Voltage regulation cuts energy costs more efficiently

As energy management issues rise ever higher on nearly every organisation's agenda, users can increasingly benefit from using energy saving regulators. These cut costs by controllably reducing site voltage and therefore energy consumption. They also extend electrical equipment lifetime while reducing maintenance expense. Martin Ward, Technical Director of Claude Lyons, explains how they operate, the savings they can achieve and why they offer greater savings and benefits than simply using fixed ratio step down transformers.

Faced with ever increasing energy costs and pressure to demonstrate their green credentials, organisations are examining all possible ways to reduce their power consumption. One of these is Voltage Reduction, sometimes known as Voltage Optimisation or Voltage Correction. This technique has been available for decades, but the current energy climate is increasingly prompting users to deploy it as part of their energy management strategy.

Voltage reduction is best effected using Energy Saving Regulators, with savings of up to 25% being possible; sometimes with effectively no cost to the user. But voltage reduction, however it is implemented, is not a magic solution for all applications. So, to get the best from this technique it is essential to consider four issues; Why there is both an opportunity and a need for voltage optimisation; what benefits and savings are achievable; why energy saving regulators are better solutions than fixed ratio step down transformers; and where voltage optimisation should be used.

Regulators reduce the electrical energy consumed on a site by reducing and stabilising its input supply voltage. And, for historical reasons, there is plenty of scope for reduction. Currently, the UK standard voltage as supplied from the National Grid is, in harmony with European Standards, specified at 230V ± 10% (207 – 253V). Accordingly, electrical equipment manufactured for the EU market is specified for 230V, or sometimes 220V, which was the previous EU voltage level. Meanwhile, for a variety of reasons the National Grid voltage hasn't changed from pre 2007 levels, which were typically 240V or even higher. Although these fall within the 230V +10% -14% (197 – 253V) range permissible for EU equipment, they are unnecessarily high. This creates unnecessary energy losses as well as extra heating and stress in users' electrical equipment. So voltage optimisation has a significant role to play in reducing the mains input voltage from 240V to 220V, or, depending on the load, 210V.

There is another mains supply factor that, while not receiving the same media attention as energy costs and carbon footprint issues, is potentially of great importance to electricity users. A report by economic consultancy NERA for Powergen stated that the UK could soon face power shortages. Closure of uneconomic, ageing plants and low investment could lead to electricity shortages in a severe winter. Energy generators could respond by reducing voltage levels during peak demand periods to reduce consumption. This contingency should be allowed for within any energy management strategy.

Within the Claude Lyons energy saving regulators, the regulator output can be set to a site's optimum voltage level by a simple user adjustment. A servo amplifier uses the difference between the actual and desired output voltage to drive a motorised variable transformer. This applies a variable voltage to the primary winding of a buck transformer which in turn controls the voltage in the secondary winding. As the secondary is in series with the mains supply and the load, the load enjoys a stable supply regulated to within typically ±1% of its setpoint level. This design provides a fast, smooth, step less and harmonic free response. It is also typically 99% efficient, partly because the control circuit operates only on the variable component of the mains input voltage.

Figs 1 and 2 comprise a real example showing why an energy saving regulator is a better solution than a fixed ratio step down transformer. In both cases, the objective was to ensure that the supply to the site did not dip much below 220V, making adequate allowance for voltage drops across the site. To achieve this, the transformer output must average over 228V; while the voltage regulator's tightly controlled regulation allows an average of 220V without risk of unacceptably low voltage excursions at the user equipment inputs. Whereas the transformer yields an energy saving of 8.7%, the voltage regulator achieves 14.9%. On some sites, depending on their wiring and load conditions, larger voltage reductions and energy savings of up to 25% may be possible.

