

Trouble-shooting during euLINK gateway operation

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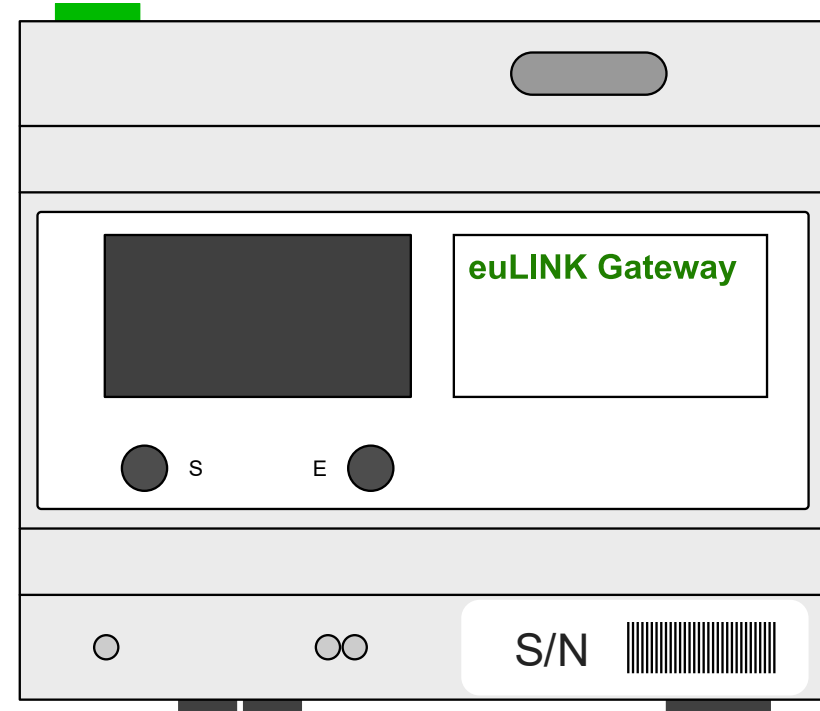
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Skills to help diagnose problems with the euLINK gateway:

- Basic knowledge of computers and networks
- Knowledge of the basics of the operation of specific devices integrated into the gateway (including DALI, HVAC, PV, EV, etc.).
- Installation practice in the field of electronic equipment will be useful

1. Incomplete delivery

The euLINK gateway is supplied complete with plugs (1 x plug for 110-240V AC power supply, 2 plugs for RS-485 port), two 120Ω/0.5W resistors (RS-485 bus terminators), a spare 2A/250V fuse and instructions in several languages. There should be a reader in the USB port with a spare 32 GB microSD card. The optional euLINK DALI port is supplied with a plug for connecting the DALI bus and with a 20cm-long ribbon connecting it to the euLINK gateway. The box of the euLINK gateway and DALI port is protected by a disposable seal sticker. If the sticker is damaged, or the box is missing the accessories listed above, please email the service department at support@eutonmy.com. Please quote the serial number of the euLINK gateway in your correspondence. The serial number can also be read from the menu on the OLED display and from the gateway's configuration page, it is also, together with the barcode, printed on the housing:



2. Problems during euLINK gateway installation

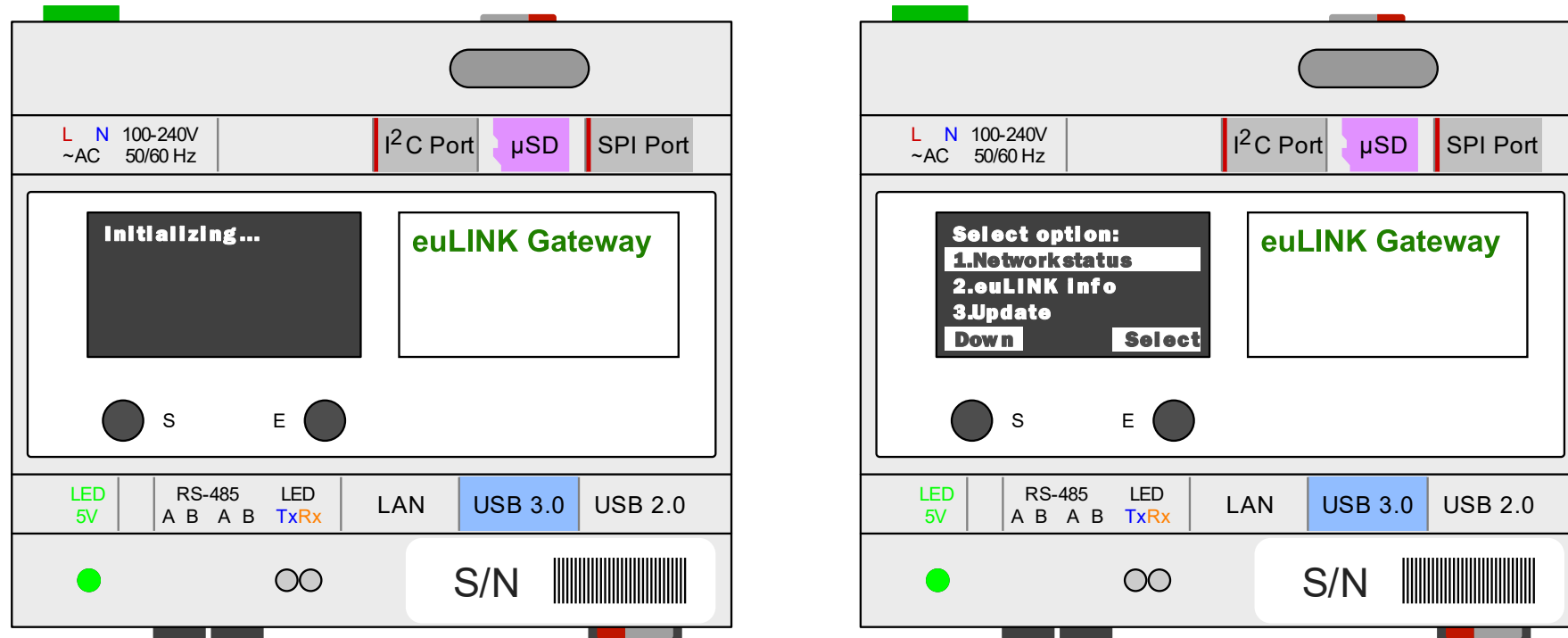
When integrating the euLINK gateway with complex devices, doubts may arise as to the correct connections. The same can happen if there are a large number of even simpler devices in the installation. The euLINK gateway manual and the manufacturer's documentation for the devices to be integrated - in particular the connection diagrams provided there - should provide assistance.

- The manufacturer's documentation for the integrated devices can be downloaded using the link provided in the header of the device template,
- Connection diagrams for the euLINK gateway can be downloaded from the manufacturer's website: www.eutonmy.com/products/eulink

Some communication issues specific to Modbus and DALI technology are discussed in the following sections, starting on page 18.

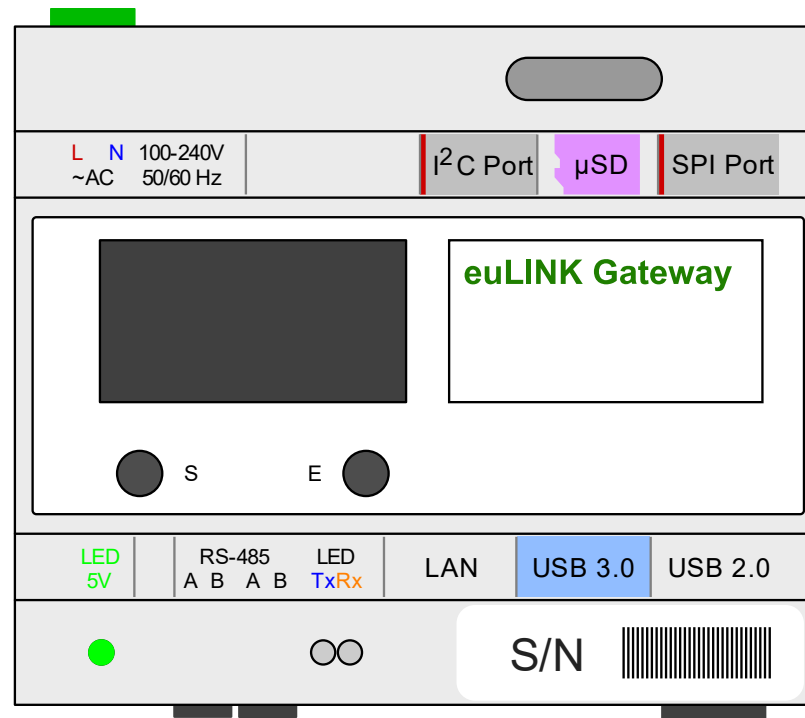
3. Problems at the launch of the euLINK gateway

Normal start-up of the euLINK gateway takes approximately 2 minutes. One minute after power-up, the manufacturer's logo appears on the OLED screen and the software initialisation process begins:



At the end of the second minute, a menu should appear on the OLED screen with some basic information (including IP address, serial number, software version, etc.). If the menu is not visible and the OLED screen is black, check the following steps:

- The OLED screen has a built-in sleep mode in case of inactivity. This means that a few minutes after switching on, or after the last time the S or E button was pressed, the OLED screen goes out. It will be awakened from sleep by pressing any of the S or E buttons.
- If the OLED screen does not light up and the S or E buttons do not wake it up, check the power supply to the gateway. If the euLINK gateway is correctly powered, the green LED on the gateway housing (with the description 5V) should be illuminated:

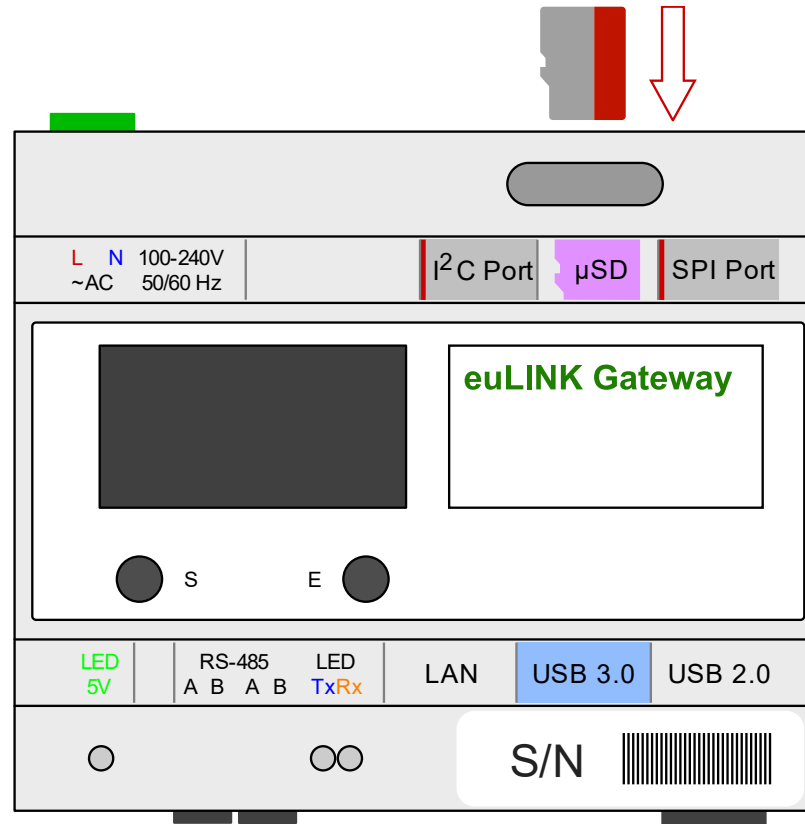


- If the 5V LED does not light up, the reasons may be as follows:

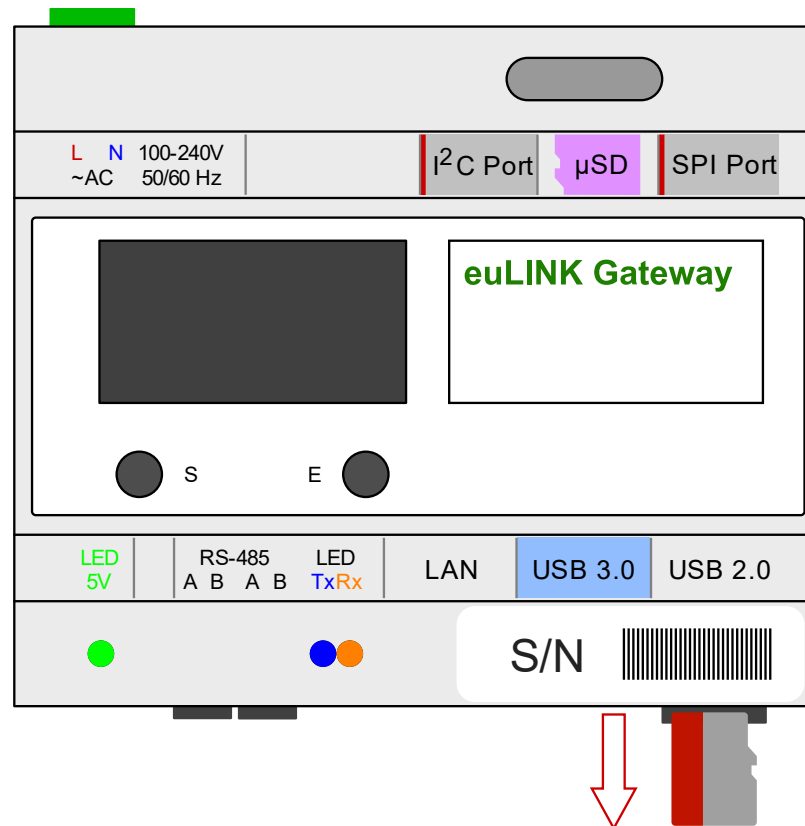


- No voltage in the range 110-240V AC is supplied to the power socket of the euLINK gateway. The status of the overcurrent circuit breaker for this circuit should be checked, possibly also the residual current protection. The euLINK gateway power supply circuit should be protected with an overcurrent circuit breaker with C characteristic and a value of 10A. The input voltage is best measured at the terminals of the power supply socket using a universal meter set to a voltage range of 600V AC. Please note that the 110-240V AC voltage expected at this point is life-threatening, so caution and proper training of the installer is required.
- It is possible that either the internal 2A/250V fuse has blown or the built-in power supply of the euLINK gateway has failed. Although the fuse is replaceable and a spare is supplied, the fuse never blows for no reason. Therefore, in any such case, the euLINK gateway should go to the manufacturer's service department for warranty or post-warranty repair. To do this, please contact the manufacturer's service by e-mail at support@eutonomy.com, stating the serial number of the gateway and a description of the incident. If, as a result of a consultation with the user, the service technician considers it possible to attempt to replace the fuse on site, he will also explain how to do so safely.

- If the 5V LED lights up green and the OLED screen does not display the menu and does not wake up after 2 minutes, this may indicate a problem with the microSD card. In this case, disconnect the power supply to the euLINK gateway, use tweezers to remove the main microSD card (from the top) and check for signs of damage. Then insert it back into the reader from the top and make sure it is fully inserted.



- On power-up, both diagnostic LEDs Tx (blue) and Rx (yellow) should be on continuously, but must go out before 10 seconds. If they are not off, this indicates a problem loading the operating system from the main microSD card. It is possible that the microSD card has been damaged and should be replaced with a spare card, removed from the USB reader at the bottom of the euLINK gateway:



- The backup card is automatically backed up every day (around 6:30 a.m.) with a copy of the contents of the main card, so it should be operational. If there has been a change in the configuration of the euLINK gateway over the past 24 hours, it can be restored from the backup copy downloaded from the euCLOUD network database. Since the backup card has successfully replaced the main card, it is worth placing a new card in the reader to take over the role of the backup card. This can even be a blank microSD card with a minimum capacity of 32GB, compliant with HC I Class 10 specification. During the warranty period, the manufacturer will either send a new microSD card or reimburse the purchaser for the purchase of a compatible card.
- It is unlikely that both microSD cards are damaged, but it cannot be ruled out that the fault in the main card occurred earlier than 24 hours ago. And in such a situation, the backup card has been stored with the wrong data and may be unusable. As a precautionary measure, the manufacturer therefore makes the current software version of the euLINK gateway available for download in the form of a compressed microSD card image, which

can be downloaded and uploaded to a clean microSD card with a minimum capacity of 32GB, compliant with HC I Class 10 specification. It is best to save the card image with the [Etcher](#) programme using the "Flash from URL" function). The card image file can be safely downloaded from the manufacturer's server using the following link: https://www.eutonomy.com/download/eulink/firmware/latest_euLINK_firmware.img.gz The saved microSD card should be inserted into the main (top) reader and the euLINK gateway powered on. After successfully booting the system from a clean card, go through all the steps of the wizard, in particular giving permission to upgrade the software. Having regained access to the administration page of the euLINK gateway, the latest configuration backup from the euCLOUD server can be restored.

- If both diagnostic LEDs Tx and Rx are off 10 seconds after power-up, the blue Tx LED may flicker for another minute while the gateway operating system is loaded. However, if 2 minutes pass and the OLED screen does not display the menu, this may indicate a fault with the OLED display. If the euLINK gateway is wired to the LAN (via the Ethernet port), it may have already been assigned IP address and its configuration page can be opened in a browser on the installer's PC. The inoperable OLED screen makes it difficult to read the IP address, but it can be found in a DHCP dynamic address server management application (usually a router or LAN server). There is a sticker on the casing of the euLINK gateway with a barcode and serial number, which is the last 6 characters of the gateway's Ethernet port MAC address. So knowing the serial number should help you find the IP address, assigned by the DHCP server to the euLINK gateway. Simply enter this IP address in a browser on a computer connected to the same network to see if the euLINK configuration wizard page shows up. If the basic configuration process of the euLINK gateway is successfully carried out, it will be possible to start a remote support session, allowing a manufacturer's specialist to connect remotely to the euLINK gateway and carry out the diagnostic procedure. How to start a remote support session is described in chapter no. 8 on page 46.
- If the euLINK gateway has not asked for an IP address or does not show the configuration wizard page in the browser, it is likely that the Raspberry Pi on-board microcomputer is faulty. In this situation, please email the manufacturer's service at support@eutonomy.com to arrange a replacement gateway procedure.

