COMSYS

Hardware Manual

ADF P300

comsys.se/ADF

1 199 459 – REV17

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.

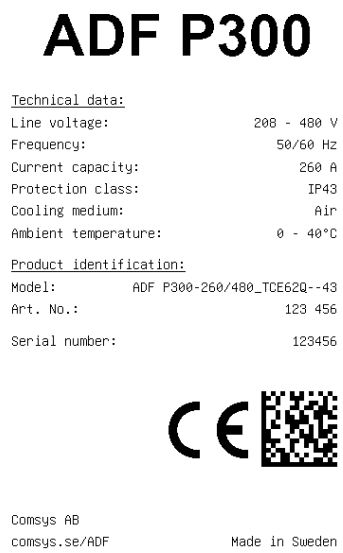
ATTENTION: Before manipulating current transformers, make sure that the secondary is short-circuited. Never open the secondary of a loaded current transformer. You must always wear isolating gloves and eye-protection when working on electrical installations. Also make sure that all local safety regulations 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	PPM gen.	Cabinet width	Current rating	Voltage
ADF P300v2/v4 Air cooled, 3 wire	ADF P300-50/480	v2B	400 mm	50 A_{RMS}	208 – 480 V
	ADF P300-75/480	v2B	400 mm	75 A_{RMS}	
	ADF P300-90/480	v2B	400 mm	90 A_{RMS}	
	ADF P300-110/480-UL	v2	400 mm	110 A_{RMS}	
	ADF P300-120/480	v2B	400 mm	120 A_{RMS}	
	ADF P300-130/480	v4	400 mm	130 A_{RMS}	
	ADF P300-150/480	v2B	400 mm	150 A_{RMS}	
	ADF P300-220/480-UL	v2	600 mm	220 A_{RMS}	
	ADF P300-240/480	v2B	400 mm	240 A_{RMS}	
	ADF P300-260/480	v4	600 mm	260 A_{RMS}	
	ADF P300-300/480	v2B	600 mm	300 A_{RMS}	
	ADF P300-330/480-UL	v2	800 mm	330 A_{RMS}	
	ADF P300-360/480	v2B	800 mm	360 A_{RMS}	
	ADF P300-390/480	v4	800 mm	390 A_{RMS}	
	ADF P300-90/600-UL	v2	400 mm	90 A_{RMS}	480 – 600 V
	ADF P300-180/600-UL	v2	600 mm	180 A_{RMS}	
	ADF P300-270/600-UL	v2	600 mm	270 A_{RMS}	
	ADF P300-90/690	v2	400 mm	90 A_{RMS}	480 – 690 V
	ADF P300-180/690	v2	600 mm	180 A_{RMS}	
	ADF P300-270/690	v2	800 mm	270 A_{RMS}	

Standards

These products are CE compliant, which means that the product is in conformity with the European Community low voltage directives 2014/35/EU and 93/68/EEC and it carries 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	IP22 according to IEC 60529 (ADF P300) IP43 according to IEC 60529 (ADF P300, option) UL Type 1 according to NEMA 250 (ADF P300-UL)
Approval marking	2014/35/EU (Low Voltage Directive), 2011/65/EU (RoHS II) 93/68/EEC (CE-mark)

UL/cUL version Standards

The UL/cUL versions are approved according to UL/CSA standards.

Table 3: UL/cUL Standards

Standards	
Electrical design and safety	UL508/CSA22.2

File no NMTR.E357863.

NOTE. UL-version of this product is pending.

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
D13	2015-11-04	MINOR CORRECTIONS; UPDATE X11/X12 TERMINALS	RELEASED
REV15	2016-03-10	MINOR CORRECTIONS; REMOVAL OF EOL PRODUCTS ADF P300W and ADF P300N	RELEASED
REV16	2021-02-02	UPDATE FOR GENERATION V4 & NEW CABINET	RELEASED
REV17	2021-03-17	MINOR CORRECTIONS	RELEASED

Contents

List of figures

List of tables

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 1 199 459 (this document)
2. ADF P25/P100/P300 User Manual, doc no 1 199 172

The Hardware Manual covers hardware related topics, 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 P25/P100/P300 User Manual (doc no 1 199 172)
- ADF P300 Circuit diagram
- ADF P300 Service Manual

2 Active Filter Overview

2.1 Introduction to the Technology

Comsys offers a new generation of high performance power quality products for industrial, utility and commercial 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 reduced 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 other installed equipment 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 and voltage delivered from the network are measured and analyzed, to determine if disturbances such as e.g. reactive displacement and/or harmonics are present.

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

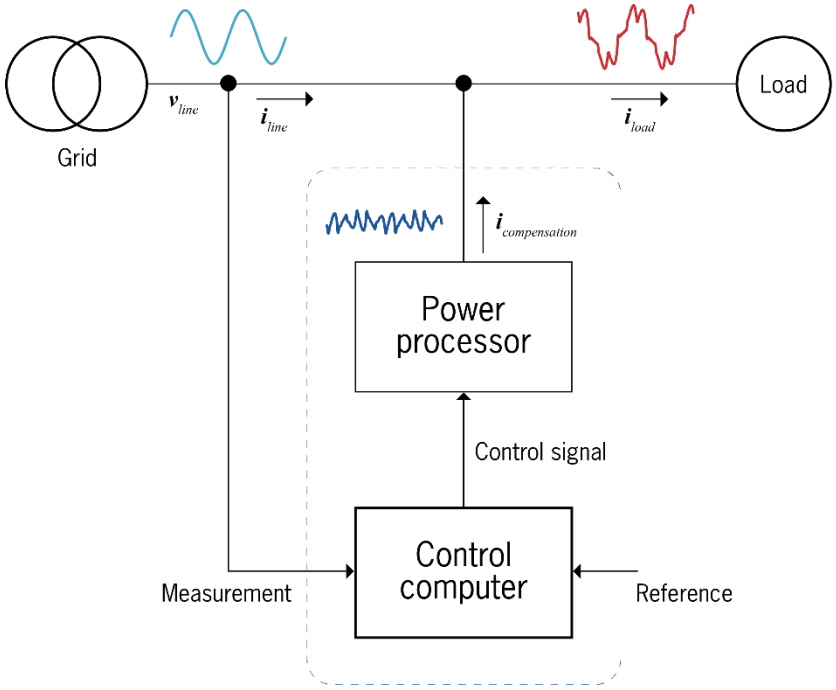


Figure 1: Basic operating principle

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.

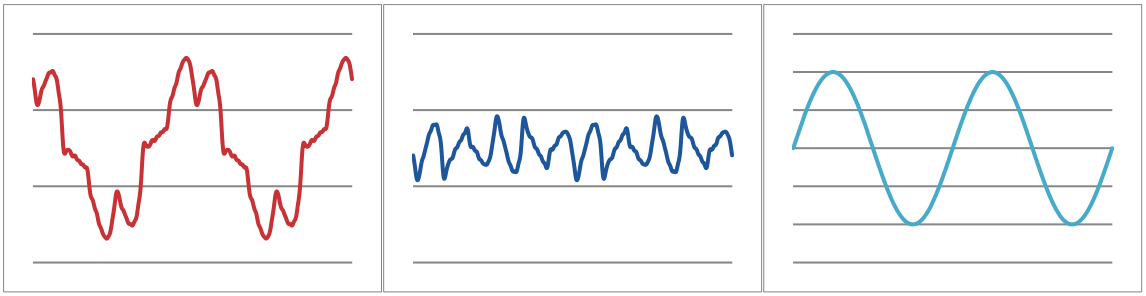


Figure 2: Uncompensated load current (left), Compensation current (middle), Compensated net current (right)

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 50 A up to 390 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

The ADF P300 is available in three cabinet widths, 400, 600 and 800 mm.

