SW-SO
Serial Output Module

User Manual

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Introduction / Overview

The SW-SO creates a serial output which can include data from up to 8 devices and optionally sum them. The output is suitable for connecting to a printer, serial display or for feeding directly into a PC, PLC or any device that is capable of using numeric values in readable ASCII format.

The actual serial output can be designed by the user using multiple lines which can include free text or tokens which can represent real data. i.e. **<V1>** would be decoded as the value from input 1 when the print is triggered.
Printing can be triggered from a contact, an external command or the arrival of a specific **Data Provider** message.
The serial output can consist of a single line of data suitable for feeding into an LED display module or a more complex multi-line result that can contain a mixture of fixed and variable data suitable for tickets, receipts etc for printed output.

Communications Overview

The wireless 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

Once it has been determined how many devices are feeding data to this device you need to record the Data Tag that each of these devices are attaching to their Data Provider packets.
These Data Tags are then entered into the **ValueDataTagx** parameters. Once the rate at which this data arrives is known you can enter the **Timeoutx** values.
Leave unused **ValueDataTagx** parameters with a value of zero to ensure that they are not checked for timeouts and do not contribute to gross or net sums.

When a data provider packet arrives whose Data Tag matches one of those in the **ValueDataTagx** parameters the value it contains will be placed in the **Valuex** parameter.

If data does not arrive from a device within the **Timeoutx** period then any reference to either the individual **Vx** tokens or one of the summing tokens will result in **------** rather than a numeric value.

The actual serial output can now be constructed using **Line1** to **Line25**. These parameters take text into which you can insert tokens. When a 'Print' is generated these lines are parsed and tokens replaced with the values they represent and the resulting data sent to the serial port.

A 'Print' is generated by either issuing a DoPrint command, activating switch input when **SwitchMode** is set to zero or by receiving a Data Provider packet whose Data Tag matches the **PrintDataTag** parameter. When a 'Print' is executed each of the parameters Line1 to Line 25 will be parsed. Every token will be evaluated and replaced with the live value.

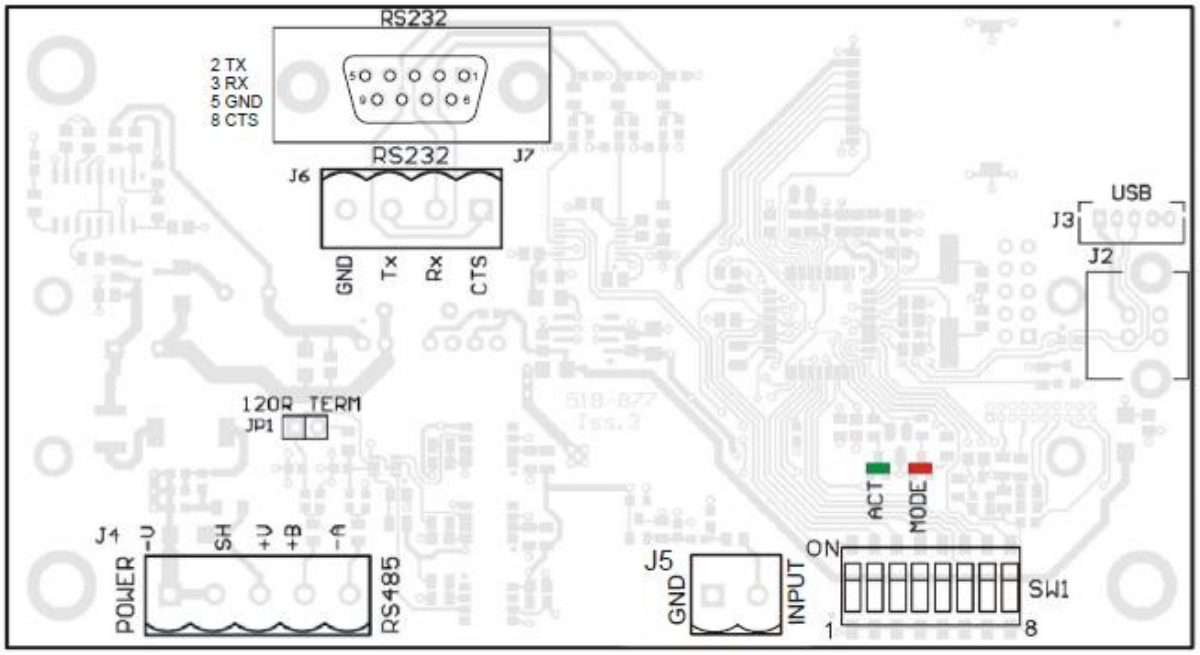
Getting Started

To attach acquisition devices to the SW-SO we must first ensure that the appropriate devices are transmitting their values at a suitable rate such as the default of 3 per second. Then we can configure the module to use the data from these devices.
Configuration must be done with the T24 Toolkit software and a base station.

Connecting Power

SW-SO

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



Switch

Serial Settings

The serial output is set at 8 data bits, 1 stop bit and no parity. The baudrate can be selected as can RS232 or RS485 operation.

SW1 Settings
Switch positions 1 to 4 are not used.

Switch positions 5 to 7 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			
NA	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

This switch position selects whether the serial interface is RS232 or RS485.

	8
232/485	
RS232	Off
RS485	On

SW-SO Operation

The only way to affect operation of the SW-SO is as follows:

- The digital input (switch input) which may trigger an output/print or tare the summed value.
- Arrival of a data packet identified with a Data Tag that matches what the SW-SO uses to trigger an output/print.
- Arrival of a command to trigger an output/print or to tare or zero etc.

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 SW-USBBSE 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.

SW-USBBSE Base Station

If you have a USB version of the base station 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.

