Sontay® SonNet Radio Sensor System
For Tridium JACE Integration

User Manual

Version 1.0

January 2012

Audience

This manual is intended for specifiers, users and installers of the Sontay® SonNet radio sensor system.

Content

This manual provides a complete reference for the Sontay® SonNet radio sensor system.

Related Documents

The Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide
The Sontay® SonNet radio sensor system Site Survey Kit Manual
The Sontay® SonNet radio sensor system Quick Start Guide
The Sontay® SonNet radio sensor system product datasheets

Table Of Contents:

Overview

The wireless nodes are based on direct-sequence spread spectrum communication in the 2.4 - 2.5GHz band, compliant with IEEE 802.15.4-2006.

All nodes have a unique MAC address, equivalent to a unique serial number.

All nodes have a PCB-mounted on/off switch or jumper.

All nodes retain their configuration properties across a power failure.

Environmental

- Storage temperature range of -10 to +80°C
- Storage relative humidity range of 0 to 90% (non-condensing).
- Ambient (operating) temperature range of -10°C to +50°C
- Ambient (operating) relative humidity range of 0 to 90%, (non-condensing).

Battery Fitting and Replacement

When a battery is installed, or when it is replaced, observing the correct polarity is very important. Fitting the battery incorrectly may result in permanent damage to the sensor.

Recommended batteries are 3.6Vdc 2.4Ah AA size Lithium-Thionyl Chloride types for space housing sensors, or 3.6Vdc 2.1Ah 2/3 A size Lithium-Thionyl Chloride types for plant housing sensors, and are **not rechargeable**.

This type of battery should be stored in a clean, cool (not exceeding +30°C), dry and ventilated area.

Disposal of Batteries - Warning! Fire, Explosion And Burn Hazard

Disposal of Batteries - Warning! Fire, Explosion and Burn Hazard.

Do not short-circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose the battery contents to water. Do not solder directly to the cell.

All batteries must be disposed of in accordance with EC Directive 2006/66/EC, amended by EU Directive 2008/12/EC.

Battery Powered Nodes

Battery powered sensor nodes are used in conjunction with the Sontay® **RF-RXS** serial receiver and **RF-RXS-N** internally mounted JACE option card, and if required (depending on installation topography), Sontay® **RF-RS** series of routers. Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement.

The sensors automatically find the best path back to the receiver, which may be directly to the receiver or *via* "parent" routers.

To power a battery powered node, jumper J400 must be fitted. To switch off, remove J400.

Battery powered nodes are available in 4 formats:

- Space mounting temperature, with setpoint and momentary switch options
- Space mounting RH&T, with setpoint and momentary switch options
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
- Frequency 2.4GHz
- 16 channels, automatically selected, direct-sequence spread spectrum
- Compliance IEEE 802.15.4-2006

Aerial Characteristics:
- Gain 1.2dBi
- VSWR 1.5:1

Data Encryption: AES 128
Power Output: 0dBm (1mW @ 50Ω)
Accuracy:
- Temperature ±0.3°C
- Optional RH ±3% RH

Battery Type: 3.6V AA 2.4Ah Li-$SOCl_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant)
Dimensions: 85 x 85 x 23mm
Environmental:
Operating:
- Temperature: -10°C to +50°C
- RH: 0 to 90%, non-condensing

Storage:
- Temperature: -10°C to +80°C
- RH: 0 to 90%, non-condensing

Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:
- Frequency 2.4GHz
- 16 channels, automatically selected, direct-sequence spread spectrum
- Compliance IEEE 802.15.4-2006

Aerial Characteristics:
- Gain 2.0dBi
- VSWR 2:1

Data Encryption: AES 128
Power Output: 0dBm (1mW @ 50Ω)
Accuracy:
- Temperature ±0.3°C
- Optional RH ±3% RH

Battery Type: 3.6V 2.1Ah 2/3 A Li-$SOCl_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 55mm x 90mm dia.
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
- Temperature: -10°C to +50°C
- RH: 0 to 90%, non-condensing

Storage:
- Temperature: -10°C to +80°C
- RH: 0 to 90%, non-condensing

Country of origin: UK

Temperature Sensor Types:
- Duct
- Outside air
- Outside air with solar radiation shield
- Immersion
- Strap-on
- Flying lead

Refer to product datasheets for installation instructions.

Part Codes: Battery Powered Space Housing Nodes:

- **RF-RS-T-911** - Temperature sensor
- **RF-RS-T-911-SP** - Temperature sensor c/w setpoint knob
- **RF-RS-T-911-MS** - Temperature sensor c/w momentary switch
- **RF-RS-T-911-SP-MS** - Temperature sensor c/w setpoint knob & momentary switch
- **RF-RS-R-911** - RH&T sensor
- **RF-RS-R-911-SP** - RH&T sensor c/w setpoint knob
- **RF-RS-R-911-MS** - RH&T sensor c/w momentary switch
- **RF-RS-R-911-SP-MS** - RH&T sensor c/w setpoint knob & momentary switch

Part Codes: Battery Powered Plant Housing Nodes:

- **RF-RS-T-522** – Duct temperature sensor
- **RF-RS-T-531** – OAT temperature sensor
- **RF-RS-T-532** – OAT + radiation shield temperature sensor
- **RF-RS-T-541** – Immersion temperature sensor
- **RF-RS-T-551** – Strap-On temperature sensor
- **RF-RS-T-555** – Flying Lead temperature sensor
- **RF-RS-R-522** – Duct RH&T sensor

24V Powered Routers

24V powered routers are used in conjunction with the Sontay® **RF-RXS** or **RF-RXS-N** receivers, and **RF-RR** series of battery powered radio sensors, and are used to route signals from battery powered nodes and other routers to the receiver module, where the signal strength of a direct path is not sufficient for reliable communications. **NB** Each router can support a maximum of 16 "children", which can consist of a maximum of 8 battery powered nodes and 8 routers, ***or*** up to 16 routers ***if*** there are no battery powered nodes. Consideration should be given on network planning for redundancy in case of router failure or damage.

Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement. Routers automatically find the best path back to the receiver, which may be directly to the receiver or *via* other "parent" routers.

To power a router, jumper J200 must be fitted. To switch off, remove J200.

