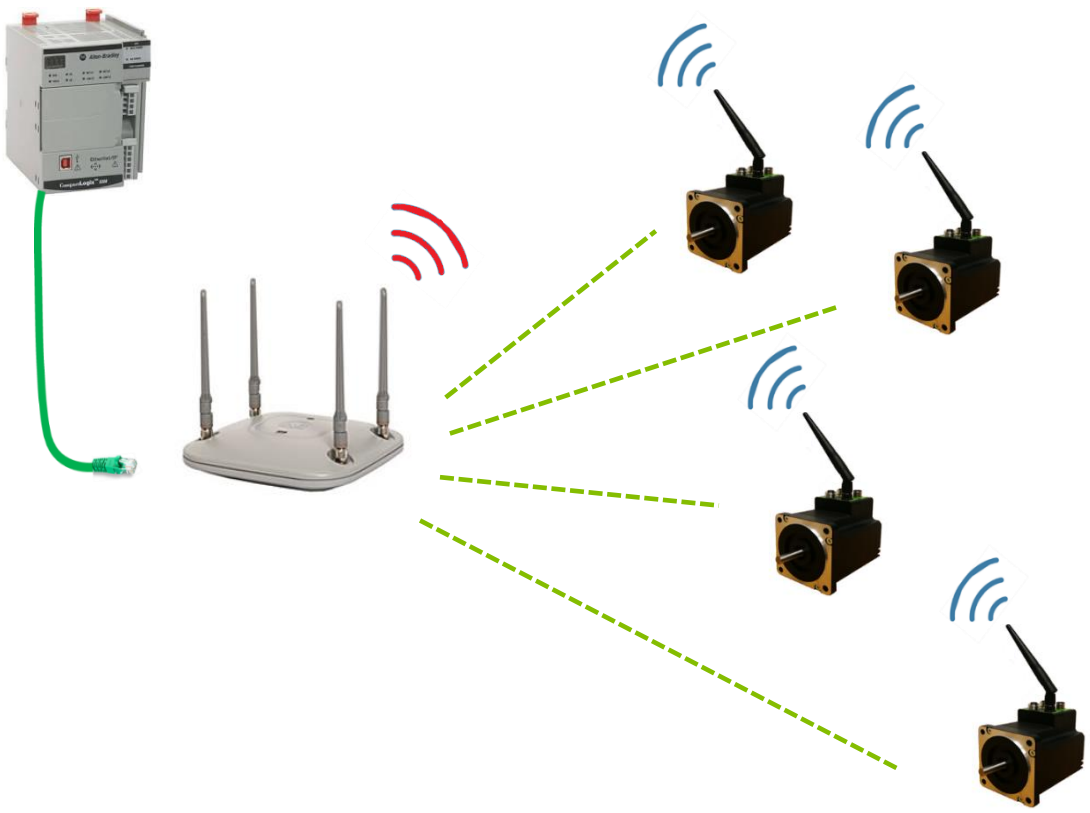
WIRELESS INDUSTRIAL ETHERNET

User manual

PRELIMINARY



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1 Setting up the JVL wireless connection.

Motors equipped with an ethernet bussystem is equipped with 2 ethernet ports and an internal ethernet switch.

When a motor is equipped with the wireless system, one of the ethernet ports are used for the wireless connection.

The second ethernet port is available but only in a certain wireless configuration.

The following equipment is recommended to get a reliable wireless network up and running.

1. JVL motor equipped with the wireless option and one and running one of the following ethernet busses:
    - EthernetIP
    - ProfiNet
    - ModbusTCP
2. A good wireless access point designed for industrial use with good diagnostic features.
   In house tests has been conducted with Siemens Scalance W76x, other vendors offers the same features.
3. Industrial grade switch systems to manage the wired connections from the PLC and Access point(s).
4. MacTalk V1.90.019 or better.

To get a reliable wireless network established requires some planning and a good knowledge of the environment the system is supposed to be working in.

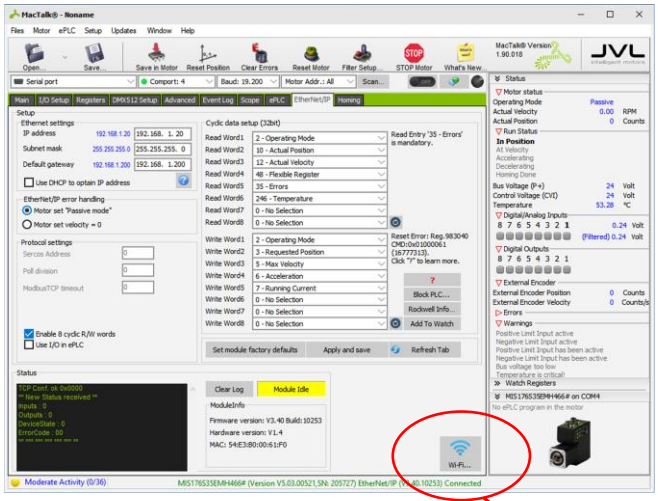
However wireless networks are by definition not as reliable as the wired solution and loss of packages can occur at a random interval so the system must be designed to accommodate that. Careful planning is also vital to get a good and reliable connection to the wireless nodes.

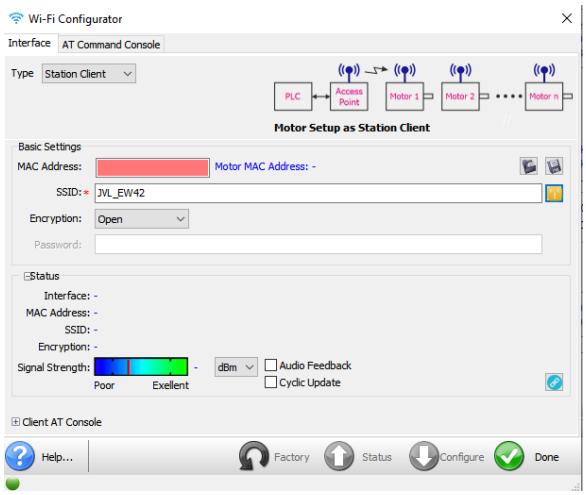
The JVL wireless network can run in 2 different modes depending on which topology is required.

