



SPECIFICATION FOR THE SUPPLY OF CONTROL PANELS

Any variation from the specification to be agreed with Oracle Drive Systems and confirmed in writing.

Rev Level: 20

Date: 25th Nov 2013

GENERAL ELECTRICAL SPECIFICATION

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1.1 APPLICATION AND SCOPE OF THE SPECIFICATION

All electrical equipment used must be to I.E.C. Standard except where this would be less than that acceptable to British Standard, in which case British Standard is to be used. **Particular attention should be drawn to BS EN 60204-1 (Electrical equipment of industrial machines).**

All work should be done in accordance with I.E.E. Regulations for electrical installations and in compliance with EN60204-1

All work should comply to the current statutory legislation governing electricity at work regulations.

A technical construction file will be supplied by Oracle Drive Systems Ltd for each panel build showing Electrical Diagrams, and voltage supply requirements if specified in the scope of work. The requirements defined in the said technical construction file shall be met.

Any special requirements stated in the purchase order or correspondence shall supersede any item stated in this specification. Any conflict or areas of uncertainty shall be confirmed with Oracle Drive Systems.

The construction of the panel will be to EN60204-1 unless stated in the technical construction file.

SUMMARY OF THE MAIN POINTS IN THE SPECIFICATION

In order to give the panel builder a quick guide to the areas of the specification that he may not meet automatically, a summary is listed below detailing the reference number within the specification. This list is not exhaustive and the panel builder must read and comply with all the items within the specification.

- 1.3.1.6** Any item that may have a high surface temperature such as break resistors or anti-condensation heaters etc, must have appropriate warning sign nearby.
- 1.3.1.8** Terminal rails shall carry 20% spare terminals. The spare terminals shall have blank markers fitted to allow the terminals to be labelled on site if required.
- 1.3.1.9** Incoming cables after glanding shall be kept tidy by means of cable trunking where necessary.
- 1.3.1.10** 20% space shall be provided in all trunking as a minimum
- 1.3.1.12** A pocket for placing the drawings shall be provided inside the door of the electrical cabinet where space permits. This pocket should be of sufficient size to hold all manuals and documentation for the panel normally in the way of a 25mm A4 Binder
- 1.3.1.13** All power contactors shall have suppression fitted across the coils.
- 1.5.3.4** Terminal rail for external field cables must be mounted on angled brackets for easy installation.
- 1.6.8** A separate earth bar shall be generated within control panel for termination of all earth wires. This earth bar shall normally be insulated from the backplate but connected by one earthing conductor to the backplate.
- 1.6.10** All earth terminations shall only have one conductor per terminal without exception.
- 1.8** Minimum testing requirements on any panel will be:
 - Continuity of the protective bonding circuit.
 - Insulation resistance tests.
 - Voltage tests.
 - Protection against residual voltages.
 - Functional tests.

Documentation and certification showing the above have been carried out to be provided by the panel builder.

1.2 NAME PLATES AND IDENTIFICATION

- 1.2.1 **Inside** the electrical cabinet the nameplate showing the specifications shall be attached with rivets or a self adhesive durable label in a place readily seen, usually at the point of isolation. The nameplate shall be as follows:

Oracle Number	W???
Telephone Number:	
Supply Voltage:	
Frequency and Phases:	
Rated Full load Current:	
Short circuit rating of equipment:	
Manufacturer:	
Date of Manufacture:	

- 1.2.2 All information plates which are attached shall be written in English unless specified otherwise.
- 1.2.3 Legend plates shall be provided, for the function of operating devices, these plates shall be written in English to give concise information. And shall comply with details listed in the drawings supplied. Legend plates to be provided for remote mounted operator stations fitted to control panel doors etc if required.
- 1.2.4 Legend plates shall be individual and made of plastic, with black lettering on white. Where possible they shall be held in place by the operating device, ie; selector switch/pushbutton etc. Where this is not possible miniature hammered in rivets shall be used, or suitable double sided tape.
- 1.2.5 All wiring shall be numbered, which shall correspond to the wiring diagram. Each end of the wire shall be numbered using standard colour coded ferrule markers.
- 1.2.6 Numbers must be attached so that numbers read left to right and bottom to top.
- 1.2.7 A general electrical hazard sign shall be suitably fixed to all electrical cabinets at access points (hazard sign shall be to BS5499 and BS5378).

