



**Transport  
for NSW**

## ***INTELLIGENT TRANSPORT SYSTEMS***

### ***TRAFFIC SYSTEMS***

**SPECIFICATION NO. TSI-SP-008**

**VARIABLE MESSAGE SIGNS**

Issue: 7.0  
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**RECORD OF AMENDMENTS**

Version	Summary	Date	Approved by
1	Original	02/02/04	A/Mgr. TSI
2.0	Major changes	18/03/05	Mgr. TSI
3.0	Major changes	08/01/13	A/Mgr. TSI
4.0	Major changes	23/06/15	PM - ITS
5.0	Major changes including: <ul style="list-style-type: none"> <li>Type A sign reduced from 4 to 3 text rows.</li> <li>Minimum 58 vertical pixels required.</li> <li>Colours Yellow, White, Red and Green mandated.</li> <li>Sign (display) enclosure IP rating changed to IP55.</li> <li>Changes to methods of specifying text dimensions.</li> <li>Removal of text flashing from Messages 1 and 2.</li> <li>Conspicuity diameter reduced, placements defined.</li> <li>Luminance and Luminance ratio limits changed.</li> <li>Dimming level values aligned with sign illuminance.</li> <li>Increase half angles, upwards light not required</li> <li>Dimming step duration changed to 5 - 15 seconds.</li> <li>Operating voltage range defined as 205 V to 264 V.</li> <li>Local control port may also be RS485 or Ethernet.</li> <li>Alarm and Event logs readable by PHCS.</li> <li>Power consumption information to be provided.</li> <li>Sign only require font sets 1 and 2 pre-equipped</li> <li>Duty cycle added for different colours</li> <li>Remote update capability now required.</li> <li>Sign placement appendix inserted.</li> <li>Facility switch "Off" depowers display electrically.</li> <li>Surge protection item added</li> </ul>	5/6/19	Director ITS Engineering
6.0	References changed to align to AS 4852.1:2019 Content reduced where covered by AS 4852.1:2019 Appendices A and C deleted. Monitoring aligned to the AS 4852.1:2019 method. Half angle measurements to include 'up' angle to 5°. EMC testing to be to NATA standards or equivalent. Fault log min 500 entries to align with AS 4852.1:2019 TSI-TG-001 required as default for TS201 submission Adjusted clauses for Frames, Messages and Plans.	12/03/20	Mgr. TSI
7.0	Add ELV variant option as item 5.7 Add safety in design approval requirement as item 4.2.2	07/06/21	Director ITS Engineering

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## 1 SCOPE

This specification covers the general requirements for general purpose variable message signs (VMS) that are used in permanent positions above or adjacent to the roadway for traffic management and/or drivers' information applications in the state of New South Wales. This specification includes requirements for the design, performance and quality assurance of variable message signs including their associated sign controllers.

Portable variable message signs are not included within the scope of this specification. Sign support structures are not included within the scope of this specification.

For guidance on selection of sign type or size for a location, see reference [18].

## 2 REFERENCES AND APPLICABLE DOCUMENTS

### 2.1 Australian Standard Specifications

- [1] AS 3000 – Electrical Installations (“Wiring Rules”)
- [2] AS 4852.1 – Variable message signs – Fixed signs
- [3] AS 60529 – Protection provided by enclosures for electrical equipment (IP Code)
- [4] AS/NZS 1170.2 – Structural design actions - Wind actions
- [5] AS 1744 – Standard alphabets for road signs
- [6] AS/NZS 61000.6.1 – Electromagnetic Compatibility (EMC) - Immunity
- [7] AS/NZS 61000.6.3 – Electromagnetic Compatibility (EMC) – Emission
- [8] AS/NZS 4417.2 – Regulatory compliance mark for electrical and electronic equipment

### 2.2 TfNSW Specifications and Documents

- [9] TSI-SP-003 – Communications Protocol for Roadside Devices
- [10] TSI-SP-062 – User Manual Requirements for ITS Equipment
- [11] TSI-SP-012 – General Requirements for Roadside equipment Housings
- [12] TSI-SP-071 - ITS Equipment Communication Interface Requirements
- [13] TSI-TG-001 - Submission guide for Variable Message Signs
- [14] TS200 – Register of ITS Field Equipment
- [15] TS201 – Approval of ITS Field Equipment
- [16] TS202 – Approval of ITS Solutions for Projects
- [17] VM005-01 – Housing Facility Key drawing
- [18] TfNSW Supplement to Austroads Guide to Traffic Management Part 10

### 2.3 Other References

- [19] AS/NZS ISO 9001 – Quality management system – Requirements
- [20] NTCIP 1203 – Object definitions of Dynamic Message Signs
- [21] Austroads Guide to Traffic Management Part 10
- [22] NSW Work Health and Safety Act 2011

## 2.4 Compliance with Specifications

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 Standards/Specifications.

