CABLEFORM

Based in Sowerby Bridge in the heart of West Yorkshire, Cableform is part of the Electrical Engineering Division of the Hallmark Industries Group.

The company is renown for manufacturing and supplying high standard, innovative electrical products and appliances to a range of industries.

ISO 9001 accredited, Cableform employs nearly 200 people in its five specialist business units: Zodion Street Lighting Controls, Lumo Lighting, Zodion Wholesale, ENM & HA Birch.

Cableform products are recognised as the leading brand in a number of industries including; photo electric control devices and electronic ballasts for the switching and control of streetlights, low voltage lighting for caravans, motor homes and commercial vehicles and hand numbering machines for the stationery and legal industries.

A 10,000 m² factory, at Cableform's Sowerby Bridge headquarters, houses the company's comprehensive manufacturing facilities, which include; press shops, tool-room, machine shop, foundry, injection moulding facilities and assembly floors.

Photocell and Street Lighting Controls

Effective lighting plays an important role in keeping our streets and roads safe for drivers and pedestrians alike.

Zodion Street Lighting Controls has gained an unrivalled reputation in this specialised field. Indeed, we engineer, manufacture and supply an extensive range of high quality electronic photo control units and lamp ballasts for highway, street and amenity lighting.

Over the years we have developed a wide-ranging and prestigious customer base that includes:

- Local Authorities
- Utility companies
- Blue chip OE M's
- Contractors

To coincide with the release of our new catalogue we are equally excited to announce the launch of an extensive range of new one part NEMA and miniature photocells. These PECU's utilize our patent pending DyeMatch™ filtering process, which coupled with our commitment to an innovative and ongoing research and development programme, now firmly entrenches our status as UK's leading designer and manufacturer of photo control switching devices.

We fully recognise that business should progress in an atmosphere of continuing professional entrepreneurship on the back of win-win relationships, and that constant change is inevitable as we strive to be innovative in the many and varied markets in which we operate.

Our ambitious year on year plans for continuing growth will be secured through the hard work of all of our employees by committing themselves to achieving total customer satisfaction.

On behalf of Cableform's street lighting division we are proud to be able to present to you our new product catalogue and hope that you will enjoy and benefit by it.

What are Photo Electric Control Units (PECUs)?

PECUs are light operated switches. They switch the supply ON to a load when the light level falls beneath a given value (usually at Dusk), and switch the supply OFF when it rises above another level (usually at Dawn). The ratio between the two light levels is known as the switching ratio.

Positive Ratio

When the ON level is lower than the OFF level (e.g if the load switched ON at 70Lux and switched OFF again at 105Lux, then the unit has a ratio of 1:1.5). As can be seen from Table 1, below positive ratio units have significantly longer annual burning hours than negative ratio units.

Unity Ratio

When the ON and OFF levels are the same (1:1 ratio).

Negative Ratio

Most streetlighting loads have a warm-up time during which the lamp achieves full brightness. This is typically a number of minutes, and the idea of negative ratio units is that the ON level needs to predict when the lamp will achieve sufficient output, whereas the OFF level is when the light is no longer needed. Typically a 1:0.5 ratio is ideal for this (e.g. turning ON at 70Lux and OFF at 35Lux).

Part night PECUs

Using advanced functionality; PECUs can be designed to predict the time of day by measuring the day length. They are then able to turn OFF at midnight, and turn back on at say 5:30am. The time is determined from cumulative light measurements at dusk and dawn over a number of nights. The timing is not exact and does not compensate for changes in the time due to daylight saving. Use of such systems can dramatically reduce annual burning hours. For the timing to be maintained it is important that the PECU remains continuously powered. If the power is removed, it will take the PECU some days to re-synchronise and re-establish the correct timing. An example of such a product is the *Zodion SS9*.

A further variant is a Part Night dimming PECU. These PECUs operate similarly to the above, but instead of extinguishing the light during the early morning hours, the lamp is operated at reduced output. Dimming is achieved by use of suitable control gear in the lantern. Whilst this does not affect burning hours, it reduces the average consumption as the light is operating at reduced consumption for several thousand hours annually. An example of such a product is the *Zodion Sontek*.

Energy Consumption

PECUs affect energy consumption in 2 ways:

PECU Consumption

The PECU consumes energy. The amount varies according to the technology used. Generally consumption is less than 5W (approx 44kWh/year) and many are less than 0.25W (which equates to 2.2kWh/year)

Burning Hours

Burning hours have the most dramatic effect on consumption. A further 100hrs/year on a typical 100W load results in an additional 10kWh/year consumption. Switching level, switching accuracy, and switching ratio most affect burning hours.

