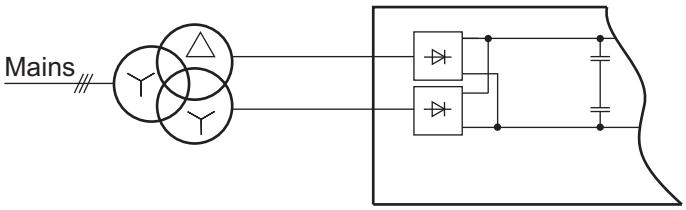
Altivar 61 & 71

Variable speed drives
Option for 12 & 24 - pulse supply

Planning and installion guide for 90...2400 kW

10/2010



ATV61, ATV71

8 PO2 502 EN.01/01

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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 frequency inverter 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.

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Option for harmonic mitigation on ATV61 and ATV71 with 12- and 24-pulse solution

ATV61HD90••• and higher and ATV71HD90••• and higher

90...2400 kW, 3AC 400 to 690 V

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Theme Page

☞ This guide is made for the use in Engineered Drives Teams of Schneider Electric.

☞ Use these instructions additionally to the device documentation "Description of functions" and "Mounting instructions".

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It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof.

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Failure to observe this information can result in injury or equipment damage.

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12- and 24-pulse solution for ATV61 / 71

The standard frequency inverter uses a diode rectifier on the input to generate dc voltage. Due to this rectifier the mains input current gets harmonics which lead to a voltage distortion of the supplying mains.

There are several possibilities to reduce this current harmonics and to decrease the total mains current:

- Use of a DC choke – THD(i) less than 42 %
- Use of a three-phase choke – THD(i) less than 44 %
- Installation of a passive mains current harmonic filter – THD(i) less than 20 %
- Installation of an active mains current harmonic filter – THD(i) less than 5 %
- AFE (Active Front End) – THD(i) less than 5 %
- 12-pulse connection – THD(i) less than 12 %
- 18-pulse connection – THD(i) less than 5 %
- 24-pulse connection – THD(i) less than 3 %

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In order to reduce the current harmonics in the line supply the ATV 61/71 (above 18 kW) is delivered with DC-choke as standard. In addition to this harmonic reduction drives above 400 kW are prepared for 12-pulse supply too.

For the power range between 90...400 kW an additional rectifier bridge including contactor and fuses offers a 12-pulse solution. 18-pulse supply would be possible with the same rectifier bridge for power range from 90...630 kW.

The basic design of the Altivar customized enclosure complies with protection degree IP23 and IP54 and includes a main switch, mains fuses, AC choke, sinus filter and motor terminals. Further installed components, such as circuit breaker, line contactor, various control options, alternatively with a field bus, safety relay, cubicle heating, and much more, see ATV61 and ATV71 catalogues.

Further installed components are possible to get harmonic mitigation by 12 - pulse supply. For the power range from 630...2400 kW also a 24-pulse solution can be selected.

12-pulse-supply

General specification

12-pulse supply is a simple solution for harmonic mitigation. A transformer with two out-of-phase secondary windings (each for half of the nominal power) is used to supply the drive system. The frequency inverter has to be provided by two input rectifiers in parallel. On the mains side of the transformer the 5^{th} and 7^{th} current harmonics are practically non-existent as they have been cancelled by the shifted transformer windings.

Following frequency inverters are standard equipped with two parallel input rectifiers and therefore well prepared for 12-pulse rectification:

ATV61HC50N4(D) and HC63N4(D)

ATV61HC50Y...HC80Y

ATV71HC40N4(D) and HC50N4(D)

ATV71HC40Y...HC63Y

Using an additional external "Rectifier bridge" all other frequency inverters are able to run in a 12-pulse-supply operating mode:

ATV61HD90N4D...HC31N4D

ATV61HC11Y...HC40Y

ATV71HD90N4D...HC25N4D

ATV71HC11Y...HC31Y

At ATV●1EX●●●●● (IP23 or IP54 floor-standing enclosure compact version) the cubicle can be prepared for 12-pulse-supply by selecting it as an option.

The frequency inverters of the enclosure units ATV61EXA●●●●● are standard equipped with two parallel input rectifiers. Thus it is easy to equip them with 12-pulse rectification optionally.

The supply results from a separate transformer with two out-of-phase secondary windings (e.g. superimposing transformer Yy6 Yd5).

If the existing mains distortion is mainly caused by frequency inverters with normal 6-pulse-circuit, a superimposing transformer in zig-zag-connection (± 15° phase shift at each secondary windings e.g. Yy1130 Yy0030) will be highly recommended.

On the main side of the transformer the 5th and 7th current harmonics are practically non-existent as they have been cancelled by the shifted transformer windings.

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The following specifications must be kept at a minimum in order to ensure trouble-free operation and even current sharing:

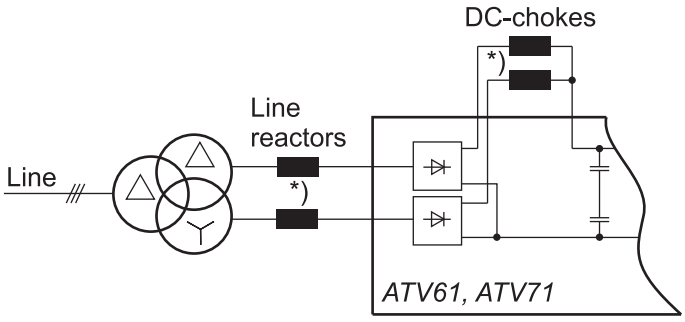
Transformer:

- Converter transformer for 12-pulse supply with two non-controlled rectifier bridges in a common voltage DC link.
- Recommended design: superimposing
- Nominal voltage at the primary side: according to application
- Voltage adaptation at the primary side: +5% / +2.5% / 0 / -2.5% / -5%
- Nominal output current: see the following table
- Current harmonics at the secondary side: see the following table
- Nominal output voltage (= no-load voltage): see the following table
- Tolerance of the secondary voltages to each other: < 0.3% (< 0.1%) of V_{NOM}
- Short circuit voltage: see the following table
- Tolerance of the relative short circuit voltage: ±10% of v_{SC_NOM}
- Tolerance of the relative short circuit voltage between both secondary windings: < 5% (< 2%) of v_{SC_NOM}
- Further specifications: according to the application
- Tolerance for unbalance of phaseshift (±0.5°)

Mains:

- allowed mains distortion: THD(u) < 5%
- max. single harmonic (5^{th}): < 3%

( ) ..... Values in brackets for transformer in zig-zag-connection (±15° phase shift at both secondary windings e.g. Yy1130 Yy0030)



*) Line chokes (or alternative DC-chokes for some power ratings only) are just necessary if the transformer is larger than 1.5-times of the inverter power.

