

# Ecosine evo, 400 VAC 50 Hz Passive Harmonic Filters for 6-pulse rectifier with 8% DC-Link choke



- The industry standard for 6-pulse rectifier and motor drives
- Filters for diode rectifier with 8% DC-link choke
- Best-in-class partial load performance
- Most compact design
- Plug and play, ready to use



### Approvals & Compliances



(depending on filter configuration)

### Features and benefits

Schaffner ecosine harmonic filters represent an economical solution to the challenge of load-applied harmonics mitigation in three-phase power systems. With a plug-and-play approach and more compact dimensions than comparable products, they can be quickly installed and easily commissioned. They increase the reliability and service life of electric installations, help utilize electric system capacity better, and are the key to meet Power Quality standards such as IEEE 519. Ecosine filters reshape your distorted current back to the desired sinusoidal waveform. Schaffner ecosine filters can be applied to virtually any kind of power electronics with front-end six-pulse rectifiers, 3-phase diode or thyristor bridges, where harmonic current distortion needs to be reduced to defined limits.

### Typical applications

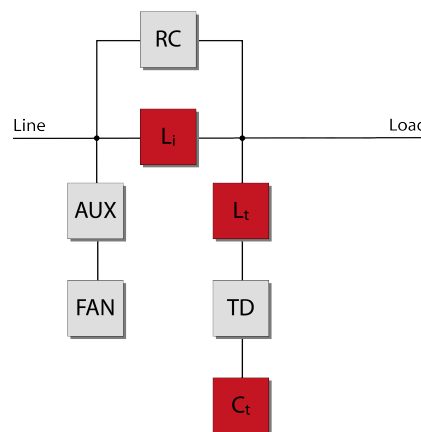
- Equipment with front-end six-pulse rectifier
- Motor drives
- Factory automation equipment
- Water/wastewater treatment facilities
- Fan and pump applications
- HVAC installations
- Mission-critical processes
- DC fast chargers

### Technical specifications

|  |  |
|--|--|
| <b>Nominal operating voltage</b>               | 3 x 380 VAC to 415 VAC ±10%  |
| <b>Operating frequency</b>                     | 50 Hz ±1 Hz  |
| <b>Nominal motor drive input power rating</b>  | 1.1 to 250 kW  |
| <b>Total harmonic current distortion THDi*</b> | ≤5% at rated power   |
| <b>Efficiency</b>                              | >98% for rated voltage and power   |
| <b>Overload capability</b>                     | 1.6x rated current for 1 minute, once per hour   |
| <b>SCCR**</b>                                  | 100 kA   |
| <b>High potential test voltage</b>             | P → E 2160 VAC (1 s)   |
| <b>Earthing System</b>                         | TN, TT, IT   |
| <b>Protection category</b>                     | IP 00, IP 20   |
| <b>Cooling</b>                                 | Internal fan cooling or external cooling***  |
| <b>Ambient temperature range</b>               | -25°C to +45°C fully operational<br>-25°C to +85°C transport and storage<br>+45°C to +70°C derated operation**** |
| <b>Design corresponding to</b>                 | Filter: UL 61800-5-1, EN 61800-5-1<br>Chokes: EN 61558-2-20 or EN 60076-6  |
| <b>Flammability corresponding to</b>           | UL 94 V-2  |
| <b>MTBF @ 45°C/400 V (Mil-HB-217F)</b>         | >200,000 hours   |

\* System requirements: THDv <2%, line voltage unbalance <1%  
 Note: performance specifications in this brochure refer to six-pulse diode rectifiers with 8% DC-link choke. THDi ~5% at rated power for filter <6 kW/HP  
 \*\* External UL-rated fuses required. Please consult the user manual.  
 \*\*\* Please check the inlet air flow required for cooling table further in this document and the user manual.  
 \*\*\*\*  $I_{derated} = I_{nominal} \cdot \sqrt{\frac{(T_{max} - T_{amb})}{(T_{max} - T_{nominal})}} = I_{nom} \cdot \sqrt{\frac{(70^{\circ}\text{C} - T_{amb})}{25^{\circ}\text{C}}}$

### Typical electrical schematic



(all configurable optional functionalities shown)

