THE QUEEN'S AWARDS
FOR ENTERPRISE
2009

T24-RM1

Relay Module

User Manual
www.mantracourt.co.uk

mantracourt

Wireless Telemetry Range 2.4Ghz

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Introduction / Overview

The T24-RM1 offers dual power relays capable of mains power switching. These relays can be configured as high, low or window alarms and can be associated with a group of up to 8 T24 acquisition modules per relay. Relays can operate when the sum of the assigned acquisition modules reach a setpoint or when any of the modules reach the setpoint. There is also a mode where the difference between the lowest and highest value is compared to the setpoint. This is ideal for applications where you are looking for a group of weights to be within a certain band. i.e. balancing four corners of a weigh scale or a hanging truss.
Relays can be latched and a digital input or external command can be used to reset them.
An alarm/error signal relay is operated if communication is lost or other selectable errors occur and this alarm resets once the source of the alarm or error is removed.
This module is supplied in an IP65 sealed ABS case but a DIN rail option is available.
The state of the power relays during an error can be selected.

Communications Overview

The T24 range of telemetry devices each have a factory set unique **ID**.
Data is shared between devices using **Data Provider** messages. A device generates these messages which can then be used by many other devices simultaneously.
These messages (or packets) of information contain a single value of data and each is identified by a **Data Tag**.
The **Data Tag** should be unique for each message.

ID **Identifies each device**
Each device has a unique **ID** that is factory set. This is represented as a 6 character hexadecimal number consisting of the digits 0 to 9 and the letters A to F.
I.e. **`FFD3BE`**

Data Tag **Identifies each Data Provider message**
A **Data Tag** consists of a 4 character hexadecimal number consisting of the digits 0 to 9 and the letters A to F. The **Data Tag** can be changed by the user but the factory default is to match the last 4 characters of the device **ID**.
I.e. An acquisition device of **ID** **`FFC12B`** would have a default **Data Tag** of **`C12B`**.

When a device consumes data (i.e. a handheld displaying data from an acquisition device) all it is doing is listening to all of the **Data Provider** messages and selecting the one it wants to use. It then extracts the data and displays it.

Some devices that use **Data Provider** messages also need to know the **ID** of the device providing the data. This is necessary if that device needs to specifically wake the data providing device as opposed to using a broadcast wake that will wake all devices on the same channel and using the same encryption key.

Pairing offers an automated method of hooking a provider and consumer of data together. However, some devices may require you to manually enter **Data Tag** and **ID** information so it would be beneficial to the user to understand the above mechanism.

Configuration Overview

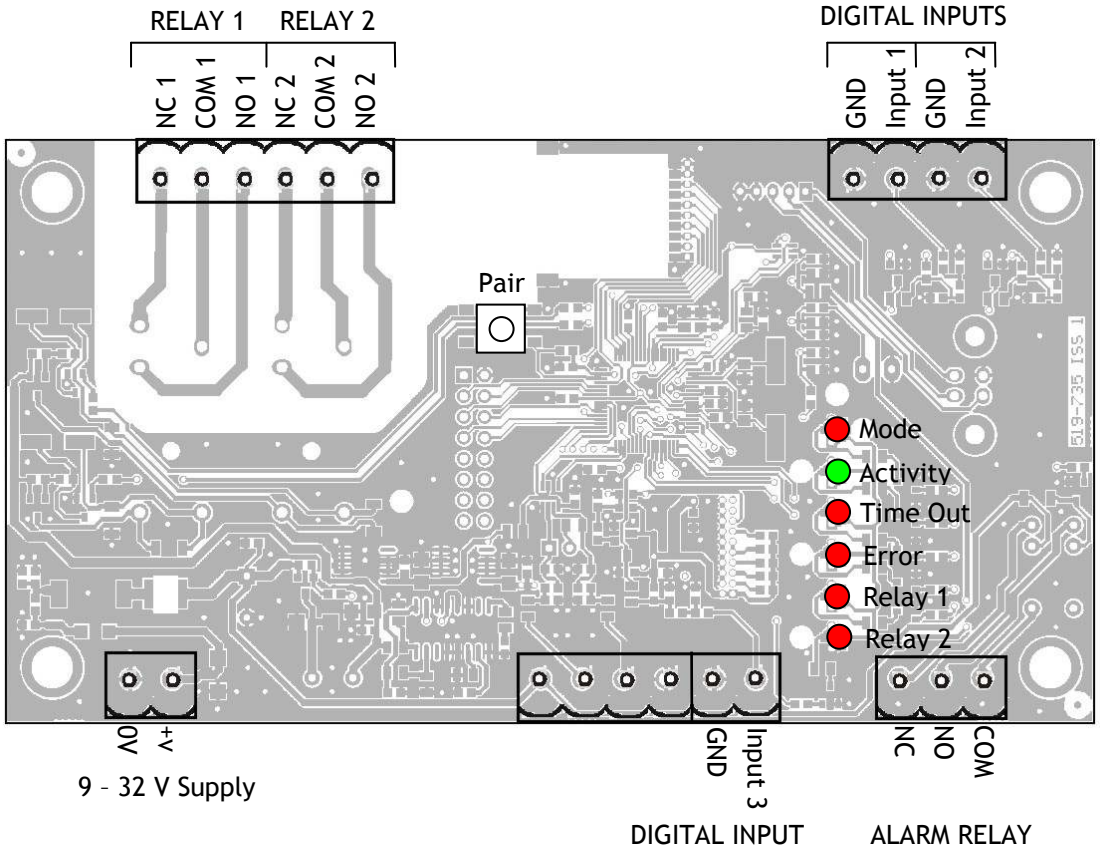
You need to determine the Data Tags of all acquisition modules that are to contribute data to this relay module.
Each relay can use the value of up to 8 inputs which are, depending on the mode selected, used to generate a value that is checked against your setpoint.
The toolkit allows you to see the calculated value of the selected set of Data Tags. In the case of ‘sum’ mode this will help in determining whether you want to apply an offset. This may be useful to effectively ‘zero’ the input total to make calculating the setpoints easier.

Getting Started

To be able to see the totals from acquisition devices supplying data to the T24-RM1 and to avoid entering error mode due to timeouts, we must first ensure that the appropriate modules are transmitting their values at a suitable rate such as the default of 3 per second. Then we can configure the T24-RM1 to use the data from these devices.
Configuration must be done with the T24 Toolkit software and a base station.

Connections & Indicators

You will need to connect power to the T24-RM1 for it to operate. Only power is required to enable configuration using a base station and the appropriate toolkit software.



