Investment Information

SIEMENS NetworkRail

What's happening?

Improvement Opportunity using TLP KO2 as a case study
Maximising Energy Efficiency of LED Lights in Signalling Equipment
Siemens Rail Automation

Background:

Trackside signalling equipment using LED signals has replaced conventional equipment using filament lamps. On the TLP KO2 project, some 476 pieces of related equipment are being installed namely:

- 315 x Main Signals
- 24 x Banner Repeater Signals
- 6 x Position Light Signals (GPLS)
- 70 x Position Light Junction Indicators (PLJIs)*
- 80 x Miniature Route Indicators (MRIs)*
- 46 x Standard Route Indicators (SRIs)*

**Trackside equipment that do not work in 24hr base. Average of 1hr per day operation is assumed.*

Led Signals are more robust, have longer life expectancy and require less maintenance compared to conventional filament light signals. In addition, LED signals are more energy efficient and capable of operating with a lower current feed. Dorman LITE signals used in TLP KO2 operate with a current feed of 45 mA compared to the 300mA required by filament lamp signals.

Fig 1: Front and back view of Dorman CTS LiTE

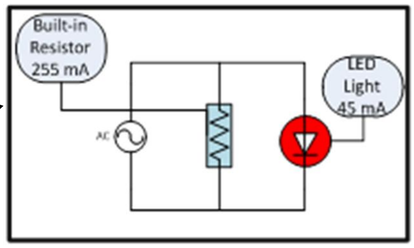

Fig 2: Existing LED module internal schematic

However, due to signals being driven by conventional RRI or SSI technology, it is necessary to operate the new LED signals with the same current supply as for the old filament lamps, while staging in the equipment. As a result of these differences between the design (45mA) and supply (300 mA) currents of the LED modules, the supplier (Unipart Dorman) previously identified a solution in the form of a resistor built into the LED modules inside the signals. The built-in resistor disposes the excess current in the form of heat and hence energy (refer Figures 1 and 2).

The 'Current' Problem

The built-in resistors are fitted in every signal's LED module, in all trackside equipment. This means the potential energy efficiency gains from using LEDs over traditional filament lamps is effectively lost.

Yearly KO2's Equipment Power Consumption		
Trackside Equipment	102.60	MWh
Resistors	87.10	MWh
LED Lights	15.49	MWh

Table 1: Total power consumption of all trackside equipment

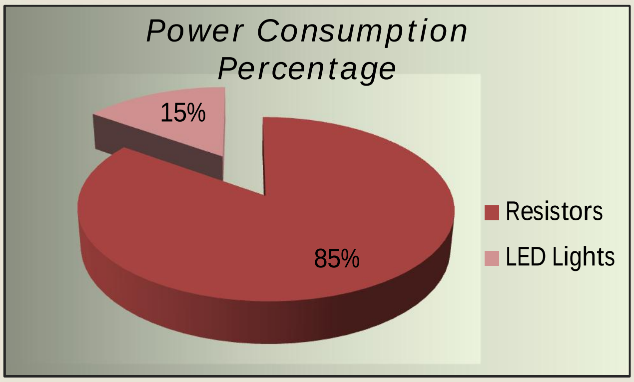

Chart 1: Trackside equipment power consumption analysis

As shown in Table 1 and Chart 1 the actual power required by the LED and therefore the equipment is only 15.49 MWh (or 15%) of the total power consumption, resulting in the remaining 87.10 MWh (or 85%) of energy used being wasted.

Contact: Evangelos.Tsiapalas@siemens.com, Graduate Development Engineer, Siemens Rail Automation **Version**: Draft 2, Mar 2014

To Plug or not to Plug

While the use of the resistor addresses the current (mA) design vs. supply problem, two interrelated issues warrant attention:

1. Due to the requirement to 'waste' excessive current, no energy savings are actually being realised through the use of LEDs. This matter can only be addressed through adjusting (down) the current supply to the signals.
2. As at present the resistor is built into the signal head, should the current supply be lowered, the LED signal and/or entire signal head would need to be replaced, with consequent labour requirements and material wastage.

Fig.3 LED module with internal resistor

Fig.4 LED module with pluggable resistor. Recommended position.

A potential solution lies in the use of pluggable resistors located inside the signal case, but outside the LED module, as shown in Figure 4. The advantage of this design is that the resistor would continue to serve the same (slugging) purpose but could then easily be removed so that the current (mA) supply (and hence power consumption) is lowered, leading to significantly less material wastage and labour requirements.

Maximising the benefit of LEDs

In order to realise the energy saving benefits of LEDs, the current (mA) supply needs to be lowered from the 300mA used at present to as close to 45mA as possible. However, WestRACE application manual states that current proving function can be pre-set to 150mA as the lowest threshold.

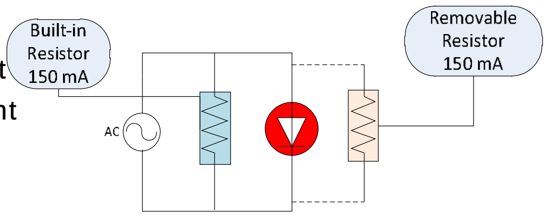

Fig.5 Schematic of LED module with pluggable resistor

A solution was identified whereby the use of both an interior and an exterior resistor has to be adopted. With this design, the interior resistor would remain inside the signal case indefinitely while the exterior would be fitted outside the LED head, enabling it to be removed when/if lowering of the current (mA) was enabled. Refer Figure 5.

A comparison in the amount spent on electricity to power a signal at 300mA (i.e.: with a built-in [non-removable] resistor) and a signal at 150mA (ie: one 150mA built-in resistor and one 150mA pluggable resistor) over a period of 25 years is shown in Chart 2. Benefits as far as energy, spent and CO_2 savings are shown in Table 2.

Benefits			
Period	**Energy *(MWh)***	**Savings (£)**	**CO2 Reduced (t)**
Yearly	103	£6,989.08	54.3
10 Years	1030	£77.235.86	543.0
25 Years	2641	£229,681.93	1391.7

Table 2: Gains from using 150mA pluggable resistor

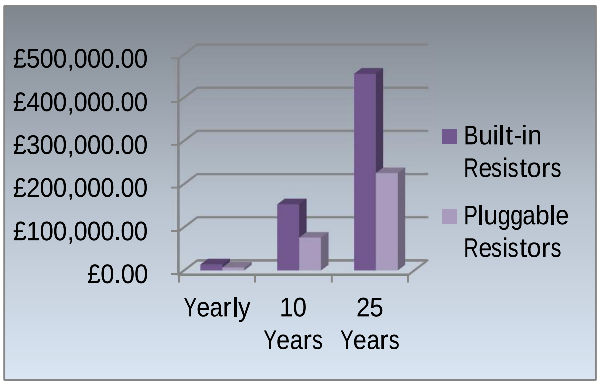

Chart 2: Cost comparison of built-in and pluggable resistor

Present and Future Applications

Due to insufficient time before TLP KO2 installation and changes required in equipment design as well as hardware the pluggable resistor solution will not be adopted in the TLP.