From MacTalk the configuration is done from the dialog that is accessed by pressing the “WIFI” -button.

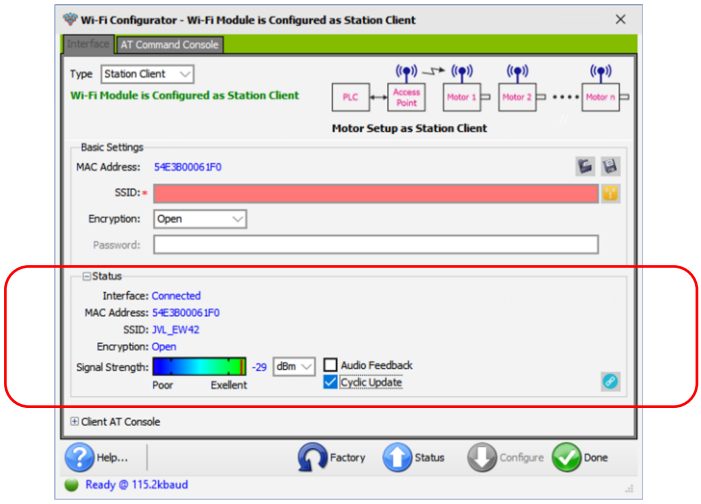


Please note that configuration of the wireless network in the motor is only possible through a serial connection. When the wireless connection is running the motor can be accessed over the wireless connection, but the wireless settings are not available.





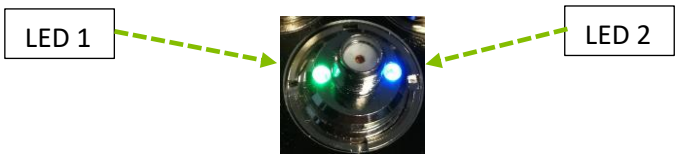
After the connection to the module has been established, the current setup is read and displayed in the “Status” -section.



Status indication on the motor

On the motor 2 LED's indicate the current status of the wireless connection.

Please note that for convenience the antenna has been removed in the following illustration, do not operate the device without the antenna connected.





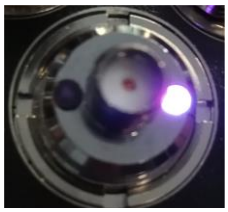
LED 1: Solid or blinking Green, data traffic is transferred from the wireless chip to the ethernet bus chip.

LED 2: Solid or blinking Purple Connection to the accessspoint or clients are attempted.



LED 1: Solid or blinking Green, data traffic is transferred from the wireless chip to the ethernet bus chip.

LED 2: Blue solid or blinking, Connection to the wireless accesspoint (or client) has been established and data is transferred.



LED 1: Off Indicates that no internal communication path has been established between the ethernet controller and the wireless controller.

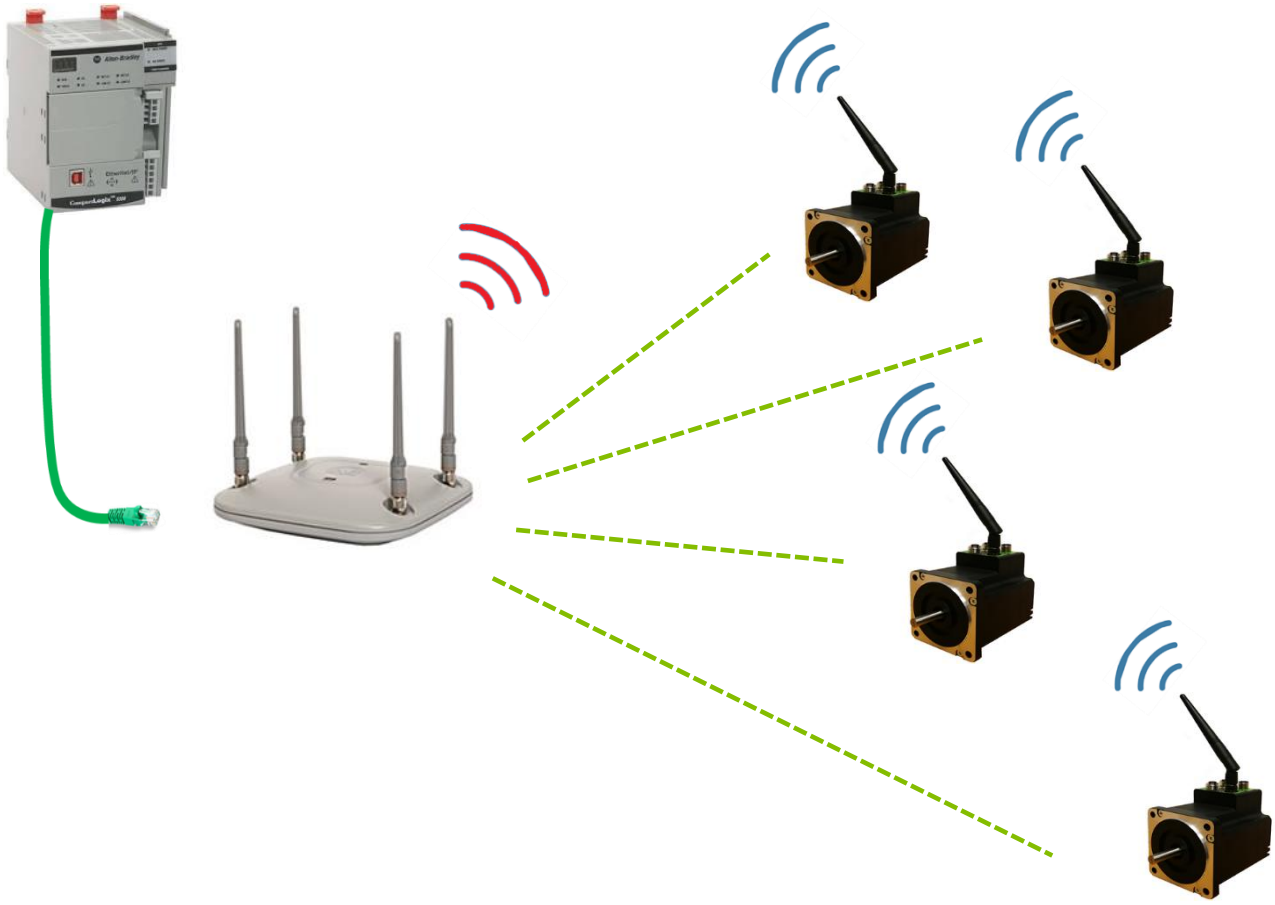
LED 2: Solid or blinking Blue or Purple indicates that an active setup is running.

