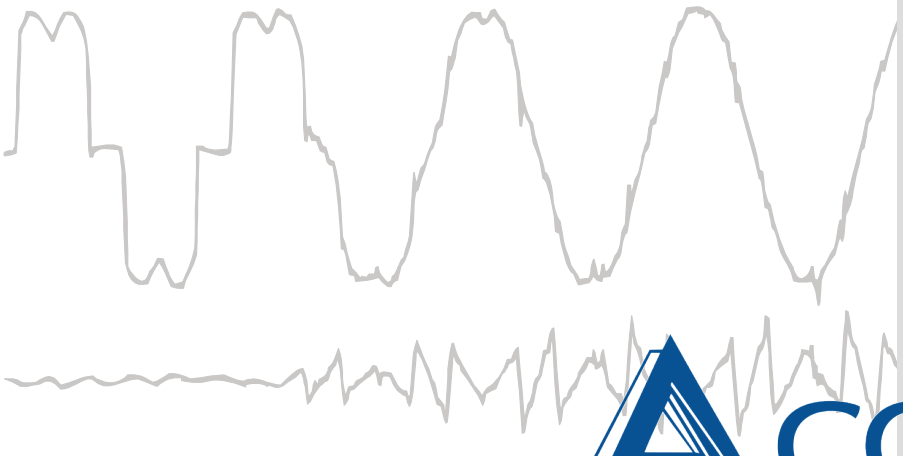
Hardware Manual

July 2014

ADF P300 Hardware Manual



COMSYS

Creating Value through Power Quality™

Safety notes

Read these instructions carefully and look at the equipment to become familiar with the product before trying to install, operate or maintain it. The following special messages may appear throughout this manual to warn of potential hazards or to call attention to that which clarifies or simplifies a procedure:

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or loss of life, property damage, or economic loss.

NOTE Provides additional information to clarify or simplify a procedure.

ATTENTION: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: The product contains DC bus capacitors which retain hazardous voltages in excess of 1000 V after input power has been disconnected. After disconnecting input power, wait at least sixty (60) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: This product may have been modified from factory in order for the auxiliary power to be supplied externally. After disconnecting main fuses, the external auxiliary power must also be disconnected.

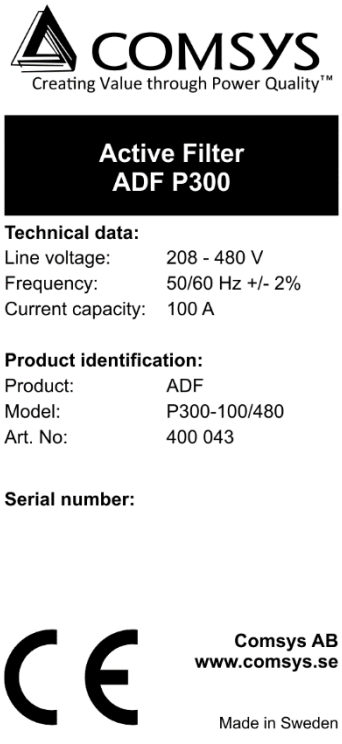
ATTENTION: Before manipulating current transformers, make sure that the secondary is short-circuited. Never open the secondary of a loaded current transformer. You must always wear isolating gloves and eye-protection when working on electrical installations. Also make sure that all local safety regulations are fulfilled.

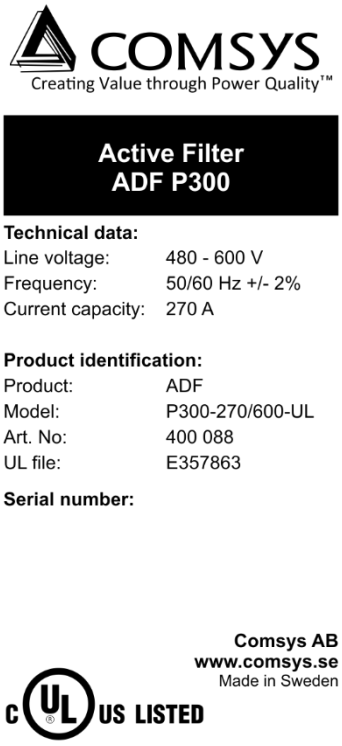
ATTENTION: Only qualified personnel or other trained personnel who understand the potential hazards involved may make service, updates, troubleshooting, repair or similar work to the product. Any such activities not made corrects may result in uncontrolled operation. Failure to observe this precaution could result in damage to equipment and bodily injury. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by **Comsys** for any consequences arising out of the use of this material.

The information in this document is subject to change without notice.

Product identification

The product identification label is found inside the door of the cabinet. Remember to check that your supply is compatible with the technical data stated on the label before installing and commissioning the Active Filter.





This manual applies to products listed in the table below:

Table 1: Applicable ADF P300 models

Product line	Models	Current rating	Voltage	Art no
ADF P300 Air cooled, 3 wire	ADF P300-120/480	120 A_{RMS}	208 – 480 V	400 089
	ADF P300-240/480	240 A_{RMS}		400 090
	ADF P300-360/480	360 A_{RMS}		400 091
	ADF P300-90/690	90 A_{RMS}	480 – 690 V	400 092
	ADF P300-180/690	180 A_{RMS}		400 093
	ADF P300-270/690	270 A_{RMS}		400 094
ADF P300 UL/cUL version Air cooled, 3 wire	ADF P300-110/480-UL	110 A_{RMS}	208 – 480 V	400 083
	ADF P300-220/480-UL	220 A_{RMS}		400 084
	ADF P300-330/480-UL	330 A_{RMS}		400 085
	ADF P300-90/600-UL	90 A_{RMS}	480 – 600 V	400 086
	ADF P300-180/600-UL	180 A_{RMS}		400 087
	ADF P300-270/600-UL	270 A_{RMS}		400 088
ADF P300N Air cooled, 4 wire	ADF P300N-100/480	100 A_{RMS} / 300 A_{RMS}	208 – 480 V	400 051
ADF P300W Water cooled, 3 wire	ADF P300W-150/480	150 A_{RMS}	208 – 480 V	400 072
	ADF P300W-300/480	300 A_{RMS}		400 073
	ADF P300W-450/480	450 A_{RMS}		400 074
	ADF P300W-140/690	140 A_{RMS}	480 – 690 V	400 056
	ADF P300W-280/690	280 A_{RMS}		400 057
	ADF P300W-420/690	420 A_{RMS}		400 058

Standards

This product is CE compliant, which implies that is in conformity with the European Community low voltage directives 72/23/EEC and 93/68/EEC and it bears the CE label.

The following standards apply:

Table 2: Standards

Standards	
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4
Electrical design and safety	EN 50178 / VDE0160
Protection class	IP20 according to IEC 529 (ADF P300) IP54 according to IEC 529 (ADF P300W)
Approval marking	72/23/EEC, 93/68/EEC CE-mark

UL/cUL version Standards

The UL/cUL versions, art no 400 083, 400 084, 400 085, 400 086, 400 087, 400 088 are approved according to UL/CSA standards.

Table 3: UL/cUL Standards

Standards	
Electrical design and safety	UL508/CSA22.2

File no NMTR.E357863.

Document revision

Table 4: Document revision

Revision	Date	History:	Status:
A	2008-02-19	ORIGINAL	RELEASED
A2	2008-08-10	REVISED FOR SCC2 CONTROL	RELEASED
A3	2009-11-25	REVISED FOR RELEASE 1.0	RELEASED
C1	2010-02-08	REVISED FOR RELEASE 1.1	RELEASED
C2	2010-06-04	REVISED UPDATED NAMING	RELEASED
C4	2010-09-30	MINOR REVISION	RELEASED
D05	2011-12-20	MAJOR UPDATE	RELEASED
D07		SPLIT BETWEEN HARDWARE AND USERS MANUAL	RELEASED
D08	2012-03-16	ADDED P300N	RELEASED
D09	2012-06-04	MINOR CORRECTIONS	RELEASED
D10	2014-01-17	MINOR CORRECTIONS	RELEASED
D11	2014-06-17	MAJOR CORRECTIONS; UL/cUL UPDATE	FOR REVIEW
D12	2014-07-29	MINOR CORRECTIONS	RELEASED

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1 Overview

1.1 Content

This manual describes the hardware, installation and maintenance topics of the Comsys ADF P300 series of active filters.

1.2 Organization of manual

The ADF P300 manual is organized in two parts, namely:

1. ADF P300 Hardware Manual, doc no 1 199 171 (this document)
2. ADF P100/P300 User Manual, doc no 1 199 172

The Hardware Manual covers hardware related issues, such as installation, cable selection, CT configuration, preventive maintenance, and troubleshooting.

The user manual covers issues which are governed by the installed software in the system such as operation, initial configuration and commissioning. Hence, when the system is updated, a new User Manual is supplied.

1.3 Related documentation

- ADF P100/P300 User Manual (doc no 1 199 172)

2 Active Filter Overview

2.1 Introduction to the Technology

COMSYS offers a new generation of high performance power quality products for industrial applications based on active filter technology, which removes the losses and restores the natural wave shape of the current.

2.1.1 The Problem: Poor Power Quality

Transients, harmonics, voltage variations (including flicker) and unbalance puts the power grid, machines, motors and computer equipment under considerable stress resulting in disturbances, production stops, waste of energy and decreased lifetime. These terms, among others, constitute power quality.

A large part of the equipment connected to the power grid creates disturbances, voltage variations and undesired harmonics that pollute the grid. This pollution generates losses, disturbances, productions stops and reduces expected lifetime of cabling, transformers and machines as a cause of the excess load.

This leads to decreased capacity in the electrical network, less effective electrical power consumption and energy losses that transforms into both technical and economic costs.

2.1.2 The Solution: Active Filters

Traditionally fixed, electro-mechanical and semiconductor controlled filters and/or compensators have been used to limit or minimize power quality problems in the network.

They operate mainly on a fixed or stepped basis using passive elements. All these solutions suffer from the same drawbacks – they add losses, are installation specific and have no ability to adapt to or follow dynamic load changes.

The Active Dynamic Filter (ADF) eliminates loss creating behaviors such as harmonics, flicker, voltage variations, resonances and reactive energy using a highly dynamic, step less digitally controlled compensation and filtering approach. By continuously monitoring the network and injecting exactly the right amount of compensation current – at exactly the right time – the most efficient and accurate solution to any power quality problem can be achieved.

This approach enables the current waveform to be restored instantaneously, the current consumption to be lowered and changes in load or installation conditions to be fully compensated at all times.

2.1.3 Common applications which can benefit from Active Filters

- Harmonic/reactive power suppression in 3-phase systems
- Industrial production machines (e.g. mills, presses)
- Variable speed drive systems (AC drives, DC drives)
- Electrical welding systems
- Plastic machinery (extruders, injection molders, film treatment machines)
- Power generation systems and UPS equipment
- Electrolytic processes
- Induction heating

2.1.4 How Active Filters Work

An active filter is basically a very advanced computer controlled current generator with the ability to produce any shape or form of current with little or no delay.

A simplified diagram of the operating principle is shown in Figure 1. The system is connected in parallel with the load requiring compensation.

Currents delivered from the network are measured and analyzed **[3]**, to determine if disturbances such as e.g. reactive displacement and/or harmonics are present.

The system injects compensation currents **[2]** which is the exact opposite of the e.g. harmonics and/or reactive displacement to cancel out the undesired behavior of the load **[1]**.

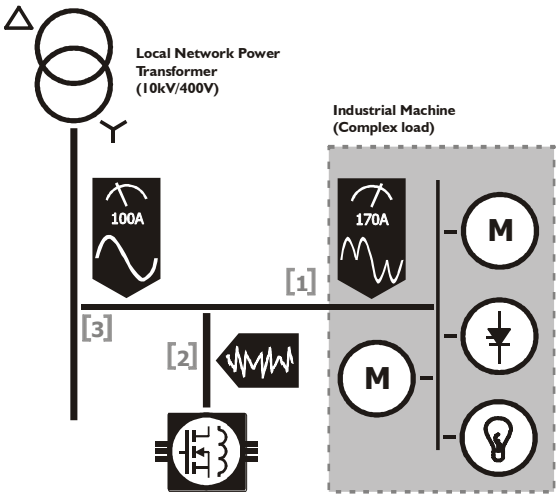

Figure 1: Basic operating principle

The Figure 2 shows how the current consumed by an electrical load may look like prior to and during compensation. Before compensation, the current consists of several harmonics in addition to the fundamental, which are apparent from the current's deformed waveform. After injection of the compensation current, the load current's natural sinusoidal waveform is restored and the loss creating behaviors have been eliminated.

