

REACTORS

HARMONIC FILTER REACTORS

Non-linear components and loads in a power system generate 'Harmonics'. These elements are characterized by a voltage drop which is not proportional to the current flow. There are a lot of such non-linear loads exist, in components and devices such as;

- Uninterruptible power supplies (UPS),
- Motor starters and variable frequency drives,
- Electronic drive systems
- Computer, TV sets
- Fluorescent lighting
- Welding machines,
- Rectifiers

Harmonic currents may have an adverse effect on different electrical components. These include transformers, switches, capacitors, fuses and relays. The detrimental effects are increased losses and heating and/or excessive dielectric stresses. Electric utilities very often impose high charges when certain maximum levels of harmonic distortion are exceeded.

DISTURBANCES CAUSED BY HARMONIC DETERIORATIONS

- Quality of electrical power is downgraded that can disturb sensitive loads,
- Increasing in rms current that cause overload in distribution networks,
- Increasing in voltage value
- Vibration and overload on devices and equipments that cause premature ageing,
- Power loss and failures in capacitors
- Failures in computers and electronic devices
- Overheat on cables and devices,
- Quality of the signal transmission in communication networks and on telephone lines is downgraded
- Mono phase loads cause cumulative increasing in third-order harmonics and it causes overloads in neutral conductors

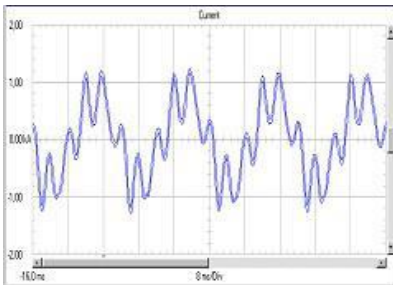
Harmonic currents must be eliminated by filter systems, consisting of reactors and capacitors. The filtering system must be installed close to the source of harmonics so as to provide a low impedance path for the harmonic currents. This is achieved by series connection of a filter reactor with a capacitor bank, forming a filter circuit tuned to the harmonic frequency which needs to be eliminated.



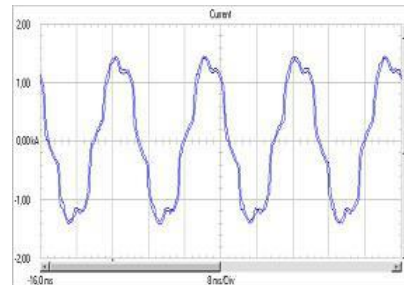
REACTORS

HARMONIC FILTER REACTORS

Harmonic currents of a compensation system - without harmonic filter



Harmonic currents of a compensation system - with harmonic filter



Choosing correct filters for the capacitors in a compensation system is crucial because choosing incorrect filter for the capacitor may shift the resonance frequency of the system and it decreases the efficiency of the compensation system.

Output voltage value of a harmonic filter is higher than its input value. Capacitor's voltage value must be chosen according to the filter's output voltage; otherwise the capacitor will be damaged due to the higher output voltage of the filter and keep in mind that in the industrial fields the mains voltage is higher during night.

Designing most effective detuned filter reactor for the compensation system the following information must be given;

1. Utility voltage value
2. Resonance frequency value (134, 189, 210 Hz, or specify)
3. Power and voltage values of the capacitors

ROUTINE TESTS

Following 1... 5 tests are the routine tests that are performed for each filter during the manufacturing process and the other tests (6,7 and 8) are performed upon request.

1. Inductance test
2. Current test
3. Resistance Test
4. Impulse voltage withstand test
5. One minute Insulation voltage withstand test (AC)
6. Short circuit withstand test
7. Temperature rise Test
8. Sound level test