In environments with particularly high reliability requirements (medical, industrial, etc.), a variant of the euLINK gateway with a 120GB SSD can be used instead of a standard microSD card.

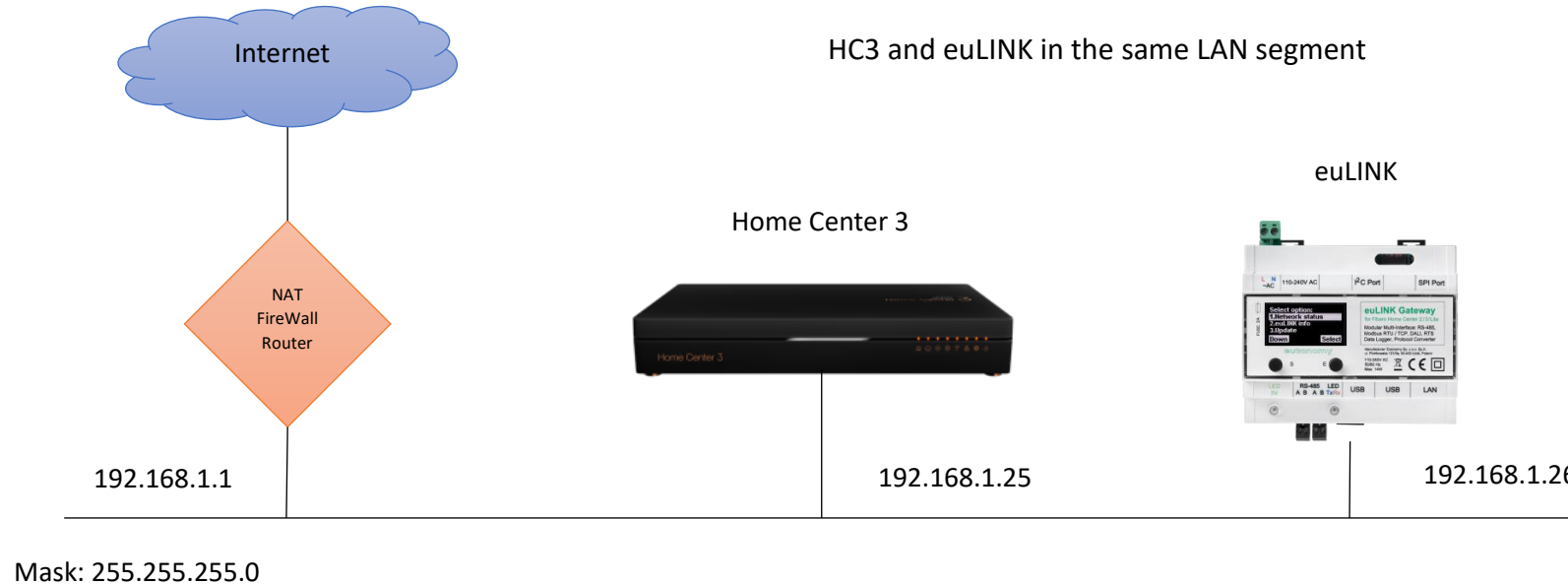
4. Communication problems with the FIBARO Home Center controller in a LAN network

In practice, two types of problems are encountered in communication between the euLINK gateway and the FIBARO Home Center controller: problems with addressing one or both devices and problems with the euLINK gateway logging into the Home Center controller.

a) IP addressing problems with euLINK gateway, Home Center controller or both

Both devices need to know each other's IP addresses, so the addresses must remain constant throughout their lifetime. Traffic between the devices is kept to a minimum, so they only pass information (euLINK to HC3) and commands (HC3 to euLINK) to each other when they really need to. And for this they need to know each other's IP addresses. If one or both the devices have addresses assigned dynamically by the DHCP service, then even with a minor network reconfiguration, these addresses can change and communication in one or both directions becomes impossible. This can manifest itself, for example, in such a way that information about the integrated devices will be sent via the euLINK gateway to HC3, but no longer commands from HC3 will reach the euLINK gateway and further to the integrated devices. This almost certainly indicates that the IP address of the euLINK gateway has recently changed and the HC3 controller has not been informed of this. It is therefore necessary to assign constant IP addresses for both devices - HC3 and euLINK gateway - and try not to change them afterwards. This can be achieved by entering fixed IP addresses in the configuration of both devices, but this will make any future LAN reconfiguration more difficult. It is therefore much better to indicate in the configuration of the DHCP address broadcasting service that the IP addresses currently assigned to the euLINK gateway and HC3 are to be permanently assigned to their unchangeable MAC addresses.

In order for the two devices to work together correctly, it is not required that they be connected to the same LAN segment. But, of course, this is the recommended option, as this facilitates a number of activities. For example, when entering the access data for an HC3 controller into the configuration of the euLINK gateway, you can enter the IP address manually, but if both devices are in the same segment, you can have the euLINK gateway search the network environment and euLINK will display any HC2, HC Lite, HC3, HC3 Lite or Yubii controller found in the segment.



HC3 and euLINK in the same LAN segment

euLINK

Home Center 3

192.168.1.1

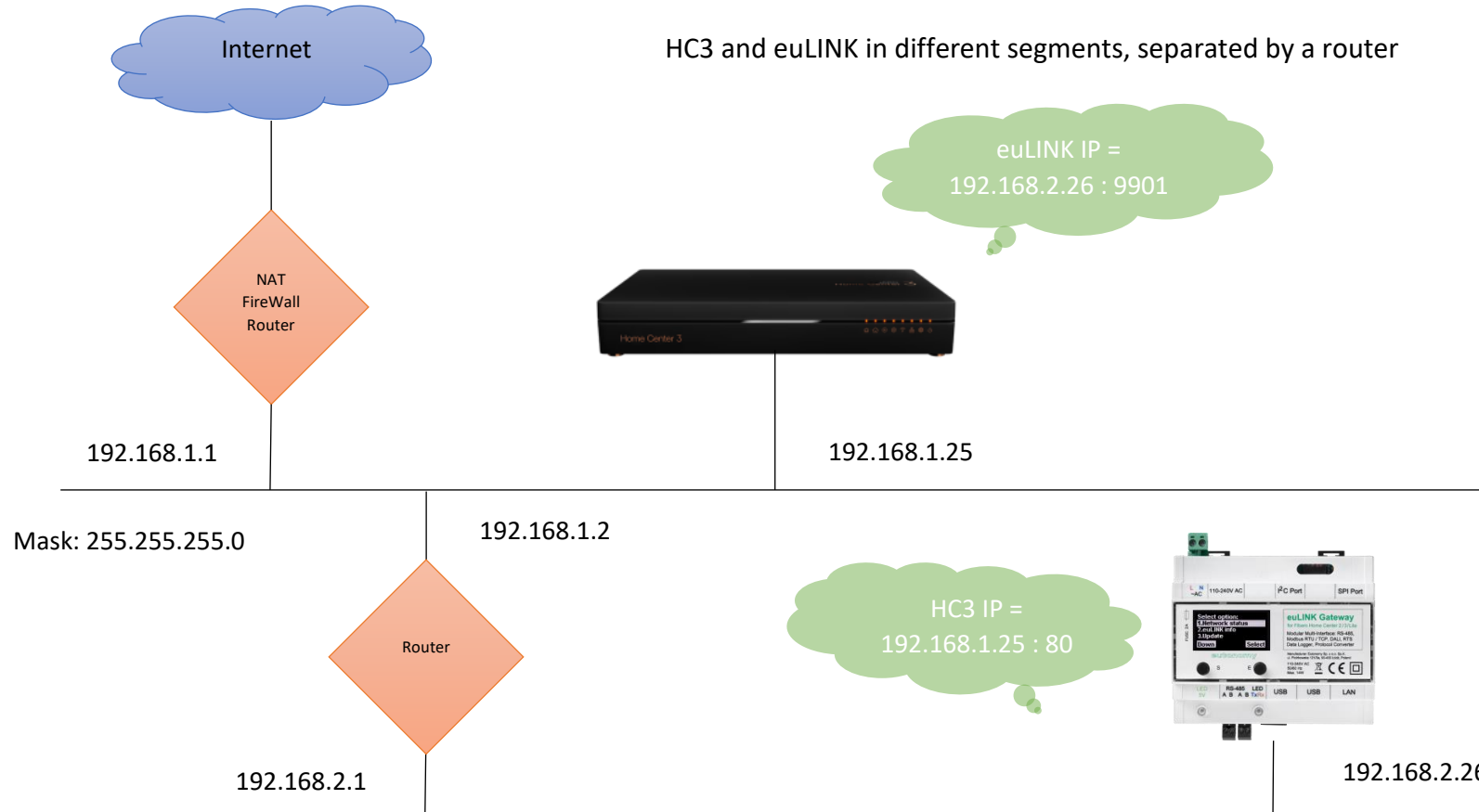
192.168.1.25

192.168.1.26

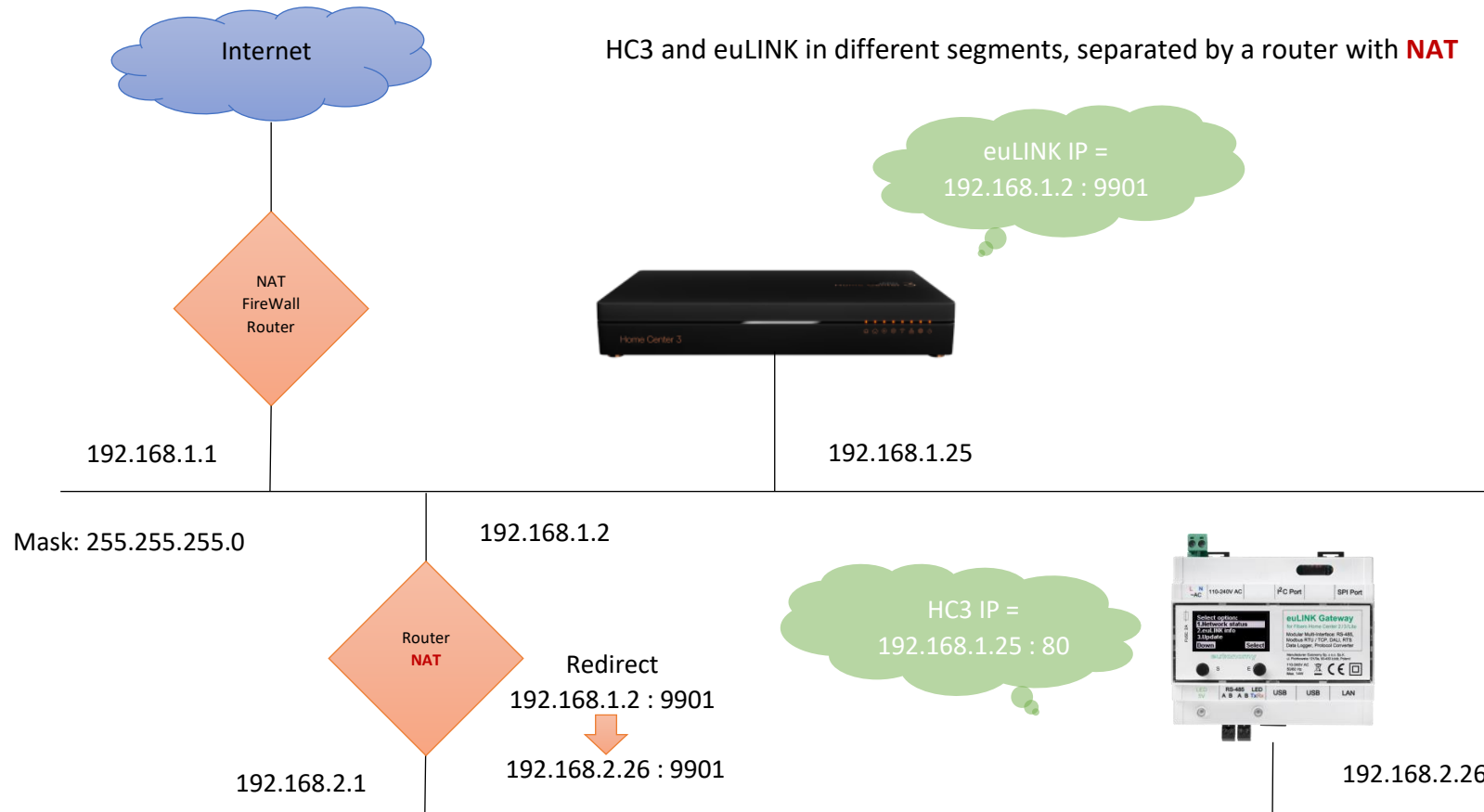
Mask: 255.255.255.0

Furthermore, if at some point the euLINK gateway finds that the HC3 controller does not respond at a stored IP address, it will attempt to find it and, if it detects an HC3 controller operating on a different IP address with the same serial number as the one stored, it will attempt to log in using the stored username and password. If this attempt is successful, the euLINK gateway recognises that the IP address of the HC3 controller has changed and will henceforth use this newly found address.

It is also possible to work in a multi-segment network, connected by one or more routers. It is important that both IP addresses are reachable for each other and that the TCP ports needed for communication are not blocked, i.e. port 80 in the direction euLINK=>HC3 and port 9901 in the direction HC3=>euLINK. For the older controller family (HC2, HC Lite), port 9900 is used instead of port 9901.



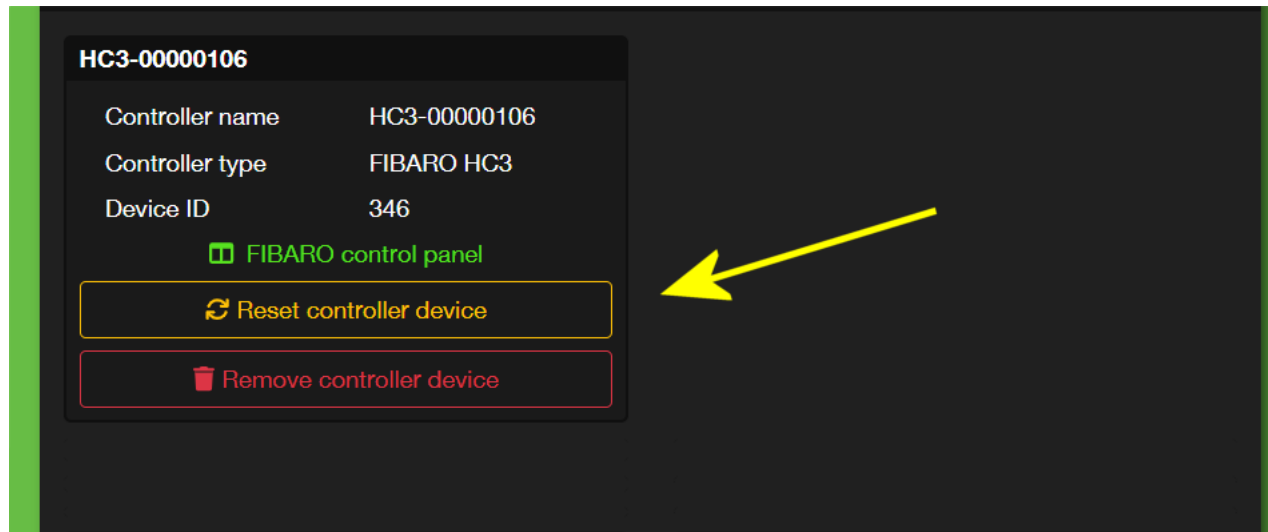
It is even possible to work in a network whose segments are separated by a NAT-translated router. The addressing should then look as follows:



In the euLINK gateway settings in the controller section, the option "NAT Traversal" must then be selected and the IP address of the NAT-translated router, as seen from the HC3 controller side, must be indicated. The euLINK gateway configured in this way will import any QuickApp objects with the NAT router address, instead of the euLINK gateway address. Of course, on the NAT router you must then configure the redirection of traffic entering TCP port 9901 to the euLINK gateway address and the same TCP port 9901. The controller settings page on the euLINK gateway for the above example looks as follows:

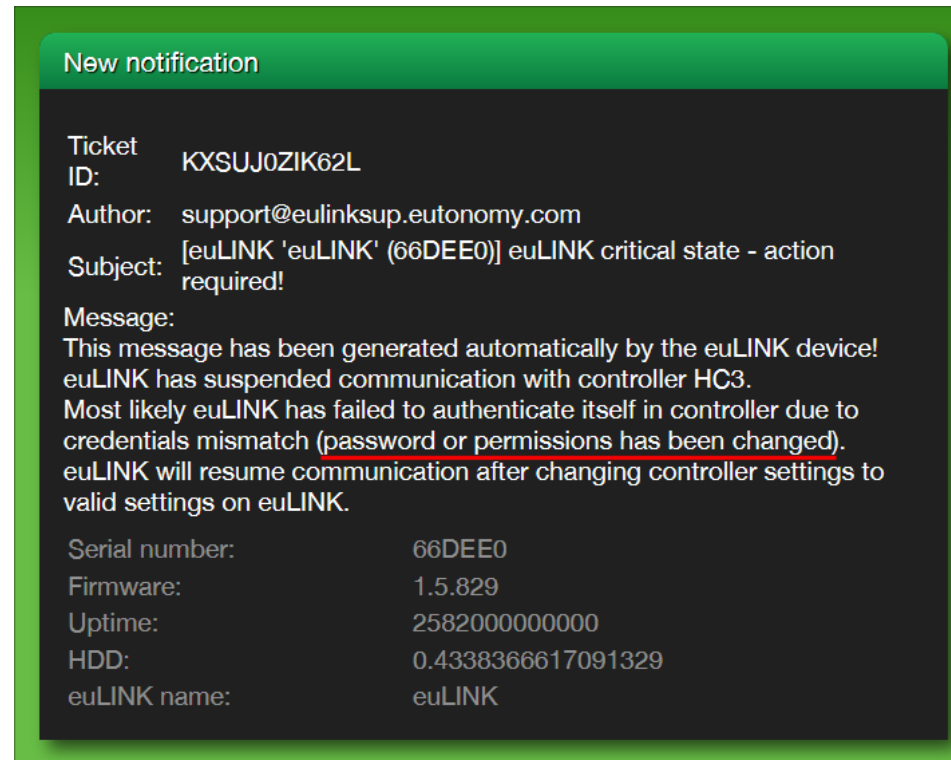
The screenshot displays the 'Settings' page for a controller with ID HC3-00000106. On the left, a sidebar menu includes 'Settings', 'General', 'Backup', 'Users', 'Network', 'Controllers', and 'Hardware Interfaces'. The main content area shows the controller's name 'FIBARO HC3-00000106', its status as 'Active', and a checked 'FIBARO control panel' option. Below this, a table lists 'Serial number' (HC3-00000106), 'Firmware version' (5.061.36), and 'Language' (PL). A 'Settings' section follows, containing input fields for 'Controller name' (HC3-00000106), 'IP Address' (192.168.1.25), 'Username' (admin), and 'Password' (masked with dots). The 'NAT Traversal' checkbox is checked and highlighted with a yellow arrow. Other fields include 'NAT euLINK IP' (192.168.1.2) and 'NAT euLINK Port' (9901). A 'Save' button is located at the bottom right of the settings section. The bottom of the page is labeled 'Sections/Rooms'.

