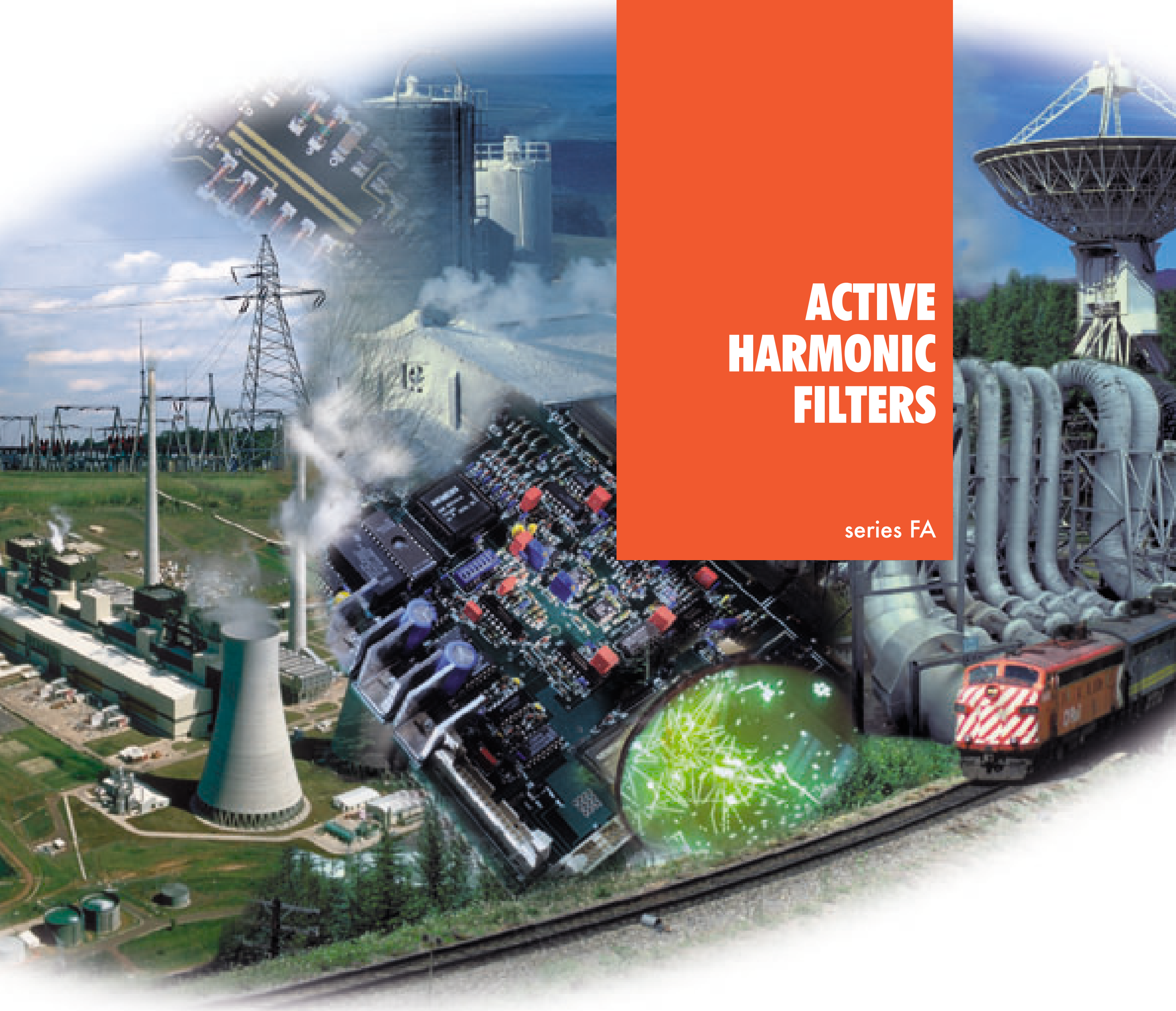
ACTIVE HARMONIC FILTERS

series FA



FILTERS

MEDCOM

AC & DC POWER SOLUTIONS
TRACTION CONVERTERS

DESIGNATION

The FA series Active Harmonic Filters are designed to reduce passive power of deformations with or without compensation displacement power factor (dpf - phase shift).

