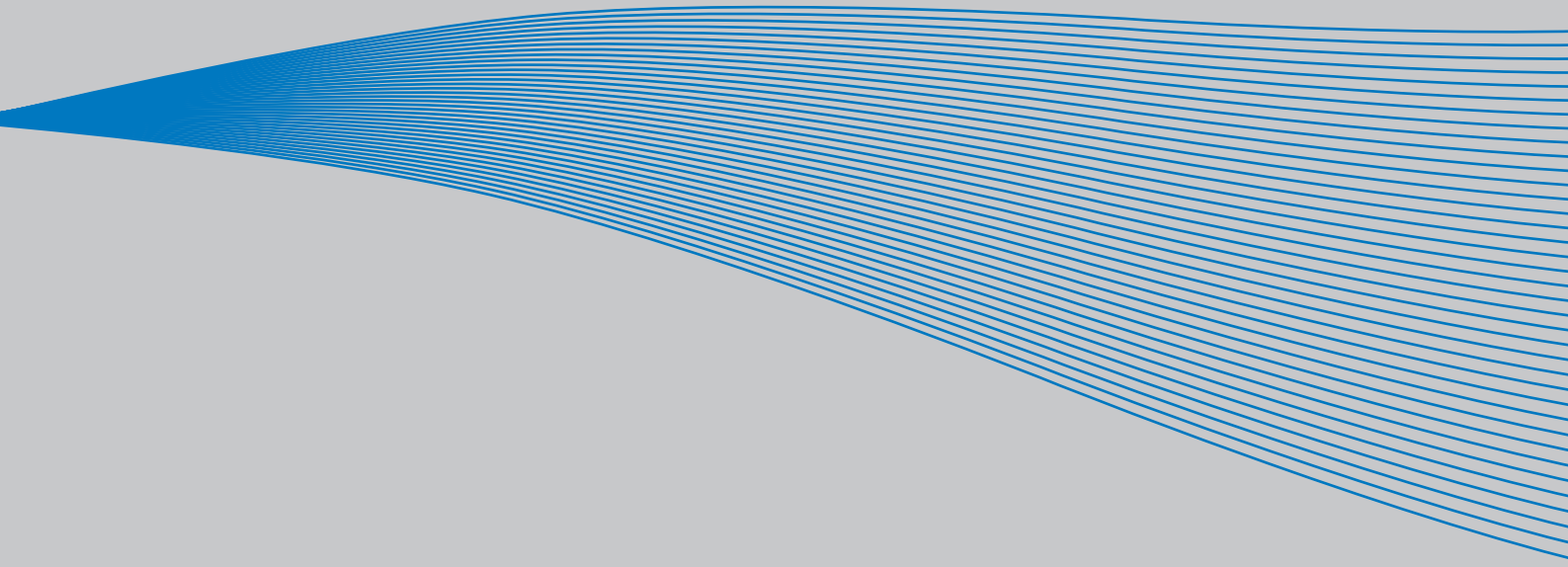
VACON® NX
AC DRIVES

RFI-FILTERS
DU/DTFILTERS
SINUS FILTERS

FILTER MANUAL



VACON®
DRIVEN BY DRIVES

REVISION HISTORY:

REV	DATE/ PREPARED	NOTES & CHANGES
B	2008-08-19 M: Björkman	Updated version: 1. New DUT Filter types: New type Old type DUT-0280-6-0-P1 DUT-0280-6-0-P DUT-0350-6-0-P1 DUT-0350-6-0-P DUT-0600-6-0-P1 DUT-0600-6-0-P DUT-0820-6-0-P1 DUT-0820-6-0-P DUT-1200-6-0-P1 DUT-1200-6-0-P DUT-1500-6-0-P1 DUT-1500-6-0-P DUT-0012-6-2-P1 DUT-0012-6-2-P DUT-0034-6-2-P1 DUT-0034-6-2-P Note that the types are not interchangeable due to differences in mechanical dimensions. 2. New DUT filter range – DUT – xxx-6-x-S

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Document code: DPD01571A
Date: 15.4.2014

Note! All internal components and component boards, with the exception of the galvanically separated input and output terminals are connected to high voltage when the frequency converter is connected to the mains. It is extremely dangerous to touch these live parts. Touch may cause severe injury or death

The I/O terminals are separated from the high potential of the mains, but the relay outputs and other I/O terminals may carry high voltages even if the frequency converter is not connected to the mains.

Do not perform any high pot tests (megger) on the filters
The Vacon_RFI_ filters are intended for use in earthed supplies only
For unearthed (IT) supplies, contact our representative or us.

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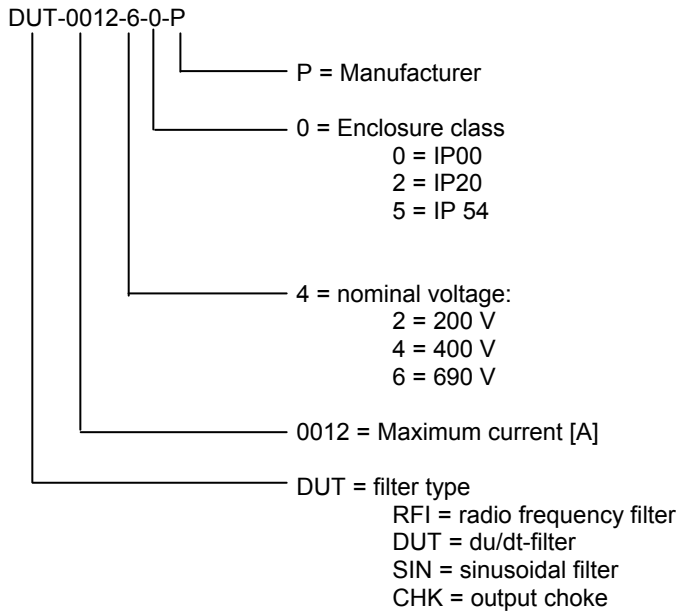
1. GENERAL

Frequency converters do not supply a smoothly changing AC voltage to the motor, but a pulsed DC voltage. The sum of the three phase voltage does not sum to zero, as in the case of mains supply, leading to the presence of a common mode voltage between the motor coils and ground.

The pulses fed to the motor have very steep flanks, the rate of voltage change (dU/dt) may reach several kV/us. Unloaded IGBTs will switch at speeds of about 6 – 8 kV/us, when a motor cable and motor is connected the speed will drop to about 2 kV/us. The voltages caused by these steep pulses may be dangerous to the insulation of the motor.
The high switching speeds give rise to EMC effects, both as radiated disturbances as well as to disturbance currents in galvanically connected cables. The radiated interference is usually grounded by the metallic enclosure of the converter as well as through the use of shielded cable and does not cause any problems in the environment. The galvanically coupled interference may have to be filtered in order to achieve EMC compliance. The Vacon NX range of frequency converters contains an internal filter for bringing the drives into compliance with the standard (specifically IEC 61800-3:2004) , but in some cases additional filtering is required. Both input and output filters are available for the Vacon NX range of drives. The converter may also have to be protected against various overvoltages occurring in the supply. On the input side RFI filters and additional chokes can be installed, on the output side dU/dt filters or sinus filters.

Type designations



2. FILTER TYPES

2.1 RFI-filters

The table below shows the filters used in order to make the Vacon NX range of frequency converters comply with EN61800-3 for the domestic and industrial environment, if the basic drive does not comply. All frame sizes 4 – 9 comply with the requirements of EN/IEC 619800 – 3, ed 2 for the categories 1 and 2, the 690 V versions for category 3. The common DC bus system components and drives > 400 A are designed to category 4 => the basic modules do not have any specific compliance, but the whole installation has to be designed to comply with the requirements.
The stand – alone and NXC solutions comply with category 3 requirements.

Definitions:

First environment

environment that includes domestic premises, it also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes

NOTE Houses, apartments, commercial premises or offices in a residential building are examples of first environment locations.

Second environment

environment that includes all establishments other than those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

NOTE Industrial areas, technical areas of any building fed from a dedicated transformer are examples of second environment locations.
IEC 923/04

EMC designation C => fulfills the requirements of category 1: PDS (power drive system (frequency converter plus motor)) of rated voltage less than 1000 V, intended for use in the first environment

EMC designation H => fulfills the requirements of category 2: PDS of rated voltage less than 1000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional

NOTE A professional is a person or an organisation having necessary skills in installing and/or commissioning power drive systems, including their EMC aspects.

EMC designation L => fulfills the requirements of category 3: PDS of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment

EMC designation N => fulfills the requirements of category 4: PDS of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment

Note that in this case the compliance has to verified on a case by case basis.

The filters must be correctly installed and grounded.

There are no standards at present for IT supplies (floating supplies) – the EMC code T shows that the drives and drive modules have very small earth capacitance making them suitable for use in IT

supplies. The small capacitance is required as larger values would cause the installed earth circvuit monitoring circuits to fail. We recommend the use of monitors manufactured by Bender.

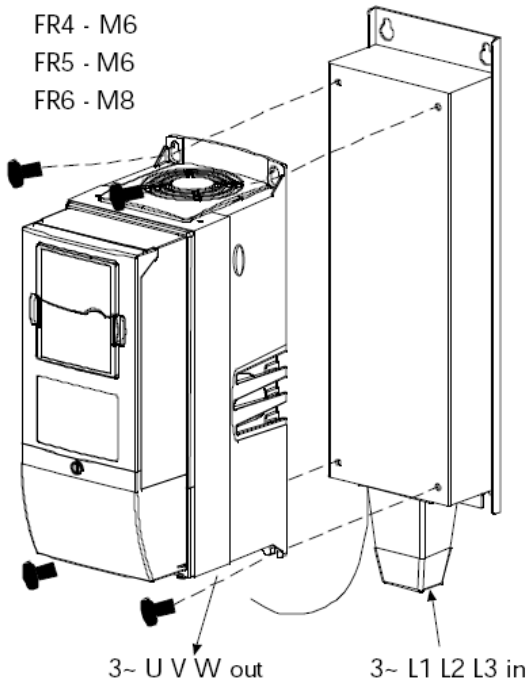
The Vacon NX frequency converters comply with the immunity requirements EN 61800-3; 2004, second environment as standard.

Note that the filters RFI-0012 -5-5 to RFI 0061-5-5 are designed to fit mechanically directly to the corresponding drive. All others are loose and must be connected to the drive separately.

2.1.1 Footprint filters

Type	Suitability	Name	Size (mm)
RFI-0012-5-5	FR4,MF4 / 380-500V	C-LEVEL, IP54, footprint	125x390x65
RFI-0031-5-5	FR5,MF5 / 380-500V	C-LEVEL, IP54, footprint	135x490x65
RFI-0061-5-5	FR6,MF6 / 380-500V	C-LEVEL, IP54, footprint	185x620x75

Installation



2.1.2 External filters

These are external filters, which have to be mounted close to the input of the drive or drive system. Note that the cable layout must be such that the maximum physical separation possible exists between the filter input and output cables, otherwise the effect of the filter is negated.

Manufacturer*s part #	Vacon code

500Vac

FN3258H-130-35	
FN3359-150-28	RFI-0150-5-0
FN3359-250-28	RFI-0250-5-0
FN3359-320-99	RFI-0320-5-0
FN3359-400-99	RFI-0400-5-0
FN3359-600-99	RFI-0600-5-0
FN3359-1000-99	RFI-1000-5-0
FN3359-1600-99	RFI-1600-5-0

690Vac

FN258HV-42-33	RFI-0042-6-0
FN258HV-100-35	RFI-0100-6-0
FN3359HV-180-28	RFI-0180-6-0
FN3359HV-320-99	RFI-0320-6-0
FN3359HV-400-99	RFI-0400-6-0
FN3359HV-600-99	RFI-0600-6-0
FN3359HV-1000-99	RFI-1000-6-0

2.1.3 Filter data

2.1.3.1 380 – 500 V

2 RFI-0130-5-0

A	B	C	D	E	F	G	H	I2	J	K	L2	Weight kg	Losses W
270	90	150	240	255	65	6,5	1,5	45	M10	45	64	43,1	4,5

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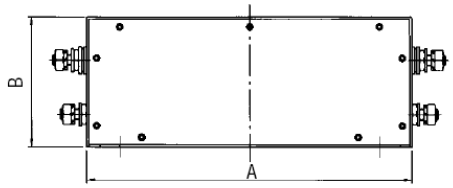
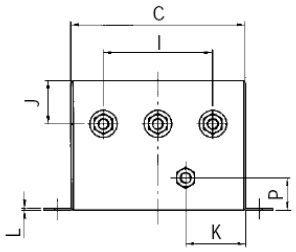
3 RFI –xxxx-5-0

	Dimensions														Weight	Losses
Type code	A	B	C	D	E	F	G	H	I	J	K	L	M	N	kg	W
3RFI-0150-5-0	300	120	160	185	210			120	100	40	55	2	M10	12	6,5	28
3RFI-0250-5-0	300	125	180	205	230			120	110	40	62,5	2	M10	12	7	57
3RFI-0320-5-0	300	115	210	235	260	306	40	120	60	35	20	2	M12	12	10,5	40
3RFI-0400-5-0	300	135	210	235	260	306	40	120	60	35	25	2	M12	12	10,5	50
3RFI-0600-5-0	350	170	230	255	280	356	50	145	60	64	25	3	M12	12	11	65
3RFI-1000-5-0	400	160	250	275	300	406	90	170	60	64	25	3	M12	12	18	91
3RFI-1600-5-0	600	200	300	330	370	606	95	250	100	80	25	3	M16	14	27	180

150A to 250A types





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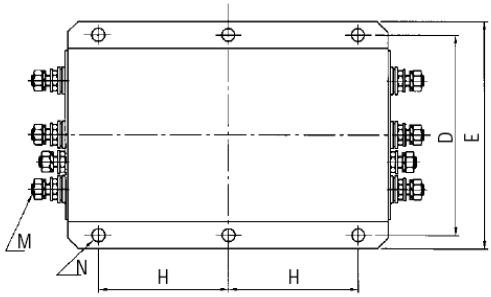
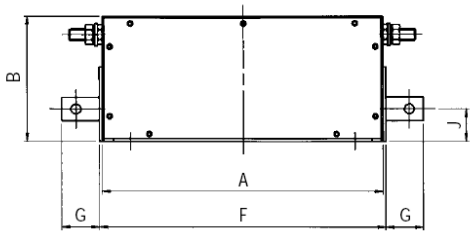


320A to 2500A types



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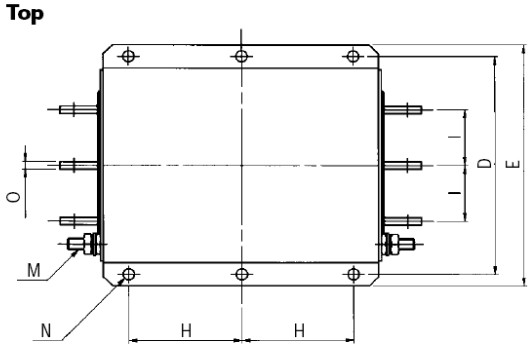
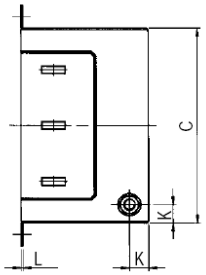




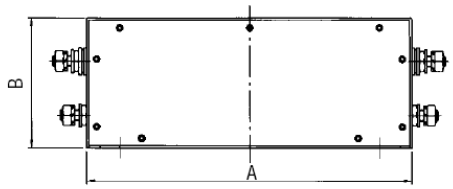
4 RFI 0042-6-0 and 0100-6-0

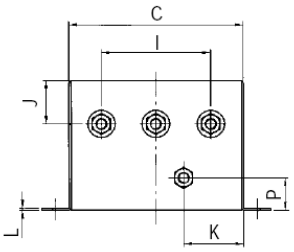
Vacon type code	Dimensions												Weight	Losses
	A	B	C	D	E	F	G	H	I	J	K	L	kg	W
3RFI-042-6-0	329	70	185	300	314	45	6,5	1,5	25	M6	35	130	2,6	30
3RFI-0100-6-0	379	90	220	350	364	65	6,5	1,5	45	M10	45	130	5,6	51

5 RFI-xxxx-6-0

Type code	Dimensions																Weight	Losses
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	kg	W
3RFI-0180-6-0	300	120	160	185	210			120	100	40	55	2	M10	12		30	6,5	28
3RFI-0320-6-0	300	125	180	205	230			120	110	40	62,5	2	M10	12		35	7	40
3RFI-0400-6-0	300	115	210	235	260	306	40	120	60	35	20	2	M12	12	6		10,5	50
3RFI-0600-6-0	300	135	210	235	260	306	40	120	60	35	25	2	M12	12	8		10,5	65
3RFI-1000-6-0	350	170	230	255	280	356	50	145	60	64	25	3	M12	12	8		11	91

150A to 250A types





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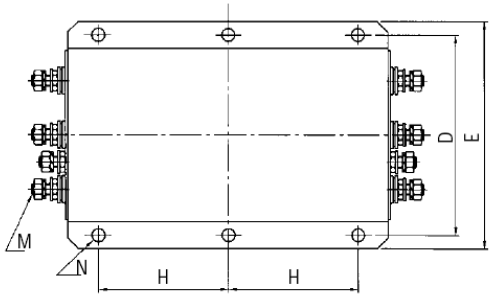
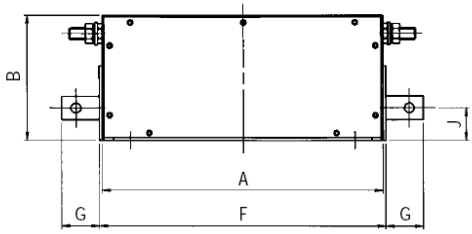


320A to 2500A types



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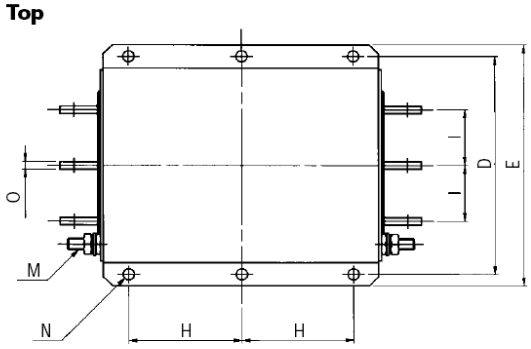
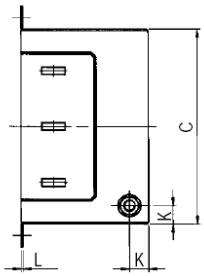




Recommendations:

The motor cable must be kept as short as possible both inside and outside the enclosure. This means that the optimum location for the drive is close to the driven motor in wall mounted units or close to the cable conduit hole in enclosed units.

Separate the supply cable and the motor cable by at least 20 cm (8"). If it isn't possible to achieve spatial separation, use a separator shield, which must be solidly, multiply grounded. The cable from filter to drive must be a shielded one. The grounding must be done through a large area.

If several drives are used, check if it is feasible to use one common filter for all drives. Additional filtering in the drives is then unnecessary. The cable between the filter and the drives should be kept as short as possible, which usually leads to mounting the drives and the filter adjacent to one another.

Ground the filter over a large surface to the mounting plate or the back of the enclosure. If the plate is varnished, remove the varnish to ensure a good electrical connection at the screw locations.

All metal parts of the enclosure must be connected to one another with low impedance, large area cables. The door must be grounded through short flexible leads to the frame of the enclosure

Cross cables at right angles (90°)

Connect all unused poles of all cables to ground

2.2 dU/dt filters

The Vacon NX- ranges use IGBT transistors as the output element. These semiconductors give the correct voltage to the motor, switching it at a very high speed, 4 – 6 kV/µs with an unloaded IGBT. This high speed will, under certain circumstances, cause extra voltage stress on the main insulation of the motor. Usually there are no problems with motors designed for a 400 V supply. Such motors are usually designed for a voltage level of 1200 V, which exceeds the frequency converter induced stress. In 500 V supplies the motor has to withstand at least 1600 V. A dU/dt filter is often required with these motors in order not to exceed the allowable voltage stress. In 690 V supplies the motor has to stand at least 1800 V. A dU/dt filter is required in these cases.

In uncertain cases, confirm the rating of the motor in frequency converter application with the motor manufacturer.

The dU/dt filter also reduces ground currents, easing the job of earth-fault protectors. They also lessen the impact of the various sources of bearing current. The filters are LC filters.

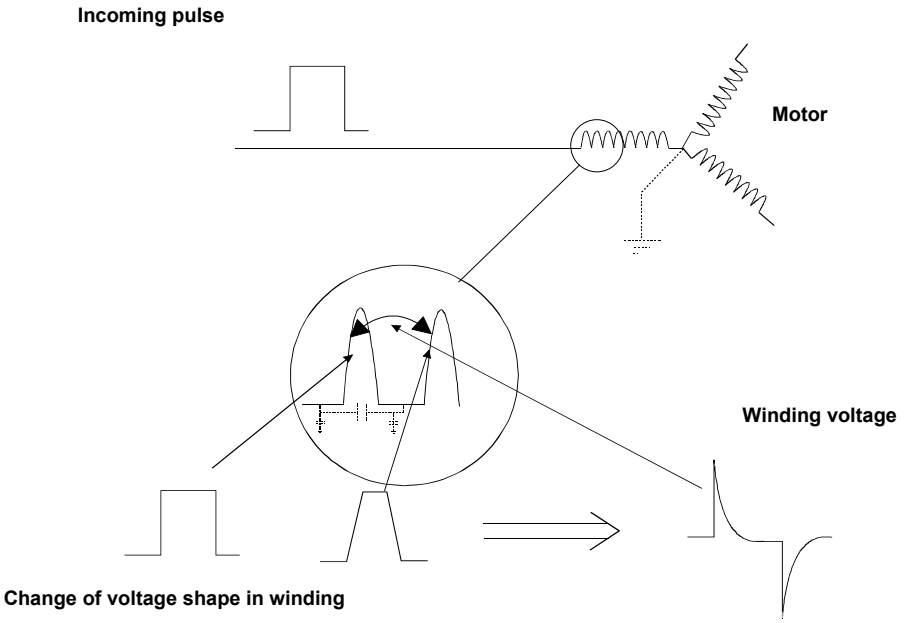
NOTE! Set the switching frequency parameter to correspond to the value printed on nameplate of the filter. The dU/dt filters are designed for a switching frequency of 3,6 kHz for all voltages.

The high switching speed, about 2 kV/µs with the motor and cable connected, creates a travelling wave in the cable. The speed of this wave is set by the cable wave impedance, usually about 50 – 100 ohms. This is less than the motor wave impedance, which is on the order of 1 kohm. As the travelling voltage wave hits this discontinuity, it is reflected back, increasing the instantaneous voltage on the motor winding. The wave is reflected back and forth between motor and drive and finally the steady state voltage is reached.

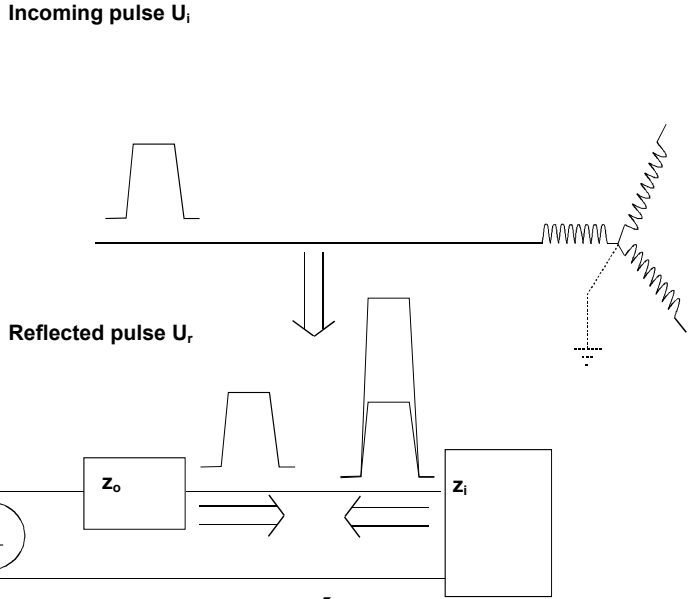
The worst case instantaneous voltage is 2 times the DC-link voltage, usually the reflection coefficient is about 1,8 – 1,9.

1. Winding voltage stresses

The rapid change in voltage is not distributed equally over all windings, but the first windings show higher voltage stresses than the inner ones, due to the capacitive coupling between windings. Modern motors can withstand voltage rise times of < 2 kV/us. In case of doubt, use a dU/dt filter or contact the motor manufacturer.



2 Voltage stresses caused by reflections



$r = \frac{z_i - z_o}{z_i + z_o}$

Total Voltage = $U_i + U_r = U_i(1+r) =$ $2U_i(\frac{z_i}{z_i + z_o})$

The reflected voltage maximum value is 2 x DC link voltage, in practice about 1,8 .. 1,9 x Udc. The voltage is fully developed at cable lengths > 5 m.

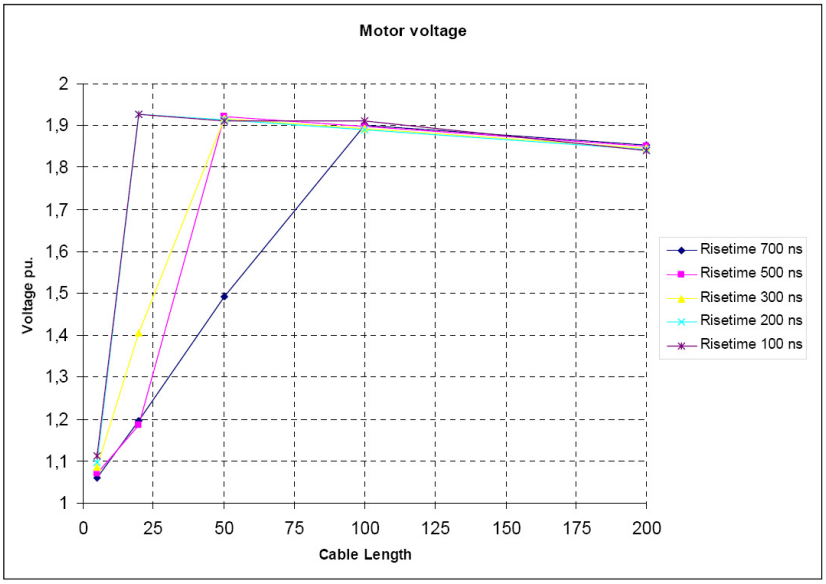
Note that the DC link voltage is increased if the supply is high or if an active front end maintains a high DC link voltage or if the drive is in a regenerative (braking) mode

The use of dU/dt filters is recommended, if this voltage stress is too high.

