The Nano User Guide

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The Nano is NOT a Medical Device (EU)

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209-J00320

Please consult MotionWare Software User Guide ref 30238 for details of software installation, and data analysis.

CONTENTS

1 Getting started with the Nano

1.1 An Overview of the Nano

The Nano is a compact, lightweight, activity monitoring device intended for veterinary use. It can be used to monitor a variety of animals, either using Bluetooth to download data without removing the device from the animal, or longer-term actigraphy recording followed by download using the charging dock. The Nano is fully waterproof, and its small size makes it suitable for monitoring locomotor activity in smaller animals.

Components Required for a System

- One (or more) Nano devices.
- A Nano charging dock or MultiDock
- PC based MotionWare Software

1.2 The Nano

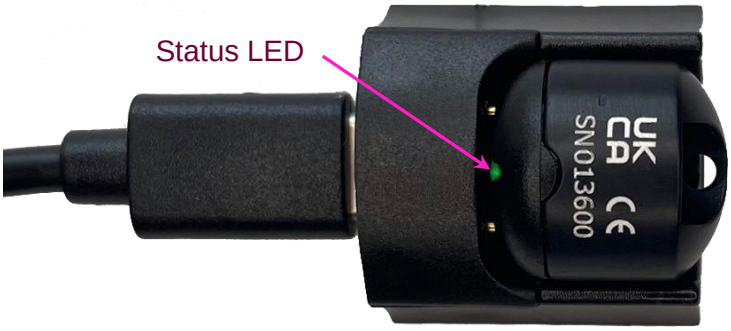
Docking Contacts:	Allows the Nano to recharge when connected to its charging dock and enables Bluetooth communication after long term recordings.
Status LED:	Flashes to indicate charging once your nano is correctly in the dock. It will flash faster when communicating and remain on once fully charged.
Mounting Loop:	The Nano is designed with a strong mounting hole at the top, for attachment to short chains or collars. A strong 7mm split ring is supplied to assist attachment.

The Nano has two main communication options:

- Long-Term (Bluetooth off): This is like a traditional actigraphy device where the data are downloaded at the end of the study – the Nano must be docked to download.
- Scheduled: This option allows the data to be wirelessly downloaded at scheduled times to avoid handling the animal.

1.3 Using the NanoDock

The NanoDock is used to recharge the Nano battery and to set-up and download the device. To re-charge the Nano battery, place it in the dock as shown below, with the Nano serial number facing upwards. It is usually easiest to angle the “top” of the device in first, then press down the base into the dock.



1.4 Charging the Battery

Always fully charge the Nano battery before starting a new recording. The Nano can be recharged by connecting the USB cable to a PC however, most computers will shut down their USB ports when sleeping hence the Nano will stop charging.
It is recommended to use a standard USB 5V wall adaptor to recharge the Nano – CamNtech have suitable chargers available if required.
The battery will typically allow 90 days of recording before requiring recharging, however this may be affected by environmental conditions (i.e. cold temperature) and ageing of the battery.
Always shut down the Nano when not in use by using the ‘Shutdown’ button in the Nano Manager window.
To maximise the service life of the battery, always fully charge the Nano then shut down before any period of storage.

Status LED

Flashing Slowly:	The Nano battery is charging – typically allow 2-3 hours to fully recharge the battery.
Permanently On:	The Nano battery is fully charged.
Rapid Flickering:	The Nano is communicating via Bluetooth.

1.5 Using the Nano MultiDock

The Nano MultiDock allows up to 6 Nano devices to recharge simultaneously. The operation is identical to the NanoDock.

1.6 Install MotionWare Software

The Nano uses MotionWare software to configure, download, analyse and manage the devices. Please refer to the MotionWare Software User Guide for full details of MotionWare software installation and use.

2 Connecting to the Nano

2.1 Place the Nano in a Charging Dock

As described in section 1, place your Nano into the NanoDock or MultiDock, which should be connected to a mains power supply or spare USB port for power.

The Nano will flash to indicate it is charging. Once fully charged, the LED will stay on.

Connecting the Nano to its dock will make it available for configuration over its wireless Bluetooth connection.