In both cases the active harmonic filter reduces the higher harmonics created in mains current by the nonlinear loads.

The three-phase FA series active armonic filters have an important additional feature - balancing of the load on the three phases of the power supply line. In the case of installations with a neutral wire, this ensures compensation of the current in that wire. Three-phase filters are produced in versions designed to work with a three-wire line or for universal use (with three or four-wire lines).

The active harmonic filters should be used, for example, in the power circuits of widely dispersed computer networks, in “smart devices” in buildings, on pulsed feeder cables, in circuits powered by generator units, and on ships, submarines and aircraft.

The use of the filter enables:

- Reduction of harmonic distortions in line current;
- Reduction of the peak value of the line current;
- Reduction of rms of the current;
- Reduction of the start-up current during switching on the load;
- Reduction of potentially harmful network interference.

Benefits:

- Reduction in the cross-section of the power cables;
- Reduction in the size of fuses in the line;
- Reduction in the power of the generator or inverter used to supply nonlinear loads.

OPERATING PRINCIPLES

The principles of operation of the filter are shown on the flow diagram in Fig. 1.

The following are shown on the diagram: input fuses, surge protection system, passive LC filter, transistor inverter (IGBT), capacitor bank C_f connected in a steady-voltage circuit, and control unit. The control unit determines the shape of the current generated by the inverter by the comparing the load current with a model sine wave. This current results in a sinusoidal flow of current from the AC network when added to the current of the load. The operation of the active filter is possible due to a bi-directional energy flow within the inverter-capacitor system (C_f).

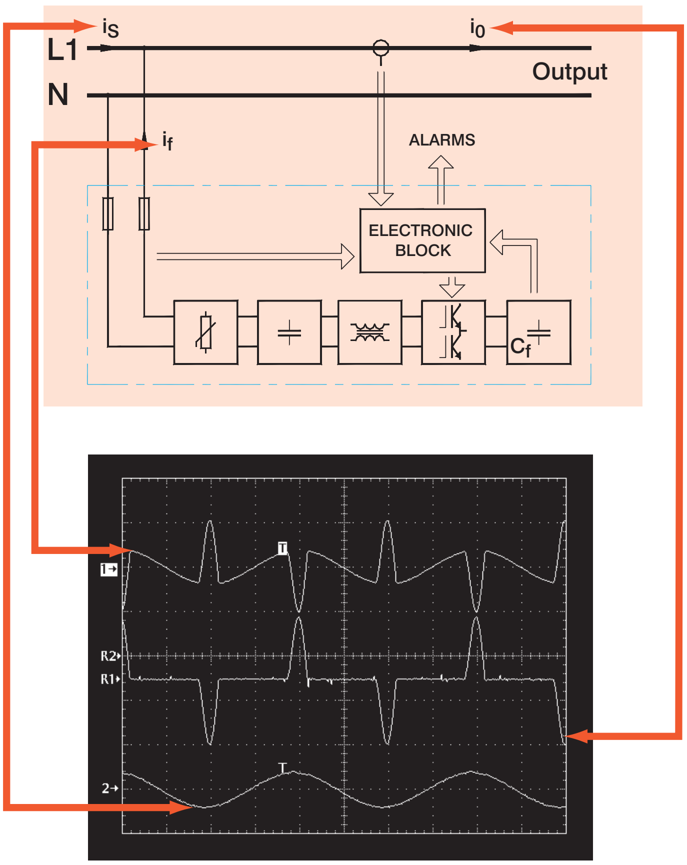


Fig. 1. Current flow diagram

ISO 9001:2001 Quality Assurance System covering development, design, manufacture and service of industrial electronics products

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SYSTEM CONFIGURATIONS

Independently of the basic configuration as shown in Fig. 1, the single-phase filters are able to operate in three-phase systems or, in the case of receivers with higher nominal power, in parallel operation systems.

