Edge Computing Gateway

IQEG-500

User Manual

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1. Product Introduction

1.1 Overview

The IQEG-500 is an industrial AI high-performance Edge Computing Gateway for IoT applications. Powered by Raspberry Pi CM4, expanded common I/O ports and various networks to support IoT needs. With rugged, fanless enclosure design. The truly IPC-grade EG500 is used as an IoT gateway, edge device, or customizable industrial controller… for today's industrial and embedded applications.

1.2 Features

- Powered by Raspberry Pi industrial compute module 4 (CM4), up to 8GB RAM and 32GB eMMC
- Built-in dual mini-PCIe sockets for 4G LTE, and LoRaWAN
- Reserved SX-NEWAH module for WiFi HaLow (802.11ah) connectivity
- Isolated DI/DO/AI/RS232/RS485 interfaces
- Embedded watchdog for work stability
- Aluminium chassis Fanless cooling design for rugged structural

  and wide operating temperature -25~70℃
- Fully compatible with Raspbian, OpenWRT, Ubuntu OS, etc.

1.3 Specifications

Hardware platform	
CPU	Broadcom BCM2711, Quad-core A72 (ARM v8)@ 1.5 GHz
Memory	(2GB/4GB/8GB optional) LPDDR4
FLASH	(16GB/32GB optional) eMMC
Network & Interfaces	
Ethernet	2x Gigabit Ethernet, (1-WAN+1-LAN or 2-LAN Configurable)
Cellular	4G LTE, 3G, 2G, NB-IoT, CAT-M1 Via mPCIe socket
Wi-Fi	Dual Band 2.4GHz & 5GHz + Bluetooth 5.0
LoRaWAN	Supported (Optional, reserved mPCIe for LoRaWAN module)
WiFi HaLow (802.11ah WiFi)	Supported (Optional, reserved SX-NEWAH module for WiFi HaLow)
GPS	Cellular Module built-in supported (Optional)
SIM	1.8 V/3 V; drawer-type Nano card holder × 1
	15KV ESD Protection

Antenna	4G: inside SMA x 1、WiFi/Buletooth: inside SMA x 1, LoRa/WiFi Halow: inside SMAx1
Industrial Serial Port	RS-232 x 1， RS-485 x 1;
	RS-232 signal: TXD, RXD, GND; RS-485 signal: A, B, GND; ESD protection: 15KV
I/O	6-channel digital input DI (0..24VDC, Configurable Status/Count mode)
	3-channel Analog input AI (0-10V DC, 4-20mA, 18-bit resolution)
	6-channel digital/pulse output DO (0..60V, Max. power 6fficiency: 500 mA)
USB	USB 2.0 x 2 for peripherals,
	USB-C x 1 for Console
HDMI	HDMI 2.0 x 1, (Up to 4kp60 video & audio output)
Reset Button	Supported
Power	
Power supply	Wide Range Voltages 9~36V DC/1A, recommended 24V/1.5A
Power Terminal	Unpluggable industrial terminal connection
Power consumption	Less than 10 W (system)
Power Output	2-channel power supply for slave devices, same value as Power input (24V)
Mechanical features	
Protection	IP30
Housing	Aluminum Heatsink
Cooling	Fanless cooling
Dimensions (cm)	187mm x 112mm x 42mm
Installation	DIN-rail, wall mounting
Weight	790g
Ambient temperature and humidity	
Storage temperature	-30 ~ 75°C
Ambient humidity	5 ~ 95% (non-condensing)
Operating temperature	-25 ~ 70°C (industrial grade)
EMC index	
Static electricity	level 3
Radiated electric field	level 3
Surge	level 3
Others	
LED Indicator	1-POWER, 1-WiFi, 1-SYSTEM, 1-ALARM,1-ONLINE, 3-Signal Strength
Watchdog	Standalone Hardware Watchdog
Warranty	Standard 12 Months
Software Features	
OS	Optimized OpenWRT V21 with SDK /Raspbian
Configuration	WebUI, Local CLI, Remote configuration

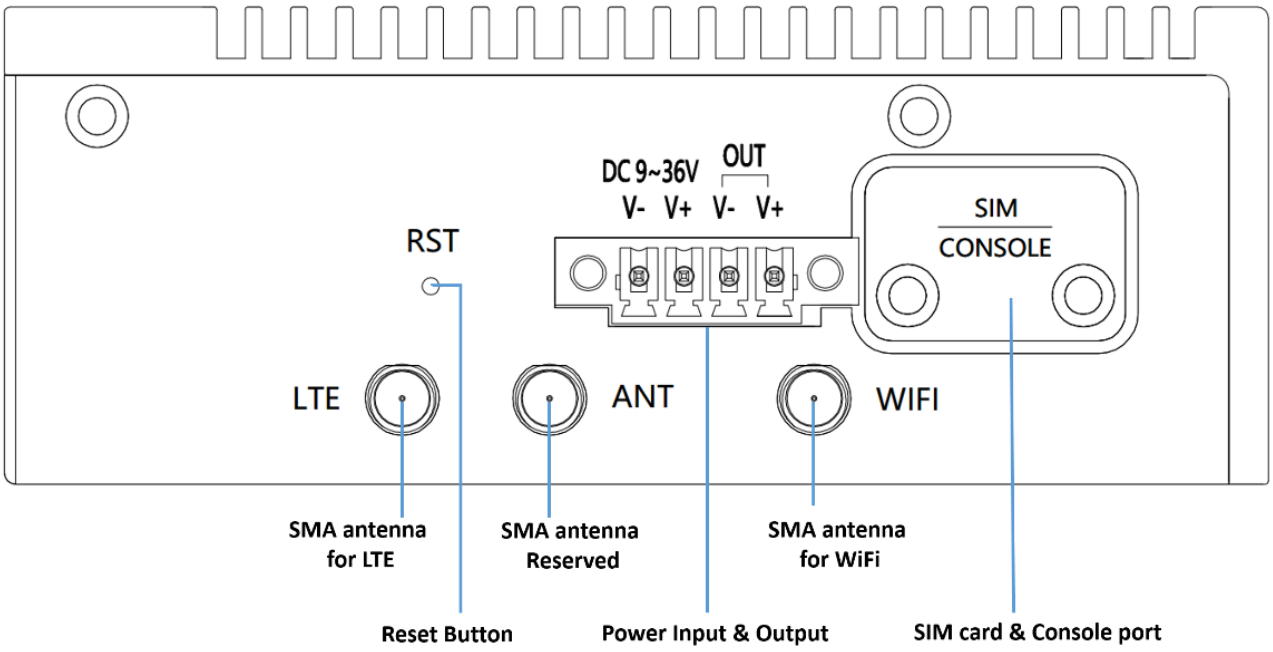
Upgrade operate	WebUI, Local USB upgrade and remote upgrade (optional)
Timed startup and shutdown	Supported
Application features	Data Acquisition, Modbus RTU, VPN, Router, Firewall, Media Player… Python, Node-RED, Docker…, Support Secondary Development with SDK
Network Features	WWAN and WAN Failover, Load Balance, PPP, PPPoE, SNMP v1/v2c/v3, TCP, UDP, DHCP, RIPv1/v2, OSPF, BGP, DNS, DDNS, Modbus RTU/TCP, Siemens S7, OPC UA, HTTP, MQTT, ARP, QoS, SNTP, Telnet, SSH

2. Hardware Introduce

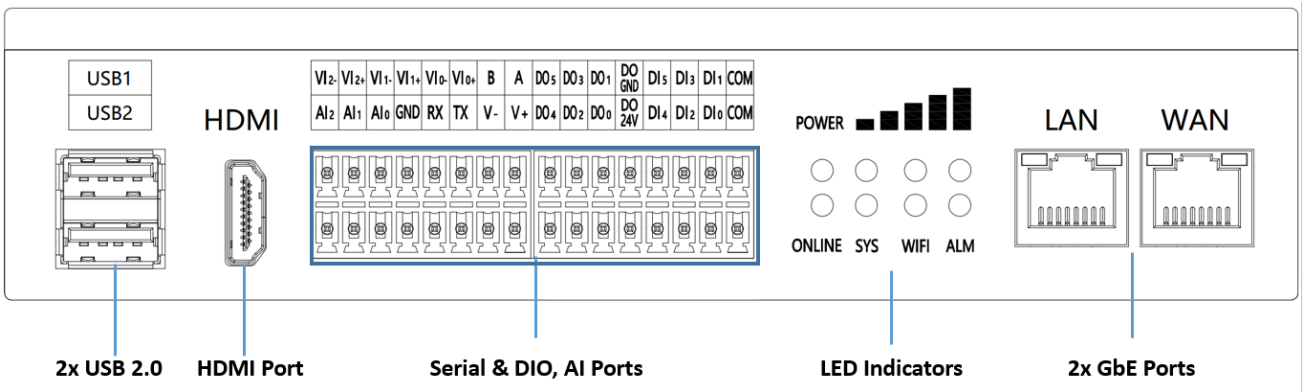
2.1 Overview and Dimension

2.2 Interfaces Overview

Side Panel Interfaces

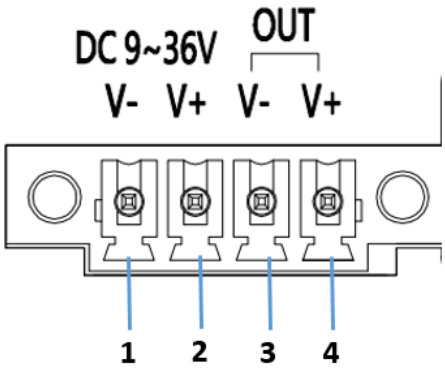


Front Panel Interfaces



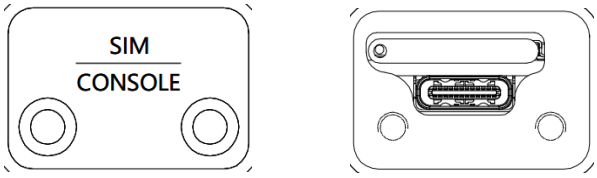
2.3 Interfaces Definition & Installration

2.3.1 Power supply



EG500 right side panel provide a 4-pin terminal block connector for Power input and a bridge connection for power output. The defination of PIN 1 “V-“ as GND, PIN 2 “V+” for 9V~36V DC input. While PIN 3 & PIN 4 is a parallel power from PIN 1 & PIN 2, which considering designed for slave devices power supply.

2.3.2 SIM card and console



There is a secure lock panel on the right side of EG500 to protect the SIM card and Console port from external unauthorized extraction or tampering. You are allowed to install SIM card and connect USB-C console port after unlock the cover screws.

Please note Only NANO SIM card size is accepted, and the NANO sim card is inserted with chip side down.

You may need a PIN insert the hole to pop up the SIM card holder if you need take out the SIM card.

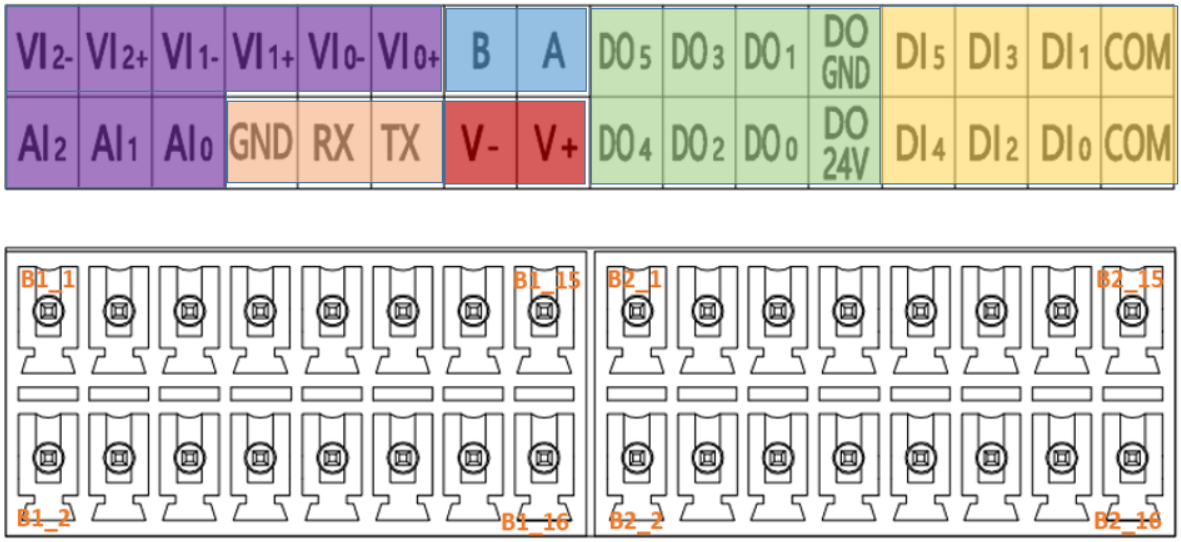
2.3.3 Antenna connectors

EG500 provide 3 SMA antenna connectors, two of them are predefined for cellular antenna and WiFi antenna, while reserved one for other usages, like GPS or second cellular antenna. Rotate the antenna into the antenna connector accordingly.
The external antenna should be installed vertically always on a site for a good signal.

2.3.4 Reset Button

Reset Button is for reset the EG500 configuration to factory default. To perform reset operation, you may need a PIN to press and hold the reset button for more than 10 seconds till the alarm LED indicator flashing, then release. The device will reset all user's configuration to factory default and restart.

