

Australian Standard[®]

Traffic signal controllers



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Australian Standard[®]

Traffic signal controllers

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PREFACE

This Standard was prepared by Standards Australia Committee LG-006, Road Traffic Signals, to supersede AS 2578.1—1983, *Traffic signal controllers*, Part 1: *Physical and electrical compatibility*.

The objective of this Standard is to provide mechanical, electrical and functional requirements for traffic signal controllers for physical and electrical interchangeability and for functional compatibility between controllers of different manufacture.

The terms ‘normative’ and ‘informative’ are used to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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FOREWORD

The Standard is structured as follows:

Section 1 provides the scope, definitions and general requirements, such as the environmental requirements and the expansion capability of controllers to meet the various configurations that may be required.

Section 2 provides the mechanical and electrical requirements for the controller housing, including the Flasher Unit and Site Identification Encoder, but excluding the Logic Module.

Section 3 provides the requirements for the controller Logic Module electronics.

Section 4 provides the requirements for the controller software and the functional requirements for the controller software.

Appendix A provides a guide for information that should be provided to a manufacturer when purchasing a controller.

Appendix B provides details of the data format for Electronic Identities for electronic modules.

Appendix C provides details for connectors and connector pin functions for connectors for the Logic Module.

Appendix D provides details of the connectors and connector pin functions for connectors for the Flasher Unit.

Appendix E provides details of the connectors and connector pin functions for connectors for the Site Identification Encoder.

Appendix F provides the mechanical details for all of the connectors defined in Appendices C to E.

Appendix G provides informative information regarding hazards and the approach to achieving functional safety.

Appendix H provides additional information for the controller housing. This includes terminal block arrangements and electrical wiring diagrams.

STANDARDS AUSTRALIA

Australian Standard

Traffic signal controllers

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the mechanical, electrical and functional requirements for the control equipment used for operation of road traffic signals, with the objective of ensuring that, as far as practicable—

- (a) controllers from different manufacturers will be physically interchangeable; and
- (b) controllers from different manufacturers will have functional compatibility.

NOTE: The requirements of this Standard may not ensure total physical and electrical interchangeability, but should enable a replacement controller to be installed with a minimum of alteration.

The Standard seeks to ensure compatibility between the electronic modules (i.e. the Logic Module, the Flasher Unit and the Site Identification Encoder) mounted in the controller housing. The Standard is necessarily prescriptive in some areas to achieve this purpose.

NOTE: Compliance with this Standard may not ensure full compatibility between Logic Modules and housings of different manufacture since the method of dimming the signal displays is not specified.

The Standard specifies general requirements for the design and construction of traffic signal controllers to meet the needs of users. The Standard specifies technology that has been proven in the field to provide safe and reliable operation.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
1055	Acoustics—Description and measurement of environmental noise (series)
1275	Metric screw threads for fasteners
1319	Safety signs for the occupational environment
2353	Pedestrian push-button assemblies
2700	Colour standards for general purposes
2703	Vehicle loop detector sensors
60068	Environmental testing
60068.2.6	Part 2.6: Tests—Test Fc: Vibration (sinusoidal)
60068.2.29	Part 2.29: Tests—Test Eb and guidance: Bump
60269	Low-voltage fuses
60269.1	Part 1: General requirements
60529	Degrees of protection provided by enclosures (IP Code)

AS

- 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems
- 61508.1 Part 1: General requirements
- 61508.2 Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
- 61508.3 Part 3: Software requirements
- 61508.4 Part 4: Definitions and abbreviations

AS/NZS

- 1768 Lightning protection
- 2144 Traffic signal lanterns
- 2276 Cables for traffic signal installations
- 2276.1 Part 1: Multicore power cables
- 2276.2 Part 2: Feeder cable for inductive type vehicle-detector loops
- 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- 3100 Approval and test specification—General requirements for electrical equipment
- 3190 Approval and test specification—Residual current devices (current-operated earth-leakage devices)
- 61000 Electromagnetic compatibility (EMC)
- 61000.4 Part 4: Testing and measurement techniques
- 61000.6 Part 6: Generic standards
- 61558 Safety of power transformers, power supply units and similar
- 61558.2.6 Part 2.6: Particular requirements for safety isolating transformers for general use (IEC 61558-2-6:1997, MOD)
- ACMA Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice 2001 as amended.
- AS/ACIF
- S008 Telecommunications Technical Standard (Requirements for customer cabling products – AS/ACIF S008:2006) 2006
- JEDEC Common Flash Interface Standard, JEDEC JESD68.01
- PCMCIA PC Card Standard, Release 8.0

1.3 DEFINITIONS

For the purpose of this Standard, the following definitions and those given in AS/NZS 2144 apply.

1.3.1 Accident

An unintended event that may cause harm.

1.3.2 ACMA

Australian Communications and Media Authority (ACMA). The body responsible for regulating communications and media.

1.3.3 A-Tick

Telecommunications compliance labelling

1.3.4 Conflict (conflicting signal displays)

A conflict exists where right of way is given to two traffic movements that cannot safely operate together.

1.3.5 Controller

An automatic device that regulates the sequence and timing of the illumination of traffic signal lanterns.

NOTE: A traffic signal controller is hereinafter referred to as a 'controller'.

1.3.6 Coordination facilities

Equipment provided remotely or within a controller to enable it to operate in conjunction with one or more adjacent controllers, with a defined time relationship between their respective signal sequences.

1.3.7 C-Tick

Radiocommunications and EMC compliance labelling.

1.3.8 EMC

Electromagnetic compatibility.

1.3.9 Error

Any abnormal condition or failure detected by the controller that does not prevent the controller from providing safe operation.

1.3.10 Facility Switch

An externally accessible means of switching a signal installation to 'ON', 'OFF' or 'FLASH'.

1.3.11 Fail-safe

A property of a system, by virtue of its design, whereby the system maintains a safe state regardless of failures. However, the system may not continue to operate while the fault is present.

1.3.12 Fault

Any condition or failure detected by the controller that prevents the controller from providing safe operation.

1.3.13 Flash mode

A mode of operation in which a predetermined combination of yellow aspects are flashing.

1.3.14 Flasher Unit

A self-contained unit that supplies the flashing active voltage to signal aspects for the Flash mode of operation.

1.3.15 Flashing yellow facility

A feature that causes the flashing operation of a predetermined combination of yellow aspects when the normal signal operation is discontinued.

1.3.16 Flexilink

A mode of operation providing coordinated control of traffic movements in the road network, in accordance with the time of day and the day of week.

1.3.17 Harm

Death or personal injury, but may also include damage to property or the environment.

1.3.18 Hazard

A state of a system that has potential to cause harm.

1.3.19 HHT (hand held terminal)

A user interface to the controller.

1.3.20 Housing (controller housing)

The weatherproof enclosure that provides physical protection and houses the signal control equipment.

1.3.21 Independent detector

One or more sensor units contained within an independent enclosure, and incorporating a power supply for the functioning of its sensing circuit(s).

1.3.22 Integral detector

Traffic signal controller specific vehicle detector unit that operates as one of the controller's integral functional units.

1.3.23 Logic Module

A rack containing the controller's functional electronic circuits as plug-in circuit cards.

1.3.24 Masterlink

A mode of operation providing coordinated control of traffic movements in the road network, in accordance with commands from a master computer. (See Clause 4.2.11.5.)

1.3.25 MEN

Multiple Earthed Neutral. See AS/NZS 3000.

1.3.26 Module

A plug-in circuit card containing electronic circuits.

1.3.27 Off mode

A mode of operation in which all signal displays are off.

1.3.28 PCMCIA

Personal Computer Memory Card International Association (PCMCIA). An international standards body that defines and promotes PC Card and ExpressCard standards.

1.3.29 Pedestrian push-button assembly

An enclosure incorporating a push-button switch that is designed for use in conjunction with a signalized intersection or crossing to register a pedestrian demand. It may also incorporate, or have associated with it, facilities for the generation of audible signals.

1.3.30 Personality card

A device that stores Personality data.

1.3.31 Personality data or Personality

Site specific configuration parameters that define the operation of a controller.

1.3.32 Phase

A set of compatible traffic movements controlled by signal groups.

1.3.33 Rack-mounted detector

One or more sensor units comprising printed circuit cards designed for mounting with other similar sensor units in a common mounting rack within the housing of a traffic signal controller. Each rack-mounted sensor unit may incorporate its own power supply or a number of sensor units may be supplied from a common power source.

1.3.34 RCD

Residual Current Device (RCD). An electrical wiring device that disconnects a circuit whenever it detects that the electric current is not balanced between the energized conductor and the return neutral conductor.

1.3.35 Risk

A combination of the likelihood that a hazard will cause harm and the severity of the resultant harm.

1.3.36 Safety

Freedom from unacceptable risk.

1.3.37 Safety function

A safety-related part of a system that eliminates or reduces the likelihood of harm occurring, or the severity of the harm if it does occur.

1.3.38 SCATS (Sydney coordinated adaptive traffic system)

A traffic signal coordination system developed by the Roads and Traffic Authority, NSW.

1.3.39 Signal group

A set of lanterns that always have an identical display driven by a single set of outputs from a controller.

1.3.40 SIL

Safety Integrity Level (SIL). A discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the electrical/electronic/programmable electronic system safety-related systems, where safety integrity level 4 (SIL4) has the highest level of safety integrity and safety integrity level 1 (SIL1) has the lowest. (AS 61508.4).

1.3.41 Site Identification Encoder

A circuit card mounted in the controller housing that encodes the intersection number and revision level. The card also provides a single connection point to the Logic Module for various hardware items mounted in the controller housing.

1.3.42 Streams

A traffic signal coordination system developed by the Department of Main Roads, Queensland.

1.3.43 Traffic signal controller

See definition for controller in Clause 1.3.5.

NOTE: A traffic signal controller is hereinafter referred to as a 'controller'.

1.3.44 Wander lead

A flexible part of the fixed wiring in the controller housing that provides a connector to mate with equipment that is designed to be mounted in the housing.

1.4 GENERAL REQUIREMENTS

1.4.1 Ambient conditions

The controller and associated ancillaries shall operate correctly in an ambient with free air temperature in the range -10°C to $+50^{\circ}\text{C}$, and with up to 90% relative humidity, and with up to 1 kW/m^2 insolation applied to the maximum exposed surface.

The controller shall not be adversely affected by storage in an ambient with free air temperature in the range -20°C to $+70^{\circ}\text{C}$, and with relative humidity up to 90% within the temperature range 0°C to $+50^{\circ}\text{C}$.

1.4.2 Atmospheric pollutants

1.4.2.1 General

Adequate anti-corrosive measures shall be taken in the design of the controller so that it is suitable for use in fume or salt laden atmospheres over a minimum service life of 15 years. In particular, the controller shall tolerate continuous exposure to high levels of motor vehicle exhaust gases, and salt laden atmospheres as found in coastal environments.

For the purpose of this clause, the typical values for atmospheric pollutants shall be as shown in Table 1.1.

TABLE 1.1
POLLUTANT LEVELS

Pollutant	Level
Total suspended particles 30–50 μm	23–300 $\mu\text{m/m}^3$
Dust deposit $>30\text{ }\mu\text{m}$	0.5–5 $\text{g/m}^2/\text{month}$
Sulphur dioxide	0.005–0.05 ppm (vol)
Nitrogen dioxide	0.001–0.3 ppm (vol)
Hydrogen sulphide	0.001–0.02 ppm (vol)
Airborne salt (NaCl) deposited	2–30 $\text{g/m}^2/\text{month}$

1.4.2.2 Metallic parts

All metallic parts, including screws, nuts and washers, shall be suitably protected by plating, or be manufactured of non-corrodible material to prevent corrosion for the levels of atmospheric pollutants specified in Clause 1.4.2.1, and such that dissimilar metals in contact shall have an electro-chemical potential difference not exceeding 0.5 V.

1.4.3 Power supply

1.4.3.1 Operating voltage

The controller shall operate from a nominal 230 V r.m.s. 50 Hz mains supply.

The controller shall operate correctly and reliably for mains supply voltages over the range 180–280 V r.m.s. and for any variations of frequency in the range 48–52 Hz.

The power supply for the logic circuits shall maintain the d.c. supply rails within tolerance for mains supply voltages in the range 150 V r.m.s. to 280 V r.m.s.

The controller shall not be damaged by mains supply voltages over the range 0–280 V r.m.s. and for any variations of frequency in the range 45–55 Hz.