Because the regulators maintain all three phases to within ±1% of their target level, their output is always phase balanced. This is important for some loads where unbalanced phases cause equipment overheating and shortened service life. And should the mains voltage unexpectedly drop because of grid capacity problems or any other reason, the regulator will maintain its controlled output, shielding the onsite load from external events. By contrast a fixed ratio transformer output will drop in proportion to the input voltage, even if this takes the load voltage below acceptable operating levels.

Not all loads benefit from voltage optimisation. Examples of such equipment include computers, communications systems and other IT hardware using switched mode power supplies, variable speed inverter drives, lighting with high frequency ballasts and thermostatically controlled items such as ovens, fryers and kettles. It is therefore essential to perform a detailed site survey which includes an estimate of expected savings before investing in voltage optimisation equipment.

However energy savings can typically be expected to reach 5 – 15%, with values up to 25% sometimes being achievable. And this is without the cost savings arising from longer equipment lifetime and reduced maintenance costs. The payback period is usually between 12 and 36 months. Reduction in carbon footprint can also be significant, as each kWh saved is equivalent to 0.43kg of CO_2. This fact is not lost on The Carbon Trust, which offers interest free loans to purchase the energy saving regulators. As these are repayable over up to four years, they are often more than covered by the energy savings. The regulators have essentially cost nothing to install.

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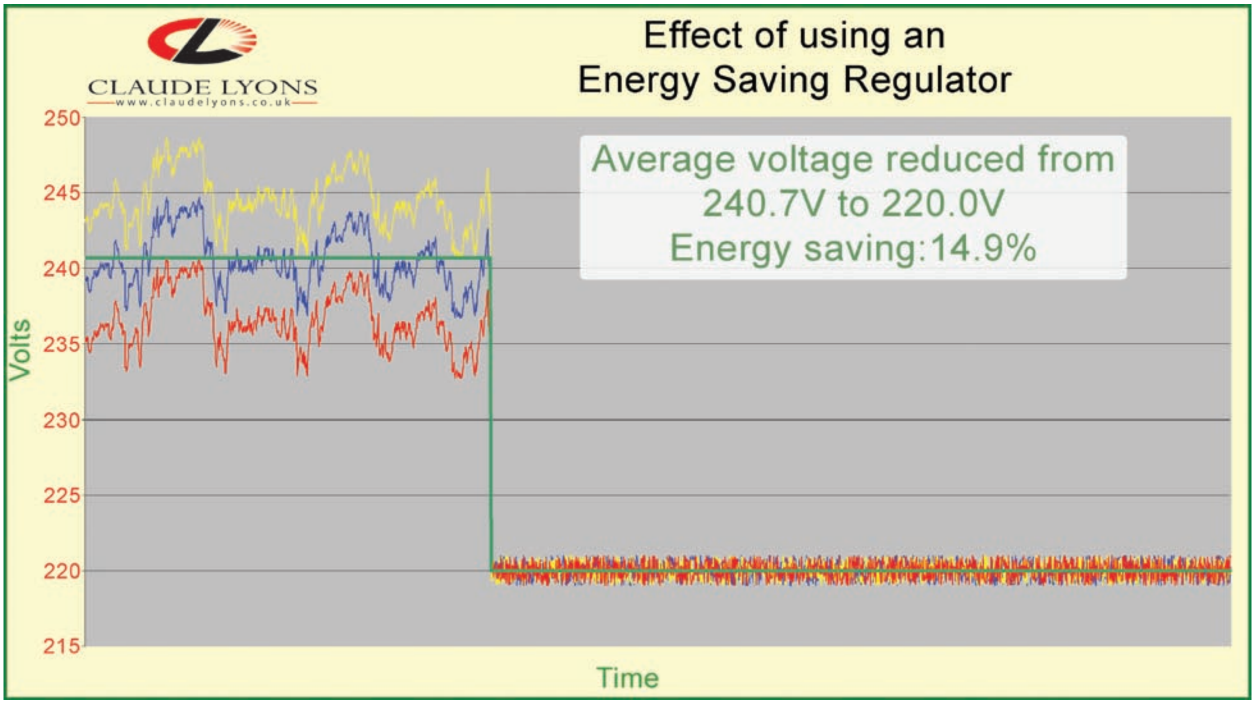

