KNM01 Sound Level Meter

Manual and User Guide

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CORRESPONDING FIRMWARE

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Table of Contents

1 Introduction

The KNM01 is a 2 channel sound level meter designed for measuring sound pressure levels (noise) according to AS-IEC-61672 and AS-IEC-61260.

The device is designed to allow handheld operation for ad-hoc measurements, with results displayed on the graphic interface.

The KNM01 contains an internal battery to allow handheld operation for a period of time without an external power connection.

As an Internet of Things (IoT) device, it is also capable of publishing the noise results to online services, allowing remote and long term monitoring. It may be operated permanently connected to an external power connection.

Basic metrics are provided on all KNM01 meters, including Lpk, Lmax, Lmin, Leq and Lsel on each channel. Extended capabilities may be unlocked through the purchase of several options. These options are unlocked through the provision of a unique ‘unlock code’ which unlocks the capability for the selected unit.

2 Overview

1. InstraLabs KNM01 Sound Level Meter (KNM01)
2. InstraLabs microphone (Sensor)
3. USB-C Charge port
4. Power button

5. Reset button

6. Graphic display with touch interface
7. Wifi antenna connector
8. Wifi antenna
9. uSD card socket
10. 3.5mm Audio line output
11. BNC coupler

2.1 Operation

The Sensor is the transducer which must be located in a suitable position and orientation for measuring the ambient sound levels. It must be connected to the KNM01 body, either directly using the provided BNC coupler, or optionally with a BNC cable for remote mounting.

The charge port allows powering the KNM01 and recharging its internal battery.

The power button turns the KNM01 on and off, and illuminates the graphic display if it has entered a power saving mode.

The reset button allows the user to initiate a hard reset if the unit has entered an unrecoverable software state.

The uSD card socket allows long term storage of large quantities of data to user accessible memory.

The graphic display allows the user to control many aspects of the unit's operation, and view live noise levels.

The wifi interface allows reporting of measurements to internet services (if connected and configured). It also allows the user to control and configure advanced device options.

To power on the unit, ensure the sensor is connected to the KNM01 using the coupler or cable, and press the power button on the KNM01. The graphic display will illuminate, and indicate the device status.

2.2 Navigating the User Interface

The graphic display and touchscreen provides the primary user interface for the KNM01.

The user interface is comprised of many 'pages', which the user may navigate between.

When there has been no user activity on the graphic display for more than 30s (default, adjustable) the graphic display illumination will be disabled until the graphic display or power button is pressed again. The KNM01 remains turned on.

In general, pressing the ‘Back’ icon in the top left of the display will take the user to the previous page. Pressing this repeatedly will typically take the user back to the main page.

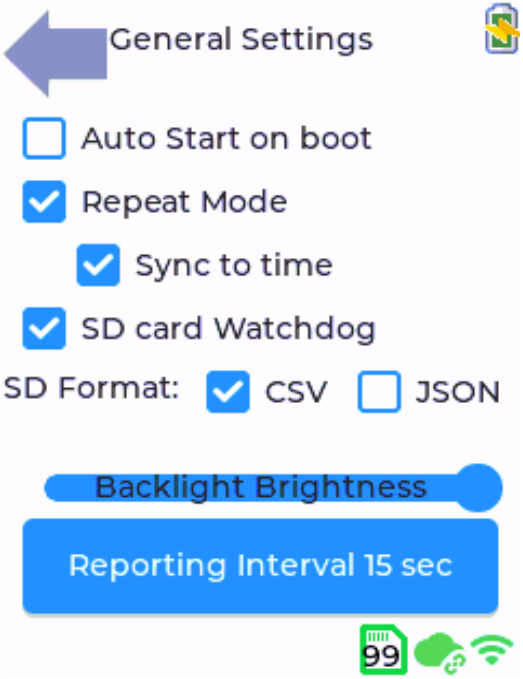
Pressing a button may initiate an action, or navigate the user to a related page.

When the unit is powered up it takes the user to the main page, which displays the noise levels, wifi status, measurement filename and current time.

To view or modify the unit configuration, press the ‘settings’ button in the top left corner of the main page.

The status of the SD card, Wifi and MQTT is displayed using icons in the bottom right corner of the display.

- The SD status icon is the left-most icon
    - It is red if the SD card is not detected



- It is green if it is detected and operating.
- The percentage free space remaining on the SD card is overlaid on the icon.

- The MQTT status icon is the middle icon, which looks like a cloud
  - It is green if the MQTT connection to the MQTT broker is connected.
  - It is red if the unit is not connected to the MQTT broker.
- The Wifi status icon is the right-most icon
  - It is not displayed if Wifi is turned off.
  - It is yellow if the unit is in AP mode.
  - It is red if the unit is configured to connect to a wifi network and it has not successfully connected to the network.
  - It is green if the unit is connected to a wifi network.

2.3 Real-Time Clock

How it keeps track of time and under what conditions it loses time

When the KNM01 is connected to a wifi network with internet, it automatically connects to an internet time server and synchronises it's internal clock. It will continue to use the internet time server to synchronise its time.

The KNM01 has an internal GPS which provides high accuracy timekeeping to the KNM01. Once the GPS has obtained a fix, the time is accurate and remains so, including when internet time servers are unavailable, over device resets, and periods powered off.

If the battery becomes discharged, the time will be reset, but when the unit is charged and powered back on, the time will be restored either when the unit connects to wifi, or when the GPS gets a fix.

3 Getting Started

3.1 Power Supply

The KNM01 contains a Lithium Polymer battery which is capable of operating the unit for a period of up to 2 days from a full charge.

The unit is charged by USB-C. The maximum charge rate is 15W, but any USB charger may be used to power and charge the unit at a reduced rate.

With a high power USB charger, the unit will charge to full charge in 24 hours or less

Internal battery	20Ah, 3.7V
USB-C Charge maximum	5V @ 3A
Compatible USB chargers	Any
Time to full charge (with 15W supply)	24 hours
Battery operating time from full charge	48 - 72 hours

3.2 Data Storage

The unit requires a uSD card be installed for storing noise data. It is recommended to use a quality card from a well known manufacturer and reliable supply chain. Any capacity of card may be used. It is the users responsibility to install a card which has sufficient capacity for the intended application and duration.

SanDisk cards are suggested. uSD cards must be formatted as either FAT32 or exFAT. They will come from the manufacturer formatted appropriately.

The noise data is stored to the SD card in CSV or JSON format.

To insert a uSD card, simply push it into the uSD card socket with the contacts facing down until a click is felt, then release.

To remove the uSD card, push the uSD card until a click is felt, then release it and allow it to pop out. Gently withdraw the card.

3.3 Connecting the InstraLabs microphone sensor

The InstraLabs microphone sensor must be connected to the KNM01 for successful operation.

The cable should be a coaxial cable terminated with BNC connections. Either 50 ohm or 75 ohm cable may be used.

When connecting the microphone using a different length cable, an acoustic calibration shall be performed to ensure there is no offset to the noise readings.

3.4 Switching the KNM01 On and Off

To turn the KNM01 on, briefly press the power button once. If it is off, it will turn on. If it is already on, the graphic display will illuminate. If unsuccessful, ensure the KNM01 is charged or powered.

To turn the KNM01 off, press and hold the power button until the graphic display illumination is deactivated. Alternatively, navigate to the ‘Settings’ page of the graphic display and press the power button in the top right of the screen.