LED1	LED2	Description
Green	Green	No wireless setup in the motor, make a new setup from MacTalk.
Green	Purple	Connection attempt to either access point (Configuration #1) or Client (Configuration #2)
Green	Blue	Connection is established, blinking indicates traffic
OFF	Purple	Internal communication is missing between ethernet controller and wireless controller, connection is attempted on the wireless interface.
Off	Blue	Internal communication is missing between ethernet controller and wireless controller, connection is established on the wireless interface.
Off	Red	Internal error in the wireless controller, try setting factory default and make a new setup.

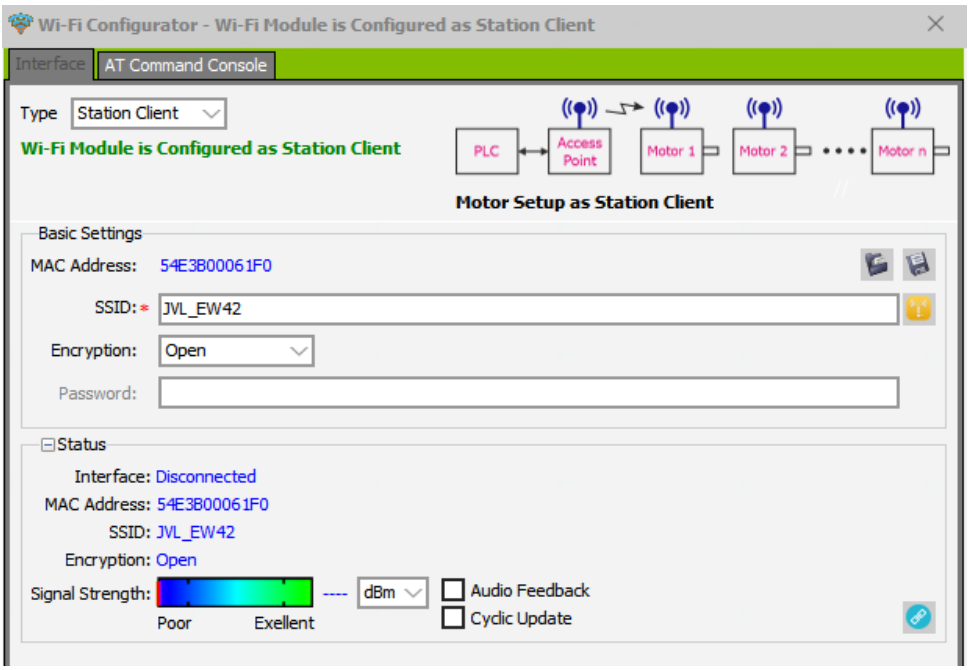
Configuration #1, Station Client

When the motor is configured as “Station Client”, the secondary ethernet port on the motor is not available. In other words it is not possible to connect other equipment to this port and reach it through the wireless connection.

The Access point connected to the PLC works as an access point and the motors connects to this access point as clients.



MacTalk "Station Client" configuration



Basic settings

In this section data for the setup can be entered.

MAC Address (read only): Current MAC address of the Ethernet processor in the motor.

SSID: Enter the SSID of the access point.

Encryption: Encryption method used in the access point. WPA/WPA2 can be selected.

Password: Enter the WPA/WPA2 password of the access point. Note, by pressing the "Eye"-button, the entered password is readable.

Status

This section holds the actual setup and status of the wireless interface.

Interface: Shows the connection state to an access point [Connected / Disconnected].

MAC Address: Current MAC address used for the wireless interface. This address should be the same as the MAC address printed on the label.

SSID: Current SSID configuration. This is the SSID the motor will try to connect to.

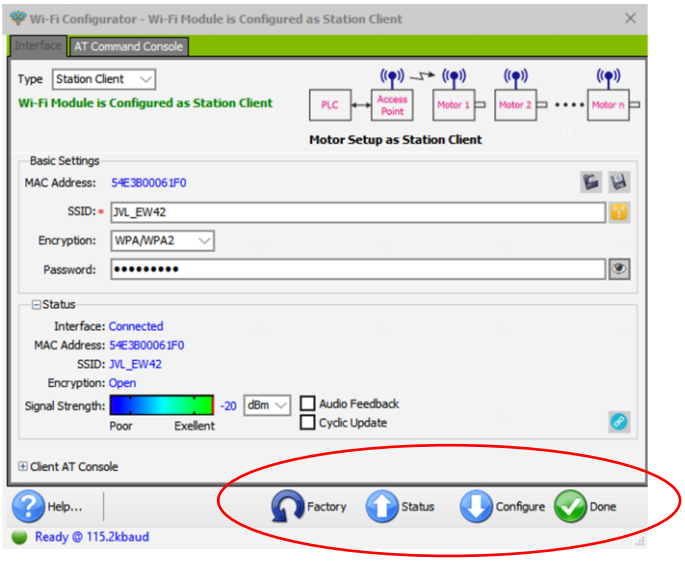
Encryption: Current encryption setting [WPA/WPA2 or OPEN]. Observe that the password is protected from viewing.

