

TAC7 + MODBUS TCP/IP

User's manual



Swegon 

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1 Overview

1.1 Scope

TAC7 regulations for GLOBAL / ESENSA units.

The MODBUS TCP/IP communication with the TAC7 regulation boards requires an additional satellite circuit being used as interface of communication:

- Option SAT WIFI-ETHERNET or SAT INSIDE Ready¹ (referenced as “SAT WIFI-ETHERNET” only for the rest of the document):
 - Remote control with specific Swegon App for Windows 11 or custom software.
 - Enables MODBUS TCP/IP protocol on wireless Wi-Fi network IEEE 802.11 b/g/n or on Ethernet over twisted pair 10 BASE T/100Base-TX IEEE 802.3 network.

1.2 The label of the SAT WIFI-ETHERNET

The label placed on the SAT WIFI-ETHERNET contains 5 lines text:

- 1- Name of the SAT: SAT WIFI-ETHERNET (or SAT INSIDE Ready)
- 2- Code ID of the SAT: G020055 (G020056 for SAT INSIDE Ready)
- 3- The unique MAC ADDRESS of the Ethernet module
- 4- The unique MAC ADDRESS of the Wi-Fi module
- 5- The Software and Hardware versions of the SAT

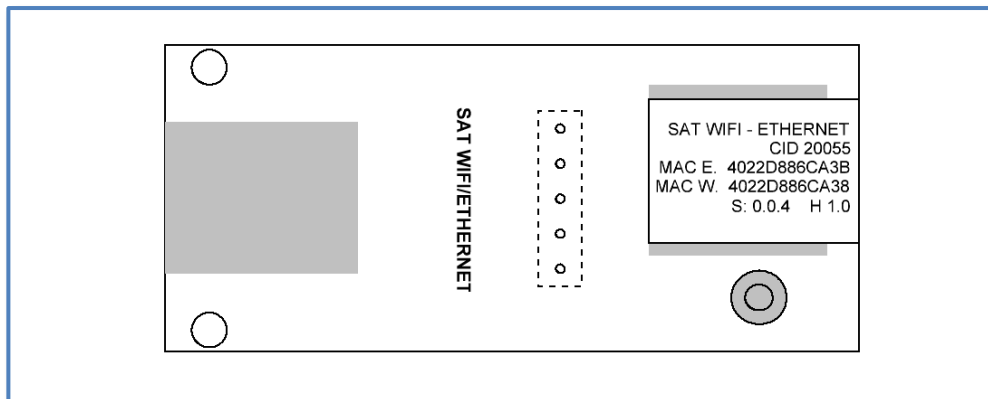


Figure 1 - LABEL OF SAT WIFI-ETHERNET

¹ SAT INSIDE Ready is a SAT WIFI-ETHERNET device with additional MQTT protocol and certification, enabling connection to Swegon INSIDE services.

1.3 Plugging the satellite module

The assembly must be carried out with the power OFF. The satellite module must be plugged on the « SAT COM » plug of the TAC7 regulation board.



Caution: A bad positioning of the satellite module on circuit TAC7 can fatally damage both circuits!
The following figure shows the installation of SAT WIFI-ETHERNET on TAC7 control boards.

