edition 6 | June 2017

POWER NEWS

SUMMARY

Welcome

to our latest newsletter all of which we hope have helped to keep you updated on our latest news and products.

The shortest day of the year is behind us. It's all onwards and upwards for the remainder of the year.

Power Electronics continues to move from strength to strength. Our variable speed drive offer continues to develop with new products and our power quality business is growing beyond belief.

We trust that you find this newsletter informative, and as always, if we can be of any assistance then please don't hesitate to contact us.

SD300 IP66 – THE PROOF IS IN THE PUDDING

The launch of the SD300 variable speed drive range has been a huge success – in particular the IP66 models.

There is finally a compact variable speed drive, from 0.37kW to 22kW, that will operate reliably in the harshest of environments without the need for additional enclosures.

To prove the ability of the IP66 models a number of demonstration units have been constructed. These units show the SD300 operating under a stream of pressurized water. These demonstration units can currently be viewed at

- **Telfer Electrical Dunedin**
- **Telfer Electrical, Fitzgerald Ave, Christchurch**
- **Active Electrical Blenheim**
- **Ideal Electrical Taupo**
- **Active Electrical Suppliers Hastings**
- **J A Russell Te Puke**

Alternatively click on the video or contact your local Power Electronics sales engineer

POWER ELECTRONICS

POWER ELECTRONICS ASVG POWER QUALITY SYSTEM AT FONTERRA HAUTAPU TICKS ALL OF THE BOXES...

Vishaal Lad, Electrical Engineer for Fonterra Hautapu identified that several switchboards on site had power factor correction equipment that was either not working, non-existent or not economical to maintain due to age.

He was accutely aware that low power factor causes many issues including penalty charges, reduced efficiency, reduced capacity and increased heat losses.

A Power Quality meter was connected by Power Electronics to three switchboards and the data recorded.

The Cheese Packing switchboard had no power factor correction due to failure of the original capacitor based system.

Measurements revealed the true power factor averaging 0.82 with displacement power factor averaging 0.90.

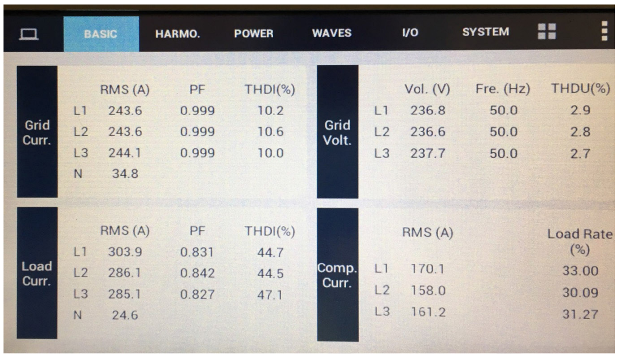
True Power Factor is a combination of displacement pf, by induction motors causing current to lag the voltage, and distortion pf, caused by non-linear load's harmonics such as VSDs, LEDs and switched mode power supplies. In order to improve True Power Factor some form of Active Harmonic Filtering was required to mitigate harmonics and thus improve true power factor.

Power Electronics recommendation was to use 300kVAr ASVG (Advanced Static Var Generator) which would mitigate harmonic levels, correct displacement pf and bring true power factor up to > 0.95. This would also allow for the additional load which was not running at the time of the test.

Vishaal's decision to choose the ASVG and the Cheese Packing switchboard was for the following reasons;

- There was no PFC on this board due to a failure in the original capacitor based system
- The ASVG assesses and corrects within 15ms or ¾ of a cycle. This enables a setpoint of unity pf to be maintained without the concern of under or over correcting.
- The ASVG is immune to existing system harmonics and eliminates the risk of fire from failing capacitor based PFC systems.
- The plug-in module design allows for simple addition of extra modules.
- Inverter technology eliminates the possibility of resonance.
- Low losses and maintenance free with a service life exceeding 10 years.
- The new inverter technology is a much better solution compared with the traditional Capacitor based PFC which are becoming more redundant in today's harmonic rich environments.
- Total cost of ownership is very similar to a properly designed capacitor based system
- Shorter delivery timeframe due to parts available in NZ