2.2 Pairing (for first use)

The first time you use each Nano with your Windows PC, you must ensure that you enable Bluetooth and then pair with the device.

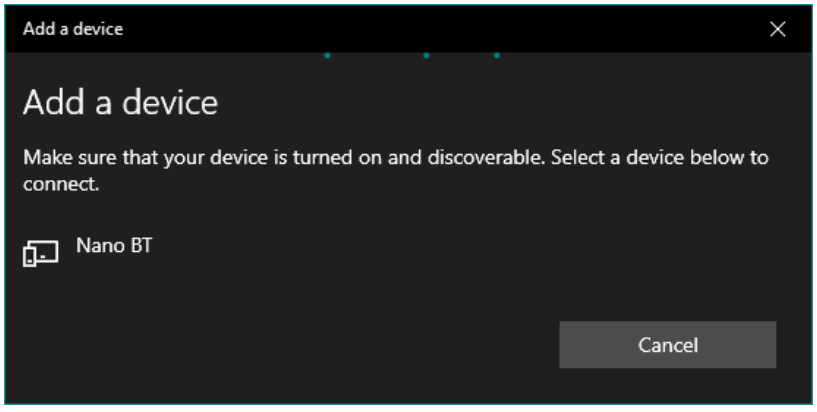
First, use the Windows start menu to open the settings window, and then select the “Devices” section, and specifically “Bluetooth & other devices”.

Next, ensure that the Bluetooth function is set to “On”.

For Windows 11, it may be necessary to change Bluetooth discovery to ‘Advanced’ to allow the Nano BT to be discovered. In the Bluetooth and devices window, first click ‘view more devices’ then scroll down to the setting ‘Bluetooth device discovery’. Change this setting to ‘Advanced’. Now scroll back up to add the new device.

Then, click “Add Bluetooth or other device”, and choose to add a “Bluetooth” device.

The computer will then display any nearby devices. Your Nano must be powered in a charging dock in order to appear in this list.



Click on the “Nano BT” to pair with it and close the window.

You will need to repeat this process for each of your individual Nano devices to be used with this computer.

Note: if using a MultiDock, please connect only one Nano device at a time and follow the pairing process otherwise several ‘Nano BT’ devices will appear in the list, and it will be difficult to identify individual devices.

2.3 Connecting from MotionWare

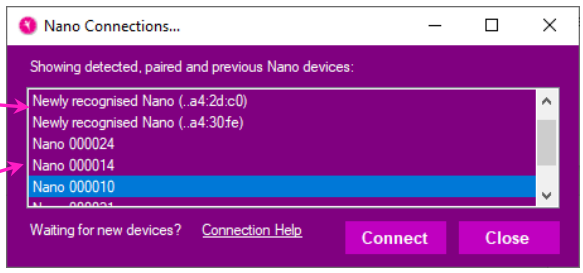
Having installed MotionWare (see MotionWare User Guide) and when you have paired the Nano as above, run the MotionWare software then connect by using the “MotionWatch/Nano” button in the main menu. This open the ‘Nano Connections’ window which will display a list of recent or nearby Nano devices to connect to.

Click to open ‘Nano Connections’

It may take up to a minute for your newly paired Nano to appear in the list after the first time you pair to it. Subsequently it will be available as a recent device and connect more quickly.

New devices

Recent devices



You will typically see a single ‘Newly recognised Nano’ at this stage – this will be the new device that has just been paired.
Once your new device has appeared, double-click on it, or select and use the “Connect” button to continue.
After the first connection, the Nano will subsequently be listed with its own serial number in the Nano connections list.

Following Connection, the Nano Manager window will show the current device configuration; an example is below.