It is a good idea to plan the IP address of both devices in advance and not to change it afterwards without a valid reason, as this can have time-consuming consequences. This is because every QuickApp object imported by the euLINK gateway has the gateway's IP address stored, and if this is later changed, you will need to remember to update it for each QuickApp object. However, should the need arise, the fastest way to make corrections is from the device configuration screen on the euLINK gateway. This is done using the 'Reset controller device' function, which sets all the parameters of the imported QuickApp object to the current values, including saving the current IP address of the euLINK gateway:



b) Problems with euLINK gateway logging into Home Center controller

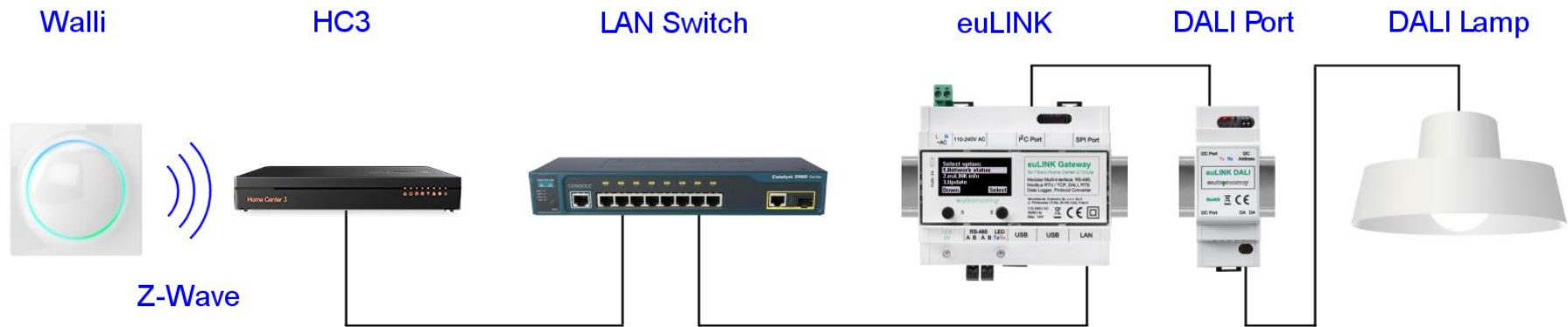
In order to automatically import QuickApp objects, global variables, icons and for subsequent status updates of integrated devices, the euLINK gateway must be able to log in to the Home Center controller with local administrator rights. Usually, the username and password for logging in to Home Center are entered at the beginning of the installation. If the administrator name or password needs to be changed later, remember to update this name and/or password in the euLINK gateway settings as well. Otherwise, the euLINK gateway will lose the ability to update the status readings of the integrated devices. To make matters worse, once several unsuccessful attempts to log in from the same IP address are detected, the HC3 controller will consider this as an intrusion attempt and will block any possibility of logging in from this suspicious IP address for the next 30 minutes. To avoid this, the euLINK gateway stops further attempts to log in to HC3 after 2 unsuccessful attempts to avoid being blacklisted by the IP address. Instead, it displays a message about login problems and sends an email to the administrator similar to the following:



You should then enter a new name or password as soon as possible and save the change. This should restore normal communication with HC3. It is worth checking that the login error message has disappeared and that the readings from the devices are updated in HC3. If not, please wait 30 minutes or restart HC3.

c) Delays in the execution of commands sent from the Home Center to devices integrated by euLINK

Occasionally, users point out that commands issued on the Home Centre side are executed with an awkwardly long delay, or sometimes not executed at all. The problem can relate to switching on or off both DALI lighting and integrated HVAC/PV/EV equipment. When looking for the source of the problem, it is important to remember that any such integration is a serial connection of multiple links and it only takes the failure of one link for the whole chain to operate unstably or not at all. We can analyze this phenomenon using the example of using Z-Wave switches to control DALI lighting. The following illustration shows how many links make up the implementation of such a 'chain':



In the example shown, there are as many as 6 of these links and any one of them could be responsible for any delays. Each transmission path also has a limited transmission speed, but this should not matter much in the examples discussed. On a LAN, transmission can occur at 1Gbit/s or 100Mbit/s, much slower is the Z-Wave protocol (40kbit/s or 9.6kbit/s), Modbus serial transmission is usually at 9.6kbit/s and the slowest is DALI transmission - it is only 1.2kbit/s (a million times slower than LAN). Fortunately, the commands sent are very short, numbering from a few to a dozen bytes, so in each technology their sending time does not exceed a few milliseconds. However, problems can arise with any transmission technology, e.g. in wired networks (Ethernet, Modbus RTU, DALI) it may be too much traffic or high interference, in wireless transmission (Z-Wave, WiFi) there may be a weak signal at the edge of range and also external interference. In any such case, the transmitted command may be distorted to such an extent that it is not decoded correctly and the protocol will try to repeat it. These repetitions are also subject to distortion and, as a result, it can take many seconds before a command can be successfully delivered along the entire chain. This is an inconvenience that will certainly be noticed by users.

There is no point in looking for the cause by trial and error if these links are numerous. Use simple methods to check individual links, eliminating as far as possible all other question marks and keeping an eye on the logical sequence of steps. For example:

- It is a good idea to connect the computer (laptop) to the LAN by wire, to make it independent of any possible WiFi transmission problems.
- Then log in to the euLINK gateway and try to send a command from it (e.g. switching on a DALI luminaire, changing the mode of an air conditioner, etc.). The response should be immediate, so if you are already seeing repetitive delays here, run a DALI or Modbus diagnostic as described in the following sections.

- If there are no delays, it is worth logging on to the Home Centre controller and repeating the issuing of the same test commands. Thanks to the high transmission speed of the LAN, all test commands should be transmitted to the euLINK gateway in no time and executed in practically the same time as local tests from the euLINK gateway.
- However, if delays are noticeable, LAN diagnostics should be carried out, e.g. using popular traffic analysers such as [Wireshark](#). Such tools can usually detect LAN congestion or determine the source of interference (e.g. "jabber") occurring on the LAN.
- If no abnormalities are detected in the LAN, it is worth checking whether any of the key devices are overloaded or overheating. Both the Home Centre controller and the euLINK gateway provide diagnostics where you can check, among other things, the CPU and RAM memory occupancy. In normal operation, the CPU occupancy does not exceed a few or several percent, with occasional pulses reaching several tens of percent. However, if the CPU is constantly loaded in the vicinity of 100 per cent or the RAM is 100 per cent occupied, the cause of this must be found and removed, as the observed delays are only an offshoot of this. The configuration should be reviewed (e.g. temporarily disable scenes on the HC3 or 'sleep' the DALI/Modbus devices on the euLINK), and if this proves insufficient, perhaps the manufacturer should be contacted, as such symptoms may herald a failure of the HC3 controller or the euLINK gateway.
- Both the Home Center controller and the euLINK gateway present a record of the history of events (log), where it is worth taking a look for possible abnormality messages - both internal and some external.
- Sometimes it happens that scenes on the Home Centre controller are the source of the delay. The quickest way to locate the cause is to convert a block scene into a LUA scene (if it is not already one) and add a *debug()* command in a few characteristic places (e.g. at the entry and exit of each stage of the scene). It is then possible to find out unequivocally whether the Home Centre controller received and executed the command, whether any error occurred in the process, and if so, what kind of error. It may turn out, for example, that the observed scene collides with another scene (or other scenes) because the conditions for triggering the scene were incorrectly defined. Alternatively, you can always run the scene manually to see if its execution may be introducing delays.
- If none of the above links reveal the source of the delays, they may be caused by problems in Z-Wave transmission between the module and the Home Center controller. The most common cause is a weak radio signal at the Z-Wave range limit. Both the HC3 controller and the individual Z-Wave modules offer simple methods for checking direct and indirect range. For the purpose of the test, you can temporarily entrust the same function to a Z-Wave module that is in the immediate vicinity of the Home Center controller, i.e. no more than 2m away.
- A very effective tool for diagnosing Z-Wave communication is the "Z-Wave Zniffer" application from Sigma Designs, using a hardware USB↔Z-Wave adapter, e.g. type DSA07203-ZWEU manufactured by Aeon Labs LLC.

Although the above steps are several, they only appear to be time-consuming. Practice proves that it takes much longer to eliminate delays and similar anomalies by replacing individual links or changing their configuration by trial and error.

5. Communication problems with Modbus RTU devices

Serial transmission in the Modbus protocol is very resistant to interference and does not present any serious limitations. The transmitted signals have low power, so the transceiver circuits do not process large energies, so ageing of components occurs very slowly. Most systems also have good surge protection. Therefore, failures of the transmission circuits of Modbus devices are very rare. In practice, a fault in the power supply circuit of the integrated device is much more likely, and even more often the source of the problem is the cabling or terminators. And the elimination of the latter suspects should be the primary focus.

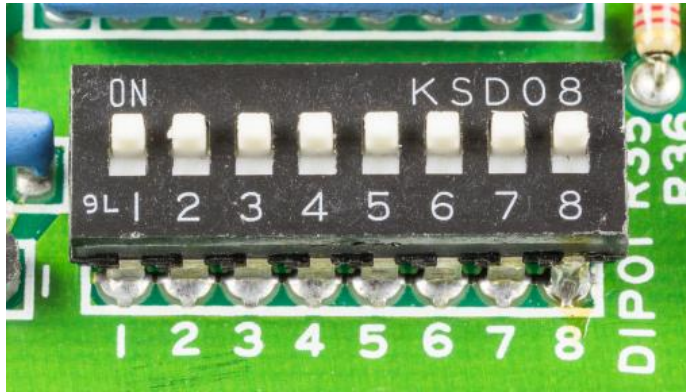
a) Addressing Modbus RTU devices on the RS-485 serial bus

The Modbus RTU protocol uses a two-wire serial bus compatible with the RS-485 standard for communication.

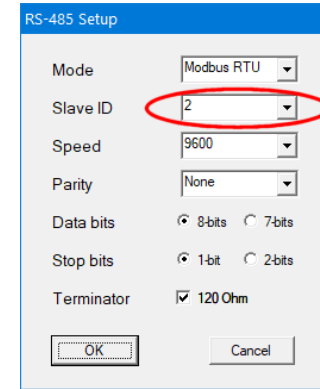
All communication on the RS-485 bus takes place at the initiative of a single device, the Modbus Master. The euLINK gateway acts in this role. The Modbus Master sends requests and commands to a single slave device using its Slave_ID address, which is unique within the RS-485 bus. Although the Modbus RTU protocol defines the possibility of sending a single request to all slaves (*broadcast* to the Slave_ID=0 address), this approach is not used in home systems, but only in some industrial systems. The called slave is obliged to respond - either in the form of an acknowledgement or to report an error code. Failure to respond within the specified waiting time (generally the *timeout* is around 1s) is also treated as an error by the Modbus Master. Only after the response has been received or the waiting time has elapsed can the Modbus Master proceed to query the next Modbus Slave.

According to the Modbus RTU standard, slave addresses can take values in the range from 1 to 247. However, there are some devices that do not comply with the standard and their addresses can even reach values of 255. The euLINK gateway is even able to handle these non-standard addresses. Some devices have a narrower range of permissible Slave_ID addresses (e.g. from 1 to 15 or up to 63), but this still falls within the Modbus RTU standard.

It is the responsibility of the installer to give each Modbus Slave on the RS-485 bus a unique Slave_ID address to the extent, described in the manual by the slave device manufacturer. The manual always also explains how this address change can be performed. Most often a DIP Switch is used for this, less often it is set in the software configuration of the slave:



Setting the Slave_ID address on the DIP switch



Software address configuration

The installer should make a list of the slaves and note down the Slave_ID addresses assigned to them, for example in the form of the table below:

Room		Slave_ID	Name	Terminator	Device			
Section	Room				Manufacturer	Category	Type	Interface
Ground floor	Boiler room	-	euLINK	120 Ω	Eutonomy	Gateway	euLINK Lite	Built-in
Ground floor	Boiler room	2	Heat pump	-	NIBE	Heat pump	Fighter 1120	RCU-10
Ground floor	Salon	3	AC Salon	-	Daikin	Air conditioner	FXAQ-A	RTD-RA
Ground floor	Garage	4	Charger	-	Go-e	EV charger	Gemini	Built-in
Floor 1	Bedroom	5	AC Bedroom	-	Daikin	Air conditioner	FXDQ-M	RTD-RA
Floor 1	Roof	6	PV	120 Ω	RCT Power	Photovoltaics	Power Storage DC 6.0	Built-in

Without such a table, subsequent configuration, commissioning, diagnostics and servicing will be virtually impossible, so it is best to create such a table at the outset and keep it up to date.

It is a very costly and time-consuming mistake to connect all devices without changing the factory configuration, as there will almost certainly be a conflict of default Slave_ID addresses and it will be very difficult to identify individual devices - even after adjusting their settings. Most manufacturers default to a factory Slave_ID=1 address, so it is best avoided when planning and configuring devices. It is a very good habit to start the addressing with **Slave_ID=2** and subsequent

values, because if a new device is connected in the future, the chance of conflict will be minimised. And because some devices can be changed to a Slave_ID address remotely, it will be possible to switch a new device to a different address, freeing up the controversial Slave_ID=1 for subsequent, future devices.

b) RS-485 bus cabling problems

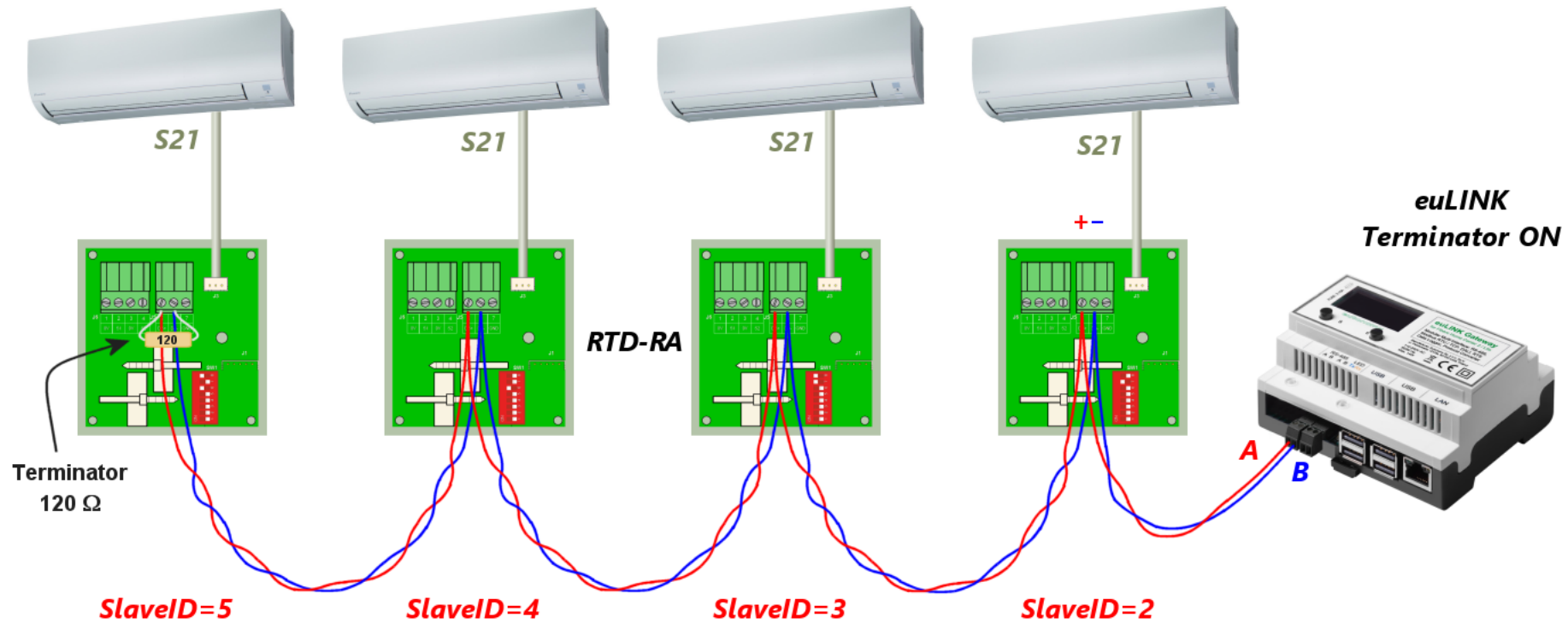
RS-485 serial bus cabling is best carried out using a 2-wire "twisted pair" cable with a conductor cross-section of $2 \times 0.4 \text{mm}^2$ (AWG 22) with an impedance of 120Ω , such as the popular Belden 3105A type. Theoretically, the RS-485 bus can be as long as 1200m, but in practice many equipment manufacturers limit this length to a few hundred meters - especially for transmission speeds higher than the popular 9600bit/s.

For shorter distances (roughly up to 100m), the use of popular UTP, STP or FTP category 5e or better twisted pair cables gives good results. In environments with high levels of interference (e.g. in industrial conditions), it is worth using a shielded twisted pair cable, but then it is important to ensure that the shield is connected to earth at one end only. Some disadvantages of UTP cables are their smaller cross-section (AWG 24) and, in the case of wire, the greater brittleness (breakage) of the conductors, especially in the commonly used screw terminals. This can cause a lack of contact around any type of cable connection (sockets, plugs, terminals and other connectors) and it is from these places that the search for a possible break in the cabling should begin.

