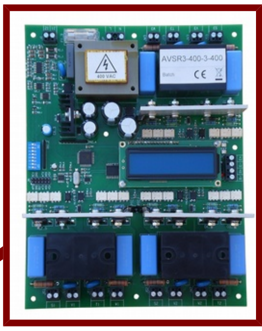
POWER FACTOR TECHNOLOGIES

Overview and General Specifications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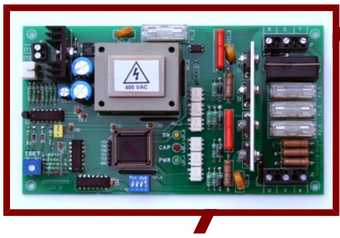
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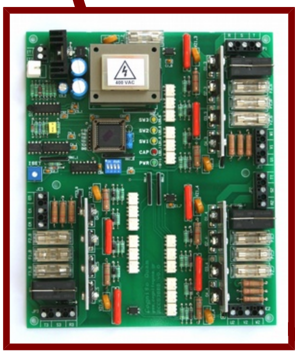
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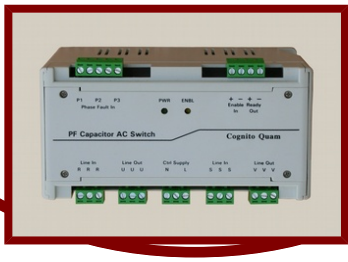
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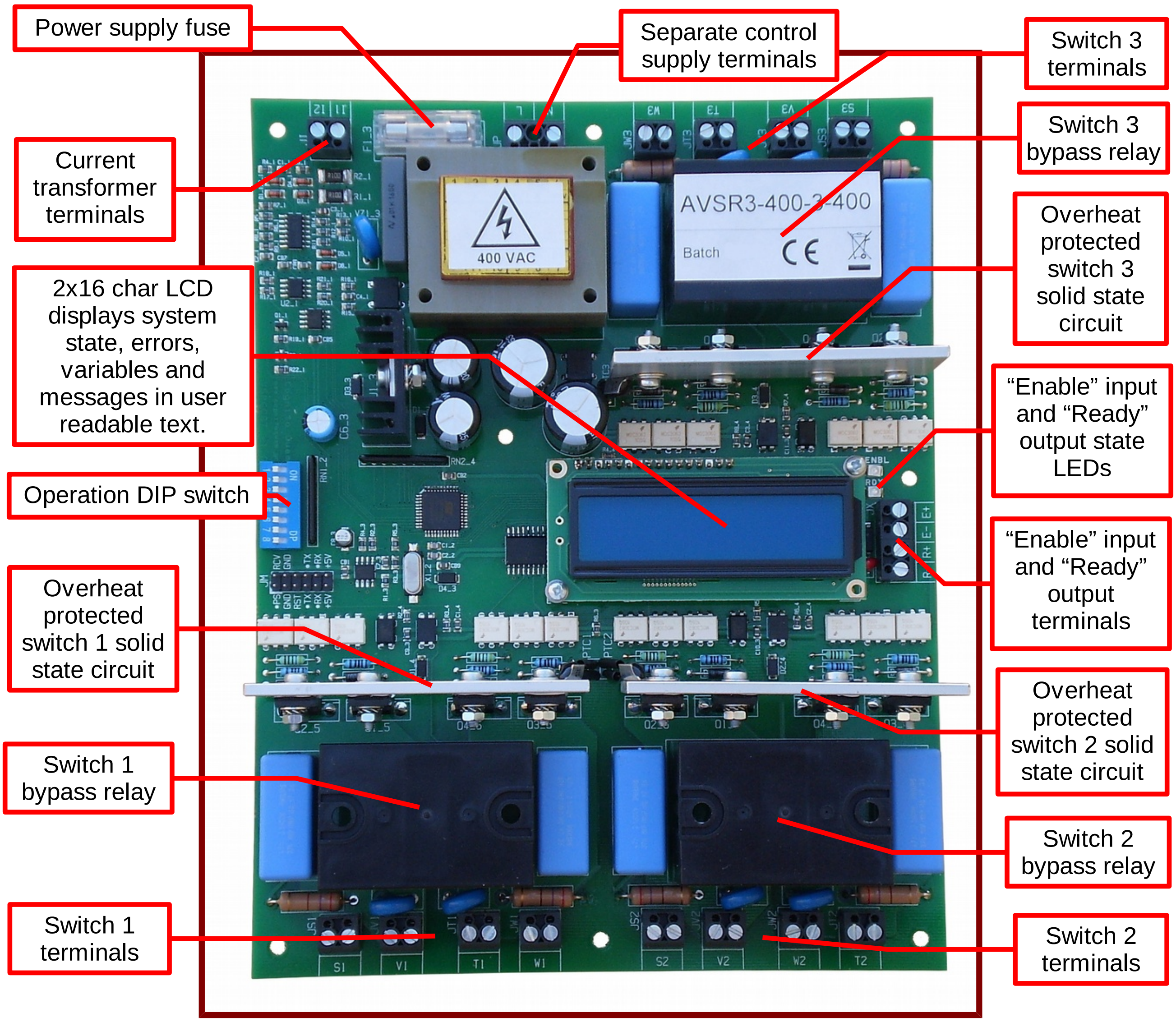
1. AVSR3 Triple Switch Autocalibrating Variable Step Regulator

The AVSR3 employs our variable step technology to compensate reactive current in seven steps. It features three 25 A solid state switches to connect three compensating capacitor banks in and out of the single- or three-phase line system. At installation no adjustments are required as each capacitor size is detected automatically making AVSR3 commissioning purely “wire-up-and-play”.



AVSR3 autocalibrating power factor regulator

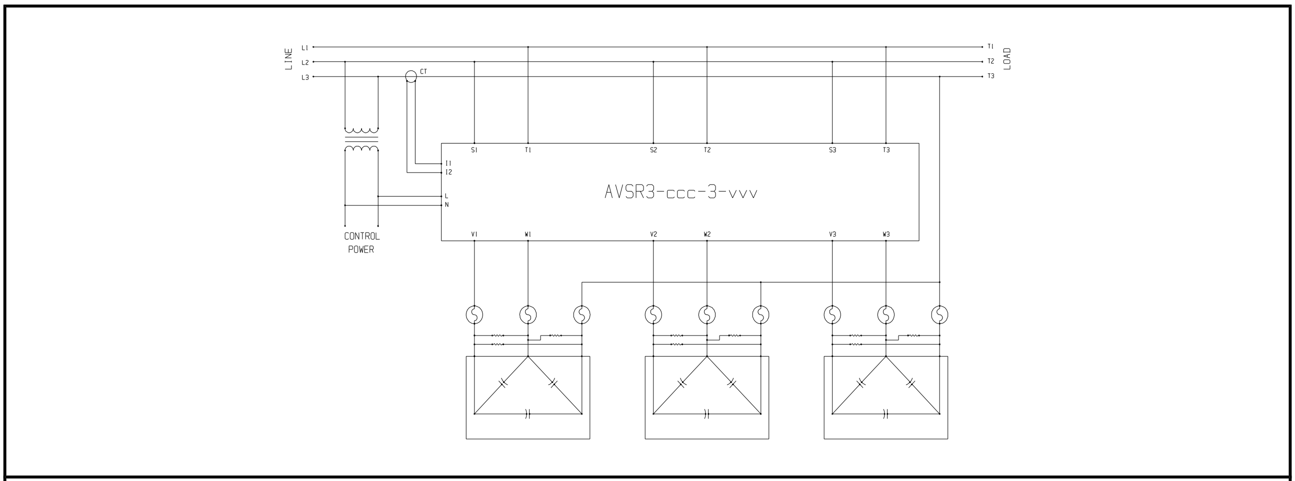
The variable step technology provides for different capacitor banks of any size to correct power factor in practically any arbitrary minimum step and correction range size. At every sampling instant, the controller calculates the required compensation step and connects or disconnects a combination of banks whose sum is equal or closest to the calculated step value. In the AVSR3, three banks are used and, if sized as x1, x2 and x4 multiples of the smallest required step, provide seven steps of compensating operation. Switch activation/deactivation happens at every sampling instant as set at the DIP switch between 5 and 30 seconds making the AVSR3 particularly suitable for dynamic power factor (PF) compensation of frequently-started, low-duty or variable loads such as lifts, conveyors, compressors, pumps and office lighting.

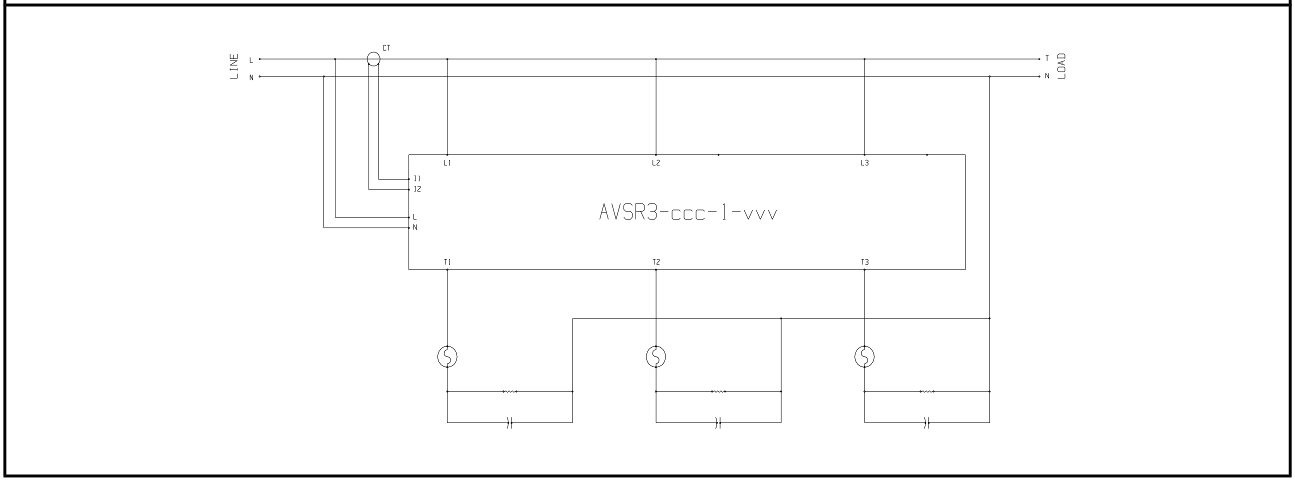
Each capacitor bank size is autodetected during AVSR3 installation. The unit features an autocalibrating function during which the AVSR3 corrects all internal errors and offsets, measures the current transformer phase shift and the individual capacitor bank sizes. The measured parameters are then used during normal operation ensuring accurate, effective and dependable performance. Following autocalibration no other adjustment is required making AVSR3 installation quick and error-free.