The function of the power transmission system is restored, which leads to saved energy, lower disturbances or in short – improved power quality and significantly lowered costs in electrical installations.

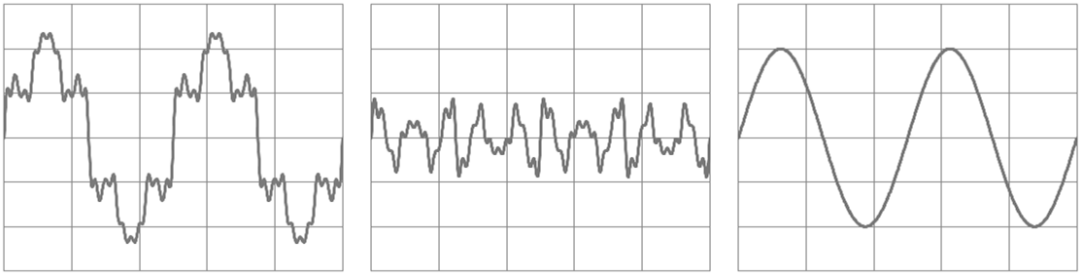

Figure 2: Uncompensated load current (left), Compensation current (middle), Compensated net current (right)

2.2 System Overview

The Active Filter ADF P300 is a series of modular high power active power filters available in the power range from 90 A up to 450 A of compensation power per cabinet. The ADF Active Filter products are delivered in industry standard cabinet system cabinets.

2.2.1 Features

General features:

- Compact design in standard floor standing enclosure cabinet
- High performance and reliability
- Advanced digital control and low response time
- Several units can be operated in parallel for higher power ratings
- Non-overloadable and insensitive to changes in network or load conditions
- Main fuse block included and high short circuit capacity
- Easy installation, commissioning and maintenance

2.2.2 Main components overview

This section describes the major components of the Active Filter. Each unit is enclosed in one cabinet holding all necessary functions and modules.

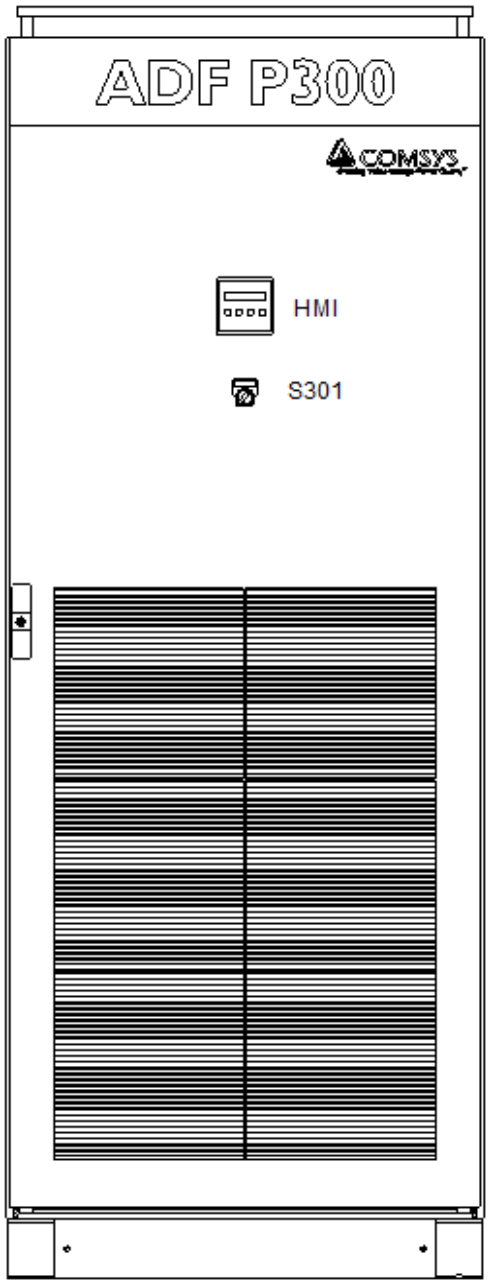

Figure 3: ADF P300-100, 200 and 300 cabinet overview

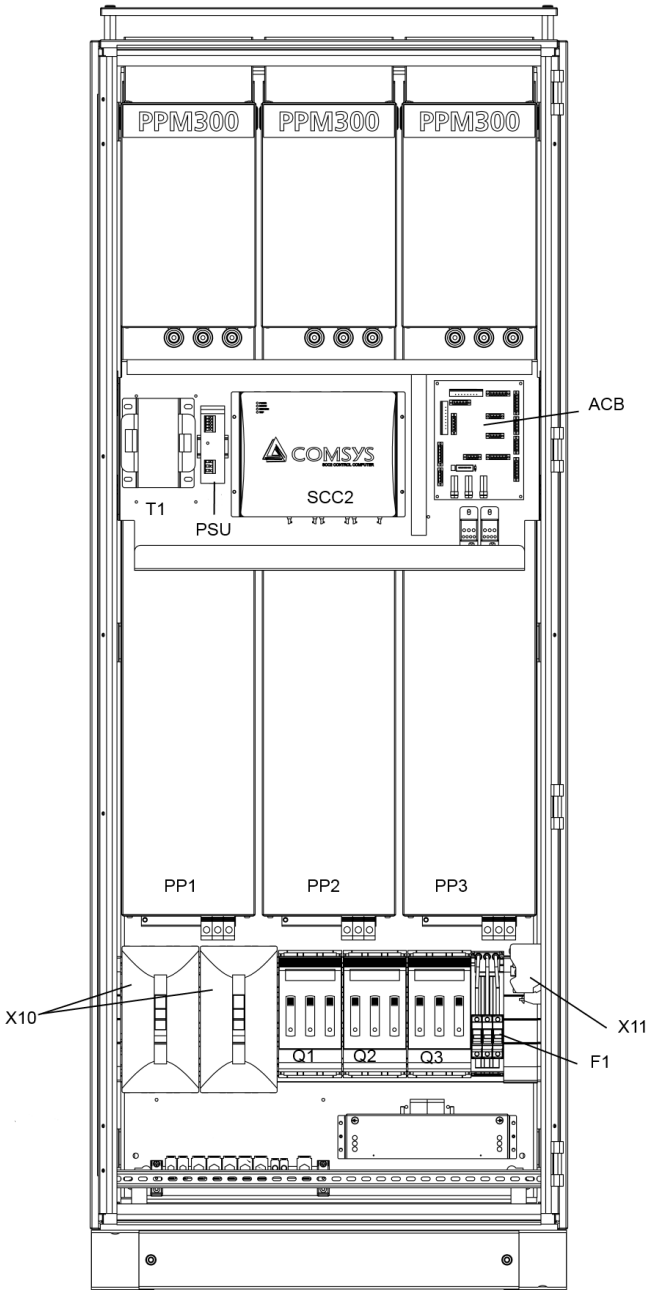

Figure 4: ADF P300-100 main components

2.2.2.1 User interface (HMI)

All settings, configuration and operation can be performed from the HMI (Human- Machine Interface) panel, see Figure 3. Please refer to the ADF P100/P300 User Manual (1 199 172) on how to use the HMI.

2.2.2.2 Control computer (SCC2)

The SCC2 control computer is a stand-alone digital processing system containing all functions for controlling the power processor modules. It also features protection circuitry for monitoring and main contactor control. Indicators on the front panel display operational modes and status as well as power as shown in Table 5.

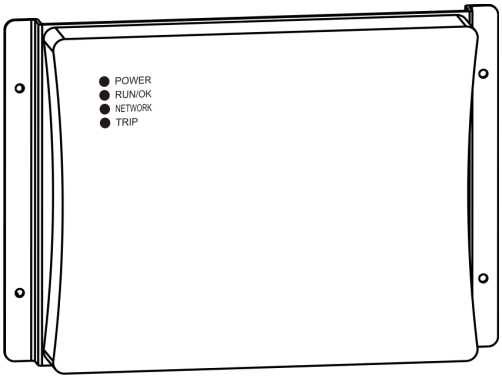

Figure 5: SCC2 control computer front panel indicators location

Table 5: SCC2 control computer front panel LED indicators

Description	Color	Description
POWER	Blue	Indicates that the control computer has power.
RUN/OK	Red/ Green/ Yellow	Active Filter operational status: **Green blink** = System is running. **Yellow blink** = System is stopped. **Red/yellow blink** = System is tripped / an alarm is active. **Steady yellow** = System is in Setup mode. **Fast red blink** = SCC2 boot-up failure.
NETWORK	Yellow	LAN network activity (if connected)
TRIP	Red	SCC2 hardware trip. If lit the control computer is malfunctioning.

2.2.2.3 Automation power supply switch (S301)

The Automation power supply switch (S301) controls power to automation and control computer power supply circuits.

2.2.2.4 Automation circuit board (ACB)

The Automation Circuit Board (ACB) routs all signal and auxiliary circuit inside the ADF.

2.2.2.5 Auxiliary voltage transformer (T1)

The auxiliary voltage transformer (T1) transforms mains voltage to 230VAC.

2.2.2.6 Auxiliary voltage supply Unit (PSU)

The auxiliary voltage supply (PSU) transforms 230VAC to 24VDC.

2.2.2.7 Auxiliary fuse block (F1)

The auxiliary fuse block (F1) protects voltage measurement circuits, pre charging circuits and auxiliary power systems inside the Active Filter.

2.2.2.8 Power processor units (PP1…PP3)

Every Active Filter is equipped with one or more power processing modules (PPs) which are the power electronic converters that actually generate the compensation currents. Power processors work in parallel in a modular approach to achieve higher power output and compensation currents. Each power processor contains power electronics such as IGBT modules and driver electronics, EMC-filter, DC-storage, cooling fans and line filtering components.

2.2.2.9 Power processor fuse block (Q1…Q3)

The Power Processor fuse block (Q1…Q3) provides protection for the system in the event of hardware failure. Each power processor has its own individual fuse block allowing quick disconnection of a failed power processor. Note that there is only one fuse block installed per module installed.

2.2.2.10 Power connection terminals (X10)

Used for connection of mains to the system. See section 4.3.2 for detailed connection information. The terminals are placed in the lower part of the cabinet.

2.2.2.11 User signal interface and CT terminals (X11)

The user signal interface terminals, X11 are used for connecting current transformers, interface to external devices via alarm outputs and digital inputs and for interconnecting the systems for parallel operation. See section 4.3.3.1 for more information on how to connect current transformers (CTs), digital inputs and outputs.

2.2.3 Components specific to ADF P300W overview

The following subsection treats components that are specific to ADF P300W system, i.e., water cooled ADF P300 units.

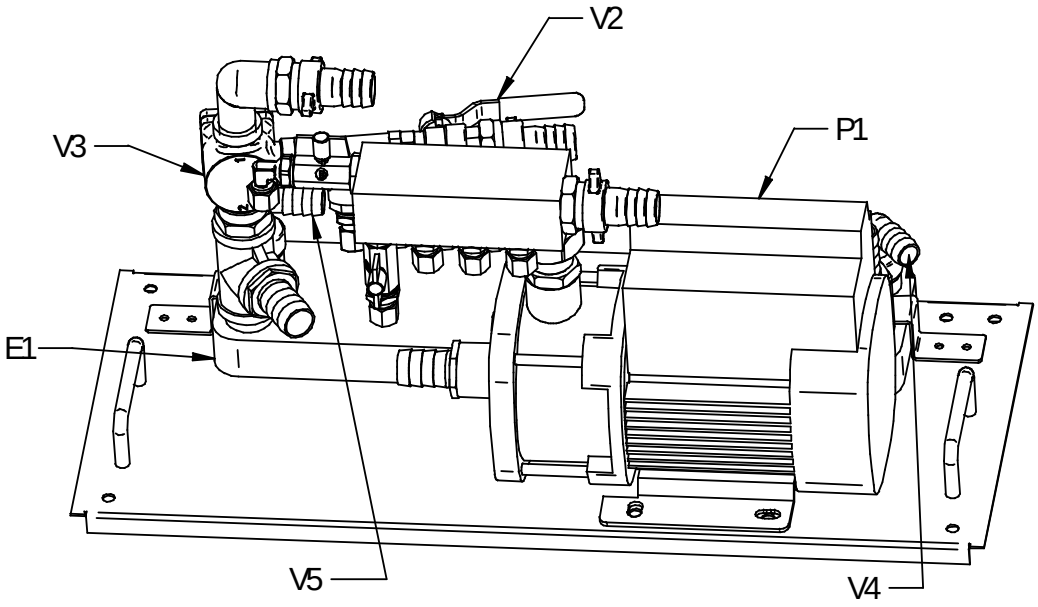

Figure 6: Water pump assembly

2.2.3.1 Water cooling pump (P1)

The water pump provides the circulation flow in the internal circuit of the water cooling system. The pump is controlled by the control computer. When actuator S301 on the cabinet door is turned off the pump will also be turned off.