3.5 Select Measurement characteristics

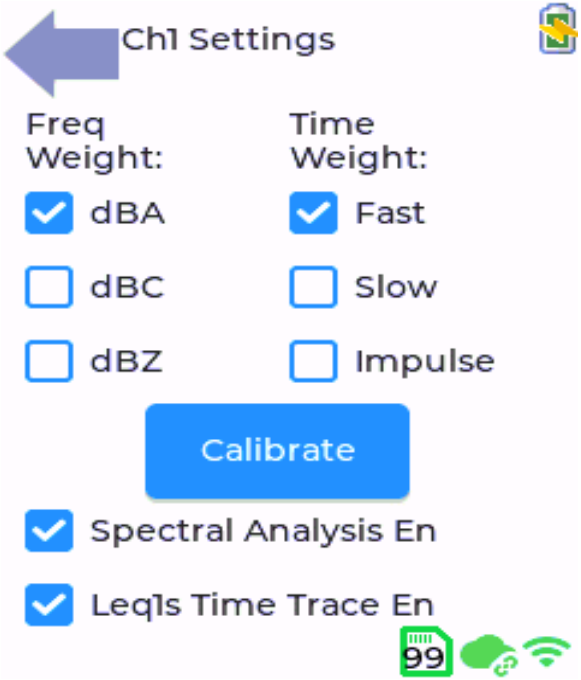
The characteristics of the measurement being made may be adjusted using the following settings

3.5.1 Frequency weighting

Each channel of the KNM01 may be independently set to one of the following frequency weightings, according to AS-IEC-61672:

- A weighting
- C weighting
- Z weighting

To adjust the frequency weighting, power on the KNM01 and navigate to the ‘Settings’ > ‘Ch1 Settings’ or ‘Ch2 Settings’ page. The currently selected option will be checked. Press the preferred filter checkbox to select it.



3.5.2 Time weighting

Each channel of the KNM01 may be independently set to one of the following time weightings, according to AS-IEC-61672:

- Fast weighting
- Slow weighting
- Impulse weighting

To adjust the time weighting, power on the KNM01 and navigate to the ‘Settings’ > ‘Ch1 Settings’ or ‘Ch2 Settings’ page. The currently selected option will be checked. Press the preferred filter checkbox to select it.

3.5.3 Measurement Interval

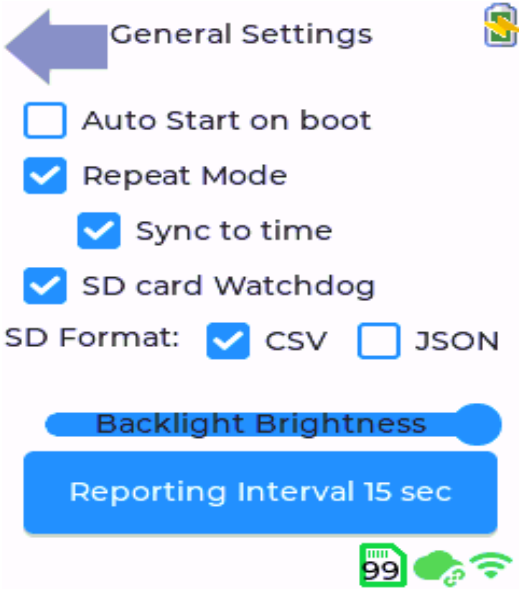
The measurement interval may be set between 1 second and 1 hour.

To adjust the measurement interval, power on the KNM01 and navigate to the ‘Settings’ > ‘General Settings’ > ‘Measurement Interval’ page. The selected option will be indicated at the top of the screen. Scroll through the list and select the preferred option from the list.

3.5.4 Measurement Timing

The measurement timing may be adjusted with the ‘Repeat Mode’, ‘Sync to Time’ and ‘Auto Start on boot’ options. To adjust these options, power on the KNM01 and navigate to the ‘Settings’ > ‘General Settings’ page.

- ‘Repeat Mode’ will, if enabled, stop each measurement once the measurement interval is completed, and immediately begin a new measurement. If not enabled, the measurement will continue indefinitely until stopped.
- ‘Sync to Time’ will, if enabled, align the end of each measurement interval so that it aligns with the start of the hour (eg. 15 min intervals started at 6:07 will begin at 6:07, 6:15, 6:30, 6:45, …). If not enabled, the measurement will begin at whatever time it is initiated, and a new measurement will begin every subsequent interval (eg. 15 min intervals started at 6:07 will begin at 6:07, 6:22, 6:37, 6:52, …)



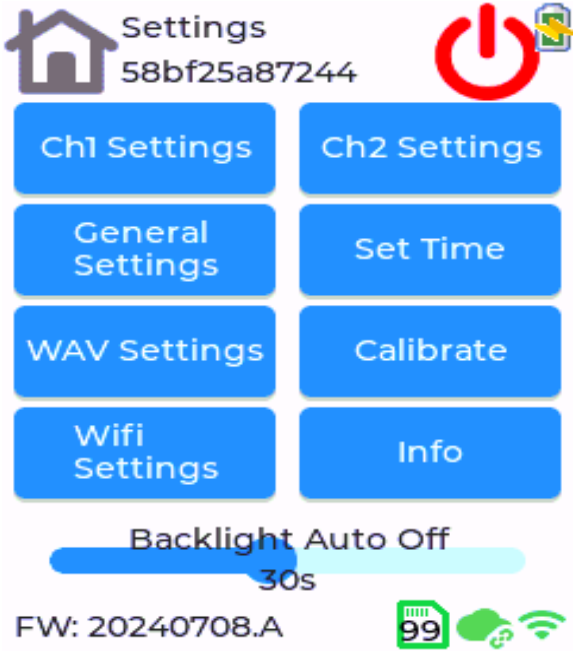
- ‘Auto Start on boot’ will, if enabled, begin a measurement immediately after the unit powers up. This ensures that if the unit restarts for any reason, it will automatically continue measurements. It is critical that this setting be enabled for any remote or long term logging scenario.

3.6 Display Backlight

To save power when deployed in a logging system, the KNM01 will turn off the backlight of the graphic display after 30 seconds (default) of no user activity.

When the backlight is disabled, if the user touches the graphic display, the backlight is illuminated and the 30s timer is reset. If the user briefly presses the power button, the backlight will also illuminated and reset the 30s timer.

When the backlight is disabled, the graphic display is still active and the user may still press buttons, so they should take care not to stop a measurement when reactivating the display.



The user may adjust the display inactivity timeout or stop it altogether. To adjust the backlight inactivity timeout, power on the KNM01 and navigate to the ‘Settings’ page. Select the

'Backlight Auto Off' slider and drag it to the desired timeout. To disable the timeout, drag the slider fully to the left and observe the indication 'Always ON'.

The Backlight timeout option will reset to 30s after the unit is power cycled.

4 Sound Level Measurement

Describes the measurements which are recorded by the KNM01

4.1 Base measurements

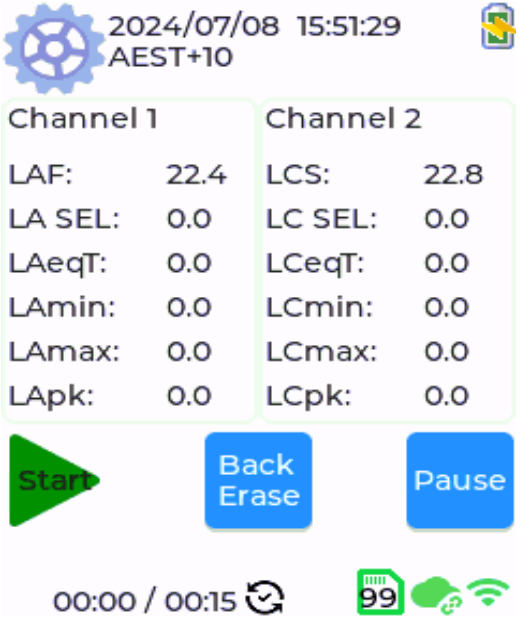
The base measurements taken by the KNM01 (without purchasing extended options) are as follows:

- Measurements are taken over a time interval between 1 second and 1 hour, and provided for 2 independently time and frequency weighted channels.