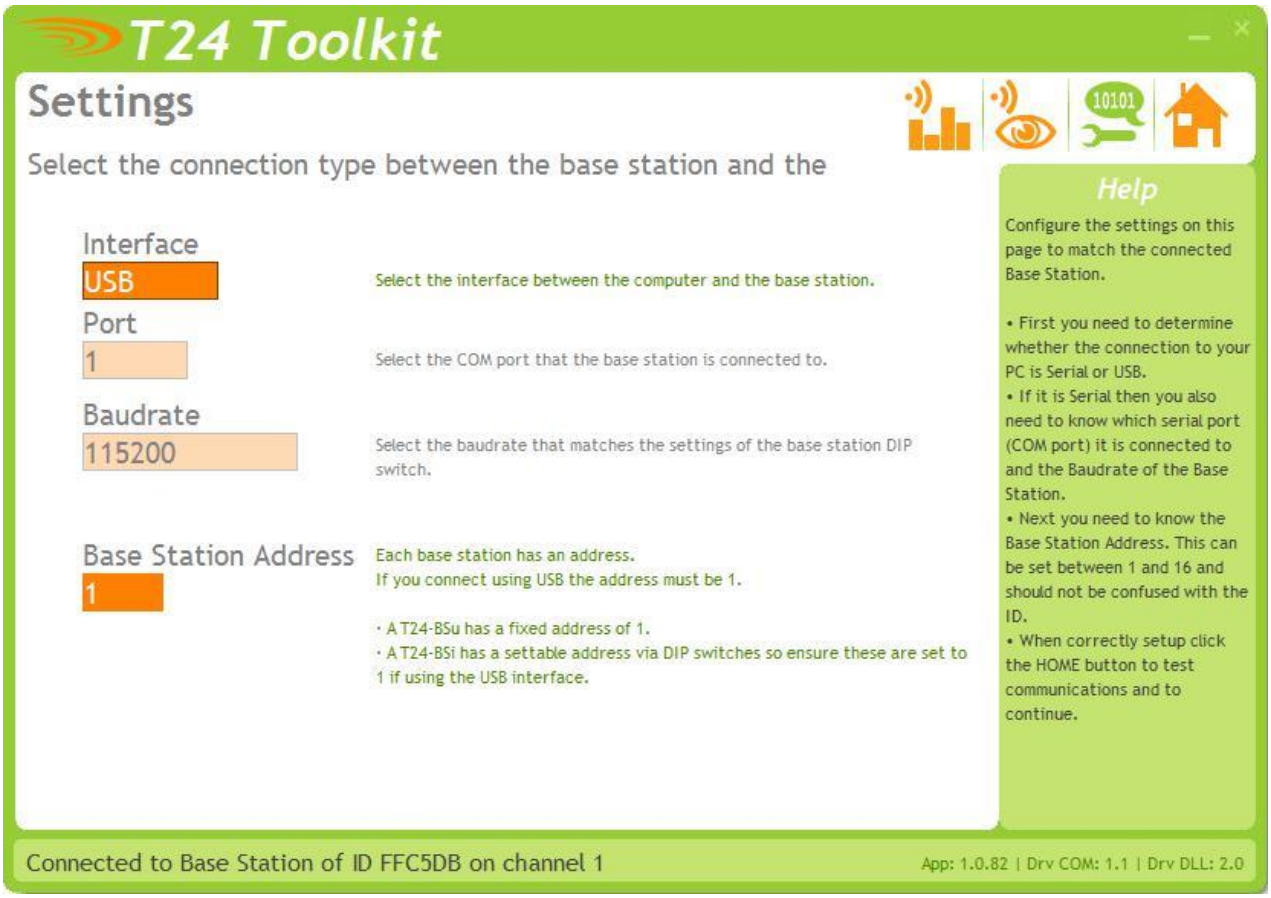
T24 Toolkit

The T24 Toolkit provides a means of simple configuration of the SW-SO 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

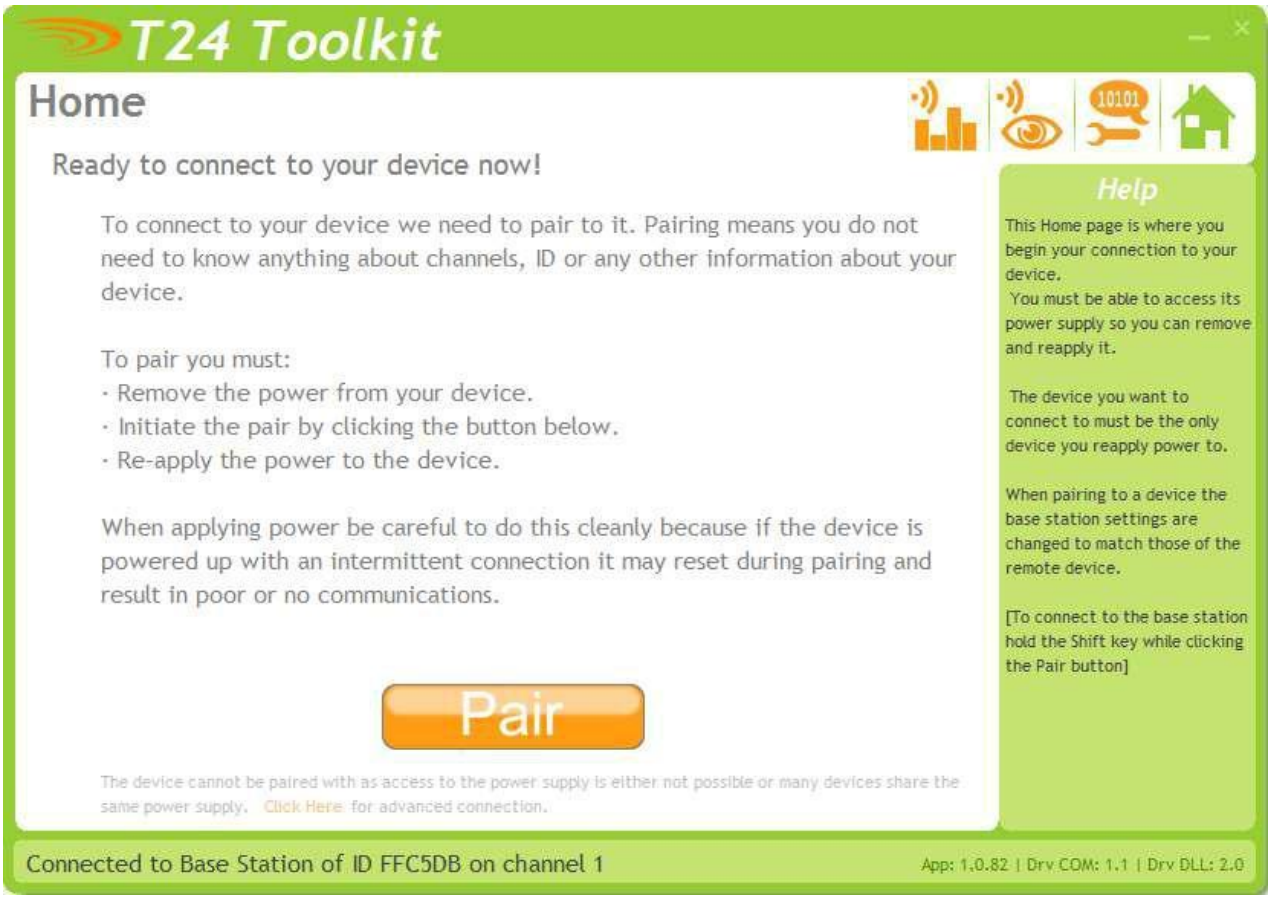
Setup Base Station Communications



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.

