Selection Guide

Total Power Factor Correction (TPFC System – APF + SVG)

Selection guide

Total Power Factor Correction (TPFC System – APF + SVG)

The Total Power Factor Correction (TPFC) system utilises the modular design of the Delta APF and SVG to combine displacement and distortion power factor correction in a single cabinet.

Whilst an APF does provide a level of power factor correction in addition to harmonic mitigation, it is generally not economically viable to solely rely upon a harmonic filter to correct significant reactive power at a site. The TPFC serves as an all-in-one solution to boost the true power factor of an electrical network.

There are five steps in selecting the right system for you.

This guide also includes CT and breaker cable selection guides which are critical components in the installation and operation of the system.

Step 1
How much reactive power (kVAr) and distortion power (A) compensation is required?

To determine the amount of compensation required for an existing site you will ideally have the following information:

- Existing power factor
- Total load kVA
- New target power factor
- Total harmonic current distortion (THDi) in Amperes (A) under load conditions
- New target THDi level in Amperes (A) under load conditions

Existing power factor and total load kVA may already be available via your electricity bill or can be requested from your energy retailer as part of your meter data. The THDi is generally available on advanced energy meters or multifunction power meters. As the harmonics vary according to the load profile throughout the day/week, the measurements should be taken under different load conditions to get the compensation current.

The best way to determine the compensation size required for a TPFC system is to have a power quality audit conducted at the site. NHP's technical team can assist with sizing up an appropriate system in accordance with the project details and organize a power quality audit. A detailed report on site power quality is provided with suggested solutions.

For sites in the design and construction stage, required compensation can be calculated using tools such as PowerCad or other vendor tools. Please contact NHP for assistance with this.

Step 2
How much spare capacity is required?

As previously mentioned, the power quality on a site can change with the type and number of loads that are running. If you plan to expand your site, add equipment, or replace existing products, including slots for spare capacity would be beneficial as a future proof option.

Important Note

Even though high kVAr can be a burden on supply and electricity costs, inductive loads such as motors and welding equipment need some kVAr to maintain electromagnetic fields required to operate.

Step 3
3 wire or 4 wire?

The four-wire option is required when there is an imbalance in the network.

Network imbalance is when differing line voltages across phases occurs, caused by unbalanced loads and single phase and phase-to-phase connections. This information can be found on your energy meter or power quality audit report.

	Use	Applicable industry examples
3 Wire	For balanced networks	Mining
		Industrial
		Food and beverage
		Manufacturing
4 Wire	For an unbalanced network with a fully rated neutral wire	Commercial
		Office
		Education
		Shopping centers

Step 4
IP rating requirement?

The environment that the cabinet would be installed has a major impact on the IP rating. NHP offers options for IP30 or IP54 floor standing cabinets. Outdoor installation is not recommended for any IP rated cabinets.

Step 5
Colour of cabinet

RAL7035 Light Grey or RAL2000 Orange.

Ordering guide

Cabinet

Max. number of modules	IP rating	Colour	Catalogue no.
2	30	Grey	PQ SVGC 200 30 G X F FC X 1A
5			PQ SVGC 500 30 G X F FC X 1A
7			PQ SVGC 700 30 G X F FC X 1A
3	54		PQ SVGC 300 54 G X F FC X 1A
2	30	Orange	PQ SVGC 200 30 O X F FC X 1A
5			PQ SVGC 500 30 O X F FC X 1A
7			PQ SVGC 700 30 O X F FC X 1A
3	54		PQ SVGC 300 54 O X F FC X 1A

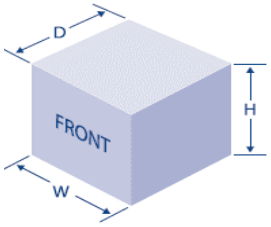
Note Draw type modules and cabinets are also available on a non-stocked basis. For selection, please contact NHP.

Modules

Module type	Output	3 wire or 4 wire	Catalogue no.
APF	100A	3 Wire	PQ APFM 100 X G 3 F FC X 1A
SVG	100kVAr		PQ SVGM 100 X G 3 F FC X 1A
APF	100A	4 Wire	PQ APFM 100 X G 4 F FC X 1A
SVG	100kVAr		PQ SVGM 100 X G 4 F FC X 1A

Product dimensions (excluding packaging)

Product	Dimension (W x H x D mm)	Weight (kg)
IP30 2x and 5x module cabinets	810 x 1960 x 1000	330
IP30 7x module cabinets	1000 x 2258 x 1000	370
IP54 3x module cabinets	1000 x 2050 x 1000	340
100kVAr SVG power module	684 x 190 x 701	57
100A APF power Module	684 x 190 x 701	53



Power quality commissioning services

FREE EXTENDED WARRANTY *for all NHP Power Quality systems when commissioned by NHP Service team*

- Standard 12-month warranty is provided with all NHP Power Quality systems
- Systems commissioned by NHP service team will receive an additional 12 months warranty

It is critical that your power quality system is installed, connected, and commissioned to ensure correct and reliable operation.

