T24-HS

Handheld Display Single Input

User Manual
mantracourt.com

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Wireless Telemetry Range 2.4Ghz

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Introduction / Overview

The T24-HS is a simple handheld display. This allows wireless remote viewing of various remote inputs such as strain gauge or voltage etc using 2.4GHz radio.
The remote acquisition module measures its input value (strain gauge, voltage, current etc) and periodically transmits it.
The T24-HS captures this data and displays it. The T24-HS also performs the function of waking the acquisition module when it is turned on and sending it to deep sleep mode when it is turned off. The acquisition module will automatically enter deep sleep mode after 1 minute (default) if a T24-HS is not present.
If no buttons are pressed on the T24-HS it too will turn off after 5 minutes.

Quick Start

This section will show you how to get the device pair working out of the box.
You will require 2 X AA alkaline batteries for the handheld and a 3 Volt dc supply for the acquisition module which may also be a pair of AA batteries.

Connecting Power

T24-HS

Remove the two screws on the rear battery compartment. Insert two alkaline AA batteries. Refit the battery compartment cover. The handheld device is now switched on so should be turned off until the acquisition module is ready. To turn off just hold down the power key until the display shows **BUSY** then release it.

Acquisition Module

See the acquisition module manual.

Pairing

We will use automatic pairing to prove the connectivity and operation. Pairing sets the communications configuration parameters to allow the two devices to communicate. We do not need a PC or laptop or any configuration software to perform basic pairing.

- Ensure that acquisition module is not powered.
- We need to turn on the T24-HS in pairing mode. To do this we start with it turned off, then press and hold the power key then press and hold the Tare key. Now both keys are held down until PAIRING is seen on the display. The keys can now be released.
- Now apply power to the acquisition module within 10 seconds.
- If successful the T24-HS will pair to the acquisition module and the display will show a numeric value. (Or **Error 2** if the input integrity has failed. For example if the acquisition module is a T24-SA and the strain gauge is not connected).
  If the display shows **Failed** or **--------** then the pairing failed.

Once successful the T24-HS will be linked to the acquisition module and will send it to sleep when the handheld is turned off and wake it when the handheld is turned on.

Remember that from this point onwards to turn the handheld on you just need to press and hold the power key as the pairing mode is no longer required.

T24-HS Operation

Keys

Press and hold the power key until the display shows BUSY then release the key. Can also be used, by giving a quick press, to reset the Auto-Sleep delay.

Press the TARE key. This will toggle between gross and zeroed net mode. I.e. If the display shows gross then pressing the key will zero the display. Pressing the key when in net mode will return the display to gross mode. The Gross and Net modes are indicated as described below. Gross and Net are retained through power off.

Modes

Pairing

When you want to use the T24-HS with a different acquisition module you use pairing. (Ensure that the acquisition module is unpowered for at least 10 seconds.)
Press and hold the Power key then while still holding down the power key press and hold the Tare key.
Hold both keys until you see PAIRING on the display.
Release the keys and apply power to the acquisition module.
NOTE: When pairing, the channel and encryption key settings on the acquisition module are changed to match those on the T24-HS.

Indicators

G The display is showing Gross weight.

NET The display is showing Net weight.

SIG LOW The radio signal from the acquisition module is low. The device is still functioning but the limit of the range may be near. Communications may start to deteriorate when this indicator is visible. Until ------ is displayed the communications is still OK and the display can be relied on for accuracy.
Note: Even with a degraded signal the display value will always be correct.

BATT LOW The batteries in the handheld are low and need to be replaced.

REMOTE ERROR The acquisition module has an error that the handheld does not recognise.

REMOTE BATT LOW The battery or supply to the acquisition module is low.

Errors

Displayed on handheld LCD.

Error 1 The acquisition module has a strain gauge input and is in shunt cal mode. An external device has placed the acquisition module in Shunt Calibration mode so rather than display a misleading reading this error is displayed instead.
Modules such as the T24-SA support this error type.

Error 2 Input integrity error. The acquisition module has found a problem with the input. There may be open or short circuits. Rather than display a misleading reading this error is displayed instead.
Only certain acquisition modules support this error such as the T24-SA.

Overload A user settable value which when exceeded causes this message to be displayed.

Configuration

This section explains how to install software and connect the required devices together. Please note that you will need the T24 Toolkit software and a T24-BS base station to allow your computer to communicate with T24 telemetry devices.

Installation

T24 Toolkit

To configure the devices we must use the **T24 Toolkit** software application. This can be downloaded from our web site or may be shipped with your products.
Install this on a PC or laptop.
Run setup.exe and follow the prompts to install the software.

T24-BSu Base Station

If you have a USB version of the base station (T24-BSu) then you just need to plug this into a USB socket on your PC. If you are using an alternative base station then please refer to the appropriate manual.

