

THE QUEEN'S AWARDS FOR ENTERPRISE 2009

T24-BSi, T24-BSu, T24-BSue

T24 Base Station

User Manual

www.mantracourt.co.uk

mantracourt

Wireless Telemetry Range 2.4Ghz

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Introduction / Overview

Base stations are the interface between the T24 radio system and a PC, PLC or other controller.
A base station would be required to configure T24 modules from a PC using the T24 Toolkit software and also required if you are to capture data from devices to a PC or PLC.

Addressing

Usually only a single base station is required in a telemetry installation. If a telemetry device is outside the range of the base station a repeater may be deployed.
Some complex topologies may only be realized by using multiple base stations which may require changes to the **Address** switches. (See **Advanced Multipoint Base Station** Section)

Our industrial base station (T24-BSi) has interfaces for USB, RS232 and RS485 and is addressable. Our USB only base station (T24-BSu & T24-BSue) has a fixed address of 1 so only one can be connected to a PC at a time.

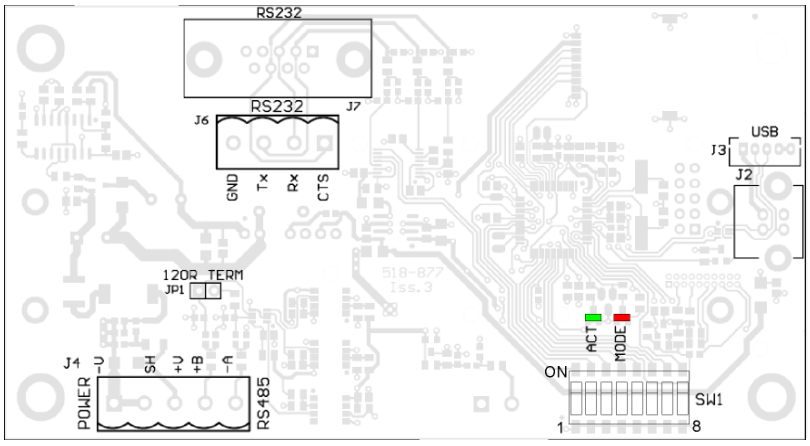
Connections

T24-BSu & T24-BSue

This base station simply connects to the USB port of a PC and is powered from the USB bus. The T24-BSue is an IP65 sealed unit with increased radio range over the T24-BSu.

T24-BSi

This diagram shows the available connections, switches and LEDs.



The interface can be selected from the DIP switches **SW1** as can baudrates for serial interfaces and the Address of the base station.

SW1 Settings

Address

Switch positions 1 to 4 select the base station **Address**. This should normally be 1.

	1	2	3	4
Address				
1	Off	Off	Off	Off
2	On	Off	Off	Off
3	Off	On	Off	Off
4	On	On	Off	Off
5	Off	Off	On	Off
6	On	Off	On	Off
7	Off	On	On	Off
8	On	On	On	Off
9	Off	Off	Off	On
10	On	Off	Off	On
11	Off	On	Off	On
12	On	On	Off	On
13	Off	Off	On	On
14	On	Off	On	On
15	Off	On	On	On
16	On	On	On	On

Serial/USB

Switch positions 5 to 7 set whether serial or USB is used. If USB is not selected then the chosen switch settings control the baudrate for the serial interface. Whether the serial interface is RS485 or RS232 is selected by switch position 8.

	5	6	7
Baudrate / USB			
USB	Off	Off	Off
9600	On	Off	Off
19200	Off	On	Off
38400	On	On	Off
57600	Off	Off	On
115200	On	Off	On
230400	Off	On	On
460800	On	On	On

NOTE:

A baudrate of 9600 (and in some cases 19200) is not suitable for 2 way communication with remote devices as it is too slow and causes timeouts. This baudrate has been included to enable the base station to be connected to a 9600 baud device to allow low rate Data Provider packets to be received.

At any rate below 230400 is may be possible to lose packets at high data rates as the serial connection cannot keep pace with the radio transmissions.

If USB is not selected as the interface (Switch positions 5 to 7) then this switch position selects whether the serial interface is RS232 or RS485.

	8
232/485	
RS232	Off
RS485	On

Power
If the base station is configured as USB then it will be powered by the USB bus. If RS232 or RS485 are selected then external power will need to be connected to J4 on the –V and +V pins.

LED Indication
Two LEDS indicate Power/Mode and Activity.
The red LED indicates mode and should flash at a 2Hz rate. If any errors are detected with the radio then the LED will remain lit.
The green LED flashes once for each packet received or transmitted via radio, USB or serial.

RS232
The RS232 interface uses TX, RX and GND to connect to a PC, PLC etc and uses standard RS232 voltage levels.

The baudrate can be selected by setting the DIP switches stated above. NOTE: the base station will require power cycling to utilise a baudrate change.

Example connection to a PC 9 way D serial connector.

PC 9 Way D Plug Pin	Signal Direction	Base Station Connection	
3 (TX)	->	RX	J6 RX or J7 Pin 3
2 (RX)	<-	TX	J6 TX or J7 Pin 2
5 (Gnd)		GND	J6 GND or J7 Pin 5
8 (CTS)	<-	CTS	J6 CTS or J7 Pin 8

RS485
The RS485 interface (This is a 2 wire 485 interface and will not work with 4 wire 485 buses) uses TX, RX and GND to connect to a PC, PLC etc and uses standard RS485 voltage levels.

The baudrate can be selected by setting the DIP switches stated above. NOTE: the base station will require power cycling to utilise a baudrate change.

