# POWER QUALITY

*Power Quality. Done Right.*

# Power Quality

FUSECO

# Active Harmonic Filters

146

## Sinexcel Active Harmonic Filters (AHF)

THDi < 5%

Wall Mounted Solutions

Modular

Load balancing and reactive power (PFC)

Up to 900A from a single cabinet solution

Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations

Sinexcel®

# Passive Harmonic Filters

154

## MTE Matrix AP Passive Filters

5% THDi performance

Adaptive passive technology

Reduces energy costs

Better power factor

Compatibility with generators

Meets IEEE-519 requirements for harmonic current

MTE

# Line & Load Reactors

158

## MTE RL Reactors

Applied to the load side and line side of a VSD

Reduces harmonic distortion

Reduces surge currents

Eliminates nuisance tripping

Improves power factor

Extends lifespan of VSD rectifier

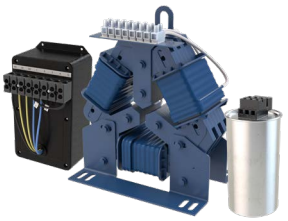
MTE

# Motor Protection

160

## Sine Wave Filters

- Increases motor life
- Allows for the use of longer motor cables
- Reduces motor audible noise, vibration and heat
- Reduces radiated emissions
- Protects your motor cable
- Reduction of bearing currents



## dV/dT Filters

- Provides >50% common mode reduction, peak voltage protection, and rise time reduction - all in one filter.
- Protects motors from long lead peak voltages
- Prevents voltage spikes from exceeding 1kV
- Increases motor bearing life and up-time

# Voltage Regulators

164

## Wide Range of Voltage Regulators

- Indoor and outdoor solutions available
- Wide input range (184-287V for 230V)
- Precise regulation (±3%)
- Features complete line conditioning
- 96-98% efficiency
- Single & Three phase available
- 3kVA to 4,000kVA

# RFI/EMI Filters

166

## Schaffner RFI Filters

- Single Phase & 3 phase available
- Blocks radio frequencies that cause electrical interference
- Reduces inverter instability
- Reduces control systems interference

# Power Quality

The term 'Power Quality' is used to describe the quality or 'fitness' of electric power that drives an electrical load and the load's ability to function properly. Without the proper power, an electrical device may malfunction, fail prematurely or not operate at all.

DIRTY POWER CLEAN POWER

The term 'clean power' is used to describe electricity that is considered to be of good quality (see below) with particular reference to a very low harmonic content. Therefore, the term 'dirty power' is used to describe electricity that is considered to be of low quality (opposite to the above) with particular reference to a very high harmonic content.

Fuseco is committed to providing power quality solutions that represent great value. Current generation technology applied with a practical, proven approach that represents a sensible value for money outcome.

The following list of characteristics are considered to be necessary for 'good power quality'.

### 1. It must have a continuity of service (not be interrupted).

Contact Fuseco to discuss solutions that are often used to provide continuity of supply in the event of 'power outages'.

### 2. It must have a very low harmonic content.

Harmonics can be created by non-linear loads such as variable speed drives, lighting and computer servers / data centers. Refer to pages 146-163 for information on harmonic mitigation solutions.

### 3. It must have a very low variation in the voltage magnitude.

Voltage regulators are often used to provide a stable voltage supply in challenging electrical environments. Refer to pages 164-165 for more information.

### 4. It must have very low transient voltages and currents.

In most cases, these phenomena are a by-product of the system load, especially environments with mechanical or high speed switching. Active Harmonic Filters (refer pages 146-151) and SVG units (refer pages w127-134) can provide improvements this area.

If we look beyond the power quality of the supply, there are also considerations regarding the power quality of a particular localised electrical environment. The power supply may be of good quality, however if the loads in a particular system are challenging (eg. non-linear, mechanical & high speed switching environments), the resulting power quality of that system may be poor.

In these cases, Active Harmonic Filters on pages 146-151 can be employed within a customised solution to improve the quality and efficiency of that particular electrical environment. Contact Fuseco for specific solutions to challenging electrical environments.

# Power Quality – Applications

**Solar Inverters** can create RFI. RFI filters can be installed to eliminate or reduce the issues.

**Hydraulic Systems** Hydraulic Systems that manage the movement of water (eg, bathrooms, kitchens, waste and irrigation) incorporate pumps, motors and VSDs that propagate harmonics.

**Lighting Systems** can create RFI and harmonics due to operational high frequency switching.

**HVAC Systems** that manage heating, air ventilation and air conditioning incorporate pumps, motors and VSDs, resulting in the propagation of harmonics.

**Vertical Transport Systems** such as elevators, lifts and escalators incorporate VSDs, resulting in the propagation of harmonics.

**The Distribution Boards** on each floor are a location where harmonic mitigation devices are often installed to reduce the system harmonic content.

**The Main Switchboard** is the location where Power Factor Correction Solutions are installed to bring the system power factor to unity and Active Harmonic Filters are installed to mitigate harmonics to comply with IEEE519-1992 and AS/NZS 61000.3.6

**Data Centers & Computer Server Rooms** utilise systems that can create harmonics and a leading power factor.

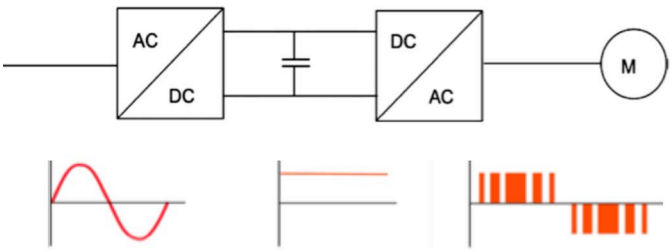
FUSECO

# VSDs and Harmonics

For motors to be used in a practical and useful way, we need to be able to control their speed of operation. A Variable Speed Drive (VSD), also known as a Variable Frequency Drive (VFD) is a programmable device that controls motor speed.

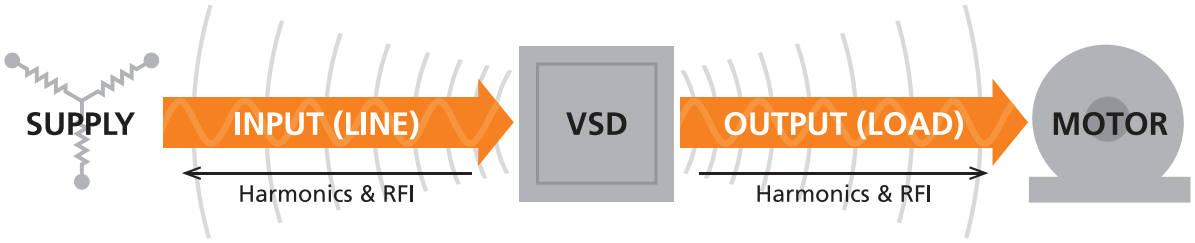
A VSD works by having a rectifier section at the input and this creates DC voltage on the DC bus (needed for switching). The inverter section at the output side provides the Pulse Width Modulation (PWM) waveform. A drive changes the speed of the motor by changing the frequency to the motor. As an aside, the impedance of the motor is determined by the inductive reactance in the windings, and it changes as the frequency changes.

**Rectifier DC Bus Inverter IGBT**




PWM is employed to control the voltage and frequency to the motor drive. DC voltage is applied to the motor by controlled pulses at high frequency, which results in voltage that approximates a sine wave of the chosen frequency.

This PWM method creates harmonics in the system. The switching also creates radio frequency interference (RFI) and voltage spikes that can be up to 1200V at the motor terminals. The high switching frequency can also lead to 'capacitive bearing currents' that flow through the motor bearings and can damage the bearing surfaces. A portion of the harmonics are reflected back to the VSD by the motor, creating further issues in the electrical environment.




The presence of harmonics in an electrical system can result in:

- Degradation of motors, especially the bearings and insulation = higher costs.
- Significant reduction of the lifespan of equipment due to excessive heat = higher costs.
- Although you will get billed for the power that you are supplied, a large percentage of that power may be unusable = higher costs.
- Unusual events such as flickering lights, alarms going off, or MCB's, MCCB's, RCD's and Earth Leakage devices tripping for no apparent reason = more down time = higher costs.

VSDs are prolific creators of harmonics in electrical systems and as a result, most of the harmonic mitigation effort focuses on the input side and output side of a VSD. For the mitigation of harmonics on the input side (line side) of a VSD we recommend Line Reactors, Passive Harmonic Filters and Active Harmonic Filters. For the mitigation of harmonics on the output side (load side) of a VSD we recommend Load Reactors, dV/dT Filters and Sine Wave Filters.

## Sellers of VSDs please note:

- Customers are becoming more aware of the damage caused by VSD related harmonics. Harmonic mitigation products are now being offered to customers as a 'value-add', in essence as an 'insurance policy' against the detrimental effects of harmonically rich environments, enhancing the longevity of both the motors and the drives.
- These products are also used on the input side of a drive in situations where harmonics are causing issues and in cases where a site needs to comply to supply authority requirements for harmonic content coming back onto the grid.
- Harmonic mitigation products MUST be considered for applications with long cable runs and/or multiple VSDs in the one environment.

# Harmonic Mitigation Solutions

SUPPLY

INPUT (LINE)

VSD

OUTPUT (LOAD)

MOTOR


## Active Harmonic Filters

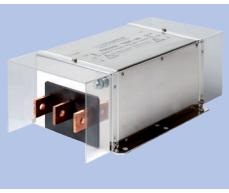
- Reduces harmonics to 5% or less
- Simultaneous compensation of 2nd to 50th harmonic order
- Provides leading & lagging power factor correction
- Load balancing
- Reduces supply sags & surges
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations

## Passive Harmonic Filters (Low Pass Filters)

- Reduces harmonics to 5%
- Reduces cable heating & energy losses
- Improves power factor and reduces system losses
- Minimises interference with other equipment
- Easy installation and operation
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations

## Line Reactors (Chokes, Inductors, Line Filters)

- Reduces harmonic distortion
- Reduces surge currents
- Virtually eliminates nuisance tripping
- Improves power factor
- Extends lifespan of semiconductors
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations



## RFI Filters

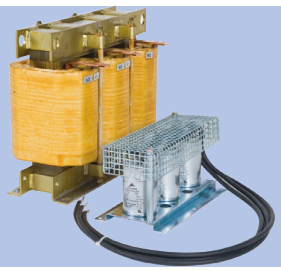
- Blocks radio frequencies that cause electrical interference
- Reduces inverter instability
- Improves radio & TV reception
- Reduces control systems interference

## Load Reactors (Motor Chokes, Inductors, Load Filters)

- Reduces harmonic distortion
- Reduces surge currents
- Protects motors from long lead effects
- Reduces reflective currents
- Reduces motor temperatures & audible noise
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations

## dV/dT Filters

- Protects motors from long lead peak voltages
- Prevents voltage spikes from exceeding 1kV
- Increases motor bearing life & up-time
- Reduces common mode noise and currents
- Reduction of motor temperatures & peak voltages
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations



## Sine Wave Filters

- Allows for the use of unshielded cables (lower project costs)
- Allows for the use of longer motor cables
- Reduces eddy currents, stray flux losses & bearing currents
- Eliminates torque ripple & voltage wave reflection
- Reduces motor noise, vibration & heat
- Meets AS/NZS 61000.3.6 standards and IEEE519 recommendations

# Power Quality Standards

## Australian Standards

The relevant standard for harmonic voltage distortion in Australia is AS/NZS 61000.3.6 and it is compatible with the IEEE 519 recommendations. If the supply authority is dissatisfied with the degree of voltage distortion at the point of common coupling (PCC), harmonic filtering may be specified to comply with the Australian Standards.

| Odd harmonics, non-multiples of 3 | | Odd harmonics, multiples of 3 (triplens) | | Even harmonics | |
|---|---|---|---|---|---|
| Order, h | % harmonic voltage | Order, h | % harmonic voltage | Order, h | % harmonic voltage |
| 5 | 5 | 3 | 5 | 2 | 2 |
| 7 | 5 | 9 | 1.5 | 4 | 1 |
| 11 | 3.5 | 15 | 0.3 | 6 | 0.5 |
| 13 | 3 | 21 | 0.2 | 8 | 0.5 |
| 17 | 2 | >21 | 0.2 | 10 | 0.5 |
| 19 | 1.5 | | | 12 | 0.2 |
| 23 | 1.5 | | | >12 | 0.2 |
| 25 | 1.5 | | | | |
| >25 | 0.2 + 1.1(25/h) | | | | |

NOTE: total harmonic distortion (TDHV) 8% max

## IEEE 519

The IEEE is the Institute of Electrical and Electronics Engineers. IEEE 519 'Recommended Practices and Requirements for Harmonic Control in Electric Power Systems', was published in 1981. The document established the levels of voltage distortion that are acceptable to a distribution system and has been widely applied in establishing required harmonic correction throughout the electrical industry.

The new IEEE 519, published in 1992, sets forth limits for both harmonic voltages on the utility transmission and distribution systems and harmonic currents within the industrial distribution systems. Since harmonic voltages are generated by the passage of harmonic currents through distribution system impedances, by controlling the currents or system impedances within the industrial facility, one can control harmonic voltages on the utility distribution.

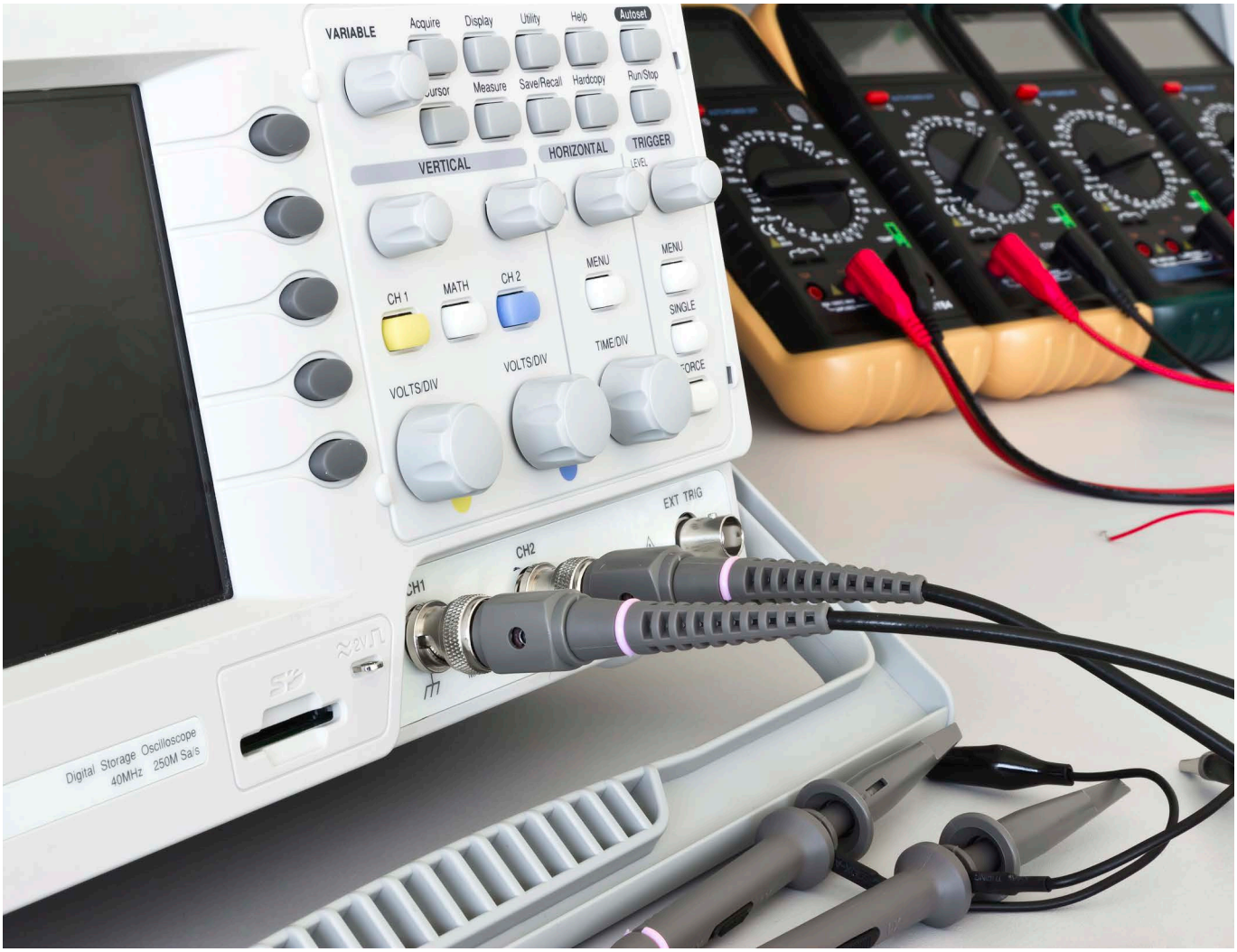
### IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

**Table 10-3 of IEEE Std 519-1992**

| ISC/IL | <11 | 11≤h<17 | 17≤h<23 | 23≤h<35 | 35≤h | Total Demand Distortion |
|---|---|---|---|---|---|---|
| <20* | 4.0 | 2.0 | 1.5 | 0.6 | 0.3 | 5.0 |
| 20<50 | 7.0 | 3.5 | 2.5 | 1.0 | 0.5 | 8.0 |
| 50<100 | 10.0 | 4.5 | 4.0 | 1.5 | 0.7 | 12.0 |
| 100<1000 | 12.0 | 5.5 | 5.0 | 2.0 | 1.0 | 15.0 |
| >1000 | 15.0 | 7.0 | 6.0 | 2.5 | 1.4 | 20.0 |

Note:
- Current Distortion Limits for General Distribution Systems (120V through 69,000V)
- Maximum Harmonic Current Distortion in Percent of I L • Individual Harmonic Order (Odd Harmonics)
- Even harmonics are limited to 25% of the odd harmonic limits above
- Current distortions that result in a DC offset, e.g. half-wave converters, are not allowed
- All power generation equipment is limited to these values of current distortion, regardless of actual ISC/IL (ISC = maximum short-circuit current at PCC; IL = maximum demand load current, fundamental frequency component, at PCC)

# Site Audit




A Power Quality Site Audit is a service offered by Fuseco to our customers and the industry. A power quality consultant visits your site and conducts a power quality audit of your electrical system.

This involves setting up sophisticated measuring equipment on site that monitors and records all of the electrical activity that is occurring within the system over a period of time. The equipment is compact, easily transportable to most locations and can be set up indoors or outdoors.

An analysis of the recorded data usually helps to reveal any harmful harmonics, voltage supply and power factor issues. Our consultant will consider the data and present you with a power quality report, outlining the observed issues and suggesting solutions if required.

Audits are useful in determining electricity usage inefficiencies and identifying damaging harmonics which occur in electrical systems.

Even correctly functioning power systems require routine auditing to ensure early identification of any potential issues and proactive servicing requirements to keep power equipment operating to its full potential and the electrical environment complying to the Australian Standard AS/NZS 61000.3.6 and compatible with the IEEE519 recommendations.