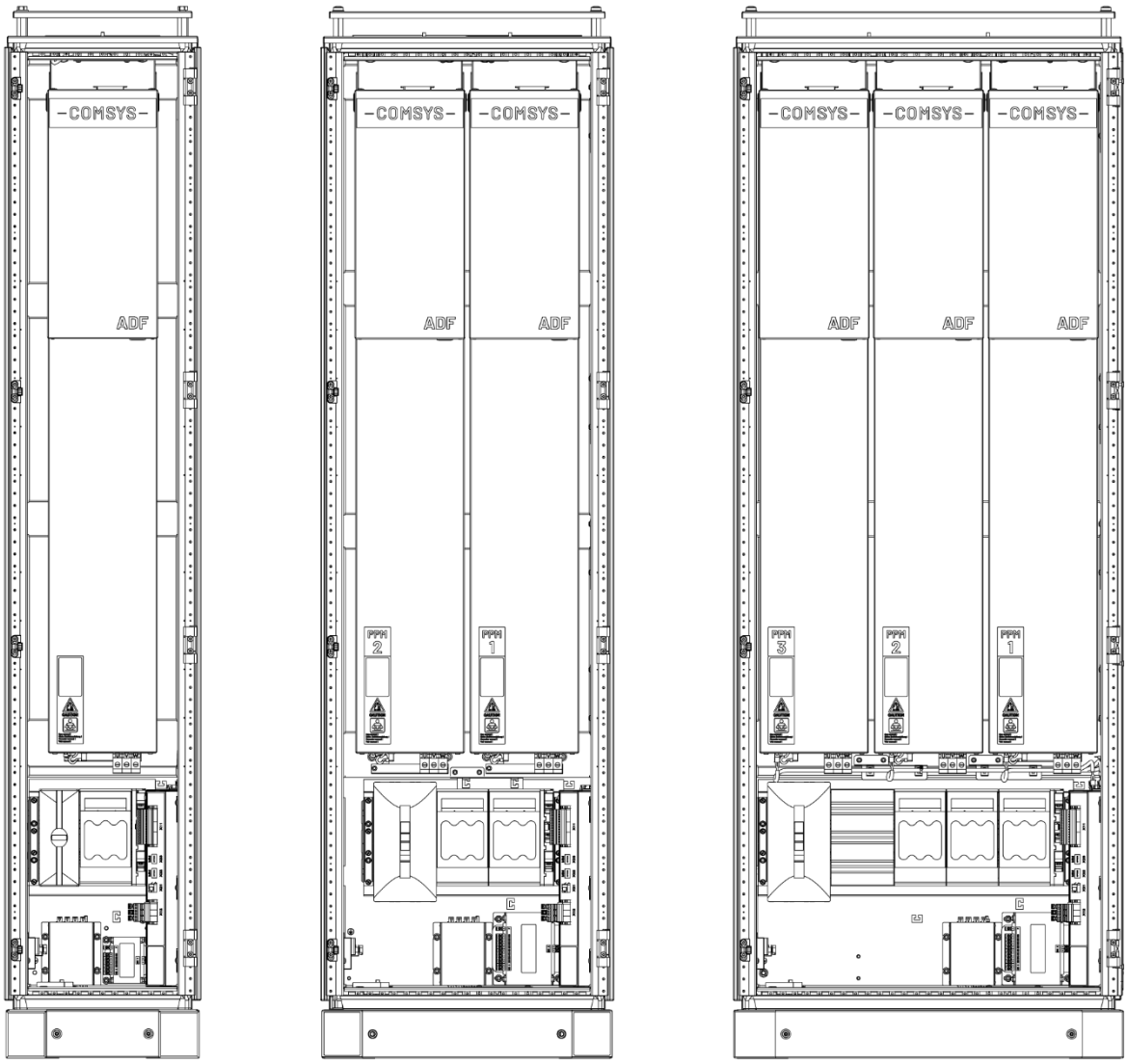


Figure 3: ADF P300 in 400, 600 and 800 mm configurations

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.

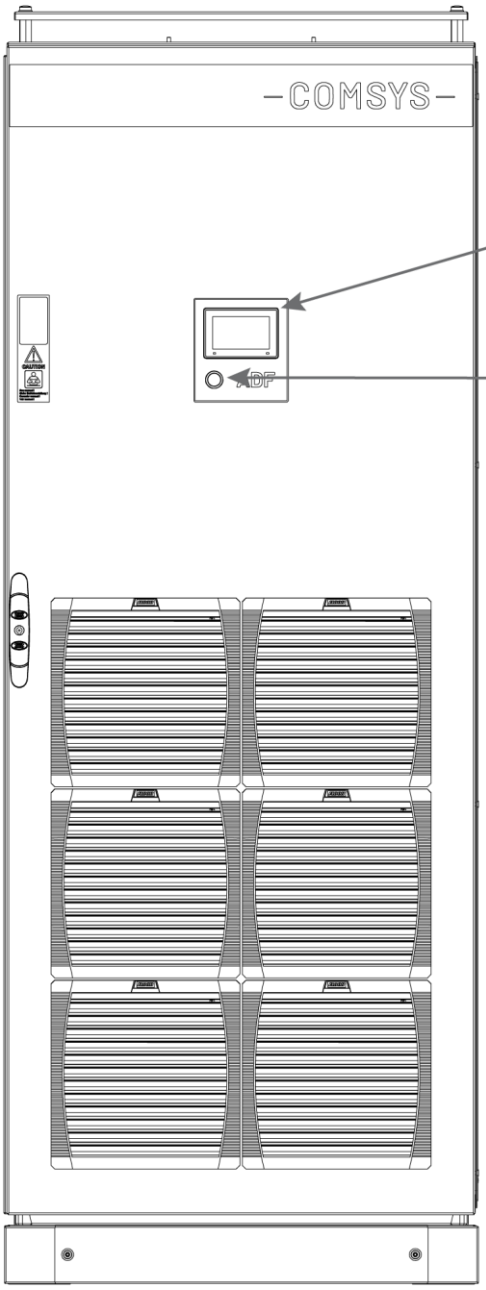


Figure 4: ADF P300 cabinet overview

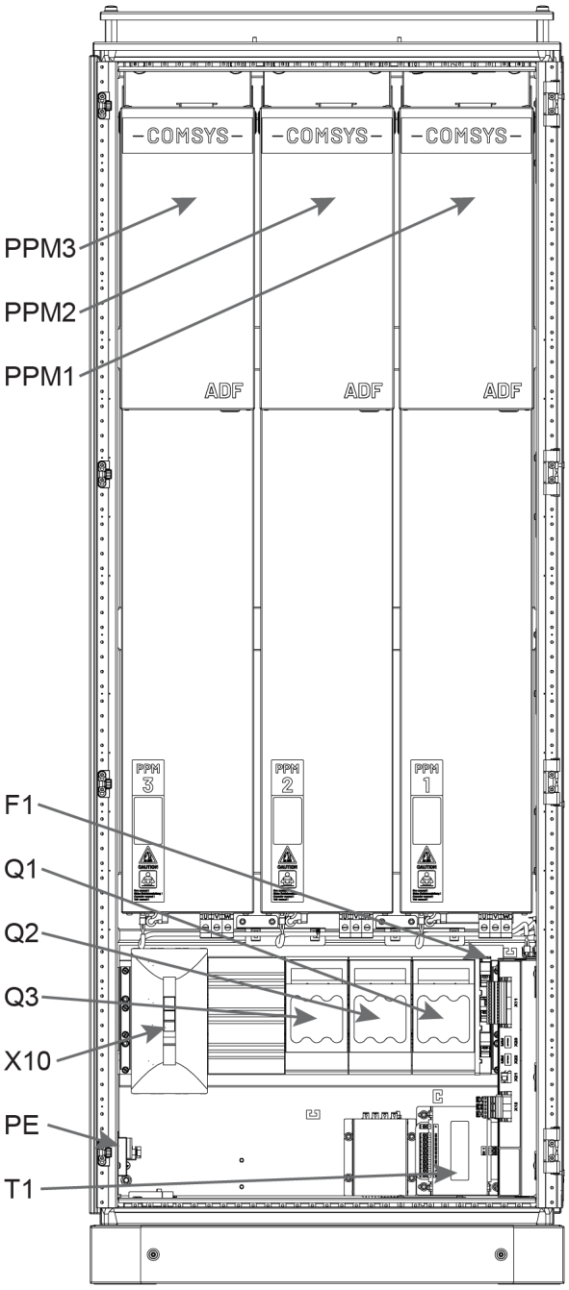


Figure 5: ADF P300 main components

Please note that the modules are numbered from right to left.

Rotated picture of bottom section (automation components) following in the figure below:

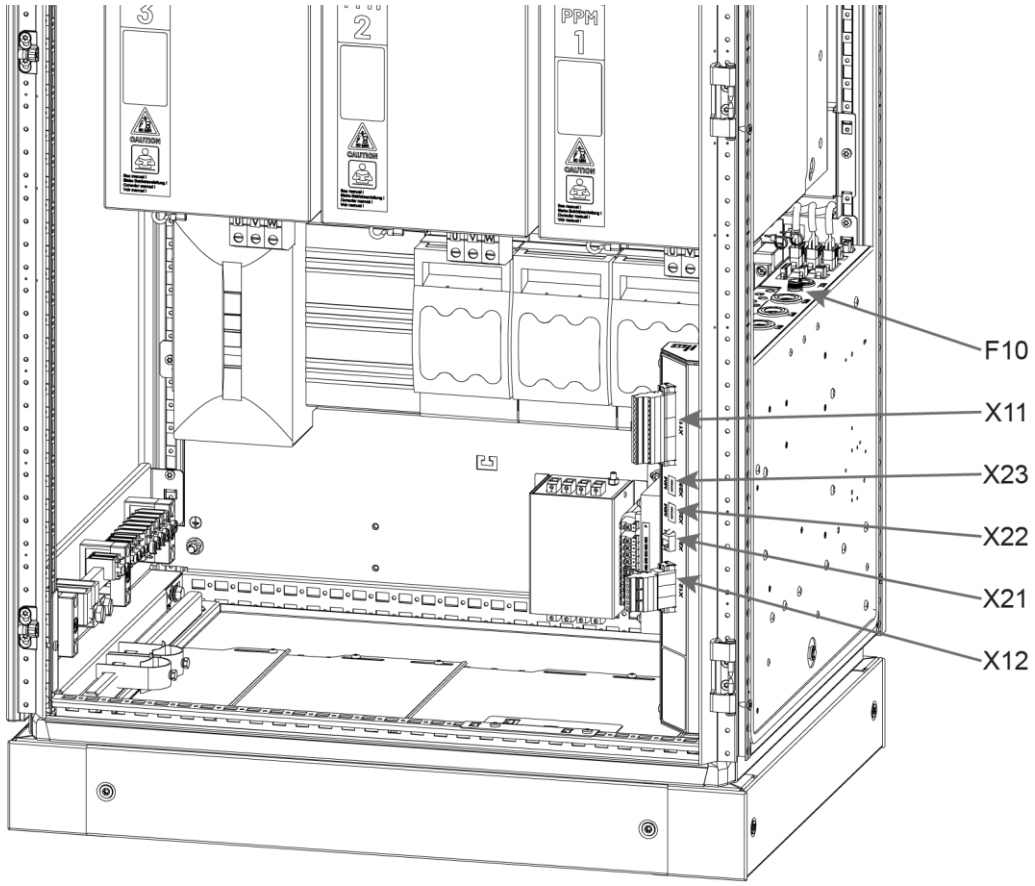


Figure 6: ADF P300 cabinet lower part overview

2.2.2.1 User interface (HMI-3 Extended)

All settings, configuration and operation can be performed from the HMI (Human- Machine Interface) panel, see Figure 4. Please refer to the ADF P25/P100/P300 User Manual (1 199 172) on how to use the HMI.

