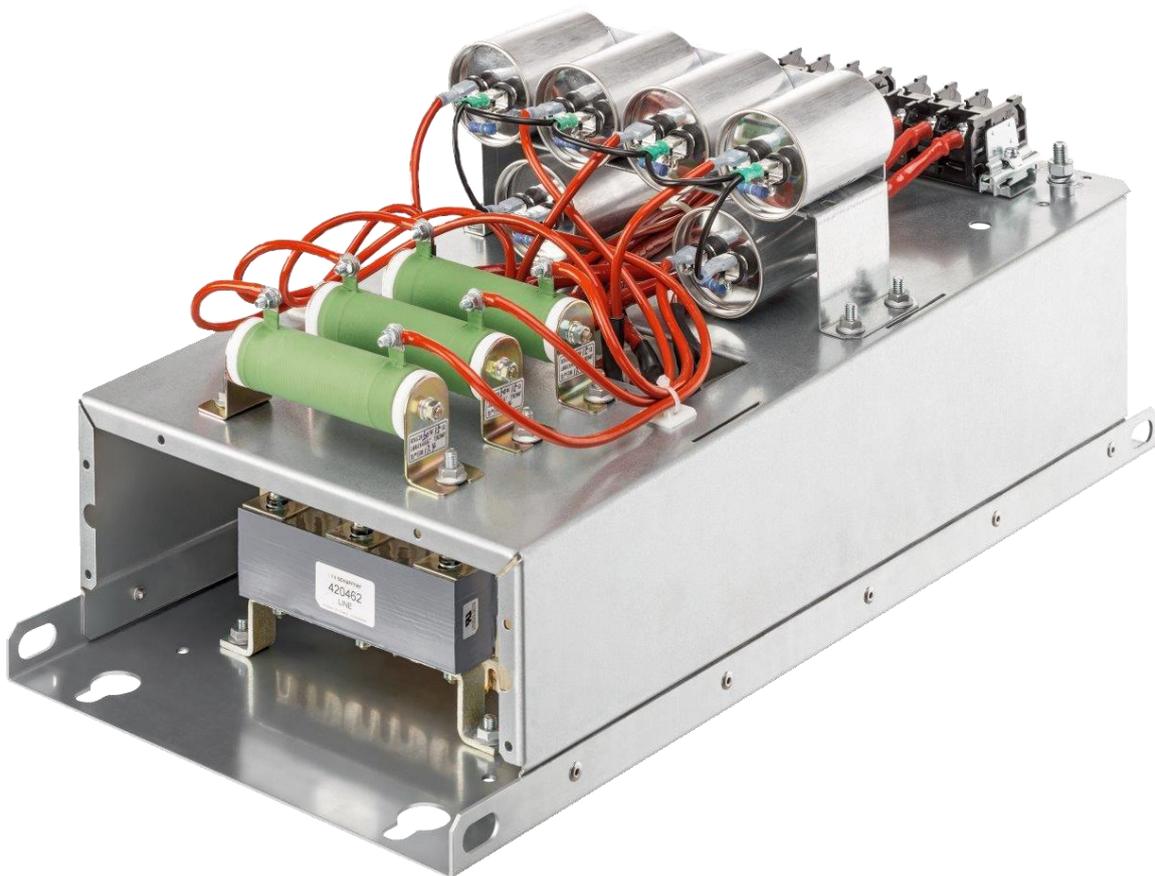


USER AND INSTALLATION MANUAL

LCL Filters



Revision: 02 (July 2023)

English version (original instructions)

The most current edition of this document (PDF format) can be obtained from your contact of the Schaffner organization or at [schaffner.com/downloads](https://www.schaffner.com/downloads).

Other technical documentation of our products is also available in the download area of our website [schaffner.com](https://www.schaffner.com).

Document name:

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Valid for LCL Filters version:

FN6840

Version history

Revision	Date	Description
01	July 2018	Initial version
02	July 2023	Update to new Schaffner branding template. Minor corrections and clarification across the document. Section 3.2.2 current derating by altitude, new calculation.

i. LCL Filters

Product characteristics and field of application

The LCL family FN6840 has been designed for AFE (Active Front End) drives. In addition, the LCL filter can also be applied in combination with other AIC (Active Infeed Converter) applications in case the specification does fit their requirements.

An LCL filter belongs as a functional part to the AFE or AIC. As a functional part it provides an impedance between grid and drive, which is necessary to connect the AFE to the grid and to control the input current. Depending on the grid impedance and drive settings, the LCL filter can limit the ripple current generated by the AFE/AIC to a level of <5%.

The ready-to-be-connected compact enclosed filter includes all the necessary LCL components in one package.

Please note that some information in this document relate to filter sizes and versions that might not be available at the time of reading. Please consult Schaffner sales to get the latest information about our offering.

The standard FN6840 LCL filter series from Schaffner has the following key features:

- Current and voltage range of 25 A ... 380 A @ 50°C, up to 480 VAC 50/60Hz
- Versions with or without resonance damping
- Versions without cooling fan and without power supply (up to 250A)
- Versions with cooling fan and with power supply (380A only)
- Versions in IP00
- Custom specific adaptations to fulfil dedicated requirements

Typical examples of regenerative motor drives applications:

- Elevator, hoists and cranes, transportation systems
- Machine tools, machines with frequent breaking cycles
- Centrifuges, flywheels (when switched off)
- Winder / Unwinder, rolling mills run-out tables
- Press feeders
- Test stands

Typical examples of other AIC applications:

- Renewable energy, e.g. Wind generator or Photovoltaic inverter
- Energy storage or battery charging systems

To fulfill customized application requirements please contact our local sales and support organization. The LCL filter from Schaffner can be configured in different ways (with/without resonance damping, with/without cooling fan).