LEDs

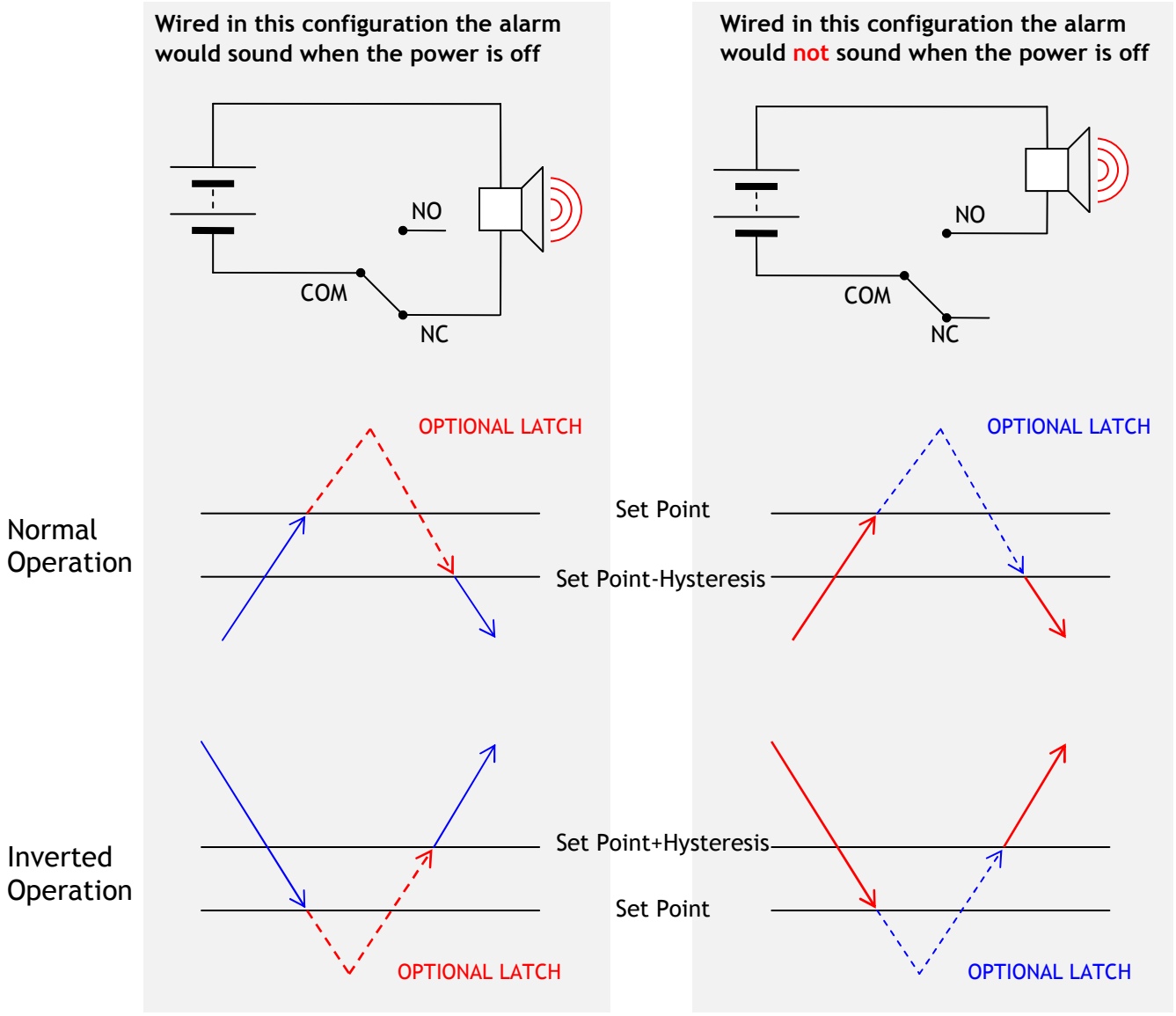
Mode	Flashes 2 x per second when operational
Activity	Flashes when T24 data packets are received
Time Out	No T24 data present for longer than user defined period
Error	Remote T24 error from any defined T24 input device
Relay 1	Relay 1 Energised (Connection between COM and NO)
Relay 2	Relay 2 Energised (Connection between COM and NO)

Inputs

Digital Input 1	Can either reset a latched relay 1 or transmit a Data Provider Packet of a specified Data Tag
Digital Input 2	Can either reset a latched relay 2 or transmit a Data Provider Packet of a specified Data Tag
Digital Input 3	Resets both latched relays

T24-RM1 Operation

The T24 RM1 can accept 8 T24 data inputs for each of the two relays, the total of the inputs compared to the set point and mode of the relay channel affects whether the relay is energised or not. In addition when considering the use relays attention should be paid as to what state the system will be in when the power is off. The diagram below outlines how wiring and normal and inverse modes influence the state of relays. (COM = Common, NO = Normally Open, NC = Normally Closed)



KEY:

↗	Increasing Value	_____	Relay Energised	_____	Alarm Activated
↘	Decreasing Value	---------	Relay Unenergised	_____	Alarm Deactivated

Relays can change state due to the following events:

- Arrival of T24 data from user defined T24 device that causes the relay output to trigger.
- Triggering of digital input 1 or 2 (switch input) which if configured reset latched relays
- Arrival of data from a specified data tag can reset latched relays.
- A change in error state of a module specified in a relays list of inputs

The T24-RM1 also features a third Alarm relay. The Alarm relay is energised from start up, (connection made between COM and NO). The relay de-energises if an error is detected, an error is classed as a timeout and optionally can include Integrity error or low Battery. The Alarm Relay will return to normal once the source of the error is removed.

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.

