

# Altivar AFE

Active Front End

Option for Altivar 61 & Altivar 71

## Configuration guide for 120...860 kW

04/2010



# General remarks

The following symbols should assist you in handling the instructions:



Advice, tip !



General information, note exactly !

The requirements for successful commissioning are correct selection of the device, proper planning and installation. If you have any further questions, please contact the supplier of the device.

## Capacitor discharge !

Before performing any work on or in the device, disconnect it from the mains and wait at least 15 minutes until the capacitors have been fully discharged to ensure that there is no voltage on the device.

## Automatic restart !

With certain parameter settings it may happen that the Active Front End restarts automatically when the mains supply returns after a power failure. Make sure that in this case neither persons nor equipment is in danger.

## Commissioning and service !

Work on or in the device must be done only by duly qualified staff and in full compliance with the appropriate instructions and pertinent regulations. In case of a fault contacts which are normally potential-free and/or PCBs may carry dangerous voltages. To avoid any risk to humans, obey the regulations concerning "Work on Live Equipment" explicitly.

## Terms of delivery

The latest edition "General Terms of Delivery of the Austrian Electrical and Electronics Industry Association" form the basis of our deliveries and services.

## Specifications in this document

We are always anxious to improve our products and adapt them to the latest state of the art. Therefore, we reserve the right to modify the specifications given in this document at any time, particular those referring to weights and dimensions. All planning recommendations and connection examples are non-binding suggestions for which we cannot assume liability, particularly because the regulations to be complied depend on the type and place of installation and on the use of the devices. All foreign-language translations result from the German or English version. Please consider those in case of unclarity.

## Basis of contract

The specifications in text and drawings of this document are no subject of contract in the legal sense without explicit confirmation.

## Regulations

The user is responsible to ensure that the device and its components are used in compliance with the applicable regulations. It is not permitted to use these devices in residential environments without special measures to suppress radio frequency interferences.

## Trademark rights

Please note that we do not guarantee that the connections, devices and processes described herein are free from patent or trademark rights of third parties.

## Copyright

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## **Active Front End Altivar AFE**

### **Configuration guide for 120...860 kW**

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Product	Active Front End AFE
Brief description	The Active Front End is used to reduce the mains current harmonics as well as to return excess energy to the mains. Consequently it is possible to save energy by reducing the share of reactive power and the costs can be reduced because the accumulating energy is returned to the mains.
Power range	120...860 kW
Voltage ranges	3 AC 380...480 V (120...675 kW) 3 AC 480 V (120...675 kW) 3 AC 500...690 V (145...860 kW)
Mains frequency	50 / 60 Hz $\pm 5$ %
Interfaces	Removable operating panel, control terminals can be extended, fieldbus connection via Modbus or CANopen
Protection degree	Built-in units IP00
Components	Active Infeed Converter AIC Line Filter Module LFM Line Filter Choke LFC
Further reading	This catalogue contains all information about project planning and order of the Active Front End. Further information about mounting are given in the mounting instructions and information about parameterization in the Description of functions.

## The Active Front End allows energy regeneration

The Active Front End is an option for the frequency inverter to return energy to the mains.  
It provides 4-quadrant operation and thus it is well qualified for all applications with generator operating mode.



### Special features

The Active Front End is a supply and regeneration unit that provides a constant DC voltage supply independent of the load situation. At this DC bus one or several inverters can be operated. In this way up to four Active Front End units can be connected to this DC bar in parallel in order to improve the redundancy and to increase the total power.

### Mains interferences / mains conditions

- Power factor  $\cos \Phi$  1 independent of the load situation and the energy direction
- No converter transformer required
- Mains voltage drops up to 40 % without interruption of operation
- Wide mains frequency range permitted
- Adjustable regenerating power e.g. for operation with diesel generator
- Mains short circuit power up to 100 kA permitted

### Simple planning and installation

- Line contactor already integrated
- No external control voltage supply necessary
- Integrated charging circuit for max. fourfold power at the DC bus
- Operation independent of the phase sequence
- Optimised administration of spare parts due to equal components in the Active Infeed Converter and the inverter

### Energy-saving operation

- Energy regeneration to the supplying mains
- Improved efficiency due to innovative control system
- No damping resistors with heavy losses required and thus it is especially robust in respect of heavily distorted mains voltages.



### Typical applications

Crane applications (hoists, long-travels, ...)  
Downhill conveyors, winches, escalators  
Complex drive systems  
Test benches and high dynamic drives  
Pump / turbine combinations

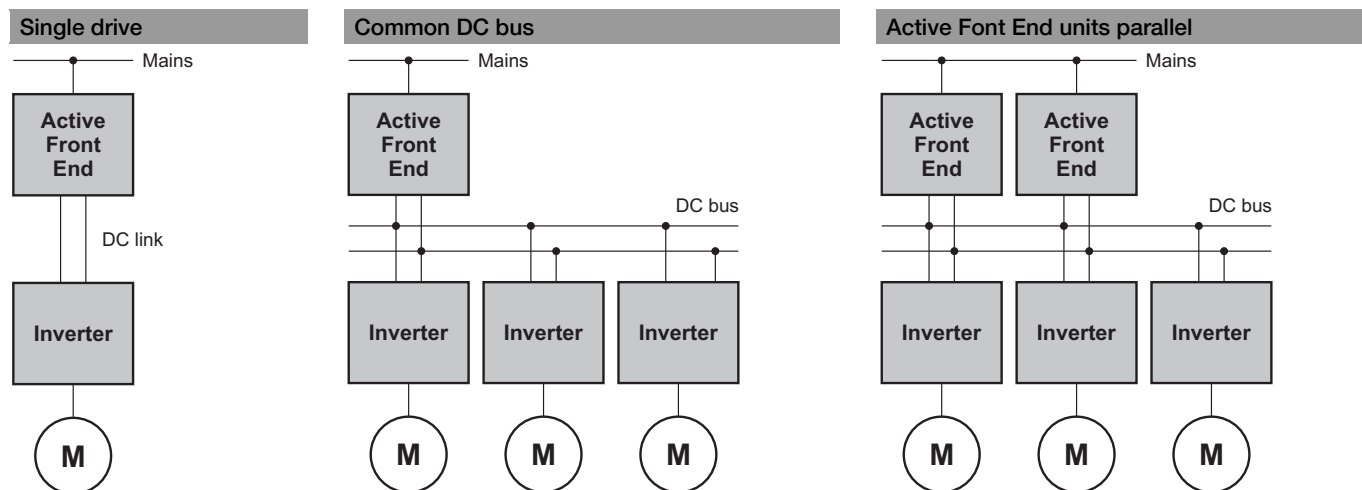
## Applications

The Active Front End is equipped with numerous integrated functions and thus it meets the sophisticated demands in industry, machine building and automation.

The design allows the simple use in combination with an inverter as well as building up a common DC bus for a multitude of drives.

The Active Front End is connected upstream to the standard frequency inverter and consists of three components:

- Active Infeed Converter
- Line Filter Module (EMC filter, line contactor and charging circuit)
- Line Filter Choke (3 parts)



When adding an Active Front End to a standard drive the arising energy (e.g. when lowering a load) is returned to the mains.

The supply via a common DC bus is often a perfect solution for group drives (e.g. at sheet metal processing machines, roller conveyors or test benches). In this case the total power of the inverters can be fourfold higher than the nominal power of the Active Front End.

The parallel connection of up to four Active Front End units is used to increase the safety by redundancy and furthermore it enables increase of power or the use of smaller Active Front End units.

## General technical data

Voltage / frequency	380...400 V / 440 V / 480 V $\pm 10$ %: 500...525 V $\pm 10$ %: 575...600 V / 690 V $\pm 10$ %:	50/60 Hz $\pm 5$ % (30...70 Hz for short periods) 50 Hz $\pm 5$ % 50/60 Hz $\pm 5$ % (30...70 Hz for short periods)
Overvoltage class	Category III	
Power range	120...860 kW	
Overload	+20 % for 60 seconds per 10 minutes	
Operating temperature	-10...+45 °C (+60 °C with derating)	
Protection degree	IP00	
Control concept	Controllable via terminals, CANopen bus or Modbus built-in	
Approvals	CE, in preparation: UL, CSA	

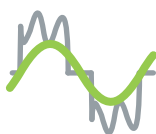
AFE-type 400V	120	145	175	240	275	340	430	540	675
AFE input current in A	177	212	255	348	395	495	628	780	980
DC power (400 V) in kW	120	143	172	238	268	336	425	530	665
AFE-type 480V	120	145	175	240-13	275	340	430-15	540-15	675
AFE input current in A	160	200	200	348	395	495	628	780	980
DC power (480 V) in kW	130	162	162	277	315	390	490	610	770
AFE-type 690V	145	175	220	275	340	430	540	675	860
AFE input current in A	120	150	185 (160) <sup>1)</sup>	228	285	360	450	563	715
DC power (500 V) in kW	102	127	157	193	242	305	382	478	607
DC power (600 V) in kW	123	153	162	230	290	365	460	575	730
DC power (690 V) in kW	142	172	215	268	335	424	528	663	842

1) only for DC-power (600 V)

## The Active Front End allows sinusoidal mains current

The Active Front End is used when drives should contain mains harmonics particularly low.

State-of-the-art components, a new control concept as well as a top-quality filter module reduce the total current distortion factor THD(i) to a value less than 4 %.



### Typical applications

Pumps  
Fans  
Conveyor belts  
Compressors

### Special features

In combination with the well-proven frequency inverters Altivar 61 & 71 the Active Front End represents a "Low Harmonic Drive" for almost all applications.

### Mains interferences / mains conditions

- THD(i) less than 4 %
- No converter transformer required
- Integrated radio frequency interference filter according to EN 61800-3 category C3
- Power factor  $\cos \Phi$  1 independent of the load situation and the energy direction
- Mains voltage drops up to 40 % without interruption of operation
- Wide mains frequency range permitted
- Operation at a diesel generator possible
- Mains short circuit power up to 100 kA permitted

### Simple planning and installation

- Line contactor already integrated
- No external control voltage supply necessary
- Operation independent of the phase sequence
- Optimised administration of spare parts due to equal components in the Active Infeed Converter and the inverter

### Energy-saving operation

- Improved efficiency due to innovative control system
- No damping resistors with heavy losses required and thus it is especially robust in respect of heavily distorted mains voltages.
- Reduction of transformer losses, wiring and switching devices

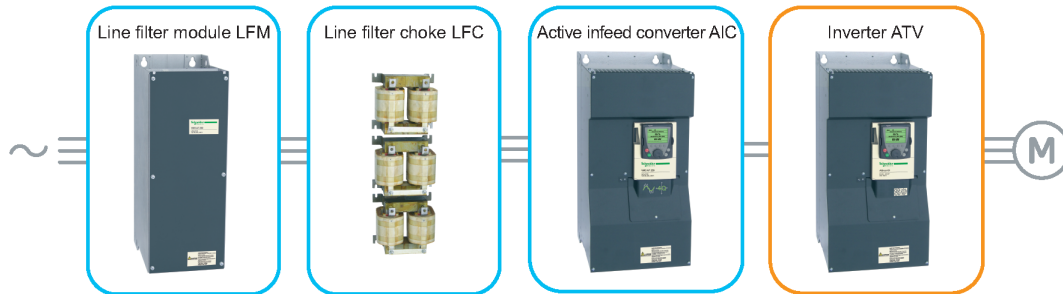


## Applications / capabilities / design

The Active Front End with quite simple construction is quickly set up. All control connections are pre-assembled and clearly marked. Usually it is sufficient to adjust the existing mains voltage for parameterization of the whole Active Front End.

The Active Front End is connected upstream to the standard frequency inverter and consists of three components:

- Active Infeed Converter
- Line Filter Module (EMC filter, line contactor and charging circuit)
- Line Filter Choke (3 parts)



## General technical data

Voltage / frequency	380...400 V / 440 V / 480 V $\pm 10\%$ : 500...525 V $\pm 10\%$ : 575...600 V / 690 V $\pm 10\%$ :	50/60 Hz $\pm 5\%$ (30...70 Hz for short periods) 50 Hz $\pm 5\%$ 50/60 Hz $\pm 5\%$ (30...70 Hz for short periods)
Overvoltage class	Category III	
Power range	120...860 kW	
Overload	+20 % for 60 seconds per 10 minutes	
Operating temperature	-10...+45 °C (+60 °C with derating)	
Protection degree	IP00	
Control concept	Controllable via terminals, CANopen bus or Modbus built-in, other field busses via option cards	
Standards	Devices are designed, built and tested on the basis of EN 61800-5-1	
Approvals	CE, in preparation: UL, CSA	

Inverter		Active Front End			
Altivar 71	Altivar 61	Type	AIC	LFM	LFC
up to ATV71HD90N4D	up to ATV61HC11N4D	400V 120kW	VW3A7250	VW3A7260	VW3A7265
ATV71HC11N4D	ATV61HC13N4D	400V 145kW	VW3A7251	VW3A7261	VW3A7266
ATV71HC13N4D	ATV61HC16N4D	400V 175kW	VW3A7252	VW3A7261	VW3A7266
ATV71HC16N4D	ATV61HC22N4D	400V 240kW	VW3A7253	VW3A7262	VW3A7267
ATV71HC20N4D	ATV61HC25N4D	400V 275kW	VW3A7254	VW3A7262	VW3A7267
ATV71HC25N4D	ATV61HC31N4D	400V 340kW	VW3A7255	VW3A7262	VW3A7267
ATV71HC28N4D...C31N4D	ATV61HC40N4D	400V 430kW	VW3A7256	2xVW3A7262	2xVW3A7267
ATV71HC40N4D	ATV61HC50N4D	400V 540kW	VW3A7257	2xVW3A7262	2xVW3A7267
ATV71HC50N4D	ATV61HC63N4D	400V 675kW	VW3A7258	2xVW3A7262	2xVW3A7267
up to ATV71HD90N4D	up to ATV61HC11N4D	480V 120kW	VW3A7250	VW3A7260	VW3A7265
ATV71HC11N4D	ATV61HC13N4D	480V 145kW	VW3A7251	VW3A7261	VW3A7266
ATV71HC13N4D	-	480V 175kW	VW3A7252	VW3A7261	VW3A7266
ATV71HC16N4D	ATV61HC16N4D...C22N4D	480V 240kW	VW3A7283	VW3A7262	VW3A7267
ATV71HC20N4D	ATV61HC25N4D	480V 275kW	VW3A7254	VW3A7262	VW3A7267
ATV71HC25N4D	ATV61HC31N4D	480V 340kW	VW3A7255	VW3A7262	VW3A7267
ATV71HC28N4D...C31N4D	ATV61HC40N4D	480V 430kW	VW3A7286	2xVW3A7262	2xVW3A7267
ATV71HC40N4D	ATV61HC50N4D	480V 540kW	VW3A7287	2xVW3A7262	2xVW3A7267
ATV71HC50N4D	ATV61HC63N4D	480V 675kW	VW3A7258	2xVW3A7262	2xVW3A7267
ATV71HC11Y <sup>1)</sup>	ATV61HC11 and HC13Y <sup>1)</sup>	690V 145kW	VW3A7270	VW3A7263	VW3A7268
ATV71HC13Y <sup>1)</sup>	ATV61HC16Y <sup>1)</sup>	690V 175kW	VW3A7271	VW3A7263	VW3A7268
ATV71HC16Y <sup>1)</sup>	ATV61HC20Y <sup>1)</sup>	690V 220kW	VW3A7272	VW3A7263	VW3A7268
ATV71HC20Y <sup>1)</sup>	ATV61HC25Y <sup>1)</sup>	690V 275kW	VW3A7273	VW3A7264	VW3A7269
ATV71HC25Y <sup>1)</sup>	ATV61HC31Y <sup>1)</sup>	690V 340kW	VW3A7274	VW3A7264	VW3A7269
ATV71HC31Y <sup>1)</sup>	ATV61HC40Y <sup>1)</sup>	690V 430kW	VW3A7275	VW3A7264	VW3A7269
ATV71HC40Y <sup>2)</sup>	ATV61HC50Y <sup>2)</sup>	690V 540kW	VW3A7276	2xVW3A7264	2xVW3A7269
ATV71HC50Y <sup>2)</sup>	ATV61HC63Y <sup>2)</sup>	690V 675kW	VW3A7277	2xVW3A7264	2xVW3A7269
ATV71HC63Y <sup>2)</sup>	ATV61HC80Y <sup>2)</sup>	690V 860kW	VW3A7278	2xVW3A7264	2xVW3A7269

1.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 1x

2.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 2x



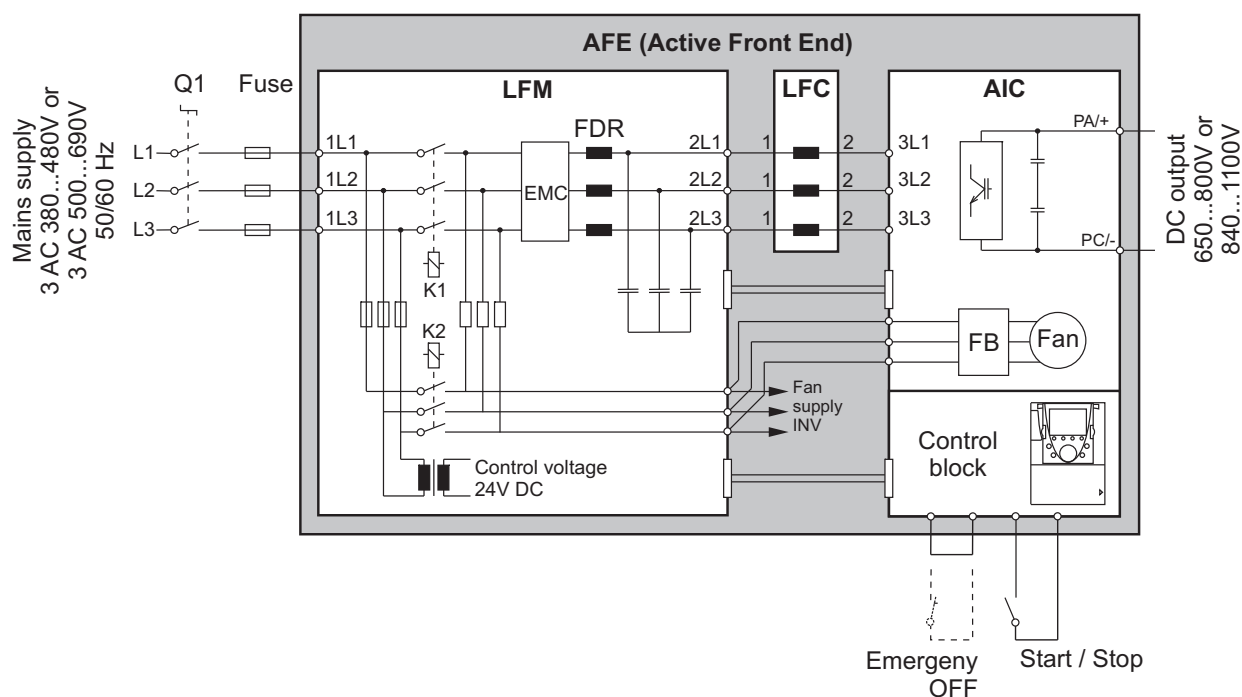
The Active Front End AFE is an option for the frequency inverters Altivar 61/71. With this option it is possible to return the braking energy to the mains. Therefore it enables a 4-quadrant operation of the drive (motor and generator operation in both directions of rotation).

The use of the Active Front End leads to a significant increase of the total system efficiency in the case of crane hoistings, test benches, winches and other drives with frequent generator load. On the other hand not only the environment is conserved but also the operating costs are reduced so that amortisation is often possible after a few months.

The Active Front End operates with high pulse frequency and carries a sinusoidal mains current. Therefore it represents next to the possibility of energy regeneration also an alternative for active and passive filters. By using the Active Front End the THD(i) of the frequency inverter is reduced to a value lower than 4 %.

The Active Front End AFE is connected in front of the frequency inverter and consists of several components:

- Line Filter Module LFM
- Line Filter Choke LFC
- Active Infeed Converter AIC



Already during the development of the individual components of the Active Front End a simple and safe installation and commissioning has been kept in mind. Therefore the line filter module LFM contains in addition to the real filter elements also all components of the charging circuit, the main contactor (= line contactor), the supply of all device fans and the required supply units for the control voltages. For the control connections between the individual components pre-assembled cables and robust connections are available.

## CAUTION

### PERMISSIBLE FREQUENCY INVERTERS

Only the following frequency inverters may be operated with the Active Front End AFE:

ATV61H075N4 ... HC63N4  
 ATV61HC11Y ... HC80Y  
 ATV61EX●●D90N4 ... M14N4  
 ATV61EX●●D90N ... M18N  
 ATV61EX●●C11Y ... M24Y

ATV71H075N4 ... HC50N4  
 ATV71HC11Y ... HC63Y  
 ATV71EX●●D90N4 ... M13N4  
 ATV71EX●●D90N ... M15N  
 ATV71EX●●C11Y ... M20Y

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

### Robustness of the Active Front End

Due to a new control concept the Active Front End operates independent of the applied rotary field. At the same time this control concept enables operation without damping resistors, whereby reliability is ensured also in case of distorted mains voltages and also the losses are significantly reduced.

The line filter module is suitable for operation at all mains up to a mains short-circuit current of 100 kA.

An EMC filter with EMC category C3 is integrated. For higher requirements an additional EMC filter can be connected upstream.

Our high degree of quality awareness ranges from the basic requests in the product specification over the development of the cooling system, of the mechanical design, of the electrical circuit diagram and the individual functions up to the production of the device. This quality level is also long-term guaranteed by means of the corresponding quality assurance systems in the individual business processes and is certified every year by independent authorities according to DIN EN ISO 9001:2000 and ISO 14001:2004.

### Low harmonic drive – 1:1 application

The Altivar 61/71 standard frequency inverter becomes a "Low Harmonic Drive" by connecting the Active Front End in series. By this way it reaches a THD(i) value smaller than 4 % and fulfills the requirements according to the recommendations in IEEE 519 to reduce the current harmonics in the mains.

Assembling and connecting all components to a complete drive is simply possible by pre-assembled connecting lines and a well-structured concept. Optimal presettings and a very simple control concept are the reason for blindingly easy commissioning.

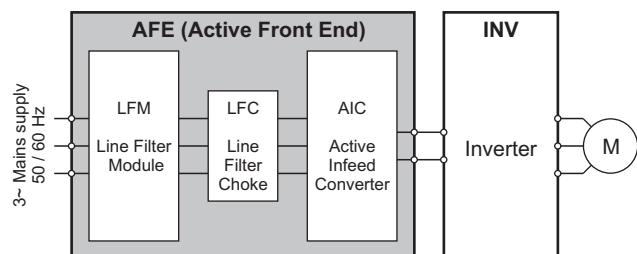
As the inverter and the Active Infeed Converter have similar hardware structure, about 90 % of the spare parts are identical.

No additional fuses are required in the DC link.

### 4-quadrant single drive – 1:1 application

For the 1:1 application typically one Active Front End AFE and one inverter INV (= standard frequency inverter Altivar 61/71) of same size are interconnected. Thus they form a fully-fledged 4-quadrant-drive with variable energy and speed direction. The accumulating generator energy e.g. due to lowering a load or braking of a drive is returned to the mains.

Changing from motor to generator operation occurs completely shock-free, with any frequency and duration. For instance, a downhill conveyor often works in a permanent interplay of the load affected by the current load of the conveyor. Also a 24-hours continuous operation in generator power range is no problem for the Active Front End.



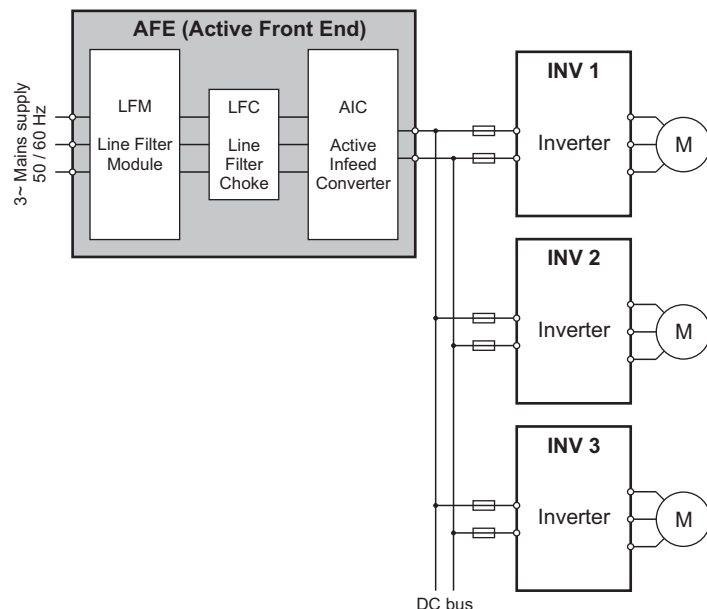
In case of the 1:1 application the Active Infeed Converter is connected with the inverter only via the DC link.

Therefore no additional fuses are required in the DC link.

As the inverter and the Active Infeed Converter have similar hardware structure, about 90 % of the spare parts are identical.

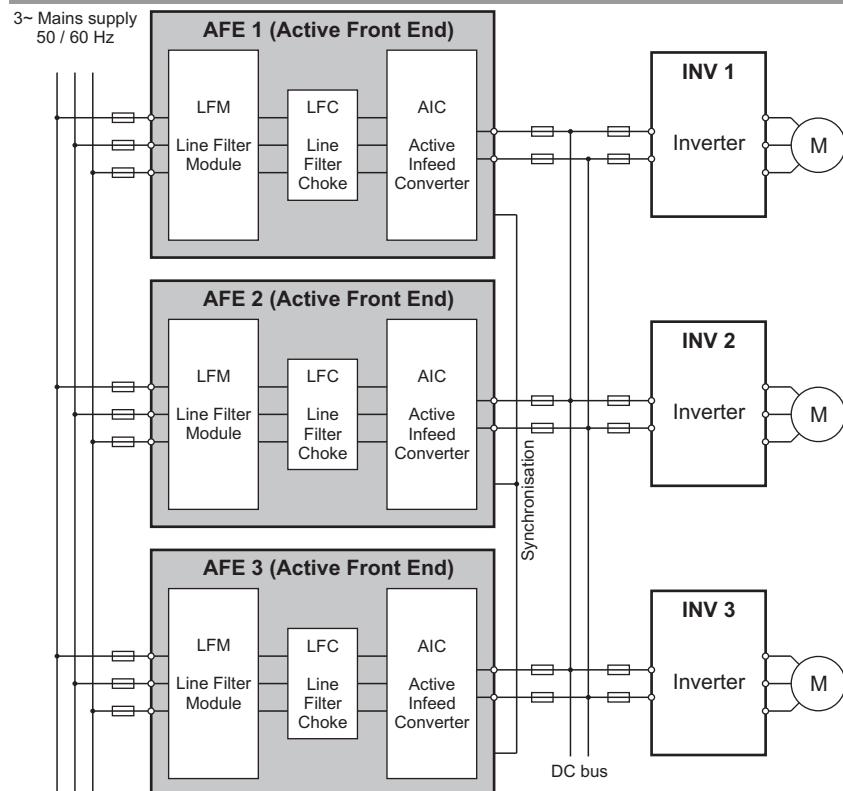
### Common DC bus – 1:n application

Additionally to the single drive it is possible to supply several inverters with an Active Front End via a common DC link (1:n configuration). Common applications are e.g. group drives in sheet metal processing machines, roller conveyors and motor test benches. Thereby the Active Front End supplies energy into the DC bus or feeds the accumulating braking energy back into the mains.



The total power of the installed inverters can be higher than the nominal power of the Active Front End. Next to the performance record also the maximum possible load capacity of the line filter module LFM has to be observed when dimensioning the complete configuration.

### Active Front End units parallel – n:n application



Due to the special design it is also possible to connect several Active Front End units in parallel (n:n application).

This enables

- a higher supply / regenerating power
- the use of smaller units e.g. adapted to the size of the inverter in order to reduce the spare parts
- an increased reliability due to redundancy.

Depending on the power demand individual Active Front End units can be locked or released during operation.

However, connection and disconnection must be only executed when there is no voltage!

## CE Marking

All devices and drives of the electric drive engineering may cause electromagnetic interferences and otherwise they may be influenced by such interferences. Therefore, they are subject to the **EMC directive 2004/108/EEC** since 1.1.1996.

The Active Front End units have an operating voltage which is clearly in the range of 50...1000 V AC or 75...1500 V DC. Therefore, they are also subject to the Low-voltage directive 2006/95/EEC since 1.1.1997.

Because of the line filter module of the Active Front End the device is in conformity with **EN 61800-3** and **EN 61800-5-1**.

Active Front End units are not considered as machines with at least one mechanically moving part. Therefore, they are not subject to the Machine directive 2006/42/EEC.



Active Front End units are a product of the restricted sales according to IEC 61800-3. In a residential environment this product can cause radio frequency interferences whereupon the user can be called on to take suitable measures.

The components of the Active Front End have a CE marking on the rating plate. However, it is necessary to observe the installation regulations to achieve the corresponding limits.

## Installation regulations

- The Active Front End units AFE include a radio frequency interference filter in the line filter module LFM for use in industrial environments as standard. In case of long motor cables, when several inverters are operated on a common DC bus and for the use in residential environment the implementation of an additional external filter is necessary to reduce the radio interferences.

The installation regulations given in the respective device documentation are valid for the total drive unit:

- Use and proper connection of screened control cables
- Consider the protective separation when preparing control lines and coupling relays
- Separate laying of power cables and control wiring

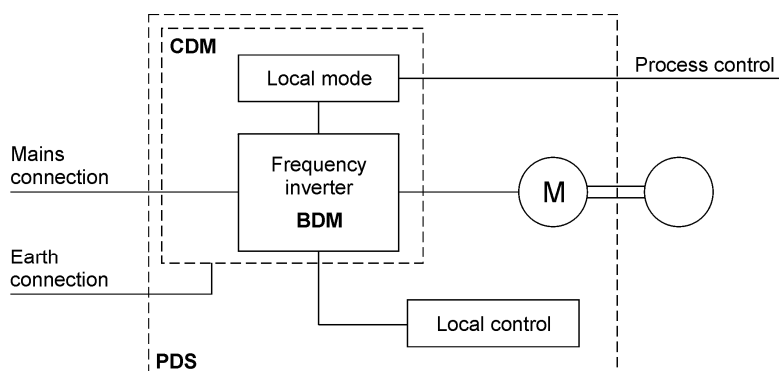
### EMC product standard for PDS (Power Drive Systems) EN 61800-3

For frequency inverter drives the product standard EN/IEC 61800-3 edition 1 and 2 appeared. It has first priority over the existing general standards (generic standards). If a drive is installed into another device for which a separate EMC product standard exists, then this standard applies.

The aim of the **EMC directive 2004/108/EEC** is the ability of electric and electronic installations to operate satisfactorily in their electromagnetic environment without influencing the environment or other loads therein.

Therefore, the PDS product standard contains both limits for admissible interferences and requirements for the necessary interference resistance.

The power drive standard EN 61800-3 covers the complete drive from the mains supply to the motor shaft.



BDM:	Base-Drive-Module	Basic drive consisting of the power part and the control electronics (e.g. frequency inverter - built-in unit)
CDM:	Complete-Drive-Module	Drive modules consisting of BDM (basic drive) and extensions, if existing (e.g. enclosure including EMC filter, motor choke, line contactor, ...)
PDS:	Power-Drive-System	Drive system consisting of CDM (drive module) and motor, motor cable, local control, power transformer, ... (e.g. the complete electric drive of a machine)

The differentiation in respect of the sales method and the range of use is essential for the handling of frequency inverters.

Use in residential environment

Drives that are connected without an intermediate transformer to the power supply network which also supplies residential areas. The standard refers to these application areas as "first environment".

The valid limits for interferences are very low and can only be observed by compliance with all installation instructions.

Category C1

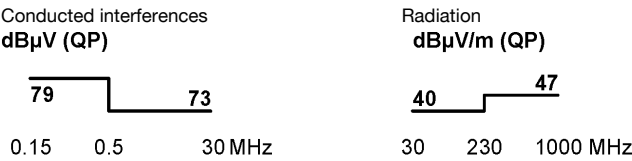
Use in residential environments with general sales (unrestricted to every person)



The admissible limits for interferences comply with the applied standard EN 55011 class B; i.e. 66-56/56/60 dB( $\mu$ V) quasi-peak and 30/37 dB( $\mu$ V/m) at a distance of 10 m.

Category C2

Use in residential environments with restricted sales (only EMC qualified resellers)



All drives must comply with the limits of interferences of the former class A group 1.

i.e. 79/73/73 dB( $\mu$ V) quasi-peak and 40/47 dB( $\mu$ V/m) at a distance of 10 m



## Use in industrial environment

The standard refers to these application areas as "second environment". These are areas that are separated from the public network by means of an own transformer. The user must ensure that the suppression components recommended by the manufacturer are used and that the introductions of the manufacturer are observed. Moreover, the user must ensure that strong interferences do not couple into neighbouring low-voltage networks.

If the neighbouring network is a public network with residential areas, the limits 66-56/56/60 dB( $\mu$ V) quasi-peak apply. In case of industrial networks the higher limits 79/73/73 dB( $\mu$ V) quasi-peak can be used.

Furthermore, it is necessary to enhance the suppression of interferences if other devices are influenced. The operator of the plant is responsible for this improvement.