Example connection
Depending on the RS485 interface or hardware the connections vary and are not standard therefore we can only show the connections to the base station. You must refer to the user manual regarding your RS485 connection to ascertain the correct connections.

PC / PLC Connection	Signal Direction	Base Station Connection	
Refer to RS485 Device User Manual		A	J4 -A
Refer to RS485 Device User Manual		B	J4 +B
Refer to RS485 Device User Manual		GND	J4 SH

NOTE: There are two connectors for RS485, J4 and J5. This is to facilitate easy daisy chaining of devices if required.

Serial Limitations
- When using RS232 or RS485 you should use the fastest baudrate possible. At lower rates data can be lost because it can arrive from the radio faster than the base station can send it serially.
- At 9600 baud you will experience communications problems when configuring devices. This baudrate is too slow for anything other than monitoring data provider packets from devices and even then these should be at a low rate (around 20 per second). The slow baudrates are provided to get low rate data into older systems.
- RS485 is a bus master system and is not ideally suited to full communications with devices when multiple devices are providing data. This is fine for the normal operation of data acquisition but it is recommended that only the device to be configured is active during configuration.

USB
Connection to the base station will be either a captive USB cable (T24-BSu & T24-BSue) or a USB socket B for connection using a standard USB A-B cable (T24-BSi). There is an optional cable assembly for the T24-BSi to provide for a USB connection while the device is still fitted to the ABS case.

To communicate with the base station the connected device must use the USB HID Device Class and support USB 2.0 full speed interface (12mbits).
The USB connection will also power the base station.

Communications

In a lot of installations the base station is used to configure and calibrate the T24 modules by use of the T24 Toolkit software.
In this case the user needs only connect the base station to the PC by means of a suitable interface as described above. The Toolkit software can then be configured to use the desired interface to the base station.
If you intend to write your own software to connect to a T24 module please refer to the T24 Technical Manual for descriptions of communications protocols.

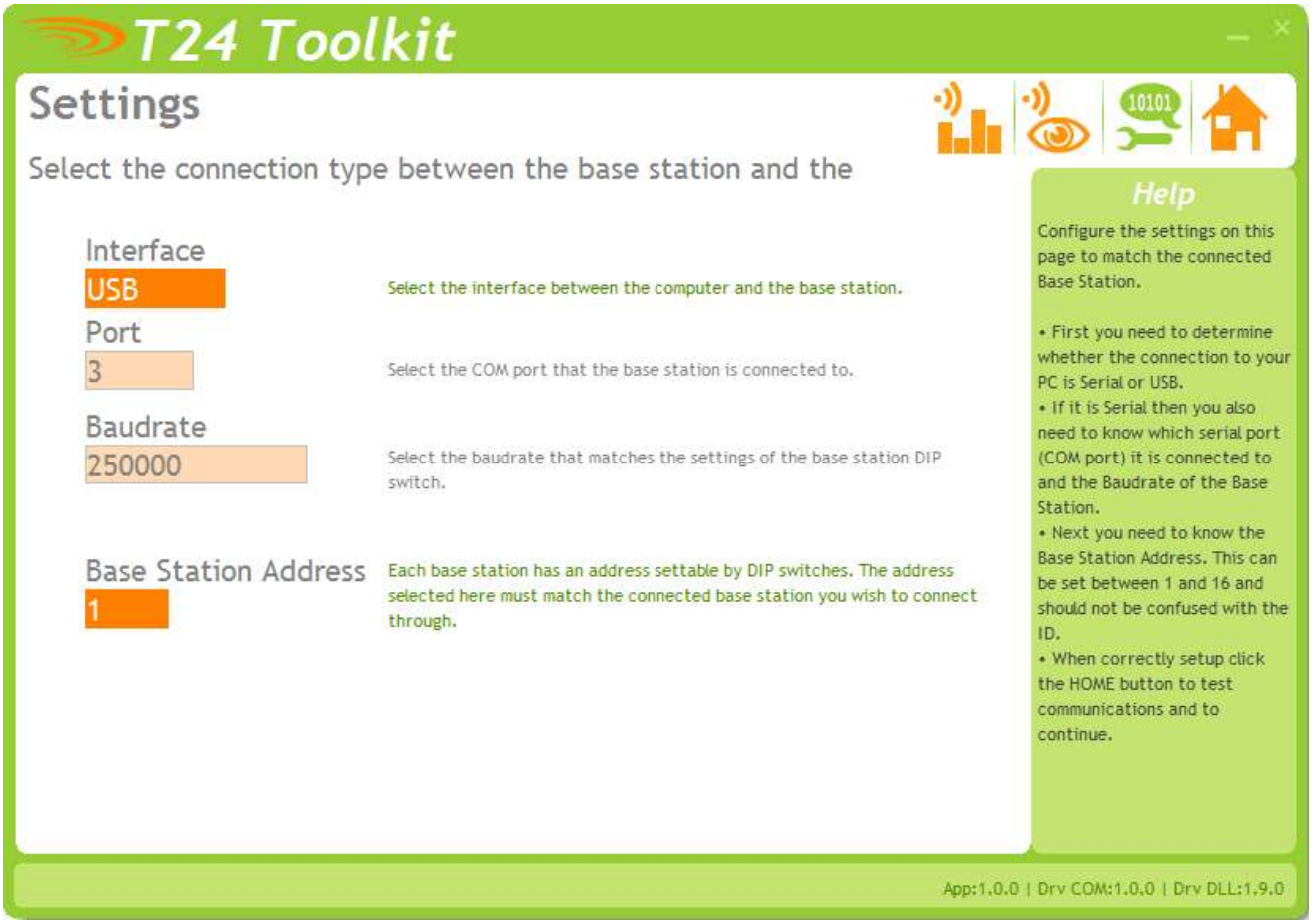
T24 Toolkit

The T24 Toolkit provides a means of simple configuration and calibration of the T24 modules along with useful tools to aid integration.

