USER AND INSTALLATION MANUAL

Ecosine Active Sync

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Revision: 3.0 (November 2023)
English version (original instructions)
The most current edition of these instructions and possible translations (PDF format) can be obtained from your contact at the Schaffner organization or at schaffner.com/downloads.

Document name:
User and Installation Manual Ecosine Active Sync rev3.0.pdf

This document is valid for
Firmware package version: **V01.04.00 or higher**
Content of the firmware package:
Power module firmware: **V03.05.00 or higher**
Sync module firmware: **V04.03.00 or higher**
(For firmware version, see parameter P010)

Meaning of firmware version number:
V XX.xx.xx – hardware release, downwards incompatible
V xx.**XX**.xx – function version
V xx.xx.**XX** – small compatible changes

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1 Version History

Revision	Date	Description
1.0	February 2018	Initial version
1.1	March 2018	Added index of figures, index of tables Optimized chapters order and content Updated LED indication table and parameters list
1.2	May 2018	Added Figure 7-3 dimension of drill pattern for wall mount Revised Group P4XX
1.3	June 2018	Added Appendix 17.2 Type Plate of ecosine active sync. Corrected control response time from 300 µs (AHF Gen I) to 100 µs. Corrected height of cabinet in chapter 6.5 to: 2328mm (including top Fan and socket). Replaced P203 (not used) by P559 in chapter 9.5.
1.4a	September 2018	Corrected description of X11 connector (valid for FW **V03.01.02** or higher)
1.5	March 2019	Added Sync Module (SYNC300A) technical specification and electrical connection. Updated Firmware of power module information to **V03.01.07** or higher
1.6	July 2019	- Updated Label and technical specification of power modules with UL. - Updated parameters table of power modules for **V03.02.03**. - Updated commissioning procedure with sync module. - Changed description of P320 settings in chapter 8.2 (with new Firmware V03.02.03 and higher, P320: Total current parallel = 120A for master and slave modules)
1.7	October 2019	Introduction of the new firmware Update Tool software replacing the bootloader in chapter 0 Additional information regarding the usage of the sync module Update of terminal X11 description in Table 15 Update of the parameters lists for power module Addition of the parameters lists for sync module Additional details in the commissioning procedure Additional appendix with calculation examples Several minor corrections across the whole document
1.8	December 2019	Chapter 6.10: add description of SYNC300X Chapter 8.7: more detail about CT secondary connection Chapter 9.2.3: addition of screenshots of the display module interface Chapter 10: update of the parameters lists of power module and sync module Chapter 12: updated instruction for AHF Firmware Update Tool V2.1.0.3 - introduction of the new firmware package Minor corrections and clarification across the document

2.0	December 2022	Introduction of the HMI with Chapter 9.1 and other mention across the document. Chapter 6.2: Addition of HMI in product code and update cabinet versions table. Chapter 6.6: addition of chapter. Maximum current by harmonic order Chapter 8.9.6: Correction of some wrong parameter number Chapter 10: Update of parameter list according to latest firmware Chapter 11.2 first paragraph and Table 27: Error in service port terminal number X15 -> X13 Chapter 11.2: New chapter with instruction to connect Ecosine Active Sync to an ethernet network (information previously maintained in a separate document) Document template updated to reflect the new Schaffner branding Minor corrections and clarification across the document
2.1	January 2023	Cover picture updated Table 2 split in two, versions with Sync module and without. Versions order improved. Adding missing values in Table 6 and Table 10 Drawing updated in Figure 7-8 Chapter 8.3.1 Additional information for powering the HMI. Minor corrections and clarification across the document
3.0	November 2023	Update the operating voltage range from 200 VAC following firmware update package **V01.04.00** and cabinet CE change. Addition of section 8.11 for installation of IP20 terminal covers and communication port covers. Addition of section 13.1 Instructions for the removal of a power module in cabinet Update all pictures and drawings to replace or remove the old Schaffner branding.

2 Introduction

2.1 Purpose

The Ecosine Active Sync User and Installation Manual provides information for unpacking, installation and commissioning of the active harmonic filter and describe mechanical and electrical installation of the filter power module and cabinet version. It contains basic information about parameters and communication as well as troubleshooting information.

The instructions are intended for use by qualified personnel. Reading and following these instructions is mandatory. Particular attention needs to be given to the general safety notes and installation guidelines (cautions and warnings)! always keep these instructions available with the filter(s).

Installation of the Ecosine Active Sync filter, inspections for proper operation, and certain troubleshooting measures may only be performed by qualified personnel. All other measures may be performed by people who have read these instructions.

2.2 Additional Resources

The Schaffner group does provide a number of additional resources available at schaffner.com to understand power quality in general and product in particular.

The Ecosine Active Sync filter maintenance instruction provides information on maintenance and testing for field service technicians, as well as disassembly and assembly instructions for wear parts.

2.3 Naming convention

In this document the acronym AHF, standing for Active Harmonic Filter, is often used in the text for easier reading. It refers to the Ecosine Active Sync power module, Double Power Pack (DPP) or cabinet system.

3 General Safety Notes and Installation Guidelines for harmonic filters

3.1 Important Information

These general safety notes refer to the group of power quality filters including active and passive harmonic filter (AHF, PHF), AC line chokes and output filters. Do not attempt to install, operate, maintain or inspect power quality filters until you have read through the safety notes and installation guidelines as well as installation manual and product specification. Do not use any Schaffner product until you have a full knowledge of the equipment, safety notes and installation guidelines. The same applies to all warnings placed on the filters. Please ensure that those are not removed and their legibility is not influenced by external factors.
The following symbols, terms and designations are used in these general safety notes and installation guidelines:

Label	Description
⚠ CAUTION	Follow these instructions to avoid hazardous conditions which could cause minor or moderate injury or may cause damages to the unit.
⚠ WARNING	Follow these instructions to avoid hazardous conditions which could result in death or serious injury.
NOTICE	Indicates content to be noted by the reader.

3.2 General Installation Notes

- Please read and follow the safety and application notes below.
- Carefully inspect the shipping container and the product prior to the installation. In case of visual damage, don't install the filter and file a claim with the freight carrier involved.
- Filters may be heavy. Follow the instructions for lifting heavy equipment defined by your company.
- Use an appropriately sized threaded bolt for every mounting hole/slot provided by the filter flange. The strength class of the bolt must be determined by the installer, depending upon filter weight and the material of the mounting surface.
- Connect the filter to the protective earth (PE) terminal(s).
- Remove all line side power, then connect the phase terminal(s) and neutral terminal (if any) of the filter. The filter label may also indicate LINE (grid side terminals) and LOAD (power electronics terminals).
- For the electrical connection of the filter terminals, apply the torques recommended on the filter label and/or in the published filter datasheets.
- Cable or busbar cross sections have to be chosen in accordance with national and international electric codes and applicable product standards governing the equipment that will incorporate the power quality filters and the equipment in use.
- Some filters provide additional terminals, e.g. for over-temperature monitoring. These features have to be properly used before energizing the filter. If uncertain, please consult your local Schaffner representative.
- Active Harmonic Filters (AHF) are working with current transformers (CTs which are a 3rd party product and which are typically installed in electrical equipment with lethal high voltage levels. Before attempting to install CTs read the CT installation safety page provided by the CT manufacturer. Always consider transformer as a part of the circuit to which it is connected, and do not touch the leads and terminals or other parts of the transformer unless they are known to be grounded.
- In order to get the maximum benefit out of your power quality filter, please also consult additional user manuals, installation manuals, whitepaper and other material, published in the download section of www.schaffner.com. These additional guidelines provide helpful hints for equipment related topics as well as technical knowledge.

3.3 Safety Notes and Regulations

1. Label on equipment 2. Safety note category	Safety note regulations
⚠ WARNING	Equipment installation, start-up, operation and maintenance (if any) have to be carried out by a trained and certified electrician or technician, who is familiar with safety procedures in electrical systems. Non-qualified persons are not allowed to use, install, operate or maintain PQ filters!
⚠ WARNING	High voltage potentials are involved in the operation of power quality equipment. Always remove power before handling energized parts of the filter, and let ample time elapse for the capacitors to discharge to safe levels (<42V). Residual voltages are to be measured both line to line and line to earth.
⚠ CAUTION	Correct protective earthing of the equipment must be established and the user must be protected against supply voltage in accordance with applicable national and local regulations. Always practice the safety procedures defined by your company and by applicable national electric codes when handling, installing, operating or maintaining electrical equipment.
⚠ CAUTION	Some product may include EMC filters which may cause leakage currents to ground. Always connect the filter to protective earth (PE) first, then continue with the wiring of phase/neutral terminals. When decommissioning the filter, remove the PE connection at the end.
⚠ WARNING	Using the direct OFF setting in AHF does not disconnect the equipment from mains and is thus not to be used as a safety switch.
⚠ CAUTION	Follow the general installation and environmental condition notes closely. Ensure that cooling slots (if any) are free from obstructions that could inhibit efficient air circulation. Operate the filter within its electrical, mechanical, thermal and ambient specifications at all times.
⚠ CAUTION	Power quality filters are lossy electrical components. Parts/surfaces of the equipment may get hot under load operating conditions.
NOTICE	At altitudes above 2000m, please contact Schaffner prior to installation.
NOTICE	Filter suitability for a given application must ultimately be determined by the user (the party that is putting the filter into operation) on a case by case basis. Schaffner will not assume liability for any consequential downtimes or damages resulting from use of filters outside their specifications.
⚠ CAUTION	In case of uncertainty and questions please contact your local Schaffner partner for assistance (details per region available at www.schaffner.com).

4 General Safety Notes and Installation Guidelines for AHF accessories

4.1 Important Information

These general safety notes refer to accessories for Active Harmonics Filters (AHF). Do not attempt to install, operate, maintain or inspect any Schaffner product and accessories until you have read through the safety notes and installation manual and reach full knowledge of the equipment. The same applies to all warnings placed on the products. Please ensure that those are not removed and their legibility is not influenced by external factors.
The following symbols, terms and designations are used in these safety notes and installation guidelines:

Label	Description
⚠ CAUTION	Follow these instructions to avoid hazardous conditions which could cause minor or moderate injury or may cause damages to the unit.
NOTICE	Indicates content to be noted by the reader.

4.2 General Installation Notes

- Please read and follow the safety and application notes below.
- Carefully inspect the shipping box and the product prior to the installation. In case of visual damage, don't install the product and file a claim with the freight carrier involved.
- Use appropriately sized screw and bolt and respect tightening torque when provided in order to avoid any potential damage to the product and surrounding equipment.
- Carefully follow the assembly instruction to ensure a proper installation of the sealing which will ensure to achieve the advertised IP code protection level.
- Connect the product to the ground terminal(s) when present.
- Remove all line side power when connecting the product.
- Check the DC power supply voltage before connecting powered accessories, inappropriate voltage could damage the product permanently.
- To get the maximum benefit out of your AHF accessories, please also consult the latest version of the complete AHF user and installation manual, published in the download section of www.schaffner.com.

4.3 Safety Notes and Regulations

1. Label on equipment 2. Safety note category	Safety note regulations
⚠ CAUTION	Follow the general safety notes and environmental condition closely. Ensure that the hot air from the power equipment are not impacting the accessories proper operation. Operate the product within its electrical, mechanical, thermal and ambient specifications at all times.
NOTICE	At altitudes above 2000m, please contact Schaffner prior to installation.

⚠ CAUTION	**Passwords for products with software** Some accessories run with a software. This software is protected by one or several passwords to ensure that no third party might get access to the operating system or advanced functionalities restricted to certain group of users. The accessories with software are always delivered with default passwords from factory. The customer is responsible to change all passwords during commissioning and to store them safely. Schaffner will not be able to assist into the restoration of lost passwords or data following the loss of password. In extreme case the accessory software would need to be return to Schaffner for a complete factory reset and will need to be commissioned again. Failing to change the default passwords, to set safe enough passwords and to store them properly might result in unintended access to the device, to all devices connected to it or any device connected to the same network. Schaffner will decline all responsibilities for any unintended access.
⚠ CAUTION	**Updates for product with software** Regularly new software might be made available by Schaffner to correct bug and update security fix from the operating system and front-end user interface. The user must ensure to always use the latest version available. Customer and partners will be informed by a product change notification for all new software release. Schaffner will not be liable for any damage resulting from operating the product with older version of the software.
⚠ CAUTION	**Modifications of products** Hardware and corresponding software of the accessories must never be modified, damaged, downgraded to a previous version or exploited maliciously in order to change the intended behavior of the product, bypass programmed safety check and/or use it for any other purpose than what is intended by Schaffner. Schaffner will not be liable for any damage resulting from any deliberate or undeliberate hardware and/or software modification as well as using the product with older version of the software.
⚠ CAUTION	**Input/output and communications** Some accessories offer several input/output and communications ports. Before connecting the product to any other device, network or communication device, the user must ensure the compatibly of the device connected. For IT equipment, with the help from the IT administrator when relevant, the user must ensure that all security practices regarding IT communication are respecting the end user and/or local operator IT security and privacy policies.
NOTICE	In case of uncertainty and questions please contact your local Schaffner partner for assistance (details per region available at www.schaffner.com).

5 Environmental Conditions / Exclusion of warranty

This document classifies groups of environmental parameters and their severities to which Ecosine Active Sync harmonic filters are subjected when mounted for stationary use at weather protected locations under use conditions, including periods of erection work, down time, maintenance and repair. The lifetime of electronic equipment is depending on the environmental conditions they are exposed to. Especially in harsh environments lifetime is reduced due to the corrosiveness of the atmospheric environment. Generally, corrosion in micro or power electronics depends on several factors such as the package type, materials involved, assembly processes, moisture, inorganic and organic contaminants, atmospheric pollutants, temperature, thermal stress and electrical bias. To increase the lifetime Schaffner provides all Ecosine Active Sync filters with the ability to work within pollution degree 2 (PD2) and does use coated PCB's according to IEC61721-3-3. Schaffner standard PCB construction complies with class 3C2. Please carefully read the provided information and check if your application fulfills the required specifications as **Schaffner expressly points out that the manufacturer's warranty shall lapse with immediate effect if Ecosine Active Sync harmonic filters are transported, stored, installed or operated outside their published specifications.**

Important 	Ecosine Active Sync harmonic filters (AHF) listed below are IP20 or IP54 devices to be installed in an environment in compliance with the requirements named in this document. All active harmonic filters (AHF) must be installed in a clean, dry location, e.g. in sufficiently ventilated or airconditioned electric cabinets or closed electric rooms. Contaminants such as oils, liquids, corrosive vapors, abrasive debris, dust and aggressive gases must be kept out of the filter enclosure. **WARNING: Conductive dust may cause damage to Ecosine Active Sync harmonic filters. Ensure that installation site of Ecosine Active Sync is free of conductive dust.**
Products	FN3530/31 series, 3-wire filters, 200-480VAC, models 60A FN3540/41 series, 4-wire filters, 200-415 VAC, models 60A FN3532 series, 3-wire filters, 200-480VAC, models 120A FN3542 series, 4-wire filters, 200-415VAC, models 120A FN3545 series, 3/4-wire filters, models 60…300A SYNC300A, optional sync module for ecosine active sync SYNC300X, optional sync module for Ecosine Active Sync without CT module
Overvoltage class (EN50178)	Ecosine Active Sync are designed according to EN 50178 overvoltage class III

<table>
<tr><td>Storage environmental specifications
(IEC 60721-3-1, EN50178)</td><td>Climate conditions for storage class 1K3:
Temperature range: -25°C to +55°C
Relative humidity: < 95%, no condensation
Atmospheric pressure: 70KPa to 106KPa</td></tr>
<tr><td>Transportation environmental specifications
(IEC 60721-3-2, EN50178)</td><td>Climate conditions for transport class 2K3:
Temperature range: -25°C to +70°C
Relative humidity: < 95%, no condensation
Atmospheric pressure: 70KPa to 106KPa
Vibrations according to IEC 60068-2-6
Shocks according to IEC 60068-2-27</td></tr>
<tr><td>Operation environmental specifications
(IEC 60721-3-3, EN50178)</td><td>Climate conditions for operation class 3K3:
Temperature range:
Power module: 0°C to +50°C
Cabinet: 0°C to +40°C
Relative humidity: < 95%, no condensation
Atmospheric pressure: 70KPa to 106KPa</td></tr>
<tr><td>Degree of pollution
(IEC 61010, EN50178)</td><td>Pollution conditions for operation class PD2</td></tr>
<tr><td>Corrosive levels
(IEC 60721-3-3)</td><td>Corrosive levels for storage, transport and operation Class 3C2[3]:
Applies to locations with normal levels of contaminants, experienced in urban areas with industrial activities
Levels:
<table>
<tr><th>Environmental parameter</th><th>Units[1]</th><th colspan="2">Class 3C2[2]</th></tr>
<tr><td></td><td></td><td>Mean value</td><td>Max value</td></tr>
<tr><td>Sea salt</td><td></td><td colspan="2">Salt mist</td></tr>
<tr><td>Sulphur dioxide</td><td>ppm</td><td>0.3</td><td>1.0</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.11</td><td>0.37</td></tr>
<tr><td>Hydrogen sulfide</td><td>ppm</td><td>0.1</td><td>0.5</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.071</td><td>0.36</td></tr>
<tr><td>Chlorine</td><td>ppm</td><td>0.1</td><td>0.3</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.034</td><td>0.1</td></tr>
<tr><td>Hydrogen chloride</td><td>ppm</td><td>0.1</td><td>0.5</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.066</td><td>0.33</td></tr>
<tr><td>Hydrogen fluoride</td><td>ppm</td><td>0.01</td><td>0.03</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.012</td><td>0.036</td></tr>
<tr><td>Ammonia</td><td>ppm</td><td>1.0</td><td>3.0</td></tr>
<tr><td></td><td>cm³/m³</td><td>1.4</td><td>4.2</td></tr>
<tr><td>Ozone</td><td>ppm</td><td>0.05</td><td>0.1</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.025</td><td>0.05</td></tr>
<tr><td>Nitrogen oxides</td><td>ppm</td><td>0.5</td><td>1.0</td></tr>
<tr><td></td><td>cm³/m³</td><td>0.26</td><td>0.52</td></tr>
</table>
[1]The values given in cm3/m3 have been calculated from the values given in mg/m3 and refer to a temperature of 20 °C and a pressure of 101,3 kPa. The table uses rounded values.
[2]Mean values are expected long-term values. Maximum values are limit or peak values, occurring over a period of time of not more than 30 min per day.
[3]IEC 60721-3-3 is only applied to the coated PCB covered areas and not the entire device. The unprotected areas, such as connections, terminations and exposed magnetics, may not survive these exposure levels over time.</td></tr>
</table>

6 Ecosine Active Sync Product Line Overview

6.1 Principle of operation

Ecosine Active Sync filters are used for harmonic current mitigation, reactive current compensation (both inductive and capacitive) and phase unbalance correction and optimization. The filter units can be integrated into systems and applications as a centrally installed filter unit to mitigate all application related harmonics or can be combined with frequency converters and motor drives to turn standard converters and motor drives into low harmonic solutions.

Ecosine Active Sync filters are connected in parallel to the load and do steadily monitor all 3-phase line currents (simplified schematic in Figure 6-1). Harmonic currents and reactive power components are reliably detected and processed in an ultra-fast digital control structure. By generating and actively imposing currents in the opposite phase shift, unwanted harmonic and reactive currents are reliably mitigated. By using the latest generation of 3-level IGBT technology ultra-fast (real time) feeding is possible with lower losses compared to older generation active harmonic filters. Build-in LCL-filter technology ensures that neither the switching frequency (16 kHz) nor DC components are imposed into the mains. Operation is possible independent of the source, thus the use of the filter in generator or transformer supply applications is feasible. Connected loads can be of various nature, e.g., individual non-linear loads or groups of non-linear loads.

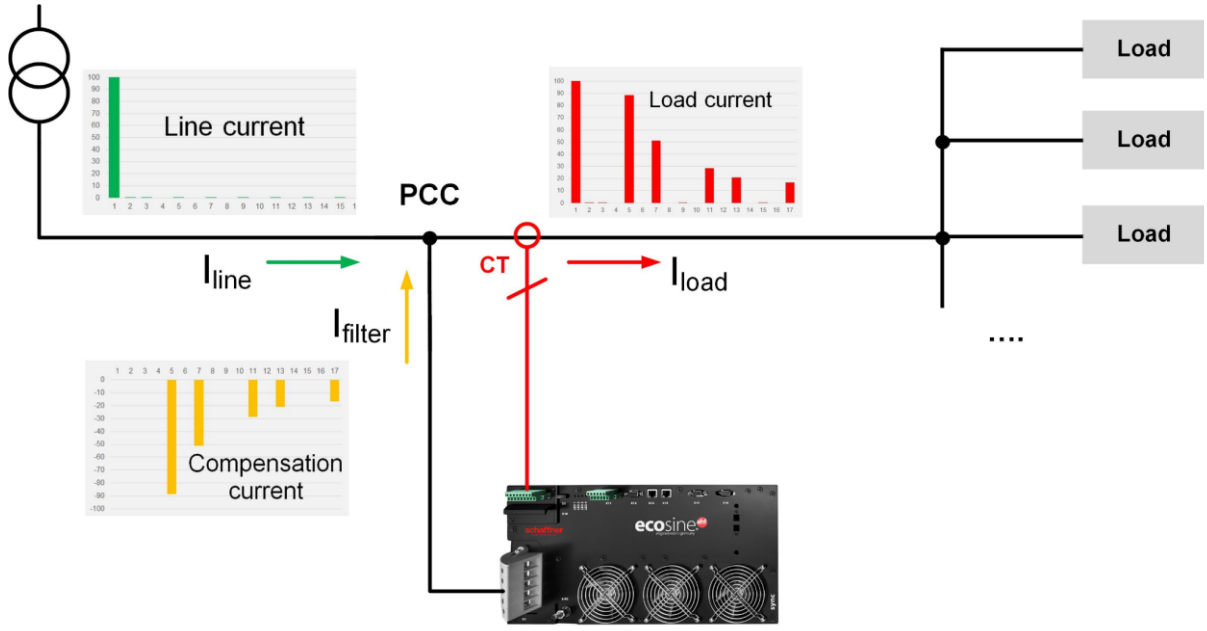


Figure 6-1 Principle of operation of the Ecosine Active Sync harmonic filter

6.2 Ecosine Active Sync system configuration

With the below listed power module variants, optional kits and cabinet variants it is possible to build tailored Ecosine Active Sync filters and systems. Schaffner offers power modules, optional kits and cabinets independently or ready to use filter systems integrated in cabinets.

In the following the designations of Ecosine Active Sync systems and options are introduced.

Table 1 Ecosine Active Sync power modules versions and options

Designation	Description
FN3530	Power Module 200-480 VAC 3-wire
FN3531	Power Module 200-480 VAC 3-wire with CT Module
FN3540	Power Module 200-415 VAC 4-wire
FN3541	Power Module 200-415 VAC 4-wire with CT Module
FN3532	DPP Double Power Pack 120A 200-480 VAC 3-wire
FN3542	DPP Double Power Pack 120A 200-415 VAC 4-wire
CTM	Current Transformer Module
SYNC300A	Sync module for Ecosine Active Sync with CT module
SYNC300X	Sync module for Ecosine Active Sync without CT module
AHF HMI 7”	HMI color touch screen 7” for AHF
Display	Display module
Patch Cable Set	Patch cable set sync module
Ethernet Adapter	Ethernet adapter kit to connect Ecosine Active Sync to an ethernet network
KITIP21	Ecosine Active Sync IP21 cover KIT

6.2.1 Ecosine Active Sync power module FN3530 and FN3531

FN3530 and FN3531 Ecosine Active Sync power modules are 3-phase 3-wire power modules with 60A of mitigation current. FN3530 and FN3531 are applied to 3-phase network without neutral line. FN3530 power modules do not have the CT module included whereas FN3531 power modules come with the CT module included.

FN3530/31

Number of phases (system input)	3-phase 3-wire
Mains frequency	50/60 Hz ± 3 Hz
Mains voltage	200VAC to 480VAC± 10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	16 kHz
Response time	<100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	cosφ = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Mitigation current	60Arms
Dimensions of a single unit	440 mm × 420 mm × 222mm (w × d × h)

6.2.2 Ecosine Active Sync power module FN3540 and FN3541

FN3540 and FN3541 Ecosine Active Sync power modules are 3-phase 4-wire power modules with 60A of mitigation current. FN3540 and FN3541 are applied to 3-phase network with neutral line. FN3540 power modules do not have the CT module included whereas FN3541 power modules come with the CT module included.

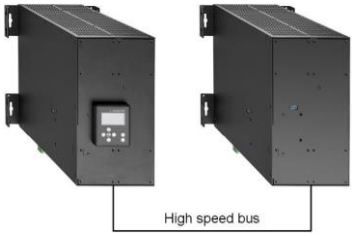
FN3540/41

Number of phases (system input)	3-phase 4-wire
Mains frequency	50/60 Hz ± 3 Hz
Mains voltage	200VAC to 415VAC± 10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	16 kHz
Response time	<100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	cosφ = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Rated phase mitigation current	60Arms
Rated neutral conductor mitigation current	180Apk
Dimensions of a single unit	440 mm × 420 mm × 222mm (w × d × h)

6.2.3 Ecosine Active Sync Double Power Pack (DPP) FN3532 and FN3542

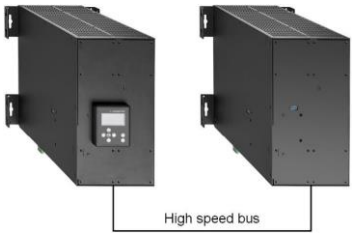
FN3532 and FN3542 are so called Double Power Packs consisting of two Ecosine Active Sync power modules. FN3532 is applied to 3-phase 3-wire networks without neutral wire. FN3542 is applied to a 3-phase 4-wire network with neutral wire. Both DPP packages will always include two power modules (3-wire or 4-wire) and will work in master-slave architecture. That's why only one CT module and only one display module is needed and will be included in the package. Communication between the modules is realized via a high-speed bus.

FN3532



Number of phases (system input)	3-phase 3-wire
Mains frequency	50/60 Hz ± 3 Hz
Mains voltage	200VAC to 480VAC± 10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	2x16kHz interleaved (32kHz effective)
Response time	<100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	cosφ = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Rated phase mitigation current	60Arms
Dimensions of a single unit	440 mm × 420 mm × 222mm (w × d × h)

FN3542



Number of phases (system input)	3-phase 4-wire
Mains frequency	50/60 Hz ± 3 Hz
Mains voltage	200VAC to 415VAC± 10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	2x16kHz interleaved (32kHz effective)
Response time	100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	cosφ = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Mitigation current	120A
Rated neutral conductor mitigation current	180Apk
Dimensions of a single unit	440 mm × 420 mm × 222mm (w × d × h)

6.2.4 Ecosine Active Sync cabinet version (cabinet + power modules)

The Ecosine Active Sync power modules can be integrated into a cabinet and delivered as a system. The cabinet version can include up to 5 modules depending on the configuration and options defined in the type code (see chapter 6.3). The cabinet version is designated as FN3545 + the type code as shown later in Table 2. The main features are summarized below:

FN3545-_ _ _ _ _ _ _ _ _ _

Number of phases (system input)	3-phase 3-wire or 3-phase 4-wire
Mains frequency	50/60 Hz ± 3 Hz
Mains voltage 3-wire	200VAC* to 480VAC -5%/+10%
Mains voltage 4-wire	200VAC* to 415VAC -5%/+10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	number of modules x 16kHz interleaved (up to 5x16kHz effective)
Response time	<100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	cosφ = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Mitigation current	60A, 120A, 180A, 240A, 300A
Dimensions	600 mm × 600 mm × 2265mm (w × d × h)

* UL versions mains voltage starting at 380VAC.

6.3 Ecosine Active Sync cabinet version type code information

Schaffner Ecosine Active Sync series offers a modular solution which enables users to build tailored systems with respect to application and installation needs. Ecosine Active Sync power modules and options are listed in Table 1, while cabinet versions are listed in Table 2.

The Type code is defined as a combination of FN3545 (indicating a cabinet version) plus an extension containing information about configuration and options.
Not all combinations of options are available, please consult Schaffner sales or your local representative

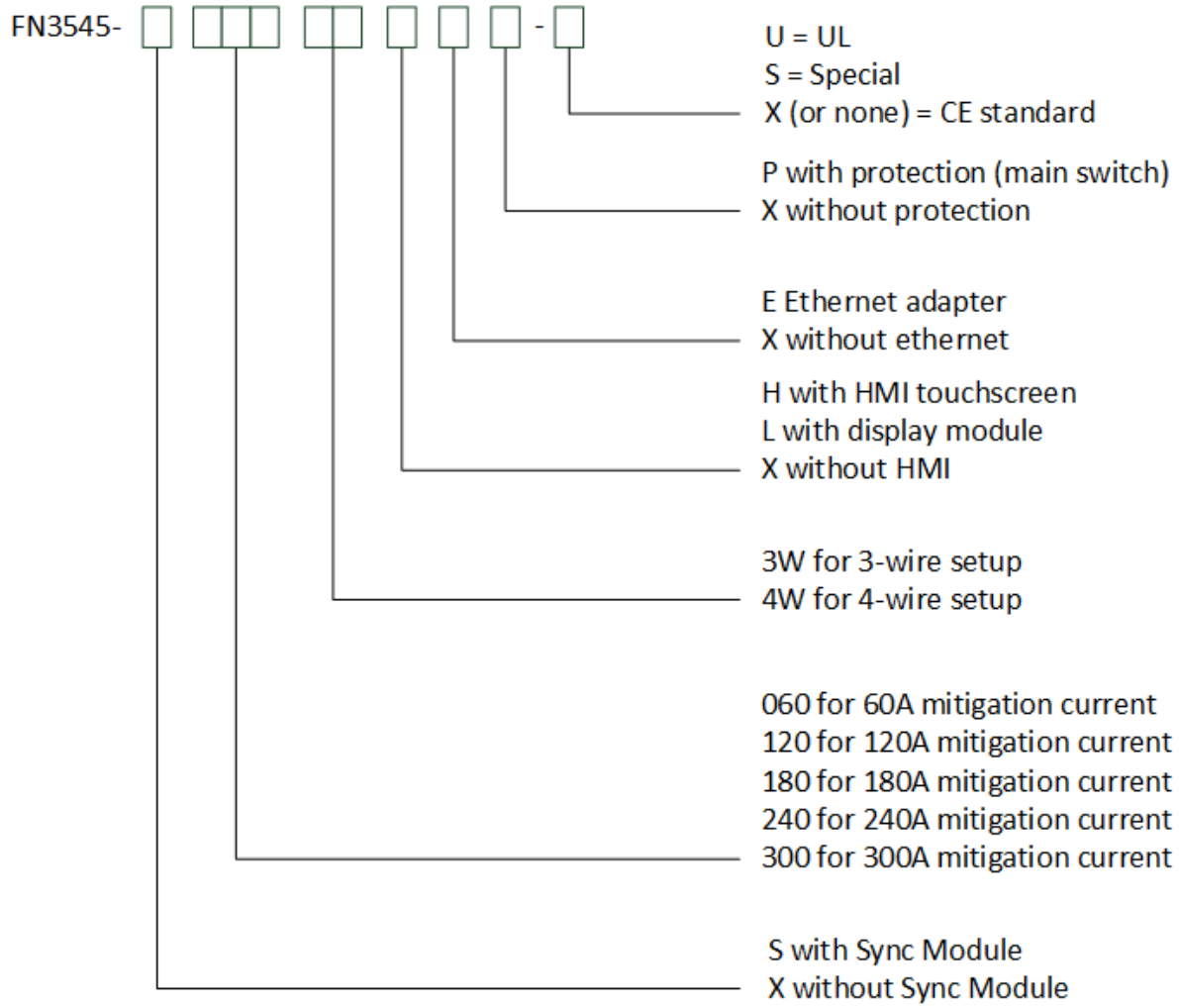


Figure 6-2 Type code description of Ecosine Active Sync cabinet version

Table 2 Ecosine Active Sync cabinet versions with Sync module

Material description	Voltage (VAC)	Sync Module	Mitigation Current	Set up	Power Module	User inter-face	Protec-tion	Certifica-tion
FN3545-S0603WHXP	200-480	Yes	60	3W	1x FN3530	HMI 7"	Yes	CE
FN3545-S0604WHXP	200-415	Yes	60	4W	1x FN3540	HMI 7"	Yes	CE
FN3545-S1203WHXP	200-480	Yes	120	3W	2x FN3530	HMI 7"	Yes	CE
FN3545-S1204WHXP	200-415	Yes	120	4W	2x FN3540	HMI 7"	Yes	CE
FN3545-S1803WHXP	200-480	Yes	180	3W	3x FN3530	HMI 7"	Yes	CE
FN3545-S1804WHXP	200-415	Yes	180	4W	3x FN3540	HMI 7"	Yes	CE
FN3545-S2403WHXP	200-480	Yes	240	3W	4x FN3530	HMI 7"	Yes	CE
FN3545-S2404WHXP	200-415	Yes	240	4W	4x FN3540	HMI 7"	Yes	CE
FN3545-S3003WHXP	200-480	Yes	300	3W	5x FN3530	HMI 7"	Yes	CE
FN3545-S3004WHXP	200-415	Yes	300	4W	5x FN3540	HMI 7"	Yes	CE
FN3545-S0603WLXP	200-480	Yes	60	3W	1x FN3530	Display	Yes	CE
FN3545-S0604WLXP	200-415	Yes	60	4W	1x FN3540	Display	Yes	CE
FN3545-S1203WLXP	200-480	Yes	120	3W	2x FN3530	Display	Yes	CE
FN3545-S1204WLXP	200-415	Yes	120	4W	2x FN3540	Display	Yes	CE
FN3545-S1803WLXP	200-480	Yes	180	3W	3x FN3530	Display	Yes	CE
FN3545-S1804WLXP	200-415	Yes	180	4W	3x FN3540	Display	Yes	CE
FN3545-S2403WLXP	200-480	Yes	240	3W	4x FN3530	Display	Yes	CE
FN3545-S2404WLXP	200-415	Yes	240	4W	4x FN3540	Display	Yes	CE
FN3545-S3003WLXP	200-480	Yes	300	3W	5x FN3530	Display	Yes	CE
FN3545-S3004WLXP	200-415	Yes	300	4W	5x FN3540	Display	Yes	CE
FN3545-S0603WXXP	200-480	Yes	60	3W	1x FN3530	None	Yes	CE
FN3545-S0604WXXP	200-415	Yes	60	4W	1x FN3540	None	Yes	CE
FN3545-S1203WXXP	200-480	Yes	120	3W	2x FN3530	None	Yes	CE
FN3545-S1204WXXP	200-415	Yes	120	4W	2x FN3540	None	Yes	CE
FN3545-S1803WXXP	200-480	Yes	180	3W	3x FN3530	None	Yes	CE
FN3545-S1804WXXP	200-415	Yes	180	4W	3x FN3540	None	Yes	CE
FN3545-S2403WXXP	200-480	Yes	240	3W	4x FN3530	None	Yes	CE
FN3545-S2404WXXP	200-415	Yes	240	4W	4x FN3540	None	Yes	CE
FN3545-S3003WXXP	200-480	Yes	300	3W	5x FN3530	None	Yes	CE
FN3545-S3004WXXP	200-415	Yes	300	4W	5x FN3540	None	Yes	CE
FN3545-S0603WHXP-U	380-480	Yes	60	3W	1x FN3530	HMI 7"	Yes	UL
FN3545-S0604WHXP-U	380-415	Yes	60	4W	1x FN3540	HMI 7"	Yes	UL
FN3545-S1203WHXP-U	380-480	Yes	120	3W	2x FN3530	HMI 7"	Yes	UL
FN3545-S1204WHXP-U	380-415	Yes	120	4W	2x FN3540	HMI 7"	Yes	UL
FN3545-S1803WHXP-U	380-480	Yes	180	3W	3x FN3530	HMI 7"	Yes	UL
FN3545-S1804WHXP-U	380-415	Yes	180	4W	3x FN3540	HMI 7"	Yes	UL
FN3545-S2403WHXP-U	380-480	Yes	240	3W	4x FN3530	HMI 7"	Yes	UL
FN3545-S2404WHXP-U	380-415	Yes	240	4W	4x FN3540	HMI 7"	Yes	UL
FN3545-S3003WHXP-U	380-480	Yes	300	3W	5x FN3530	HMI 7"	Yes	UL
FN3545-S3004WHXP-U	380-415	Yes	300	4W	5x FN3540	HMI 7"	Yes	UL
FN3545-S0603WLXP-U	380-480	Yes	60	3W	1x FN3530	Display	Yes	UL
FN3545-S0604WLXP-U	380-415	Yes	60	4W	1x FN3540	Display	Yes	UL
FN3545-S1203WLXP-U	380-480	Yes	120	3W	2x FN3530	Display	Yes	UL
FN3545-S1204WLXP-U	380-415	Yes	120	4W	2x FN3540	Display	Yes	UL
FN3545-S1803WLXP-U	380-480	Yes	180	3W	3x FN3530	Display	Yes	UL
FN3545-S1804WLXP-U	380-415	Yes	180	4W	3x FN3540	Display	Yes	UL
FN3545-S2403WLXP-U	380-480	Yes	240	3W	4x FN3530	Display	Yes	UL
FN3545-S2404WLXP-U	380-415	Yes	240	4W	4x FN3540	Display	Yes	UL
FN3545-S3003WLXP-U	380-480	Yes	300	3W	5x FN3530	Display	Yes	UL
FN3545-S3004WLXP-U	380-415	Yes	300	4W	5x FN3540	Display	Yes	UL

Table 3 Ecosine Active Sync cabinet versions without Sync module

Material description	Voltage (VAC)	Sync Module	Mitigation Current	Set up	Power Module	User inter-face	Protec-tion	Certifica-tion
FN3545-X0603WLXP	200-480	No	60	3W	1x FN3531	Display	Yes	CE
FN3545-X0604WLXP	200-415	No	60	4W	1x FN3541	Display	Yes	CE
FN3545-X1203WLXP	200-480	No	120	3W	2x FN3531	Display	Yes	CE
FN3545-X1204WLXP	200-415	No	120	4W	2x FN3541	Display	Yes	CE
FN3545-X0603WXXP	200-480	No	60	3W	1x FN3531	None	Yes	CE
FN3545-X0604WXXP	200-415	No	60	4W	1x FN3541	None	Yes	CE
FN3545-X1203WXXP	200-480	No	120	3W	2x FN3531	None	Yes	CE
FN3545-X1204WXXP	200-415	No	120	4W	2x FN3541	None	Yes	CE

Table 4 Ecosine Active Sync cabinet without module installed and cabinet accessories

Designation	Description
Cabinet 200-480V IP54 3W	IP54 Cabinet 600x600x2328 3-wire (w/o modules) 480V
Cabinet 200-415V IP54 4W	IP54 Cabinet 600x600x2328 4-wire (w/o modules) 415V
Plinth 100	Cabinet plinth 100mm
Plinth 200	Cabinet plinth 200mm

6.4 Technical specification Ecosine Active Sync power module versions

Number of phases (system input)	**3-phase 3-wire or 3-phase 4-wire**
Mains frequency	50/60Hz ± 3 Hz
Mains voltage	3-wire: 200VAC - 480VAC± 10% 4-wire: 200VAC - 415VAC± 10%
Inverter topology	3-level NPC topology, IGBT
Switching frequency	16 kHz
Response time	<100 µs
Harmonic mitigation performance	Up to the 50th harmonic
Total harmonic current distortion THDi	< 5%
Power factor correction	*cos φ* = -0.7 … 1 … 0.7 (inductive and capacitive compensation)
Dimensions of a single unit	440 mm × 420 mm × 222mm (w × d × h)
Rated phase mitigation current	60Arms
Rated neutral conductor mitigation current	180Apk
Overload capability (Amp for 10 ms)	150A
Current transformer placement	Mains side or load side
Current transformer ratio	50…50000:5A or 50…50000:1A
Mounting	Wall-mounting (book or flat mounting)
Weight of a single unit	44 kg
Cooling type	Air cooling
Communication interface	Ethernet TCP/IP, Modbus RTU RS485
Digital I/O	2 DIO + 2 DO
Ambient temperature	0 …50°C full performance, up to 55°C with derating of 3% per Kelvin[i]
Power Losses	<1100W under full mitigation performance (< 2.6%) <970W in typical operation (< 2.3%)
Protection class	IP 20 / IP 21
Noise level	< 56 to 63 dB A (depending on load situation)
Self-protection	Yes
Overheat protection	Yes
Overvoltage and undervoltage protection	Yes
Recommended fuse protection	100A, type gL or gG
Earthing system	TT, TN-C, TN-S, TN-C-S, IT, corner grounded delta
Altitude	<1000m without derating; Up to 4000m with derating 1% / 100m
Ambient conditions	Pollution degree 2 Relative humidity < 95% non-condensing, 3K3 Temperature: Storage 55°C, 1K3, 1K4, Transportation -25°C to 75°C, 2K3
Approval	CE, RoHS, cUL
Design standards	IEC 61000-4-2, 4-4, 4-5, 4-6 EN 61000-3-11, 3-12 EN 61000-6-2 EN 55011 EN 62477-1 EN 61800-3

[i] See chapter 6.6

6.5 Technical specification Ecosine Active Sync cabinet versions

Number of phases (system input)	**3-phase 3-wire or 3-phase 4-wire**					
Mains frequency	50/60Hz ± 3 Hz					
Mains voltage	3-wire: 200VAC - 480VAC -5%/+10%					
	4-wire: 200VAC - 415VAC -5%/+10%					
Inverter topology	3-level NPC topology, IGBT					
Switching frequency	16 kHz					
Response time	<100 µs					
Harmonic mitigation performance	Up to the 50th harmonic					
Total harmonic current distortion THDi	< 5%					
Power factor correction	cosφ = -0.7 … 1 … 0.7					
	(inductive and capacitive compensation)					
Dimensions cabinet	600 mm × 600 mm × 2328mm (w × d × h)					
Number of Modules	0 [i]	1	2	3	4	5
Rated phase mitigation current	0 A	60A	120A	180A	240A	300A
Rated neutral conductor mitigation current	0 A	180A	360A	540A	720A	900A
Overload capability (for 10 ms)	0 A	150A	300A	450A	600A	750A
Weight	180kg	224kg	268kg	312kg	356kg	400kg
Power Losses full mitigation performance	200W	< 1300W	<2400W	<3500W	<4600W	<5700W
Power Losses typical operation	200W	< 1170W	<2100W	<3100W	<4000W	<5000W
Current transformer placement	Mains side or load side					
Current transformer ratio	50…50000:5A or 50…50000:1A					
Mounting	Floor mounting					
Cooling type	Air cooling					
Communication interface	Ethernet TCP/IP, Modbus RTU RS485					
Digital I/O	2 DIO + 2 DO					
Ambient temperature	0 …40°C full performance, up to 50°C with derating of 3% per Kelvin[ii]					
Protection class	IP 54					
Noise level	< 75 dB A (depending on load situation)					
Self-protection	Yes					
Overheat protection	Yes					
Overvoltage and undervoltage protection	Yes					
Earthing system	TT, TN-C, TN-S, TN-C-S, IT, corner grounded delta					
Altitude	<1000m without derating; Up to 4000m with derating 1% / 100m					
Ambient conditions	Pollution degree 2					
	Relative humidity < 95% non-condensing, 3K3					
	Temperature: Storage 55°C, 1K3, 1K4, Transportation -25°C to 75°C, 2K3					
Approval	CE, RoHS, cUL[iii]					
Design standards	IEC 61000-4-2, 4-4, 4-5, 4-6					
	EN 61000-3-11, 3-12					
	EN 61000-6-2					
	EN 55011					
	EN 62477-1					
	EN 61800-3					

[i] Parameters of cabinet only configuration
[ii] See chapter 6.8
[iii] UL cabinet version available on request

6.6 Maximum output current by harmonics order

The following curve gives an indicative maximum available compensation current according to the harmonic order. This is an indicative curve based on 50Hz system measurement, the actual limit can be lower, depending on the application.

Note: the total RMS current cannot exceed the device limit.

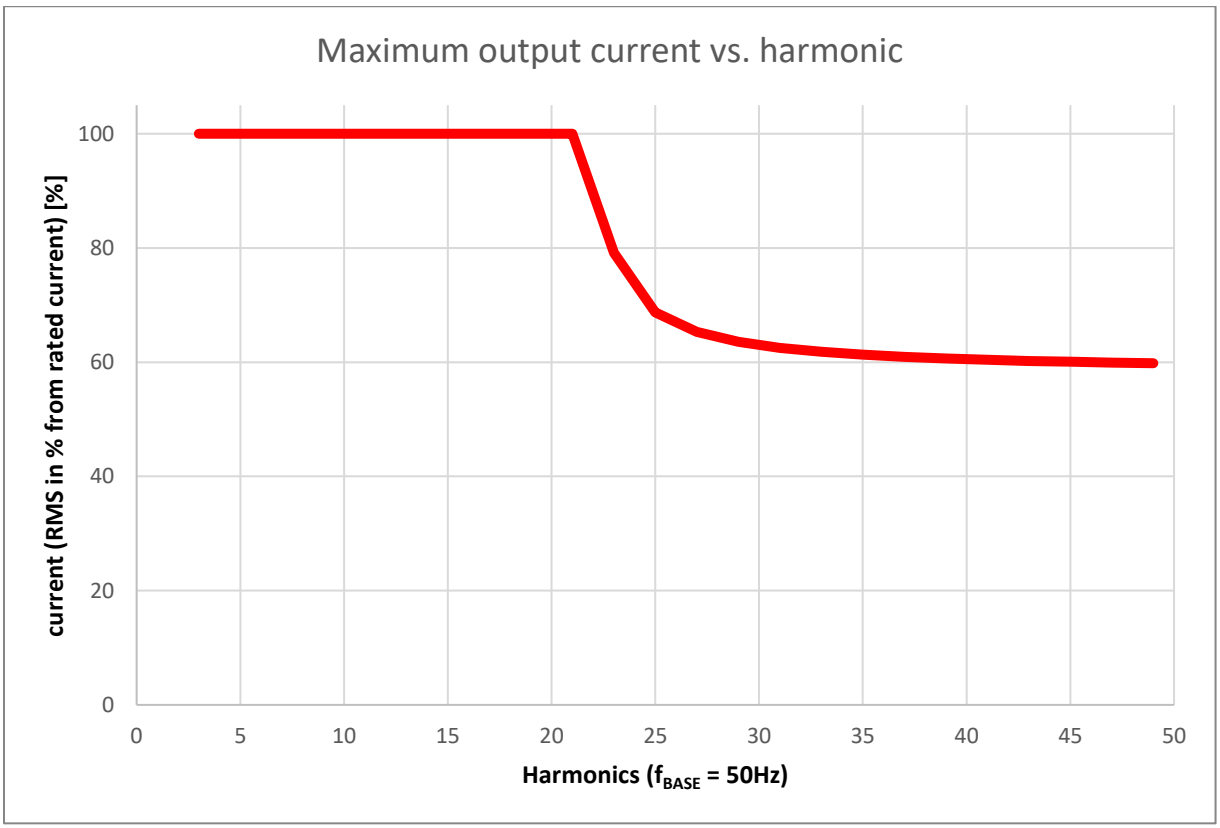


Figure 6-3 Curve of maximum output current vs. harmonics

6.7 Temperature derating of Ecosine Active Sync power module

The rated current of Ecosine Active Sync power module is 60A when the ambient temperature is between 0°C and 50°C. Derated operation is necessary if the ambient temperature is above 50°C, the rated current reduced 3% per kelvin, and the maximum ambient temperature for derated operation is 55°C. The derating curve of Ecosine Active Sync power module is shown below in Figure 6-4.

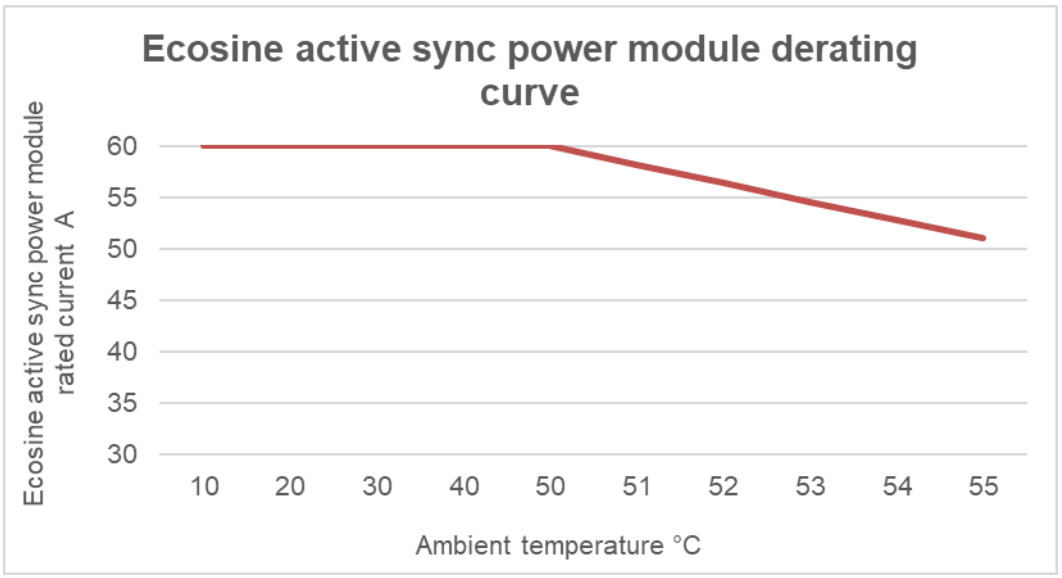


Figure 6-4 Temperature derating curve of Ecosine Active Sync power module

6.8 Temperature derating of Ecosine Active Sync cabinet version

The rated current of Ecosine Active Sync cabinet version is n*60A (with n = number of installed power modules in operation) when the ambient temperature is between 0°C and 40°C. Derated operation is necessary if the ambient temperature is above 40°C, the rated current reduced 3% per kelvin, and the maximum ambient temperature for derated operation is 50°C. The derating curve of Ecosine Active Sync power module is shown below in Figure 6-5.

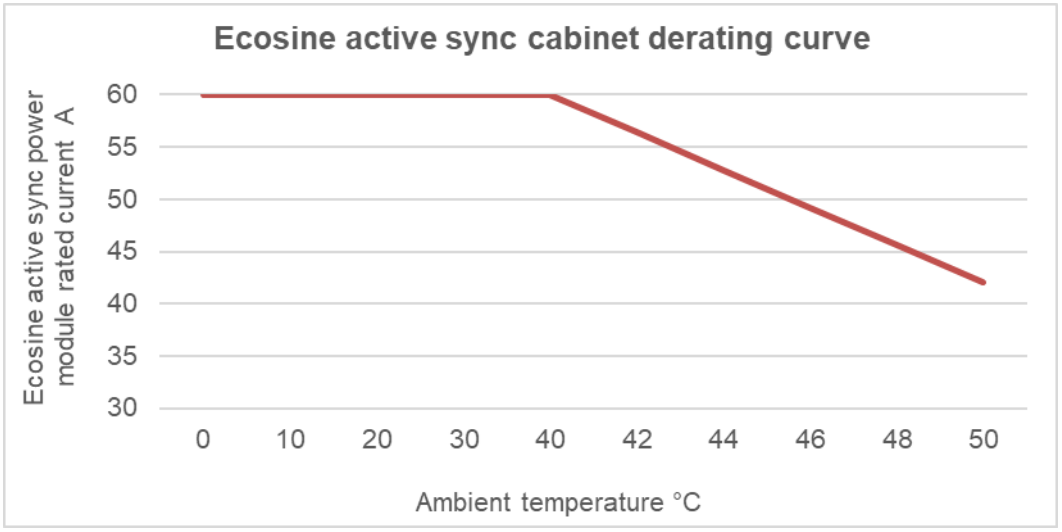


Figure 6-5 Temperature derating curve of Ecosine Active Sync cabinet versions referred to the rating of one module

6.9 Sync Module SYNC300A

The Sync Module SYNC300A is a master communication module with following features and advantages:

- Intelligent load and energy management
- Redundancy management
- Flexible installation with current transformers on mains or load side; one simple CT connection point for all modules
- Recommended for more than two power modules in parallel operation
- Simple and modular installation (wall-mount or rack-mount)
- Available as part of the Ecosine Active Sync cabinet FN 3545 or as an option for later upgrade in wall-mounting or custom cabinet configurations
- Easy filter scalability and extension of mitigation current beyond 300 A.
- one sync module can connect and coordinate up to 5 power modules (5x60A) in parallel; interconnection of up to 4 sync modules for a total compensation current up to 1200 A.

6.9.1 Technical specification for Sync module SYNC300A

Input voltage	**22,0 … 27,0 VDC**
Nominal current	< 1 A
Dimensions	440 mm × 200 mm × 87 mm (w × d × h)
Weight	3.0 kg
Protection class	IP20 (option IP21)
Digital I/O	3 DI, 2 DO, 4 DI/O (programmable) 2 relays NO/NC - 2 relays NO with common COM (250/3A) 24VDC GND
Ambient conditions	Pollution degree 2 Relative humidity < 95% non-condensing, 3K3 Temperature: Storage 55°C, 1K3, 1K4, Transportation -25°C to 75°C, 2K3
Approval	CE, RoHS

The sync module does not contain live parts and has no risk of shock and fire. Due to the low-voltage level of nominal 24 Volts and design as load (in point of limited current consumption), the sync module does not require UL approval.

It is applicable for use in industrial control equipment (i.e., for listed components of category NMTR or NITW).

6.9.2 Mechanical dimensions of SYNC300A

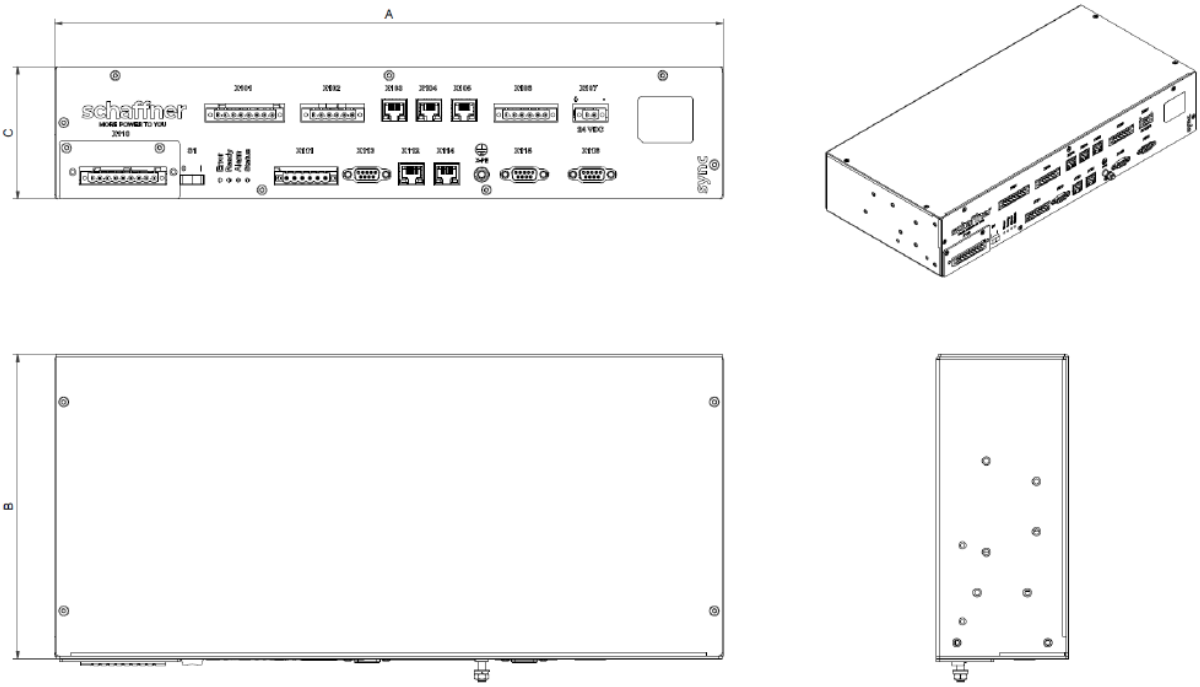


Table 5 Sync module dimensions

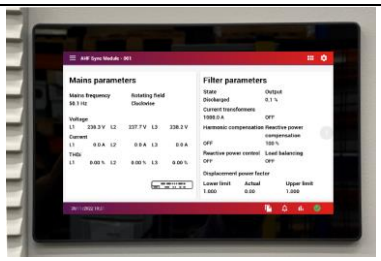
	[mm]	[in]
A	440	17.32
B	200	7.88
C	87	3.43

6.10 Sync Module SYNC300X

The Sync Module SYNC300X is the same device as SYNC300A but without the CT module board. It's dedicated to additional Ecosine Active Sync cabinet and means to be set in slave mode. It doesn't require to be connected to a set of CT as it will get the information about currents from the sync module SYNC300A set as master in the system.

6.11 Ecosine Active Sync HMI

Ecosine Active Sync harmonic filters can be commissioned via the HMI touch screen. It furthermore can be used to change and monitor all filter parameters and measured values of the three-phase network, plot measurement in an oscilloscope style view and save/restore parameter sets of the complete system.

Function	HMI	Mounting types
The HMI is used to monitor the measured values of the three-phase network and to change the filter parameters. More details can be found in chapter 8.11.		

6.12 Ecosine Active Sync display module

Ecosine Active Sync harmonic filters can be commissioned via the display module. It furthermore can be used to change and monitor all filter parameters and measured values of the three-phase network. One display module fits all power modules and can be used in any of the system setups, whether it is single power module, Double Power Pack or cabinet version.

Function	Display module and keypad	Mounting types
The display module is used to monitor the measured values of the three-phase network and to change the filter parameters. More details can be found in chapter 8.11.		  

For DPP configuration, one display module is used and mounted on the master power module as shown in section 6.2.3.

For cabinet version, the display module is mounted on the front door of the cabinet as shown on the cover picture.

6.12.1 RS485 communication

The display module is connected to the AHF through an RS485 bus and the communication protocol used is Modbus. In addition, the display module acts like a master and the AHF acts like a slave.

The display module can address only one slave device connected on an RS485 multi-slave bus and the target slave device is defined by the Modbus address.

During the normal working conditions, the display module polls almost continuously the AHF slave device to get the required information. In case the communication is missing, an exclamation mark is shown on the top-right corner of the window in order to make the user aware of the situation.

6.12.2 AHF parameters and INI file

The display module can access all parameters of the AHF and, for the purpose of supporting them dynamically, the display module is also able to manage the INI file. Exactly like for AHF-viewer, the INI file is the format used to get all the data regarding parameters and folder structure from the AHF.

Since the downloading and parsing of the INI file is a time-consuming operation, the display module saves it on the serial flash memory in order to avoid this operation at every start up.

