ESCG

802.11 a/b/g

WLAN-Client Adapter and Bridge

Manual

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System Overview

The ESCG is intended to connect devices with ethernet or serial interfaces to a Wireless Local Area Network (WLAN) corresponding to the 802.11 a/b/g standard.

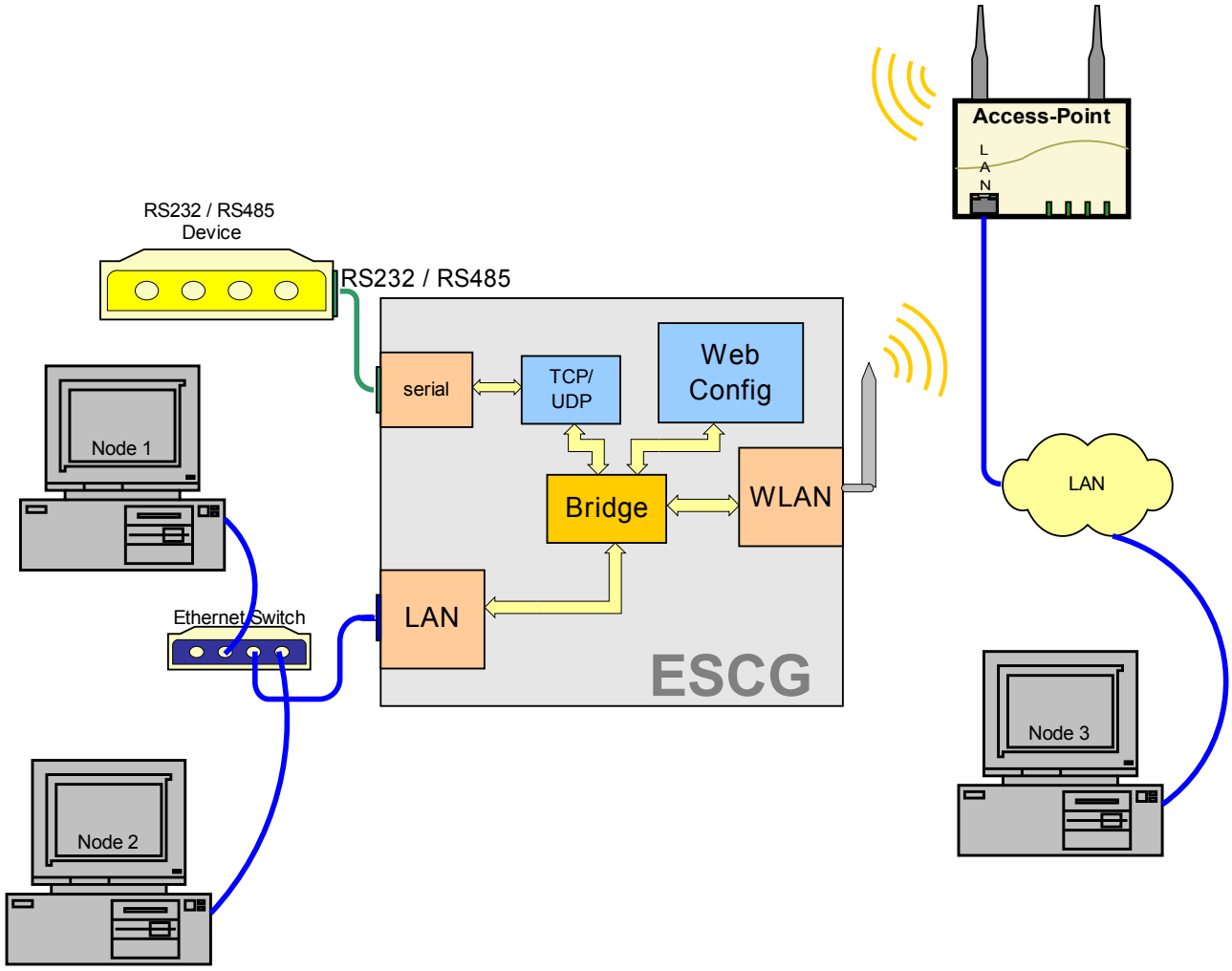


Illustration 1: System overview

The ESCG can receive and transmit data via a Ethernet LAN port and can transfer this data via a WLAN Interface to a matching WLAN access point that is connected to a stationary LAN.
The ESCG can also receive and transmit data via a serial port. This data can be exchanged via a TCP- or UDP-Socket with other devices by using the LAN or WLAN interfaces of the ESCG.
The ESCG needs many parameters to handle all the different interfaces. The ESCG supports a Web interface to configure all these parameters. In addition a further interface is available to locate, configure, update and to monitor the ESCG. This interface is used by the ESCG-Config-Program.

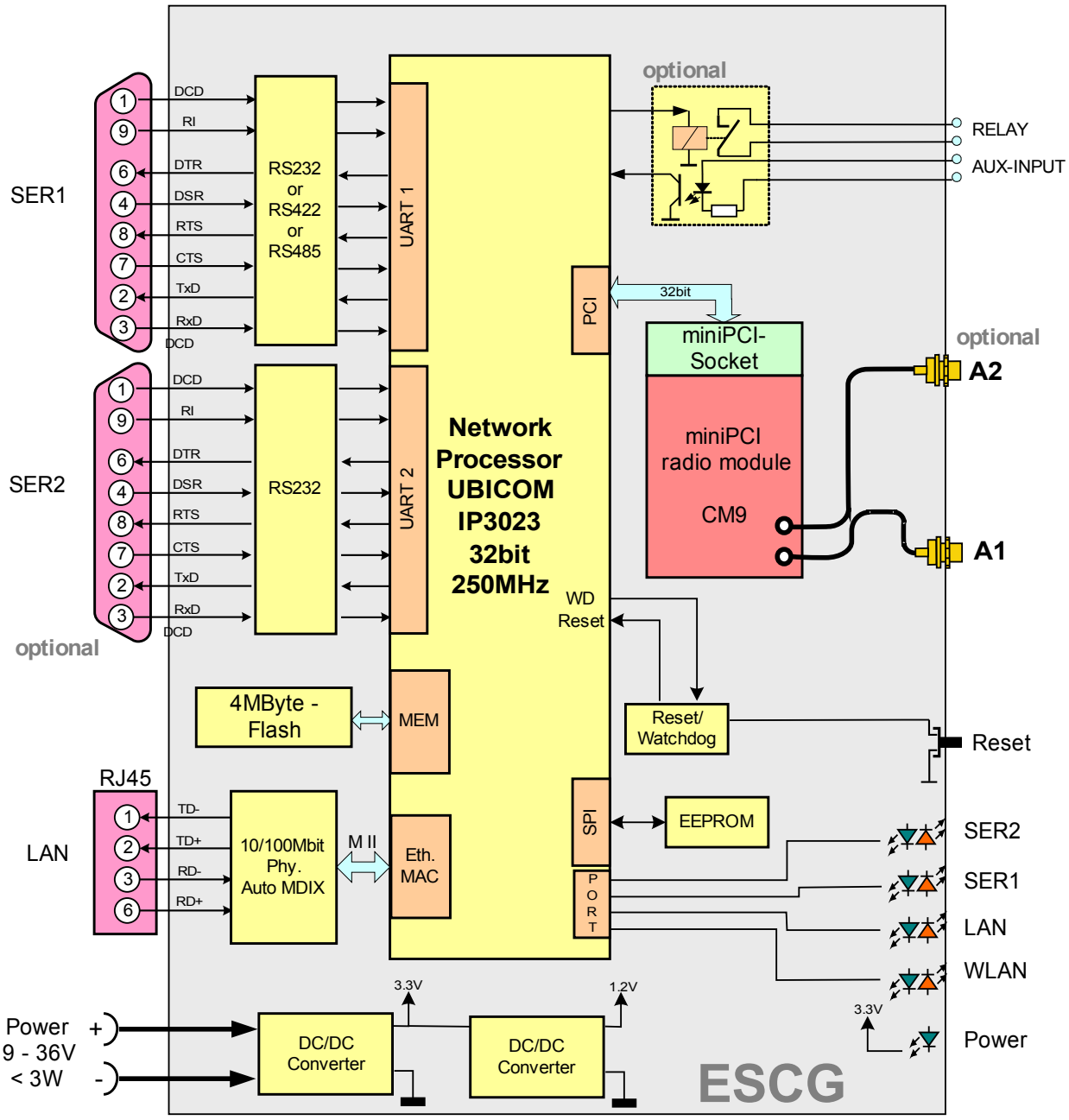


Illustration 2: Block schematic

Connections to the ESCG

The core of the ESCG is a 32bit network processor that controls all functions.

The interfaces are:

1) Mini-PCI-Socket
2) Ethernet-Interface 10/100 MBit + auto MDI (auto crossover function)
3) 1 or 2 serial interfaces with 6 status lines each
4) optional: Relay contact and AUX input with optocouple

The Ethernet port has a RJ45 plug. Because of the auto MDI functionality the ESCG can be attached to a HUB or the LAN port of a computer with standard patch cables. The ESCG recognizes the cable polarity and automatically connects the right signal lines.

The serial port is a 9 pin female D-SUB connector. The pinout makes it possible to connect to a computer COM port with a 1 to 1 serial cable. The exact pinout is shown in Illustration 3 below.

In the standard version the power supply should be 8 – 30VDC / 3W. At 12VDC the input current is typically 250mA.