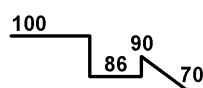
The limits for immunity are much stricter because they are based on a generally higher level of interferences.

## Category C3

Use in industrial environments

Conducted interferences  
drive  $\leq 100$  A

**dB $\mu$ V (QP)**



0.15 0.5 5 30 MHz

Radiation

**dB $\mu$ V/m (QP)**

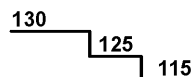


30 230 1000 MHz

For drives with a size  $\leq 100$  A the admissible limits for interferences are 100/86/90-70 dB( $\mu$ V) quasi-peak and 50/60 dB( $\mu$ V/m) at a distance of 10 m (class A group 2).

Conducted interferences  
drive  $> 100$  A

**dB $\mu$ V (QP)**



0.15 0.5 5 30 MHz

Radiation

**dB $\mu$ V/m (QP)**



30 230 1000 MHz

For drives with a size  $> 100$  A the admissible limits for interferences are 130/125/115 dB( $\mu$ V) quasi-peak and 50/60 dB( $\mu$ V/m) at a distance of 10 m (class A group 2).

## Category C4

Use in industrial environments for drives  $> 1000$  V or  $> 400$  A

For these drives are no limits defined. An EMC concept has to be compiled within project planning.

In case of non-grounded mains it is usually not possible to keep the limits. Filter capacitors make detection of insulation faults difficult and thus they interfere with the concept of a floating power supply. However, filters that are developed especially for IT mains can be used because they also cause a high reduction of the conducted interferences in non-grounded mains.



The basic requirements for compliance with the relevant limits are the observance and compliance of the installation requirements and the use of the recommended options.

#### Mains undervoltage

The Active Front End is very in respect of mains undervoltages. Voltage drops of up to 40 % (depending on the nominal voltage) can be balanced without interruption of operation.

As the low voltage is compensated by a higher current, there is an overload situation that is limited in time. Therefore a switch-off due to overload may take place when the Active Front End operates already close to the performance limit.

Supplying the fans during mains undervoltage is also only possible for a limited time.

#### Short-time mains interrupts – Automatic restart

In case of 1- or 3-phase mains failure, the Active Front End AFE can continue operation only for short time. The control system has to initiate a safety shutdown of the Active Front End and thus of the whole drive. When the mains returns within short time, a restart takes place as standard by means of the autoreset function when there is still a start command.

#### Locking of the Active Front End

The Active Front End can be locked by means of the logic input "PWR" so that a given or incoming start command is ignored. Independent thereof also an external emergency off command can be integrated into the control of the Active Front End. Also this command leads to an immediate mains cut-off and prevents any start. In both cases the device shows the device state "Lock" at the display.

#### Parameter settings

After device replacement, software update or reset to factory default, carry out all settings that are required to guarantee the protection of the drive.



This is also valid for the inverter because it has to be adapted for the operation with an Active Front End.

## Mains voltage

The Active Front End AFE is designed for the following mains voltages:

- AFE 400 V:  
3 AC 380...400 V  $\pm 10\%$  (-30% for less than 1 min), 50 / 60 Hz  $\pm 5\%$   
(30...70 Hz short-term or with separate fan supply)  
3 AC 440 V  $\pm 10\%$  (-40% for less than 1 min), 50 / 60 Hz  $\pm 5\%$   
(30...70 Hz short-term or with separate fan supply)
- AFE 480V  
3 AC 480 V  $\pm 10\%$  (-40% for less than 1 min), 50 / 60 Hz  $\pm 5\%$   
(30...70 Hz short-term or with separate fan supply)
- AFE 690 V:  
3 AC 500...525 V  $\pm 10\%$  (-20% for less than 1 min), 50 Hz  $\pm 5\%$   
3 AC 600 V  $\pm 10\%$  (-30% for less than 1 min), 50 / 60 Hz  $\pm 5\%$   
(30...70 Hz short-term or with separate fan supply)  
3 AC 690 V  $\pm 10\%$  (-40% for less than 1 min), 50 / 60 Hz  $\pm 5\%$   
(30...70 Hz short-term or with separate fan supply)

The nominal mains voltage has to be set at the Active Infeed Converter AIC and the inverter INV. Thereby an optimal adjustment of the undervoltage protective function takes place in both devices.

## Radio interferences

The Active Front End units include a radio frequency interference filter in as standard. This filter fulfils the requirements for category "C3 – industrial environments" according to EN/IEC 61800-3 (in the past: EN 55011 class A group 2).



Active Front End units are a product of the restricted sales according to IEC 61800-3. In a residential environment this product can cause radio frequency interferences whereupon the user can be called on to take suitable measures.

## Mains current harmonics / Mains voltage distortion

Due to the Active Front End the typical harmonic currents of frequency inverters, caused by the mains supply via diode rectifier, do not occur. The remaining total current distortion factor THD(i) is clearly less than 4 % during mains supply operation as well as during regenerating operation.

Also the distortion of the mains voltage is very low according to the lower current harmonics.

This table represents typical values of the individual current harmonics at operation with the Active Front End.

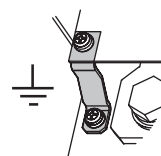
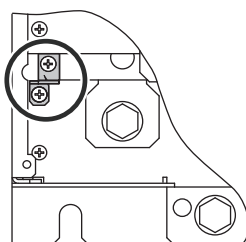
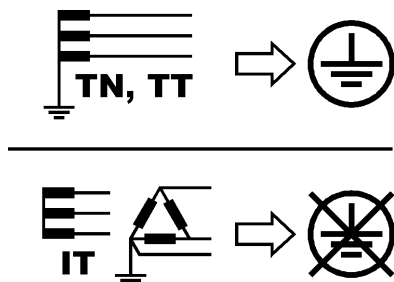
Operating mode	Current harmonics in %																	
	H1	H5	H7	H11	H13	H17	H19	H23	H25	H29	H31	H35	H37	H41	H43	H47	H49	THD
motor	100	1.33	1.06	0.39	0.20	0.20	0.20	0.35	0.24	0.08	0.04	0.16	0.12	0.24	0.16	0.04	0.04	2.42
generator	100	1.30	0.55	0.39	0.39	0.71	0.63	0.24	0.43	0.20	0.24	0.16	0.20	0.16	0.08	0.04	0.04	2.40

## Nongrounded mains

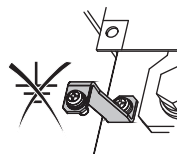
The use of the Active Front End units is basically in all mains variants permitted.

## Required settings at the line filter module LFM

The radio frequency interference filter built-in into the line filter module LFM has to be adapted to the respective mains by means of switch-over/reconnection.



TN or TT mains  
(factory default)

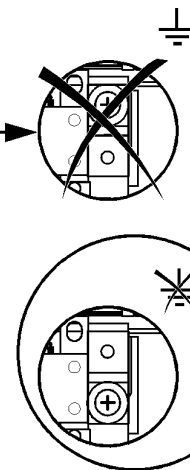
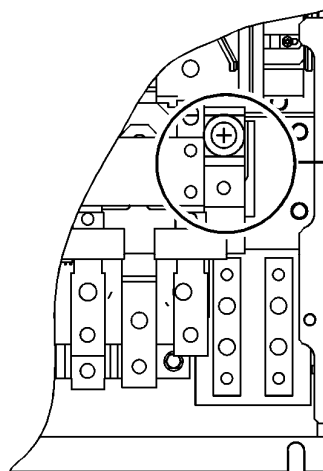
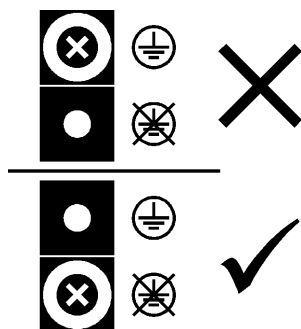


IT mains or  
Corner grounded

In case of nongrounded mains a single earth fault in the supplying mains has no effect to the function of the Active Front End. If the earth fault occurs in the motor or the motor cables, the inverter is switched off. But the recognition heavily depends on the earth capacitance of the mains.

## Required settings at the Active Infeed Converter AIC

The integrated RFI filter has to be deactivated (position IT, non-grounded mains) at all devices because there exists no direct mains connection of the frequency inverter in case of operation with an Active Front End.



The radio frequency interference filters of the Active Infeed Converter AIC and the inverter INV must be always set to position "non-grounded mains".

## Mains impedance / Short-circuit current

The Active Front End is designed for a maximum mains short-circuit current of 100 kA. A corresponding supply and correct fuse protection must be provided.

## Power factor correction systems

In spite of the heavily reduced harmonics, resonances in power factor correction systems without chokes cannot be excluded.



To protect against overload, we recommend the installation of chokes for those parts.

**Ripple control signals**

The effects of the operation of Active Front End units on ripple control signals in a system have to be checked from the operator of the plant.

**Switching rate**

The maximum switching rate for the whole life cycle must not exceed 10 switching operations per hour.

**Responsibility**

The users are responsible to integrate the Active Front End units into the protection and safety concept of the plant or machine.

All stated connection recommendations and planning remarks are to be taken merely as suggestions which must be adapted to the local conditions and regulations concerning installation and usage.

This applies especially to the safety regulations for machines, the EMC regulations and the general regulations for human protection.

**Overvoltage protective circuit**

All inductivities like relays, contactors, magnetic brakes, etc. have to be equipped with an overvoltage protective circuit. It prevents malfunctions of the conventional device control as well as of the fieldbus.

A free-wheeling diode is provided for DC control circuits.

For AC control circuits the R/C wiring is preferable compared to a wiring with varistors because as a result not only the peak overvoltage is reduced but also the rise-time.

**Earth leakage circuit breaker**

The Active Front End as well as the inverter lead an increased leakage current against earth.



Particularly because of the capacitors of the radio frequency interference filter, an unintentional triggering of an earth leakage circuit breaker may occur at the moment of switching on. As well, the earth capacitances may cause an incorrect triggering during operation. On the other hand, it is possible that the triggering is blocked by means of DC component.

Therefrom, you should observe following:

- Only use short-time delayed and pulse current sensitive earth leakage circuit breakers with considerably higher tripping current.
- Protect the other loads by means of a separate earth leakage circuit breaker.
- Earth leakage circuit breakers in front of an Active Front End AFE do not provide absolutely reliable protection in case of direct contact!! So they should be always used in combination with other protective measures.
- The Active Front End units have no current-limiting effect (in case of earth leakage currents) and therefore they do not violate the protective multiple earthing.

Depending on the conditions, the leakage current can be absolutely higher than 100 mA!!



The earth leakage detection built into the inverter INV has no current-limiting effect. It only protects the drive and is no human protection.

### Automatic restarting of the Active Front End

By fixed wiring of a logic input and setting of the required parameters at the Active Infeed Converter AIC, the Active Front End is switched on automatically after each mains switch-on or mains recurrence without the power failure having to be confirmed. This is an important and valuable function for the increase in availability, especially for drives that are not integrated into the plant control via a fieldbus system.

The automatic start of the Active Front End takes place in case of:

- Switch-on of the mains voltage and given start command (only in case of 2-wire control)
- After a mains failure when there is still a start command (only in case of 2-wire control)
- After each trip confirmation and given start command (only in case of 2-wire control)

### Automatic restarting of the inverter

If the Active Front End breaks down the inverter INV changes to drive state "Ready" and shows USF [Undervoltage] at the display. As soon as the Active Front End AFE restarts and thus the DC link voltage is increased to nominal operating voltage, the inverter INV is ready for restart.

When a start command is given the inverter INV is starting automatically after start of the Active Front End and after mains failure. When this behaviour is not permitted for safety reasons, the following functions of the inverter can be adjusted:

- Behaviour of the trip relay
- Trip state after each mains disconnection or mains failure
- Selection of the start command (level rated, edge rated or 3-wire control)

### Connecting and disconnecting the inverter

Due to the capacities, connecting and disconnecting an inverter INV is only allowed when the Active Front End is switched off and when the DC link is discharged.



Connecting the inverter leads to a current pulse and thus may cause damage of the devices connected to the DC bus.

### Connecting and disconnecting the Active Front End

In case of parallel operation at a common DC bus, connecting and disconnecting an Active Front End AFE is only allowed when there is no mains connection and the DC link is discharged because of the capacities.

### Description

For a single drive, typically one Active Front End AFE and one inverter INV (= standard frequency inverter) of same size are interconnected. Their power connection is simply done via the DC bus.

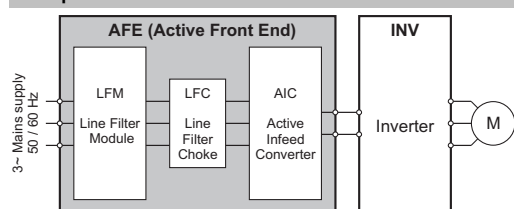
Typical applications for the Active Front End are:

- To enable 4-quadrant operation of a drive and thus to return energy to the mains.
- To reduce the current harmonics to a  $THDi \leq 4\%$ .



When the Active Front End AFE and the inverter INV have the same power, there are no DC fuses required.

### Components of the Active Front End



The Active Front End AFE is connected upstream to the inverter INV (= standard frequency inverter) and consists of several components:

- Active Infeed Converter AIC
- Line Filter Module LFM
- Line Filter Choke LFC

The Active Front End as well as its components can be allocated to the respective inverter using the following tables.

Active Front End units of higher power are realized by parallel connection of two line filter modules LFM and two line filter chokes LFC.

Active Front End for 400 V mains							
Inverter INV	Power VT [kW]	Active Front End AFE					
ATV 61		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV61H075N4...D90N4D	up to 90	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV61HC11N4D	110	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV61HC13N4D	132	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
ATV61HC16N4D	160	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
ATV61HC22N4D	220	4V240	VW3A7253	4V340	VW3A7262	4V340	VW3A7267
ATV61HC25N4D	250	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
ATV61HC31N4D	315	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
ATV61HC40N4D	400	4V430	VW3A7256	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV61HC50N4D	500	4V540	VW3A7257	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV61HC63N4D	630	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
Inverter INV	Power CT [kW]	Active Front End AFE					
ATV 71		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV71H075N4...D90N4D	up to 90	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV71HC11N4D	110	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
ATV71HC13N4D	132	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
ATV71HC16N4D	160	4V240	VW3A7253	4V340	VW3A7262	4V340	VW3A7267
ATV71HC20N4D	200	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
ATV71HC25N4D	250	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
ATV71HC28N4D	280	4V430	VW3A7256	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV71HC31N4D	315	4V430	VW3A7256	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV71HC40N4D	400	4V540	VW3A7257	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV71HC50N4D	500	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

Active Front End for 480 V mains							
Inverter INV	Power VT [HP]	Active Front End AFE					
ATV 61		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV61H075N4...D90N4D	up to 125	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV61HC11N4D	150	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV61HC13N4D	200	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
-	250	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
ATV61HC16N4D...C22N4D	350	4V240-13	VW3A7283	4V340	VW3A7262	4V340	VW3A7267
ATV61HC25N4D	400	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
ATV61HC31N4D	500	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
ATV61HC40N4D	600	4V430-15	VW3A7286	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV61HC50N4D	700	4V540-15	VW3A7287	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV61HC63N4D	900	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
Inverter INV	Power CT [HP]	Active Front End AFE					
ATV 71		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV71H075N4...D90N4D	up to 125	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
ATV71HC11N4D	150	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
ATV71HC13N4D	200	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
ATV71HC16N4D	250	4V240-13	VW3A7283	4V340	VW3A7262	4V340	VW3A7267
ATV71HC20N4D	300	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
ATV71HC25N4D	400	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
ATV71HC28N4D...C31N4D	500	4V430-15	VW3A7286	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV71HC40N4D	600	4V540-15	VW3A7287	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
ATV71HC50N4D	700	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

Active Front End for 500 ... 690 V mains							
Inverter INV	Power VT [kW]	Active Front End AFE					
ATV 61		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV61HC11Y <sup>1)</sup>	110	6V145	VW3A7270	6V220	VW3A7263	6V220	VW3A7268
ATV61HC13Y <sup>1)</sup>	132	6V145	VW3A7270	6V220	VW3A7263	6V220	VW3A7268
ATV61HC16Y <sup>1)</sup>	160	6V175	VW3A7271	6V220	VW3A7263	6V220	VW3A7268
ATV61HC20Y <sup>1)</sup>	200	6V220	VW3A7272	6V220	VW3A7263	6V220	VW3A7268
ATV61HC25Y <sup>1)</sup>	250	6V275	VW3A7273	6V430	VW3A7264	6V430	VW3A7269
ATV61HC31Y <sup>1)</sup>	315	6V340	VW3A7274	6V430	VW3A7264	6V430	VW3A7269
ATV61HC40Y <sup>1)</sup>	400	6V430	VW3A7275	6V430	VW3A7264	6V430	VW3A7269
ATV61HC50Y <sup>2)</sup>	500	6V540	VW3A7276	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
ATV61HC63Y <sup>2)</sup>	630	6V675	VW3A7277	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
ATV61HC80Y <sup>2)</sup>	800	6V860	VW3A7278	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
Inverter INV	Power CT [kW]	Active Front End AFE					
ATV 71		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
ATV71HC11Y <sup>1)</sup>	110	6V145	VW3A7270	6V220	VW3A7263	6V220	VW3A7268
ATV71HC13Y <sup>1)</sup>	132	6V175	VW3A7271	6V220	VW3A7263	6V220	VW3A7268
ATV71HC16Y <sup>1)</sup>	160	6V220	VW3A7272	6V220	VW3A7263	6V220	VW3A7268
ATV71HC20Y <sup>1)</sup>	200	6V275	VW3A7273	6V430	VW3A7264	6V430	VW3A7269
ATV71HC25Y <sup>1)</sup>	250	6V340	VW3A7274	6V430	VW3A7264	6V430	VW3A7269
ATV71HC31Y <sup>1)</sup>	315	6V430	VW3A7275	6V430	VW3A7264	6V430	VW3A7269
ATV71HC40Y <sup>2)</sup>	400	6V540	VW3A7276	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
ATV71HC50Y <sup>2)</sup>	500	6V675	VW3A7277	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
ATV71HC63Y <sup>2)</sup>	630	6V860	VW3A7278	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269

3.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 1x

4.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 2x



Further technical data can be found in chapter "Technical data".



### Order examples

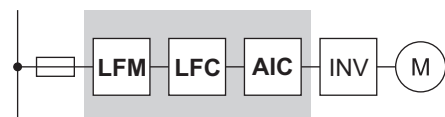
Following there are some order examples given for explanation.

#### Order example of an Active Front End for 400V and 145kW

One line filter module LFM, one line filter choke LFC and one Active Infeed Converter AIC have to be ordered.

The listing of the components to be ordered follows:

Simplified diagram



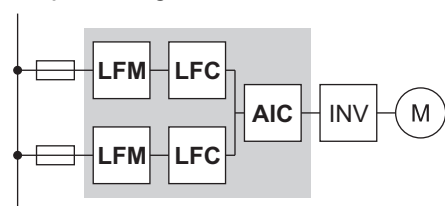
Device type	Pcs.	Order number
LFM 4V175	1	VW3A7261
LFC 4V175	1	VW3A7266
AIC 4V145	1	VW3A7251

#### Order example of an Active Front End for 480V and 540kW

Two line filter modules LFM, two line filter chokes LFC and one Active Infeed Converter AIC have to be ordered.

The listing of the components to be ordered follows:

Simplified diagram



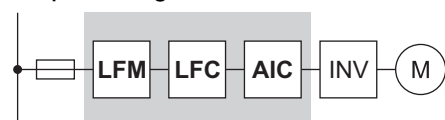
Device type	Pcs.	Order number
LFM 4V340	2	VW3A7262
LFC 4V340	2	VW3A7267
AIC 4V540-15	1	VW3A7287

#### Order example of an Active Front End for 690V and 220kW

One line filter module LFM, one line filter choke LFC and one Active Infeed Converter AIC have to be ordered. Furthermore the option "Fan wiring 6V" for the inverter has to be ordered once.

The listing of the components to be ordered follows:

Simplified diagram



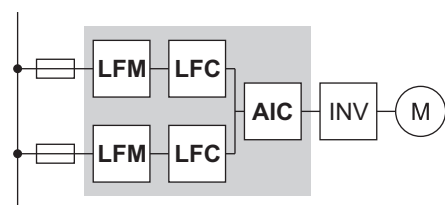
Device type	Pcs.	Order number
LFM 6V220	1	VW3A7263
LFC 6V220	1	VW3A7268
AIC 6V220	1	VW3A7272
Option "Fan wiring 6V"	1	VW3A7280

#### Order example of an Active Front End for 690V and 675kW

Two line filter modules LFM, two line filter chokes LFC and one Active Infeed Converter AIC have to be ordered. Furthermore the option "Fan wiring 6V" for the inverter has to be ordered twice.

The listing of the components to be ordered follows:

Simplified diagram



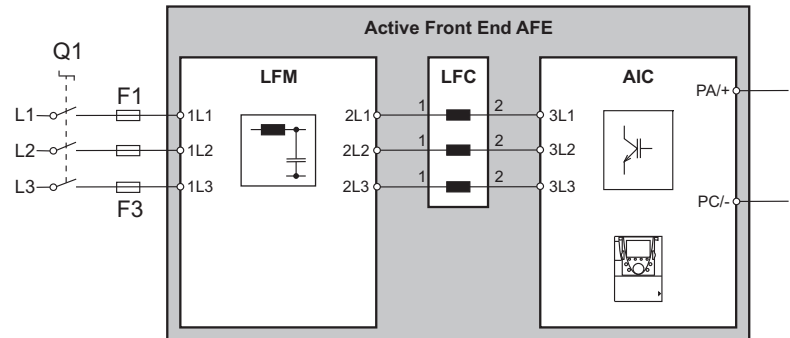
Device type	Pcs.	Order number
LFM 6V430	2	VW3A7264
LFC 6V430	2	VW3A7269
AIC 6V675	1	VW3A7277
Option "Fan wiring 6V"	2	VW3A7280

#### Power wiring

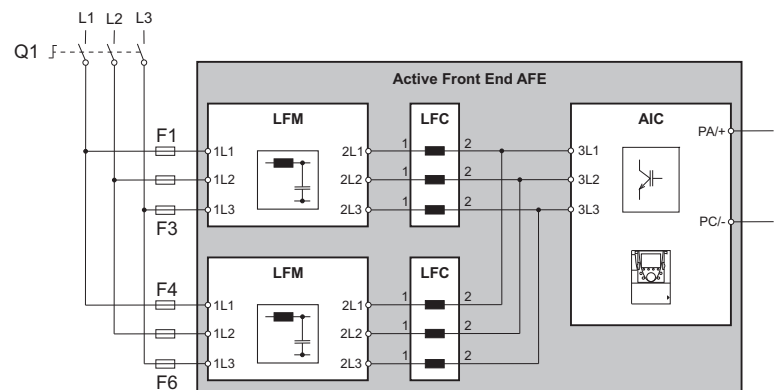
The Active Front End consists of three components in principle: the Line Filter Module LFM, the Line Filter Choke LFC and the Active Infeed Converter AIC.

The 3-phase mains connection is done at the Line Filter Module LFM. Further power connection is done via the Line Filter Choke LFC (3 single phase chokes) to the Active Infeed Converter AIC.

In the power range to 340 kW (up to 430 kW at 500 / 690 V) **one** LFM and **one** LFC (consisting of three parts) is connected upstream to the Active Infeed Converter AIC.



In the power range from 430 kW (from 540 kW at 500 / 690 V) the Active Front End consists of an AIC, **two** LFM's and **two** LFC's (each consisting of three single phase chokes).



In case of a single drive an Active Front End AFE is directly connected to the DC link of the inverter (= standard frequency inverter).



Basically the expansion of the DC bus should be kept as small as possible. The distance between the components (AIC, INV) must not exceed 3m. Arrangements with longer DC wiring must be checked and damping elements to avoid resonances have to be built in when required. Further information is available on request.



In case of faulty wiring of the DC link, e.g. due to exchanging terminals PA/+ and PC/- or an earth fault, the inverter as well as the Active Front End may be damaged or destroyed.

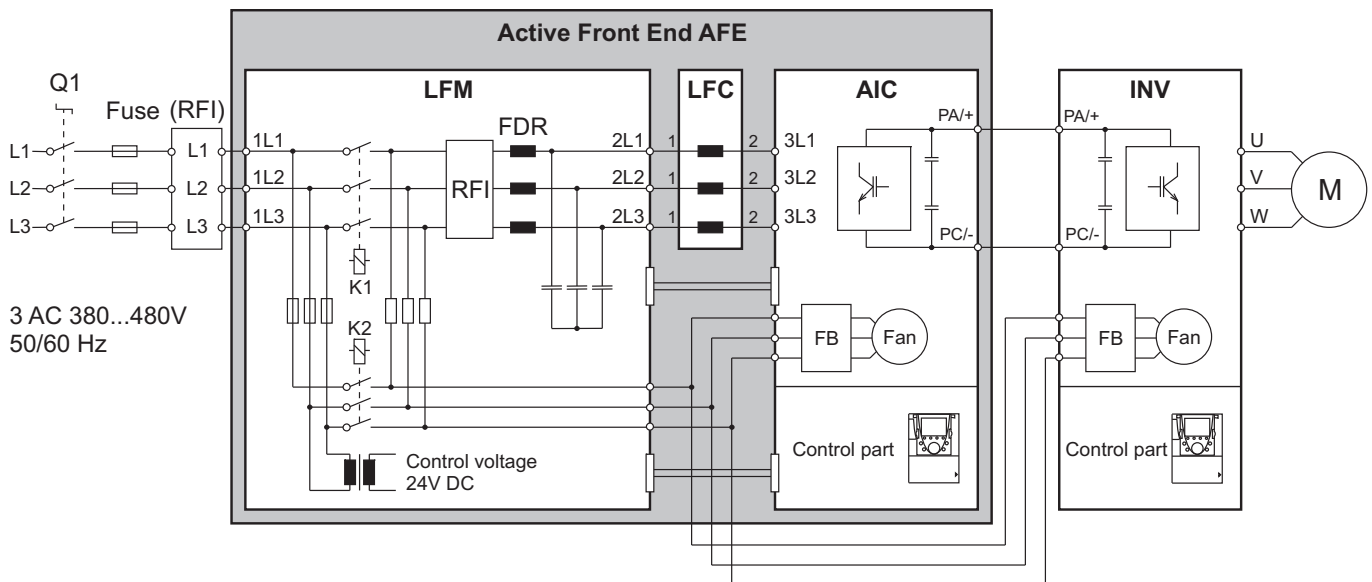
#### Internal control wiring Fan supply and control voltage

The voltage for fan supply and the control voltage are generated in the line filter module LFM.

The control wiring between the line filter module LFM and the Active Infeed Converter AIC is realized by the provided connecting cables W2 and W3. As soon as mains voltage is applied to the terminals 1L1, 1L2, 1L3, a 24 V auxiliary voltage is produced to supply the Active Infeed Converter AIC. It can be also used to buffer the control electronics of **one** inverter INV.

For the 400 V devices (except VW3 A7 250 due to DC fans) the cable W1 has to be connected to the line filter module LFM in order to supply the fans in the Active Infeed Converter AIC. The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the auxiliary terminal block R0/S0/T0 (switching to external supply) in the INV.

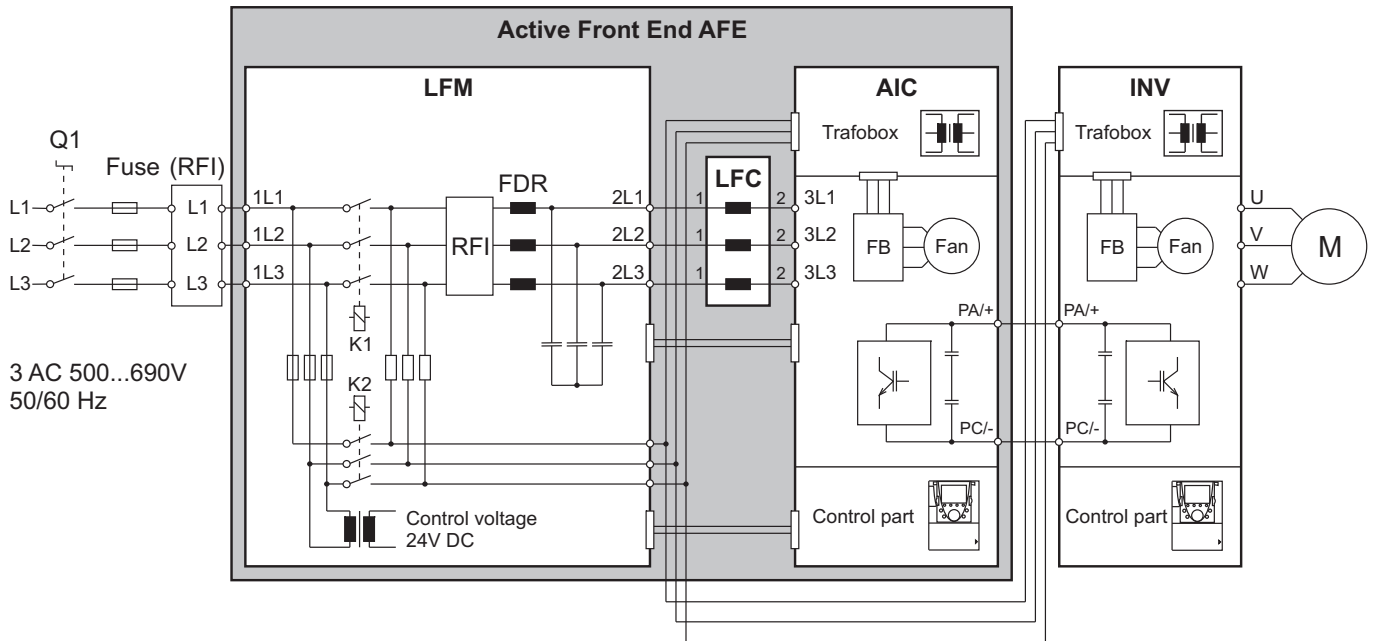
With the fan supply it is possible to operate all fans of the Active Infeed Converter AIC and the fans of up to four inverters.



The fans are internally protected when supplied via the line filter module LFM. Therefore no additional fuses are required.

At the 690 V devices the fans are supplied via the transformer box at the top side of the devices. The connection to the Active Infeed Converter AIC is included in delivery and has to be connected to the Line Filter Module LFM only.

The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the Line Filter Module LFM and the transformer box at the top side of the INV. Therefore a special connecting-option is necessary (as option deliverable).



The fans are internally protected when supplied via the line filter module LFM. Therefore no additional fuses are required.



For fan supply of the inverter(s) INV it is necessary to order the option "Fan wiring 6V" with reference number VW3A7280.