At the beginning, the display module compares the software version of the current AHF with the software version of the saved INI file. In case of match, the display module loads the INI file from the serial flash memory and, after a couple of seconds, is already able to launch the application. In case of mismatch, the display module must download the INI file from the AHF, do the parsing and overwrite the old one in the serial flash memory.

This process could take more than one minute and depends strictly on the baudrate of the RS485 communication and on the number of parameters.

6.12.3 Event log and LOG file

With the display module it is possible to see the latest record of the event log, just like AHF-viewer does. The number of visible events is not fixed, it depends on how long the description strings associated to every event are, but it can be considered between 250 to 350 events.

6.12.4 Load and save AHF parameter set

The display module is able to save up to 10 different parameters sets on the serial flash memory. Every set is made up by all the “read/write” parameters of the AHF, the “read only” parameters are not taken into consideration. In addition, the display module is also able to load a complete parameter set to the AHF.

In order to guarantee the compatibility between parameter sets and AHF devices, the software version of the AHF and the software version the parameter set to be loaded must be the same.

7 Mechanical Installation Guidelines

7.1 Pre-Installation Guidelines

7.1.1 Receiving ecosine active sync

Every single Ecosine Active Sync power module is packed in a wooden box, additionally there are two sets of handlebars (wall-mount and rack-mount), a screw-set as well as the User and Installation manual.

The pre-attached handlebars are necessary for lifting the Ecosine Active Sync base modules from the pallet using a crane or other appropriate lifting equipment. The handlebars might be removed from the power modules after lifting depending on the way of installation of the modules.

Every Ecosine Active Sync cabinet version is packed in a wooden box.

Please carefully inspect the shipping container and the product prior to the installation. In case of visual damage, don't install the filter and file a claim with the freight carrier involved.

7.1.2 Transportation and unpacking of power modules

Please note that transportation of Ecosine Active Sync power modules must always be realized with the original packaging. Any other than that might lead to damage and will void warranty.

After receiving Ecosine Active Sync power modules please follow carefully the unpacking instructions. Please refer to the document "Unpacking Instruction Ecosine Active Sync filters (module or cabinet)", which is attached to the transportation package.

7.1.3 Lifting

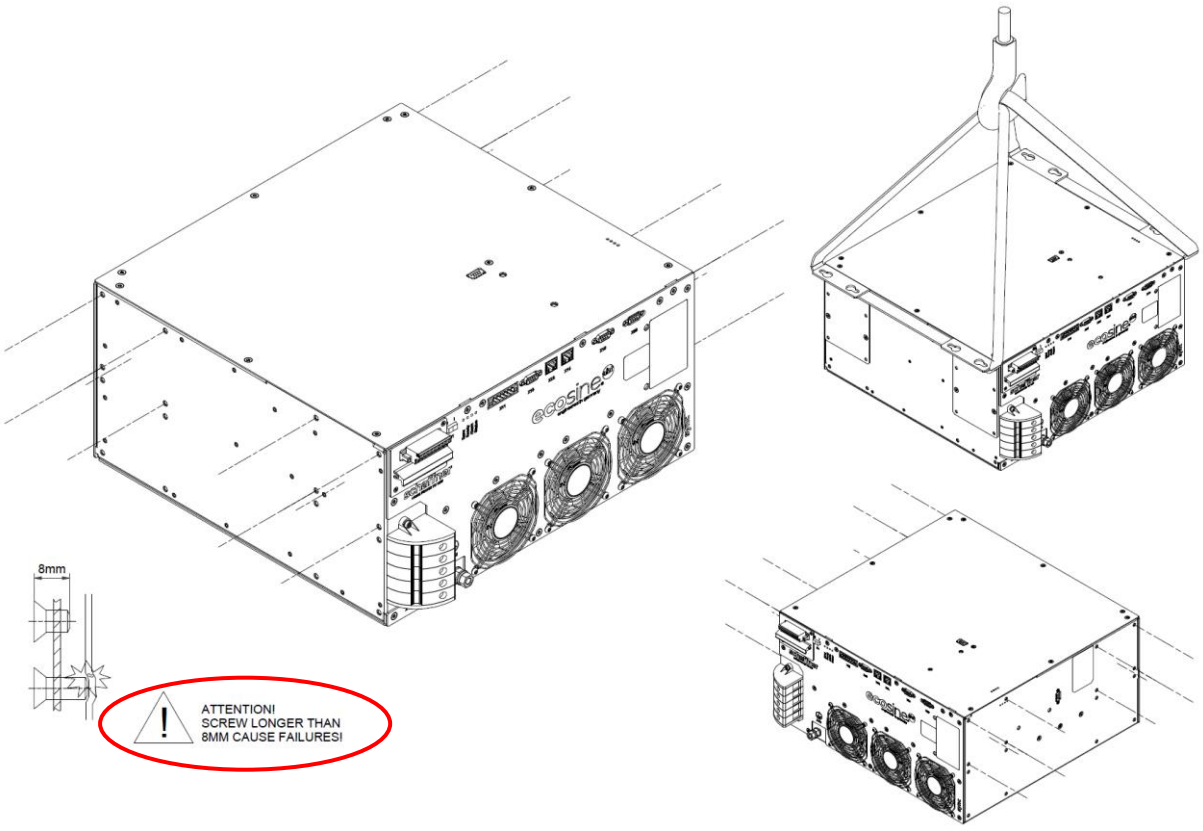


Figure 7-1 Instruction for lifting power module

7.1.4 Important note for installation

All other installation positions than the ones described in the following chapters of this manual are prohibited and might result in improper air-cooling capabilities or unsafe operation.

Additionally, in the case of wall mounted modules, the customer or installer is fully responsible to ensure proper mounting on a suitable wall using appropriate and compatible fixation material.

Schaffner is not responsible for any damage to the Ecosine Active Sync device or any other device due to improper usage. Failing to respect the requirement will void the guarantee.

7.2 Mechanical installation of Ecosine Active Sync power module

7.2.1 Dimensions of an Ecosine Active Sync power module

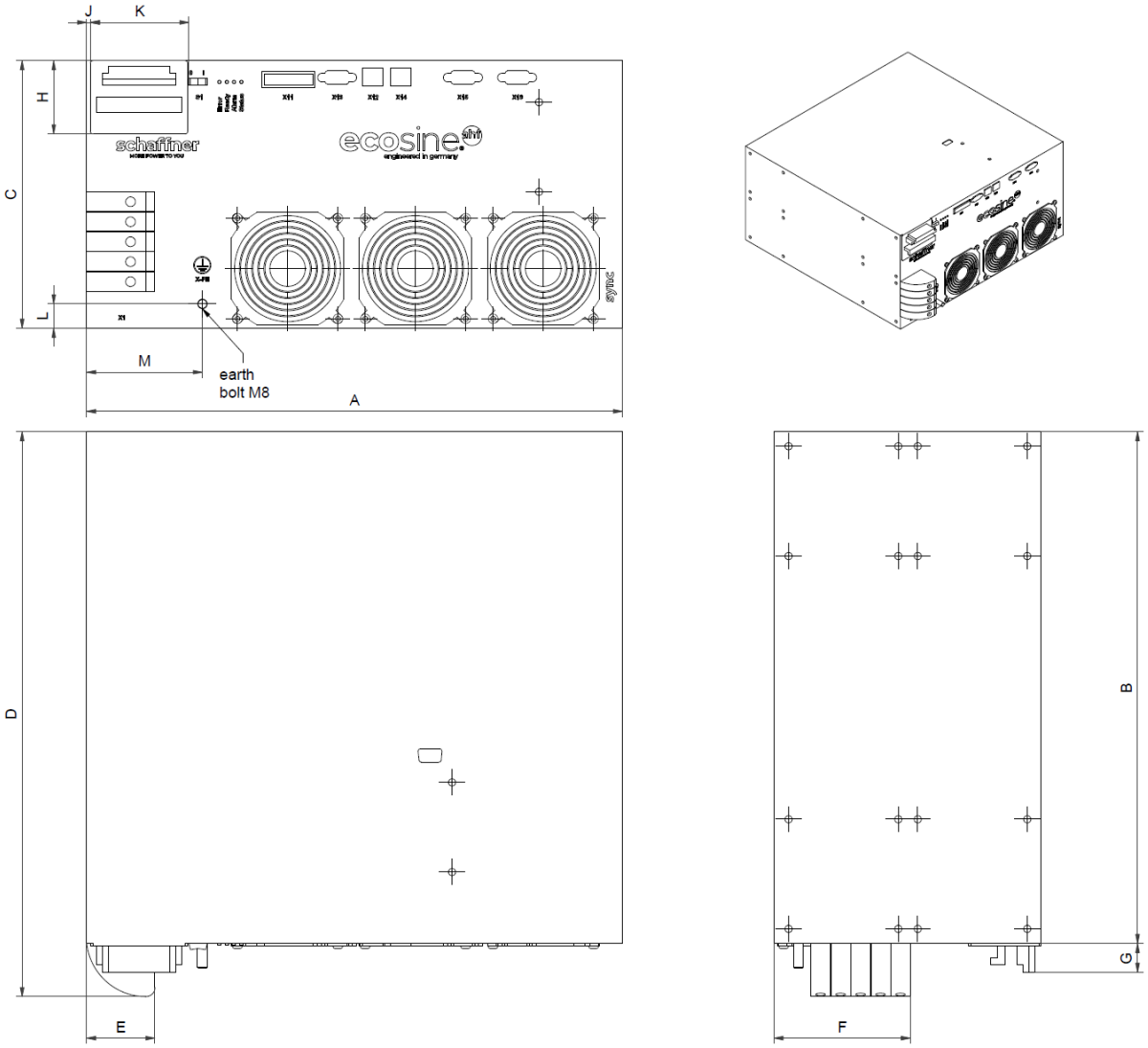


Figure 7-2 mechanical drawing of Ecosine Active Sync power module (see dimensions in Table 6 and Table 7 below)

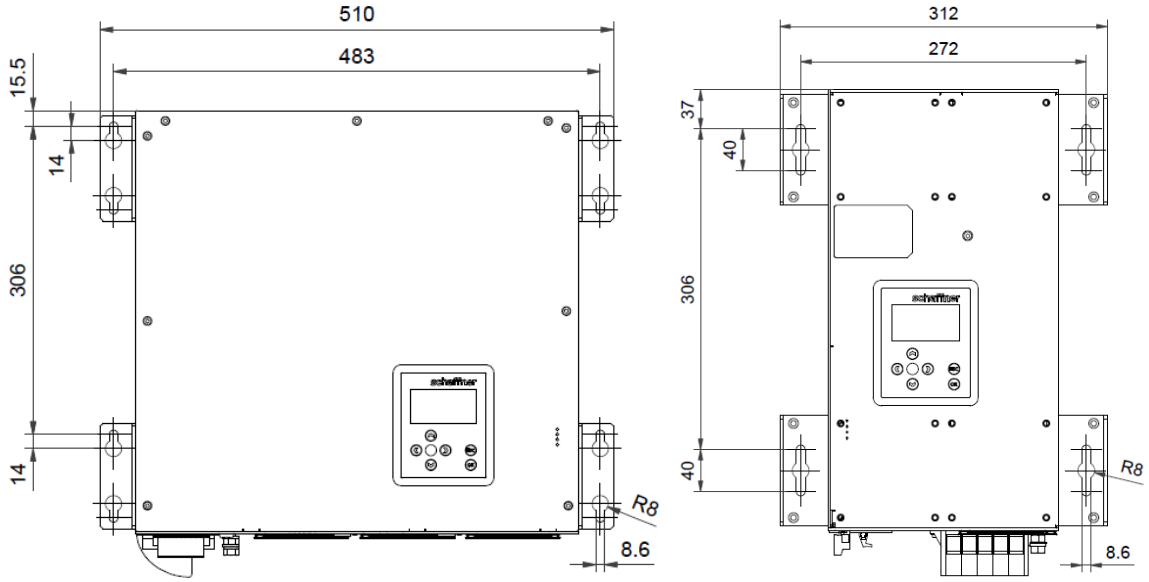


Figure 7-3 Dimensions [mm] drill-pattern for wall-mount (book and flat mounting)

Dimensions of Ecosine Active Sync power module and minimum required clearance are shown in the following tables.

Table 6 Ecosine Active Sync power module dimensions

	[mm]	[in]
A	440	17.32
B	420	16.54
C	219.5[i]	8.64
D	463.5	18.25
E	56	2.20
F	112	4.41
G	23.5	0.93
H	60	2.36
J	3	0.12
K	80	3.15
L	20	0.79
M	95	3.74

Table 7 Ecosine Active Sync power module (internal dimensions)

	[mm]	[in]
a	90	3.54
b	12	0.47
c	11.5	0.45
d	20	0.79
e	95	3.74
f	105	4.13
g	65	2.56
h	82.5	3.25
j	49	1.93

Table 8 Ecosine Active Sync power module clearance distances

Side	Minimum required clearance [mm]	[in]
Front (air inlet)	200	7.85
Back (air outlet)	200	7.85
Lateral	50	1.97

[i] Module height: ~ 5 rack units

7.2.2 Ecosine Active Sync power module mounting options

Ecosine Active Sync power module is designed for wall-mounting installation. Two possible wall-mounting positions exist, flat mounting and book mounting. The mounting brackets are mounted on the power module differently for flat mounting or book mounting, the details are presented in the following.

7.2.2.1 Flat mounting

For flat mounting, please mount the four mounting brackets as shown in Figure 7-4.

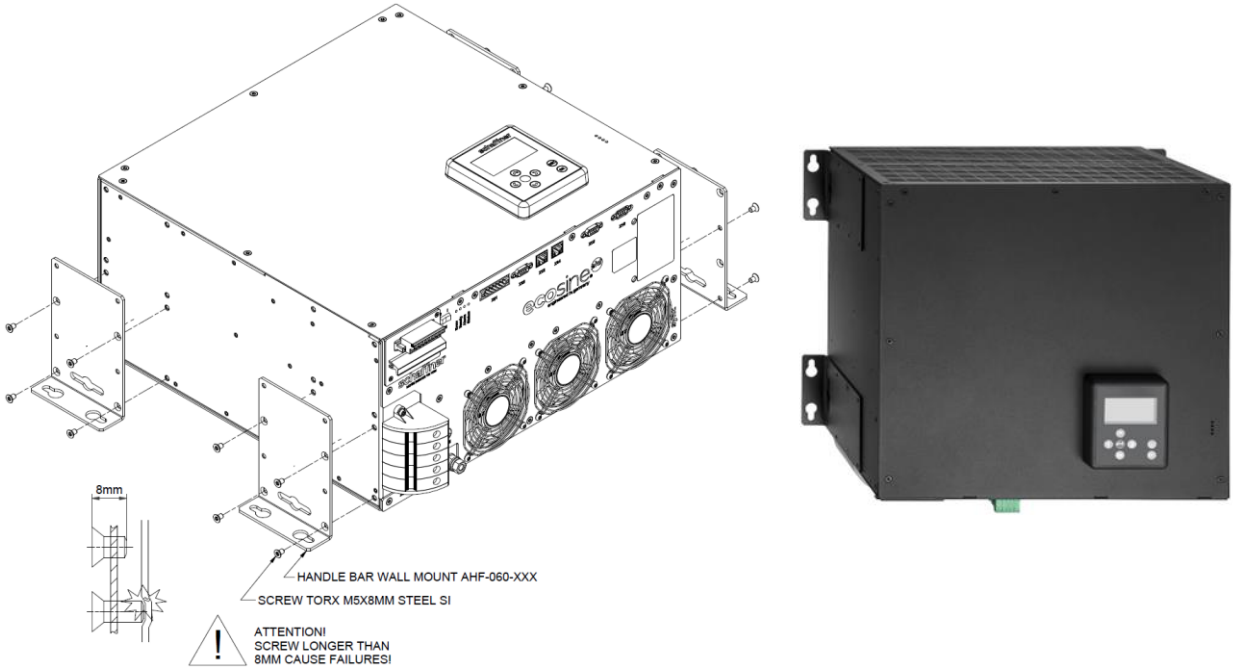


Figure 7-4 Instruction of power module flat mounting

7.2.2.2 Book mounting

For book mounting please mount the four mounting brackets as shown in Figure 7-5

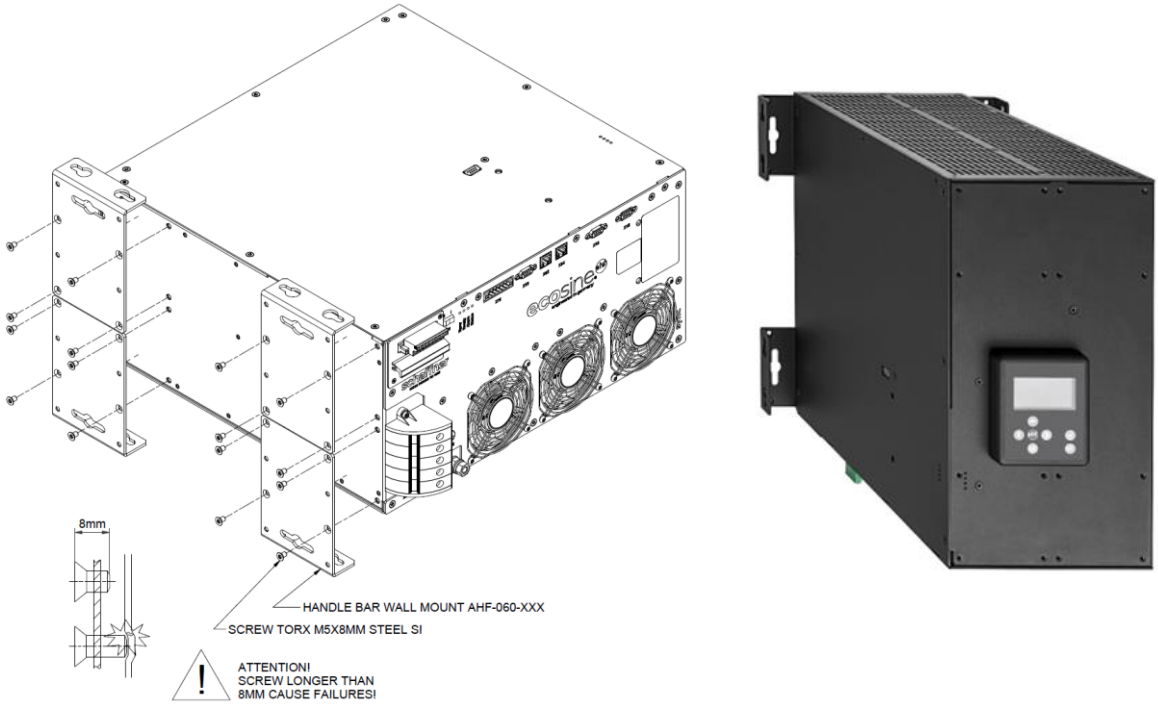
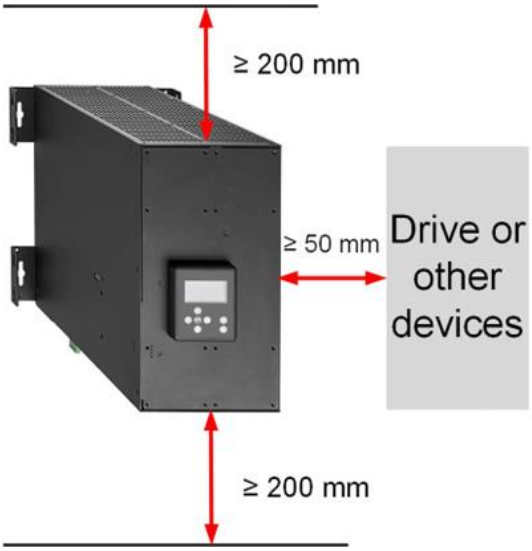


Figure 7-5 Instruction of power module book mounting

Important

In order to ensure sufficient air flow, make sure a clearance of minimum 200mm, above and below the filter to walls or other components, is available.



7.3 Mechanical installation of Ecosine Active Sync DPP

7.3.1 Dimensions of Ecosine Active Sync DPP

A double power pack DPP filter is composed of two single Ecosine Active Sync power modules. The dimensions as in 7.2.1 apply.

7.3.2 Mounting options of Ecosine Active Sync DPP

For Double Power Pack mounting, please install the modules next to each other horizontally, and keep the clearance distance above and below the power module as mentioned above. This principle also applies when more than two power modules are installed on the wall.

(a) Book mounting (b) Flat mounting

Figure 7-6 Double Power Pack installation variants

It is not recommended to install power modules vertically close to each other, as shown in Figure 7-7; because the warm exhaust air of the lower module heats up the upper module and therefore the air cooling for the upper module may not be sufficient.

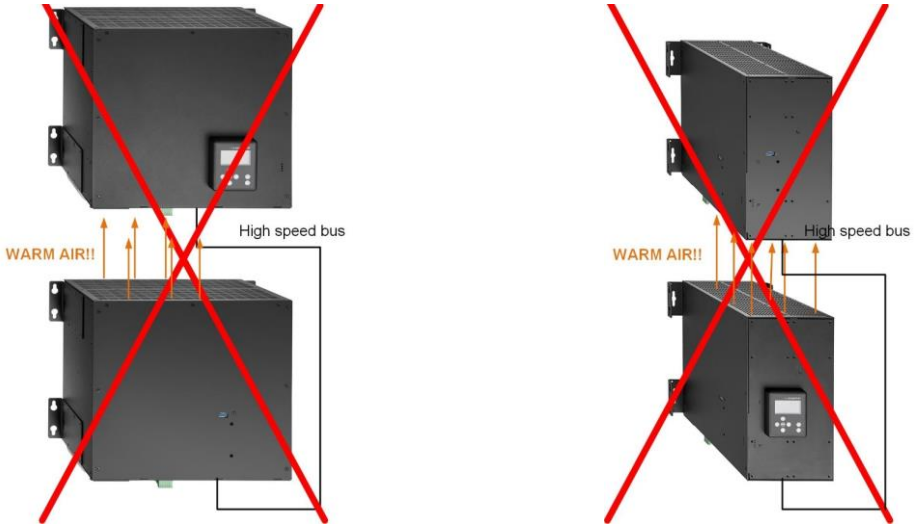


Figure 7-7 Wrong ways to install DPP

7.4 Mechanical installation inside customer cabinet

7.4.1 Customer cabinet requirements

Ecosine Active Sync power module up to five modules in total can also be installed in a cabinet provided by a third party. To ensure the normal operation of Ecosine Active Sync modules the cabinet must fulfill the cooling requirements mentioned below in chapters 7.4.2 and 7.5.2; the power modules must be connected according to the power module electrical installation as described later in chapter 8.

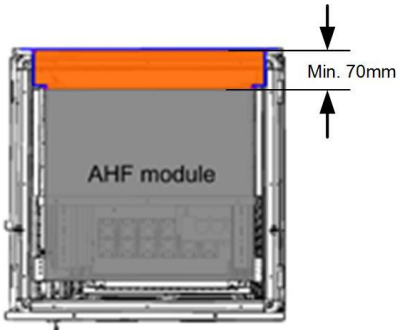
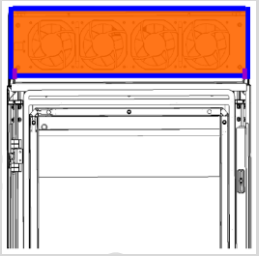
Table 9 Technical data for one Ecosine Active Sync power module

Parameter	Value	Comments
Recommended fuse protection	100A	e.g. gL or gG
Cross-section of power cables (cable from distribution to power module)	▪ 3 Phase and PE: 1 x 25mm2 ▪ Neutral: 2 x 25 mm2	
System input (number of phases)	50/60Hz ± 3Hz 3-wire or 4-wire	
Input voltage	▪ For 3-wire module: 200VAC … 480VAC ± 10% ▪ For 4-wire module: 200VAC … 415VAC ± 10%	
Rated current	Phase: 60 A Neutral: 180A	
CT cable cross section	2.5 mm^2	If input is 1A signal, the cross section can be reduced to 1.5 mm^2.

7.4.2 Cooling requirements of customer cabinet

If recommended components are used, it is important to seal the air channel as good as possible. The following points should be double checked to ensure the normal operation conditions for Ecosine Active Sync modules.

1. The minimum required cross-section and length for air channel must be fulfilled.
2. Air channels between modules and air outlet must be sealed (metal sheets must be overlapped; foam or gaskets should be used).
3. There is no air flow shortage. Attention should be paid to the holes on the cabinet frame.

Parameter	Value	Comments
Power losses per module	Typical 1200 W Max. 1450 W	At maximum load current of 60 Arms
Air flow per module	270 m^3/h	Depending on the position and pressure it can deviate
Max. air flow per cabinet	Max. 1400 m^3/h	Including the cooling for fuse section
Area – air inlet per module	Min. 450 cm^2	Placement in front of fans on each power module
Max. length of air guide channel behind power module	Max. 1200 mm	
Min. space in air guide channel behind modules	Min. 70 mm	Top view of a cabinet. 
Area – air guide channel in the roof	Min. 900 cm^2	Front view of a cabinet 
Max. length of air guide channel in the roof	Max. 800 mm	
Distance air inlet filter to the front of power module	Min. 45 mm	Placement in front of fans on each power module (not interfered by cable connections)

Note: the above conditions are valid only when the channel is completely sealed. A small opening can cause shortages in air flow. In consequence, the module temperature increase is unbalanced among modules and the module operation can change to derating mode.

7.5 Mechanical data of Ecosine Active Sync cabinet version

7.5.1 Dimensions of Ecosine Active Sync cabinet version

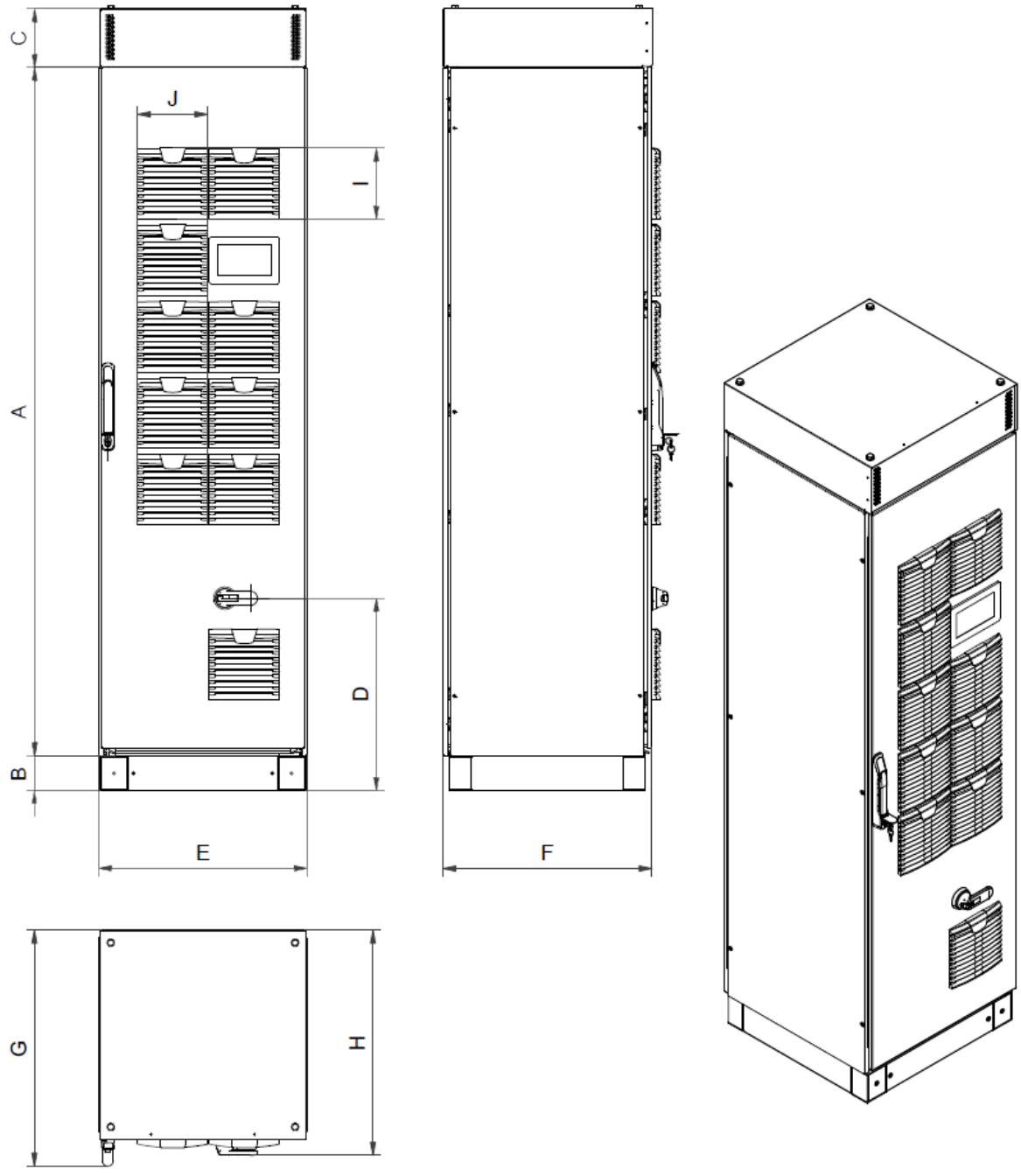


Figure 7-8 mechanical drawing of Ecosine Active Sync cabinet (see Table 10 below)

The Ecosine Active Sync cabinet has protection degree IP54. The default color of the cabinet is RAL 7035. The cabinet dimensions are as shown in Table 10.

Table 10 Ecosine Active Sync cabinet dimensions

	[mm]	[in]
A	2057	81
B	100	3.94
C	171.2	6.74
D	458.3	18.04
E	606.7	23.9
F	608	23.9
G	642.5	25.3
H	653.7	25.7
I	204	8.03
J	205	8.07

Table 11 Ecosine Active Sync cabinet clearance distance

Side	Minimum required clearance [mm]	[in]
Front (air inlet)	900 mm (to open the door)	35.43
Back	-	-
Lateral	-	-

There are no clearance requirements for back and lateral installation of Ecosine Active Sync cabinet version.

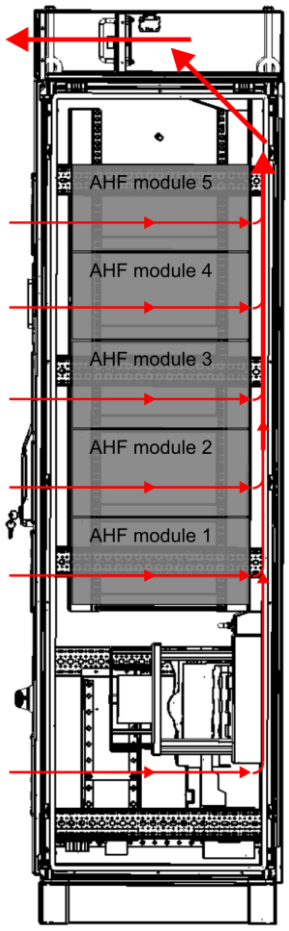
7.5.2 Cooling requirements of Ecosine Active Sync cabinet versions

The cooling air inlet is in the front door and outlet is in the top front of the cabinet cover.

Table 12 Air cooling requirement for Ecosine Active Sync cabinet version

Parameter	Values
Protection category	IP54
Default color	RAL 7035
Required air flow per module	270 m^3/h
Maximum air flow per cabinet	1400 m^3/h
Air flow through fuse section	100 m^3/h
Area - air inlet per module	Min. 450 cm^2
Area - air duct channel behind power modules	Min. 370 cm^2
Max. length of air duct channel behind power modules	Max. 1200 mm
Min. space in air duct channel behind modules	Min. 70mm
Area - air duct channel in the roof	Min. 900cm^2
Max. length of air duct channel in the roof	Max. 800mm
Distance between air inlet filter and front of power module	Min. 45mm

Side view into cabinet with direction of air flow



8 Electrical Installation Guidelines

8.1 Protection (Fuses, Breakers)

Ecosine Active Sync filters must always be protected on the mains side of the filter with suitable fuses or circuit breakers. Depending on the operation mode, alternation of the load and the harmonic spectrum of Ecosine Active Sync output current, fuses will be stressed differently. Recommended fuse protection type can be found in the technical specification in section 6.4.
Each power module must have its own fuse protection of 100A e.g. type gL or gG.

8.2 Installation with power factor correction (PFC) systems

In the case of installation of the Ecosine Active Sync in combination with a PFC system, the following requirement are mandatory.

- The use of pure capacitive PFC system is not allowed, a reactor must be installed
- The PFC system must be de-tuned to avoid overloading the capacitors

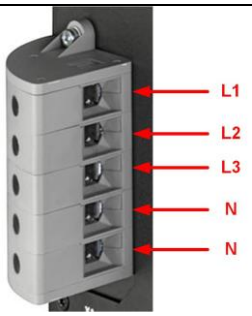
Table 13: Example of typical detuning order for 50Hz and 60Hz networks

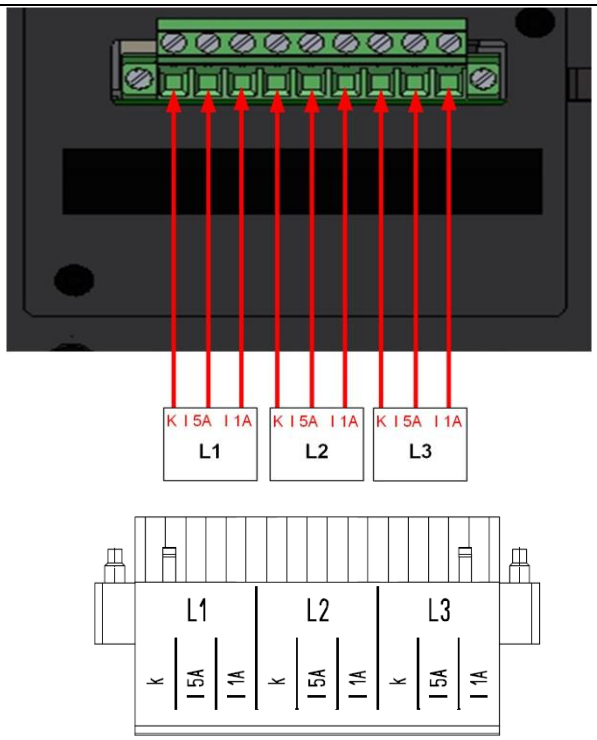
Tuning order	Relative impedance [%]	Tuning frequency [Hz] @50Hz	Tuning frequency [Hz] @60Hz
2.7	14	135	162
3.8	7	190	228

8.3 Power Module electrical installation

8.3.1 Connecting terminal locations

- X1: Mains power input
- X2: Current transformer input
- S1: Switch on/off
- LEDs: Indication LEDs
- X11: Customer IOs: Digital Inputs and outputs
- X12: HS-Bus Port
- X13: Service port RS485
- X14: Ethernet / Modbus TCP
- X15: Modbus Daisy Chain RS485
- X16: HMI/Display Module Port
- X-PE: Protective Earth Connection

Terminal X1 - Mains Power Input The three-phase conductor and neutral line connection. Details of connecting Ecosine Active Sync to the mains see section 8.5.2.	

Terminal X2 – Current transformer input (CT Module)	

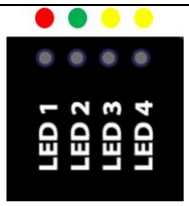
Switch S1 – Switch on/off To switch on or switch off Ecosine Active Sync module, when the parameter P202 is set to “Switch S1”. Left is OFF (0), right is ON (1).	
LEDs – Indication LEDs To show the status of Ecosine Active Sync module, the color of each LED is relevant. The indications of the LEDs are listed in Table 14.	

Table 14 Indication of LED

Color	LED# / name	Meaning
●	LED1 Error	Blinking = Error ON = Fatal Error / Restart blocked
●	LED2 Ready/Operation	Blinking = ready to operate ON= operating
●	LED3 Alarm/Warning	ON= warning (HSB link not o.k.)
●	LED4 Status/Notice	Blinking 0.5sec = overload condition Blinking 1sec = Standby

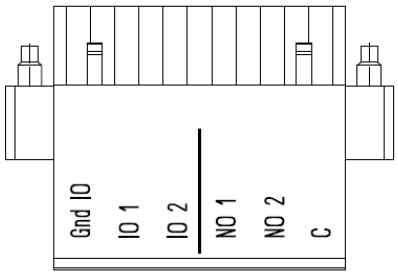
Terminal X11 (PM) and X111 (SM) - Customer IOs: Digital Inputs and Outputs	

Table 15 Terminal X11 (PM) and X111(SM) - customer Digital IOs (see chapter 10.1.2 for more detail)

Pin-No.	Signal	Description
1	GND (potential-free)	Ground 0V (Reference for digital outputs)
2	IN1 / OUT4	Digital input/output (24 V, 20 mA) ▪ Set P262 as “Input” for using X11.2 as digital input or “Output” for using X11.2 as digital output. ▪ Set P261 to select the polarity of the Input/Output X11.2, “low active” or “high active”. ▪ Select the function of X11.2 from the list of functions in P260
3	IN2 / OUT3	Digital input/output (24 V, 20 mA) ▪ Set P265 as “Input” for using X11.3 as digital input or “Output” for using X11.3 as digital output. ▪ ▪ Set P264 to select the polarity of the Input/Output X11.3, “low active” or “high active”. ▪ ▪ Select the function of X11.3 from the list of functions in P263
4	OUT1	Relay output (250 V, 3 A) ▪ Select the function of X11.4 relay output from the list in P266 ▪ Set P267 to select the polarity of the relay X11.4, “normal open” or “normal closed”.
5	OUT2	Relay output (250 V, 3 A) ▪ Select the function of X11.5 relay output from the list in P268 ▪ Set P269 to select the polarity of the relay X11.5, “normal open” or “normal closed”.
6	COM	Relay input (common) for both relay outputs

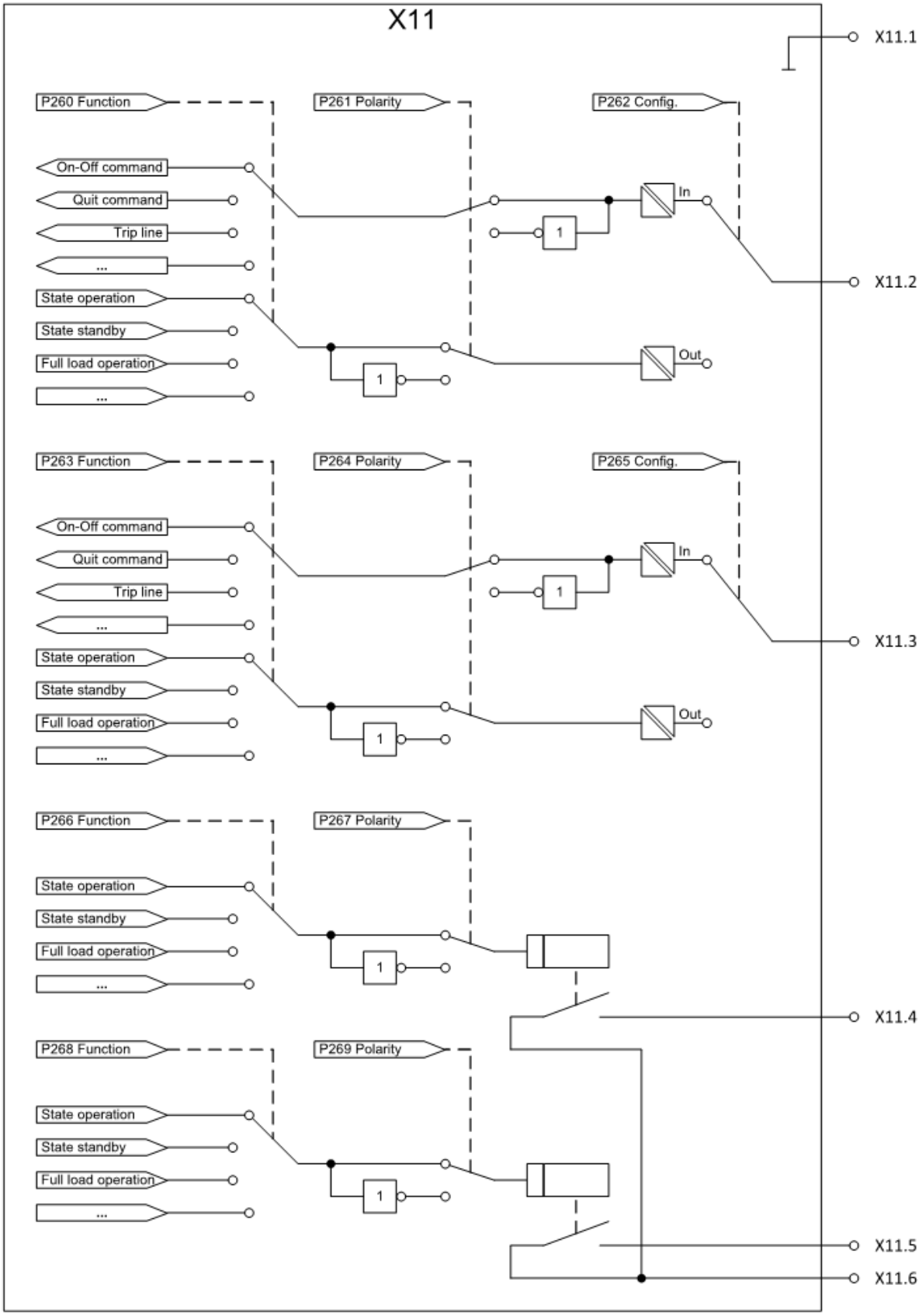


Figure 8-1: Logic schematic of the digital input/output terminal X11 (PM) and X111 (SM)

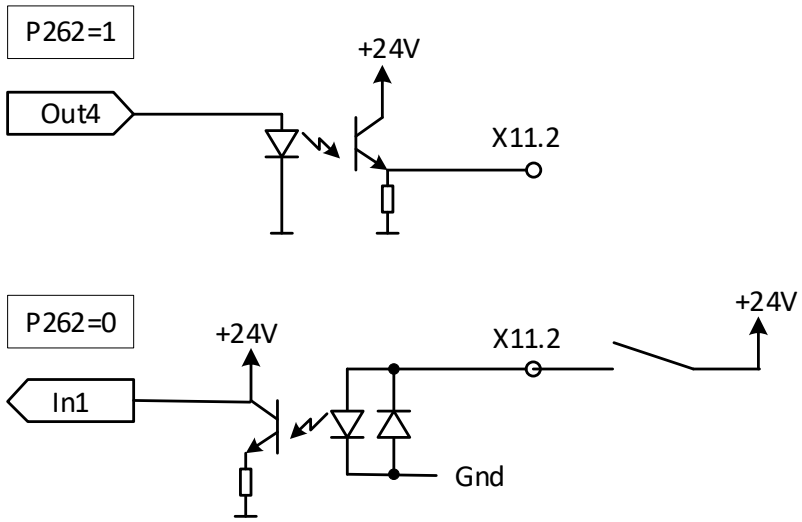


Figure 8-2: Functional connection of digital input/output

Terminal X12 - HS-Bus Port

HSB is used to realize data exchange and synchronization of interconnected sync module and power modules, more details refer to section 8.10.

Terminal X13 – Service port RS485

This port is mainly used for firmware updates. For further information please contact your local Schaffner Partner or Schaffner service.

Terminal X14 – Ethernet / Modbus TCP

HSB is used to realize data exchange and synchronization of interconnected sync module and power modules, for more details refer to section 8.10. Alternatively, this interface could be used to connect AHF with a device on LAN network, i.e., a PC with the AHF Viewer program.

Terminal X15 – Modbus Daisy Chain RS485

For DPP version as well as for sync module, only one HMI/display module is used to display the information of multiple modules by connecting the X15 terminal of the power modules and sync module.

Terminal X16 – Display Module Port

HMI/Display Module port provides a Modbus connection including 24V powering the display module.

Note: HMI cannot be powered using the 24V from the Power module or Sync module. A dedicated cable directly connected to the 24V power supply of the cabinet it installed for powering the HMI.

Warning: 24V power supply must be switched off before connecting the HMI or other than original Schaffner display module (P255=OFF). There is a risk that external interface adapters will be damaged.

Terminal X-PE – Protective Earth Connection

Ecosine Active Sync power module must be grounded by connecting the protective earth at terminal X-PE.

8.3.2 Connection of AC Mains

The device must be grounded (connect the protective earth at terminal X-PE of the power module). The AC mains connection cross sections and the tightening torque are presented in Table 16:

Table 16 Connection cross sections and tightening torque mains connection

Device	Min. value cable cross section	Max. value cable cross section	Connecting bolt and tightening torque
Ecosine Active Sync single 60A Power Module	1 x 25 mm^2 per phase and PE 2 x 25 mm^2 (N)	1 x 25 mm^2 per phase and PE 2 x 25 mm^2 (N)	**Terminal L1, L2, L3, N** ▪ 4.2 Nm (0.47 lbf in) **PE bolt:** ▪ M8 ▪ 9.5 Nm (1.07 lbf in)

Always use the correct cable cross sections in consideration of cable type and type of cable mounting. To ensure UL conformity, use UL listed cable (90°C, AWG4 or larger) and suitable UL listed wire-lugs.

Danger: Ensure correct grounding

Insufficient grounding of Ecosine Active Sync filter may cause malfunction of the device and its destruction.

Each power module must have its own fuse protection of 100A e.g., type gL or gG (see section 8.1).

8.4 Sync Module electrical installation

8.4.1 Connecting terminal location

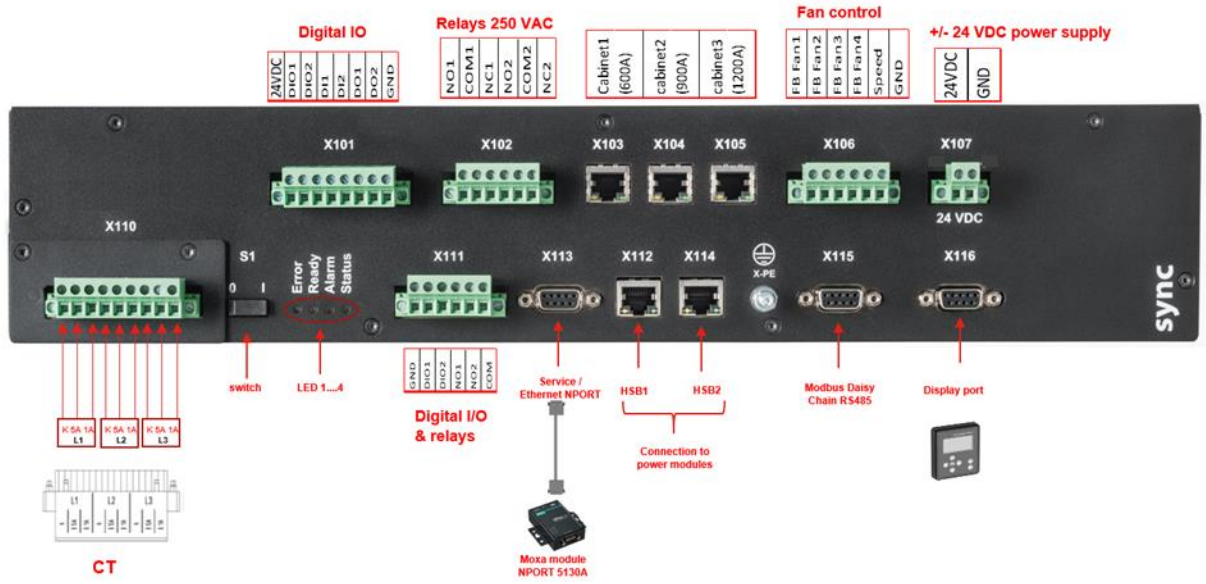


Figure 8-3 Sync module front view with input-output legends

- X101: Customer IOs: Digital Inputs and outputs
- X102: Customer interface: relays 250
- X103, X104, X105: HS-Bus to additional sync module (up to 3)
- X106: Fans feedback signals
- X107: power supply of sync module, 24 VDC
- X110: Current transformer input
- S1: Switch on/off
- LEDs: Indication LEDs
- X111: Customer IOs: Digital Inputs and outputs
- X112: HS-Bus #1 Port to power module
- X113: Service port RS485 – interface to Ethernet Port
- X114: HS-Bus #2 to power module
- X115: Modbus Daisy Chain RS485
- X116: HMI/Display Module Port
- X-PE: Protective Earth Connection

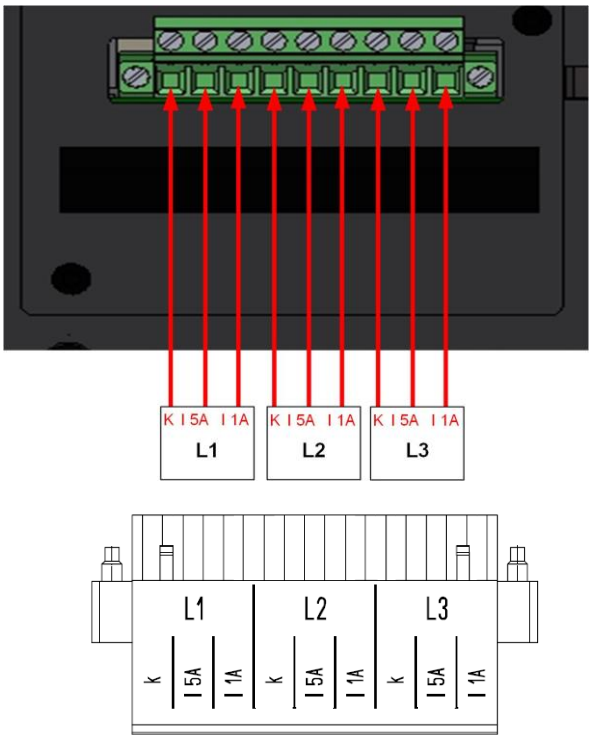
Terminal X110 – Current transformer input (CT Module)

When Sync module is installed, the CT connections are only done to the CT Module of SYNC300A.

No need to wire through the power modules.

With SYNC300A, the connection of the current transformers is done at one single point to the X110 CTM-interface of the sync module.

The sync module transmits the current measurements over the HSB to the installed power modules.

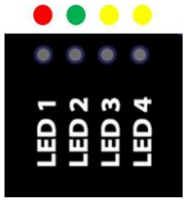


Switch S1 – Switch on/off

To switch on or switch off the sync module, when the parameter P202 is set to “Switch S1”.

LEDs – Indication LEDs

To show the status of Ecosine Active Sync power module and/or sync module, the color of each LED is relevant. The indications of the LEDs are listed in Table 14.



8.4.2 Interconnection between Sync Module and Power Modules

The connection between the Sync Module (designated as SM) and the power modules (designated as PM) is done via HSB-link on terminal X112 and X114 of the sync module and terminal X12 and X14 of the power modules using with RJ45 cables.

The sync module connection needs to be done exact in the way seen on Figure 8-4, otherwise the sync module is not able to read the power modules correctly. In Schaffner's Ecosine Active Sync cabinet, the power modules 1 to 5 are installed from bottom to top.

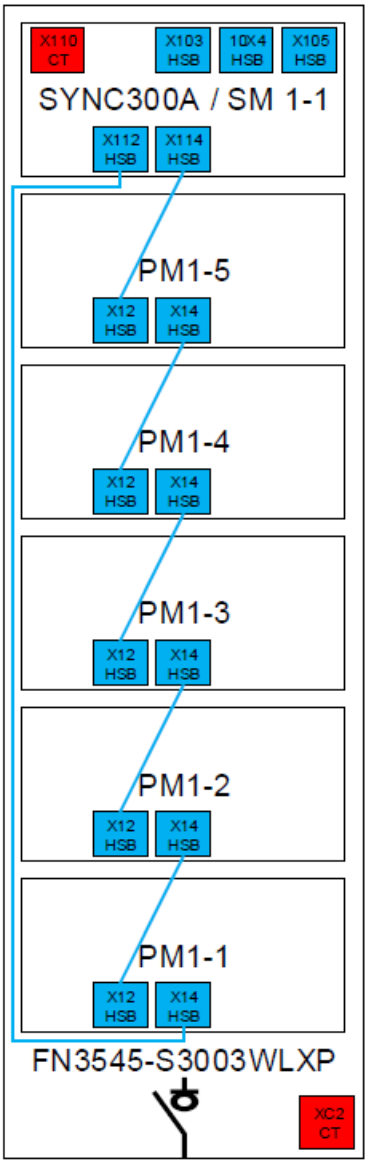
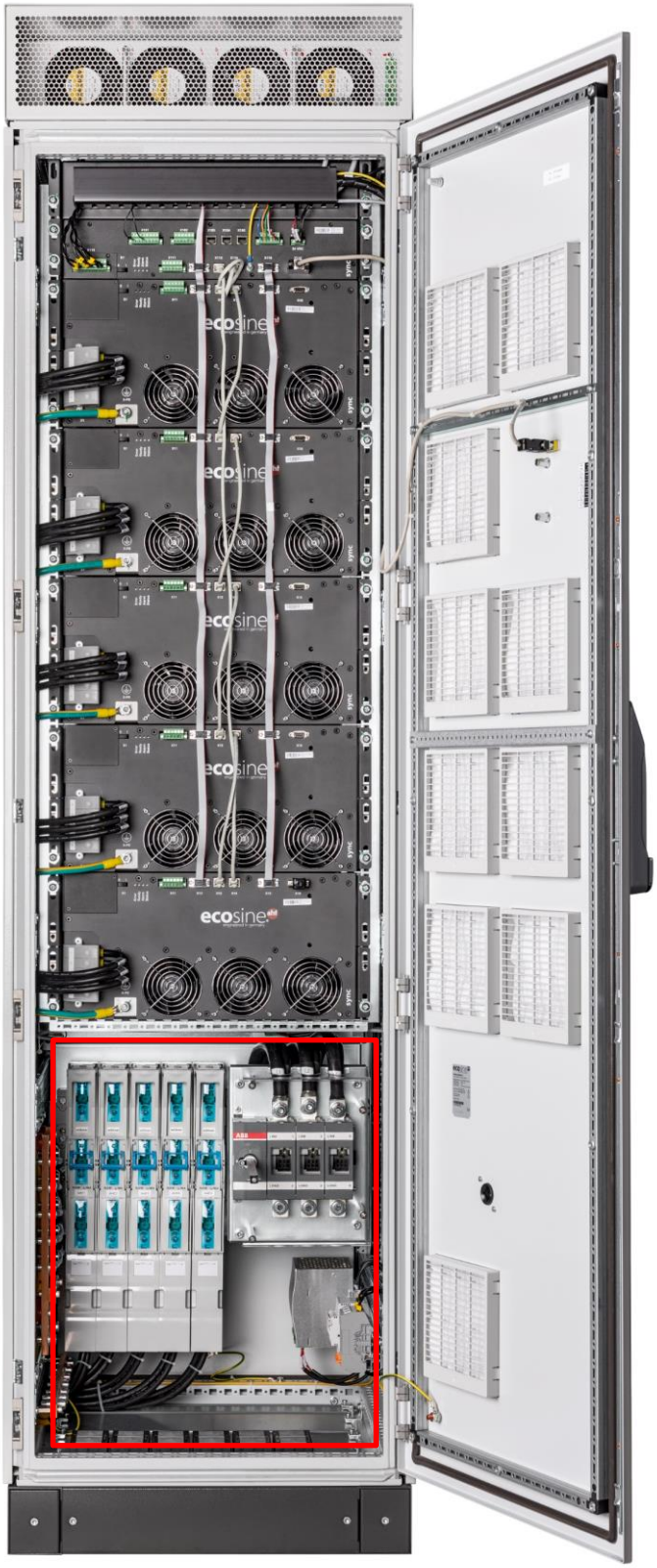


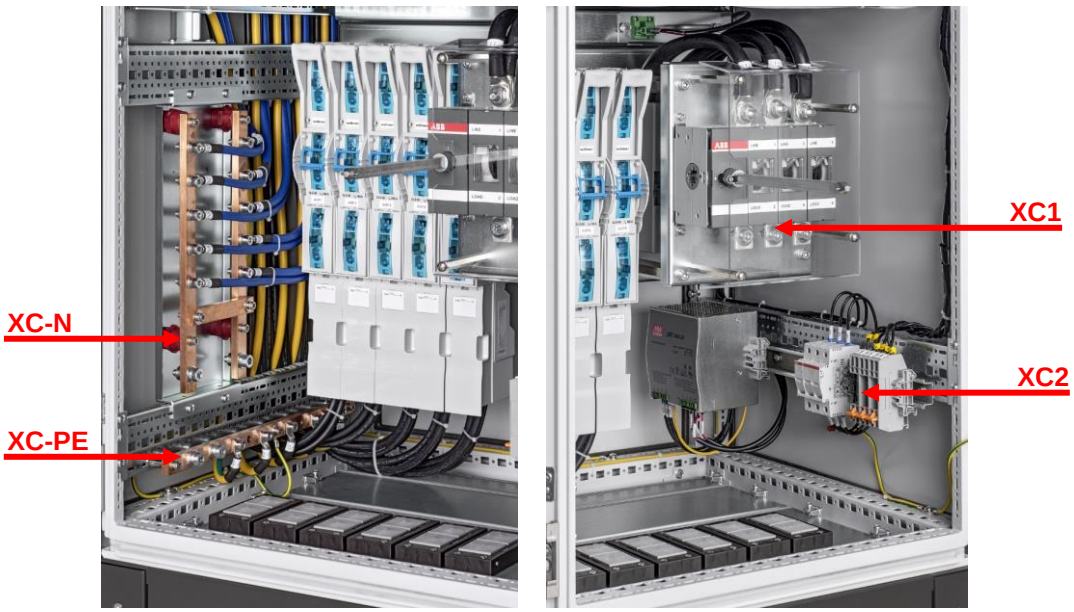
Figure 8-4 HSB connection between sync module and power modules

8.5 Ecosine Active Sync cabinet version electrical installation

8.5.1 Connecting terminal locations

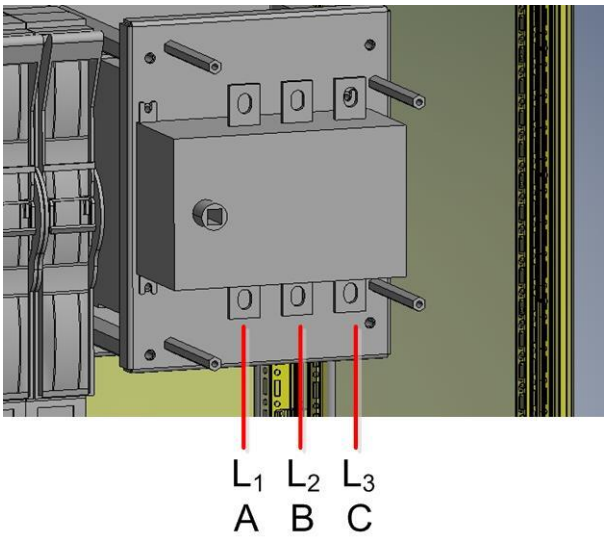


See detailed pictures and drawing of the lower part of the cabinet in the following pages.