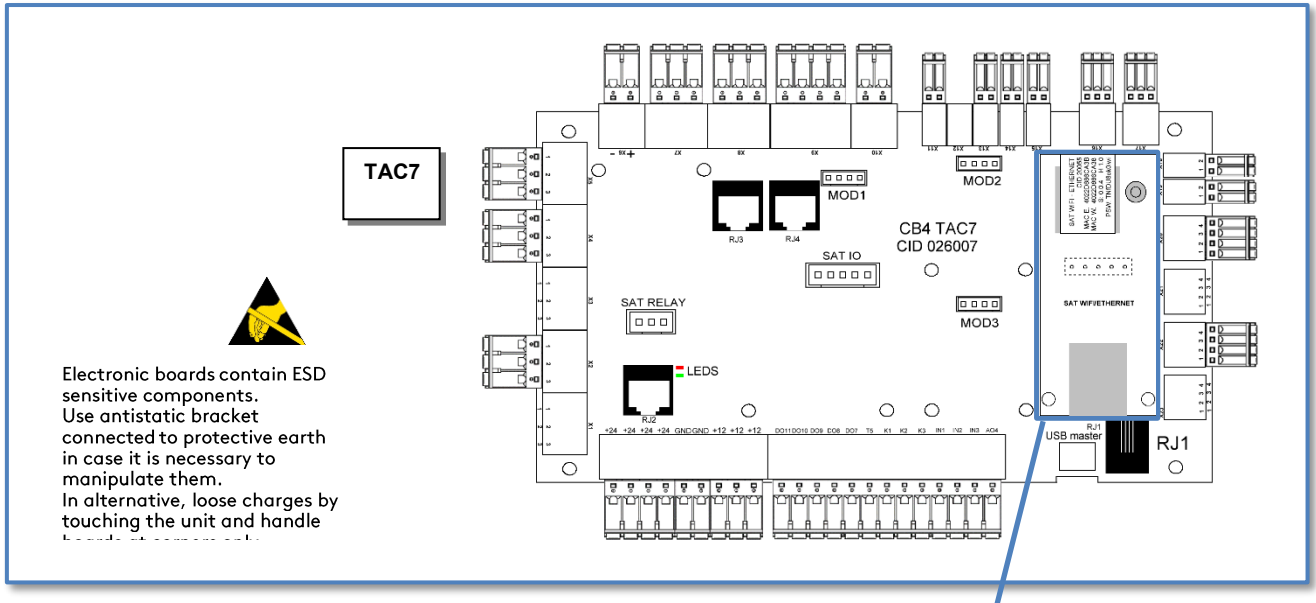


Figure 2 - Installation of SAT WIFI-ETHERNET on TAC7 circuit

1.4 Connections of the SATELLITE MODULES

1.4.1 Wi-Fi connection

To communicate with the SAT WIFI-ETHERNET through Wi-Fi, no other particular physical connection is necessary.

1.4.2 ETHERNET connection

To communicate through Ethernet with the SAT WIFI-ETHERNET, this one has to be connected either to an existing local area network (LAN, see figure 3), or directly to a PC in a Point-to-point link (see figure 4). Just plug the Ethernet cable into the RJ45 connector on SAT WIFI-ETHERNET and, only for Point-to-point connection with a PC, connect the other extremity of the cable to the Ethernet network adapter of the PC.



Figure 3 - SAT WIFI-ETHERNET connection in a LAN

Figure 4 - SAT WIFI-ETHERNET Point-to-point connection with a PC

Cable Specifications:

- Ethernet cable, UTP category 5, 5e or 6 with RJ45 male connectors (figure 5).
- Maximal length = 100m.



Figure 5 - Example of UTP category 5 cable with RJ45 male connectors

2 Definition of the MODBUS TCP/IP communication

2.1 MODBUS TCP/IP Protocol

The TAC7 controllers use the communication protocol MODBUS TCP/IP in one server, the satellite board, to multiple clients (maximum 3) architecture. The server is addressed by the client thanks to its IP address and communication port number which is 502.

Each message has the same structure: the frame is made of the transaction identifier, protocol identifier, length field, unit identifier, the function code (writing or reading) and the data bytes.

Main specifications:

- MODBUS TCP/IP protocol
- Physical layer:
 - o Ethernet over twisted pair 10 BASE T,
 - o Compatible Wi-Fi 802.11b/g/n.

2.2 MODBUS TCP/IP frame

The MODBUS frame is presented in the following way:

Transaction identifier	Protocol identifier	Length field	unit identifier	Function code	Data
2 bytes	2 bytes	2 bytes	1 byte	1 byte	N bytes

Transaction identifier: Used for synchronization between messages of server and client

Protocol identifier: Always 0 for Modbus TCP/IP

Length field: Number of remaining bytes in this frame

Unit identifier: This is the Modbus address of the SAT module device. 1 must be used and only this address will be accepted since the SAT WIFI-ETHERNET is not Modbus TCP/IP bridge to Modbus RTU.

Function code:

- Supports function code 3 (decimal) for reading multiple holding registers.
- Supports function code 6 (decimal) for writing a single holding register.
- Supports function code 16 (decimal) for writing multiple holding registers.

Data: All TAC7 data is in 16-bit Modbus holding registers. Modbus coils, discrete inputs or input registers are not used. The Modbus communication buffers size is sufficient for reading 125 registers at once or writing 123 registers at once.

In the Modbus.org standard documents, holding register addresses are given a prefix of "4" to distinguish them from other register types. For example, in their documentation a holding register at address 1001 is referred to by "41001". However, the leading "4" is not really part of the address. Also, the Modbus.org standard documents refer to register addresses using "one-based" numbering. However, the addresses that are actually sent in a Modbus command message are "zero-based". For example, to read register 1001, the address that is actually sent in the command message is 1000.

2.3 MODBUS exception

The TAC7 Modbus protocol may respond with an exception code if the read or write command was invalid. Possible exceptions are:

- 01 ILLEGAL FUNCTION: The function code received in the query is not an allowable action for the slave.
- 02 ILLEGAL DATA ADDRESS: The data address received in the query is not an allowable address for the slave. Or the combination of data address and transfer length is not allowable.
- 03 ILLEGAL DATA VALUE: The master attempted to write a non-allowed value into a register. Which values are allowed may depend on configuration settings of other registers.

When a write of multiple registers is executed, the execution stops at the first invalid data address or invalid value.

2.4 MODBUS values

All values are signed values.

As usual, all Modbus words are in big endian byte order.

Some registers act as bitmaps with 16 status bits.

Some values are 32-bit. They are transferred as two 16-bit registers, first low word, and then high word.