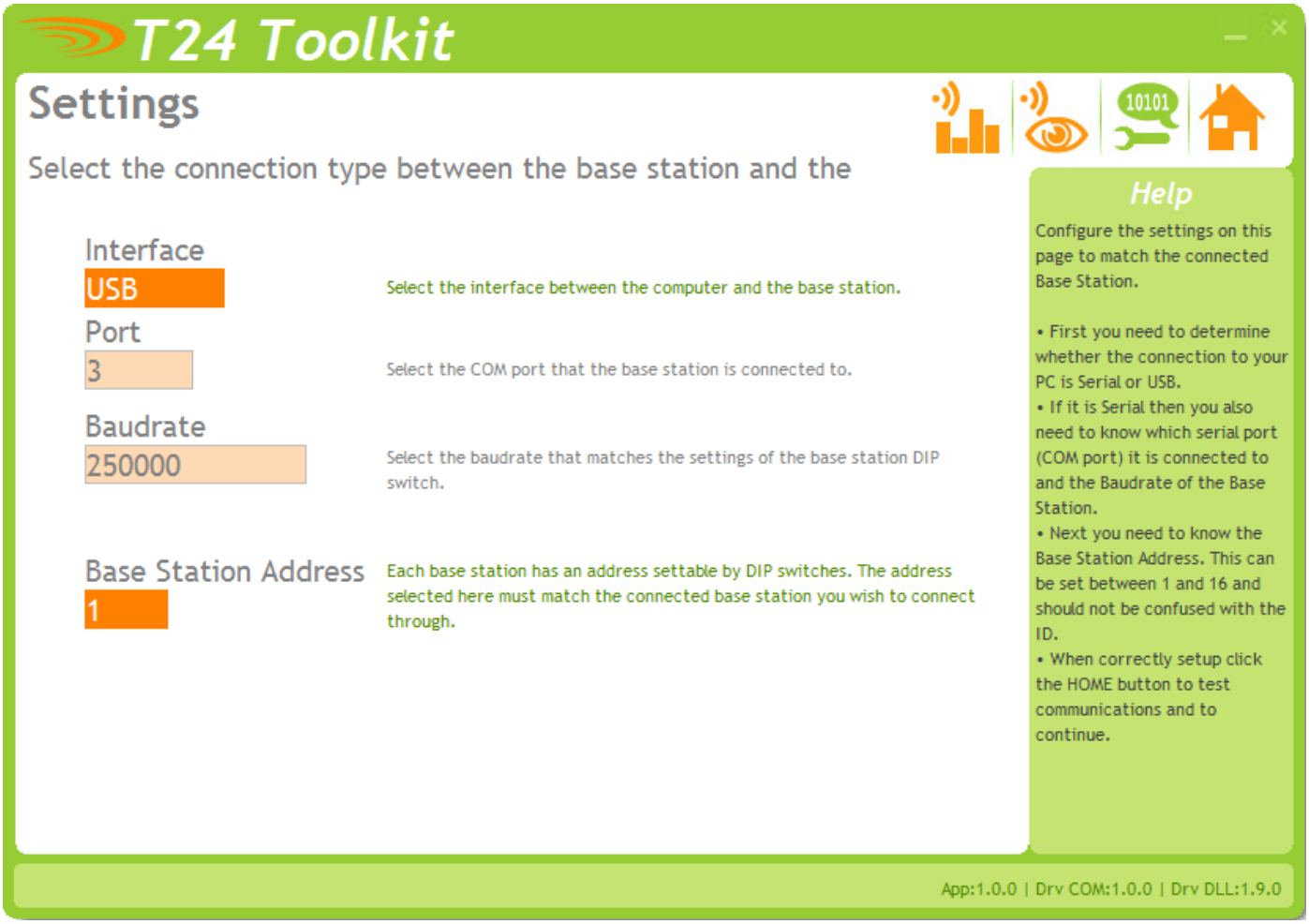
T24 Toolkit

The T24 Toolkit provides a means of simple configuration of the T24-HS handheld and associated acquisition module along with useful tools to aid integration. Calibration of the acquisition module is also provided.

Run the T24 Toolkit software application.

PLEASE NOTE: Depending on which acquisition module is selected the screenshots may vary slightly. This will generally be in naming of units and device descriptions. The screenshots shown are those shown when a T24-SA strain gauge acquisition module is connected.

Setup Base Station Communications



Select **USB** as the interface and select 1 as the Base Station Address.
In the toolkit all items that can be changed by the user are coloured orange.
To change a value just click on the relevant orange item. You will then be presented with a new dialog window allowing you to change the value.
This may use a slider, text box or list to allow your new value to be entered.

Click the Home button to attempt communications with the base station.
If no communications can be established the toolkit will remain on this page. You will need to check that the base station is powered and that it is connected to the converter correctly.

Home

We now have successful communications with the base station so we can now pair with our device or we can select the Spectrum Analyser mode or Data Provider Monitor mode.

To connect to our device we will pair. This is achieved by power cycling the device. Pairing removes the need to know the radio settings of the device you are connecting to and also ensures that it is in a suitable state for configuration.

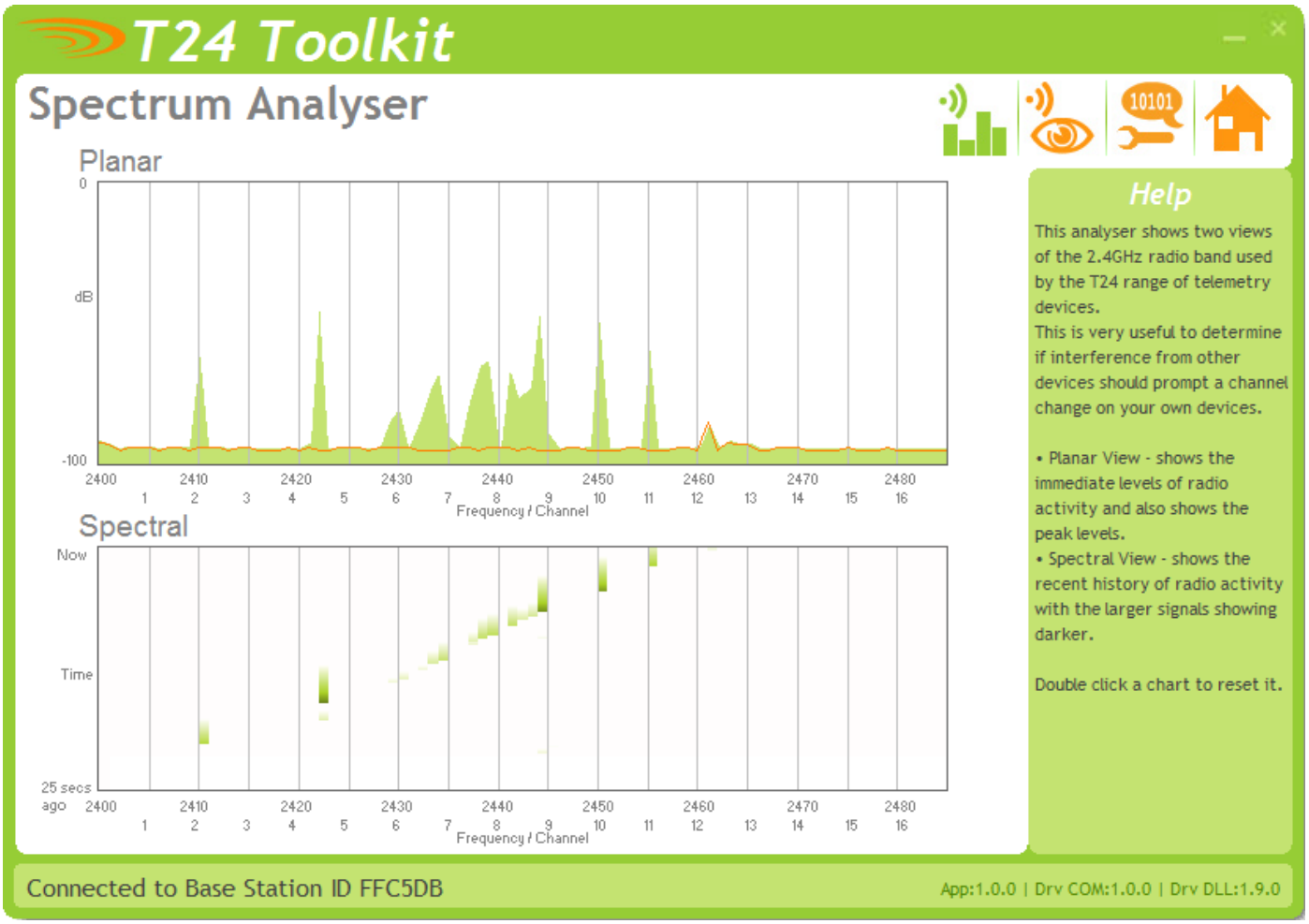
Pairing Procedure

- Remove at least one battery from the handheld module.
- Click the Pair button on the toolkit.
- You now have 10 seconds to replace the handheld batteries.