## Filter selection table – IP 00 enclosure

| Filter                    | Rated load power<br>@ 400 V/50 Hz<br>[kW] | Motor drive<br>input current<br>[Arms]** | Rated filter<br>input current<br>[Arms] | Min. required<br>LDC<br>[mH]***** | Min. required<br>LAC<br>[mH]***** | Weight<br>[kg] | Typical<br>losses<br>[W]**** | Terminal | Frame<br>size |
|---------------------------|---|--|---|-----------------------------------|-----------------------------------|----------------|------------------------------|----------|---------------|
| FN 3441-1-110-E0_*****    | 1.1                                       | 1.7                                      | 1.62                                    | 37.41                             | 9.8                               | 6              | 53                           | 110      | A             |
| FN 3441-2-110-E0_*****    | 2.2                                       | 3.4                                      | 3.23                                    | 18.71                             | 6.01                              | 9              | 73                           | 110      | A             |
| FN 3441-4-112-E0_*****    | 4.0                                       | 6.2                                      | 5.9                                     | 10.29                             | 3.48                              | 12             | 104                          | 112      | B             |
| FN 3441-6-112-E0_*****    | 5.5                                       | 8.5                                      | 8.1                                     | 7.483                             | 2.548                             | 15             | 143                          | 112      | C             |
| FN 3441-8-112-E0_*****    | 7.5                                       | 12                                       | 11                                      | 5.487                             | 1.818                             | 16             | 193                          | 112      | C             |
| FN 3441-11-113-E0_****    | 11  | 17                                       | 16                                      | 3.741                             | 1.264                             | 23             | 233                          | 113      | D             |
| FN 3441-15-113-E0_****    | 15  | 23                                       | 22                                      | 2.744                             | 0.909                             | 26             | 285                          | 113      | D             |
| FN 3441-19-113-E0_****    | 19  | 29                                       | 28                                      | 2.166                             | 0.724                             | 30             | 271                          | 113      | D             |
| FN 3441-22-115-E0_****    | 22  | 34                                       | 32                                      | 1.871                             | 0.637                             | 38             | 355                          | 115      | E             |
| FN 3441-30-115-E0_****    | 30  | 46                                       | 44                                      | 1.372                             | 0.454                             | 43             | 452                          | 115      | E             |
| FN 3441-37-115-E0_****    | 37  | 57                                       | 54                                      | 1.112                             | 0.361                             | 48             | 468                          | 115      | E             |
| FN 3441-45-115-E0_****    | 45  | 70                                       | 66                                      | 0.915                             | 0.297                             | 54             | 596                          | 115      | E             |
| FN 3441-55-115-E0_****    | 55  | 85                                       | 81                                      | 0.748                             | 0.245                             | 63             | 665                          | 115      | E             |
| FN 3441-75-116-E0_****    | 75  | 116                                      | 110                                     | 0.549                             | 0.178                             | 98             | 757                          | 116      | G             |
| FN 3441-90-116-E0_****    | 90  | 140                                      | 133                                     | 0.457                             | 0.147                             | 106            | 854                          | 116      | G             |
| FN 3441-110-118-E0_****   | 110                                       | 171                                      | 162                                     | 0.374                             | 0.12                              | 127            | 1032                         | 118      | H             |
| FN 3441-132-118-E0_****** | 132                                       | 205                                      | 195                                     | 0.312                             | 0.099                             | 149            | 1062                         | 118      | H             |
| FN 3441-160-118-E0_****** | 160                                       | 249                                      | 238                                     | 0.257                             | 0.085                             | 167            | 1073                         | 118      | H             |
| FN 3441-200-118-E0_****** | 200                                       | 312                                      | 297                                     | 0.206                             | 0.064                             | 168            | 1228                         | 118      | H             |
| FN 3441-250-119-E0XXSXX   | 250                                       | 392                                      | 376                                     | 0.165                             | 0.051                             | 246            | 1398                         | 119      | J             |

\* Filter rating which does not require forced cooling or fan module

\*\* Filter rating which does not require RC damping module for rectifiers with EMI filter

\*\*\* Motor drive input current without harmonic filter

\*\*\*\* Typical losses @ 45°C, 400V, 50Hz and rated load power

\*\*\*\*\* In order to apply FN 3441 filters, motor drives have to be equipped with either DC-link choke or AC line choke. The minimum required inductance values are given in mH in the filter selection table. If neither DC-link choke nor AC line choke is present, or if the minimum mH rating is not fulfilled, FN 3441 filter must not be used. In this case, FN 3440 need to be chosen.

## Filter power terminals

| Terminal designation* | Screw thread | Flex wire AWG | Flex wire<br>[mm <sup>2</sup> ] | Screw torque value<br>[Nm] | Max width**<br>cable lug<br>[mm] | Frame size |
|-----------------------|--------------|---------------|---------------------------------|----------------------------|----------------------------------|------------|
| 110                   | M3           | 14-22         | 0.4-2.5                         | 0.5                        | 7                                | A          |
| 112                   | M4           | 10-22         | 0.4-6                           | 1.2                        | 10                               | B, C       |
| 113                   | M6           | 6-18          | 0.75-16                         | 3                          | 15                               | D          |
| 115                   | M8           | 1/0-8         | 10-50                           | 8                          | 15                               | E, F       |
| 116                   | M8           | 3/0-8         | 10-95                           | 8                          | 17                               | G          |
| 118                   | M10          | 3/0-500 kcmil | 95-240                          | 10                         | 35                               | H          |
| 119                   | M16          | 350-750 kcmil | 185-400                         | 10                         | 48                               | J          |

\* Recommended connector type: wire or cable lug for 110 to 113, only cable lug for 115 to 119

