

## Compliant 110V Site Power & Lighting Schemes

Providing construction sites with an effective, reliable and compliant 110V power and lighting scheme is an essential ingredient in improving site safety and productivity. Although installations are “only temporary”, the potentially dangerous working environment necessitates that systems have a high level of integrity, they must be adaptable and not create hazards such as risk of fire or electric shock due to ineffective, non-compliant circuit protection.

When considering a 110V site power and lighting scheme, the starting point for every installation should be compliance with the requirements of the IET Wiring Regulations (BS 7671) and the light level recommendations of BS EN 12464-2. Cost effective compliance can be achieved through the adoption of modern site transformers, low energy LED luminaires and a structured lighting system. In the table below we have identified compliant illumination and distribution schemes, which should enhance on-site safety and productivity.

### Light Levels

We have produced a series of generic lighting schemes for open floor areas and corridors that provide a guide to the illuminance that can be expected to be achieved on site. These schemes utilise LED luminaires and cross refer to the light levels recommended in BS EN 12464-2 for Building Sites, Table 5.3 refers. The results below are based on using our 5m spacing Flori-67 plug-in lighting system, which is the most popular spacing. However, we are also able to provide results for the 7m and 10m spacing varieties. As can be seen from the table below, even at 5m spacing, not all schemes can achieve the lighting levels required in 5.2.3 (100 lux) and, in order to achieve the levels required by 5.2.4 (200 lux), it would be necessary either to utilise local task lights or to produce a site specific lighting scheme, which might include the use of floodlights, a greater concentration of standard luminaires or the deployment of luminaires with a higher light output. It should be noted that the generic schemes are comparatively conservative in their assumptions and it may well be that higher average lux levels are achieved in practice.

### Electrical Protection

The use on site of 110V Reduced Low Voltage (RLV) must have saved countless lives over the last 40 years. However, no system is perfect and meeting disconnection times and clearing line to line faults before cabling overheats and potentially causes a fire is a challenge for designers. However, it is possible to design economic, compliant power and lighting systems using standard Blakley products and some are shown in the chart below. Compliance is based on assumptions about the supply impedance. If these assumptions do not apply to a specific installation, we are able to check compliance based on your site specific figures. Please see over the page for further details.

Compliant RLV Distribution and Lighting Schemes based on Hard Wired Lighting Circuits

		Compliance with Light Levels per BS EN 12464-2, Table 5.3						Compliance with 17th Edition Disconnection Time and Fault Clearance Requirements ##			
		Internal "Open" Area			3m Wide Corridor			Cable Cross-section and Length of Flori-67 String	Single Phase Site Transformers, 5kVA #	Three Phase Site Transformers, 7.5kVA and 10kVA #	
BS EN 12464-2 Sub-section		5.3.1	5.3.2	5.3.3	5.3.1	5.3.2	5.3.3	Cable CSA	Length of Circuit	Part Nos. S210343 and S210345	Part Nos. S210303, S210304, S210305, S210307, S210356 and S210358
Generic lighting schemes are based on 5m spacing Flori strings, a reflectance level of 20% for all surfaces, a Maintenance Factor of 0.72 and a mounting height of 3M.	30W LED, 5m spacing (1 every 25m <sup>2</sup> in open areas)	Compliant	Compliant	Non-Compliant (77 lux)	Compliant	Compliant	Non-Compliant (72 lux)	1.5mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Non-compliant	Non-compliant
								2.5mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Compliant	Compliant
								4mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Compliant	Compliant
	44W LED, 5m spacing (1 every 25m <sup>2</sup> in open areas)	Compliant	Compliant	Compliant	Compliant	Compliant	Compliant	1.5mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Non-compliant	Non-compliant
								2.5mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Compliant	Compliant
								4mm <sup>2</sup>	50m	Compliant	Compliant
									100m	Compliant	Compliant

BS EN 12464-2	Type of area, task or activity	Illuminance, Lux
5.3.1	Clearance, excavation and loading	20
5.3.2	Construction areas, drain pipes mounting, transport, auxiliary and storage tasks	50
5.3.3	Framework element mounting, light reinforcement work, wooden mould and framework mounting, electric piping and cabling	100
5.3.4	Element jointing, demanding electrical, machine and pipe mountings (would typically require local task lighting)	200

# Hard wired lighting circuits are protected by specific 10A DP MCB / RCD combinations or RCBOs. See over the page for details.

