eliwell

RadioAdapter

ISM 2.4 GHz wireless system for plant monitoring and control
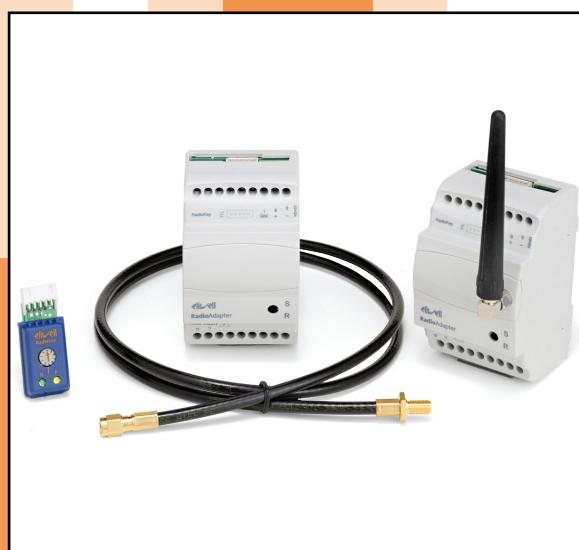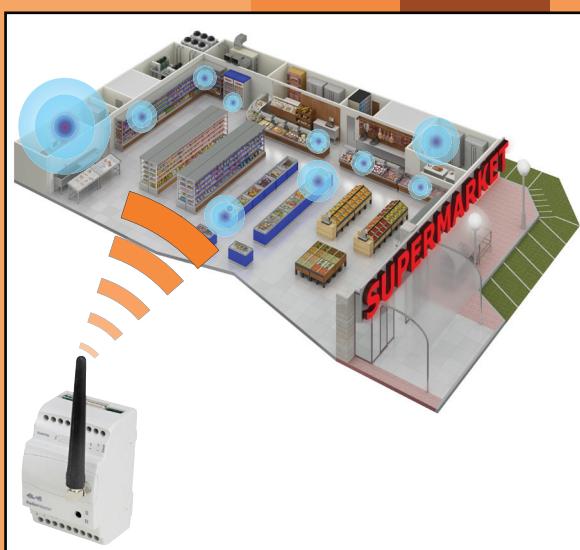
USER MANUAL

invensys
Controls

SUMMARY

1 -INTRODUCTION

RadioAdapter provides a cost-effective, reliable way of building cable-free communication networks between monitoring systems and controllers or of extending existing networks.

RadioAdapter features IEEE 802.15.4 standard functions and runs on ISM frequency band at 2.4GHz.

Thanks to MESH networking technology and associated dynamic routing combined with **Radio**Adapter capabilities to act as a repeater for adjacent nodes, large surface areas can be covered, getting around blocked paths to send or receive messages and continuous function guaranteed even when one or more nodes breaks down.

1.1 - REGULATIONS

Radio and telecommunications equipment: Directive 95/05/EC.
The use is permitted in the countries belonging to the European Economic Area (EEA) and where the FCC is recognized (see box).

FCC notes (only for model with internal antenna)

- This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- Unauthorized repairs, changes or modifications could result in permanent damage to the equipment and void your warranty and your authority to operate this device under Part 15 of the FCC Rules.
- **NOTE**: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

  Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**IC note (only for model with internal antenna)**
- This device is compliant to RSS 102
- Cet instrument répond aux normes RSS 102

1.2 - TECHNICAL DATA (EN 60730-2-9)

Class of use	Class 4 classification ISA SP100.11 (do not use for safety devices)
Network architectures permitted	star, tree and MESH
Protocols supported	Televis e Modbus RTU
Modbus configurations permitted:	serial speed: 9.600 / 19.200 bps parity: Even / Odd / None stop bit: 1
Frequency band	ISM 2.400 GHz...2.485 GHz (<10mW EIRP)
Channel selection	Automatic
Max. radio packet payload size	52 bytes
Antenna	2.4 GHz integrated, multidirectional or external (only on RadioAdapter EXT models - see 1.4 Models and Accessories)
Maximum number of nodes per network	100
Maximum number of controllers per NODE	240
Maximum response time of radio	800msec (value to be added to the response time of the controller to calculate transmission timeout)
Container	container: 3 plastic DIN modules
Mounting	on DIN guides
Operating temperature	-5...60°C
Storage temperature	-20...85°C
Operating and storage environment humidity	10...90% (non-condensing)
Serial connections	TTL port for connection to devices RS-485 serial port (on two **Radio**Adapter /S models only)
Insulation class	2
Consumption	2W
Power supply	100...240 V~ ±10% 50/60Hz

