**Introduction / Overview**

The SW-AC is an advanced handheld display. This allows wireless remote viewing of multiple inputs such as strain gauge or voltage etc using 2.4GHz radio.

The SW-AC also performs the function of optionally waking the remote devices when it is turned on and sending them to deep sleep mode when it is turned off.

The handheld can operate in two modes. The operation of the buttons and the automatic sleep/wake functions are dependant on these modes.

**Result Mode**

This is the default mode in which multiple acquisition modules are used to create a result which is displayed. Currently the SW-AC only provides a sum of the remote devices but this function may be added to in future versions. Although the handheld usually shows the result (sum) there is an option of viewing the discrete values that make up the result.

**Item Mode**

In this mode each acquisition device is treated as a separate reading and the handheld is used to cycle through the available items and the value of each can be viewed.

**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.

**Getting Started**

This section will show you how to get the device pair working out of the box.

You will require 2 X AA alkaline batteries for the handheld and a 3 Volt dc supply for the strain acquisition module(s) which may also be a pair of AA batteries.

To attach acquisition devices to the handheld 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 handheld to use the data from these devices.

Initial configuration must be done with the T24 Toolkit software and a base station.
Connecting Power

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

Acquisition Module
Attach power supply as instructed in the acquisition module user manual. You may not want to actually connect an input signal yet as we can still establish communications between devices without this.

**SW-AC Operation**
The handheld can operate in two modes and the button operation is dependant on these modes.

**Item Mode**
Up to 12 individual devices can be connected to and the user can step through each one in sequence. If DoSleepWake is set then the handheld will wake all configured devices when turned on and send them all to sleep again when turned off. NOTE: When the handheld wakes devices this achieved through the transmission of a broadcast wake. I.e. all devices on the same channel and with the same encryption key will wake.

**Keys**
- Send the currently selected device to sleep.
- Will attempt to wake the currently selected device.
- Press the TARE key. This will toggle between gross and zeroed net mode. I.e. If the display shows gross then pressing the key will zero the display. Pressing the key when in net mode will return the display to gross mode. The Gross and Net modes are indicated as described below. Gross and Net are retained through power off.
- Step to the next device.
- If motion detection is activated then the reading must be steady to enable this key. Pressing this key with an unstable reading will do nothing.
  - This transmits a Data Provider packet marked with a Data Tag held in **F1DataTag** and can also contain data as defined by **F1Data**. This can be used to trigger external actions such as a printout.
  - Press and hold the power key until the display shows **BUSY** then release the key. Can also be used, by giving a quick press, to reset the Auto-Sleep delay.

**Result Mode**
Up to 12 individual devices can be summed and the result displayed.
If DoSleepWake is set then the handheld will wake all configured devices when turned on and send them to sleep again when turned off. NOTE: When the handheld wakes devices this achieved through the transmission of a broadcast wake. I.e. all devices on the same channel and with the same encryption key will wake.

In this mode there is an option of retrieving a system zero value from an external source. This is activated by supplying the Data Tag to the **ExtZeroDataTag** parameter. When activated the value supplied by the Data Provider packet marked with this tag will be used as the system zero and will be subtracted from the sum of all contributing inputs.

Usually in this mode only the result is displayed (sum) but by holding the **Next** key for a configurable number of seconds will activate the ability to step through each contributing input using the **Next** key.
Keys when viewing Result

No effect.

Will attempt to wake any sleeping devices.

NOTE: This uses a broadcast wake so any devices on the same channel with the same encryption key will wake.

Toggle between displaying gross sum or tared sum.

No effect unless held for a number of seconds to activate individual item view. This can be disabled. See Later

If motion detection is activated then the reading must be steady to enable this key. Pressing this key with an unstable reading will do nothing.

This transmits a Data Provider packet marked with a Data Tag held in F1DataTag and can also contain data as defined by F1Data. This can be used to trigger external actions such as a printout.

Toggles between on and off. Hold for 2 seconds to activate.

Keys when viewing an individual item

No effect.