A major consideration is how accurately and consistently the load is controlled over a long period of time. PECUs have benefits over time-clocks since they turn the lights on when the light falls, ensuring that light is provided when there is poor visibility prior to dusk, yet providing optimum control on clear evenings, taking full opportunity of good daylight. The total number of hours that a PECU operates the light for each year is called the annual burning hours. Table 1 below shows a *typical* example of the burning hours for PECUs with various switching ratios and switching levels. The actual number of hours will vary according to the weather profile of the year, and exact location of the installation.

Switching Level	Switching Ratio	Annual Burning Hours
70 Lux	1:3	4365
	1:2	4290
	1:0.5	4145
55 Lux	1:0.5	4115

Table 1:
Comparison of typical burning hours

Zodion

Daylight

Daylight contains much more than just visible light, however our eyes are only sensitive to a specific band of wavelengths. The intensity of visible light, corrected for the eyes' varying sensitivity to colour is measured in Lux. Wavelengths of daylight that the eye is not sensitive to do not contribute to a measurement of Lux.

The day-night cycle results from the earth's rotation. A consequence of this is a relatively quick decline of light at dusk. The proportion of visible light to other wavelengths varies not only on a diurnal cycle, but also seasonally and as a result of weather conditions. This means that only direct measurement of visible light level can accurately reflect the level of light that our eyes see as a result of daylight. This poses a problem when sensors used in PECUs have marked sensitivity to wavelengths of daylight outside of that visible to our eyes.

These sensors, although very accurate, may not be accurate at measuring Lux. A particular issue is Infra-Red (IR). Daylight contains significant infra-red however IR is strongly affected by atmospheric conditions and can be strongly attenuated in conditions where visible light is much less affected. Accordingly IR levels can be much lower than those anticipated by the level of visible light. Many semiconductor sensors have marked sensitivity to IR as well as visible light; hence a PECU with significant IR sensitivity could switch on before reaching the target visible light level (in Lux). Sensors with IR sensitivity tend to underestimate equivalent visible light levels in daylight rather than over-estimating them, hence they always tend to operate in a 'safe' manner.

Sensors used in PECUs

The most critical part of any PECU is the light sensor. The spectral sensitivity and long-term stability play an important role in providing reliable daylight detection.

		Drift	Dusk / Dawn Switching Repeatability	Spectral Sensitivity vs Photopic Response	Other
Cadmium Sulphide (CdS)		Moderate	Moderate	Good	Contains Cadmium
Photodiode	**Unfiltered**	Imperceptible	Moderate	Moderate	
	IR Filtered	Imperceptible	Poor	Very Poor	Insensitive to Visible Light
	Glass Filtered	Imperceptible	Excellent	Excellent	
	DyeMatch Filtered	Imperceptible	Excellent	Excellent	

Table 2: Comparison of sensors commonly used in PECUs

Cadmium Sulphide (CdS)

CdS sensors operate as light dependant resistors. They have conductivity approximately proportional to the level of light. They were the predominant sensor 10 years ago and are still frequently used. CdS sensors are becoming less popular due to environmental considerations and they are also subject to some long-term drift.

Photodiode Sensors

It is possible to construct a semiconductor diode to produce a current proportional to the incident light level. The currents generated are small and need careful amplification by a circuit that compensates for thermal effects. The fundamental physics of semiconductor junctions means that silicon photo-diodes have significant sensitivity to light outside the visible spectrum. Although semiconductor technology can limit this, other measures e.g. filters are needed for matching of sensitivity to that of the human eye. This is usually achieved by the addition of a filter that blocks light outside the visible spectrum. Filters can take a number of forms, but are usually bulk-coloured glass slips added to the photodiode assembly during manufacture. Zodion's DyeMatch™ is a novel approach whereby a special Infra-red blocking dye is added to a polymer and special lens caps moulded from this material are fixed over the photodiodes.