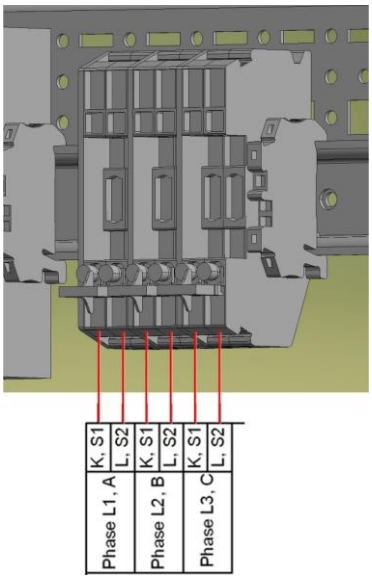
Terminal	Description
XC1	Terminal for connection of mains input cable
XC2	Terminal for connection of current transformers
XC-N	Terminal for connection of neutral conductors
XC-PE	Terminal for connection of protective earth conductors

Terminal XC1 – connection of mains 3-phase input cables L1, L2 and L3 (phase A, phase B and phase C)



Terminal XC2 – connections of external Current Transformers (CT)

Note:
The cabinet is assembled per default for 5A CT secondary output.
For CTs with 1A secondary output, the terminations must be re-wired during electrical installation (same as indicated in Figure 8-10).



8.5.2 Connection of AC Mains

The device must be grounded (connect the protective earth at terminal XC-PE at the bottom left of the cabinet). The AC mains connection cross sections and the tightening torque are presented in Table 17:

Table 17 Connection cross sections and tightening torque mains connection

Device	Min. value cable cross section	Max. value cable cross section	Connecting bolt and tightening torque
Ecosine Active Sync max. 300A cabinet version	1 x 185 mm² per phase and PE 2 x 240 mm² (N)	2 x 120 mm² or 1 x 240 mm² per phase and PE 2x 240 mm² (N)	▪ M10 ▪ 19Nm (168.0 lbf in)

Always use the correct cable cross sections in consideration of cable type and type of cable mounting. To ensure UL conformity, use UL listed cable (90°C, AWG4 or larger) and suitable UL listed wire-lugs.

DANGER

Ensure correct grounding

Insufficient grounding of Ecosine Active Sync filter may cause malfunction of the device and its destruction.

Each power module has its own fuse protection of 100A e.g., type gL or gG (see section 8.1) installed. Customers must ensure that protection fuses according to local regulations are installed for the mains input cables.

8.6 Connection of current transformers

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

De-energize the active harmonic filter before carrying out this procedure.

Failure to follow these instructions will result in death or serious injury.

CAUTION RISK OF INCORRECT MOUNTING

Respect and check the phase order and polarity of the current sensors.

Failure to follow these instructions can result in injury or equipment damage.

Dangerous Voltage Risk of death due to short circuits and electric shock if the current transformers are connected incorrectly

BEFORE installing current transformers on the primary conductor short circuit CTs on secondary side with separable short-circuit jumpers (not in the scope of delivery)

Keep the current transformers short circuited until

- the Ecosine Active Sync devices are connected with these separable connecting terminals
- the correct wiring of the secondary circuit has been confirmed (5A or 1A)

BEFORE disconnecting current transformers from Ecosine Active Sync devices always short-circuit them with separable short-circuit plugs.

8.6.1 Connection of 3-phase 3-wire devices CT secondary output 5A

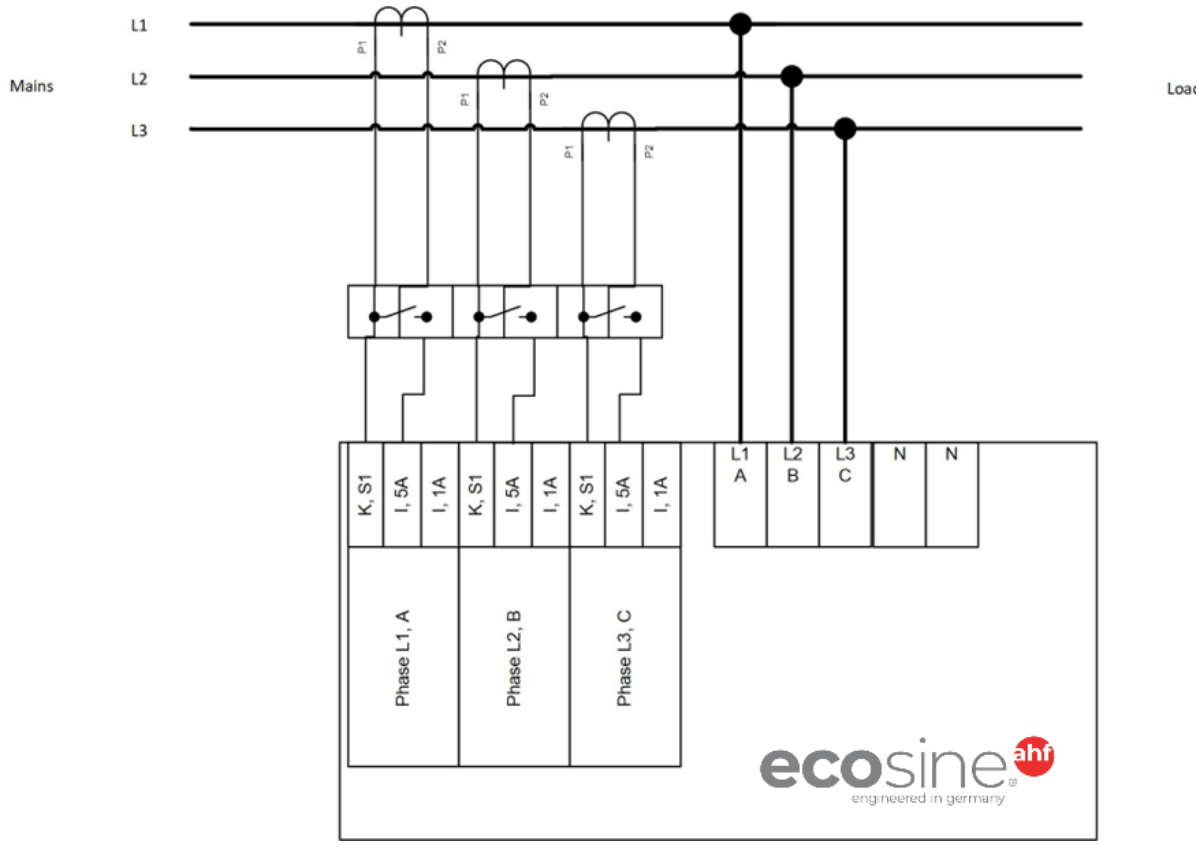


Figure 8-5 Connection of 3-phase 3-wire device CT secondary output 5A

8.6.2 Connection of 3-phase 3-wire devices CT secondary output 1A

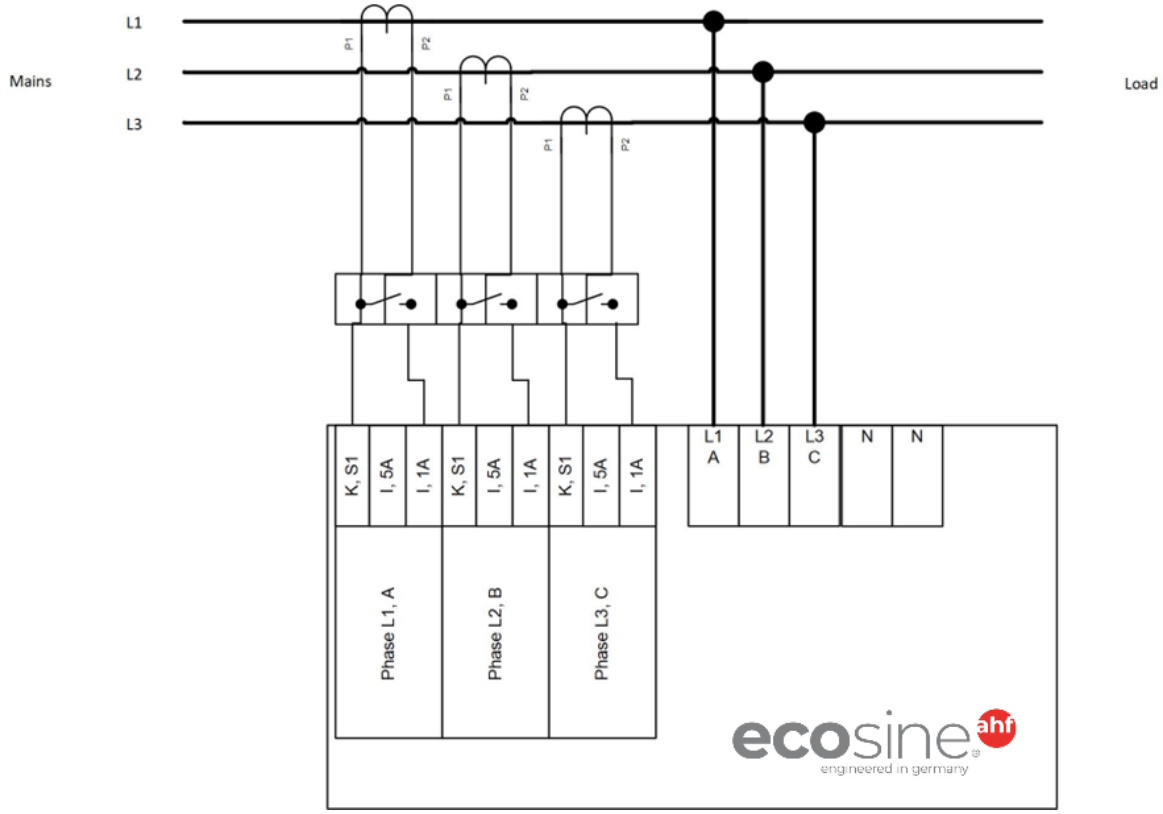


Figure 8-6 Connection of 3-phase 3-wire device CT secondary output 1A

8.6.3 Connection of 3-phase 4-wire devices CT secondary output 5A

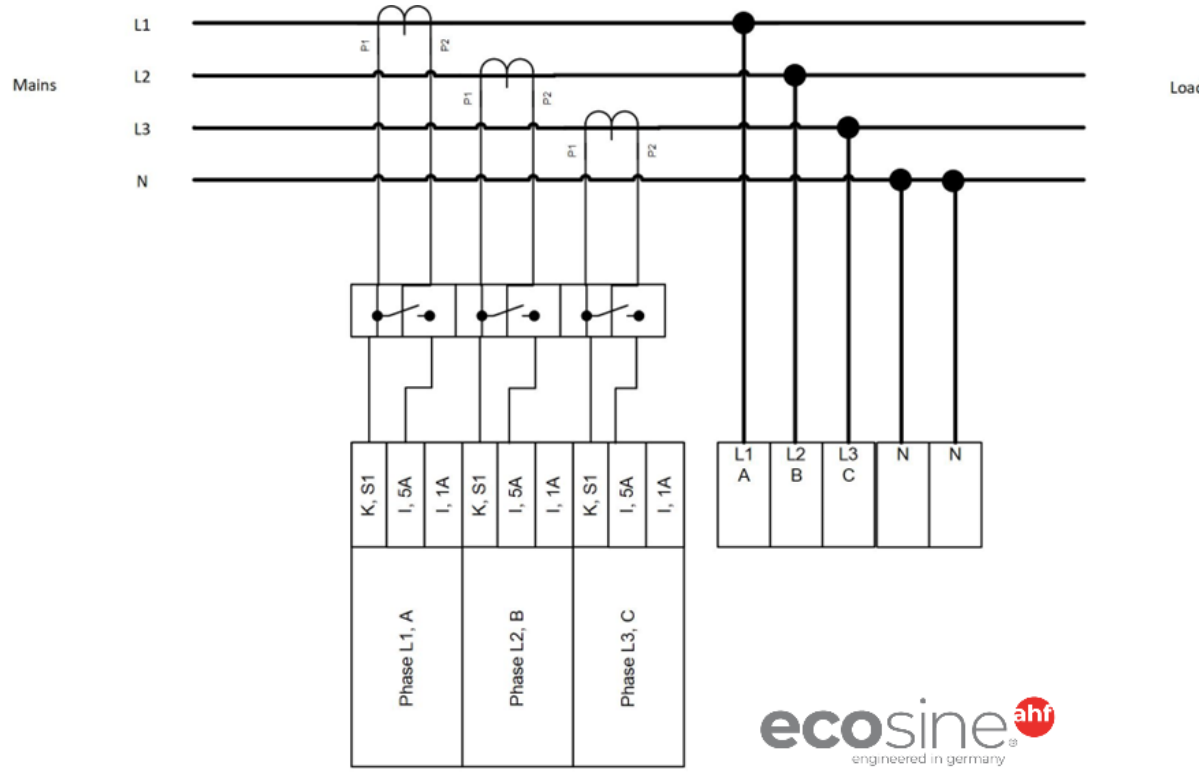


Figure 8-7 Connection of 3-phase 4-wire devices CT secondary output 5A

8.6.4 Connection of 3-phase 4-wire devices CT secondary output 1A

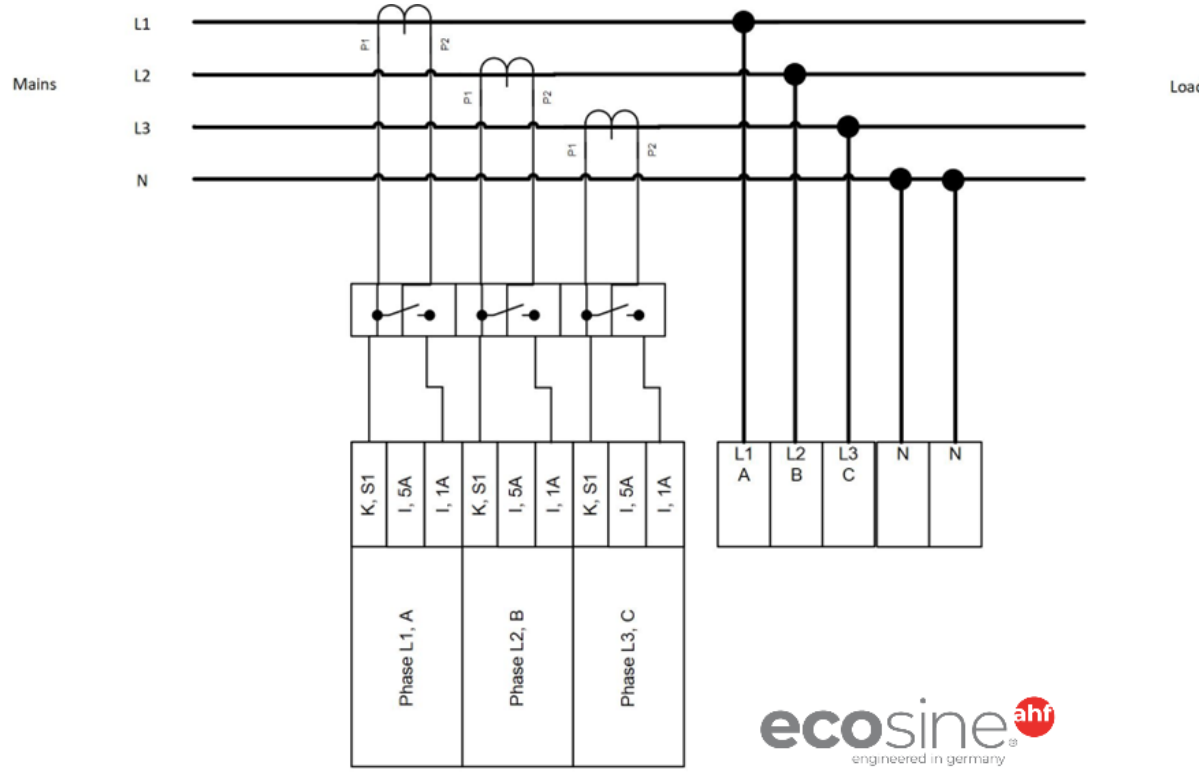


Figure 8-8 Connection of 3-phase 4-wire devices CT secondary output 1A

8.7 Current transformers specifications and cable selection

For correct Ecosine Active Sync operation, **three** external current transformers (CT) must be connected. This applies regardless of whether Ecosine Active Sync is used as 3 phase 3-wire or 3 phase 4-wire filter,

Please observe the following instructions when installing external current transformers:

- For operation of one Ecosine Active Sync power module FN3531 or FN3541, the CTs can be installed on the mains or load side of the filter.
- For Double Power Pack FN3532 and FN3542, current transformers can be installed either on the mains or load side.
- For use of more than two power modules in parallel, the use of the sync module SYNC300A offers the optimal and more flexible solution. In this configuration, the CTs can be installed either on the mains or load side. Moreover, the PWM switching patterns of all power modules are synchronized leading to the lowest switching harmonic content.
- For use with more than two power modules in parallel without the sync module, the CTs must be installed on the load side only. For installations with main side CTs special summation CTs are needed (for more information please refer to the document “Knowledge base information No. 002”).
- Separate transformer circuits are mandatory for proper operation of ecosine active sync. Dedicated current transformers must be used. Current transformer secondary circuits must not be looped through additional loads (i.e., the CT cable should not be routed through the CT loop itself or other burden that could influence the signal).
- A current transformer terminal-block with separable short-circuit plugs must be installed between the external current transformers and the connecting terminal of CT module interface of the Ecosine Active Sync device (CTM terminal strip X2 for power module, X110 for sync module). This is necessary to be able to short-circuit the current transformers before disconnecting the CTM terminal strip on the Ecosine Active Sync device during any kind of service work.
- The power dissipation of the current transformer wiring must be considered when selecting the current transformer power. See Table 18 and Table 19.
- Grounding of CT secondary circuit should be avoided.
- The CT secondary cables must be separated from the power cables of the Ecosine Active Sync filter and the power cables of other loads, to avoid disturbing the CT secondary signal.
- Schaffner highly recommends using twisted pair cables for the CT secondary signals in order to avoid risk of distortion of the CT signal. In case of high disturbances in the environment, twisted pair cables are mandatory for a proper operation of the Ecosine Active Sync filters.

Characteristic	Value
Rated secondary current	1 A or 5 A
Primary current	For current signals with high crest factor, the primary current must be selected according to the peak value of the current signal. Nominal CT current > I_{peak} / √2
Accuracy class	1.0 (or better) The total accuracy calculated from CT primary current and CT class should not exceed 10% of the AHF nominal current. example 1: CT 1000:5A (class 1.0), AHF 120A accuracy 10A (1% of 1000A) ≤ 12A (10% of 120A) ⇨ ok example 2: CT 2000:5A (class 1.0), AHF 60A accuracy 20A (1% of 2000A) ≥ 6A (10% of 60A) ⇨ not ok example 3: CT 2000:5A (class 0.5), AHF 120A accuracy 10A (0.5% of 2000 A) ≤ 12 A (10% of 120 A) ⇨ ok
Output power[i]	At least 1.5 VA (1 ecosine active sync) At least 3.0 VA (2 Ecosine Active Sync in parallel operation) At least 4.5 VA (3 Ecosine Active Sync in parallel operation) At least 6.0 VA (4 Ecosine Active Sync in parallel operation) At least 7.5 VA (5 Ecosine Active Sync in parallel operation)

[i] The output power is defined for CT with 5A secondary output. For CTs with 1A secondary output, the CT output power should be lower (i.e. around 0.25 VA pro power module).

Table 18 Power consumption of the CT lines valid for copper wires and CT with secondary output 5A

Cross section	AWG	Distance between current transformer and Ecosine Active Sync vs. CT 5A secondary burden in VA (Twin Wire) (Consider forward and return lines!)					
		1 m	2 m	4 m	6m	8 m	10m
1.0 mm²	18	-	-	-	-	-	-
1.5 mm²	16	0.58	1.15	2.31	3.46	4.62	5.77
2.5 mm²	14	0.36	0.71	1.43	2.14	2.86	3.57
4.0 mm²	12	0.22	0.45	0.89	1.34	1.79	2.24
6.0 mm²	10	0.15	0.30	0.60	0.89	1.19	1.49
10.0 mm²	8	0.09	0.18	0.36	0.54	0.71	0.89

Example: With 4 meters between current transformer and ecosine active sync, the line length in the CT circuit is 8 meters. If 2.5mm² cables are used, the CT output power need to be at least 2.86VA.

Table 19 Power consumption of the CT lines valid for copper wires and CT with secondary output 1A

Cross section	AWG	Distance between current transformer and Ecosine Active Sync vs. CT 1A secondary burden in VA (Twin Wire) (Consider forward and return lines!)					
		10 m	20 m	40 m	60m	80 m	100m
1.0 mm²	18	0.35	0.71	1.43	2.14	2.85	3.57
1.5 mm²	16	0.23	0.46	0.92	1.39	1.85	2.31
2.5 mm²	14	0.14	0.29	0.57	0.86	1.14	1.43
4.0 mm²	12	0.09	0.18	0.36	0.54	0.71	0.89
6.0 mm²	10	0.06	0.12	0.24	0.36	0.48	0.60
10.0 mm²	8	0.04	0.07	0.14	0.21	0.29	0.36

Example: With 20 meters between current transformer and ecosine active sync, the line length in the transformer circuit is 40 meters. If 1.5mm² cables are used, the CT output power need to be at least 0.92VA.

8.8 Current transformer specification for UL conformity

To ensure UL conformity, UL-compliant external current transformers must be used.

Table 20 Example of a current transformer with UL conformity

Manufacturer	Current transformer type
Flex Core	FCL series

8.9 Connection and verification of current measurements

8.9.1 CT connection for operation of single Ecosine Active Sync power module

To ensure that currents are correctly detected, observe the specified direction of the current flow from the transformers and the correct phase assignment. The CT wiring for operation of single power module is shown below in Figure 8-9 for secondary output 5A, resp. Figure 8-10 for secondary output 1A.

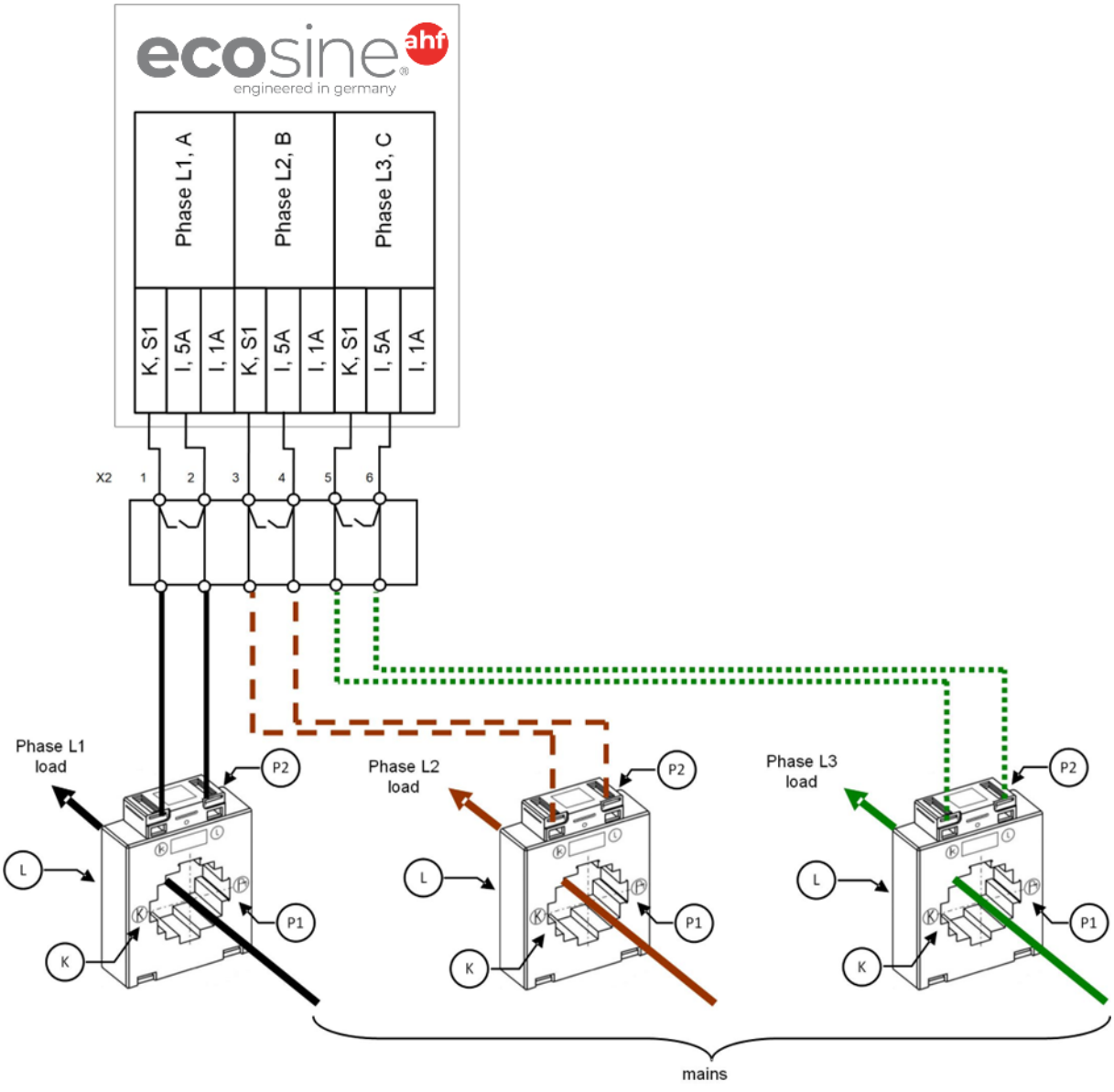


Figure 8-9 CT (5A) wiring for single power module

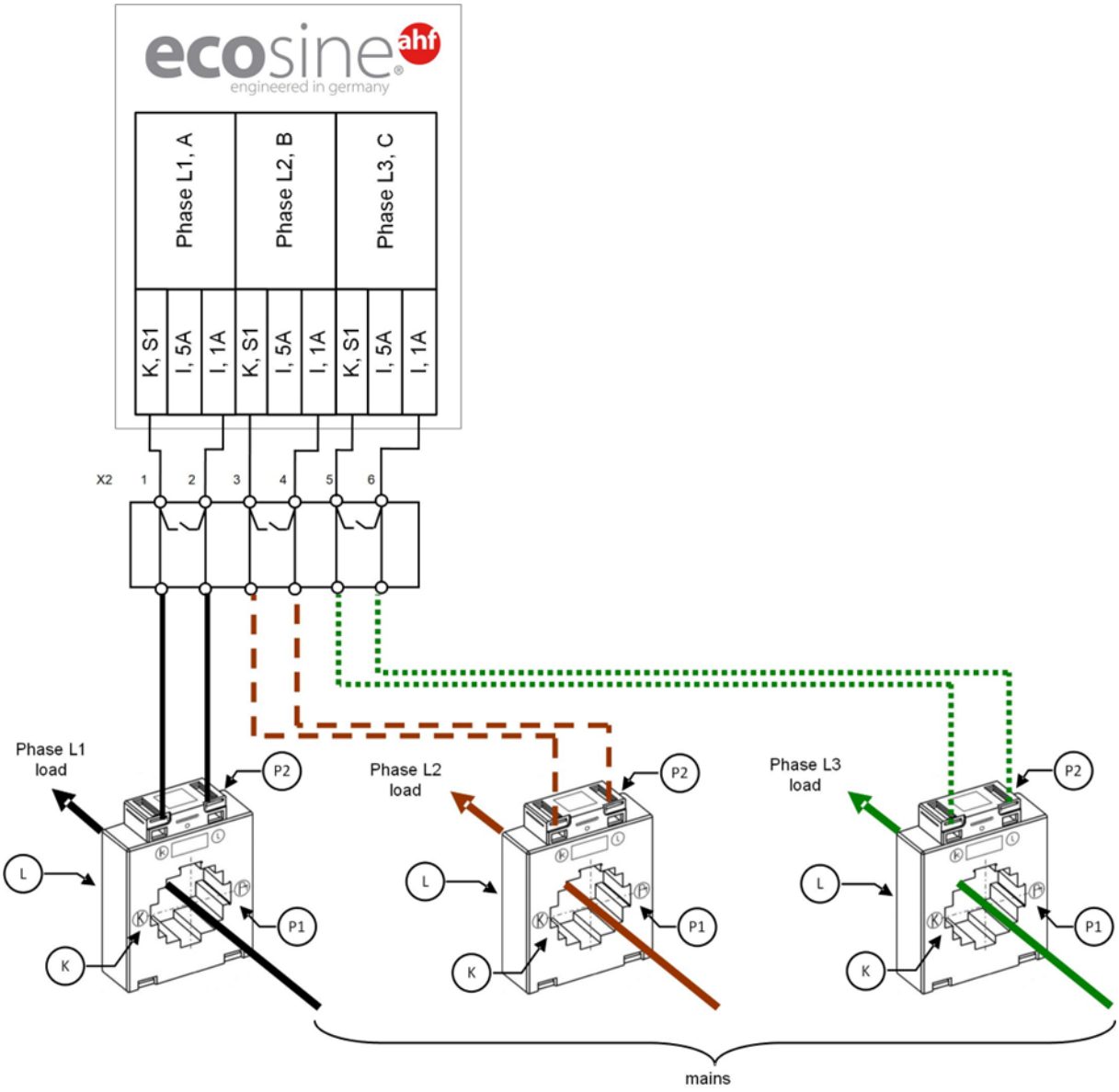


Figure 8-10 CT (1A) wiring for single power module

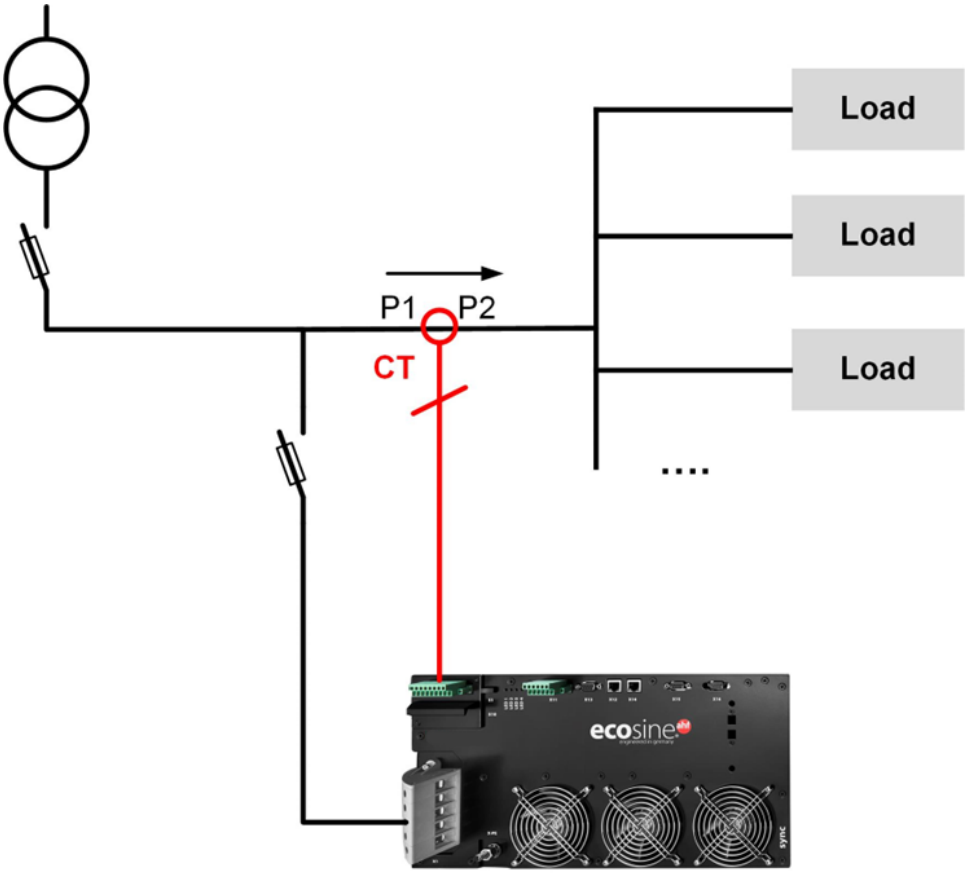


Figure 8-11 CT installation on load side for operation of one power module

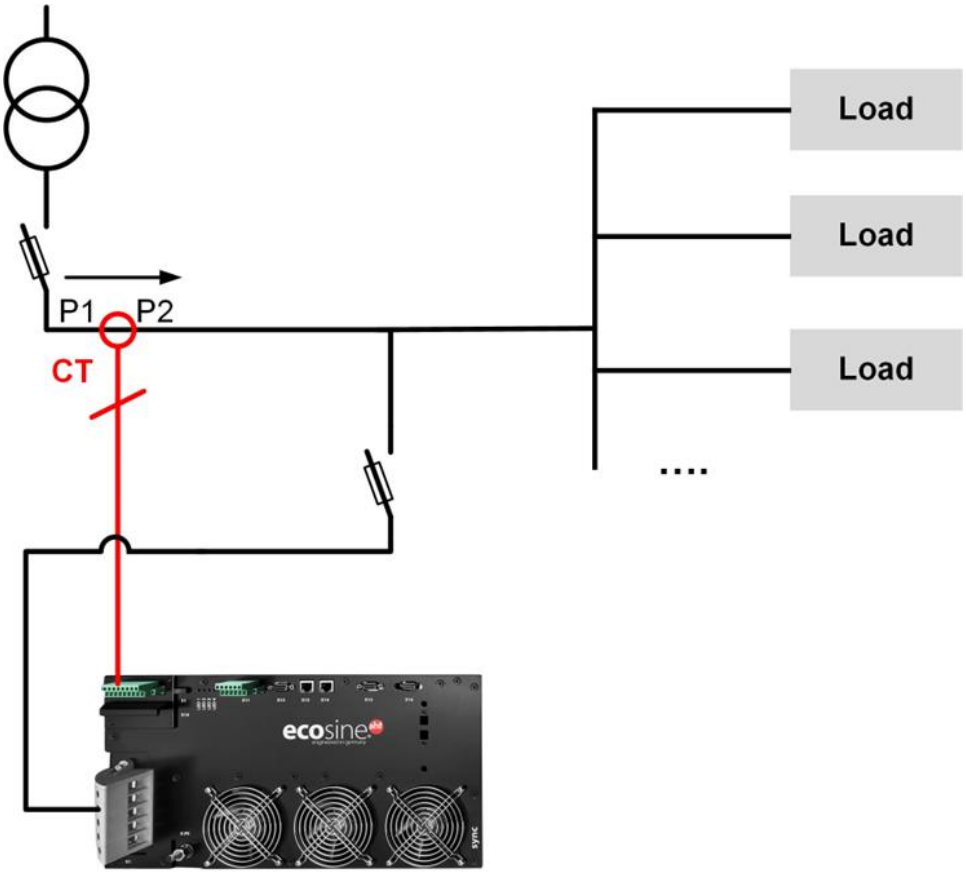


Figure 8-12 CT installation on mains side for operation of one power module

8.9.2 CT connection for operation of double power pack (DPP) ecosine active sync

Configuration with double power pack (DPP) need to have the CTs connected to one power module only. For DDP, the current transformer can be installed on the mains or the load side like for operation with one single power module**.**

To ensure that currents are correctly detected, observe the specified direction of the current flow from the transformers and the correct phase assignment. The CT wiring for operation of single power module is shown below in Figure 8-9 for secondary output 5A, resp. Figure 8-10 for secondary output 1A.

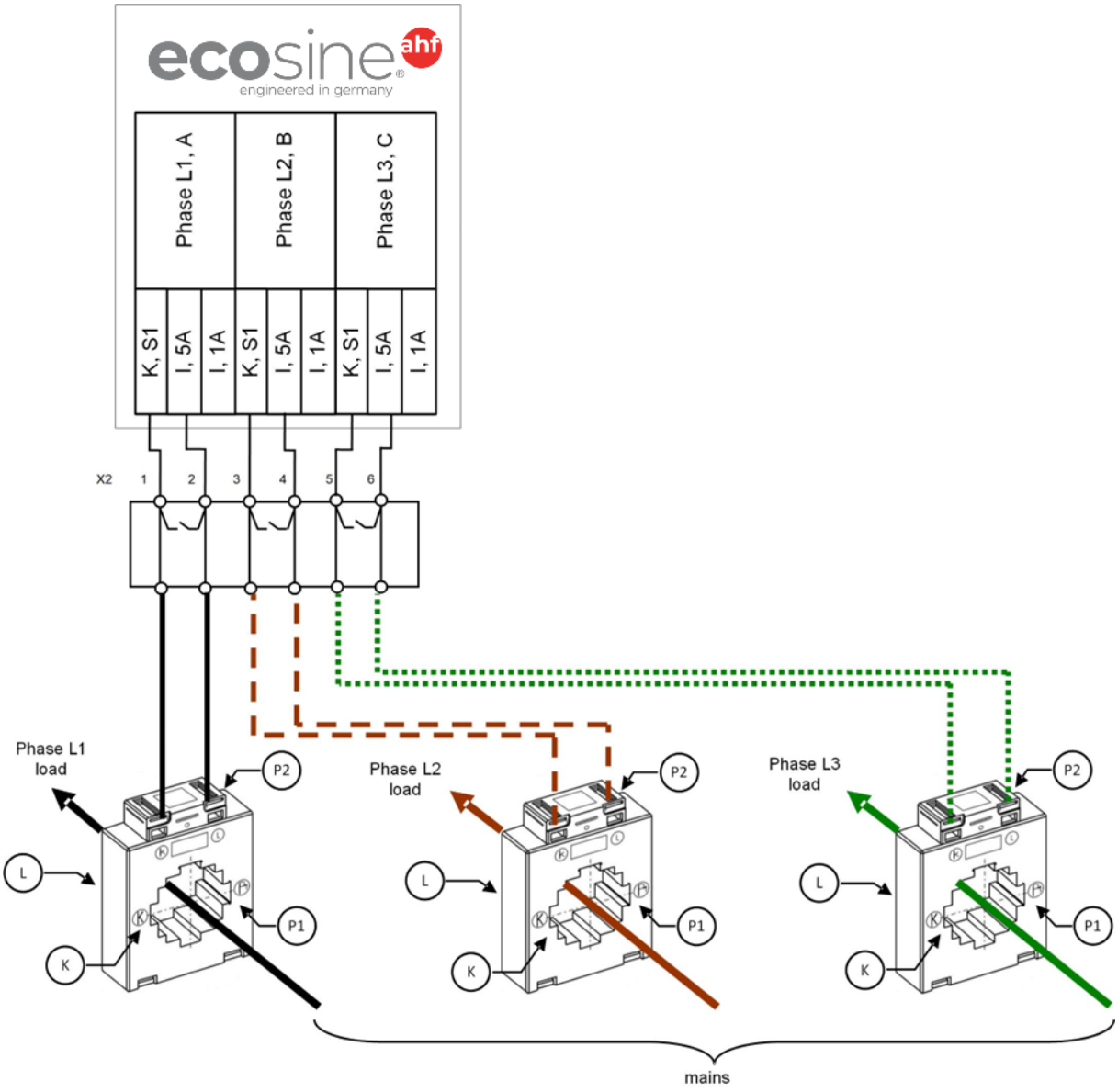


Figure 8-13 CT (5A) wiring for DPP, CTs connected to one module only

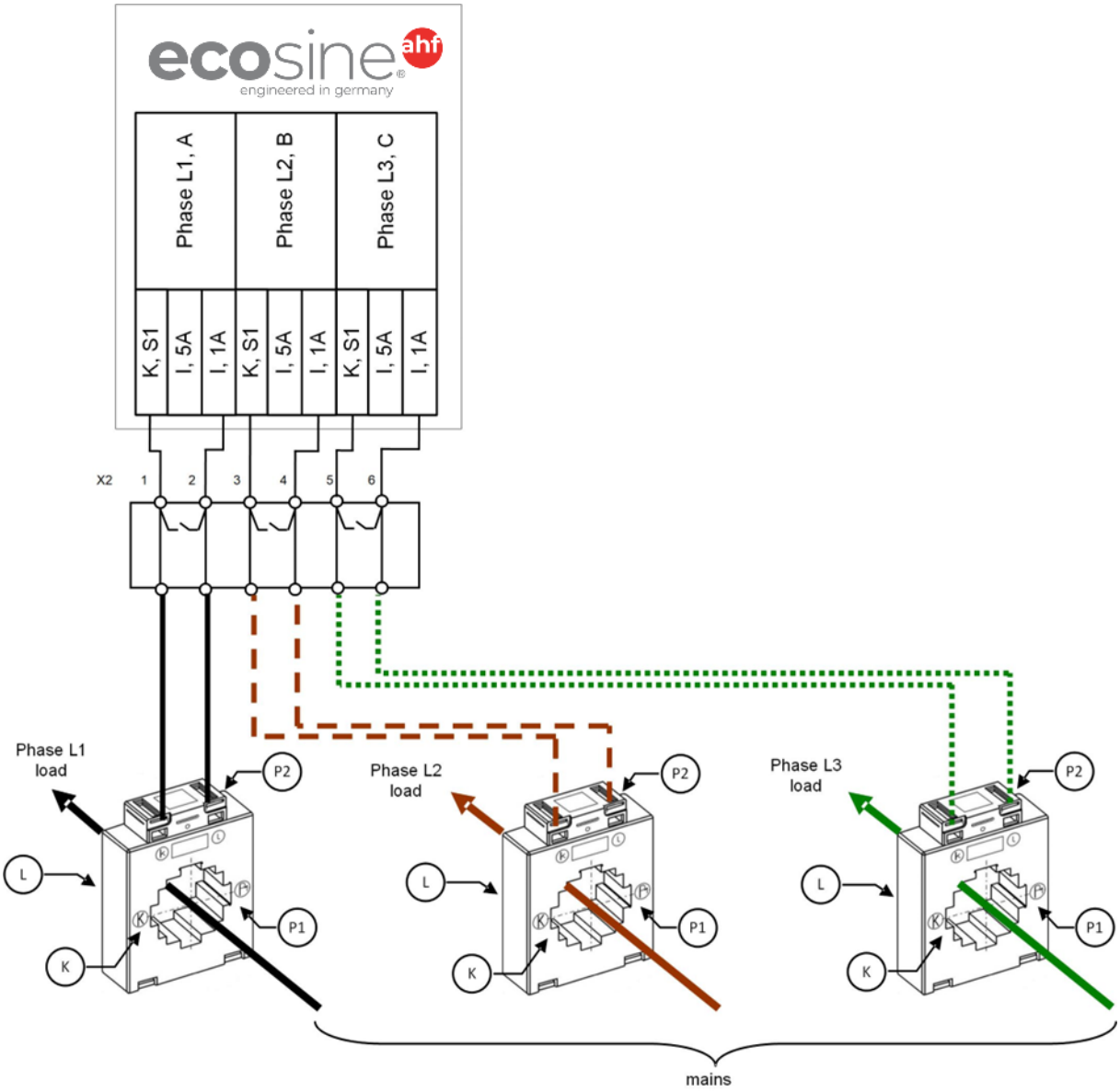


Figure 8-14 CT (1A) wiring for DPP, CTs connected to one module only

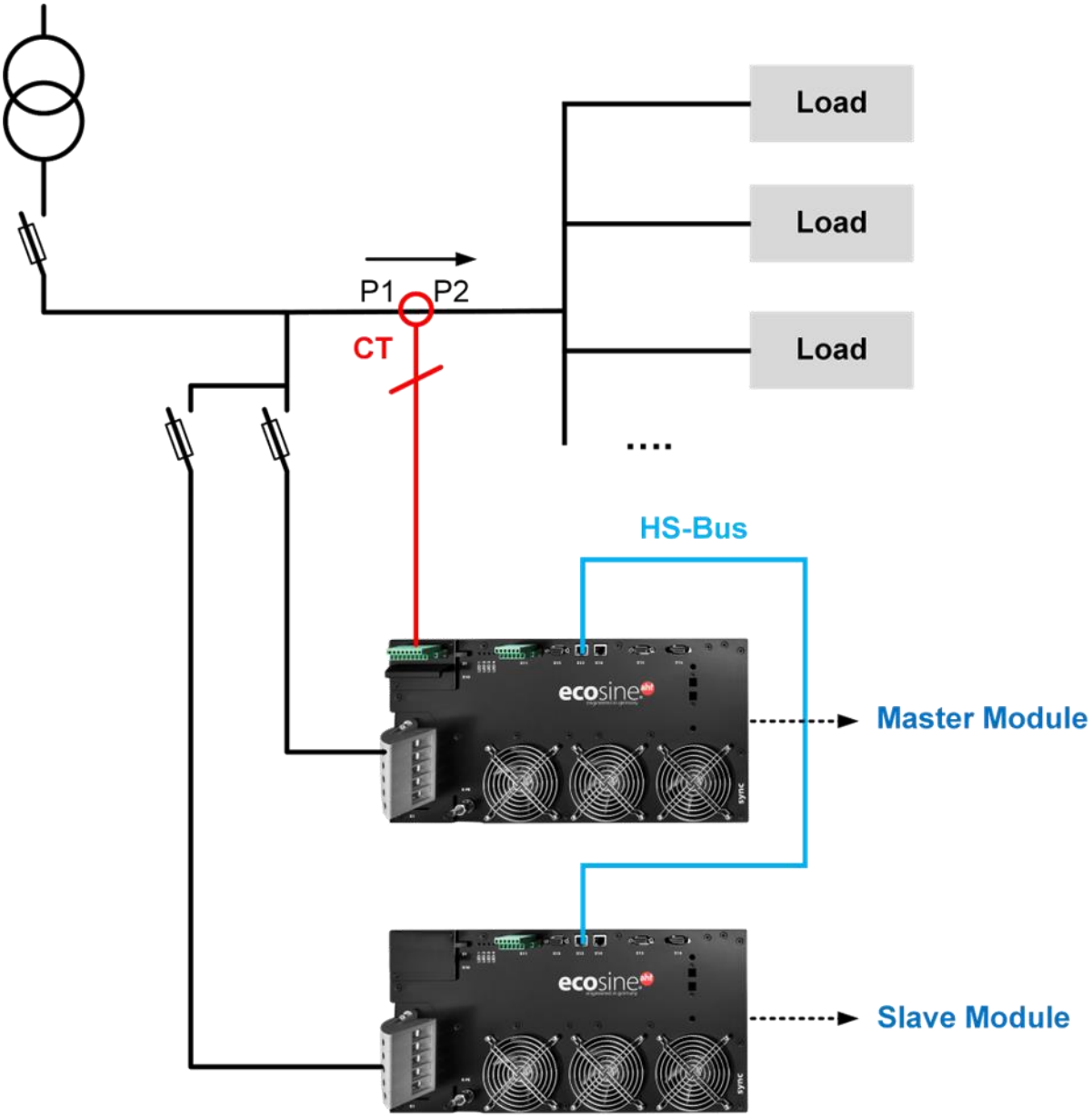


Figure 8-15 CT installation on load side for operation of DPP

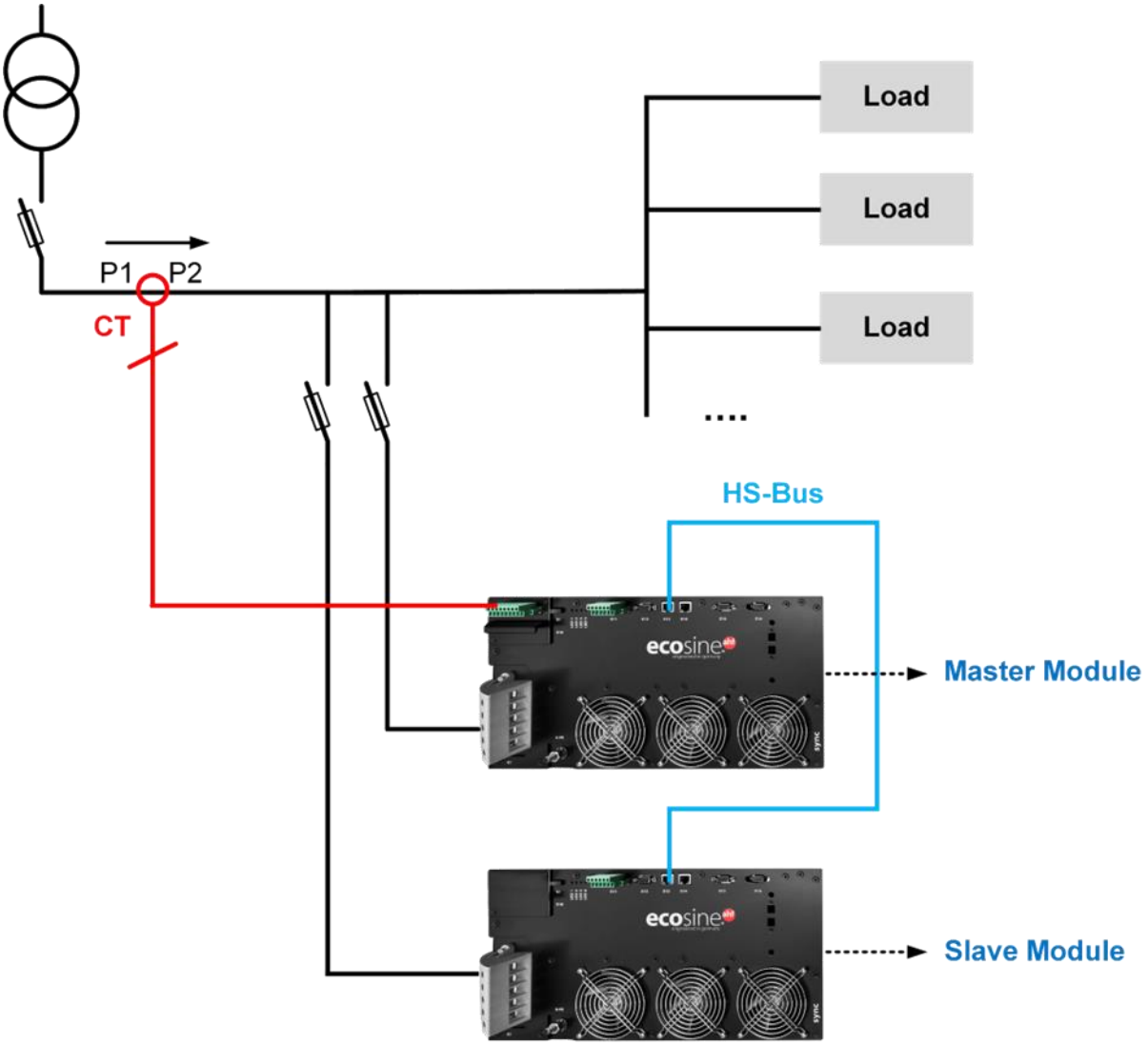


Figure 8-16 CT installation on mains side for operation of DPP

8.9.3 CT connection for operation of the sync module and multiple Ecosine Active Sync power modules

Configuration using the sync module need only to have the CT connect to the sync module.

To ensure that currents are correctly detected, observe the specified direction of the current flow from the transformers and the correct phase assignment. The CT wiring for operation of single power module is shown below in Figure 8-9 for secondary output 5A, resp. Figure 8-10 for secondary output 1A.

