



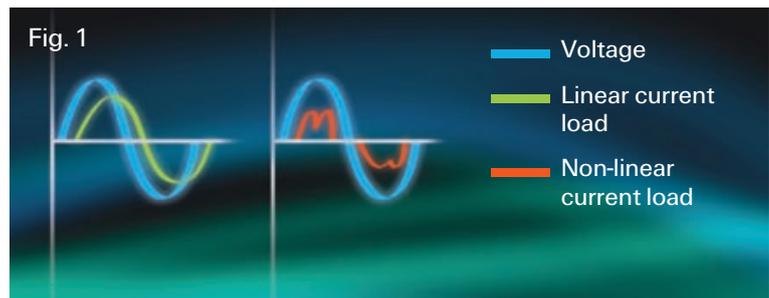
# Power System Harmonics in Commercial and Industrial Applications

Why are  
harmonics  
such a  
problem?

*With the continuing growth of electronics and proliferation of non-linear loads in commercial and industrial building applications, the effects of power system harmonics is a growing concern for power distribution system designers.*

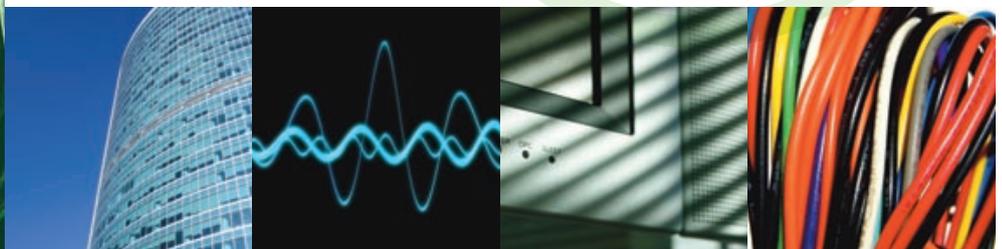
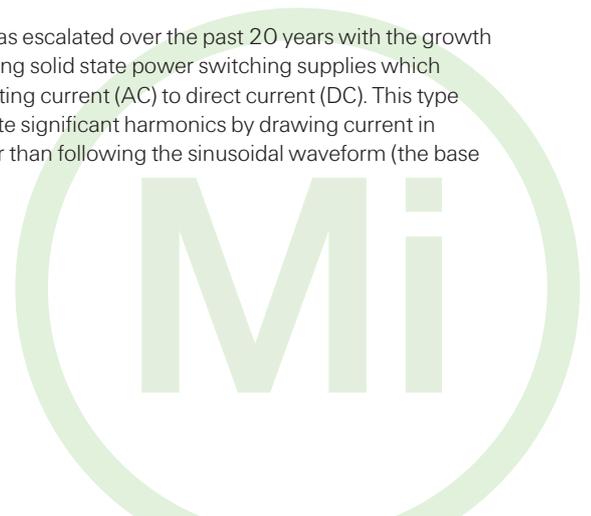
For many Power System designers, understanding the load requirement is only the first step. As equipment complexity increases, so does the diversity of use. One aspect seems to remain constant; the growth of non-linear loads due to DC equipment such as computers, fax machines, uninterruptible power supplies (UPS's), monitors and displays, fluorescent lighting, and many other devices that switch on and off rapidly such as variable frequency drives (VFD's) for motors. The result of the introduction of such equipment is the proliferation of "harmonic pollution".

## What are Harmonics?



A "Harmonic" is a component of a periodic wave (Sine Wave) having a frequency that is a multiple of the base power line frequency, typically 50–60 Hz in the UK. Harmonic pollution is therefore the sum effect of all the harmonics.

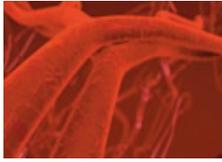
The issue of harmonics has escalated over the past 20 years with the growth of modern electronics using solid state power switching supplies which convert incoming alternating current (AC) to direct current (DC). This type of equipment will generate significant harmonics by drawing current in abrupt short pulses rather than following the sinusoidal waveform (the base frequency waveform.)





Particularly with 3-phase power supplies, a high density of non-linear loads has adverse effects on power distribution circuits and supply equipment (fuses, RCDs, transformers, generators etc.)

A power system with high harmonic loads is like a human body with high blood pressure causing increased strain on veins and arteries. In analogous terms the same can be said of a power system.