2.2.2.2 PIB - Power Indication Button (HMI-3 Basic)

Basic operations like start and stop, can be performed on the PIB. The button also shows basic operation information on an indication light, integrated in the button.

The ADF is powered ON by pressing this button short and powered OFF by pressing the button for two seconds.

Table 5: PIB color coding

Color	Description	Button action
Fading red	System in trip and log is being written to SD-card	None
Solid red	System in trip	Acknowledge all alarms
Fading yellow	Pre-charge / all other states	None
Solid yellow	System stopped	Start system
Fading green	System is in standby mode	Stop system
Solid green	System is running	Stop system
None	System is powered off	Boot system

2.2.2.3 Auxiliary voltage transformer (T101)

The auxiliary voltage transformer (T101) transforms mains voltage to 230 V_{AC}. The T101 transformer must be configured for the correct mains voltage prior to starting the active filter, see section 4.4.

2.2.2.4 Auxiliary fuse block (F1)

The auxiliary fuse block (F1), consisting of three 10 x 38 mm fuses, protects voltage measurement circuits, pre-charging circuits and auxiliary power systems in the Active Filter.

2.2.2.5 Auxiliary fuse 230 V (F10)

Auxiliary 230 V fuse (secondary of auxiliary transformer). The secondary auxiliary fuse block, consisting of a single 5 x 20 mm fuse, protects secondary side of the 230 V_{AC} auxiliary transformer inside the Active Filter.

2.2.2.6 Control module (CM-CAB)

The control module contains the SCC2 controller, auxiliary 24 V_{DC} power supply and wiring.

ATTENTION: Live components under CM-CAB cover. All fuses (Q1…Q3 and F1) must be opened prior to removing CM-CAB cover, or the user can be exposed by up to 690 V system voltage.

2.2.2.7 Power processor module (PPM1…PPM3)

Every Active Filter is equipped with one or more power processing modules (PPMs) which are the power electronic converters that 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, IGBT driver electronics, EMC-filter, DC-storage, cooling fans and line filtering components.

NOTE In this generation ADF P300 system, PPM300 modules are numbered from *right to left*. The module number is apparent on the sticker.

2.2.2.8 Power processor fuse block (Q1…Q3)

The Power Processor fuse block (Q1…Q3), consisting of NH fuse block holders, 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.

NOTE In this generation ADF P300 system, power fuse blocks are numbered from *right to left*. The fuse number corresponds to the module number on the sticker (of PPM).

2.2.2.9 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.

Standard configuration is one connection terminal is installed. If required a second terminal can be ordered with the article number 100 430.

2.2.2.10 Protective Earth Bus-bar (PE)

The protective earth bus bar, PE, is used to connect protective earth when connecting the filter.

2.2.2.11 User signal interface (X11)

The user signal interface terminals, X11, are used for interface to external devices via alarm outputs and digital inputs. See section 4.5 for more information on how to connect digital inputs and outputs.

2.2.2.12 Current transformer interface (X12)

Current transformer interface terminals, X12, are used for connecting current transformers. See section 4.6 for more information on how to connect current transformers (CT's).

2.2.2.13 Ethernet RJ45 connection (X21)

The RJ45 connector, X21, is used to connect Ethernet (and Modbus TCP) to the SCC2. A "FTP category 5" or better Network cable can be used to connect to the ADF.

2.2.2.14 Multi-master connection (X22 & X23; optional)

When paralleling ADF P300 systems in closed loop configuration, the multi-master interface is used for synchronization purposes.

2.2.3 Control Module (CM-CAB)

The control module is placed in the right bottom side of the cabinet. It contains the SCC2 controller, 24 V_{DC} power supply, fuses and wiring harnesses.

> **ATTENTION:** Live components under CM-CAB cover. All fuses (Q1…Q3 and F1) must be opened prior to removing CM-CAB cover, or the user can be exposed by up to 690 V system voltage.

The connectors on top of the control module are described below. The user interface connectors on the front (facing the door) are explained in chapter 4.

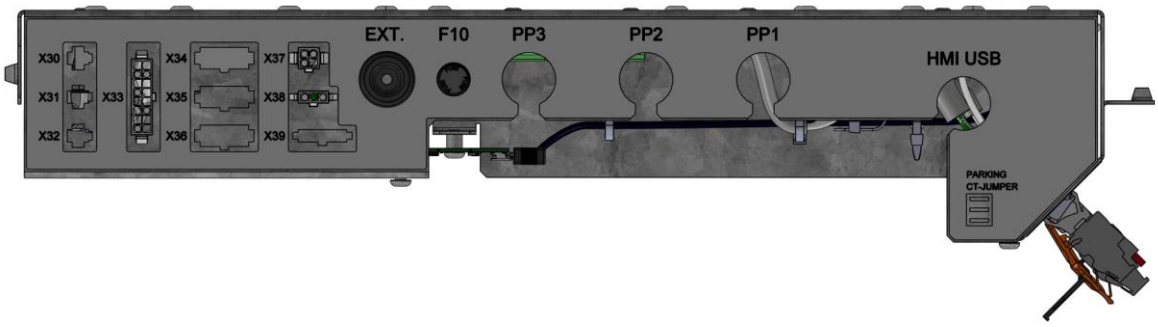


Figure 7: CM-CAB top view

The connectors on top of the CM are described in Table 6 below.

Table 6: CM-CAB top connectors

Connector/Item	Description
PP1…PP3	Band cable control connectors to PPM300 modules. The cable goes through the gromet and is connected directly on the SCC2 controller.
F10	Auxiliary 230V fuse (secondary of auxiliary transformer). The secondary auxiliary fuse block, consisting of a single 5x20 mm fuse, protects secondary side of the 230 V_{AC} auxiliary transformer inside the Active Filter.
EXT.	External cable entry, not used in ADF P300 product.
X30…X32	Feeder for PPM300 top fan ($24V_{DC}$; not used in all products).
X33	Phase voltage input and 230V input to CM-CAB. Phase voltages are fed via F1 fuses from bus bar.
X34…X36	PPM300 module automation connector. If v2/v2B modules are used, only X34 is used. If v2B-150A is used, X34 and X35 is used. If v4 modules are used, one connector per module is used.
X37	HMI 24VDC connection and feedback
X38	230V outlet for additional cabinet fan (IP54 cabinets only)
X39	Pre-charge for v2 and v2B modules
HMI USB	Cable routing for HMI
Parking CT-Jumper	Parking for safe storage of short circuit CT jumpers when system is in operation.

For the remaining (front) connectors/interfaces, see section 4.3.

2.2.3.1 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.

2.2.3.2 Auxiliary voltage supply Unit (PSU)

The auxiliary voltage supply (PSU) transforms 230 V_{AC} to 24 V_{DC}.

2.3 Filter Configuration

The ADF P300 filter comes in a variety of configurations. The product configuration is defined by the product string. The product string consists of the basic type of product, such as ADF P300-240/480, but also a list of factory built-in options.

Please note that other options exist that are not immediately part of the product string, such as software licenses that do not have a hardware impact. The nomenclature of the product string is defined as below:

```
ADF Pmod-cur/vol{-UL}_{OPTION STRING: ABCDEFGHIJ}
```

```
ADF P300-240/480{-UL}_ABCDEFGHIJ
```

```
ADF P300-240/480_TCE62A--22
```

All positions are always visible within the product string, except for ‘Q’ that is a qualifier that enables a certain type of product.

When an option is enabled, it is lit up in the string. For example, the multi-master option is on position B in the string ABCDEFGHIJ above, and is indicated by letter ‘C’ so it can immediately be seen if multi-master is enabled by looking below:

```
ADF P300-240/480_TCE62A--22
```

A similar system *without* multi-master looks like the following:

```
ADF P300-240/480_T-E62A--22
```

Also note that the encapsulation class (ingress protection) is documented in the last two letters. 22 in this case means IP22. All relevant ADF P300 article strings are listed in the table below.

