



**Transport  
for NSW**

## ***INTELLIGENT TRANSPORT SYSTEMS***

### ***TRAFFIC SYSTEMS***

**SPECIFICATION NO. TSI-SP-083**

**SCHOOL ZONE ALERT SIGNS**

Issue: 1.0  
Dated: 07/06/2021

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## RECORD OF AMENDMENTS

Issue	Summary	Date	Approved by
1.0	Original, based on multiple ITS-SZAS series documents.	07/06/2021	Director ITS Engineering

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## 1 SCOPE

This specification covers the general requirements for School Zone Alert Signs. It covers:

- Supply of a complete device including controller, able to communicate to the CMC.
- Multiple sign variants.

Note: This document supersedes ITS-SZAS-SD-002. As the scope is increased to that of a complete device, it also incorporates aspects of ITS-SZAS-SD-021, -024, -029, and -032.

This Specification does not cover

- Placement of the sign.
- How the variant of sign is to be chosen for a site.
- Manufacture or assembly of the sign
- Requirements for back-end systems
- Pre-existing school zone signs and their maintenance or rework.
- Contractual arrangements

## 2 REFERENCES AND APPLICABLE DOCUMENTS

### 2.1 Australian and International Standards

- [1] AS/NZS 1170.2 – Structural design actions - Wind actions
- [2] AS/NZS 1734 – Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate
- [3] AS/NZS 2144 – Traffic Signal Lanterns
- [4] AS 2852 – Packaging - Pictorial marking for the handling of packages
- [5] AS/NZS 3000 – Electrical installations (known as the Australian/New Zealand Wiring Rules)
- [6] AS/NZS 3100 – Approval and test specification - General requirements for electrical equipment
- [7] AS/NZS 4417.2 – Regulatory compliance mark for electrical equipment.
- [8] AS 4509.1 – Stand-alone power systems – Safety and Installation
- [9] AS 4509.2 – Stand-alone power systems – Design
- [10] AS 4086 – Secondary batteries for use with standalone power systems
- [11] AS 5156 – Electronic Speed Limit Signs
- [12] AS 60529 – Degrees of protection provided by enclosures (IP Code)
- [13] AS/NZS 60950.1 – Information technology equipment - Safety
- [14] AS/NZS 61000.6.1 – Electromagnetic compatibility (EMC) – Immunity
- [15] AS/NZS 61000.6.3 – Electromagnetic compatibility (EMC) – Emission
- [16] IEC 60068-2-30 – Environmental testing, Damp heat, cyclic.
- [17] ISO 9001 – Quality Management System

## 2.2 TfNSW Specifications

- [18] IC-QA-3400 – Manufacture and Delivery of Road Signs
- [19] TS200 – Register of ITS Field Equipment
- [20] TS201 – Approval of ITS Field Equipment
- [21] TS202 – Approval of ITS Solutions for Projects
- [22] TSI-SP-062 – User Manual Requirements for ITS Field Equipment
- [23] TSI-SP-071 – ITS Equipment Communication Interface Requirements
- [24] TSI-SP-084 – Communication Protocol for School Zone Alert System (formerly ITS-SZAS-SD-022)
- [25] T MU EN 00005 ST Ambient Environmental Conditions

## 2.3 TfNSW Drawings

- [26] DS2016\_001398\_03 – SZAS Alert Sign Selection, Design and Install Criteria Requirements
- [27] DS2016\_001520\_01 – Type 3 mast arm with school zone sign R4-230-1B and solar panel structural details
- [28] DS2017\_02663\_03 - 40W Solar panel structure SZAS general arrangement
- [29] R4-230-1n – School Zone (8-9:30am 2:30-4pm) School Days (With Flashing Lights)
- [30] R4-230-1-1n – School Zone (8-930am 230-4pm) School Days (With Flashing Lights)(30)
- [31] R4-235-1 – School Zone (Times) School Days (With Flashing Lights)
- [32] R4-235-1-1n – School Zone (Times) School Days (With Flashing Lights)(30)
- [33] VM208-48 – Visors for flashing lights on school zone signs
- [34] VM005-01 – Housing Facility Key drawing

## 2.4 Other Documents

- [35] NSW Work Health and Safety Act 2011

## 2.5 Clause referencing of documents

Within this document a numbered clause reference has sometimes been given to help the user to locate the relevant section of a document. Where this has been done, it respectively refers to the versions listed below:

- AS 2144 [3]: references apply to version 2014.
- AS 5156 [11]: references apply to version 2020.

Note however that the most recent version of a referenced document typically applies, so if a later version is issued, the equivalent section shall be sought and applied.

### 3 DEFINITIONS AND GLOSSARY OF TERMS

For the purposes of this Specification, the following definitions and abbreviations shall apply:

Term	Definition
Annulus	The whole annulus including both the printed and light emitting parts.
APN	Access Point Name
Alert Annulus	The light emitting part of the annulus that can be flashed.
Alert Display	The light emitting parts of a sign that are flashed when the sign is active. In this sign it includes both the lanterns and the alert annulus.
CMC	Central Management Computer; the system used to remotely operate, configure and monitor signs.
DC	Direct current, or direct current electricity
Housing	The main enclosure containing the sign controller, regulator, battery and other items, unless the context indicates otherwise.
Lantern	Light emitting elements located near the top corners of sign that can be flashed. Referenced in other sources as “conspicuities” or “beacons”.
ELV	Extra-low voltage, as defined in AS/NZS 3000
IEC	International Electrotechnical Commission
IP	Internet Protocol
ISO	International Organisation for Standardisation
ITS	Intelligent Transportation Systems
LED	Light emitting diode
LV	Low voltage, as defined in AS/NZS 3000 (includes mains supply voltage)
NATA	National Association of Testing Authorities
PPP	Point to Point Protocol
Regulator	The component responsible for regulating voltage supplied by the solar panel.
RCM	Regulatory Compliance Mark
SHS	Square Hollow Section. The shape of a steel post, in this spec’s context.
Sign	The complete school zone flashing sign, as described by the scope of this specification, unless the context indicates otherwise.
Sign Controller	The controller unit that operates and drives Alert Displays and communicates to the Central Management Computer.
Static Annulus	The printed front face of the annulus that does not flash.
Static Sign	The printed front face of the sign that does not flash.
SZAS	School Zone Alert System
TCP	Transmission Control Protocol
TfNSW	Transport for NSW, a New South Wales government agency
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunications System
VPN	Virtual Private Network

