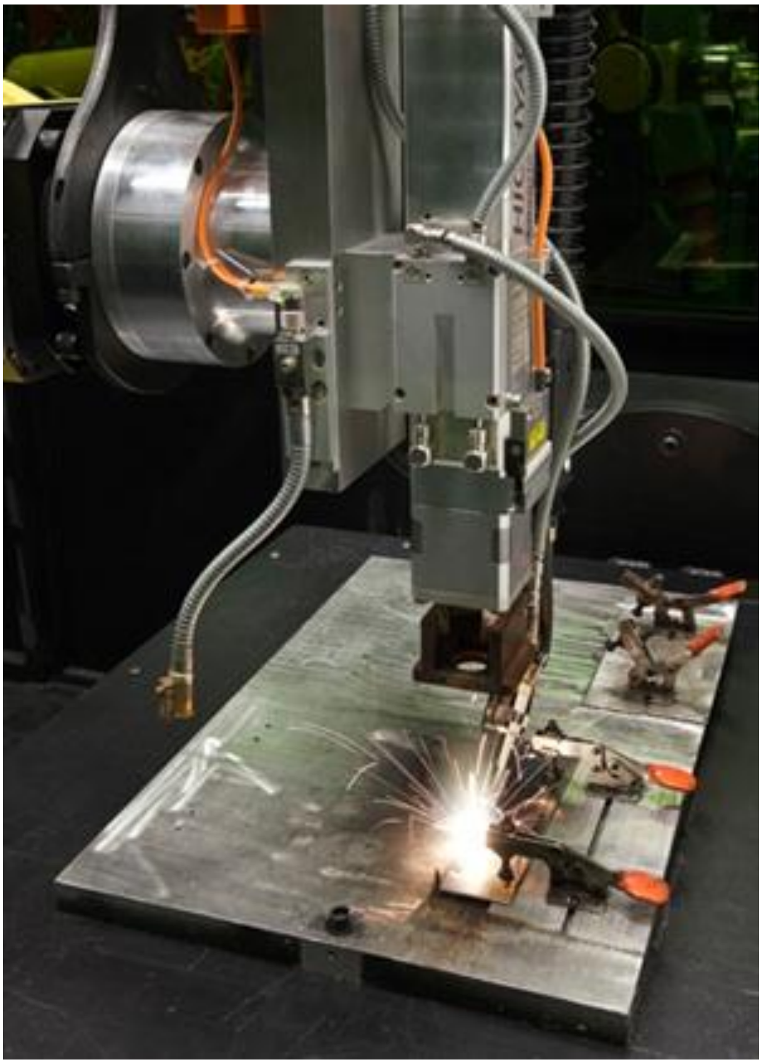
Power your power

P2 Power Solutions

Active Power Conditioners



Poor Power Quality

The huge gap between energy demand and supply has put extra ordinary stress on electrical supply infrastructure. Utilities are introducing increasingly stricter regulations on industries with specific focus on power quality.

Common measures of poor power quality are:

- High current and voltage harmonics
- Load imbalances
- Low power factor

Poor power quality has severe cost implications for the industries:

- Frequent failures of equipment
- Reduced lifetime of equipment
- Production losses
- Reduced safety levels of installations
- Increased carbon footprint
- Non-compliance with utility regulations

In addition to financial losses there are costs incurred due to extra kWh losses in typical network components such as transformers, cables and motors.

Traditionally, low power factor has been considered to be the only parameter responsible for introducing inefficiencies in the electrical systems. More emphasis was given on conventional passive solutions like APFC, Fixed Capacitor Banks etc. However, these solutions do not address the real problem of presence of high harmonics in the electrical network.

Harmonics are generated due to the increasing use of non linear loads by the modern industries.

