CAP TECH

POWER QUALITY SOLUTIONS

Harmonic Filters and Reactors

CAPTECH
POWER QUALITY SOLUTIONS

Harmonics are invisible but costly

If one looks up the meaning of 'harmonics' in any one of several technical dictionaries, it is normally defined as being 'A sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency'. Total harmonic distortion is the contribution of all the harmonic frequency components to the fundamental.

Harmonics are the by-products of modern electronics. They are produced by any non-linear loads such as:

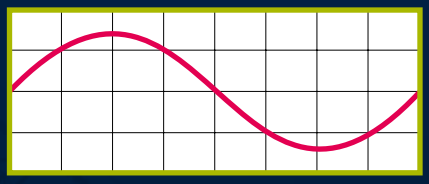
- Variable Speed Drives (AC and DC),
- Switch mode power supplies from personal computers,
- Uninterruptible Power Supplies (UPS),
- Most low-energy lighting systems, or
- Any electronic device using solid-state power switching supplies to convert incoming AC to DC.

Non-linear loads generate harmonics by drawing current in abrupt short pulses, rather than in a smooth sinusoidal manner.

Harmonics is a very costly overhead.

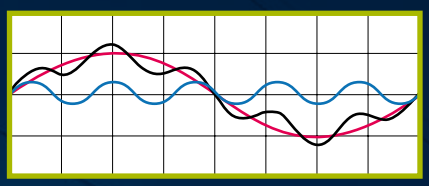
Its effect can range from spurious operation of equipment to a complete shutdown of important plant equipment, such as machines or assembly lines.

Fundamental Component Only



Total RMS Current = 1 pu

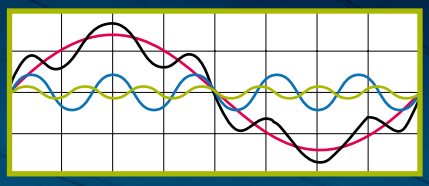
Fund with 30% 5th Harmonic



Total RMS Current = 1.044 pu

Equivalent to 20% Power Washed

Fund with 30% 5th and 10% 7th Harmonic



Total RMS Current = 1.049 pu

Equivalent to 25% Power Washed

Effects of Harmonics are Similar to High Blood Pressure

With the advent of power electronics and proliferation of non-linear loads in industrial applications, power harmonics and their effects on power quality are a topic of concern. The effects of three-phase harmonics on circuits are similar to effects of stress and high blood pressure on the human body. High levels of stress or harmonic distortion can lead to problems for the utility's distribution system, plant distribution system and any other equipment serviced by that distribution system.

Harmonics can lead to power system inefficiency. Some of the negative ways that harmonics may affect plant equipments include:

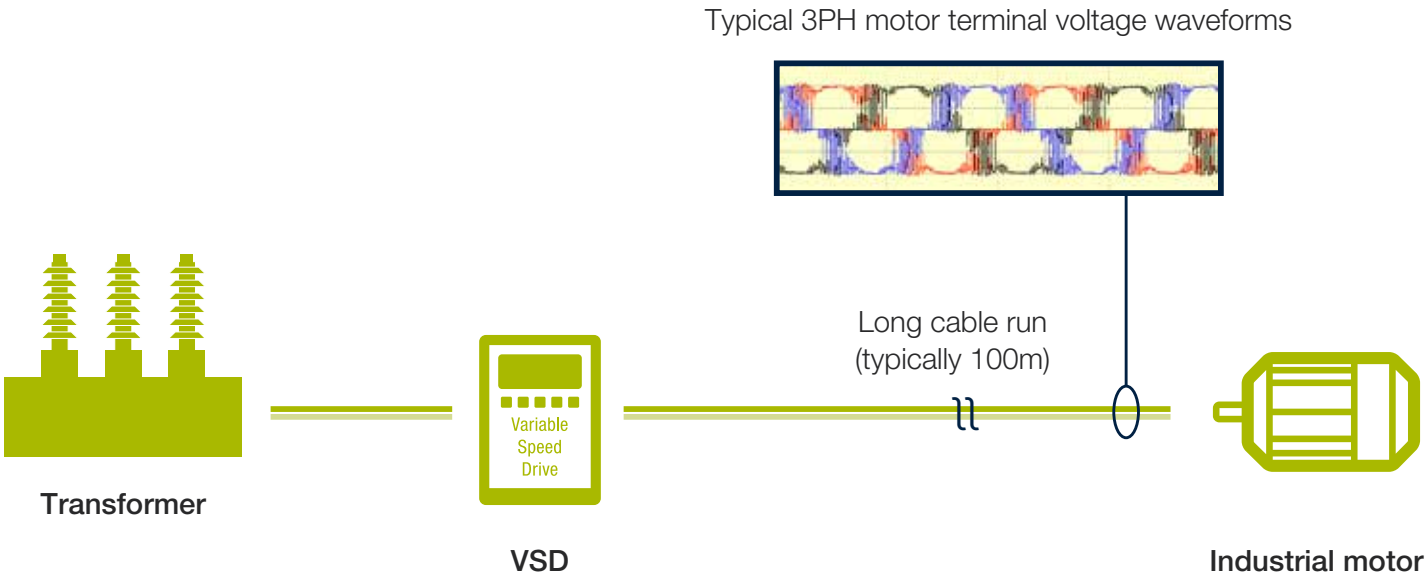
- **Conductor Overheating.** A function of square RMS current per unit volume of conductor. Harmonic currents on under sized conductors or cables can cause 'skin effect', which increases with frequency and is similar to centrifugal force.
- **Transformer Overheating.** In the presence of current harmonics, transformers will have increased iron and copper losses or Eddy currents due to stray flux losses. This causes excessive overheating in the transformer windings.
- **Generator Instability.** In addition to similar problems to transformer, excessive harmonic voltage distortion will affect timing of voltage regulator, causing 'zero-crossing' interference and operation instability.
- **Capacitor Rupture.** If Power Factor Correction (PFC) equipment is connected to system with harmonics, the inevitably rapid heat rise will reduce service life of capacitor drastically. If capacitor is tuned to one of the characteristic harmonics (such as 5th or 7th), over-voltage and resonance can occur, causing dielectric failure or rupture of capacitor.
- **Malfunction of Fuses & Circuit Breakers.** Harmonics can cause false or spurious operation and trips, damaging or blowing components for no apparent reasons.
- **Malfunction of Utility Meters.** May record measurements incorrectly, resulting in higher billings to consumers.
- **Drives Failure.** Harmonics can cause failure of commutation circuits found in DC/AC drives with silicon-controlled rectifiers (SCRs).
- **Telephone Interference.** Harmonics may cause interference in telecommunications systems.

What Causes Motor Failure?

Variable Speed Drives (VSDs) are one of the most popular and widely used pieces of equipment in DC/AC motor control. They are found in virtually every sector of industry, in applications as diverse as pumps, air conditioning systems, elevators, cranes, conveyors, machine tools, alternative energy production and in a vast array of other industrial and domestic automation.

Recent advancements in power electronic switching devices have enabled high-frequency switching operation and have improved the performance of Pulse-Width Modulated (PWM) inverters in VSDs. While the high switching speeds and advanced PWM schemes significantly improve the performance and hence results in huge energy savings, the generation of fast rise-time voltage pulses has adverse effects on the motor insulation.

These extremely steep rising and falling pulses lead to uneven distribution of voltages within motor especially during switching transitions, and contributes to insulation deterioration and subsequent failure of motor. In many cases where long cable is employed between VSD and motor, damped high frequency ringing at motor terminal occurs resulting in excessive over-voltage which further stresses motor insulation.



Some problems associated to these include:

- Excessive motor overheating, leading to insulation breakdown.
- Increased motor audible noise, degrading working environment.
- Reduce motor service life, especially when long cable run is used.

How Does Harmonic Filtering Work?

Harmonic filtering acts to filter out the harmonics in a system. This can reduce overheating of equipment, reduce nuisance tripping of circuit breakers and fuses and improve power quality contributing to reduced energy costs.

Types of Harmonic Filtering

- **Line and load reactors-** Reactors are used to provide current limiting. Reactors oppose rapid changes in current and hence limit spikes as a result of current pulses.
- **Passive harmonic filtering -** Uses a combination of reactors and capacitors to filter out harmonic frequencies.
- **Active harmonic filtering -** Provides harmonic compensation by being installed on the line side of the offending load (for example, a VSD). They introduce current waveforms which cancel out undesired harmonic components.