Position	ADF	Active Dynamic Filter
Product Type (mod)		
ADF P300 **ADF P300**-330/480-UL_TCE83C--N1	**P300**	3phase-3wire, air cooled, Standalone Active Dynamic Filter
Current Rating (cur)		
cur ADF P300-**330**/480-UL_TCE83C--N1	**50, 75, 90, 110, 120, 130, 220, 240, 260, 330, 360, 390**	50/75/90/120/130/240/260/360/390 A rating on ADF P300 in particular 480 V versions
	90, 180, 270	90/180/270 A rating on ADF P300 in particular 690 V versions
Voltage Level (vol)		
vol ADF P300-330/**480**-UL_TCE83C--N1	**480**	Permissible voltage level: 208 – 480 V
	600	Permissible voltage level: 480 – 600 V (UL/cUL only)
	690	Permissible voltage level: 480 – 690 V
Certification (-UL)		
-UL ADF P300-330/480**-UL**_TCE83C--N1	**-UL**	If present in the model string, UL/cUL approval is present. If not present, IEC/CE approval.
Options (ABCDEFGH)		
Grounding System (A)		
A ADF P300-330/480-UL_**T**CE83C--N1	**T**	TN/TT grounding system (standard if not otherwise specified)
	I	IT grounding system
Multi-master (B)		
B ADF P300-330/480-UL_T**C**E83C--N1	**C**	Multi-master option included
HMI (C)		
C ADF P300-330/480-UL_TC**E**83C--N1	**B**	Basic HMI with PIB only
	E	Extended HMI with PIB and 4.3'' color touchscreen
Cabinet width (D)		
D ADF P300-330/480-UL_TCE**8**3C--N1	**4/6/8**	Indicates cabinet width in hundreds of mm.
Number of modules (E)		
E ADF P300-330/480-UL_TCE8**3**C--N1	**1/2/3**	Indicates number of PPM modules mounted
Module type (F)		
F ADF P300-330/480-UL_TCE83**C**--N1	**A**	PPM300v2B-3-A-120/480
	B	PPM300v2B-3-A-120/480-IT
	C	PPM300v2-3-A-110/480-UL
	D	PPM300v2-3-A-90/600-UL
	E	PPM300v2-3-A-90/600-UL-IT
	F	PPM300v2-3-A-110/480-UL-IT
	G	PPM300v2-3-A-90/690
	H	PPM300v2-3-A-90/690-IT
	I	PPM300v2B-3-A-50/480
	J	PPM300v2B-3-A-50/480-IT
	K	PPM300v2B-3-A-75/480
	L	PPM300v2B-3-A-75/480-IT
	M	PPM300v2B-3-A-90/480
	N	PPM300v2B-3-A-90/480-IT
	O	PPM300v2B-3-A-150/480
	P	PPM300v2B-3-A-150/480-IT
	Q	PPM300v4-3-A-130/480
Reserved (unused) option codes (GH)		
GH ADF P300-330/480-UL_TCE83C**--**N1	**-**	**Currently not in use**
Protection class (IJ)		
IJ ADF P300-330/480-UL_TCE83C--**N1**	**22**	IP22 (IEC/CE systems only)
	43	IP43 (IEC/CE systems only)
	N1	UL Type 1 (UL/cUL systems only)

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, important information 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 4.6.1 and if possible, use separate CTs not shared with other equipment e.g. power quality meters.

Notice that an operation without current transformers is also possible. “Sensorless Control” is an optional operation mode.

Good earth connection is also important to achieve best results and electrical safety as described in the section 4.3.3.

It is important that any materials or method for connection used is within limits with respects to local safety regulations. Also make sure that appropriate fuses are 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 P25/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 below listed items are present in the package:

- ADF P300 Hardware Manual (1 199 459) (this document)
- The ADF P25/P100/P300 User Manual (1 199 172)
- Bag with distances, screws and cabinet key
- IP22 (UL Type 1) or IP43 roof

ATTENTION: Before unpacking and installing the Active Filter please read through the following pages THOROUGHLY to make sure that it is 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 act 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 system protected from dust and water ingression.

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

The ADF P300 must be lifted and moved according to the instructions in this section.

Start by removing part of freight box in such a way that the ADF P300 is accessible from all sides and top when lying on its back. Only the part of the freight box under the ADF P300 back is then left.

The Active Filter may only be lifted in the lifting lugs on top of the Active Filter. This is only possible without the IP22/IP43 roof. Also, the angle between the lifting wire and the top of the Active Filter must be minimum 60 degrees according to Figure 8. Protect the ADF P300 from scratching and other damages during lifting, by adding soft protective material between the ADF P300 and other objects.

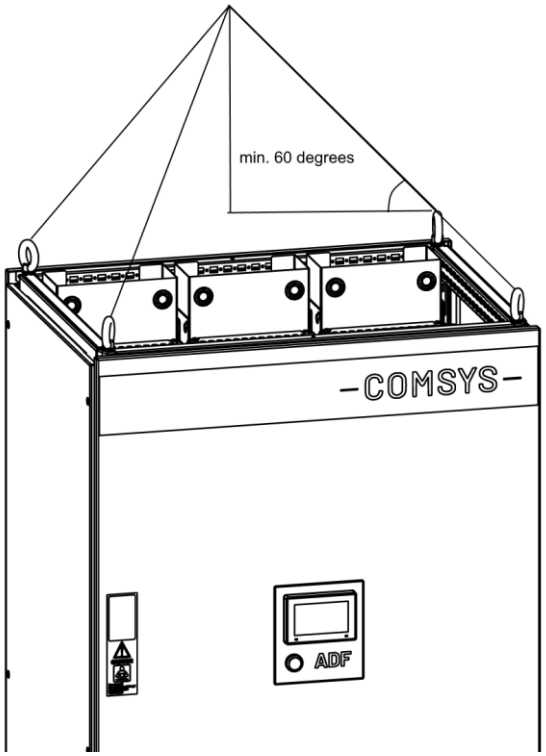


Figure 8: Correct lifting the Active Filter

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 location, the following steps has to be observed:

- Always keep the door closed on the cabinet, this to keep out dust and other particles that may harm the system.
- Cover up the air-outlet on the top of the filter

4.1.4 Mounting IP22/IP43 roof

The ADF P300 is always shipped without the IP22 (UL Type 1) or IP43 roof installed. This needs to be done after the ADF is placed it its final position.

Mounting IP22 (UL Type 1) roof:

- Loosen and remove all four lifting lugs from the top of the cabinet.
- Install the supplied standoff screws and distance bolts in the position shown in Figure 9.
- Place the IP22 roof on top of the distances.
- Install the supplied M12 screws through a plastic washer in each corner to secure the IP22 roof in place.

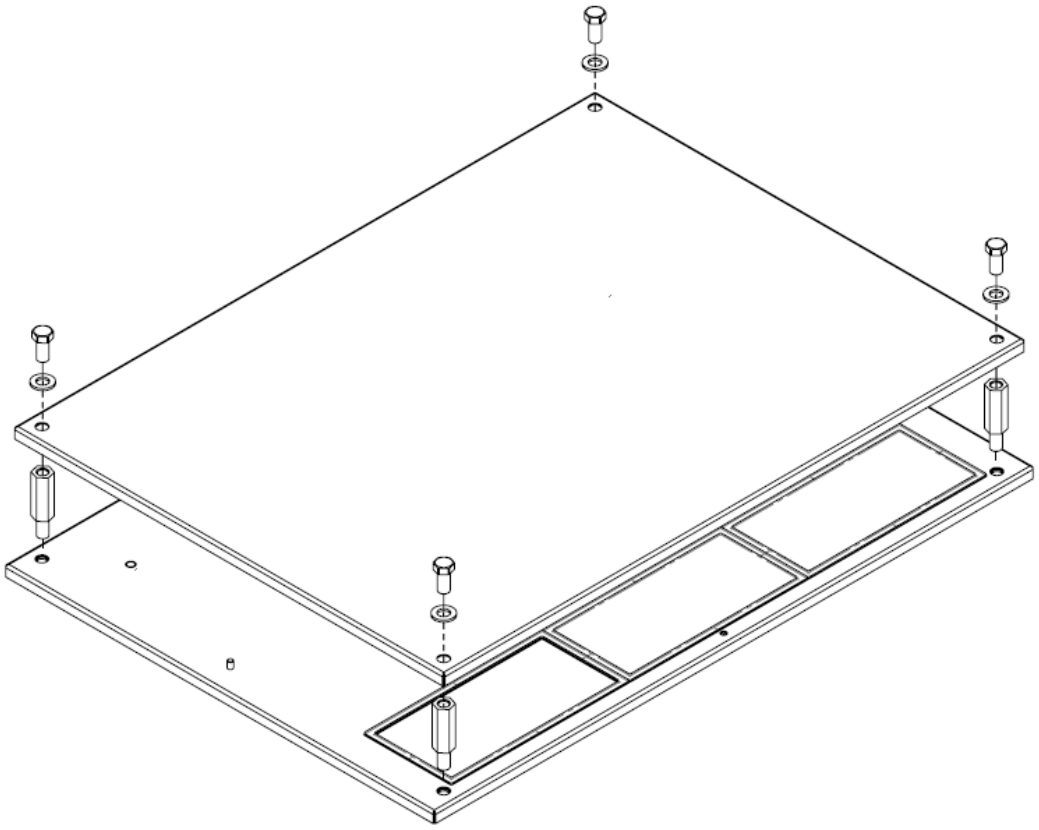


Figure 9: Active Filter IP22 (UL Type 1) roof installation

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

Mounting IP43 roof:

- Loosen and remove all four lifting lugs from the top of the cabinet.
- Place the IP43 roof over the PPM chimneys. Make sure the roof fits on the 4 bolts on the top of the cabinet.
- Mount the four supplied M12 bolts an four nylon washers.
- Cover the holes in the IP43 roof with the supplied rubber grommets.

