Cirrus Research plc
dedicated to noise measurement

# INVICTUS NOISE MONITOR

## USER MANUAL

CIRRUS RESEARCH PLC
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Reference Number 10/16/MK247/1.5

# Contents

# Introduction

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Welcome to your **Invictus** Environmental Noise Monitor.

This next-generation instrument from Cirrus Environmental is powerful yet simple to use, and is capable of a wide range of noise measurement functions as well as measuring data from other external sources such as weather sensors.

The Invictus provides the following features:

1. IEC 61672-1:2002 Class 1 performance
2. 120dB dynamic span in a single measurement range
3. Simultaneous recording of all measurements
4. A large, full-colour touch screen display to show live data and review instrument settings
5. Fully weather protected outdoor microphone with dual-layer windscreen and electrostatic actuator to provide single tone self-calibration and wide band white noise testing to test for damaged microphones
6. 32Gb memory as standard
7. Long battery life with internal power and support for external power input
8. Optional support for communications over 3G/GPRS, Wi-Fi, Ethernet, USB and RS232
9. Optional support for external weather sensors

**To prevent damage during shipping, the MK:180 outdoor microphone is delivered with the windshield assembly pulled away from the preamplifier body.**

**Please refer to page 45 for details of connecting the windshield assembly. This must be done before the equipment is used.**

# Components of your Invictus system

## Components of your Invictus system

A standard CR:247 Invictus is supplied with the following components:

- CR:247 Main Unit
- MK:180 Preamp Assembly consisting of MV:180 Pre-amp Housing and UA:180 Windshield
- MM:247/5 GPS Antenna
- MM:247/6 SMA-FME Adaptor for Antenna
- CF:32G 32G Compact Flash Card (preinstalled into unit)
- CU:247/1 Mains DC Power Supply
- SP:200 Cirrus Stylus Pen
- UM:247 User Manual & Certificates of Calibration
- Noise-Hub2 Installation CD

Other items may be included with your equipment if they have been specifically ordered. Please refer to the shipping information supplied with your Invictus unit.

If you find that any components are missing, please contact Cirrus Environmental or your local distributor.

## Warnings

The following symbol is shown where caution or attention is required to the information given.

Please read these sections carefully. If you have any questions, please contact your Cirrus Environmental representative.

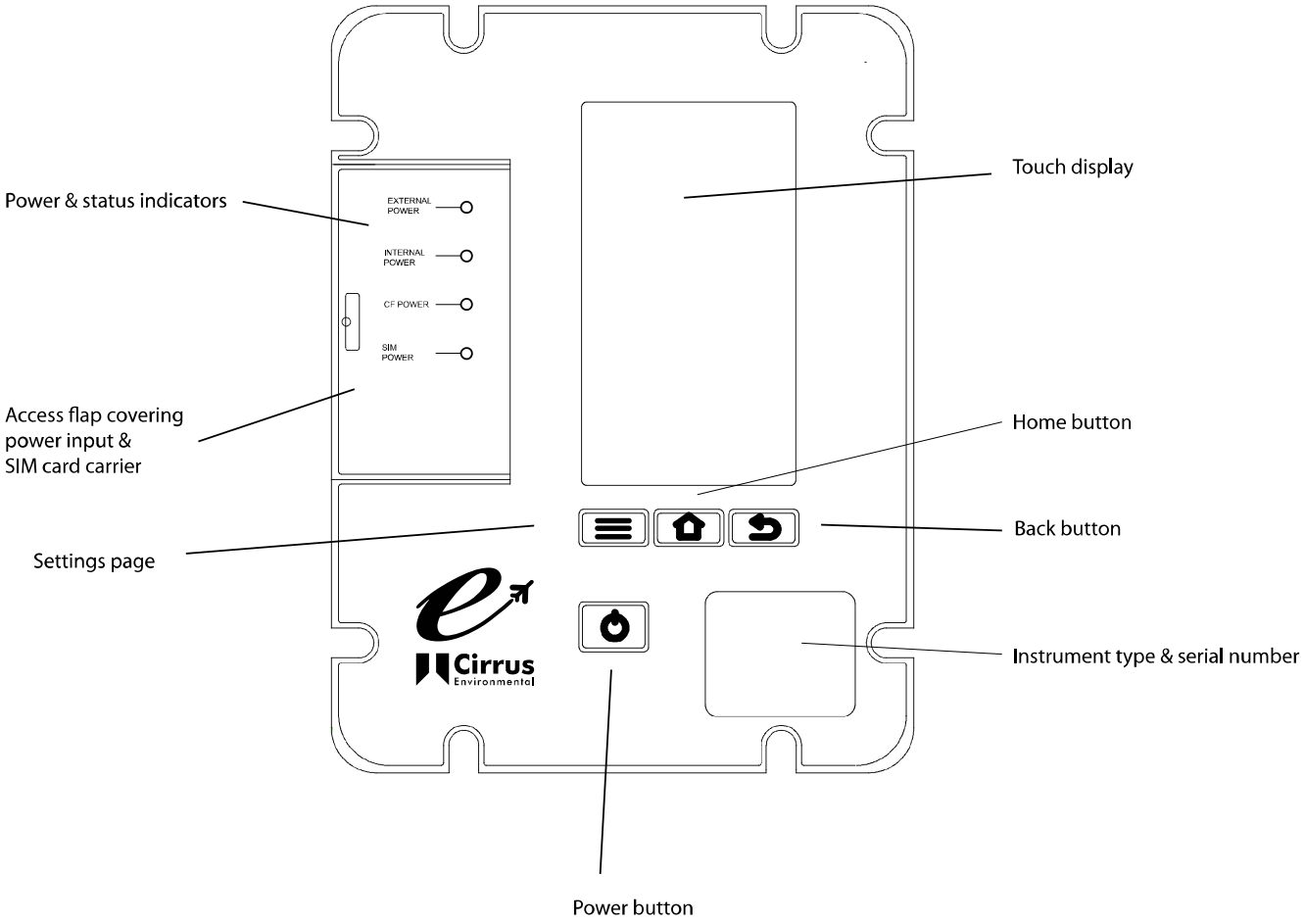
Additional information may be provided with the Invictus User Manual.

Please read any additional information carefully.

# Unit overview

# Unit Overview

## Front panel




### Touch Display

- The touch display will power up after the Invictus has been switched on, when the case is opened or when the power button is pressed after the unit it has gone to sleep.
- The display is powered down when the case is closed to conserve power
    - When the case is opened, the display may be off. Press the power button once and wait for the display to start
- The display powers down after 10 minutes of no user activity.

### Power Button

- If the power switch (under the Access Flap) is set to ON, pressing this button will power up the unit or wake up the display.
- A press of a few seconds will result in a pop up menu option to shut down Invictus.
- An extended >15 second press will result in a forced shutdown of Invictus.
  This is not recommended in normal operation as it will bypass file shutdown, and possibly result in lost measurement results.

### Display navigation buttons

- Menu button selects the settings page.
- Home button selects the home page.
- Back Button selects the last viewed page.

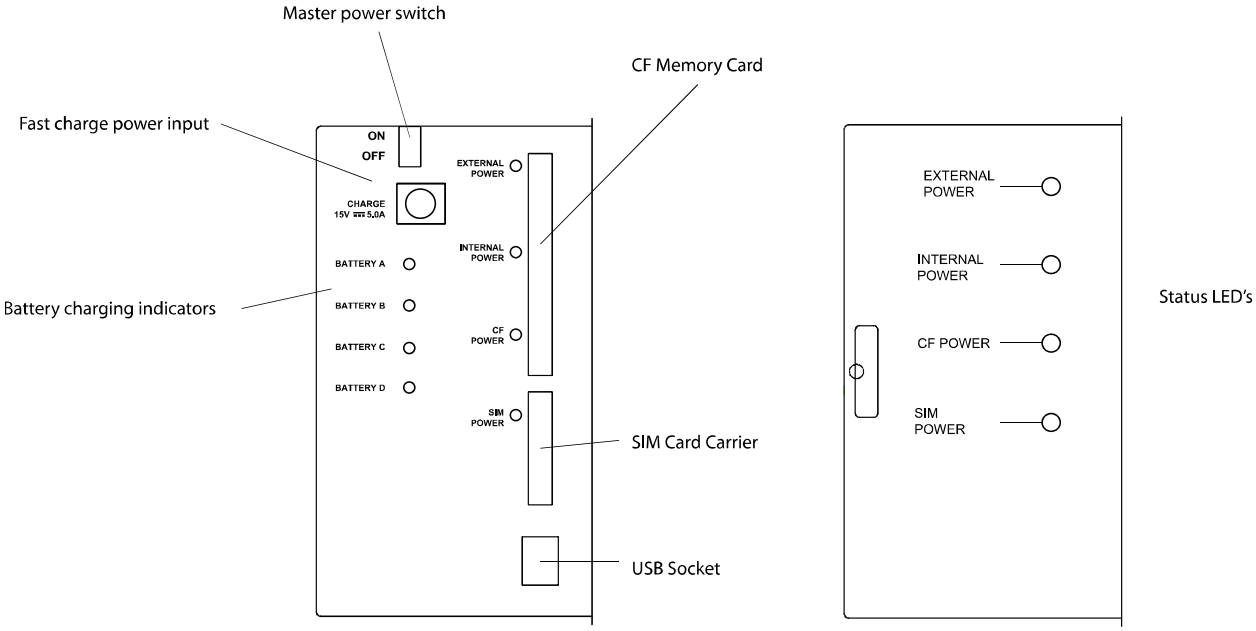
### Access flap

The Access Flap shows the status of the following:

- External Power – The LED shows when external power is connected
- Internal Power – The LED shows when the internal power is active
- CF Power – The LED shows when the Compact Flash card (CF) is powered
- SIM Power - The LED shows when the SIM card is powered

See the following section for details of the functions and connectors under the Access Flap.