**Table 1 – Definitions and Glossary of Terms**



## 4 SYSTEM OVERVIEW

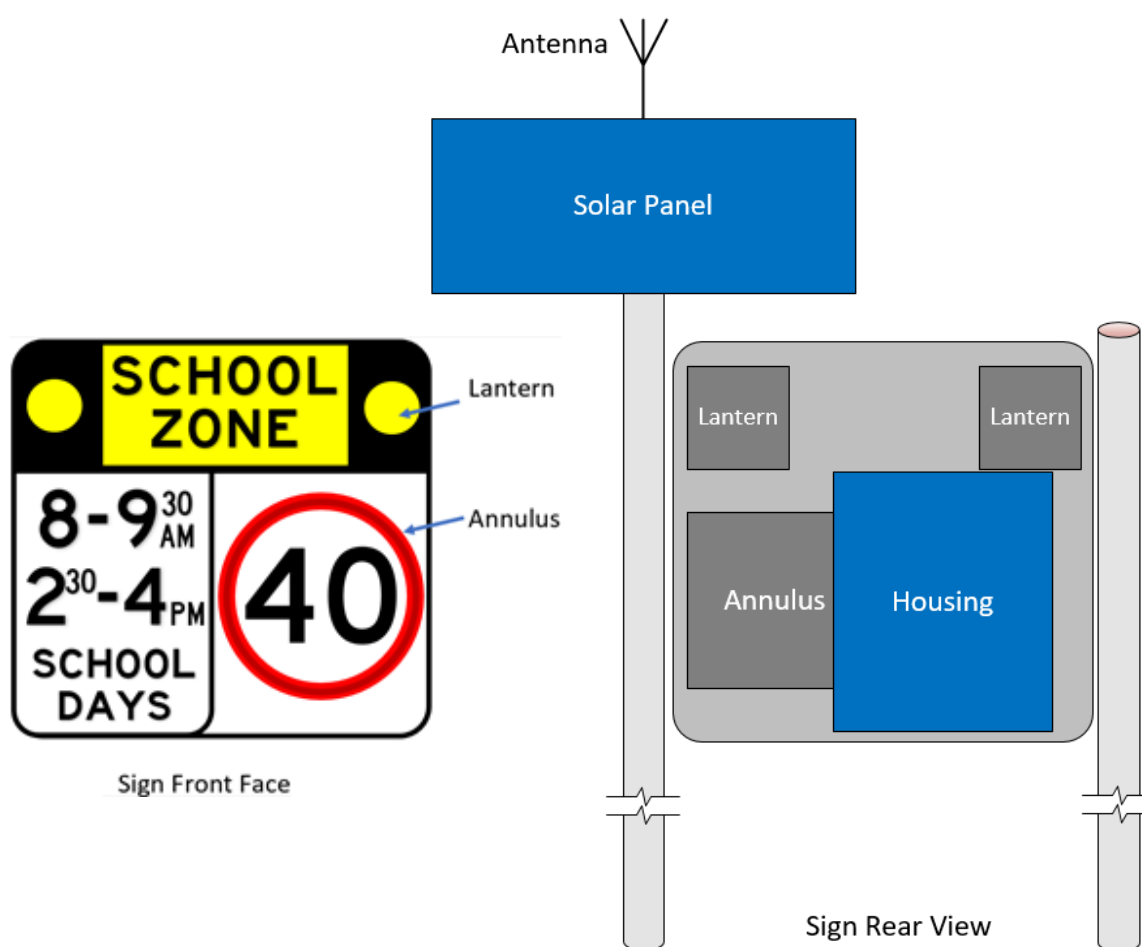
The School Zone Alert System (SZAS) operates in the State of New South Wales. It is intended to alert motorists of the speed limit around school zones and thereby improve compliance with the school zone regulatory speed limits.

These reduce the speed limits on designated school days, over limited time periods.

School Zone Flashing Signs indicate when the reduced speed limits apply by flashing part of their display at those times. They are typically installed at the entry point of school zones on the roadside footpath or road median.

These signs are centrally controlled from a central management computer (CMC), and link to this by wireless communications.

The typical sign appearance is as shown below.



**Figure 1 – Typical sign appearance**

The housing is mounted on the rear of the sign. The solar panel is typically mounted either on a separate post, or on one of the posts that support the sign. The communications antenna is typically mounted on the top edge of the solar panel. Cables, sign bracing, post attachment brackets and a bird landing deterrent for the solar panel will also be present but are omitted from the figure above for clarity.

## 5 SIGN VARIANTS

### 5.1 Size

Sign drawings (see item 6.4) define sizes A, B, C and D. Typically only sizes B and C are used.

### 5.2 Alert Type

Signs shall exist in variants that have as their alert (flashing) hardware either:

- a) Alert type L – Lanterns (usage limited to roads of speed limit 50km/h or lower)
- b) Alert type LA – Lanterns and Alert Annulus

### 5.3 Zone Speed

Sign school zone speed is either 30km/hr or 40km/hr.

### 5.4 Operating Time Range Display

The sign's displayed time range may be either:

- a) Standard - top panel background yellow, hours 8-9:30am & 2:30-4pm.
- b) Non-standard – top panel orange background, hours as specified in order.

### 5.5 Power

Signs are powered as follows

- a) Solar powered (in variants to suit sites with different sun/shade conditions).
- b) Mains powered (a small minority of sites)

### 5.6 Configuration summary example (informative)

The table below gives some examples of how variants might be defined in an order.

Item #	Size (B, C)	Alert type (L, LA)	Speed (30,40)	Operating Time specify if non-standard	Power supply	Solar site peak sun hours (daily winter average)
1	B	L	30	Standard	Solar	Standard (5 hrs or more)
2	B	L	30	8:30-10am & 3-4:30pm	Solar	Standard (5 hrs or more)
3	B	LA	40	Standard	Solar	Standard (5 hrs or more)
4	B	LA	40	Standard	Solar	3.2 hours
5	C	LA	40	Standard	Solar	2.0 hours
6	C	LA	30	Standard	Mains	Not applicable

Note: This table gives examples only, but does not constrain. Other combinations may be used

**Table 2 – Configuration examples**

## 6 GENERAL REQUIREMENTS

### 6.1 Work Health and Safety

- 6.1.1 The sign and its installation and maintenance, including the Supplier's instructions for installation and maintenance, shall comply with the NSW Work Health and Safety Act [35].
- 6.1.2 As part of approval process, evidence of safety in design shall be supplied.

### 6.2 Generic Compliance

All equipment and materials, where not otherwise specified, shall be in accordance with Australian Standard Specifications where such exist, and in their absence, with appropriate IEC or ISO Specifications.

### 6.3 Compliance to IC-QA-3400

- 6.3.1 The sign shall comply with IC-QA-3400 [18], except where requirements are varied by the content of this specification.
- 6.3.2 The static part of the regulatory sign face shall be protected with a graffiti protection film as defined in 7.7.3 of IC-QA-3400 [18].

### 6.4 Drawings

- 6.4.1 The sign shall comply with the applicable drawing tabled below, unless varied by detail in this specification:

Times operating	Speed limit km/hr	Drawing number	Reference
Standard (8-9:30am & 2:30-4pm)	40	R4-230-1n	[29]
	30	R4-230-1-1n	[30]
Non-standard	40	R4-235-1	[31]
	30	R4-235-1-1n	[32]

Note: These drawings may be found by entering the drawing reference number into the search field at the following TfNSW website: <https://www.rms.nsw.gov.au/cgi-bin/index.cgi?action=searchtrafficsigns.form>

**Table 3 – Drawing references**

- 6.4.2 The nominal static annulus dimensions are tabled below (informative). The explicit dimensions are provided on the relevant sign design plan:

Sign Size	A	B	C	D
Static annulus nominal outer diameter mm	440	588	880	1180
Static annulus nominal width mm	35	47	70	120

**Table 4 – Static annulus nominal dimensions**

## 7 ALERT DEVICES

### 7.1 General

- 7.1.1 It shall be possible to hose-wash the sign with no adverse effect on the function of the alert devices.
- 7.1.2 Protection to vulnerable components in the alert devices shall not be less than classification IP65 in AS 60529 [12].
- Note: The IP rating for the housing is given at item 14.3.
- 7.1.3 Alert devices are not mandated to dim in response to external illuminance, but if they do dim, this shall be automatic using at least one light sensor on the sign.
- 7.1.4 Alert devices shall revert to full brightness on failure of all light sensors.

