FiO2 is controlled externally by setting an appropriate Oxygen input flow rate from the external Oxygen source.

This stand-alone calculator enables calculating the required Oxygen flow rate given the following parameters.

- Deployment Altitude
- Desired FiO2
- Purity of the Oxygen Source
- Tidal Volume
- Respiration Rate

Simply position the mouse over any gauge and turn the scroll wheel to change its value. Else, the required value can be typed in the center of each gauge.

This calculator is merely for exploratory purposes and is not required for the operation of the INSIRE-100 system. The appropriate calculator is already built in the INSIPRE-100 system firmware.

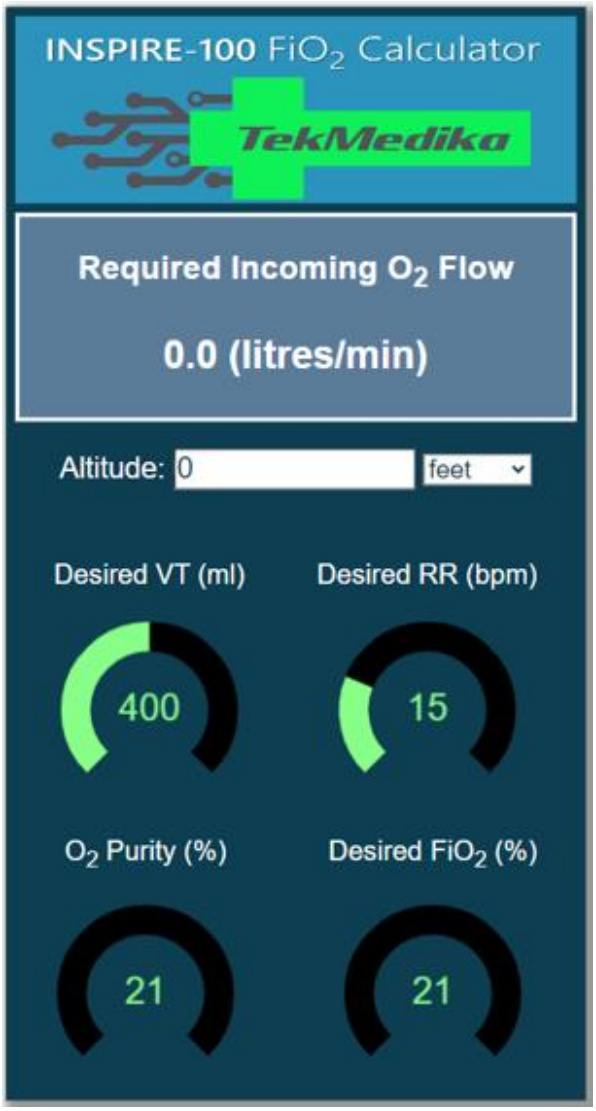


Figure 25: FiO2 Calculator