A correctly functioning system could save you upwards of 30% off your power bills. In some industries and installations, that could translate to significant increases to your bottom line. By running an efficient system, you also use less energy and therefore help the environment.

To discuss our site analysis service in more detail, please contact a power quality consultant at Fuseco.

# Selection Guide

| | | 3% IMPEDANCE Reactors | | | | 5% IMPEDANCE Reactors | | | | RFI FILTERS | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VOLTAGE** | | **415V** | **415V** | **415V** | **415V** | **415V** | **415V** | **415V** | **415V** | **415V** | **415V** |
| **BRAND** | | **MTE** | **MTE** | **TCI** | **TCI** | **MTE** | **MTE** | **TCI** | **TCI** | **SCHAFFNER** | **SCHAFFNER** |
| **kW** | **AMPS** | IP00 (open) | Nema 1 IP20 | Open Panel | IP20 (enclosed) Nema 1, 2 | IP00 (open) | IP20 (enclosed) Nema 1, 2 | Open Panel | IP20 (enclosed) Nema 1, 2 | Low Leakage | Ultra Low Leakage (Data centre compatable) |
| **0.18** | 0.4 | RL-00103 | RL-00113 | KDRA6L | KDRA6LC1 | RL-00102 | RL-00112 | KDRA6H | KDRA6HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **0.25** | 0.6 | RL-00103 | RL-00113 | KDRA6L | KDRA6LC1 | RL-00102 | RL-00112 | KDRA6H | KDRA6HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **0.37** | 0.9 | RL-00202 | RL-00212 | KDRA7L | KDRA7LC1 | RL-00203 | RL-00213 | KDRA6H | KDRA6HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **0.55** | 1.3 | RL-00202 | RL-00212 | KDRA7L | KDRA7LC1 | RL-00203 | RL-00213 | KDRA8H | KDRA8HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **0.75** | 1.8 | RL-00201 | RL-00211 | KDRA8L | KDRA8LC1 | RL-00202 | RL-00212 | KDRA8H | KDRA8HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **1.1** | 2.6 | RL-00403 | RL-00413 | KDRA9L | KDRA9LC1 | RL-00404 | RL-00414 | KDRA9H | KDRA9HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **1.5** | 3.5 | RL-00402 | RL-00412 | KDRA1L | KDRA1LC1 | RL-00404 | RL-00414 | KDRA1H | KDRA1HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **2.2** | 4 | RL-00803 | RL-00813 | KDRA2L | KDRA2LC1 | RL-00804 | RL-00814 | KDRA2H | KDRA2HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **3** | 6 | RL-00803 | RL-00813 | KDRA3L | KDRA3LC1 | RL-00804 | RL-00814 | KDRA3H | KDRA3HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **4** | 7 | RL-01202 | RL-01212 | KDRA4L | KDRA4LC1 | RL-01203 | RL-01213 | KDRA3H | KDRA3HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **5.5** | 10 | RL-01202 | RL-01212 | KDRA5L | KDRA5LC1 | RL-01203 | RL-01213 | KDRA4H | KDRA4HC1 | FN3287-10-44-C26 | FN3288-10-44-C21 |
| **7.5** | 14 | RL-01802 | RL-01812 | KDRA5L | KDRA5LC1 | RL-01803 | RL-01813 | KDRA5H | KDRA5HC1 | FN3287-16-44-C26 | FN3288-16-44-C21 |
| **11** | 20 | RL-02502 | RL-02512 | KDRB2L | KDRB2LC1 | RL-02503 | RL-02513 | KDRB2H | KDRB2HC1 | FN3287-20-33-C26 | FN3288-20-33-C21 |
| **15** | 27 | RL-03502 | RL-03512 | KDRB1L | KDRB1LC2 | RL-03503 | RL-03513 | KDRC3H | KDRC3HC2 | FN3287-40-33-C26 | FN3288-40-33-C21 |
| **18.5** | 33 | RL-04502 | RL-04512 | KDRD1L | KDRD1LC2 | RL-04503 | RL-04513 | KDRC1H | KDRC1HC2 | FN3287-40-33-C26 | FN3288-40-33-C21 |
| **22** | 40 | RL-04502 | RL-04512 | KDRD2L | KDRD2LC2 | RL-04503 | RL-04513 | KDRE2H | KDRE2HC3 | FN3287-40-33-C26 | FN3288-40-33-C21 |
| **30** | 55 | RL-05502 | RL-05512 | KDRF2L | KDRF2LC2 | RL-05503 | RL-05513 | KDRF4H | KDRF4HC3 | FN3287-63-53-C26 | FN3288-63-53-C21 |
| **37** | 66 | RL-08002 | RL-08012 | KDRF4L | KDRF4LC3 | RL-08003 | RL-08013 | KDRF1H | KDRF1HC3 | FN3287-80-34-C26 | FN3288-80-34-C21 |
| **45** | 80 | RL-10002 | RL-10012 | KDRF3L | KDRF3LC4 | RL-10003 | RL-10013 | KDRF2H | KDRF2HC4 | FN3287-80-34-C26 | FN3288-80-34-C21 |
| **55** | 97 | RL-13002 | RL-13012 | KDRF3L | KDRF3LC4 | RL-13003 | RL-13013 | KDRH2H | KDRH2HC4 | FN3287-100-35-C26 | FN3288-100-35-C21 |
| **75** | 130 | RL-16002 | RL-16012 | KDRH3L | KDRH3LC4 | RL-16003 | RL-16013 | KDRI2H | KDRI2HC4 | FN3287-160-40-C26 | FN3288-160-40-C21 |
| **90** | 160 | RL-20002B14 | RL-20012B14 | KDRH2L | KDRH2LC4 | RL-20003B14 | RL-20013B14 | KDRG3H | KDRG3HC4 | FN3287-160-40-C26 | FN3288-160-40-C21 |
| **110** | 195 | RL-25002B14 | RL-25012B14 | KDRG3L | KDRG3LC4 | RL-25003B14 | RL-25013B14 | KDRJ1H | KDRJ1HC5 | FN3359-250-28 | – |
| **132** | 230 | RL-32002B14 | RL-32012B14 | KDRG3L | KDRG3LC4 | RL-32003B14 | RL-32013B14 | KDRJ1H | KDRJ1HC5 | FN3359-250-28 | – |
| **160** | 280 | RL-32002B14 | RL-32012B14 | KDRG1L | KDRG1LC4 | RL-32003B14 | RL-32013B14 | KDRL1H | KDRL1HC5 | FN3359-320-99 | – |
| **200** | 350 | RL-40002B14 | RL-40012B14 | KDRG2L | KDRG2LC5 | RL-40003B14 | RL-40013B14 | KDRL2H | KDRL2HC5 | FN3359-400-99 | – |
| **250** | 440 | RL-50002 | RL-50012 | KDRJ1L | KDRJ1LC5 | RL-50003 | RL-50013 | KDRL4H | KDRL4HC5 | FN3359-600-99 | – |
| **280** | 490 | RL-50002 | RL-50012 | KDRL1L | KDRL1LC5 | RL-50003 | RL-50013 | KDRL5H | KDRL5HC5 | FN3359-600-99 | – |
| **315** | 550 | RL-60002 | RL-60012 | KDRL2L | KDRL2LC5 | RL-60003 | RL-60013 | KDRL6H | KDRL6HC5 | FN3359-600-99 | – |
| **335** | 590 | RL-60002 | RL-60012 | KDRL2L | KDRL2LC5 | RL-60003 | RL-60013 | KDRL6H | KDRL6HC5 | FN3359-600-99 | – |
| **355** | 620 | RL-75002 | RL-75012 | KDRL3L | KDRL3LC5 | RL-75003 | RL-75013 | KDRS1H | KDRS1HC5 | FN3359-800-99 | – |
| **400** | 700 | RL-75002 | RL-75012 | KDRL3L | KDRL3LC5 | RL-75003 | RL-75013 | KDRS1H | KDRS1HC5 | FN3359-800-99 | – |
| **450** | 790 | RL-90002B14 | RL-90012B14 | KDRS1L | KDRS1LC7 | RL-90003B14 | RL-90013B14 | KDRS2H | KDRS2HC5 | FN3359-800-99 | – |
| **500** | 880 | RL-100002B14 | RL-100012B14 | KDRX2L | KDRX2LC7 | RL-100003B14 | RL-100013B14 | KDRX2H | KDRX2HC7 | FN3359-1000-99 | – |
| **560** | 980 | RL-100002B14 | RL-100012B14 | KDRX3L | KDRX3LC7 | RL-100003B14 | RL-100013B14 | KDRX3H | KDRX3HC7 | FN3359-1000-99 | – |
| **630** | 1100 | RL-120002B14 | RL-120012B14 | KDRX1L | KDRX1LC7 | RL-120003B14 | RL-120013B14 | KDRX4H | KDRX4HC7 | FN3359-1600-99 | – |
| **670** | 1170 | RL-120002B14 | RL-120012B14 | KDRX1L | KDRX1LC7 | RL-120003B14 | RL-120013B14 | KDRX4H | KDRX4HC7 | FN3359-1600-99 | – |
| **710** | 1240 | RL-140002 | RL-140012 | KDRY1L | KDRY1LC7 | RL-140003 | RL-140013 | KDRY2H | KDRY2HC7 | FN3359-1600-99 | – |
| **800** | 1400 | RL-150002 | RL-150012 | KDRY2L | KDRY2LC7 | RL-150003 | RL-150013 | KDRY1H | KDRY1HC7 | FN3359-1600-99 | – |
| **1000** | 1740 | Special | Special | Special | Special | Special | Special | Special | Special | FN3359-2500-99 | – |
| **1200** | 2100 | Special | Special | Special | Special | Special | Special | Special | Special | FN3359-2500-99 | – |
| **1320** | 2500 | – | – | – | – | – | – | – | – | FN3359-2500-99 | – |

# Selection Guide

| | | dV/dT FILTERS | | | | SINE WAVE FILTERS | | | | PASSIVE FILTERS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **VOLTAGE** | | **600V** | **600V** | **600V** | **600V** | **500V** | **500V** | **480V** | **480V** | **415V** | **415V** | **415V** |
| **BRAND** | | **MTE** | **MTE** | **TCI** | **TCI** | **SCHAFFNER** | **SCHAFFNER** | **MTE** | **MTE** | **MTE** | **MTE** | **TCI** |
| **kW** | **AMPS** | IP00 (open) | IP20 (enclosed) Nema 1, 2 | Open Panel | IP20 (enclosed) Nema 1, 2 | IP00 (open) | IP20 (enclosed) | IP00 (open) | IP20 (enclosed) | IP00 (open) | IP20 (enclosed) | IP54 |
| **0.18** | 0.4 | – | – | – | – | – | – | – | – | – | – | – |
| **0.25** | 0.6 | – | – | – | – | – | – | – | – | – | – | – |
| **0.37** | 0.9 | – | – | V1K2A00 | V1K2A01 | FN5040-4.5-82 | FN5045-4.5-44 | – | – | – | – | – |
| **0.55** | 1.3 | DVSP0003E | DVSG0003E | V1K2A00 | V1K2A01 | FN5040-4.5-82 | FN5045-4.5-44 | SWNM0002D | SWNG0002D | – | – | – |
| **0.75** | 1.8 | DVSP0003E | DVSG0003E | V1K2A00 | VIK2A01 | FN5040-4.5-82 | FN5045-4.5-44 | SWNM0003D | SWNG0003D | – | – | – |
| **1.1** | 2.6 | DVSP0003E | DVSG0003E | V1K3A00 | V1K3A01 | FN5040-4.5-82 | FN5045-4.5-44 | SWNM0003D | SWNG0003D | – | – | – |
| **1.5** | 3.5 | DVSP0004E | DVSG0004E | VIK4A00 | V1K4A01 | FN5040-4.5-82 | FN5045-4.5-44 | SWNM0005D | SWNG0005D | MAPP0006C | MAPG0006C | – |
| **2.2** | 4 | DVSP0004E | DVSG0004E | V1K4A00 | V1K4A01 | FN5040-4.5-82 | FN5045-4.5-44 | SWNM0005D | SWNG0005D | MAPP0006C | MAPG0006C | – |
| **3** | 6 | DVSP0007E | DVSG0007E | V1K6A00 | V1K6A01 | FN5040-8-82 | FN5045-8-44 | SWNM0012D | SWNG0012D | MAPP0006C | MAPG0006C | – |
| **4** | 7 | DVSP0009E | DVSG0009E | V1K8A00 | V1K8A01 | FN5040-10-83 | FN5045-10-44 | SWNM0012D | SWNG0012D | MAPP0008C | MAPG0008C | HG4LX54ST |
| **5.5** | 10 | DVSP0012E | DVSG0012E | V1K12A00 | V1K12A01 | FN5040-17-83 | FN5045-17-33 | SWNM0012D | SWNG0012D | MAPP0011C | MAPG0011C | HG5LX54ST |
| **7.5** | 14 | DVSP0017E | DVSG0017E | V1K16A00 | V1K16A01 | FN5040-17-83 | FN5045-17-33 | SWNM0022D | SWNG0022D | MAPP0014C | MAPG0014C | HG7LX54ST |
| **11** | 20 | DVSP0022E | DVSG0022E | V1K21A00 | V1K21A01 | FN5040-24-84 | FN5045-24-33 | SWNM0022D | SWNG0022D | MAPP0021C | MAPG0021C | HG11LX54ST |
| **15** | 27 | DVSP0027E | DVSG0027E | V1K27A00 | V1K27A01 | FN5040-38-84 | FN5045-38-33 | SWNM0027D | SWNG0027D | MAPP0027C | MAPG0027C | HG15LX54ST |
| **18.5** | 33 | DVSP0035E | DVSG0035E | V1K35A00 | V1K35A01 | FN5040-38-84 | FN5045-38-33 | SWNM0045D | SWNG0045D | MAPP0034C | MAPG0034C | HG18LX54ST |
| **22** | 40 | DVSP0045E | DVSG0045E | V1K45A00 | V1K45A01 | FN5040-48-85 | FN5045-48-34 | SWNM0045D | SWNG0045D | MAPP0044C | MAPG0044C | HG22LX54ST |
| **30** | 55 | DVSP0055E | DVSG0055E | V1K55A00 | V1K55A01 | FN5040-62-86 | FN5045-62-34 | SWNM0065D | SWNG0065D | MAPP0052C | MAPG0052C | HG30LX54ST |
| **37** | 66 | DVSP0080E | DVSG0080E | V1K80A00 | V1K80A01 | FN5040-75-87 | FN5045-75-35 | SWNM0065D | SWNG0065D | MAPP0066C | MAPG0066C | HG37LX54ST |
| **45** | 80 | DVSP0080E | DVSG0080E | V1K80A00 | V1K80A01 | FN5040-115-87 | FN5045-115-35 | SWNM0110D | SWNG0110D | MAPP0083C | MAPG0083C | HG45LX54ST |
| **55** | 97 | DVSP0110E | DVSG0110E | V1K110A00 | V1K110A01 | FN5040-115-87 | FN5045-115-35 | SWNM0110D | SWNG0110D | MAPP0103C | MAPG0103C | HG55LX54ST |
| **75** | 130 | DVSP0130E | DVSG0130E | V1K130A00 | V1K130A01 | FN5040-180-99 | FN5045-180-99 | SWNM0130D | SWNG0130D | MAPP0128C | MAPG0128C | HG75LX54ST |
| **90** | 160 | DVSP0160E | DVSG0160E | V1K160A00 | V1K160A01 | FN5040-180-99 | FN5045-180-99 | SWNM0160D | SWNG0160D | MAPP0165C | MAPG0165C | HG90LX54ST |
| **110** | 195 | DVSP0200E | DVSG0200E | V1K200A00 | V1K200A01 | FN5040-260-99 | FN5045-260-99 | – | – | MAPP0208C | MAPG0208C | HG110LX54ST |
| **132** | 230 | DVSP0250E | DVSG0250E | V1K250A00 | V1K250A01 | FN5040-260-99 | FN5045-260-99 | – | – | MAPP0240C | MAPG0240C | HG132LX54ST |
| **160** | 280 | DVSP0305E | DVSG0305E | V1K305A00 | V1K305A01 | FN5040-410-99 | FN5045-410-99 | – | – | MAPP0320C | MAPG0320C | HG160LX54ST |
| **200** | 350 | DVSP0365E | DVSG0365E | V1K362A00 | V1K420A01 | FN5040-410-99 | FN5045-410-99 | – | – | MAPP0403C | MAPG0403C | HG200LX54STC |
| **250** | 440 | DVSP0515E | DVSG0515E | V1K480A00 | V1K480A01 | FN5040-480-99 | FN5045-480-99 | – | – | MAPP0482C | MAPG0482C | HG250LX54STC |
| **280** | 490 | DVSP0600E | DVSG0600E | V1K600A00 | V1K600A01 | FN5040-660-99 | FN5045-660-99 | – | – | MAPP0636C | MAPG0636C | HG315LX54STC |
| **315** | 550 | DVSP0600E | DVSG0600E | V1K600A00 | V1K600A01 | FN5040-660-99 | FN5045-660-99 | – | – | MAPP0636C | MAPG0636C | HG315LX54STC |
| **335** | 590 | DVSP0600E | DVSG0600E | V1K600A00 | V1K600A01 | FN5040-660-99 | FN5045-660-99 | – | – | MAPP0636C | MAPG0636C | HG355LX54STC |
| **355** | 620 | – | – | V1K750A00 | V1K750A01 | FN5040-660-99 | FN5045-660-99 | – | – | MAPP0636C | MAPG0636C | HG355LX54STC |
| **400** | 700 | – | – | V1K750A00 | V1K750A01 | FN5040-750-99 | FN5045-750-99 | – | – | MAPP0786C | MAPG0786C | HG400LX54STC |
| **450** | 790 | – | – | V1K820A00 | V1K820A01 | FN5040-880-99 | FN5045-880-99 | – | – | MAPP0850C | MAPG0850C | HG450LX54STC |
| **500** | 880 | – | – | – | – | FN5040-1200-99 | FN5045-1200-99 | – | – | MAPP1000C | MAPG1000C | HG500LX54STC |
| **560** | 980 | – | – | – | – | FN5040-1200-99 | FN5045-1200-99 | – | – | MAPP1000C | MAPG1000C | HG560LX54STC |
| **630** | 1100 | – | – | – | – | FN5040-1200-99 | FN5045-1200-99 | – | – | MAPP1200C | MAPG1200C | HG630LX54STC |
| **670** | 1170 | – | – | – | – | FN5040-1200-99 | FN5045-1200-99 | – | – | MAPP1200C | MAPG1200C | HG710LX54STC |
| **710** | 1240 | – | – | – | – | – | – | – | – | – | – | HG710LX54STC |
| **800** | 1400 | – | – | – | – | – | – | – | – | – | – | – |
| **1000** | 1740 | – | – | – | – | – | – | – | – | – | – | – |
| **1200** | 2100 | – | – | – | – | – | – | – | – | – | – | – |
| **1320** | 2500 | – | – | – | – | – | – | – | – | – | – | – |

# Sinexcel Active Harmonic Filter (AHF)

Harmonics are extra frequencies that when present in an electrical system, cause the current and voltage to be distorted and deviate from sinusoidal waveforms. Harmonic currents are caused by non-linear loads connected to the distribution system (rectifiers, discharge lighting, or saturated magnetic devices). A load is said to be non-linear when the current it draws does not have the same waveform as the supply voltage.