- 1.2.8** A free issue “ORACLE DRIVE SYSTEMS” external sign to be fitted as specified on technical drawings supplied or as otherwise instructed.
- 1.2.9** Major components such as drives shall have a label attached to the front of the drive or the back plate, in addition to the device reference (ie 24A1), showing the name of the drive as marked on the electrical drgs, This is to aid quick and easy identification of the drive function in multi drive systems. This can be self adhesive such as dymo tape.

1.3 CONTROL PANEL AND COMPARTMENT

1.3.1 Panel Build

- 1.3.1.1** The door shall be interlocked through main isolator to prevent unauthorised entry, however this may be overridden with a special tool.
- 1.3.1.2** Trunking to be coloured grey, slotted.
- 1.3.1.3** All devices should be fixed using screws and tapped holes with screws to the front for ease of access or devices mounted on to 35mm DIN rail. Where the backplate thickness is insufficient to handle the weight of an item this should be attached using a suitable clinch nut system.
- 1.3.1.4** I.S.O. metric screws shall be used throughout.
- 1.3.1.5** All panels and enclosures shall be sealed to IP55 as a minimum unless specifically stated otherwise
- 1.3.1.6** Any item that may have a high surface temperature such as break resistors or anti-condensation heaters etc, must have appropriate warning sign nearby.
- 1.3.1.7** All lids and gland plates shall be gasketed.
- 1.3.1.8** Terminal rails shall carry 20% spare terminals.
- 1.3.1.9** Incoming cables after glanding shall be kept tidy by means of cable trunking where necessary.
- 1.3.1.10** 20% space shall be provided in all trunking as a minimum
- 1.3.1.11** Panel internally: All equipment shall be identified by durable labels onto PVC trunking or backplate located above each piece of equipment. Where this is not possible the label should be located near to the

equipment in a suitable location. The labels should correspond to each item number detailed on electrical drgs.

- 1.3.1.12** A pocket for placing the drawings shall be provided inside the door of the electrical cabinet where space permits. On multiple cabinet systems this shall be placed at the main incomer panel. This pocket should be of sufficient size to hold all manuals and documentation for the panel normally in the way of a 25mm A4 Binder
- 1.3.1.13** All relays to be mounted directly next to each other, as shown on layout diagram (if supplied.) All power contactors shall have suppression fitted across the coils.
- 1.3.1.14** Internal guarding to be IP2X minimum, i.e., No live parts should be able to be touched with the bare hand. If it can be touched then the guarding will be deemed as insufficient

1.3.2. Painting

External panel stove enamelled or powder coated as stated on purchase order.

All backplates to be unpainted galvanised steel.

1.3.3 Panel Lighting

Where panel lighting is provided that remains energised when mains isolator is off, suitable warning plates shall be attached.

Panel lighting to be of the fluorescent type Rittal Manufacturer and operated by Rittal std door switch unless specified.

1.4 SWITCHES AND PROTECTIVE DEVICES

- 1.4.1 Switches and circuit breakers should be clearly marked for on/off condition.
- 1.4.2 Every panel shall have a means of isolation via a fused isolator or disconnecter which is capable of locking. Isolator to be located within control panel with switch handle mounted onto door panel as shown on layout diagrams if supplied.
- 1.4.3 Where a hand auto selector switches are used, the hand position shall be to the left auto to the right.
- 1.4.4 All safety switches shall be to BS EN 60204 and BS5304.

1.5 WIRING

1.5.1 Wiring Colours

The wire colour to be employed as follows unless specified otherwise:-

- | | | |
|----|--|----------------|
| a) | 3 phase power circuits | |
| | Brown/black/Grey | |
| b) | Electric power circuit >110v of AC and DC | Black |
| | c) AC 110v | |
| | Red | |
| d) | DC 12/24v | Blue |
| e) | AC/DC circuits greater than 24v but less than 110V | Pink |
| f) | Neutral line of power circuit on 415/240v system | Light Blue |
| g) | Interlinks (between machines) or conductors that remain energised when main isolator off | Orange |
| h) | Earth conductor to be 1 cable | Green & Yellow |

1.5.2 Indicator Lamps

The colour of indicator lamps shall be as follows unless otherwise stated:-

- | | | |
|----|--|--------|
| a) | Power source | White |
| b) | Normal operation | Green |
| c) | Stop and abnormal condition | Red |
| d) | Attention and abnormal condition | Yellow |
| e) | Others (e.g: Over-ride, reset, Enable) | Blue |
| f) | Set up enable/disable | Green |

