VACON

CX/CXL/CXS

FREQUENCY CONVERTERS

Filter Manual

RFI-filters

Du/dt-filters

Sinus filters

Subject to changes without notice.

FOR SMOOTH CONTROL

vacon

Table of contents

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 Vacon_SIN_B filters
The Vacon_RFI_A0 filters are intended for use in earthed supplies only For unearthed (IT) supplies, contact our representative or us.

1 General

Modern frequency converters do not supply a smoothly changing AC voltage , but a pulsed DC voltage to the motor. The pulses have very steep flanks, the du/dt may reach several kV/µs. These steep pulses may be dangerous to the insulation of the motor. The pulses may also cause various disturbing currents in galvanically connected cables as well as radiated interference. The radiated interference is usually grounded by the metallic enclosure of the converter 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 converter may also have to be protected against various overvoltages occurring in the supply.

Both input and output filters are available for the Vacon CX_ range of drives. These filters help compliance with the EMC regulations. On the input side RFI filters and additional chokes can be mounted, on the output side du/dt filters or sinus filters. No other filters are necessary. The basic connection is shown in Figure 1-1

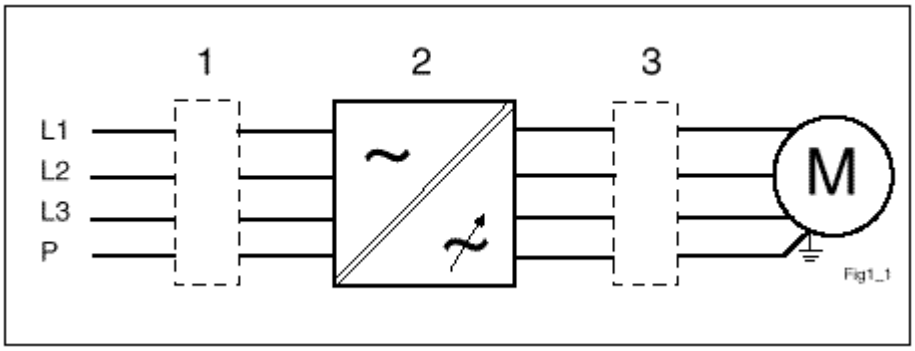


Figure 1-1. The basic filtering principle of the Vacon CX_ filters. 1 = input filters, 2 = frequency converter, 3 = output filter.

Type designation

VACON 250 RFI 4 A 0 AA

- 250 = Maximum current [A]
- RFI = filter type
  - RFI = radio frequency filter
  - DUT = du/dt-filter
  - SIN = sinusoidal filter
  - CHK = output choke
- 4 = nominal voltage:
  - 2 = 200 V
  - 4 = 400 V
  - 5 = 500 V
  - 6 = 690 V
- A = Filter type:
  - A = input filter
  - B = Output filter
  - C = Both
- 0 = Enclosure class
  - 0 = IP00
  - 2 = IP20
- AA = Special

2. Filter types

2.1 RFI-filters

The table below shows the filters used in order to make the Vacon CX___N range of frequency converters comply with EN50082-2 for the industrial environment and with EN61800-3 for the domestic and industrial environment. The filters must be correctly installed and grounded.

There are no standards at present for IT-supplies (floating supplies)

The Vacon CX__ frequency converters comply with the immunity requirements of EN50081 and EN 61800-3 as standard.

Note that the filters 16 – 100 RFI5C2 are designed to fit mechanically directly to the corresponding drive. All others are loose and must be connected to the drive separately.

3 x 500, 400 V, 50/60 Hz T 40/F, IP00		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
		mm	mm	mm	mm	mm	mm	kg	mm2	
16	Vacon 16 RFI 5C2	241	120	130		95	7		6	15
43	Vacon 43 RFI 5C2	267	165	157		127	9		16	45
100	Vacon 100 RFI 5C2	370	253	220		180	9		50/70	70
210	Vacon 210 RFI 5A0	740	180	132	100	720	8		150	100
400	Vacon 400 RFI 5A0	564	300	160	210	275	12	18,5	M12	65
600	Vacon 600 RFI 5A0	564	300	160	210	275	12	20,5	M12	87
900	Vacon 900 RFI 5A0	564	300	160	210	275	12	20,5	M12	104
1200	Vacon 1200 RFI 5A0	564	300	160	210	275	12	20,5	M12	146