2.2.3.2 Heat exchanger (E1)

Transfers heat from the internal cooling system in the cabinet to the external cooling water on site. Contains the connection points for the external water, see section 5.2.1 “Connection of external water circuit” on how to connect the external water.

2.2.3.3 Bypass valve (V3)

The bypass valve is used for protection against condensation. Bypassing the heat exchanger depending on a set value keeps the coolant temperature and thus the temperature of the cooling plates above the dew point for the air in the cabinet.

2.2.3.4 External water connections (V4, V5)

External water circuit is connected to V5 (inlet) and V4 (outlet).

2.2.3.5 Expansion tank / deaeration tank (C1) (not in picture)

The tank at the top of the cabinet doubles as both expansion tank and deaeration tank. Water expands when heated and the tank has spare space for this expansion.

When filling up the system with coolant air is inevitably trapped. When flow is passing through the tank the flow slows down and entrapped air escapes. See chapter 5.2.2 “Filling up and deaerating the cooling system” for more information.

2.2.3.6 Coolant

Antifrogen N is the approved coolant to provide protection against freezing, corrosion and algae growth. Refilling should be done with the same mixture of Antifrogen N and deionized water.

NOTE	Warranty is void if another coolant than Antifrogen N is used. The system is not filled with coolant during shipping. Attempts to start the system without filling it with coolant will immediately void warranty and may damage the cooling system.

2.2.4 Components specific to ADF P300N overview

The following subsection treats components that are specific to ADF P300N system, i.e., the 4-wire version of the P300 series.

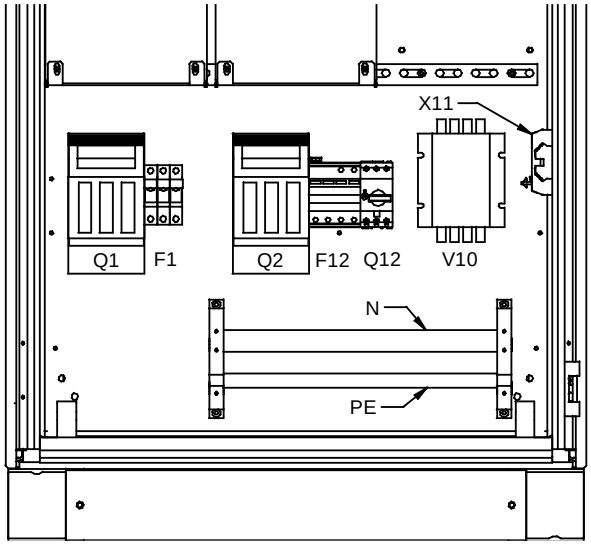

Figure 7: P300N-specific components

2.2.4.1 Neutral busbar (N)

Used to connect the neutral power connection.

2.2.4.2 Three phase Power connection (Q1) / Fuse disconnector

Q1 replaces X10 as the main power connection in the P300N.

2.2.4.3 Neutral Fuse Disconnector (Q2)

The Q2 fuse disconnector protects the neutral IGBT compensator from overcurrent.

2.2.4.4 Overvoltage protection (F12)

The F12 overvoltage protection is comprised of Metal Oxide Varistors in conjuction with an arc-gap to provide protection for overvoltage.

2.2.4.5 Motor protection (Q12)

The Q12 overvoltage protection limits the current going in to the F12 overvoltage protection. Note that the active filter can be operated normally when Q12 is open, in this case operation is normal but overvoltage protection is disabled.

3 Getting started

This section is intended to help you get through to operate the Active Filter with the least work on your part. Guidance and hints are provided. First it is important that you read and observe the safety notes in the beginning of this manual to help avoid damage to equipment, installation and persons.

3.1 Receiving and unpacking

On receiving the unit read notes in section 4.1 “Unpacking the Active Filter”. If the system is to be transported on site please be sure to avoid excessive strains. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact must be made with electronic components and contacts. Also note that all operations serving transport, installation and commissioning as well as maintenance must to be carried out by skilled technical personnel.

Active Filters contain electrostatic sensitive components which are liable to damage through improper use. Electric components must not be mechanically damaged or destroyed (potential health risks).

3.2 Installation

It is important to prepare the installation site prior to installing and connecting the Active Filter. In the section 4 “Installation”, important issues such as location of terminals, cable size recommendations and cooling air flow requirements are discussed. To maintain operation and long equipment life it is vital to keep environmental conditions in accordance with the specifications.

Current transformer (CT) selection is important for good performance. Read about CT selection and connection in section 4.5.1 “Current transformer connection” and if possible use separate CTs not shared with other equipment e.g. power quality meters.

Good earth connection is also important to achieve best results and electrical safety as described in the section 4.3.3 “Protective earth (PE) connection”.

It is important that any materials or method for connection used is within limits with respects to local safety regulations. Also that appropriate fuses is fitted in the mains connection.

3.3 Configuration and Commissioning

The Active Filter has extensive functionality built-in for several modes of operation.

The ADF P100/P300 User Manual (1 199 172) details how to configure the software parameters for the ADF P300.

4 Installation

4.1 Unpacking the Active Filter

Each Active Filter is delivered in packaging suitable for transportation. Upon reception of the Active Filter, visually inspect that the packaging is in good condition. Verify that all items are present in the package:

- This manual (1 199 171)
- The ADF P100/P300 User Manual (1 199 172)
- Bag with distances, screws and cabinet key
- External water hoses (only ADF P300W)
- V4 and V5 valve in a box (only ADF P300W)

ATTENTION: Before unpacking and installation the Active Filter please read through the following pages THOROUGHLY to make sure that it's handled in the right way.

The unit is heavy and weighs several hundred kilograms.

Do not attempt to move the unit before reading the lifting instruction and acting accordingly.

Attempt to move the equipment without proper equipment and not according to instructions may result in damage of the equipment and injury.

4.1.1 Before unpacking and Installation/Commissioning

Before moving the Active Filter without its protective packaging please pay extra attention to the section in this document that handles lifting. During transport and storage and before commissioning, keep the roof mounted without distances and plastic film over the filter inlets on the cabinet's front to protect from dust and water ingression of the system. For extra protection of the system we also recommend that the plastic cover which the cabinet comes in also is kept on as long as possible.

ATTENTION: Make sure the cabinet is closed at all time, even when installing it since it contains very sensitive power electronics.

4.1.2 Lifting the Active Filter

If the Active Filter is to be moved when not in its protective packaging please do it according to this document. Always handle the Active Filter with care since it consists of sensitive power electronics.

The Active Filter may only be lifted in the lifting lugs on top of the Active Filter. Also the angle between the lifting wire and the top of the Active Filter must be minimum 60 degrees according to Figure 8. Please note that roof should not be raised until commissioning and start-up of the system.

Figure 8: Correct lifting the Active Filter

If moving the Active Filter with for example a fork lift, it may only be moved on its back or standing up, not on its sides.

4.1.3 Preservation of the Active Filter

After the Active Filter has been placed in its intended physical position, following steps has to be followed:

- Always keep the door closed on the cabinet, this to keep out dust and other particles that may harm the system.
- Keep roof on without distances
- Keep plastic film over filter inlets on cabinets front until commissioning
- Keep plastic cover from wooden box on

4.1.4 Startup preparations

Follow the following instructions before attempting start-up of the filter:

- **Remove plastic cover:** Remove the plastic cover (if kept from protective packaging) that is covering the whole cabinet.

- **Remove plastic film from cabinet doors:** The plastic film placed at the front over the filter intake has to be removed before starting up the system to make sure that the system gets sufficient amount of air.

- **Raise the roof:** Loosen the four lifting lugs and remove the outer roof. Install the inner roof in its place and make sure to align the cut out holes with the air channels from the power modules. Install the supplied standoff screws in each corner on top of the cabinet and place the outer roof on top of them. Install the supplied M6 screws through a plastic washer in each corner to secure the outer roof in place. Finally install the protective plastic cap on top of each screw.

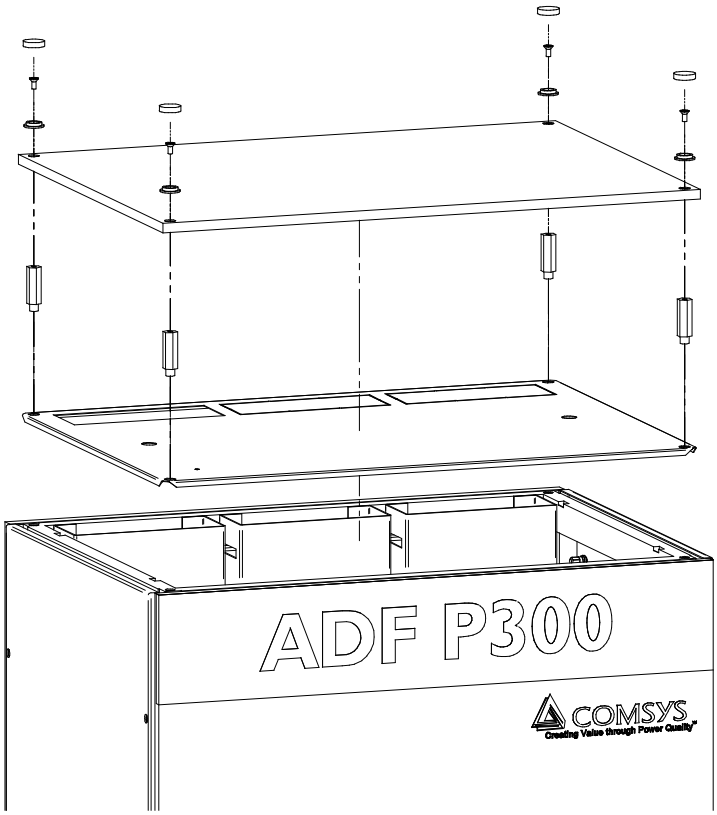

Figure 9: Active Filter with raised roof

ATTENTION: A blocked power module air channel will lead to insufficient cooling and can cause damage to the system. Ensure that the air channels are unobstructed before starting the system.

ATTENTION: The system must be fixed to the floor, or the top of the system must be fixed to a wall similar solid object. The system is top heavy.

4.1.5 Storage conditions

During storage of the unit, the unit should be kept within the following conditions. The conditions are acceptable only when the unit is kept in its shipping packaging.

Table 6: Maximum storage conditions

Maximum storage conditions (in protective shipment package)	
Temperature	-25 °C to 70 °C (-13 °F to 158 °F)
Relative humidity	Less than 95 %, non-condensing
Environmental conditions	Chemical class 3C3 Mechanical class 3S3

Long term storage conditions.

Maximum storage conditions (in protective shipment package)	
Temperature	-25 °C to 35 °C (-13 °F to 158 °F)
Relative humidity	Less than 75 %, non-condensing
Environmental conditions	Chemical class 3C3 Mechanical class 3S3

4.1.6 Transport conditions

During transport of the unit, the unit should be kept within the following conditions. The conditions are acceptable only when the unit is kept in its shipping packaging.

Table 7: Maximum transport conditions

Maximum transport conditions (in protective shipment package)	
Temperature	-25 °C to 70 °C (-13 °F to 158 °F)
Relative humidity	Less than 95 %, non-condensing
Environmental conditions	Chemical class 3C3 Mechanical class 3S3

4.2 Environmental conditions

4.2.1 Operating conditions

The unit is suitable for indoor operation only. If the unit is operated within the below limits, full power may be utilized. During more demanding conditions, the unit will be derated when approaching full power.

The unit must be placed in a well-ventilated area. For cooling requirements, see section 4.2.3 “Cooling air flow requirements” below.