Some of the commonly found non linear loads are:

- Variable frequency drives
- Welding loads
- Electric Arc Furnaces
- Computers

Typical industries affected by harmonic issues are:

- Automotive Industry
- Cement Industry
- Steel/Foundries
- Pulp Processing Industry
- Printing Industry



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Components of Poor Power Quality

Harmonics

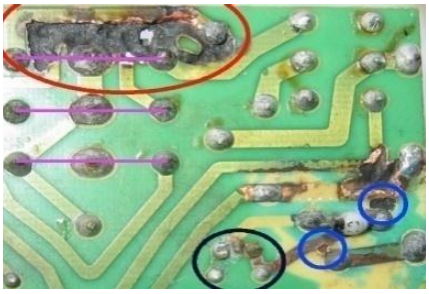
Power Quality relates to the amplitude, frequency and distortion of the supply system. While the amplitude and frequency of the supply is largely controlled by the utility, the distortion of the wave (voltage or current) is attributed to the user (of the power) or the loads.

- Harmonic currents increase the rms current in electrical systems and deteriorate the supply voltage quality.
- They stress the electrical network and can potentially damage equipments.

Effects of Harmonics

- ✓ Failure of electronic cards
- ✓ Failure of power factor correction capacitors
- ✓ Heating in transformers
- ✓ Diesel generator hunting
- ✓ Vibration and audible noise in electrical machines (AC motors, transformers, reactors).
- ✓ Low Power Factor
- ✓ Reduced system capacity.
- ✓ Nuisance tripping of safety devices

Burnt electronic cards



Failure of capacitor

Load Unbalance

Commercial complexes and industries sometimes have a large number of single phase and two phase loads which results in the unbalanced loading of transformers. Unbalance leads to the flow of negative sequence current in the network.

- Negative sequence current will cause voltage unbalance (known as negative sequence voltage). Likewise, an unbalanced 3-phase voltage will cause unbalanced current in other loads.
- Negative sequence current reduces the overall system capacity–transformers, cables, and bus capacity is lost.

Effects of Load Unbalance

- ✓ Increased voltage unbalance
- ✓ Increased heating in generators
- ✓ Nuisance tripping of safety devices
- ✓ Reduced system capacity
- ✓ Increased production downtime

Components of poor power quality

Low Power Factor

Maintaining a high power factor is important for reducing utility bills and reducing the current loading of the safety devices and conductors within the facility. However, correction of power factor is fast becoming very difficult due to the increased use of nonlinear loads.

- Use of power factor correction capacitors in electrical systems where nonlinear loads are present can be hazardous to the capacitors and all other equipments connected in the network.
- Capacitors can lead to electrical resonance in the presence of harmonics. Resonance can cause very high peak AC voltages detrimental to all loads.
- Premature tripping of circuit breakers; nuisance faulting of equipment; or damage to equipments.

In all cases, plant interruptions occur. When electrical systems contain nonlinear loads that exceed about 50 % of the total load, the solution for poor DPF is no longer viable with PF capacitors. DPF correction must be achieved with alternate mean. One method is using active power conditioners.

Effects of poor DPF

- ✓ Increased energy bills.
- ✓ Reduced network capacity.
- ✓ Increased network losses.
- ✓ Over rating of equipments increases installation costs.

Reactive Current Compensation

Equipment such as welders, arc furnaces, crushers, shredders, steel mills, ball mill operate with rapid and frequent load variations. This results in rapid changes of real and reactive power requirements. Real current must be supplied by the power grid and is usually the basis of the network design. Reactive power surges can cause the network voltage to drop significantly and often to levels that cause sensitive loads to fault or lights to flicker.