Install and run the T24 Toolkit software application.

General Pages

Setup Base Station Communications

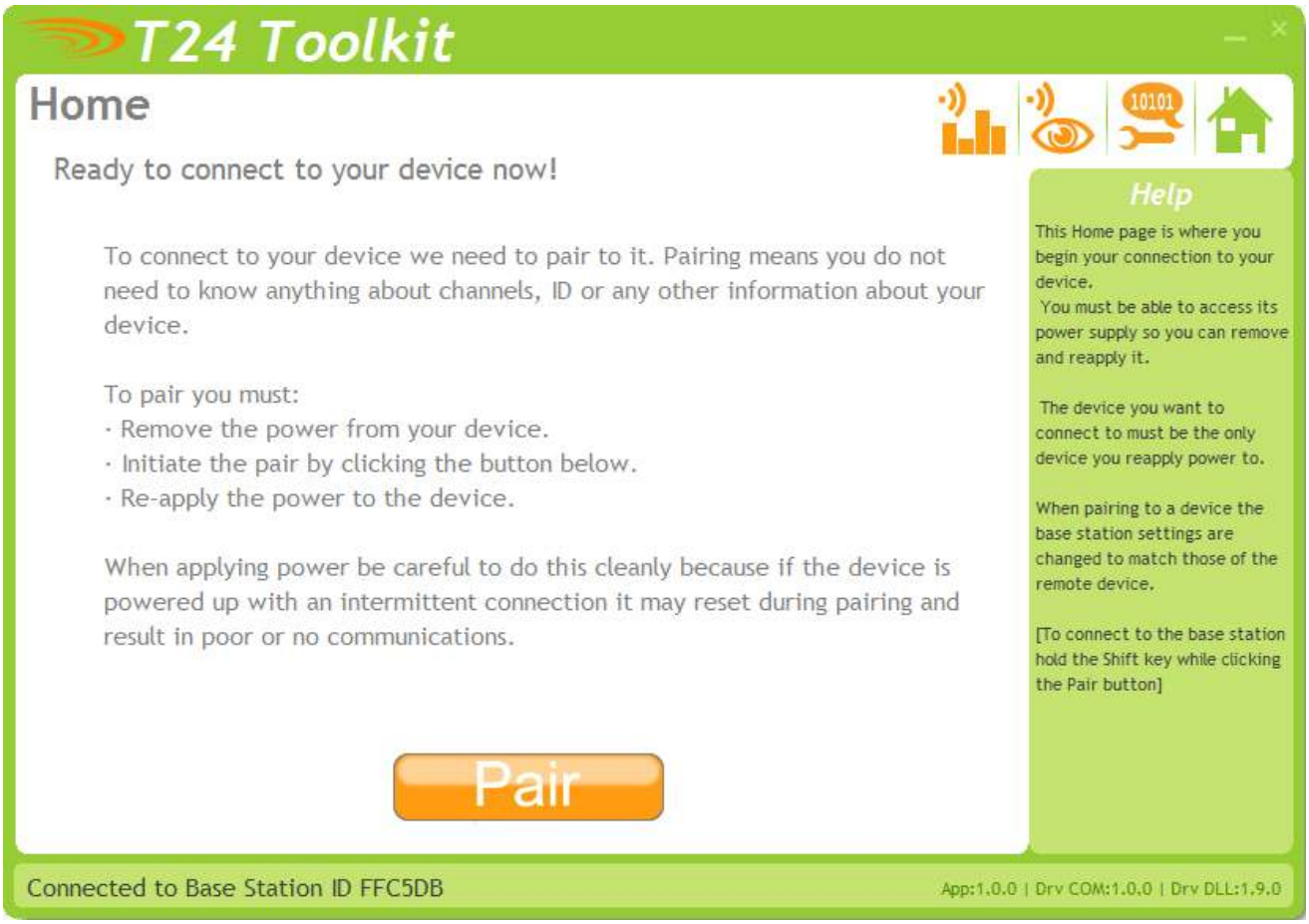


Select the required interface type and base station address.
If you are using a T24-BSu you just need to choose **USB** as the interface and select **1** as the Base Station Address.

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 other T24 modules or we can select the Spectrum Analyser mode or Data Provider Monitor mode.