1.5.3 General Wiring

1.5.3.1 The minimum cross sectional area for 415v class circuit shall be 2.5mm² unless otherwise specified.

1.5.3.2 DC control wiring on P.L.C. equipment shall be no less than 0.5mm².

1.5.3.3 Push button switches or indicator lamps shall be 22mm diameter including the LED type unless otherwise specified. The following colours shall be used unless otherwise specified on drgs or client specification:

a)	Start operation	Green
b)	Stop Operation	Red
c)	Jog/Inch/Crawl	Black
d)	Emergency stop	Red (Mushroom
e)	Others (e.g: Over-ride, reset, Enable)	Blue

head)

1.5.3.4 Terminal rail for control wiring shall be suitable for their use, also the rail for external field cables must be mounted on angled brackets for easy installation.

1.5.3.5 Where terminals for cables of different voltages are mounted side by side a suitable barrier shall be provided.

1.5.3.6 Where fuse terminals are required for solenoid valves and other small items of plant requiring a supply. These fuses shall be of the clip in, indicating cartridge type. All fuses shall be 20mm in size and identified together with fuse rating.

1.5.3.7 All spare I/O terminals on P.L.C.'s to be wired and terminated at relevant terminal rails if this is shown on drg.

1.5.3.8 Where Orange cables are used for circuits as stated above, they shall be wired to an independent bank of terminals.

1.5.3.9 The arrangement of terminals will be numbered in ascending order, from left to right, or top to bottom.

1.5.3.10 No more than 2 wires shall be connected to any one terminal.

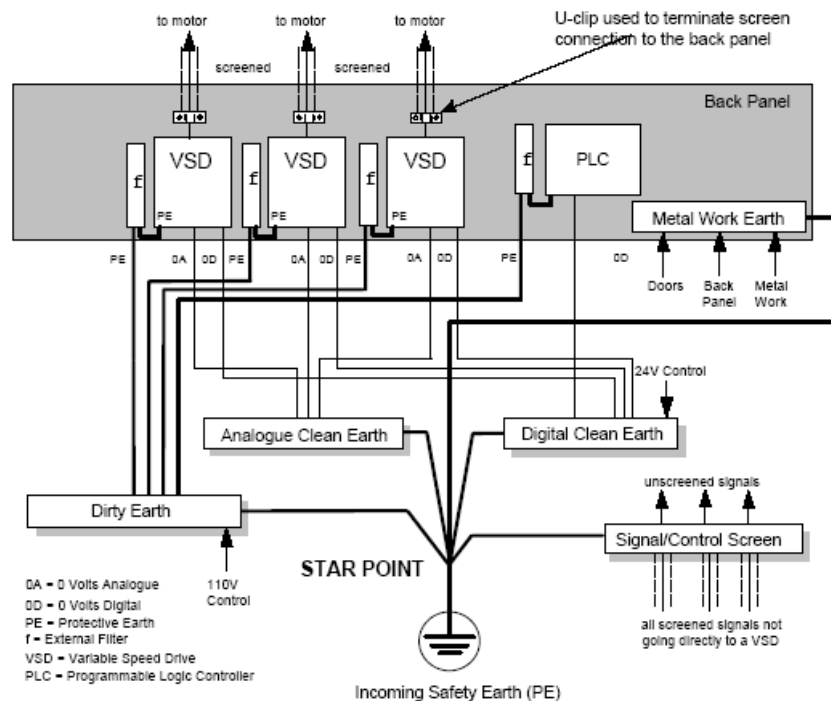
- 1.5.3.11** Every wire shall be attached to the relevant terminal by means of a crimp connector, to be attached using a ratchet type crimping tool. Crimp connector shall be of the boot lace ferrule type wherever possible
- 1.5.3.12** Signal, control and power shall be segregated as far as is reasonable.
- 1.5.3.13** All wiring shall be installed in slotted PVC trunking where possible. Unless in a fault free zone as indicated on diagrams, in this case they shall be segregated from other wiring, double insulated, (Spiraband ok), and be not more than 3mtrs in length (EN60204-1)
- 1.5.3.14** Wiring from panels onto doors etc. shall be harnessed using spira band or similar product to protect cables from wear on opening and closing doors.
- 1.5.3.15** Incoming and outgoing cables shall be identified with a cable numbering system and conform to wiring diagrams. (Numbering shall not be duplicated).
- 1.5.3.16** Bus bars mounted in panels shall conform to British Standard. All bus bars shall be totally enclosed with 3mm polycarbonate and carry suitable warning notices.
- 1.5.3.17** Cable used on all wiring is to be multi stranded type (no solid drawn).
- 1.5.3.18** All relays shall be type with an indication of state. Preferably LED.
- 1.5.3.19** 20% spare space should be left within panels (usable base plate area). This should automatically conform if panel is built to specified layouts if supplied.
- 1.5.3.20** All component groups will be surrounded by flexible plastic trunking with sufficient clearance to allow component placement and removal, and component wiring. Trunking mounted either vertically or horizontally. Components will be mounted in straight lines (i.e. at 90° to the trunking).
- 1.5.3.21** All components will be wired from the nearest section of trunking. All individual connecting wires will either be vertical or horizontal, and of the shortest practical length.