The controller shall switch off the normal signal displays when the mains supply voltage falls below the low mains threshold and shall not attempt to switch on the signal displays until the mains supply voltage rises above the mains restored threshold.

For a nominal mains supply voltage of 230 V r.m.s., the low mains threshold shall be nominally 180 V r.m.s.

For a nominal mains supply voltage of 230 V r.m.s., the mains restored threshold shall be nominally 192 V r.m.s.

The hysteresis provided by the low mains threshold and the mains restored threshold shall be not less than 10 V r.m.s.

NOTE: It is permissible for the controller to operate in either the Flash Mode or the Off mode when the mains supply voltage is less than the low mains threshold.

1.4.3.2 *Surges on mains supply voltage*

The controller shall be designed to withstand transient disturbances and surges induced onto the mains supply, such as by lightning. The controller shall provide surge protection to withstand the surges specified in AS/NZS 1768, Category B, with medium exposure peak amplitudes.

1.4.3.3 *Breaks and brownouts in mains supply voltage*

The controller shall maintain normal operation and shall not be adversely affected by breaks or brownouts in the mains supply of duration up to 100 ms.

Breaks in the mains supply of duration greater than 250 ms shall cause the controller to switch off the signal displays and restart when the mains supply is restored.

NOTE: The controller may either continue normal operation or switch off due to low mains supply voltage or breaks in the mains supply of duration greater than 100 ms and less than 250 ms.

1.4.3.4 *Insulation resistance*

The insulation resistance test shall be performed with all the equipment comprising the controller mounted and connected in the housing, but with the MEN link removed, and the surge protection circuitry disconnected.

For low voltage circuits, the insulation resistance between the active and neutral conductors to earth shall be as per AS/NZS 3000.

1.4.4 Shock and vibration

1.4.4.1 *Shock*

All removable sub-assemblies, in an unpacked condition, shall withstand the bump test (Test Eb) to AS 60068.2.29. The severity shall be 1 000 bumps at an acceleration of 98 m/s^2 (10 g) with a pulse duration of 16 ms.

The entire controller, packaged for transport, shall be subjected to a bump test. This test shall be carried out in accordance with AS 60068.2.29. The severity shall be 4 000 bumps at an acceleration of 98 m/s^2 (10 g) with a pulse duration of 16 ms.

1.4.4.2 *Vibration*

The entire controller shall be subjected to the vibration tests specified in this Clause. The test procedures shall be in accordance with AS 60068.2.6 for sinusoidal vibration. For all tests specified in this clause, the amplitude shall be 0.75 mm up to the cross-over frequency, (approximately 8.2 Hz), where the acceleration is 0.2 g, and for higher frequencies the acceleration shall be maintained constant at 0.2 g.

The tests shall be performed for 3 mutually perpendicular axes with the controller in the normal (upright) orientation.

For each axis of the tests, an investigative sweep cycle shall be performed on the test specimen over the frequency range 5–55 Hz with an amplitude of up to 0.75 mm to identify critical frequencies at which—

- (a) controller malfunction and/or deterioration of performance are exhibited which are dependent on vibration; and/or
- (b) mechanical resonances and other response effects, such as chatter, occur.

The frequencies and the applied amplitudes at which these effects occur shall be noted, together with the behaviour of the test specimen at each critical frequency.

The controller shall be tested for 10 min at each of the critical frequencies identified, with vibration amplitude of 0.75 mm below the cross-over frequency, and 0.2 g acceleration above the cross-over frequency.

For each axis of the tests, the entire controller shall be tested with an endurance of 20 sweep cycles over the frequency range 5–55 Hz with initial amplitude of 0.75 mm. The sweep rate shall be 1 octave per minute.

The controller shall operate without malfunction during the tests.

1.4.5 Electromagnetic compatibility

1.4.5.1 General

The controller shall comply with all applicable statutory requirements for electromagnetic compatibility.

1.4.5.2 Immunity to surges and electromagnetic radiation

The controller shall comply with AS/NZS 61000.6.1. Tests shall be performed for immunity to—

- (a) electrostatic discharge (AS/NZS 61000.4.2);
- (b) radiated radio frequencies (AS/NZS 61000.4.3);
- (c) fast transients on the mains supply (AS/NZS 61000.4.4);
- (d) surges on the mains supply (AS/NZS 61000.4.5); and
- (e) conducted radio frequencies (AS/NZS 61000.4.6).

1.4.5.3 Electromagnetic emissions

The controller shall be provided with radio interference suppression to comply with the requirements of AS/NZS 61000.6.3.

Separate tests shall be performed on—

- (a) the Logic Module alone, with no lamp loads and not connected in a housing, but with a Site Identification Encoder connected by a cable not less than 0.3 m, and with a hand held terminal connected by a cable not less than 1.5 m;
- (b) the Flasher Unit alone, with no lamp loads and not connected in a controller housing;
- (c) the complete controller, with lamp loads connected and switched on, and the controller cycling;
- (d) the complete controller, with lamp loads connected and switched on, with the signals in Flash mode; and
- (e) the complete controller, with lamp loads connected but switched off, by command from the Logic Module.

The test for electromagnetic emission on the complete controller shall include tests performed with the signal lamps dimmed, with the mains supply voltage at the nominal voltage specified in Clause 1.4.3.1.

1.4.5.4 Lamp load configuration and cable length for testing

For the EMC tests in Clause 1.4.5.3, the lamp load configuration shall be as for a 12 vehicle group, 4 pedestrian group controller with lamp loads fitted to signal groups as specified in Table 1.2.

TABLE 1.2
LAMP LOAD REQUIREMENTS OF EMC TESTING

Item	Signal groups	Incandescent lamp load per signal group	Quartz halogen lamp load per signal group
1	2 Veh	600 W	
2	2 Veh	300 W	
3	2 Veh		170 W
4	2 Veh	120 W	
5	2 Veh		105 W
6	1 Veh	60 W	
7	1 Veh		35 W
8	2 Ped	120 W	
9	2 Ped		70 W

Cable lengths between the housing and the lamp loads should not be greater than 2 m.

1.4.6 Weather resistance

The complete controller, when installed as in normal service, shall provide a degree of protection not less than classification IP45 in AS 60529.

1.4.7 Acoustic noise

Where the predominant noise characteristics of a controller are not transient or impulsive in nature, the controller shall satisfy the noise criteria specified in AS 1055.

Where the predominant noise characteristics of a controller are of an impulsive nature, with pulse durations typically less than one second, then the noise level shall not exceed 40 db A-scale when measured at a distance of 5 m from the controller under free field (anechoic) measurement conditions.

1.4.8 Vandal resistance

As far as practicable, the controller shall be designed to withstand damage by vandalism and shall not malfunction due to vandalism.

The controller shall continue to operate reliably under conditions of sustained shock, such as by kicking against the exterior of the housing. Under such conditions—

- (a) the circuit cards in the Logic Module shall not unseat from the mating connectors in the Logic Module;
- (b) the Logic Module shall not be damaged; and
- (c) no connectors to the Logic Module or other equipment in the housing shall become unplugged or give unreliable connection.

See also Clauses 2.3.2, 2.3.3, 2.3.6, 2.3.15 and 2.7.6.

1.4.9 Fire hazard

The controller shall be designed to be inherently fire resistant and shall comply with the relevant requirements of AS/NZS 3100.

1.4.10 Electrical safety

The Traffic Signal Controller shall be designed in compliance with Part 1 of AS/NZS 3000 to ensure electrical safety and that it functions correctly for the purpose intended.

The disconnection of the traffic signal circuits by an RCD could cause a danger, to road users, greater than earth leakage current. Therefore, as permitted by AS/NZS 3000:2007 Clause 2.6.3.2 Exception 5, an RCD shall not be installed in any of the circuits used to drive the traffic signals.

For all circuits leaving the controller, the rating of the protection device and maximum allowable circuit impedance are to be clearly labelled.

In addition to overcurrent protection, all ancillary LV circuits, such as the socket outlet and service light, require an RCD in accordance with AS/NZS 3000.

1.4.11 Functional safety

This Standard requires that the design, development and construction of traffic signal controllers be performed using valid processes for safety-related systems. This Standard recommends the application of AS 61508 Parts 2 and 3 with Safety Integrity Level 2 (SIL2).

1.4.12 Safety Case

This Standard requires the provision of a Safety Case for the complete controller. The Safety Case shall present a reasoned argument to justify that the system is safe. The Safety Case shall include the hazards listed in Appendix G and the safety functions to mitigate those hazards, with references to all necessary substantiating documents.

1.5 EXPANSION CAPABILITY

Controllers shall have the capability of being expanded to provide at least the appropriate capacity prescribed in Table 1.3.

The manufacturer shall provide options for the controller size, the number of facilities required and the type of detectors to be used with the controller to meet purchasers' requirements.

NOTE: See Appendix A, Item (a) and Item (c).

TABLE 1.3
MINIMUM EXPANSION CAPABILITY

Size	Signal groups	Detectors		SG terminals	Det terminals	Special Facilities	
		Loop detectors	External inputs			Outputs	Inputs
4	4	Up to 16	Up to 16	A	E (1–20, 37)	0	0
8	8	Up to 16	Up to 16	A, B	E (1–20, 37)	0	0
12	12	Up to 32	Up to 32	A, B, C	E (1–37)	12	12
16	16	Up to 32	Up to 32	A, B, C, D	E (1–37)	12	12
20	20	Up to 32	Up to 32	A, B, C, D, AA	E (1–37)	24	24
24	24	Up to 32	Up to 32	A, B, C, D, AA, BB	E (1–37)	24	24
32	32	Up to 32	Up to 32	A, B, C, D, AA, BB, CC, DD	E (1–37)	24	24

SECTION 2 CONTROLLER HOUSING

2.1 GENERAL

The controller housing is a weatherproof enclosure that contains the controller electronics and ancillary circuits.

This section specifies the controller housing and the items of equipment that are fixtures in the housing, such as the Flasher Unit, Site Identification Encoder and terminal blocks.

Clause 2.2 to Clause 2.23 specify the requirements for the housing and for the particular equipment mounted in the housing.

NOTES:

- 1 The Logic Module is a shelf mounted unit within the housing. The Logic Module contains the controller logic circuits, interface circuits and d.c. power supplies. See Section 3 for the requirements for the Logic Module.
- 2 Vehicle detectors may be mounted within the controller housing, or provided as circuit cards within the Logic Module, or may be mounted external to the controller on traffic signal posts.

2.2 PHYSICAL REQUIREMENTS

The housing shall be designed for mounting on a concrete footing or a flat surface. Figure 2.1 provides an outline arrangement for the controller housing.

The housing shall be designed to accommodate a Logic Module with the maximum dimensions and free space requirements specified in Clause 3.7.2 for the Size 32 Logic Module.

The external dimensions for the housing shall be within the limits specified in Table 2.1.

TABLE 2.1
HOUSING DIMENSIONS

Dimension	Minimum, mm	Maximum, mm
Height	1375	1700
Depth	365	420
Width	780	800

The housing shall be designed to accommodate all equipment and terminals required for controlling up to thirty-two signal groups.