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

## Filter signal and earth terminals

| Terminal type | Screw thread | Screw torque value<br>[Nm] | Frame size |
|---------------|--------------|----------------------------|------------|
| Signal        | M3*          | 0.5                        | All        |
| Earth (PE)    | M5           | 2.2                        | A          |
| Earth (PE)    | M6           | 4                          | B, C       |
| Earth (PE)    | M8           | 9                          | D, E       |
| Earth (PE)    | M10          | 17                         | F, G, H    |
| Earth (PE)    | M12          | 25                         | J          |

\* Max width cable lug = 7 mm

## Filter selection table - IP 20 enclosure

| Filter                       | Rated load power<br>@ 400 V/50 Hz<br>[kW] | Motor drive<br>input current<br>[Arms]** | Rated filter<br>input current<br>[Arms] | Min. required<br>LDC<br>[mH]***** | Min. required<br>LAC<br>[mH]***** | Weight<br>[kg] | Typical<br>losses<br>[W]**** | Terminal | Frame<br>size |
|------------------------------|---|--|---|-----------------------------------|-----------------------------------|----------------|------------------------------|----------|---------------|
| FN 3441-1-110-E2_ _ _ _ *    | 1.1                                       | 1.7                                      | 1.62                                    | 37.41                             | 9.8                               | 7              | 53                           | 110      | A             |
| FN 3441-2-110-E2_ _ _ _ *    | 2.2                                       | 3.4                                      | 3.23                                    | 18.71                             | 6.01                              | 9              | 73                           | 110      | A             |
| FN 3441-4-112-E2_ _ _ _ *    | 4.0                                       | 6.2                                      | 5.9                                     | 10.29                             | 3.48                              | 13             | 104                          | 112      | B             |
| FN 3441-6-112-E2_ _ _ _ *    | 5.5                                       | 8.5                                      | 8.1                                     | 7.483                             | 2.548                             | 16             | 143                          | 112      | C             |
| FN 3441-8-112-E2_ _ _ _ *    | 7.5                                       | 12                                       | 11                                      | 5.487                             | 1.818                             | 18             | 193                          | 112      | C             |
| FN 3441-11-113-E2_ _ _ _     | 11  | 17                                       | 16                                      | 3.741                             | 1.264                             | 27             | 233                          | 113      | D             |
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| FN 3441-22-115-E2_ _ _ _     | 22  | 34                                       | 32                                      | 1.871                             | 0.637                             | 44             | 355                          | 115      | E             |
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| FN 3441-45-115-E2_ _ _ _     | 45  | 70                                       | 66                                      | 0.915                             | 0.297                             | 59             | 596                          | 115      | E             |
| FN 3441-55-115-E2_ _ _ _     | 55  | 85                                       | 81                                      | 0.748                             | 0.245                             | 68             | 665                          | 115      | E             |
| FN 3441-75-116-E2_ _ _ _     | 75  | 116                                      | 110                                     | 0.549                             | 0.178                             | 107            | 757                          | 116      | G             |
| FN 3441-90-116-E2_ _ _ _     | 90  | 140                                      | 133                                     | 0.457                             | 0.147                             | 115            | 854                          | 116      | G             |
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| FN 3441-132-118-E2_ _ _ _ ** | 132                                       | 205                                      | 195                                     | 0.312                             | 0.099                             | 166            | 1062                         | 118      | H             |
| FN 3441-160-118-E2_ _ _ _ ** | 160                                       | 249                                      | 238                                     | 0.257                             | 0.085                             | 185            | 1073                         | 118      | H             |
| FN 3441-200-118-E2_ _ _ _ ** | 200                                       | 312                                      | 297                                     | 0.206                             | 0.064                             | 186            | 1228                         | 118      | H             |
| FN 3441-250-119-E2FASXX      | 250                                       | 392                                      | 376                                     | 0.165                             | 0.051                             | 274            | 1398                         | 119      | J             |

\* Filter rating which does not require forced cooling or fan module

\*\* Filter rating which does not require RC damping module for rectifiers with EMI filter

\*\*\* Motor drive input current without harmonic filter

\*\*\*\* Typical losses @ 45°C, 400V, 50Hz and rated load power

\*\*\*\*\* **In order to apply FN 3441 filters, motor drives have to be equipped with either DC-link choke or AC line choke. The minimum required inductance values are given in mH in the filter selection table. If neither DC-link choke nor AC line choke is present, or if the minimum mH rating is not fulfilled, FN 3441 filter must not be used. In this case, FN 3440 need to be chosen.**

## Filter power terminals

| Terminal designation* | Screw thread | Flex wire AWG | Flex wire<br>[mm <sup>2</sup> ] | Screw torque value<br>[Nm] | Max width**<br>cable lug<br>[mm] | Frame size |
|-----------------------|--------------|---------------|---------------------------------|----------------------------|----------------------------------|------------|
| 110                   | M3           | 14-22         | 0.4-2.5                         | 0.5                        | 7                                | A          |
| 112                   | M4           | 10-22         | 0.4-6                           | 1.2                        | 10                               | B, C       |
| 113                   | M6           | 6-18          | 0.75-16                         | 3                          | 15                               | D          |
| 115                   | M8           | 1/0-8         | 10-50                           | 8                          | 15                               | E, F       |
| 116                   | M8           | 3/0-8         | 10-95                           | 8                          | 17                               | G          |
| 118                   | M10          | 3/0-500 kcmil | 95-240                          | 10                         | 35                               | H          |
| 119                   | M16          | 350-750 kcmil | 185-400                         | 10                         | 48                               | J          |

