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STAPS
Wireless Receiver/Repeater
Installation and Maintenance Instructions

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First for Steam Solutions

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1. Safety information

Safe operation of this unit can only be guaranteed if it is properly installed, commissioned and maintained by a qualified person (see Section 1.7) in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

Manufacturer:
Spirax-Sarco Limited
Charlton House
Charlton Kings
Cheltenham
Glos
GL53 8ER

The product is designed and constructed to withstand the forces encountered during normal use. Use of the product for any other purpose, or failure to install the product in accordance with these Installation and Maintenance Instructions, could cause damage to the product, will invalidate the CE marking, and may cause injury or fatality to personnel.

EMC directive

The product complies with the Electromagnetic Compatibility Directive 2004 / 108 / EC. A technical file with a reference title of 'UK Supply STAPS Wireless Steam Trap Monitoring System' supports the Spirax Sarco claim that the product complies with the requirements of the Directive and the product can be used in Class A (heavy industrial) and Class B (domestic / commercial areas).

The following conditions should be avoided as they may create interference above the heavy industrial limits if:

- The product or its wiring is located near a radio transmitter.

- Cellular telephones and mobile radios may cause interference if used within approximately 1 metre (39") of the product or its wiring. The actual separation distance necessary will vary according to the surroundings of the installation and the power of the transmitter.

If this product is not used in the manner specified by this IMI, then the protection provided may be impaired.

Software copyright

Certain computer programs contained in this product [or device] were developed by Spirax-Sarco Limited ('the Work(s)').

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Spirax-Sarco Limited grants the legal user of this product (or device) the right to use the Work(s) solely within the scope of the legitimate operation of the product (or device). No other right is granted under this licence. In particular and without prejudice to the generality of the foregoing, the Work(s) may not be used, sold, licensed, transferred, copied or reproduced in whole or in part or in any manner or form other than as expressly granted here without the prior written consent of Spirax-Sarco Limited.

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1.1 Intended use

Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended use / application.

Please note that Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.

1.2 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

1.3 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

1.4 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

1.5 Tools and consumables

Before starting work ensure that you have suitable tools and / or consumables available. Use only genuine Spirax Sarco replacement parts.

1.6 Protective clothing

Consider whether you and / or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high / low temperature, radiation, noise, falling objects, and dangers to eyes and face.

1.7 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions.

Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety.

Post 'warning notices' if necessary.

1.8 Handling

Manual handling of large and / or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

1.9 Freezing

This product does not contain fluid that will freeze, however lower temperatures will affect the product performance. Do not subject the product to temperatures below the stated minimum.

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1.10 Disposal

Unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken. The product should be recycled in line with local legislation.

1.11 Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

1.12 Use of non genuine components or spare parts.

This product is certified by a number of health and safety regulatory bodies for health and safety and environmental purposes. To maintain the approvals only genuine components and spare parts must be used.

2. General product information

2.1 General description

The STAPS wireless receiver / repeater is specifically designed for use with the STAPS wireless steam trap monitoring system.

In conjunction with the STAPS heads units and PC software, the STAPS receiver / repeater monitors steam trap operation to ensure optimum plant performance.

Please note: To ensure that the unit is installed correctly and for optimum performance, please read these instruction in conjunction with the STAPS head and software installation and maintenance instructions.

How does it work?

The STAPS wireless receiver / repeater takes the wireless signal from the STAPS head unit (see separate IMI) and passes the data onto the PC software (again see separate IMI) via a LAN connection or network switch. In areas with considerable RF obstructions it can act as a repeater, relaying the data onto another receiver using the same 2.4 GHz wireless network.

The receiver is the link for the STAPS wireless system to the LAN network if powered and its RJ45 is connected to a network point / PC. If the receiver is powered, but does not have a RJ45 socket connected it will act as a repeater. As a repeater it will only relay signals from other head units to another receiver.

Fig. 1

LEDs

The LEDs on the coordinator indicate operation of its functions as described below:

- **(1) Power on** - Constantly illuminated.
- **(2) Transmitting** - Single flash when communicating.
- **(3) Receiving** - Single flash when communicating.