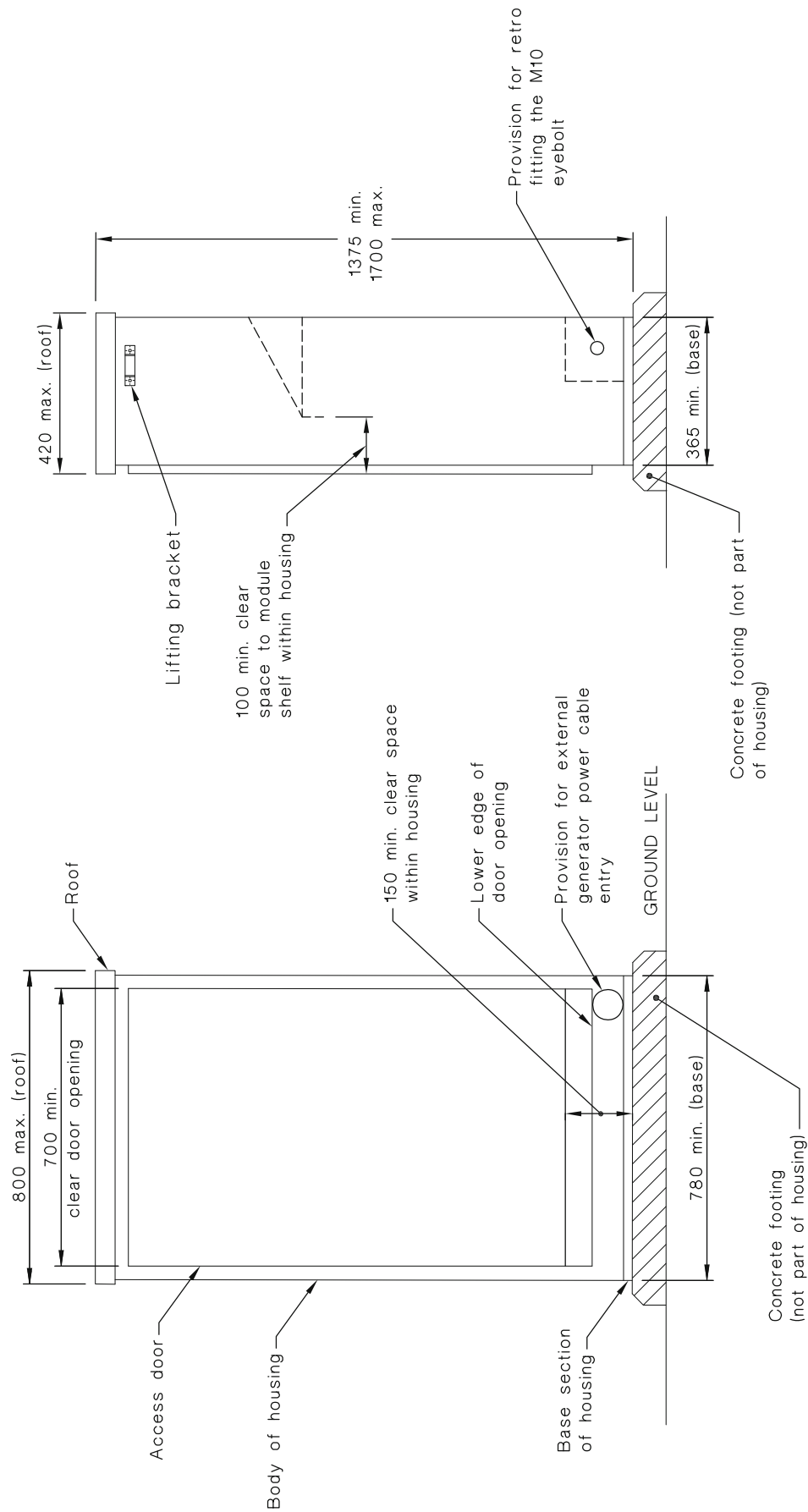


FIGURE 2.1 OUTLINE ARRANGEMENT FOR CONTROLLER HOUSINGS

2.3 HOUSING CONSTRUCTION

2.3.1 General

The housing shall be designed to allow it to be installed with the rear side adjacent to a wall or fence or similar structure without impeding access to the equipment within it.

The housing shall be constructed with a body section, a roof, a base section, and an access door at the front of the housing. Additional requirements for the base section and the access door are specified in Clause 2.3.3 and Clause 2.3.5 respectively.

The housing shall be of rigid construction formed from folded metal with welded joints. The housing roof shall provide run off (e.g. of rain water) to the rear and/or sides of the housing.

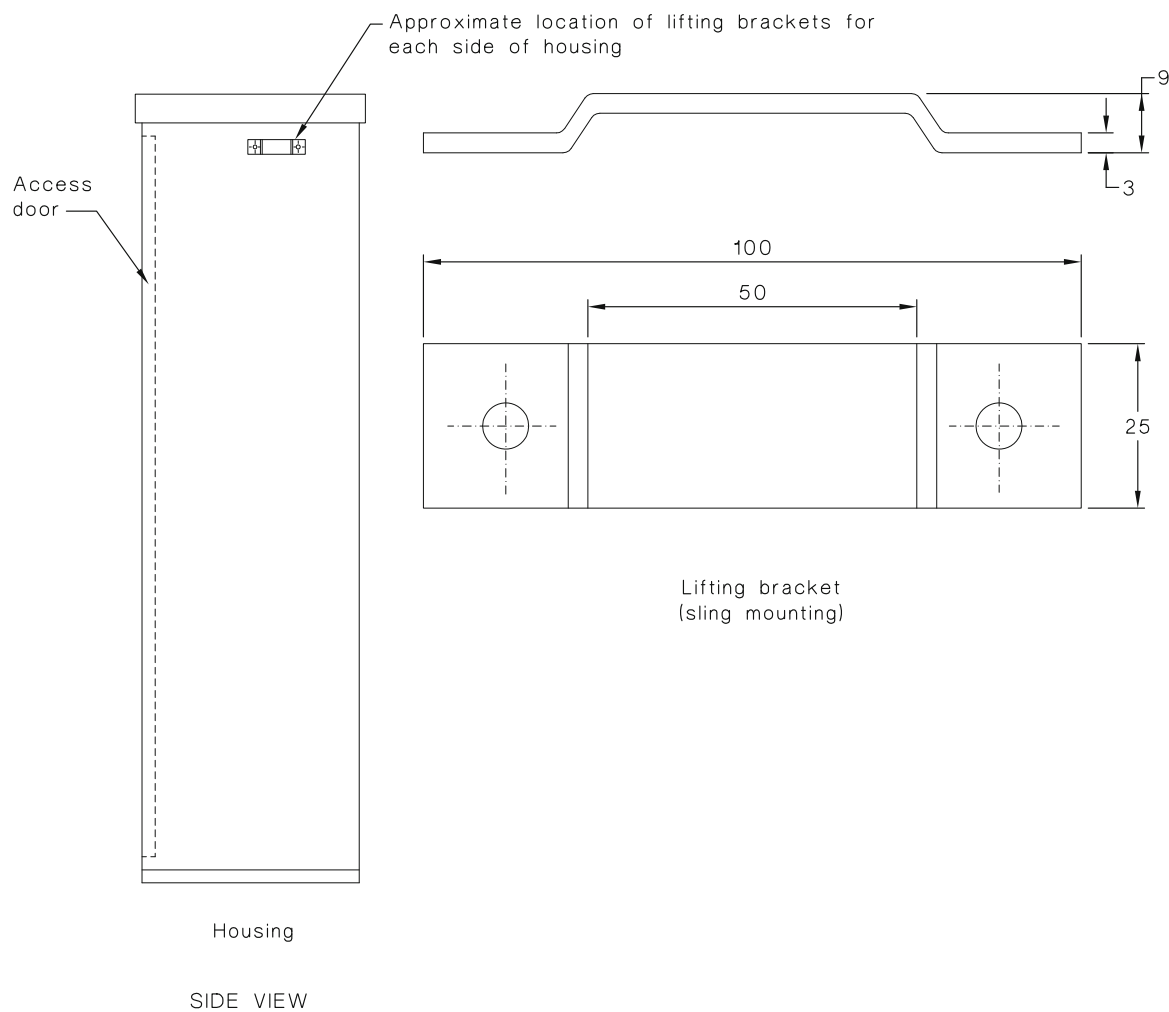
The exterior of the housing shall be free from irregularities and as far as practicable, free from fasteners such as bolts, screws and pop-rivets.

The interior and exterior of the housing shall be free from sharp corners and projections that may cause injury. All exterior corners of the housing and roof shall have a minimum external radius of 3 mm. All accessible edges shall be de-burred.

The housing shall be fitted with brackets to facilitate lifting the housing during transportation and installation (see Figure 2.2).

All metallic fixtures included in the controller housing, including fasteners, shall be suitably protected to prevent corrosion for the levels of atmospheric pollutants specified in Clause 1.4.2.

As far as practicable, all materials used in the construction and wiring of the housing shall be of composition that does not support combustion, or that is self extinguishing.



DIMENSIONS IN MILLIMETRES

NOTES:

- 1 The lifting bracket to suit 40 mm wide 2000 kg capacity polyester webbing.
- 2 Bracket to be located on the centre of gravity of the housing.

FIGURE 2.2 LIFTING BRACKET DETAILS (SLING MOUNTING)

2.3.2 Material

The housing (i.e. body, roof, base and access door) shall be constructed from A5251 H34 or A5005 H34 aluminium sheet with a minimum thickness of 2 mm. Reinforcing shall be provided as necessary to produce a rigid structure and to provide adequate strength against vandalism.

2.3.3 Mounting

The base of the housing shall be constructed with adequate strength for mounting on a footing. The housing shall not distort when mounted on a reasonably even footing.

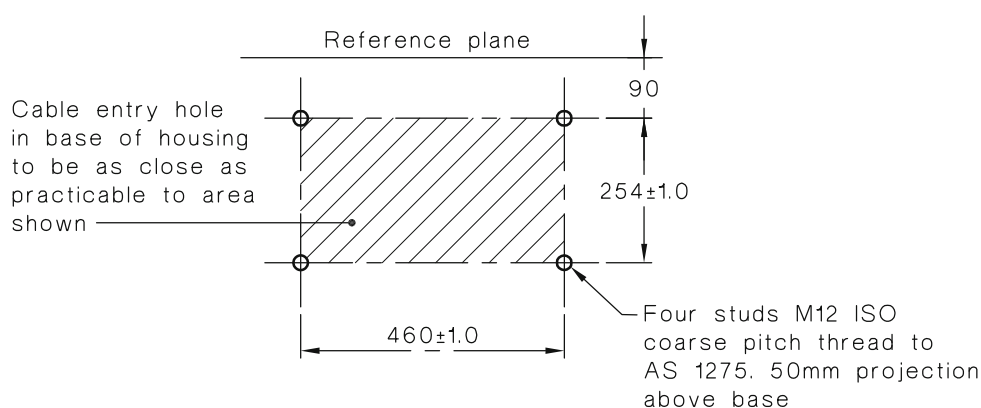
Notwithstanding the requirements of Clause 2.3.2, it is permissible for the base section of the housing to be a frangible aluminium alloy casting. In such case, the alloy shall contain not less than 5% silicon. The casting shall be suitably treated to prevent electrolytic and chemical corrosion.

If the base for the housing is constructed from aluminium sheet, then the base shall include an integral reinforcing frame to provide rigidity and to provide adequate strength for the mounting bolts. The reinforcing frame shall be made from heavy gauge aluminium.

The mounting bolt positions for the housing shall comply with the requirements of Figure 2.3. Oversize clearance holes shall be provided for 12 mm diameter mounting studs to facilitate installation.

Frangible plates shall be supplied for mounting the housing to the footing. The frangible plates shall be designed such that the housing will be dislodged from its mountings, without damage to the mounting bolts, in the event of a severe impact, such as from an errant motor vehicle. However, the frangible plates shall withstand a minor impact from a motor vehicle or a vandal.

The top of the housing shall not deflect more than 10 mm when a force of 2 kN is applied at the top of the housing in any direction. The housing and base shall provide adequate strength to withstand damage by vandalism.



DIMENSIONS IN MILLIMETRES

NOTE: The reference plane may be a building alignment or edge of a wall.

FIGURE 2.3 MOUNTING DIMENSIONS FOR CONTROLLERS

2.3.4 Cable access and telecommunications conduit access

Provision shall be made for entry of all external cables through the base of the housing. The size of the entry hole shall be in accordance with Figure 2.3. The entry position of the telecommunications conduit shall be as shown in Figure 2.4. The manufacturer shall make provision for the telecommunications conduit to enter in the preferred or alternate position.

NOTE: See Appendix A, Item (j).

No equipment shall be mounted within the space 150 mm above the bottom edge of the housing base. This is to provide protection of equipment against minor flooding and to ensure a minimum level of accessibility for installation staff.

No equipment shall be mounted in the area directly below the terminal blocks used for connection of external cables, other than the clamps for securing the incoming cables. This is to provide free entry of external cables into the housing and to facilitate forming and termination of the cables.