Signal strength: When the motor is connected, the signal strength can be monitored. The units can be presented in either [dBm or %]. In good industrial access points the signal strength of the clients can be monitored as well in the managing software for the access point.

When the settings has been configured, the setup is transferred to the motor by pressing the “Configure” -button found in the bottom of the dialog.

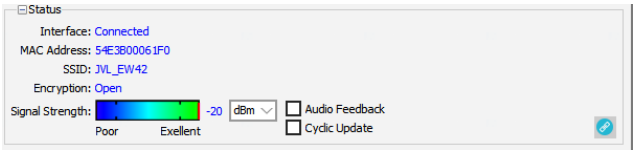


Note: The settings are sved permanently in the motor after they are transfered.



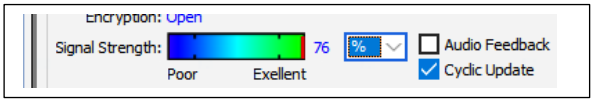
When the transferring has completed, the motor will connect to the access point with the SSID entered, using the encryption and credentials configured.

When the motor has established a wireless connection the status changes from “Disconnected” to “Connected”. The signal strength is also changed from “---“ to a value either in dBm or %.



In the screenshot above the motor is connected to an access point with the SSID “JVL_EW42”, there is no encryption configured. The signal strength is reported by the motor to be -20dBm (very good).

For a more human readable value the unit can be switched to %.



For the best performance and reliability the signal strength should always be in the “Excellent” -area of the status bar.

Setting up the accesspoint for the Configuration #1

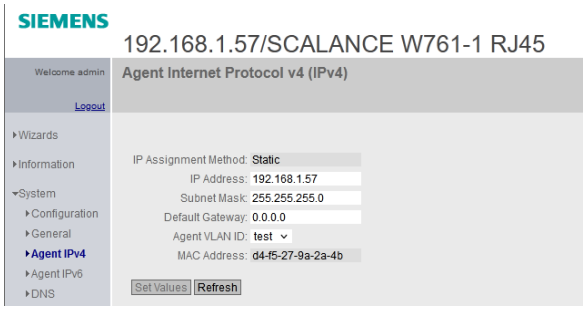
In this section we will cover the basic settings of the access point when a motor is configured as “Station Client”.

The access point is the ethernet wired to wireless gateway on which the PLC is connected.

The access point used is a Siemens scalance W76x, but the same settings are available in other good industrial access point.

IP address of the access point

The IP address settings of the wired part must match the PLC settings. In this example all the equipment is running on the subnet 192.168.1.xxx. The access point is configured for the same range with the IP address 192.168.1.57.

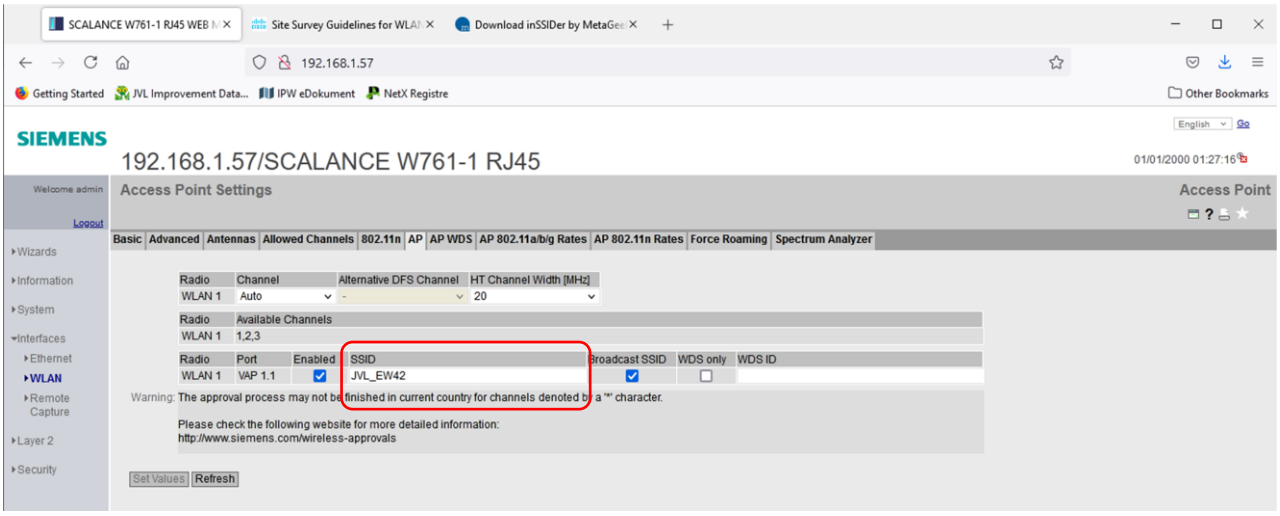


The way IP addresses are configured can be manufacture specific and is covered in the manual for the device.

SSID (ServiceSetIdentifier)

The SSID is basaically the identification on the wireless network. The SSID can be either visible or invisible for a scanner. When wireless network are scanned it is the SSID of the networks that appears in the list.