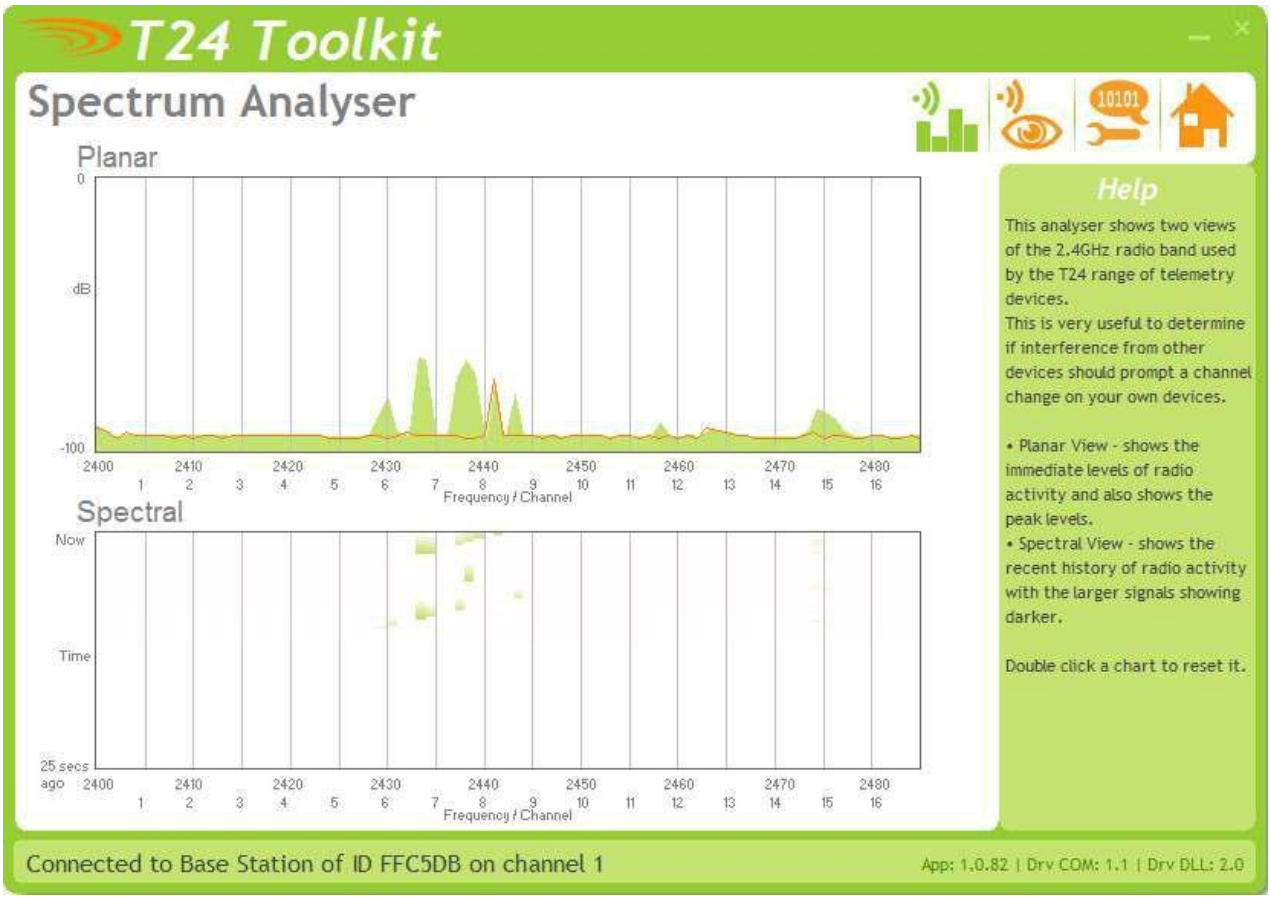
Pairing Procedure

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

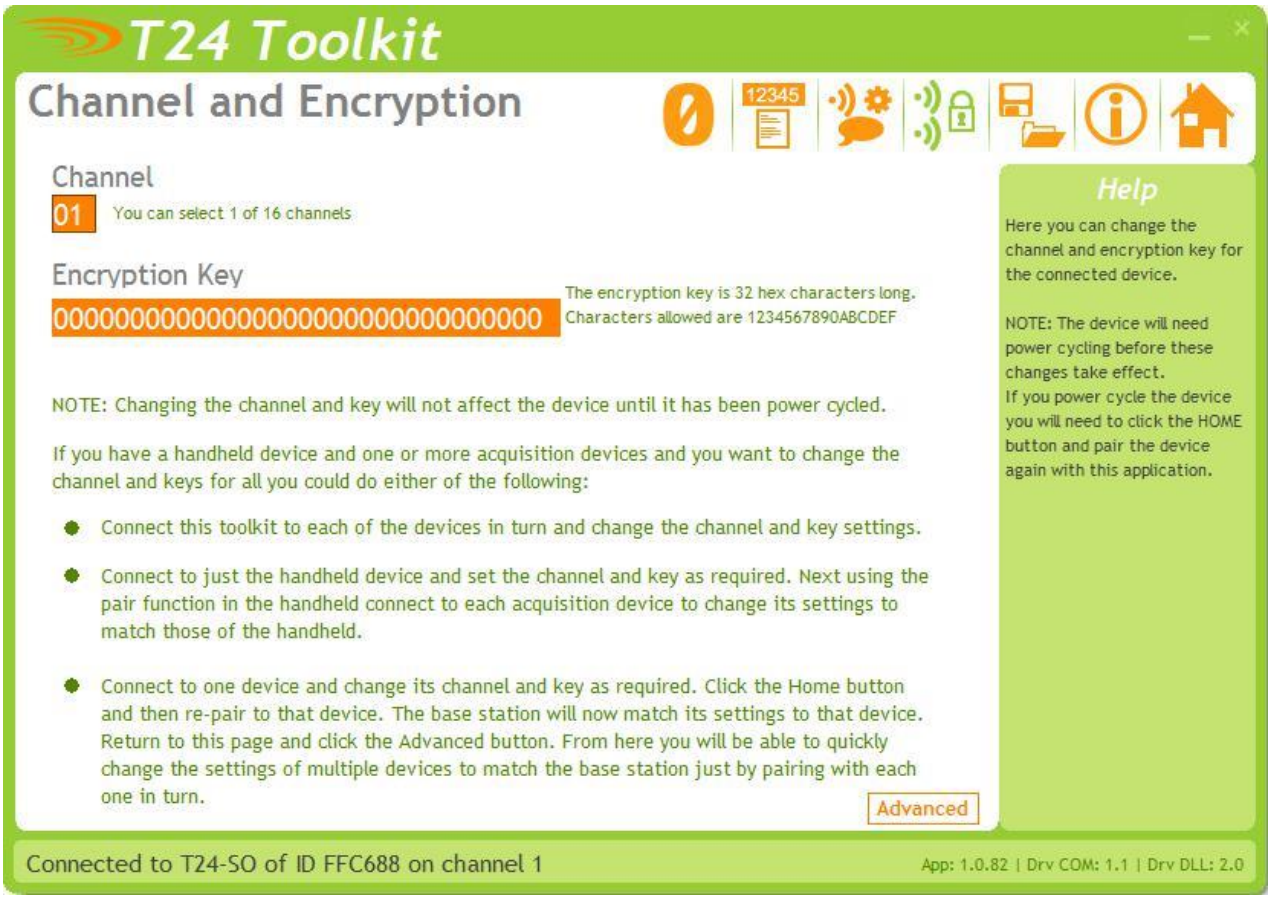
Information

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



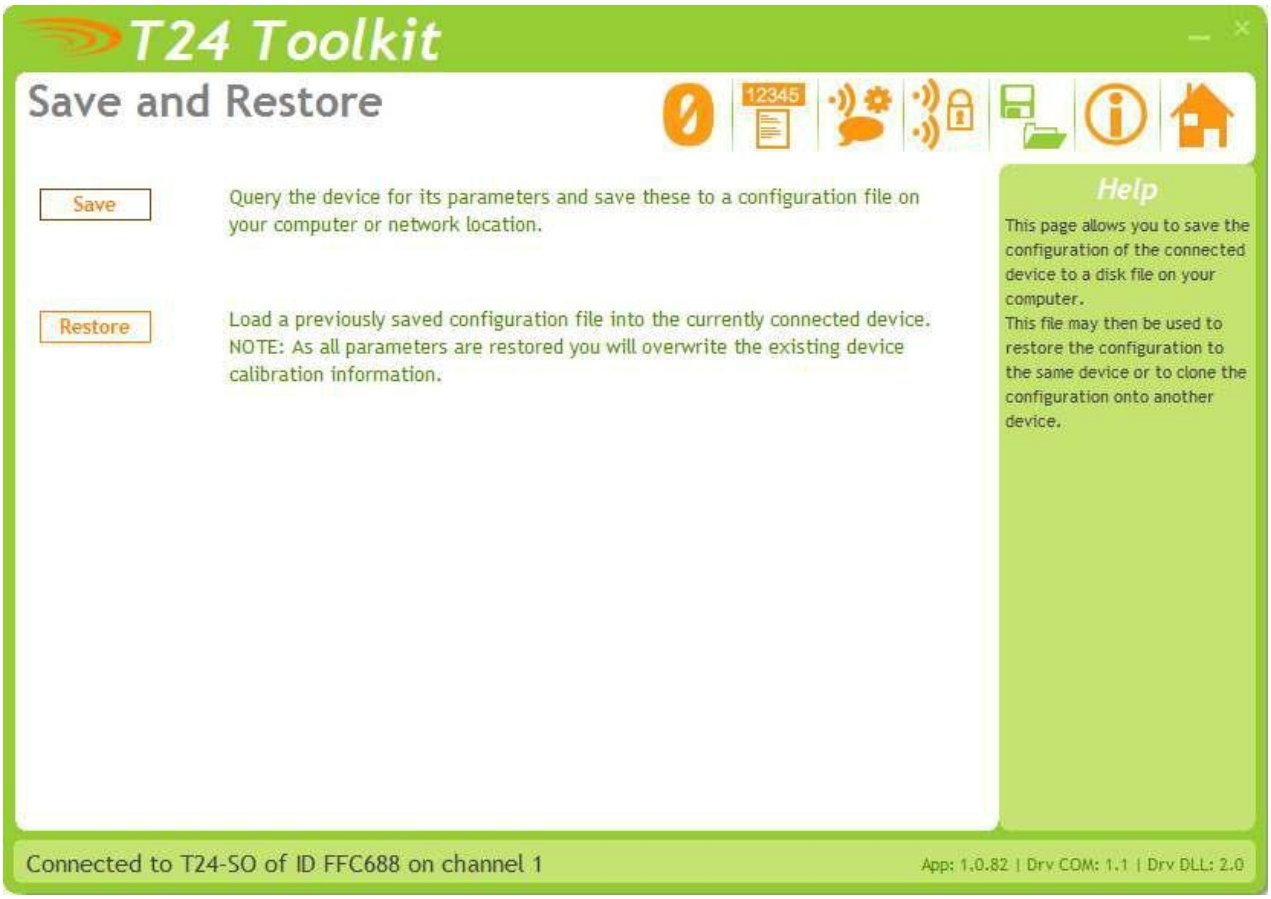