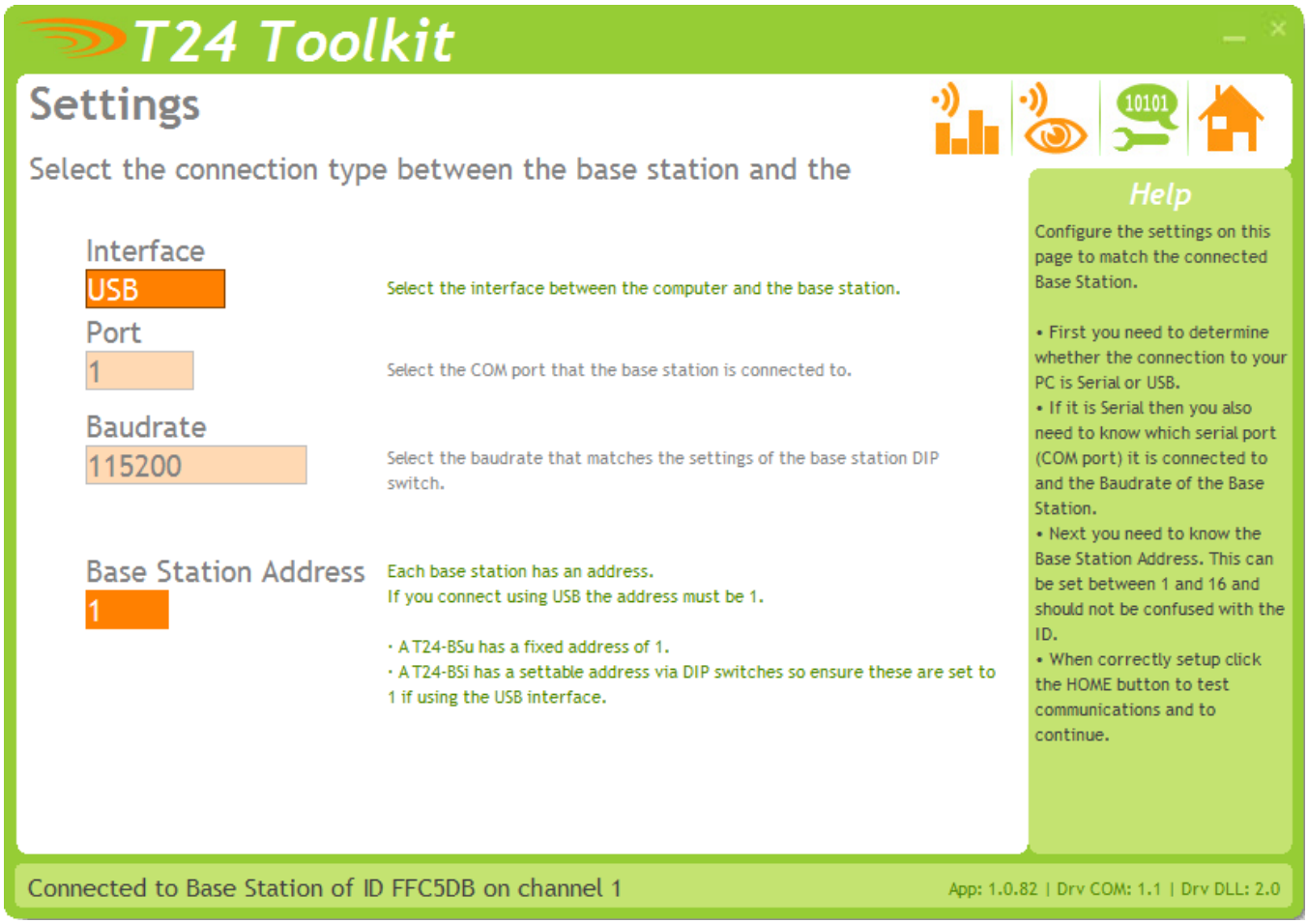
T24 Toolkit

The T24 Toolkit provides a means of simple configuration of the T24-RM1 and associated acquisition module along with useful tools to aid integration. Calibration of the acquisition modules is also provided.

Run the T24 Toolkit software application.

General Pages

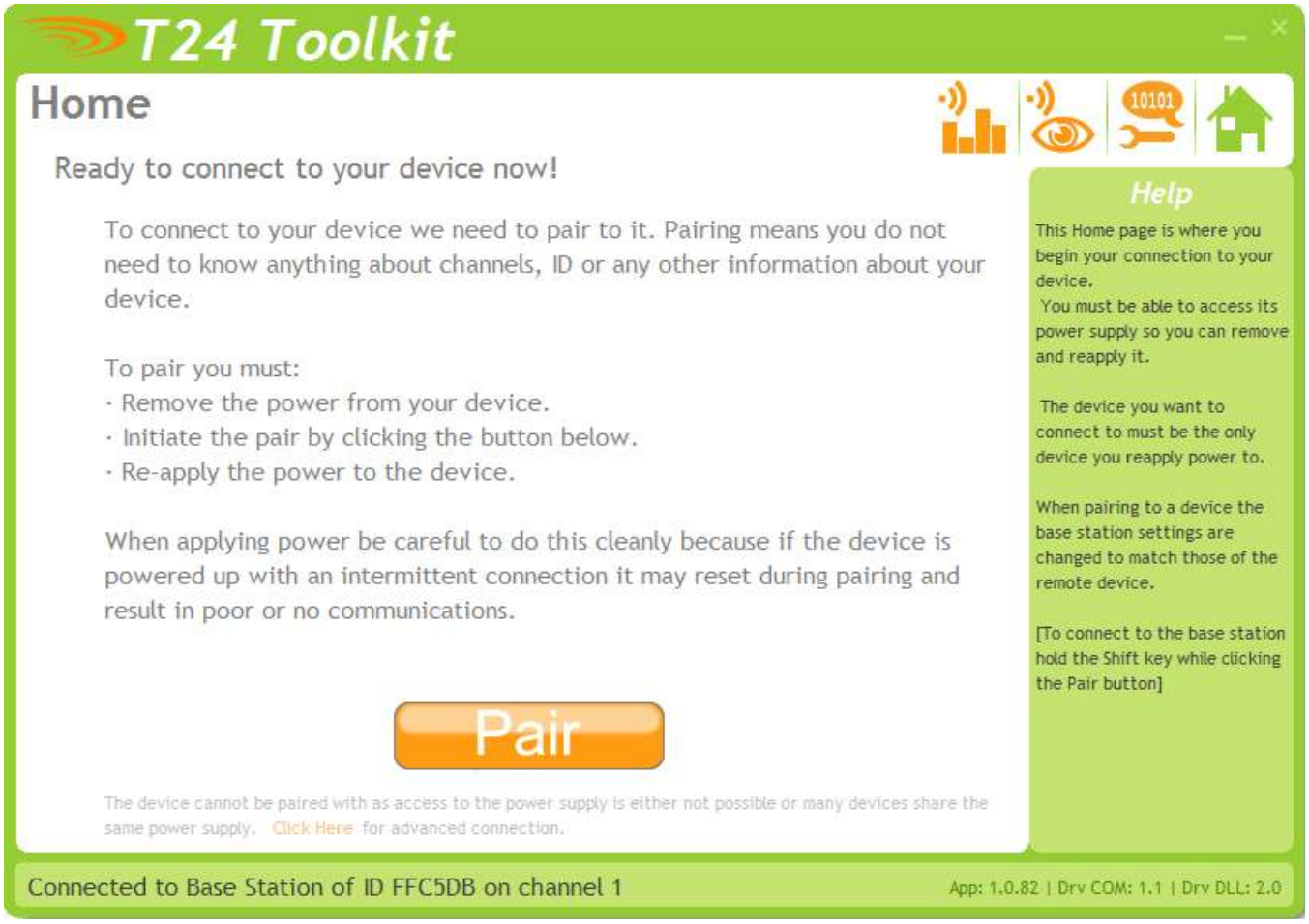
Setup Base Station Communications



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.