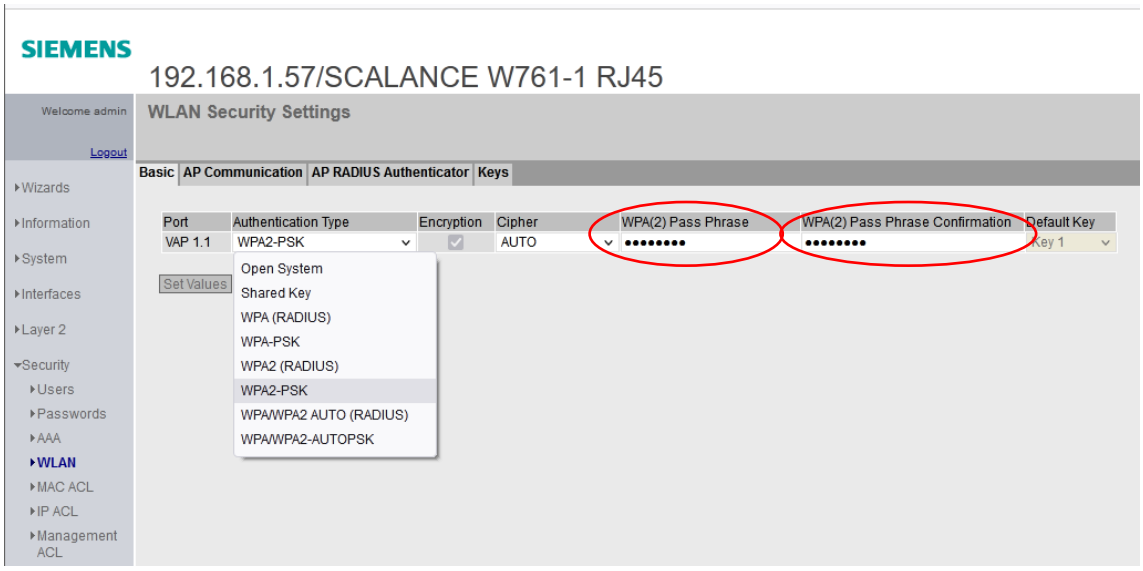
In this example we use “JVL_EW42” as SSID, in the Siemens configuration this is setup in the following dialog:



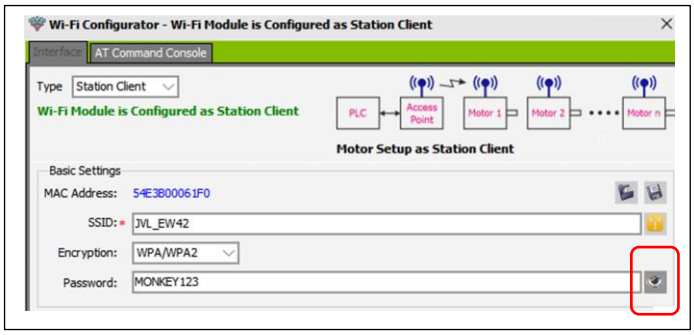
Encryption

The encrytion scheme supported in the motor is WPA/WPA2.

The password “MONKEY123” is chosen and configured in the access point.



The same password credentials must be configured in the motor. Press the “Configure” button to transfer the settings to the motor.



TIP:

By pressing and holding down the “Eye” -button, the Password is viewable.

When everything has been configured, the motor will try establishing a connection to the access point.

when the connection has been established, the LED’s on the motor will show the following indication:



Green and Blue indicates that the internal bridging between the wireless controller and the ethernet bus controller has been established.

The blue LED indicates that the wireless connection is established.

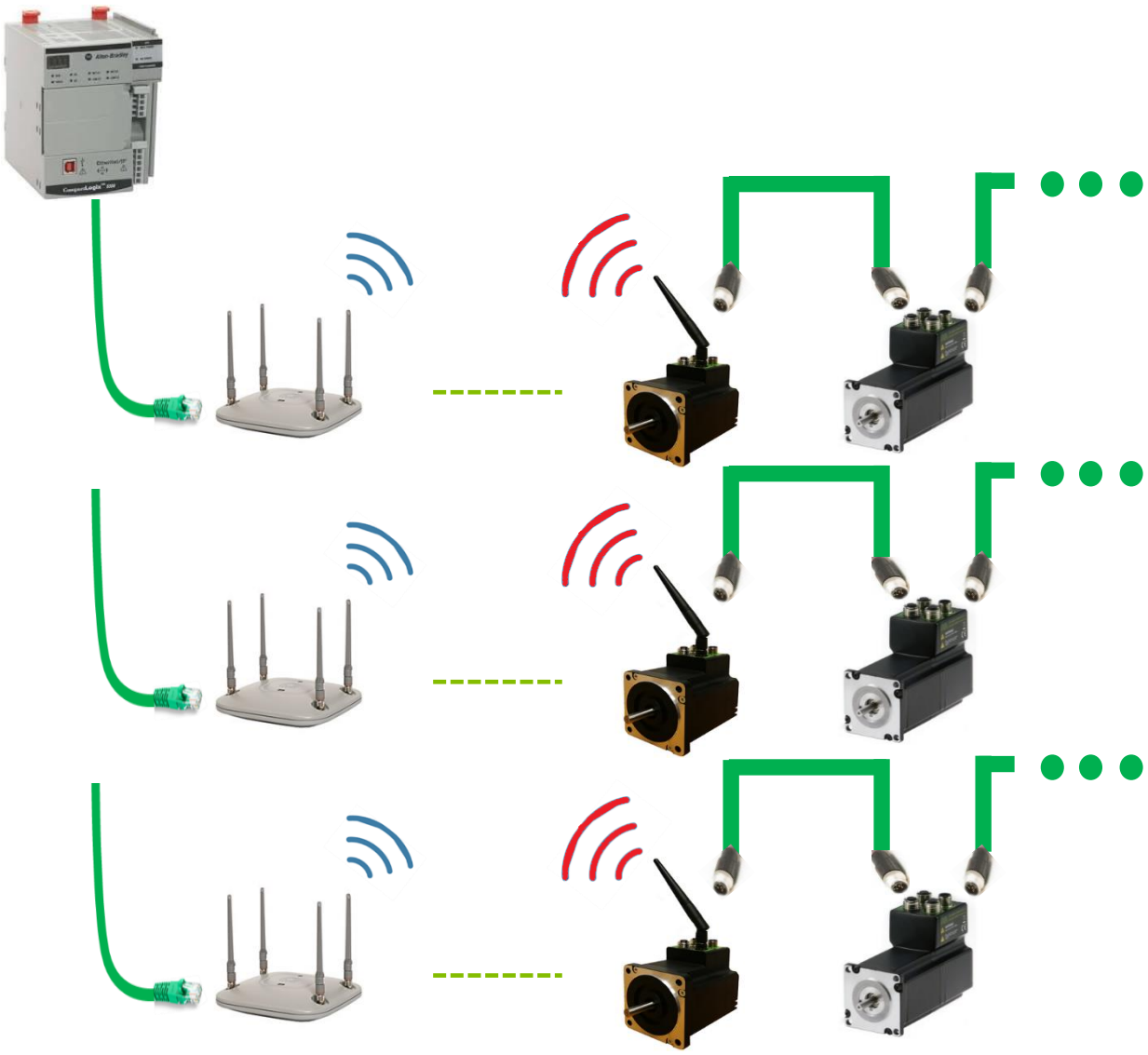
When data is transmitted the LED’s are blinking indicating the traffic.