3 x 690 V, 50/60 Hz T 40/F, IP00		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
		mm	mm	mm	mm	mm	mm	kg	mm2	
42	Vacon 42 RFI 6A0	329	80	185	314	55	6	2,8	AWG8	
100	Vacon 100 RFI 6A0	379	90	220	364	65	6,5	5,8	50	
185	Vacon 185 RFI 6A0	438	110	240	413	80	6,5	11,5	95	
300	Vacon 300 RFI 6A0	564	300	160	210	275	12	17	M8	48
400	Vacon 400 RFI 6A0	564	300	160	210	275	12	19,5	M10	65
500	Vacon 500 RFI 6A0	564	300	160	210	275	12	19,5	M10	75
900	Vacon 900 RFI 6A0	564	300	160	210	275	12	19,5	M12	104

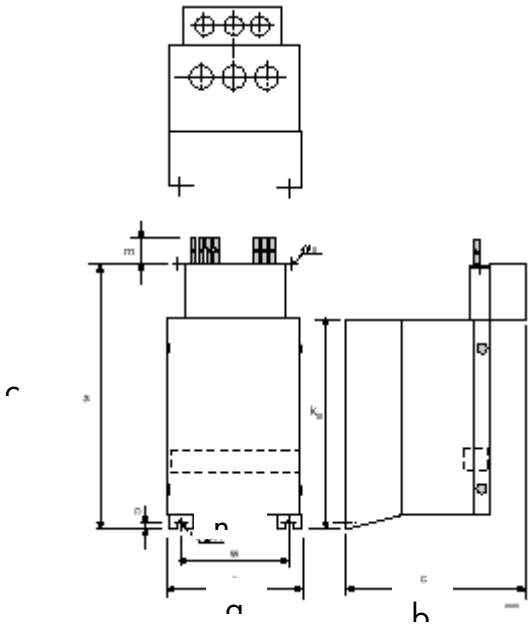


Figure 2 –1 Filters Vacon 16 – 100 RFI 5C2

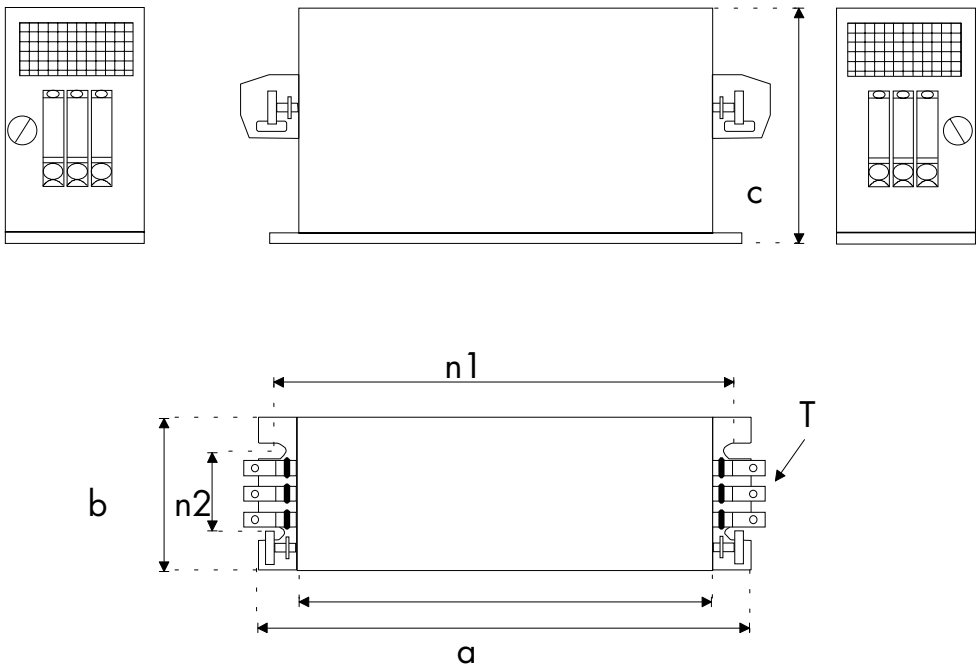


Figure 2 –2 Filters Vacon Vacon xxx RFI 6A0 and 5A0

2.2 dU/dt filters

2.2.1 dU/dt – maker Platthaus

The Vacon CX- ranges use IGBT transistors as the output element. These semiconductors give the correct voltage to the motor, switching it at a very high speed, 2 - 4 kV/µs. 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.