Here you can change the channel and encryption key for the module.

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

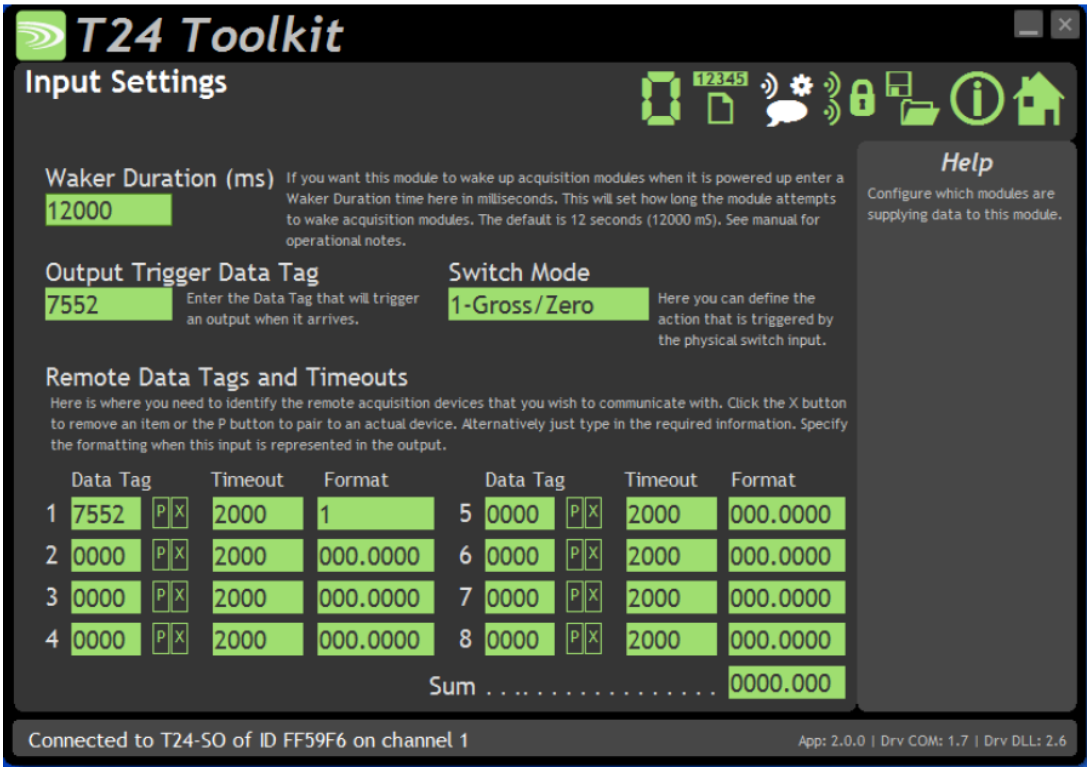


Here you can save the device settings to a file on your PC so that they can be later loaded back into the same or different device.