INSTALLATION

The connecting terminals and the manner of connecting the external current transformers are shown in Fig. 2 and Fig. 5. Terminal Z2 can be connected to an LED (or transoptor) signalling that the filter is working at maximum compensatory current.

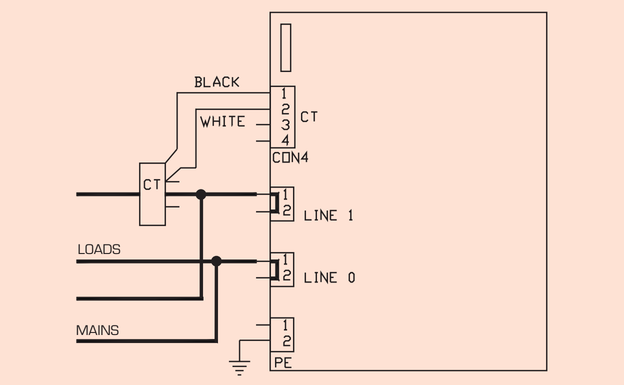


Fig. 2. Terminals of high-current circuits for the single-phase filter

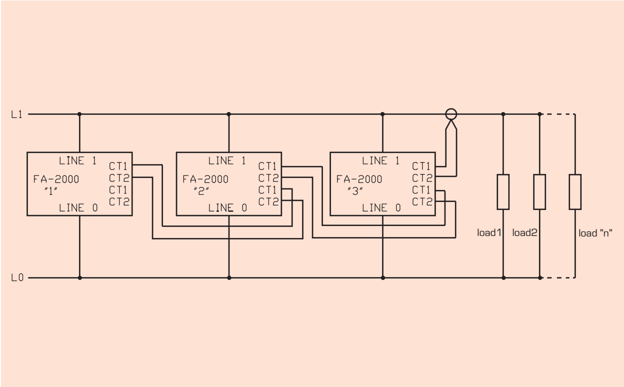


Fig. 4. Installation diagram for the parallel operation of three single-phase filters

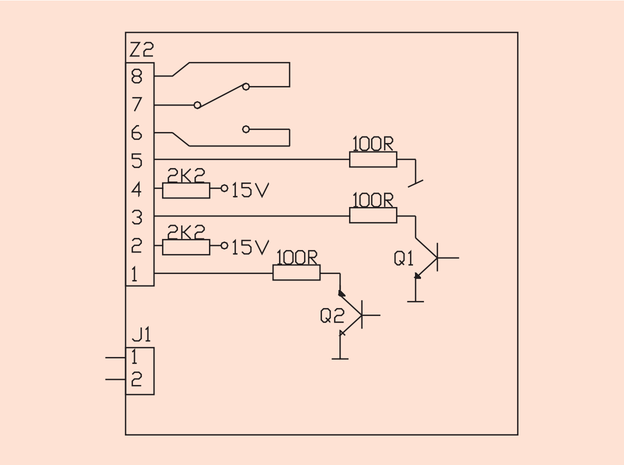


Fig. 3. Terminals of signalling circuits on the control board of the single-phase filter

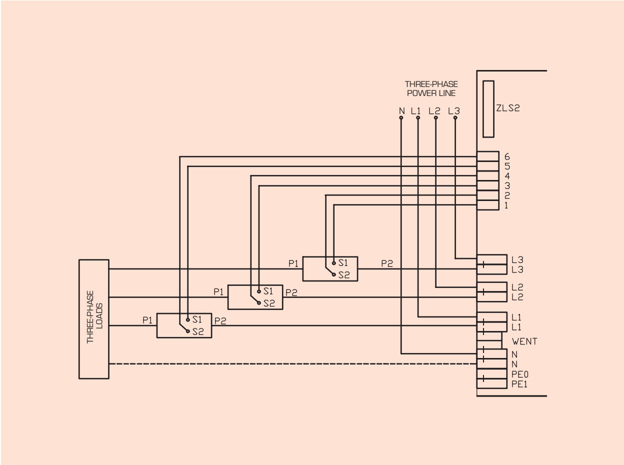


Fig. 5. Installation diagram for a three-phase filter (FA-3-10k)

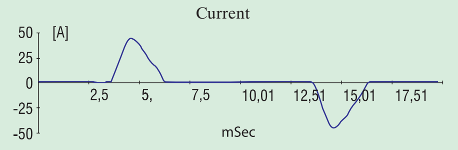
MAINTENANCE

When properly installed the device works fully automatically, and requires no maintenance other than regular cleaning.