## 2.5 Clause Referencing of AS4852.1 [2]

There are many references to the document AS4852.1 in the body of this specification. If a numbered clause reference is given in this specification to help the user locate the relevant clause of the standard AS4852.1, then it refers to the version AS4852.1:2019.

## 3 DEFINITIONS AND GLOSSARY OF TERMS

The definitions and abbreviations given in AS4852.1 [2] shall apply, unless varied by the listing below:

Display System	The visual display seen by the road user
Host control system	A remote computer system that communicates with the sign to effect control of the sign under normal operation. May be referred to as the 'master' in communications protocols.
Product Host control System	A sign control system with additional functions, provided by the sign manufacturer or supplier as required by clause 6.1 of AS4852.1 [2].
ELV	Extra-Low Voltage, as defined in AS 3000 [1]
IEC	International Electro-technical Commission
ISO	International Standards Organisation
LED	Light emitting diode
NSW	New South Wales
RCM	Regulatory Compliance Marking
RGB	Red-Green-Blue
TfNSW	Transport for New South Wales, a NSW Government agency
Sign(s)	Electronic variable message sign(s) including their associated sign controller(s), but excluding the support structure.
Sign controller	The control equipment unit that is a required component for operation of the sign.
Supplier	An organization that is contracted or intending to supply sign(s) covered by this Specification.

## 4 GENERAL

### 4.1 AS4852.1 Compliance

Signs shall comply with AS4852.1 [2], except where otherwise detailed in this specification.

### 4.2 Work Health and Safety

4.2.1 The sign and its installation, including the Supplier's instructions for installation, shall comply with the requirements of the NSW Work Health and Safety Act [22].

4.2.2 As part of approval process, the supplier shall provide a "Safety in Design" evaluation.

### 4.3 Sign Capability Outline

The sign described in this specification includes the following general capabilities

- Type A, B and C dimensioned signs.
- Able to deliver 4 colours; Yellow, White, Red and Green.
- Resolution sufficient to display pictograms, at least 58 pixels high.
- Delivery of 3 lines of text, including lower case text.
- Delivery of 18 characters of fixed width characters per line (assuming no pictogram is being used at that time).
- Conspicuity devices located outside the main message display area, in the border.

## 5 GENERAL DESIGN AND ARRANGEMENT

### 5.1 Sign Enclosure

5.1.1 The requirements for sign enclosure given in clauses 3.1 of AS4852.1 [2], shall apply, except as supplemented and varied below.

5.1.2 Regarding clause 3.1.4 of AS4852.1 [2], access to all internal components of the sign shall be maintained when the sign is mounted on a suitable support structure.

### 5.2 Environmental

5.2.1 The sign shall meet the temperature and humidity requirements described in clause 7.1 of AS4852.1 [2], consistent with use in the State of NSW.

5.2.2 The sign shall meet the wind loading conditions set down in AS/NZS 1170.2 [4] for Terrain Category 2, Region B.

5.2.3 The sign enclosure shall provide at least protection level IP55, in accordance with AS60529 [3]. This clause replaces clause 7.2a of AS4852.1 [2].

5.2.4 Dust and other airborne contaminants shall be prevented from reaching or accumulating in critical internal areas or components of the sign in a manner that may cause adverse impact on the specified functional requirements, including sign light output and electrical items.



- 5.2.5 The sign shall prevent moisture and condensation from accumulating in a manner that may cause adverse impact on the specified functional requirements, including sign light output and electrical items. It shall be assumed that high humidity air will enter the sign during service activity. Consideration shall be given to whether wind induced flex of panels may affect seals and permit additional water entry.
- 5.2.6 Preference will be given to environmental protection methods that do not require service activity. If service activity is required to support environmental protection, the design shall not require scheduled intervals more frequent than annually.
- 5.2.7 As part of approval processes, it shall be declared whether environmental protection methods are used that require service activity within the operating life given in clause 2.2 of AS 4852.1 [2]. If such activity is required in this timeframe, the service intervals and any required consumables shall be declared.

