CIRCUIT MONITORING SYSTEM

CMS-700

User manual

- Energy transparency at branch level for optimal load distribution
- Measurements of all kinds of currents (DC,AC, or mixed) up to 160A
- Simplified installation thanks to quick mounting of sensors
- Smart commissioning in only a few minutes
- Easy retrofitting and upgrades thanks to the flexible, modular design

Table of contents


- Online values
L1
L2
L3
N
Total
Current [A]
Voltage [V]
THD I [%]
THD U [%]
Power Factor [-]
Active Power [W]
Reactive Power [var]
Apparent Power [VA]
Voltage [V]

Use and Storage of the Manual

This manual contains all of the safety information, the technical aspects and the operating necessary to ensure the correct use of the device and maintain it in safe conditions.

Storing
The manual must be stored close to the device; safe from liquids and anything else which may compromise its leggibility. The manual and the declaration of conformity are both an integral part of the device until it is dismantled. If the manual is lost or illegible please request a copy from the manufacturer.

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Meaning of symbols

	Warning – can result in death or serious personal injury		Non-safety related, but useful and important information
	CE conformity mark		Torque
	Observe the accompanying documents		Disposal
	Installation, electrotechnical expertise		Equipment protected throughout by reinforced insulation

General Information

Cleaning

Use a dry cloth.

Installation to mains
Installation of CMS-700 to mains shall include a switch or circuit breaker for the connection to mains. The switch or circuit breaker must be suitably located and easily reachable and must be marked as the disconnecting device for the CMS-700.

Disconnection from mains or connection to mains
Switch off circuit breaker or switch before disconnecting from the mains supply or connecting to the mains supply. Same applies for all other connections (L1, L2, L3, N).

Safety warnings

Attention: Non-adherence to the following points can lead to serious injury or death.

Use the suitable personal protection devices and adhere to the current regulations governing electrical safety.

This device must be installed exclusively by qualified personnel who have read all of the information relative to the installation.

Check that the voltage on the main side is compatible with the range permitted by the device.

Ensure that all current and voltage supplies are disconnected prior to carrying out any controls, visual inspections and tests on the device.

Always assume that all circuits are under voltage until they are completely disconnected, subjected to tests and labelled.

Disconnect all of the power supply prior to working on the device.

Always use a suitable voltage detection device to check that the supply is interrupted.

Pay attention to any dangers and carefully check the work area ensuring that no instruments or foreign objects have been left inside the compartment in which the device is housed.

The correct use of this device depends on a correct manipulation, installation and use.

Failure to adhere to the basic installation information can lead to injuries as well as damage to the electric instruments or to any other product.

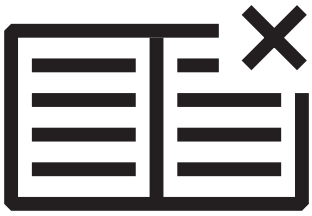
The tests carried out at a high voltage can damage the device's electronic components.

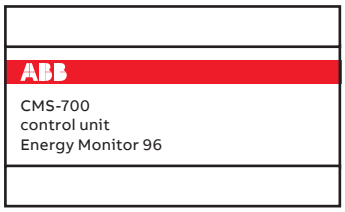
Disposal
Defective devices must be disposed of as special waste at the appropriate collection points set up for this purpose. National or regional regulations on the disposal of special waste must be followed.

Service and maintenance
The device undergoes several safety assessments before shipment and will be sealed. If a device is opened, the safety assessments have to be repeated. A warranty will be provided for unopened devices only.

Packaging Contents

- Control unit (CMS-700)
- Installation manual





Attention: The following items are not included in the delivery of the product

1) CMS-Sensors

2) Current transformer (CT)

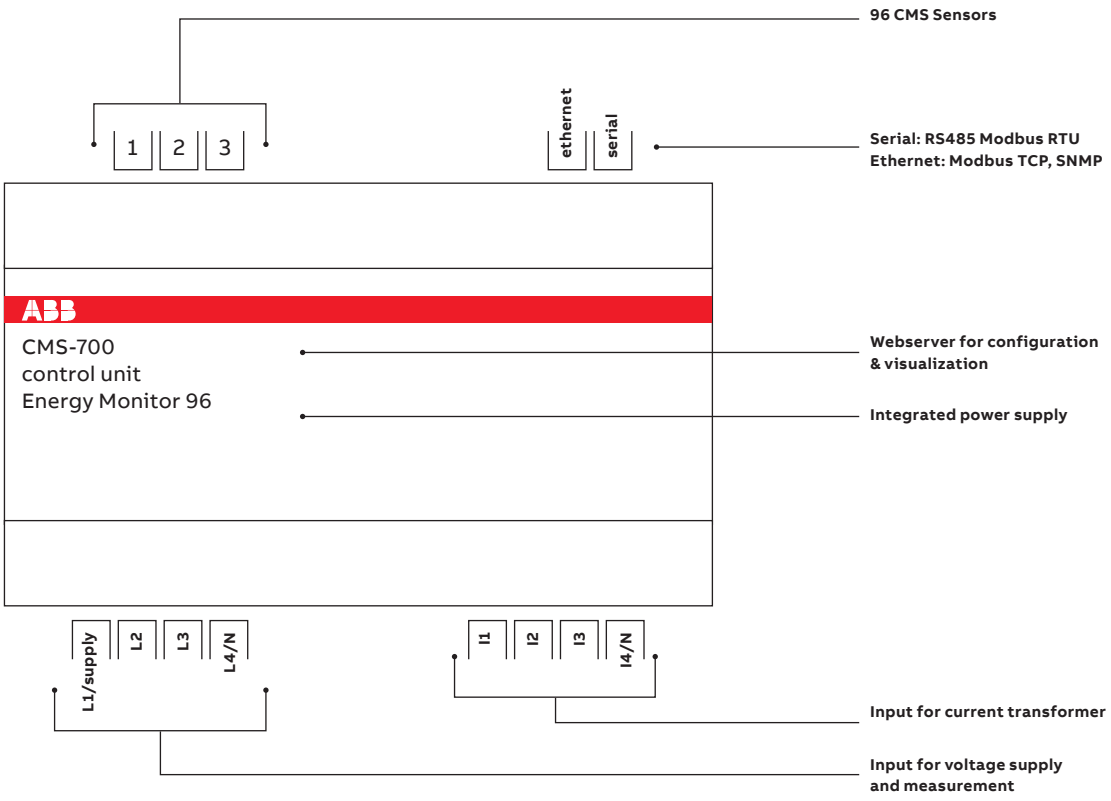
3) CMS-Bus

4) Connector set

Product Overview
Intended use

The CMS-700 control unit is a measuring instrument for recording the performance and energy of mains and of up to 96 branch sensors.

The system consists of a control unit and sensors with different measurement ranges.
The sensors measure alternating, direct and mixed currents (TRMS) and get connected to the control unit by a flat cable, the CMS-Bus. The measurement data can be displayed or analyzed via LAN interface with the integrated web server or Modbus TCP or SNMP protocols or via RS485 interface, such as Modbus RTU.



Cyber Security Disclaimer

The CMS-700 is designed to be connected and to communicate information and data via a network interface, which should be connected to a secure network. It is your sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be) and to establish and maintain appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the CMS-700 product, the network, its system and interfaces against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its affiliates are not liable for damages and/or losses related to such security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
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Product Overview

Reset button

There is a recessed button to restart the device or for resetting it to a defined as-delivered condition.
• Pressing the button for 3 to less than 6 seconds restarts the device with current settings
• Pressing the button for more than 10 seconds resets the device to the factory settings
Do not switch off the device during the reset process.

LEDs

Two LEDs indicate respectively the status of the device and the one of the network.

1. LED Status

Display	Function
Off	Device is off
Green on	Device is ready
Green flashing slowly	Firmware is ready, Web server is loading
Orange flashing slowly	Firmware update ongoing
Orange on	Booting
Red on	Booting error

2. LED Network

Display	Function
Off	LAN is not connected
Green on	LAN is connected
Green flashing	Network traffic

Product Overview
Technical specifications

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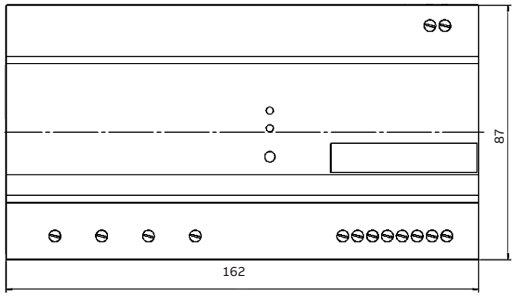
CMS-700

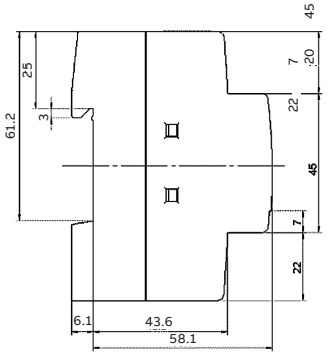
CMS-700 Control Unit

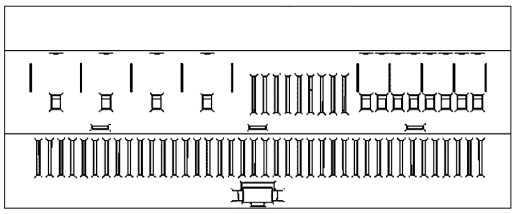
IEC61010-1		
Supply voltage	[VAC]	90-240 (L1-N)
Voltage measurement range	[VAC]	90-240 (L1-N, L2-N, L3-N)
UL 508 / CSA C22.2 No. 14		
Supply voltage	[VAC]	80-277 (L1-N)
Voltage measurement range	[VAC]	80-277 (L1-N, L2-N, L3-N)
General		
Frequency	[Hz]	50 / 60
Power consumption (L1-N)	[VA]	5 .. 40 (depending on number of sensors)
Current measurement range, Current transformer (secondary wire of CT)	[A]	nominal: 5 max.: 6
Data refresh time sensor values		1 sec
Operating temperature	[°C]	-25 .. +60
Storage temperature	[°C]	-40 .. +85
LAN (RJ45 connector)	[Mbit/s]	100
Modbus RTU	[Baud]	RS485 2-wire, 2400..115200
Cable cross section		1.0.. 2.5 mm², max. 0.8 Nm *)
Stripping length	[mm]	10
Tightening torque of screws	[Nm]	0.5..0.8
Mounting DIN-rail		35 mm DIN50022
Dimensions	[mm]	160.0 x 87.0 x 64.9 (9 DIN modules)
Overvoltage category		II
Pollution degree		2
Altitude	m	2000
Safety class		IP20
Main circuit accuracy		
Voltage		± 1%
Current		± 1%
Harmonic component (up to 2500Hz)		± 1%
Active power		± 2 %
Apparent power		± 2 %
Reactive power		± 2 %
Power factor		± 2 %
Standards		
Electrical safety		IEC 61010-1, UL 508, CSA C22.2 No.14
EMC		IEC61326-1

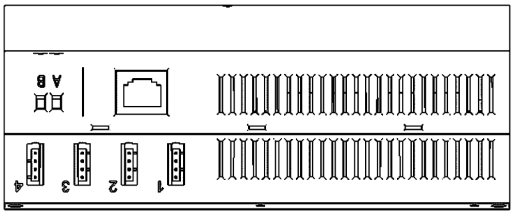
*) Line protection is recommended (acc. IEC61439) min. 6A, max 8A for 1mm², 12A for 1.5mm², 20A for 2.5mm²

Product Overview
Overall dimensions









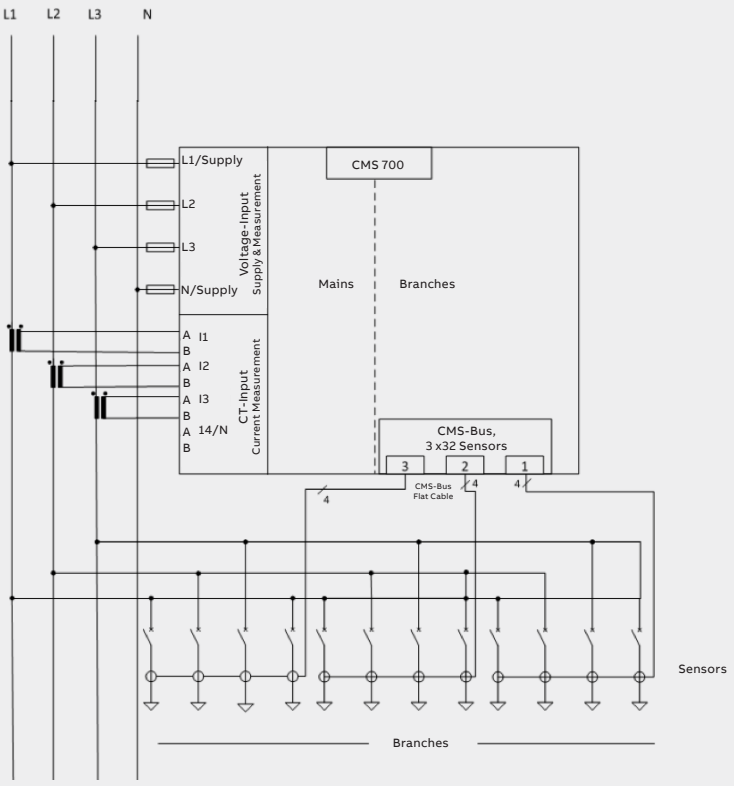
Measurements and Events Definition

Principle of measurement

The principle of measurement for AC of the CMS-700 control unit includes measurement on the mains and branches. On the mains side, all values are measured directly. On the branches, current is measured while voltage, power factor as well as active power and energy are calculated using measured mains values.

For further information, please refer to the following table

Mains	Branches/Sensors
Measurement of	
I_{MAINS} (Current) [A]	I_{TRMS}, I_{AC}, I_{DC} (Current TRMS, AC, DC) [A]
Measured mains values used for calculation	
U_{MAINS} (Voltage) [V]	U_{MAINS} (Voltage) [V]
PF (Power Factor)	PF (Power Factor) (manual configuration is possible)
THD (Voltage, Current) (%)	
Calculation of	
Power: – active [W] – apparent [VA] – reactive [var]	P_{SENS} (Active power) [W] $P_{SENS} = U_{MAINS} \cdot I_{AC} \cdot PF$
Energy [kWh]	$Energy_{SENS}$ [kWh]



Attention: Referring to the diagram in the figure aside, please note that N on the supply has to be connected in order to avoid damage of the device. Twisting the phase and neutral can damage the device.

Measurements and Events Definition

Events

If a measurement object (e.g. TRMS current of a branch) crosses predefined threshold conditions (value, direction and delay time) then an event is registered.

Following options linked to events logging are available:
- Visualization of all detected events in WebUi
- Reading event/alarm status through Modbus register or SNMP traps
- Export via FTP and Email

In order to configure an event, specifications of the following are required:
- The threshold value
- Indication of cross direction (cross up, cross down)
- Indication of delay time

Events can be linked both to mains and branches object values:

Branches

Object	Unit	Alarm Status	cross up/down	Resolution Threshold	Format
no Alarm		0			
Current TRMS	A	11	up	0.01	unsigned
Current TRMS	A	12	down	0.01	unsigned
Active power P	W	41	up	1	unsigned
Active power P	W	42	down	1	unsigned

Mains

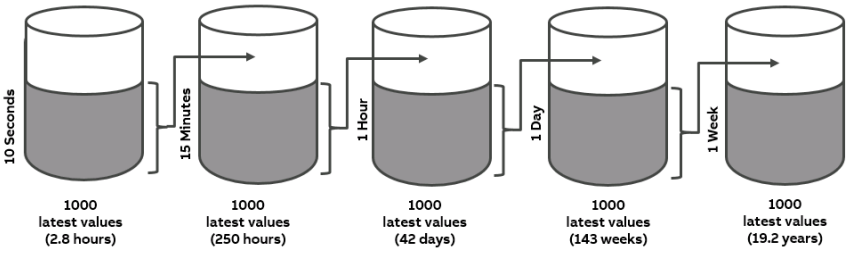
Object	Unit	Alarm Status	cross up/down	Resolution Threshold	Format	L1	L2	L3	N
no Alarm		0				x	x	x	x
I	A	11	up	0.01	unsigned	x	x	x	x
I	A	12	down	0.01	unsigned	x	x	x	x
THD-I	%	21	up	0.01	unsigned	x	x	x	x
THD-I	%	22	down	0.01	unsigned	x	x	x	x
U	V	31	up	0.01	unsigned	x	x	x	
U	V	32	down	0.01	unsigned	x	x	x	
THD-U	%	41	up	0.01	unsigned	x	x	x	
THD-U	%	42	down	0.01	unsigned	x	x	x	
P	W	51	up	1	singed	x	x	x	
P	W	52	down	1	singed	x	x	x	
S	VA	61	up	1	unsigned	x	x	x	
S	VA	62	down	1	unsigned	x	x	x	
Q	var	71	up	1	signed	x	x	x	
Q	var	72	down	1	signed	x	x	x	
Power factor	-	81	up	0.01	singed	x	x	x	
Power factor	-	82	down	0.01	singed	x	x	x	
Active Energy	Wh	121	up	10	singed	x	x	x	
Active Energy	Wh	122	down	10	singed	x	x	x	

The type of event is available on Modbus map as Alarm Status. Resolution refers to the accuracy with which the value is defined. If several events occur for the same main or branch, the newest one will be given out via Modbus.