1.3 - CIRCUIT DIAGRAM
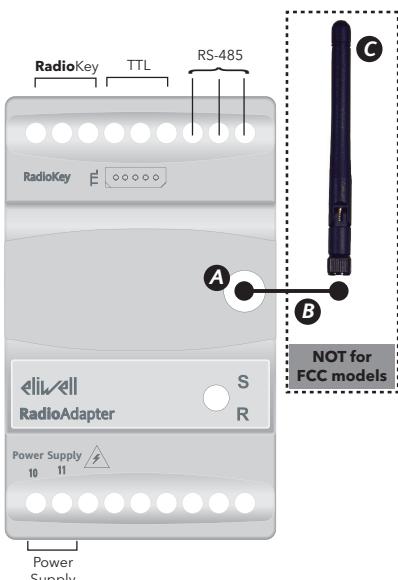
TERMINALS

RadioKey	Connector to connect the **Radio**Key
TTL	TTL serial port to connect directly to devices
7-8-9	RS-485 serial port to connect directly to devices or to the monitoring system (on in **Radio**Adapter /S models)
10-11	Power supply 100...240V~
A	SMA connector for external antenna (only on **Radio**Adapter EXT models)
B	Cable for external antenna (length: 1m)
C	External antenna

IMPORTANT: For RadioAdapters with an external antenna, use Eliwell supplied cable and antenna only.

⚡ **IMPORTANT**! Do not touch the SMA connection for external antenna (A) as static electricity may have built up!
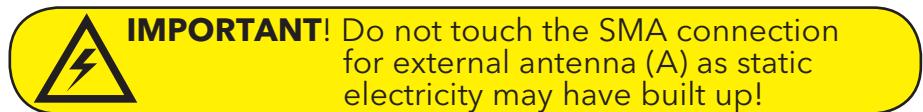
1.4 - MECHANICAL ASSEMBLY

This device is designed to be wall-mounted or on a DIN rail.
The ambient temperature range for correct operation is -5 to 60°C, and the permitted humidity range is 10 to 90% (non-condensing).
Sufficient ventilation should be provided if the device is installed inside an electrical panel or switchboard.
Do not install the device in damp or dirt-laden areas.

1.5 - INSTALLING THE ANTENNA (NO FCC MODELS)

The antenna can be inserted straight into the **Radio**Adapter connector or panel-mounted and connected to **Radio**Adapter using the cable supplied in the Antenna kit.
N.B.: The panel that the antenna is mounted on must be no more than 3mm thick.
For the panel mounting of the antenna, please follow the proceduredescribe below:
ANTENNA KIT COMPONENTS:
- 1m cable
- antenna + SMA 90° connector
- Seal ring, nut and washer to fit the cable to SMA 90° connector

- Drill a hole in the panel as shown in Figure 1:

6.8 mm

7.2 mm

Figura 1
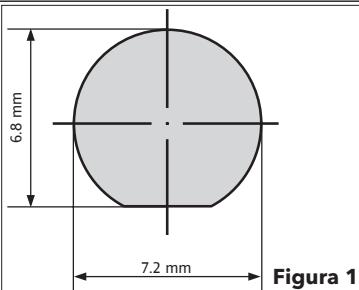
- Tighten the nut to firmly clamp the cable (see Figure 3)
- Rub some more thread locker onto the connector as shown in Figure 3

max 3 mm
Threadlocker
O-ring
Connettor SMA 90°
Washer
Nut
Panel
Figura 3
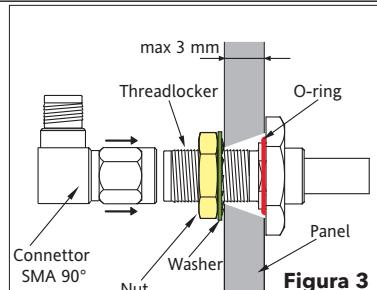
- Fit the seal ring (o-ring) to the end of the cable to be fitted to the panel (see Figure 2)
- Insert the end of the cable to be fitted to the panel through the previously drilled hole.
- Slip the washer over the end of cable pushed through the hole (see Figure 2).
- Rub a little thread locker onto the connector as shown in Figure 2.

max 3 mm
Threadlocker
O-ring
Nut
Washer
Panel
Figura 2
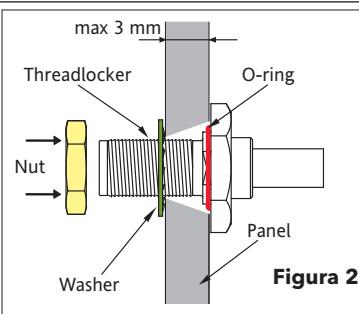
- Tighten the SMA 90° connector and fit it to the antenna (see Figure 4)

NOTE: LOCTITE® 243 threadlocker is recommended.

