

APPLICATION NOTE 0001

ACTIVE HARMONIC FILTERS – DESIGN AND INSTALLATION ASSISTANCE

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Introduction

Active Harmonic Filters are available in two ranges, the low power Accusine SWP range and the larger Accusine PCS range. Both are discussed in separate chapters. This document aims to assist with the integration of the Active Filter in the power distribution and deals with some specifics associated with this technology. This note is valid for filters being used for Harmonic Compensation. Other filter modes have not been considered in this note.

The Accusine PCS Active Filter

One of the most important aspects of an active filtering solution relates to the CT's. It is extremely important correct CT's be installed in the correct spots.

Selecting the CT's:

Rating: 400Hz
 Accuracy: Class1
 Secondary: 5 A
 VA rating: the Accusine represents a 2.5VA burden per unit. It is advised to select a CT VA rating of 30VA or more as this will allow reasonable cable runs.

General CT wire length for a 5A secondary : $L=(CT\ VA -2.5)/(50 * R)$
 L= cable length
 R= resistance in Ohm/m for the cable

Cross section in mm ²	Resistance in Ohm/m
1.0	0.018
1.5	0.012
2.5	0.0074
4.0	0.0046

The total burden, Accusine + twin wire must be below the CT VA rating to avoid saturation.

Example:

A CT with a 15VA Rating is installed 30m away from the Accusine unit. What would be a correct cable size?

Select a 1.5mm². Maximum length $L=(15-2.5)/(50 * 0.012) = 20m$.
 1.5mm² is not suitable.

Select a 2.5mm². Maximum length $L=(15-2.5)/(50 * 0.0074) = 33m$.
 2.5mm² is suitable for this application.

CT's supplied by Schneider Electric have a minimum VA rating of 30.

Primary CT rating:

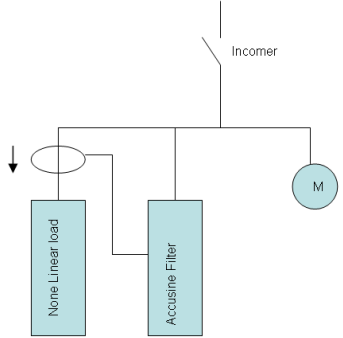
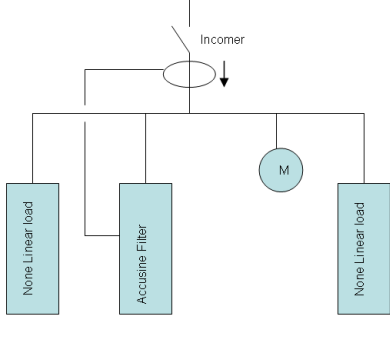
The maximum primary rating is 6000Amp. However accurate performance at low loads requires the CT to match the load. Typically a reasonable accuracy down to 10% of the CT rating can be expected.

Cable: Twisted and/or shielded pairs. Keep the twisting going all the way to the CT terminals.

No required: 3 or more depending on the configuration

Positioning of the CT's

CT sizing and CT mounting is critical for correct operation of active filters. Consideration in the design phase of a project can likely reduce the number of CT's required and/or increase the performance. The diagrams below outline some of the options available for the most common applications. For more complex applications please consult with Schneider Electric.