### 7.2 Lanterns

- 7.2.1 Signs shall have two lanterns, able to be flashed yellow.
- 7.2.2 Size B signs may use a 150mm diameter lantern positioned on the same centre as shown in the drawings listed in 6.4.1 (instead of the 120mm size).
- 7.2.3 Lanterns shall include visors or an equivalent to limit reflections. The shading provided shall be equivalent to the visor given in drawing VM208-48 [29].

### 7.3 Alert Annulus

For sign variants requiring an alert annulus (Type LA as given in 5.2), the following apply:

- 7.3.1 The alert annulus shall comprise two or more concentric circular rings of red LEDs located within the boundaries of the static annulus.
- 7.3.2 The alert annulus shall be able to be flashed red.
- 7.3.3 The alert annulus lit element edges shall be at least 5mm within the static annulus boundaries.
- 7.3.4 When not lit, the alert annulus shall be inconspicuous within the static annulus, when viewed from 30 meters away.
- 7.3.5 The radial distance between the boundaries of outermost and innermost light emitting edges (width of the LED band) shall be from 45% to 65% of the nominal width of the static annulus (see 6.4.2 for this dimension).
- 7.3.6 The requirement given in note 3 of drawings listed in 6.4.1 that the alert annulus be located on the inner half of the static annulus does not apply. E.g., the alert annulus may be centred midway in the static annulus.
- 7.3.7 LEDs within each concentric ring shall be distributed at a uniform pitch.
- 7.3.8 The maximum gap between LED lens edges within a ring shall be 15 mm.

## 8 OPTICAL PERFORMANCE

### 8.1 General

8.1.1 Test reports to demonstrate optical compliance shall be provided as part of the approval process. These shall be from a nationally accredited laboratory, or an equivalent, with associated traceable calibration and method documentation.

8.1.2 Photometric performance shall either wholly comply with clause 8.2, or wholly comply with clause 8.3. Clause 8.3 shall be used for signs that dim.

### 8.2 Photometric Requirements based on AS2144

8.2.1 Colour shall comply with Table 2.1 of AS 2144 [3], both on the light axis and at the horizontal and vertical half angle positions.

8.2.2 The lantern shall comply with the luminous intensity distribution requirements tabled below, when tested by the methods of Appendix D of AS 2144 [3].

Degrees down from beam axis	Minimum normalized luminous intensity, cd						
	Degrees left and right from beam axis						
	0	5	8	10	15	20	25
0	350	350		205			
3	350		205				
5	205					39	
7.5					65		
10	65						
15							39
20	39						

Note: The angles are relative to the lantern beam axis, rather than the sign face axis.

**Table 5 – Lantern luminous intensity**

8.2.3 Lantern uniformity shall comply with clause 3.2 of AS 2144 [3].

8.2.4 The alert annulus shall comply with the luminous intensity distribution requirements tabled below, when tested by the methods of Appendix D of AS 2144 [3].

Degrees down from beam axis	Minimum normalized luminous intensity, cd	
	Degrees left and right from beam axis	
	0	15
0	5000	1500
10	1500	1500

**Table 6 – Alert annulus luminous intensity**

8.2.5 The alert annulus shall present a uniform appearance, free from excessively bright or dark spots when viewed from angles within the range 0° to 10° down and 0° to 15° left and right, relative to the beam axis.

### **8.3 Photometric Requirements based on AS5156**

- 8.3.1 The minimum luminous intensity half angle in the left, right and down directions shall be 10°. The test method shall be as defined in Appendix 4 of AS 5156 [11].
- 8.3.2 Luminance and Luminance ratio shall comply with clause 5.2.1 of AS 5156 [11].
- 8.3.3 Luminance matching of colours shall comply with clause 5.2.2 of AS 5156 [11].
- 8.3.4 Luminous intensity uniformity shall comply with clause 5.2.3 of AS 5156 [11].
- 8.3.5 Colours shall comply with clause 5.2.4 of AS 5156 [11].

## **9 ELECTRICAL**

### **9.1 Wiring Rules**

- 9.1.1 The sign shall comply with AS/NZS 3000 [5]
- 9.1.2 The sign shall comply with AS/NZS 3100 [6].

### **9.2 Electromagnetic Compatibility (EMC)**

- 9.2.1 The sign shall comply with AS/NZS 61000.6.1 [14] – immunity.
- 9.2.2 The sign shall comply with AS/NZS 61000.6.3 [15] – emission.
- 9.2.3 Tests to demonstrate compliance shall be conducted by a NATA accredited independent test organisation, or equivalent. Test reports from that organisation, including a conclusion of compliance, shall be provided as part of approval submissions.

### **9.3 Power supply**

- 9.3.1 The sign shall either be solar powered (default), or mains powered as described in clause 9.9.
- 9.3.2 The battery used to store solar input on solar powered signs shall operate at nominally 12V DC.

### **9.4 Voltage**

- 9.4.1 The sign shall operate correctly from a DC supply voltage range of 9 V to 15 V.
- 9.4.2 The sign shall not be damaged by DC voltages from 0 V to 24 V.
- 9.4.3 The sign shall not be damaged by reverse polarity connection of supply inputs.

### **9.5 Current**

- 9.5.1 Each Lantern shall not consume more than 0.6A when lit.
- 9.5.2 The Alert Annulus shall not consume more than 2A when lit.
- 9.5.3 Sign total in-rush current shall not exceed 5A.
- 9.5.4 When turned on, the sign shall not trip out due to in-rush current, whatever the demand state for alert devices at the time.

## **9.6 Solar power supply**

- 9.6.1 The solar-battery power supply shall comply with AS/NZS 4509.1 [7], AS/NZS 4509.2 [9], and AS 4086 [10].
- 9.6.2 Sizing calculations shall be performed according to the methodology of AS/NZS 4509.2 [9] and supplied as part of approval submissions.
- 9.6.3 Demand calculations shall assume daily 3 hours of flashing of alert devices at 50% duty cycle, 5 times a week, and continuous operation of other sign functions including communications.
- 9.6.4 The solar battery (de-rated) shall have capacity to provide at least 7 days of autonomy.
- 9.6.5 The solar panel (de-rated) shall provide least 1.3 times the electrical energy required for powering the sign for 24 hours, using the daily sun hours defined in clause 9.6.6.
- 9.6.6 A range of size of solar panels shall be available for solar insolation conditions for 5 peak sun hours per day down to 2 peak sun hours per day.

## **9.7 Wiring and connections**

- 9.7.1 Wires shall be terminated with ferrules before insertion into the respective connector.
- 9.7.2 Connectors and terminal blocks shall be legibly and durably marked or tagged with an identifying reference that is also shown in the circuit diagram.
- 9.7.3 Wires and cables shall be colour coded or otherwise distinguishable and identifiable by a means that retains the identity when a cable is re-terminated.

## **9.8 Protection and Mechanical Support**

- 9.8.1 Cables shall be arranged in an orderly manner, located and supported and appropriate to minimise risk of damage, limit strain on connectors, maintain reliability and facilitate maintenance.
- 9.8.2 Adhesive cable fixing systems shall not be used.
- 9.8.3 Printed circuit cards shall have a conformal coating or be equivalently protected to limit functional risk from moisture and surface contamination.

## **9.9 Mains power supply option**

The supplier shall offer an option for mains (LV) power supply, as detailed further below.