Serial & DI/DO/AI Ports

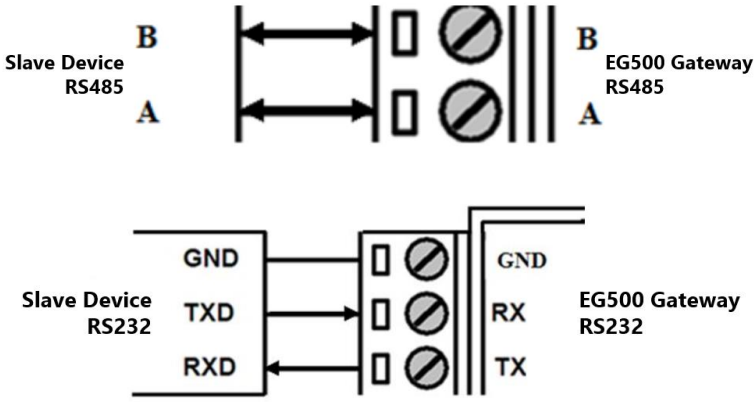


EG500 provides two terminal blocks for expanded I/O ports, the ports PIN defination as shown as the printed label above terminal block accordingly.

They are Serial COM ports as 1xRS485 and 1xRS232, 6 Digital Input ports as DI0 ~DI5, 6 Digital Output ports as DO0 ~ DO5, 3 Analog Input ports as AI0 ~AI2 (4-20mA current input) or VI0 ~VI2 (0-10VDC voltage input).

Also provide a parallel power (V- V+) from power input supply for slave devices.

2.3.5 Serial Port (RS232 and RS485)

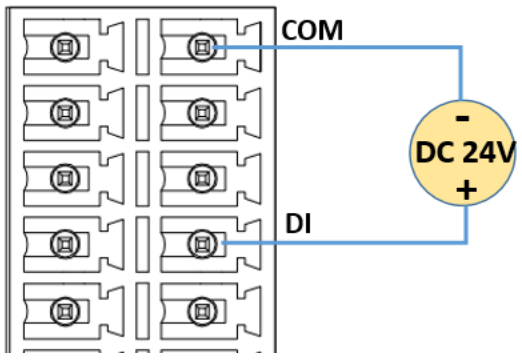


EG500 provide isolated serial COM ports, 1x RS485 and 1xRS232, the PIN B1_15 defined RS485_A (difference line high), PIN B1_13 defined RS485_B (difference line low).

While the PIN B1_12 defined RS232_Tx (transit line), PIN B1_10 defined RS232_Rx (receive line), PIN B1_8 defined RS232_GND (reference potential).

A 120 Ohm termination resistor for RS485 has been installed inside.
Check the above application wiring for reference.

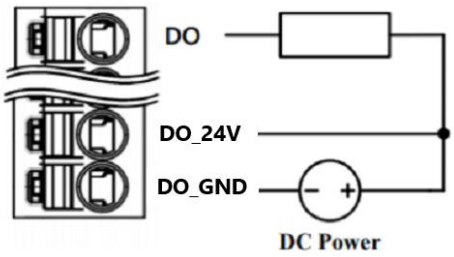
2.3.6 DI (Digital Input)



EG500 provide 6x DI to detect the status of outside digital signal, also support count mode to calculate the frequency.
The DC input voltage is 24V. The 6 digital input are isolated to each other.

Check the above application wiring for reference.

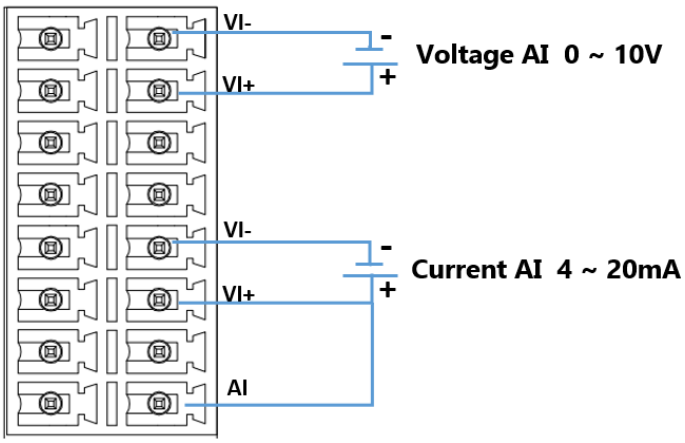
2.3.7 DO (Digital Output)



EG500 provide 6x DO to control the external slave devices. With an overvoltage protection circuit that DO 24V wiring, it could filter the overvoltage to avoid destroying device itself.

The external DC power voltage should be under 60V. Check the above application wiring for reference.

2.3.8 AI (Analog input)



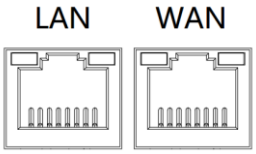
EG500 provide 3x Analog input ports with two types of analog signal, 4-20mA current input, or 0-10VDC voltage input.

Check the above application wiring for reference.

2.3.9 HDMI

EG500 uses the CM4's integrated HDMI to drive the external HDMI Port.
Resolutions up to 4K@ 60Hz are supported.
CEC (Consumer Electronics Control) functionality is also supported, depending on software configuration

2.3.10 Ethernet



EG500 provide two Gigabit Ethernet ports, the one came out from Raspberry Pi CM4 is pre-defined as WAN port which supports up to 1Gbps link speeds over standard shielded CAT5e or CAT6 cables. The connector is the industry standard RJ45 connector.

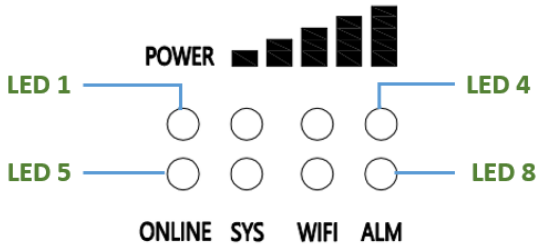
The second Etherenet port which bridged from Realtek RTL8111 is pre-defined as LAN Port on EG500, supports up to 1Gbps link speeds over standard shielded CAT5e or CAT6 cables as well. The connector is the industry standard RJ45 connector.

Two Ethernet ports can be configured as both LAN or other usages freely.

2.3.11 USB 2.0

2x USB 2.0 ports on EG500 front panel are provided for peripheral usage. Together, they may deliver a maximum of 1A at 5V, depending on peripheral and device configuration.

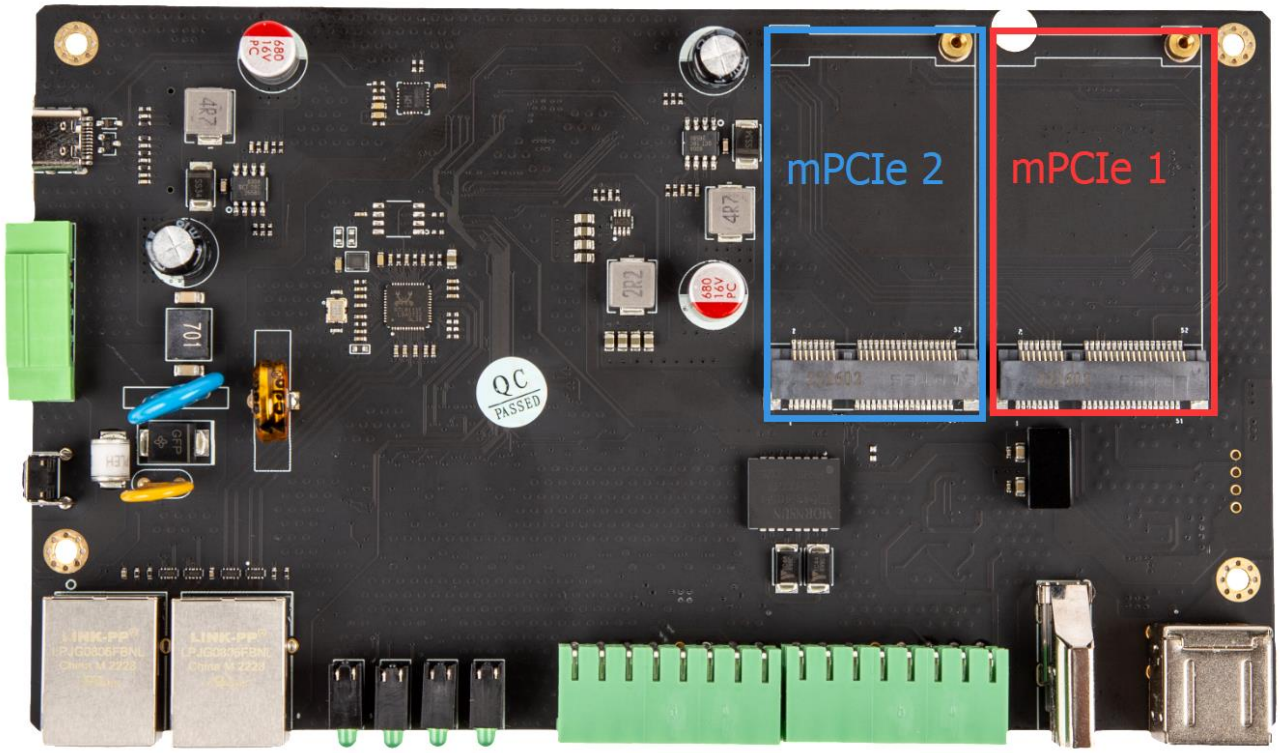
2.3.12 LED indicator

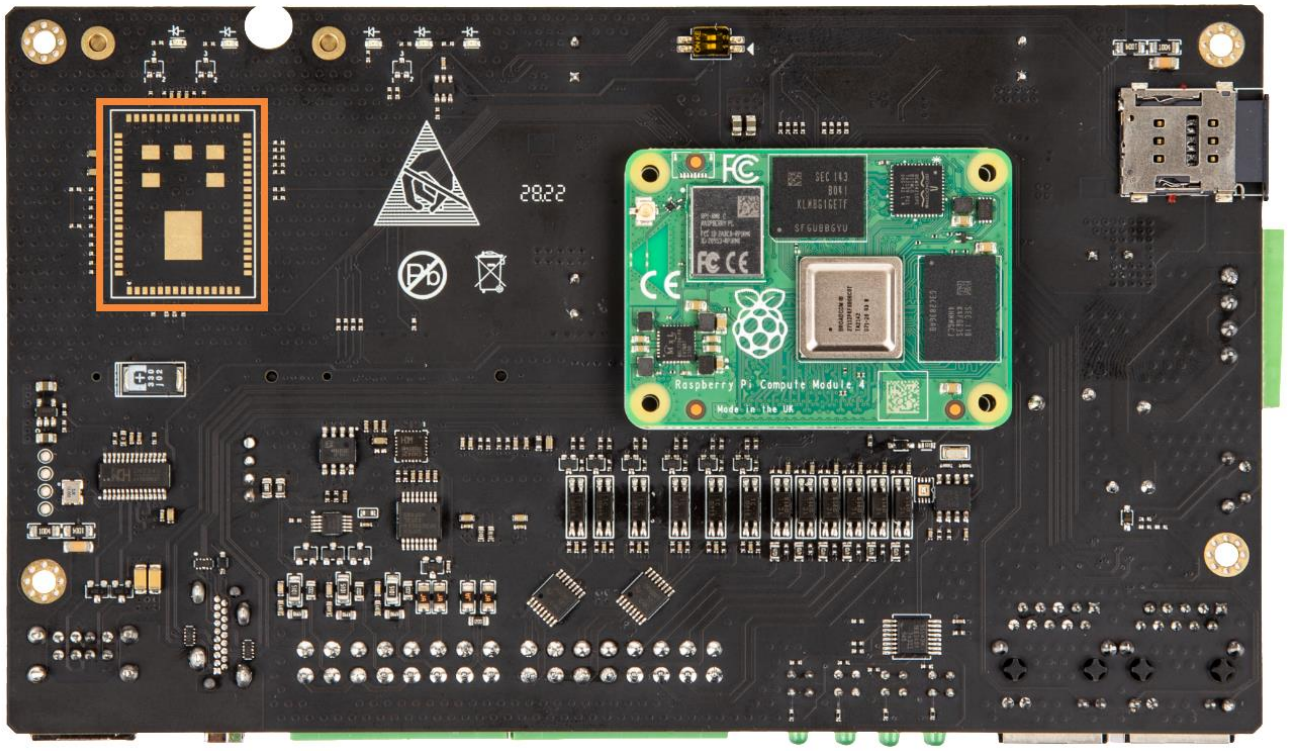


EG500 extend 8 LED indicators for apparent status indication as printed label shown,
LED1 is defined as Power indicator which on once power on.
LED2 ~LED4 are defined as cellular signal strength.
LED5 as ONLINE which indicate the network online status.
LED6 for system status.
LED7 for WiFi status.
LED8 for Alarm in case any system error or resetting.

2.4 Carrier Board Connectors

The EG500 carrier board provides some reserved interfaces for user mount necessary modules as needed, it contains dual mini-PCIe, WiFi HaLow module SX-NEWAH, and Raspberry Pi CM4 socket.





2.4.1 Mini-PCIe 1

EG500 cellular network is implemented with a mini-PCIe cellular module. To setup EG500 for cellular functionality, install a cellular module into mini-PCIe socket 1 as drawing red area add-on module position, only one M2x5 screw is needed.

You can also include cellular network function when place an order from Elastel, Elastel logistic team will preinstall that from factory.