## Access flap




The access flap provides environmental protection for the following user functions. Lift the rubber cover to view the connectors and

### Master power switch

- This is a physical switch to minimise power drawn from Invictus and internal power pack when the instrument is not in use for extended periods.
- This switch also removes power from the external 12V supply on Comms B connector.

### Fast charge power input

- Connect the supplied 15V 5A DC power supply to fast charge the internal battery packs.
- See Charging the Invictus on page 34.

### Battery charging indicators

- The LED indicators indicate charging status of the internal battery packs.
- See Charging the Invictus on page 34.

### External Power LED

- This LED indicates that power has been applied to either the external Power/Comms A connector or the fast charge port.

### Internal Power LED

- This LED indicates that the unit is powered.  The LED flashes to indicate that the unit is running correctly.
  - Slow flashing once every 3 seconds indicates the internal battery power is good
  - Fast flashing twice per second indicates that internal battery power is low.

**WARNING - Connect External Power before trying to power up the Display if the Internal Power LED is indicating battery low.**

### Compact Flash LED

- This LED indicates that power is applied to the Compact Flash

### SIM Power LED

- This LED indicates that power is applied to the communications module and it is enabled.

### Compact Flash

- Slot for Compact Flash Memory Card. The maximum support size is 32GB.

**WARNING - take care when removing and inserting the card to ensure it is located correctly into the guide rails.**

**WARNING - only remove or insert a Compact Flash card when the unit is powered down.**

### SIM card carrier for Modem option

- Slot with card holder for Modem SIM card.

**WARNING - take care when removing and inserting the card to ensure it is located correctly into the guide rails.**

**WARNING - only remove or insert a SIM Card when the unit is powered down.**

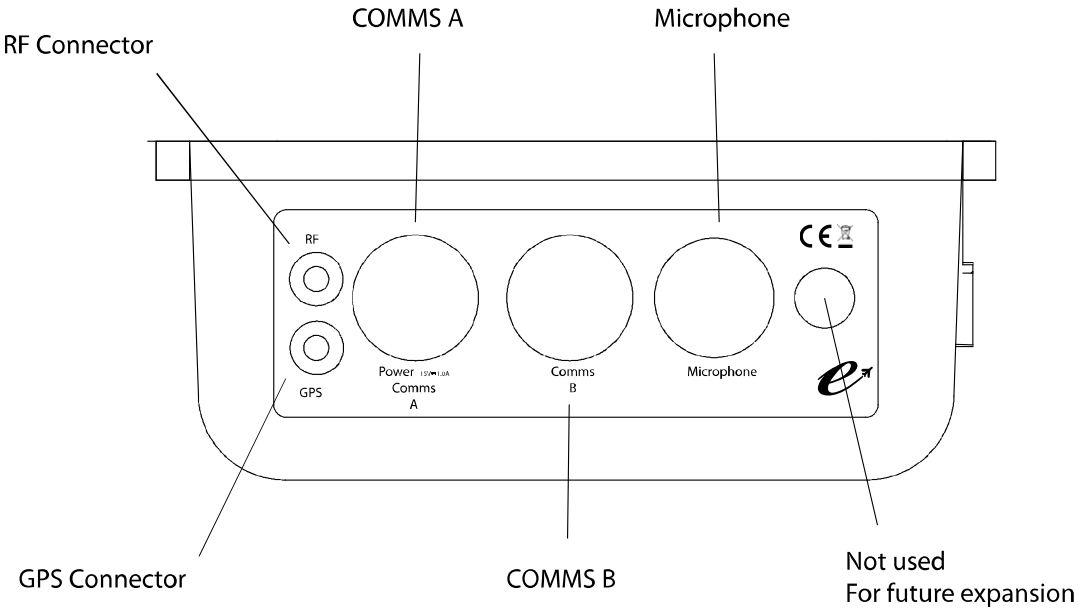
**Note: The SIM Carrier may be different depending upon the specification of the Invictus unit. Please see page 42 for details of the SIM card requirements and fitting of the SIM card to the Invictus.**

### USB socket

- This Mini USB socket can be to connector the Invictus directly to a PC.

**WARNING - avoid using USB at the same time as having a peripheral attached to Comms A. These both share some of the same resources so may result in lost connections or data loss.**

## External Connectors




The connector panel on the side of the Invictus provides access to the following functions:

### RF Connector

- RF connector for Modem or Wi-Fi antenna depending on options fitted to the Invictus.
- The connector is an FME style RF connector. Use the supplied FME to SMA adaptor as required.

### GPS Connector

- GPS connector for the GPS sensor supplied with the Invictus.
- The connector is an FME style RF connector. Use the supplied FME to SMA adaptor as required.

### COMMS A

- Trickle charge power and COMMS A Connector (see Appendix B – Invictus External Connectors for more information)
- 7 pin connector for external power to trickle charge the batteries and power the unit for extended periods.  Only use Cirrus provided power supplies.
- Serial data interface for Cirrus peripherals (COM 0).

### COMMS B

- COMMS B Connector (see Appendix B – Invictus External Connectors for more information)
- 19 way socket
- Provides a regulated 12V DC supply out for use with other external peripherals
- Serial data interface for Cirrus Peripherals (COM 4)

### Microphone

- Connection for the outdoor microphone

### Gland for custom options

- As standard, this connection is not used and is reserved for future use

# Getting started

# Getting started

When you receive your Invictus unit, please follow the steps 1 to 11 below before installing or deploying the unit.

| | |
|---|---|
| 1. Assemble the instrument | Connect the Microphone to the Invictus through the Microphone connector<br><br>Ensure that the windshield assembly is fully fitted. See page 45.<br><br>Connect the GPS Antenna (where provided)<br><br>Connect any communications antenna provided with the system (where provided) |
| 2. Charge the internal battery | See 'Charging the Invictus battery' on page 34 |
| 3. Switch on the Invictus | Slide the main power switch under the flap to the ON position.<br><br>The Invictus should power up if external power is applied.<br><br>If the unit is running on the internal batteries, press the power button.<br><br>The Internal Power LED should light up immediately followed by the display |
| 4. Enter a PIN | The display will initially show the Invictus logo followed by a page to set the PIN.<br><br>If a PIN is required enter it twice and select **<Confirm>**<br><br>If a PIN is not required, do not enter a PIN and select **<Confirm>** |
| 5. Select the operating language | Choose the required language for the instrument<br><br>The display will default to the **Home** page (See page 18). |
| 6. Check the instrument status | Select the instrument **Status** (See page 21 and check the time and date is set correctly (See page 24). |

| | |
|---|---|
| | If the time and date are not correct, adjust the settings through the **Settings** page (See page 24) or through the Noise-Hub2 software (See page 48). |
| 7. Connect the Invictus to the Noise-Hub2 software over a USB connection | Using the USB connection under the Access Flap, connect to the Noise-Hub2 software.<br><br>Connect the Invictus to a PC running the Noise-Hub2 software via a **USB connection** and confirm that the measurement setup is as required.<br><br>Check the duration of the measurements<br><br>The instrument will be configured with 1 hour measurements as default. To change the duration of measurement, configure the settings from the Noise-Hub2 software.<br><br>The calendar based measurements are also configured from within Noise-Hub2.<br><br>Check that any required triggers are active and are programmed into the instrument.<br><br>Check that any communications options are configured correctly. |
| 8. Calibrate the Invictus | From the Noise-Hub2 software or from the **Settings** screen carryout a calibration of the Invictus system. |
| 9. Disconnect from the Noise-Hub2 software | If the configuration is correct, disconnect the Invictus from the Noise-Hub2 software. |
| 10. Check remote communications between the Invictus and the Noise-Hub2 software. | Before deploying the Invictus, it is recommended to check that any remote communications are operating correctly and that the Noise-Hub2 software can connect to and download from the instrument |
| 11. | If the instrument is ready to start making measurements, go to the **Home** screen and press **Start Measuring** (See page 18).<br><br>If repeat or calendar based timers are enabled, the instrument will start measuring data according to the settings. |

# The Invictus display

## The Invictus display

The Invictus display contains 4 main pages:

- Home
- Live Data
- Status
- Settings

Navigation between each page is via the tabs at the top of the page or the three navigation buttons.