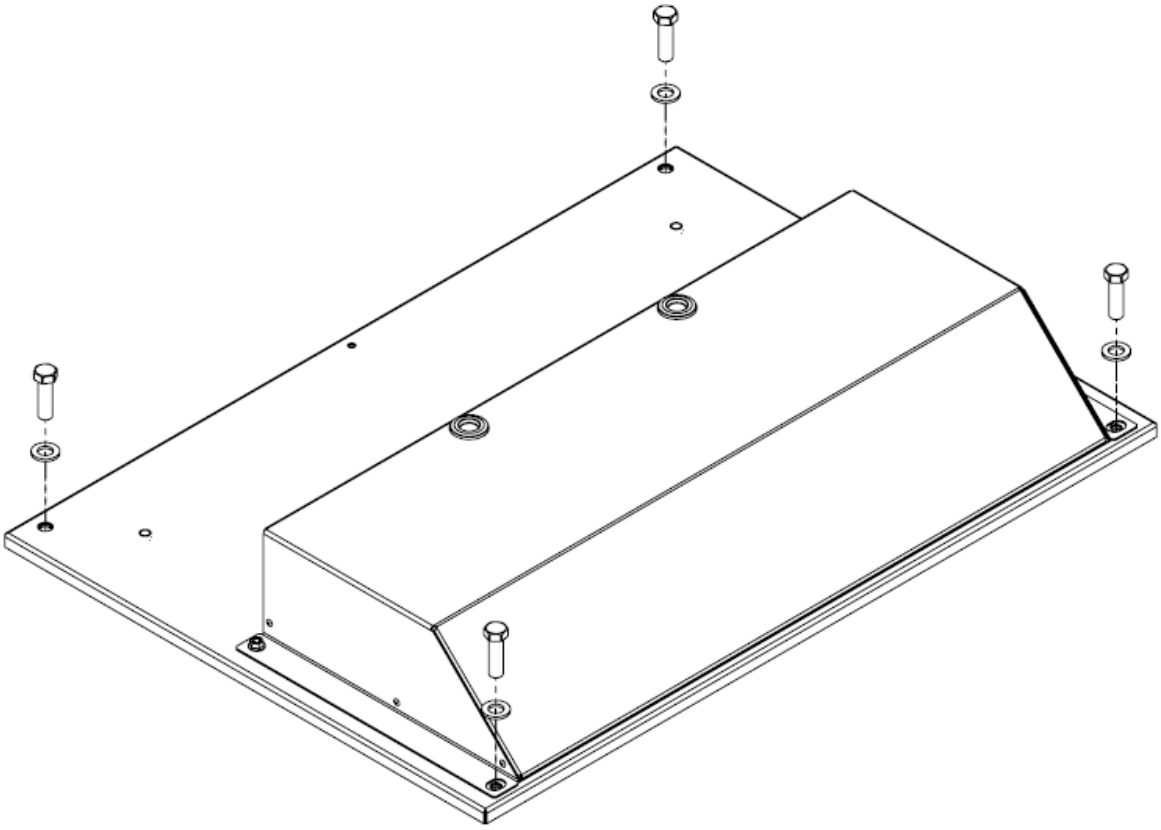


Figure 10: Active Filter IP43 roof installation

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 7: 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

4.1.6 Transport conditions

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

Table 8: 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 9: Maximum operating environmental conditions

Maximum operating environmental conditions	
Temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating
Relative humidity	Less than 95 %, non-condensing
Altitude	1000 m (3300 ft) Derating may be required at higher altitude. For more details, see “Appendix D Power derating”
Environmental conditions	Chemical class 3C3 Mechanical class 3S3

ATTENTION: 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 200 mm / 8” 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.

Local regulations may impose stricter demands.

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

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 10: Minimum air flow requirements

Model	Maximum air flow	Maximum losses
ADF P300-{50/75/90/110/120/130}/4xx	600 m^3/h / 353 cfm	see data sheet section at end of manual
ADF P300-{220/240/260}/4xx	1200 m^3/h / 706 cfm	
ADF P300-{330/360/390}/4xx	1800 m^3/h / 1056 cfm	
ADF P300-90/6xx	600 m^3/h / 353 cfm	
ADF P300-180/6xx	1200 m^3/h / 706 cfm	
ADF P300-270/6xx	1800 m^3/h / 1056 cfm	

It is crucial that the Active Filter can utilize the needed air flow during maximum operating conditions. The cooling air may not exceed 50 °C / 122 °F under any circumstances. Derating applies above 40 °C / 104 °F.

ATTENTION: Make sure that the ambient temperature is below 50 °C / 122 °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's main connector terminals are, X10 for the power interface, X11 for external user functionality and X12 for CT connections as seen in Figure 5. They 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.

4.3.1.1 Prior to any connection ADF P300

The following image shows the connection area for the ADF P300 products. The conduit entry is located at the gland plates covering the bottom inside area of the cabinet.

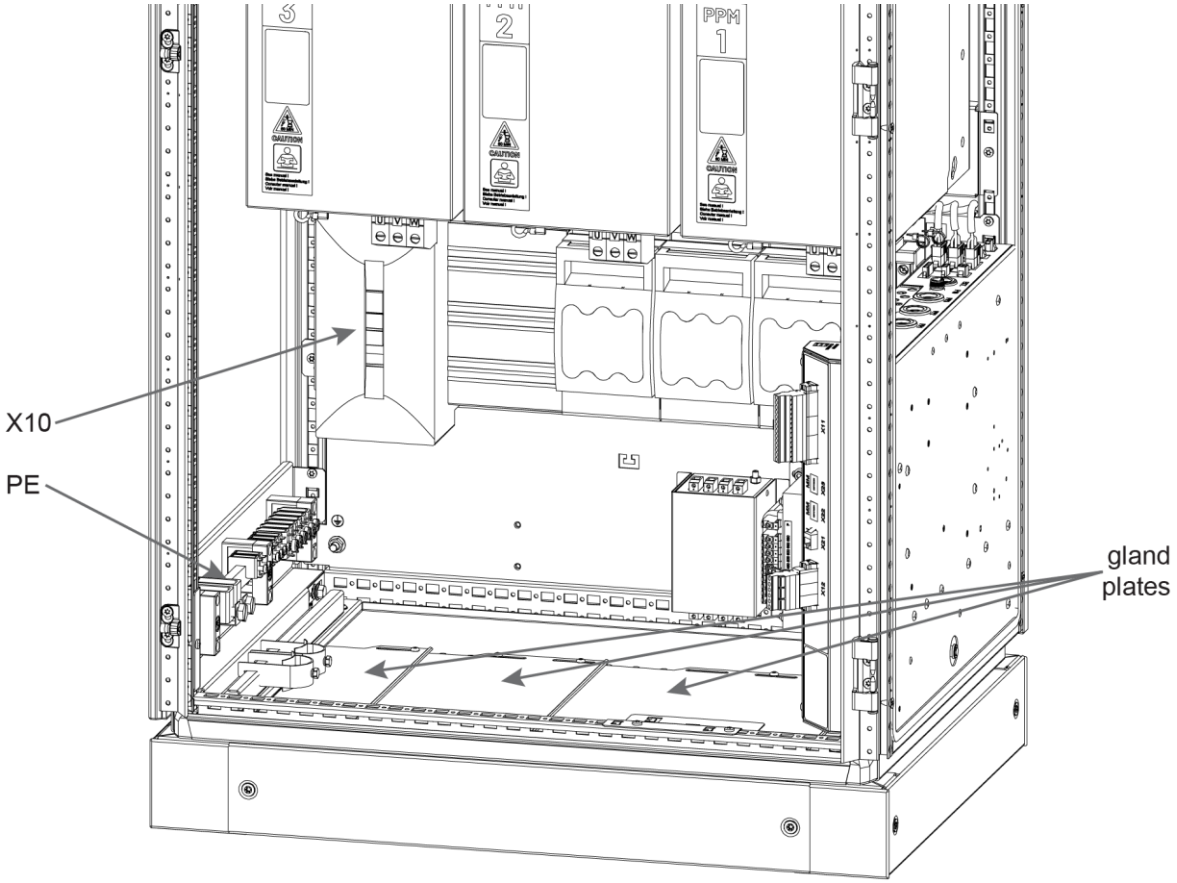


Figure 11: ADF P300 cabinet lower part overview

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 PPM1-PPM3. Note that X10 only accepts copper cables.

A second X10 can be added to the ADF. It can be ordered with the article number 100 430.

After connecting the cables, the plastic covers must be remounted.

The following work flow should be followed:

1. Make sure Q1…Q3 and F1 are open.
2. Mount the cabling using the appropriate accessories. Use a torque of 12 – 14 Nm.
3. 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.

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 11 are given as recommendations without warranty of suitability. The cables shall enter the cabinet from the bottom.

Table 11: Recommended cable sizes

Number of PPMs	Filter capacity	Derating factor
1	50 – 130 A_{RMS}	x 1,5
2	150 – 240 A_{RMS}	x 1,4
3	260 - 390 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.

ATTENTION: The dimensions given in Table 11 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 ADF P300-UL:

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

*) Using dual cables and connection boxes.

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 AWG 4/0 or 90º C for 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, 480 V versions) or 600 V (phase to phase, 600 V 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 ADF P300 UL/cUL version. The ADF P300 is rated 50 kAIC. Upstream branch protection must limit fault current to 50 kA.

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, 250 A, 690 V aR type, such as *Eaton Bussmann series 170M1571D*.

4.3.2.7 Auxiliary fuse (F1) selection

The Active Filter has internal fuse blocks for protection of the auxiliary power circuit. The fuse types are defined in the below table.

Table 12 Auxiliary fuse selection

Product line 480 V, IEC	**Fuse type**	**Brand example**
ADF P300, F1 fuse (3x)	Ferrule fuse link, 10x38, aM, 500VAC, 10A	Eaton Bussman series C10M10
Product Line 690 V, IEC		
ADF P300, F1 fuse (3x)	Ferrule fuse link, 10x38, gG, 690VAC, 10A	Mersen FR10GG69V10
Product Line 480/600 V UL/cUL		
ADF P300, F1 fuse (3x)	Ferrule fuse link, UL-approved class CC cat. JDDZ 10 A motor or transformer protection fuse	Eaton Bussman series LP-CC-10
F10 fuse (all products)		
ADF P300, F10 fuse (1x)	Miniature fuse link, UL Recognized, fast acting, 5x20, 250V, 10A	Mersen X090525

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 left inner side 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.

