PQC-STATCON

Instantaneous and stepless compensation for dynamic reactive power and unbalanced loads

Power and productivity
for a better world™

ABB and power quality

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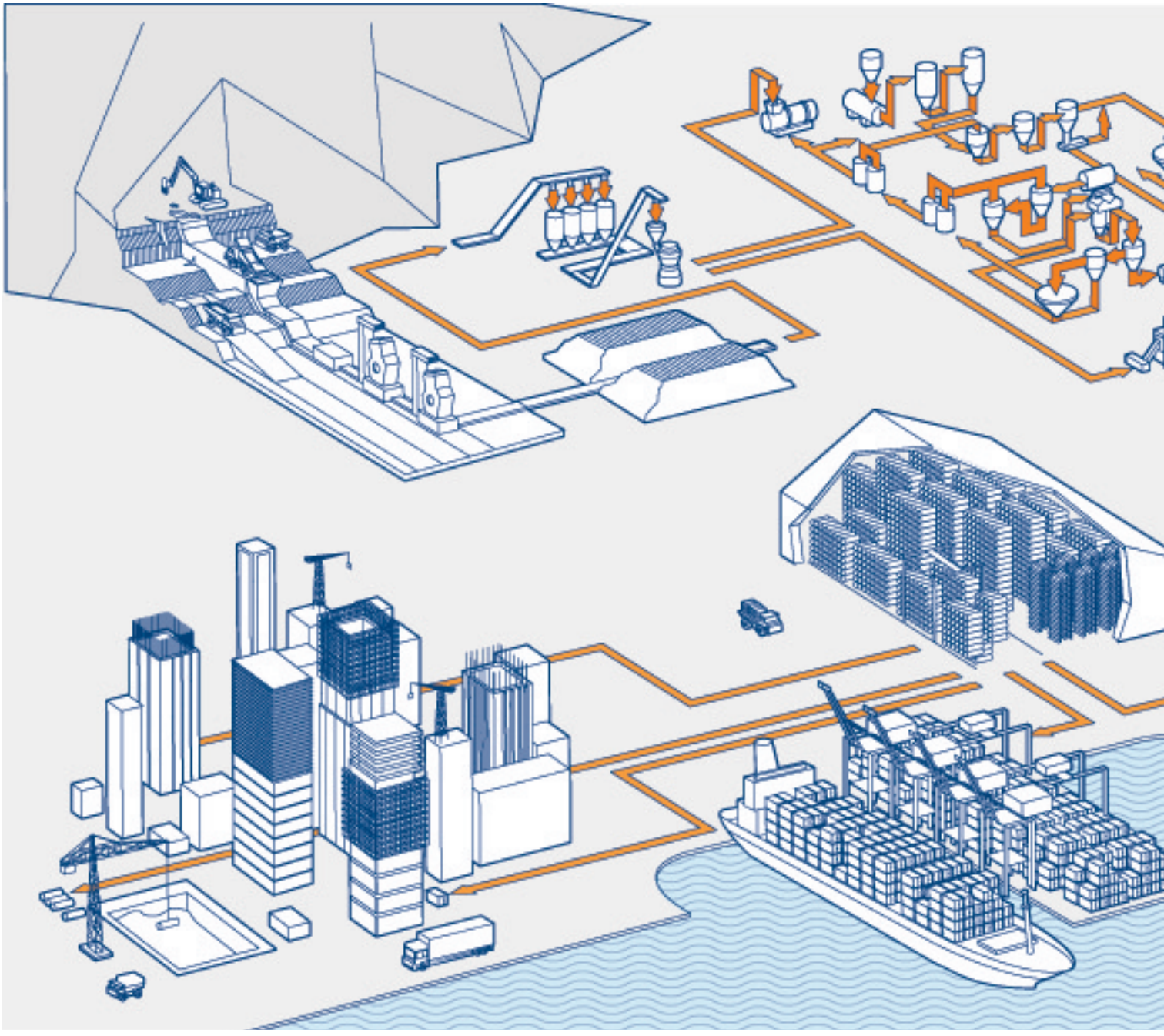
ABB delivers the full value chain in low, medium and high voltage technologies for electrical power transmission, distribution and usage. ABB has been driving development in the field of Power Quality for over 70 years and is responsible for several important developments in reactive power and filtering technologies.

Today, ABB is recognized as a leader in Power Quality, partnering our customers to define the optimal solution for their systems.