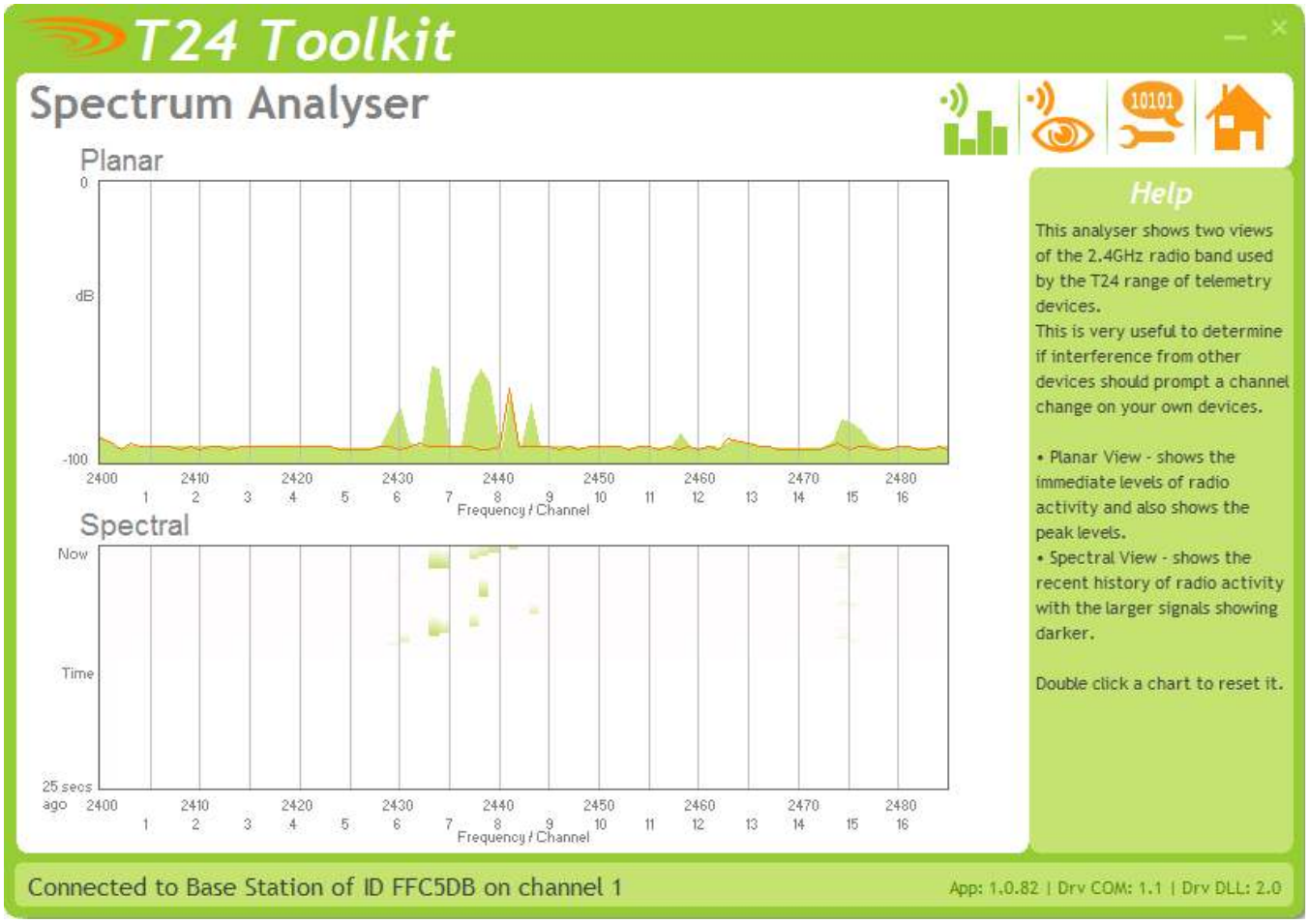
Pairing Procedure

- Remove power from the T24-RM1 module.
- Click the Pair button on the toolkit.
- You now have 10 seconds to re-apply power to the T24-RM1 module.

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

NOTE: The act of Pairing with the toolkit will **not** change the radio configuration settings of the connected device. The settings will only change if you change them yourself within the toolkit.

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.