When reading, the client must combine two 16-bit words into one 32-bit value. With shift:

$Val32 = (((long)HIGH) \ll 16) | LOW$. With math: $Val32 = HIGH * 65536 + LOW$. For example: Reg1=33041, Reg2=13:

$Val32 = 885009$.

When writing a 32-bit parameter, the server first buffers the low word. Then, when the high word is written, the 32-bit parameter is updated. This low-word buffer is shared for all 32-bit parameters.

2.5 Write cycles limitation

The controller stores all setup parameters and some control parameters in non-volatile EEPROM memory to protect against power failure. This EEPROM memory has an endurance of 1 000 000 write cycles. Therefore, these parameters should not be changed too often! Writing a parameter with the same value is not a change. Changing a parameter once per hour would result in 8760 writes per year or 1 000 000 writes in 110 years. Changing a setup parameter once per minute would result in 1 000 000 writes in only 690 days!

Those parameters are marked as "E1" in the MODBUS map.

Some parameters are stored in a non-volatile RAM memory. Those parameters have no writing limitation and their value is not lost in case of power break.

Those parameters are marked as "R" in the MODBUS map.

3 Setup

3.1 ETHERNET SETUP

3.1.1 Configuration for LAN

By default, the IP address of SAT WIFI-ETHERNET is 192.168.1.1 with netmask 255.255.255.0, gateway 0.0.0.0 and DNS 192.198.100.1.

It may be configured, and can be either a static IP address, by default, or a dynamic address assigned by the DHCP server of the LAN to which the SAT is connected to. If not DHCP, the netmask, gateway and DNS of the Ethernet network have also to be setup.

The setup can be done through a point-to-point connection with a PC (see point 3.1.2) or with the TACtouch, function Communication/SAT LAN:

Parameter	Value
IP CNFG	Select DHCP if the IP address of the unit is assigned dynamically, select MANUAL to enter a static IP address. Default is MANUAL.
IP address	If IP CNFG= MANUAL, enter the static IP address: 4 numbers from 0 to 255 in IP address 1, IP address 2, IP address 3 and IP address 4.
netmask	If IP CNFG= MANUAL, enter the netmask: 4 numbers from 0 to 255 in netmask 1, netmask 2, netmask 3 and netmask 4.
gateway	If IP CNFG= MANUAL, enter the gateway: 4 numbers from 0 to 255 in gateway 1, gateway 2, gateway 3 and gateway 4.
DNS	The DNS (Domain Name Server) setting. If IP CNFG= MANUAL, enter the DNS: 4 numbers from 0 to 255 in DNS 1, DNS 2, DNS 3 and DNS 4.



N.B.: it is necessary to reset the control board after the change of configuration to validate it.

3.1.2 Configuration for point-to-point connection with a PC

Configure the address 192.168.1.2 and the subnet mask 255.255.255.0 as in the example of figure 12 with Windows 10 operating system.