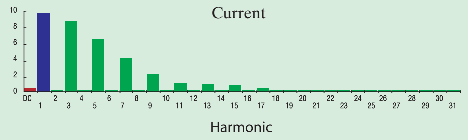
Alarm signals are generated in the following circumstances:

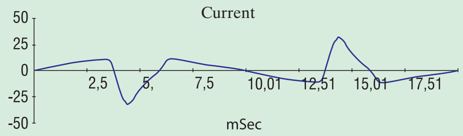
- Relay alarm (and LED1):
  - When the permitted temperature of the radiator is exceeded
  - When the line voltage is too high or too low
  - When the filter is damaged
- LED2:
  - When the filter is operating at maximum compensation current

EXAMPLE MEASUREMENTS FOR PC-TYPE LOAD

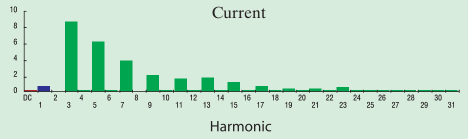


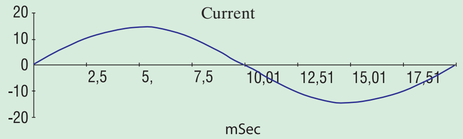
Load current



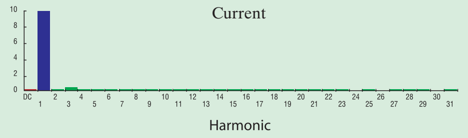


Inverter current





Line current



Load current: Single Phase Readings

			Voltage	Current
Frequency	49,97	RMS	228,2	15,46
Power		Peak	316,3	45,99
KW	2,21	DC Offset	0,3	0,43
KVA	3,53	Crest	1,39	2,98
KVAR	0,16	THD Rms	2,08	77,31
Peak KW	14,59	THD Fund	2,08	121,87
Phase	4° lead	HRMS	4,8	11,94
Total PF	0,63	KFactor		16,03
DPF	1,00			

Harm.	Freq.	V Mag	%V RMS	V F°	I Mag	%I RMS	I F°	Power (KW)
DC	0,00	0,34	0,15	0	0,43	2,75	0	0,00
1	49,97	228,14	99,98	0	9,79	63,39	4	2,23
2	99,94	0,25	0,11	103	0,34	2,18	91	0,00
3	149,90	1,77	0,77	132	8,59	55,62	-172	0,01
4	199,87	0,03	0,01	-134	0,22	1,42	-93	0,00
5	249,84	3,97	1,74	170	6,53	42,23	15	-0,03
6	299,81	0,09	0,04	68	0,08	0,53	82	0,00
7	349,78	1,81	0,79	-18	4,18	27,06	-155	-0,01
8	399,74	0,05	0,02	77	0,03	0,20	128	0,00
9	449,71	0,38	0,16	-106	2,19	14,20	47	0,00
10	499,68	0,03	0,01	-59	0,09	0,57	-76	0,00
11	549,65	0,09	0,04	65	1,18	7,61	-88	0,00
12	599,62	0,08	0,03	90	0,08	0,53	94	0,00
13	649,58	0,28	0,12	-33	1,04	6,76	139	0,00
14	699,55	0,02	0,01	-59	0,03	0,20	-93	0,00
15	749,52	0,09	0,04	-32	0,88	5,70	-20	0,00
16	799,49	0,03	0,01	-120	0,02	0,12	-61	0,00
17	849,46	0,16	0,07	53	0,49	3,16	174	0,00
18	899,42	0,06	0,03	122	0,04	0,28	94	0,00
19	949,39	0,20	0,09	-60	0,09	0,57	40	0,00
20	999,36	0,05	0,02	-96	0,04	0,24	-107	0,00
21	1049,33	0,02	0,01	-78	0,22	1,42	-23	0,00
22	1099,30	0,05	0,02	57	0,01	0,08	34	0,00
23	1149,26	0,08	0,03	133	0,25	1,62	163	0,00
24	1199,23	0,02	0,01	111	0,03	0,20	148	0,00
25	1249,20	0,08	0,03	-66	0,12	0,77	-32	0,00
26	1299,17	0,02	0,01	115	0,03	0,20	-32	0,00
27	1349,13	0,08	0,03	25	0,11	0,73	39	0,00
28	1399,10	0,00	0,00	-164	0,03	0,16	119	0,00
29	1449,07	0,08	0,03	156	0,21	1,38	-160	0,00
30	1499,04	0,05	0,02	-60	0,01	0,08	172	0,00
31	1549,01	0,05	0,02	-4	0,21	1,33	17	0,00