24V powered nodes are available in 5 formats:

- Space mounting temperature, with setpoint and momentary switch options
- Space mounting RH&T, with setpoint and momentary switch options
- Plant mounting router, no sensor functions
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
- Frequency 2.4GHz
- 16 channels, automatically selected
- Direct-sequence spread spectrum
- Compliance IEEE 802.15.4-2006

Aerial Characteristics:
- Gain 1.2dBi
- VSWR 1.5:1

Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Accuracy:
- Temperature ±0.3°C
- Optional RH ±3% RH

Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant)
Dimensions: 85 x 85 x 23mm

Environmental:
Operating:
Temperature: -10°C to +50°C
RH: 0 to 90%, non-condensing
Storage:
Temperature: -10°C to +80°C
RH: 0 to 90%, non-condensing
Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:
Frequency 2.4GHz
16 channels, automatically selected, direct-sequence spread spectrum
Compliance IEEE 802.15.4-2006
Aerial Characteristics:
Gain 2.0dBi
VSWR 2:1
Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)
Accuracy:
Temperature ±0.3°C
Optional RH ±3% RH
Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 55mm x 90mm dia.
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
Temperature: -10°C to +50°C
RH: 0 to 90%, non-condensing
Storage:
Temperature: -10°C to +80°C
RH: 0 to 90%, non-condensing
Country of origin: UK

Temperature Sensor Types:
Duct
Outside air
Outside air with solar radiation shield
Immersion
Strap-on
Flying lead

Refer to product datasheets for installation instructions.

Part Codes: 24V Powered Space Housing Routers:

- **RF-RR-T-911** – Router temperature sensor
- **RF-RR-T-911-SP** - Router temperature sensor c/w setpoint knob
- **RF-RR-T-911-MS** - Router temperature sensor c/w momentary switch
- **RF-RR-T-911-SP-MS** - Router temperature sensor c/w setpoint knob & momentary switch
- **RF-RR-R-911** - Router RH&T sensor
- **RF-RR-R-911-SP** - Router RH&T sensor c/w setpoint knob
- **RF-RR-R-911-MS** - Router RH&T sensor c/w momentary switch
- **RF-RR-R-911-SP-MS** - Router RH&T sensor c/w setpoint knob & momentary switch

Part Codes: 24V Powered Plant Housing Routers:

- **RF-RR** - Router
- **RF-RR-T-522** – Router duct temperature sensor
- **RF-RR-T-531** – Router OAT temperature sensor
- **RF-RR-T-532** – Router OAT + radiation shield temperature sensor
- **RF-RR-T-541** – Router immersion temperature sensor
- **RF-RR-T-551** – Router strap-On temperature sensor
- **RF-RR-T-555** – Router flying Lead temperature sensor
- **RF-RR-R-522** – Router duct RH&T sensor

The System Receiver

The Sontay® **RF-RXS** and **RF-RXS-N** receivers collect data from all other devices on the radio network, including measurements from sensors, link quality for all links formed in the network, battery levels for all battery powered devices, hours run for all devices and the current status of all devices. **NB** Each receiver can support a maximum of 16 ***directly connected*** "children", which can consist of a maximum of 12 battery powered nodes and 4 routers, ***or*** up to 16 routers ***if*** there are no battery powered nodes.

Receivers are available in 2 formats:

- **RF-RXS** - RS-232 serial connection to JACE
- **RF-RXS-N** - Internally fitted option card for JACE

Receiver Specification:

Radio Output:
- Frequency 2.4GHz
- 16 channels, automatically selected
- Direct-sequence spread spectrum
- Compliance IEEE 802.15.4-2006

Aerial Characteristics:
- Gain 2.0dBi
- VSWR 2:1

Data Encryption: AES 128
Power Output: +10dBm (10mW @ 50Ω)

Power Supply:	24Vac/dc
Housing:	
DIN Rail	100mm x 70mm x 58mm (excluding aerial)
Environmental:	
Operating:	
Temperature:	-10°C to +50°C
RH:	0 to 90%, non-condensing
Storage:	
Temperature:	-10°C to +80°C
RH:	0 to 90%, non-condensing
Country of origin:	UK

Refer to product datasheets for installation instructions.

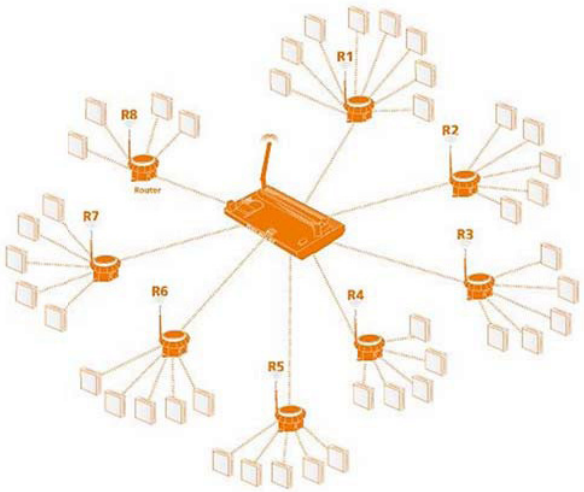
Part Codes:

- **RF-RXS** - Receiver with RS-232 serial connection to JACE
- **RF-RXS-N** - Internally fitted receiver option card for JACE
- **RF-AERIAL** – Replacement whip aerial
- **RF-AERIAL-PM2** – 2m coaxial cable extension
- **RF-AERIAL-PM5** – 5m coaxial cable extension

The Radio Network

A Sontay® SonNet radio system is comprised of a receiver, battery powered sensors and permanently powered routers.

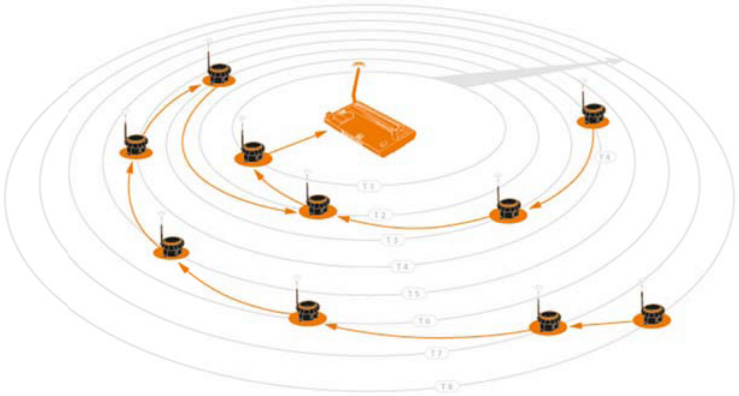
Routers, though permanently powered, can also have sensing elements, accomplishing both router and sensors functions. Routers and sensors can either communicate directly with the receiver or *via* other routers. Routers are required to be permanently powered as they need to stay "awake" at all times to allow signals from "child" nodes to be instantly forwarded to their "parent" nodes. Battery powered sensors only "wake" for very short periods to send data.