Three register blocks are available in the Modbus register map:
- only object type with alarm code
- object type with alarm code and threshold value
- number of currently active alarms

Memory Architecture

The measured values of the main power network and those of the 96 outputs are stored in the following memory areas:



Stored values

Mains
- Voltage [V]: L1, L2, L3
- Current [A]: L1, L2, L3, N
- Power factor [-]: L1,L2,L3
- THD U [%]: L1, L2, L3
- THD I [%]: L1, L2, L3, N
- Active power[W]: L1, L2, L3
- Apparent power [VA]: L1, L2, L3
- Reactive power [VAR]: L1, L2, L3
- Active power summation [W]
- Apparent power summation [VA]
- Reactive power summation [VAR]
- Active energy [Wh]: L1, L2, L3
- Apparent energy [VAh]: L1, L2, L3

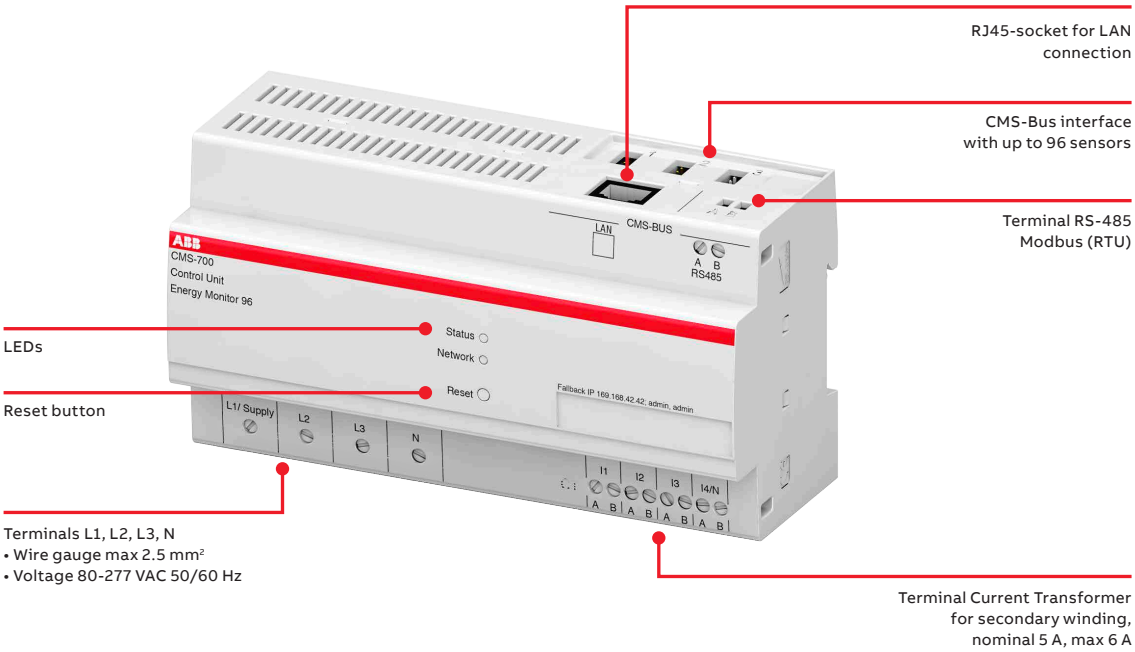
Branches
- Current (TRMS, AC, DC) [A]
- Active power [W]
- Active energy [Wh]

These values of the respective stacks can be exported as a CSV-file and pulled into an FTP or sent by email.

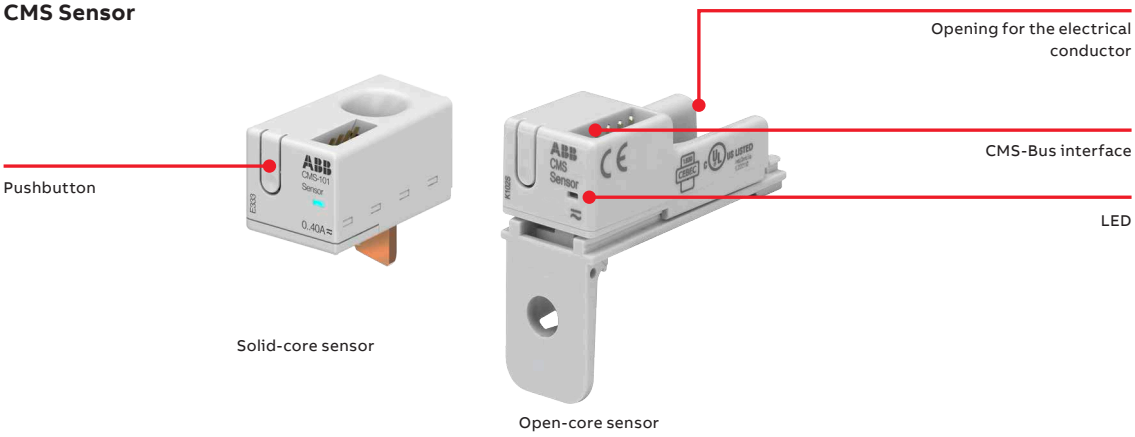
Time reference
The measured values are provided with a UTC time stamp. UTC (Universal Coordinated Time) stands for the location-independent world time in seconds.

Components of CMS system

Control Unit



CMS Sensor



Sensor LED Status:

ON
Sensor is online and in measurement mode. There is a feature in the configuration to switch off the LED after a specified time.

OFF
Sensor is not connected to CMS-Bus or LED is switched off in the configuration.

Flashing slowly
Sensor is not assigned.

Flashing fast
Sensor in assign process or in “setting/branches” mode. This sensor is the sensor corresponding to the yellow-marked row on the screen for webserver settings.

Components of CMS system

Sensors overview

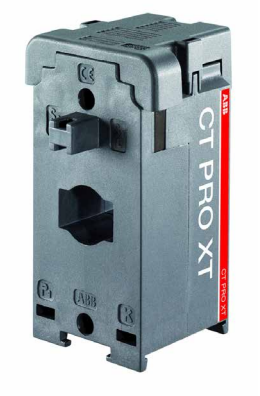
		System Pro M, SMISSLINE		S800	DIN rail	Cable tie
						
Mounting method	for all MCBs, RCDs, RCBOs with twin terminals	for MCBs (S200, SMISSLINE) and RCBOs (SMISSLINE)	for fuse holders E90 (1000VDC)	for all S800 devices with cage terminals	universally usable	universally usable
Open-core sensors						
AC accuracy* of ≤ ± 1.0% The laying method influences the accuracy.						
18-mm overall width						
CMS-120xx (80 A)	CMS-120PS	CMS-120LA	-		CMS-120DR	CMS-120CA
CMS-121xx (40 A)	CMS-121PS	CMS-121LA	CMS-121FH		CMS-121DR	CMS-121CA
CMS-122xx (20 A)	CMS-122PS	CMS-122LA	CMS-122FH		CMS-122DR	CMS-122CA
Solid-core sensors						
AC accuracy* of ≤ ± 0.5%						
18-mm overall width						
CMS-100xx (80 A)	CMS-100PS			CMS-100S8	CMS-100DR	CMS-100CA
CMS-101xx (40 A)	CMS-101PS			CMS-101S8	CMS-101DR	CMS-101CA
CMS-102xx (20 A)	CMS-102PS			CMS-102S8	CMS-102DR	CMS-102CA
25-mm overall width						
CMS-200xx (160 A)				CMS-200S8	CMS-200DR	CMS-200CA
CMS-201xx (80 A)				CMS-201S8	CMS-201DR	CMS-201CA
CMS-202xx (40 A)				CMS-202S8	CMS-202DR	CMS-202CA

* All accuracy specifications refer to the relevant full scale value and apply to 25°C

Components of CMS system

Current Transformer

Example: CT PRO XT 250



CMS Flat Cable

The CMS flat cable is a 4-pin cable for connecting multiple sensors to one control unit. The cable is available in the following four lengths: 2 m (CMS-800), 5 m (CMS-802), 10 m (CMS-803), and 30 m (CMS-805).

Please take into account the following information on the possible cable length of the CMS flat cable depending on the number and shape of sensors:

	Maximum flat cable length in m	
Number of sensors	**Solid-core sensors**	**Open-core sensors**
32	4.5	7.5
28	5.0	8.5
24	6.0	10.0
20	7.0	12.0
16	8.5	15.0
12	11.0	20.0
8	16.0	30.0

- Do not exceed a total flat cable length of 32m for all CMS-Bus lines for each control unit.
- Flat cables longer than approx. 15m could require a 120Ω terminating resistor between the two inner wires at the far end.
- For the flat cable, please consider:
  - Use within closed housings only
  - Keep a distance of min. 5.5 mm to uninsulated live parts
  - Where necessary, additional protection against mechanical stress or UV radiation must be ensured.

Components of CMS system

Connector Set

The CMS-820 connector set contains connector housings and connectors to connect the flat cable to the sensors.

35 x connector housing

35 x connector

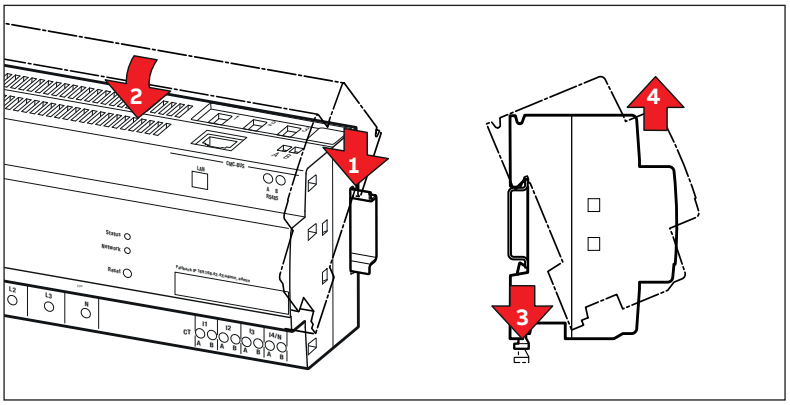
Installation Guide

Warranty
Safe operation is ensured if assembly work has been carried out according to these user instructions. Furthermore, the instructions in the manual must be observed.

Authorized Personnel
Assembly, connection, and removal work should only be carried out by authorized and qualified personnel.

Assembly on 35mm DIN-Rail

To assemble of the control unit, perform steps 1 and 2. The device can be mounted horizontally or vertically. To disconnect, perform steps 3 and 4.



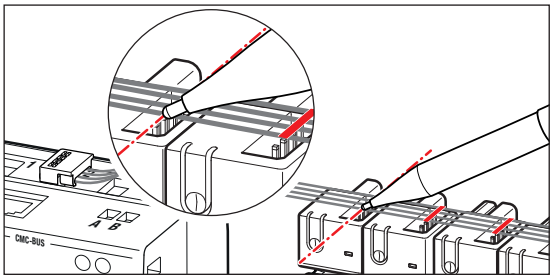
- The CMS-700 can be mounted on all 35 mm DIN rails (DIN50022)
- The device can be installed for single or three phase use
- When available, connect the LAN cable of the local network

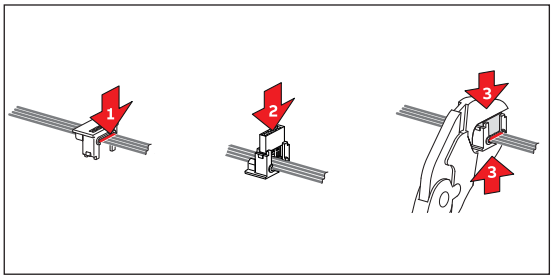
Installation Guide

Flat Cable – Assembly of Connectors

- Use the connectors only once
- Connect max. 96 sensors to each CMS-Bus interface of the control unit
- Consider the maximum flat cable length
- Flat cable should not exert force on the sensor, otherwise measuring errors may occur
- Keep a distance of 5.5mm minimum between the flat cable and uninsulated live parts

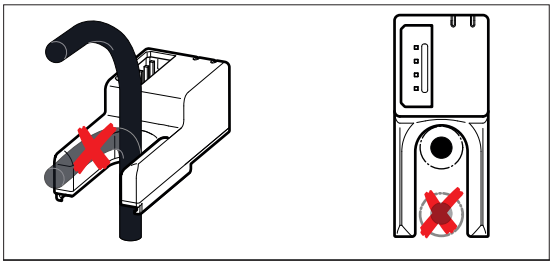
Mark the desired placement of the connector with a pen:





1. Press the flat cable into the cable duct of the connector housing.
2. Insert the connector into the connector housing at the marked position.
3. Press together using parallel pliers. Repeat the process at all other marks.

Position of the Cable

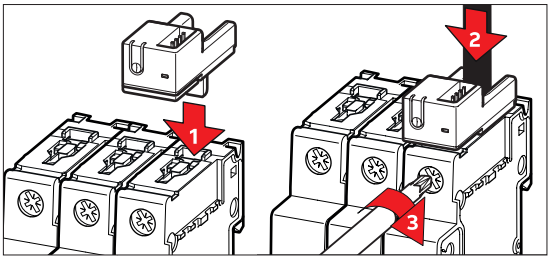


The cable must not bend directly above the sensor. If you use open-core sensors, make sure the cable is at the correct position, otherwise measuring errors may occur.

Installation Guide

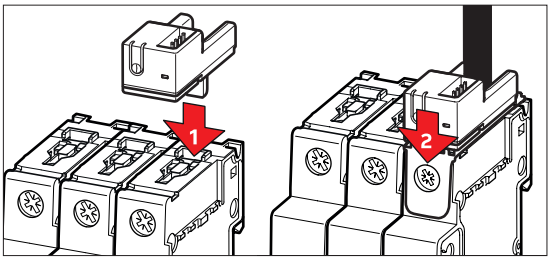
Mounting of System pro M compact and SMISSLINE Sensors

- Sensors fit to all ABB installation devices with twin terminals
- Flat cable should not exert force on the sensor, otherwise measuring errors may occur



1. Unscrew the terminal of the installation device. Plug in the metal pin of the sensor into rear terminal connection.
2. Put the cable through the opening of the sensor into the installed device. The cable has to be insulated within the sensor!
3. Then tighten the screw.

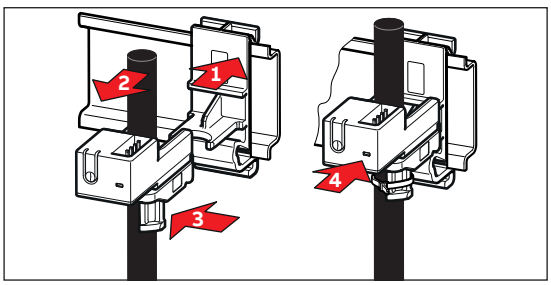
- Sensors fit ABB MCBs (S200, SMISSLINE) and RCBOs (SMISSLINE)
- Flat cable should not exert force on the sensor, otherwise measuring errors may occur



1. Insert the sensor on the existing device, in order to have the cable passing through the opening of the sensor.
2. Snap the adapter of the sensor on the upper screw hole of the already installed device.

Mounting Sensors on DIN-Rails

- Sensors can be mounted on all 35-mm DIN-Rails (DIN50022)
- The cable should not exert force on the sensor, otherwise measuring errors may occur

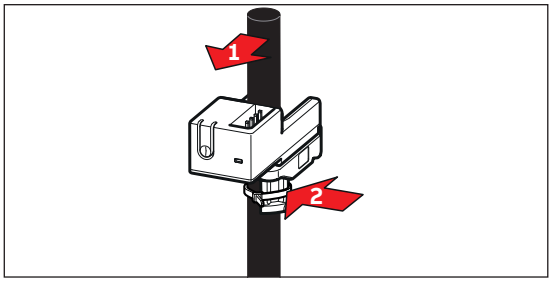


1. Snap in the bracket on the DIN-rail.
2. Insert the cable into the installed device through the opening on the sensor. The cable has to be insulated within the sensor.
3. Fix the cable with a cable tie.
4. Snap in the sensor on the bracket.

Installation Guide

Mounting of cable tie sensors

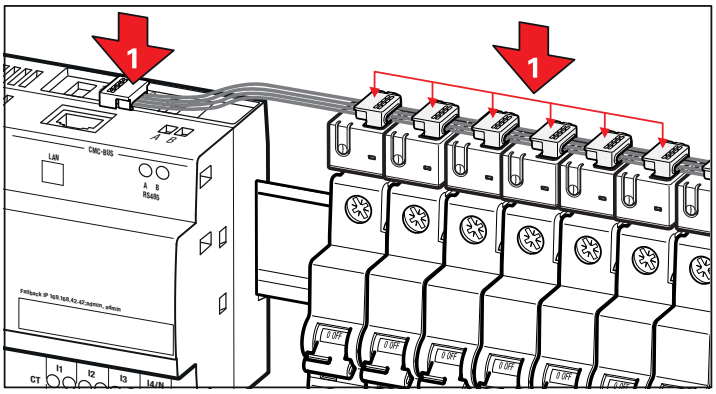
- The cable should not exert force on the sensor, otherwise measuring errors may occur

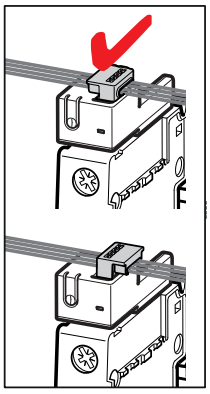


1. Insert the cable into the installed device through the opening on the sensor.
2. Fix the cable with a cable tie.

Connection

Finally, connect the CMS- Sensors to the control unit.
Plug in the cable, check the correct connection direction. (Picture to the right)





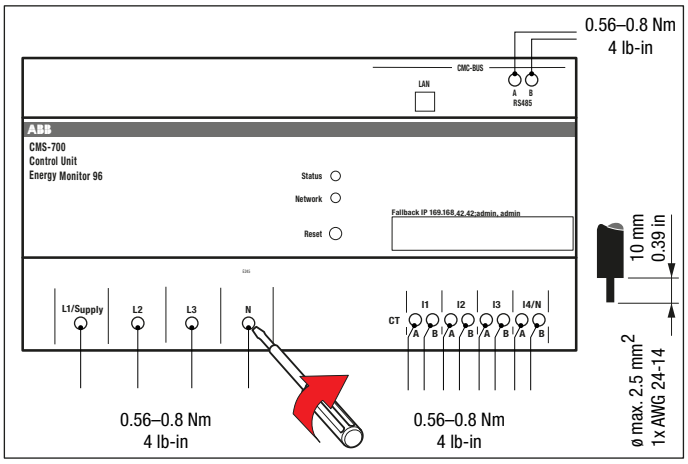
Attention: When plugging in the CMS flat cable on the sensors, check the correct connection direction.

Wiring Diagrams

The operations to carry out for the correct connection of the device, based on the type of electric line available, are described in this section.
The CMS-700 includes an own power supply on L1-N. No external power supply is required.
The contacts I1, I2, I3, I4/ N are provided for connecting the external current transformer.

Installation to mains
Installation of CMS-700 to mains shall include a switch or a circuit breaker for the connection to them. The switch or circuit breaker must be suitably located and easily reachable and must be marked as the disconnecting device for the CMS-700.