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Recommended values for dimensioning a "12-pulse transformer"

Inverter power [kW]	Transformer Output current 400V	Output current 500V	Output current 690V	Inverter power [HP]	Transformer Output current 480V	Output current 600V	Harmonics Secondary (THDi LV)	Short-circuit voltage	Harmonics Primary (THDi HV)
90	2x 90 A	2x 70 A	2x 60 A	**125**	2x 80 A	2x 65 A	42 %	4 %	12 %
110	2x 110 A	2x 80 A	2x 65 A	**150**	2x 95 A	2x 75 A	42 %	4 %	12 %
132	2x 130 A	2x 95 A	2x 75 A	**200**	2x 125 A	2x 115 A	42 %	4 %	12 %
160	2x 155 A	2x 120 A	2x 90 A	**250**	2x 155 A	2x 140 A	42 %	4 %	12 %
200	2x 190 A (2x 175 A)	2x 145 A (2x 140 A)	2x 120 A (2x 100 A)	**300**	2x 185 A (2x 170 A)	2x 160 A (2x 140 A)	42 %	4 %	12 %
220	2x 210 A (2x 195 A)	2x 160 A (2x 150 A)	2x 130 A (2x 110 A)	**350**	2x 215 A (2x 185 A)	2x 175 A (2x 160 A)	42 %	4 %	12 %
250	2x 240 A (2x 215 A)	2x 180 A (2x 175 A)	2x 145 A (2x 130 A)	**400**	2x 245 A (2x 220 A)	2x 200 A (2x 180 A)	42 %	4 %	12 %
280	2x 265 A (2x 240 A)	2x 205 A (2x 195 A)	2x 160 A (2x 145 A)	**450**	2x 275 A (2x 245 A)	2x 225 A (2x 200 A)	42 %	4 %	12 %
315	2x 300 A (2x 275 A)	2x 230 A (2x 215 A)	2x 180 A (2x 160 A)	**500**	2x 305 A (2x 275 A)	2x 250 A (2x 225 A)	42 %	4 %	12 %
355	2x 340 A (2x 310 A)	2x 250 A (2x 245 A)	2x 210 A (2x 180 A)	**550**	2x 330 A (2x 310 A)	2x 275 A (2x 255 A)	42 %	4 %	12 %
400	2x 380 A (2x 355 A)	2x 285 A (2x 275 A)	2x 230 A (2x 200 A)	**600**	2x 365 A (2x 330 A)	2x 290 A (2x 270 A)	42 %	4 %	12 %
500	2x 490 A (2x 455 A)	2x 385 A (2x 360 A)	2x 285 A (2x 255 A)	**700**	2x 420 A (2x 390 A)	2x 340 A (2x 315 A)	35 %	6 %	10 %
560	2x 550 A (2x 510 A)	2x 440 A (2x 410 A)	2x 320 A (2x 275 A)	**800**	2x 480 A (2x 440 A)	2x 395 A (2x 370 A)	35 %	6 %	10 %
630	2x 610 A (2x 565 A)	2x 490 A (2x 460 A)	2x 365 A (2x 335 A)	**900**	2x 540 A (2x 500 A)	2x 430 A (2x 400 A)	35 %	6 %	10 %
710	2x 680 A (2x 630 A)	2x 540 A (2x 505 A)	2x 420 A (2x 385 A)	**1000**	2x 600 A	2x 480 A (2x 445 A)	35 %	6 %	10 %
800	2x 770 A (2x 710 A)	2x 610 A (2x 570 A)	2x 465 A (2x 430 A)	**1150**	–	2x 540 A (2x 505 A)	35 %	6 %	10 %
900	2x 860 A (2x 800 A)	2x 685 A (2x 635 A)	2x 525 A (2x 485 A)	**1250**	–	2x 590 A (2x 550 A)	35 %	6 %	10 %
1000	2x 940 A (2x 870 A)	2x 770 A (2x 710 A)	2x 570 A (2x 525 A)	**1400**	–	2x 660 A (2x 615 A)	35 %	6 %	10 %
1100	2x 1040 A (2x 960 A)	2x 840 A (2x 780 A)	2x 620 A (2x 575 A)	**1600**	–	2x 755 A (2x 705 A)	35 %	6 %	10 %
1200	2x 1110 A (2x 1030 A)	2x 900 A (2x 840 A)	2x 665 A (2x 620 A)	**1700**	–	2x 790 A (2x 740 A)	35 %	6 %	10 %
1300	2x 1200 A (2x 1120 A)	2x 980 A (2x 910 A)	2x 725 A (2x 670 A)	**1900**	–	2x 885 A (2x 825 A)	35 %	6 %	10 %
1400	2x 1300 A (2x 1200 A)	2x 1050 A (2x 980 A)	2x 780 A (2x 720 A)	**2000**	–	2x 930 A (2x 865 A)	35 %	6 %	10 %
1500	–	2x 1120 A (2x 1040 A)	2x 840 A (2x 770 A)	**2100**	–	2x 980 A (2x 905 A)	35 %	6 %	10 %
1800	–	2x 1330 A (2x 1230 A)	2x 1000 A (2x 920 A)	**2200**	–	2x 1020 A (2x 950 A)	35 %	6 %	10 %
2000	–	–	2x 1100 A (2x 1000 A)	**2500**	–	2x 1150 A (2x 1070 A)	35 %	6 %	10 %
2100	–	–	2x 1150 A (2x 1050 A)	–	–	–	35 %	6 %	10 %
2400	–	–	2x 1300 A (2x 1200 A)	–	–	–	35 %	6 %	10 %

( ) ..... Values in brackets for transformer in zig-zag-connection (±15° phase shift at both secondary windings e.g. Yy1130 Yy0030)

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Recommended output voltage for the transformer

The nominal output voltage of a transformer is specified at no load operation. Therefore this value should be 3...5 % higher than the rated voltage of the drive.

Inverter	Transformer output voltage phase / phase (no load)						
	Nominal voltage 380V	Nominal voltage 400V	Nominal voltage 440V	Nominal voltage 480V	Nominal voltage 500V	Nominal voltage 600V	Nominal voltage 690V
400 V range	400V	425V	460V	500V	–	–	–
690 V range	–	–	–	–	525V	630V	715V

☞ In case of higher transformer power (transformer power [kVA] is higher than 1.5-times of the inverter power [kW]; e.g. when the transformer is used to supply several drives) additional chokes are necessary (line chokes, for some drive ratings dc-chokes are possible too).

Harmonics level

In a 12-pulse supply system many harmonics are compensated to zero in the mains side of the 3-windings transformer due to a phase shifting of the secondary windings. Therefore 12-pulse supply is a simple solution for harmonic mitigation.

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The following lines show the harmonic values based on a mains voltage without any disturbances:

	Voltage harmonics in %																	
Power range	H1	H5	H7	H11	H13	H17	H19	H23	H25	H29	H31	H35	H37	H41	H43	H47	H49	THD
up to 500kW	**100**	0	0	6.37	3.57	0	0	1.68	1.19	0	0	0.66	0.61	0	0	0.32	0.33	**7.66**
above 500kW	**100**	0	0	5.38	3.08	0	0	1.42	1.07	0	0	0.55	0.52	0	0	0.28	0.27	**6.51**

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In a typical medium voltage mains the THD(u) value can be assumed with 3 %. Due to this voltage harmonics there is no total compensation of harmonics.

The following lines show the harmonic values based on a mains voltage with a THD(u) of 3 %:

	Voltage harmonics in %																	
Power range	H1	H5	H7	H11	H13	H17	H19	H23	H25	H29	H31	H35	H37	H41	H43	H47	H49	THD
up to 500kW	**100**	7.10	4.75	6.48	3.82	1.29	1.00	1.46	0.95	0.45	0.50	0.37	0.39	0.34	0.30	0.12	0.11	**11.67**
above 500kW	**100**	6.04	4.22	5.45	3.51	0.94	0.77	1.27	0.88	0.34	0.37	0.36	0.37	0.29	0.25	0.15	0.13	**10.19**

Voltage harmonics in the mains supply lead to a different current value for both rectifier bridges. In bad conditions the current can be different by 10 % at most.

☞ Passive filters can not be used together with 12-pulse solution.