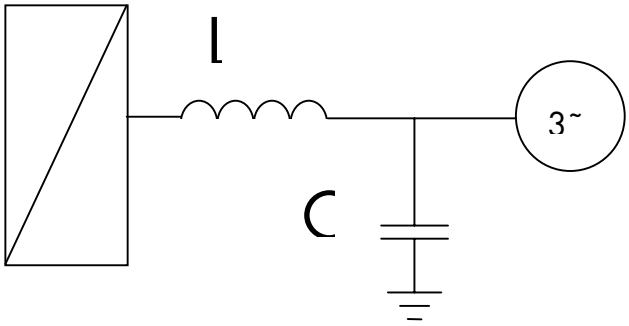
In 690 V supplies the motor has to stand at least 1800 V. A dU/dt filter is required in these cases.

! 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.
All filters are IP00

The filters are LC filters, with a cut-off frequency of about 500 kHz. The exact value changes due to component tolerances and available standard values.

NOTE! Set the switching frequency parameter to correspond the value printed on nameplate of the filter.



3 x 230, 400, 500 V, 50/60 Hz fs = 3,6 kHz, T 40/F, IP00, VBG4		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
		mm	mm	mm	mm	mm	mm	kg	mm2	W
8	VACON 8 DUT 5 B 0	100	110	180	60	48	4	1,2	4	
15	VACON 15 DUT 5 B 0	125	110	200	100	55	5	3	6	
42	VACON 42 DUT 5 B 0	155	125	225	130	72	8	7	16	
96	VACON 96 DUT 5 B 0	190	135	260	170	78	8	12	35	
160	VACON 160 DUT 5 B 0	240	175	310	190	106	11	22	95	
220	VACON 220 DUT 5 B 0	240	195	310	190	126	11	30	95	
325	VACON 325 DUT 5 B 0	320	225	410	240	134	11	46	240	
410	VACON 410 DUT 5 B 0	400	320	530	310	126	11	65	2 x M12	
510	VACON 510 DUT 5 B 0	400	350	530	310	156	11	95	2 x M12	
600	VACON 600 DUT 5 B 0	420	340	560	370	167	11	130	2 x M12	
750	VACON 750 DUT 5 B 0	480	390	800	430	185	11	200	2 x M12	
840	VACON 840 DUT 4 B 0	480	420	800	430	210	11	230	2 x M12	

3 x 690 V, 50/60 Hz fs = 1,5 kHz, T 40/F, IP00, VBG4		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
		mm	mm	mm	mm	mm	mm	kg	mm2	
14	VACON 14 DUT 6 B 0	120	110	170	60	48	4	1,3	10	15
23	VACON 23 DUT 6 B 0	125	110	190	100	55	5	3	10	45
35	VACON 35 DUT 6 B 0	155	110	220	130	57	8	4,5	16	70
62	VACON 62 DUT 6 B 0	190	110	255	170	58	8	9	35	100
100	VACON 100 DUT 6 B 0	190	135	255	170	78	8	12	35	120
145	VACON 145 DUT 6 B 0	240	160	310	190	100	11	20	70	180
222	VACON 222 DUT 6 B 0	240	200	310	190	126	11	30	95	210
287	VACON 287 DUT 6 B 0	300	230	400	240	134	11	46	150	350
325	VACON 325 DUT 6 B 0	360	220	450	310	126	11	65	240	480
390	VACON 390 DUT 6 B 0	360	240	450	310	141	11	75	240	

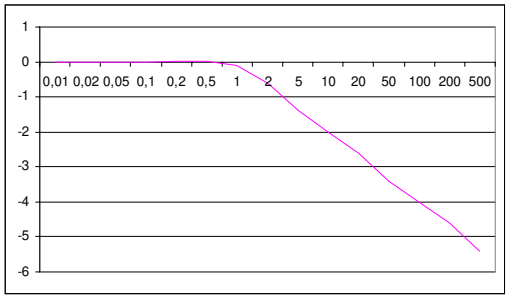


Figure 2-3 Typical relative attenuation for dU/dt and sinusoidal filters. Corner frequency about 500 kHz for dU/dt filters, about half default switching frequency for sinusoidal filters.