CURRENT SETUP INFORMATION

Details of the current configuration and subject-details stored in the Nano

4 FUNCTIONS:

Setup Nano: Click to reconfigure the Nano

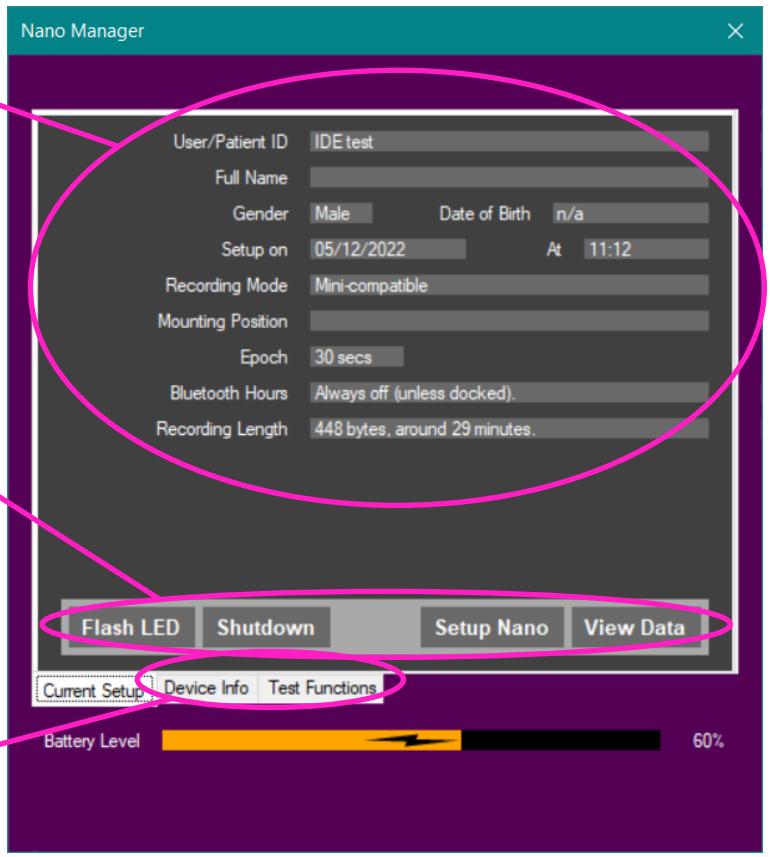
View Data: Click to view the data in the device, and save it

Flash LED: When in a dock, flash the LED

Shutdown: Shut down the Nano

Device Info and Test functions

Click to view device information or test functions (if instructed by CamNtech support)



The Nano Manager window has two main functions for normal use:

Setup Nano	This allows you to reconfigure the device for a new recording, choosing recording mode, epoch, Bluetooth availability, and other settings.
View Data	This will transfer and show a quick preview of the data collected by the device, along with the option to save that data for analysis.

And two additional device management functions:

Flash LED	If you have multiple Nano devices nearby, this will help to identify the currently selected one by flashing its LED. The device must be in a charging dock.
Shutdown	This will power-down the device, so that no further battery life is used during storage. It will end any data capture and shut down Bluetooth connectivity until the device is next placed in a charging dock again.

3 Setting up the Nano

3.1 Editing the Configuration

Click the ‘Setup Nano’ button; the new setup tab will be activated and the settings may now be edited:

User ID: Enter characters to identify the subject/patient/study.

Full Name: [optional] Enter characters to identify the patient/study.

Gender: Use the dropdown to select M, F or X (if gender is to be undisclosed).

Date of Birth: Use the date control to enter the date of birth of the subject.

Start Date & Time: Select delayed start to begin a recording up to 30 days in the future. Immediate start will begin in 1-2 minutes after disconnection.

Recording Mode: Use the drop down control to select the recording mode.

Mounting Position: Note the mounting location of the Nano. This is not essential, but may help your records.