Will attempt to wake the currently selected device.

If sum was currently tared then this key will toggle between displaying gross or tared value of current device. If sum view was displaying gross then this key has no effect. If an external system zero is used then only gross values actually supplied to the handheld can be displayed.

Selects next device to view.

If motion detection is activated then the reading must be steady to enable this key. Pressing this key with an unstable reading will do nothing.

This transmits a Data Provider packet marked with a Data Tag held in F1DataTag and can also contain data as defined by F1Data. This can be used to trigger external actions such as a printout.

Toggles between on and off. Hold for 2 seconds to activate.

All Modes

Indicators

G The display is showing Gross weight.
NET
The display is showing Net weight.

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

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

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

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

LOW Errors
Displayed on handheld LCD.

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

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

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

{Display Flashing}
The motion detection has been enabled and the reading is deemed in motion or unstable.

Other Functions
System Zero
If enabled, holding the Tare key for a number of seconds will perform a system zero.

Pairing
See Field Acquisition Module Replacement later
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- base station to allow your computer to communicate with T24 USBBSE 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 (SW-USBBSE) 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-AC handheld 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.

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

**Setup Base Station Communications**

Select **USB** as the interface and select 1 as the Base Station Address.

In the toolkit all items that can be changed by the user are coloured orange.

To change a value just click on the relevant orange item. You will then be presented with a new dialog window allowing you to change the value.

This may use a slider, text box or list to allow your new value to be entered.

Click the Home button to attempt communications with the base station.

If no communications can be established the toolkit will remain on this page. You will need to check that the base station is powered and that it is connected to the converter correctly.
We now have successful communications with the base station so we can now pair with our device or we can select the Spectrum Analyser mode or Data Provider Monitor mode.

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

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

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

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

<table>
<thead>
<tr>
<th>Data Tag</th>
<th>Total</th>
<th>Per sec</th>
<th>LQI</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C629</td>
<td>18</td>
<td>3</td>
<td>100</td>
<td>0.0160147</td>
</tr>
<tr>
<td>C623</td>
<td>58</td>
<td>10</td>
<td>100</td>
<td>0.0129487</td>
</tr>
<tr>
<td>C628</td>
<td>18</td>
<td>3</td>
<td>100</td>
<td>0.0218671</td>
</tr>
<tr>
<td>C62C</td>
<td>18</td>
<td>3</td>
<td>100</td>
<td>0.0152698</td>
</tr>
<tr>
<td>C627</td>
<td>17</td>
<td>3</td>
<td>100</td>
<td>0.0172869</td>
</tr>
<tr>
<td>C624</td>
<td>17</td>
<td>3</td>
<td>100</td>
<td>0.0130830</td>
</tr>
</tbody>
</table>

Select the devices you wish to log from the above list by checking them. Pressing the Start Logging button will allow you to select a filename to log the data to.

The View Last Log button will launch the application associated with CSV files and open the last logged file.
Once successfully paired to a device this page is displayed. This page shows you information about the connected device.

**Items you can change:**

Name  
You can enter a short description which may help you recognise this device in the future.
This page allows you to set the operational mode of the device and configure which external acquisition devices the handheld will connect to.

**Items you can change:**

**Operational Mode**
- **Result Mode**
  - Select in which mode the handheld will operate.
  - Up to 12 individual acquisition devices can be summed and displayed. Optionally the operator can view the individual device values (See Allow Next Key).
- **Item Mode**
  - Up to 12 individual devices can be connected to and the user can step through each one in sequence.

**Allow Next Key**
- Only used in Result Mode. Usually in Result mode only the result (sum) of the individual devices is shown. By entering a non-zero value here this will define the number of seconds that the Next key needs to be held down to enable individual item values to be viewed. Once available the Next key will cycle between all the individual values and the result. This will remain available until the handheld is powered off.
- Each time the Next key is pressed the display will show a brief message indicating what will be displayed; Input 1, Input 2, Result etc.