A dU/dt filter is a serial LC filter, with a resonance frequency of about 120 kHz – this will limit the voltage rise speed to < 1000 V/us. If lower speeds are required, the capacitance can be increased.

The filter, cable and motor form a complex high frequency circuit, which causes the voltage at the motor to have different rise times and different peak values depending on the cable length, type etc.

Typical values as a function of cable length are as follows:



Typical rise times are about 300 – 400 ns for the NX range of drives.

Due to the inductance in series with the load there is a voltage drop across the dU/dt filter, decreasing the voltage available for the motor. At full rated current this drop is about 5 V

Filters are chosen so their rated current > motor rated current. They will thermally withstand the same overload specifications as the drive. For the Vacon NX there is only one range of filters, suitable for the voltage range from 380 to 690 V, They can also be used at lower voltages, if required.

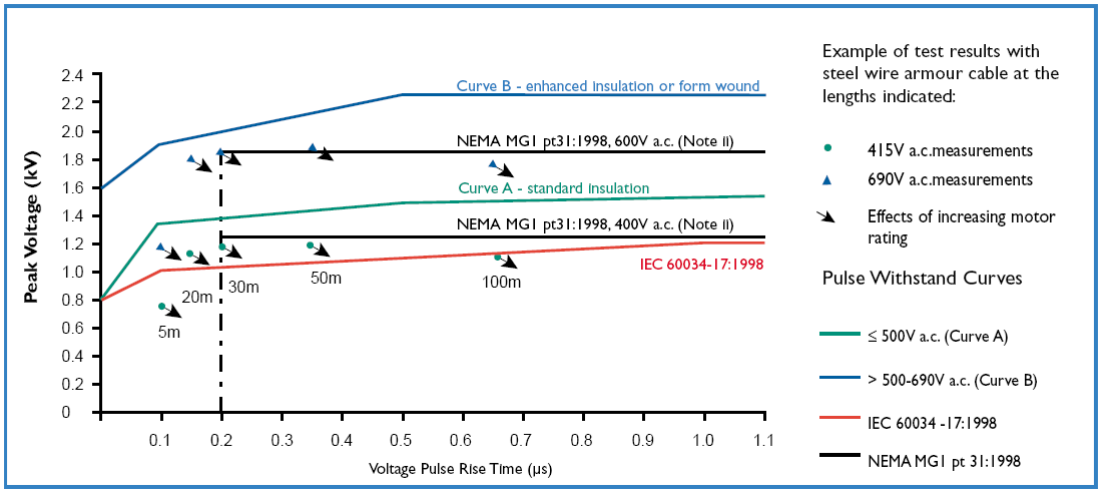
The filters are designed for a switching frequency of 3,6 kHz. DO NOT EXCEED THIS VALUE, as it will cause the filter to overheat. Using lower switching frequencies is not a problem.

The filters are designed for a maximum output frequency of 70 Hz – if this value is exceeded there is a risk of overheating.

Recommendations

for 200-400V: no special precautions need to be taken
for 440-525V: motor must be equipped with enhanced (double) insulation which can withstand high voltage spikes or dU/dt-filter must be used (from frame size 200kW upwards, no special precautions need to be taken)
for 525-690V: sinus or dU/dt-filters must be used (if the motors are not double insulated and specially designed for this purpose (usually form wound))

Typical values



Limit curves of admissible motor terminal peak voltage for a.c. motors up to and including 500V a.c. (Curve A) and from >500V a.c. to 690 a.c. (Curve B). Source : Gambica Report No 1, 2nd edition.

2.2.1 Version DUT – xxx- 6- 0- P

The filters are available as IP00, IP21 and IP54

IP00 filters

Part number Vacon IP00 200 - 690 V	In	Weight	Copper weight	Connections	Losses W	Max cable length m
DUT 0012 6 0 P	12					100
DUT 0025 6 0 P	25	6	1	0,5-10	90	100
DUT 0055 6 0 P	55	10	2,5	2,5-35	120	100
DUT 0080 6 0 P	80	13	4	2,5-35	140	150
DUT 0130 6 0 P	130	21	8	50-95	190	200
DUT 0210 6 0 P	210	32	12	35-150	210	250
DUT 0280 6 0 P1	280	50	20	M12	350	250
DUT 0350 6 0 P1	350	60	26	M12	480	300
DUT 0420 6 0 P	420	73	30	M12	650	300
DUT 0600 6 0 P1	600	100	35	M12	850	300
DUT 0820 6 0 P1	820	120	50	2xM12	1050	400
DUT 1200 6 0 P1	1200	160	70	2xM12	1200	400
DUT 1500 6 0 P1	1500	210	100	2xM12	1400	400

Note that the max cable length is limited as the cable length grows, so does the capacitance and the switching currents => leading to risk of overheating the filter. I f the cable length is not sufficient, use a filter one size larger.

Suitability

Drive	Filter
200 V class	
NX 0003–0012 2	DUT 0012 6 0 P
NX0017-0025 2	DUT 0025 6 0 P
NX0038-0048 2	DUT 0055 6 0 P
NX0048-0075 2	DUT 0080 6 0 P
NX0088-0114 2	DUT 0130 6 0 P
NX0140-0205 2	DUT 0210 6 0 P
NX0261 2	DUT 0280 6 0 P1
NX0300 2	DUT 0350 6 0 P1

Drive	Filter
500 V class	
NX 0003–0012 5	DUT 0012 6 0 P
NX0016-0022 5	DUT 0025 6 0 P
NX0031-0045 5	DUT 0055 6 0 P
NX0061-0072 5	DUT 0080 6 0 P
NX0087-0105 5	DUT 0130 6 0 P
NX0140–0205 5	DUT 0210 6 0 P
NX0261 5	DUT 0280 6 0 P1
NX0300 5	DUT 0350 6 0 P1
NX0385 5	DUT 0420 6 0 P
NX0460-0590 5	DUT 0600 6 0 P1
NX0650-0730 5	DUT 0820 6 0 P1
NX0820 5	2 x DUT 0420 6 0 P
NX0920-1030 5	2 x DUT 0600 6 0 P1
NX1150 5	DUT 1200 6 0 P1
NX1300-1450 5	DUT 1500 6 0 P1
NX1770 – 2150 5	2 x DUT 1200 6 0 P1
NX2700 5	2 x DUT 1500 6 0 P1

Drive	Filter
690 V class	
NX0005-0010 6	DUT 0012 6 0 P
NX0013-0022 6	DUT 0025 6 0 P
NX0027-0052 6	DUT 0055 6 0 P
NX0062+0080 6	DUT 0080 6 0 P
NX0100-0125 6	DUT 0130 6 0 P
NX0144-0208 6	DUT 0210 6 0 P
NX0261 6	DUT 0280 6 0 P1
NX0325 6	DUT 0350 6 0 P1
NX0385-0416 6	DUT 0420 6 0 P
NX0460-0590 6	DUT 0600 6 0 P1
NX0650 6	2 x DUT 0350 6 0 P1
NX0750-08206	2 x DUT 0420 6 0 P
NX0920-1180 6	DUT 1200 6 0 P1
NX1300-1500 6	2 x DUT 0820 6 0 P1
NX 1900–2250 6	2 x DUT 1200 6 0 P1

Liquid cooled drives :

Drive	Filter
500 V class	
NXP0170-208 6	DUT 0210 6 0 P
NXP0261 6	DUT 0280 6 0 P1
NXP0325 6	DUT 0350 6 0 P1
NXP0385-416 6	DUT 0420 6 0 P
NXP0460 6	DUT 0600 6 0 P1
NXP0502-590 6	DUT 0600 6 0 P1
NXP0650-0820 6	DUT 0820 6 0 P1
NXP0920-1180 6	DUT 1200 6 0 P1
NXP1300-1500 6	DUT 1500 6 0 P1
NXP1700-2340 6	2 x DUT 1200 6 0 P1
NXP2700 6	2 x DUT 1500 6 0 P1

Drive	Filter
690 V class	
NXP0016-0022 5	DUT 0025 6 0 P
NXP0031-0045 5	DUT 0055 6 0 P
NXP0038-0045 5	DUT 0055 6 0 P
NXP0061-0072 5	DUT 0080 6 0 P
NXP0087-0105 5	DUT 0130 6 0 P
NXP0140-0205 5	DUT 0210 6 0 P
NXP0261 5	DUT 0280 6 0 P1
NXP0300 5	DUT 0350 6 0 P1
NXP0385 5	DUT 0420 6 0 P
NXP0460-0590 5	DUT 0600 6 0 P1
NXP0650-0820 5	DUT 0820 6 0 P1
NXP0920-1150 5	DUT 1200 6 0 P1
NXP1370 5	DUT 1500 6 0 P1
NXP1640 5	2 x DUT 0820 6 0 P1
NXP2060-2300 5	2 x DUT 1200 6 0 P1
NXP2470-2950 5	2 x DUT 1500 6 0 P1
NXP3710-4140 5	4 x DUT 1200 6 0 P1

IP 21 filters

Part number Vacon IP21 200 - 690 V	In	Weight	Connections	Losses W
DUT 12 6 2 P1	12	8,6	M5	60
DUT 34 6 2 P1	34	8,6	M5	75
DUT 55 6 2 P	55	13	M6	110
DUT 100 6 2 P	100	23	M6	160
DUT 210 6 2 P	210	42	M8	220

The filters are chosen according to drive rated current – see above table

IP54 filters

Part number Vacon IP54 200 - 690 V	In	Weight	Connections	Losses W
DUT-0012-6-5-P	12	8,6	M5	60
DUT-0034-6-5-P	34	8,6	M5	75
DUT-0055-6-5-P	55	13	M6	110
DUT-0100-6-5-P	100	23	M6	160
DUT-0130-6-2 P	130	60	M8	220
DUT-0210-6-2 P	210	75		

The filters are chosen according to drive rated current – see above table

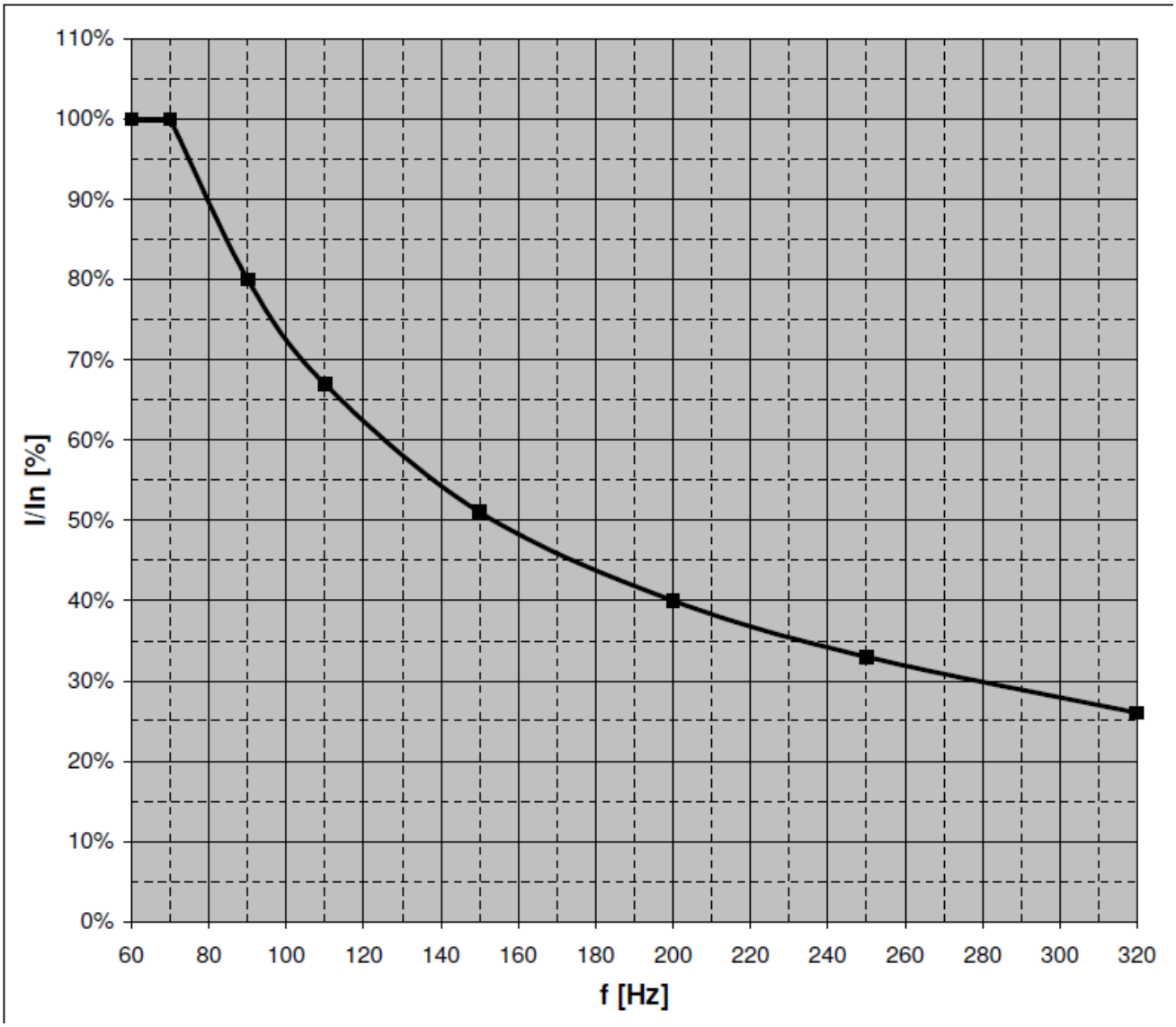
For drawings, see appendix

2.2.2 Allowed cable length:

Type	Max cable length	Max cable capacitance
DUT-0012-6-0-P	100 m	0,02 uF
DUT-0025-6-0-P	100 m	0,02 uF
DUT-0034-6-2-P	100 m	0,02 uF
DUT-0055-6-0-P	100 m	0,02 uF
DUT-0055-6-2-P	100 m	0,02 uF
DUT-0080-6-0-P	150 m	0,03 uF
DUT-0100-6-2-P	150 m	0,03 uF
DUT-0130-6-0-P	200 m	0,04 uF
DUT-0210-6-0-P	250 m	0,05 uF
DUT-0210-6-2-P	250 m	0,05 uF
DUT-0280-6-0-P1	250 m	0,05 uF
DUT-0350-6-0-P1	300 m	0,06 uF
DUT-0420-6-0-P	300 m	0,06 uF
DUT-0600-6-0-P1	300 m	0,06 uF
DUT-0820-6-0-P1	400 m	0,08 uF
DUT-1200-6-0-P1	400 m	0,08 uF
DUT-1500-6-0-P1	400 m	0,08 uF

Note that in case of multiple cables the legth is defined as the total laength of the cables i.e. 2 x 100 m = 200 cable.

2.2.3 Output frequency derating



2.2.4 Version DUT – xxx- 6- 0- S

The filters are available in IP 00/IP20 . For dimensional drawings, see appendix. The filters are force air cooled, requiring an external 48 VDC supply - included in the delivery

Part number Vacon *IP00* *200 - 690 V*	*In*	*Weight*	*Connections*	*Losses* *W*	*Max cable length* *m*
DUT 0280 6 0 S	*280*	*42*	*M 10*	*1500*	*250*
DUT 0420 6 0 S	*420*	*50*	*M 10*	*1600*	*250*
DUT 0590 6 0 S	*590*	*50*	*M 10*	*1700*	*250*
DUT 0820 6 0 S	*820*	*110*	*M 12*	*2000*	*250*
DUT 1250 6 0 S	*1250*	*95*	*M 12*	*2300*	*300*
DUT 1600 6 0 S	*1600*	*95*	*M 12*	*2400*	*300*

Suitability

Drive	Filter
200 V class	
NX0261 2	DUT 0280 6 0 S
NX0300 2	DUT 0420 6 0 S

Drive	Filter
500 V class	
NX0261 5	DUT 0280 6 0 S
NX0300 5	DUT 0420 6 0 S
NX0385 5	DUT 0420 6 0 S
NX0460-0590 5	DUT 0590 6 0 S
NX0650-0730 5	DUT 0820 6 0 S
NX0820 5	2 x DUT 0420 6 0 S
NX0920-1030 5	2 x DUT 0590 6 0 S

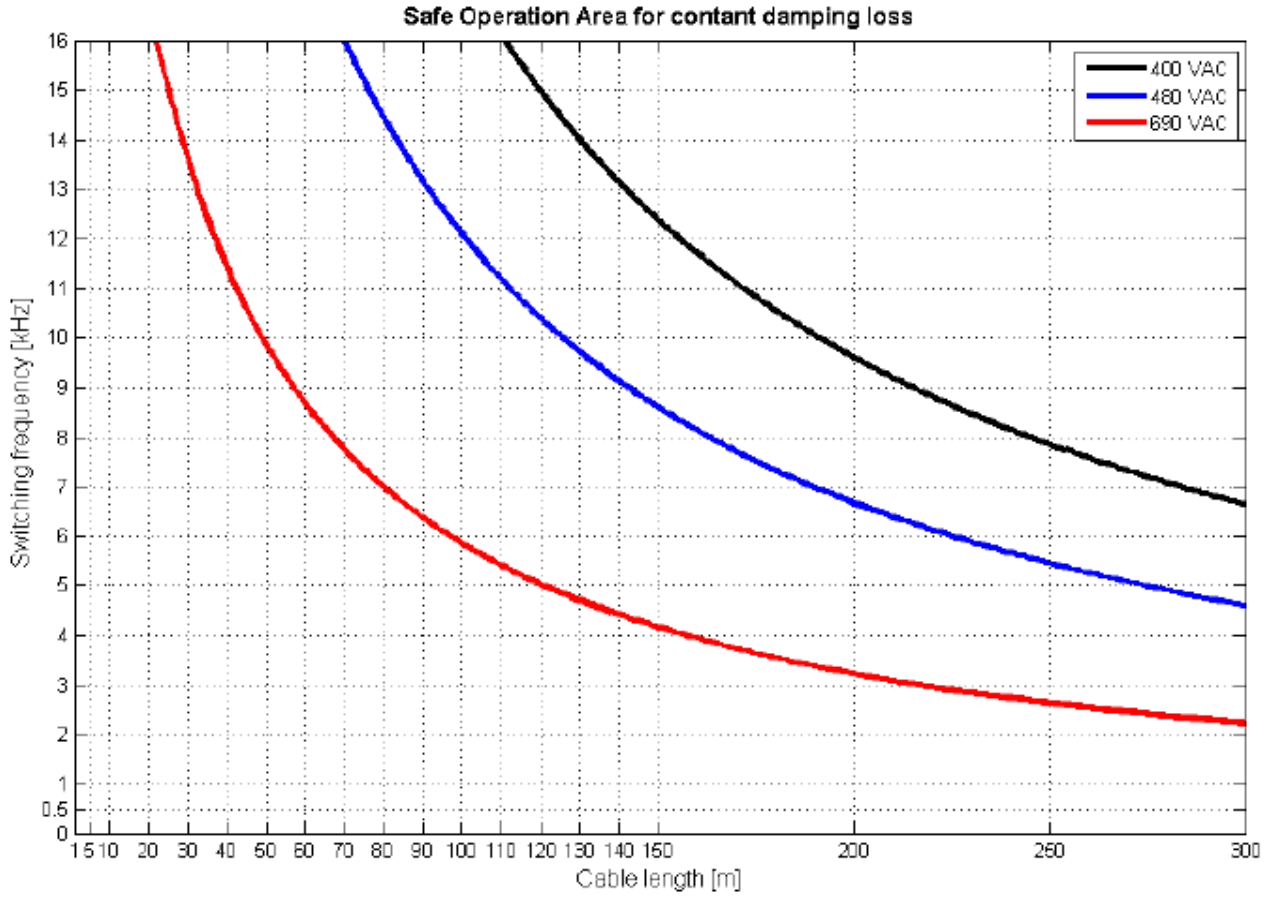
Drive	Filter
690 V class	
NX0261 6	DUT 0280 6 0 S
NX0325 6	DUT 0420 6 0 S
NX0385-0416 6	DUT 0420 6 0 S
NX0460-0590 6	DUT 0590 6 0 S
NX0650-08206	2 x DUT 0420 6 0 S
NX0920-1180 6	n/a
NX1300-1500 6	2 x DUT 0820 6 0 S

Liquid cooled drives :

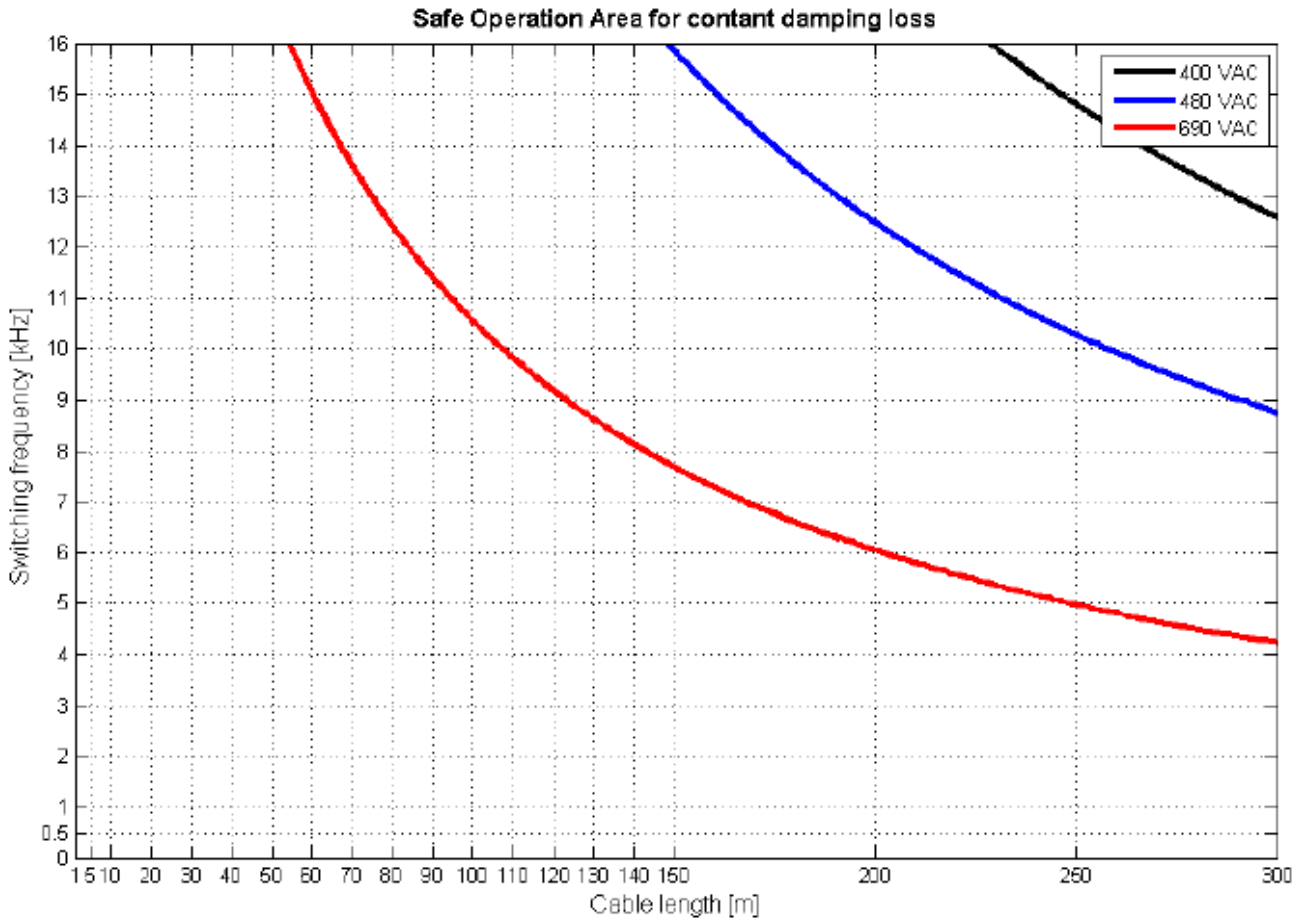
Drive	Filter
500 V class	
NXP0170-208 6	DUT 0280 6 0 S
NXP0261 6	DUT 0280 6 0 S
NXP0325 6	DUT 0420 6 0 S
NXP0385-416 6	DUT 0420 6 0 S
NXP0460 6	DUT 0590 6 0 S
NXP0502-590 6	DUT 0590 6 0 S
NXP0650-0820 6	DUT 0820 6 0 S

Drive	Filter
690 V class	
NXP0140-0205 5	DUT 0280 6 0 S
NXP0261 5	DUT 0280 6 0 S
NXP0300 5	DUT 0420 6 0 S
NXP0385 5	DUT 0420 6 0 S
NXP0460-0590 5	DUT 0590 6 0 S
NXP0650-0820 5	DUT 0820 6 0 S