This user manual is intended to support designers, installers, and application engineers with filter selection, installation, application, and maintenance.

For additional support, please feel free to contact your local Schaffner sales and support organization.

ii. Important user notice

Schaffner LCL Filters are designed for the operation on the input (grid) side of power electronic equipment with AFE (Active Front End) or AIC (Active Infeed Converter) in balanced three-phase power systems, like typically used for AC motor drives and other converter systems. Filter suitability for a given application must be determined by the user on a case-by-case basis. Schaffner will not assume liability

for any consequential downtimes or damages resulting from the use of LCL Filters outside of their specifications.

iii. General Safety Notes and Installation Guidelines (Cautions and Warnings)

Schaffner LCL Filters delivery package contains the following important “General Safety Notes and Installation Guidelines” which needs to be carefully read and understood before the product is being installed.

Please contact your local Schaffner sales and support organization in case the document is not contained within the delivery.

1. Important information

These general safety notes refer to the group of LCL filters. Do not attempt to install, operate, maintain or inspect LCL filters until you have read through the safety notes and installation guidelines as well as installation manual and product specification. Do not use any Schaffner products until you have a full knowledge of the equipment, safety notes and installation guidelines. The same applies to all warnings placed on the filters. Please ensure that those are not removed and their legibility is not influenced by external factors.

The following symbols, terms and designations are used in these general safety notes and installation guidelines:

Label	Description
 CAUTION	Follow these instructions to avoid hazardous conditions which could cause minor or moderate injury or may cause damages to the unit.
 WARNING	Follow these instructions to avoid hazardous conditions which could result in death or serious injury.
NOTICE	Indicates content to be noted by the user.

2. General installation notes

- Please read and follow the safety and application notes below.
- Carefully inspect the shipping container and the product prior to the installation. In case of visual damage, don't install the filter and file a claim with the freight carrier involved.
- Filters may be heavy. Follow the instructions for lifting heavy equipment defined by your company.
- Use an appropriately sized threaded bolt for every mounting hole/slot provided by the filter flange. The strength class of the bolt must be determined by the installer, depending upon filter weight and the material of the mounting surface.
- Connect the filter to the protective earth (PE) terminal(s).
- Remove all line side power, then connect the phase terminal(s) and neutral terminal (if any) of the filter. The filter label may also indicate LINE (grid side terminals) and LOAD (power electronics terminals).
- For the electrical connection of the filter terminals, apply the torques recommended on the filter label and/or in the published filter data sheets.
- Cable or bus bar cross sections have to be chosen in accordance with national and international electric codes and applicable product standards governing the equipment that will incorporate the LCL filters and the equipment in use.
- Some filters provide additional terminals, e.g. for over-temperature monitoring. These features have to be properly used before energizing the filter. If uncertain, please consult your local Schaffner representative.
- In order to get the maximum benefit out of your LCL filter, please also consult additional user manuals, installation manuals, white paper and other material, published in the download section of www.schaffner.com. These additional guidelines provide helpful hints for equipment related topics as well as technical knowledge.

3. Safety notes and regulations

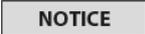
1. Label on equipment 2. Safety note category	Safety note regulations
 	Equipment installation, start-up, operation and maintenance (if any) have to be carried out by a trained and certified electrician or technician, who is familiar with safety procedures in electrical systems. Non-qualified persons are not allowed to use, install, operate or maintain LCL filters!
 	High voltage potentials are involved in the operation of power quality equipment. Always remove power before handling energized parts of the filter, and let ample time elapse for the capacitors to discharge to safe levels (<42V). Residual voltages are to be measured both line to line and line to earth.
 	Correct protective earthing of the equipment must be established and the user must be protected against supply voltage in accordance with applicable national and local regulations. Always practice the safety procedures defined by your company and by applicable national electric codes when handling, installing, operating or maintaining electrical equipment.
 	When an EMI filter is required together with the LCL filter contact your local Schaffner partner for assistance.
 	Some products may include EMI filters which may cause leakage currents to ground. Always connect the filter to protective earth (PE) first, then continue with the wiring of phase/neutral terminals. When decommissioning the filter, remove the PE connection at the end.
 	LCL filters are working with resonance circuits to fulfill specified performance. Always operate the system within specified switching frequency range.
 	In some filter types circuit breakers are limiting short circuit current flowing into the capacitors in case of filter malfunction. Do not manually operate the circuit breaker under voltage or during operation of the system.
	The system performance is highly dependent on the control parameters. The setting of the parameters must be advised or done by a technical AFE/AIC expert.
 	Follow the general installation and environmental condition notes closely. Ensure that cooling slots (if any) are free from obstructions that could inhibit efficient air circulation. Operate the filter within its electrical, mechanical, thermal and ambient specifications at all times.
 	LCL filters are lossy electrical components. Parts/surfaces of the equipment may get hot when the filter is working (also when the system is idle). Damping resistors can reach temperatures up to 275 °C.
	At altitudes above 2000 m, please contact Schaffner prior to installation.
	Filter suitability for a given application must ultimately be determined by the user (the party that is putting the filter into operation) on a case by case basis. Schaffner will not assume liability for any consequential downtimes or damages resulting from use of filters outside their specifications.
	In case of uncertainty and questions please contact your local Schaffner partner for assistance (details per region available at www.schaffner.com).