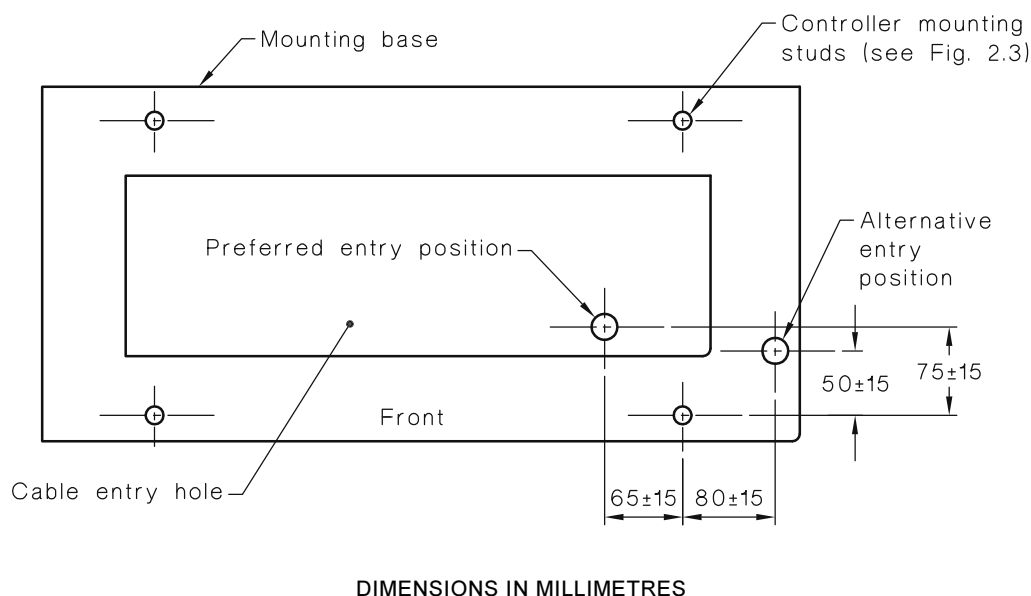


FIGURE 2.4 ENTRY POSITIONS FOR TELECOMMUNICATIONS CONDUIT

2.3.5 Door

A door shall be incorporated at the front of the housing to provide direct access to all internal equipment, including cable clamps and terminals for the connection of external wiring. The required access shall be provided when the door is opened not more than 110° from the closed position.

The size of the door opening shall be as close as practicable to the external dimensions of the housing, subject to the requirements for mechanical strength.

No equipment shall be mounted on the door.

2.3.6 Door hinges

The door shall be hinged on either the left or the right side.

The door hinges shall be of the concealed type or be equivalently vandal resistant and shall not restrict the door from being opened a minimum of 110° from the closed position.

The door hinges shall be of robust construction and shall be made of a corrosion resistant material such as stainless steel. The hinges shall be of a type that does not require lubrication to prevent seizing.

The door hinges shall not be damaged when the door is swung forcefully open or closed, such as may occur when the door is blown by a gust of wind. Long hinges, such as 'piano hinges', shall not be used.

The door shall swing freely without binding on any portion of the housing.

2.3.7 Door locks

The door shall be capable of being locked to prevent unauthorized access. The lock shall be of a type that is suitable for fixing to the dimensions specified in Figure 2.5.

NOTE: The type of lock is the subject of agreement between the purchaser and the manufacturer. (See Appendix A, Item (b).)

The action of securing the door locking mechanisms shall compress the door sealing gasket, such that there is an effective weatherproof seal when the door is locked.

When the door is locked, the door locking mechanisms shall securely hold the door in the closed position.

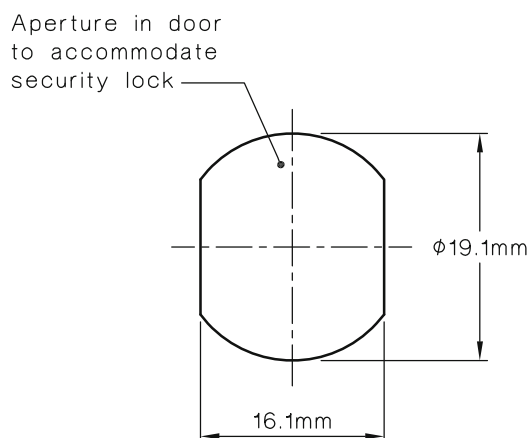


FIGURE 2.5 FIXING DIMENSIONS FOR SECURITY LOCK

2.3.8 Door retainer

A retaining device shall be provided to securely hold the door in the open position under all weather conditions. As a minimum, the retaining device shall provide for the door to be held open at 110° and at 90° from the closed position.

2.3.9 Weather sealing

The housing door shall be provided with durable and resilient weatherproof sealing gaskets. The sealing gaskets shall be made of an ultra-violet stable, closed-cell material. The sealing gaskets shall be securely held in position and shall be readily replaceable while the controller is in service.

2.3.10 Ventilation

Ventilation shall be provided to allow free air flow for cooling and to prevent condensation inside the housing under all weather conditions.

The ventilation system shall be designed to permit the escape of any gas that may enter the housing.

Electric fans, blowers, and similar devices shall not be used to provide the air flow for ventilation.

The ventilation system shall be designed to minimize the ingress of dust and insects into the housing.

The ventilation openings shall be designed to prevent objects, such as wires, from gaining entry into the housing and making contact with any electrical circuit.

2.3.11 Plan pocket

A storage pocket shall be provided on the inside of the access door for storage of binders with A4 size drawings. The pocket shall have the dimensions specified in Table 2.2.

TABLE 2.2
PLAN POCKET DIMENSIONS

Width	Height	Depth
350 mm	200 mm	25 mm

A finger slot or other suitable means shall be provided to facilitate removal of service cards and drawings from the pocket.

2.3.12 Equipment shelf

The housing shall have a rigid equipment shelf for mounting the Logic Module and any other free standing ancillary equipment.

The equipment shelf shall be mounted not less than 390 mm below the top of the door opening and shall be approximately the width of the door opening.

The front edge of the shelf shall be turned down and shall have a series of holes for securing the wander leads with cable ties.

2.3.13 Finish and protection

Both the interior and exterior of the housing shall be suitably treated to prevent corrosion.

All exterior surfaces of the housing shall have a durable gloss finish of anti-graffiti polyester powder coating with a minimum thickness of 50 microns or equivalent finish.

The colour of the exterior finish shall be smoke blue (colour No. T33) as defined in AS 2700.

2.3.14 Controller nameplate

A metal nameplate shall be affixed to the exterior of the controller housing. The positioning of the nameplate is related to the positioning of the Facility Switch (see Clause 2.7). The key access for the Facility Switch shall be via a suitable cut-out in the controller nameplate.

The nameplate shall provide the following information:

- (a) Manufacturer.
- (b) Controller type, (name and identifying numbers).
- (c) Electrical ratings.
- (d) C-tick.
- (e) Certificate of suitability number.
- (f) Facility Switch position indications (Clause 2.7.5).

The nameplate shall be made from aluminium, or a suitable alternative material. Adhesive labels shall not be used. A high quality process (such as photo engraving, anodizing or equivalent) shall be used to produce the legends on the nameplate. The legends shall be clearly legible, indelible, and non-fading.

Notwithstanding the requirements of Clause 2.3.1, the nameplate may be mounted on the housing by screws with blind cup heads, or by suitable sealed pop-rivets with smooth low profile heads.

2.3.15 Resistance to vandalism

The controller housing shall be designed to withstand vandalism. As a minimum, particular attention shall be given to the design to withstand, as far as practicable, the following:

- (a) Forcibly opening the door manually or using simple tools to open the door locks or part the door hinges.
- (b) Forcibly pushing the housing from its mountings.
- (c) Damage to the housing or door or mounting base by kicking or pushing.

NOTE: Refer also to Clause 1.4.8 for additional requirements for vandal resistance.

2.3.16 Housing top extension

The manufacturer shall make provision for the addition of a top extension section to the housing. The purpose of the top extension is for the location of ancillary equipment in the housing. It should be possible to retrofit the top extension to a housing on site.

The housing top extension shall have its own front access lockable door.

The housing top extension shall provide the following facilities to permit the mounting of internal components:

- (a) A 19 inch mounting frame, 7U in height. The mounting surface of the frame shall be not less than 45 mm from the door when closed.
- (b) Space for mounting a mains panel or switchboard.

Ventilation shall be provided for the housing top extension. The housing top extension shall not impede the ventilation of the main housing.

Provision shall be made for cable access from the main housing to the housing top extension.

NOTE: The manufacturer is only required to fit the housing top extension when so specified by the purchaser. (See Appendix A, Item (m).)

2.4 CABLE CLAMPING BARS

2.4.1 General

Clamping bars shall be provided for securing and supporting all external cables, other than the telecommunications line. That is, clamping bars shall be provided for:

- (a) Consumer mains.
- (b) Signal cables.
- (c) Linking cables.
- (d) Detector loop feeder cables.

2.4.2 Position

The clamping bars for each group of cables shall be positioned in the immediate vicinity below the respective termination points for the cables.

2.4.3 Clamping action and capacity

The method for clamping the cables shall be such that all cables shall be uniformly clamped regardless of the mix of cable types and sizes.

The clamping bar for the consumers mains shall accommodate two single double insulated (SDI) cables with sizes from 6 mm² to 16 mm².

The clamping bars for signal cables shall accommodate up to six cables complying with AS/NZS 2276.1, with any mix of cable sizes up to 51 cores. The maximum cable diameter is 40 mm and the minimum diameter is 10 mm.

Provision shall be made for clamping a linking cable, either separately or together with the signal cables. Alternatively, a tie bar may be provided for a linking cable.

The clamping bars for detector loop feeder cables complying with AS/NZS 2276.2 shall accommodate feeder cables for up to 32 detector loops.

2.5 SWITCHBOARD

2.5.1 General

The switchboard and wiring shall comply with all relevant requirements of AS/NZS 3000.

The switchboard circuits shall be as specified in Figure H1.

2.5.2 Mounting position

The switchboard shall be mounted in a readily accessible position in the lower part of the housing. With the housing door open, the main switch, fault current limiter and circuit breakers shall be directly accessible without the need to remove or swing back any panel or any equipment in the housing.

The switchboard shall be suitably positioned to be protected from rain, as far as is practicable, when the housing door is open.

The switchboard components shall be protected by covers or protective barriers to preclude accidental contact with mains voltage.

2.5.3 Main switch and fault current limiter

The main switch shall control the supply to all circuit breakers comprising the switchboard, but shall not control supply to the fault current limiter.

The main switch shall be a 32 A Type C circuit breaker with a fault-make load-break fault current rating not less than 8 kA.

The fault current limiter shall be a fuse with a replaceable cartridge element, rated at a maximum of 32 A with a breaking capacity not less than 27 kA, and shall comply with the requirements of AS 60269.1. The fault current limiter shall be suitably positioned to facilitate connection of the active conductor of the Consumer Mains.

2.5.4 Lamps circuit breaker

The lamps circuit breaker shall be rated at 16 A, Type C, with a fault-make load-break fault current rating not less than 8 kA, and shall control the supply to all signal lamp circuits.

2.5.5 Flash circuit breaker

The flash circuit breaker shall be rated at 16 A, Type C, with a fault-make load-break fault current rating not less than 8 kA, and shall control the supply to a Flasher Unit for the Flash mode signal display.

2.5.6 Logic circuit breaker

The logic circuit breaker shall be rated at not greater than 10 A, Type C, with a fault-make load-break fault current rating not less than 8 kA, and shall control the supply to the controller electronics, other than the Flasher Unit.

2.5.7 Detector circuit breaker

The detector circuit breaker shall be rated at not greater than 10 A, Type C, with a fault-make load-break fault current rating not less than 8 kA, and shall control the supply to detector equipment.

2.5.8 Auxiliary circuit breaker

The auxiliary circuit breaker shall be rated at 16 A, Type C, with a fault-make load-break fault current rating not less than 8 kA, and shall control the socket-outlet and any auxiliary circuits.

The auxiliary circuit breaker shall not be a type with an integral residual current circuit breaker. The auxiliary circuit breaker will control mains supply to external equipment, such as closed circuit television cameras and red signal violation cameras. The requirement is that the external equipment is not subject to nuisance tripping of a residual current circuit breaker.

2.5.9 Socket-outlet with integral residual current device

The controller housing shall provide a double socket-outlet with an integral 30 mA Type II residual current device, complying with AS/NZS 3190.

The socket-outlet shall be mounted in an accessible position in the housing. Where the socket-outlet is mounted on the switchboard, a barrier shall be provided to segregate the rear of the socket-outlet from the switchboard components and wiring.

2.5.10 Surge diverter

The controller shall be protected against surges on the incoming mains supply as far as practicable, such as surges induced by lightning, switching spikes, and similar transients.

Where a surge diverter incorporates one or more metal oxide varistor (MOV) devices, it shall include an indicator, which shall be lit while the MOV devices are functional, and extinguished when any of the MOV devices has failed. MOV devices shall be rated at not less than 385 V a.c.

The surge diverter shall be effectively isolated from the mains supply when the main switch is in the open position.