Fig 1. Effect of using an Energy Saving Regulator

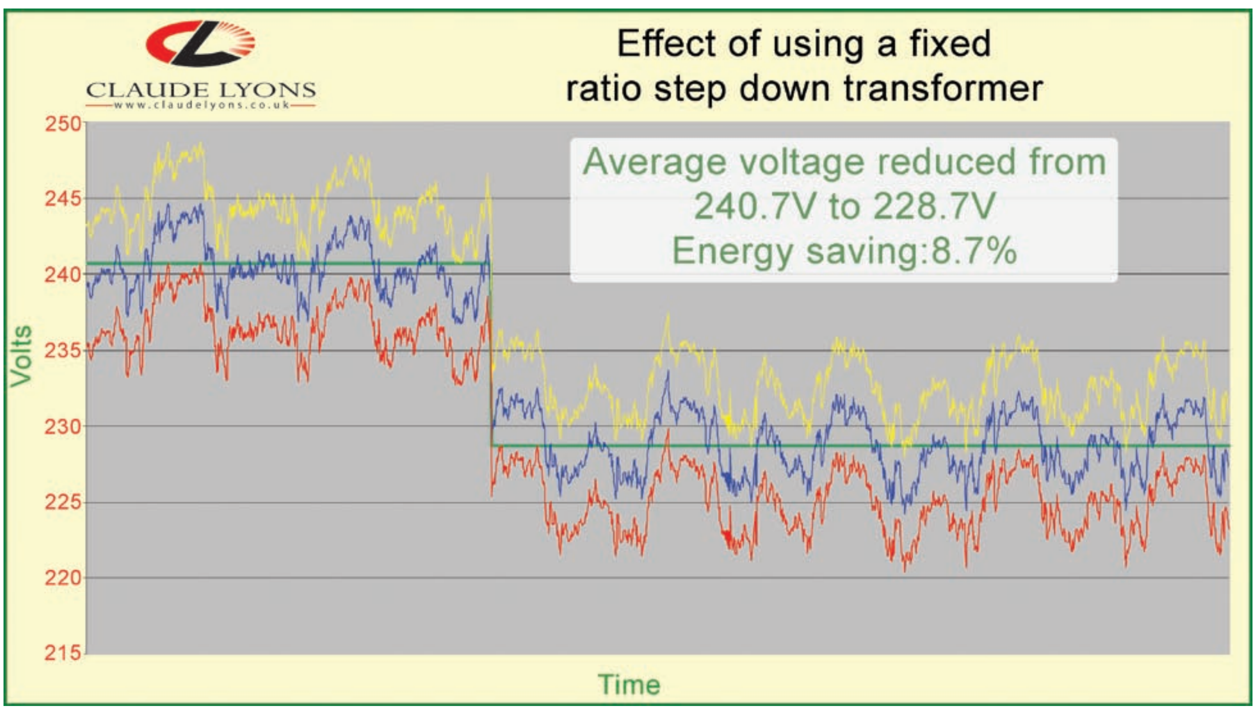

Fig 2. Effect of using an fixed ratio step down transformer

About Claude Lyons

Based in the UK, The Claude Lyons Group designs and manufactures Voltage Regulators, Voltage Stabilisers and related equipment including harmonic mitigation products, fixed and variable transformers, power resistors and rheostats. In today's conditions, electricity users are turning increasingly to Claude Lyons' products to manage and reduce their organisations' energy costs and carbon footprint. Claude Lyons ensures that energy management configurations are optimised to the needs of each individual customer, and only proposes equipment where it can be justified by projected energy cost savings. The Group, founded in 1918, is registered with BSI to the latest quality management standard BS EN ISO 9001:2000

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