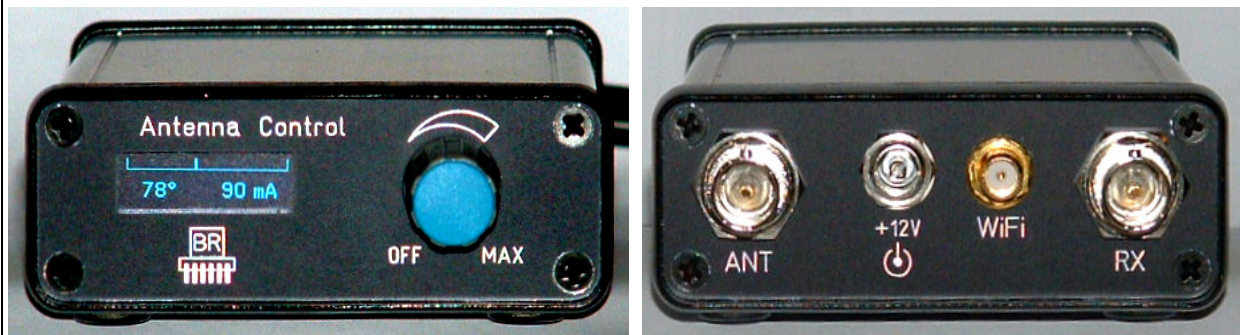


Specifications

and Operator's Manual

Control unit RSW3 for RLA4



Version: 1.2

Created: 15.02.2020

Specifications

| | |
|--|--|
| Dimensions (W x H x D): | 85 mm x 50 mm x 127 mm |
| Frequency range: | 10 kHz ... 156 MHz |
| Power supply: | +10.0 ... +15.0 V- / max. 150 mA |
| Connectors: | BNC 50 Ohm, hollow pin 2.5 mm, SMA female (not "reversed") |
| Maximum cable length from control unit to antenna: | depends on HF cable, max. 10 ohm DC resistance |
| Weight: | <= 500 g |
| Environmental conditions: | 0 ... +40 °C ambient temperature, <=90 % rel. humidity non-condensing, indoor application |
| Compliance: | CE according to DIN EN 55013, EN 55020, EN 60065 RoHS / WEEE Directive, ear-Reg. 27676700 |

All specifications are subject to design changes!

Safety precautions

Please always keep the following safety precautions in mind!

Never connect the device to any other voltage than indicated in the specifications. Under no circumstances should the device come into contact with the mains voltage of 230 V ~!

It is essential to observe the lightning protection regulations for the outdoor operation of electrotechnical systems! When connecting an antenna outside the protected area (e.g. your house), it must be professionally provided with lightning protection. The HF bypass must be equipped with overvoltage protection. In case of lightning hazard, immediately take the antenna out of operation and disconnect it safely from other devices (remove HF connection and power supply)!

Observe the permitted temperature range for starting up the device! Do not switch the device on or off again if this range is exceeded or fallen below!

Always provide a safe placement on a flat, straight and solid base of sufficient carrying capacity! Always transport the device either in solid cardboard or wooden boxes (e.g. the delivery packaging), or transport it by firmly gripping the housing! The device may cause injury in the event of a fall due to its own weight!

Never expose the device to mechanical stress due to impact, pressure, vibration or shock which exceed a normal level.

If you notice any damage to the device, immediately take it out of operation (remove power supply)! If necessary, send it to the supplier for repairs.

Would you like to dispose the device due to damage or no more usability, send it back to the supplier or return it to your local waste collection center. Never dispose of the appliance elsewhere, such as household waste. It pollutes our environment!

Operator Manual

The RSW3 control unit is designed to operate the RLA4 in a remote configuration and to control mode and direction switching. Wireless remote control via a WiFi connection is possible.

The RLA4 can be supplied with power via the HF cable ("remote power supply" to the "+12 V" socket). The control unit supplies the antenna cable with the necessary voltages (socket "ANT"). The HF voltage supplied by the antenna can be taken from the "RX" socket and fed to the receiver (DC-free). An antenna for radio connection to an access point can be connected to the "WiFi" socket.