- The reported metrics for each channel over the measurement interval are:
    - Lpk
    - Lmax
    - Lmin
    - LeqT
    - Lsel

The measurements are displayed on the ‘Main’ page as follows:

- The current instantaneous level is displayed at all times (whether a recording is active or not) and is updated every 1 second.
- The 2 channels are displayed in adjacent labelled panels. Channel 1 is displayed on the left panel, and Channel 2 is displayed on the right panel.
- The measurements are displayed in dB



- When a measurement is active, the Lsel, Leq, Lmin, Lmax and Lpk display the relevant value for the period up to now.
- When a measurement is stopped, the Lsel, Leq, Lmin, Lmax and Lpk hold the values from the most recently stopped measurement.

These measurements will all be recorded to the uSD card in CSV or JSON format

4.2 Time Trace Option

The ‘Time Trace’ option is an extended capability which may be purchased for the KNM01 sound level meter. This option adds a ‘time trace’ of the Leq1s over the duration of the measurement to the saved data. This allows the operator to identify at what point within the measurement window certain noise events occurred and make judgements about their nature.

This time trace is reported in the data saved to the SD card, and reported to the internet.

4.3 Percentiles Option

The ‘Percentiles’ option is an extended capability which provides percentile analysis on the noise level of each channel at a 40ms sampling interval under the selected frequency and time weighting.

Percentile analysis will be performed for the 1, 5, 10, 50, 90, 95 and 99 percentiles.

4.4 Audio Record Option

The ‘Audio Record’ option is an extended capability which allows the user to record the audio input as a WAV (uncompressed) or OPUS (compressed) formatted audio file. This audio file is saved to the uSD card format, and may on request be published to a remote internet service.

The audio is split into files matching the time period the measurement covers.

The audio is recorded at 48kSps (the same as the internal sample rate of the unit) and is recorded with the Z frequency weighting (flat/no weighting).

4.5 1/3 Octave Spectral analysis Option

The ‘1/3 Octave Analysis’ option is an extended capability which provides 1/3 octave spectral analysis on the noise level of Channel 1.

Spectral analysis will be performed for the 1/3 octave bands between 20Hz, and 20kHz.

4.6 Wifi Mesh Option

The ‘Wifi Mesh’ option is an extended capability which allows the unit to be connected to an access point using a ‘mesh’ wifi topology, allowing a network of geographically dispersed units to relay data packets from more distant units to the access point.

5 Wifi Interface setup

Describes the purposes of the Wifi interfaces and how to use them

5.1 Web Configuration

The unit contains a web configuration page which may be accessed by any standard web browser. This is referred to hereafter as the web config.

The settings which are likely to be most frequently modified are available on the graphic display for convenience, however some settings which would be difficult to modify on the small display (eg. wifi passwords) are only accessible through the web config pages.

Before the unit has been configured to connect to a valid wifi network, the user must use ‘AP mode’ to connect to the unit and configure the wifi settings. Once the unit has been connected to a wifi network, this web config page may be accessed by a computer connected to the same network in a similar manner.

5.1.1 Enable AP mode

This commands the unit to create a wifi network to which a computer system may be connected to perform initial configuration using the web config interface.

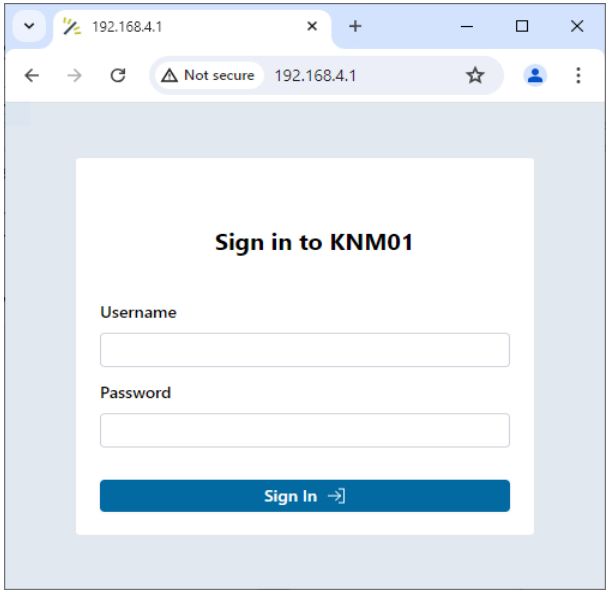
1. Power on the KNM01 and navigate to the ‘Settings’ > ‘Wifi Settings’ page.

2. Ensure that the ‘On’ checkbox and the ‘AP’ checkbox are checked
3. Power the unit off and back on
4. A wifi network corresponding to the unit serial number will appear

5.1.2 Connect to the created wifi network and access web config interface

1. Connect your computer system to the newly created wifi network. The wifi password is the same as the network name (the unit serial number)

2. Open a web browser and navigate to the configuration webpage at http://192.168.1.4



You should be taken to a login page similar to the below.

5.1.3 Configure settings using web config interface

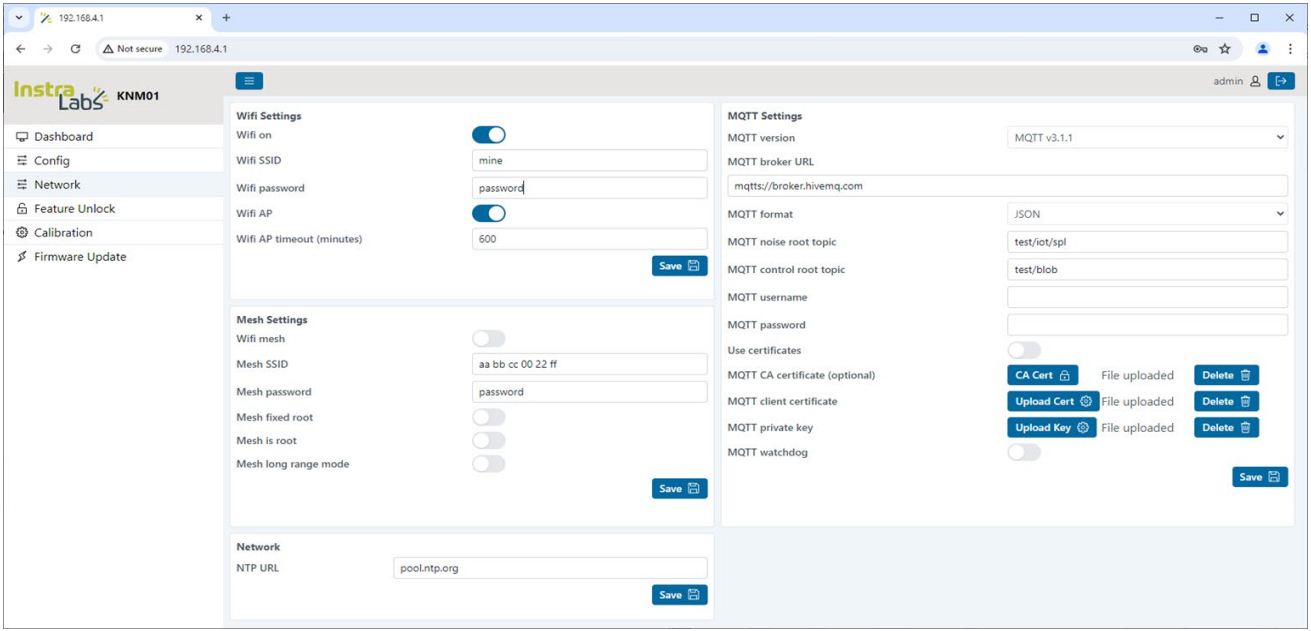
1. Log in to the web config interface

   The default username/password combinations are:
   User level (restricted access):
   username: user
   password: user

