

Innovating Energy Technology

Fuji Electric Harmonic Mitigation



Installation & User Manual



Fuji Electric Asia Pacific Pte. Ltd.

F Fuji Electric



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These instructions (PDF format) can be obtained from www.fujielectric.com or from your local Fuji Electric sales representative.

Other technical documentation of our products is also available in the download area of www.fujielectric.com

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Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



High voltage potentials are involved in the operation of power quality equioment. Always remove power before handling energized parts of the filter, and let ample time elaspse for the capacitors to dischange to safe levels (<42V). Residual voltage are to be measured both line to line and line to earth.



Equipment installation, start-up. operation and maintenance (if any) have to be carried out by a trained and certified electrician or technician, who is familiar with safety procedures in electrical system. Non-qualified person are not allowed to use, install, operate or maintain the PQ filters!

Ω DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a hazardous situation which, if not avoided, will result in death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, will result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical imjury

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Fuji Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification Of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

Product Application type

This product is a Passive Harmonic Filter for 3-phase 400V class inverter, UPS, DC fast chargers ect. Or any 3-phase power conversion equipment with front-end six-pulse rectifier AC and DC motor drives in low dynamic applications intended for industrial use according to this manual. The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data. Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented. Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design). Any use other than the use explicitly permitted is prohibited and can result in hazards. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

Product Related Information

Read and understand these instructions before performing any procedure with this product.



HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this filter system. Installation, adjustment, repair and maintenance must be performed by gualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage. Do
 not touch. Use only electrically insulated tools.
- Do not touch unshielded components or terminals with voltage present.
- Prior to performing any type of work on the filter system, isolate power supply to prevent electric shock circuit.
- AC voltage can couple voltage to unused conductors in the power cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the filter's bus terminals or control bus terminals.
- Before performing work on the passive harmonic filter system:
 - Disconnect all power, including external control power that may be present.
 - Place a Do Not Turn On label on all power switches.
 - Lock all power switches in the open position.
 - Wait 15 minutes to allow the DC bus capacitors to discharge.
 - If the AC bus capacitors do not discharge properly, contact your local Fuji Electric representative. Do not repair or operate the product.
- Install and close all covers before applying voltage.

Failure to follow these instructions will result in death or serious injury.

WARNING

UNEXPECTED SHOCK CIRCUIT

Harmonic Filter systems may result unexpected shock circuit because of incorrect power wiring, incorrect control wiring or other errors.

- Carefully install the wiring in accordance with this manual's informatiuon.
- Do not operate the product with unknown or unsuitable applications or connection.
- · Perform a comprehensive commissioning test.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.



ELECTRIC SHOCK OR UNANTICIPATED EQUIPMENT OPERATION

Do not use damaged products or accessories.

Failure to follow these instructions will result in death or serious injury.

Contact your local Fuji Electric sales office if you detect any damage whatsoever.

NOTICE

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

Before switching on and configuring the product, verify that it is approved for the mains voltage Failure to follow these instructions can result in equipment damage.

The metal surfaces of the product may exceed 100 °C (212 °F) during operation.

\land WARNING

HOT SURFACES

- Ensure that any contact with hot surfaces is avoided.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About this manual

At a Glance

Document Scope

The purpose of this document is:

- to give you mechanical and electrical information related to the ecoWAVE Passive Harmoinc Filter,
- to show you how to install and wire this filter.

Validity Note

NOTE: The products listed in the document are not all available at the timeof publication of this document online. The data, illustrations and product specifications listed in the guide will be completed and updated as the product availabilities evolve. Updates to the guide will be available for download once products are released on the market.

This documentation is valid for the ecoWAVE Econ-Line IP20 Passive Harmonic Filter series.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Fuji Electric home page www.fujielectric.com .
2	In the Search box type the reference of a product or the name of a product range or look under Inverter product category for ecoWAVE Passive Harmonic Filter series.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise contentover time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.



How to read the model code

		F١	۷0.	75 E	VI - 4	4 G	5		
CODE	Product Type							CODE	HZ
FN	Passive Harmonic Filter							5	50Hz
								6	60Hz
CODE	kW Rating								
0.75	0.75kW							CODE	Destination
~	~							G	Global Model
160	160kW								
								CODE	Input power source
CODE	Series							4	400 Voltage Class
AL1	Advance-Line Series 1								
EL1	Econ-Line Series 1								
CODE	Protection								
М	IP20 Enclosure Type								
S	IP00 Skid Type								

urce

* Exact input power source please refer to technical specifications

Model selection

Select the most suitable filter rating for your application.

In case of inverter application, the inverter must incorporate with a 5% impedance DC-Link choke to achieve THID 10% @ rated power result with the ecoWAVE Econ-Line PHF series or apply ecoWAVE Advance-Line series if these 5% impedance DC-Link choke is absent.

In other words, there are two chokes (line choke and trap choke) included in this filter series.

For ecoWAVE Econ-Line series.

Examples of 22kW 50Hz filter select to meet 10% THDi; ecoWAVE Econ-Line PHF FN22EL1M-4G5 : Filter for 50 Hz, 380...415 V AC grid, motor inverter power rating 22kW, IP20

Examples of 22kW 60Hz filter select to meet 10% THDi; ecoWAVE Econ-Line PHF FN22EL1M-4G6 : Filter for 60 Hz, 380...480 V AC grid, motor inverter power rating 22kW, IP20

In case you have difficulties to decide for the right filter, please contact your local Fuji Electric or representative for support.

Nameplate example

The product nameplate contains the following data:



Additional Electrical Specifications

Altitude correction

ecoWAVE Econ-Line PHF general electrical specifications refer to operating altitudes up to 2000m a.s.l. (6600ft). Operation between 1000m and 4000m (3300ft and 13123ft) requires a derating according to the table 1 below:



Note: Do not use ecoWAVE Econ-Line PHF in altitudes above 4000m without consulting Fuji Electric first. ecoWAVE Econ-Line PHF have been designed and certified acc. UL508, resp. UL508C, so there is no limitation in terms of altitude up to 4000m for clerance and creepage.