**F1 Data Tag**
- The F1 key can be used to trigger other devices such as a T24-SO device to provide printer services etc. This key will generate a Data Provider message which other devices can use. Set this value to non zero to enable this function and to define the Data Tag that will identify the message sent.
- The content of the message is defined by the F1 Data parameter.
- NOTE: If motion detection is configured then this key will have no effect while the reading is not steady.
### F1 Data

Define what data is carried in the Data Provider message when the F1 key is pressed. Select **Always Gross** to transmit the gross value regardless of whether the Tare key has been pressed. Select **As Displayed** to transmit either the gross or net value depending on the currently displayed data.

### Remote Data Tags and IDs

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Tag</strong></td>
<td>Enter the Data Tag of the message to use for the specified input item.</td>
</tr>
<tr>
<td><strong>ID</strong></td>
<td>Enter the ID of the device used to supply the specified input item. <strong>NOTE:</strong> This is only necessary for <strong>Item Mode</strong> where individual items are to be woken using the <strong>Wake</strong> key as opposed to letting the handheld wake all devices. If you are not using Item mode then you are not required to enter the ID although it will be filled in automatically if you pair to a device to retrieve its settings.</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>X</strong></td>
<td>Click this to reset the Data Tag and ID to zero (disabling the input item).</td>
</tr>
</tbody>
</table>
Zero Settings

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

**Items you can change:**

- **Power On Auto Zero**
  
  Here you can determine whether the SW-AC performs automatic zero when it is powered on.
  
Enter zero to disable this function.
  
  If you enter a non-zero value then when the handheld is first turned on it checks the value read from the acquisition module. If this falls within ± of this value then the display will be altered so this reads zero.

  **Example:** A strain gauge acquisition module (T24-SA) is calibrated in Kgs and measures the weight of boxes on a platform. The weight of the platform itself has been removed using system zero on the acquisition module.
  
  Sometimes there is debris on the platform which you do not want to see when viewing the weight of boxes that will be placed on the platform later.
  
  The minimum weight of a box is 5 Kg so you could set the Power On Auto Zero to 2 Kg.
  
  When you turn on the handheld, if the weight on the platform is between -2 and +2Kg then the handheld will tare this weight off and so read zero.

- **Zero Indication Band**
  
  Using this setting you can mask tiny changes in input after you press the Tare button.
  
Enter zero will disable this function.
  
  Entering a non-zero value will provide a band within which the display will always read zero.
  
  Once the reading exceeds this value the real weight will be displayed as no taring is taking place.
Example: You are adding boxes to a platform and you press tare between adding each one so you can see the weight of each box.
Without this setting activated each time you tare the display will be around zero but not exactly zero (By setting the display resolution you may hide this difference) by setting a small value here such as 0.2Kg the display will show a stable zero while actual weight is fluctuating less than ± 0.2Kg.

Allow System Zero
Entering a non-zero value here will enable system zero to be performed by holding down the Tare key for a number of seconds.
The value entered here represents the number of seconds the key needs to be held.

Perform System Zero
This section allows the user to apply or remove a system zero.
This will require that the acquisition modules are configured, attached to the handheld and the entire system is ready for zeroing.
Zero Settings Advanced

This advanced section allows the use of a specially configured external device to supply the system zero value for the handheld to use.

Example:
The same handheld 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).
Here you can adjust the display.

**Items you can change:**

**Format & Resolution**
Here you can define how the values are displayed on the LCD. There are 7 digits available and you can define where the decimal point is shown by entering text where a zero indicates a numeric digit position.

When the data is being displayed the number of decimal places you define may be overridden as the display will always show the correct number of integer digits.

Example: If you set the format to 000.0000 and the value to display is 1000.1234 the display will show 1000.123

You can also define the resolution, which is the block size of changes to the display.

Example: If you enter the format as 000.0005 the display will only change in steps of 0.0005 which can be used to mask noisy digits at high resolutions.

**Leading Zero Suppression**
This can be turned on or off and will suppress leading zeroes when on.
Example: If the display reads 000.123 with leading zero suppression turned off it will display 0.123 when turned on.