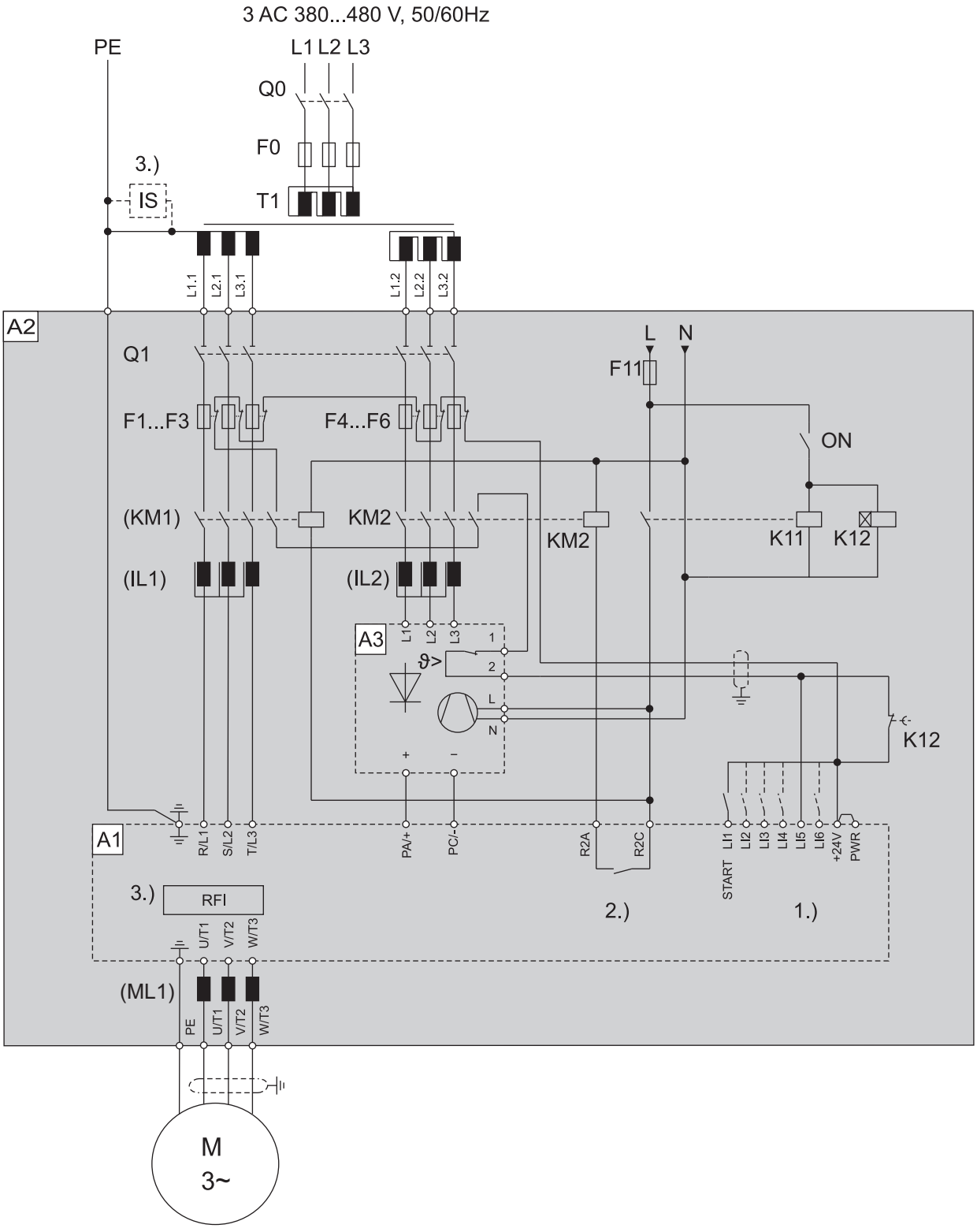
Wiring and connection

Wiring diagram 380...480V

The following diagrams show the typical wiring of the Altivar frequency inverters with 12-pulse-mains-supply and its options which are required for the protection of the plant or the device.

ATV61HD90N4D ... HC31N4D

ATV71HC11N4D ... HC25N4D



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A1 ..... ATV●1H●●●N4D Frequency inverter built-in device (dc-choke must not be used)
One relay and one logic input is used to control the additional circuit for 12-pulse supply

A2 ..... ATV●1EXC●●N4 IP23 or IP 54 floor standing enclosure compact version
12-pulse supply is available as a pre engineered option

A3 ..... 8 P01 510 Rectifier bridge
The additional rectifier is operating in parallel to the rectifier inside the drive

Q0 and F0 ..... Disconnecting switch and transformer protection. An additional short circuit protection on the secondary side of the transformer could be necessary in case of higher distance to the drive and in case of lower short circuit capability of the medium voltage supply (transformer protection has to be designed according to the local regulations).

T1 ..... Transformer with two out-of-phase secondary windings (e.g. Dy5d6)
(for grounding concept check the remark below)

IS ..... Insulation monitoring relay
(It has to be used in case of non rounded neutral point)

Q1 ..... Main switch (to be used if required according to the local regulations)
6-pole switch (For 3-pole switches there must be a mechanical or electrical coupling to ensure the earth fault protection of the low voltage side.)

F1...F6 ..... Mains fuses considering the reference table (absolutely necessary).
The fuses are necessary to protect the wiring and the rectifier bridges.

K11 ..... Auxiliary ON-Relay

K12 ..... Time-delay relay, necessary to avoid a defect detection during the start-periode.

(KM1) ..... Mains contactor (to be used if required according to the local regulations)
Instead of KM1 the start/stop control of the drive can be done via the PWR input.

(KM2) ..... Mains contactor (absolutely necessary).
This contactor must not be closed before the dc-link of the drive is charged!

(IL1, IL2) ..... Line reactor - these reactors are just necessary if the transformer power is larger than 1.5-times of the inverter power.

(ML1) ..... Motor choke – independent of 12-pulse supply.
Option to reduce the voltage spikes at the motor in case of long motor cables.

1.) Logic Input LI5 must be assigned to the "ext. Fault" parameter. It is used for monitoring all fuses, the line contactor (or both contactors) and the thermal overload of the rectifier bridge.

2.) Logic Relay output R2A must be assigned to the "dbL – DC-charged" parameter

3.) The internal RFI filter has to be set in accordance to the grounding concept of the transformer

☞ In case of supply by means of a three-winding-transformer the neutral point can be grounded or alternatively an insulation monitoring relay can be used.

- Grounding of the neutral point:
  The built-in RFI-Filter has to be set to "TT or TN mains"
  (Category C3 according to EN / IEC 61800-3)
- Insulation monitoring relay:
  The built-in RFI-Filter has to be set to "IT mains / corner grounded"
  (Category C4 according to EN / IEC 61800-3)