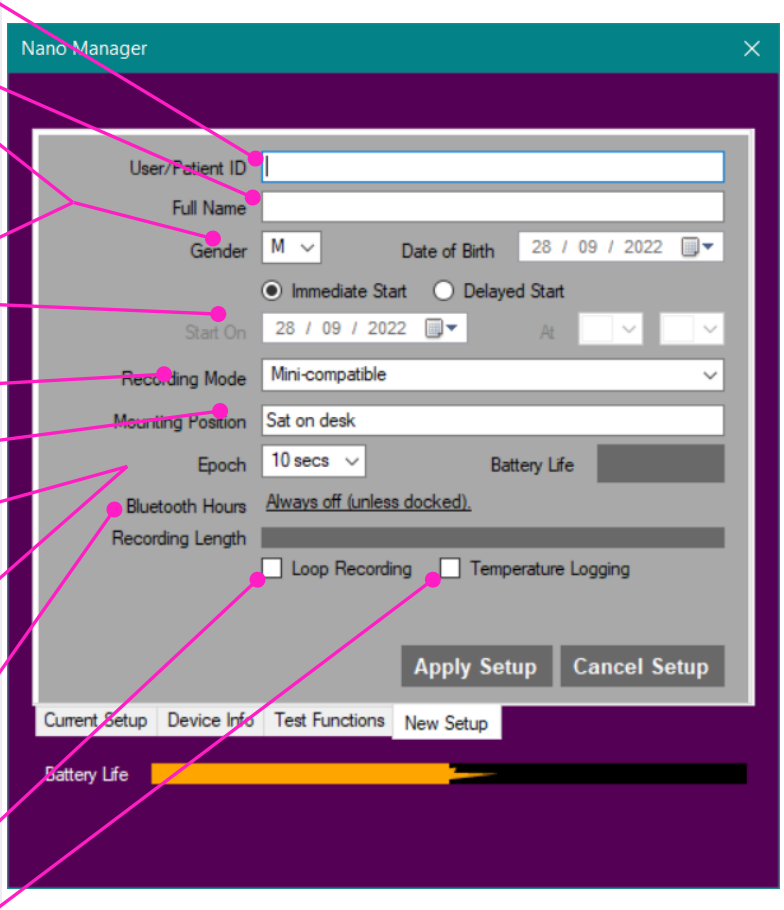
Epoch: Use the drop down to select the required recording epoch.

Battery Life: Indication of approximate battery life remaining.

Bluetooth Hours: You can configure which hours of the day are enabled for data download. Fewer hours will produce a longer battery life.

Loop Recording: This option allows the device to continue recording while charge is available, overwriting older data.

Temperature Logging: Record temperature of the Nano device throughout the recording. This occurs less frequently than the activity logging epoch.



Note that the User ID, Full Name, Gender and DOB may be anonymised and are not required for data analysis.

3.2 Configuration options

Immediate or Delayed Start

Select ‘Immediate Start’ to ensure that the Nano begins recording straight away. The start date and time are taken from your computer clock so please ensure that this is correct. Note that recording will only start on a following one-minute boundary, rather than instantly.

Select ‘Delayed Start’ to adjust the start date/time. This option allows the recording to be delayed into the future. This may be useful if you want to place the device later and have the recording only start after that. Use the date, hours and minutes controls to select the required start date and time.

Recording Mode

"Mini-compatible" recording mode will produce counts as close as possible to that of the legacy Actiwatch Mini while using a more modern sensor (so cannot guarantee an exact match).
Triaxial recording mode will show greater consistency across a range of movements as it does not depend on a single axis of movement, like the Mini-compatible mode.

Body Position

The Nano can be mounted to a collar, harness, or other part of an animal. It can also be mounted tightly taped or allowed to hang on a short chain. This field allows you to make a record of the location and type of mounting for your future reference when examining the recording later.