Specifications

50Hz model

Item	50 Hz System
Nominal operating voltage	3x 380 to 415 VAC ± 10%
Operating frequency	50 Hz ± 1 Hz
Nominal motor drive input power rating \bigcirc	50 Hz, 3.7 to 160kW
Total harmonic current distortion THiD	≤10% at rated power
Total harmonic current distortion THID ②	According to IEEE 519 <10% @ rated power (with Ldc) <15% @ rated power (without Ldc)
Total demand distortion TDD	According to IEEE 519
Partially weighted harmonic distortion PWHID	<22% @ rated power
Drive dc-link voltage ③	No load: +10%, Full load: -5%
Efficiency	>98% for rated voltage and power
High potential test voltage ④	P> E 2500VAC (1min)
Protection category	IP20
Overload capability	1.6x rated current for 1 minute, once per hour 2x rated current for 10 seconds, once per hour 5x rated current for 1 second, once per hour
Capacitive current @ no load:	<30% of rated input current, at 400VAC <37% of rated input current, at 500VAC
Cooling	Natural convection cooling (0.75 to 7.5kW) Internal forced cooling (11kW and above)
Ambient temperature rage	- 25°C to +45°C fully operational +45°C to +70°C derated operation ⑥ - 25°C to +85°C transport and storage
Flammability corresponding to	UL 94V-2 or better
Insulation class of magnetic components	H (180°C)
Design corresponding to	UL 508, EN 61558-2-20, CE (LVD 2006/95/EC)
Earth system	TN, TT, IT
SCCR (5)	100 kA
MTBF @ 45°C) / 415V (Mil-HB-217F)	>200,000 hours
MTTR	<15 minutes (capacitor modules and fan modules)
Safety monitoring functions	Over-temperature of magnetic components
Pollution degree	1, 2 (according to EN 61800-5-1, EN 50178)
Lifetime (calculated)	≥10 years
Typical applications	Equipment with front-end six-pulse rectifier / Motor drives / Factory automation equipment/ Water/wastewater treatment facilities / Fan and pump applications / HVAC applications Mission-critical processes / DC fast chargers

① ecoWAVE Econ-Line filters reduce RMS input and peak current by reducing harmonic currents and improving true power factor.

2 System requirements: THVD <2%, line voltage unbalance <1% Performance specification for six-pulse diode rectifiers. SCR rectifier front-ends produce different results, depending upon the firing angle of the thyristors. 3 Conditions: line impedance <3%
4 Repetitive tests to be performed at max. 80% of above levels, for 2 seconds.

- 6 External UL-rated fuses required.
 6 Iderated = Inominal×√ ((70°C-Tamb)/25°C)

Specifications 50 Hz Type

Technical data

3-Phase, 380...415VAC, 50 Hz

Rated	Nominal	Filter	Motor drive	Typical	Term	ninal	Frame	
Voltage	[kW]		[Arms]**	[W]***		•	Frame	
	0.75	-	-	-	-		-	
	1.5	-	-	-	-		-	
	2.2	-	-	-	-		-	
	3.7	FN3.7EL1M-4G5 *	10	135	-44			
	5.5	FN5.5EL1M-4G5 *	13	183	-44		А	
	7.5	FN7.5EL1M-4G5 *	16	256	-44			
	11	FN11EL1M-4G5	24	287	-33			
	15	FN15EL1M-4G5	32	359	-33		В	
50Hz	18.5	FN18.5EL1M-4G5	38	343	-33			
3-Phase	22	FN22EL1M-4G5	45	460	-33			
Class	30	FN30EL1M-4G5	60	570	-34		C	
	37	FN37EL1M-4G5	75	581	-34		C	
	45	FN45EL1M-4G5	90	783	-35		П	
	55	FN55EL1M-4G5	110	858	-35		D	
	75	FN75EL1M-4G5	150	1036	-40			
	90	FN90EL1M-4G5	180	1166	-40		E	
	110	FN110EL1M-4G5	210	1365	-40			
	132	FN132EL1M-4G5	260	1392		-99	L	
	160	FN160EL1M-4G5	320	1462		-99	F	

Filter rating which does not require forced cooling or fan module. Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input ** current. Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not recommended. *** Calculated power loss at rated load power.

Mechanical frame sizes

ecoWAVE Econ-Line PHF are implemented on a base plate or base frame featuring 6 different frame sizes, Frame A to Frame F, from the lowest to the highest rating. Dimensions and footprint are provided in diagram 1 below.

In particular, frame sizes A do not require air flow, while frame sizes B to F with embedded fan.





Specifications

60Hz model

Item	60 Hz System
Nominal operating voltage	3x 380 to 480 VAC ± 10%
Operating frequency	60 Hz ± 1 Hz
Nominal motor drive input power rating \bigcirc	60 Hz, 3.7 to 160kW
Total harmonic current distortion THiD	≤10% at rated power
Total harmonic current distortion THID ②	According to IEEE 519 <10% @ rated power (with Ldc) <15% @ rated power (without Ldc)
Total demand distortion TDD	According to IEEE 519
Partially weighted harmonic distortion PWHID	<22% @ rated power
Drive dc-link voltage ③	No load: +10%, Full load: -5%
Efficiency	>98% for rated voltage and power
High potential test voltage ④	P> E 2500VAC (1min)
Protection category	IP20
Overload capability	1.6x rated current for 1 minute, once per hour 2x rated current for 10 seconds, once per hour 5x rated current for 1 second, once per hour
Capacitive current @ no load:	<30% of rated input current, at 400VAC <37% of rated input current, at 500VAC
Cooling	Natural convection cooling (0.75 to 7.5kW) Internal forced cooling (11kW and above)
Ambient temperature rage	 - 25°C to +45°C fully operational +45°C to +70°C derated operation 6 - 25°C to +85°C transport and storage
Flammability corresponding to	UL 94V-2 or better
Insulation class of magnetic components	H (180°C)
Design corresponding to	UL 508, EN 61558-2-20, CE (LVD 2006/95/EC)
Earth system	TN, TT, IT
SCCR 5	100 kA
MTBF @ 45°C) / 415V (Mil-HB-217F)	>200,000 hours
MTTR	<15 minutes (capacitor modules and fan modules)
Safety monitoring functions	Over-temperature of magnetic components
Pollution degree	1, 2 (according to EN 61800-5-1, EN 50178)
Lifetime (calculated)	≥10 years
Typical applications	Equipment with front-end six-pulse rectifier / Motor drives / Factory automation equipment/ Water/wastewater treatment facilities / Fan and pump applications / HVAC applications Mission-critical processes / DC fast chargers