   Admin level (unrestricted access):
   username: admin
   password: admin

   Calibration level (calibration access)
   username: calibration
   password: ELoC6t

2. Having successfully navigated to the configuration webpage and logged in using the above credentials, click the menu

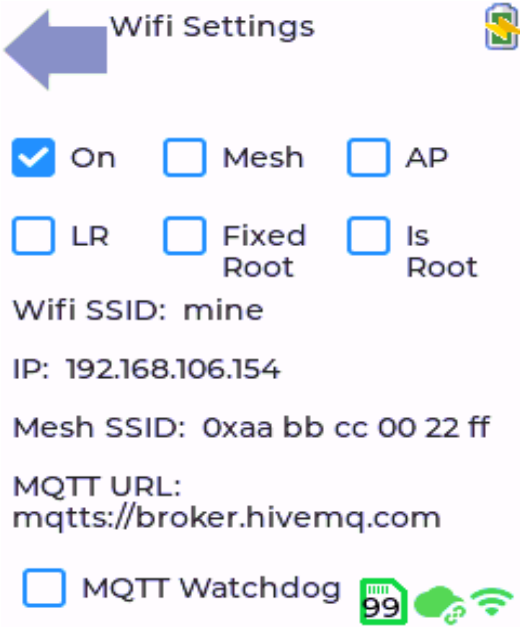


which contains the desired configuration options (eg. Network).

3. Modify the configuration values in accordance with your requirements. When the options are set, click the 'Save' button associated with that panel.
4. Repeat for other configuration panels and pages as required until the settings are set as required.

5.1.4 Connect to web config interface without AP mode

Once the unit has been successfully configured to connect to a wifi network, it is no longer necessary to put the unit into AP mode to connect to the webserver. To connect:

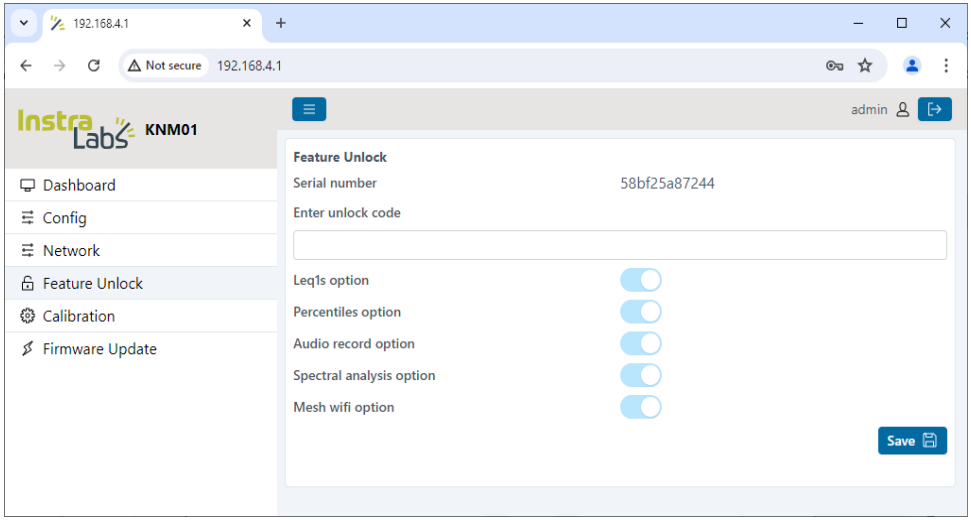


1. Ensure the KNM01 is successfully connected to a wifi network (the Wifi indicator in the bottom right corner should be green, and the unit should have been restarted after disabling AP mode)
2. Connect your computer to the same network you have connected the KNM01 to

3. On the KNM01 graphic display, navigate to ‘Settings’ > ‘Wifi Settings’ page and take note of the IP value shown. This is the address you must navigate to in the browser.
4. Open a web browser and navigate to the address indicated by the ‘IP’ field, eg: 192.168.106.154

5.1.5 Unlock Options with web config interface

1. Purchase the desired option(s) for your unit serial number, and receive the unlock code
2. Connect to the unit Put the unit into AP mode and connect to it (as above)
3. From the ‘Index’ page, navigate to the ‘Feature Unlock’ page

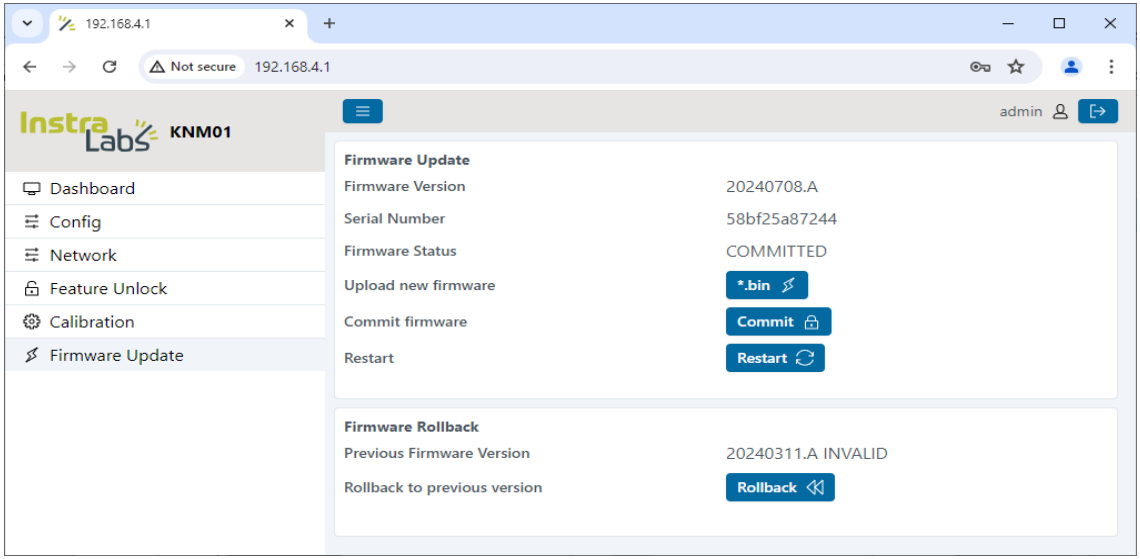


4. Observe the available options and their status.
5. Copy the unlock code you received into the ‘Enter Unlock Code’ field and click ‘Save’
   Note: some characters look very similar and may be confused with one another, eg. O and 0, 1, l and I. To avoid mistakes and confusion, it is advised to copy the unlock code instead of typing it in.

6. If the unlock code was valid for your serial number and was correctly entered, observe the newly available option(s) indicating ‘ENABLED’ (blue, right) instead of ‘DISABLED’ (grey, left)
7. Power off the KNM01 and power it back on. Enjoy your newly available options!