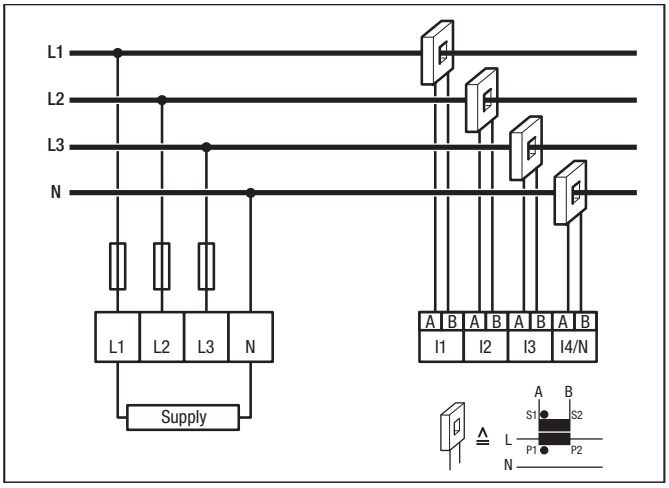
Disconnection from mains or connection to mains
Switch off circuit breaker or switch before disconnecting from the mains supply or connecting to the mains supply. Same applies for all other connections (L1, L2, L3, N).



Attention: The installation and the cabling of the device must be carried out by qualified personnel. Danger of electrocution, burning and electric arc. Use the personal protection devices suitable to adhere to the current regulations governing electrical safety. Prior to carrying out any connections check the sectioning of the electric supply with the voltage detection device.

Wiring Diagrams

Three phase plus neutral

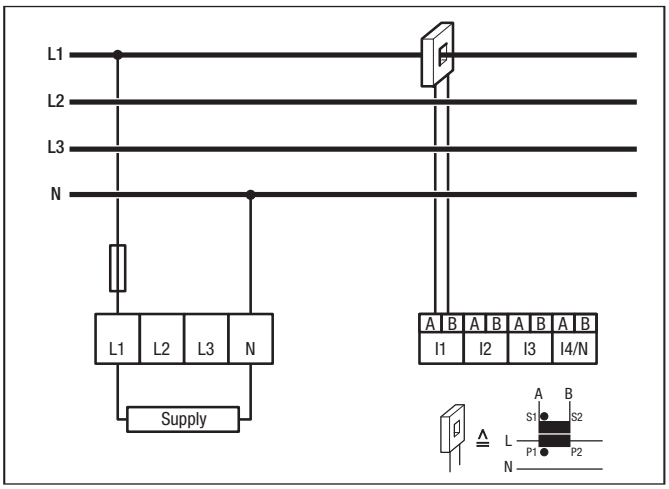


Attention: Please, referring to the diagram in the figure aside, notice that N on the supply has to be connected in order to avoid damage of the device

Attention: Make sure that N is not mixed up with the phases L1, L2, L3.

Attention: CT output should not be connected to the earth. It is not possible to connect more than one CMS-700 in series with the same CT.

Single phase



Attention: Please, referring to the diagram in the figure aside, notice that N on the supply has to be connected in order to avoid damage of the device

Attention: Make sure that N is not mixed up with the phases L1, L2, L3.

Attention: CT output should not be connected to the earth. It is not possible to connect more than one CMS-700 in series with the same CT.

Initial Commissioning

Static access with default factory setting		Details
1	Access to web user interface with default IP of control unit	192.168.1.200:8000
2	Define static IP address for PC, for example: Make sure the IP address in the assigned LAN is not used twice. If it is used twice, an adjustment is required.	192.168.1.5 192.168.1.X (X = 0..255)
3	Subnet Mask	255.255.255.0
4	DHCP access Note: If you change after initial commissioning for DHCP access	Hostname: CMS-700
5	Download latest software version here: http://new.abb.com/low-voltage/products/system-pro-m/measurement-products-for-din-rail/circuit-monitoring-systems	

For the first setup you have to use the direct LAN connection.
Follow instructions under item b. Direct LAN Connection

Check the internal time of the device.
If it is not correct, it has to be set manually.
For further information about manual time setting, settings menu - Other / Time.

Network Connection

The following sections show the steps needed to set up the CMS-700 control unit.
The control unit can be used in different operating modes:

- LAN connection via router
- Direct LAN connection
- Additionally, all data are available through serial port:
  - Modbus RTU (RS485)

Initial Commissioning

—

LAN connection via Router

The CMS-700 control unit is connected to the router using a RJ45 cable (network).

Accessing the Web UI via hostname

Host name: CMS-700, Port: 8000
To be added to the IP address to define the port number (e.g. 192.168.1.200:8000) to access your web browser. Defining the port number is important because without a port number access is not possible.

In case of DHCP, the system administrator can read the IP address assigned to the CMS-700 device by DHCP on the router.

—

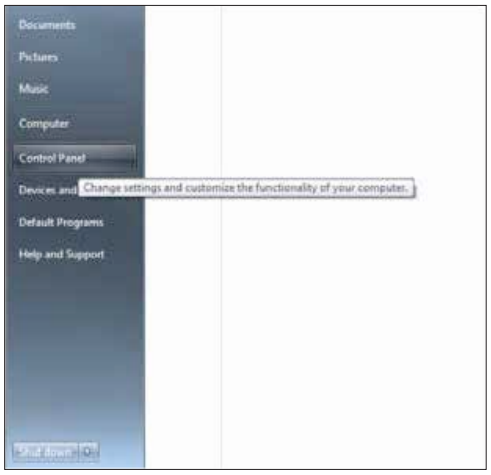
Direct LAN connection

For network connection, an access with static address may be necessary in the first step.
IP Address: 192.168.1.200:8000 / Subnet Mask: 255.255.255.0

Initial Commissioning

The control unit is set up using a web interface. To connect a PC or laptop to the CMS-700 without DHCP, you need to configure the LAN interface with a static IP address.
Using the example of Windows, the following shows the configuration steps.

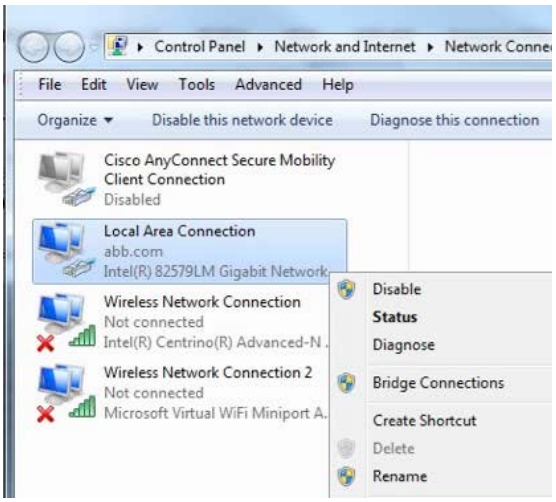
Select Control Panel → Network and Internet → Network and Sharing Center → Change Adapter Settings

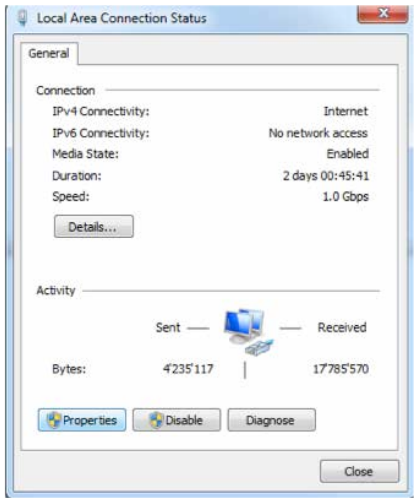


or type in the search bar of the Start button → View Network Connections

↓

Select on Local Area Connection with right mouse button Properties → Select Properties

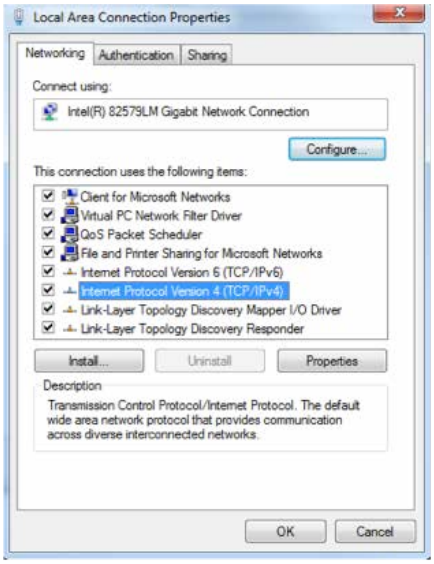




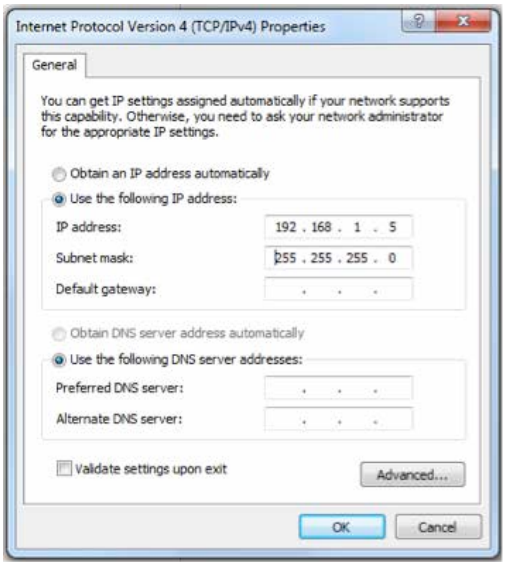
→

Initial Commissioning

→ Double-click Internet Protocol Version 4 (TCP/IPv4)



→ Select Internet Protocol Version 4 (TCP/IPv4)



→ Enter IP Address: 192.168.1.200:1.5 and Subnet Mask: 255.255.255.0 and confirm with OK

Make sure that the IP address on the LAN is not already taken. In case it is taken, adjustments are necessary.
(192.168.1.x; x = 2…199, 201…255)

→ Now connect your device to the CMS-700 control unit

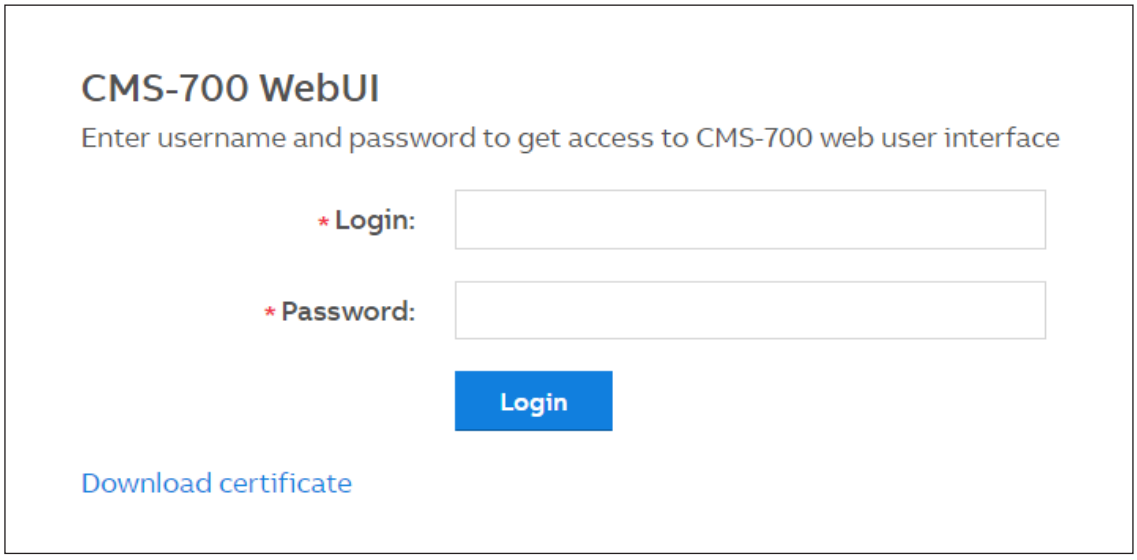
Web User Interface Overview

The web user interface is designed for use on browser-based devices. The recommended web browser is Google Chrome, other supported web browsers are Safari, Firefox, Opera, Internet Explorer.

Start Screen (Login)

Insert the IP address of the device in the browser address bar.
To access the web browser, it is also important to define port number 8000.
Factory settings with

Fallback IP: 192.168.1.200:8000
Fallback login - username: admin, password: admin

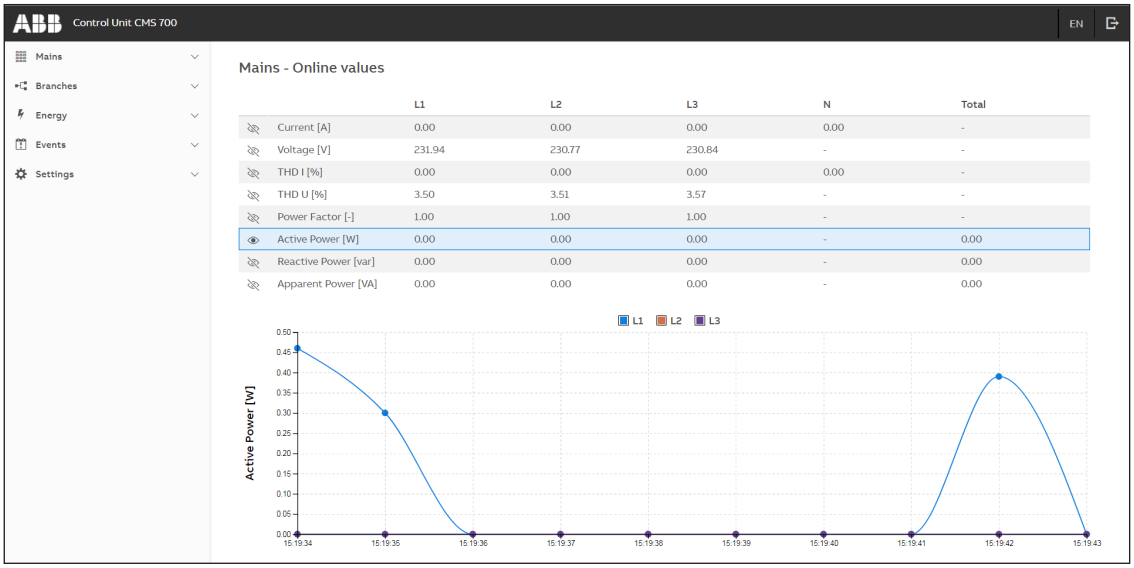


Please note that the control unit uses a secure https:// connection and port 7999.
First, it is necessary to confirm the secure connection. Later on you won't be asked to confirm it provided that you upload the SSL Certificate as described in the dedicated section.

After login, you will be asked to change the login data. It is highly recommended to change the login data as soon as possible for security reasons. The new password must contain minimum 8 characters, at least one uppercase letter and one number.

Web User Interface Overview

Web Server overview



CMS-700 Web-UI Structure

Operation area

Mains
- Online values
- Historical values

Branches
- Online values
- Historical values

Energy
- Mains
- Groups
- Branches

Events
- Online events
- Historical events

Settings area

Mains

Branches

Groups

Events

Users

Data export

Email, FTP
- Email
- FTP

Communication
- IP
- SNMP
- SNMP trap
- Modbus

SSL certificate
- Upload
- Generate

Export/Import
- Export
- Import

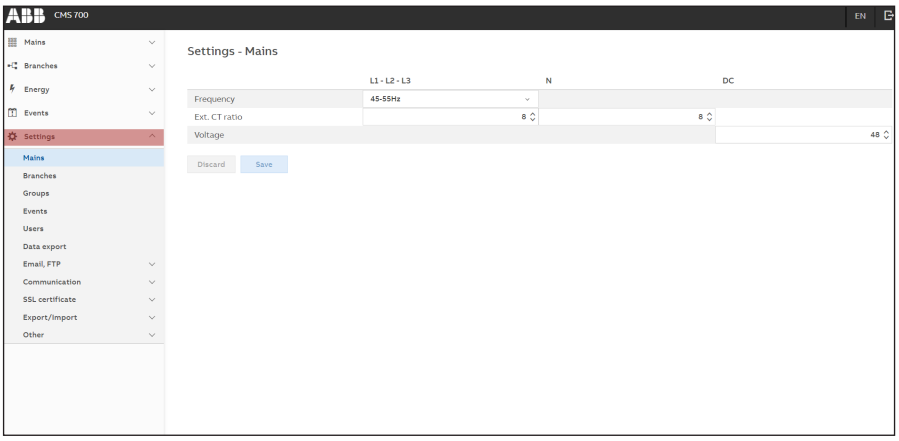
Other
- Time
- Session
- FW Update
- System

WEB UI – Settings

Safe shutdown: To make sure all settings are saved, it is recommended to carry out a safe shutdown after changing any settings and then restart the system (Settings – Other / System reset).

Settings – Mains

It is possible to set frequency, external CT ratio for phases and neutral, and reference DC voltage, if needed.



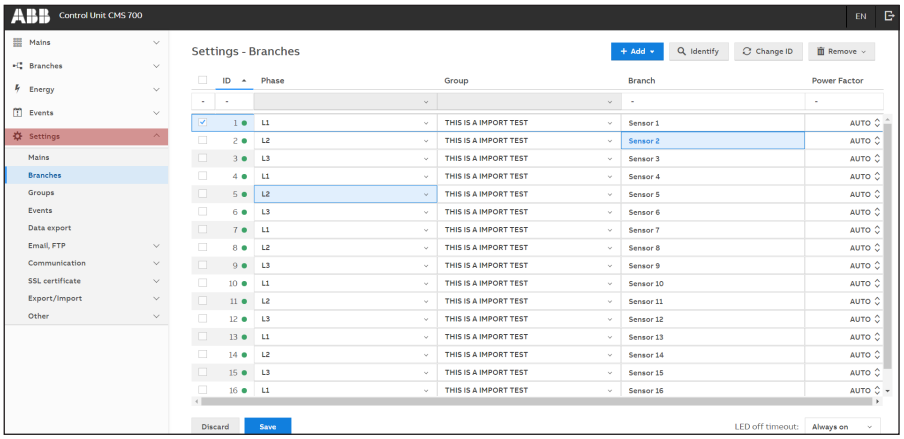
The CT ratio for L1, L2, L3 has to be the same, while it can be different for N.
The CT ratio is calculated dividing the primary rated current by the standard secondary current (5A).