Back and front view:

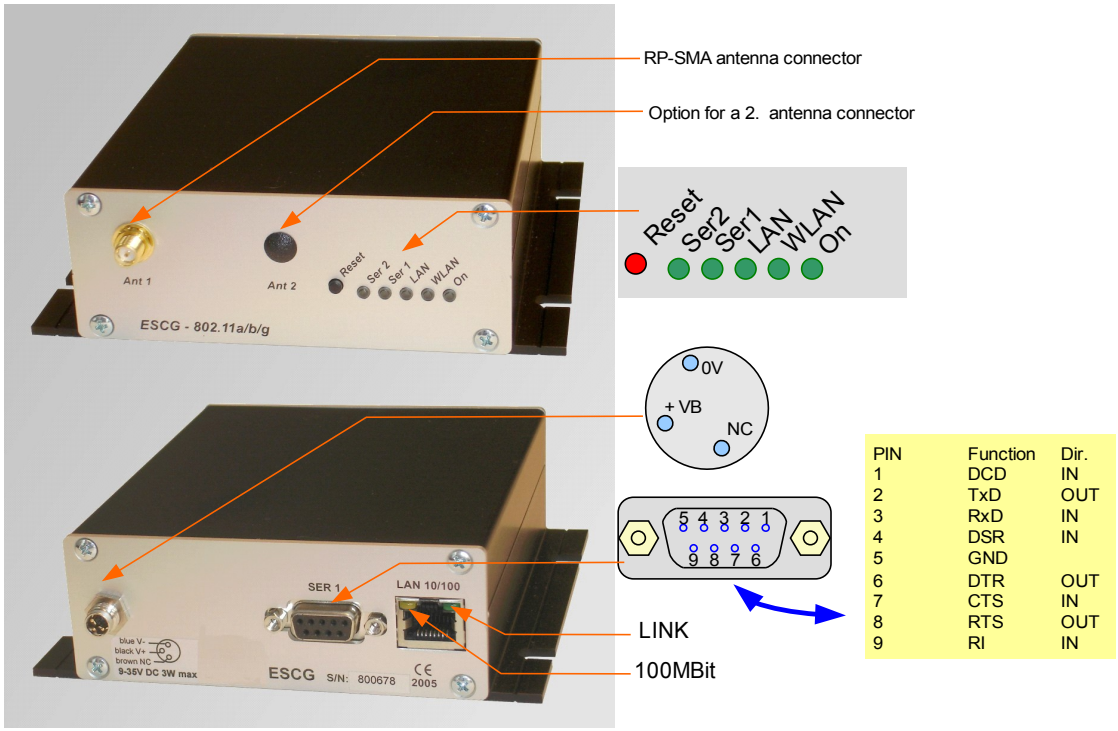


Illustration 3: Connections and LED's

LED	Function	
On	**Green**	always on when power is on
WLAN	**Red blinking**	searching for RF-connection (scanning)
	Steady green	found a suitable Access-Point and established a connection
	Green blinking	802.1x Authentication is in process
	Green + red blinking	RF activity (receive or transmit)
LAN	**Off**	no link is recognized
	Green	link is established with another LAN device.
	Green + red blinking	activity on the LAN interface
Ser1 (2)	**Off**	interface is inactive or not connected to the other (W)LAN-.communication side
	Green	connected to other serial device.
	Green + red blinking	activity on the serial interface (receive or transmit)

Technical features

Processor	Type	32bit network processor 250MHz clock
	Memory	256KByte program (internal) 64KByte data (internal) 4MByte flash (external) 4MByte SDRAM (external, optional)
Interface	Ethernet	10/100 Mbps fast Ethernet auto MDI/MDIX
	Serial 1	RS232 with control lines RTS, CTS, DSR, DTR,DCD (input), RI (input) (optional as RS485, RS422)
	Serial 2	Same as serial 1 but only RS232
	Mini-PCI	Socket for RF cards with Atheros chipsets (AR5112, AR5113, AR5414)
	Relay (optional)	Relay contact can be operated over LAN or WLAN Connection with circular M8-4pin connector with screw locking
	AUX input (optional)	Isolated input with optocouple
LEDs	LEDs	- Power (green) - WLAN (green, red) - LAN (green, red) - SER1 (green, red) - SER2 (green, red)
Power supply	Connector	Standard: DC jack (2.1mm pin / 5.5mm hole) optional: Circular M8-3pin connector with screw locking
	Power consumption	< 2.5W (typ.) < 3W (max.)
	Voltage range	Standard: 8-30V non isolated optional: 18-72V or 9-36V isolated
Temperature range		operating 0 - 70°C (32 - 158°F) storage -20 - 80°C (-4 - 176°F)
Dimensions	Board	120x100x20mm
	Case	standard: 125x105x40mm
	Weight	approx. 500g

WLAN - Interface

WLAN	Encryption	64, 128bit WEP, TKIP, AES
	Security	802.11i WPA + WPA2 (Wifi Protected Access) (PSK/TKIP/AES) 802.1x (EAP-(T)TLS, EAP-PEAP), LEAP
	Data rates	802.11b 11, 5,5, 2 & 1 MBit/Sec. 802.11g 54, 48, 36, 24, 18, 12, 9, 6 MBit/Sec. 802.11a 54, 48, 36, 24, 18, 12, 9, 6 MBit/Sec.
	Frequencies	ISM band: 2.400 MHz to 2.483 MHz U-NII band: 5.150 MHz to 5.350 MHz (ETSI, RegTP indoor) 5.470 MHz to 5.725 MHz (ETSI, RegTP outdoor)
	Channels	802.11b/g: ETSI: 1-13, (3 non overlapping) 802.11a: ETSI: 19 non overlapping (5.150-5.350 & 5.470-5.725 MHz)
	Power output	802.11b/g: 18dBm peak 802.11a: 18 or 17dBm

First Time Setup

To set up the ESCG it has to be connected with a patch cable to the Ethernet interface of a computer. Because of the auto MDI/MDIX capability, you can use a straight or crossover patch cable.
After applying power, the green “Link LED“ on the RJ45 connector shines when a link is detected. The yellow “100 MBit LED“ indicates whether the connection is capable of 100 MBit.
The “LAN” LED on the front panel shines green when a connection has been established via the Ethernet.
The “WLAN” LED on the front panel will be blinking red because usually no suitable WLAN is recognized.

The ESCG-Config Program

To do the „first time setup“ the ESCG has to be connected via the LAN-Interface to the computer (PC) that runs the ESCG-Config-Program.

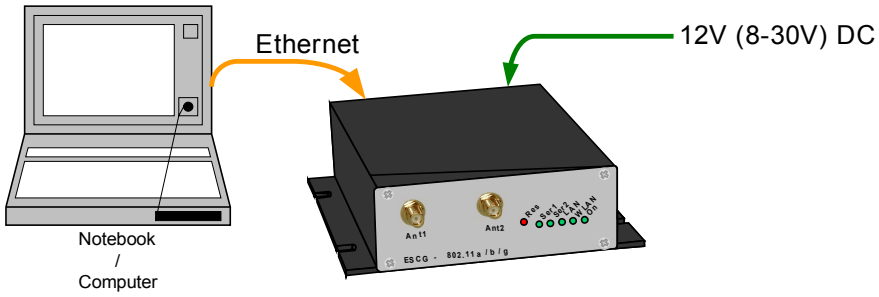


Illustration 4: arrangement to configure the ESCG

You have to observe:

- The connected PC should have an fixed IP address. (no DHCP)
- The LAN-Interface at the PC must be detected as connected. Check the parameter of the LAN-Interface with the „ipconfig“-command.
- If the LAN-Interface of the PC is correctly recognized then press the „refresh“-button of the ESCG-config-program.
- An active firewall could prevent the communication to the ESCG.

After the start the ESCG-Config-Program ascertained all network interfaces that are active at the PC. After that the ESCG-Config-Program sends broadcast UDP requests to all these interfaces. The registered answers of the ESCG devices are shown in a list.

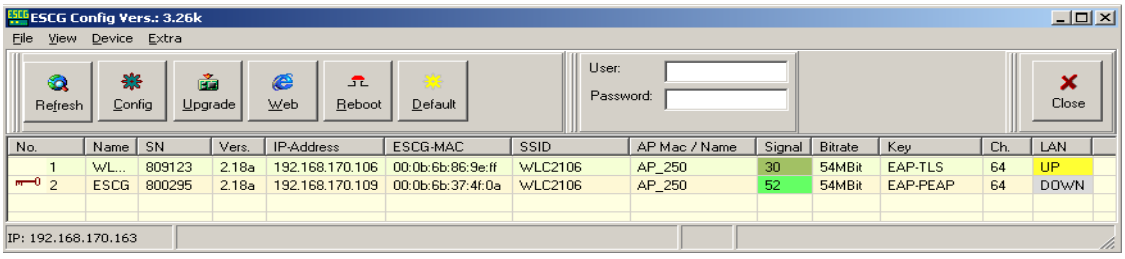


Illustration 5: ESCG-config screenshot

All located ESCG-Devices are shown in a list with there station names, firmware versions and addresses.
The WLAN connection is also shown with a signal quality value.
The value can be interpreted as follows:

Signal >= 40 → connection very good
Signal >= 30 → connection good
Signal >= 20 → connection is ok, but the ESCG starts to search for better AP's.
Signal < 20 → connection restricted, the bit rates will be lowered.