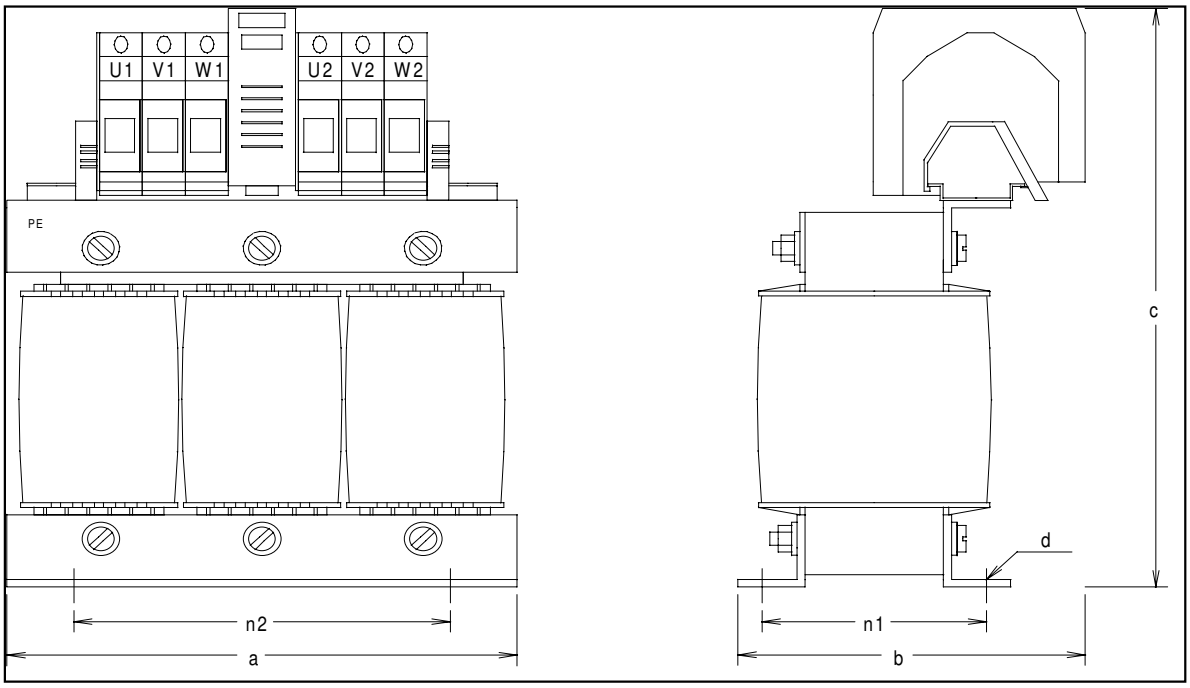
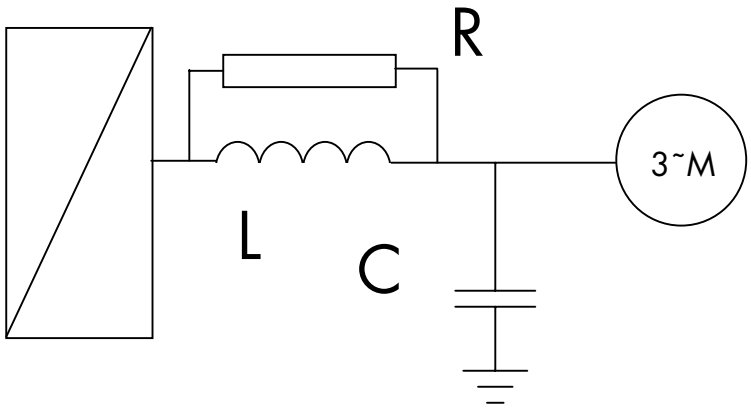


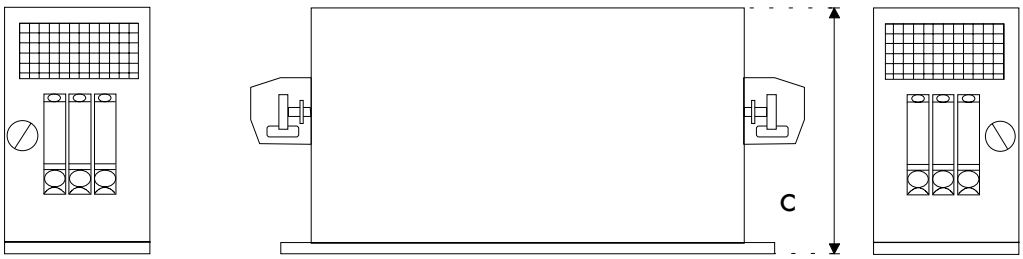
Figure 2-4. Main dimensions for dU/dt filters ≤ 410 A/400V, ≤400A/500V and ≤360A/690V