Line current: Single Phase Readings

			Voltage	Current
Frequency	49,97	RMS	228,3	9,90
Power		Peak	316,1	15,04
KW	2,25	DC Offset	0,0	-0,01
KVA	2,26	Crest	1,38	1,52
KVAR	0,16	THD Rms	2,17	6,49
Peak KW	4,75	THD Fund	2,17	6,50
Phase	4° lead	HRMS	4,9	0,64
Total PF	1,00	KFactor		1,22
DPF	1,00			

Harm.	Freq.	V Mag	%V RMS	V F°	I Mag	%I RMS	I F°	Power (KW)
DC	0,00	0,05	0,02	0	0,01	0,13	0	0,00
1	49,97	228,25	99,97	0	9,88	99,78	4	2,25
2	99,94	0,05	0,02	-58	0,08	0,78	-94	0,00
3	149,90	1,77	0,77	127	0,53	5,34	-167	0,00
4	199,87	0,02	0,01	-90	0,02	0,16	-120	0,00
5	249,84	4,28	1,88	169	0,23	2,30	-69	0,00
6	299,81	0,02	0,01	15	0,03	0,29	54	0,00
7	349,78	1,64	0,72	-8	0,11	1,16	122	0,00
8	399,74	0,03	0,01	4	0,01	0,13	49	0,00
9	449,71	0,33	0,14	-107	0,02	0,21	60	0,00
10	499,68	0,02	0,01	67	0,03	0,29	179	0,00
11	549,65	0,02	0,01	169	0,06	0,61	6	0,00
12	599,62	0,00	0,00	48	0,01	0,09	127	0,00
13	649,58	0,20	0,09	-32	0,07	0,72	-126	0,00
14	699,55	0,03	0,01	121	0,01	0,11	-47	0,00
15	749,52	0,14	0,06	-39	0,16	1,67	44	0,00
16	799,49	0,02	0,01	-89	0,01	0,10	-167	0,00
17	849,46	0,20	0,09	49	0,08	0,78	-174	0,00
18	899,42	0,02	0,01	96	0,01	0,10	-61	0,00
19	949,39	0,22	0,10	-90	0,10	0,97	-36	0,00
20	999,36	0,02	0,01	-153	0,01	0,06	-144	0,00
21	1049,33	0,06	0,03	-67	0,04	0,45	22	0,00
22	1099,30	0,02	0,01	25	0,01	0,07	79	0,00
23	1149,26	0,08	0,03	89	0,07	0,67	177	0,00
24	1199,23	0,02	0,01	13	0,01	0,07	92	0,00
25	1249,20	0,08	0,03	-102	0,02	0,20	-21	0,00
26	1299,17	0,03	0,01	60	0,00	0,01	121	0,00
27	1349,13	0,08	0,03	14	0,01	0,13	-170	0,00
28	1399,10	0,02	0,01	41	0,01	0,09	-13	0,00
29	1449,07	0,05	0,02	95	0,02	0,25	122	0,00
30	1499,04	0,02	0,01	-167	0,01	0,06	117	0,00
31	1549,01	0,03	0,01	20	0,02	0,21	10	0,00