AVSR3 Feature Summary	
Variable compensating capacitance step	Variable compensating capacitance step is any combination of the three driven banks, effectively realizing an up to 7 step system.
Autocalibration mode	Autocalibration function corrects all errors and detects the current transformer phase shift and each capacitor bank size. No other adjustment is needed.
Line connection	Separate, galvanically isolated control supply terminals can be connected directly to the line or a separate control power line.
Isolated enabling bit input and output pair	Enabling bit I/O pair allows for integration in a supervisory system or connection to an external master. The input interfaces to a NPN (current sink) external control source or enabling signal. It is internally connected to the isolated internal interface power supply and is protected against overvoltage transients. The output features a 24 VDC optotransistor which is protected against overvoltage transients and is isolated from all other AVSR3 supply potentials.
Modes of external control	The “Enable” and “Ready” pair allow for the following DIP switch selectable operation modes: • Standard or static mode: Operation is enabled by the “Enable” input and reported by the “Ready” output. • Tandem mode: A number of AVSR3s are connected in tandem (ie each “Ready” output driving the “Enable” input of the next unit) to realize systems with more capacitor banks. Group control is effected via the “Enable” input of the first unit. • Interlock mode: A number of AVSR3s are connected in a ring (ie each “Ready” output driving the “Enable” input of the next unit in the ring) allowing for only one bank of the group to switch in/out. Used typically with single phase AVSR3s controlling the individual phases of a three phase load to minimize line disturbances when connected to a weak neutral. Group control is effected via a series switch in one of the “Enable” input.
Current detection	By standard 5 A secondary current transformer (CT). The transformer phase shift is detected at autocalibration and, as such, the CT can be placed in any of the phase lines.
Detection method	The reactive current is determined by measuring the current phase and magnitude.
Overheat protected solid state switch	Solid state circuits switch each 25 A compensating capacitor in and out of the line at every sampling instant. Each circuit is protected against overheating, typically caused by bypass relay failure (below).
Zero crossing type solid state switch	The capacitor is switched in when the line voltage equals the capacitor voltage ensuring very “quiet” operation. Capacitor inrush current and the associated generation of harmonics and ringing is eliminated and capacitor life is extended and safeguarded.
Bypass relay	Bypass relay across each solid state switch minimizes switch losses. Its eventual wear-out will trigger the power circuit overheat protection.
Sampling time	DIP switch selectable of 5, 10, 20 and 30 seconds.
Forced state	DIP switch selectable state turns each switch on or off regardless of current input enabling individual power circuit testing or orderly system disconnection.
2x16 character LCD	LCD display shows system state, variable and error messages in user readable and friendly format.
Isolated control circuit	Control circuit is galvanically isolated enhancing safety and noise immunity.
Protection	Against line overvoltages, faults and power circuit overheating.

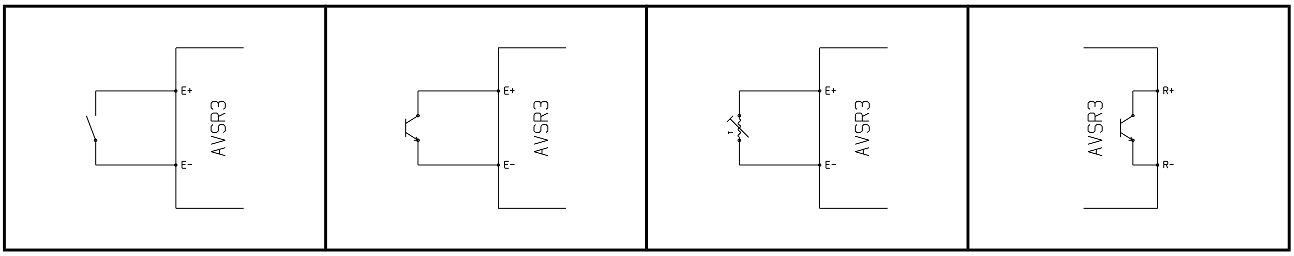
During normal operation the AVSR3 display indicates system status, error conditions (such as out-of-range line frequency or an overheated switch) and variables such as load/line power factor and power, percentage capacity switched-in and switch state. In the event of a power circuit overheating, the failing switch is deactivated until power is removed. Overheating is usually the result of switch bypass relay failure and in such a case the worn relay must be replaced.

The AVSR3 is highly integrated and adaptable to all power factor capacitor compensation applications. The only other parts required to build a complete power factor correction system are the current transformer, the compensating capacitors and their protective fuses.





Typical three-phase (top) and single-phase (bottom) power factor correction AVSR3 systems. (Model number “ccc” refers to the AVSR3 control voltage and “vvv” to the installation line voltage). In the three-phase system the AVSR3 is powered by a separate control supply, as provided by the shown isolation transformer. The current transformer (CT) phase shift is detected at autocalibration and can be placed in any phase line. In the presence of significant line harmonics, the capacitors must be protected by detuning chokes.



AVSR3 enable input connection (from left to right) to a switch or relay contacts, optotransistor and thermistor. The system is enabled with the switch closed or the optotransistor conducting current. The AVSR3 output (right) is an uncommitted optotransistor and is on when the system is ready.

The AVSR3 can be specially ordered with the LCD on the back so that it can be placed on the cabinet door inside and show through a suitable viewing hole. Assembled, ready-to-install systems are also available on a custom order basis.

Ordering Information by Line System and Supply Voltage					
Description	**Single phase 110-130 V, 50-60 Hz lines**	**Single phase 220-240 V, 50-60 Hz lines**	**Three-phase 3x220-240 V, 50-60 Hz lines**	**Three-phase 3x400 V, 50-60 Hz lines**	**Three-phase 3x480 V, 50-60 Hz lines**
Triple switch autocalibrating variable step regulator, 110-130 VAC supply	AVSR3-115-1-115	AVSR3-115-1-230	AVSR3-115-3-230	AVSR3-115-3-400	AVSR3-115-3-480
Triple switch autocalibrating variable step regulator, 220-240 VAC supply		AVSR3-230-1-230	AVSR3-230-3-230	AVSR3-230-3-400	AVSR3-230-3-480
Triple switch autocalibrating variable step regulator, 400 VAC supply				AVSR3-400-3-400	
Triple switch autocalibrating variable step regulator, 480 VAC supply					AVSR3-480-3-480

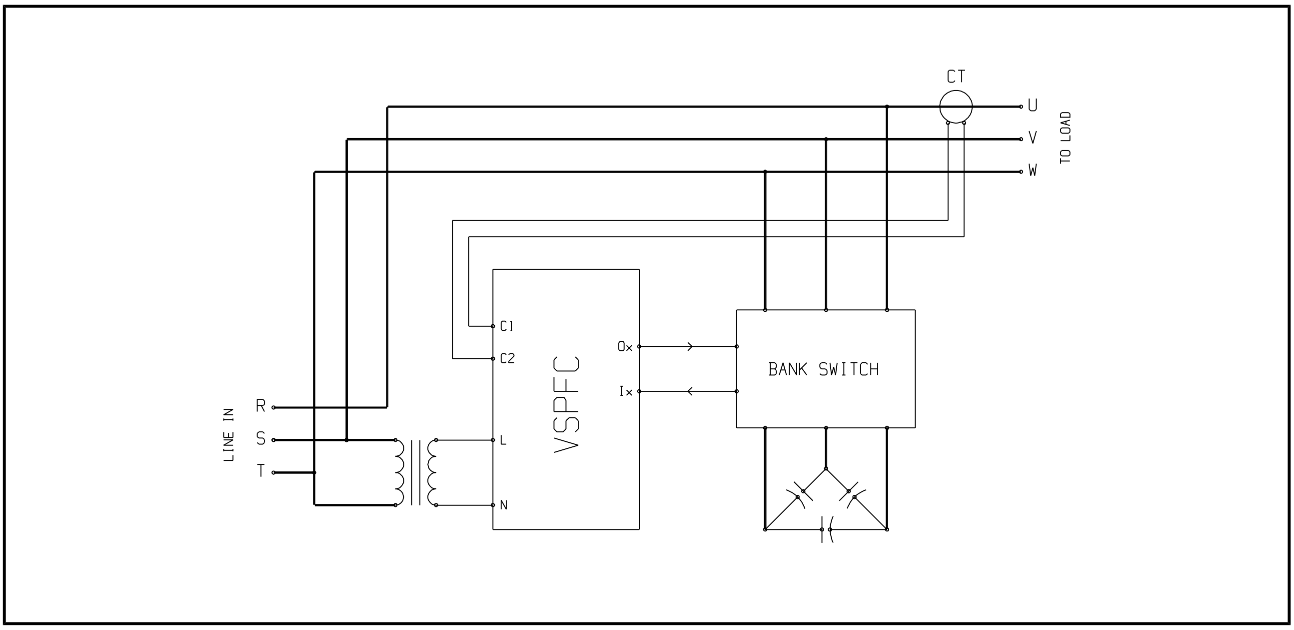
2. VSPFC Variable Step Power Factor Controller

The VSPFC variable step controller provides for different capacitor banks of any size to correct power factor in practically any arbitary minimum step and correction range size. At every sampling instant, the controller calculates the required compensation step and connects or disconnects a combination of banks whose sum is equal or closest to the calculated step value. As an example, four banks sized as x5, x2, x2 and x1 multiples of the smallest required step provide a decade of compensating operation and function as a typical ten equal step system. The maximum correction range possible with the VSPFC is when all its 12 outputs are employed in a binary weighted system (x1, x2, x4, x8 .. x2048) and equal to 4095 steps.

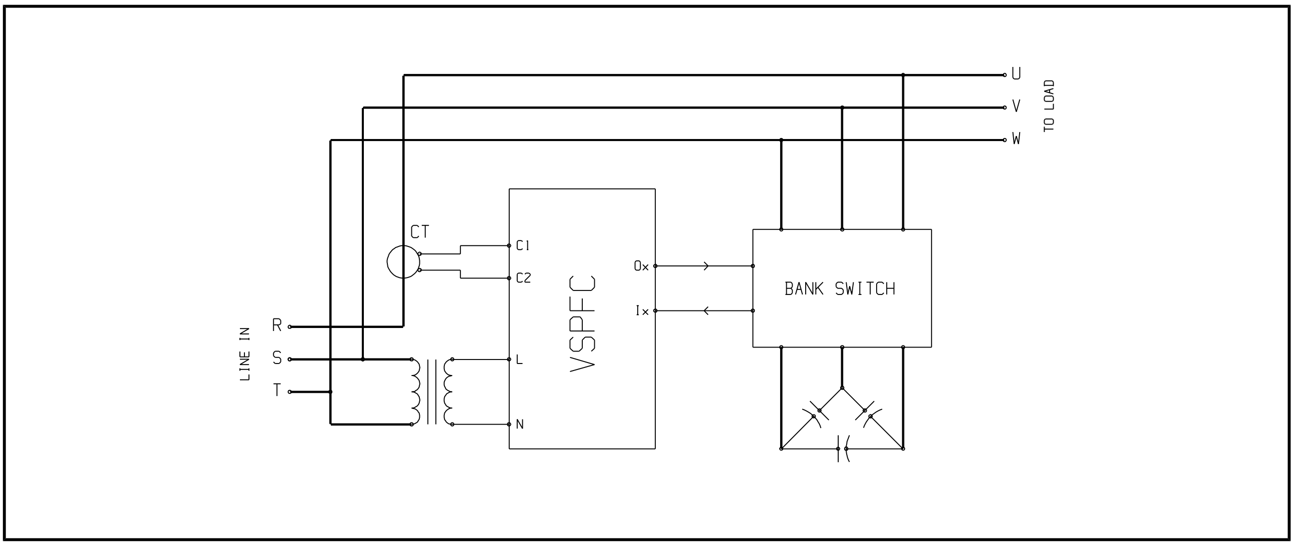
The VSPFC Variable Step Power Factor Controller

VSPFC Feature Summary	
Variable compensating capacitance step	Variable compensating capacitance step can be any combination of the driven banks, effectively realizing an up to 4095 step system.
Compensating or regulating mode	Operates in compensating or regulating mode with the detecting current transformer (CT) either on the line or load side.
Connection	Single- or three- phase connection.
Twelve bit inputs and outputs	Twelve bit inputs and outputs to drive up to twelve capacitor bank switches with individual or group fault/error feedback.
Option to use one bit output to drive a fan	Specific bit output can be assigned to drive a fan as a function of the connected bank size sum.
Current detection with standard transformer	5A CT secondary interface detects the CT apparent current and its phase-detected component (locked to the VSPFC supply voltage).
Dual standard serial port	Dual standard serial communication port: EIA(RS)232 for local communications and/or EIA(RS)485 for connection to Quamatic (and similar byte oriented) networks and remote sensors.
Functional front panel	Five digit plus sign LED display with four operator switches on the front panel protected to IP54 and covered by a polyester membrane.
Fully programmable	Fully programmable parameters and function can be set via the front panel or the serial port.
Supplies all relevant quantities	Provides all quantities relevant to power factor control applications regardless of mode (regulating or compensating) and installation type (single- or three-phase) for the line and the load.
Complete integration	Complete integration within a Quamatic or similar network or other supervisory systems via an assigned bit input and output pair.
Operation by non-specialist personnel	Simple, self-contained, unattended operation by non-specialist personnel.
Standard dimensions	Standard front panel cut-out dimensions (per DIN 43700).

