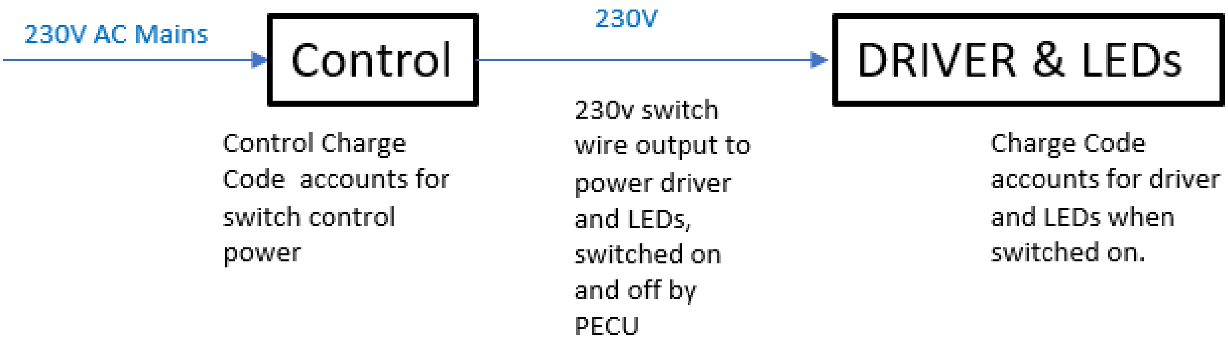
# UMSUG paper – Permanently powered LED Drivers

## 1. Purpose

There have been recent applications for Control Charge Codes for DC powered PECUs and CMS Nodes. This document identifies that the energy consumed by this equipment is understated in Settlements. In addition, it identifies that there could be an issue with LED drivers utilising mains powered PECUs and CMS Nodes to control LED lighting. It is seeking to reach agreement on an approach to ensure all energy consumed is correctly captured in settlements.

## 2. Traditional Arrangement

The traditional arrangement is that a control is connected to the incoming mains supply and that a PECU/CMS Node switches the supply to the LED Driver/lamp on and off as illustrated below.




So, the inventory would include two items:

| | | |
|---|---|---|
| Control Charge Code | 9400011000100 = 0.25watts | Switch Regime = 001 (continuous), plus |
| Lamp Charge Code | 4200200000100 = 20watts | Switch Regime = 821 (70/35lux) |

This correctly accounts for the continuous load of the PECU and the switched load of the lamp.

## 3. Issues

### 3.1. LED drivers permanently powered with DC outputs

LED drivers have been developed to include additional DC outputs that will power equipment added to street lighting, for example as part of a Smart City initiative such as air quality sensors, traffic counters and other ancillary equipment. It may also be used to power a PECU/CMS Node. This requires that the LED driver, acts as a power supply (PSU) which needs to be powered 24 hours per day.

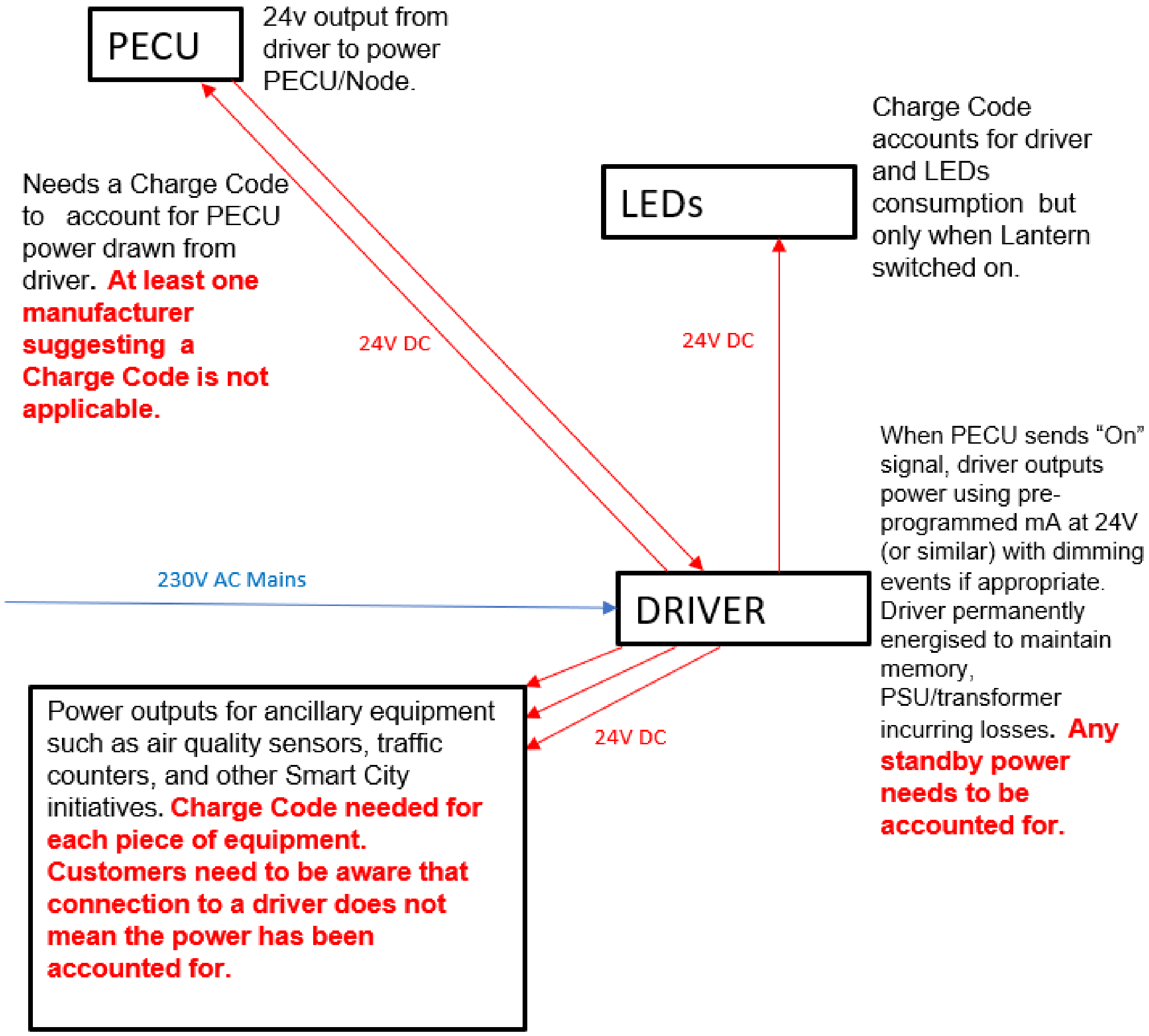
If a driver is powered 24 hours per day converting the mains supply at a nominal 230V AC to 24V DC (or similar) it will incur continuous power losses that need to be included in the daytime energy consumption whilst a LED lamp is switched off. Any existing power losses incurred by the driver in powering the LED lamp at night are included in its lamp circuit watt rating.