Various settings can be selected via the rotary knob. A small OLED display shows the current setting:

- Turn the knob all the way to the left ("Off"): Shutdown of the antenna. There is a delay of about 2 s before the antenna is actually switched off. This avoids constant switching back and forth in case of accidental turning to the Off-range (e.g. when fine adjusting to 0°). In position "Off", no voltage is conducted to the antenna. However, the control unit itself still needs some supply current. For complete shutdown of all devices, the power supply must be removed! ***For environmental protection reasons, please always do this if the control unit and antenna are not to be used for a long time (> a few minutes). Do not forget a possibly existing power supply!***

- Rotary knob between "Off" and "Max": Directional control of the antenna. The RLA4 is supplied with a voltage of approx. 8 V. With every movement of the rotary knob (noticeable latching step) that changes the direction setting, a data word is sent to the antenna (RS-232 inverse, approx. 10 V level for low bit). After switching on the antenna, the values start at 0° (transition "Off" to direction control). In this case, a "transition state" occurs: After switching on, the antenna can not be controlled for approx. 2 s (as when using the antenna without control device). After approx. 2s, the first control word is sent to the antenna. This switches the antenna to the current direction according to the rotary knob / display.

The RLA4 has 4 main reception directions. At 0° (or 180°), only loop 1 operates (the one going from the RX socket on the antenna to the left front). At 90° (= 270°) only loop 2 is in operation (from DC jack to the front right). At 45° (= 225°) or 135° (= 315°) both loops are active with the same gain. When setting directions between these main receiving directions, the loops (or their respective amplifiers) are operated with different gains.

Caution! The RLA4 does not linearly follow the setting of the rotary knob or the degree indicator on the display! It prefers the main directions for a long time and switches between them in a narrow range with just a few steps.

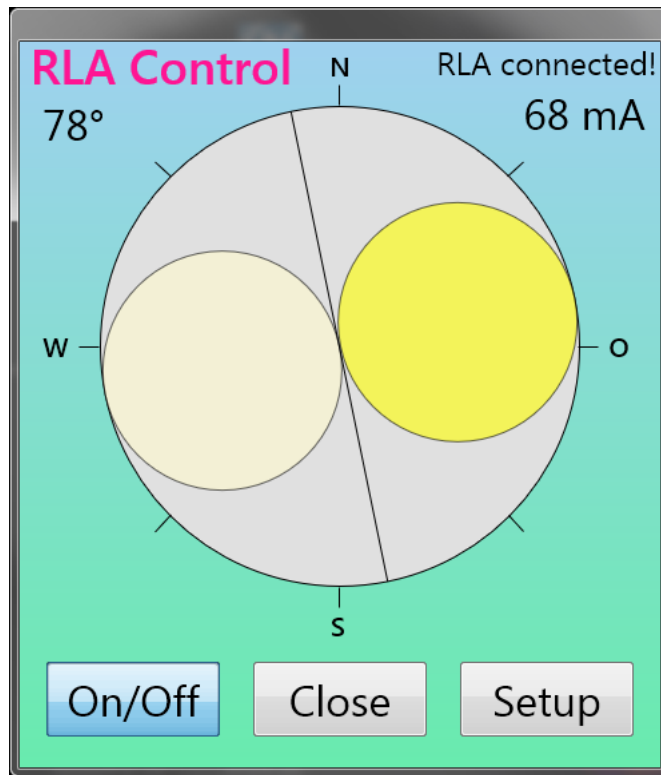
A pointer in the upper area of the display enables quick graphic orientation of the current setting. The far left corresponds to 0°, the far right corresponds to 180°.

The current indicator on the display can be used to check the proper function of the RLA4. If a constant switching between smaller values and a maximum value (approx. 150 mA) occurs, there is a short circuit in the antenna cable. The control unit is permanently short-circuit proof, so the overcurrent is only displayed briefly and then switched off immediately. If "0 mA" is displayed despite the setting being "Off" or "0°", there is an interruption.

Remote control

The RSW3 possesses a network controller with appropriate software ("TCP/IP Stack") and a 2.4 GHz transceiver for establishing network connections via a WLAN ("WiFi"). The RSW3 can be controlled via such a connection as well as by direct operation on the rotary knob. That means it can be switched on and off remotely and the direction setting of the RLA4 can be remotely controlled. Due to the standardized IP connection, control by any suitable software is possible via any available connection (e.g. Internet).