It is essential to observe the polarity of the connections, as the RS-485 serial bus is characterised by the strict assignment of the individual wires to the negative and positive poles of the RS-485 transmitter and receiver. The accepted standards for the designation of these poles are helpful, i.e. the positive pole is labelled "A" or "+", possibly "A+". Correspondingly, the negative pole is designated as "B" or "-", possibly "B-". Therefore, connect the "A" terminal of the RS-485 port on the euLINK gateway to the "A" or "+" terminal of the slave device and the "B" terminal of the euLINK gateway to the corresponding "B" or "-" terminal of the device. Caution should be exercised, however, as there are exceptions to this rule as well. For example, RTD-RA communication interfaces made by *RealTime Control Systems* for Daikin air conditioners have slightly opposite descriptions, i.e. "DB+" and "DA-". In this case, check the manufacturer's instructions carefully and connect terminal "A" of the RS-485 port on the euLINK gateway to terminal "DB+" on the RTD-DA interface, and terminal "B" of the euLINK gateway to terminal "DA-" of the RTD-RA interface, as shown in the diagram below.

If in doubt, the unique feature of the euLINK gateway, which is the ability to invert the polarity of the built-in RS-485 port by software, can be used. To do this, navigate to *Menu => Settings => Hardware Interfaces => Default RS-485 => Edit Data Bus => Swap AB*. If the connected device is configured correctly (e.g. speed, parity), but you only suspect that it has been reverse-connected, you can swap the polarity of the port on a trial basis and see if this restores communication with the device. However, all other correctly connected devices will then cease to function and, although they will not break down, the correct setting of the euLINK gateway port must be restored and the connection of the suspected device corrected by physically swapping the wires on its terminals.

Please note in the diagram below how the cabling is routed, i.e. from one terminal to the other, without any intermediate branches or "bridges". The RS-485 serial bus must have a bus topology, i.e. no branches, "star", "tree" or "ring" connections of any kind are permitted. Individual sections must run directly from the terminals of one device to another, and if sections are to connect, then only at the terminals of the device and not somewhere near it.



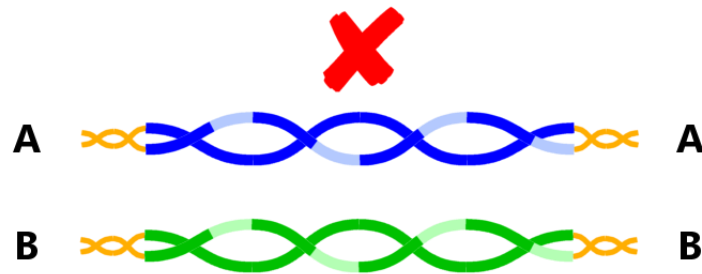
A 120Ω resistor should be connected at the beginning and end of the RS-485 bus as a line terminator, as shown in the diagram above. Since sometimes the method of connecting the terminator is questionable, this subject is described in great detail in the following section c) on page no. 22.

It is worth ensuring that the pair of transmission cables is twisted together over the longest possible length, as illustrated in the diagram above. Due to the differential method of signal transmission, the use of twisted pair cable means that interference occurring along the cable path cancels each other out on reception. This makes RS-485 transmission very resistant to external interference.

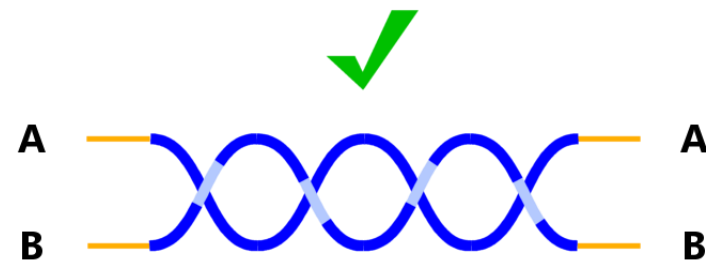
A common mistake made by cabling installation teams is that they want to reduce cable losses by connecting several conductors together if there are unused pairs in the cable. For example, a popular UTP cable has 4 pairs, while only one pair is needed for RS-485 transmission. Installers are therefore keen to combine conductors within pairs, in the hope of reducing the voltage drop. However, this is a serious mistake, as it results in the loss of all the advantages of a twisted

pair cable. Susceptibility to interference will increase greatly, and a negligible reduction in voltage drop will not bring the expected improvement in transmission quality.

The following illustration shows the incorrect and correct connection of a twisted pair cable for RS-485 serial transmission:



Incorrect use of twisted pairs



Correct use of twisted pairs

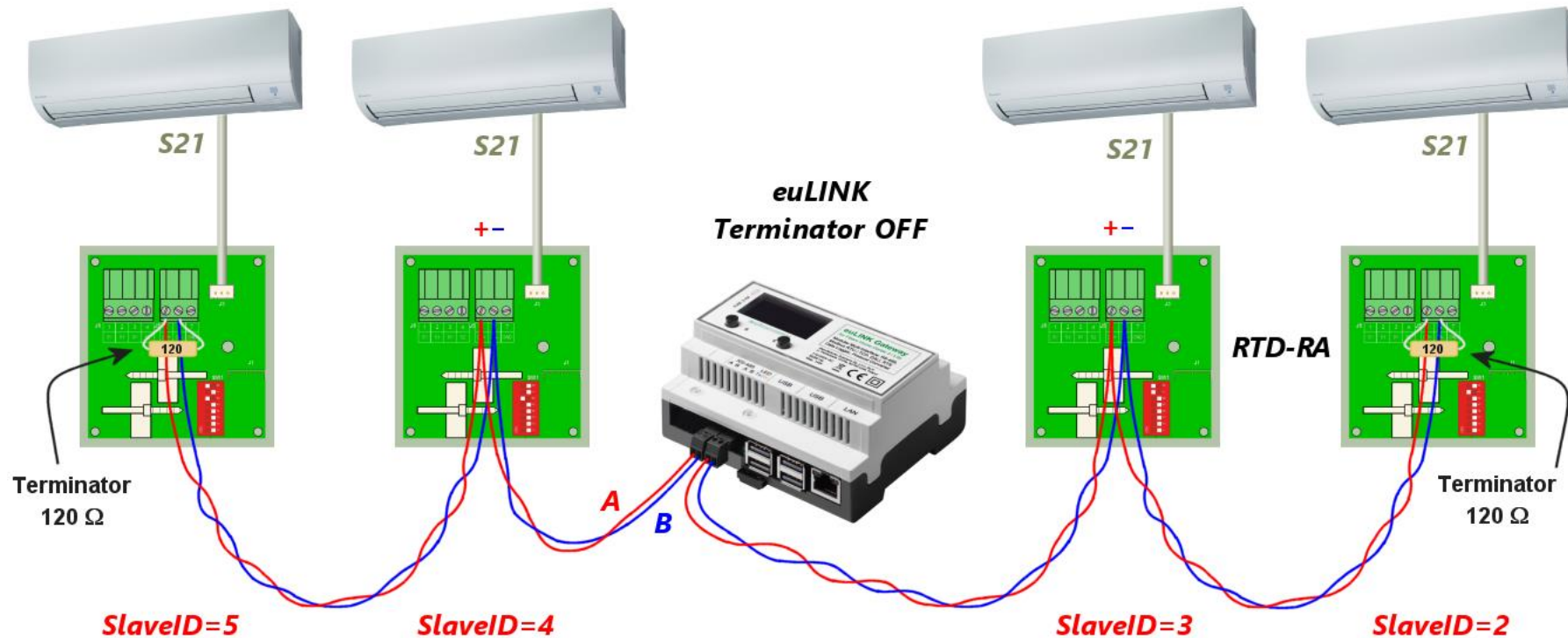
If wiring cannot be provided to the device, there are methods of wireless connection, described in more detail on page no. 32

c) RS-485 bus terminators

The technique of using terminators is sometimes questionable, and there are even quite a few myths surrounding the subject. For example, some publications state that terminators are not needed at all, which is not true. The function of terminators is to match the cable termination to the impedance of the bus, thus avoiding signal reflections and interference, which greatly improves the signal shape and facilitates the work of the RS-485 receiver. The more difficult the transmission conditions, the more helpful is the beneficial effect of terminators. Indeed, if the RS-485 bus is only a few meters long, the signal is strong enough that communication will work even without terminators. But even at several meters or at higher transmission speeds, terminators at the end of the line help a lot. The ideal is 2 terminators - no more and no less, one terminator at each end of the line. A common mistake is to unintentionally connect a third terminator, which will almost certainly prevent correct transmission. Similarly, placing one of the terminators somewhere in the middle of the bus instead of at the end can do more harm than good.

The terminator role is performed by a resistor with a value of 120Ω and a power of 0.5W. The euLINK gateway is supplied with two such resistors. They are fitted by screwing their ends together with the cable wires into the screw terminals of the first and last device on the bus - as shown in the diagram below.

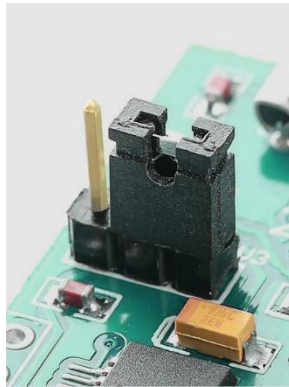
However, these resistors are not always needed, as some devices already have the appropriate resistor soldered on the PCB, only the installer needs to decide whether the terminator should be included or not in a particular device. If it is neither the first nor the last device on the bus, then of course the terminator must not be enabled. For example, in the diagram below, the euLINK gateway is in the middle of the bus and not at either end (as often happens in practice) and then the internal 120Ω terminator in the euLINK gateway must not be switched on. Please also note that both bus segments (left and right) are connected to separate RS-485 port sockets of the euLINK gateway. This is *de facto* one port, and its two sockets are deliberately duplicated to facilitate a more secure cable connection and to allow independent measurements of each Modbus segment:



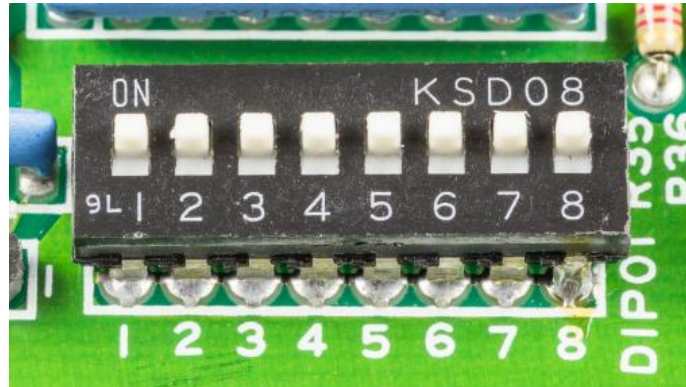
The method of enabling the built-in resistor depends on the design of the device and is always described in the device manual. The built-in terminator can be switched on by inserting (or relocating) a jumper, by adjusting a DIP switch or by software in the device configuration. For example, the euLINK gateway has

the terminator switched on programmatically in the configuration of the built-in RS-485 port. To do this, use the browser by navigating to *Menu => Settings => Hardware interfaces => Default RS-485 => Edit the data bus => Terminator*.

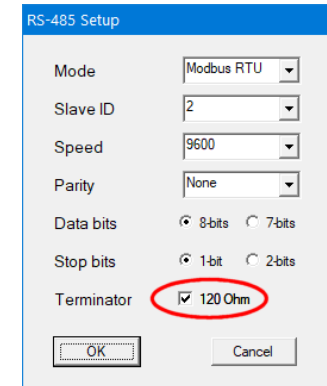
The following illustrations show the most common methods of incorporating the terminator:



Inserting a jumper



DIP switch setting



Software configuration



There are devices on the market which have a 120Ω terminator permanently soldered on, without any possibility of switching it off. If we are not aware of this and we connect such a device somewhere in the middle of the bus, it will prevent any transmission, because it will introduce a third terminator on the bus, in addition at the wrong place.

Therefore, if in doubt, it is best to confirm this empirically by simply measuring the resistance with a universal meter on a range up to 200Ω or in automatic range selection mode¹. Of course, the device should be disconnected from the power supply during the measurement.

¹ It is worth starting by measuring the included 120Ω resistor to check how the meter presents the result multiplier (Ω/kΩ/MΩ) in the automatic range mode.

If the result of the measurement is between 100Ω and about 130Ω , the resistor should be considered switched on and look for a way to switch it off in the instructions. However, if the manufacturer has not provided for the possibility of disabling the terminator, then such a device can only be located at the beginning or end of the bus and absolutely no external 120Ω resistor should be attached next to it.



One example of such devices are various types of USB \leftrightarrow RS-485 converters, which are readily used with the euLINK gateway to increase the number of serial ports to support a second Modbus. There are several reasons why such converters can be useful, e.g. if the number of devices on one bus exceeds 30, it would be better to create a new bus using a USB \leftrightarrow RS-485 converter and transfer redundant devices to it. The same can be done if the permissible length of one bus segment is exceeded, although it is difficult to imagine a distance of 1200m being exceeded in a domestic environment. The most common reason for splitting devices into 2 or more buses is the inability to reconcile their communication parameters. All devices on a single RS-485 bus must have the same communication parameters, i.e. baud rate, parity check, number of data and stop bits, and can (and must) differ only in the Slave_ID address. If two or more integrated devices have disjoint sets of communication parameters, then 2 or more buses with different parameters can be configured and the grouped devices connected to them accordingly. However, the principle of the presence of terminators at the beginning and end of the line also applies to any such additional bus.

It is also worth bearing in mind the additional limitation that it is not possible to swap the polarity of terminals A and B by software, as this is only possible on the built-in RS-485 port of the euLINK gateway.

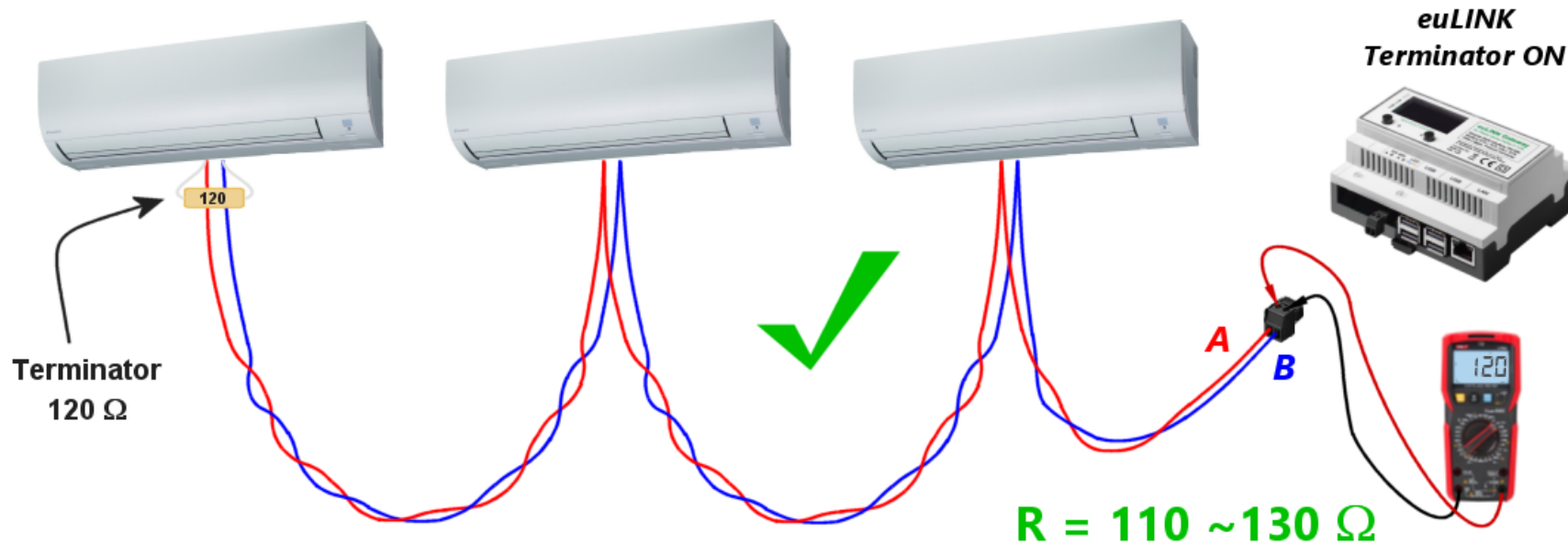
If you change the USB port to which the converter is connected, the euLINK gateway may lose its converter assignment - especially if there are more than 1, because they are identical. You should then restart the euLINK gateway, scan the USB ports for the converter, and after finding it, you can re-assign the Modbus RTU devices to it. However, it is best to avoid unnecessarily reassigning converters to individual USB ports.