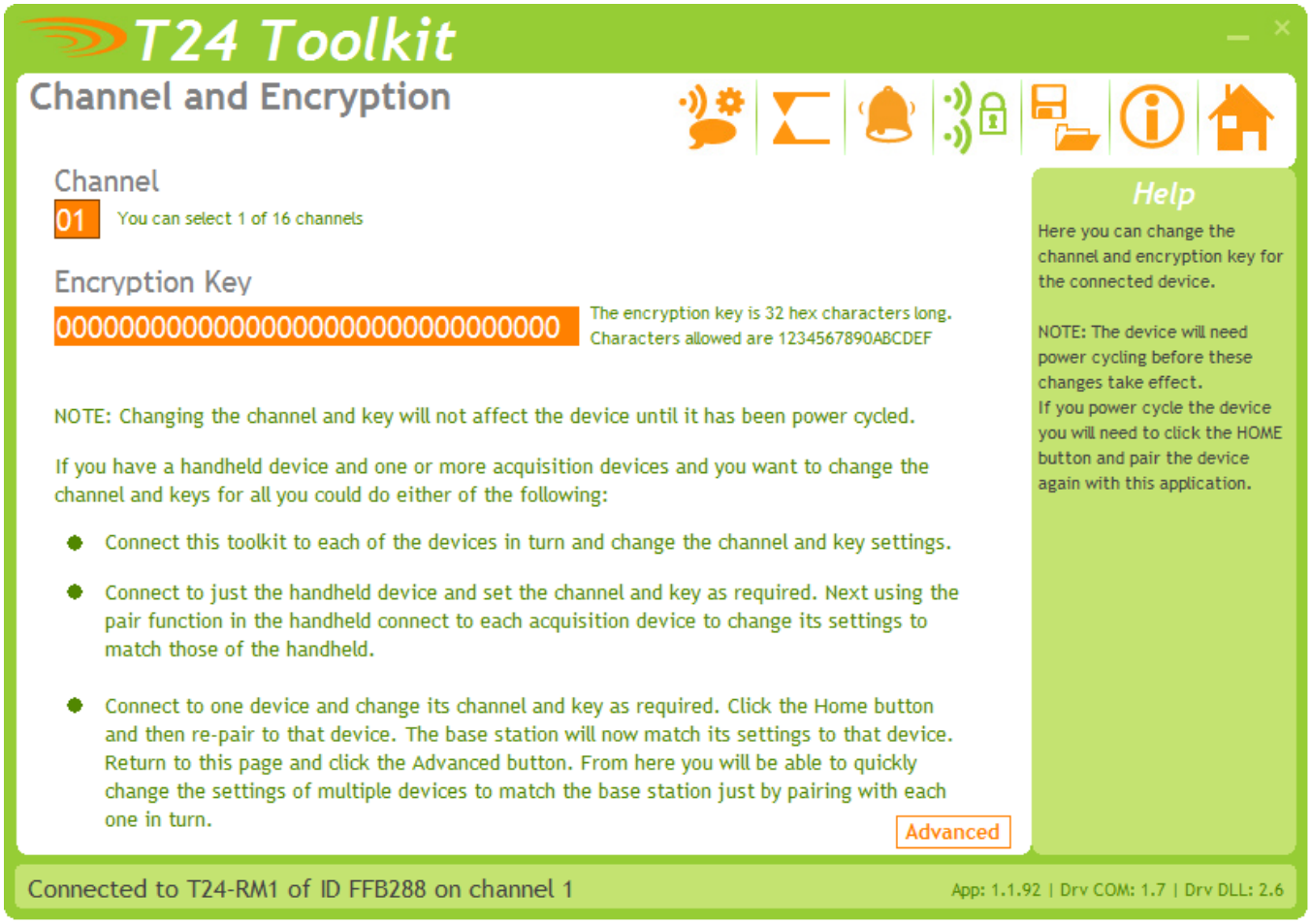
Information

This page shows you information about the connected device.

Items you can change:

Name	You can enter a short descriptive name (11 characters) which may help you recognise this device in the future.

Channel and Encryption



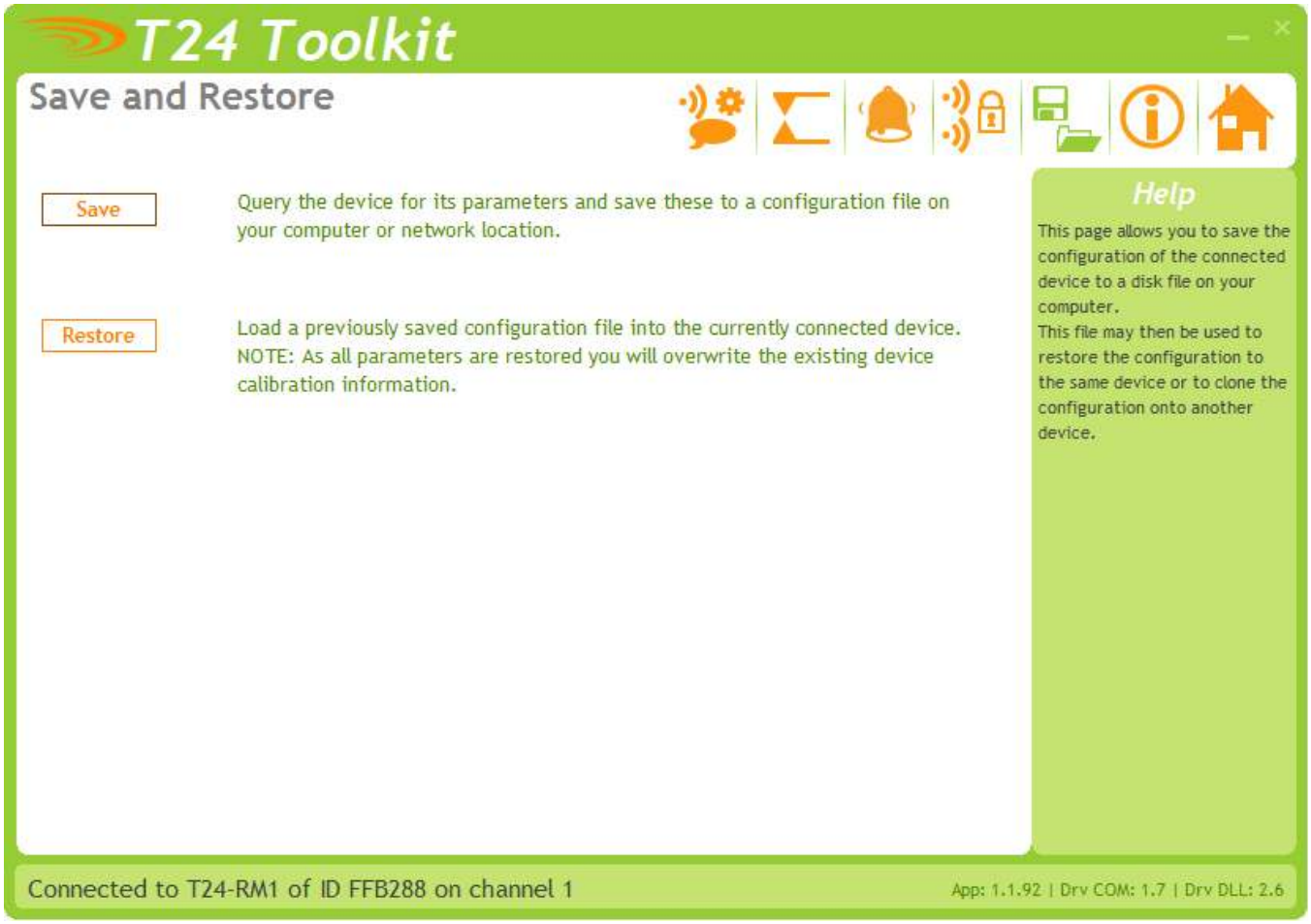
Here you can change the channel and encryption key for the module.