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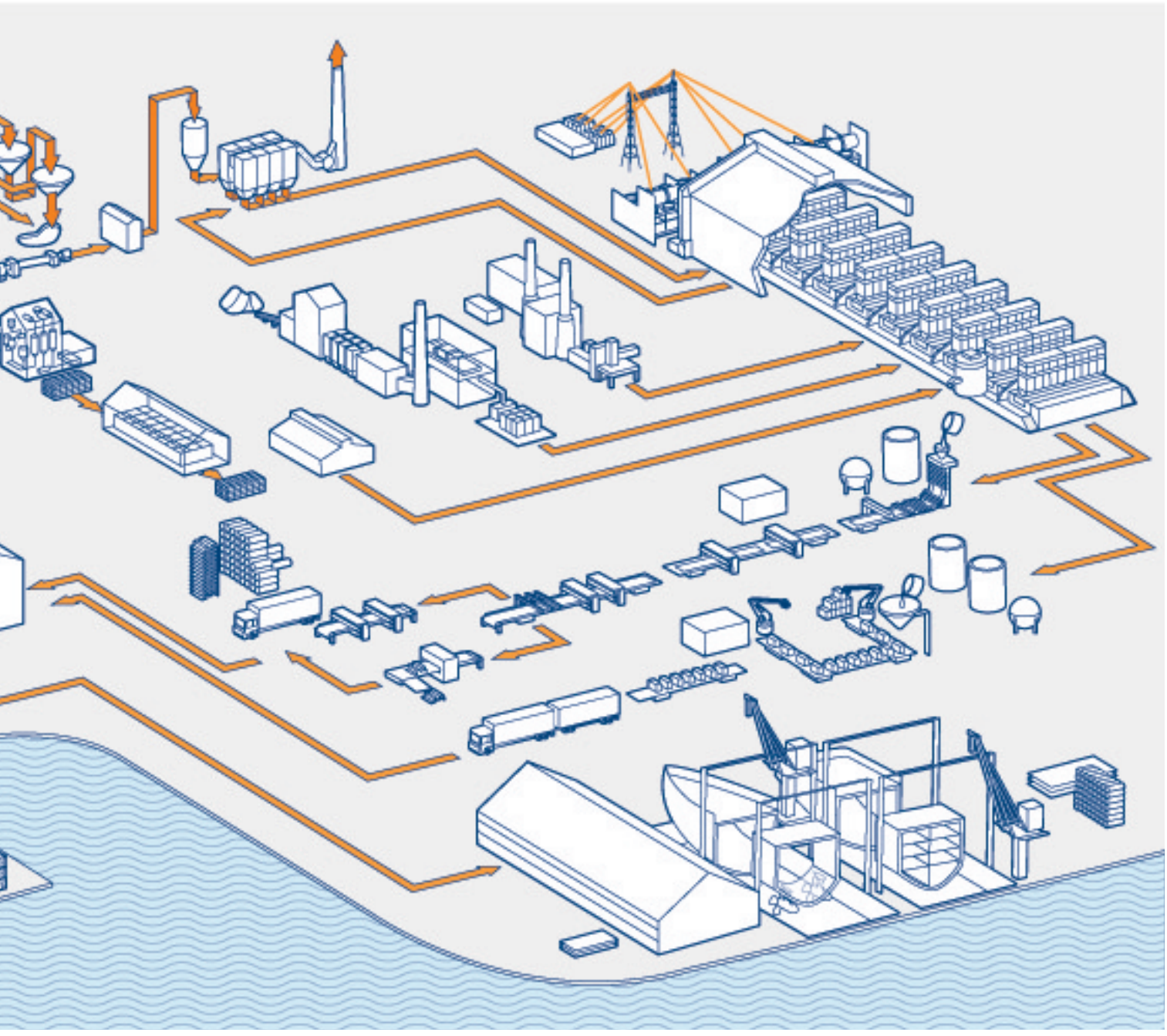
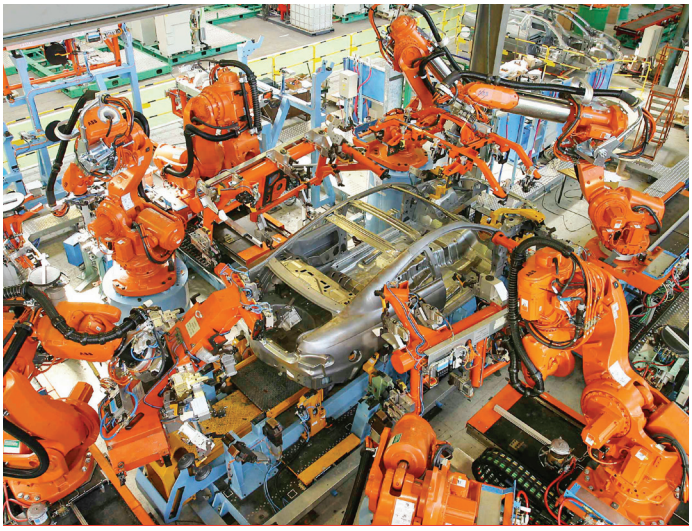


Applications and key benefits

PQC-STATCON technology is used for dynamic reactive power compensation, unbalanced load compensation and voltage stability improvement. It can provide compensation in grid supply. Apart from the grid supply network, it can support dynamic loads fed from generator. PQC-STATCON has a good steady state performance with ultra fast response and superior control characteristics. It can be operated dynamically to compensate to fast varying capacitive, inductive and unbalanced loads.