### **5.3 Interface with Sign Support Structure**

- 5.3.1 The mounting points on the sign, and other mechanical attributes of the sign, shall meet the structural requirements as specified in AS4852.1 [2] and elsewhere as relevant, including capability to withstand wind loading.
- 5.3.2 The sign display with its mounts shall be certified as able to meet the structural requirements when supported as detailed in item 5.3.5.
- 5.3.3 The sign shall have appropriate structural integrity and features to enable it to be lifted into position without being damaged with the use of a lifting beam.
- 5.3.4 The supplier shall provide drawings as part of approval submissions, to show how the sign can be attached to a typical sign support structure to meet the required structural and alignment outcomes.
- 5.3.5 Sign support structures are not considered part of the sign itself, so are not directly subject to approvals process TS201 [15]. However, where a project requires provision of a sign support structure, the relevant processes and standards shall be used.

### **5.4 Sign controller**

- 5.4.1 A sign controller shall be provided. Sign controllers shall be a separable item, able to be used in a ground level roadside cabinet (see item 5.5). This is the default location.
- 5.4.2 The sign controller may be within the sign (display) enclosure, if the following requirements are met:
- (a) In a highly accessible location to support maintenance activity.
  - (b) Equipped with means to connect to a 4-way facility switch located in a ground level housing, to deliver the functions of clause 3.2.7 of AS4852.1 [2].
  - (c) Designed such that it may be easily relocated to a separate ground level roadside cabinet where desired, including reinstatement of all connections.

## 5.5 Roadside Cabinet

- 5.5.1 A roadside cabinet compliant with clause 3.2 of AS4852.1 [2] is required to operate a VMS. However, it is not considered directly a part of the VMS. The roadside cabinet may be provided by the VMS supplier (default) or separately by the project. As part of a TS201 [15] submission, the supplier shall clarify if they are offering a roadside cabinet, and if so provide details in the submission.
- 5.5.2 The roadside cabinet may be post mounted or ground mounted, but shall be usable by a technician standing at ground level.
- 5.5.3 The roadside cabinet shall comply with TSI-SP-012 [11].
- 5.5.4 The ground level housing shall contain the mains switchboard, power supplies and facility switch, and associated markings and labels. It shall provision space for a modem/ communications device, and space for a sign controller. It may contain other items.
- 5.5.5 A facility switch shall be provided on the exterior of the roadside cabinet. Unless otherwise dictated by a project, the switch shall be operated by a triangular key as per TfNSW drawing VM005-01 [17], with the actuator head recessed 10 mm to 12 mm inside a metal ferrule.

## 5.6 Electrical requirements

- 5.6.1 The sign shall meet the EMC immunity requirements of clause 4.5.1 of AS4852.1 [2], except that the VMS test unit may optionally have larger maximum dimensions than described in that clause, and may be a full-sized VMS.
- 5.6.2 The sign shall meet the EMC emission requirements of clause 4.5.2 of AS4852.1 [2], except that the VMS test unit may optionally have larger maximum dimensions than described in that clause, and may be a full-sized VMS.
- 5.6.3 EMC testing shall be performed to NATA standards, or a nationally traceable equivalent.
- 5.6.4 Test results for EMC immunity and EMC emissions shall be supplied as part of approval submissions.

## 5.7 ELV variant

An ELV variant may be provided if it meets the following requirements in addition to those of a standard sign:

- 5.7.1 The display and all parts of the sign that are on the gantry shall be ELV only.
- 5.7.2 The voltage used for cable between roadside cabinet and sign display on the gantry shall be ELV.
- 5.7.3 Example circuit and layout diagrams for the ELV variant shall be given in manuals.
- 5.7.4 The sign controller may be ELV supplied (this varies clause 4.2 of AS4852.1 [2])

## 6 DISPLAY REQUIREMENTS

The sign shall meet the display requirements of clause 5.1 of AS4852.1 [2], except as varied or supplemented below.