1.5.3.22 The wiring configuration shall be live in feed to the top switched output to the bottom e.g. isolators, contactors, unless it is very inappropriate to do so. (Large mains incoming isolators for example).

1.6 EARTHING

1.6.1 Continuously bond, both electrically and mechanically, the metal frames of all electrical apparatus, metal trunking, conduits sheathing and armoring of cables.

1.6.2 A “Star Point” earthing type arrangement should be used, i.e.;



1.6.3 Lighting apparatus shall have an earth.

1.6.4 All 415v class devices must be provided with a separate earth.

1.6.5 Transformers that supply 110v control circuit shall be double wound, air cooled, with an earthed screen between primary and secondary windings and one leg of the secondary winding earthed.

1.6.6 A panel earthing strap shall be provided for doors and hinged flaps. Earth studs shall be provided on all doors.

1.6.7 A flexible conduit must not be employed as an earth.

- 1.6.8** A separate earth bar shall be generated within control panel for termination of all earth wires. This earth bar shall normally be insulated from the backplate but connected by one earthing conductor to the backplate.
- 1.6.9** A “PE” Sign shall be applied at the point where the mains incoming earth will be terminated as required by EN60204-1. This will usually be somewhere on the busbar. A copper/brass terminal block would normally be bolted to the bus bar to allow terminating of many earth cables in a small area
- 1.6.10** All earth terminations shall only have one conductor per terminal without exception.

1.7 PREFERRED SUPPLIERS OF ELECTRICAL ITEMS

The list below is not exhaustive or rigid. However;

Where the preferred suppliers are not stocked or not easily available to the panel builder provider to provide rapid spares support then standard stock items held by the panel builder should be used after confirming this with Oracle Drive Systems Ltd.

Where Oracle Drive systems Ltd has provided a parts list with the supplied documentation, it will be supplied as a guide only. **It is the responsibility of the panel builder to check the items listed are suitable for the job and have been correctly specified.**

EQUIPMENT	SUPPLIER
PLC	As supplied/ specified
Safety Equipment	PILZ / Guardmaster /Siemens
Data Display	As Supplied/specified
Signal Relays	Omron with indicator, imo, GE
Pilot Lamps	Idec(Izumii) / Telemecanique / Siemens
Push Buttons/ Selector Switches	Idec (Izumii) / Telemecanique / Siemens
Contactors / Overloads	Telemecanique / Siemens / Allen Bradley
Circuit Breakers	Merlin Geran / Siemens
Fuse Holders	Ferraz
Isolators	Telemecanique / Siemens / Socomec
Transformers	Sturdy Electric / Siemens
Power Supplies	Omron / Coutant Lambda / Siemens
Terminals	Weidmuller, allen Bradley

1.8 ACCEPTANCE

All wiring shall be neat and tidy.

Panel should conform to requirements as set out in the Technical Construction File, the purchase order requirements, EN60204-1 and to this panel specification.