Reset to factory default

The factory default settings can be restored by pressing the reset button located on the front panel for a longer period. After about 5 seconds the LEDs "SER1" and "SER2" starts blinking red and green alternately. By keeping the button depressed the factory default values are restored. After finishing all LEDs except the "ON" LED are turned off. Now the reset button can be released.

main factory default values:

SSID =	"ESCG_WLAN"
WEP =	OFF
WPA =	OFF
MODE=	802.11b/g
IP =	192.168.170.100
Netmask =	255.255.255.0
Gateway =	192.168.170.1
SER1+2 :	off
802.1x user:	„admin"
802.1x password:	„password"

Parameter setting via WEB interface

Information page

General informations regarding firmware versions and status reports are shown on this page.

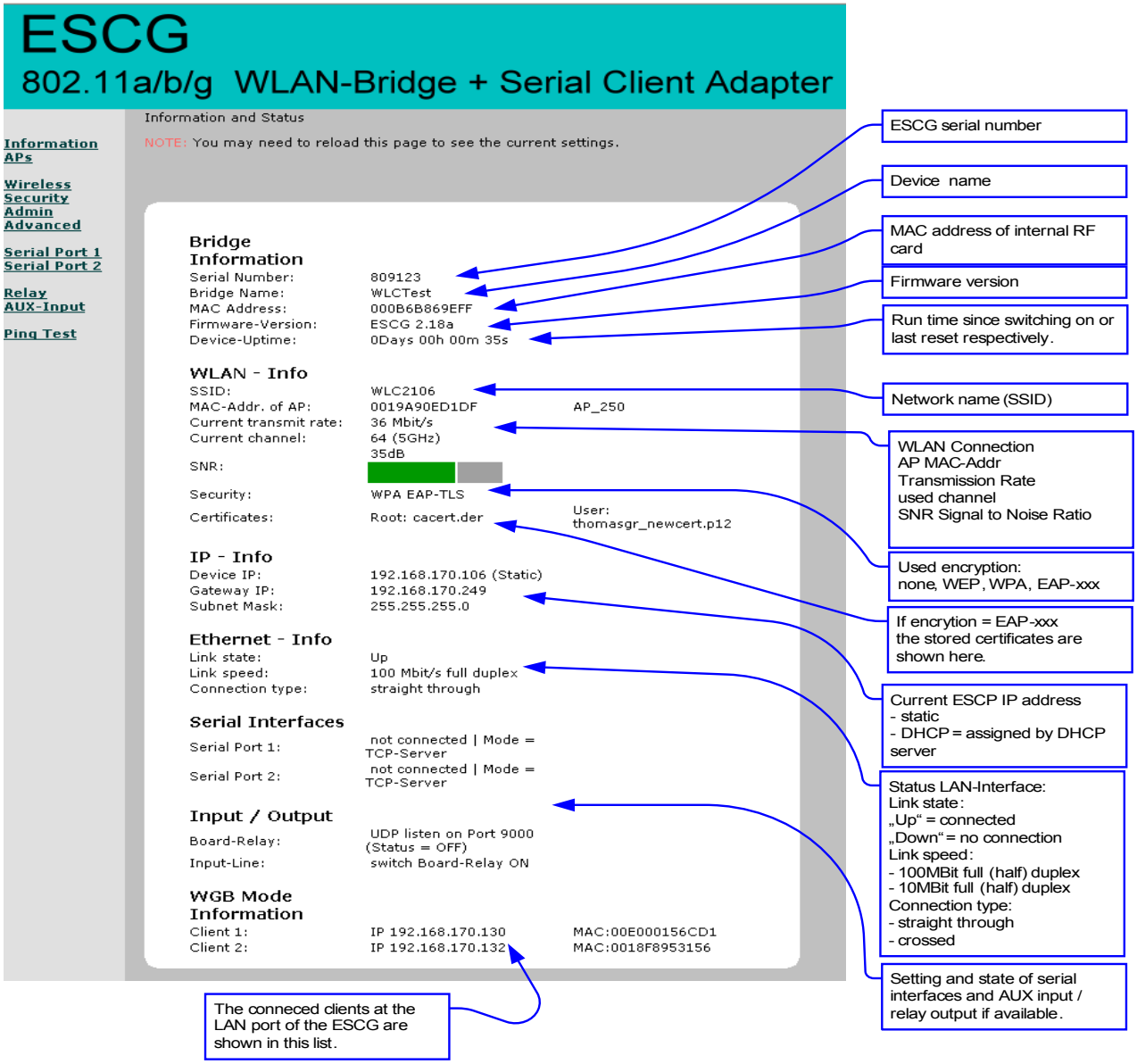


Illustration 6: Information page

On the left hand side are links to different setup and information pages.

- Information — the page above(Illustration 6)
- APs — a table with all access points currently seen by the ESCG (Illustration 7).

- Wireless — WLAN interface setup (SSID, mode, frequencies etc.) (Illustration 8)
- Security — Encryption setup (WPA, WEP) (Illustration 9)
- Admin — - reboot ESCG
  - reset all parameters to default.

- firmware updates
- configure IP-address, subnet mask, gateway IP
- configure setup options
- enter username and password

(Illustration 12)

- serial Port 1 setup of serial port 1 (Illustration 19)
- serial Port 2 setup of serial port 2

- Relay internal relay setup. (Illustration 20)
- AUX-input optocouple input setup. (Illustration 21)
- Ping Test settings for a special mode to test the WLAN connection.

Access point page

Information on all access points currently available to the ESCG.