Variable Speed Drives are prolific creators of harmonics in electrical systems and as a result, most of the harmonic mitigation effort focuses on the input side and output side of a VSD. Harmonics are very harmful within an electrical system and can have serious consequences. The presence of harmonics reduces the life of equipment. It is possible that the investment that you made in your motors & drives will not be realised if they are damaged and need replacing before their expected life span. This can be very expensive. Harmonic mitigation is taking action to minimise the presence of harmonics in your electrical system and can achieve great cost savings as well as comply with the Australian standards for harmonic voltage distortion.

- Wall Mounted Solutions
- Load Balancing
- Reactive Power (PFC)
- Advanced Harmonic Compensation

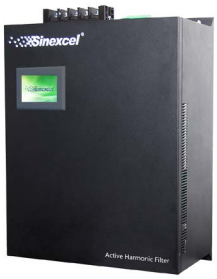
Sinexcel®


# The Sinexcel AHF (Active Harmonic Filter)

Sinexcel have applied new generation thinking and innovative design principles to create a new range of Active Harmonic Filters that have redefined what is possible from a cost vs performance vs space perspective. Their performance and ease of use is unsurpassed, able to compensate the 2nd to the 50th harmonic order or the simultaneous compensation of all 50 harmonic orders in real time!

Operating with up to 98.5% efficiency, the Sinexcel AHF offers instantaneous, dynamic harmonic compensation, ideal for the challenging demands of modern electrical environments. The Sinexcel AHF are a compact, light-weight and modular design, available in wall mounting and rack/cabinet configurations. The Sinexcel AHF has set the standards for all others to follow.

# The AHF Range





## Wall-Mount Solutions

**25A & 35A**
440W x 150D x 485H (mm)
**Weight: 18kg**

**50A & 60A**
500W x 180D x 540H (mm)
**Weight: 23kg**

**75A**
500W x 190D x 586H (mm)
**Weight: 28kg**

**100A**
500W x 200D x 605H (mm)
**Weight: 35kg**

**150A**
500W x 273D x 638H (mm)
**Weight: 44kg**

**300A**
500W x 370D x 729H (mm)
**Weight: 110kg**





## Rack-Mount Solutions

**25A & 35A**
440W x 490D x 150H (mm)
**Weight: 18kg**

**50A & 60A**
500W x 515D x 180H (mm)
**Weight: 23kg**

**75A**
500W x 586D x 190H (mm)
**Weight: 28kg**

**100A**
500W x 605D x 200H (mm)
**Weight: 35kg**

**150A**
500W x 630D x 270H (mm)
**Weight: 44kg**

**300A**
500W x 726D x 370H (mm)
**Weight: 110kg**

FUSECO

# The AHF Range


## Flexi-Cabinet Series

**Capacity: Up to 900A**
800W x 1000D x 2200H (mm)

**Capacity: Up to 750A**
800W x 800D x 2200H (mm)

### Features

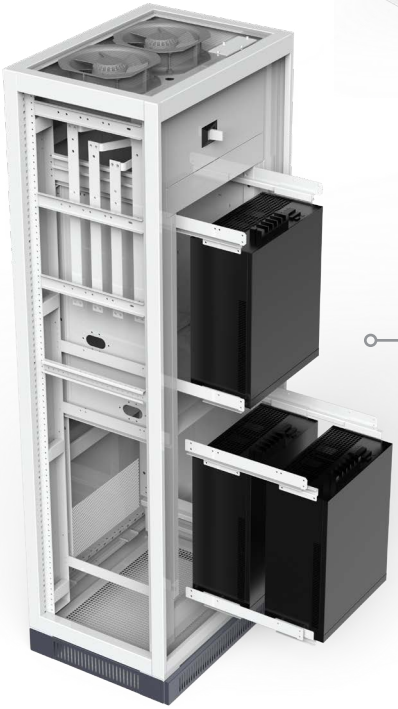
- Large Capacity


## Slimline Series

**Capacity: Up to 750A**
600W x 1000D x 2200H (mm)

### Features

- Fits in Narrow Spaces (600mm wide)



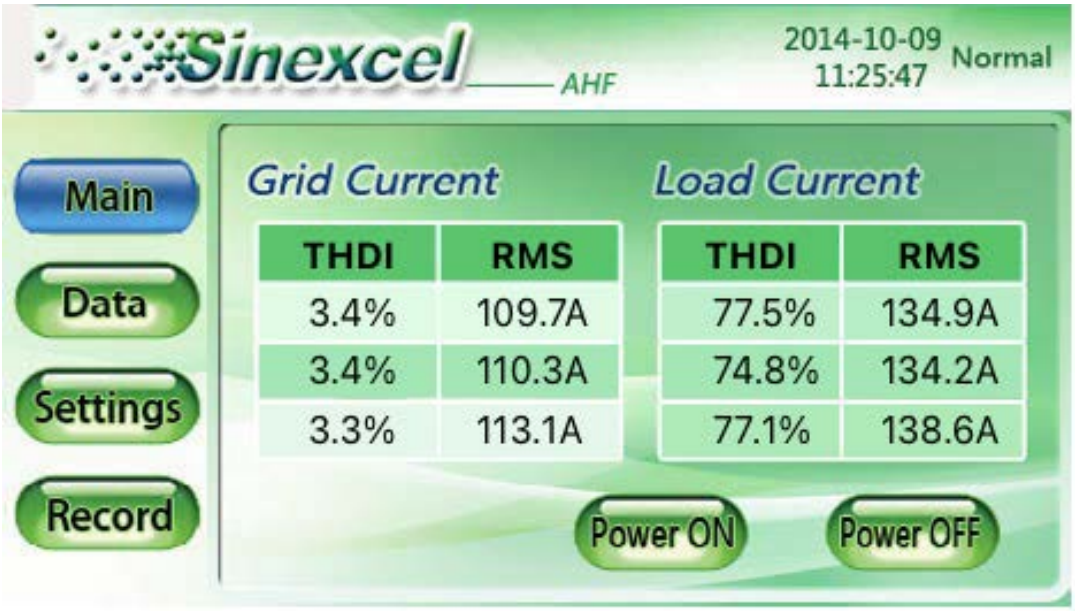
## Space Saver Series

**Capacity: Up to 450A**
800W x 600D x 2200H (mm)

### Features

- Only 600mm deep
- Top ventilated

# AHF in Action




**This screen shot is from a Sinexcel AHF unit operating at one of our customer locations.**

**Please note:**

- The Load Current THDI, which is the Total Harmonic Distortion Current across the 3 phases at the site. It is between 74.8% and 77.5% which is very high.
- The Grid Current THDI, which is the Total Harmonic Distortion Current across the 3 phases after the Sinexcel Active Harmonic Filter has compensated the current. It is between 3.3% and 3.4% which is a significant reduction in harmonics. This is an exceptional result and indicative of the advanced performance of the Sinexcel 3-level topology and the algorithms employed by Sinexcel engineering.
- The second benefit is the reduction in the RMS current as shown by the Load and Grid RMS figures in the display. This is achieved by the injection of the compensating current from the Sinexcel Active Harmonic Filter to reduce the damaging effects of the load harmonics and the natural by-product of this is the correcting of the distortion power factor.

## Unprecedented Performance

- Up to 300A capability from a single wall-mounted module – can be parallel connected for unlimited capacity.
- Up to 300A capability from a single rack-mounted module.
- Up to 900A capability from a single cabinet solution

# Features & Benefits

## Compact Size and Light Weight

- Can be wall mounted and installed in small spaces.
- Wall mounted units can be parallel connected for unlimited capacity.

## Harmonics Compensation Capability

- Harmonics filtering performance THDi < 5%.
- Selection of every harmonic to the 50th order.
- Filter up to 50 harmonics simultaneously.
- Harmonic filtering levels [%] can be pre-configured.
- Resonance protection by means of pre-configuring harmonic filtering levels for the potential resonance zones.
- Capable of suppressing ripple currents effectively and promote a high compensation precision for the output waveform with respect to the sinusoidal waveform.
- Unique 3-level topology based on a zero voltage transformation design & incorporating a high frequency inductor technology results in up to 98.5% efficiency.

## Load Balancing and Reactive Power

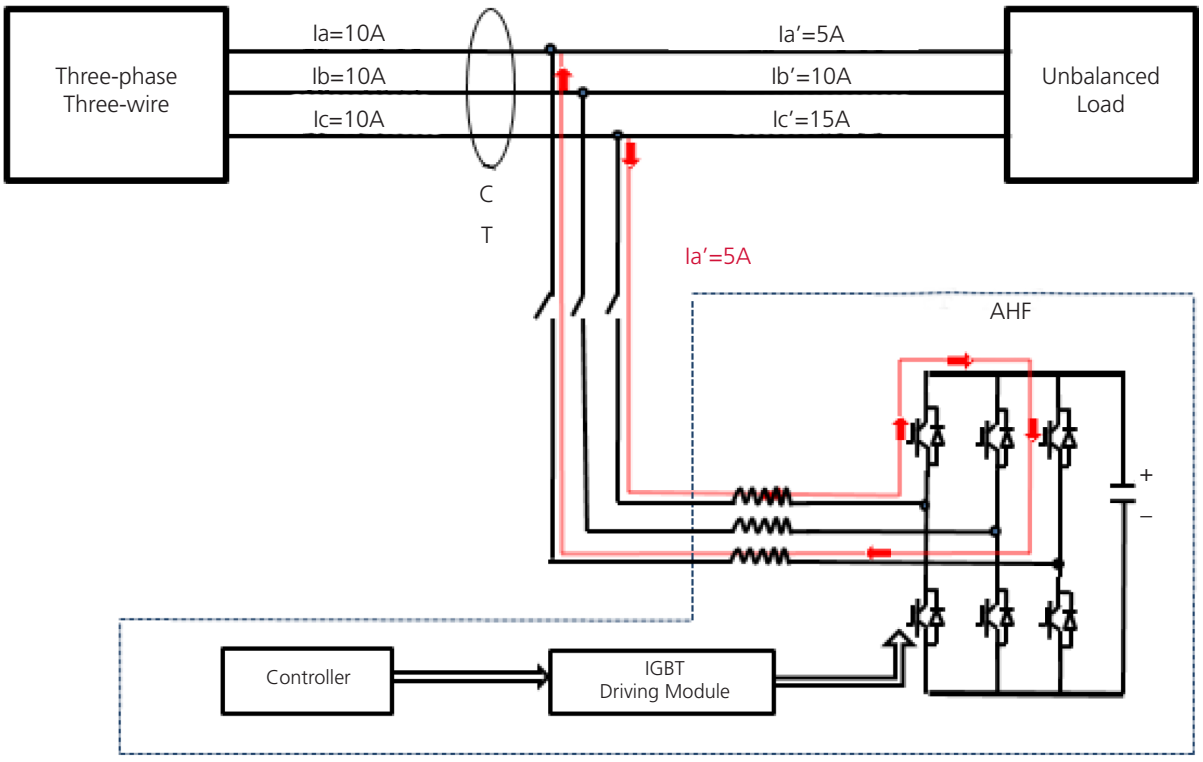
- Capable of measuring each phase and then redirecting the existing load current to balance the phases.
- Also capable of using their remaining capacity to dynamically inject reactive power to correct the power factor.
- It is possible for the user to program the unit to prioritise load balancing or reactive power, depending on the application.

## Available in Various Configurations

- 3-Wire and 4-Wire versions available
- Available in 690V
- Available in IP20, IP31 and IP54 versions to suit a wide variety of industry applications

## Flexibility and Ease of Commissioning

- Designed to be a 'Plug and Play' experience for the user.
- Available in wall mounting or rack/cabinet options.
- Unlimited parallel operation of modular AHF units in combination as per system requirements.
- Installation & commissioning process is the industry benchmark for simplicity and ease of use.



## User-friendly Interface and Monitoring

- Very easy to operate.
- Online monitoring and programming available. Presents information in terms of numerical data, waveform analysis, etc.
- Incorporates a backlit HMI graphical user interface, offering direct control, complete configuration, monitoring and harmonic analysis of the AHF without the need of a PC.

## Backlit Display

- Incorporates a high level of readability and ease of menu navigation, the backlit LCD display offers:
- Access and configuration of operating parameters.
- Measurement data in numerical, graphical and spectrum formats.
- Operation status inclusive of detailed alarms and fault messages.
- Password protected for critical settings.

## 1 Year Warranty

## Standards

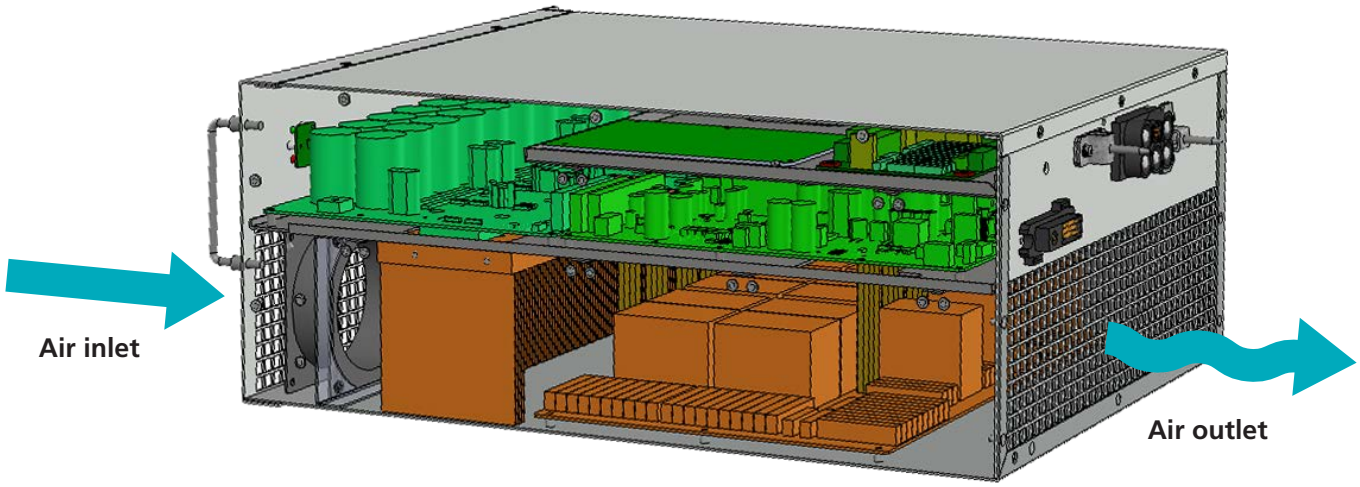
IEC61000 / IEC60146 / EN55011 / EN50091 / IEEE519

## Measurements

- Provides a comprehensive set of measurement data for analysis, such as:
- Network RMS voltages and currents
- Network Voltage and current distortions (THDu and THDi)
- Total RMS load currents and THDi
- System frequency
- Load factor
- Compensated RMS currents
- Comparison of PF (before and after)
- Graphical waveform of network voltages and currents, load and compensated currents
- Harmonic spectrum for network and load currents, from 2nd to 50th harmonic order

## Designed for Efficiency and Minimal Maintenance

- Minimises dust ingress
- Electronic components separated from heat producing components and housed in their own sealed compartment, resulting in greater protection from the effects of heat and dust ingress.
- Optimum heat dissipation
- Heat sinks, IGBT's, inductors and other heat producing components housed in a separate compartment optimised for efficient ventilation and cooling.



FUSECO

# Advanced Static Var Generator (ASVG)

The Sinexcel ASVG represents the latest generation technology in the power factor correction field with the added functionality of being able to compensate low order harmonics (3rd – 11th harmonic). It operates by detecting the load current on a real-time basis through an external CT (current transformer) and determining the reactive content of the load current. The data is analysed and the ASVG's controller drives the internal IGBT's by using PWM signals to make the inverter produce the exact reverse reactive current of the corresponding load reactive content which is injected into the grid.

The ASVG range offers instantaneous, dynamic step-less power factor compensation as well as low order harmonic mitigation, ideal for the challenging demands of modern electrical environments. Sinexcel ASVG solutions do not need an AC capacitor bank and offer many advantages due to their compact & modular configuration (including wall-mount options).

## Features

- Exceptional power factor correction performance
- Dynamic step-less compensation
- Compensates low order harmonics (3rd – 11th)
- Wall mounted modules can be parallel connected
- Corrects lagging (inductive loads) AND leading (capacitive loads)
- Corrects Load Imbalance
- Operates in all 3 Phases
- Not affected by resonance & harmonics
- Can work with & enhance existing capacitor bank systems
- Can operate at low voltages

## ASVG Range

### Wall-Mount Solutions

**50kVAr**
500W x 190D x 585H (mm)
weight: 28kg

**100kVAr**
00W x 286D x 557H (mm)
weight: 44kg

**200kVAr**
00W x 370D x 722H (mm)
weight: 110kg


### Rack-Mount Solutions

**50kVAr**
500W x 600D x 190H (mm)
Weight: 28kg

**100kVAr**
500W x 560D x 269H (mm)
Weight: 44kg

**200kVAr**
500W x 722D x 370H (mm)
Weight: 110kg


### Cabinets

**Up to 500kVAr**
Standard Flexi-Cabinet
800W x 800D x 2200H (mm)

**Up to 600kVAr**
Large Flexi-Cabinet
800W x 1000D x 2200H (mm)

# Installation of Current Transformers (CT's)

The current transformer (CT) plays a key role in the normal operation of an AHF/SVG/ASVG, so the correct selection and installation of CT's is vital. In a 3-phase 3-wire system, two CT's are required, each installed on phase A and phase C; while in 3-phase 4-wire system, three CT's are required, each installed on the circuits of phase A, phase B and phase C.

In the AHF/SVG/ASVG module, the allowable ratio of an external CT is 150:5 (min) – 10,000:5 (max). The ratio can be selected between the two levels in accordance with the actual load current. When selecting the CT ratio, the actual magnitude of load current should be taken into consideration so as to obtain a more accurate compensation. Generally, a selection of x1.5 of the maximum current during normal operation is preferred, and an appropriate level of margin is recommended to ensure more accurate harmonic suppression.

For example, suppose the maximum load current detected is 1,000A. The best selection of CT ratio is between

1,500:5 to 2,000:5. The accuracy of the external CT should be above level 0.2 (solid core) or above level 0.5 (split core). A lower degree of accuracy may affect the compensation accuracy.