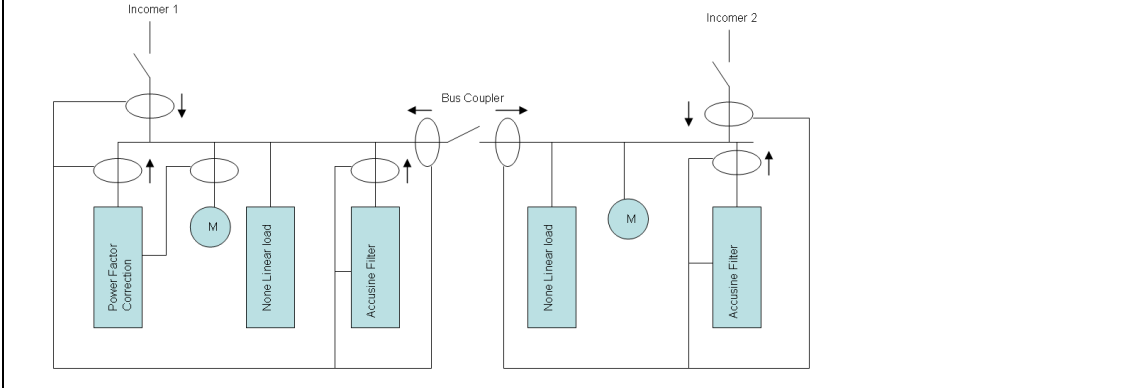
Situation 1: No power factor correction capacitors and one feeder	
Load Sense	Source Sense
	
<p>Preferred option due to best CT sizing possible</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads</p>	<p>Universal solution</p> <p>CT sizing needs consideration as CT will now see all load</p>

Situation 2 : Power factor correction and one feeder	
Load Sense	Source Sense, PFC upstream
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>CT sizing needs consideration as CT will now see all load</p>
Source Sense, PFC on bus	
<p>CT sizing needs consideration as CT will now see all load</p> <p>The auxiliary CT (around the Power factor feed) can be reduced in rating, but the ratio must be maintained. Example: if the CT around the incomer is a 3000/5 then the CT around the power factor feed can for example be 600/1</p>	

Situation 3: Two Accusine filters in parallel and one feeder	
Load Sense	Source Sense
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>Three set's of CT's required</p> <p>Sizing of CT's need careful consideration to optimise performance</p> <p>The auxiliary CT's (around the Accusine feeds) can be reduced in rating, but the ratio must be maintained. Example: if the CT around the main incomer is a 3000/5 then the CT's around the Accusine feeds can for example be 600/1</p>

Situation 4: Source-change over with power factor correction	
Load Sense	Source Sense
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>Three set's of CT's required</p> <p>Sizing of CT's need careful consideration to optimise performance</p> <p>The auxiliary CT (around the Power factor feed) can be reduced in rating, but the ratio must be maintained. Example: if the CT's around the incomers are a 3000/5 then the CT around the power factor feed can for example be 600/1</p>

Situation 5: Two incomers, bus coupler and power factor correction

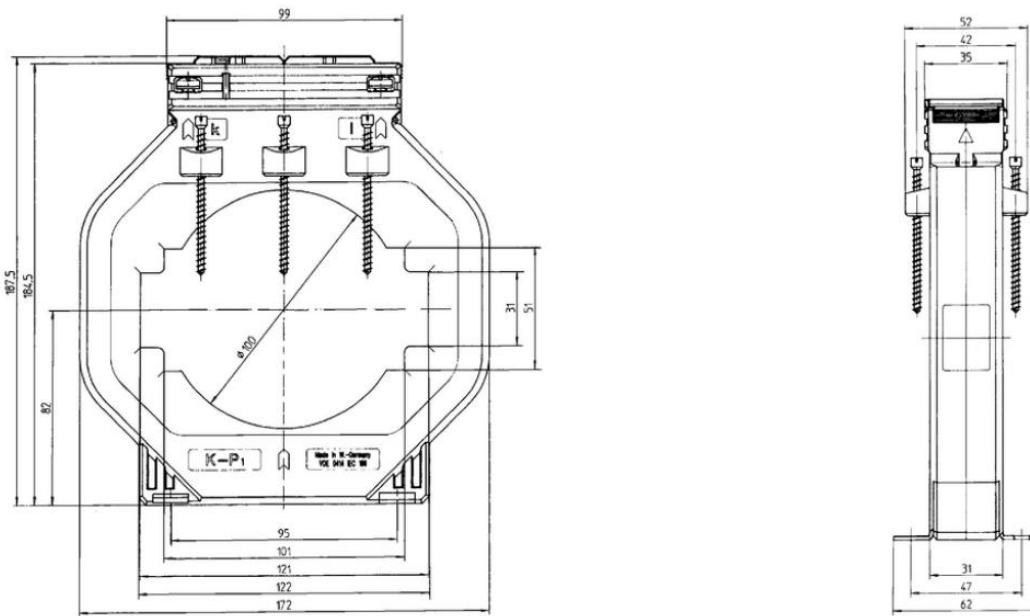


Allows for all incomer and bus coupler combinations.