EFFICIENCY OF THE ACTIVE HARMONIC FILTERS – NOMOGRAMS

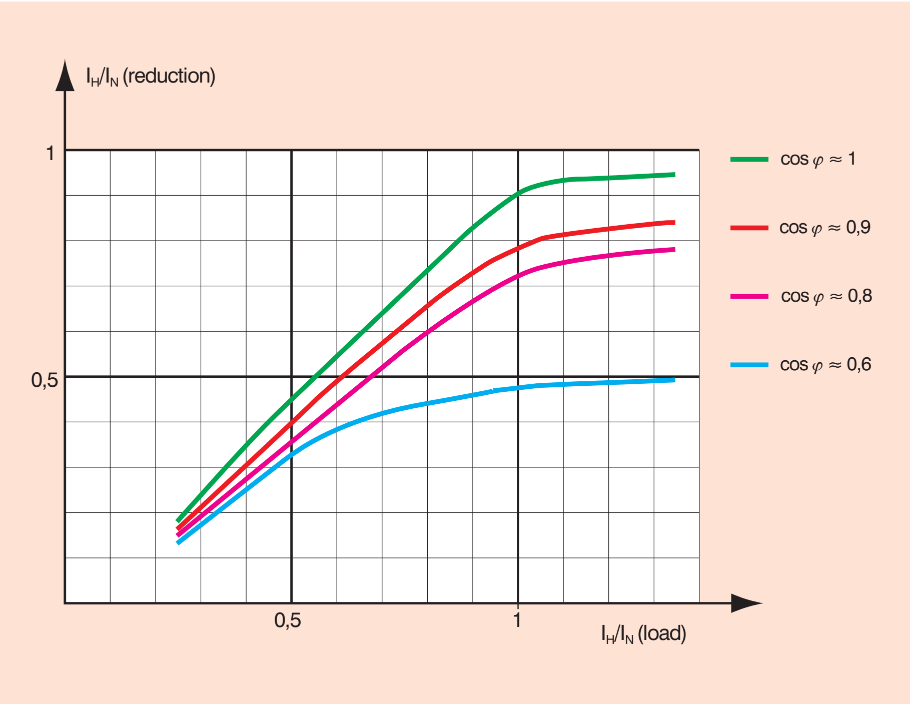


Fig. 6. Total load current harmonics reduction - compensation displacement power factor ON

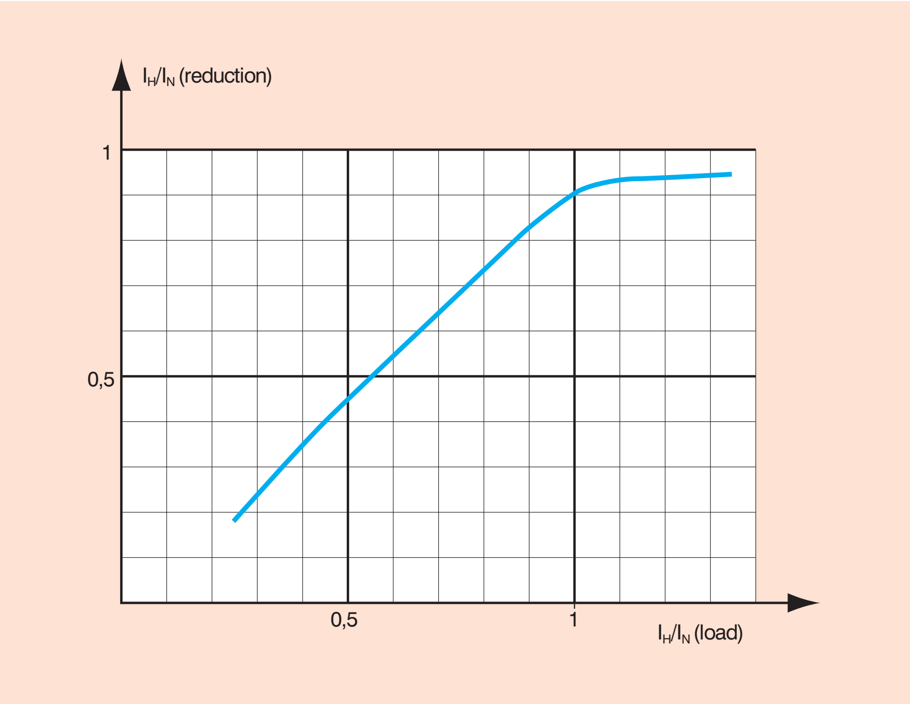


Fig. 7. Total load current harmonics reduction - compensation displacement power factor OFF