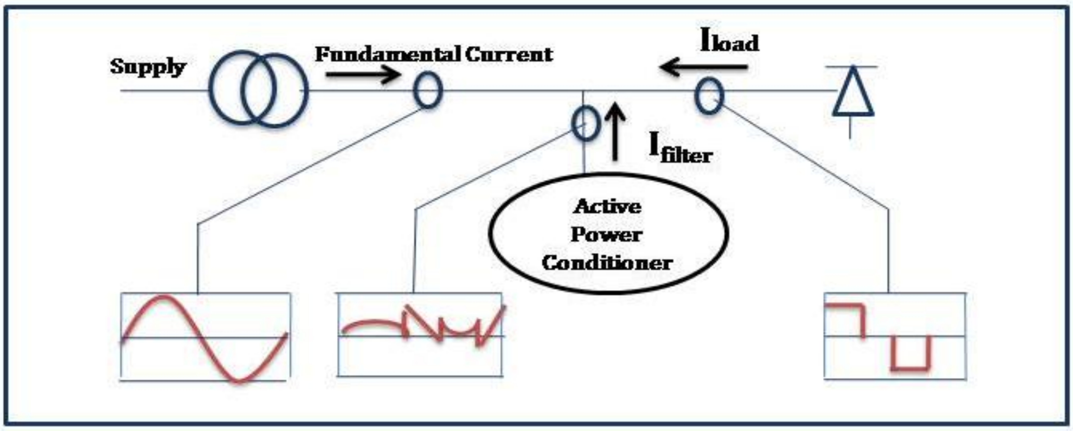
Effects of Reactive Energy Fluctuations

- ✓ Flicker in the electrical network
- ✓ Frequent interruptions
- ✓ Poor quality of goods.
- ✓ Increased scrap.
- ✓ Lost productivity.

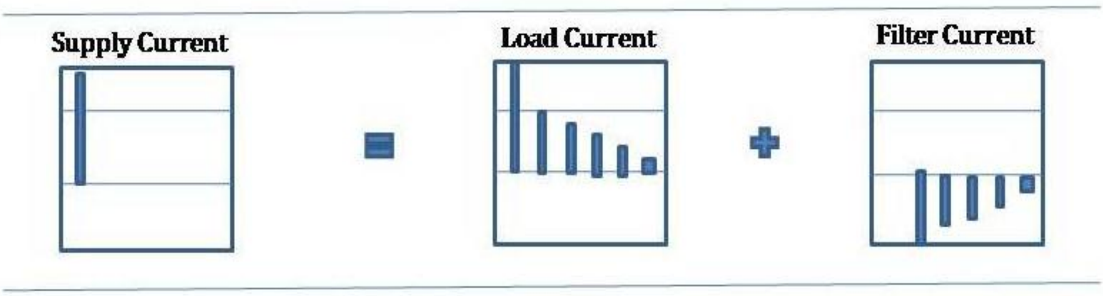
Active Power Conditioners

iCon – an IGBT based Intelligent Power Conditioner is an innovative engineering solution, with specific focus on extreme energy efficiency and power quality enhancement. The core of the active filter system is an IGBT inverter. It has excellent dynamics of <0.2 milli seconds. The conditioner is connected in parallel to the polluting load, thus protecting the rest of the electrical infrastructure. The controller of the power conditioner (iCon) analyzes the line currents and cancels out the harmonics generated by the load in real time.

