

# Guide For The



UK granted patent GB 2435557B

## Electrical Disconnection System



**SIS QUAD for traffic signal installations**



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## Overview

This manual is for the SIS QUAD SENSE System, a system for providing the automatic electrical isolation of traffic signal equipment in the event of an impact. It ensures compliance with this requirement under BS EN 12767 providing full electrical isolation in under 0.4 seconds. In brief the system comprises of a dedicated power supply unit (PSU) and a 4 channel/pole monitoring unit (SIS QUAD SENSE) which can be mounted into a standard 3U rack. Each QUAD SENSE unit will monitor up to 4 traffic signal poles, each QUAD Sense PSU can power up to 8 monitor units. Each protected pole is fitted with an Inertia sensor connected to the QUAD SENSE unit, if the pole is struck the inertia switch will operate and trigger isolation. The monitoring units will operate a number of individual multi pole isolators, up to 6 per pole if required.

## Monitor Units

The QUAD SENSE monitor unit is capable of monitoring 4 traffic signal poles. The addition of extra units enables the monitoring of additional poles. The unit has onboard software coupled with dual processors to monitor the sensors and its own operation. The QUAD SENSE unit has an additional feature, whereby it can detect when one individual isolator has tripped in a group of isolators, this would be due to an equipment or wiring fault as opposed to an impact fault. Sense will detect that an individual isolator has tripped and after a sampling period it will trip any other isolators in that pole/group. The Monitor board is also fitted with an 8 position DIP switch, switches 1 to 4 will turn a channel off completely and switches 5 to 8 will turn off the "Sense" mode. To differentiate between the two operating modes (Sense on or off) the channel LED will flash slowly if the channel has switched off due to detecting an overload or wiring fault if SIS Sense is active, or it will remain steady if due to an impact fault. If SIS Sense is inactive there will be a shunt trip open circuit fault indication on the monitor board should an isolator trip.

Once a channel has tripped manual intervention is required to reset the channel. This is done by pressing the channel reset button to extinguish the red channel LED. If it has tripped due to an impact it will only reset once the equipment is made safe or replaced. If it has tripped due to an equipment or wiring fault, pressing the channel reset will allow 10 seconds to reset all isolators (with Sense mode ON). During this period the channel LED will flash quickly.

Each monitor channel can accommodate up to 6 five pole isolators, providing a maximum of 30 connections per pole.

In the unlikely event of a pole being struck during a general power failure, the system will start up and isolate any damaged pole in less than 5 seconds.

The unit is also fitted with fault outputs that will operate if the system malfunctions, a sensor is operated or if the equipment suffers a power failure. These outputs can be connected to a remote monitoring system to give remote indication of system operation, or fed directly to the traffic controller for a predetermined action. In addition to remote fault outputs the Monitor board channel LED will also display internal faults if found, the list below gives the codes and their meaning. Fault outputs can now also be normally open, or normally closed by simply changing two jumper connections on the monitor board.

## Isolators

The devices used are supplied in 2, 3, 4 and 5 pole versions, supplied with a built in shunt trip. (Shunt trip connections are now polarity sensitive, please note labelling on the isolators).

As these units are mechanical devices they draw no current, the tripping coil will however energise for 0.2 seconds or less when a channel is tripped. Once the isolator has been tripped the shunt trip coil is also disconnected, leaving the circuit again drawing no current, and protecting the tripping coil. The isolators cannot be reset whilst a sensor remains open circuit.

As the isolators include over current protection (3A) it is also possible that an equipment or wiring fault will operate a single isolator on its own (subject to SENSE being switched off), isolating the faulty equipment and leaving the junction still operational. Isolators can also be used to isolate a pole to enable maintenance and repairs to be undertaken.

## Impact Sensor

The impact sensor is a tried and tested unit. It is a completely mechanical device and therefore requires no external power, and as such draws no current. The device is normally closed circuit, going open circuit under impact.

The sensor should be mounted vertically, preferably at the base of the pole being monitored. If this is not possible then it can be mounted within the signal head. At installation the red cap should be depressed to reset the sensor.

## PSU

The power supply unit is a dedicated unit. It can supply up to 8 monitor boards and copes easily with any load generated by multiple pole strikes should they occur at the same time.