1x VW3A7280 for ATV61HC11Y...C40Y; ATV71HC11Y...C31Y

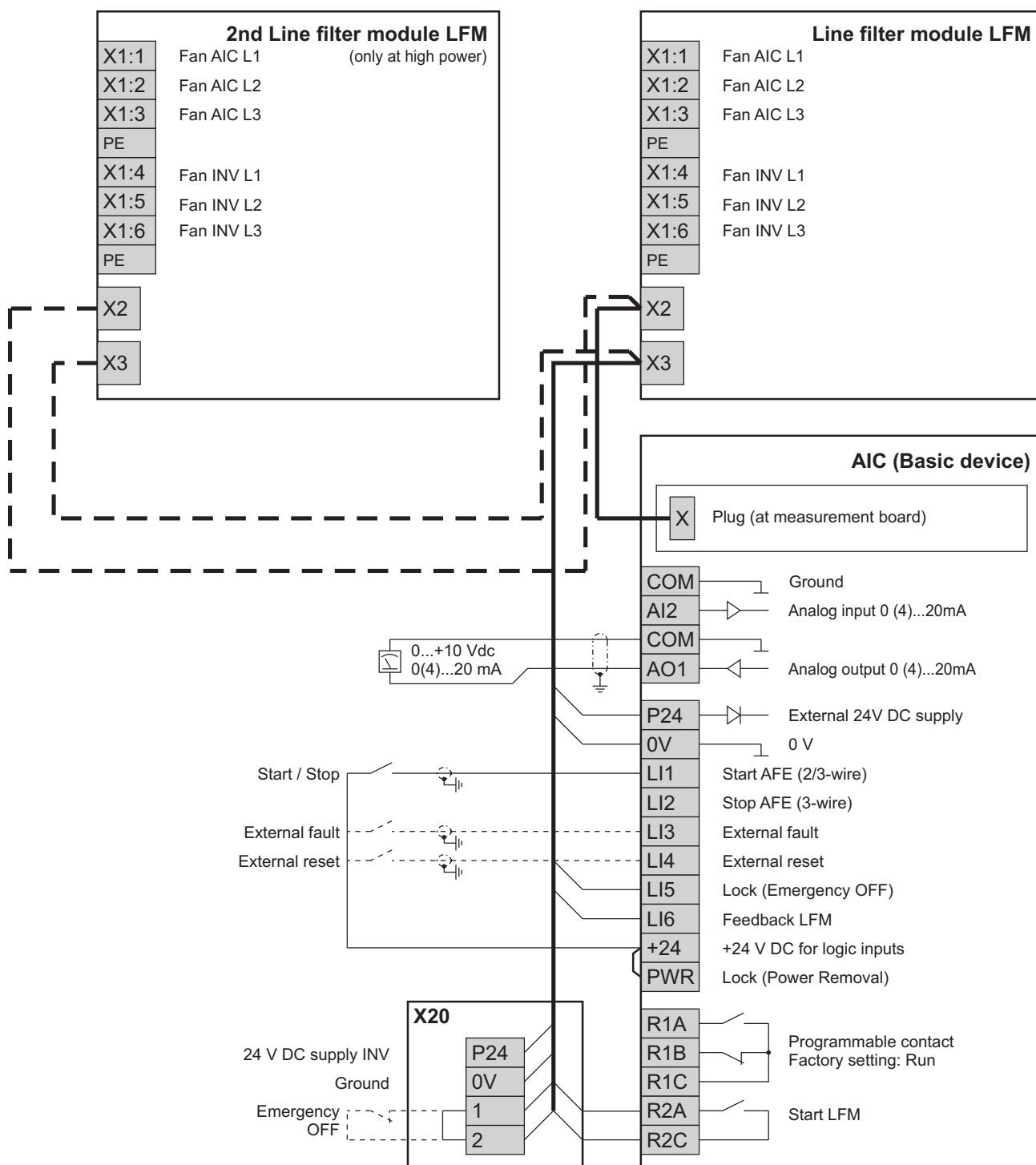
2x VW3A7280 for ATV61HC50Y...C80Y; ATV71HC40Y...C63Y

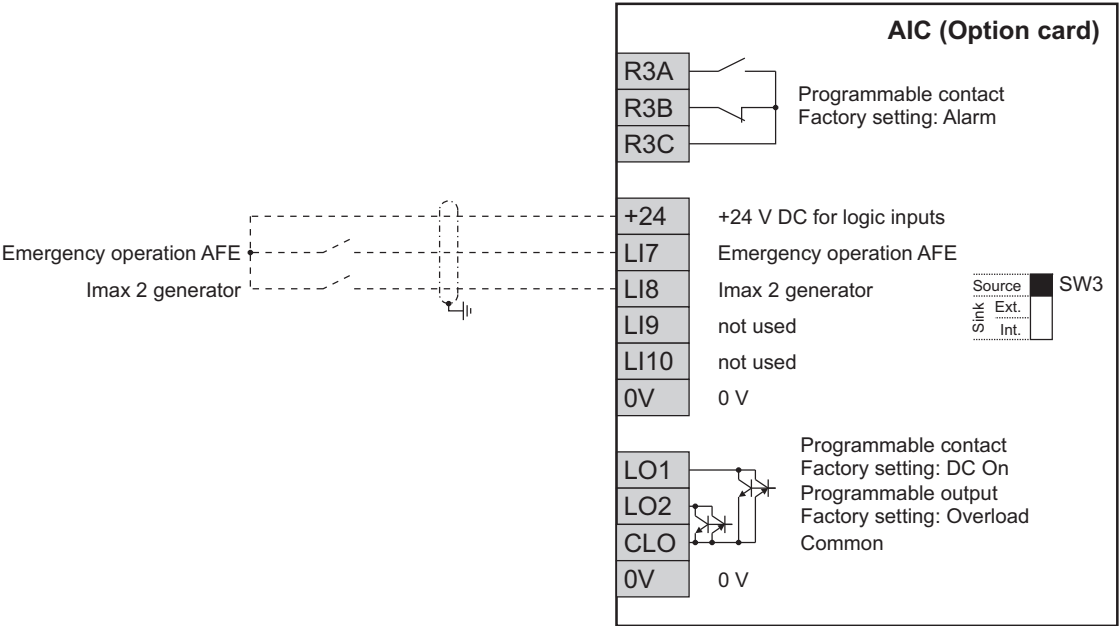
#### Terminal connections

The following presentation shows the wiring of the control terminals between the line filter module LFM and the Active Infeed Converter AIC.

The wiring is significantly simplified by means of two ready-made cables with plugs which are already connected to the AIC. The cables are designed for a maximum distance of 1 m between AIC and LFM.

At 400 V devices up to 340 kW and at 690 V devices up to 430 kW, the Active Infeed Converter AIC is connected with only one LFM. In case of higher power the AIC is connected with two LFMs.





## External control wiring

The following diagrams show typical wiring variants of the Active Front End.



The users are responsible to integrate the Active Front End units into the protection and safety concept of the plant or machine.

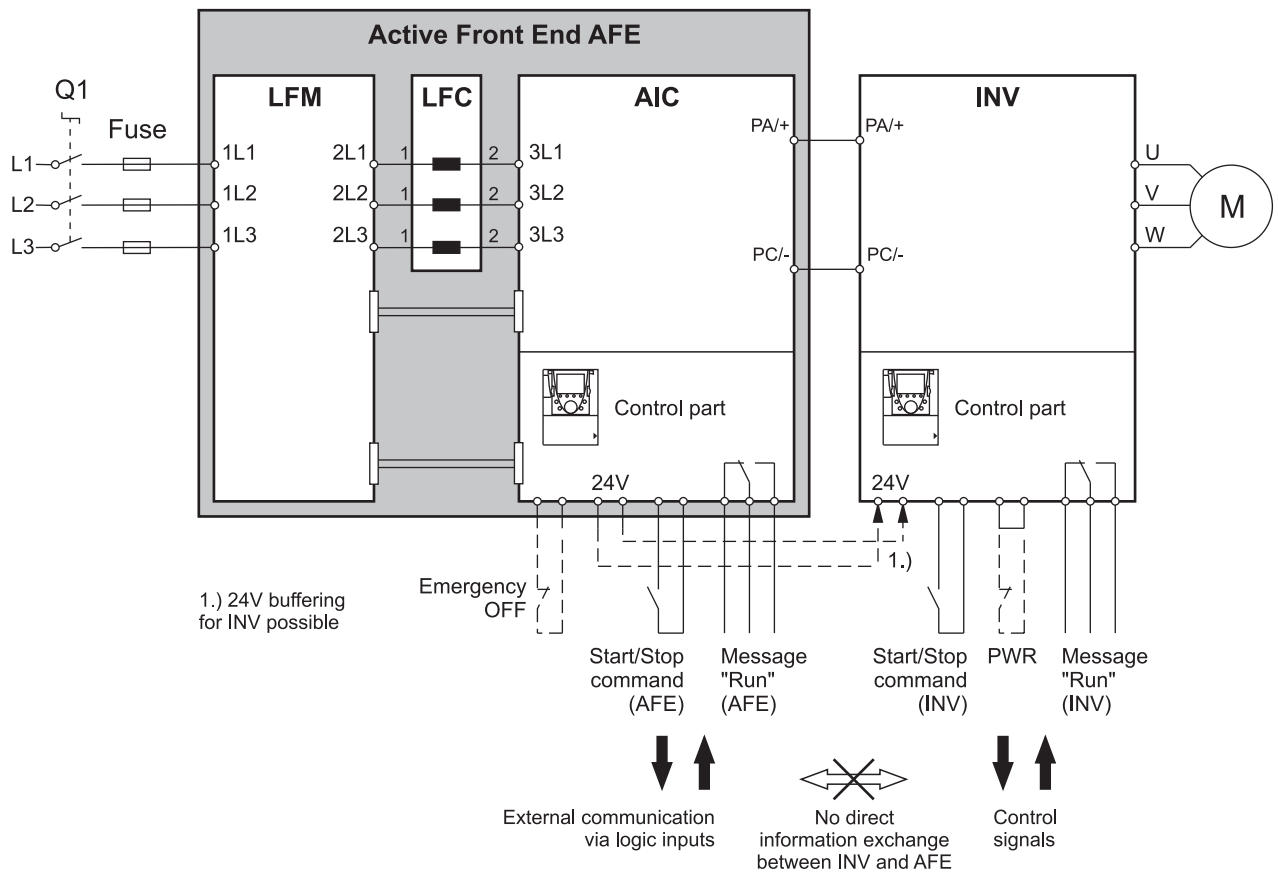


In case of a mains failure during motor operation, the Active Front End as well as the inverter recognise the undervoltage and react according to their parameterization (impulse inhibit, alarm, trip). In generator operation the inverter may not recognize a mains failure always.

## Control via start/stop signals

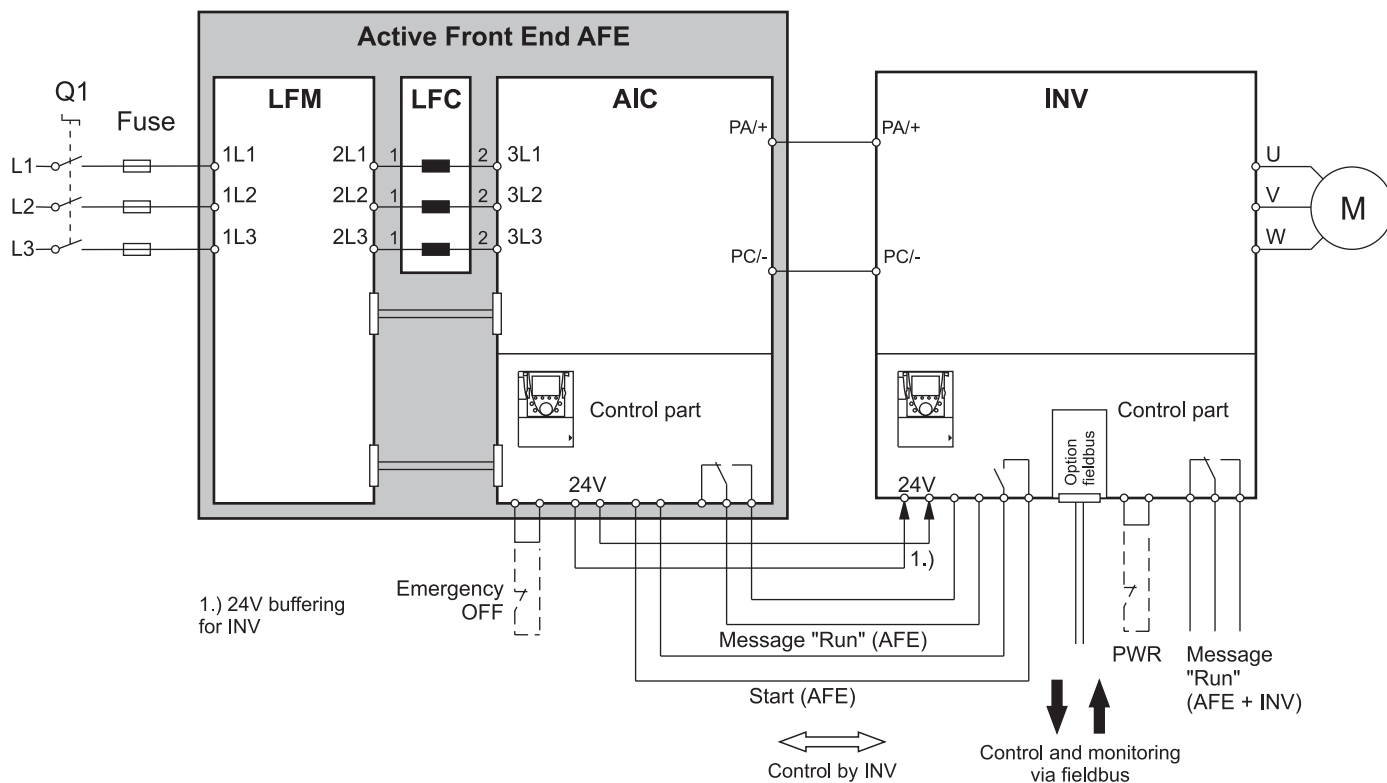
The Active Front End is controlled separately from the inverter by means of an own start command.

In this case the Active Front End AFE and the inverter INV have to be integrated to the superior control concept.



#### Control via start/stop signals of the inverter

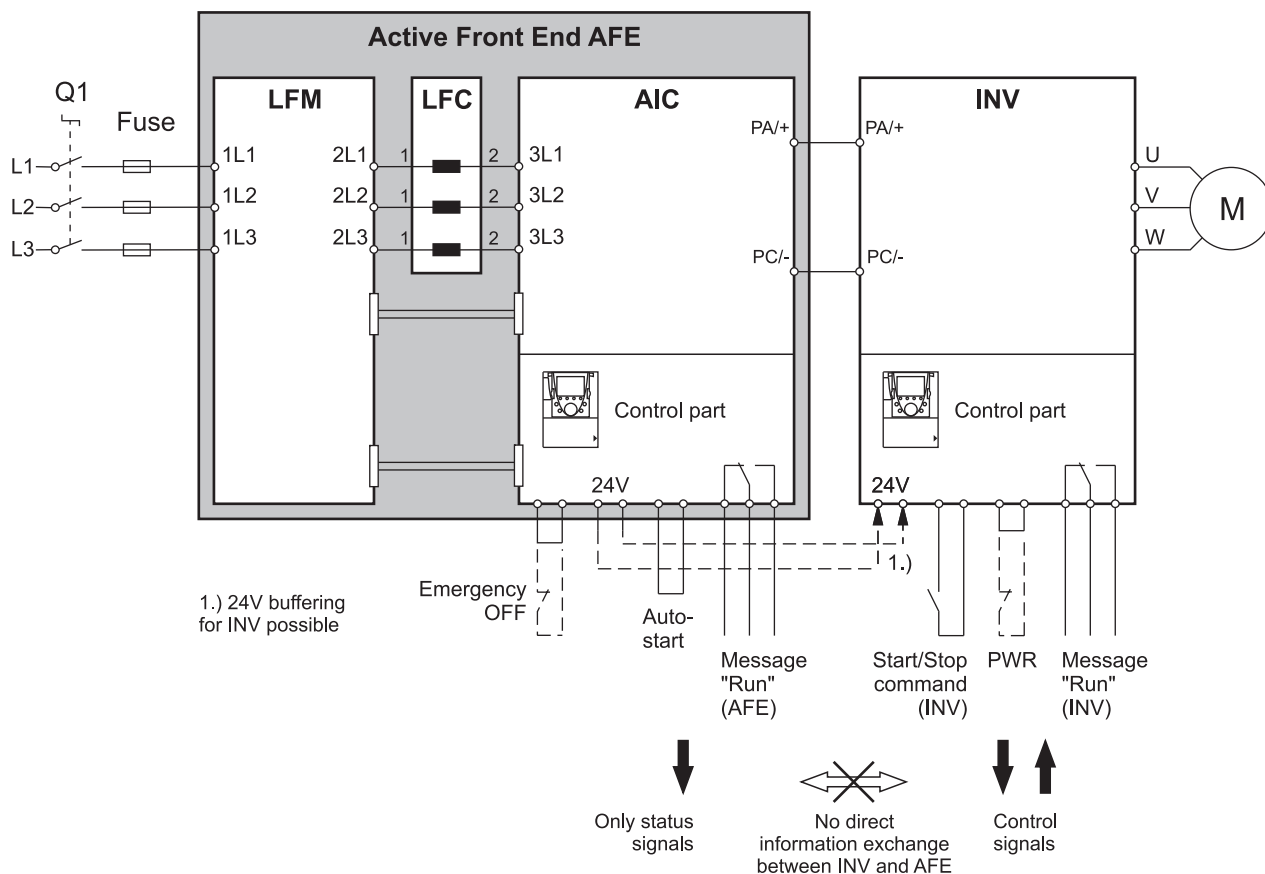
The Active Front End is not controlled by an own start command but via the inverter. The 24 V buffer voltage for the INV and for the AIC are provided from the line filter module LFM.





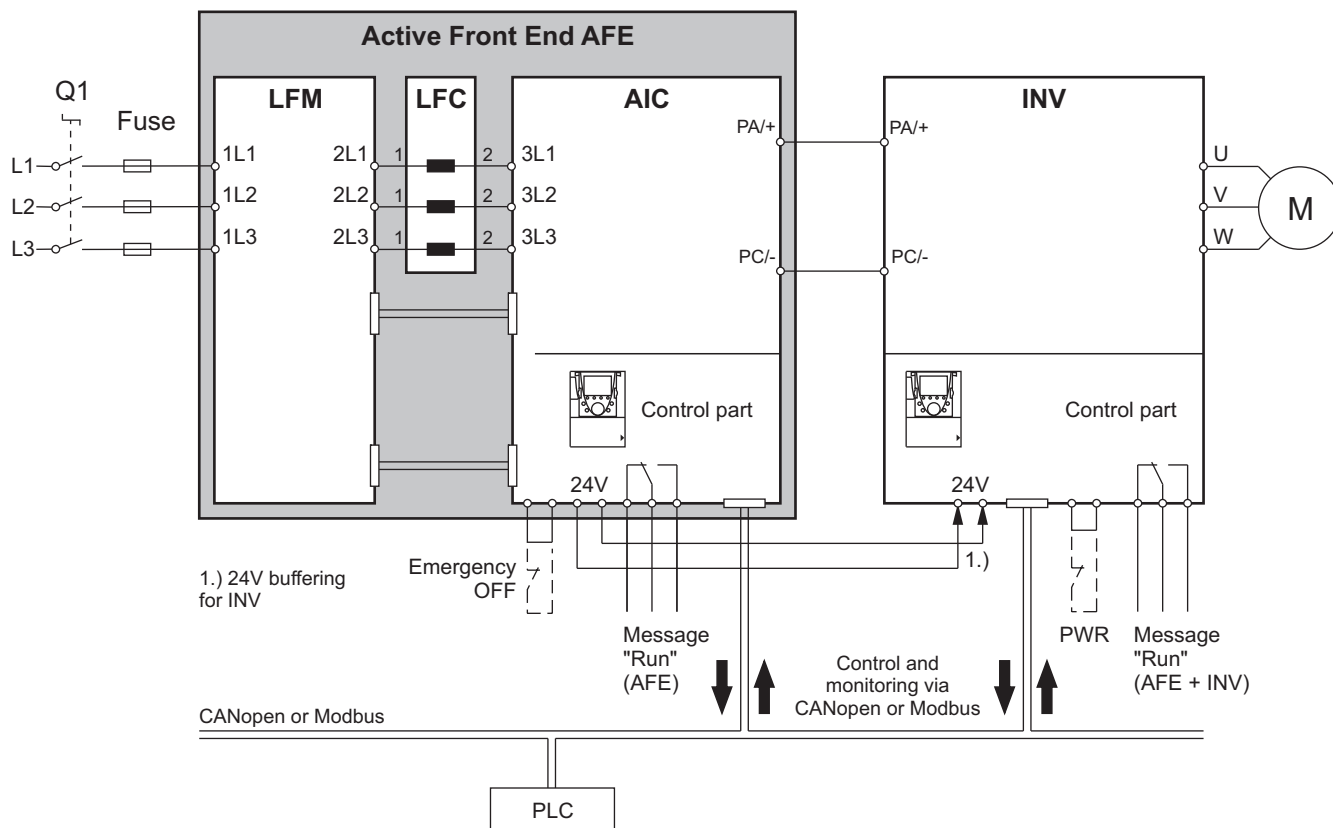
#### Control of the Active Front End via mains connection/disconnection

It is also possible to operate the Active Front End without additional control. In this case the Active Front End starts as soon as voltage is applied to the input terminals of the line filter module LFM.



#### Control of the Active Front End via direct fieldbus control

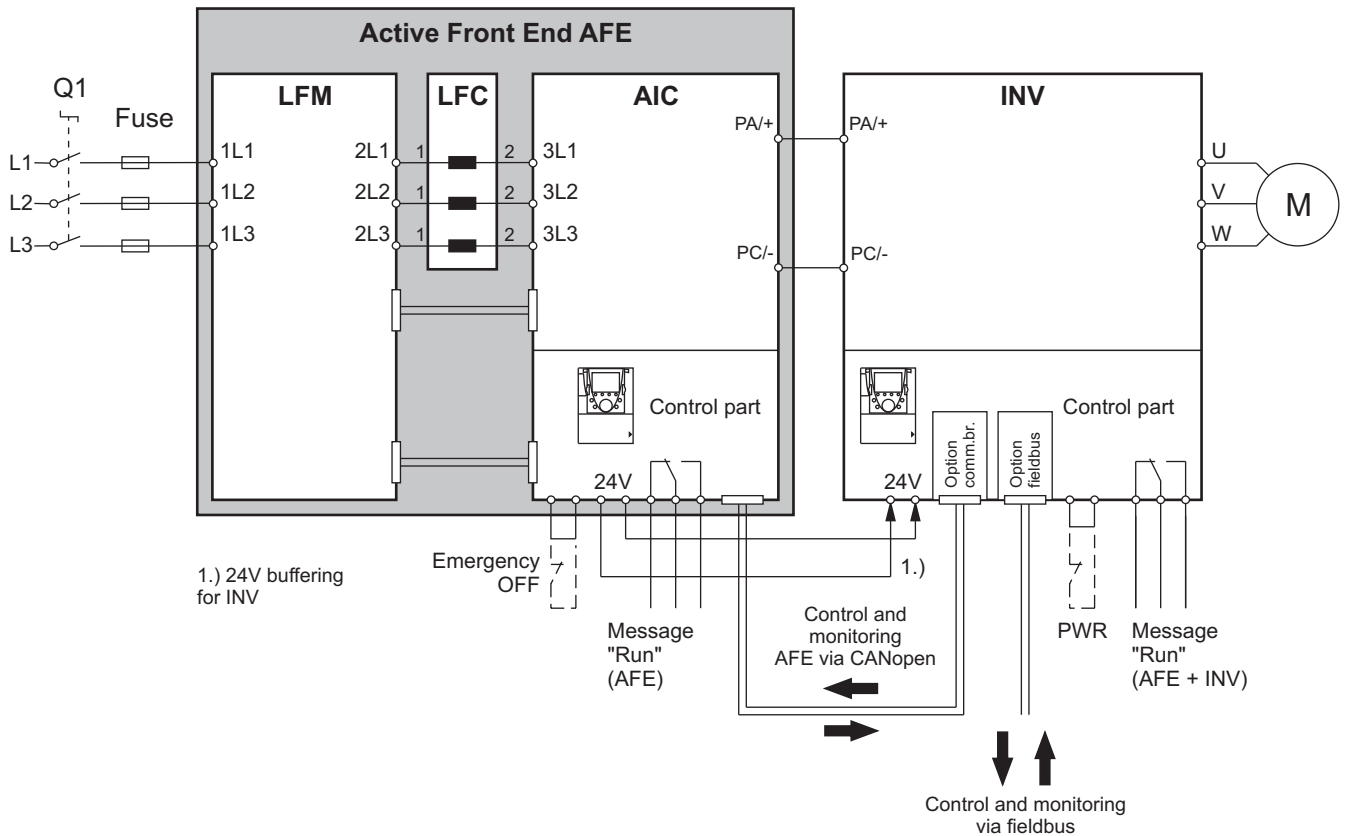
When the communication at the PLC system takes place with CANopen or Modbus, the inverter and the Active Infeed Converter can be directly connected to and controlled by the bus system.



#### Control of the Active Front End via indirect fieldbus control

The Active Front End is controlled and monitored by means of the option card "communication bridge" of the inverter. The connection to the Active Front End AFE is done via CANopen.

By using a fieldbus option card it is possible to control the inverter as well as the Active Infeed Converter via the inverter. Therefore each fieldbus system, which is available for the inverter, can be used.



### Required settings at the inverter

It is absolutely necessary to carry out the following settings for all frequency inverters connected to an Active Front End:

- **AFE** [Regen. connection] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [REGEN. CONNECTION] (Olr-) Setting: [Yes] (YES)  
Thereby the undervoltage level of the frequency inverter is adapted to the operation with the Active Front End.  
Please contact our service team if this parameter is not available in the parameter list of your device!
- **brR** [Braking balance] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) Setting: [No] (nO)
- **dEC** [Deceleration] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) For dynamic processes a very short deceleration ramp can cause an overload on the DC-bus with an overvoltage fault shut-down.  
This can be prevented by an extension or rounding of the deceleration ramp (parameters **LAR** [Begin Dec round]; **LAR** [End Dec round]).
- **UrES** [Mains voltage] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [UNDERVOLTAGE MGT.] (USb-) Same setting as the Active Front End.  
Thereby the internal voltage levels of the frequency inverter are adapted.
- **IPL** [Input phase loss] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [INPUT PHASE LOSS] (OPL-) Setting: [Ignore] (nO)
- **bUb** [Brake res. fault Mgt] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [BU PROTECTION] (bUF-) Setting: [Ignore] (nO)
- **LEL** [2 wire type] in menu [1.5 INPUTS/OUTPUTS CFG] (I-O-) Setting: [Level] (LEL)  
In order to ensure an automatic restart by the AFE after an undervoltage recognition. An automatic restart only possible with 2-wire control.
- **RFI filter**  
The integrated RFI filter has to be deactivated (position IT, non-grounded mains) at all devices because there exists no direct mains connection of the frequency inverter in case of operation with an Active Front End.



Non-observance of these precautions may cause material damage.



The 24 V control voltage of the Active Front End AFE can also be used to buffer the control electronics of the frequency inverter.



When the frequency inverter is supplied via the DC link an external supply for the device fans is required!

Via the LFM (line filter module) it is possible to supply the device fans with up to 4 additional inverters (with the same power as the AIC).

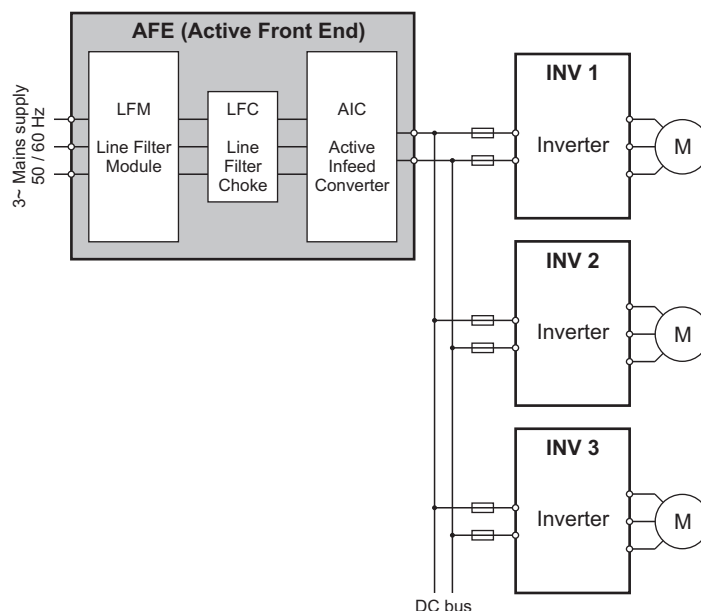
## Description

The Active Front End supplies a common DC bus at which several inverters INV are connected. This enables an energy exchange between the individual motor drives.

This concept is advantageous when there is a "load conjunction" that leads to motor and generator operation of the individual inverters at the same time. Thus, dimensioning of the Active Front End can be reduced to the required acceleration and braking power of the of the whole drive unit.

Examples therefor are:

- Test benches  
(driving a shaft that is braked at the same time in order to test loads)
- Belt drives  
(winding up and off the belt with permanent traction)



Inverters of different power can be operated at the common DC bus.

Depending on the power demand individual Active Front End units can be locked or released during operation.

However, connection and disconnection must be only executed when there is no voltage!



Take care of correct fuse protection of all inverters.



Next to the performance record also the maximum possible load capacity of the Active Front End has to be observed when dimensioning.



Please observe the information and notes about the inverters in chapter "Inverter", page 92 and the device documentation provided on the CD-ROM which is attached to each inverter.

## Dimensioning

Pay attention to following points when several inverters are operated at a common DC bus:

■ Total DC power

Check the sum of the motor power and the generator power at the DC bus separately. The higher value determines the selection of the Active Front End.

■ Capacity of the DC bus

In order to avoid overload of the charging circuit of the Active Front End, observe the sum of the capacities of all inverters connected to the DC bus.

## Active Front End for 400 V mains

Continuous DC power [kW] 400 V	Load capacity [mF]	Active Front End AFE					
		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
120	30	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
143	40	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
172	40	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
238	80	4V240	VW3A7253	4V340	VW3A7262	4V340	VW3A7267
268	80	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
336	80	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
425	160	4V430	VW3A7256	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
530	160	4V540	VW3A7257	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
665	160	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

## Active Front End for 480 V mains

Continuous DC power [kW] 480 V	Load capacity [mF]	Active Front End AFE					
		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
130	30	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
162	40	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
162	40	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
277	80	4V240-13	VW3A7283	4V340	VW3A7262	4V340	VW3A7267
315	80	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
390	80	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
490	160	4V430-15	VW3A7286	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
610	160	4V540-15	VW3A7287	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
770	160	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

## Active Front End for 500 / 690 V mains

Continuous DC power [kW]			Load capacity [mF]	Active Front End AFE					
500 V	600 V	690 V		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
				Type	Reference	Type	Reference	Type	Reference
102	123	142	16	6V145	VW3A7270 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
127	153	172	16	6V175	VW3A7271 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
157	162	215	16	6V220	VW3A7272 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
193	230	268	32	6V275	VW3A7273 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
242	290	335	32	6V340	VW3A7274 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
305	365	424	32	6V430	VW3A7275 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
382	460	528	64	6V540	VW3A7276 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
478	575	663	64	6V675	VW3A7277 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
607	730	842	64	6V860	VW3A7278 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269

1.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 1x

2.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 2x



Further technical data can be found in chapter "Technical data".

**Winch**

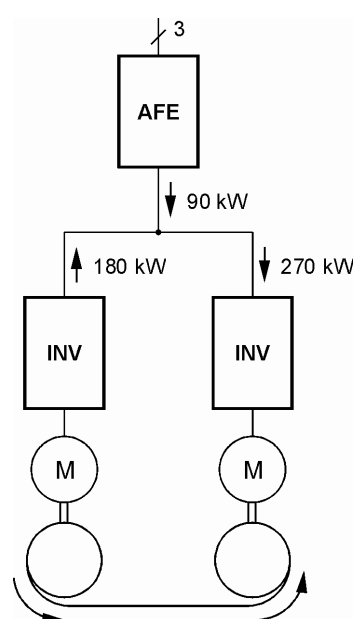
In this example the winch is operated by an inverter and it is braked by a further drive. A mains voltage is 400 V is expected.

In order to select the Active Front End, the performance record and the total charging capacity at the DC bus have to be checked.

The drive is realised with a ATV71HC25N4D frequency inverter. Thus the inverter has to be supplied with a DC power of 270 kW, as specified in the tables chapter "Inverter", page 92.

For braking of the second shaft a ATV71HC20N4D is used. As this inverter is used to return energy to the mains, its generator power is deducted from the required DC power of the system.

As the capacities at the DC bus (independent of the energy direction) have to be charged by the Active Front End, they have to be added.



Inverter	Power	Energy direction	Capacity
ATV71HC20N4D	180 kW	generator	14 mF
ATV71HC25N4D	270 kW	motor	20 mF
Sum	90 kW	motor	34 mF

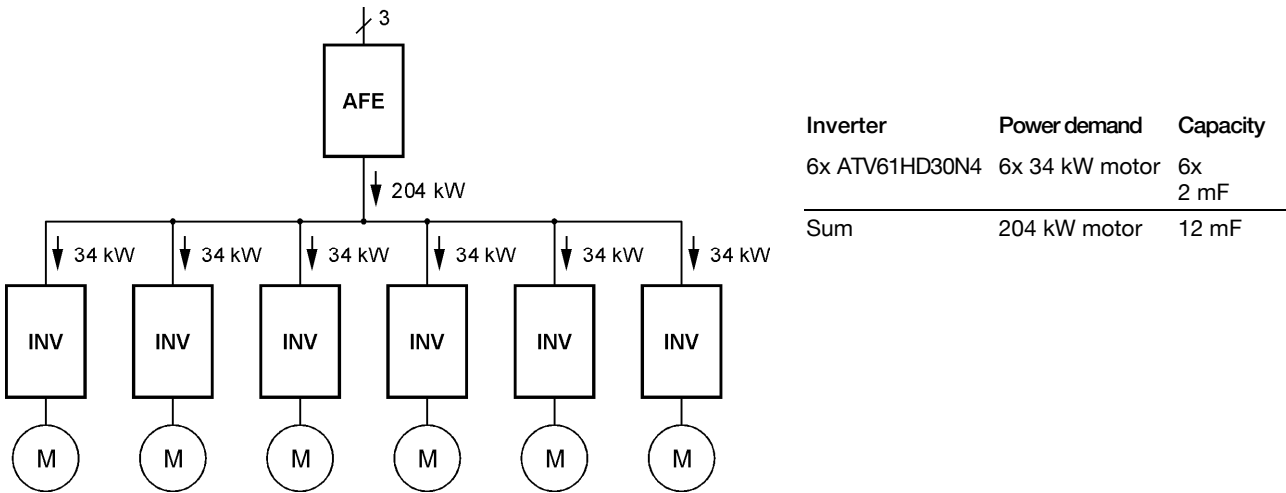
In this example, due to the capacity the Active Front End with a load capacity of 40 mF is selected, consisting of following components:

AIC	4V145	VW3A7251	Load capacity: 40 mF
LFM	4V175	VW3A7261	
LFC	4V175	VW3A7266	

For drive groups with nearly balanced performance record, typically the load capacity of the Active Front End is determining the selection of the device.

**Roller conveyor**

In this example the roller conveyor is operated by several inverters. A mains voltage is 400 V is expected.  
In order to select the Active Front End, the performance record and the total charging capacity at the DC bus have to be checked.  
The drives are realised with ATV61HD30N4 frequency inverters. Thus each inverter has to be supplied with a DC power of 34 kW, as specified in the tables in chapter "Inverter", page 92.  
As the capacities at the DC bus (independent of the energy direction) have to be charged by the Active Front End, they have to be added.