NOTE: Early acquisition module 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

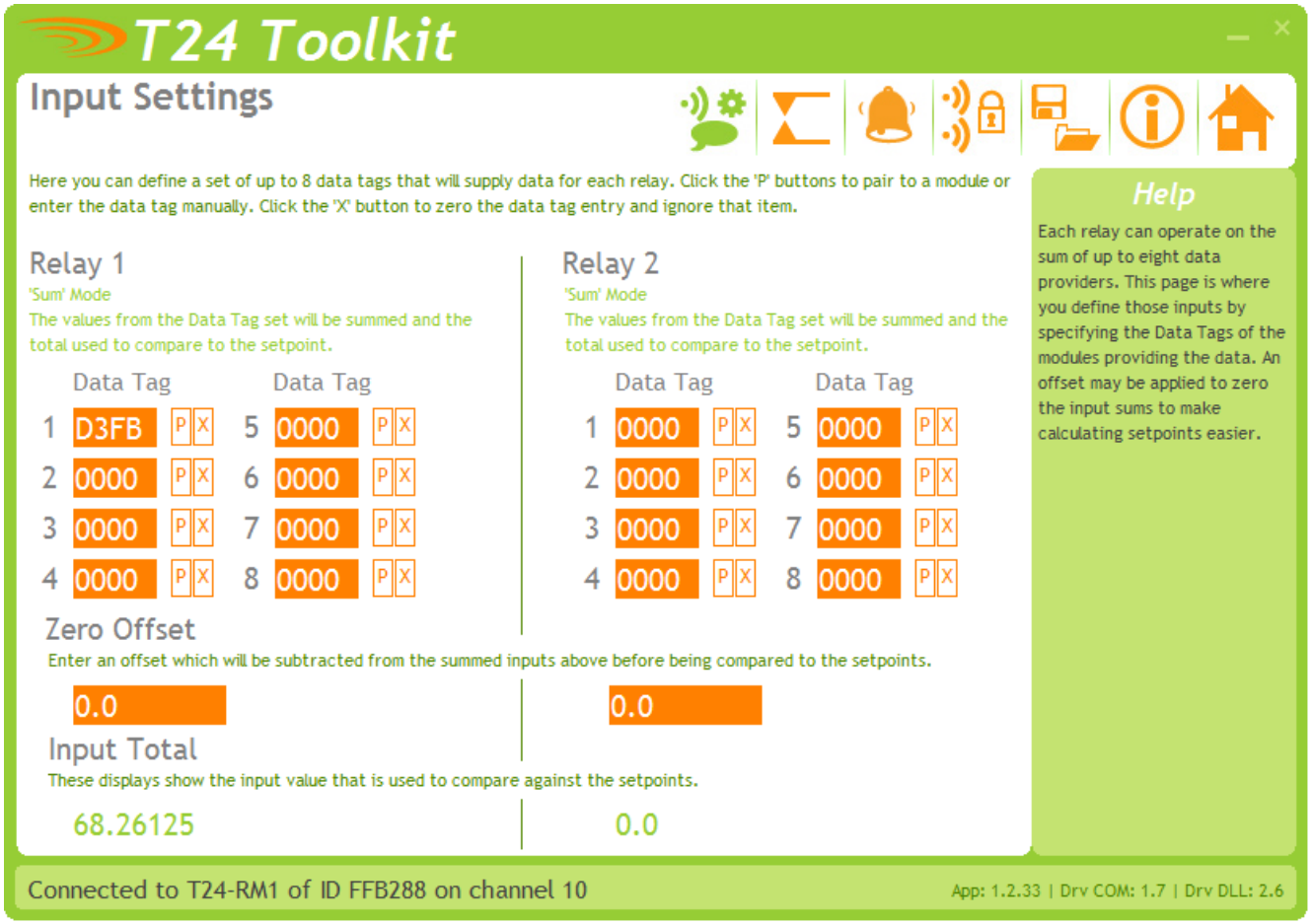


Here you can save the device settings to a file on your PC so that they can be later loaded back into the same or different device.

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.

Input Settings

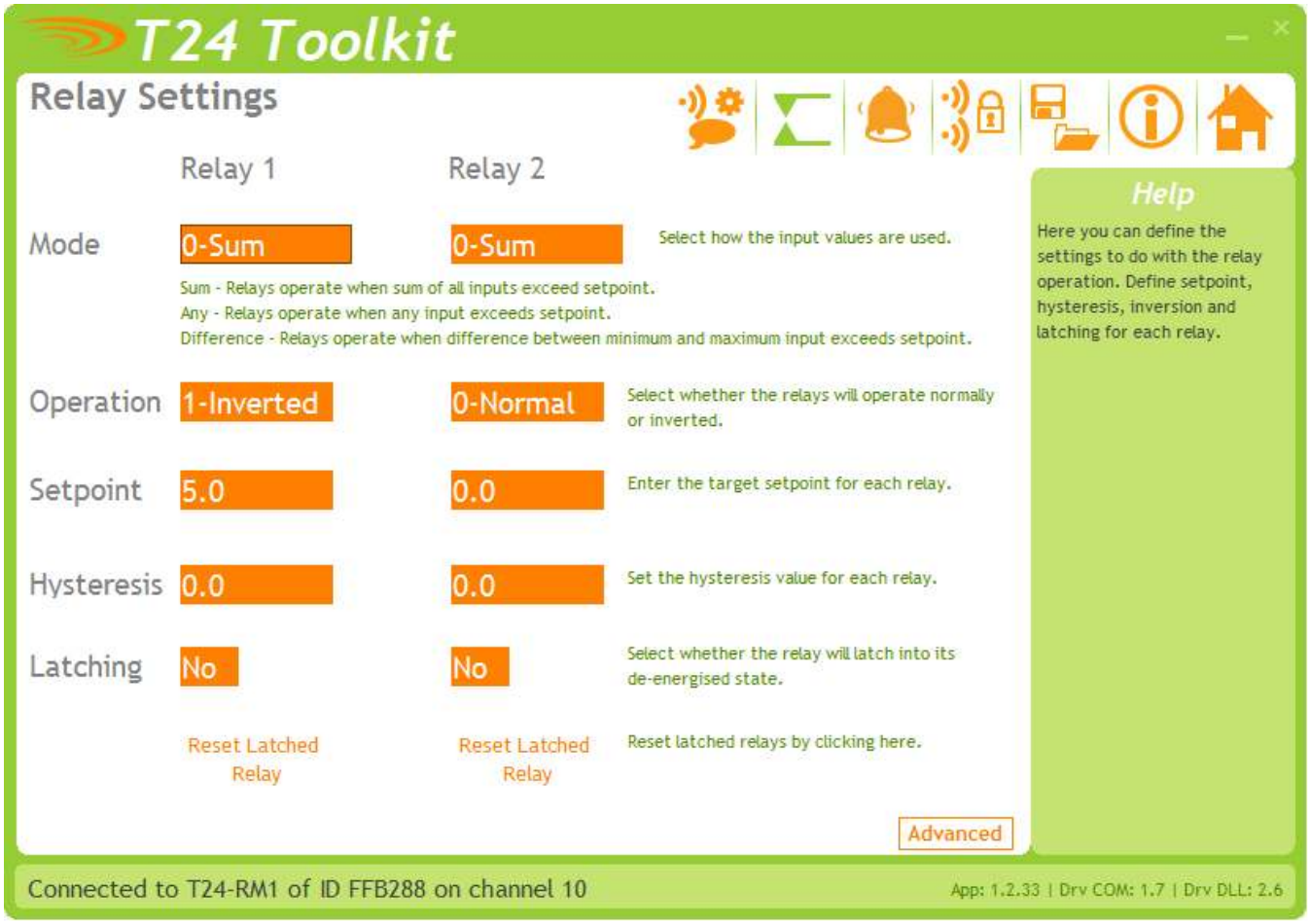


Here you can set the Data Tags of the data used as the inputs.
The description in green below the 'Relay1' and 'Relay2' captions indicate the way in which the values from the Data Tags will be used to compare against the setpoint to determine whether the relay will activate.
See the **Relay Operation Settings** section for details.