In the schematic above, routers **R2 to R7** have 5 children each, all battery powered sensors. Their parent is the receiver. Router **R1** has 6 children and **R8** has 4 children, giving a total number of network devices of 200, including the receiver.

The receiver can support a **maximum** of 16 directly connected "child" devices, of which a maximum of 12 can be battery powered nodes, plus up to 4 routers.

Routers can support a **maximum** of 16 directly connected "child" devices, of which a maximum of 8 can be battery powered nodes, plus up to 8 routers.



There can be a maximum depth of 8 layers of routers in a network and a maximum of 200 nodes per network with the **RF-RXS** series of receivers.

Note that battery powered devices can only route their signals to the receiver directly or through routers, and **not through other battery powered devices**.

When planning a SonNet radio network, it is recommend that the Sontay® SonNet Sitte Survey Kit be used. This easy-to-use package allows installers to test signal strengths between locationss required for battery powered sensors and the receiver prior to installing the full system. It can also identifyy whether routers are needed to ensure reliable communications between all devices on the network backk to the receiver. This removes any guesswork from planning a system and allows the installer to order exactly and only the devices required.

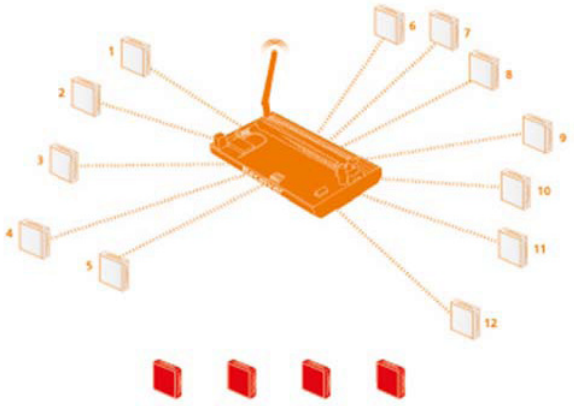
See the Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide and The Sontay® SonNet radio sensor system Site Survey Kit Manual for full details.

Network Planning Considerations

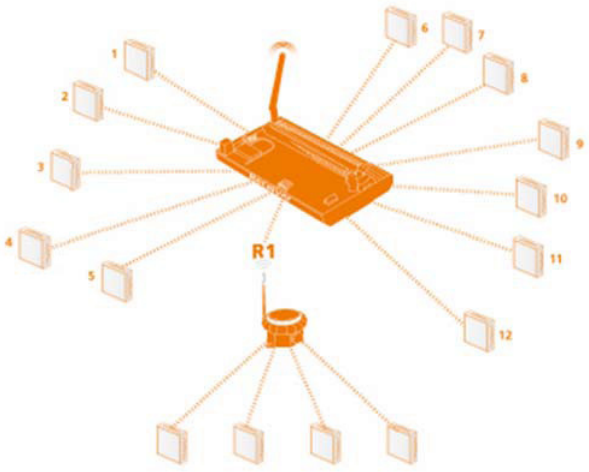
When planning a SonNet radio system, it is always worth considering the placement oof routers, and should be capable of handling the consequences of a router failing or being damaged.

Example:

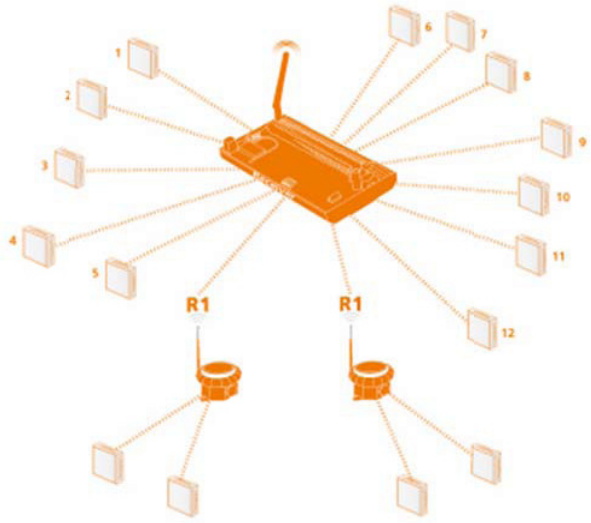
Consider a network with a requirement for 16 EDs:



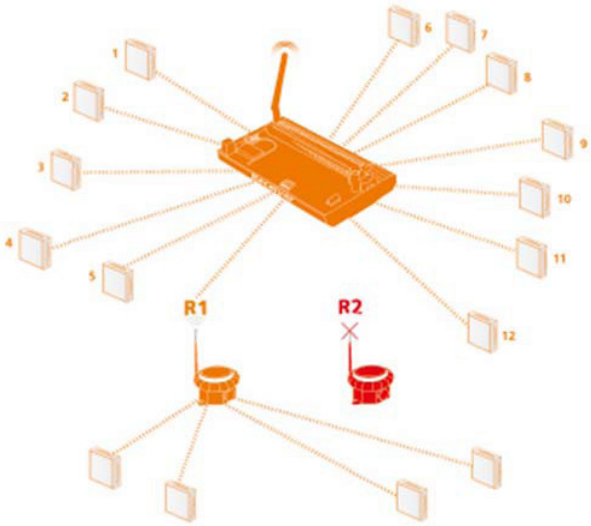
1. At least one rouuter is required, as 16 directly connected EDDs will exceed the maximum limit of 12. Four EDs will be orphaned.



2. A single router (R1) will work, but gives no redundancy if thhe router should fail.



3. Optimal network uses 2 routers, R1 and R2.



4. If either of the routers fail, the network can still be maintained, as the 2 orphaned EDs can re-route via the other router.

The Radio System

The radio system used by the Sontay SonNet devices is divided into 3 sections or 'layers'.