### Solid Core CT's

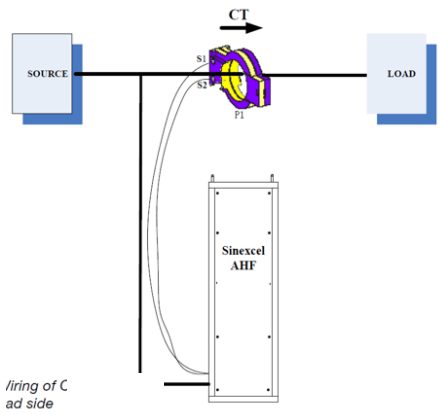
| SERIES | DESCRIPTION | RATIO RANGE (5A Secondary) | BUSBAR (mm) | CABLE DIAMETER (mm) |
|---|---|---|---|---|
| **TUC30 Series** | Solid Core | 200-600 | 30 x 10 | 25 |
| **TUC40 Series** | Solid Core | 50-1000 | 40 x 10 | 32 |
| **TUC50 Series** | Solid Core | 400-2000 | 50 x 10 | 40 |
| **TUC60 Series** | Solid Core | 400-2000 | 60 x 10 | 51 |
| **TUC80 Series** | Solid Core | 400-2500 | 80 x 30 | 65 |
| **TU100PSH Series** | Solid Core | 400-5000 | 100 x 30<br>80 x 50 | 85 |

### Split Core CT's

| SERIES | DESCRIPTION | RATIO RANGE (5A Secondary) | BUSBAR (mm) | CABLE DIAMETER (mm) |
|---|---|---|---|---|
| **TA30P Series** | Split Core | 100-400 | 30 x 20 | 20 |
| **TA60P Series** | Split Core | 250-1000 | 60 x 30 | 30 |
| **TA80P Series** | Split Core | 250-1000 | 80 x 50 | 50 |
| **TA100P Series** | Split Core | 250-2000 | 100 x 80 | 80 |
| **TA125P Series** | Split Core | 500-3000 | 125 x 80 | 80 |
| **TA160P Series** | Split Core | 500-5000 | 160 x 80 | 80 |

## Installation on the Load Side

As shown in the figure below, the signal is sent to the AHF/SVG/ASVG by a CT installed at the load side. In a 3-phase 4-wire system, one set of 3 CT's is required to detect the current of the harmonic source. The polarity of the CT's must be correct and the phase rotation must also be correct.

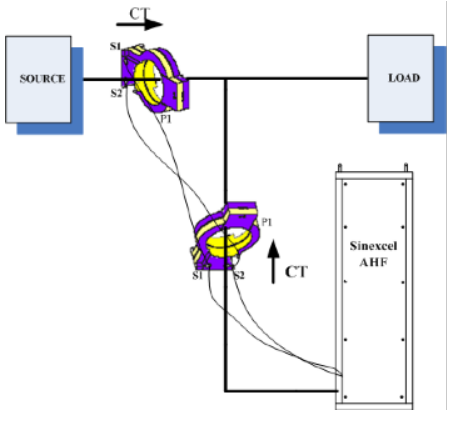



/iring of C
ad side

## Installation on the Supply Side

If it's not possible to install the CT's on the load side, they can be installed on the supply side. When using one module you can have one set of CT's on the supply side.

However when using multiple modules, a second set of CT's must be connected in parallel on the cables supplying the AHF/SVG/ASVG to measure the combined output of the modules therefore subtracting it from the main measuring CTs as per the diagram below.




**Please note that the above diagrams are indicative of some common installations. For other configurations, please contact Fuseco.**

# MTE Matrix® AP Filters (5% THD)

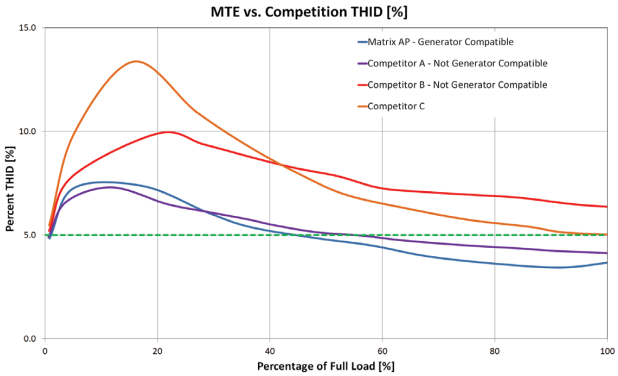
## The key to success: Adapt.

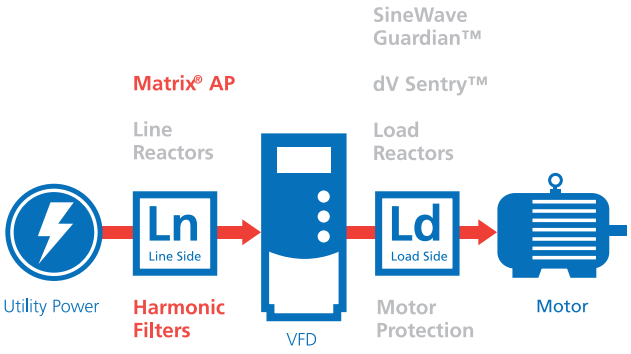
### Adaptive Passive Technology for superior harmonic mitigation at varying loads.

The MTE Matrix AP is the most advanced passive filter on the market today. Most traditional filters work fine at 100% power load but severely under-perform at lower loads.

The MTE Matrix AP has Adaptive Passive Technology that virtually eliminates harmonic distortion by adapting to various power loads. Its unique design generates less heat, is easy to install and maintain and is generator compatible.

It delivers better THDi performance, increases the reliability and service life of electric installations, increases energy efficiency and allows you to meet Power Quality standards such as IEEE 519.




## Key Features:

- **5% THDi Performance**
  The MTE Matrix AP offers equal to or better than 5% THDi performance at full load current and starts to achieve that 5% performance from loads as low as 40% of full load current.
- **Adaptive Passive Technology**
  The Matrix AP features MTE's patented Adaptive Passive Technology for superior harmonic mitigation and better THDi performance over a wider load range.
- **3 Year Warranty (industry leading)**
- **Reduce Maintenance Costs**
  Extends the service life of electrical equipment due to the virtual elimination of CEMF and the skin effect, the Matrix AP extends the life of electrical equipment, especially transformers and motors.
- **Ease of Installation**
  Passive filters are virtually 'Plug and Play'.
- **Reduces Downtime**
  Alleviates system downtime by preventing blown fuses and tripped circuit breakers.
- **Intelligent Design - Less Cost to Install**
  The unique design of the MTE Matrix AP filter incorporates only one reactor which has the input and the shunt coil on the same core. This requires less cabling and connections by the installer, therefore less cost to install.
- **Enclosed Filters Do Not Require Fans**
  When the Matrix AP filters are built within an enclosure to comply with IP20 or IP21 requirements, their unique patented design results in such low heat loss that they do not require fan assisted cooling. This design removes the traditional risk of filter damage in the event of a fan malfunction.
- **Better Power Factor and Compatibility with Generators**

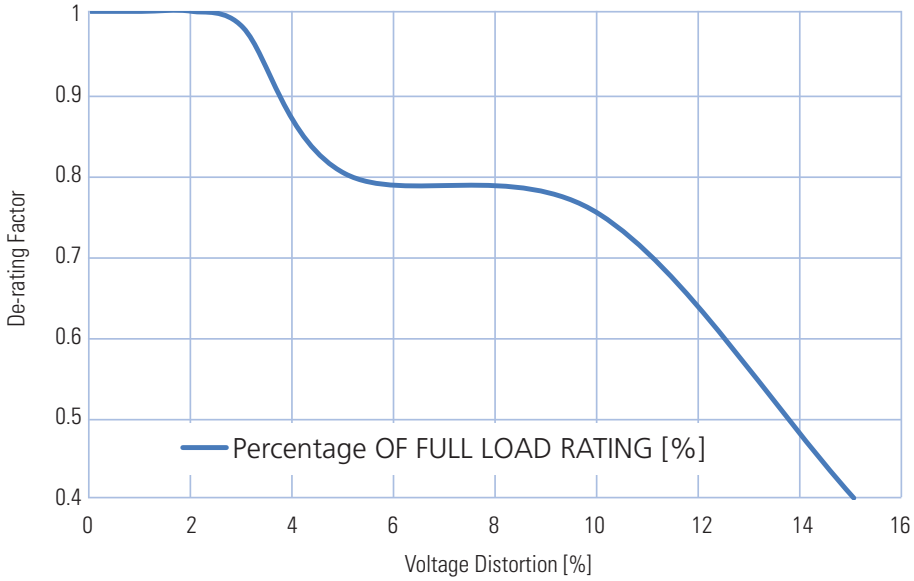
## Performance Specifications

| | |
|---|---|
| Input Voltages | 480V 60Hz<br>380V/400V/415V 50Hz<br>600V 60Hz<br>690V 50Hz |
| Total Harmonic Current Distortion | 8% Max at 30% Load<br>5% Max at Full Load |
| Load | 6 pulse rectifier |
| Input Voltage | Nominal voltage VAC +/– 10%, 3 Phase |
| Frequency | Nominal Frequesncy +0.75Hz |
| Insertion loss at full load | <4% |
| Efficiency | 97% – 99% |
| Operating Temperature | –40°C to +50°C Open Panel Filters<br>–40°C to +40C°–45°C Enclosed Filters<br>–40°C to +90°C Storage |
| Altitude without Derating | 1000 meters (3,300 feet) |

## Performance with Unbalanced Line Voltage (Typical)

| All Components at Nominal Values and Worse Case Service Conditions | |
|---|---|
| **100% Load** | |
| Nominal THDi | 4.2% |
| 1% Unbalance | 4.4% |
| 2% Unbalance | 4.8% |
| 3% Unbalance | 5.4% |
| **30% Load** | |
| Nominal THDi | 7.0% |
| 1% Unbalance | 7.3% |
| 2% Unbalance | 7.9% |
| 3% Unbalance | 8.8% |

## Voltage Distortion De-Rating Curve




This plot assists in proper de-rating of a Matrix AP Harmonic Filter in environments with a given voltage distortion. Example: In a system with 10% voltage distortion, a Matrix filter will need to be oversized by 25% to obtain the same performance as an appropriate filter in a 0% distortion environment.

# Applications for Passive Filters

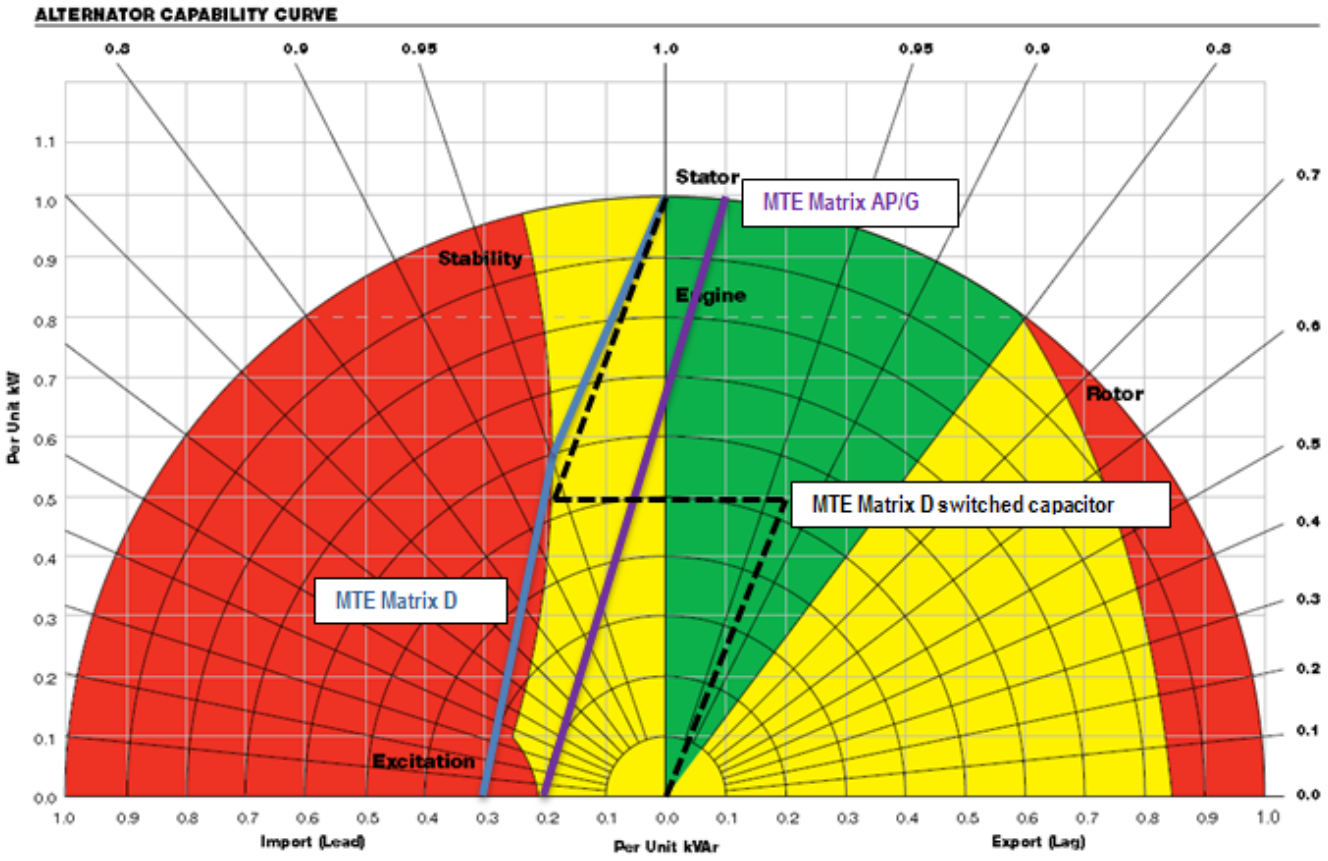
## Passive Harmonic Filters for Generator Power Supply Applications

The ability of a generator to handle leading power factor loads is often raised as a concern. Although it is true that excessive capacitive reactive power can cause voltage regulation, excitation control and other issues with a generator's operation, generators can tolerate a leading power factor at certain levels. All generator manufacturers publish reactive power capability curves for their generators from which a user can determine the acceptable levels of reactive power for the generator, both capacitive and inductive.

Six pulse VSD loads operated with a passive harmonic filter have characteristics that can impose a leading power factor (kVAr) onto the power source. While these loads are typically not a problem for utility power sources, leading power factor can cause a generator to shut down or prevent certain loads from operating properly under generator power. Control systems used in generators are very sensitive to capacitive kVAr from loads and exceeding their limit will result in the generator shutting down due to over-voltage.

At the same time, VSD manufacturers have started to use Passive Harmonic Filters to limit the harmonic current distortion feeding back to the power source. A Passive Harmonic Filter can produce a leading power factor at light loads and this can be very disruptive to generator operation. At light loads there may be excess filter capacitance, causing a leading power factor on the generator. A utility supply simply absorbs the reactive power output because it is extremely large relative to the filter system. The ideal solution is to choose a harmonic filter that will not adversely affect the generator's operation.

To work with generators, the harmonic filter's capacitance must not exceed the alternator's ability to absorb reverse kVAr loading. The ideal choice should be a filter that has a low kVAr (15% of its kW rating) such as the MTE Matrix AP filter. The Matrix AP filter possesses better control of leading power factor and will always be in the 'generator safe operating area'. Due to the fact that the Matrix AP filter operates in a safe power factor range for gen-sets, most applications do not require the capacitors switched in and out. This results in an increase in the life span of the capacitors.



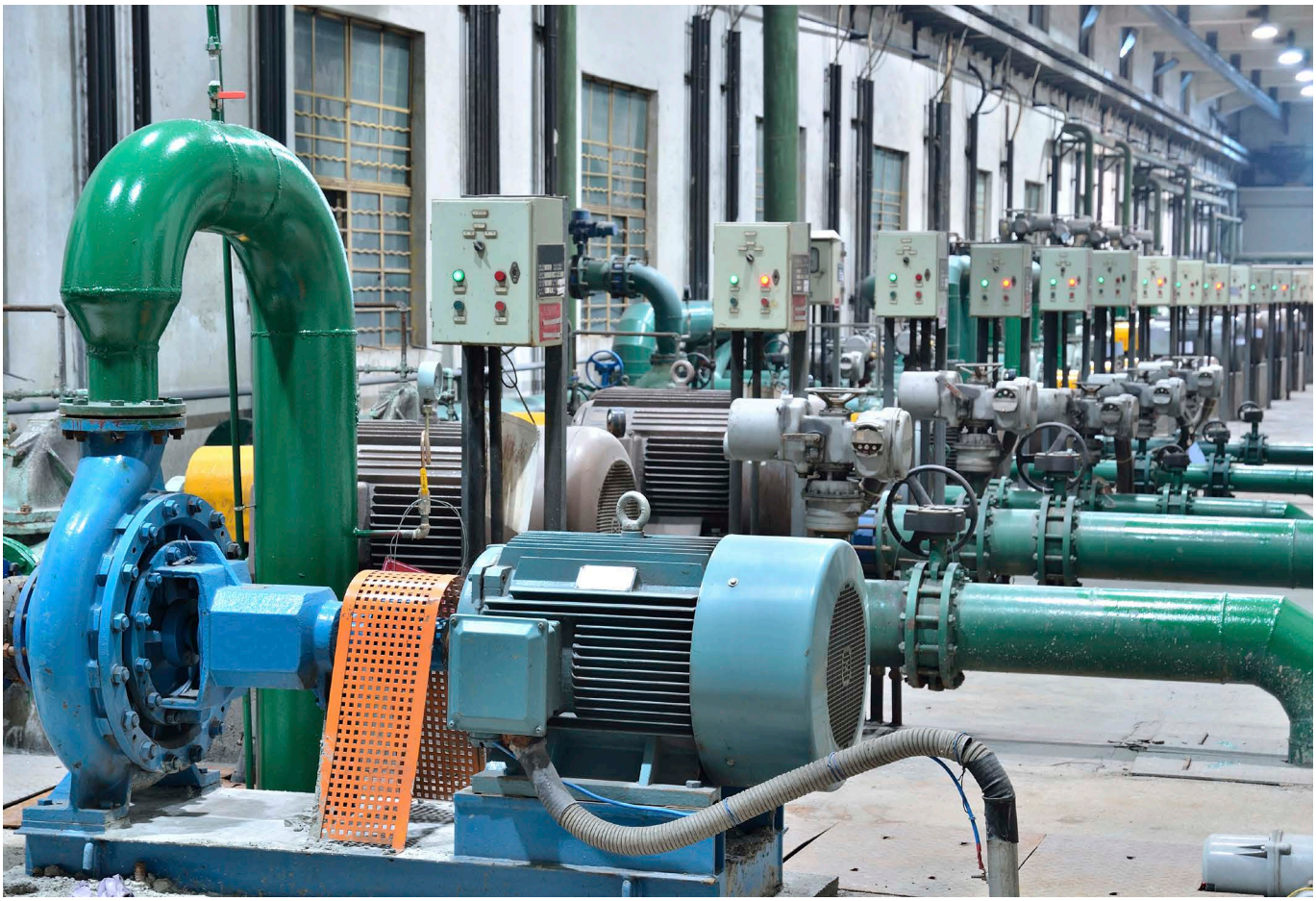
## Irrigation and Pumping Station Applications

The use of VSDs in the electrical systems of irrigation and pumping stations has grown by 60% in the last five years. This clearly indicates that the concept of saving energy is being accepted and adopted rapidly within the industry.