Applications

Instantaneous stepless power electronics based dynamic compensator for dynamic reactive power (power factor) and unbalanced loads (<1 cycle response time)

- For inductive and capacitive loads
- For highly fluctuating loads
- For industrial loads fed by weak networks
- For three phase and single phase applications
- For LV networks and MV networks with step-up transformer

Key benefits

- Improved power quality
- Enhanced energy efficiency by reducing system losses
- Reduced carbon foot print
- Improved reliability of existing capacitor banks under dynamic condition
- Reduced maintenance needs and enhances life of electrical installations
- Easy installation and commissioning
- Easy and convenient operation with touch screen interface
- No risk for harmonic amplification

Typical installations include

- Automotive, welding plant
- Steel plants, rolling mills, furnace applications
- Railway traction substations
- Airports, shipyards, ships
- Off-shore drilling
- Process industries
- Sky lifts, compressor loads
- Pulp and paper industries
- Chemical plants
- Rubber industries
- Hydro power plants
- Cement factories
- Water treatment plants
- Wind mills

Technology

The PQC-STATCON is based on Voltage Source Converter (VSC) technology. VSC consists of Insulated Gate Bipolar Transistor (IGBT) as fully controlled power semiconductor devices.

VSC produces single or three phase AC voltage from a DC input voltage. The VSC generated voltage is coupled to the source voltage through a Pulse Width Modulation (PWM) reactor. By varying the magnitude of AC terminal voltage of VSC, reactive power exchange takes place between the VSC and the AC source. If the magnitude of VSC voltage is more than the AC source voltage, capacitive current flows from supply voltage to VSC and the PQC-STATCON generates capacitive reactive power. If the magnitude of VSC voltage is less than the AC source voltage, inductive current flows from supply voltage to VSC and the PQC-STATCON generates inductive reactive power. If the amplitude of VSC voltage is equal to the AC source voltage, no current flow happens between supply voltage and VSC; PQC-STATCON does not generate reactive power.

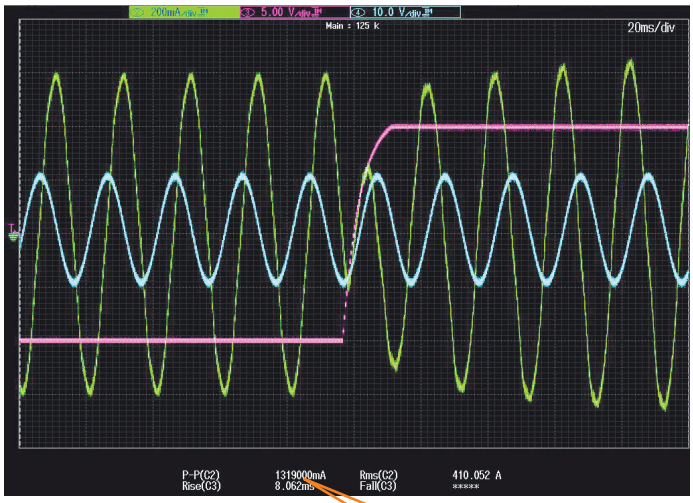
Further, PQC-STATCON generates appropriate magnitude of voltages at the AC terminal of VSC to compensate for negative sequence current caused due to unbalanced loads.

Hence, the source will be totally relieved from reactive current and negative sequence current (due to unbalanced loads). This results in flow of balanced real current in all three phases in the source.

PQC-STATCON provides excellent steady state performance, instantaneous response (<1 power cycle) and has superior control characteristics, thanks to high speed Digital Signal Processor (DSP) technology.

PQCS / PQCT for high kvar single / three phase applications

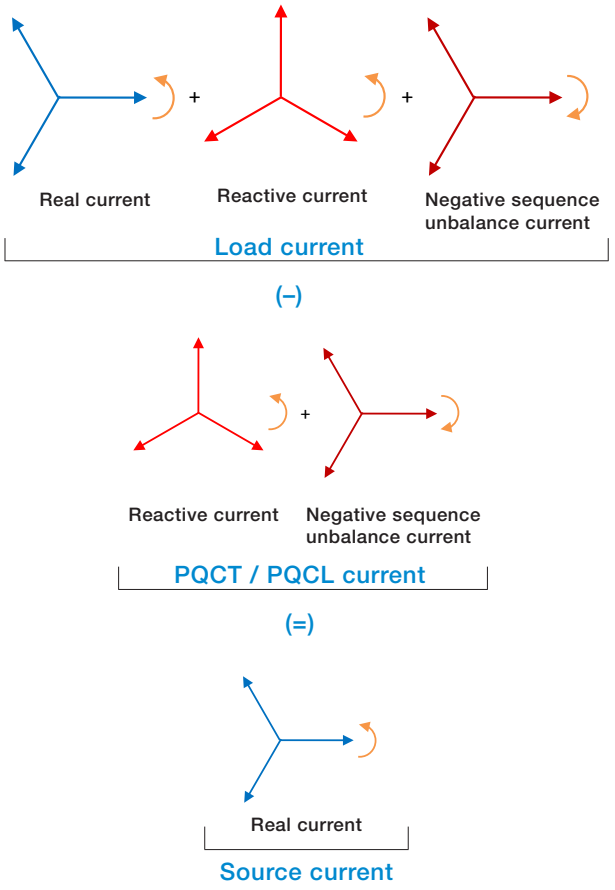
PQCT-Light (PQCL) for low kvar three phase applications