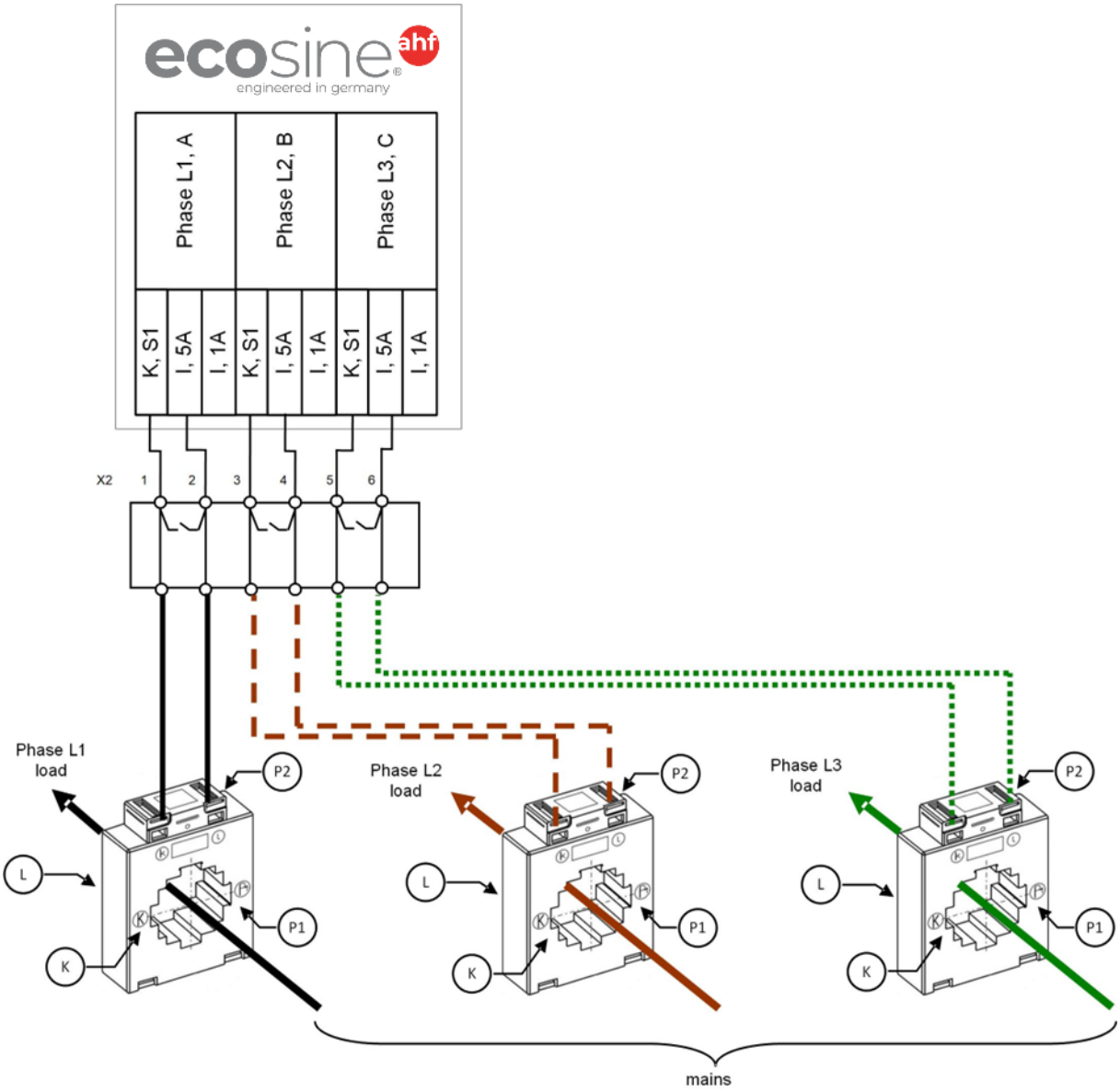


Figure 8-17 CT (5A) wiring for the sync module

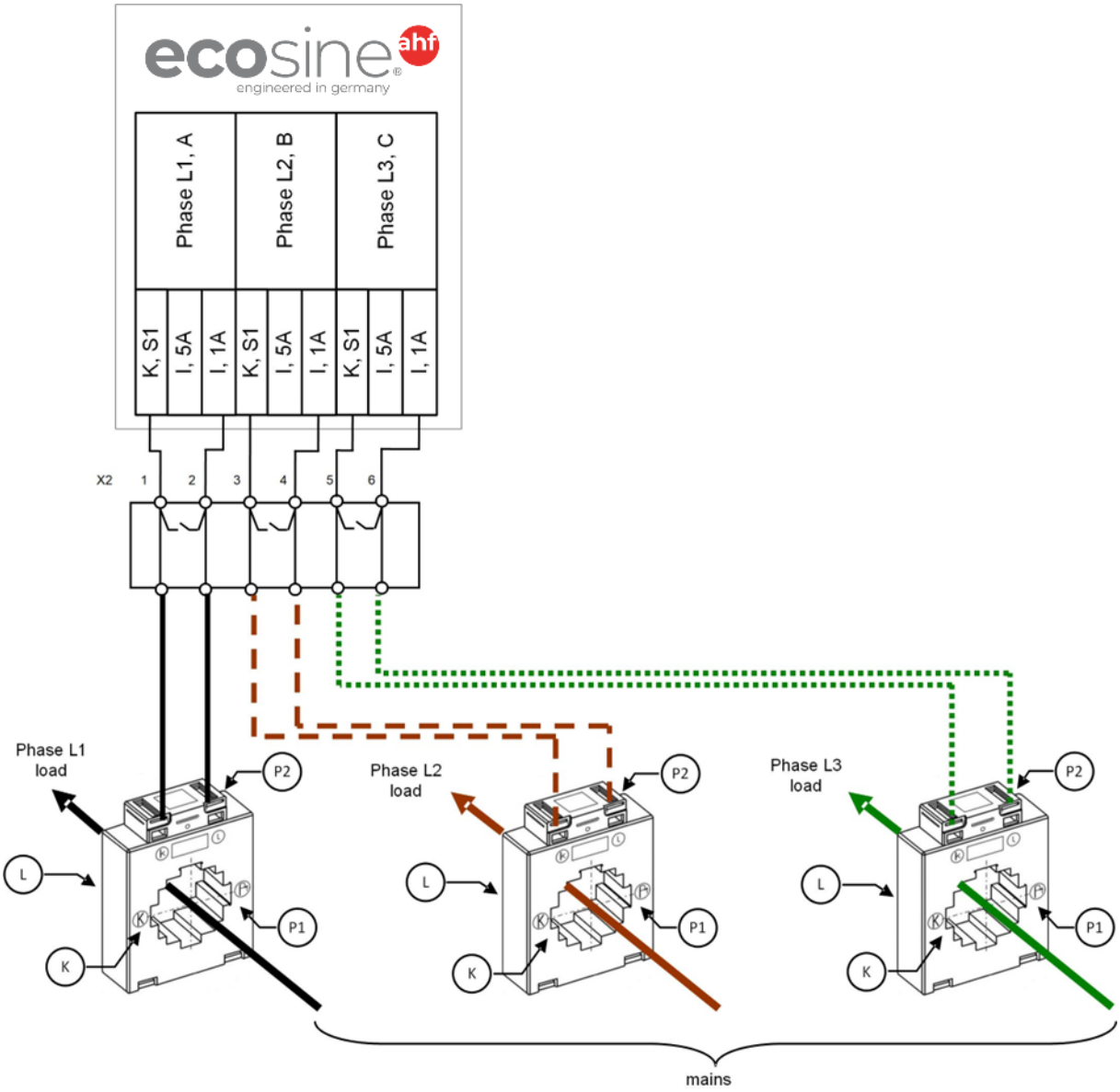


Figure 8-18 CT (1A) wiring for the sync module

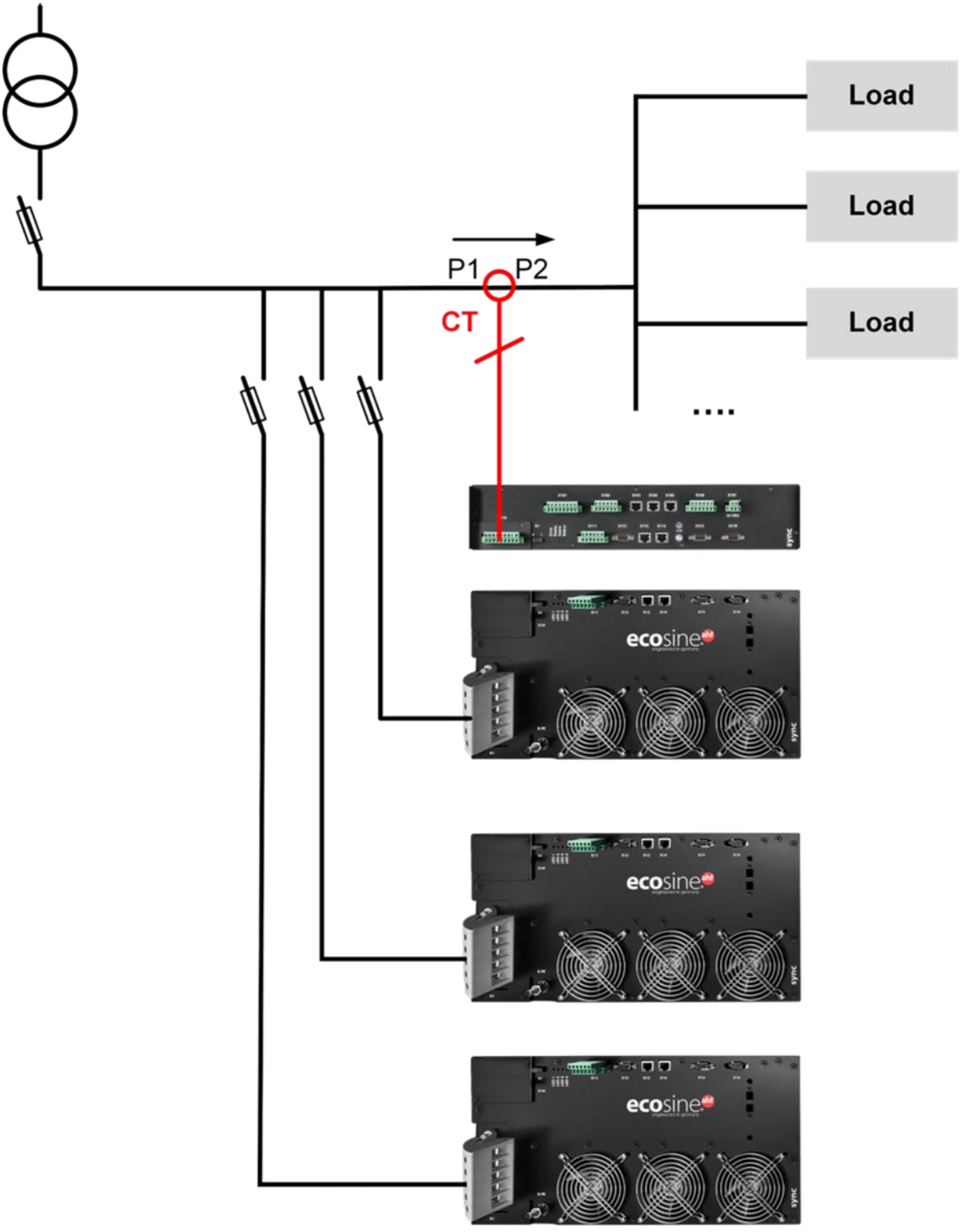


Figure 8-19 CT installation on load side for operation of the sync module and multiple power modules

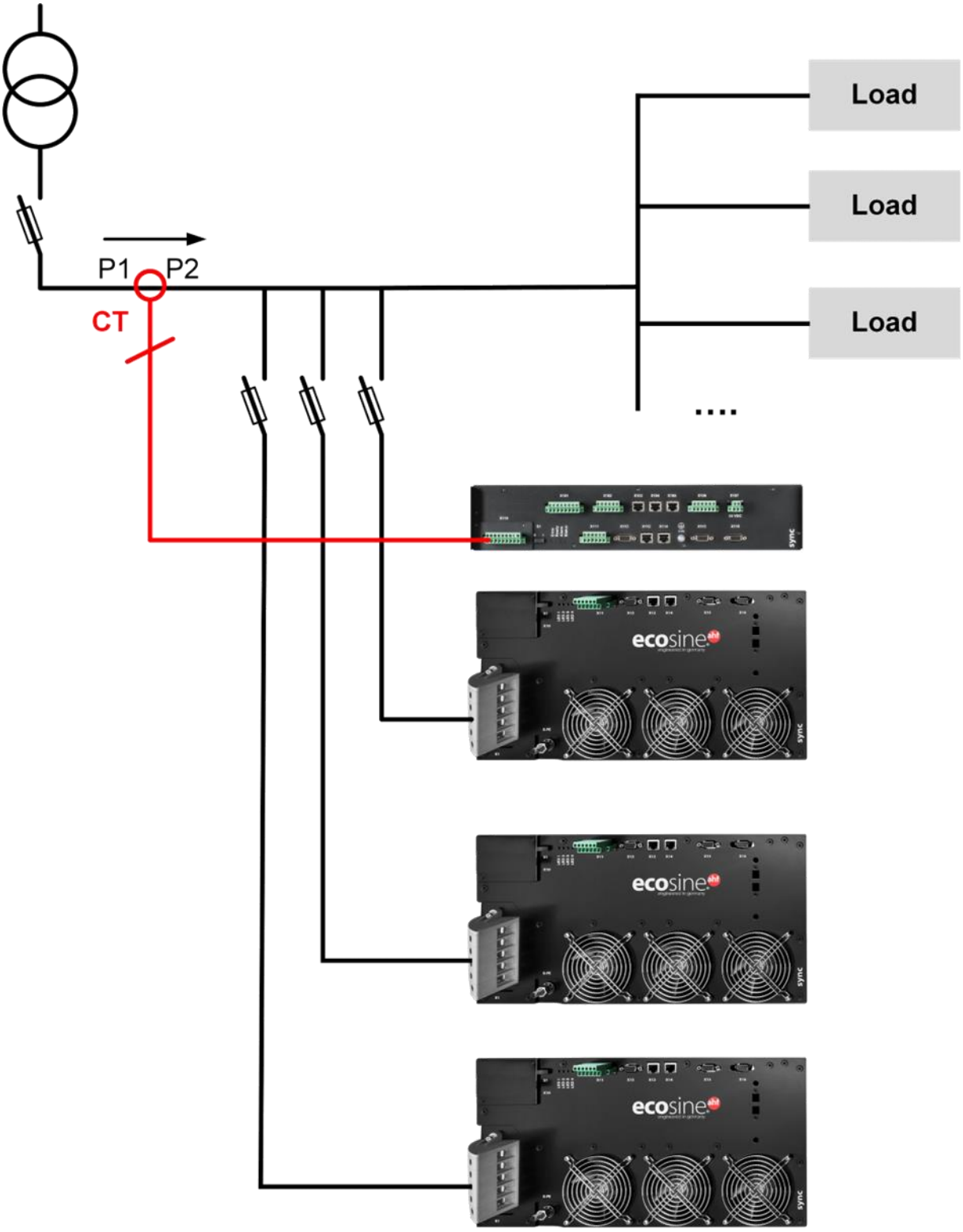


Figure 8-20 CT installation on mains side for operation of the sync module and multiple power modules

8.9.4 CT connection for parallel operation of several Ecosine Active Sync power modules without sync module

Warning: this operating mode is no more supported by Schaffner on newer systems. This section is for reference only when servicing older systems using this configuration.

The available compensation current can be increased through parallel operation of several Ecosine Active Sync devices. In doing so, the current signal from the external current transformers is looped through all the Ecosine Active Sync devices in accordance with the following schematic.

For more than 2 Ecosine Active Sync power modules in parallel connection, the current transformers must be installed on load side. For installation on mains side, the usage of the sync module is mandatory.

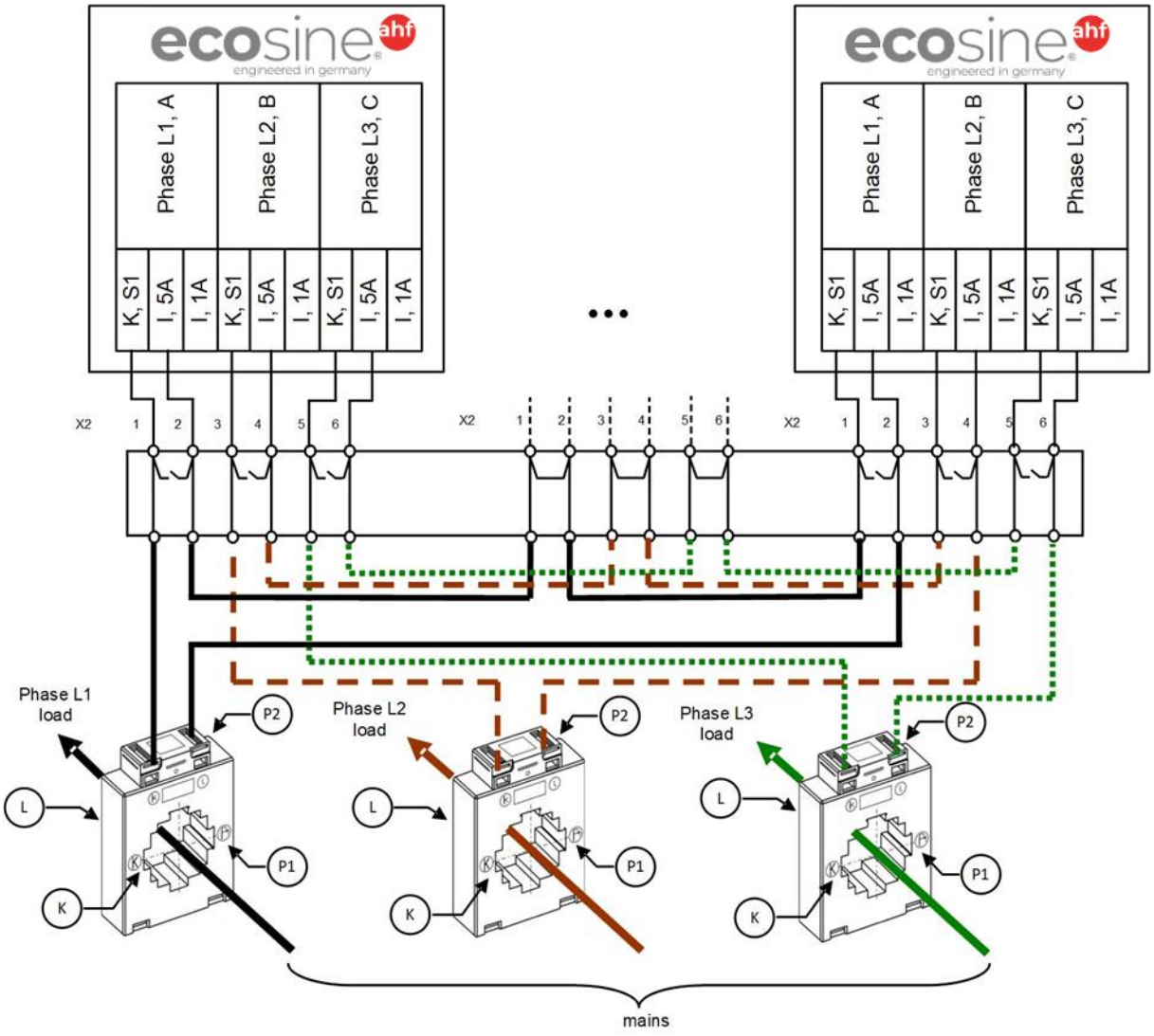


Figure 8-21 CT (5A) wiring for parallel operation up to five power modules, no sync module

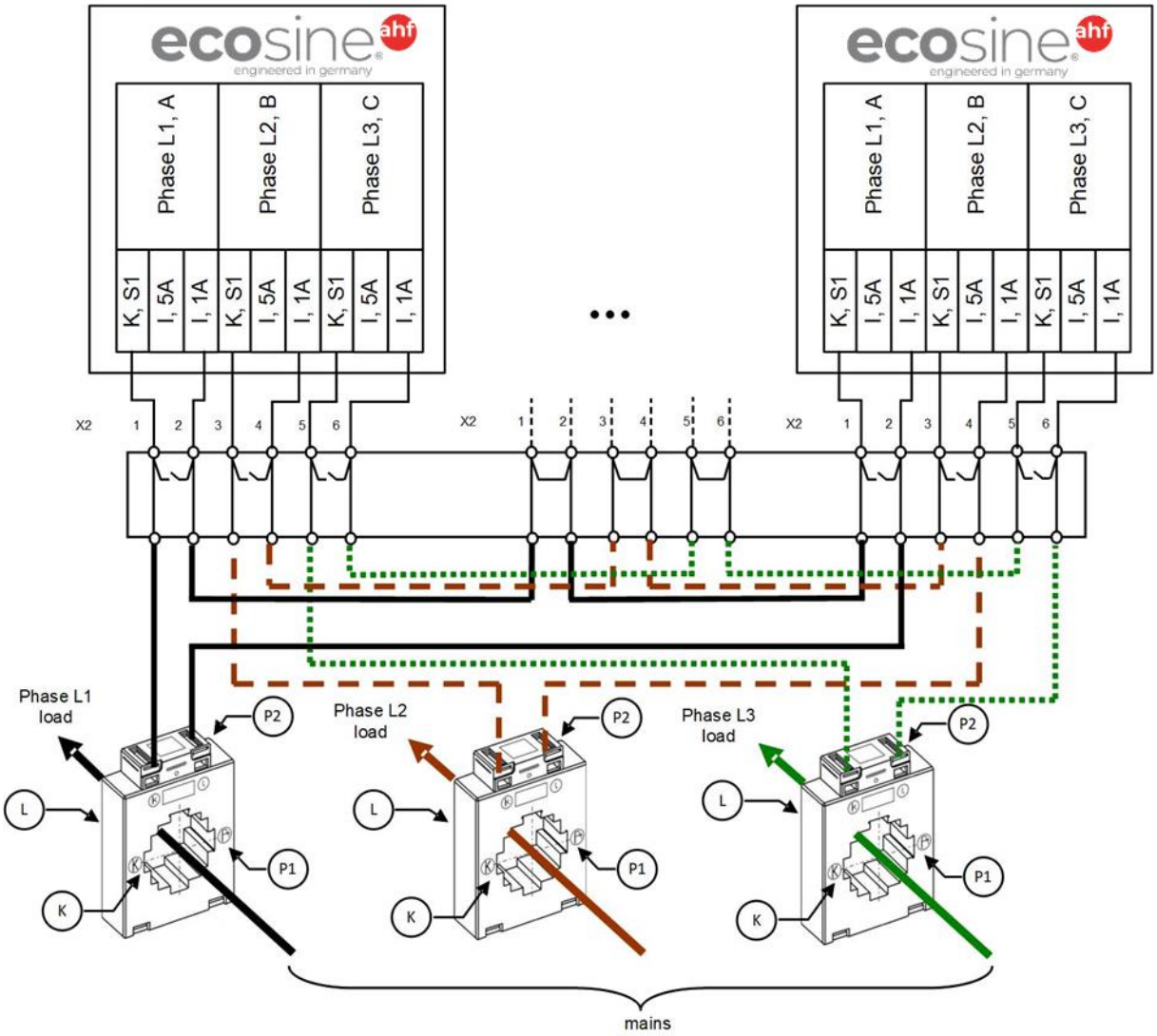


Figure 8-22 CT (1A) wiring for parallel operation up to five Ecosine Active Sync power modules

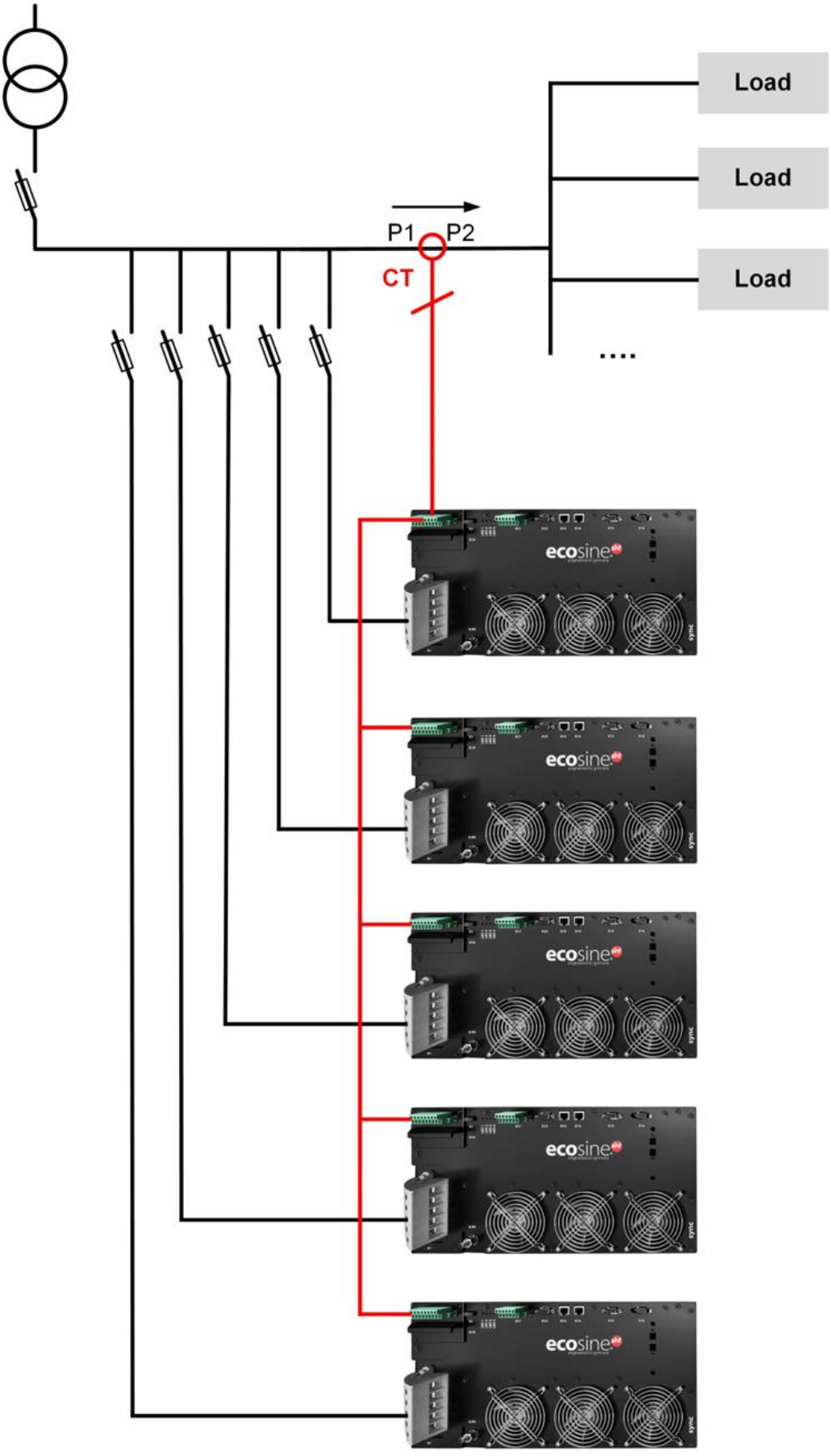


Figure 8-23 CT installation on load side for parallel operation of several (>2) Ecosine Active Sync modules FN3531 or FN3541 without sync module

Note

A maximum of five Ecosine Active Sync devices may be operated on one current transformer set due to the maximum power output of the external current transformers. Usage of the sync module or additional current transformers must be installed if more than five devices are to be operated in parallel.

For parallel operation of more than one Ecosine Active Sync without sync module (except for DPP), the current transformers must be installed on **load side** of the filter. Operation using the sync module allows to have the current transformers either on load or mains side.

P320 must be set to the sum of the entire rated compensation currents connected in parallel (See section 10.1.2).

8.9.5 Grounding of the current transformers

According to DIN VDE 0100 one-side grounding of the current transformers is compulsory only starting from 3 kV rated voltage, it helps to prevent risk for the operating personnel in case of an insulation fault. For voltages below 3 kV, grounding of the current transformers is not required, unless it is necessary for a correct measurement. If it is necessary to ground the current transformers, then grounding should be performed in the following way:

Note
Grounding must be performed only once for each current transformer circuit!

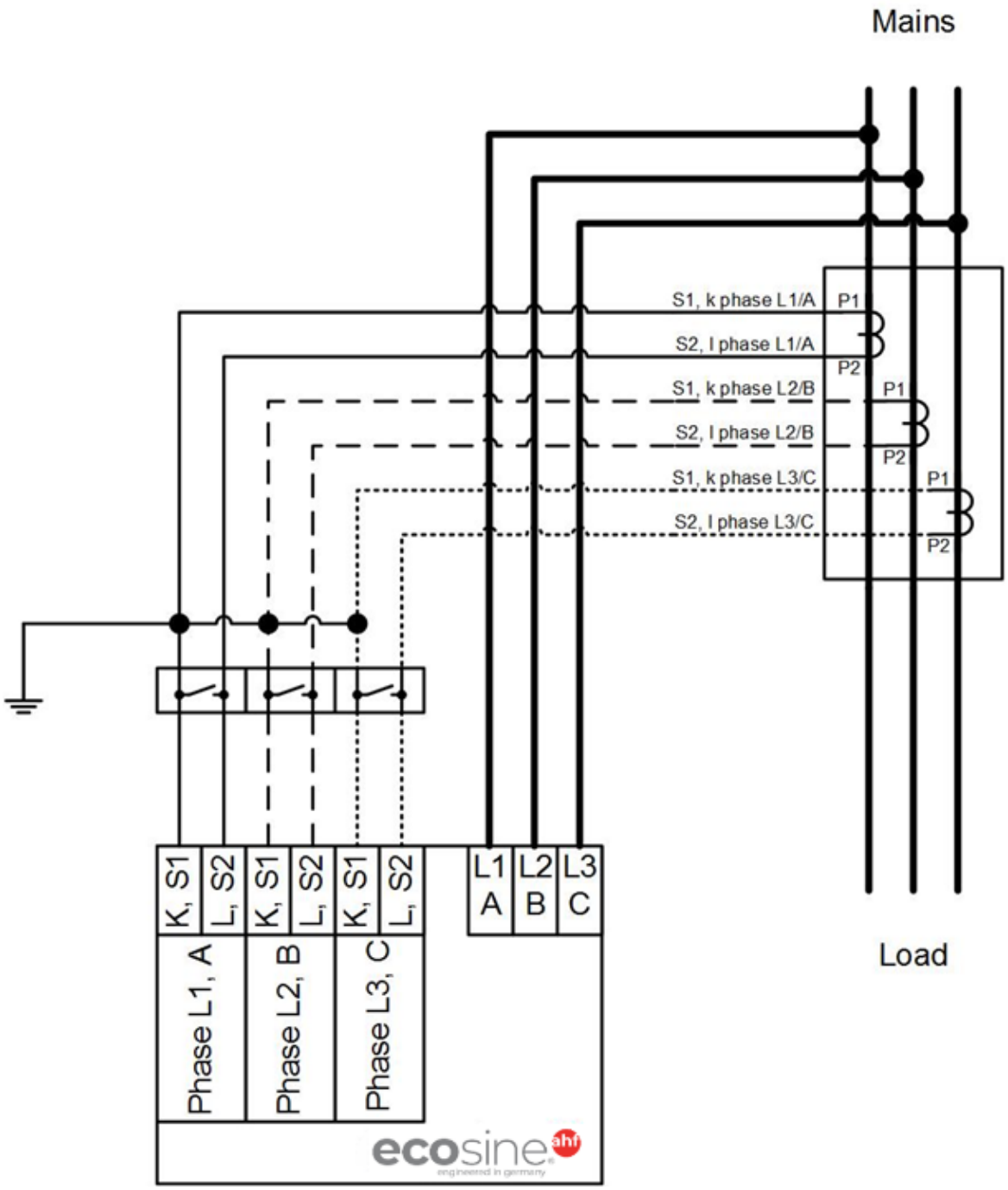


Figure 8-24 Grounding of the current transformers (optional)

8.9.6 Checking current transformers rotating field

Start a single measurement using the AHF Viewer and display the following parameters:

- Voltage values
  - Instantaneous voltage value in phase 1 (P153)
  - Instantaneous voltage value in phase 2 (P154)
  - Instantaneous voltage value in phase 3 (P155)
- Current values depending on the installation of the current transformers

Current transformers on the load side:

- Load current phase 1 (P133)
- Load current phase 2 (P134)
- Load current phase 3 (P135)

Current transformers on the mains side:

- Mains current phase 1 (P123)
- Mains current phase 2 (P124)
- Mains current phase 3 (P125)

If the current transformers are connected correctly, then the rotating field of the voltage and current is identical. If the rotating field is revolving in the opposite direction, two current transformers are reversed in the phases.

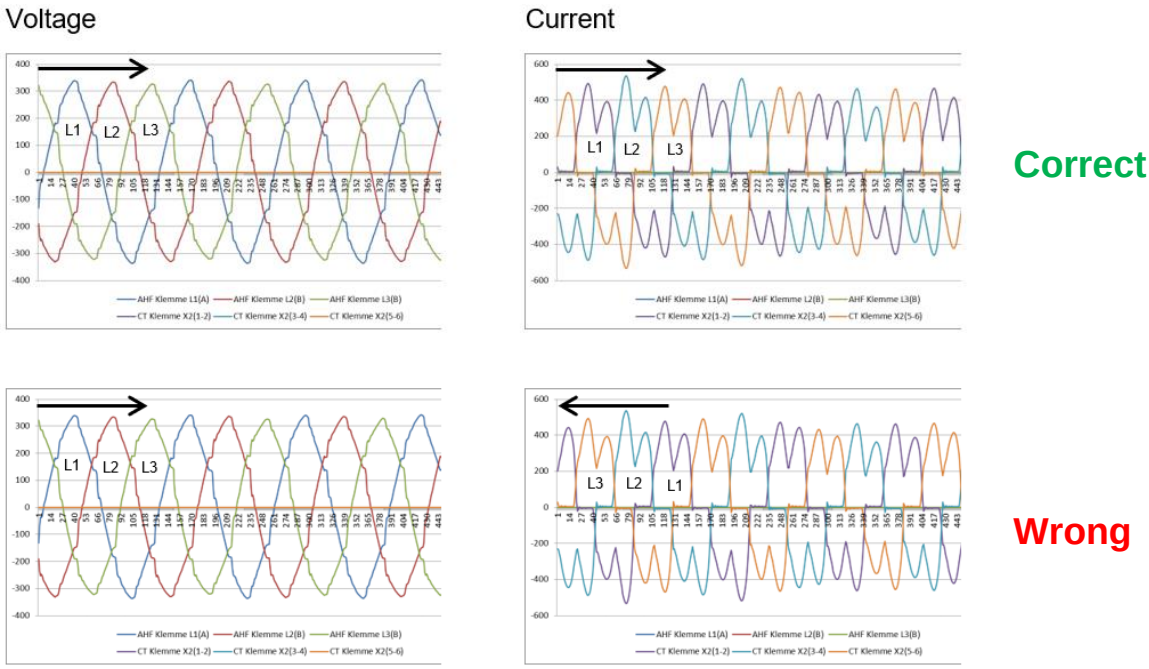


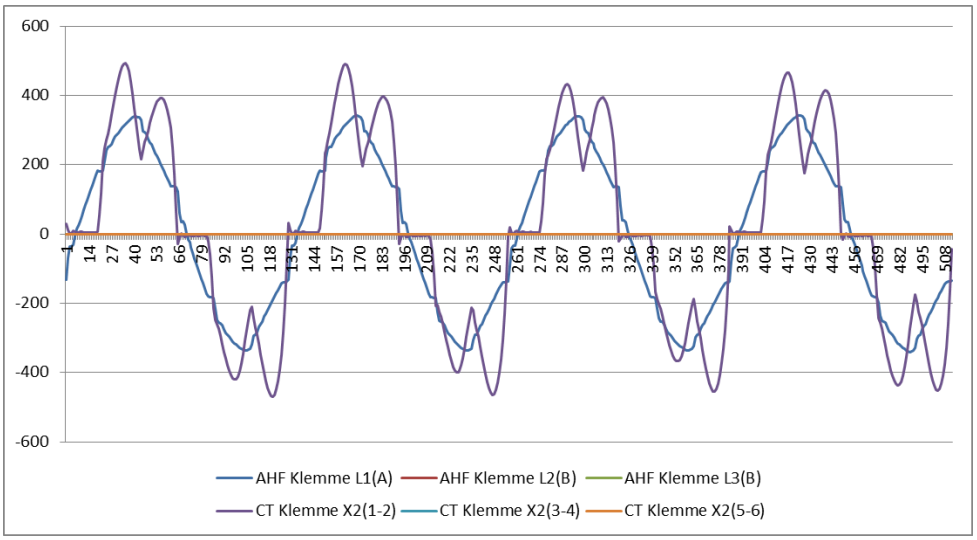
Figure 8-25 Checking rotating field of current and voltage

8.9.7 Checking current transformers phase assignment

If the rotating field is correct, the same measured values can be used to check the phase location of current and voltage.

Example 1:

Phase location of current and voltage match.

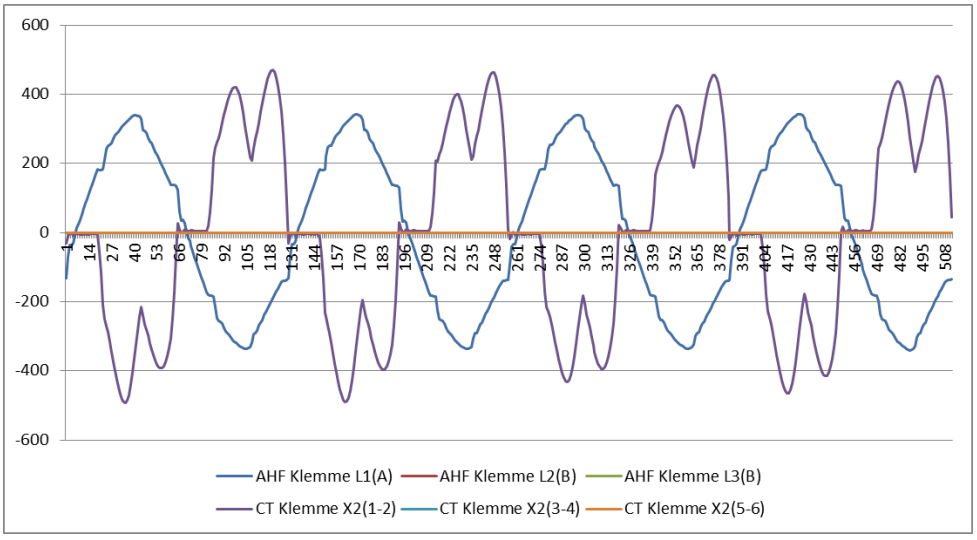


Correct

Figure 8-26 Phase of current and voltage is correct

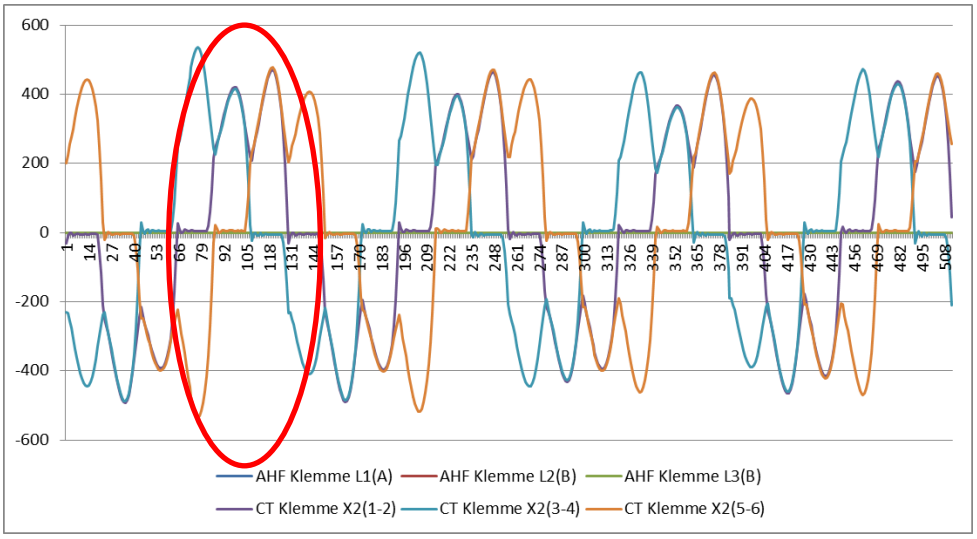
Example 2:

Phase location of current and voltage is shifted through 180°. Here both connections (S1 and S2) of the current transformer are interchanged or the current transformer is installed incorrectly. It becomes evident in 2 different ways. On the one hand, it becomes apparent, as shown in Figure 8-27, in form of the opposite current with respect to the voltage curve of the same phase. Just as it is apparent in Figure 8-28 when displaying all 3 currents, on the basis of incomplete current pattern which does not have a negative current curve for each positive current curve.



Wrong

Figure 8-27 Phase of current and voltage is shifted through 180°

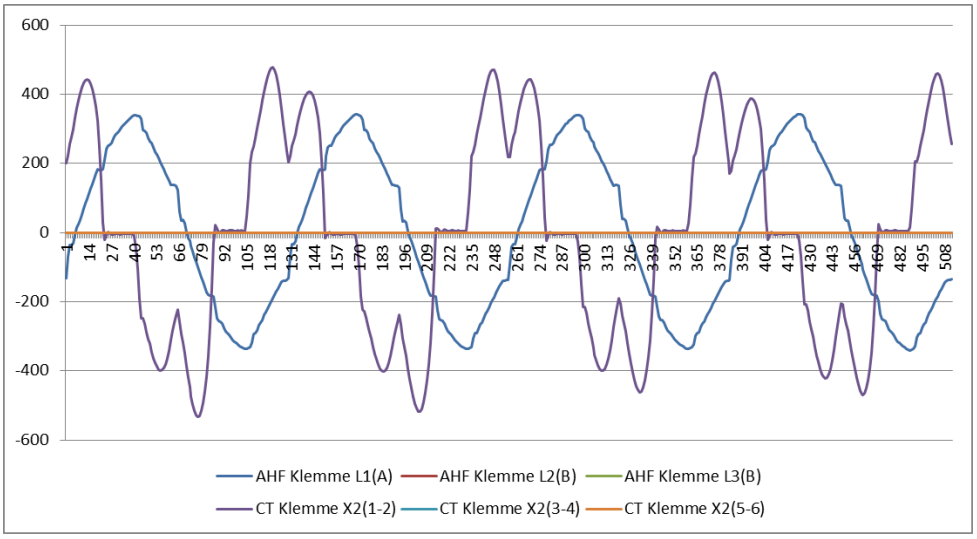


Wrong

Figure 8-28 Current transformer 1 phase-is shifted through 180°.

Example 3:

Current transformers of individual phases are interchanged, it becomes apparent already during the rotating field check. The comparison of current and voltage shows that the phase shifting of current and voltage exceeds 90°. See Figure 8-29.



Wrong

Figure 8-29 Current transformers of phases 1 and 3 are interchanged

8.10 HS-Bus connection (master-slave configuration)

Double Power Pack is realized by connecting two Ecosine Active Sync power modules in parallel via HS-Bus. HS-Bus enables communication between the modules and the workload is distributed equally between the two modules.

HSB communication link implements a MASTER-SLAVE point to point protocol. The MASTER device measures the external current (mains side or load side) needed by the current controllers and generates the base PWM modulation and control loop frequency used by MASTER and SLAVE devices.

HS-Bus configuration steps

Step 1: Master-slave device assignment

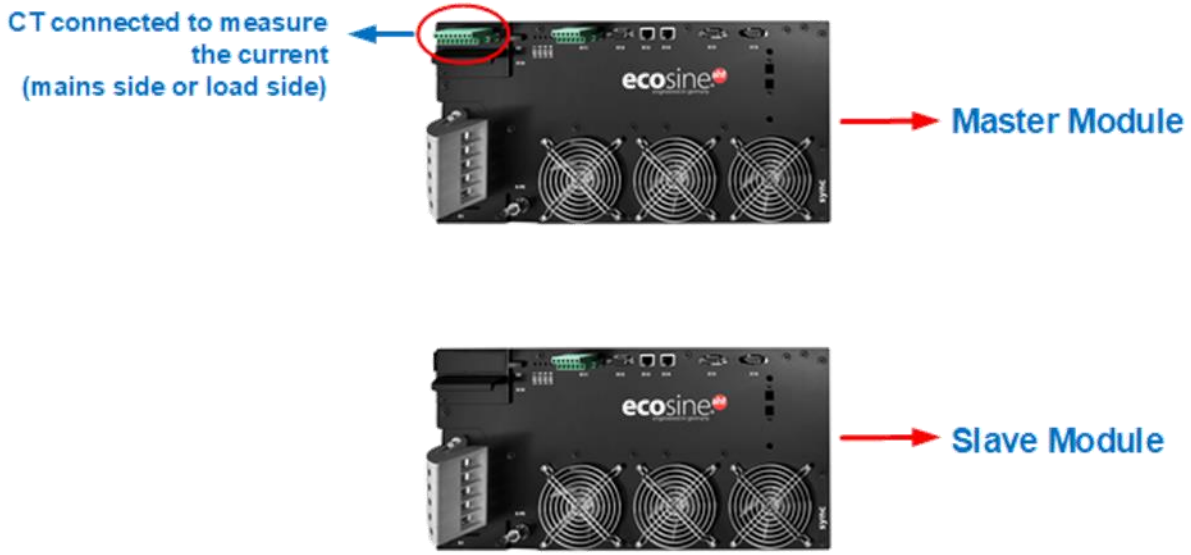


Figure 8-30 Master slave device assignment

Step 2: Connect the modules in parallel to the grid

Step 3: Connect the modules via Terminal X12

Build HSB between the master and slave module by connecting Terminal X12 of both modules with a twisted pair Ethernet CAT5 cable with RJ45 connectors not longer than 10m.

CT can be installed on the mains or the load side of the filters, see Figure 8-16 and Figure 8-15.

Figure 8-31 Location of Terminal X12 on Ecosine Active Sync module

Software setup:

Software settings must be independently configured, this means that two different AHF viewer sessions will be needed to set both MASTER and SLAVE devices up.

Step 4: Check firmware version

To read the firmware version of the Ecosine Active Sync filter module, connect the target device with AHF viewer; under *Device Parameters* | *0 device specifications*, the parameter with ID10 shows the present firmware version.

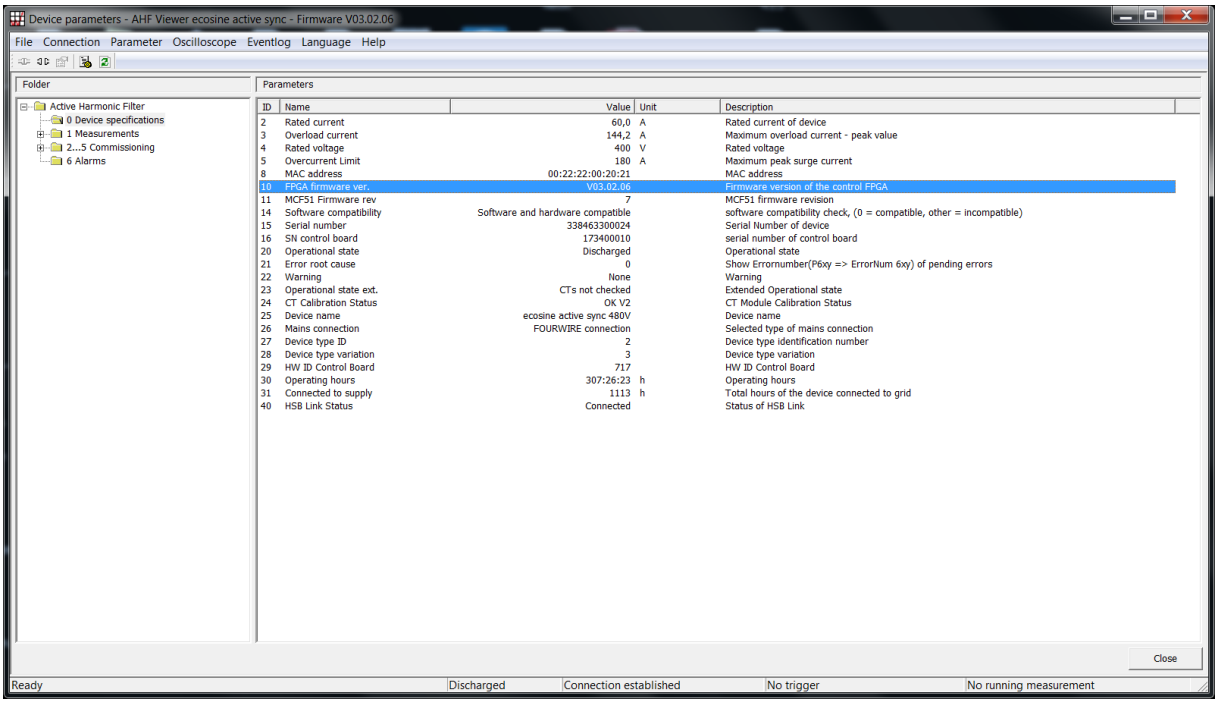


Figure 8-32 Ecosine Active Sync device Firmware version in AHF viewer.

Step 5: Master-Slave configuration

In AHF Viewer ecosine active sync, under *Device Parameters* | *2..5 commissioning* | *base settings* double click on parameter with ID205 (Operation Mode).

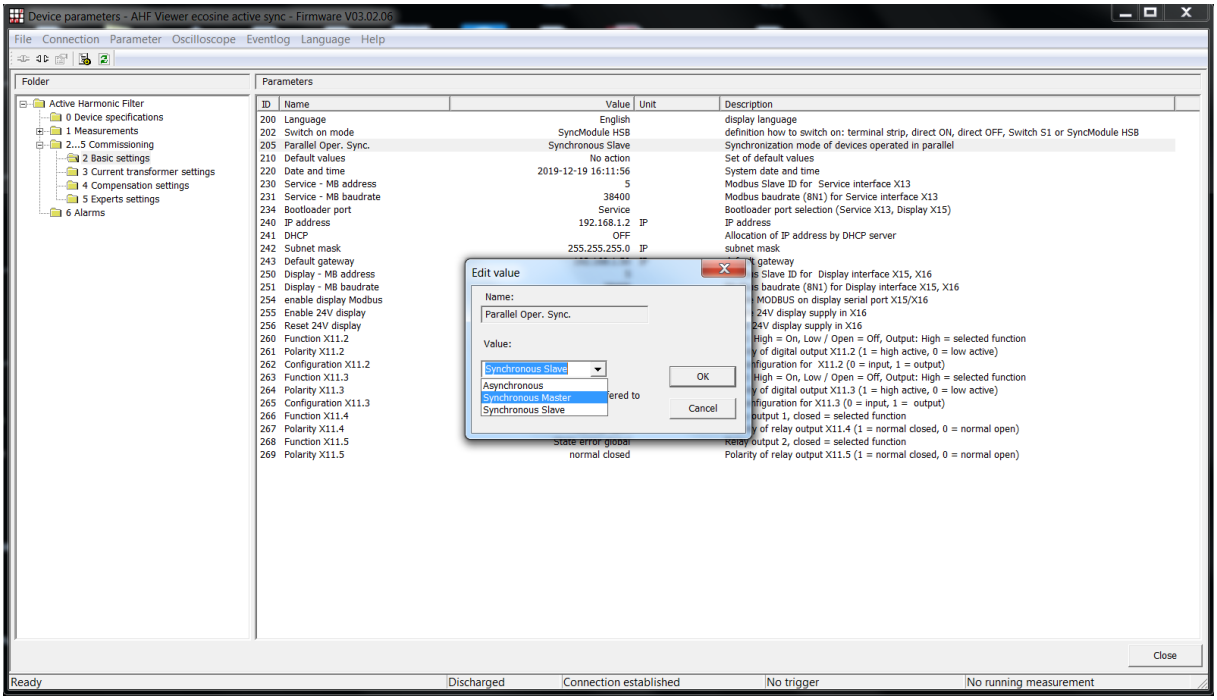


Figure 8-33 Ecosine Active Sync DPP operation Master/Slave configuration.

Table 21 Operation mode, parameter P205

Value	Description
Asynchronous	Single or asynchronous operation mode.
Synchronous Master	HSB Master configuration. With this configuration, the AHF device must have a CT module connected. In this mode (DDP), each power module will compensate 50% of the grid distortion.
Synchronous Slave	HSB Slave configuration. This power module will act as SLAVE and does not need a CT module. The load current values, PWM modulation and base control frequency will follow the MASTER device. In DPP configuration, the power module will compensate 50% of the grid distortion. With sync module as MASTER, each power module is set automatically by the sync module to compensate 1/n (where n is the total number of installed power module in operation) of the total compensation current.

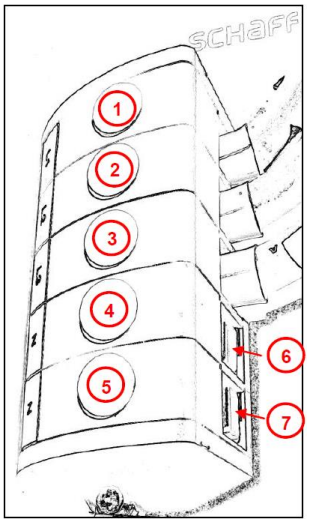
8.11 Additional steps when installing Ecosine Active Sync

To conclude the mechanical and electrical installation of Ecosine Active Sync, the placement of IP20 protection covers and communications ports dust cover, must be done as instructed below.

8.11.1 Power terminals IP20 covers placement

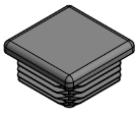
Danger: Protection against contact (electrical shock)

If the Active harmonic filter Ecosine Active Sync is not installed in a cabinet, which ensures protection against contact, a kit of plastic caps must be installed on the AC terminal X1. The kit consists of 5 caps for screw holes plus 2 caps for neutral connection (only required in 3-wire application). It's provided with each single power module and double power pack.



Pos. 1 … 5 5x

Pos. 6 … 7 2x



8.11.2 Communication ports dust covers

Each Ecosine Active Sync power module, sync module and cabinet is delivered with a kit of dust covers (Figure 8-34) for the unused communications ports. This will protect the port from dust and humidity for the years after commissioning until the port will be used again.

Simply place a cover on all unused RJ45 (e.g., X12, X14, X103, ...) and d-sub (e.g. X13, X113, ...) ports, as represented in Figure 8-35.

Figure 8-34 RJ45 (left) and d-sub (right) dust covers as provided in the accessory bag.

Figure 8-35 Example of communication ports with covers installed.

9 Monitoring, and commissioning

Ecosine Active Sync harmonic filters can be monitored and commissioned via the HMI touch screen or the display module.

Warning: Before using the HMI for the first time, you must change the default passwords. See section 9.1.10 for more details.

9.1 HMI functions

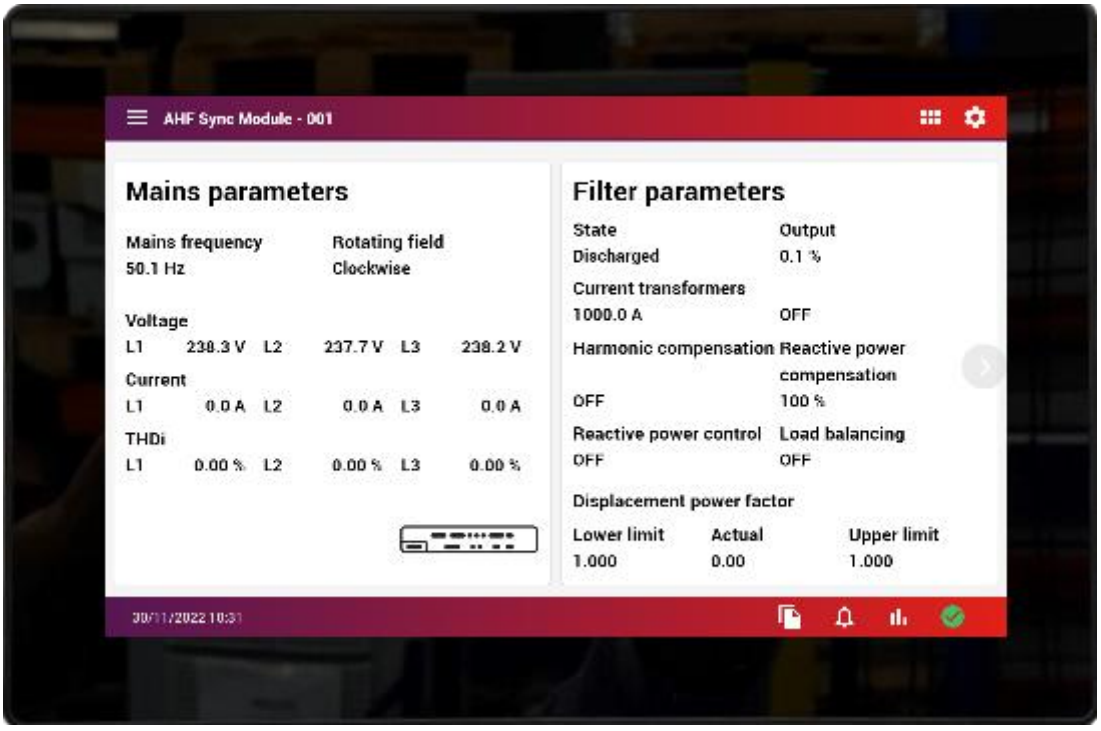


Figure 9-1 HMI 7" touch screen

The HMI 7” touch screen offers the most comfortable way to interact with ecosine active sync. It offers the following features:

- Monitoring of the mains parameters
- Monitoring of the filter parameters
- Programming parameters from all ecosine devices connected to the system
- Plot measurements in an oscilloscope style view
- Save and restore a set of parameters and settings

9.1.1 Main screen

The main screen of the HMI offers a summary of the AHF current state. The left side shows measurements from the mains (grid) as measured by the AHF and the CTs connected to it. The right side shows a selection of the most useful filter parameters.

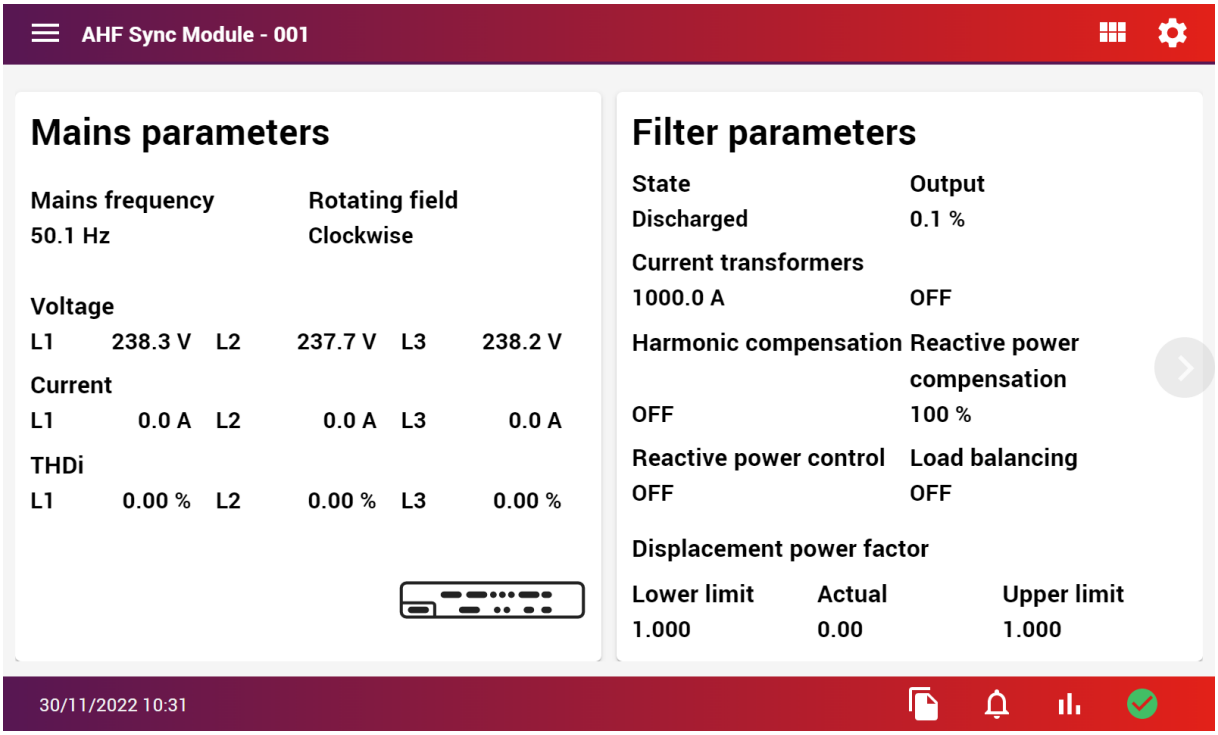
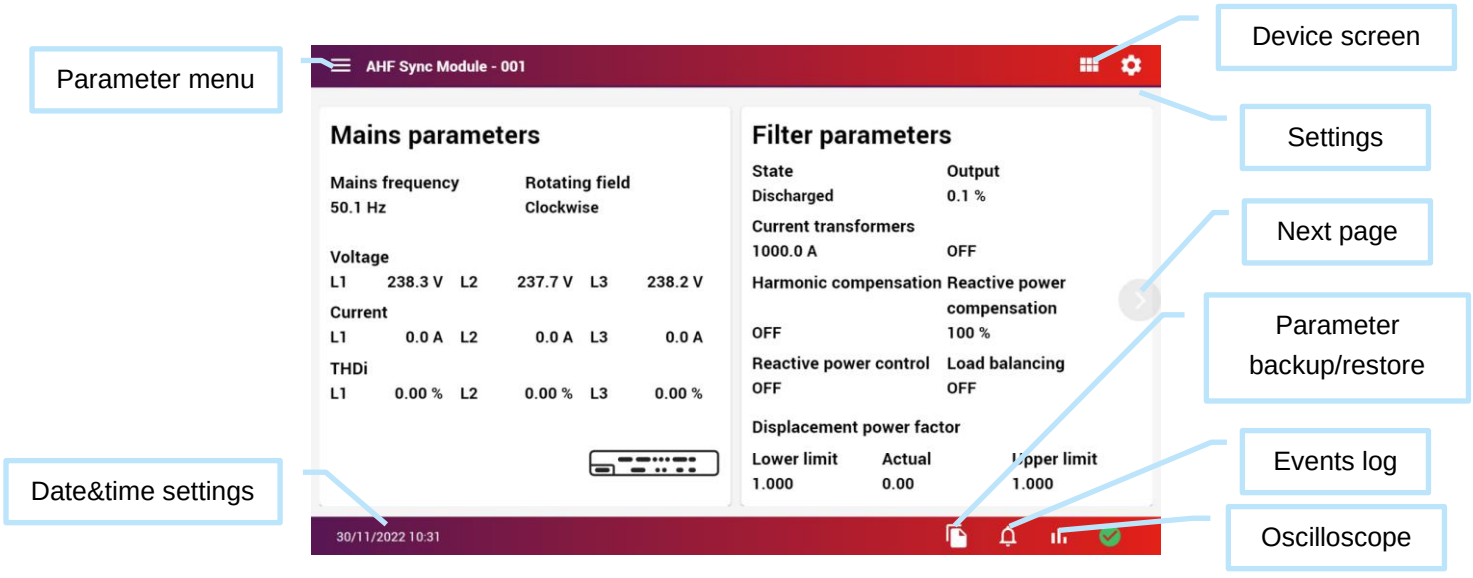


Figure 9-2 HMI main screen

Below are listed all functions and menus accessible from the main screen.



The bottom left of the screen also indicates the status of the connected device. A green checkmark indicate that the device is reachable, a disconnected plug indicated that the device is disconnected.

9.1.2 Devices screen

The devices screen lists all devices connected in the system. It's possible to run a scan to refresh the devices list, see if a previously connected device is now offline, display the type (Power Module or Sync Module with the matching icon on bottom right of the device card), the Modbus-address number and firmware version of the device.

By pressing a device, it opens the main screen of this device.

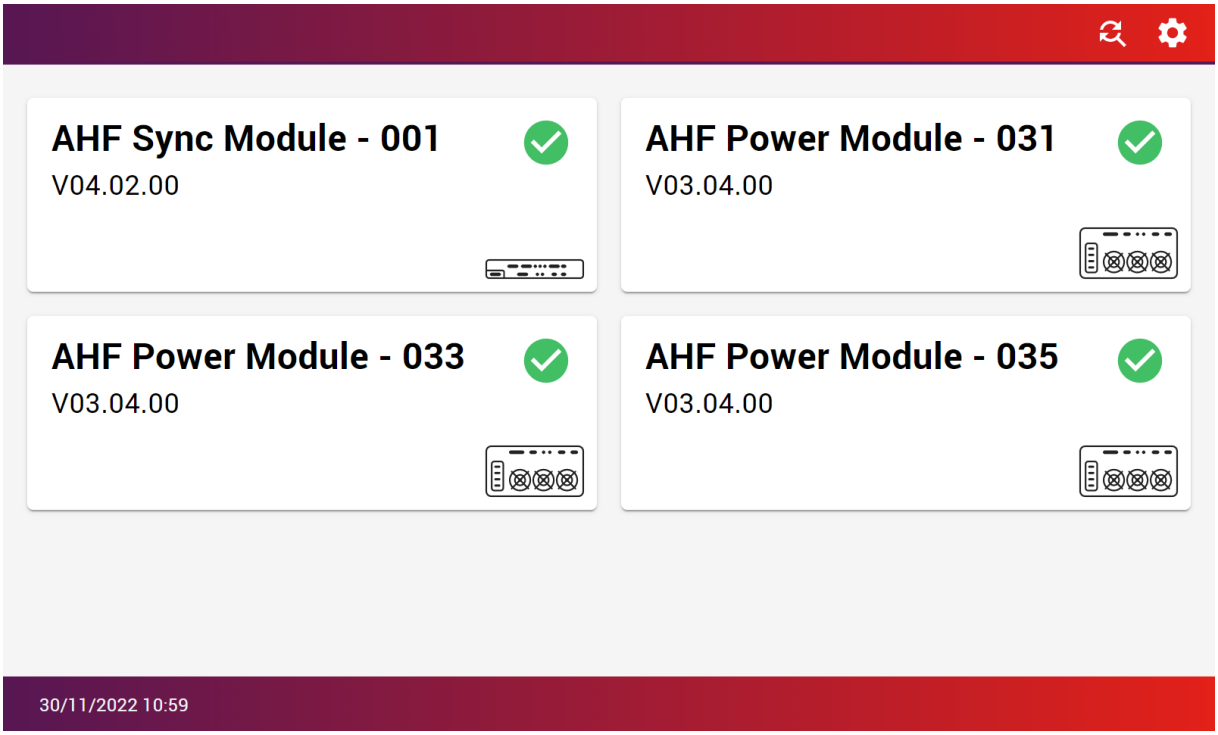


Figure 9-3 Device screen with 4 devices connected

Pressing the circle-arrow icon will trigger a scan and refresh the list. During the scan a message in the bottom left will inform the user of a scan in progress and show how many addresses have already been scanned. Device can have a number ranging from 001 to 255.