Mechanical dimensions for standard Schneider CT's

Dimensions below are for Schneider's standard active filter CT's. CT's with different mechanical dimensions, different ratings or even split core CT's are available on request.

Part number ASK123-3000-5A-400, 3000/5A 30VA 400Hz



Environmental considerations, protection and wiring

Environmental Specification:

Ambient Temperature: 0-40 Degree C

Humidity level: below 95% non-condensing

Protection Rating: IP54

Pollution Degree 2

Storage: -40 to 65 Degree C

Heat losses:

50 Amp filter: 2.25 kW

100 Amp filter: 3.75 kW

300 Amp filter: 10kW

EMC emission: EN61000-6-4 Class A: 2001

EMC immunity: EN61000-6-2: 2001

Protection:

50 Amp filter: C120N, 3P 80A B-Curve

100 Amp filter: NSX160 +MICROLOGIC2.2 125D

300Amp filter: NSX400 +MICROLOGIC2.3 400A

Power Cables :

Top or bottom entry

Power Cables should be rated at 125% of the filter rating current to avoid excessive heating. The phase sequence of the 3-phase power wires feeding the active filter must be positive sequence, i.e. a phase rotation meter should indicate clockwise.

Accusine PCS utilises a significant airflow to cool the units. Filters must be kept clean to prevent the units from tripping on over temperature. The Accusine is not suited to an extreme dusty environment.

Dimensions:

50 Amp filter: W=800 H=2000 D=600

100 Amp filter: W=800 H=2000 D=600

300Amp filter: W=1000 H=2000 D=800

General Considerations

Some loads powered off distribution boards may have “exposed” capacitors. These loads may require blocking chokes, or alternatively move the feed for the distribution board to upstream from the filter.

The Accusine SWP (SineWave) Active Filter

Selecting the CT’s:

- Rating: 400Hz
- Accuracy: Class1
- Secondary: 1 A
- VA rating: the Accusine SWP represents a 3.5 VA burden per unit. It is advised to select a CT VA rating of 10VA or more as this will allow reasonable cable runs.

General CT wire length for a 1A secondary : $L=(CT\ VA - 2.5)/(10 * R)$
 L= cable length
 R= resistance in Ohm/m for the cable

Cross section in mm ²	Resistance in Ohm/m
1.0	0.018
1.5	0.012
2.5	0.0074
4.0	0.0046

The total burden, Accusine + twin wire must be below the CT VA rating to avoid saturation.

Example:

A CT with a 5VA Rating is installed 20m away from the Accusine unit. What would be a correct cable size?

Select a 1.5mm². Maximum length $L=(5-3.5)/(10 * 0.012) = 12.5m$.
 1.5mm² is not suitable.

Select a 2.5mm². Maximum length $L=(5-3.5)/(10 * 0.0074) = 20.4m$.
 2.5mm² is suitable for this application.

CT’s supplied by Schneider Electric have a minimum VA rating of 5.

Primary CT rating:

Acceptable primary ratings are: 300 / 500 / 600 / 1000 / 1500 / 2000 / 3000 / 4000 / 5000 / 6000. The maximum primary rating is 6000Amp. However accurate performance at low loads the requires the CT to match load. Typically a reasonable accuracy down to 10% of the CT rating can be expected.