5.1.6 Update Firmware with web config interface

1. Download the firmware file to your computer
2. Connect to the web config interface (as above)
3. From the ‘Index’ page, navigate to the ‘Firmware Update’ page



4. Click the '*.bin' button beside the 'Upload new firmware' label and select the firmware file from the location in which you downloaded it.

5. Wait for the upload to complete.
   Note: This may take a while, wait for the button to indicate completion.

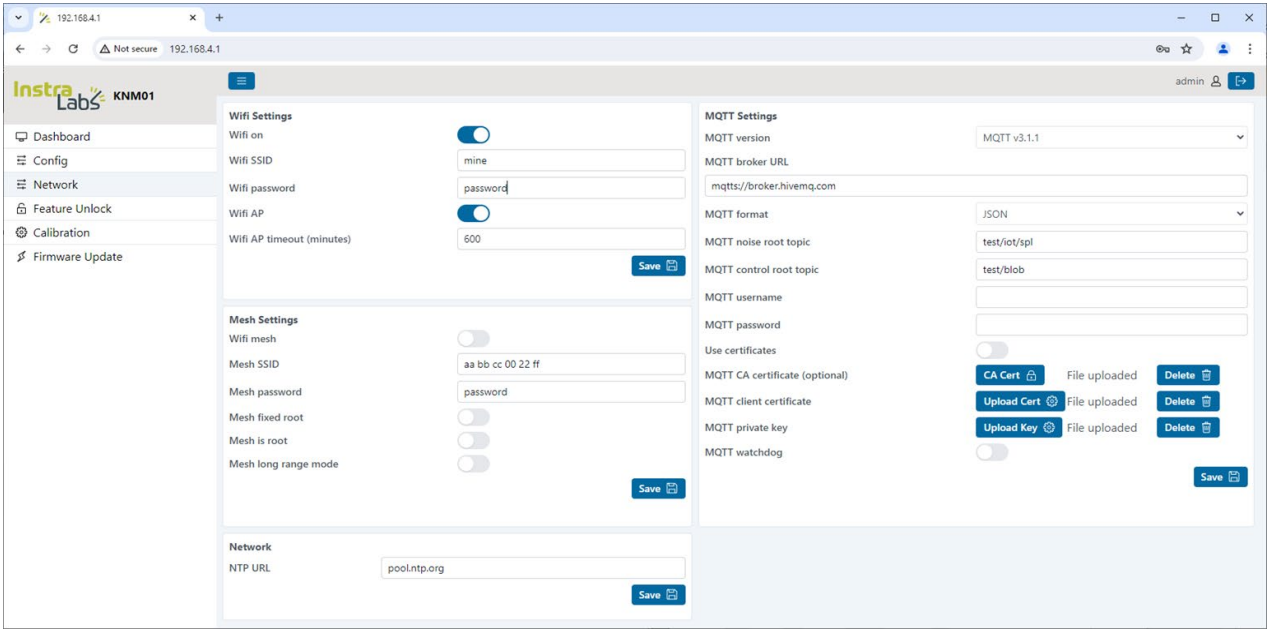
6. The KNM01 will reboot when the update has completed.
7. Check that the firmware version running on the KNM01 matches the version you uploaded (View at the bottom of the ‘Settings’ page on the graphic display)

5.2 Wifi Client mode – MQTT Data publication

How to set up the Wifi Client mode and settings to publish MQTT data to a private MQTT broker

1. Set up an MQTT broker (or use an existing one) which you will use in your internet data storage system. It is advised to use certificate authentication to prevent unauthorised access.
2. If using certificate authentication, generate and download the certificate and key files for your unit.
3. Create a Wifi network with internet access (or access to your private MQTT broker if not connected to the internet)
4. Connect to the web config interface and log in as ‘admin’ (See 24 Web Configuration for details)

5. Navigate to the ‘Network’ page



6. Set the settings as follows:

Wifi On	TRUE
Wifi SSID	The SSID of the wifi network the KNM01 will connect to
Wifi Key	The password of the wifi network the KNM01 will connect to
MQTT URL	The URL of the MQTT broker you set up in step 1
MQTT Username	If using username/password authentication, this is the username. If using Certificates or No authentication, leave blank
MQTT Password	If using username/password authentication, this is the password. If using Certificates or No authentication, leave blank
MQTT Format	Select JSON
MQTT Version	Set this to the MQTT protocol version your server requires. Most typically v3.1.1
MQTT noise root topic	prod/iot/spl
MQTT control root topic	prod/blob
Use certificates	True if using certificates

7. Click ‘Save’
8. If using certificate authentication, upload the certificates as follows:

MQTT CA Certificate (optional)	Leave blank
MQTT Client Certificate	Upload the certificate (in .pem or .der format) you generated above. Leave blank if not using certificate authentication.
MQTT Client Private Key	Upload the private key (in .pem or .der format) you generated above. Leave blank if not using certificate authentication.

9. Disable AP mode (if required) and reboot. The KNM01 will try to connect to the specified network, and will publish its’ data to the specified MQTT server. It is the user’s responsibility to set up a system to catch the published MQTT data and store and present it.

   Note: Matrix Hub is an all in one subscription service which receives, stores and presents data from KNM01 sensors with dashboards for interacting with the measurement data.

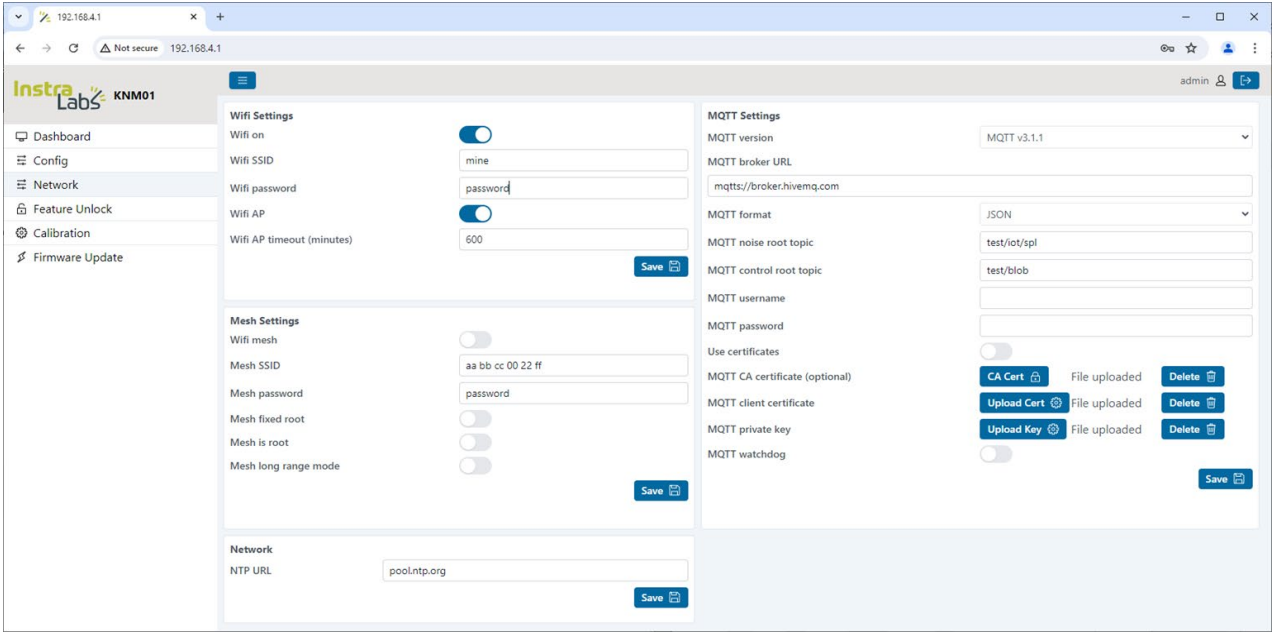
5.3 Wifi Mesh mode – Multi-hop Wifi connection

The Wifi Mesh mode (if option purchased) allows multiple KNM01 units to form a wifi mesh network. In this mesh network, units may connect to the main wifi network via other units, allowing a unit which may be out of range from the base wifi station to have its communication relayed to the base station by another unit which is in range of both.