Elastel supplies EG500 with following cellular module options as default,

- 4G/LTE CAT4 cellular module, Quectel EC25-E (for EMEA/APAC bands)
- 4G/LTE CAT4 cellular module, Quectel EC25-AF (for NA bands)
- 4G/LTE CAT4 cellular module, Quectel EC25-AU (for ANZ/LATAM bands)

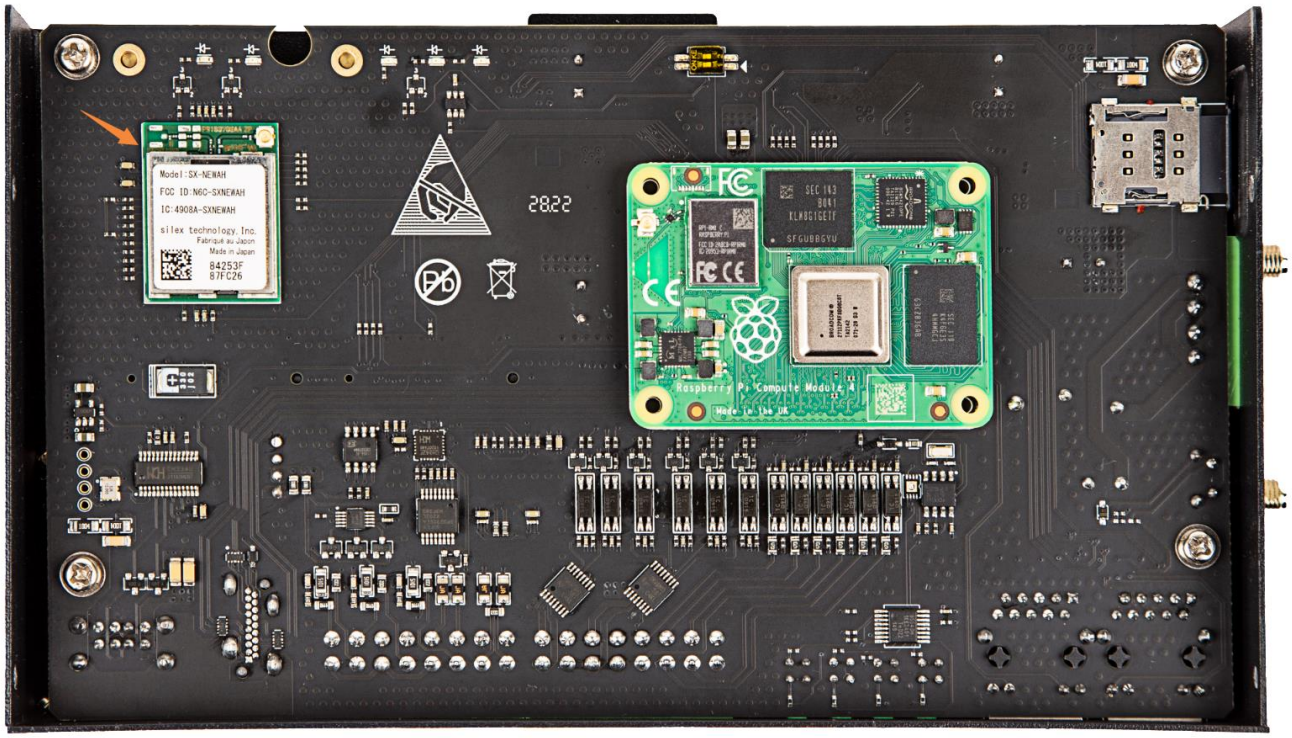
2.4.2 Mini-PCIe 2

EG500 reserved another mini-PCIe socket for LoRaWAN module which develop from Semtech SX1301, SX1302 solution. Users are allowed to install a LoRaWAN module into mini-PCIe socket 2 as drawing blue area add-on module position, only one M2x5 screw is needed.

You can also include LoRaWAN network function when place an order from Elastel, Elastel logistic team will preinstall that for you from factory.

Other mini-PCIe type modules like Zigbee, RF module, WiFi module are supported as well. Please contact Elastel technical support for further assistance.

2.4.3 WiFi HaLow



EG500 IoT gateway support 802.11ah WiFi (also named WiFi HaLow) network powered by SX-NEWAH module from SilexTechnology, the first industrial IEEE 802.11ah Wi-Fi module that operates in the **Sub 1GHz** band.
Visit SX-NEWAH to learn more benefit of WiFi HaLow technology in IoT.

Or you are allowed to mount SX-NEWAH by yourself, the carrier board reserved the interface for SX-NEWAH module, check the above drawing orange area for module position. Attention! You may need special weld tool and skill to mount SX-NEWAH on EG500 by yourself. Incorrect operation may destroy the carrier board and SX-NEWAH.

2.4.4 Raspberry Pi CM4

EG500 is built around the Raspberry Pi 4 module (CM4), which provides the following key features:

- Broadcom BCM2711 quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 1GB, 2GB, 4GB or 8GB LPDDR4 (depending on model)
- 8GB, 16GB, 32GB eMMC
- Optional on-board 2.4GHz and 5.0GHz IEEE 802.11b/g/n/ac WiFi, Bluetooth 5.0, BLE

WiFi / Bluetooth antenna connection is available via RP-SMA connector on the EG500 side panel, check “2.3.3 Antenna Connectors” section for more details.

The carrier board provide the CM4 corresponding socket on it, you are allowed to mount or replace different CM4 variants by yourself (Check section 4.1 for more details).

Use caution as the connector is fragile. And be careful the CM4 direction when re-install it, the position will not match the white area sketch map if CM4 rotated 180 degrees.

3. ElastOS Operating System Guide

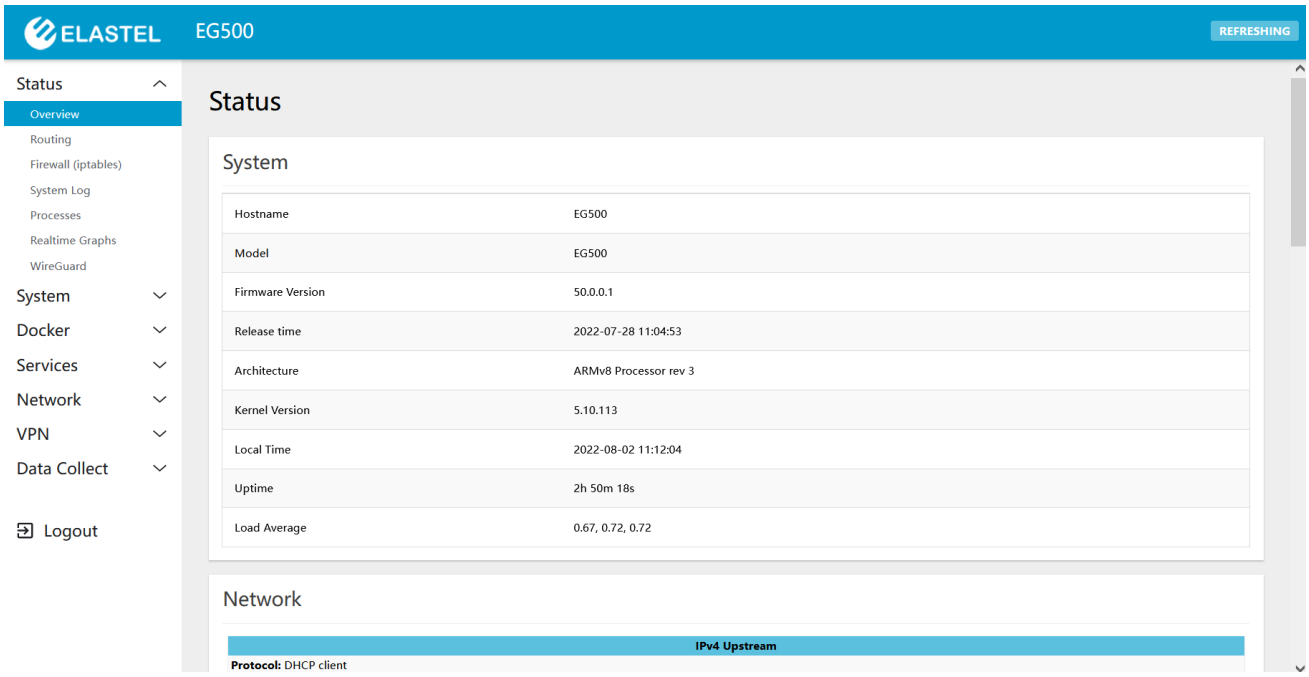
Device provide ElastOS operating system which optimized from OpenWRT OS for basic system management, software management, networks management, I/O (serial ports, DI, AI, DO) ports communication operations, and other usages. This section guide you how to use ElastOS on EG500.

3.0 Access to WebUI

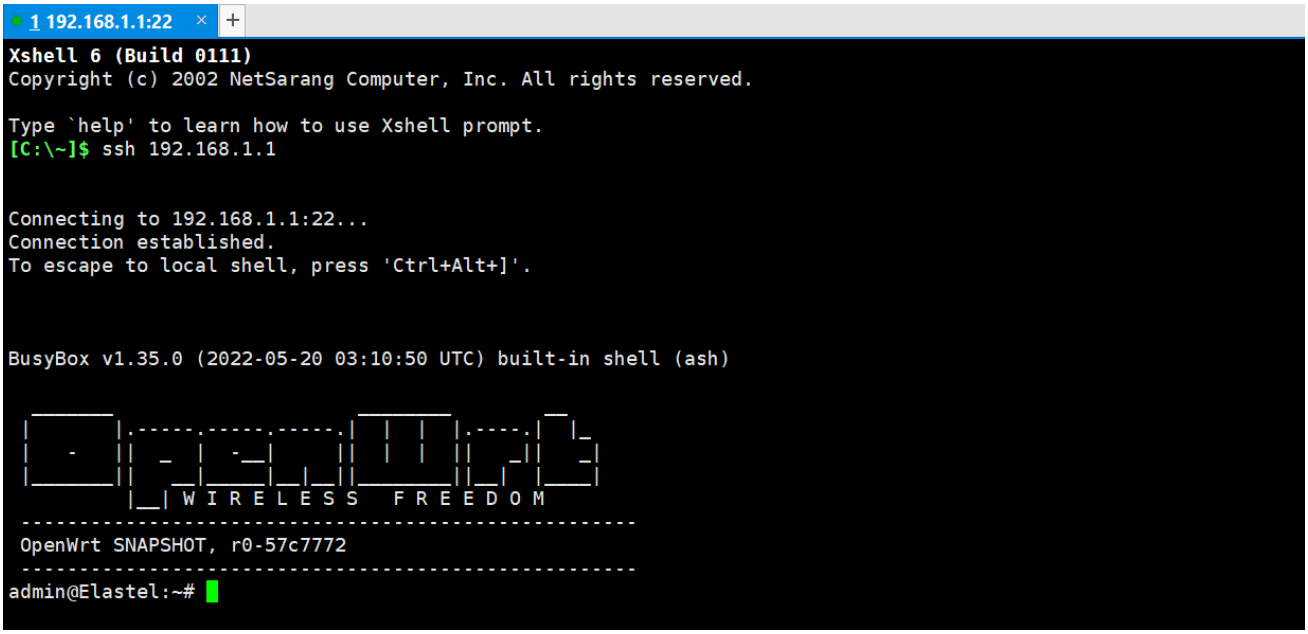
1) Connect your PC to LAN port of EG500 Gateway directly. Normally your PC will obtain an IP address 192.168.1.X from EG500 DHCP automatically. If not, please assign a static IP manually within the same subnet as 192.168.1.1 at 255.255.255.0 mask, while default gateway as 192.168.1.1

2) Open a web browser on your PC and visit 192.168.1.1 gateway address. The webUI of EG500 should appear and request an username and password to login.

3) Enter the default username and password both “admin” to login the webUI of EG500



Note, you are also allowed to access to EG500 CLI (Command Line Interface for batch scripting) via SSH or Telnet, once connected your PC to EG500 LAN, rely a putty or Xshell tool to ssh 192.168.1.1 with “admin” for both username and password.



3.1 Status

3.1.1 Overview

The overview page shows the system information of EG500, it contains system hostname, model, firmware version, uptime… and so on.

Network section shows the current active network and correspond network type. The Memory and Storage section shows the status of total available/used space, and others.

3.1.2 Routing

Routing page shows the routing rules are currently active on this system. including IPv4 Routing and IPv6 Routing.

3.1.3 Firewall Status

Firewall status page shows the current filter, NAT, Mangle tables status.

3.1.4 System Log

The printed system log shows the current behaviors of system, it is useful for troubleshooting and status moniting.
It provide “Clear log” “Save log” and “Refresh log” operation buttons. You may need click “Refresh log” to get the real-time log.

3.1.5 Processes

This list gives an overview over currently running system processes and their status.