The need to ensure the correct placement of terminators on the bus is therefore not particularly onerous, and the presence of terminators can be extremely useful when looking for the cause of communication problems. This is because it is sufficient to disconnect the Modbus Master (i.e. remove the plug from the RS-485 port of the euLINK gateway) and measure the resistance between terminals A and B on the plug or on the cable with an ohmmeter. After all, such a bus segment disconnected from the euLINK gateway should have a 120Ω terminator at the end, so a measurement at the beginning of this segment should give a result between 100Ω and 130Ω , depending on the length of the segment and the type of cable. However, if the result is within the range of 50Ω to 70Ω , this indicates a parallel connection of two 120Ω resistors, so such a measurement result reveals the existence of a redundant terminator within the measured segment. And yet it should not be there if we remembered to disconnect the bus segment from the euLINK gate. On the other hand, a measurement result exceeding several tens of kilohms indicates the



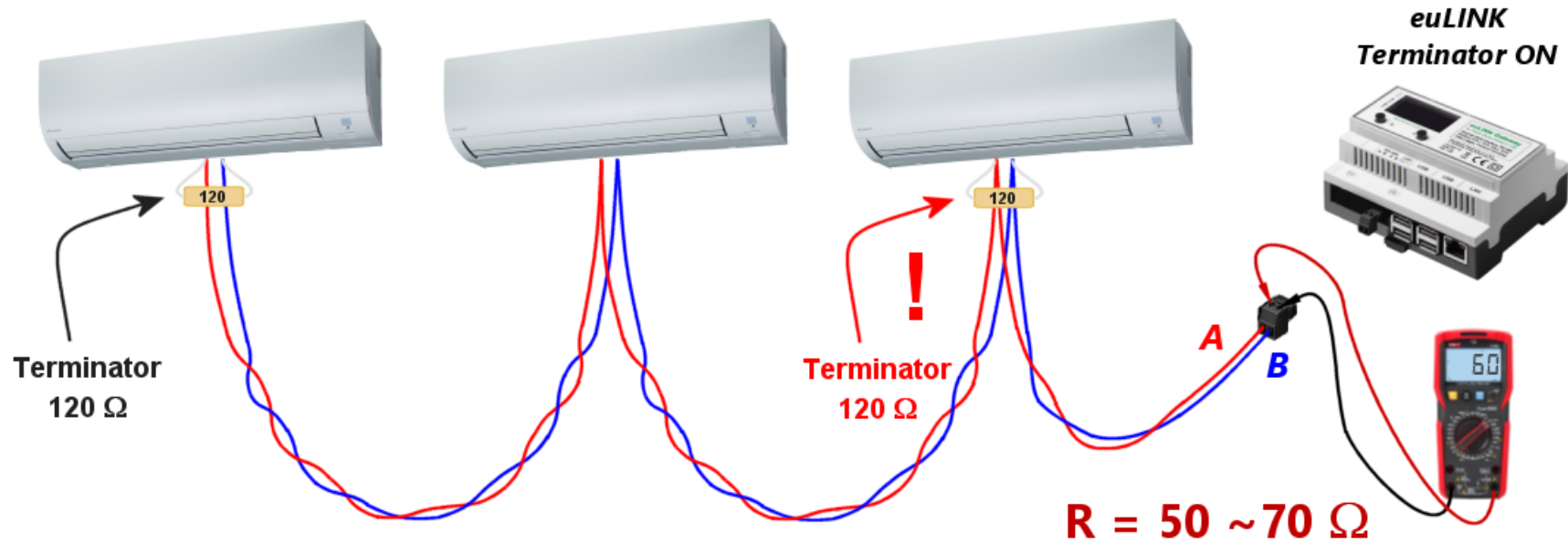
absence of the required terminator at the other end of the bus. A measurement of infinite resistance indicates a break on the bus, and a result close to zero indicates a short circuit. Any such wiring fault can be found by dividing the bus into individual sections and repeating the above resistance measurements for each section.

The following illustrations show the correct installation and possible anomalies and associated measurement results (with the euLINK gateway disconnected).



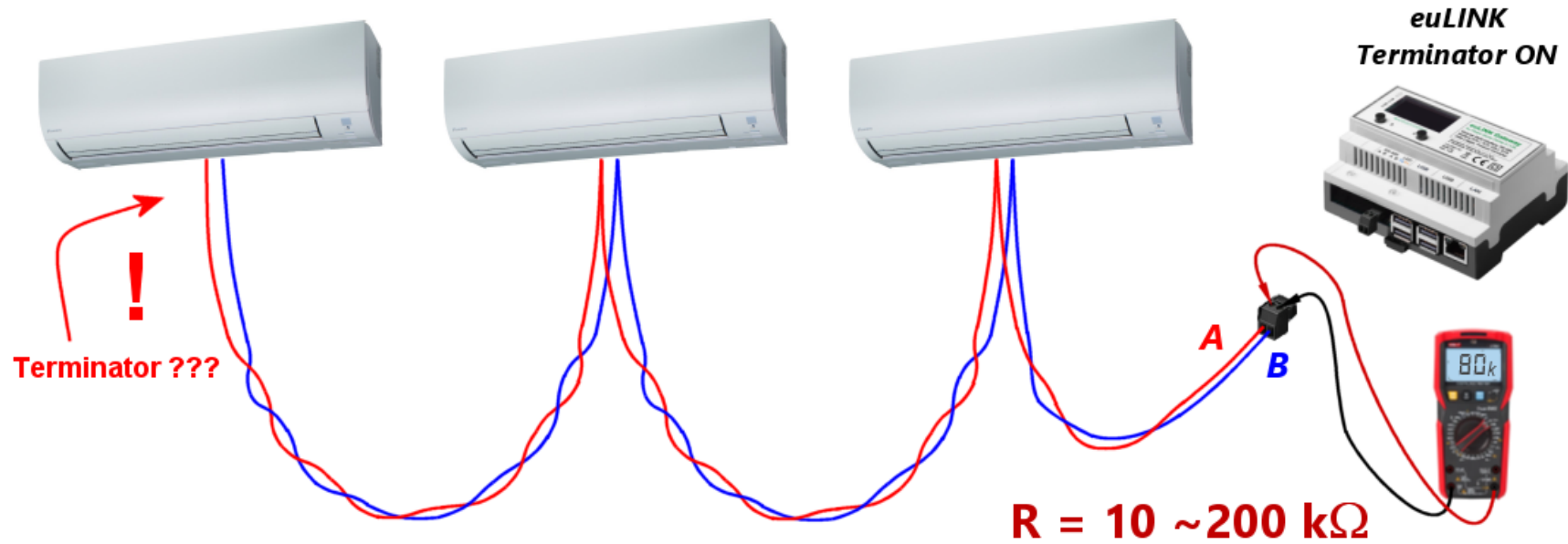
Correct installation, terminator fitted at the end, resistance reading: approx. 110Ω - 130Ω

The measurement result is unlikely to ever indicate an exact value of 120Ω, as the non-zero resistance of the wires is added to the result, depending proportionally on their length. On the other hand, each Modbus-connected device reduces the resistance reading somewhat, as their input impedance is also finite.



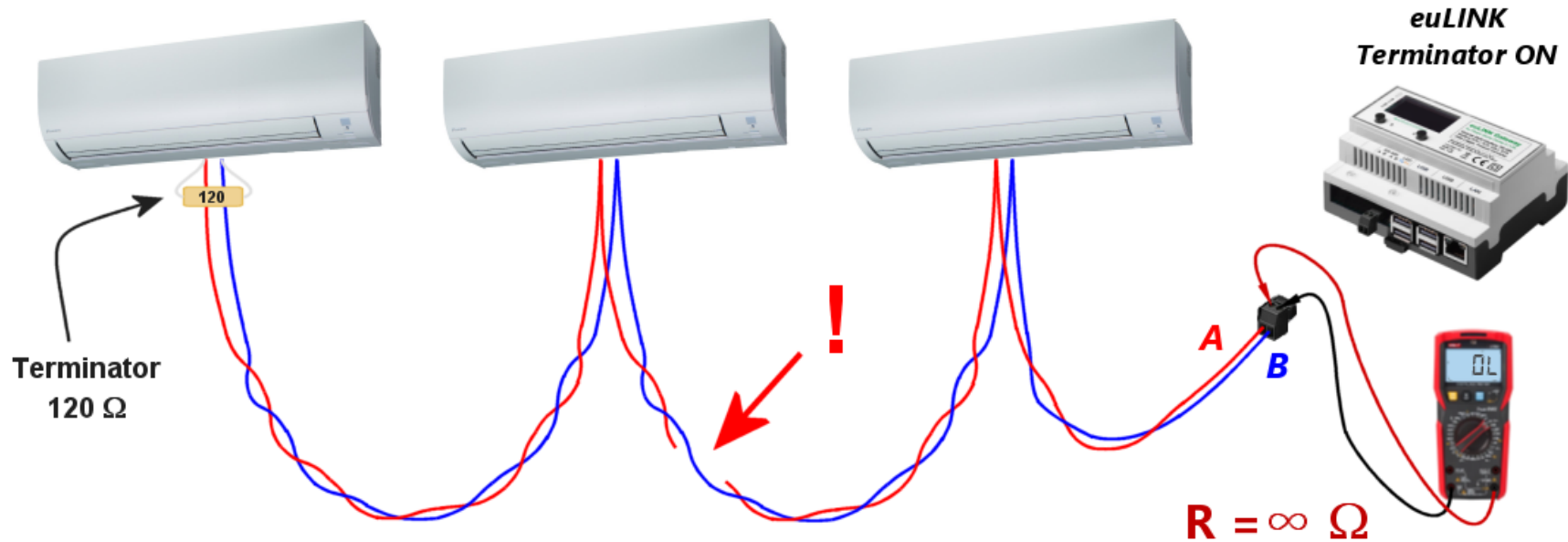
Undesired, excess terminator, resistance reading: approx. 50Ω - 70Ω

Please note that if there are more than 1 redundant terminator, the measurement will show an even lower resistance because all these resistors will be connected in parallel. It is essential to remove all redundant terminators and leave only the one mounted at the end of the line.



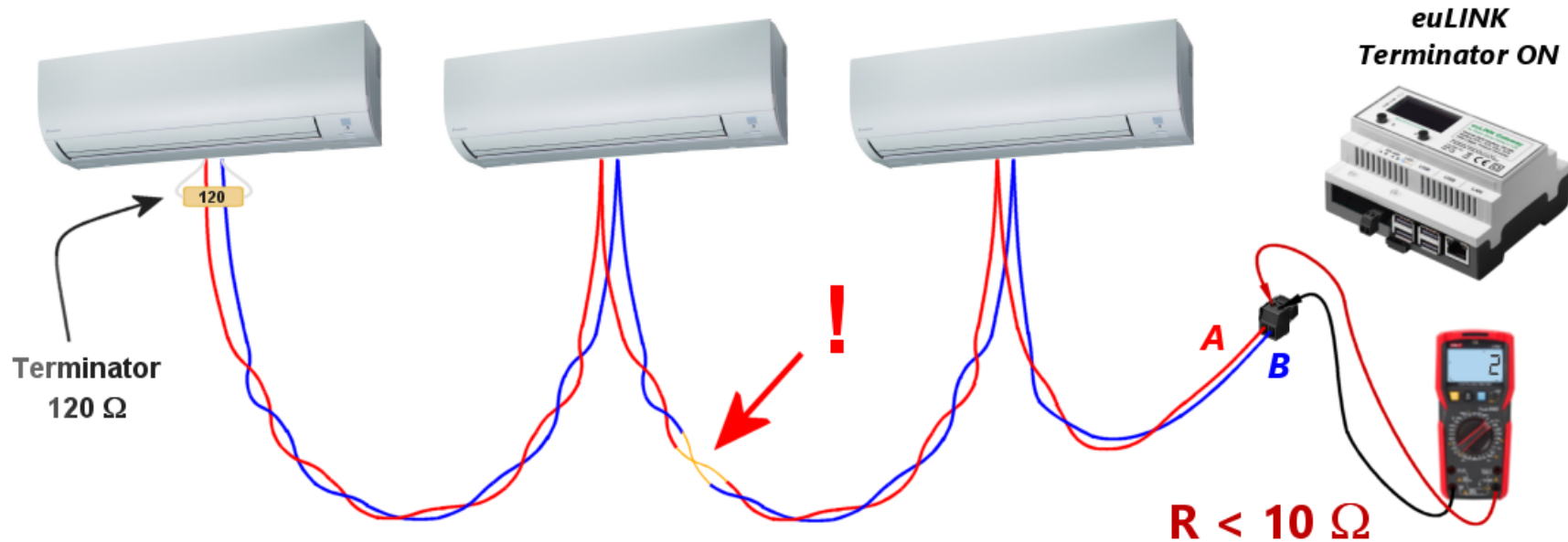
No terminator at the end of the line, resistance reading: tens of kilohms or sometimes hundreds of kilohms

The result can be in the wide range of tens of kilohms or hundreds of kilohms, as it depends only on the input impedance of the connected devices. Of course, the terminator at the end of the line should be switched on and the measurement repeated with the ohmmeter.



Break in wiring, resistance reading: infinity or hundreds of kilohms

If one or more Modbus devices are connected between the wiring break and the measurement location, the ohmmeter will not read an infinite resistance value, only a few hundred or a few tens of kilohms. You can use this indication to make a rough estimate of where the wiring is damaged. To narrow down the search area, the same measurement can be repeated at other points in the wiring - preferably where Modbus devices are connected to the bus.



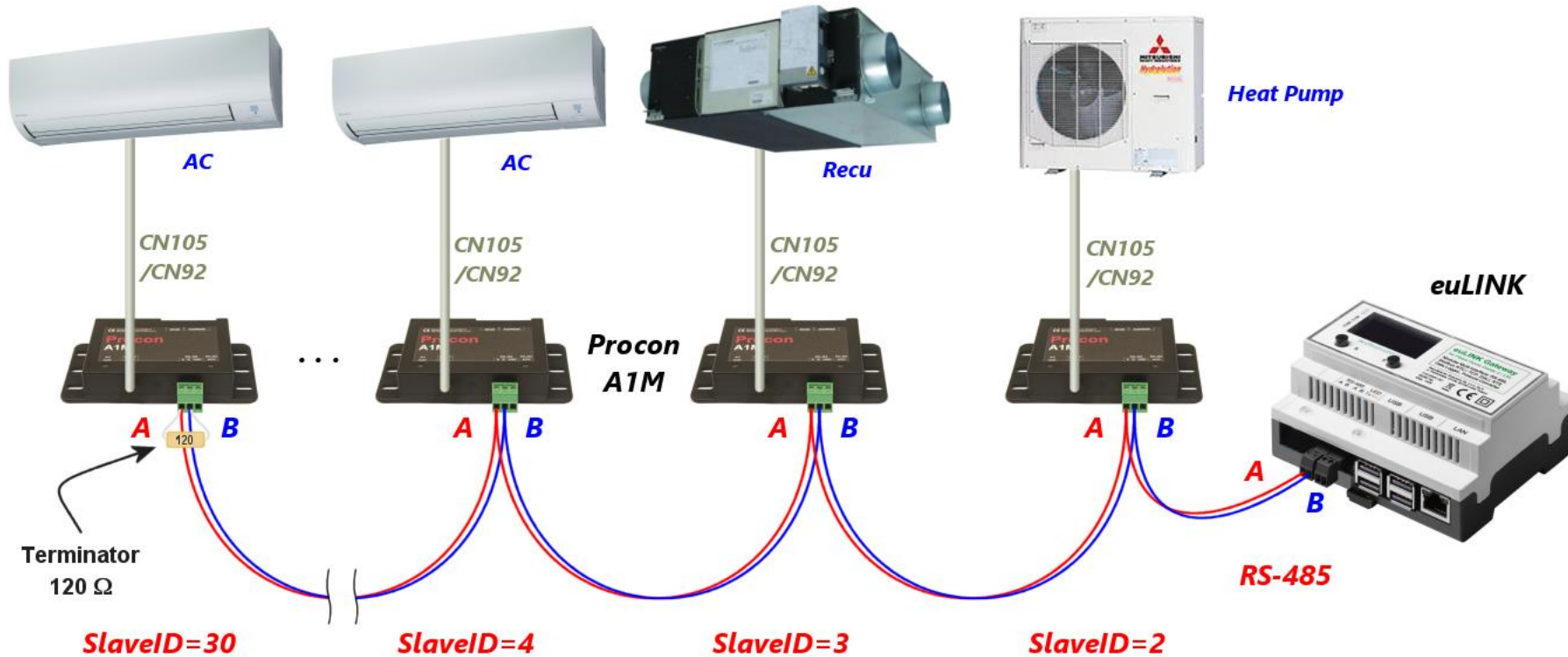
Short circuit in the wiring, resistance reading: several ohms

Each of the above scenarios gives very far apart measurement readings, making it relatively easy to determine the source of the problem. Just remember to take all such measurements on the plug after disconnecting it from the euLINK gateway.

If no errors were found in the cabling and communication is still unstable or does not work at all, you can still try to disable the terminator in the euLINK gateway, which in some cases may increase the signal level and improve the stability of the connection.

For the sake of clarity of the diagrams, all the above examples discussed communication with one type of integrated devices, i.e. air conditioners. However, the described principles of building and testing cabling for Modbus RTU transmission are independent of the type of integrated devices. The same phenomena and testing techniques are used when integrating all HVAC devices (heat pumps, recuperators, air conditioners), photovoltaics, energy storage, electric car chargers, energy consumption meters, weather stations, swimming pool and sauna equipment. All these enumerated devices can be connected to the same

Modbus RTU bus, as long as there are no more than 30 of them, they have the same communication parameters and differ only in Modbus Slave_ID addresses. Devices can come from one manufacturer or from many different manufacturers, as long as they are compatible with the Modbus RTU standard:



If it is not possible to select an identical set of parameters for all devices, the bus can be divided into two and a USB⇌RS-485 converter can be used.

d) Collision with another (new) device on Modbus RTU bus

A new device connected to an existing Modbus RTU can cause some problems. All it needs to do is to have the Slave_ID address set identical to another device already connected to the same bus. This will not cause any permanent damage, but communication with either device will not be possible until the address conflict is resolved. It is therefore worth remembering the good habit of configuring connected devices to a Slave_ID address other than 1, as 1 is the most common factory assigned Slave_ID address.

It may also happen that the connected device is configured not as a Modbus Slave but as a Modbus Master and it will then try to send its commands and queries to the devices on the bus. This will certainly prevent correct communication on the bus, as according to the Modbus RTU standard, only one device can act as Modbus Master on the bus. The Modbus RTU protocol does not provide for any synchronisation of commands issued by Modbus Master devices, so if two such devices are connected, the commands they send will overlap and interfere with each other, as will the responses of confused Modbus Slaves. Therefore, the configuration of each newly connected device should be looked at carefully.

6. Communication problems with Modbus TCP devices

When communicating with devices in the Modbus TCP protocol, problems typical of LAN traffic occur and occasionally problems are encountered with multi-channel devices such as Modbus↔M-bus converters and similar.

A separate category are RS-485↔WiFi converters, which are used when it is not possible to run RS-485 bus cabling to a device that only has a serial port and does not have a WiFi or LAN port.

a) Communication problems on a wired or wireless LAN

In any case, it is worth ensuring that the IP addresses of collaborating devices are static or that the addresses assigned to them by DHCP are always fixed (e.g. an example based on the unchanging MAC address of the device). In the euLINK gateway configuration, the IP address of each device is stored when it is first connected and subsequent changes to the addresses assigned by DHCP will result in a loss of communication between the euLINK gateway and the Modbus TCP device. This phenomenon is analogous to the communication between the euLINK gateway and the Fibaro Home Center controller, which was described in more detail in chapter 4 on page 9. The procedure for IP addressing and for finding irregularities in the LAN is also similar. However, there is rarely a need for traffic analysers, as the euLINK gateway and Modbus TCP devices exchange relatively small portions of information between each other and are therefore not very sensitive to congestion and interference on the LAN.