Software

The PC software for the STAPS system is supplied as a separate item on a CD. The wireless network firmware is preloaded onto each head and receiver / repeater.

2.2 System equipment and network overview

Network

The STAPs steam trap monitoring system is based on a wireless network. Each steam trap is monitored by an individual STAPs sensor head, that communicates directly to a receiver or repeater, using wireless 2.4 GHz protocol.

Each head needs to be sited within 20 - 30 m of a receiver / repeater to ensure good communication. Obstructions such as walls, pipework and other industrial furniture may reduce the distance that a head can communicate.

A receiver / repeater can accommodate up to 200 heads.

Ideally the receiver should be fitted in the geographical centre of the heads that it is going to receive signals from.
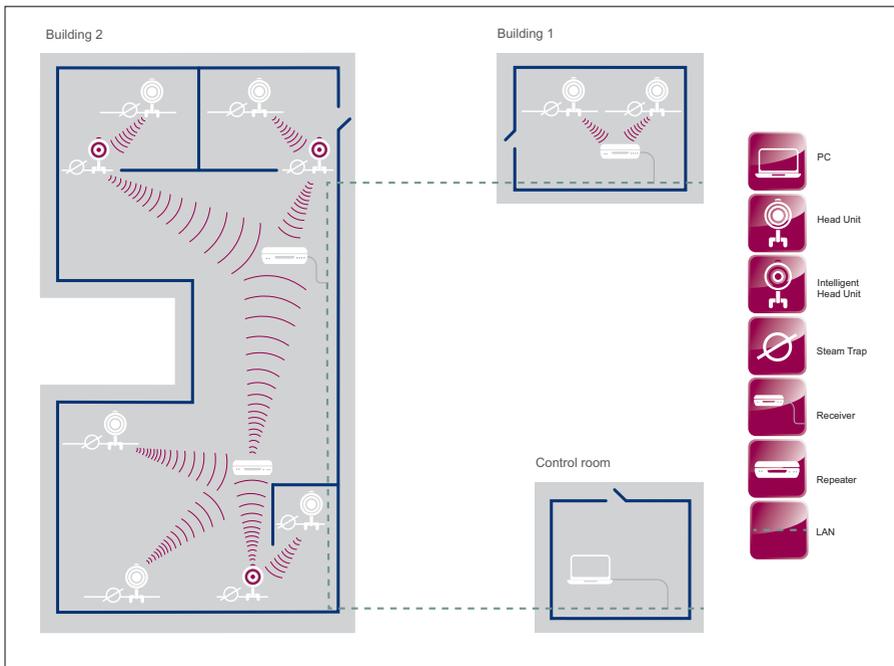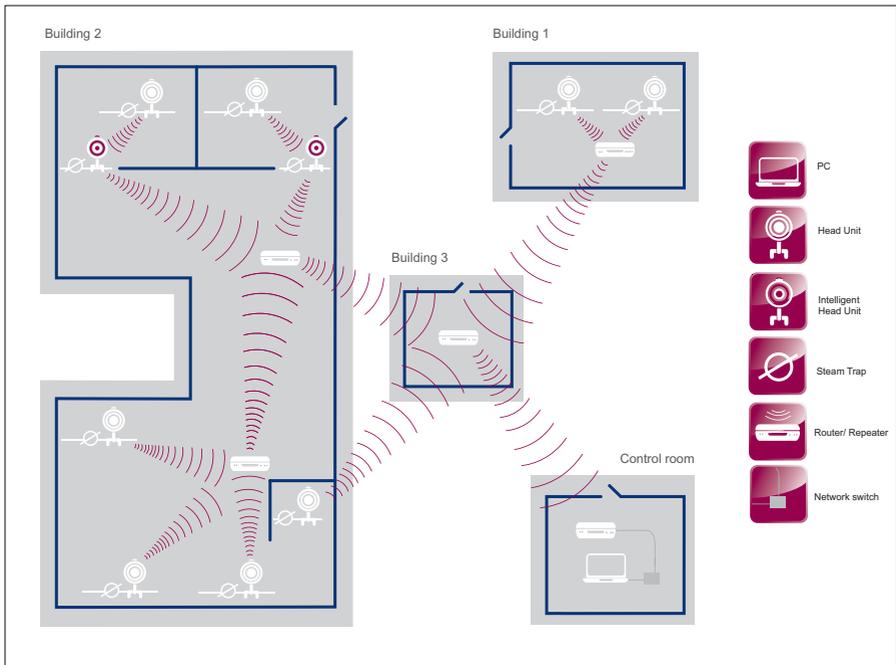