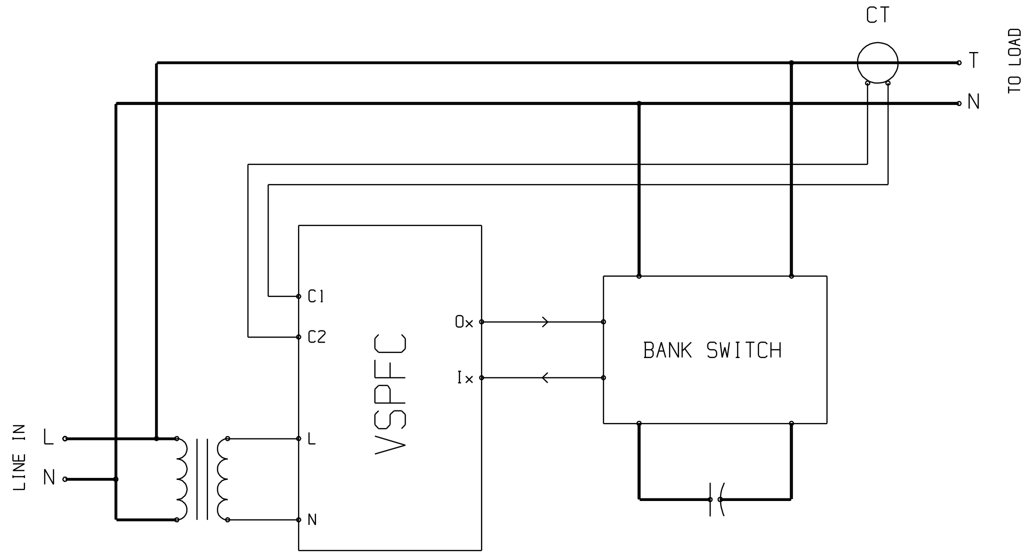
The VSPFC operates in regulating or compensating mode. In regulator mode the current is detected at the line side and equals to the sum of the load and connected capacitor currents. In this mode the Controller switches capacitor banks in and out of the line to minimize reactive current at the line side. In compensator mode the current is detected at the load side and is equal only to the load current. In this mode the Controller switches the banks in and out of the line to compensate the detected reactive load current as closely as feasible by the available bank sizes.



Three-phase VSPFC system operating in compensation mode. The current transformer (CT) detects the load current only. The transformer at the VSPFC supply is used to isolate the system power and control circuits and/or when the line voltage is other VSPFC supply. The capacitor bank switches can interface bidirectionally with the VSPFC.

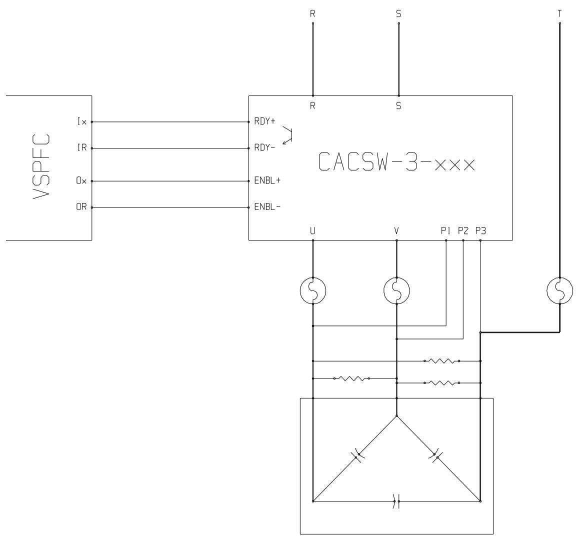


Three-phase VSPFC system operating in regulation mode. The current transformer (CT) detects the load current plus any compensating capacitor bank current. The transformer at the VSPFC supply is used to isolate the system power and control circuits and/or when the line voltage is other VSPFC supply. The capacitor bank switches can interface bidirectionally with the VSPFC.



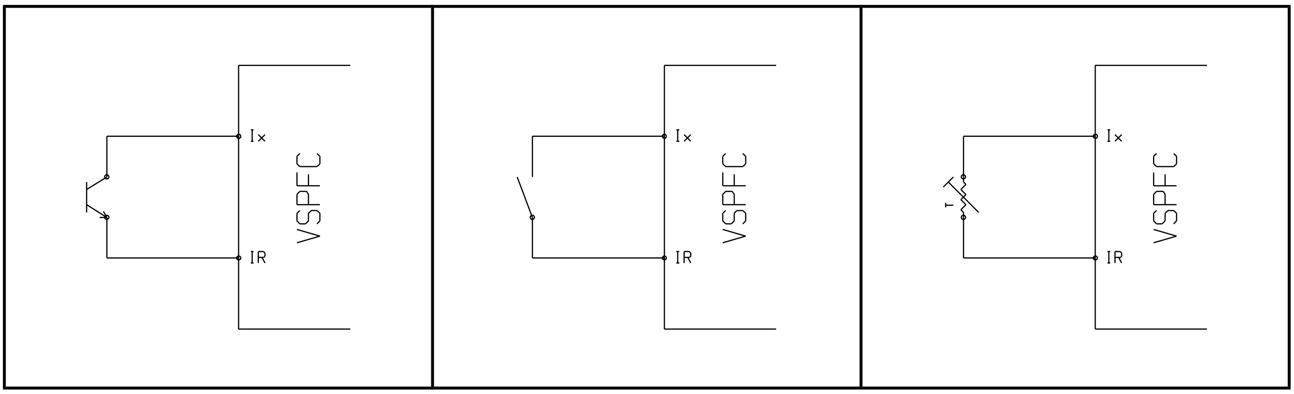
Single-phase VSPFC system operating in compensation mode. The current transformer (CT) detects the load current only. The transformer at the VSPFC supply is used to isolate the system power and control circuits and/or when the line voltage is other VSPFC supply. The capacitor bank switches can interface bidirectionally with the VSPFC.

The Controller bit outputs feature 24 VDC optotransistors commoned in NPN (current sink) type. They are protected against overvoltage transients and are isolated from all other Controller supply potentials.



Direct VSPFC interface to a CACSW capacitor bank switch (page 21). The CACSW is driven by the VSPFC, detects the capacitor fuses state and reports it via its "Ready" output.

The VSPFC bit inputs are of NPN (current sink) type and are used to interface to any capacitor bank switch status feedback or enabling signal. They are internally connected to the galvanically isolated internal interface power supply and are protected against overvoltage transients.



VSPFC enable bit inputs driven by an open collector, NPN, current sink source (left), switch or relay contacts (middle) and PTC thermistor (right).

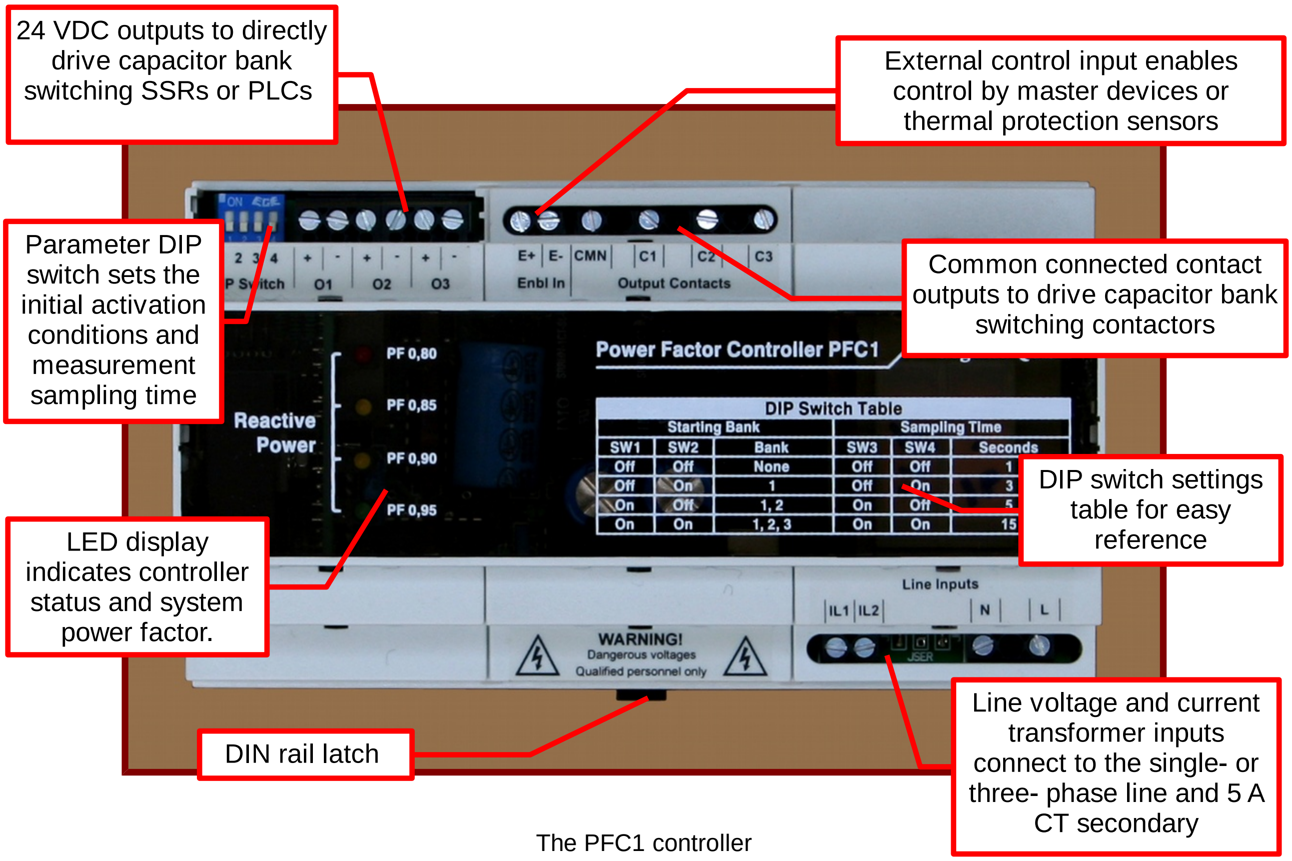
Ready-to-install, completely assembled systems are available on a custom order basis.