Epoch

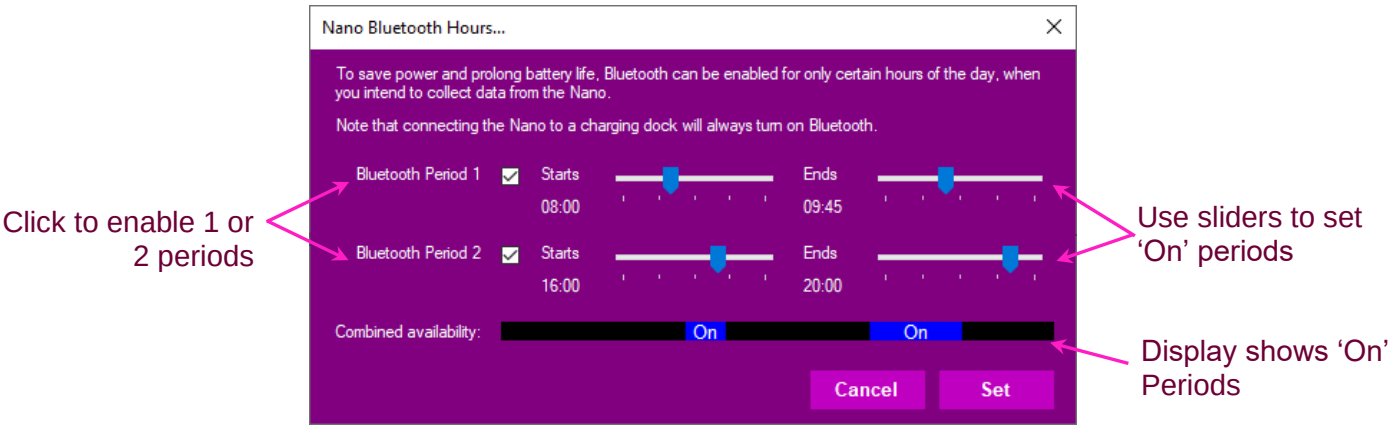
The epoch is the duration for which the Nano will accumulate samples before storing the result in memory. For example, using a 30 second epoch, there will be two activity counts per minute of recording. The Nano offers the following epoch length options:

1, 2, 5, 10, 30 and 60 seconds.

Bluetooth Hours

The Nano has two main communication options:

Always Off	Like a traditional long-term actigraphy device where the data are downloaded at the end of the study – the Nano must be docked to download. This will maximise recording time between battery charging.
Scheduled	This option allows the data to be wirelessly downloaded at scheduled times to avoid handling the animal. For example, if you know that you can connect and transfer data between 9-10am, then you can set the device to minimise battery use by only turning the Bluetooth connection on in this time window but continuing the recording with minimum battery use during the other 23 hours of every day. The Bluetooth Hours option allows you to set up to two separate periods of the day when the device will be available for communications. Both of these can be as long or short (to 15 minute steps) as you wish, with a corresponding effect on battery life. Furthermore, it is possible to set the Bluetooth Hours to make the Nano permanently connected (i.e. midnight to midnight), however this will seriously impact the battery life. The scheduled download is not automatic – you must connect to the device and download in the scheduled window.



Click 'Set' to apply the chosen Bluetooth hours to the setup.
The recording length will be updated in the Nano Manager to reflect the impact upon battery life of the Bluetooth Hours.

Temperature Logging

The Nano has an in-built temperature sensor which can be useful to monitor changes in the environment around the animal. The temperature sensor logs data at 12 times the activity epoch, so for example with a 30s activity epoch, the temperature is logged every 6 minutes.

Apply Setup

Having entered your required setup information, click the 'Apply Setup' button to write the setup to the Nano. Observe the message window for the confirmation message before removing the Nano from its charging dock.

Attach the Nano

Attach the Nano to the animal using a suitable chain, pouch or other means that will prevent the device from becoming detached. If the nano is placed inside a separate metal casing, the Bluetooth communications will no longer function as the wireless signal will be blocked.
Allow the Nano to record for the required period before downloading (viewing) the data.

4 View Data

A new Nano device that has not been set-up will not contain any meaningful data – please set-up and complete a recording prior to attempting to view data.

4.1 Nano Download

The Nano is downloaded over its Bluetooth connection. To connect to a Nano, you must either:

- Plug the device into a charging dock, or
- Connect during its scheduled "Bluetooth Hours". This allows you to leave the device on the animal.

Run the MotionWare software and click on "MotionWatch / Nano" from the main menu. Then double-click on the device you want to connect to in the 'Nano Connections…' window.

The Nano Manager window will display the current device configuration; click the 'View Data' button to begin the data download.
The % download will be displayed followed by a preview of the data as shown below:

From this preview, you can now choose to immediately view the data using "Save and Open", which will firstly save the data to a chosen file and then open it for analysis. Or simply save the data for analysis later using "Save .mtn". Selecting 'Close' will close the preview window without saving the data.

4.2 Analysing Data

Once you have saved a copy of the data, it will be available in the recently used files of your MotionWare main menu. You can click on the recording and choose to analyse for sleep or daytime-activity measures.