PQC-STATCON – Dynamic response

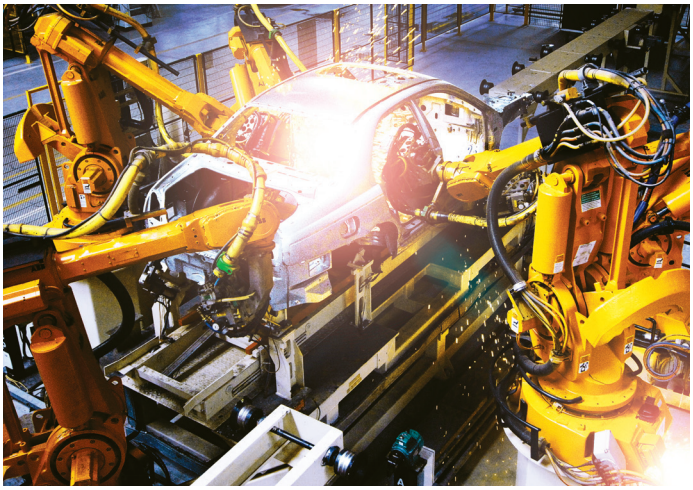
- PQC-STATCON current
- Source voltage
- Step response

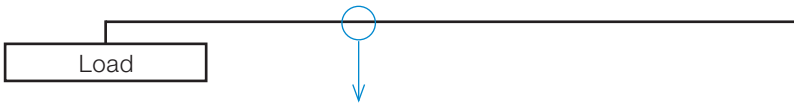
Load current – PQC-STATCON current = Source current



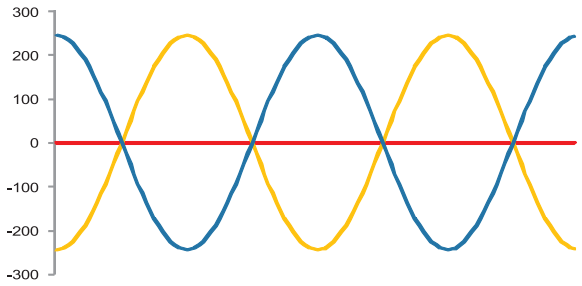
PQCT / PQCL nullifies the reactive & unbalance currents at the source
Note: PQCT / PQCL is a three wire device. It compensates the phase to phase unbalance currents.

Improved power quality and energy efficiency - Graphical representation of typical applications



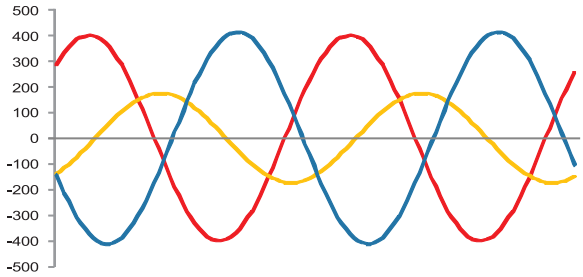


Case 1: Typical resistive loads



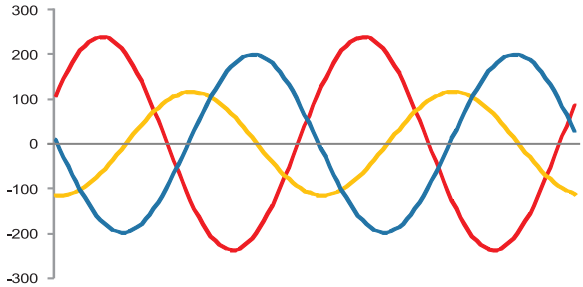
I_R = 0 A; I_Y = 173 A; I_B = 173 A; S = 83 kva;
PF = 1; I_{UB} = 100 %