2.5.11 Order of switches on the switchboard

The order of the circuit breakers, from left to right as viewed from the front of the switchboard, shall be:

- (a) Lamps circuit breaker.
- (b) Flash circuit breaker.
- (c) Logic circuit breaker.
- (d) Detector circuit breaker.
- (e) Auxiliary circuit breaker.
- (f) Spare position for additional circuit breaker.

2.6 FIELD TERMINAL BLOCKS

2.6.1 Terminal types

The field terminal blocks provide connection of field wiring to—

- (a) signal lanterns;
- (b) pedestrian pushbuttons;
- (c) external vehicle detectors;
- (d) detector loops;
- (e) linking connections; and
- (f) all other external low voltage circuits.

The terminals for (a), (b), (c) and (f) above shall be rail-mounted, screw-clamp types with spring-loading. The voltage rating shall be not less than 500 V r.m.s. and the continuous current rating shall be not less than 30 A. The terminals shall be capable of accepting conductors with cross sectional areas from 0.5 mm² to 6 mm². Refer to the large terminals in Figure 2.6.

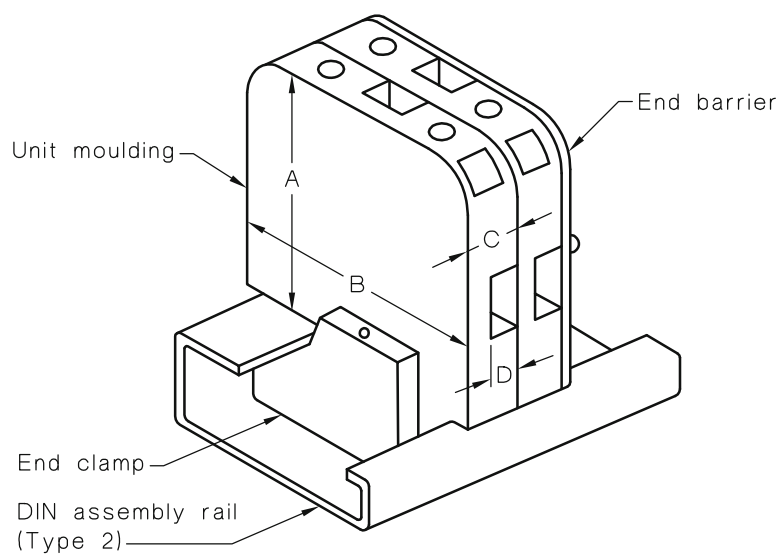
Flash barriers shall be provided between adjacent low voltage (LV) circuits, and between adjacent low voltage and extra low voltage (ELV) circuits.

A removable, clip-on transparent cover shall be provided for each of the field terminals (a), (b), (c) and (f) above, to prevent accidental contact with live circuits. The cover(s) shall have sufficient rigidity to maintain protection while fitted in place, and shall not be easily deformed by heat or environmental effects.

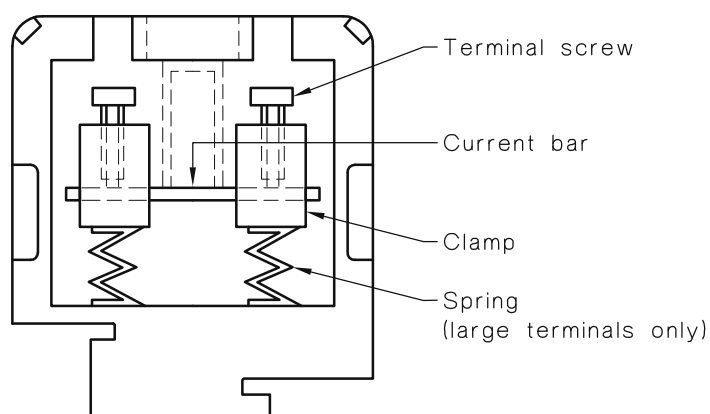
Insulating cover(s) are not required where the terminals preclude contact with live parts and conductors.

The terminals used for connection of detector loop feeder cables (d), and the terminals for field wiring for Linking (e), shall have voltage rating not less than 250 V a.c. and shall have continuous current rating not less than 10 A. The terminals shall be capable of accepting conductors with cross sectional areas from 0.5 mm² to 2.5 mm².

The terminal block layout, assembly and numbering shall be in accordance with Figures H2 and H3. Terminal blocks shall be conveniently accessible in the housing and shall not be less than 280 mm above the base of the housing.



(a) Typical assembly



(b) Typical arrangement

Dimension	millimetres			
	Small terminals		Large terminals	
	min.	max.	min.	max.
A	25	55	—	55
B	25	55	—	55
C	6	11	6.5	11
D	4.2	—	4.2	—

FIGURE 2.6 TYPICAL ARRANGEMENT AND DIMENSIONS OF TERMINALS

2.6.2 Signal circuits

Terminal blocks shall be fitted for the number of signal groups specified by the purchaser and in accordance with Figures H2 and H3.

Where specified by the purchaser, the manufacturer shall provide alternative terminal types to those specified in Clause 2.6.1, such as terminals for accepting tab connectors.

NOTE: See Appendix A, Item (n).

A minimum of three termination points shall be provided for connection of external cables for each aspect of each signal group.

Mounting points and any necessary fittings shall be provided to allow up to the full complement of terminal block assemblies to be readily fitted in the field or in the workshop.

2.6.3 Lamp active and neutral

Terminals shall be provided for connection of external cables to the lamp active and lamp neutral circuits. Two termination points shall be provided for the lamp active and four termination points shall be provided for the lamp neutral at each of the terminal block assemblies A, B, C and D, for signal group circuits (refer to Figure H3).

The lamp active at terminals A2, B2, C2 and D2 shall not be subject to dimming. There is no requirement for the Lamp Active at these terminals to be regulated.

There is no requirement for terminals to be provided for lamp active or lamp neutral on the AA, BB, CC, or DD terminal block assemblies.

2.6.4 Detector active and neutral

Three termination points shall be provided for each of the detector active and detector neutral circuits for connection of external cables (i.e. for external detector units). (See Figure H3.)

2.6.5 External detector inputs and detector common

Three termination points shall be provided for connection of external cables for each of sixteen external inputs (i.e. external detector and/or pushbutton inputs 1–16).

Provision shall be made for mounting terminals for a further sixteen inputs. A single termination point is required at each of the terminals for external inputs 17–32.

Seven terminations shall be provided for each of Terminals E3 and E4 on the E terminal block assembly (see Figure H3) for connection of detector and pushbutton common returns (and Wait Indicator returns).

2.6.6 Loop terminations

Terminal blocks shall be provided for connecting loop feeder cables (complying with AS/NZS 2276.2) for detector units mounted inside the housing. A single terminal is required for each loop feeder cable connection (i.e. two terminals per detector loop).

Terminals shall be provided for connection of feeder cables for sixteen detector loops. Provision shall be made for expansion up to the full complement of thirty-two detector loops.

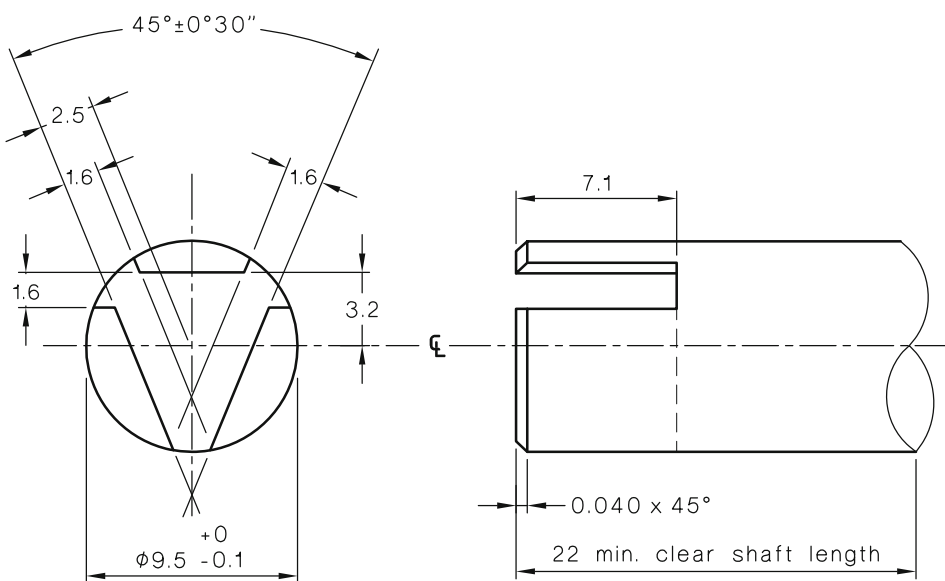
A bar or link shall be provided for earthing the screens of loop feeder cables. The earthing bar or link shall be connected to the earth link on the switchboard. The link for earthing cable screens shall provide a minimum of five available termination points.

2.7 FACILITY SWITCH AND KEY

2.7.1 General

The Facility Switch provides safety related functions. The Facility Switch shall provide for the signal displays to be switched to the 'On', 'Off' and 'Flash' modes, by means of a key complying with Figure 2.7.

The key access shall be provided from the exterior of the controller housing, without the need to open the housing access door.



ALL DIMENSIONS ARE IN MILLIMETRES

FIGURE 2.7 OPERATING KEY FOR FACILITY SWITCH

2.7.2 Switch positions and function

The Facility Switch shall provide three positions, in clockwise order—

- 'OFF'.
- 'FLASH'.
- 'ON'.

The 'OFF' position shall remove voltage from the following external circuits deriving supply from within the controller housing:

- Signal circuits.
- Flashing active outputs from the Flasher Unit.
- External auxiliary circuits.
- External detector equipment.
- Audio-tactile driver equipment.

The isolation of the above circuits shall not be dependent upon the controller logic circuits.

The 'FLASH' position shall place the signals in the Flash mode. In this mode the Flash Change-Over Relays (see Clause 2.9) shall be energized and the Flasher Unit output (see Clause 2.11) shall be applied to the yellow aspect of designated signal groups. This function shall not be dependent upon the controller logic circuits.

The 'FLASH' position shall remove the lamp active supply from the signal switching circuits and audio-tactile driver equipment, but shall not remove the supply voltage from external detector equipment or from external auxiliary circuits.

The 'ON' position shall allow the controller logic to operate the signals with normal displays. The supply voltage shall be available to external detector equipment, audio tactile driver equipment and auxiliary circuits for normal operation.

The supply voltage to the controller Logic Module shall not be interrupted by the Facility Switch in any of its positions.

The Facility Switch shall isolate the drive to the Master Relay (see Clause 2.8) when the Facility Switch is in the 'OFF' and 'FLASH' positions.

The Facility Switch shall isolate the drive to the Auxiliary Relay (see Clause 2.8) when the Facility Switch is in the 'OFF' position.

The Facility Switch shall disable the flashing active outputs on the Flasher Unit when the Facility Switch is in the 'OFF' position.

The Facility Switch shall provide contacts to allow the controller logic circuits to sense the position of the Facility Switch. The switch position shall be encoded using the Gray code specified in Table 2.3.

TABLE 2.3
SWITCH POSITION ENCODING

Switch position	Gray code	
	Contact A	Contact B
Off	1	0
Flash	1	1
On	0	1

2.7.3 Type and rating

The Facility Switch shall be an industrial grade switch suitable for use in outdoor equipment.

The Facility Switch contacts shall be rated for switching control signals, operating at voltages of nominally 12 V d.c., and currents of 1 mA to 10 mA.

2.7.4 Mounting

The Facility Switch shall be mounted inside the controller housing. Key access shall be in accordance with Clause 2.3.14.

The Facility Switch shall be mounted within 250 mm of the top of the housing, on either the left or right side of the housing. The Facility Switch shall not be mounted on the rear side of the housing or the controller access door.

2.7.5 Marking

The switch positions shall be indelibly and durably marked on the controller nameplate affixed to the outside of the housing (see Clause 2.3.14). The switch positions shall be marked in clockwise order—

- (a) 'OFF'
- (b) 'FLASH'
- (c) 'ON'

The acute angle of the switch actuator shall indicate the current switch position (see Figure 2.8).