Two demonstration recordings are included with the software already in your recent files list. You can view these recordings while waiting for your own test data to be recorded.

More information about analysis is available in the MotionWare Software User Guide. Be aware that most measures are only validated in the context of human use.

5 Troubleshooting and Maintenance

5.1 FAQ's

Below is a list of frequently asked questions, guidance and support information:

I cannot 'Pair' my Nano or my Nano will not connect from the 'Connections' window.	The Nano must be powered by a charging dock (NanoDock or MultiDock) to allow pairing and communication. If the Nano battery is very low, the device may not be recognised until sufficient charge has been applied. Adjust the position/location of the Nano so that it is closer to the host PC attempting to connect – Bluetooth is sensitive to distance. For Windows 11, it may be necessary to change Bluetooth discovery to 'Advanced' to allow the Nano BT to be discovered. In the Bluetooth and devices window, first click 'view more devices' then scroll down to the setting 'Bluetooth device discovery'. Change this setting to 'Advanced'. Now scroll back up to add the new device.
I get the message 'Problem in data transfer: Nano not responding to read'	It may be necessary to close and re-open MotionWare and/or turn off/on Bluetooth on your PC. The Nano uses the latest low power Bluetooth low energy (LE5) protocol which is technically backwards compatible with older Bluetooth 4. However, we have found that some older Bluetooth hardware can be unreliable when operating at high data rates over LE5. Try updating your Bluetooth device drivers and try placing the docked Nano closer to the host PC to minimise the wireless distance. Windows trouble-shooter can also be helpful to resolve Bluetooth communications issues; From 'Updates and Security' select 'Troubleshoot' then 'Additional troubleshooters'. Under 'Find and fix other problems', select 'Bluetooth' then 'Run the Troubleshooter' and wait for the process to complete. If it is not possible to establish reliable communications, it may be necessary to purchase a Bluetooth LE5 dongle - contact us for advice.
The software offers to update the Nano firmware – what does this mean?	The 'firmware' is the software inside the Nano that allows it to operate. The MotionWare Software is shipped with the latest device firmware. If the software detects that any Nano device has older firmware, it will (optionally) inform you that an update is available. It is recommended that firmware updates are applied to ensure that you benefit any improvements to the device (see maintenance section below for details of firmware update process).

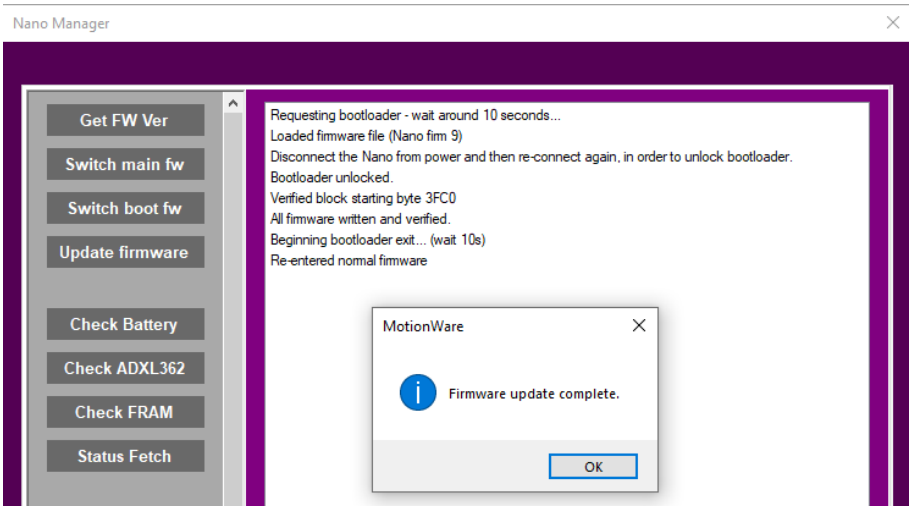
5.2 Maintenance

Cleaning the Nano

The Nano should be cleaned after each use using Clinell antibacterial wipes. Ensure all surfaces are thoroughly cleaned and ensure that the charging contacts are free from contamination. It is advisable to replace the mounting chain between uses on different animals if there is a risk of cross-contamination.