3.1.6 Realtime Graphs

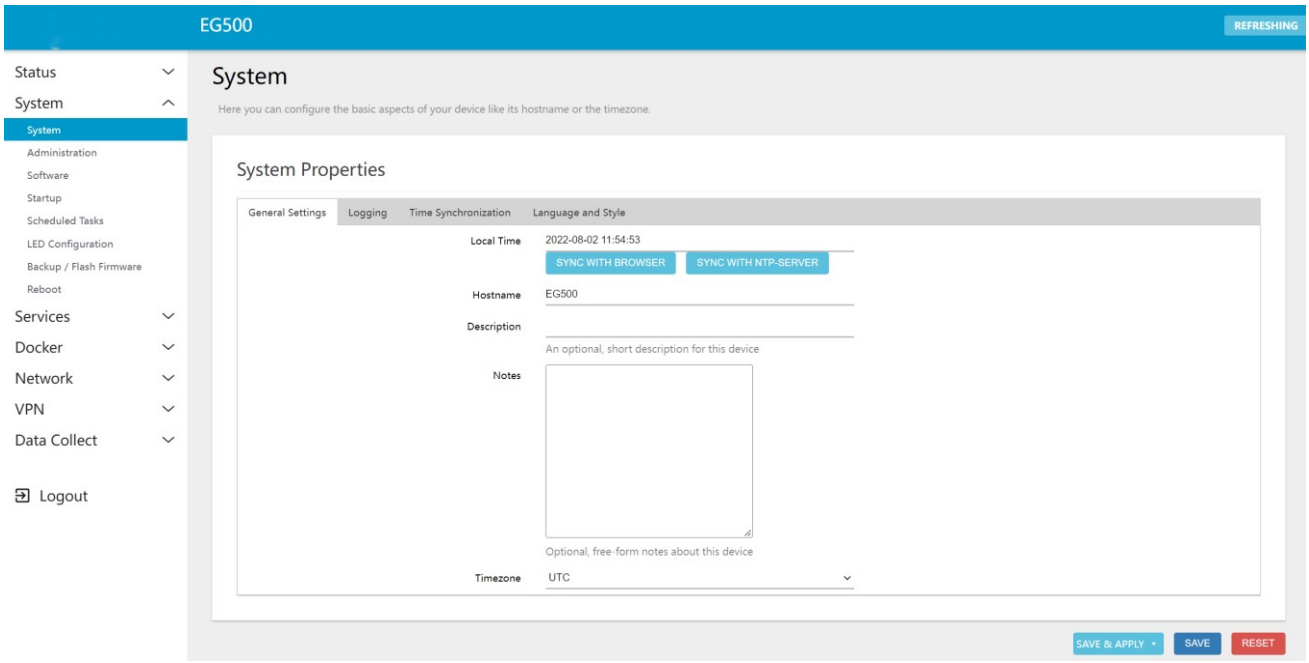
This page shows the status of Load, Traffic, Wireless status and rate, connections in real time graphicly.

3.1.7 WireGuard

WireGuard features was enabled as default, this page shows the current status of wireguard connection.

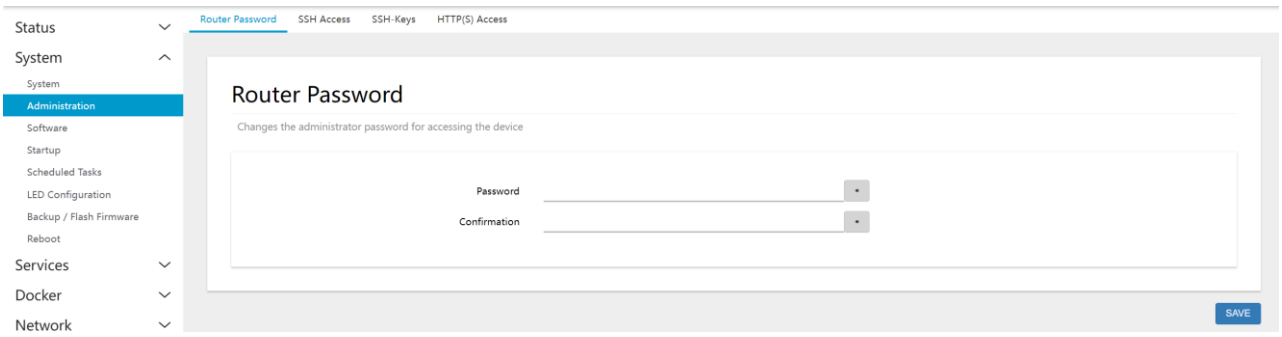
3.2 System

3.2.1 System



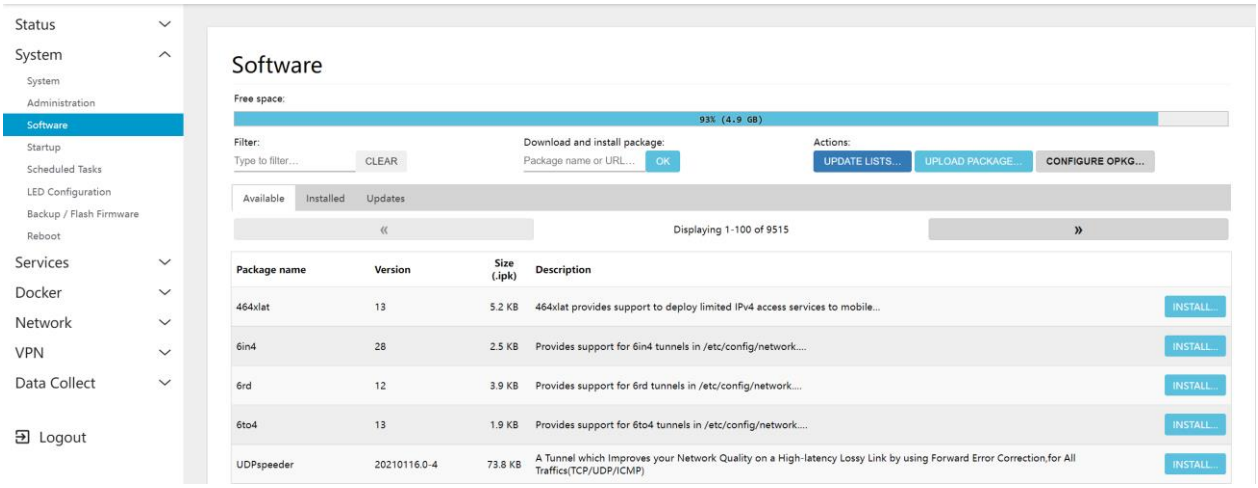
System pages provide the basic aspects of EG500 you can configure, like hostname, timezone, Logging, Time sync, Language…, and so on.

3.2.2 Administration



This page provide the settings items of changing administrator password, SSH Access settings, SSH Keys, and HTTP(S) Access related settings.

3.2.3 Software



This page provide user check the current installed softeware, and the available software list from OpenWRT software repertory.
You can also configure the respertory address of your owns from “Configure OPKG”

3.2.4 Startup

You can enable or disable installed initialization scripts here. Changes will applied after a device reboot.
Warning: If you disable essential init scripts like "network", your device might become inaccessible!

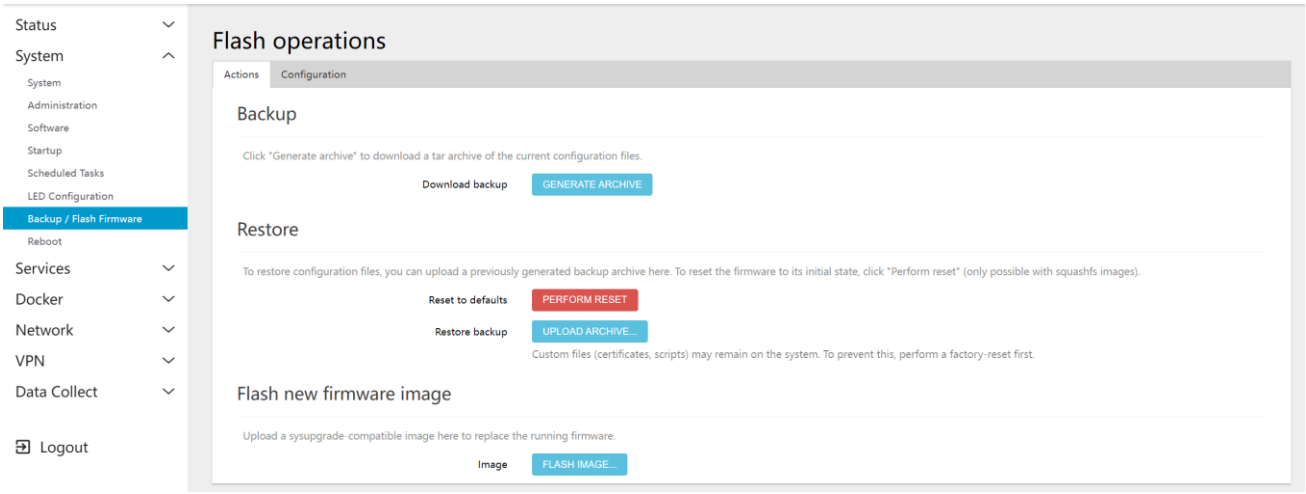
3.2.5 Scheduled Tasks

This is the system crontab in which scheduled tasks can be defined.

3.2.6 LED Configuration

Customizes the behaviour of the device LEDs if possible.

3.2.7 Backup / Flash Firmware

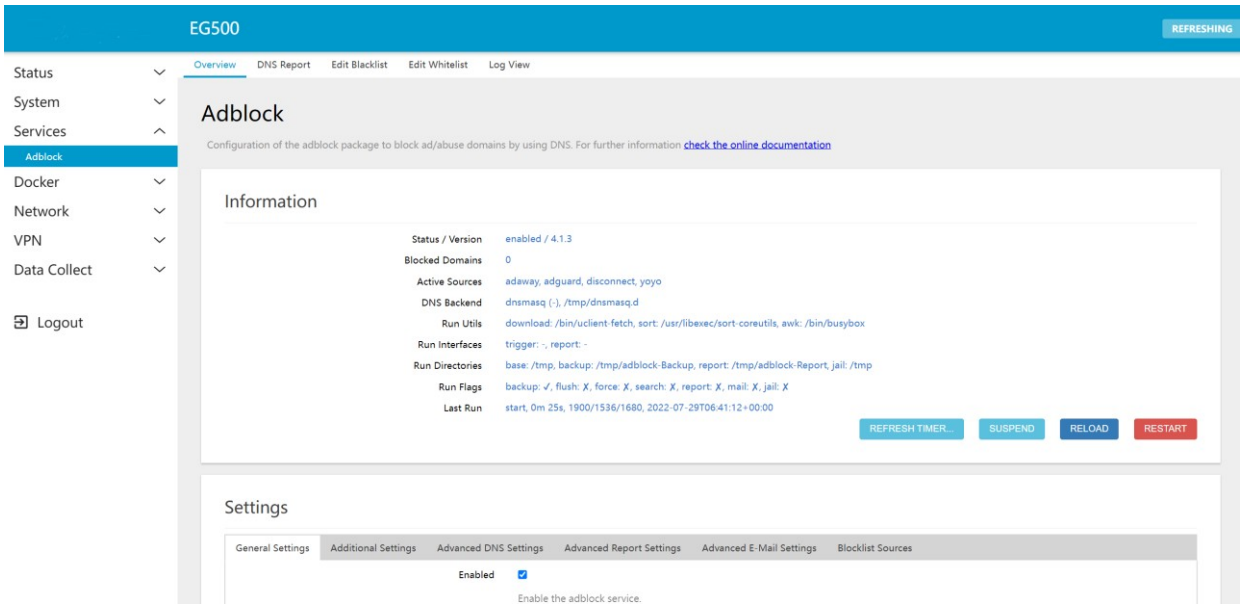


This page provides the operation of current configuration backup, restore, reset to factory, and Firmware upgrade.

3.2.8 Reboot

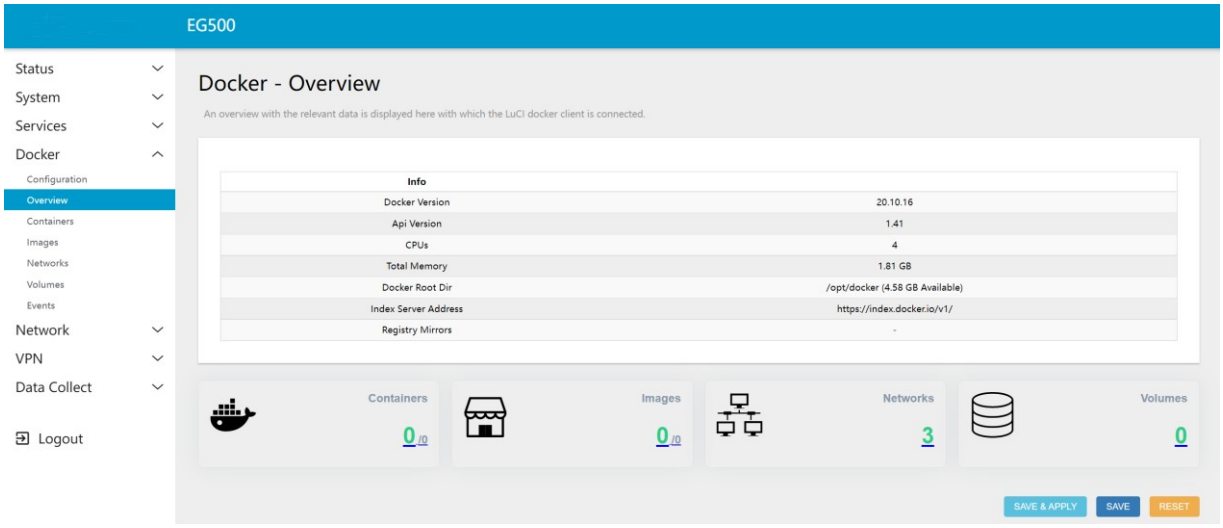
Perform manually reboot operation from webUI.