### 6.1 Display Diagrams

#### 6.1.1 Diagram for mixed-case proportional text terminology

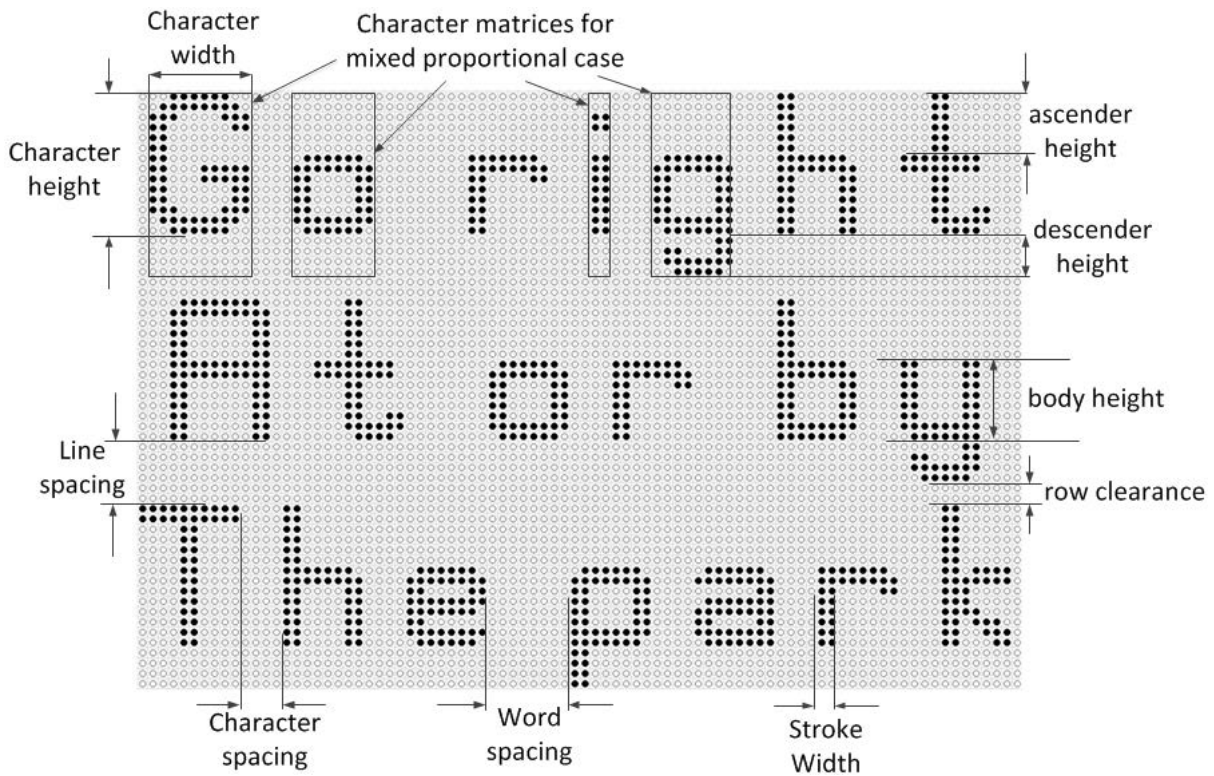


Figure 1 – Display for mixed case proportional text

#### 6.1.2 Diagram for fixed width text

For fixed width text, all characters have the same width of character matrix (outlined). Narrower characters are padded as shown below. Standard word and character spacing is applied between the character matrices.

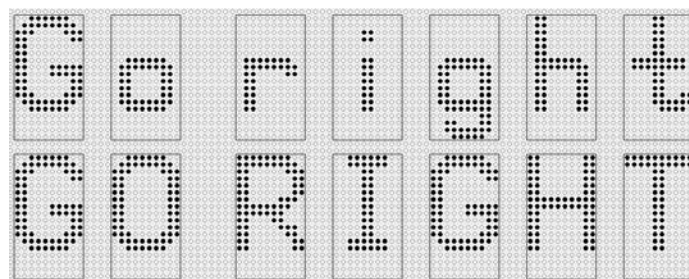


Figure 2 – Fixed width text

### 6.1.3 Diagram for character measurement

Dimensions are based on distances between pixel edges, except for pixel pitch which is from pixel centre to pixel centre.