Fit the antenna
max 3 mm
O-ring
Connector SMA 90°
Washer
Nut
Panel
Figura 4
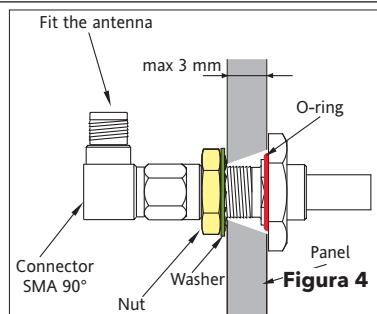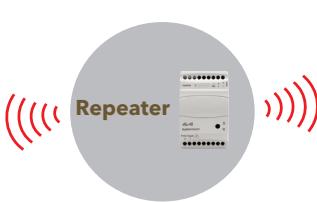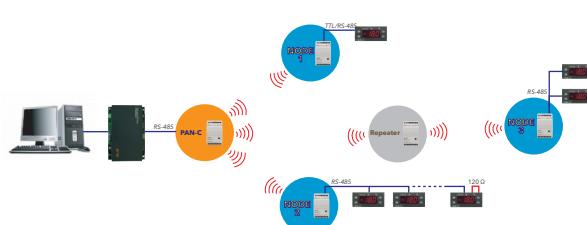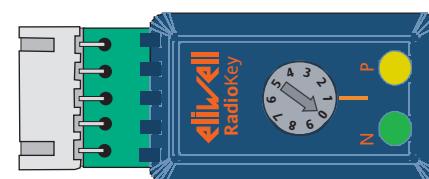
1.6 - MODELS AND ACCESSORIES

| Model Name	Description
RadioAdapter (FCC)	Radio device with internal antenna and TTL connection
RadioAdapter /S (FCC)	Radio device with internal antenna and TTL + RS-485 connections
RadioAdapter EXT	Radio device with external antenna and TTL connection
RadioAdapter /S EXT	Radio device with external antenna and TTL and RS-485 connections

Accessory	Description
Kit Antenna esterna + cavo	Antenna + SMA 90° connector + 1m cable
RadioKey	Network configuration device (1 **Radio**Key per network)

Radiokey Part Number	Tipo Radiokey	Descrizione
CCA0B0T01T000	**Radio**Key Televis	
CCA0B0T01M000	**Radio**Key Modbus	bit rate: 9600 bps; parity: even; stop bit: 1
CCA0B0T01M100	**Radio**Key Modbus	bit rate: 9600 bps; parity: odd; stop bit: 1
CCA0B0T01M200	**Radio**Key Modbus	bit rate: 9600 bps; parity: none; stop bit: 1
CCA0B0T01M300	**Radio**Key Modbus	bit rate: 19200 bps; parity: even; stop bit: 1
CCA0B0T01M400	**Radio**Key Modbus	bit rate: 19200 bps; parity: odd; stop bit: 1
CCA0B0T01M500	**Radio**Key Modbus	bit rate: 19200 bps; parity: none; stop bit: 1
NOTE: The features described in this table depend on the value of the 11th digit of the **Radio**Key Part Number		

1.7 - DEFINITIONS

PAN-C

PAN-C (PAN-Coordinator) is the network coordinator. PAN-C is the access point that the monitoring system is connected to

NODE

A NODE is a **Radio**Adapter connected to one or more devices.

REPEATER

The repeater is a RadioAdapter that is not connected to any devices. It is installed between two NODES when the signal between the two has to travel too far and is too weak as a result.

INSTRUMENT

Controller fitted with serial port that can be connected to the NODE via a Televis or Modbus protocol.

NETWORK

A network featuring at least one PAN-C and one or more NODES and repeaters

RADIOKEY

Device used for network installation and configuration.

2 - INSTALLATION

The **Radio**Adapter device can function as part of the network, as a PAN-C, as a NODE or a repeater.
The **Radio**Adapter should therefore be configured accordingly when it is actually inserted into the network.
The communication network consists of:
- A **Radio**Adapter configured as PAN-C and connected to a monitoring system (Televis or Modbus)
- A **Radio**Key device to identify and configure the network.
- Up to 100 **Radio**Adapters serving as communication NODES for devices. Just one device or a sub-network of up to 240 devices can be connected to a node.

2.1 - HOW TO INSTALL THE PAN-C

2.1.1 - INITIALIZING THE PAN-C

- Connect the **Radio**Adapter to the power supply.

- Set the switch on the **Radio**Key to position 0.

- Connect the **Radio**Adapter to the **Radio**Key and wait for the YELLOW LED (P) (on the **Radio**Key) to switch on (GREEN LED (N) off).
  At this point, theRadioAdapter is now configured as PAN-C and all PAN-C information is sent to the **Radio**Key.

- From now on, the **Radio**Key can only be used with this network.

- We recommend you mark this **Radio**Adapter with the sticker supplied.

Power Supply

eliwell	RadioAdapter	
	PAN-C	

2.1.2 - CHANNEL SEARCH

- Install the PAN-C and connect it to the power supply when all potential forms of radio interference are present (e.g. alarm systems, WiFi, etc..)