### Home Page

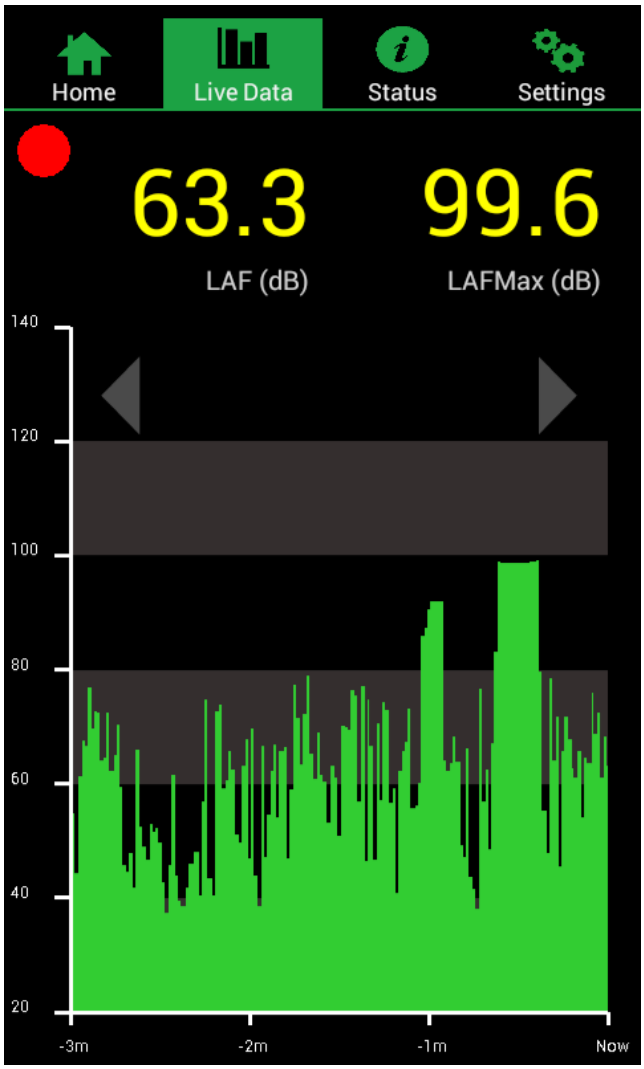

The following functions are available on the HOME page:

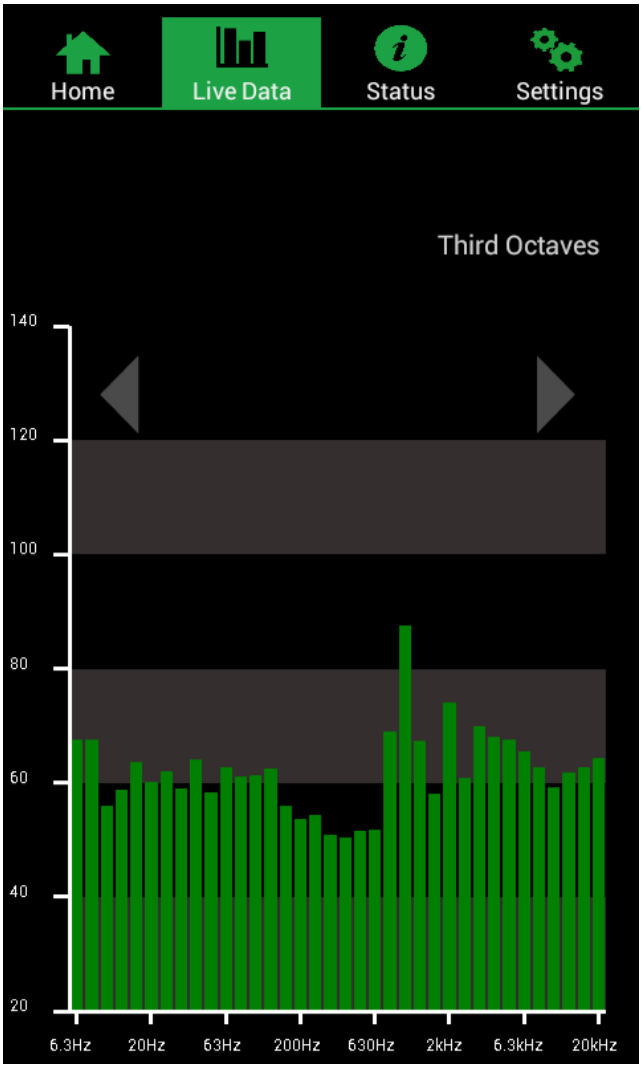
- Manual start/stop measuring
  The button will also be available when the unit is measuring due to timers or calendars.
  Pressing this button will stop or start current measurement, but will be overridden by any preset timers or calendars on the next schedule stop or start.

- Time history graph and number view of LAeq,1s in dB.

    a. The colour of the live view graph shows the following
        i. Dark green – not measuring
        ii. Light green – measuring
        iii. Blue – recording audio
        iv. Red – overload condition
- During an audio overload condition an ‘Overload’ message will be displayed for 5 mins
- Indication of whether the Instrument is ready and capable of measurements, for example a Pre-Amp not fitted or a non-formatted compact flash card will prevent a measurement.
- Indication of whether timers have been set
- Indication of which communication module has been fitted and whether it is ready to communicate
- Indication of the power source, whether running on internal batteries or external power
- Indication of last factory calibration date.

## Live View




The following functions are available on the LIVE DATA page:

- Indication of whether Invictus is measuring – shown by a large flashing red circle
- Time history graph and number for the following measurements:
    - When measuring
        - LAF/LAF Max
          LAS/LAS Max
          LAeq,1s/LAeq,t
          LZeq,1s/LZeq,t
        - Real-time 1:3 Octaves, Real-time 1:3 Octaves A-weighted
        - Real-time 1:3 Octaves Leq, Real-time 1:3 Octaves LAeq.
    - When not measuring
        - LAF, LAS, LAeq,1s, LZeq,1s,
        - Real time 1:3 Octaves, Real time 1:3 A-Weighted Octaves
- To scroll through the various measurement views, press the left or right arrows on the edge of the graph.
- The colours of the time history graph are the same as the home page.

- Dark green – not measuring
- Light green – measuring
- Blue – recording audio
- Red – overload condition

## Status Page


The status page can be used to view the status of the instrument.

The following functions are available on the STATUS page.

Scroll up and down the page by sweeping up and down on the display.

- **General** - shows general information about the Invictus unit:
  - Serial number of the main unit
  - Model number
  - Current date stored within the instrument
  - Current time stored within the instrument
  - Firmware version

- **Calibration** – shows calibration info:
  - Time & date of last factory calibration
  - Time & date of last user calibration

- Calibration offset
- Indicates whether instrument is set for regular scheduled auto calibration

- **Battery**
  - Indicates the estimated battery life remaining until the next charge.
    Note that external power must not be connected to view remaining battery life. If external power is applied, this will show '**External**'.
  - When running from batteries pressing the 'Advanced' button, will display the current voltage and current drawn from each of the four internal battery packs.
    The voltage should be similar for each battery pack, in the event that one of more battery packs various significantly from the others Invictus will display an **Error** message instead of a battery percentage, indicating that a battery pack may be faulty.

- **Communication module** – The Invictus can be fitted with one of the following communication modules:
  - **Wi-Fi**
    - Status - Ready, not connected, receiving and sending
    - Signal Strength - Shows the Wi-Fi signal strength, move unit to achieve best possible signal strength.
    - SSID - Shows the Wi-Fi SSID (Service Set Identifier) that Invictus is connecting to or searching for.
    - IP Address - Shows the static IP Invictus Wi-Fi is set to when a connection has been made.
  - **Modem** – See page **Error! Bookmark not defined.** for more information
    - **Status** -Ready, not connected, receiving and sending, hardware failure, GSM failure.
    - **Signal Strength** - Indicates the mobile signal strength.
      Move unit to achieve best possible signal strength.
    - **Network** - Indicates the network provider the Invictus modem is connected to.
    - **Connection type** - Indicates the data connection type
      - GPRS or 3G.
  - **Ethernet**
    - Ethernet is not displayed on the status page.
      The Home page identifies that the unit has been configured for Ethernet.

- **GPS** – Indicates the following
  - **Signal Strength**
    - A weak GPS signal may result in providing an accurate UTC clock signal, but not a location.
      Move the GPS Antenna to provide best signal strength. Avoid locating under cover or close to tall obstructions.
  - **Longitude**
    - Indicates the measured longitude location

- Latitude
  - Indicates the measured latitude location.