NOTE : The above image shows a motor without the antenna connected, this is purely for demonstration reasons, do not operate the motor without the antenna connected.

Configuration #2, Access point

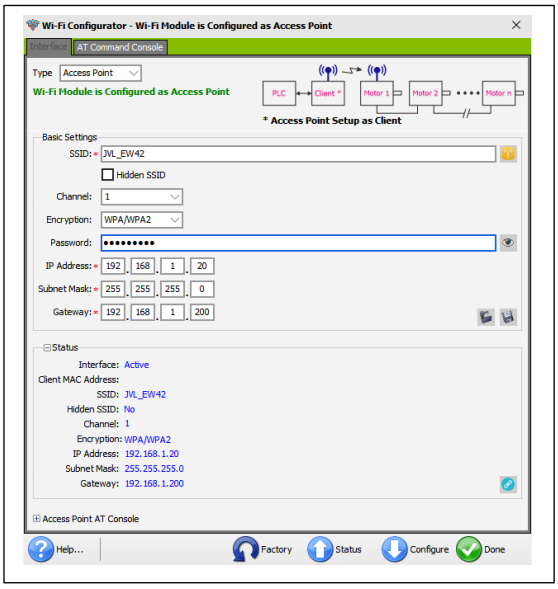
Each wireless motor is configured as an access point and the PLC is connected to a wireless client. This method leaves the secondary ethernet port in the motor, open for connecting another wired node and the internal switch in the motor will route the packages through the wireless network to and from the PLC to the nodes connected to the port.

The drawback of this setup is that it gets very complicated requiring a lot of bandwidth if many wireless “strings” are needed. The PLC and each Client should be connected to a industrial grade managed switch.



Mactalk setup "Access point"

When the motor acts as an access point there are more settings that must be considered. An additional set of IP addresses must be setup.



Basic settings

In this section data for the setup can be entered.

SSID: Enter the SSID for the Access point. This is the ID the motor will use for the Clients to connect to.

Hidden SSID: Check this setting if the SSID should not be visible in a network scan.

Channel: Select the channel for the Access point configuration.

Encryption: Select the encryption that must be used. Note, by pressing the "Eye"-button, the entered password is shown.

Password: Enter the WPA/WPA2 password of the access point. Note, by pressing the "Eye"-button, the entered password is shown.

IP Address: Enter the IP address that the Wireless adapter in the motor should have. Note the clients that connects to this motor must be in the same IP address space.

Subnet Mask: Subnet mask settings of the wireless network.

Gateway: Gateway settings the wireless adapter.

Status

This section holds the actual setup and status of the wireless interface.

Interface: Shows the connection state to an access point [Connected / Disconnected].

MAC Address: Current MAC address used for the wireless interface. This address should be the same as the MAC address printed on the label.

SSID: Current SSID configuration. This is the SSID the motor will try to connect to.

Encryption: Current encryption setting [WPA/WPA2 or OPEN]. Observe that the password is protected from viewing.

Signal strength: When the motor is connected, the signal strength can be monitored. The units can be presented in either [dBm or %]. In good industrial access points the signal strength of the clients can be monitored as well.



Interface: Active/Passive

Client MAC Address: Not used

SSID: Setting of the SSID that clients can connect to.

Hidden SSID: Yes/No

Channel: Active channel number

Encryption: Encryption method used.

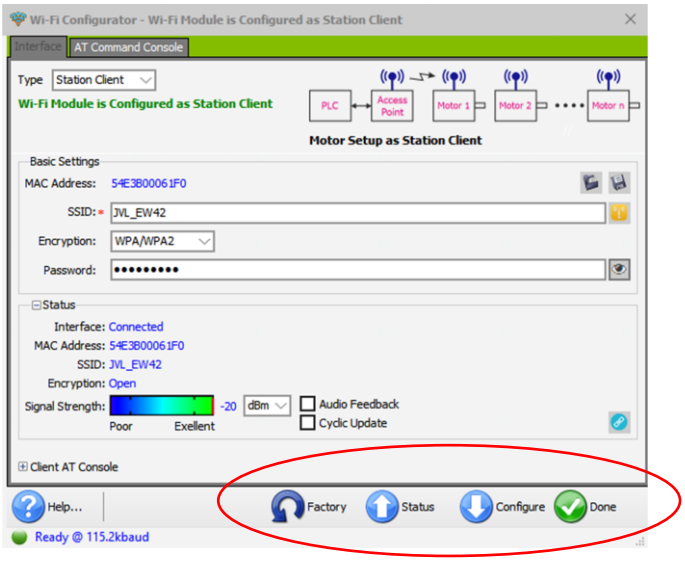
IP Address: IP address of the wireless AP in the motor.