3.3 Services



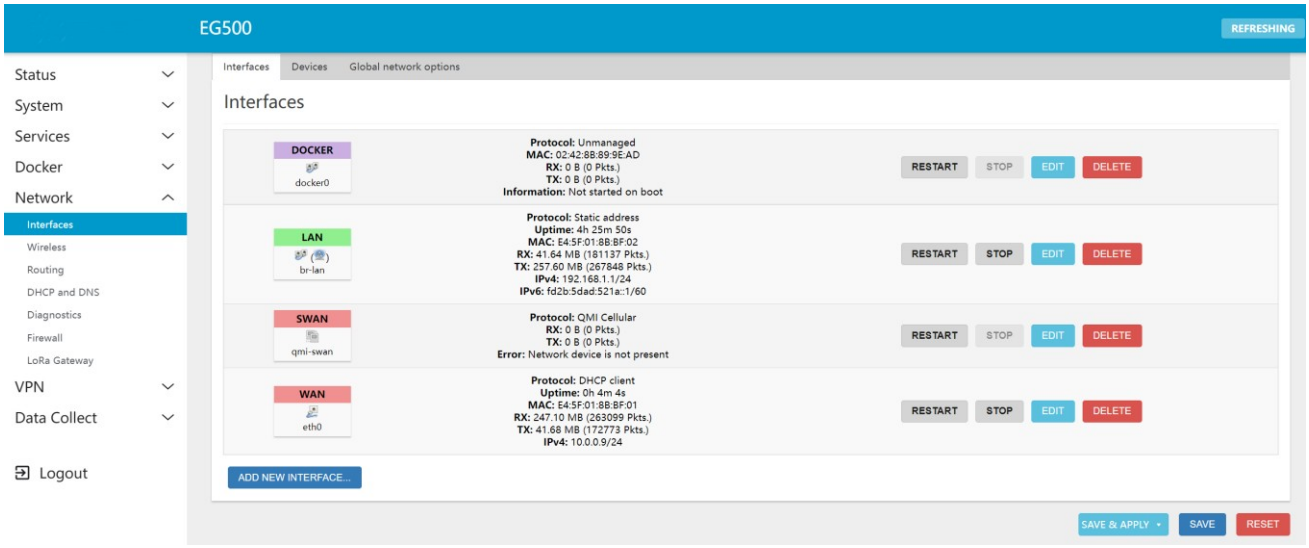
The service menu provide the webUI of related setting itmes that installed software.
The Adblock software was pre-installed as default for reference.
Please note some of the software may don't provide webUI configuration items, in that case you may SSH to CLI and manually configure them via commands.

3.4 Docker



Docker was pre-installed on EG500 Firmware, this page provide the docker related configuration for users via webUI powered by DockerMan, a simple docker manager client for LuCI. It provides overview, images management, network management, and other Docker related settings.
Please check DockerMan manual for more details.

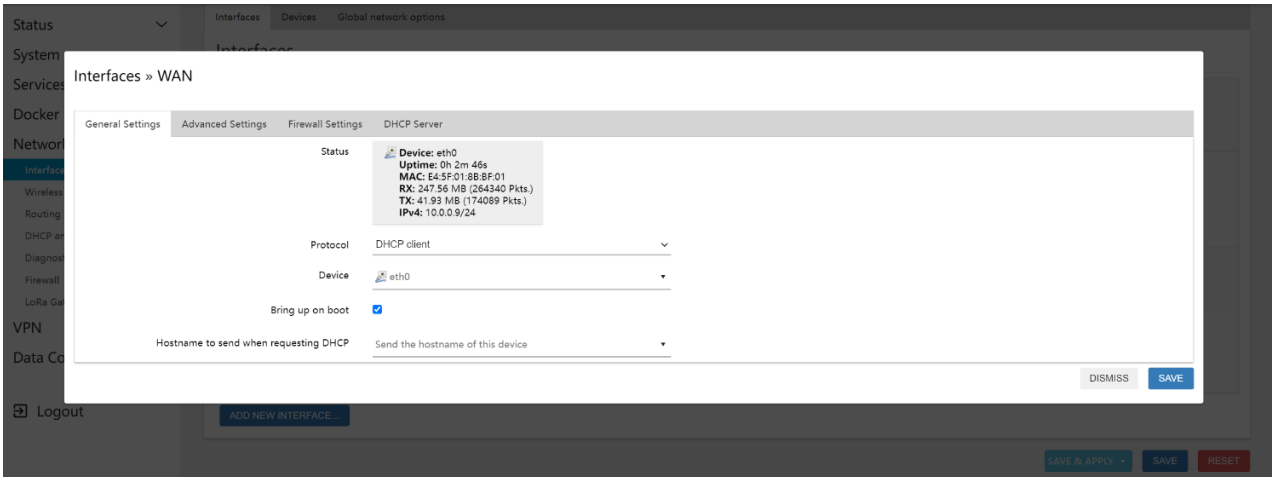
3.5 Network



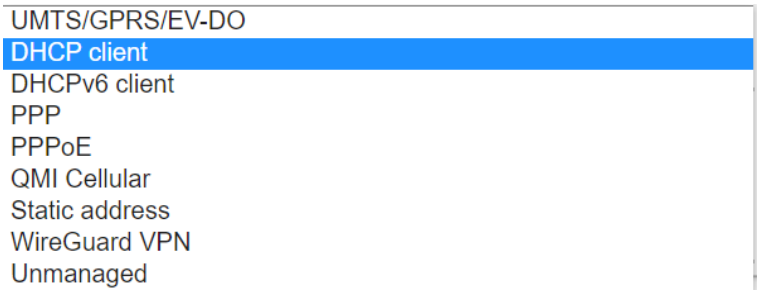
Network menu provide the network management related settings like interfaces, wireless, DHCP, LoRa Gateway…..and so on.

3.5.1 Interfaces

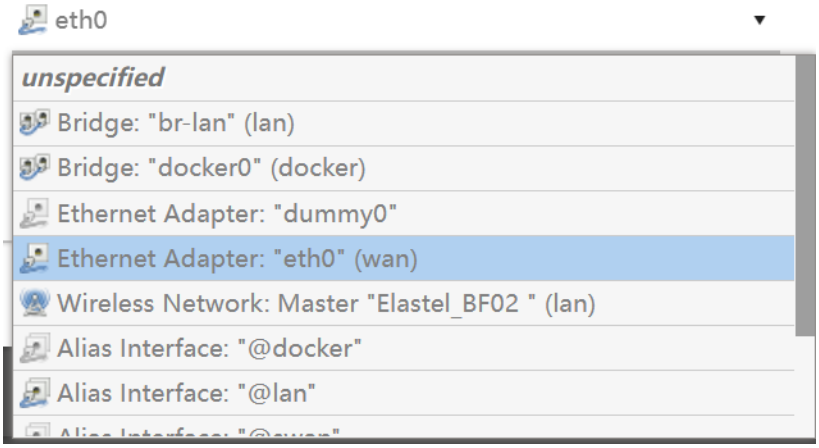
This page you are able to Add, Delet, Edit a network interface. Take WAN interface setting as an example.



General Settings provide Portocol setting with “DHCP Client”, “PPP”, “PPPoE”, “QMI Cellular”, “Static address”… options for choose.



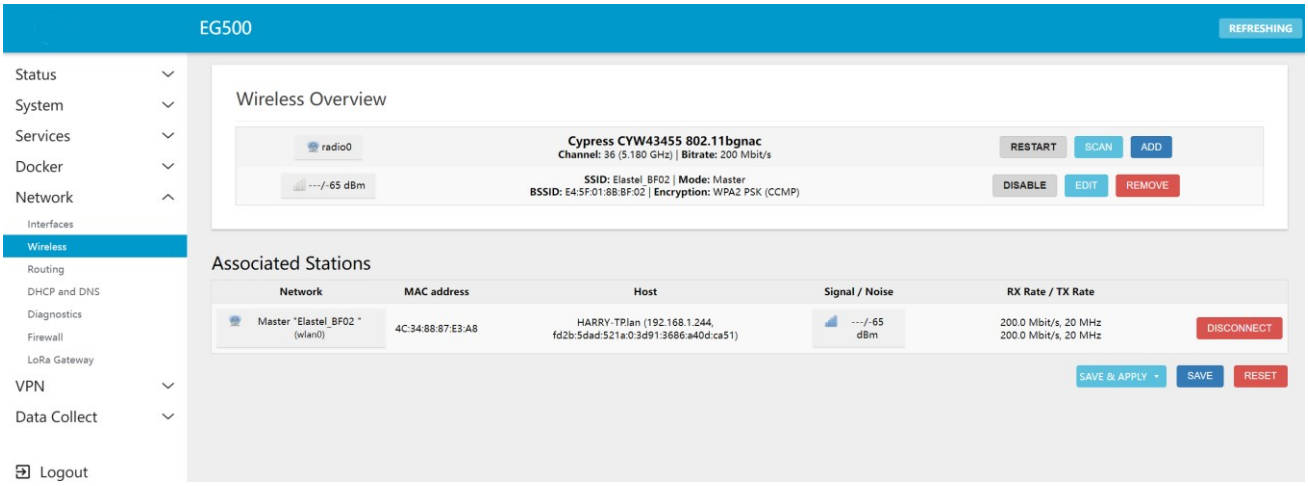
And the “Device” provide Ethernet adaptor and others options for choose.



As default, ElastOS pre-configured the zero-touch network configuration that WAN for wired WAN, SWAN for cellular WAN, and LAN for LAN.
Normally the device will detect WAN/SWAN/LAN available and running up itself without any extra settings when power on.

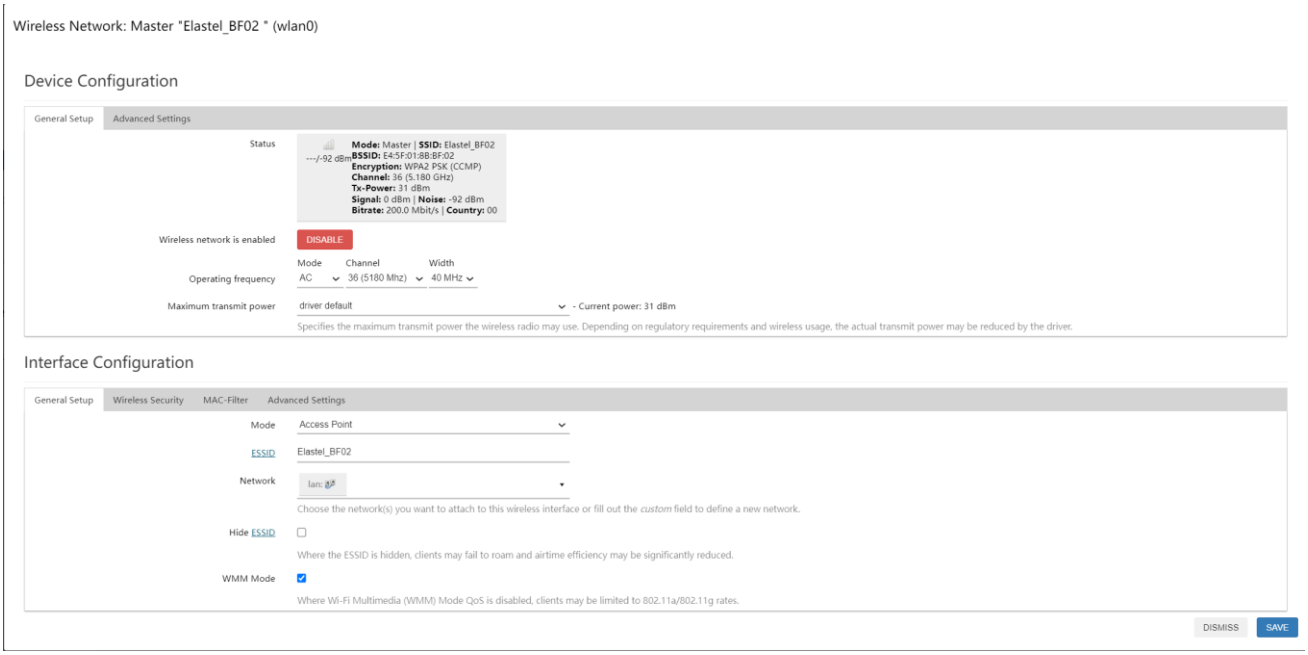
It takes Ethernet WAN as main WAN if both interfaces available. And failover between WAN and SWAN in case the working network failed. You are allowed to modify the settings as your specific needs.

3.5.2 Wireless



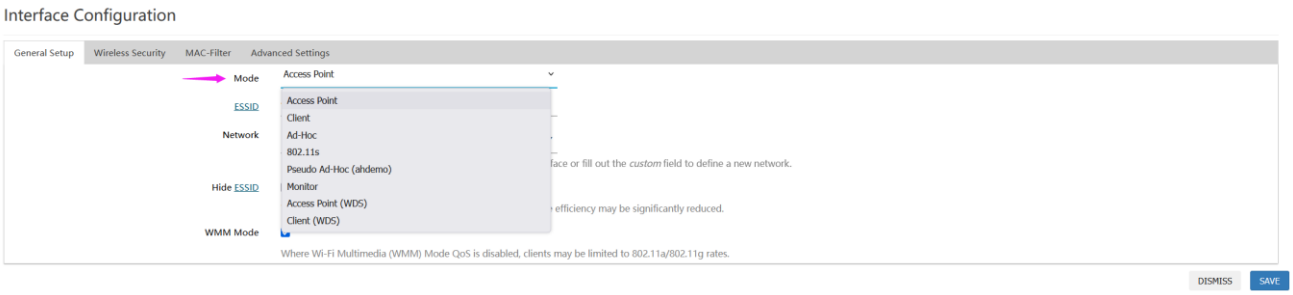
This page provide current wireless overview and asociated stations.

Click the “EDIT” button to go into wireless configuration pages.