ATTENUATION COEFFICIENT OF HARMONICS (for nominal load)

Component number	2	3	4	5	7	8-11	12-15	16-21	22-27	28-31
Load $\mathbf{I_H}$ / Line $\mathbf{I_H}$	10	15	20	25	30	30	15	7	7	6

MODEL NUMBER CONSTRUCTION

FA-3-50k-380

FAMILY NAME
FA = Shunt Active Harmonic Filter 1-phase
FA-3 = Shunt Active Harmonic Filter 3-phase

MAX OUTPUT POWER
2000 = 3 kVA
10k = 10 kVA
20k = 20 kVA
30k = 30 kVA
50k = 50 kVA
75k = 75 kVA
100k = 100 kVA
150k = 150 kVA
200k = 200 kVA
300k = 300 kVA
500k = 500 kVA
750k = 750 kVA
1000k = 1 MVA

INPUT VOLTAGE
120 = 120 V / 60 Hz
208 = 208 V / 60 Hz
220 = 220 V / 50 Hz
230 = 230 V / 50 Hz
380 = 380 V / 50 Hz
400 = 400 V / 50 Hz
480 = 480 V / 60 Hz

ACTIVE HARMONIC FILTERS MODELS

MODEL NUMBER	INPUT VOLTAGE [V]	FREQUENCY [Hz]	OUTPUT CURRENT [Arms]	CORRECTED POWER [KVAR]	POWER LOSSES [W]	DIMENSIONS H×W×D [mm]	WEIGHT [Kg]
FA-2000-120	120	60	30	3	170 W	210×175×370	9
FA-2000-208	208	60	15	3	150 W	210×175×370	9
FA-2000-230	220/230	50	15	3	150 W	210×175×370	9
FA-2000-380	380/400	50	10	3	120 W	210×175×370	9
FA-3-10k-380	3×380/400	50	15	10	360 W	564×264×155	17
FA-3-10k-208	3×208	60	30	10	420 W	564×264×155	17
FA-3-10k-480	3×480	60	12	10	530 W	700×500×250	60
FA-3-10k-380	3×380/400	50	12	10	530 W	700×500×250	60
FA-3-20k-480	3×480	60	24	20	800 W	1000×600×250	80
FA-3-20k-380	3×380/400	50	24	20	800 W	1000×600×250	80
FA-3-30k-480	3×480	60	45	30	1.3 kW	1000 ×800×400	120
FA-3-30k-380	3×380/400	50	45	30	1.1 kW	1000 ×800×400	120
FA-3-50k-480	3×480	60	75	50	2 kW	1200 ×800×400	150
FA-3-50k-380	3×380/400	50	75	50	1.6 kW	1200 ×800×400	150
FA-3-75k-480	3×480	60	120	75	2.5 kW	1600 ×800×400	190
FA-3-75k-380	3×380/400	50	120	75	2.1 kW	1600 ×800×400	190
FA-3-100k-480	3×480	60	150	100	3 kW	1800 ×800×500	260
FA-3-100k-380	3×380/400	50	150	100	2.6 kW	1800 ×800×500	260
FA-3-150k-380	3×380/400	50	230	150	3.7 kW	1800 ×800×500	300
FA-3-200k-380	3×380/400	50	300	200	5 kW	2000×1000×600	400
FA-3-300k-380	3×380/400	50	450	300	7 kW	2200×1200×600	500
FA-3-500k-380	3×380/400	50	750	500	11 kW	2200×1200×800	750
FA-3-750k-380	3×380/400	50	1200	750	17 kW	2200×2400×600	2×540
FA-3-1000k-380	3×380/400	50	1500	1000	22 kW	2200×2400×600	2×750