A DC PECU/Node powered by the driver will add to the continuous power consumed by the driver during the day and night.

DC powered PECUs and Nodes are already being used. A customer was advised that a Control Charge Code was not required because it was powered by the driver. See extract below from the technical specification for the PECU issued by the manufacturer. However, this advice does not reflect the correct energy in settlement.

| | |
|---|---|
| **Power consumption** | From SR Driver |
| **UMSUG Charge CODE** | n/a |

The diagram below illustrates where energy consumption is occurring that is not accounted for by the existing arrangements for a lamp Charge Code and a Control Charge Code.




It is appreciated that individually the control equipment accounts for very little energy, but collectively in an inventory with some 50,000 PECU controlled streetlights, using a 0.25 watt generic control charge code would result in an annual consumption of 109,500 kWh.

Removing the control charge code from the inventory based on the manufacturer advice would be attractive to the customer as an additional energy saving when replacing their existing stock with LED. It is also attractive to the manufacturer promoting the sale of their equipment.

It has not been possible prior to this meeting to gain a full understanding of the potential losses, but a Control Charge Code was approved for a DC powered CMS node in July 2021, no associated DC powered PECU Control Charge Codes have yet been approved.

The testing documentation for the July Charge Code has been reviewed. It took the following approach:

- a lamp was tested at 240V without a node connected, and
- then with a node connected.

The difference between the test results gave the additional power consumed by the CMS node and the standby power, an average of 1.71 circuit watts.

As part of the testing, results were also provided with the LEDs in the lamp:

- switched off (0% brightness), and
- no CMS node connected.

The test result showed that the driver when powered by the mains but with no other equipment connected or using energy incurred a 0.48W power loss in standby mode **(twice as much power as a generic PECU).**

The node was given a circuit watt rating of 1.23 watts (1.71W-0.48W), meaning that whilst the energy used directly by the DC node is being captured as a continuous supply, **the daytime standby consumption of the driver acting as a power supply for the CMS Node is not being captured**. Note that at night any power loss will have been included in the circuit watt rating of the LED lamp

Overall powering the DC node from the driver will use 1.71 watts during the day but will only add 1.23 watts to the overall night-time consumption.

This specification for a LED driver has a maximum power loss given which will have been included in the circuit watts for the LED Charge Code, but note that the standby power is again circa 0.5W. Under the traditional arrangements this power will not be captured in settlements and the customer's energy bills.