- 9.9.1 The solar panel, solar battery and solar regulator is not required for this option.
- 9.9.2 The design shall segregate LV sufficiently that a person who is not a qualified electrician is permitted to open the sign housing door to access the ELV area.
- 9.9.3 If a separate external LV enclosure is used to meet clause 9.9.1, it shall meet the same requirements for corrosion, materials and sealing as the sign housing.
- 9.9.4 If the supply is an unmetered connection, the LV enclosure described in clause 9.9.3 shall lock with the same key type as the sign housing.

NOTE: If unmetered supply is proposed, then all power consuming devices need to be listed in the AEMO load table to qualify as an "Unmetered Market Load".

- 9.9.5 If the supply is a metered connection, then the LV enclosure described in clause 9.9.3 shall lock with the approved key/lock of the electricity network distributor.
- 9.9.6 The LV circuits shall incorporate an RCD.
- 9.9.7 Surge protection shall be provided.
- 9.9.8 Means shall be provided to reduce risk to personnel from over-voltage or over-current in the event of a fault, from being transmitted from the LV area into the ELV area.
- 9.9.9 The LV area/enclosure shall be appropriately and durably marked, including for voltage and rating, including the legend, "MAINS VOLTAGE".
- 9.9.10 A backup battery shall be provided in the sign housing that shall provide at least 1 day of autonomy (1 day of communications and 3 hours of flashing) for the sign, in the event of loss of mains supply.
- 9.9.11 As part of approval process, details of physical layout, components, circuit diagrams, cables, terminals, and markings shall be supplied for this option.

NOTE: Mains supply shall comply with "Service and Installation Rules of New South Wales"

## 9.10 Mandatory Regulatory items

Either all of 9.10.1 shall be supplied, or all of 9.10.2 shall be supplied.

- 9.10.1 Evidence of valid RCM compliance as defined in AS/NZS 4417.2 [7].

Note 1: Associated details are provided on the ACMA website, such as at <https://www.acma.gov.au/Industry/Suppliers/Regulatory-arrangements/EMC-Electromagnetic-compatibility/device-compliance-levels>.

Note 2: Further associated details are provided on the NSW fair trading website such as at <https://www.fairtrading.nsw.gov.au/trades-and-businesses/business-essentials/selling-goods-and-services/electrical-articles/approval-of-electrical-articles>. The sign is classed as a 'non-declared article'.

- 9.10.2 Both items below:

- (a) Certificate of Suitability issued by the NSW Office of Fair Trading.
- (b) Declaration of Conformance of the sign to AS/NZS 61000.6.3 [15]

## 10 DESIGN AND RELIABILITY

### 10.1 Design

- 10.1.1 Signs shall be designed to provide a minimum life of fifteen (15) years of compliant operation.
- 10.1.2 The design shall ensure batteries do not need to be replaced any more frequently than once every 5 years.
- 10.1.3 The design shall ensure batteries retain capacity for 7 days of autonomy at the 5-year point.
- 10.1.4 Signs shall be corrosion resistant, sufficient to reach a 15-year life.
- 10.1.5 Signs shall maintain a good cosmetic appearance for the design life.
- 10.1.6 Metals of dissimilar electro-potential exceeding 0.5 volts shall not be in electrical contact in a location that can get wet and give accelerated corrosion.



- 10.1.7 Signs shall be UV resistant, sufficient to reach a 15-year life.
- 10.1.8 Sign legibility shall be maintained for a minimum of 15 years. Static face elements shall not fade to a significant degree.
- 10.1.9 Optical performance shall remain within specification for a minimum of 15 years without any requirement to perform preventative maintenance. It shall be assumed that Alert Displays will be operating 15 hours per week at a 50% duty cycle.
- 10.1.10 As far as practicable, materials used in the sign should not support combustion.
- 10.1.11 As far as practicable, materials used in the sign should be self-extinguishing.

## **10.2 Reliability**

- 10.2.1 Signs shall have a calculated mean-time-between-failure (MTBF) of not less than 45,000 hours in operation.

A failure for the purpose of the above MTBF limit is defined as any defect (hardware or software) which causes the alert devices to be inactive when scheduled to operate, or the alert devices to be stuck 'ON'.
- 10.2.2 When calculating MTBF, it shall be assumed that communications to the CMC are continuously maintained, with alert displays operating for part of that time as described in clause 10.1.9.
- 10.2.3 The Supplier shall provide the following information as part of approval submissions, to help evaluation of reliability:
  - (a) Mean Time between Failures (MTBF) for the Sign;
  - (b) Mean Time between Failures (MTBF) for the sign display system.

## **10.3 Maintainability**

- 10.3.1 A modular approach shall be used in designing the equipment to facilitate maintainability, ease of installation and commissioning.
- 10.3.2 The modularity shall be at least sufficient to permit easy field replacement of the Lanterns, Alert Annulus, Controller, Solar panel, Solar Regulator, and Batteries.
- 10.3.3 Equipment layout within housings shall be designed for ease of access during operation, maintenance and service.
- 10.3.4 Access to individual modules shall be provided for replacement of the module without the need for removing other components or wiring.
- 10.3.5 The access to and replacement of modules shall not require the removal of fasteners that are not reusable.
- 10.3.6 Modules intended for field replacement or access shall be secured such that their re-securing and release functions are not impaired with multiple re-use.
- 10.3.7 The securing componentry shall not be vulnerable to seizing, stripping, corroding or otherwise deteriorating with time or foreseeable usage.
- 10.3.8 Preference shall be given to fasteners which are held captive when loosened.
- 10.3.9 Preference shall be given to only requiring standard tools for preventive and repair maintenance activities. A standard tool in this context is considered one that is readily available from common hardware retailers, as distinct from one that has very restricted supply sources, such as only available from the manufacturer.

- 10.3.10 The Supplier shall provide the following information as part of approval submissions, to help evaluation of maintainability:
- (a) Mean Time to Repair (MTTR) for the Sign;
  - (b) Mean Time to Repair (MTTR) for the sign display system.

## 11 PHYSICAL REQUIREMENTS

### 11.1 Mechanical

- 11.1.1 The solar panel orientation shall be adjustable in rotation and tilt so it can be secured to optimise solar input, irrespective of the sign face orientation.
- 11.1.2 The sign shall have no sharp edges that present a hazard to personnel (see clause 6.1 for WHS requirements).

### 11.2 Impact Resistance

When the exterior of the sign housing is hit by hand or kicked by a person, the following requirements shall be met.

- 11.2.1 Equipment shall continue to operate reliably;
- 11.2.2 Functional modules and circuit card racks shall not be damaged; and
- 11.2.3 Connectors shall not become unplugged or give unreliable connection.

### 11.3 Bird Perching deterrent

Physical means shall be incorporated to deter or prevent birds from perching or landing on the upper edge of the solar panel (chemical repellents are not permitted).