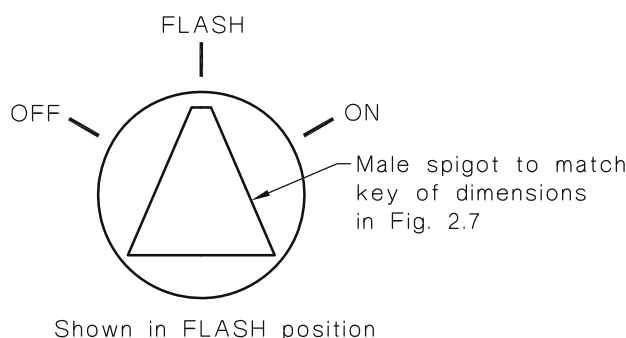


FIGURE 2.8 RELATIVE POSITION OF OPERATING KEY AND SWITCHING MODES

2.7.6 Resistance to vandalism

The Facility Switch shall be vandal resistant such that it shall not be possible to change the switch position with simple tools or implements, such as screwdrivers or pliers.

2.7.7 Connection to the Site Identification Encoder (connector ZSW)

The wiring to the Facility Switch contacts shall be terminated in a connector to mate with the corresponding header connector (ZSW) on the Site Identification Encoder. The pin connections for connector ZSW shall be as specified in Appendix E, Paragraph E7.

The connections between the housing wiring and the Facility Switch are shown in Figure H6.

2.8 MASTER RELAY AND AUXILIARY RELAY

2.8.1 Function

The Master Relay shall provide the means for the logic circuits and the Facility Switch to control the low voltage supply to the signal group circuits (including the lamp active supply at terminals A2, B2, C2 and D2 on the A, B, C and D terminal block assemblies).

The Auxiliary Relay shall provide the means for the logic circuits and the Facility Switch to control the low voltage supply to equipment external to the controller housing.

2.8.2 Type and rating

The Master Relay and the Auxiliary Relay shall each be a heavy-duty contactor. The coil for each contactor shall be rated for operation from a nominal 24 V d.c. supply with a current not exceeding 200 mA.

Each contactor shall provide a minimum of two load switching contacts and one control contact. The load switching contacts shall be rated for loads of 20 A, AC 2 service. The control contacts shall be rated for switching extra-low voltage control signals, operating at voltages of nominally 12 V d.c. and currents of 1 mA to 10 mA.

2.8.3 Connection to the Site Identification Encoder (connector ZMR)

The wiring to the coil and control contact for both the Master Relay and the Auxiliary Relay shall be terminated in a connector to mate with the corresponding header connector (ZMR) on the Site Identification Encoder. The pin connections for connector ZMR shall be as specified in Appendix E, Paragraph E6.

The connections between the housing wiring and the contactors are shown in Figure H6.

2.9 FLASH CHANGE-OVER RELAYS

2.9.1 Function

The Flash Change-Over Relays provide the means for switching the Flasher Unit output (see Clause 2.11.3) to the yellow aspect of designated signal groups, and disconnecting the normal signal drives from those aspects.

The yellow aspects shall be driven by the normal signal drive outputs while the Flash Change-Over Relays are de-energized (normal signal operation) and shall be driven by the Flasher Unit outputs while the Flash Change-Over Relays are energized (Flash mode).

The Flash Change-Over Relays shall be driven from the Flash Change-Over Relay drive output on the Flasher Unit (see Clause 2.11.7).

2.9.2 Provision of Flash Change-Over Relays

Flash Change-Over Relays shall be provided for the minimum number of signal groups specified in Table 2.4.

TABLE 2.4
NUMBER OF FLASH CHANGE-OVER CIRCUITS

No. of signal groups wired in the housing	Minimum no. of signal groups with flash change-over switching
8	8 (SG1–SG8)
12	12 (SG1–SG12)
16	16 (SG1–SG16)
Above 16	16 (SG1–SG16)

2.9.3 Flash Change-Over Relay type and ratings

The Flash Change-Over Relays shall be plug-in heavy duty relays or contactors with the following characteristics:

- The coils shall be rated for nominal 24 V d.c. operation.
- The maximum coil operating power shall not exceed 3.0 W (125 mA at 24 V d.c.).
- Each relay shall provide the equivalent of four heavy duty change-over contact sets, i.e. 4 change-over, or 4 normally-open and 4 normally-closed.
- The contact material for all contact sets shall be silver-cadmium-oxide, or fine silver.
- Each contact set shall be rated for switching the nominal mains supply voltage.

- (f) Each contact set shall be rated for a minimum of 100 000 operations when switching a load current of 5 A, AC 2 service at the nominal mains voltage.

2.9.4 Selection of signal groups for flashing yellow

Enabling or disabling specific yellow aspects for connection to the Flasher Unit outputs shall be achieved by changing the position of links on one or more terminal blocks provided for this purpose.

The wiring to each terminal block shall be colour coded and marked in such a way that there will not be any confusion in enabling or disabling the flashing yellow facility for particular signal groups.

The housing shall be supplied with the links wired to enable flashing yellow on the minimum number of signal groups specified in Table 2.4.

2.10 MISCELLANEOUS RELAYS AND CONTACTORS

2.10.1 Function

Provision shall be made for relays to switch low voltage to Special Facility circuits and to a Daily Event circuit. The Special Facility outputs 1–24 shall control the Special Facility relays or contactors (see Clause 3.4.8). The controller logic Daily Event output shall control the Daily Event relay(s) (see Clause 3.4.9).

NOTE: The manufacturer is only required to fit the Special Facility and/or Daily Event relays when so specified by the purchaser. (See Appendix A, Item (f) and Item (g).)

2.10.2 Type and rating

The Daily Event relay(s) and the Special Facility relays shall be a suitable plug-in relay type with four heavy duty change-over contact sets. Each contact set shall be rated at not less than 5 A, AC 2 service. Each relay coil shall be rated for nominal 24 V d.c. operating voltage with a current not exceeding 80 mA.

2.11 FLASHER UNIT

2.11.1 Function and connections

The Flasher Unit provides safety related functions. The Flasher Unit shall provide the flashing active supply for the Flash mode of operation for the signal displays. The Flasher Unit shall be a self-contained unit that connects to the housing wiring circuits by means of plug and socket connectors.

The Flasher Unit shall accept the following inputs:

- (a) Flasher Unit mains active supply (see Clause 2.11.2).
- (b) Lamp active sensing input (see Clause 2.11.5).
- (c) Two inputs for disabling flashing (see Clause 2.11.6).
- (d) Mains neutral.
- (e) Protective earth.

The Flasher Unit shall provide the following outputs:

- (i) Two flashing active outputs (see Clause 2.11.3).
- (ii) An output to indicate that a residual direct current fault has been detected on one or both of the flashing active outputs (see Clause 2.11.4).
- (iii) An output to switch the Flash Change-Over Relays (see Clause 2.11.7).

- (iv) A status output to indicate the state of the Flash Change-Over Relays (see Clause 2.11.8).

The Flasher Unit shall operate independently of the controller logic circuits such that the signal displays can be operated in the Flash mode with the Logic Module disconnected and removed from the controller housing.

Figure H5 provides a functional block diagram of the Flasher Unit. Figure H6 details the connections for the housing wiring between the Site Identification Encoder and the Flasher Unit.

NOTE: Refer to Figure H1 and Figure H4 for details of the housing low voltage wiring connections to the Flasher Unit.

2.11.2 Mains active supply to the Flasher Unit

The mains active supply to the Flasher Unit shall be controlled by the flash circuit breaker on the switchboard, i.e. an independent circuit in order to allow Flash mode in the event that the lamps circuit breaker trips.

The Flasher Unit shall operate correctly and reliably for all incoming mains supply voltages in the range 150–280 V r.m.s.

The Flasher Unit shall de-activate the Flash Change-Over Relay drive output when the mains supply voltage is too low to provide reliable triggering of the flashing active outputs (see Clause 2.11.9).

2.11.3 Flasher Unit flashing active outputs

The Flasher Unit shall provide two flashing active output circuits, with each output circuit rated for flashing a 10 A lamp load at a nominal rate of one flash per second.

The duty cycle for the outputs shall be selectable to provide a duty cycle of either 40% on and 60% off; or 50% on and 50% off. The flashing active outputs shall operate in anti-phase such that only one output circuit is supplying power at any time.

The Flasher Unit shall provide reliable operation for load power factors in the range 0.9 leading to 0.75 lagging. There is no requirement for the Flasher Unit to provide either voltage regulation or dimming for the flashing active outputs.

2.11.4 Prevention of residual direct current to the load

The Flasher Unit shall be designed to supply power to the load from integral numbers of complete mains cycles (i.e., an even number of mains half-cycles).

The Flasher Unit shall automatically switch off both flashing active output circuits when there is a residual direct current greater than 50 mA in either of the output circuits for 5 s or more (such as when an output circuit half waves or fails to trigger reliably with an inductive load). As an alternative for sensing residual direct current in the load, the Flasher Unit shall respond to a d.c. voltage greater than 50 V, averaged across the load for 5 s or more.

When a residual direct current is detected, the Flasher Unit shall switch the flashing active outputs off, release the Flash Change-Over Relays, light a fault LED indicator and remain in this state until the mains supply to the Flasher Unit is removed.

The Flasher Unit shall provide an isolated (e.g. opto-isolated) output to the controller logic circuits to indicate that a residual direct current fault has occurred. The residual direct current fault output shall conform to the following requirements:

- (a) In the active state, the output shall sink 5 mA d.c. to the isolated logic common, with a stand-off voltage less than 0.5 V d.c.
- (b) In the inactive state, the output shall have a leakage current less than 0.5 mA d.c. to the isolated logic common with an applied voltage of 15 V d.c.

- (c) The output shall not be damaged by an applied voltage of 15 V d.c. with a source impedance of 1 k Ω or greater.
- (d) The output shall be isolated from the low voltage circuits in the Flasher Unit with a breakdown voltage not less than 3 kV r.m.s.

2.11.5 Lamp active sensing input

The Flasher Unit shall provide an input for sensing the presence of the lamp active supply to the signal displays.

The Flasher Unit shall provide an interlock such that the flashing displays cannot be enabled simultaneously with normal signal displays, i.e. while the lamp active sensing input is active. (See Clause 2.11.9.)

2.11.6 Disable flash inputs

The Flasher Unit shall provide an isolated (e.g. opto-isolated) input driven from the controller logic circuits, as follows:

- (a) The input shall be active when the input current exceeds 5 mA d.c.
- (b) The input shall be inactive when the input current is less than 0.5 mA d.c.
- (c) The input stand-off voltage shall not exceed 2.5 V d.c. with an input current of 10 mA d.c.

The Flasher Unit shall de-activate the Flash Change-Over Relay drive output when the disable flash input toggles between the inactive and active states at a rate greater than 2 Hz.

The Flasher Unit shall provide a second isolated input for disabling the flashing active outputs when the Facility Switch is in the 'OFF' position. A logic ground at the input shall disable the flashing active outputs. The input interface circuit shall not present a voltage greater than 24 V with respect to logic ground at the input terminal.

2.11.7 Flash Change-Over Relay drive output

The Flasher Unit shall provide an output to drive the coils of up to four Flash Change-Over Relays (see Clause 2.9).

The Flash Change-Over Relay drive output shall conform to the following requirements:

- (a) In the active state the output shall switch a nominal 24 V d.c. voltage to the coils and shall provide a current switching capability of 500 mA or greater.
- (b) In the inactive state the output leakage current, (including snubber circuit), shall be less than 0.1 mA.
- (c) The output shall be referenced to the mains neutral for the Flasher Unit.

The Flash Change-Over Relay drive output shall be inactive when there is no supply voltage to the mains active supply input to the Flasher Unit, such as when the flash circuit breaker is off.

2.11.8 Flash Change-Over Relay status output

The Flasher Unit shall provide an electrically isolated (e.g. opto-isolated) output to the controller logic circuits to indicate the state of the Flash Change-Over Relays (i.e. operated or released). This output shall allow the controller logic to detect the possibility of flashing yellow displays together with normal signal displays. The output shall also indicate to the controller logic circuits whether the signal displays are in Off mode or Flash mode when the lamp active is not present.

The Flash Change-Over Relay status output shall conform to the following requirements:

- (a) In the active state, the output shall sink 5 mA d.c. to the isolated logic common, with a stand-off voltage less than 0.5 V d.c.
- (b) In the inactive state, the output shall have a leakage current less than 0.5 mA d.c. to the isolated logic common with an applied voltage of 15 V d.c.
- (c) The output shall not be damaged by an applied voltage of 15 V d.c. with a source impedance of 1 k Ω or greater;
- (d) The output shall provide isolation from the Low Voltage circuits in the Flasher Unit with a breakdown voltage not less than 3 000 V r.m.s.