Subnet Mask: Subnet mask

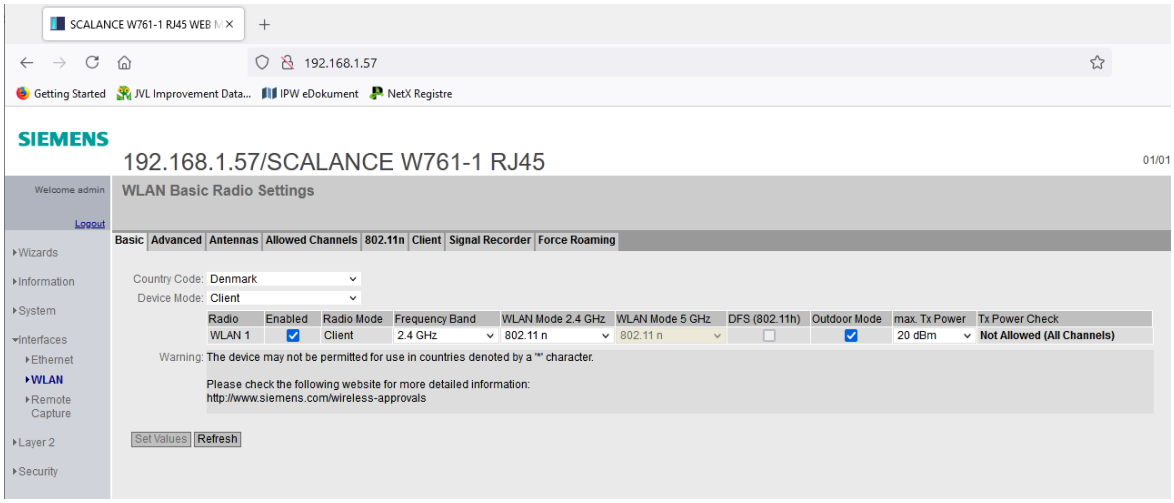
Gateway: Gateway

When the settings are entered, the setup is transferred to the motor by pressing the “Configure” -button found in the bottom of the dialog.



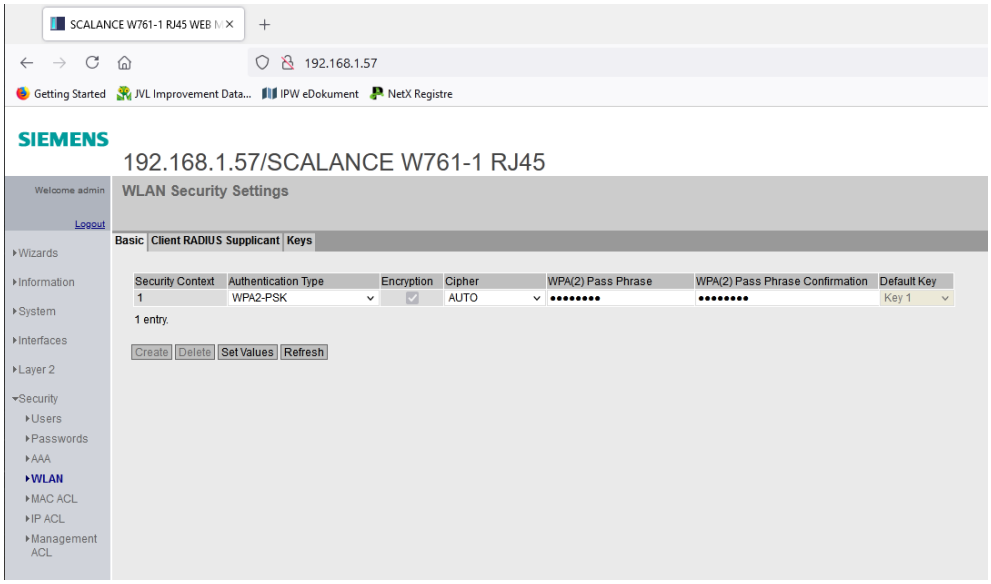


Setting up the accesspoint for the Configuration #2



Observe the Device mode and the Radio mode which is set to “Client”.

Encryption is configured according to the encryption settings configured from MacTalk.



The Password is off cause defined in the motor, since the motor acts as the access point. The Password is in this case MONKEY123 as configured from MacTalk.

When everything has been configured, the motor will wait for Client(s) to connect, when a client is connected, the LED's on the motor will show the following indication:



Green and Blue indicates that the internal bridging between the wireless controller and the ethernet bus controller has been established.

The blue LED indicates that the wireless connection is established.

When data is transmittet the LED's are blinking indicating the traffic.

NOTE : The above image shows a motor without the antenna connected, this is purely for demonstration reasons, do not operate the motor without the antenna connected.

WIFI settings, optimal settings for best and most reliable connection

In some cases it may be necessary to reduce the RPI (Requested Package Interval) compared to a classic wired connection. The bandwidth the wireless network can be significantly lower than the bandwidth of a wired connection.

In order to have a stable reliable connection it is imperative that the correct settings are achieved in the access point.

Using a good access point designed to work in an automation environment is the first step to success establishing a wireless network.

Wireless networks will always be less deterministic than a traditional wired ethernet network, so careful planning must be done with considerations of lost connections, lost packages etc.

Most access points designed for industrial use, supports a lot of finetuning to optimize the infrastructure for the actual usage end existing infrastructure.

This section will cover some of the considerations and features modern access points offer for industrial use.

All demonstrations are carried out using the **Siemens Scalence W761** -Access point and configuration software.

First step in determining how reliable or/and fast a wireless network can be on the plant floor is to analyze the channels in use and the traffic load on each.

Please note that most access points offer running on both 2.4GHz and 5GHz so in case channels are heavily loaded on 2.4GHz, 5 GHz can be used instead.

The JVL wireless system supports running either 2.4GHz or 5GHz.