Table 8: Maximum operating environmental conditions

Maximum operating environmental conditions	
Temperature	0 °C to 40 °C, < 25 °C recommended 32 °F to 104 °F, < 77 °F recommended
Relative humidity	Less than 95 %, non-condensing
Altitude	1000 m (3300 ft) Derating may be required at higher altitude. ADF P300W can be placed in higher altitude without thermal derating.
Environmental conditions	Chemical class 3C3 Mechanical class 3S3

ATTENTION: In case of an air-cooled unit, make sure that the unit is installed in an environment without conductive or corrosive dust. If conductive or corrosive dust is present extra precautions must be taken. Contact your COMSYS representative.

4.2.2 Physical conditions

The Active Filter should be placed with at least 50 mm / 2” clearance to the wall behind it. There should be a minimum of 500 mm / 20” clearance to the ceiling above the roof of the unit.

In front of the door, there should be a minimum clearance of 800 mm / 32” to allow the door to fully open.

In general local regulations may impose stricter demands.

4.2.3 Cooling air flow requirements

The cooling air flow requirements are dependent of the amount of Power Processors present in the Active Filter, operating conditions and load cycles. The following table states the maximum demanded air flow from each ADF P300 cabinet type:

Table 9: Minimum air flow requirements

Model	**Maximum air flow**	**Maximum losses**
ADF P300-120/480	600 m^3/h	< 2725 W
ADF P300-240/480	1200 m^3/h	< 5325 W
ADF P300-360/480	1800 m^3/h	< 7925 W
ADF P300-110/480-UL	600 m^3/h	< 2480 W
ADF P300-240/480-UL	1200 m^3/h	< 4835 W
ADF P300-330/480-UL	1800 m^3/h	< 7190 W
ADF P300-90/690	600 m^3/h	< 2969 W
ADF P300-180/690	1200 m^3/h	< 5813 W
ADF P300-270/690	1800 m^3/h	< 8657 W
ADF P300-90/600-UL	600 m^3/h	< 2836 W
ADF P300-180/600-UL	1200 m^3/h	< 5547 W
ADF P300-270/600-UL	1800 m^3/h	< 8258 W
ADF P300N-100/480	1200 m^3/h	< 3800 W

It is crucial that the Active Filter can utilize the needed air flow during maximum operating conditions. The cooling air may not exceed 40 °C / 104 °F under any circumstances.

ATTENTION: Make sure that the ambient temperature is below 40 °C / 104 °F under all circumstances.

Make sure that the air drawn into the unit does not contain corrosive or conductive gases of any kind. Make sure that the physical mounting guidelines are followed and that no obstruction lower the air flow. Take care of the hot air emitted from the unit in a proper way.

Failure to observe these guidelines may result in premature aging or failure of the equipment.

The Active Filter contains internal fans that will ensure that the air flow reaches the needed capacity during maximum operating conditions. The emitted hot air must be taken care of by the room housing the unit. Hot air is emitted from the top of the unit.

4.3 Connection of the Active Filter

The Active Filter has two main connector terminals, X10 for the power interface and X11 for CT and external user functionality signal interface as seen in Figure 11. Both connectors are located in the bottom of the cabinet for easy access.

4.3.1 Prior to any connection

Make sure that all fuse blocks, Q1 (Q2, Q3 if applicable) and F1, are open and that S301 is put in the “off” position.

4.3.1.1 Prior to any connection P300

The following image shows the connection area for the P300 products. The conduit entry is located at the metal sheets covering the bottom of the cabinet.

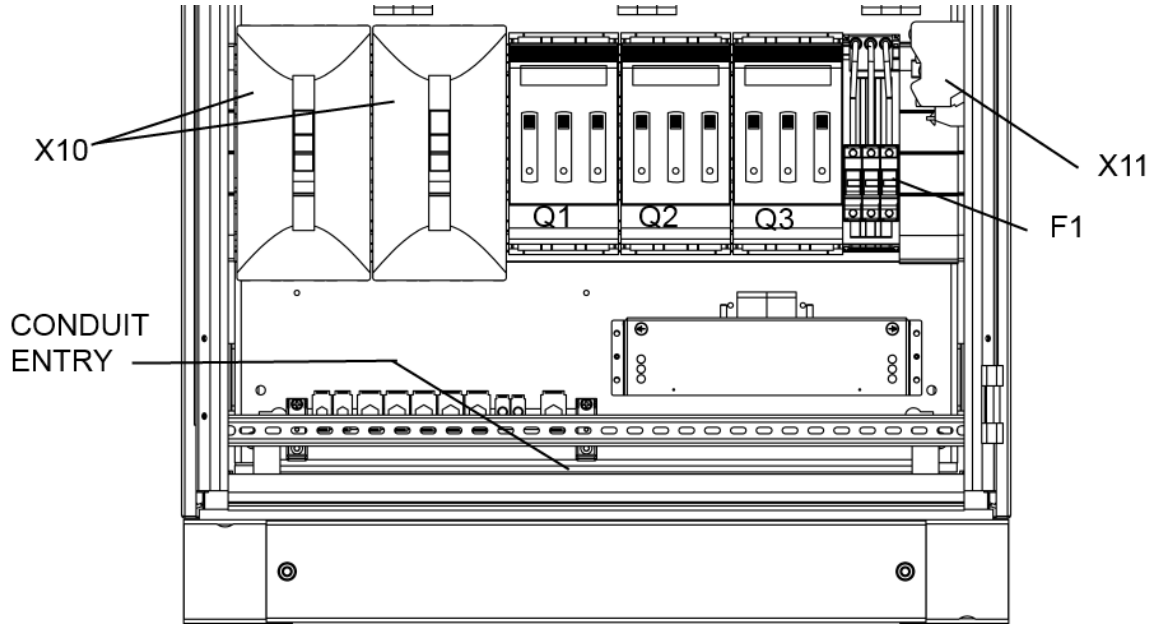

Figure 10: P300, Active Filter power (X10) and user (X11) connectors, Conduit Entry

4.3.1.2 Prior to any connection P300W

The following image shows the connection area for the P300W products.

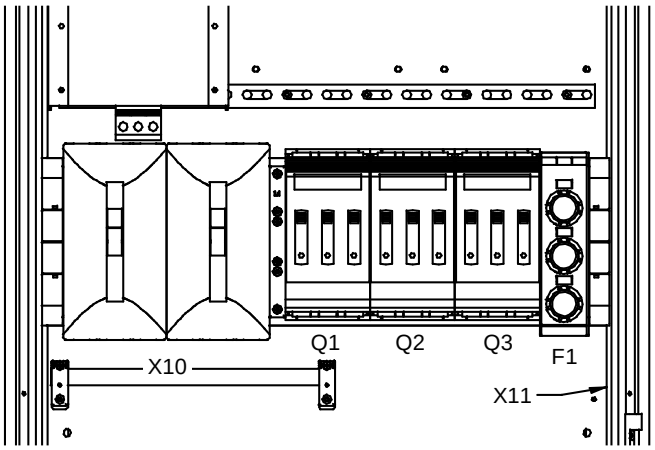

Figure 11: P300W Active Filter power (X10) and user (X11) connectors

4.3.1.3 Prior to any connection P300N

The following image shows the connection area for the P300N product.

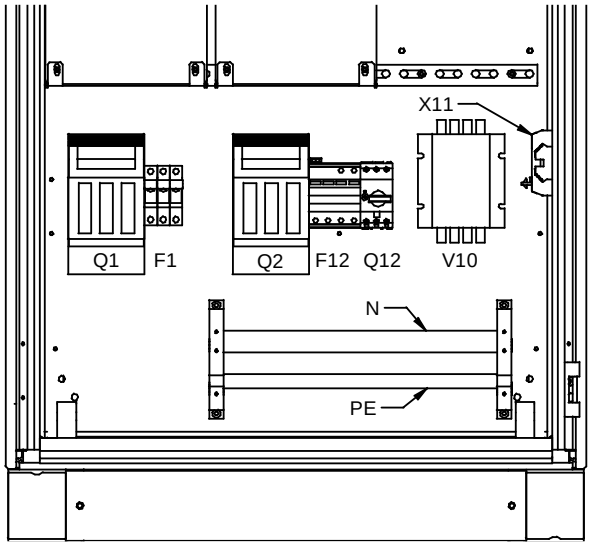

Figure 12: P300N Active Filter power (Q1, N) and user (X11) connectors

4.3.2 Power connection terminals (X10)

The mains power connection is made at terminals X10, found in the bottom of the cabinet. The actual connections are beneath plastic covers for safety reasons. These connectors access the bus bar system feeding PP1-PP3. Note that X10 only accepts copper cables.

After connecting the cables plastic covers must be remounted.

The following work flow should be followed:

1. Make sure Q1…Q3, F1, and S301 are open.
2. Remove the plastic cover.
3. Mount the cabling using the appropriate accessories. Use a torque of 12 – 14 Nm. On P300N, use a torque of 3 – 4 Nm.
4. Remount the touch protection plastic cover.

ATTENTION: After running the Active Filter, wait at least 60 minutes after opening the pre charge circuit to guarantee that there is no residual voltage on the DC capacitors. Failure to observe these guidelines may result in injury or loss of life.

ATTENTION: Note that X10 only accepts Cu cable.

ATTENTION: Note that in the P300N, the X10 terminal block is the bottom edge of the Q1 fuse-disconnector.

4.3.2.1 Preparation prior to cable installation (only ADF P300W)

In case of a water cooled system; prior to installing the main cables, the entire water pump assembly can be rotated out of the cabinet to gain access to the main connection terminals. Please see section 5.5.2 “Removal of cooling system assembly” for instructions.

4.3.2.2 Selection of power cable size – CE systems

In order to guarantee that the cables are not overheated some derating has to be introduced. This is due to the skin effect caused by the harmonics. The cable sizes in Table 10 are given as recommendations without warranty of suitability. The cables shall enter the cabinet from the bottom.

Table 10: Recommended cable sizes

Number of PPs	Filter capacity	Derating factor
1	90 – 150 A_{RMS}	x 1,5
2	180 – 240 A_{RMS}	x 1,4
3	270 - 450 A_{RMS}	x 1,3

Note that the connectors in the ADF P300 are only approved for Copper cable. The maximum usable cable diameter on the X10 connector is 300 mm^2 per connector. In the case of the P300N, the maximum allowed cable capacity is 70 mm^2 per phase (in Q1).

ATTENTION: The dimensions given in Table 10 only take the skin effect into consideration due to the load current being mostly harmonics. Local regulations must be observed and followed and other installation conditions which may affect the sizing of the cables, number of parallel conductors, distance and layout between conductors, and such parameters. Consult your cable manufacturer for the appropriate cable. The above guidelines are only recommendations with no warranty of suitability.

4.3.2.3 Selection of power cable size - UL/cUL systems

The following types of cables are allowed for use with the P300:

Cable Area		Maximum allowed nominal current	Number of modules (AIR COOLED ONLY)	
mm2	AWG		480V systems	600V systems
120	4/0	286	2	3
150	300MCM	310	3	3

Note that no other cable types than the above dimensions are approved.

ATTENTION: The cable used for power terminals in UL/cUL systems must be rated for at least 75º C for twin AWG 4/0 or 90º C for a single 300MCM.

Only Copper conductors may be used.

4.3.2.4 Surge Protection (UL/cUL versions only)

Transient surge suppression shall be installed on the line side of this equipment, and shall be rated 480 V (phase to phase, 480V versions) or 600 V (phase to phase, 600V versions), suitable for overvoltage Category III, and shall provide protection for a rated impulse withstand voltage peak of 6 kV.

ATTENTION: It is not allowed to use the UL/cUL version of the filter without external, approved surge suppression.

4.3.2.5 Branch protection (UL/cUL versions only)

Upstream branch protection must be provided when installing the P300 UL/cUL version. The ADF P300 is rated 50 kAIC. Upstream branch protection must limit fault current to 50kA.

4.3.2.6 Main fuse selection

The Active Filter has internal fuse blocks (Q1…Q3). If the connecting cables can handle the short circuit power of the connecting system no fuses or breakers are needed. However local regulations may impose demands on external fusing and/or external circuit breakers. The maximum allowed short circuit power to be connected to the system is 80 kA / 1 s with the supplied fuses. If higher levels are present in the facility connected to the unit, the switchgear feeding the unit must provide a breaker or fusing capable of interrupting the short circuit power.

Standard fuses with blade contacts are used.

The fuse should be of size NH000, 250A, 690V aR type, such as *Cooper Bussmann CB170M1571D*.

4.3.2.7 Auxiliary fuse selection

The Active Filter has internal fuse blocks for protection the Auxiliary power circuit. CE systems have DIAZED type fuses. UL/cUL systems have NH000 type fuses.