In this example, due to the performance record the Active Front End is selected, which is able to supply the DC-bus with 204 kW. It consists of the following components:

AIC	4V240	VW3A7253	DC power: 238 kW
LFM	4V340	VW3A7262	
LFC	4V340	VW3A7267	

For drive groups with predominant motor power, the power sum of all inverters is determining the selection of the Active Front End.

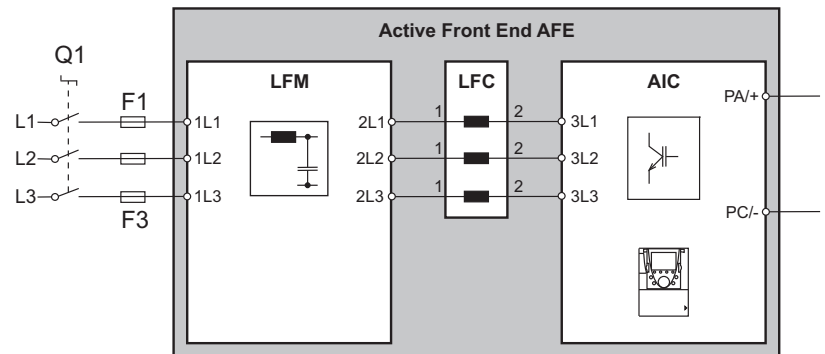


#### Power wiring

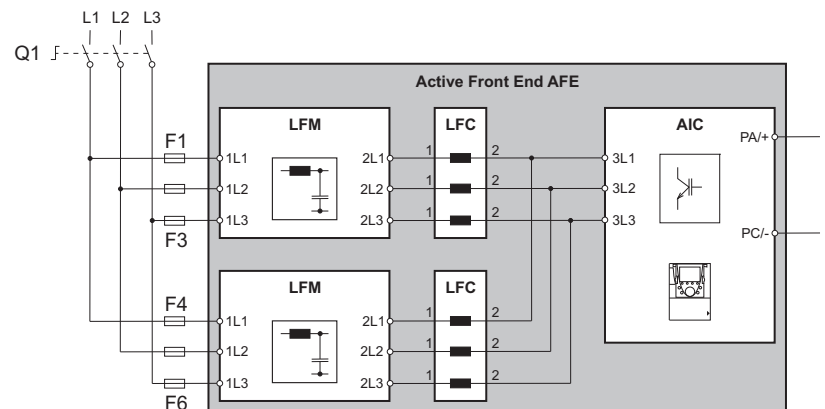
The Active Front End consists of three components in principle: the Line Filter Module LFM, the Line Filter Choke LFC and the Active Infeed Converter AIC.

The 3-phase mains connection is done at the Line Filter Module LFM. Further power connection is done via the Line Filter Choke LFC (3 single phase chokes) to the Active Infeed Converter AIC.

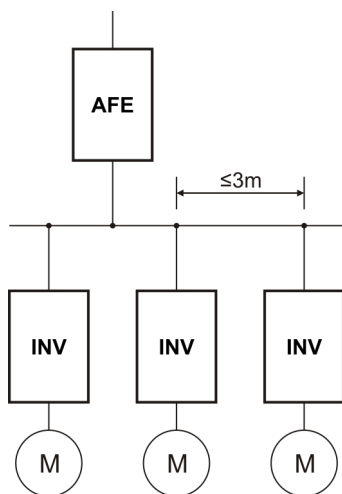
In the power range to 340 kW (up to 430 kW at 500 / 690 V) **one** LFM and **one** LFC (consisting of three parts) is connected upstream to the Active Infeed Converter AIC.



In the power range from 430 kW (from 540 kW at 500 / 690 V) the Active Front End consists of an AIC, **two** LFMs and **two** LFCs (each consisting of three single phase chokes).



In case of the common DC bar all inverters are connected to the DC output of the Active Front End AFE.



Basically the expansion of the DC bus should be kept as small as possible. The distance between the components (AFC, INV) must not exceed 3m. Arrangements with longer DC wiring must be checked and damping elements to avoid resonances have to be built in when required. Further information is available on request.



In case of faulty wiring of the DC link, e.g. due to exchanging terminals PA/+ and PC/- or an earth fault, the inverter as well as the Active Front End may be damaged or destroyed.

#### Internal control wiring

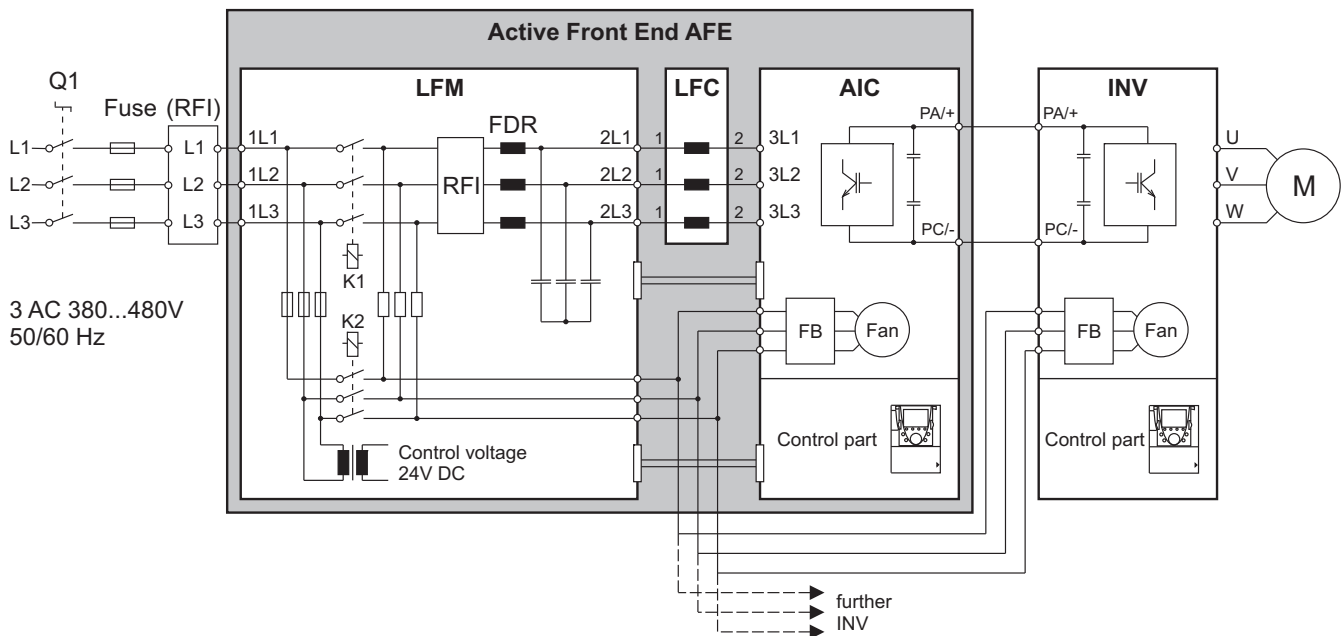
##### Fan supply and control voltage

The voltage for fan supply and the control voltage are generated in the line filter module LFM.

The control wiring between the line filter module LFM and the Active Infeed Converter AIC is realized by the provided connecting cables W2 and W3. As soon as mains voltage is applied to the terminals 1L1, 1L2, 1L3, a 24 V auxiliary voltage is produced to supply the Active Infeed Converter AIC. It can be also used to buffer the control electronics of one inverter INV.

For the 400 V devices (except VW3 A7 250 due to DC fans) the cable W1 has to be connected to the line filter module LFM in order to supply the fans in the Active Infeed Converter AIC. The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the auxiliary terminal block R0/S0/T0 (switching to external supply) in the INV.

With the fan supply it is possible to operate all fans of the Active Infeed Converter AIC and the fans of up to four inverters.



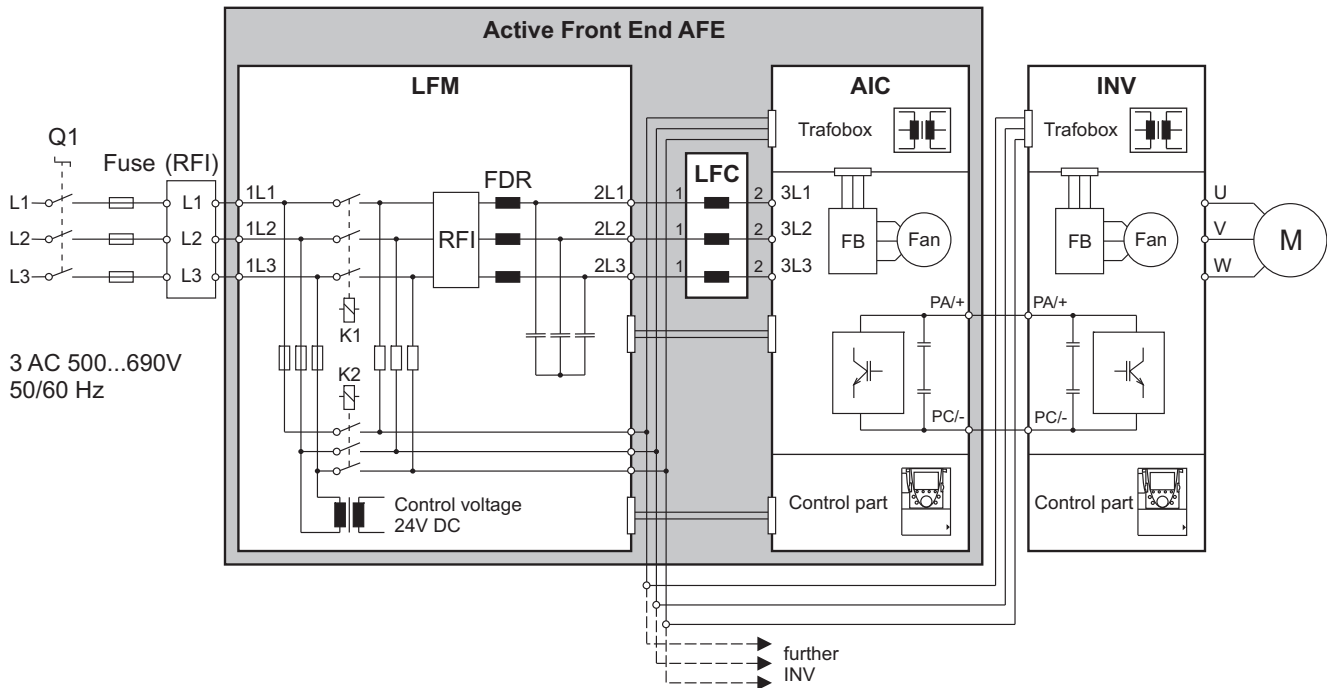
The inverters INV of the types  
ATV61H075N4 ... HC11N4  
ATV71H075N4 ... HD90N4  
do not require an external fan supply from the line filter module LFM.



The fans are internally protected when supplied via the line filter module LFM. Therefore no additional fuses are required.

For the 690 V devices the fans are supplied via the transformer box at the top side of the devices. The connection to the Active Infeed Converter AIC is included in delivery and has to be connected to the line filter module LFM only.

The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the transformer box at the top side of the INV. Therefore a terminal module is necessary (deliverable as option "Fan wiring 6V" with reference number VW3A7280)



The fans are internally protected when supplied via the line filter module LFM. Therefore no additional fuses are required.



For fan supply of the inverter(s) INV it is necessary to order the option "Fan wiring 6V" with reference number VW3A7280.

1x VW3A7280 for ATV61HC11Y...C40Y; ATV71HC11Y...C31Y

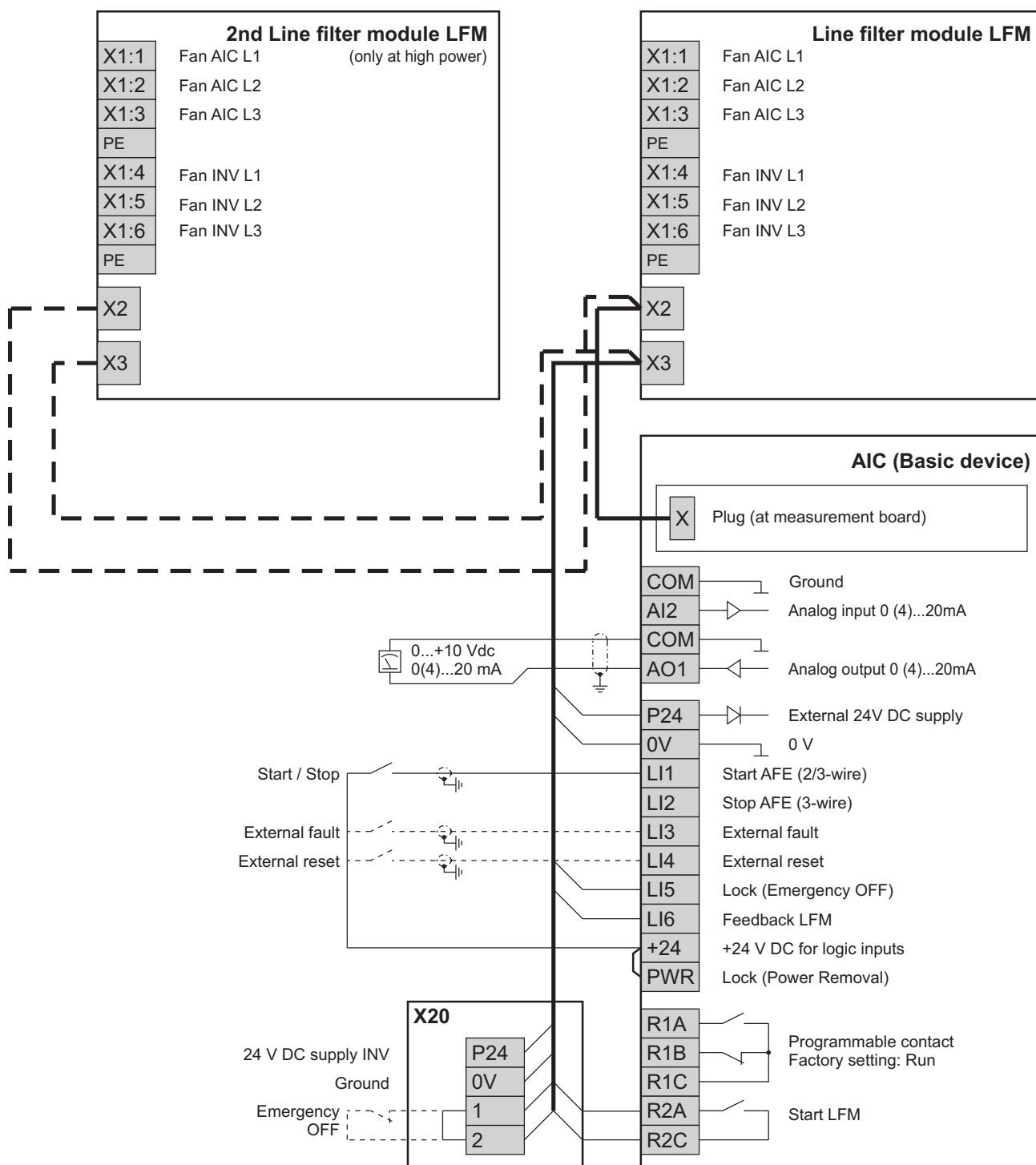
2x VW3A7280 for ATV61HC50Y...C80Y; ATV71HC40Y...C63Y

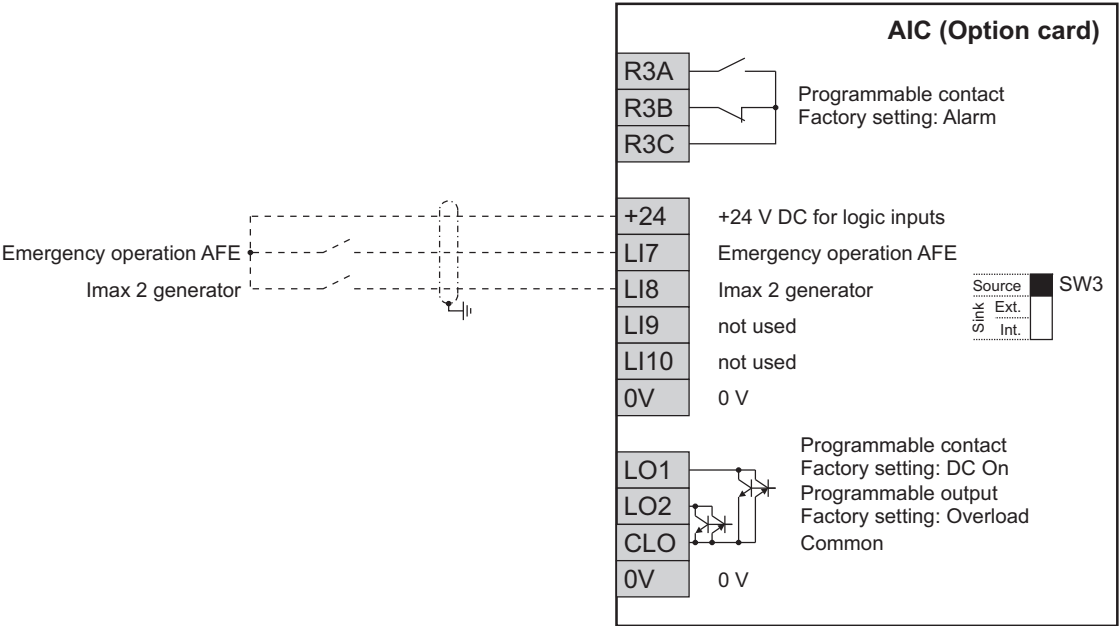
#### Terminal connections

The following presentation shows the wiring of the control terminals between the line filter module LFM and the Active Infeed Converter AIC.

The wiring is significantly simplified by means of two ready-made cables with plugs which are already connected to the AIC. The cables are designed for a maximum distance of 1 m between AIC and LFM.

At 400 V devices up to 340 kW and at 690 V devices up to 430 kW, the Active Infeed Converter AIC is connected with only one LFM. In case of higher power the AIC is connected with two LFMs.





#### External control wiring

The following diagrams show the control wiring when several inverters are operated at an DC bus supplied by the Active Front End. Similar to the single drive, there are several possibilities for control of the Active Front End.

The inverters supplied via the DC bus may have different power.



Ensure that the sum of the required DC power and the sum of the capacities at the DC bus do not exceed the limits of the Active Infeed Converter AIC.



The users are responsible to integrate the Active Front End units into the protection and safety concept of the plant or machine.

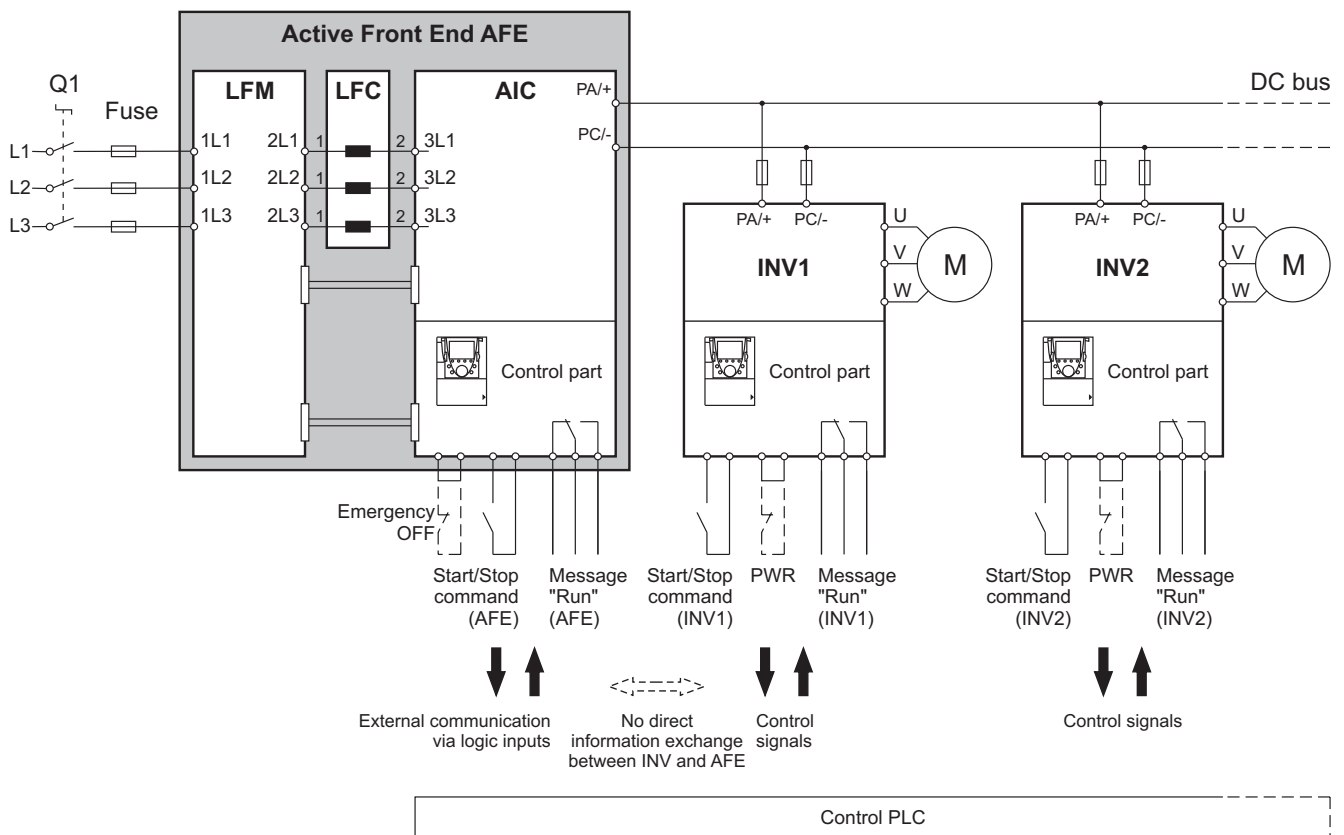


In case of a mains failure during motor operation, the Active Front End as well as the inverter recognise the undervoltage and react according to their parameterization (impulse inhibit, alarm, trip). In generator operation the inverter may not recognize a mains failure always.

#### Control via start/stop signals

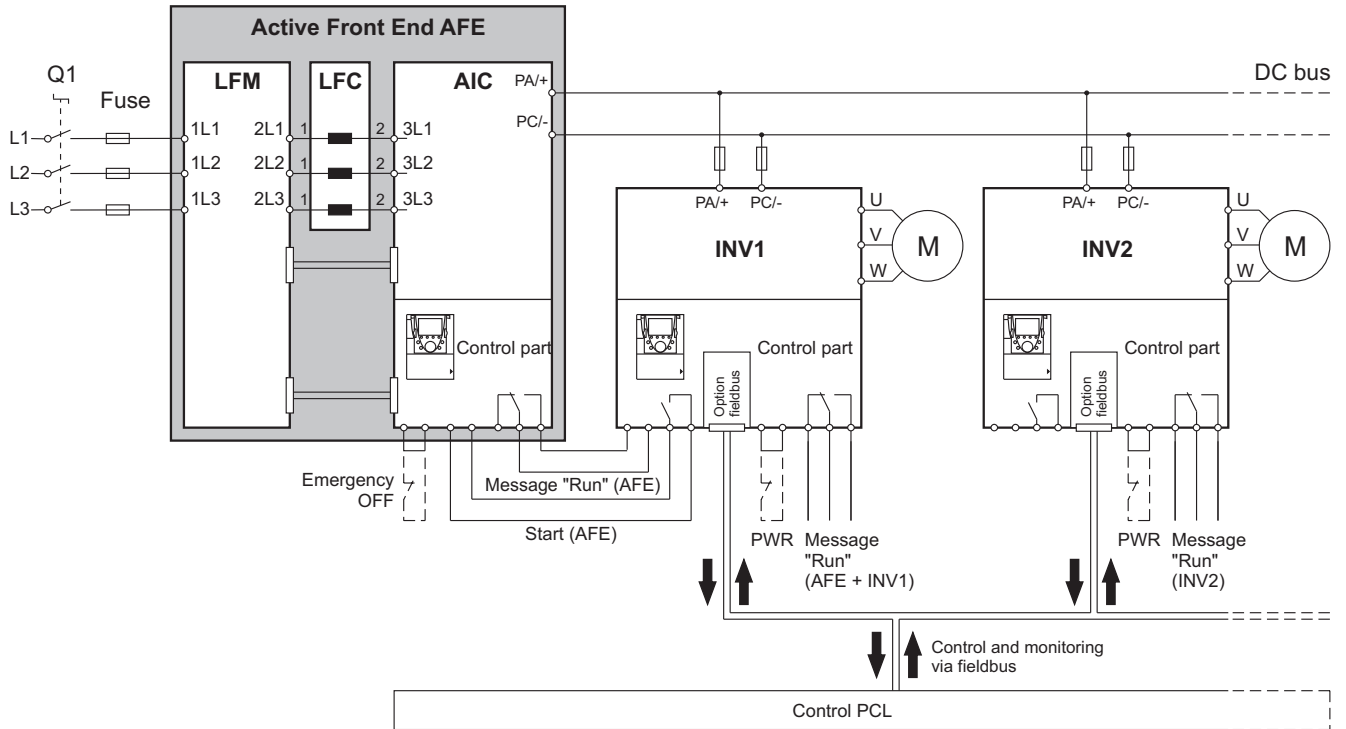
The Active Front End is controlled separately from the inverters by means of an own start command.

In this case the Active Front End AFE and the inverters INV have to be integrated separately to the superior control concept.



#### Control via start/stop signals of the inverter

The Active Front End is not controlled by an own start command but via the inverter.



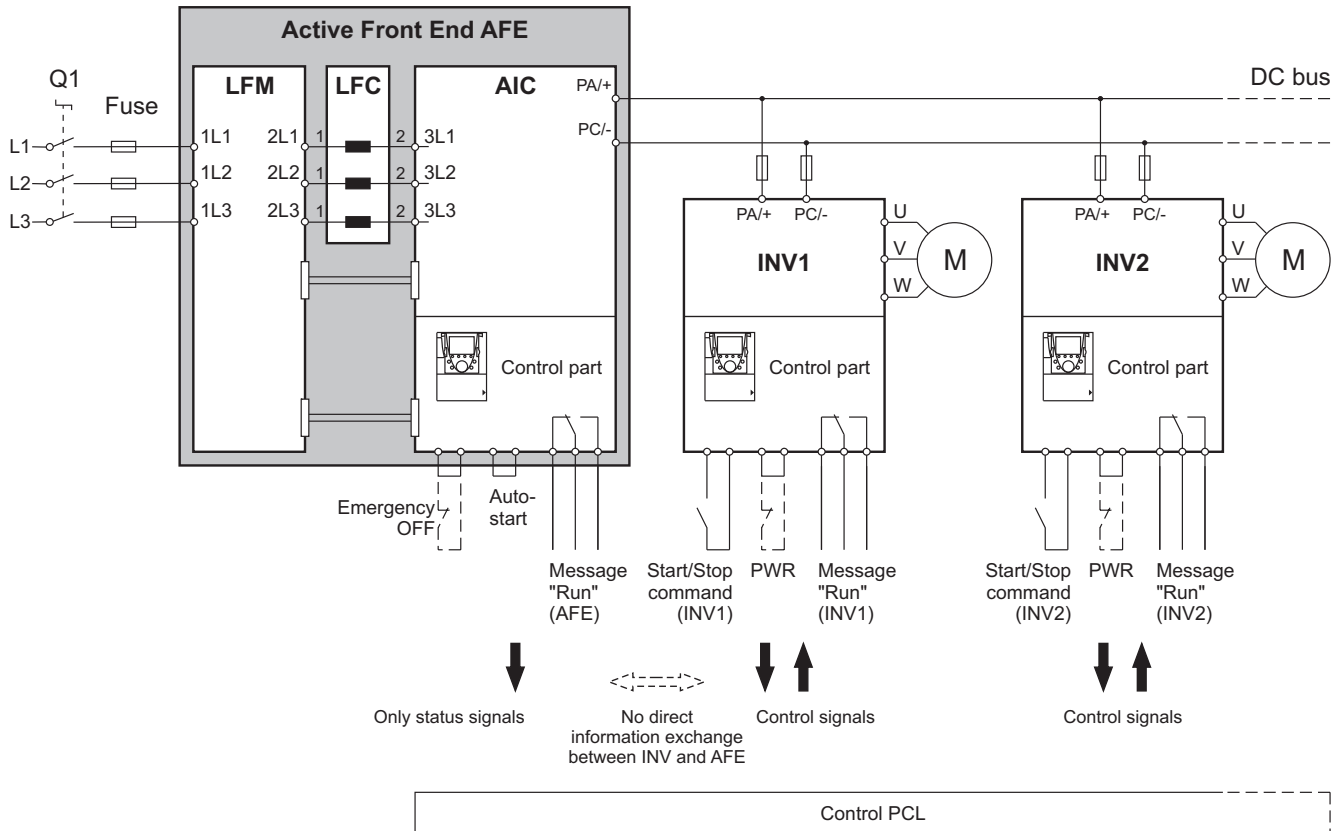
The 24 V DC buffer voltage of the inverter, that controls the Active Front End, can be taken from the Active Infeed Converter AIC.

When further inverters should be supplied with a buffer voltage, it has to be generated external.



#### Control of the Active Front End via mains connection/disconnection

It is also possible with a common DC bus to operate the Active Front End without additional control. In this case the Active Front End starts as soon as voltage is recognised at the input.



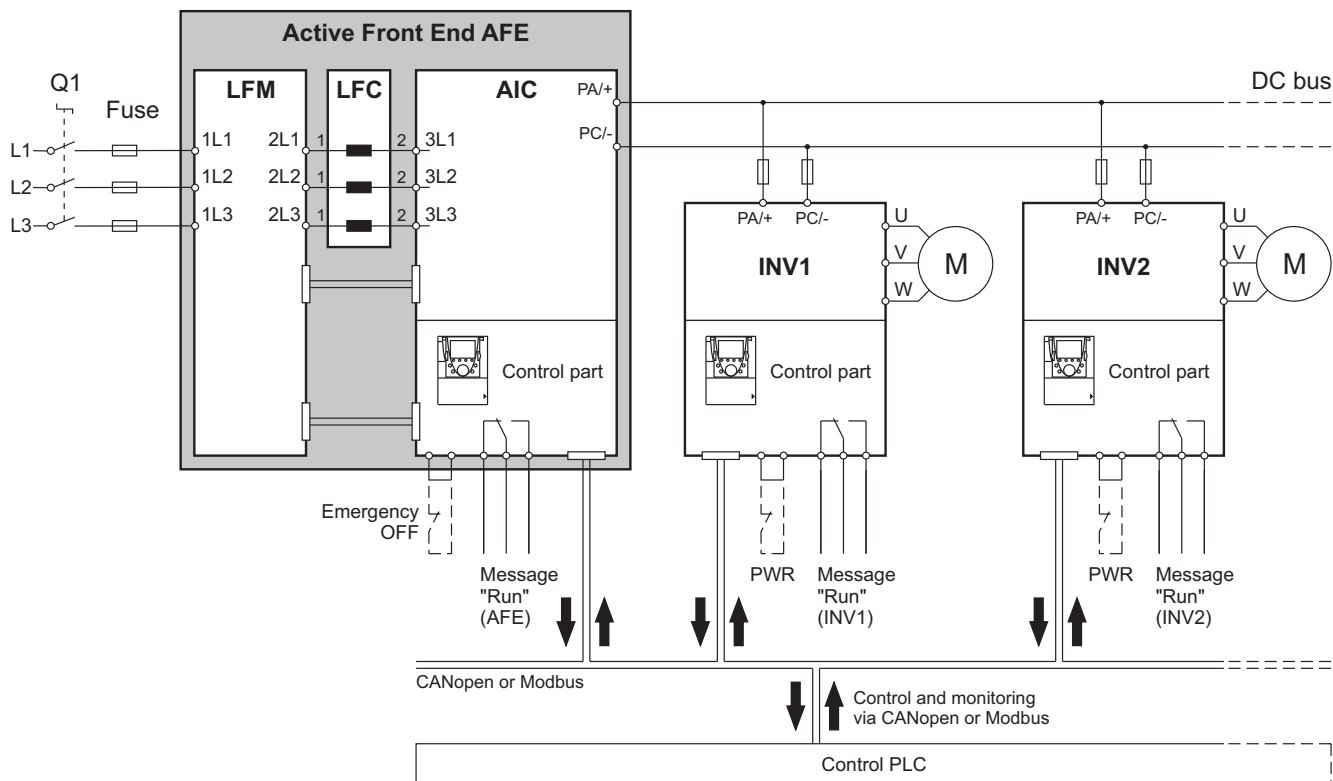
In case of a mains failure during motor operation, the Active Front End as well as the inverter recognise the undervoltage and react according to their parameterization (impulse inhibit, alarm, trip). In generator operation the inverter may not recognize a mains failure always.



The 24 V DC buffer voltage of an inverter INV can be taken from the Active Infeed Converter AIC. When further inverters should be supplied with a buffer voltage, it has to be generated external.

#### Control of the Active Front End via direct fieldbus control

When the communication at the control system takes place with CANopen or Modbus, the inverters and the Active Infeed Converter can be directly connected to and controlled by the bus system.