(1) ecoWAVE Econ-Line filters reduce RMS input and peak current by reducing harmonic currents and improving true power factor.

true power factor.
 System requirements: THVD <2%, line voltage unbalance <1% Performance specification for six-pulse diode rectifiers. SCR rectifier front-ends produce different results, depending upon the firing angle of the thyristors.
 Conditions: line impedance <3%
 Repetitive tests to be performed at max. 80% of above levels, for 2 seconds.

5

6 External UL-rated fuses required.
 6 Iderated = Inominal×√ ((70°C-Tamb)/25°C)

Specifications 60 Hz Type

Technical data

3-Phase, 380...480VAC, 60 Hz

Rated	Nominal		Filter	Motor drive	Typical	Terminal		Frame	
Voltage	[kW]	[HP]		[Arms]***	[W]****		•	Tame	
	0.75	1	-	-	-	-		-	
	1.5	2	-	-	-	-		-	
	2.2	3	-	-	-	-		-	
	3.7	5	FN3.7EL1M-4G6 *	10	135	-44			
	5.5	71/2	FN5.5EL1M-4G6 *	13	183	-44		А	
	7.5	10	FN7.5EL1M-4G6 *	16	256	-44			
	11	15	FN11EL1M-4G6	24	287	-33			
	15	20	FN15EL1M-4G6	32	359	-33		В	
50Hz	18.5	25	FN18.5EL1M-4G6	38	343	-33			
380-480V	22	30	FN22EL1M-4G6	45	460	-33			
Class	30	40	FN30EL1M-4G6	60	570	-34		C	
	37	50	FN37EL1M-4G6	75	581	-34		C	
	45	60	FN45EL1M-4G6	90	783	-35		П	
	55	75	FN55EL1M-4G6	110	858	-35		D	
	75	100	FN75EL1M-4G6	150	1036	-40			
	90	125	FN90EL1M-4G6	180	1166	-40		Е	
	110	150	FN110EL1M-4G6	210	1365	-40			
	132	200	FN132EL1M-4G6	260	1392		-99	_	
	160	250	FN160EL1M-4G6	320	1462		-99	Г	

Filter rating which does not require forced cooling or fan module.

** Filter to be selected by system voltage and load (motor drive) power. Note: the harmonic filter will reduce RMS input current. Therefore, filter selection by current rating, as it is common for EMC/EMI filters, is not recommended. *** Calculated power loss at rated load power.

**** In case of filter accurate rating, please refer to Horsepower (HP) rating.

Mechanical frame sizes

ecoWAVE Econ-Line PHF are implemented on a base plate or base frame featuring 6 different frame sizes, Frame A to Frame F, from the lowest to the highest rating. Dimensions and footprint are provided in diagram 1 below.

In particular, frame sizes A do not require forced cooling fan air flow, while frame sizes B to F with embedded fan.





Filter Overview

Frame Sizes



The ecoWAVE Econ-Line PHF includes 6 frame sizes for IP20 products.



Specifications 50 Hz Type

Dimensions

3-phase, 380...415V, 50 Hz

Model Number	Nominal Power	Outside dimensions (mm)			Mounting Drill (mm)			Frame Size
	kW	W	н	D	W1	H1	т	
-	0.75	-	-	-	-	-	-	-
-	1.5	-	-	-	-	-	-	-
-	2.2	-	-	-	-	-	-	-
FN3.7EL1M-4G5*	3.7							
FN5.5EL1M-4G5*	5.5	185	390	190	140	370	M6	А
FN7.5EL1M-4G5*	7.5							
FN11EL1M-4G5	11		455					
FN15EL1M-4G5	15	250		220	200	135	MQ	P
FN18.5EL1M-4G5	18.5	230		230	200		MO	Б
FN22EL1M-4G5	22							
FN30EL1M-4G5	30		E 20				Мо	6
FN37EL1M-4G5	37	200	520	240	255	500	IVIO	C
FN45EL1M-4G5	45	200	500	240	255	500		5
FN55EL1M-4G5	55		580				MIU	D
FN75EL1M-4G5	75							
FN90EL1M-4G5	90	450	700	385	350	665	M12	Е
FN110EL1M-4G5	110							
FN132EL1M-4G5	132	450	700	205	350	665	M10	Е
FN160EL1M-4G5	160	400	100	300				Г

Filter rating which does not require forced cooling or fan module.
 Filter rating which does not require RC damping module for rectifiers with EMI filter.
 Motor drive input current without harmonic filter

NOTE: Frame E & Frame F are same in dimension but different terminal type.

Specifications 60 Hz Type

Dimensions

3-phase, 380...480V, 60 Hz

Model Number	Nominal**** Power		Outs	Outside dimensions (mm)			Mounting Drill (mm)		
	kW	HP	W	н	D	W1	H1	т	
-	0.75	1	-	-	-	-	-	-	-
-	1.5	2	-	-	-	-	-	-	-
-	2.2	3	-	-	-	-	-	-	-
FN3.7EL1M-4G6*	3.7	5							
FN5.5EL1M-4G6*	5.5	71/2	185	390	190	140	370	M8	A
FN7.5EL1M-4G6*	7.5	10							
FN11EL1M-4G6	11	15		455	230	200		M10	
FN15EL1M-4G6	15	20	250				435		в
FN18.5EL1M-4G6	18.5	25	200	400	200	200	400		D
FN22EL1M-4G6	22	30							
FN30EL1M-4G6	30	40		520				M40	C
FN37EL1M-4G6	37	50	280	520	2/8	255			C
FN45EL1M-4G6	45	60	200	580	240	200	500	WITO	П
FN55EL1M-4G6	55	75		500					D
FN75EL1M-4G6	75	100							
FN90EL1M-4G6	90	125	450	700	385	350	665	M12	Е
FN110EL1M-4G6	110	150							
FN132EL1M-4G6	132	200	450	700	385	350	665	M10	F
FN160EL1M-4G6	160	250	430	100	303		005		ſ

Filter rating which does not require forced cooling or fan module.
 Filter rating which does not require RC damping module for rectifiers with EMI filter.
 Motor drive input current without harmonic filter.
 In case of filter accurate rating, please refer to Horsepower (HP) rating.