REACTORS

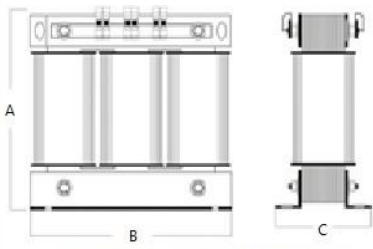
HARMONIC FILTER REACTORS

TECHNICAL SPECIFICATIONS

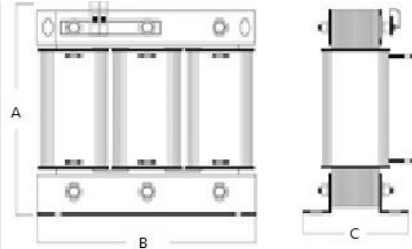
STANDARDS	EN 61558-1, EN 61558 2-20, EN 60289, EN 60076-6, CE conformity
DESIGN	Air gapped design
NOMINAL POWER	Single phase 0,10 - 10 kVAr, Three phase 0,5 - 100 kVAr
NOMINAL INPUT VOLTAGE	230 VAC 1000 VAC
NOMINAL FREQUENCY	50 Hz (60 Hz optional)
RESONANCE FREQUENCIES	134 Hz p= %14 189 Hz p= % 7 210 Hz p=%5,67
TOLERANCE OF INDUCTANCE	± % 3
LINEARITY RANGE	from 1,6 In to 2,2 In
MAGNETIC CIRCUIT	0,35 mm- high grade iron core
WINDINGS	Electrolytic copper or aluminum wire - foil
CONNECTIONS	Transformer terminal blocks, rail terminals, copper cable lugs, copper bar
PROTECTION (electricity)	Thermistor 90 °C 1 NK contact
PROTECTION CLASS	IP 00
INSULATION TEST VOLTAGE	3000 VAC (Windings-metal core)
INSULATION CLASS	1. class, upon request; F 155 °C or H 180 °C
THERMAL CLASS	Ta 55 °C / F or Ta 60 °C / H
IMPREGNATION	Upon request F or H class varnish vacuum impregnation
COOLING	Natural
HUMIDITY	%95 non-condensing (DIN 40040)
OPERATING ALTITUDE	0 - 2000 m
AMBIENT TEMPERATURE	- 10 °C + 40 °C
STORING TEMPERATURE	- 10 °C + 70 °C
SPECIAL DESIGN	Special design is possible upon request.

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HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B

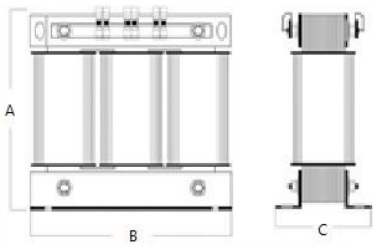


189 Hz $p=7\%$ THREE PHASE DETUNED FILTER REACTOR DIMENSIONS

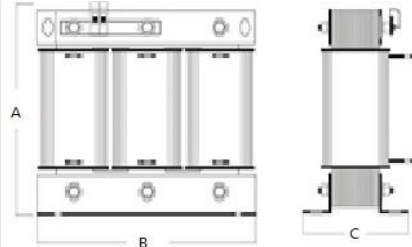
RODUCT CODE	Qc (kVar)	Ln (mH)	In (A)	Ith (A)	Ilin (A)	A (mm)	B (mm)	C (mm)	Weight(kg)
GVN HF T 7 1	1,00	38,35	1,53	1,68	2,75	145	150	64	2,30
GVN HF T 7 2,5	2,50	15,34	3,83	4,21	6,89	145	150	70	3,10
GVN HF T 7 4	4,00	9,59	6,12	6,73	11,02	168	180	74	6,70
GVN HF T 7 5	5,00	7,67	7,65	8,42	13,77	168	180	79	7,60
GVN HF T 7 6,25	6,25	6,14	9,56	10,52	17,21	168	180	84	8,70
GVN HF T 7 7,5	7,50	5,11	11,48	12,62	20,66	168	180	94	10,90
GVN HF T 7 10	10,00	3,83	15,30	16,83	27,54	210	240	100	12,50
GVN HF T 7 12,5	12,50	3,07	19,13	21,04	34,43	210	240	100	14,90
GVN HF T 7 15	15,00	2,56	22,95	25,25	41,31	210	240	100	16,40
GVN HF T 7 20	20,00	1,92	30,60	33,66	55,08	210	240	110	20,50
GVN HF T 7 25	25,00	1,53	38,25	42,08	68,85	210	240	120	24,20
GVN HF T 7 30	30,00	1,28	45,90	50,49	82,62	260	300	126	30,30
GVN HF T 7 40	40,00	0,96	61,20	67,32	110,16	260	300	136	32,00
GVN HF T 7 50	50,00	0,77	76,50	84,15	137,70	260	300	146	38,4
GVN HF T 7 60	60,00	0,64	91,80	100,98	165,24	260	300	156	49
GVN HF T 7 70	70,00	0,55	107,10	117,81	192,78	310	360	156	55,2
GVN HF T 7 80	80,00	0,48	122,40	134,64	220,32	310	360	166	57,6
GVN HF T 7 90	90,00	0,43	137,70	151,47	247,86	310	360	166	59,2
GVN HF T 7 100	100,00	0,38	153,00	168,30	275,40	310	360	176	63,2