TECHNICAL PARAMETERS

SINGLE-PHASE FILTERS

Power supply parameters		
Input voltage (U_n)	120/208/230/380/400 V	
Range of changes of input voltage	-15 % ÷ +10 %,	
Range of changes of line frequency	±5 %	
Insulation resistance	2.5 kV / 1 min	
Output parameters		
Output power (S_n)	3000 VA	
Peak output current	3 × In	
Maximum slew rate of compensatory current	100 A/ms	
Response time	0.5 ms	Reaction to jump in load current
Set-up time	40 ms	Time of equalization of active power of load and line
Measurement of load current		
External current transformer	1:2000, S>1 VA	
Alarm signals		
Relay alarm and LED1		Permitted radiator temperature exceeded, supply voltage too high or too low, damage to the filter
LED2 (or transoptor)		Maximum value of compensatory current
Max. voltage for operation of alarm contacts	300 V= or 250 V~	
Max. load on contacts	4 A for 230 V~ 0.3 A for 220 V=	
Operating conditions		
Operating temperature	(5 ÷ 40) °C	
Storage temperature	(5 ÷20) °C	
Humidity	95 % at 40 °C	
Cooling	Natural	at S>70 % Sn, forced
Level of disturbances emission	N	
Case		
Protection class	IP20	

THREE-PHASE FILTERS

Power supply parameters		
Input voltage (U_n)	208/380/400/480 V	
Range of changes of input voltage	-15 % ÷ + 10%,	
Range of changes of line frequency	±5 %	
Insulation resistance	2.5 kV / 1 min	
Output parameters		
Output power (S_n)	10 kVA, 20 kVA, 30 kVA, 50 kVA, 75 kVA, 100 kVA, 150 kVA, 200 kVA, 300 kVA, 500 kVA,750 kVA, 1000 kVA	
Peak output current	3 × In	
Maximum slew rate of compensatory current	$30\sqrt{S_n[kVA]}$ [A/ms]	
Response time	0.5 ms	Reaction to jump change in load current
Set-up time	40 ms	Time of equalization of active power of load and line
Measurement of load current		
External current transformer	Transformer selected to match load current	
Alarm signals		
Relay alarm and LED1		Permitted radiator temperature exceeded, supply voltage too high or too low, damage to the filter
LED2 (or transoptor)		Maximum value of compensatory current
Max. voltage of operation of alarm contacts	300 V= or 250 V~	
Max. load on contacts	4 A for 230 V~ 0,3 A for 220 V=	
Operating conditions		
Operating temperature	(5 ÷ 40) °C	
Storage temperature	(5 ÷ 20) °C	
Humidity	95 % at 40 °C	
Cooling	forced	
Level of disturbances emission	N	
Case		
Protection class	IP20	

MEDCOM

AC & DC POWER SOLUTIONS
TRACTION CONVERTERS

MEDCOM Sp. z o.o.
Founded in 1988, active in the design, manufacture, installation and servicing of modern electronic devices, aimed mainly at the power industry, military, railway and tramway transport, industry and health service customers. The use of latest technologies and system solutions, the services of highly experienced structural designers and the introduction of an ISO9001:2001 Quality Assurance System, ensure that the devices produced are state-of-the-art and highly reliable. The technical design for all products is carried out in-house. In 2001 the company was awarded a prize The Polish President's Economy Award for THE BEST POLISH SMALL ENTERPRISE.

The most important products in the company's offer:

- **DC power supplies**
- **Uninterruptible power systems**
- **High-voltage power supplies**
- **Power supplies (MIL standards)**
- **Static converters for railway and tramway applications**
- **Power supplies for industrial applications**
- **Power active harmonic filters**
- **Traction battery chargers**
- **Static switches**
- **"Fail-safe" power supplies**
- **Motor driving systems: AC and DC motors**
- **Measurement devices: battery ground-fault meters, battery operation monitors**
- **Wind power converters**

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Due to constant introduction of newest technological advances, our products may be subject to modifications.
For that reason, the above-presented description may be partially outdated.

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