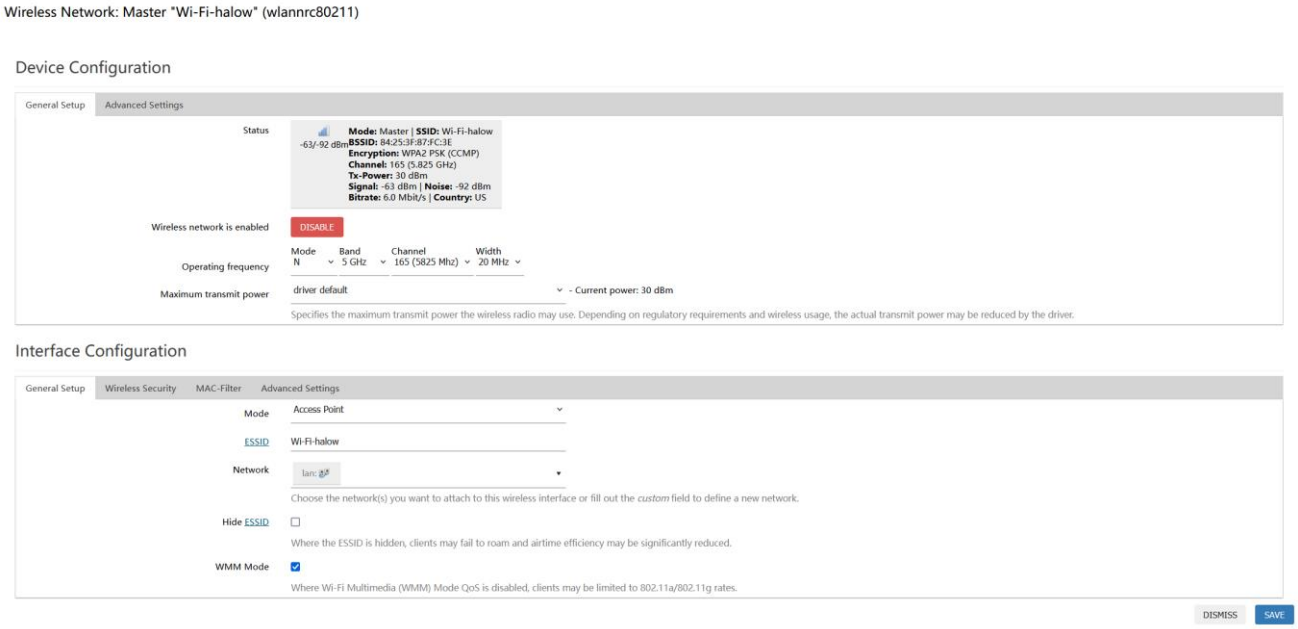
In Mode field, it provides three Modes for setting, “Legacy”, “N”, and “AC”.
Mode Legacy: 802.11b/g protocol,
Mode N: 802.11b/g/n protocol,
Mode AC: 802.11ac protocol.
Each mode have corresponding Channel frequency setting.

In Interface Configuration, you can set EG500 as different mode like Access Point, Client….and others.
Also set the encryption methods and secuirty key in “Wireless Security” label, and other “Advanced Settings”



3.5.3 WiFi HaLow Settings (EG500 WiFi HaLow Version)

ElastOS integrated the 802.11ah WiFi HaLow Settings like regular 802.11 b/g/n/ac WiFi.
To enable the 802.11ah WiFi, you need set the Mode as “N” Band as “5GHz”, and the default Channel as 165.
Please check the WiFi HaLow setting instruction for more details.



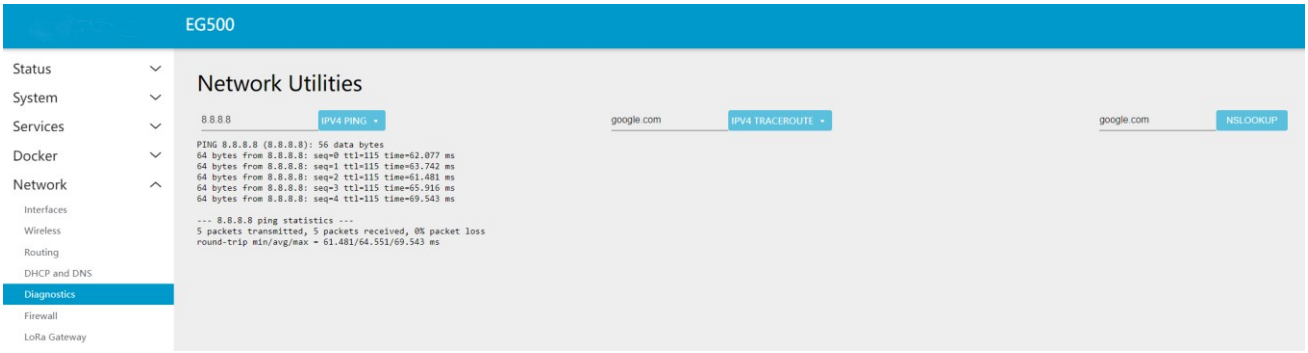
3.5.4 Routing

Routes specify over which interface and gateway a certain host or network can be reached.

3.5.5 DHCP and DNS

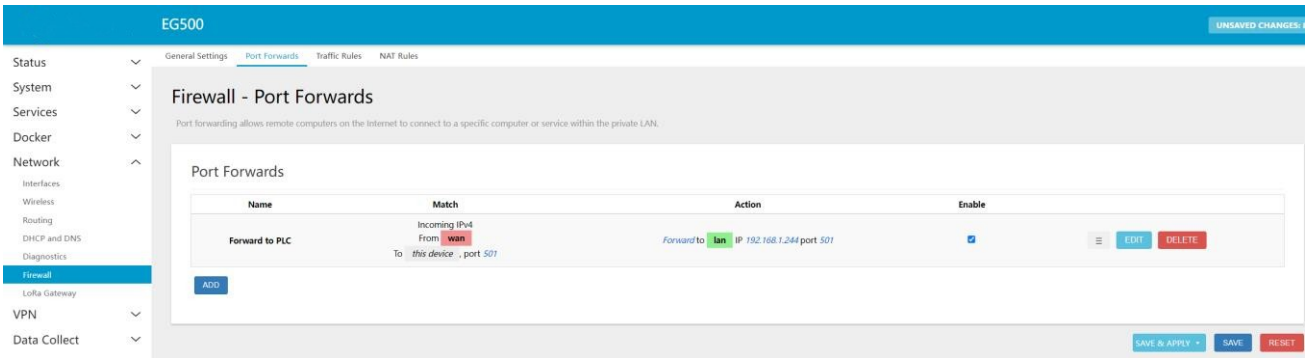
DHCP and DNS settings are powered by Dnsmasq, which combined DHCP-Server and DNS-Forwarder for NAT firewalls

3.5.6 Diagnostics



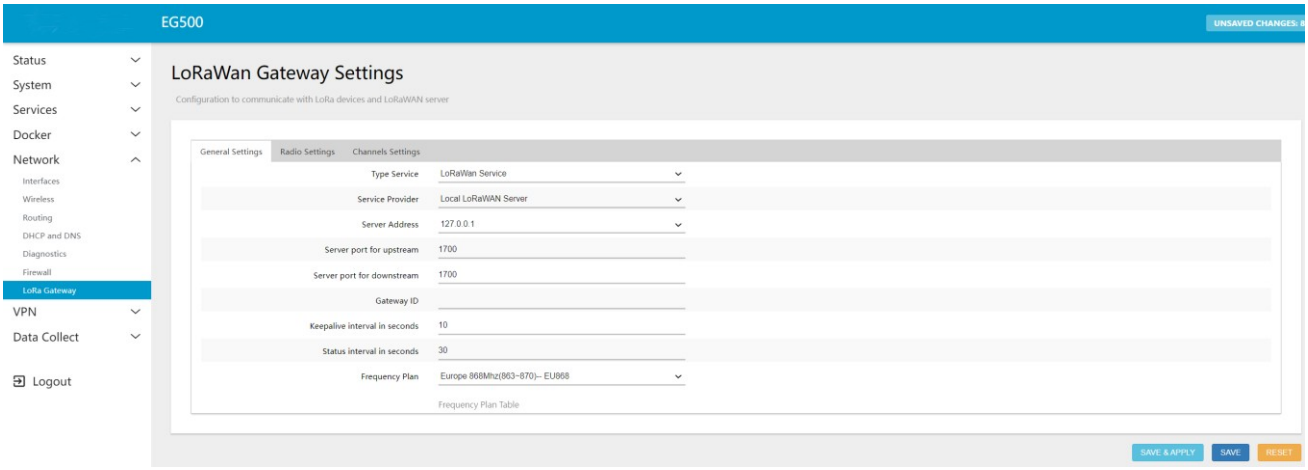
EG500 webUI integrated a web-based diagnostics tool including PING, Traceroute, Nslookup for troubleshooting the network status.

3.5.7 Firewall



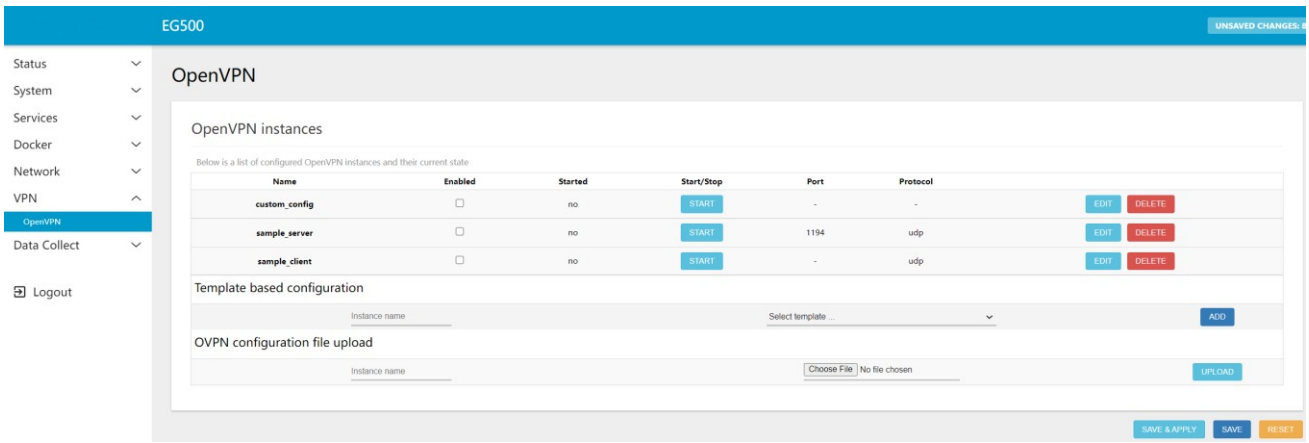
This menu provide Firewall related settings, including general settings for Firewall Zone, Port Forwards, Traffic Rules, NAT rules.

3.5.8 LoRa Gateway Settings (EG500 LoRaWAN Version)



EG500 support add a LoRaWAN module powered by SX1301/1302 solution, and the webUI provide corresponding configuration to communicate with LoRa devices and LoRaWAN server.

3.6 VPN



The VPN menu provides the VPN service you have installed, OpenVPN was pre-installed as default and webUI provide related configuration for it.

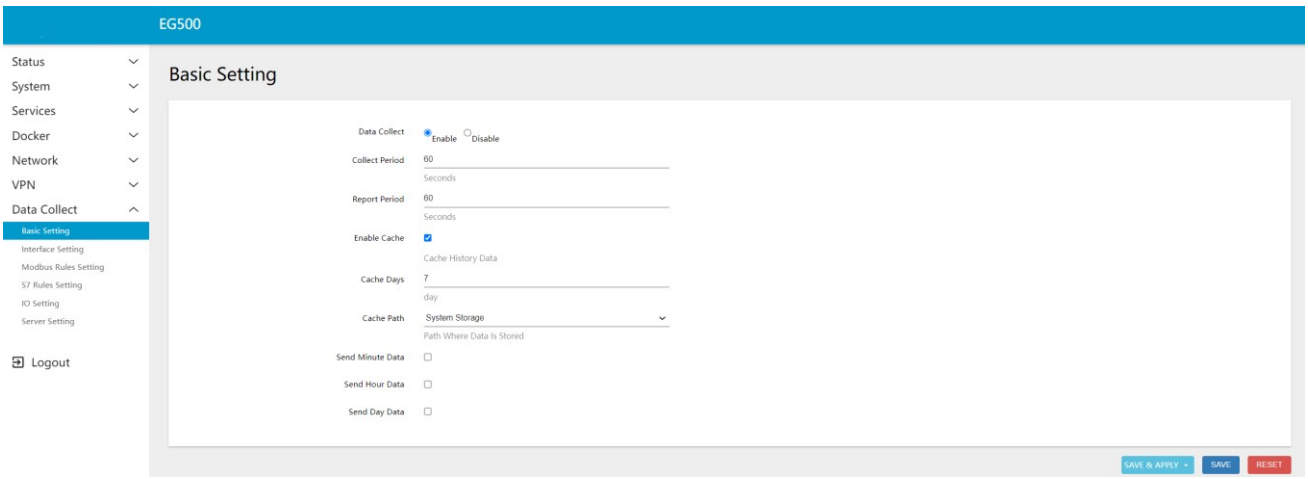
Other VPN service like L2TP, IPSec, GRE please install them as your needs from Software list (refer Session 3.3.3), and the webUI will appear corresponding configurations on VPN menu.

3.7 Data Collect

ElastOS provide a I/O configuration management visible portal for expended I/O ports including Ethernet/RS485/RS232/DI/DO/AI ports data acquisition and control. Support Modbus protocol, Siemens S7, and other customizable protocols.