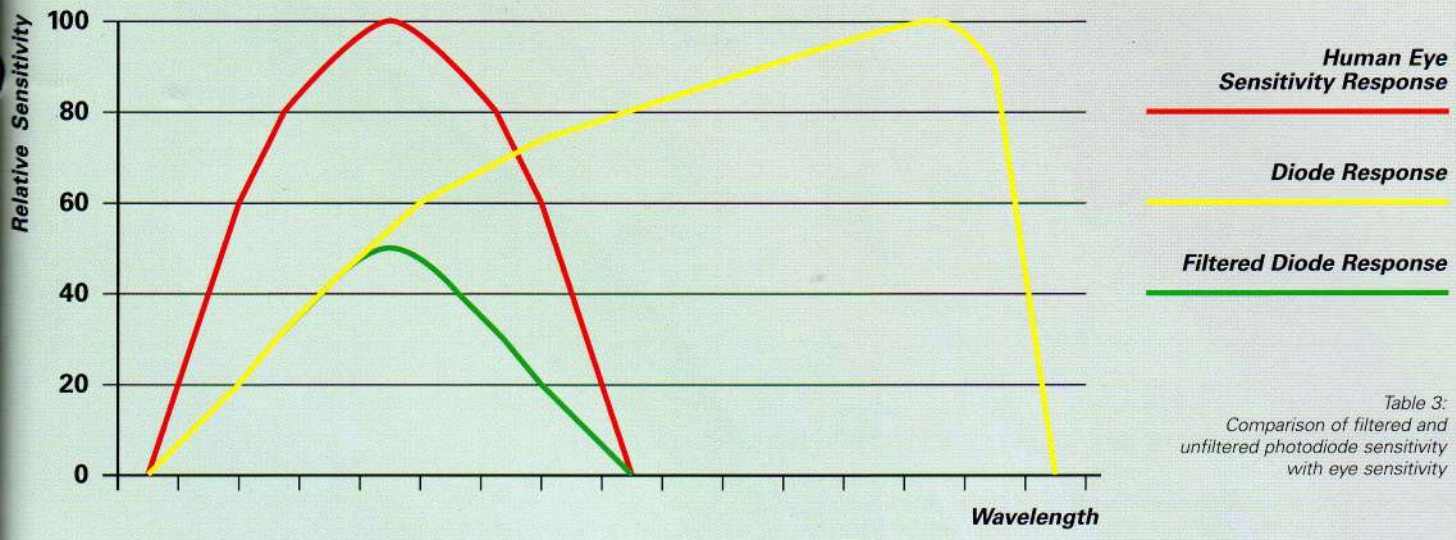

Table 3: Comparison of filtered and unfiltered photodiode sensitivity with eye sensitivity

A variant of the above is to add a filter that blocks all visible light, so that the photodiode is only sensitive to Infra-red light. This can be incorporated into a PECU that is only sensitive to IR, and virtually insensitive to visible light. This means that the PECU can be used where it is partially illuminated by visible light, often produced by the light that is being controlled by the PECU. Such a product is the Zodion 'Lowlight'. It is typically used in bollards, where the PECU is incorporated into the base compartment and is illuminated by visible light from the lamps within the base reflected from the inside of the cover. The lowlight is insensitive to this light, and operates by sensing the IR component of daylight transmitted through the cover.

There are 3 cautionary notes:

- Such PECUs can only be used with light sources that generate virtually no IR (Incandescent lamps generate huge amounts of IR)
- That the PECU, although insensitive to visible light, will still be affected by very high levels of visible light. The arrangement of the PECU within the luminaire should minimise such light.
- The proportion of IR to visible light in daylight varies with weather conditions so the PECU will not switch as accurately as a conventional PECU. An increase in annual burning hours of up to 25% can be expected.

Photodiode sensors can also be incorporated into integrated circuits although the functionality may be limited due to the competing requirements of semiconductor processing for optoelectronics and integrated circuits.

Load Switches

PECUs typically use one of three devices to switch the load:

- Thermal Relay
- Electromagnetic Relay
- Semiconductor

Thermal Relay

These relays are suited to use with CdS sensors. They have a number of drawbacks, principally power consumption and size. They are increasingly being replaced by products using other load-switches. They operate by the action of a heating element on a bi-metal strip, as the strip deflects it causes contacts to make, or break.

Electromagnetic Relays

These relays are widely used in many applications. They are both small and capable of operation at low power. They are relatively poor at transferring high inrush loads (common to many streetlighting applications); this can be mitigated by techniques such as predictive load transfer.

Semiconductor

There are a number of semiconductor devices capable of switching streetlighting loads. Triacs are the most common, however Thyristors and MOSFETs have also been used. These devices are reliable, simple to control, and have a good ability to transfer high inrush loads. It is relatively easy to implement zero-cross switching with semiconductor switches.