In addition to device-specific software (e.g. user interface of the RDR53 "sPocket"), remote control software for Windows-compatible PCs for the RSW3 is available: RLA4V_xx.EXE (xx = 2-digit version number). It allows the RLA4 to be controlled via the RSW3 control unit by remote control.



After opening the file RLA4V_xx.EXE the program window appears. It contains the graphic replica of the antenna diagram of the RLA4 as well as some displays and buttons. The degree indicator on the top left and the power display on the top right correspond to the displays on the control unit. A text box above the current display shows the current connection status between the software and the control unit. The buttons in the lower area can be used to switch the RLA4 on or off (corresponds to turning the control unit all the way to the left until "Off" appears or turning to the right on a degree display), the program can be ended or another window for further settings ("Setup", see below) can be opened.

The antenna diagram can be rotated within the circle by clicking with the mouse (or tapping on devices with a touchscreen) and then dragging it to a desired position. The two reception lobes of the RLA4, stylized here as a circle, indicate the direction of the maximum reception. The degree indicator on the top left (or that on the display of the control unit) always refers to the right, darker side of the reception diagram. Its maximum (point of contact with the gray circle of the compass direction) corresponds to the degree indicator.

Note: If the RLA4 is set up with its main receiving direction facing north, when the degree display is set to 0°, the antenna diagram shows the correct direction. However, attention should be paid to the sometimes large deviation of the actual antenna diagram from the ideally displayed diagram in the software or the degree indicator (see comments above for the control unit). Without the inclusion of a correction table for the exact assignment of the actual reception diagram to the displayed diagram, the RLA4 can only be used to a very limited extent for direction finding purposes.

The alignment of the maximum reception is not so necessary with the RLA4, because the reception lobes are very wide and even larger deviations hardly result in a reduction in the reception level. Rather, the exact positioning of the zero point (minimal reception) is important to suppress signals from very specific directions (attenuation of unwanted transmitters or interference). In the diagram, the zero point is displayed by the line between the circles. The line is always located at a 90° angle to the main reception direction.

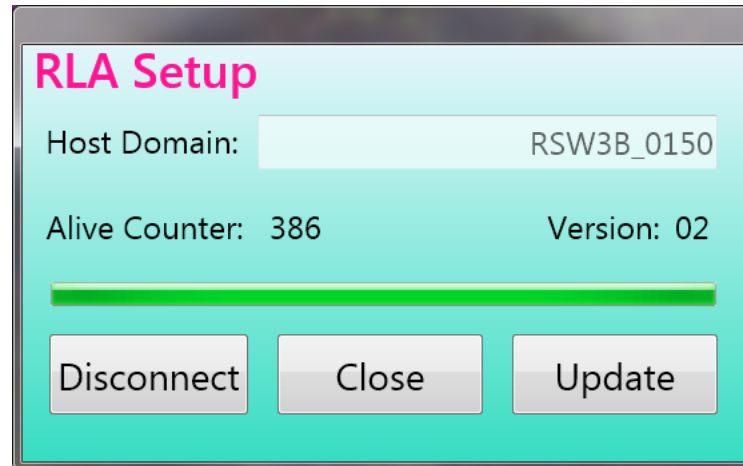
The diagram can be rotated very quickly in the program window, much faster than the RLA4 can actually react (relatively slow transmission of the control words from the control unit to the antenna). For this reason, intermediate steps are omitted in the case of a fast rotation, and the then valid data is only transferred when the desired position is reached (stopping the rotation by releasing the mouse button or lifting the finger). The diagram and the degree indicator always display the position reported by the control unit and that is actually transferred to the antenna. Delays during data exchange (for instance, because of a slow internet connection) can lead to jerky movements.

An exact and sensitive adjustment can be achieved with the computer mouse's scroll wheel. Moving the

scroll wheel one step exactly advances the antenna position by one level. This corresponds to the operation as with the control unit's rotary encoder of the antenna (its operation is also displayed by rotating the directional diagram and updating the degree indicator within the program). Please note that a position step does not exactly correspond to a 1° change in direction, but approx. 0.776° (the RLA4 has 232 steps for 180° rotation). However, there is no representation of decimal places within the degree indicator due to the anyway existing inaccuracy of the real antenna diagram.