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1 LCL filter designation

The designation of the standard offering for LCL filter FN6840 are shown as follow:

FN6840 – xxx – yyy – E 0 XX R

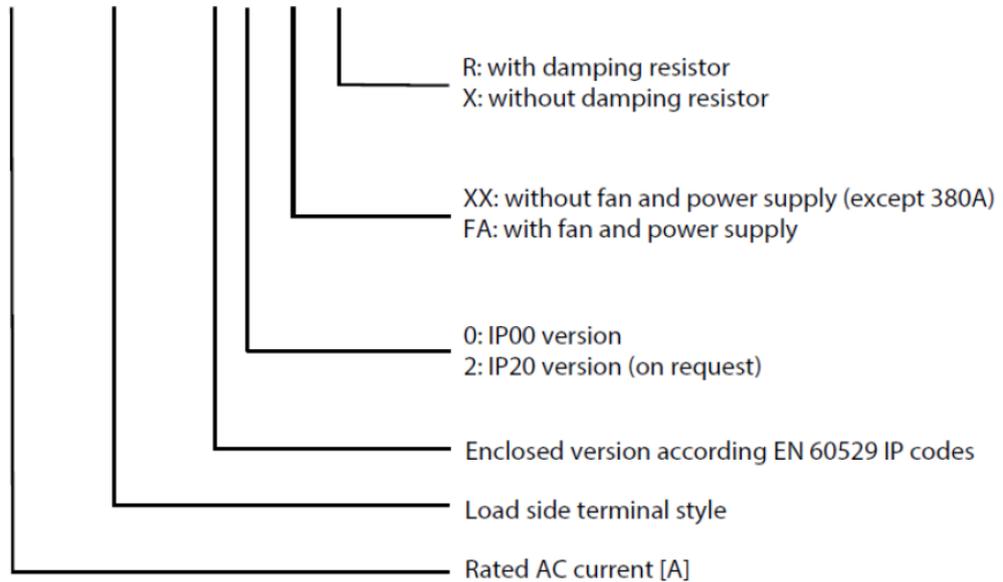


Figure 1 LCL filter FN6840 designation

Examples of LCL filter designations:

FN6840-25-113-E0XXR: Filter for 50/60 Hz, up to 480 V AC grid, current rating 25A @50°C/50Hz, with 16mm² terminals, open frame (IP 00), filter contains a damping module/resistors

FN6840-380-118-E0FAR: Filter for 50/60 Hz, up to 480 V AC grid, current rating 380A @50°C/50Hz, with 240mm² terminals, open frame (IP 00), with fan and power supply, filter contains a damping module/resistors.

2 Filter selection

LCL Filters need to be carefully selected and configured in order to fulfill the application requirements. Therefore, please select the standard LCL filter only if the specification of the LCL filter FN6840 fulfills your application needs. In case you have dedicated specifications to be fulfilled, please contact your local Schaffner sales and support organization. Based on your feedback, Schaffner will check the feasibility and provide you a customized proposal in case the requirement can be accomplished.

2.1 LCL Filter selection table FN6840

Filter*	Rated current @50°C [A]	Typical motor drive apparent power** 400V/50Hz [kVA]	Nominal inductance		Nominal capacity [µF]	Typical power losses*** [W]	Weight [kg]	Input/output terminals	Frame size
			L1 [mH]	L2 [mH]					
with RLC damping module:									
FN6840-25-113-E0XXR	25	17	2.35	1.22	30	390	26	-113	D
FN 6840-50-115-E0XXR	50	35	1.18	0.61	60	580	47	-115	E
FN 6840-80-115-E0XXR	80	55	0.74	0.33	100	750	79	-115	F
FN 6840-160-118-E0XXR	160	110	0.37	0.17	200	1430	125	-118	H
FN 6840-250-118-E0XXR	250	170	0.24	0.11	300	1880	153	-118	H
FN 6840-380-118-E0FAR	380	260	0.15	0.07	500	3005	164	-118	H
without damping module:									
FN 6840-25-113-E0XXX	25	17	2.35	1.22	30	360	24	-113	D
FN 6840-50-115-E0XXX	50	35	1.18	0.61	60	525	46	-115	E
FN 6840-80-115-E0XXX	80	55	0.74	0.33	100	660	77	-115	F
FN 6840-160-118-E0XXX	160	110	0.37	0.17	200	1250	123	-118	H
FN 6840-250-118-E0XXX	250	170	0.24	0.11	300	1595	148	-118	H
FN 6840-380-118-E0FAX	380	260	0.15	0.07	500	2625	159	-118	H

* Some rated current size might not be available now or on request only. Please contact your Schaffner sales for more information.

** Rated current @ 400 VAC/50 Hz. The proper power selection depends upon the drive specification, the motor and the application requirements.

*** Losses calculated at 400 VAC/50 Hz and 3 kHz switching frequency

2.2 Filter configurations without fan for forced cooling

Frame sizes D, E, F and H (up to 250 A) do not require air-flow for cooling hence they are not equipped with a fan. The cooling with natural convection is enough if the filter is operating within its specification.

2.3 Filter configurations with fan for forced cooling

Frame size H (380 A) has an integrated ventilation with an fan and auxiliary power supply. For operating the filter within its specification, the air flow of the forced cooling needs to be ensured within the cabinet.