- The PAN-C will start searching for a free channel: this step is indicated by the flashing RED LED (it will take about 4 minutes)

- When this scan has finished, the RED LED will start to blink more slowly

Power Supply

2.1.3 - SAVING PAN-C SETTINGS

- Set the switch on the **Radio**Key to position 0 and connect it to the PAN-C in turn connected to the power supply.

- When the YELLOW LED (P) on the **Radio**Key lights up, disconnect the **Radio**Adapter from the power supply.

- Disconnect the **Radio**Key.

- Install and configure NODES and any REPEATERS.
  (see section "How to install a NODE")

Power Supply

NETWORK STRUCTURE

RS-485 **PAN-C**

RS-485 **PAN-C**

IMPORTANT! Radio Adapter **is not compatible with PC Interface USB**


2.2 - HOW TO INSTALL A NODE

2.2.1 - INITIALIZING A NODE

- Connect the **Radio**Adapter to the power supply.

- Set the switch on the **Radio**Key to position **1**.

- Connect the **Radio**Adapter to the **Radio**Key and wait for the GREEN LED (N) (on the **Radio**Key) to light up (YELLOW LED(P) off). The **Radio**Adapter is now configured as a NODE and information on the type of network is sent to the NODE.

Power Supply

- Disconnect the **Radio**Key when the GREEN LED on the NODE starts to blink.

- Disconnect the NODE from the power supply.

Power Supply

2.2.2 - ADDRESS CONFIGURATION AND SEARCHING FOR CONNECTED DEVICES

- Configure the Televis or Modbus address of the devices to be connected to the NODE.

TTL + RS485

Power Supply

- Connect the devices to the NODE via TTL or RS-485.

- Switch on the devices connected and then the NODE. The NODE will start to scan for connected devices, which is indicated by the fast blinking of the GREEN LED on the NODE.

- The GREEN LED switches off and the RED LED starts blinking on the NODE when the scan is complete.

Power Supply

2.2.3 - SAVING SETTINGS

- Disconnect all devices from the NODE without switching the NODE off.

- Set the switch on the **Radio**Key to position **0** then connect the **Radio**Key to the NODE.

- Wait for the GREEN LED (N) on the **Radio**Key to light up.

- Disconnect the **Radio**Key and connect the devices properly.

Power Supply

IMPORTANT! Repeat the steps outlined above for each NODE to be installed in the network