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 action to take when the switch contacts are closed, set the Data Tag that will trigger an output and also set the Data Tags of the data used as the inputs along with how the data is formatted.

Items you can change:

Switch Mode

Click to select either:
Print – Triggers an output from the serial port. Note that **Min Interval** setting on the Output Settings page may stop this from working at the rate the contact closes.
Gross/Zero – Toggles the measurement mode between gross and net. When switching to net the net value is zeroed (tared). This will affect the value of the <N> token which is the net value of all summed inputs.

Output Trigger Data Tag

Enter the Data Tag which, on arrival, will trigger an output (I.e print). Note that **Min Interval** setting on the Output Settings page may stop this from working at the rate at which the data arrives.
This is usually set to the Data Tag of one of the inputs.
Example: If the output was being sent to a serial display the same Data Tag would be assigned to input 1 and the output trigger so that each time data arrived the output would be sent to the serial display.

Remote data Tags and Timeouts

Data Tag

Enter the Data Tag (in hexadecimal) to supply data to this input.
NOTE: You can click the P button to retrieve the Data Tag of a device by pairing to it which is usually initiated by power cycling the module.
Clicking the X button zeroes the entered Data Tag.

Timeout

Enter the timeout in milliseconds for this input. If a new Data Provider packet does not arrive within this time and reference to this input value (via token <V1> for example) will result in an output of ------- . This also applies to a gross or net reading derived from this input.

Format

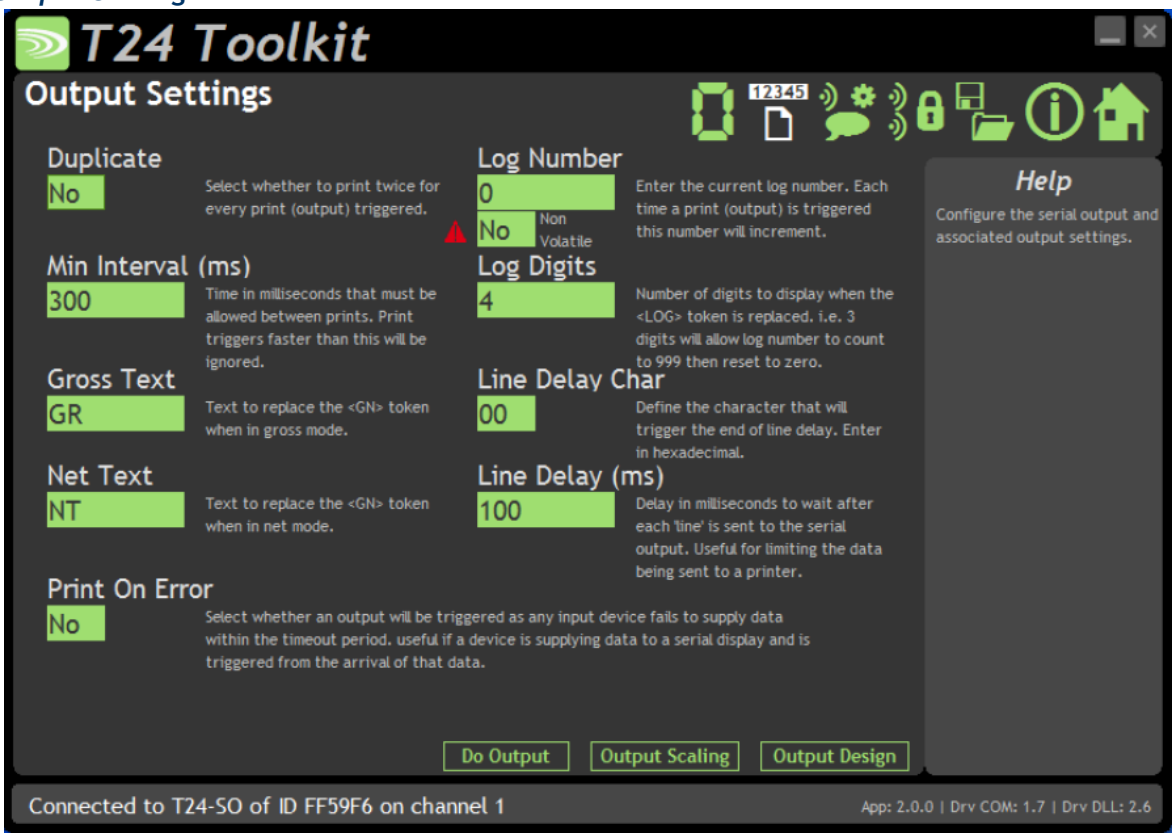
Describe the format that this value is to take when output. You specify integer digits and decimal places by entering a format consisting of zeroes and decimal points. i.e. 00.000
NOTE: The integer value of data takes precedent over your defined format so if you defined a format of 0.0 and data of value 100.8765 arrived it would be represented as 100.8

Examples

Format	Value	Representation
0.0	1.2	1.2
0.0	100.8	100.8
00.000	6.1234	06.123
00.000	123.4567	123.456
0000.00	12.0	0012.00

Resolution
It is possible to set the resolution (the smallest unit of change) of the output results by including the numeric value in the format. i.e. 00.005 would only represent the value in steps of 00.005

Output Settings



Here you can change various settings that influence the output from the module.

Items you can change:

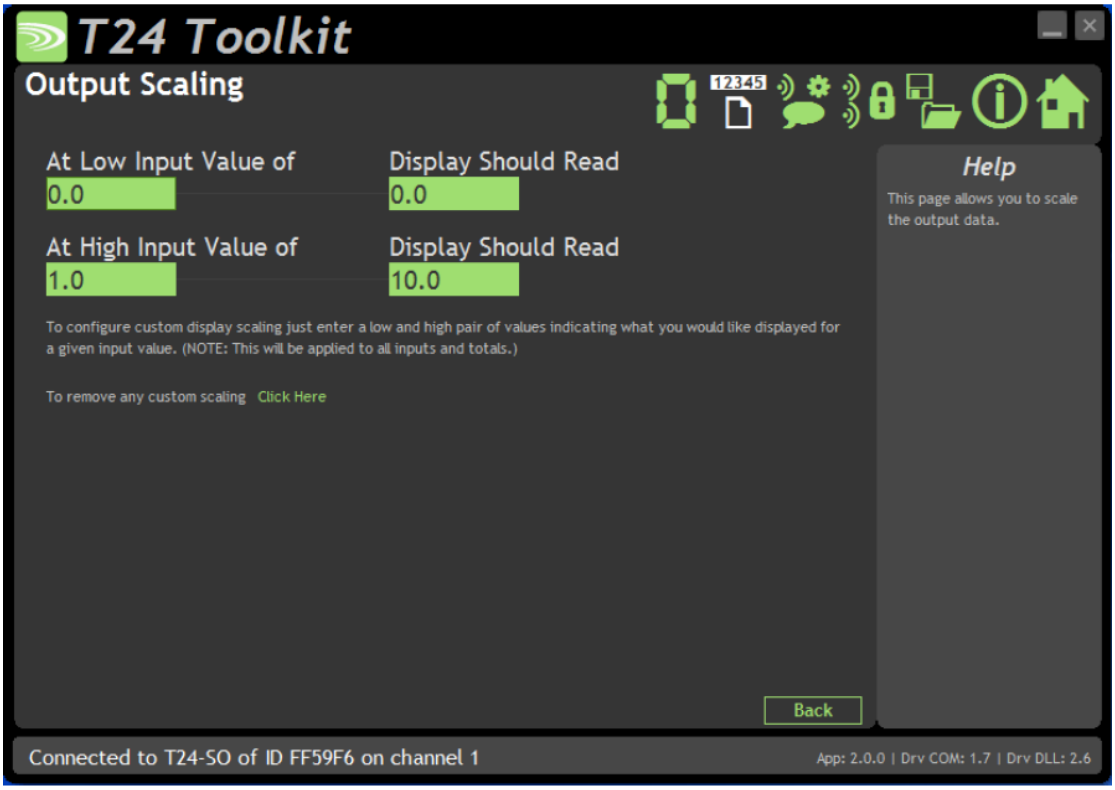
Duplicate	Whether to produce the same output twice each time an output is triggered. Useful, for example, with a printed output where a customer requires a receipt.
Min Interval	Minimum time allowed between triggered outputs entered in milliseconds. Triggers arriving within this time since the previous trigger will be ignored. Example: A Data Tag is used to supply data to input 1 and is used to trigger an output. This data arrives at a rate of 50 per second but the output is connected to a serial display which would have problems if it were sent data at this rate. By setting the Min Interval to 300 the outputs would be limited to 3 per second even though the data was arriving at a higher rate.
Gross Text	Enter text to replace the <GN> token with when the device is in gross mode.
Net Text	Enter text to replace the <GN> token with when the device is in net mode.
Print On Error	Whether to trigger an output when any input device fails to deliver new data within the timeout period. Example: Data arrives which is used as input 1. This same data tag is used to trigger an output which is sent to a serial display. Normally if the data fails to arrive the display would not get updated as no output would occur. By setting this property an output would be triggered when the data failed to arrive thus setting the serial display which would show ------- instead of the value when <V1> is decoded.
Log Number	Enter a log number that is used when the <LOG> token is decoded. Each time

	an output is triggered this log number is incremented. This number will wrap to zero once it reaches the maximum value displayable due to the Log Digits.
Log Number (Non Volatile)	The Log number defaults to being volatile. Power cycling the SW-SO will revert the log number to the value seen on this page. This is ideal for when you have a fast output and you want the outputs to be numbered sequentially. i.e. with a fast output being sent to a data logger. Sometime it is required that the log number is Non Volatile, that is, the log number is restored each time the SW-SO is power cycled. This is useful when the output is used to drive a printer, for example, and the log number acts as a unique number on the customer ticket. When set to Yes the module must store the new Log Number each time it is incremented. This takes time and also uses up the finite write cycles of the internal flash memory. Therefore it is recommended that turning on the Non Volatile option is only done when the output (containing a <LOG> token) is triggered at 30 second intervals or less.
Log Digits	Set the number of digits to display when the <LOG> token is decoded. Example: If this is set to 2 then the log number will count up to 99 before resetting.
Line Delay Char	As the serial output is has no hardware handshaking it is sometimes necessary to limit the rate at which the output is sent. This is most apparent with multiline outputs to a printer. Example: A printer requires a 0x0A (decimal 10) character (linefeed) to be sent at the end of each line to cause the printer to actually print the line. This character would be embedded in the actual designed output and the Line Delay Char set to 0A so each time a line is sent to the printer a delay occurs before the next part of the output is initiated. The delay is set by **Line Delay**.
Line Delay	The delay in milliseconds that occurs when the Line Delay Character has been sent to the output.

Buttons

Do Output	Trigger the output when clicked.
Output Scaling	Will display the Output Scaling page.
Output Design	Will display the Output Design page. This is where you define the output data.

Output Scaling



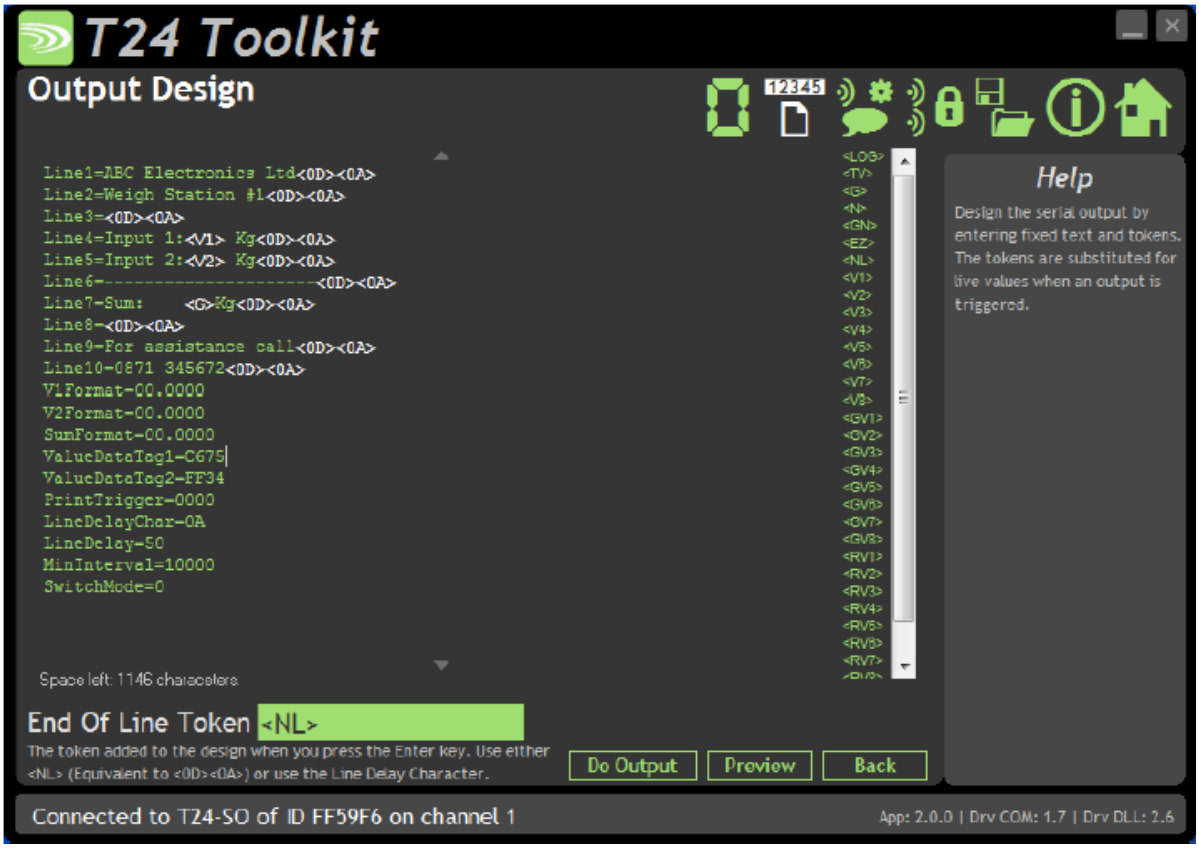
This page allows effective conversion between units. i.e. Although all devices supplying data are configured in Kg you can get a printed output in Lbs.