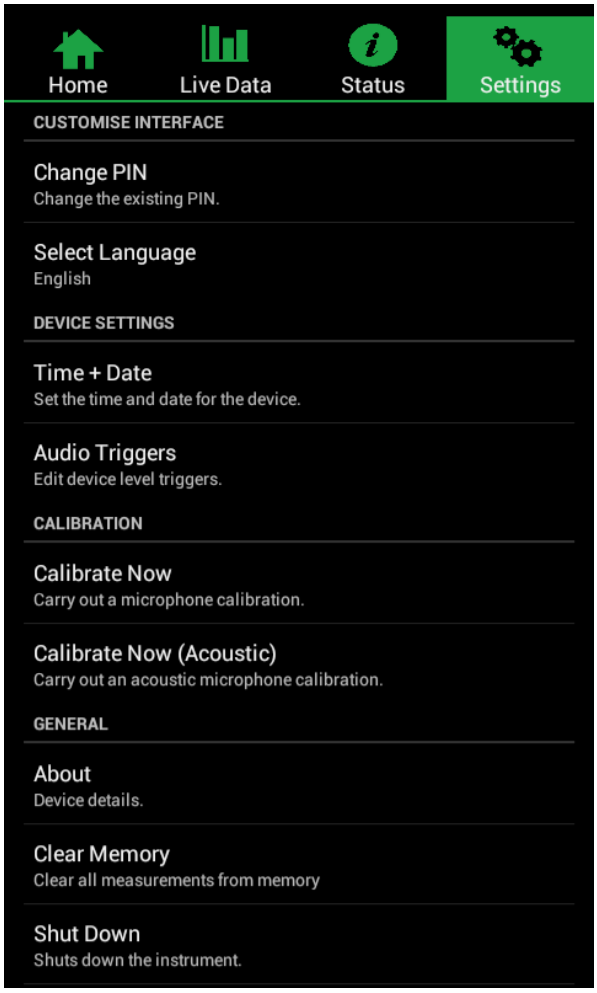
- **Modules Connected**
  - Indicates which modules Invictus has been configured for.
    - Port A – serial port available on the Comms A external connector (COM 0).
    - Port B – indicates which main communication module has been fitted internal to Invictus (COM 1)

- **Microphone/Pre-Amplifier**
  - Indicates the following
    - The outdoor microphone is attached
    - The Windshield is attached
    - Microphone serial number
    - Pre-Amp serial number

- **Timers/Audio**
  - Indicates the following
    - Time history sample rate – 2s, 1s (default), 1/2sec. 1/4sec, 1/8sec, 1/16sec, 1/100sec.
      1:3 Octaves Bands are limited to 1/16sec
    - Audio quality – adjust in Noisehub2
    - Whether timers are set – enable in Noise-Hub2

- **Memory Card** –
  - Indicates the following
    - Formatted – whether the card has been formatted suitable for Invictus – if not see 'Formatting the Memory Card' on page 30.
    - Memory free on the memory card indicates how much free space there is on the memory.
      The memory is a cyclic memory, so when this indicates gets to 0% the Invictus will continue to measure by over writing old measurements.
      It is not necessary to clear the memory for correct operation.
      See 'Formatting the Memory Card' on page 30 for storage capability of the factory fitted 32GB memory card.

## Settings Page




The settings page provides limited control over Invictus.

- **Change PIN**
  - Press to enter current PIN and new PIN to change.
- **Select Language**
  - Press to select between English, French, German, Spanish and Chinese.
- **Time + Date**
  - Select to change time and date – PIN protected.
- **Audio Triggers**
  - Enables any of the loaded triggers to be enabled or switched off. These settings are overwritten if triggers are enabled or disabled in Calendars during the next measurement.
- **Calibrate Now**
  - Enables an automatic calibration of the outdoor microphone. The progress of the calibration will be shown during the calibration and the resulting offset will be displayed at the end if successful.
- **Calibrate Now (Acoustic)**
  - This allows a manual calibration of the system using an Acoustic Calibration.
  - See page 27 for details of carrying out a manual calibration.

- **About**
    - Shows the various firmware versions and the model number of the unit.
- **Clear Memory**
    - The memory of the Invictus can be cleared.
    - CAUTION. This will delete all measurements from the unit and they cannot be retrieved after the memory has been cleared.
- **Shutdown**
    - This provides a pop-up to enable Invictus to be shutdown.
      To shut down Invictus for long periods of time power the unit off with the slide switch under the protective flap after the unit has been shut down.
- **Factory Reset**
    - This will reset the user interface settings for the display, including the PIN and language.  PIN protected.

# Calibrating the Invictus

# Calibration of the Invictus

The Invictus and associated outdoor microphone will have been factory calibrated before shipping. The outdoor microphone unit should not be swapped without returning to Cirrus for a factory calibration

## Auto Calibration

The Invictus can be set to schedule an automatic calibration at set times per the day using the in-built electrostatic actuator system.

These scheduled times can be viewed and adjusted within the Noise-Hub2 software.

During an automatic calibration, the Invictus will initially check that the windshield is fitted and the background noise is low enough to allow for calibration to proceed.

The unit will then apply a multi-frequency white noise signal to the microphone and check the measured signal to determine whether the microphone or pre-amp has been damaged.

Finally, a single tone 1kHz signal is applied for a fixed period of time to allow for the signal to settle and determine whether an offset is required. This offset is automatically applied and the calibration process is complete.

The calibration process can be triggered manually from the Invictus display or through the Noise-Hub2 software.

WARNING: During an automatic or self-calibration, the Invictus generates high voltages in the microphone preamplifier. These voltages are not exposed to the user, but it is recommended that the outdoor microphone or preamplifier is not handled during a calibration.

Do not use the system if the outdoor microphone unit or pre-amplifier are damaged in any way.

## Acoustic Calibration

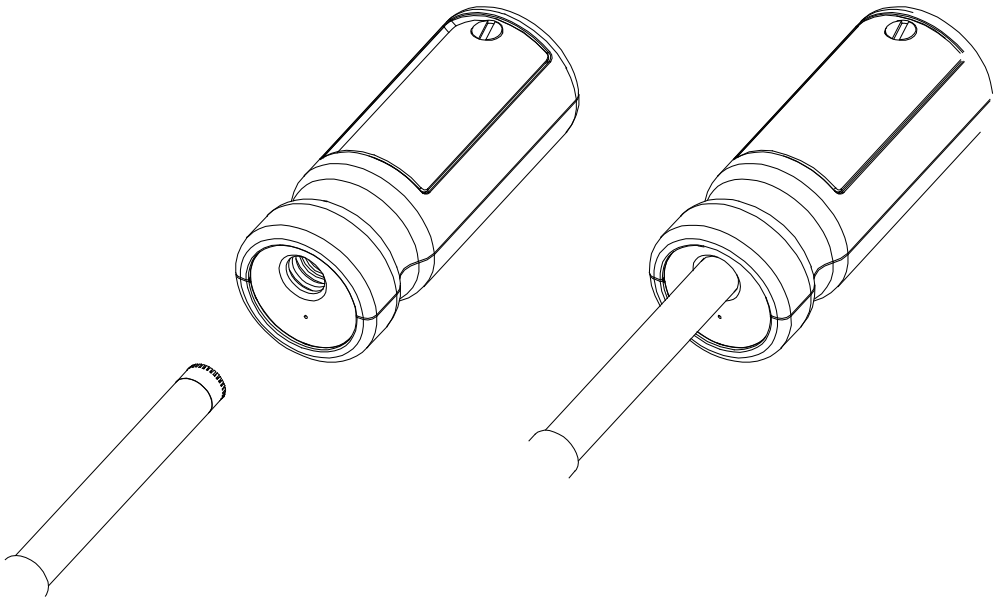
An acoustic calibration can be triggered from the Settings page on the instrument display (see page 24) or from within the Noise-Hub2 software.

The acoustic calibration can be performed by carefully removing the windshield from the outdoor microphone and connecting an acoustic calibrator.

To remove the windshield assembly, pull the windshield away from the body of the outdoor microphone.

The recommended acoustic calibrator for use with the Invictus is a Cirrus Research CR:515 Class 1 unit.

Carefully push the microphone into the cavity at the end of the calibrator. Ensure the microphone is fully inserted into the cavity and is past the ‘O’ ring seals.



Ensure that the small bleed hole next to the microphone cavity on the calibrator is not blocked, as this could cause damage to the microphone.

Press the ‘on’ button on the end of the calibrator, and select **Calibrate Now (Acoustic)** on the Settings page of the instrument or from within the Noise-Hub2 software.

The instrument will measure the sound level from the acoustic calibrator to determine if it is within the required tolerance and levels.

The calibration level must be stable to within ±0.075dB for 5 consecutive seconds for the calibration to be successful.

Invictus is preset with the correction values needed for Cirrus Research microphone capsules, so no manual adjustment is required. The calibration level you should expect is 93.7dB.

# Operating the Invictus

# Operating the Invictus

## Starting & Stopping measurements

The Invictus is delivered with a default configuration of repeating 1 hour measurements.

When the Invictus is switched on and either a calendar or repeat timer is programmed, the instrument will automatically start and begin recording noise measurement data.

The measurements will automatically start at the next measurement period boundary. For example, 12:00, 1:00, 2:00 and so on.

The instrument can be started manually when it is deployed by pressing the **Start Measuring** button on the **Home** screen.

## Repeat Timers & Calendar based measurements

A default configuration of 1 hour repeating measurements is programmed into the Invictus when it is delivered.

Measurements can be either configured to repeat or can be controlled by the calendar system.

### Repeat timers

Repeat timers can be set to 1min, 2min, 5min, 15min, 30min and 1 hour.

The repeat timer is synchronised to the real time clock, so if you choose a 30 minute repeat, it will start on the hour and 30mins after, each for 30 minute duration.

### Calendar Timers

Calendar timers are similar to repeat timers except they allow for the repeat time to be adjusted for various parts of the day and various days over the week.

For example a calendar could be set up to perform 15 minute repeat measurements during the working day with 1 hour measurements during the evening and night and weekends.

Calendars can also be used to enable or disable triggers for various times and days.