The integrated device can use wireless communication, as the Modbus TCP protocol does not impose any restrictions here. And most devices (including HC3, Yubii, euLINK, heat pumps, PV inverters, etc.) already have wireless communication capabilities. This is quite an improvement, but only provided that there is adequate WiFi coverage of the device's installation site. While low traffic volumes give good immunity to network troubles, poor WiFi signal coverage makes communication susceptible to all kinds of interference and periodic communication outages. Fortunately, all the diagnostic tools and techniques for improving WiFi signal strength are identical to those for normal LANs and the Modbus TCP protocol does not introduce any impediments to their use.

b) Multi-channel protocol converters, e.g. Modbus↔M-bus

Various converters and other multi-channel devices operating in the Modbus TCP protocol can be found on the market. Examples include Modbus↔M-bus converters (for integrating meters equipped with an M-bus port) or Modbus↔DMX512 for controlling stage lighting. These are converters in which each

device to be integrated is represented as a separate channel, and the number of supported channels can reach tens or even hundreds. Unfortunately, some of these devices have incorrectly implemented Modbus TCP session differentiation support, which can make it difficult to identify the correct target devices. If you see such problems, please let us know at support@eutonmy.com and, if necessary, we will quickly add a specially developed mechanism to the euLINK gateway software to bypass such a problem in the specific device.

c) Serial to wireless RS-485 transmission converters ⇔ WiFi



Sometimes it is technically very difficult or uneconomic to bring the RS-485 bus cabling to the installation location of the integrated device. This is particularly the case if the system is to be expanded with new devices in the future and it is not possible to lay the cabling, for example, under the plaster so that the cables do not spoil the aesthetics of the room. In such cases, an inexpensive RS-485⇔WiFi converter can be used, which converts the Modbus RTU transmission into Modbus TCP and transmits it to the LAN wirelessly via WiFi. An example of this is the popular [Elfin-EW11A](#) converter, available from many online retailers in Europe and internationally at a price of around €10 to €45. The converter supports WiFi 802.11 b/g/n communication, consumes only 5W of power and can use a supply voltage in a wide range from 5V to 18V DC. This often makes it possible to draw power from an integrated device, such as an air conditioner. The small dimensions (61 x 26 x 17.8 mm) allow the device to be hidden under the air conditioner housing.

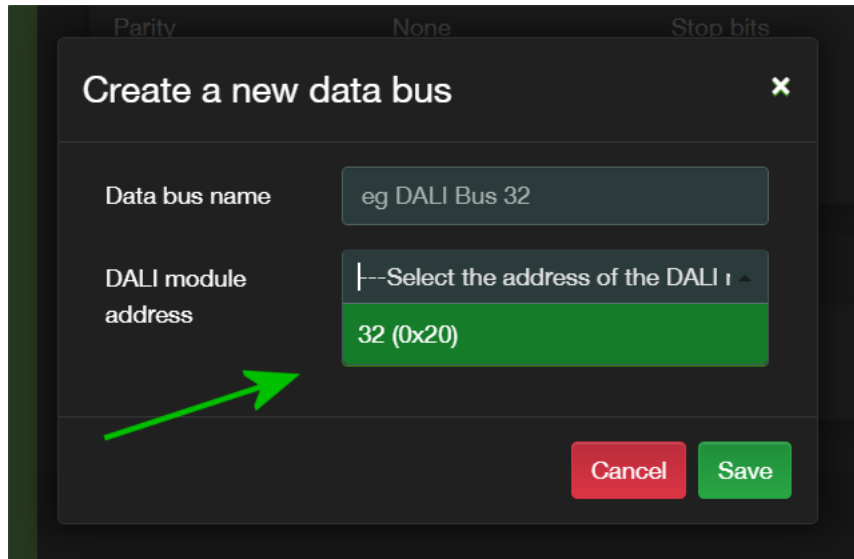
If the euLINK gateway has a template for the integrated device, but only in Modbus RTU protocol, it is very easy to convert it into a template for Modbus TCP. To do this, simply use the "Clone template to new device" option, add "TCP" to the template name and select the Modbus TCP communication method instead of the previous RTU. It is worth checking in the documentation of the RS-485⇔WiFi converter the TCP port number used for communication. The default is port 502, but there are exceptions to this rule. And it is traditional to ensure that the converter always receives the same IP address as entered in the euLINK gateway configuration.

7. Communication problems with DALI devices

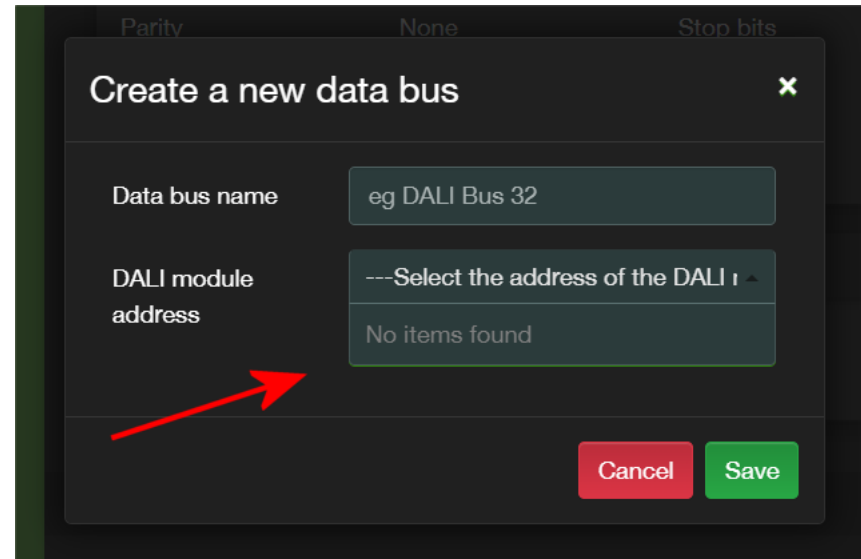
The following description assumes that the installation has been built and tested in accordance with the DALI standard and with the recommendations described, among other things, in the [DALI integrator guide](#) we have prepared. If problems are encountered during commissioning of the installation or in subsequent operation, simple diagnostic tools can be used, built into the euLINK gateway and popular DALI_USB programmers with PC software. And most often a voltmeter will help ;-)

a) Simple DALI diagnostics built into the euLINK gateway

Some installation problems become apparent as soon as the euLINK DALI port is added to the euLINK gateway configuration. By navigating to *Menu => Settings => Hardware interfaces => DALI* one reaches the point where a connected euLINK DALI port can be added. At least one such port should be visible in the drop-down list of DALI modules and will have an address of 32, 33, 34 or 35 - as in the screen copy below left:



euLINK gateway correctly identifies DALI port

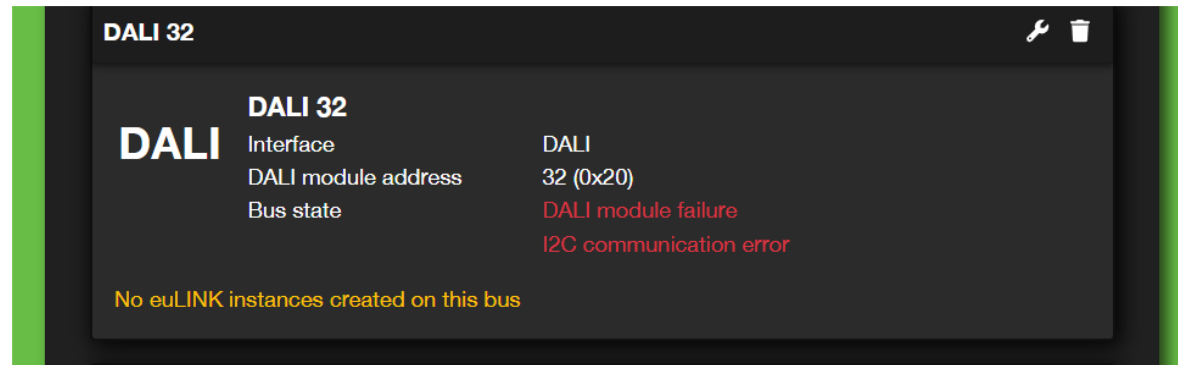


euLINK gateway does not find DALI port

If, on the other hand, the list of DALI modules is empty (as in the screen copy above right), this indicates a communication problem between the euLINK gateway and the euLINK DALI port(s). Until the source of the problem is found and fixed, there is no point in looking for problems in the rest of the DALI installation.

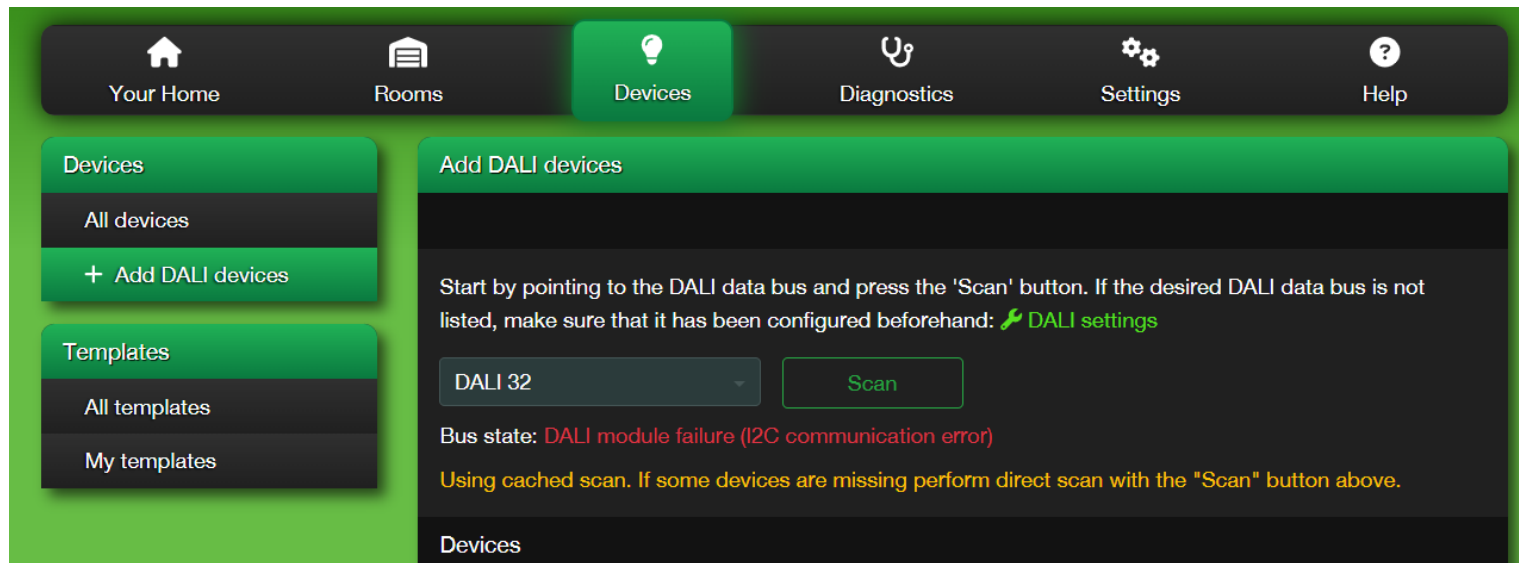
A communication problem between the euLINK gateway and a correctly added euLINK DALI port may also become apparent during later operation, in which case the slightly different messages described below will be displayed.

So if you see the below message:

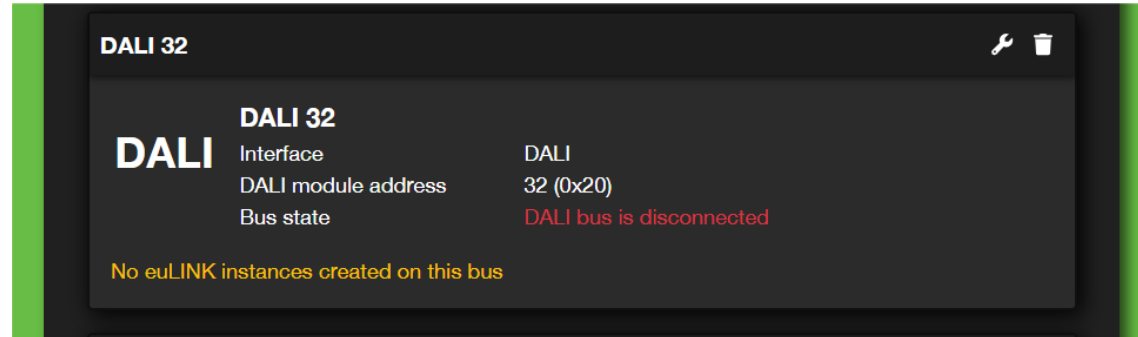


This is clear evidence of a lack of proper communication between the output port I²C of the euLINK gateway and the input I²C of the euLINK DALI port.

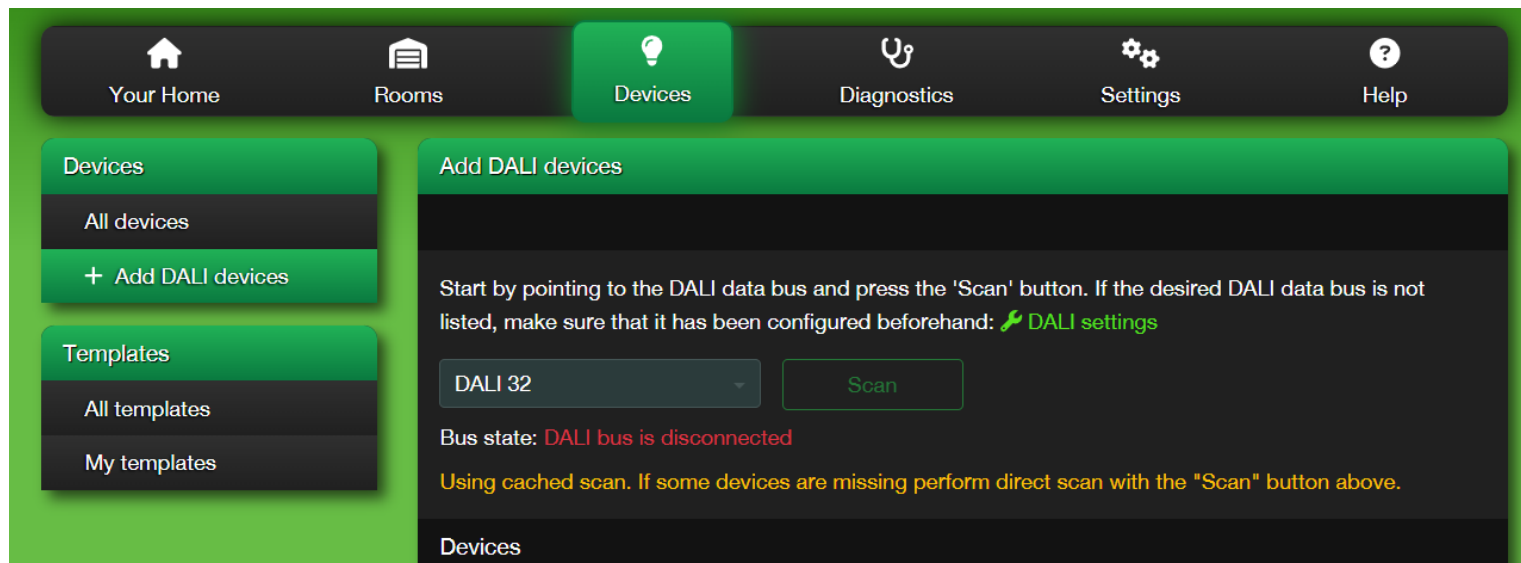
The same problem will reveal itself in the place where the installer normally scans the DALI bus and assigns individual luminaires, i.e. *Menu => Devices => Add DALI devices*. Instead of a list of luminaires found and a confirmation of readiness, the following message will appear:



In the same locations, similar messages may appear, but indicating that the euLINK DALI port is not connected to the bus or that the DALI bus is not properly powered. The message in question in the hardware interfaces configuration menu looks as follows:



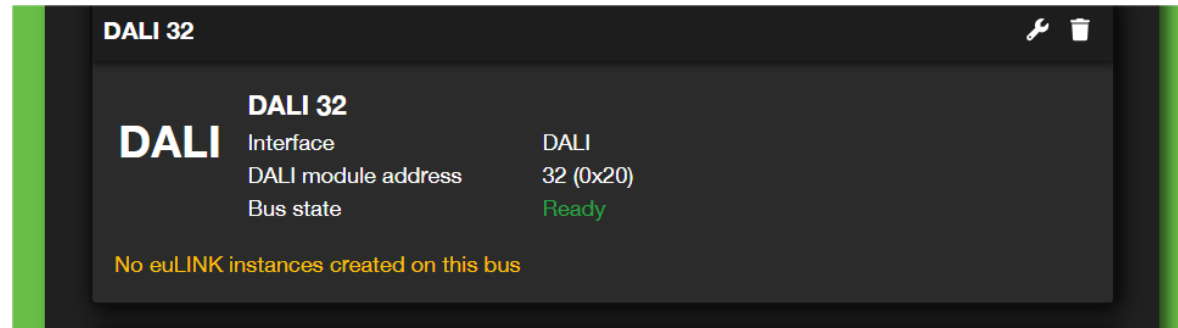
And in the menu for adding DALI devices, the bus disconnection manifests itself as follows:



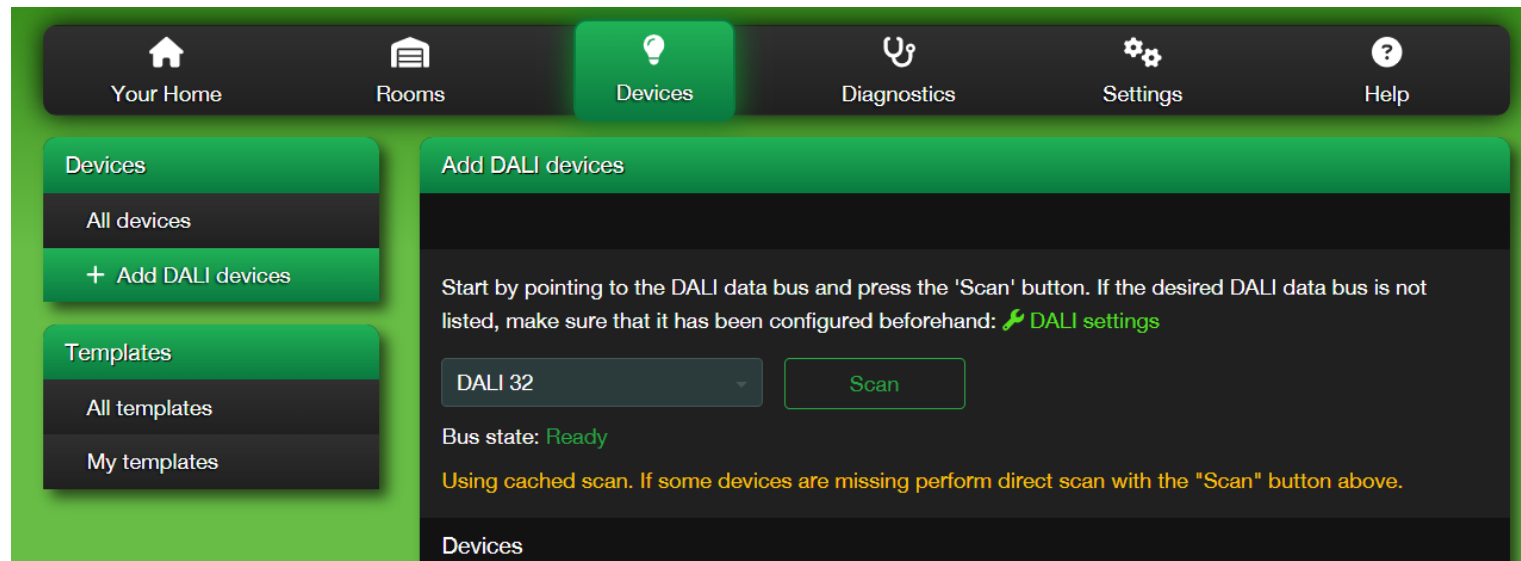
But there is certainly then no objection to the gateway communicating with the euLINK DALI port via the I²C tape.