Current of mains are measured by CTs.
DC voltage reference is needed to calculate DC power at branches level.

WEB UI – Settings

Settings – Branches

The menu allows to have access to the information briefly listed below together with the buttons you can use. It is possible to use Selection Filter and Sort Function on Phase and Group labels to find desired values. It is also possible to add new sensors by own defined ID number and to change the ID number.



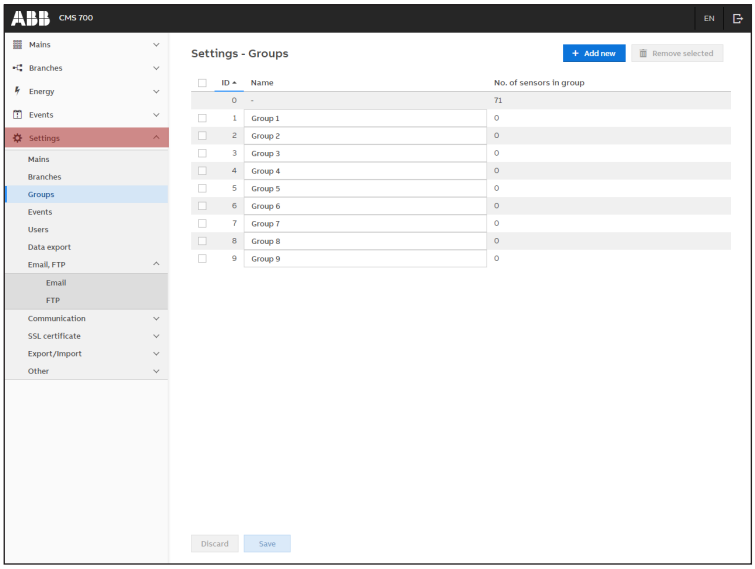
Buttons		
Add		
	Add and assign new sensor	Create a new branch ID and then assign it to the physical sensor by clicking the pushbutton of the sensor (Note: Wait for confirmation before assigning the next sensor)
	Assign sensor (already added)	If a branch ID has already been created but is unassigned, it is here possible to assign it to the physical sensor by clicking the pushbutton of the sensor.
	Add new sensor (no assigning)	Create a new branch ID without assigning it to the physical sensor.
Identify		Clicking the pushbutton of the sensor allows to display the sensor ID number.
Change ID		Select the current ID number of the sensor and define its new ID number
Remove		
	Remove selected	Remove selected sensor and branch definition
	Remove all	Remove all sensors and branch definitions
Branch Definitions		
ID		Sensor identification number (at this time it cannot be modified)
Phase		Selects the corresponding branch phase for the calculation of branch active power and energy. It is possible to choose: - L1, L2, L3, N for alternate current measurements - DC for direct current measurements.
Group		Defines the name of a parent group through the selection of an existing group or definition of a new group (up to 96 group names)
Branch		Defines the name of the branch. It must be unique and can be composed by up to 64 characters
Power Factor		Defines which power factor shall be used for calculation: AUTO - uses the Power Factor of defined mains phase x.xx - you can manually define a constant power factor (e.g. 0.85) 0 - type zero for changing from manual to auto power factor
[Click a row]		By clicking a row, the row is highlighted in light blue and the corresponding box is checked. Additionally the LED of the selected sensor will start to blink.

Make sure to select the correct phase on which the CMS sensor is installed in the phase column. If needed, change the Power Factor (PF) from Auto to a manual value corresponding to the PF of the measured load.

WEB UI – Settings

Settings – Groups

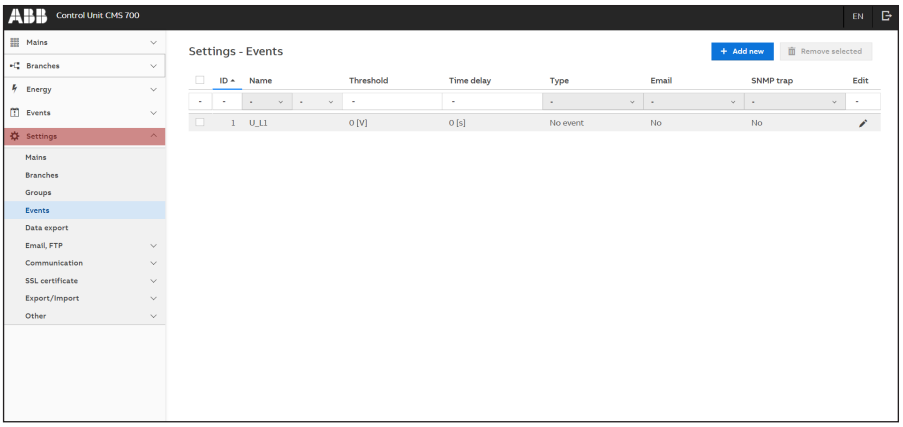
This page allows to create or remove groups of sensors.
By clicking on “Add new”, it is possible to create a new group. Once a group has been created, it is possible to associate a sensor to a group in the “Settings – Branches” section.
It is possible to rename a group and to visualize the number of sensors associated to the specific group.
By clicking on “Remove selected”, the selected group ID will be deleted.
Please note that it is possible to associate a sensor to a single group only.



WEB UI – Settings

Settings – Events

This page allows to set events. If an event occurs, it is shown in the historical events menu. An event can occur after exceeding the selected threshold values (cross-up) or after measuring values lower than the selected threshold values (cross-down) for a determined period (time delay). The email report is sent after 1 minute from the first event occurance and consists of all events that occured in this period. The next report can only be sent after at least 30 minutes since the first event occurance and only in case event conditions are still ongoing.
The event status can be requested via Modbus (for further information please refer to “Measurements and Events definition”).
If a SNMP trap is set up, a notification of the event will be sent.

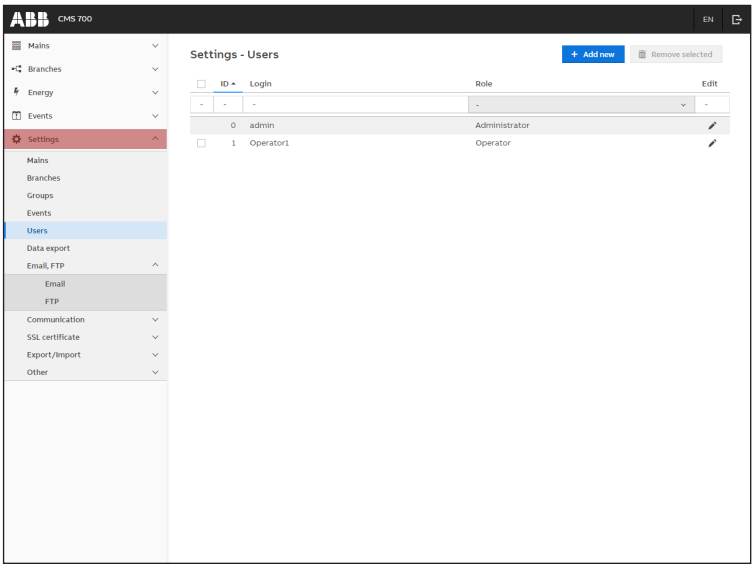


When adding or editing an event, please set the following:	
Mains/Branches	Select whether the event shall be created for mains or branches
Owner	Select main line or the branch name. For branches it is possible to create the same event for several branches by selecting “Add many” option.
Value	It identifies the quantity to which the event is linked
Type	Type of alarm: Cross-up, Cross-down or No event
Threshold	Threshold of selected value
Time delay	Define for how long the event criteria should be fulfilled in order to consider the occurrence as an event
Email notification	If the box is selected, an email will be sent when an event occurs. The email address has to be defined in “Settings – Email, FTP”.
SNMP trap	If the box is selected, notification of event will be sent via SNMP trap. SNMP trap settings have to be defined in “Settings – Communication / SNMP traps”

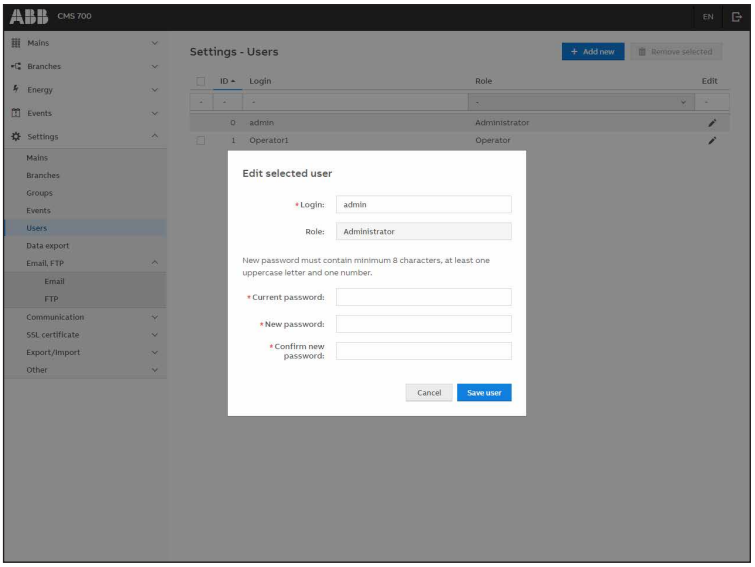
WEB UI – Settings

Settings – Users

This page allows to add new device's users, only at operators' level, by clicking on "Add new". In order to remove users already created, select the user you want to delete and click on "Remove selected".
The device can have only one single administrator.



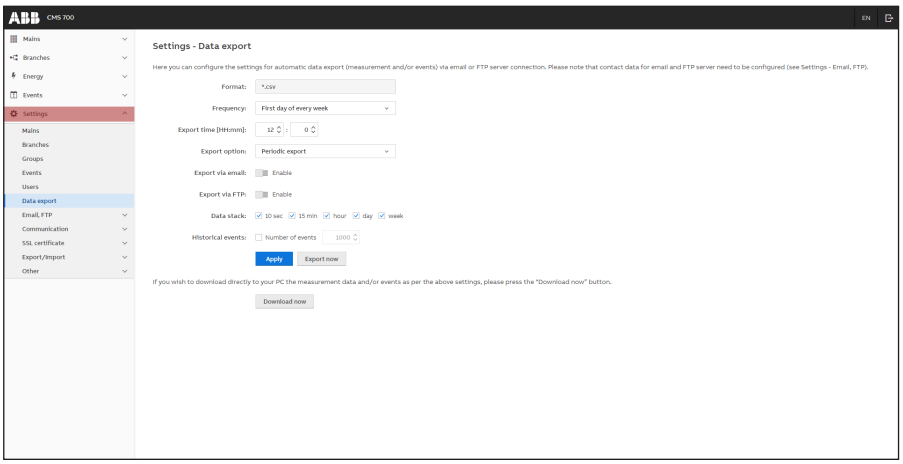
By clicking on the pencil-icon, it is possible to edit the selected user, changing password and/or user name. While editing the sole administrator device, it is required to insert the administrator current password.



WEB UI – Settings

Settings – Data export

In order to carry out data export via email and/or FTP, contact data for email and FTP server need to be configured (see Settings – Email, FTP). The following information has to be provided for automatic data export via email or FTP server connection:

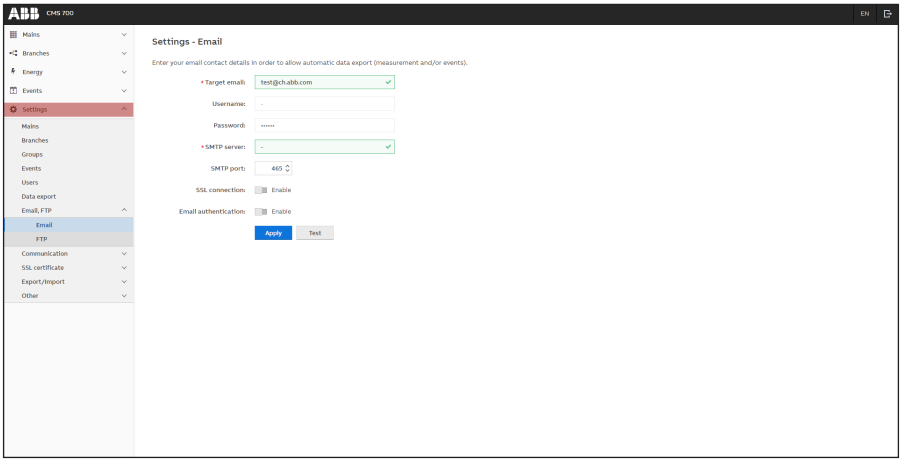


Settings	
Frequency	It indicates how often you would like to receive notifications.
Export option	Two options can be selected: “One export” and “Perodic exporting”.
Export time	Time, when the data shall be exported.
Export via email	If selected, mains and branches values will be exported as csv file by email. Please note that email configuration is needed.
Export via FTP	If selected, mains and branches values will be exported as csv file by FTP. Please note that FTP configuration is needed.
Data stack	Export data stack of last 1000 of 10 sec, 15 minutes, hour, day and week values.
Historical events	If selected, historical events wil be exported as csv file via FTP according to the defined event log size.
Apply	Apply settings to carry out automatic data export with defined frequency and export options, via email and/or FTP.
Export now	Export now the selected data stacks via email and/or FTP. Set the time of the corresponding frequency of export.
Download now	Download now directly to the PC the selected data stacks.

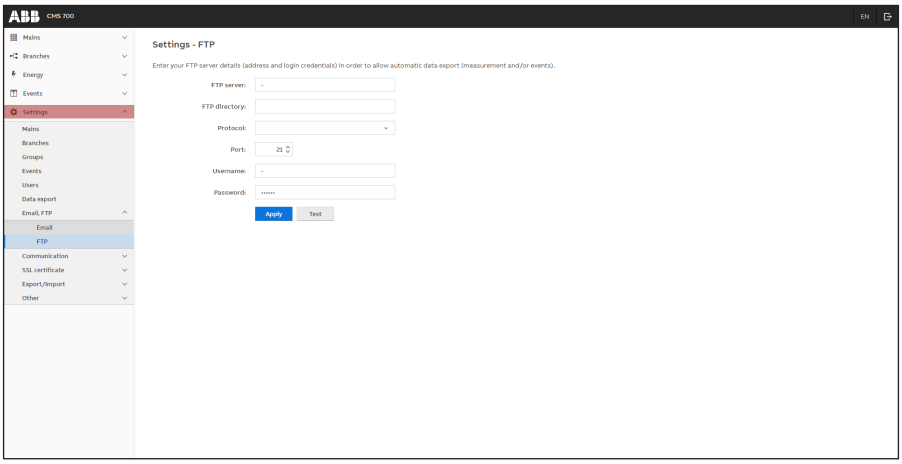
WEB UI – Settings

Settings – Email / FTP

Settings for contact details. Email and FTP settings are needed in order to carry out email and FTP data export. Please make sure that no firewall will block the export.

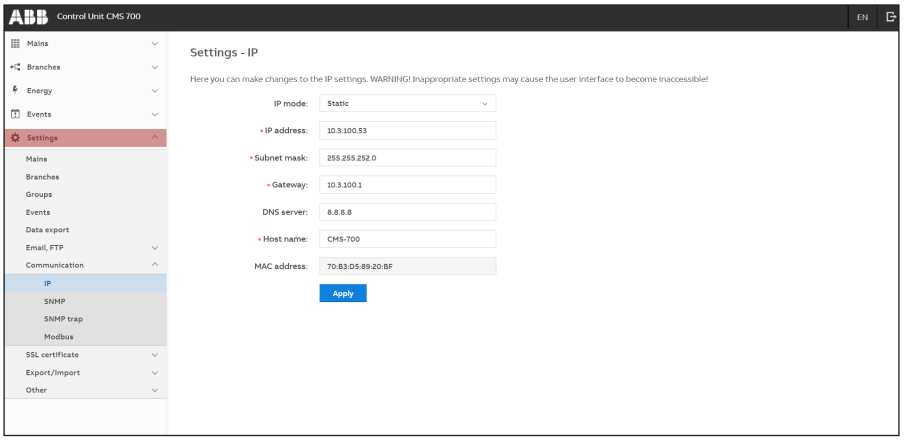


Make sure communication on SMTP port 587 or 465 (SSL) is allowed in your network.
Enter your FTP server details (address and login credentials) in order to allow automatic data export (measurement and/or events).



WEB UI – Settings

Settings – Communication / IP



The following information have to be set to correctly have access to the user interface via IP:

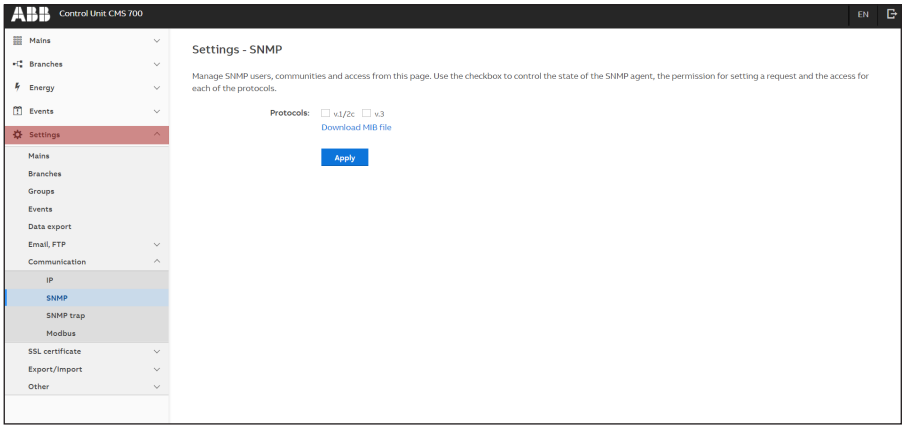
IP Mode	DHCP or static (Note: With DHCP you can find and define an IP address via the router by MAC address or device/host name - CMS-700) The fallback IP address is: 192.168.1.200:8000
IP Address	Current IP address of device or possibility to define a new IP address
Subnet Mask	Current Subnet Mask or possibility to define another Subnet Mask
Gateway	Current Gateway or possibility to define another Gateway Address
DNS Server	Default: 8.8.8.8 or possibility to define another DNS Server
Host name	CMS-700 or possibility to define another Host Name
MAC Address	Shows the MAC Address of the device
Apply	By clicking the Apply pushbutton changes are stored

Inappropriate settings may cause the user interface to become inaccessible.
In order to be able to restore device access to the fallback IP, please use the reset button.
(The device is visible when DHCP is active).