Minimum testing requirements on any panel to be carried out by the panel builder will be:

Point to point wiring tests,

Continuity of the protective bonding circuits, this should be carried out as per requirements under EN60204-1 section 18.2.2 test 1. *This actual figure should be recorded and tests carried out should be from PE connection to each outgoing earth busbar/circuit*

Fault Loop Impedance verification, this should be carried out as per requirements under EN60204-1 section 18.2.2 test 2. *This should be verified by calculation or measurement and confirm that the characteristics of the automatic disconnection of supply device is suitable.*

Insulation resistance tests on power circuits, typically 500V DC on mains circuits, *The value should not be less than 1MΩ*

Voltage tests, according to EN60204-1 clause 18.4 the test voltage should be twice the working voltage or 1000V whichever is greater and should be applied between the power circuit conductors and the protective bonding circuit for a period of 1 second. No disruptive discharge should occur in order to satisfy the test. Components that cannot withstand the test voltage shall be disconnected before testing.

The test certification provided by the panel builder must include the name of the tester, the instrument used and the calibration date, It must also note the actual measurement.

Functional tests i.e., all contactors and relays must be energised and confirmed working correctly either by driving by the circuits or by simulation (if full test is not possible)

Safety Control Relays must be confirmed by ensuring correct operation including testing of the reset circuit to confirm this will not reset until all feedback contacts are healthy, and ensure that the unit does not reset in the event a feedback contact should remain open.

Earth fault detection circuits shall be tested.

Documentation and certification showing the above have been carried out to be provided by the panel builder.

The panel builder is requested to forward on all delivery notes etc for free issue items supplied direct to there premises. Preferably by email or fax.

Oracle Drive Systems usually witness test the panel at the panel builder's premises. The panel builder shall take internal and external photos immediately before shipping the panel without protective packing on, and email these to the nominated contact from Oracle Drive Systems. Normally john.mullins@oracledrivesystems.co.uk.

Acceptance will be subject to Oracle Drive Systems Ltd. approval.

APPENDIX I

APPROPRIATE EUROPEAN STANDARDS

STATUS AND NUMBER	TYPE	ABRIDGED TITLE
BS EN 292-1	A	Basic terminology, methodology
BS EN 292-2	A	Technical principles and specifications
BS EN 294	B1	Safety distances to prevent danger zones being reached by the upper limbs
BS EN 418	B2	Emergency stop equipment; functional aspects; principles for design
pr EN 563	B1	Temperatures of touchable surfaces: Ergonomics data to establish temperature limit values for hot surfaces
pr EN 574	B2	Two-hand control device
pr EN 953	B2	Guarding of machinery; fixed and movable guards
pr EN 954-1	B2	Safety related parts of control systems; General principles for design
pr EN 954-2	B2	Safety related parts of control systems; Validation, testing, fault lists
pr EN 1037	B1	Isolation and energy dissipation; Prevention of unexpected start-up
pr EN 1050	A	Risk assessment
BS 5304		Safety of machinery
BS 5378-1		Safety signs and colours
BS 5378-3		Additional signs
BS EN50081-1		Electromagnetic compatibility - Generic Emission Standard: Residential, commercial and light industry
BS EN50081-2		Electromagnetic compatibility - Generic Emission Standard: Industrial environment
BS EN50082-1		Electromagnetic compatibility - Generic Immunity Standard: Residential, commercial and light industry
BS EN50082-2		Electromagnetic compatibility - Generic Immunity Standard:Industrial environment
pr EN 50100		Electro Sensitive Protective Equipment
BS EN60204-1	B1	Electrical equipment of machines Pt1: General requirements
BS EN 60529		Specifications for degrees of protection provided by enclosures (IP code)
BS EN 60950		Safety of information technology equipment, including electrical business equipment
BS EN60947-2		Specification for low-voltage switchgear and control gear: Circuit-breakers
BS EN60947-3		Specification for low-voltage switchgear and control gear:Switches, disconnectors, switch-disconnectors and fuse-combination units
BS EN60947-4-1		Contactors and motor-starters: Electromechanical contactors and motor-starters
BS EN60947-5-1		Control circuit devices and switching elements: Electromechanical control circuit devices
BS EN60947-6-1		Multiple function equipment: Automatic transfer switching equipment
BS EN60947-6-2		Multiple function equipment: Control and protective switching devices (or equipment) (CPS)
BS EN60947-7-1		Ancillary equipment: Terminal blocks for copper conductors