The remote area irrigation systems and pumping stations equipped with VSDs often experience problems related to harmonics on grid or generator supply. This often leads to disturbances in the supply systems of nearby residential areas. For these remote sites, achieving the mitigation of harmonics in the electrical system can be a big challenge.

## Solutions for Harmonic Mitigation and the Protection of Motors

- As a general guide, for cable runs up to 30m, reactors can be a cost effective solution.
  Refer to page 158 for information on our range of MTE reactors
- For cable runs of 30m – 100m, dV/dt filters are a suitable choice and also provide the added benefit of protecting motors from long lead peak voltages and voltage spikes.
  Refer to page 163 for information on our range of MTE dV Sentry dV/dT Filters
- For cable runs above 100m, sine wave filters are a great choice. With their ability to reduce eddy currents, stray flux losses, bearing currents, torque ripple and voltage wave reflection, sine wave filters provide the ultimate motor protection.
  Refer to page 160-162 for information on our range of Sine Wave Filters
- The design of the MTE Matrix AP passive filters is suitable for such remote applications as they are extremely robust, reliable and virtually ‘plug and play’. The specially designed capacitors with screw on terminals provide reliability and require minimal maintenance. Furthermore, they mitigate the harmonics (THDi) to <5%.
  Refer to page 154-155 for information on the MTE Matrix AP Filters
- For IP54 applications, the TCI HG7 series of passive harmonic filters is ideal.



FUSECO

# MTE RL Series

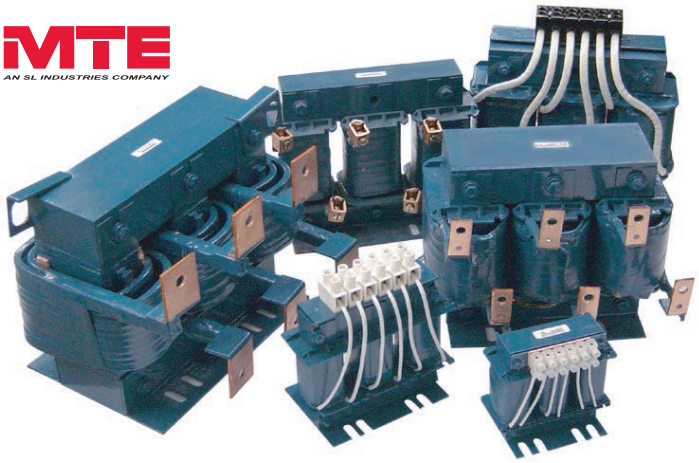
## Peace of mind included.

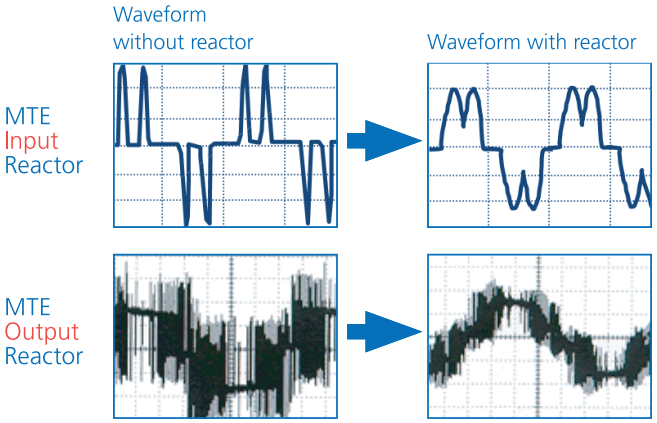
Reactors provide a cost effective solution to power quality degradation due to the increase in non-linear loads such as those produced by variable speed drives (VSDs).

The MTE RL series of line and load reactors are best-in-class power quality units with a long history of proven performance. Rugged and robust, they are unequalled in absorbing power line disturbances that can damage or shut down VSDs and other sensitive equipment. They are built to withstand even the most severe power spikes. They work on both the line side and load side to give you an easy solution that reduces nuisance tripping, reduces harmonic distortion and minimises long lead effects.

The RL series reactors are a robust, high performance filtering solution for virtually any 4 or 6-pulse rectifier or power conversion unit. There is no need to de-rate these reactors. They are harmonic compensated and protected to assure optimum performance in the presence of harmonics, and can help you meet IEEE-519.

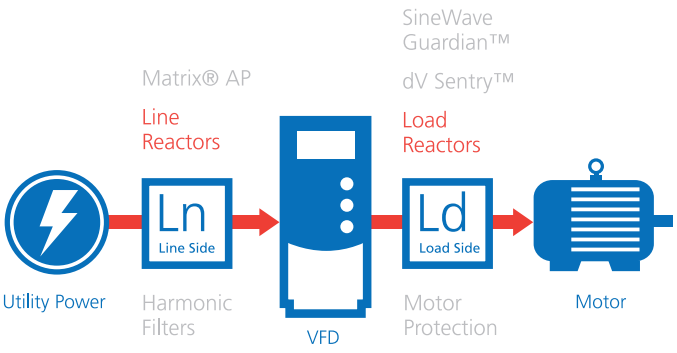
Improved power quality, enhanced productivity and complete peace of mind are easy with RL line/load reactors.




## Key Features:

- **Available for 1A to 1,500A applications**
- **Impedance options 3% and 5%**
- **Most robust, highest continuous service factor**
- **Low watts loss**
- **Ease of installation**
- **Reduces energy costs**
- **Reduces audible noise**
- **Available in multiple cabinet designs IP00, IP20 & NEMA 3R**
- **Performance and durability that is unmatched by the competition**
- **3 year warranty (industry leading)**




## Preliminary Performance Specifications

| | |
|---|---|
| Impedence Levels | 3% and 5% |
| Continuous Service Factor | Reactors rated 1 to 750 Amps – 150% of rating<br>Reactors rated above 750 Amps – 125% of rating |
| Overload Rating | 200% of rated for 30 minutes<br>300% of rated for 1 minute |
| Voltage Range | 208V – 690V |
| Current Range | 1A – 1,500A |
| Temperature Rise | 135°C |
| Ambient Temperature | –40°C to 50°C |
| Altitude Maximum | 1,000 meters |
| Fimda,emta;Freqiemcu | 50/60Hz |
| Inductance Curve | 100% at 100% Current<br>100% at 150% Current<br>50% at 350% Current |

# MTE RL Reactor Selection Table

| OPEN (IP00) PART NUMBER | AMP RATING | INDUCTANCE (mH) | WATTS LOSS | OPEN WEIGHT (kg) | SIZE (mm) H x W x D |
|---|---|---|---|---|---|
| **RL-00102** | 1 | 50 | 12.8 | 0.95 | 89 x 97 x 31 |
| **RL-00103** | 1 | 36 | 11.9 | 0.95 | 89 x 97 x 31 |
| **RL-00201** | 2 | 12 | 7.5 | 1.81 | 104 x 112 x 71 |
| **RL-00202** | 2 | 20 | 11.3 | 1.81 | 104 x 112 x 71 |
| **RL-00403** | 4 | 9 | 20 | 2.26 | 104 x 112 x 86 |
| **RL-00404** | 4 | 12 | 21 | 2.72 | 104 x 112 x 86 |
| **RL-00803** | 8 | 5 | 25.3 | 4.98 | 122 x 152 x 86 |
| **RL-00804** | 8 | 7.5 | 28 | 5.89 | 122 x 152 x 86 |
| **RL-01202** | 12 | 2.5 | 31 | 4.53 | 127 x 152 x 84 |
| **RL-01203** | 12 | 4.2 | 41 | 8.16 | 127 x 152 x 84 |
| **RL-01802** | 18 | 1.5 | 43 | 5.44 | 135 x 152 x 89 |
| **RL-01803** | 18 | 2.5 | 43 | 7.25 | 155 x 206 x 102 |
| **RL-02502** | 25 | 1.2 | 52 | 6.35 | 147 x 183 x 89 |
| **RL-02503** | 25 | 1.8 | 61 | 9.07 | 147 x 183 x 109 |
| **RL-03502** | 35 | 0.8 | 54 | 7.25 | 147 x 183 x 102 |
| **RL-03503** | 35 | 1.2 | 54 | 13.6 | 188 x 229 x 119 |
| **RL-04502** | 45 | 0.7 | 62 | 12.7 | 188 x 229 x 119 |
| **RL-04503** | 45 | 1.2 | 65 | 17.69 | 185 x 229 x 135 |
| **RL-05502** | 55 | 0.5 | 67 | 12.24 | 178 x 229 x 135 |
| **RL-05503** | 55 | 0.85 | 71 | 18.59 | 178 x 229 x 152 |
| **RL-08002** | 80 | 0.4 | 86 | 14.96 | 183 x 229 x 165 |
| **RL-08003** | 80 | 0.7 | 96 | 27.66 | 216 x 274 x 173 |
| **RL-10002** | 100 | 0.3 | 84 | 16.78 | 185 x 229 x 173 |
| **RL-10003** | 100 | 0.45 | 108 | 33.56 | 210 x 274 x 156 |
| **RL-13002** | 130 | 0.2 | 180 | 19.5 | 183 x 229 x 173 |
| **RL-13003** | 130 | 0.3 | 128 | 29.02 | 216 x 279 x 156 |
| **RL-16002** | 160 | 0.15 | 149 | 23.13 | 211 x 274 x 152 |
| **RL-16003** | 160 | 0.23 | 138 | 32.65 | 216 x 292 x 229 |
| **RL-20002B14** | 200 | 0.11 | 168 | 24.49 | 191 x 229 x 211 |
| **RL-20003B14** | 200 | 0.185 | 146 | 45.35 | 211 x 274 x 254 |
| **RL-25002B14** | 250 | 0.09 | 231 | 36.28 | 216 x 274 x 229 |
| **RL-25003B14** | 250 | 0.15 | 219 | 56.69 | 284 x 366 x 262 |
| **RL-32002B14** | 320 | 0.075 | 264 | 46.26 | 229 x 274 x 254 |
| **RL-32003B14** | 320 | 0.125 | 351 | 72.57 | 286 x 366 x 267 |
| **RL-40002B14** | 400 | 0.06 | 333 | 53.52 | 286 x 381 x 292 |
| **RL-40003B14** | 400 | 0.105 | 293 | 67.58 | 286 x 366 x 318 |
| **RL-50002** | 500 | 0.05 | 340 | 53.52 | 292 x 366 x 292 |
| **RL-50003** | 500 | 0.085 | 422 | 95.25 | 292 x 366 x 338 |
| **RL-60002** | 600 | 0.04 | 414 | 79.37 | 286 x 366 x 305 |
| **RL-60003** | 600 | 0.065 | 406 | 122.47 | 286 x 366 x 381 |
| **RL-75002** | 750 | 0.029 | 630 | 86.18 | 292 x 366 x 318 |
| **RL-75003** | 750 | 0.048 | 552 | 120.2 | 368 x 366 x 356 |
| **RL-85002B14** | 850 | 0.027 | 930 | 97.52 | 394 x 452 x 394 |
| **RL-85003B14** | 850 | 0.042 | 1133 | 142.88 | 394 x 452 x 445 |
| **RL-90002B14** | 900 | 0.025 | 1020 | 97.52 | 394 x 452 x 394 |
| **RL-90003B14** | 900 | 0.04 | 1365 | 142.88 | 401 x 452 x 434 |
| **RL-100002B14** | 1000 | 0.022 | 1090 | 97.52 | 394 x 452 x 394 |
| **RL-100003B14** | 1000 | 0.038 | 1500 | 142.88 | 401 x 452 x 445 |
| **RL-120002B14** | 1200 | 0.019 | 1130 | 124.73 | 394 x 452 x 452 |
| **RL-120003B14** | 1200 | 0.03 | 1550 | 176.9 | 391 x 442 x 465 |
| **RL-140002** | 1400 | 0.016 | 1523 | 238.13 | 432 x 483 x 483 |
| **RL-140003** | 1400 | 0.027 | 1680 | 385.55 | 432 x 559 x 559 |
| **RL-150002** | 1500 | 0.015 | 1671 | 306.17 | 432 x 429 x 406 |
| **RL-150003** | 1500 | 0.025 | 1815 | 408.23 | 432 x 559 x 559 |

## Impedance Rating:

- 3% impedance reactors are typically sufficient to absorb power line spikes and motor current surges. They will prevent nuisance tripping of drives or circuit breakers in most applications. They are also suitable for use as motor chokes/load reactors.
- 5% impedance reactors are best for reducing harmonic currents and frequencies. Use them when you must reduce VFD drive generated harmonics, and to reduce motor operating temperature, or to reduce motor noise. For complete IEE-519 compliance for VSD's please see the AP Matrix Passive Harmonic Filters on pages 154-155 or the Sinexcel Active Harmonic Filters on pages 146-151.

## Please note:

- The recommended reactor selections above are based on fundamental current ratings. Contact Fuseco with any questions regarding the proper reactor selection.
- The effective impedance of the reactor changes with actual RMS current. A 5% impedance reactor becomes 3% if its current is reduced to 60%.
- Weights and dimensions are for reference only and are subject to change without notice.

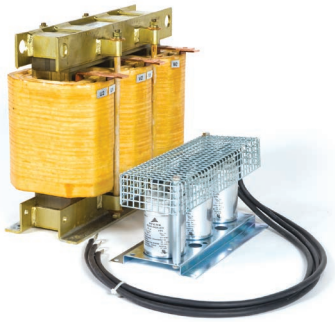
FUSECO

# Schaffner Sine Wave Filters

Deployed at the output side of a VSD, Schaffner sine wave filters are a proven motor protection solution that ensure system reliability and motor longevity.

Schaffner sine wave filters can facilitate the use of unshielded motor cables, the use of multiple motors in parallel on the same driver or the retrofit of modern drives in existing installations with old motors and unshielded cabling. A great investment for your electrical system.

SCHAFFNER



**FN 5040**
500V
IP00 (open panel)

**FN 5045**
500V
IP20 (enclosed)

## Key Features:

- Converts the rectangular PWM output voltage of motor drives into a smooth sine wave with low residual ripple.
- Allows for the use of unshielded cables (lower project costs).
- Allows for the use of longer motor cables.
- Reduces eddy currents, stray flux losses and bearing currents.
- Improves bearing life time because of bearing currents caused by circulating currents, eddy currents and stray flux losses.
- Eliminates torque ripple and voltage wave reflection.
- Eliminates premature motor damage caused by high dv/dt, over-voltages, cable ringing, motor overheating, pulse pattern stress and eddy current losses.
- Reduces motor noise, vibration and heat.
- Meets AS/NZ 61000.3.6 standards and IEEE519 recommendations. Complies with IEC 60034-17* and NEMA-MG1 requirements for general purpose motors.
- Available in 690V.

## Technical Specifications

| | |
|---|---|
| Nominal operating voltage | 3x480 VAC |
| Rated operating voltage | 3x525 VAC |
| Overload capability | 1.5× rated current for 1 minute, once per hour |
| Motor frequency | 0...70 Hz (up to 200Hz with derating) |
| Rated currents | 4.5 to 1200 A @ 45°C |
| Motor cable length | Up to 2,000 m (contact Fuseco) |
| Impedance (uk) | 8 to 10% @ 400 V, 50 Hz and rated current |
| Residual ripple voltage | < 5% |
| High potential test voltage | P –> E 3000 VAC, 1 minute<br>P –> P 2500 VAC, 1 minute |
| Protection category | IP 00 (FN 5040)<br>IP 20 (FN 5045) |

SCHAFFNER

Typical motor power [kW]
Rated current [A]

| OUTPUT FILTERS AND LOAD REACTORS | max voltage | 0 60 120 180 240 300<br>0 200 400 600 800 >1000 | features: dv/dt restriction | Overvoltage restriction | Motor temperature reduction | Red. acoustic motor noise | Sym. sinusoidal output signal | Asym. sinusoidal output signal | Eliminat. of bearing damage | Replaces cable shields | Connection to dc link required | Improves overall EMC | Reduces equipment downtime | typical applications: Motor drives | Servo drives, torque motors | High-speed motor applications | Appl. with long unshield. cabl. | Retrofit of motor drives |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FN 5040** (refer to page 9) | 500 VAC | 1.1 – 630<br>4.5 – 1200 | ● | ● | ● | ● | ● | | | | | ● | ● | ● | | | | ● |
| **FN 5045** (refer to page 9) | 500 VAC | 1.1 – 630<br>4.5 – 1200 | ● | ● | ● | ● | ● | | | | | ● | ● | ● | | | | ● |
| **FN 5040 HV** | 690 VAC | 75 – 1200<br>13 – 1320 | ● | ● | ● | ● | ● | | | | | ● | ● | ● | | | | ● |