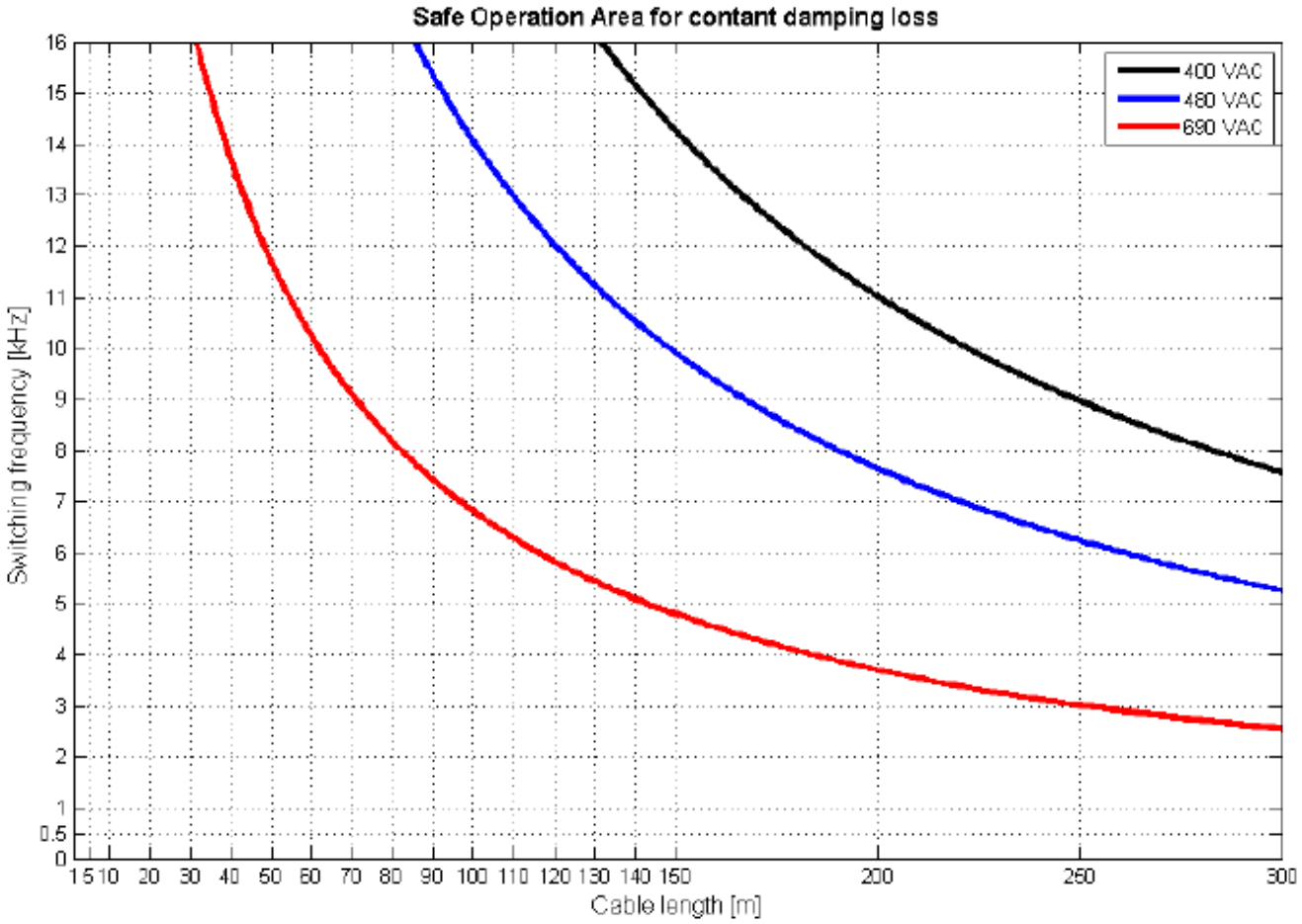
2.2.5 Safe operating area of the filters



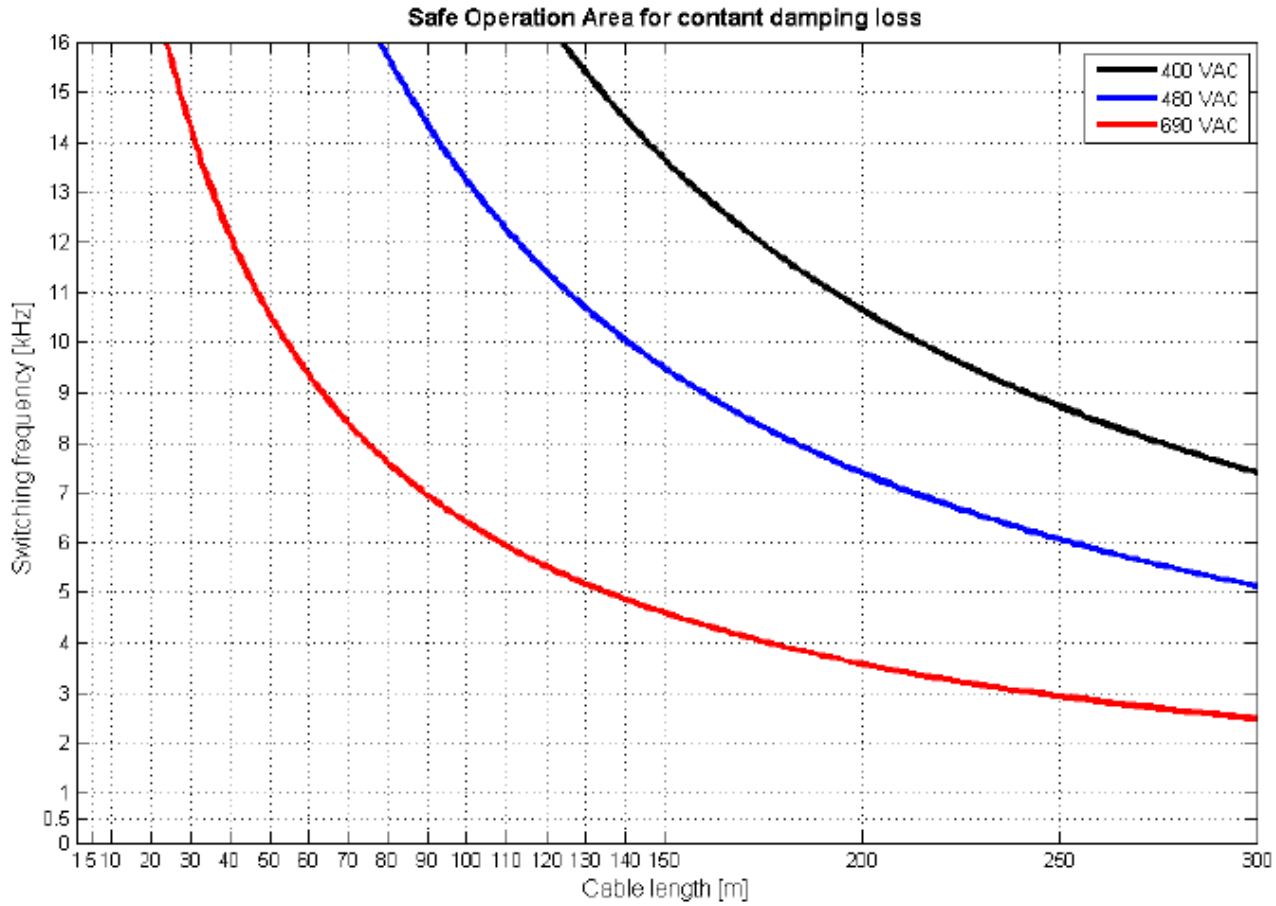
Safe operating area for DUT 0280 6 0 S – assuming a cable capacitance of 750 pf/m. The values should be scaled according to the actual cable capacitance. In case of multiple cables the capacitance is the sum of the cable capacitances.



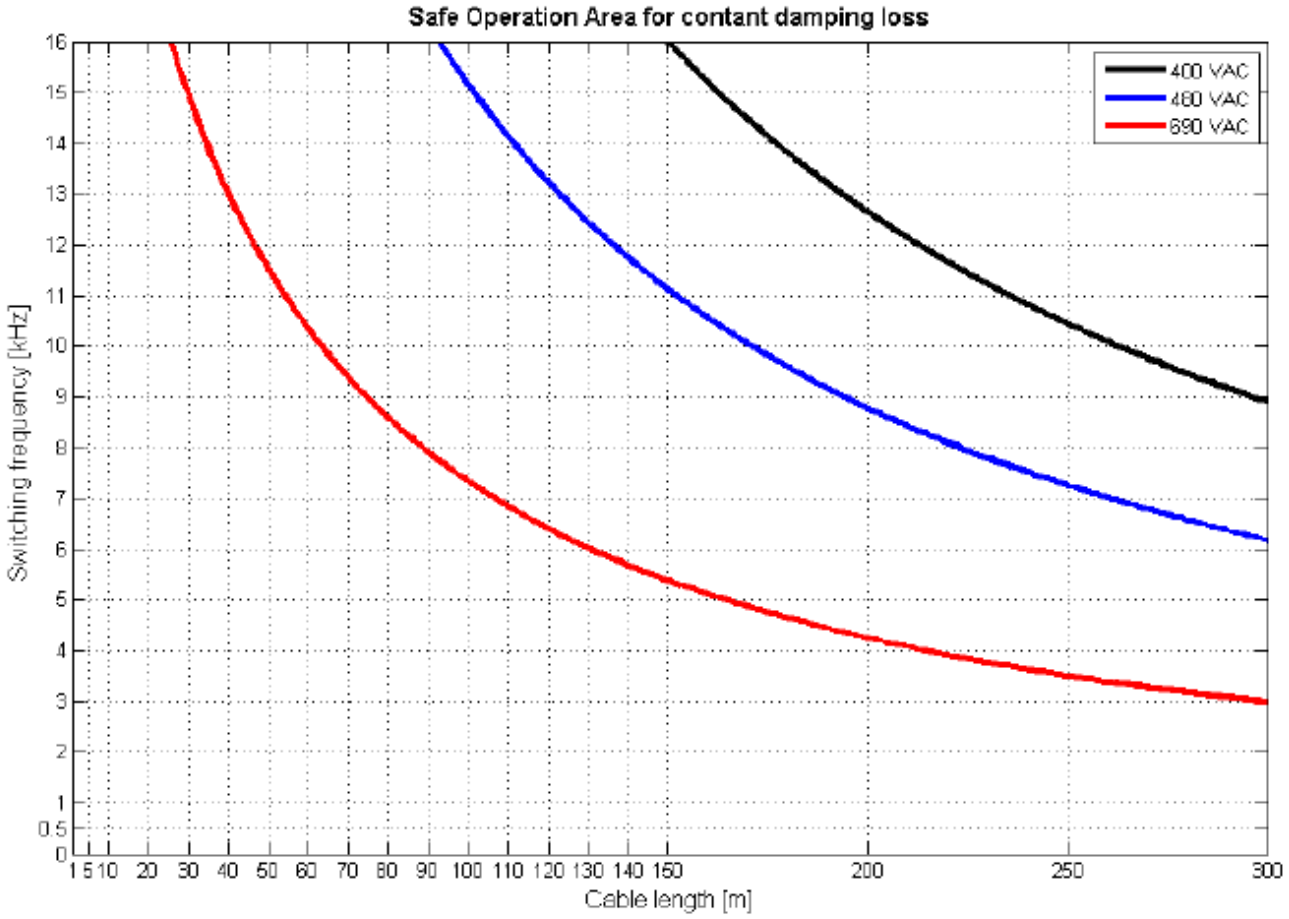
Safe operating area for DUT 0420 6 0 S – assuming a cable capacitance of 800 pf/m. The values should be scaled according to the actual cable capacitance. In case of multiple cables the capacitance is the sum of the cable capacitances.



Safe operating area for DUT 0590 6 0 S – assuming a cable capacitance of 1700 pf/m. The values should be scaled according to the actual cable capacitance. In case of multiple cables the capacitance is the sum of the cable capacitances.



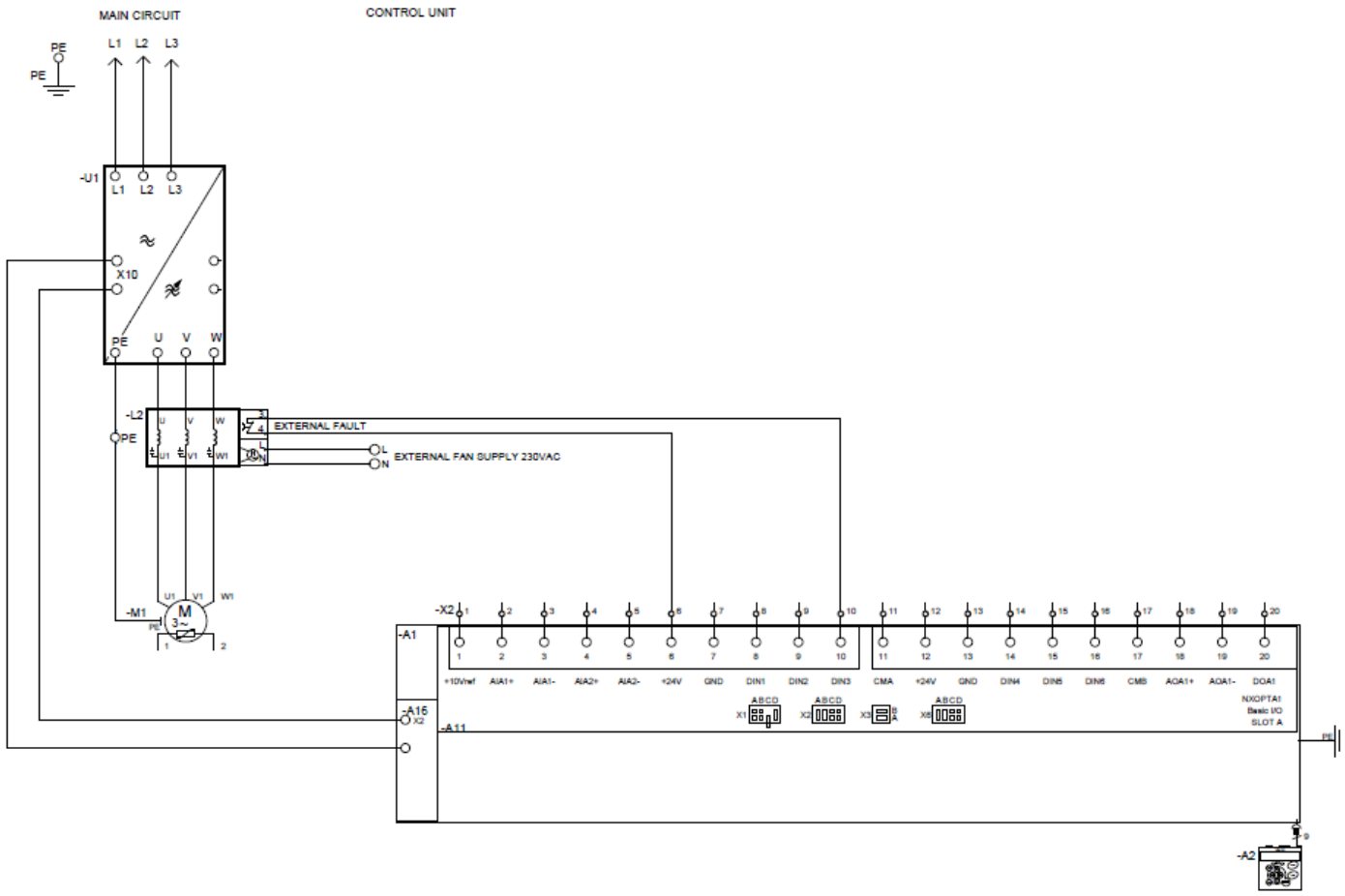
Safe operating area for DUT 0820 6 0 S – assuming a cable capacitance of 1700 pf/m. The values should be scaled according to the actual cable capacitance. In case of multiple cables the capacitance is the sum of the cable capacitances.



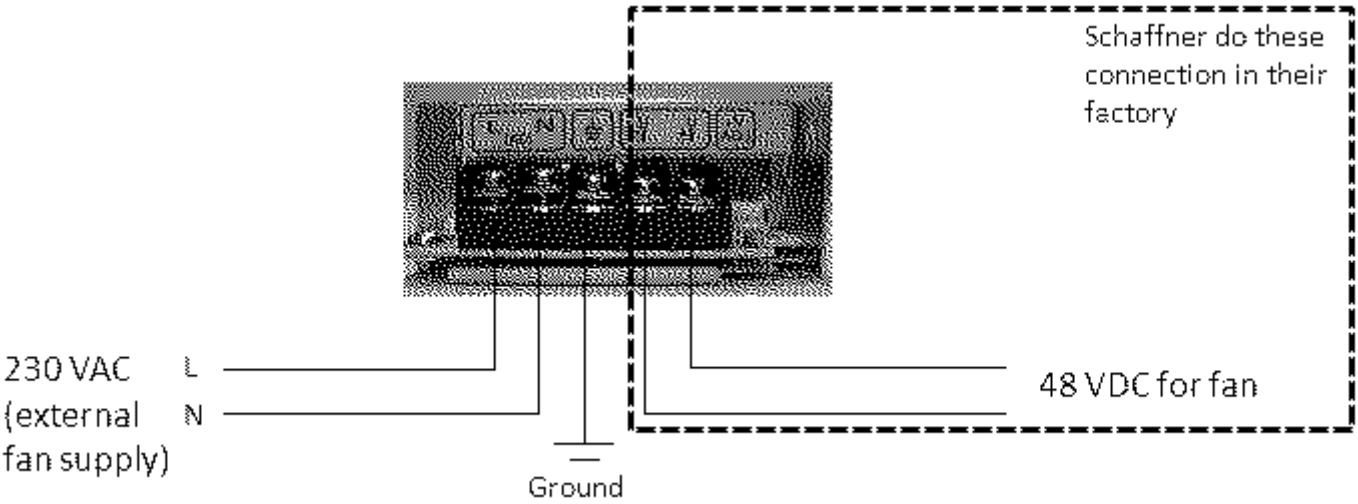
Safe operating area for DUT 1250 6 0 S and DUT 1600 6 0 S– assuming a cable capacitance of 1700 pf/m. The values should be scaled according to the actual cable capacitance. In case of multiple cables the capacitance is the sum of the cable capacitances.

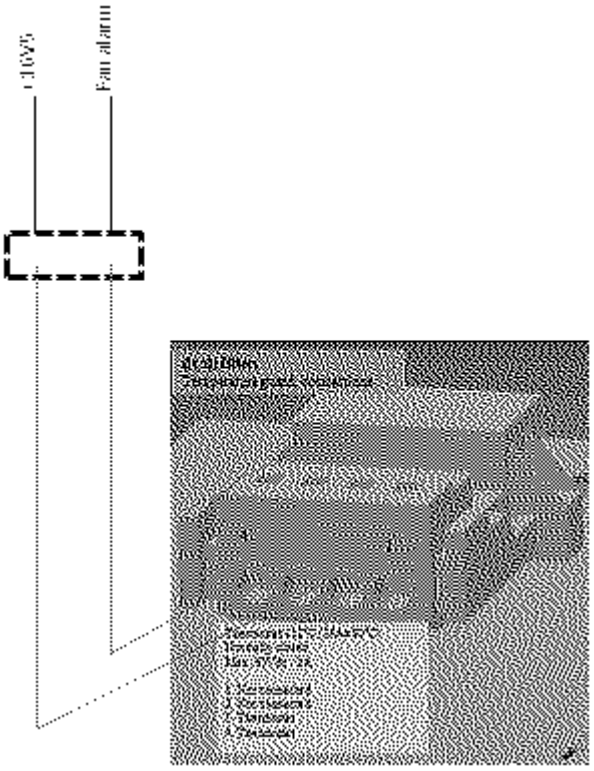
2.3 Connecting the filter

The filters are forced air cooled and require a 220 V AC power supply for their fans. The filter has a thermal supervision (clixon, 60 VDC max. 1A) which will indicate if the filter temperature has exceeded safe limits. This NC contact can be wired to the External fault input of the drive – see the schematic.
NOTE: Which input is used depends on the application in use in the drive – see the application manual for the relevant application. If the external fault input is used for other purposes other possibilities are to connect the fault contact in series with the RUN command or the RUN ENABLE command – for their terminal assignment see the relevant application manual.



Typical connection diagram for the DUT – S filter range





Thermal supervision connection

2.4 Sine filters

If the motor cannot withstand any additional voltage stresses, or a dU/dt filter does not decrease them sufficiently, a sine filter can be used. A sine filter is also a LC filter, but with a resonance frequency < 50 % of the switching frequency, i.e. about 600 V for 690 V drives and about 1,2 kHz for 500 V drives. Hence there are two different ranges. The filter removes the carrier frequency, leaving only the output frequency thus eliminating all voltage stress on the motor.

At full load the voltage drop is about 30 V – a significant part of the available voltage. This has to be taken into account when the motor sizing is done. The voltage can be partly compensated by changing the fieldweakening point down, feeding the motor the correct voltage up to this point, but the motor will not receive full voltage at nominal speed. It can also be compensated by using an active front end drive, increasing the DC link voltage.

The filters are designed for the nominal switching frequency of the corresponding drive. It is safe to increase the switching frequency, but it must not be decreased. As the Vacon NX drive has a switching frequency foldback feature on overtemperature this has to be disabled for 500 V drives when sine filters are used. See the drive application manual.

The filters are designed for a maximum output frequency of 70 Hz. Do not exceed this. For higher frequencies, contact factory.

Filters are chosen so their nominal current > motor nominal current. They are thermally designed for the same overload cycle as the drives.

Filter data

Part number Vacon	In	Weight	Connections	Losses
				W
500 V				
SIN 0010 5 0 P	10	10	5	90
SIN 0018 5 0 P	18	14	10	140
SIN 0032 5 0 P	32	18	16	180
SIN 0048 5 0 P	48	24	35	230
SIN 0075 5 0 P	75	48	35	350
SIN 0110 5 0 P	110	65	70	450
SIN 0180 5 0 P	180	65	95	550
SIN 0270 5 0 P	270	125	1xM12	800
SIN 0410 5 0 P	410	185	1xM12	1200
SIN 0580 5 0 P	580	195	1xM12	1500
SIN 0840 5 0 P	840	270	2xM12	1850
SIN 1160 5 0 P	1160	390	2xM12	2600
SIN 1480 5 0 P	1480	470	2xM12	3300
690 V				
SIN-0005-6-0-P	4,5			
SIN-0008-6-0-P	7,5	6,8	0,25-4	70
SIN-0014-6-0-P	14	10	0,25-4	120
SIN-0023-6-0-P	23	17	0,5-10	160

SIN-0035-6-0-P	35	26	2,5-35	210
SIN-0052-6-0-P	52	36	2,5-35	300
SIN-0085-6-0-P	85	68	25-50	430
SIN-0122-6-0-P	122	78	50-95	600
SIN-0185-6-0-P	185	110	50-95	730
SIN-0287-6-0-P	287	210	M12	1100
SIN-0390-6-0-P	390	300	M12	1250
SIN-0460-6-0-P	460	300	M12	1550
SIN-0620-6-0-P	620	400	2xM12	2000
SIN-0780-6-0-P	780	430	2xM12	2700
SIN-0920-6-0-P	920	500	2xM12	2900
SIN-1180-6-0-P	1180	660	2xM12	3150

Choice of drive & filter

Air cooled drives

	Part number Vacon
500 V	
NX0003-0009 5	SIN 0010 5 0 P
NX0012-0016 5	SIN 0018 5 0 P
NX0022-0031 5	SIN 0032 5 0 P
NX0038-0045 5	SIN 0048 5 0 P
NX0061-0072 5	SIN 0075 5 0 P
NX0087-0105 5	SIN 0110 5 0 P
NX0140-0168 5	SIN 0180 5 0 P
NX0205-0261 5	SIN 0270 5 0 P
NX0300-0385 5	SIN 0410 5 0 P
NX0460-0520 5	SIN 0580 5 0 P
NX0590-0730 5	SIN 0840 5 0 P
NX0820 5	2 x SIN 0410 5 0 P
NX0920-1030	2 x SIN 0580 5 0 P
NX1150 5	SIN 1160 5 0 P
NX1300-1450 5	SIN 1480 5 0 P
690 V	
NX0005-0007 6	SIN 0008 6 0 P
NX0010-0013 6	SIN 0014 6 0 P
NX0018-0022 6	SIN 0022 6 0 P
NX0027-0034 6	SIN 0034 6 0 P
NX0041-0052 6	SIN 0057 6 0 P
NX0062-0080 6	SIN 0080 6 0 P
NX0100-0125 6	SIN 0125 6 0 P
NX0144-0170 6	SIN 0170 6 0 P
NX0208-0261 6	SIN 0261 6 0 P
NX0325-0385 6	SIN 0385 6 0 P
NX0416-0502 6	SIN 0502 6 0 P
NX0590 6	SIN 0650 6 0 P
NX0650-0750 6	2 x SIN 0385 6 0 P

NX0820 6	2 x SIN 0502 6 0 P
NX0920-1180 6	SIN 1200 6 0 P

Liquid cooled drives

Drive type 500 V class	Filter type
NXP0016 5	SIN 0018 5 0 P
NXP0022 5	SIN 0032 5 0 P
NXP0031 5	SIN 0032 5 0 P
NXP0038 5	SIN 0048 5 0 P
NXP0045 5	SIN 0048 5 0 P
NXP0061 5	SIN 0075 5 0 P
NXP0072 5	SIN 0075 5 0 P
NXP0087 5	SIN 0110 5 0 P
NXP0105 5	SIN 0110 5 0 P
NXP0140 5	SIN 0180 5 0 P
NXP0168 5	SIN 0180 5 0 P
NXP0205 5	SIN 0270 5 0 P
NXP0261 5	SIN 0270 5 0 P
NXP0300 5	SIN 0410 5 0 P
NXP0385 5	SIN 0410 5 0 P
NXP0460 5	SIN 0580 5 0 P
NXP0520 5	SIN 0580 5 0 P
NXP0590 5	SIN 0840 5 0 P
NXP0650 5	SIN 0840 5 0 P
NXP0730 5	SIN 0840 5 0 P
NXP0820 5	SIN 0840 5 0 P
NXP0920 5	SIN 1160 5 0 P
NXP1030 5	SIN 1160 5 0 P
NXP1150 5	SIN 1160 5 0 P
NXP1370 5	SIN 1480 5 0 P
NXP1640 5	2 x SIN 0840 5 0 P
NXP2060 5	2 x SIN 1160 5 0 P
NXP2300 5	2 x SIN 1480 5 0 P
NXP2470 5	2 x SIN 1480 5 0 P
NXP2950 5	4 x SIN 0840 5 0 P
NXP3710 5	4 x SIN 1160 5 0 P
NXP4140 5	4 x SIN 1160 5 0 P

Drive type 690 V class	Filter type
NXP0170 6	SIN 0261 6 0 P
NXP0208 6	SIN 0261 6 0 P
NXP0261 6	SIN 0261 6 0 P
NXP0325 6	SIN 0385 6 0 P
NXP0385 6	SIN 0385 6 0 P
NXP0416 6	SIN 0502 6 0 P
NXP0460 6	SIN 0502 6 0 P
NXP0502 6	SIN 0502 6 0 P
NXP0590 6	SIN 0650 6 0 P