The Flash Change-Over Relay status output shall be active when the Flash Change-Over Relay drive output is active, and shall be inactive when the Flash Change-Over Relay drive output is inactive.

The Flash Change-Over Relay status output shall be inactive when there is no supply voltage to the mains active supply input to the Flasher Unit, such as when the flash circuit breaker is off.

2.11.9 Flasher Unit control logic

The Flasher Unit control logic shall energize the Flash Change-Over Relays and activate the flashing active outputs when all of the following conditions are satisfied:

- (a) The incoming mains supply voltage at the mains active supply input to the Flasher Unit is greater than 150 V r.m.s.
- (b) The lamp active voltage is below 50 V r.m.s., (i.e. the signal lamps are off).
- (c) The flash disable input is not toggling.
- (d) The Facility Switch Disable Flasher input is open circuit.
- (e) The residual direct current fault latch is not set.

The Flasher Unit control logic shall de-energize the Flash Change-Over Relays when one or more of the following conditions are satisfied—

- (i) The incoming mains supply voltage at the mains active supply input to the Flasher Unit is less than 150 V r.m.s.
- (ii) The lamp active is above 120 V r.m.s.
- (iii) The flash disable input is toggling.
- (iv) the Facility Switch Disable Flasher input is at logic ground.
- (v) The residual direct current fault latch is set.

The Flasher Unit control logic may optionally de-activate the flashing active outputs when the Flash Change-Over Relays are de-energized.

2.11.10 ELV connector (XFC)

The Flasher Unit shall be provided with a 9-pin male 'D' connector (XFC), for connections to the controller logic circuits, via the Site Identification Encoder.

The Flasher Unit shall provide a link between two pins at the connector, (i.e. internal to the Flasher Unit), to allow the controller logic circuits to sense that the corresponding connector is mated to the Flasher Unit. All inputs and outputs to this connector shall be isolated from the mains supply voltage with a breakdown voltage not less than 3000 V r.m.s.

The pin functions for connector XFC shall be as specified in Appendix D, Paragraph D1

2.11.11 LV connector (XFP)

The Flasher Unit shall be provided with a 9 pin connector (XFP) with socket pins for connection to the low voltage circuits in the wired housing. All low voltage connections to the Flasher Unit shall be taken through the connector XFP.

The pin functions for connector XFP shall be as specified in Appendix D, Paragraph D2.

2.11.12 Earthing

Provision shall be made for earthing the exposed metal parts of the Flasher Unit through the low voltage connector XFP and the Flasher Unit mounting fasteners.

The Flasher Unit shall not rely solely upon the mounting fasteners for providing earthing of the unit. Two earthing conductors shall be included in the wander lead for the purpose of earthing the exposed metal parts of the Flasher Unit.

2.11.13 Marking

The Flasher Unit shall be clearly marked with the following information:

- (a) Manufacturer.
- (b) Type and identifying numbers.
- (c) Serial number.
- (d) Certificate of suitability number.
- (e) Rating for each output circuit (load voltage and current).
- (f) Safety warning for mains voltage.
- (g) Pin connections for the LV connector.
- (h) Pin connections for the ELV connector.

2.11.14 Connection to the Site Identification Encoder (connector ZFL)

The wiring to connector XFC for the Flasher Unit shall be terminated in a connector to mate with the corresponding header connector (ZFL) on the Site Identification Encoder.

The pin connections for connector ZFL shall be as specified in Appendix E, Paragraph E2.

The connections between the housing wiring and the Flasher Unit are shown in Figure H6.

2.12 SITE IDENTIFICATION ENCODER

2.12.1 Drawings

The Site Identification Encoder shall comply with Figure H6 Site Identification Encoder circuit, and Figure H7 Site Identification Encoder arrangement.

2.12.2 Function

The Site Identification Encoder circuit card shall provide the encoding for the site number at which the controller is installed. The card shall also provide encoding of the revision level.

The Site Identification Encoder circuit card shall provide an interface between the housing wiring and the controller logic circuits to minimize the number of connectors required to the Logic Module.

The Site Identification Encoder circuit card shall provide connections to the following devices:

- (a) Site number (see Clause 2.12.3).

- (b) Master Relay (see Clause 2.12.4).
- (c) Auxiliary Relay (see Clause 2.12.4).
- (d) Facility Switch (see Clause 2.12.5).
- (e) Flasher Unit (see Clause 2.12.6).
- (f) Light sensor (see Clause 2.12.7).
- (g) Gas sensor (see Clause 2.12.8).
- (h) Housing door switch (see Clause 2.12.9).
- (i) Controller Logic Module (see Clause 2.12.10).

2.12.3 Site number

The Site Identification Encoder is used to specify the site number at which the controller is installed.

The site number shall be expressed in binary coded decimal format with five digits. The digits shall be programmed by clipping components out of circuit on the encoder. Removal of a component shall be equivalent to setting the corresponding weighted binary bit value to a logic one.

The Site Identification Encoder shall also specify the particular revision level for the controller Personality data that is appropriate to the site.

The revision level shall take the values A to I. Removal of the next component in sequence shall effectively raise the revision level to the next higher level. The effective revision level shall correspond to the highest level with the component removed from circuit, regardless of whether all components in lower positions have been removed or not.

The Site Identification Encoder shall be supplied programmed for site number zero and revision level A, (i.e. with all components fitted except for the A revision level).

The Site Identification Encoder shall use silicon signal diodes (such as 1N914A or equivalent) for encoding the site number and the revision level. The diodes shall be grouped and labelled in accordance with Figure H7.

2.12.4 Master Relay and Auxiliary Relay connections (ZMR)

The connections to the Master Relay and the Auxiliary Relay shall share a common connector (ZMR) to the Site Identification Encoder circuit card.

The Master Relay shall have the following connections to the Site Identification Encoder circuit card:

- (a) Coil (+).
- (b) Coil (–).
- (c) Normally-open control contact set (2 connections).

The Auxiliary Relay shall have the following connections to the Site Identification Encoder circuit card:

- (i) Coil (+).
- (ii) Coil (–).
- (iii) Normally-open control contact set (2 connections).

The Site Identification Encoder circuit card shall provide mounting for a suppression network for the Master Relay coil. The suppression network shall be designed to minimize the release (de-operation) time of the Master Relay and to quench the back-emf from the coil. The suppression network shall be a silicon avalanche diode such as type 1N5060, with a series connected 24 V 3 W zener diode.

The Site Identification Encoder circuit card shall provide mounting for a back-emf diode for the Auxiliary Relay coil. The diode shall be a silicon avalanche type, such as type 1N5060.

The wander lead connector shall have a link for sensing that the connector (ZMR) is mated to the Site Identification Encoder circuit card. The pin functions for connector ZMR and the mating wander lead connector shall be as specified in Appendix E, Paragraph E6.

2.12.5 Facility Switch connections (ZSW)

The connections to the Facility Switch shall share a common connector (ZSW) to the Site Identification Encoder circuit card.

The Facility Switch shall have the following connections to the Site Identification Encoder circuit card:

- (a) Facility Switch position encoding contacts—3 connections.
- (b) Connector sensing link—2 connections.
- (c) Master Relay contact—2 connections.
- (d) Auxiliary Relay contact—2 connections.
- (e) Disable Flasher Unit—2 connections.

The coil drives to the Master Relay and the Auxiliary Relay shall be switched by contacts on the Facility Switch.

In the 'OFF' position, the Facility Switch shall provide a logic ground to the Facility Switch Disable Flasher input at the Flasher Unit to disable the flashing active outputs from the Flasher Unit.

The wander lead connector shall have a link for sensing that the connector (ZSW) is mated to the Site Identification Encoder circuit card.

The pin functions for connector ZSW and the mating wander lead connector shall be as specified in Appendix E, Paragraph E7.

2.12.6 Flasher Unit connections (ZFL)

The extra low voltage connections to the Flasher Unit shall share a common connector (ZFL) to the Site Identification Encoder circuit card.

The wander lead connector shall have a pair of conductors for sensing that the connector (ZFL) is mated to the Site Identification Encoder circuit card and that the extra low voltage connector is mated at the Flasher Unit. The sensing link is internal to the Flasher Unit.

The pin functions for connector ZFL and the mating wander lead connector shall be as specified in Appendix E, Paragraph E2.

2.12.7 Light sensor connections (ZLS)

The connections to the light sensor shall share a common connector (ZLS) to the Site Identification Encoder circuit card.

The wander lead connector shall have a link for sensing that the connector (ZLS) is mated to the Site Identification Encoder circuit card.

The pin functions for connector ZLS and the mating wander lead connector shall be as specified in Appendix E, Paragraph E5.

2.12.8 Gas sensor connections (ZGS)

The connections to the gas sensor shall share a common connector (ZGS) to the Site Identification Encoder circuit card.

The wander lead connector shall have a link for sensing that the connector (ZGS) is mated to the Site Identification Encoder circuit card.

The pin functions for connector ZGS and the mating wander lead connector shall be as specified in Appendix E, Paragraph E3.

2.12.9 Housing door switch connections (ZDR)

The connections to the housing door switch shall share a common connector (ZDR) to the Site Identification Encoder circuit card.

The wander lead connector shall have a link for sensing that the connector (ZDR) is mated to the Site Identification Encoder circuit card.

The pin functions for connector ZDR and the mating wander lead connector shall be as specified in Appendix E, Paragraph E1.

2.12.10 Controller Logic Module connections (ZID)

The connections to the Logic Module shall share a common connector (ZID) to the Site Identification Encoder circuit card.

The Site Identification Encoder circuit card shall provide a diode link to allow the controller logic circuits to determine whether the connector (ZID) is mated to the Site Identification Encoder circuit card.

The pin functions for connector ZID and the mating wander lead connector shall be as specified in Appendix E, Paragraph E4.

2.12.11 Mounting, visibility and accessibility

The Site Identification Encoder circuit card shall be mounted in a convenient position in the housing, which will not provide any risk of damage to either the circuit card, or the cabling to the circuit card, by equipment being installed into or removed from the housing during normal maintenance activities.

The mounting position shall be accessible to allow the site number and revision level to be conveniently programmed. Plug-in equipment (such as the Logic Module) may be removed from the housing to gain access to the Site Identification Encoder.

It is desirable that the mounting position provides good visibility of the encoding of the site number and the revision level, without removal of panels or equipment.

2.13 TELECOMMUNICATIONS INTERFACE

2.13.1 Conformance with ACMA standards

Any device designed or intended for connection to a telecommunications network shall comply with the applicable requirements of the Australian Communications and Media Authority (ACMA) Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice 2001.

2.13.2 Transient voltage protection device

A transient voltage protection device shall provide protection against transients and surges present on the telecommunications line by limiting the transient and surge voltage presented to the control equipment to a safe value. The device shall be installed between the telecommunications line connection and the modem. It shall be located as close as is practicable to the telecommunications line terminal box.

The protection circuits shall not include fuses with replaceable fuse cartridges; however low-value or zero-ohm resistors may be used as fusible links.

The earth connection for the transient voltage protection device shall be bonded to the housing adjacent to it.

2.13.3 Telecommunications line terminal box

The telecommunications line terminal box shall comprise the following:

- (a) A telecommunications access door.
- (b) An instruction label.
- (c) A binding post, (e.g. a hook).
- (d) ACMA compliant insulation displacement connector (IDC) terminals for connection of the telecommunications line.

The telecommunications line terminal box shall be mounted inside the controller housing with a cut-out in the housing to provide access via the telecommunications access door. The telecommunications line terminal box shall be located on the right hand side of the housing, as viewed from the front of the housing, mounted at a height not less than one metre above the controller base.

Both the telecommunications line terminal box and the telecommunications access door shall be made of a suitable insulating material that is stable to ultra violet radiation.

The telecommunications access door shall be provided with a concealed hinge made from a non-corrodible material, such as stainless steel. The telecommunications access door shall be provided with a lock, with key combination ZA0805. The telecommunications access door shall not be embossed with any logo or legend.

2.13.4 Cable and connector for PSTN modem connection

A cable shall be provided from the telecommunications line terminal box to connect the telephone line to a modem. The cable shall be fitted with a 6P2C (RJ11) connector for connection to the modem. The cable, complete with connector(s), shall comply with the relevant requirements for cordage and cords in AS/ACIF S008.

2.13.5 Instruction label

An instruction label shall be permanently affixed to the inside of the telecommunications access door. The label shall be made from a durable material that can be marked indelibly.