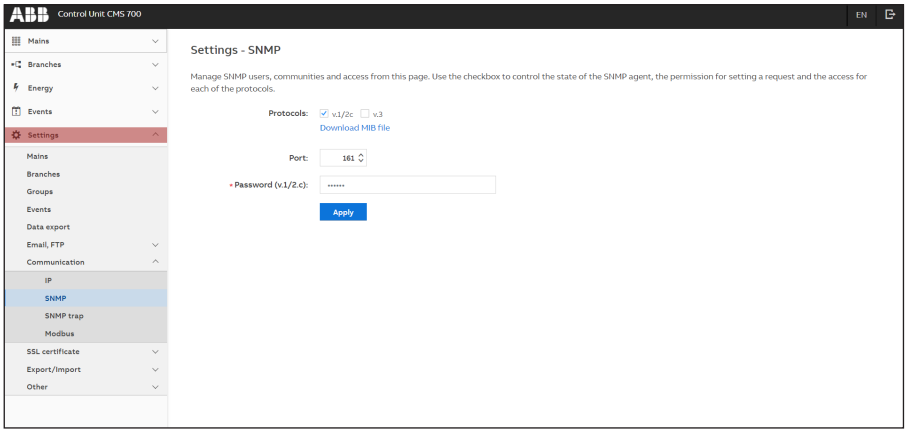
WEB UI – Settings

Settings – Communication / SNMP

The SNMP service is disabled on the device by default. In order to activate it, please use this section:



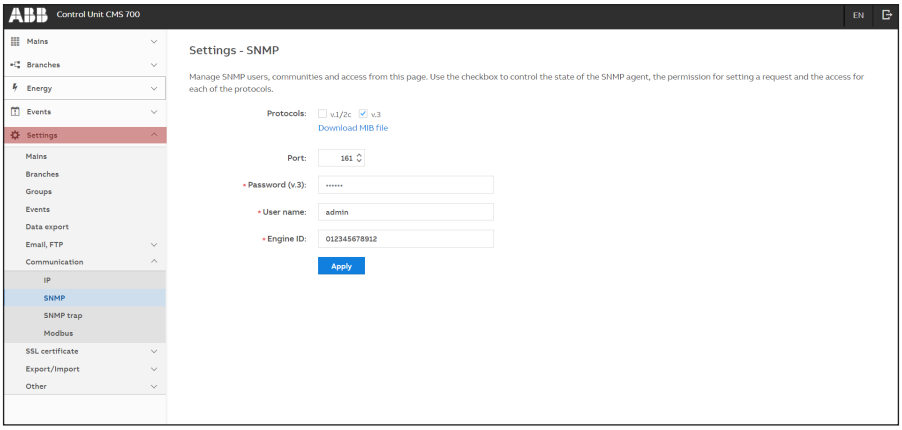
Version 1/2c: To enable versions 1 and 2c mark the v.1/2c checkbox, enter port number and password for the protocol. The port number must be 161 or greater than 1024. The SNMP service is working on UDP port so there is no port collision with the Modbus or web service which are working on TCP ports. The password must have at least 5 signs. In versions 1 and 2c authentication is only by the password which is not encrypted.



WEB UI – Settings

Settings – Communication / SNMP

Version 3: To enable version 3 mark the v.3 checkbox, enter port number, password, user name, and engine ID. The same as for versions v.1/2c port number must be 161 or greater than 1024. The password for version 3 must have at least 8 signs, while the engine ID must have at least 12 characters in hexadecimal format. To access data using SNMPv3 the authenticated and encrypted request must be sent. The authentication is performed by username and password. For the authentication the MD5 protocol is used. Messages are additionally encrypted with the DES algorithm.



Download MIB file: click the button to download CMS-700 MIB file to your PC.

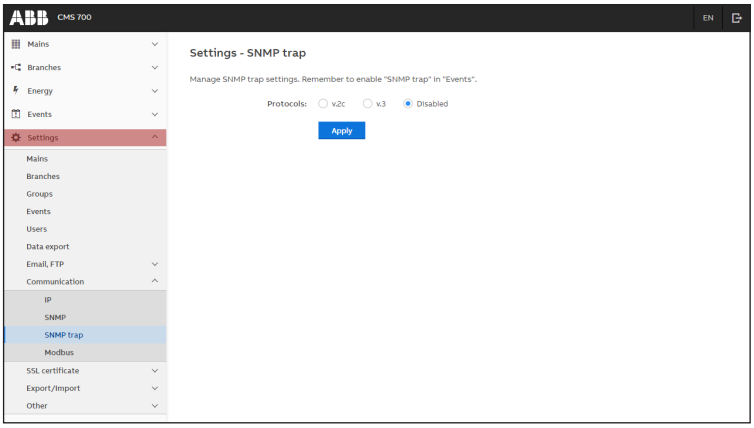
Please note that versions 1/2c and 3 can work simultaneously.

WEB UI – Settings

Settings – Communication / SNMP trap

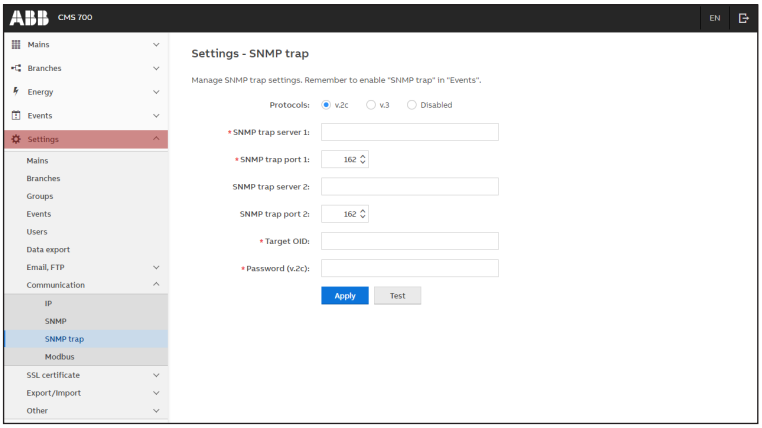
This page allows to enable/disable the SNMP trap system. SNMP trap is a protocol that allows for messages (traps) to be sent from the device to the monitoring server.

SNMP is meant to be used to report events.
Is it possible to enable the trap for each individual event in the “Event-Settings” page.



Two different versions of SNMP trap protocol are available on the device: version 2c (v.2c) and version 3 (v.3). Version 2c is simpler to use and faster. Version 3 provides a better security.

Version 2c: to enable version 2c, mark the v.2c checkbox. For all the related settings, please refer to the following table:

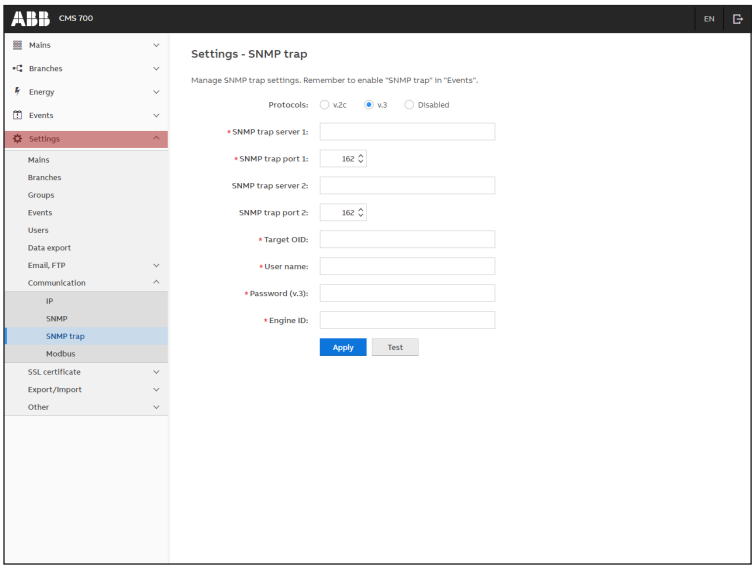


v.2c protocol configuration	
SNMP trap server 1	insert here the address (IP or name) of the trap server.
SNMP trap port 1	provide the port of the trap server.
SNMP trap server 2	insert here the address (IP or name) of the second optional trap server. If configured, every trap is sent to both servers.
SNMP trap port 2	provide the port of the second optional trap server.
Target OID	the trap type OID is here indicated. Only numeric format is supported. Please note that all traps are sent with this type.
Password (2.c)	SNMP password
Test	Send a test trap. There is no need to press the “Apply” button for testing. After clicking the “Test” button, please check if the trap has been received on the trap server.
Apply	By clicking the Apply pushbutton changes are stored.

WEB UI – Settings

Settings – Communication / SNMP trap

Version 3: to enable version 3, mark the v.3 checkbox. For all the related settings, please refer to the following table:



v.3 protocol configuration	
SNMP trap server 1	insert here the address (IP or name) of the trap server.
SNMP trap port 1	provide the port of the trap server.
SNMP trap server 2	insert here the address (IP or name) of the second optional trap server. If configured, every trap is sent to both servers.
SNMP trap port 2	provide the port of the second optional trap server
Target OID	the trap type OID is here indicated. Only numeric format is supported. Please note that all traps are sent with this type.
User name	insert here the SNMP username.
Password (v.3)	SNMP password.
Engine ID	SNMP security engine ID must be inserted here.
Test	Send a test trap. There is no need to press the “Apply” button for testing. After clicking the “Test” button, please check if the trap has been received on the trap server.
Apply	By clicking the Apply pushbutton changes are stored.

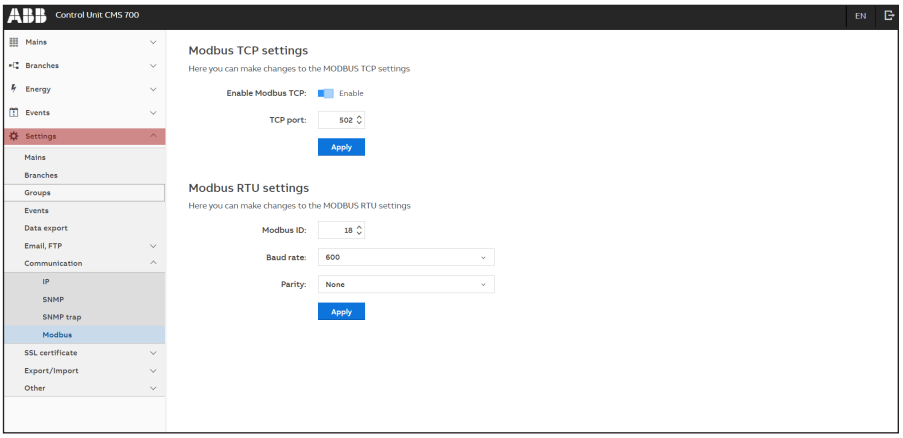
WEB UI – Settings

Settings – Communication / Modbus

This section allows to have access to both Modbus TCP and RTU settings.

Modbus TCP
It is possible to enable or disable the corresponding communication protocol and to change the TCP port.

Modbus RTU
Modbus ID, baud rate and parity fields can be configured here.



Due to cyber security, port numbers < 1025 are not allowed, except the standard Modbus port, which is port 502. Ports 8000 and 7999 are instead reserved for web service.

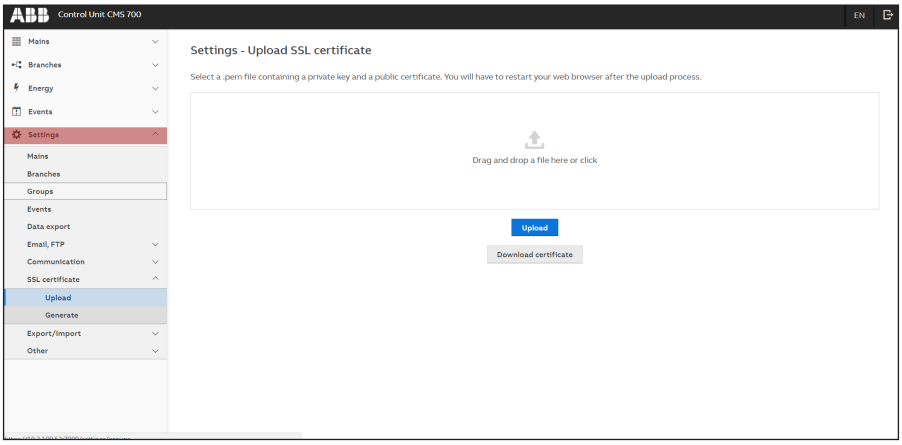
WEB UI – Settings

Settings – SSL Certificate

In this section it is possible to upload or generate a .pem file containing a private key and a public certificate in order to provide a secure connection via the web browser.

Upload

It is possible to browse, upload or download the currently in place certificate.
For this purpose, please drag and drop the .pem file to the browser or click to browse, then push the upload button and wait for the uploading to finish. After a successful uploading process, the web server reboots.
It is also possible to download a currently used certificate by clicking download certificate.



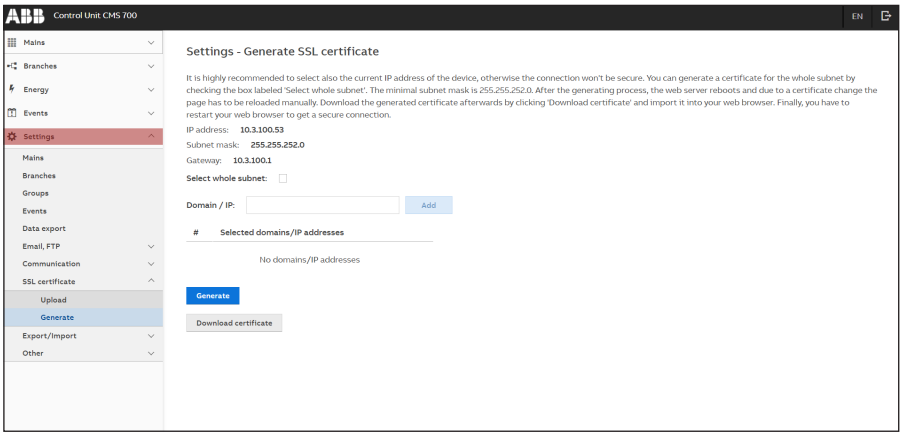
WEB UI – Settings

Settings – SSL Certificate

Generate

In order to generate a SSL certificate, following configurations must be considered:

IP address	Indicates your currently configured IP address on the device
Subnet mask	Indicates your currently configured subnet mask on the device
Gateway	Indicates your currently configured gateway on the device
Select whole subnet	If checked, you can generate a certificate for the whole subnet. The minimal subnet mask is 255.255.252.0.
Domain / IP	You can manually type in IP addresses and insert them to the table with the Add button



After configuration of domains/IP addresses table, please click the Generate button. When the generating process finishes, the web server reboots and due to a certificate change the page has to be reloaded manually.

Follow the passages reported below to import the downloaded certificate into your web browser.

Certificate Import Wizard

INTERNET EXPLORER (Windows 10 only)
1. Open Internet options
2. Choose Content tab and then Certificates one
3. Select Trusted Root Cerfification Authorities and then select Import

GOOGLE CHROME
1. Open Settings
2. Scroll down to open Advanced
3. Click Manage Certificates and choose Trusted Root Cerfification Authorities and then select Import

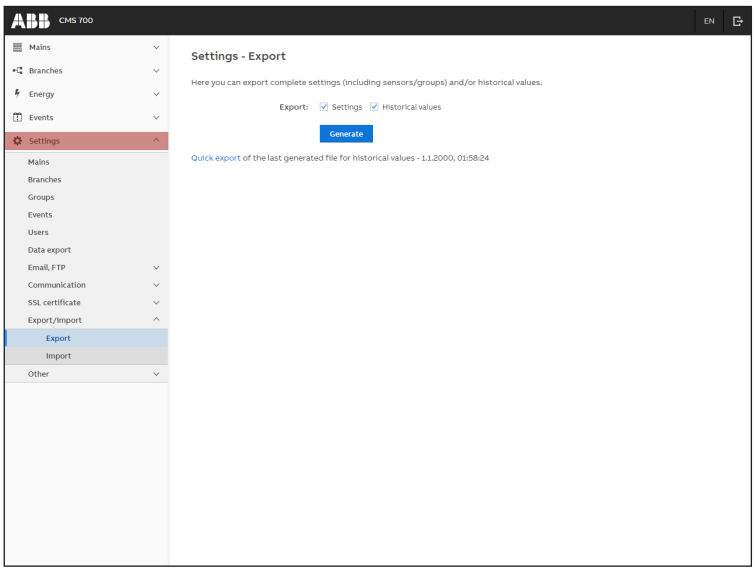
It is necessary at first to open the Certificate Import Wizard according to the browser you are using and then to install the certificate.

WEB UI – Settings

Settings – Export / Import

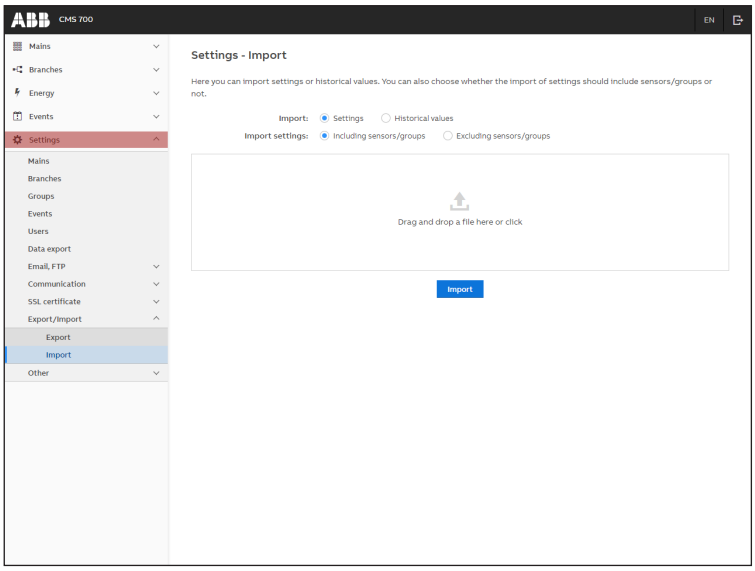
Export

This page allows the export of settings of sensors/groups and of historical values by checking the corresponding boxes and then clicking on “Generate”.