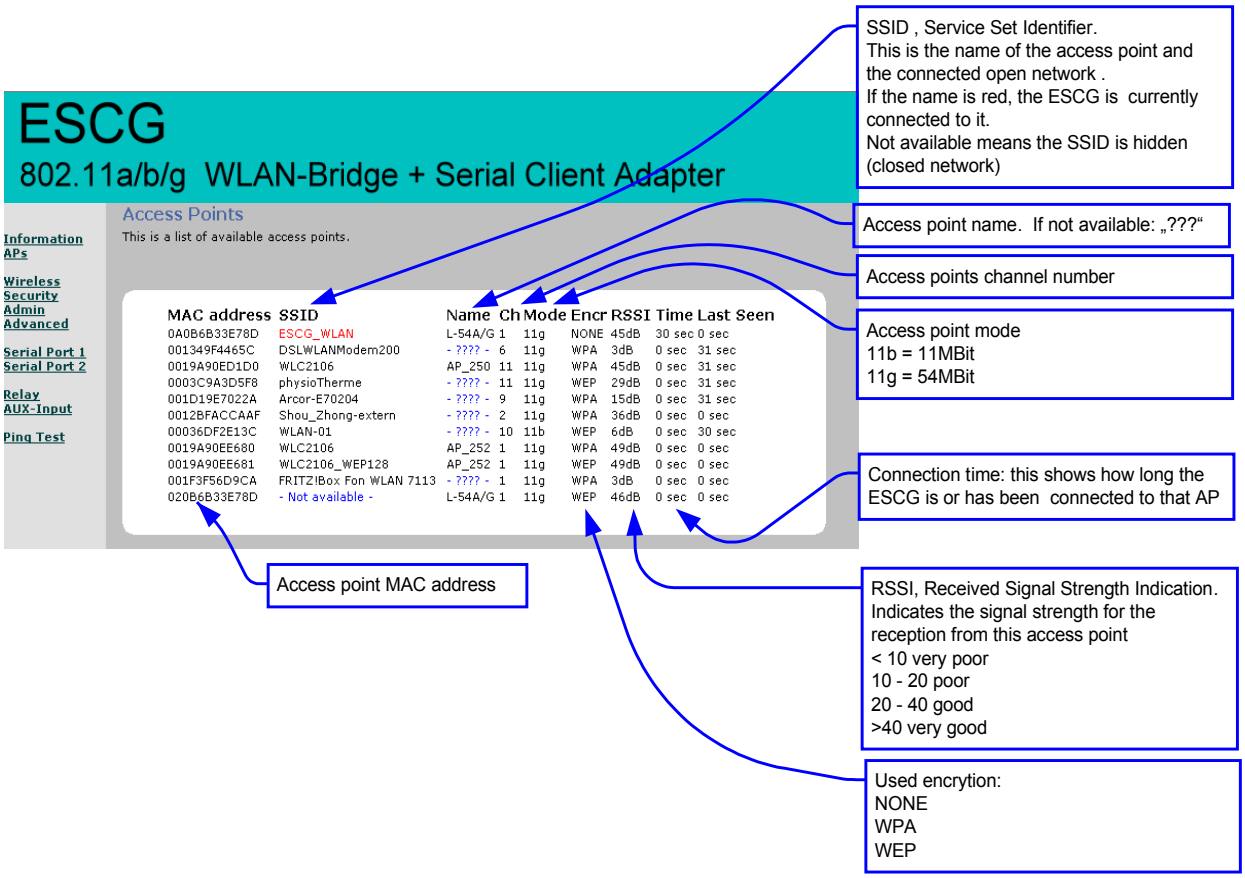


Illustration 7: Access point page

Wireless page

Configuring the WLAN interface

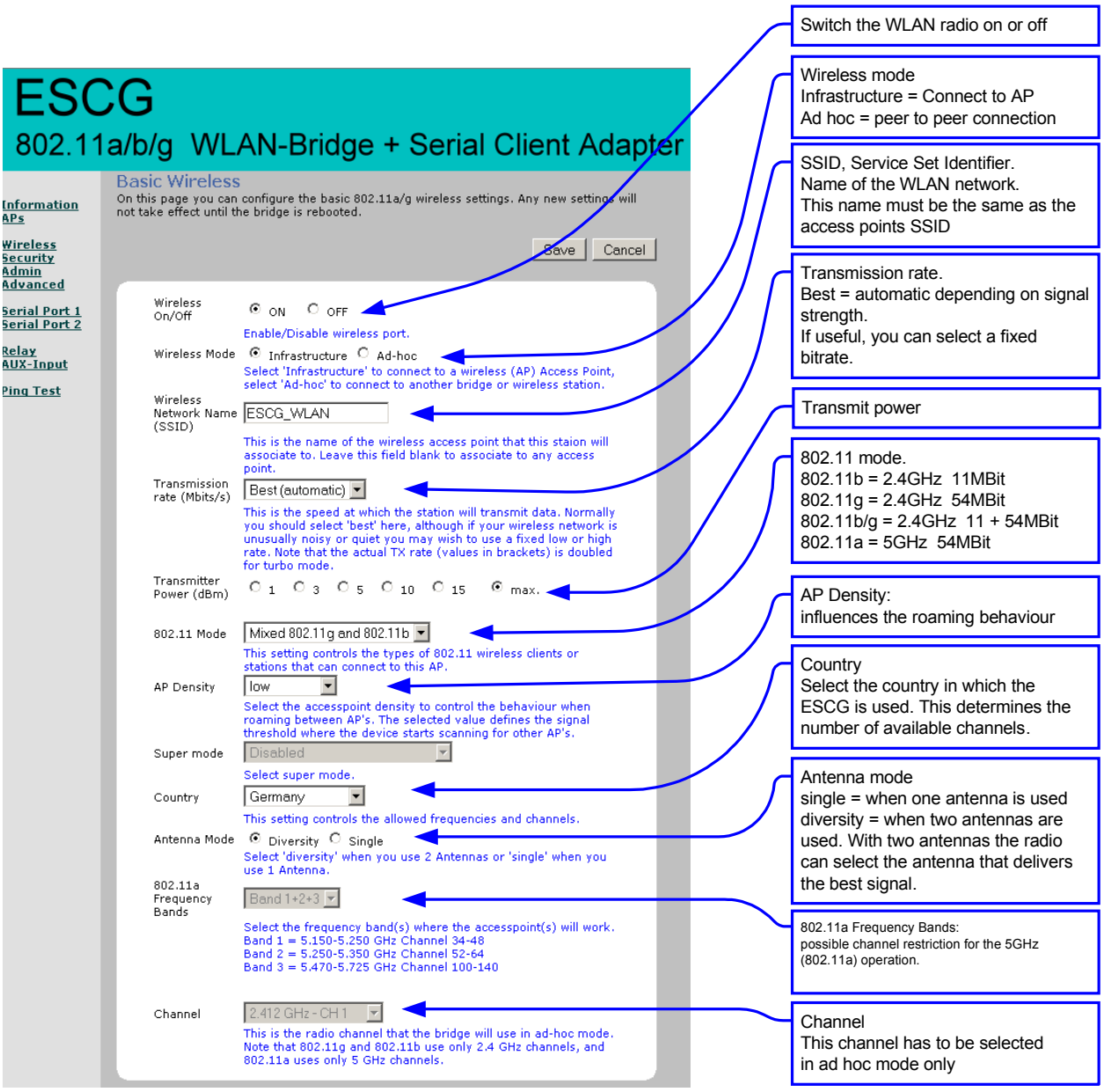


Illustration 8: Wireless page

I

By clicking the “Save“ button all changes on this page are stored. Use “Cancel” to undo any changes. After clicking “Save” the program prompts the user to make a reboot. This should be done after all necessary changes on all pages have been made.

Security page

Setting up the security options.
If the user selects the 802.1x authentication the PSK or the WEP-Keys don't have to be defined because the ESCG and the Radius-Server will determine these parameters automatically.