## Sensor Cabling

The Sensor cabling we would recommend is Orange PVC sheathed twisted one pair armoured cable such as that used for traffic signal detector feeder cables. This was chosen for its integral strength and being twisted its immunity to induced voltages. The contractor carrying out the installation will carry out the supply and installation of the sensor feeder cables.

If installation is ELV then spare cores can be used in the signal cable to provide a sensor pair back to the MEC or controller.

The following link typed in to your web browser will provide one example of the preferred cable.

<http://www.clevelandcable.com/products.asp?id=4021&step=2&catid=32>

## Installation

### PSU

The PSU units mount into a standard 3U rack, they can use spare space in an existing rack if available. They should only go into the existing rack when the monitor boards and the isolators are also located in the same cabinet. If a separate cabinet is used they should be located in their own rack with the monitor boards within the separate cabinet. Each PSU will require a 240V mains supply rated at 3 amps, additional power boards will require an additional mains supply. The monitor board power supplies are to be taken from the PSU. One PSU can supply power to up to 8 monitor boards. (Details of connection colour coding can be found in Appendix A.)

### QUAD Sense Monitor Units

Monitor Boards mount into a standard 3U rack, they will be supplied with a dual backplane that can accommodate two monitor boards, and the backplane will have screw terminals. The sensor leads are to be soft wired to the incoming sensor cabling terminations. The trip leads are taken to the isolators; one trip pair will be connected in parallel to all of the isolators in one pole/group. Isolators are polarity sensitive, ensure + from the backplane goes to + on the isolator. For example the sensor in connection 1 will be connected to Ch1 sensor terminals. Trip 1 will be connected to the corresponding trip terminals and connected in parallel to all associated isolators for pole 1. (More wiring details can be found in Appendices A and B)

If set to ON the Sense Monitor Board can detect when one isolator for a pole has tripped due to an equipment or wiring fault and not due to an impact. DIP switches 5 to 8 turn this option on or off by channel. They will be set inactive by default and will need to be turned on if required, any change in their setting will not be activated until the system is powered down and back on.

With "Sense" activated the channel LED will flash if it has been tripped by the "Sense" system. Therefore a channel LED which is flashing slowly will indicate one isolator had tripped and because Sense for that channel had been set to ON, it switched off the whole pole. Pressing channel reset will now start a learning time to enable the isolators to be reset. This period will last for 10 seconds, during this period the channel LED will flash quickly. (multiple flashes will be due to other faults, see table on page 3)

In reality some equipment faults may take a period of time to trip the isolator; in this instance it may be desirable to temporarily disable the "Sense" system to determine the fault location.

The board has two fault outputs. The outputs are supplied normally open circuit, without power, going closed circuit with power on. F1 will go open circuit to indicate a pole strike or sense activation, and F2 will go open circuit to indicate system failure. In the event of loss of power to the SIS system both F1 and F2 will give an open circuit output. Fault outputs can also be changed to open circuit by moving the two jumpers on the monitor board.

Finally DIP switches 1 to 4 will turn off any unused channels, switches 5 to 8 will turn Sense mode on or off. Details of connections and colour coding can be found in Appendix A. An example of the controller wiring is shown in Appendix B.

### Note

It is important that any unused channels are switched off; channels not switched off have the potential to output trip voltages to unconnected wiring. If this results in a short the monitor board could be damaged.

### Isolators

Isolators supplied can be in 2, 3, 4 or 5 pole units, they will be supplied with an integral shunt trip mounted on the left or bottom. Therefore this connection is reserved for the SIS system.

Ideally the installed system should allow for one isolator per signal head. With up to 5 available connections to use, isolators can cope with up to a four aspect signal head together with its associated neutral. Where additional neutral connections are required, then it may be necessary to add an additional 2 pole isolator. If an integral Box Sign is fitted this will require an additional 2 pole isolator.

If LV (230V) cabling is used it is important that one signal head is isolated completely including the neutral, spare connections should be left empty. Following this method ensures that a signal head will be isolated completely should isolators be tripped independently due to a transformer fault etc. If a neutral to a signal head is not in its associated isolation unit it is possible for the signal head to be unilluminated yet still have live feeds. Being unilluminated this may cause personnel to believe the head is safe when it is not. It also ensures compliance with BS 7671.

All isolators associated to a pole are to be wired in parallel to isolate all equipment on the pole, up to 6 isolators can be connected to each channel allowing up to 30 cable cores to be disconnected simultaneously.