Case 2: Typical welding loads



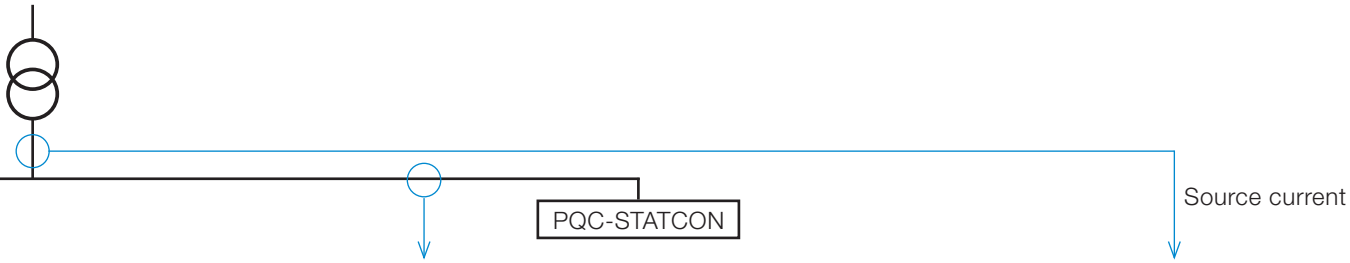
I_R = 283 A; I_Y = 124 A; I_B = 291 A; S = 167 kva;
PF = 0.45; I_{UB} = 45 %

Case 3: Typical process industries



I_R = 168 A; I_Y = 81 A; I_B = 140 A; S = 93 kva;
PF = 0.80; I_{UB} = 40 %

Note: x-axis = Time; y-axis = Ampere



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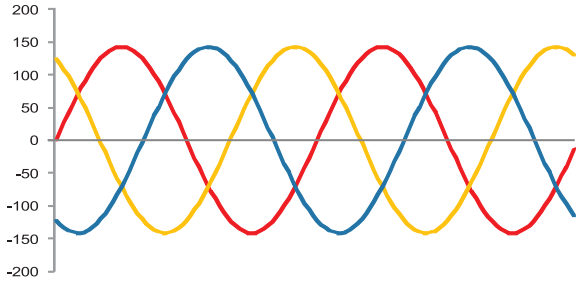

I_R = 100 A; I_Y = 100 A; I_B = 100 A;
I_Q = 0 A; I_{Neg} = 100 A

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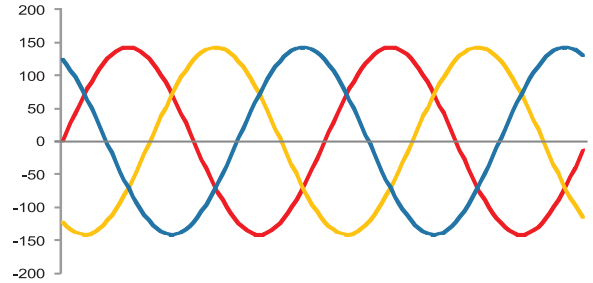
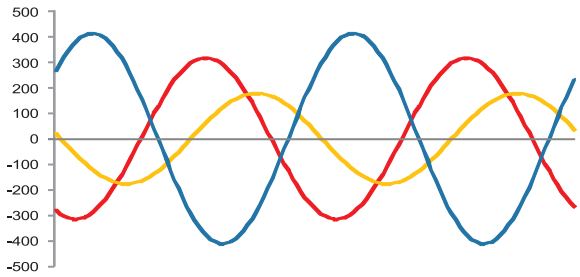


I_R = 100 A; I_Y = 100 A; I_B = 100 A; S = 72 kva;
PF = 1; I_{UB} = 0 %; kva reduction = 13 %

+



I_R = 224 A; I_Y = 124 A; I_B = 291 A;
I_Q = 200 A; I_{Neg} = 100 A

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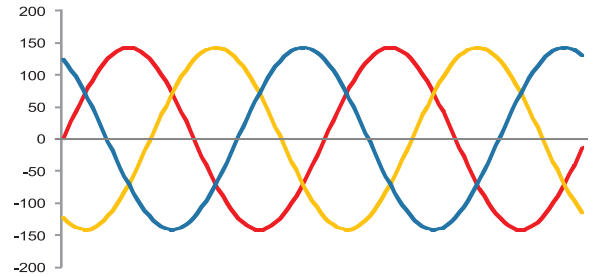

I_R = 100 A; I_Y = 100 A; I_B = 100 A; S = 72 kva;
PF = 1; I_{UB} = 0 %; kva reduction = 57 %

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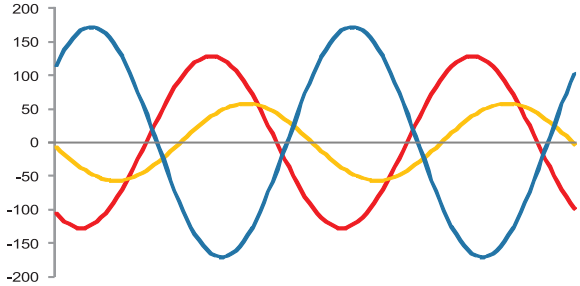

I_R = 90 A; I_Y = 40 A; I_B = 121 A;
I_Q = 75 A; I_{Neg} = 50 A

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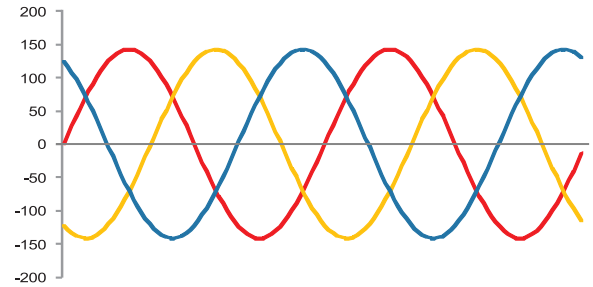


I_R = 100 A; I_Y = 100 A; I_B = 100 A; S = 72 kva;
PF = 1; I_{UB} = 0 %; kva reduction = 23 %

Note: I_R - R phase current; I_Y - Y phase current; I_B - B phase current; I_{UB} - % Current unbalance; S - kva; PF - Power Factor; I_{Neg} - Negative sequence current; I_Q - Reactive current.