1. The radio layer is where physical control of the radio signal is done. This conforms to international standard 802.15.4, and determines the frequency of the radio signals, the number of 'channels' available for use, the bandwidth and power level of the signal etc. There are 16 channels available, and the best one is automatically selected by the receiver. The frequencies used are in the ISM (Industrial, Scientific and Medical) 2.4GHz band, with a maximum data rate of 250kb/s.
2. The network management layer is where the self-healing tree functionality is run, which controls network topology. 'ZigBee' is an example of a network management MESH protocol. SonNet does not use ZigBee, but instead uses a 'self-healing tree' protocol to control network topology.
3. The application layer determines what the device does – i.e. makes it a temperature sensing device, a router or a receiver. SonNet devices use specific applications, and include features such as configuration properties.

Security

All SonNet system devices have the same, unique network identifier. Only devices with the correct ID will be allowed to join the network. The ID used by system devices is different from the ID used for site survey kit (SSK) devices. Hence, SSK devices cannot join a system network and vice versa. When a SonNet system network has been formed, it can be 'locked' to prevent any unauthorised devices joining, even if they are SonNet devices. The CMS can be used to authorise extra SonNet system devices if required.

All data transmitted by SonNet devices is encrypted.

How the Self-Healing Tree Network Is Formed

The network is formed based on 3 rules, and in a specific order of priority.

1. *How many 'tiers' a device is away from the receiver.*

If a device can communicate directly with the receiver, it will, even if the link quality is poorer than if it went through a router. If a device has a choice of more than one router, it will *always* choose the router closest to the receiver (the least number of tiers away), *even if the link quality is poor*.

2. *The number of 'child' devices a router already has.*

A router can have a maximum of 16 'children'. If a device has a choice of more than one router of the same tier level, it will *always* choose the router with the least number of children, *even if the link quality is poor*.

3. *Signal Strength (link quality).*

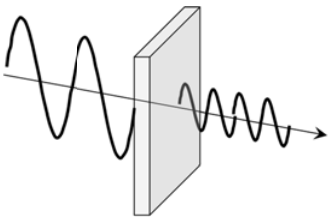
Finally, if a device has a choice of more than one router of the same tier level and the same number of children, it will choose the router with the best link quality.

If, for any reason, a device (node or router), loses it's preferred path back to the receiver, it will automatically search for an alternative – still obeying the 3 rules above in sequence. If, despite employing Direct Sequence Spread Spectrum (DSSS) techniques, interference on the currently occupied channel prevents communications, the receiver will automatically look for another channel which is clear. All other devices, having lost their links to the receiver, will then also automatically scan the 16 channels until they find the receiver again, and the network will re-form without user intervention.

Propagation Of Radio Signals In Buildings

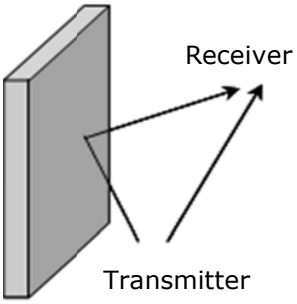
The propagation of microwave radio signals in a building can be affected in several wayss:

Attenuation



Radio signal strength is attenuated when it passes through air. Signals are attenuated much more when passing through other media, such as materials typically used in construction, such as brick, stone, wood and especially steel.

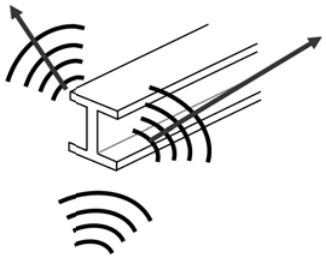
Reflection



Depending on the building, radio signals can take many paths from the transmitter to the receiver, rather than just one single path.

'Multipath' signals can have the effect of cancelling each other out, reducing overall received signal strength.

Scattering



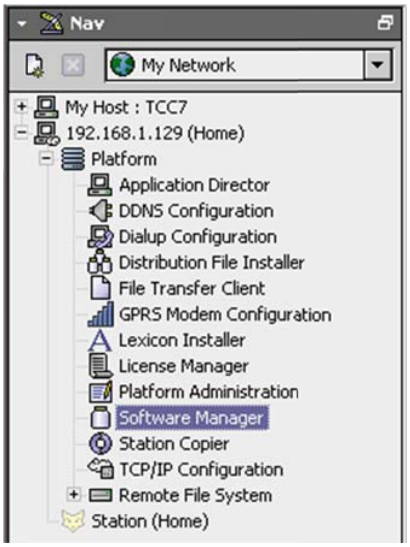
Scattering the radio signal can also reduce it's signal strength.

System Requirements

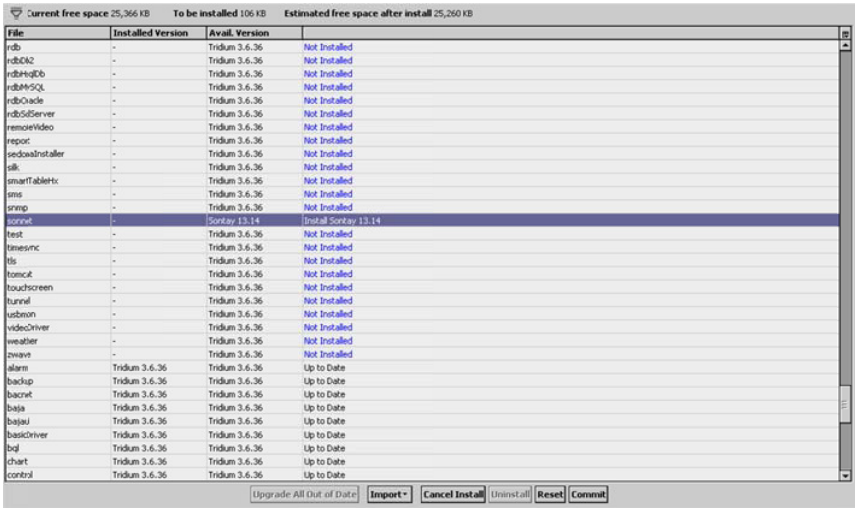
1. Tridium JACE 2xx series or 6xx series
2. Niagara Workbench
    a. **RF-RXS** - V3.5.34 or later
    b. **RF-RXS-N** - V3.6.36 or later

Installing the SonNet Driver to a Tridium JACE

1. If not pre-installed, download a copy the SonNet driver file “sonnet.jar” from www.sontay.com and copy it to the <Modules> folder on the PC running Niagara Workbench, for example < C:\Niagara\Niagara-3.5.34\modules>

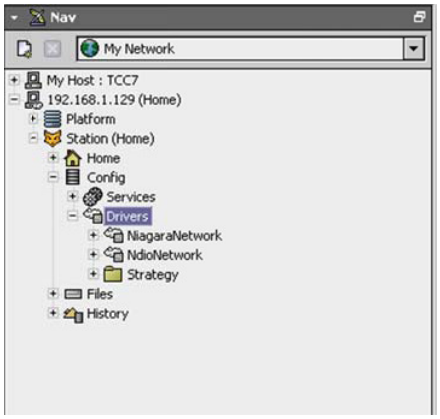


2. Start Niagara Workbench and log into the JACE platform
3. From the platform tree, open <Software Manager>



4. From the list of modules and driver, locate and select <sonnet>
5. Click the <Commit> button. The driver will be installed. **NB** - this action will cause the JACE to reboot.