REACTORS

HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B



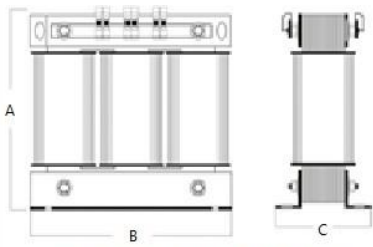
Fr : 189 Hz p= %7 HARMONIC FILTER – CAPACITOR SELECTION TABLE (Un= 400 VAC Fn = 50 Hz)

CAPACITOR POWER Qcn (kVAr)	440 VAC CAPACITOR HARMONIC FILTER		480 VAC CAPACITOR HARMONIC FILTER		525 VAC CAPACITOR HARMONIC FILTER	
	Qc (kVAr)	Ln (mH)	Qc (kVAr)	Ln (mH)	Qc (kVAr)	Ln (mH)
0,5	0,44	86,30	0,37	102,87	0,31	122,87
1	0,89	43,15	0,75	51,43	0,624	61,43
1,5	1,33	28,77	1,12	34,29	0,94	40,96
2,5	2,22	17,26	1,87	20,57	1,56	24,57
5	4,44	8,63	3,73	10,29	3,12	12,29
7,5	6,66	5,75	5,60	6,86	4,68	8,19
10	8,89	4,32	7,47	5,14	6,24	6,14
12,5	11,11	3,45	9,33	4,11	7,80	4,91
15	13,33	2,88	11,20	3,43	9,36	4,10
20	17,77	2,16	14,93	2,57	12,48	3,07
25	22,22	1,73	18,67	2,06	15,61	2,46
30	26,66	1,44	22,40	1,71	18,73	2,05
40 (2x20)	35,54	1,08	29,87	1,29	24,97	1,54
50 (2x25)	44,43	0,86	37,34	1,03	31,21	1,23
60 (2x30)	53,32	0,72	44,80	0,86	37,45	1,02
75 (3x25)	66,65	0,58	56,00	0,69	46,82	0,82
80 (4x20)	71,09	0,54	59,74	0,64	49,94	0,77
90 (3x30)	79,97	0,48	67,20	0,57	56,18	0,68
100 (5x25)	88,86	0,43	74,67	0,51	62,42	0,61

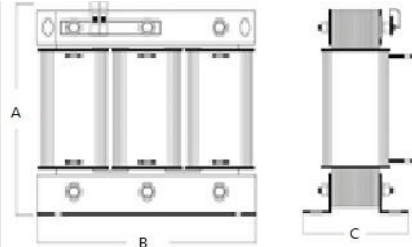
Detuned filter reactor power values are crucial for % 100 compensation performance, in order to avoid performance loss please use proper filter with the capacitor.