NOTE: Frame E & Frame F are same in dimension but different terminal type.

Terminals

Terminal Data

50 Hz / 60 Hz IP20 Power Terminals

Power Terminal							erminal (PE)	Signa	l Terminal
Frame	Screw Thread	Solid Wire mm²	Flex Wire mm²	AWG Type Wire	Recommended Torque Nm	Screw Thread	Screw Torque Value [Nm]	Screw Thread	Screw Torque Value [Nm]
Α	M8	10	6	8	1.0 - 1.2	M8	9		
В	M10	16	10	6	1.4 - 1.6		17	M3	0.5
С	M10	35	25	2	4.0 - 4.5	M10			
D	M10	50	50	1/0	7.0 - 8.0				
E	M12	95	95	4/0	17 - 20	M12	35		
F	M12	150	150	6/0	25 - 30	IVITZ	55		

ecoWAVE Econ-Line PHF need to be carefully selected and configured in order to enjoy maximum benefits.

Step 1: Grid frequency

Determine, whether the system in consideration will be operated in a 50 Hz or 60 Hz electricity grid, and select the corresponding filter series according to the following table:

- 50 Hz grid Europe, Middle East, parts of Asia, parts of South America (FNXXXEL1M-4G5)
- 60 Hz grid North and Central America, parts of Asia, parts of South America (FNXXXEL1M-4G6)

Note: a 50 Hz filter will not provide satisfying harmonics mitigation in a 60 Hz grid, and vice versa.

Step 2: Grid voltage

Verify that the grid configuration is suitable for standard ecoWAVE Econ-Line PHF according to the following table:

- 50 Hz grid Nominal voltage 380–415 V AC TN, TT, IT configuration
- 60 Hz grid Nominal voltage 380–480 V AC ______ TN, TT, IT configuration

Step 3: Rectifier type, presence of DC-link choke in drive

 ecoWAVE Econ-Line filter only for use in 6-pulse diode rectifier with a 5% impedance DC-link choke for guarantee performance.

Step 4: Rectifier/Drive input power

• The individual filter must be selected with respect to the rectifier/motor drive input power in kW respectively. It is important to match rated filter power as close as possible with the effective input power of the rectifier/ drive.

Note that if the rectifier/drive is being operated very close to its rated power, then the filter can be selected by the motor drive's nominal power rating. However, if the drive will be operated e.g. at only 66% of its rated power, then a smaller filter should be selected in order to get maximum harmonics mitigation performance and the optimum in terms of cost, size, and weight. In that case the customer is responsible to ensure that ecosine passive harmonic filter will be operated within specification. This is particular important in terms of overload.

Terminals

Please refer to the following examples:

Example 1:

Power line rating: 415 V, 50 Hz (FN15EL1M-4G5) Drive rating: 380–500 V, 50–60 Hz, 15 kW, 22.5 A, B6-diode rectifier with DC-link choke Planned rectifier/drive input real power: 15 kW (100% of drive rating)

Example 2:

Power line rating: 480 V, 60 Hz (FN15EL1M-4G6) Drive rating: 380–500 V, 50–60 Hz, 15 kW, 22.5 A, diode rectifier Planned rectifier/drive input real power: 15 kW (100% of drive rating)

NOTICE

Oversizing of passive harmonic filters is not recommended because of the inherent lower harmonic mitigation performance at partial load as well as higher cost, size, and weight.

NOTICE

ecoWAVE Econ-Line Filter with embedded ventilation

The filters 11kW - 160kW IP20 enclosure type contain embedded ventilation, which means the filters contain fan and aux. power supply. (refer to page 24 Figure 3 for sample view of filter with embedded ventilation)

Performance Data

ecoWAVE Econ-Line PHF achieve % THID with 6-pulse diode rectifiers under the following condition.

Filter is applied to rated voltage and power THVD <2%, line voltage unbalance <1%

The values of EMI-filter components present in the same non-linear load (e.g. motor drive) can influence the mitigation performance of passive harmonic filters. For ecoWAVE Econ-Line PHF the following boundary conditions exist for the smallest frame sizes: Typical expected EMI filter capacitance (phase to star point) are shown in Table 3.

Table 3

Typical expected EMI filter capacitance (phase to star point) for series 60Hz ecoWAVE Econ-Line PHF

Model	Typical drive dc-linke choke	Max. recommended EMI-filter X-capacitor	Expected THID *
	8.4mH	≤ 1.0µF	~10%
FN3.7 EL 110-460	-	≤ 2.2µF	~15%
EN5 5EL 1M-4G6	6.7mH	≤ 1.5µF	~10%
1103.0LL111-400	-	≤ 1.5µF	~13%
EN7 5EL 1M-4G6	4.2mH	≤ 3.3µF	~10%
1 W. JEL IW-400	-	≤ 3.3µF	~15%

* System requirements: THVD <2%, line voltage unbalance <1%

NOTICE

All other ecoWAVE Econ-Line 50 Hz / 60 Hz filters are not subject to any such limitations.

Power factor vs. load (diode rectifier front-ends)



Note: in SCR rectifier applications, filter characteristics greatly depend upon the firing angle of the thyristors.



Drive dc-link voltage vs. load (diode rectifier front-ends)

Note: in SCR rectifier applications, filter characteristics greatly depend upon the firing angle of the thyristors.

Performance Data

Note: in SCR rectifier applications, filter characteristics greatly depend upon the firing angle of the thyristors.