3 Filter description

3.1 General electrical specifications of LCL filter FN6840

Nominal operating voltage:	max. 480 VAC
Rated operating voltage:	max. 530 VAC
Operating frequency:	50/60 Hz
AFE/AIC Switching frequency:	3 kHz up to 10 kHz
Rated currents:	25 to 380 A
Rated inductance L2 (inverter/converter side):	8% @ 400V, 50 Hz and rated current
Rated inductance L1 (grid/line side):	4% @ 400V, 50 Hz and rated current
Overload capability:	1.6 x rated current for 1 min., ones per hour
Filter performance:	Prerequisite: Grid supply by insulated transformer
Remaining ripple current ¹⁾ :	< 5% (max. ripple _{pk-pk} vs. fundamental _{pk-pk})
Line impedance:	$L_{grid} \geq 1\%$
THDi ²⁾ :	$\leq 5\%$ acc. EN61000-3-12
High potential test voltage: ³⁾	P → E 2480 VAC (1s)
Protection category:	IP 00 (IP20 on request)
Ambient temperature range:	-25°C to +45°C fully operational >45°C to +70°C derated operation ⁴⁾ -25°C to +85°C transportation and storage
Flammability class:	UL 94V-2
Insulation class of magnetic components:	N (200°C)
Creepage and clearance distances:	According UL61800-5-1
Design corresponding to:	Filter: UL61800-5-1, EN61800-5-1 Chokes: EN61558-2-20 or EN60076-6
Temperature monitor output contact:	Thermal switch NC 180° C (UL-approved) to detect overtemperature of chokes

1) for detailed resulting ripple current, please contact your local Schaffner office or partner.

2) the THDi acc. EN61000-3-12 or IEEE519 is not required for AFE applications as those standards refer to the harmonics of the grid frequency generated by e.g. 6-pulse rectifier.

3) Repetitive tests to be performed at max. 80% of above levels, for 1 second.

4) I_{derated} = I_{nominal} × $\sqrt{((70^\circ\text{C} - T_{amb})/20^\circ\text{C})}$

3.2 Additional electrical specifications

LCL Filters general electrical specifications refer to operating altitudes up to 2000m (6600ft) above sea level.

Operation between 2000m and 4000m (6600ft and 13123ft) requires a derating for clearance and current.

3.2.1 Clearance derating by altitude

Table 1 Altitude correction factors for clearances (extract from table A.2 in IEC 60664-1)

Altitude [m]	Normal barometric pressure	Multiplication factor for clearances
[m]	[kPa]	
2'000	80.0	1.00
3'000	70.0	1.14
4'000	62.0	1.29

3.2.2 Current derating by altitude

The current derating is the factor to which the nominal current needs to be multiplied. A simplified equation can be defined as function of ΔH ($H - 2000$). This equation is valid for H up to 4000 meters ($\Delta H = 2000$ m).

$$\text{Current derating } [I_n^{-1}] = -5 * 10^{-5} * \Delta H + 0.9937$$

Example: at an altitude of 3'500m, we get $\Delta H = 1'500$ m and the current derating = 0.9187. A filter with a rated current of 100A can only be used up to 91.87A.

Remark: Do not use LCL Filters in altitudes above 4000m without consulting Schaffner first.

3.3 Screw size, torque and cable cross-section requirement

3.3.1 Power terminals

The cable cross-section must be selected according the rated filter input current, the maximum current, the environment and other special requirement of the application. It should be stranded copper wire cable with a temperature rating of $\geq 75^\circ\text{C}$. Recommended cable cross-section is given in Table 2. The customer is fully responsible to define the most appropriate conductor type according to the application and ensure a proper connection of the filter.

Table 2 LCL Filters power terminals designation

Terminal designation	Screw thread	Flex wire AWG	Flex wire	Screw torque value	Max width cable lug*	Frame size
			[mm ²]			
-113	M6	6-18	0.75-16	3	15	D
-115	M8	1/0-8	10.50	8	15	E, F
-118	M10	3/0-500 kcmil	95-240	10	35	H

* Recommended connector type: wire or cable lug for 110 to 113, only cable lug for 115 to 118

** To fulfill creepage/clearance acc. UL 61800-5-1 without additional protection (insulation). Creepage/clearance can vary depending on applicable standard and must be reviewed by customer. Creepage/clearance may be reduced when additional protection (insulation) is provided.

3.4 Cooling requirement

Please note that only the 380A LCL Filters have an embedded fan and powered supply. The lower rated LCL Filters do not require forced air cooling.

3.5 Damping resistors

The versions E0xxR have in use power resistors to ensure proper damping of the switching frequency. The damping resistors are designed to dissipate the energy in the resonance circuit. Thus the damping resistors can reach temperatures as high as 275°C !

Caution: risk of burning - do not touch the damping resistors during operation.

3.6 Circuit breaker

The ratings 160, 250 and 380A have installed a circuit breaker in the capacitor circuit to ensure safe capacitor disconnection in case of a short circuit. The capacitors can safely handle a short circuit current of 10'000A, but for these filter size, in case of short-circuit, the current could reach higher values in the trap circuit. This is why a safety device is installed to protect the capacitors.

For the ratings 25, 50 and 80A the impedance of the line choke is limiting the current to a value < 10 kA. By default, the circuit breaker is set to status "on".

Auxiliary contacts are provided along with the circuit breaker, with one NC normally closed and one NO normally open contact. The NO auxiliary contact must be used in the control system to ensure the interruption of the power branch the filter is connected to. The NC auxiliary contact is available to be used for signaling and/or warning purpose.

The circuit breaker must never be switched-off manually when the application is in operation or under voltage. There is a risk of electrical shock when doing so!

3.7 Mechanical frame sizes

The components of the LCL Filters FN6840 are implemented on a base plate or base frame with 4 different frame sizes, Frame D to Frame H, from the lowest to the highest rating. Dimensions and footprint are provided in section 3.8.