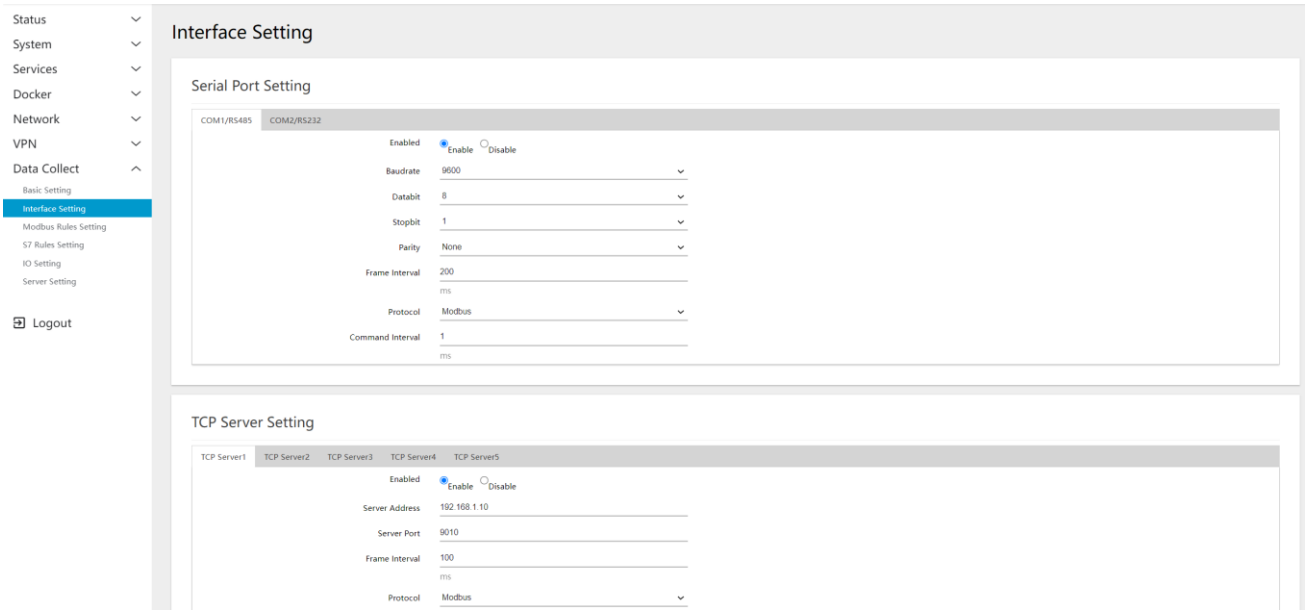
3.7.1 Basic Setting

This page provide settings for enable or disable the data collect feature, set the collect period, and report period in seconds, also enable/disable data cache in fail to upload data to cloud.



1) Data Collect: Enable or Disable data collect feature.
2) Collect Period: Set the period of data acquire from slave devices.
3) Report Period: Set the Period of data report to server.
4) Enable Cache: Enable or Disable history data cache feature.
5) Related data cache setting if enable the cache feature.

3.7.2 Interface Settings

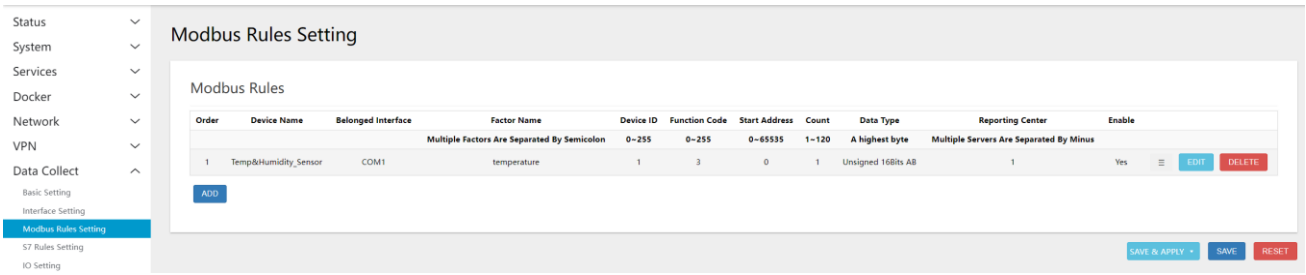


Switch the hardware interfaces for data acquisition from kinds of slave devices. Including Serial ports (COM1 as RS485, COM2 as RS232), Modbus TCP base on Ethernet LAN,

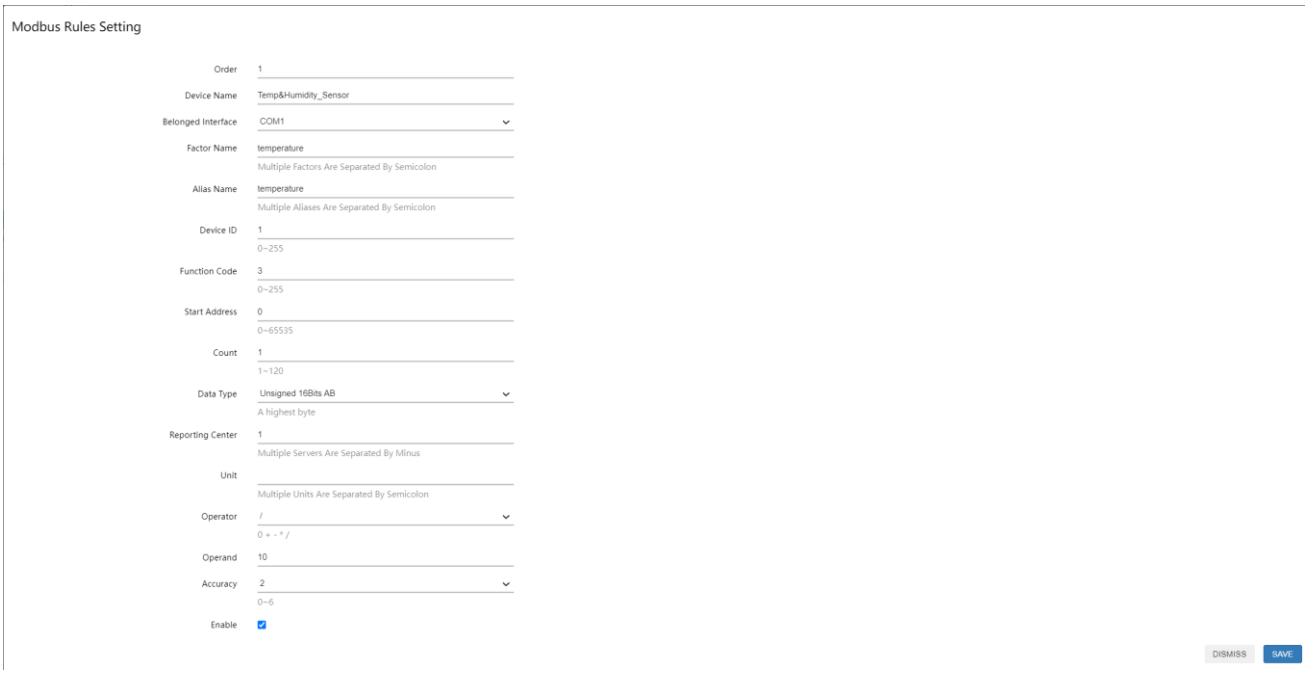
3.7.3 Modbus Rule Setting

Modbus Rules Setting is for EG500 as a Modbus master to acquire data from slave devices based on Modbus protocol. You can configure unlimited Modbus rules on it.

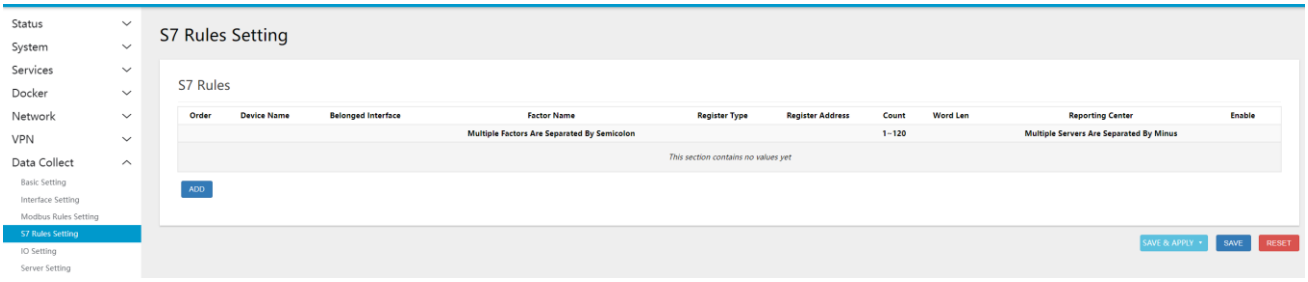
EG500 provide the options of definable factor name, device ID, function code, register address and count register number, please following the slave device datasheet to get these information.



Click ADD or EDIT button to add or edit a modbus rule, it provide visible Modbus related setting items.

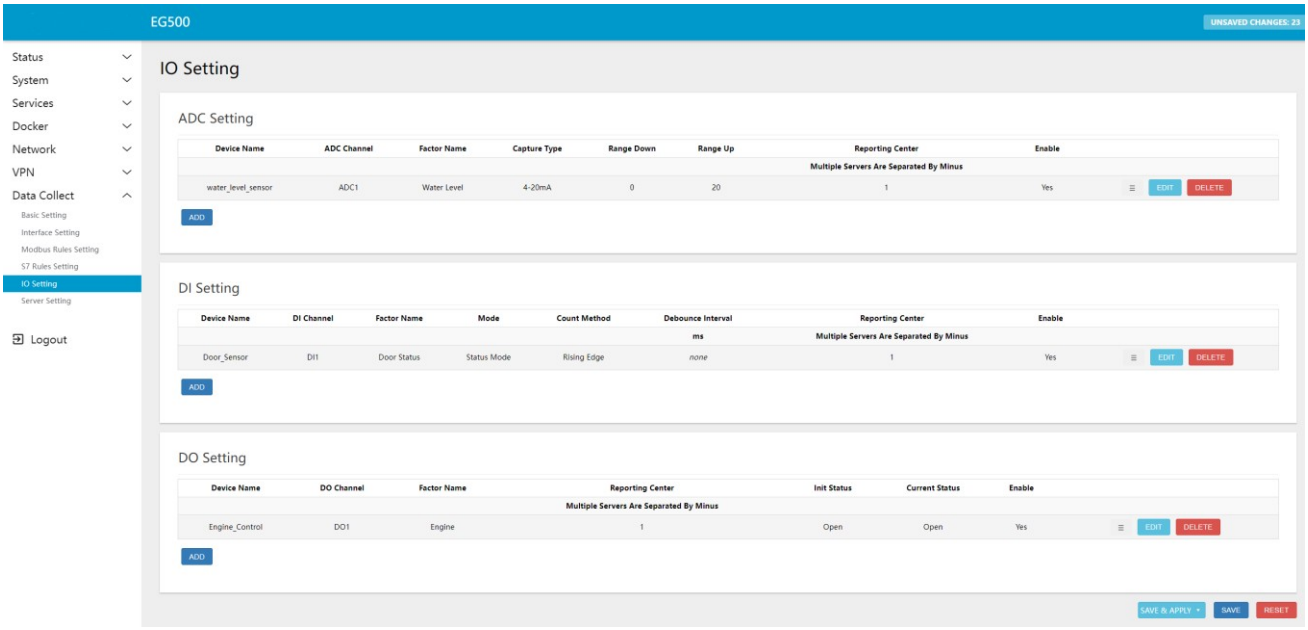


3.7.4 S7 Rules Setting



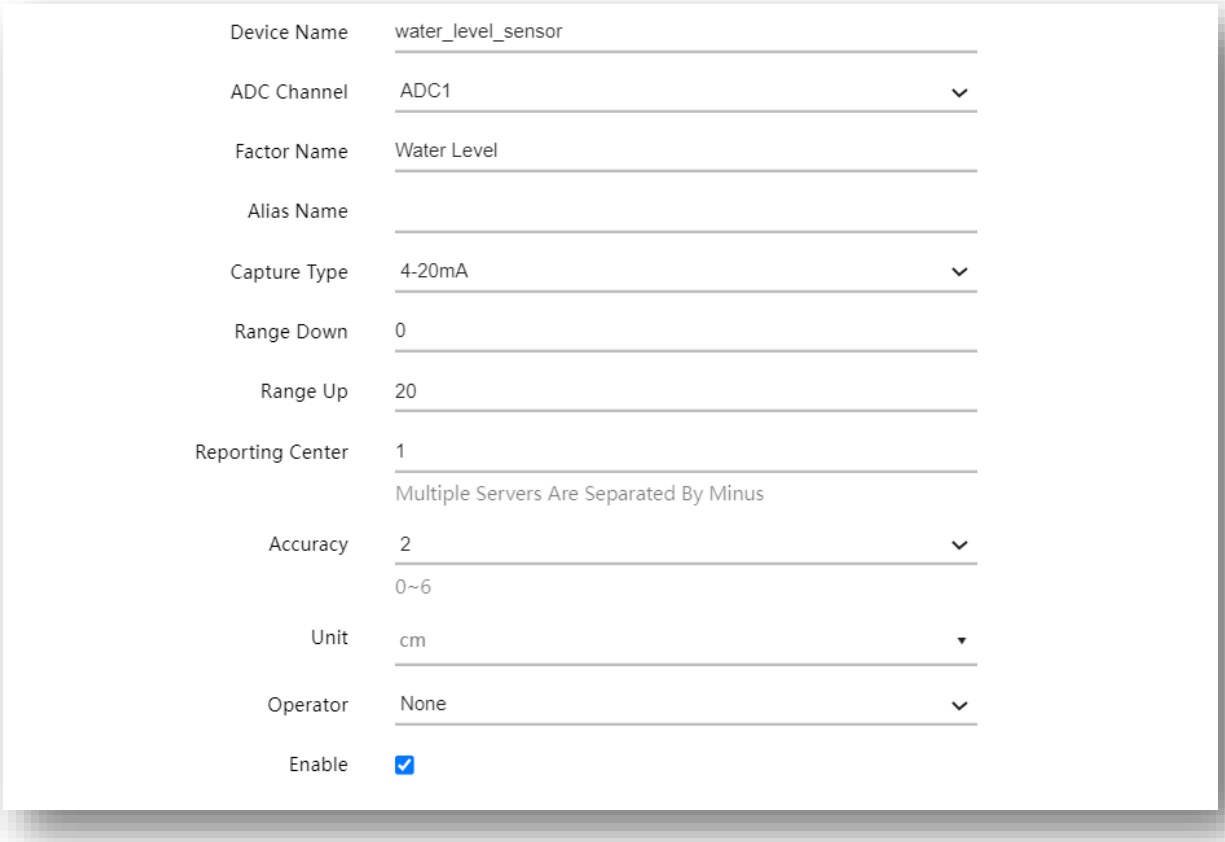
This menu provide the Siemens S7 protocol data acquisiton settings.