6. After the JACE has rebooted, log into the JACE station. Expand the station tree and expand the <Config> branch to show the <Drivers> branch.

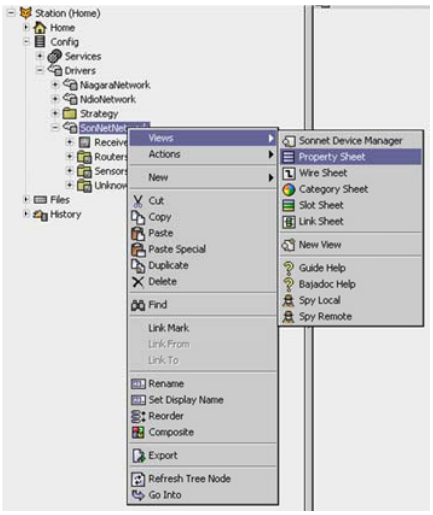


Adding a SonNet Network

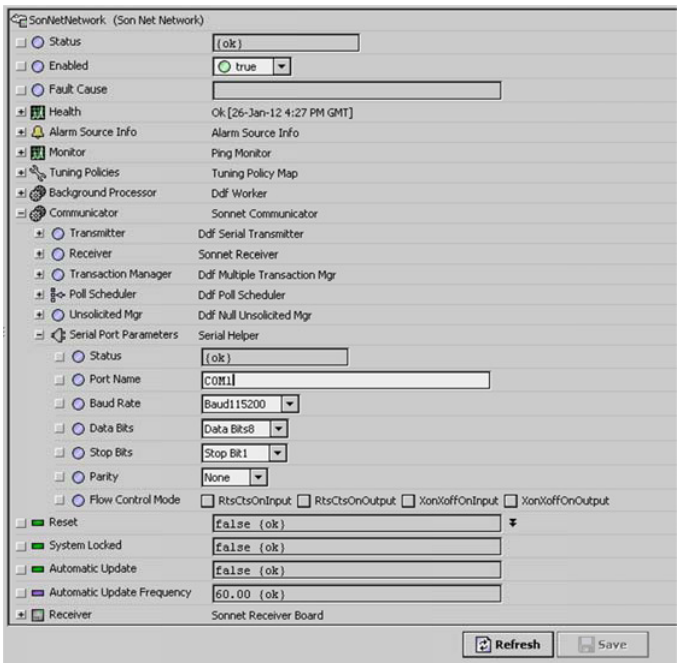
Prerequisites:

- The **RF-RXS** must be connected to COM1 of the JACE by a serial cable (9-pin D male to 9-pin D female). Do not use a null modem serial cable.
- The **RF-RXS-N** should be installed on COM3 of the JACE. See "Installing the SomNet option card"
- Observing power supply polarity, switch on the **RF-RXS**
    - Observer the red LED nearest the aerial of the **RF-RXS**. If it is blinkingg on and off it means the receiver has no child devices yet.

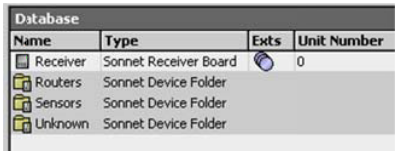
1. Double-click the <Drivers> folder in the <Station\Config > navigation treee to open the Driver Manager window. Click the <New> button.
2. From the <Type to Add" drop-down box, scroll down and select <SonNet Netwwork>
3. Click the <OK> button, ensure the new driver is enabled and then click the <OOK> button to add the network driver.
    a. At this point, the new SonNet network may be shown in orange the Driver Manager window.
4. Right click on the <SonNetNetwork> folder in the <Station\Config\Drivers > nævigation tree , select <Views> then <Property Sheet> to open the SonNet driver property sheet.



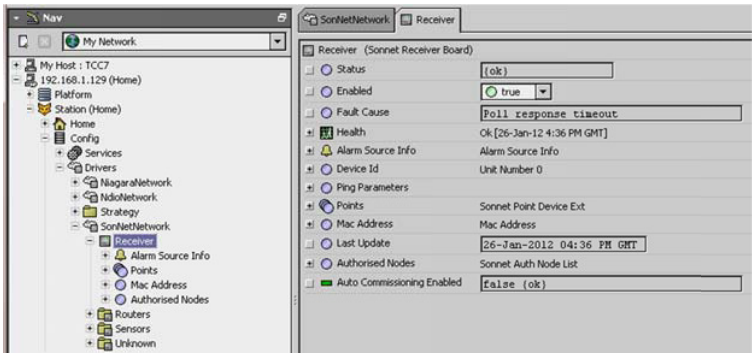
5. Expand the <Communicator> section, then expand the <Serial Port Parameters> section. Set the port name as required and ensure the other parameters are as shown below. [*Tip! Use COM1 for **RF-RXS** or COM3 for **RF-RXS-N***]



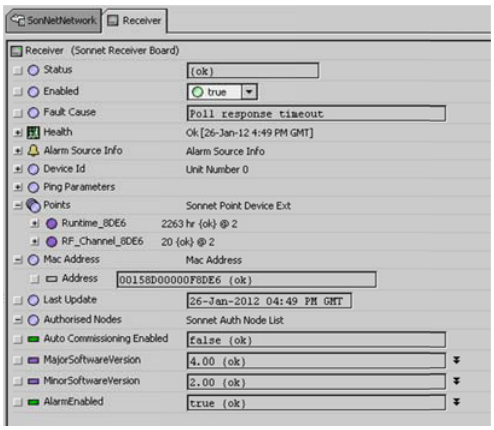
6. Double click on the <SonNetNetwork> folder in the <Station\Config\Drivers> navigation tree to open the SonNet Device Manager window. The <Receiver> should be shown in white, indicating the receiver is online.
7. Double click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree to open the receiver property sheet. [*Tip! Hold the <Ctrl> key while double-clicking open the new view in a separate tab*]