Units are mounted on high hat DIN rail, each unit requires approximately 100mm x 100mm of space.

(Full connection details can be found in Appendices A and B)

### Note

Under certain exceptional conditions ELI testing could possibly cause SIS isolators to trip. In this situation we would advise using separate cable cores for testing or the "Soft Test" option if available.

### Controllers

In the unlikely event of a SIS unit failure it will provide a system fault output and suspend monitoring. We would advise that junction controllers should include red lamp monitoring as a further precaution for this unlikely event.

## Testing

As the SIS system has an independent power supply to the signal controller the signal lamps can remain off whilst the system is tested.

Once all items comprising the SIS system are connected all isolators should be switched on. Then the SIS system should be powered up, the yellow flashing LED on the front of the monitor board will indicate the system is running. The SIS system will at power up learn the state of all the isolators. It is now possible to test the full functions of the installed SIS system.

**(Note: Functions will be dependent on DIP switch settings.)**

Each pole fitted with an impact sensor should be visited and the sensor operated by hand, or disconnected to create an open circuit to simulate sensor operation. It is preferable to operate the sensor itself where practicable.

With the sensor operated or an open circuit created, the SIS system should be checked to ensure the correct red channel LED is lit and steady and that the correct isolators have tripped. Whilst the open circuit remains the isolators should be operated to ensure they will not reconnect whilst an open circuit is present.

If the additional "SENSE" mode has been activated then continuing testing as follows:

Again all signals can be left off to check this operation. With all isolators switched on chose a channel that has more than one isolator (this facility does not apply to channels with only one isolator), now switch off one isolator. The system should see this and within four seconds turn off all other isolators on that channel. The channel LED should be flashing to indicate why it has tripped. If a channel has only one isolator the SENSE system will still indicate if it has tripped due to an equipment fault.

To reset the isolators first reset the channel which will enter learning mode, indicated by a rapidly flashing LED, this will last for ten seconds, this provides time to reset the isolators. After ten seconds the system will be set and an alternative channel can be tested. Continue this process for all other channels until you are satisfied that all are working correctly.

These tests should be carried out on all poles fitted with isolators before any signals are illuminated.

Finally it is recommended that at annual inspection all the poles fitted with sensors are checked for correct operation.

## Equipment Supply

**The SIS QUAD SENSE system can be supplied in two ways.**

A pre-wired cabinet of a size to suit the installation complete with all required equipment and including a detailed connection sheet with termination details. One impact sensor per pole will be supplied separately, to be cabled on site using twisted one pair armoured cabling 2.5mm. (Armoured feeder cable not supplied), or using spare cores if it is an ELV site.

Alternatively the system can be supplied as a kit containing all the items for the users to install themselves in third party equipment. Installation should be carried out by Sector 8 approved personnel.

## Sample Specification

1. The system will be housed within a suitably sized MEC cabinet to house all isolation equipment. This cabinet will be located alongside the signal controller cabinet.
2. Monitoring units and power supplies to be 3U rack mounted within the MEC, isolators to be DIN rail mounted also within the same MEC cabinet.
3. Disconnection must be achieved in under 0.4 seconds in accordance with BS EN 12767
4. System to include a self checking system, with an output to indicate system malfunction.
5. In normal operation the system must give a visual indication that it is operational, a heartbeat or similar.
6. If the system is activated it must provide a positive visual indication of this.
7. The isolation will be so designed that on impact all LV and ELV live and neutral circuit conductors are disconnected from the signal pole, together with any sensor voltages.
8. The system must be capable of isolating up to 30 signal cores per signal pole simultaneously.
9. It must not be possible to re-energise a circuit that has been tripped.
10. Isolators to be rated at 3A unless otherwise indicated.
11. The system will provide outputs to indicate a) Activation by impact, b) Activation by signal equipment fault, c) Isolation system malfunction and d) Isolation system power failure.
12. The isolation system must also be capable of isolating a whole signal pole due to a signal equipment fault; this facility is to be selectable by pole.
13. The sensor is to be a mechanical device operated by inertia of greater than 10G. Upon trip activation the power to the sensor is to be removed.
14. The sensors are to be mounted by the most appropriate means, ideally behind the base door if available. The location is to be agreed with the engineer before installation.
15. The cabling to the sensors is to be run in separate ducts to the LV cables, using orange PVC sheathed SWA 2 core 2.5mm cable, traffic signal loop feeder cable. If the controller is ELV then spare cores in the signal cable to the signal equipment can be used for the sensor.