Pictured left, the 300kVAr ASVG unit installed in the Cheese Packing Switch Room



BASIC | HARMO. | POWER | WAVES | I/O | SYSTEM

Grid Curr.	RMS (A)	PF	THDI(%)
L1	243.6	0.999	10.2
L2	243.6	0.999	10.6
L3	244.1	0.999	10.0
N	34.8		

Grid Volt.	Vol. (V)	Fre. (Hz)	THDU(%)
L1	236.8	50.0	2.9
L2	236.6	50.0	2.8
L3	237.7	50.0	2.7

Load Curr.	RMS (A)	PF	THDI(%)
L1	303.9	0.831	44.7
L2	286.1	0.842	44.5
L3	285.1	0.827	47.1
N	24.6		

Comp. Curr.	RMS (A)	Load Rate (%)
L1	170.1	33.00
L2	158.0	30.09
L3	161.2	31.27

As can be seen from the screenshot above pf has been improved from a low of 0.827 to 0.999.

TDHi has been reduced from 44-47% to 10%. Current that the mains cables feeding the Cheese Packing switchboard sees has not only been reduced by 60 amps, it has also been balanced out by the ASVG. The plant was not operating under full load at the time of the screenshot however there was plenty of capacity left in the ASVG.

The ASVG's dynamic performance and infinitely variable reactive power compensation makes it an ideal solution for rapidly changing loads, allowing a setpoint of unity achievable.

Vishaal concludes "This has been a successful project and is in keeping with Fonterra's drive to be an industry leader by utilising the latest technology".

HARMONIC BLOCKING CHOKES – ARE THEY A GUARANTEED SOLUTION FOR CAPACITOR BASED POWER FACTOR?

So you have a traditional capacitor based power factor correction system specified or installed complete with blocking chokes. "I don't need to worry about my capacitors failing from harmonic currents. The blocking chokes are protecting my system". It is not quite as easy as that!

This article introduces how easily blocking chokes can become ineffective and how important it is to know every facet of the sites electrical impedance, which must always stay the same, for the blocking system to work. You cannot just indiscriminately add blocking chokes or capacitors to a system without understanding how their presence will affect the system.

What does a harmonic blocking choke do?

The purpose of a blocking choke is simple. The inductance of the choke and the capacitance of the power factor correction capacitors form a simple tuned LC filter. The impedance of this is designed to allow low frequencies like 50Hz to pass easily thru the filter but to "block" high frequencies – for power factor correction systems this is normally frequencies above the fourth harmonic or 200Hz – from passing through. Because the current at these frequencies are blocked they do not enter the capacitor and cause overloading.

That sounds simple – what is the problem?

As you can see a blocking choke is a simple LC circuit. The problem is that every site has a supply impedance prior to the power factor correction system. This is the impedance of the transformers, cabling, switchgear etc. This supply impedance (Z) is made of a combination of Inductance (L), Resistance (R) and sometimes Capacitance (C). The supply impedance is connected directly to the power factor correction system (blocking chokes and capacitors) so there is electrical interaction between the two. Unless you know the exact the supply impedance, and engineered this into your calculations, you have may changed the tuning point of the filter. Installation of a standard off the shelf blocking choke is not a solution. It is essential the design of the blocking chokes must take system impedance into consideration. It is also important to note that any change in system impedance, for example adding a new supply transformer to site or adding further electrical infrastructure, can change supply impedance and effect existing blocking choke performance.