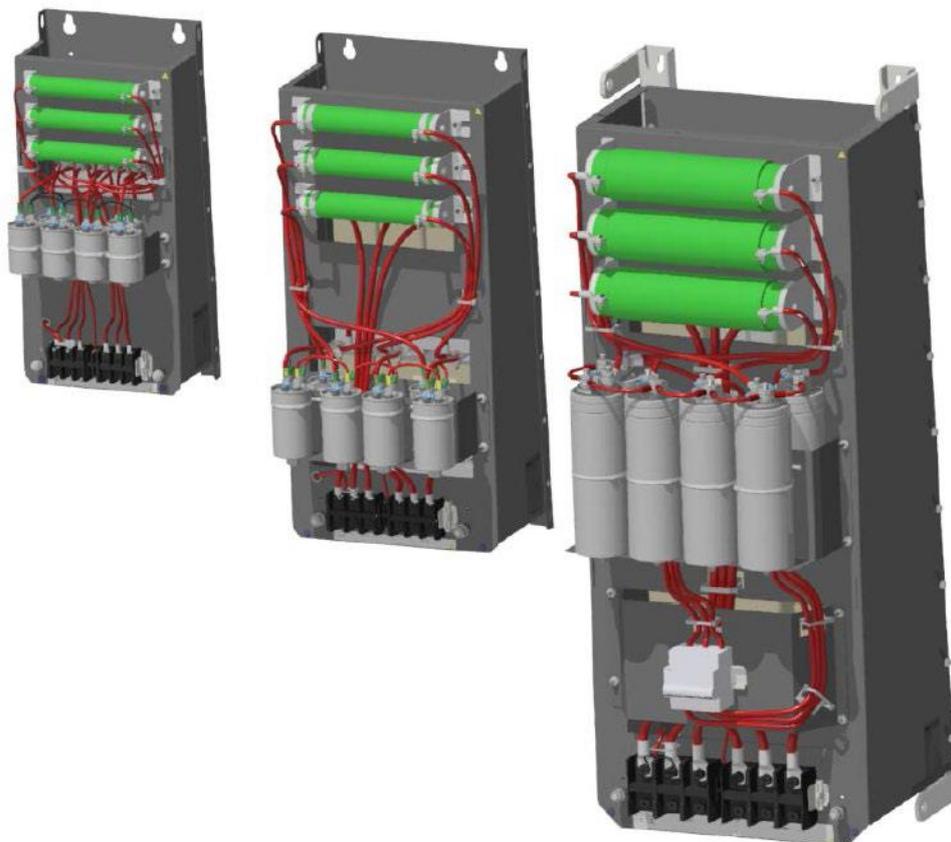


Figure 2 Overview of all IP 00 frame size versions

3.8 LCL filter FN6840 footprint

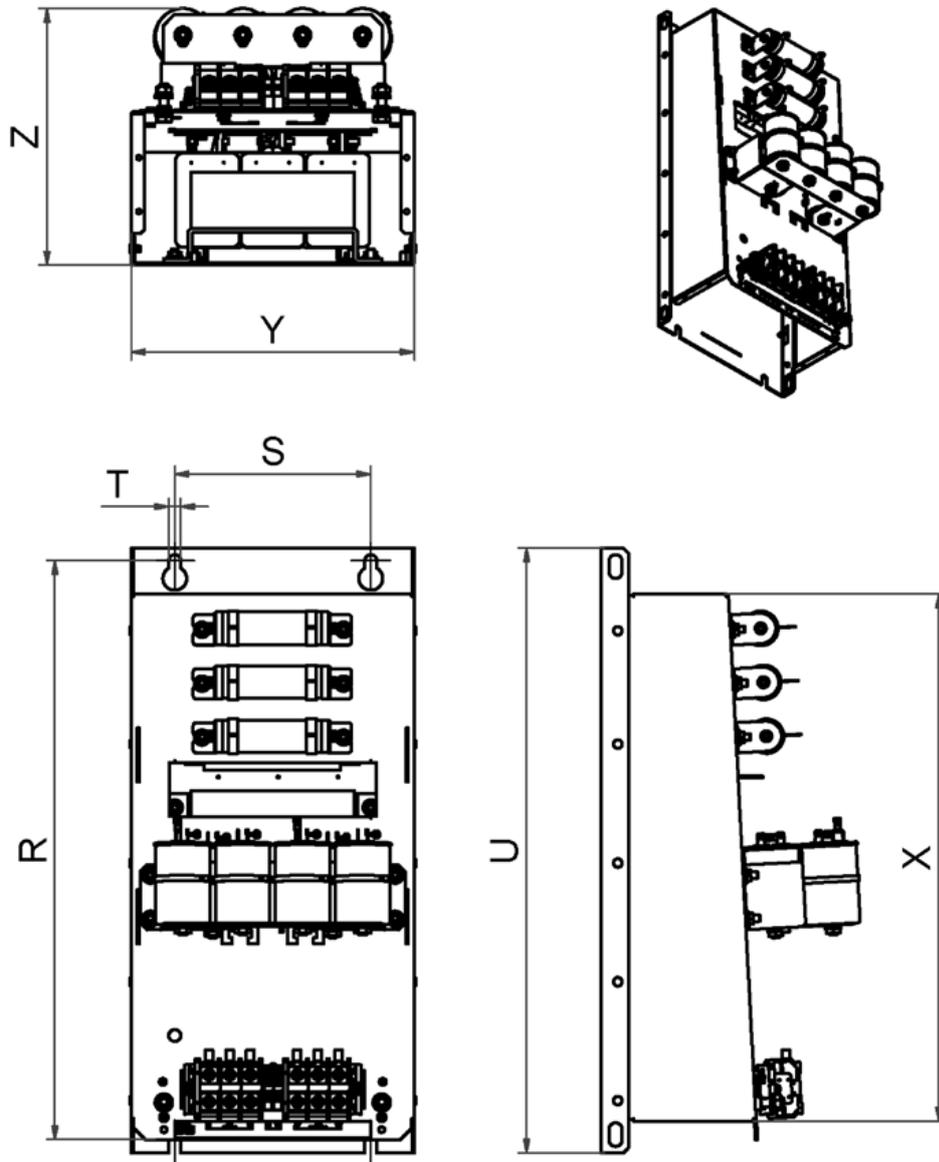


Figure 3 Mechanical Data of FN6840

Table 3 Dimensions of all frame sizes

Frame	Dimensions in [mm]									Dimensions in [in]					
	Drill pattern			Base	Volume			Drill pattern			Base	Volume			
	R	S	T	U	X	Y	Max. Z	R	S	T	U	X	Y	Max. Z	
D	540	180	11	560	491	260	252	21.3	7.1	0.4	22.0	19.3	10.2	9.9	
E	680	220	11	705	635	290	318	26.8	8.7	0.4	27.8	25.0	11.4	12.5	
F	730	250	11	752	684	340	343	28.7	9.8	0.4	29.6	26.9	13.4	13.5	
H	1115	390	11	1150	1053	462	456	43.9	15.4	0.4	45.3	41.5	18.2	18.0	

For Dimensions without Tolerances: ISO2768-m/EN22768-m applies

3.9 LCL Filter performance

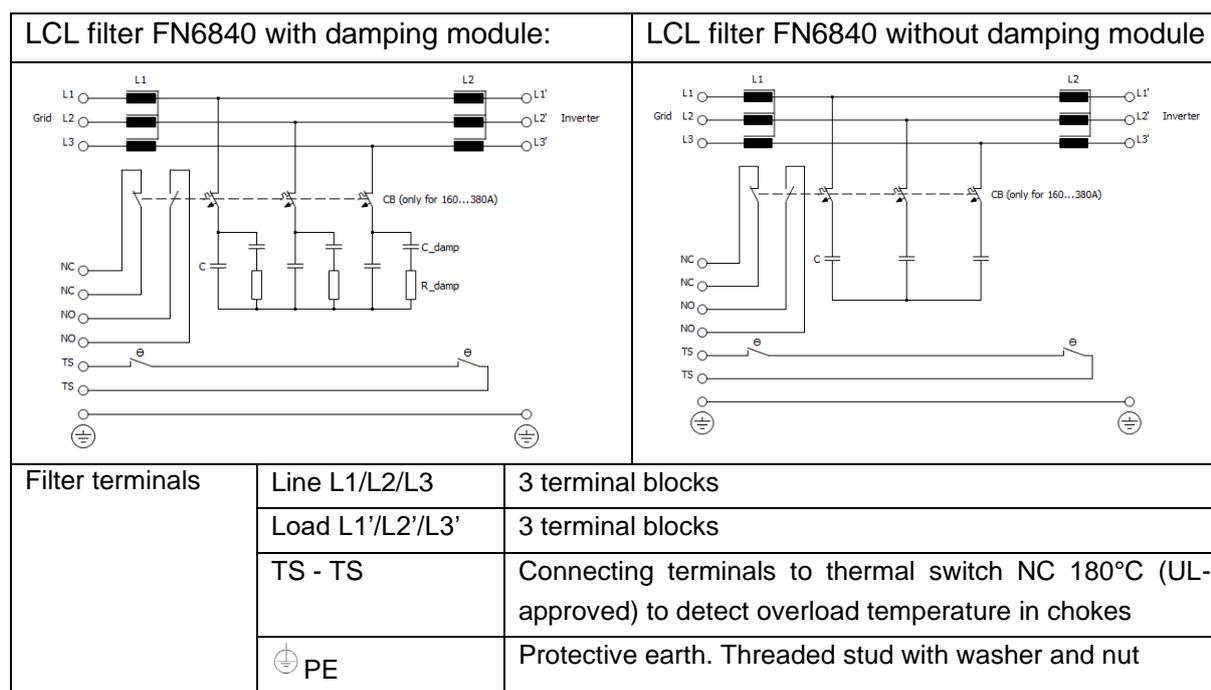
The LCL filter can achieve its performance, if the LCL filter FN6840 specification is suitable to the application requirements. Additional prerequisites are that the line side is supplied by a main isolation transformer and that the grid impedance is $\geq 1\%$. Under those conditions and within the kept filter specifications the remaining ripple current is $< 5\%$ (max.ripple current_{pk-pk} vs fundamental_{pk-pk}). THDi according EN61000-3-12 is $< 5\%$ in any case. This value shall be used just for reference only as that standard is not applicable for LCL filter applications.

Schaffner strongly recommends, that the LCL filter version with damping module/resistors are used in case the AFE motor drive or AIC has no active damping function. Only in case the drive has a working active damping function, an LCL filter without a damping module would be tolerable.

3.10 Drive settings

The performance (stability, ripple current, phase shift) is highly dependent on the control parameters. The setting of the parameter must be advised or done by a technical expert. It is not Schaffner's responsibility to set up the drive correctly to make the system work properly.

3.11 Functional diagram



3.12 EMI-filter

When the LCL filter must be combined with an EMI-filter to fulfill an EMI-standard, your local Schaffner office or Schaffner partner shall be contacted in order to support the selection of the matching product.