Table 11 Auxiliary fuse selection

Product line 480 V	**Fuse type**	**Brand**
P300	500V 10A gG Diazed	Ifö electric AB Item nr: 479210
P300W		
P300N	ATDR10 10A Class CC	Mersen Item nr. ATDR10
Product Line 690 V		
P300	5SD8 010 10A gL/gG DIAZED	Siemens Item nr. 5sD8 010
P300W		
Product Line 480/600 V UL/cUL		
P300	UL-approved class CC cat. JDDZ 10 A motor or transformer protection fuse	Mersen Item nr. ATDR10

ATTENTION: Warranty is void if the wrong fuse type is used.

4.3.3 Protective earth (PE) connection

Connect the protective earth to the terminal (see Figure 11) in the bottom inner back of the cabinet. A cable area of at least 16 mm^2 is recommended. Tighten the connection with a torque of 20 Nm.

ATTENTION: The protective earth connection must be connected to PE in the installation and NOT to the neutral (N/PEN).

4.3.3.1 Protective earth in UL/cUL systems

The ground terminal must be connected with UL Listed ring type crimp.

4.3.4 Neutral (N) connection (P300N only)

Connect the neutral to the Neutral bus bar (see Figure 12) in the bottom inner back of the cabinet. A cable supporting up to 300 A_{RMS} is necessary. Tighten the connection with a torque of 20 Nm.

4.4 Auxiliary Transformer Setup

The ADF P300 includes an auxiliary transformer which supplies internal circuits with 230 V AC voltage. The auxiliary transformer is marked T1 in the previous figures. The standard transformer is supplied with the following taps:

Table 12: Auxiliary standard voltages

Nominal Primary	Min input	Maximum input
208V	188 V	228 V
400V	360 V	440 V
480V	432 V	528 V
600V	540 V	660 V
690V	621 V	725 V

Voltage range 208 – 415 V

Nominal Primary	+15	0	-15	230	400
215 V			N	P	
230 V		N		P	
245 V	N			P	
385 V			N		P
400 V		N			P
415 V	N				P

Voltage range 380 – 480 V

Nominal Primary	+20	0	-20	400	460
380 V			N	P	
400 V		N		P	
420 V	N			P	
440 V			N		P
460 V		N			P
480 V	N				P

Voltage range 480 – 600 V

Nominal Primary	+25	0	-25	500	575
475 V			N	P	
500 V		N		P	
525 V	N			P	
550 V			N		P
575 V		N			P
600 V	N				P

The transformer primary is not connected when the unit is delivered from factory. Thus, it is necessary to select the proper primary winding in order to supply 230 V AC to the internal circuits. Please select a tap that is closest to the operating voltage of your system.

The connection is made by connecting the loose wire to the appropriate terminal.

ATTENTION: Do not use a primary voltage that differs more than 10 per cent from the nominal voltage. In case such a primary voltage must be used, order a custom transformer from Comsys AB. Please refer to the table above.

ATTENTION: Selecting a too low voltage will result in overheating of some components. In worst case selecting a too low voltage will cause fire.

4.5 User signal interface and CT terminals (X11)

The external interface terminal block X11 located in the bottom of the cabinet (see Figure 11) includes connections for current transformers (CTs), digital inputs, digital outputs and alarm output.

Table 13: External interface terminals X11

Terminal No.	Description
X11:1	S1, Current transformer L1
X11:2	S2, Current transformer L1
X11:3	S1, Current transformer L2
X11:4	S2, Current transformer L2
X11:5	S1, Current transformer L3
X11:6	S2, Current transformer L3
X11:7	ALARM relay, NO/NC
X11:8	ALARM relay, COM
X11:9	Digital OUT1 relay, NO/NC
X11:10	Digital OUT1 relay, COM

Terminal No.	Description
X11:11	RESERVED
X11:12	RESERVED
X11:13	RESERVED
X11:14	RESERVED
X11:15	Digital IN1, 24 VDC
X11:16	Digital IN2, 24 VDC
X11:17	Digital IN3, 24 VDC
X11:18	RESERVED
X11:19	Digital IN COM GND

Specification for the digital output: Alarm and Digital OUT1 are the following:

- Switches 5 A at 250 VAC/30 VDC, resistive load

Do not connect external signal voltages greater than 230VAC to the digital outputs.

ATTENTION: The cable used for X11 control terminals in UL/cUL systems must be rated for at least 60º C.

X11:1 – X11:6 should be tightened to 1.2 – 1.4 Nm. X11:7 – X11:19 should be tightened to 0.5 – 0.6 Nm.

4.5.1 Current transformer connection

Current transformers are connected to terminal block X11:1 – X11:6 in the bottom of the cabinet (see Figure 11). It is possible to shorten the CT with the switching jumper (1) mounted in the lower part of the terminal block (see Figure 13). Observe that the CT is shorted by default.

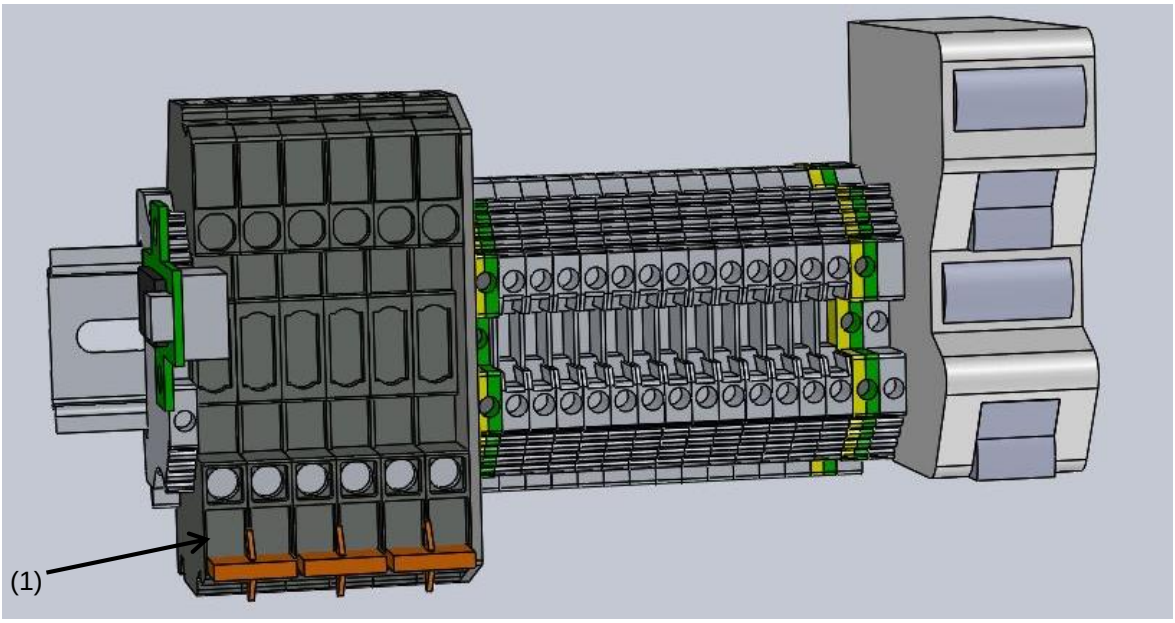

Figure 13 X11 Terminal block, CT opened in this figure.

4.5.1.1 Selection of current transformers

The current transformers should fulfill the following specification:

Table 14: Current transformer (CT) specification

Current transformer specification	
Class	1.0 or better
Primary ratio	Exceeding the maximum load current including harmonics, reactive power, and transients
Secondary ratio	5 A maximum
ADF total CT burden	0.193 VA
Symmetry	Three identical CTs must be used

Note that the size of the CT is critical to the performance of the system. Using a very large CT in relation to the active filter size will result in poor resolution and hence poor results.

ATTENTION: For UL/cUL systems, the installer must use Listed Current Transformers, rated at 600 V and Secondary 5A maximum.

4.5.1.2 Recommended current transformer cable size

The recommended cable size used for connection of the current transformers is dependent of the output power of the current transformers and total length of the cables. A calculation of burden must be performed to guarantee that the burden of the CT is not exceeded.

Table 15 ADF CT connection data

ADF CT connection data	
Conductor cross section solid min.	0.5 mm^2
Conductor cross section solid max.	10 mm^2
Conductor cross section stranded min.	0.5 mm^2
Conductor cross section stranded max.	6 mm^2

4.5.1.3 Location of current transformers

The location of the current transformers is critical to the function of the Active Filter. The following guidelines should be observed for proper operation:

Closed loop control is preferred. This means that the CTs monitor the load current and the Active Filter current. However, open loop control is also possible – meaning that the CTs are placed downstream to the mains connection of the Active Filter unit.

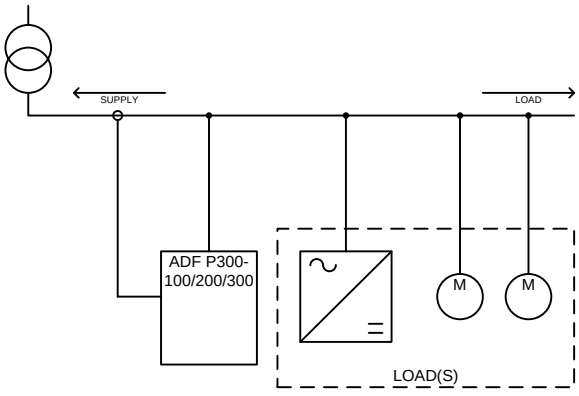

Figure 14: Current Transformer placement diagram – closed loop

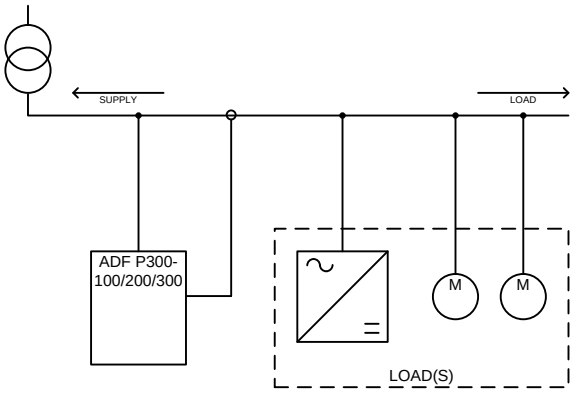

Figure 15: Current Transformer placement diagram – open loop

ATTENTION: Never open the circuit of a connected current transformer. During all connection work, short circuit the secondary of the current transformers.

Failure to short circuit the current transformers may cause dangerous voltages, arcs and destruction of the current transformers. When connection is complete, the short circuit must be removed.

4.5.1.4 Connection and wiring of current transformers

- The S1 terminal of each CT must be oriented to the supply side. The S2 of each CT must be oriented toward the load side.
- The CTs must be grouped properly phase wise with the corresponding mains connection. This means that the connected to phase 1 on X11 must monitor the current corresponding to phase L1 of the network line connection.
- The phases must be connected in proper rotation. L2 must lag L1, L3 must lag L2 and L1 must lag L3.
- Either S1 or S2 must be individually connected to PE (Protective Earth). The connection must be performed identically for each CT.
- The connection is made to terminal block X11:1 through X11:6.
- When using the Active Filter in conjunction with a passive filter, special requirements apply. See “Appendix B Compatibility with passive compensation” for further information.

The wiring should be connected according to Table 16.

Table 16: CT connection table

Phase	Current transformer	Terminal block
Phase L1 / A	S1	X11:1
	S2	X11:2
Phase L2 / B	S1	X11:3
	S2	X11:4
Phase L3 / C	S1	X11:5
	S2	X11:6

In Figure 16, the correct connection of mains power and current transformers with correct grounding is illustrated. The example shows close loop operation.