NETWORK STRUCTURE

TTL/RS-485

NODE 1

RS-485

PAN-C

RS-485   120 Ω

NODE 2
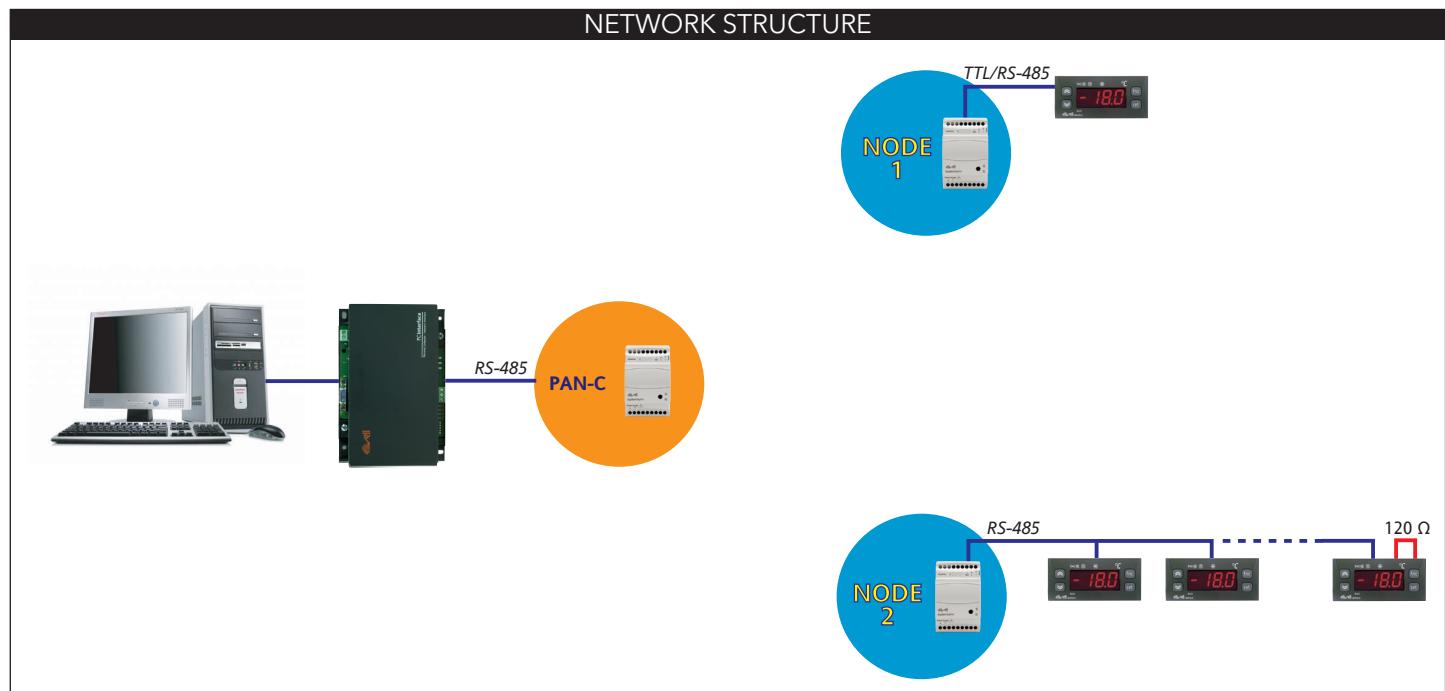
2.3 - HOW TO INSTALL A REPEATER

If two NODES fail to communicate due to the distance the signal has to travel, a repeater can be inserted.

2.3.1 - INITIALIZING A REPEATER

- Connect the **Radio**Adapter to the power supply.

- Set the switch on the **Radio**Key to position 1.

- Connect the powered-on **Radio**Adapter to the **Radio**Key and wait for the GREEN LED (N) (on the RadioKey) to light up (YELLOW LED (P) off). The **Radio**Adapter is now configured as a REPEATER and information on the type of network is sent to the REPEATER.

- The GREEN LED on the repeater will now start to blink fast.

Power Supply

2.3.2 - SELF-CONFIGURING A REPEATER

- Disconnect the **Radio**Key from the repeater.

- Wait for self-configuration to complete. This is indicated when the GREEN LED switches off and the RED LED starts to blink

Power Supply

2.3.3 - SAVING REPEATER SETTINGS

- Connect the **Radio**Adapter to the power supply.

- Set the switch on the **Radio**Key to position **0**

- Connect the **Radio**Key to the **Radio**Adapter and wait for the GREEN LED (N) on the **Radio**Key to light up.

- Disconnect the **Radio**Key.

Power Supply

IMPORTANT! Repeat the steps outlined above for each repeater to be installed in the network

NETWORK STRUCTURE

TTL/RS-485

NODE 1

RS-485

NODE 3

PAN-C

Repeater

RS-485

120 Ω

NODE 2

RS-485
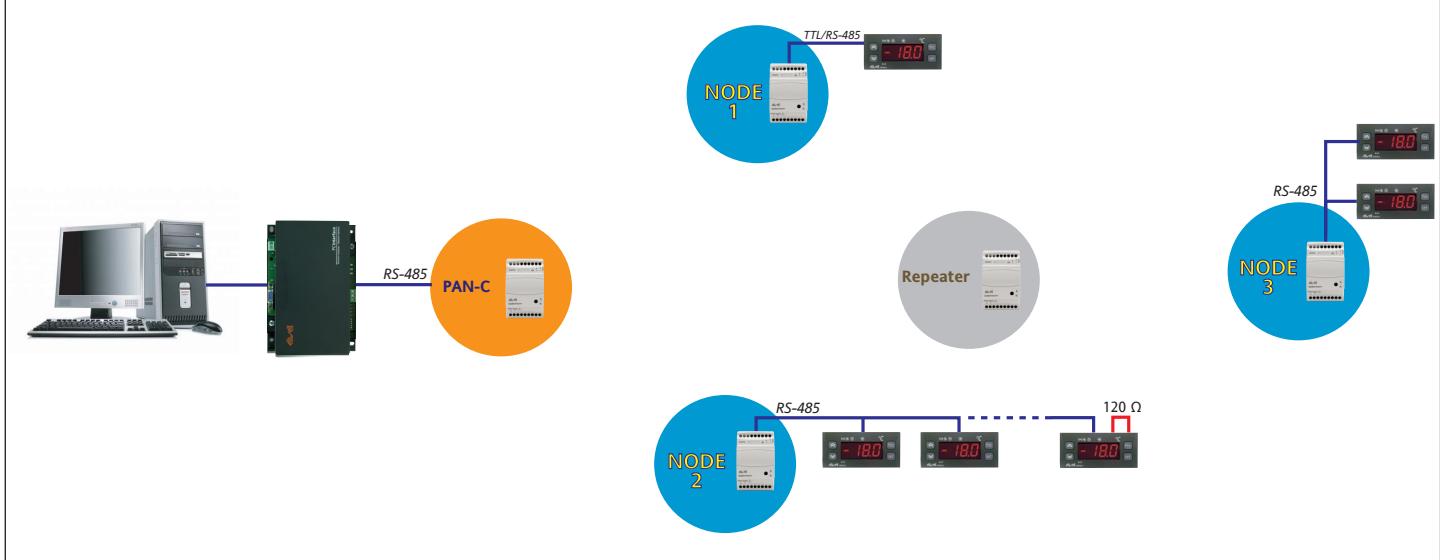
2.4 - CONFIGURING THE PAN-C

After installing the PAN-C and all devices/components have been installed and configured (NODES and any repeaters), the PAN-C just installed must be configured in order to enable the network.