8. Right click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Get All Data>.



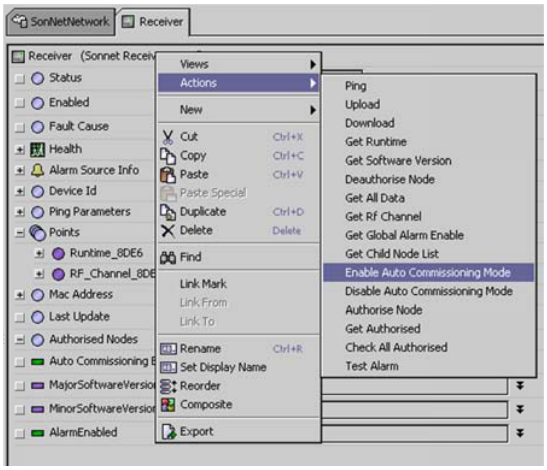
Extra information on the receiver and it's parameters are now available.



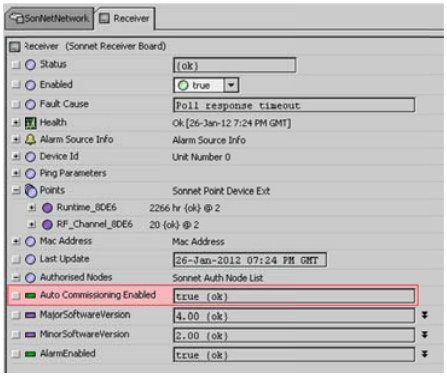
Commissioning SonNet Devices onto the Wireless Network

NB - Also refer to the step-by-step guide on pages 20 -21

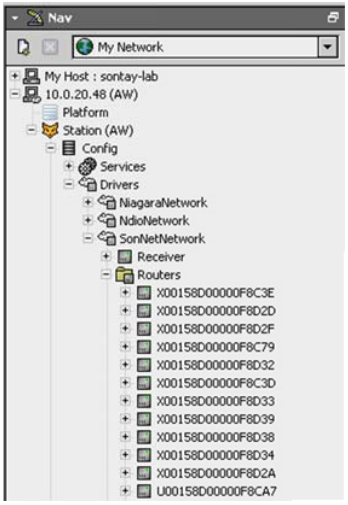
1. Power all routers on, starting with those closest to the receiver (i.e. "layer 1") and continue with the next layers of routers until all routers are switched on.
2. Place the receiver into auto-commissioning mode. Right click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Enable Auto Commissioning Mode>



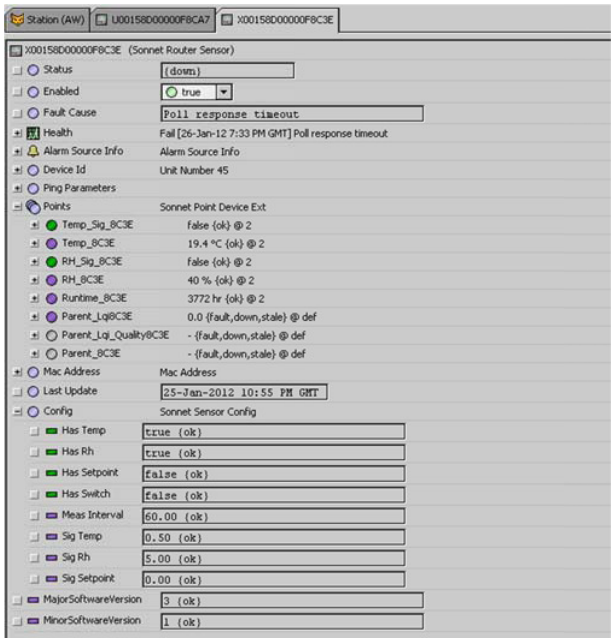
3. Observe, in the receiver property sheet, that the receiver is now in auto commissioning mode



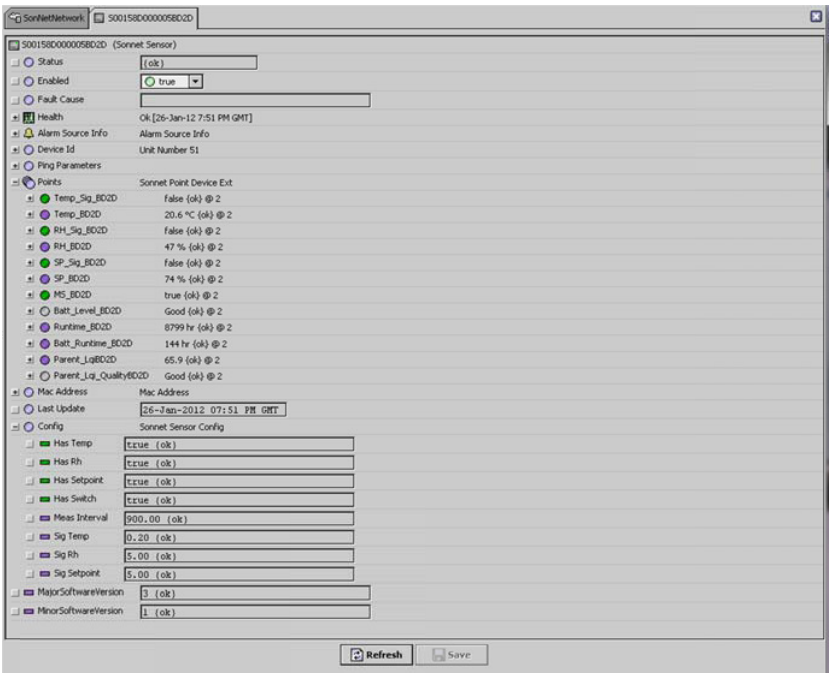
4. Routers will initially appear in the <Unknown> folder. This is normal. Ensure that each router moves to the “Routers” category of the SonNet driver. Depending on the number of devices on the network, this may take a couple of minutes.