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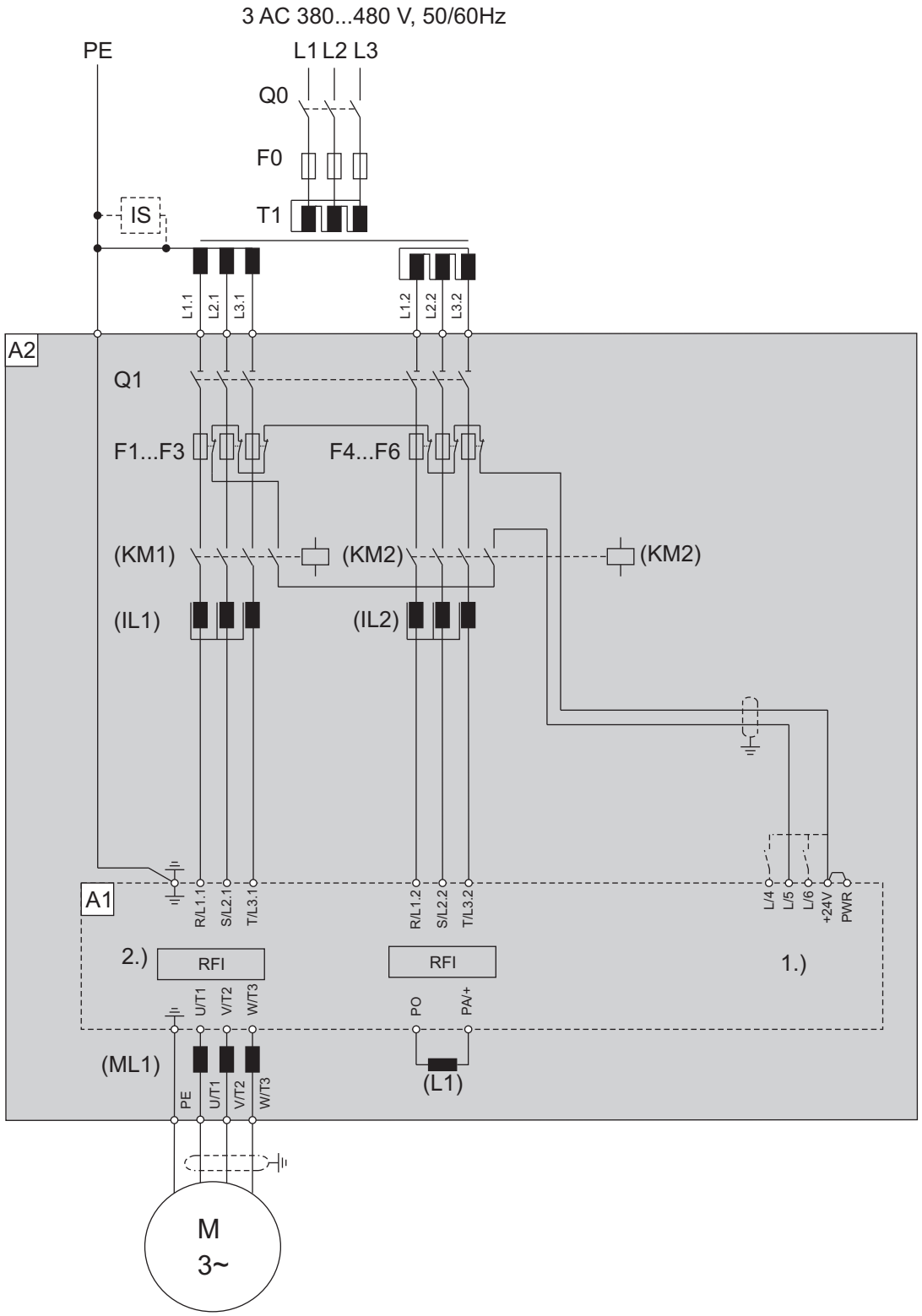
ATV61HC50N4(D) ... HC63N4(D) and ATV61EXA●●●●
ATV71HC40N4(D) ... HC50N4(D) and ATV71EXA●●●●



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A1 ..... ATV●1H●●●N4D Frequency inverter built-in device – already designed for 12-pulse supply
All 6 phases are monitored by the drive – no input has to be used

A2 ..... ATV●1EX●●●N4 IP23 or IP 54 floor standing enclosure compact version
12-pulse supply is available as a pre engineered option

Q0 and F0 ..... Disconnecting switch and transformer protection. An additional short circuit protection on the secondary side of the transformer could be necessary in case of higher distance to the drive and in case of lower short circuit capability of the medium voltage supply (transformer protection has to be designed according to the local regulations).

T1 ..... Transformer with two out-of-phase secondary windings (e.g. Dy5d6)
(for grounding concept check the remark below)

IS ..... Insulation monitoring relay
(It has to be used in case of non rounded neutral point)

Q1 ..... Main switch (to be used if required according to the local regulations)
6-pole switch (For 3-pole switches there must be a mechanical or electrical coupling to ensure the earth fault protection of the low voltage side.)

F1...F6 ..... Mains fuses considering the reference table (absolutely necessary).
The fuses are necessary to protect the wiring and the rectifier bridges.

(KM1, KM2) ..... Mains contactors (to be used if required according to the local regulations)
Instead of KM1 and KM2 the start/stop control of the drive can be done via the PWR input.

(IL1, IL2) ..... Line reactor - these reactors are just necessary if the transformer power is larger than 1.5-times of the inverter power.

L1 ..... DC-choke - it can be used instead of IL1 / IL2 if the transformer power is larger than 1.5-times of the inverter power.

(ML1) ..... Motor choke (independent of 12-pulse supply).
Option to reduce the voltage spikes at the motor in case of long motor cables.

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1.) Logic Input LI5 must be assigned to the "ext. Fault" parameter. It is used for monitoring all fuses.
This is not obligatory, because the inverter monitors the mains voltage. Therefore set parameter "Mains phase monitoring" to "active" (factory default).

2.) The internal RFI filters have to be set in accordance to the grounding concept of the transformer

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☞ In case of supply by means of a three-winding-transformer the neutral point can be grounded or alternatively an insulation monitoring relay can be used.

- Grounding of the neutral point:
  The built-in RFI-Filter has to be set to "TT or TN mains"
  (Category C3 according to EN / IEC 61800-3)
- Insulation monitoring relay:
  The built-in RFI-Filter has to be set to "IT mains or corner grounded"
  (Category C4 according to EN / IEC 61800-3)

Reference table for ATV 61•••N4

Power at 400 V [kW]	A1 Drive Reference ATV61H	A2 Enclosure drive Reference ATV61EX••	A3 Rectifier bridge Reference	KM2 Line contactor Reference	KM1 Line contactor (if requested)	IL1, IL2 Line reactor (if necessary)	F1…F6 Line Fuses (semiconductor fuses)	Line & DC Cable cross section (recommended values)
90	D90N4D		8 P01 510	LC1 D115	(LC1 D115)	(VW3 A4 570)	160A sf	2x 50mm²
		D90N4	on request					
110	C11N4D		8 P01 510	LC1 D115	(LC1 D115)	(VW3 A4 570)	160A sf	2x 50mm²
		C11N4	on request					
132	C13N4D		8 P01 510	LC1 F150	(LC1 F150)	(VW3 A4 558)	200A sf	2x 70mm²
		C13N4	on request					
160	C16N4D		8 P01 510	LC1 F150	(LC1 F150)	(VW3 A4 559)	250A sf	2x 95mm²
		C16N4	on request					
200… 220	C22N4D		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 560)	315A sf	2x 120mm²
		C22N4	on request					
250	C25N4D		8 P01 510	LC1 F265	(LC1 F265)	(VW3 A4 561)	400A sf	2x 150mm²
		C25N4	on request					
280… 315	C31N4D		8 P01 510	LC1 F330	(LC1 F330)	(VW3 A4 561)	500A sf	2x 150mm²
		C31N4	on request					
355… 400	C50N4 (D)	1.)	–	(LC1 F400)	(LC1 F400)	(VW3 A4 561)	500A sf	
		C50N4	on request					
500	C50N4 (D)		–	(LC1 F500)	(LC1 F500)	(VW3 A4 569)	630A sf	
		C50N4	on request					
560… 630	C63N4 (D)		–	(LC1 F500)	(LC1 F500)	(VW3 A4 564)	800A sf	
		C63N4	on request					
	ATV61EXA•		Option for "Configured drive systems"					
630	C63N4		1x VW3 AE 2416	12 – pulse supply 400V				
710	C71N4		1x VW3 AE 2416	12 – pulse supply 400V				
900	C90N4		1x VW3 AE 2418	12 – pulse supply 400V				
1100	M11N4		1x VW3 AE 2419	12 – pulse supply 400V				
1300	M13N4		1x VW3 AE 2420	12 – pulse supply 400V				
1400	M14N4		1x VW3 AE 2420	12 – pulse supply 400V				

1.) For motor power of 355...400 kW the use of size ATV 61HC50N4(D) (which is already designed for 12-pulse supply) is recommended (reduce current/power setting).