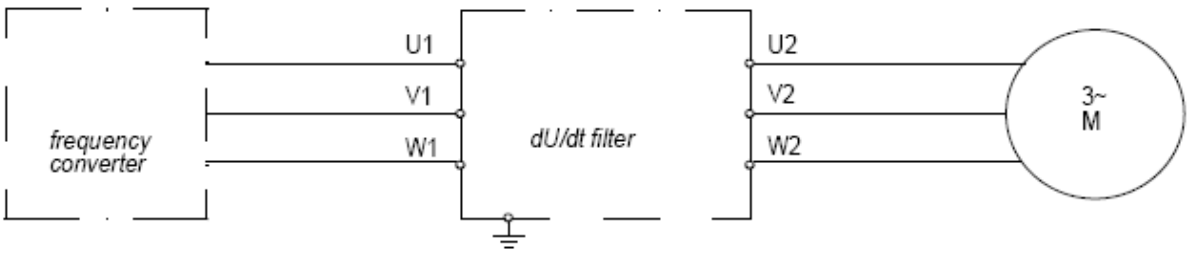
NXP0650 6	SIN 0650 6 0 P
NXP0750 6	SIN 0820 6 0 P
NXP0820 6	SIN 0820 6 0 P
NXP0920 6	SIN 01200 6 0 P
NXP1030 6	SIN 01200 6 0 P
NXP1180 6	SIN 01200 6 0 P
NXP1300 6	2 x SIN 0650 6 0 P
NXP1500 6	2 x SIN 0820 6 0 P
NXP1700 6	2 x SIN 01200 6 0 P
NXP1850 6	2 x SIN 01200 6 0 P
NXP2120 6	2 x SIN 01200 6 0 P
NXP2340 6	2 x SIN 01200 6 0 P
NXP2700 6	4 x SIN 0820 6 0 P
NXP3100 6	4 x SIN 0820 6 0 P

IP54 500 V filters

Part number Vacon	In	Weight	Connections	Losses
	A	kg	mm	W
SIN-0004-5-5-P	4			
SIN-0008-5-5-P	8	9,5		
SIN-0012-5-5-P	12	11,2		
SIN-0016-5-5-P	16	23,2		
SIN-0023-5-5-P	23	28,7		
SIN-0032-5-5-P	32	34,2		
SIN-0038-5-5-P	38	37,0		
SIN-0046-5-5-P	46			
SIN-0055-5-5-P	55			
SIN-0061-5-5-P	61			
SIN-0072-5-5-P	72			

For drawings, see appendix

CONNECTION OF DUT AND SIN FILTERS



2.5 Common mode filters

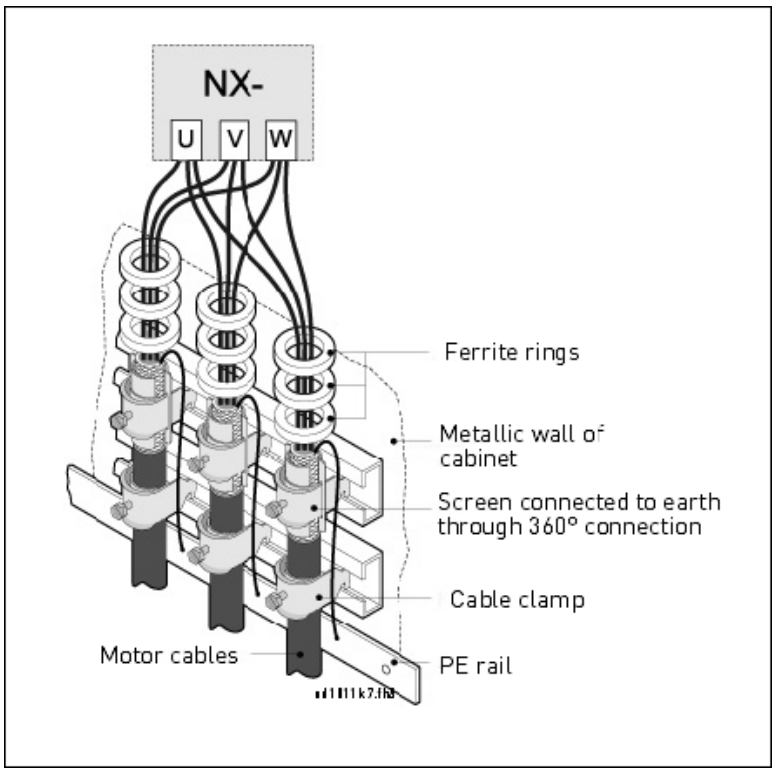
In some cases common filters are required, specifically if bearing current problems are experienced.

The average output voltage of a drive is never zero, as the average voltage of the supply is. The average voltage is +-1/3 of the DC link voltage, formed by two switches connected to one polarity and one to the other.. This voltage changes with the switching pattern of the drive. The changing voltage can cause c currents to flow in the motor circuit formed by the motor frame, stator and rotor. If the current value is too high, bearing damage can occur.

PICTURE

This voltage can be counteracted by properly grounding the motor cable shield at drive and motor end, creating a low impedance path for the currents. Also make sure that the motor frame and the drive enclosure are at the same potential. If these measures are not sufficient, use a motor with an insulated N- end bearing.

A common mode filter consists of a number of toroidal ferrite cores through which the motor cables are drawn. In case of multiple cables that do not fit through the opening, each cable has to be equipped with multiple cores , in order to bring the parallel connected impedances to a suitable value and not to saturate the ferrites.



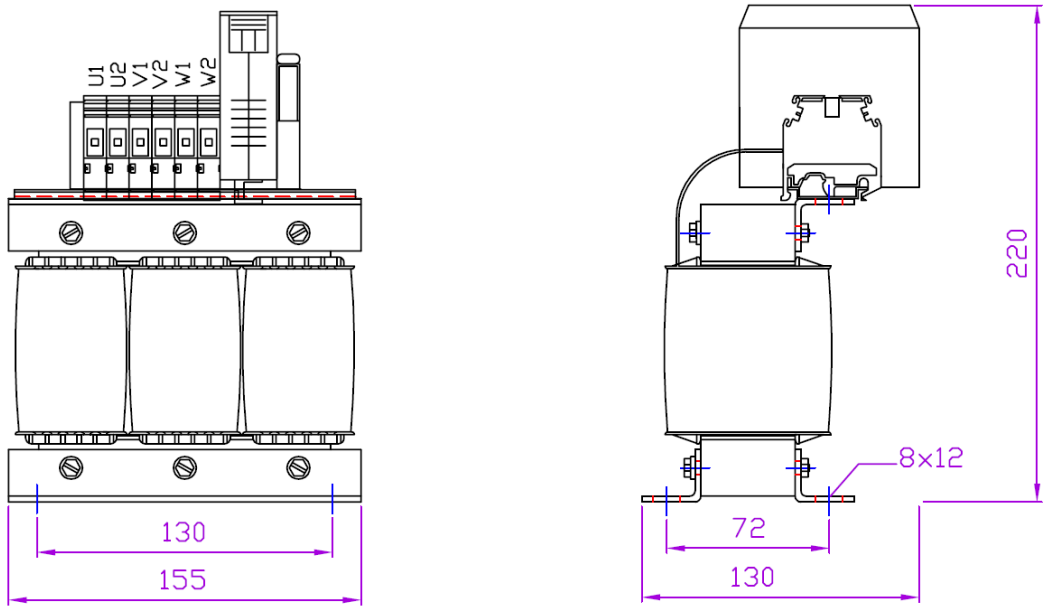
Installing ferrite rings

Appendix

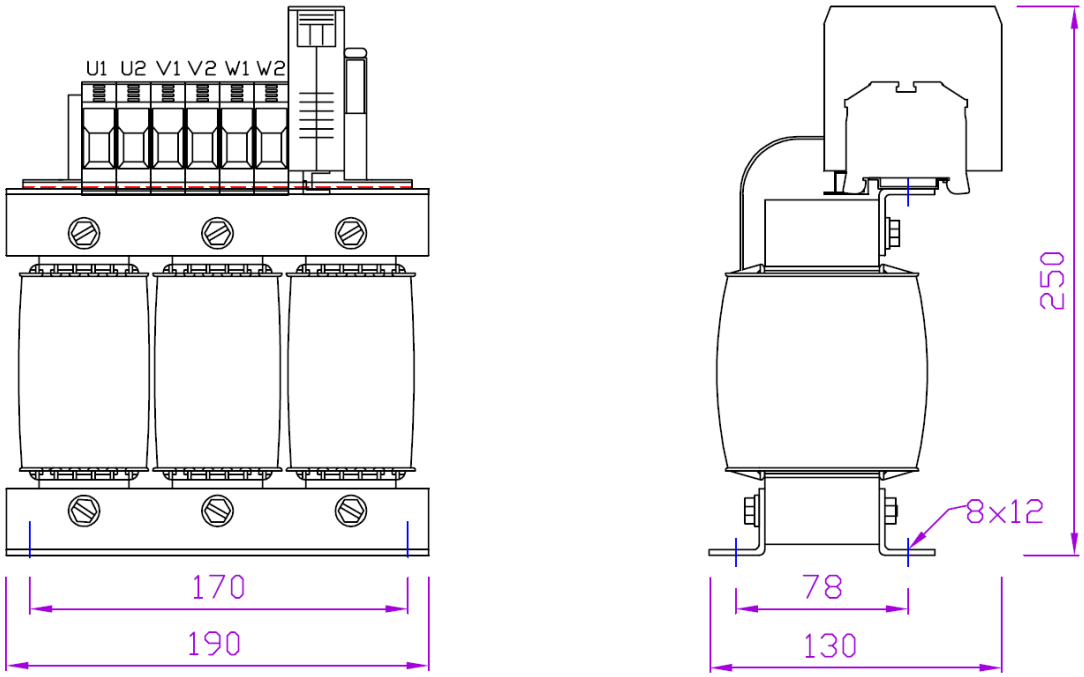
3. DU/DT FILTER DRAWINGS

3.1 P version

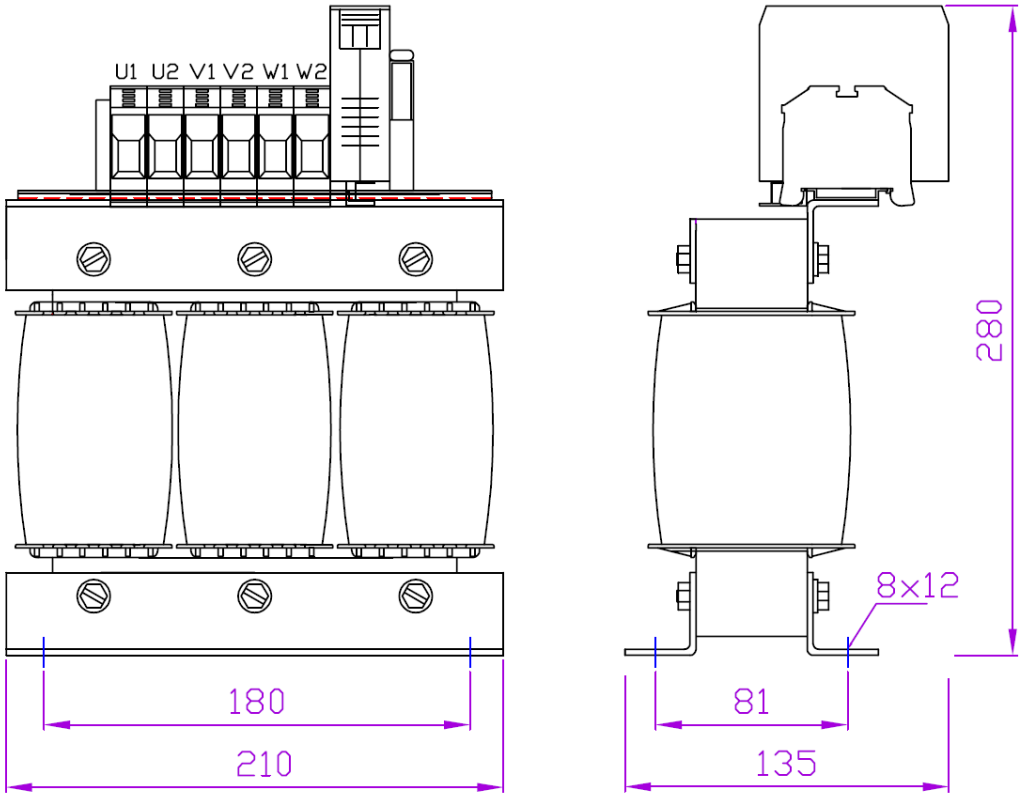
3.1.1 IP00



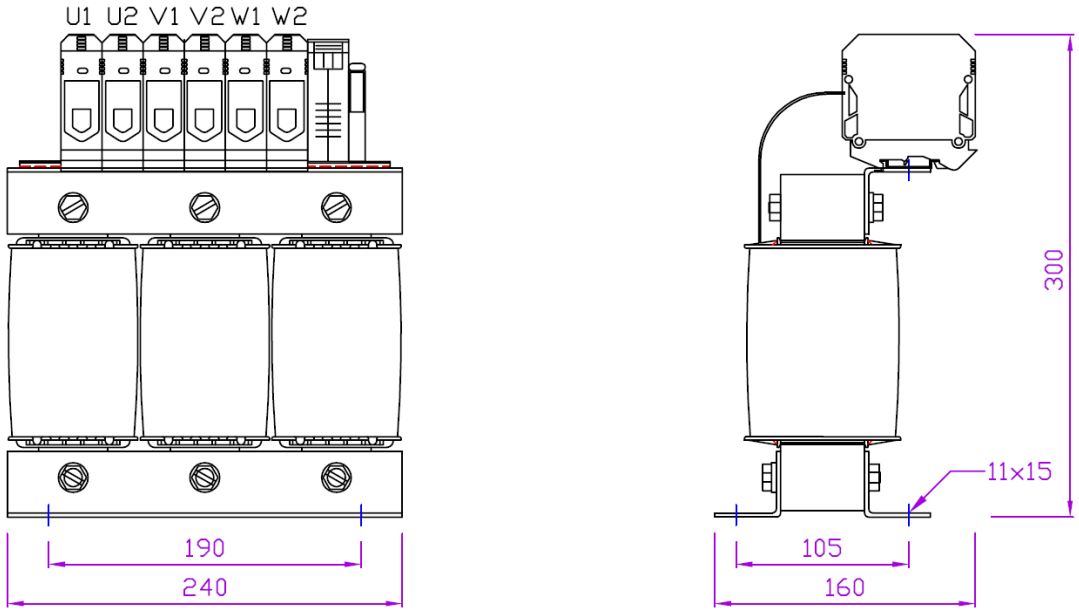
DUT 0025 6 0 P



DUT 0055 6 0 P



DUT 0080 6 0 P



DUT 0130 6 0 P

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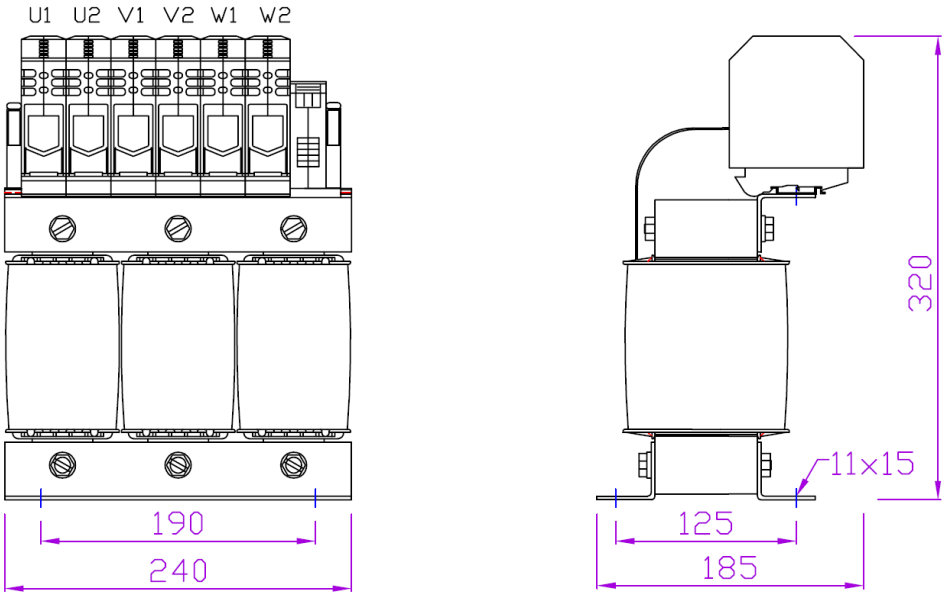
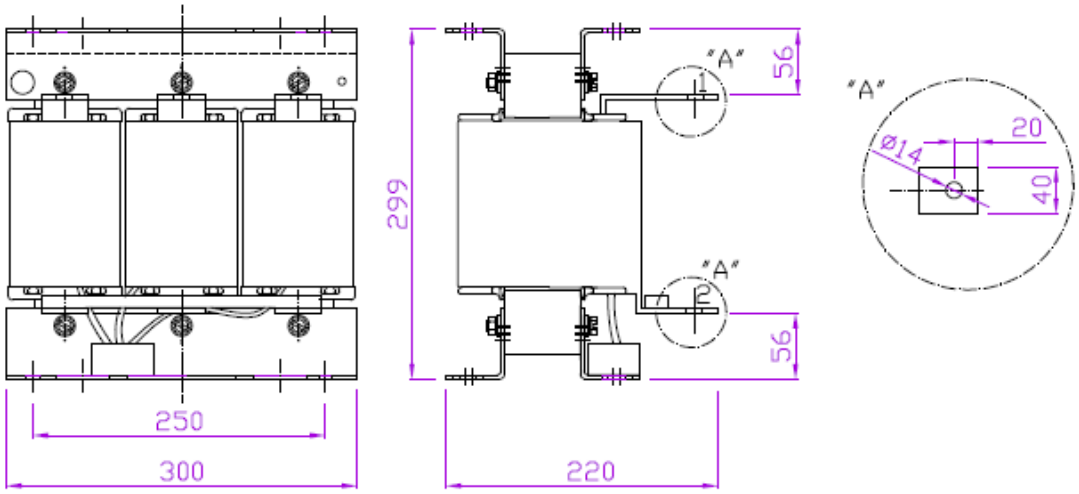
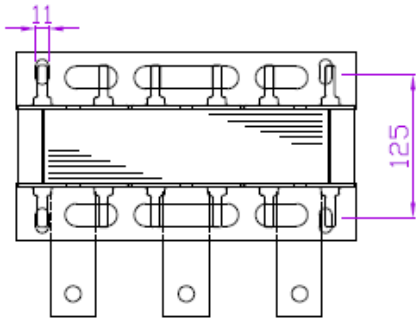
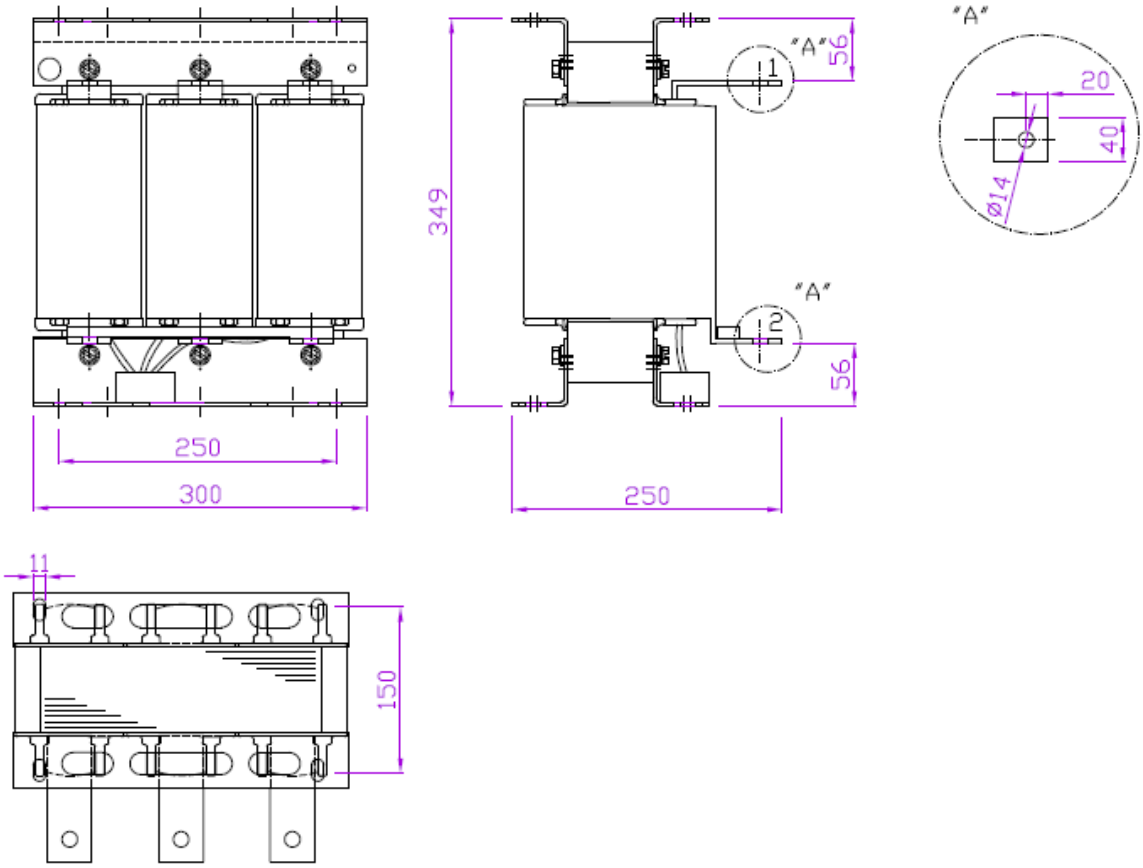


DUT 0210 6 0 P





DUT 0280 6 0 P1



DUT 0350 6 0 P1

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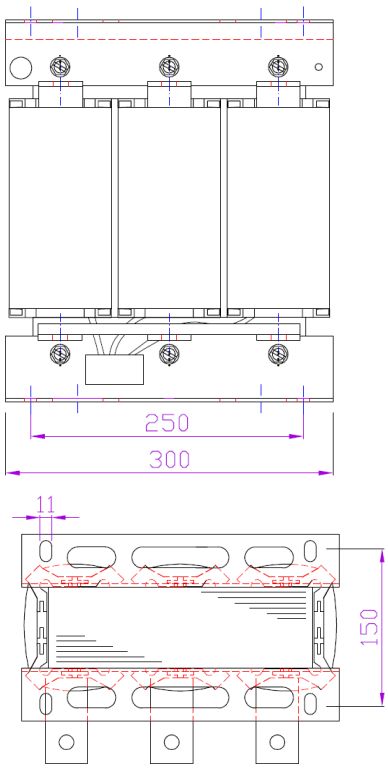
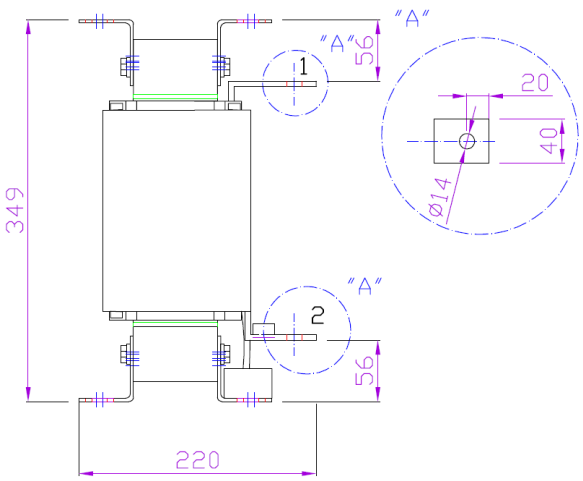
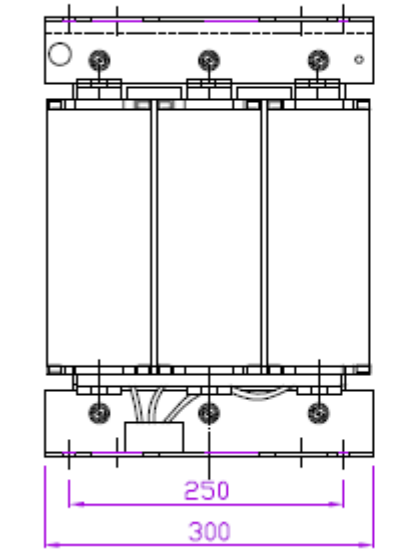
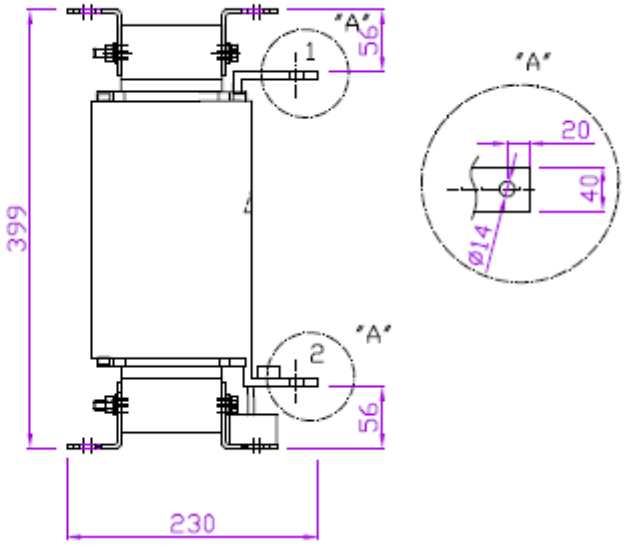