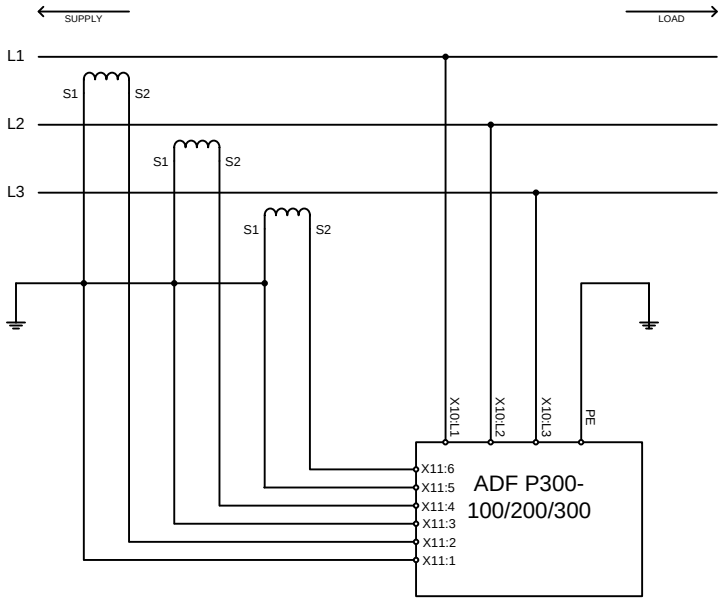

Figure 16: Current Transformer connection diagram – closed loop

4.5.1.5 Connection of current transformers with paralleled systems

Figure 17 illustrates correct connection of two paralleled Active Filters, again in closed loop operation with correct grounding:

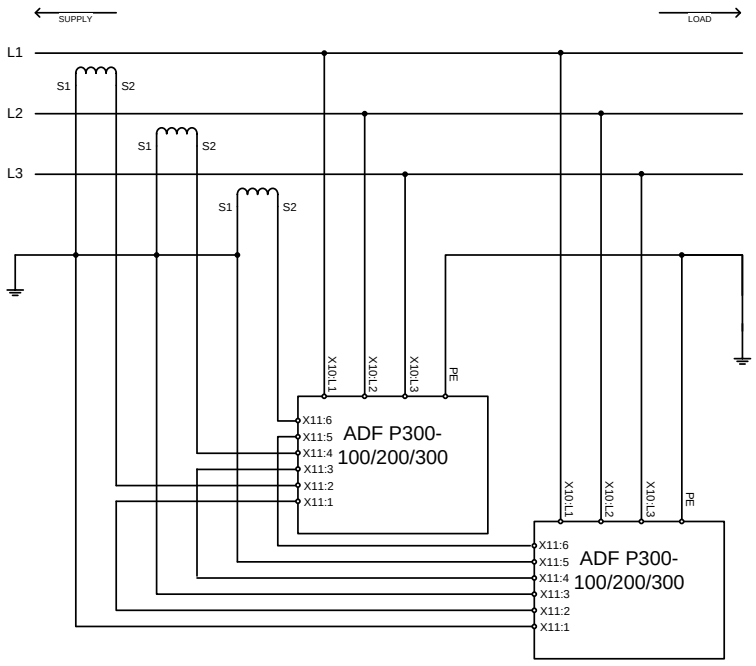

Figure 17: Current Transformer connection diagram – paralleled units

4.5.1.6 Use of summation transformers

Summation transformers can be used in certain configurations. Some examples of usable scenarios:

- When compensating loads, in closed loop operation, fed by two or more transformers which are paralleled. The secondary sides must then be added to the current input of the ADF P300 using a summation transformer.
- When compensating loads, in open loop configuration, where the main CTs must be placed on two or more outgoing groups.

In all cases, when using summation CT's, the ratio must be selected so that full signal corresponds to 5 A on the secondary of the summation transformer going into the X11 terminal block.

5 ADF P300W Water cooling system

This chapter describes the water cooling system in ADF P300W.

5.1 Overview

A system with one pump (P1) circulates water in up to three parallel modules. Each module has two cooling plates connected in series. The internal water is then distributed to the heat exchanger (E1) where it's cooled by external water provided by costumer, and finally led back to the pump. A 3-way valve (V3) bypasses the heat exchanger when the internal water temperature is low in order to avoid condensation. An open expansion/deaeration tank (C1) is placed on top of the modules, taking care of thermal expansion and providing effective deaeration.

All water cooling equipment is placed on the pump assembly. The pump assembly can easily be removed from the cabinet by loosening the fixing screws on the border of the mounting plate in the bottom of the cabinet and lifting/rotating the entire assembly.

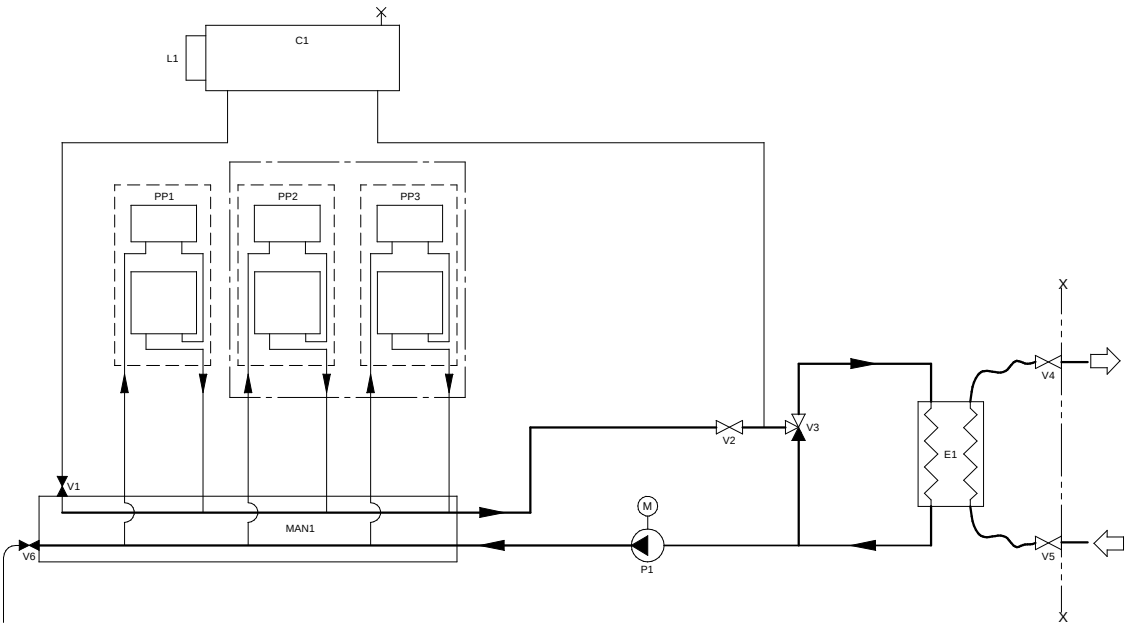

Figure 18: Flow diagram

5.2 Installation

See section 5.5.2 "Removal of cooling system assembly" for removal and section 5.5.3 "Mounting of cooling system assembly" for reassembly.

5.2.1 Connection of external water circuit

The cooling system is delivered with two shut off valves V4 and V5 (ISO Rp3/4, internal thread) to be mounted in the external water circuit.

The provided flexible hoses, length 1,5m from cabinet floor to customer connection point, should be used when connecting the heat exchanger with the external water. The connection should be done with the hoses running around the pump unit so as to allow the cooling system to be lifted and rotated out (see chapter 5.5.2) while still connected.

The left connection on the heat exchanger is the inlet and the right one is the outlet. Compare with the flow diagram. This is to assure that the flow on the external side has the opposite direction as the flow on the internal side. If not so the capacity of the heat exchanger is degraded.

After completed installation, make sure the valves V4 and V5 are open!

ATTENTION: The external water flow must not be obstructed by bending or twisting of the hoses. Route the hoses naturally without stresses.

5.2.2 Filling up and deaerating the cooling system

If the system shall be started for the first time or after maintenance it should be filled up and deaerated.

Start by mixing 18 liter coolant (7 liter Antifrogen N, 11 liter deionized water). Close valve V6 (Figure 19) and open V1 and V2 and then dismount the cabinet roof in order to access the water tank. Remove the cap (Figure 20) on the water tank and fill the system with the specified coolant. The level meter L1 should be filled to the highest visible point. Place the plastic hose leading from drainage valve V6 into a vessel, open V6 and be prepared to close it when coolant appears.

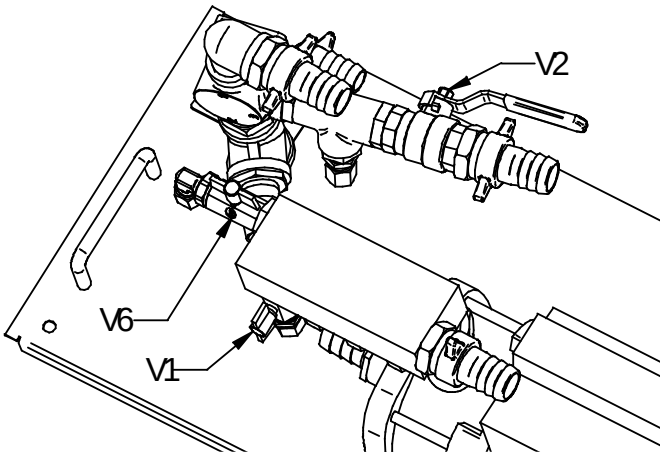

Figure 19: Valve V1 (open in the picture), Valve V2 (open in the picture) and valve V6 (open in the picture)

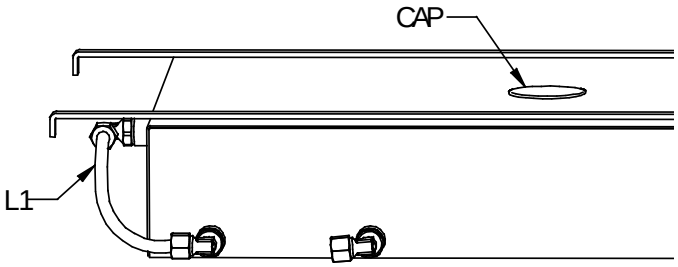

Figure 20: Level meter L1 and cap

Check that the coolant level is visible in L1 or above, otherwise top up.

Close valve V2 and check that V1 is open and V6 is closed. Run the pump by removing the plastic lid of the contactor and push the contactor button (1) (see Figure 21). Do this for a few minutes letting the entrapped air escape through the water tank.

ATTENTION: The air in the pump must be released via valve V6 before running the pump. The pump will be damaged if ran without water for even just a few seconds.

Stop the pump and look for entrapped air in the clear plastic hoses. If air is detected repeat the procedure. This has to be repeated several times for 15 to 20 minutes.

Sometimes if an air pocket has been created in one of the modules it can be hard to get rid of since it is easier for the water to run through the other modules. Try then also to open and close V2 several times with an interval of a few seconds.

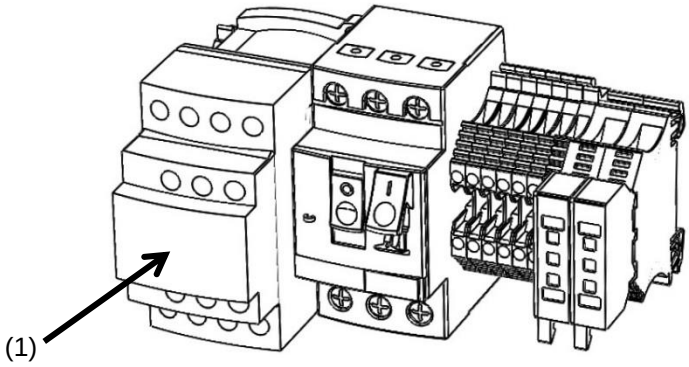

Figure 21 X12 Terminal block, location of contactor pushbutton

When no air is detected in the plastic hoses open V2, close V1, top up with coolant a last time to the highest visible point in L1, replace the cap and re-mount the cabinet roof.

ATTENTION: Important to make sure that V2 is open and V1 is shut off during normal operation.

5.3 Operation of cooling system

5.3.1 Start up

The cooling system is controlled by the control computer and will start together with the System.

5.3.2 Stop

The cooling system is controlled by the control computer and will stop together with the System.

5.3.3 Maintaining coolant level

The coolant level in L1 should be checked at regular interval. The first week after commissioning the coolant level should be checked daily. When no drop in level is detected the interval can be extended to once in 6 months.

5.4 Cooling system technical data

5.4.1 Data for external cooling water

Our recommendations is to use an external refrigerant with quality's similar to tap water, impurities and particles are contributing to corrosion and inhibits heat transfer inside the brazed plate heat exchanger (E1) mentioned in section 5.1. Salt water or desalinated water is due to its corrosive properties to steel and copper not recommended.

Table 17: Data for external cooling water

Characteristics	
Flow	21 l/min (7 l/min for each module))
Pressure drop	70 kPa
Temp inlet	max 38 °C / 100 °F
Recommended water quality	
Appearance	Clear
pH	7-10
Impurities	None

5.5 Mounting and unmounting the cooling system

The following chapters describe how to mount and unmount the cooling system if needed. Can be needed in case of adding or removing a PP-module, and while installation of the system.