Fig. 2 Wireless architecture with access to customer LAN network

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The receiver draws its power from a local mains supply. A suitably sized circuit breaker is to be fitted. Ensure that the power supply has a free flow of air, do not cover the power supply.

Fig. 3 Wireless architecture without access to LAN network

2.3 Preliminary site survey

Before any installation is started a preliminary survey of the plant by trained personnel must be conducted to establish what network access points are available adjacent to the steam traps that are to be monitored. Consideration should be made to obstructions that may interrupt the wireless signal. For the best results a direct line of sight between the head and the receiver / repeater should be maintained.

2.3.1 Fresnel

STAPS RF communication

Like all RF Communication devices, the STAPS Wireless Steam Trap Monitoring System has a transmitting and a receiving device. The STAPS head unit contains an inbuilt antenna that transmits the encoded data obtained from the sensor attached to the pipeline, via a wireless radio connection (2.4 GHz). The STAPS receiver decodes the data received through its own inbuilt antenna and communicates it through the LAN to the PC based software.

System environment

The space between the STAPS head unit and receiver (or repeater) is known as the system environment. Any physical obstructions or electrical devices within the system environment can reduce the communication range of the devices. The physical obstructions maybe static items such as walls, pipework, tanks and machinery or mobile items like vehicles or pedestrians, if the system is communicating across a road or path. Noise interference may be caused by other devices using the same communication frequency or machinery that is transmitting RF / electrical noise from items such as motors for instance.

For the best communication a line of sight (LOS) must be maintained between the STAPS head and the receiver within the system environment.

Visual and RF LOS

There are two types of LOS that must be maintained to achieve clear communications. Firstly, visual LOS, which is purely a direct clear linear path (sight) between the STAPS head and the receiver.

Secondly RF LOS must also be maintained, which is a concentric ellipsoid (rugby ball shaped) tunnel that provides a path for the RF signals to pass through between the transmitter (STAPS head) and receiver. This is known as the Fresnel Zone.

Any obstacles within the Fresnel Zone will reduce the quality and distance that the RF signals are transmitted.
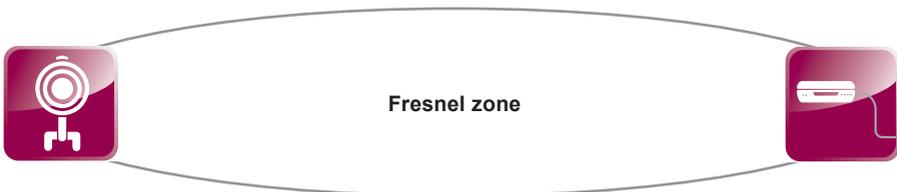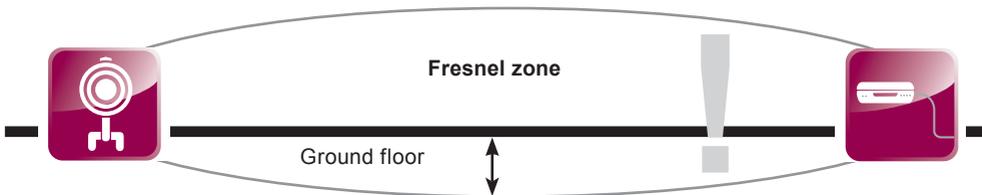

Fresnel zone

Fig. 4 Clear Fresnel zone – Good

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Fig. 5 Fresnel zone with blockage (obstacle) - Bad

Fig. 6 Fresnel zone with floor obstruction - Bad

The area of the Fresnel zone below the floor will be obstructed. For this reason it is suggested that the STAPS heads and receivers are fitted at a minimum of 1.5 m above the ground / floor.