4.4 Auxiliary Transformer Setup

The ADF P300 includes an auxiliary transformer which supplies internal circuits with 230 V_{AC}. The auxiliary transformer is marked T101 in the previous figures. The transformer has standard taps for the following mains voltages: 208, 380, 415, 480, 525, 600, 660 and 690 V. In additions to this there is a +20 V tap to modify these voltages. Several different transformers are used for depending on size and voltage class of the product, target market and cabinet size.

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 tables 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.

Table 13: Auxiliary standard voltages

Cabinet type	Voltage rating	Transformer table below
400 mm IEC	208 – 480 V	Table 14
400 mm IEC	525 – 690 V	Table 15
600 or 800 mm IEC	208 – 690 V	Table 16
UL/cUL	380 – 480 V	Table 17
UL/cUL	525 – 600 V	Table 18

Table 14: Voltage range 208 – 500 V (400 mm IEC) (Tramo)

Nominal Primary	+20 V	0 V	208 V	380 V	415 V	480 V	P
Parking (default)		N					P
208 V		N	P				
230 V	N		P				
245 V	N		P				
380 V		N		P			
400 V	N			P			
415 V		N			P		
440 V	N				P		
460 V		N				P	
480 V		N				P	

Table 15: Voltage range 525 – 690 V (400 mm IEC) (Tramo)

Nominal Primary	+20 V	0 V	525 V	600 V	660 V	690 V	P
Parking (default)		N					P
525 V		N	P				
550 V	N		P				
575 V		N		P			
600 V		N		P			
630 V		N			P		
660 V		N			P		
690 V		N				P	

Table 16: Voltage range 208 – 690 V (600 mm and 800 mm IEC) (Tramo)

Nominal Primary	+20 V	0 V	208 V	380 V	415 V	480 V	525 V	600 V	660 V	690 V	P
Parking (default)		N									P
208 V		N	P								
230 V	N		P								
245 V	N		P								
380 V		N		P							
400 V	N			P							
415 V		N			P						
440 V	N				P						
460 V		N				P					
480 V		N				P					
500 V	N					P					
525 V		N					P				
550 V	N						P				
575 V		N						P			
600 V		N						P			
630 V	N							P			
660 V		N							P		
690 V		N								P	

Table 17: Voltage range 380 – 480 V (UL/cUL) (Noratel)

Nominal Primary	+20 V	0 V	-20 V	400 V	460 V	P
Parking (default)		N				P
380 V			N	P		
400 V		N		P		
420 V	N			P		
440 V			N		P	
460 V		N			P	
480 V	N				P	

Table 18: Voltage range 480 – 600 V (UL/cUL) (Noratel)

Nominal Primary	+25 V	0 V	-25 V	500 V	575 V	P
Parking (default)		N				P
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 wire from the parking terminal to the appropriate terminal.

4.5 User signal interface (X11)

The external interface terminal block X11 (see section 2.2.2.11) is the connection for digital inputs, digital outputs and alarm output.

Table 19: External interface terminal X11

Terminal No	Description
X11:1	Digital IN1 NO, 24 V_{DC}
X11:2	Digital IN2 NO, 24 V_{DC}
X11:3	Digital IN3 NO, 24 V_{DC}
X11:4	Digital IN4 NO, 24 V_{DC}
X11:5	COM GND
X11:6	Digital OUT1 NO
X11:7	Digital OUT1 COM
X11:8	N/A
X11:9	N/A
X11:10	Digital OUT3 NO
X11:11	Digital OUT3 COM
X11:12	Alarm relay NO
X11:13	Alarm relay COM
X11:14	PE

The digital outputs Alarm relay and Digital output OUT1 are of the following specification:

- Switches 5 A at 250 V_{AC}/30 V_{DC}, resistive load

Do not connect external signal voltages greater than 230 V_{AC} to the digital outputs.

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

Table 20: ADF user signal connection data

ADF user signal connection data	
Conductor cross section solid min.	0.14 mm^2 / AWG 26
Conductor cross section solid max.	4 mm^2 / AWG 12
Conductor cross section stranded min.	0.14 mm^2 / AWG 26
Conductor cross section stranded max.	4 mm^2 / AWG 12
Stripping length	9 mm
Torque	0.5 – 0.6 Nm

4.6 Current transformer terminals (X12)

Current transformers are connected to terminal block X12:1 – X12:6 (see section 2.2.2.12).

CT’s are not needed in all installations. The optional Sensorless Control operates without the need of CT’s. In Current Control (standard), CT’s are required.

The terminal block X12 provides a short circuit possibility for the incoming cable. The short circuit needs to be removed before operating and can be placed on the parking on the CM-CAB.

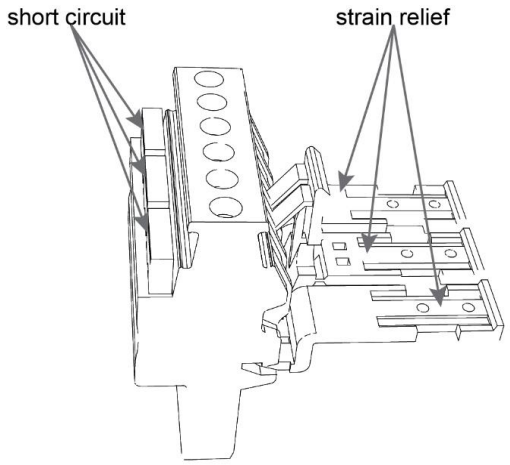


Figure 12: X12 terminals; with closed short circuit

Table 21: External interface terminals X12

Terminal No	Description
X12:1	S1 (k), Current transformer U (L1)
X12:2	S2 (l), Current transformer U (L1)
X12:3	S1 (k), Current transformer V (L2)
X12:4	S2 (l), Current transformer V (L2)
X12:5	S1 (k), Current transformer W (L3)
X12:6	S2 (l), Current transformer W (L3)

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

- Switches 5 A at 250 V_{AC}/30 V_{DC}, resistive load

Do not connect external signal voltages greater than 230 V_{AC} to the digital outputs.

ATTENTION: The cable used for X12 CT terminals in UL/cUL systems must be rated for at least 60º C.

Table 22: ADF CT connection data

ADF CT connection data	
Conductor cross section solid min.	0.14 mm^2 / AWG 26
Conductor cross section solid max.	6 mm^2 / AWG 10
Conductor cross section stranded min.	0.14 mm^2 / AWG 26
Conductor cross section stranded max.	6 mm^2 / AWG 10
Stripping length	9 mm
Torque	0.6 – 0.8 Nm

4.6.1 Current transformer connection

Current transformers are connected to terminal block X12:1 – X12:6 in the bottom of the cabinet (see Figure 6). It is possible to short circuit the CT circuit. Observe that the CT circuit is shorted by default (see Figure 12). The short-circuit must be removed before operating.

CT’s are not needed in all installations. The optional sensorless control operates without the need of CT’s. In Current Control (standard), CT’s are required.

4.6.1.1 Selection of current transformers

The current transformers should fulfill the following specification:

Table 23: 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 when operating in current control. Using a very large CT in relation to the total load size will result in poor resolution and hence poor results.

ATTENTION: Current Transformers with 5 A secondary must be used. CTs with 1 A secondary will give a too low measurement resolution.

4.6.1.2 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 24 shows the need required burden in relation to the cable size and length for some examples.

Table 24: Burden as function of cable size and length

	5 m	10 m	20 m	30 m	50 m	100 m	160 m
0.5 mm²	4.4 VA	8.6 VA	17.0 VA	25.4 VA	42.2 VA	84.2 VA	134.6 VA
0.8 mm²	3.0 VA	5.8 VA	11.4 VA	17.0 VA	28.2 VA	56.2 VA	89.8 VA
1.0 mm²	2.3 VA	4.4 VA	8.6 VA	12.8 VA	21.2 VA	42.2 VA	67.4 VA
1.5 mm²	1.6 VA	3.0 VA	5.8 VA	8.6 VA	14.2 VA	28.2 VA	45.0 VA
2.5 mm²	1.1 VA	1.9 VA	3.6 VA	5.3 VA	8.6 VA	17.0 VA	27.1 VA
4.0 mm²	0.8 VA	1.3 VA	2.3 VA	3.4 VA	5.5 VA	10.7 VA	17.0 VA
6.0 mm²	0.6 VA	0.9 VA	1.6 VA	2.3 VA	3.7 VA	7.2 VA	11.4 VA

4.6.1.3 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.

Beside the current control in, in open and closed loop, the ADF systems also support the optional Sensorless Control.