Note: A typical arrangement is shown in drawing DS2017\_02663\_03 [28]

### 11.4 Provisions for Sign Mounting and Installation

- 11.4.1 Signs shall be capable of being mounted and installed as shown in drawings DS2016\_001398\_03 [26] and DS2016\_001520\_01 [27].
- 11.4.2 Mounting brackets shall be provided as follows:
- (a) To mount a size B sign on a single SHS post.
  - (b) To mount a size B sign on dual circular posts (type 2).
  - (c) To mount a size B sign on an over-road mast arm.
  - (d) To mount a size C sign on dual circular posts.
  - (e) To mount a size C sign on an over-road mast arm.
- 11.4.3 The mounting brackets shall permit adjustment of the sign face direction.
- 11.4.4 Adjustment of alignment shall be capable of being made with the sign in situ and without the removal or replacement of the mounting brackets or accessories such as spacers or fasteners.
- 11.4.5 For dual posts, alignment adjustment shall permit a minimum of 10° rotation of the sign face in the horizontal plane, either side of the axis between the two posts.
- 11.4.6 Access to the functional modules and units, and interior of the equipment housing shall not be impeded by the mounting arrangement.

## 11.5 Design for Safe Lifting

- 11.5.1 The sign shall be designed such that it can be installed and maintained in a safe manner, including consideration of component weights (see clause 6.1 for WHS requirements).
- 11.5.2 The sign installation manual shall describe how to conduct the sign installation activity and battery replacement activity, such that any manual lifting required by that process is within safe limits (see clause 6.1 for WHS requirements).

## 12 MARKINGS AND LABELS

### 12.1 Longevity

- 12.1.1 Marking and labels shall be durable.
- 12.1.2 Marking and labels shall be legible for the design life.
- 12.1.3 Marking and labels shall be secure to remain in place for the design life.

### 12.2 Housing

The sign shall bear the following information on or within the housing.

- 12.2.1 Product/model name or brief description identifying the unit
- 12.2.2 Manufacturer's name
- 12.2.3 Manufacturer's type/model number
- 12.2.4 A unique serial number providing traceability under the manufacturer's quality management system
- 12.2.5 Description and rating of the primary power supply, including nominal voltage, current and power consumption for operation.
- 12.2.6 Relevant Regulatory Compliance marking (RCM)
- 12.2.7 The sign shall bear the following information within the housing.
  - (a) A sign layout diagram. This shall identify the location of each component and shall include connector marking references for each component module.
  - (b) A sign wiring diagram. This shall provide sufficient detail, including terminal numbers, connector pin numbers, wire numbers or codes and wire colour coding, to allow each wire to be traced in the housing, and in the sign.

### 12.3 Component serial numbering

All field replaceable components shall be marked with serial numbers.

Note: For example: controller, modem, each lantern, annulus (or part thereof), sign face, solar panel, battery, solar regulator.

## 13 ENVIRONMENTAL REQUIREMENTS

### 13.1 Conditions

The sign shall perform within specification for the following conditions.

- 13.1.1 Installed and fully exposed on any roadside in NSW.
- 13.1.2 Air temperature: -10°C to +55°C.
- 13.1.3 Relative humidity: Up to 95%.
- 13.1.4 Insolation: Up to 1000 W/m<sup>2</sup>.
- 13.1.5 Condensation conditions caused by humid air dropping in temperature.
- 13.1.6 Wind loading as in AS/NZS 1170.2 [1] for Terrain Category 2, Region B.
- 13.1.7 Movement including vibration caused by passing vehicles.
- 13.1.8 Water splash due to passing vehicles going through puddles.
- 13.1.9 Washing of the sign face by hose and by hand.

NOTE: TfNSW document T MU EN 00005 ST [25] gives information on NSW ambient environmental conditions for rail assets. Many aspects apply also to the roadside environment.

### 13.2 Cycling test

- 13.2.1 The sign when operating shall be subjected to the thermal/humidity cycling test IEC 60068-2-30 [16]. The conditions to be used for this test (beyond those fixed by the standard), are given in Appendix B.
- 13.2.2 Test reports for the cycling test shall be provided as part of the approval process. These shall be from a nationally accredited laboratory, or an equivalent, with associated traceable calibration and method documentation.
- 13.2.3 Information providing details of field experience for more than 12 units for more than 2 years, including faults, may be substituted instead of the cycling test, together with a justification, for approval purposes. The justification shall detail how the evidence on the field sign is relevant to the submitted sign and how the submitted sign will remain in specification for the range of temperature and humidity expected for NSW.

### 13.3 Vibration test

- 13.3.1 The entire sign, while in operation, shall withstand the vibration test described in clause 7.4 of AS 5156 [11] without any adverse effect to its operation and mounting arrangement.
- 13.3.2 Test reports for the vibration test shall be provided from a nationally accredited laboratory, or an equivalent, as part of the approval process.

### 13.4 Structural Requirements

- 13.4.1 The sign, including mounting brackets, shall have adequate strength and rigidity for the wind loading conditions set down in AS/NZS 1170.2 [1] for Terrain Category 2, Region B.
- 13.4.2 The sign shall be certified for the above conditions.

### **13.5 Design for crash integrity**

- 13.5.1 The sign shall be designed such that as far as practicable, in the event of a crash of a vehicle into a support post, detached elements, fragments or other debris from the sign should not penetrate the occupant compartment or present undue hazard to other traffic, pedestrians or personnel in a work zone.
- 13.5.2 The design should be such that in the event of a crash of a 1100kg car with a support post at 50km/hr, the main sign components, including housing and solar panel, remain attached to the sign face and at least one post.

## **14 HOUSING**

### **14.1 Housing contents**

The housing shall include the sign controller, solar regulator, battery, door switch, and entry for cables including antenna provision.

### **14.2 Material**

- 14.2.1 The housing walls shall be constructed from aluminium alloy sheet to AS/NZS 1734 [2] with a minimum thickness of 2 mm.
- 14.2.2 The grade of aluminium alloy used for the housing walls shall be declared in approval submissions.

Note: The grades expected to be used are either A5052-H32, A5251-H32 or A5251-H34.

- 14.2.3 Reinforcing may be present, as necessary to meet the overall needs.
- 14.2.4 Exterior surfaces of the housing shall have a durable mid-grey finish of anti-graffiti polyester powder coating with a minimum thickness of 50 microns.

### **14.3 Housing Protection**

- 14.3.1 The housing shall be rated to at least IP45 in accordance with AS 60529 [12].
- 14.3.2 Housings rated below IP65 shall be provided with a means for liquid water to drain from the base of the housing at its lowest point.
- 14.3.3 If a drain is present, the drainage exit design shall limit water entry from upward spray and splashes caused by passing vehicles in wet conditions.
- 14.3.4 As part of approvals, the housing's IP rating shall be verified with all cable entries and glands present, including cables of the types intended to be used. Testing shall be conducted by a NATA accredited independent test organisation, or equivalent.

Note: The IP rating for the alert devices is at item 7.1.2.

### **14.4 Housing Door**

- 14.4.1 The housing shall have a hinged door that is lockable using the key defined in Drawing VM005-01 [34].
- 14.4.2 When secured the door closure mechanism shall seal the door such that the IP rating is met, and hold the door firmly such that it does not rattle and create noise due to either traffic induced vibration or windy conditions.

- 14.4.3 Gaskets used for door seals shall be ultra-violet stable, non-absorbent, and weatherproof.
- 14.4.4 A retaining device shall be provided to securely hold the door in the open position, at least 110° from the closed position.
- 14.4.5 When open, the door shall provide unimpeded access to all components within the enclosure.
- 14.4.6 The door shall be fitted with a weather resistant switch that detects when the door is open.
- 14.4.7 The sign controller shall report door opened events and closure of door events via the protocol of TSI-SP-084 [24].
- 14.4.8 The door switch and associated wiring shall be mounted so it does not obstruct access and has low risk of damage during operation and maintenance.
- 14.4.9 The design of the door opening shall be such that water is channelled away from the interior.
- 14.4.10 The exterior face of the enclosure's access door shall allow a TfNSW sign identification label of dimension 200mm x 250mm to be placed.