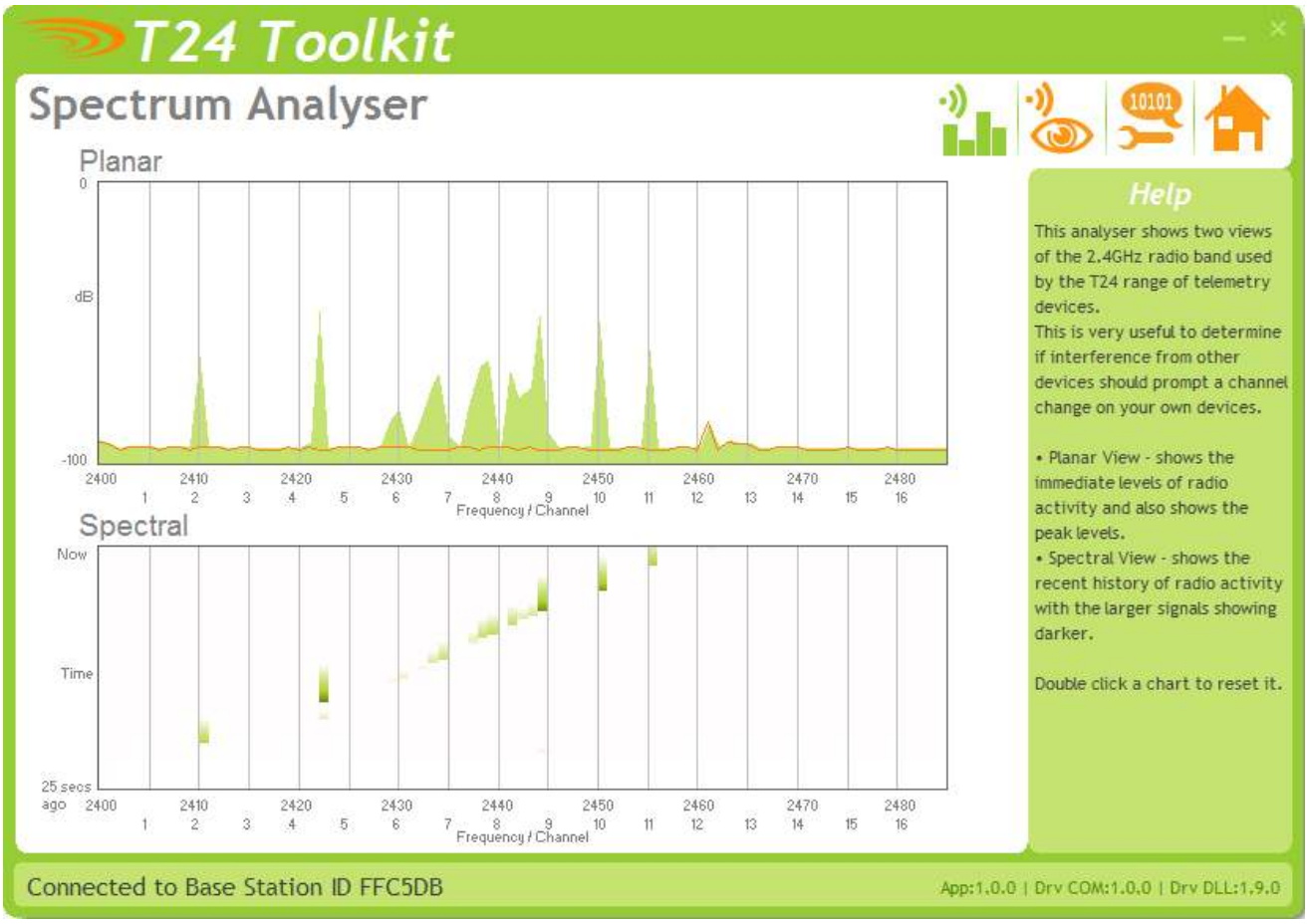
To connect to other T24 modules (anything other than a base station) you will need to pair to that module. Refer to the module manual for instructions.

In this manual we are going to show how to configure the base station itself.

Please note that in normal use when connecting to other T24 modules the base station is automatically configured to match the settings of the paired module so it is not normally required that you configure the base station itself.

But, if for some reason you do need to (such as reducing the output power) you can ‘pair’ to the base station by holding down the SHIFT key and clicking the Pair button.