# Sine Wave Filter Selection Table

| Filter | Rated current @ 45°C/ 50Hz (A) | Rated current @ 45°C/ 100Hz (A) | Typical motor drive power rating @ 400 V* (kW) | Typical motor drive power rating @ 480 V** (kW) | Nominal inductance (mH) | Nominal capacitance (µF) | Capacitance connection | Min. switching frequency (kHz) | Typical power loss*** (W) | Input/Output connections | | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FN 5040-4.5-82** | 4.5 | 4.05 | 1.1/1.5 | 1.3/1.8 | 13 | 2.2 | Y | 4 | 65 | -82 | | 3.3 |
| **FN 5040-8-82** | 8 | 7.2 | 2.2/3 | 2.64/3.6 | 6.9 | 4.7 | Y | 4 | 80 | -82 | | 4.6 |
| **FN 5040-10-83** | 10 | 9 | 4 | 4.8 | 5.2 | 6.8 | Y | 4 | 90 | -83 | | 6.1 |
| **FN 5040-17-83** | 17 | 15.3 | 5.5/7.5 | 6.6/9.0 | 3.1 | 10 | Y | 4 | 115 | -83 | | 7.8 |
| **FN 5040-24-84** | 24 | 21.6 | 11 | 13.2 | 2.4 | 10 | Y | 4 | 150 | -84 | | 14.4 |
| **FN 5040-38-84** | 38 | 34.2 | 15/18.5 | 18/22.2 | 1.6 | 10 | Y | 4 | 170 | -84 | | 25 |
| **FN 5040-48-85** | 48 | 43.2 | 22 | 26.4 | 1.1 | 14.7 | Y | 4 | 260 | -85 | | 33 |
| **FN 5040-62-86** | 62 | 55.8 | 30 | 36 | 0.85 | 30 | Y | 3 | 280 | -86 | | 36 |
| **FN 5040-75-87** | 75 | 67.5 | 37 | 44.4 | 0.75 | 30 | Y | 3 | 330 | -87 | | 42 |
| **FN 5040-115-87** | 115 | 103.5 | 45/55 | 52.8/66 | 0.5 | 20 | △ | 3 | 500 | -87 | | 68 |
| **FN 5040-180-99** | 180 | 162 | 75/90 | 90/108 | 0.3 | 33 | △ | 3 | 680 | | -99 | 86 |
| **FN 5040-260-99** | 260 | 234 | 110/132 | 132/158.4 | 0.2 | 47 | △ | 3 | 880 | | -99 | 125 |
| **FN 5040-410-99** | 410 | 369 | 160/200 | 192/240 | 0.13 | 66 | △ | 3 | 1100 | | -99 | 184 |
| **FN 5040-480-99** | 480 | 432 | 250 | 300 | 0.11 | 94 | △ | 3 | 1350 | | -99 | 235 |
| **FN 5040-660-99** | 660 | 594 | 315/355 | 378/426 | 0.14 | 141 | △ | 2 | 2000 | | -99 | 310 |
| **FN 5040-750-99** | 750 | 675 | 400 | 480 | 0.12 | 165 | △ | 2 | 2800 | | -99 | 470 |
| **FN 5040-880-99** | 880 | 792 | 400/500 | 480/600 | 0.11 | 188 | △ | 2 | 3400 | | -99 | 640 |
| **FN 5040-1200-99** | 1200 | 1080 | 560/630 | 672/756 | 0.075 | 282 | △ | 2 | 3800 | | -99 | 680 |
| **FN 5045-4.5-44** | 4.5 | 4.05 | 1.1/1.5 | 1.3/1.8 | 13 | 2.2 | Y | 4 | 65 | -44 | | 4.1 |
| **FN 5045-8-44** | 8 | 7.2 | 2.2/3 | 2.64/3.6 | 6.9 | 4.7 | Y | 4 | 80 | -44 | | 5.4 |
| **FN 5045-10-44** | 10 | 9 | 4 | 4.8 | 5.2 | 6.8 | Y | 4 | 90 | -44 | | 6.9 |
| **FN 5045-17-33** | 17 | 15.3 | 5.5/7.5 | 6.6/9.0 | 3.1 | 10 | Y | 4 | 115 | -33 | | 9 |
| **FN 5045-24-33** | 24 | 21.6 | 11 | 13.2 | 2.4 | 10 | Y | 4 | 150 | -33 | | 15.6 |
| **FN 5045-38-33** | 38 | 34.2 | 15/18.5 | 18/22.2 | 1.6 | 10 | Y | 4 | 170 | -33 | | 18.9 |
| **FN 5045-48-34** | 48 | 43.2 | 22 | 26.4 | 1.1 | 14.7 | Y | 4 | 260 | -34 | | 35.8 |
| **FN 5045-62-34** | 62 | 55.8 | 30 | 36 | 0.85 | 30 | Y | 3 | 280 | -34 | | 37.8 |
| **FN 5045-75-35** | 75 | 67.5 | 37 | 44.4 | 0.75 | 30 | Y | 3 | 330 | -35 | | 60 |
| **FN 5045-115-35** | 115 | 103.5 | 45/55 | 52.8/66 | 0.5 | 20 | △ | 3 | 500 | -35 | | 70 |
| **FN 5045-180-99** | 180 | 162 | 75/90 | 90/108 | 0.3 | 33 | △ | 3 | 680 | | -99 | 92 |
| **FN 5045-260-99** | 260 | 234 | 110/132 | 132/158.4 | 0.2 | 47 | △ | 3 | 880 | | -99 | 131 |
| **FN 5045-410-99** | 410 | 369 | 160/200 | 192/240 | 0.13 | 66 | △ | 3 | 1100 | | -99 | 198 |
| **FN 5045-480-99** | 480 | 432 | 250 | 300 | 0.11 | 94 | △ | 3 | 1350 | | -99 | 243 |
| **FN 5045-660-99** | 660 | 594 | 315/355 | 378/426 | 0.14 | 141 | △ | 2 | 2000 | | -99 | 425 |
| **FN 5045-750-99** | 750 | 675 | 400 | 480 | 0.12 | 165 | △ | 2 | 2800 | | -99 | 482 |
| **FN 5045-880-99** | 880 | 792 | 400/500 | 480/600 | 0.11 | 188 | △ | 2 | 3400 | | -99 | 652 |
| **FN 5045-1200-99** | 1200 | 1080 | 560/630 | 672/756 | 0.075 | 282 | △ | 2 | 3800 | | -99 | 692 |

* General purpose four-pole (1500 r/min) AC induction motor rated 400 V/50 Hz.
** General purpose four-pole (1500 r/min) AC induction motor rated 480 V/50 Hz.
*** Exact value depends on the motor cable length and type, switching frequency and further stray parameters of the system.

## Required drive settings

**Ensure the drive's switching frequency is set to the required minimum switching frequency (refer to selection table above). The mode of operation must be "scalar" (V/Hz) with a fixed switching frequency. Check the drives manufacturer manual whether special settings are necessary. In any doubt contact the drives manufacturer. CAUTION: If the motor drives settings are not correct the filter may be damaged.**

FUSECO

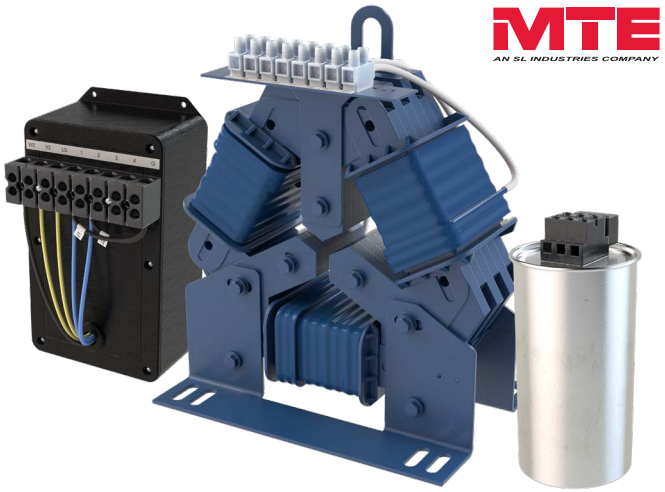
# MTE SineWave Nexus™ Filters

## An Optimal Integrated Solution for both Differential and Common Mode Filtering

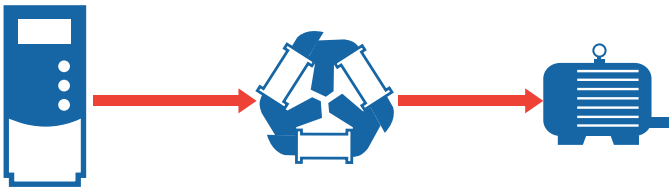
MTE's SineWave Nexus™ filter combines the performance of a sinewave filter with their patented common mode protection technology into a single passive device. It cleans the PWM waveform generated by a VSD and virtually eliminates common mode voltage which causes motor bearing failures. By filtering out the damaging common mode voltage, motor bearings are never subjected to those harmful voltages that cause pitting, frosting, or fluting damage that leads to motor failure.

### Key Features:

- Reduces Common Mode voltage to zero
- Increases motor life
- Eliminates motor failures due to bearing currents
- Reduces motor noise and heating
- Protects motor cable
- Small Package Solution
- 3 year warranty (industry leading)

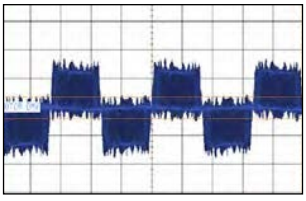



## Application Configurations

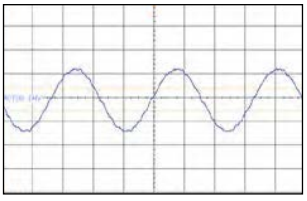



## SineWave Nexus Performance

### Total Harmonic Voltage Distortion

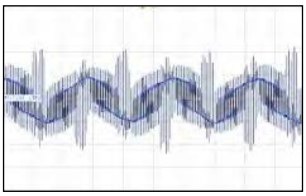


Without SineWave Nexus

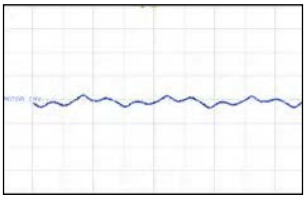


With SineWave Nexus

### Common Mode Voltage

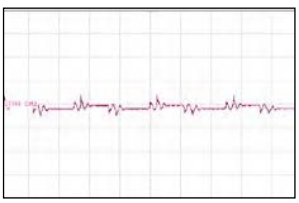


Without SineWave Nexus

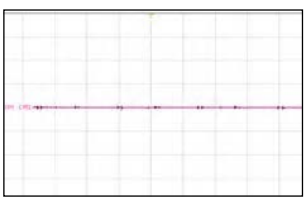


With SineWave Nexus

### Common Mode Current



Without SineWave Nexus



With SineWave Nexus

## Performance Specifications

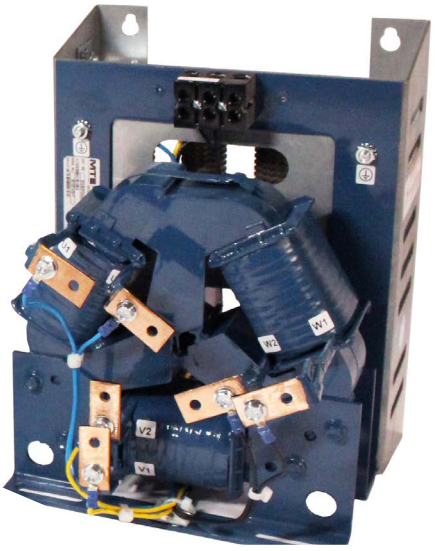
| | |
|---|---|
| Input Voltage | 380V - 600V +/- 10%; 60Hz |
| Current Range | 2A - 160A (0.75 HP - 125 HP) |
| Harmonic Voltage Distortion | 5% maximum @ 4-8kHz |
| Inverter Switching Frequency | 2kHz to 8kHz |
| Inverter Operating Frequency | 6Hz to 75Hz; >75Hz to 120Hz with derating |
| Insertion Loss (Voltage) | 10% maximum @ 60Hz |
| Efficiency | >98% |
| Common Mode Attenuation | -20dB (>90% PWM common mode RMS voltage reduction) @ 4-8kHz |
| Maximum Sound Level | 75dB @ 1 meter |
| Maximum Ambient Temperature | -40C to +60C modular filter<br>-40C to +55C enclosed filter<br>-40C to +90C storage |
| Altitude Without Derating | 3,300 feet above sea level |
| Maximum Motor Lead Length | 15,000 feet |
| Relative Humidity | 0% to 95% non-condensing |
| Current Rating | 100% RMS continuous; 150% for 1 minute intermittent |

# MTE dV Sentry™ dV/dT Filters

## The future is here.

MTE's latest technological innovation has made the dV Sentry™ the revolutionary solution for motor protection. With its patented design, the dV Sentry™ is the first proven filter that provides common mode reduction, peak voltage protection and rise time reduction – all in one unit. This gives greater motor protection over time.

It features a small footprint and easy terminations to make installation faster and easier. It also runs quietly and radiates less heat than previous filters. The unique design of the dV Sentry™ allows for greater load side protection from voltage spikes and common mode voltage for your AC motors, cable and VFDs.



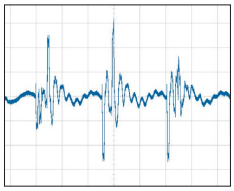
## Key Features:

- **Patented design**
  Revolutionary new design provides over 50% common mode reduction, peak voltage protection, and rise time reduction - all in one filter.
- **Low watts loss**
  Reduces radiated heating in systems.
- **Small footprint**
  The dV Sentry's unique flat design, allows the filter to be easily integrated.
- **Strong robust design**
  Allows the filter to withstand challenging installation applications and other difficult environments.
- **Runs quieter**
  Unlike other 'noisy' filters in this class, the dV Sentry™ runs quieter - comparable to a normal conversation.
- **3 year warranty (industry leading)**

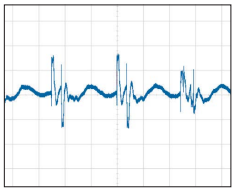
## Performance Specifications

| | |
|---|---|
| Input Voltage | 380V – 600V |
| Current Range | 3A – 600A |
| Available form factors | Panel<br>NEMA 1/2<br>NEMA 3R |
| Max Peak motor Voltage | 150% of DC bus voltage at 1000 feet |
| Rise Time | Less than 0.1uS |
| Insertion Loss | No more than 1.7% at 60Hz<br>No more than 2.6% at 90Hz |
| Intermittent Current Ratings | 150% continuous RMS (1 minute)<br>200% continuous RMS (10 seconds) |
| Carrier Frequency Range | 3A – 110A: 900Hz – 10kHz (up to 14Khz with derating)<br>130A – 600A: 900Hz – 5kHz |
| Motor Frequency | Up to 90Hz without de-rating<br>Up to 120Hz with de-rating |
| Agency Apporvals | UL, cUL, CE, and RoHS |
| Motor Audible Noise | Less thank 65dB |
| Service Temperatures | –40°C to 50°C Enclosed<br>–40°C to 60°C Open |
| Warranty | 3 years from the date of shipment |

## Common Mode Reduction

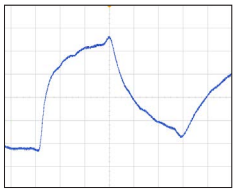


**Without dV Sentry™**

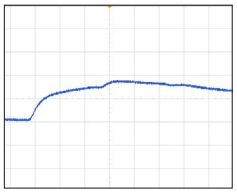


**With dV Sentry™**

## Peak Rise Protection

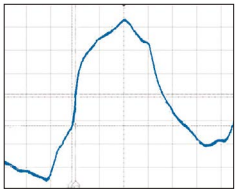


**Without dV Sentry™**

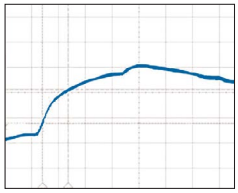


**With dV Sentry™**

## Rise Time Reduction



**Without dV Sentry™**



**With dV Sentry™**

FUSECO

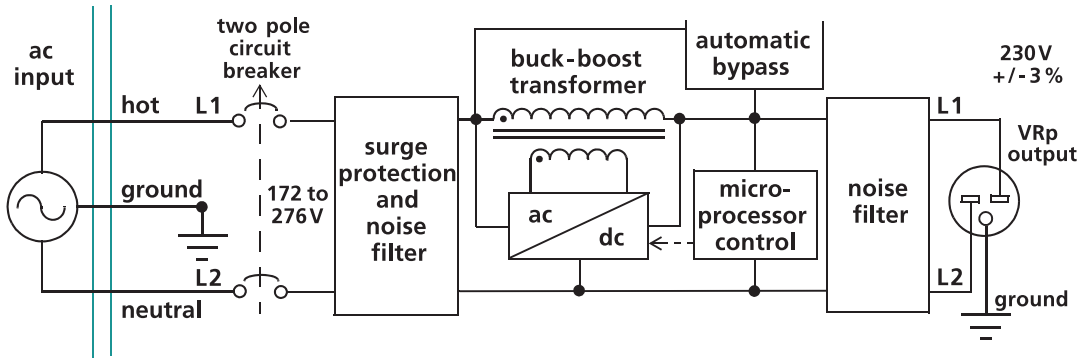
# TSI Automatic Voltage Regulators

TSi Power's VRP & VRX range of automatic voltage regulators have a wide input range and precise regulation. Indoor AVR's are ideally suited to protecting sensitive equipment such as laboratory analysers, medical imaging systems & security scanners. Outdoor AVR's are ideally suited to end-of-line voltage correction. The TSi Power range features heavy duty electronics and magnetics designed to operate under worst case conditions. They incorporate industrial strength surge protection, unique AC-chopper technology for very high efficiency and complete line conditioning.

## Key Features:

- VRX: Under normal input range of 172-276VAC (47-63Hz), output regulation will be 276VAC (±3%).
- VRP: Under normal input range of 184-287V for 230V with output regulated to ±3%.
- VRX range incorporates an aluminium enclosure that is rain tested to UL 50E / NEMA 3R.
- Complete line conditioning.
- The extended input voltage range is 160-330V with reduced regulation.
- 96-98% efficiency
- Fail-safe. No switching of the power path.
- Fast regulation & automatic bypass.
- Low impedance, low weight & quiet operation.
- 2 year limited warranty.

## VRP/VRX System Architecture




## VRP Single Phase 230V

- Available in 3, 5, 7.5, 10, 15 and 20 kVA
- Over/under voltage cut-off is available as an option
- Control PCB assembly is designed for easy replacement

## VRP Three Phase 230/400V

- Available in 9, 15, 22.5, 30 and 45 kVA
- Other sizes are available upon request
- Over/under voltage cut-off is available as an option
- Control PCB assembly is designed for easy replacement

## VRX Three Phase 230/400V

- Available in 15, 22.5 and 30kVA
- Ambient operating temperature range –20°C to +50°C
- Other sizes are available upon request
- Over/under voltage cut-off is available as an option
- Control PCB assembly is designed for easy replacement
- Wall mounting is standard. Pad or pole mounting available as an option

## VRX Single Phase 230V

- Available in 3, 5, 7.5, 10, 15 and 20 kVA
- Ambient operating temperature range –20°C to +50°C
- Over/under voltage cut-off is available as an option
- Control PCB assembly is designed for easy replacement
- Wall mounting is standard. Pad or pole mounting available as an option

# AC Voltage Regulators

A voltage regulator generates a fixed output voltage of a preset magnitude that remains constant regardless of changes to its input voltage or load conditions. Fuseco supplies a large range of Voltage Regulators to suit virtually every application. Contact the team at Fuseco to discuss your requirements.