The euLINK DALI port simply measures the voltage at the DA-DA terminals of the bus and if it does not read between 12V and 18V there, this qualifies as a disconnection of the euLINK DALI port from the bus. But if the connection physically looks OK, the state of the DALI bus power supply should also be checked.

When all the malfunctions described further on in the connections of the I²C tape and the DALI bus have been corrected, the message should look as follows:



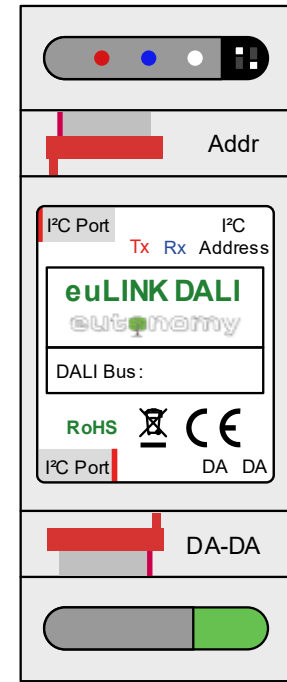
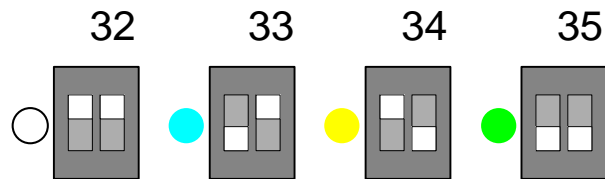
And in the menu for adding DALI devices, respectively:



The following section describes methods for localising and eliminating the problems in question.

Failure of proper communication between the output port I²C of the euLINK gateway and the input I²C of the euLINK DALI port may be due to one of the following reasons:

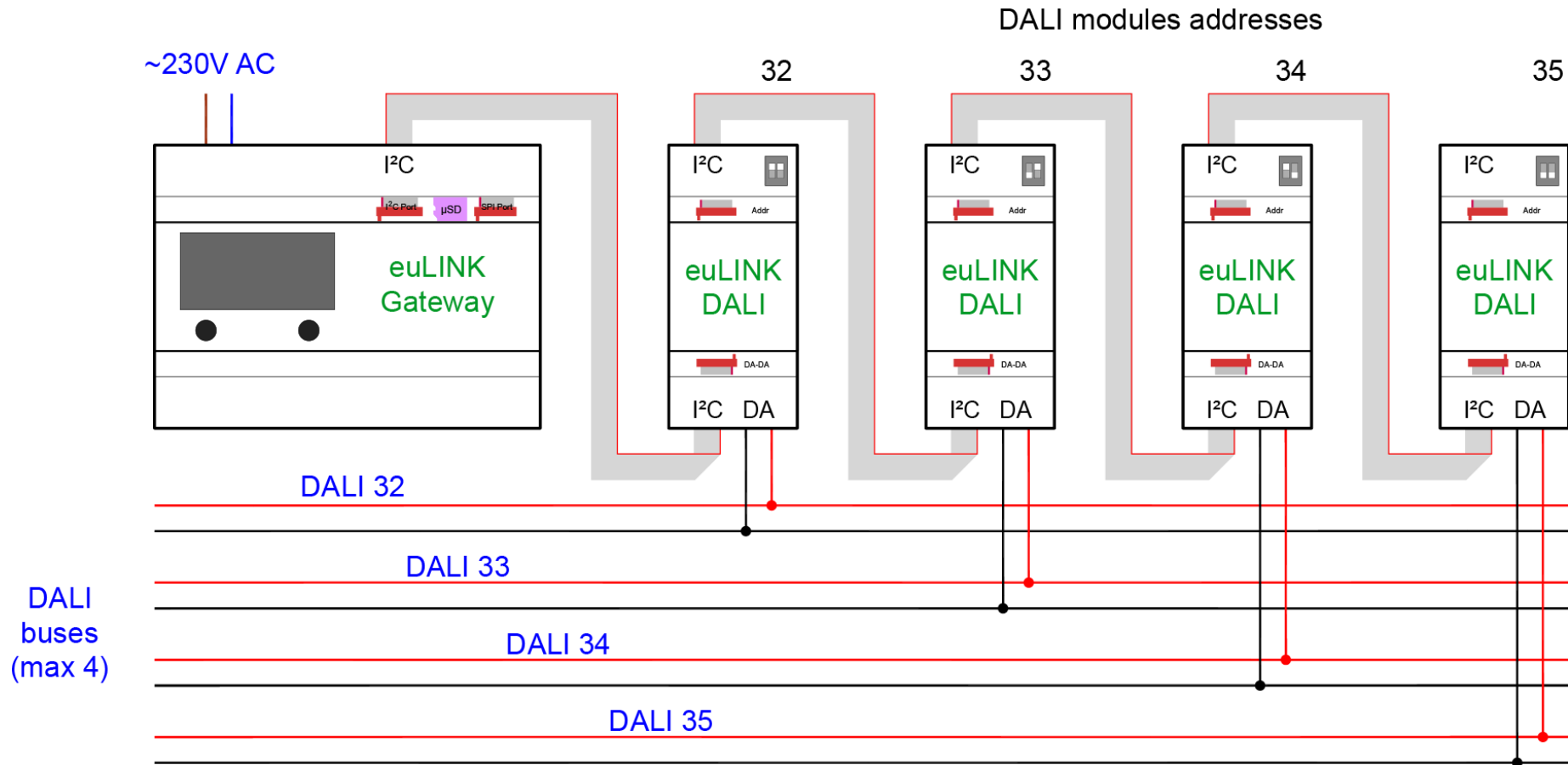
- Unconnected or incorrectly connected tape between the I²C sockets of the euLINK gateway and the euLINK DALI port. Disconnect the power supply to the gateway and check the correct connection of the I²C tape. The tape is grey in colour with the exception of wire 1, which is always **red** and its position is always indicated by a sticker at the I²C socket. The miniature plug at the end of the I²C tape has an asymmetrical key on one side, which makes it difficult to reverse-insert the plug into the I²C socket. However, careless handling of the plug can break the key and it is then possible to insert the plug in reverse, i.e. it will be rotated 180° in the I²C socket. There is no way to effectively protect the sensitive digital circuits from reverse voltages, so the result of such carelessness will be irreparable damage to one or more euLINK DALI modules, depending on where the I²C strip has been reversed. This is why there are stickers next to each I²C socket, indicating the correct direction to connect the I²C tape (as in the adjacent illustration).
- One or more euLINK DALI ports may have an incorrectly set I²C address. Between 1 and 4 euLINK DALI ports can be connected to the I²C output of the euLINK gateway, provided that each port has a unique I²C address, set on the DIP switch at the top right of each module. The possible addresses are 32, 33, 34 and 35, and their setting is indicated by a multicoloured RGB LED located near the DIP switch. The colour assignment of the RGB LED to the individual addresses I²C is shown in the following illustration. It is worth bearing in mind that the address setting of the euLINK DALI port is only read once - after a reset of the module - so changing the position of the DIP switch sliders while the unit is running will not yield the desired results. Therefore, it is best to plan, assign and make a note of the addresses of the individual euLINK DALI ports in the documentation before applying power to the euLINK gateway.



The correct connection of the euLINK DALI ports is particularly important when the euLINK gateway supports more than one DALI bus. In such cases, it is best to compare the I²C ribbon routing and address order with the diagram below. A certain simplification of installation is the fact that the upper and lower sockets I²C of the euLINK DALI port are connected in parallel, so it doesn't matter which socket the I²C tape is connected to - as long as its connector is connected in the right direction, according to the label on the DALI port and the euLINK gateway. For example, the first DALI port with address 32 can connect to the euLINK gateway via the I²C tape connected to the upper I²C socket, and a tape running to the next euLINK DALI ports can be brought out from the lower I²C socket. However, if it is more convenient for the installer, the first DALI port can connect with tape, connected to the lower I²C socket, in the upper socket can be used to connect the rest of the cascade. However, before powering up the gateway, you need to make sure that the top tape has the red wire on the left and

the bottom tape on the right. Also, the order of the I²C addresses does not have to follow the order in which the euLINK DALI ports are connected, as long as each I²C address is unique.

euLINK DALI multiple buses connection



b) Eliminating wiring and DALI bus power problems

Relatively common are mundane DALI bus wiring problems (e.g. a short circuit, a break in the wiring) and a missing or incorrectly selected DALI bus power supply. The presence of a DALI bus power supply also makes it very easy to locate DALI wiring faults.

The DALI specification is very flexible and the data connections between the DALI controller and the DALI luminaires can be arranged in a variety of topologies such as bus, star, tree or any combination of these. The only topology prohibited is the ring. If the DALI bus forms a closed loop, correct communication will be impossible and it will be extremely difficult to find the source of the anomaly.

Each DALI bus segment requires its own additional voltage source to transmit and power small accessories (such as DALI motion sensors or light sensors). For this reason, a specialised DALI bus power supply (16V/240mA) is required for each DALI bus segment. Please do not confuse this with the power supplies, built into the lamps - the DALI bus has its own low voltage source. If it is missing, communication on the DALI bus will not work. Sometimes such a specific power supply is built into some other device - a luminaire or even a DALI programmer. But the DALI bus power supply must remain connected to the bus forever - even after the programmer is disconnected and moved to another installation. It cannot be an ordinary 16VDC/4W power supply because of its specific response to a short circuit. A good example of such a specific DALI bus power supply is the [DLP-04R](#) product from MEAN WELL, shown in the photo on the right.



Photo: www.meanwell-web.com

The bus is insensitive to polarity, so the installer does not need to pay attention to positive and negative terminals.



However, it is worth making sure that the DALI bus is not shorted or disconnected at any point. One quick method is to measure the voltage at the start and end of the bus - at both points the reading should be between 12V and 18V DC, usually around 16V DC. Please set the voltmeter to a DC voltage in the range of 20V - 60V and take the measurement. If the measured voltage is close to 0V, this could mean that the bus is short-circuited or the DALI bus power supply is not working. A simple way to proceed is to divide the bus into shorter sections and measure each section separately until the fault is located. In addition, it is a good idea to disconnect the DALI bus power supply for a while and make sure that it is supplying between 16V and 18V DC at the output terminals. Also ensure that there are no loops on the DALI bus.

Each sensor connected to the DALI bus (e.g. presence sensor, lighting sensor, pushbutton interface, etc.) draws some small current from the DALI bus for its power supply. The communication interface of a DALI luminaire can also draw current from the bus, although usually very little, on the order of parts of a milliampere. The more luminaires and sensors connected to the bus, the greater the total current they draw and the greater the voltage drops caused by cable resistance losses. For this reason, the length of the DALI bus is limited to 300m for a 1.5mm cable². This is a typical cable used in lighting installations. With a cable of this sizeable cross-section the voltage drops are small and should not exceed 2V even at the furthest points of the bus. In practice, DALI communication stops working if the voltage drops below 12V, so with a 16V supply, the 1.5mm cable² gives a sufficient margin of resistance against surprises

such as careless connectors. The table below illustrates the voltage drops depending on the length of the bus and the current consumption of the devices, connected to the DALI bus:

Load current	Cable length YDY 3x1.5 mm ² in meters													
	25 m	50 m	75 m	100 m	125 m	150 m	175 m	200 m	225 m	250 m	275 m	300 m	325 m	350 m
50 mA	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4
100 mA	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8
150 mA	0.1	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
200 mA	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.5	1.6	1.7
250 mA	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1

Voltage drop (in volts) on the DALI bus depending on cable length and load current of the DALI devices

Trying to use a cable with a smaller cross-section will only work for very short distances. For example, a popular UTP cable as short as 100m at 200mA will cause problems, making DALI transmission impossible.

c) Bus traffic analysis using the DALI Monitor

A very effective tool to help locate various anomalies on the DALI bus is the **Monitor DALI** application in conjunction with a DALI hardware programmer, such as a DALI USB type. The Monitor DALI application is part of the [masterCONFIGURATOR](#) package from Tridonic and - subjectively a little better - the [DALI-Cockpit](#) package from Lunatone. With this tool, it is possible to monitor in real time the exchange of information between the various devices connected to the DALI bus. It shows the type of command intercepted, its addressee, the command code, the possible response and the date, time and distance in time between consecutive commands (in milliseconds). Thus, it is possible to ascertain whether an expected command was actually sent on the bus (e.g. an OFF command to switch off a luminaire or a group of luminaires) via the euLINK gateway, whether the recipient's address is correct and what the delay was compared to sending a command e.g. from a Home Center controller via the euLINK gateway to a DALI luminaire. The euLINK gateway views all traffic on the DALI bus and, if it detects the sending of a command by any other device, after a short time (200ms) it sends a query to the addressee about its status (QUERY ACTUAL LEVEL), so it is able to communicate to the Home Center controller what the actual status of the observed luminaire or group of luminaires is. The euLINK gateway sends such a query even when it has sent the command itself, because it is not known whether the target luminaire has carried out the command or ignored it (e.g. due to a light source burning out or other failure).

All this dialogue can be seen clearly in the Monitor DALI application window, making it easier to understand the operation of a specific DALI installation and to spot and locate any anomalies:

The screenshot shows the DALI-Monitor application window with a toolbar containing icons for file operations, search, and control. Below the toolbar are search filters for Hex, Address, and Command. The main area displays a table of log entries with columns for Type, Hex Data, Address, Command, Time, Date, Delta (mS), and Comment. The log shows a sequence of DALI16 queries and DALI8 answers, including commands like 'RECALL MAX LEVEL', 'QUERY ACTUAL LEVEL', and 'OFF'. At the bottom, a status bar indicates 'DALI USB (S/N 134328)', '49387/49387 entries', and 'Not using logfile.'.

Type	Hex Data	Address	Command	Time	Date	Delta (mS)	Comment
DALI16 IAP	81 05	G0	RECALL MAX LEVEL	03:13:08.836	16.03.2024	2022	
DALI16 Query	01 A0	A0	QUERY ACTUAL LEVEL	03:13:09.040	16.03.2024	204	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.051	16.03.2024	11	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:09.088	16.03.2024	37	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.100	16.03.2024	12	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:09.131	16.03.2024	31	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.145	16.03.2024	14	
DALI16 Query	05 A0	A2	QUERY ACTUAL LEVEL	03:13:09.173	16.03.2024	28	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.184	16.03.2024	11	
DALI16 Query	01 A0	A0	QUERY ACTUAL LEVEL	03:13:09.223	16.03.2024	39	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.236	16.03.2024	13	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:09.274	16.03.2024	38	
DALI8 Answer	FE		= 254 (0xFE)	03:13:09.285	16.03.2024	11	
DALI16 Query	01 A0	A0	QUERY ACTUAL LEVEL	03:13:10.090	16.03.2024	805	
DALI8 Answer	FE		= 254 (0xFE)	03:13:10.102	16.03.2024	12	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:10.141	16.03.2024	39	
DALI8 Answer	FE		= 254 (0xFE)	03:13:10.152	16.03.2024	11	
DALI16 IAP	81 00	G0	OFF	03:13:13.760	16.03.2024	3608	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:13.963	16.03.2024	203	
DALI8 Answer	00		= 0 (0x00)	03:13:13.975	16.03.2024	12	
DALI16 Query	01 A0	A0	QUERY ACTUAL LEVEL	03:13:14.016	16.03.2024	41	
DALI8 Answer	00		= 0 (0x00)	03:13:14.028	16.03.2024	12	
DALI16 Query	01 A0	A0	QUERY ACTUAL LEVEL	03:13:14.091	16.03.2024	63	
DALI8 Answer	00		= 0 (0x00)	03:13:14.104	16.03.2024	13	
DALI16 Query	05 A0	A2	QUERY ACTUAL LEVEL	03:13:14.142	16.03.2024	38	
DALI8 Answer	00		= 0 (0x00)	03:13:14.154	16.03.2024	12	
DALI16 Query	03 A0	A1	QUERY ACTUAL LEVEL	03:13:14.193	16.03.2024	39	
DALI8 Answer	00		= 0 (0x00)	03:13:14.206	16.03.2024	13	

DALI USB (S/N 134328) 49387/49387 entries Not using logfile.