The current timer can be stopped by manually selecting ‘Stop Measuring’ on the Invictus home page.  Measurements will start with the next calendar or repeat timer.

## Noise Event Triggers

Noise event triggers are created and loaded into the Invictus through the Noise-Hub2 software.

Triggers can be set based on noise level, noise tone and noise duration to create a trigger event during a measurement.

A trigger can be set to perform any of the following, depending on the communication option selected:

- Create Marker (always selected)
- Record audio

- Send an SMS
- Send an Email
- Tweet on Twitter

Triggers are only applicable during a measurement and can be used with repeat timers or individually set for each time period within the calendar.

Triggers can be enabled or disabled within the Invictus by selecting **Setting>Audio Triggers**.

Calendar settings for triggers take priority over other settings and are set at the start of each measurement.

See 'Notifications' for limitations of notifications with various communications options.

## System alarms

Alarms are Instrument based events that can be configured within NoiseHub2 to alert the user to events that may affect Instrument performance.

Alarms available include:

- Outdoor microphone unit disconnected
- Outdoor microphone tilted (possibly blown over)
- Windshield removed
- Batteries running low
- External power disconnected
- Case opened
- CF Memory Card Failure
- Calibration Failed
- Bad Microphone

The following Notifications can be set:

- SMS
- Email
- Twitter

See 'Notifications' for limitations of notifications with various communications options.

## Notifications

There are two forms of notifications available, instrument and software:

### Instrument Based Notifications

Notification options for noise trigger events and alarms, include SMS, Email or Twitter, but depend on the communication option selected:

| | MODEM | MODEM | MODEM | Wi-Fi | Ethernet |
|---|---|---|---|---|---|
| | Public IP SIM | VPN SIM (non Internet) | VPN SIM (internet enabled) | | |

| OPTION | MM:247/1 | MM:247/1 | MM:247/1 | MM:247/2 | MM:247/3 |
|---|---|---|---|---|---|
| SMS | Y | Y | Y | N | N |
| Emails | Y | N | Y | N | N |
| Twitter | Y | N | Y | N | N |

### Software Based Notifications

When the instrument is connected to a PC running Noise-Hub2 with access to the internet, the software is able to connect to the 'optimus cloud'.

This configuration enables noise threshold based notifications to be sent via SMS or Email.

## Live Audio Playback

The user can listen to live audio through Noisehub2 to identify potential noise sources.

Live audio listening is only available with compressed audio. The type of audio recording is configured in the Noise-Hub2 software.

## Downloading measurements

Measurements are downloaded from the Invictus to the Noise-Hub2 software using one of the support communications methods.

Refer to Noise-Hub2 software package on page 48 for details of downloading measurements.

# Charging the Invictus battery

# Charging the Invictus battery

The internal Invictus batteries should be fully charged before any long term measurement is performed.

Invictus contains 4 high power capacity Nickel Metal Hydride battery packs.

Please note that the Invictus should be returned to Cirrus Research to replace any faulty battery packs.

## Checking the battery power

The remaining battery level can only be checked when external power is not connected.

A low battery level warning is provided by the Internal Power LED flashing quickly, approx. at 2Hz.

If this LED is flashing quickly external power should be applied to the unit before trying to power up the main Invictus display.

An approximate battery remaining percentage is available via the Invictus display.

Select **Status>Battery**.

Selecting 'Advanced' displays the current voltage and current drawn from each battery pack.

The voltage should be similar for each battery pack. In the event that one of more battery packs various significantly from the others, the Invictus will display an **Error** instead of a battery percentage, indicating that it thinks a battery pack may be faulty.

Providing no fault is detected, you can now start charging the unit.

## Charging the internal battery packs

### Fast Charge

**Warning - only use the power supply supplied by Cirrus to charge the unit.**
**Warning - only perform charging at room temperature (less than 30 Deg C) and in a well-ventilated area.**

**The unit will become hot whilst charging. Charging in hot conditions could result in unit damage or fail to fully charge the batteries.**

**Warning - only connect the power supply to the fast charge port when the unit is indoors. The power supply and unit are not weatherproof with the lid open.**

Open the unit, lift the access flap and plug in the power supply into the charge socket (see page 10 for details of the location of these connectors).

Each of the four battery pack LED's will start flashing slowly at 1Hz to show they are charging. If a fault occurs, this LED will flash quickly at 4Hz.

From a fully discharged state, the battery pack will take approximately 8 hours to charge.

When charging is complete, the charge indicators will stop flashing and will remain lit. Check the battery status on the display to confirm batteries are fully charged.

### Trickle Charge

Batteries packs are 'trickle charged' when external power is applied to the Power/Comms A connector.

This is a very low current charge mainly aimed at keeping the batteries 'topped-up' rather than charging.

# Data storage

# Data storage on the memory card

## Formatting the memory card

**WARNING – Only use compact flash cards provided by Cirrus for use in Invictus. Other cards may result in loss of data.**

**WARNING – Only insert or remove a compact flash card after the unit has been switched off.**

The Compact Flash card should be installed and formatted when you receive your unit from Cirrus Research.

If the card is not formatted, or a new card is placed in Invictus and the unit switched on, the Invictus will report on the display that 'The memory card is not formatted. Would you like to format it now?'.

Select OK. Formatting will start which will take a few minutes.

After formatting, the '**Formatting Memory Card. This may take several minutes**' message will disappear. The card can also be formatted through the Noise-Hub2 software.

To check if the Memory Card has been formatted select **Status** and scroll down to Memory Card.

## Memory storage size

The 32GB Compact Flash card supplied with the Invictus is partitioned to provide separate areas for measurements and audio.

The maximum length that the card is able to store will depend on the time history rate and audio quality selected in the Noise-Hub2 software.

The table below shows typical data storage times:

| Time History Rate | Storage Up to |
|---|---|
| 1/16s | 20 days |
| 1s | 320 days |

| Audio Quality | Storage Up to |
|---|---|
| Standard | 7 days |
| Compressed | 28 days |

The memory storage in the Invictus is cyclic and when the memory is full, the instrument will start to overwrite existing data.

Always ensure that you have downloaded your measurements on a regular basis.

It is not necessary to clear the memory contents in normal operation.

# Peripherals

# Peripherals

The Invictus provides the option for a number of peripherals, including communications, weather, power and video overlay.

Peripherals can be configured at the factory or by a Cirrus Service Engineer.

## Communications ports

| Internal Unit Ref | External Unit Ref | Options | |
|---|---|---|---|
| COM0 | Comms A | USB, Weather, Terminal or Wi-Fi dongle | Note A |
| COM1 | | Modem, Ethernet or Wi-Fi Modules | Note B |
| COM2 | | Pre-Amp | Fixed |
| COM3 | | GPS | Fixed |
| COM4 | Comms B | Weather, Video or Terminal | Note C |

**Note A:** COM0 A is used for USB when connected, but can also be used for the following options

- External RS232 serial terminal port. Default serial settings when set as terminal are 115200, N, 1, N. Maximum cable length 10m.
- Weather station input for use as Option VC:247/2 (with video as well). Maximum cable length 10m.
- Wi-Fi Dongle internally mounted within unit – option MM:247/4. The Wi-Fi dongle needs to be configured at the factory and uses an internal antenna only. This option is only suitable if COM1 is not available for Wi-Fi.

**Note B:** COM1 is only available internally to the unit and is used for the following options:

- Modem (3G/GPRS) – Option MM:247/1 (3G/GPRS Modem for Invictus) or MM:247/10 (3G/GPRS Modem for Invictus for US/Canada)
- Wi-Fi Module – Option MM:247/2 – this can be configured at the factory or by a Cirrus Service Engineer on site.
- Ethernet Module – Option MM:247/3 - this can be configured at the factory or by a Cirrus Service Engineer on site.

**Note C:** COM4 is a general purpose serial port available at the external Comms B connector. Maximum cable length 10m. Can be used for the following options:

- External RS232 serial terminal port. Default serial settings when set as terminal are 115200, N, 1, N.
- Weather Station – Option MT:247/1
- Video OSD text stamping – Option VC:247/2

## Ethernet

Ethernet is provided as a factory fitted option and suitable for semi fixed locations. Invictus is supplied with an Ethernet cable routed through the M12 gland and terminated with a standard RJ45 plug.  Specify the desired length when ordering, default length is 10m.

Ethernet configuration should be set up at Cirrus, with a static IP.

# Invictus Modem, SIM Card Requirements & Installation

# Invictus Modem, SIM Card Requirements & Installation

The Invictus Noise Monitor can be fitted with a cellular data packet modem that allows the instrument to communicate with the Noise-Hub$^2$ software remotely over a 3G/GPRS protocol and for the measurement data to be downloaded.

The instrument must be fitted with a suitable SIM Card to allow for the connection to be made.

The Technical Note **INVICTUS 3G/GPRS MODEM TECHNICAL INFORMATION** details the following information:

- Versions of the Modem installed in the Invictus
- SIM Card Requirements
- Installation of the SIM Card
- FCC Regulatory information

Please refer to this Technical Note for details of the type of SIM Card and connection required for the Invictus Noise Monitor.