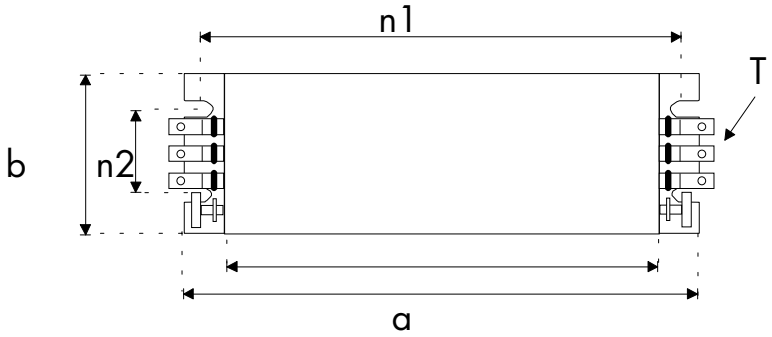
2.2.2 dU/dt filter with resistance

The SH filter differs from the standard in that they contain a resistance to reduce the 'ringing' created by the interaction of the choke and the stray inductance of the motor. Functionally they are equivalent.



3 x 400 - 690 V , 50/60 Hz fswitching = 16 kHz max., T 40/F, IP00 max. output f=60 Hz max. motor cable length=100 m		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Power loss at IVT/3.6 kHz	Terminals mm2	Weight [kg]
18	Vacon 18DUT 6B0 SH	260	82	160	240	60	M4			4,8
42	Vacon 42DUT 6B0 SH	350	110	190	330	70	M6			9
60	Vacon 60DUT 6B0 SH	470	140	235	440	100	M8		50	15
110	Vacon 110DUT 6B0 SH	470	140	235	440	100	M8		50	22
210	Vacon 210DUT 6B0 SH	564	300	160	420 (2 x 210)	275	M9		M8	32
410	Vacon 410DUT 6B0 SH	680	300	180	424 (2 x 212	275	M9	65	M10	60
600	Vacon 600DUT 6B0 SH	850	300	160	630 (3 x 210)	275	M9	87	M10	80


c


n1
T
b
n2
a

2.3 Sine-filters

If you wish to avoid all extra voltage stresses on the motor at all voltages, sine-filters can be used. They remove all high frequency components from the motor voltage. The voltage stresses on the motor correspond to those existing in normal DOL use on a source of the same voltage.

Note! Check that the set switching frequency corresponds the value printed on nameplate of the filter.

3 x 690 V, 50/60 Hz fs = 1,5 kHz, T 40/F, IP00, VBG4		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
A		mm	mm	mm	mm	mm	mm	kg	mm2	
10	VACON 10 SIN 6 B 0	160	190	155	130	72	8	7	10	85
14	VACON 14 SIN 6 B 0	190	190	185	170	68	8	12	10	110
19	VACON 19 SIN 6 B 0	210	220	210	180	82	8	16	10	140
23	VACON 23 SIN 6 B 0	240	220	240	190	96	11	20	10	170
26	VACON 26 SIN 6 B 0	240	225	240	190	100	11	22	10	180
35	VACON 35 SIN 6 B 0	240	240	280	190	121	11	28	16	210
42	VACON 42 SIN 6 B 0	300	250	350	240	121	11	33	36	290
52	VACON 52 SIN 6 B 0	300	250	350	240	121	11	35	36	290
62	VACON 62 SIN 6 B 0	300	270	350	240	134	11	38	36	350
85	VACON 85 SIN 6 B 0	360	270	400	310	141	11	45	50	480
100	VACON 100 SIN 6 B 0	360	380	400	310	156	11	63	70	600
122	VACON 122 SIN 6 B 0	360	400	400	310	156	11	63	70	600
145	VACON 145 SIN 6 B 0	420	400	470	370	152	11	70	95	680
185	VACON 185 SIN 6 B 0	420	430	490	370	182	11	85	150	750
222	VACON 222 SIN 6 B 0	480	430	540	430	210	11	150	150	900
287	VACON 287 SIN 6 B 0	480	460	560	430	240	11	170	240	950
360	VACON 360 SIN 6 B 0	480	460	560	430	240	11	170	240	950
430	VACON 430 SIN 6 B 0	480	520	560	430	240	11	180	240	