Typically a blockage affecting 20% of the Fresnel zone will introduce little signal loss. However beyond 40% blockage the signal loss becomes rapidly significant.

2.4 Contacting site network administrator

In most cases, the STAPs system will be run through the sites internal computer network. Before any installation, preferably at the site survey stage, it is strongly recommended that the local network administrator is informed. The administrator will need to confirm that a suitable PC is available that supports the STAPS software, (refer to the relevant PC application IMI for details) and they are able to offer suitable TCP / IP addresses for the equipment.

3. Order of installation

3.1 Accompanying documents

The following Installation and Maintenance Instructions are required to complete the system installation:

IM-P014-16 STAPS Wireless Head Unit Quick Installation Guide

IM-P014-25 STAPS Wireless Receiver / Repeater Installation Guide

IM-P014-26 STAPS Wireless Steam Trap Monitoring System Installation and Operating Instructions for use with Windows 7 operating systems

Or

IM-P014-24 STAPS Wireless Steam Trap Monitoring System Installation and Operating Instructions for use with Windows XP operating systems

> **To ensure that the STAPS system operates correctly adhere to Section 3.2 and <u>you must</u> follow the sequence of installation specified in Section 3.3**

3.2 Before Installation:

A preliminary site survey of the plant must be conducted by trained personnel, the survey will identify the optimum number of Receivers and Repeaters together with their most effective location, to give the most robust wireless network.

Ensure a discussion has taken place with your Network Administrator, showing them Section 4.1 of IM-P014-26 or IM-P014-24.

Observe the 'Safety Information' in each of the above documents.

3.3 Recommended order of installation:

1. Install the application software onto the supporting PC, refer to Section 4.2 of IM-P014-26 or IM-P014-24.

2. From the results of the site survey, carefully select the optimum position for the Receiver ensuring that there is a direct line of sight (20 - 30 m) with as many steam traps that are to be monitored as possible, referring to IM-P014-25.

3. Plug in the Receiver into the network point using an RJ45 cable plug.

4. Plug in the Receiver to the mains power supply, and proceed to switch it on.

5. After a short delay the Receiver symbol will appear in the network maintenance window on the PC application software, refer to Section 5.3 - Network Maintenance of IM-P014-26 or IM-P014-24.

   If the Receiver is installed on a different sub-net to the PC, refer to Section 5.13 of IM-P014-26 or IM-P014-24.

If during the site survey it was identified that Repeaters are required complete Steps 6 to 9, if no Repeaters are required skip to Step 10.

6. Carefully select the optimum site for the Repeater ensuring that there is a direct line of sight (20 - 30 m) with as many steam traps that are to be monitored as possible, referring to IM-P014-25.

7. Plug in the Repeater to the mains power supply, and proceed to switch it on (do not plug a cable into the network connection).

8. After a short delay the Repeater symbol will appear in the network maintenance window on the PC application software, refer to Section 5.3 - Network Maintenance of IM-P014-26 or IM-P014-24.

9. Repeat Steps 6 to 8 if further Repeaters were recommended or required.

10. Fit a battery to the first Head, refer to IM-P014-16. As soon as the battery is connected into the Head it will start to transmit and will communicate with the Receiver or Repeater. This will show up on the PC software, after 15 to 30 minutes.
    Please note:
    If a Head is powered up without a Receiver being powered up first, the Head battery will discharge quickly as the Head is trying to associate itself with a network.

11. Install the Head unit to the upstream side of the assigned trap (within 150 mm).

12. Using the software, assign a trap to the Head, refer to Section 5.6 - Assigning traps to Heads IM-P014-26 or IM-P014-24.

13. Repeat Steps 6 to 8 for other STAPS Heads until all traps to be monitored within signal range are completed.
    It is recommended to connect all of the Heads in each area of the network associated to a single Repeater or Receiver identified in the site survey.