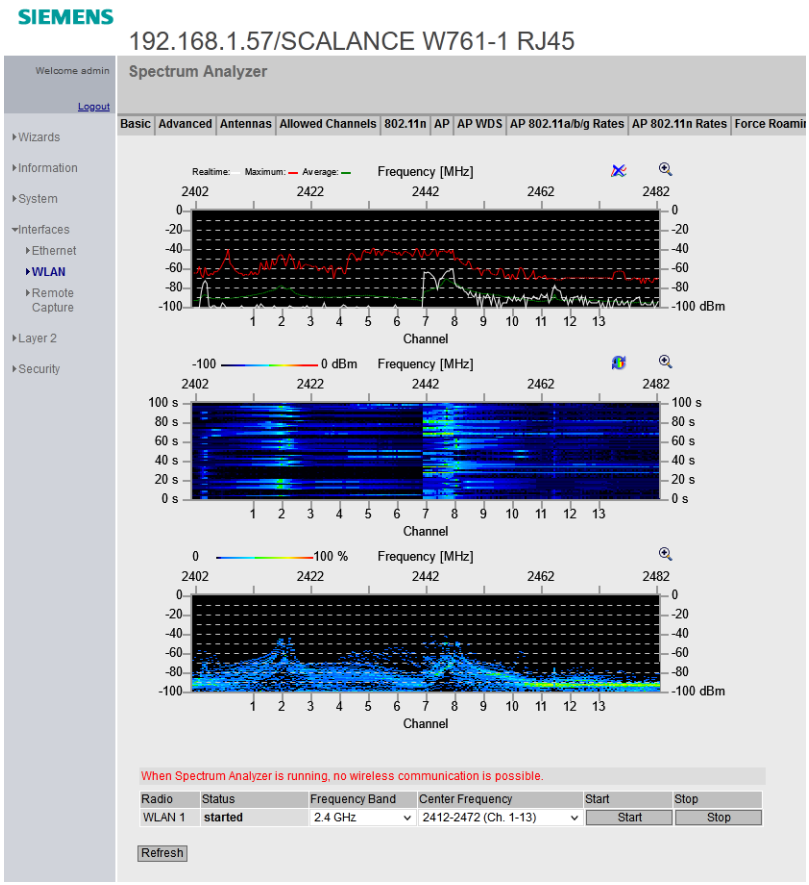
The channel selection determines whether the motor operated on 2.4GHz or 5 GHz.

For operation in 2.4GHz, select a channel in the range: **1 - 11**

For operation in the 5GHz band, select a channel in the range: **36 – 64, 100 - 116, 132 - 140**.

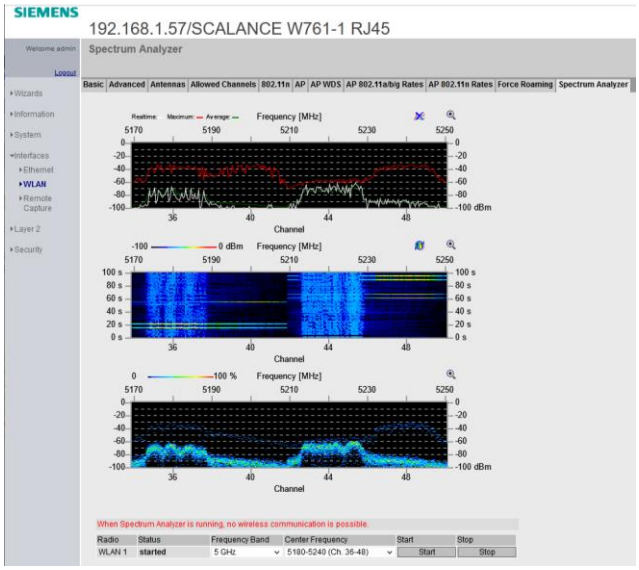
NOTE: Observe the local regulations of allowable channels before commissioning.

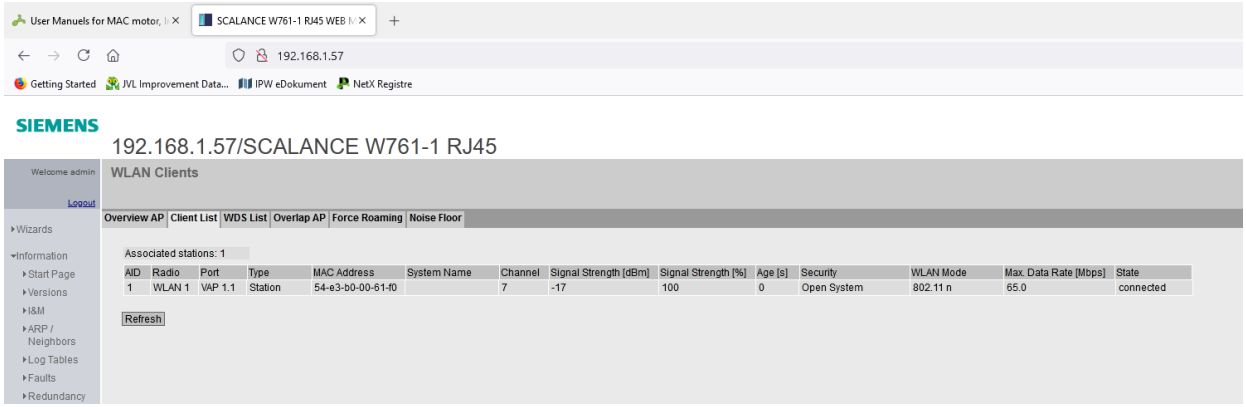
Spectrum analyzer in Siemens Scalence W761 Showing the channel load on the different channels at 2.4GHz.



Motor and AP appx. 300mm apart using a std. JVL antenna on the motor.

On the 5GHz frequency band the channel loading on Channel 36-48, leaving Channel 40 as a good choice of operation:





Note the reception quality in the motor can be monitored from the access point.

A lot of information is available on the internet regarding planning and designing of wireless networks. Covering everything is beyond the scope of this manual.