REACTORS

HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B

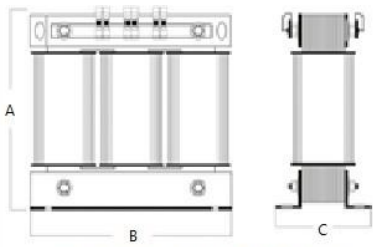


210 Hz $p=5,67$ THREE PHASE DETUNED FILTER REACTOR DIMENSIONS

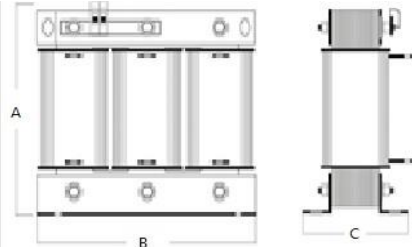
PRODUCT CODE	Qc (kVar)	Ln (mH)	In (A)	Ith (A)	Ilin (A)	A (mm)	B (mm)	C (mm)	Weight (kg)
GVN HF T 5,67 1	1,00	30,62	1,53	1,68	2,75	145	150	64	2,20
GVN HF T 5,67 2,5	2,50	12,25	3,83	4,21	6,89	145	150	70	3,10
GVN HF T 5,67 4	4,00	7,66	6,12	6,73	11,02	168	180	74	6,40
GVN HF T 5,67 5	5,00	6,12	7,65	8,42	13,77	168	180	79	7,20
GVN HF T 5,67 6,25	6,25	4,90	9,56	10,52	17,21	168	180	84	8,30
GVN HF T 5,67 7,5	7,50	4,08	11,48	12,62	20,66	168	180	94	10,40
GVN HF T 5,67 10	10,00	3,06	15,30	16,83	27,54	210	240	100	12,10
GVN HF T 5,67 12,5	12,50	2,45	19,13	21,04	34,43	210	240	100	13,50
GVN HF T 5,67 15	15,00	2,04	22,95	25,25	41,31	210	240	100	14,30
GVN HF T 5,67 20	20,00	1,53	30,60	33,66	55,08	210	240	110	17,50
GVN HF T 5,67 25	25,00	1,22	38,25	42,08	68,85	210	240	120	23,30
GVN HF T 5,67 30	30,00	1,02	45,90	50,49	82,62	260	300	126	27,50
GVN HF T 5,67 40	40,00	0,77	61,20	67,32	110,16	260	300	136	30,20
GVN HF T 5,67 50	50,00	0,61	76,50	84,15	137,70	260	300	146	36,5
GVN HF T 5,67 60	60,00	0,51	91,80	100,98	165,24	260	300	156	43,5
GVN HF T 5,67 70	70,00	0,44	107,10	117,81	192,78	310	360	156	52,2
GVN HF T 5,67 80	80,00	0,38	122,40	134,64	220,32	310	360	166	53,5
GVN HF T 5,67 90	90,00	0,34	137,70	151,47	247,86	310	360	166	54,8
GVN HF T 5,67 100	100,00	0,31	153,00	168,30	275,40	310	360	176	60,6

REACTORS

HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B



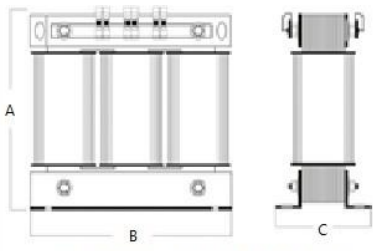
Fr : 210 Hz P= %5,67 HARMONIC FILTER – CAPACITOR SELECTION TABLE (Un= 400 VAC Fn = 50 Hz)

CAPACITOR POWER	440 VAC CAPACITOR HARMONIC FILTER		480 VAC CAPACITOR HARMONIC FILTER		525 VAC CAPACITOR HARMONIC FILTER	
	Qcn (kVAr)	Qc (kVAr)	Ln (mH)	Qc (kVAr)	Ln (mH)	Qc (kVAr)
0,5	0,44	69,90	0,37	83,19	0,31	99,52
1	0,88	34,95	0,74	41,60	0,62	49,76
1,5	1,31	23,30	1,10	27,73	0,92	33,17
2,5	2,19	13,98	1,84	16,64	1,54	19,90
5	4,38	6,99	3,68	8,32	3,08	9,95
7,5	6,57	4,66	5,52	5,55	4,62	6,63
10	8,76	3,50	7,36	4,16	6,15	4,98
12,5	10,95	2,80	9,20	3,33	7,69	3,98
15	13,14	2,33	11,04	2,77	9,23	3,32
20	17,52	1,75	14,72	2,08	12,31	2,49
25	21,90	1,40	18,41	1,66	15,39	1,99
30	26,28	1,17	22,09	1,39	18,46	1,66
40 (2x20)	35,04	0,87	29,45	1,04	24,62	1,24
50 (2x25)	43,81	0,70	36,81	0,83	30,77	1,00
60 (2x30)	52,57	0,58	44,17	0,69	36,92	0,83
75 (3x25)	65,71	0,47	55,22	0,55	46,16	0,66
80 (4x20)	70,09	0,44	58,90	0,52	49,23	0,62
90 (3x30)	78,85	0,39	66,26	0,46	55,39	0,55
100 (5x25)	87,61	0,35	73,62	0,42	61,54	0,50

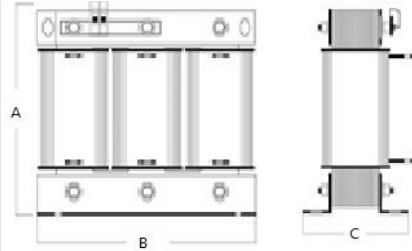
Detuned filter reactor power values are crucial for % 100 compensation performance, in order to avoid performance loss please use proper filter with the capacitor.