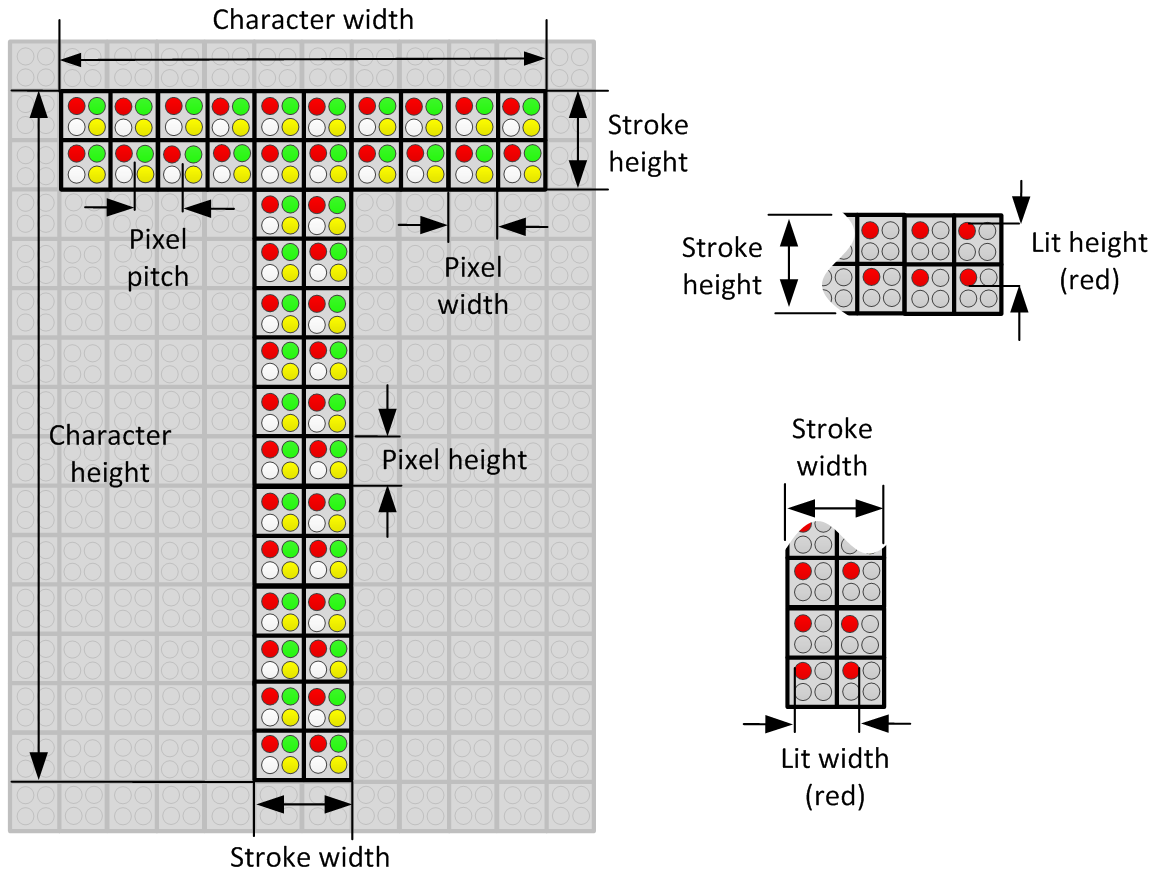


Figure 3 – Character Measurement

### 6.1.4 Diagram for Pixel Detail

Informative: Many different combinations of LEDs may potentially be used in a pixel to achieve the required colours, as shown in the examples below.

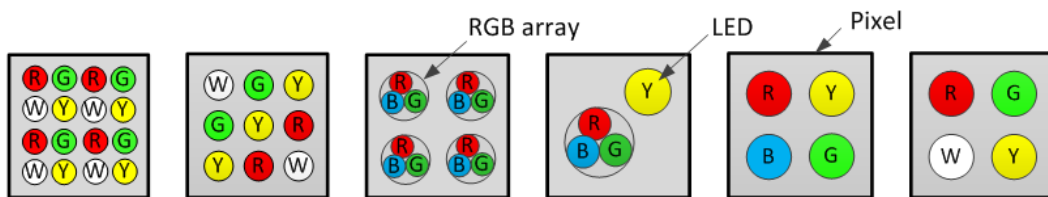


Figure 4 – Pixel Detail

### 6.1.5 Font shape in Diagrams

The font shapes shown in the preceding diagrams are to be taken as examples only, to clarify terminology. They do not limit the range of permissible detail shape of character fonts, nor constrain body height ratios. For character fonts, refer to item 6.3.

## 6.2 Display Dimensional Requirements

### 6.2.1 Number of characters

Signs shall have sufficient horizontal pixels to display 18 fixed width characters, with a compliant character space between each.

### 6.2.2 Table of display dimensional requirements

The requirements of Table 5.2 of AS4852.1 [2] for character proportions are replaced by the table below. Dimensions are to the edge of the pixels.

Parameter	Sign Size (Type Category)		
	A	B	C
Minimum character height H <sup>(1)</sup> (mm)	200	320	400
Minimum character width <sup>(2)</sup> (mm)	140	224	280
Minimum word spacing (mm)	110	176	220
Minimum character spacing (mm)	50	80	100
Minimum descender height (mm)	50	80	100
Minimum row clearance (mm)	25	40	50
Minimum line spacing (mm)	75	120	150
Minimum stroke width (mm)	20	32	40

Note (1): Character height value applies for upper case text.

Note (2): Character width applies for fixed width text.

**Table 1 – Display Dimensional Requirements**

Table 5.3 of AS4852.1 [2] for character proportions is to be regarded as informative only. Whilst the underlying basis is the same, Table 1 above takes precedence.

Note: Refer Appendix A for guidance on the speed zones of use for the different sign types.