## Performance Specifications

| | |
|---|---|
| Single Phase | 500VA – 200kVA (Other ratings available upon request) |
| Three Phase | 20kVA – 4,000kVA (Other ratings available upon request) |
| System Frequency | 50/60Hz |
| Input Voltage | Single phase: 220, 230 or 240V selectable<br>Three phase: 380, 400 or 415V selectable |
| Input Variation | Single phase: 140-270VAC selectable Three phase: ± 20%, 30% or 40% selectable |
| Output Accuracy | Single phase: ±3%<br>Three phase: ±2-5% (adjustable) |
| Efficiency | Single phase: ≥90%<br>Three phase: ≥95% |
| Adjusting time | ≤1.5s (when input voltage within the change of 10% |
| Wave distortion | No additional wave distortion |
| Overload capability | 2 times rated current, for 1 min |
| Bypass function | Manual or Automatic |
| Control | Manual or Automatic |
| Display | Input Voltage / Output Voltage / Input Current |
| Insulation resistance | ≥2MΩ |
| Electrical strength | 2000VAC for 1min without breakdown or flash over |
| Ambient temperature | -15℃ to +40℃ |
| Humidity | ≤90% |
| Altitude | ≤1000m |

## Key Features:

- Single phase unit: Under normal input range of 140-270VAC (50/60Hz), output regulation will be 220, 230 or 240VAC (±3%).
- Three phase unit: Under normal input range of 380, 400 or 415V ± 20%, 30% or 40% selectable. With output regulated to ±2 to 5% adjustable.
- Optional split-phase regulating
- No additional waveform distortion
- Protection: Over-voltage, over-current, phase failure and phase sequence
- Single phase ≥90%; Three phase ≥95% efficiency
- Fast regulation with manual or automatic bypass options.
- Automatic or manual start selectable
- Low impedance, low weight & quiet operation
- ≤1.5s Adjusting time
- 1 year factory warranty

**SBW DBW**

**SVC**

FUSECO

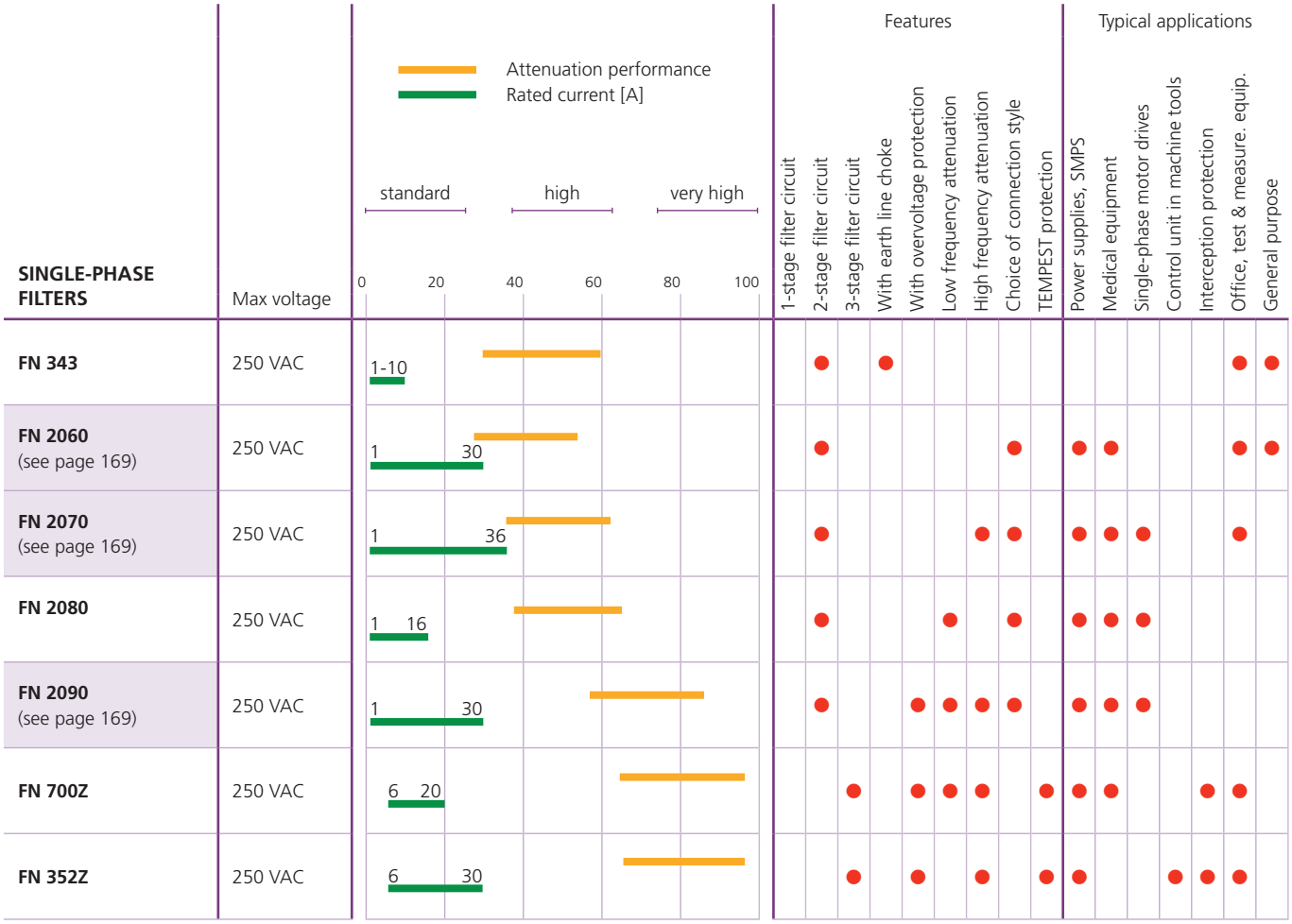
# Single-Phase RFI & DC Filters

Single-phase filters for chassis or DIN-rail mounting are key for EMC compliance of higher power office equipment and low to medium power industrial applications. A broad selection of electrical and mechanical features allows a specific choice and deployment for countless applications. DC filters are specifically optimised for applications with DC supply like e.g. PV inverters.

SCHAFFNER


| SINGLE PHASE FILTERS | Max voltage | Features: 1-stage filter circuit | 2-stage filter circuit | 3-stage filter circuit | For DC applications | With overvoltage protection | Low frequency attenuation | High frequency attenuation | Choice of connection style | DIN-rail mounting | Typical applications: Power supplies, SMPS | Medical equipment | Single-phase motor drives | Control unit in machine tools | PV inverters | Office, test & measure. equip. | General purpose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FN 332** | 250 VAC | ● | | | | ● | | | | | | | | | | | ● |
| **FN 350** | 250 VAC | ● | | | | | | | | | ● | | ● | | | ● | |
| **FN 2010** (see page 168) | 250 VAC | ● | | | | | | | ● | | | ● | | | | | ● |
| **FN 2020** (see page 168) | 250 VAC | ● | | | | | | | ● | | | ● | | | | ● | ● |
| **FN 2030** (see page 168) | 250 VAC | ● | | | | ● | ● | ● | ● | | | ● | | | | ● | ● |
| **FN 2200** | 1200 VDC | ● | | | ● | | ● | ● | | | ● | | | | ● | | ● |
| **FN 2210**<br>**FN 2211** | 1000 VDC | ● | | | ● | | ● | ● | | | ● | | | | ● | | ● |
| **FN 2210 HV**<br>**FN 2211 HV** | 1500 VDC | ● | | | ● | | ● | ● | | | ● | | | | ● | | ● |
| **FN 2410** (see page 168) | 250 VAC<br>520 VAC (H) | ● | | | | | ● | | | | ● | | ● | | | | |
| **FN 2412** | 250 VAC<br>520 VAC (H) | ● | | | | | ● | | | ● | ● | | ● | ● | | | |
| **FN 2450** | 250 VAC | ● | | | | | ● | ● | | | ● | ● | | | | ● | ● |
| **FN 2415** (see page 169) | 250 VAC | | ● | | | | ● | ● | | | ● | ● | | ● | | ● | ● |

SCHAFFNER




| SINGLE-PHASE FILTERS | Max voltage | Features: 1-stage filter circuit | 2-stage filter circuit | 3-stage filter circuit | With earth line choke | With overvoltage protection | Low frequency attenuation | High frequency attenuation | Choice of connection style | TEMPEST protection | Typical applications: Power supplies, SMPS | Medical equipment | Single-phase motor drives | Control unit in machine tools | Interception protection | Office, test & measure. equip. | General purpose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FN 343** | 250 VAC | | ● | | ● | | | | | | | | | | | ● | ● |
| **FN 2060** (see page 169) | 250 VAC | | ● | | | | | | ● | | ● | ● | | | | ● | ● |
| **FN 2070** (see page 169) | 250 VAC | | ● | | | | | ● | ● | | ● | ● | ● | | | ● | |
| **FN 2080** | 250 VAC | | ● | | | | ● | | ● | | ● | ● | ● | | | | |
| **FN 2090** (see page 169) | 250 VAC | | ● | | | ● | ● | ● | ● | | ● | ● | ● | | | | |
| **FN 700Z** | 250 VAC | | | ● | | ● | ● | ● | | ● | ● | ● | | | ● | ● | |
| **FN 352Z** | 250 VAC | | | ● | | ● | | ● | | ● | ● | | | ● | ● | ● | |

FUSECO

# Single-Phase RFI Filters

## FN 2010
250VAC

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| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @ 250VAC/50Hz (mA) | POWER LOSS @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE CX (µF) | CAPACITANCE CY (nF) | RESISTANCE R (KΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN 2010-1-06** | 1 (1.15) | 0.66 | 0.8 | 12 | 0.1 | 4.7 | 1000 | 0.065 |
| **FN 2010-3-06** | 3 (3.45) | 0.66 | 1.1 | 2.5 | 0.1 | 4.7 | 1000 | 0.065 |
| **FN 2010-6-06** | 6 (6.9) | 0.66 | 1.7 | 1 | 0.1 | 4.7 | 1000 | 0.065 |
| **FN 2010-10-06** | 10 (11.5) | 0.66 | 2.5 | 0.8 | 0.1 | 4.7 | 1000 | 0.085 |
| **FN 2010-12-06** | 12 (13.8) | 0.66 | 3.6 | 0.7 | 0.1 | 4.7 | 1000 | 0.085 |
| **FN 2010-16-06** | 16 (18.4) | 0.66 | 2.5 | 0.7 | 0.1 | 4.7 | 1000 | 0.14 |
| **FN 2010-20-06** | 20 (23) | 0.66 | 3.8 | 0.6 | 0.1 | 4.7 | 1000 | 0.21 |
| **FN 2010-30-08** | 30 (34.5) | 0.79 | 6.3 | 0.7 | 0.47 | 10 | 1000 | 0.47 |
| **FN 2010-60-24** | 60 (69) | 0.79 | 14.7 | 1 | 1.5 | 10 | 330 | 1.1 |

## FN 2020
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @ 250VAC/50Hz (mA) | POWER LOSS @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE CX (µF) | CAPACITANCE CY (nF) | RESISTANCE R (KΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN 2020-1-06** | 1 (1.15) | 0.66 | 0.8 | 12 | 0.15 | 4.7 | 1000 | 0.08 |
| **FN 2020-3-06** | 3 (3.45) | 0.66 | 1.2 | 2.5 | 0.15 | 4.7 | 1000 | 0.08 |
| **FN 2020-6-06** | 6 (6.9) | 0.66 | 1.5 | 1 | 0.15 | 4.7 | 1000 | 0.08 |
| **FN 2020-10-06** | 10 (11.5) | 0.66 | 2.9 | 0.8 | 0.15 | 4.7 | 1000 | 0.085 |
| **FN 2020-12-06** | 12 (13.8) | 0.66 | 3.6 | 0.7 | 0.15 | 4.7 | 1000 | 0.085 |
| **FN 2020-16-06** | 16 (18.4) | 0.66 | 2.5 | 0.65 | 0.15 | 4.7 | 1000 | 0.14 |
| **FN 2020-20-06** | 20 (23) | 0.66 | 3.8 | 0.6 | 0.15 | 4.7 | 1000 | 0.21 |
| **FN 2020-30-08** | 30 (34.5) | 0.79 | 6.3 | 0.67 | 0.47 | 10 | 470 | 0.47 |
| **FN 2020-60-24** | 60 (69) | 0.79 | 14.7 | 1 | 1.5 | 10 | 220 | 1.1 |

## FN 2030
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @ 250VAC/50Hz (mA) | POWER LOSS @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE CX (µF) | CAPACITANCE CY (nF) | RESISTANCE R (KΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN 2030-1-06** | 1 (1.1) | 0.31 | 0.9 | 20 | 0.22 | 2.2 | 1000 | 0.058 |
| **FN 2030-3-06** | 3 (3.4) | 0.47 | 2.2 | 14 | 0.33 | 3.3 | 1000 | 0.087 |
| **FN 2030-4-06** | 4 (4.5) | 0.47 | 2.9 | 14 | 0.33 | 3.3 | 1000 | 0.092 |
| **FN 2030-6-06** | 6 (6.7) | 0.66 | 3.2 | 8 | 0.47 | 4.7 | 680 | 0.1 |
| **FN 2030-8-06** | 8 (8.9) | 0.66 | 3.1 | 8 | 0.47 | 4.7 | 680 | 0.17 |
| **FN 2030-10-06** | 10 (11.2) | 0.66 | 5.3 | 8 | 0.47 | 4.7 | 680 | 0.196 |
| **FN 2030-12-06** | 12 (13.4) | 0.79 | 7.6 | 4 | 1 | 10 | 330 | 0.185 |
| **FN 2030-16-06** | 16 (17.9) | 0.79 | 6.1 | 4 | 1 | 10 | 330 | 0.225 |
| **FN 2030-20-06** | 20 (22.4) | 0.79 | 4.6 | 4 | 1 | 10 | 330 | 0.285 |
| **FN 2030-30-08** | 30 (33.5) | 0.79 | 6 | 2 | 1 | 10 | 330 | 0.326 |

## FN 2410
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURRENT @50°C (40°C) (A) | LEAKAGE CURRENT @250 VAC /50 Hz | POWER LOSS @25°C/50Hz (W) | WEIGHT (kg) |
|---|---|---|---|---|
| **FN2410-8-44** | 8 (8.8) | 2.6 | 2.6 | 0.4 |
| **FN2410-16-44** | 16 (17.5) | 2.6 | 3.5 | 0.5 |
| **FN2410-25-33** | 25 (27.4) | 2.6 | 5.5 | 0.6 |
| **FN2410-32-33** | 32 (35.0) | 2.6 | 5.6 | 0.7 |
| **FN2410-45-33** | 45 (49.3) | 2.6 | 7.4 | 0.7 |
| **FN2410-60-34** | 60 (65.7) | 2.6 | 5.5 | 1.8 |
| **FN2410-80-34** | 80 (87.6) | 2.6 | 9.9 | 1.8 |
| **FN2410-100-34** | 100 (109.5) | 2.6 | 15.4 | 1.8 |

## Key Features

**Rated currents from 1 to 100A**

**General purpose filtering performance**

SCHAFFNER

## FN 2415
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @250 VAC/50 Hz (mA) | Power loss (W) | INDUCTANCE L (mH) | CAPACITANCE Cx (µF) | CAPACITANCE Cy (nF) | RESISTANCE R (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN2415-6-29** | 6 (6.6) | 7.85 | 2.2 | 8 | 3.3 | 100 | 220 | 0.4 |
| **FN2415-10-29** | 10 (11) | 7.85 | 2.4 | 4.2 | 3.3 | 100 | 220 | 0.4 |
| **FN2415-16-29** | 16 (17.5) | 7.85 | 4.3 | 3 | 3.3 | 100 | 220 | 0.4 |

## FN 2060
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @250 VAC/50 Hz (mA) | Power loss @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE Cx (µF) | CAPACITANCE Cy (nF) | RESISTANCE R (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN2060-1-06** | 1 (1.2) | 0.66 | 1.6 | 12 | 0.22 | 4.7 | 1000 | 0.12 |
| **FN2060-3-06** | 3 (3.5) | 0.66 | 2.2 | 2.5 | 0.22 | 4.7 | 1000 | 0.12 |
| **FN2060-6-06** | 6 (6.9) | 0.66 | 3.2 | 0.97 | 0.22 | 4.7 | 1000 | 0.12 |
| **FN2060-10-06** | 10 (11.5) | 0.66 | 4.3 | 0.8 | 0.47 | 4.7 | 470 | 0.19 |
| **FN2060-12-06** | 12 (13.8) | 0.66 | 6.2 | 0.58 | 0.47 | 4.7 | 470 | 0.19 |
| **FN2060-16-06** | 16 (18.4) | 0.66 | 4.4 | 0.65 | 0.33 | 4.7 | 1000 | 0.26 |
| **FN2060-20-06** | 20 (23) | 0.66 | 5.3 | 0.6 | 1 | 4.7 | 220 | 0.48 |
| **FN2060-30-08** | 30 (34.5) | 0.79 | 9.1 | 0.6 | 1 | 10 | 220 | 0.95 |

## FN 2070
250VAC

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| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @250 VAC/50 Hz (=) | Power loss @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE Cx (µF) | CAPACITANCE Cy (nF) | RESISTANCE R (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|
| **FN2070-1-06** | 1 (1.2) | 0.66 | 2.4 | 22 | 0.33 | 4.7 | 1000 | 0.19 |
| **FN2070-3-06** | 3 (3.5) | 0.66 | 2.2 | 9.8 | 0.47 | 4.7 | 470 | 0.25 |
| **FN2070-6-06** | 6 (6.9) | 0.66 | 3.2 | 7.8 | 1 | 4.7 | 220 | 0.45 |
| **FN2070-10-06** | 10 (11.5) | 0.66 | 9.1 | 4.5 | 1 | 4.7 | 220 | 0.67 |
| **FN2070-12-06** | 12 (13.8) | 0.66 | 13.1 | 3.25 | 1 | 4.7 | 220 | 0.67 |
| **FN2070-16-06** | 16 (18.4) | 0.66 | 9.6 | 2.8 | 1 | 4.7 | 220 | 1 |
| **FN2070-25-06** | 20 (23) | 0.66 | 11.6 | 2 | 2.2 | 4.7 | 220 | 0.76 |
| **FN2070-36-08** | 30 (34.5) | 0.79 | 13.1 | 1.23 | 2.2 | 4.7 | 220 | 0.79 |

## FN 2090
250VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @40°C (25°C) (A) | LEAKAGE CURR @250 VAC /50 Hz | POWER LOSS @25°C/DC (W) | INDUCTANCE L (mH) | CAPACITANCE Cx (µF) | CAPACITANCE Cy1 (nF) | CAPACITANCE Cy2 (nF)" | RESISTANCE R (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|---|---|---|
| **FN2090-1-06** | 1 (1.1) | 0.45 | 1.8 | 20 | 0.22 | 2.2 | 1 | 680 | 0.073 |
| **FN2090-3-06** | 3 (3.4) | 0.45 | 3.7 | 14 | 0.33 | 2.2 | 1 | 470 | 0.158 |
| **FN2090-4-06** | 4 (4.5) | 0.45 | 6.4 | 14 | 0.33 | 2.2 | 1 | 470 | 0.176 |
| **FN2090-6-06** | 6 (6.7) | 0.61 | 7.1 | 8 | 0.47 | 3.3 | 1 | 330 | 0.191 |
| **FN2090-8-06** | 8 (8.9) | 0.61 | 7.7 | 8 | 0.47 | 3.3 | 1 | 330 | 0.33 |
| **FN2090-10-06** | 10 (11.2) | 0.61 | 8.4 | 8 | 0.47 | 3.3 | 1 | 330 | 0.369 |
| **FN2090-12-06** | 12 (13.4) | 0.93 | 12.1 | 4 | 1 | 10 | 1 | 220 | 0.391 |
| **FN2090-16-06** | 16 (17.9) | 0.93 | 10.7 | 4 | 1 | 10 | 1 | 220 | 0.425 |
| **FN2090-20-06** | 20 (22.4) | 0.93 | 8.2 | 2.7 | 1 | 10 | 1 | 220 | 0.53 |
| **FN2090-30-08** | 30 (33.5) | 0.93 | 10.1 | 1.5 | 1 | 10 | 1 | 220 | 0.548 |

FUSECO

# Three-Phase RFI Filters

EMC/EMI filter solutions for industrial applications like motor drives and machine tools. Furthermore, these types of filters are also suitable for mainframe computer systems, large uninterruptible power supplies, medical equipment, wind turbine power stations and a vast array of other three-phase power electronics. LCL filters are used with active infeed converters (AFE) to allow a norm conform grid connection.