If you connect successfully the toolkit will change to the Information page.
If the pairing fails try again.

NOTE: Pairing with the toolkit will **not** change the radio configuration settings of the connected device.

Analyser

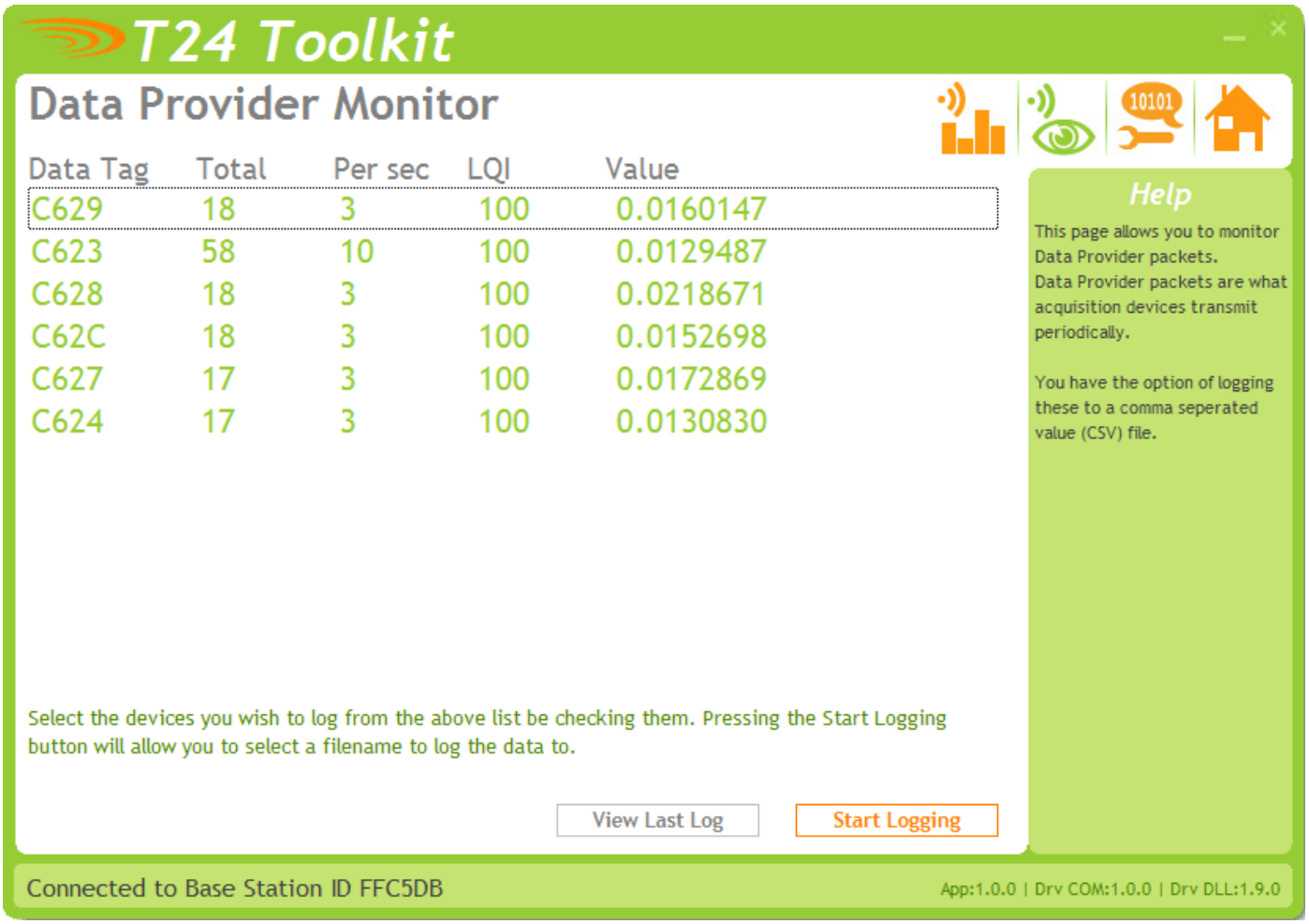


The analyser page is provided as a tool and will not normally be needed unless you plan to change channels and want to find the best channel to select, or to diagnose poor communications issues.

This page shows the radio signal levels detected across all the channels available to the T24 series of devices. Using this tool may help in detecting noisy areas and allow you to decide on which channels you may want to use.

The above charts show the traffic from a Wi-Fi network and it can be seen to be operating over channels 6 to 9 and it would be best (though not essential) to avoid using these channels.

Data Provider Monitor



T24 acquisition devices normally operate in low power mode and periodically transmit Data Provider packets This page shows all detected Data Provider packets which may be useful for checking that a device is operational.

NOTE: When the toolkit connects to a device to enable configuration it will usually inhibit the transmission of Data Provider packets.

The Start Logging button will ask for a filename and proceed to log the received data to a CSV file in the following format:

```
Data Tag, Elasped mS, Value
```

The View Last Log button will launch the application associated with CSV files and open the last logged file.