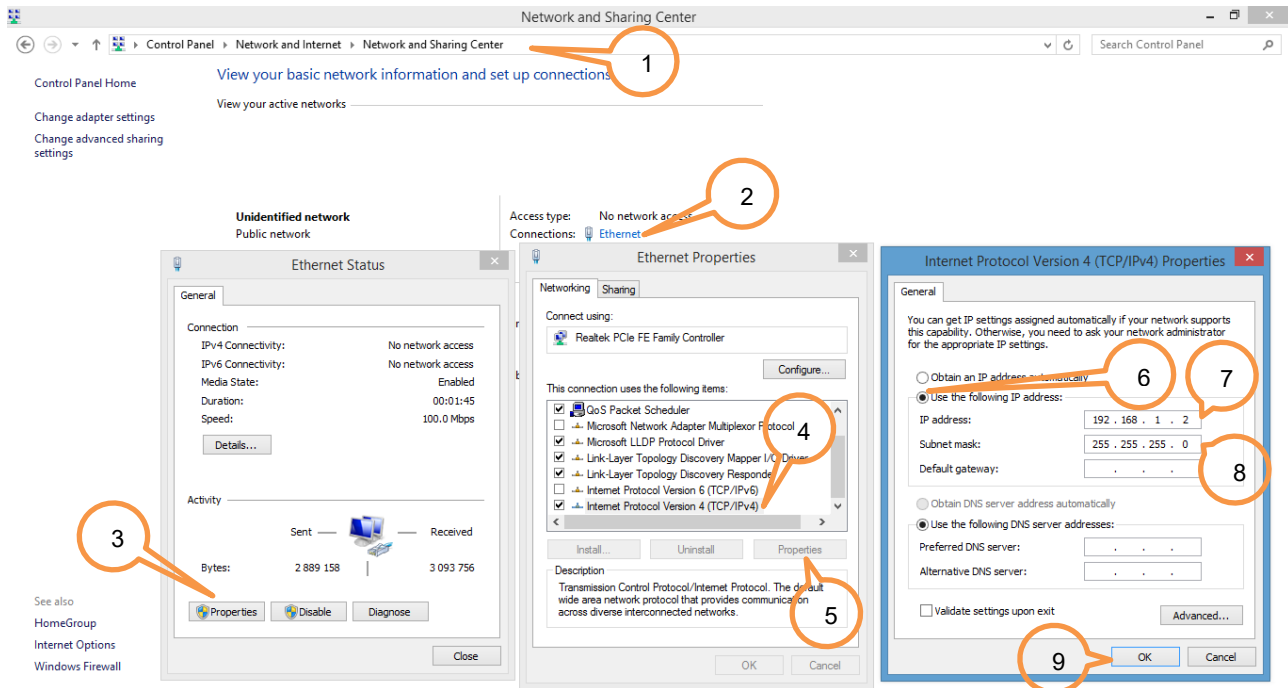


Figure 6 - Example of Static IP configuration on PC for point-to-point connection

3.1.2.1 IP Address Modification via PC

If the SAT WIFI-ETHERNET IP address has to be modified once that the connection has been established with the PC, it will be possible to use the software « TACsimulatorV2 » (see point 3.2.5). This will allow to interface with the control board via the PC only.

- Connect to the control board using TACsimulatorV2 (see point 3.2.5).
- Go in menu Settings/Advanced settings/Configuration of the SAT LAN and modify the parameters associated to the IP configuration of the SAT WIFI-ETHERNET (see point 3.1.1). The modifications will be active after the reset of the control board.

3.1.2.2 IP Address Modification via TACTouch

If the default settings of the SAT WIFI-ETHERNET have been changed, the IP address of SAT WIFI-ETHERNET has to be configured with the same static IP address of the computer less 1 withdrawn at the last part, so, if figure 6 example is considered, it would be 192.168.1.1 (which is the default setting).

The net mask will be the same as the one of the PC, with same example, it would be: 255.255.255.0.

The gateway and DNS are not used so 0.0.0.0.

The setup is done through the advanced setup with the TACTouch, function Communication/SAT LAN (see point 3.1.1).

3.2 Wi-Fi SETUP

The Wi-Fi configuration can be done through web pages provided by the SAT WIFI-ETHERNET integrated web server. The SAT WIFI-ETHERNET comes in configuration mode and cannot be directly used without a first configuration; **it is necessary to configure it**.

It can be configured as Access Point (AP), then no pre-existing network is required because the SAT WIFI-ETHERNET automatically creates its own network allowing up to **3** connections.

Alternatively, it can also be configured as station of another existing Wi-Fi network (which can be another SAT WIFI-ETHERNET access point).



In this case, the **WPS** is available, and it is advised to use it: simply press once the push-button (See figure 7) and activate the WPS operation on Wi-Fi router as well.

In case a new configuration needs to be done, in order to access the web pages to perform the configuration, the push-button of the SAT WIFI-ETHERNET must be double-pressed. Once reset done, the red led above the push button will light for 2 seconds. Then, the SAT WIFI-ETHERNET will be in configuration mode with an access point of a Wi-Fi network which SSID (Service Set Identifier) is composed by the prefix "SatWifi_" and a suffix which is the unique MAC address of the SAT WIFI-ETHERNET related to Wi-Fi module reported on the sticker above the component and preceded by "W" (the other MAC address, preceded by "E" is the one of the Ethernet module, see label description at point 1.2). WPA2 key is indicated on the sticker as well (PSW).