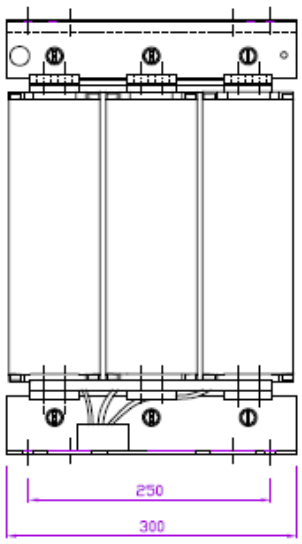


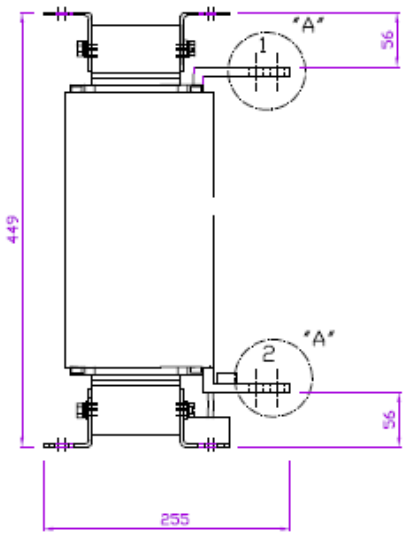
DUT 0420 6 0 P

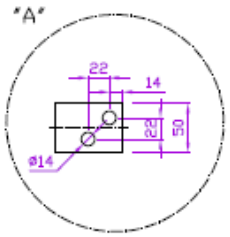


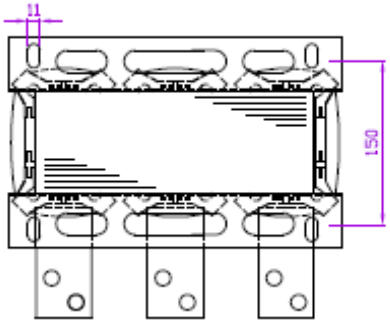


DUT 0600 6 0 P1









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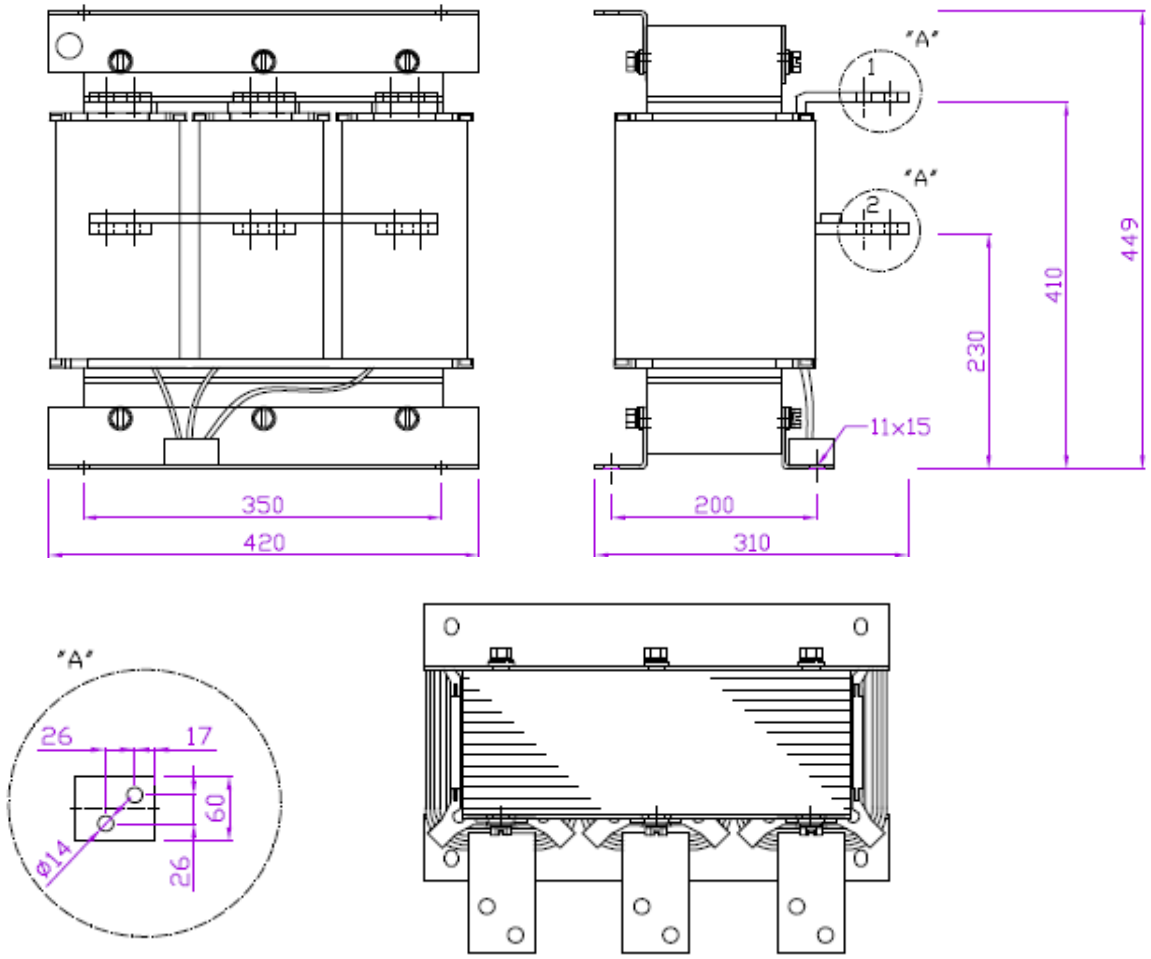
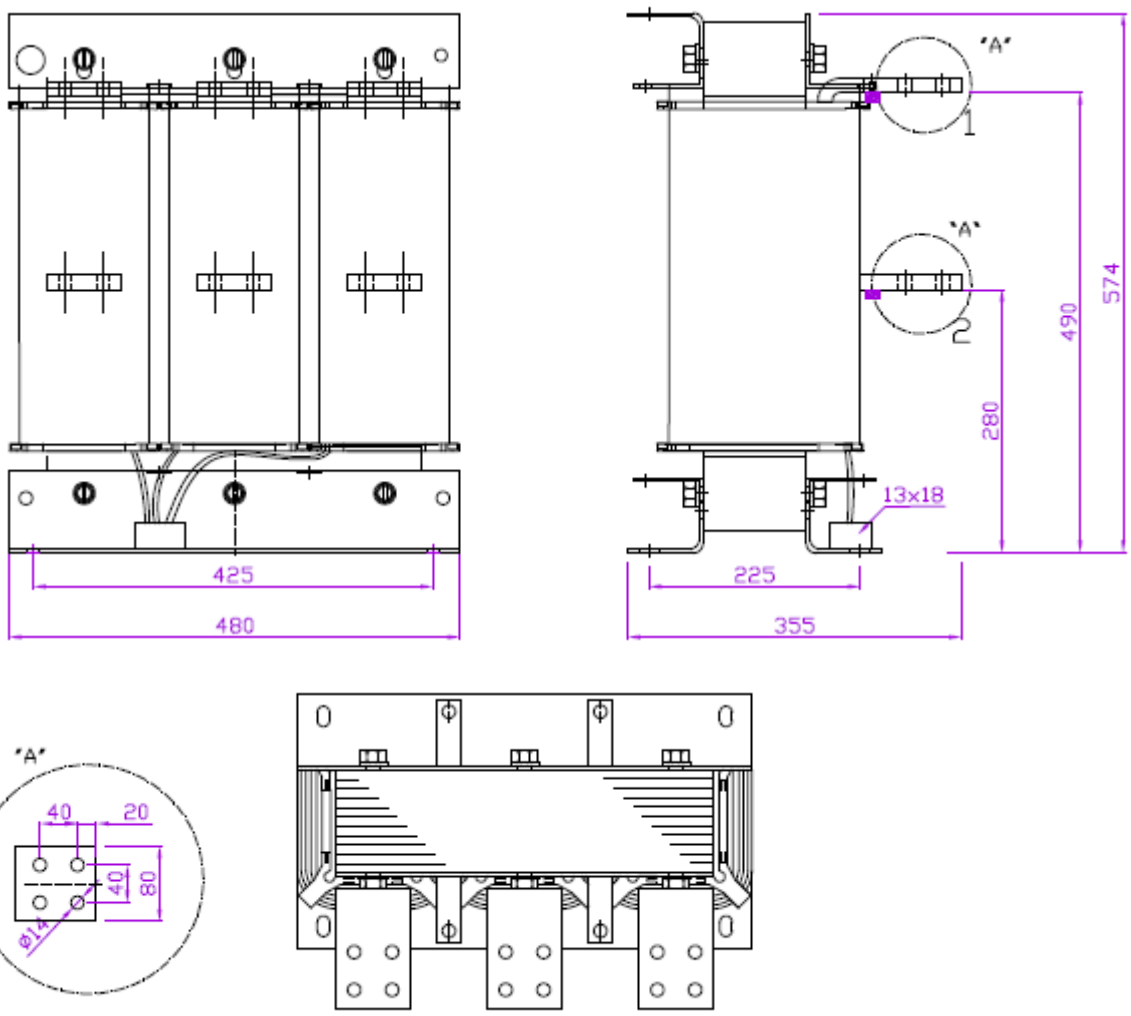


DUT 1200 6 0 P1



DUT 1500 6 0 P1

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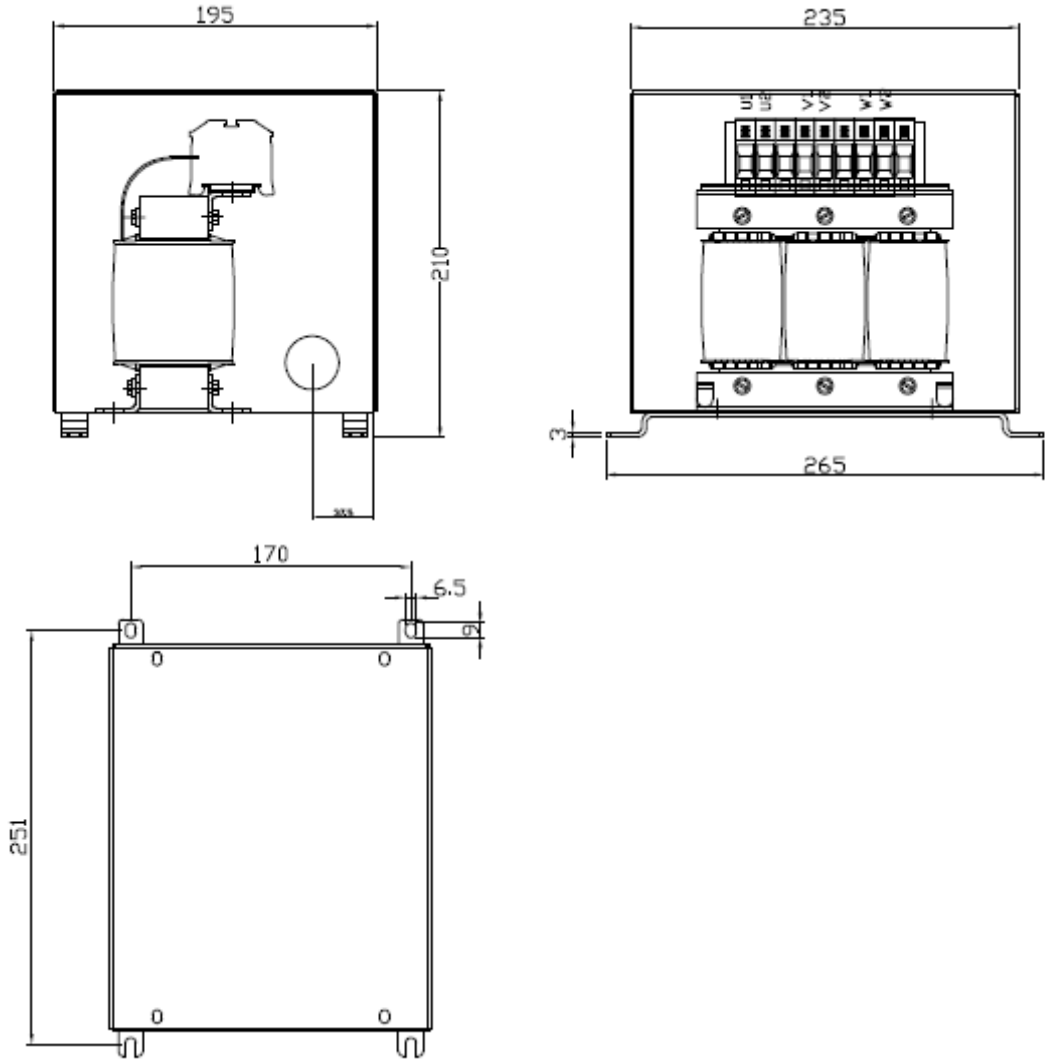
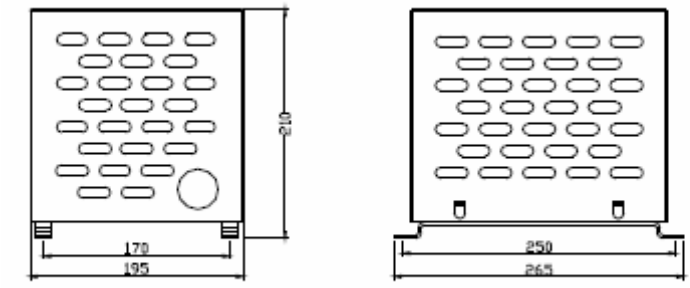
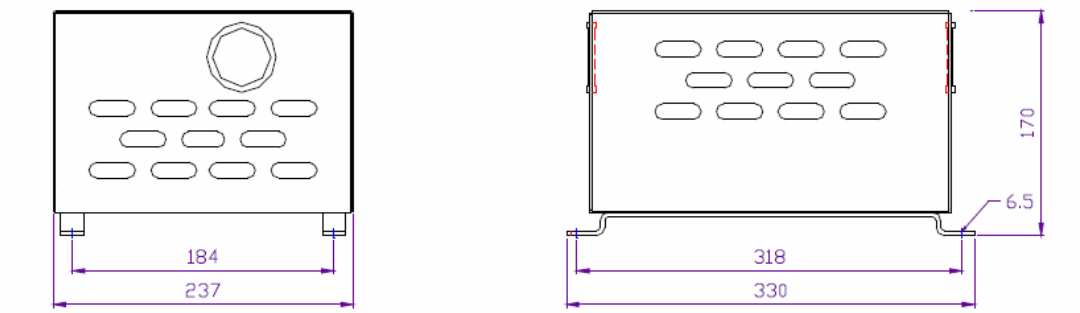
3.1.2 DUT filters, IP 21



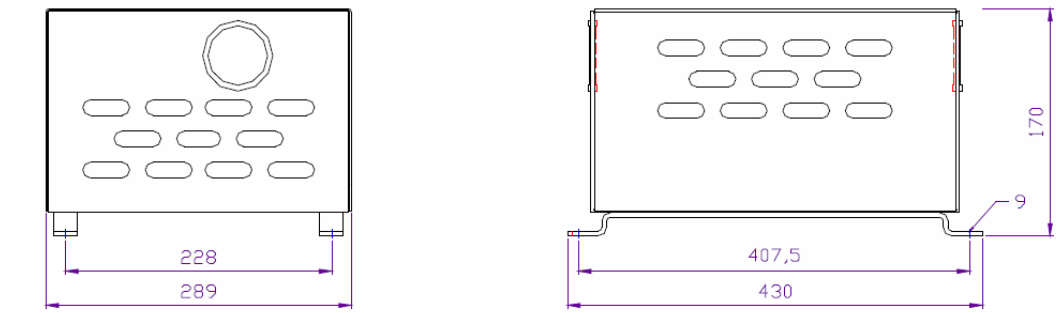
DUT 0012 6 2 P1



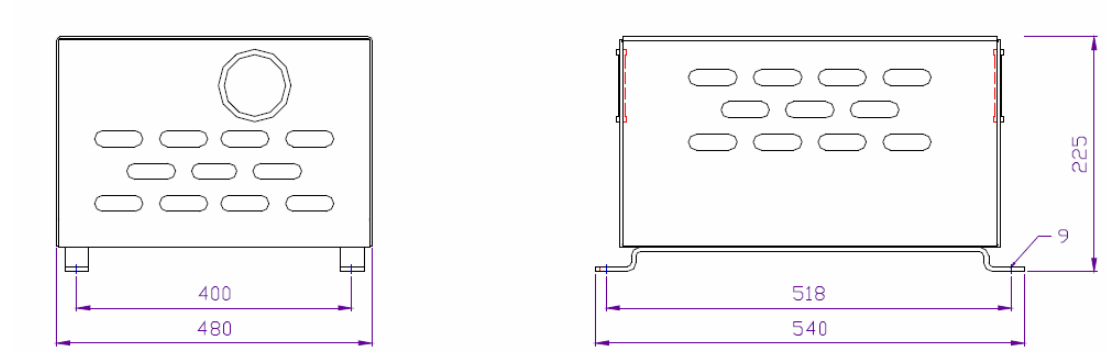
DUT 0034 6 2 P1



DUT 0055 6 2 P

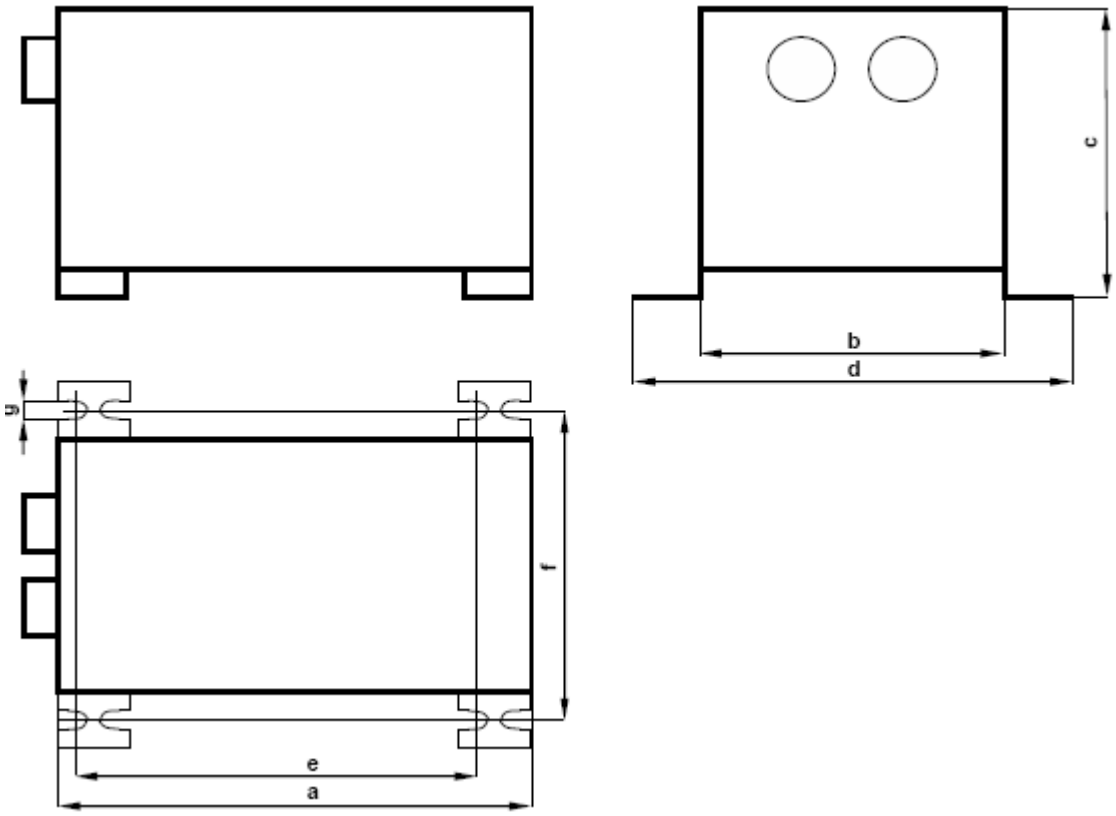


DUT 0100 6 2 P

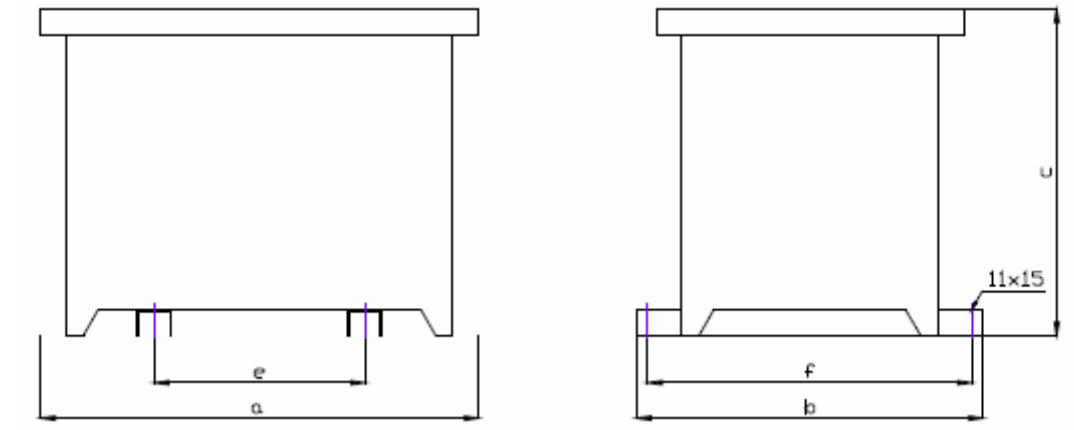


DUT 0210 6 2 P

3.1.3 IP54 range

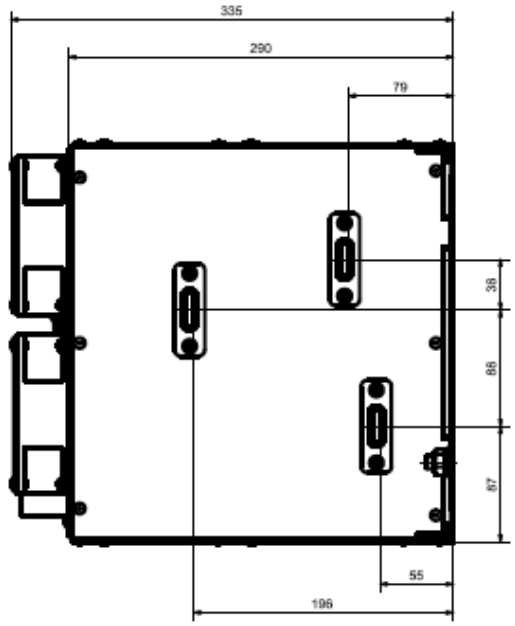


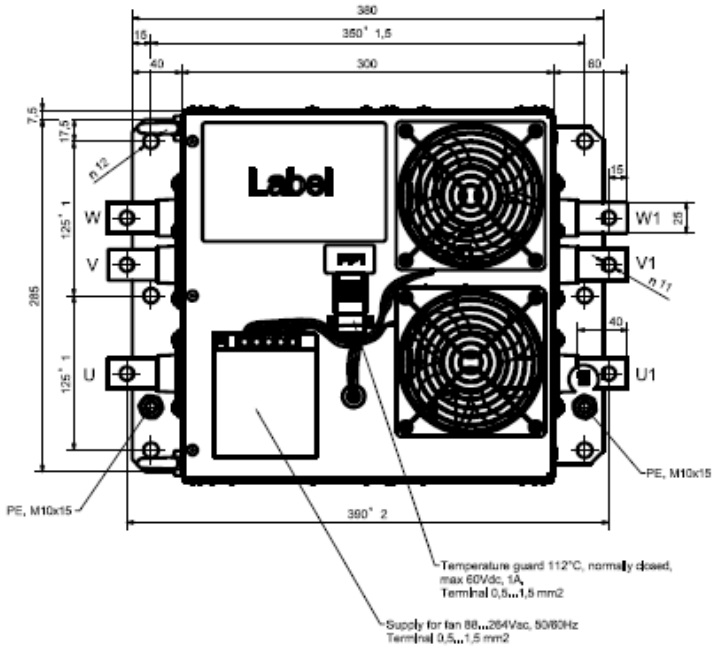
	a	b	c	d	e	f	g
DUT-0012-6-5-P	150	150	135	210	100	180	9
DUT-0034-6-5-P	200	200	135	260	150	230	9
DUT-0055-6-5-P	300	300	215	360	250	330	9
DUT-0100-6-5-P	300	300	215	360	250	330	9



	a	b	c	d	e	f
DUT-0130-6-5-P	610	500	500	240	460	60
DUT-0210-6-5-P	610	500	500	240	460	75