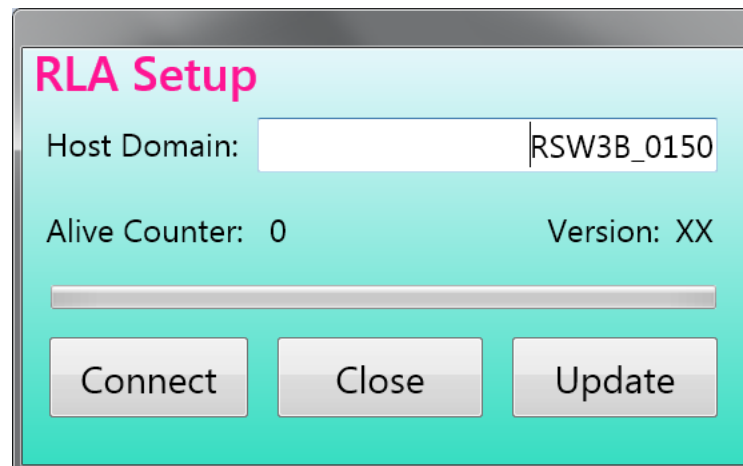
Setup

To set the connection parameters from the RLA4V_xx.EXE program to the RSW3 control unit, another window can be opened with the "Setup" button.



When the antenna is connected (note "RLA connected!" at the top right of the main program window), an "Alive Counter" (activity counter) counts the data that is constantly exchanged between the program and the control unit (at least 2 data packets per second). To the right of this, the firmware version contained in the RSW3 is displayed (see below under "Update").

By pressing the "Disconnect" button, the connection to the RSW3 can be disconnected. The counter then stops, the name of the button changes to "Connect" and the input field for the network name of the RSW3 becomes active. This state is also present when the setup window is opened if there is no connection to the control unit.



The address at which the control unit can be accessed by the program must be entered in the "Host Domain" text field. Depending on how the control unit is connected to other devices (computer, router, ...) via a WiFi connection (see below), and which connections the program can facilitate to access these devices (LAN connection, internet, WiFi Direct, mobile radio, ...), different options are available. 2 basic variants exist:

1. The RSW3 and the computer on which the RLA4V_xx program is started are located in a common network with free access between the devices. Example: Home or corporate network under Windows.

In this case, the control unit can be directly accessed via its designation in the network. The designation is always formed from the word "RSW3B" with the following underscore "_" and the four-digit serial number of the device. This is indicated on the type plate on the bottom of the housing and is briefly shown on the display when it is switched on (when the power supply is connected). The serial number must always be entered with 4 digits, i.e. with shorter numbers with leading zeros.

2. The RSW3 and the computer on which the RLA4V_xx program is started are in separate networks. The connection is established via various media and is usually secured by protection software (firewall) in such a way that no arbitrary access from one network to the other is possible. Example: Remote control via the internet.

In this case, additional preparations must be made to make the RSW3 control unit or its network "visible" for the program. Various options and additional software exist for this purpose, which cannot be described in more detail here. In principle, all of these variants enable the program or the computer on which it is running to use an address or a name with which the control unit can be accessed. This address / name must then be entered in the Setup.

Example: Access via port forwarding in the network's router, in whose WiFi access point the control unit has logged in.

In this case, the RSW3 is connected to a WiFi router and all computers that are also connected to this router have direct access via the designation of the control unit (variant 1). If the router is connected to the internet (e.g. via DSL), other computers on the Internet cannot normally access the network or the devices in it (meaning the RSW3 and other computers). The router's firewall prevents it.

In order to "forward" a connection from the internet to the RSW3, the router must explicitly allow this connection(s) for certain ports. This so-called port forwarding can be configured in any conventional router. Please utilize the router's documentation for this process. The following variables must be set:

- The device to be accessed via the forwarded ports. The RSW3 is listed in the router either under its designation "RSW3" (possibly with attached additions such as version and serial number), or under the designation "espressif" (the name of the RSW3 network processor).
- The port or ports to be forwarded. In case of the RSW3, it is always the same port number: 55556.
- The protocol(s) with which the RSW3 can be accessed via the forwarded port. The protocols "TCP" and "UDP" must be enabled for the RSW3. Depending on the router, this can be achieved with one setting (both protocols can be selected in the port forwarding dialog at the same time), or you have to set up port 55556 for each protocol individually.

After confirming these settings, the RSW3 can be accessed via the internet. To do this, the IP4 address of the router that contains the port release and the RSW3 is logged in must be entered within the RLA4V_xx.EXE program. This address is displayed within the router configuration program if it is connected to the internet.