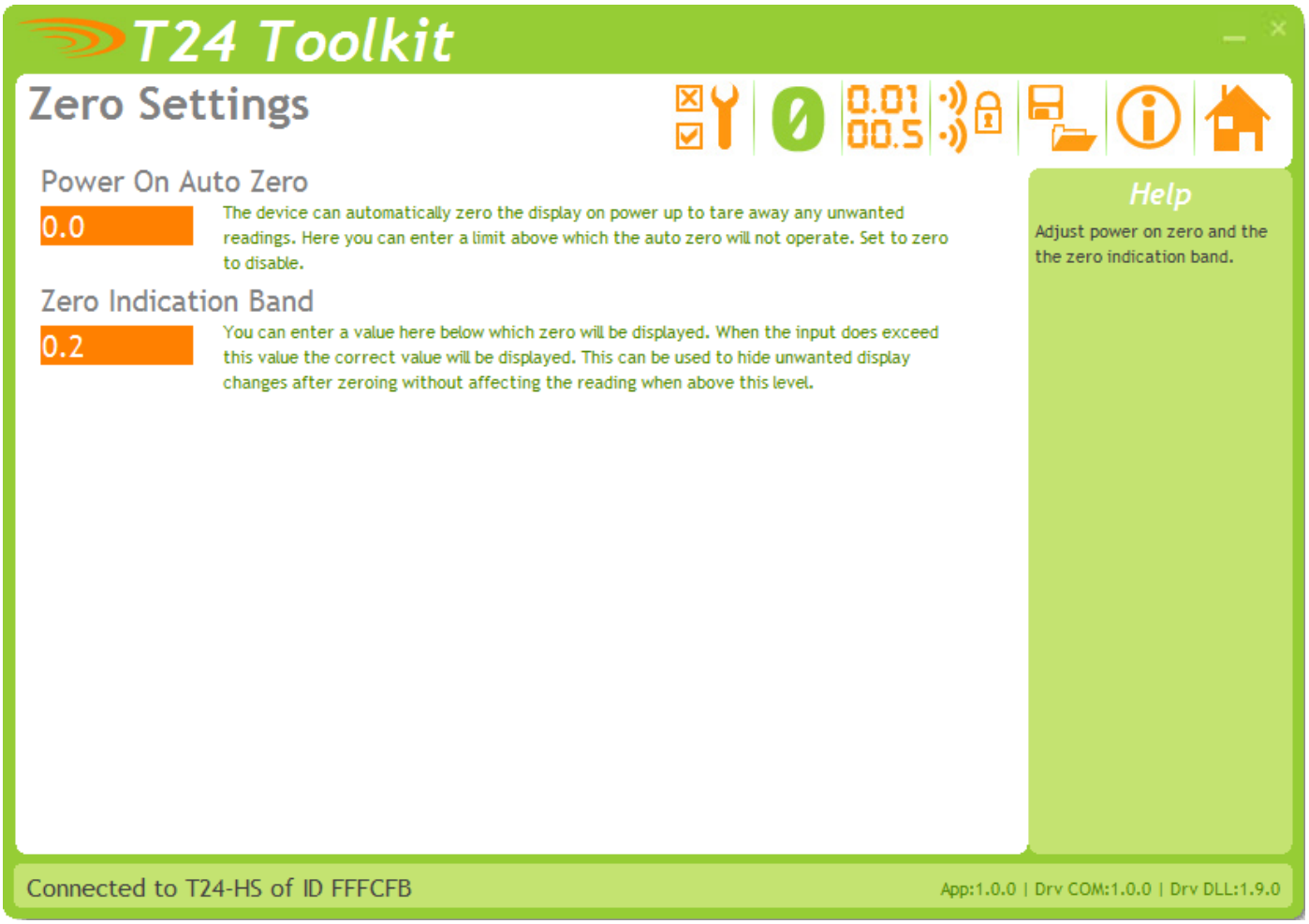
Information

Once successfully paired to a device this page is displayed.
This page shows you information about the connected device.

Items you can change:

Name — You can enter a short description which may help you recognise this device in the future.

Zero Settings



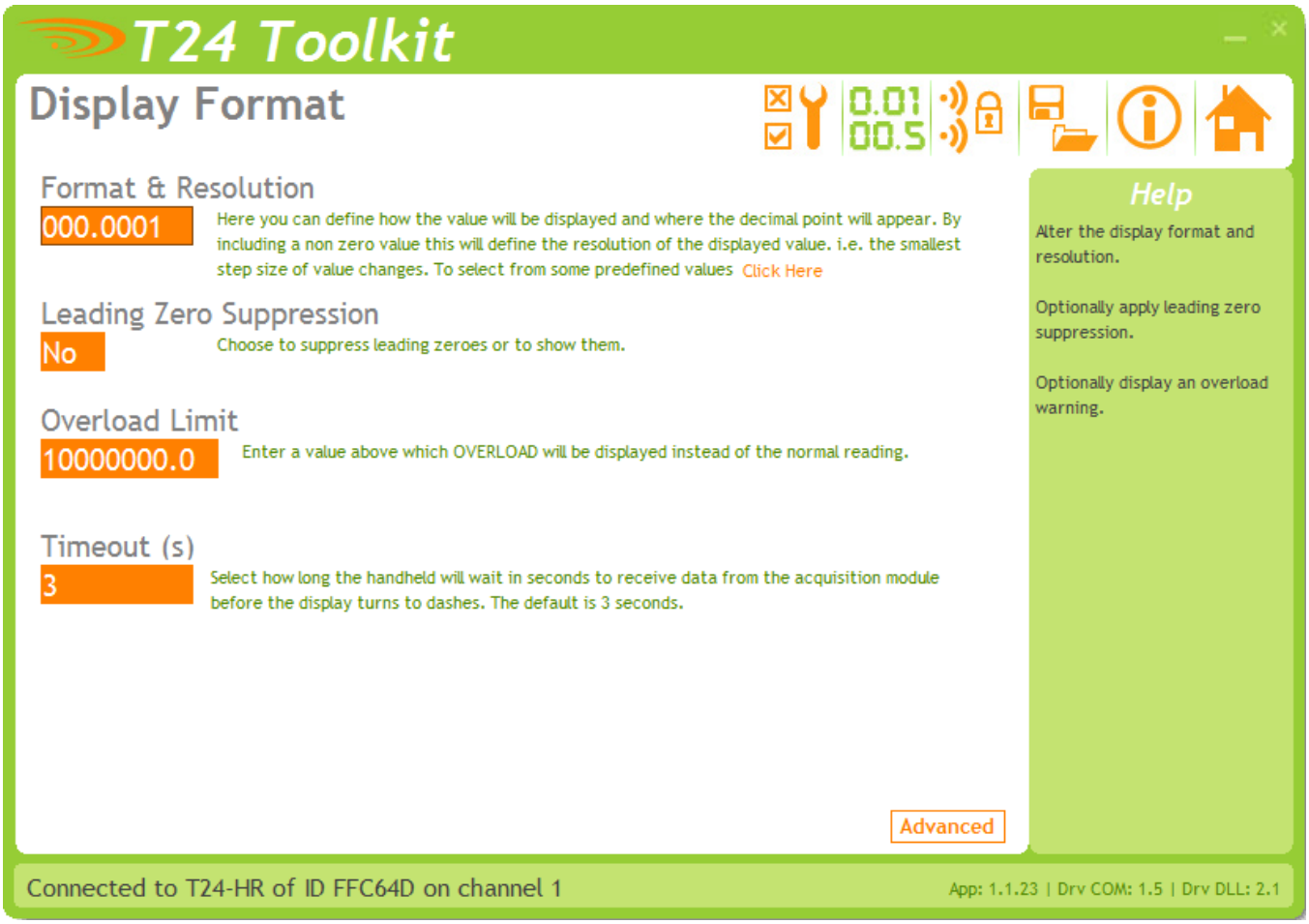
Here you can adjust settings that affect the display of zero.

Items you can change:

Power On Auto Zero	Here you can determine whether the T24-HS performs automatic zero when it is powered on. Enter zero to disable this function. If you enter a non-zero value then when the handheld is first turned on it checks the value read from the acquisition module. If this falls within ± of this value then the display will be altered so this reads zero. **Example:** A strain gauge acquisition module (T24-SA) is calibrated in Kgs and measures the weight of boxes on a platform. The weight of the platform itself has been removed using system zero on the acquisition module. Sometimes there is debris on the platform which you do not want to see when viewing the weight of boxes that will be placed on the platform later. The minimum weight of a box is 5 Kg so you could set the Power On Auto Zero to 2 Kg. When you turn on the handheld, if the weight on the platform is between -2 and +2Kg then the handheld will tare this weight off and so read zero.
Zero Indication Band	Using this setting you can mask tiny changes in input after you press the Tare button. Entering zero will disable this function. Entering a non-zero value will provide a band within which the display will always read zero. Once the reading exceeds this value the real weight will be displayed as no taring is taking place.