### What effects do Harmonics have on power cables?

When a power system is being designed, the level of harmonic pollution is not yet known precisely as the quantity of harmonic generating equipment installed is only known after a building (for example) is equipped by the tenant or building owner. If the effect of harmonics is underestimated, the power cables, in particular the neutral, may operate at an elevated temperature. Independent studies suggest that in polymeric type cables, a 10°C increase in cable temperature above its nominal rating can result in a 50% drop in cable life expectancy. Therefore, for polymeric cables, harmonics can have a critical impact on life expectancy. In the worst case, a power cable rated to either 70°C (PVC) or 90°C (thermosetting insulation such as XLPE) may over-heat, reducing its actual life to below designed expectations.

This is commonly counteracted by over-sizing power cables (which reduces resistance and results in lower temperature).

Unfortunately, over-sizing increases cable costs and takes up additional space – a prized resource in modern buildings, particularly in renovation, and upgrades of power systems.

### How does Pyrotex MI cable help mitigate the problem of harmonics?

Specifying and installing Pyrotex MI cables is just one part of the total power quality solution. However, the appropriate design and selection of MI cables can help reduce the need for other solutions to power quality problems which range from upsizing the neutral cables and passive filtering, to adding multiple wiring for dedicated circuits and surge protection installations.

Features & Benefits	
Feature	Benefit
Non-aging mineral insulated cable	High performance and long life expectancy
Highest levels of fire survival performance	Recognized world-wide as the premier fire resistant cable - the "fire survivor", MI produces zero smoke, zero flame spread and contributes zero fuel to a fire.
Inorganic materials (Copper & MgO)	Zero fuel contribution to a building
250°C continuous withstand temperature	Insulation unaffected by harmonic heating
Extremely robust construction	Can withstand high levels of mechanical impact & abrasion compared to polymeric alternatives
High current carrying capacity	Well in excess of polymeric alternatives
100% copper sheath coverage	Most effective screening of electromagnetic interference (EMI)
Optional polymer jacketing	Easy identification of critical systems
Small cross-sectional area	Saves space in buildings
Installed without the need for conduit	Can offer saving in associated materials and installation time.

### Pyrotex MI as part of a total power quality solution



*Mi Cable with 3x25 mm<sup>2</sup> has diameter of 18.2 mm. A typical polymeric equivalent 3 core 25 mm<sup>2</sup> cable is 27.4 mm diameter (50% larger than the MI equivalent.) Remember, it is typical for conductors on polymeric cables to be over-sized to protect the cable from harmonic loads, overheating and premature aging.*

Safety and reliability at a competitive cost are important objectives for power system designers and specifiers. Pyrotex MI cables provide robust solutions to power supply applications. The physical and electrical characteristics of the cables far exceed those of the polymeric alternatives.

Pyrotex MI cables are part of a complete solution, including termination glands, seals, cable clips, and saddles for total system quality. Specification support for power systems is available from Tyco Thermal Controls.



### For technical support, contact:

[www.tycothermal.com](http://www.tycothermal.com)

Pyrotex, is a trademark of Tyco Thermal Controls and its affiliates in designated countries

 Our products satisfy the requirements of the relevant European Directives.



**tyco** / Thermal Controls

#### United Kingdom

Tyco Thermal Controls (UK) Ltd  
3 Rutherford Road,  
Stephenson Industrial Estate  
Washington, Tyne & Wear  
NE37 3HX  
Tel. 0191 419 8200  
Fax 0191 419 8201

#### Ireland

free phone 1800 654 241  
free fax 1800 654 240  
salesE@tycothermal.com

#### European Headquarters Tyco Thermal Controls

Staatsbaan 4A  
3210 Lubbeek  
Belgium  
Tel. (32) 16 213 511  
Fax (32) 16 213 610

#### Asia/Middle East

Tyco Thermal Controls  
1st Floor, Ujagar Compound,  
Sub Plot 2A, CTS No. 653/6,  
Opp. Deonar Bus Depot,  
Deonar, Mumbai  
400 088 India  
Tel: 91-22-2550 9890/91/92/...98  
Fax: 91-22-2556 1491

#### Australia/New Zealand

Tyco Thermal Controls  
c/- Goyen Controls Co Pty Ltd  
268 Milperra Road  
Milperra NSW 2214  
Australia  
Tel. +61 2 9792 0279  
Fax +61 2 9792 0224