	Consumption	Load Switching Capacity	Load Holding Capacity	Size
Thermal Relay	Poor	Moderate	Excellent	Large
Electromagnetic Relay	Moderate	Moderate	Excellent	Moderate
Semiconductor	Excellent	High	High	Small

Table 4: Load Switching Devices

Characteristics of a Streetlighting Load

Typical lighting loads have a number of principal characteristics:

Inrush

Most discharge lighting loads require Power Factor Correction. The most common method of providing this is by the use of PFC capacitors. When connected to the supply it is possible for many hundreds of amps to flow momentarily. The magnitude and duration of the inrush current depends upon the value of capacitance (measured in µF), and the impedance of the supply network. This current is capable of welding together contacts of relays and other switching devices. It is also possible for these currents to fuse semiconductors, and it is reliant on good product design to ensure that the effect of inrush has been taken into account.

PF

Power factor can dramatically change the characteristics of a load. Whilst a load may be 100W and draw about 0.4A at unity power factor, it will draw over 1A with a power factor below 0.35 (common for discharge loads with failed PFCs). Also, various common lamp or ballast faults can give rise to a situation where just the PFC is connected. In this case although no power is consumed the current through the PECU will also be above 1A. Hence the PECU must be capable of operating the load over the range of likely load conditions, including common failure modes of lantern control gear.

Ratings

It is important to ensure that the maximum ratings are not exceeded, care must be taken to observe both the current rating and also the maximum capacitive load that can be connected.

Formats for Photocells

NEMA

The 'NEMA' socket is partially defined in BS5972 and has become the de facto connector for most 1-part photocells. The three connections are the incoming live, the switched live out, and a neutral connection (used only for powering the PECU).

Conduit Mounting

This allows for the direct mounting of a photocell onto a Ø20mm thread. Connection is made via wire leads. This arrangement is often used for 'special' photocells where more than 3 connections are required (such as the Zodion Sontek).

Miniature

Miniature photocells are principally used for direct integration within luminaires. As they operate inside the luminaire specific consideration needs to be given to the operating temperature. It is possible for the internal temperature within a streetlighting luminaire to rise to over 100°C, and the photocell needs careful selection to ensure that a reasonable life is achieved.

IP65

This designation relates to the degree of weatherproofing. IP65 is ideal for use in all applications; however IP67 may be applicable where the unit is subjected to power washing, or exceptionally forceful jets of water.

Cableform Ltd · Gratrix Lane · Sowerby Bridge · West Yorkshire HX6 2PH
Tel: +44 (0) 1422 833 533 · Fax: +44 (0) 1422 836 103

Technical Specification - PHOTO ELECTRIC CONTROL UNITS · ONE & TWO-PART

Zodion

Family	SS4D			SS54B	SS5DR			SS6				SS9		SS5		
Model	SS4D	SS4ED	SS4DN		SS3DR	SS5DR	SS5DR/HD	SS3	SS6	SS6C	Super 6	SS9MP	SS9MPC	SS5	SS5C	SS55B
Type	One Part	One Part	One Part	Two Part	One Part	One Part	One Part	One Part	One Part	One Part	One Part	One Part	One Part	One Part	One Part	Two Part
Electronic Solid State								✓	✓	✓	✓	✓	✓	✓	✓	✓
Electronic EM Relay Load Switching	✓	✓	✓		✓	✓	✓									
Thermal Relay				✓												
Voltage (VAC) Range 50/60HZ	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264
70 Lux Standard Switch-On Level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
55 Lux Option	✓	✓							✓					✓	✓	
100 Lux Option	✓															
Switching Differential	1:1.5 POS	1:1.5 POS		1:2.5 POS												
			1:0.5 NEG		1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG
Typical Load Watts HPS	2 x 250	2 x 250	2 x 250	2 x 250	2 x 250	2 x 250	3 x 400	2 x 400	3 x 400	3 x 400	3 x 400	400	400	2 x 250	2 x 250	2 x 250
Max Operating Ambient Temp Range (°C)	-20/+70	-20/+70	-20/+70	-20/+55	-20/+80	-20/+80	-20/+80	-20/+80	-20/+80	-20/+80	-20/+80	-20/+60	-20/+60	-20/+70	-20/+70	-20/+70
Max Switching Capacity (Whichever is Greatest)	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	8 Amps or 90 mfd	7.5 Amps or 90 mfd	10 Amps or 90 mfd	10 Amps or 90 mfd	10 Amps or 90 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd
Switching Delay in Seconds	10	10	10	60	10-15	10-15	10-15	10-15	10-15	10-15	10-15	60	60	10-15	10-15	10-15
Polycarbonate Enclosure (UV Stabilised)																
Power Consumption Watts	<0.5	<0.5	<0.5	3 Watts Day Zero Night	<0.25	<0.25	<0.25	<0.25	<0.25	<0.2.5	<0.25	<0.5	<0.5	<0.25	<0.25	<0.25
Sensor Type	Photodiode	Photodiode	Photodiode	CdS	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	CdS	CdS	CdS
Sensor Drift	Negligable	Negligable	Negligable	Slight	Negligable	Negligable	Negligable	Negligable	Negligable	Negligable	Negligable	Negligable	Negligable	Slight	Slight	Slight
Fixing	NEMA	NEMA	NEMA	2-Part	NEMA	NEMA	NEMA	NEMA	NEMA	20mm Conduit	NEMA	NEMA	20mm Conduit	NEMA	NEMA	2-Part
IP Rating (Installed)	IP65	IP65	IP65	Sensor: IP65 Unit: Ipxx	IP65	IP65	IP65	IP65	IP65	IP65	IP67	IP65	IP65	IP65	IP65	Sensor: IP65 Unit: Ipxx
IP67 Option						✓	✓		✓		Standard			✓	✓	
VDR Voltage Supression		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Additional Features					Predictive Transfer Switching "Dyematch" Filter System	Predictive Transfer Switching	Predictive Transfer Switching	Zero Cross Switching "Dyematch" Filter System	Zero Cross Switching	Zero Cross Switching	Zero Cross Switching Ultra Long Life Components 10 Year Warranty	Part Night Switching Micro Processor Control	Part Night Switching Micro Processor Control			