### 6.2.3 Text Character resolution

The upper-case text character shall be at least 14 pixels high

### 6.2.4 Display vertical resolution

The display vertical resolution shall be at least 58 pixels high

### 6.2.5 Lit Width and Lit Height (stroke)

Clause 5.1.2.2 of AS4852.1 [2] applies ((titled 'Pixel Lit Area' therein). As clarification, Lit width and Lit height for a colour relate to the stroke, and are shown in the insets of Figure 3 of this specification. Lit dimensions are to be measured between outermost edges of lit light source elements, such as lit LEDs or lit array lenses, used in the stroke.

### 6.2.6 Sign pixel counts (Informative Only)

The following table shows examples of the minimum pixel counts resulting from application of Table 1. It assumes the pixel pitch used is sufficient to meet the required minimum character height H.

Pixels for upper case character height H	14	15	16	21
Pixels per character width	10	11	12	15
Pixels for word spacing	8	8	9	12
Pixels for character spacing	4	4	4	6
Pixels for descender height	4	4	4	6
Pixels for row clearance	2	2	2	3
Pixels for line spacing	6	6	6	9
Pixels for stroke width	2	2	2	3
Pixels horizontal for whole display	248	266	284	372
Pixels vertical for whole display	58	61	64	87

**Table 2 – Pixel count example**

Note: The table above does not show all permissible examples. Other numbers of pixels may be used to comprise the upper-case character height, with fundamental requirements defined by Table 1.

### 6.2.7 Sign pixel count verification

As part of the approval process, the Supplier shall provide a table equivalent to Table 2, detailing pixel counts used for the sign, and giving the pixel pitch dimension.

## 6.3 Character Formats

- 6.3.1 Character formats shall meet the requirements of clause 5.1.4 of AS4852.1 [2] except as varied below
- 6.3.2 The sign shall provide the following pre-defined fonts that give good legibility, and meet the dimensional requirements of Table 1.
- (a) Font 1 – Standard character height fixed width font.
  - (b) Font 2 – Standard character height proportional width font.
- 6.3.3 Font shapes should be similar to those in series D of AS1744 [5]. An exact match is not required.
- 6.3.4 As part of the TS201 [15] approval process, the Supplier shall provide dot matrix diagrams (or an equivalent) covering the full set of characters of Fonts 1 and 2, similar to Figure 5.4 of AS4852.1 [2].
- 6.3.5 As part of the TS201 [15] approval process, the supplier shall provide a diagram or photo representing the full display showing 3 lines of mixed case text, lower case text descenders on each line, and at least one word separator, similar to Figure 1.

## 6.4 Display changes

- 6.4.1 The sign shall meet the requirements of clause 5.1.5 of AS4852.1 [2], except where varied or supplemented below.
- 6.4.2 Frame changes shall be effected by blanking the frame, followed by display of the next frame. The frame shall appear as a single step to a human observer, rather than progressive. To achieve this, the duration from starting to change the first element of the display, to finishing changing the final element of the display should be 16ms or less.
- 6.4.3 An active message shall run to completion before a new message is displayed. A message is considered to have run to completion if the last frame of the message is currently on display and has completed its ON time or been displayed for 3 seconds or more, whichever occurs first.
- 6.4.4 Display handling features, including blanking, scrolling, and handling of schedules shall be consistent with use of the full range of control capability available in the communications protocol.

## 6.5 Display Changes Due To Facility Switch Operation

- 6.5.1 The sign shall meet the requirements of clause 5.1.6 of AS4852.1 [2].
- 6.5.2 When the facility switch is set to the “off” position, this shall disconnect the display from power by direct electrical means, rather than via software. This shall turn off the display even if the sign’s software and processors are unresponsive or “browned out”.
- 6.5.3 Message 1 shall be pre-programmed as below, using centred yellow standard character height proportional width text (Font 2), with conspicuity devices off.



Figure 5 – Message 1 display

- 6.5.4 Message 2 shall be pre-programmed as below, using centred yellow standard character height proportional width text (Font 2), with conspicuity devices flashing ‘ON’ in the up-down pattern.

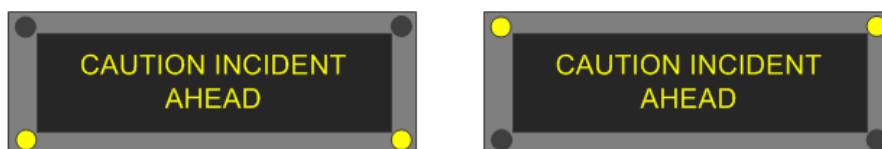


Figure 6 – Message 2 display

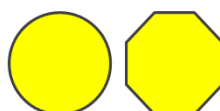
## 6.6 Display Colours

- 6.6.1 Signs shall be able to display Yellow, Red, Green and White colours, against a matt black background.
- 6.6.2 LEDs shall be used to generate the output colours but technology is not otherwise constrained. Signs may use RGB colour mixing, discrete LEDs, or other approaches.
- 6.6.3 The sign's display colours shall remain within their corresponding chromaticity coordinates, as specified in clause 5.2.4 of AS4852.1 [2], when in the dimmed and undimmed condition, including the 5 sign illuminance levels given in item 7.1.1.
- 6.6.4 The sign's display colours shall remain within their corresponding specified chromaticity coordinates for at least 10 years (Based upon the rated minimum pixel element service life given in clause 5.1.1.4 of AS4852.1 [2]).