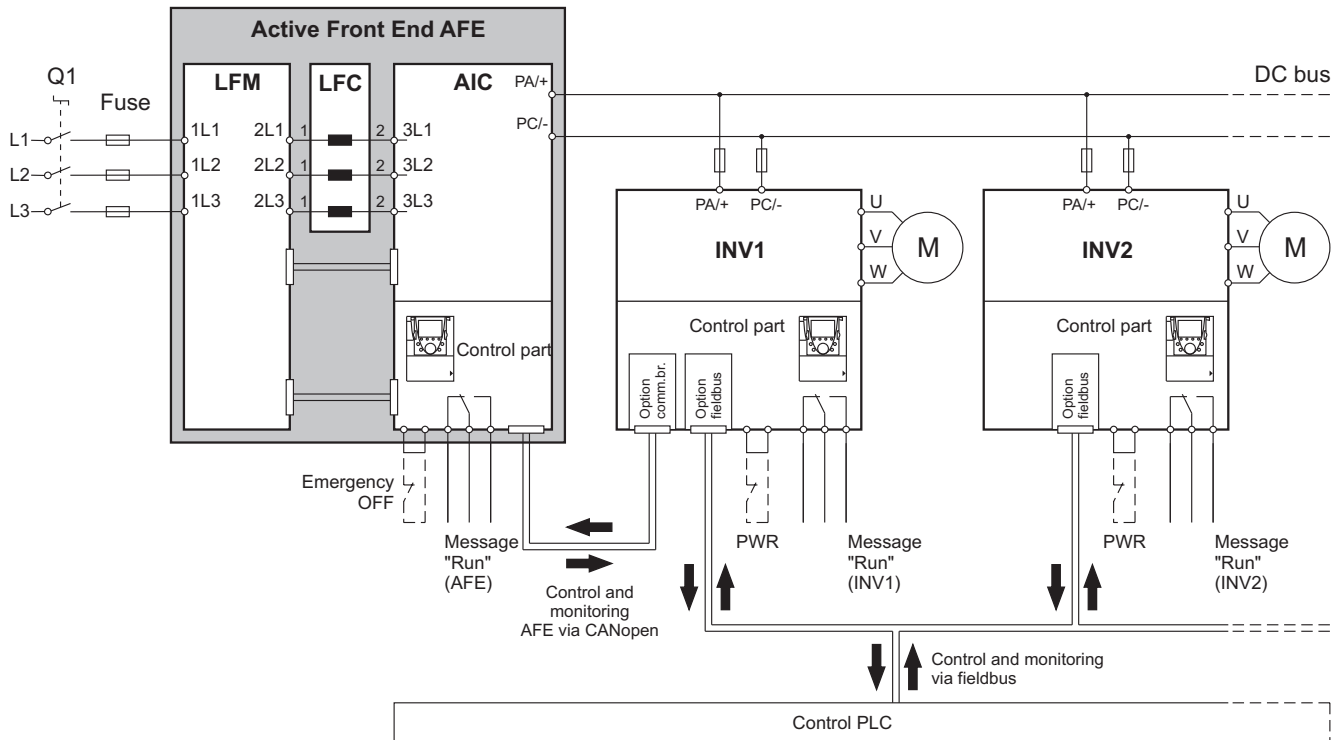


The 24 V DC buffer voltage of an inverter INV can be taken from the Active Infeed Converter AIC. When further inverters should be supplied with a buffer voltage, it has to be generated external.

#### Control of the Active Front End via indirect fieldbus control

The Active Front End is controlled and monitored by means of the option card "communication bridge" of the inverter. The connection to the Active Front End AFE is done via CANopen.

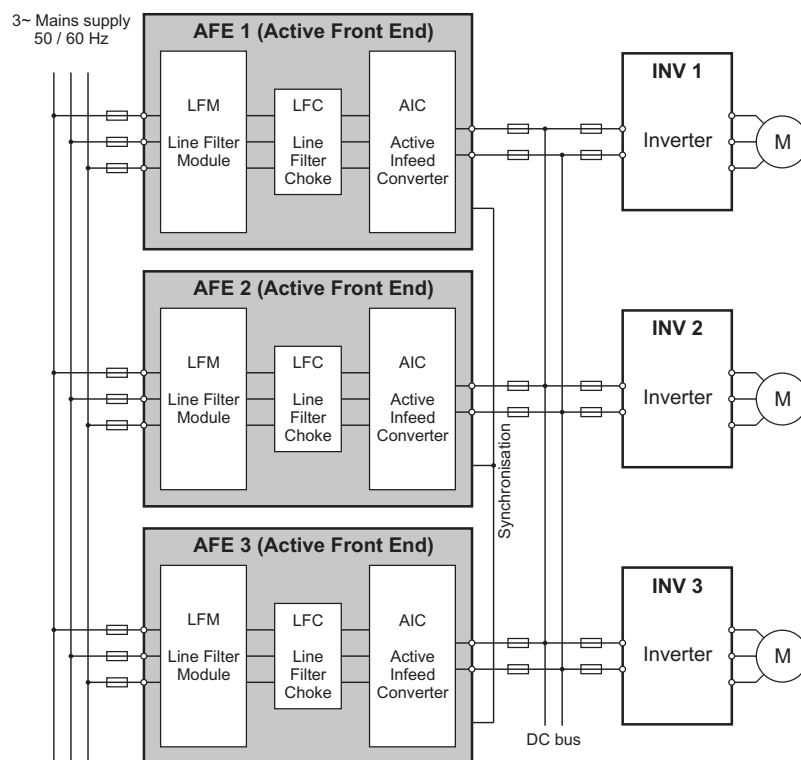
By using a fieldbus option card it is possible to control the inverter as well as the Active Infeed Converter via the inverter. Therefore each fieldbus system, which is available for the inverter, can be used.



The 24 V DC buffer voltage of an inverter INV can be taken from the Active Infeed Converter AIC. When further inverters should be supplied with a buffer voltage, it has to be generated external.

## Description

In case of parallel connection of several Active Front End units AFE they supply a common DC bus. Thus it is possible to ensure a higher power at the DC bus or to increase reliability due to redundancy. Up to four Active Front End units can be connected in parallel. Several inverters of different power can be operated at the DC bus. This enables also balance of energy at the DC link.



Parallel connection of the Active Front End units is possible without derating. Units of different power can be operated parallel whereas the smallest AFE unit should not be less than 50 % of the power of the biggest unit.

Depending on the power demand individual Active Front End units can be locked or released during operation.

However, connection and disconnection must be only executed when there is no voltage!



Take care of correct fuse protection of all components connected to the DC bus.



Please observe the information and notes about the inverters in chapter "Inverter", page 92 and the device documentation provided on the CD-ROM which is attached to each inverter.

## Dimensioning

Pay attention to following points when several inverters are operated at a common DC bus that is supplied by one or several Active Front End units:

■ Total DC power

Add the required DC power of all drives that are connected to a DC bus, which is supplied by an Active Front End. Thereby you have to check the motor and generator powers.

The DC link power of all connected inverters must not exceed the sum of the DC link power of the Active Front End units.

■ Capacity of the DC bus

In order to avoid overload of the charging circuit of the Active Front End, observe the sum of the capacities of all inverters connected to the DC bus. The connected capacities must not be higher than the load capacity of the Active Front End units.

■ AFE type

It is possible to connect two different types of Active Front End units parallel. However, the smallest Active Front End should not be less than 50 % of the power of the biggest unit.

Nevertheless we recommend to connect only Active Front End units of same type parallel.

## Active Front End for 400 V mains

Continuous DC power [kW] 400 V	Load capacity [mF]	Active Front End AFE					
		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
120	30	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
143	40	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
172	40	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
238	80	4V240	VW3A7253	4V340	VW3A7262	4V340	VW3A7267
268	80	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
336	80	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
425	160	4V430	VW3A7256	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
530	160	4V540	VW3A7257	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
665	160	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

## Active Front End for 480 V mains

Continuous DC power [kW] 480 V	Load capacity [mF]	Active Front End AFE					
		Active Infeed Converter AIC		Line Filter Module LFM		Line Filter Choke LFC	
		Type	Reference	Type	Reference	Type	Reference
130	30	4V120	VW3A7250	4V120	VW3A7260	4V120	VW3A7265
162	40	4V145	VW3A7251	4V175	VW3A7261	4V175	VW3A7266
162	40	4V175	VW3A7252	4V175	VW3A7261	4V175	VW3A7266
277	80	4V240-13	VW3A7283	4V340	VW3A7262	4V340	VW3A7267
315	80	4V275	VW3A7254	4V340	VW3A7262	4V340	VW3A7267
390	80	4V340	VW3A7255	4V340	VW3A7262	4V340	VW3A7267
490	160	4V430-15	VW3A7286	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
610	160	4V540-15	VW3A7287	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267
770	160	4V675	VW3A7258	2x4V340	2xVW3A7262	2x4V340	2xVW3A7267

Active Front End for 500 / 600 / 690 V mains									
Continuous DC power [kW]			Load capacity [mF]	Active Front End AFE		Line Filter Module LFM		Line Filter Choke LFC	
500 V	600 V	690 V		Active Infeed Converter AIC Type	Reference	Type	Reference	Type	Reference
102	123	142	16	6V145	VW3A7270 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
127	153	172	16	6V175	VW3A7271 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
157	162	215	16	6V220	VW3A7272 <sup>1)</sup>	6V220	VW3A7263	6V220	VW3A7268
193	230	268	32	6V275	VW3A7273 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
242	290	335	32	6V340	VW3A7274 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
305	365	424	32	6V430	VW3A7275 <sup>1)</sup>	6V430	VW3A7264	6V430	VW3A7269
382	460	528	64	6V540	VW3A7276 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
478	575	663	64	6V675	VW3A7277 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269
607	730	842	64	6V860	VW3A7278 <sup>2)</sup>	2x6V430	2xVW3A7264	2x6V430	2xVW3A7269

3.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 1x

4.) ... additionally the option Fan wiring 6V (VW3 A7 280) has to be ordered 2x

DC bus capacities for 400 V – 440 V mains					
Active Infeed Converter AIC		DC fuse [A]	Recommended type of fuse		DC capacity [mF]
Type	Reference		Ferraz Shawmut 1)	Bussmann 2)	
4V120	VW3A7250	250	12.5 URD 70 TTF 0250	170M3395	6.5
4V145	VW3A7251	315	12.5 URD 71 TTF 0315	170M3396	9.8
4V175	VW3A7252	350	12.5 URD 71 TTF 0350	170M3397	9.8
4V240	VW3A7253	500	12.5 URD 72 TTF 0500	170M4445	13
4V275	VW3A7254	550	12.5 URD 72 TTF 0550	170M4446	14
4V340	VW3A7255	700	12.5 URD 73 TTF 0700	170M5447	20
4V430	VW3A7256	2x450	2x 12.5 URD 72 TTF 0450	2x 170M4394	21
4V540	VW3A7257	2x550	2x 12.5 URD 72 TTF 0550	2x 170M4446	30
4V675	VW3A7258	2x700	2x 12.5 URD 73 TTF 0700	2x 170M5447	39

1.) ... Ferraz Shawmut - Protistor semiconductor fuse PSC aR sizes 7x – 1250/1300Vac

2.) ... Bussmann - High speed fuse square body flush end contact – 1250/1300Vac

DC bus capacities for 480 V mains (UL)					
Active Infeed Converter AIC		DC fuse [A]	Recommended type of fuse		DC capacity [mF]
Type	Reference		Ferraz Shawmut 1)	Bussmann 2)	
4V120	VW3A7250	250	A130 URD 70 TTI 0250	170M3395	6.5
4V145	VW3A7251	315	A130 URD 71 TTI 0315	170M3396	9.8
4V175	VW3A7252	350	A130 URD 71 TTI 0350	170M3397	9.8
4V240-13	VW3A7283	500	A130 URD 72 TTI 0500	170M4445	14
4V275	VW3A7254	550	A130 URD 72 TTI 0550	170M4446	14
4V340	VW3A7255	700	A130 URD 73 TTI 0700	170M5447	20
4V430-15	VW3A7286	2x450	2x A130 URD 72 TTI 0450	2x 170M4394	39
4V540-15	VW3A7287	2x550	2x A130 URD 72 TTI 0550	2x 170M4446	39
4V675	VW3A7258	2x700	2x A130 URD 73 TTI 0700	2x 170M5447	39

1.) ... Ferraz Shawmut - Protistor semiconductor fuse PSC aR sizes 7x – 1250/1300Vac

2.) ... Bussmann - High speed fuse square body flush end contact – 1250/1300Vac

DC bus capacities for 500 / 690 V mains					
Active Infeed Converter AIC		DC fuse [A]	Recommended type of fuse		DC capacity [mF]
Type	Reference		Ferraz Shawmut 1)	Bussmann 2)	
6V145	VW3A7270	160	CC 7.5 gRC 120 TTF 0160	170E3581	3.9
6V175	VW3A7271	200	CC 7.5 gRC 121 TTF 0200	170E5417	3.9
6V220	VW3A7272	250	CC 7.5 gRC 121 TTF 0250	170E5418	3.9
6V275	VW3A7273	315	CC 7.5 gRC 122 TTF 0315	170E8336	7.8
6V340	VW3A7274	400	CC 7.5 gRC 122 TTF 0400	170E8337	7.8
6V430	VW3A7275	500	CC 7.5 gRC 123 TTF 0500	170E9681	7.8
6V540	VW3A7276	630	2x CC 7.5 gRC 122 TTF 0630	2x 170E8336	16
6V675	VW3A7277	800	2x CC 7.5 gRC 122 TTF 0800	2x 170E8337	16
6V860	VW3A7278	1000	2x CC 7.5 gRC 123 TTF 1000	2x 170E9681	16

1.) ... Ferraz Shawmut - Protistor semiconductor fuse PSC aR sizes 7x – 1250/1300Vac

2.) ... Bussmann - High speed fuse square body flush end contact – 1250/1300Vac

DC bus capacities for 600 V mains (UL/CSA)				
Active Infeed Converter AIC		DC fuse [A]	Recommended type of fuse Bussmann 1)	DC capacity [mF]
Type	Reference			
6V145	VW3A7270	160	170M1826	3.9
6V175	VW3A7271	200	170M1827	3.9
6V220	VW3A7272	250	170M1828	3.9
6V275	VW3A7273	315	170M1829	7.8
6V340	VW3A7274	400	170M1831	7.8
6V430	VW3A7275	500	170M1833	7.8
6V540	VW3A7276	2x315	2x 170M1829	16
6V675	VW3A7277	2x400	2x 170M1831	16
6V860	VW3A7278	2x500	2x 170M1833	16

1.) ... Bussmann - High speed fuse square body flush end contact – 1250/1300Vac



Further technical data can be found in chapter "Technical data".



Generally also other models and types of fuses can be used provided that their electrical data are comparable.  
In order to meet the requirements of UL/CSA, the specified fuse types have to be used.

**Parallel connection**

In this example two Active Front End units supply a common DC bus at which several inverters are operated. A mains voltage is 400 V is expected.

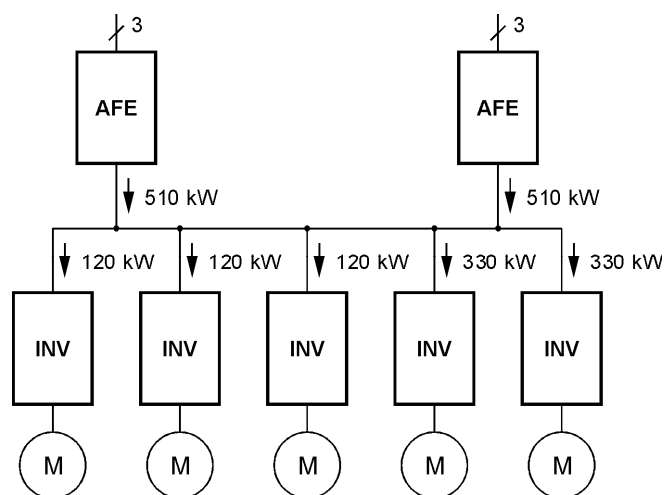
The two Active Front End units are used to reach a higher power at the DC bus. The control has to ensure that both Active Front End units are controlled simultaneously. It is not necessary to take the capacity of the Active Front End units into account because the Active Front End itself supplies its capacities.

In case of parallel connection due to increase redundancy, the capacity of the Active Front End has to be observed because the supply of the whole DC bus has to be provided if the Active Front End breaks down.

In order to select the Active Front End units, the performance record and the total charging capacity at the DC bus have to be checked.

3 pieces ATV61HC11N4D and 2 pieces ATV61HC31N4D are used as inverters. Thus each inverter needs a DC power of 120 kW or 330 kW, as specified in the previous tables.

As the capacities at the DC bus (independent of the energy direction) have to be charged by the Active Front End, they have to be added.



Inverter	Power demand	Capacity
ATV61HC11N4D	120 kW motor	6.5 mF
ATV61HC11N4D	120 kW motor	6.5 mF
ATV61HC11N4D	120 kW motor	6.5 mF
ATV61HC31N4D	330 kW motor	20 mF
ATV61HC31N4D	330 kW motor	20 mF
Sum	1020 kW motor	59.5 mF

Due to the parallel connection, two Active Front End units of same type are selected. Based on the performance record the following two Active Front End units are selected, consisting of following components:

2x 1x	AIC	4V540	VW3A7257	Total power (of both AFEs): 1060 kW
2x 2x	LFM	4V340	VW3A7262	Load capacity (per AFE): 160 mF
2x 2x	LFC	4V340	VW3A7267	

Due to the tolerances of components, the load sharing between the two AFEs may differ up to 40 % in partial-load range.



When connecting two or more AFEs parallel to increase the total power, it has to be ensured by the superior control that all AFEs are ready to run and that they are started simultaneously (within 100ms). Derating by parallel connection is not required.

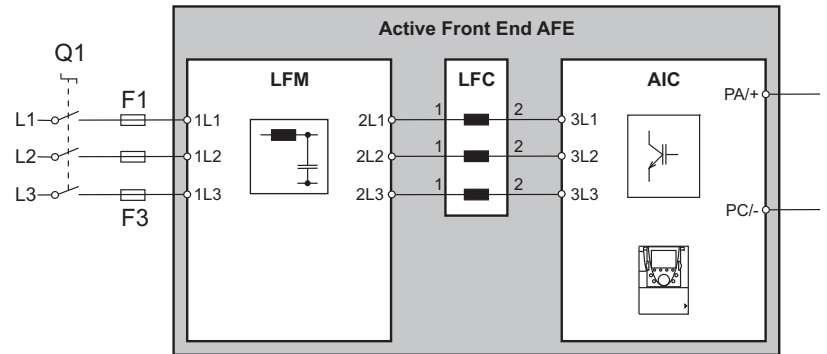


#### Power wiring

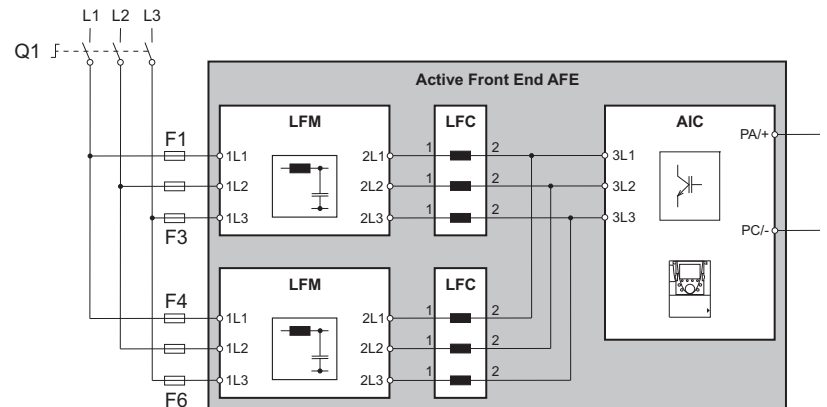
The Active Front End consists of three components in principle: the Line Filter Module LFM, the Line Filter Choke LFC and the Active Infeed Converter AIC.

The 3-phase mains connection is done at the Line Filter Module LFM. Further power connection is done via the Line Filter Choke LFC (3 single phase chokes) to the Active Infeed Converter AIC.

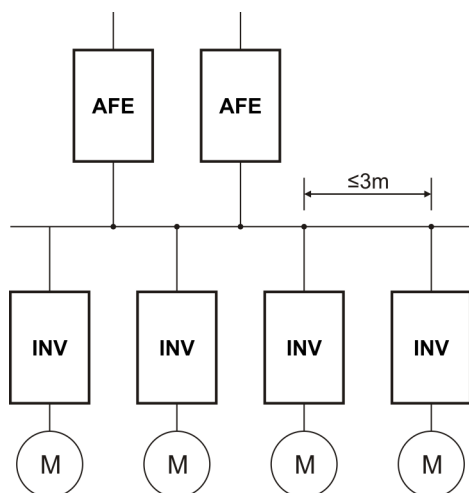
In the power range to 340 kW (up to 430 kW at 500 / 690 V) **one** LFM and **one** LFC (consisting of three parts) is connected upstream to the Active Infeed Converter AIC.



In the power range from 430 kW (from 540 kW at 500 / 690 V) the Active Front End consists of an AIC, **two** LFMs and **two** LFCs (each consisting of three single phase chokes).



In case of parallel connection of Active Front End units they are connected to all inverters via a DC bus.



Basically the expansion of the DC bus should be kept as small as possible. The distance between the components (AFE, INV) must not exceed 3m. Arrangements with longer DC wiring must be checked and damping elements to avoid resonances have to be built in when required. Further information is available on request.



In case of faulty wiring of the DC link, e.g. due to exchanging terminals PA/+ and PC/- or an earth fault, the inverter as well as the Active Front End may be damaged or destroyed.

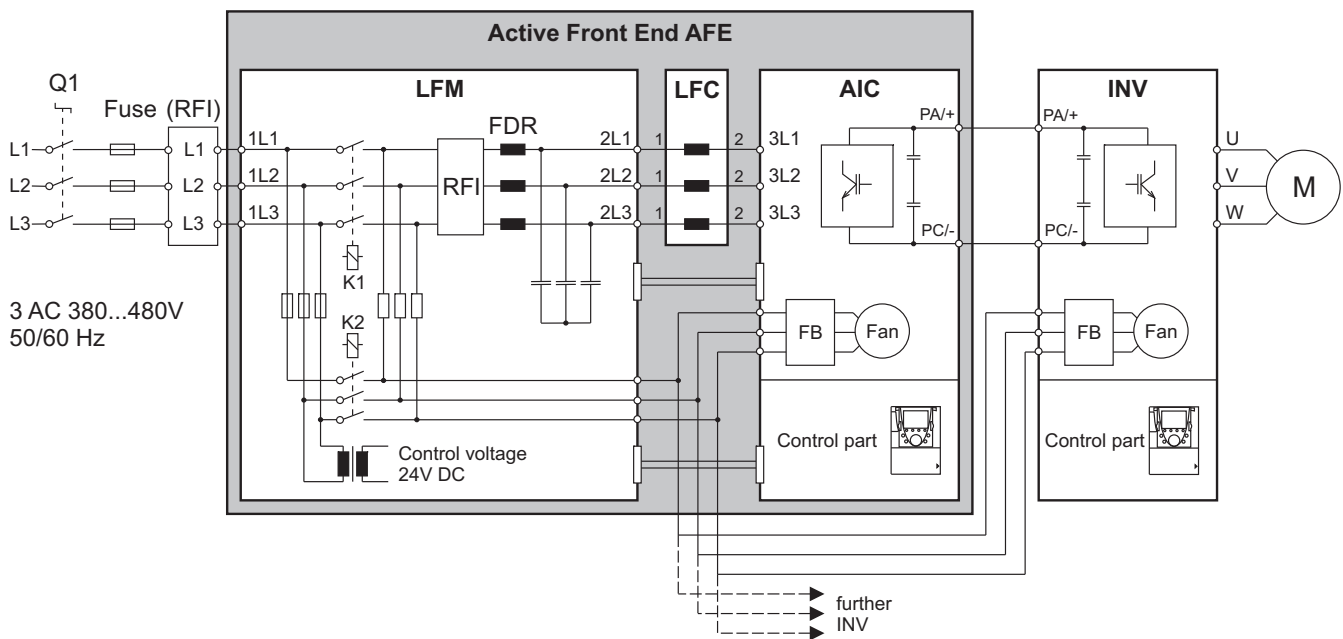
#### Internal control wiring

The voltage for fan supply and the control voltage are generated in the line filter module LFM.

The control wiring between the line filter module LFM and the Active Infeed Converter AIC is realized by the provided connecting cables W2 and W3. As soon as mains voltage is applied to the terminals 1L1, 1L2, 1L3, a 24 V auxiliary voltage is produced to supply the Active Infeed Converter AIC. It can be also used to buffer the control electronics of one inverter INV.

For the 400 V devices (except VW3 A7 250 due to DC fans) the cable W1 has to be connected to the line filter module LFM in order to supply the fans in the Active Infeed Converter AIC. The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the auxiliary terminal block R0/S0/T0 (switching to external supply) in the INV.

With the fan supply it is possible to operate all fans of the Active Infeed Converter AIC and the fans of up to four inverters.



The inverters INV of the types  
ATV61H075N4 ... HC11N4  
ATV71H075N4 ... HD90N4  
do not require an external fan supply from the line filter module LFM.



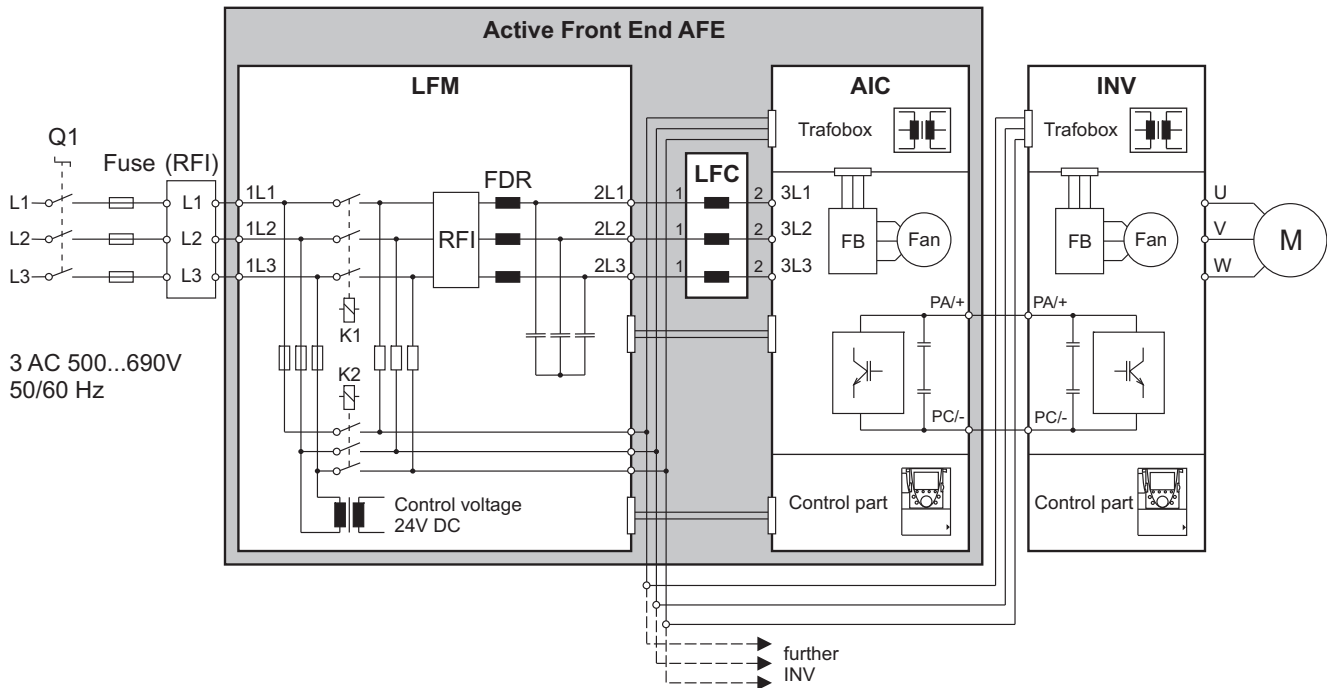
The fans are internally protected when supplied via the line filter module LFM. Therefore no additional fuses are required.



For parallel operation of Active Front End units an additional control line is required. It "synchronizes" the individual Active Front End units.

For the 690 V devices the fans are supplied via the transformer box at the top side of the devices. The connection to the Active Infeed Converter AIC is included in delivery and has to be connected to the line filter module LFM only.

The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the transformer box at the top side of the INV. Therefore a terminal module is necessary (deliverable as option "Fan wiring 6V" with reference number VW3A7280)



For fan supply of the inverter(s) INV it is necessary to order the option "Fan wiring 6V" with reference number VW3A7280.

1x VW3A7280 for ATV61HC11Y...C40Y; ATV71HC11Y...C31Y

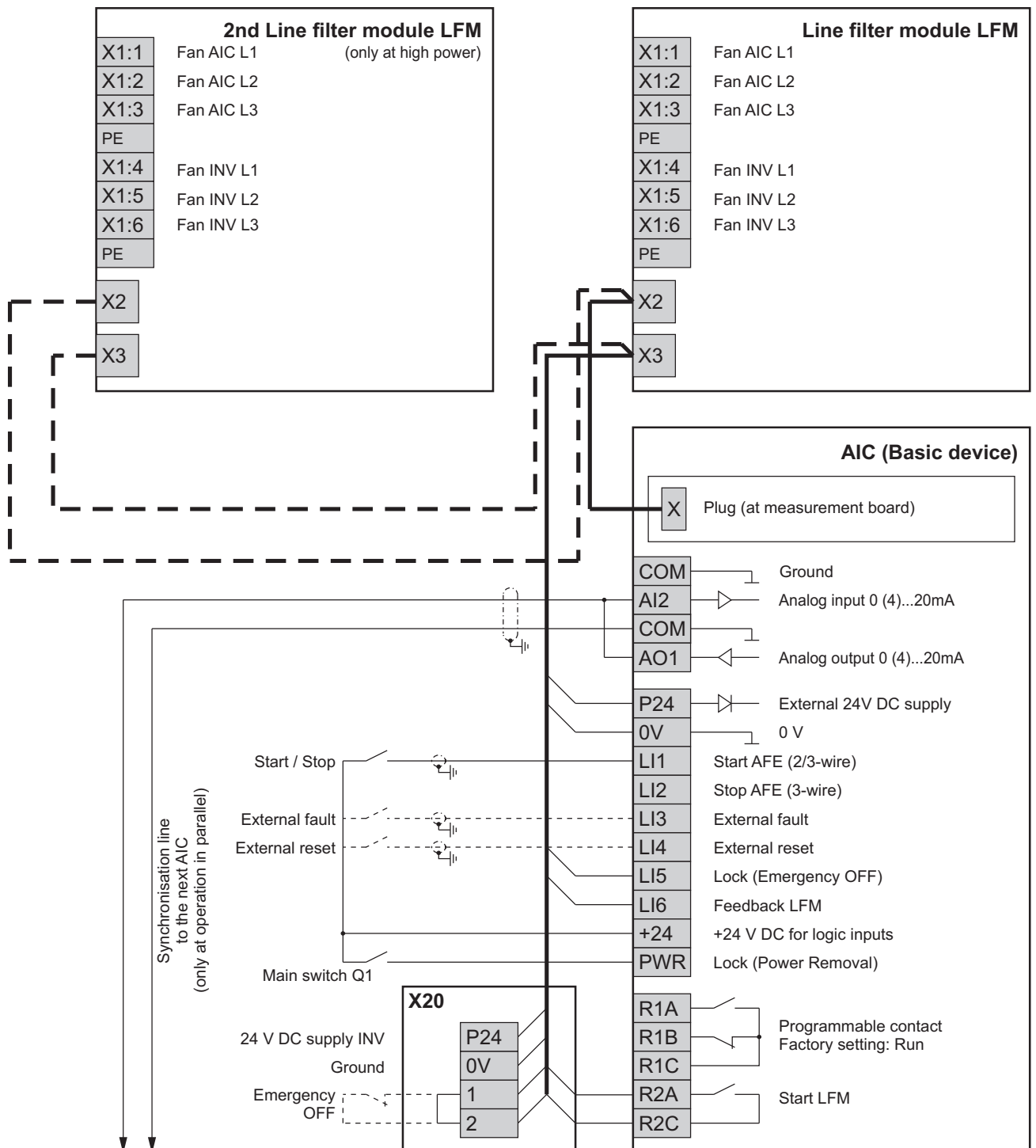
2x VW3A7280 for ATV61HC50Y...C80Y; ATV71HC40Y...C63Y

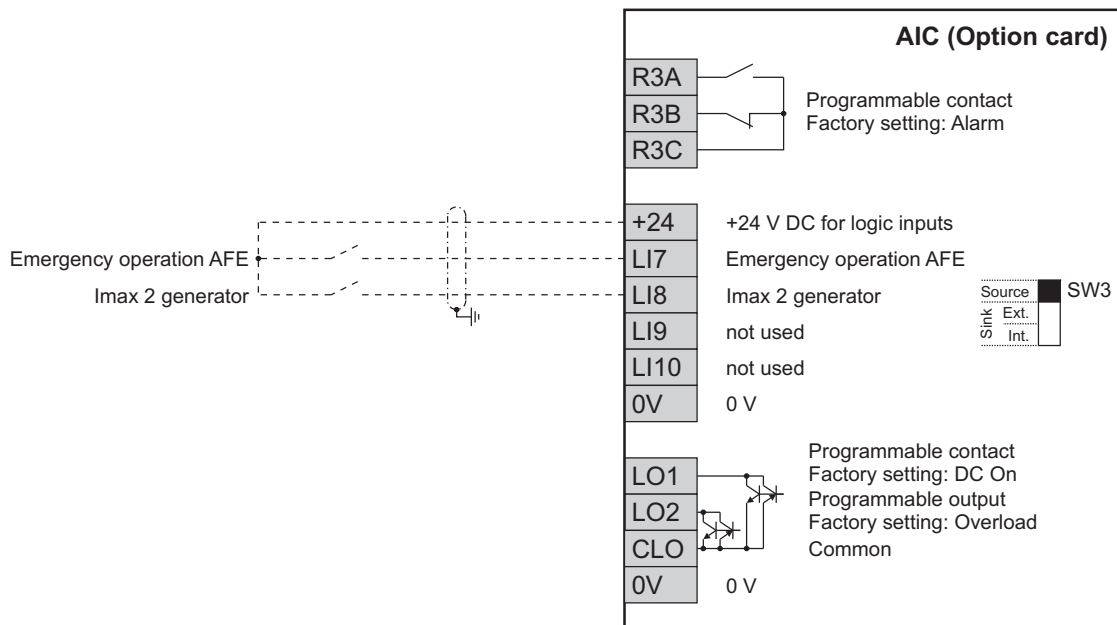
#### Terminal connections

The following presentation shows the wiring of the control terminals between the line filter module LFM and the Active Infeed Converter AIC.