5.5.1 Procedure for draining cooling system

Dismount the cabinet roof and open the cap to the tank. Place the plastic hose leading from drainage valve V6 into a 20 l vessel. Open valve V1, check that V2 is open and open drainage valve V6. Close V6 when no more water pours out.

There will still be water left in the modules and in the pump unit after draining through V6. For removal of the remaining water follow chapter 5.5.2 “Removal of cooling system assembly”.

5.5.2 Removal of cooling system assembly

Prior to attempting removal of cooling assembly, make sure that the system is electrically disconnected – all fuses should be open!

Unscrew the 4 screws holding the mounting plate and then lift and rotate carefully out the mounting plate with the pump unit (Figure 22) by lifting in the two handles. Rotate around the left corner of the cabinet. The pump unit weighs about 30kg.

ATTENTION: Use only the handles to lift in. Pay attention not to damage the hoses and the connection cable e.g. by over bending.

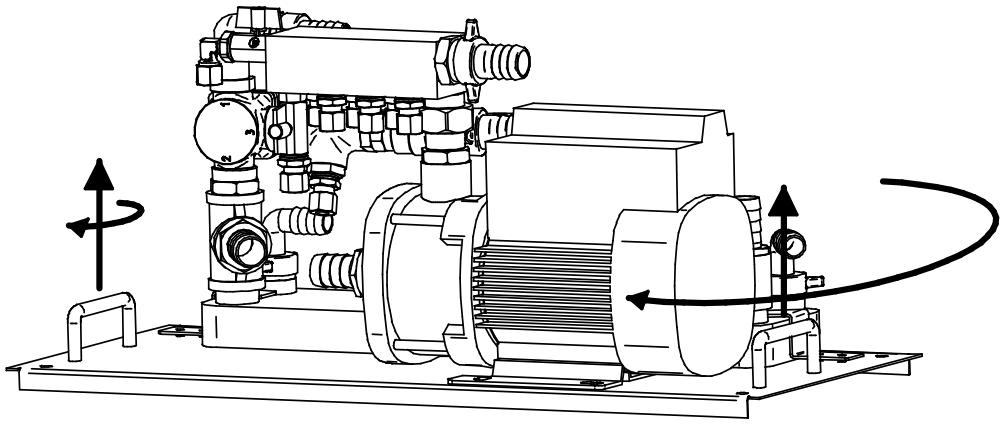

Figure 22: Removal procedure

There is still water in the modules which has to be evacuated by compressed air when the pump unit is out of the cabinet.

Place a cloth under one connection on the manifold to the module you are dismounting. Unscrew the connection and place the hose in the same vessel as the V6 drainage hose. Do the same with the other connection to the module and connect compressed air to it. Blow out the remaining coolant into the vessel while holding a cloth around the connection. Reconnect the in- and outlet hoses to the manifold and disconnect them instead on the module.

Repeat the drainage procedure with all the modules you want to remove.

Disconnect the hoses from the tank while protecting the modules from water with a cloth. The tank still holds some water so tilt the tank backwards when lifting it out. Dismount the tank and remove it.

ATTENTION: Be careful not to damage level meter L1!

Now the way is cleared for removing the module.

5.5.3 Mounting of cooling system assembly

When the module has been refitted connect the inlet hose from the manifold to the left side of the module and the outlet to the right. Lift and rotate in the cooling system and secure it with the four screws on the mounting plate.

ATTENTION: Be careful not to damage any clear plastic hoses by over bending or obstructing the external water by over bending or twisting the hoses for the external water.

6 Maintenance

This chapter is divided into two parts; firstly, all systems maintenance which is identical to all variants of the ADF P300 is covered, thereafter maintenance specific to for example ADF P300W is discussed.

Every 6 months, a routine inspection is performed. In most cases, no components are exchanged during biannual inspection.

NOTE Warranty is void if maintenance is not performed according to schedule.

ATTENTION: All maintenance must be performed by trained and qualified personnel.

Make sure no voltage is present in main circuit, auxiliary power system, AC voltage measurement circuits and power capacitors.

Follow the guidelines for preparing the ADF P300 for maintenance before attempting to perform any work in this section.

ADF P300 consists of electronics sensitive to electrostatic voltage.

When tightening electrical or mechanical connections be sure to apply the correct torque.

Before attempting any maintenance, the ADF P300 must be shut down.

6.1 Biannual inspection

The following items are included in the maintenance procedure:

- Visual inspection
- Cleaning
- Inspection of fuses
- Cooling system
- Door, lock inspection
- Air filter
- Electrical connections

6.1.1 Visual inspection

All cabinets should be opened. A visual inspection must be performed of all cabinets in the system. Check for any of the following items:

- Dust
- Condensation
- Abnormal smell, discoloration, soot or swelling of components
- Cracks in plastic covers
- Inspect DC capacitors for signs of overheating; be aware of swollen capacitors and signs of overheating. Such capacitors must be replaced.

Pay particular attention to presence of conductive dust.

6.1.2 Cleaning

All dust must be removed. The best way of doing this is to use pressurized air (from a compressor system).

ATTENTION: The equipment is sensitive to ESD. Avoid cleaning the system with any method which may cause build-up of ESD; such as vacuum cleaning, using cloths, etc.

Dust build-up may cause unreliability and component failure in the worst case.

Check the air filter and exchange them if necessary.

6.1.3 Fuses

Inspect all fuses, check for signs of premature wear. If fuses have been used during abnormal situations causing overheating and/or overcurrent, replace the fuses.

The following fuses should be inspected:

- Main fuses connecting PPs to the main bus bar (Q1…Q3)
- DC link fuses
- Fuses on ACB
- Auxiliary fuse block (F1)

6.1.4 Cooling system (not ADF P300W)

Check the fans by holding a piece of paper on top of each outlet. The outlets are located on the top of the cabinet, below the roof, close to the back of the cabinet.

6.1.5 Door, lock inspection

Inspect door and locks, including the seals. Check that the lock operates without problem and that the door is fully closed and in contact with the whole frame when the lock is enabled. If the door is not tight, the cooling will not work correctly.

6.1.6 Air filter

Inspect the air filter and exchange them if the dirt restricts the airflow. The exchange schedule can very a lot depending on the air pollution at site.

6.1.7 Electrical connection

Visually inspect all electrical connections. Check for signs of heated cable terminations and damaged insulation.

Check the torque on mains connections and PE.

6.2 ADF P300W-specific maintenance

This subsection details maintenance specific to the water cooled version of ADF P300W.

6.2.1 Visual inspection

Check:

- The coolant level in L1.
- For leakage in couplings or signs of leakage on the mounting plate.
- Listen for uneven noise from the pump bearing.

Appendix A Technical Specifications

The product is named according to current capacity and maximal nominal voltage. The naming follows the form

```
ADF P300-200/480
```

Where ‘P300’ indicates the model family, ‘200’ is the current capacity, and ‘480’ the maximum allowed nominal voltage. Note that the voltage always indicates a usable interval; please see the specification tables below.

Currently, the following models exist:

Table 18: Available ADF P300 models

Product Line	Models	Art no
ADF P300 Air cooled, 3 wire, CE-version	ADF P300-120/480	400 089
	ADF P300-240/480	400 090
	ADF P300-360/480	400 091
	ADF P300-90/690	400 092
	ADF P300-180/690	400 093
	ADF P300-270/690	400 094
ADF P300 Air cooled, 3 wire, UL/cUL-version	ADF P300-110/480-UL	400 083
	ADF P300-220/480-UL	400 084
	ADF P300-330/480-UL	400 085
	ADF P300-90/600-UL	400 086
	ADF P300-180/600-UL	400 087
	ADF P300-270/600-UL	400 088
ADF P300N Air cooled, 4 wire	ADF P300N-100/480	400 051
ADF P300W Water cooled, 3 wire	ADF P300W-150/480	400 072
	ADF P300W-300/480	400 073
	ADF P300W-450/480	400 074
	ADF P300W-140/690	400 056
	ADF P300W-280/690	400 057
	ADF P300W-420/690	400 058

A.1 Technical Data – ADF P300-XXX/480

Table 19: Technical specifications ADF P300-XXX/480

Characteristics			
Model	ADF P300-120/480	ADF P300-240/480	ADF P300-360/480
Article Number	400 089	400 090	400 091
Rated power, nominal 400 V / 480 V	83 kVA / 100 kVA	166 kVA / 200 kVA	249 kVA / 299 kVA
Compensation current capacity at 50/60 Hz	120 A_{RMS}	240 A_{RMS}	360 A_{RMS}
System voltage *	208 – 480 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300 units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 2725 W	< 5325 W	< 7925 W
Maximum air flow requirement	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m (3300 ft)		
Operation temperature	0 to 40 °C, < 25 °C recommended 32 to 104 °F, < 77 °F recommended		
Dimensions	800 x 2155 x 610 mm (W x D x H) 31,5” x 84,8” x 24” (W x D x H)		
Weight	335 kg	472 kg	609 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	IP20 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		

* please state your system voltage and line frequency when ordering

A.1 Technical Data – ADF P300-XXX/480 – UL/cUL version

Table 20: Technical specifications ADF P300-XXX/480

Characteristics			
Model	ADF P300-100/480-UL	ADF P300-200/480-UL	ADF P300-300/480-UL
Article Number	400 083	400 084	400 085
Rated power, nominal 400 V / 480 V	76 kVA / 91 kVA	152 kVA / 183 kVA	229 kVA / 274 kVA
Compensation current capacity at 50/60 Hz	110 A_{RMS}	220 A_{RMS}	330 A_{RMS}
Short Circuit Rating	50 kAIC		
System voltage *	208 – 480 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300 units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 2480 W	< 4835 W	< 7190 W
Maximum air flow requirement	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m (3300 ft)		
Operation temperature	0 to 40 °C, < 25 °C recommended 32 to 104 °F, < 77 °F recommended		
Dimensions	800 x 2155 x 610 mm (W x D x H) 31,5” x 84,8” x 24” (W x D x H)		
Weight	335 kg	472 kg	609 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	NEMA Type 1 IP20 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	UL, cUL		

* please state your system voltage and line frequency when ordering

A.2 Technical Data – ADF P300-XXX/690

Table 21: Technical specifications ADF P300-XXX/690

Characteristics			
Model	ADF P300-90/690	ADF P300-180/690	ADF P300-270/690
Article Number	400 092	400 093	400 094
Rated power, nominal 600 V / 690 V	94 kVA / 108 kVA	187 kVA / 215 kVA	281 kVA / 323 kVA
Compensation current capacity at 50/60 Hz	90 A_{RMS}	180 A_{RMS}	270 A_{RMS}
System voltage *	480 – 690 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300 units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 2969 W	< 5813 W	< 8657 W
Maximum air flow requirement	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dBA		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m (3300 ft)		
Operation temperature	0 to 40 °C, < 25 °C recommended 32 to 104 °F, < 77 °F recommended		
Dimensions	800 x 2155 x 610 mm (W x D x H) 31,5” x 84,8” x 24” (W x D x H)		
Weight	351 kg	495 kg	639 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	IP20 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		

* please state your system voltage and line frequency when ordering

A.2 Technical Data – ADF P300-XXX/600 – UL/cUL version

Table 22: Technical specifications ADF P300-XXX/600

Characteristics			
Model	ADF P300-90/600-UL	ADF P300-180/600-UL	ADF P300-270/600-UL
Article Number	400 086	400 087	400 088
Rated power, nominal 600 V	94 kVA	187 kVA	281 kVA
Compensation current capacity at 50/60 Hz	90 A_{RMS}	180 A_{RMS}	270 A_{RMS}
Short Circuit Rating	50 kAIC		
System voltage *	480 – 600 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300 units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 2836 W	< 5547 W	< 8258 W
Maximum air flow requirement	600 m^3/h	1200 m^3/h	1800 m^3/h
Noise level	< 70 dB		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m (3300 ft)		
Operation temperature	0 to 40 °C, < 25 °C recommended 32 to 104 °F, < 77 °F recommended		
Dimensions	800 x 2155 x 610 mm (W x D x H) 31,5” x 84,8” x 24” (W x D x H)		
Weight	351 kg	495 kg	639 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	NEMA Type 1 IP20 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	UL, cUL		