The problem with variant 2 consists in the automatic changing of this "public IP address" each time the router is reconnected to the internet. This means that every time this happens, you would have to look up the address and enter it in the remote control software again. There are many ways to avoid this problem. For instance, it is common to use a "DNS service" that always assigns a unique name to the router, regardless of current IP address. The router manufacturer often offers a service like this, e.g. "MyFritz" for the widespread Fritz Box router. After setting up this service, the name assigned to the router can be permanently entered in the Setup of the RLA program.

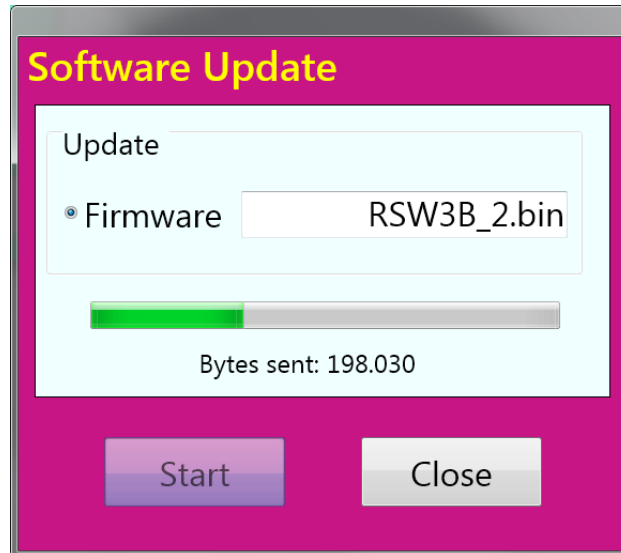
Pressing the "Connect" button initiates the establishment of the connection to the control unit. The green progress bar shows the progress. If the connection is successful, the button name changes to "Disconnect" and the Alive Counter begins to count. The version number appears on the firmware display.

If the progress bar completes to the end without a connection being established, the attempt is terminated and the setup window remains in the disconnected state. In this case, it must be checked whether all the

necessary conditions for establishing a connection are met (RSW3 switched on, logged into a WLAN, access to this WLAN from the program possible, correct address / correct designation entered in the Setup, ...).

Firmware Update

The control unit contains integrated software ("firmware"), which controls its function and the connection via WiFi. If there is a connection, this firmware can be updated from the RLA4V_xx.EXE program. To do this, press the "Update" button in the Setup. Another window opens.



The "Firmware" field is initially empty. With a double click / tap on it, the program searches for transferable files. These files must always have the extension .BIN and be located directly in the folder of the program file RLA4V_xx.EXE. If there are several such files in the folder, the first one that can be found (depending on the arrangement of the files in the folder) is used. To avoid confusion, there should always be only one update file in the folder, namely exactly the (new) firmware to be transferred.

Pressing the "Start" button starts the transfer to the RSW3.

Caution! The transfer can only take place if the control unit is connected to the software (see above) and the control of the RLA4 works correctly (the antenna diagram reacts and the alive counter in the Setup ticks)!

The progress of the transfer is indicated by the green progress bar and the count of the transferred bytes. If an error message appears (transmission could not be started or was canceled due to long interruptions in the connection), the Update window must be closed. After a few seconds, the connection must be re-established in the Setup, if this has not already been done automatically. The update can then be retried. In the event of multiple cancellations, the reliability of the connection between the program and RSW3 must be checked or established (perfect and largely delay-free operability of the antenna).

Caution! Only start the update if you have direct manual access to the control unit! Depending on the changes in the firmware or in the event of serious data errors, it may be necessary to disconnect the RSW3 from the power supply and reconnect it. In addition, the network data (names, addresses, password ...) may have changed so that the WiFi connection of the RSW3 must be set up again (see below).

The successful end of the transmission is reported with a message window. An automatic reset then takes place in the RSW3 and the device starts with the new firmware. Now the connection between the program and the RSW3 must be re-established (this can also occur automatically, please wait a few seconds). The Update window must be closed and the old connection must be interrupted in the Setup window with the button "Disconnect". The button now called "Connect" allows the connection to be re-established as specified in the description of the Setup window. The software version of the new (previously transferred) firmware must now appear in the version display (corresponds to part of the name of the firmware's BIN file).