The sensor cable is to be terminated using a CET cable gland or equivalent, with the armouring being taken to earth

## Appendix A

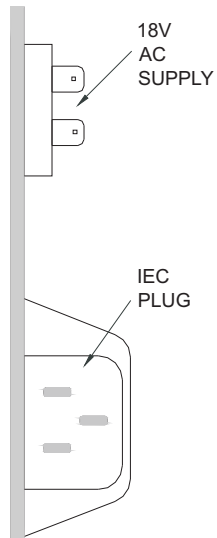
### SIS Quad Fault Indications

The SIS Quad system now has additional fault indications, the table below gives F1/F2 status as well as the indications on the monitor board itself. The monitor board indications are derived from onboard system checking which occurs every 800ms.

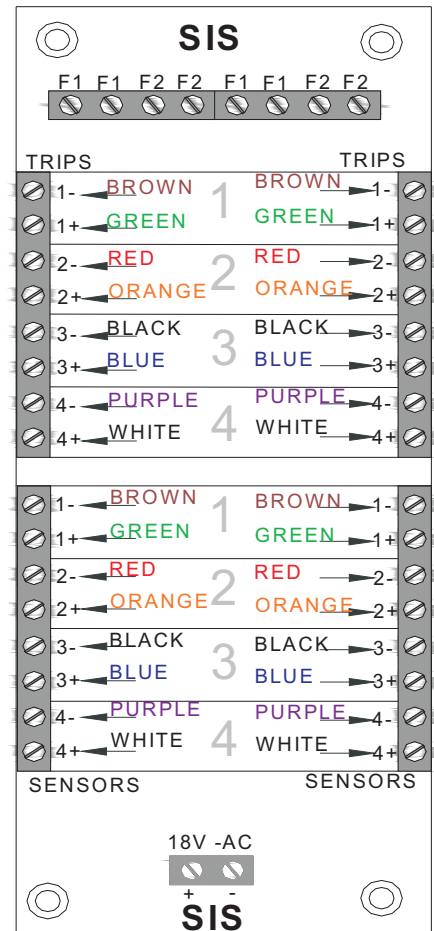
| SIS Quad Fault Outputs                   |                 |                 |          |          |
|------------------------------------------|-----------------|-----------------|----------|----------|
| Condition                                | Heartbeat LED   | Channel LED     | F1 State | F2 State |
| Impact fault                             | Flashes once    | LED On          | Open     | Closed   |
| Isolator tripped (Sense ON)              | Flashes once    | LED Slow Flash  | Open     | Closed   |
| Power Failure                            | Off             | Off             | Open     | Open     |
| SIS Quad Monitor Board Fault Indications |                 |                 |          |          |
| Condition                                | Heartbeat LED   | Channel LED     | F1 state | F2 state |
| Normal operation                         | Flashes once    | Off             | Closed   | Closed   |
| Channel tripped                          | Flashes once    | On              | Open     | Closed   |
| Low voltage                              | Flashes 5 times | Off             | Closed   | Open     |
| Sense tripped                            | Flashes once    | Slow flash      | Closed   | Open     |
| Coil O/C - sense on                      | Flashes once    | Slow flash      | Closed   | Open     |
| Coil O/C - sense off                     | Flashes once    | Flashes twice   | Closed   | Open     |
| No sensor power                          | Flashes once    | Flashes 3 times | Closed   | Open     |
| No sensor isolation                      | Flashes once    | Flashes 4 times | Closed   | Open     |
| Coil short circuit                       | Flashes once    | Flashes 5 times | Closed   | Open     |
| Watchdog override                        | Off             | All off         | Open     | Open     |