Working Principle

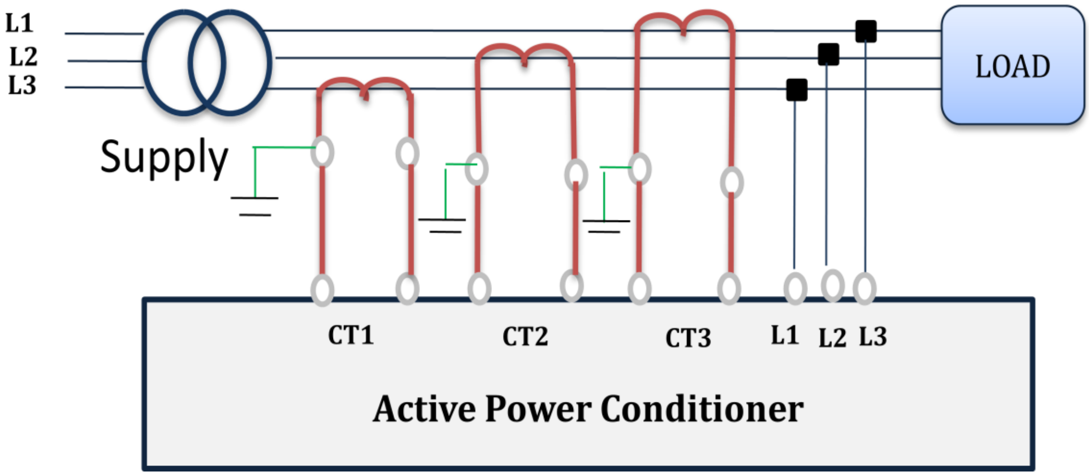


The fundamental frequency component is removed from the measured current signal. The remaining waveform is then inverted and the controller reference signal drives the IGBT bridge of the active filter. In the frequency-domain approach each harmonic and its corresponding system characteristics are treated individually and performance can be optimized for the harmonic components in the filtering bandwidth. As a result the same (high) filtering performance can be maintained through the entire filtering bandwidth. The principle of the frequency-domain filtering approach is depicted in the following diagram:

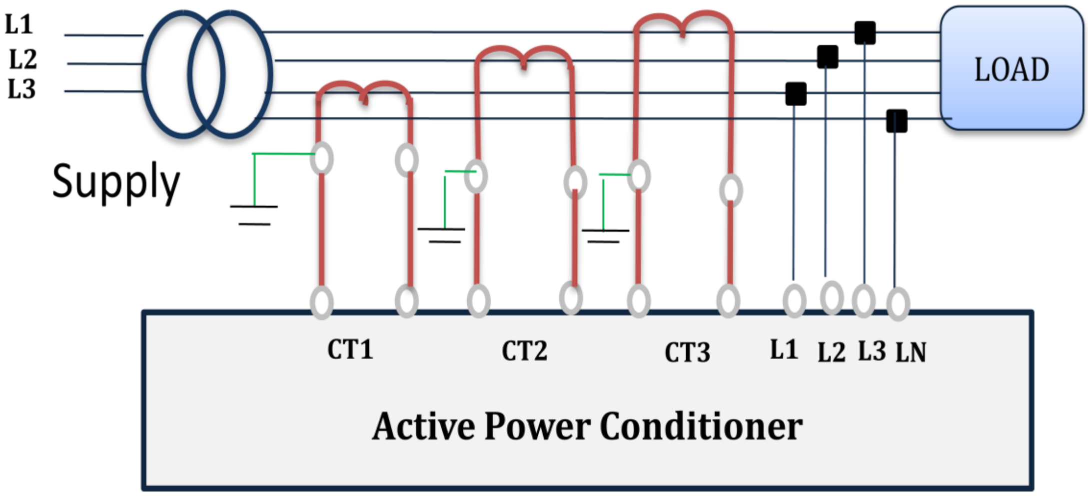


Frequency domain filtering approach

Connection Diagram - APC



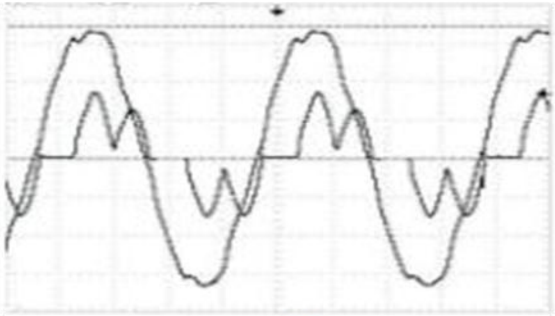
Connection Diagram – APC in 3-wire configuration



Connection Diagram – APC in 4-wire configuration

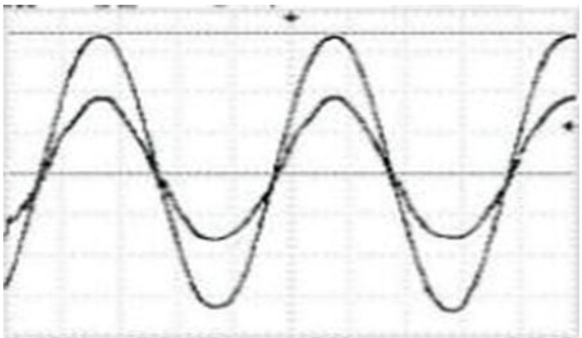
Application Example

The following image depicts the performance of an active power conditioner when coupled with a variable frequency drive. The image shows the network voltage and current as captured by a digital oscilloscope.