Ordering Information	
Model	**Description**
VSPFC-115	Variable step power factor panel controller, 115 VAC, 50-60 Hz supply.
VSPFC-230	Variable step power factor panel controller, 230 VAC, 50-60 Hz supply.

3. PFC1 Fast Power Factor Controller

The PFC1 controller measures the phase angle between the voltage and current vectors in a single- or three- phase line system and activates its three-step output to switch in and out of the line compensating capacitor banks. The current is detected with a standard current transformer (CT) in one of the line phases and measurement duration is selectable from 1 to 15 seconds.

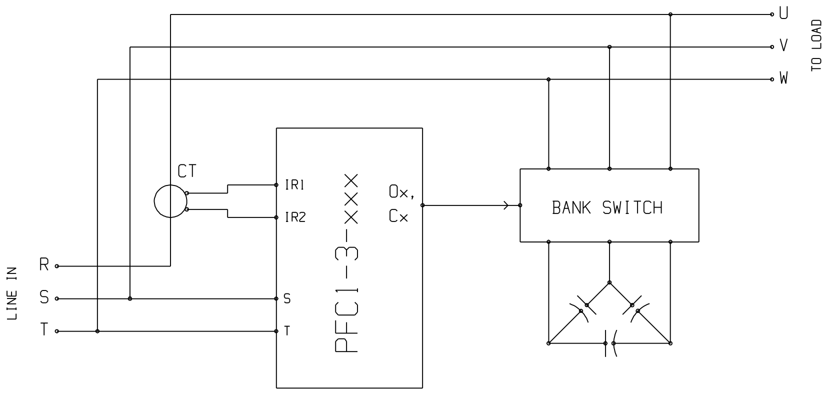
The PFC1's fast response makes it particularly suitable for very fast dynamic compensation of frequently-started, low-duty or variable loads such as lifts, conveyors, pumps, fans and office lighting rows.



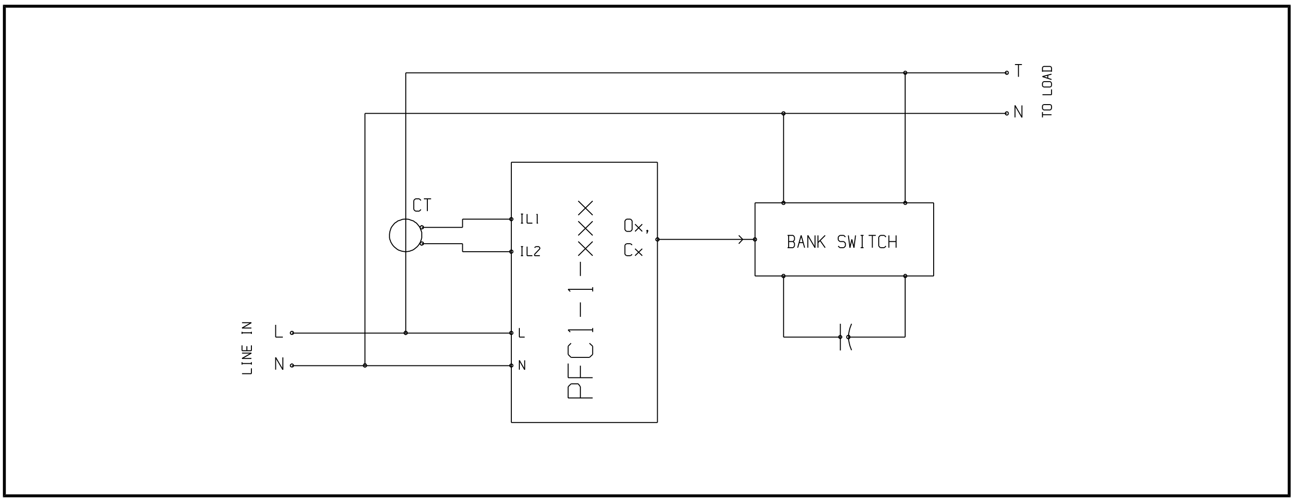
The PFC1 controller

The controller is active while the CT secondary current is above 0.5 A (10 % of range) and enabled at the external control input. On activation the outputs are initialized as selected at the DIP switch until the first measurement is completed. If the measured power factor is above 0.95 the outputs remain unchanged until the next measurement is completed. The outputs are incremented (the next step output is activated) for inductive power factors below 0.95 and the activated output protection time-out has elapsed. Correspondingly, the outputs are decremented (the highest step output is deactivated) for capacitive power factors below 0.95.

PFC1 Feature Summary	
Line connection	No connection to the neutral is required for three-phase models
Current detection	By standard 5 A secondary current transformer (CT)
Controller activation limit	0.5 A in the CT secondary (10 % of CT range) ensures reliable, robust and noise-free controller operation
Three-step output system	Switches the compensating capacitor banks progressively in and out of the line at every measured sample
Dual type galvanically isolated outputs	Directly drive solid state relays (SSR) and/or higher voltage loads such as contactors. The SSRs can be driven directly by the 24 VDC outputs while contactors are controlled via the PFC1 isolated contact outputs.
External control input	Control input to interface to external master devices or thermal protection sensors.
Measurement time	DIP switch selectable averaging/sampling time of 1, 3, 5 and 15 seconds
Initial output state	DIP switch selectable at controller activation until the first measurement is ready to immediately compensate known loads
DIP switch changes	Immediately effective at the next controller activation
Four LED display	Simple and intuitive display indicates the measured power factor and controller status
Comprehensive error handling	Handles reverse current transformer connection, out-of-range line frequency (valid range is 45 - 66 Hz) and line faults. Outputs are deactivated during a fault and the error clears after its cause is removed.
CT phase error compensation	The phase error introduced by the current transformer is compensated by a programmable amount.
Capacitor bank time-out protection	Time-out after deactivation allows proper capacitor discharging before next switch-in.
Protection	Line inputs are protected against line overvoltages and faults. 24 VDC outputs are protected against over-voltages and are current-limited.

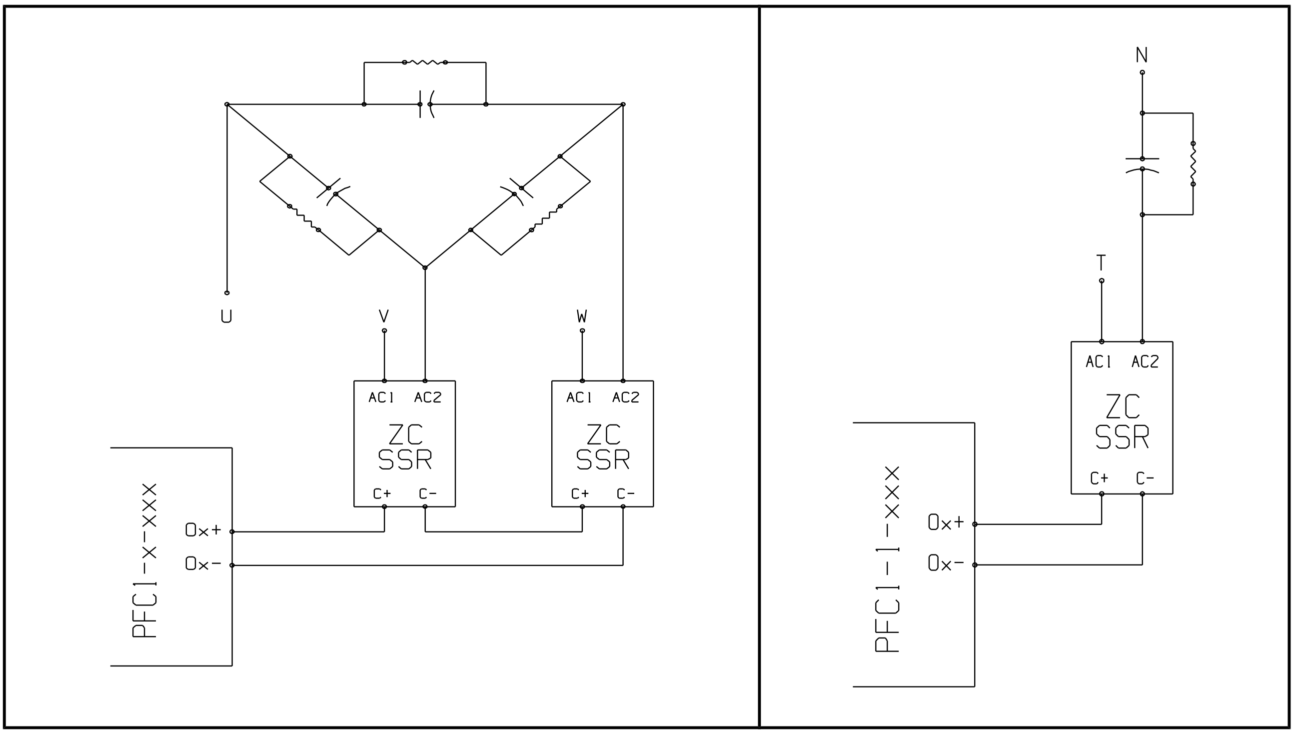


Typical three-phase power factor correction PFC1 system. Only one capacitor bank is shown for clarity. The bank switch can either be a set of solid state switches or a relay contactor.



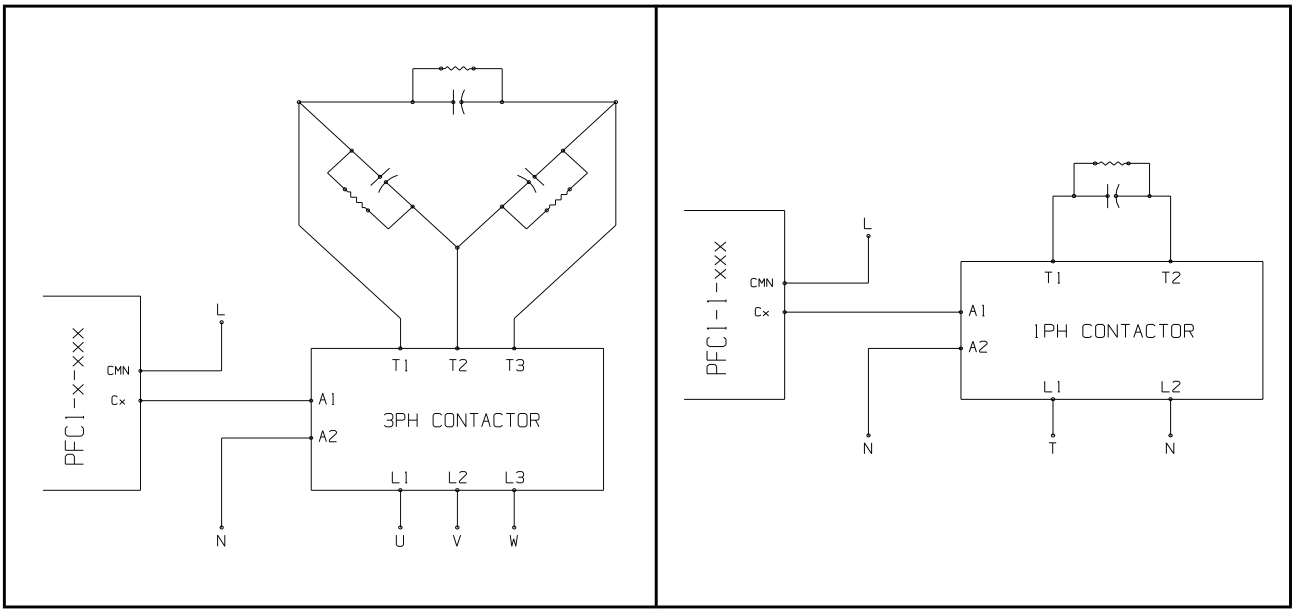
Typical single-phase power factor correction PFC1 system. Only one capacitor bank is shown for clarity. The bank switch can either be a set of solid state switches or a relay contactor. A single-phase model can also be used in a three-phase system with neutral by connecting to the detected current line and the neutral.