\* Recommended connector type: wire or cable lug for 110 to 113, only cable lug for 115 to 119

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

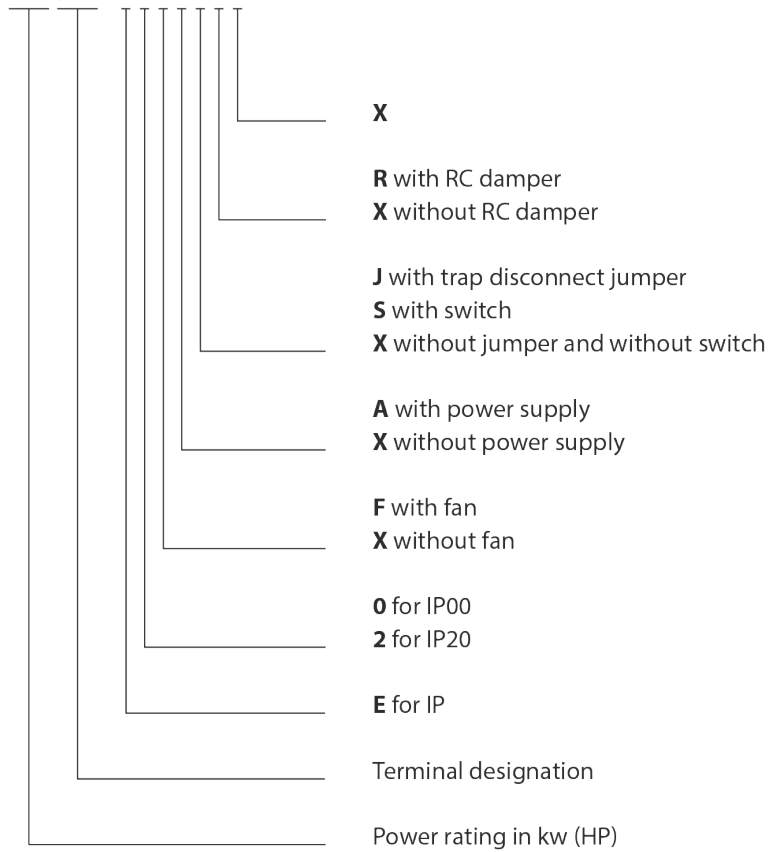
## Filter signal and earth terminals

| Terminal type | Screw thread | Screw torque value<br>[Nm] | Frame size |
|---------------|--------------|----------------------------|------------|
| Signal        | M3*          | 0.5                        | All        |
| Earth (PE)    | M5           | 2.2                        | A          |
| Earth (PE)    | M6           | 4                          | B, C       |
| Earth (PE)    | M8           | 9                          | D, E       |
| Earth (PE)    | M10          | 17                         | F, G, H    |
| Earth (PE)    | M12          | 25                         | J          |

\* Max width cable lug = 7 mm

Product selector

FN 34nn-xxx-yyy-

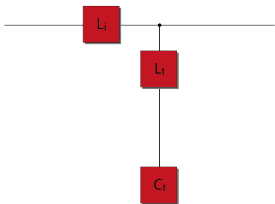


**Table 1: Filter configurations if external air flow is available for cooling**

(Filters do **not** contain fan and do **not** contain aux. power supply)

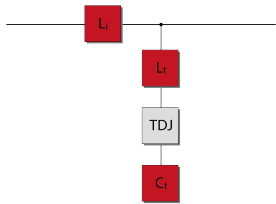
**E0XXXXX**

- For rectifiers with DC-link choke



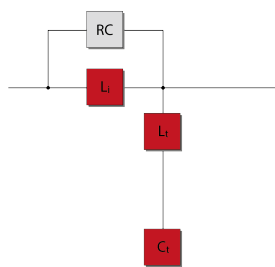
**E0XXJXX**

- For rectifiers with DC-link choke  
- Filters contain trap disconnect jumper



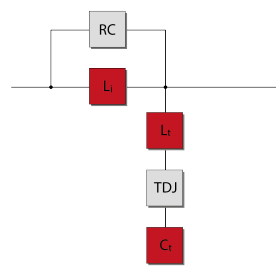
**E0XXXRX**

- For rectifiers with DC-link choke and with EMI filter  
- Filters contain RC damper module



**E0XXJRX**

- For rectifiers with DC-link choke and with EMI filter  
- Filters contain RC damper module and trap disconnect jumper

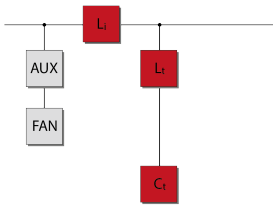


### Table 2: Filter configurations with embedded ventilation

(Filters contain fan and aux. power supply)