Example: You are adding boxes to a platform and you press tare between adding each one so you can see the weight of each box.
Without this setting activated each time you tare the display will be around zero but not exactly zero (By setting the display resolution you may hide this difference) by setting a small value here such as 0.2Kg the display will show a stable zero while actual weight is fluctuating less than ± 0.2Kg.

Display Format



Here you can adjust the display.

Items you can change:

Format & Resolution	Here you can define how the values are displayed on the LCD. There are 7 digits available and you can define where the decimal point is shown by entering text where a zero indicates a numeric digit position. When the data is being displayed the number of decimal places you define may be overridden as the display will always show the correct number of integer digits. Example: If you set the format to 000.0000 and the value to display is 1000.1234 the display will show 1000.123 You can also define the resolution, which is the block size of changes to the display. Example: If you enter the format as 000.0005 the display will only change in steps of 0.0005 which can be used to mask noisy digits at high resolutions.
Leading Zero Suppression	This can be turned on or off and will suppress leading zeroes when on. Example: If the display reads 000.123 with leading zero suppression turned off it will display 0.123 when turned on.
Overload Limit	You can enter a limit here above which **Overload** will be shown on the display instead of the actual value. Enter zero to disable this feature.
Timeout	Enter the timeout in seconds. This sets the time allowed without any data arriving from the viewed module before all dashes are displayed on the LCD. Should be at least 3 times the interval between the data being transmitted by the acquisition module.
Advanced	This opens the advanced page where you can scale the displayed data.

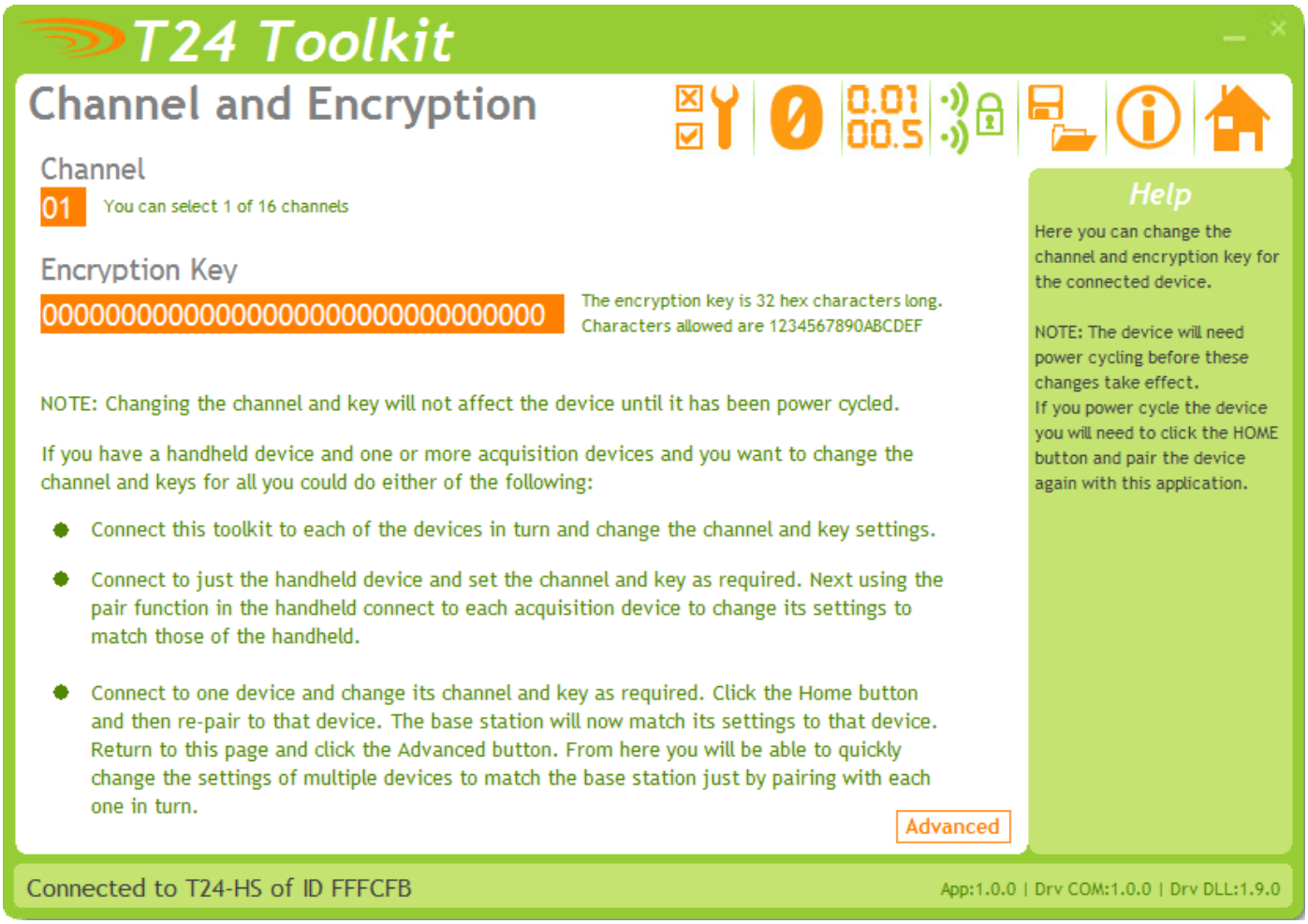
Display Format Advanced Settings

Here you can adjust the display update rate and also scale the displayed data. This may be used, for example, to convert the data from a T24-SA calibrated in Kgs so that the handheld display shows Lbs.

Items you can change:

Display Update Rate	Enter the interval in milliseconds between display updates. The default is 300 milliseconds. i.e. 3 updates per second.
Custom Display Scaling	This can be used to change the displayed value to a different unit or to otherwise scale it. You simply enter the original and required values at a low and high point. Example: If a T24-SA was supplying data in Kgs and you wanted to show tonnes. You would keep both the low points at zero. Enter **At High Input Value** of 1000 and **Display** Sh**ould Read** Value of 1.