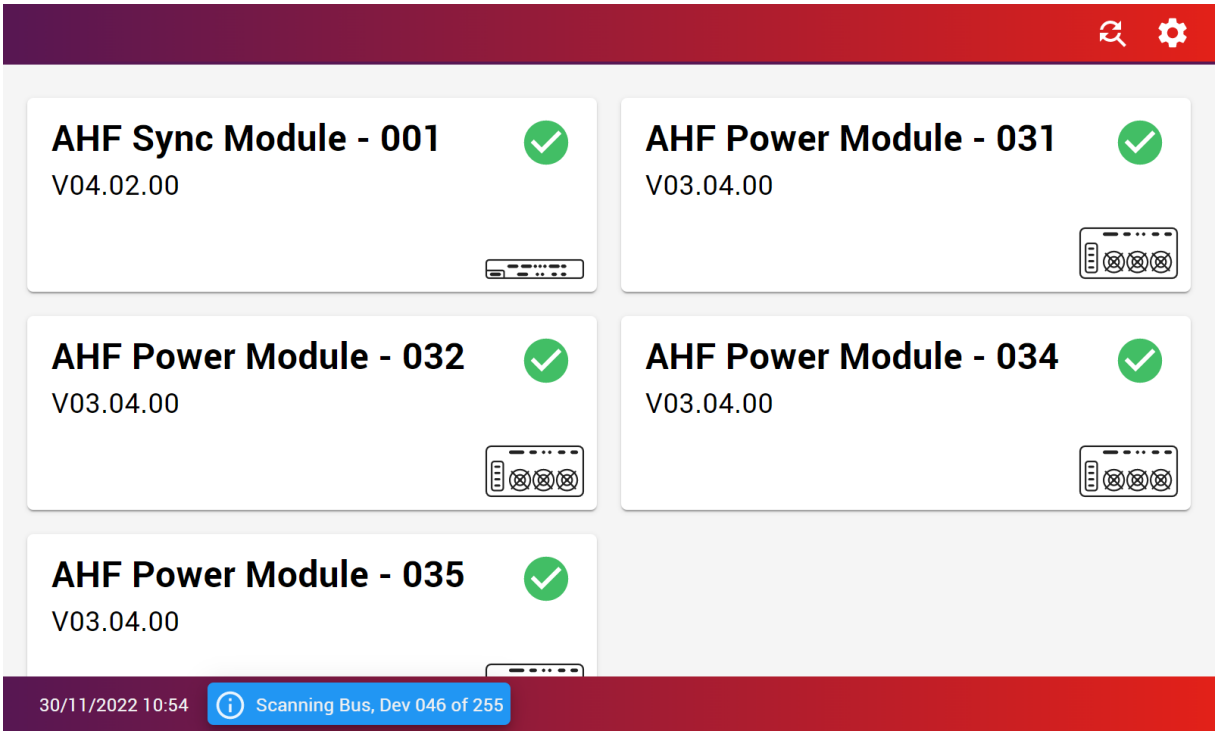


Figure 9-4 Device screen, scan in progress

When more than 4 devices are connected, some devices are partially or completely off the screen. Doing a swipe up gesture on the touch screen will allow you to see the rest of the devices.

When the last used device (last one opened on main screen) is disconnected, the scan screen will show it with a disconnected icon instead of the green checkmark. Check that the devices are connected and power and trigger a new scan to see the connected device again. While disconnected it's still possible to open the last opened device and read the last parameter in memory as seen last time it was refreshed by the HMI.

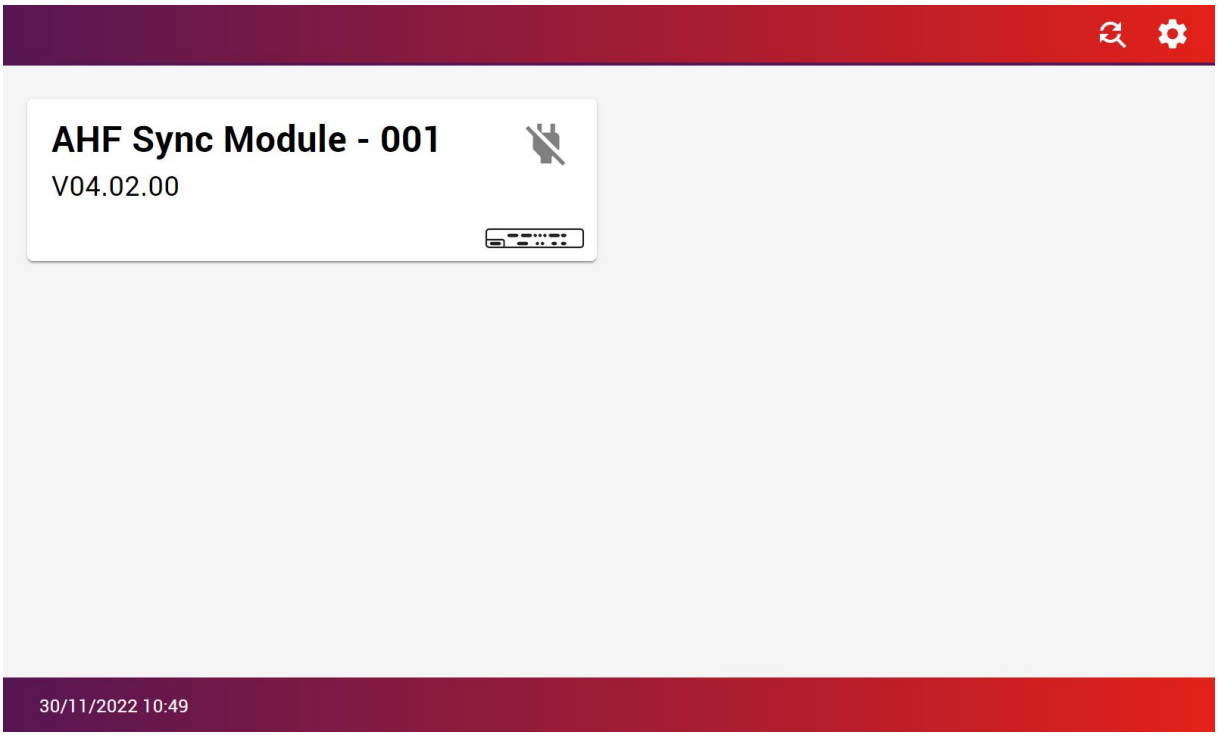


Figure 9-5 Last used device seen disconnected

9.1.3 Parameter menu

By clicking on the menu icon, in the top left corner, you can access all parameter screens directly by selecting a category in the list. Some parameter categories are only visible with service level access.

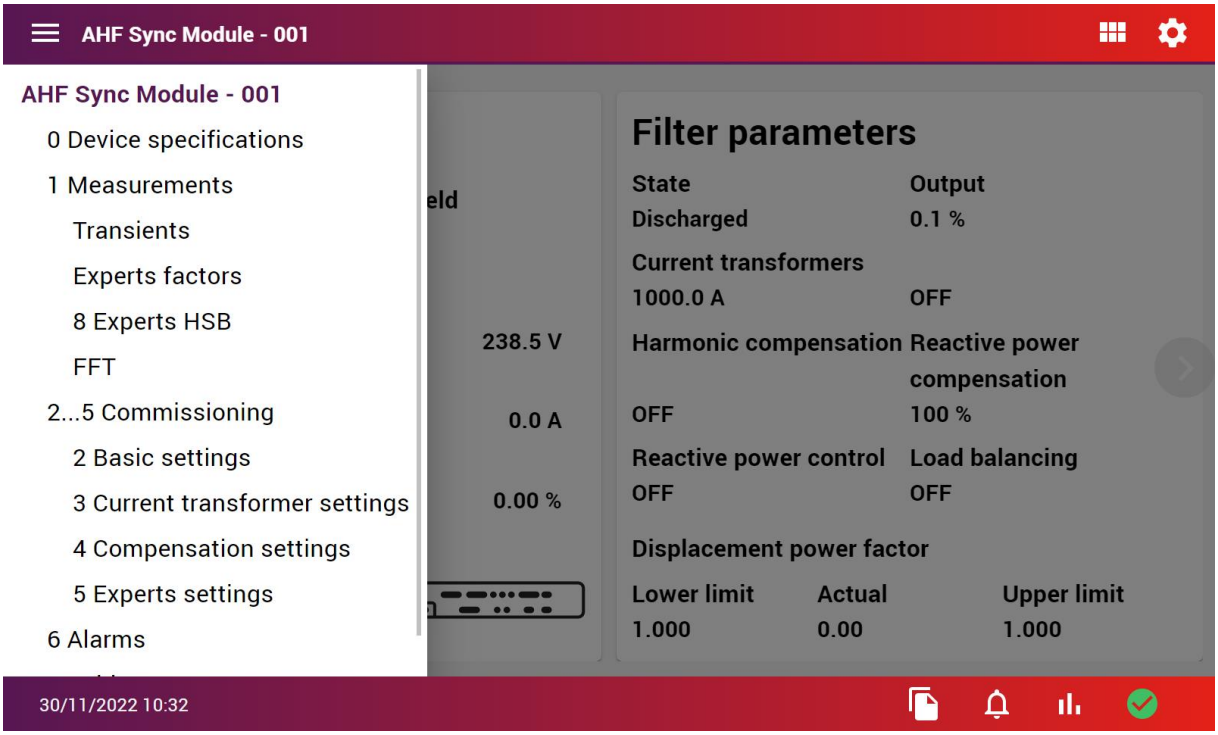


Figure 9-6 Parameter menu

9.1.4 Parameter screens

You can access the various parameter screens using the parameter menu as described above or by swiping right to left from the main screen. Alternatively, you can click the light transparent arrow circle on the middle of the right side of the screen.

Each parameter screen lists all relevant parameter in each category. The top part of the screen gives you the information about the current device selected and the category currently in view. Some parameters might be off the screen and need a scroll down to see them. You can swipe up and down using the touch screen.

Swipe left and right or use the arrow to quickly switch to the next or previous category list.

Click on any parameter to see more information and possibly edit the parameter. Read & write parameters can be modified by open the parameter card, clicking on the value and either entering the value using the virtual keyboard or selecting from a list of possible value.

The small pencil icon on the top right corner of a parameter card indicated that the parameter is read & write. Parameters without icon are read only.

Some parameters are restricted to certain types of value like integer number, floating number, alphanumeric text, IP address or only pre-defined choice from a given list.

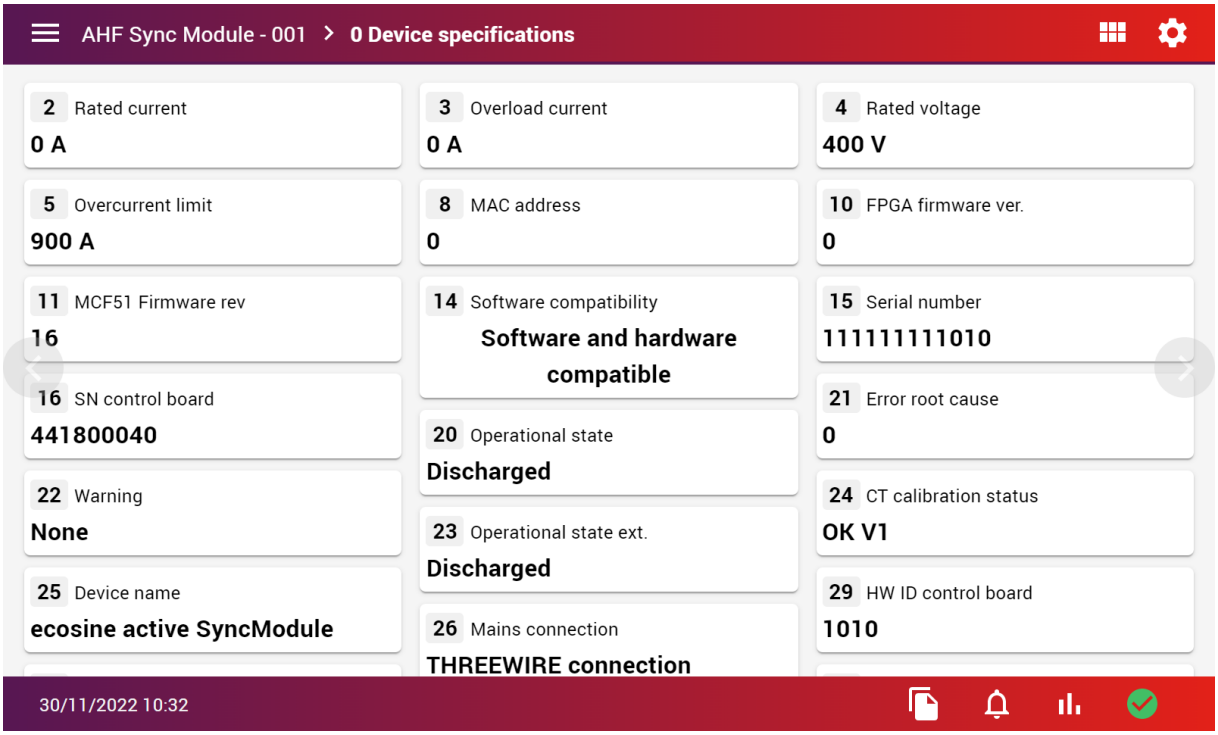


Figure 9-7 Parameter list category 0 - Device specifications

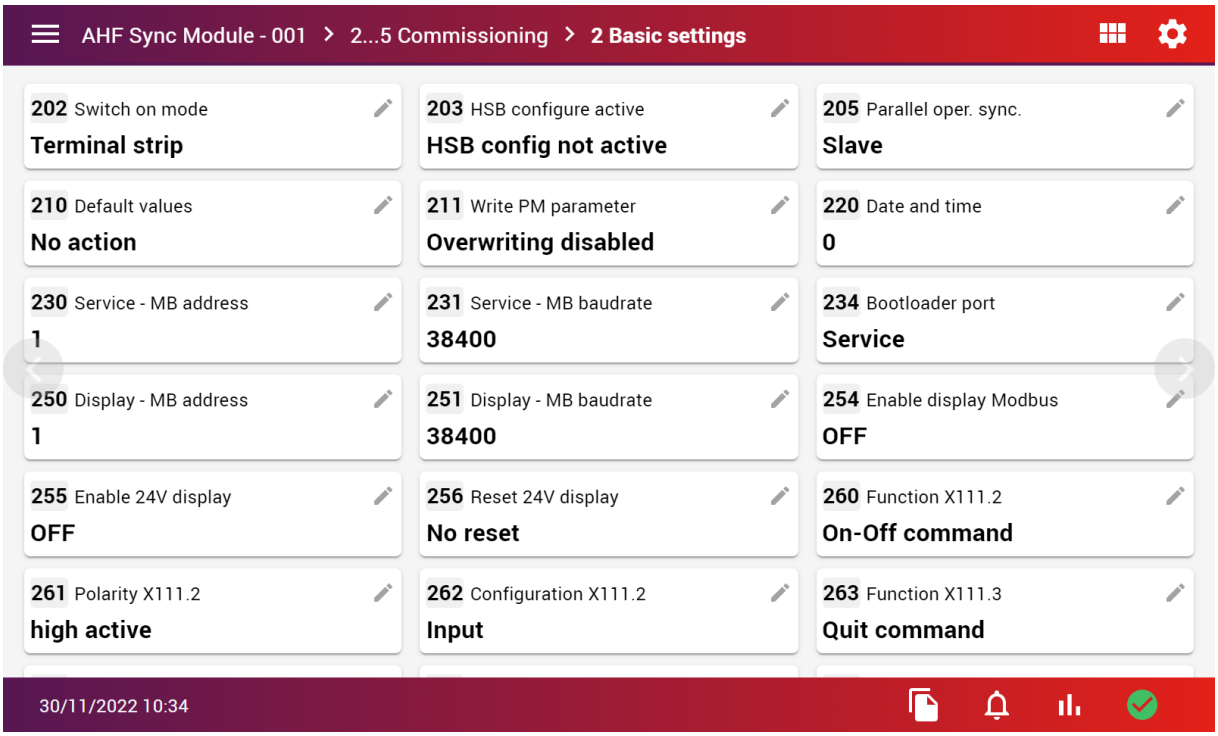


Figure 9-8 Parameter list category 2 - basic settings. These are read & write parameters (see the pencil icon)

Some parameters are organized in sub-folders. Click on a folder card to open the sub-folder or use the parameter menu on the top left to directly reach a sub-folder parameter list.

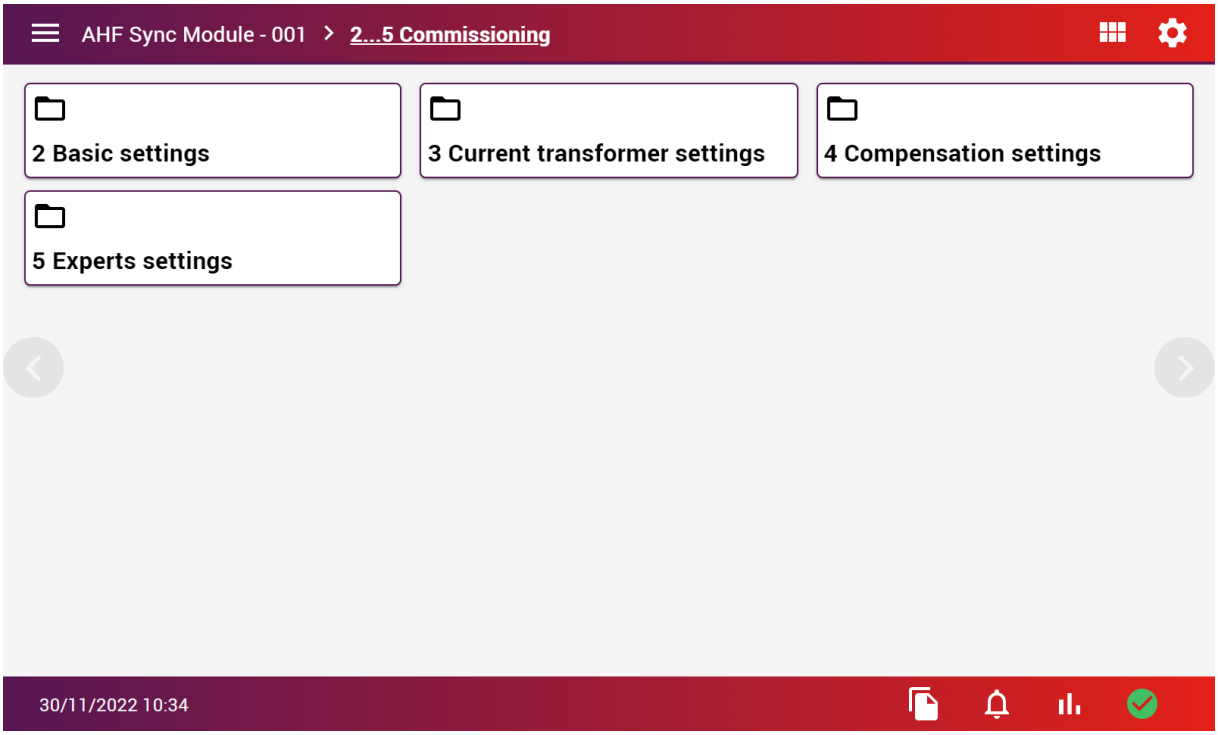


Figure 9-9 Parameter screen showing some sub-folders

9.1.5 Parameter set backup and restore

Using the file icon from the bottom of the screen you can access the parameter file backup and restore screen.

From this screen you can:

- Read the parameter set from the device to the HMI memory
- Write a set of parameters to the device that were previously saved in the HMI memory
- Check the parameter list before saving or restoring

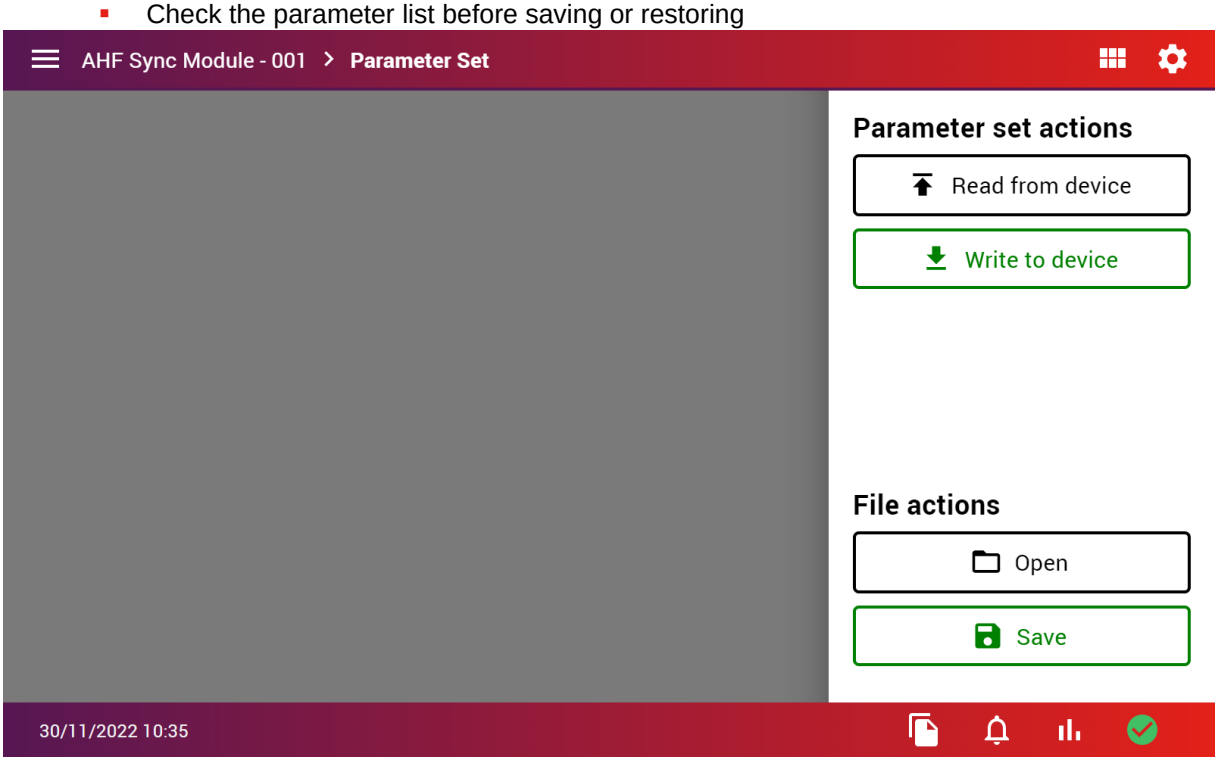
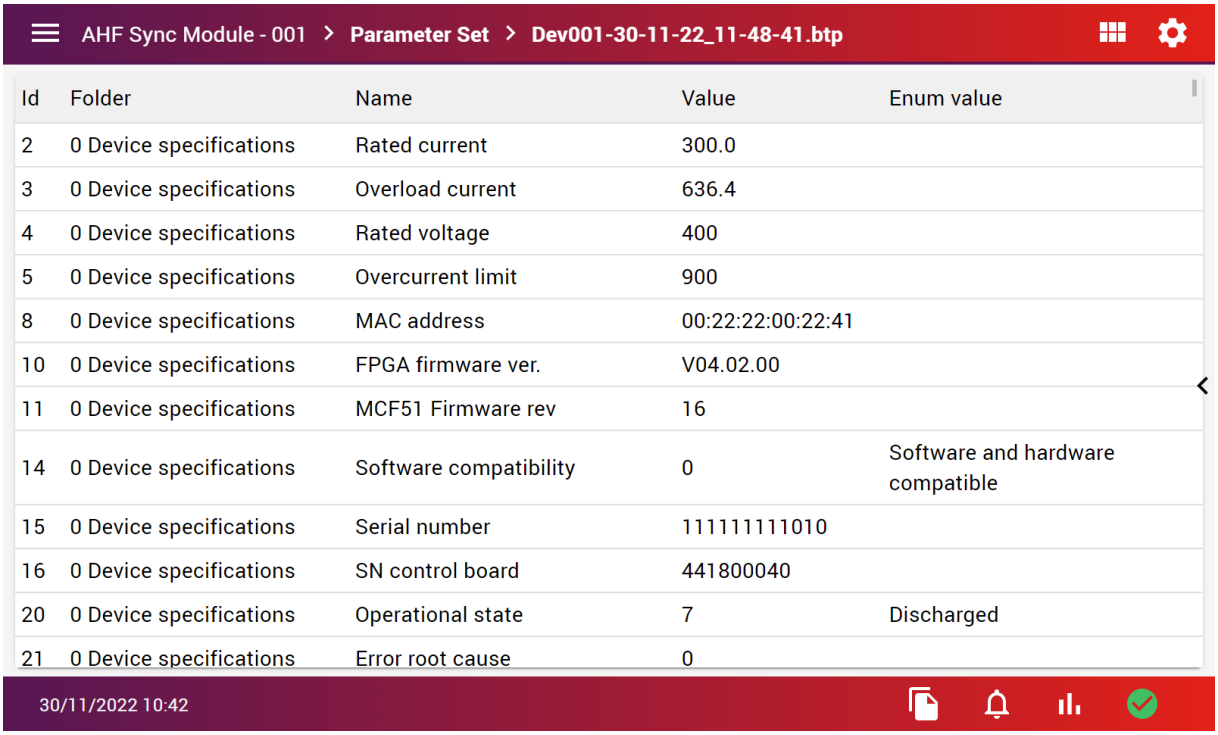


Figure 9-10 parameter backup and restore screen (no parameter loaded)



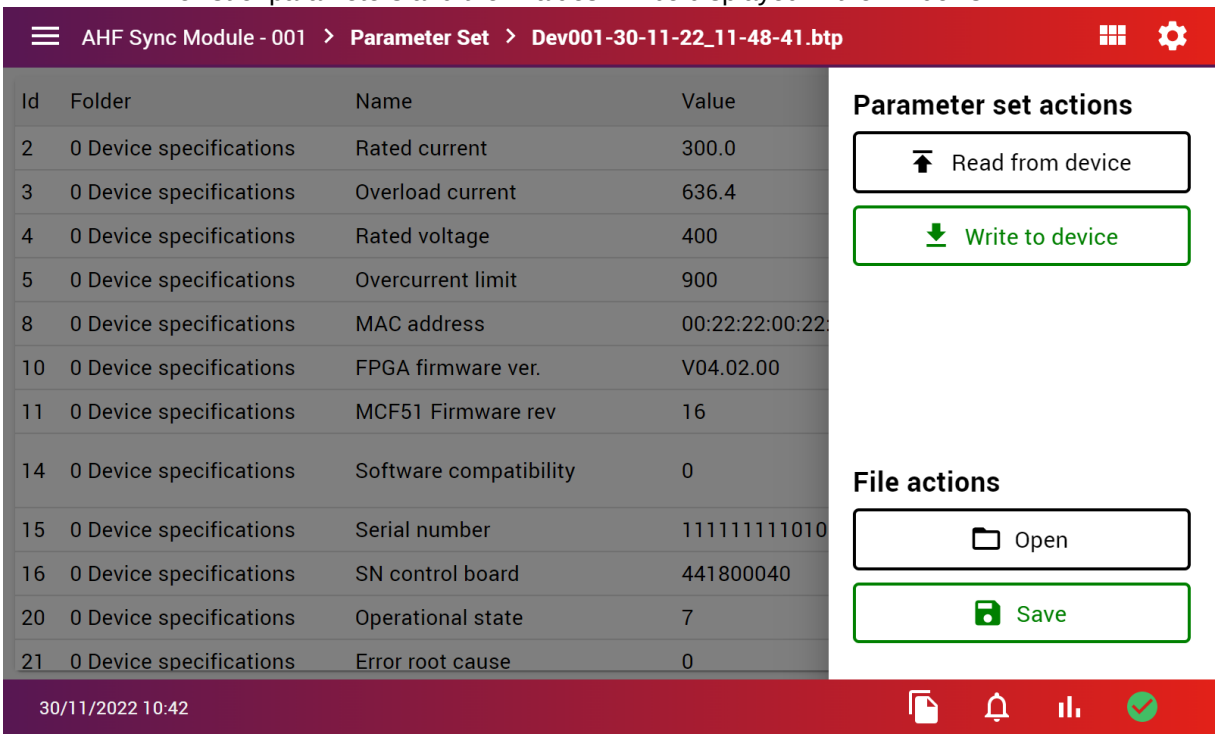
Id	Folder	Name	Value	Enum value
2	0 Device specifications	Rated current	300.0	
3	0 Device specifications	Overload current	636.4	
4	0 Device specifications	Rated voltage	400	
5	0 Device specifications	Overcurrent limit	900	
8	0 Device specifications	MAC address	00:22:22:00:22:41	
10	0 Device specifications	FPGA firmware ver.	V04.02.00	
11	0 Device specifications	MCF51 Firmware rev	16	
14	0 Device specifications	Software compatibility	0	Software and hardware compatible
15	0 Device specifications	Serial number	111111111010	
16	0 Device specifications	SN control board	441800040	
20	0 Device specifications	Operational state	7	Discharged
21	0 Device specifications	Error root cause	0	

Figure 9-11 parameter backup and restore screen (with file loaded and menu closed)

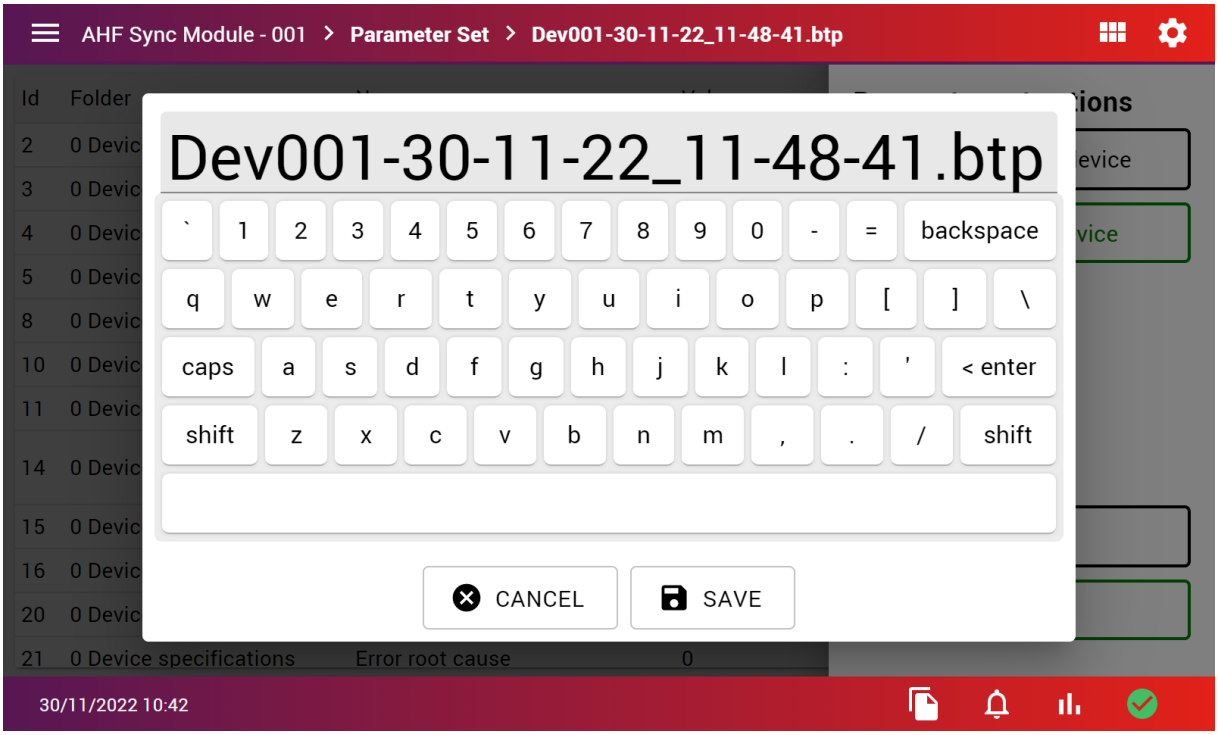
Use the arrow on the right or swipe from the right edge of the screen to the left to open the menu.

9.1.5.1 Procedure to save a parameter set

- Click “Read from device” to load the parameters from the currently connected device (the device name is visible on the top of the screen)
- The list of parameters and their values will be displayed in the windows

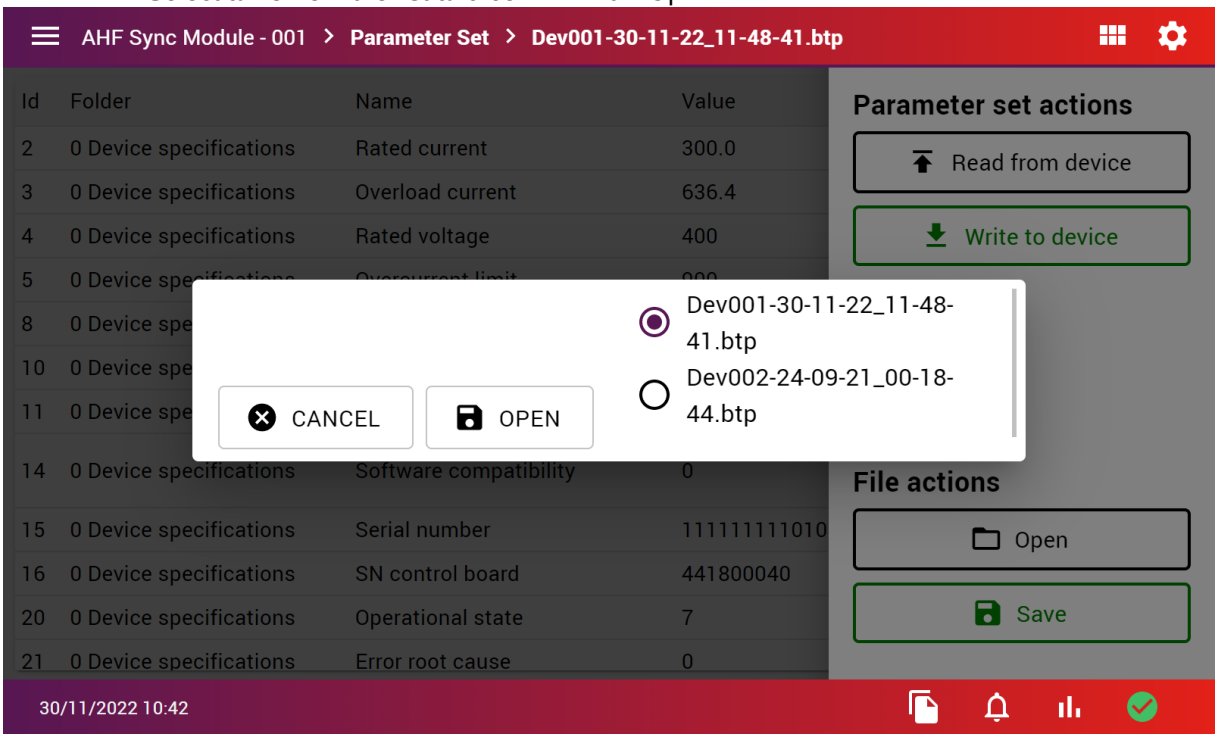


- Click “Save” to save the visible parameter list to the internal HMI memory
- Choose a name for the file to be saved and click “save” again to confirm.



9.1.5.2 Procedure to restore a parameter set file to the currently connected device.

- Click “Open” under “File actions”
- Select a file from the list and confirm with “Open”



- The newly loaded parameter list is visible in the windows but not yet uploaded to the device. Check the file name of the loaded file on the top of the screen and check the parameter list by scrolling down.
- Double check that you are connected to the correct device by checking the device type and number on the top of the screen.
- Click “Write to device” to replace all parameters values by the one from the file loaded.

9.1.6 Event log

The event log lists the events that happen on the connected device, from the latest one on top to the oldest one in the bottom. To access the event log of the currently connected device, click on the bell icon on the bottom right of the screen (from any screen beside the device screen).

At the first start the event log will be empty. The records must be updated from the device by using one of the 2 options:

- Update latest records (load only the 200 last events, faster and usually enough)
- Update all records (load all events in the device memory, in case more are needed)

For the initial load both options will have the same behavior. For future updates the use of “Latest records” option is usually enough, except if an event log file has been loaded (see below).

9.1.6.1 Read the event log

Once loaded you can click on the left side of the screen to close the menu and read the event log entries. Scroll down to see older entries. Use the arrow on the right or swipe from the right edge to the left to reopen the menu.

They are 4 different types of events:

- Information (in blue)
- Status (in green)
- Warning (in yellow)
- Error (in red)

Each log entry is split on 5 columns:

- Event type icon and color (see below)
- Date of event
- Time of event
- Event description
- Number of operating hours of the device when the event occurred

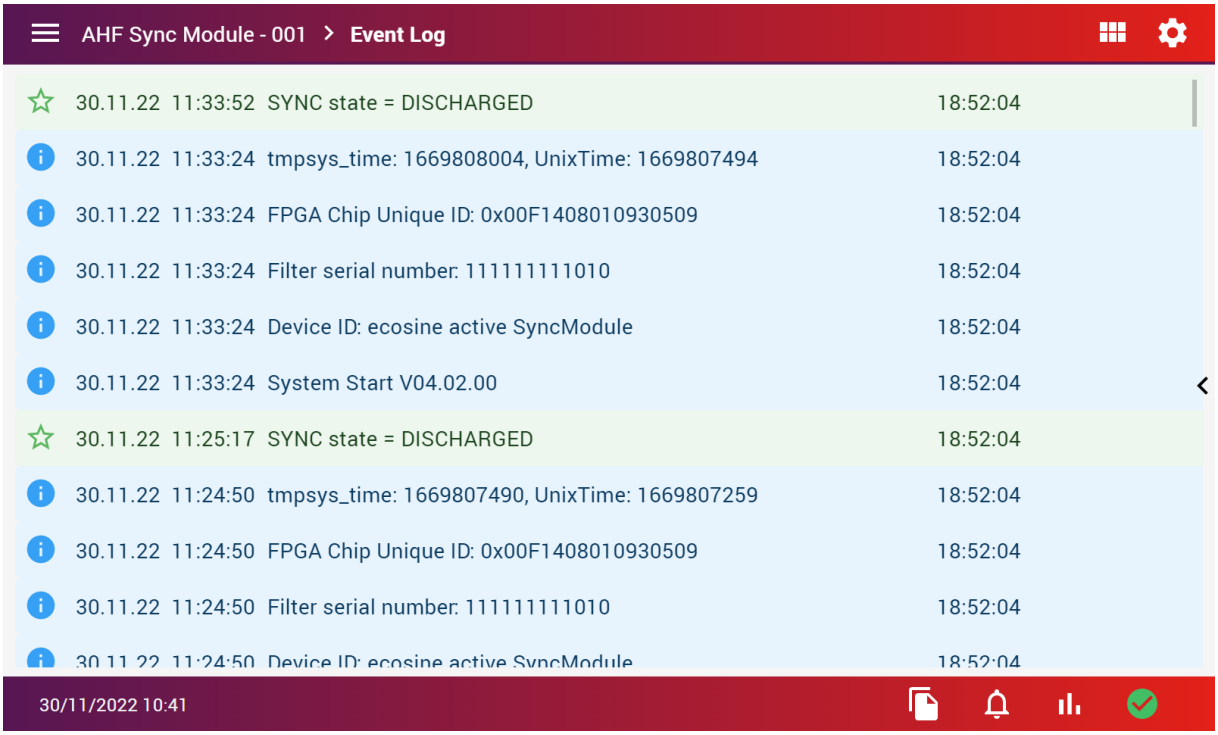
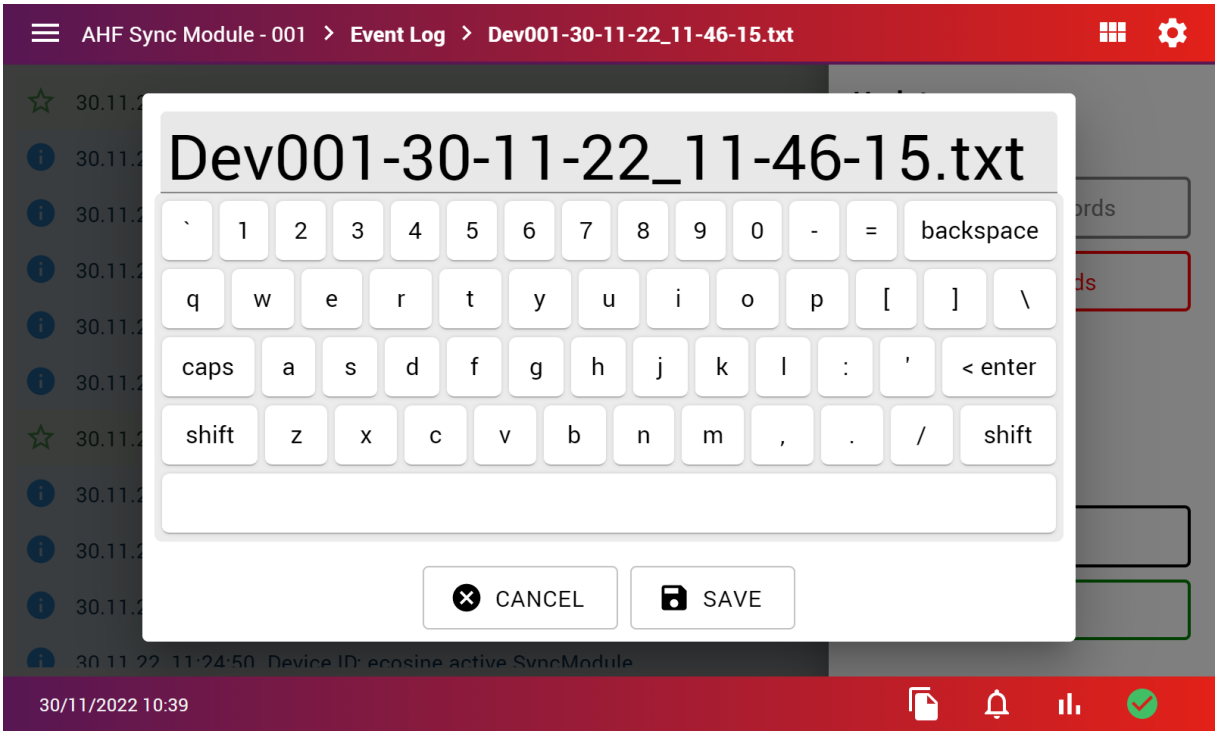


Figure 9-12 event log loaded from the device

9.1.6.2 Save the event log to a file

Once loaded the event log can be saved to the internal HMI memory.



9.1.6.3 Load an event log stored on a file

It's also possible to load a previously loaded event log file to see it on the screen. Click "Open" and select an event file (*.txt) from the list of file present in the internal HMI memory. You can see that you are reading the event log from a file by looking at the top of the screen. If ending by "Event Log", it's the records last updated from the device. If it's a file name ending by *.txt you are reading the event log from a file.

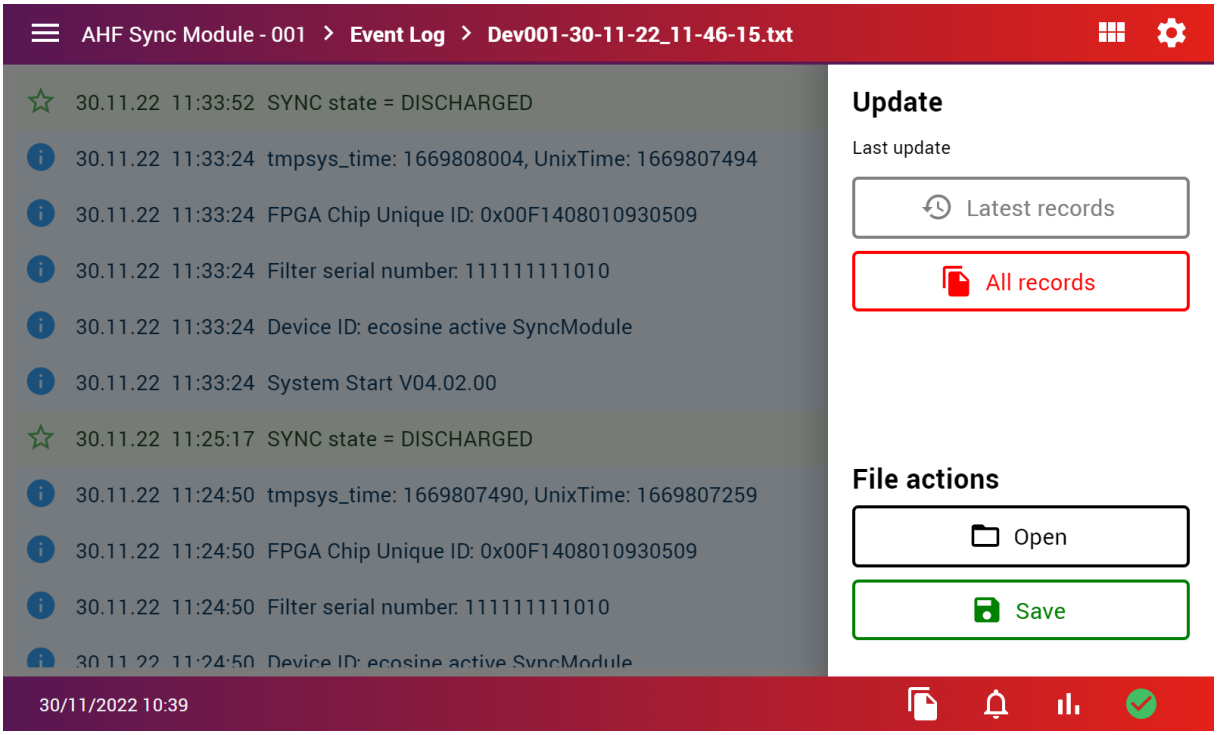


Figure 9-13 event log loaded from a file

After usage of an external event log file, you must update the records from the device again, entries loaded from the file will be discarded and replaced by entries from the device, it will never be merged or added.

9.1.7 Oscilloscope measurement

The oscilloscope function offers a simple way to do measurement using AHF internal sensors and CT sensors connected to the system. Open the oscilloscope from the icon on the bottom right.

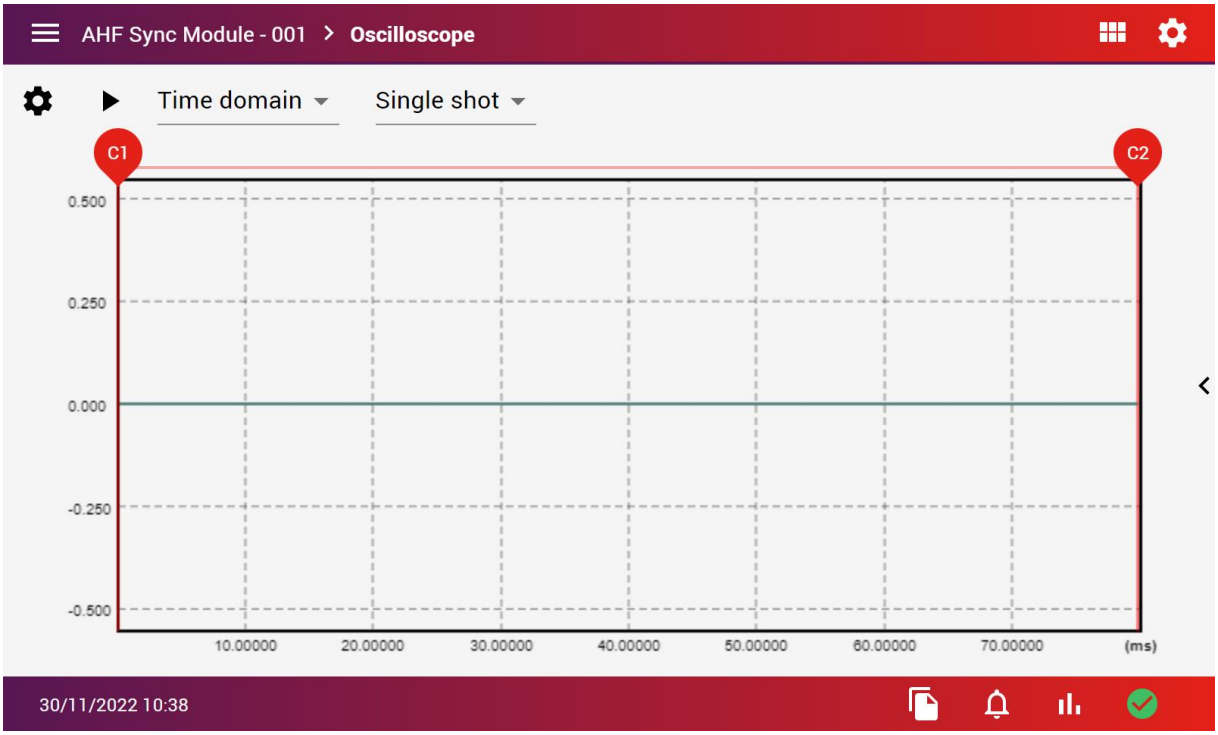


Figure 9-14 oscilloscope view

9.1.7.1 Plot measurements

Click the “play” icon ▶ to trigger a measurement. The graph has 2 cursors, C1 and C2 to display up to 6 measured or calculated values from the measurement sampling in 2 positions. Slide the cursor to change its position.

Click the arrow on the right side of the screen or swap from outside right to the left, to open the measurement menu, which shows the selected values at these 2 cursors as well as the delta (time difference) between both cursors.

It’s possible to enable or disable any of the 6 measurements from this menu.

9.1.7.2 Save measurements

Measurements are saved automatically on the HMI internal memory. It’s possible to reopen the files or copy them to an USB disk using the “File operations” function in the HMI settings, disk manager tab.

Figure 9-15 oscilloscope with open measurement panel

9.1.7.3 Oscilloscope settings

At the top of the graph are 2 drop down option lists. The first is to select between time domain and frequency domain (FFT). It will change the x axis into time (in ms) or frequency (in Hz).

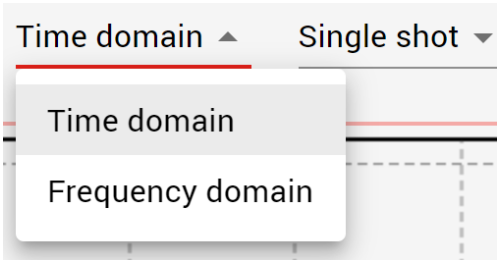


Figure 9-16 time domain/frequency domain option

The second is the trigger behavior. Single shot will trigger once and stop. Continuous measurement will trigger continuously, when the trigger condition is met.

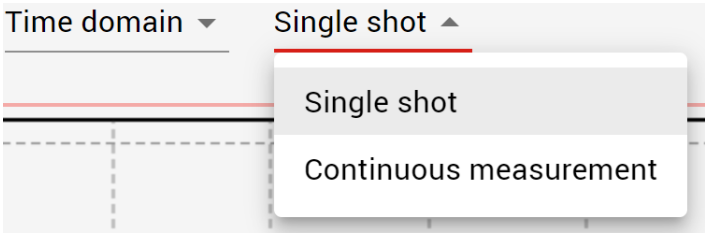


Figure 9-17 trigger behavior option

Additional settings can be found in the oscilloscope settings menu, accessible from the gear icon on the top left of the oscilloscope screen. These settings offer the most advanced options for configuring your oscilloscope.
In the oscilloscope settings, you can select the channel used for triggering, as well as the trigger level and direction (e.g., trigger when crossing upward or downward).

You can also configure the sample period and delay in the oscilloscope settings.

The bottom 6 options are the choice of the 6 traces to display. Each can be selected from a long list of possible measurement and calculated values.

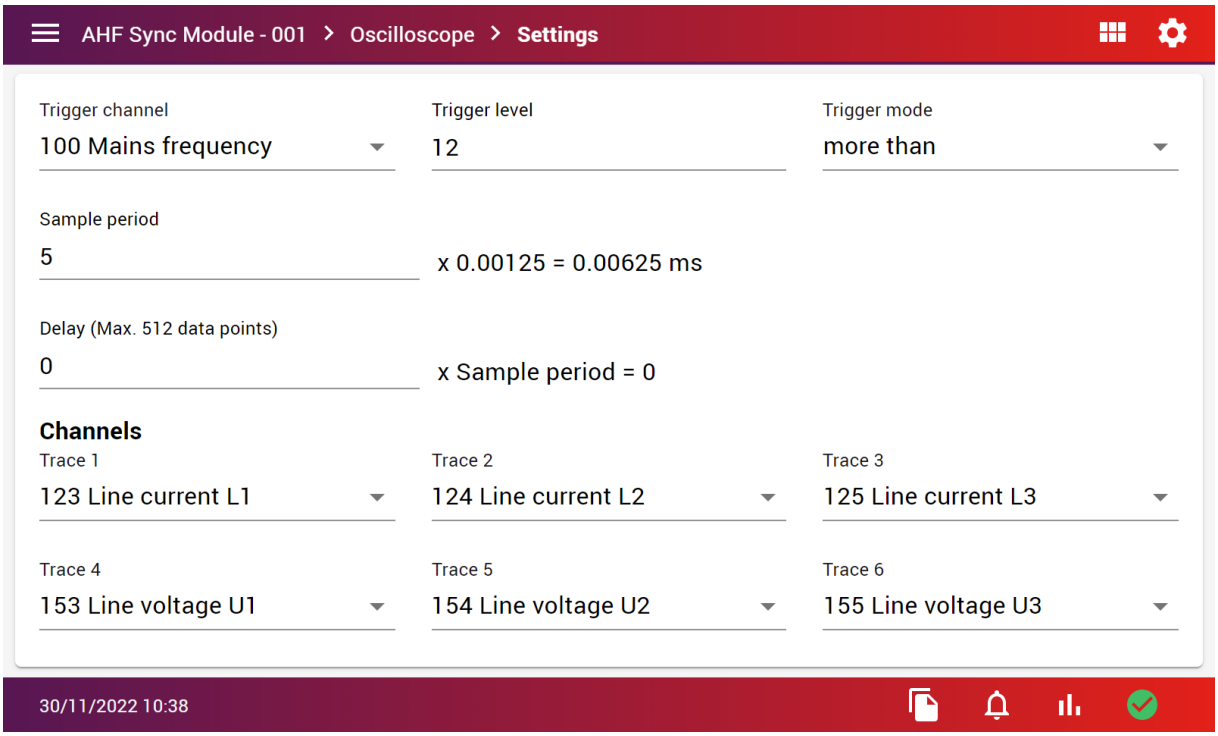


Figure 9-18 oscilloscope settings

9.1.8 HMI settings

The settings menu offers several tabs to configure the behavior of the HMI with the device and its environment.

9.1.8.1 System tab

- MAC address of the HMI
- AHF firmware version
- HMI firmware version
- HMI serial number
- Set HMI and AHF language
- Set backlight dimming
- Enter service password to access special service menus, options and expert parameters

Warning: Please consult your local IT team to configure properly the network settings according to internal rules and safety requirement and allow other machines to access the HMI from the same network.