Analyser

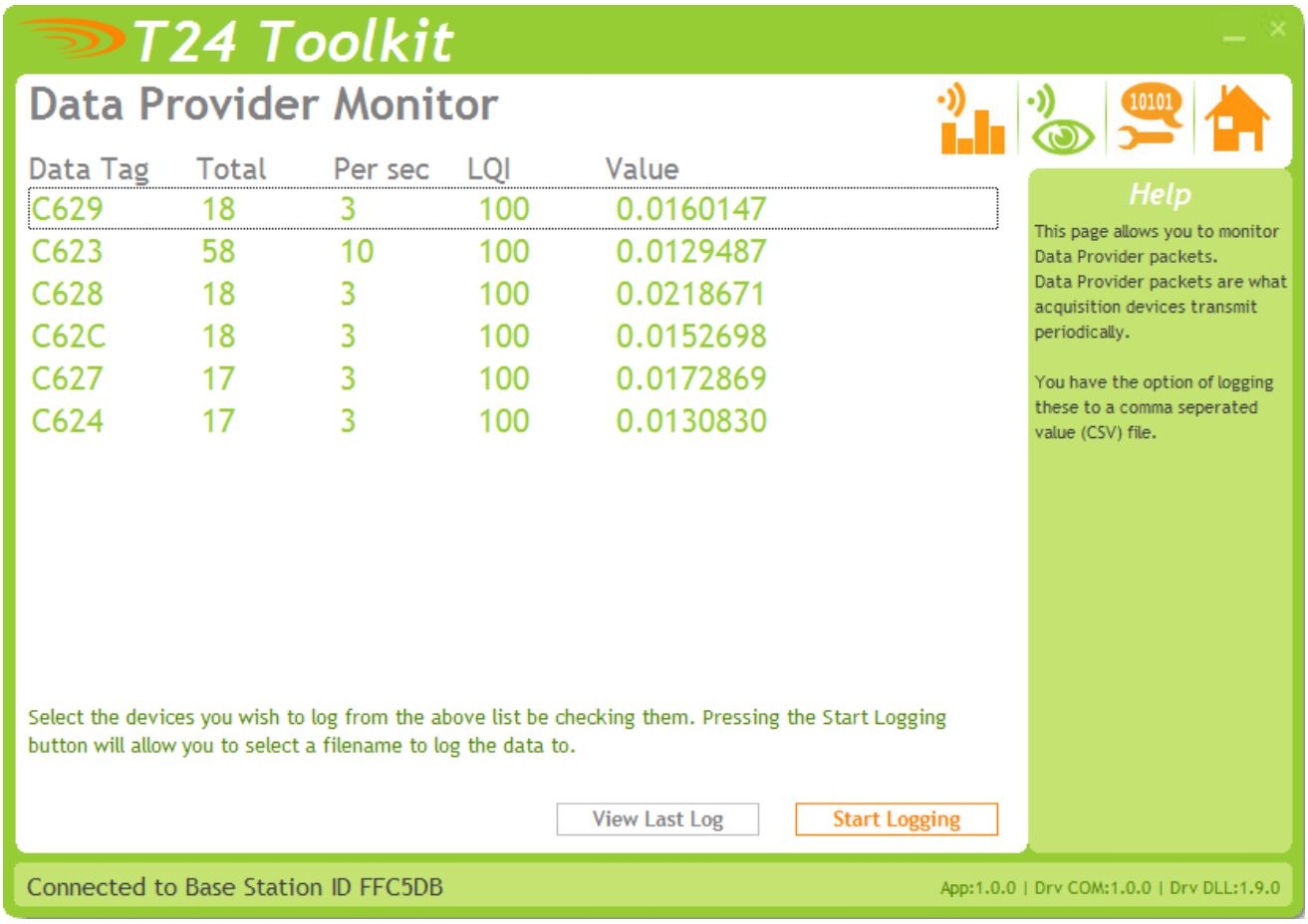


The analyser page is provided as a tool and will not normally be needed unless you plan to change channels and want to find the best channel to select, or to diagnose poor communications issues.

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.

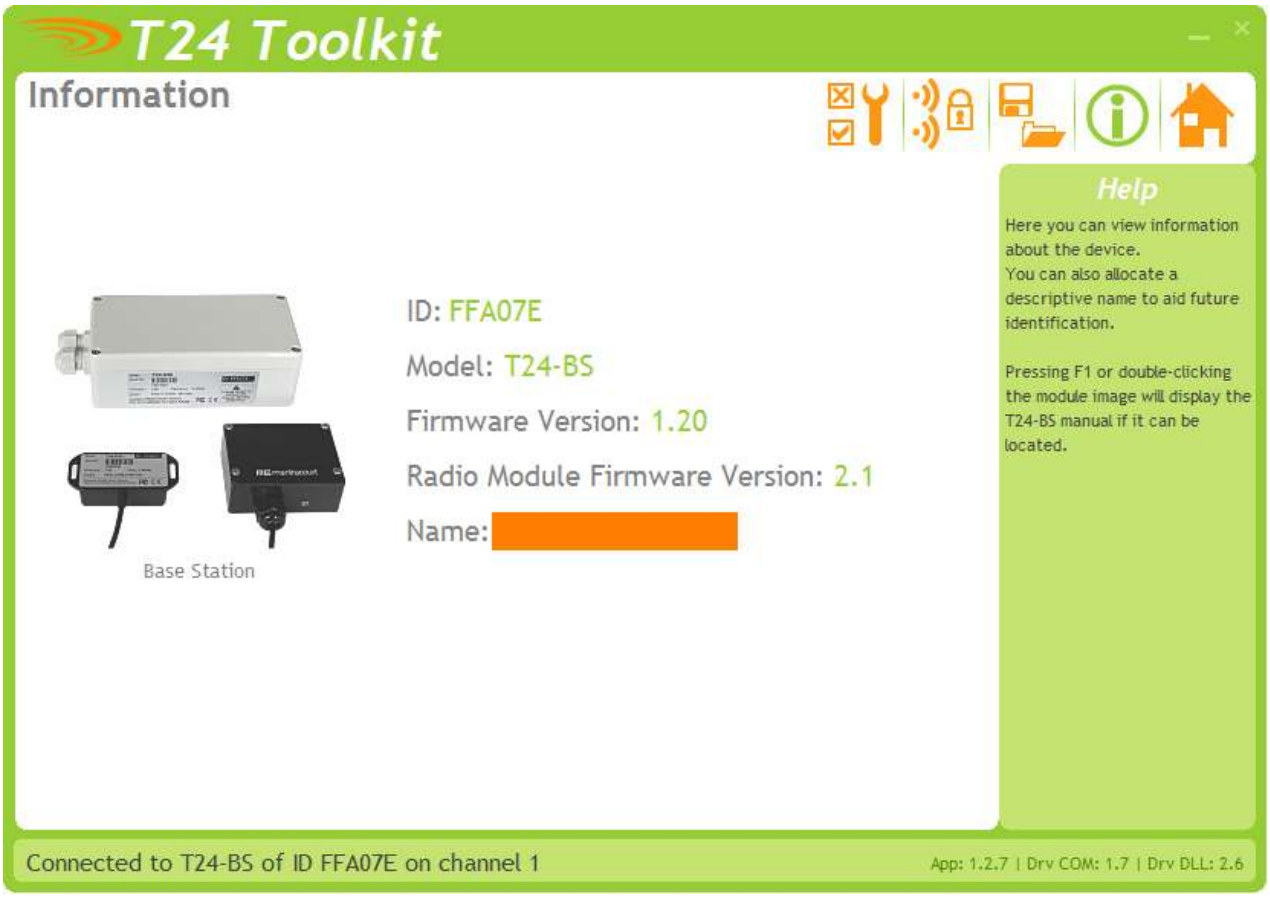
NOTE: When the toolkit connects to a device to enable configuration it will usually inhibit the transmission of Data Provider packets.