Key product features

PQC-STATCON is available for single phase and three phase applications

PQCS-STATCON performs fast reactive power compensation for a single phase network.

PQCT-STATCON performs fast reactive power and unbalanced load compensation for a three phase network.

Versatile configuration options allow for variety of applications

PQCS-STATCON can be configured with main and auxiliary target PF settings. This option enables the system to work at unity PF (or any other Main PF setting), when supplied from utility source and to work at 0.8 lag PF (or any other Auxiliary PF setting), when supplied from generator.

PQCT-STATCON has priority option to allocate the converter resources between reactive power and unbalance compensation requirements, in addition to the dual PF target option as in PQCS-STATCON. The priority compensation can be selected to be reactive power or unbalance. If reactive power is selected as priority, PQC-STATCON will compensate for reactive power to the specified target PF and use the remaining resources for unbalance compensation. If unbalance is selected as priority, PQC-STATCON will nullify the unbalance current components in the load and use the available remaining resources for reactive power compensation. In addition to priority setting, the dual PF target option enables the system to work at unity PF (or any other main PF setting), when supplied from utility source and to work at 0.8 lag PF (or any other auxiliary PF setting), when supplied from generator.

Energy efficient operation

Energy save mode is a feature available in PQCS and PQCT range of PQC-STATCON. If the PQC-STATCON is operating at near zero current levels for 30 seconds, IGBT converter is switched off and successively the blowers are switched off in 2 minutes. The system enters a sleep mode and the stress on power components is minimized. The power consumption of PQC-STATCON in sleep mode is almost zero, but the system is available in hot standby. As the load demand rises, the system can supply the rated kVAr within 5-8 power cycles.

Operation with parallel fixed capacitor bank for better economics

PQC-STATCON has the capability to operate in inductive and capacitive dynamic range of –X to + X kVAr. In order to achieve higher kVAr, PQC-STATCON may be operated in parallel with a fixed capacitor bank/ de-tuned filter bank of fixed size X kVAr. The dynamic range will be modified as 0 to 2X kVAr, increasing compensation capability for inductive loads.

PQC-STATCON may also control the parallel filter banks through a potential free contact, by which energy efficient operation is achieved more efficiently and the system will achieve a dynamic range of -X to +2X kVAr.

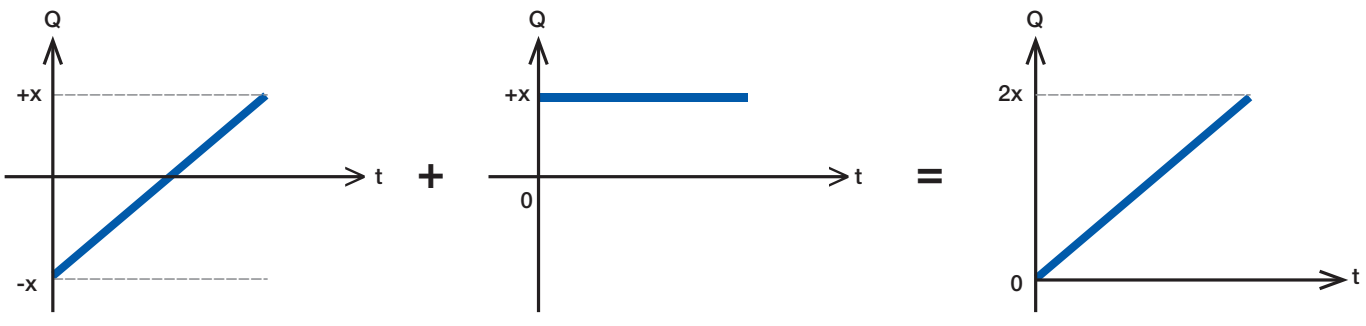
PQC-STATCON is designed with customers in mind

PQC-STATCON is an advanced, reliable and user friendly solution for power quality problems.

It uses robust control and protection techniques implemented on a high speed digital control system. It is a modular non-overloadable technology, which can be upgraded in the future.

PQC-STATCON has advanced fault diagnostic features to provide a maximum protection level. This feature monitors the performance of the system and its components. The observed abnormal conditions are recorded with time stamping. The logged history is accessible through the graphical user interface (GUI).

User friendly backlit touch-screen graphical user interface allows easy programming, monitoring of the system.
Works with standard class CT‘s.
PQC-STATCON is a compact solution usable in both new and retrofit applications.