* please state your system voltage and line frequency when ordering

A.3 Technical Data – ADF P300W-XXX/480

Table 23: Technical specifications ADF P300W-XXX/480

Characteristics			
Model	ADF P300W-150/480	ADF P300W-300/480	ADF P300W-450/480
Rated power, nominal 400 V / 480 V	104 kVA / 125 kVA	208 kVA / 250 kVA	312 kVA / 375 kVA
Compensation current capacity at 50/60 Hz	150 A_{RMS}	300 A_{RMS}	450 A_{RMS}
System voltage *	208 – 480 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300W units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 2550 W	< 5100 W	< 7650 W
Water flow requirement	ΔP = 66 kPa at 21 l/min		
Noise level	< 65 dB		
Environment	0 to 95 % RH non-condensing		
Operation temperature	0 to 50 °C ambient and 38 °C water temperature 32 to 122 °F ambient and 100 °F water temperature		
Dimensions	800 x 2105 x 610 mm (W x D x H) 31,5” x 82,8” x 24” (W x D x H)		
Weight	367 kg	500 kg	633 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	IP54 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		

* please state your system voltage and line frequency when ordering

A.4 Technical Data – ADF P300W-XXX/690

Table 24: Technical specifications ADF P300W-XXX/690

Characteristics			
Model	ADF P300W-140/690	ADF P300W-280/690	ADF P300W-420/690
Rated power, nominal 600 V / 690 V	146 kVA / 168 kVA	291 kVA / 335 kVA	437 kVA / 502 kVA
Compensation current capacity at 50/60 Hz	140 A_{RMS}	280 A_{RMS}	420 A_{RMS}
System voltage *	480 – 690 V		
Nominal frequency *	50/60 Hz ± 2 %		
Number of phases	3		
Connection type	3 phase without neutral (TN, TT, IT)		
Harmonic current compensated	individual compensation up to 49th order		
Rate of harmonic reduction	better than 98 %		
Current compensation of cos φ	up to 1.0		
Expandability	ADF P300W units can be used in parallel		
Response time	< 1 ms		
Power dissipation	< 3600 W	< 7200 W	< 10800 W
Water flow requirement	ΔP = 66 kPa at 21 l/min		
Noise level	< 65 dB		
Environment	0 to 95 % RH non-condensing		
Operation temperature	0 to 50 °C ambient and 38 °C water temperature 32 to 122 °F ambient and 100 °F water temperature		
Dimensions	800 x 2105 x 610 mm (W x D x H) 31,5” x 82,9” x 24” (W x D x H)		
Weight	372 kg	510 kg	648 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)		
Protection class	IP54 according to IEC 529		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4		
Certificates	CE		

* please state your system voltage and line frequency when ordering

A.5 Technical Data – ADF P300N-100/480

Table 25: Technical specifications ADF P300N-100/480

Characteristics	
Model	ADF P300N-100/480
Rated power, nominal 400 V / 480 V	70 kVA \ 84 kVA
Compensation current capacity at 50/60 Hz	100 A_{RMS}
Compensation current capacity at 50/60 Hz, Neutral	300 A_{RMS}
System voltage *	208 – 480 V
Nominal frequency *	50/60 Hz ± 2 %
Number of phases	3 phase with neutral
Connection type	3 phase with neutral (TN, TT, IT)
Harmonic current compensated	individual compensation up to 49th order
Rate of harmonic reduction	better than 98 %
Current compensation of cos φ	up to 1.0
Expandability	ADF P300N units can be used in parallel
Response time	< 1 ms
Power dissipation	< 3800 W
Maximum air flow requirement	1200 m^3/h
Noise level	< 70 dB
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m (3300 ft)
Operation temperature	0 to 40 °C, < 25 °C recommended 32 to 104 °F, < 77 °F recommended
Dimensions	800 x 2155 x 610 mm (W x D x H) 31,5” x 84,8” x 24” (W x D x H)
Weight	430 kg
Cabinet color	cabinet RAL 7035 (gray), base RAL 7022 (dark gray)
Protection class	IP20 according to IEC 529
Environmental conditions	chemical 3C3, mechanical 3S3
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4
Certificates	CE

* please state your system voltage and line frequency when ordering

Appendix B Compatibility with passive compensation

Capacitor banks are often used in various configurations to lower the reactive power in an installation. It is a recognized problem that capacitors have impedance the falls with rising frequency and hence act as a sink for harmonics.

It is **not recommended** to use Active Filter units in conjunction with direct connected passive compensation without series reactors. Detuned capacitor banks are easier to integrate with Active Filters.

In all cases, the capacitor bank should be connected prior to the current measurement used for the Active Filter, as illustrated in Figure 23 below. When using the Active Filter in conjunction with detuned capacitor banks, it is strongly recommended to configure the Active Filter for closed loop current measurement.

The passive compensation **must** be placed upstream to the Active Filter.

Note that the Active Filter unit's current transformers (CTs) are placed prior to the load, but after the passive compensation, viewing from the supply side.

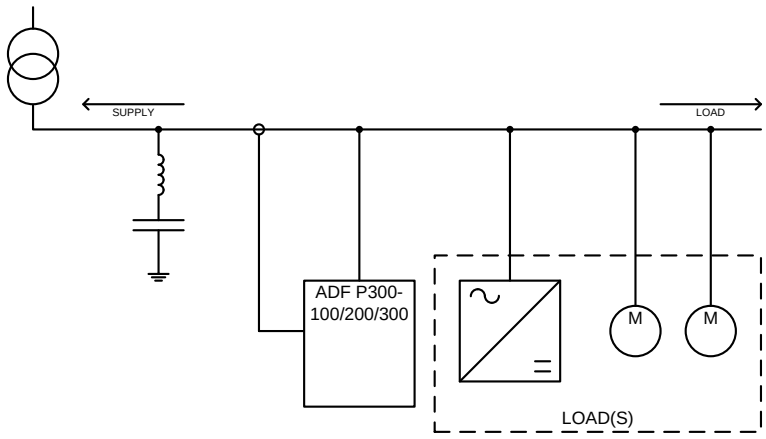

Figure 23: Connection of an Active Filter unit, passive compensation, and location of CTs.

ATTENTION: Failure to observe the orientation guidelines above will significantly shorten the lifetime of the passive compensation, lower the efficiency of both the Active Filter unit and the passive compensation, and may cause unpredictable results.

Appendix C Harmonics derating

The current rating of Active Filter units is specified at the system frequency (50 or 60 Hz). This is sufficient in all normal applications since higher harmonics are lower in amplitude in most cases. For special application, requiring very high harmonic current in high harmonic orders, special care must be taken. A rating of 100 A_{RMS} does not imply that the unit can output 100 A RMS @ 1250 Hz (25th harmonic in a 50 Hz system).

The following guidelines are useful for determining the maximum allowable higher harmonic current during normal operation of COMSYS Active Filters.

C.1 Single harmonic maximum current

The following guidelines are established for maximum continuous current only when the unit is running at maximum rated ambient temperature. During dynamic operation with lower ambient temperature than the maximally allowed, burst currents may be significantly higher. In the same fashion, in continuous operation at temperatures higher than the maximum allowed, the unit automatically derates the output in order to not shorten component lifetime.

The following formula, valid up to the 50th harmonic, can be used to determine the maximum individual current, as percentage of the rated maximum compensation current:

$$I_{max} = 0{,}025*h^2 – 2{,}8*h + 102{,}775 \text{ (50 Hz systems only)}$$

$$I_{max} = 0{,}036*h^2 – 3{,}36*h + 102{,}775 \text{ (60 Hz systems only)}$$

In the given equation, h is the harmonic order. For a unit rated at 100 A_{RMS}, the maximum current of the 5th harmonic is consequently 89.4 A_{RMS}, in 50 Hz systems. The graph below shows a graphical representation of the equation:

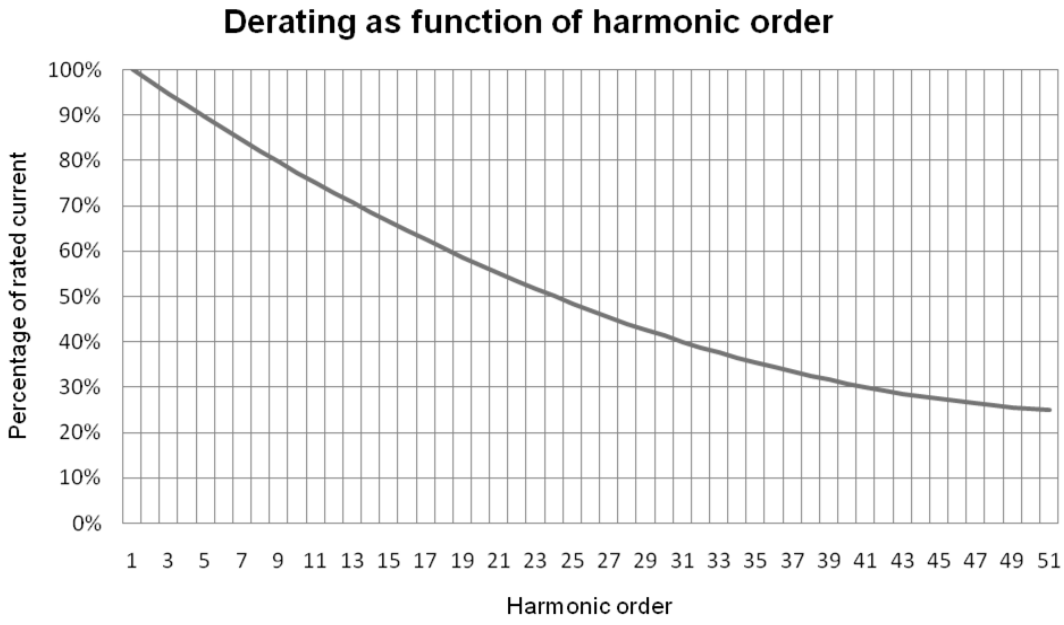

Figure 24: Harmonics derating function

C.2 Determining the thermal limit

Given that each harmonic current is within the limits outlined above, the total limit of the system as a whole can be determined as follows. First, calculate the individual contribution of each harmonic:

$$I_{h,contrib} = 100*I_h / (0{,}025*h2 – 2{,}8*h + 102{,}775) \text{ (50 Hz)}$$

$$I_{h,contrib} = 100*I_h / (0{,}036*h2 – 3{,}36*h + 102{,}775) \text{ (60 Hz)}$$

where h is the harmonic order and I_h is the corresponding current. Finally, add the individual harmonic contributions as a root sum:

$$I_{total} = SQRT(I_{3,contrib}^2 + I_{5,contrib}^2 + \ldots + I_{49,contrib}^2 + I_{reactive,contrib}^2)$$

The answer is the amount of unit current rating needed to be able to compensate the load. Eventual reactive current can be added in the formula above as $I_{reactive,contrib}$.

Example:

A load needs 70 A_{RMS} at 250 Hz and 45 A_{RMS} at 350 Hz. The individual contributions are $I_{5,contrib}$ = 78,3 A_{RMS} for fifth harmonic and $I_{7,contrib}$ = 53,3 A_{RMS} for the seventh harmonic. The RMS sum of the two components are 94,7 A_{RMS}. Thus, a 100 A unit will be sufficient to compensate the load. Adding an 11^{th} harmonic of 35 A_{RMS} adds an equivalent contribution of 46,7 A_{RMS} yielding a total needed capacity of 105,6 A_{RMS} which will not work in an 100 A unit in continuous operation at maximum allowed ambient temperature.

C.3 Summary

In most cases the above guidelines are sufficient to establish the needed Active Filter size in order to fully compensate the desired harmonics. Since the exact calculations are complex the guidelines established in this document can be considered safe limits.

For detailed calculations or custom solutions, please contact your Comsys ADF supplier.

The formulas and guidelines are valid for all ADF P300 Active Filters systems up to the 49^{th} harmonic.

Appendix D Altitude derating

The current rating of the ADF units is specified up to a height of 1000 m. In higher altitudes the current rating will be lowered depending on the height. The following rules apply when using ADF units above altitudes of 1000 m:

D.1 Air cooling derating

When using a ADF P300 or ADF P300N on heights above 1000 m, the maximum output will be derated according to the following:

Altitude derating [%] = (h – 1000) / 100

For example, at an altitude of 1500 m, the derating will be 5 %. In this case a ADF P300-200 will not have the capability to compensate 200 A_{RMS} but only 190 A_{RMS}.

NOTE Water cooled ADF P300W units are not affected by altitude derating.

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