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, Time & Date
```

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

Information

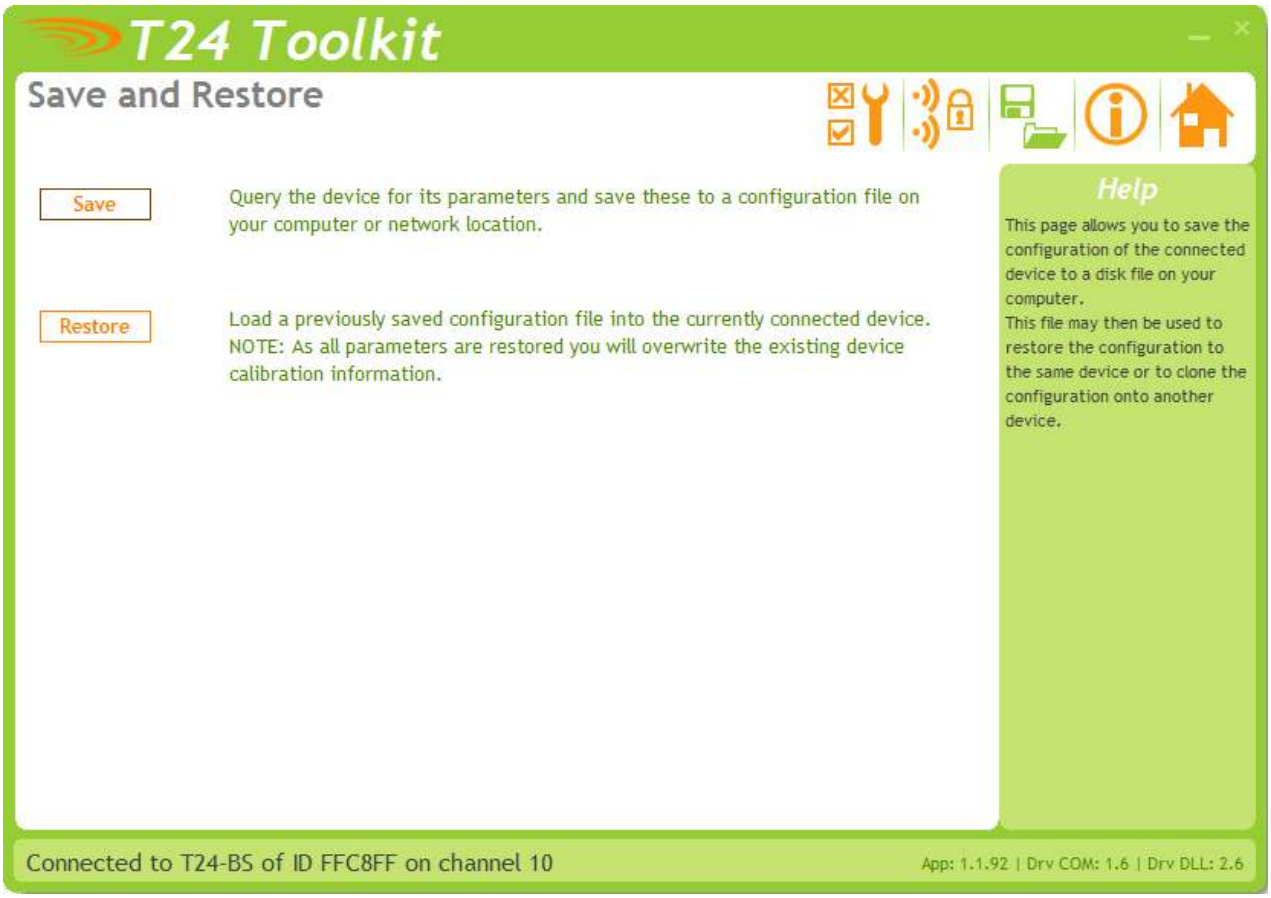


Once successfully paired to the base station this page is displayed.
This page shows you information about the connected module.

Items you can change:

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

Save and Restore

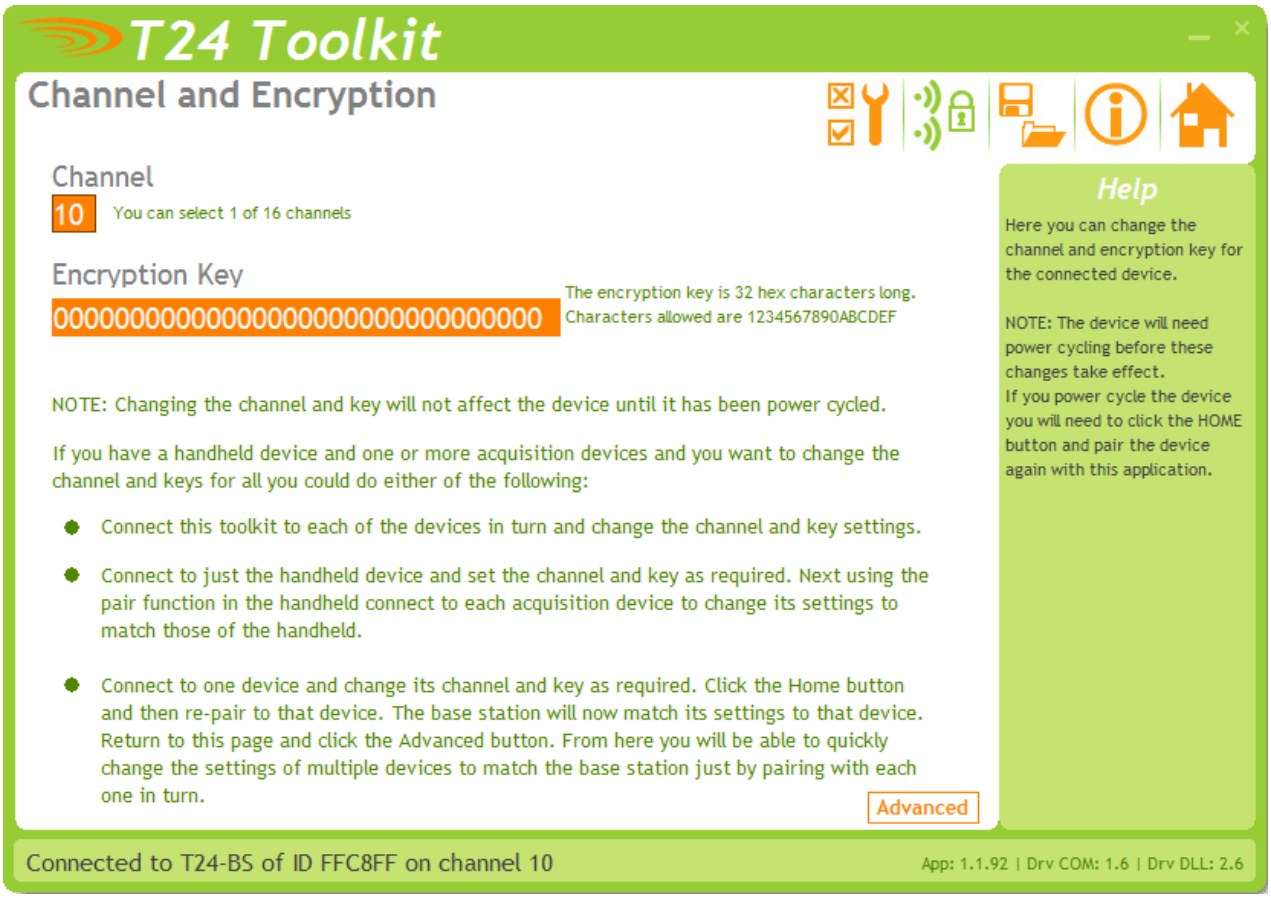


Here you can save the device settings to a file on your PC so that they can be later loaded back into the same or different module.

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**.

Channel and Encryption



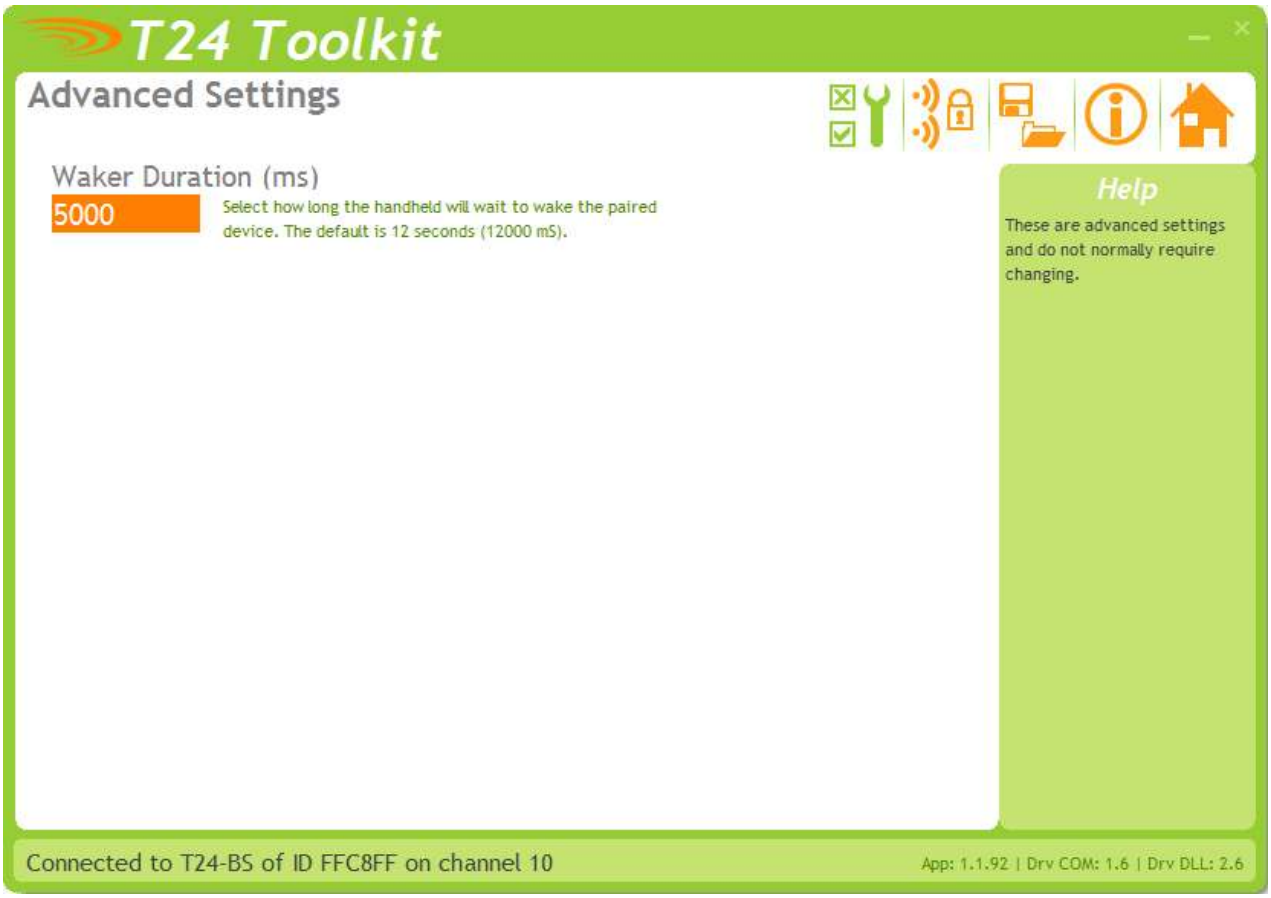
Here you can change the channel and encryption key for the base station.
This is only useful if you intend to communicate with the T24 modules using your own software as in normal operation when you 'Pair' to a module to configure it the base station is automatically configured to match the radio settings of that module.

NOTE: Early acquisition 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.

Advanced Settings



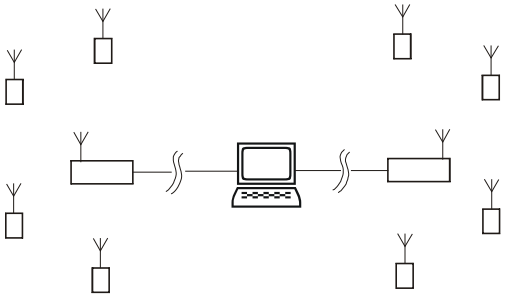
You should not normally need to change these settings.

Items you can change:

Waker Duration	When you send a wake command to a T24 module via the base station the duration of this wake attempt is controlled by this setting. Enter the desired duration in seconds.

Advanced Multipoint Base Stations

Sometimes more than one base station is required in a system. This may simply be a central PC with two base stations wired off in opposite directions.



Where one base station handles devices on the left and the other those on the right.