3.2 DUT – S range





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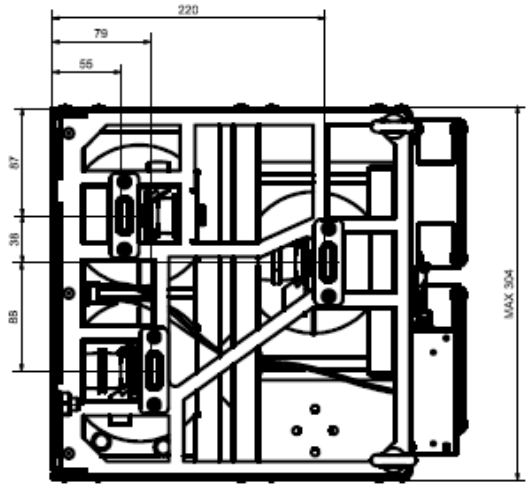
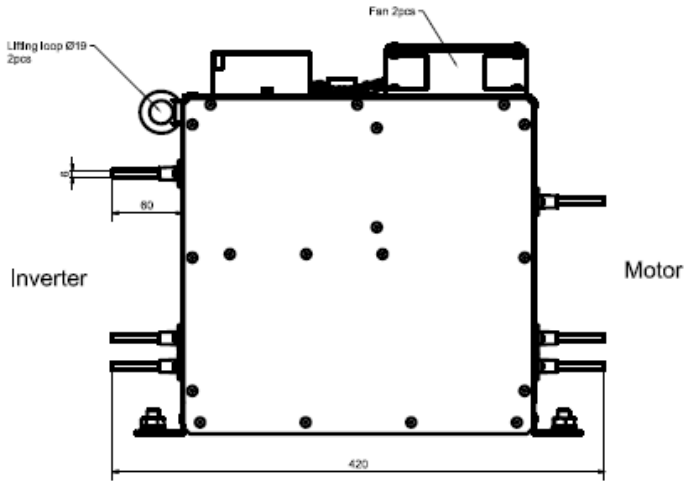
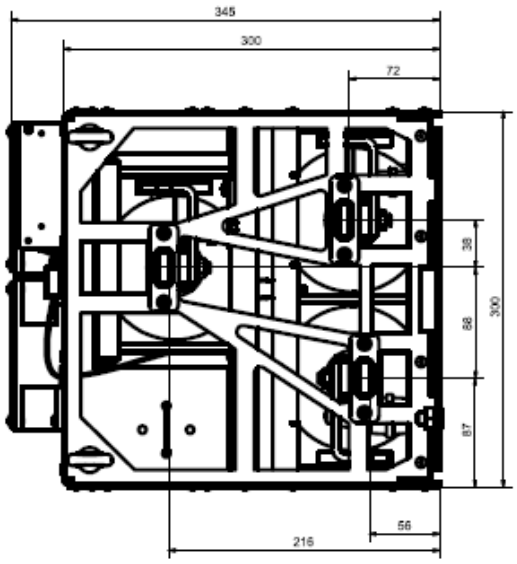
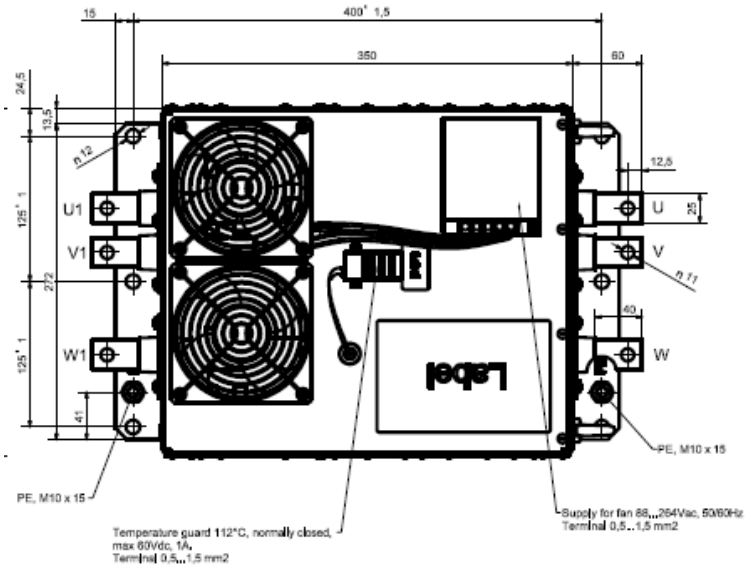
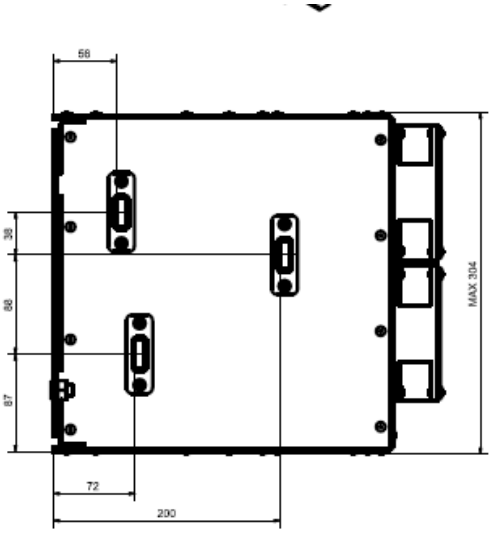

220
79
55
67
38
88
MAX 304

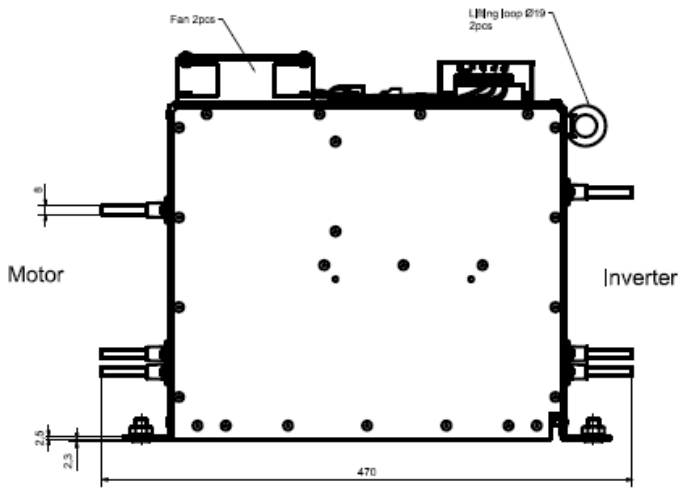

Fan 2pcs
Lifting loop Ø19
2pcs
6
80
Inverter
Motor
420

DUT 0280 6 0 S









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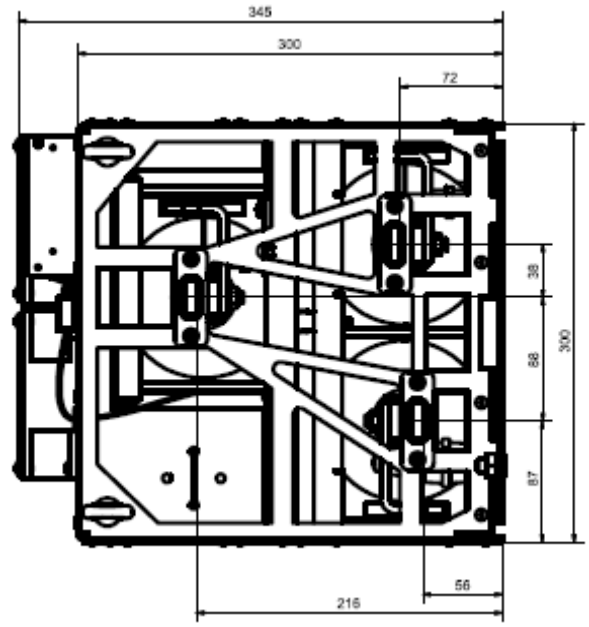
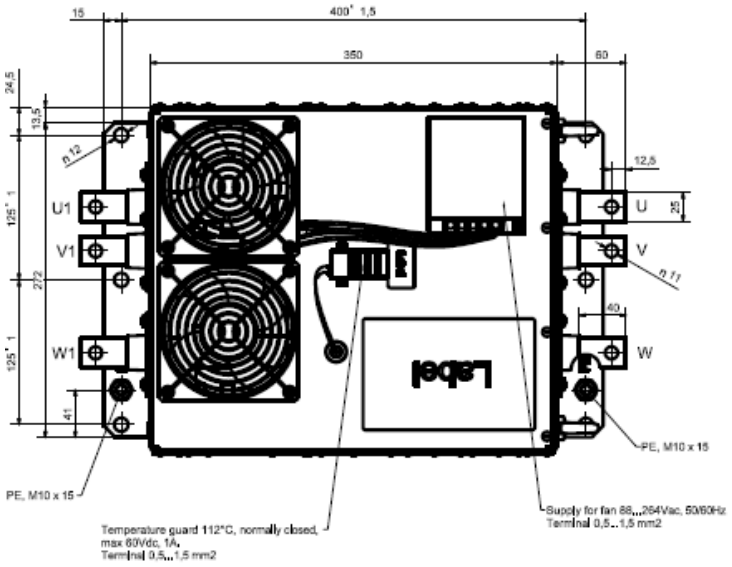
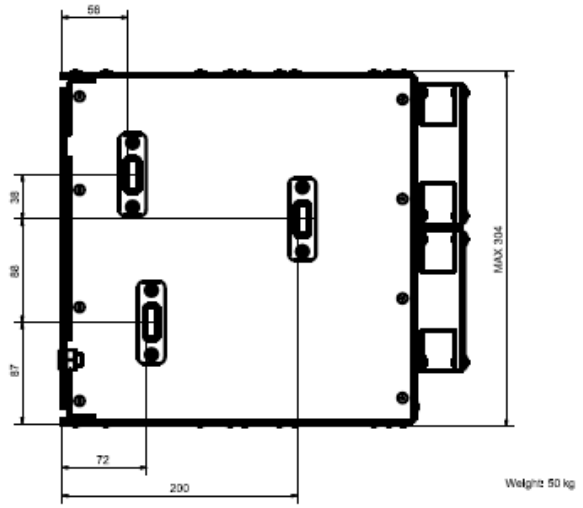
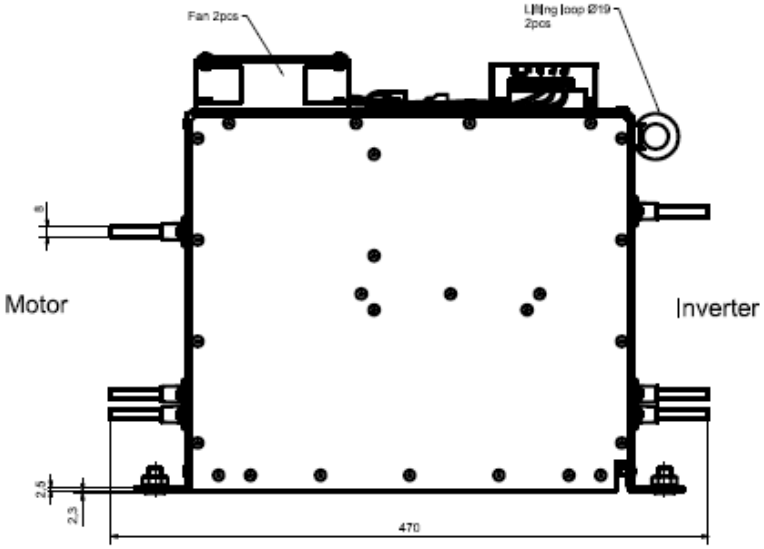

345
300
72
38
88
87
300
56
216


15
400 ' 1,5
350
60
24,5
13,5
n.12
125 ' 1
272
125 ' 1
41
U1
V1
W1
12,5
U
V
W
25
40
n.11
Label
PE, M10 x 15
PE, M10 x 15
Temperature guard 112°C, normally closed,
max 60Vdc, 1A,
Terminal 0,5...1,5 mm2
Supply for fan 88...264Vac, 50/60Hz
Terminal 0,5...1,5 mm2





DUT 0590 6 0 S

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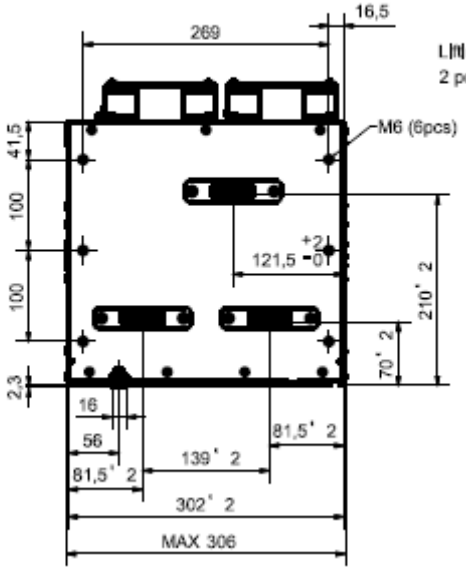
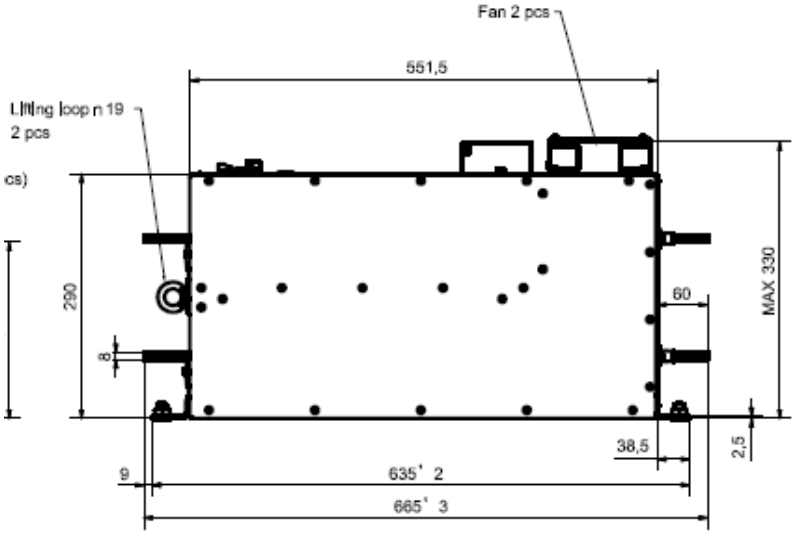
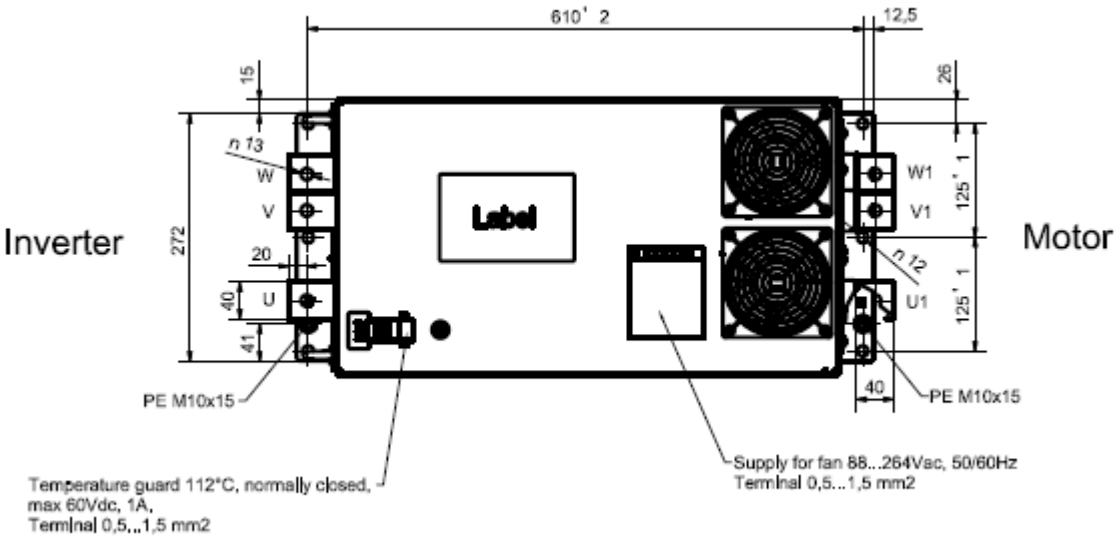
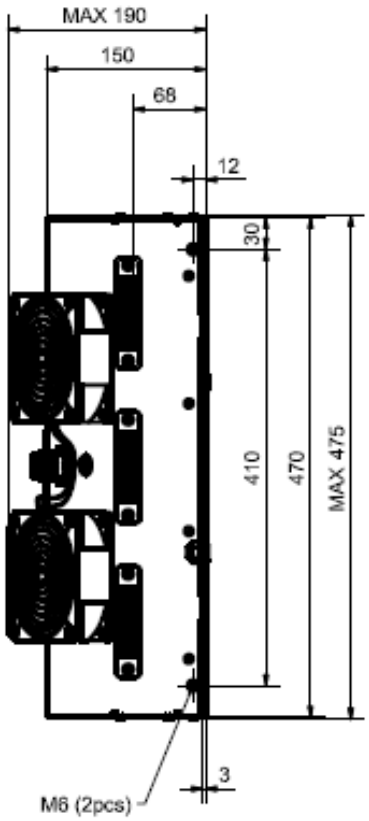
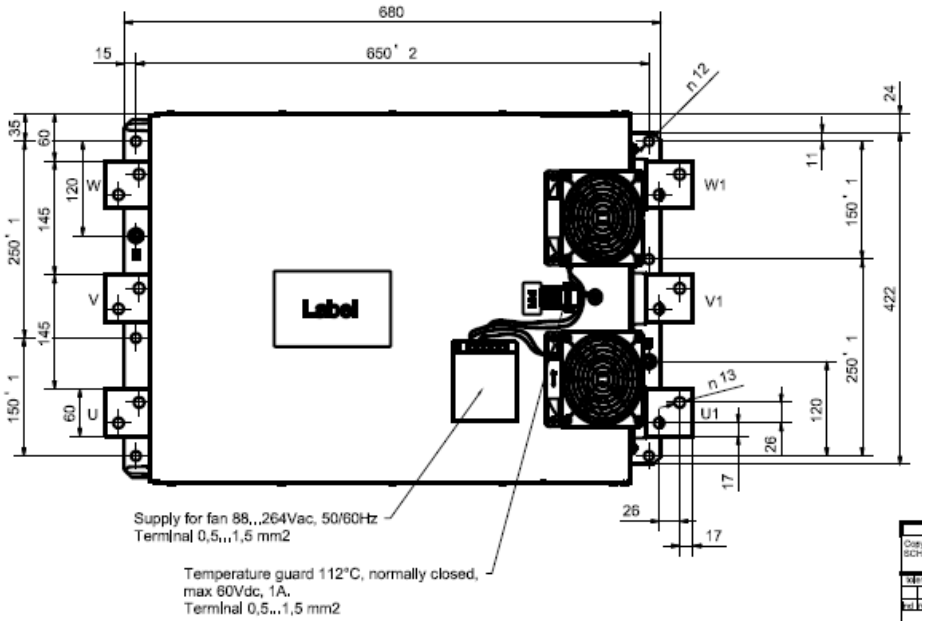

16,5
269
M6 (6pcs)
41,5
100
100
2,3
121,5 +2 -0
210 ' 2
70 ' 2
16
56
81,5 ' 2
139 ' 2
81,5 ' 2
302 ' 2
MAX 306

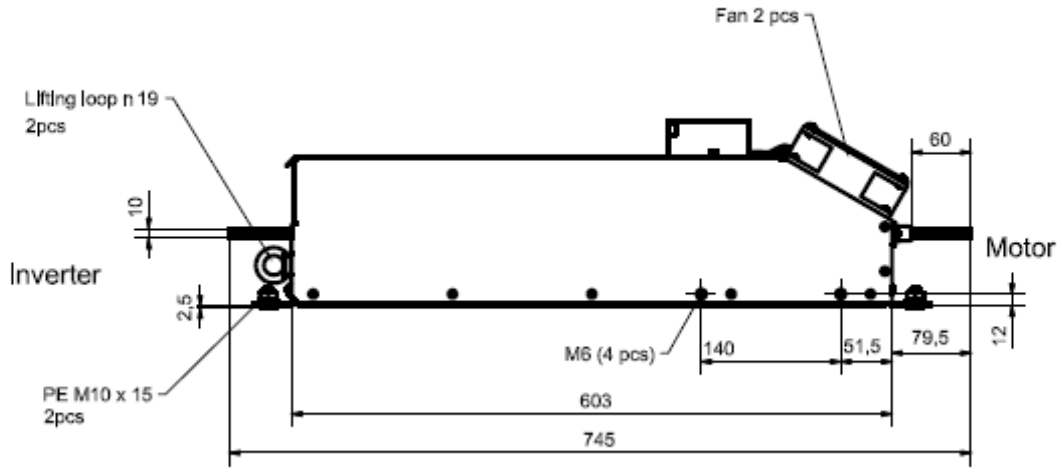

Fan 2 pcs
551,5
290
8
60
MAX 330
38,5
2,5
9
635 ' 2
665 ' 3


610 ' 2
12,5
15
26
n 13
W
V
U
20
40
41
272
Label
W1
V1
U1
n 12
125 ' 1
125 ' 1
40
Inverter
Motor
PE M10x15
PE M10x15
Temperature guard 112°C, normally closed,
max 60Vdc, 1A,
Terminal 0,5...1,5 mm2
Supply for fan 88...264Vac, 50/60Hz
Terminal 0,5...1,5 mm2

DUT 0820 6 0 S


MAX 190
150
68
12
30
410
470
MAX 475
3
M6 (2pcs)


680
15
650 ' 2
n 12
24
11
35
60
120
W
145
250 ' 1
W1
150 ' 1
422
V
145
V1
Label
n 13
U1
120
250 ' 1
150 ' 1
60
U
26
17
26
17
Supply for fan 88,..264Vac, 50/60Hz
Terminal 0,5,..1,5 mm2
Temperature guard 112°C, normally closed,
max 60Vdc, 1A.
Terminal 0,5..1,5 mm2

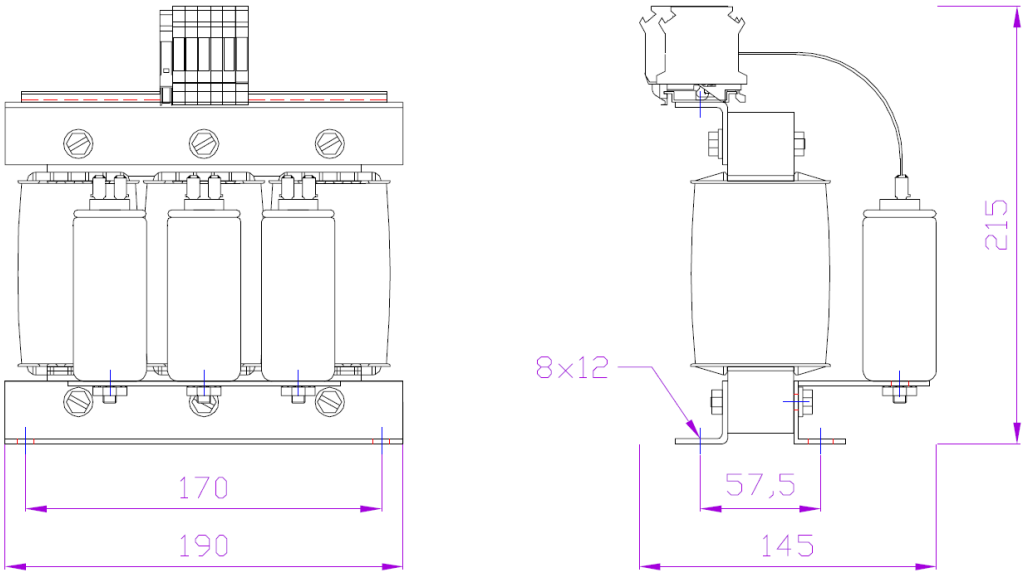


DUT 1250 6 0 S and DUT 1600 6 0 S

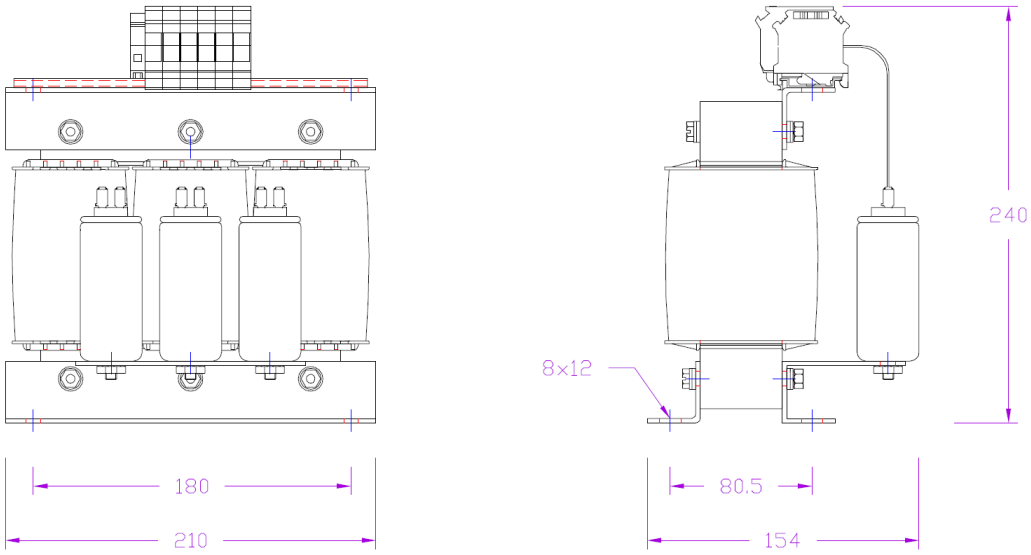
Sine filters

3.3 500 V range

3.3.1 IP 00 500 V filters



SIN 0010 5 0 P



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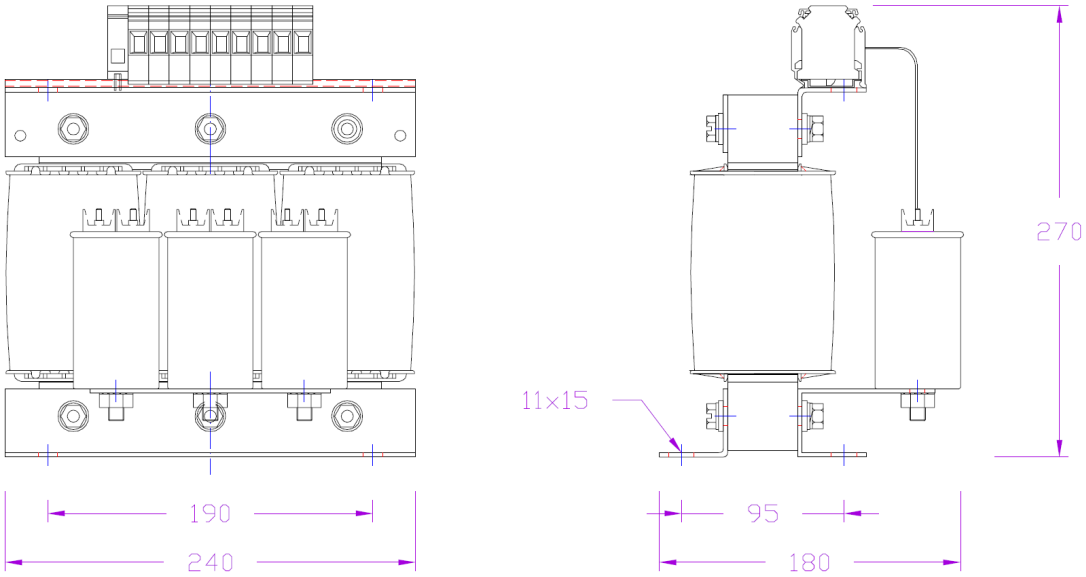
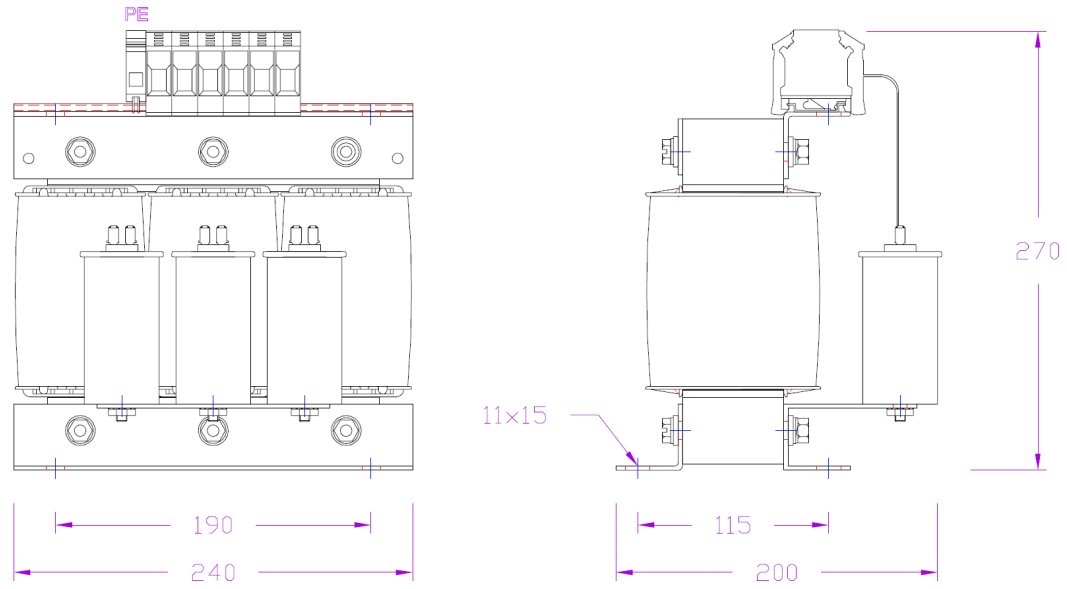
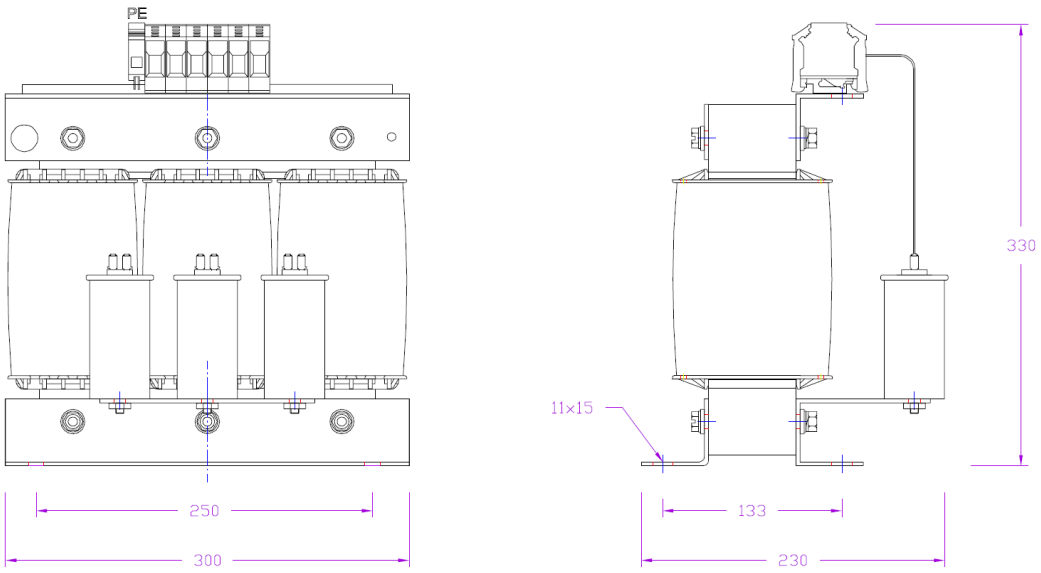