The wiring is significantly simplified by means of two ready-made cables with plugs which are already connected to the AIC. The cables are designed for a maximum distance of 1 m between AIC and LFM.

At 400 V devices up to 340 kW and at 690 V devices up to 430 kW, the Active Infeed Converter AIC is connected with only one LFM. In case of higher power the AIC is connected with two LFMs.





At parallel operation of 4 Active Front End units AFE an interruption of the synchronisation line may not be detected definitely !



As soon as parameter 2.1.02 "Parallel operation" is set to "active", the analog outputs and inputs are not available any longer because they are used for synchronisation.

#### External control wiring

The following diagrams show the control wiring when several inverters are operated at an DC bus supplied by several Active Front End units. There are several possibilities for control of the Active Front End units.

For parallel operation of Active Front End units an additional control line is required. It "synchronizes" the individual Active Front End units.

The inverters supplied via the DC bus may have different power.



Ensure that the sum of the required DC power and the sum of the capacities at the DC bus do not exceed the limits of the Active Infeed Converter AIC.



The users are responsible to integrate the Active Front End units into the protection and safety concept of the plant or machine.



In case of a mains failure during motor operation, the Active Front End as well as the inverter recognise the undervoltage and react according to their parameterization (impulse inhibit, alarm, trip). In generator operation the inverter may not recognize a mains failure always.



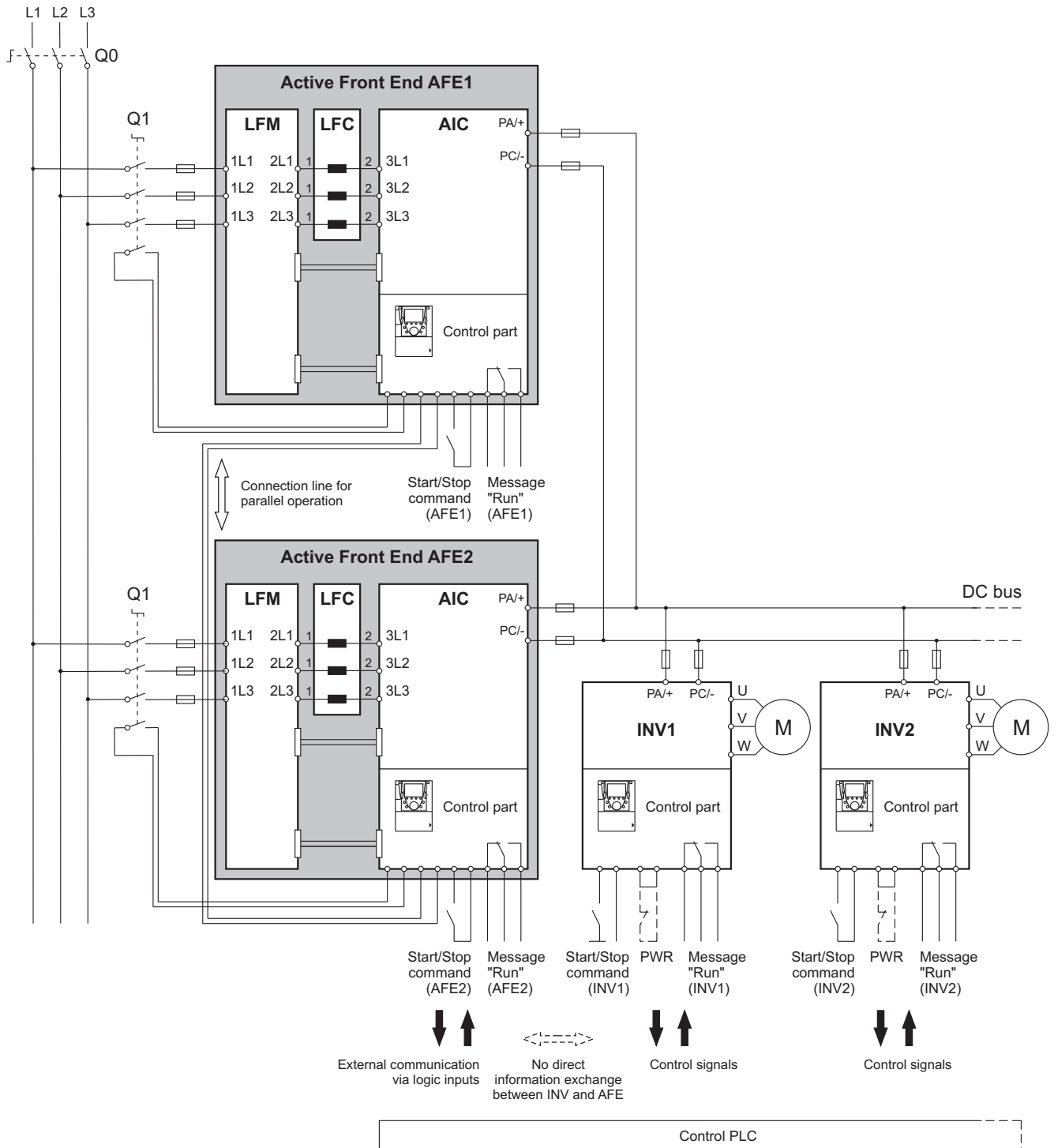
When main switches Q1 are used in case of parallel connected Active Front End units, they have to be integrated into the locking of the Active Front End by means of an auxiliary contact (e.g. input PWR).

#### Control via start/stop signals

The Active Front End units are controlled separately from the inverters by means of an own start command.

In this case the Active Front End units and the inverters have to be integrated separately to the superior control concept.

For parallel operation of AFEs a connection between the Active Front End units is required.

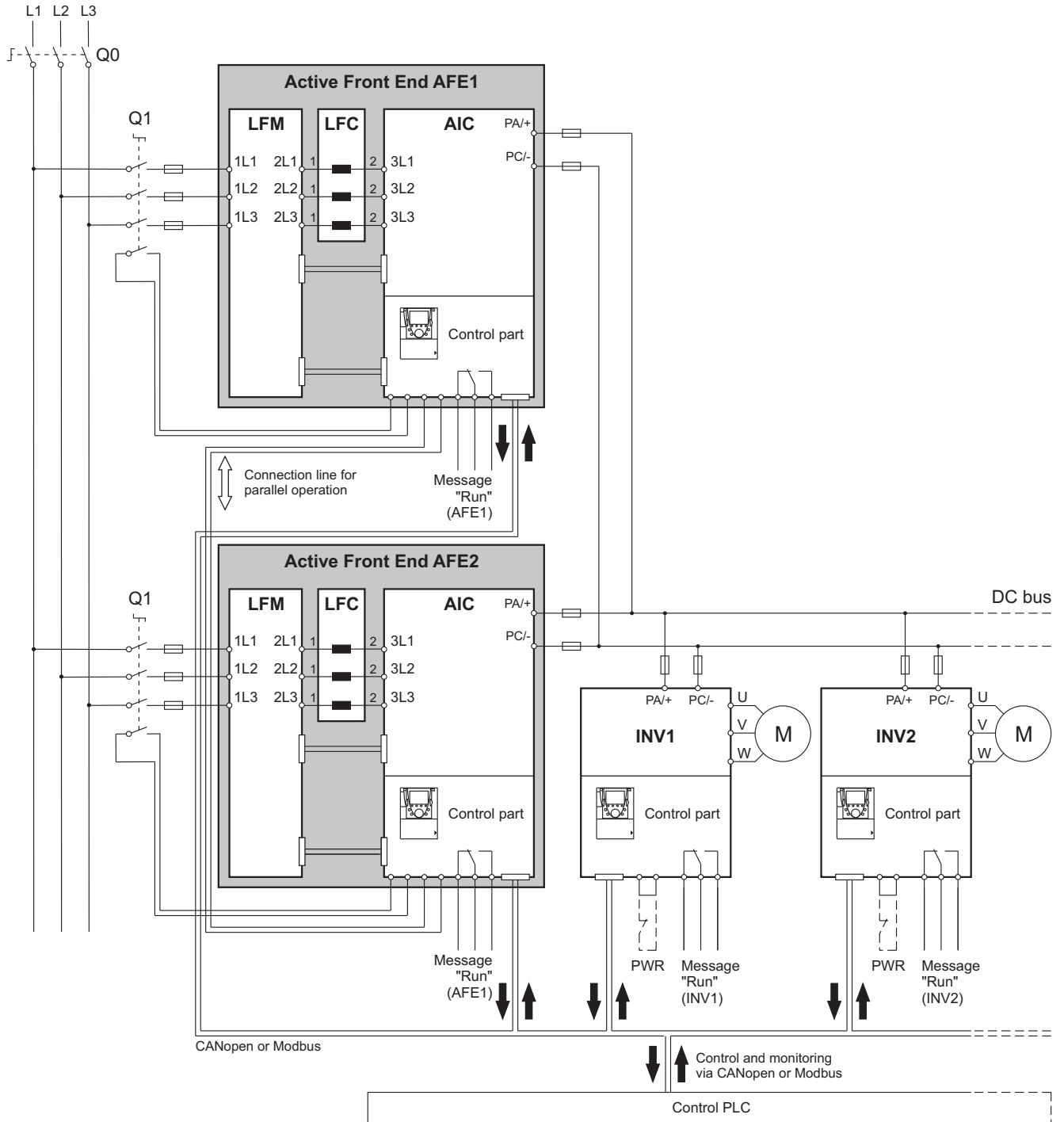




#### Control of the Active Front End via direct fieldbus control

The inverters INV as well as the Active Front End units can be tested and monitored via CANopen or Modbus using the built-in interface.

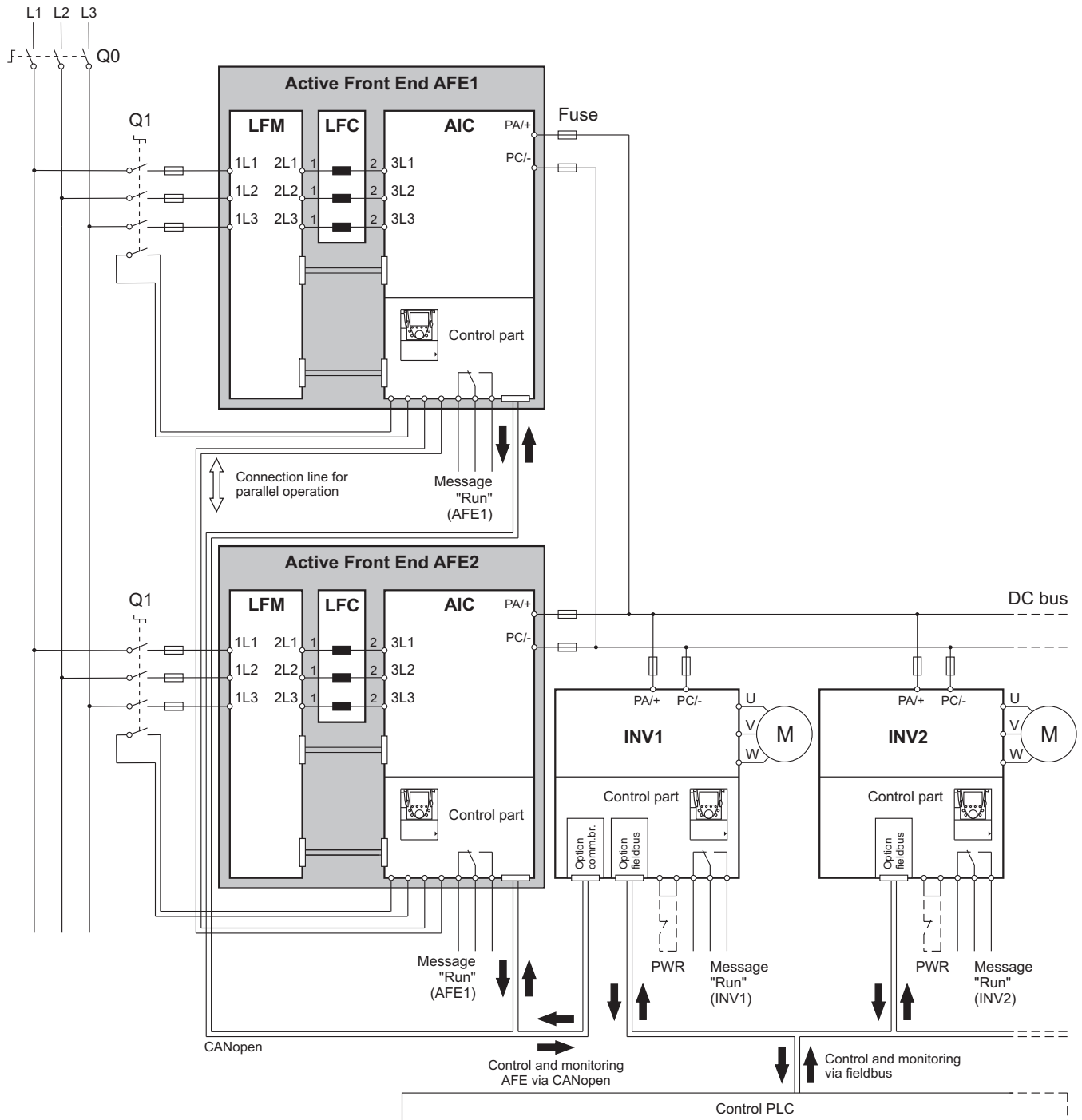
For parallel operation of AFEs a connection between the Active Front End units is required.



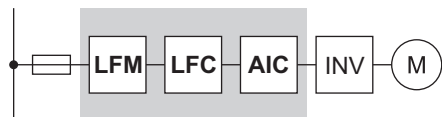
#### Control of the Active Front End via indirect fieldbus control

When communication at the control system is not realized with CANopen or Modbus but with another fieldbus system, the option card "communication bridge" is required. Combined with a "fieldbus option card" it allows indirect communication with the fieldbus system.

Please observe that the "communication bridge" card is built into the inverter. By using the fieldbus option card it is possible to control the inverter as well as the Active Infeed Converter.



## Active Front End AFE



The Active Front End AFE is used to reduce the mains current harmonics as well as to return excess energy to the mains.

It consists of following components:

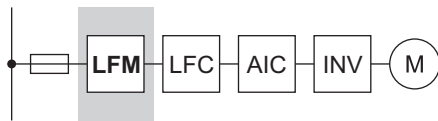
- Line Filter Module LFM
- Line Filter Choke LFC
- Active Infeed Converter AIC

Active Front End AFE	400 V	480 V	500 V / 690 V
Input			
Voltage	380...400 V ±10 % (during operation: -30 % for less than 1 min) for TT, TN or IT mains	480 V ±10 % (during operation: -40 % for less than 1 min) for TT, TN or IT mains	500...525 V ±10 % (during operation: -20 % for less than 1 min) for TT, TN or IT mains
	440 V ±10 % (during operation: -40 % for less than 1 min) for TT, TN or IT mains		600 V ±10 % (during operation: -30 % for less than 1 min) for TT, TN or IT mains
			690 V ±10 % (during operation: -40 % for less than 1 min) for TT, TN or IT mains
Frequency	50/60 Hz ±5 % (30...70 Hz short-term or with separate fan supply)		50 Hz ±5 % at 500...525 V
			50/60 Hz ±5 % at 600 V (30...70 Hz short-term or with separate fan supply)
			50/60 Hz ±5 % at 690 V (30...70 Hz short-term or with separate fan supply)
Overvoltage class	Class III according to EN EN 61800-5-1		
Output			
Nominal output voltage	650 V DC at a mains voltage of 3AC 380V/400V	770 V DC at a mains voltage of 3AC 480V	840 V DC at a mains voltage of 3AC 500V/525V
	720 V DC at a mains voltage of 3AC 440V		960 V DC at a mains voltage of 3AC 600V
			1100 V DC at a mains voltage of 3AC 690V
Overload	20 % for 60 seconds per 10 minutes, 35 % for 2 seconds		



Active Front End units are a product of the restricted sales according to IEC 61800-3. In a residential environment this product can cause radio frequency interferences whereupon the user can be called on to take suitable measures.

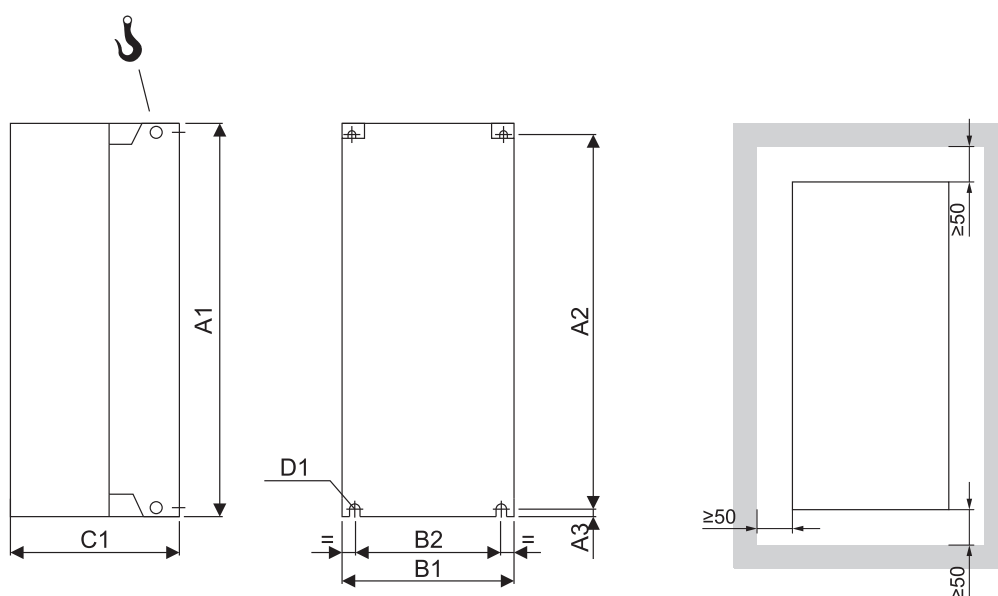
## Line filter module LFM



The line filter module LFM contains next to the real filter components also all components of the charging circuit, the main contactor (= line contactor), the supply of all device fans and the required supply units for the control voltages.

Line Filter Module LFM		400 V	500 V / 690 V
General			
Design	Built-in unit for vertical mounting		
Cooling	Natural convection / no forced ventilation		
Switching rate	Max. 10 switching operations per hour		
Short circuit protection	Due to upstream semiconductor fuses		
Auxiliary voltage output	24 V DC, suitable to supply the control electronics of the AIC and of an inverter		
Fan supply	380...480 V (according to mains voltage) suitable to supply the fans in the AIC and 4 inverters of the same power (direct connection possible)	500...690 V (according to mains voltage) suitable to supply the fans in the AIC and 4 inverters of the same power (fan supply via transformer box in the AIC and INV)	
Mechanical strength			
Mechanical vibration	According to IEC/EN 60068-2-6 1.5 mm in the range of 3...10 Hz, 0.6 g of 10...200 Hz (3M3 according to IEC/EN 60721-3-3)		
Shock	According to IEC/EN 60068-2-27 7 g for 11 ms (3M3 according to IEC/EN 60721-3-3)		
Ambient conditions			
Operating temperature	-10...+45°C (3K3 according to IEC/EN 60721-3-3) Beyond power decrease of 2 % per 1°C up to +60°C		
Storage / Transport temperature	-25...+70°C		
Protection degree	IP00		
Environmental class / Humidity	Class 3K3 in accordance with IEC/EN 60721-3-3 / no condensation, max. 95 % relative humidity		
Altitude	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 3000 m	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 2400 m	
Allowed pollution	Pollution degree 2 according to EN 61800-5-1 3C2 and 3S2 according to EN 60721-3-3		
Protection class	Class 1 according to EN 61800-5-1		
Standards			
Basic standard	The devices are designed, built and tested on the basis of EN 61800-5-1.		
Insulation	Galvanic insulation from the control electronics in accordance with EN 61800-5-1 PELV (Protective Extra Low Voltage)		
Approvals	CE, in preparation: UL, CSA		

	400 V			690 V	
	LFM 4V120	LFM 4V175	LFM 4V340	LFM 6V220	LFM 6V430
Order number	VW3 A7 260	VW3 A7 261	VW3 A7 262	VW3 A7 263	VW3 A7 264
Nominal current @50°C [A]	185	255	495	185	360
Losses [W]	290	360	560	360	560
Weight [kg]	60	80	125	80	125
Dimension A1 [mm]	630	730	1100	730	1100
Dimension A2 [mm]	650	695	1065	695	1065
Dimension A3 [mm]	15	15	15	15	15
Dimension B1 [mm]	240	290	290	290	290
Dimension B2 [mm]	170	220	220	220	220
Dimension C1 [mm]	377	377	377	377	397
Fixing D1 [mm]	4 x Ø11.5	4 x Ø11.5	4 x Ø11.5	4 x Ø11.5	4 x Ø11.5

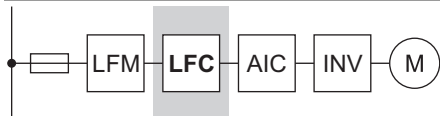


## Losses regarding the Active Infeed Converter AIC

As the line filter module LFM is used in different Active Front End units AFE, its losses are varying. In the following table the losses of the line filter module LFM are given related to the respective Active Infeed Converter AIC.

Losses			
Active Front End	Line Filter Module LFM Type	Order number	Losses
400V 120kW	LFM 4V120	VW3A7260	290 W
400V 145kW	LFM 4V175	VW3A7261	320 W
400V 175kW	LFM 4V175	VW3A7261	360 W
400V 240kW	LFM 4V340	VW3A7262	410 W
400V 275kW	LFM 4V340	VW3A7262	480 W
400V 340kW	LFM 4V340	VW3A7262	560 W
400V 430kW	2x LFM 4V340	2x VW3A7262	2x 410 W
400V 540kW	2x LFM 4V340	2x VW3A7262	2x 480 W
400V 675kW	2x LFM 4V340	2x VW3A7262	2x 560 W
480V 120kW	LFM 4V120	VW3A7260	290 W
480V 145kW	LFM 4V175	VW3A7261	320 W
480V 175kW	LFM 4V175	VW3A7261	360 W
480V 240kW	LFM 4V340	VW3A7262	410 W
480V 275kW	LFM 4V340	VW3A7262	480 W
480V 340kW	LFM 4V340	VW3A7262	560 W
480V 430kW	2x LFM 4V340	2x VW3A7262	2x 410 W
480V 540kW	2x LFM 4V340	2x VW3A7262	2x 480 W
480V 675kW	2x LFM 4V340	2x VW3A7262	2x 560 W
690V 145kW	LFM 6V220	VW3A7263	350 W
690V 175kW	LFM 6V220	VW3A7263	370 W
690V 220kW	LFM 6V220	VW3A7263	400 W
690V 275kW	LFM 6V430	VW3A7264	430 W
690V 340kW	LFM 6V430	VW3A7264	510 W
690V 430kW	LFM 6V430	VW3A7264	600 W
690V 540kW	2x LFM 6V430	2x VW3A7264	2x 430 W
690V 675kW	2x LFM 6V430	2x VW3A7264	2x 510 W
690V 860kW	2x LFM 6V430	2x VW3A7264	2x 600 W

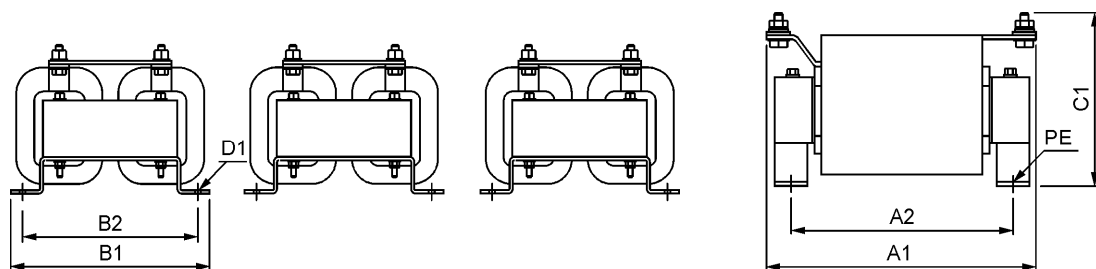
## Line filter choke LFC



The line filter choke LFC is an essential component of the Active Front End AFE. It is connected in the power path between the line filter module LFM and the Active Infeed Converter AIC and consists of three single-phase chokes.

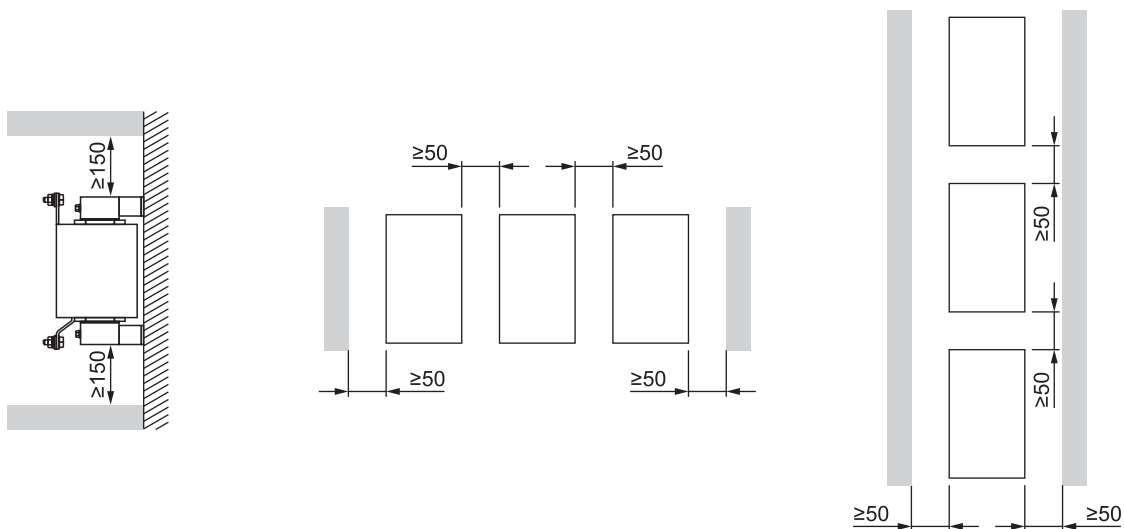
Line Filter Choke LFC	400 V	500 V / 690 V
General		
Nominal voltage	380 V -30 % / 480 V +10 %	500 V -20 % / 690 V +10 %
Design	Open constructions for installation into the cubicle	
Cooling	Natural convection / no forced ventilation	
Mechanical strength		
Winding protection	Drenched in synthetic resin	
Mechanical vibration	According to IEC/EN 60068-2-6 1.5 mm in the range of 3...10 Hz, 0.6 g of 10...200 Hz (3M3 according to IEC/EN 60721-3-3)	
Shock	According to IEC/EN 60068-2-27 7 g for 11 ms (3M3 according to IEC/EN 60721-3-3)	
Ambient conditions		
Operating temperature	45°C, up to +60°C with derating	
Storage / Transport temperature	-25...+70°C	
Protection degree	IP00	
Environmental class / Humidity	Class 3K3 in accordance with IEC/EN 60721-3-3 / no condensation, max. 95 % relative humidity	
Altitude	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 3000 m	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 2400 m
Standards		
Insulation class	H	
Approvals	CE, in preparation: UL, CSA	

	400 V and 480 V			690 V	
	LFC 4V120	LFC 4V175	LFC 4V340	LFC 6V220	LFC 6V430
Order number	VW3 A7 265	VW3 A7 266	VW3 A7 267	VW3 A7 268	VW3 A7 269
Nominal current @50°C [A]	180	255	495	185	360
Max. losses [W]	3x 320	3x 425	3x 790	3x 410	3x 650
Weight [kg]	3x 18	3x 23	3x 44	3x 33	3x 70
Dimension A1 [mm]	210	295	360	295	540
Dimension A2 [mm]	190	250	313	250	452
Dimension B1 [mm]	245	245	290	245	295
Dimension B2 [mm]	215	215	250	215	255
Dimension C1 [mm]	185	195	255	210	250
Fixing D1 [mm]	9x15	9x15	11x18	9x22.5	11x18



The line filter chokes LFC consist of 3 single-phase chokes.

During installation observe the free space above and below as well as the required minimum distance between the three components.



It is recommended to install the chokes of the LFC one upon the other only at forced cooling because in case of worse ventilation the topmost choke may overheat.

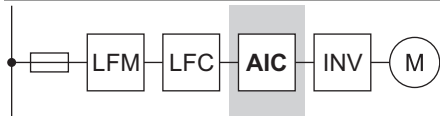


## Losses regarding the Active Infeed Converter AIC

As the line filter choke LFC (as the line filter module LFM) is used in different Active Front End units AFE, its losses are varying. In the following table the losses of the line filter choke LFC are given related to the respective Active Infeed Converter AIC.

Losses			
Active Front End	Line Filter Choke LFC Type	Order number	Losses
400V 120kW	LFC 4V120	VW3A7265	3x 320 W
400V 145kW	LFC 4V175	VW3A7266	3x 370 W
400V 175kW	LFC 4V175	VW3A7266	3x 425 W
400V 240kW	LFC 4V340	VW3A7267	3x 530 W
400V 275kW	LFC 4V340	VW3A7267	3x 620 W
400V 340kW	LFC 4V340	VW3A7267	3x 790 W
400V 430kW	2x LFC 4V340	2x VW3A7267	2x (3x 530) W
400V 540kW	2x LFC 4V340	2x VW3A7267	2x (3x 620) W
400V 675kW	2x LFC 4V340	2x VW3A7267	2x (3x 790) W
480V 120kW	LFC 4V120	VW3A7265	3x 320 W
480V 145kW	LFC 4V175	VW3A7266	3x 370 W
480V 175kW	LFC 4V175	VW3A7266	3x 425 W
480V 240kW	LFC 4V340	VW3A7267	3x 530 W
480V 275kW	LFC 4V340	VW3A7267	3x 620 W
480V 340kW	LFC 4V340	VW3A7267	3x 790 W
480V 430kW	2x LFC 4V340	2x VW3A7267	2x (3x 530) W
480V 540kW	2x LFC 4V340	2x VW3A7267	2x (3x 620) W
480V 675kW	2x LFC 4V340	2x VW3A7267	2x (3x 790) W
690V 145kW	LFC 6V220	VW3A7268	3x 360 W
690V 175kW	LFC 6V220	VW3A7268	3x 380 W
690V 220kW	LFC 6V220	VW3A7268	3x 410 W
690V 275kW	LFC 6V430	VW3A7269	3x 440 W
690V 340kW	LFC 6V430	VW3A7269	3x 540 W
690V 430kW	LFC 6V430	VW3A7269	3x 650 W
690V 540kW	2x LFC 6V430	2x VW3A7269	2x (3x 440) W
690V 675kW	2x LFC 6V430	2x VW3A7269	2x (3x 540) W
690V 860kW	2x LFC 6V430	2x VW3A7269	2x (3x 650) W

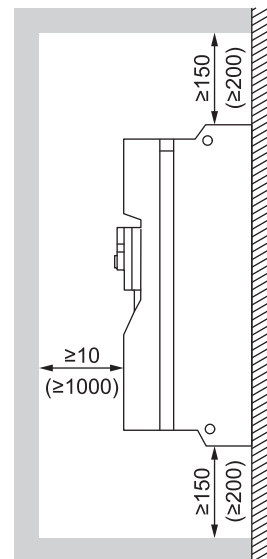
### Active Infeed Converter AIC



The Active Infeed Converter AIC is connected to the inverter INV via the DC bus. During operation the energy is supplied to the DC bus or the accumulating braking energy is feed back into the mains.