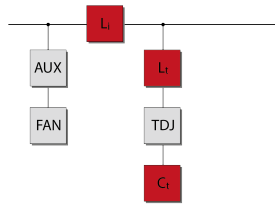
#### E0FAXXX and E2FAXXX

- For rectifiers with DC-link choke
- Filters contain fan and aux. power supply



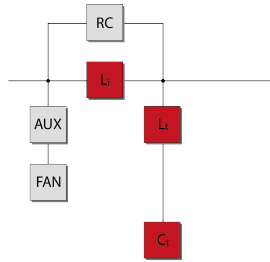
#### E0FAJXX and E2FAJXX

- For rectifiers with DC-link choke
- Filters contain fan, aux. power supply and trap disconnect jumper



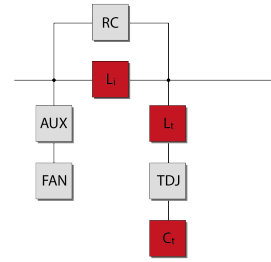
#### E0FAXRX and E2FAXRX

- For rectifiers with DC-link choke and with EMI filter
- Filters contain fan, aux. power supply and RC damper module



#### E0FAJRX and E2FAJRX

- For rectifiers with DC-link choke and with EMI filter
- Filters contain fan, aux. power supply, RC damper module and trap disconnect jumper

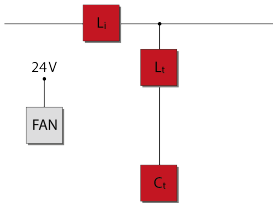


### Table 3: Filter configurations if external aux. power supply for the fan is available

(Filters contain fan but do not contain aux. power supply, user should provide aux. power supply to the fan)

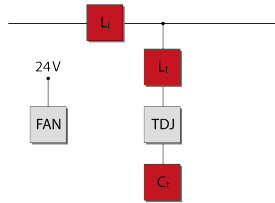
#### E0FXXXX and E2FXXXX

- For rectifiers with DC-link choke
- Filters contain fan



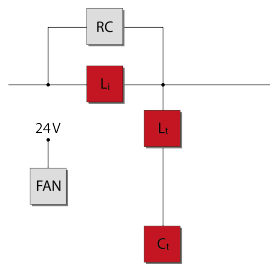
#### E0FXJXX and E2FXJXX

- For rectifiers with DC-link choke
- Filters contain fan and trap disconnect jumper



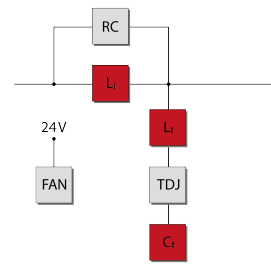
#### E0FXRX and E2FXRX

- For rectifiers with DC-link choke and with EMI filter
- Filters contain fan and RC damper module



#### E0FXJRX and E2FXJRX

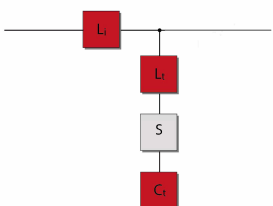
- For rectifiers with DC-link choke and with EMI filter
- Filters contain fan, RC damper module and trap disconnect jumper