## Appendix B

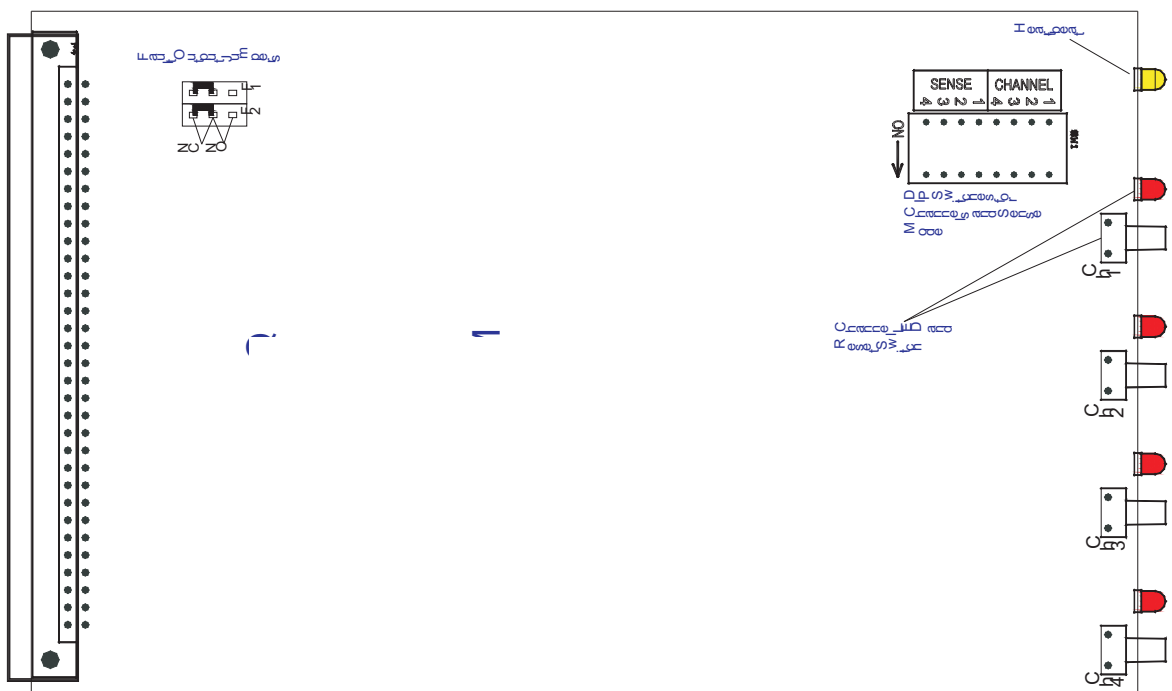
### PSU Connection Details



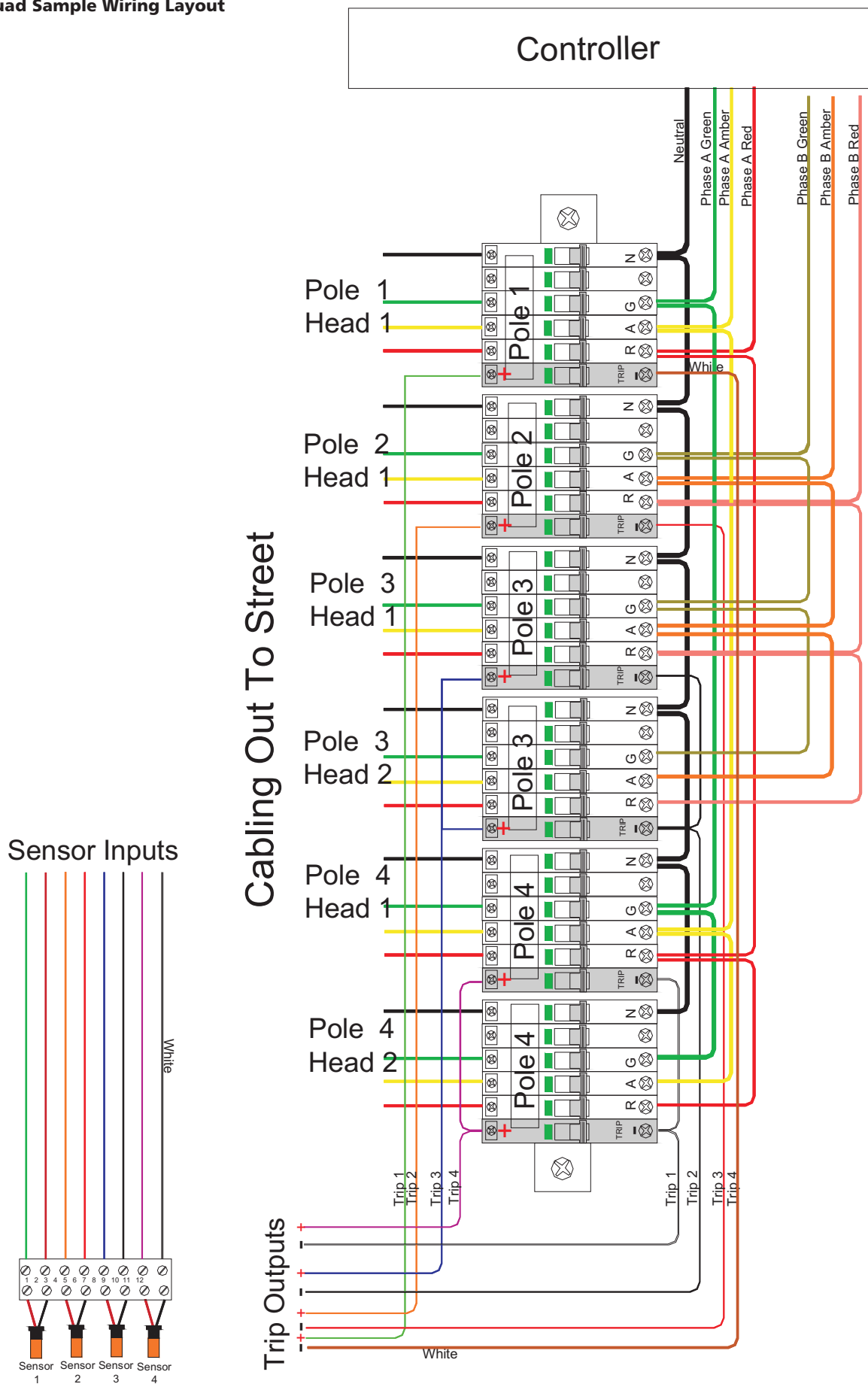
### Backplane Connection Details



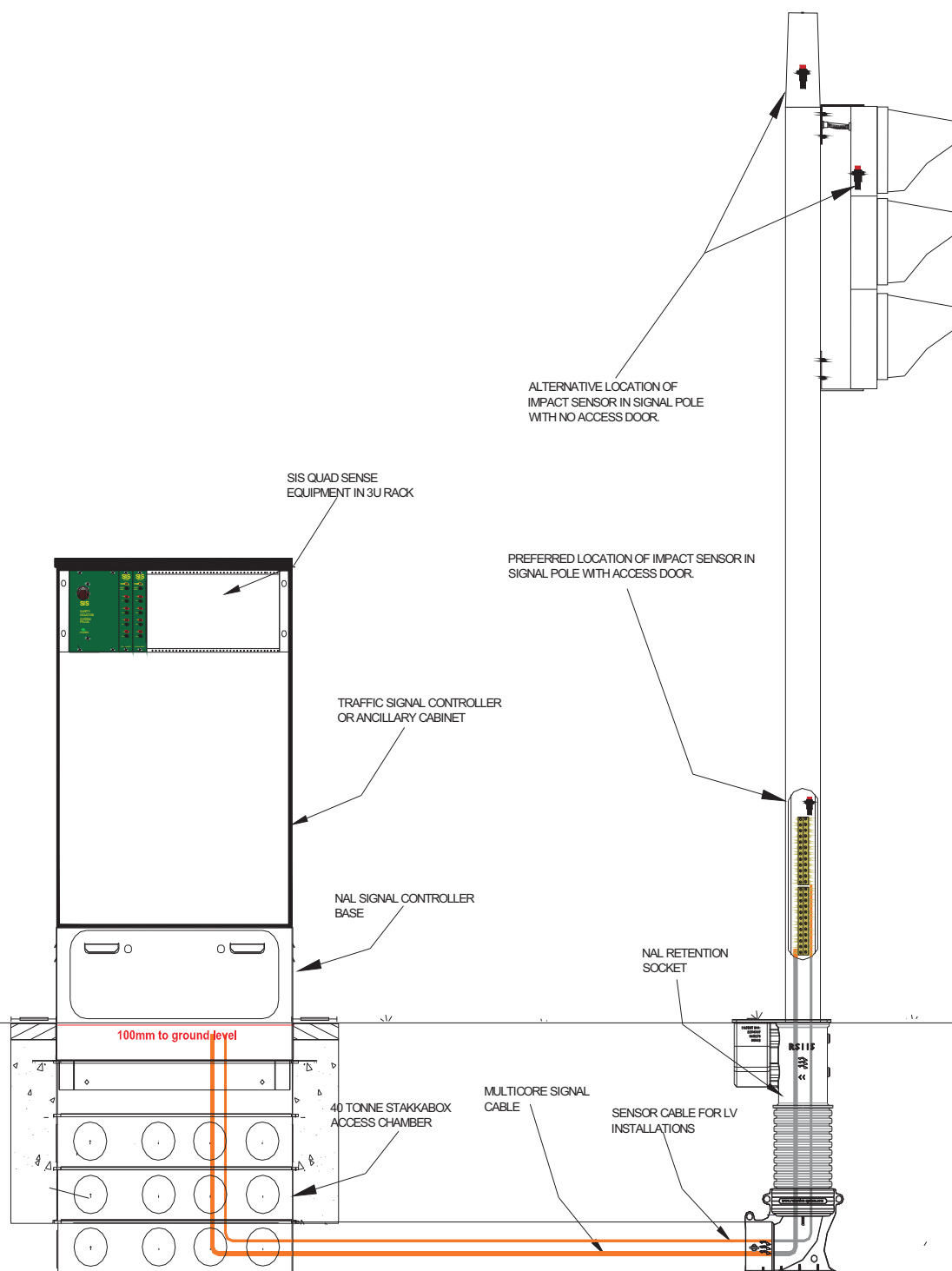
### Monitor Board Details



## SIS Quad Sample Wiring Layout



## Appendix C Sample Drawing 2



## Appendix D

### Technical Specification

#### PSU

|                            |                  |
|----------------------------|------------------|
| Input                      | 230v AC 50/60Hz  |
| Power Consumption          | 1.0 Watts        |
| Output                     | 18v AC Max 2A    |
| Umsug Code                 | 821001000100     |
| Anti surge Protection Fuse | 1A HRC (IEC 127) |

#### Dimensions

|        |         |
|--------|---------|
| Height | 128.5mm |
| Depth  | 160mm   |
| Width  | 95mm    |

|                          |   |
|--------------------------|---|
| Number of 17v AC outputs | 4 |
|--------------------------|---|

#### SIS Monitor Board

|                   |                     |
|-------------------|---------------------|
| Input             | 18V AC/DC           |
| Power Consumption | 3.0 watts           |