Power Supply

2.4.1 - TRANSFERRING NETWORK CONFIGURATION TO THE PAN-C

- Check that the PAN-C is connected to the power supply.

- Check that serial connections (TTL and RS-485) are not connected.

- Set the switch on the **Radio**Key to position **0**

- Connect the powered-on PAN-C to the **Radio**Key and wait for the YELLOW LED (P) (on the **Radio**Key) to light up (GREEN LED (N) off).

- Disconnect the **Radio**Key from the PAN-C.

- Connect the PAN-C to the PC-Interface or monitoring device via an RS-485 serial port

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NETWORK STRUCTURE
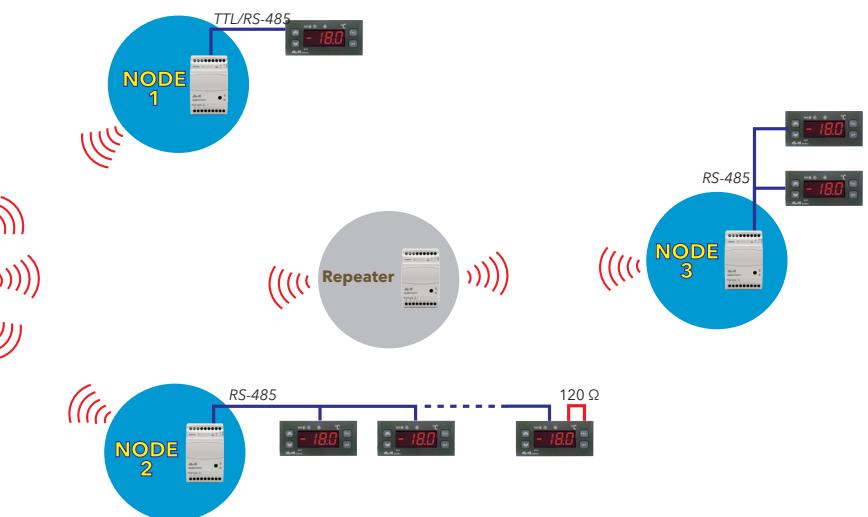
To enable the network, just switch on the NODES, devices, repeaters and PAN-C.
To start up the monitoring device (Televis or Modbus), refer to the relative user manuals for configuration and use.

NOTA: Communication between NODES, repeaters and PAN-C and the monitoring device will commence after at least 1 minute has passed after each component of the network was switched on

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2.5 - CHANGES TO NETWORK

2.5.1 - ADDING A NEW NODE

Instructions on how to install a new NODE and all relative connections in an existing network are provided below:

- Turn off the monitoring device.
- Install the NODE as described in section "**How to install a NODE**"
- Repeat the PAN-C configuration as described in section "**Configuring the PAN-C**"

2.5.2 - ADDING A NEW DEVICE

Instructions on how to install a new device on one of the NODES of an existing network are provided below:

- assign a Televis or Modbus address to the device.
- Connect the new device to the selected NODE.
- Wait for the NODE to finish scanning.
- Disconnect the device from the NODE.
- Set the switch on the **Radio**Key to position 1
- Connect the **Radio**Key to the NODE and wait for the GREEN LED (N) on the **Radio**Key to light up.

The NODE has now reset.

- Disconnect the **Radio**Key and configure the NODE as explained in section 2.2 How to install a NODE
  (ignore the first section 2.2.1 Initializing a NODE).

- Configure the PAN-C again as explained in section 2.4 Configuring PAN-C

3 - TROUBLESHOOTING

3.1 - REPLACING THE PAN-C

When a PAN-C is found to be faulty, replace it with a new RadioAdapter.
Follow the steps below when replacing a faulty PAN-C with a new one.