Performance characteristics ecoWAVE Econ-Line 50 Hz / 60 Hz



THID vs. load (diode rectifier front-ends)

shown above is the typical performance characteristic of ecoWAVE Econ-Line series in balanced diode rectifier front-end. In SCR rectifier applications, filter performance greatly depends upon the firing angle of the thyristors.

Power factor vs. load (diode rectifier front-ends)





Drive dc-link voltage vs. load (diode rectifier front-ends)

Note: in SCR rectifier applications, filter characteristics greatly depend upon the firing angle of the thyristors.

Typical electrical schematic - IP20 Enclosure Type



The typical electrical schematic shows ecoWAVE filter connected directly to an AC drive's appplication. The ecoWAVE filter can be appiled in electrical system level (electrical main supply board) to achieve result if load factor is well calculated. (consult your local Fuji Electric for more solutions)

Wiring Diagram - IP20 Enclosure Type



Wiring

Outline Diagram



Function diagram - IP20 Type



Parts	Terminal	Functions
LINE Choke (in)	L1 / L2 / L3	Incoming supply terminal
LINE Choke (out)	L1' / L2' / L3'	Outgoing load terminal
Thermal Switch	TS / TS'	Connecting terminals to thermal switch NC 180°C (UL approved) to detect overload in chokes
Protective Earth	PE	Protective earth. Threaded stud with washer and nut
Trap disconnect	D1 / D2 / D3 D1'/ D2'/ D3'	3 couples of terminals. For optional configurations with TDJ*, wire bridges are installed for immediate operation of the filter. They allow for the connection of an external contactor for load dependent disconnection of the trap circuit, if needed.
Chokes	Temperature sensors	Power magnetic components incl. temperature sensors
Capacitors	Discharge resisitors	Power capacitors incl. discharge resistors
Fan	24V ventilation Fan	Field replaceable fan for choke air cooling
Power Supply	24V power supply	Internally generate 24 V DC source for fan supply

Structure Design

Module

The base module of 50Hz / 60Hz filter series contains line choke, trap choke and trap capacitor, which helps reduce THDi to 10%.



Note: illustration above is different from actual due to terminal upgraded. Latest model come with TDJ Module (Trap Disconnect Jumper). (refer to page 22 & 36 on TDJ Module)

Filter appearance and elements

The very compact and neat design of ecoWAVE Econ-Line PHF is realized by single eclosure construction. with protection category IP20/NEMA1 must be mounted in a clean, dry location. Contaminants such as oils, corrosive vapors and abrasive debris must be kept out of the enclosure. These filter enclosures are intended for indoor use, primarily to provide a degree of protection against contact with enclosed equipment. These enclosures offer no protection against airborne contaminants.

Application

(continued)



Figure 3. Design of ecoWAVE Econ-Line filter with frame size B.

Note: illustration above is different from actual due to terminal upgraded. Latest model come with TDJ Module (Trap Disconnect Jumper). (refer to page 22 & 36 on TDJ Module)

Application

Example

ecoWAVE Econ-Line PHF are designed to mitigate harmonic current of non-linear loads, in particular of three-phase diode-type rectifiers. Contrary to "bus-applied or PCC" filters, which are being installed e.g. at the main feeder, they are specifically designed to be used with either an individual non-linear load, or with a group of non-linear loads.

One advantage of load-applied filtering is the fact that the upstream power (relative to the harmonic filter) is clean, i.e. unloaded by the harmonics. This can be of vital importance when the same power bus supplies both motor drives and sensitive loads. ecoWAVE Econ-Line PHF are also suitable for paralleling lower power non-linear loads on a higher power harmonic filter to improve overall system economy. In this case the total expected load power of all connected drives must match the filter.



If the expected input power exceeds the rating of the largest available filter, and a custom solution is not desired, then two or more filters can be wired in parallel. In this mode of operation, it is recommended to use filters with equal power ratings to ensure proper current sharing.



Application example with 2 filters in parallel for larger load

Example

Please follow the simple steps below to ensure a safe and reliable filter function for many years. Please do also always follow the general safety and installation guidelines provided within this document as well as relevant local, national or international standards that are applicable. Please note that the following installation steps are applicable for the IP 20 enclosure.

Step 1: Visual inspection

All ecoWAVE Econ-Line PHF have undergone rigorous testing before they left the ISO 9001:2008 certified factories. They are packaged with great care in a sturdy container for international shipment.

However, carefully inspect the shipping container for damage that may have occurred in transit. Then unpack the filter and carefully inspect for any signs of damage. Keep the shipping container for future transportation of the filter.

In the case of damage, please file a claim with the freight forwarder involved immediately and contact your local Fuji Electric partner for support. Under no circumstances install and energize a filter with visible transportation damage.

If the filter is not going to be put in service upon receipt, store within the original container in a clean, dry location, free of dust and chemicals and with respect to named temperature limits, refer to page 10 on specification's Ambient temperature range.

Step 2: Mounting

ecoWAVE Econ-Line PHF are best installed as close as possible to the non-linear load. Ideally they are mounted next to the rectifier or motor drive inside the electrical cabinet or control room.

The ecoWAVE Econ-Line PHF are designed for wall-mounting installation.

Important:

In order to ensure sufficient air flow, keep a clearance of min. 150mm above and below the filter to walls or other components. Additional work to access the device, caused by not respected clearance distances, will be accounted separately.

It must be ensured that the environmental temperature is kept below 45°C with appropriate thermal management (e.g. cabinet cooling). Filter operation in environments with higher temperatures require a temperature derating.



(continued)

1) Screw hole positions for wall mounted filters (as indicated in Table 6):

Table 6. Mounting screw hole positions.

France		Drill pattern [mm]	
Frame	W1	H1	ТØ
Α	140	370	8
В	200	435	10
С	225	500	10
D	225	500	10
E	350	665	12
F	350	665	12

All dimensions in mm; 1 inch = 25.4mm



2) Screw selection:

Fuji Electric recommends zinc coated hex ribbed flange steel bolts. Respect filters weight for appropriate choice of screws! Head diameters must not exceed these dimensions:



M6: d ≤14.2mm, M10: d ≤21.2mm

3) Filter placement:

- 1. Set screws loose into wall, leave 5mm distance from head to wall.
- 2. Lift filter with appropriate crane, smallest types (up to 25kg) may be lifted manually by two persons.
- 3. Place filter first onto lower screws...
- 4. ...then position it through backplane head openings on upper screws.
- 5. Fix screws with appropriate torque (depending upon the material of the back plane and local standards).