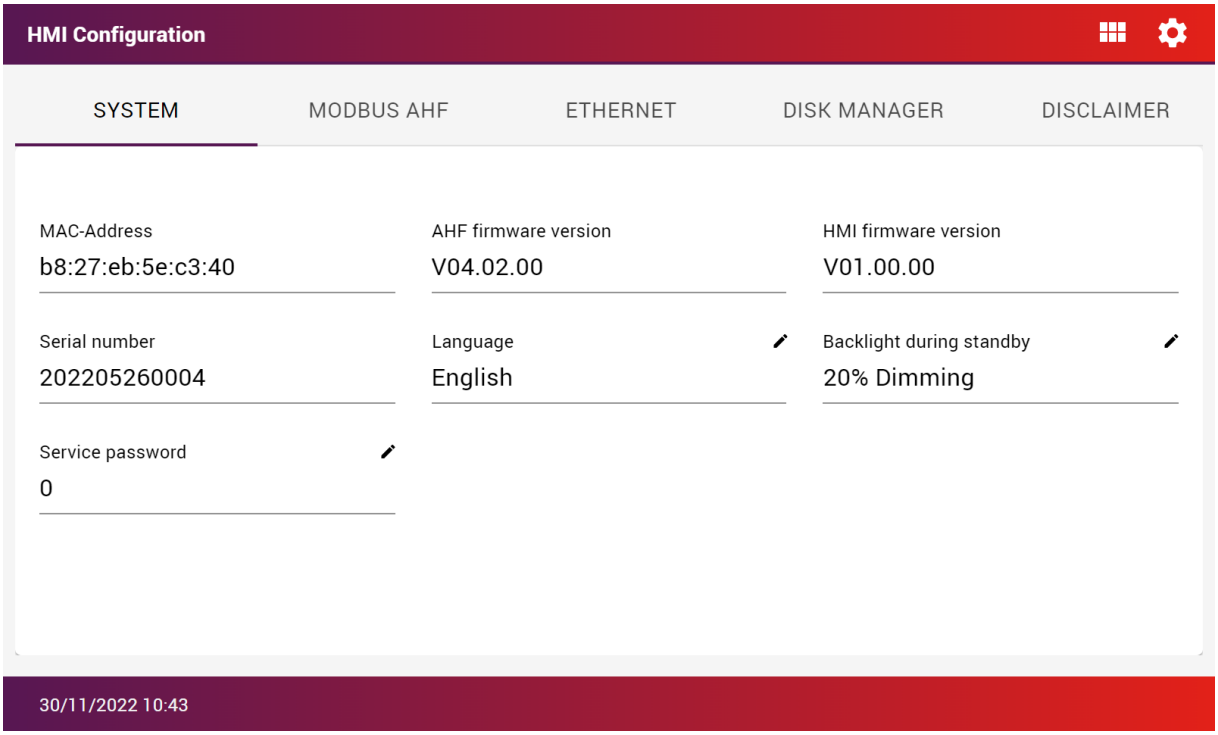


Figure 9-19 Settings menu system tab

9.1.8.2 MODBUS AHF tab

- AHF MODBUS address
- AHF MODBUS baudrate
- AHF MODBUS port

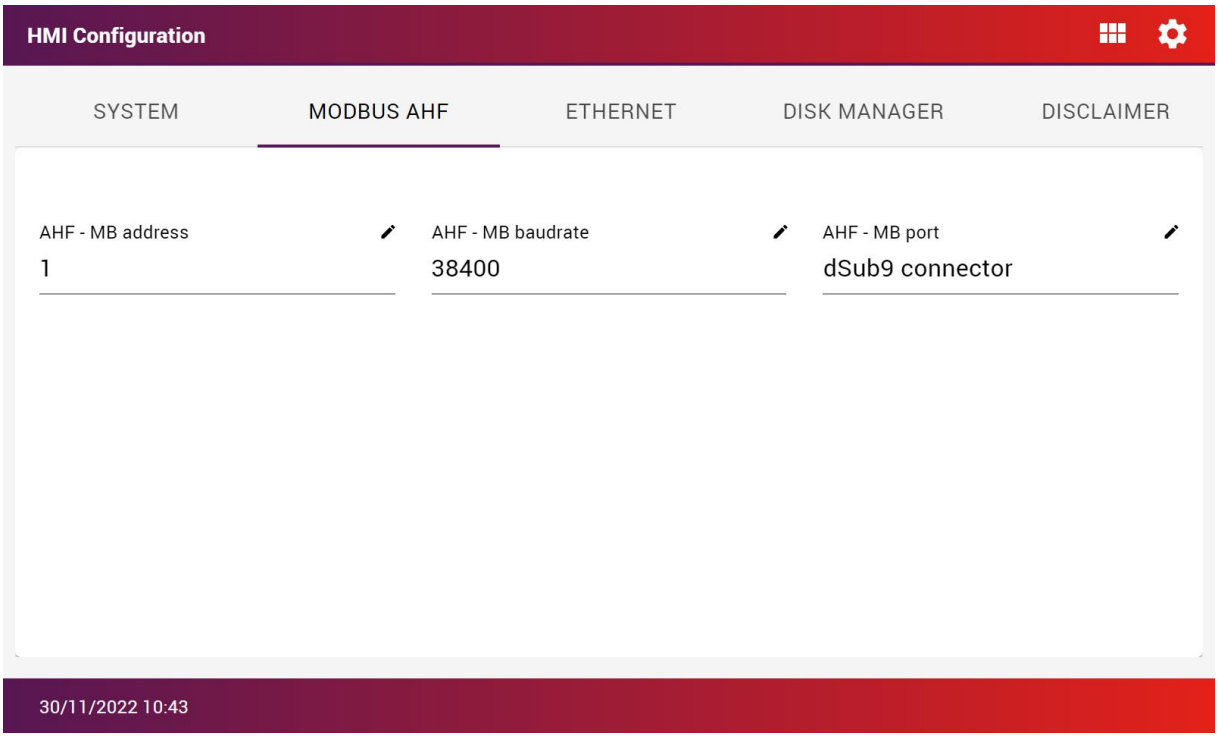


Figure 9-20 Settings menu MODBUS AHF tab

9.1.8.3 Ethernet tab

- HMI IP address
- DHCP (whenever the HMI must get an IP from the network or manually entered)

- Subnet mask
- Default gateway
- Hostname (name as visible from the ethernet network)

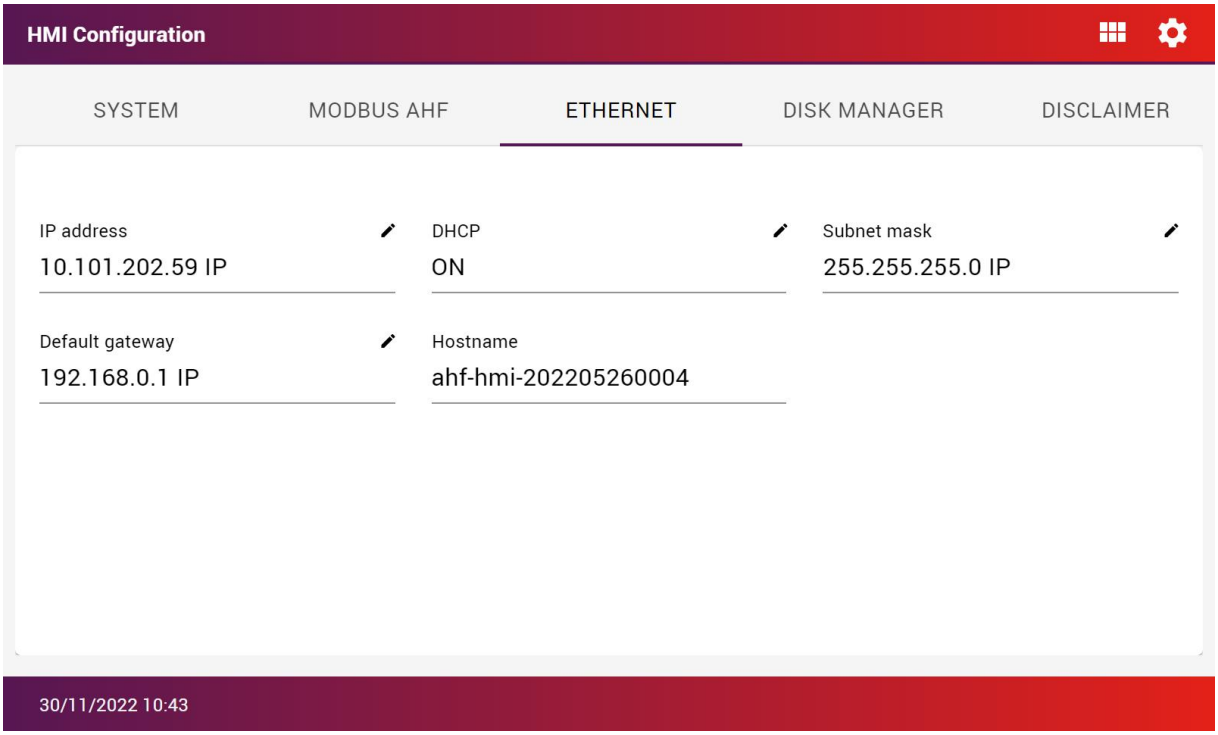
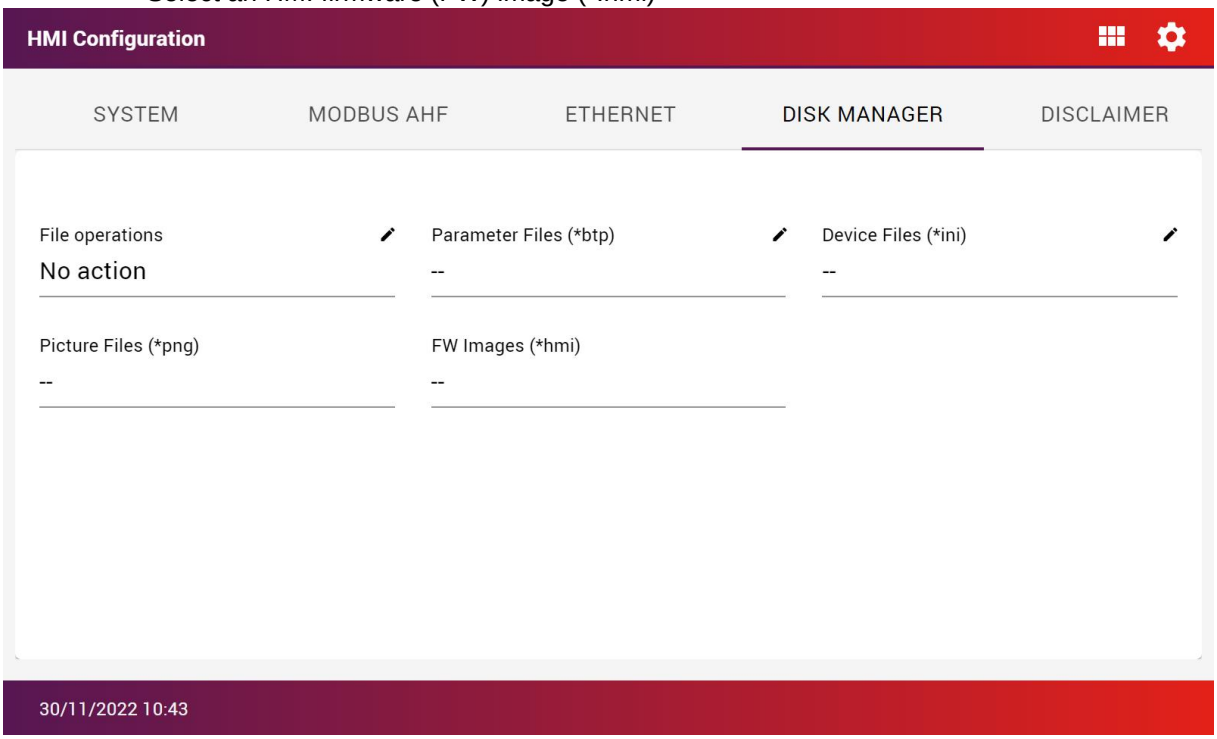


Figure 9-21 settings menu ethernet tab

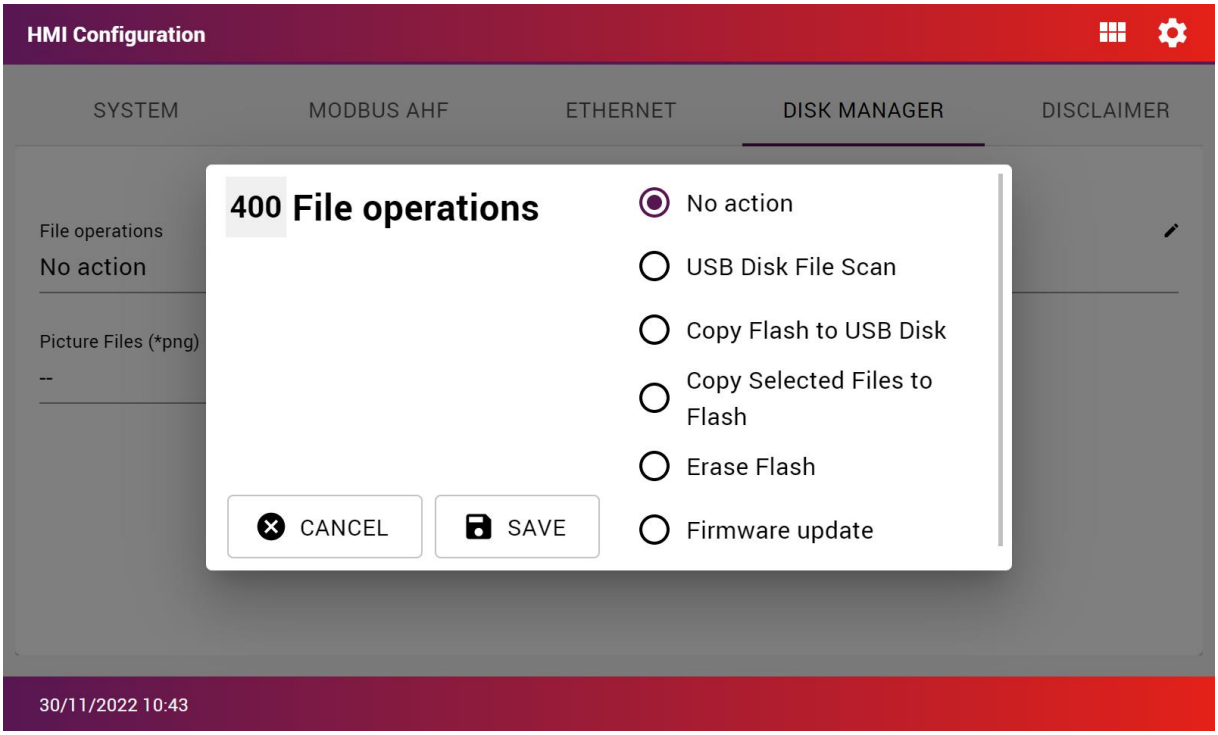
9.1.8.4 Disk manager tab

- Select a file operation
- Select a parameter file (*.btp)
- Select a device file (*.ini)
- Select a picture file (“.png)
- Select an HMI firmware (FW) image (*.hmi)



Clicking “File operations” will allow you to select:

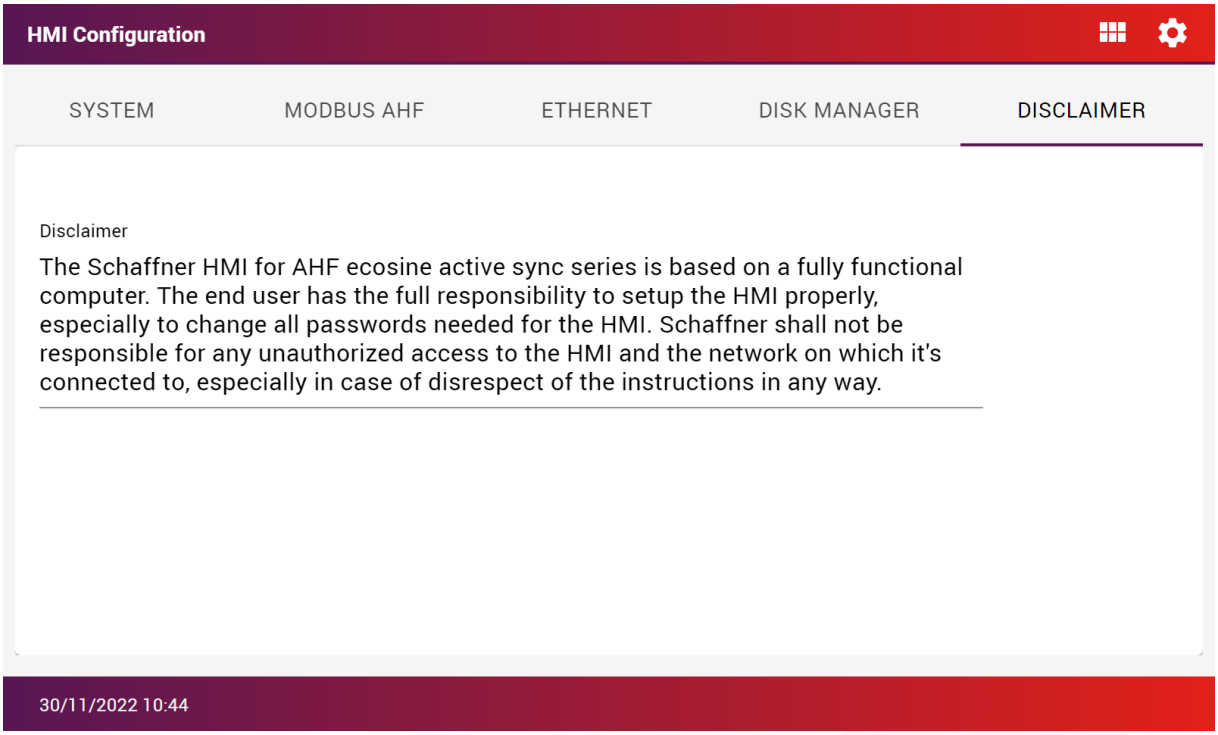
- No action: no operation activated
- USB Disk File Scan: scan the USB disk and list the present files
- Copy Flash to USB Disk: copy the flash memory of the HMI to the USB disk
- Copy Selected Files to Flash: restore a backup present on the USB disk to the HMI memory
- Erase Flash: erase the HMI memory
- Firmware update: load a firmware file from the USB disk and update the HMI firmware



When the operation “Copy Selected Files to Flash” is selected, click on Parameter File and select a file from the USB disk to upload it to the flash. The same can be done to upload a device file, a picture file or a Firmware file.

9.1.8.5 Disclaimer tab

Read the disclaimer related to the usage of the HMI.



9.1.9 Changing language of the HMI and AHF

Open the settings menu (top right gear icon from the main screen), under system, click language, and select a language from the available ones.
This action will change the language of the HMI for all AHF Sync Module and Power Module connected to it.

9.1.10 HMI accounts and passwords

9.1.10.1 Account types

The Schaffner HMI for AHF Ecosine Active Sync is running on a computer operated with a Linux operating system (OS). This OS must have at least two accounts, one account with all access called root account and one user account for daily use. The access to the root account is only needed to do a system update. It should be only used on request from a Schaffner service team member.
The HMI app is running on top of this OS. The app has two accounts with different restrictions levels. Normal user, without password, that allows to operate the HMI and a service operator account, password protected, which allow to do update without involving Schaffner and to change the start screen logo.

Table 22 HMI account types with their purpose, user and password.

System	Restriction level	Purpose	User	Password
HMI APP	User account	Used in normal operation	Everyone	No
	Service account	Used for app and AHF devices updates and settings in the HMI APP	Schaffner service and R&D and customer administrators	Yes (default password: HMIAPP_SERIALNUMBER)
Linux OS	Root account	To change OS settings and to update OS	R&D	Yes (default password: HMIOSroot_SERIALNUMBER)
	Service account	Used for updates of the HMI APP	Service	Yes (default password: HMIOS_SERIALNUMBER)

9.1.10.2 Password management

Warning: the default passwords are not secure and must be changed at the beginning of the commissioning

The HMI software is protected by several passwords to ensure that no third party might get access to the operating system or advanced functionalities restricted to certain groups of users. The HMI software is delivered with default passwords from factory constructed out of the serial number of the HMI. The customer is responsible for changing all passwords during commissioning and to store them safely (e.g.in a passwords manager database set with a strong master password and stored on a network share with automated backup). Schaffner will not be able to assist in the restoration of lost passwords or data following the loss of password. In extreme cases the HMI would need to be return to Schaffner for a complete factory reset and will need to be commissioned again.

The customer must ensure that the passwords can be found rapidly in the future in case Schaffner service needs to do servicing or repair on the AHF system but that it cannot be found by any unauthorized person.

Failing to change the default passwords, to set safe enough passwords and to store them properly might result in unintended access to the device, to all devices connected to it or any device connected to the same network. The default passwords can be easily guessed by anyone who reads this user manual and has physical or remote access to the HMI through the network on which it is connected.

Schaffner will decline all responsibilities for any unintended access.

The above disclaimer is extracted and slightly adapted from the General Safety Notes and Installation Guidelines leaflet provided in printed version with every AHF accessory. This leaflet is provided in 25 languages to ensure good comprehension by a maximum of end users.

9.1.10.3 How to change the HMI passwords

Assistance from an IT technician or a person familiar with the basis of command line interface and Linux is recommended for the following steps.

- Use a computer with network access and configured according to the end user internal IT policies.
- Prepare the passwords for each of the 3 accounts listed below using unique strong and long passwords according to the same IT policies.
- HMIOSroot

- HMIOS
- HMI service
- Connect the HMI and a computer on the same local network (or alternatively change the computer network settings to connect directly to the HMI).
- Write down the IP address of the HMI as defined in the settings.
- SSH into the HMI using terminal on Linux/MacOS or using the free software Putty (or equivalent) on Windows. Typical Linux/MacOS command: **ssh HMIOSroot@IP_address_of_HMI**
- Enter the password for the root user. The Default one is given in Table 22.
- Enter the command: **passwd** and hit enter.
- Enter the new root password for the user HMIOSroot.
- Enter a second time to confirm.
- The new root user has changed the password.
- Enter the command: **sudo passwd HMIOS** and hit enter.
- (optionally if required: you might need to enter your root password to validate the use of sudo, which gives elevated privileges).
- Enter the new root password for the user HMIOSroot.
- Enter a second time to confirm.
- The new HMIOS service user has changed the password.

Optionally it's possible to change the hostname (the name of the HMI as visible by the network) by editing the hostname file using the command: **sudo nano /etc/hostname**

9.2 Display module functions

Figure 9-22 Display module and keypad

Key	Function
→	▪ Go down one menu level
←	▪ Back to the higher menu level, exit menu ▪ Scroll inside information screen
↑	▪ Go up one line ▪ Change information screen
↓	▪ Go down one line ▪ Change information screen
OK	▪ Change parameters ▪ Save value ▪ Go down one menu level
ESC	▪ Discard selection or new value ▪ Back to home window

9.2.1 Boot window

The boot window automatically appears at every start up for some seconds and simply represents the “Schaffner” logo.

9.2.2 Home window

The home window shows some basic information about the AHF.

Here are the descriptions of the fields:

- **product code: it’s a string defining the device type**
- **AHF state: it represents the current status of the AHF, and it corresponds to the parameter P020**
- **grid voltage: is the rms value of the line voltage U12, it corresponds to the parameter P110**
- **load current: this is the line current and it corresponds to the parameter P120**
- **device load %: this is the percentage value of the output current of the AHF, it corresponds to the parameter P104**

9.2.3 Main menu

The main menu is where the user can select the available functionalities, it is made up by the following five entries:

- AHF parameters
- Event log
- Save parameter set
- Load parameter set
- Settings

Figure 9-23 Display module screen, main menu

Figure 9-24 Display module screen, parameters

9.2.3.1 Ecosine Active Sync (AHF) parameters

In the following section as in the whole document AHF designates the Ecosine Active Sync filter.

Table 23 AHF parameter menu on the display module

Level 1	Level 2	Level 3
AHF Parameters 0 Device Specifications 1 Measurements 2…5 Commissioning 6 Alarms	**0 Device specifications** 002 Rated current 003 Overload current …	
	1 Measurements 100 Mains frequency 102 Cos phi …	
	2 ... 5 Commissioning 2 Basic settings 3 Current transformer s 4 Compensation settings 5 Experts settings	**2 Basic settings** 200 Language 202 Switch on mode …
		3 Current transformer settings 300 CT placement 310 CT primary value …
		4 Compensation settings 400 Reactive power 401 Cosphi lower limit …
	6 Alarms 600 Phase L3 IGBT4 615 Overcurrent L1 …	

9.2.3.2 Event log

When entering the event log, the display module downloads from the AHF the last record of events.
By pushing the up and down arrow it is possible to scroll the event log and move through the event list.
For each event the following information is recorded:

- State
- Date
- Time
- Description
- Operating hours

Figure 9-25 Display module screen, events examples

9.2.3.3 Save parameter set

By entering this menu, the user has access to the 10 spots available for saving a parameter set. If a spot is already used, the relative SW version of the parameter set is shown aside from the set number. If a spot is empty, nothing is shown aside from the set number.
By pressing the right arrow button or ok button, the user can start a saving procedure on the selected spot.

9.2.3.4 Load parameter set

By entering this menu, the user can check all the available parameter sets that have been previously saved. Like before, next to the set number lies the SW version of the parameter set.
By pressing the right arrow button or ok button, the user can start a loading procedure of the selected set to the AHF. The SW version of the AHF and the SW version of the parameter set must match, otherwise the load procedure does not start, and an info message is shown to the user.

9.2.3.5 Settings

This sub-menu “Settings” contains all the features related to the display module itself; it has the following items:

- Modbus
- Password
- Screen saver
- Information
- FW update
- Reload INI file
- Restart

Figure 9-26 Display module screen, settings

item	Description
Modbus	Here the user can configure the Modbus features (address, baudrate and frame type) of the display module itself. The Modbus configuration of the AHF has to be done separately through the proper parameters, not in this sub-menu. Beware that the Modbus configuration of the display module and AHF must match, otherwise the communication between the two devices doesn’t work.
Password	Access to change the expert parameters password. The password is only needed for accessing expert parameters and can be used only by Schaffner service team or selected partners. First enter the old password then enter the new one twice. After pressing OK, the display module confirms if the operation was successful or not.
Screen saver	Access to set the timeout of the screen saver. Press the right arrow or OK button to modify the numerical value of the timeout before showing the screen saver.
Information	Information about the firmware. Page 1 is the firmware of the sync module or power module currently selected. Page 2 (press down arrow to access) displays the display module firmware information.
FW update	Access to update the firmware of the display module. Note: Updating the firmware of the sync or power module cannot be done from the display. Please refer to chapter 0 for more information.
Reload INI file	Access to force the loading of the INI file if necessary.
Restart	Select to restart the display module.

9.3 Ways of Software Commissioning

9.3.1 Commissioning via Ethernet

Commissioning via Ethernet interface or RS485 can be used by connecting a PC with the AHF Viewer operating program (see section 11.2.2).

9.3.2 Commissioning via HMI touch screen

Commissioning Ecosine Active Sync via display module please refer to section 9.1.

9.3.3 Commissioning via display module

Commissioning Ecosine Active Sync via display module please refer to section 9.2 and Table 23.

9.4 Commissioning procedure

Note for Commissioning with AHF-Viewer (PC commissioning tool)

It is always recommended to use the newest version of AHF-Viewer. The software can be downloaded at www.schaffner.com in Media Downloads, category Software.

9.4.1 Common steps for all configurations

1. Check the ambient conditions
   - Ambient temperature < 40°C (cabinet) or 50°C (power module), with higher temperature values of up to max. 55°C, the device switches to derating mode.
   - Altitude < 1000 m, for higher altitudes the output power needs to be derated by setting the output current limit in parameter P510.
     - $P510 = 100 - \frac{(Altitude - 1000m)}{100}$
   - Check the ventilation of the room or control cabinet to find out whether sufficient cooling air is available.
   - Make sure that the ambient conditions from section 5 (environmental condition) are complied with and no conductive dust can enter the ecosine active sync.
   - The line voltage must be within 480V ±10% rms, corresponding to a maximum peak voltage of 746Vpk
   - The commutation notches, if present, must be acceptable based on calculation according to IEEE 519 (see appendix 19.1 for detail and examples).

2. Make sure that the electrical connection has been made correctly. The following prerequisites must be met.
   - External fuse protection is installed, see section 8.1.
   - Make sure that the grounding has been performed correctly, check the conductor cross-section.
   - Mains phases L1, L2 and L3 are connected correctly (see section 8.5.2).
   - Check the conductor cross-section of the external conductors
   - Check the conductor cross-section of the neutral conductor (for 4-wire devices)

- Check the tightening torque of the conductors

3. Check the current transformers
   - External current transformers for all three mains phases are correctly connected, installation site, current flow direction and phase assignment are ok (see section 8.6).
   - Check if the power of the current transformers is suitable for the application, see section 8.7.
   - Check if the current transformers are connected correctly to the current transformers input terminals of the device (5A or 1A input). **NOTICE! Incorrect connection of the current transformers can result in damage to the CT module!**

4. Check the installation clearances and conditions (power module and cabinet)
   - Minimum installation clearance for wall mounting see section 7.1.4.
   - Minimum installation clearance for Schaffner cabinet version see section 7.5.
   - Minimum installation clearance for customized cabinets.

5. Before the first switching-on
   - Check if formation of the DC-link capacitor is necessary in case manufacturing date is over one year. (see section 18.1)
   - Disconnect the short circuit jumpers of the external current transformers
   - Switch Ecosine Active Sync control off: Terminal X11.2 = open (neither 0V nor +24V shall be connected to X11.2)
   -
   - Switch on the mains voltage and wait until green LED2 is blinking (see Table 14) and the Ecosine Active Sync is showing state OFF.
   -
   - Set all Modbus addresses of the interconnected modules to different values
   - We recommend using the same address for Service (P230) and Display Modbus (P250)
   - We recommend using the number according to the module number
   - Make sure all RS-485 connections between the Ecosine Active Sync power modules and sync modules (if installed) are correctly connected
   - Now a normal operation and parametrization is possible

In the following paragraphs the commissioning procedure differs depending on the configuration of your active harmonic filter.
Application parameters P300, P310 and P312 must be set in each power module (single and Double Power Pack) with the correct application values independently of filter's configuration. If the sync module is installed in the AHF system, the parameters shall be set only into the sync module.

9.4.2 Single power module or asynchronous operation

1. Check whether the DC-link has been charged correctly and if the mains voltage and frequency have been determined correctly. (Note: A short-term charging current is flowing in the DC-link.)
   - P100 = 50 Hz (60 Hz) mains frequency
   - P110, P111, P112 = 342… 528 V mains voltages
   - P109: Check the rotating field to be the same at all power modules

2. Set the factory settings
   - P210 = load default values
   - P220 = set date and time

3. Set Ecosine Active Sync parameters for the application accordingly (for exact meaning of the parameters refer to section 10):
   - P300: Positioning of the external current transformers (mains side, load side)
   - P310: Primary current value of the external current transformers
   - P312: Secondary current value of the external current transformers
   - P300, P310 and P312 must be set in each power module with the correct application values independently of filter configuration.

   Following parameters must be set as shown below:
   - P205: Parallel Operation Mode = Asynchronous
   - P320: Sum of the rated compensating currents of the overall Ecosine Active Sync power modules connected to one current transformer set (maximum 5 devices).
   - If more than 5 devices are operated at the same time, the power of the current transformers must be increased, or additional current transformers must be installed.

4. Check whether the displayed values are plausible. For motor load, the values must be positive and approximately the same:
   - P102 = cosφ has a plausible value
   - Check active power value per phase:
   - P105 = + … kW? – power L1
   - P106 = + … kW? – power L2
   - P107 = + … kW? – power L3
   - P105 ≈ P106 ≈ P107? Are all values positive?
   - Check the phase voltages and currents by measuring them using the AHF Viewer oscilloscope function to determine whether they are in phase (see sections 8.9.6 and 8.9.7).
   - Otherwise, the current transformers wiring and parameter settings must be checked, except for generator load.

5. Check whether the compensation has been deactivated (these parameters are set OFF by default when loading default factory settings in point 2. above):
   - P403: Reactive power control = OFF
   - P405: Load balancing = OFF
   - P410: Harmonic current compensation = OFF

6. Switch on Ecosine Active Sync control:
   - P202 = Terminal strip
   - Terminal X11.2 = 0 V or open => OFF command
   - Terminal X11.2 = +24 V => ON-command (e.g., from external PLC)
   - P202 = Switch S1, use the control switch S1 on the front plate of the device
   - P202 = Direct ON (filter is always on)

7. Activate the required type of compensation:
   - P400: Reactive power compensation degree = 0 ... 100%

- P401: min. cos phi = -0.7 … +0.7
- P402: max. cos phi = -0.7 … +0.7
- P403: Reactive power control
- P405: Load balancing
- P407: Priority at full load
- P410: Harmonic current compensation

8. Set degrees of compensation P421 and Pxyz (xyz = 421+(3*n), with n = 1, 2, …,23)
   - If necessary, adjust the standby limit (P406)
   - Check if the compensation result on the mains side is correct by using a suitable measuring instrument

9.4.3 Double Power Pack (DPP) operation

1. Check in both power modules whether the DC-link has been charged correctly and whether the mains voltage and frequency have been determined correctly. (Note: A short-term charging current is flowing in the DC-link.)
   - P100 = 50 Hz (60 Hz) mains frequency
   - P110, P111, P112 = 342… 528 V mains voltages
   - P109: Check the rotating field to be the same at both power modules
   - P010 "FPGA Firmware Version" needs to be the same at all power modules
   - P026 "Mains connection" needs to be the same at all power modules
   - P230 "Service - MB address" needs to be different at all power modules and the sync module
   - P250 "Display - MB address" needs to be different at all power modules and the sync module

2. Set the factory settings at both power modules
   - P210 = load default values
   - P220 = set date and time

3. Set Ecosine Active Sync parameters at both power modules for the application accordingly (for exact meaning of the parameters refer to section 10):
   - P300: Positioning of the external current transformers (mains side, load side)
   - P310: Primary current value of the external current transformers
   - P312: Secondary current value of the external current transformers
   - P300, P310 and P312 must be set in each power module with the correct application values independently of filter configuration.

   Following parameters must be set as shown below:
   - Master power module (FN3531/FN3541 with CT module):
   - P205: Parallel Operation Mode = Synchronous Master
   - P320: Total current parallel = 120A

   - Slave power module (FN3530/FN3540):
   - P205: Parallel Operation Mode = Synchronous Slave
   - P320: Total current parallel = 120A

4. Check whether the displayed values are plausible. For motor load, the values must be positive and approximately the same.
   - P102 = cosφ has a plausible value
   - Check active power value per phase:
     - P105 = + … kW? – power L1
     - P106 = + … kW? – power L2
     - P107 = + … kW? – power L3
   - P105 ≈ P106 ≈ P107? Are all values positive?
   - Check the phase voltages and currents by measuring them using the AHF Viewer oscilloscope function to determine whether they are in phase (see sections 8.9.6 and 8.9.7).
   - Otherwise, the current transformers wiring and parameter settings must be checked, except for generator load.
5. Check whether the compensation has been deactivated (these parameters are set OFF by default when loading default factory settings in point 2. above):
   - P403: Reactive power control = OFF
   - P405: Load balancing = OFF
   - P410: Harmonic current compensation = OFF

6. Switch on Ecosine Active Sync control at both modules:
   - P202 = Terminal strip
     - Terminal X11.2 = 0 V or open => OFF-command
     - Terminal X11.2 = +24 V => ON-command (e.g., from external PLC)
   - P202 = Switch S1, use the control switch S1 on the front plate of the device
   - P202 = Direct ON (filter is always on)

7. Activate the required type of compensation:
   - P400: Reactive power compensation degree = 0 ... 100%
   - P401: min. cos phi = -0.7 … +0.7
   - P402: max. cos phi = -0.7 … +0.7
   - P403: Reactive power control
   - P405: Load balancing
   - P407: Priority at full load
   - P410: Harmonic current compensation

8. Set degrees of compensation P421 and Pxyz (xyz = 421+(3*n), with n = 1, 2, … 23)

   - If necessary, adjust the standby limit (P406)
9. Check if the compensation result on the mains side is correct by using a suitable measuring instrument

9.4.4 Sync module operation (with SYNC300A installed)

Note! The sync module (SM) has a different firmware than the power module (PM).

1. Check at each power module whether the DC-link has been charged correctly and the mains voltage and frequency have been determined correctly. (Note: A short-term charging current is flowing in the DC-link.)
   - P100 = 50 Hz (60 Hz) mains frequency
   - P110, P111, P112 = 342… 528 V mains voltages
   - P109: Check the rotating field to be the same at all power modules
   - P010 "FPGA Firmware Version" needs to be the same at all power modules
   - P026 "Mains connection" needs to be the same at all power modules
   - P230 "Service - MB address" needs to be different at all power modules and the sync module
   - P250 "Display - MB address" needs to be different at all power modules and the sync module

2. Set P220 “Date and time” at each power module

The following settings need to be done only at the sync module:

3. Set the factory settings at the sync module
   - P210 = keep com. values
   - P220 = set date and time

4. Check the sync module firmware to be the correct one.
   - The sync module (SM) firmware starts with V04.01.xx and is compatible with power module (PM) firmware V03.02.xx

5. Check at the sync module whether the mains voltage and frequency have been determined correctly
   - P100 = 50 Hz (60 Hz) mains frequency
   - P110, P111, P112 = 342… 528 V mains voltages

6. Check at the sync module if all power modules are recognized correctly:
   - P032 " No. of installed PM”: number of installed power modules needs to be the same as the total installed power modules
   - P033 "No. of detected PM”: number of detected power modules needs to be the same than the total installed power modules
   - P034 " No. of functional PM”: number of functional power modules needs to be the same than the total installed power modules
   - P040 "SM1 operational state" = discharged

7. Check the power module state reported in the sync module
   - P041 to P045 "PM1-x operational state" = “discharged” for installed modules
   - P041 to P045 "PM1-x operational state" = “inactive” for not installed modules

8. IF steps 6 or 7 are not correct, please do the following:
   - Please double check the HSB wiring according to Figure 8-4
   - Start a new detection of the HSB with P203 "HSB configure active" = HSB config active

9. Set Ecosine Active Sync parameters in the sync module for the application accordingly:
   - P300: Positioning of the external current transformers (mains side, load side)
   - P310: Primary current value of the external current transformers
   - P312: Secondary current value of the external current transformers
   - P320: Sum of the rated compensating currents of the overall Ecosine Active Sync power modules connected to one current transformer set (maximum 5 devices).
     If more than 5 devices are operated at the same time, the power of the current transformers must be increased, or additional current transformers must be installed.

10. Check whether the displayed values are plausible. For motor load, the values must be positive and approximately the same:
    - P102 = cosφ has a plausible value
    - Check active power value per phase:
    - P105 = + … kW? – power L1
    - P106 = + … kW? – power L2
    - P107 = + … kW? – power L3
    - P105 ≈ P106 ≈ P107? Are all values positive?
    - Check the phase voltages and currents by measuring them using the AHF Viewer oscilloscope function to determine whether they are in phase (see sections 8.9.6 and 8.9.7).
    - Otherwise, the current transformers wiring and parameter settings must be checked, except for generator load.
11. Check whether the compensation has been deactivated (is set automatically when setting the default values in item 7 (Set the factory settings):
    - P403: Reactive power control = OFF
    - P405: Load balancing = OFF
    - P410: Harmonic current compensation = OFF

12. Set a reactive current to be created in the sync module
    - P593 "Test reactive cur" = 30
    - After setting P593 the filter needs to be switch on with P202

13. Start a single trace measurement with the following signals and check whether all currents are identical and do not have any phase shift to the voltage as well as against each other. Otherwise please double check the mains wiring to the modules:
    - P153 "Line voltage U1"
    - P705 "PM1-1 current L1"
    - P710 "PM1-2 current L1"
    - P715 "PM1-3 current L1"
    - P720 "PM1-4 current L1"
    - P725 "PM1-5 current L1"

14. Set back P593 "Test reactive cur" = 0 – No reactive current in the sync module
    - Switch off the filter with P202 before setting P593 back
    - P593 "Test reactive cur" = 0

15. Switch on sync module control:

- P202 = Terminal strip
- Terminal X11.2 = 0 V or open => OFF command
- Terminal X11.2 = +24 V => ON-command (e.g., from external PLC)
- P202 = Switch S1, use the control switch S1 on the front plate of the device
- P202 = Direct ON (filter is always on)

16. Activate the required type of compensation:
    - P400: Reactive power compensation degree = 0 ... 100%
    - P401: min. cos phi = -0.7 … +0.7
    - P402: max. cos phi = -0.7 … +0.7
    - P403: Reactive power control
    - P405: Load balancing
    - P407: Priority at full load
    - P410: Harmonic current compensation

17. Set degrees of compensation P421 and Pxyz (xyz = 421+(3*n), with n = 1, 2, …, 23)

    - If necessary, adjust the standby limit (P413)

18. Check if the compensation result on the mains side is correct by using a suitable measuring instrument

9.5 Status message

Message at display	Meaning	Note
Initialize	Initial state directly after powering up	Initialization of control and protection; check of system; check of external voltages and currents
Discharged	OFF state after SHUTDOWN and after INIT	No error pending; Ecosine Active Sync ready for startup; P559=0 (Discharged state, see Figure 9-27).
Precharge	Passive charging of DC-link	Starts passive charging by closing auxiliary contactors: dc link is charged from grid mains voltage; inrush current is limited by charging resistors
Close main	Close mains contactor	Bypasses charging resistors and waits 3 seconds
Off	Off state after precharge	Precharge is finished; Ecosine Active Sync ready for operation; P559=1 (OFF state).
Standby	Standby state at low load	Ecosine Active Sync standby state when Ecosine Active Sync is turned ON and load current is smaller than standby threshold (P406 = 0…100% of rated current)
Charge	Active charging of DC-link	DC link is charged to target dc link voltage. Harmonic current compensation is disabled, i.e., Ecosine Active Sync generates only charging current. P559=1: Filter waits in OFF state until user turns on AHF by sending ON command or via S1 switch, then the filter's state changes to Standby, then to Charge and starts switching IGBTs; P559=0: Filter starts switching IGBTs automatically after receiving user's ON command (with P559 = 0), AHF is in Discharged state, when receiving ON command the state of the filter changes to Precharge, Close Main, Off, Standby and then to Charge.
Operation	Normal operation	Compensation of load currents according to user settings
Error	Fault state	Error logging; reset of errors; Automatic restart after fault clearance
Restart blocked	Restart after fault blocked	Fault state after multiple repetitive faults. Restart by means of turning Ecosine Active Sync OFF/ON.

Fatal error	Restart after fault not possible	Fault state after fatal error. Disconnect Ecosine Active Sync from the grid. Contact Schaffner Service.

Table 24 AHF status

Activity	**AHF Status**
Connect AHF to the grid	Init → Discharge → Precharge → Close main → Charge → Operation
AHF is off	Charge (**AHF auxiliaries are supplied from dc link; control is operating; DC-link is charged!!**) This state is “idle state” when AHF is turned off by user.
Switch on AHF	OFF → Charge → Operation
Switch off AHF	Operation → OFF

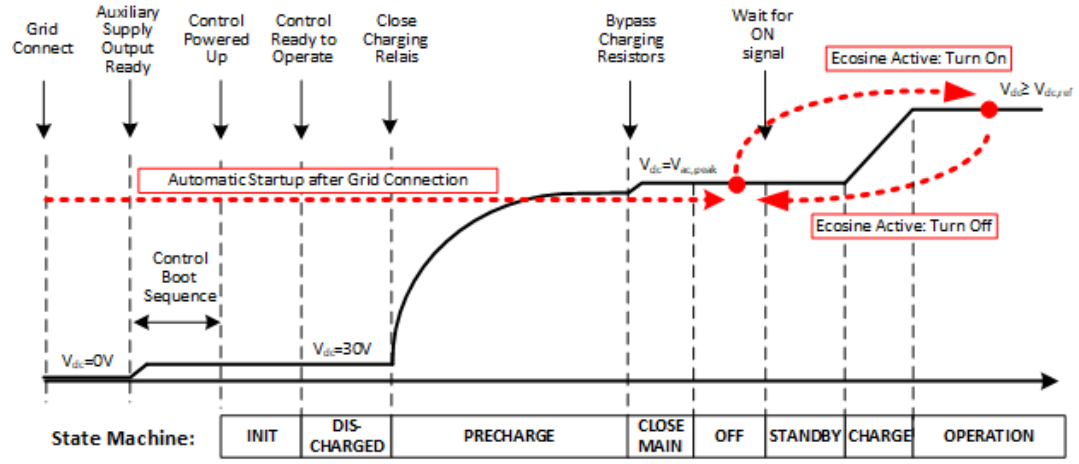


Figure 9-27 Ecosine Active Sync status and DC-link voltage level during startup and normal operation

9.6 Error message

Ecosine Active Sync filter is always shut down after a fault. After fault clearance Ecosine Active Sync restarts within 3sec.
In case multiple faults occur in a short time, Ecosine Active Sync restart is blocked. Restart can be triggered by user by means of turning Ecosine Active Sync OFF/ON. Prior to restarting fault investigation is strongly recommended. Contact Schaffner service in case fault root cause cannot be evaluated.
In case a fatal error (e.g., internal HW fault) is detected, restart is blocked permanently. Disconnect Ecosine Active Sync from grid and contact Schaffner service.

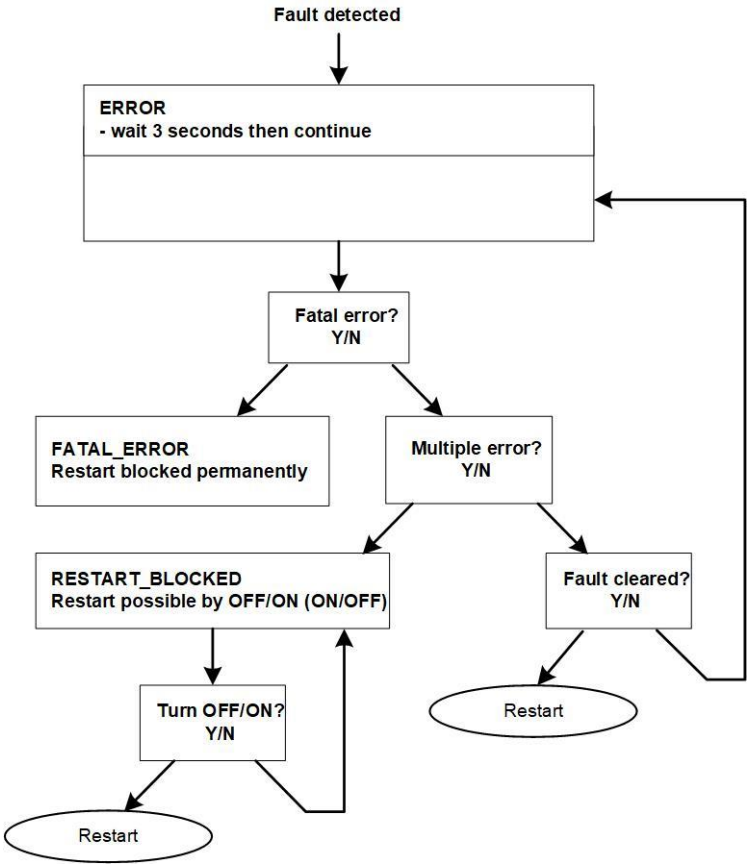


Figure 9-28 Error handling

Errors are displayed in parameter P6XX (see section 10.1.4) and stored permanently in Error Log. Users can see only pending errors in parameter P6XX. Cleared errors are logged in the Error Log.
If error messages are displayed, please document them by proceeding as follows (before clearing the error):

- Copy all parameters using the AHF Viewer Ecosine Active Sync while the error is still active to prevent loss of the error codes due to a reset.
- Copy the event log using the AHF Viewer Ecosine Active Sync to be able to analyze the preceding errors.
- Save both files for later error analysis.
- If necessary, note down further information.

10 Parameter List

In the following the parameters of the AHF are listed and described in detail. The parameters are divided in two categories:

- Read only parameters are information, measurements or error messages; they cannot be changed.
- Parameters: such as commissioning, maintenance and tuning parameters; they are set per default to factory settings and can be changed if needed during commissioning.

Parameter group	Meaning	Comments
P0XX	Device specification	Read only Display of device data (rated current, overload current, …)
P1XX	Measured values	Read only Display of measured values (mains voltage and current, load current, filter current, DC-link voltage, …)
P2XX	Basic settings	Commissioning parameter (Language settings, date settings and so on)
P3XX	Current transformer settings	Commissioning parameter (Settings for current transformer position, CT ratio, parallel operation of ecosine active sync, …)
P4XX	Compensation settings	Commissioning parameter (Enabling reactive power compensation, harmonic current compensation options, …)
P6XX	Error message	Read only Display error messages

10.1 Parameter list of power module

10.1.1 Power module parameter group P0XX, P1XX: Measurements and information (read only)

No	Name	Unit	Values	Factory setting	Description
2	Rated current	A		60Arms	Rated current of device
3	Overload current	A		150A	Maximum overload current - peak value
4	Rated voltage	V		480V (3wire) or 400V (4wire)	Rated voltage
5	Overcurrent Limit	A		180A	Maximum peak surge current
8	MAC address		example: 08:00:70:22:44:11 =17 ASCII characters	MAC addr.	MAC address
10	FPGA firmware ver.		example: V03.01.04 = 9 ASCII characters		Firmware version of the control FPGA
11	MCF51 Firmware rev				MCF51 firmware revision
14	Software compatibility		0 = Software and hardware compatible 1 = Software and hardware NOT compatible		software compatibility check, (0 = compatible, other = incompatible)
15	Serial number				Serial Number of the device
16	SN control board				serial number of control board
20	Operational state		2 = Fatal Error 3 = Restart blocked 4 = Error... 5 = Error 6 = Initialize 7 = Discharged 8 = Shut down 9 = Precharge 10 = Close main 11 = Off 12 = Standby 13 = Charge 14 = Operation		Operational state
21	Error root cause				Show Errornumber (P6xy => ErrorNum 6xy) of pending errors
22	Warning		0 = None 1 = Maintenance 2 = Overload condition 3 = Power Derating 4 = HSB link NOK 5 = Aux. power supply NOK		Warning

No	Name	Unit	Values	Factory setting	Description
23	Operational state ext.		15 = CTs not checked 16 = 3-ph load too low 17 = No 3-ph load 18 = Wrong rotation field 19 = Generator load 20 = Motor and gen. load 21 = CT check Ok		Extended Operational state
24	CT Calibration Status				CT Module Calibration Status
25	Device name				Device name
26	Mains connection		0 = undefined wire connection 1 = FOURWIRE connection 2 = THREEWIRE connection	3-wire (3wire) or 4-wire (4wire)	Selected type of mains connection
27	Device type ID				Device type identification number
28	Device type variation				Device type variation
29	HW ID Control Board				HW ID Control Board
30	Operating hours	h			Operating hours
31	Connected to supply	h			Total hours of the device connected to grid
40	HSB Link Status		0 = Not Connected 1 = Connected 2 = N/A		Status of HSB Link
41	Status-this PM		2 = Fatal Error 3 = Restart blocked 4 = Error... 5 = Error 6 = Initialize 7 = Discharged 8 = Shut down 9 = Precharge 10 = Close main 11 = Off 12 = Standby 13 = Charge 14 = Operation		Operational state of the directly connected PM
42	Status-PM HSB		2 = Fatal Error 3 = Restart blocked 4 = Error... 5 = Error 6 = Initialize 7 = Discharged 8 = Shut down 9 = Precharge 10 = Close main 11 = Off 12 = Standby 13 = Charge 14 = Operation		Operational state of the PM connected via HSB
100	Mains frequency	Hz			Mains frequency

No	Name	Unit	Values	Factory setting	Description
102	Cos phi				Displacement Power Factor
103	DC link voltage	V			DC link voltage
104	Device load	%			Load of the device related to nominal current.
105	Active power L1	kW			Active power, phase L1
106	Active power L2	kW			Active power, phase L2
107	Active power L3	kW			Active power, phase L3
109	Rotating field		0 = Clockwise 1 = Counter clockwise 2 = No synchronization		Direction of rotating field.
110	Line voltage rms U12	V			rms value of line voltage U12
111	Line voltage rms U23	V			rms value of line voltage U23
112	Line voltage rms U31	V			rms value of line voltage U31
113	Line voltage U12	V			Instantaneous value of line to line voltage U12
114	Line voltage U23	V			instantaneous value of line to line voltage U23
115	Line voltage U31	V			instantaneous value of line to line voltage U31
116	uDC-this PM	V			DC-link voltage of the directly connected PM
117	uDC-PM HSB	V			DC-link voltage of the PM connected via HSB
120	Line current rms L1	A			Line current rms, phase L1
121	Line current rms L2	A			Line current rms, phase L2
122	Line current rms L3	A			Line current rms, phase L3
123	Line current L1	A			Instantaneous value of line current, phase L1
124	Line current L2	A			Instantaneous value of line current, phase L2
125	Line current L3	A			Instantaneous value of line current, phase L3
126	Line current rms N	A			Line current rms, neutral
127	Line current N	A			instantaneous value of line current, neutral
130	Load current rms L1	A			Load current rms, phase L1
131	Load current rms L2	A			Load current rms, phase L2
132	Load current rms L3	A			Load current rms, phase L3
133	Load current L1	A			Instantaneous value of load current, phase L1
134	Load current L2	A			Instantaneous value of load current, phase L2
135	Load current L3	A			Instantaneous value of load current, phase L3
136	Load current rms N	A			Load current rms neutral
137	Load current N	A			instantaneous value of load current, neutral
138	Max output current	A			Maximum output current instantaneous value of all phases
139	Load current rms max	A			Maximum load current rms of 3 phases
140	Output current rms L1	A			Device output current rms L1
141	Output current rms L2	A			Device output current rms L2

No	Name	Unit	Values	Factory setting	Description
142	Output current rms L3	A			Device output current rms L3
143	Output current L1	A			Instantaneous value of output current L1.
144	Output current L2	A			Instantaneous value of output current L2
145	Output current L3	A			Instantaneous value of output current L3
146	Output current rms N	A			Device output current rms neutral
147	Output current N	A			Instantaneous value of device output current neutral
148	Max output current rms	A			Maximum output current rms of all phases
149	Reactive current rms	A			fundamental reactive current rms
150	Line voltage rms U1	V			Line voltage rms, L1 to N
151	Line voltage rms U2	V			Line voltage rms, L2 to N
152	Line voltage rms U3	V			Line voltage rms, L3 to N
153	Line voltage U1	V			Instantaneous value of line voltage, L1 to N
154	Line voltage U2	V			Instantaneous value of line voltage, L2 to N
155	Line voltage U3	V			Instantaneous value of line voltage, L3 to N
160	THDu line voltage U12	%			Total harmonic distortion line voltage U12
161	THDu line voltage U23	%			Total harmonic distortion line voltage U23
162	THDu line voltage U31	%			Total harmonic distortion line voltage U31
166	THDu Umains	%			distortion factor of the instantaneous mains voltage
167	Cos phi L1				Displacement Power Factor L1
168	Cos phi L2	-	-	-	Displacement Power Factor L2
169	Cos phi L3	-	-	-	Displacement Power Factor L3
170	THDi current L1	%			Total harmonic distortion line current L1
171	THDi current L2	%			Total harmonic distortion line current L2
172	THDi current L3	%			Total harmonic distortion line current L3
175	THDu reference	%			THDu reference in % at standby; minimum 5%
176	THDu low limit	%			Voltage resonance detection, low limit
177	THDu high limit	%			Voltage resonance detection, high limit
178	CT check Result				Result of current transformer check
180	IGBT module temper.	°C			Module temperature in degree Celsius
181	Device temperature	°C			Device temperature in degree Celsius
183	Disabled Harmonics				Disabled harmonics controllers, order coded
184	Harm ctrl output peak	V			Harmonic Controller peak
185	Load-this PM	%			Utilization of the directly connected PM
186	Load-PM HSB	%			Utilization of the PM connected via HSB
190	Fan Speed 1	*100RPM			Speed of fan 1
191	Fan Speed 2	*100RPM			Speed of fan 2

No	Name	Unit	Values	Factory setting	Description
192	Fan Speed 3	*100RPM			Speed of fan 3
195	CPU load				for experts only
196	ON command				Status of turn-on command
197	External Trigger				Trace trigger from external devices received from HSB
198	IGBT On Signal				Flag=1 when IGBTs are switching
199	Global Error Signal				Flag=1 in case of any fault

10.1.2 Power module parameter group P2XX, P3XX: Commissioning parameters

No.	Parameter	Factory setting	Description
200	Language	English	Language shown on display module (parameter ignored when using the HMI, see HMI section): ▪ Deutsch ▪ English ▪ Chinese ▪ Français
202	Switch on mode	Terminal strip	Definition how to switch on: ▪ Terminal strip ▪ Direct ON ▪ Direct OFF ▪ Switch S1 ▪ SyncModule HSB
205	Parallel Oper. Sync.	Asynchronous	Synchronization mode of devices operated in parallel ▪ Asynchronous ▪ Synchronous Master ▪ Synchronous Slave If 202 = SyncModule HSB, P205 = Synchronous Slave
210	Default values	No action	Set of default values: ▪ No action ▪ Load all values ▪ Keep communication values
220	Date and time		System date and time
230	Service – MB address	1	Modbus Slave ID for Service interface X13
231	Service – MB baudrate	38400	Modbus baudrate (8N1) for Service interface X13 ▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200
234	Bootloader port	Service	Bootloader port selection (Service X13, Display X15) ▪ Service ▪ Display
240	IP address	192.168.1.2	IP address
241	DHCP	OFF	Allocation of IP address by DHCP server ▪ OFF ▪ ON
242	Subnet mask	255.255.255.0	Subnet mask
243	Default gateway	192.168.1.50	default gateway
250	Display – MB address	1	Modbus Slave ID for Display interface X15, X16
251	Display - MB baudrate	38400	Modbus baudrate (8N1) for Display interface X15, X16 ▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200
254	Enable Display Modbus	ON	Enable MODBUS on display serial port X15/X16 ▪ OFF ▪ ON

No.	Parameter	Factory setting	Description
255	Enable 24V display	ON	Enable 24V display supply in X16 ▪ OFF ▪ ON
256	Reset 24V display	No reset	Reset 24V display supply in X16 ▪ No reset ▪ Reset

Configuration of customer I/O Interface on terminal X11:

260	Function X11.2	Fixed logical 0	Digital input/output (24 V) Input: High = On, Open /Low = Off Output: High = selected function Output function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation ▪ Derating temperature ▪ State error global Input function ▪ On-Off command ▪ Quit command
261	Polarity X11.2	low active	Polarity of digital output X11.2 (1=high active / 0=low active) ▪ low active ▪ high active
262	Configuration X11.2	Input	Set configuration for digital port X11.2 (0=input, 1=output) ▪ Input ▪ Output
263	Function X11.3	Derating operation	Digital input/output (24 V) Input: High = On, Open /Low = Off Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation ▪ Derating temperature ▪ State error global ▪ On-Off command ▪ Quit command
264	Polarity X11.3	high active	Polarity of digital output X11.3 (1=high active / 0=low active) ▪ low active ▪ high active
265	Configuration X11.3	Output	Set configuration for digital port X11.3 (0=input, 1= output) ▪ Input ▪ Output

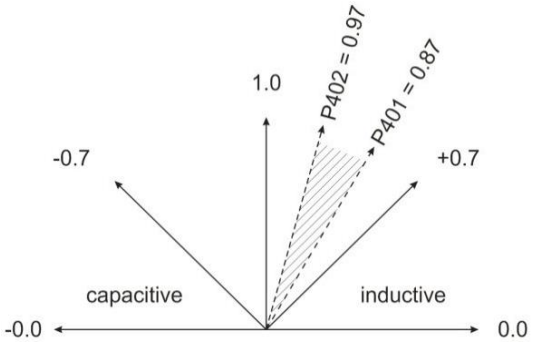
No.	Parameter	Factory setting	Description
266	Function X11.4	State standby	Relay output 1 (250 V, 3 A), closed = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation ▪ Derating temperature ▪ State error global ▪ On-Off command ▪ Quit command
267	Polarity X11.4	normal open	Polarity of relay output X11.4 (1 = normal closed, 0 = normal open) ▪ normal open ▪ normal closed
268	Function X11.5	State error global	Relay output 2 (250 V, 3 A), closed = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation ▪ Derating temperature ▪ State error global ▪ On-Off command ▪ Quit command
269	Polarity X11.5	normal closed	Polarity of relay output X11.5 (1 = normal closed, 0 = normal open) ▪ normal open ▪ normal closed
CT configuration:			
300	CT placement	OFF	Placement of the external current transformers ▪ Mainside ▪ Loadside ▪ OFF
310	CT primary value	1000A	Primary full-scale value of external current transformer.
312	CT secondary value	: 5A	Secondary full-scale value of external current transformer. ▪ : 1A ▪ : 5A
313	CT check	ON	Activate/deactivate the current transformer check ▪ OFF ▪ ON
320	Total current parallel	60A	Total current of all parallel devices: 60A if only one power module is installed. The value to enter in this parameter = 60A x Nb of Power Modules connected

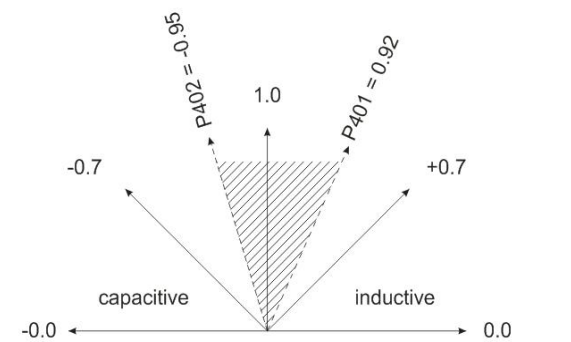
10.1.3 Power module parameter group P4XX: Compensation settings