Common issues when equipment is not commissioned properly

- System performance compromised - inability to reach and maintain target power factor and reduce onsite harmonics. This can also impact your energy bills, particularly where kVA and kVAr tariffs are in place.
- Incorrect operation of power quality equipment with potential impact on other onsite equipment
- Reduced equipment operating life
- Void of equipment warranty

Please note

Commissioning outside metropolitan areas may incur "Additional Travel and Accommodation Cost".

Please contact service@nhp.com.au or 1300 NHP NHP

Cable and breaker selection guide

Appropriate cable and breaker selection are a vital part of ensuring the system will operate at its optimal capacity. Selection of each depends on the dominant power quality correction type of the TPFC. For example, for a system with more APF modules than SVG, use the APF cable and breaker selection table with total module quantity as a guide. Circuit breaker and cable size should be based on the maximum desired size of future expansion.

Note: The cable sizes are a guide only, always refer to AS/NZS3008 for specific requirements. Individual de-rating based on method of installation, cable lengths, volt drop, ambient temperature and cable configuration must be allowed for when sizing cable.

Example 1

A 4-wire system with 200A and 100kVAr compensation uses 3 power modules in an enclosure with capacity for 3 modules.

From the tables, it is seen that a 550A breaker and minimum conductor size of 2x120mm2 is required for Power and Neutral cables, 1x120mm2 for PE.

Example 2

A 3-wire system with 200A and 200kVAr compensation uses 4 power modules in an enclosure with capacity for 7 modules.

From the table, it is seen that a 1250A breaker and a minimum conductor size of 2x300mm2 is required for power cables and 300mm2 for PE cable. Since this is a 3-wire system, only a 1.5mm^2 Neutral is required for the cabinet cooling fans.

TPFC Cable and breaker selection table

The TPFC cable and breaker size is base on cabinet size with any combination of SVG + APF

Cabinet size (No. of modules)	MCCB rated current (A)	Min. conductor size R/S/T phases	Min. Conductor size neutral 3P4W	Min. Conductor size neutral 3P3W	Min. conductor size PE
2	350A	150mm^2	150mm^3	1.5mm^2	70mm^2
3	550A	2x120mm^2	2x120mm^3	1.5mm^2	120mm^2
5	900A	2x240mm^2	2x240mm^3	1.5mm^2	240mm^2
7	1250A	2x300mm^2	2x300mm^3	1.5mm^2	300mm^2

Note: For 3P3W system a 1.5mm2 neutral is required for the internal cabinet cooling fans.

CT selection guide

The correct CTs must be selected according to the electrical condition of the installation site. In general, the CT primary current size for a TPFC needs to be 1.7x the full rated load of the system. NHP can provide recommendations on the correct CT and wire size to suit your application.

Critical installation information

The placement of the CTs during the installation is critical to the operation of the system. This section outlines the placement options for different applications.

These guides are for the most common installations. Like the APF systems, the CT placements are the same for both balanced and unbalanced loads. For application where more than one TPFC unit is required, capacitor banks are present and any other variations to these scenarios outlined below please refer to the full CT selection and installation guide.

Note: The TPFC system follows the same CT placement as the APF systems. The cabinets are referred to as TPFC cabinets in the drawings for simplicity. When placing orders, the cabinets will be APF or SVG cabinets depending on the system type.

For more information on our range of CTs, please use our **CT Selection Guide.**

External CT connection guide – Single TPFC system

1. Closed loop

In this scenario, 3 CTs shall be installed at grid side (R/S/T phases), and another 3 CTs shall be installed at TPFC input side. All the CTs P1 should be facing grid side with same CT ratio.

Refer to Figures 1-1 and 1-2 for single line diagram (SLD) and detailed connection.