14. When all the Heads and Repeaters under a Receiver are installed and reporting correctly, it is recommended that a unique PAN ID is set for that section of the network before continuing with other Receiver sections.
    Refer to Section 5.8 of IM-P014-26 or IM-P014-24.

For full instructions on each step see individual sections.

4. Installation of the receiver / repeater

Note: Before actioning any installation, observe the 'Safety information' in Section 1.

4.1 The STAPS receiver includes the following parts:
- 1 off Receiver with mounting lugs
- 1 off dc power supply
- 1 off Mains lead with country specific plug

4.2 Consider where the Receiver is to be fitted:
- The weather - Is the monitor suitable for the worst case weather conditions? The receiver is IP65 rated, excluding the power supply.
- Wireless signal obstructions - Will adjacent buildings, pipework or other objects obstruct the wireless signal?
- Interference - Is there any electrical or RF interference that may affect the performance of the head?
- Access - Is there sufficient access to the monitor to change batteries or for maintenance?
- Power supply - Access to suitable mains power supply and Ethernet connection where applicable.

4.3 Mounting the receiver / repeater
The receiver / repeater should be mounted to a wall / surface using suitable fixing screws.

Fig. 7

4.4 Wiring the receiver / repeater

The receiver / repeater can be used as either a receiver to convert the Wireless signal received from heads and connect to the LAN to communicate with the PC software, or as a repeater to relay the signal to another receiver using the Wireless signal.

To connect to the LAN the 3 m (118") long Ethernet cable supplied must be connected to the receiver via the RJ45 socket.

The receiver / repeater requires a power supply and should be wired as shown in Figures 9 and 10. Use the correct mains lead and plug (supplied).

In addition a receiver can be set up as a wireless repeater, able to process signals from up to 200 individual trap heads. The repeater will then repeat these signals to a receiver.

Important note: If the receiver / repeater is required to act as a receiver, the Ethernet cable must be connected between the receiver and the LAN before the mains power supply is connected. If the power supply is connected first, the receiver will automatically set itself up as a repeater and will not communicate to the LAN, even if a network cable is then connected. **Ensure network cable is fully engaged.**

If the STAPS system is being set up with a stand alone network, using a network switch (Figure 8), the power to the switch must be switched on before power to the receiver.

If the receiver / repeater is set up as a repeater in error, turn off the power, unplug and start again.
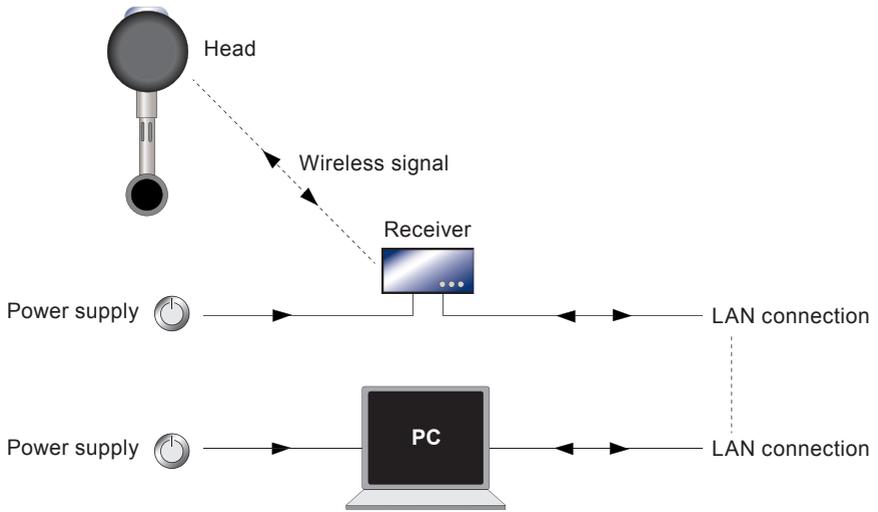