## BS7671:2008+A3 Regulations 411.8.3 and 434.5.2 refer. See over the page for assumptions made in claiming compliance.

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## Flori Lighting Systems

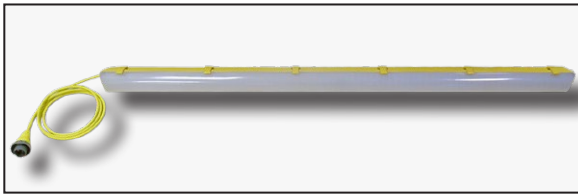
Flori-67/3P and Flori-67/4P are 3C and 4C, 110V, plug-and-play, structured lighting systems developed by Blakley Electrics specifically for temporary site installations. They are factory made and tested with all wiring carried out “off site”. The standard systems comprise of two main elements:

- (i) Anti-corrosive LED luminaires pre-wired with an Adaptor cable made from 1.5mm<sup>2</sup> Yellow flexible cable fitted with a moulded-on, 6A, 110V, IP67 plug (the standard length Adaptor cable is 2 metres).
- (ii) 100m lengths of 3C or 4C Yellow PVC Arctic grade cable fitted with unique 3P or 4P moulded-on, 6A, 110V, IP67 outlets at 5m, 7m or 10m intervals. We can also supply strings made from LSOH cable.

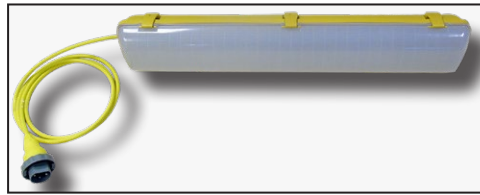
Once luminaires are fixed in position, electrical connection is simply achieved by plugging fittings in to the nearest Flori-67 outlet.

As Flori-67/3P utilises 3 core cable only, circuits with emergency fittings should be permanently energised to avoid damage to battery packs through repetitive deep discharging. Therefore, where there is a requirement for emergency fittings to be switched off routinely, Flori-67/4P should be adopted, which incorporates 4 core cable and 4 pin connectors, enabling an unswitched supply to be provided for emergency packs.

As can be seen from the table on page 1, in our generic schemes, 30W LED luminaires enable compliance with BS EN 12464-2 parts 5.3.1 and 5.3.2. Whilst the 44W LED luminaire also achieves compliance with 5.3.3 in open areas and in corridors. Please refer to Site Lighting data sheets SLDS001 and SLDS002 for full details of the Flori-67/3P and Flori-67/4P, which are our two types of plug-in lighting system.



5' 44W 110V LED



2' 30W 110V LED



Flori-67/3P outlet & adaptor

## Site Transformers

Installing a “compliant” RLV supply scheme depends on a number of factors including the impedance of the supply to the transformer, the specification of the transformer winding, the characteristics of the circuit protection and the impedance of the 110V circuit. In order for us to describe schemes as “compliant” (on page 1) it has been assumed that the supply impedance does not exceed 0.8 ohms (this figure is taken from the maximum earth fault loop impedance  $Z_e$  figure typically quoted by Distribution Network Operators for a 100A rated TN system supply and is used by the BS 7671:2008+A3 On-site Guide) and that site transformers are installed on circuits not exceeding certain lengths (please see adjacent diagrams for specific details). If the “actual” supply impedance is higher than the assumed figures or the circuit lengths are longer, we can recalculate based on specific measurements. However, it is believed that the assumed figures are typical.

### *Meeting the 5 second Line to Earth Disconnection Time for Lighting Circuits, BS7671 Regulation 411.8.3*

Using conventional overcurrent MCBs to meet the 5 second disconnection time specified in BS7671 has long been recognised as the Achilles Heel of 110V Reduced Low Voltage (RLV) distribution systems, particularly when supplying long, hard wired lighting circuits. Whilst it may be possible to achieve compliance by lowering the rating of the MCB, increasing the cross section of the cable and significantly shortening the circuit length, most have concluded that the only practical way of providing compliant protection for longer circuits is to provide RCD protection. When supplying lighting circuits, we recommend that they are hard wired in to the transformer and we advocate one RCD per circuit, to limit the effect when a device operates.