Channel and Encryption



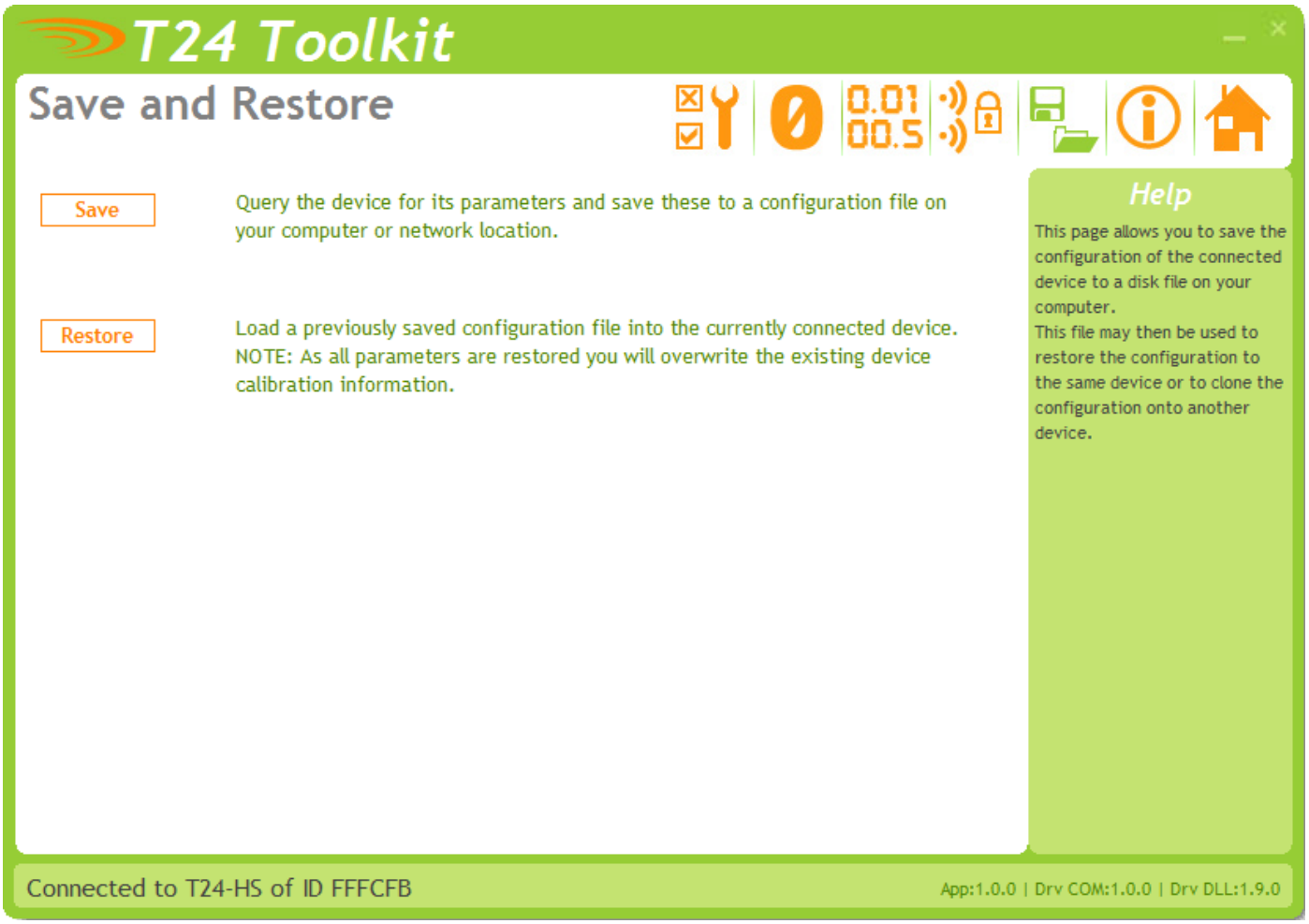
Here you can change the channel and encryption key for the acquisition module.
If you want to change the channel of an acquisition module and T24-HS pair there is no need to change both devices.
Simply pair to the handheld and change its channel and key.
Now perform pairing to the acquisition module from the handheld and the acquisition module will be configured to match the handheld.

NOTE: Early T24 modules do not yet utilise the encryption keys so these should be left at all zeros.

Items you can change:

Channel	Select a channel between 1 and 16. The default is channel 1. You can use the Spectrum Analyser mode to determine a good clean channel to use. NOTE: Channel 16 is used to negotiate pairing so avoid this channel if possible.
Encryption Key	Only devices with identical encryption keys can communicate. You can isolate groups of devices on the same channel or just use the key to ensure the data cannot be read by somebody else.