Each PFC1 24 VDC output is current-limited by 210 Ohms of resistance and protected against overvoltages and reverse inductive current. It can typically drive two or three SSRs (one at each controlled arm) connected in series with 20 mA control current.



Typical solid state relay bank switch connection in three-phase (left) and single-phase (right) line systems. The SSRs must be of the zero-crossing (or line synchronized) type to ensure that the capacitors are switched in when the line voltage equals the capacitor voltage thus eliminating capacitor inrush current and extending capacitor service life. The capacitor discharging resistors are for safety only and can be any suitable value giving minimum heat dissipation while connected to the line.

The PFC1 contact outputs are common-connected, normally-open, potential-free types and can switch up to 4 A loads at 240 VAC.



Typical contactor bank switch connection in three-phase (left) and single-phase (right) systems. The control voltage live (typically 230 VAC) is switched to activate the contactor coil.

The contactor must be of special two stage design limiting capacitor inrush current at bank switch in. The capacitor discharge resistors should be sized to optimally bring down the capacitor voltage before a possible bank switch-in (within the DIP selectable capacitor protection time-out) minimizing average capacitor inrush current.

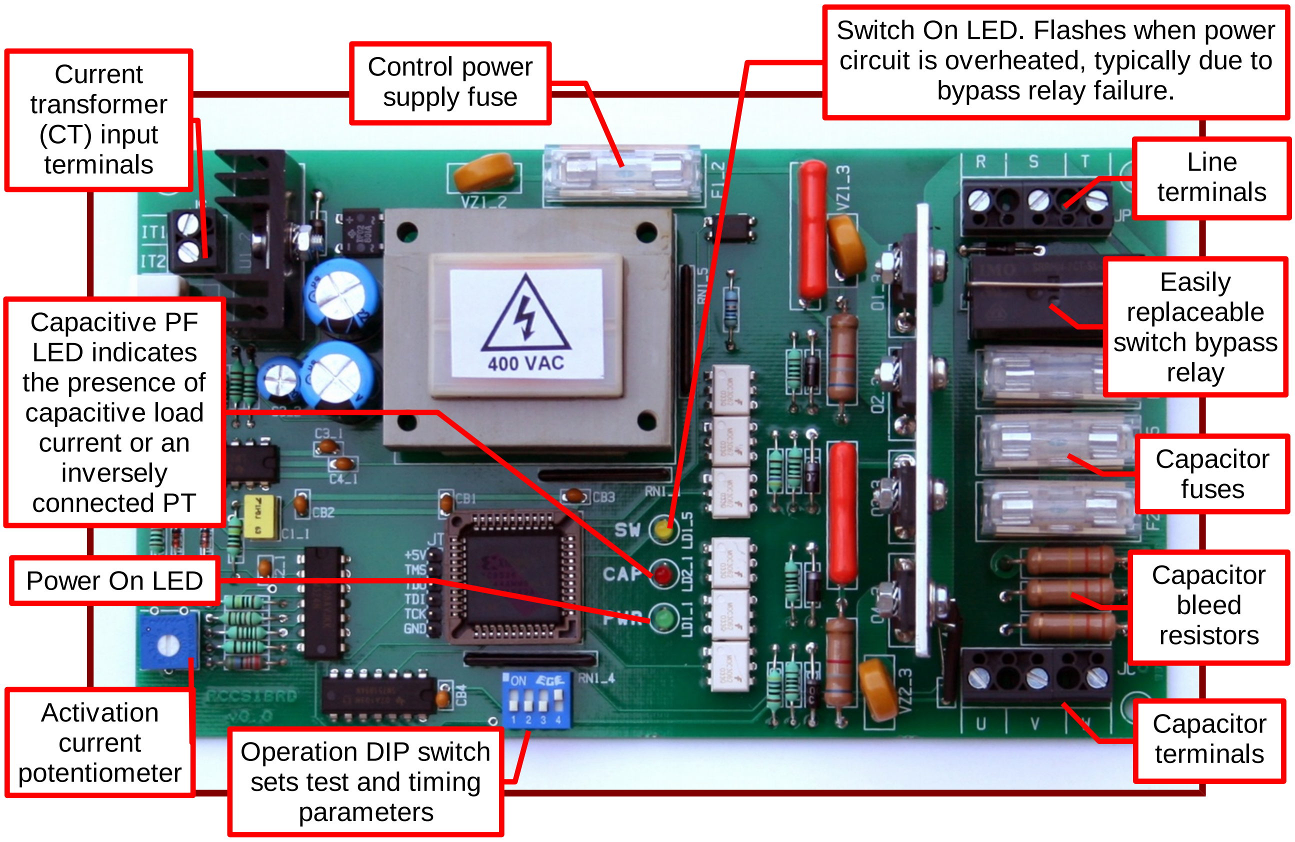
Assembled, ready-to-install power factor correction systems in wall mountable cabinets are available on a custom basis.

Ordering Information by Line System				
Description	**110-120 V**	**220-240 V**	**400 V**	**480 V**
Single-phase PFC1 fast power factor controller	PFC1-1-120	PFC1-1-240		
Three-phase PFC1 fast power factor controller	PFC1-3-120	PFC1-3-240	PFC1-3-400	PFC1-3-480

4. Single (RCCS1) and Triple (RCCS3) Reactive Current Controlled Switch

The new (v1.1) RCCSx switches measure the reactive current in single- and three- phase line systems and activate one (RCCS1) or three (RCCS3) 8 A solid state switches to connect compensating capacitors in and out of the line system. The current is detected with a current transformer (CT) in one of the lines and the sampling period is selectable from 4 to 32 seconds.

The RCCSx response makes it particularly suitable for fast dynamic power factor (PF) compensation of frequently-started, low-duty or variable loads such as lifts, conveyors, compressors, pumps and fans.