Items you can change:

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** Should **Read** Value of 1.

NOTE: This affects all inputs and sums (both gross and net). All tokens will effectively be decoded using the new scale factor.

Output Design



This is where you define the actual output based on free text and tokens.
Tokens are special codes contained within angled brackets <token> which have special meanings and are converted to actual values once an output is triggered. See list of tokens at the bottom of this section.

Items you can change:

End Of Line Token — When you press the Enter key on the keyboard we need to know which token to include in the design area. For single line outputs this is not an issue but for multiline printer outputs for example it becomes important. You need to know what character is used to cause the printer buffer to be printed. For this you will need to refer to the printer manual. Some printers just require a Carriage Return <0D> and some may require a Line Feed <0A> or some may require both <NL>. You would need to set the Line Delay Char on the Output Settings page to the appropriate character. And here you can select whether to use that character each time Enter is pressed or you can opt for <NL>.

Design Area — This is where you create your output using a mixture of free text and tokens. See the example in the screenshot above.
To enter a token you can type it in or double click the token list on the right of the page (a single click will display the description of the token).

Available Tokens

Token	Function	Example
<V1> … <V8>	Substitutes token with the last value received from the input. This will already have system zero subtracted (If a DoSysZero command has been issued.) and tare subtracted. (If a DoTare command has been issued or the switch input has executed a tare.)	1.2345

<GV1> … <GV8>	Substitutes token with the last value received from the input. This will already have system zero subtracted (If a DoSysZero command has been issued.) but no tare subtracted. i.e. it will always contain the Gross value of the specified input.	1.2345
<RV1> … <RV8>	Substitutes token with the last value received from the input. This will NOT have system zero or tare values subtracted.	1.2345
<TV>	Substitutes token with the value carried in the Data Provider packet that has triggered the 'Print'.	1.2345
<LOG>	Substitutes token with the log value. Each time a 'Print' occurs the log number will be incremented.	0003
<G>	Substitutes token with the Gross sum of all active inputs. System zero values will have been extracted.	1.2345
<N>	Substitutes token with the Net sum of all active inputs. System zeros will have been subtracted and also if a Tare has been issued then the tare value will be extracted.	1.2345
<EZ>	Substitutes token with the External System Zero.	1.2345
<GN>	Substitutes token with the GrossText or NetText parameter contents depending on the NetMode.	Gross
<xx>	Substitutes token with the ASCII character whose ASCII value is xx where xx is a two digit hexadecimal value. i.e. <0D>	ÆÖ-ü■

Below are listed some useful hex codes.

Hex Value Token	Description
<0D>	Carriage Return
<0A>	Line Feed
<09>	Tab
<1B>	Escape

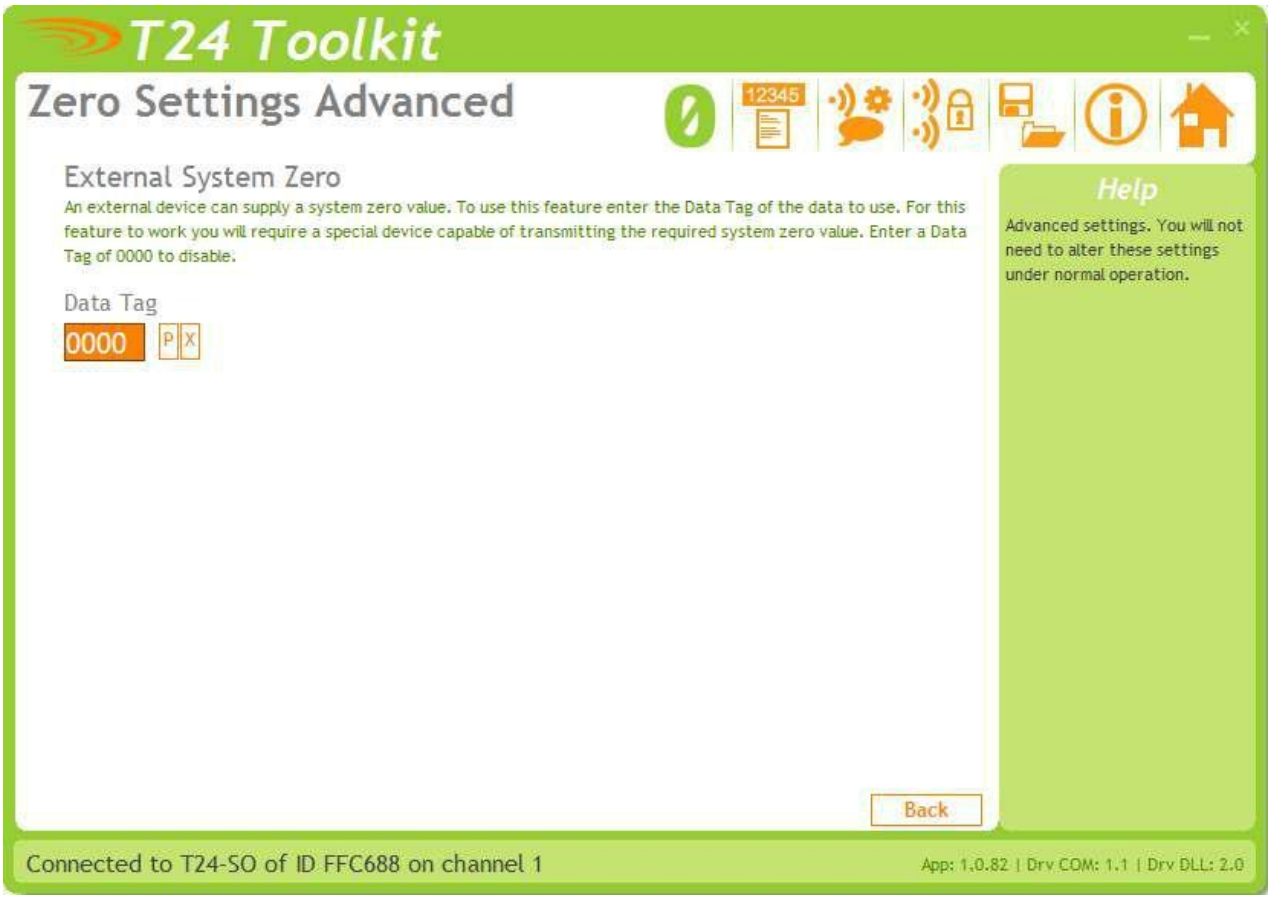
Zero Settings

Here you can set a system zero.