Step 3: Wiring

1. Verify safe disconnection of all line side power. Consult your local safety instructions.



2. Carefully connect protective earth (PE) wire to adequate earth potential close to ecoWAVE filter.

Use a wire diameter of equal or bigger size as foreseen for line/load side power cables – according to your local codes and safety instructions.

3. Connect PE wire of ecosine filter with appropriate cable lug to threaded stud.



4. Connect ecosine load side terminals L1', L2', L3' to respective motor drive or rectifier inputs.

See page 17 for the recommended wire size and torque. Use standard copper wire with a temperature rating of 75°C or higher.

An optional workflow to connect power terminals without having the TDJ module in way is applied. You might consider following these steps:

Connecting power terminals of passive harmonic filters ordered with TDJ module can be facilitated by removing the trap disconnect wires while connecting the cables to the main terminals. Afterwards the trap disconnect jumper cables need to be applied to the original position again. Please follow these steps: Open terminals D1- D1', D2- D2' and D3- D3', remove the wires, add main terminals and then fix wires on terminals D1- D1', D2- D2'and D3- D3' again. The recommended torques given on the terminal label must be applied.

Remarks regarding IP 20 enclosure

1. To connect ecoWAVE line and load side terminals, the fingure guard has to be removed as a first step, and be installed again when the line and load side terminals are connected. The screw thread and torque value for all the frame sizes are:

Screw thread: M5 Screw torque value: 4Nm

2. The metal finger guard for frame sizes E and F are equipped, ensure cable lug insulation sleeve is use during power cable terminating to fulfill the clearance and creepage requirement.

(continued)

3. For safety, ensure cable lug insulation sleeve is use during power cable terminating to fulfill the clearance and creepage requirement.



Diagram 5. Cable lug insulation sleeve

NOTICE

DESTRUCTION DUE TO INCORRECT MAINS VOLTAGE

In case the cables on the power terminals are installed without cable lug, it is recommended to follow the maintenance manual closely. For maintenance information, consult our local Fuji Electric.

Failure to follow these instructions can result in equipment damage.

4. Use wired trap circuit or install external capacitive current control. When interconnected via an external capacitor contactor (not supplied by Fuji Electric) they allow for load dependent disconnection of the trap circuit, if needed. Thus capacitive current can be minimized for low load operation. Estimation of required contactor size: see box to the right.

THE USE OF CAPACITIVE SWITCHES/CONTACTORS IS REQUIRED. OTHERWISE CAPACITOR LIFETIME MAY BE REDUCED.

Contactor performance estimate:

Example: FN55EL1M-4G5

The nominal power rating in kW multplies 20% and the grid voltage, then divided by the nominal voltage.

Is the approximate reactive power Contactor rating =

$$55KW * 20\% * \frac{V_{grid}}{V_{nom}} = 55KW * 20\% * \frac{400V}{400V} = 11KVAR$$

5. Connect monitor switch TS- TS'

The monitor switch is a relay contact, which is open in ALARM state. It is constituted by a thermal switch NC 180°C (UL-approved) to detect overload of chokes. It may either be used to remotely disconnect the drive's load via respective input of drive control (check drive manual) or as alarm sensor for system control unit.

AN ENGAGED MONITOR SWITCH MUST LEAD TO IMMEDIATE LOAD SHUTDOWN AND INVESTIGATION OF THE PROBLEM.

6. Connect auxiliary switch AS- AS' (only relevant for frame J filter 50Hz types)

The auxiliary switch is a contact, which indicates state.

AN ENGAGED AUXILIARY SWITCH MUST LEAD TO IMMEDIATE LOAD SHUTDOWN AND INVESTIGATION OF THE PROBLEM.

(continued)

The over temperature contact, enable protection in the event of filter overheat due to short circuit overcurrent in the trap circuit or too hot ambient temperature.



Note: illustration above is different from actural due to terminal upgraded.

Latest model come with TDJ Module (Trap Disconnect Jumper). (refer to page 22 & 36 on TDJ Module)

- 8. Connect ecoWAVE line side terminals L1, L2, L3 to power input protection (current limiting fuses see below). IP 20 enclosure cable wiring please refer to the remarks for the load side cable wiring.
 - Note: The IP 20 finger guard for frame E and F must be installed with cable lug insulation sleeve in order to achieve IP 20 protection. When the finger guard and cable lug insulation sleeve is not installed, Fuji Electric do not guarantee IP 20 protection.

9. Fuses

ecoWAVE PHF need external over-current protection for compliance with UL/cUL standard. Fuses and associated fuse holders must be UL listed and rated for 100kA SCCR supplies. Table 7 on page 31 show requested fuse current ratings for UL class J and, where UL compliance is not mandatory, for IEC class gG. The fuse rating is independent of the supply voltage.

A system with multiple ecoWAVE PHF paralleled for a high power load need each a separate 3-phase line side fuse block, corresponding to the respective filter and according to above table.

The drive's application manual may prescribe line-side fuse protection as well, which in this case either corresponds to the sum of the filter fuse ratings or, if lower, would request separate drive fuses at its input.



An application, having one ecoWAVE filtering harmonics of several drives, requires in any case line side fuse protection of the drives as well as the correct filter protection according to Table 7 on page 31.