**Overload Limit**
You can enter a limit here above which *Overload* will be shown on the display instead of the actual value.
Enter zero to disable this feature.
Advanced  This opens the advanced page where you can scale the displayed data.

Motion Band  By entering a non-zero value here you activate the motion detection. If, within the Motion Time, the displayed value changes by more than the amount entered the reading will be deemed in motion or unstable and the display will flash. The F1 key will be disabled while the reading is in motion.

Motion Time  Enter a time in seconds over which the motion detection operates.
Display Format Advanced Settings

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

**Items you can change:**

**Display Update Rate**
- Enter the interval in milliseconds between display updates. The default is 300 milliseconds, i.e., 3 updates per second.

**Custom Display Scaling**
- This can be used to change the displayed value to a different unit or to otherwise scale it. You simply enter the original and required values at a low and high point.
- Example: If a T24-SA was supplying data in Kgs and you wanted to show tonnes, you would keep both the low points at zero. Enter **At High Input Value** of 1000 and **Display Should Read** Value of 1.

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Channel and Encryption

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

If you want to change the channel of an acquisition module and SW-AC pair there is no need to change both devices.

Simply pair to the handheld and change its channel and key.

Now perform pairing to the acquisition module from the handheld and the acquisition module will be configured to match the handheld.

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

Items you can change:

Channel
Select a channel between 1 and 16. The default is channel 1. You can use the Spectrum Analyser mode to determine a good clean channel to use.
NOTE: Channel 16 is used to negotiate pairing so avoid this channel if possible.

Encryption Key
Only devices with identical encryption keys can communicate. You can isolate groups of devices on the same channel or just use the key to ensure the data cannot be read by somebody else.
Save and Restore

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

**Items you can change:**

**Save**

Click this button to open a file dialog window to allow you to select a filename and location to save the configuration file to. All configuration information including calibration data will be saved to the file. The file extension is tcf.

**Restore**

Click this button to open a file dialog window to allow you to select a filename and location of a previously saved file to load into the connected device. All configuration information including calibration data will be overwritten. The file extension is tcf.

**Advanced Settings**

Click this button to enter the Advanced Settings Page. Here are settings which do not normally require changing.
**Advanced Settings**

**Waker Duration (mS)**
- **8000**
  - Select how long the handheld will wait to wake the paired devices. The default is 12 seconds (12000 mS).

**Do Sleep Wake**
- **Yes**
  - Whether the handheld will wake and sleep the paired devices as it is turned on and off. The default is YES.

**Auto Off Delay (m)**
- **5**
  - The handheld will power off if no button is pressed within this time. Enter zero to disable this function. The default is 5 minutes.

**Keep Awake Interval (s)**
- **5**
  - Paired devices need to be kept awake. Enter the interval in seconds to transmit Keep Awake messages. The default is 5 seconds.

**Pair Wait Duration (s)**
- **5**
  - This determines how long to wait in seconds when pairing a device to the handheld. The default is 5 seconds.

You should not normally need to change these settings.

**Items you can change:**

- **Waker Duration**: When the handheld is turned on it may attempt to wake the paired acquisition modules. This setting allows you to adjust the time it will wait to wake the remote devices in milliseconds. The default is 12000.

- **Do Sleep Wake**: You can select whether the handheld wakes the remote acquisition modules on power up and sends them to sleep on power down. Select No to disable this function. The default is Yes.

- **Auto Off Delay**: Here you can specify the delay in minutes after which the handheld will automatically turn off after no button is pressed. Enter zero to disable this function. The default is 5 minutes. The On/Off key can be used to reset this by giving a quick press. This may be more suitable than using the Tare key!

- **Keep Awake Interval**: While the handheld is retrieving data from the acquisition module it periodically sends out a **Keep Awake** packet. This will stop the acquisition module from going to sleep while the handheld is in use. The default is 5 seconds.

- **Pair Wait Duration**: Here you can set the duration that the handheld will wait to achieve successful pairing when it is turned on in Pairing mode. The default is 5 seconds.