Technical Specification - PHOTO ELECTRIC CONTROL UNITS · MINIATURES

Family	SS10							SS11			SS12				Lowlight Bollard Cell
Model	SS10	SS10N	SS10ZA	SS10ZB	SS10NR	SS10ZAR	SS10ZBR	SS11N	SS11ZA	SS11ZB	SS12A	SS12A-R	SS12-HT	SS12HD	
Type	Miniature	Miniature	Miniature	Miniature	Miniature Remote Sensor	Miniature Remote Sensor	Miniature Remote Sensor	Miniature	Miniature	Miniature	Miniature	Miniature	Miniature Remote Sensor	Miniature	Miniature
Electronic Solid State	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓
Electronic EM Relay Load Switching											✓	✓	✓	✓	
Voltage (VAC) Range 50/60HZ	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264	198-264
70 Lux Standard Switch-On Level	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Dusk to Dawn
55 Lux Option											✓				
100 Lux Option				✓						✓					
Switching Differential	1:1.5 POS		1:1.5 POS	1:3 POS		1:1.5 POS	1:3 POS		1:1.5 POS	1:3 POS					Off at Dawn
		1:0.5 NEG			1:0.5 NEG			1:0.5 NEG			1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	1:0.5 NEG	
Typical Load Watts HPS	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	1 x 70	2 x 250	2 x 250	2 x 250	3 x 400	70
Max Operating Ambient Temp Range (°C)	-20/+75	-20/+75	-20/+75	-20/+75	-20/+75	-20/+75	-20/+75	-15/+75	-15/+75	-15/+75	-15/+75	-15/+75	-15/+100	-15/+75	-15/+75
Max Switching Capacity (Whichever is Greatest)	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	0.62 Amps @ 55C or 10 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	5 Amps or 60 mfd	8 Amps or 90 mfd	10 mfd
Switching Delay in Seconds	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	5-15	15-60
Polycarbonate Enclosure (UV Stabilised)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Power Consumption Watts	0.45 Watts	0.45 Watts	0.45 Watts	0.45 Watts	0.45 Watts	0.45 Watts	0.45 Watts	0.45	0.45	0.45	<0.25	<0.25	<0.25	<0.25	0.45
Sensor Type	CdS	CdS	CdS	CdS	CdS	CdS	CdS	CdS	CdS	CdS	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Filtered Photodiode	Infra Red Photodiode
Sensor Drift	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Slight	Negligable	Negligable	Negligable	Negligable	Negligable
Fixing	Dia 16mm	Dia 16mm	Dia 16mm	Dia 16mm	20mm Remote Head	20mm Remote Head	20mm Remote Head	Dia 16mm	Dia 16mm	Dia 16mm	20mm	20mm	20mm	20mm	Miniature 16mm
IP Rating (Installed)	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP65	IP20
VDR Voltage Supression											✓	✓	✓	✓	
Additional Features			Zero Cross Switching	Zero Cross Switching		Zero Cross Switching	Zero Cross Switching		Zero Cross Switching	Zero Cross Switching	Predictive Transfer	Predictive Transfer	High Temperature Operation Predictive Transfer	High Temperature Operation Predictive Transfer	Use Alongside Fluorescent Lighting