REACTORS

HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B



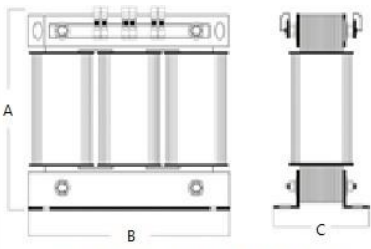
134 Hz $p=14\%$ THREE PHASE DETUNED FILTER REACTOR DIMENSIONS

PRODUCT CODE	Qc (kVar)	Ln (mH)	In (A)	Ith (A)	Ilin (A)	A (mm)	B (mm)	C (mm)	Weight (kg)
GVN HF T 14 1	1,00	82,49	1,53	1,68	2,75	145	150	64	3,90
GVN HF T 14 2,5	2,50	33,00	3,83	4,21	6,89	145	150	75	6,80
GVN HF T 14 4	4,00	20,62	6,12	6,73	11,02	168	180	79	8,50
GVN HF T 14 5	5,00	16,50	7,65	8,42	13,77	168	180	84	13,00
GVN HF T 14 6,25	6,25	13,20	9,56	10,52	17,21	168	180	94	14,70
GVN HF T 14 7,5	7,50	11,00	11,48	12,62	20,66	210	210	100	16,20
GVN HF T 14 10	10,00	8,25	15,30	16,83	27,54	210	240	100	19,10
GVN HF T 14 12,5	12,50	6,60	19,13	21,04	34,43	210	240	110	21,50
GVN HF T 14 15	15,00	5,50	22,95	25,25	41,31	210	240	110	23,30
GVN HF T 14 20	20,00	4,12	30,60	33,66	55,08	210	240	120	33,50
GVN HF T 14 25	25,00	3,30	38,25	42,08	68,85	260	300	126	38,00
GVN HF T 14 30	30,00	2,75	45,90	50,49	82,62	260	300	136	43,20
GVN HF T 14 40	40,00	2,06	61,20	67,32	110,16	260	300	146	59,20
GVN HF T 14 50	50,00	1,65	76,50	84,15	137,70	260	300	156	67,5
GVN HF T 14 60	60,00	1,37	91,80	100,98	165,24	310	360	156	72,3
GVN HF T 14 70	70,00	1,18	107,10	117,81	192,78	310	360	166	89,4
GVN HF T 14 80	80,00	1,03	122,40	134,64	220,32	310	360	176	98,8
GVN HF T 14 90	90,00	0,92	137,70	151,47	247,86	310	360	176	105,8
GVN HF T 14 100	100,00	0,82	153,00	168,30	275,40	410	480	208	126,9

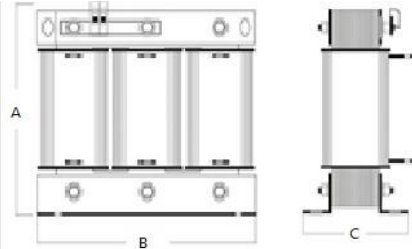
Detuned filter reactor power values are crucial for % 100 compensation performance, in order to avoid performance loss please use proper filter with the capacitor.