# MK:180 Outdoor Microphone

## MK:180 Outdoor Microphone

The Invictus outdoor microphone provides the following features:

- Single tone electrostatic actuator self-calibration.
- Multi frequency white noise electrostatic actuator for detecting faulty microphone.
- Dual-layer 200mm windshield with hydro-phobic coating
- Automatic built in heater which switches on at approx. 0ºC
    - This is disabled when the battery volts drop to preserve battery voltage.
- Tilt sensor which can be used to send Alarm to user to indicate that Pre-Amp may have been tampered with or fallen over.
- Windshield fitted detection
    - Provides automatic acoustic correction for when the windshield is fitted and preventing calibration when not fitted.

The height from the tripod mount at the base of the preamplifier and the microphone is 29.5cm.

See page 27 for details on how to calibrate the system.

Each MK:180 unit is paired with its associated Invictus main unit and should not be swapped without a full factory calibration from being carried out.

The diagrams below show the two components of the MK:180.

## Connecting the windshield assembly

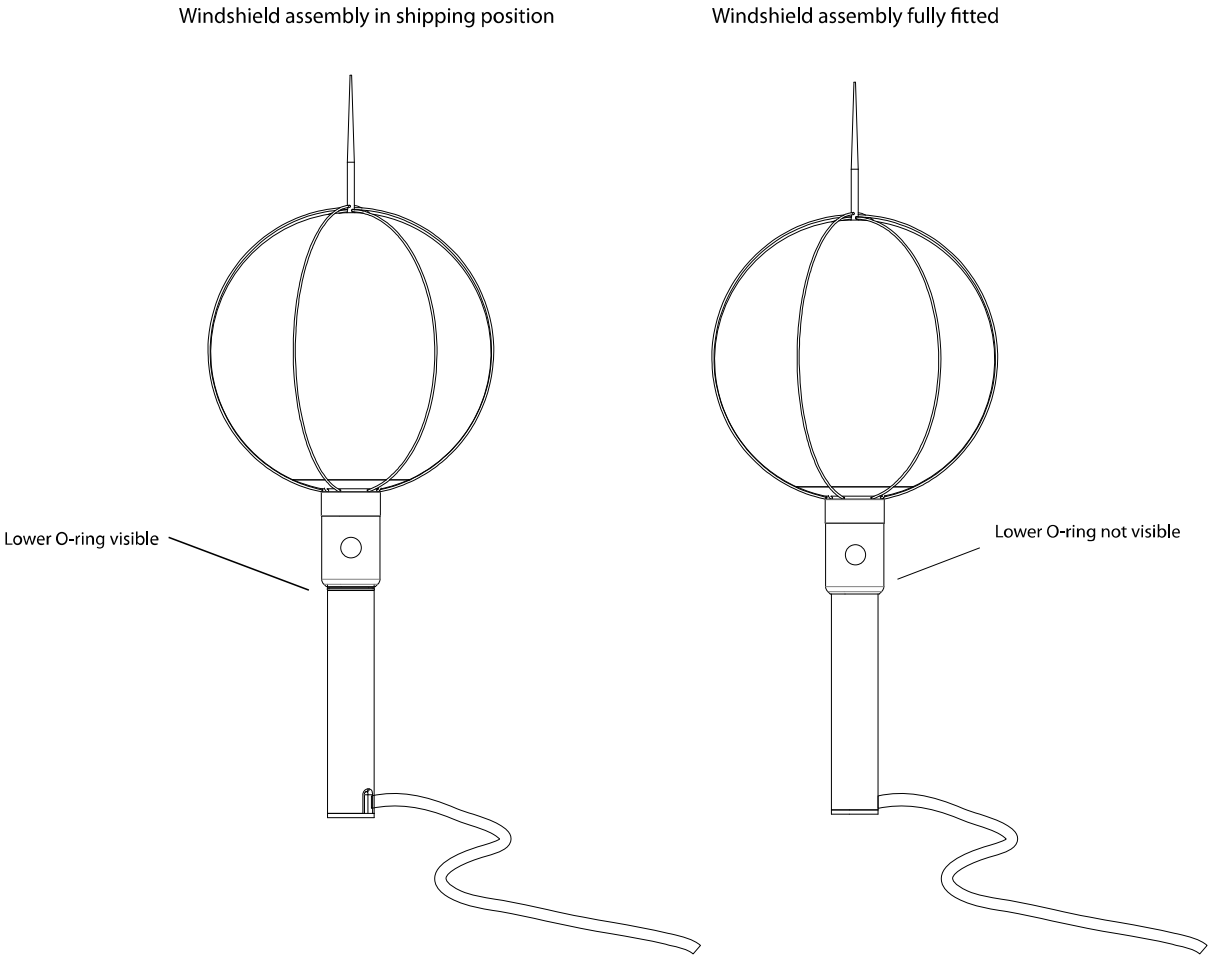
**WARNING – To prevent damage to during shipping, the MK:180 outdoor microphone is shipped with the windshield assembly pulled away from the preamplifier body.**

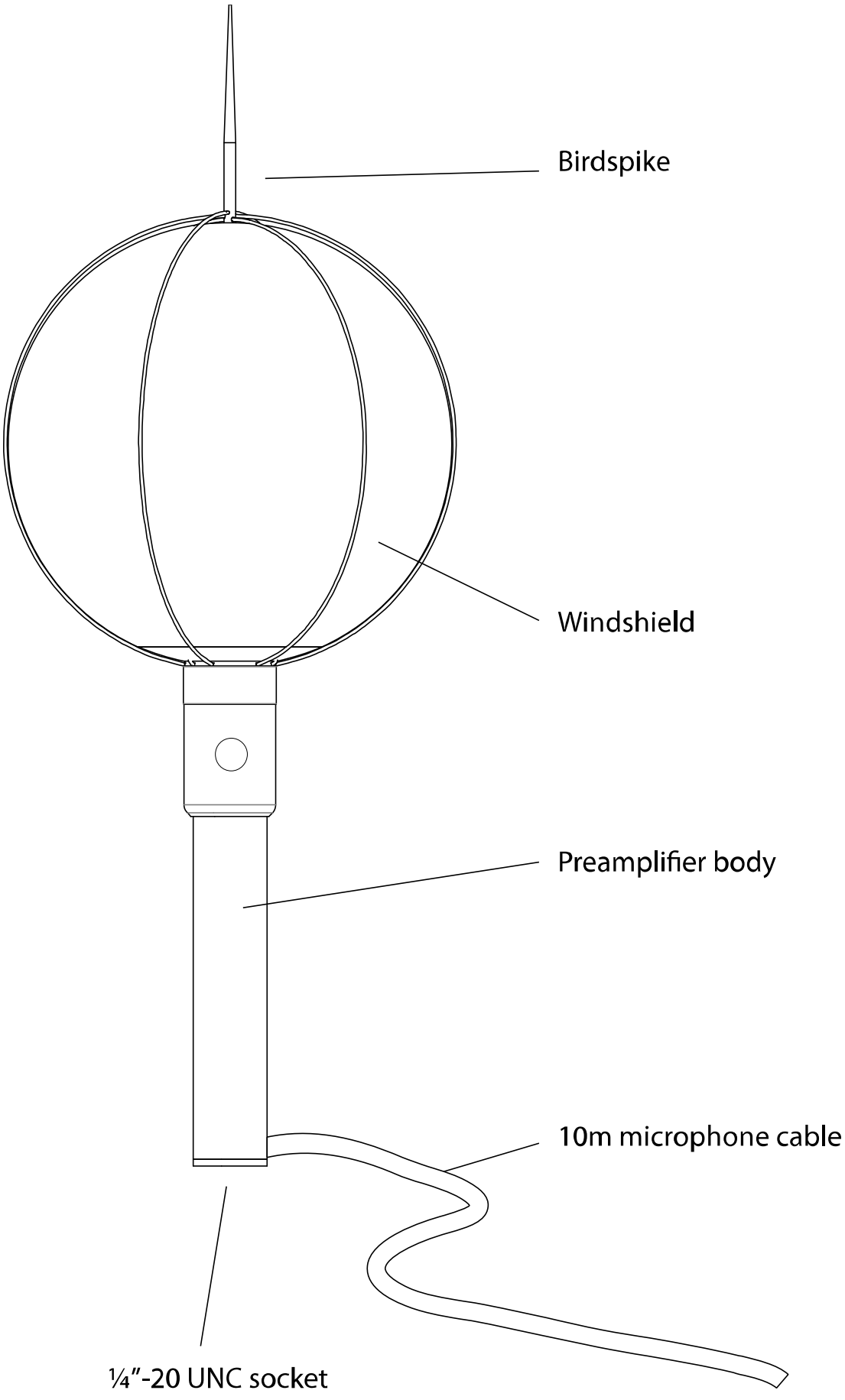
**This will allow the lower rubber O-ring on the preamplifier to be visible.**