Items you can change:

Relay1DataTag[1-8]	Enter up to eight Data Tags the data from which will be used to determine the value compared to the set point to control relay 1.
Relay2DataTag[1-8]	Enter up to eight Data Tags the data from which will be used to determine the value compared to the set point to control relay 2.
Zero Offset [1-2]	This value will be subtracted from the total of the summed data from the data tags for Relay 1.

Relay Operation Settings



Here you can change various settings that influence the operation of the individual relays.

Items you can change:

Mode [1-2]

This setting determines how the Data Tag values are used to compare against the setpoint. This is only available in firmware versions 2.0 and above. Previous versions will operate only in 'Sum' mode.

- **Sum** – The values of the defined Data Tags are summed and this summed total is compared to the setpoint.
- **Any** – The Data Tags with the highest value is compared to the setpoint. i.e. If any of the individual acquisition modules exceed the setpoint.
- **Difference** - The difference between the lowest and highest values of all the Data Tags is calculated and this difference (Which is absolute i.e. always positive) compared to the setpoint.
-

Operation [1-2]

Whether set to normal or inverse decides how the relay state corresponds to the set point and hysteresis. (See diagram on next page)

Setpoint [1-2]

The Set Point is the level at which the relay state will change, see below.

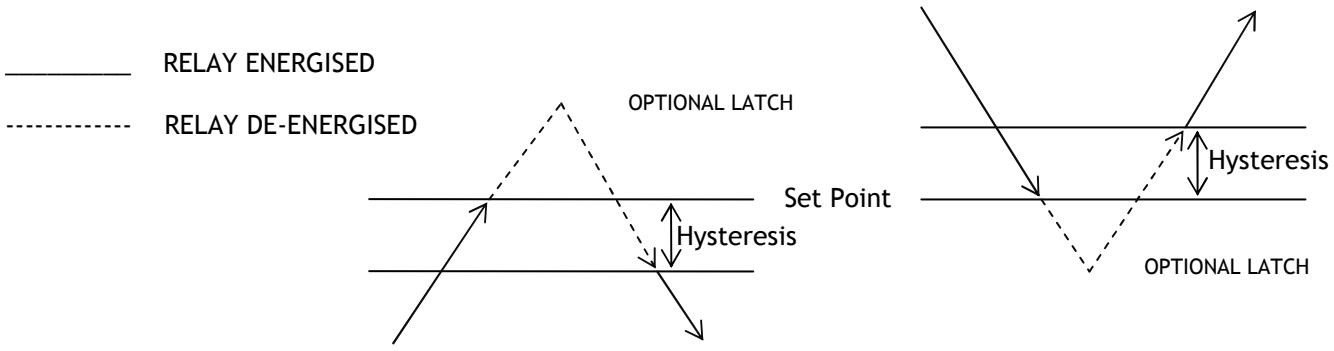
Hysteresis [1-2]

This value set on offset between when the relay is engergised and de-energised creating a de-bounce for the relay. (See diagram on next page)

Latching [1-2]

Latching locks the state of the relay when it passes the set point.