Active Power Conditioner
iTHDs – 29.5% , PF – 0.90

iCon – Active Power Conditioner



Active Power Conditioner
iTHDs – 6% , PF – 0.99

iCon Active Power Conditioners

The iCon range of active power conditioners from P2 Power Solutions brings cutting edge technology to solve all power quality related problems in the industry.

Harmonic Mitigation

Active power conditioners can filter out harmonic pollution. They can be extended in parallel for increased capacity requirements. The on board digital signal processor analyzes changes in the network parameters and drives the IGBT switches to provide the required compensation in real time.

The controller can be programmed to compensate all harmonic waves or optionally remove only selected harmonic orders.

Load Balancing and Neutral Compensation

Active power conditioners can perform load balancing and neutral compensation. They can be connected in two configurations depending on the requirement:

- ✓ **3-wire system:** Compensates the negative sequence current.
- ✓ **4-wire system:** It has an extra power leg to compensate current flowing in the neutral conductor.

A load balancer reduces the stress on the electrical system by:

- Reducing voltage imbalances.
- Offloading the supply and neutral cables.
- Reducing the voltage difference between neutral and earth.

Reactive Power Compensation

Active power conditioners have several advantages over traditional reactive compensation systems:

- ✓ Step less reactive power compensation of both inductive and capacitive loads
- ✓ Unity power factor
- ✓ Ultra fast response time of <0.2 milli seconds

Advantages:

- Offload network components resulting in reduced system losses.
- Avoid penalties from utilities.
- Allow generator compensation without the risk of overcompensation.
- Compensate capacitive loads such as modern blade-server systems, allowing for UPS-systems to run at nominal rating.

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Technical Specifications

	Model Name		iCon35	iCon70	iCon100	iCon140	iCon210
AC Input Supply							
1	Nominal Voltage	:	415V +/- 5%				
2	Nominal Freqency	:	50Hz +/- 1%				
3	No. of Phases	:	3 phase, 4 wire				
4	Current Transformer	:	Supplied loose (as per load specification)				
5	Capacity (kVA)	:	25	50	70	100	150
6	Current (Amps)	:	35	70	100	140	210
Features							
7	Harmonic Current	:	3rd to 23rd or specific harmonic compensation				
8	Reactive Current compensation (Max.)	:	35	70	100	140	210
9	Maximum amps in parallel	:	upto 10 units				
10	Initialization Time	:	4 seconds				
11	Swtching Frequency	:	10 kHz				
12	Current Limited	:	100% of rated or as per the requirement of the load				
13	Percentage losses in Active filter inverter		< 2%				
14	Overload	:	Auto foldback to maximum rating				
15	Inrush Current	:	< Peak Current				
16	Peak Harmonic current	:	2 x peak instantaneous				
17	Maximum Dimensions (LxBxH cm)	:	75X60X75	75X60X75	75X60X100	75X60X140	90X70X160
18	Cooling	:	Forced air cooled				
19	Harmonic Compensation	:	Yes				
20	Power Factor Correction	:	Yes				
21	Load Balancing		Optional				
22	Rapid Load Variation	:	Yes				
23	Parallel Configuration	:	Optional				
24	Derating of Active filter vs PF	:	None				
25	LED Monitoring meter		Yes				
26	Key pad	:	Optional				
27	User Interface	:	Optional				
Environmental Conditions							
29	Operating Temperature	:	0 to 40°C continuous				
30	Relative Humidity	:	up to 95%, non-condensing				
31	Operating Altitude	:	up to 1000 m				
32	Life Expentancy	:	20000 hrs @ full load				
Harmonic Standards							
33	Harmonic Limits	:	IEEE 519 (1992) UK: ER G5/4				
			General Guide on Harmonic, Interharmonic Measurements and Instrumentation EN 1000-427 (1994), IEC1000-3-4				
User Interface							
34	Control and Indication Panel		Yes				
35	Switch	:	On- Off/ Reset				
36	Indicators	:	Power Applied, Temp. warning, Operate, Faults				
		:					

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