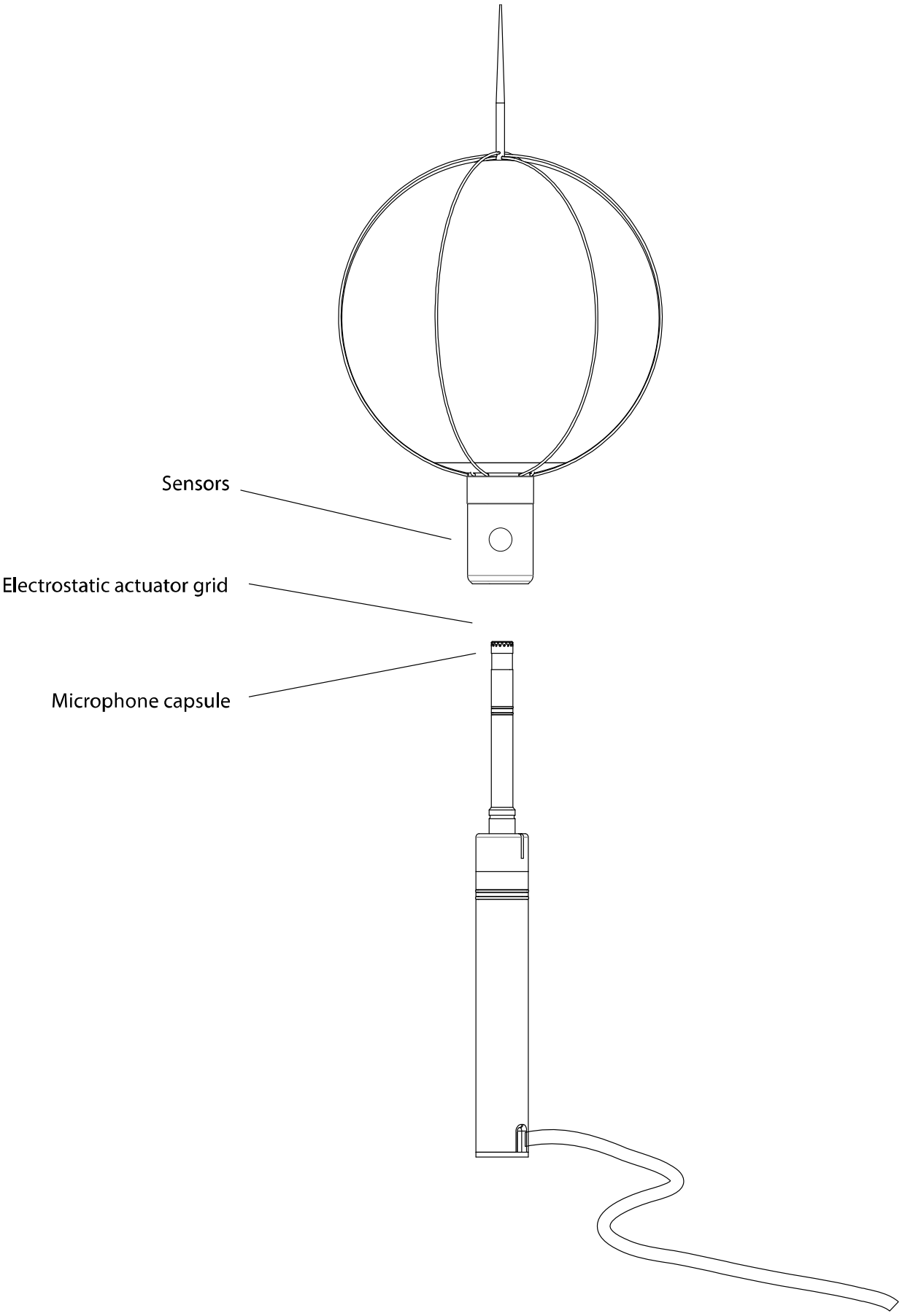
**If the Windshield assembly is not fitted correctly, a "Windshield Not Fitted" message will be displayed and the automatic calibration system will not function.**

**Ensure that the windshield assembly is correctly seated before using the system. Ensure that the windshield assembly is fully located onto the preamplifier as shown in the following diagrams.**

**It is also recommended that the windshield assembly is set to the shipping position before shipping in the provided tube.**




Birdspike
Windshield
Preamplifier body
10m microphone cable
¼"-20 UNC socket


Sensors
Electrostatic actuator grid
Microphone capsule

## Noise-Hub2 software package

Most user settings and configuration for the Invictus is done through Noise-Hub2.

Noise-Hub2 allows the user to perform the following:

- Connect to one or more units through Modem, Ethernet or Wi-Fi (depending on unit configuration ordered).
- View live data
- Change unit information, including description.
- Change measurement settings, including time history rate, timers and calendars.
- Set audio record quality and max duration.
- Configure and set audio triggers.
- Set custom Ln's (noise level exceeded percentage)
- Set noise Alert levels
- Set Alarms
- Configure user notification and alarm settings via SMS, Email & Twitter.
- Download measurements
- Create reports
- View and post process downloaded measurements

Please refer to the Noise-Hub2 documentation for further information.

# Appendix A - Specifications

This appendix contains the overall specifications of a standard CR:247 Invictus Noise Monitor.

For further technical specifications or details, please contact Cirrus Environmental. See page 56 for contact details.

## Standards, Frequency & Time Weightings

| | |
|---|---|
| Applicable standards | Designed in accordance with IEC 61672-1:2002 Class 1<br>1:3 Octave Band Filters designed in accordance with IEC 61260 and ANSI S1.11-2004 |
| Total Measurement Range: | 20dB to 140dB RMS Single Range |
| Noise Floor | < 18dB(A) |
| Frequency Weightings | RMS: A, C, & Z Measured Simultaneously<br>Peak: A, C, & Z Measured Simultaneously |
| Time Weightings | Fast, Slow & Impulse Measured Simultaneously |
| Frequency Filters | 6.3Hz to 20kHz for 1:3 Octaves |

## Measurements

| | |
|---|---|
| Measurement Control | Calendar<br>Up to 6 time slots per day, fully customisable for each day of the week.<br>Repeat Timers<br>User selectable duration between 1 minute to 23 hours |
| Stored Functions | Overall measurements:<br>Time, date & duration of measurement<br>$L_{Aeq}$, $L_{Ceq}$, $L_{Zeq}$, $L_{CPeak}$, $L_{ZPeak}$, $L_{APeak}$, $L_{AIeq}$<br>$L_{XYMax}$, $L_{XYMin}$<br>1:3 Octave Bands: $L_{Zeq}$<br>Tonal Noise Detection in 1:3 Octave Bands<br>Ln Values: 28 independent statistical values (Ln)<br>Up to 14 1:3 Octave Bands statistical values (Ln)<br>Time History:<br>$L_{Aeq}$, $L_{Ceq}$, $L_{Zeq}$, $L_{CPeak}$, $L_{ZPeak}$, $L_{APeak}$, $L_{AIeq}$, $L_{XYMax}$<br>1:3 Octave Bands: $L_{Zeq}$<br>Audio recording during measurement<br>Weather measurements (Option):<br>Wind Speed, Wind Direction, Temperature, Humidity, Pressure, Rainfall |

| | |
|---|---|
| Time History Data storage | Up to 32 days at 1/16s time history data rate<br>Up to 512 days at 1 second time history data rate |
| Time History Data Rates (Global settings) | User selectable data rates of 10ms, 62.5ms, 125ms, 250ms, 1/2 sec, 1 sec, 2 sec |
| AuditStore | For each measurement, the following data is stored onto an independent, non-volatile memory for use with the AuditStore function:<br>Start Time, Duration, $L_{AFMax}$, $L_{Aeq}$, $L_{CPeak}$, $L_{10}$, $L_{90}$, Overload, Calibration data, Diagnostic information. |
| Acoustic Fingerprint Audio Recording | Triggered audio recording with options of:<br>Compressed 8kHz, 8bits µLaw<br>Standard 16kHz, 16bits WAV<br>Studio 96kHz, 32bits WAV |
| Ln Statistical Values | 2 sets of 14 independent statistical Ln values:<br>7 preset to L1.0, L5.0, L10.0, L50.0, L90.0, L95.0 & L99.0<br>7 user defined Ln values<br>1 set of 14 independent 1:3 Octave Bands statistical Ln values:<br>Preset to L1.0, L5.0, L10.0, L50.0, L90.0, L95.0 & L99.0<br>7 user defined Ln values |
| Alarms | Preamplifier disconnected<br>Preamplifier tilt<br>Windshield removed<br>Low battery power<br>External power disconnected<br>Case open<br>Compact Flash card failure<br>Calibration failure<br>Microphone fault |
| Predicted Leq triggers | Shows % of dose and predicted exposure if level maintained. |
| Acoustic Fingerprint Triggers | Up to 12 independent triggers with 24 rules available across all triggers<br>Rules based on %Dose or Level, Tone or Rate of Change with minimum duration |
| Event measurements | Triggered recording of small measurements (up to 5 min) with $L_{Aeq}$ time history, 1:3 Octave bands spectrum and overall values. |
| Notifications | SMS, Email or Twitter<br>Depending on modules selected. |
| Live Audio Listen: | Live audio listening of compressed audio. |
| GPS | Global positioning for accurate time synchronization and location. |
| Weather station (Option): | Ultrasonic Wind speed, Wind Direction, Humidity.<br>Temperature, Pressure, Tip bucket Precipitation |

| | |
|---|---|
| Video OSD text stamping (Option): | Option to enable analogue video (CCTV etc) to be stamped with live LAF value and instrument description. |