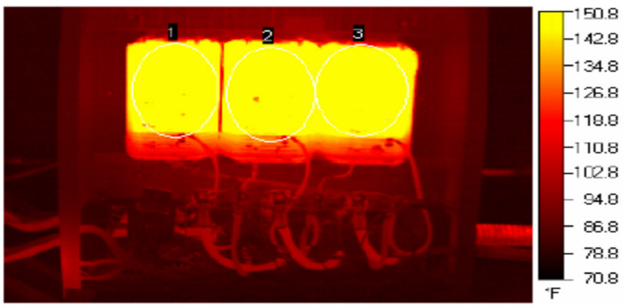
So what happens if the harmonic blocking chokes are not working correctly?

There are two major risks when blocking chokes do not perform as designed:

1. Harmonic currents pass directly through the blocking choke and are consumed in the capacitor. The power factor capacitor is acting like a sink. These additional currents overload the capacitor which can result in capacitor failure or fire. The total current being consumed by a capacitor can be measured by using a true RMS clamp meter and compared to the stated capacitor full load current.

2. Resonance can occur at any of the harmonic frequencies resulting in high voltage and high currents circulating in the system. This can damage equipment on the entire electrical distribution system or cause the current flowing to the capacitors to increase resulting in capacitor failure and the risk of fire. This phenomenon can be easily identified by looking at the Current Total Harmonic Distortion (THDi) with a power quality meter. When resonance is occurring on the harmonics the current being consumed by the power factor system will be greater with the power factor turned on, than when turned off. **Don't forget you must evaluate every capacitor step to determine possible resonant conditions for every harmonic present on the system**

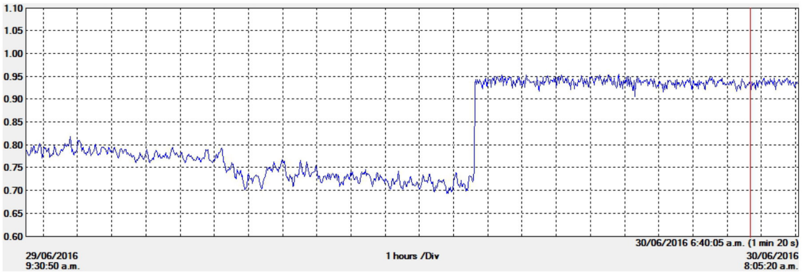
Tongue in cheek – harmonic resonance is said to be a self-correcting problem. Most times capacitors will fail, fuses will open, or the source transformer will fail. Any of the previous will lead to the removal of that component from the system.



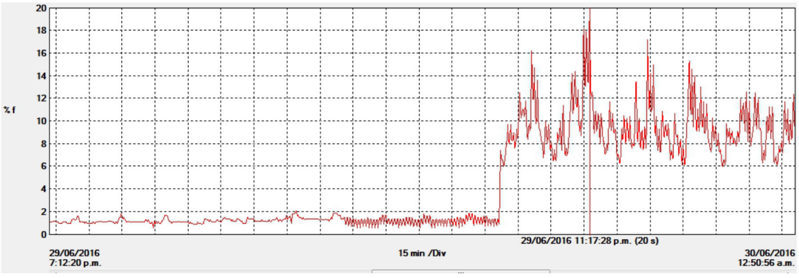
A harmonic blocking choke completely overloaded with harmonic currents

POWER ELECTRONICS

HARMONIC BLOCKING CHOKES – ARE THEY A GUARANTEED SOLUTION FOR CAPACITOR BASED POWER FACTOR? CONT.



The blue trace shows an example of a plant with the power factor correction capacitors turned off (on the left) and then the power factor correction capacitors turned on (to the right). Note the correction of power factor from 0.70 at lowest, to 0.95 at best.



The red trace shows the THDi at the exact time scale of the above chart. Note the massive increase in THDi when the power factor correction is turned on. This is as a result of resonance on the 5th and 7th harmonic in this case.

So what do we do?

Our onsite power quality assessment have shown that this a more regular occurrence than you might think. In reality it is almost impossible to engineer a traditional capacitor based power factor system correctly as there are too many site variables, which often don't stay constant through plant expansions and changes, and highlights another reason to consider inverter based power factor equipment like the Sinexcel StaticVar Generator (SVG) which is harmonic immune.