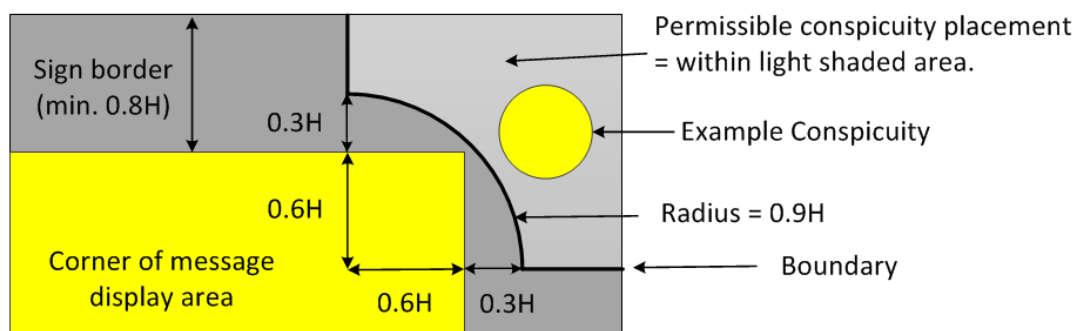
## 6.7 Conspicuity Requirements

- 6.7.1 Conspicuity devices shall be provided as per the conspicuity devices requirements in AS4852.1 [2], except as varied below.
- 6.7.2 The conspicuity optical requirements described in clause 5.1.10 (d) of AS4852.1 [2] shall be met, except that the luminance requirements are defined by Table 4 of this specification.
- 6.7.3 Conspicuities shall be either circular (normally used), or a regular polygon with eight or more sides, with straight or curved sides.



**Figure 7 –Conspicuity shape**

- 6.7.4 Conspicuities shall be located within the sign border, at the corners and outside the boundary shown in the diagram, where H is the minimum character height given in Table 1 of this specification:



**Figure 8 – Conspicuity placement**

- 6.7.5 The conspicuity device diameter shall be at least 50% of the minimum character height H as defined in Table 1. This is summarised below:

VMS Type	A	B	C
Minimum character height H (mm)	200	320	400
Minimum conspicuity diameter <sup>(1)</sup> (mm)	100	160	200

Note (1): If non-circular conspicuities are used, this limit shall apply to the shortest dimension measured edge to edge through the centre of the conspicuity.

**Table 3 – Conspicuity dimensions**

- 6.7.6 The default flash pattern shall be ‘up-down’, where the top conspicuities are illuminated together, followed by the bottom pair.
- 6.7.7 Where a frame or message with conspicuity devices flashing is replaced by another frame or message with conspicuity devices set to flash in the same pattern, the flash cycling shall continue to flash as per the defined flash pattern, without break or disruption in the flash timing sequence.

## 7 OPTICAL REQUIREMENTS

### 7.1 General

The sign shall meet the optical requirements of clause 5.2 of AS4852.1 [2] except as varied and supplemented below.

#### 7.1.1 Luminance

The luminance values specified in table 5.5 of AS4852.1 [1] are replaced by the values of Table 4 below:

Sign Illuminance level (lx)	Dimming level	Luminance(cd/m <sup>2</sup> )							
		White		Yellow		Green		Red	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
40000	16	10330	82640	6200	49600	3100	24800	2580	20640
4000	11	1830	14640	1100	8800	550	4400	460	3680
400	6	500	4000	300	2400	150	1200	125	1000
40	3	230	1840	140	1120	70	560	60	480
≤ 4	1	70	560	42	336	21	168	18	144

**Table 4 – Luminance**

#### 7.1.2 Luminance Ratio

The luminance ratio (LR) values in table 5.5 of AS4852.1 [2] are replaced by the values of Table 5 below.

Sign Illuminance level (lx)	Minimum Luminance Ratio			
	White	Yellow	Green	Red
40000	14	10	5	4
4000	14	10	5	4
400	14	10	5	4

**Table 5 – Luminance Ratio**

#### 7.1.3 Luminous intensity uniformity

The luminous intensity uniformity requirements described in clause 5.2.3 of AS4852.1 [2] apply.