Fuse

Table 7 Requested fuse current rating for UL class J and for IEC class gG

Nominal applied motor [kW]	50Hz Filter	Fuse class J [A]	Fuse class gG [A]
0.75	-	-	-
1.5	-	-	-
2.2	-	-	-
3.7	FN3.7EL1M-4G5	10	10
5.5	FN5.5EL1M-4G5	15	10
7.5	FN7.5AL1M-4G5	20	16
11	FN11EL1M-4G5	25	20
15	FN15EL1M-4G5	35	35
18.5	FN18.5EL1M-4G5	40	35
22	FN22EL1M-4G5	50	50
30	FN30EL1M-4G5	75	63
37	FN37EL1M-4G5	80	80
45	FN45EL1M-4G5	100	100
55	FN55EL1M-4G5	150	125
75	FN75EL1M-4G5	175	160
90	FN90EL1M-4G5	200	200
110	FN110EL1M-4G5	250	224
132	FN132EL1M-4G5	300	250
160	FN160EL1M-4G5	350	300

Nominal applied motor [kW]	60Hz Filter	Fuse class J [A]
0.75	-	-
1.5	-	-
2.2	-	-
3.7	FN3.7EL1M-4G6	7
5.5	FN5.5EL1M-4G6	10
7.5	FN7.5EL1M-4G6	15
11	FN11EL1M-4G6	20
15	FN15EL1M-4G6	30
18.5	FN18.5EL1M-4G6	35
22	FN22EL1M-4G6	40
30	FN30EL1M-4G6	50
37	FN37EL1M-4G6	60
45	FN45EL1M-4G6	80
55	FN55EL1M-4G6	90
75	FN75EL1M-4G6	125
90	FN90EL1M-4G6	150
110	FN110EL1M-4G6	175
132	FN132EL1M-4G6	250
160	FN160EL1M-4G6	250

Maintenance

Detail

Detail

ecoWAVE PHF described in this manual are equipped with long life components that ensure a satisfactory function for many years under normal operating conditions. Any operation under extreme conditions such as over-temperatures, overvoltage situations, polluted environments etc. reduces the life expectancy. Following maintenance recommendation will help maximizing filter lifetime.

Safety



UNEXPECTED SHOCK CIRCUIT

High voltage potentials are involved in the operation of this product. Always remove line side power before attempting to perform maintenance, and let ample time elapse for the capacitors to discharge to safe levels (<42 V). Residual voltages are to be measured both line to line and line to earth.

Line side power must be disconnected prior to replacement of any part.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

1. Maintenance schedule

Table 8. Maintenance schedule

Year	1	2	3	4	5	6	7	8	9	10	11	12
Check and clean fan(s)	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
Replace fan(s)					Х					Х		
Check & tighten el. Connections *	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
Check el. values of capacitors												
Replace power capacitors										Х		

* Only external connections need to be checked.

2. Fan

ecoWAVE PHF are reliable low maintenance products. Many products like power supplies, inverters or motor drives utilize fans for forced cooling to minimize size and weight. ecoWAVE PHF are designed with a similar temperature management concept and therefore, fans may have to be maintained and replaced in certain intervals to sustain the function and value of the product. Fans are 100% field replaceable without the need to uninstall and disconnect the filter.

Forced cooling devices are needed for the operation of ecoWAVE passive harmonic filters up to their nominal rating. Such cooling devices must be checked and cleaned regularly (if installed) to ensure sufficient air flow at all times.

Note: increased audible noise is a typical indicator of a fan that needs maintenance or replacement also outside of a maintenance schedule.

Before cleaning or replacing the cooling devices, make sure to consult the recommended maintenance procedures and schedules of the supplier of the cooling device in use.

Maintenance

(continued)

3. Power capacitors

The power capacitors supplied with the filter modules are high quality components with an expected life time of up to 100'000 hours (11 years). Nevertheless, their useful service life can be shortened by electrical or thermal stress beyond their specification.

Power capacitor damage may also be caused by severe abnormal supply voltage peaks (i.e. lightning – depending upon system protection), but may only be recognizable through the measurement of line side harmonics distortion. This may be checked with a modern energy meter or by regular checkup with a power quality analyzer. According to the above considerations, a 2 year inspection interval is advisable.

Note: an inspection should as well be performed after extreme overvoltage situations in the system.

Note: Storage of capacitors

Up to 3 years-long storage, electrolitic capacitors can be operated without any restriction and the nominal voltage can be applied without any preliminary preparation. System reliability and life-time expectancy are not affected.

On the other side, a longer (>3 yrs) storage of electrolitic capacitors without applying any voltage can weaken the dielectric properties because of disslution processes. The electrolitic solution is aggressive and it can affect and weaken the dielectric in the timeframe between production and product commissioning. The weak points are responsible for the higher leakage current shortly after the device turn-on on site.

The residual current of electrolitic capacitors depends upon time, voltage and temperature. The residual current increases after long storage without applying voltage.

The amplitude of resulting residual current during unit commissioning can be up to 10 times larger on short term. The capacitor's residual current assumes the typical expected value at steady state for nominal voltage.

During comissioning after long storage, it is recommended to restore the dielectric characteristics by applying voltage progressively and with respect to the time frame the filters have been stored.

4. Electrical connections

Depending upon the environment and application, electrical connections, in particular threaded bolts and nuts, can degrade over time by means of losing their initial tightening torque. This holds true not only for the filter, but for any such joint within an electrical installation.

Therefore, Fuji Electric recommends to check and tighten all electrical connections on the occasion of a regular scheduled maintenance of the entire device that incorporates the filter.

Check of internal connections within the filters is not needed or should be conducted by a Fuji Electric service representative

Detail

When applying ecoWAVE Econ-Line PHF on inverter application the capacitive current during low load or no load operation may present which will create a power leading factor on the electrical system. The trap circuit disconnect feature is a modular option for the purpose of reducing the capacitive current during low load or no load operation, if needed. With permanently connected trap circuit, $\cos\varphi$ vs. load shows following characteristics:



When the trap circuit is disconnected, cos(phi) returns to ~0.98. At the same time, the THID will increase. This may be negligible, since absolute values are low due to reduced load power. Needed external components (not part of ecoWAVE filter) or system functions for fully automated capacitive current control:

| Motor load (power factor) monitoring device

| Capacitor contactor

A reduced load system status may be available as system controller output signal. In this case, only adequate driving of capacitor contactor has to be assured.

Note: It is necessary to take into account overall concept of power factor correction. A system PFC correction unit with large capacitor banks may become obsolete or massively reduced, when harmonic filters are installed. In such cases it may not be necessary to install trap circuit disconnect functions.

