Constant Voltage Transformer (CVT) or Automatic Voltage Stabiliser (AVS) ?

Nathan Briggs, of Advance Electronics Ltd considers the benefits of constant voltage technology, especially in regions where power quality is not always consistent

AGT 1000
Fifty year design life, completely passive pure sine wave output

AVS 1000
Smaller, lighter and cheaper but without "bulletproof" protection

The problem

Traditionally, the western world has been accustomed to consistently high standards of power quality. Even so, the variations that occur in our everyday power supplies are sufficient to cause operational problems in a variety of equipment. The popularity of surge suppressors, uninterruptible power supplies and the like provides strong evidence to support the fact that even industrialised nations are not immune from power related problems.

As such, it is hardly a surprise to learn that users of high tech electronic and electrical equipment in less developed countries face serious obstacles in the pursuit of high quality power. As most people involved in the power industry know, even the slightest variations in the AC power supply can cause vital equipment to crash, and essential processes to falter. Worse still, data processing errors can arise as sensitive equipment struggles to cope with any variety of surges, sags and noisy mains. Indeed, many equipment manufacturers now specify that their devices and electronic components must be fed by a high quality mains source.

Third World Applications

Particularly in the third world, irreparable damage can be caused to sensitive electronics simply by undesirable electrical noise, especially common mode noise. The switch mode power supplies (SMPS) used in a variety of electronic devices, especially PCs, have a wide input voltage tolerance, and can therefore operate successfully even when fed a voltage outside their normal supply. However, the SMPS is highly sensitive to so-called dirty mains. As such, data loss is frequent, as is the more insidious problem of a gradual deterioration in hardware performance.

In less developed countries, basic power problems fall into several different categories. Although most electrical equipment can operate without problems even if the voltage varies by up to 10% either way, many out of tolerance voltages can still occur, generally classified as sags, surges and brownouts. Spikes on the line are a separate problem and, although modern equipment can usually operate in an environment where spikes of up to 100V are present, more severe spikes can cause data corruption or hardware failure. Added to these two issues is the separate problem of complete power failure.

Surge Protection

Several different technologies are available to provide protection against surges, sags and brownouts in the mains supply. Probably the oldest method of combating these damaging variations is by the use of a Constant Voltage Transformer (CVT). Originally discovered during the 1930 s, the CVT makes use of an effect known as ferroresonance an oscillatory interchange of energy between a capacitor and inductor.

Core saturation causes the value of inductance to automatically adjust, thereby maintaining an oscillation frequency equal to that of the mains supply. Patents filed in the United States during the 1930 s recognised that proper control of this phenomenon would enable the creation of voltage stabilising equipment such as the CVT.

Indestructible CVT

The intervening period has seen CVTs used in any number of applications where their inherent reliability and simplicity have made them the natural choice for users that demand a highly effective AC power conditioner. Although a good manufacturing technique is essential, the CVT itself remains a very straightforward device, with only a few electrical components. This attribute is augmented by the fact

that a CVT can be completely and continuously short circuited in use, without any adverse reaction. This indestructible characteristic makes the CVT an excellent choice for countries where variations in the quality of the power supply are all too regular, but where maintenance facilities are at a premium.
A CVT is also ideal for protecting sensitive loads against direct lightning strikes on power lines, something that can occur all to frequently in the self same geographical regions where power quality is a real issue. Because the CVT is self-protecting to its supply, and to the critical load connected to it, the unit is effectively immune to damage from the rising waveform of a typical voltage caused by a lightning strike.

Mains breaks

Constant Voltage Transformers are also useful for riding out momentary breaks in the mains. Computing equipment is highly sensitive to even the shortest of interruptions in the power supply and, because the resonating circuit within a CVT stores a limited amount of energy, this renders them ideal for filling in potential small gaps in the power waveform. In fact, an average CVT will be able to cover a gap of about half a cycle in a typical situation. This will satisfactorily drive modern computer based equipment over a short-term break in the mains power.

From the foregoing, you would feel entitled to assume that the Constant Voltage Transformer is the perfect solution for any application that requires effective power conditioning.
There are some drawbacks, a CVT is a physically large device. As such, it is not always practical to site this type of equipment in either a small office or home environment, especially where space is limited. Secondly, the average CVT has an operating efficiency of 95% at full load.

While this may, in isolation, appear to be very impressive, there are other devices available with greater operating efficiencies. And, while these devices may not combine the same overall feature count as the CVT, they will generally provide highly effective power conditioning capabilities, in the same way as the Constant Voltage Transformer can. Lastly, one of the main disadvantages of the CVT is that it produces a noticeable operating hum , accompanied by a local magnetic field.

Alternatives

So, if some characteristics of the Constant Voltage Transformer make it unsuitable for use in certain non- industrial locations, what alternatives are available for those users seeking a stable power supply in regions where the mains is less than ideal? Probably the most appropriate form of technology available is the Automatic Voltage Stabiliser (AVS). These devices incorporate the latest microprocessor technology, and are specifically aimed at protecting sensitive hardware in regions and environments where the quality of the mains supply cannot be guaranteed.
A properly designed AVS will protect inductive loads such as fridges, freezers and air conditioners from a variety of mains borne conditions, including sags, surges and brownouts. Moreover, because Automatic Voltage Stabilisers feature a low impedance, they help ensure clean motor starts, a characteristic that makes them ideal for situations where motor reliability and performance are of paramount importance.
Rather than relying on electrical engineering principles to produce a stable voltage, as do CVT devices, the AVS uses electronic means to achieve the same result. Microprocessor control monitors the incoming mains supply, and automatically selects a tap configuration to meet stabilisation and output voltage set points. As such, AVS devices are highly tolerant to input voltage, which makes them ideal for operational reliability in hostile environments.
If the mains supply fails, or is subject to a momentary interruption, the Automatic Voltage Stabiliser will cut out to protect the connected load. When the mains supply returns to a value within a preset nominal band, the AVS automatically restarts. However, because an instantaneous restart could damage certain compressor- based loads, it is advisable for the AVS to incorporate a variable switch on time delay
One of the most significant advantages of the AVS over a CVT installation is its high efficiency rating. Compared to a typical CVT, an AVS can offer efficiency ratings of up to 98%. Naturally, this helps reduce running costs, which can be particularly important in regions where not only can the consistency of supply not be guaranteed, but where the cost of power can often be prohibitive.

Smaller and Lighter

Moreover, a typical AVS is much smaller and lighter than the average CVT installation. This makes a voltage stabiliser ideal for domestic and office duties, or in circumstances where portability is essential, such as in field hospitals and the like.
Therefore, the message when choosing power quality products is to classify each load as either critical, essential or non-essential. What might be ideal for an inductive load such as a refrigerator or air conditioner will not necessarily be suitable for more critical devices such as those found in a computer or comms network. In these situations, a robust CVT solution, based on sound electrical engineering principles will provide a better answer than a microprocessor-based voltage stabiliser.

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