Note: be aware that not all EMI-filters are suitable due to unwanted resonances between LCL- and EMI-filter

4 Filter appearance and elements

The very compact and neat design of LCL filter FN6840 is realized by a two-level construction. The principle filter construction of all frame size are identical, except the 380 A rating is equipped with a fan and an auxiliary supply.

4.1 IP 00 version, frame size D - F

The general design of the IP 00 versions with damping module and without fan is shown in Figure 4. The design and construction of the lower-level is shown in Figure 4 left. The line choke $L1$ and the load choke $L2$ on the base plate, which contains screw holes for wall mounting. The power terminal, the power capacitors and the resistors of the damping module are placed on the upper-level.

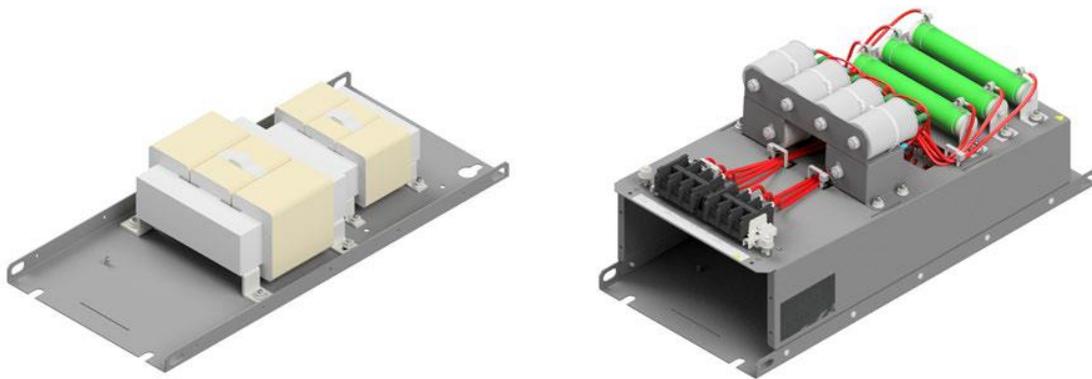


Figure 4 Design of LCL filter FN6840 (Type E0XXR, frames D to F): lower level left and upper-level right

4.2 IP 00 version, frame size H (380 A only)

The design of the LCL filter 380 A with fan- and aux. power supply module (E0FAR) is shown in Figure 5.

The design and construction of the lower-level is shown in Figure 5 left. The line choke $L1$ and the load choke $L2$ on the base frame, which contains screw holes for wall mounting. The power terminal, the power capacitors and resistors of the damping module and a circuit breaker are placed on the upper-level in Figure 5 right.

The fan module is visible at the lower level.

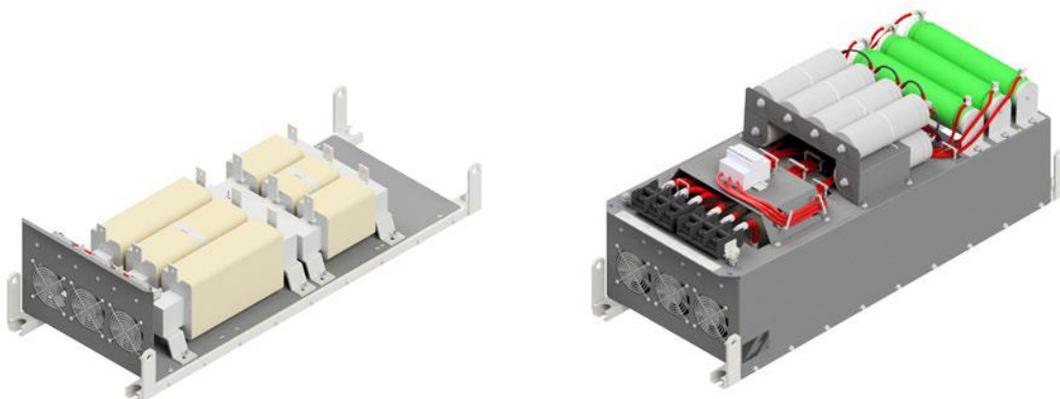


Figure 5 Design of LCL filter FN6840 (Type E0FAR, frame H): upper-level right and lower level left.

5 Filter installation

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.

5.1 Step 1: Visual inspection

All Schaffner LCL Filters have undergone rigorous testing before they left our 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 Schaffner 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, see section 3.1.

5.2 Step 2: Mounting

LCL Filters are best installed as close as possible to the AFE or AIC. Ideally they are mounted next to the rectifier or motor drive inside the electrical cabinet or control room.

All LCL Filters FN6840 are designed for wall-mounting installation.



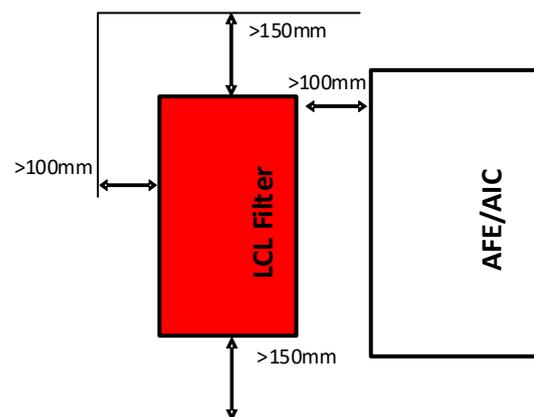
It is forbidden to mount LCL Filters in flat position or any other position than wall-mounting in upward position (cable entry from the bottom) as stated in this manual.

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 50°C with appropriate thermal management (e.g. cabinet cooling). Filter operation in environments with higher temperatures require a temperature derating.