Supervisor

Power
Supply
①

Power
Supply
②

Power
Supply
③
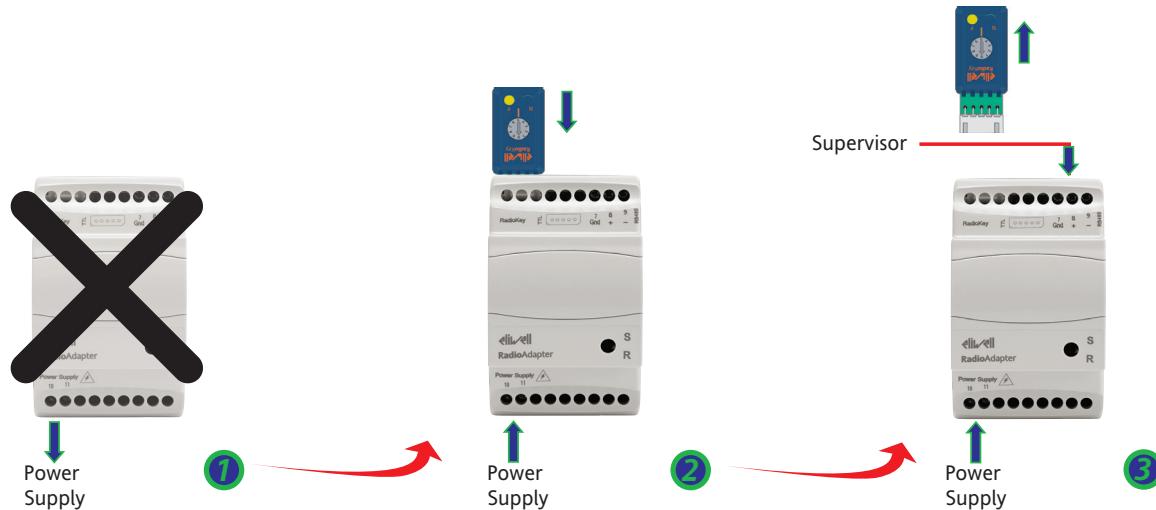
1 - Disconnect and remove the faulty PAN-C.

2 - Place a new **Radio**Adapter in the place of the PAN-C just removed.

Set the switch on the **Radio**Key to position 5.

Connect the **Radio**Key to the **Radio**Adapter and wait for the YELLOW LED (P) on the **Radio**Key to light up.

3 - Disconnect the **Radio**Key and connect the new PAN-C to the network

3.2 - REPLACING A NODE

When a NODE is found to be faulty, the component must be replaced with a new **Radio**Adapter.
Follow the steps below when replacing a faulty NODE with a new one:

- Disconnect and remove the faulty NODE.
- Place a new **Radio**Adapter in the place of the NODE you removed.
- Install and configure the new NODE following the steps outlined in section "**How to install a NODE**".
- Repeat the PAN-C configuration as described in section 2.4 Configuring the PAN-C

3.3 - REPLACING A DEVICE

Follow the steps below when replacing a faulty device with a new one:

- if the new device has the same address (Televis or Modbus) as the old one, just connect it to the NODE.

- if on the other hand the new device has a different address (Televis or Modbus) from the old one, the respective NODE will have to be Reset (see section "**Resetting a NODE**")

3.4 - RESETTING A NODE

- Disconnect the device from the NODE.

- Set the switch on the **Radio**Key to position 1.

- Connect the **Radio**Key to the NODE and wait for the GREEN LED (N) on the **Radio**Key to light up. The NODE has now reset.

- Disconnect the **Radio**Key and configure the NODE following the steps outlined in sections "**Address configuration and searching for connected devices**" and "**Saving settings**".

Power
Supply

3.5 - CHANGING CHANNEL

If there is disturbance on the network channel which is affecting communication, the channel can be forced to a new one.
A new channel scan can be forced or one of the four pre-selected channels can be set.

3.5.1 - SCANNING TO FIND A NEW CHANNEL

1 - Set the switch on the **Radio**Key to position **3** Connect the **Radio**Key to the PAN-C and wait for the YELLOW LED (P) on the **Radio**Key to light up.

2 - Disconnect the PAN-C from the power supply and disconnect the **Radio**Key.

Now follow the steps described for the PAN-C in sections "**Channel search**" and "**Saving PAN-C settings**".

After this, for each NODE follow the steps outlined in section "**Saving Settings**" and for each repeater, the instructions given in section "**Saving repeater settings**".

Power Supply ① → Power Supply ②
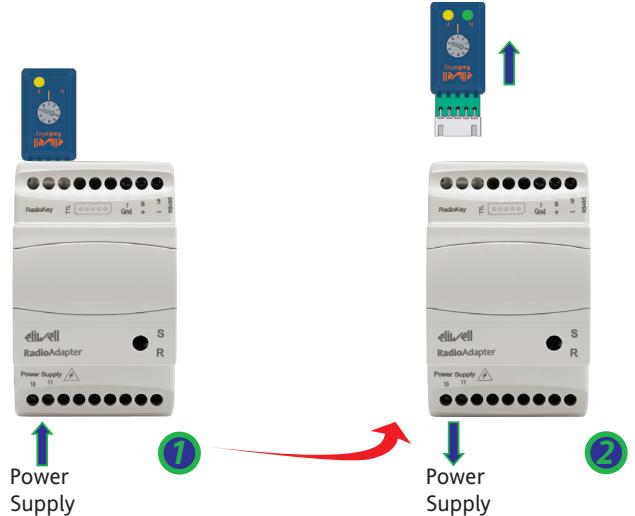
3.5.2 - SETTING COMMUNICATION CHANNEL MANUALLY