To set up a Wifi Mesh network:

1. Set up an MQTT broker and wifi network as for Wifi Client Mode
2. Configure the KNM01 as for Wifi Client Mode (See 34 Wifi Client mode – MQTT Data publication for details)

3. Navigate to the ‘Network’ page of the web config interface (See 24 Web Configuration for details).



4. Set the Mesh settings as follows:

Wifi Mesh	TRUE	Set this TRUE to enable Wifi Mesh
Mesh fixed root	FALSE	Only set this true if you need to designate a specific KNM01 unit as the gateway for all the other KNM01 units. By default, they negotiate this automatically.
Mesh is root	FALSE	Only set this true if Fixed Root is true AND this is the unit you wish to designate as the gateway for all the other KNM01 units.
Mesh long range mode	FALSE	Setting this option true MAY help to increase the range of the wifi between KNM01 units, at the cost of reduced throughput. It will NOT increase the range to the wifi base station.
Mesh AP Connections	10	This setting sets the limit of how many other KNM01 units may connect directly to this one. Recommend 10.
Mesh SSID	e2 03 c7 8c f9 27	This is the name of the mesh network the KNM01 units use to communicate to each other. It is 12 hexadecimal characters. It is suggested you generate

		this randomly. It MUST be the same for ALL units in the same mesh network.
Mesh Key	meshkeyy	This is the password of the mesh network the KNM01 units use to communicate to each other. It is 8-31 characters. It is suggested you generate this randomly. It MUST be the same for ALL units in the same mesh network.

5. Click ‘Save’
6. Repeat for all units you wish to connect as part of the same mesh network.

6 System Settings

How and where to access and change the various system settings

- Many settings may be viewed and modified using the graphic display
- All settings may be viewed and modified using the Wifi AP mode web config interface.
  See 24 Web Configuration for details on using the web config interface

6.1 Real-time Clock

The Real Time Clock in the KNM01 supports all Australian timezones, and uses internet time servers and GPS to synchronise to the current time.

6.1.1 Setting the timezone

The timezone may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the ‘Settings’ > ‘Set Time’ > ‘Set Time Zone’ page and select the desired Australian timezone from the list.
- To set using the web config interface, navigate to the ‘Dashboard’ or ‘Config’ page and select the desired Australian Timezone from the options listed at ‘Timezone’

6.1.2 Setting the current time

The current time is normally automatically detected from an internet time server. However if the unit is not connected to the internet, it may be necessary to manually set the time.

- To set the current time: Navigate to the ‘Settings’ > ‘Set Time’ page on the graphic display and press the +/- buttons to modify the Year, Month, Day, Hour, Minute and Second until the time displayed at the top of the page is accurate.

- Press ‘Back’ to set the modified time.

6.2 Channel weighting

The channel weightings for time and frequency may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the ‘Settings’ > ‘Ch1 Settings’ or ‘Ch2 Settings’ page and select the desired filter from the options.
- To set using the web config interface, navigate to the ‘Dashboard’ page and select the desired filter from the options listed in the ‘Audio’ panel.

6.3 Record options

See 16 Select Measurement characteristics for details on the operation of these settings.

The Measurement timing settings may be set from the graphic display or the web config interface.

- To set using the graphic display: Navigate to the ‘Settings’ > ‘General Settings’ page and set the value of the desired options.
- To set the measurement interval using the graphic display: Navigate to the ‘Settings’ > ‘General Settings’ > ‘Reporting Interval’ page and select the desired reporting interval from the list.

- To set using the web config interface, navigate to the ‘Config’ page and set the ‘Reporting Interval’, ‘Repeat Mode’, ‘Sync to time’ and ‘Auto Start on boot’ options to the desired values.

6.4 Default Location

The default location is used if there is not yet a valid GPS position fix. The default location may be set from the web config interface.

- To set using the web config interface, navigate to the ‘Config’ page and enter the desired latitude and longitude in the ‘Default Latitude’ and ‘Default Longitude’ fields.

6.5 Watchdogs

The KNM01 contains watchdog timers to monitor device status and trigger a system restart if there are persistent faults. The watchdog timers on the MQTT interface and on the uSD card interface may be enabled or disabled by the user.

The MQTT watchdog timer will, if enabled, trigger a system restart if MQTT connectivity is unavailable for a period of 60 minutes. It will trigger if the Wifi network has been unavailable for 60 minutes as without a working Wifi connection the MQTT connection will be unavailable. This is recommended to be enabled in a long-term logging situation.

The SD watchdog timer will, if enabled, trigger a system restart if the uSD card is unable to be opened for a period of 60 minutes. This is recommended to be enabled in a long-term logging situation.

Both watchdogs may be configured using the graphic display or the web config interface.

- To set the SD watchdog using the graphic display: Navigate to the ‘Settings’ > ‘General Settings’ page and enable ‘SD card watchdog’.
- To set the SD watchdog using the web config interface, navigate to the ‘Config’ page and set the ‘SD card watchdog’ option to ‘TRUE’ and click ‘Save’

6.6 Wifi and network Settings

The wifi settings may predominantly be configured and viewed using the web config interface, however some settings may also be configured using the graphic display. This is partly to prevent making privileged information (such as passwords) accessible easily through the graphic display, and also due to the impracticality of entering complex text data and authentication certificates on the small display.

- To view and set the available wifi and network settings using the graphic display: Navigate to the ‘Settings’ > ‘Wifi Settings’ page and view/set the value of the available options.
- To set the wifi and network settings using the web config interface, navigate to the ‘Network’ page and set the options to the desired values. See 34 Wifi Client mode – MQTT Data publication for an example of setting these options.

7 Data Management

There are two main channels through which the collected data may be accessed – the files saved onto the uSD card, and the IoT Wifi MQTT publication.

7.1 uSD card

Files are placed in directories on the SD card organised by date.

- In the root directory, there is a folder for the year (eg. 2020)
- In the year directory, there is a folder for the month (eg. 05)
- In the month directory, there is a folder for the day (eg. 18)
- Files are saved in the corresponding day directory
    - Measurements are named according to the date-time the measurement started, to the second. eg. 20200518-150832.csv
    - Audio recordings are named according to the date-time the wave recording started to the second. eg. 20200518-150850.wav or 20200518-150850.opus

For the file format, see 50 Specifications

7.2 MQTT data publication

If the unit is configured to connect to a wifi network and a valid MQTT broker, data is published to the MQTT broker.

- Data is published at the end of the measurement interval

- For a manually triggered recording, when the recording is stopped, the measurement results are published.
- For a periodic measurement, the data is published at the end of every measurement interval.

- The published data may be formatted as either JSON (recommended) or CSV.