Operation with parallel capacitor bank / detuned filter bank (Q = Reactive power; t = time)

Modes of operation

The different modes of PQC-STATCON operation are:

Fixed compensation mode

In this mode PQC-STATCON supplies a fixed lagging / leading reactive current. It functions as a fixed inductive / capacitive reactive current source. The current to be supplied can be set through the user interface.

Dynamic modes

In dynamic modes PQC-STATCON supplies a dynamic current based on the feedback from CT. It can take feedback from CT located on the source side or load side.

Dynamic, load CT mode

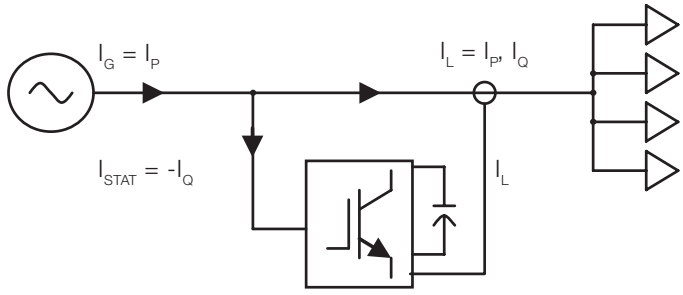
This mode can be selected through the user interface. PQC-STATCON measures the reactive/unbalance component in load current and injects an anti-phase component of the same. Since both the currents are flowing on the same bus, the reactive/unbalance currents drawn by the load are locally compensated. This mode operates in an open loop fashion. When more than one STATCON is used in parallel, all of them use the same CT feedback and share the load demand equally.

This mode is useful, when only the loads in a specific feeder are to be compensated and STATCON is located on a different feeder of the same bus.

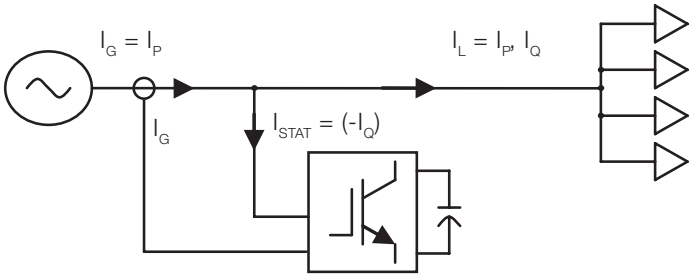
Dynamic, grid CT mode

This mode can be selected through the user interface. In this mode PQC-STATCON measures and regulates the reactive/unbalance currents at the source side to zero. This is performed in a closed loop fashion. This is the most widely used, accurate and recommended method, by which the capabilities of PQC-STATCON can be utilized to the maximum.

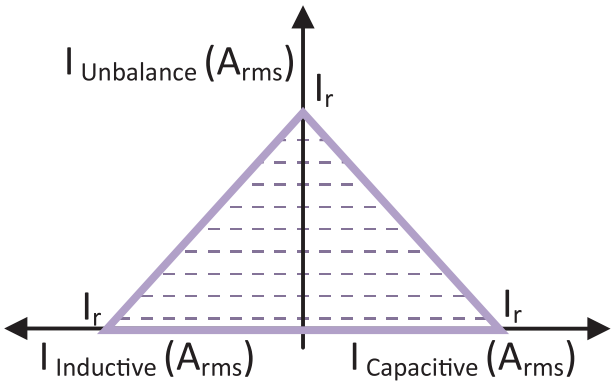
In most cases more than one STATCON is used to meet the reactive power requirement. All the PQC-STATCON systems can share the same CT feedback and regulate the source power factor.



Open loop configuration



Closed loop configuration



Operating boundaries of PQCT-STATCON
(Refer technical specifications for current details)

Note: I_P = Real current; I_Q = Reactive current; I_L = Load current, I_{STAT} = PQC-STATCON current; I_G = Source current; I_R = Rated PQC-STATCON current

Product portfolio

RATINGS

PQCS-STATCON

S. No	Type No.	Application	Voltage	kvar	Current (I_r)
1	PQCS-50-V240	1-Ph	240	50	210
2	PQCS-100-V240	1-Ph	240	100	420
3	PQCS-100-V415	1-Ph	415	100	240
4	PQCS-150-V415	1-Ph	415	150	360
5	PQCS-250-V415	1-Ph	415	250	600

PQCT-STATCON

S. No	Type No.	Application	Voltage	kvar	Current (I_r)
1	PQCT-100-V415	3-Ph.	415	100	140
2	PQCT-150-V415	3-Ph	415	150	210
3	PQCT-250-V415	3-Ph	415	250	350
4	PQCT-300-V415	3-Ph	415	300	420

PQCT-Light (PQCL)

S. No	Type No.	Application	Voltage	kvar	Current (I_r)
1.	PQCL-70-V415	3-ph	415	70	100

Type no. Nomenclature :

For example.