5. Note that a router name prefixed with a U denotes the router has no sensor ffunctionality. A router name prefixed with an X denotes the router has some sensor functionality.
6. Power all EDs on. EDs will initially appear in the <Unknown> folder. This iss normal. Ensure that each ED moves to the “Sensors” category of the SonNet driver. Dependimg on the number of devices on the network, this may take several of minutes.
7. Take the receiver out of auto commissioning mode. Right click on the <Receiver> folder in the <Station\Config\Drivers\SonNetNetwork> navigation tree, select <Actions> then <Disable Auto Commissioning Mode>. **NB** - this is very important, as trying to change configuration properties while in auto-commissioning mode may cause network errors.
8. Right click on each router, select <Actions> then <Get All Data>. Repeat this procedure for each router. All router properties and configuration settings are made available.



9. Right click on each ED, select <Actions> then <Get All Data>. Repeat this procedure for each ED. All ED properties and configuration settings are made available. note that a response from the ED may take several minutes depending on the size of the network.



10. Changes to ED (and if applicable, router) configuration properties can now be made. These can be to;

    a. Significant change of value for temperature, default value = 0.5°C
        i. Right click on the ED, select <Actions> then <Set Significant Temperature>
    b. Significant change of value for RH (if fitted), default value = 5% RH
        i. Right click on the ED, select <Actions> then <Set Significant Relative Humidity>
    c. Significant change of value for setpoint (if fitted), default value = 5%
        i. Right click on the ED, select <Actions> then <Set Significant Setpoint>
    d. Measurement interval, default value = 900 seconds
        i. Right click on the ED, select <Actions> then <Set Measurement Interval>

11. Some individual properties can be requested to save network traffic, as an altternative to the < Get All Data> option. These are;

    a. Runtime - Right click on the ED, select <Actions> then <Get Runtime>
    b. Software Version - Right click on the ED, select <Actions> then <Get Software Version>
    c. Battery Level (EDs only) - Right click on the ED, select <Actions> then <Get Battery Level>
    d. Battery Runtime (EDs only) - Right click on the ED, select <Actions> then <Get Battery Runtime>
    e. Parent LQI (Link Quality Index) - Right click on the ED, select <Actions> then <Get Parent LQI>

12. When complete, back up the station.

Commissioning A SonNet System: Step-By-Step

14. Mount the **RF-RXS** using the DIN carrier clip and connect to the JACE with a serial cable, or install the **RF-RXS-N** option card. **NB** - it is extremely important that if the receiver is to be mounted in an enclosed panel (metal or plastic) that an external aerial extension is used. Two are available from Sontay, a 2 metre version **RF-AERIAL-PM2** and a 5 metre version **RF-AERIAL-PM5**. If the aerial is to be mounted on top of the receiver panel, the extension bulk head jack should be mounted through a hole (preferably on the top of the panel) and secured in place with the star washer and hex nut. If the aerial is to be mounted remotely, the extension lead should be passed through a protective cable gland on the panel. The connector on the other end of the extension should be screwed hand tight onto the aerial connector located on the receiver PCB. Do NOT over tighten.
15. Fit the receiver aerial to the receiver, or if using an aerial extension, to the bulk head jack connector.
16. Ensure, where possible, that the receiver aerial is aligned vertically, and as far away from obstructions as possible.
17. **Important!** Ensure that the receiver power supply polarity is correct.
18. Mount all routers in their appropriate positions, as determined by the site survey. **Important!** Ensure that the power supply polarity is correct.
19. Ensure, where possible, that the router aerials are aligned vertically, and as far away from obstructions as possible.
20. Do NOT switch on the router(s) until all SonNet devices are mounted and ready for commissioning.
21. Mount all end devices (EDs) in their appropriate positions.
    a. Ensure that each space housing ED is mounted with the tamperproof screw at the bottom. This ensures the integral PCB aerial is in the correct alignment.
    b. Ensure that each plant housing ED is mounted with the aerials aligned vertically, and as far away from obstructions as possible.
22. Do NOT switch on EDs until the receiver and ALL routers are installed and commissioned.
23. Place the receiver in auto-commissioning mode (see page 19).
24. Referencing the site survey plans, switch on all the routers using the PCB jumper, starting with those closest to the receiver (i.e. “layer 1”). Carry on with the next layers of routers until all routers are switched on.
25. Using the web interface or Niagara AX, ensure that all the routers appear in the router section of the SonNet driver.
    a. Note that initially, the routers will be shown in the “Unknown” category of the SonNet driver. This is normal.
    b. Ensure that each router moves to the “Router” category of the SonNet driver. Depending on the number of devices on the network, this may take a couple of minutes.
26. Ensure all routers are shown as on-line. Ensure all links are good and note the LQIs (see page 21).
    a. If any routers don’t show as on-line or are not in the “Router” category of the SonNet driver, check that the PCB fuse is intact (0Ω on a multimeter) and that the correct power supply is present.
    b. Check to see that the aerial is fitted and is vertical.
27. Referencing the site survey plans, switch on all the EDs by fitting the power jumper and remount into the housing (for space housing devices).
    a. If this is the first time the ED has been switched on (or after replacing an EDs battery), hold down the reset button on the ED’s PCB while powering up by fitting the power jumper. This resets the battery hours run to 0.
28. Ensure that all the EDs appear in the sensor section of the SonNet driver.
    a. Note that initially, the EDs will be shown in the “Unknown” section of the SonNet driver. This is normal.
    b. Ensure that each ED moves to the “Sensor” section of the SonNet driver. Depending on the number of devices on the network, this may take several minutes.

29. When all EDs have joined the network - *even if still shown in the "Unknown" category* - disable auto-commissioning mode. **NB** - this is very important, as trying to change configuration properties while in auto-commissioning mode may cause network errors.
30. Ensure all EDs are shown as on-line. Ensure all links are good and note the LQIs (see page 21).
    a. If any EDs don't show as on-line or are not in the "Sensor" section of the SonNet driver, check that the correct battery is fitted, observing polarity.
    b. Check to see that the aerial is fitted and is vertical (for plant housing EDs) or that the housing is mounted correctly (for space housing EDs).
31. Right-click on each ED, select <Actions> then <Get All Data> . This will cause the ED to transmit not only it's measurements, but also it's hours run and battery hours run data as well. **NB** - This extra data is NOT normally transmitted, but must be requested.
32. When the installed network is finally formed, briefly press the receiver reset button and ensure the network reforms properly. This may take several minutes, depending on the number of network devices.
33. When the network topology has been verified and all devices are working correctly, user configuration can begin (see page 21).
34. When configuration is complete, back up the station.