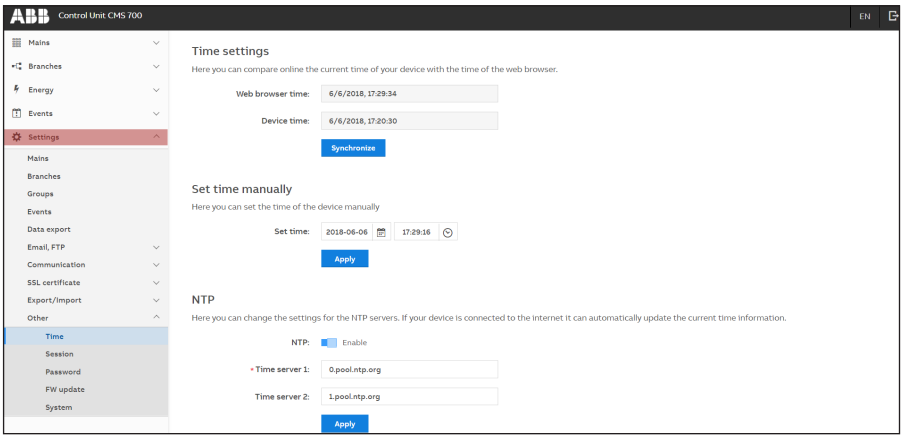
Import

This page allows the import of settings and/or historical values. It is possible to choose to include or exclude sensors/groups in the import. Before starting the import, clicking on “Import”, make sure the settings’ file you want to import has been drag and dropped in the corresponding “Drag and drop” window.



WEB UI – Settings

Settings – Other / Time



Time settings
It is possible to synchronize the time to compare the time of the device and the one on the web browser. The synchronization is mandatory in order to correctly visualize and store data.
By clicking on “Synchronize” button, the CMS will synchronize with the web browser time.
Please note: if device time differs by more than 10min from the web browser time, a warning message will be shown.

Set time manually
It is also possible to manually set the time. Please select date and time using calendar and clock icons.

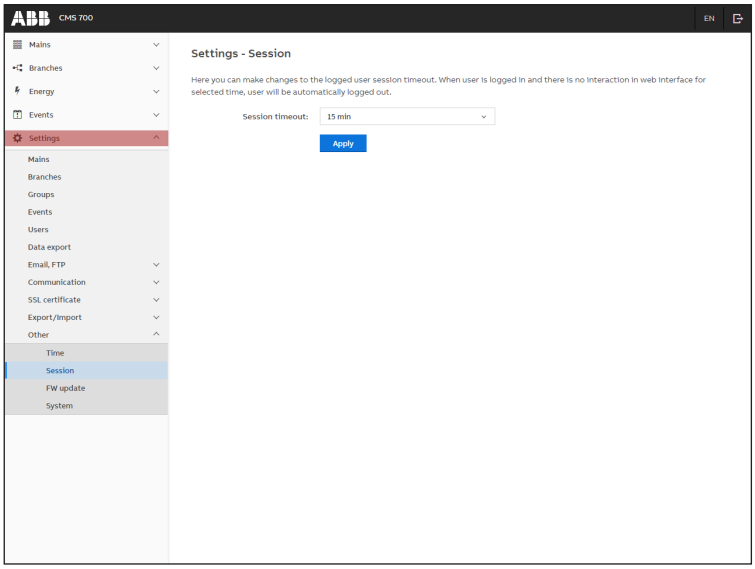
NTP
If an NTP Server is available you can set the IP address (Time Server 1, Time Server 2) for automatic time synchronization. In this case, the synchronization procedure can take up to 10 minutes.
Please make sure that no firewall will block the NTP server.

Check the internal time of the device in order to guarantee correct operation of the CMS-700. If it is not correct, it has to be set manually.
Once date and time are set, it is not possible to change them without corrupting the database.

WEB UI – Settings

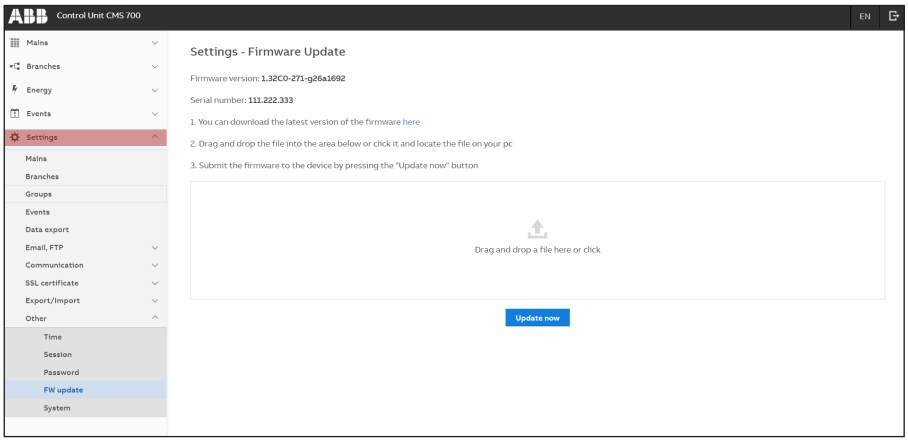
Settings – Other / Session

This page allows to change the logged user session timeout.
Select the desired session timeout from the dropdown list and then click “Apply” to save the changes.



Settings – Other / FW Update

Using this menu you can update the firmware of the control unit.

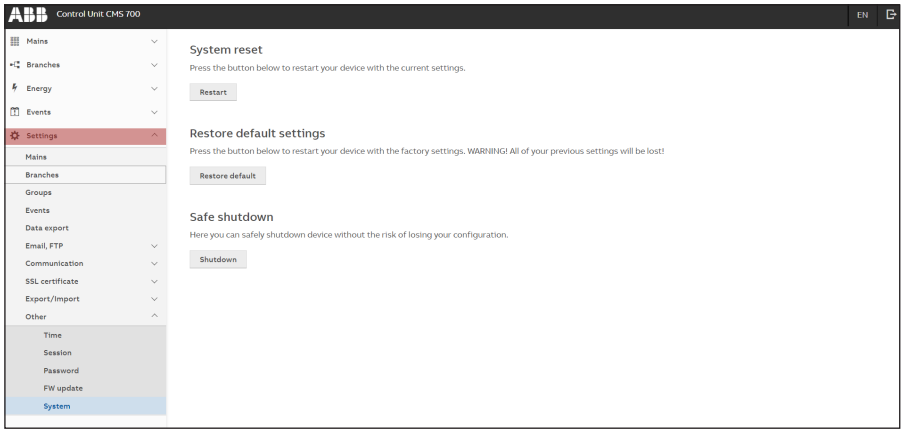


It is highly recommended to update the firmware to the latest version for security and functionality reasons. Please check the ABB website for current SW revision and to download the latest version of the firmware.

After browsing the downloaded file, please use the “Update file” button to submit the new firmware to the device. In addition, you can find the installed firmware version and the serial number of the device at the bottom of the web page.

WEB UI – Settings

Settings – Other / System

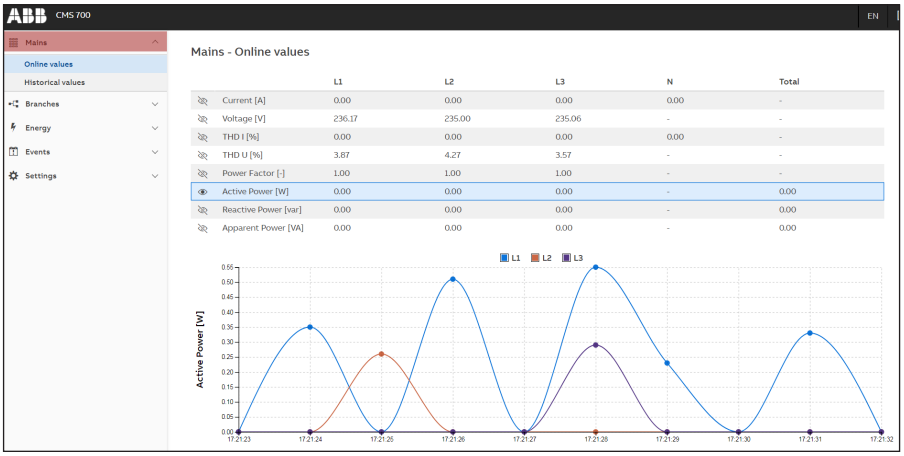


In this section it is possible to carry out a system reset (to restart the device with the current settings), to restore the default settings and to carry out a safe shutdown. After any change in the settings we recommend you to do a safe shutdown. To do so, push the ''Shutdown'' button. If the Status LED is shining green without flashing, and if the network LED is out, you can turn off the power supply.
For starting the device, turn on the power supply. The CMS-700 will automatically start.

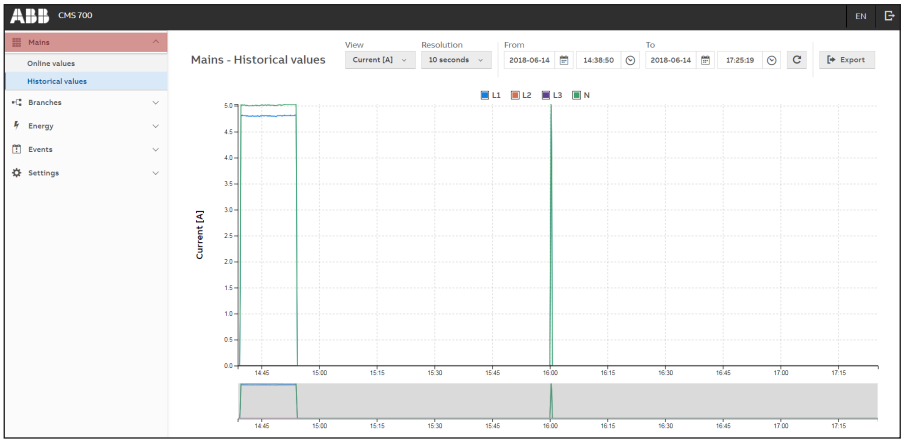
WEB UI – Mains

Mains – Online values, Historical values

The “Online Values” section shows all measured values on mains side reporting the trend of the last 10s.
The “Historical values” section allows you to change, zoom-in or zoom-out the time frame on which measured values are displayed. After selecting the parameter, the resolution and the reference time frame, the “Export” button allows the user to carry out direct data export as .CSV file.



Note: If no graph is visible, it is necessary to synchronize the device time with the “Set time manually” button in the Settings – Other / Time menu.



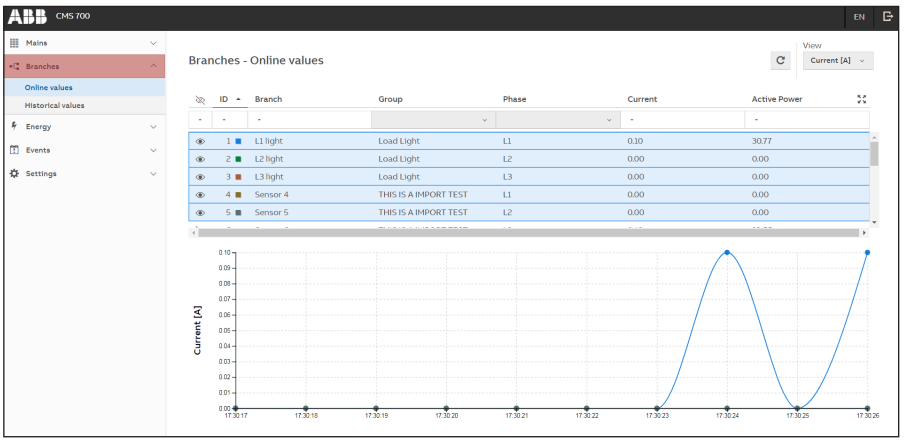
WEB UI – Branches

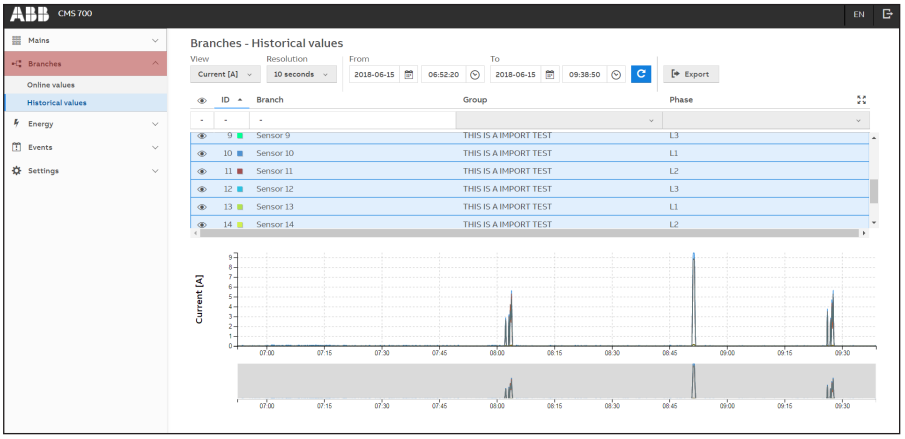
Branches – Online values, Historical values

Here it is possible to visualize both “Online values” and “Historical values” for the Branches.

Sensors for branch measurement have to be first assigned and configured (please refer to Settings – Branches).

In case of DC branch measurement, please refer to “Settings-Branches” and configure “Phase” as DC. Accordingly, when “DC” is displayed under “Phase”, DC current and active power values are displayed on this page.



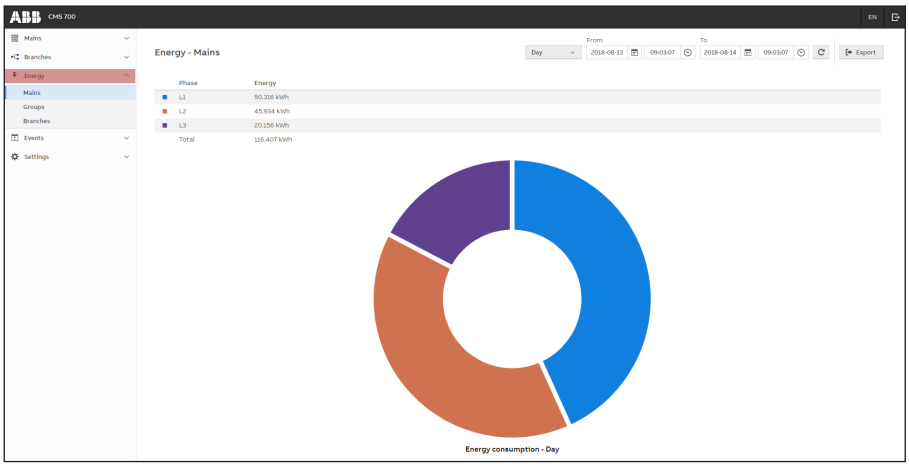


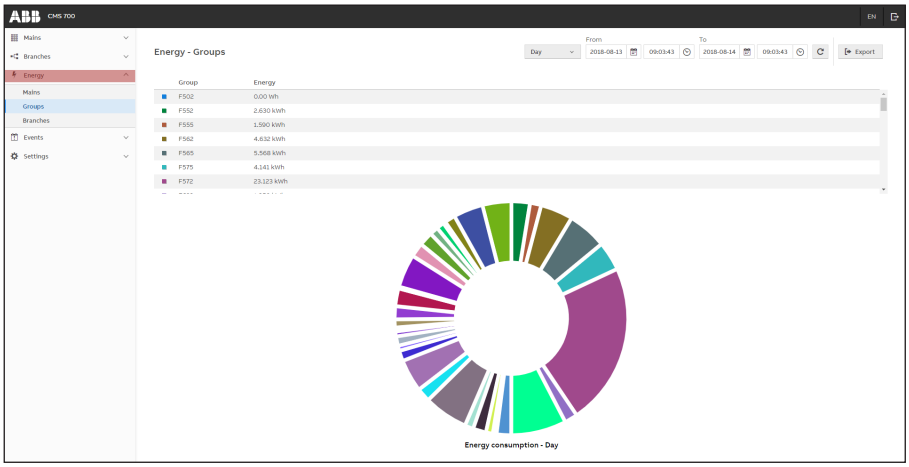
WEB UI – Energy

Energy – Mains, Groups, Branches

Here it is possible to visualize energy consumptions of Mains, Groups and Branches.

For Mains, consumptions are visualized by phases (L1,L2 and L3), while for Groups they are visualized divided by user-defined groups. For Branches energy visualization is divided per sensor; it is possible to filter by phases and/or groups. For all energy consumptions a starting, end and resolution time have to be defined.

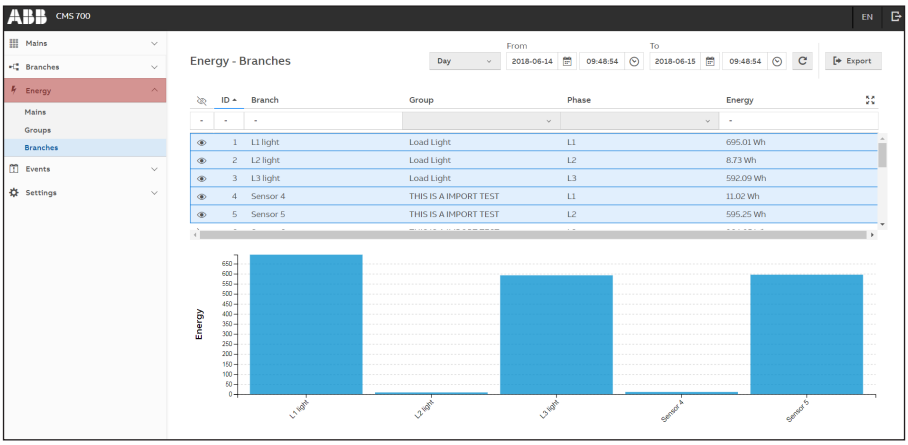




WEB UI – Energy / Events

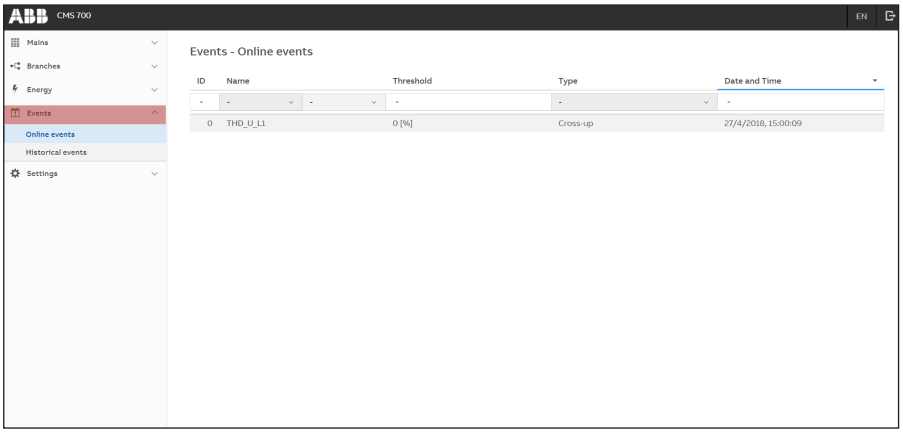
Energy – Mains, Groups, Branches

The Energy – Branches Menu displays active energy values for each individual sensor. You can select more sensors to compare energy consumption within a defined period of time. You can set the display by selecting a date range and resolution.



