Application Notes

Electrocorder Range of data logging proudcts

EC-3V

EC-1V

- Data measurement - identify Voltage Optimisation savings
- Ongoing Data Logging - capture your voltage profile
- Calculate acceptable voltage reduction and savings
- Low cost investment for long term voltage monitoring

Voltage Optimisation (VO)

The average voltage supply from many national grids around the world is often higher than the ideal operating voltage for most electrical equipment like lighting and motors. For example, a 230V linear appliance used on a 240V supply will take 4.3% more current and will consume almost 9% more electricity than at 230V. Sites fitted with a voltage optimisation system often achieve reductions in the region of 5 to 15% for energy consumption, costs and therefore carbon emissions! The first step in voltage optimisation is to monitor and know your present incoming voltage levels, the Electrocorder allows you to determine this.

Single Phase voltage only monitoring	-	Electrocorder EC-1V
Single Phase voltage and current monitoring	-	Electrocorder EC-2VA
Three Phase voltage only monitoring	-	Electrocorder EC-3V
Three Phase voltage and current monitoring	-	Electrocorder EC-6VA

EC-6VA

EC-2VA

Effects on various electrical loads

A common misconception about VO is that a reduction in voltage will result in an increase in current and therefore power consumed will remain constant. This is true for certain fixed-power loads, however most sites have a diversity of loads that will benefit to a greater or lesser extent with energy savings aggregating across a site as a whole. The benefit to typical equipment at three phase sites is discussed below.

Three Phase AC Motors

The three phase induction motor is one of the most common type of three phase loads and is used in many items of equipment including refrigeration, pumps, compressors, fans, air conditioning, conveyor drives and lifting systems. Overvoltage results in flux saturation of the iron core, wasting energy through eddy currents, increased hysteresis losses. The drawing of excessive current results in excess heat output from copper losses. The additional stress of overvoltage on motors will decrease motor lifetime. Avoiding overvoltage high enough to cause saturation does not reduce the motors running efficiency therefore substantial energy savings can be made through reducing iron and copper losses. However motors designed for the nominal voltage (e.g. 400V Ph-Ph or 230V Ph-N) should be able to cope with normal variation in voltage within the supply limits(+/-10%) without saturation, so these motors are unlikely to be running in saturation, so savings are small.

Reducing voltage to an induction motor will slightly affect the motor speed as slip will increase, but speed is mainly a function of the supply frequency and the number of poles. Motor efficiency is optimum at reasonable load (typically 75%) and at the designed voltage, and will fall off slightly with small variations either side of this voltage. Larger variations affect efficiency more. Very lightly loaded motors with loading of around 25% and small motors benefit most from reducing voltage.

Motors driven by Variable Speed Drives will use the same power as before, but may draw more current, it should be noted that with reduced stored energy in the DC Bus capacitors, they may be more vulnerable to power dips.

Lighting

When lighting loads are in use for a high proportion of the time, energy savings on lighting equipment are extremely valuable. When voltage is reduced, incandescent lighting will see a large decrease in power drawn, as well as large decrease in light output and an increase in lifetime.

Other types of lighting can also benefit from improved power quality, including systems with resistive or reactive ballasts. Fluorescent & discharge lighting is more efficient than incandescent lighting. Fluorescent lighting with conventional magnetic ballasts will see a reduced power consumption but also a reduced lumen output from the lamp. Fluorescent lamps on modern electronic ballasts will use approximately the same power and give the same light. To provide the same wattage at the reduced voltage will require a greater current and increase cable losses. Lighting controllers and ballasts are responsible for generating high levels of harmonic distortion, which can be filtered with some types of voltage optimiser, therefore reducing the need for lighting controllers. A common concern is that some lighting will fail to strike at lower voltages. This should not occur since the aim of VO is not simply to reduce the voltage as far as possible, rather to bring it to the service level voltage at which it was designed to operate most efficiently.

Heating

Heaters will consume less power, but give out less heat. Thermostatically controlled space or water heaters will consume less power while running, but will have to run for longer in each hour to produce the required output, resulting in no saving.

Switched mode power supplies

Switched mode power supplies will use the same power as before, but will draw a slightly greater current to achieve this, with slightly increased cable losses, and slight risk of the increased current tripping MCBs.

Energy and emissions savings

The energy savings achieved by VO are an aggregation of the improved efficiency of all equipment across a site in response to the improvements in the power quality problems outlined above. It has been and continues to be a key technique for savings in energy consumption and consequently carbon dioxide emissions.

Research in Taiwan suggested that, for an industrial supply with voltage reduction upstream of the transformer, there is a 0.241% decrease of energy consumption when the voltage is decreased by 1%, and an increase of 0.297% when the voltage is increased by 1%. This assumed a mixture of loads including 7% fluorescent lighting, 0.5% incandescent lighting, 12.5% single-phase air conditioners, 5% single phase motors, 22.5% small 3-phase motors, 52.5% large 3-phase motors. It is likely that a modern installation would have less opportunity, with almost no incandescent lighting, partly high-frequency fluorescent lighting (no saving), some variable speed drives (no saving), higher motor efficiencies (so less waste to save). A northern European installation would not have the large number of small single phase motors for air conditioning.

The best potential for saving is probably with older lighting (incandescent or fluorescent) and discharge lighting with conventional control gear. Therefore older commercial and office premises are likely to have a better saving potential than modern buildings or industrial sites

In summary Voltage Optimisation does offer savings, like any product it is the purchaser's responsibility to determine the likely savings in their environment. A word of warning, one company a plastic extrusion company, was told that they could save 20% of their total electricity bill with VO. The salesman ignored the fact that 85% of their electricity usage was in the heating of extruder heads for the extrusion process, these heads need to be heated to a certain temperature as part of the process, therefore no savings would be possible on these items, the total saving was actually only 20% of remaining 15%, which is a 4% saving.