Multiple base stations allow flexibility in routing requests from a PC as each time a packet is sent to a base station it is targeted to a particular base station **Address**. When a packet arrives back at a PC it contains the **Address** of the base station that routed it.
If a base station is the only one connected to a particular serial port then every base station can have **Address** 1 as the PC will send packets to a particular port to select which base station handles a packet, likewise packets arriving back at the PC will be identified by the port that they arrive on.
RS232 devices can only be connected one at time anyway but RS485 allows multiple devices on the same bus. This is where the **Addressing** is vital as it is this that distinguishes between base stations.
When using USB base stations you may only ever have one T24-BSu connected to a PC at any time. Using T24-BSi will allow multiple USB base stations to be connected to single PC. Unique **Addresses** are again required in this instance.

Note that broadcast packets can be received by multiple base stations so packets may appear duplicated at the PC end.
It is also possible for the PC to route a packet through all connected base stations by **Addressing** a packet to Address 0.

NOTE: Although it is possible to connect multiple USB base stations to a PC the **T24drv.dll** driver supplied by Mantracourt only supports up to three Base Stations **Addressed** as 1 to 3.
So when using a T24-BSi which supports USB but also has a DIP switch to allow **Address** setting the **Address** must be set between 1 and 3. The T24-BSu devices are manufactured with a fixed **Address** of 1.

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.

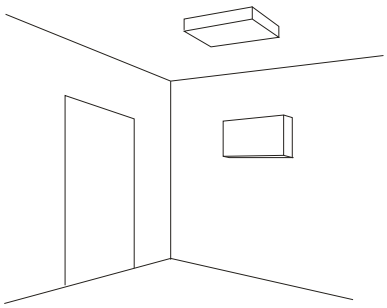
Guidelines for installation:
When planning installations ensure that line-of –sight between nodes is maintained and that objects or structures are kept at least one metre away from antennae wherever possible.

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

The base T24-BSi should be mounted horizontally on a wall or ceiling so that the side face containing the PCB antenna faces the general direction of the target devices.



The T24-BSu should also be positioned to present itself to the other radios in a 'landscape' aspect.

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
Channels (DSSS)		16		

T24-BSi

Parameter	Minimum	Typical	Maximum	Units	Notes
External Supply voltage Range	9	12	32	V DC	
Average Operational Current	-	100	-	mA	At 12 V
Operating Temperature Range	-40	-	85	Deg C	
Storage Temperature Range	-40	-	85	Deg C	
Reverse polarity Protection		-	-32	V DC	Maximum Supply
Environmental Protection			IP65		
Radio Range			200 (650)	Metres(feet)	See * note

T24-BSu

Parameter	Minimum	Typical	Maximum	Units	Notes
USB Supply Range	4.875	5	5.125	Volts	As defined by USB 2.0 Specification
USB Bus Powered Operational Current	-	100	-	mA	
Operating Temperature Range	-40	-	85	Deg C	
Storage Temperature Range	-40	-	85	Deg C	
Environmental Protection			IP50		
Radio Range			100 (325)	Metres (feet)	See * note

T24-BSue

Parameter	Minimum	Typical	Maximum	Units	Notes
USB Supply Range	4.875	5	5.125	V DC	As defined by USB 2.0 Specification
USB Bus Powered Operational Current	-	100	-	mA	
Operating Temperature Range	-40	-	85	Deg C	
Storage Temperature Range	-40	-	85	Deg C	
Environmental Protection			IP65		Does not apply to USB connector at cable end.
Radio Range			200 (650)	Metres (feet)	See * note

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

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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