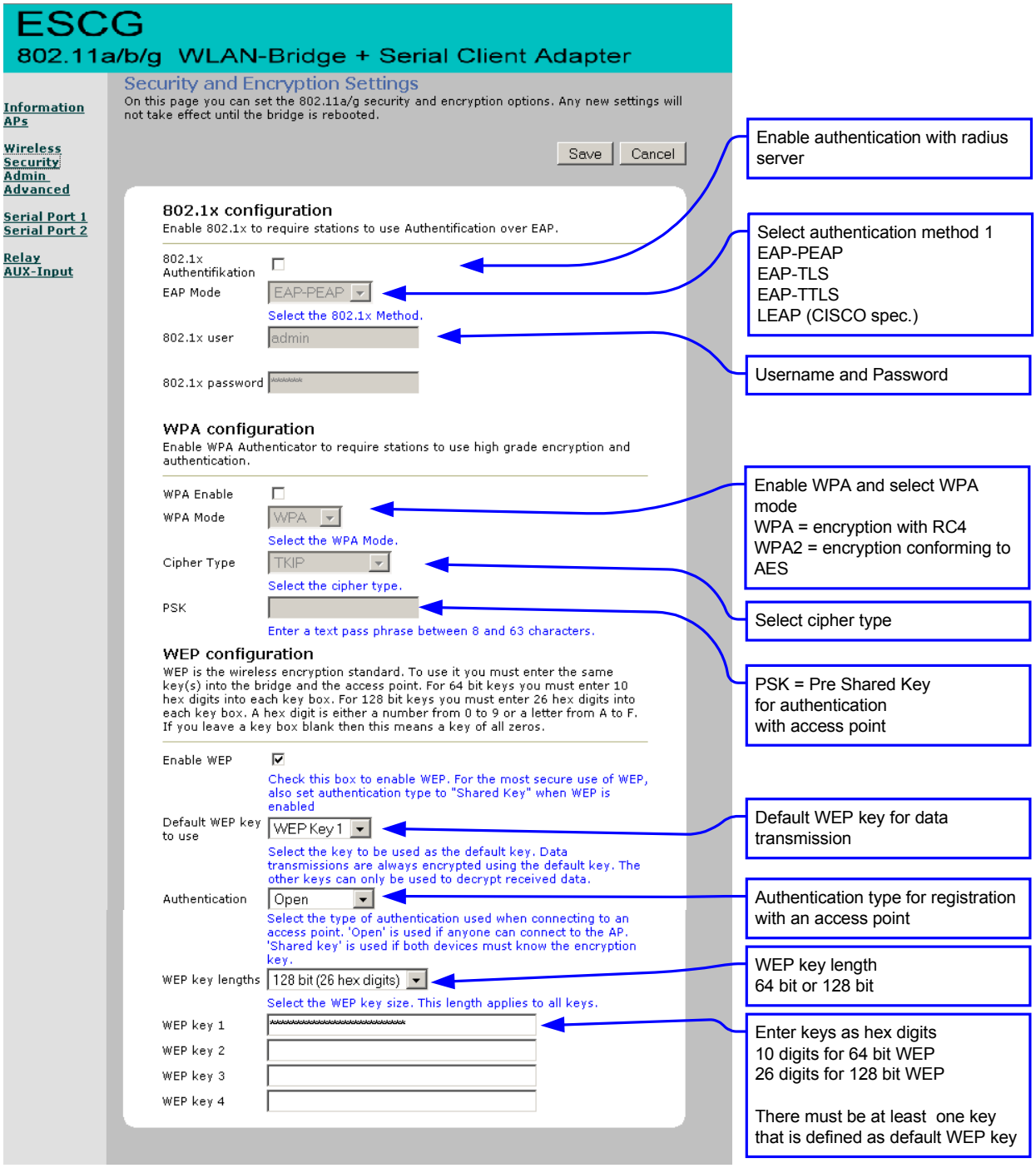


Illustration 9: Security page

Admin page

Setting up administration rights and configure basic features, update firmware

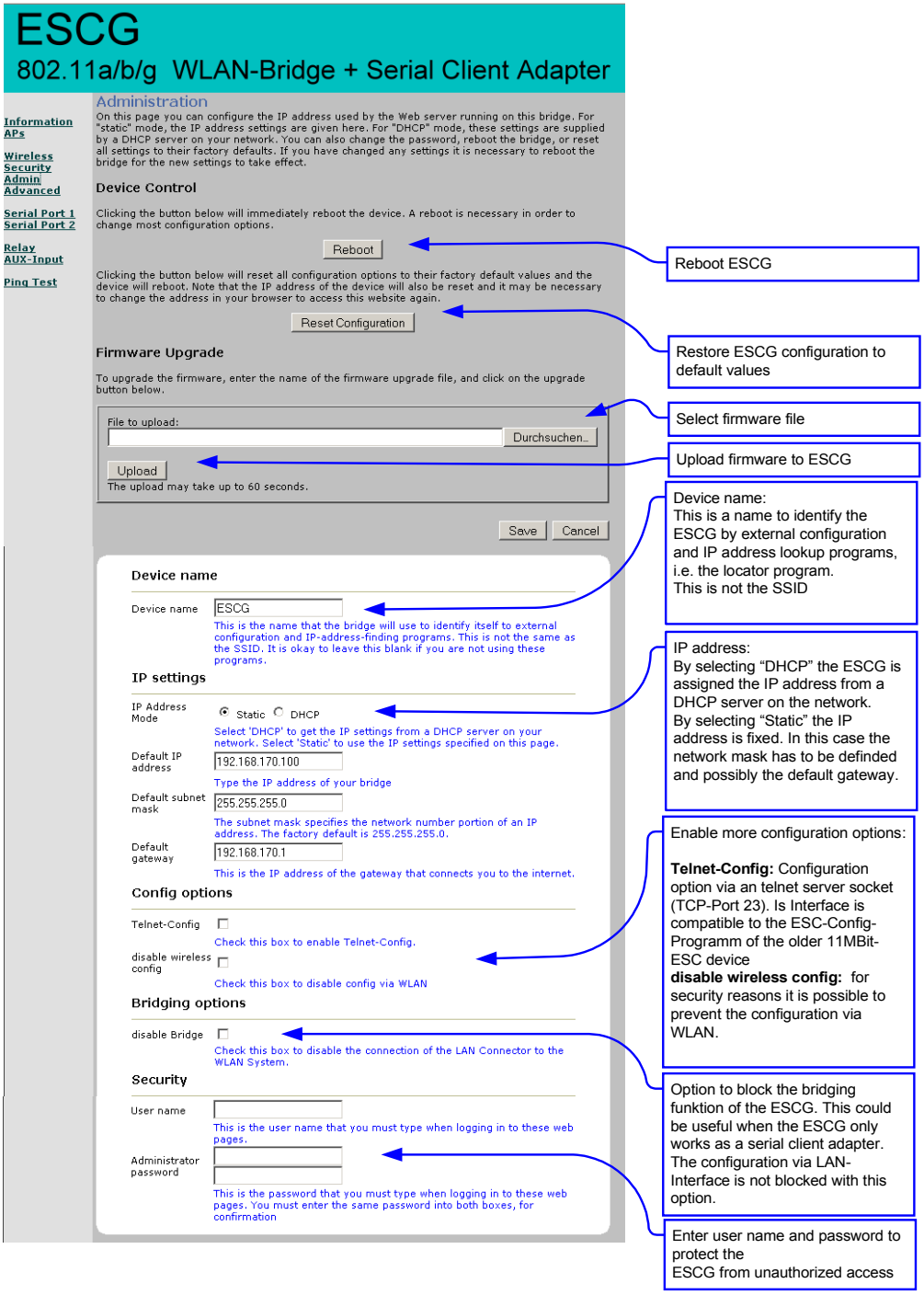


Illustration 10: Administration page

Advanced page

The advanced page offers more detailed options to define the behavior of the ESCG in the WLAN environment.

Cloning

The cloning parameter defines the MAC address of the ESCG's radio. Usually the ESCG leaves the MAC address at the manufacturers value. All devices which are connected to the ESCG's ethernet port use this MAC address for communication via WLAN.
The ESCG keeps a table where the original MAC address of the connected device is linked to its IP address.

If a data package arrives at the ESCG on the ethernet port, the ESCG first checks if there is an entry in its table with the source MAC address of this device. If the answer is no, this MAC address is added to the table.
Next it checks if there is an entry for the target MAC address.
If the answer is yes it means that the receiver of this data packet is located on the wired side of the ESCG and therefore there is no need to send it over the wireless radio.
If the answer is no, the source MAC address is replaced by the radio's MAC address and the data package is sent over the radio to the WLAN
If the ESCG receives a data package from the WLAN, it first extracts the target IP address. Next it looks up the corresponding MAC address in its table. This MAC address is placed in the data package which is then sent over the ethernet port to the connected devices.
With this method several devices can be connected to the ESCG.
This procedure only works in LAN's / WLAN's that use the IP protocol. If other protocols are used, the ESCG can be forced to transfer the MAC address of the first data packet that arrives on the ethernet port to the radio. This method is called cloning. It ensures that all data packages intended for the connected device are received by the ESCG. The ESCG can forward the data to the ethernet port without any further processing. This method allows only one device to be connected to the ESCG ethernet port. This strategy is activated by selection the option "Eth. Client (var)".

With the option "Eth. Client (fixed)" the user can defined a MAC address that the ESCG will use for the WLAN Connection.

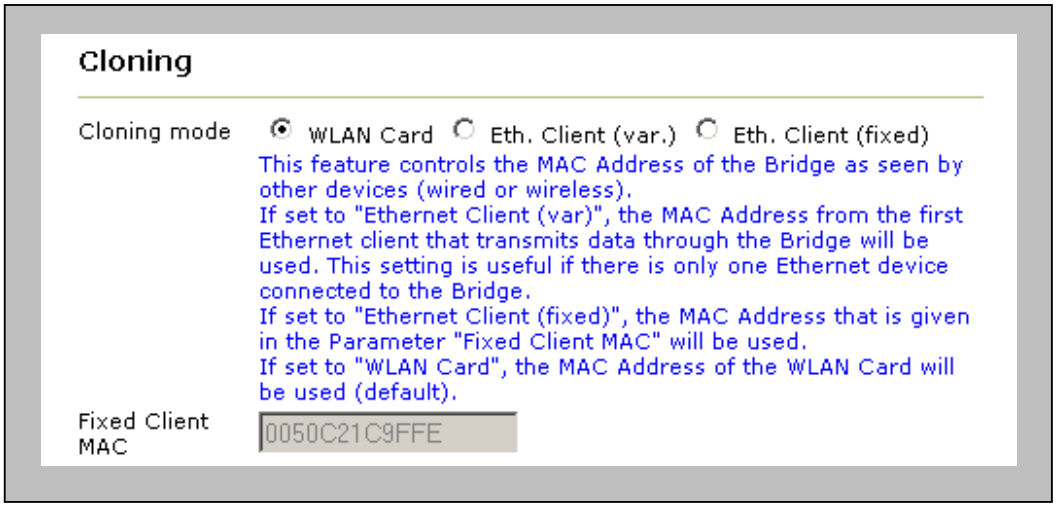


Illustration 11: Cloning section

Advanced bridging

Because some WLAN-Systems (especially centralized solutions like wireless LAN controller) don't accept that 2 different devices with different IP addresses are working with the same MAC-Address, it is possible to hide the IP-Address of the ESCG to the WLAN side.
To reach the ESCG from the WLAN side you have to define the IP address of the client that is connected to the LAN port of the ESCG.

If the connected client also operates a webserver on TCP port 80 an alternative webserver port for the ESCG can be defined. To reach the webside of the ESCG with the configuration shown in (Illustration 12) you have to input the address "192.168.170.130:8033" to the webbrowser.

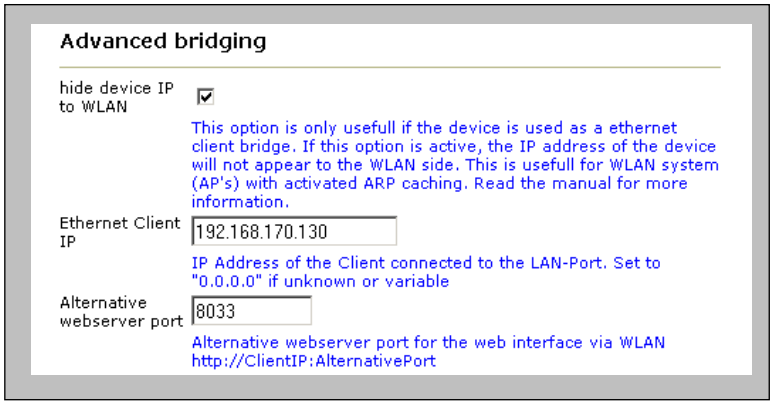


Illustration 12: Configuration example

WGB-Mode (Workgroup Bridge)

The WGB-Mode works exclusively in environments with CISCO access points and (or) CISCO Wireless LAN controller (WLC). If the ESCG works in systems with CISCO WLC's it is strongly recommended to configure the ESCG to work in WGB-Mode.
CISCO had implemented this special mode for client adapters. In this mode the clients which are connected to the LAN port of the ESCG are separately declared as WGB – clients to the wireless controller. The clients are communicating with there own MAC addresses via WLAN.

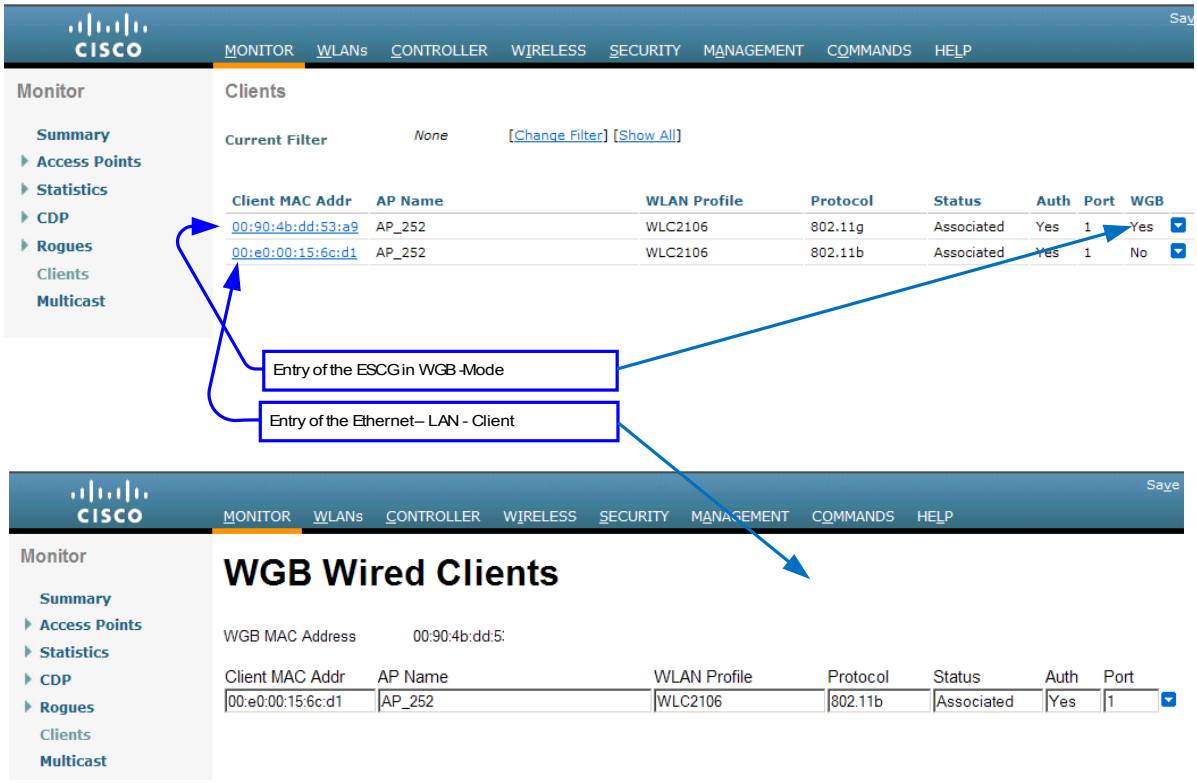


Illustration 13: Screenshots of the client table from a CISCO WLC 2106

The configuration of the WGB-mode can be completed by the definition of the IP addresses of the clients which are connected to the LAN Port. This is recommended for clients that don't communicate constantly. With a defined client entry in the WGB section, the ESCG can ping this client after startup. If the client answers the device can login the client to the wireless controller. A non defined client can only be announced to the wireless controller when the first ethernet data has been received to the ESCG.