Active Infeed Converter AIC	400 V	500 V / 690 V
General		
Design	Built-in unit for vertical mounting	
Cooling	Forced	
Mechanical strength		
Mechanical vibration	According to IEC/EN 60068-2-6 1.5 mm in the range of 3...10 Hz, 0.6 g of 10...200 Hz (3M3 according to IEC/EN 60721-3-3)	
Shock	According to IEC/EN 60068-2-27 AIC 4V120...AIC 4V175: 7 g for 11 ms (3M3 according to IEC/EN 60721-3-3) AIC 4V240...AIC 4V675: 4 g for 11 ms (3M2 according to IEC/EN 60721-3-3)	AIC 6V145...AIC 6V220: 7 g for 11 ms (3M3 according to IEC/EN 60721-3-3) AIC 6V275...AIC 6V860: 4 g for 11 ms (3M2 according to IEC/EN 60721-3-3)
Ambient conditions		
Operating temperature	-10...+45°C (3K3 according to IEC/EN 60721-3-3) Beyond power decrease of 2 % per 1°C up to +60°C	
Storage / Transport temperature	-25...+70°C	
Protection degree	IP00	
Environmental class / Humidity	Class 3K3 in accordance with IEC/EN 60721-3-3 / no condensation, max. 95 % relative humidity	
Altitude	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 3000 m	Up to 1000 m, beyond power decrease of 1 % per 100 m up to 2400 m
Allowed pollution	Pollution degree 2 according to EN 61800-5-1 3C2 and 3S2 according to EN 60721-3-3	
Protection class	Class 1 according to EN 61800-5-1	
Standards		
Basic standard	The devices are designed, built and tested on the basis of EN 61800-5-1.	
EMC immunity	According to EN 61800-3, 1 <sup>st</sup> and 2 <sup>nd</sup> environment (IEC 1000-4-2; IEC 1000-4-3; IEC 1000-4-4; IEC 1000-4-5; IEC 1000-4-6)	
EMC emission	In accordance with product standard EN 61800-3, 2 <sup>nd</sup> environment, category C3	
Insulation	Galvanic insulation from the control electronics in accordance with EN 61800-5-1 PELV (Protective Extra Low Voltage)	
Approvals	CE, in preparation: UL, CSA	

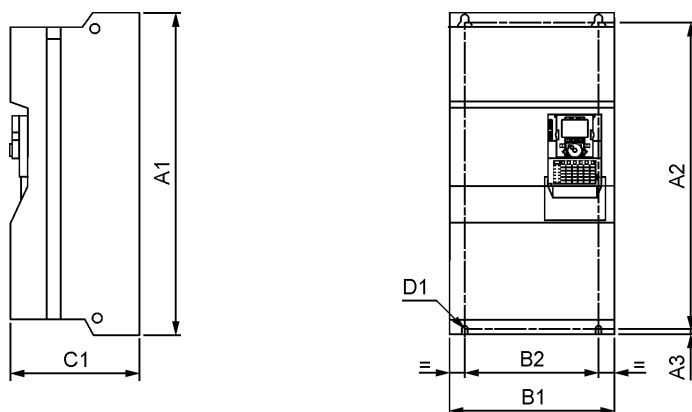
AIC		4V120	4V145	4V175
Order number		VW3 A7 250	VW3 A7 251	VW3 A7 252
<b>Nominal data</b>				
Input voltage				
$V_N$ [V]		380 V -30% ... 480 V +10%	380 V -30% ... 480 V +10%	380 V -30% ... 480 V +10%
Input current				
$I_N$ [A]	$V_N = 400$ V	177	212	255
$I_N$ [A]	$V_N = 480$ V	160	200	200
Input power				
$P_{N400}$ [kW]	$V_N = 400$ V	123	146	175
$P_{N480}$ [kW]	$V_N = 480$ V	133	166	166
<b>Characteristics</b>				
Losses [W]	at $I_N$	2250	2660	2970
Losses control part [W]		270	300	360
Losses power part [W]		1980	2360	2610
Weight approx. [kg]		60	74	80
<b>Ambient conditions</b>				
Volume of cooling air IP23 [m³/h]		400	600	600
Volume of cooling air IP54 [m³/h]		115	145	165
Min. air inflow and air outlet (IP23) [dm²]		5	7	7
<b>Dimensions</b>				
Dimension A1 [mm]		680	782	950
Dimension A2 [mm]		650	758	920
Dimension A3 [mm]		15	12	15
Dimension B1 [mm]		310	350	330
Dimension B2 [mm]		250	298	285
Dimension C1 [mm]		377	377	377
Fixing D1 [mm]		4x Ø11.5	4x Ø11.5	4x Ø11.5



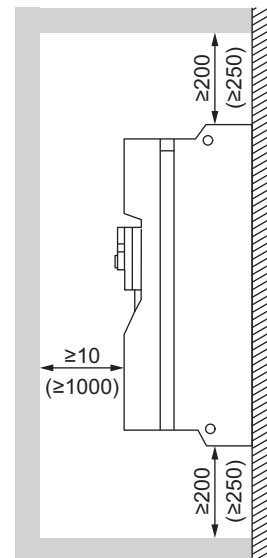
If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

In either case avoid air short circuits.

Basic device without or with 1 option card



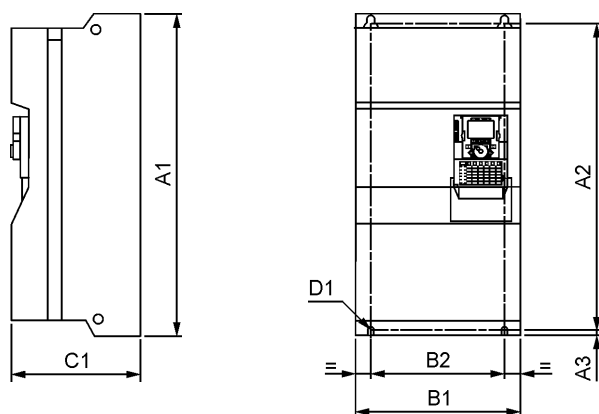
AIC	4V240	4V240-13	4V275	4V340
Order number	VW3 A7 253	VW3 A7 283	VW3 A7 254	VW3 A7 255
<b>Nominal data</b>				
Input voltage				
$V_N$ [V]	380 V -30% ... 440 V +10%	480 V -40/+10%	380 V -30% ... 480 V +10%	380 V -30% ... 480 V +10%
Input current				
$I_N$ [A]	348	348	395	495
Input power				
$P_{N400}$ [kW] $V_N = 400$ V	242	242	273	342
$P_{N480}$ [kW] $V_N = 480$ V	-	281	320	396
<b>Characteristics</b>				
Losses [W] at $I_N$	3560	3560	4710	5800
Losses control part [W]	430	430	610	770
Losses power part [W]	3130	3130	4100	5030
Weight approx. [kg]	110	140	140	140
<b>Ambient conditions</b>				
Volume of cooling air IP23 [m³/h]	800	1200	1200	1200
Volume of cooling air IP54 [m³/h]	200	270	270	330
Min. air inflow and air outlet (IP23) [dm²]	8	10	10	10
<b>Dimensions</b>				
Dimension A1 [mm]	950	950	950	950
Dimension A2 [mm]	920	920	920	920
Dimension A3 [mm]	15	15	15	15
Dimension B1 [mm]	430	585	585	585
Dimension B2 [mm]	350	540	540	540
Dimension C1 [mm]	377	377	377	377
Fixing D1 [mm]	4x Ø11.5	4x Ø11.5	4x Ø11.5	4x Ø11.5



If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

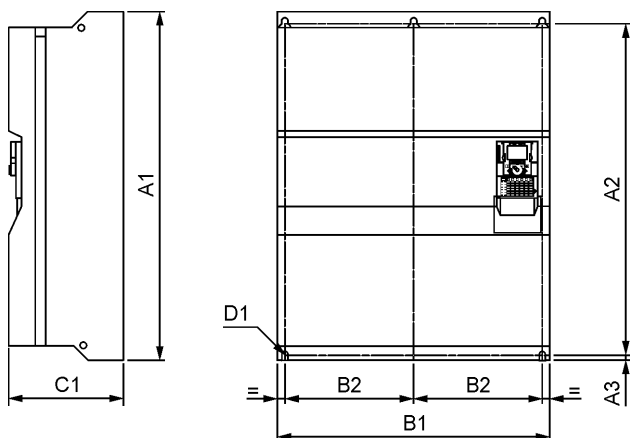
In either case avoid air short circuits.

Basic device without or with 1 option card



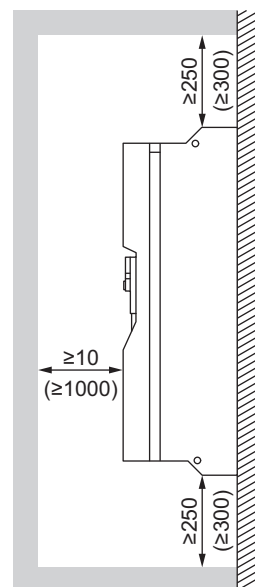
AIC	4V430	4V430-15	4V540	4V540-15	4V675
Order number	VW3 A7 256	VW3 A7 286	VW3 A7 257	VW3 A7 287	VW3 A7 258
<b>Nominal data</b>					
Input voltage					
$V_N$ [V]	380 V -30% ... 440 V +10%	480 V -40/+10%	380 V -30% ... 440 V +10%	480 V -40/+10%	380 V -30% ... 440 V +10%
Input current					
$I_N$ [A]	628	628	780	780	980
Input power					
$P_{N400}$ [kW] $V_N = 400$ V	431	431	539	539	676
$P_{N480}$ [kW] $V_N = 480$ V	-	496	-	619	781
<b>Characteristics</b>					
Losses [W] at $I_N$	6130	6130	8920	8920	11060
Losses control part [W]	860	860	1190	1190	1500
Losses power part [W]	5270	5270	7730	7730	9560
Weight approx. [kg]	215	300	225	300	300
<b>Ambient conditions</b>					
Volume of cooling air IP23 [m³/h]	1800	2400	1800	2400	2400
Volume of cooling air IP54 [m³/h]	450	660	500	660	660
Min. air inflow and air outlet (IP23) [dm²]	15	20	15	20	20
<b>Dimensions</b>					
Dimension A1 [mm]	1150	1150	1150	1150	1150
Dimension A2 [mm]	1120	1120	1120	1120	1120
Dimension A3 [mm]	15	15	15	15	15
Dimension B1 [mm]	880	1110	880	1110	1110
Dimension B2 [mm]	417.5	533	417.5	533	533
Dimension C1 [mm]	377	377	377	377	377
Fixing D1 [mm]	5x Ø11.5	6x Ø11.5	5x Ø11.5	6x Ø11.5	6x Ø11.5

Basic device without or with 1 option card



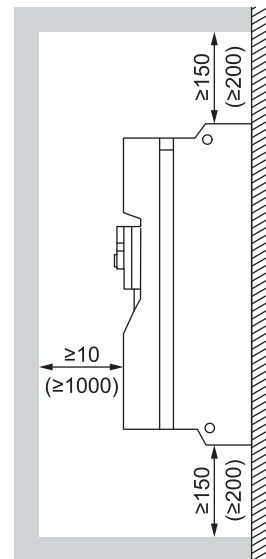
If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

In either case avoid air short circuits.



AIC	6V145	6V175	6V220
Order number	VW3 A7 270	VW3 A7 271	VW3 A7 272
<b>Nominal data</b>			
Input voltage			
$V_N$ [V]	500V -20% ... 690V +10%	500V -20% ... 690V +10%	500V -20% ... 690V +10%
Input current			
$I_N$ [A]	120	150	185 (160) <sup>1)</sup>
Input power			
$P_{N400}$ [kW] $V_N = 500$ V	104	130	160
$P_{N480}$ [kW] $V_N = 600$ V	125	156	166
$P_{N480}$ [kW] $V_N = 690$ V	144	175	218
<b>Characteristics</b>			
Losses [W] at $I_N$	2200	2630	3220
Losses control part [W]	190	220	250
Losses power part [W]	2010	2410	2970
Weight approx. [kg]	110	110	110
<b>Ambient conditions</b>			
Volume of cooling air IP23 [m³/h]	600	600	600
Volume of cooling air IP54 [m³/h]	190	220	250
Min. air inflow and air outlet (IP23) [dm²]	7	7	7
<b>Dimensions</b>			
Dimension A1 [mm]	950	950	950
Dimension A2 [mm]	920	920	920
Dimension A3 [mm]	15	15	15
Dimension A4 [mm]	1190	1190	1190
Dimension B1 [mm]	330	330	330
Dimension B2 [mm]	285	285	285
Dimension B3 [mm]	340	340	340
Dimension C1 [mm]	377	377	377
Fixing D1 [mm]	4x Ø11.5	4x Ø11.5	4x Ø11.5

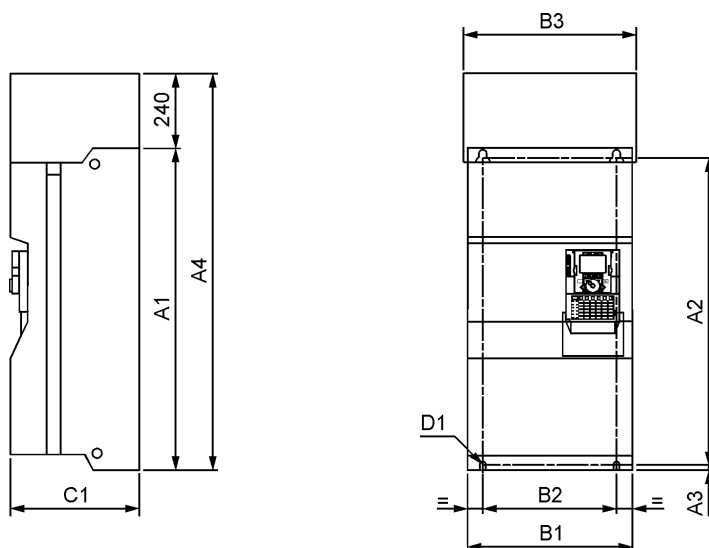
1) only at 600 V



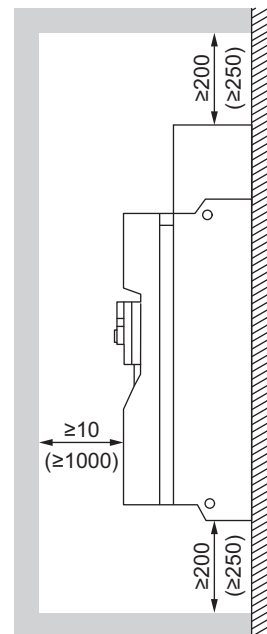
If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

In either case avoid air short circuits.

Basic device without or with 1 option card



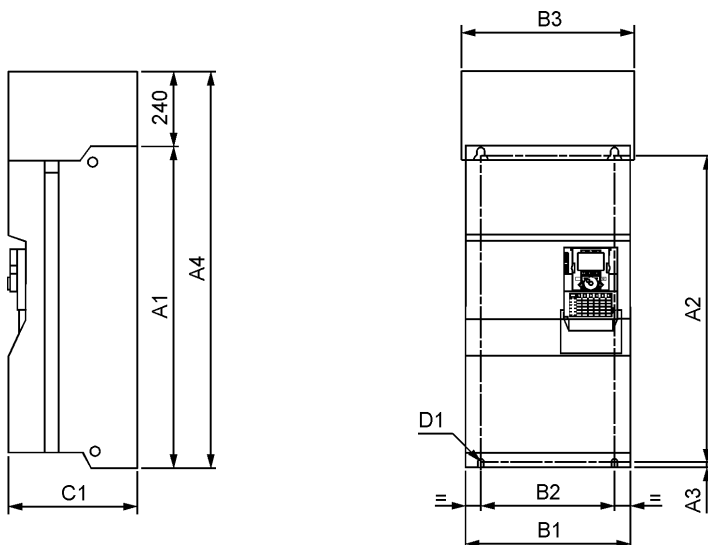
AIC	6V275	6V340	6V430
Order number	VW3 A7 273	VW3 A7 274	VW3 A7 275
<b>Nominal data</b>			
Input voltage			
$V_N$ [V]	500V -20% ... 690V +10%	500V -20% ... 690V +10%	500V -20% ... 690V +10%
Input current			
$I_N$ [A]	228	285	360
Input power			
$P_{N400}$ [kW] $V_N = 500$ V	198	247	312
$P_{N480}$ [kW] $V_N = 600$ V	235	295	371
$P_{N480}$ [kW] $V_N = 690$ V	272	340	430
<b>Characteristics</b>			
Losses [W] at $I_N$	4130	5050	6040
Losses control part [W]	330	380	440
Losses power part [W]	3800	4670	5600
Weight approx. [kg]	190	190	190
<b>Ambient conditions</b>			
Volume of cooling air IP23 [m³/h]	1200	1200	1200
Volume of cooling air IP54 [m³/h]	160	180	200
Min. air inflow and air outlet (IP23) [dm²]	10	10	10
<b>Dimensions</b>			
Dimension A1 [mm]	950	950	950
Dimension A2 [mm]	920	920	920
Dimension A3 [mm]	15	15	15
Dimension A4 [mm]	1190	1190	1190
Dimension B1 [mm]	585	585	585
Dimension B2 [mm]	540	540	540
Dimension B3 [mm]	595	595	595
Dimension C1 [mm]	377	377	377
Fixing D1 [mm]	4x Ø11.5	4x Ø11.5	4x Ø11.5



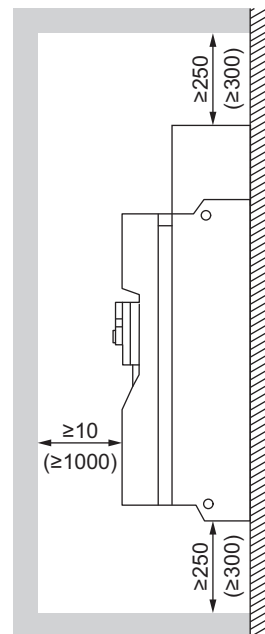
If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

In either case avoid air short circuits.

Basic device without or with 1 option card



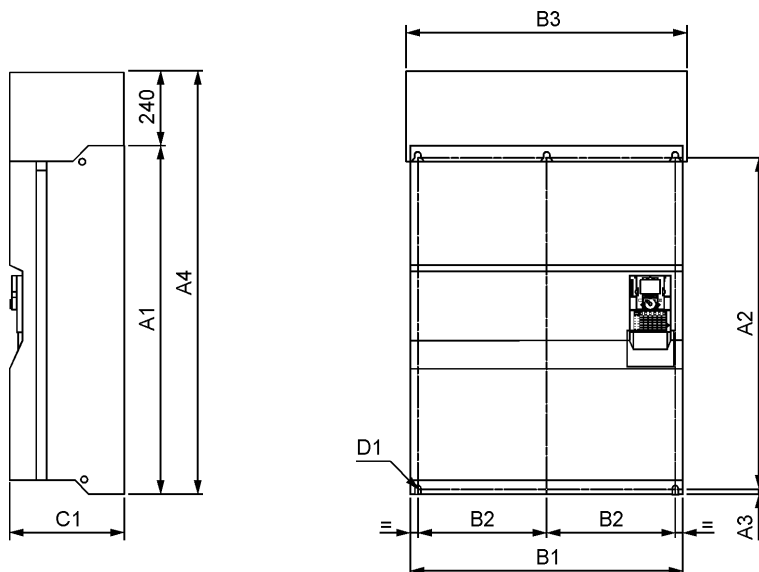
AIC	6V540	6V675	6V860
Order number	VW3 A7 276	VW3 A7 277	VW3 A7 278
<b>Nominal data</b>			
Input voltage			
$V_N$ [V]	500V -20% ... 690V +10%	500V -20% ... 690V +10%	500V -20% ... 690V +10%
Input current			
$I_N$ [A]	450	563	715
Input power			
$P_{N400}$ [kW] $V_N = 500$ V	390	488	619
$P_{N480}$ [kW] $V_N = 600$ V	468	585	742
$P_{N480}$ [kW] $V_N = 690$ V	536	673	854
<b>Characteristics</b>			
Losses [W] at $I_N$	7730	9560	11980
Losses control part [W]	580	690	860
Losses power part [W]	7150	8870	11120
Weight approx. [kg]	400	400	400
<b>Ambient conditions</b>			
Volume of cooling air IP23 [m³/h]	2400	2400	2400
Volume of cooling air IP54 [m³/h]	260	300	400
Min. air inflow and air outlet (IP23) [dm²]	20	20	20
<b>Dimensions</b>			
Dimension A1 [mm]	1150	1150	1150
Dimension A2 [mm]	1120	1120	1120
Dimension A3 [mm]	15	15	15
Dimension A4 [mm]	1390	1390	1390
Dimension B1 [mm]	1110	1110	1110
Dimension B2 [mm]	532.5	532.5	532.5
Dimension B3 [mm]	1120	1120	1120
Dimension C1 [mm]	377	377	377
Fixing D1 [mm]	6x Ø11.5	6x Ø11.5	6x Ø11.5



If the devices are installed without any free space sideways, higher minimum distances are required for sufficient cooling (values in brackets).

In either case avoid air short circuits.

Basic device without or with 1 option card





The Active Front End is equipped with comprehensive protective devices.

It is absolutely necessary to protect the mains side of the whole Active Front End AFE with superfast (semiconductor) fuses additionally as secondary protection. This protects the individual components in case of an internal short-circuit or if the electronic protective mechanisms fail. It is also a precondition for operation at mains with high short-circuit power.

The protection at the DC output side is only required in case of connection variant "Active Front End units parallel". When selecting the fuses, pay attention to the nominal voltage of the fuses and their special qualification to switch-off DC currents.

The mentioned diameters for 3-wire cables are recommended values for laying the cable in air at max. 40°C ambient temperature, based on the regulations ÖVN EN 1 and VDE 0100.

The lines in the cubicles are dimensioned according to the specification for single conductors XLPE/EPR copper 90°C.



In case of other ambient conditions and different regulations the cable diameters must be adjusted.

Mains supply 3AC 400...440 V						AFE	DC output		
Pre- or conduit fuses	Cu cable [mm²]	Mains fuse "AFE protection"	Lines in the cubicle [mm²] (per phase)	Continuous current AC [A]	Connection LFM	Type	Continuous current DC	Connection AIC	Cable for DC connection (per pole) [mm²]
250 A	3x120	250 A sf	95	177 A	1 x M10	120	185 A	1 x M12	95
315 A	3x185	315 A sf	120	212 A	1 x M10	145	220 A	1 x M12	120
400 A	2x (3x120)	350 A sf	150	255 A	1 x M10	175	265 A	1 x M12	150
500 A	2x (3x150)	500 A sf	2x95	348 A	1 x M10	240	366 A	1 x M12	2x95
630 A	2x (3x185)	550 A sf	2x95	395 A	1 x M10	275	412 A	2 x M12	2x95
800 A	3x (3x185)	700 A sf	2x150	495 A	1 x M10	340	517 A	2 x M12	2x150
1000 A	4x (3x185)	450 A sf	2x95	314 A	1 x M10	430	654 A	4 x M12	4x95
		450 A sf	2x95	314 A	1 x M10				
1250 A	4x (3x240)	550 A sf	2x95	390 A	1 x M10	540	815 A	4 x M12	4x120
		550 A sf	2x95	390 A	1 x M10				
1600 A	6x (3x240)	700 A sf	2x150	490 A	1 x M10	675	1023 A	4 x M12	4x185
		700 A sf	2x150	490 A	1 x M10				

Mains supply 3AC 480 V						AFE	DC output		
Circuit breaker Rated current	Cu cable [mm²]	Mains fuse "AFE protection"	Lines in the cubicle [mm²] (per phase)	Continuous current AC [A]	Connection LFM	Type	Continuous current DC	Connection AIC	Cable for DC connection (per pole)
250	1x (3x250 MCM)	250 A sf	AWG 1/0	160 A	1 x M10	120	163 A	1 x M12	AWG 1/0
250	1x (3x 350 MCM)	315 A sf	AWG 3/0	200 A	1 x M10	145	203 A	1 x M12	AWG 3/0
400	2x (3x AWG 4/0)	350 A sf	AWG 4/0	200 A	1 x M10	175	203 A	1 x M12	AWG 4/0
400	2x (3x350 MCM)	500 A sf	300 MCM	348 A	1 x M10	240	366 A	1 x M12	350 MCM
600	2x (3x 400 MCM)	550 A sf	350 MCM	395 A	1 x M10	275	412 A	2 x M12	400 MCM or 2x AWG 4/0
600	2x (3x 400 MCM)	700 A sf	2x 250 MCM	495 A	1 x M10	340	517 A	2 x M12	2x 300 MCM
800	5x (3x 400 MCM)	500 A sf *)	300 MCM	314 A	1 x M10	430	654 A	4 x M12	2x 400 MCM
		500 A sf *)	300 MCM	314 A	1 x M10				
1000	6x (3x 500 MCM)	550 A sf *)	350 MCM	390 A	1 x M10	540	815 A	4 x M12	2x 600 MCM or 3x 350 MCM
		550 A sf *)	350 MCM	390 A	1 x M10				
1200	6x (3x 700 MCM)	700 A sf *)	2x 250 MCM	490 A	1 x M10	675	1023 A	4 x M12	3x 500 MCM
		700 A sf *)	2x 250 MCM	490 A	1 x M10				

\*) Parallel connection of 2 LFM and 2 LFC

Mains supply 3AC 500/690 V						AFE	DC output		
Pre- or conduit fuse	Cu cable [mm <sup>2</sup> ]	Mains fuse "AFE protection"	Lines in the cubicle [mm <sup>2</sup> ] (per phase)	Continuous current AC [A]	Connection LFM	Type	Continuous current DC	Connection AIC	Cable for DC connection (per pole) [mm <sup>2</sup> ]
200 A	3x95	160 A sf	50	120 A	1 x M10	145	130 A	1 x M12	50
250 A	3x120	200 A sf	70	150 A	1 x M10	175	156 A	1 x M12	70
315 A	3x185	250 A sf	95	185 A	1 x M10	240	195 A	1 x M12	95
400 A	2x (3x120)	315 A sf	120	228 A	1 x M10	275	244 A	2 x M12	120
400 A	2x (3x120)	400 A sf	150	285 A	1 x M10	340	305 A	2 x M12	150
500 A	2x (3x150)	500 A sf	2x 95	360 A	1 x M10	430	386 A	2 x M12	2x 95
800 A	3x (3x185)	315 A sf *)	120	225 A	1 x M10	540	481 A	4 x M12	2x 120
		315 A sf *)	120	225 A	1 x M10				
800 A	3x (3x185)	400 A sf *)	150	282 A	1 x M10	675	604 A	4 x M12	2x 150
		400 A sf *)	150	282 A	1 x M10				
1000 A	4x (3x185)	500 A sf *)	2x 95	358 A	1 x M10	860	765 A	4 x M12	3x 150
		500 A sf *)	2x 95	358 A	1 x M10				

Mains supply 3AC 600 V						AFE	DC output		
Circuit breaker Rated current	Cu cable [mm <sup>2</sup> ]	Mains fuse "AFE protection"	Lines in the cubicle [mm <sup>2</sup> ] (per phase)	Continuous current AC [A]	Connection LFM	Type	Continuous current DC	Connection AIC	Cable for DC connection (per pole)
160	1x (3x AWG 2/0)	160 A sf	AWG 2	120 A	1 x M10	145	130 A	1 x M12	AWG 2
250	1x (3x AWG 4/0)	200 A sf	AWG 1/0	150 A	1 x M10	175	156 A	1 x M12	AWG 1/0
250	1x (3x 300 MCM)	250 A sf	AWG 2/0	160 A	1 x M10	240	170 A	1 x M12	AWG 2/0
400	1x (3x 400 MCM)	315 A sf	AWG 3/0	228 A	1 x M10	275	244 A	2 x M12	AWG 3/0
400	2x (3x 250 MCM)	400 A sf	AWG 4/0	285 A	1 x M10	340	305 A	2 x M12	250 MCM
600	2x (3x 350 MCM)	500 A sf	350 MCM	360 A	1 x M10	430	386 A	2 x M12	350 MCM
600	3x (3x 350 MCM)	315 A sf *)	AWG 3/0	225 A	1 x M10	540	481 A	4 x M12	500 MCM or 2x250 MCM
		315 A sf *)	AWG 3/0	225 A	1 x M10				
800	3x (3x 500 MCM)	400 A sf *)	AWG 4/0	282 A	1 x M10	675	604 A	4 x M12	2x350 MCM
		400 A sf *)	AWG 4/0	282 A	1 x M10				
1000	6x (3x 400 MCM)	500 A sf *)	350 MCM	358 A	1 x M10	860	765 A	4 x M12	3x350 MCM
		500 A sf *)	350 MCM	358 A	1 x M10				

\*) Parallel connection of 2 LFM and 2 LFC



As mains fuses for protection of the AFE superfast (semiconductor) fuses have to be used.



If the mains fuses blow the Active Front End already has a primary defect. Therefore, exchanging the blown fuses and switching the Active Front End on again is not effective.



In order to meet the requirements of UL/CSA, copper cables with temperature class 60/70°C have to be used.



In order to meet the requirements of UL/CSA, a listed circuit breaker has to be used.

### Recommended mains fuses

#### Types of mains fuses for 400 V – 440 V mains

AFE Type 400V-440V	Mains fuse	Recommended type of fuse	
		Ferraz Shawmut, Protistor semiconductor fuse, PSC aR sizes 3x – 690/700Vac	Bussmann High speed fuse square body flush end contact – 690/700Vac
120	250 A	6.9 URD 30 TTF 0250	170M3416
145	315 A	6.9 URD 30 TTF 0315	170M3417
175	350 A	6.9 URD 30 TTF 0350	170M3418
240	500 A	6.9 URD 30 TTF 0500	170M3421
275	550 A	6.9 URD 30 TTF 0550	170M3422
340	700 A	6.9 URD 31 TTF 0700	170M4417
430	2x450	2x 6.9 URD 30 TTF 0450	2x 170M3420
540	2x550	2x 6.9 URD 30 TTF 0550	2x 170M3422
675	2x700	2x 6.9 URD 31 TTF 0700	2x 170M4417

#### Types of mains fuses for 480 V mains (UL)

AFE Type 480V	Mains fuse	Recommended type of fuse	
		Ferraz Shawmut, Protistor semiconductor fuse, PSC aR sizes 3x – 690/700Vac	Bussmann High speed fuse square body flush end contact – 690/700Vac
120	250 A	A070 URD 30 TTI 0250	170M3416
145	315 A	A070 URD 30 TTI 0315	170M3417
175	350 A	A070 URD 30 TTI 0350	170M3418
240	500 A	A070 URD 30 TTI 0500	170M3421
275	550 A	A070 URD 30 TTI 0550	170M3422
340	700 A	A070 URD 32 TTI 0700	170M4417
430	2x450	2x A070 URD 30 TTI 0450	2x 170M3421
540	2x550	2x A070 URD 30 TTI 0550	2x 170M3422
675	2x700	2x A070 URD 32 TTI 0700	2x 170M4417

#### Types of mains fuses for 500 V / 690 V mains

AFE Type 500V / 690V	Mains fuse	Recommended type of fuse	
		Ferraz Shawmut, Protistor semiconductor fuse, PSC aR sizes 3x – 690/700Vac	Bussmann High speed fuse square body flush end contact – 690/700Vac
145	160 A	6.9 URD 30 TTF 0160	170M3414
175	200 A	6.9 URD 30 TTF 0200	170M3415
220	250 A	6.9 URD 30 TTF 0250	170M3416
275	315 A	6.9 URD 30 TTF 0315	170M3417
340	400 A	6.9 URD 30 TTF 0400	170M3419
430	500 A	6.9 URD 30 TTF 0500	170M3421
540	2x315	2x 6.9 URD 30 TTF 0315	2x 170M3417
675	2x400	2x 6.9 URD 30 TTF 0400	2x 170M3419
860	2x500	2x 6.9 URD 30 TTF 0500	2x 170M3421

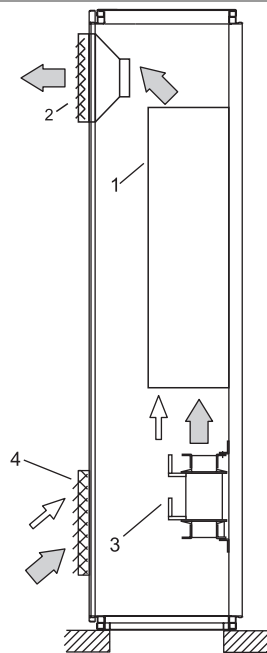
Types of mains fuses for 600 V mains (UL/CSA)			
AFE Type 500V / 690V	Mains fuse	Recommended type of fuse	
		Ferraz Shawmut, Protistor semiconductor fuse, PSC aR sizes 3x – 690/700Vac	Bussmann High speed fuse square body flush end contact – 690/700Vac
145	160 A	A070 URD 30 TTI 0160	170M3414
175	200 A	A070 URD 30 TTI 0200	170M3415
220	250 A	A070 URD 30 TTI 0250	170M3416
275	315 A	A070 URD 30 TTI 0315	170M3417
340	400 A	A070 URD 30 TTI 0400	170M3419
430	500 A	A070 URD 32 TTI 0500	170M3421
540	2x315	2x A070 URD 30 TTI 0315	2x 170M3417
675	2x400	2x A070 URD 30 TTI 0400	2x 170M3419
860	2x500	2x A070 URD 32 TTI 0500	2x 170M3421



Generally also other models and types of fuses can be used provided that their electrical data are comparable.  
In order to meet the requirements of UL/CSA, the specified fuse types have to be used.