CAPTECH
POWER QUALITY SOLUTIONS

We Provide Total Filtering Solutions

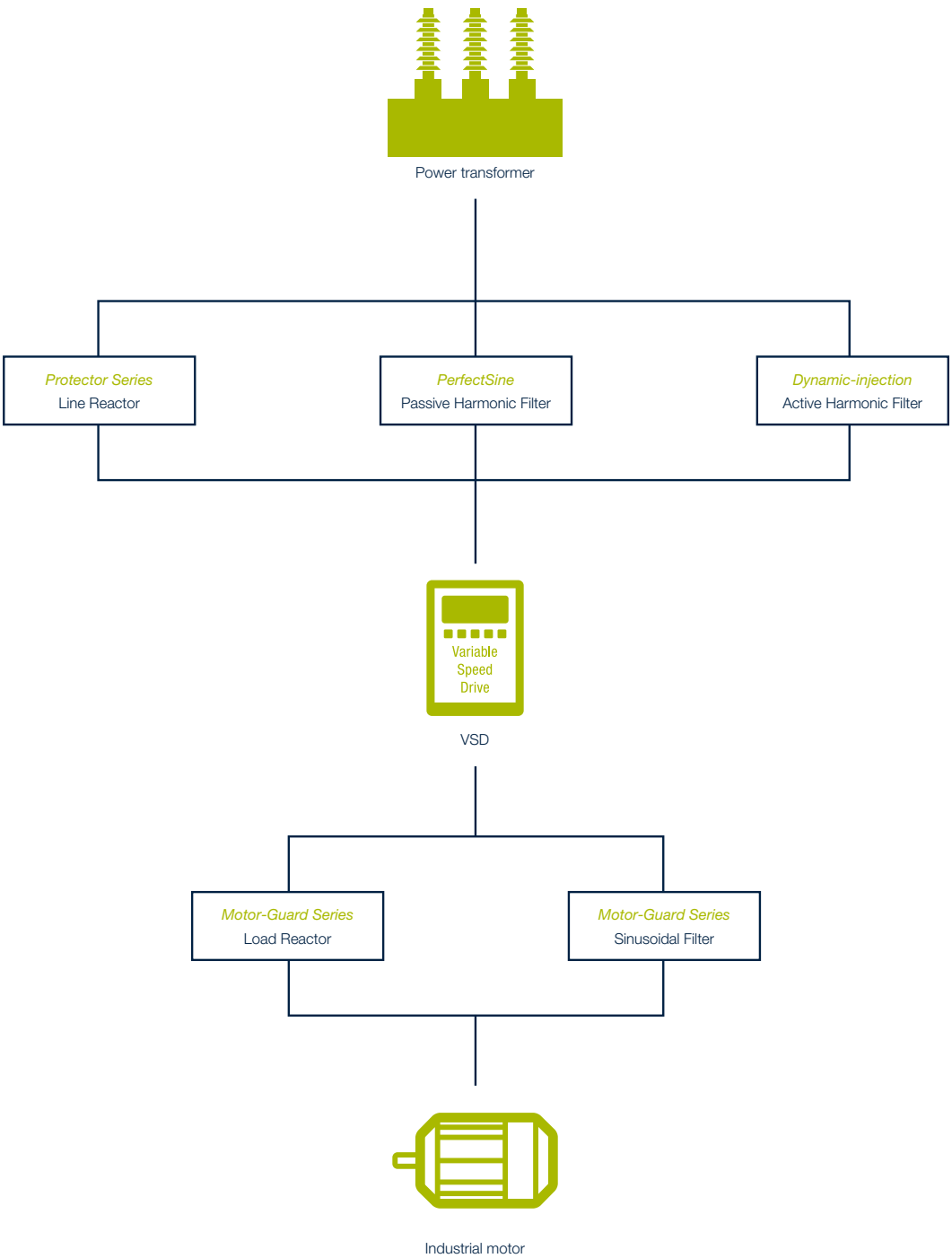
In most cases, several phenomena previously discussed occur in the same system, a fact which underlines the idea of combined components and total filtering solutions. As leading filter solution provider in Australia, Captech can help against all these problems by offering the followings:

- Protector Series Line Reactor
- Motor-Guard Series Load Reactor
- Motor-Guard Series Sinusoidal Filter
- Dynamic-Injection Active Harmonic Filter
- PerfectSine Passive Harmonic Filter

The decision to favour a certain solution above another depends entirely on system requirements and should be backed by technical and economic analysis.

As we design and manufacture reactors in-house, we can custom-make filter and reactor units to a quality and performance suited to customer's specifications. Hence you will receive all the local technical supports you need. No more long lead times! No more high overseas freight costs! All filter and reactor units are fully tested in accordance to our Quality Assurance Policy.

Filters and Reactors in Industrial System



CAPTECH

POWER QUALITY SOLUTIONS

W: www.captech.com.au
P: 1300 280 010
E: sales@captech.com.au