Save and Restore

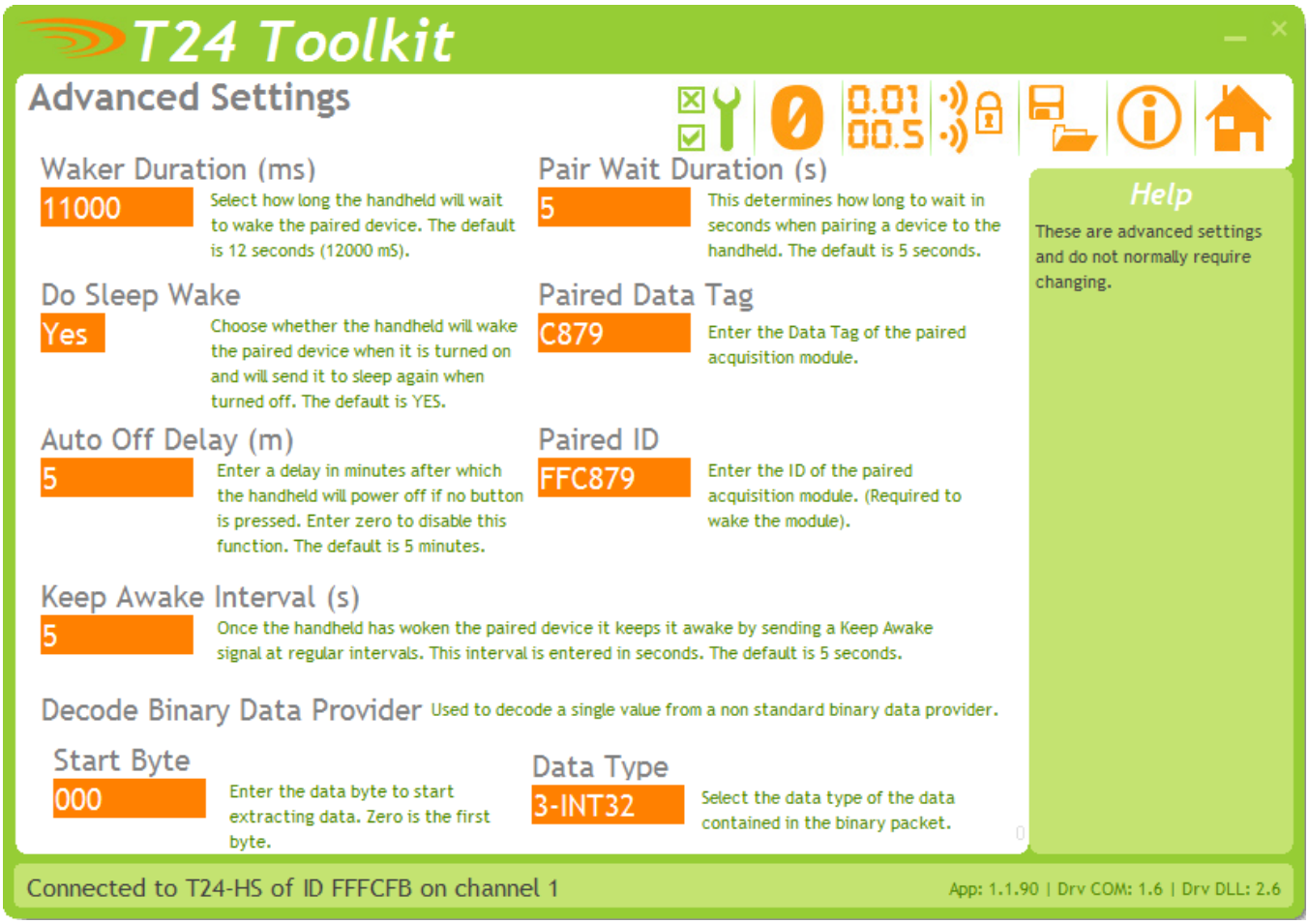


Here you can save the device settings to a file on your PC so that they can be later loaded back into the same or different device.

Items you can change:

Save	Click this button to open a file dialog window to allow you to select a filename and location to save the configuration file to. All configuration information including calibration data will be saved to the file. The file extension is **tcf**.
Restore	Click this button to open a file dialog window to allow you to select a filename and location of a previously saved file to load into the connected device. All configuration information **including** calibration data will be overwritten. The file extension is **tcf**.
Advanced Settings	Click this button to enter the Advanced Settings Page. Here are settings which do not normally require changing.

Advanced Settings



You should not normally need to change these settings.

Items you can change:

Waker Duration	When the handheld is turned on it may attempt to wake the paired acquisition module. This setting allows you to adjust the time it will wait to wake the remote device in milliseconds. The default is 12000.
Do Sleep Wake	You can select whether the handheld wakes the remote acquisition module on power up and sends it to sleep on power down. Select No to disable this function. The default is On.
Auto Off Delay	Here you can specify the delay in minutes after which the handheld will automatically turn off after no button is pressed. Enter zero to disable this function. The default is 5 minutes. The On/Off key can be used to reset this by giving a quick press. This may be more suitable than using the Tare key!
Keep Awake Interval	While the handheld is retrieving data from the acquisition module it periodically sends out a **Keep Awake** packet. This will stop the acquisition module from going to sleep while the handheld is in use. The default is 5 seconds.
Pair Wait Duration	Here you can set the duration that the handheld will wait to achieve successful pairing when it is turned on in Pairing mode. The default is 5 seconds.

Decode Binary Data Provider (versions 1.06 onwards)

Start Byte	When the handheld is used with a module that transmits a binary data provider packet the following two parameters are required to describe how the handheld

should extract a single value to display. The start byte (zero based) specifies where in the data provider data to start decoding.

Data Type	Specify the data type to extract. The choices are UINT8, UINT16, INT32 or FLOAT. You would need to refer to the programmers manual of the appropriate acquisition module to work out where to extract data from and what type. The default of INT32 with a Start Byte of zero is the default which will be correct for a T24-SAF module.

Installation

Overview

Radio performance at microwave wavelengths is very dependent upon the operating environment; any structure within the operating region of the radios will give rise to three effects:

Obscuration. Obscuration will result in reduced range and occurs when an obstruction masks the line-of-sight between radios.

Aberrations to the horizontal and vertical space patterns. Distortion of these patterns may occur if structures or objects are placed in the near or intermediate field of the antenna. The effect will be to distort the coverage patterns, adversely affecting range and link quality.

Reflection. Any object placed in line-of-sight of the transmit antenna will result in signals arriving at the receiver by an indirect path. Degradation of performance due to reflection (multipath effects) appears as reduced range or poor link quality.

Any of the above will cause poor RSSI figures, an increase in the packet loss rate and in extreme cases complete loss of signal. Fortunately, if consideration is given to these effects at the integration stage then a good quality link will be obtained.

Guidelines for product design:
When selecting materials for product enclosures, preference should be given to fibreglass, light coloured ABS or Polypropylene; at the wavelength of 2.4GHz radio other materials will adversely affect the signal by attenuation, refraction or change in polarisation.

If the application demands that the radio is fitted inside a metal enclosure then ensure that the specified clearances are maintained around the antenna and design in a fibreglass RF window at least as large as the clearance dimensions but ideally as large as possible.

RAD24i radios fitted inside a product should be oriented so that the chip antenna will be vertical when the product is in its normal operating position.

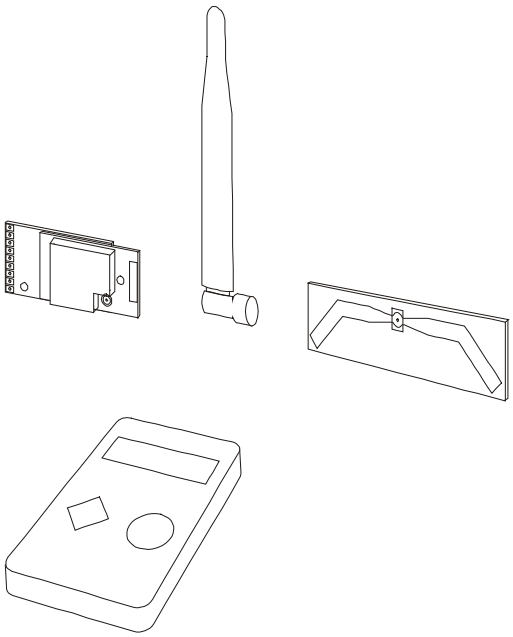
Guidelines for installation:
When planning installations ensure that line-of –sight between nodes is maintained and that objects or structures are kept at least one metre away from antennae wherever possible.

To avoid poor link quality between a RAD24i radio and a handheld device ensure that the RAD24i is mounted so that the chip antenna is vertical. Improvement may also be obtained by altering the height above ground of the RAD24i; a small increase or reduction in antenna elevation will often improve reception.

Range underwater is only a decimetre or so depending on packet rate. Best performance underwater is obtained by using low packet rates and immersing water-proofed antennae rather than water-tight enclosures containing the antennae.

Antenna Orientation

For the maximum range the acquisition module and the T24-HS should be orientated as shown.
The sensitivity to the radio transmission will be reduced if the acquisition module is oriented in a vertical or portrait position.



Battery

Use a pair of alkaline AA batteries. Due to the higher voltage requirements of this device NiMh and NiCad batteries are not recommended.