Cable: Twisted and/or shielded pairs

No required: 3 or more depending on the configuration

Positioning of the CT's

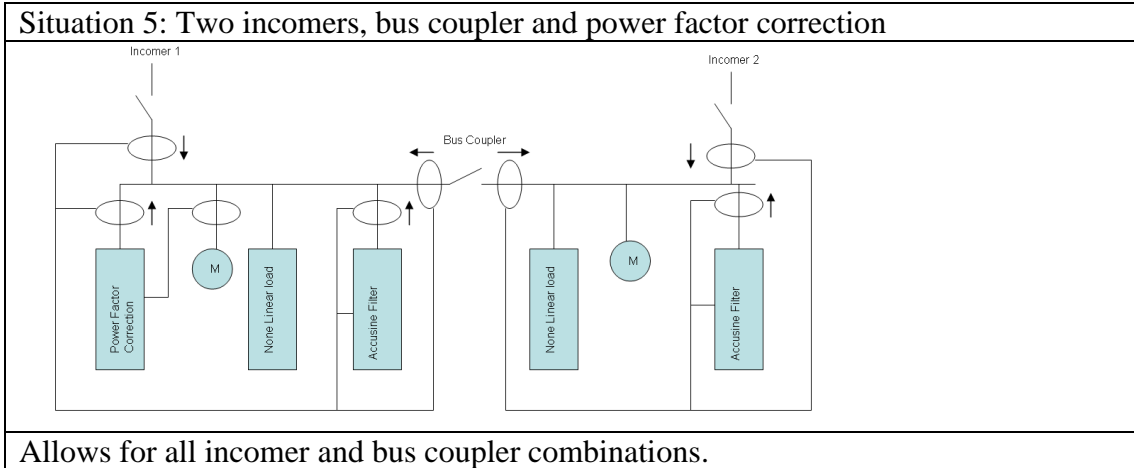
CT sizing and CT mounting is critical for correct operation of active filters. Consideration in the design phase of a project can likely reduce the number of CT's required and/or increase the performance. The diagrams below outline some of the options available for the most common applications. For more complex applications please consult with Schneider Electric.

Situation 1: No power factor correction capacitors and one feeder	
Load Sense	Source Sense
<p>Preferred option due to best CT sizing possible</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads</p>	<p>Universal solution</p> <p>CT sizing needs consideration as CT will now see all load</p> <p>Extra set of CT's required</p>

Situation 2 : Power factor correction and one feeder	
<p>Load Sense</p>	<p>Source Sense, PFC upstream</p>
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>CT sizing needs consideration as CT will now see all load</p> <p>Extra set of CT's required</p>
<p>Source Sense, PFC on bus</p>	
<p>CT sizing needs consideration as CT will now see all load</p> <p>Three sets of CT's required</p>	

Situation 3: Two Accusine filters in parallel and one feeder	
Load Sense	Source Sense
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>Three set's of CT's required</p> <p>Sizing of CT's need careful consideration to optimise performance</p>

Situation 4: Source-change over with power factor correction	
Load Sense	Source Sense
<p>Preferred option due to optimum CT sizing and only one set of CT's required</p> <p>Can only be used when CT can be mounted to see all none linear loads without seeing linear loads or power factor correction</p>	<p>Four set's of CT's required for the filter</p> <p>Sizing of CT's need careful consideration to optimise performance</p>