Recommended settings:

Fuji Electric recommends to engage and disengage the trap circuit disconnect at following load levels:

Trap circuit status	Proposed load level
Disconnect	When load level drops under 10-15%
Connect	When load level rises above 20-25%

Troubleshooting

ecoWAVE PHF are high quality products and have undergone rigorous testing and qualification procedures. Every unit runs through suitable tests in our ISO 9001:2000 factories. Due to this reason no major issues need to be expected if the filter is installed, operated, and maintained as described in this document.

In the unlikely event of a problem, please contact your local Fuji Electric or partner for assistance.

For Inverter Application

Introduce an optional isolation contactor to disconnect trap capacitor and eliminate power leading factor when inverter is not operating (stand-by mode).

(refer to page 35 to 36 for sizing of the contactor for diffrent rating.)

(continued)

Fuji Electric recommends to engage and disengage the trap circuit disconnect using mangetic contactor. The contactor will disconnect the filter's capacitor when the application's equipment is on stand-by (not operating) mode to prevent the leading power factor occurred and achieve a better system power quality. The recommended Fuji Electric contactor selection shown in the table below.

3-phase, 380...415Vac 50 Hz

Model Number	Nominal Power		Fuji Electric SC series contactor		
	kW	HP	Туре*	[A]	
-	0.75	1			
-	1.5	2	_	-	
-	2.2	3			
FN3.7EL1M-4G5	3.7	5			
FN5.5EL1M-4G5	5.5	71/2			
FN7.5EL1M-4G5	7.5	10	SC-03 AC220V/ 1A	2.4	
FN11EL1M-4G5	11	15	00-00 002200 10	8.7	
FN15EL1M-4G5	15	20			
FN18.5EL1M-4G5	18.5	25			
FN22EL1M-4G5	22	30		10	
FN30EL1M-4G5	30	40	5C-4-0 AC220V TA	15	
FN37EL1M-4G5	37	50	SC-4-1 AC220 1A	17	
FN45EL1M-4G5	45	60	SC N1 AC220 1A	24	
FN55EL1M-4G5	55	75	3C-NT AC220 TA	24	
FN75EL1M-4G5	75	100	SC-N2 AC220 1A	32.5	
FN90EL1M-4G5	90	125	SC-N2S AC220 1A	39.5	
FN110EL1M-4G5	110	150	SC-N3 AC220 1A	46.5	
FN132EL1M-4G5	132	200	SC-N4 AC220 1A	62	
FN160EL1M-4G5	160	250	SC-N5A AC220 1A	76	

* All contractor come with 1 "NO" aux contract.

Sizing of contactor

Step 1

Step 1
 Step 1

 Example: FN55EL1M-4G5
 55kW x 20% x
$$\frac{Vgrid}{Vnom}$$
 55kW x 20% x $\frac{400V}{400V}$ = 11kVAR

Contactor performance estimate: The nominal power rating in kW multplies 20% and the grid voltage, then divided by the nominal voltage. The approximate reactive power Contactor rating for FN55EL1M-4G5 = 11kVAR

Step 2

Calculate the line current i1 :

i1=
$$\frac{Q}{U\sqrt{3}}$$
 = $\frac{11000}{400 \times 1.732}$ = 15.87A

In case of 60 Hz calculation, use 460V instead of 400V.

Step 3

Use a safety factor (standard) to take harmonics into account, this gives :

The selected contactor should not be smaller then 22.7A

The selected contactor SC series : SC-N1/AC220V/1A (24A)

(continued)

Fuji Electric recommends to engage and disengage the trap circuit disconnect using mangetic contactor. The contactor will disconnect the filter's capacitor when the application's equipment is on stand-by (not operating) mode to prevent the leading power factor occurred and achieve a better system power quality. The recommended Fuji Electric contactor selection shown in the table below.

3-01105E. 300400Vac 00 T.	3-phase.	380.	480\	/ac	60	Ha
---------------------------	----------	------	------	-----	----	----

Model Number	Nomin Power	al	Fuji Electric SC series contacto	or
	kW	HP	Туре*	[A]
-	0.75	1		
-	1.5	2	-	-
-	2.2	3		
FN3.7EL1M-4G6	3.7	5		
FN5.5EL1M-4G6	5.5	71/2		
FN7.5EL1M-4G6	7.5	10		2.4
FN11EL1M-4G6	11	15	SC-03 AC220V 1A	~
FN15EL1M-4G6	15	20		8.7
FN18.5EL1M-4G6	18.5	25		
FN22EL1M-4G6	22	30		
FN30EL1M-4G6	30	40	SC-4-0 AC220V 1A	13
FN37EL1M-4G6	37	50	SC-4-1 AC220 1A	17
FN45EL1M-4G6	45	60	00-4-1 A0220 1A	17
FN55EL1M-4G6	55	75	SC-N1 AC220 1A	24
FN75EL1M-4G6	75	100	SC-N2 AC220 1A	32.5
FN90EL1M-4G6	90	125	SC N2S AC220 1A	30.5
FN110EL1M-4G6	110	150	00-1120 A0220 TA	39.5
FN132EL1M-4G6	132	200	SC-N4 AC220 1A	62
FN160EL1M-4G6	160	250		02

* All contractor come with 1 "NO" aux contract.

Wiring Diagram



Troubleshooting

(continued)

Fuji Electric ecoWAVE passive harmonic filters are high quality products and have undergone rigorous testing and qualification procedures. Every unit runs through suitable tests in our ISO 9001:2000 factories. Due to this reason no major issues need to be expected if the filter is installed, operated, and maintained as described in this document.

In the unlikely event of a problem, please contact your local Fuji Electric or partner for assistance.



This document has been carefully checked. However, Fuji Electric does not assume any liability for errors or inaccuracies. Published specifications are subject to change without notice. Product suitability for an area of application must ultimately be determined by the customer. In all cases, products must never be operated outside their published specifications.

The purpose of this manual is to provide accurate information in the handling, setting up and operating of the ecoWAVE Passive Harmonic Filter series. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric be liable for any direct or indirect damages resulting from the application of the information in this manual.

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Note





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