REACTORS

HARMONIC FILTER REACTORS



THREE PHASE HARMONIC FILTER TYPE A



THREE PHASE HARMONIC FILTER TYPE B



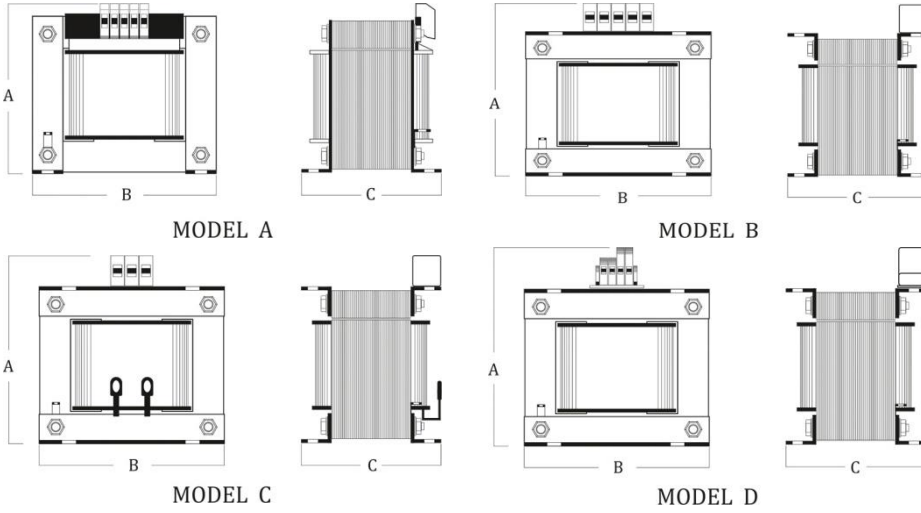
Fr : 134 Hz P= %14 HARMONIC FILTER – CAPACITOR SELECTION TABLE (Un= 400 VAC Fn = 50 Hz)

CAPACITOR POWER	440 VAC CAPACITOR HARMONIC FILTER		480 VAC CAPACITOR HARMONIC FILTER		525 VAC CAPACITOR HARMONIC FILTER	
	Qcn (kVAr)	Qc (kVAr) Ln (mH)	Qc (kVAr)	Ln (mH)	Qc (kVAr)	Ln (mH)
0,5	CAN NOT BE USED	0,40	204,32	0,34	244,43	
1	CAN NOT BE USED	0,81	102,16	0,68	122,21	
1,5	CAN NOT BE USED	1,21	68,11	1,01	81,48	
2,5	CAN NOT BE USED	2,02	40,86	1,69	48,89	
5	CAN NOT BE USED	4,04	20,43	3,38	24,44	
7,5	CAN NOT BE USED	6,06	13,62	5,06	16,30	
10	CAN NOT BE USED	8,08	10,22	6,75	12,22	
12,5	CAN NOT BE USED	10,09	8,17	8,44	9,78	
15	CAN NOT BE USED	12,11	6,81	10,13	8,15	
20	CAN NOT BE USED	16,15	5,11	13,50	6,11	
25	CAN NOT BE USED	20,19	4,09	16,88	4,89	
30	CAN NOT BE USED	24,23	3,41	20,25	4,07	
40 (2x20)	CAN NOT BE USED	32,30	2,55	27,00	3,06	
50 (2x25)	CAN NOT BE USED	40,38	2,04	33,75	2,44	
60 (2x30)	CAN NOT BE USED	48,45	1,70	40,50	2,04	
75 (3x25)	CAN NOT BE USED	60,56	1,36	50,63	1,63	
80 (4x20)	CAN NOT BE USED	64,60	1,28	54,00	1,53	
90 (3x30)	CAN NOT BE USED	72,68	1,14	60,75	1,36	
100 (5x25)	CAN NOT BE USED	80,75	1,02	67,50	1,22	

Detuned filter reactor power values are crucial for % 100 compensation performance, in order to avoid performance loss please use proper filter with the capacitor