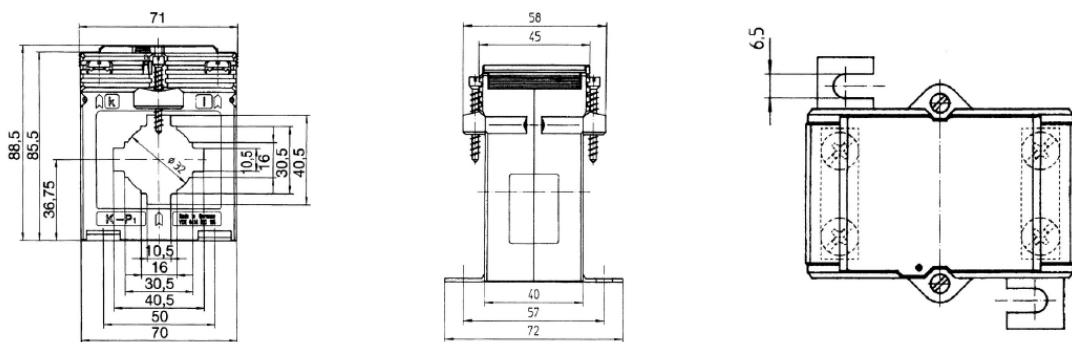


Mechanical dimensions for standard Schneider CT's

Dimensions below are for Schneider's standard active filter CT's. CT's with different mechanical dimensions, different ratings or even split core CT's are available on request.

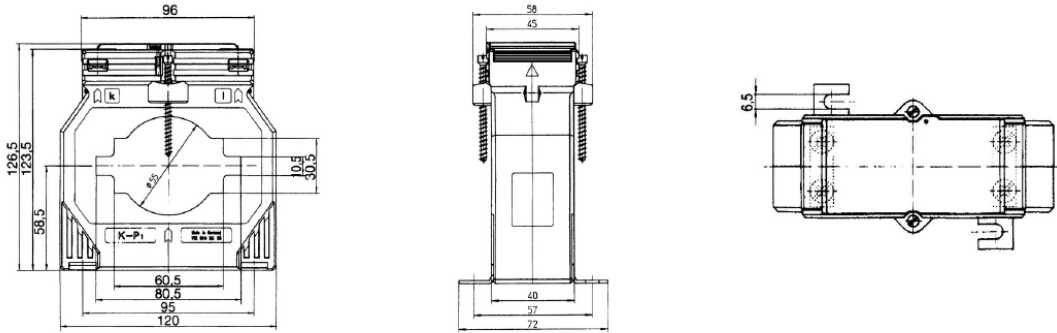
Part number ASK414-600-1A-400, 600/1A 400Hz 5VA

Part number ASK414-300-1A-400, 300/1A 400Hz 5VA



Part number ASK814-2000-1A, 2000/1A 400Hz 15VA

Part number ASK814-1000-1A, 1000/1A 400Hz 10VA



Environmental considerations, protection and wiring

Environmental Specification:

- Ambient Temperature: 0-40 Degree C
- Humidity level: below 95% non-condensing
- Protection Rating: IP20 as standard, IP54 on request
- Storage: -40 to 65 Degree C

Heat losses:

20 Amp filter:	1 kW
30 Amp filter:	1.2 kW
45 Amp filter:	1.9 kW
60 Amp filter:	2.4 kW
90 Amp filter:	3.8 kW
120 Amp filter:	4.8 kW

EMC conducted and radiated emissions: EN55011 levelA (residential filter available on request)

Protection:

20 Amp filter:	32 Amp Breaker B curve, ref. 25873
30 Amp filter:	40 Amp Breaker B curve, ref. 25874
45 Amp filter:	63 Amp Breaker B curve, ref. 25876
60 Amp filter:	80 Amp Breaker B curve, ref. 18349
90 Amp filter:	(63 Amp Breaker B curve, ref. 25876) x2
120 Amp filter:	(80 Amp Breaker B curve, ref. 18349) x2

Power Cables:

Bottom entry

Power Cables should be rated at 125% of the filter rating current to avoid excessive heating. The phase sequence of the 3-phase power wires feeding the active filter must be positive sequence, i.e. a phase rotation meter should indicate clockwise.

Dimensions:

20 Amp filter:	W=540 H=680 D=280
30 Amp filter:	W=540 H=680 D=280
45 Amp filter:	W=590 H=780 D=325

60 Amp filter:	W=590 H=780 D=325
90 Amp filter:	(W=590 H=780 D=325) x2
120 Amp filter:	(W=590 H=780 D=325) x2

General Considerations

Some loads powered off distribution boards may have “exposed” capacitors. These loads may require blocking chokes, or alternatively move the feed for the distribution board to upstream from the filter.