### Table 4: 250 kW Filter configuration

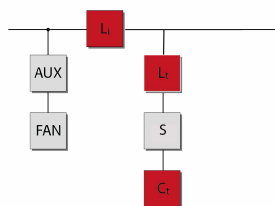
#### E0XXSXX

- For rectifiers with DC-link choke
- Filters contain circuit breaker

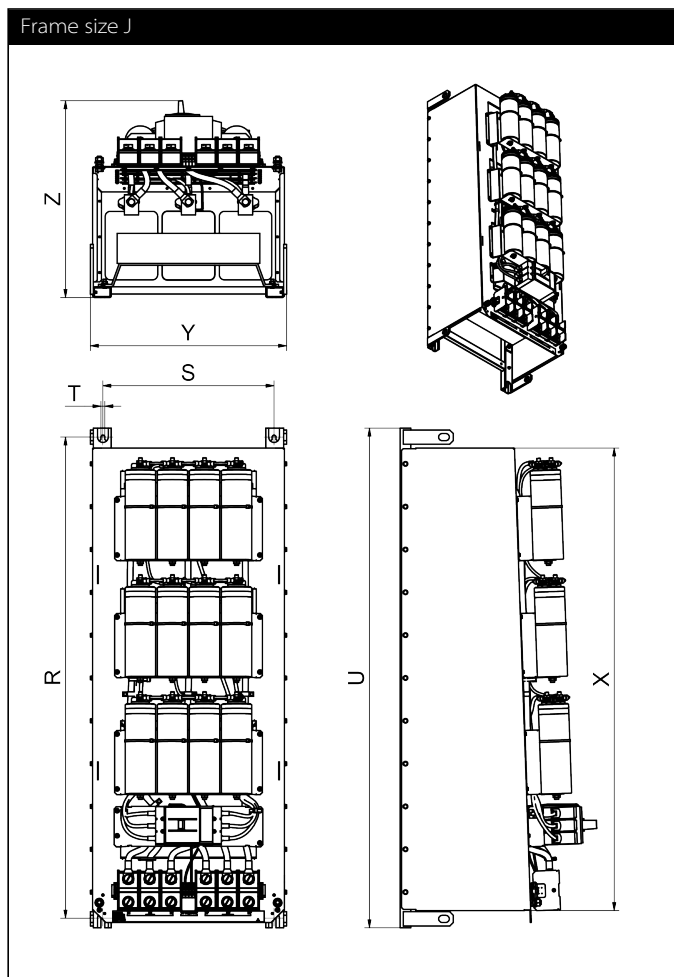
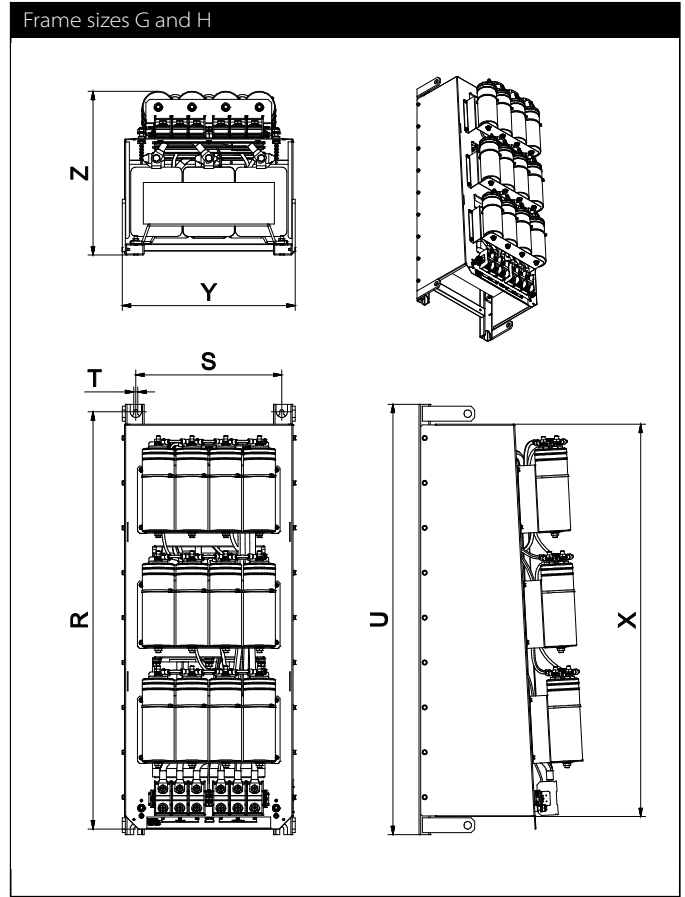
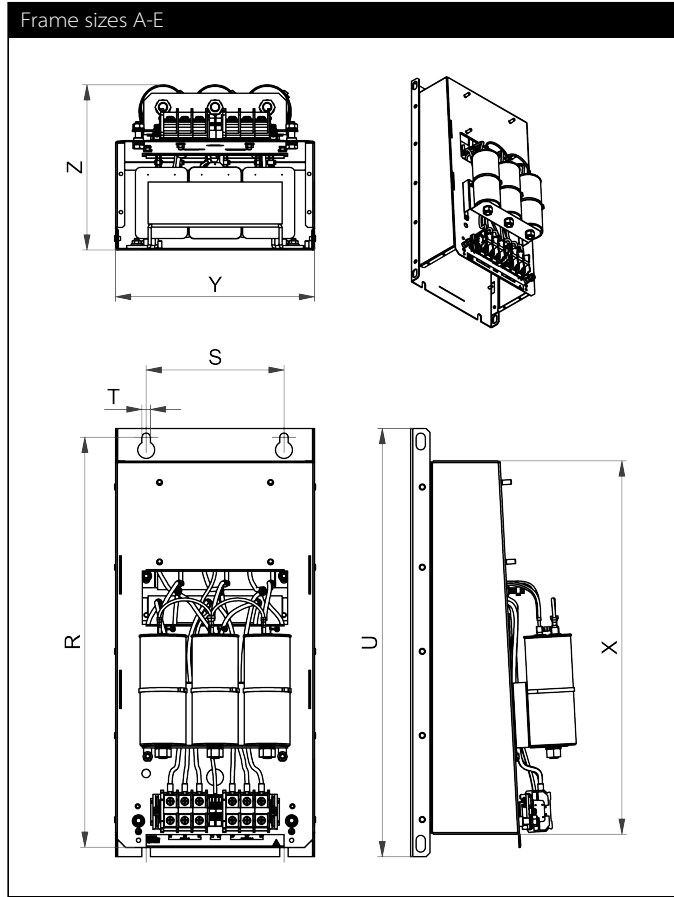