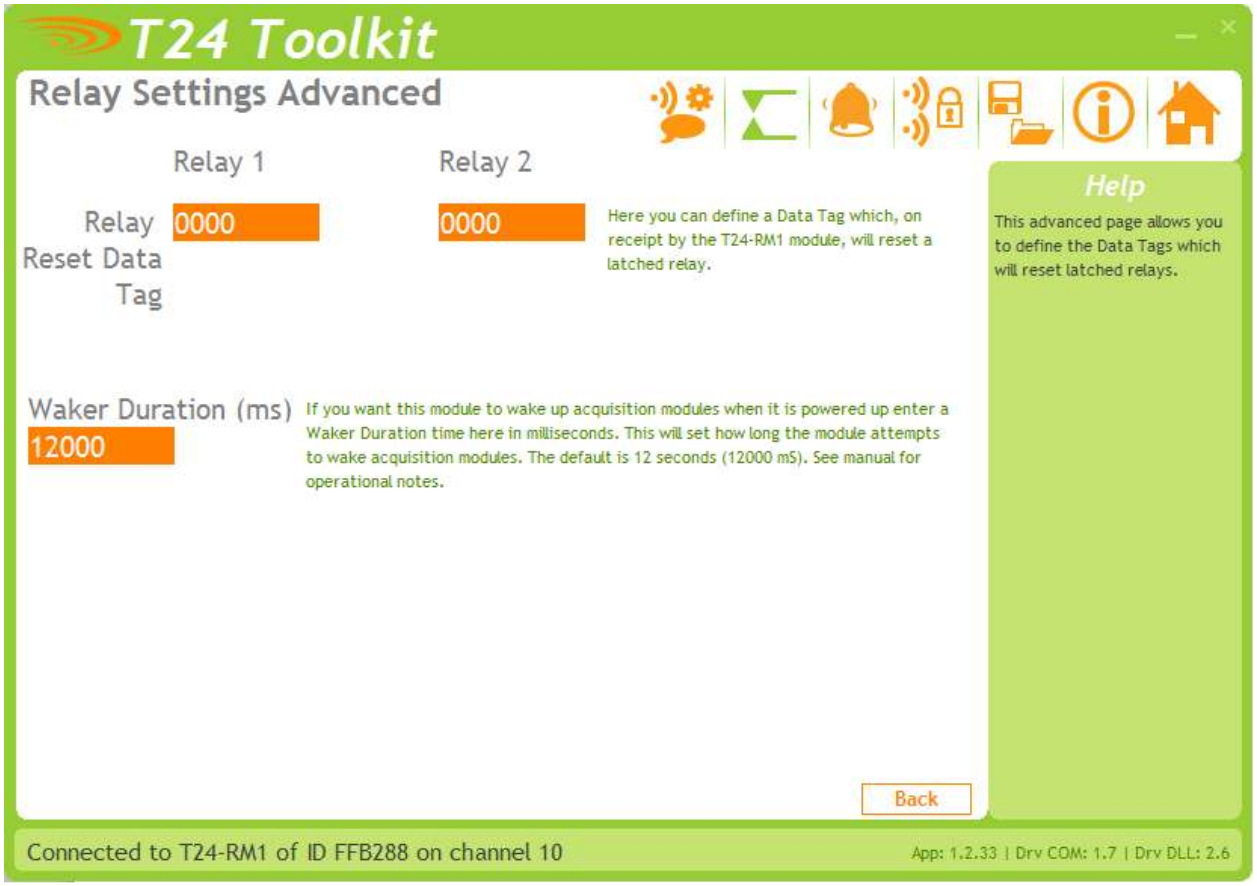
Operation and Hysteresis Settings



Normal Operation

Inverted Operation

Relay Settings Advanced

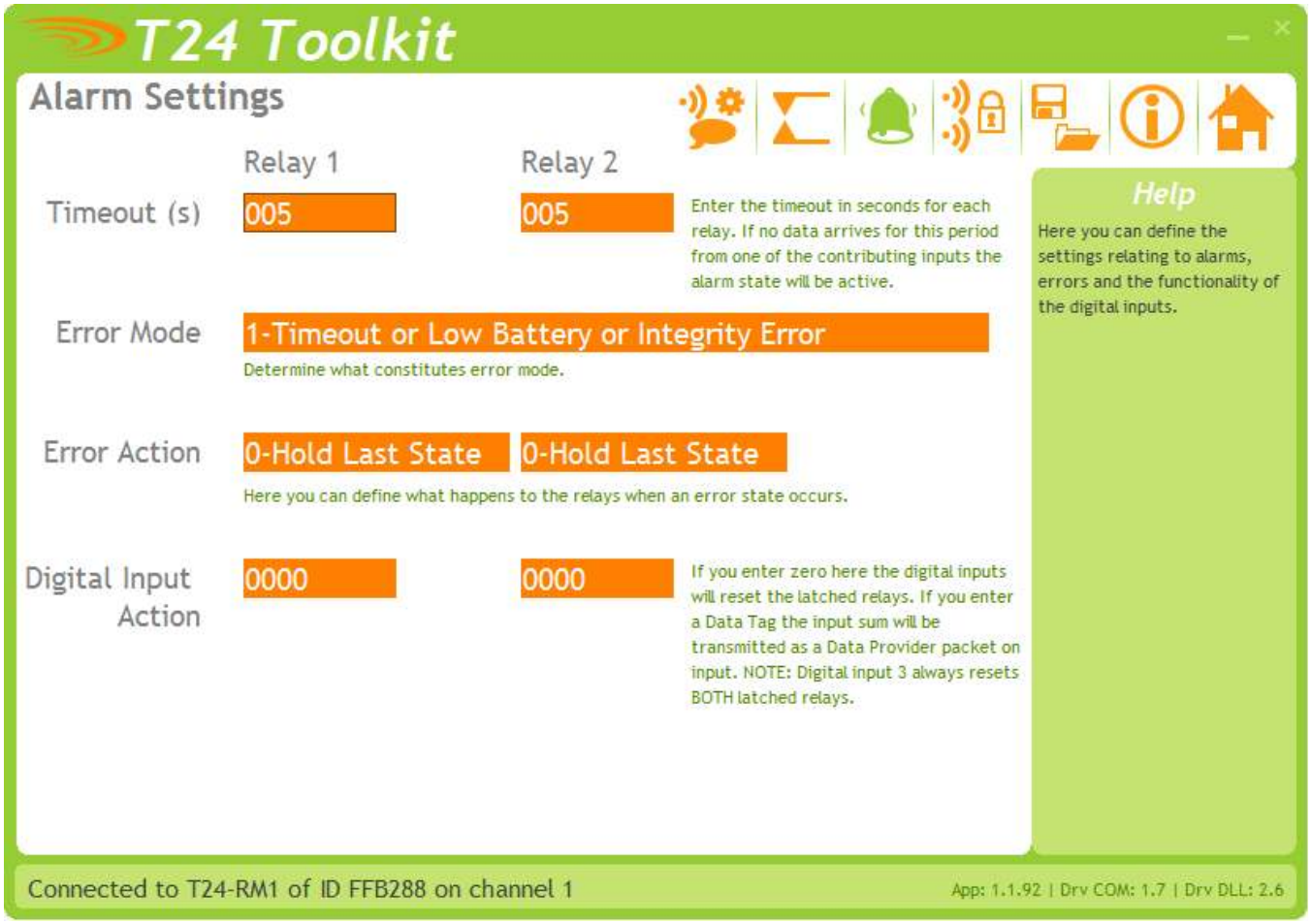


Here you can change various settings that influence the operation of the individual relays.

Items you can change:

Relay Reset Data Tag [1-2]	Enter a Data Tag that on receipt will reset the latched relay. Enter zero to disable this feature.
Waker Duration	Enter a time in milliseconds for this module to attempt to wake acquisition modules when first powered up. The default is 12000 milliseconds (12 seconds). When this is non zero the acquisition modules will be kept awake while this module has power applied. The acquisition modules should have a Sleep Delay set so that after the relay module has been powered down the acquisition modules then return to sleep. Enter zero to disable this feature.

Errors & Input Settings



This page defines how the individual relays will react to time outs and errors present from any defined T24 device, as well as how Digital inputs 1 and 2 are used.

Items you can change:

Timeout	Enter a time in seconds that if exceeded the T24-RM1 will affect the relay state according to the error action, as well as set the alarm relay and light the time out LED
Error Action	For each relay the action upon error detection can be defined as ; • Hold Last State • De-Energise Relay • Energise Relay
Error Mode	The error mode defines what is causes the alarm relay and individual error action to be triggered. Errors can be defined as • Time out • Time out or Low Battery • Time out or Low Battery or Integrity Error
Digital Input 1	Digital input 1 can be used to either • Reset Relay 1 from its latched state • Transmit a data provider with user defined data tag containing the total of the inputs of Relay 1
Digital Input 2	Digital input 2 can be used to either • Reset Relay 2 from its latched state • Transmit a data provider with user defined data tag containing the total of the inputs of Relay 2

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.

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-RM1

	Min	Typical	Max	Units
PSU	9	-	32	V DC
Operational Current All Relays Active		155**		mA
Operational Temperature Range	-10		60	Deg C
Storage Temperature Range	-40		70	Deg C
Power Relays		240V 5A		
Alarm Relay		1A 24V DC	120 V AC	

** At 12 Volt nominal Supply

Approvals

CE

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

FC

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.

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CE

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

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