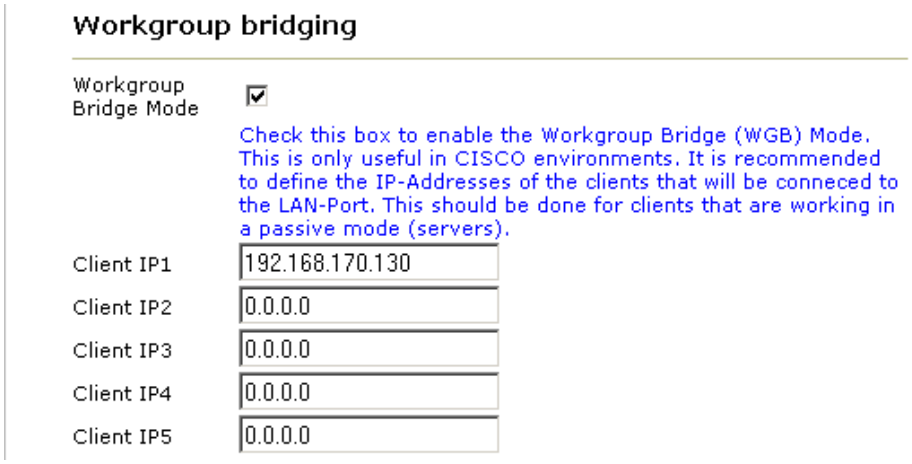


Illustration 14: Configuration example

Roaming

Roaming is the term for automatically changing to another access point when the ESCG recognizes a decreasing RF signal level when leaving the covered area of the current access point and a better level with another AP is available.
For this purpose the ESCG keeps a table with a list of access points from which it is receiving signals (beacons).
To receive these beacons the ESCG has to tune to the different channels and listen for incoming signals for a certain amount of time. This hampers the regular data traffic which the ESCG has to process. Therefore this procedure is handled in different ways depending on the current signal level.
To make this procedure even more effective, the user can restrict the channels where the ESCG is allowed to look for beacons of other access points.

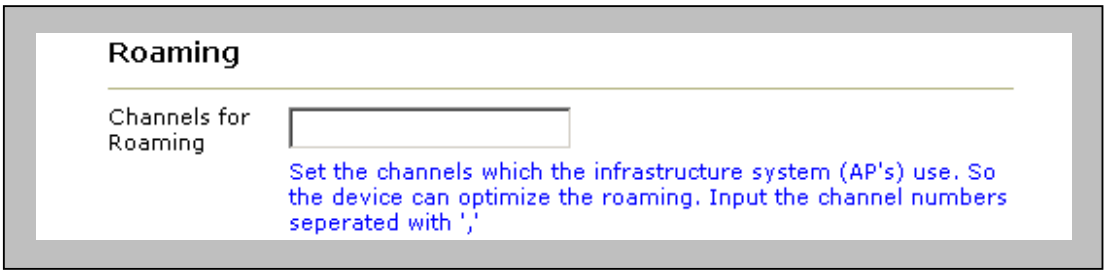


Illustration 15: Roaming channels

Ethernet Port

Check this option to enable manual settings for the ethernet port.

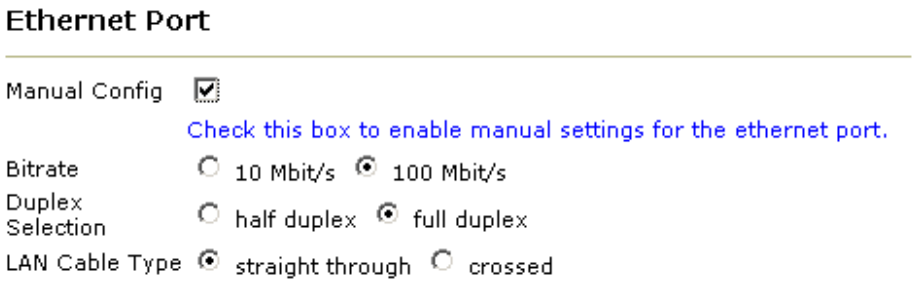


Illustration 16: Manual settings for the ethernet port

DHCP-Relay-Agent

Check this option to enable the DHCP-Relay-Agent of the ESCG. This is useful if the connected clients at the ethernet port of the ESCG are using DHCP. This option is not active in WGB-Mode.

Serial interface setup

The ESCG can have one or two serial interfaces, depending on the options. Each interface is configured on its own WEB page.

Network configuration

There are different modes available for the use of the serial interfaces:

1) **TCP/IP server mode**:
   In this mode the ESCG opens a socket in a “listen mode”, which means that it is waiting on a certain port (local port) for a connection. The ESCG only holds one connection at a time. In this mode only the port number has to be specified.
2) **TCP/IP client mode**:
   In this mode the ESCG actively opens a TCP connection on the specified port of another network node. This node can be another ESCG or a computer which is waiting for a connection on the specified port. In this mode the port number and the IP address of the connected device have to be specified.
3) **UDP/IP mode**:
   In this mode the ESCG is waiting for data on the “local port“ which are sent with UDP/IP. The received data are then sent to the “remote port” of the remote IP address. The UDP should be used in circumstances where the communication between the devices is frequently interrupted. It should be considered though that the UDP protocol does not guarantee the correct transfer of data.
4) **Printerserver mode**:
   In this mode the ESCG starts a TCP/IP socket in server mode which is waiting for a connection on port 515. The ESCG is then able to execute print jobs corresponding to RFC1179. If you want to enable a printer with this method under Windows, it has to be set up like the following example:

   Example:
   Windows setup for a printer connected over LPR

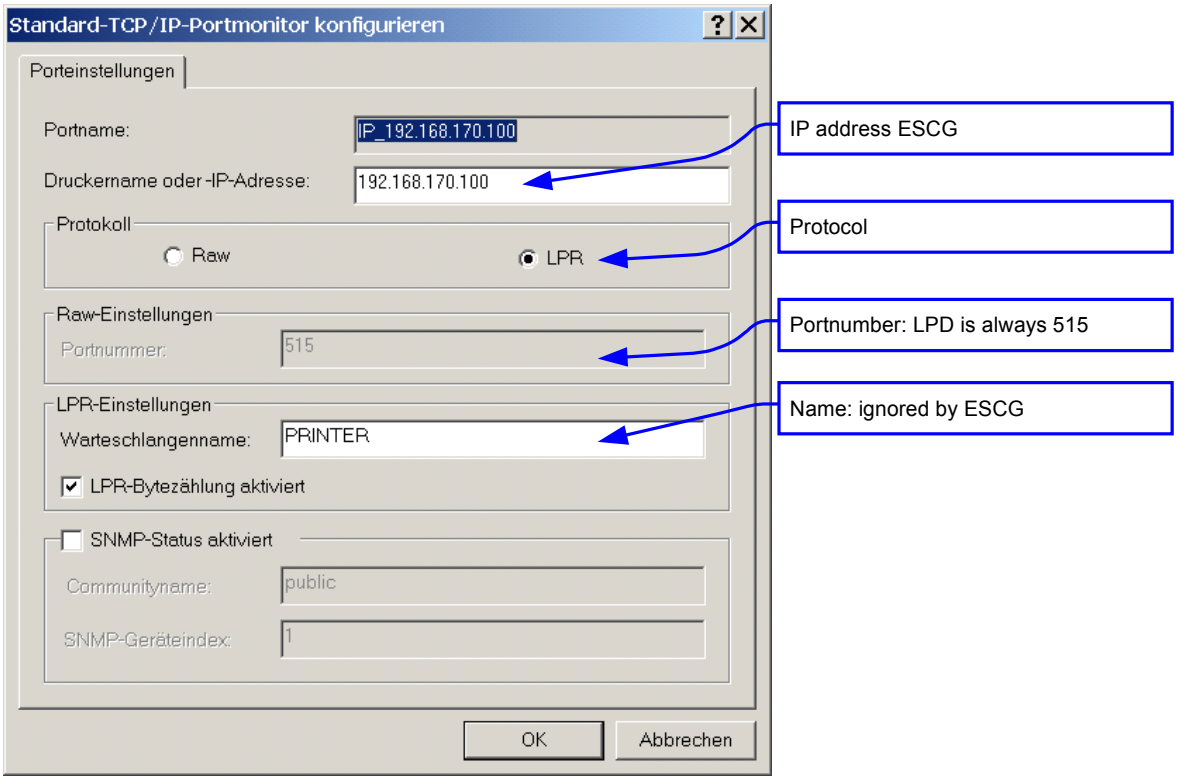


Illustration 17: Windows TCP/IP port monitor

5) **COM server mode**:
   In this mode the ESCG provides virtual COM ports under Windows. For this purpose a software tool from the company Wiesemann & Theis (www.wut.de) has to be installed. The tool is named “COM Umlenkung.