The instruction label shall provide space for recording the telephone line number for the telecommunications line. The label shall also have the legend 'WIND TELECOMMUNICATIONS CABLE AROUND HOOK BEFORE TERMINATING'.

2.13.6 Telecommunications access conduit

A telecommunications access conduit shall be provided in the housing for a telecommunications line. The conduit shall have a nominal internal diameter of 20 mm, shall be white in colour, and shall be ACMA compliant.

The conduit shall begin (bell coupling) at the housing base and shall end inside the telecommunications connection box. The conduit entry to the telecommunications connection box shall be sealed to prevent water entry into the housing.

The conduit shall be secured by saddles or clamps in the housing but shall have free movement at the base of the housing to facilitate mating with the telecommunications provider's conduit. The position of the conduit relative to the controller mounting bolts is specified by Figure 2.4.

2.14 LIGHT SENSOR

2.14.1 Function

A light sensor shall be used to sense the ambient light level in the vicinity of the controller. The Light Sensor shall be used to prevent dimming of the signal displays in bright ambient light levels. Refer to Clause 3.4.16 and Clause 4.4.12 for details regarding sensing thresholds and operation.

2.14.2 Type

The light sensor shall be a silicon NPN photo-transistor.

2.14.3 Mounting

The light sensor shall be mounted on the front face of the controller above the access door. The light sensor shall be mounted in an unobtrusive manner in the gap between the housing roof and the door. The light sensor shall have a field of view with an axis normal to the front of the housing.

2.14.4 Connection to the Site Identification Encoder (connector ZLS)

The wiring to the light sensor shall be terminated in a connector to mate with the corresponding header connector (ZLS) on the Site Identification Encoder.

The pin connections for connector ZLS shall be as specified in Appendix E, Paragraph E5.

The connections between the housing wiring and the light sensor are shown in Figure H6.

2.15 GAS SENSOR

2.15.1 Function

The manufacturer shall make provision for a gas sensor to detect the presence of combustible gases inside the controller housing.

The housing shall make provision for mounting the gas sensor and associated interface circuit, and for the installation of a wander cable from the interface circuit to the Site Identification Encoder.

It shall be possible for a gas sensor to be installed with minimal effort with the controller in service.

NOTE: The manufacturer is only required to fit the gas sensor when so specified by the purchaser. (See Appendix A, Item (e).)

2.15.2 Type

The gas sensor shall be a semiconductor device.

2.15.3 Sensing threshold

The gas sensor interface circuit shall provide a combustible gas detection threshold of between one and twenty-five percent of the lower explosive limit (LEL) of the gases, within the temperature range -10°C to $+40^{\circ}\text{C}$, and relative humidity up to 90%. The interface circuit shall not require calibration.

The sensing threshold is intended to provide early warning that combustible gases are present in the controller housing before the concentration is sufficient to cause an explosion. The threshold should not be set to a level that produces nuisance warnings.

2.15.4 Gas sensor interface circuit

The gas sensor requires a controlled voltage to the heating element and a resistance measurement for its sensing element to determine the presence of combustible gases.

The output circuit for the gas sensor interface circuit shall be an open-collector transistor.

The output from the gas sensor interface circuit shall provide a current sink of 20 mA minimum to the logic common when combustible gases present in the controller housing are below the detection threshold.

The output from the gas sensor interface circuit shall have a maximum leakage current of 1 mA to the logic common when combustible gases present in the controller housing are above the detection threshold.

2.15.5 Mounting

The gas sensor and interface circuit shall be mounted in a position not higher than 300 mm above the base of the housing.

2.15.6 Connection to the Site Identification Encoder (connector ZGS)

The wiring to the gas sensor shall be terminated in a connector to mate with the corresponding header connector (ZGS) on the Site Identification Encoder.

The pin connections for connector ZGS shall be as specified in Appendix E, Paragraph E3.

The connections between the housing wiring and the gas sensor are shown in Figure H6.

2.16 HOUSING DOOR SWITCH

2.16.1 Function

A door switch shall be used to sense that the controller housing door is not fully closed.

The switch shall provide a normally-open contact set. The contact shall be closed when the housing door is fully closed and open when the door is not fully closed.

2.16.2 Mounting

The door switch and associated wiring shall be mounted in a position that—

- (a) is unobtrusive;
- (b) minimizes the possibility of damage by normal maintenance activities; and
- (c) provides protection against rain and weather when the housing door is open.

2.16.3 Connection to the Site Identification Encoder (connector ZDR)

The wiring to the door switch shall be terminated in a connector to mate with the corresponding header connector (ZDR) on the Site Identification Encoder.

The pin connections for connector ZDR shall be as specified in Appendix E, Paragraph E1.

The connections between the housing wiring and the door switch are shown in Figure H6.

2.17 EXTRA LOW VOLTAGE (ELV) TRANSFORMER

2.17.1 Function

An extra low voltage transformer shall be provided for supplying alternating voltage to the interface circuits for pushbuttons and independent detectors.

The transformer shall provide a single secondary winding. One side of the secondary winding shall be connected to the detector common terminals on the E terminal block. The detector common shall be connected to earth. See Figures H1 and H4.

The supply voltage to the transformer primary shall be controlled by the logic circuit breaker on the switchboard.

2.17.2 Type, voltage and rating

The extra low voltage transformer shall be a safety isolating transformer complying with the requirements of AS/NZS 61558.2.6. The transformer shall not have a built-in thermal cut-out.

The transformer shall provide a voltage of 30 V r.m.s. $\pm 10\%$ at the secondary winding at the rated load with the nominal mains supply voltage specified in Clause 1.4.3.1 applied to the primary winding. The transformer secondary winding shall be rated at 1 A minimum.

2.17.3 Fusing and connections

The transformer shall be protected against overload by a replaceable cartridge fuse connected in series with the secondary winding.

2.18 SERVICE LIGHT

The manufacturer shall make provision for fitting a service light within the controller housing. The light shall be located under the equipment shelf of the controller and shall be protected from accidental damage.

The light shall be activated via a separate switch. The switch and all connected wiring shall be suitably insulated to prevent contact with any live parts by service personnel.

NOTE: The manufacturer is only required to fit the service light when so specified by the purchaser. (See Appendix A, Item (k).)

2.19 HOUSING EQUIPMENT LAYOUT

2.19.1 Mechanical arrangement

Figure 2.9 provides an example arrangement of equipment in the housing that complies with the requirements of this Standard.

2.19.2 Shelf space

Clear shelf space shall be provided in the housing for free-standing ancillary equipment. The clear shelf space shall not be less than—

- (a) 225 mm wide;
- (b) 260 mm deep; and
- (c) 350 mm high.

2.19.3 Blank panel space

Clear vertical panel space shall be provided in the housing for mounting ancillary equipment such as transformers and contactors. The vertical panel space shall not be less than 300 mm by 180 mm, with a clear space of 180 mm in front of the panel.

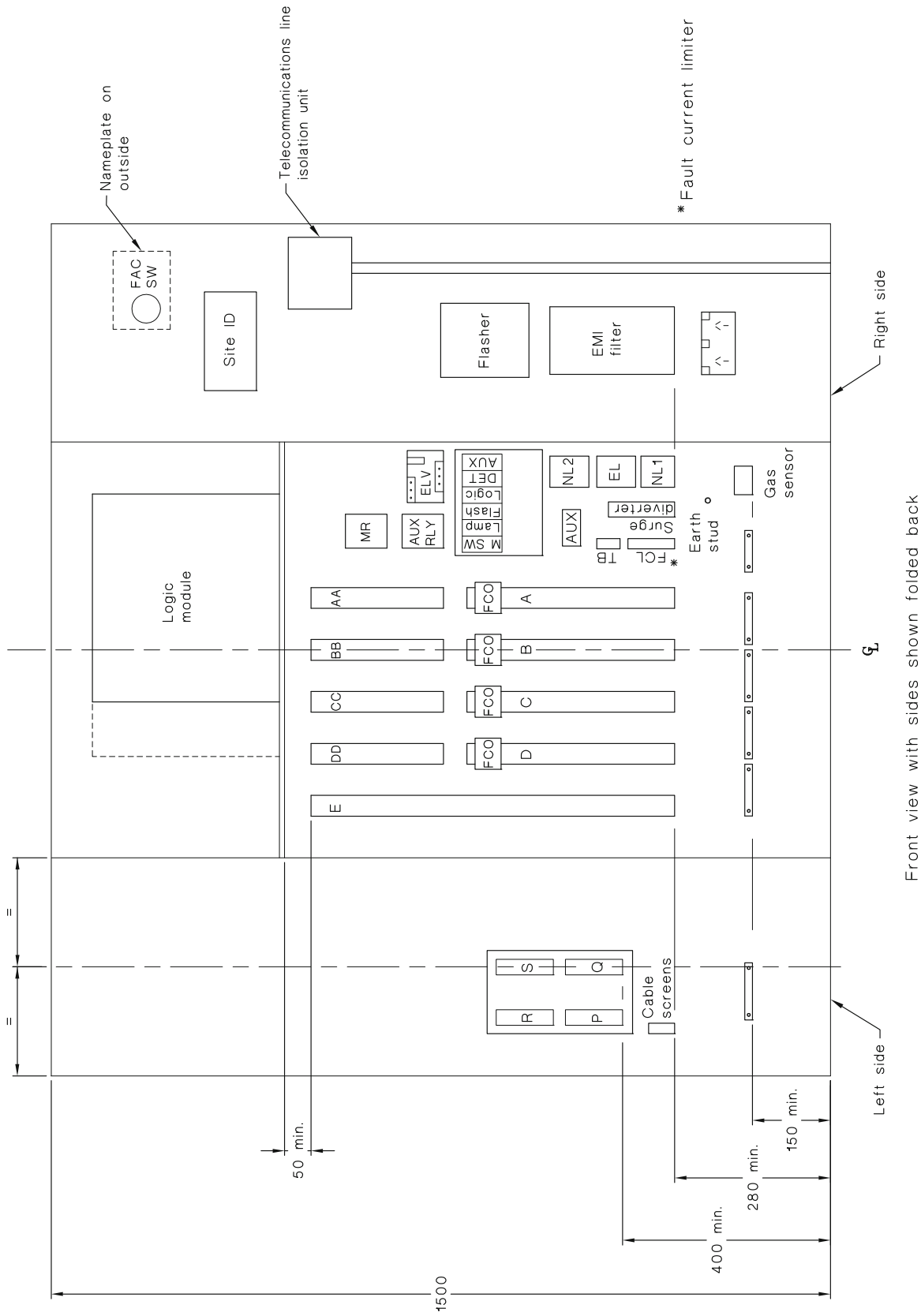


FIGURE 2.9 HOUSING EQUIPMENT LAYOUT

2.20 CONNECTORS

2.20.1 Interface connectors

The pin functions for the interface circuits shall be as specified in Appendices C, D and E.

2.20.2 Connector sensing and encoding

Sensing links and diodes shall be provided as specified in the Appendices C, D and E to allow confirmation of mating of connectors.

2.20.3 Connector coding or keying

Keying pins shall be provided as specified in the Appendices C and D to prevent incorrect mating of connectors.

2.20.4 Connector retention

All wander lead connectors shall be fitted with retaining devices to provide secure mating and retention of each connector pair.

2.21 WIRING

2.21.1 Safety Standards

The housing wiring shall comply with the safety standards specified in AS/NZS 3000.

2.21.2 Type and rating

The housing circuits shall be wired with flexible multi-strand cable having insulation rating not less than V90HT.

The switchboard wiring shall use flexible cables, or cables with a minimum of seven strands, having insulation rating not less than V90HT.

Cables in low voltage circuits shall have a minimum conductor size of 1.5 mm².

2.21.3 Terminations

Crimp lugs shall be fitted to flexible cables at all terminations. The crimp lugs shall be robust types that retain the cable insulation and that provide adequate current carrying capacity.

The live terminals at the switchboard, all terminal blocks, all relays, all contactors, and all transformers shall be protected against accidental contact. Any live terminal that is readily accessible, and that does not prevent accidental contact by design, shall be protected by suitable covers.

2.21.4 Marking and colour coding

Every connector and terminal block shall be legibly, indelibly and durably marked with an identifying number corresponding to the circuit reference. Cables shall be identified by wire numbers or codes, or by colour coding or both and shall be readily related to the housing wiring diagram.

2.21.5 Protection and mechanical support

Cables in wander leads shall be protected by flexible sleeving. Cables shall be mechanically supported, e.g. by lacing, to prevent a cable dislodged from one circuit from coming into contact with any terminal of another circuit.