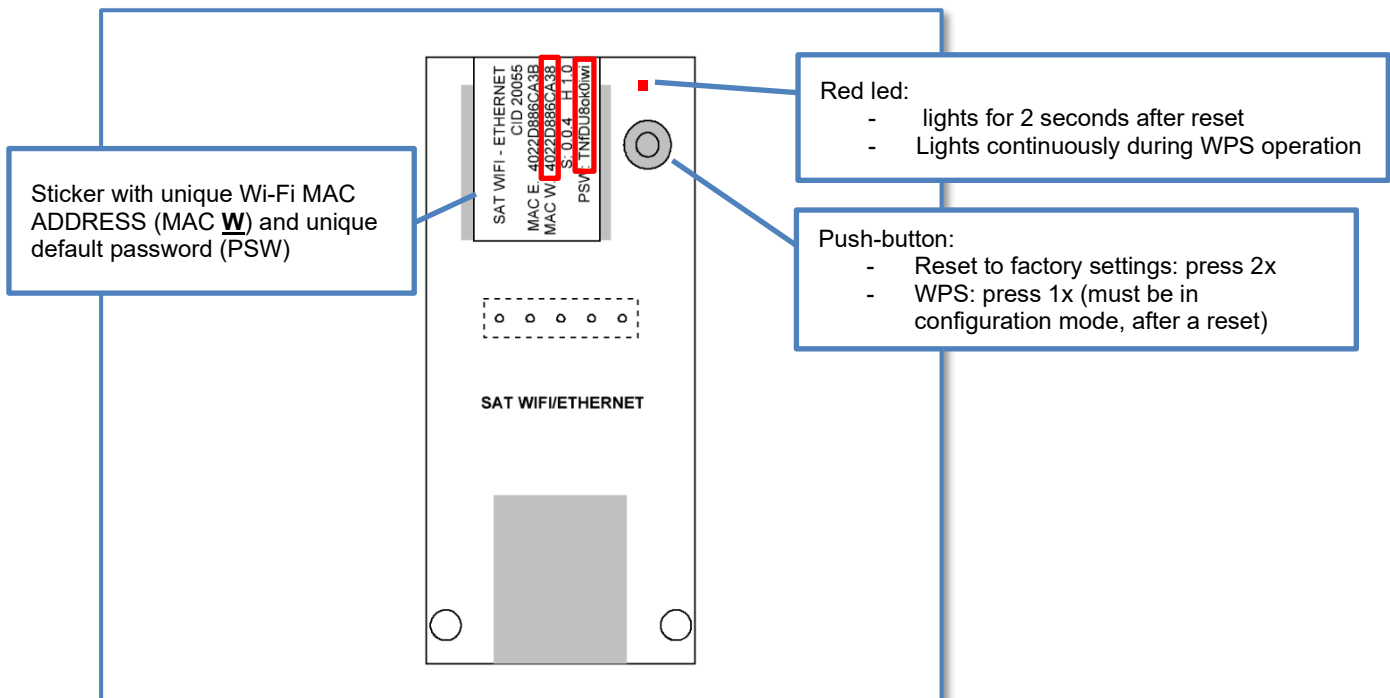


Figure 7 – Default SSID of SAT WIFI-ETHERNET as access point

TNfDU8ok0iwj

Connect to this Wi-Fi network with a pc, tablet or smartphone that has Wi-Fi access and navigate with a web browser to address "192.168.0.1". The home page will appear where the current configuration of the SAT WIFI-ETHERNET is displayed:

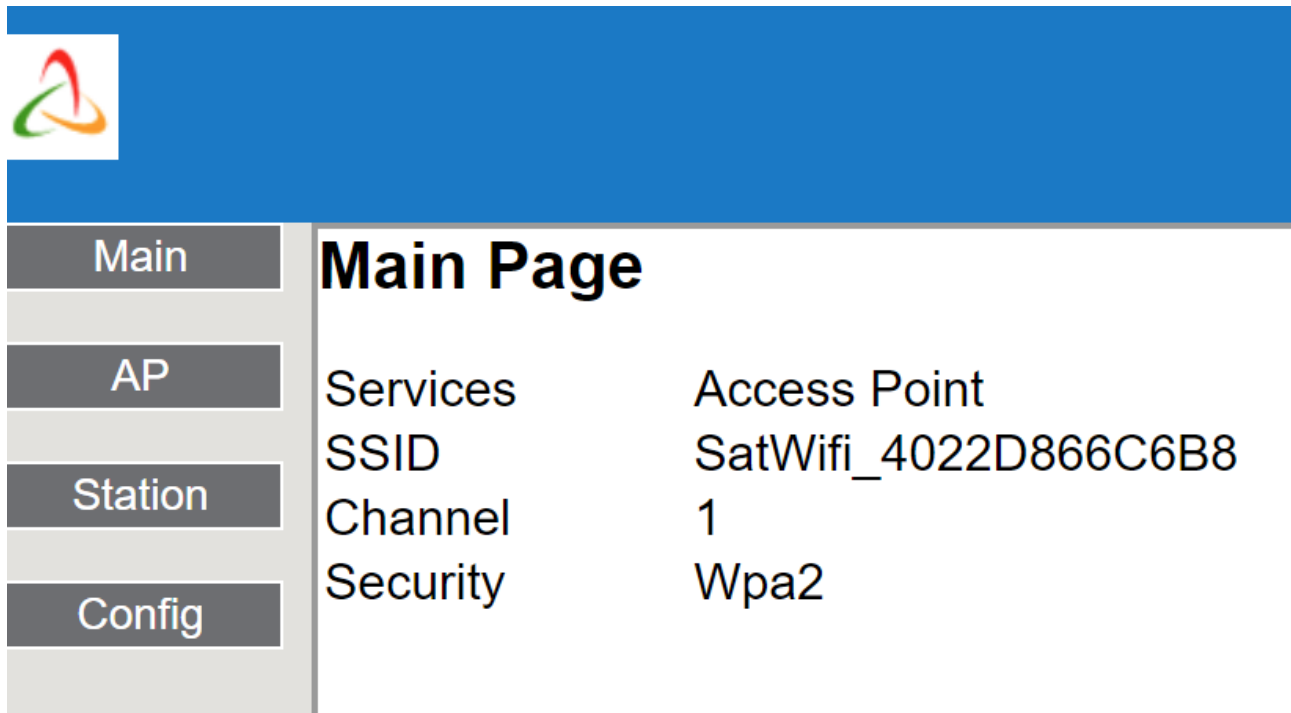


Figure 8 - SAT WIFI-ETHERNET configuration Web Server - Home Page

3.2.1 Access Point Configuration

Press "AP" button in the left menu to configure the SAT WIFI-ETHERNET as an access point:

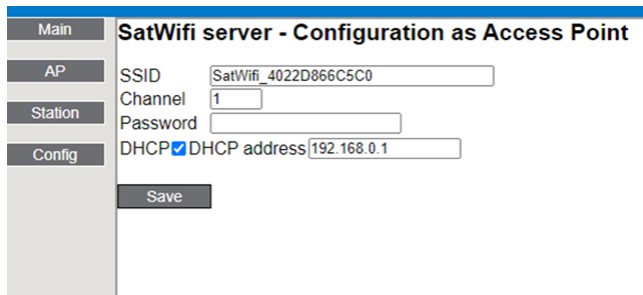


Figure 9 - SAT WIFI-ETHERNET configuration Web Server - Access Point Configuration Page

The SSID name can eventually be changed. The WPA2 password with at least 12 characters and not more than 16 must be entered (if not, the setting will not be validated, so no change applied). The other parameters should be changed only by expert user if necessary. Press then the "SAVE" button.

3.2.2 Station Configuration



In this case, the **WPS** is available, and it is advised to use it: simply press once the push-button (See figure 7) and activate the WPS operation on Wi-Fi router as well. Otherwise, follow instructions here below.

Press "Station" button in the left menu to configure the SAT WIFI-ETHERNET as a station of an existing Access Point:

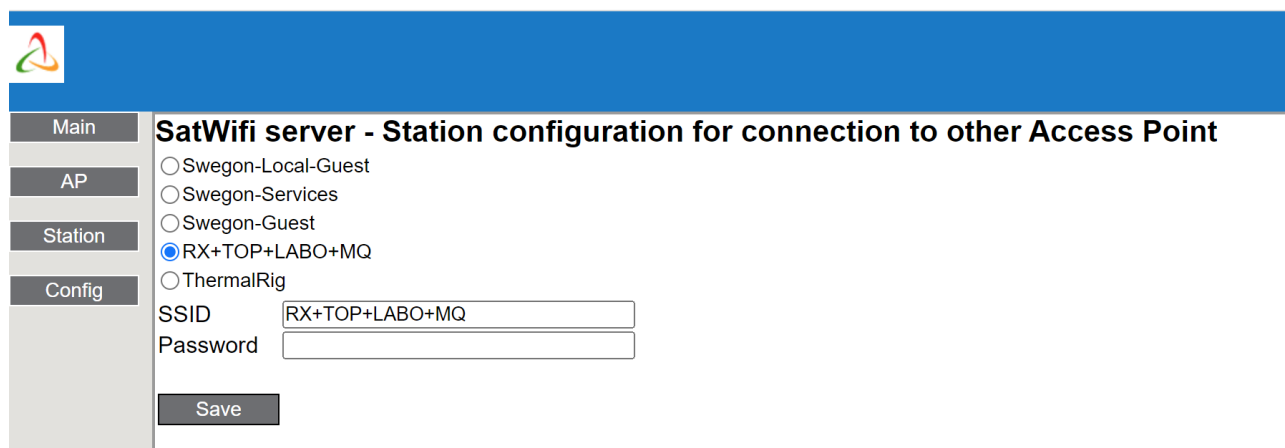


Figure 10 - SAT WIFI-ETHERNET configuration Web Server - Station Configuration Page

Select in the top list the Wi-Fi network to which the SAT WIFI-ETHERNET will connect to as station, the SSID text box will then be refreshed with the name of the selected Access Point.
Insert the password for the connection to this Wi-Fi network.
Press then the “SAVE” button.

3.2.3 TCP/IP Parameters Configuration

Press “Config” button in the left menu to configure the TCP/IP parameters of the SAT WIFI-ETHERNET (both AP and station).