No.	Parameter	Factory setting	Description
400	Reactive Power	100%	Degree of the reactive power compensation 0 … 100%
401	Cosphi lower limit	1.0	Specifies the lower limit of target cos phi range on mains side

Only one of the two cosφ – controls can be activated at a time in parameter 403:

- P400 – direct reactive power compensation in percent. The reactive current compensation is dependent of P400 (0% to 100%). Fast iq control compensates the specified percentage value of the currently measured reactive power.
- cos phi control. The cos phi controller is dependent of the specified values in parameter P401 (lower limit) and P402 (upper limit), keeping cos φ in the specified target range





402	Cosphi upper limit	1.0	Specifies the upper limit of target cos phi range on mains side
403	Reactive Power Control	OFF	Activation reactive power control (fast iq control or cos phi control) ▪ OFF ▪ Reactive current control ▪ Cos phi control
405	Load balancing	OFF	Activation or deactivation of load balancing between phases ▪ OFF ▪ ON
406	Standby threshold	0%	Standby Threshold of measured harmonic current (RMS)
407	Priority full load	Harmonics	Priority of compensation when full load is reached ▪ None ▪ Reactive current ▪ Harmonics
410	Harmonic compens.	OFF	Activation of operation mode harmonic compensation. ▪ OFF ▪ ON
420	Harmonic order A	3	Harmonic order of controller A (typically A=3)
421	Compensation A	0% for FN3530/31 80% for FN3540/41	Adjustable degree of compensation harmonic A (typically A=3)

423	Harmonic order B	5	Harmonic order of controller B (typical B=5)
424	Compensation B	80%	Adjustable degree of compensation harmonic B (typically B=5)
426	Harmonic order C	7	Harmonic order of controller C (typically C=7)
427	Compensation C	80%	Adjustable degree of compensation Harmonic C (typically C=7)
429	Harmonic order D	9	Harmonic order of controller D (typically D=9)
430	Compensation D	0% for FN3530/31 50% for FN3540/41	Adjustable degree of compensation harmonic D (typically D=9)
432	Harmonic order E	11	Harmonic order of controller E (typically E=11)
433	Compensation E	50%	Adjustable degree of compensation harmonic E (typically E=11)
435	Harmonic order F	13	Harmonic order of controller F (typically F=13)
436	Compensation F	40%	Adjustable degree of compensation harmonic F (typically F=13)
438	Harmonic order G	15	Harmonic order of controller G (typically G=15)
439	Compensation G	0%	Adjustable degree of compensation harmonic G (typically G=15)
441	Harmonic order H	17	Harmonic order of controller H (typically H=17)
442	Compensation H	30%	Adjustable degree of compensation harmonic H (typically H=17)
444	Harmonic order I	19	Harmonic order of controller I (typically I=19)
445	Compensation I	20%	Adjustable degree of compensation harmonic I (typically I=19)
447	Harmonic order J	21	Harmonic order of controller J (typically J=21)
448	Compensation J	100% for FN3530/31 0% for FN3540/41	Adjustable degree of compensation harmonic J (typically J=21)
450	Harmonic order K	23	Harmonic order of controller K (typically K=23)
451	Compensation K	15%	Adjustable degree of compensation harmonic K (typically K=23)
453	Harmonic order L	25	Harmonic order of controller L (typically L=25)
454	Compensation L	15%	Adjustable degree of compensation harmonic L (typically L=25)
456	Harmonic order M	27	Harmonic order of controller M (typically M=27)
457	Compensation M	0%	Adjustable degree of compensation harmonic M (typically M=27)

459	Harmonic order N	29	Harmonic order of controller N (typically N=29)
460	Compensation N	10%	Adjustable degree of compensation harmonic N (typically N=29)
462	Harmonic order O	31	Harmonic order of controller O (typically O=31)
463	Compensation O	10%	Adjustable degree of compensation harmonic O (typically O=31)
465	Harmonic order P	33	Harmonic order of controller P (typically P=33)
466	Compensation P	0%	Adjustable degree of compensation harmonic P (typically P=33)
468	Harmonic order Q	35	Harmonic order of controller Q (typically Q=35)
469	Compensation Q	0%	Adjustable degree of compensation harmonic Q (typically Q=35)
471	Harmonic order R	37	Harmonic order of controller R (typically R=37)
472	Compensation R	0%	Adjustable degree of compensation harmonic R (typically R=37)
474	Harmonic order S	39	Harmonic order of controller S (typically S=39)
475	Compensation S	0%	Adjustable degree of compensation harmonic S (typically S=39)
477	Harmonic order T	41	Harmonic order of controller T (typically T=41)
478	Compensation T	0%	Adjustable degree of compensation harmonic T (typically T=41)
480	Harmonic order U	43	Harmonic order of controller U (typically U=43)
481	Compensation U	0%	Adjustable degree of compensation harmonic U (typically U=43)
483	Harmonic order V	45	Harmonic order of controller V (typically V=45)
484	Compensation V	0%	Adjustable degree of compensation harmonic V (typically V=45)
486	Harmonic order W	47	Harmonic order of controller W (typically W=47)
487	Compensation W	0%	Adjustable degree of compensation harmonic W (typically W=47)
489	Harmonic order X	49	Harmonic order of controller X (typically X=49)
490	Compensation X	0%	Adjustable degree of compensation harmonic X (typically X=49)

10.1.4 Power module parameter group P6XX: Error message

No.	Parameter	Description
600	Phase L3 IGBT4	Phase L3 IGBT4 HW fault
601	Phase L3 IGBT3	Phase L3 IGBT3 HW fault
602	Phase L3 IGBT2	Phase L3 IGBT2 HW fault
603	Phase L3 IGBT1	Phase L3 IGBT1 HW fault
604	Phase L2 IGBT4	Phase L2 IGBT4 HW fault
605	Phase L2 IGBT3	Phase L2 IGBT3 HW fault
606	Phase L2 IGBT2	Phase L2 IGBT2 HW fault
607	Phase L2 IGBT1	Phase L2 IGBT1 HW fault
608	Phase L1 IGBT4	Phase L1 IGBT4 HW fault
609	Phase L1 IGBT3	Phase L1 IGBT3 HW fault
610	Phase L1 IGBT2	Phase L1 IGBT2 HW fault
611	Phase L1 IGBT1	Phase L1 IGBT1 HW fault
615	Overcurrent L1	Overcurrent phase L1 (peak value)
616	Overcurrent L2	Overcurrent phase L2 (peak value)
617	Overcurrent L3	Overcurrent in AHF phase L3 (peak value)
618	Over current RMS	Current RMS is higher than maximum allowed RMS current
620	DC volt not reached	DC-Link voltage NOT reached at the end of passive charging
621	DC voltage not increased	DC-Link voltage NOT increased during passive charging
622	DC voltage too low	DC-Link voltage during passive charging is too low
623	DC voltage too high	DC-Link overvoltage; SW detection
624	Max DC voltage too high	DC-Link overvoltage; HW detection
625	DC volt imbalance	DC link voltage imbalance
626	DC voltage not stable	DC-Link voltage NOT stable at the end of passive charging
627	Precharge timeout	Timeout during passive charging
630	Overtemperature IGBT	Over-Temperature at IGBT
635	Fan failure	Collective fault: One of the three fans is in fault state.
636	Fan speed incorrect	Collective fault: One of the three fans has too low speed.
640	No line synchronization	Line synchronization failure
641	Error grid rotation field	No rotation field or counterclockwise rotation detected
642	Mains connection error	4-wire/ 3-wire connection NOT correct
643	Grid volt rms too high	AC line voltage RMS is too high
644	Grid volt rms too low	AC line voltage rms is too low
646	Line volt too high	Instantaneous line voltage is too high
647	Int voltage failure	Collective fault: One of the internal power supplies has wrong voltage.
650	Harm ctrl limit reached	Device turned off due to detection of line current resonance
651	THDu resonance	Device turned off due to detection of line voltage resonance
655	SW not compatible	software is incompatible with hardware revision

656	Controller task overflow	Overflow of control interrupt
657	High speed bus error	High speed bus connection lost
658	Precharge relay error	Precharge relay error or current sensor broken
660	Collective HW Fault	Collective HW Fault
670	Err. code-this PM	Error code of the directly connected PM
671	Err. code-PM HSB	Error code of the PM connected via HSB
672	Warn.-this PM	Warning of the directly connected PM
673	Warn.-PM HSB	Warning of the PM connected via HSB
680	Enable HW error	Enabled error flags in uFaultLines_Enable.
681	Enable ErrorWord	Bit mask of enabled fast error flags. 1 = enabled 0 = disabled
682	Enable ErrorWordSlow	Bit mask of enabled Slow error flags. 1 = enabled 0 = disabled
691	Device statusword	Device statusword of resonance detection, full load situation, derating
694	Hardware fault flags	Fault flags for HW detected events (32 fault flags)

10.1.5 Power module parameter group P7XX: Transients

No.	Parameter	Description
772	iOUT L1-this PM	Filter output current L1 of the directly connected PM
773	iOUT L2-this PM	Filter output current L2 of the directly connected PM
774	iOUT L3-this PM	Filter output current L3 of the directly connected PM
775	iOUT N-this PM	Filter output current N of the directly connected PM
776	iOUT L1-PM HSB	Filter output current L1 of the PM connected via HSB
777	iOUT L2-PM HSB	Filter output current L2 of the PM connected via HSB
778	iOUT L3-PM HSB	Filter output current L3 of the PM connected via HSB
779	iOUT N-PM HSB	Filter output current N of the PM connected via HSB

10.1.6 Power module parameter group P8XX: FFT measurement

No.	Parameter	Description
800	FFT Selection	FFT Selection
801	FFT peak H1	FFT peak H1
802	FFT peak H2	FFT peak H2
803	FFT peak H3	FFT peak H3
804	FFT peak H4	FFT peak H4
805	FFT peak H5	FFT peak H5
806	FFT peak H6	FFT peak H6
807	FFT peak H7	FFT peak H7
808	FFT peak H8	FFT peak H8
809	FFT peak H9	FFT peak H9
810	FFT peak H10	FFT peak H10
811	FFT peak H11	FFT peak H11
812	FFT peak H12	FFT peak H12
813	FFT peak H13	FFT peak H13
814	FFT peak H14	FFT peak H14

815	FFT peak H15	FFT peak H15
816	FFT peak H16	FFT peak H16
817	FFT peak H17	FFT peak H17
818	FFT peak H18	FFT peak H18
819	FFT peak H19	FFT peak H19
820	FFT peak H20	FFT peak H20
821	FFT peak H21	FFT peak H21
822	FFT peak H22	FFT peak H22
823	FFT peak H23	FFT peak H23
824	FFT peak H24	FFT peak H24
825	FFT peak H25	FFT peak H25
826	FFT peak H26	FFT peak H26
827	FFT peak H27	FFT peak H27
828	FFT peak H28	FFT peak H28
829	FFT peak H29	FFT peak H29
830	FFT peak H30	FFT peak H30
831	FFT peak H31	FFT peak H31
832	FFT peak H32	FFT peak H32
833	FFT peak H33	FFT peak H33
834	FFT peak H34	FFT peak H34
835	FFT peak H35	FFT peak H35
836	FFT peak H36	FFT peak H36
837	FFT peak H37	FFT peak H37
838	FFT peak H38	FFT peak H38
839	FFT peak H39	FFT peak H39
840	FFT peak H40	FFT peak H40
841	FFT peak H41	FFT peak H41
842	FFT peak H42	FFT peak H42
843	FFT peak H43	FFT peak H43
844	FFT peak H44	FFT peak H44
845	FFT peak H45	FFT peak H45
846	FFT peak H46	FFT peak H46
847	FFT peak H47	FFT peak H47
848	FFT peak H48	FFT peak H48
849	FFT peak H49	FFT peak H49

10.2 Parameter list of sync module

10.2.1 Sync module parameter group P0XX, P1XX: Measurements and information (read only)

No.	Parameter	Unit	Description
002	Rated current	A	Rated current of device
003	Overload current	A	Maximum overload current- peak value
004	Rated voltage	V	Rated voltage of the active harmonic filter 480 for 3-wire 400 for 4-wire
005	Overcurrent limit	A	Maximum peak surge current
008	MAC address		MAC address
010	FPGA Firmware ver.		Firmware version of the control FPGA
011	MCF51 Firmware rev		MCF51 firmware revision
014	Software compatibility		software compatibility check (0=compatible, other=incompatible)
015	Serial number		Serial number of device
016	SN control board		Serial number of control board
020	Operational state		Operational state
021	Error root cause		Show Errornumber (P6xy => ErrorNum 6xy) of pending errors
022	Warning		Warning
023	Operational state ext.		Extended Operational state
024	CT Calibration Status		CT Module Calibration Status
025	Device name		Device name
026	Mains connection		Selected type of mains connection
029	HW ID control board		HW ID control board
030	Operating hours	h	Operating hours of active compensation
031	Connected to supply	h	Total hours of the device connected to grid
032	No. of installed PM		Number of installed power modules
033	No. of detected PM		Number of detected power modules
034	No. of functional PM		Number of functional power modules
035	No. of active PM		Number of active power modules
040	SM1 operational state		Operation state of the SM1 system with up to 5 PM
041	PM1-1 operational state		Operation state of PM1 of SM1
042	PM1-2 operational state		Operation state of PM2 of SM1
043	PM1-3 operational state		Operation state of PM3 of SM1
044	PM1-4 operational state		Operation state of PM4 of SM1
045	PM1-5 operational state		Operation state of PM5 of SM1
046	SM2 operational state		Operation state of the SM2 system with up to 5 PM
052	SM3 operational state		Operation state of the SM3 system with up to 5 PM
058	SM4 operational state		Operation state of the SM4 system with up to 5 PM

100	Mains frequency	Hz	Mains frequency
102	Cos phi		Displacement Power Factor
103	DC link voltage	V	DC-link voltage of device.
104	Device load	%	Load of the device related to nominal current.
105	Active power L1	kW	Active power rms, phase L1
106	Active power L2	kW	Active power rms, phase L2
107	Active power L3	kW	Active power rms, phase L3
109	Rotating field		Direction of rotating field
110	Line voltage rms U12	V	rms value of line voltage U12
111	Line voltage rms U23	V	rms value of line voltage U23
112	Line voltage rms U31	V	rms value of line voltage U31
113	Line voltage U12	V	Instantaneous value of line to line voltage U12
114	Line voltage U23	V	instantaneous value of line to line voltage U23
115	Line voltage U31	V	Instantaneous value of line to line voltage U31
120	Line current rms L1	A	Line current rms, phase L1
121	Line current rms L2	A	Line current rms, phase L2
122	Line current rms L3	A	Line current rms, phase L3
123	Line current L1	A	Instantaneous value of line current, phase L1
124	Line current L2	A	Instantaneous value of line current, phase L2
125	Line current L3	A	Instantaneous value of line current, phase L3
126	Line current rms N	A	Line current rms, neutral
127	Line current N	A	Instantaneous value of line current, neutral
130	Load current rms L1	A	Load current rms, phase L1
131	Load current rms L2	A	Load current rms, phase L2
132	Load current rms L3	A	Load current rms, phase L3
133	Load current L1	A	Instantaneous value of load current, phase L1
134	Load current L2	A	Instantaneous value of load current, phase L2
135	Load current L3	A	Instantaneous value of load current, phase L3
136	Load current rms N	A	Load current rms neutral
137	Load current N	A	Instantaneous value of load current neutral
139	Load current rms max	A	Maximum load current rms of 3 phases
140	Output current rms L1	A	Device output current rms L1
141	Output current rms L2	A	Device output current rms L2
142	Output current rms L3	A	Device output current rms L3
143	Output current L1	A	Instantaneous value of output current L1
144	Output current L2	A	Instantaneous value of output current L2
145	Output current L3	A	Instantaneous value of output current L3
146	Output current rms N	A	Device output current rms neutral

147	Output current N	A	Instantaneous value of device output current neutral
148	Max. output current rms	A	Maximum output current rms of all phases
149	Reactive current rms	A	fundamental reactive current rms
150	Line voltage rms U1	V	Line voltage rms, L1 to N
151	Line voltage rms U2	V	Line voltage rms, L2 to N
152	Line voltage rms U3	V	Line voltage rms, L3 to N
153	Line voltage U1	V	Instantaneous value of line voltage, L1 to N
154	Line voltage U2	V	Instantaneous value of line voltage. L2 to N
155	Line voltage U3	V	Instantaneous value of line voltage, L3 to N
160	THDu line voltage U12	%	Total harmonic distortion line voltage U12
161	THDu line voltage U23	%	Total harmonic distortion line voltage U23
162	THDu line voltage U31	%	Total harmonic distortion line voltage U31
166	THDu Umains	%	Distortion factor of the instantaneous mains voltage
167	Cos phi L1	-	Displacement Power Factor L1
168	Cos phi L2	-	Displacement Power Factor L2
169	Cos phi L3	-	Displacement Power Factor L3
170	THDi current L1	%	Total harmonic distortion line current L1
171	THDi current L2	%	Total harmonic distortion line current L2
172	THDi current L3	%	Total harmonic distortion line current L3
178	CT check Result		Result of current transformer check
181	System temperature	°C	System temperature in degree Celsius
182	Overtemp threshold	°C	Shutdown threshold on overtemperature
184	ON command		On command
190	Speed fan 1	100*RPM	Speed of Fan 1
191	Speed fan 2	100*RPM	Speed of Fan 2
192	Speed fan 3	100*RPM	Speed of Fan 3
193	Speed fan 4	100*RPM	Speed of Fan 4
196	ON command		On command
197	Cross Trigger		Trace trigger from neighbor devices received via HSB
198	IGBT ON signal		Flag=1 IGBT are switching
199	Global Error Signal		Flag=1 in case of any fault

10.2.2 Sync module parameter group P2XX and P3XX: Commissioning parameters

No.	Parameter	Factory setting	Description
200	Language	English	Language shown on display module (ignored when using the HMI): ▪ Deutsch ▪ English ▪ Chinese ▪ Français
202	Switch on mode	terminal strip	definition how to switch on: ▪ terminal strip ▪ direct ON ▪ direct OFF ▪ Switch S1 ▪ SyncModule HSB
203	HSB configure active	HSB config not active	Activate HSB ring configuration
205	Parallel Oper. Sync.	Master 300	Synchronization mode of devices operated in parallel. ▪ Master 300 (only one SM) ▪ Master 600 (parallel sync modules) ▪ Master 900 ▪ Master 1200 ▪ Slave (parallel sync modules) The sync module where the CT measurements are connected is the master P205 = MasterXXX. The other sync modules are the slave P205 = Slave
210	Default values	no action	Set default values
211	Write PM parameter	Overwriting enabled	Enable overwriting of the parameters in the power module
220	Date and time		System date and time
230	Service – MB address	1	Modbus Slave ID for Service interface X113
231	Service – MB baudrate	38400	Modbus baudrate (8N1) for Service interface X113
234	Bootloader port	Service	port selection (Service X113, Display X115); User can select to perform Firmware update via service or display terminal
240	IP address	192.168.1.2	IP address
241	DHCP	OFF	Allocation of IP address by DHCP server
242	Subnet mask	255.255.255.0	Subnet mask
243	Default gateway	192.168.1.50	default gateway
250	Display – MB address	1	Modbus Slave ID for Display interface X115, X116
251	Display - MB baudrate	38400	Modbus baudrate (8N1) for Display interface X115, X116
254	Enable Display Modbus	ON	Enable MODBUS on display serial port X115/X116
255	Enable 24V display	ON	Enable 24V display supply in X116
256	Reset 24V display	No reset	Reset 24V display supply in X116.
260	Function X111.2	On-Off command	Digital input/output (24 V)

			Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
261	polarity X111.2	High active	polarity of digital output X111.2 ▪ 1=high active ▪ 0=low active
262	Configuration X111.2	Input	Set configuration for digital port X111.2 ▪ 0=input ▪ 1=output
263	Function X111.3	Quit command	Digital input/output (24 V) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
264	Polarity X111.3	1	polarity of digital output X111.3 ▪ 1=high active ▪ 0=low active
265	Configuration X111.3	1	Set configuration for digital port X111.3 ▪ 0=Input ▪ 1=output
266	Function X111.4	State operation	Relay output (250 V, 3 A) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor

			▪ Trip line
267	Polarity X111.4	normal open	Polarity of relay output X111.4 ▪ 1= normal closed ▪ 0 = normal open
268	Function X111.5	State error global	Relay output (250 V, 3 A) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
269	Polarity X111.5	normal closed	Polarity of relay output X111.5 ▪ 1= normal closed ▪ 0 = normal open
270	Function X101.2	State error global	Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
271	Polarity X101.2	high active	polarity of digital output X101.2 ▪ 1=high active ▪ 0=low active
272	Configuration X101.2	output	Digital input/output (24 V) Set configuration for digital port X101.2 ▪ 0=Input ▪ 1=output
273	Function X101.3	State error global	Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor

			▪ Trip line
274	Polarity X101.3	high active	polarity of digital output X101.3 (1=High active / 0=low active) ▪ high active ▪ low active
275	Configuration X101.3	output	Digital input/output (24 V) Set configuration for digital port X101.3 (0=input, 1= output) ▪ input ▪ output
276	Function X101.6	State error global	Digital output (24 V) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
277	Polarity X101.6	normal open	Polarity of digital output X101.6 ▪ 1= high active ▪ 0 = low active
278	Function X101.7	State error global	Digital output (24 V) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
279	Polarity X101.7	normal closed	Polarity of digital output X101.7 ▪ 1= high active ▪ 0 = low active
280	Function X102.1 - .3	State error global	Relay output (250 V, 3 A) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature

			▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
281	Polarity X102.1 - .3	normal closed	Polarity of relay output X102.1 - .3 ▪ 1= normal closed ▪ 0 = normal open
282	Function X102.4 - .6	State error global	Relay output (250 V, 3 A) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
283	Polarity X102.4 - .6	normal closed	Polarity of relay output X102.4 - .6 ▪ 1= normal closed ▪ 0 = normal open
284	Function X101.4	Temperature sensor	Input (24 V) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command ▪ Temperature sensor ▪ Trip line
285	Polarity X101.4	low active	polarity of digital output X101.4 ▪ 1 = high active ▪ 0 =low active
286	Function X101.5	Trip line	Input (24 V) Input: High/Low = On, Open = Off, Output: High = selected function ▪ Fixed logical 0 ▪ Fixed logical 1 ▪ State operation ▪ State standby ▪ Full load operation ▪ Derating operation global ▪ Derating operation temperature ▪ State error global ▪ On-Off command ▪ Quit command

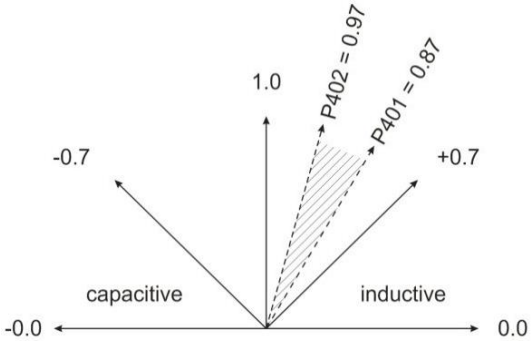
			▪ Temperature sensor ▪ Trip line
287	Polarity X101.5	high active	polarity of digital output X101.5 ▪ 1 = high active ▪ 0 = low active
300	CT placement	OFF	Placement of the external current transformers: ▪ Mainside ▪ Loadside ▪ OFF
310	CT primary value	1000	Primary full-scale value of external current transformer.
312	CT secondary value	: 5A	Secondary full-scale value of external current transformer. ▪ :5A ▪ :1A
313	CT check	ON	Activate/deactivate the current transformer check
320	Total current parallel	60A	total current of all parallel devices, required for asynchronous mode with additional cabinet.

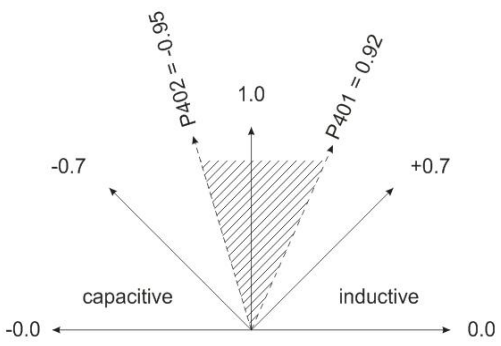
10.2.3 Sync module parameter group P4XX: Compensation settings

No.	Parameter	Factory setting	Description
400	Reactive Power	100%	Degree of the reactive power compensation 0 … 100%
401	Cosphi lower limit	1.0	Specifies the lower limit of target cos phi range on mains side

Only one of the two cosφ – controls can be activated at a time in parameter 403:

- P400 – direct reactive power compensation in percent. The reactive current compensation is dependent of P400 (0% to 100%). Fast iq control compensates the specified percentage value of the currently measured reactive power.
- cos phi control. The cos phi controller is dependent of the specified values in parameter P401 (lower limit) and P402 (upper limit), keeping cos φ in the specified target range





402	Cosphi upper limit	1.0	Specifies the upper limit of target cos phi range on mains side
403	Reactive Power Control	OFF	Activation reactive power control (fast iq control or cos phi control)
405	Load balancing	OFF	Activation or deactivation of load balancing between phases
407	Priority full load	None	Priority of compensation when full load is reached
410	Harmonic compens.	OFF	Activation of operation mode harmonic compensation.
411	Minutes counter	min	Minutes counter
412	Standby mode	Standby controlled by SM	Selection of standby mode: ▪ No standby control ▪ Standby controlled by PM ▪ Standby controlled by SM
413	Standby threshold	0,0 A	Minimum current reserve (rms) for standby of next PM is P413 + 60A
414	Standby hysteresis	0,0 A	Minimum current reserve (rms) for reactivation of a standby-PM is P413 - P414
415	No. of PM in hot standby	0	Number of standby devices remaining in hot standby. Surplus standby devices change into cold standby. Values [0…5]
416	Zero load standby	0,0 A	Minimum load current threshold (rms), below which all power modules are set into standby
417	Enable hot standby timeout	Disabled	Enable automatic change of power module from hot standby into cold standby

418	Hot standby timeout	0 min	Span of time of devices changing automatically from hot standby into cold standby
419	Smoothing utilization	0 %	Internally applied falling rate of utilization (in %/min) at falling load
420	Harmonic order A	3	Harmonic order of controller A (typically, A=3)
421	Compensation A	0% for FN3530/31 80% for FN3540/41	Adjustable degree of compensation harmonic A (typically A=3)
423	Harmonic order B	5	Harmonic order of controller B (typical B=5)
424	Compensation B	80%	Adjustable degree of compensation Harmonic B (typically B=5)
426	Harmonic order C	7	Harmonic order of controller C (typically C=7)
427	Compensation C	80%	Adjustable degree of compensation Harmonic C (typically C=7)
429	Harmonic order D	9	Harmonic order of controller D (typically D=9)
430	Compensation D	0% for FN3530/31 50% for FN3540/41	Adjustable degree of compensation harmonic D (typically D=9)
432	Harmonic order E	11	Harmonic order of controller E (typically E=11)
433	Compensation E	50%	Adjustable degree of compensation harmonic E (typically E=11)
435	Harmonic order F	13	Harmonic order of controller F (typically F=13)
436	Compensation F	40%	Adjustable degree of compensation harmonic F (typically F=13)
438	Harmonic order G	15	Harmonic order of controller G (typically G=15)
439	Compensation G	0%	Adjustable degree of compensation harmonic G (typically G=15)
441	Harmonic order H	17	Harmonic order of controller H (typically H=17)
442	Compensation H	30%	Adjustable degree of compensation harmonic H (typically H=17)
444	Harmonic order I	19	Harmonic order of controller I (typically I=19)
445	Compensation I	20%	Adjustable degree of compensation harmonic I (typically I=19)
447	Harmonic order J	21	Harmonic order of controller J (typically J=21)
448	Compensation J	100% for FN3530/31 0% for FN3540/41	Adjustable degree of compensation harmonic J (typically J=21)
450	Harmonic order K	23	Harmonic order of controller K (typically K=23)
451	Compensation K	15%	Adjustable degree of compensation harmonic K (typically K=23)
453	Harmonic order L	25	Harmonic order of controller L (typically L=25)
454	Compensation L	15%	Adjustable degree of compensation harmonic L (typically L=25)
456	Harmonic order M	27	Harmonic order of controller M (typically M=27)

457	Compensation M	0%	Adjustable degree of compensation harmonic M (typically M=27)
459	Harmonic order N	29	Harmonic order of controller N (typically N=29)
460	Compensation N	10%	Adjustable degree of compensation harmonic N (typically N=29)
462	Harmonic order O	31	Harmonic order of controller O (typically O=31)
463	Compensation O	10%	Adjustable degree of compensation harmonic O (typically O=31)
465	Harmonic order P	33	Harmonic order of controller P (typically P=33)
466	Compensation P	0%	Adjustable degree of compensation harmonic P (typically P=33)
468	Harmonic order Q	35	Harmonic order of controller Q (typically Q=35)
469	Compensation Q	0%	Adjustable degree of compensation harmonic Q (typically Q=35)
471	Harmonic order R	37	Harmonic order of controller R (typically R=37)
472	Compensation R	0%	Adjustable degree of compensation harmonic R (typically R=37)
474	Harmonic order S	39	Harmonic order of controller S(typically S=39)
475	Compensation S	0%	Adjustable degree of compensation harmonic S (typically S=39)
477	Harmonic order T	41	Harmonic order of controller T (typically T=41)
478	Compensation T	0%	Adjustable degree of compensation harmonic T (typically T=41)
480	Harmonic order U	43	Harmonic order of controller U (typically U=43)
481	Compensation U	0%	Adjustable degree of compensation harmonic U (typically U=43)
483	Harmonic order V	45	Harmonic order of controller V (typically V=45)
484	Compensation V	0%	Adjustable degree of compensation harmonic V (typically V=45)
486	Harmonic order W	47	Harmonic order of controller W (typically W=47)
487	Compensation W	0%	Adjustable degree of compensation harmonic W (typically W=47)
489	Harmonic order X	49	Harmonic order of controller X (typically X=49)
490	Compensation X	0%	Adjustable degree of compensation harmonic X (typically X=49)

10.2.4 Sync module parameter group P6XX, P7XX: Error message

No.	Parameter	Description
609	Software not compatible	software is incompatible with hardware revision
610	System error code	System error code
611	SM1 error code	Error code for Sync module #1
612	SM2 error code	Error code for Sync module #2
613	SM3 error code	Error code for Sync module #3
614	SM4 error code	Error code for Sync module #4
615	PM1-1 error code	Error code for Power Module #1 connected to this sync module
616	PM1-2 error code	Error code for Power Module #2 connected to this sync module
617	PM1-3 error code	Error code for Power Module #3 connected to this sync module
618	PM1-4 error code	Error code for Power Module #4 connected to this sync module
619	PM1-5 error code	Error code for Power Module #5 connected to this sync module
620	System warning	System warning
621	SM1 warning	Warning for Sync Module #1
622	SM2 warning	Warning for Sync Module #2
623	SM3 warning	Warning for Sync Module #3
624	SM4 warning	Warning for Sync Module #4
625	PM1-1 warning	Warning from Power Module #1 connected to this sync module
626	PM1-2 warning	Warning from Power Module #2 connected to this sync module
627	PM1-3 warning	Warning from Power Module #3 connected to this sync module
628	PM1-4 warning	Warning from Power Module #4 connected to this sync module
629	PM1-5 warning	Warning from Power Module #5 connected to this sync module
630	Fan 1 status	Status of Fan 1
631	Fan 2 status	Status of Fan 2
632	Fan 3 status	Status of Fan 3
633	Fan 4 status	Status of Fan 4
634	DI X111.2 error signal	DI X111.2 error signal
635	DI X111.3 error signal	DI X111.3 error signal
636	DI X101.2 error signal	DI X101.2 error signal
637	DI X101.3 error signal	DI X101.3 error signal
638	DI X101.4 error signal	DI X101.4 error signal
639	DI X101.5 error signal	DI X101.5 error signal
640	SM1 over temperature	Over temperature detected by sync module
641	High speed bus error	High speed bus connection lost
642	Cab1 link error	HSB Link error to first additional sync module
643	Cab2 link error	HSB Link error to second additional sync module
644	Cab3 link error	HSB Link error to third additional sync module

645	Temp switch cabinet	Temperature error from switch supervising the lower part of the cabinet (connected to X102)
646	controller task overflow	controller task overflow. Please contact Schaffner service.
647	Internal voltage failure	Collective fault: one of the internal power supplies has wrong voltage.
648	PM firmware incompatible	Firmware version of PM not compatible
649	HSB activity error	No HSB interface activity detected
650	PM mains connection incompatible	Mains connection of PM not compatible
688	Digital inputs	Collective fault: error of digital inputs.
691	Device statusword	Device statusword of error flags, full load situation, derating a.o.
693	ErrorWord	Error flags in ErrorWord
694	ErrorWord 2	Error flags in ErrorWord 2
696	Num of SPI CRC faults	Number of SPI CRC faults
697	Num of good SPI CRCs	Number of good SPI CRCs
791	Aux supply 24V	Measured auxiliary supply 24V
792	Aux supply 2,5V	Measured auxiliary supply 2,5V
793	Aux supply 5V	Measured auxiliary supply 5V
794	Aux supply -15V	Measured auxiliary supply -15V
795	Aux supply +15V	Measured auxiliary supply +15V

10.2.5 Sync module parameter group P8XX: FFT measurement

No.	Parameter	Description
800	FFT Selection	FFT Selection
801	FFT peak H1	FFT peak H1
802	FFT peak H2	FFT peak H2
803	FFT peak H3	FFT peak H3
804	FFT peak H4	FFT peak H4
805	FFT peak H5	FFT peak H5
806	FFT peak H6	FFT peak H6
807	FFT peak H7	FFT peak H7
808	FFT peak H8	FFT peak H8
809	FFT peak H9	FFT peak H9
810	FFT peak H10	FFT peak H10
811	FFT peak H11	FFT peak H11
812	FFT peak H12	FFT peak H12
813	FFT peak H13	FFT peak H13
814	FFT peak H14	FFT peak H14
815	FFT peak H15	FFT peak H15
816	FFT peak H16	FFT peak H16
817	FFT peak H17	FFT peak H17
818	FFT peak H18	FFT peak H18
819	FFT peak H19	FFT peak H19
820	FFT peak H20	FFT peak H20
821	FFT peak H21	FFT peak H21
822	FFT peak H22	FFT peak H22
823	FFT peak H23	FFT peak H23
824	FFT peak H24	FFT peak H24
825	FFT peak H25	FFT peak H25
826	FFT peak H26	FFT peak H26

827	FFT peak H27	FFT peak H27
828	FFT peak H28	FFT peak H28
829	FFT peak H29	FFT peak H29
830	FFT peak H30	FFT peak H30
831	FFT peak H31	FFT peak H31
832	FFT peak H32	FFT peak H32
833	FFT peak H33	FFT peak H33
834	FFT peak H34	FFT peak H34
835	FFT peak H35	FFT peak H35
836	FFT peak H36	FFT peak H36
837	FFT peak H37	FFT peak H37
838	FFT peak H38	FFT peak H38
839	FFT peak H39	FFT peak H39
840	FFT peak H40	FFT peak H40
841	FFT peak H41	FFT peak H41
842	FFT peak H42	FFT peak H42
843	FFT peak H43	FFT peak H43
844	FFT peak H44	FFT peak H44
845	FFT peak H45	FFT peak H45
846	FFT peak H46	FFT peak H46
847	FFT peak H47	FFT peak H47
848	FFT peak H48	FFT peak H48
849	FFT peak H49	FFT peak H49

10.2.6 Sync module parameter group P9XX: cabinet related values

No.	Parameter	Description
980	PM1-1 FW Version	PM1-1 FW Version
981	PM1-2 FW Version	PM1-2 FW Version
982	PM1-3 FW Version	PM1-3 FW Version
983	PM1-4 FW Version	PM1-4 FW Version
984	PM1-5 FW Version	PM1-5 FW Version
985	PM1-1 Mains connection	PM1-1 Mains connection
986	PM1-2 Mains connection	PM1-2 Mains connection
987	PM1-3 Mains connection	PM1-3 Mains connection
988	PM1-4 Mains connection	PM1-4 Mains connection
989	PM1-5 Mains connection	PM1-5 Mains connection

11 AHF Viewer Software

The AHF viewer PC operating program supports Ecosine Active Sync commissioning and enables further diagnosis.

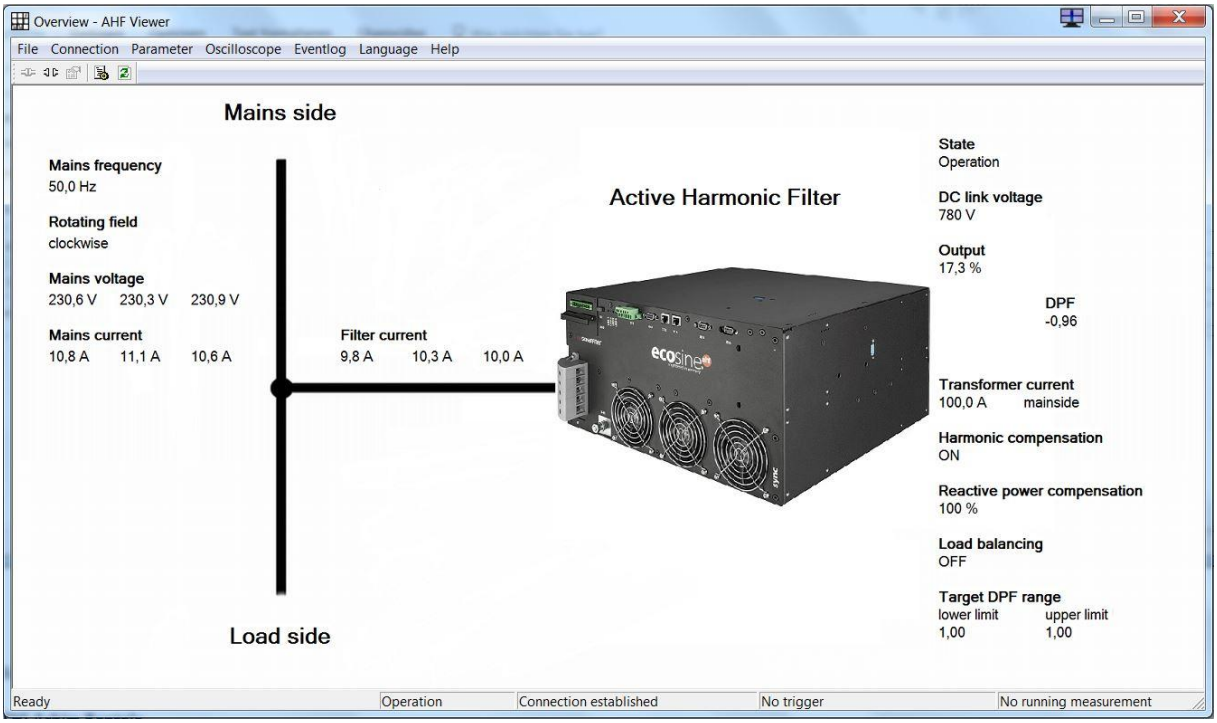


Figure 11-1 AHF viewer basic screen

11.1 Requirements and Setup

The following operating systems are recommended to run AHF viewer software.

- Windows XP
- Windows Vista (see “readme.txt” before installation)
- Windows 7 (run in “compatibility mode” when indicated)
- Windows 10
- Windows 11

11.2 Connections

The connection is established via the RS485 Ecosine Active Sync interface (service port on terminal X13) or via Ethernet (terminal X14).

11.2.1 Connection via RS485

PC connection with RS485 requires a suitable interface converter. The specification of the interface converter is shown in Table 25.

Table 25 Interface converter specifications RS485

Item	Status
Galvanic isolation	With
Terminating resistance	Activated (On last bus participant)
Echo mode	Off

Table 26 Recommended galvanic isolation interface converter USB – RS485

Designation.	Manufacturer	Illustration
USB-485-Mini/OP	CTI GmbH www.cti-lean.com www.cti-shop.com	  CTI GmbH Order No.: 95030202
AHF-PC interface	CTI GmbH www.cti-lean.com www.cti-shop.com	 CTI GmbH Order No.: 95030212

The connection to Ecosine Active Sync filter is established by means of a galvanically isolated interface converter via a 2-wire cable. Both items shown in Table 26 are needed.

Table 27 Pin assignment of connecting cable interface converter – ecosine active sync

Terminal Interface converter	Terminal X13	Meaning
A	X13.9	Signal A
B	X13.5	Signal B
Gnd_iso	X13.4	Ground (isolated, not connected to internal ground)

For proper operation of the RS485 bus a **termination resistor 120 Ω** is needed, especially if long cables or a bus structure with more than one unit is used. The interfaces are configured with the following parameters.

Table 28 Parameters for the interface configuration RS485

Parameter No.	Parameter	Factory setting	Description
230	MB slave ID	1	Modbus node address (1 … 247)
231	MB baud rate	38400	Modbus baud rate for service interface ▪ 9600 ▪ 19200 ▪ 38400 ▪ 57600 ▪ 115200

11.2.2 Direct connection via Ethernet

It is possible to connect a power module or a DPP directly by ethernet. For system with a sync module and cabinet, an additional RS485 to ethernet adapter is needed, see section 11.2.3. To establish connection to Ecosine Active Sync via Ethernet, both devices must be in the same subnet or a connection via router must be available. During this process Ecosine Active Sync can optionally obtain an IP address, subnet mask and the default gateway using a DHCP server or they must be preset manually.

To establish a direct connection between the PC and ecosine active sync, a simple Ethernet cable (not a crossover cable) is necessary. DHCP must be switched off for this purpose and the corresponding settings must be performed at the PC. For PC and Ecosine Active Sync a different IP address must be set, for example on the PC 192.168.1.1. The subnet mask must be set to 255.255.255.0 and the default gateway can remain empty. If you modify the default IP setting in the power module, you might need to adapt your computer network settings accordingly, ask your local IT support when needed.

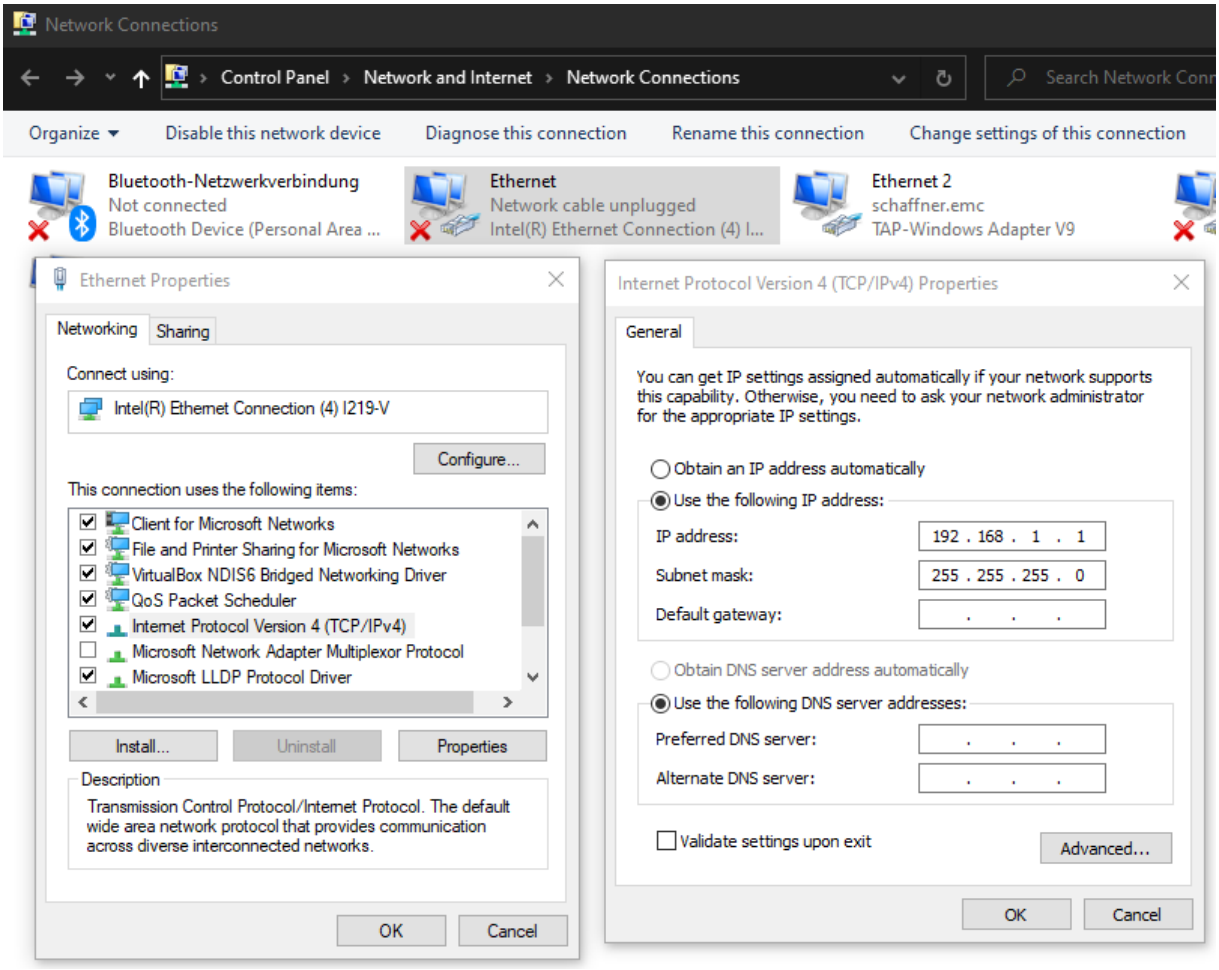
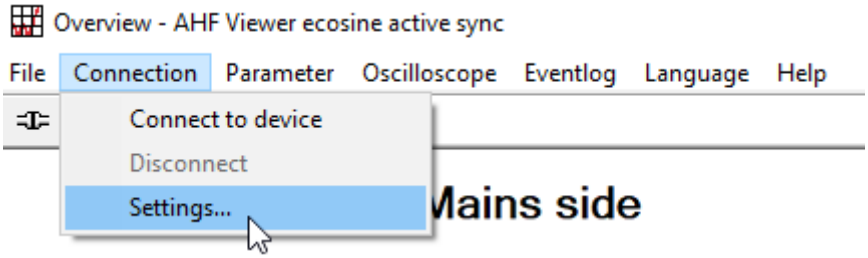


Figure 11-2 example of IP configuration on a Windows 10 PC to connect directly to the power module via ethernet

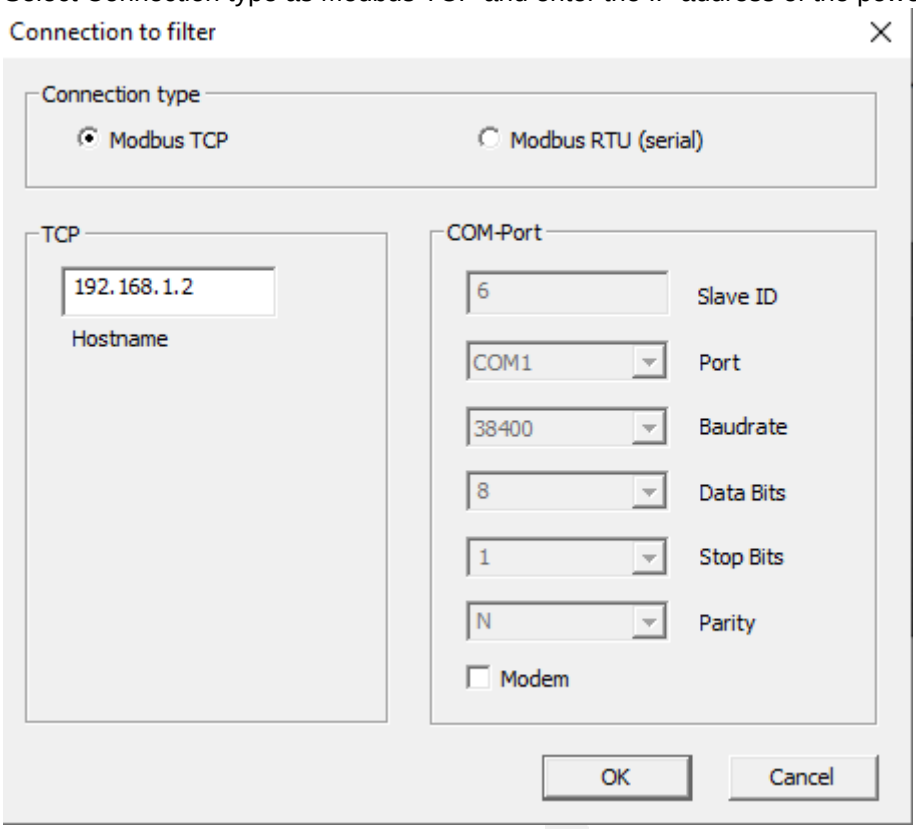
Table 29 Parameters for interface configuration

Parameter No.	Parameter	Factory setting	Description
240	IP address	192.168.1.2	**IP address** Fixed IP address if P241 DHCP = OFF Automatic assignment of an IP address by a DHCP server if P241 = ON
241	DHCP	ON	Activation of the IP address allocation by DHCP server **OFF** **the following parameters must be set:** ▪ P240 IP address ▪ P242 subnet mask ▪ P243 default gateway **ON** the following parameters are automatically assigned by the DHCP server: ▪ P240 IP address ▪ P242 subnet mask ▪ P243 default gateway
242	Subnet mask	255.255.255.0	Subnet mask ▪ Fixed subnet mask if P241 DHCP = OFF ▪ Automatic assignment of the subnet mask by a DHCP server if P241 DHCP = ON
243	Default gateway	192.168.1.50	Default gateway address ▪ Fixed address of the default gateway if P241 DHCP = OFF (leave empty in case of direct connection) Automatic assignment of the default gateway by a DHCP server if P241 DHCP = ON

Start AHF Viewer Ecosine Active Sync (always start it as administrator)
Open the connection settings



Select Connection type as Modbus TCP and enter the IP address of the power module as in P240.



Connect the device with the button on the left  .

Note: After commissioning of Ecosine Active Sync power module you might want to set back in your computer the original IP address configuration (usually DHCP enable to automatically get an IP from the network but once again to be check with local IT if necessary).

11.2.3 Connection via RS485 to ethernet adapter

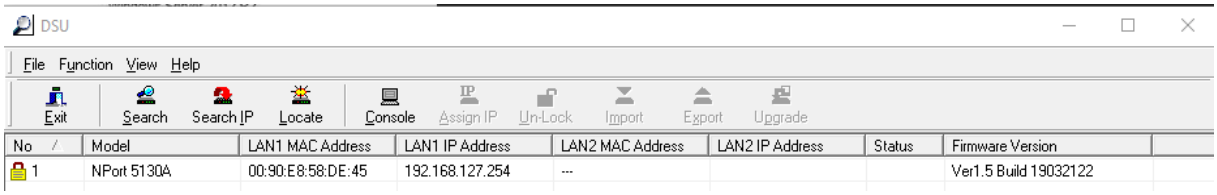
When using an AHF system with multiple power module connected to a sync module, like an AHF Ecosine Active Sync cabinet. An additional RS485 to ethernet adapter is necessary.
Schaffner offers a ready to use kit sold as ETHERNET ADAPTER with part number 820667.
Other models and brands of RS485 to ethernet adapter are compatible, the user is responsible to review if the selected model is compatible, Schaffner has review and tested some models, see Table 30.

Table 30 list of recommended RS485 to ethernet adapter

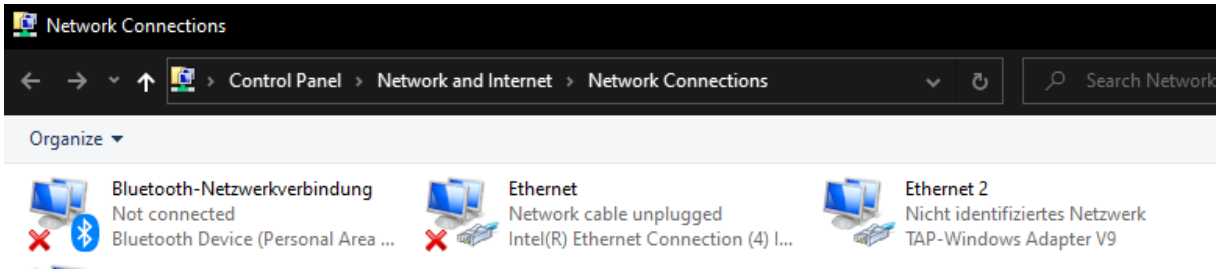
Brand	Model	Tested by Schaffner	Sold by Schaffner
Moxa	NPort 5130A	Yes	Yes, part 820667
Moxa	MGate MB3170i	Yes	No
Moxa	MGate MB3170/80	No	No
USR	N510	Yes	No

Following is a step-by-step instruction on how to connect the ethernet adapter Moxa NPort 5130A to the AHF system and to your network. Instructions might be similar

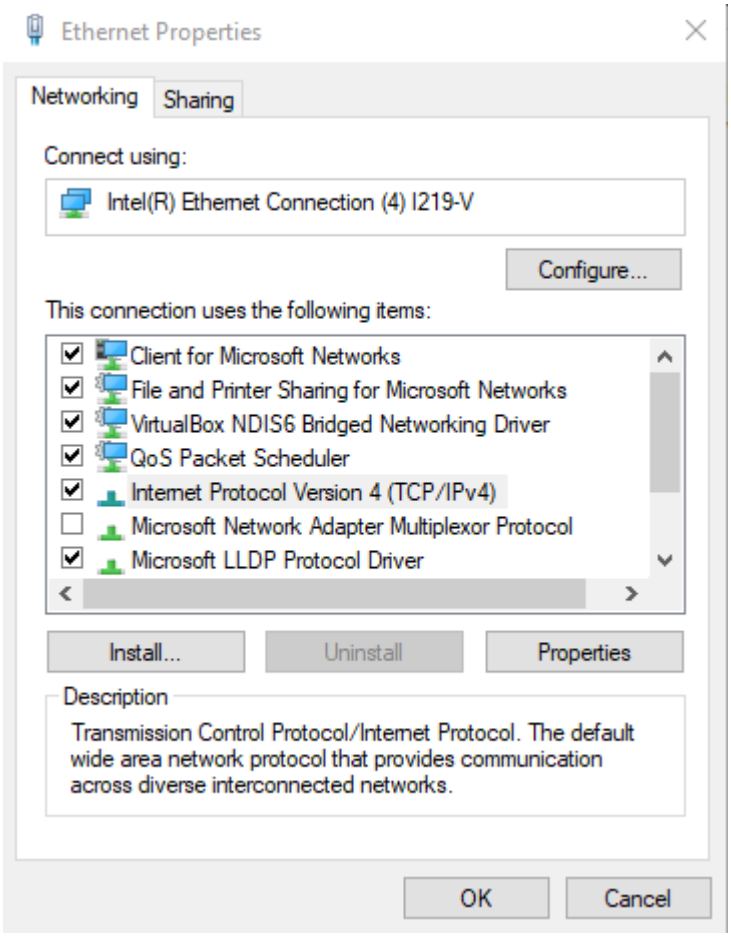
1. From Moxa website find for NPort 5100 series resources here: https://www.moxa.com/en/products/industrial-edge-connectivity/serial-device-servers/general-device-servers/nport-5100-series#resources
2. Download and install both of the following programs:
   Windows Driver Manager (for Windows 7, Server 2008, or later) v3.2
   Device Search Utility v2.3
3. If you know that your network assign an IP address automatically to new devices and you know how to find this IP address, you can skip to step 12. If not continue with step 4.
4. Directly connect your PC to the Moxa with a straight (standard) ethernet cable.
5. Open Device Search Utility (DSU) and click on “Search”. It should find the device.



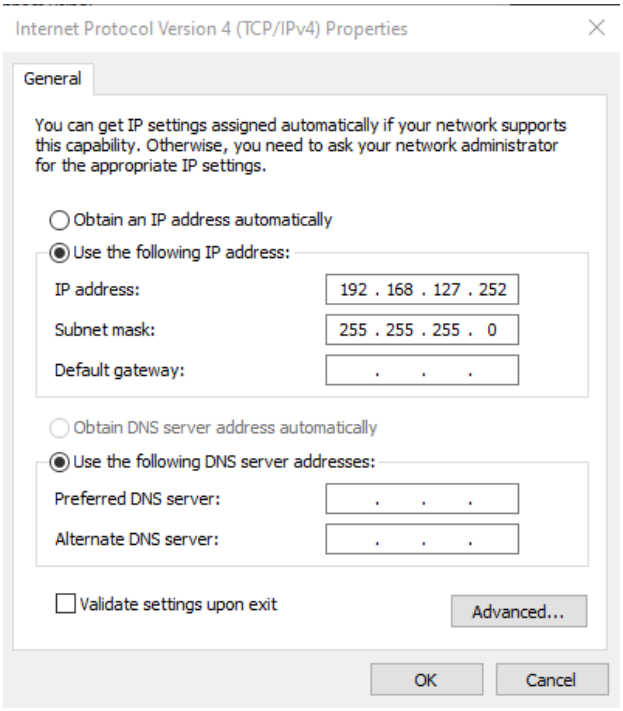
6. Note the IP address found for the device and exit DSU.
7. Open Network Connection from Windows control panel (search directly from start menu)



8. Right click on your ethernet card and select Properties.
9. Select Internet Protocol Version 4 (TCP/IPv4) and click Properties

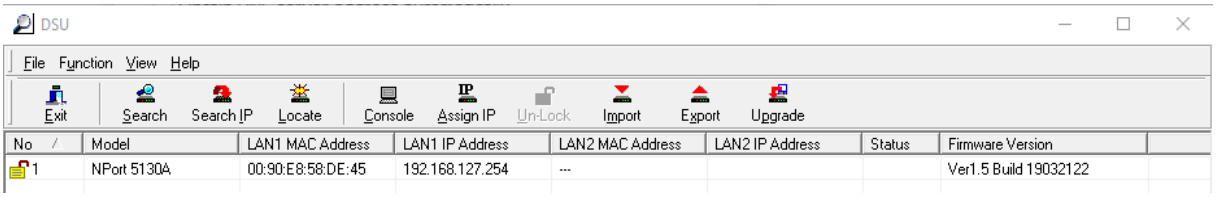


10. Enter a manual IP address for the PC within the same subnet, i.e., 192.168.127.252. Press tab to populate the subnet mask field (it should be 255.255.255.0).