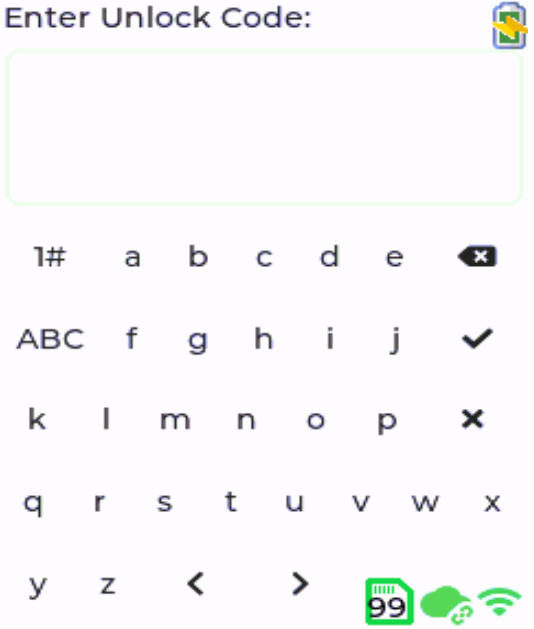
For the data format, see 50 Specifications

8 Extended Options

The KNM01 has several optional capabilities which may be purchased. After purchasing the desired option(s), an unlock code will be delivered. This unlock code must be entered into the KNM01 to unlock the purchased features. Unlock codes are unique to the specific unit serial number they were purchased for.

- To enter the unlock code using the web config interface (preferred), see 30 Unlock Options with web config interface
- To enter the unlock code using the graphic display: Navigate to ‘Settings’ > ‘Info’ > ‘Options’ and type in the unlock code using the on screen keyboard.

- To cancel the code entry and return to the Info screen, press the ‘Cross’ key
- To apply the code, press the ‘Tick’ key.
  - If the code is valid and entered correctly, the user will be returned to the ‘Info’ screen, and the newly unlocked options will be black (instead of greyed out). Restart the unit to fully apply the changes.
  - If the code is not not valid or not entered correctly, ‘INVALID unlock code’ will be indicated at the top of the screen. Check and correct the code and try again. In particular, check for where `1`, `I` and `l` may have been interchanged, and likewise `0` and `O`.



8.1 Time Trace Option

Adds a time trace of the Leq1s to the recorded and published data. See 22 Time Trace Option

8.2 Percentiles Option

Adds percentile analysis to the displayed, recorded and published data. See 22 Percentiles Option

8.3 Audio Record Option

Add ability to record and publish an audio file. See 23 Audio Record Option

8.4 1/3 Octave analysis

Adds ability to perform 1/3 octave analysis on the input signal, and display, record, and publish this analysis.

See 23 1/3 Octave Spectral analysis Option

8.5 Mesh Wifi Option

Add Mesh Wifi communication option. This option allows units to forward wifi communications from one unit to another to reach the primary wifi access point over a range greater than the unit may be able to reach independently.

See 38 Wifi Mesh mode – Multi-hop Wifi connection

9 Specifications

Channels	2
Measured parameters	Lpk (the peak instantaneous frequency weighted value in the measurement period)
	Lmax (the maximum time-frequency weighted value in the measurement period)
	Lmin (the minimum time-frequency weighted value in the measurement period)
	Lsel (the sound exposure level, a cumulative measure of sound exposure)
	LeqT (the average sound level over the measurement interval)
	Leq1s (option) – time trace over measurement window
	Percentiles (1%, 5%, 10%, 50%, 90%, 95%, 99%)
	Spectral analysis (LeqT for each spectral band over the measurement interval) 20Hz to 20kHz in 1/3 octave increments – Channel 1 only
Frequency weightings	A
	C

	Z
Time weightings	Fast
	Slow
	Impulse
Noise floor (dBA)	22dB

9.1 JSON data format

The JSON format is primarily intended to be published over the MQTT interface and automatically processed by an internet service. It is however a text based format which can be read by any computer system or determined user.

JSON is a format which uses key-value pairs, in a hierarchical structure.

9.1.1 Description

- The root level keys are as follows:

key	Format	Meaning
utc	Quoted string	Timestamp formatted as YYYY-MM-DD HH:mm:SS
utc_us	Number	Microseconds value of timestamp
localtime_offset	Number	Minutes difference between local time and utc
serial	Quoted string	Unit serial number
sensor	Quoted string	Sensor name (KNM01)
id	Quoted string	Sensor ID
lat	Decimal number	Latitude in decimal degrees
long	Decimal number	Longitude in decimal degrees
measurement_duration_s	Number	Duration of measurement in seconds
sd_percentage_free	Number	Percentage of SD card space remaining (0-99)
measurement	Array of JSON objects	Contains values from measurement

- The keys of the first and second element of the measurement array correspond to the values of the record and are as follows:

key	Format	Meaning
channel	string	What channel number this record corresponds to
freq_weight	string	The frequency weighting applied to this channel. • “Freq A” • “Freq C” • “Freq Z”
time_weight	string	The time weighting applied to this channel. • “Fast” • “Slow” • “Impulse”
L	number	The time weighted sound level at the end of the measurement (dB)
Lpk	number	The peak sound level during the measurement window (dB)
Lmin	number	The minimum time weighted sound level during the measurement window (dB)

Lmax	number	The maximum sound level during the measurement window (dB)
LSEL	number	The Sound Exposure Level level of the measurement window (dB)
LeqT	number	The average sound level during the measurement window (dB)
LP1	number	The 1% time-frequency weighted level (dB)
LP5	number	The 5% time-frequency weighted level (dB)
LP10	number	The 10% time-frequency weighted level (dB)
LP50	number	The 50% time-frequency weighted level (dB)
LP90	number	The 90% time-frequency weighted level (dB)
LP95	number	The 95% time-frequency weighted level (dB)
LP99	number	The 99% time-frequency weighted level (dB)
Leq1s	Array of numbers	The Leq1s for each 1s during the measurement window, ordered from beginning to end. (dB)

- The keys of the third element of the measurement array corresponds to the frequency analysis on Channel 1 and is as follows:

key	Format	Meaning
freq_leq	Array of numbers	Contains the LeqT for each spectral band from 20Hz to 20kHz (dB)

9.1.2 Example


```
{ "utc":"2024-07-09 03:24:42", "utc_us":926049, "localtime_offset":600,
"serial":"58bf25a87244", "sensor":"KNM01", "id":"Bob", "lat":-27.580040,
"long":151.941193, "measurement_duration_s":1, "sd_percentage_free":99, "measurement":
[

{"channel":1, "freq_weight":"Freq A", "time_weight":"Fast", "L":22.6, "Lpk":35.6,
"Lmin":22.3, "Lmax":22.6, "LSEL":22.4, "LeqT":22.4, "LP1":22.6, "LP5":22.6,
"LP10":22.6, "LP50":22.5, "LP90":22.5, "LP95":22.4, "LP99":22.4, "Leq1s":[22.6]},

{"channel":2, "freq_weight":"Freq C", "time_weight":"Slow", "L":25.9, "Lpk":40.9,
"Lmin":24.7, "Lmax":25.9, "LSEL":23.6, "LeqT":23.7, "LP1":25.9, "LP5":25.9,
"LP10":25.8, "LP50":25.1, "LP90":24.8, "LP95":24.8, "LP99":24.8, "Leq1s":[26.5]},

{"freq_leq":[0.1, 0.3, -1.6, -3.9, -2.2, -1.8, -0.9, 1.8, -4.6, -3.6, -2.9, -1.8, -0.7,
-0.2, 1.8, 2.4, 3.5, 4.9, 5.5, 6.8, 8.2, 9.2, 9.8, 10.9, 11.5, 11.8, 12.2, 12.6, 12.6,
12.6, 12.6]}

]}
```

9.2 CSV data format

The CSV format is primarily intended to be saved to the uSD card and processed by a user using a utility such as Microsoft Excel or similar.