Items you can change:

Perform System Zero	Clicking this will store the current values on all inputs and subtract the value from all subsequent outputs thus rendering the current input as zero. Example: A 4 input weigh platform will have calibrated acquisition modules but when the actual platform structure is in place each module has a weight value thus the gross value is 50Kg. By performing a system zero (with all inputs operational) this is zeroed away so next time the SW-SO is powered on the same input will yield a zero result.
Remove System Zero	Clicking this will remove all system zeros and restore all outputs normal.

Zero Settings Advanced



This advanced section allows the use of a specially configured external module to supply the system zero value for the handheld to use.
Example:
The same SW-SO is used with a truck that picks up different trailers and is required to display the sum of 4 strain gauges connected to each trailer (Using T24-SAs).
Because each trailer will have a different system zero requirement we would add a further device to each trailer set to transmit the system zero value. It is the Data Tag that is entered here.

Note: On all trailers the acquisition module sets share the same Data Tags.

Items you can change:

Data Tag — Enter the **Data Tag** of the message to use for the external system zero.

ID — Contains the ID of the device used to supply the external system zero. This is only necessary to provide a visible record of the remote device and is shown to keep compatibility with the **Mode and Communications** page.
You do not need to enter anything here although it will be filled in automatically if you perform a pair to retrieve data.

P — Click this to give 5 seconds to perform pairing to automatically provide the Data Tag and ID from a specific device. Usually pairing is activated by removing and replacing the power supply.

X — Click this to reset the Data Tag and ID to zero (disabling the external system zero function).

Configuration Examples

LED Display from a Single Source

We want to put data from a T24-SA onto a large LED display.
We will use the out of the box rate of 3 per second. The display only needs the ASCII data followed by a carriage return.
Assuming the T24-SA sends its data on Data Tag C675

```
Line1=<V1><0D>
V1Format=00.000
Timeout1=2000
ValueDataTag1=C675
PrintDataTag=C675
MinInterval=100
LineDelay=0
PrintOnError=1
SwitchMode=1
```

Summed LED Display from Dual Source

We want to put the summed Net data from a pair of T24-SAs onto a large LED display. We want the switch input of the SW-SO to toggle between Gross and zeroed net mode. (The printed output will reflect whether the device is in gross or zeroed net mode).
We will use the out of the box rate of 3 per second. The display only needs the ASCII data followed by a carriage return.
Assuming the T24-SAs send data on Data Tag C675 and FF34

Parameter settings:

```
Line1=<NET><0D>
FormatSUM=00.000
ValueDataTag1=C675
ValueDataTag2=FF34
PrintTrigger=C675
MinInterval=100
LineDelay=0
PrintOnError=1
SwitchMode=1
```

Print Gross Sum of 2 Devices to Printer

We need to print the gross sum of 2 devices to a printer with each time the switch input is activated on the SW-SO.
We need to display the value of each input as well as the gross sum.
The printer is not very fast so we can only send a line every 50mS. Also we do not want to print more often than once every 30 seconds even if the switch is pressed. The printer requires a linefeed 0x0A at the end of each line.

We want the printed output to look like:

```
Mantracourt Electronics Ltd
Weigh Station #1

Input 1: xx.xxxx Kg
Input 2: xx.xxxx Kg

--------------------
Sum:    xx.xxxx Kg

For assistance call
```

```
0871 345672
```

Parameter settings:

```
Line1=Mantracourt Electronics Ltd<0D><0A>
Line2=Weigh Station #1<0D><0A>
Line3=<0D><0A>
Line4=Input 1:<V1> Kg<0D><0A>
Line5=Input 2:<V2> Kg<0D><0A>
Line6=---------------------<0D><0A>
Line7=Sum:    <GRO>Kg<0D><0A>
Line8=<0D><0A>
Line9=For assistance call<0D><0A>
Line10=0871 345672<0D><0A>
V1Format=00.0000
V2Format=00.0000
SumFormat=00.0000
ValueDataTag1=C675
ValueDataTag2=FF34
PrintTrigger=0000
LineDelayChar=0A
LineDelay=50
MinInterval=10000
SwitchMode=0
```

Customer Ticket From Handheld Device

We have a handheld device T24-HA already configured to sum data from 4 devices. We want the F1 button on the handheld to trigger a printout to a serial printer connected to the SW-SO.
We only want to print the gross sum that the handheld passes us. The handheld is configured to send the Gross value as Data Tag **ABCD** when the **F1** button is pressed. This is referenced using the <TV> token (Trigger Value). The printer is not very fast so we can only send a line every 50mS. Also we do not want to print more often than once every 5 seconds even if the handheld tries to do so. The printer requires a carriage return 0x0D and linefeed 0x0A at the end of each line.
We also want two tickets printed each time it is triggered.
We want the printed output to look like:

```
Mantracourt Electronics Ltd
Weighment: xx.xxxx Kg
```

Parameter settings:

```
Line1=Mantracourt Electronics Ltd<NL>
Line2=Weighment: <TV> Kg<NL>
SumFormat=00.0000
PrintTrigger=ABCD
LineDelayChar=OD
LineDelay=50
MinInterval=5000
Duplicate=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.

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 RAD24i (Integrated antenna)			120 (400)	Metres (feet) *
Range RAD24e (External antenna)			200 (650)	Metres (feet) *
Channels (DSSS)		16		

* Maximum range achieved in open field site with T24-SA at a height of 3 metres above ground and SW-SO held at chest height pointing towards the T24-SA.

SW-SO

Parameter	Minimum	Typical	Maximum	Units	Notes
External Supply voltage Range	4.5	12	32	Volts	
USB Supply Range	4.875	5	5.125	Volts	As defined by USB 2.0 Specification
Average Operational Current (T24-BSi)	-	TBD	500	mA	
USB Bus Powered Operational Current	100		200		
Operating Temperature Range	-40	-	65	Deg C	
Storage Temperature Range	-40	-	65	Deg C	
Reverse polarity Protection		-	-32	Volts	Maximum Supply level