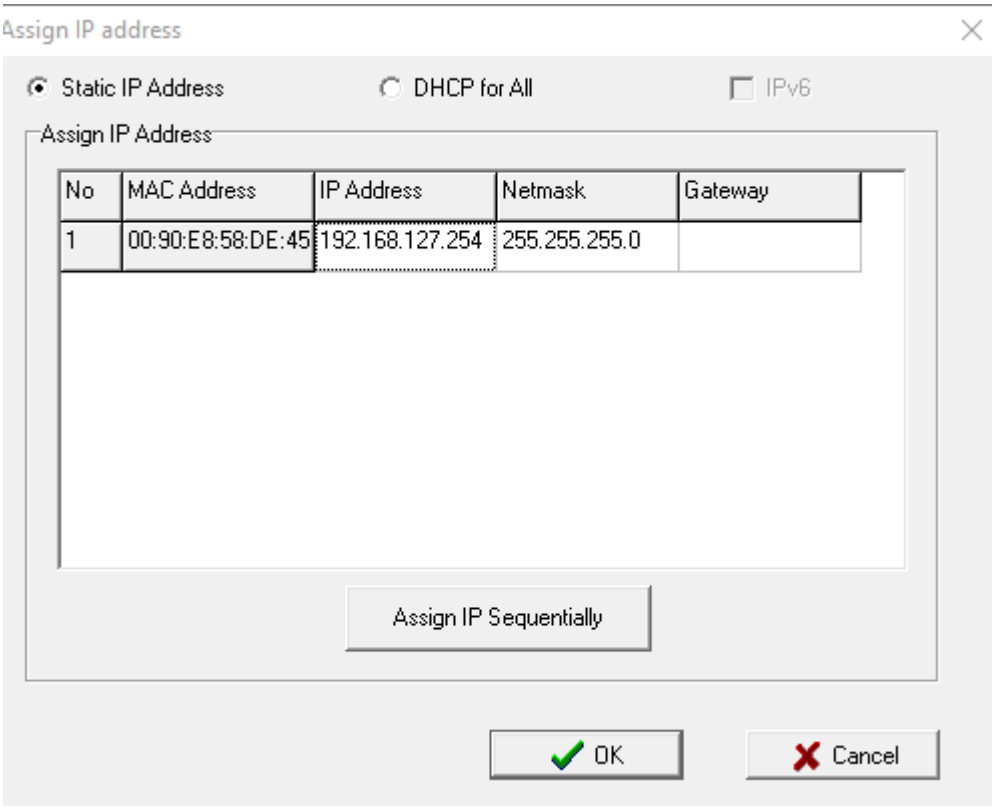


11. Click OK
12. Open DSU again, click on “Un-lock”. Enter Login: admin and Password: moxa (if you changed the default password previously, use the new password)

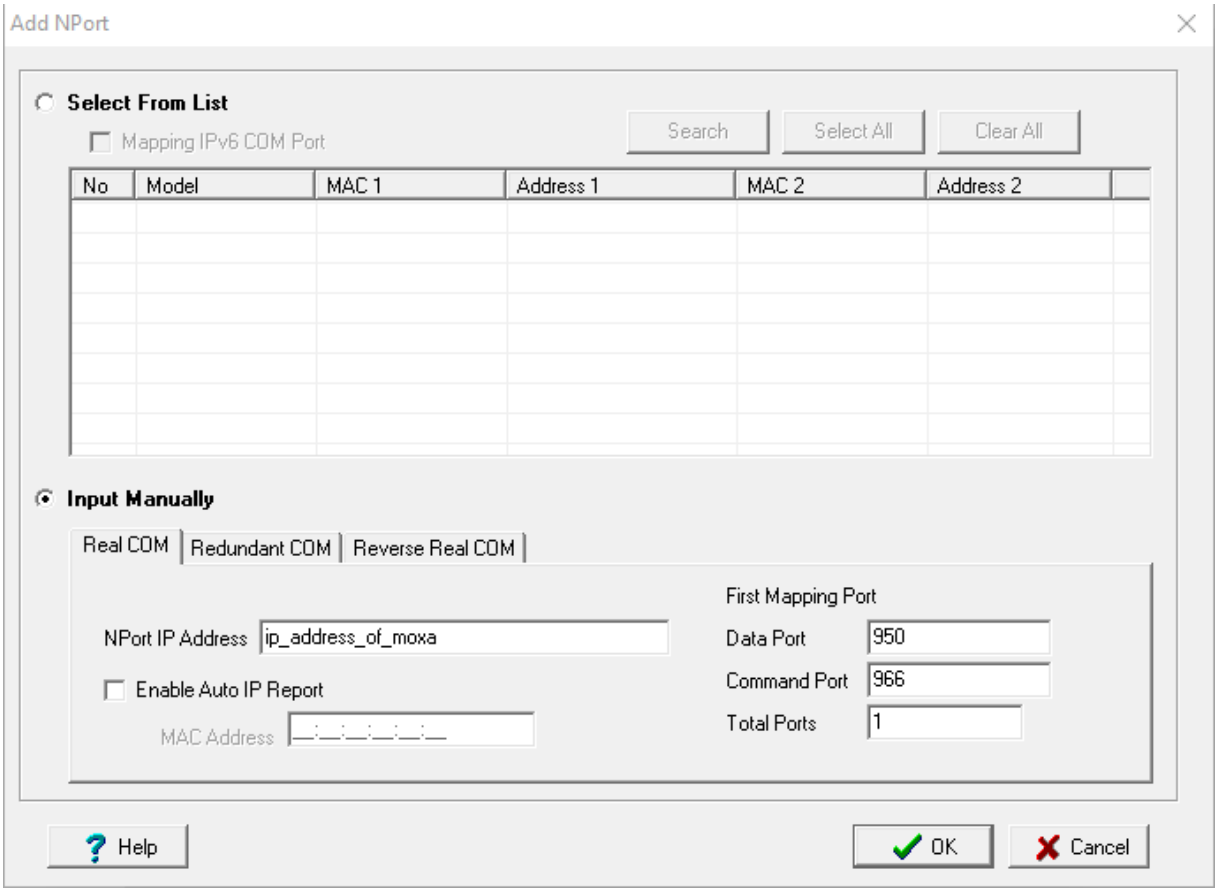
13. The device should be unlocked now with an unlocked lock icon in front of it.



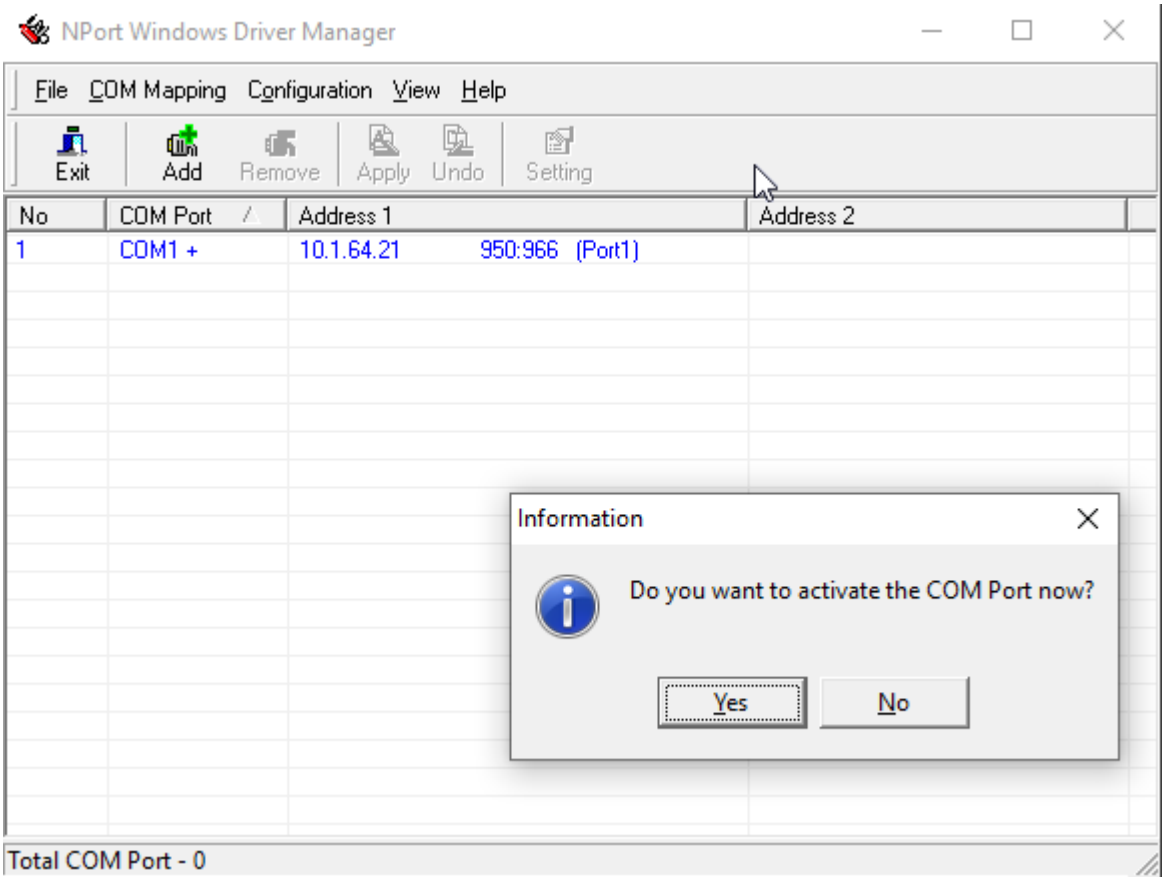
14. Click on Assign IP and change the IP address, Netmask and Gateway to match your network requirement (ask your local IT if necessary).



15. Connect back the Moxa to your local network and make sure your computer is on the same network, you should set back your original IP address configuration (usually DHCP enable to automatically get an IP from the network but once again to be check with local IT if necessary).
16. Start the program NPort Windows Driver Manager
17. Add the Moxa by entering the IP address manually.

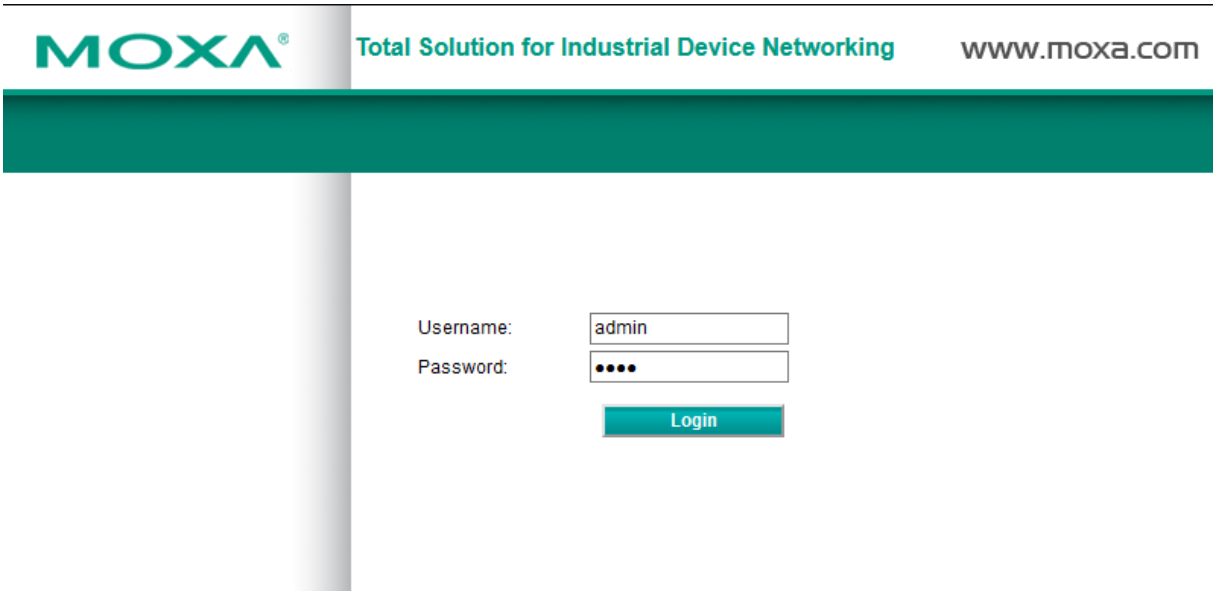


18. It will ask you if you want to activate the COM port now, click yes.

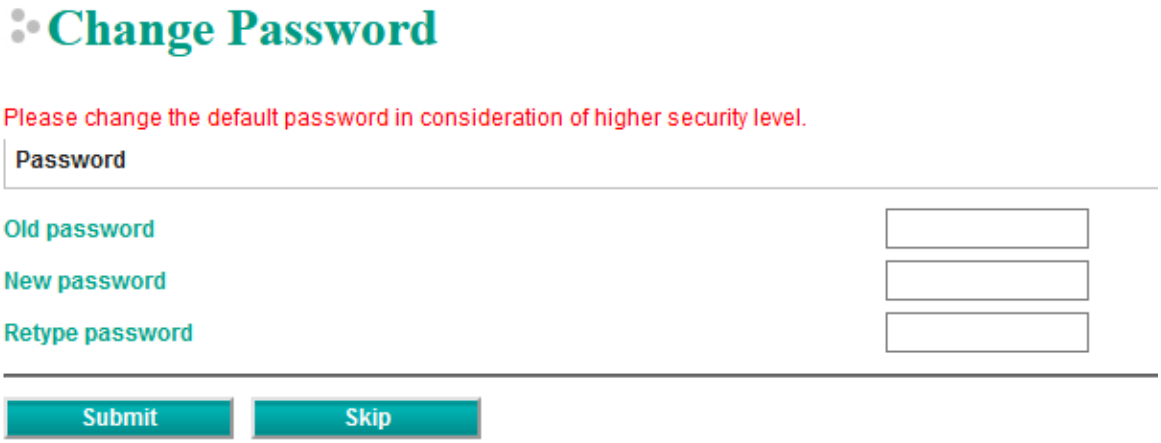


19. Note the COM Port number for later use, then you can close NPort Windows Driver Manager.

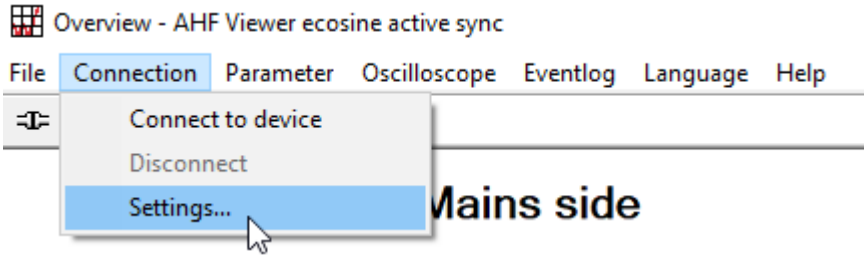
20. Open your web browser and enter the IP address of the Moxa in the address bar.
21. Login with the default Login: admin and password: moxa



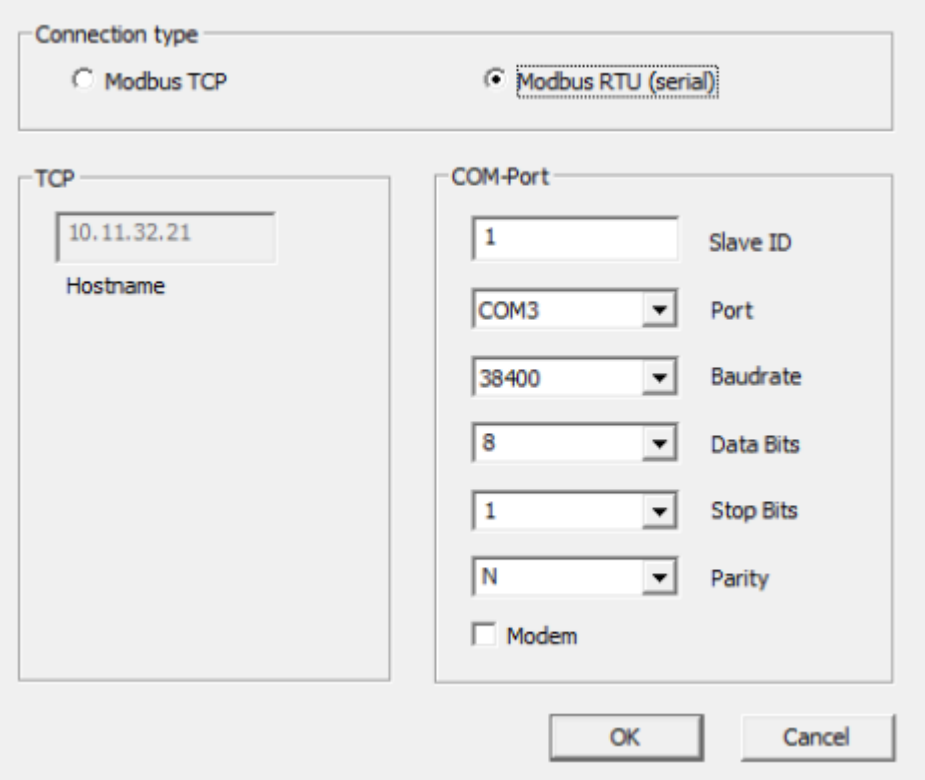
22. It will strongly suggest you to change the password. Change it for something secure.



23. After entering the new password, you must click submit and then save and reset.
24. You can try to connect again to check the new password, then you can log out and close the browser.
25. Start AHF Viewer Ecosine Active Sync (always start it as administrator)
26. Open the connection settings



27. Set the COM port as defined in the NPort Windows Driver Manager
28. The other parameters can be chosen according to the AHF viewer manual



29. Connect the device with the button on the left
30. It might ask you if you want to load the parameter set from the device, say yes. It might ask you to restart the software.
31. You can now interact with the master sync module on which the Moxa is connected and all the power modules and slave sync modules connected on the master sync module.

12 AHF Firmware Update Tool

To update Ecosine Active Sync firmware, an external program and a USB-RS485 converter are needed. The “AHF FW Update Tool” is the PC software that allows the user to update the firmware of the Ecosine Active Sync (AHF Gen2) products and this document shows how to use it.
This tool is suitable for updating the firmware of the Power Modules as well as the Sync Modules. It recognizes by itself if the selected firmware package is not appropriate and avoids the update, e.g., trying to update a PM or a SM with the wrong firmware package.
The latest Tool version V2.1.0.3 supports V2 of the .sfn file that is represented by the file format FWP_AHF_Gen2_Vxx.xx.xx. This new Firmware Package (FWP) *.sfn file contains both sync module (SM) and power module (PM) firmware. It will not allow to use the previous .sfn files. Older .schaffner firmware files are obsolete since V2.x.y.z of the AHF FW Update Tool. The tool will report an error if the user tries to open an older and incompatible version of the .sfn file, see AHF FW Update Tool - user manual for details.

12.1 Usage

Updating the device firmware consists of the following steps:

1. Select and open the COM port
2. Select the communication settings
3. Load the firmware package
4. Start the update

A detailed explanation of the update procedure is described in the following sections.
When working with the AHF Update Tool you might get different error messages. For troubleshooting of what may be the problem refer to the troubleshooting section of the complete AHF FW Update tool user manual.
After successfully opening a COM port, you can search for available devices on the selected COM port. This step is not mandatory and is provided for diagnostic purposes only.

12.2 Select serial port

In the first step, select the serial port for communication with the Control-Board. The panel on the top-left corner, highlighted in the picture below, shows all the serial ports available on the PC and the user can open or close the selected serial port.
Clicking the button “Refresh” triggers an update of the serial port list.

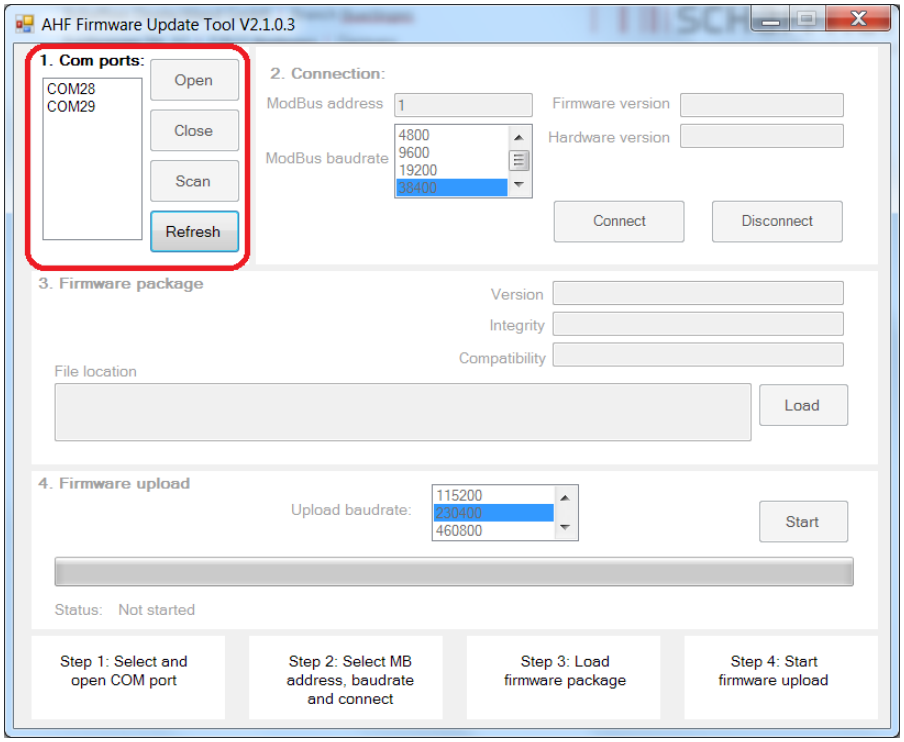


Figure 12-1 Selection of the COM port

12.3 Search for devices

After successfully opening a COM port, you can search for devices by clicking the “Scan” button in Figure 12-2. Once scan is clicked, following window appears where you can start the scan or setup 2 options:

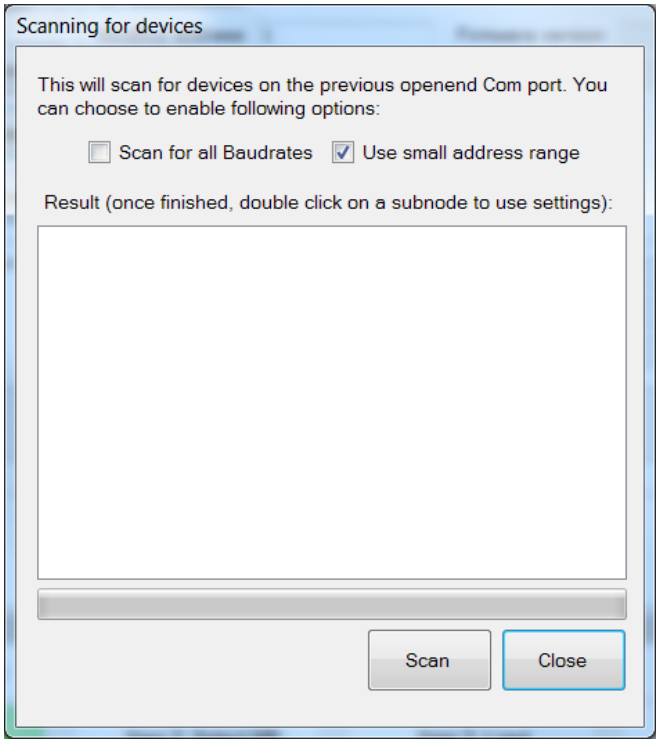


Figure 12-2 Search for devices

The “Scan for all Baudrates” option tries to search devices using following Baudrates instead of only 38400 baud:

- 9600
- 19200
- 38400
- 57600
- 115200

If the “Use small address range” option is checked (as per default), the tool searches only devices with an address from 1 to 33, else from 1 to 247.

Changing the default options will make the search last longer. If you enable all Baudrates and the full address range it will typically last about 10-20 minutes, while with the default options it will take only less than a minute!

Once the scan is finished you can double click on a subnode and the respective COM settings will be used in the main window. Double or single click on the parent node will not transfer the COM settings (see Figure 12-3). This is because you need to click on the parent nodes to open the detailed view.

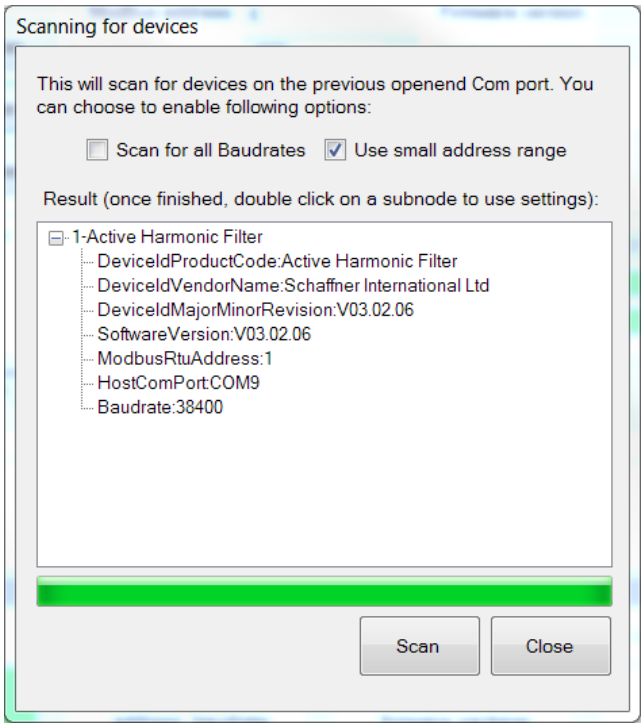


Figure 12-3 The scan result

The COM settings that will be transferred into the main window are:

- Baudrate
- Modbus Address

In Figure 12-4 you can see the result when only one device is found; where 1 is the Modbus Address and 2 is the *DeviceIdProductCode*. The subnodes present a more detailed information about the device:

- DeviceIdProductCode: is a manufacturer defined text that identifies the device
- DeviceIdVendorName: is a text defining the manufacturer
- DeviceIdMajorMinorRevision: the version of the device in text form
- Software Version: the firmware version stored in P10 of the device
- ModbusRtusAddress: the address of the device on the bus
- HostComPort: the COM port of the PC where the device was found
- Baudrate: the Baudrate at which the device responded

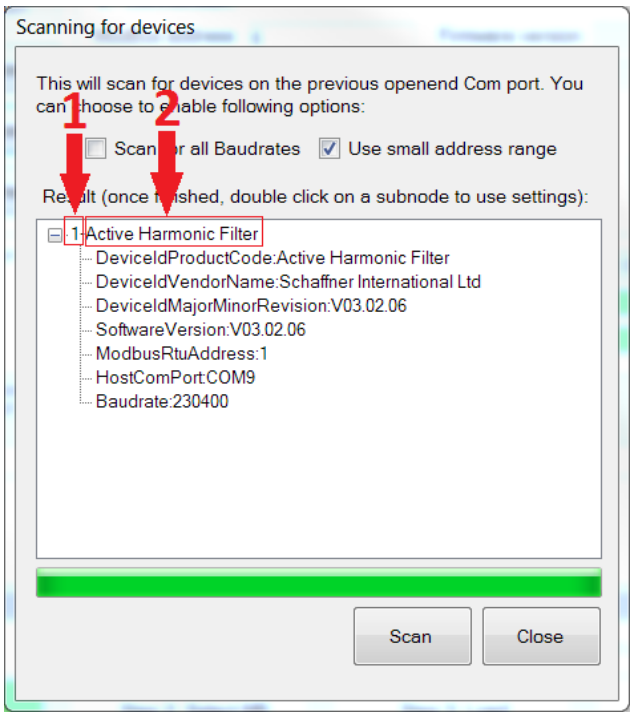


Figure 12-4 Details of the scan's result

12.4 Communication configuration

Once the correct serial port is selected, the user has to configure the Modbus address and the baudrate in order to communicate with the Control-Board, as illustrated in Figure 12-5.

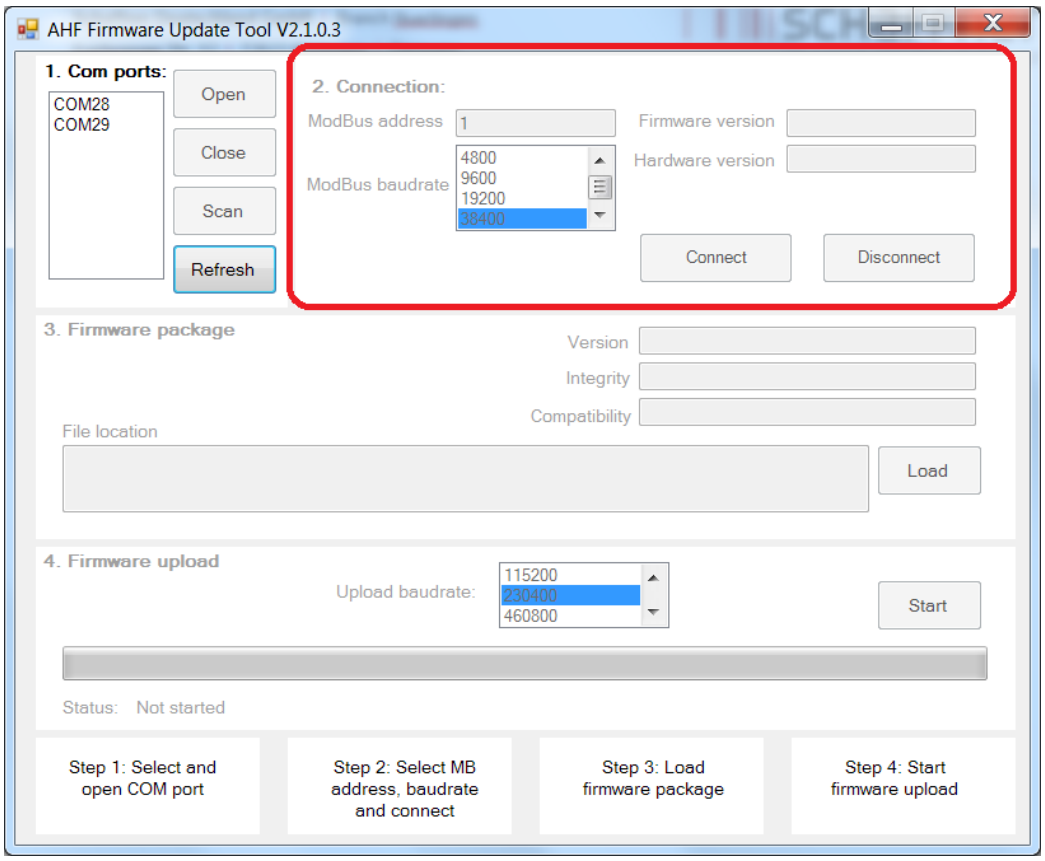


Figure 12-5 Selection of the communication settings

By clicking the button “connect”, the tool tries to connect to the device and get some information which is shown in the related textboxes.

12.5 Load firmware package

In the next step we select the firmware package file to upload: The requested file must have the ".sfn" extension. After clicking the "Load" button, a file dialog pops up and the user can browse the PC folders and select the correct file.
Figure 12-6 displays the proper panel.

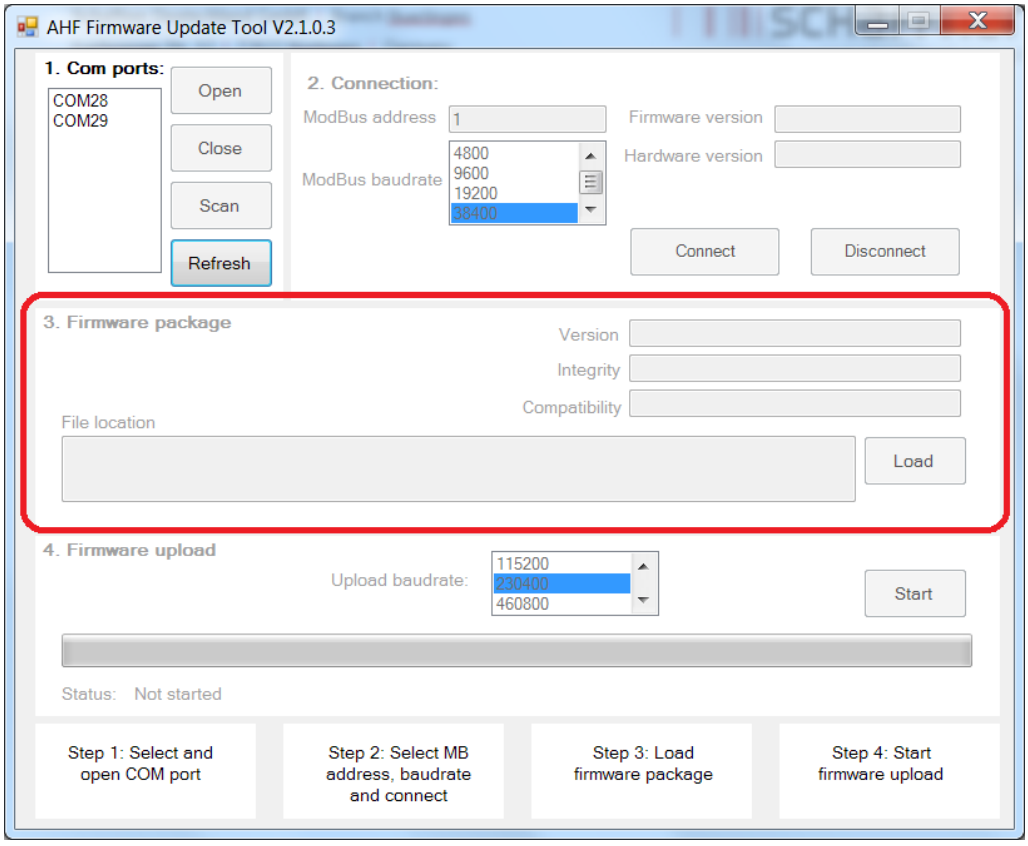


Figure 12-6 Loading the *.sfn file

If the firmware is compatible with the PC Software and not corrupted, you will get the feedback in Figure 12-7.

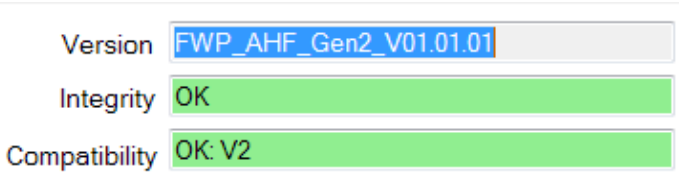


Figure 12-7 SW package check

12.6 Upload Firmware

Launch the update process by clicking the “start” button, as shown in Figure 12-8. The panel features a progress bar as well, which indicates the status of the upload process.

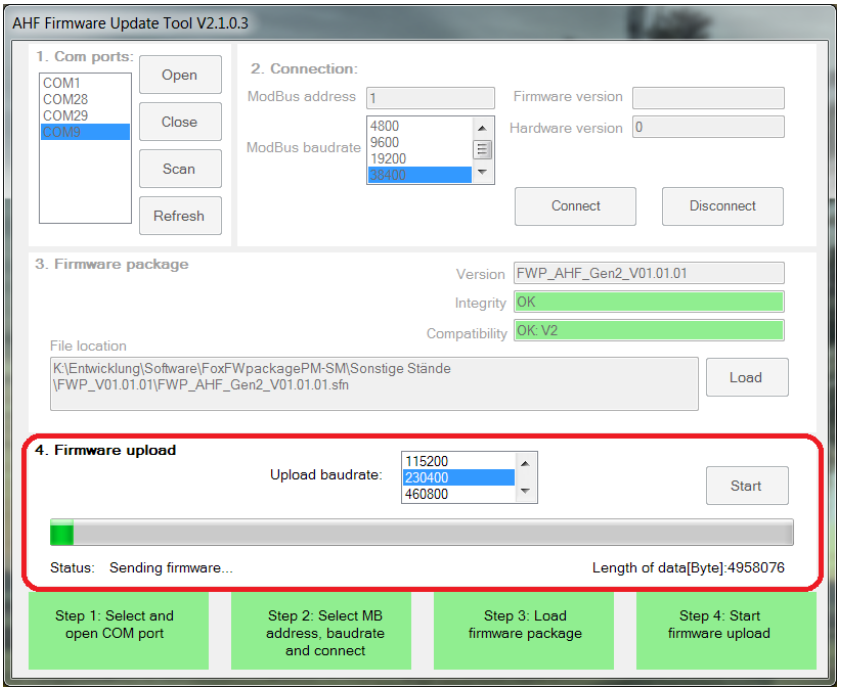


Figure 12-8 Upload of firmware

When the update is finished, a pop-up windows appears indicating that the process is completed (see Figure 12-9).

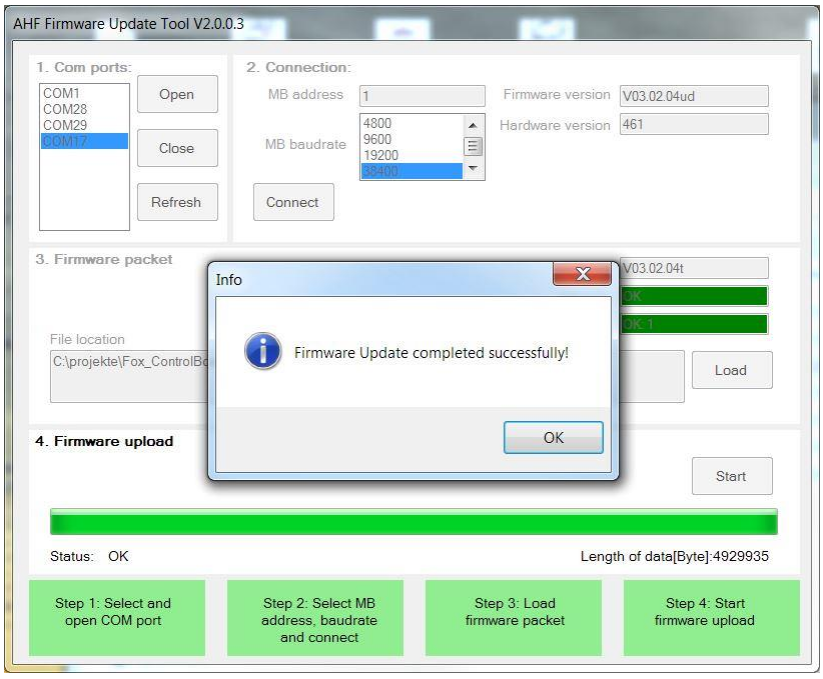


Figure 12-9 A popup window informs that the upload is finished

13 Maintenance

Table 31 Maintenance schedule power module

Year after start operation / Maintenance job	1	2	3	4	5	6	7	8	9	10	11	12
Check operation and clean fan guard of power module fans	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace power module fans Fan 1-3			✓			✓			✓			✓
Replace PDB Board fuses F100, 101 & 102			✓			✓			✓			✓
Replace PDC Board fuses F701 & 705			✓			✓			✓			✓
Replace Control Board Battery						✓						✓

Table 32 Maintenance schedule cabinet

Year after start operation / Maintenance job	1	2	3	4	5	6	7	8	9	10	11	12
Check operation, clean fan guard of cabinet and filter pad	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace filter pads		✓		✓		✓		✓		✓		✓
Replace cabinet fans Fan 4-7			✓			✓			✓			✓
Replace internal fan Fan 8			✓			✓			✓			✓
Replace Main fuses			✓			✓			✓			✓
Replace Power Supply fuses			✓			✓			✓			✓

For details regarding maintenance please refer to the maintenance Instruction of Ecosine Active Sync available for Schaffner service team and selected partners.

13.1 Instructions for the removal of a power module in cabinet

Removing a power module from a cabinet might be challenging as there is no grip or handle to pull out the heavy module from the rack.

First remove all cables and fixing screws from the power module and make sure nothing is blocking the power module from sliding to the front (see Figure 13-1).

Figure 13-1 Example of a power module with all cables and fixation screws removed

The usage of a lifting ring nut size M8 (see Figure 13-2) will help to release the power module from its service position. There is a gasket at the back of the power module (preventing leakage in the air channel) that can be slightly sticky when new. The first time a power module is removed, it might need extra force to unstick the module from the gasket.

Figure 13-2 Lifting ring nuts M8

Once the module has moved to the front about 2 or 3 cm (1 inch), it can be grabbed by its brackets on the left and right of the module and pulled out completely.

Danger: The weight of a power module is 44 kg (97 lb), the usage of a trolley (server lift) that can be aligned in front of the cabinet to slide the power module on it, is strongly recommended. Without trolley a minimum of two persons is mandatory to manipulate the power modules.

14 Abbreviation

AHF:	Active Harmonic Filter
CT:	Current Transformer / Transducer
CTM:	Current Transformer Module
DPP:	Double Power Pack
HMI:	Human-Machine Interface (typically a color touch screen)
HS:	High Speed
HSB:	High Speed Bus
LAN:	Local Area Network
LCD:	Liquid Crystal Display / Display Module
PCB:	Printed Circuit Board
PDB:	Power Distribution Board
PDC:	Power DC-Link Board
PHF:	Passive Harmonic Filter
PWM:	Pulse Width Modulation
fPWM:	Frequency of the PWM or switching frequency

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17 Appendix A: References

The following table summarizes the documents referenced in this document.

Document Name and Version	Description	Location
Knowledge base information No. 002	Current transformer special applications	Document available to the Schaffner service team and service partners. Please contact Schaffner service if necessary.
Unpacking Instruction Ecosine active sync	Unpacking Instruction for the Ecosine Active Sync power module / Cabinet version	This document is attached to the transportation box
Maintenance instruction of ecosine active sync	Instruction for maintenance and failure analysis of Ecosine Active Sync	Document available to the Schaffner service team and service partners. Please contact Schaffner service if necessary.
AHF FW Update Tool user manual	Installation, usage and troubleshooting for AHF Firmware Update Tool	This document is included with the software, available to the Schaffner service team and service partners. Please contact Schaffner service if necessary.
CE_FN353x_FN354x	CE declaration of conformity for FN353x and FN354x series, including the list of directives and standards applied.	https://www.schaffner.com

18 Appendix B

18.1 Commissioning after longer storage

Ecosine Active Sync filters contain – like frequency inverters – capacitors in the DC link. After longer storage without connection to the grid the DC link capacitors must be formed.
Please observe the following instructions and contact Schaffner service if necessary.
Please always keep in mind that storage time is calculated from the date of manufacture and not when the AHF was supplied. The week and year of manufacture is coded on the type plate (see 18.2).
To keep formation during longer storage please follow these instructions:

Table 33 Formation instructions for DC link capacitors

Storage time	Procedure
<1 year	No additional action required
1 – 2 years	Connect AHF to grid min. 1 hour before operating. Afterwards AHF is ready for normal operation.
2 – 3 years	With a regulated power supply, apply the voltage in the following manner: 30 min. under 25% of capacitor rated voltage, then 30 min. under 50% of capacitor rated voltage, then 30 min. under 75% of capacitor rated voltage, then 30 min. under 100% of capacitor rated voltage Afterwards AHF is ready for operation.
>3 years	With a regulated power supply, apply the voltage in the following manner 2 hours under 25% of rated voltage, then 2 hours under 50% of rated voltage, then 2 hours under 75% of rated voltage, then 2 hours under 100% of rated voltage. Afterwards AHF is ready for operation.

General note on the formation procedure with a regulated power supply:

The regulated power supply needs to be selected with respect to the required line supply voltage of the Ecosine Active Sync filter. Thus, it has to be ensured that the required voltage (e.g. 400V) is available. The filter shall be connected to the power supply through its input terminals, whereby filters are fed with single-phase (L+ at L1 and N at L2 or L3 terminals). All the DC link capacitors are uniformly charged since a rectifier is present. As only low current is drawn when forming the dc-link capacitors power supplies with even lower rating can be selected (e.g. 2A).

18.2 Type Plate of ecosine active sync

Below is an example of a type plate of one 60A power module FN3531. The module has two labels; one simplified label is stick on the front side and one label with details is stick on the right side of the power module:

19 Appendix C: Calculation example

19.1 Commutation notches

The commutation notches must be according to IEEE 519 ≤ 50%

- Select the deepest notch in phase to phase voltage
- Calculate the commutation area (A_N)

5. Limit ≤ 76µs · UNominal
6. 400V devices -> 30400Vµs
7. 480V devices -> 36480Vµs

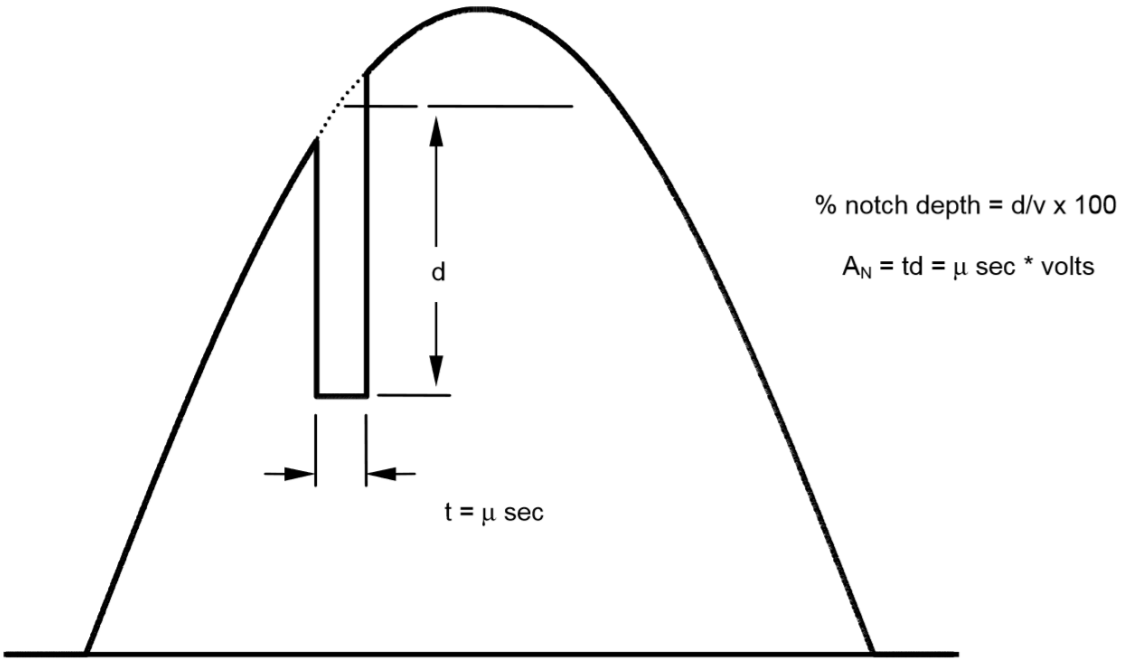

Figure 19-1 calculation of commutation notch area

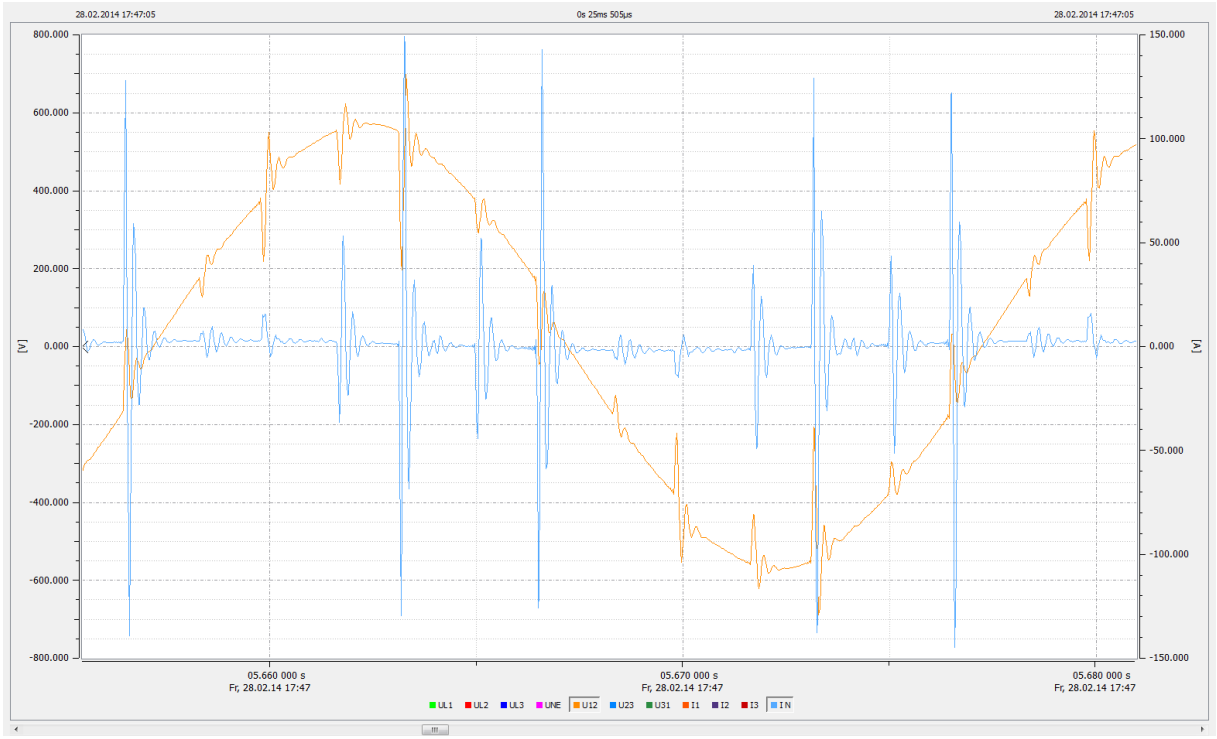

Figure 19-2: Filter current (blue) caused by commutation notches

Figure 19-3: Filter current (blue) caused by commutation notches during compensation

19.1.1 Commutation notches calculation example 1

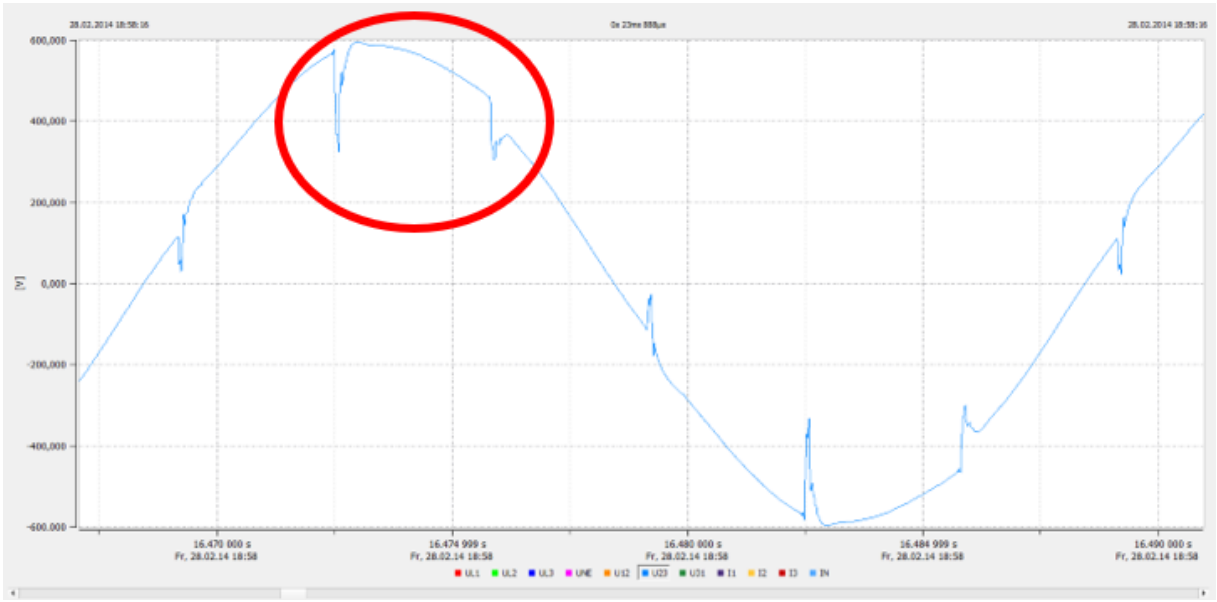

Figure 19-4 Example 1, voltage phase to phase U23 with sample rate > 10kHz

- v = 592V
- d = 268V
- t = 319µs

- $Notch = \frac{d}{v} * 100$
- $Notch = \frac{268V}{592V} * 100$
- $Notch = 45.2\%$ → **OK**

- $A_N = t * d * \frac{1}{2}$
- $A_N = 319\mu s * 268V * \frac{1}{2}$
- $A_N = 42746$ → **NOK**

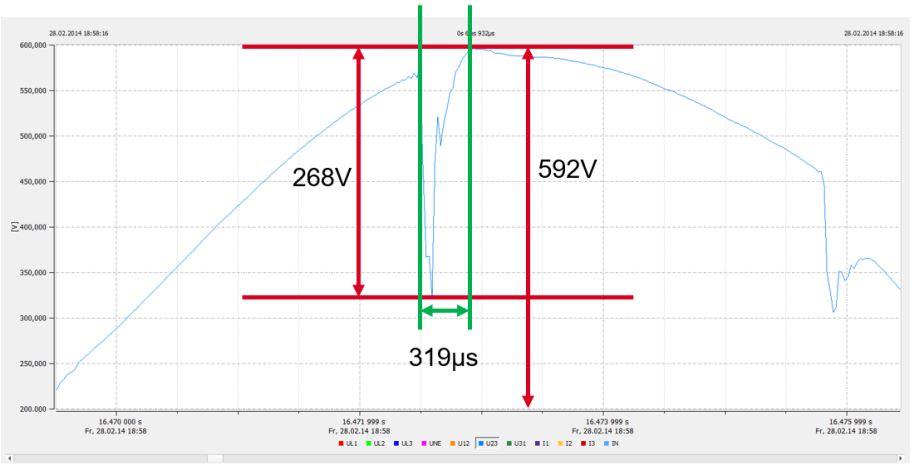

Figure 19-5: Example of notch calculation where notch depth is OK, but commutation area is NOK. These notches are not acceptable.

19.1.2 Commutation notches calculation example 2

Figure 19-6: Example 2, voltage phase to phase U23 with sample rate > 10kHz

v = 717V
d = 380V
t = 122µs

$Notch = \frac{d}{v} * 100$

$Notch = \frac{380V}{717V} * 100$

$Notch = 52.9\%$ → **NOK**

$A_N = t * d * \frac{1}{2}$

$A_N = 122\mu s * 380V * \frac{1}{2}$

A_N =23180 → **OK**

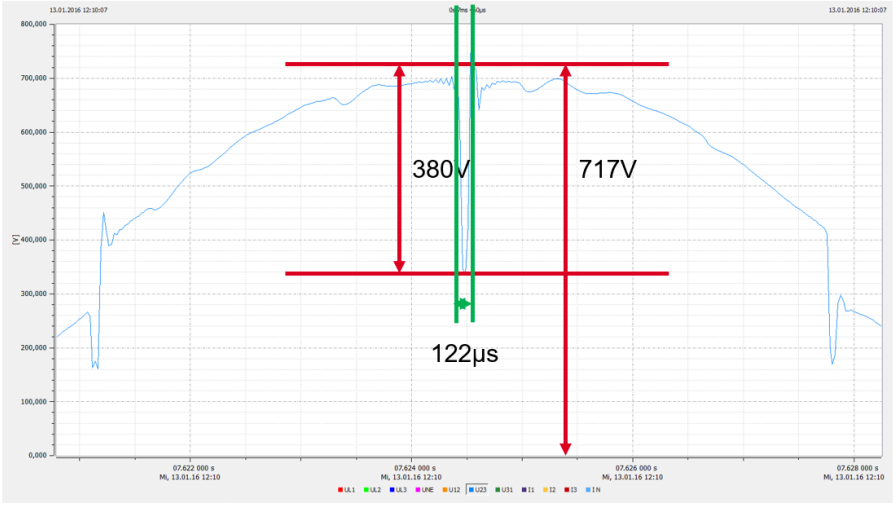

Figure 19-7: Example of notch calculation where notch depth is NOK, while commutation area is OK. These notches are not acceptable.

19.1.3 Commutation notches calculation example 3

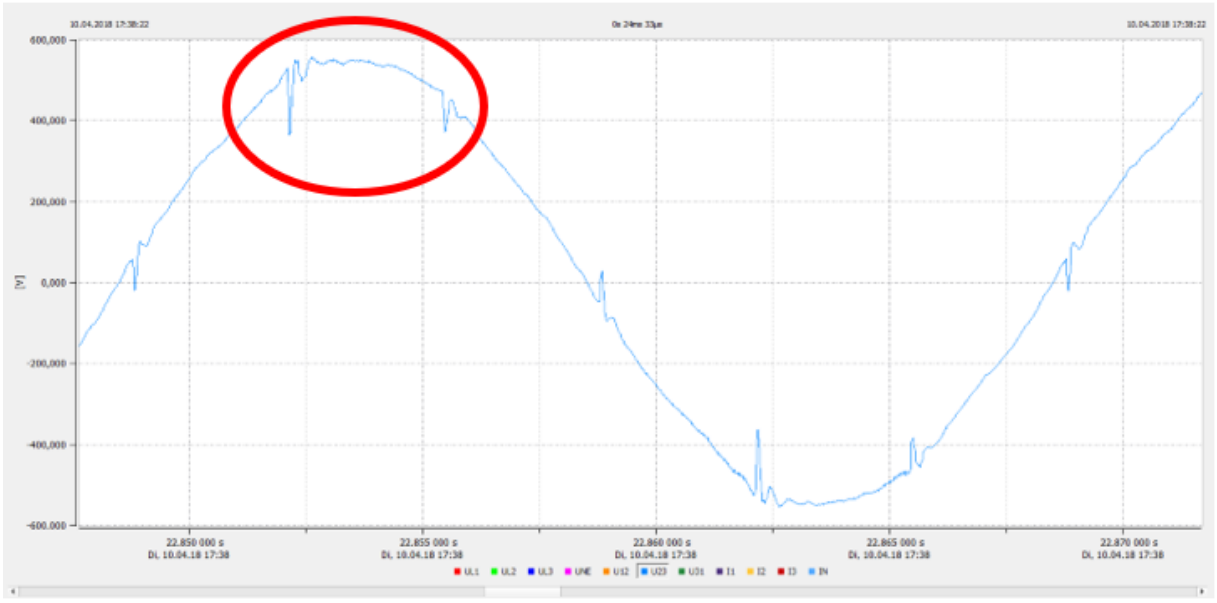

Figure 19-8 Example 3, voltage phase to phase U23 with sample rate > 10kHz

- v = 550V
- d = 186V
- t = 170µs

- $Notch = \frac{d}{v} * 100$
- $Notch = \frac{186V}{550V} * 100$
- $Notch = 33.8\%$ → **OK**

- $A_N = t * d * \frac{1}{2}$
- $A_N = 170\mu s * 186V * \frac{1}{2}$
- $A_N = 15810$ → **OK**

Figure 19-9: Example of notch calculation where both notch depth and commutation area are OK. These notches are acceptable.

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