### Cubicle installation IP23

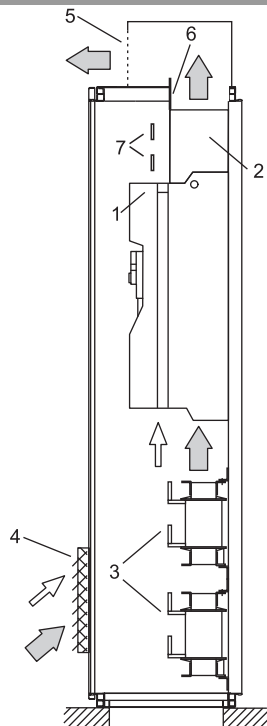
#### Line Filter Module LFM



As the line filter module does not include an internal fan, it is necessary to provide a fan in the door of the cubicle for exhaust. This prevents heat accumulation and it also provides cooling of the Line Filter Choke LFC. The air flow must not be constrained by means of fixtures or filter mats. The air flow has to be determined regarding the ambient conditions and the losses in the Line Filter Module LFM and Line Filter Choke LFC.

1. Line Filter Module LFM
2. Fan (without filter mat for IP23, with filter mat for IP54)
3. Line Filter Choke LFC
4. Air inlet grid (without filter mat for IP23, with filter mat for IP54)

#### Active Infeed Converter AIC



The illustration besides shows the typical cubicle design in protection degree IP23. The stated losses and minimum cross sections for air inlet are related to the Active Infeed Converter AIC. Further heat sources like fuses and contactors must be considered additionally. The fan of the power part, which is inside the device, provides the exhaust of the enclosure. The air flow must not be constrained by means of fixtures or filter mats. Provide a separation of the power part air to avoid internal air short-cuts.

1. Active Infeed Converter AIC
2. Air guide or transformer
3. Line Filter Choke LFC
4. Air inlet grid (without filter mat)
5. Metal cover with splash water protection
6. Separation wall to avoid internal air short-cuts
7. DC bus



A design with higher protection degrees (e.g. IP54) is possible on the basis of the inverters INV.

**Exhaust concept for cubicle installation**

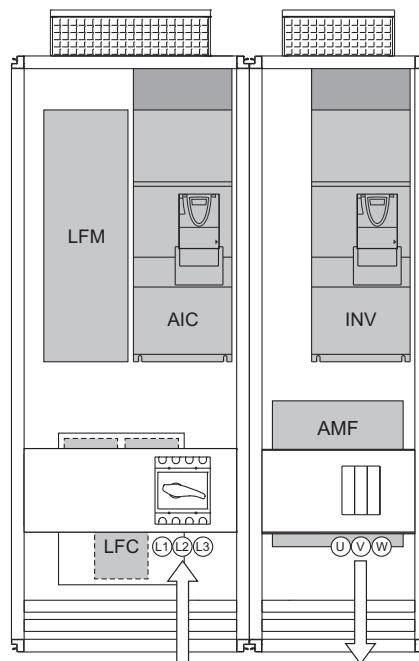
The components of the Active Front End AFE are designed in protection class IP00 and thus they are intended for cubicle installation.

The following illustrations show the recommended installation of the individual components into the cubicle. In order to avoid air short-cuts, it is necessary to install a suitable air guide above the Active Infeed Converter AIC. The losses of the line filter module LFM must be exhausted by means of filter fans in the cubicle door.

**AFE 400V to 175kW**

**AFE 480V to 175kW**

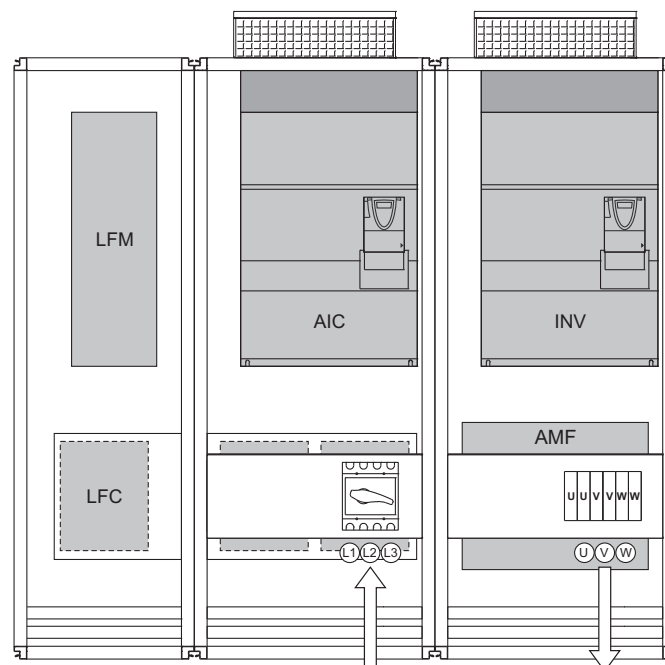
**AFE 690V to 220kW**



AFE 400V to 340kW

AFE 480V to 340kW

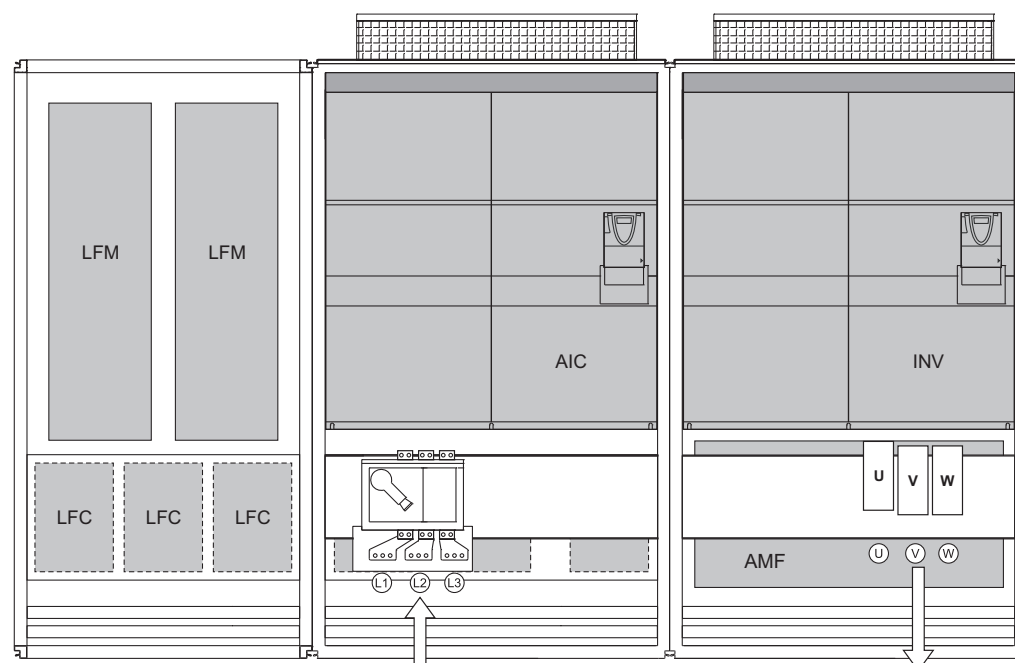
AFE 690V to 430kW



AFE 400V to 675kW

AFE 480V to 675kW

AFE 690V to 860kW



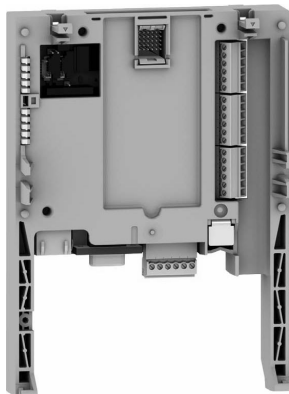
Operating and control options				
Option	Brief description	Order number	Weight [kg]	Reference
<b>Operating options</b>				
Remote mounting kit	Enables the installation of the graphic display terminal in the cubicle door (protection degree IP54).	VW3 A1 102	0.150	See product catalogue
IP65 transparent cover	Transparent IP65 cover for the door mounting kit of the operating panel	VW3 A1 103	0.040	See product catalogue
Connecting cable for decentralised installation of the graphic display terminal	Pre-assembled RJ45 connecting cable 1 m	VW3 A1 104 R10	0.050	See product catalogue
	Pre-assembled RJ45 connecting cable 3 m	VW3 A1 104 R30	0.150	See product catalogue
	Pre-assembled RJ45 connecting cable 5 m	VW3 A1 104 R50	0.250	See product catalogue
	Pre-assembled RJ45 connecting cable 10 m	VW3 A1 104 R100	0.500	See product catalogue
RJ45 adapter socket	RJ45 F/F adapter is required for the connection of the operating panel to the connecting cable	VW3 A1 105	0.010	See product catalogue
<b>Control options</b>				
Basic I/O options card	Terminal extension for additional logic inputs and outputs	VW3 A3 201	0.320	See product catalogue
Option card "Communication bridge"	Option card for communication with other fieldbus systems (only useful for the inverter INV)	on request	0.320	Page 88
<b>Wiring options</b>				
Fan wiring 6V	Option for connecting the fans at 690V devices. This option is only necessary for the inverters. 1x for ATV61HC11Y...C40Y; ATV71HC11Y...C31Y 2x for ATV61HC50Y...C80Y; ATV71HC40Y...C63Y	VW3 A7 280	0.320	Page 89



Fieldbus options				
Option	Brief description	Order number	Weight [kg]	Reference
<b>Modbus</b>				
Modbus splitter	Divides the Modbus signal into eight additional channels using a star configuration. Several Modbus splitters can be connected parallel.	LU9 GC3	0.500	See product catalogue
Modbus T-adapter	Modbus T-adapter with 0.3 m connecting cable	VW3 A8 306 TF03	0.190	See product catalogue
	Modbus T-adapter with 1 m connecting cable	VW3 A8 306 TF10	0.210	See product catalogue
Connecting cable	Pre-assembled RJ45 connecting cable 0.3 m	VW3 A8 306 R03	0.025	See product catalogue
	Pre-assembled RJ45 connecting cable 1 m	VW3 A8 306 R10	0.060	See product catalogue
	Pre-assembled RJ45 connecting cable 3 m	VW3 A8 306 R30	0.130	See product catalogue
Bus termination	Bus termination RC	VW3 A8 306 RC	0.010	See product catalogue
<b>CANopen</b>				
CANopen adapter	RJ45/Sub-D adapter for connecting the Active Front End to a CANopen fieldbus system.	VW3 CAN A71	–	See product catalogue
Plug connector	Connecting plug for CANopen fieldbus system	VW3 CAN KCDF 180T	–	See product catalogue
Standard connecting cable	Pre-assembled standard connecting cable 50 m minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CA 50	4.930	See product catalogue
	Pre-assembled standard connecting cable 100 m minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CA 100	8.800	See product catalogue
	Pre-assembled standard connecting cable 300 m minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CA 300	24.560	See product catalogue
UL connecting cable	Pre-assembled UL connecting cable 50 m self-extinguishing (IEC 60332-2)	TSX CAN CB 50	3.580	See product catalogue
	Pre-assembled UL connecting cable 100 m self-extinguishing (IEC 60332-2)	TSX CAN CB 100	7.840	See product catalogue
	Pre-assembled UL connecting cable 300 m self-extinguishing (IEC 60332-2)	TSX CAN CB 300	21.870	See product catalogue
Connecting cable for difficult environment	Pre-assembled connecting cable 50 m for difficult ambient conditions or mobile installation. Minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CD 50	3.510	See product catalogue
	Pre-assembled connecting cable 100 m for difficult ambient conditions or mobile installation. Minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CD 100	7.770	See product catalogue
	Pre-assembled connecting cable 300 m for difficult ambient conditions or mobile installation. Minimal smoke emission, non-halogen self-extinguishing (IEC 60332-1)	TSX CAN CD 300	21.700	See product catalogue

## Option card "Communication bridge"

## Description

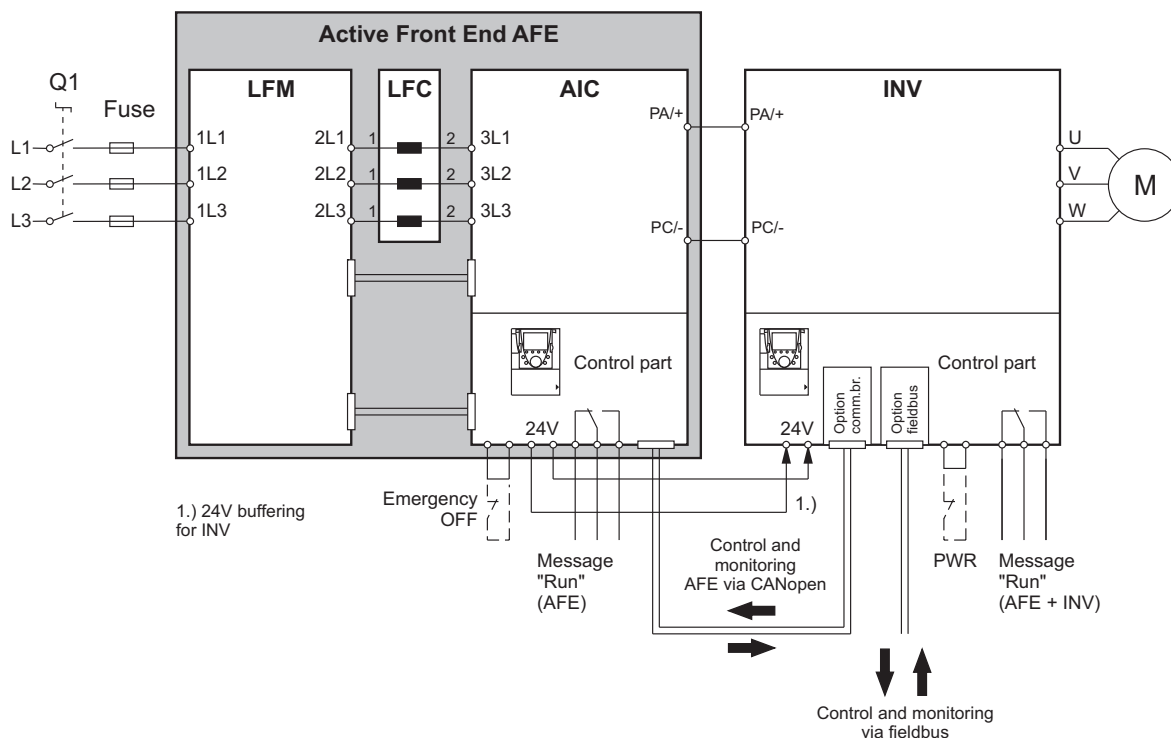


The option card "Communication bridge" enables indirect connection of the Active Front End AFE to further fieldbus systems.

This option card serves as compiler between two fieldbus systems. It is installed together with a fieldbus card in an inverter INV. By means of this combination it is possible to address the inverter as well as up to 4 Active Front End units AFE.

The communication between the option card "AFE COMM-Bridge" and the Active Front End unit(s) takes place via CANopen.

## Application



The control and status word of the inverter is used for control and monitoring of the Active Front End unit(s).

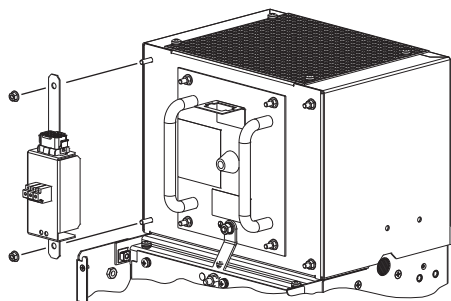
The management of the control and status words has to be realised in the control system (PLC, ...).



As the option card "AFE COMM-Bridge" can be only used together with an option card "Fieldbus", there are no further card slots available at the inverter.

## Option "AFE Fan wiring 6V" VW3A7280

## Description



The option "AFE Fan wiring 6V" enables simple wiring of the fans in the inverter INV (at 690 V devices).

For the 690 V devices the fans are supplied via the transformer box at the top side of the devices. The fans in the inverter INV are supplied from the drive side between the terminals 4/5/6 in the line filter module LFM and the transformer box at the top side of the inverter INV.



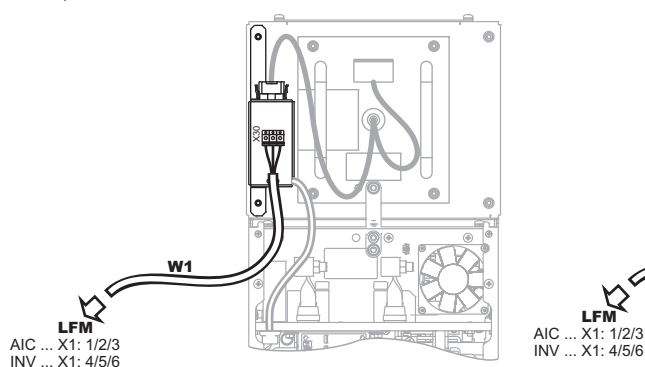
For fan supply of the inverter(s) INV it is necessary to order the option "Fan wiring 6V" with reference number VW3A7280.

1x VW3A7280 for ATV61HC11Y...C40Y; ATV71HC11Y...C31Y

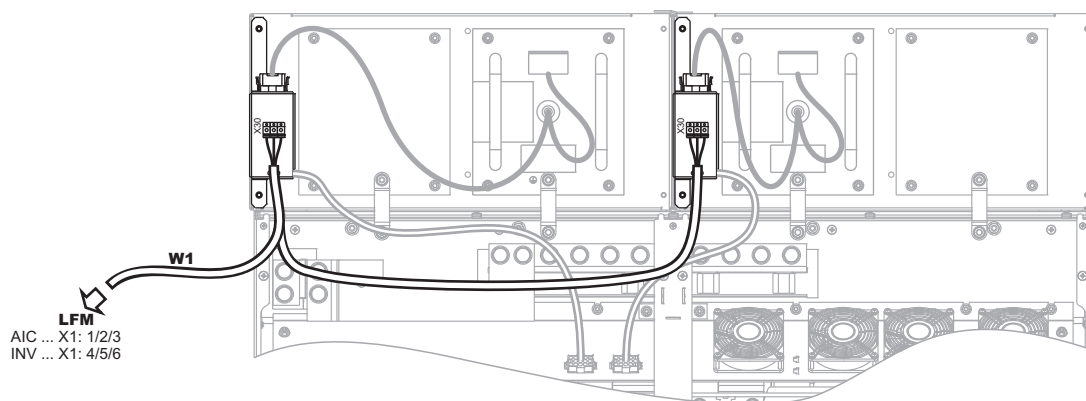
2x VW3A7280 for ATV61HC50Y...C80Y; ATV71HC40Y...C63Y

## Application

To wire the fan supply at the inverters ATV71HC11Y to HC31Y and ATV61HC11Y to HC40Y respectively option "Fan wiring 6V" (VW3 A7 280) has to be ordered once.

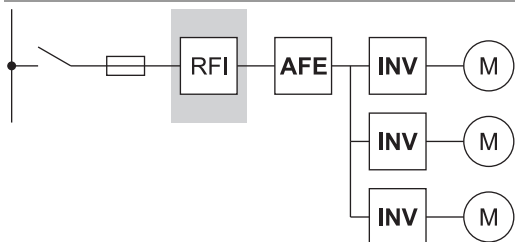


To wire the fan supply at the inverters ATV71HC40Y to HC63Y and ATV61HC50Y to HC80Y respectively option "Fan wiring 6V" (VW3 A7 280) has to be ordered twice.



As the option card "AFE COMM-Bridge" can be only used together with an option card "Fieldbus", there are no further card slots available at the inverter.

#### Radio frequency interference filter RFI



The Active Front End units include a radio frequency interference filter for use in industrial environments according to EN 61800-3 category C3 as standard.

For applications in "1<sup>st</sup> environment - residential environments" of category C2, when several inverters INV are operated at the DC bus and in case of long motor cables, the use of the additional RFI filters is required. These filters are connected at the mains side of the Active Front End.



The determining factor for the radio frequency interference filters to be effective is a HF connection as good as possible between motor, motor cable screen, inverter components, line filter module and filter!



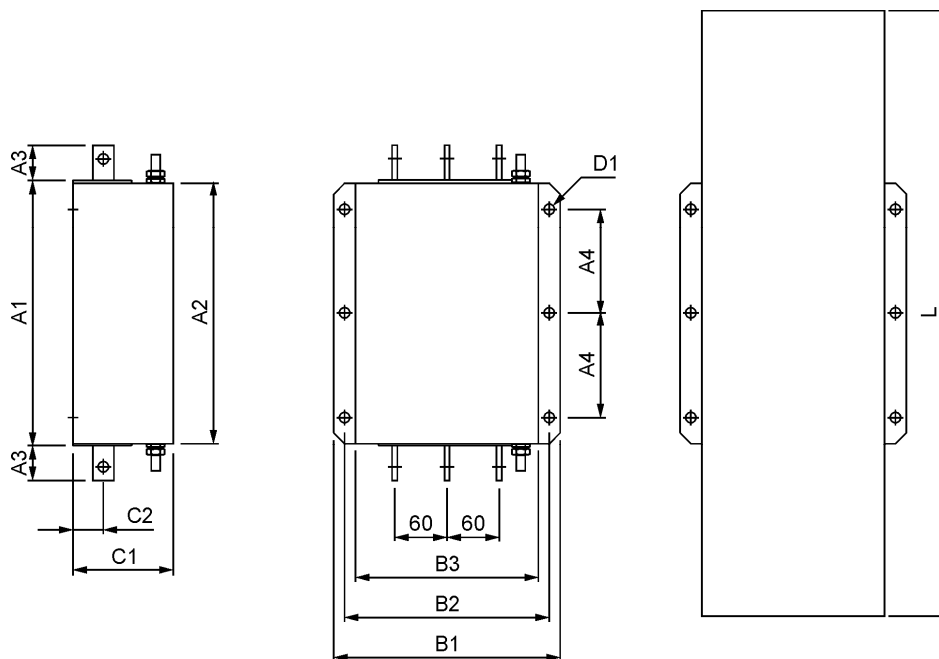
The RFI filters are not qualified for nongrounded (IT) mains as well as for "Corner Grounded Networks". The radio frequency interference filter which is built-in as standard can be switched-over/reconnected.

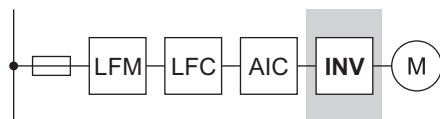
General technical data	
Operating voltage RFI 480	3AC 380 V -15 % ... 480 V +10 %
Operating voltage RFI 6V	3AC 500 V -15 % ... 690 V +10 %
Nominal frequency	50/60 Hz ±5 %
Overload capability	150 % for 60 s per 10 min, 200 % for 2 s
Ambient temperature	-10...+50 °C (up to 60 °C with derating)
Storage temperature	-40...+70 °C
Altitude	0...1000 m (up to 3000 m with derating)
Vibration resistance	1.5 mm at 3...13 Hz, 1 g at 13...200 Hz according to IEC/EN 60068-2-6
Shock resistance	15 g for 11 ms according to IEC/EN 60068-2-27
Approvals	CE, UR, GOST

#### Allocation table

Description	Altivar	Order number	Weight [kg]
RFI filter 400V	4V120 ... 4V175	VW3 A4 410	13.000
	4V240 ... 4V340	VW3 A4 411	15.000
	4V430 ... 4V675	2x VW3 A4 411	30.000
RFI filter 690V	6V145 ... 6V220	VW3 A4 414	14.000
	6V275 ... 6V430	VW3 A4 415	18.000
	6V540 ... 6V860	2x VW3 A4 415	36.000

	Radio frequency interference filter			
	RFI 480/300-TN	RFI 480/600-TN	RFI 6V220-TN	RFI 6V430-TN
Order number	VW3 A4 410	VW3 A4 411	VW3 A4 414	VW3 A4 415
Nominal current	300 A	580 A	220 A	430 A
Max. leakage current	350 mA	350 mA	450 mA	450 mA
Cont.leakage current	3 mA	3 mA	5 mA	5 mA
Protection degree	IP00, with protection against contact			
Losses	60 W	125 W	45 W	90 W
Weight	13 kg	15 kg	14 kg	18 kg
Dimension A1	306 mm	306 mm	306 mm	306 mm
Dimension A2	300 mm	300 mm	300 mm	300 mm
Dimension A3	40 mm	95 mm	40 mm	95 mm
Dimension A4	120 mm	120 mm	120 mm	120 mm
Dimension B1	260 mm	260 mm	260 mm	260 mm
Dimension B2	235 mm	235 mm	235 mm	235 mm
Dimension B3	210 mm	210 mm	210 mm	210 mm
Dimension C1	135 mm	135 mm	135 mm	135 mm
Dimension C2	65 mm	65 mm	65 mm	65 mm
Protective cover L	800 mm	800 mm	800 mm	800 mm
Fixing D1	6 x Ø 12 mm	6 x Ø 12 mm	6 x Ø 12 mm	6 x Ø 12 mm
Connection bar	25 x 6 mm 1 x M10	32 x 8 mm 2 x M10	25 x 6 mm 1 x M10	30 x 8 mm 2 x M10
PE connection	M12	M12	M12	M12





Additionally to the single drive it is possible to supply several inverters with an Active Front End via a common DC link (1:n configuration). Also parallel connection of several Active Front End units AFE is possible (n:n configuration).

As the total power of the installed inverters may be higher than the nominal power of the Active Front End, next to the performance record also the maximum possible load capacity (see tables on page 36 or page 51) of the line filter module LFM has to be observed when dimensioning the complete configuration.

In the following tables the DC bus power and capacities of the inverters INV are given:

DC bus power demand / capacities						
Inverter INV Type		Power Motor (VT) [kW]	DC (at 400 V) [kW]	DC (at 480 V) [kW]	DC fuse <sup>1)</sup> [A]	DC capacity [mF]
ATV61H	075N4	0.8	1.1	1.2	16	0.2
	U15N4	1.5	2.0	2.3	16	0.2
	U22N4	2.2	2.8	3.2	16	0.3
	U30N4	3.0	3.7	4.3	16	0.4
	U40N4	4.0	4.9	5.6	20	0.6
	U55N4	5.5	6.6	7.6	25	0.8
	U75N4	7.5	8.8	10	32	1.1
	D11N4	11	13	15	40	1.4
	D15N4	15	17	20	63	1.9
	D18N4	18	21	24	63	1.9
	D22N4	22	25	29	80	1.4
	D30N4	30	34	39	100	2.0
	D37N4	37	41	47	125	2.4
	D45N4	45	50	58	160	2.7
	D55N4	55	60	69	160	3.9
	D75N4	75	82	94	200	4.8
	D90N4D	90	98	115	250	6.5
	C11N4D	110	120	140	250	6.5
	C13N4D	130	140	160	315	9.8
	C16N4D	160	170	195	350	9.8
	C22N4D	220	240	275	500	13
	C25N4D	250	270	310	550	14
	C31N4D	310	330	380	700	20
	C40N4D	400	420	480	2x450	21
	C50N4D	500	530	610	2x550	30
	C63N4D	630	660	760	2x700	39
ATV61EXA●	C63N4	630	660	706	–	60
	C71N4	710	750	783	–	60
	C90N4	900	940	977	–	120
	M11N4	1100	1200	1170	–	120

- 1.) For the DC fuse the type "Ferraz Protistor DC fuse gR" is recommended. Otherwise a similar type for 800VDC at 10ms L/R has to be used for the DC fuse. (Also see AFE DC fuses)

DC bus power demand / capacities						
Inverter INV Type		Power			DC fuse <sup>1)</sup> [A]	DC capacity [mF]
		Motor (CT) [kW]	DC (at 400 V) [kW]	DC (at 480 V) [kW]		
ATV71H	075N4	0.8	1.1	1.2	16	0.2
	U15N4	1.5	2.0	2.3	16	0.2
	U22N4	2.2	2.8	3.2	16	0.3
	U30N4	3.0	3.7	4.3	20	0.4
	U40N4	4.0	4.9	5.6	25	0.6
	U55N4	5.5	6.6	7.6	32	0.8
	U75N4	7.5	8.8	10	40	1.1
	D11N4	11	13	15	63	1.4
	D15N4	15	17	20	63	1.9
	D18N4	18	21	24	80	1.9
	D22N4	22	25	29	100	1.4
	D30N4	30	34	39	125	2.0
	D37N4	37	41	47	160	2.4
	D45N4	45	50	58	160	2.7
	D55N4	55	60	69	200	3.9
	D75N4	75	82	94	250	4.8
	D90N4	90	98	115	250	6.5
	C11N4D	110	120	140	315	9.8
	C13N4D	130	140	160	350	9.8
	C16N4D	160	170	195	500	13
	C20N4D	200	210	240	550	14
	C25N4D	250	270	310	700	20
	C28N4D	280	300	345	800	20
	C31N4D	310	330	380	2x450	21
	C40N4D	400	420	485	2x550	30
	C50N4D	500	530	610	2x700	39
ATV71EXA●	C50N4	500	530	550	–	60
	C63N4	630	660	706	–	60
	C71N4	710	750	784	–	120
	C90N4	900	940	977	–	120
	M11N4	1100	1150	1170	–	120

- 1.) For the DC fuse the type "Ferraz Protistor DC fuse gR" is recommended. Otherwise a similar type for 800VDC at 10ms L/R has to be sued for the DC fuse. (Also see AFE DC fuses)

DC bus power demand / capacities									
Inverter INV Type		Power at 500 V		Power at 600 V		Power at 690 V		DC fuse <sup>1)</sup>	DC capacity
		Motor (VT) [kW]	DC [kW]	Motor (VT) [HP]	DC [kW]	Motor (VT) [kW]	DC [kW]	[A]	[mF]
ATV61H	C11Y	90	100	125	105	110	120	160	3.9
	C13Y	110	120	150	120	132	142	160	3.9
	C16Y	132	142	180	143	160	172	200	3.9
	C20Y	160	172	200	159	200	215	250	3.9
	C25Y	200	215	250	199	250	268	315	7.8
	C31Y	250	268	350	279	315	335	400	7.8
	C40Y	315	335	450	355	400	424	500	7.8
	C50Y	400	424	550	431	500	528	630	16
	C63Y	500	528	700	547	630	663	800	16
ATV61EXA●	C80Y	630	663	800	624	800	842	1000	16
	C80Y	630	665	800	630	800	838	–	31
	M10Y	800	842	1000	787	1000	1050	–	31
	M12Y	900	948	1250	981	1200	1250	–	31

- 1.) For the DC fuse the type "Ferraz Protistor DC fuse gR" is recommended. Otherwise a similar type for 800VDC at 10ms L/R has to be sued for the DC fuse. (Also see AFE DC fuses)

DC bus power demand / capacities									
Inverter INV Type		Power at 500 V		Power at 600 V		Power at 690 V		DC fuse <sup>1)</sup>	DC capacity
		Motor (CT) [kW]	DC [kW]	Motor (CT) [HP]	DC [kW]	Motor (CT) [kW]	DC [kW]	[A]	[mF]
ATV71H	C11Y	90	100	125	103	110	120	160	3.9
	C13Y	110	120	150	120	132	142	200	3.9
	C16Y	132	142	180	143	160	172	250	3.9
	C20Y	160	172	200	159	200	215	315	7.8
	C25Y	200	215	250	199	250	268	400	7.8
	C31Y	250	268	350	279	315	335	500	7.8
	C40Y	315	335	450	355	400	424	630	16
	C50Y	400	424	550	431	500	528	800	16
	C63Y	500	528	700	547	630	663	1000	16
ATV71EXA●	C63Y	500	529	700	552	630	662	–	31
	C80Y	630	665	800	631	800	838	–	31
	M10Y	800	842	1000	787	1000	1050	–	31

- 1.) For the DC fuse the type "Ferraz Protistor DC fuse gR" is recommended. Otherwise a similar type for 800VDC at 10ms L/R has to be sued for the DC fuse. (Also see AFE DC fuses)



### Required settings at the inverter

It is absolutely necessary to carry out the following settings for all frequency inverters connected to an Active Front End:

- **RFE** [Regen. connection] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [REGEN. CONNECTION] (Olr-) Setting: [Yes] (YES)  
Thereby the undervoltage level of the frequency inverter is adapted to the operation with the Active Front End.  
Please contact our service team if this parameter is not available in the parameter list of your device!
- **brA** [Braking balance] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) Setting: [No] (nO)
- **dEC** [Deceleration] in menu [1.7 APPLICATION FUNCT.] (FUn-) in submenu [RAMP TYPE] (rPt-) For dynamic processes a very short deceleration ramp can cause an overload on the DC-bus with an overvoltage fault shut-down.  
This can be prevented by an extension or rounding of the deceleration ramp (parameters **LR3** [Begin Dec round]; **LR4** [End Dec round]).
- **UrES** [Mains voltage] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [UNDERVOLTAGE MGT.] (USb-) Same setting as the Active Front End.  
Thereby the internal voltage levels of the frequency inverter are adapted.
- **IPL** [Input phase loss] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [INPUT PHASE LOSS] (OPL-) Setting: [Ignore] (nO)
- **bUb** [Brake res. fault Mgt] in menu [1.8 FAULT MANAGEMENT] (FLt-) in submenu [BU PROTECTION] (bUF-) Setting: [Ignore] (nO)
- **LEL** [2 wire type] in menu [1.5 INPUTS/OUTPUTS CFG] (I-O-) Setting: [Level] (LEL)  
In order to ensure an automatic restart by the AFE after an undervoltage recognition. An automatic restart only possible with 2-wire control.
- **RFI filter**  
The integrated RFI filter has to be deactivated (position IT, non-grounded mains) at all devices because there exists no direct mains connection of the frequency inverter in case of operation with an Active Front End.



Non-observance of these precautions may cause material damage.



The 24 V control voltage of the Active Front End AFE can also be used to buffer the control electronics of the frequency inverter.



When the frequency inverter is supplied via the DC link an external supply for the device fans is required!

Via the LFM (line filter module) it is possible to supply the device fans with up to 4 additional inverters (with the same power as the AIC).





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