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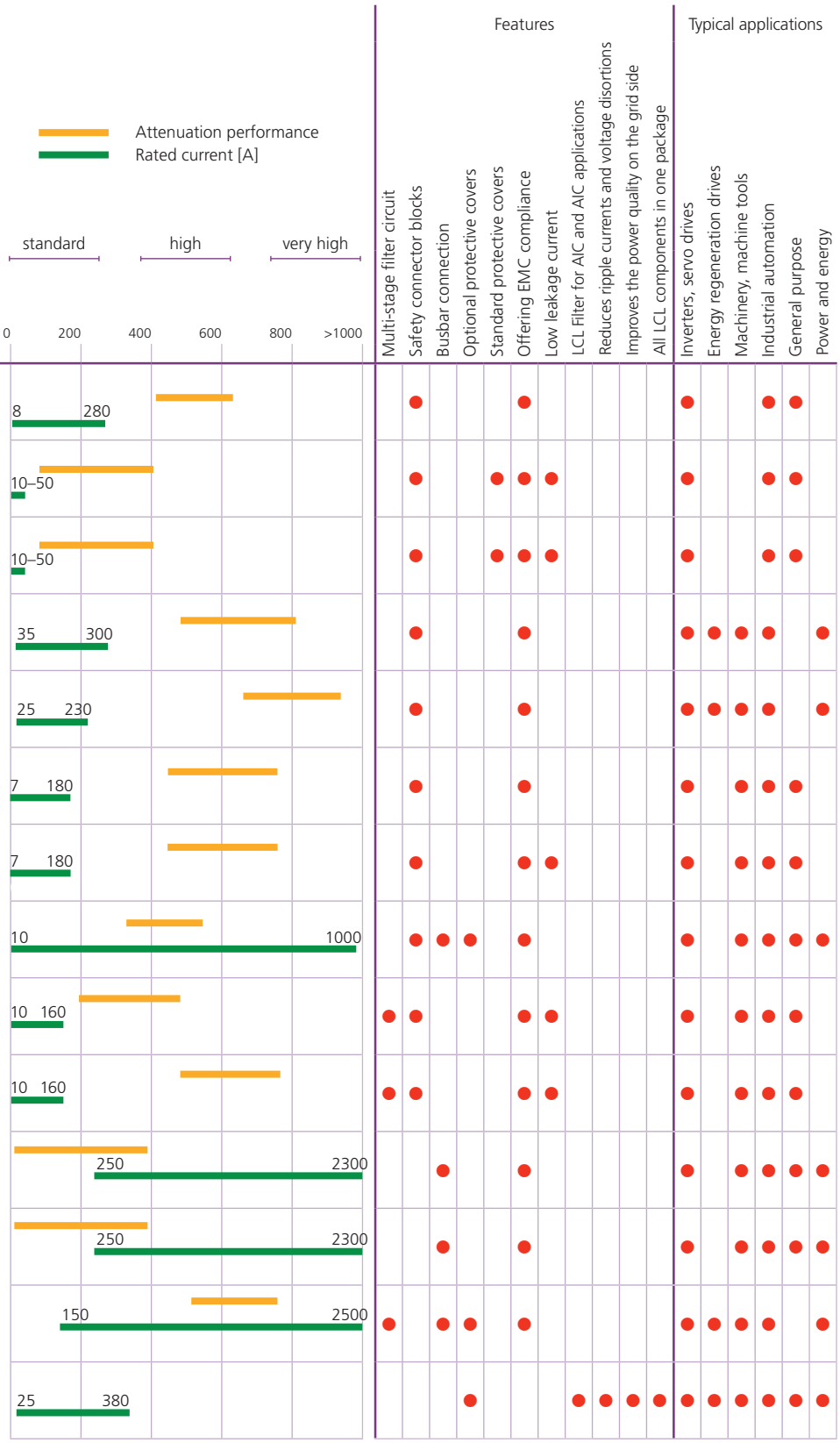


| THREE PHASE FILTERS | Max voltage | |
|---|---|---|
| **FN 351** | 440 VAC<br>520 VAC (H) | 8 – 280 |
| **FN 3025** | 520 VAC | 10–50 |
| **FN 3026** | 520 VAC | 10–50 |
| **FN 3100** | 520 VAC | 35 – 300 |
| **FN 3120** | 520 VAC (H) | 25 – 230 |
| **FN 3258** | 480 VAC<br>520 VAC (H) | 7 – 180 |
| **FN 3268** | 520 VAC | 7 – 180 |
| **FN 3270** | 520 VAC | 10 – 1000 |
| **FN 3287**<br>**FN 3288** (see page 171) | 530 VAC | 10 – 160 |
| **FN 3288 HV** | 690 VAC | 10 – 160 |
| **FN 3310**<br>**FN 3311** | 520 VAC | 250 – 2300 |
| **FN 3310 HV**<br>**FN 3311 HV** | 690 VAC | 250 – 2300 |
| **FN 3359** (see page 171) | 520 VAC<br>690 VAC (HV) | 150 – 2500 |
| **FN 6840** | 530 VAC | 25 – 380 |

# Three-Phase RFI Filters

## Key Features

SCHAFFNER

- Industry standard EMC solution for three-phase PDS filtering
- Slim space-saving book-style housing
- Solid safety connector blocks or optional wire output connections
- Excellent attenuation performance
- HV versions for up to 690VAC
- HVIT versions for IT distribution networks
- P/L versions with low leakage current

## FN3287-C26

530VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @ 50°C (40°C) (A) | TYPICAL DRIVE POWER RATING (kW) | LEAKAGE CURR @ 530VAC/50Hz (mA) | POWER LOSS @ 25°C (W) | WEIGHT (kg) |
|---|---|---|---|---|---|
| FN3287-10-44-C26-R65 | 10 (11) | 5.5 | 2.2 | 7.5 | 0.7 |
| FN3287-16-44-C26-R65 | 16 (17) | 7.5 | 2.4 | 9.5 | 0.8 |
| FN3287-20-33-C26-R65 | 20 (22) | 11 | 2.5 | 10 | 0.9 |
| FN3287-25-33-C26-R65 | 25 (27) | 15 | 2.5 | 11.4 | 1 |
| FN3287-40-33-C26-R65 | 40 (44) | 22 | 2.5 | 22.6 | 1.5 |
| FN3287-50-53-C26-R65 | 50 (55) | 30 | 2.5 | 25.5 | 2.1 |
| FN3287-63-53-C26-R65 | 63 (69) | 37 | 2.5 | 32.1 | 2.2 |
| FN3287-80-34-C26-R65 | 80 (88) | 45 | 2.7 | 32.6 | 3.4 |
| FN3287-100-35-C26-R65 | 100 (110) | 55 | 2.7 | 33 | 4.2 |
| FN3287-125-35-C26-R65 | 125 (137) | 75 | 2.7 | 37.5 | 4.6 |
| FN3287-160-40-C26-R65 | 160 (175) | 90 | 2.7 | 38.4 | 6 |

## FN3288-C21

530VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @ 50°C (40°C) (A) | TYPICAL DRIVE POWER RATING (kW) | LEAKAGE CURR @ 530VAC/50Hz (mA) | POWER LOSS @ 25°C (W) | WEIGHT (kg) |
|---|---|---|---|---|---|
| FN3288-10-44-C21-R65 | 10 (11) | 5.5 | 0.4 | 7.1 | 0.8 |
| FN3288-16-44-C21-R65 | 16 (17) | 7.5 | 0.4 | 10.5 | 1 |
| FN3288-20-33-C21-R65 | 20 (22) | 11 | 0.4 | 10.7 | 1.2 |
| FN3288-25-33-C21-R65 | 25 (27) | 15 | 0.4 | 17.8 | 1.2 |
| FN3288-40-33-C21-R65 | 40 (44) | 22 | 0.4 | 21.6 | 1.8 |
| FN3288-50-53-C21-R65 | 50 (55) | 30 | 0.4 | 29.3 | 2.5 |
| FN3288-63-53-C21-R65 | 63 (69) | 37 | 0.4 | 34.5 | 2.7 |
| FN3288-80-34-C21-R65 | 80 (88) | 45 | 0.4 | 28.8 | 4.3 |
| FN3288-100-35-C21-R65 | 100 (110) | 55 | 0.4 | 36 | 5.1 |
| FN3288-125-35-C21-R65 | 125 (137) | 75 | 0.4 | 42.2 | 5 |
| FN3288-160-40-C21-R65 | 160 (175) | 90 | 0.4 | 46.1 | 6.6 |

## FN 3359

520VAC

SCHAFFNER

| FUSECO PART NUMBER | RATED CURR @ 50°C (40°C) (A) | TYPICAL DRIVE POWER RATING (kW) | LEAKAGE CURR @ 520VAC/50Hz (mA) | POWER LOSS @ 25°C (W) | WEIGHT (kg) |
|---|---|---|---|---|---|
| FN3359-150-28 | 150 (164) | 75 | 5.1 | 24 | 5.8 |
| FN3359-180-28 | 180 (197) | 90 | 5.1 | 34 | 5.8 |
| FN3359-250-28 | 250 (250) | 132 | 5.1 | 49 | 9 |
| FN3359-320-99 | 320 (350) | 160 | 5.1 | 19 | 10.5 |
| FN3359-400-99 | 400 (438) | 220 | 5.1 | 29 | 10.5 |
| FN3359-600-99 | 600 (657) | 315 | 5.1 | 44 | 11 |
| FN3359-800-99 | 800 (876) | 400 | 5.3 | 39 | 20 |
| FN3359-1000-99 | 1000 (1095) | 560 | 5.3 | 60 | 20 |
| FN3359-1600-99 | 1600 (1600) | 900 | 5.1 | 131 | 17 |
| FN3359-2500-99 | 2500 (2500) | 1320 | 5.1 | 300 | 69 |

FUSECO

# Three-Phase and Neutral Line RFI Filters

Three-phase and neutral line filters are a compact solution for the interference suppression on the mains input of cabinets and control units of equipment, ranging from industrial applications like machine tools to sensitive medical installations.

These typically involve separate and often insufficiently filtered frequency inverters and SMPS, causing current imbalance and significant interference problems.

As individual elements they may be interference suppressed already. The conjunction of several switching components in the same cabinet and a non-EMC conscious cabling will rise the demand for an additional RFI/EMI filter on the mains input of the whole installation.

Many times this is the only way to get the CE mark for the cabinet in accordance with the EMC directive.

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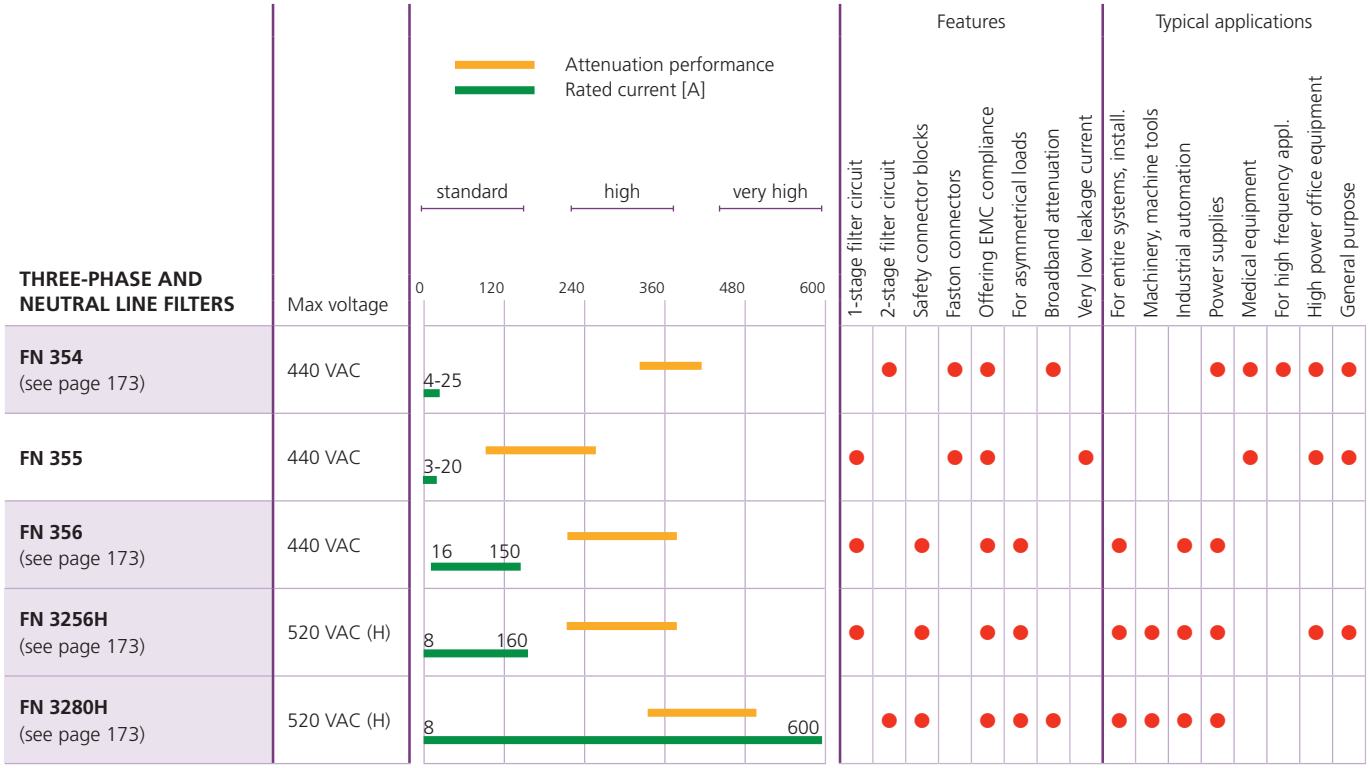


| THREE-PHASE AND NEUTRAL LINE FILTERS | Max voltage |
|---|---|
| **FN 354** (see page 173) | 440 VAC |
| **FN 355** | 440 VAC |
| **FN 356** (see page 173) | 440 VAC |
| **FN 3256H** (see page 173) | 520 VAC (H) |
| **FN 3280H** (see page 173) | 520 VAC (H) |

SCHAFFNER

## FN 354
440VAC
SCHAFFNER

| FUSECO PART NUMBER | RATED CURRENT @40°C (25°C) (A) | LEAKAGE CURRENT @ 440 VAC/50 HZ (mA) | POWER LOSS @ 25°C/50 HZ (W) | WEIGHT (KG) |
|---|---|---|---|---|
| **FN 354-4-05** | 4 (4.5) | 0.1 | 2 | 0.23 |
| **FN 354-6-05** | 6 (6.7) | 0.1 | 3.9 | 0.38 |
| **FN 354-12-05** | 12 (13.4) | 0.1 | 7.8 | 1.1 |
| **FN 354-15-47** | 15 (16.8) | 0.1 | 10.8 | 4.3 |
| **FN 354-25-47** | 25 (28) | 0.2 | 16.9 | 4.4 |

## FN 356
440VAC
SCHAFFNER

| FUSECO PART NUMBER | RATED CURRENT @40°C (25°C) (A) | LEAKAGE CURRENT @ 440 VAC/50 HZ (mA) | POWER LOSS @ 25°C/50 HZ (W) | WEIGHT (KG) |
|---|---|---|---|---|
| **FN 356-16-29** | 16 (18.4) | 0.1 | 7 | 1.2 |
| **FN 356-25-33** | 25 (28.8) | 0.1 | 10.1 | 1.5 |
| **FN 356-36-33** | 36 (41.5) | 0.1 | 10.9 | 1.6 |
| **FN 356-50-33** | 50 (57.7) | 0.1 | 15.8 | 2.3 |
| **FN 356-100-34** | 100 (115.0) | 0.3 | 24 | 5.9 |
| **FN 356-150-28** | 150 (172.5) | 1.7 | 45.9 | 8.1 |

## FN 3256H
520VAC
SCHAFFNER

| FUSECO PART NUMBER | RATED CURRENT @50°C (40°C) (A) | LEAKAGE CURRENT @ 520 VAC/50 HZ (mA) | POWER LOSS @ 25°C/50 HZ (W) | RESISTANCE R (KΩ) | RESISTANCE R1 (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|
| **FN3256H-8-29** | 8 (8.8) | 0.6 | 2.7 | 1500 | 680 | 0.6 |
| **FN3256H-16-29** | 16 (17.5) | 0.6 | 5 | 1500 | 680 | 0.7 |
| **FN3256H-25-33** | 25 (27) | 0.6 | 9.8 | 1500 | 680 | 1.1 |
| **FN3256H-36-33** | 36 (39) | 0.6 | 11.3 | 1500 | 680 | 1.2 |
| **FN3256H-64-34** | 64 (70) | 0.6 | 17.2 | 1500 | 680 | 2.3 |
| **FN3256H-80-35** | 80 (88) | 0.6 | 14.5 | 1500 | 680 | 3.5 |
| **FN3256H-120-35** | 120 (131) | 0.9 | 25 | 1500 | 680 | 4.7 |
| **FN3256H-160-40** | 160 (175) | 1.3 | 26.9 | 1500 | 680 | 5.7 |

## FN 3280H
520VAC
SCHAFFNER

| FUSECO PART NUMBER | RATED CURRENT @50°C (40°C) (A) | LEAKAGE CURRENT @ 520 VAC/50 HZ (mA) | POWER LOSS @ 25°C/50 HZ (W) | RESISTANCE R (KΩ) | RESISTANCE R1 (kΩ) | WEIGHT (kg) |
|---|---|---|---|---|---|---|
| **FN3280H-8-29** | 8 (8.8) | 10.7 | 2.7 | 1500 | 660 | 0.8 |
| **FN3280H-16-29** | 16 (17.5) | 10.7 | 6 | 1500 | 660 | 0.8 |
| **FN3280H-25-33** | 25 (27) | 10.7 | 11.6 | 820 | 660 | 1.3 |
| **FN3280H-36-33** | 36 (39) | 10.7 | 14.8 | 820 | 660 | 1.6 |
| **FN3280H-64-34** | 64 (70) | 10.7 | 18.4 | 820 | 660 | 2.7 |
| **FN3280H-80-35** | 80 (88) | 10.7 | 18.9 | 1000 | 660 | 4.1 |
| **FN3280H-120-35** | 120 (131) | 10.7 | 28.5 | 1000 | 660 | 5.9 |
| **FN3280H-160-40** | 160 (175) | 10.7 | 30.7 | 1000 | 660 | 7.9 |
| **FN3280H-200-40** | 200 (219) | 10.7 | 46.8 | 1000 | 660 | 8.5 |
| **FN3280H-300-99** | 300 (328) | 42.1 | 20.3 | 1000 | 680 | 10 |
| **FN3280H-400-99** | 400 (438) | 42.1 | 36 | 1000 | 680 | 10 |
| **FN3280H-600-99** | 600 (657) | 42.1 | 64.8 | 1000 | 680 | 11 |

# Notes