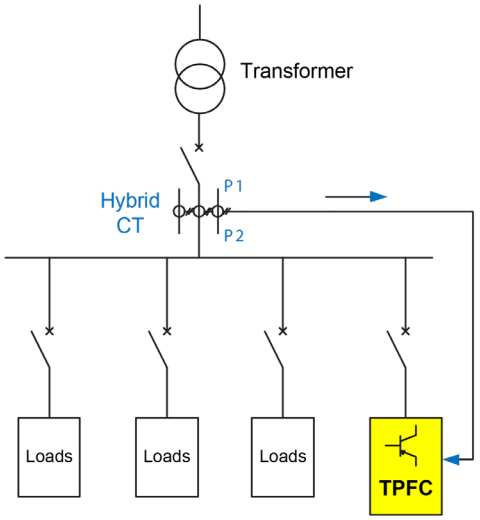


Figure 1-1
CT Connection for closed loop, without cap bank scenario – SLD

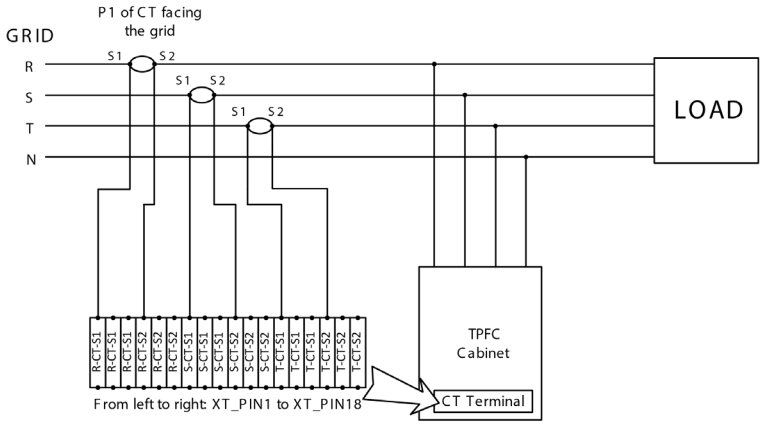


Figure 1-2
CT Connection for closed loop, without cap bank scenario – details

2. Open loop

In this scenario, 3 CTs shall be installed at the load side (R/S/T phases), P1 should be facing the grid side. Refer to Figures 2-1 and 2-2 for single line diagram (SLD) and detailed connection.

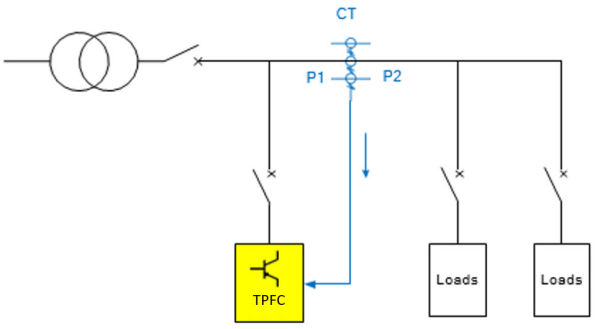


Figure 2 -1
CT Connection for open loop, without cap bank scenario – SLD

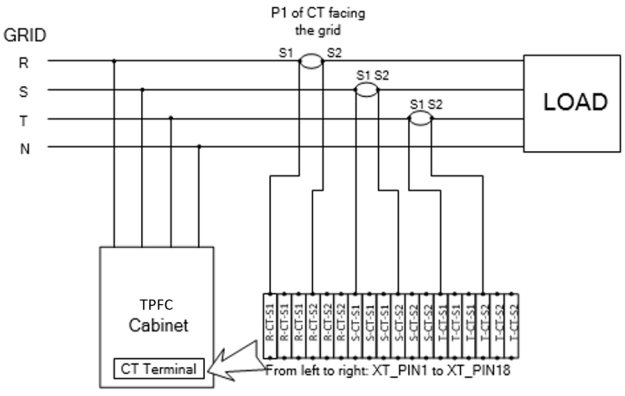


Figure 2-2
CT Connection for open loop, without cap bank scenario – details

TPFC technical specifications

	Rated voltage	SVG AC 415V	APF AC 415V
Electrical specification	Input voltage range	AC 308 ~ 480V (3-wire), 308 ~ 456V (4-wire)	
	Electric connection	3-phase, 3-wire (3P3W) / 3-phase, 4-wire (3P4W)	
	Rated frequency	50(60)Hz ±10%	
	Operating THDv	≤15%	
	Rated capacity per module	100kVAr	100A
	Modules per cabinet	1~7 (four sizes available)	
	Redundancy	Each module is an independent reactive compensation system	Each module is an independent filtering system
	Harmonic elimination range	N/A	
	Harmonic filtering degree	N/A	0 - 100% programmable per harmonic in Ampere value
	Harmonic filtering performance	N/A	Filter up to 98% harmonics at rated load, THDV<3%, THDi<5% after filtering
	Reactive power compensation capability	Both inductive and capacitive reactive power	
	Reactive power compensation performance	Cosφ ≥ 0.99 after compensation (if the SVG capacity is sufficient)	Cosφ ≥ 0.99 after compensation (if the APF capacity is sufficient)
	Imbalance correction capability	Mitigate negative and zero sequence	
	Full response time	<20ms	
	Instant response time	<100us	
	Thermal loss	≤3% of rated capacity	
	Output current limitation	Automatic (100% rated capacity)	
	Parallel expansion (System)	Up to 10 Cabinets in parallel (max. 7 modules per cabinet)	
	MTBF	>100,000 hours	
Control technology	Switching frequency	30kHz	
	Controller	DSP control	
	Communication	Modbus RTU (RS-485), TCP (RJ-45)	
	Monitoring	HTTPS via internal webserver	
Physical specifications	IP grade of cabinet	IP30, IP54 available	
	Cooling method	Intelligent forced air cooling	
	Noise level	< 60dB(A) @1m (Module)	< 65dB(A) @1m (Module)
	Dust filter	IP54 enclosure only	
	Weights and dimensions	See Product Dimensions table	
Environmental requirement	Ambient temperature	'-10~40°C rated capacity, derating from 40~55°C	
	Relative humidity	0~95% (non-condensing)	
	Altitude	≤1000m rated capacity, 1000~2000m(derating 1% per 100m)	

Notes

nhp.com.au
SALES 1300 NHP NHP
sales@nhp.com.au

nhp-nz.com
SALES 0800 NHP NHP
sales@nhp-nz.com

NHP Electrical Engineering Products

A.B.N. 84 004 304 812

NHP31BCH 07/11/21