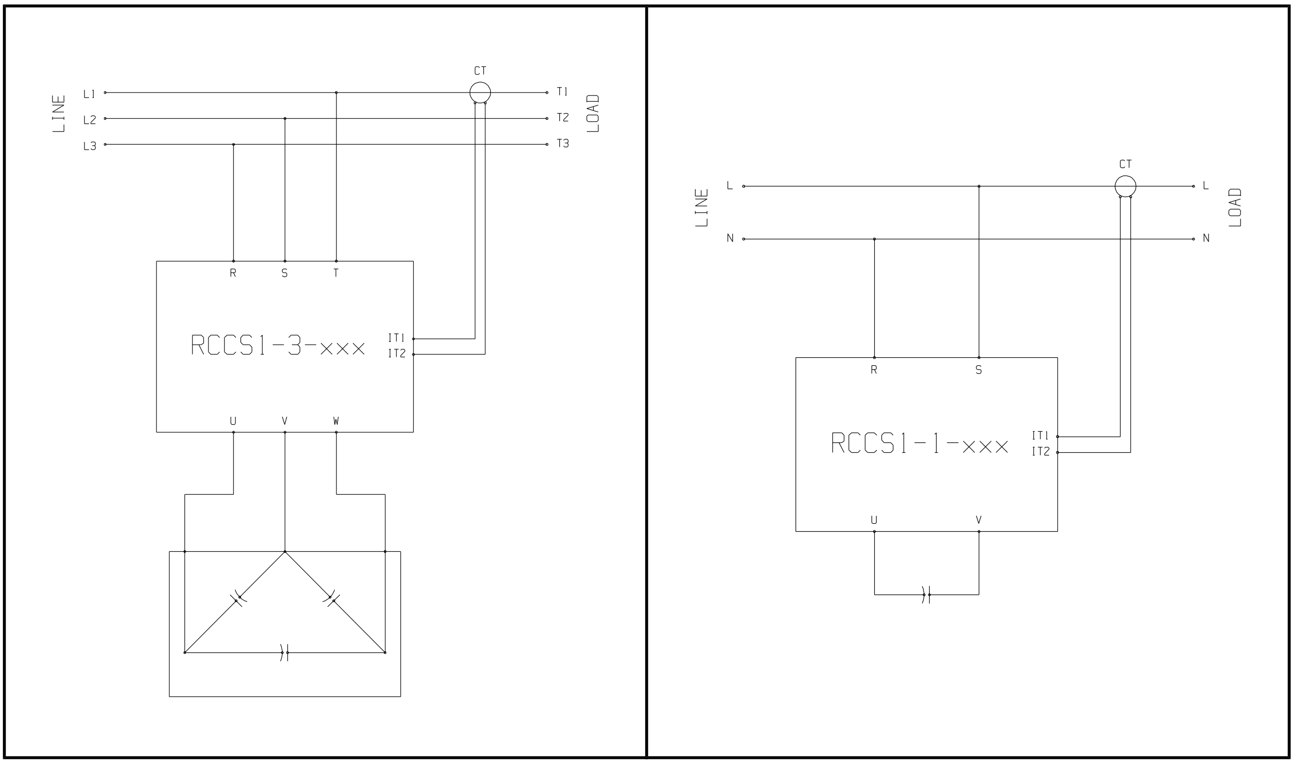


The RCCS1 v1.1 single switch

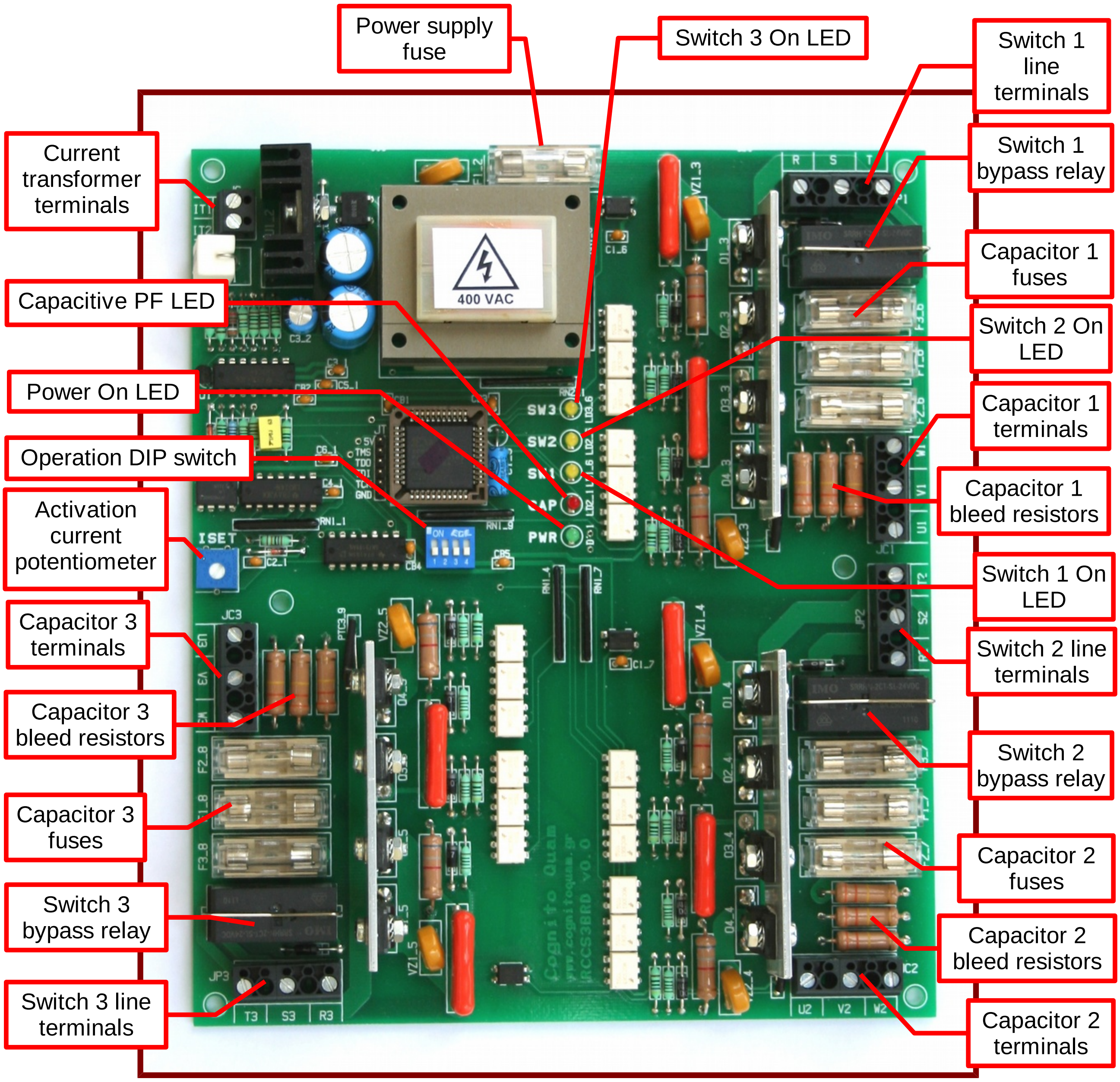
Each switch is activated when the detected reactive current is above the respective set value as determined at the activation potentiometer. Switch activation/deactivation happens at every sampling instant as set at the DIP switch.

The RCCSx is a fully protected, digitally-controlled unit, simple to install and adaptable to all power factor capacitor compensation applications. The only other parts required to build a complete power factor correction system are the current transformer and the compensating capacitor(s).

RCCSx Feature Summary	
Line connection	No neutral connection for the three-phase models.
Current detection	By standard 5 A secondary current transformer (CT).
Reactive current activation range	Activation potentiometer range of 0.3 - 3 Ar (measured at the current transformer secondary) ensures versatile and scalable operation.
Phase sensitive detection method	Reactive current is measured by phase sensitive detection rejecting noise and line harmonic effects.
Overheat protected three-phase solid state relay	Solid state relay circuits switch each 8 A compensating capacitor in and out of the line at every sampling instant.
Zero crossing type solid state relay	The capacitor is switched in when the line voltage equals the capacitor voltage thus eliminating capacitor inrush current and extending service life.
Bypass relay	Bypass relay across each solid state switch minimizes switch losses.
Sampling time	DIP switch selectable of 4, 8, 16 and 32 seconds.
Forced state	DIP switch selectable state turns each switch on or off regardless of current input enabling individual power circuit testing or orderly system disconnection.
Indicating LEDs	LEDs show the power supply state, each switch activation/overheat status and the capacitive PF condition (or a reverse connected current transformer).
Bleed resistors	Capacitor bleed resistors ensure charge-free capacitors after shut-down.
Isolated control circuit	Control circuit is galvanically isolated enhancing safety and noise immunity.
Protection	Against line overvoltages, faults and power circuit overheating.

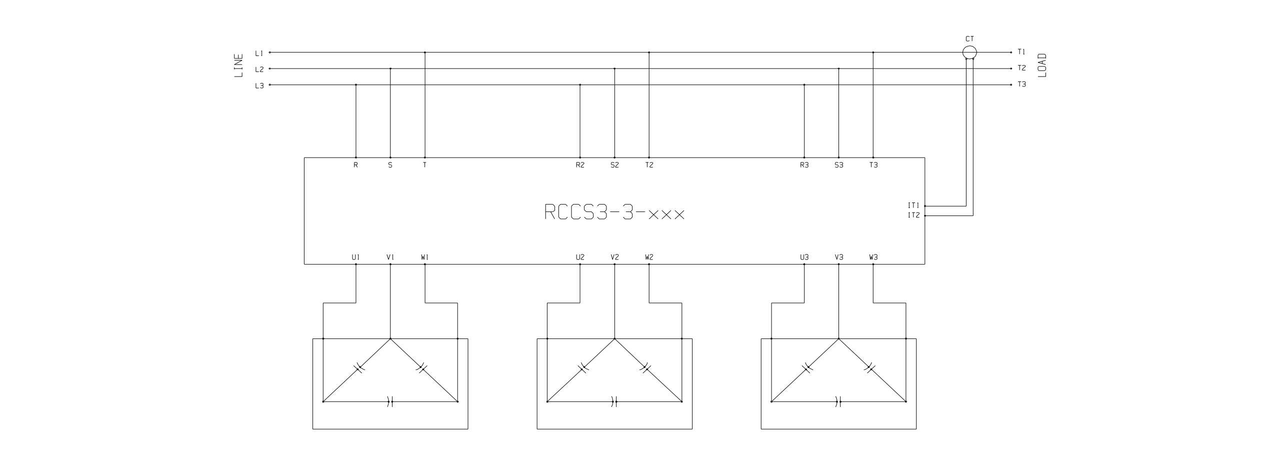


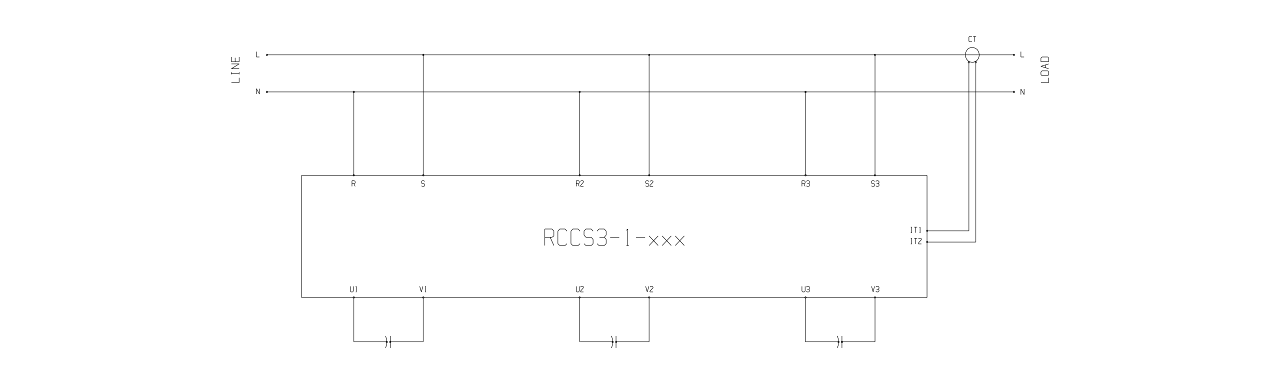
Typical three-phase (left) and single-phase (right) power factor correction RCCS1 systems.



The RCCS3 v1.1 triple switch

During normal operation each “Switch ON” LED indicates the on or off condition of the relevant switch. In the event of its power circuit overheating, the switch is deactivated and the “Switch ON” LED flashes until power is removed. Overheating is usually the result of switch bypass relay failure and in such a case the worn relay is easily removed from its socket and replaced.



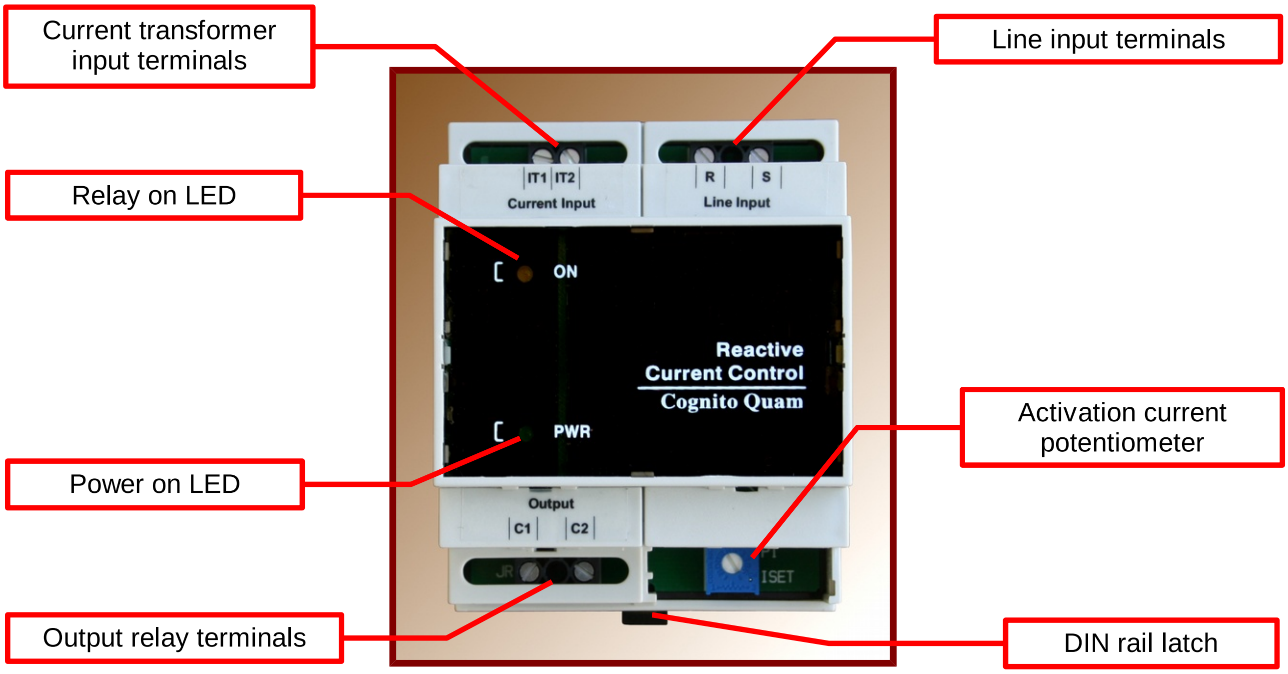


Typical three-phase (top) and single-phase (bottom) power factor correction RCCS3 systems.