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Reference table for ATV 71●●●N4

Power at 400V [kW]	A1 Drive Reference ATV71H	A2 Enclosure drive Reference ATV71EX●●	A3 Rectifier bridge Reference	KM2 Line contactor Reference	KM1 Line contactor (if requested)	IL1, IL2 Line reactor (if necessary)	F1…F6 Line Fuses (semiconductor fuses)	Line & DC Cable cross section (recommended values)
90	D90N4D		8 P01 510	LC1 D115	(LC1 D115)	(VW3 A4 570)	160A sf	2x 50mm²
		D90N4	on request					
110	C11N4D		8 P01 510	LC1 D115	(LC1 D115)	(VW3 A4 570)	160A sf	2x 50mm²
		C11N4	on request					
132	C13N4D		8 P01 510	LC1 F150	(LC1 F150)	(VW3 A4 558)	200A sf	2x 70mm²
		C13N4	on request					
160	C16N4D		8 P01 510	LC1 F150	(LC1 F150)	(VW3 A4 559)	250A sf	2x 95mm²
		C16N4	on request					
200	C20N4D		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 560)	315A sf	2x 120mm²
		C20N4	on request					
250	C25N4D		8 P01 510	LC1 F265	(LC1 F265)	(VW3 A4 561)	400A sf	2x 150mm²
		C25N4	on request					
280	C31N4D		8 P01 510	LC1 F330	(LC1 F330)	(VW3 A4 561)	500A sf	2x 150mm²
		C31N4	on request					
315	C40N4 (D)	1.)	-	(LC1 F400)	(LC1 F400)	(VW3 A4 561)	500A sf	
		C40N4	on request					
400	C40N4 (D)		-	(LC1 F500)	(LC1 F500)	(VW3 A4 569)	630A sf	
		C40N4	on request					
500	C50N4 (D)		-	(LC1 F500)	(LC1 F500)	(VW3 A4 564)	800A sf	
		C50N4	on request					
	ATV71EXA●		Option for "Configured drive systems"					
500	C50N4		1x VW3 AE 2415	12 – pulse supply 400V				
630	C63N4		1x VW3 AE 2416	12 – pulse supply 400V				
710	C71N4		1x VW3 AE 2417	12 – pulse supply 400V				
900	C90N4		1x VW3 AE 2418	12 – pulse supply 400V				
1100	M11N4		1x VW3 AE 2419	12 – pulse supply 400V				
1300	M13N4		1x VW3 AE 2420	12 – pulse supply 400V				

1.) For motor power of 315 kW the use of size ATV 71HC40N4(D) (which is already designed for 12-pulse supply) is recommended (reduce current/power setting).

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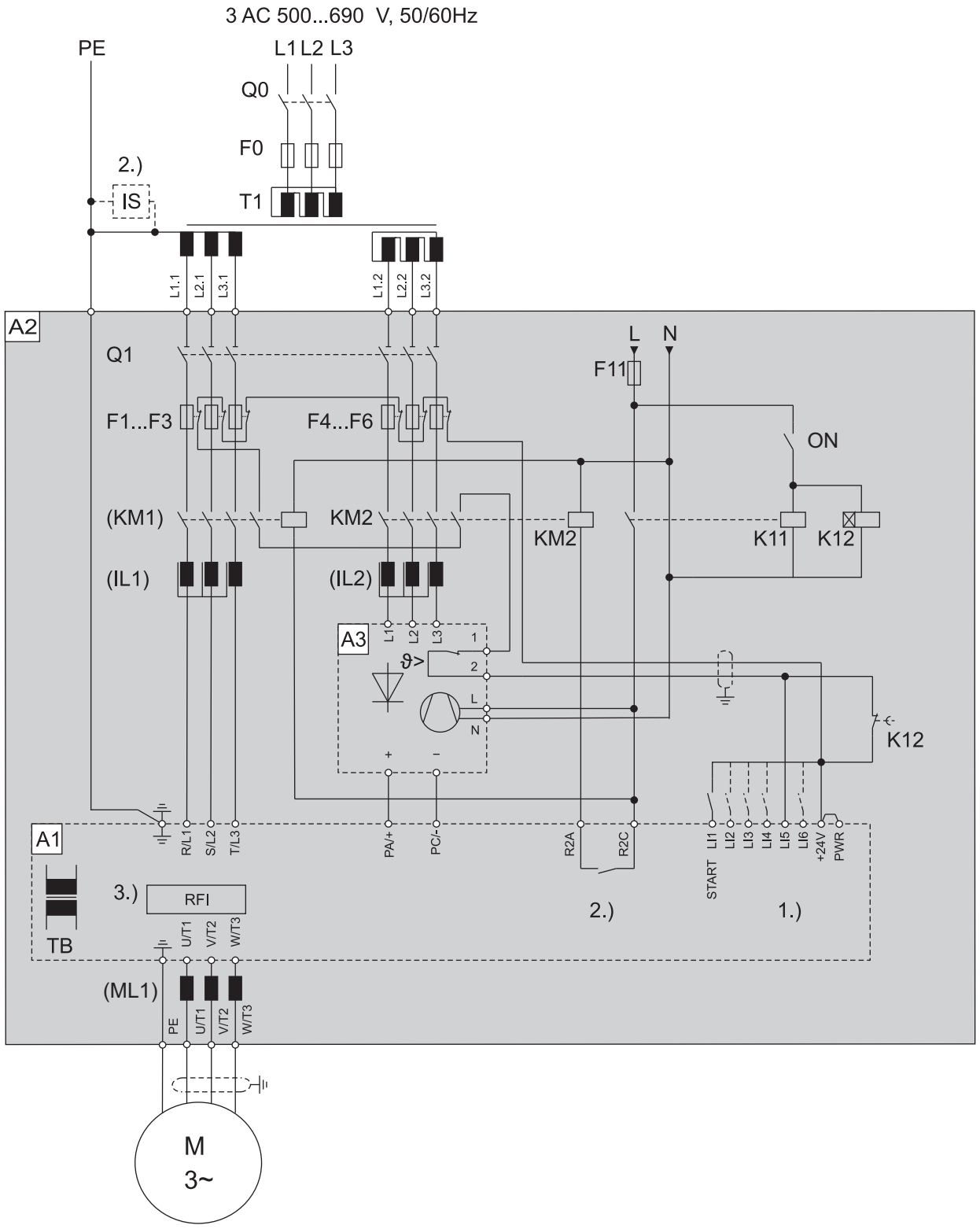
Wiring diagram 500...690 V

The following diagrams show the typical wiring of the Altivar frequency inverters with 12-pulse-mains-supply and its options which are required for the protection of the plant or the device.

ATV61HC11Y ... HC40Y
ATV71HC11Y ... HC31Y



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A1 ..... ATV●1H●●●Y Frequency inverter built-in device
One relay and one logic input is used to control the additional circuit for 12-pulse supply

A2 ..... ATV●1EXC●●Y IP23 or IP 54 floor standing enclosure compact version
12-pulse supply is available as a pre-engineered option

A3 ..... 8 P01 510 Rectifier bridge
The additional rectifier is operating in parallel to the rectifier inside the drive.

Q0 and F0 ..... Disconnecting switch and transformer protection. An additional short circuit protection on the secondary side of the transformer could be necessary in case of higher distance to the drive and in case of lower short circuit capability of the medium voltage supply (transformer protection has to be designed according to the local regulations).

T1 ..... Transformer with two out-of-phase secondary windings (e.g. Dy5d6)
(for grounding concept check the remark below)

IS ..... Insulation monitoring relay
(It has to be used in case of non rounded neutral point)

Q1 ..... Main switch (to be used if required according to the local regulations)
6-pole switch (For 3-pole switches there must be a mechanical or electrical coupling to ensure the earth fault protection of the low voltage side.)

F1...F6 ..... Mains fuses considering the reference table (absolutely necessary).
The fuses are necessary to protect the wiring and the rectifier bridges.

K11 ..... Auxiliary ON-Relay

K12 ..... Time-delay relay, necessary to avoid a defect detection during the start-periode.

(KM1) ..... Mains contactor (to be used if required according to the local regulations)
Instead of KM1 the start/stop control of the drive can be done via the PWR input.

KM2 ..... Mains contactor (absolutely necessary).
This contactor must not be closed before the dc-link of the drive is charged!

(IL1, IL2) ..... Line reactor - these reactors are just necessary if the transformer power is larger than 1.5-times of the inverter power.