PAN-C — PAN-C — NODE — NODE

Power Supply ① → Power Supply ② → Power Supply ③ → Power Supply ④ → OTHER NODES...
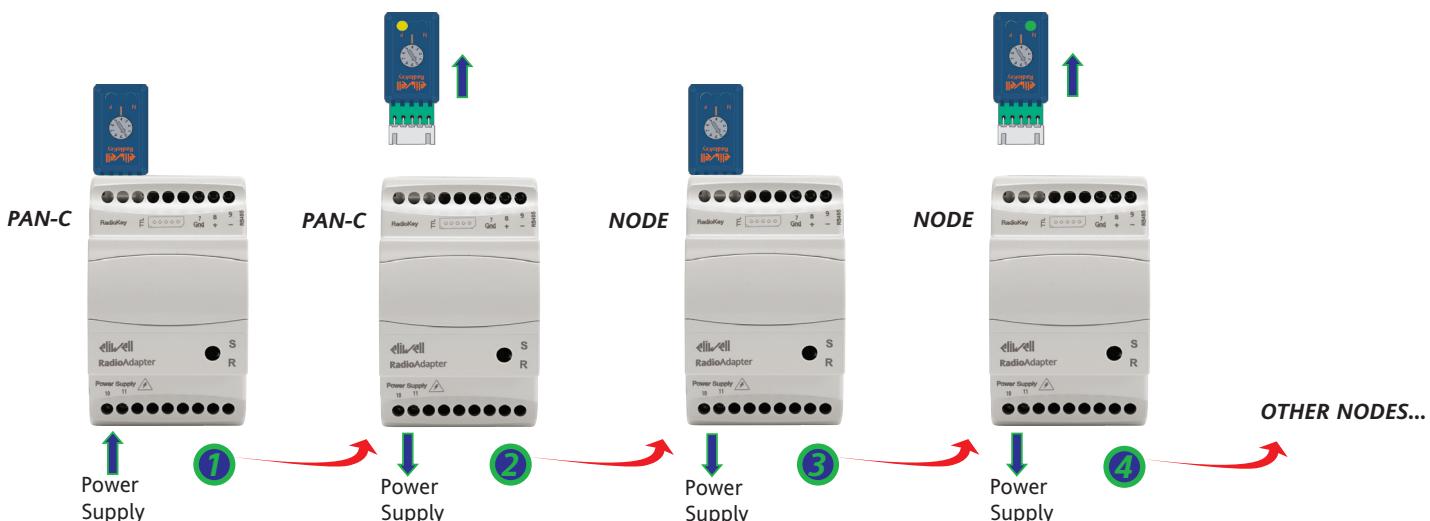
1 - Set the switch on the **Radio**Key to position 4, 6, 7 or 8 (depending on the channel you want to set).
Connect the **Radio**Key to the PAN-C and wait for the YELLOW LED on the **Radio**Key to light up.

2 - Disconnect the PAN-C from the power supply and disconnect the **Radio**Key.

3 - Leave the switch on the **Radio**Key in the same position (position 4 in this example).
Connect the **Radio**Key to a NODE (or to a repeater) that has been powered-on, and wait for the GREEN LED (N) on the **Radio**Key to light up.

4 - Disconnect the NODE from the power supply and disconnect the **Radio**Key.

Repeat the steps listed in points 3 and 4 for each NODE and repeater in the network without changing the setting on the **Radio**Key

Position of **Radio**Key switch	Channel
4	12
6	16
7	20
8	25

4.1 - ELECTRICAL CONNECTIONS

Important! Switch off the device before working on the electrical connections.

The instrument is equipped with screw terminal boards for connection of electrical cables with a diameter of 2.5 mm2 (one conductor only per terminal for power connections). Make sure that power supply is the correct voltage for the device. TTL serial port cables and RS-485 serial port cables must be kept separate from the power cables.

The RS-485 network must be appropriately terminated, i.e. by inserting a 120 Ohm terminal resistor between the - and + terminals of the interface module.

4.2 - DISCLAIMER

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4.3 - RESPONSIBILITY AND RESIDUAL RISKS

ELIWELL CONTROLS SRL shall not be liable for damage resulting from:
 - Installation/uses other than those specified and, in particular, which do not comply with the safety requirements set out in the regulations and/or stated herein.
 - Use on panels that do not provide adequate protection against electric shock, water or dust when assembled.
 - Use on panels that allow access to dangerous parts without having to use tools.
 - Tampering and/or modification of the product.
 - Installation/use on panels that do not comply with applicable standards and regulations.

4.4 - CONDITIONS OF USE

PERMITTED USE

For safety reasons, the device must be installed and used according to the instructions provided. In particular, parts carrying dangerous voltages must not be accessible in normal conditions. The device must be adequately protected from water and dust according to the application, and must also be accessible only using tools (with the exception of the front panel).
Class 4 classification ISA SP100.11 (do not use for safety devices)

USES NOT PERMITTED

The device must not be used for applications other than those described.
Note that the relay contacts provided are of a functional type and therefore subject to malfunction: Any protection devices required by product standards, or suggested by common sense, must be installed externally to the instrument for obvious safety reasons.

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