Ordering Information by Line System					
Description	**120 V, 60 Hz lines**	**230 V, 50 Hz lines**	**240 V, 60 Hz lines**	**400 V, 50 Hz lines**	**480 V, 60 Hz lines**
Single-phase RCCS1 single reactive current controlled switch	RCCS1-1-120	RCCS1-1-230	RCCS1-1-240		
Three-phase RCCS1 single reactive current controlled switch	RCCS1-3-120		RCCS1-3-240	RCCS1-3-400	RCCS1-3-480
Single-phase RCCS3 triple reactive current controlled switch	RCCS3-1-120	RCCS3-1-230	RCCS3-1-240		
Three-phase RCCS3 triple reactive current controlled switch	RCCS3-3-120		RCCS3-3-240	RCCS3-3-400	RCCS3-3-480

5. RCCx-xxx Reactive Current Control

The RCCx reactive current control detects reactive current in a single- or three- phase line and closes its output contacts if above the set limit. It can thus dynamically compensate low inductive power factor lines by signaling the need to switch capacitors in and out of the line. It is very simple to install and adaptable to all power factor compensation applications.



Three-phase reactive current control RCC3-xxx.

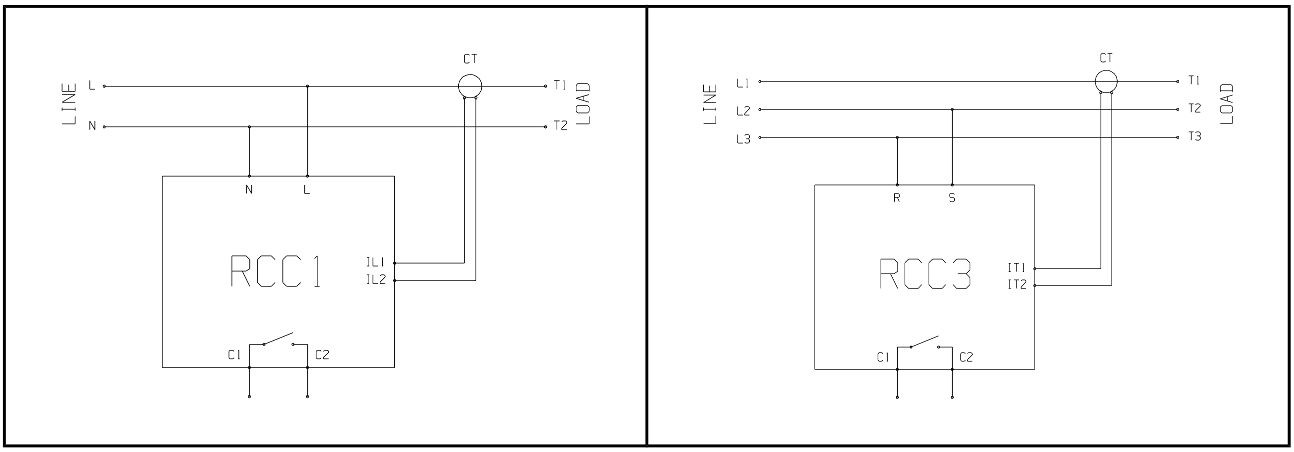
The RCC measures the reactive current in a single-phase (RCC1-xxx models) or three-phase (RCC3-xxx models) system and closes the 12 A output contacts when the monitored reactive current is above the preset value. The current is detected with a current transformer (CT) in one of the phase lines with a maximum response time of 30 seconds.

The RCC response time makes it particularly suitable to activate contactor switched capacitor banks in dynamically compensating low-duty or variable loads such as:

- Lifts,
- Conveyors,
- Compressors,
- Pumps,
- Fans, and
- Office lighting.

The RCC is designed for single-phase (RCC1-xxx models) or three-phase (RCC3-xxx models) lines. Characterizing features are shown in the following table.

RCCx-xxx Characteristics	
Three-phase line connection without neutral	The RCC3-xxx connects to two of the three-phase lines and no connection to the neutral.
Current detection	By standard 5 A secondary current transformer.
Reactive current activation range	Activation potentiometer range of 0.3 - 3 Ar (measured at the current transformer secondary) ensures versatile, reliable and robust operation.
Phase sensitive detection method	Reactive current is measured without being affected by noise and harmonics in the line.
Output relay contacts	12 A output relay contacts are closed when the detected reactive current is above the set value at the activation potentiometer.
Indicating LEDs	LEDs show the power supply and relay activation state.
Control circuit	Isolated control circuit enhances safety and noise immunity.
Protection	Protection against line overvoltages and faults.

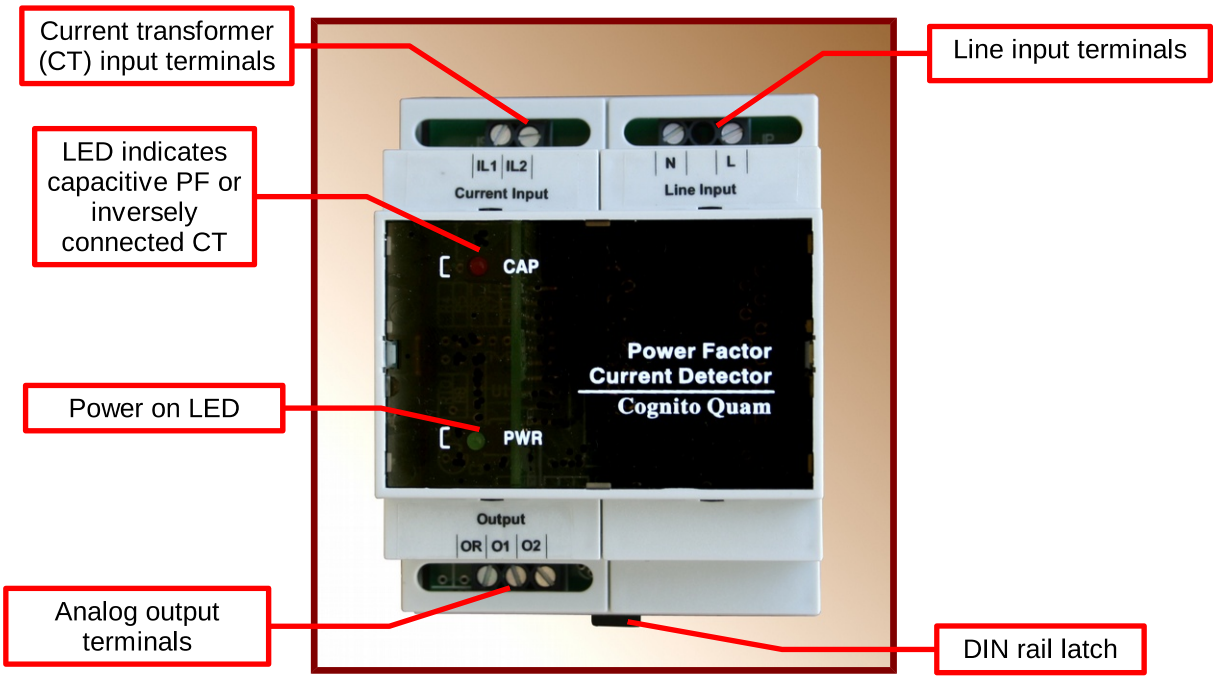


Connection diagram of an RCC1-xxx to a single-phase line (left) and an RCC3-xxx to a three-phase line (right).

Ordering Information by Line Voltage					
Description	**120 V, 60 Hz lines**	**230 V, 50 Hz lines**	**240 V, 60 Hz lines**	**400 V, 50 Hz lines**	**480 V, 60 Hz lines**
Reactive current control, single-phase	RCC1-120	RCC1-230	RCC1-240		
Reactive current control, three-phase	RCC3-120		RCC3-240	RCC3-400	RCC3-480

6. PFCDxx-xxx Power Factor Current Detector

The PFCDxx-xxx power factor current detector measures the apparent and either the active or reactive current in a single- or three- phase power line to respectively produce a set of two 10 VDC analog signals. The two outputs can then be used by a PLC or other controlling device to calculate line power factor as well as monitor the applicable active or reactive current characteristics. It is very simple to install and adaptable to all power factor compensation applications.



Power Factor Current Detector PFCD1R

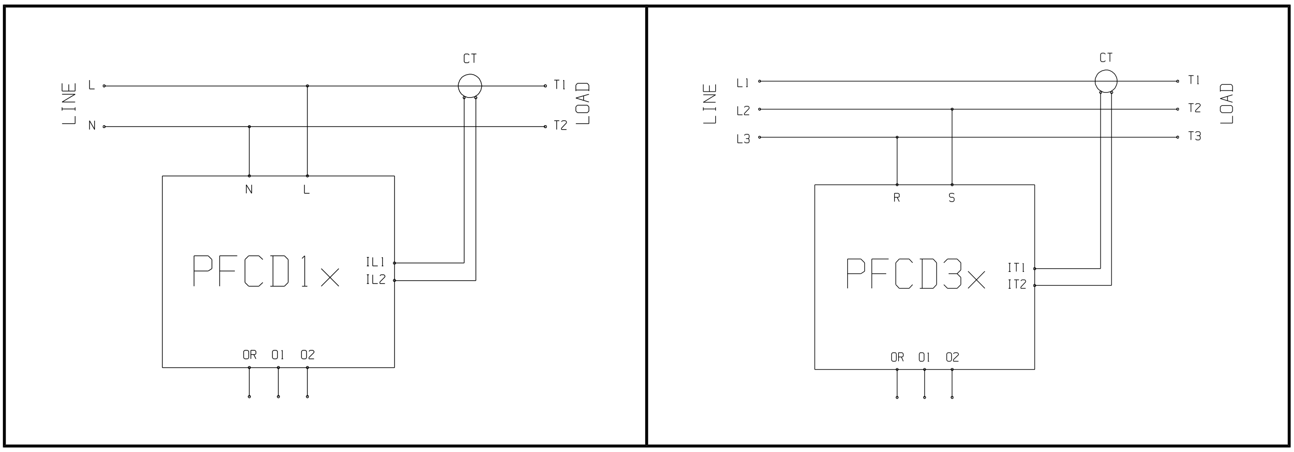
The PFCD measures the power factor related currents in a single-phase (PFCD1x-xxx models) or three-phase (PFCD3x-xxx models) system and produces a unipolar 0-10 VDC signal representing the apparent current and a bipolar ±10 VDC signal representing the active (PFCDxA-xxx models) or reactive (PFCDxR-xxx models) current. The current is picked up with a current transformer (CT) in one of the phase lines with a response time of about 3 seconds.

The PFCD's versatility and fast response make it particularly suitable for integrating into systems such as:

- Power factor measurement and compensation,
- Power factor and energy flow measurement,
- Reactive current measurement and compensation, and
- Line current measurement and overload/underload protection.

The PFCD is designed for single-phase (PFCD1x-xxx models) or three-phase (PFCD3x-xxx models) lines. Characterizing features are shown in the following table.

PFCDxx Characteristics	
Line connection	The PFCD connects to two of the three-phase lines and no connection is needed to the neutral for the three-phase version (PFCD3x-xxx models).
Current detection	By standard 5 A secondary current transformer.
Phase sensitive detection	The active or reactive current is measured without being affected by noise and harmonics in the line.
Analog outputs	Analog outputs can drive loads with up to 10 mA.
Indicating LEDs	LEDs show the power supply state and the existence of capacitive current in the monitored line or an inversely connected CT.
Isolated control circuit	Isolated control circuit enhances safety and noise immunity.
Protection	Protection against line overvoltages and faults.