- **Item Duration**: Used when in Result Mode and the Next key has been enabled to allow viewing of discrete inputs. Enter a time in seconds that the individual item value will be displayed for before the display is automatically switched back to showing the result.
Each time the Next key is used to step through available items the display shows a brief description of the data about to be displayed. Input 1, Input 2, Result etc. The time you enter here in milliseconds is the time that this message will be displayed before the actual value is shown.
**Installation**

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

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

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

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

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

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

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

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

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

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

Range underwater is only a decimetre or so depending on packet rate. Best performance underwater is obtained by using low packet rates and immersing water-proofed antennae rather than water-tight enclosures containing the antennae.
Antenna Orientation
For the maximum range the acquisition module and the SW-AC should be orientated as shown. The sensitivity to the radio transmission will be reduced if the acquisition module is oriented in a vertical or portrait position.
**Specifications**

**General Radio**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>License</td>
<td></td>
<td>License Exempt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulation method</td>
<td></td>
<td>MS (QPSK)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio type</td>
<td></td>
<td>Transceiver (2 way)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data rate</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Radio Frequency</td>
<td>2.4000</td>
<td>2.4835</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>1</td>
<td>1</td>
<td>mw</td>
<td></td>
</tr>
<tr>
<td>Range RAD24i (Integrated antenna)</td>
<td>120 (400)</td>
<td>120 (400)</td>
<td>Metres (feet) *</td>
<td></td>
</tr>
</tbody>
</table>
| Range RAD24e (External antenna) | 200 (650) | 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-AC held at chest height pointing towards the T24-SA.

**SW-AC**

**Electrical**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply voltage</td>
<td>2.4</td>
<td>3.0</td>
<td>3.6</td>
<td>V dc</td>
</tr>
</tbody>
</table>

**Power Supply**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>35</td>
<td>40</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Low power mode</td>
<td>120</td>
<td>160</td>
<td>uA</td>
<td></td>
</tr>
</tbody>
</table>

**Estimated Battery life using 2Ahr batteries:**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standby mode (Powered off)</td>
<td>1.5</td>
<td>1.5</td>
<td>Years</td>
<td></td>
</tr>
<tr>
<td>Continuous operation</td>
<td>40</td>
<td></td>
<td>Hours</td>
<td></td>
</tr>
</tbody>
</table>

**Environmental**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP rating</td>
<td>IP65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-10</td>
<td>+50</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40</td>
<td>+85</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>0</td>
<td>95</td>
<td>%RH</td>
<td></td>
</tr>
</tbody>
</table>

**Physical**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand Held Dimensions</td>
<td>90 x 152 x 34mm</td>
</tr>
</tbody>
</table>
**Field Acquisition Module Replacement**

The following technique can be employed if an acquisition device needs replacing in the field. It is good practice to calibrate all acquisition modules in absolute units such as Kg. By doing this it is easy to send a replacement to a customer. If the calibration is more complex then a copy of the configuration can be made using the Toolkit and the settings can then be uploaded to the replacement module before shipping to the customer.

Configure the replacement acquisition device to match the original in terms of calibration.

Once a customer has received the replacement device and connected it to replace the original the following procedure could be instructed.

Use the built in pairing function to retrieve the Data Tag and ID of the replacement device.

Using the handheld view the item that is being replaced. In **Result Mode** the ability to view individual items **must** have already been enabled and activated.

This will display -------- if the original device is unavailable.

Power off the handheld using the Power key.

Ensure that new acquisition module is not powered for at least 10 seconds.

We need to turn on the handheld in pairing mode. To do this we start with it turned off, then press and hold the power key then press and hold the Tare key. Now both keys are held down until PAIRING is seen on the display. The keys can now be released.

Now apply power to the new acquisition module within 10 seconds.

If successful the handheld will pair to the acquisition module and the display will show a numeric value. If the display shows Failed or -------- then the pairing failed.

The system zero may require resetting. If enabled this may be achieved by holding the Tare key down for a number of seconds. See **Zero** page of the Toolkit section.