Firmware Update

The Nano internal operating software (firmware) may require updating as new functions are added. By default, the MotionWare software will warn if a Nano is connected and newer firmware is available. To manually check if the Nano firmware is up to date, open the 'Device Info' tab in the nano Manager then click the 'Check for update' button. If a software update is available, the button will be marked as 'Change firmware' – click to update. Follow the on-screen instructions to complete the firmware update which will require a disconnect and re-connect of the Nano.



Disposal at End of Life

Waste Electrical & Electronic Equipment (WEEE) The EU requires, under the Waste Electrical and Electronic Equipment Directive 2012/19/EU that manufacturers and/or distributors of Electronic and/or Electrical Equipment manage and pay for the collection and further handling of WEEE products, as well as provide WEEE-related information to their customers. CamNtech has taken the following approach to complying with this Directive:

- CamNtech has registered with an approved Producer Compliance Scheme (PCS) in accordance with the requirements of the WEEE Directive.
- CamNtech will provide free recycling for all of its WEEE products when returned to CNT.
- CamNtech WEEE products will be designed with recycling, reuse and waste management as a consideration.
- CamNtech WEEE products will be labelled or stamped with the WEEE marking in accordance with European Standard EN 50419.

Appendix A – Technical Specifications

Specifications

Functional Specifications	
Size (mm)	Diameter 16 x 16.75 (excluding mountings)
Weight	5.2 grams (excluding mountings)
Accelerometer	Tri-axial, MEMs technology. +/- 8g
Resolution	12 bits
Temperature sensor	+/-2°C (-5°C to + 35°C)
Battery Life	Up to 90 days
Battery	Rechargeable Lithium-Ion (not user replaceable)
Memory	4Mbits non-volatile
Waterproof	IP67 - up to 1 hour at 1m
Epoch	1, 2, 5, 15, 30, 60 seconds
Comms	Bluetooth LE5
Charging	Via NanoDock or MultiDock – standard USB-C connection
Data Output	Proprietary .MTN or open .CSV formats

Recording Times

Recording Times @ Epoch	
1s	3 days
2s	6 days
5s	15 days
15s	45 days
30s	90 days
60s	90 days (limited by battery life)

Note: using a 60s epoch it is possible to recharge the Nano and continue recording beyond 90 days.

Operating & Storage Conditions

	Operating	Storage
Temperature	+5°C to + 40°C	-25°C to +70°C
Relative Humidity	0 to 93%	0 to 93%
Atmospheric Pressure	70kPa to 106kPa	70kPa to 106kPa

Radio Information (Bluetooth)

The Nano contains a certified Bluetooth radio module:

Contains FCCID: 2APD9-RSL10SIP

Contains IC: 23763-RSL10SIP

209-J00320

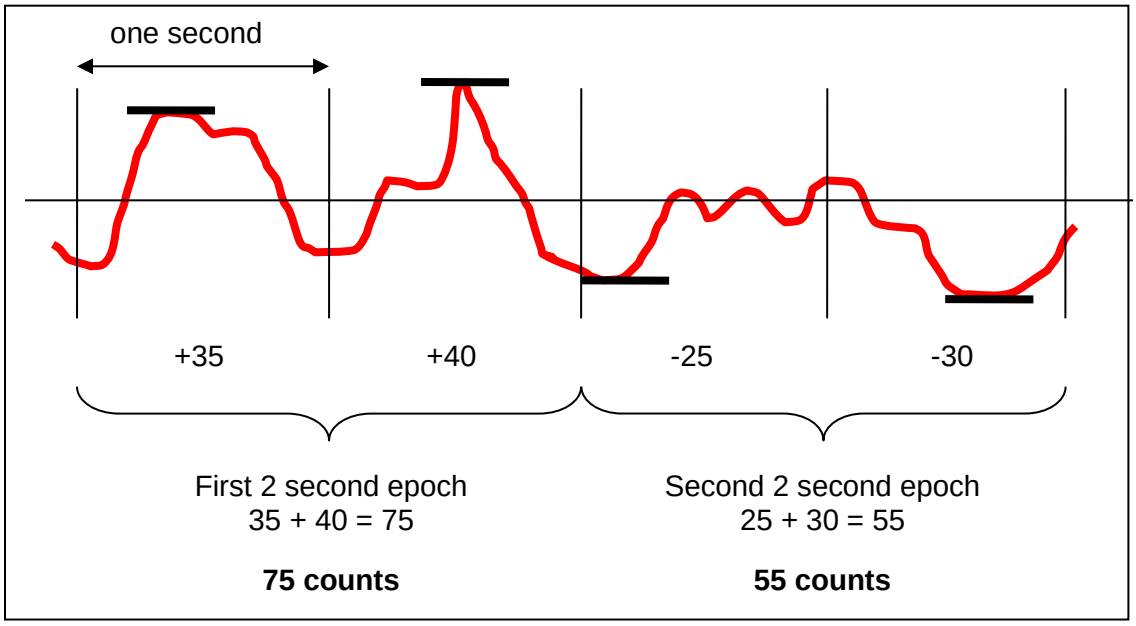
Accelerometer Processing – Actiwatch Mini Mode

