A line voltage of 230 V and a frequency of 50 Hz are customary at the user level in South African power supply systems. Regardless of the primary energy carrier selected, power stations generate three-phase current. The three-phase system comprises the phase conductors L1, L2 and L3, the neutral conductor N and an earth connection. The voltage of each phase conductor to the neutral conductor is 230 V and is used for the majority of consumers. Neutral conductor and protective earth conductor both have earth potential.

In this Y-connection (Fig. 1), the neutral conductor supplies the consumers, together with L1, L2 and L3. The protective earth conductor ensures personal safety e.g. by earthing metal housings. The sinusoidal voltages of L1, L2 and L3 are each 120° out of phase.

The voltage between two phase conductors is usually 400 V, or 230 V in exceptional cases, and is not suitable for operating most commercially available consumers. This delta connection is customarily used only in industry and in drive systems. Given absolutely uniform loading of the three circuits, the current in the neutral conductor is equal to zero.

**Spotlight on uniform loading**

Although network operators aim for uniform loading of the three circuits, this requirement is only approximately met in practice. If the loading of the three circuits is non-uniform, what is known as a compensating current flows in the neutral conductor.

When operated on a three-phase system, an input voltage of 230 V is present at the electronic control gear, provided that a neutral conductor is incorporated in the cable and connected.

**Effect of asymmetry**

If the load in the three-phase system is asymmetrical, and the neutral conductor is not corrected or connected incorrectly, neutral point displacement can occur (Fig. 2).

Since no neutral conductor is connected, the total of the conductor currents at the neutral point is always zero. To ensure that this condition is met, phase voltages U1N, U2N and U3N change their magnitude, among other things. This leads to what is known as neutral point displacement and an associated overvoltage or undervoltage in the three-phase system. The result is the voltage profile of the three phase voltages, as shown in Fig. 3.

**The phenomenon in practice**

A lighting installation can be taken as an example for a practical explanation of the phenomenon of neutral point displacement.

If the neutral conductor is not connected in a “three-phase installation”, the result is both overvoltage and undervoltage at the consumers, i.e. the electronic control gear units. This means that the input voltage at the ECG can theoretically be between 0 V and 400 V.

**Effects on the electronics**

The power supply in South Africa is so stable that voltage fluctuations in excess of 10% in either direction are generally not exceeded. Advanced electronic control gear is engineered in such a way that the probable fluctuations in the line input voltage are already taken into account in the design.

Operators of lighting installations equipped with advanced electronic control gear cannot detect any difference.
in brightness in this fluctuation range of ± 10%. This ECG is designed in such a way that, on the lamp side, hardly any fluctuations in the line input voltage in the range from 207 V to 254 V are transmitted. The lamp output remains virtually constant in this voltage range.

Line voltages in excess of 264 V either occur briefly in the form of “voltage peaks”, or they are permanently present as a result of faulty installation in the three-phase system.

With advanced ECG, the input voltage can even assume values of up to 350 V for a defined period of time. This has no effect on the operation of the ECG.

In most cases, faulty installation involves the neutral conductor not being connected. This can, for example, happen following official acceptance of a large-scale installation by a test institute, since the neutral conductor has to be disconnected for some tests.

Depending on where the neutral point is displaced to (Fig. 2), the applied input voltage can also drop to below 200 V. Advanced ECG is likewise designed to cope with this phenomenon.

However, regardless of the ECG used, a fluorescent lamp can only be ignited at above 198 V. In other words, reliable “switching on” of the lighting cannot be guaranteed below this voltage value.

Experience in recent years has shown that product characteristics of advanced control gear are perfectly adequate (Table 1) for preventing the ECG from being damaged by overvoltage or undervoltage.

O sram “ECG from the Professional segment” is equipped for all phenomena in the network and requires no additional audible or visual signals, which put an additional burden on the electronics as a result of rapidly alternating high voltages and 0 V on the components.

**Characteristics:**

- AC voltage from 198 V to 264 V for reliable lamp ignition
- No damage in case of a permanent input voltage of up to 320 V
- Short-term input voltages of 350 V (up to 2 hours) do not damage this ECG.

Contact Michael Clarkson, Osram, Tel (011) 206-5600, michael@osram.co.za

---

**Table 1: QuickTronic control gear from the professional segment.**

<table>
<thead>
<tr>
<th>T5 FO fluorescent lamps</th>
<th>T5 FH fluorescent lamps</th>
<th>T8 fluorescent lamps</th>
<th>Compact fluorescent lamps</th>
</tr>
</thead>
<tbody>
<tr>
<td>QTI DALI 1x2x... DIM*</td>
<td>QTI DALI 1x2x... DIM*</td>
<td>QTI DALI 1x2x... DIM*</td>
<td></td>
</tr>
<tr>
<td>QTI DALI-Q1x2x... DIM*</td>
<td>QTI DALI-Q1x2x... DIM*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QTI 1x2x... DIM*</td>
<td>QTI 1x2x... DIM*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QTI-FQ 1x2x... DIM</td>
<td>QTI-FQ 1x2x... DIM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QTI-FQ 1x2x... F/OW</td>
<td>QTI-FQ 1x2x... F/OW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>QT-FH 3x4x14</td>
<td>QT-FH 3x4x14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Additional product characteristics can be found at www.osram.com/products/controls/quicktronic/