Our expert team are happen to conduct an onsite assessment of your existing plant power factor. Just touch base with your local Power Electronics sales engineer to discuss.

FREQUENTLY ASKED QUESTIONS

What are the advantages of a soft starter fitted with an integral bypass contactor?

There are two major advantages in using a soft starter fitted with an integral bypass contactor. Both these advantages relate to removing the heat losses associated with the conduction of current through the SCRs.

1 - If your soft starter is mounted in an enclosure the heat generated from the SCRs is about 3.3W per amp. This heat is dissipated from the soft starter heat sink and passed to the ambient environment. Obviously when the soft starter is installed in an enclosure this heat is dissipated into the enclosure where it must be conveyed to the great ambient environment by:
1) Conducted through the enclosure surface. This often results in needing a much larger enclosure than the soft starter to provide enough surface area and makes fiberglass and plastic enclosures difficult to use because of their thermal insulation characteristics.
2) You must introduce forced air into the cabinet to remove the heat but this introduces the risk of bringing contamination from the environment into the soft starter.

A soft starter fitted with an integral bypass contactor removes this heat loss allowing the installer to have a mechanically small cabinet in relation to the soft starter size. This has both savings from a switchroom real estate perspective and allows cost savings on the enclosure purchase.

2 – Because a soft starter fitted with an integral bypass contactor is only conveying heat to the heatsink during the starting and stopping operation – this extra thermal capacity can be used to re-rate the soft starter. In the V5 range this often results in being able to reduce the softer by at least one, if not two, sizes depending on application and motor full load current details. Obviously this gains a significant commercial advantage on purchase.

Both the Power Electronics V2 and V5 ranges can supplied with integral bypass options. Your local area sales engineer can assist with sizing and re-rating details.

My old power factor correction unit only had one CT. Why does my new SVG inverter based power factor need three CTs?

Traditional capacitor based power factor systems switch banks of three phase capacitors in and out as necessary to correct plant power factor to the level required. Obviously the three phase capacitor has equal capacitance across all three phases (except if it is damaged). Thus traditional power factor controllers looked at just the displacement between current and voltage in one phase only, switched the capacitance as required by that one monitored phase, and applied it to all three phases.

In the real world the power factor on all three phases tends to be quite different and this is determined by the different loads on each phase. With the SVG inverter based power factor correction system we have the ability to apply the exact amount of correction as required by each individual phase. Thus providing correct power factor across all three phases, not just one. To achieve this control we must use three CTs – one to monitor each individual phase.

The MCCB feeding my VSD trips out even when the motor we are controlling is not operating in an overloaded condition?

This is a very common problem – particularly on lower power variable speed drives.

Variable Speed Drives draw current not only at 50Hz but also at many other frequencies (including 250 Hz, 350Hz, 550Hz, 650Hz, 850Hz, 950Hz). These currents are called harmonic currents. All these currents pass through the MCCB feeding your VSD and if their total is greater than the MCCB cope with then the obvious result is an MCCB trip.

These effect of these currents can be minimized by varying mitigation methods – primarily three phase line chokes or DC Bus chokes. Having these devices integral in your variable speed drive lower the total current being drawn resulting in the elimination of nuisance tripping of the MCCB.

POWER ELECTRONICS

sales@power-electronics.co.nz

www.power-electronics.co.nz

Christchurch Head Office
(Southern Region)
14B Opawa Road
P.O. Box 1269
Christchurch
New Zealand

Phone: 03 379 9826
Fax: 03 379 9827

Napier
(Central Region)
Unit 1, 105 Ford Rd
Ford Road Business Park
Onekawa
Napier

Phone: 06 845 9067
Fax: 06 845 9046

Auckland
(Northern Region)
16 Aranui Rd
Mt Wellington
Auckland

Phone: 09 527 8523
Fax: 03 379 9827