### *Adiabatic Protection of Lighting Circuits by Overcurrent Devices*

A less well documented “problem” with 110V RLV systems is that associated with failing to clear line to line faults before cable is damaged or overheats and causes a fire. This issue arises from a combination of: low short circuit levels found on the secondary of relatively small power transformers; the high impedance of small flexible cables; the need to incorporate a 16A MCB to feed traditional festoon and fluorescent lighting circuits. As a result of the adoption of LED light sources, it is now possible to provide a high level of illumination (to BS EN 12464 section 5.3.3) on comparatively long circuits of 2.5mm<sup>2</sup> cable (up to 100m) with adiabatic protection provided by 10A “C” trip Schneider DP MCBs or 10A “C” trip ABB DP RCBOs.

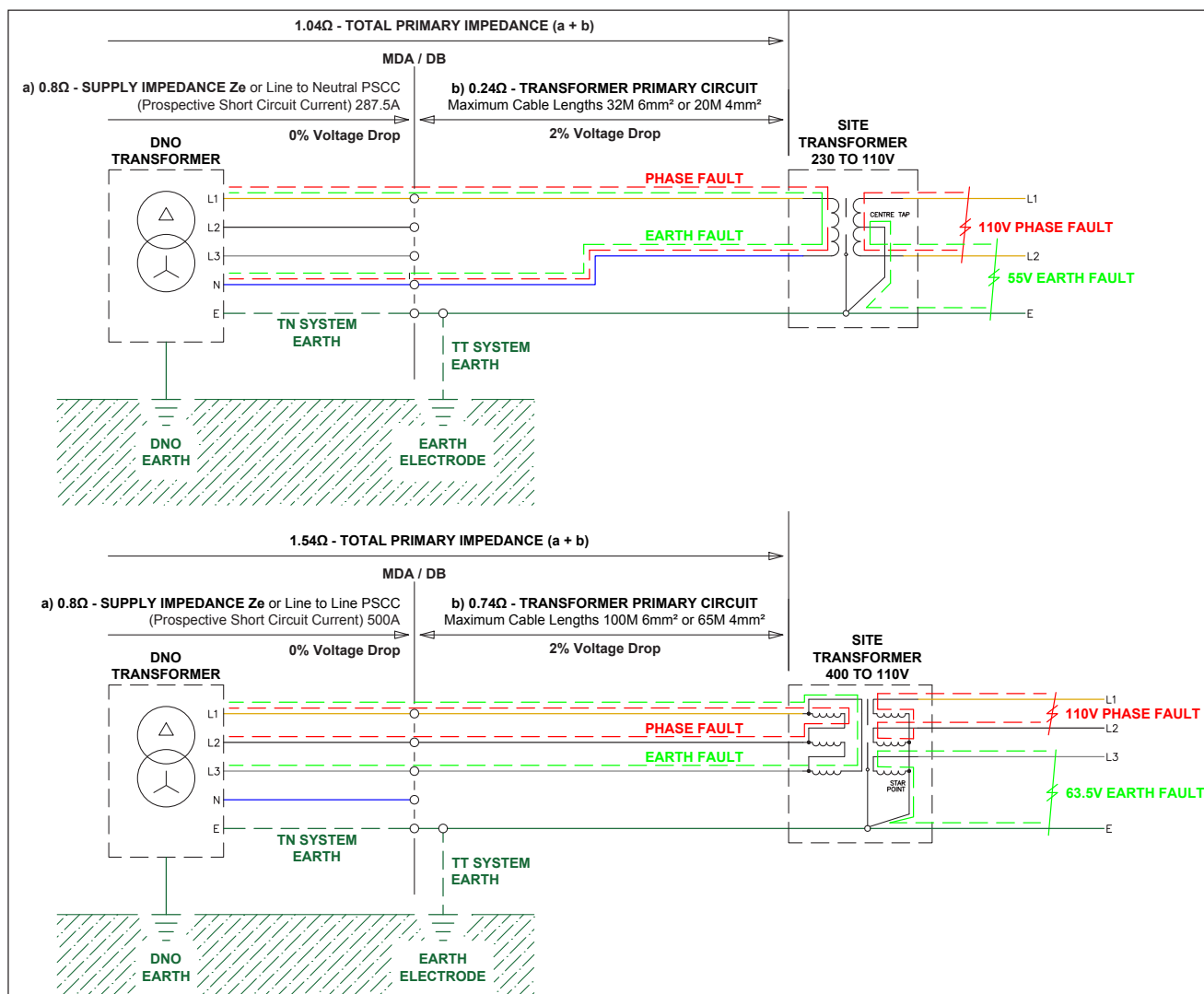
### *Protection of Sockets*

The protection of 110V sockets is a greyer area with regards to compliance with all aspects of BS7671. There are concerns relating to volts drop, line to earth disconnection times and the protection of cables from line to line faults, all of which require the close control of extension leads as a minimum. The addition of RCD protection for sockets also addresses some of the concerns. Sockets can be protected individually by RCD or they can be group protected. Individual protection is preferable but group protection is more cost effective. For group protection we would recommend an RCD sensitivity of 300mA to reduce the likelihood of nuisance tripping. We have a standard range of Site transformers with RCD protection of sockets but they are made to order.

We offer a range of “compliant” transformers with hard wired lighting outputs (see page 4) and other configurations can be supplied to suit specific site requirements.

## Assumptions Made to Support Claim of Compliance

The diagrams and notes below detail various assumptions that have been made re: Compliance. In particular we would bring Note 1 to your attention, which relates to the way that earth faults on the secondary side of site transformers are fed from the mains supply. This is particularly fortuitous when considering TT installations with a high earth loop impedance figures.