#### E2FASXX

- For rectifiers with DC-link choke
- Filters contain fan aux. power supply and circuit breaker



### Mechanical data of IP 00 enclosure



## Dimensions

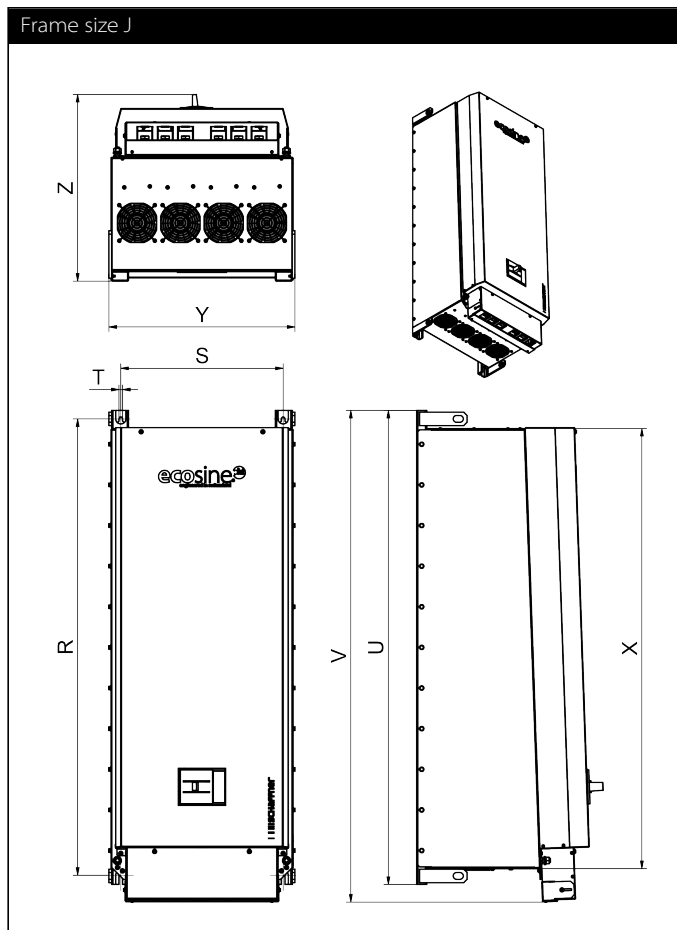
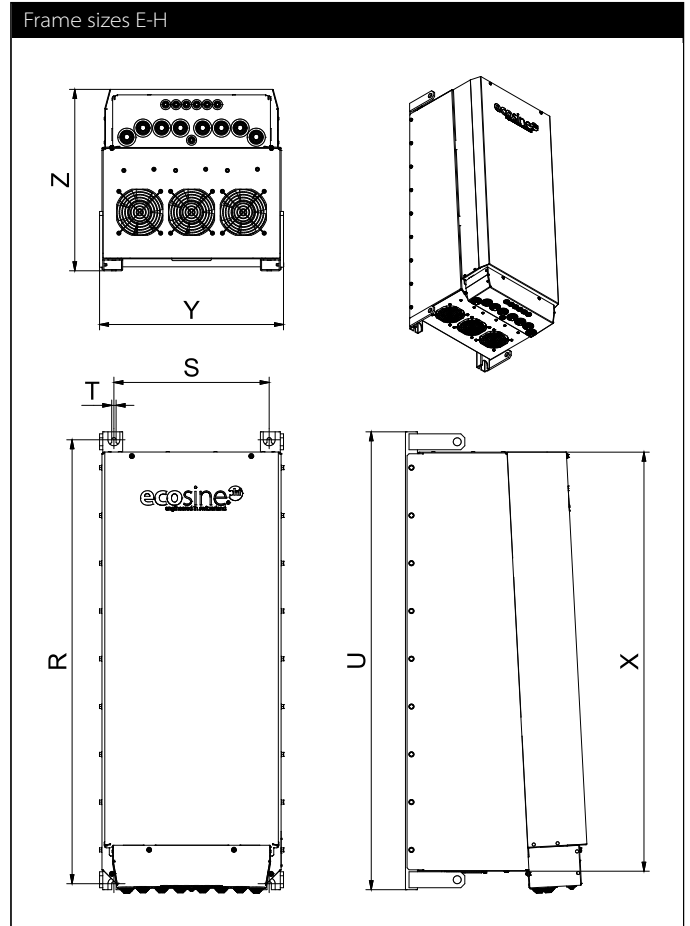
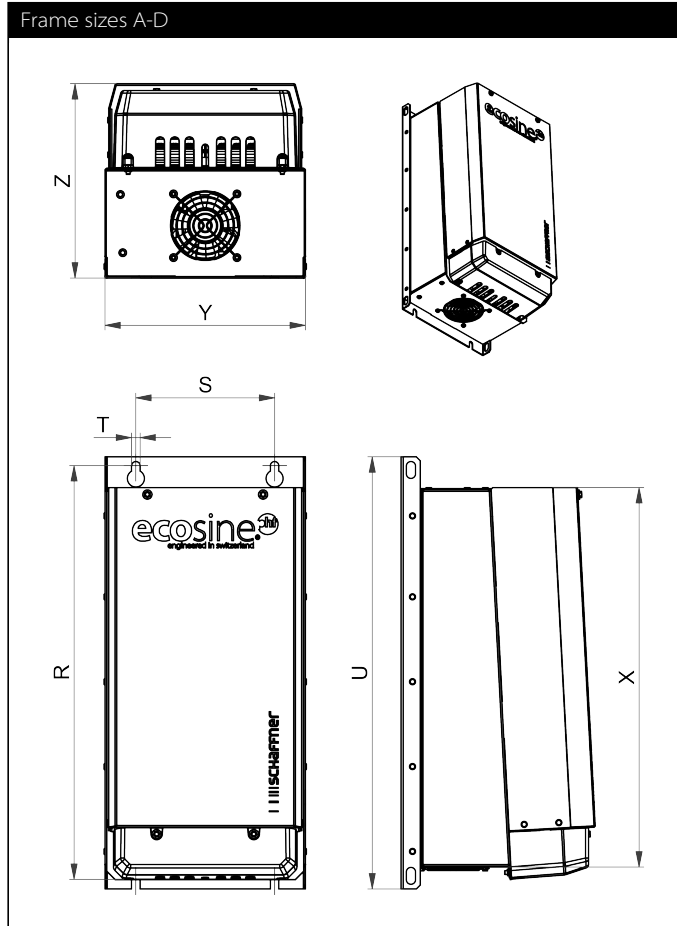
| Frame    | Drill pattern<br>[mm] |     |    | Base<br>[mm] |      |     | Volume<br>[mm] |
|----------|-----------------------|-----|----|--------------|------|-----|----------------|
|          | R                     | S   | T  | U            | X    | Y   |                |
| <b>A</b> | 340                   | 120 | 7  | 360          | 302  | 160 | 185            |
| <b>B</b> | 405                   | 120 | 7  | 425          | 370  | 180 | 206            |
| <b>C</b> | 460                   | 150 | 7  | 483          | 430  | 210 | 221            |
| <b>D</b> | 540                   | 180 | 11 | 560          | 491  | 260 | 252            |
| <b>E</b> | 680                   | 220 | 11 | 705          | 635  | 290 | 319            |
| <b>F</b> | 730                   | 250 | 11 | 752          | 684  | 340 | 343            |
| <b>G</b> | 920                   | 280 | 11 | 960          | 863  | 353 | 386            |
| <b>H</b> | 1115                  | 390 | 11 | 1150         | 1053 | 462 | 456            |
| <b>J</b> | 1348                  | 480 | 11 | 1400         | 1300 | 550 | 555            |