Fig. 8

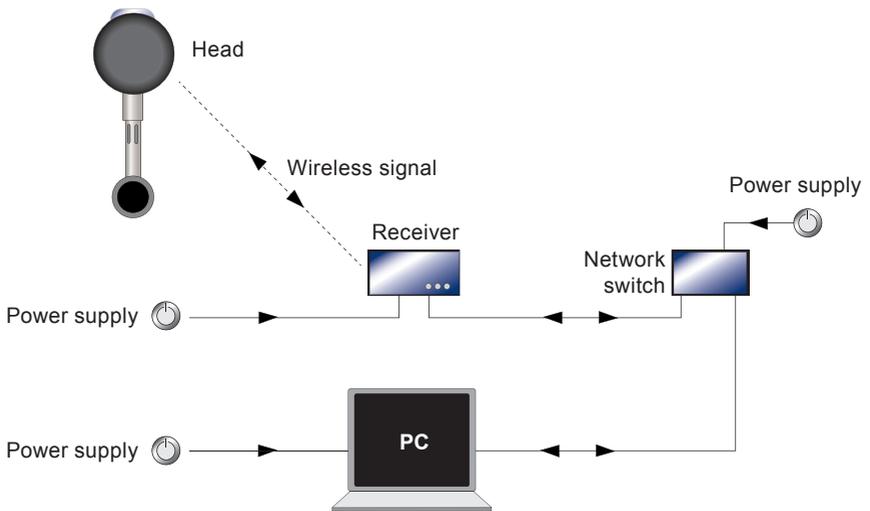**The receiver is now ready to receive signals from heads that are within range.**

Fig. 9

Power supply

RJ45 network cable

Fig. 10

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Fig. 11 System using building LAN (network)

Fig. 12 System using network switch

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Once connected to the network the receiver icon will show on the network maintenance screen of the software (see separate IMI for software).
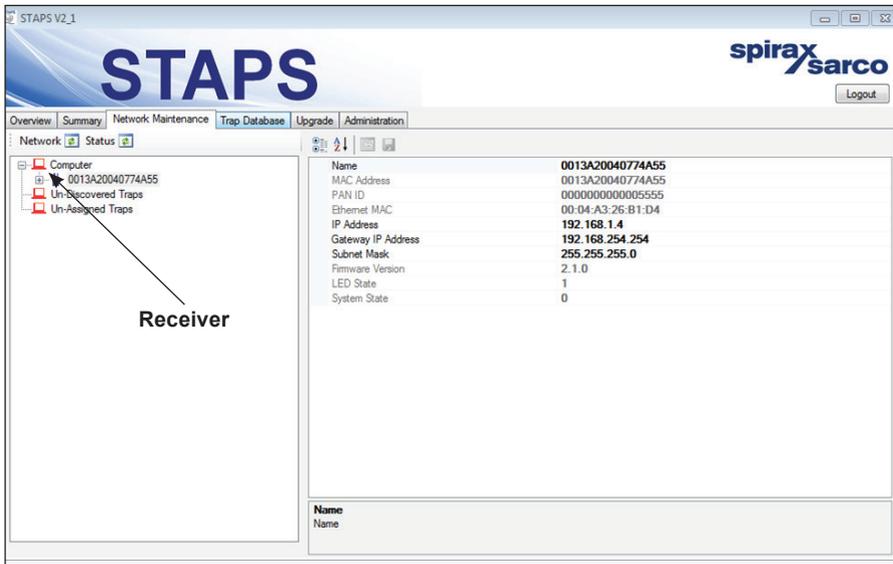

Fig. 13

5. Spare parts

Only the parts listed below are available for the STAPS receiver / repeater. No other parts are supplied as spares.

Available spares

Ethernet cable spares kit	**15**
Power supply (UK) spares kit	**11** and **14**
Power supply (US) spares kit	**12** and **14**
Power supply (EU) spares kit	**13** and **14**
Spare receiver mounting kit	**16**, **17** and **18**

How to order spares
Always order spare parts by using the description given in the column headed 'Available spares' and state the size and unit nomenclature that they are intended for.