Best Practise Points:

1. Always conduct a site survey, and ensure that if you plan to use an external extension aerial on the system receiver (for example, if the receiver is to be in a metal panel), you use the same external extension aerial on the SSK receiver for the survey. Document the survey thoroughly, and leave a copy on site.
2. When planning where routers are going to be needed, plan for "redundancy", i.e. what happens to all the EDs connected to a router if the router fails? Backup routers are worth considering. See pages 11 - 13.
3. Don't switch on EDs until they're ready to be commissioned. If they're powered on without a parent in range, they will eventually sleep to preserve battery life, only "waking" occasionally to scan for a parent. This may slow commissioning down. If an ED has been powered up for more than 20 minutes without a parent, power-cycle it. ***Pressing the reset button on an ED DOESN'T reset the ED, it only resets the battery hours run time***.
4. Generally speaking, wireless works best in a horizontal plane, so expect reduced signal strength if he receiver is on a different floor to the routers/EDs. A good rule of thumb is have the receiver on the same floor as it's children, though this isn't always the case.
5. 2.4GHz wireless signals don't go through metal! Plan to circumvent metal obstructions where possible.
6. If the installation environment is one where obstructions are likely to change regularly (in a warehouse, for example!), try to conduct the site survey under a "worst-case" scenario - i.e. assume that at some point, there's going to be an obstruction between the ED/router and it's parent at some time. Simulate it, if possible.
7. When commissioning the installed system, turn the receiver on first, then all the routers - starting with "layer" nearest the receiver and working outwards. It's worthwhile checking all the routers are OK ***before*** finally powering up the EDs.
8. When EDs first join a network, values such as hours run and battery hours run will not be updated. This is normal, these values need to be requested from the device (see page 21).
9. Remember that when a receiver scans all 16 channels for the best one, the channel chosen is the best *where the receiver is*. On "long" networks with several "layers" of routers, the channel chosen by the receiver may not always be the quietest at the far end of the network. When the installed network is finally formed, press the receiver reset button and ensure the network reforms properly. This will ensure that, in the event that the receiver needs to change channels (for example), it will work seamlessly.

Trouble-Shooter's Guide

System ED		
Symptom	**Cause**	**Actions**
No connectivity to receiver	ED has not been authorized to the receiver	Manually authorize ED to receiver or use auto-commissioning
	No radio connection	Check aerial on receiver
	Receiver not switched on	Switch receiver on
	ED not switched on	Switch ED on
	Incorrect battery polarity	Check battery polarity
	Flat ED battery	Change ED battery
	After switching on, if an ED cannot join a network after about 20 minutes, it will go into "sleep" mode to preserve battery life, only waking occasionally	Power-cycle the ED (switch it OFF and back ON) after ensuring all routers and the receiver are powered, and the routers have successfully joined the network
ED appears in "Unknown" section of the SonNet driver when commissioning	ED has joined network but has yet to pass configuration data to the receiver	None - normal operation
ED stays in "Unknown" section of the SonNet driver when commissioning for more than 30 minutes	ED hardware error	Check ED options fitted (SP pot, thermistor, RH&T element)
ED doesn't show hours run, firmware version, battery hours run or last update time	Normal. To help preserve battery life, an ED doesn't send this information unless it is requested	Request information using the "Refresh Node Information" method
ED connects directly to the receiver, even though there's a router between them	Normal. An ED will ***ALWAYS*** join a network using the least number of "hops" to the receiver.	None - normal operation. The ED will re-join the network *via* the router if it loses it's direct path to the receiver
Only 12 EDs connect directly to my receiver	Normal. The maximum number of directly connected EDs a receiver will allow is 12	If there are more than 12 EDs, at least one router must be used
Only 8 EDs connect directly to my router	Normal. The maximum number of directly connected EDs a router will allow is 8	If there are more than 8 EDs, at least one additional router must be added
I replaced the battery in my ED, but the battery hours run doesn't show as having been reset.	Normal. Updated ED information hasn't been requested	Request information using the "Refresh Node Information" method
	The battery hours run reset procedure wasn't carried out when the battery was replaced	Power OFF the ED, press and hold the PCB button near the battery WHILE powering the ED ON
My ED was switched on in error before the receiver and routers, but hasn't joined the network	After switching on, if an ED cannot join a network after about 20 minutes, it will go into "sleep" mode to preserve battery life, only waking occasionally	Power-cycle the ED (switch it OFF and back ON) after ensuring all routers and the receiver are powered, and the routers have successfully joined the network

System Router		
Symptom	**Cause**	**Actions**
No connectivity to receiver	Router has not been authorized to the receiver	Manually authorize router to receiver or use auto-commissioning
	No radio connection	Check aerial on receiver
		Check aerial on router
	Receiver not switched on	Switch receiver on
	Router not switched on	Switch router on
	Incorrect supply polarity	Check supply polarity
	Router fuse	Check router fuse is OK, replace if necessary
Router appears in "Unknown" section of the SonNet driver when commissioning	Router has joined network but has yet to pass configuration data to the receiver	None - normal operation
Router stays in "Unknown" section of the SonNet driver when commissioning for more than 3 minutes	Router hardware error	Check router options fitted (thermistor, RH&T element)
Router connects directly to the receiver, even though there's a router between them	Normal. An router will ALWAYS join a network using the least number of "hops" to the receiver.	None - normal operation. The router will re-join the network via the other router if it loses it's direct path to the receiver
Only 4 routers connect directly to my receiver	Normal. The maximum number of directly connected routers a receiver will allow is 4, if there are 12 directly connected EDs	At least one more router must be added
Only 8 routers connect directly to my router	Normal. The maximum number of directly connected routers a router will allow is 8 if there are 8 directly connected EDs	At least one more router must be added

Receiver		
Symptom	**Cause**	**Actions**
LED D603 flashing once per second	The receiver has found no children on the network	Check aerial and extension co-ax (if fitted)
		If commissioning a network, ensure the receiver is in auto-commissioning mode, or manually authorize new devices
		Ensure network devices are switched on and in range
LED D603 on receiver not lit at all	No power to receiver	Check power to receiver
	Receiver not switched on	Switch on receiver
	Receiver fuse	Check power supply polarity
		Check receiver fuse is OK, replace if necessary
LED D604 flashing occasionally	Reception of network data	None - normal operation