## Inlet air flow required for cooling

| Frame size     | Min air volume*<br>[m <sup>3</sup> /h] |
|----------------|--|
| <b>A, B, C</b> | 0                                      |
| <b>D</b>       | 128                                    |
| <b>E</b>       | 204                                    |
| <b>G</b>       | 408                                    |
| <b>H</b>       | 612                                    |
| <b>J</b>       | 816                                    |

\* External air flow required for filter configurations without embedded ventilation

### Mechanical data of IP 20 enclosure





## Dimensions

| Frame    | Drill pattern<br>[mm] |     |    | Base<br>[mm] |      |     | Volume<br>[mm] |      |  |
|----------|-----------------------|-----|----|--------------|------|-----|----------------|------|--|
|          | R                     | S   | T  | U            | X    | Y   | Z              | V    |  |
| <b>A</b> | 340                   | 120 | 7  | 360          | 302  | 160 | 185            |      |  |
| <b>B</b> | 405                   | 120 | 7  | 425          | 370  | 180 | 206            |      |  |
| <b>C</b> | 460                   | 150 | 7  | 483          | 430  | 210 | 221            |      |  |
| <b>D</b> | 540                   | 180 | 11 | 560          | 491  | 260 | 252            |      |  |
| <b>E</b> | 680                   | 220 | 11 | 705          | 635  | 290 | 319            |      |  |
| <b>F</b> | 730                   | 250 | 11 | 752          | 684  | 340 | 343            |      |  |
| <b>G</b> | 920                   | 280 | 11 | 960          | 863  | 353 | 386            |      |  |
| <b>H</b> | 1115                  | 390 | 11 | 1150         | 1053 | 462 | 456            |      |  |
| <b>J</b> | 1348                  | 480 | 11 | 1400         | 1300 | 550 | 555            | 1455 |  |

## Inlet air flow required for cooling

| Frame size     | Min air volume*<br>[m <sup>3</sup> /h] |
|----------------|--|
| <b>A, B, C</b> | 0                                      |
| <b>D</b>       | 128                                    |
| <b>E</b>       | 204                                    |
| <b>G</b>       | 408                                    |
| <b>H</b>       | 612                                    |
| <b>J</b>       | 816                                    |

\* External air flow required for filter configurations without embedded ventilation