3 x 500 V, 50/60 Hz fs = 3,6 kHz, T 40/F, IP00, VBG4		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
		mm	mm	mm	mm	mm	mm	kg	mm2	
4,7	VACON 4,7 SIN 5 B 0	100	110	170	60	48	4	1,2	2,5	40
10	VACON 10 SIN 5 B 0	125	110	190	100	45	5	2,2	4	70
18	VACON 18 SIN 5 B 0	190	140	190	170	68	8	11	10	110
32	VACON 32 SIN 5 B 0	210	150	210	180	82	8	14	10	140
60	VACON 60 SIN 5 B 0	240	195	295	190	121	11	26	35	210
90	VACON 90 SIN 5 B 0	300	230	360	240	146	11	55	70	400
150	VACON 150 SIN 5 B 0	360	250	420	310	141	11	75	95	540
210	VACON 210 SIN 5 B 0	360	270	440	310	156	11	85	150	600
260	VACON 325 SIN 5 B 0*)	420	285	500	370	182	11	120	150	750
320	VACON 320 SIN 5 B 0	480	350	560	430	240	11	250	240	950
400	VACON 400 SIN 5 B 0	480	350	560	430	240	11	250	240	950
460	VACON 460 SIN 5 B 0	480	460	560	430	242	11	280	M 12	
600	VACON 600 SIN 5 B 0	920	470	850	840	238	18	450	M 12	
672	VACON 750 SIN 5 B 0	920	500	850	840	268	18	540	M 12	

*) NOTE: The same filter as 325 A/400 V, can be used only to 260 A/500 V.

3 x 230, 400 V, 50/60 Hz fs = 3,6 kHz, T 40/F, IP00, VBG4		Fastening dimensions								
Motor current A	Type	a	b	c	n2	n1	d	Weight	Terminals	Power loss at IVT/3.6 kHz
4,5	VACON 4,7 SIN 5 B 0	125	110	180	100	45	5	2,2	4	40
10	VACON 10 SIN 5 B 0	155	110	210	130	57	8	4,7	4	70
18	VACON 18 SIN 5 B 0	190	140	190	170	68	8	11	10	110
32	VACON 32 SIN 5 B 0	210	150	210	180	82	8	14	10	140
60	VACON 60 SIN 5 B 0	240	195	295	190	121	11	26	35	210
90	VACON 90 SIN 5 B 0	300	230	360	240	146	11	55	70	400
150	VACON 150 SIN 5 B 0	360	250	420	310	141	11	75	95	540
210	VACON 210 SIN 5 B 0	420	285	500	370	182	11	120	150	750
325	VACON 325 SIN 5 B 0	420	315	510	370	212	11	150	240	800
410	VACON 410 SIN 4 B 0	480	350	560	430	240	11	250	240	950
510	VACON 510 SIN 4 B 0	480	460	620	430	242	11	270	M 12	
580	VACON 600 SIN 5 B 0	920	470	850	840	238	18	450	M 12	
750	VACON 750 SIN 5 B 0	920	500	850	840	268	18	540	M 12	
840	VACON 840 SIN 5 B 0	920	500	850	840	268	18	540	M 12	