TB ..... Transformer box is used as standard to supply the drive fan(s).

(ML1) ..... Motor choke – independent of 12-pulse supply.
Option to reduce the voltage spikes at the motor in case of long motor cables.

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1.) Logic Input LI5 must be assigned to the "ext. Fault" parameter. It is used for monitoring all fuses, the line contactor (or both contactors) and the thermal overload of the rectifier bridge.

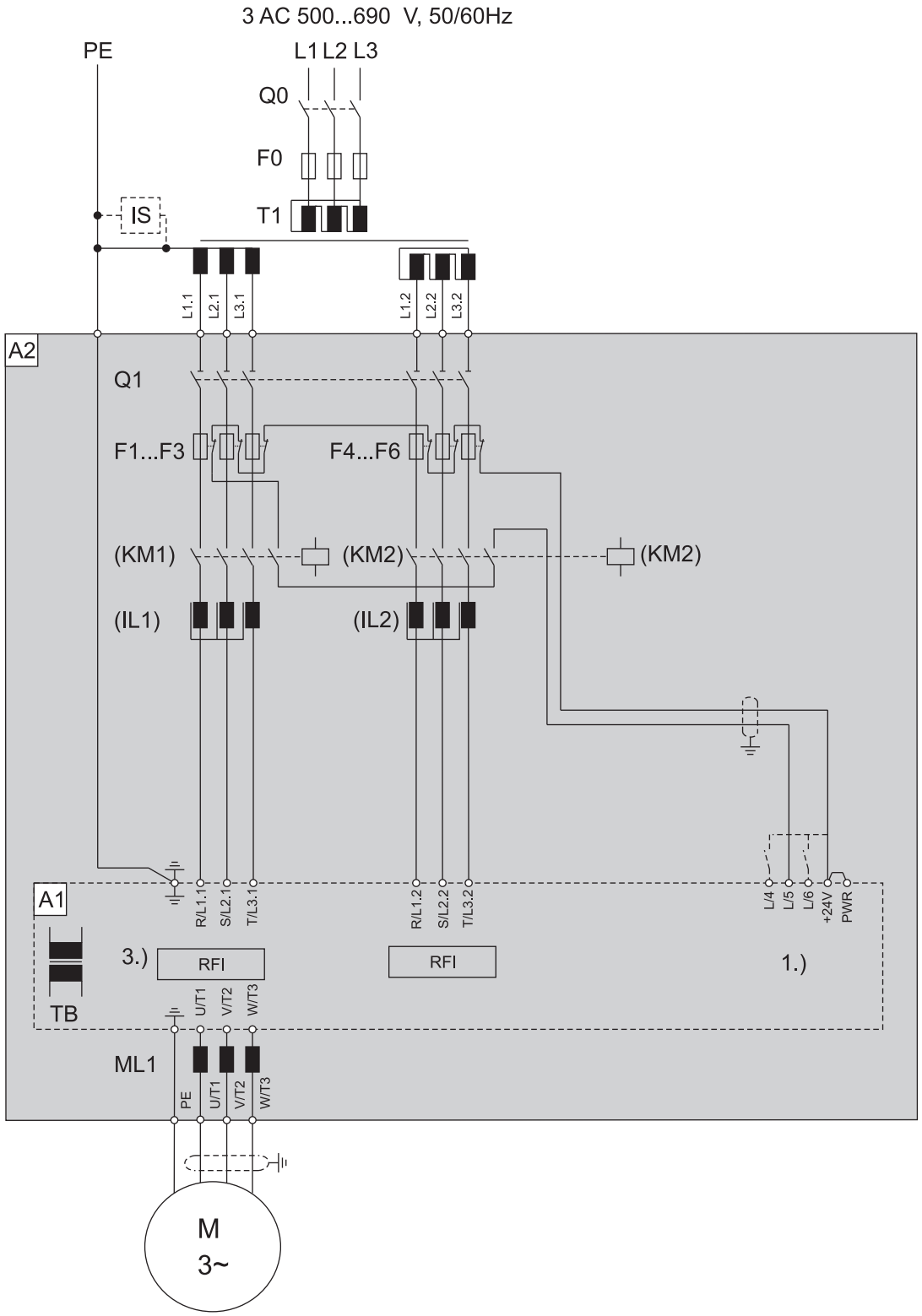
2.) Logic Relay output R2A must be assigned to the "dbL – DC-charged" parameter

3.) The internal RFI filter has to be set in accordance to the grounding concept of the transformer

☞ In case of supply by means of a three-winding-transformer the neutral point can be grounded or alternatively an insulation monitoring relay can be used.

- Grounding of the neutral point:
  The built-in RFI-Filter has to be set to "TT or TN mains"
  (Category C3 according to EN / IEC 61800-3)
- Insulation monitoring relay:
  The built-in RFI-Filter has to be set to "IT mains or corner grounded"
  (Category C4 according to EN / IEC 61800-3)

ATV61HC50Y ... HC80Y and ATV61EX●●●●
ATV71HC40Y ... HC63Y and ATV71EX●●●●



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A1 ..... ATV●1H●●●Y Frequency inverter built-in device – already designed for 12-pulse supply
All 6 phases are monitored by the drive – no input has to be used

A2 ..... ATV●1EX●●●Y IP23 or IP 54 floor standing enclosure compact version
12-pulse supply is available as a pre engineered option

Q0 and F0 ..... Disconnecting switch and transformer protection. An additional short circuit protection on the secondary side of the transformer could be necessary in case of higher distance to the drive and in case of lower short circuit capability of the medium voltage supply (transformer protection has to be designed according to the local regulations).

T1 ..... Transformer with two out-of-phase secondary windings (e.g. Dy5d6)
(for grounding concept check the remark below)

IS ..... Insulation monitoring relay
(It has to be used in case of non rounded neutral point)

Q1 ..... Main switch (to be used if required according to the local regulations)
6-pole switch (For 3-pole switches there must be a mechanical or electrical coupling to ensure the earth fault protection of the low voltage side.)

F1...F6 ..... Mains fuses considering the reference table (absolutely necessary).
The fuses are necessary to protect the wiring and the rectifier bridges.

(KM1, KM2) ..... Mains contactors (to be used if required according to the local regulations)
Instead of KM1 and KM2 the start/stop control of the drive can be done via the PWR input.

(IL1, IL2) ..... Line reactor - these reactors are just necessary if the transformer power is larger than 1.5-times of the inverter power.

TB ..... Transformer box is used as standard to supply the drive fan(s).

(ML1) ..... Motor choke (independent of 12-pulse supply).
Option to reduce the voltage spikes at the motor in case of long motor cables.

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1.) Logic Input LI5 must be assigned to the "ext. Fault" parameter. It is used for monitoring all fuses. This is not obligatory, because the inverter monitors the mains voltage. Therefore set parameter "Mains phase monitoring" to "active" (factory default).

3.) The internal RFI filters have to be set in accordance to the grounding concept of the transformer

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☞ In case of supply by means of a three-winding-transformer the neutral point can be grounded or alternatively an insulation monitoring relay can be used.