3.7.5 IO Setting

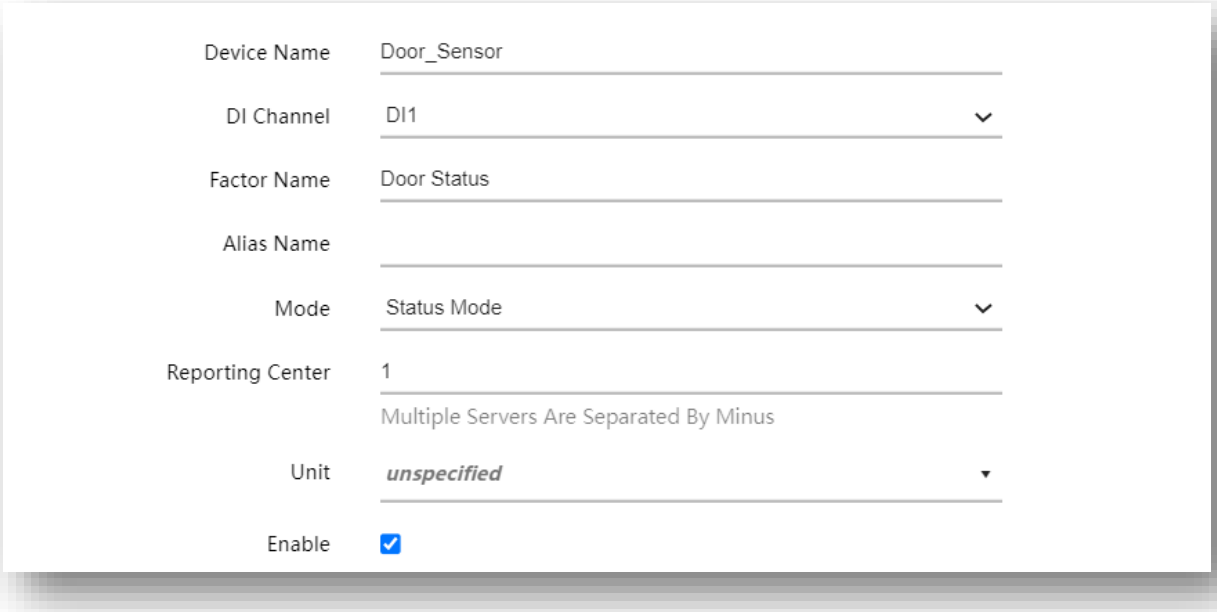


IO Setting menu is for setting ADC (AI) ports, DI ports, and DO ports data acquisition.

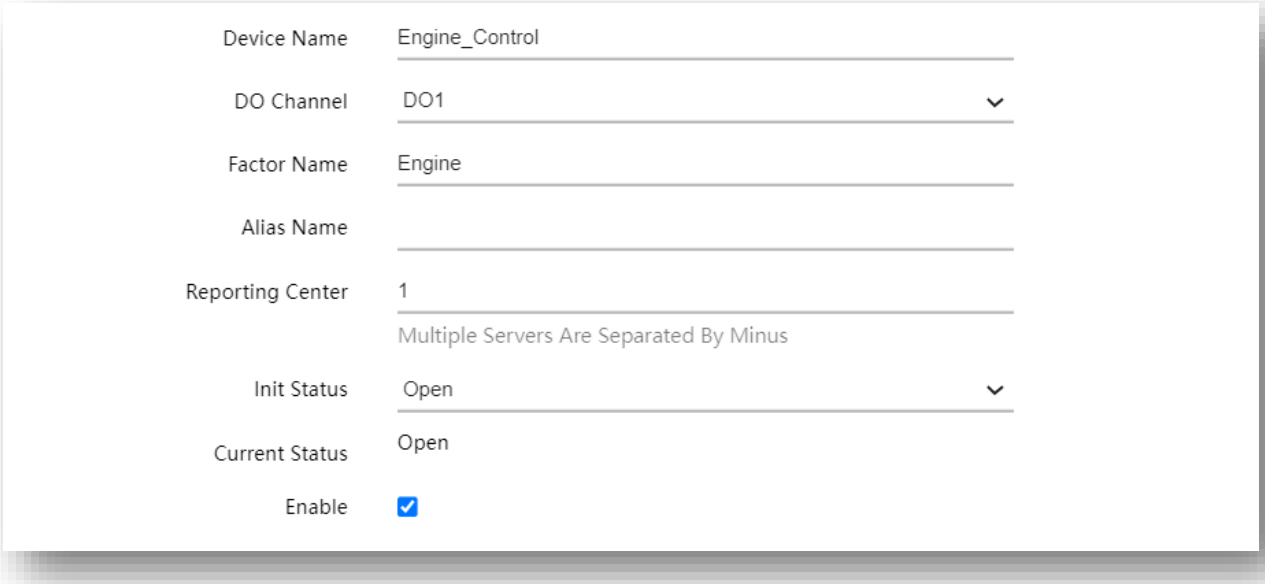
ADC setting items



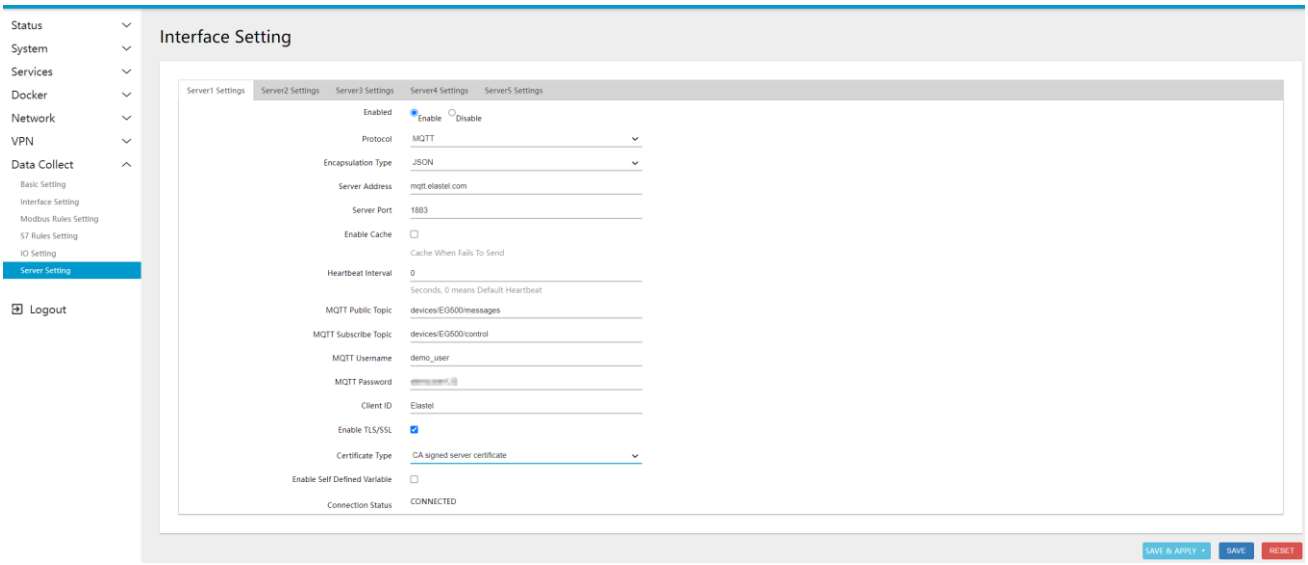
DI Setting items



DO Setting items



3.7.6 Server Setting



Server setting menu allows user set the data center address up to 5 servers with individual protocols. The EG500 support TCP, TCP Server, UDP, HTTP, MQTT, and Modbus TCP protocols for communication.

For the data format, it supports different encapsulation type, include “Transparent”, “Json”, and “HJ212” (special for some Environment SCADA). Also it support customize specific protocols for your specific data center requirements.

3.8 Logout

Logout button on menu bar provide logout the webUI manually.

4. Other Compatible OS Guide

Powered by Raspberry Pi CM4, EG500 also compatible with those Operating System which suitable for consumer Raspberry Pi 4B, like Raspbian, Ubuntu, Windows 10 IoT…

This section take install Raspbian OS on EG500 as example.

4.1 Installration

The recommand method is asking your Elastel representative manage the pre-install operation from factory for you. Or leave a note when place orders, Elastel logistic team will follow your comments.

The next section covers the guide that install the Raspbian OS or other branch version by yourself.

4.1.1 Disassembe the CM4

1) Remove the 4 M3x4 mm screws from both sides of the EG500.
2) Lift up the top side lid of enclosure by sliding.
3) The internals of the unit including CM4 and others are now accessible.
4) Gently remove the WiFi pigtail (if equipped)
5) Gently lift straight up the CM4 from sockets. Use caution as the connector is fragile.

Use caution! It is recommended not to disassemble the unit any further unless absolutely necessary. Further disassembly has greater potential to cause warranty voiding damage.

4.1.2 Install Raspbian OS on CM4

You may need a Compute Module 4 IO Board from Raspberry Pi or other alternative board which support flashing OS.

Following the document guide from Raspberry Pi official to flashing the prepared OS on CM4.
https://www.raspberrypi.com/documentation/computers/compute-module.html#flashing-the-compute-module-emmc

4.1.3 Re-installation CM4

Now you have finished the expected OS installration on CM4.

1) Re-install the CM4 module by linging up the white area sketch map, gently pop it down into the sockets.
2) Re-install the WiFi pigtail (if have) by pressing it into the connector.
3) Ensure the thermal pads are still attached on CM4 CPU.
4) Set the aluminum enclosure onto the bottom chassis, aligning the screw holes.

4.2 Operating Interfaces

Now the EG500 unit is ready to boot up. There are several operating interfaces to access the OS and further configuration.

4.2.1 HDMI GUI

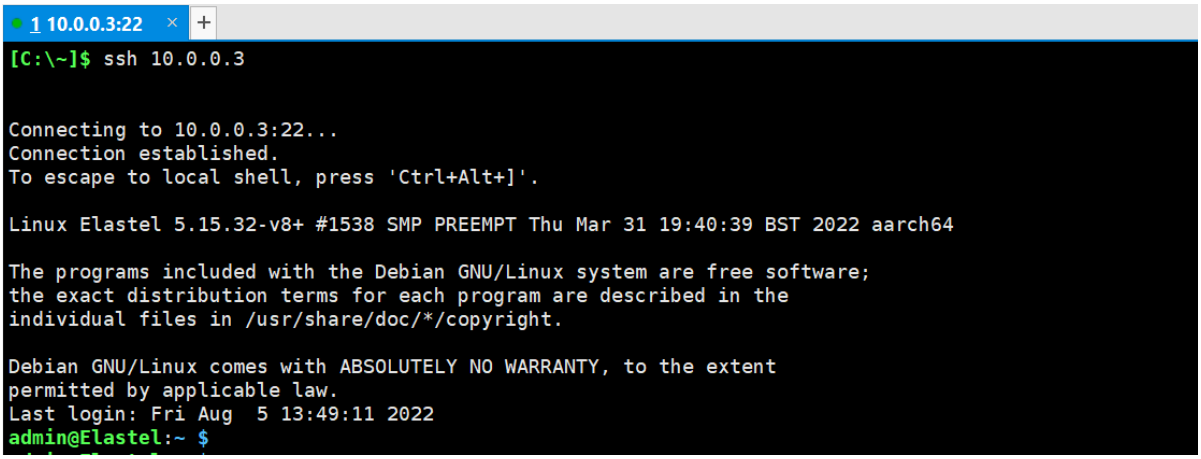
The Raspbian desktop version provide GUI desktop for operation. You will need a HDMI type screen, USB keyboard and mouse. Connect your screen to EG500 HDMI port, USB keyboard and mouse to EG500 USB ports. Now power on the EG500, you will be greeted with the Raspbian welcome screen, configure each steps following the setup wizard, and the EG500 is ready for use.

4.2.2 Console CLI

EG500 provide USB-C console port for CLI access.
Release the SIM/Console protection panel on right side of EG500, the console port are now accessible. Connect the EG500 USB-C console port with your PC, open a serial communication tool (like putty).

Boot up the EG500 and you are able to access the OS CLI via serial console.

4.2.3 SSH CLI



The WAN port on EG500 is default available in Raspbian OS, this provide possibility to access this unit via Ethernet SSH. Connect EG500 WAN port with the same subnet as your PC, obtain the internal IP address of EG500 from your upper router, then you should be able to access Raspbian OS CLI through SSH its internal IP address.

4.2.4 WebUI

Elastel provide a pre-configured programs package for user quick setup the EG500. It include the expanded peripheral ports drivers for WAN port, LAN port, mini-PCIe cellular module, DI/DO/ADC ports, and LED indicators. Also provide a WebUI for configuration management.

Please install the package from Elastel Github.

$ git clone https://github.com/Elastel/web_installer.git

$ cd web_installer

$ chmod +x install.sh

$ sudo ./install.sh

Notice: Enter Y when Y/N appears during the installation process

4.3 Individual Drivers and Programming

Please refer to the EG500 Administrator Programming Guide for more details.

-END-