| Umsug Code        | 821003000100        |
| Sensor output     | 24V DC              |
| Fault output      | N/O or N/C contacts |

|                |               |
|----------------|---------------|
| Operating time | 200ms or less |
|----------------|---------------|

|                            |                  |
|----------------------------|------------------|
| Anti surge Protection Fuse | 1A HRC (IEC 127) |
|----------------------------|------------------|

#### Dimensions

|        |         |
|--------|---------|
| Height | 128.5mm |
| Depth  | 160mm   |
| Width  | 25.5mm  |

### COMPLIANCE

#### Specifications

##### TR2130C

|             |                                                                                           |
|-------------|-------------------------------------------------------------------------------------------|
| BS EN-12767 | Use of Passively Safe Signposts, Lighting Columns and Traffic Signal Posts to BS EN 12767 |
|-------------|-------------------------------------------------------------------------------------------|

|                  |                                                             |
|------------------|-------------------------------------------------------------|
| BS EN 50293:2012 | EMC Road Traffic Signal Systems                             |
| HD 638:Jan 2001  | Road Traffic Signal Systems                                 |
| LVD:1997         | Low Voltage Directive                                       |
| BS EN 50293:2001 | Electromagnetic Compatibility – Road Traffic Signal Systems |

##### EMC Testing

|                            |
|----------------------------|
| EN 50293:2012              |
| EN 55015:2013              |
| EN 61547:2009              |
| EN 61000-3+A1:2009+A2:2009 |
| EN61000-3-3:2008           |

##### Environmental testing

TR2130 Issue C Road Traffic Signal Systems

|             |               |
|-------------|---------------|
| Dry heat    | +60° C        |
| Cold test   | -15° C        |
| Cyclic damp | +40° C, 93%RH |

|                          |   |
|--------------------------|---|
| Poles/Channels Monitored | 4 |
|--------------------------|---|

|                     |            |
|---------------------|------------|
| Initialisation time | <5 Seconds |
|---------------------|------------|



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