- Grounding of the neutral point:
  The built-in RFI-Filter has to be set to "TT or TN mains"
  (Category C3 according to EN / IEC 61800-3)
- Insulation monitoring relay:
  The built-in RFI-Filter has to be set to "IT mains or corner grounded"
  (Category C4 according to EN / IEC 61800-3)

Reference table for ATV 61•••Y

Power at 690V [kW]	A1 Drive Reference ATV61H	A2 Enclosure drive Reference ATV61EX••	A3 Rectifier bridge Reference	KM2 Line contactor Reference	KM1 Line contactor (if requested)	IL1, IL2 Line reactor (if necessary)	F1…F6 Line Fuses (semiconductor fuses)	Line & DC Cable cross section (recommended values)
110	C11Y		8 P01 510	LC1 D95	(LC1 D95)	(VW3 A4 556)	125A sf	2x 50mm²
		C11Y	on request					
132	C13Y		8 P01 510	LC1 D95	(LC1 D95)	(VW3 A4 556)	125A sf	2x 50mm²
		C13Y						
160	C16Y		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 556)	160A sf	2x 50mm²
		C16Y						
200	C20Y		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 570)	200A sf	2x 70mm²
		C20Y	on request					
250	C25Y		8 P01 510	LC1 F265	(LC1 F265)	(VW3 A4 558)	250A sf	2x 95mm²
		C25Y	on request					
315	C31Y		8 P01 510	LC1 F330	(LC1 F330)	(VW3 A4 559)	315A sf	2x 120mm²
		C31Y	on request					
400	C40Y		8 P01 510	LC1 F400	(LC1 F400)	(VW3 A4 559)	400A sf	2x 150mm²
		C40Y	on request					
500	C50Y		–	(LC1 F400)	(LC1 F400)	(VW3 A4 568)	400A sf	
		C50Y	on request					
630	C63Y		–	(LC1 F500)	(LC1 F500)	(VW3 A4 572)	500A sf	
		C63Y	on request					
800	C80Y		–	(LC1 F630)	(LC1 F630)	(VW3 A4 572)	630A sf	
		C80Y	on request					
	ATV61EXA•		Option for "Configured drive systems"					
800	C80Y		VW3 AE 2415	12 – pulse supply 690V				
1000	M10Y		VW3 AE 2416	12 – pulse supply 690V				
1200	M12Y		VW3 AE 2416	12 – pulse supply 690V				
1500	M15Y		VW3 AE 2418	12 – pulse supply 690V				
1800	M18Y		VW3 AE 2419	12 – pulse supply 690V				
2100	M21Y		VW3 AE 2420	12 – pulse supply 690V				
2400	M24Y		VW3 AE 2420	12 – pulse supply 690V				

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Reference table for ATV 71●●●Y

Power at 690V [kW]	A1 Drive Reference ATV71H	A2 Enclosure drive Reference ATV71EX●●	A3 Rectifier bridge Reference	KM2 Line contactor Reference	KM1 Line contactor (if requested)	IL1, IL2 Line reactor (if necessary)	F1…F6 Line Fuses (semiconductor fuses)	Line & DC Cable cross section (recommended values)
110	C11Y		8 P01 510	LC1 D95	(LC1 D95)	(VW3 A4 556)	125A sf	2x 50mm²
		C11Y	on request					
132	C13Y		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 556)	160A sf	2x 50mm²
		C13Y	on request					
160	C16Y		8 P01 510	LC1 F225	(LC1 F225)	(VW3 A4 570)	200A sf	2x 70mm²
		C16Y	on request					
200	C20Y		8 P01 510	LC1 F265	(LC1 F265)	(VW3 A4 558)	250A sf	2x 95mm²
		C20Y	on request					
250	C25Y		8 P01 510	LC1 F330	(LC1 F330)	(VW3 A4 558)	315A sf	2x 120mm²
		C25Y	on request					
315	C31Y		8 P01 510	LC1 F400	(LC1 F400)	(VW3 A4 559)	400A sf	2x 150mm²
		C31Y	on request					
400	C40Y		–	(LC1 F400)	(LC1 F400)	(VW3 A4 568)	400A sf	
		C40Y	on request					
500	C50Y		–	(LC1 F500)	(LC1 F500)	(VW3 A4 572)	500A sf	
		C50Y	on request					
630	C63Y		–	(LC1 F630)	(LC1 F630)	(VW3 A4 572)	630A sf	
		C63Y	on request					
	ATV71EXA●		Option for "Configured drive systems"					
630	C63Y		VW3 AE 2414	12 – pulse supply 690V				
800	C80Y		VW3 AE 2415	12 – pulse supply 690V				
1000	M10Y		VW3 AE 2416	12 – pulse supply 690V				
1200	M12Y		VW3 AE 2417	12 – pulse supply 690V				
1500	M15Y		VW3 AE 2418	12 – pulse supply 690V				
1800	M18Y		VW3 AE 2419	12 – pulse supply 690V				
2000	M20Y		VW3 AE 2420	12 – pulse supply 690V				

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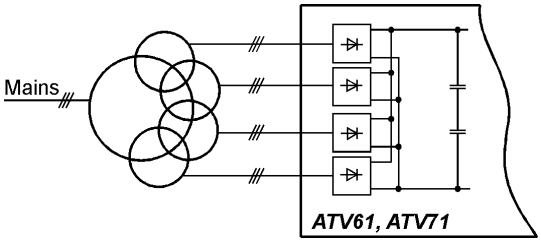
24-pulse-supply

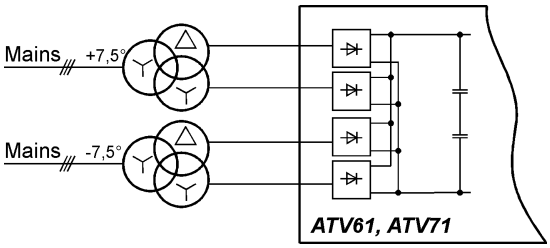
General specification

The frequency inverters of the following enclosure units are standard equipped with four parallel input rectifiers. Thus it is easy to equip them with 24-pulse rectification optionally:

from ATV61EXA●C90N4
from ATV61EXA●M11N
from ATV61EXA●M15Y



The supply results from a separate transformer with four secondary windings each separated by 15°.



Alternatively the supply can also occur via two transformers each with two out-of-phase secondary windings (e.g. superimposing transformer Yy6 Yd5) and a phase displacement of +7.5° and -7.5° at the primary winding.

The symmetry of the two transformers is a major factor for reducing the harmonics.

On the medium voltage line the 5th, 7th, 11th, 13th, 17th and 19th current harmonics are practically non-existent as they have been cancelled by the shifted transformer windings.

The following specifications must keep at a minimum in order to ensure trouble-free operation and even current sharing:

Transformer:

- Converter transformer(s) for 24-pulse supply with four non-controlled rectifier bridges in a common voltage DC link.
- Recommended design: superimposing
- Nominal voltage at the primary side: according to application
- Voltage adaptation at the primary side: +5% / +2.5% / 0 / -2.5% / -5%
- Nominal output current: see the following table
- Current harmonics at the secondary side: see the following table
- Nominal output voltage (= no-load voltage): see the following table
- Tolerance of the secondary voltages to each other: < 0.3% (< 0.1%) of V_{NOM}
- Short circuit voltage: see the following table
- Tolerance of the relative short circuit voltage: ±10% of v_{SC_NOM}
- Tolerance of the relative short circuit voltage between both secondary windings: < 5% (< 2%) of v_{SC_NOM}
- Further specifications: according to the application
- Tolerance for unbalance of phaseshift (±0.5°)

Mains:

- allowed mains distortion: THD(u) < 5%
- max. single harmonic (5^{th}): < 3%

( ) Values in brackets for transformer in zig-zag-connection (±15° phase shift at both secondary windings e.g. Yy1130 Yy0030)

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Recommended values for dimensioning a "24-pulse transformer"