#### **14.5 Housing Dimensions**

- 14.5.1 The housing depth shall not exceed 300mm.
- 14.5.2 The housing shall be mounted such that it cannot be seen from the front of the sign, when viewed from all angles that are within 10° of the sign face axis.
- 14.5.3 The housing dimensions and mounting arrangements shall facilitate replacement of either lantern or alert annulus modules, should either be needed.

#### **14.6 Battery Shelf**

- 14.6.1 A dedicated battery shelf shall be present.
- 14.6.2 Means shall be provided to secure the battery on its shelf.

#### **14.7 Cable Entry**

- 14.7.1 Cable entries shall be downward facing, such that any exterior water running down the cable will not run into the entry point of the cable at the housing.
- 14.7.2 Means shall be provided to seal the cable entry, to avoid water ingress from upward spray and splashes caused by passing vehicles in wet conditions.

#### **14.8 Clock counter**

- 14.8.1 The sign shall have a clock counter, that increments time in "ticks", where each tick is 1.0 seconds.
- 14.8.2 The clock counter shall have accuracy better than  $\pm 3$  seconds per day, across the whole temperature range defined in item 13.1.2.
- 14.8.3 The tick counter shall start at zero when the controller is first turned on and increment from that point until synchronised.

- 14.8.4 The sign shall synchronise the tick counter to CMC time via the protocol of TSI-SP-084 [24].

Note: TfNSW SZAS CMC time operates in Epoch seconds.

## 14.9 Temperature Monitor

The sign shall have a temperature monitor, able to measure the typical ambient air temperature in the enclosure accurate to  $\pm 1.0^{\circ}\text{C}$  with a precision of  $0.1^{\circ}\text{C}$ , and report this via the protocol of TSI-SP-084 [24].

## 14.10 Battery Monitor

- 14.10.1 The sign shall monitor the battery voltage and be able to report this accurate to  $\pm 0.10\text{ V DC}$ , with a precision of  $0.01\text{ V}$ , via the protocol of TSI-SP-084 [24].
- 14.10.2 The sign shall implement depth of discharge protection to the battery, if this is needed to ensure the design life of the battery defined in 10.1.2 will be met.
- 14.10.3 The sign shall monitor the state of health of the battery. If the battery is assessed as no longer able to provide the required autonomy, the 'battery replacement needed' event code shall be enabled in the log file message of protocol TSI-SP-084 [24].

## 14.11 Modem Monitor

- 14.11.1 The sign shall monitor the received signal strength (RSS) at the modem/wireless communications device, and shall be able to report this to the nearest  $1\text{ dBm}$  via the protocol of TSI-SP-084 [24].
- 14.11.2 Preferably, the sign should be able to return other data for the modem, as described in the protocol message <CEL> described in TSI-SP-084 [24].

## 14.12 Display Electrical Current Monitor

- 14.12.1 The sign shall monitor the electrical current of each of its displays.
- 14.12.2 Accuracy shall be  $\pm 1\%$  of the maximum current of the display, or better.
- 14.12.3 The electrical current is to be reported with a precision of  $1\text{ mA}$ .
- 14.12.4 The electrical current shall be sampled for each alert display at least 3 times within each activation period of the alert displays.
- 14.12.5 Each sample shall consist of at least 3 measurements within 1 second. The average of these measurements shall be used for electrical current reporting.
- 14.12.6 The sign shall store the most recent value of sampled electrical current, for the most recent activation period, and shall be able to report this if demanded to do so via the protocol TSI-SP-084 [24].
- 14.12.7 For signs have a non-zero value of minimum electrical current set, the sign shall raise an alarm (clause 15.12) if the sampled electrical current falls below the electrical current threshold for any alert display.

NOTE: Signs that dim should not use the minimum current alarm, and are expected to have a value of zero set. Such signs shall monitor their own displays and raise an alarm if they self-detect as faulty.

- 14.12.8 Signs shall cancel an electrical current alarm if the sampled electrical current exceeds the electrical current threshold plus a small margin sufficient to prevent a toggling on/off alarm state.

### **14.13 Location Monitor (optional)**

Preferably, the sign should have a GPS and antenna such that the physical location of the sign can be reported by the protocol of TSI-SP-084 [24].

## **15 OPERATION AND CONTROL**

### **15.1 Local Port for maintenance activity**

- 15.1.1 The sign shall have at least one local port of commonly used type, meeting the relevant part of TSI-SP-071 [23] that allows a technician to establish a local wired connection to the sign controller for maintenance purposes.
- 15.1.2 Preferably the local port should be an Ethernet port.
- 15.1.3 Physical access to the local port shall require opening of the housing door.
- 15.1.4 The local port shall enable configuration, monitoring, testing, and diagnostics to support maintenance.
- 15.1.5 The local port shall be usable to perform firmware updates for the sign.
- 15.1.6 The local port shall provide access to read sign logs.
- 15.1.7 Use of the local port for these activities shall be described in the sign manuals.

### **15.2 Remote access to maintenance information (optional)**

- 15.2.1 Preferably, the sign should provide means to remotely access sign controller level maintenance information (equivalent to that from the local port in 15.1.)
- 15.2.2 Remote access to this information is envisaged as granted from the CMC, via the same IP address as that used for host control operations, but on a different TCP/IP port.
- 15.2.3 If remote capability is provided, then:
- (a) Information shall be accessible via use of a web browser.
  - (b) Remote access shall be described in the sign manuals.

### **15.3 Storage and Memory**

- 15.3.1 The sign shall be capable of storing a minimum of 600 timetabled operations (sufficient for an annual schedule of planned activity).
- 15.3.2 The sign shall be capable of storing a minimum of 300 entries of system logs (alarms and non-alarm events).
- 15.3.3 The sign shall retain its firmware, configuration, settings, and logs, if the power is removed from the sign.

### **15.4 Watchdog timer**

- 15.4.1 The sign shall have a watchdog timer feature or equivalent to automatically identify if the sign is in a hung or dead-locked state.



- 15.4.2 On identifying a hung or dead-locked state, recovery activity shall be automatically triggered to attempt resumption of normal operation, such as a power cycle (reboot).

## 15.5 System Initialization

- 15.5.1 Upon an initialization event, the sign controller shall perform an integrity test of the firmware, system configuration and schedules.
- 15.5.2 The integrity test duration shall take a maximum of 10 seconds.
- 15.5.3 If the integrity of the system configuration fails, the sign controller shall log the failure, set the State of Operation to OFF state, and send the status message to the CMC.
- 15.5.4 If the Sign ID is corrupt or not set, the sign controller shall set it to “####”.
- 15.5.5 If the sign passes the integrity test, the sign controller shall move into autonomous mode of operation.

## 15.6 Autonomous operation

In autonomous operation mode the sign shall perform the following functions:

- 15.6.1 Timetabled operation
- 15.6.2 Perform fault detection on Alert Displays;
- 15.6.3 Read battery voltage
- 15.6.4 Read temperature in housing;
- 15.6.5 Monitor door position (open/closed);
- 15.6.6 Log and report operational events and alarms; and
- 15.6.7 Communicate with the CMC and respond to commands from the CMC.