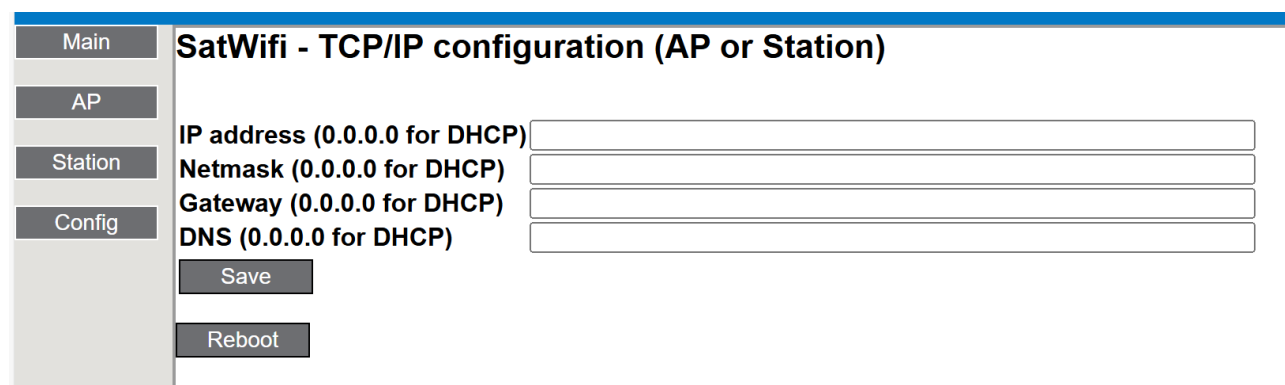


Figure 11 - SAT WIFI-ETHERNET configuration Web Server - TCP/IP Configuration Page

- If the SAT WIFI-ETHERNET is an Access Point, enter the parameters as in Figure 11. In alternative, they may be left blank in no particular setting is required.
- If the SAT WIFI-ETHERNET is a station of a Wi-Fi network
 - o with DHCP server (dynamic IP address assignation), enter the value 0.0.0.0 for IP address, Netmask gateway and DNS fields.
 - o without DHCP server, enter values in the IP address field and also the netmask, gateway and DNS provided by the local network administrator.

Press then the “SAVE” button.

Once the configuration is done, press “Reboot” button and wait 2 minutes. The changes will be applied after the reboot.

3.2.4 Connecting a client application to the SAT WIFI-ETHERNET

On the device where the client application runs, select the Wi-Fi network with the SSID of the SAT WIFI-ETHERNET Access Point if configured so, or, if the SAT WIFI-ETHERNET is base station of an existing Wi-Fi network, to this last one SSID.

The client should now be able to connect to the IP address configured at point 3.2.3 at port number 502 or, alternatively, to obtain automatically the IP addresses of all the SAT WIFI-ETHERNET available on the network thanks to the «Discovery» feature (see point 4).

Under normal conditions, the signal quality should be good at 20 m from the unit. If the signal is not enough strong at a location from where the application would be normally used, a simple commercial Wi-Fi repeater should strengthen the signal.

3.2.5 Using TACsimulatorV2 with SAT WIFI-ETHERNET

TACsimulatorV2 can be downloaded at <https://www.swegon.com/siteassets/7-support/software/tac-control/software-tac-versions/installtacsimulator2.zip>, use password 081625252 for installation.

Once connected to the correct Wi-Fi network (see point 3.2.4), TACsimulatorV2 can be used to control/monitor the unit(s) equipped with SAT WIFI-ETHERNET.

Launch it and go to the function Communication, section Connection setup, then configure the connection as below:

- Modbus TYPE: TCP/IP
- TAC Modbus Address: 1
- IP: the IP address of the SAT WIFI-ETHERNET if already known, otherwise skip this setting
- Port: 502
- Discover: if the IP address is already known and set, skip this setting, otherwise press the button and select the SAT WIFI-ETHERNET in the discovered list according to its MAC ADDRESS (see picture here below).
- Press "Reset COM" to validate the modifications

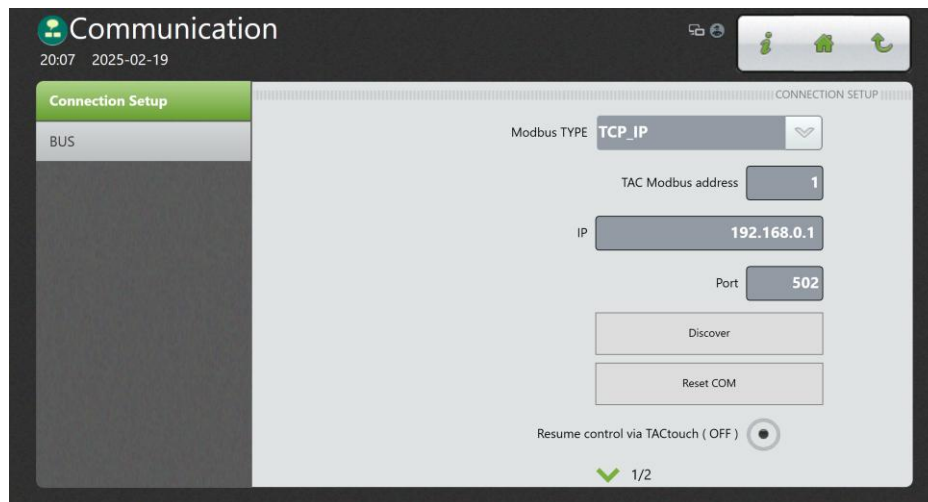


Figure 12 - Settings of TACsimulatorV2 for Communication with SAT WIFI-ETHERNET

4 “Discovery” Feature

This feature enables a client application to obtain automatically the IP addresses of all the SAT WIFI-ETHERNET on the network. Then, just select the one to which the access must be established even if the address is unknown at priori.