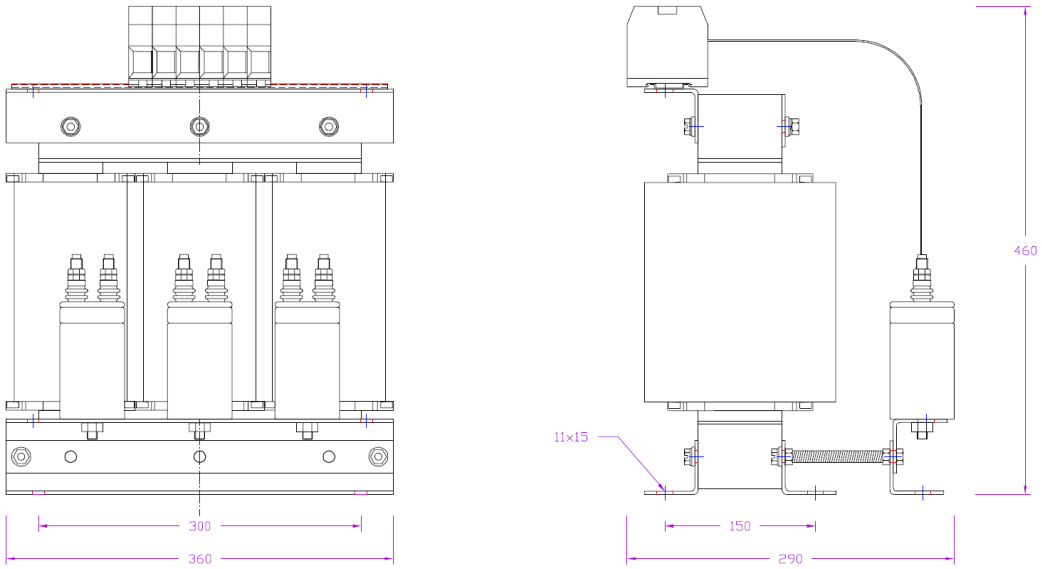
SIN 0032 5 0 P



SIN 0048 5 0 P



SIN 0075 5 0 P



Sin 0110 5 A0

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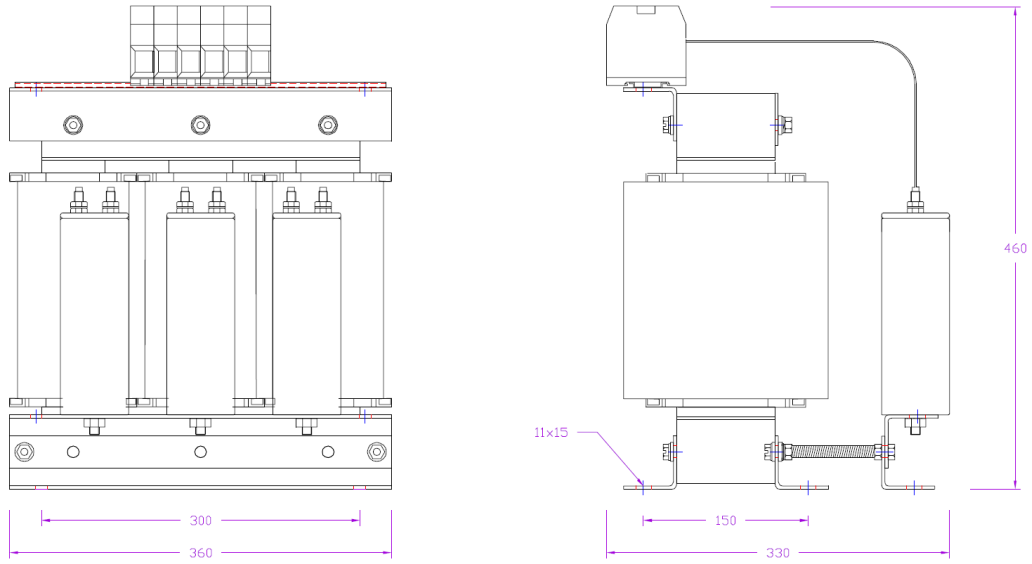
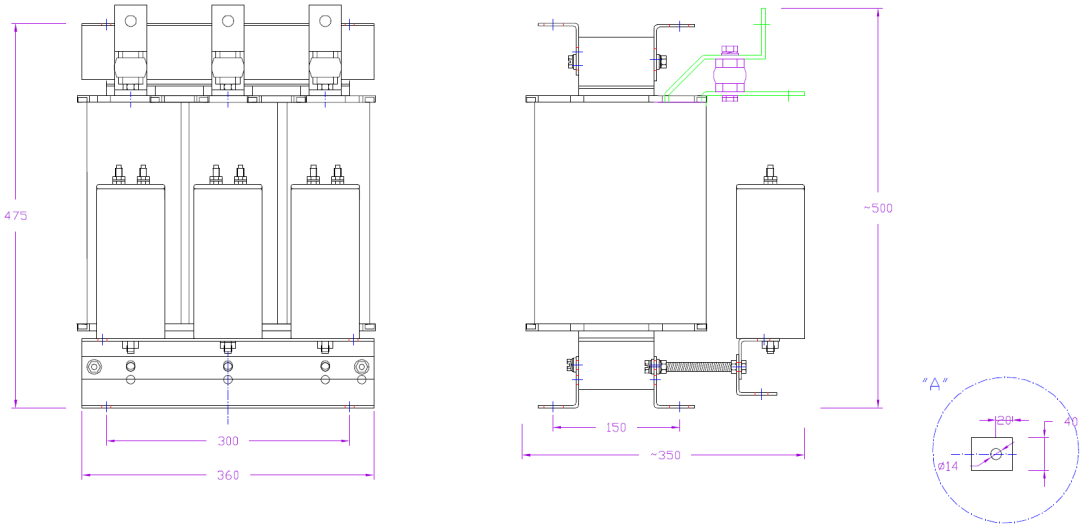
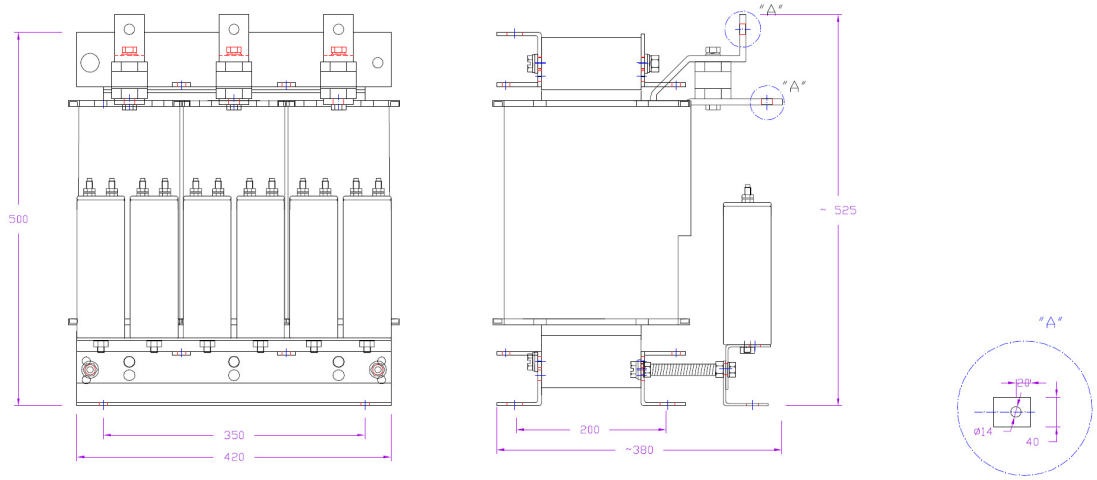


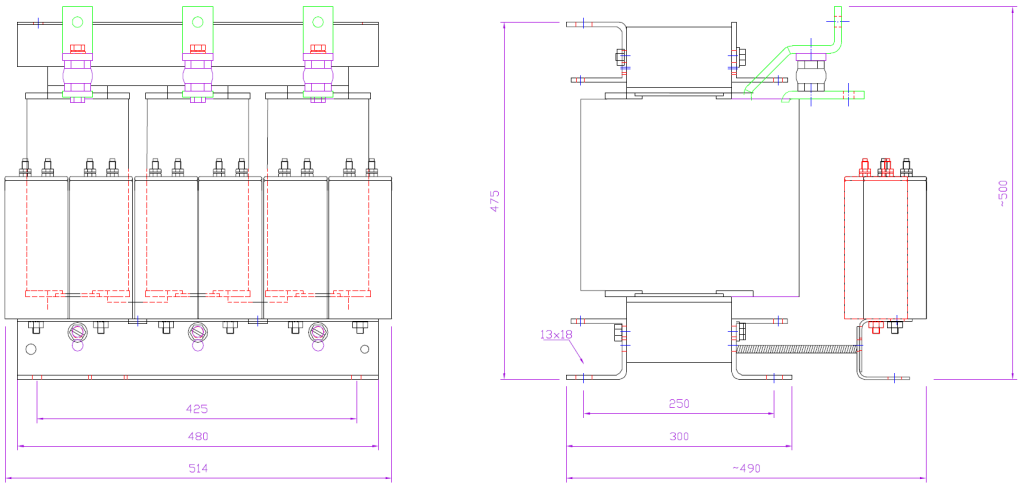
Sin 0180 5 0 P



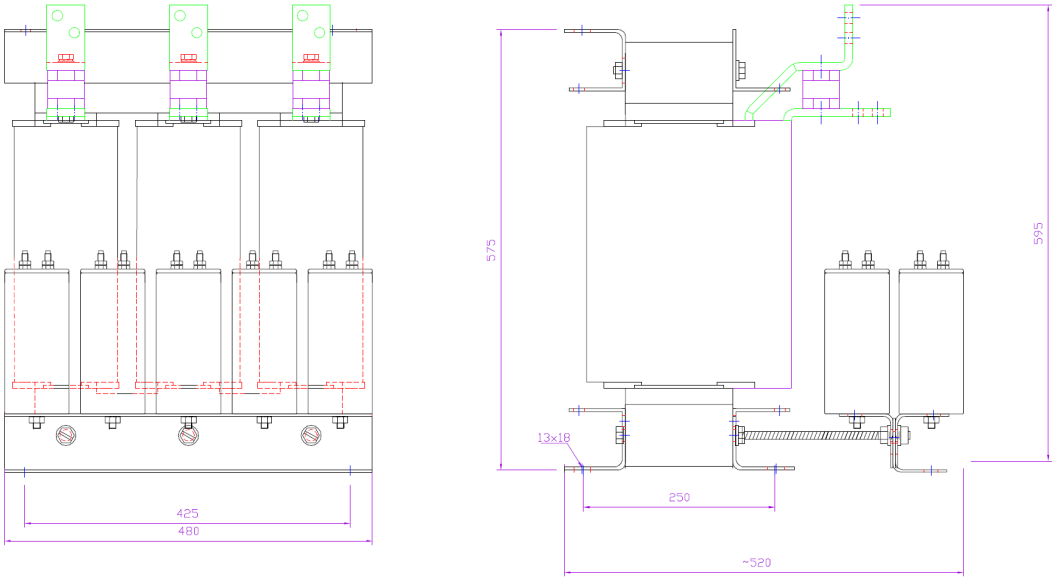
SIN 0270 5 0 P



SIN 0410 5 0 P



Sin 0600 5 0 P



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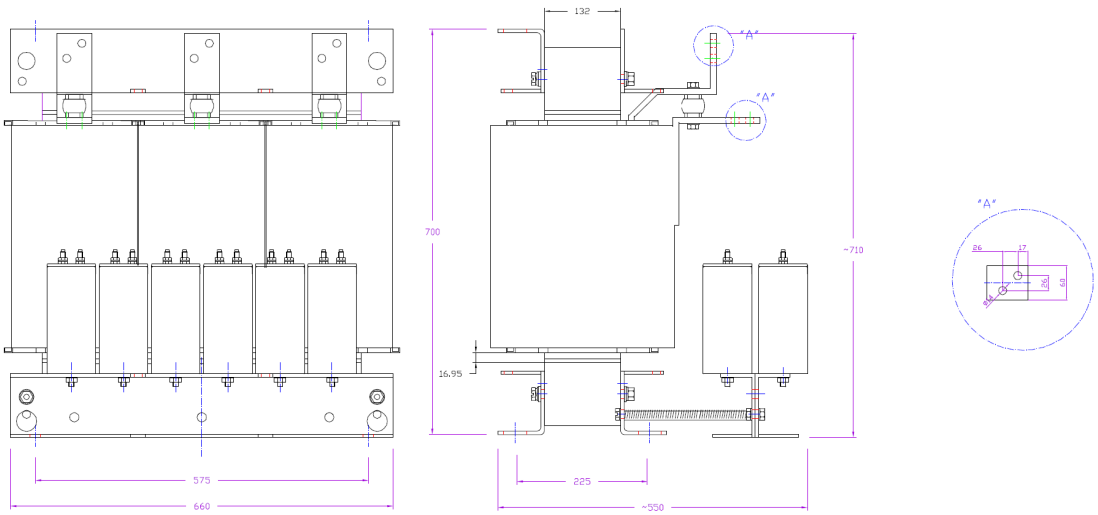
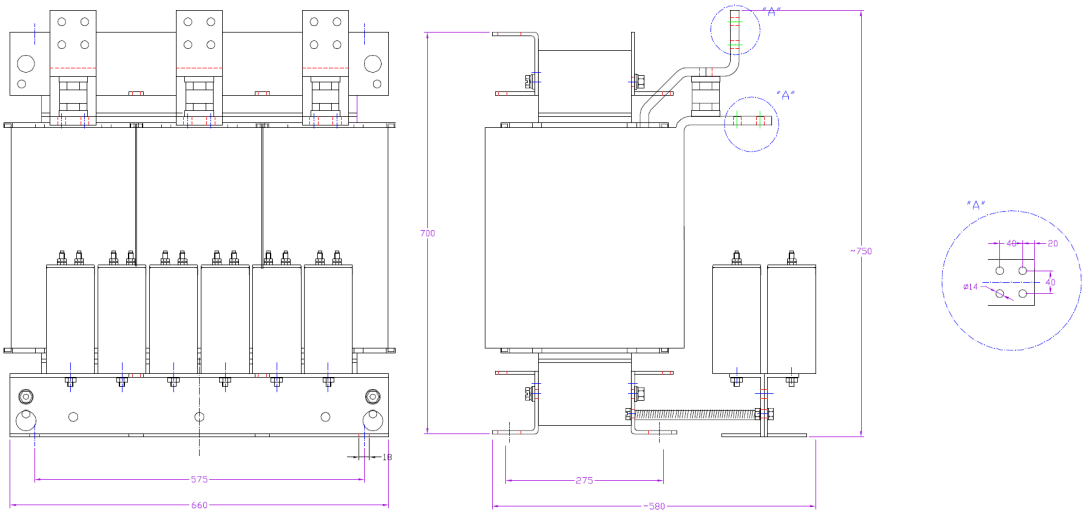
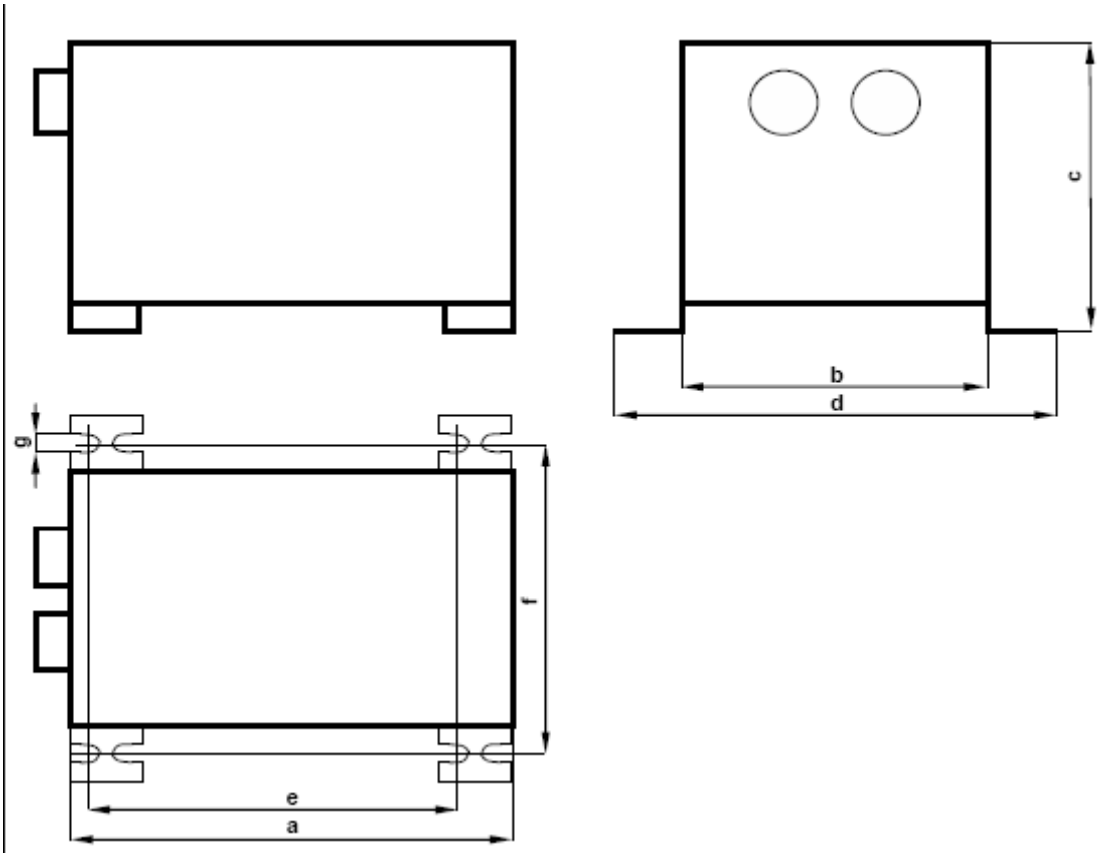


SIN 1160 5 0 P



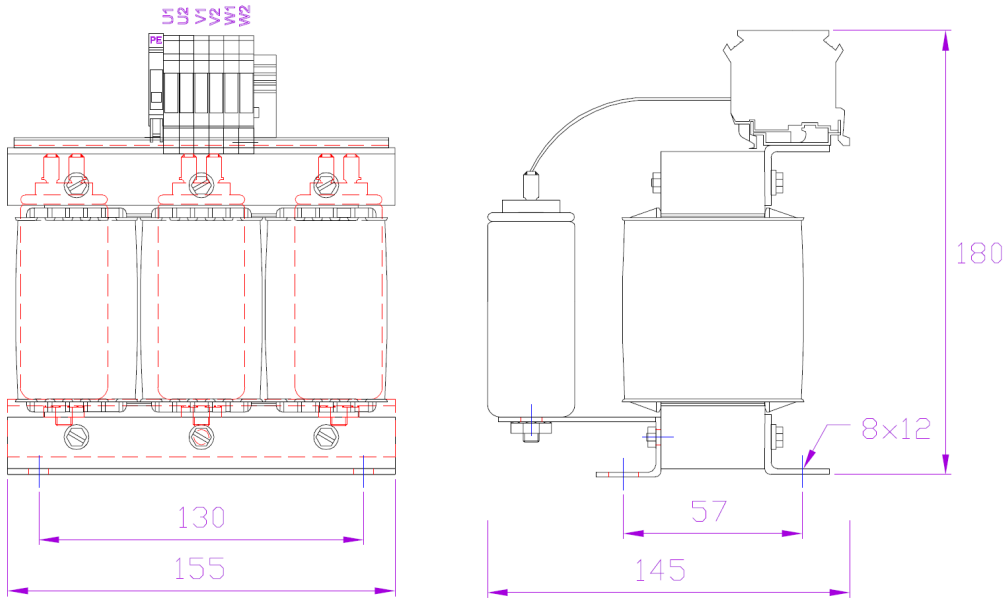
SIN 1480 5 0 P

3.3.2 IP 54 500 V filters



	a	b	c	d	e	f	g
SIN-0004-5-5-P	200	200	135	260	150	230	9
SIN-0008-5-5-P	200	200	135	260	150	230	9
SIN-0012-5-5-P	300	300	215	360	250	330	9
SIN-0016-5-5-P	300	300	215	360	250	330	9
SIN-0023-5-5-P	300	300	215	360	250	330	9
SIN-0032-5-5-P	300	300	215	360	250	330	9

3.4 690 V filters



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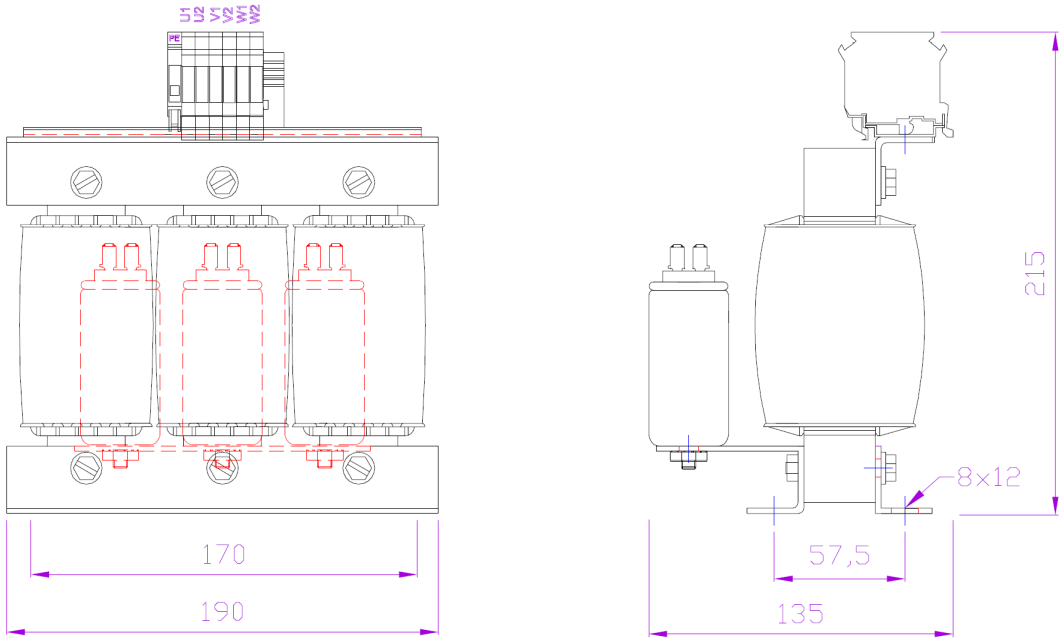