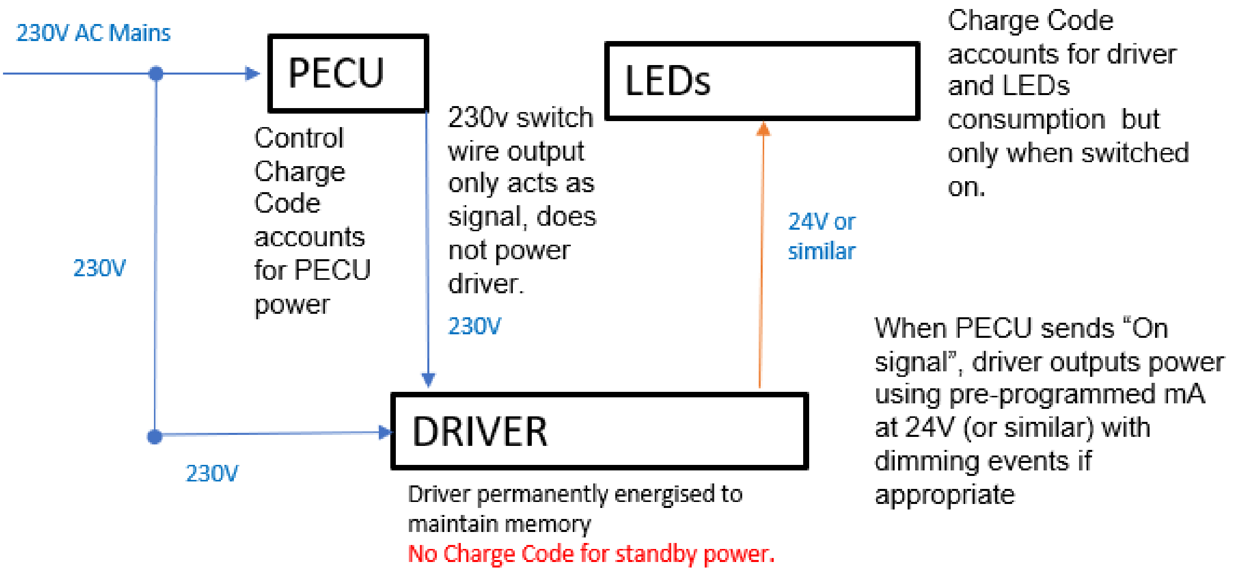
| | |
|---|---|
| Device power loss | 8.0 W |
| Networked standby power | < 0.50 W |

## 3.2. LED Drivers permanently powered to control dimming

A further potential issue is described below but no verification has been possible. When dimming of lamps by electronic ballasts first occurred it was identified that some dimming electronic ballasts needed standby power to maintain a "memory" of the dimming pattern. The approach to accounting for standby load is documented in the OID at paragraph 3.8 which contains the following;

> Where the dimming control is integral to the ballast, the equipment will be coded as 'Electronic Ballast with integral VPSR Dimming Equipment'. A dedicated Control Charge Code will be used in conjunction with these ballasts with an uplift of 1 Watt to account for the stand-by power. These codes can be coded either with specific lamp types or with any lamp type if the ballast will drive the lamps to specific values.

It is possible that some LED drivers similarly need standby power which is not accounted for under the traditional arrangements. The following diagram illustrates the potential issue. It may be that both the PECU/CMS Node (control) and the LED driver take power directly from the 230V mains supply. The switch wire from the control, which would normally provide power to the LED driver at night only, acts as a “signal” for the driver to output a supply from the driver to the LED lamps. **The driver will be in standby mode throughout the day without the power being captured**




## 4. Approaches considered.

Two different approaches have been considered to capture the unaccounted for energy;

1. Although earlier in the document it appears that the standby driver power is circa 0.5W, in both cases this is based on a driver with an output of roughly 100W. A percentage uplift to the circuit watts of the LED charge code might be appropriate, dependent on the maximum output of the driver. However, if we use 0.5W and taking the earlier example from paragraph 2 the inventory would contain the following entry:

| | | |
|---|---|---|
| Control Charge Code | 9400011000100 = 0.25watts | Switch Regime = 001 (continuous), plus |
| Lamp Charge Code | 4200210000100 = 21watts | Switch Regime = 821 (70/35lux) |

   The Lamp Charge Code has been increased by 1 watt to account for the standby power over 24 hours, i.e., doubled as night hours only. However, this approach is not ideal because the full standby consumption will not be recovered if the LEDs are dimmed and the standby consumption will all be allocated to the night hours rather than being recognised as a continuous supply. Or,

2. Set the Control Charge Code circuit watts to include the standby power, in line with 3.8 of the OID. A nominal 0.5W might be appropriate based on the two earlier examples, but again this may be dependent on the maximum output of the driver. The inventory would contain the following entry;

| | | |
|---|---|---|
| Control Charge Code | 940001100#100 = 0.75watts | Switch Regime = 001 (continuous), plus |
| Lamp Charge Code | 4200200000100 = 20watts | Switch Regime = 821 (70/35lux) |

   The Lamp Charge Code should be reduced by 0.5W, rounded to the nearest watt in line with the generic LED Charge Code protocol. This approach means that the energy is allocated correctly across 24 hours.

Both approaches are simplistic/pragmatic taking no account of variations that may occur in the design/specification of different drivers. It may be that further discussion needs to take place, including if possible manufacturers and/or the Zhaga consortium who may wish to appoint a representative to speak at UMSUG on this and other related matters. It may be that the OID defined testing requirements should be revised to make provision of the required information mandatory.

## 5. Recommendation

The UMSUG is invited to;

- Consider the issues raised in this document and recommend an approach to capture the potential energy losses, and
- Ensure that the OID is updated to clarify the testing requirements to ensure that the Controller and Lamp Charge Codes are allocated correctly.

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