FLUKE®

# Troubleshooting commercial lighting loads

## Application Note

Lighting is a major load for many large facilities. Evaluating these circuits is important for both energy conservation and power quality. Keep in mind that commercial lighting loads are wired single phase, with the loads connected from phase to neutral. Typically, the phase-to-phase voltage is 480 V, with the phase-to-neutral voltage at 277 V. Measurements must be taken at the lighting panel, on all phases, since power consumption and Power Factor could vary on each phase.

### 1. Power consumption

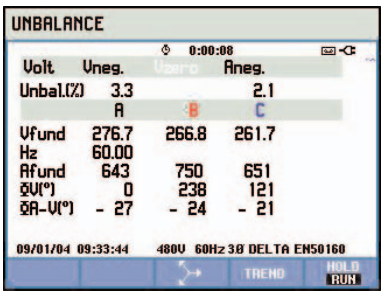
Excessive phase unbalance can cause voltage unbalance, which in turn can affect three-phase motor loads. For example, in this three-phase reading, phase A is considerably higher than B and C, when all three phases should be equal.

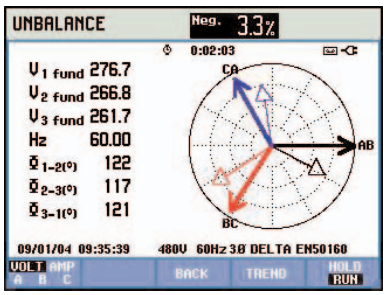
### 2. Power Factor

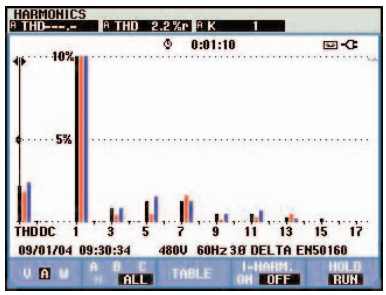
Ballast with low PF might have lower cost-of-purchase but higher cost-of-operation. This phasor diagram illustrates the unbalance along with the power factor.

### 3. Total Harmonic Distortion

Current THD should be considered when selecting ballast, especially if there is a possibility of transformer overloading. The bar graph pinpoints the 5th and 7th harmonics as the larger contributors.

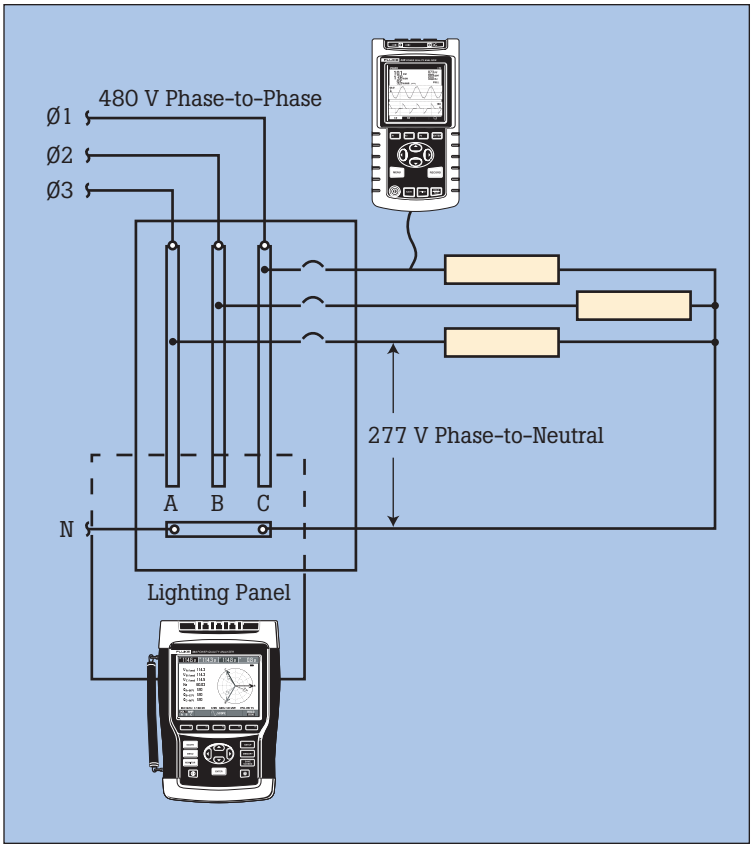


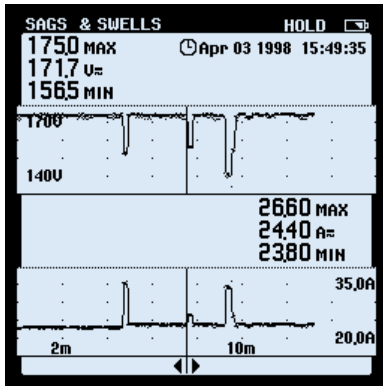




### Measurements on commercial lighting loads

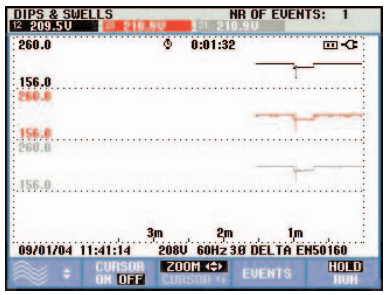
| Measurement | Look for |
|---|---|
| 1. Power consumption (kW) | Balance among three phases. |
| 2. Power Factor (DPF and PF) | Magnetic ballast will have low DPF. Electronic ballast may have low total PF, although new generations of ballast often have harmonic mitigation built-in. |
| 3. Total Harmonic Distortion (%THD) | Current %THD <20 % is desirable. |
| 4. Voltage Stability | Unstable voltage can cause lights to flicker. |




Single phase analyzers measure each ballast separately, requiring manual calculations. Three phase analyzers measure all three phases simultaneously and perform the calculations automatically.




The Fluke 43B Power Quality Analyzer trends voltage (top) and current (bottom) simultaneously. Current swells/ inrush caused voltage sags, indicating that a load downstream from the measurement point is the cause of the disturbance.




The Fluke 430 Series Power Quality Analyzers trend all three phases and compares interaction between the loads.

## 4. Voltage stability

The sags and swells mode of power quality analyzers is especially useful for recording repetitive voltage sags which can show up as flickering lights. Both current and voltage are monitored simultaneously. This helps us tell if sags are downstream of the measuring point (load-related) or upstream (source-related). For example, if voltage sags while current swells, a downstream current inrush likely caused the sag. If both voltage and current sag, some event upstream caused the sags.

It could be an upstream load like a motor on a parallel branch circuit which drew down the feeder voltage. Or it could be source voltage-related, for example, a lightning strike or breaker trip/reclosure on the utility distribution system.

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