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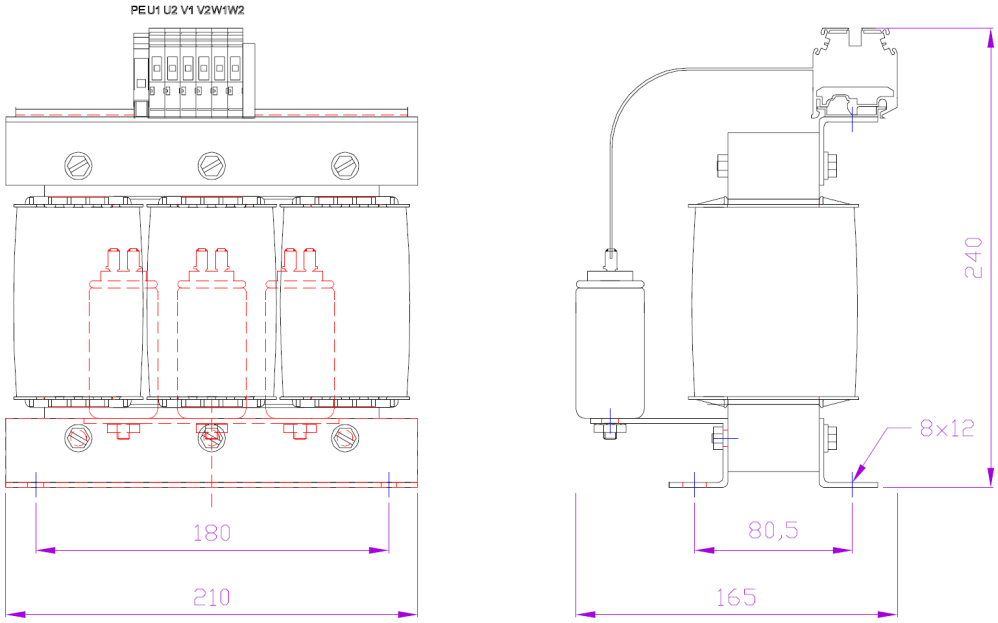

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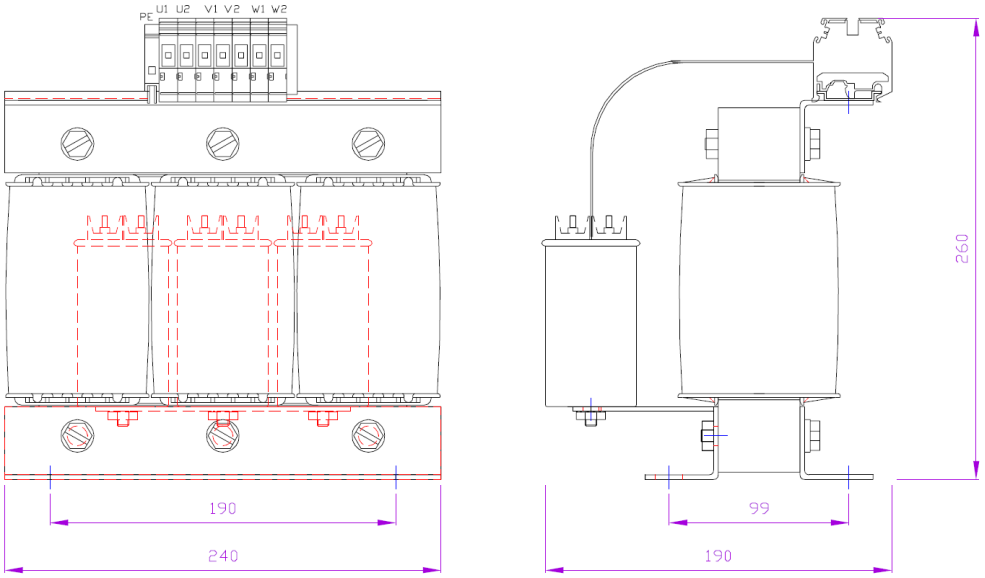

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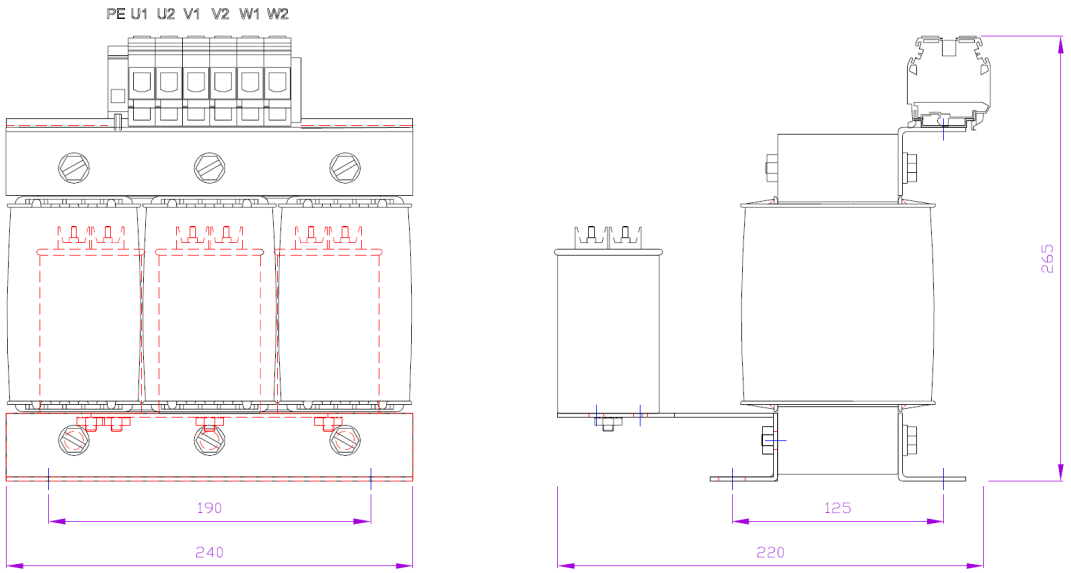

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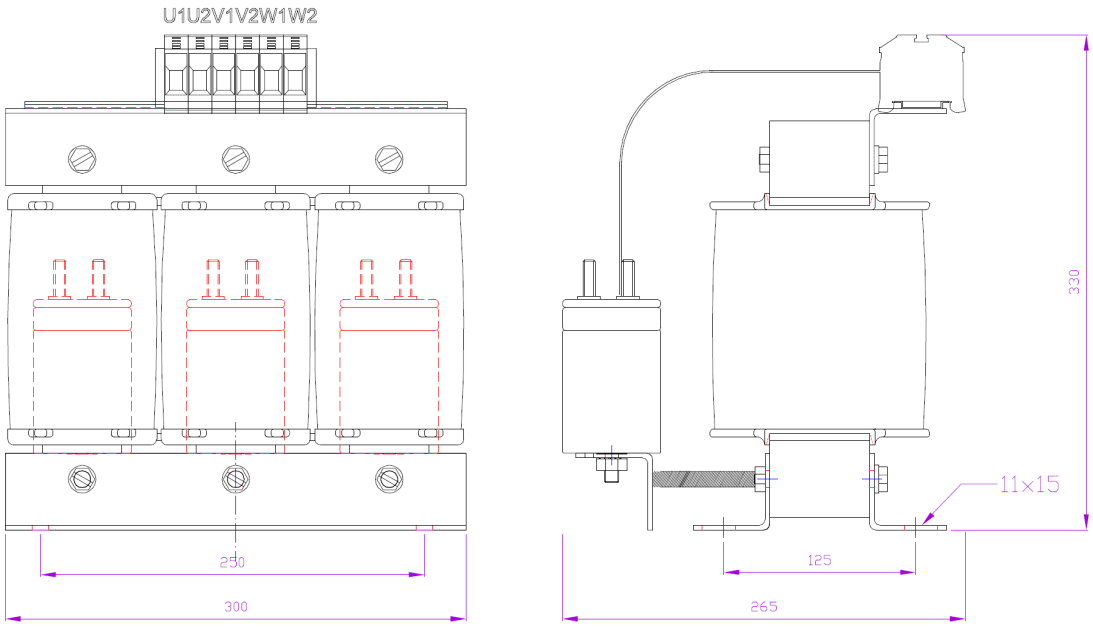

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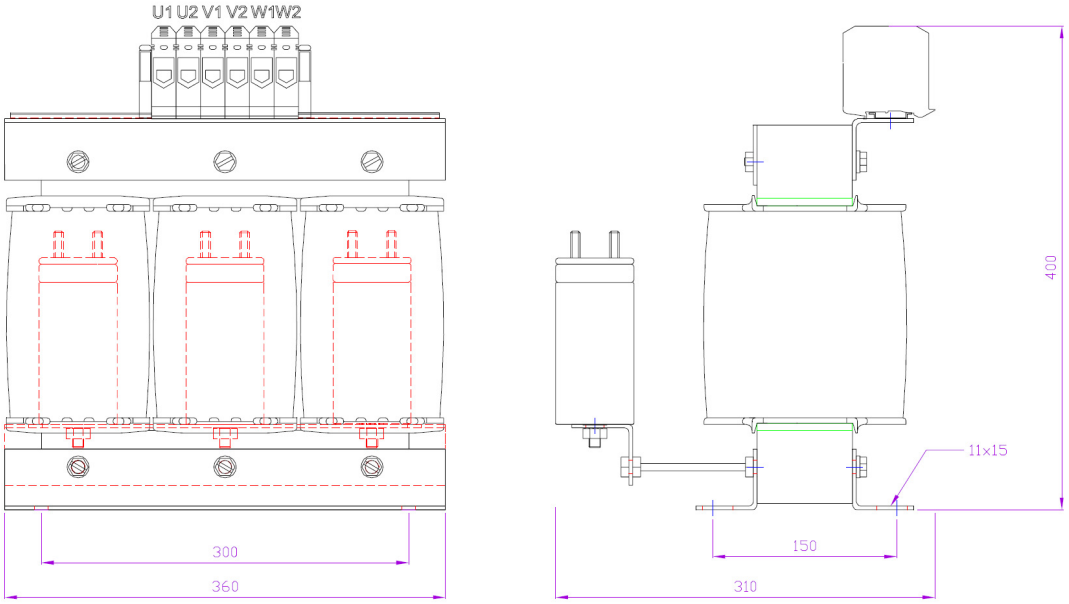

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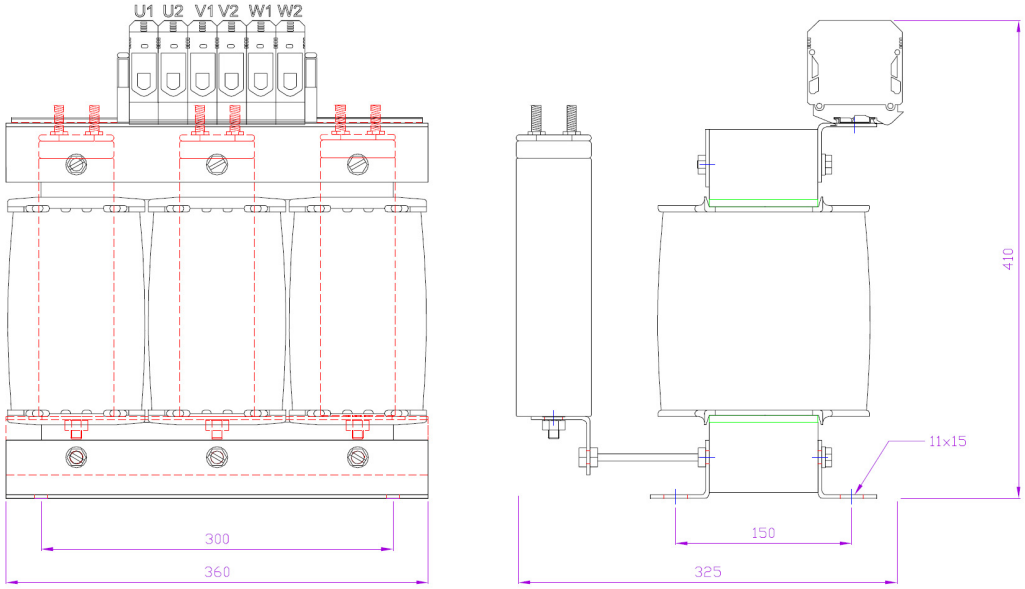

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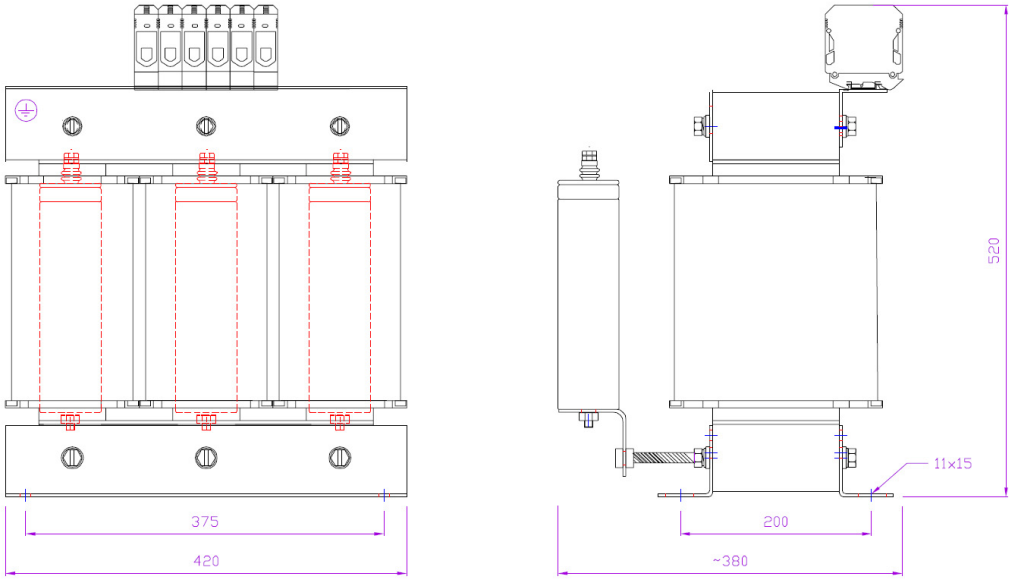

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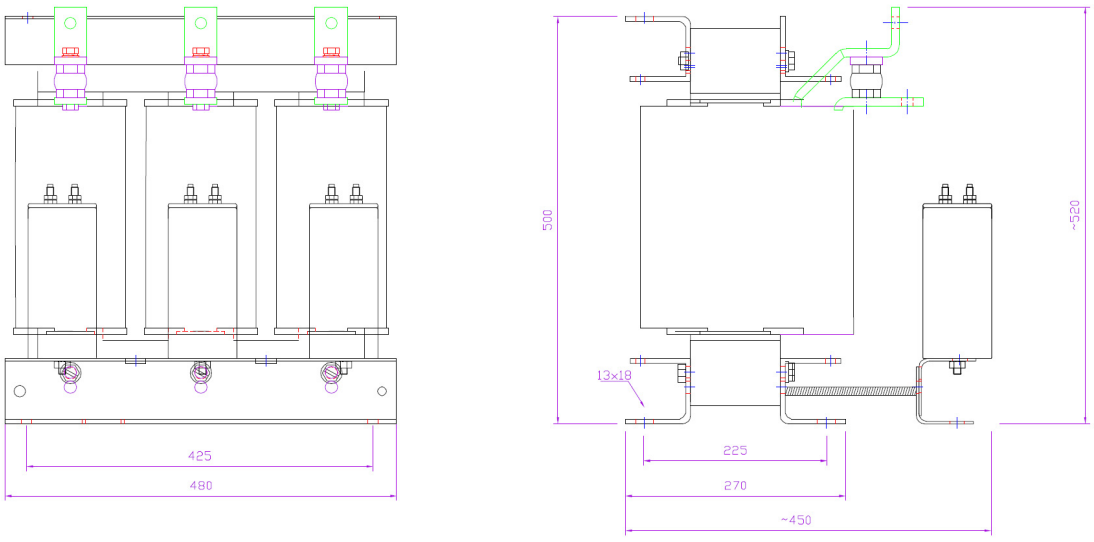

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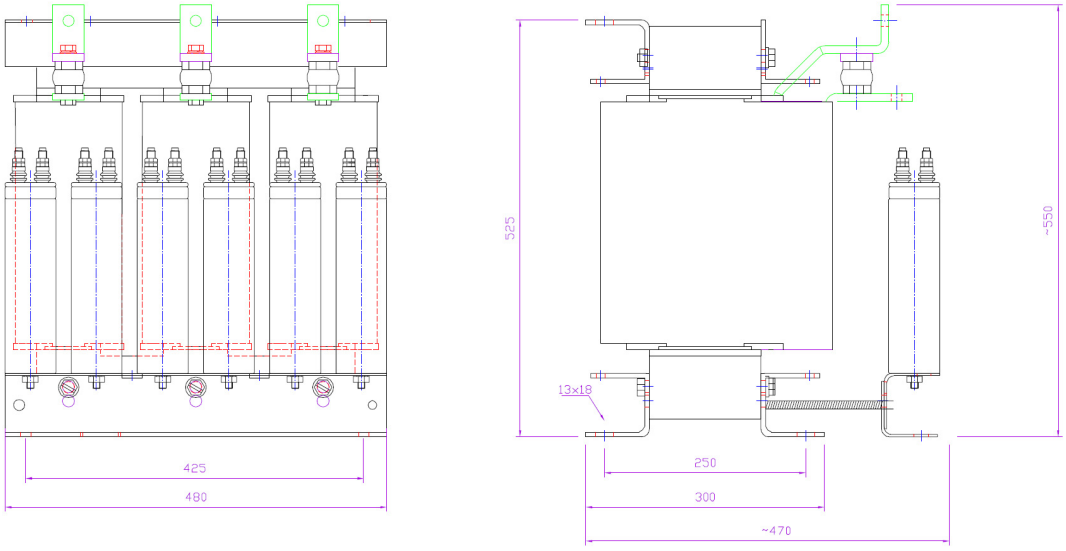

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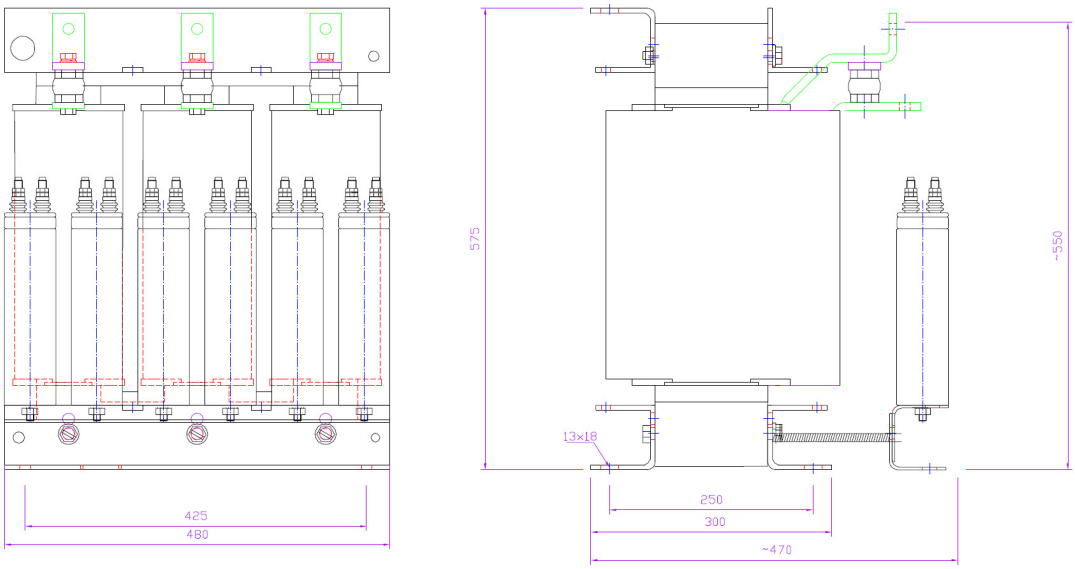

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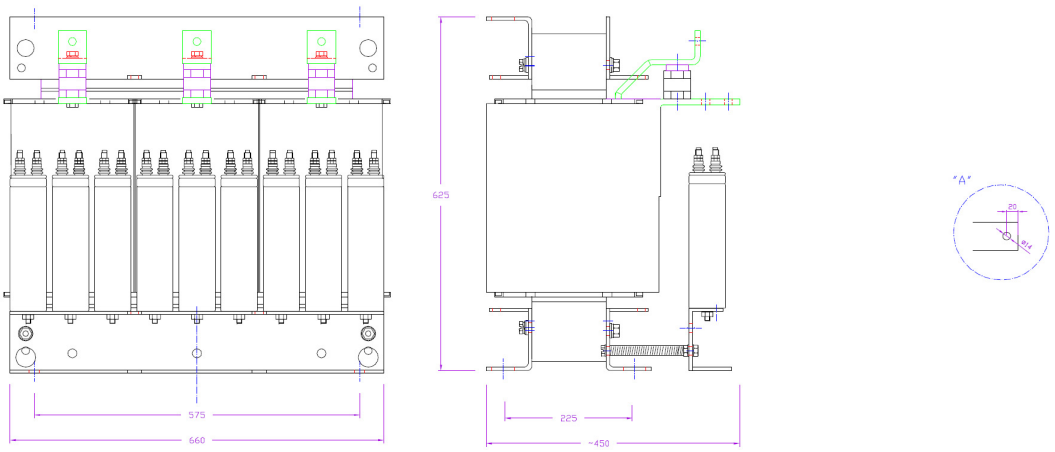

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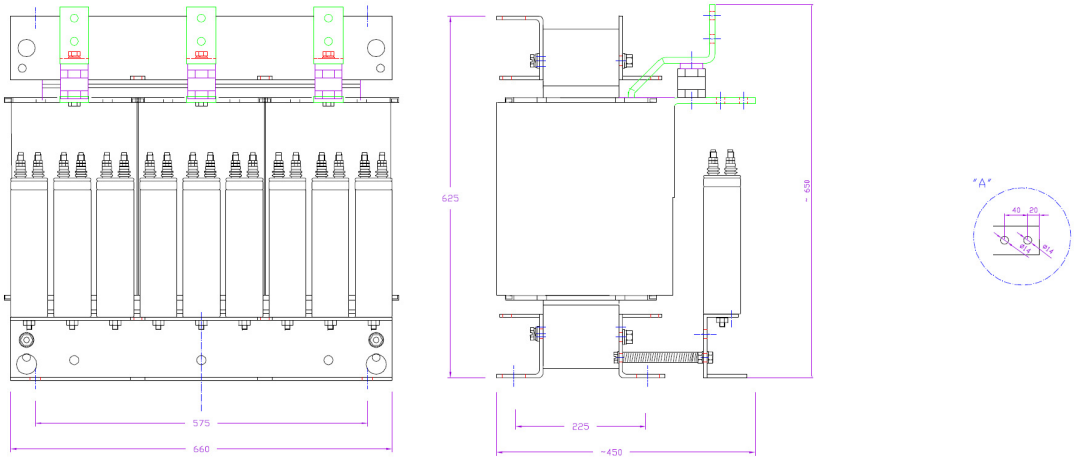

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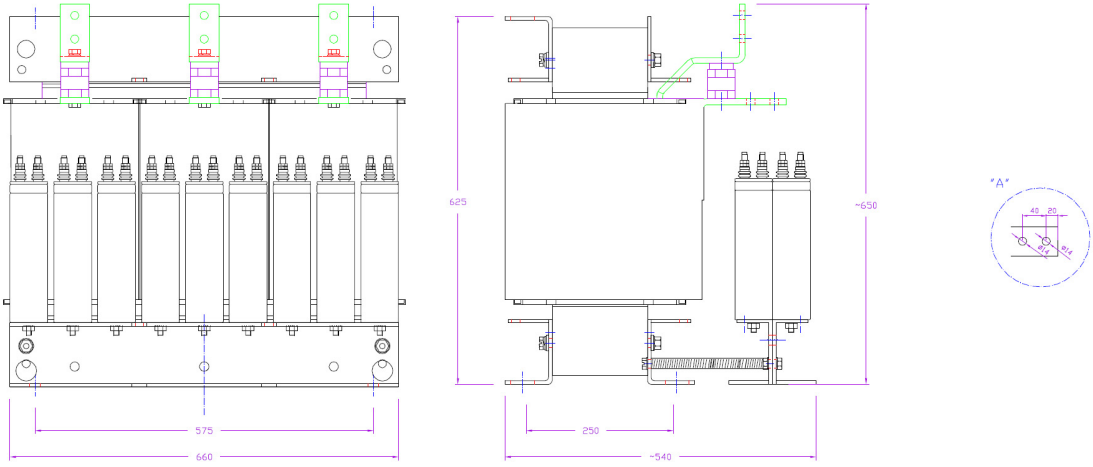

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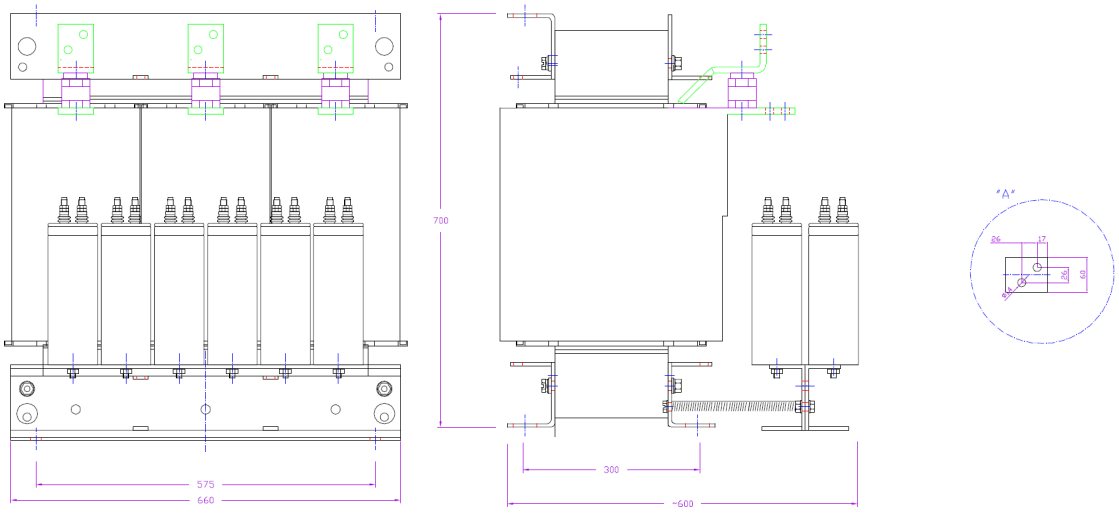

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