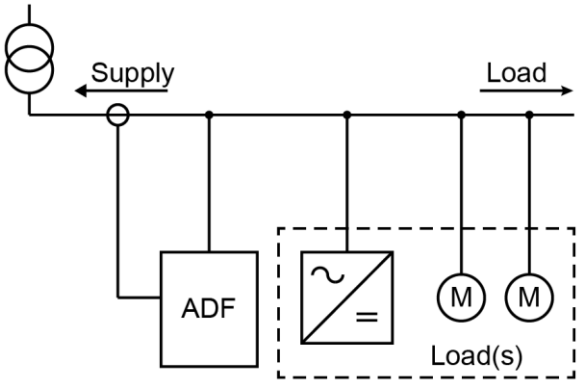


Figure 13: Current Transformer placement diagram – closed loop

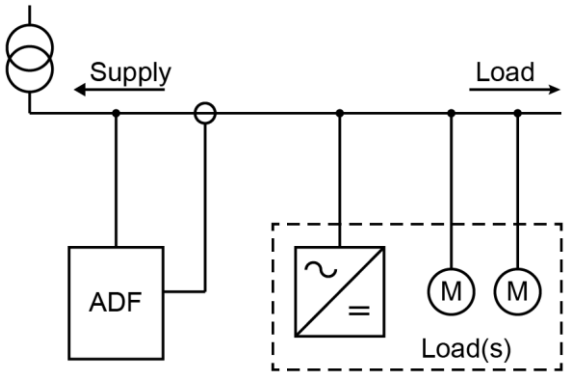


Figure 14: Current Transformer placement diagram – open loop

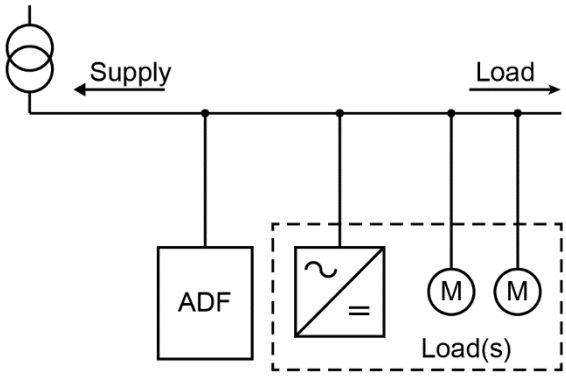


Figure 15: No current transformer in Sensorless Control

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.

4.6.1.4 Connection and wiring of current transformers

- The S1 (k) terminal of each CT must be oriented to the supply side. The S2 (l) 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 L1 (U) on X12 must monitor the current corresponding to phase L1 (U) of the network line connection on X10.
- The phases must be connected in proper rotation. V must lag U, W must lag V and U must lag W.
- Either S1 (k) or S2 (l) must be individually connected to PE (Protective Earth). The connection must be performed identically for each CT.
- The connection is made to terminal block X12:1 through X12:6.
- 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 25.

Table 25: CT connection table

Phase	Current transformer	Terminal block
U / Phase L1	S1 (k)	X12:1
	S2 (l)	X12:2
V / Phase L2	S1 (k)	X12:3
	S2 (l)	X12:4
W / Phase L3	S1 (k)	X12:5
	S2 (l)	X12:6

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

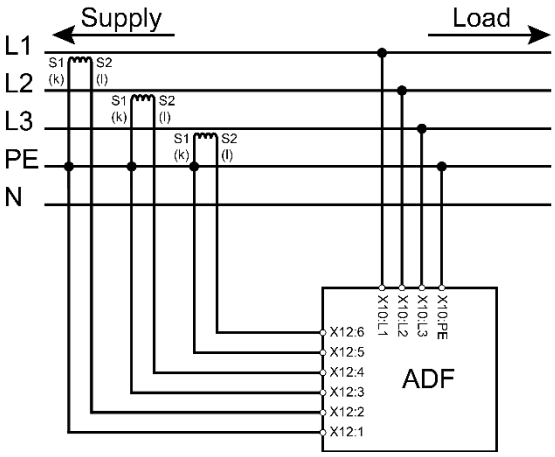


Figure 16: Current Transformer connection diagram – closed loop

4.6.1.5 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:

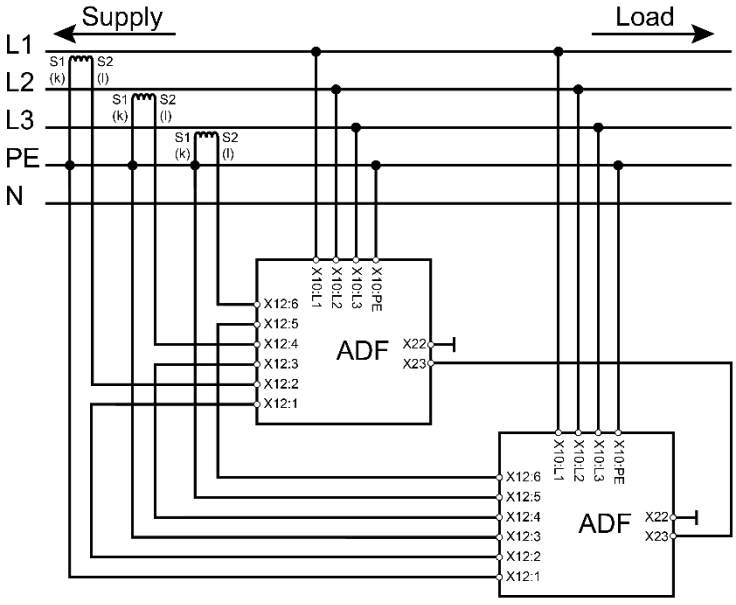


Figure 17: Current Transformer connection diagram – paralleled units

4.6.1.6 Use of summation current transformers

Summation current 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 current 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 X12 terminal block.

4.6.2 Local area network (X21)

The RJ45 LAN socket allows connection to the SCC2 control computer and is used for configuration and monitoring of the ADF via a standard Ethernet network or directly from a PC. Optional this RJ45 also supports Modbus. Please see the User Manual for more information on how to connect to the ADF.

For fixed installations, Comsys suggests using a shielded Ethernet cable.

4.6.3 Multi-master bus (X22 & X23; optional)

The RJ45 MM-bus sockets are used for inter-ADF communication for example when several ADFs are operated in parallel in Multi-master operation. ADFs are connected as a daisy-chain with termination plugs in each end of the chain like shown in figure below. X22 and X23 are freely interchangeable.

Figure 18: Example setup for Multi-master operation

A "FTP category 5" or better Network cable can be used to connect ADF's to each other. The maximum length of the entire cable is 100 m / 328 ft.

ATTENTION: The electrical interface of the RJ45 MM-bus connectors is different from that of the LAN. Be sure to only connect equipment approved by Comsys on this bus or equipment damage may result.

5 Maintenance

The following chapter covers routine maintenance of all ADF P300 versions.

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.

5.1 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

5.1.1 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.

5.1.2 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.

5.1.3 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 PPMs to the main bus bar (Q1…Q3)
- DC link fuses
- Auxiliary fuse block (F1, F10)

5.1.4 Cooling system

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.

5.1.5 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.

5.1.6 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.

5.1.7 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.

Appendix A Technical Specifications

A.1 Technical Data – ADF P300-XXX/480 (v2B; 50, 75, 90, 150 A)

Table 26: Technical specifications ADF P300-XXX/480 (50, 75, 90, 150 A)

Characteristics					
Model	ADF P300-50/480	ADF P300-75/480	ADF P300-90/480	ADF P300-150/480	ADF P300-300/480
Rated power (400 / 480 V)	35 / 42 kVA	52 / 62 kVA	62 / 75 kVA	104 / 125 kVA	208 / 249 kVA
Compensation current capacity at 50/60 Hz	50 A_{RMS}	75 A_{RMS}	90 A_{RMS}	150 A_{RMS}	300 A_{RMS}
System voltage	208 – 480 V				
Nominal frequency	45 – 65 Hz (Including floating frequency)				
Number of phases	3 phase 3 wire				
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	Up to 15 ADF P300 units can be used in parallel*				
Response time	< 1 ms				
Heat dissipation	< 1600 W	< 2535 W	< 3180 W	< 3225 W	< 6250
Maximum air flow requirement	600 m^3/h / 353 cfm				1200 m^3/h / 706 cfm
Noise level	< 70 dB (A)				
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m / 3281 ft without derating				
Operating temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating				
Dimensions (W x D x H)	405 x 2168 x 636 mm 15.9 x 85.4 x 25 inch				605 x 2168 x 636 mm 23.8 x 85.4 x 25 inch
Weight	335 kg / 739 lbs			346 kg / 763 lbs	494 kg / 1089 lbs
Enclosure color	cabinet RAL 7035 (light grey), base RAL 7022 (umbra grey)				
Protection class	IP22, IP43* according to IEC 60529, other ratings upon request				
Environmental conditions	chemical 3C3, mechanical 3S3				
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4. Conducted emission EN 55011 class A1				
Certificates	CE, DNV GL				

* Option

A.2 Technical Data – ADF P300-XXX/480 (v2B; 120 A)

Table 27: Technical specifications ADF P300-XXX/480 (v2B modules, 120 A)

Characteristics			
Model	ADF P300-120/480	ADF P300-240/480	ADF P300-360/480
Rated power (400 / 480 V)	83 / 100 kVA	166 / 200 kVA	249 / 299 kVA
Compensation current capacity at 50/60 Hz	120 A_{RMS}	240 A_{RMS}	360 A_{RMS}
System voltage (± 10%)	208 – 480 V		
Nominal frequency	45 – 65 Hz (Including floating frequency)		
Number of phases	3 phase 3 wire		
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	Up to 15 ADF P300 units can be used in parallel*		
Response time	< 1 ms		
Heat dissipation	< 2725 W	< 5325 W	< 7925 W
Maximum air flow requirement	600 m^3/h / 353 cfm	1200 m^3/h / 706 cfm	1800 m^3/h / 1056 cfm
Noise level	< 70 dB (A)		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m / 3281 ft without derating		
Operating temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating		
Dimensions (W x D x H)	405 x 2168 x 636 mm 15.9 x 85.4 x 25 inch	605 x 2168 x 636 mm 23.8 x 85.4 x 25 inch	805 x 2168 x 636 mm 31.7 x 85.4 x 25 inch
Weight	335 kg / 739 lbs	472 kg / 1041 lbs	609 kg / 1343 lbs
Enclosure color	cabinet RAL 7035 (light grey), base RAL 7022 (umbra grey)		
Protection class	IP22, IP43* according to IEC 60529, other ratings upon request		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4. Conducted emission EN 55011 class A1		
Certificates	CE, DNV GL		