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HARMONIC FILTER REACTORS

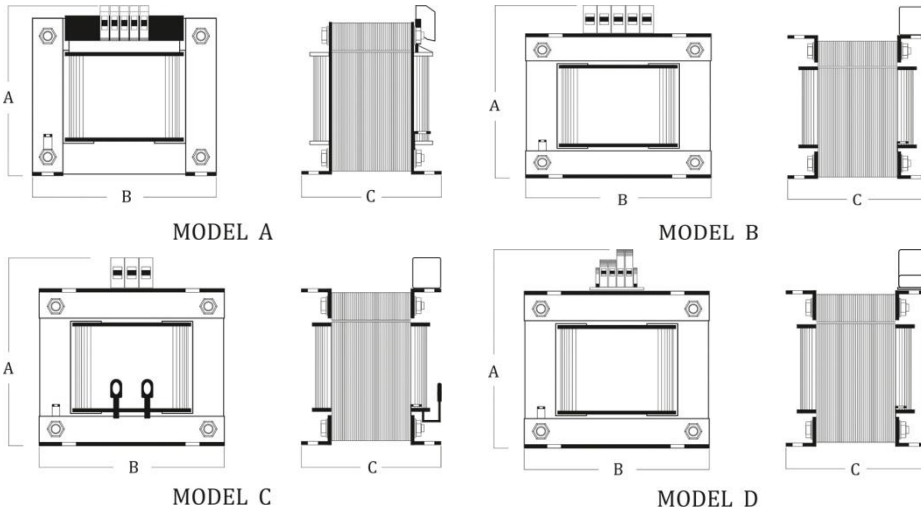


SINGLE PHASE DETUNED FILTER REACTOR DIMENSIONS fr : 189 Hz p=%7

PRODUCT CODE	Qc (kVAR)	Ln (mH)	In (A)	Ith (A)	Ilin (A)	A	B	C	Weight(kg)
GVN HF M 7 0,5	0,40	34,8	1,84	2,03	3,32	89	75	57	0,90
GVN HF M 7 0,55	0,55	25,3	2,53	2,79	4,56	89	75	66	1,20
GVN HF M 7 0,60	0,60	23,2	2,77	3,04	4,98	89	75	66	1,25
GVN HF M 7 0,8	0,80	17,4	3,69	4,06	6,64	87	85	64	1,30
GVN HF M 7 1	1,00	13,9	4,61	5,07	8,30	87	85	64	1,35
GVN HF M 7 1,5	1,50	9,28	6,91	7,60	12,44	87	85	78	1,85
GVN HF M 7 2	2,00	6,96	9,22	10,14	16,59	87	85	89	2,00
GVN HF M 7 2,5	2,50	5,57	11,52	12,67	20,74	88	95	82	2,50
GVN HF M 7 3	3,00	4,64	13,83	15,21	24,89	88	95	86	2,70
GVN HF M 7 4	4,00	3,48	18,43	20,28	33,18	109	110	100	3,85
GVN HF M 7 5	5,00	2,78	23,04	25,35	41,48	120	120	100	4,60
GVN HF M 7 7,5	7,50	1,85	34,57	38,02	62,22	145	150	120	8,00
GVN HF M 7 10	10,00	1,39	46,09	50,70	82,96	145	150	130	9,30

REACTORS

HARMONIC FILTER REACTORS



HARMONIC FILTER - CAPACITOR SELECTION TABLE ($U_n = 230 \text{ V AC}$ $F_n = 50 \text{ Hz}$)

Fr : 189 Hz p=%7

Fr : 134 Hz p=%14

CAPACITOR POWER	250 VAC CAPACITOR HARMONIC FILTER	400 VAC CAPACITOR HARMONIC FILTER	400 VAC CAPACITOR HARMONIC FILTER	400 VAC CAPACITOR HARMONIC FILTER
Qcn (kVAr)	Qc (kVAr)	Ln (mH)	Qc (kVAr)	Ln (mH)
0,25	0,23	0,09	CAN NOT BE USED	0,1
0,5	0,45	0,18	CAN NOT BE USED	0,19
0,8	0,73	0,29	CAN NOT BE USED	0,31
1	0,91	0,36	CAN NOT BE USED	0,38
1,5	1,36	0,54	CAN NOT BE USED	0,58
1,7	1,55	0,61	CAN NOT BE USED	0,65
2	1,82	0,71	CAN NOT BE USED	0,77
2,5	2,27	0,89	CAN NOT BE USED	0,96
3	2,73	1,07	CAN NOT BE USED	1,15
3,3	3	1,18	CAN NOT BE USED	1,27
4 (2x2)	3,64	1,43	CAN NOT BE USED	1,54
5	4,55	1,79	CAN NOT BE USED	1,92
6 (2x3)	5,45	2,14	CAN NOT BE USED	2,31
7,5 (3x2,5)	6,82	2,68	CAN NOT BE USED	2,88
8 (4x2)	7,27	2,86	CAN NOT BE USED	3,1
9 (3x3)	8,2	3,21	CAN NOT BE USED	3,46
10 (2x5)	9,1	3,57	CAN NOT BE USED	3,85
15 (3x5)	13,64	5,36	CAN NOT BE USED	5,77