This tool enables the ESCG to connect to serial devices over LAN/WLAN. After installation of the software enter the ESCG IP address and port number.
Please take notice of the license regulations of Wiesemann & Theis to use this tool.

Comment to the multicast settings

In the Multicast-Mode serial busmembers who are communicating with RS485 interfaces can be connected via the (W)LAN. Depending which task the serial device takes it is possible to configure different modes:

1. Slave
2. Master
3. Multimaster

As a slave the ESCG receives data on the configured multicast address and sends this data to the serial interface. Data that is received from the serial line is sent to the given unicast IP address.

As a master the ESCG receives data from the unicast IP address and transmits data to the multicast IP address.
In multimaster mode all transfers are done via the multicast IP address.

sample application:

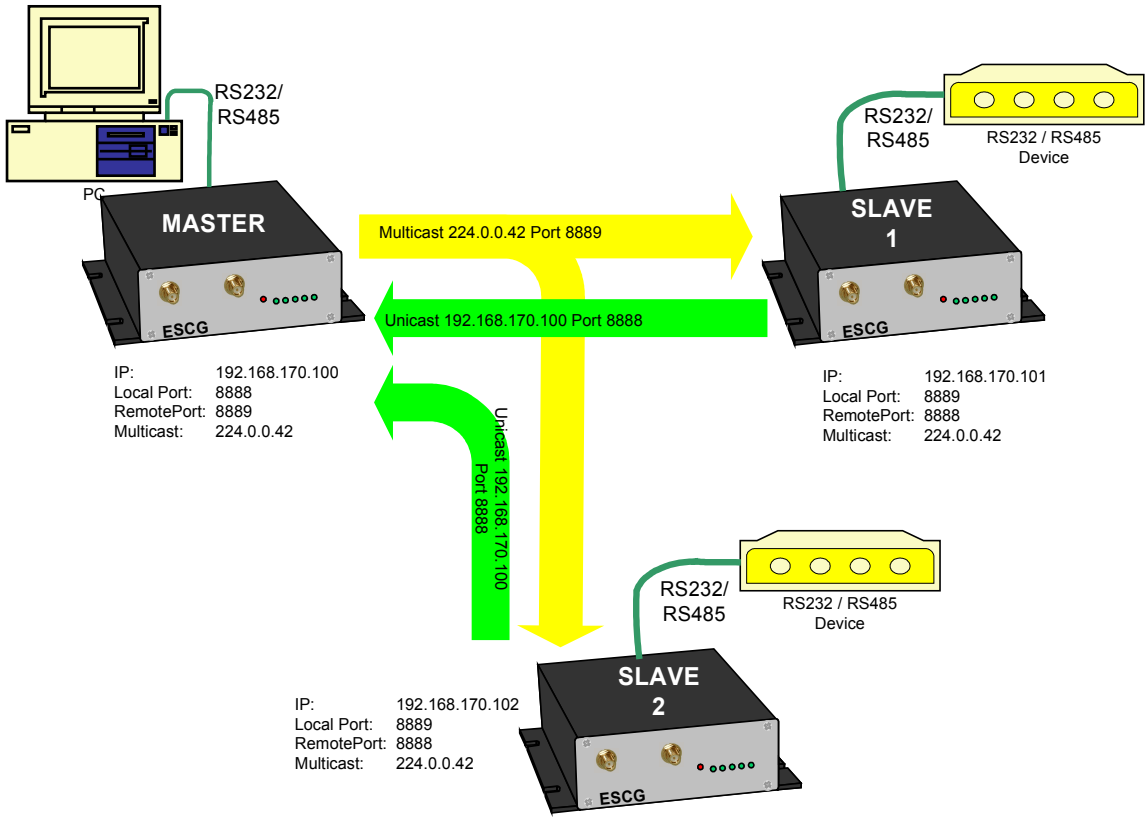


Illustration 18: Multicast-mode

“Keep alive“ settings

A TCP/IP connection remains open after being established until one of the communicating devices closes the connection. If the physical connection between the ESCG and the other device is interrupted without closing the TCP/IP connection, there is a possibility that the ESCG is not able to reconnect. The TCP/IP socket can be programmed to send an empty data package to the communication partner in regular intervals (keep alive period). If the communication partner supports this mode, it sends a corresponding answer. This answer is proof that the connection is still intact. If there is no answer for a number of times (keep alive probes), the TCP/IP connection is closed and the ESCG starts the TCP/IP socket again.

“Send trigger” configuration

The data received by the ESCG are first temporarily stored. There are different criteria when the stored data will be sent over the LAN/WLAN.

1) **Byte trigger**: The user defines a number of Bytes. After reaching that number, the stored data are sent.
2) **Timeout**: After receiving a character a timer with the programmed value is started. Each received character restarts the timer. Once the timer has elapsed the stored data are sent.
3) **Delimiter**: The user defines a certain character. When this character is received, the stored data are sent.

The parameter “**receive fifo size”** defines the quantity of bytes that can be stored in a ringbuffer before the data is sent to the (W)LAN interface. If you use the ESCG in an application that receives permanently data via the serial interface the “receive fifo size” has to be set to a value between 1024 and 2048 bytes. Because the ESCG needs all the available RAM memory in a situation of authentication with 802.1x (PEAP,TLS) this value is set to a value of 256Bytes by default to save memory space.

Handshake mode

This defines how the communication partners are signalling their ability to send and receive data. With the status lines RTS and DTR the ESCG reports that it is ready to receive. The status lines CTS and DTR are inputs where the communication partner reports its readyness to receive. The signals DCD and RI can be forwarded to the ESCGs LAN/WLAN communication partner.
The ESCG be controlled remote or local to handle the data flow.
The following modes are available to the user:

1) **no handshake**: The CTS/DSR signals are not utilized. CTS/RTS are set to active when the serial interface is connected over the LAN/WLAN.
2) **XON / XOFF** : The ESCG sends and receives the control characters XON = 0x11 and XOFF = 0x13. The ESCG sends a XOFF to his serial communication partner when the memory buffer is almost full and a XON when it is almost empty.
3) **RTS/CTS**: The ESCG signals that it is ready to receive over the RTS line and recognizes the CTS signal to determine if its serial partner is ready to receive.
4) **DTR/DSR**: The ESCG signals that it is ready to receive over the DTR line and recognizes the DSR signal to determine if its serial partner is ready to receive.
5) **Remote**: In this mode the ESCG transmits the state of the status lines CTS, DSR, RI and DCD to its LAN/WLAN communication partner. This happens over a different socket (port). This makes it necessary for the user to enter more specifications.
   The state of the status lines are described by strings of letters.
   A capital letter means the signal is active, a small letter means inactive.
   ’D’ = DSR active ‘d’ = DSR inactive
   ’R’ = CTS active ‘r’ = CTS inactive
   ’C’ = DCD active ‘c’ = DCD inactive
   ’I’ = DSR active ‘i’ = DSR inactive

   The ESCG interprets the received data as follows:
   ’D’ -> set DTR to active ‘d’ = set DTR to inactive
   ’R’ -> set RTS to active ‘r’ = set RTS to inactive
   ‘C’ or ‘c’ and ‘I’ or ‘i’ are ignored.

6) **3964R**: This is a special protocol which is commonly used for communication with SPS (programmable control systems). This protocol uses special characters and events to signal when it is ready to transmit and receive. Descriptions of this protocol are available in literature.