Note: The version number always contains the sequential version number of new firmware in the second

digit, the first digit changes between "0" and "8" with each successful update (detection of a successful retransmission of the same firmware with the same number already contained in the RSW3).

If the old version number appears again, there were errors while transferring or restarting the RSW3. In this case, the update must be repeated. If a connection is no longer possible, there may be various errors:

- The connection between the program and RSW3 was interrupted by one of the devices involved. For example, the restart of the RSW3 requires an automatic or manual re-establishment of its WiFi connection (see below), or the connection of the computer with the program RLA4V_xx.EXE to the internet was interrupted by the computer or the internet access device (router, mobile device, ...) and must first be re-established again.
- No valid (not originally downloaded from the manufacturer) or incorrect (data error, virus attack, ...) BIN file was transferred. In the vast majority of cases, the RSW3 recognizes faulty data, aborts the transmission and starts again with the old firmware. Executable new, but possibly defective firmware can still be started and can disable the function of the RSW3 if there are errors. In this case, the device must be sent to the manufacturer for basic reprogramming.

Connection of the RSW3 to a WiFi access point

For remote control of the RSW3, it must be connected ("logged in") to an access point (also called a hotspot, access point or similar) according to the WiFi standard in the 2.4 GHz band. Such an access point can e.g. be a WLAN router, a suitably configured personal computer, a smartphone, a WiFi-capable radio unit or the like. From this device, which provides the access point, the further connection to the control software (e.g. RLA4V_xx.EXE or user interface of the RDR53 "sPocket") takes place as described above.

To log in to the access point, the RSW3 uses a secure connection according to "WPA2-PSK". This requires the specification of a password with which the access point allows WLAN subscribers (stations) to log in. The participant (in this case the RSW3) must know the name ("SSID") of the access point in which it wants to log in and query it to be allowed to participate in the network using the password. If the access point grants participation (it "authenticates" the station), the requester is logged in as a station and can now exchange data via the network.

Note: The access point must be configured so that it actually grants the request of the RSW3 with the correct password and does not e.g. deny it by blocking his MAC address or the like (see notes further below).

The RSW3 does not have the option (keyboard or similar) for alphanumeric entry of names and passwords. For this reason, certain simplifications and / or restrictions regarding the selection of access points must be observed.

1. Simplified / automatic login using the "WPS push button" method.

Many access points (especially routers) allow stations to log in using this method. The access point must be switched to this mode (usually automatically limited to 2 minutes), in which case it then transmits its authentication data (name and password) to all requesting stations. They therefore have all the data to be able to log in. The access point (or its operator) can then decide whether it really wants to authenticate the logged-in stations (e.g. the RSW3) or exclude it from participating in the network (e.g. unknown stations, spies and hackers).

Caution! Depending on the control unit's firmware, it can be displayed in the list of stations found via WPS with the designation "RSW3" (possibly followed by further numbers) or as "espressif". This device must remain in the list of allowed devices.

To connect the RSW3 to the access point using the WPS push button, proceed as follows:

- Disconnect the RSW3 from the power supply, connect the antenna to the "WiFi" socket.
- Start the WPS push button method within the access point (Physical button on the router or button in configuration software).
- Press the rotary knob on the RSW3 as far as it will go and establish the power supply.
- Release the rotary knob immediately after the display shows.

The top line of the display (where the pointer scale normally appears) now shows: "Search AP ...". When the connection to the access point has been successfully established, the display shows: "AP:" followed by the name of the access point (only the first 9 characters are visible). In the access point, the WPS authentication is canceled and the device found is displayed in the list of logged-in stations. An "L" appears in the RSW3's display between the degree and the current display to indicate successful login. As a check, the power supply can be briefly interrupted and restored (without pressing the rotary knob!). After a short time, the "L" must appear on the display again and the device RSW3 or espressif must be shown as connected in the access point configuration software. Now the RSW3 automatically logs into this access point each time it is switched on (if accessible).