* Option

A.3 Technical Data – ADF P300-XXX/480 (v4)

Table 28: Technical specifications ADF P300-XXX/480 (v4 modules)

Characteristics			
Model	ADF P300-130/480	ADF P300-260/480	ADF P300-390/480
Rated power (400 / 480 V)	90 kVA / 108 kVA	180 kVA / 216 kVA	270 kVA / 324 kVA
Compensation current capacity at 50/60 Hz	130 A_{RMS}	260 A_{RMS}	390 A_{RMS}
System voltage	208 – 480 V		
Nominal frequency	45 – 65 Hz (Including floating frequency)		
Number of phases	3 phase 3 wire		
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	Up to 15 ADF P300 units can be used in parallel*		
Response time	< 1 ms		
Heat dissipation	< 2290 W	< 4580 W	< 6870 W
Maximum air flow requirement	600 m^3/h / 353 cfm	1200 m^3/h / 706 cfm	1800 m^3/h / 1056 cfm
Noise level	< 70 dB (A)		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m / 3281 ft without derating		
Operating temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating		
Dimensions (W x D x H)	405 x 2168 x 636 mm 15.9 x 85.4 x 25 inch	605 x 2168 x 636 mm 23.8 x 85.4 x 25 inch	805 x 2168 x 636 mm 31.7 x 85.4 x 25 inch
Weight	335 kg / 739 lbs	472 kg / 1041 lbs	609 kg / 1343 lbs
Enclosure color	cabinet RAL 7035 (light grey), base RAL 7022 (umbra grey)		
Protection class	IP22, IP43* according to IEC 60529, other ratings upon request		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4. Conducted emission EN 55011 class A1		
Certificates	CE		

* Option

A.4 Technical Data – ADF P300-XXX/690 (v2)

Table 29: Technical specifications ADF P300-XXX/690 (v2 modules)

Characteristics			
Model	ADF P300-90/690	ADF P300-180/690	ADF P300-270/690
Rated power (600 / 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	208 – 690 V	
Nominal frequency	45 – 65 Hz (Including floating frequency)		
Number of phases	3 phase 3 wire		
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	Up to 15 ADF P300 units can be used in parallel*		
Response time	< 1 ms		
Heat dissipation	< 2540 W	< 5080 W	< 7620 W
Maximum air flow requirement	600 m^3/h / 353 cfm	1200 m^3/h / 706 cfm	1800 m^3/h / 1056 cfm
Noise level	< 70 dB (A)		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m / 3281 ft without derating		
Operating temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating		
Dimensions	405 x 2168 x 636 mm 15.9 x 85.4 x 25 inch	605 x 2168 x 636 mm 23.8 x 85.4 x 25 inch	805 x 2168 x 636 mm 31.7 x 85.4 x 25 inch
Weight	351 kg / 774 lbs	495 kg / 1092 lbs	639 kg / 1409 lbs
Enclosure color	cabinet RAL 7035 (light grey), base RAL 7022 (umbra grey)		
Protection class	IP22, IP43* according to IEC 60529, other ratings upon request		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4. Conducted emission EN 55011 class A1		
Certificates	CE, DNV GL		

* Option

A.5 Technical Data – ADF P300-XXX/XXX-UL (v2 UL/cUL)

Table 30: Technical specifications ADF P300-XXX/480 (v2 UL/cUL modules)

Characteristics			
Model	ADF P300-110/480-UL (ADF P300-90/600-UL)	ADF P300-220/480-UL (ADF P300-180/600-UL)	ADF P300-330/480-UL (ADF P300-270/600-UL(
Rated power (400 / 480 / 600 V)	76 / 91 / 94 kVA	152 / 183 / 187 kVA	229 / 274 / 281 kVA
Compensation current capacity at 50/60 Hz	110 A_{RMS} (90 A_{RMS})	220 A_{RMS} (180 A_{RMS})	330 A_{RMS} (270 A_{RMS})
System voltage	380 – 600 V		
Nominal frequency	45 – 65 Hz (Including floating frequency)		
Number of phases	3 phase 3 wire		
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	Up to 15 ADF P300 units can be used in parallel*		
Response time	< 1 ms		
Heat dissipation	< 2480 W (< 2836 W)	< 4835 W (< 5547 W)	< 7190 W (< 8258 W)
Maximum air flow requirement	600 m^3/h / 353 cfm	1200 m^3/h / 706 cfm	1800 m^3/h / 1056 cfm
Noise level	< 70 dB (A)		
Environment	0 to 95 % RH non-condensing, max. altitude 1000 m / 3281 ft without derating		
Operating temperature	0 °C to 50 °C, up to 40 °C without derating 32 °F to 122 °F, up to 104 °F without derating		
Dimensions (W x D x H)	405 x 2168 x 636 mm 15.9 x 85.4 x 25 inch	605 x 2168 x 636 mm 23.8 x 85.4 x 25 inch	805 x 2168 x 636 mm 31.7 x 85.4 x 25 inch
Weight	335 kg / 739 lbs 351 kg / 774 lbs	472 kg / 1041 lbs 495 kg / 1092 lbs	609 kg / 1343 lbs 639 kg / 1409 lbs
Enclosure color	cabinet RAL 7035 (light grey), base RAL 7022 (umbra grey)		
Protection class	UL Type 1		
Environmental conditions	chemical 3C3, mechanical 3S3		
Electromagnetic compatibility	EN 61000-6-2, EN 61000-6-4. Conducted emission EN 55011 class A1		
Certificates	UL/cUL (UL508/CSA22.2)		

* Option

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 the impedance of capacitors falls with rising frequency and hence capacitors 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 19 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.

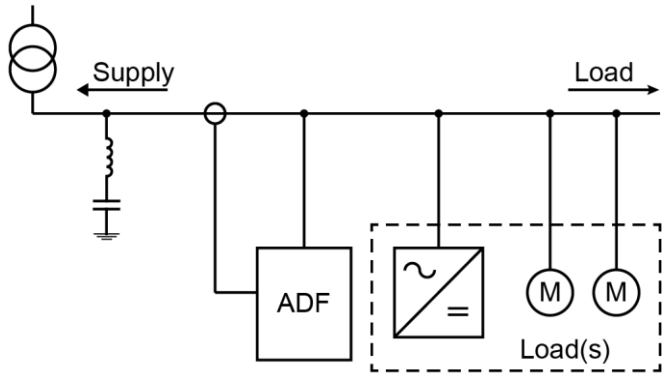


Figure 19: Connection of an Active Filter unit, passive compensation, and location of CTs.

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 applications, requiring very high harmonic current in high harmonic orders, special care must be taken. A rating of 120 A_{RMS} does not imply that the unit can output 120 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 to not shorten component lifetime.

The following table can be used to determine the maximum individual current, as percentage of the rated maximum compensation current:

Table 31: Maximum current output on single harmonics

h	Output (%)	h	Output (%)	h	Output (%)
1	100 %	19	60 %	37	40 %
3	100 %	21	55 %	39	35 %
5	100 %	23	55 %	41	35 %
7	100 %	25	50 %	43	35 %
9	90 %	27	45 %	45	30 %
11	80 %	29	45 %	47	30 %
13	75 %	31	40 %	49	30 %
15	70 %	33	40 %		
17	65 %	35	40 %		

In the given table, h is the harmonic order. For a unit rated at 120 A_{RMS}, the maximum current of the 23rd harmonic is consequently 66 A_{RMS}.

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:

$$I_{h,contrib} = I_h / OUT(\%,h)$$

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 100 A_{RMS} at the 5th harmonic and 60 A_{RMS} at 7th harmonic. The individual contributions are $I_{5,contrib}$ = 100 A_{RMS} / 100 % = 100 A_{RMS} for fifth harmonic and $I_{7,contrib}$ = 60 A_{RMS} / 100 % = 60 A_{RMS} for the seventh harmonic. The RMS sum of the two components are 116.6 A_{RMS}. Thus, a 120 A unit will be sufficient to compensate the load. Adding an 11th harmonic of 50 A_{RMS} adds an equivalent contribution of 62.5 A_{RMS} yielding a total needed capacity of 132.3 A_{RMS} which will not work in a 120 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 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 49th harmonic.

Appendix D Power derating

D.1 Altitude derating

The current rating of the ADF units is specified up to an altitude of 1000 m / 3281 ft. At higher altitudes the current rating will be reduced.

When using an ADF P300 on altitudes above 1000 m / 3281 ft, the maximum output will be derated according to the following:

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

Altitude derating [%] = (h – 3281) / 328 (h = height in feet)

For example, at an altitude of 1500 m, the derating will be 5 %. In this case the compensation capacity of an ADF P300-120/480 will be derated from 120 A_{RMS} to 114 A_{RMS}.

D.2 Overtemperature derating

The ADF P300 loses 1.5 % of output current per degree Celsius (per two degrees Fahrenheit) over 40 °C/104 °F. At 50 °C/122 °F, the output current is reduced 15 %.

The system will trip at 55 °C/131 °F. Temperature derating is automatic and only uses sensors present in the ADF P300 system.

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