Example:
1 off Ethernet cable spares kit for a DN15 STAPS wireless steam trap monitoring system.
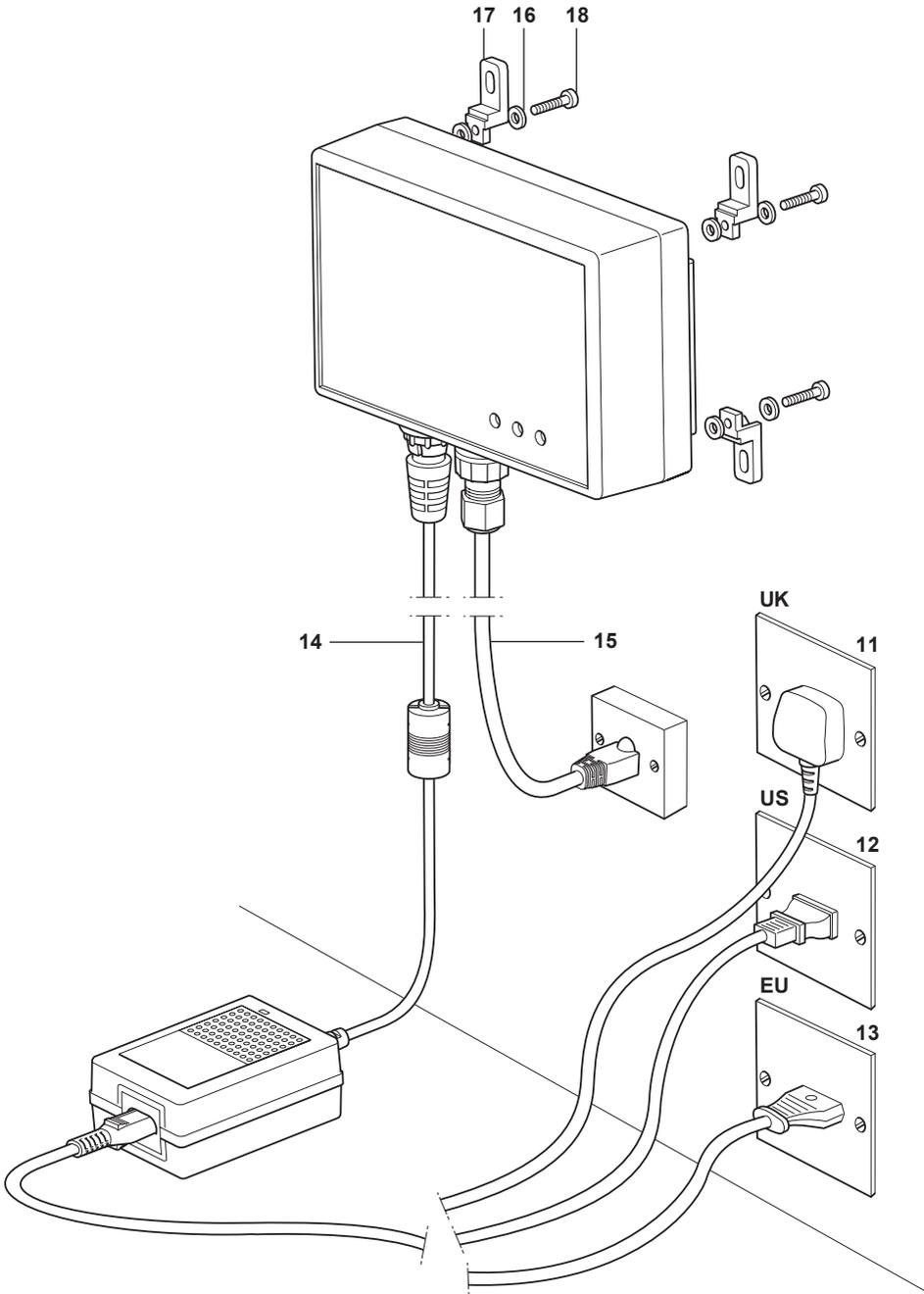
Fig. 14