Inverter power [kW]	Transformer Output current 400V	Output current 500V	Output current 690V	Inverter power [HP]	Transformer Output current 480V	Output current 600V	Harmonics Secondary (THDi LV)	Short-circuit voltage	Harmonics Primary [1] (THDi HV)
710	4x 350 A (4x 320 A)	–	–	**1000**	4x 310 A (4x 280 A)	–	35 %	6 %	10 %
900	4x 440 A (4x 400 A)	4x 350 A (4x 320 A)	–	**1250**	4x 400 A (4x 360 A)	4x 300 A (4x 280 A)	35 %	6 %	10 %
1100	4x 530 A (4x 480 A)	4x 430 A (4x 390 A)	–	**1600**	4x 480 A (4x 440 A)	4x 390 A (4x 360 A)	35 %	6 %	10 %
1200	–	–	4x 340 A (4x 320 A)	**1800**	4x 550 A (4x 500 A)	–	35 %	6 %	10 %
1300	4x 620 A (4x 570 A)	4x 500 A (4x 460 A)	–	**1900**	–	4x 450 A (4x 420 A)	35 %	6 %	10 %
1400	4x 675 A (4x 610 A)	–	–	**2000**	4x 620 A (4x 560 A)	–	35 %	6 %	10 %
1500	–	4x 530 A (4x 520 A)	4x 430 A (4x 390 A)	**2100**	–	4x 500 A (4x 460 A)	35 %	6 %	10 %
1800	–	4x 675 A (4x 620 A)	4x 510 A (4x 460 A)	**2200**	–	4x 520 A (4x 480 A)	35 %	6 %	10 %
2000	–	–	4x 560 A (4x 500 A)	**2500**	–	4x 590 A (4x 540 A)	35 %	6 %	10 %
2100	–	–	4x 585 A (4x 530 A)	**–**	–	–	35 %	6 %	10 %
2400	–	–	4x 660 A (4x 600 A)	**–**	–	–	35 %	6 %	10 %

1) ..... THDi for each transformer

( ) ..... Values in brackets for transformer in zig-zag-connection (±15° phase shift at both secondary windings e.g. Yy1130 Yy0030)

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Recommended output voltage for the transformer

The nominal output voltage of a transformer is specified at no load operation. Therefore this value should be 3...5 % higher than the rated voltage of the drive.

Inverter	Transformer output voltage phase / phase (no load) Nominal voltage 380V	Nominal voltage 400V	Nominal voltage 440V	Nominal voltage 480V	Nominal voltage 500V	Nominal voltage 600V	Nominal voltage 690V
400 V range	400V	425V	460V	500V	–	–	–
690 V range	–	–	–	–	525V	630V	715V

24 pulse supply only on request of "Flexible drive systems" enclosures !

Rectifier bridge

Specification

Technical data of Rectifier bridge

Reference	
Reference	8 P01 510
Input	
Voltage	380 V -15 % to 690 V +10 % for TT, TN or IT-mains (not for corner grounded)
Frequency	50 / 60 Hz ±5 % *)
Nominal current	400 A
Overload	20 % for 60 s or 35 % for 2 s
Over voltage class	Class III according to EN 50178
Auxiliary voltage for fan	200...240V 50/60 Hz ±5 %
Power consumption	Fan: approx. 150 W
Output	
Method	6-pulse diode bridge
Voltage	DC
DC-current	480 A
Design	Built-in unit for vertical mounting
Cooling	forced
Ambient conditions	
Operating temperature	+5...+45°C; up to +60°C with derating (3K3 according to IEC/EN 60721-3-3)
Storage / Transport temperature	Storage: -25...+55°C; 1K4 Transport: -25...+70°C; 2K3
Protection degree	IP00 (with protective front plastic plate)
Environmental class / Humidity	Class 3K3 in accordance with IEC/EN 60721-3-3 / no condensation, max. 85 % relative humidity
Altitude	up to 1000 m, beyond power decrease up to 3000 m (2 % per 100 m)
Allowed pollution	Pollution degree 2 according to EN 61800-5-1 3C2 and 3S2 according to EN 60721-3-3
Standards	
Basic standard	The devices are designed, built and tested on the basis of EN 50178.
Insulation	Galvanic insulation in accordance with EN 50178 PELV (Protective Extra Low Voltage)
Approvals	CE
Dimensions and weight	
Weight	approx. 17 kg
Dimensions	approx. H x W x D = 560 x 250 x 210 mm
Losses	approx. 1050 W
Volume cooling air	approx. 600 m³/h
Sound pressure	57 dB(A)

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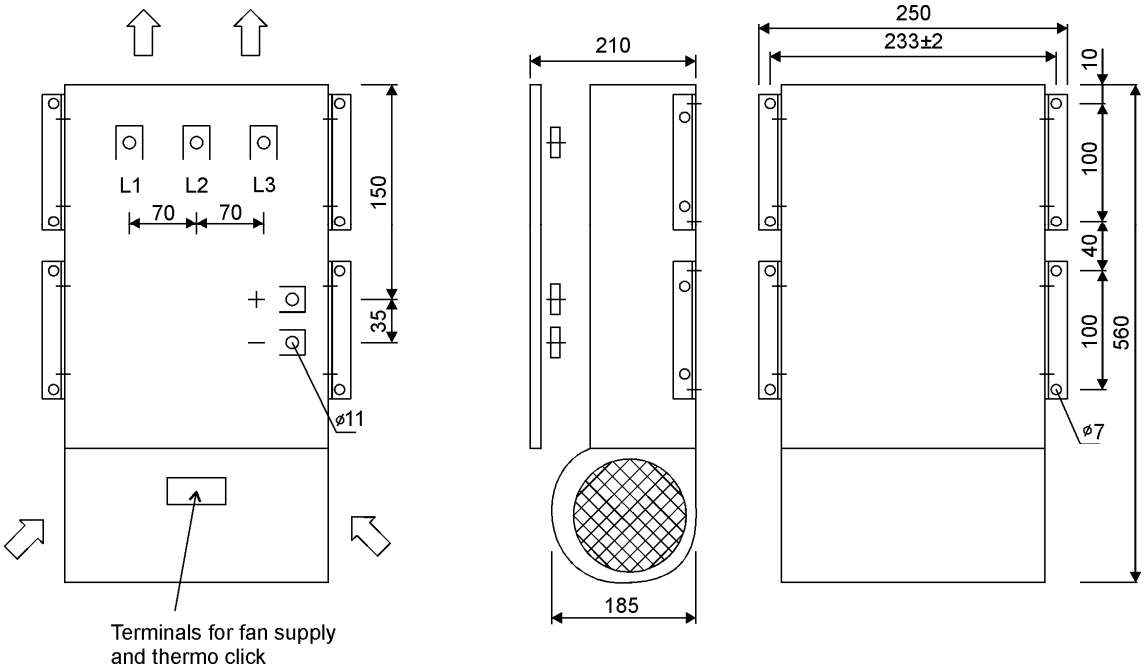
Dimensions



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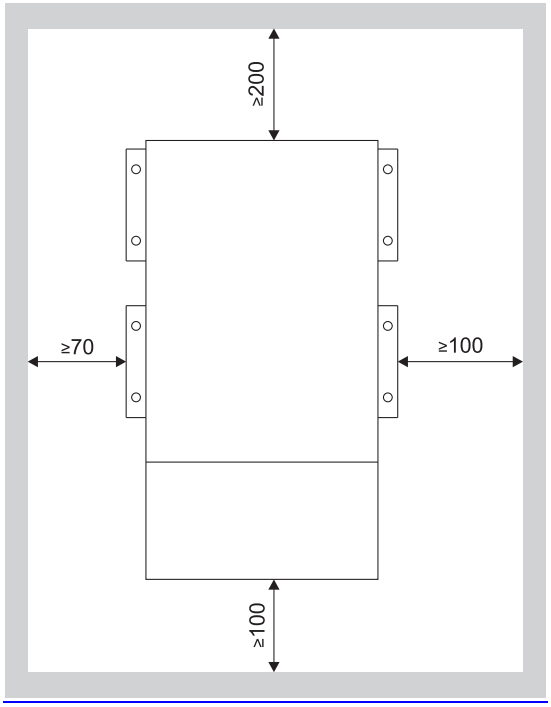
Distances to other devices or to the wall



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Schneider Electric Power Drives GmbH

Ruthnergasse 1
A-1210 Wien
Tel.: +43 (0) 1 29191 0
Fax: +43 (0) 1 29191 15

Design: Schneider Electric Power Drives
Fotos: Schneider Electric Power Drives