Refer PQCT (S.No. 3) (PQCT - 250 - V 415)

PQCT	250	V 415
3ϕ PQC STATCON	–250 kvar to 250 kvar	Nominal supply voltage 415 V

Refer PQCS (S.No. 2) (PQCS - 100 - V 240)

PQCS	100	V 240
1ϕ PQC STATCON	–100 kvar to 100 kvar	Nominal supply voltage 240 V

Sizing of PQC-STATCON for reactive power compensation

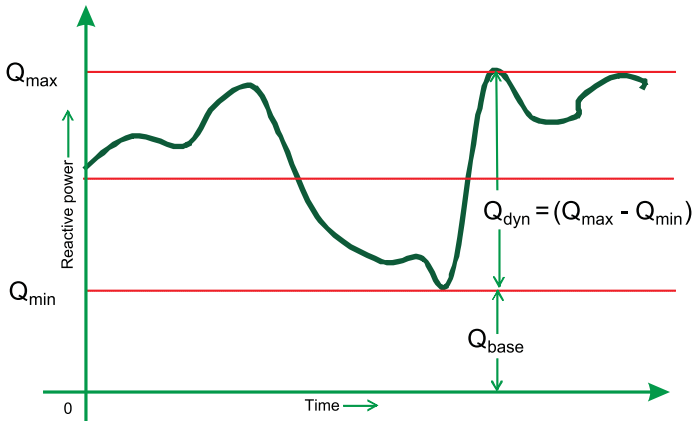
To quickly calculate the size of a PQC-STATCON based reactive power compensation system.

Calculate the required capacity for dynamic compensation through PQC STATCON, which is half of the total dynamic compensation requirement.

$Q_{PQC\text{-}STATCON^*} = Q_{dyn}/2 = (Q_{max} - Q_{min})/2$

Calculate the required capacity for fixed capacitor based compensation, which is the sum of base compensation requirement and half of the total dynamic compensation requirement.

$Q_{capacitor} = Q_{base} + Q_{dyn}/2 = Q_{base} + (Q_{max} - Q_{min})/2$



Note:
***To perform load balancing, add the negative sequence demand of load.**

Technical specifications

Detail	Unit	PQCT	PQCL	PQCS
Electrical characteristics				
Connection method		3 phase, 3 wire system	3 phase, 3 wire system	1 phase, 2 wire system
Network voltage	Volts	V415: 380V - 440V	380 - 415V	V240: 200V - 240V V415: 380V - 440V
Permissible voltage variation	%	±10%	±10%	±10%
Current ratings	Ampere	140, 210, 350, 420	100	V240: 210, 420, V415: 240, 360, 600
kvar ratings[1]	kvar	±100, ±150, ±250, ±300	±70	V240: ±50, ±100, V415: ±100, ±150, ±250
System frequency	Hz	50 Hz, 60 Hz (±5%)		
Equipment loss	%	3% of the equipment power typically		
Compensation method		Closed loop / Open loop / Fixed mode		
Reaction time	ms	< 2ms		
Response time (Completion of Compensation)	ms	Less than one power cycle		
Load balancing modes		Between line to line		Not Applicable
Modularity	Nos	Maximum 32 units can be combined		
Internal protection		Main breaker		
Programming / Communication characteristics				
Communications		Modbus[2]		
Programming interface		Using PQC-Manager (Touch screen Graphical User Interface - GUI)		
Redundancy		Master/master arrangement		
Reactive power range	kvar	100% inductive to 100% capacitive, stepless		
Auxiliary PF setting		Programmable as per the site conditions		
Target cos φ		Programmable from 0.6 (inductive) to 0.6 (capacitive)		
Physical aspects (per base unit)				
Approxmiate dimension (unpacked)	(W x D x H) mm	1000 x 900 x 2200	585 x 315 x 700	1000 x 900 x 2000
Approxmiate weight (unpacked)	kg	800kg	125kg	800kg
Mounting		Free standing	Wall mounting	Free standing
Colour		RAL 7035 (Other colours on request)		
Installation Aspects (Per base unit)				
Ingress Protection (IP)[3]		IP-31	IP-30	IP-31
Altitude	Metre	Upto 1000m [4]		
Ambient Temperature	˚C	-5˚C to (+) 45˚C[4]		
Humidity	%RH	Maximum 95% RH, Non-condensing		
Cable Entry		Bottom entry (for others please consult factory)		
CT Requirements		- 3 CT's are required (class 1.0 or better) - Burden: 5VA for upto 8 units with 25m distance - Secondary rating: 5 A - CT's must be installed in closed loop configuration		

[1] kvar rating calculated based on nominal voltages of 415V for V415 group and 240V for V240 group and 415V for PQCL
[2] Modbus connection can be used either to STATCON GUI or custom modbus RTU connection
[3] For other IP ratings please consult factory
[4] For higher altitudes (up to 2000m / 6600ft max.) and for higher temperature please consult factory

Contact us

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