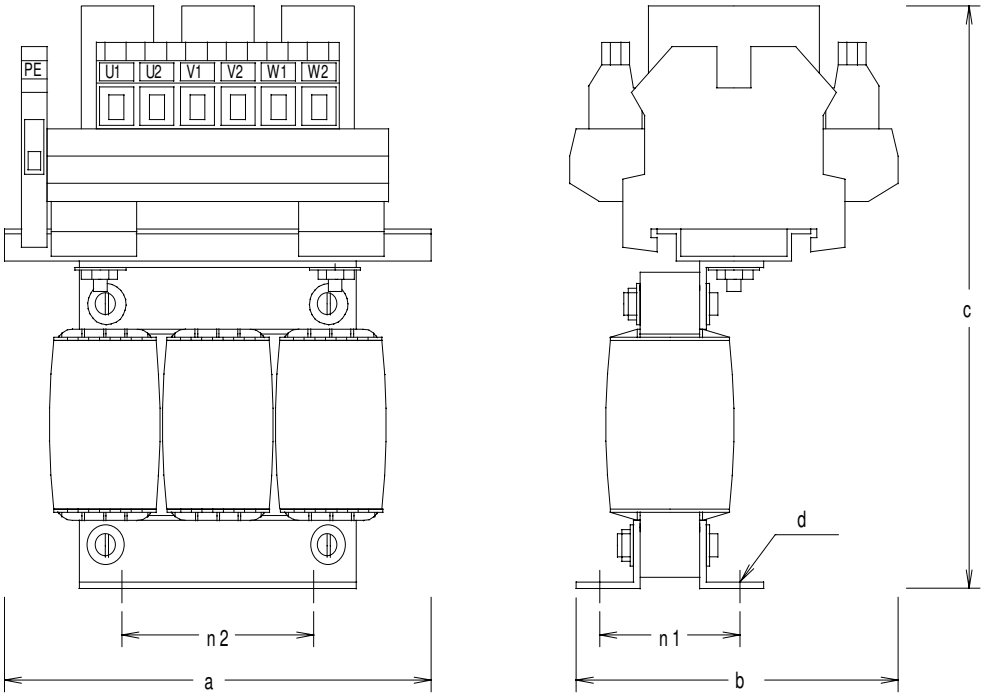


Figure 2-6. Filters <13A/400 V, <11 A/500 V and 10 A/690 V

1)I_{VT}/3,6kHz
2) See Figures 2-6 and 2-7.

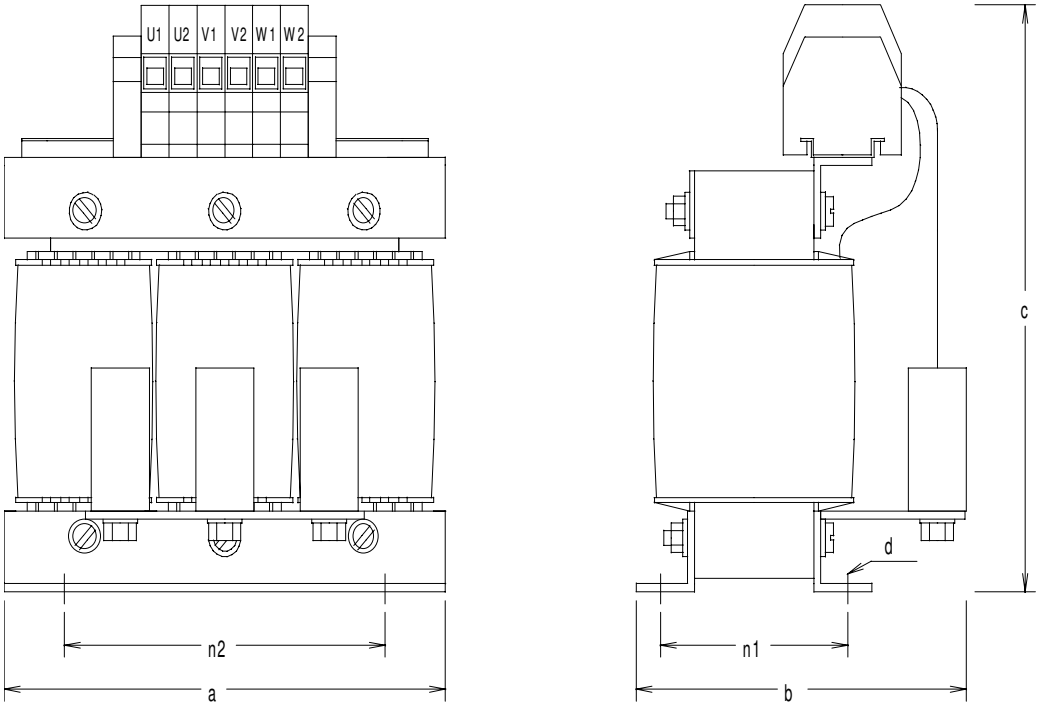


Figure 2-7 Main dimensions for sine filters ≥ 18 A/400V, ≥ 15 A/500 V and ≥ 14 A/690 V

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