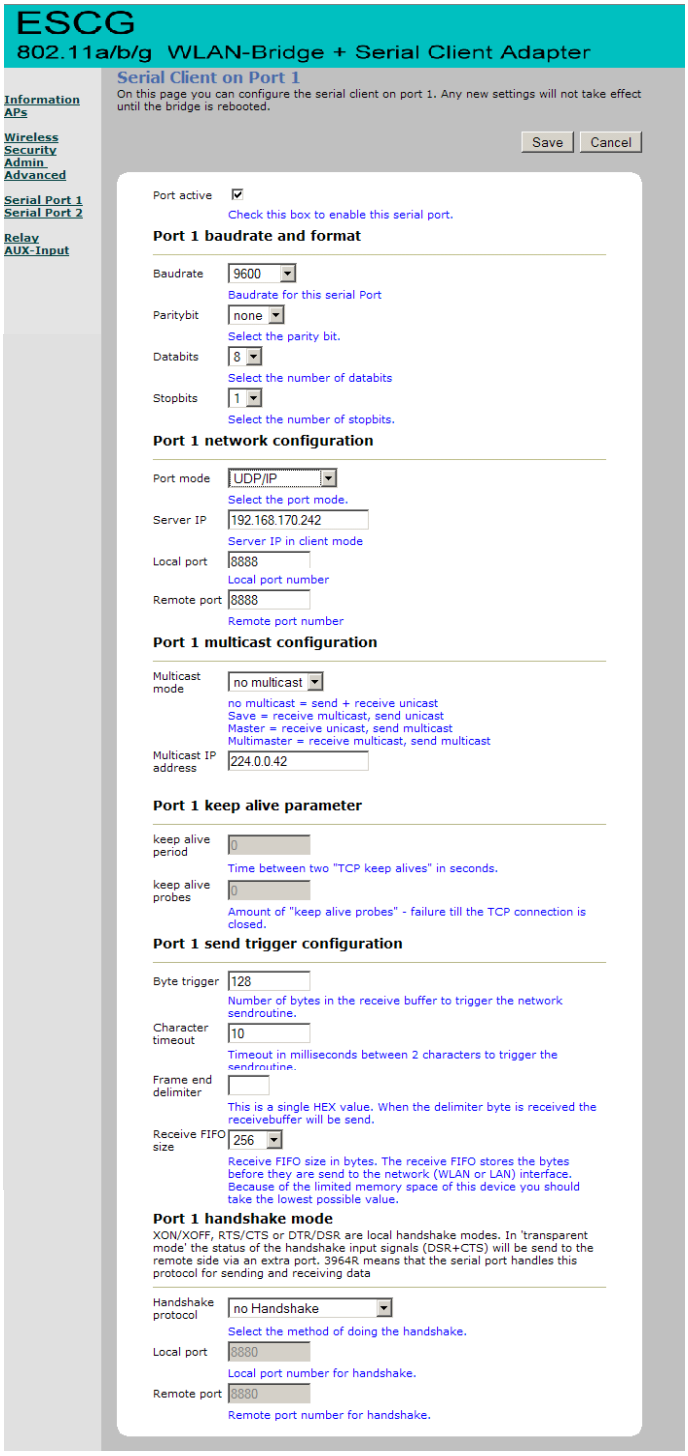


Illustration 19: Serial interface setup

Internal Relay

The ESCG can be ordered with an internal relay. This provides the user with a contact which can be opened or closed over the network or with the optional AUX input.

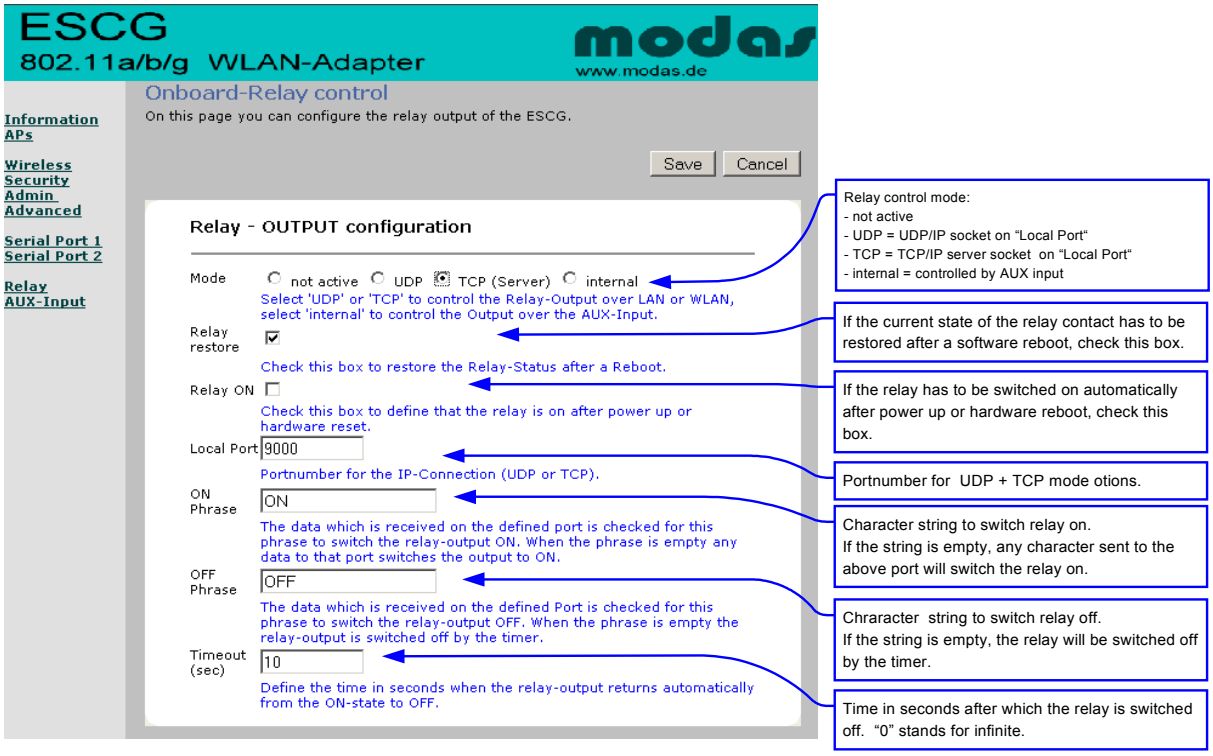


Illustration 20 Relay settings

AUX input

The optional AUX input is connected to the processor via optocouple. It can be configured that its state is signaled over the network or that it actuates the internal relay.

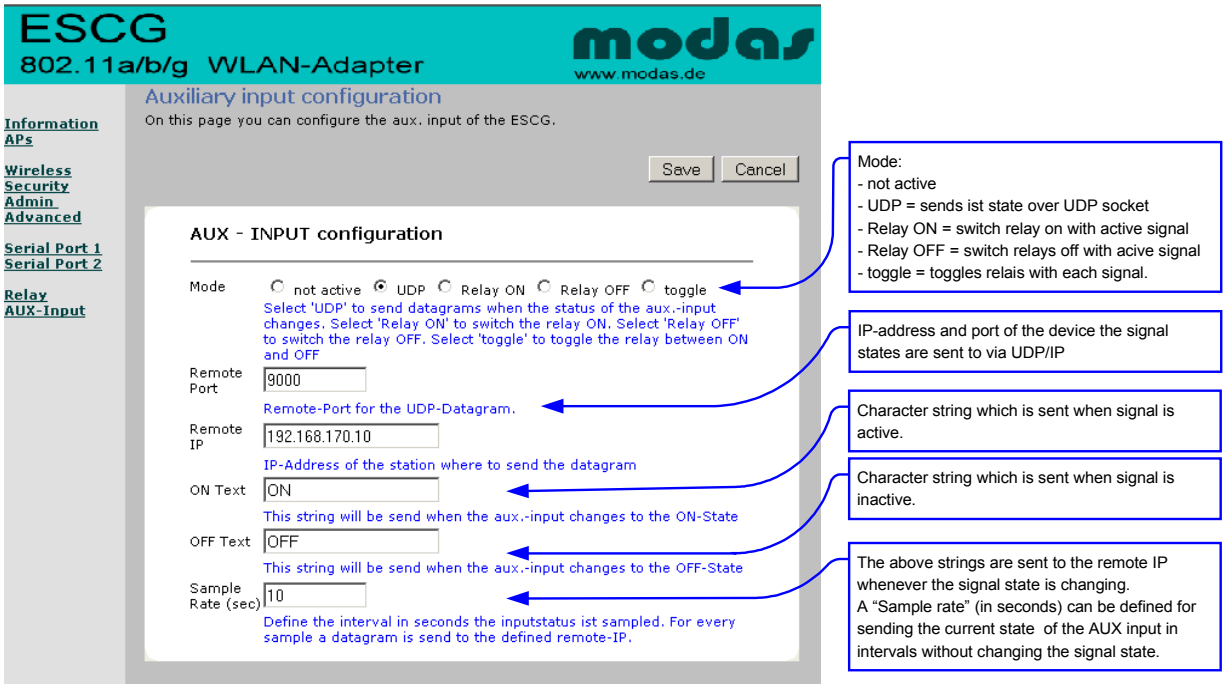
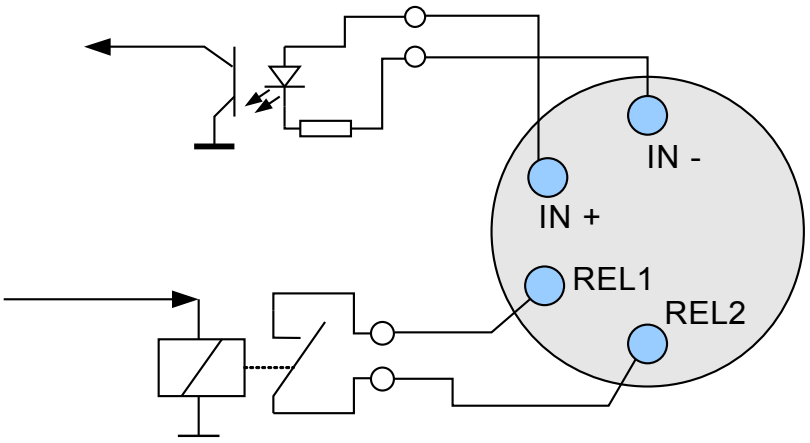


Illustration 21 AUX input settings

Connector for relay and AUX-input

If the ESCG comes with the relay option an additional connector is mounted on the back panel.



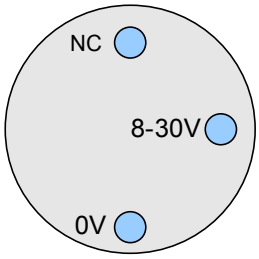
Connecting cable colors:

IN-	blue
IN+	black
REL1	white
REL2	brown

Illustration 22 Pin assignment for relay + input connector

Power supply connector

Optional the ESCG can be equipped with a circular M8- 3pin connector. The connection is as follows:



M8 cable wire colors:
0V blue
8-30V black
NC brown
NC = not connected

Illustration 23 Power supply connector

The following illustration shows the mounted connectors for relay and power supply at the rear panel.

Illustration 24 Rear panel with relay and power connector