2. Logging into a suitably configured access point

If there is no possibility of connection using the WPS method, the RSW3 can only connect to access points that use a specific password. It is called: "1234567890". Such a password is of course not secure, if only because it is publicly displayed here. This method only makes sense if an access point is used that does not allow any connections other than those to the RSW3. An example are the receivers / transceivers of the "RDR" series (if equipped with firmware for remote control of the RSW3, such as the "sPocket"). An otherwise isolated PC (no connection to other devices) with a WiFi radio module can also be configured accordingly and used with the RLA4V_xx.EXE program to control the RLA4. **Not recommended due to high power consumption and heavy "EMC pollution" of the environment!**

To log the RSW3 into an access point with password 1234567890, proceed as follows:

- Follow the steps as described for the WPS method (without starting the WPS on the router).
- After the "Search AP ..." display appears, turn the rotary knob to the right to a degree setting greater than 0°.
- Press the knob again and release it immediately.
- The message "Scan APs ..." appears.
- The RSW3 now searches for all access points within radio range.
- After a while, the name of the first access point found appears.
- You can display the list of all the access points found by turning the rotary knob.
- Select the desired access point and briefly press the rotary knob.

If the access point allows the connection (authenticates the password 1234567890), the connection is established permanently and the "L" appears on the display of the RSW3 to indicate successful login.

If the control software (program RLA4V_xx.EXE or user interface of the radio unit) has access (permanent connection, see above) to the RSW3, an "S" appears in the display instead of the "L". Remote control of the RSW3 is possible in this state. Control via the rotary knob is also always active, controls on the RSW3 are transferred to the display (antenna diagram) in the control software.

Instructions for successfully connecting the RSW3 to a WiFi router

The WPS push button method is standardized and should work with any router equipped with it. However, there are many different brands with many different setting options for the WLAN. Some of these can prevent a successful connection via WPS. Due to the large number of options, no general procedure for configuring the router can be given. There is also no guarantee that every device can be configured appropriately! But here are some tips on settings that should definitely be observed:

- WiFi radio channel: **MUST** (!) Be set to the 2.4 GHz band. "Auto" or similar is possible and should work. If a particular channel is to be used, identify a channel that is not used very often (there is often a graphic view of the channel assignment). A channel in the range of 8 to 13 is recommended.

- WiFi standard: 802.11 b. The "b" is important, combinations like "b+g+n" are also possible. "a" or "ac" or "a+c" usually do not work (but can be tried after successful login).
- Security / WPA encryption: WPA2 (CCMP). WPA (TKIP) or similar should also work. Stronger encryption such as "Enterprise" etc. do not work.
- WLAN access: "Allow all new WLAN devices" or similar setting. New devices must not be blocked (select "All devices may communicate with each other" or similar). Turn off the MAC filter. (Can be reactivated after successfully finding the RSW3 / espressif. First allow the MAC address of the new device within the router configuration software!)
- Activate WLAN coexistence if necessary.

Please note: After changes to the settings, a button "Apply" or "Save" or similar must often be pressed first so that these settings are not lost when changing the menu (call up WPS).

Firmware Update Version 3 (RSW3B_3.BIN)

Up to firmware version 2, the RSW3 always searches for a WiFi connection. If none is found, e.g. because it is not close enough to the configured access point or because no access point has been configured), this means a waste of energy (high current consumption during the search) and an unnecessary pollution of the WLAN frequency range.

The firmware update to version 3 limits the search time. An active search without a previously found connection is now shown with a "C" in the middle of the lower display line. As long as this C can be seen, the WLAN transmitter operates with full transmission power (approx. 100 mW).

If the configured access point is found, the RSW3 logs in (an "L" appears, or an "S" in the display when the control program is active) and the transmission power is reduced to a value that is just necessary to maintain the connection.

If no connection is found for approx. 10 s, the transceiver switches off completely (no more connection characters in the lower line). If you want to search for a connection repeatedly (e.g. because the access point should now be accessible), the search mode can be activated at any time by pressing the rotary knob. **To achieve this, the degree display must be set above 0°!** The search mode is of course also reactivated each time the power supply is switched on.

If the connection is interrupted during operation ("S" or "L" changes to "C"), the RSW3 switches to search mode for approx. 60 s. If the connection cannot be re-established within this time, the transceiver is switched off. A new connection can be established by pressing the button or switching the power supply off / on.

When the transceiver is switched off, the RSW3 tries to establish a new connection approx. every 3 minutes. For this, the search mode is activated for approx. 10 s. If no connection is found, the transceiver deactivates again for approx. 3 minutes. This behavior continues until a connection is found or the RSW3 is switched off.