Events – Online events, Historical events

The latest occurrencies that were set in the events settings menu are shown in the “Online events” page. Here the table is automatically refreshed every second and displays the 18 latest events. Rows can be sorted and/or filtered by clicking at headers and selecting desired value from drop-down lists. Event status is updated automatically every second to obtain new event occurrences.



In the “Historical events” page it is possible to visualize and export occurrences according to user-defined start and end date/time.

Modbus

Communication protocol

Introducing MODBUS protocol

The Modbus serial line protocol is a Master-Slaves protocol. This means that only one master and one or more slave nodes (max. 247) can be connected to the same serial bus. A Modbus communication is always initiated by the master and there is only one transaction at the same time.

For further information: www.modbus.org

If you intend to use Modbus, you should only use ASCII characters in the Web UI. Unicode characters will not be displayed in Modbus.

Modbus frame description (RTU mode)

ADU Frame

Address	PDU Frame		Error Check
Address Field	Function Code	Data	CRC
1 byte	1 byte	0 - 252 bytes	2 bytes CRC_L, CRC_H

ADU	Application Data
PDU	Protocol Data Unit
Stopbit	1
Address Field	contains the slave address
Function Code:	indicates what kind of action to perform
Data	contains request and response parameters
CRC	contains the value generated by the cyclic redundancy check (standard CRC-16 defined by CCITT)

The maximum size for a Modbus RTU frame is 256 bytes.

NOTE:
In RTU mode, message frames are separated by a silent interval of at least 3.5 character times.
The entire message frame must be transmitted as a continuous string of characters.
If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared as incomplete and should be discarded by the receiver.

Modbus Data Encoding

Modbus uses a big-endian allocation for addresses and data items. This means that, when a numerical quantity larger than a single byte is transmitted, the most significant byte is sent first.
Example: 1234h → first 12h then 34h

Modbus

Communication to CMS

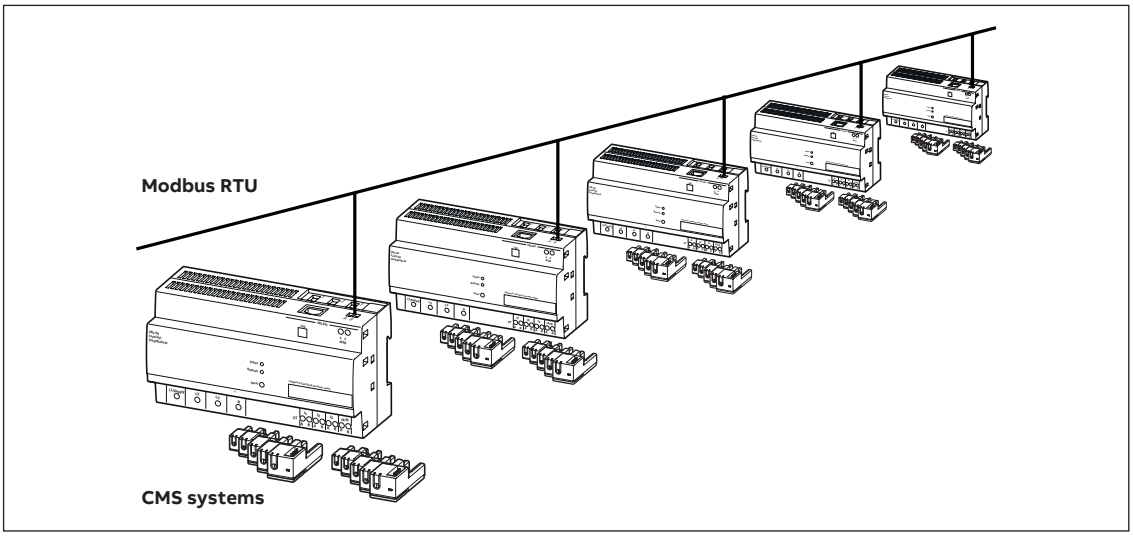
Physical Interface RS-485

To communicate with the CMS from an upper system, all devices (masters & slaves) must have the same data rate and data format. These settings are defined over the Web UI, as described in the dedicated chapter.

Parameter	Values	Default Values
Data rate	2400, 4800, 9600, 19200, 38400, 57600, 115200 Bit/s	19200 Bit/s
Data format	even parity, odd parity, without parity	even parity

Line termination resistor (120Ω) needs to be added, if necessary, for CMS-700 having serial number later than 700K1820000.

Control unit's MODBUS-ID



You can connect up to 247 control units to one Modbus RTU line. Each control unit must have a unique Modbus ID (address).

Function Code

- Read operation on registers with access code "R" or "RW" is defined by function 03h "Read Holding Registers"
- Write operation on registers with access code "W" or "RW" is defined by function 06h "Write Single Register"

Do not apply functions other than those specified.

Modbus

Error Codes

Modbus protocol defines a common way of error reporting. Every request (read or write) sent in unicast mode is expected to return a value in packet of the same structure. In case of a message delivery error (not a CRC problem but a message execution problem), the generated response contains a function code with MSB (80h) set and a single byte representing the error code, called “exception code”.

The following default exception codes are available:

Code	Name	Description
01h	Illegal function	Function is not supported
02h	Illegal data address	Register address is out of control unit’s range, or trying to write into a read only register
03h	Illegal data value	Value is out of range
04h	Slave device failure	Unrecoverable error occurred while the control unit was attempting to perform the requested action, for example, time-out
06h	Slave device busy	Control unit is currently in User Interface Configuration Mode. Unable to execute the requested action .

Data and Control Registers

A register is always a two-byte (16-bit) value, which can be interpreted as either signed or unsigned values or which has a special format.

In case of data represented in more than one register the concatenated registers will contain information with MSB in the lowest address and LSB in the highest address within concatenated addresses.

Do not use registers other than those specified.

Note 1: Format of one-word register for current values

unsigned = 16-bit unsigned integer notation, resolution 0.01 A
signed = 6-bit signed integer notation, resolution 0.01 A
0000h…7FEFh = 0.00 … 327.51 A
8000h…FFFFh = -327.66 … -0.01 A

Values with special meanings

Special values (hex)	Special values (dec)	Meaning
7FF0	32'752	Data pending, acquisition in progress
7FF1 … 7FFB	32'753 … 32'763	Reserved
7FFC	32'764	The sensor is known but not accessible at the moment
7FFD	32'765	Data type TrueRMS / AC / DC is disabled
7FFE	32'766	Overload (beyond full range)
7FFF	32'767	Forbidden (no sensor with ID xx)

Note 2: Format of double-word register for branch power and energy values

unsigned = 32-bit unsigned integer notation,
signed = 32-bit signed integer notation

Modbus

Values with special meanings: Calculated branch power and energy values

Special values (hex)	Special values (dec)	Meaning
FFFF 7FF0	4'294'934'512	Data pending, acquisition in progress
FFFF 7FF1 … FFFF 7FFB	4'294'934'513 … 4'294'934'523	Reserved
FFFF 7FFC	4'294'934'524	The sensor is known but not accessible at the moment
FFFF 7FFD	4'294'934'525	Data type TrueRMS / AC / DC is disabled
FFFF 7FFE	4'294'934'526	Overload (beyond full range)
FFFF 7FFE	4'294'934'527	Forbidden (no sensor with ID xx)

bit mask = bit-wise operation
special = as specified in register description

Note 3: Access
R (03) = Register can be read by function 03
W (06) = Register can be written by function 06

Trigger hold, reset min and max values
Write operation on this register triggers the hold measurement of all sensors, and/or resets the min and max values of all sensors.

Address (hex)	Address (dec)	Word (16-bit)	Description	Resolution and unit	Format 1	Access 2
3010	12'304	1	Trigger hold, reset min and max values		Bit Mask	W (06)

The commands have the following bit format: 0000 0000 000T 000R

- T 1 = Trigger hold measurement
- R 1 = Reset min and max values

The Command will be acknowledged by the response message on Modbus and by a short message.

Modbus

Show sensor

“Write operation on this register starts or stops fast LED blinking of one specified sensor for diagnostic purpose.”

Address (hex)	Address (dec)	Word (16-bit)	Description	Resolution and unit	Format 1	Access 2
3011	12'305	1	Show Sensor		Special	W (06)

Start / stop command is in the following bit format position: 000S 0000 0CCC CCCC

- C Sensor ID
- S 1 = Starts fast LED blinking
  0 = Stops fast LED blinking

Data written has to specify a known sensor ID.

Example: 0x1017 means “Start fast LED blinking of sensor with ID 23”

- When sensor is addressed correctly, common response will follow
- When the sensor ID is not used in the system, and exception response with Modbus exception code 03h “Illegal data value” will follow. (If fast LED blinking was already active, it will be stopped)

Return to normal display content is possible by sending the stop command.

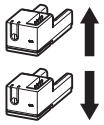
Modbus

Polarity of sensors (for DC currents)
These registers contain the configured nominal current value and the DC polarity information of each sensor with following bit format:

000P RRRR RRRR RRRR

- R Reserved for future use
- P DC polarity information
  0 = direct, DC current coming out of the cone is displayed positive
  1 = reverse, DC current coming out of the cone is displayed negative
  This setting has influence on all DC values of the specified sensor.

- 0000h DC polarity direct
- 1000h DC polarity reverse



This data has to be set user while system configuration. Factory default value is 0000h.

Serial number (SID), version and bus line of sensors
These registers contain system information about each sensor.

Offset	Words	Data
0h	4	Unique Serial Number (SID)
4h	2	HW version
6h	3	SW version
9h	1	Measurement Range (0.1A steps)
Ah	1	Enabled Data Types (as in CMS Bus Protocol defined)
Bh	4	Reserved
Fh	1	ID of internal bus line sensor is connected to 0: no sensor, 1: line 1, 2: line 2

- Each sensor has a unique serial number needed for setup procedure on internal CMS bus.
- HW and SW version of sensor are readable for diagnosis purpose.
- “ID of internal bus line” identifies the Control Unit’s internal bus line the sensor is connected to.

This data is not hold always in registers but will be prepared on read request.

Simple Network Management Protocol – SNMP

Reading of values
The protocol is applicable for the following items:

- Mains parameters
- Calculated values
- Measured branch current values

If you need to record the values of a subsequent measurement, you have to use the SNMP protocol and the external storage system. Historical data in the device is stored with a resolution of 10s.

Special values for error codes
In a fail situation you get error codes. Values with special meanings for branch current values (one word, 16bit) are summarized below.

Special values (hex)	Special values (dec)	Meaning
7FF0	32'752	Data pending, acquisition in progress
7FF1 … 7FFB	32'753 … 32'763	Reserved
7FFC	32'764	The sensor is known but not accessible at the moment
7FFD	32'765	Data type TrueRMS / AC / DC is disabled
7FFE	32'766	Overload (beyond full range)
7FFE	32'767	Forbidden (no sensor with ID xx)

Simple Network Management Protocol – SNMP

Values with special meanings for calculated branch power and energy values (double word, 32bit) are reported below:

Special values (hex)	Special values (dec)	Meaning
FFFF 7FF0	4'294'934'512	Data pending, acquisition in progress
FFFF 7FF1 ... FFFF 7FFB	4'294'934'513 ... 4'294'934'523	Reserved
FFFF 7FFC	4'294'934'524	The sensor is known but not accessible at the moment
FFFF 7FFD	4'294'934'525	Data type TrueRMS / AC / DC is disabled
FFFF 7FFE	4'294'934'526	Overload (beyond full range)
FFFF 7FFE	4'294'934'527	Forbidden (no sensor with ID xx)

MIB

To retrieve data from the device using the SNMP object identifier (OID), the MIB files from the NET-SNMP package should be copied to the correct location on the client station.

The NET-SNMP package can be downloaded from the link:
https://sourceforge.net/projects/net-snmp/files/net-snmp/5.7.3/

In the downloaded zip package, MIB files are available in directory: net-snmp-5.7.3.zip\net-snmp-5.7.3\mibs\

The objects used in CMS-700 are defined in SNMPv2-MIB.txt and NET-SNMP-EXTEND- MIB.txt. The list of available objects is shown in Table 1.

SNMP objects

SNMP Object Identifier	SMI Data Type	SMI Data Type Example Value
SNMPv2-MIB::sysDescr.0	STRING	ABBCircuitMeasurementSystemCMS700
SNMPv2-MIB::sysUpTime.0	Timeticks	(117750) 0:19:37.50
SNMPv2-MIB::sysName.0	STRING	CMS700
SNMPv2-MIB::sysLocation.0	STRING	Location of the CMS-700
SNMPv2-MIB::sysServices.0	INTEGER	72
NET-SNMP-EXTEND:nsExtendOutputFull."var"	STRING	12

All objects are read-only. In case of a NET-SNMP-EXTEND::nsExtendOutputFull object, the var field is one of variables defined in table Modbus and SNMP Mapping, for example:
NET-SNMP-EXTEND::nsExtendOutputFull."TRMSsens1".
To return all TRMSsens values in a single snmpget request, please use the “TRMSsensAll” variable name.

Simple Network Management Protocol – SNMP

Examples
Some examples of usage on the Linux system using snmpget program from NET-SNMP package are presented below. The '#' is the Linux command prompt.

SNMPv1
snmpget -v1 -c password 192.168.1.200:8002 SNMPv2- MIB::sysUpTime.0
SNMPv2-MIB::sysUpTime.0 = Timeticks: (38471) 0:06:24.71

snmpget -v1 -c password 192.168.1.200:8002 NET-SNMP-EXTEND- MIB::nsExtendOutputFull.\"TRMSsensAll\"NET-SNMP-EXTEND-MIB::nsExtendOutputFull."TRMSsensAll" = STRING:
1 5 1 4 9 0 7 0 7 6 13 8 2 13 4 0 1 5 0 7 1 6 1 14 0 8 0 0 2 1 1 0
32767 32767 32767 32767 32767 32767 32767 32767 32767 32767 32767
32767 32767 32767 32767 32767 32767 32767 32767 32767 32767 32767
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SNMPv2c
snmpget –v2c -c password 192.168.1.200:8002
SNMPv2- MIB::sysName.0
SNMPv2-MIB::sysName.0 = STRING: CMS700
snmpget –v2c -c password 192.168.1.200:8002 NET-SNMP-EXTEND-MIB::nsExtendOutputFull.\"TRMSsens1\"NET-SNMP-EXTEND-MIB::nsExtendOutputFull."TRMSsens1" = STRING: 0

SNMPv3
snmpget -v3 -e 98467c434675 -u CMSuser -a MD5 -A "v3password" - x DES -X "v3password" -l authPriv 192.168.1.200:8002 SNMPv2- MIB::sysDescr.0
SNMPv2-MIB::sysDescr.0 = STRING:
ABBCircuitMeasurementSystemCMS700
snmpget -v3 -e 98467c434675 -u CMSuser -a MD5 -A "v3password" - x DES -X "v3password" -l authPriv 192.168.1.200:8002 NET-SNMP- EXTEND-MIB::nsExtendOutputFull. \"BranchNamesens1\"
NET-SNMP-EXTEND-MIB::nsExtendOutputFull."BranchNamesens1" = STRING: Sensor 1