APPENDIX II

MODIFICATION RECORD

Date	Rev Level	Description of change
1 st June 2004	1	Initial release
11 th March 2005	2	Added paragraph on preferred suppliers and alternative components. 1.2.1 Amended to state clearly that rating legend plates for panel to be fitted on the inside of panel and to show ODS Job number 1.2.4 Amended to allow double sided tape for legends and made clear. 1.2.8 Amended detail for attaching external signage 1.5.3.3 Included reference to led lamps to be 22mm unless otherwise specified. 1.5.3.7 Included ref to drg for wiring spare plc i/o to terminals
10 th September 2005	3	1.3.1.10 Increased spare trunking capacity from 10 to 20% 1.3.3 Fluorescent panel lighting specified as a standard and added Rittal type door switches to be used for panel lighting.
25 th November 2005	4	Added document pocket to be sized to suit documentation requirements for drive equipment manuals and drgs etc. Usually this will be in a 25m A4 binder
20 th February 2006	5	Added "Documentation and certification showing the above have been carried out to be provided by the panel builder" under acceptance section 18 1.2.8 clarified requirements for free issue external signage. In section 1.1 added the words "or correspondence" in the statement "Any special requirements stated in the purchase order or correspondence shall supersede any item stated in this specification."
4 th April 2006	6	1.1 deleted panel layouts from the supplied documentation as these are normally supplied by the panel builder. 1.2.3 added legend plates on remote mounted operator stations if required 1.2.9 added labels to be fitted to drives showing text for name of drive as well as device id 1.5.1 Updated wiring colours to include the new harmonised colours for 3 phase power of Brown/Black/Grey, and neutrals to be blue. 1.3.1.11 Added back plate or trunking lids to be suitable place for fixing labels for hardware. 1.7 Updated preferred components list to include Socomec Isolators, Allan Bradley and Weidmuller terminals, Imo and GE signal relays 1.8 Added statement for the requirement of the panel builder to take photos of the panel before despatch and email them to nominated contact. Also documentation for free issue items such as delivery notes etc to forward on
22 nd July 2006	7	1.2.1 made clear the requirements for the internal panel label in table format 1.3.3 Specified all panel lighting to be of Rittal Manufacturer 1.5.2 added "unless otherwise stated" to lamp colour 1.7 In respect of Oracle Drive systems supplying parts list, Added "It is the responsibility of the panel builder to check the items listed are suitable for the job and have been correctly specified."
27 th September 2006	8	Added new logos
18 th December 06	9	Added Standard colours for pushbuttons, 1.5.1 changed colour of neutral from Blue to Light Blue, 1.6.8 added busbar to normally be isolated from backplate but connected to backplate by one earth conductor.

14 th June 2007	10	Added The following to the specification: Summary of main points of the specification. 1.6.9 A “PE” Sign shall be applied at the point where the mains incoming earth will be terminated as required by EN60204-1. This will usually be somewhere on the busbar. A copper/brass terminal block would normally be bolted to the bus bar to allow terminating of many earth cables in a small area 1.6.10 All earth terminations shall only have one conductor per terminal without exception.
18 th November 07	11	1.3.1.8 Added: The spare terminals shall have blank markers fitted to allow the terminals to be labelled on site if required.
4 th May 2008	12	Section 18 Acceptance: Included point to point wiring tests to be carried out, added all contactors and relays to be pulled in to confirm operation, and test on safety control circuit to ensure correct and proper operation.
19 th March 2009	13	Corrected revision number on front page, updated address details 1.5.1 Wiring colours: Added grey for AC/DC circuits less than 24v, Added pink for circuits greater than 24v but less than 110v
27 th Sept 2010	14	Updated Header logo
14 th April 2011	15	Section 18 Acceptance: Add requirement for panel builders test certification to include name of tester, the instrument used and the calibration date, also stated the actual figures should be recorded 1.3.1.14: Statement of IP2x Guarding clarified to confirm if it can be touched by the hand it will be deemed insufficient.
22 nd July 2011	16	Section 18 Acceptance: More details added from EN60204-1 to aid the panel builder in completing the tests required for CE marking
5 th October 2011	17	Corrected revision level on front page, 1.3.1.13 changed from all relays and contactors to have suppression fitted to all power contactors to have suppression fitted 1.3.1.5 clarified the panel ip rating will be IP55 as a minimum “unless stated otherwise”
12 th June 2012	18	1.5.1 Wire colours for circuits rated at less than dc24v was grey, this now deleted so colour defaults to Blue. This is to prevent confusion against the new harmonised phase colours.
13 th Oct 2013	19	Updated with new logo
6th Nov 2013	20	Updated with new header & footer and font.