This mode has been designed to attempt to closely match the counts from the legacy Actiwatch Mini. Note however that the Nano uses the latest MEMs accelerometer technology vs. the piezoelectric sensor used in the AW Mini. This means that the counts from the Nano and the AW Mini will not be identical in all situations. For this reason it is not advisable to mix Nano and AW Mini in the same study.
Raw acceleration measurements are processed by the on-board software of the Nano to produce a quantitative measure of the activity during each epoch. This is a four stage process which is applied to the accelerometer data:

1. The X axis data are separated and subjected to special filtering to match the Actiwatch Mini accelerometer response.
2. The peak acceleration (either positive or negative) during each second is recorded.
3. This is compared to a minimum “not moving” threshold of approximately 0.1g. Values below this threshold are ignored to simplify the final activity graph.
4. The result from each second is summed over the epoch and scaled to produce a standard result in controlled jig testing. This value is then recorded as the AW Mini Compatible count for the epoch.

This process is illustrated in the diagram below, showing the acceleration waveform over two epochs, each containing two seconds of data.

Tri-

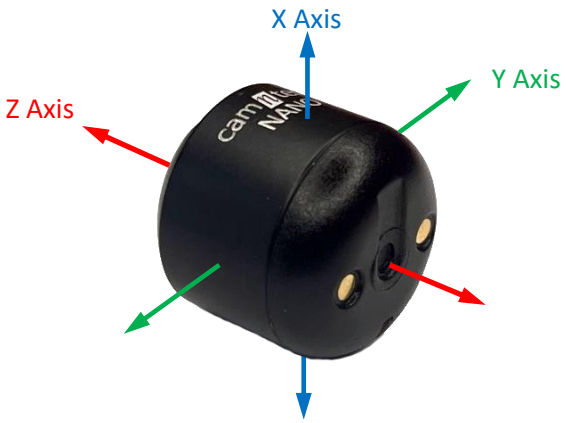


Axial Mode Data Processing

In this mode all three axes are utilized to form counts based upon a peak vector magnitude.

1. The X, Y and Z axes are sampled with filtering at 3-11Hz.
2. The peak X2 + Y2 + Z2 value is tracked.
3. At the end of each second, the square root of the peak value from that second is calculated.
4. This is compared to a minimum “not moving” threshold of approximately 0.1g. Values below this threshold are ignored to simplify the final activity graph.
5. The result from each second is summed over the epoch and scaled to produce a standard result in controlled jig testing. This value is then recorded as the ‘Tri-Axial count’ for the epoch.

The diagram below shows the X, Y, Z orientation relative to the watch casing:



Nano X-Y-Z axes using Tri-Axial mode.

Document Revision History

Issue From	Issue To	Date	Description	By
0	1.4.0	24/11/2022	Initial guide for Nano use	TE
1.4.0	1.4.14	12/06/2023	Updated all sections, added FAQ’s, maintenance and Appendix A	HS
1.4.14	1.4.19	06/09/2023	Added BT discovery mode for Win11, added radio certification information	HS
1.4.19	1.4.20	11/10/2023	Added temperature sensor specifications	HS