Specifications

General Radio

	Min	Typical	Max	Units
License		License Exempt		
Modulation method		MS (QPSK)		
Radio type		Transceiver (2 way)		
Data rate		250		K bits/sec
Radio Frequency	2.4000		2.4835	GHz
Power		1		mw
Range			200 (650)	Metres (feet) *
Channels (DSSS)		16		

***** Maximum range achieved in open field site at a height of 3 metres above ground.

T24-HS

Electrical	Min	Typical	Max	Units
Power Supply voltage	2.5	3.0	3.6	V DC

Power Supply	Min	Typical	Max	Units
Active		35	40	mA
Low power mode		120	160	uA
Estimated Battery life using 2Ahr batteries:				
Standby mode (Powered off)		1.5		Years
Continuous operation		40		Hours

Environmental	Min	Typical	Max	Units
IP rating		IP65		
Operating temperature range	-10		+50	C
Storage temperature	-40		+85	C
Humidity	0		95	%RH

Physical	
Hand Held Dimensions	90 x 152 x 34mm

Approvals

CE

Complies with EMC directive. 2004/108/EC
The Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive, 1999/5/EC,

European Community, Switzerland, Norway, Iceland, and Liechtenstein

English:	This equipment is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Deutsch:	Dieses Gerät entspricht den grundlegenden Anforderungen und den weiteren entsprecheneden Vorgaben der Richtlinie 1999/5/EU.
Dansk:	Dette udstyr er i overensstemmelse med de væsentlige krav og andre relevante bestemmelser i Directiv 1999/5/EF.
Español:	Este equipo cumple con los requisitos esenciales asi como con otras disposiciones de la Directive 1999/5/EC.
Français:	Cet appareil est conforme aux exigencies essentialles et aux autres dispositions pertinantes de la Directive 1999/5/EC.
Íslenska:	Þessi búnaður samrýmist lögboðnum kröfum og öðrum ákvæðum tilskipunar 1999/5/ESB.
Italiano:	Questo apparato é conforme ai requisiti essenziali ed agli altri principi sanciti dalla Direttiva 1999/5/EC.
Nederlands:	Deze apparatuur voldoet aan de belangrijkste eisen en andere voorzieningen van richtlijn 1999/5/EC.
Norsk:	Dette utstyret er i samsvar med de grunnleggende krav og andre relevante bestemmelser i EU-directiv 1999/5/EC.
Português:	Este equipamento satisfaz os requisitos essenciais e outras provisões da Directiva 1999/5/EC.
Suomalainen:	Tämä laite täyttää direktiivin 1999/5/EY oleelliset vaatimukset ja on siinä asetettujen muidenkin ehtojen mukainen.
Svenska:	Denna utrustning är i överensstämmelse med de väsentliga kraven och andra relevanta bestämmelser i Direktiv 1999/5/EC.

This equipment is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

FCC

Family: RAD24
Models: i and e for internal and external antenna variants. For antenna T24-ANTA and T24-ANTB
FCC ID:VHARAD24
This device complies with Part 15c 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.

CAUTION: If the device is changed or modified without permission from Mantracourt Electronics Ltd, the user may void his or her authority to operate the equipment.

Industry Canada

Industry Canada Industrie Canada

Models: i and e for internal and external antenna variants. For antenna T24-ANTA and T24-ANTB
IC:7224A-RAD24
This apparatus complies with RSS-210 - Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment RSS.

OEM / Reseller Marking and Documentation Requirements

FCC

The Original Equipment Manufacturer (OEM) must ensure that FCC labelling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents as shown:

> Contains FCC ID:VHARAD24
>
> 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.

The acquisition modules have been tested with T24-ANTA and T24-ANTB. When integrated in OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas other than T24-ANTA and T24-ANTB must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

Acquisition modules have been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by Mantracourt could void the user's authority to operate the equipment.

In order to fulfil the certification requirements, the OEM must comply with FCC regulations:
1. The system integrator must ensure that the text on the external label provided with this device is placed on the outside of the final product.
2. The acquisition modules with external antennas may be used only with Approved Antennas that have been tested by mantracourt.

IC

Labelling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display the following text:

> Contains Model RAD24 Radio (2.4 GHz), IC:7224A-RAD24

Integrator is responsible for its product to comply with RSS-210 - Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment RSS.

CE

The T24 series has been certified for several European countries.
If the acquisition module is incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive. Furthermore, the manufacturer must maintain a copy of the T24 device user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

OEM Labelling Requirements

The 'CE' marking must be affixed to a visible location on the OEM product.

The CE mark shall consist of the initials “CE” taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

Declaration Of Conformity

We, **Mantracourt Electronics Limited**
The Drive
Farringdon
Exeter
Devon EX5 2JB
declare under our sole responsibility that our products in the **T24 Radio Telemetry Product Range** to which this declaration relates are in conformity with the appropriate standard EN 300 328 following the provisions of the Radio and Telecommunications Terminal Equipment Directive **1999/5/EC**, **FCC CFR Title 47** part 15c BS EN 61000-4-2 and BS EN 61000-4-3 following the provisions of the EMC Directive **2004/108/EC** and Low Voltage Directive **2006/95/EC**.

December 2007

Brett James
Development Manager
Mantracourt Electronics Limited.

FCC ID:VHARAD24

CE

Worldwide Regional Approvals

Region	Product Conforms To
Europe	CE
USA	FCC
Canada	IC
Australia	To Be Determined
China	To Be Determined
Japan	To Be Determined

Important Note

Mantracourt does not list the entire set of standards that must be met for each country. Mantracourt customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. For more information relating to European compliance of an OEM product incorporating the T24 range of modules, contact Mantracourt, or refer to the following web site: **www.ero.dk**

Warranty

All Telemetry products from Mantracourt Electronics Ltd., ('Mantracourt') are warranted against defective material and workmanship for a period of (1) one year from the date of dispatch.

If the 'Mantracourt' product you purchase appears to have a defect in material or workmanship or fails during normal use within the period, please contact your Distributor, who will assist you in resolving the problem. If it is necessary to return the product to 'Mantracourt' please include a note stating name, company, address, phone number and a detailed description of the problem. Also, please indicate if it is a warranty repair.

The sender is responsible for shipping charges, freight insurance and proper packaging to prevent breakage in transit.

'Mantracourt' warranty does not apply to defects resulting from action of the buyer such as mishandling, improper interfacing, operation outside of design limits, improper repair or unauthorised modification.

No other warranties are expressed or implied. 'Mantracourt' specifically disclaims any implied warranties of merchantability or fitness for a specific purpose. The remedies outlined above are the buyer's only remedies. 'Mantracourt' will not be liable for direct, indirect, special, incidental or consequential damages whether based on the contract, tort or other legal theory.

Any corrective maintenance required after the warranty period should be performed by 'Mantracourt' approved personnel only.

Industry Canada
Industrie Canada

Designed, manufactured and supported in the UK

ISO 9001
REGISTERED FIRM

In the interests of continued product development, Mantracourt Electronics Limited reserves the right to alter product specifications without prior notice.

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