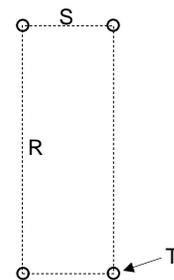


II.1 Screw hole positions for wall mounted filters
(as indicated in Table 4):

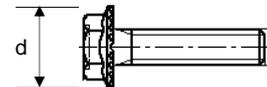
Table 4 Dimensions of frame sizes

Frame	Drill pattern [mm]		
	R	S	T
D	540	180	11
E	680	220	11
F	730	250	11
H	1115	390	11

All dimensions in mm; 1 inch = 25.4mm

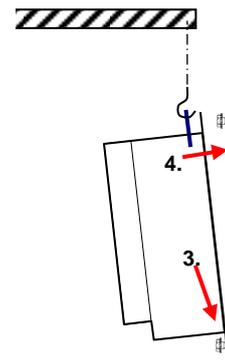


II.2 Screw selection: Schaffner recommends zinc coated hex ribbed flange steel bolts. Respect filters weight for appropriate choice of screws! Head diameters must not exceed these dimensions:
M6: $d \leq 14.2\text{mm}$, M10: $d \leq 21.2\text{mm}$



II.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).



5.3 Step 3: Wiring

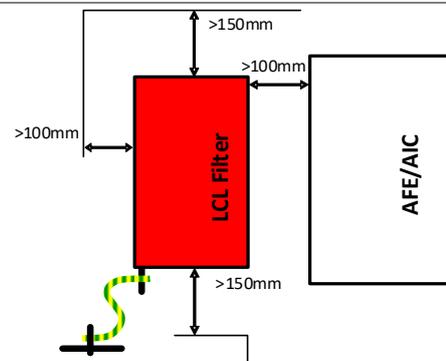
5.3.1 Verify safe disconnection of all line side power.

Consult your local safety instructions.



5.3.2 Carefully connect protective earth (PE) wire to adequate earth potential close to LCL 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.



5.3.3 Connect PE wire of LCL filter

with appropriate cable lug to threaded stud.

torque M5:	2.2 Nm
torque M6:	4 Nm
torque M8:	9 Nm
torque M10:	19 Nm
torque M12:	25 Nm

5.3.4 Connect LCL Filters load side terminals L1', L2', L3' to respective motor drive or rectifier inputs.

The third part of LCL Filters designation is a number contains three digits, i.e. FN6840-25-113, which indicates power terminal type.

See section 3.3 for the recommended wire size and torque. Use stranded copper wire with a temperature rating of 75°C or higher.

Note: In case the cables on the power terminals are installed without cable lug, it is recommended to follow the maintenance manual closely. Maintenance manual is available on your request per Schaffner contact.

5.3.5 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.

5.3.6 Connect LCL Filters line side terminals L1, L2, L3

Connect 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 (see 5.3.4).

5.3.7 Fuses

It is recommended to add external over-current protection for the LCL Filters. Table 4 shows requested fuse current ratings for UL class J and for IEC class gG. The fuse rating is independent of the supply voltage.

Table 5 Requested fuse current rating for UL class J and for IEC class gG

LCL filter rating	Fuse class J rated current [A]	Fuse class gG rated current [A]
All FN 6840		
FN6840-25-113	40	35
FN6840-50-115	80	80
FN6840-80-115	150	125
FN6840-160-118	250	224
FN6840-250-118	350	300
FN6840-380-118	600	600

6 Filter maintenance

LCL Filters 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. The following maintenance recommendations will help maximize filter lifetime.

Warnings:



High voltage potential is 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.

6.1 Maintenance schedule

Table 6 Maintenance schedule

year	1	2	3	4	5	6	7	8	9	10	11	12
check and clean fan(s)	X	X	X	X	X	X	X	X	X	X	X	X
replace fan(s)					X					X		
check & tighten el. Connections ¹⁾	X	X	X	X	X	X	X	X	X	X	X	X
check el. values of capacitors		X		X		X		X		X		X
replace power capacitors										X		

¹⁾ Only external connections need to be checked.

6.2 Fan

Schaffner LCL Filters are reliable low maintenance products. Many products like power supplies, inverters or motor drives utilize fans for forced cooling to minimize size and weight. LCL Filters 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 Schaffner LCL Filters up to their nominal rating. Such cooling devices must be checked and cleaned regularly (if installed) to always ensure sufficient air flow.

Important: increased audible noise is a typical indicator of a fan that needs maintenance or replacement. This could also occur 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.

6.3 Power capacitors

The power capacitors supplied with the filter modules are high quality components with an expected lifetime 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 also be performed after extreme overvoltage situations in the system.

6.3.1 Note regarding the storage of capacitors

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

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

The residual current of electrolytic 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 in a short term. The capacitor's residual current assumes the typical expected value at steady state for nominal voltage.

During commissioning 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.

6.4 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, Schaffner recommends checking and tightening all electrical connections during regular scheduled maintenance of the entire device that incorporates the filter. Checking of internal connections within the filters is not needed or if needed should only be conducted by a Schaffner service representative.

7 Troubleshooting

Schaffner LCL Filters are high quality products and have undergone rigorous testing and qualification procedures. Every unit runs through suitable tests in our ISO 9001:2015 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 Schaffner partner for assistance.

8 Abbreviation

PCB:	Printed Circuit Board
PHF:	Passive Harmonic Filter
AFE:	Active Front End
AIC:	Active Infeed Converter
PWM:	Pulse Width Modulation
fPWM:	Frequency of the PWM or switching frequency

To find your local partner within
Schaffner's global network, please visit
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