### IMPORTANT NOTES:

1. The above diagrams demonstrate that due to the creation of a new earth reference on the secondary side of the 110V transformer winding (centre tap on single-phase and star point on three-phase) secondary 110V line to earth faults (55V / 63.5V) do not use the earthing system on the primary side of the transformer. All secondary earth fault currents will return to the earth reference on the secondary side of the transformer winding, which will be reflected on the primary supply connections of the transformer (line and neutral for single-phase / line and line for three-phase). This is particularly beneficial for TT systems with high earth loop impedance figures.
2. The 1.54Ω (three phase transformer) and 1.04 Ω (single phase transformer) - Total Primary Impedance used above can be broken down into two elements:
  - i) 0.8Ω - Supply Impedance. This represents the loop impedance at the MDA or distribution board (DB) directly supplying the transformer primary circuit. This figure is taken from maximum earth fault loop impedance  $Z_e$  figure typically quoted by Distribution Network Operators for 100A rated TN system supplies and is quoted in the BS7671:2008+A3 On-site Guide.
  - ii) 0.74Ω (three phase) and 0.24Ω (single phase) - transformer primary circuit. This represents the loop impedance of 100m of 6mm<sup>2</sup> SWA cable or 65m of 4mm<sup>2</sup> SWA cable (three phase transformer) / 32M of 6mm<sup>2</sup> SWA cable or 20m of 4mm<sup>2</sup> SWA cable (single phase transformer).
3. Please note that the above maximum transformer primary circuit cable lengths (b) are based on transformers being fully loaded, with a 2% voltage drop allowance on the primary circuit cable (b) and a 0% voltage drop allowance for the supply impedance element (a). If the supply impedance is affected by voltage drop the maximum transformer primary circuit cable lengths would reduce in length.
4. As illustrated in the above diagrams both secondary Line to Earth (55V / 63.5V) and Line to Line (110V) faults do not use the primary earth system. Therefore for both TN and TT systems only the loop impedance of primary line conductors (Line to Line or Line to Neutral) needs to be considered.
5. The above diagrams and impedance figures are intended to represent a typical application, which may vary from actual site configurations and impedance values. For TN or TT systems with a higher earth loop impedance ( $Z_e$ ) figure, Line to Line (for three phase transformers) or Line to Neutral (for single phase transformers) loop testing will be required to establish the primary impedance or prospective short circuit currents. The Blakley Calculator can also be used to assist in establishing whether or not a specific installation can be described as Compliant.
6. Please note: other makes of MCB, RCBO and transformer will not necessarily provide a compliant scheme.