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6. Technical data

Receiver / Repeater

Power	Mains powered 100 to 250 Vac, 50 to 60 Hz
Current	ac - 0.5 A, 100 Vac
	dc - 1.5 A, 12 V
Connector	ac - 2 pin IEC 320-C8
	dc - 2 pin IP65
	3 pin UK, US and European mains plug
Maximum altitude	3000 m (0.7 bar atmospheric)
Ambient temperature range	-29 to +70°C
Maximum relative humidity	95%
Enclosure rating	IP65 (Excluding external power supply)
Visual indicators	LED
Input / Output (I/O)	IEE 802.15 2.4 GHz RJ45 port

STAPS RF security

The RF side of the network implements 128-bit advanced encryption standard (AES) cipher using a randomly generated key transmitted to the joining node by the network co-ordinator device when the node requests to join the network. All subsequent exchanges are encrypted using the key. The network header, APS header (this is the part of the frame that supports routeing, acknowledgement, binding and address maps) and application data are all authenticated with 128-bit AES. Additionally a checksum is performed on these fields and is appended as a 4-byte message integrity code (MIC) to the end of the packet. The MIC allows receiving devices to ensure the message has not been changed. If a device receives a packet and the MIC does not match the devices own checksum of the data, the packet is dropped. The network header of the encrypted packets also includes a 32-bit frame counter; each device on the network maintains a 32-bit frame counter that is incremented for each transmission. Devices track the last known 32-bit counter for each of its neighbours. If a device receives a packet from a neighbour with a smaller frame counter than it has previously seen the packet is discarded thereby protecting against 'replay' attacks.

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7. Technical glossary

Cat5e cable
Cat5e cable is used to physically connect separate networked devices. The cable can be installed permanently as part of the site infrastructure (structured cabling) or be used as short 'patch' cables to connect a networkable device to a switch or hub through the structured cabling using RJ45 plugs and wall sockets.

Encryption
Encryption refers to the encoding of information using a pre-agreed cipher key prior to over-the-air radio transmission. The same 'key' is needed to decrypt the messages into a useable form at the receiver.

Ethernet
Ethernet is the physical transport medium for a networking protocol (e.g. TCP / IP).

Ethernet Cable
See Cat5e cable.

Head
An individual trap sensing device which is networkable.

IP Address - Internet Protocol Address
A set of four binary octets represented in decimal by four numbers between zero and 255. IP addresses can be manually (static IP) or automatically (DHCP assigned) allocated to a network entity for identification purposes.

LAN - Local Area Network
A Local Area Network is a logical group of interconnected devices in a limited geographical area such as a home, school, factory, or office building.

Network Administrator / IT Administrator (IT Admin)
The network administrator is an individual that is responsible for the maintenance and monitoring of computer hardware, software systems and related equipment that make up a computer network. This individual should be able to supply the required advise and details to install the STAPS system onto your companies network.

Network Switch / Switch / Hub / Router
A switch is a device used on a computer network to physically connect devices together. Multiple devices can be connected to a switch to enable the devices to communicate with each other forming a LAN.
A router is a device that allows connections between computer networks such as a LAN and the Internet it may have a limited switch capability.

PAN - Personal Area Network
A collection of co-operative devices sharing a similar geographical location and having a common PAN-ID.

PAN-ID - Personal area network identification
A PAN-ID is a number allocated to a network co-ordinator (receiver). Heads will base a decision on which network to join based on their PAN-ID. The default PAN-ID is zero which means that the device will join any network and then assume the PAN-ID of that network. A device with a non-zero PAN-ID allocated by the user will only join a network that has the same non-zero PAN-ID.

Receiver
A receiver is a physical device that creates and manages a PAN. It also functions as a gateway between the PAN and the Ethernet network.

Repeater
A repeater is a physical device not attached to the Ethernet network but forming part of a PAN. The function of the repeater is to extend the range of the network, where mains power is available.

RJ45 - Registered Jack 45
RJ45 plugs and sockets along with cat5e cable are used to connect devices together to form a network. Sometimes called an 8P8C connector. Commonly used on standard LAN interconnections

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TCP / IP - Transmission control protocol / internet protocol
An internationally agreed suite of communications software used to implement computer networks that can range from a home wireless connection up to the internet. TCP / IP provides a framework enabling data communications to be formatted, addressed and routed between networked devices and between networks themselves.