## 15.7 Communications Network Interface

- 15.7.1 The sign shall be able to use a 4G SIM card issued by TfNSW to connect to the TfNSW School Zone Alert System (Central management computer - CMC).
- 15.7.2 The sign shall include a communications network interface that will provide 4G communications with the CMC via an IP-VPN wide area network.
- 15.7.3 The communications module shall be capable of supporting at least 3GPP LTE UE category 1 downlink and uplink parameters.
- 15.7.4 The communications module shall be capable of communications as a minimum on the following frequency bands used in Australia: LTE - 2100MHz (B1), 1800MHz (B3), 850MHz (B5), 2600MHz (B7), 900MHz (B8), 700MHz (B28), 2300MHz (B40); and UMTS – 850MHz (B5)
- 15.7.5 Upon start-up, the sign shall automatically initiate and establish communications with the CMC.
- 15.7.6 The sign shall use simple authentication with a pre-configured APN.
- 15.7.7 The communications network interface shall operate with the TCP/UDP/IP protocol suite.
- 15.7.8 The sign shall action a CMC request within 0.5 second of reception.

- 15.7.9 The IP address shall be provided using PPP.
- 15.7.10 The default gateway IP address shall be provided using PPP.
- 15.7.11 The CMC IP address shall be pre-configured in the sign controller firmware.
- 15.7.12 The sign shall automatically select a communication channel/band to achieve stable communication with sufficient bandwidth, subject to availability at the site location.
- 15.7.13 The sign controller shall only remotely communicate via CMC IP addresses and port numbers, as configured or provided.

## 15.8 Operating Timetable

- 15.8.1 The operation of the Alert Displays shall be in accordance with the timetable.
- 15.8.2 The timetable shall be stored on the sign controller and downloaded from the CMC using the protocol specified in TSI-SP-084 [24].
- 15.8.3 All changes to the timetable on the sign controller shall be made by downloading a new timetable from the CMC.

## 15.9 CMC Communications, Management and Control

- 15.9.1 The sign shall communicate with the CMC using the protocol TSI-SP-084 [24] .

Note: Unlike prior SZAS signs, TfNSW will not provide a controller to communicate between sign and CMC. The manufacturer shall include in the sign the means to communicate using the protocol to the CMC.

- 15.9.2 Log files shall be transferred to the CMC in the format of TSI-SP-084 [24].
- 15.9.3 The sign shall respond to all communications initiated by the CMC.
- 15.9.4 The sign shall initiate communications with the CMC upon the occurrence of alarm conditions that are listed in clause 15.12.1.
- 15.9.5 The sign shall initiate communications on making a successful initial connection, whereupon the sign shall report its ID and status to the CMC.
- 15.9.6 Parameters CTD, STD, and TMO shall be configurable via TSI-SP-084 [24].
- 15.9.7 The following initial values shall be set in the sign as defaults:
  - (a) CTD = 300 seconds (wait period before retrying to connect, see 15.9.8 )
  - (a) STD = 60 seconds (wait period before closing connection due to inactivity, see 15.9.9)
  - (b) TMO = 25200 seconds (session timeout for alarm, see 15.9.10)
- 15.9.8 If the sign fails to establish a connection to the CMC, the sign shall wait for duration CTD, and then initiate retry of the connection.
- 15.9.9 If during a communications session, the sign does not get a message from the CMC in duration STD:
  - (a) The sign shall close the connection and log the timeout.
  - (b) The sign shall attempt reconnection immediately thereafter (first attempt)
  - (c) If the first attempt at reconnection was unsuccessful, the sign shall wait for the duration of parameter STD, then re-attempt connection.
  - (d) The sign shall repeat this cycle of waiting, and re-attempting connection, until a successful connection is received.

- 15.9.10 If the sign is unable to establish a connection within duration TMO, the sign shall
- (a) Log the communications timeout alarm (event code 10 in TSI-SP-084 [24]).
  - (b) Report the alarm once communication with the CMC is re-established.
- 15.9.11 Upon a request to upgrade its firmware from the CMC, the sign controller shall:
- (a) Download the firmware image
  - (b) Conduct an integrity check of the downloaded firmware
  - (c) If the integrity check passed, install firmware and reboot.
  - (d) Log and report to the CMC.

## 15.10 Alert Displays

- 15.10.1 When performing a timetabled operation, the sign controller shall operate the Alert Displays in accordance with the system flash pattern as defined in TSI-SP-084 [24]. The flash pattern shall repeat for the defined duration of operation.
- 15.10.2 Each Stage of the flash pattern shall be of the same duration of 1/16 second.
- 15.10.3 The sign controller shall not perform a timetabled operation of the Alert Displays whilst the State of Operation is set to off.
- 15.10.4 The Sign Controller shall operate each Alert Display independently such that a fault occurrence on one Alert Display shall not affect operation of another.
- 15.10.5 In the event of a failure of any Alert Display(s), the Sign Controller shall continue operating using the remaining Alert Display(s).
- 15.10.6 Upon the occurrence of a failure of any Alert Display(s), the sign shall log and report the alarm as defined in section 15.12.
- 15.10.7 An Alert Display shall be considered failed if:
- (a) 20% or more of its LEDs cannot be lit as required.
  - (b) Any of its LEDs are lit when not demanded. E.g., when the sign is not in a scheduled operation period.
- 15.10.8 When requested by the CMC, the sign shall perform a self-check of each Alert Display and respond as defined in TSI-SP-084 [24]. During a self-check of an Alert Display, it is permissible for the Alert Display to be turned on for a period no greater than 1/16 second.

## 15.11 Remote test flash cycle

- 15.11.1 The Sign Controller shall provide a function to perform a remote test flash cycle on the receipt of a remote test flash cycle command from the CMC.
- 15.11.2 The remote test flash cycle shall consist of the Sign Controller operating the Alert Displays for the number of seconds specified by the CMC and using the flash pattern specified by the CMC in the test flash cycle request.
- 15.11.3 The remote test flash cycle shall not operate when a scheduled timetable flash cycle is active.

## 15.12 Alarms, Logs and Event Management

- 15.12.1 The sign shall support the TSI-SP-084 [24] protocol messages identified as required in Appendix A.

- 15.12.2 The sign shall log all events that are listed as required in clause A.2.
- 15.12.3 For events classified as alarms in clause A.2, the sign shall send the status message as soon as practical after logging the event.
- 15.12.4 Events and alarms that are logged shall be detailed in the maintenance manual.
- 15.12.5 Event reports shall be in the format defined in TSI-SP-084 [24].
- 15.12.6 Logs shall be saved to the system log memory in the sign.
- 15.12.7 Log transfer to the CMC, and log clearance shall comply with TSI-SP-084 [24].
- Note: The CMC system typically downloads the log multiple times daily and clears the log after each download.
- 15.12.8 Log transfer to the CMC shall use the format defined in TSI-SP-084 [24].
- 15.12.9 The Sign Controller shall not overwrite the system log should there be no available storage for adding additional log entries.
- 15.12.10 During timetabled operation of the Alert Displays, if the battery voltage falls to or below the threshold set, or the battery otherwise reaches a “depth of discharge” level below which battery damage might occur, the sign shall set the State of Operation to “OFF”, and log and report the alarm.
- 15.12.11 The sign shall implement means to limit “flapping” wherein a large number of alarm and recovery messages are sent by the sign as a result of a faulty sensor or a measured state being at the edge of an alarm threshold.