Symptoms of abnormalities can vary:

- Failure to respond to valid "QUERY ACTUAL LEVEL" queries - if no response comes from the queried fixture within a reasonable period of time (several ms), this may indicate a fault in the fixture or an uncontrolled change in its DALI address. Occasional power surges that occur during mains failures can occasionally change the configuration or address of a DALI luminaire. In such cases, the DALI programmer should be used to check and possibly re-address the DALI luminaire(s).
- Queries directed to non-existent DALI addresses - similar to above - this may indicate unexpected changes in the addressing of devices on the bus and needs to be checked with a DALI programmer. If all the addresses of the DALI luminaires and groups are correct, the cause could be a software error in one of the controllers on the DALI bus.
- Numerous errors of the type "Frame overrun" - an occasional occurrence of a single error of this type is not yet a cause for concern, as it could be the result, for example, of a fuse being switched on for some lighting section. However, repeated "Frame overrun" errors every now and then indicate a failure of one of the devices, connected to the DALI bus. The only way to find the culprit is by a method of elimination.
- Endless "QUERY ACTUAL LEVEL" or "QUERY STATUS" queries may indicate a hang-up of some DALI controller, which may be a euLINK gateway, another programmer or another controller (there may be more). The source of the queries should be sought by the method of elimination.
- Unexpected "OFF", "RECALL MAX LEVEL" or similar commands of unknown origin, i.e. sent when the euLINK gateway should not be sending any commands. The search for the culprit is carried out using the elimination method, i.e. first the euLINK gateway is disconnected from the DALI bus, and if the commands are still emitted, the other devices are disconnected, starting with the sensors and other controllers.
- Lack of expected commands - if a command to switch on or off a luminaire or group of luminaires has been directed to the euLINK gateway and the DALI Monitor has not detected such a command on the bus, this could indicate an error in the euLINK gateway's environment, i.e. an error in communication with the Home Center controller, an incorrect connection between the gateway and the euLINK DALI port, a disconnection of the euLINK port from the DALI bus, or an internal error in the euLINK gateway. In the latter case, review the gateway's recent event logs and perform the basic diagnostics described under 7 a) on page 34.

If you suspect that a euLINK gateway or euLINK DALI port is behaving incorrectly, please send a description of the phenomenon to support@economy.com It would then be extremely helpful if you could attach a copy of the DALI Monitor screen, including a record of the phenomenon in question.

d) Oscilloscope measurements

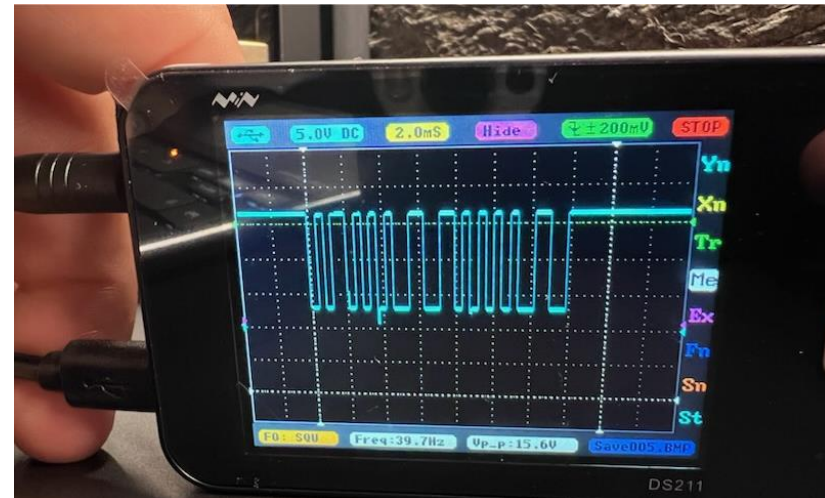
If measuring the DC voltage on the bus with a universal voltmeter shows the correct values (16-18V), but the DALI Monitor still shows numerous distortions or a notorious failure of the DALI devices to respond to simple queries, this could mean that the communication on the DALI bus is highly disturbed or that a device (or devices) are sending signals that do not comply with the DALI standard specification, i.e. distorted signals, with too little amplitude or at the wrong frequency. One hundred per cent certainty would be provided by oscilloscope measurements, but a professional oscilloscope is a tool that is not only

expensive, but also cumbersome to transport and difficult to diagnose in real installations, where access to measuring locations is often very difficult. Fortunately, miniature 'pocket' oscilloscopes can be found commercially with sufficient performance to assess the correctness of DALI signals. Communication on the DALI bus uses a very low baud rate of only 1,200 bits/s, which is within the working range of any oscilloscope, even the cheapest. For example, the MINIWARE DS211 portable mini digital oscilloscope found in many online shops costs around €60 and is the size of a small smartphone, so it can even be used in hard-to-reach places.

The reading of the DALI signal looks as follows on such an oscilloscope:



Mini oscilloscope MINIWARE DS211



Reading an 8-bit DALI command signal

And although it is not a professional oscilloscope, it clearly shows that the pulses have a correct rectangular shape, the amplitude of the signal is 15.6V, the time from start to end of transmission is 14ms, and no serious interference is superimposed on the signal.

In order to observe the DALI signal, the oscilloscope should be configured as follows:

- Time resolution (horizontal): 2.0ms/div
- Voltage axis resolution (vertical): 5V/div
- Triggering: single-shot, falling edge of a signal with the threshold of 3-5V
- Coupling: DC

Almost the same oscilloscope settings make it possible to observe the signals on the Modbus RTU, only the voltage axis is worth setting to 2V/div.

Symptoms of abnormalities may manifest themselves as follows:

- The shape of the signal significantly deviates from the appearance of rectangular pulses - this may indicate a fault in the transmitter circuit of the luminaire under observation or in the DALI controller.
- The amplitude of the signal is too low or the signal does not fall close enough to the 0V level - it is important that the lower level of the rectangular signal is as close to the 0V level as possible, but in practice this is usually a value of 2-3V. The higher this level is, the more devices will have problems interpreting the received signal correctly. If the lower level of the signal does not fall low enough, this may indicate that the resistance of the bus is too high, due to excessive length or inaccurate connections.
- The signal lasts too short - even the shortest 8-bit commands should last about 14ms, measured from the first falling edge to the last rising edge of the signal. If this time is shorter and there are too few pulses, this could indicate a fault in the transmitter circuitry or a collision between the luminaire transmitters or controllers. At the same time, the Monitor DALI application is entitled to report an error of the type 'Frame error' or 'Frame overrun'.
- Very high noise or other interference is superimposed on the signal - locate the source of the strong interference and try to reduce its intensity, as this can have a detrimental effect on the DALI network and on many other forms of communication. If it is not possible to remove interference completely (e.g. in an industrial environment), the DALI bus can be divided into shorter sections where transmission will be more resistant to interference.



Of course, measurement with a professional oscilloscope would yield more accurate readings, but in practice this does not make it any easier to find the cause of the problem. DALI technology is relatively undemanding and quite immune to interference, so if indeed the source of the problem is some extremely strong interference, it will be clearly visible even on a small pocket oscilloscope. It is very valuable experience to be able to observe the DALI signal in several correctly functioning installations, because then an experienced installer can very quickly distinguish between correct transmissions and suspect ones and locate the fault.

8. Problems accessing euCLOUD cloud and other online services

The euLINK gateway does not require permanent access to the internet to work properly. However, if such access is available, the euLINK gateway has the ability to download software updates and device templates, and backs up its configuration if it detects any changes.

The most common causes of problems when using Internet services are malfunctions in the DNS service and blocking of outgoing ports from the LAN to the Internet.

a) DNS service malfunctions

It is surprisingly common for small home LANs to experience problems with the correct configuration of the DNS service, resulting in partial or complete lack of access to external Internet services. If the euLINK gateway obtains an IP address from the DHCP service, it also obtains the other parameters necessary for network operation, i.e. the subnet mask, default gateway and DNS server address, together with the dynamic address. If the indicated DNS server does not respond correctly to some or all of the questions, the use of Internet services will be difficult or even impossible. There could be a number of reasons for this, and in addition, it is not said that all devices on the LAN will respond to DNS errors in the same way, making it difficult to locate the source of the error. To be sure, you can temporarily change the fixed IP address in the network settings of the euLINK gateway and then indicate 8.8.8.8 as the DNS server address. This is a server, or rather a distributed group of stable DNS servers from Google, whose operation is constantly supervised by experts and whose geographical dispersion ensures low latency regardless of where the euLINK gateway is installed. If such a change of DNS server address restores the possibility to use all Internet services, then the configuration of the edge router should be reviewed and all efforts should be made to eliminate the root cause of the problem. However, this is already a task for the person responsible for the proper operation of the LAN.

b) Blocking outgoing ports from the LAN to the Internet

Some professional LANs have strict restrictions not only on incoming traffic, but even on outgoing traffic from the LAN to the Internet. You may therefore find that certain TCP or UDP ports, which are needed by the euLINK gateway to communicate with Internet service servers, are blocked by default. You can then ask your network administrator to unblock certain ports for the euLINK gateway. It is worth accompanying this request with the table below with the addresses of the necessary servers and details of the services provided:

Target server				Canonical name	Service
IP address	Transport	Port	Protocol		
51.91.157.213	TCP	80	HTTP	eulinkdev2.eutonometry.com	Software updates
51.91.157.213	TCP	443	HTTPS		
51.91.157.213	TCP	7 443	HTTPS		
51.91.157.213	TCP	8 000	HTTP		
51.195.43.193	TCP	443	HTTPS	eucloud.eutonometry.com	euCLOUD services, Backup
51.195.41.140	TCP	443	SSH	eulinksup.eutonometry.com	Remote support

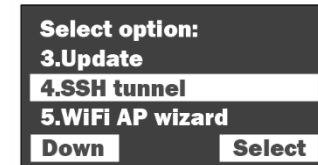
Of course, the addresses of the DNS and NTP servers available to the subnetwork in which the euLINK gateway will operate should not be blocked either. But this is always obvious to network administrators.

9. Remote technical support by the manufacturer's specialists (SSH tunnel)

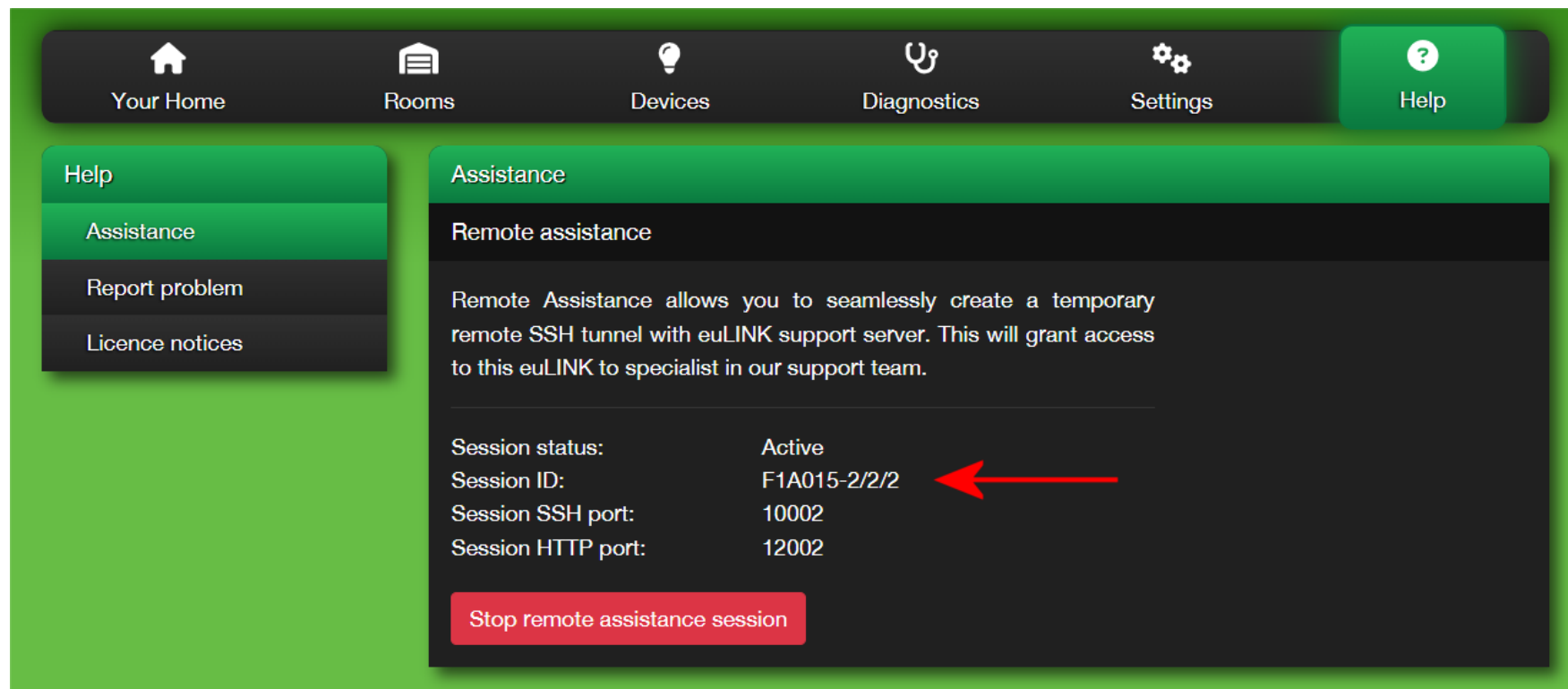
If the euLINK gateway is not working properly or its installation presents unforeseen difficulties, assistance can be sought from the manufacturer's specialists. The euLINK gateway is equipped with the ability to establish an encrypted connection to the manufacturer's server, so its engineers can carry out the diagnostic procedure at the lowest, hardware level and suggest an effective solution to the problem. The connection is secure as it does not require any TCP ports to be opened on the *FireWall*. The euLINK gateway does not accept external connections; instead, it simply establishes a connection to the server as a client, making the 'SSH tunnel' a secure, encrypted connection outbound of the local LAN. An important feature of this approach is that no one - not even the manufacturer's representative - can access the euLINK gateway without the knowledge and consent of the person who owns it.

A remote support session can be started in 2 ways:

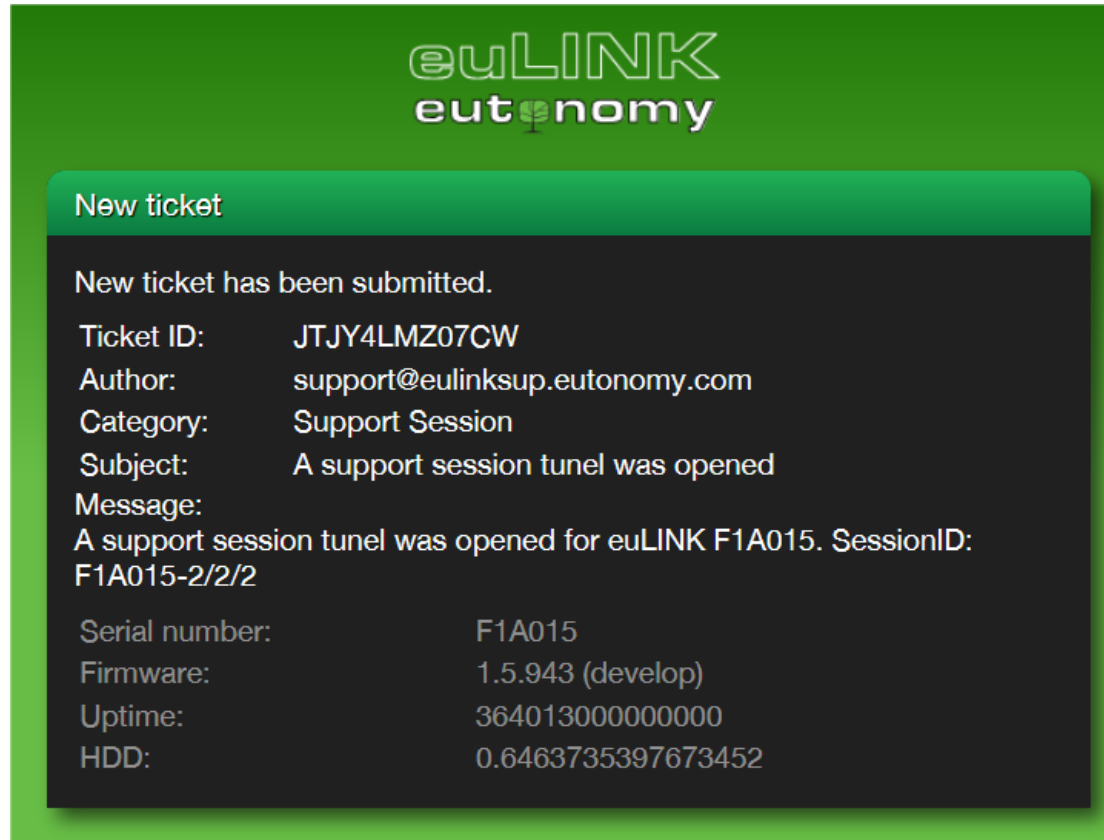
- From the OLED display on the euLINK panel, scroll down with the left button to the option "4.SSH tunnel" and accept it with the right button or
- Connecting to the euLINK gateway via a browser and navigating to *Menu => Help => Remote support => Start remote assistance session*.



To agree on a further course of action, please contact the manufacturer's service by e-mail at support@eutonomy.com and provide the SSH session ID, as read from the OLED display or from the *Help => Remote Assistance* page of the euLINK gateway:



The same information will be sent by the euLINK gateway to the email address provided during its installation. The message will have a similar appearance to the one below:



Once the work is completed, the remote support session can be stopped so as not to maintain unnecessary connections. Restarting the euLINK gateway will also disconnect the session, so if remote support is to continue, further approval from the euLINK gateway administrator will be required.

10. Other problems and additional sources of information

If you encounter problems not described in the above document, we suggest you look for suggestions for a solution on the [product page](#), where all instructions and manuals are provided, including:

1. [euLINK data sheet](#)
2. [euLINK User Manual](#)
3. [Modbus and DALI wiring diagrams](#)
4. [euLINK DALI port manual](#)
5. [DALI Integrator Guide](#)
6. [Modbus Integrator Guide](#)
7. [Diagnosing problems](#)
8. [AI-supported chatbot retrieving information from the product knowledge base](#)
9. [Forum on the euLINK gateway](#)
10. [CE Declaration of Conformity](#)
11. [CE certificate](#)
12. [RoHS certificate](#)
13. [IEC certificate](#)

If none of the above methods brings a solution, please contact the manufacturer's service via e-mail at support@eutonmy.com.