## Compliant Power and Lighting Products as defined in Blakley Tech Data Sheet ref. TDS19

Flori-67/3P, 110V - for full range please refer to Product Data Sheet SLDS001		
Part No.	Type	Description
LED Anti-Corrosive fittings, 110V, IP65, pre-wired with Flori-67/3P Adaptors, c/w hooks and arrays		
S060916	Flori-67/3P/30W/LED	Standard, 30W, 2' twin yellow body c/w Flori-67/3P input lead
S060917	Flori-67/3P/30W/LED/EMER	Emergency, 30W, 2' twin yellow body c/w Flori-67/3P input lead
S060918	Flori-67/3P/44W/LED	Standard, 44W, 5' single yellow body c/w Flori-67/3P input lead
S060919	Flori-67/3P/44W/LED/EMER	Emergency, 44W, 5' single yellow body c/w Flori-67/3P input lead
Flori-67/3P 100m Strings, 110V incorporating PVC Arctic grade cable with yellow outer sheath (LSOH cable is available)		
S060756	Flori-67/3P/10/1.5	100m 1.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 10m
S060755	Flori-67/3P/7/1.5	100m 1.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 7m
S060754	Flori-67/3P/5/1.5	100m 1.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 5m
S060759	Flori-67/3P/10/2.5	100m 2.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 10m
S060758	Flori-67/3P/7/2.5	100m 2.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 7m
S060757	Flori-67/3P/5/2.5	100m 2.5mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 5m
S060803	Flori-67/3P/10/4	100m 4mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 10m
S060802	Flori-67/3P/7/4	100m 4mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 7m
S060801	Flori-67/3P/5/4	100m 4mm <sup>2</sup> 3C cable - a Flori-67/3P outlet every 5m
Flori-67/4P, 110V - for full range please refer to Product Data Sheet SLDS002		
Part No.	Type No.	Description
Anti-corrosive fittings, 110V, IP65, LED, pre-wired with Flori-67/4P Adaptors, c/w hooks and arrays		
S060920	FLORI-67/4P/30W/LED	Standard 30W LED with Black Adaptor
S060921	FLORI-67/4P/30W/LED/EMER/3C	Emergency 30W LED with Red Adaptor (unswitched LED array supply)
S060922	FLORI-67/4P/30W/LED/EMER/4C	Emergency 30W LED with Green Adaptor (switched LED array supply)
S060923	FLORI-67/4P/44W/LED	Standard 44W LED with Black Adaptor
S060924	FLORI-67/4P/44W/LED/EMER/3C	Emergency 44W LED with Red Adaptor (unswitched LED array supply)
S060925	FLORI-67/4P/44W/LED/EMER/4C	Emergency 44W LED with Green Adaptor (switched LED array supply)
Flori-67/4P 100m Strings, 110V incorporating PVC Arctic Grade cable with yellow outer sheath		
S060713	FLORI-67/4P/5/1.5	100m 1.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 5m
S060714	FLORI-67/4P/7/1.5	100m 1.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 7m
S060715	FLORI-67/4P/10/1.5	100m 1.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 10m
S060707	FLORI-67/4P/5/2.5	100m 2.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 5m
S060708	FLORI-67/4P/7/2.5	100m 2.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 7m
S060709	FLORI-67/4P/10/2.5	100m 2.5mm <sup>2</sup> 4C cable with a Flori-67/4P outlet every 10m
Compliant Site Transformers - for full range of Site Transformers please refer to Data Sheets TRDS001 and TRDS007		
Part No.	Type	Distribution
5 kVA single-phase Slim Line site transformers fitted with a 25A DP Type "D" Input MCB		
S210343	TA-SL/P/1/5/S3/C2-10/RCCB	2 no. 16A and 1 no. 32A socket each with MCB protection. 2 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired
S210345	TA-SL/P/1/5/RCBO6-10	6 no. 10A DP ABB Type "C" RCBOs, hard wired
7.5 kVA three phase Slim Line transformers fitted with a 10A TP Type "D" Input MCB		
S210356	TA-SL/P/3/7.5/S6/C2-10/RCCB	4 no. 16A and 2 no. 32A sockets each with MCB protection. 2 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired
S210358	TA-SL/P/3/7.5/RCBO8-10	8 no. 10A DP ABB Type "C" RCBOs, hard wired
10 kVA three phase TA series Site transformers fitted with a 16A TP Type "D" Input MCB		
S210307	TA/P/3/10/S6/C2-10/RCCB	4 no. 16A and 2 no. 32A sockets each with MCB protection. 2 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired
S210303	TA/P/3/10/C6-10/RCCB	6 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired
S210304	TA/P/3/10/C6-10/RCCB/TC/3C	6 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired with integral time clock (3 core circuits)
S210305	TA/P/3/10/C6-10/RCCB/TC/4C	6 no. 10A DP Schneider Type "C" MCBs each with associated RCCB, hard wired with integral time clock (4 core circuits)