Modbus and SNMP Mapping

Modbus Standard TCP Port: 8001
Standard SNMP Port: 8002

Addr. (hex)	Addr. (dec)	Word (16-bit)	Description	Resolution (1-bit value)	Unit	Format	Access	SNMP Variable Name
Ongoing measurement values: **These registers contain the actual measured data.**								
0000	0	1	TRMS value of Sensor 1	0.01	A	unsigned	R (03)	TRMSsens1
0001	1	1	TRMS value of Sensor 2	0.01	A	unsigned	R (03)	TRMSsens2
…	…	1	…	0.01	A	unsigned	R (03)	…
005F	95	1	TRMS value of Sensor 96	0.01	A	unsigned	R (03)	TRMSsens96
0100	256	1	AC value of Sensor 1	0.01	A	unsigned	R (03)	ACsens1
0101	257	1	AC value of Sensor 2	0.01	A	unsigned	R (03)	ACsens2
…	…	1	…	0.01	A	unsigned	R (03)	…
005F	351	1	AC value of Sensor 96	0.01	A	unsigned	R (03)	ACsens96
0200	512	1	DC value of Sensor 1	0.01	A	signed	R (03)	DCsens1
0201	513	1	DC value of Sensor 2	0.01	A	signed	R (03)	DCsens2
…	…	1	…	0.01	A	signed	R (03)	…
025F	607	1	DC value of Sensor 96	0.01	A	signed	R (03)	DCsens96
Minimum measured values: **These registers contain the minimum measured values since last system start / reset or since last “reset min/max values” request.**								
0400	1'024	1	TRMS min value of Sensor 1	0.01	A	unsigned	R (03)	MINTRMSsens1
0401	1'025	1	TRMS min value of Sensor 2	0.01	A	unsigned	R (03)	MINTRMSsens2
…	…	1	…	0.01	A	unsigned	R (03)	…
045F	1'119	1	TRMS min value of Sensor 96	0.01	A	unsigned	R (03)	MINTRMSsens96
0500	1'280	1	AC min value of Sensor 1	0.01	A	unsigned	R (03)	MINACsens1
0501	1'281	1	AC min value of Sensor 2	0.01	A	unsigned	R (03)	MINACsens2
…	…	1	…	0.01	A	unsigned	R (03)	…
055F	1'375	1	AC min value of Sensor 96	0.01	A	unsigned	R (03)	MINACsens96
0600	1'536	1	DC min value of Sensor 1	0.01	A	signed	R (03)	MINDCsens1
0601	1'537	1	DC min value of Sensor 2	0.01	A	signed	R (03)	MINDCsens2
…	…	1	…	0.01	A	signed	R (03)	…
065F	1'631	1	DC min value of Sensor 96	0.01	A	signed	R (03)	MINDCsens96
Maximum measured values: **These registers contain the maximum measured values since last system start / reset or since last “reset min/max values” request.**								
0800	2'048	1	TRMS max value of Sensor 1	0.01	A	unsigned	R (03)	MAXTRMSsens1
0801	2'049	1	TRMS max value of Sensor 2	0.01	A	unsigned	R (03)	MAXTRMSsens2
…	…	1	…	0.01	A	unsigned	R (03)	…
085F	2'143	1	TRMS max value of Sensor 96	0.01	A	unsigned	R (03)	MAXTRMSsens96
0900	2'304	1	AC max value of Sensor 1	0.01	A	unsigned	R (03)	MAXACsens1
0901	2'305	1	AC max value of Sensor 2	0.01	A	unsigned	R (03)	MAXACsens2
…		1	…	0.01	A	unsigned	R (03)	…
095F	2'399	1	AC max value of Sensor 96	0.01	A	unsigned	R (03)	MAXACsens96
0A00	2'560	1	DC max value of Sensor 1	0.01	A	signed	R (03)	MAXDCsens1
0A01	2'561	1	DC max value of Sensor 2	0.01	A	signed	R (03)	MAXDCsens2
…	…	1	…	0.01	A	signed	R (03)	…
0A5F	2'655	1	DC max value of Sensor 96	0.01	A	signed	R (03)	MAXDCsens96

Modbus and SNMP Mapping

Addr. (hex)	Addr. (dec)	Word (16-bit)	Description	Resolution (1-bit value)	Unit	Format	Access	SNMP Variable Name
Measured hold values: These registers contain the hold values captured at a given time during the execution of a "trigger hold measurement" request.								
0C00	3'072	1	TRMS hold value of Sensor 1	0.01	A	unsigned	R (03)	HOLDTRMSsens1
0C01	3'073	1	TRMS hold value of Sensor 2	0.01	A	unsigned	R (03)	HOLDTRMSsens2
...	...	1	...	0.01	A	unsigned	R (03)	...
0C5F	3'167	1	TRMS hold value of Sensor 96	0.01	A	unsigned	R (03)	HOLDTRMSsens96
0D00	3'328	1	AC hold value of Sensor 1	0.01	A	unsigned	R (03)	HOLDACsens1
0D01	3'329	1	AC hold value of Sensor 2	0.01	A	unsigned	R (03)	HOLDACsens2
...	...	1	...	0.01	A	unsigned	R (03)	...
0D5F	3'423	1	AC hold value of Sensor 96	0.01	A	unsigned	R (03)	HOLDACsens96
0E00	3'584	1	DC hold value of Sensor 1	0.01	A	signed	R (03)	HOLDDCsens1
0E01	3'585	1	DC hold value of Sensor 2	0.01	A	signed	R (03)	HOLDDCsens2
...		1	...	0.01	A	signed	R (03)	...
0E5F	3'679	1	DC hold value of Sensor 96	0.01	A	signed	R (03)	HOLDDCsens96
Serial number (SID), version and bus line								
1000	4'096	16	SID, version, bus line of sensor 1			special	R (03)	SIDsens1
1010	4'112	16	SID, version, bus line of sensor 2			special	R (03)	SIDsens2
...	...	16	...			special	R (03)	...
15F0	5'616	16	SID, version, bus line of sensor 96			special	R (03)	SIDsens96
Polarity of sensors (for DC currents)								
2000	8'192	1	Polarity of sensor 1			special	RW (03,06,10)	POLsens1
2001	8'193	1	Polarity of sensor 2			special	RW (03,06,10)	POLsens2
...	...	1	...			special	RW (03,06,10)	...
205F	8'287	1	Polarity of sensor 96			special	RW (03,06,10)	POLsens96
Calculated values of sensors								
2200	8'704	2	Active Power value of Sensor 1	1	W	unsigned	R (03)	Psens1
2202	8'706	2	Active Power value of Sensor 2	1	W	unsigned	R (03)	Psens2
...	...	2	...	1	W	unsigned	R (03)	...
22BE	8'894	2	P value of Sensor 96	1	W	unsigned	R (03)	Psens96
2300	8'960	2	Active Energy value of Sensor 1	0.1	Wh	unsigned	R (03)	Whsens1
2302	8'962	2	Active Energy value of Sensor 2	0.1	Wh	unsigned	R (03)	Whsens2
...	...	2	...	0.1	Wh	unsigned	R (03)	...
23BE	9'150	2	Active Energy value of Sensor 96	0.1	Wh	unsigned	R (03)	Whsens96
Calculated values of groups								
2400	9'216	2	Active Power value of Group 1	1	W	unsigned	R (03)	PGroup1
2402	9'218	2	Active Power value of Group 2	1	W	unsigned	R (03)	PGroup2
...	...	...	...	...	...	...	...	...
24BE	9'406	2	Active Power value of Group 96	1	W	unsigned	R (03)	PGroup96
2500	9'472	2	Active Energy value of Group 1	100	Wh	unsigned	R (03)	WhGroup1
2502	9'472	2	Active Energy value of Group 2	100	Wh	unsigned	R (03)	WhGroup2
...	...	2	...	100	Wh	unsigned	R (03)	...
25BE	9'662	2	Active Energy value of Group 96	100	Wh	unsigned	R (03)	WhGroup96
Control registers								
3001	12'289	1	Physical assignment of sensor time-out, UI mode	0.1	s	unsigned	RW (03,06)	uiTIMEOUTsens
3002	12'290	1	Physical assignment of sensor time-out, UI mode	0.1	s	unsigned	RW (03,06)	busTIMEOUTsens

Modbus and SNMP Mapping

Addr. (hex)	Addr. (dec)	Word (16-bit)	Description	Resolution (1-bit value)	Unit	Format	Access	SNMP Variable Name
Branches								
3200	12'800	64	Branch name of Sensor 1	64	letter	string	RW (03,10)	BranchNameSens1
3240	12'864	64	Branch name of Sensor 2	64	letter	string	RW (03,10)	BranchNameSens2
…	…	64	…	64	letter	string	RW (03,10)	…
49C0	18'880	64	Branch name of Sensor 96	64	letter	string	RW (03,10)	BranchNameSens96
5200	20'992	64	Name of Group 1*	64	letter	string	RW (03,10)	GroupName1
5240	21'056	64	Name of Group 2	64	letter	string	RW (03,10)	GroupName2
…	…	64	…	64	letter	string	RW (03,10)	…
69C0	27'072	64	Name of Group 96	64	letter	string	RW (03,10)	GroupName96
7200	29'184	1	Phase assigned to Sensor 1	1		short	RW (03,06)	PhaseSens1
7201	29'185	1	Phase assigned to Sensor 2	1		short	RW (03,06)	PhaseSens2
…	…	1	…	1		short	RW (03,06)	…
725F	29'279	1	Phase assigned to Sensor 96	1		short	RW (03,06)	PhaseSens96
7280	29'312	1	Group number of Sensor 1**	1		short	RW (03,06)	GroupSens1**
7281	29'313	1	Group number of Sensor 2	1		short	RW (03,06)	GroupSens2
…	…	1	…	1		short	RW (03,06)	…
72DF	29'407	1	Group number of Sensor 96	1		short	RW (03,06)	GroupSensor96
7300	29'440	1	Power Factor of Sensor 1	0.01		unsigned	RW (03,06)	PowerFactorSens1
7301	29'441	1	Power Factor of Sensor 2	0.01		unsigned	RW (03,06)	PowerFactorSens2
…	…	1	…	0.01		unsigned	RW (03,06)	…
735F	29'535	1	Power Factor of Sensor 96	0.01		unsigned	RW (03,06)	PowerFactorSens96
Alarm/Event Status – only Status								
8000	32'768	1	Number of current alarms			unsigned	R (03)	
8001	32'769	1	Alarm Status Branch 1			unsigned	R (03)	
8002	32'770	1	Alarm Status Branch 2			unsigned	R (03)	
…	…	1				unsigned	R (03)	
8060	32'864	1	Alarm Status Branch 96			unsigned	R (03)	
8061	32'865	1	Alarm Status Line L1			unsigned	R (03)	
8062	32'866	1	Alarm Status Line L2			unsigned	R (03)	
8063	32'867	1	Alarm Status Line L3			unsigned	R (03)	
8064	32'868	1	Alarm Status Line L4/N			unsigned	R (03)	
Alarm/Event Status – Status and Threshold								
8100	33'024	1	Number of current alarms			unsigned	R (03)	
8101	33'025	1	Alarm Status Branch 1			unsigned	R (03)	
8102	33'026	2	Alarm Threshold Branch 1			signed	R (03)	
8104	33'028	1	Alarm Status Branch 2			unsigned	R (03)	
8105	33'029	2	Alarm Threshold Branch 2			signed	R (03)	
…	…						R (03)	
821E	33'310	1	AlarmStatusBranch96			unsigned	R (03)	
821F	33'311	2	AlarmThresholdBranch96			signed	R (03)	
…	…							
8221	33'313	1	AlarmStatusLine L1			unsigned	R (03)	
8222	33'314	2	AlarmThresholdLine L1			signed	R (03)	
8224	33'316	1	AlarmStatusLine L2			unsigned	R (03)	
8225	33'317	2	AlarmThresholdLine L2			signed	R (03)	
8227	33'319	1	AlarmStatusLine L3			unsigned	R (03)	
8228	33'320	2	AlarmThresholdLine L3			signed	R (03)	
822A	33'322	1	AlarmStatusLine L4/N			unsigned	R (03)	
822B	33'323	2	AlarmThresholdLine L4/N			signed	R (03)	

Modbus and SNMP Mapping

Addr. (hex)	Addr. (dec)	Word (16-bit)	Description	Resolution (1-bit value)	Unit	Format	Access	SNMP Variable Name
Mains measurement registers								
9002	36'866	2	PHASE VOLTAGE L1-N	0.01	V	unsigned	R (03)	uL1
9004	36'868	2	PHASE VOLTAGE L2-N	0.01	V	unsigned	R (03)	uL2
9006	36'870	2	PHASE VOLTAGE L3-N	0.01	V	unsigned	R (03)	uL3
9010	36'880	2	LINE CURRENT L1	0.01	A	unsigned	R (03)	iL1
9012	36'882	2	LINE CURRENT L2	0.01	A	unsigned	R (03)	iL2
9014	36'884	2	LINE CURRENT L3	0.01	A	unsigned	R (03)	iL3
9018	36'888	2	POWER FACTOR L1	0,01		signed	R (03)	pfL1
901A	36'890	2	POWER FACTOR L2	0,01		signed	R (03)	pfL2
901C	36'892	2	POWER FACTOR L3	0,01		signed	R (03)	pfL3
9026	36'902	2	3-PHASE SUM APPARENT POWER	1	VA	unsigned	R (03)	s3
9028	36'904	2	APPARENT POWER L1	1	VA	unsigned	R (03)	sL1
902A	36'906	2	APPARENT POWER L2	1	VA	unsigned	R (03)	sL2
902C	36'908	2	APPARENT POWER L3	1	VA	unsigned	R (03)	sL3
902E	36'910	2	3-PHASE SUM ACTIVE POWER	1	W	signed	R (03)	p3
9030	36'912	2	ACTIVE POWER L1	1	W	signed	R (03)	pL1
9032	36'914	2	ACTIVE POWER L2	1	W	signed	R (03)	pL2
9034	36'916	2	ACTIVE POWER L3	1	W	signed	R (03)	pL3
9036	36'918	2	3-PHASE SUM REACTIVE POWER	1	VAr	signed	R(03)	q3
9038	36'920	2	REACTIVE POWER L1	1	VAr	signed	R (03)	qL1
903A	36'922	2	REACTIVE POWER L2	1	VAr	signed	R (03)	qL2
903C	36'924	2	REACTIVE POWER L3	1	VAr	signed	R (03)	qL3
903E	36'926	2	3-PHASE SYS ACTIVE ENERGY	0.01	Wh	unsigned	R (03)	wh3
9040	36'928	2	3-PHASE SYS REACTIVE ENERGY	0.01	Varh	unsigned	R (03)	qh3
9074	36'980	2	ACTIVE ENERGY L1	0.01	Wh	unsigned	R (03)	whL1
9076	36'982	2	ACTIVE ENERGY L2	0.01	Wh	unsigned	R (03)	whL2
9078	36'984	2	ACTIVE ENERGY L3	0.01	Wh	unsigned	R (03)	whL3
907A	36'986	2	REACTIVE ENERGY L1	0.01	Varh	unsigned	R (03)	qhL1
907C	36'988	2	REACTIVE ENERGY L2	0.01	Varh	unsigned	R (03)	qhL2
907E	36'990	2	REACTIVE ENERGY L3	0.01	Varh	unsigned	R (03)	qhL3
90A6	37'030	2	3-PHASE SYS APPARENT ENERGY	0.01	VAh	unsigned	R (03)	sh3
90A8	37'032	2	APPARENT ENERGY L1	0,01	VAh	unsigned	R (03)	shL1
90AA	37'034	2	APPARENT ENERGY L2	0,01	VAh	unsigned	R (03)	shL2
90AC	37'036	2	APPARENT ENERGY L3	0,01	VAh	unsigned	R (03)	shL3
9300	37'632	1	CTratioL1L2L3	0.1	0,1-6000	unsigned	RW (03,06)	CTratioL1L2L3
9301	37'633	1	CTratioN	0.1	0,1-6000	unsigned	RW (03,06)	CTratioN
9302	37'634	2	LINE CURRENT L4/N	0.01	A	unsigned	R (03)	iL4N
9304	37'636	2	Current THD L4/N	0.01	%	unsigned	R (03)	thdIL4N
9082	36'994	2	VOLTAGE THD L1	0.01	%	unsigned	R (03)	thdUL1
9084	36'996	2	VOLTAGE THD L2	0.01	%	unsigned	R (03)	thdUL2
9086	36'998	2	VOLTAGE THD L3	0.01	%	unsigned	R (03)	thdUL3

Modbus and SNMP Mapping

Addr. (hex)	Addr. (dec)	Word (16-bit)	Description	Resolution (1-bit value)	Unit	Format	Access	SNMP Variable Name
Mains measurement registers								
90AE	37'038	2	ACTIVE ENERGY L1 100Wh	100	Wh	unsigned	R (03)	whL1-100
90B0	37'040	2	ACTIVE ENERGY L2 100Wh	100	Wh	unsigned	R (03)	whL2-100
90B2	37'042	2	ACTIVE ENERGY L3 100Wh	100	Wh	unsigned	R (03)	whL3-100
90B4	37'044	2	3-PHASE SUM ACTIVE ENERGY 100Wh	100	Wh	unsigned	R (03)	wh3-100
90B6	37'046	2	REACTIVE ENERGY L1 100varh	100	varh	unsigned	R (03)	qhL1-100
90B8	37'048	2	REACTIVE ENERGY L2 100varh	100	varh	unsigned	R (03)	qhL2-100
90BA	37'050	2	REACTIVE ENERGY L3 100varh	100	varh	unsigned	R (03)	qhL3-100
90BC	37'052	2	3-PHASE SUM REACTIVE ENERGY 100varh	100	varh	unsigned	R (03)	qh3-100
90BE	37'054	2	APPARENT ENERGY L1 100VAh	100	VAh	unsigned	R (03)	shL1-100
90C0	37'056	2	APPARENT ENERGY L2 100VAh	100	VAh	unsigned	R (03)	shL2-100
90C2	37'058	2	APPARENT ENERGY L3 100VAh	100	VAh	unsigned	R (03)	shL3-100
90C4	37'060	2	3-PHASE SUM APPARENT ENERGY 100VAh	100	VAh	unsigned	R (03)	sh3-100
9088	37'000	2	CURRENT THD L1	0.01	%	unsigned	R (03)	thdIL1
908A	37'002	2	CURRENT THD L2	0.01	%	unsigned	R (03)	thdIL2
908C	37'004	2	CURRENT THD L3	0.01	%	unsigned	R (03)	thdIL3

*) 96 group names with max. 64 characters can be defined in the Web-UI. The register contains the group name included in the group name list. The register indicates the number of the group within the group name list.
**) The register indicates the number of the group in the group name list.

FAQ

Number	Topic	Explanation
1	Current limit mains power factor	The CMS-700 gathers mains and N phase currents L1, L2, L3 based on the secondary current of the current transformer starting from a current of 60mA. Below 60mA, the current value is shown as 0A. For the primary current with a 20/5 current transformer this means: 60mA * 20/5 = 60mA * 4 = 240mA (phase current). Below a line current of 240mA, the current value is shown as 0A. If the CMS-700 measures no mains current (= 0A), the power factor is 1.
2	Energy value	Only the accumulated energy value can be read. In order to obtain values for 15 minutes, the control system (master system) needs to poll data every 15 minutes and then subtract the last value (previous 15 minutes).
3	Max. energy value	The max. energy value for the mains and the individual branches is 429'496 kWh each.
4	Modbus	Modbus values can be read in blocks. The Modbus protocol recognizes the “Read Holding Register” (03h) function code. This means that the start address (start register) and the number of registers to be issued are defined (see p. 40 - Read ongoing measurement values of sensor 5-16).
5	Modbus TCP	The RJ45 LAN connection of the device is compatible with Modbus TCP.
6	Master / Slave	The CMS-700 does not have a master function. It operates as a slave and can be addressed accordingly in the Web UI configuration.
7	Master / Slave	Each CMS-700 needs its own IP address on the network and must be accessed using this IP address.
8	Current direction	There is no current direction detection for AC. For DC measurement, the current direction is detected via Modbus reading.

Notes

Notes

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