### **15.13 Configuration Management**

- 15.13.1 The Sign Controller firmware shall facilitate changes to the timetable and changes to system configuration and firmware updates using the management protocol specified in TSI-SP-084 [24].
- 15.13.2 The system configuration parameters shall be consistent with supporting the messages as listed in Appendix A.

### **15.14 Controller future capability**

- 15.14.1 The sign controller shall have capability (assuming later download of an appropriate software image) to operate with a device management system using the following technology stack:
- X.509
  - TLS 1.2 or greater
  - NTP
  - MQTT

Note: The purpose for this requirement is that within the life of the sign, the TfNSW SZAS CMC may transition to another management system, with greater industry standardization and support. Sign controllers shall have hardware capability to support that, to avoid replacing hardware in that event.

- 15.14.2 An embedded device meeting the requirements below is deemed to have this capability:
- (a) Minimum 256KB RAM
  - (b) Minimum 128KB program memory
  - (c) Minimum 1MB flash memory
  - (d) Minimum 50MHz processor

## 16 MANUALS

- 16.1.1 The Supplier shall provide manuals covering transport, installation, operations and maintenance.
- 16.1.2 Manuals shall provide an appropriate level of detail.
- 16.1.3 Manuals shall comply with TSI-SP-062 [22].
- 16.1.4 The Supplier shall provide these manuals as part of the compliance approval of the devices as part of the TS201 process.

## 17 QUALITY ASSURANCE

### 17.1 Quality System

The Supplier and the manufacturer shall operate a quality management system complying with ISO 9001 [17], and certified by an accredited quality management system certification body.

### 17.2 Quality Plan

- 17.2.1 The manufacturer shall document a quality plan. A copy of this quality plan shall be provided to TfNSW as part of the approval process. Acceptance of this quality plan by TfNSW is a prerequisite to gaining overall approval.
- 17.2.2 The quality plan shall include details of model numbers, traceability of key components, in process and release inspections and records, and control of software/firmware release associated with update/rework of deployed signs.

## 18 APPROVAL

### 18.1 Approval Process

- 18.1.1 Manufacturers and Suppliers seeking approval of their signs shall follow the process defined in TS201 [19].
- 18.1.2 Projects shall either use signs listed in the ITS Register of Approved Equipment TS200 [19] or follow process TS202 [21] to seek project-based approval for a sign not listed in the Register.

### 18.2 Changes

If a design, material or manufacturing method change is made to an approved sign, the Supplier shall notify the ITS Helpdesk at [ITSHelpdesk@transport.nsw.gov.au](mailto:ITSHelpdesk@transport.nsw.gov.au), and the requirements of TS201 [19] regarding changes shall be followed.

## APPENDIX A PROTOCOL TO BE SUPPORTED

### A.1 Messages

The sign shall support protocol messages of Appendix A of TSI-SP-084 [24] as detailed in the table below.

Message Type	Tag	Required	Description
Configuration.	ADN	Yes	Sign controller number.
	BVL	Yes	Battery voltage low threshold.
	CMC	Optional	CMC IP address or hostname
	CTD	Yes	Wait period before reconnection.
	DRT	No	Electrical current hysteresis for display alarm
	ECT	Optional	Electrical current threshold for display alarm.
	FPN	Yes	Flash pattern.
	FWV	Yes	Firmware version.
	ITT	No	Call-home daily schedule
	MID	Yes	Sign's modem parameters
	PWM	No	PWM duty cycle for display
	SGN	Yes	Sign identification number.
	STD	Yes	Wait period for closing connection.
	TMO	Yes	Communications time-out duration.
	TTB	Yes	Operation timetable.
	TTC	Yes	Timetable checksum.
	TTO	Yes	Operating durations.
TTV	Yes	Timetable version.	
Telemetry	BTT	Yes	Battery voltage.
	CEL	Yes	Modem Cell Information
	DER	Yes	Display error byte.
	DMP	No	Dump trace data
	DTE	Yes	RTC (real time counter).
	ESC	Yes	Display elements electrical current.
	GPS	Optional	GPS location
	LOG	Yes	Sign log.
	TMP	Yes	Sign temperature.
	RSS	Yes	Received Signal Strength.
	STS	Yes	Sign status.
	SVN	No	Firmware information - detailed
Command	CLG	Yes	Clear sign log.
	END	Yes	Terminate session.
	RBT	Yes	Reboot with current firmware.
	SCK	Yes	Initiate sign display self-check.
	SOP	Yes	State of Operation of displays.
	SYN	Yes	Initiate time synchronisation.
	TFL	Yes	Initiate sign test flash cycle
	UFW	Yes	Initiate firmware update of sign
Other	ACK	Yes	Acknowledgement from sign to CMC
	REJ	Yes	Reject message from sign to CMC.
	;	Yes	Tag separator.

**Table 7 – Messages to be supported**

## A.2 Event codes

The sign shall support protocol event codes of Appendix D of TSI-SP-084 [24] as detailed in the table below.

Event code	Required	Description	Alarm
01	Yes	Unexpected initialisation of the sign	Yes
02	Yes	Sign housing door opened	Yes
03	Yes	Closure of sign housing door (recovery from open)	Yes
04	Yes	Configuration error	Yes
05	Yes	Firmware download error	Yes
06	Yes	Battery voltage below minimum threshold	Yes
07	Yes	Recovered from battery below minimum voltage	Yes
08	Yes	Failure of any of the Alert Displays	Yes
09	Yes	Recovered from Alert Display failure	Yes
10	Yes	CMC communications timeout	Yes
11	Yes	Commencement of timetabled operation	No
12	Yes	Cessation of timetabled operation	No
16	Yes (if a mains sign)	Mains power failure	Yes
17	Yes (if a mains sign)	Recovery from mains power failure	Yes
18	Yes	Battery needs replacement	No

NOTE: Event codes in the protocol TSI-SP-084 [24] that are not listed in this table are not required to be supported by this sign

**Table 8 – Event code capability**

## APPENDIX B IEC 60068-2-30 TEST CONDITIONS

### B.1 Scope

This defines conditions to be used for the IEC 60068-2-30 [16] thermal/humidity cycling test.

### B.2 Test Sample

All components mounted on sign face, solar panel present in test chamber and connected, sign powered by battery in sign, flashing intermittently as set. No posts present.

The sign shall be pre-set with a flash pattern to suit the test, such that there is little delay in verifying flashing is still operating. The flashing shall be 1 second on, and one second off, for several cycles, then a break to enable the battery to last the duration of the test. A sequence of 4 flashes at the start of every minute is suggested.

During the cycle, the solar panel is not required to receive solar input, nor is it required to have an active communications connection.

### B.3 Conditions

- (a) Severity: Maximum temperature = 55°C, number of cycles = 2
- (b) Initial Measurements: Verify sign flashing intermittently as set, verify solar panel providing some charge to sign/battery when exposed to light, verify communications operating, and verify battery sufficiently charged for test.
- (c) State of specimen during conditioning: All components mounted on sign face, solar panel present in test chamber, sign powered by battery in sign, flashing intermittently as set.
- (d) Details of mounting or supports: Sign to be supported such that the face is vertical, solar panel placed wherever it fits.
- (e) Variant Type: Either 1 or 2. 1 is preferred if available, but 2 is acceptable.
- (f) Intermediate measurements: None
- (g) Recovery conditions: Standard
- (h) Special precautions for removal of surface moisture: None
- (i) Final measurements: As for initial measurements, plus verify there has been no obvious change other than to battery charge levels.