The CSV format may be directly opened with Microsoft Excel or another spreadsheet program, and is labelled for convenient reference.

The CSV format may also be published over the MQTT interface if selected.

The data is formatted into rows, with each measurement point being placed on a new row.

9.2.1 Description

When imported into a spreadsheet program, the data should appear similar to the below:
(note: only enabled parameters will be populated)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	utc	2024-07-09 03:41:50																															
2	utc_us	930260																															
3	localtime_offset	600																															
4	serial	58bf25a87244																															
5	sensor	KNM01																															
6	lat	-27.58004																															
7	long	151.941193																															
8	measurement_duration_s	3																															
9	sd_percentage_free	99																															
10	Ch1 freq_weight	Freq A																															
11	Ch1 time_weight	Fast																															
12	Ch1 Lpk	35.8																															
13	Ch1 Lmin	22.2																															
14	Ch1 Lmax	22.8																															
15	Ch1 LSEL	26.9																															
16	Ch1 LeqT	22.4																															
17	Ch1 LP1	22.8																															
18	Ch1 LP5	22.7																															
19	Ch1 LP10	22.6																															
20	Ch1 LP50	22.5																															
21	Ch1 LP90	22.4																															
22	Ch1 LP95	22.4																															
23	Ch1 LP99	22.3																															
24	Ch1 Leq1s	22.4	22.4																														
25	Ch2 freq_weight	Freq C																															
26	Ch2 time_weight	Slow																															
27	Ch2 Lpk	42.1																															
28	Ch2 Lmin	23.5																															
29	Ch2 Lmax	26.2																															
30	Ch2 LSEL	28.4																															
31	Ch2 LeqT	23.9																															
32	Ch2 LP1	26.2																															
33	Ch2 LP5	25.9																															
34	Ch2 LP10	25.7																															
35	Ch2 LP50	24.3																															
36	Ch2 LP90	23.8																															
37	Ch2 LP95	23.6																															
38	Ch2 LP99	23.6																															
39	Ch2 Leq1s	23.2	23.4																														
40	Frequency	20Hz		25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1kHz	1.25kHz	1.6kHz	2kHz	2.5kHz	3.15kHz	4kHz	5kHz	6.3kHz	8kHz	10kHz	12.5kHz	16kHz	20kHz	
41	Leq	1.8	1.2	1.4	1.1	5.3	2.4	1.2	1.6	1.8	2.2	1.9	1.8	2.1	2.2	2.3	2.6	3.4	4.4	5.7	7	7.8	9.2	9.9	10.4	11.3	11.5	12	12.5	12.8	12.7	12.6	
42																																	

- Row 1 contains the UTC timestamp the measurement began
- Row 2 contains the UTC microseconds at which the measurement began
- Row 3 contains the UTC offset of the configured timezone in minutes (eg. 600 for AEST+10)
- Row 4 contains the serial number of the unit which generated the record
- Row 5 contains the sensor type
- Row 6 contains the decimal latitude the measurement was taken
- Row 7 contains the decimal longitude the measurement was taken
- Row 8 contains the measurement duration in seconds
- Row 9 contains the sd card percentage remaining
- Row 10 contains the Channel 1 frequency weighting
- Row 11 contains the Channel 1 time weighting
- Row 12 contains the Channel 1 Lpk
- Row 13 contains the Channel 1 Lmin
- Row 14 contains the Channel 1 Lmax

- Row 15 contains the Channel 1 Lsel
- Row 16 contains the Channel 1 LeqT
- Row 17 contains the Channel 1 LP1 (1% percentile)
- Row 18 contains the Channel 1 LP5 (5% percentile)
- Row 19 contains the Channel 1 LP10 (10% percentile)
- Row 20 contains the Channel 1 LP50 (50% percentile)
- Row 21 contains the Channel 1 LP90 (90% percentile)
- Row 22 contains the Channel 1 LP95 (95% percentile)
- Row 23 contains the Channel 1 LP99 (99% percentile)
- Row 24 contains the Channel 1 Leq1s time trace
- Row 25 contains the Channel 2 frequency weighting
- Row 26 contains the Channel 2 time weighting
- Row 27 contains the Channel 2 Lpk
- Row 28 contains the Channel 2 Lmin

- Row 29 contains the Channel 2 Lmax
- Row 30 contains the Channel 2 Lsel
- Row 31 contains the Channel 2 LeqT
- Row 32 contains the Channel 2 LP1 (1% percentile)
- Row 33 contains the Channel 2 LP5 (5% percentile)
- Row 34 contains the Channel 2 LP10 (10% percentile)
- Row 35 contains the Channel 2 LP50 (50% percentile)
- Row 36 contains the Channel 2 LP90 (90% percentile)
- Row 37 contains the Channel 2 LP95 (95% percentile)
- Row 38 contains the Channel 2 LP99 (99% percentile)
- Row 39 contains the Channel 2 Leq1s time trace
- Row 40 contains labels for row 41
- Row 41 contains the LeqT for each of the 1/3 octave spectral bands

9.2.2 Example

```
utc,2024-07-09 03:41:50

utc_us,930260

localtime_offset,600

serial,58bf25a87244

sensor,KNM01

lat,-27.580040

long,151.941193

measurement_duration_s,3

sd_percentage_free,99

Ch1 freq_weight,Freq A

Ch1 time_weight,Fast
```

```
Ch1 Lpk,35.8
Ch1 Lmin,22.2
Ch1 Lmax,22.8
Ch1 LSEL,26.9
Ch1 LeqT,22.4
Ch1 LP1,22.8
Ch1 LP5,22.7
Ch1 LP10,22.6
Ch1 LP50,22.5
Ch1 LP90,22.4
Ch1 LP95,22.4
Ch1 LP99,22.3
```

```
Ch1 Leq1s,22.4,22.4

Ch2 freq_weight,Freq C

Ch2 time_weight,Slow

Ch2 Lpk,42.1

Ch2 Lmin,23.5

Ch2 Lmax,26.2

Ch2 LSEL,28.4

Ch2 LeqT,23.9

Ch2 LP1,26.2

Ch2 LP5,25.9

Ch2 LP10,25.7

Ch2 LP50,24.3
```

```
Ch2 LP90,23.8

Ch2 LP95,23.6

Ch2 LP99,23.6

Ch2 Leq1s,23.2,23.4

Frequency,20Hz,25Hz,31.5Hz,40Hz,50Hz,63Hz,80Hz,100Hz,125Hz,160Hz,200Hz,250Hz,315Hz,400H
z,500Hz,630Hz,800Hz,1kHz,1.25kHz,1.6kHz,2kHz,2.5kHz,3.15kHz,4kHz,5kHz,6.3kHz,8kHz,10kHz
,12.5kHz,16kHz,20kHz

Leq,0.1,0.3,-1.6,-3.9,-2.2,-1.8,-0.9,1.8,-4.6,-3.6,-2.9,-1.8,-0.7,-
0.2,1.8,2.4,3.5,4.9,5.5,6.8,8.2,9.2,9.8,10.9,11.5,11.8,12.2,12.6,12.6,12.6,12.6
```