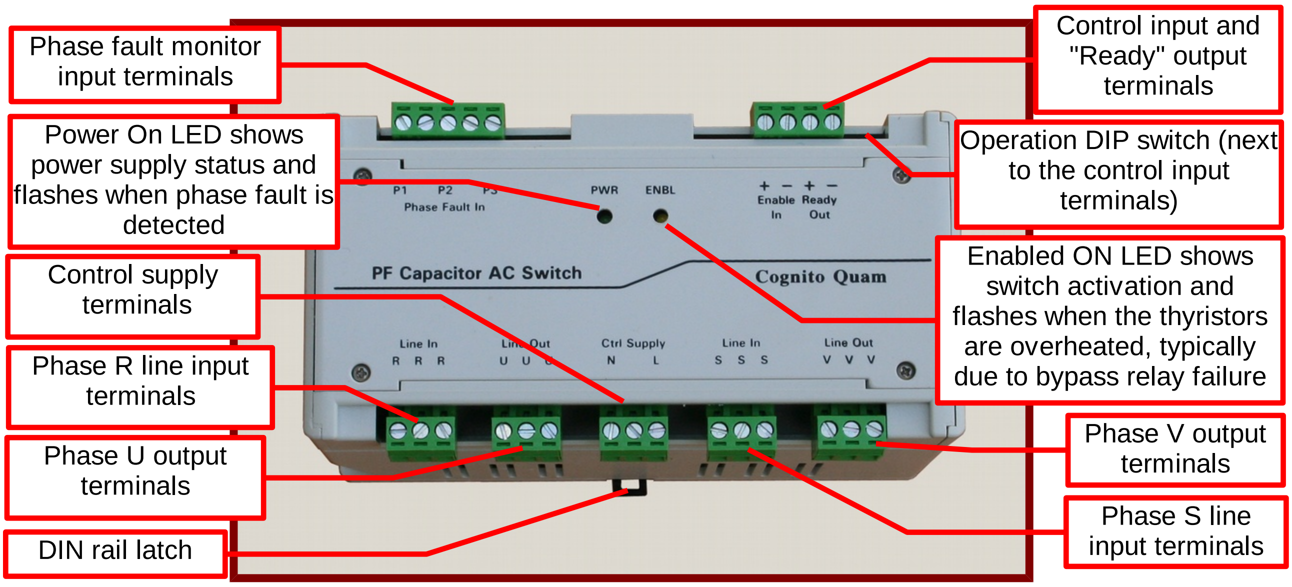


Connection diagram of a PFCD1x-xxx to a single-phase line (left) and PFCD3x-xxx to a three-phase line (right).

Ordering Information by Line Voltage					
Description	**120 V, 60 Hz lines**	**230 V, 50 Hz lines**	**240 V, 60 Hz lines**	**400 V, 50 Hz lines**	**480 V, 60 Hz lines**
PF active current detector, single-phase	PFCD1A-120	PFCD1A-230	PFCD1A-240		
PF reactive current detector, single-phase	PFCD1R-120	PFCD1R-230	PFCD1R-240		
PF active current detector, three-phase	PFCD3A-120		PFCD3A-240	PFCD3A-400	PFCD3A-480
PF reactive current detector, three-phase	PFCD3R-120		PFCD3R-240	PFCD3R-400	PFCD3R-480

7. CACSW Integrated Power Factor Capacitor AC Switch

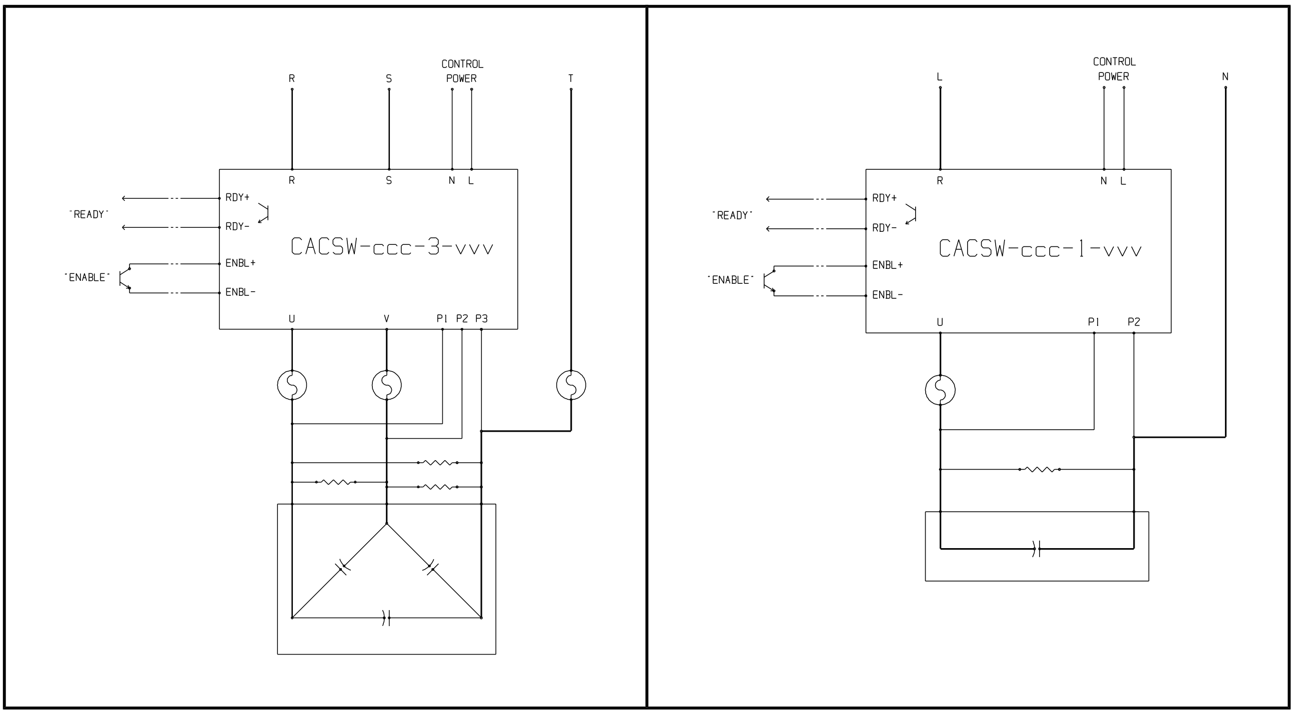
The CACSW connects a three- or single- phase 25 A power factor capacitor bank to the line, employing bypassed, zero crossing, solid state thyristor switches. Its phase fault detector can be used to either monitor the line for phase integrity or the capacitor bank circuit for fuse state as well as line faults.



The CACSW PF capacitor AC switch

The CACSW solid state thyristor switches connect to the capacitor bank at zero voltage difference without any disturbing inrush currents. They are then bypassed by a relay to eliminate all thyristor conduction losses and are protected against overheating, typically caused by failure of the relay contacts. The control input is digitally filtered to reject noise and the unit responds within a maximum time of 2.5 seconds.

CACSW Feature Summary	
Line connection	Powered by the line, without any connection to the neutral.
Own control supply	Powered separately at the control supply terminals.
Overheat protected solid state relays	Solid state relays circuits switch the 25 A compensating capacitors in and out of the line at every sampling instant.
Zero crossing type solid state relays	Each capacitor is switched in when the line voltage equals the capacitor voltage thus eliminating capacitor inrush current and extending capacitor service life.
Switch bypass relay	Bypass relay across each solid state switch minimizes/eliminates switch losses.
Sampling time	Minimum 1 second sampling time gives a maximum 2.5 s response time.
Phase fault detector	The switch is monitored for phase faults and/or blown fuses.
Stand-alone or slave operation	DIP switch selectable slave mode allows stand-alone or external master control.
Forced state	DIP switch forced state turns the switch on regardless of control input state.
Indicating LEDs	LEDs show the power supply state ("PWR", green) and the switch activation status ("ENBL", yellow). The "PWR" LED flashes on a detected phase fault (or blown fuse) while the "ENBL" flashes on thyristor switch overheating.
Isolated control circuit	Control circuit is galvanically isolated enhancing safety and noise immunity.
Protection	Against line overvoltages, faults and power circuit overheating.
DIN rail enclosure	Versatile DIN rail mountable plastic box.
Removable terminals	Removable terminal blocks ensure quick and neat wiring Installation.



Typical CACSW system switching a three-phase (left) and single-phase (right) capacitor in and out of the line. The capacitor is protected by a fuse in each live phase with the CACSW detecting their state at the P1, P2, P3 inputs. The bleed resistors can be any convenient value as the capacitor is connected at zero voltage difference with the line and no special discharge timing applies. The switch is activated at the ENBL control input and its status is reported by the RDY output. Control power may be directly obtained from the line or from a separate control/instrumenation line. The high capacitor current path is shown in bold.

Ordering Information by Line System and Control Supply Voltage
(Not shown combinations are available on a custom order basis)

Description	Single phase 110-130 V, 50-60 Hz lines	Single phase 220-240 V, 50-60 Hz lines	Three-phase 3x220-240 V, 50-60 Hz lines	Three-phase 3x400 V, 50-60 Hz lines	Three-phase 3x480 V, 50-60 Hz lines
Power factor capacitor AC switch, 110-130 VAC supply	CACSW-115-1-115		CACSW-115-3-230		CACSW-115-3-480
Power factor capacitor AC switch, 220-240 VAC supply		CACSW-230-1-230	CACSW-230-3-230	CACSW-230-3-400	CACSW-230-3-480
Power factor capacitor AC switch, 400 VAC supply				CACSW-400-3-400	
Power factor capacitor AC switch, 480 VAC supply					CACSW-480-3-480

9. Cognito Quam Profile

Cognito Quam Electrotechnologies Ltd. (established in 1990) is a privately held engineering and commercial company specializing in industrial electronics and their application. The company expertise covers all aspects of applications for the factory environment namely measurement (transducers and sensors), data processing and communication, control and actuation, automation and robotics and power and energy electronics.

Cognito Quam has contributed and been involved in the design and development of the following technologies, machinery and devices:

- Power factor controllers,
- Motor voltage and frequency inverters and converters,
- Thermal load control and management,
- Robotic interfaces and protocol converters,
- Adaptive panel controllers,
- Robotics controllers,
- Variable speed drives,
- Olive oil processing rejects control equipment (FAIR contract),
- Low Voltage and EMC CE marking compliance devices and equipment for production lines,
- Portable dioxine-furan instrumentation (SMT contract),
- Three-phase programmable soft-starters,
- Hard real time job scheduling systems,
- Hard real time industrial distributed data systems (Brite-EuRam subcontract),
- Calibration rig and supplies for power meters,
- Electrical utility Hall effect energy and power meters,
- Industrial data networks,
- Battery chargers and UPS inverters,
- Solar power air conditioning telemetry and control systems (Thermie subcontract)
- Small switching power supplies,
- Multi-port communication PC cards,
- Ship oily water separators, and
- Modem controllers.

Cognito Quam also offers its research and development services in integrating its products in larger industrial systems products as well as in the design of new and challenging devices and equipment. As such the company cooperates closely and supports its customers in their efforts for a better product.