5 Remote Access

SAT WIFI-ETHERNET can be remote accessed provided that:

- They are connected in their local area network (LAN) to a VPN router with WAN access through 4G/5G/ADSL/Optic fibre.
- The VPN router has a static public address and forwards the local ports (n°502) of the local IP address assigned to the SAT toward public static address and ports.
N.B.: if the LAN is a DHCP one, local IP addresses have to be prior reserved to the SAT with their MAC address.
- These last public address and ports shall be used to establish the connection with SAT WIFI-ETHERNET using **VPN** tunnel.



Caution: The use of global routing address or public IP static address without VPN is not allowed!

6 Topologies

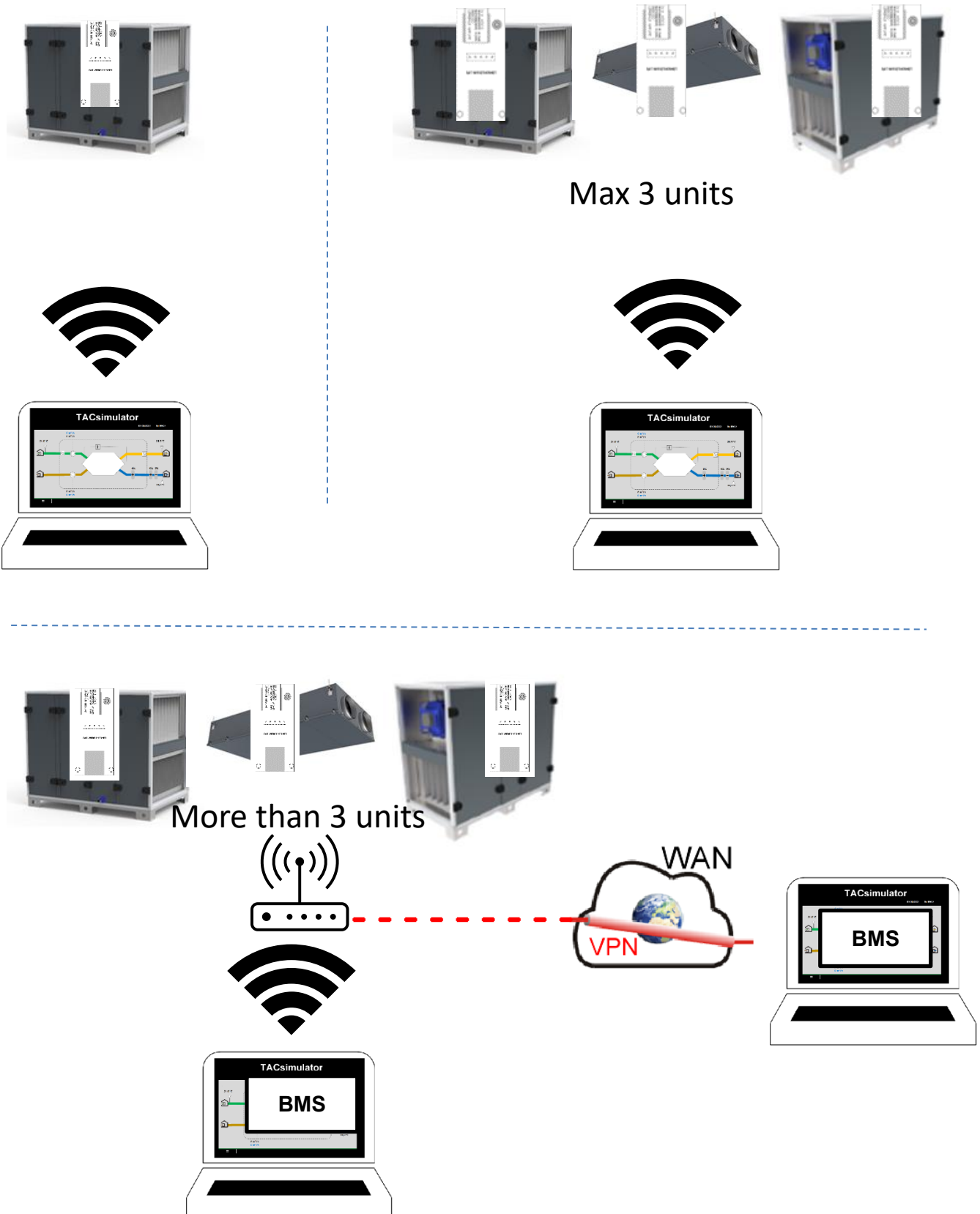
For information purposes, Appendix 1 offers a range of possible network topologies examples with different combinations of SAT WIFI-ETHERNET.

7 Modbus Registers

Please refer to documentation “MI Regulation TAC7 + MODBUS TABLE” for a complete and detailed description of the Modbus registers and their organization in tables.

Although we put a lot of care in the making of our documentation, we cannot be held responsible for any error and/or omissions that could have slipped in.

Appendix 1: examples of networking





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