## Physical

| | |
|---|---|
| Windshield | Dual foam 200mm windshield UA:180 with hydro-phobic coating |
| Display | High resolution 800x480 pixel 7" resistive touch screen.<br>Illuminated keypad. |
| Memory | 32GB Compact Flash |
| Dimensions | Main Unit: 360x150x295mm<br>Preamplifier: 500x200x200mm<br>Main Unit: 9kg<br>Preamplifier and cable: 1.2kg |
| Batteries | 4 x Internal 9.6V 10000mH NiMh battery packs. Non User changeable. |
| Battery life | Typically 11 days without communication module.<br>Typically 9 days with Modem and occasional connection.<br>Typically 9 days with WiFi Module and occasional connection.<br>Battery life is dependent on time connected to instrument communicating and time display is on.<br>(note there is very little margin in these figures and they are based on very limited testing) |
| External Power (fast charge): | 15VDC @5A – Use only Cirrus power supply CU:247/1<br>2.5mm DC Socket |
| External Power (trickle charge): | 12-15VDC @1A |
| Connections | Microphone<br>COMMS A<br>COMMS B<br>RF – SME Connector<br>GPS – SME Connector<br>Mini-USB<br>Compact Flash<br>Battery charge 2.5mm DC Socket |
| Tripod Mount | Preamplifier tripod mount: ¼"-20 UNC socket<br>5/8" Adaptor provided with Cirrus Tripod option. |
| Case | Waterproof Pelicase, size 1400, black. |
| Environmental | Operating temperature:-20 to +70ºC<br>Remaining in specification for -10 to 50ºC<br>Storage temperature:-40 to 70ºC<br>Humidity: Up to 95% RH Non Condensing |
| Electromagnetic performance | IEC 61672-1:2013<br>EN 61000-6-1:2007 & EN 61000-6-1:2007, except where modified by IEC 61672-1:2013 |

| | |
|---|---|
| Language options | English, French, Spanish, German, Chinese |
| GPS | Global positioning for accurate time synchronization and location. |
| Communications Options: | Remote: Modem (3G/GPRS), WiFi or Ethernet depending on option selected.<br>Local: USB |
| Weather station (Option): | Ultrasonic Wind speed, Wind Direction, Humidity. Temperature, Pressure, Tip bucket Precipitation |
| Video OSD text stamping (Option): | Option to enable analogue video (CCTV etc) to be stamped with live LAF value and instrument description. |

# Appendix B – Invictus External Connectors

The Invictus Noise Monitor has two connectors which are used for connecting external devices, power sources.

These connectors are labeled as COMMS A & COMMS B.

## COMMS A Connector

Mating connector type: Souriau UTS6JC147S, suitable crimp sockets SC16ML11D70.

| Pin No | Signal Name | Notes |
|---|---|---|
| 1 | Com 0 Data In (Rx) | RS232 levels |
| 2 | Com 0 Data Out (Tx) | RS232 levels |
| 3 | Com 0 HW in (CTS) | RS232 levels |
| 4 | Com 0 HW out (RTS) | RS232 levels |
| 5 | Ground | |
| 6 | Supply In | Max 15V<br>Battery trickle charge. |
| 7 | Ground | |

## COMMS B Connector

Mating connector type:  Souriau UTS6JC1419P, suitable crimp pins SM20WL3S26

| Pin No | Signal Name | Notes |
|---|---|---|
| 1 | Com 4 Data In (Rx) | RS232 levels |
| 2 | Com 4 Data Out (Tx) | RS232 levels |
| 3 | Com 4 HW in (CTS) | RS232 levels |
| 4 | Com 4 HW out (RTS) | RS232 levels |
| 5 | Ground | |
| 6 | Supply Out | 12V Out (max 0.5A) |
| 7 | Ground | |
| 8 | Reserved | |

| | | |
|---|---|---|
| 9 | Ground | |
| 10 | ACOUT | AC voltage out based on Z-weighting |
| 11 | Ground | |
| 12 | DCOUT | DC Voltage out based noise level. Not available with Wi-Fi option MM:247/4 |
| 13 | Ground | |
| 14 | Not Connected | |
| 15 | Not Connected | |
| 16 | Not Connected | |
| 17 | Not Connected | |
| 18 | Not Connected | |
| 19 | Not Connected | |

# Appendix C Noise-Hub2 system requirements

NoiseHub2 PC Specification

- Windows 7 SP1 (x64)
- or Windows Server 2008 R2 (x64)
- CPU: 3GHz Quad Core
- Memory: 4GB
- Storage: 50GB free space
- Display: 1280x1024 (dedicated NVIDIA/AMD graphics card)
- Sound card and external speakers

Storage:

- Approximately 1GB for installing Noise-Hub and dependencies
- Typically 500MB per NMT per Year (varies depending on what is downloaded {especially time history}, and how many events occur)
- Audio requires significantly more space

# CE Declaration of Conformity

**Cirrus Research plc Hunmanby UK**

**CE Certificate of Conformity**

Manufacturer:

Cirrus Research plc

Acoustic House, Bridlington Road

Hunmanby, North Yorkshire, YO14 0PH

United Kingdom

Telephone +44 1723 891655

**Equipment Description**

The following equipment manufactured after 1st January 2013

**MK:247 Invictus Environmental Noise Monitor**

Along with standard accessories

According to EMC Directives 89/336/EEC and 93/98/EEC meet the following standards

EN 61000-6-3 (2001)

EMC : Generic emission standard for residential, commercial and light industrial environments.

EN 61000-6-1 (2001)

EMC : Generic immunity standard for residential, commercial and light industrial environments.

Signed Dated 1st October 2013

S. O'Rourke

Director

# Regulatory Notices

## US FCC Notice

The United States Federal Communications Commission (FCC Part 15) has specified that the following notice be brought to the attention of the users of this product.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

### Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Cirrus Research could void the user's authority to operate the equipment.

The equipment must only be used with the antenna supplied by the equipment manufacturer.

**This device complies with Part 15 of the FCC rules.**

This device complies with Part 15 of the FCC rules.  Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and

2. This device must accept any interference received, including interference that may cause undesired operation.

## Exposure Information to Radio Frequency Energy

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.  This could impair the quality of communications and cause the device to operate at a higher power level than necessary.

The antenna must be installed in a manner that provides a minimum separation distance of 20cm (8 inches) or more between the antenna and persons, and must not be co-located or operate in conjunction with any other antenna or transmitter to satisfy FCC RF exposure requirements for mobile transmitting devices.

# Warranty information

1. This document is a summary of the full warranty document and explains the Cirrus Research plc warranty in ordinary English; not in legal or complex terms.
2. The warranty covers any acoustic instrument such as a sound level meter, acoustic calibrator, real time acoustic analyser or personal sound exposure meter (dosemeter) manufactured by Cirrus Research plc after September 1st 2011.
3. The warranty covers all faults on, and minor accidental damage to, the instrument except the microphone capsule for the period defined in para (5) below.
4. Minor accidental damage does not include blatant miss-use, damage caused by the use of any accessories or components not specified or recommended by Cirrus, damage caused through non-Cirrus modification, continued use outside of Cirrus' recommended procedure or conditions or use contrary to the any advice provided by Cirrus.
5. The initial period of the warranty is 2 (two) years or 104 weeks from the date of purchase as a new instrument from Cirrus Research plc or their formally approved distributors OR 130 weeks from the date the instrument passed its final manufacturing inspection at Cirrus Research plc - whichever is the shorter.
6. A shorter 1 (one) year or 52 week warranty is offered for used, ex-demo or ex-rental equipment unless a special arrangement is made and a written confirmation of the special warranty is given by Cirrus Research plc.
7. Any rechargeable battery only has the battery manufacturer's one year warranty, however there will be a reduced charge for their replacement during the annual "Traceable Calibration."
8. On completion of the annual "Traceable Calibration" by Cirrus Research plc, or an official Cirrus Calibration Centre, the instrument will automatically be given an additional free one year warranty.
9. It follows that should the instrument be calibrated by Cirrus Research plc, or an official Cirrus Calibration Centre every year, the warranty is effectively continuous to a maximum of 15 (fifteen) years from the date of purchase.
10. There will be a charge for this "Traceable Calibration" and the price is published in the Calibration Price List. The customer is responsible for all shipping, duty and other charges relating to the annual "Traceable Calibration".
11. Where a repair service is conducted under warranty, Cirrus Research plc will cover the shipping, duty and other costs relating to the repair of the instrument.
12. Cirrus Research endeavors to ensure stocks of instrument components for the full fifteen year period but do not guarantee to do so as certain components do become obsolete or discontinued.
13. If a sub-component becomes obsolete and stocks are depleted then Cirrus Research will endeavor to facilitate a repair but will not offer the same length warranty.
14. In the event of any dispute on the terms of the warranty Cirrus Research plc will accept pendulum arbitration by the United Kingdom Institute of Acoustics Ltd.
15. The warranty does not in any way reduce any legal right of the buyer or user of the sound level meter; it is in addition to all legal rights determined by the European Union.
16. Cirrus Research plc reserves the right to amend or update these terms and conditions without prior notice.

Warranty Terms 2.5 May 2012

## Contact information

Cirrus Research plc

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YO14 0PH
United Kingdom

| | |
|---|---|
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| Web: | www.cirrusresearch.co.uk |