#### 7.1.4 Luminous intensity half angle

The luminous intensity half angle limits specified in table 5.1 of AS4852.1 [2] shall apply.

As part of the TS201 [15] approvals process, measured half angle values shall be supplied for a representative display module, measured according to test procedure C.5 of AS4852.1 [2] to demonstrate compliance in left, right and down directions. Supplied values shall also include the up direction to at least 5 degrees.

### 7.1.5 Luminance Upwards

Light is not required to be emitted above the horizontal axis of the sign. Preferably, the VMS design should limit the extent of light emission at angles greater than 5 degrees above the horizontal axis, to limit risk of nuisance light at night in urban areas.

### 7.1.6 Glare from low sun

Preferably, the VMS design should limit the extent to which sunlight at greater than 5 degrees above the sign's horizontal axis can strike reflective sign elements such as LED display covers or lenses, to limit the glare likely from sun angles greater than 5 degrees.

### 7.1.7 Light Axis

The sign's maximum light output shall either be aligned on the mechanical axis of the sign display panel, or aligned slightly below the mechanical axis such that the luminance value measured on the axis is at least 90% of the maximum observed value of luminance (measured by test procedure C.5 of AS4852.1 [2]).

## 7.2 Maintenance of Optical Compliance

7.2.1 Luminance shall remain within the limits of Table 4 for the rated minimum service life. (10 years). This replaces the requirement given in the last paragraph of clause 5.1.1.4 in AS4852.1 [2].

7.2.2 The duty cycle below should be assumed for the purpose of calculating service life:

- (a) Yellow displayed on a continuously repeating cycle of 3.0 second on and 0.2 seconds off.
- (b) Red, Green and White each displayed on a continuously repeating cycle of 3.0 seconds on and 3.2 seconds off.
- (c) Daily dimming cycle of 11 hours at dim level 16, 1 hour at dim level 8, 11 hours at dim level 1, and 1 hour at dim level 8.

Note: A more severe duty cycle involving longer "on" durations and higher dim levels may optionally be used for calculations.

7.2.3 For chromaticity requirements over the service life, refer items 6.6.3 and 6.6.4.

## 7.3 Demonstration of Optical Compliance

7.3.1 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.

7.3.2 Information shall be provided to show that the optical requirements will be met by the sign over the rated minimum service life (10 years).

## **8 OPERATION AND CONTROL**

### **8.1 General**

- 8.1.1 Clause 6.1 of AS4852.1 [2] applies, except where varied below.
- 8.1.2 The Product Host Control System shall be usable under Windows® operating systems, or through a web interface/internet browser.
- 8.1.3 Communication interfaces listed as required by this specification shall meet the relevant detail requirements given in TSI-SP-071 [12] for those interfaces.
- 8.1.4 The sign's display shall be capable of being activated through all of the methods listed in clause 6.1 (a), (b), (c), and (d) of AS4852.1 [2].

### **8.2 Remote control**

- 8.2.1 Clause 6.3 of AS4852.1 [2] applies, except where varied below.
- 8.2.2 The sign shall be capable of being operated remotely via an IP-based telecommunications service together with a suitable modem.
- 8.2.3 In addition to the RS232/RS485 port for the modem, the sign shall be equipped with a dedicated Ethernet port for remote control.

### **8.3 Programming of Frames, Messages and Plans**

- 8.3.1 In addition to the requirements of clause 6.5 of AS4852.1 [2], the following shall apply.
- 8.3.2 A plan which is enabled by the host control centre shall override the plan currently enabled by the sign controller.
- 8.3.3 When the overriding plan expires/completes, the sign controller shall revert to the appropriate plan based on the previous plan, its schedule and any plans which are scheduled to activate.
- 8.3.4 The controller shall activate one plan at a time.
- 8.3.5 A plan shall be active until its completion, except where overridden (clause 8.3.2).
- 8.3.6 Prior to completion of a plan the sign controller shall establish which plan will be activated next, to minimise delays. If no plan is available to be activated next, the sign shall blank on completion of the running plan.
- 8.3.7 Frames, messages and plans shall reside in the Sign controller

### **8.4 Communications Protocol**

- 8.4.1 The communications protocol used by the sign shall either be:
  - (a) As defined in TSI-SP-003 [9] (default).
  - (b) As defined by NTCIP 1203 [20]
- 8.4.2 The sign shall not initiate a communication connection with the host control system.

- 8.4.3 The sign shall not respond to host control system communications messages unless the messages are addressed to that sign, or are applicable broadcast messages that require a sign response.
- 8.4.4 The sign shall respond appropriately to host control system communication messages where the messages are addressed to the sign, or are applicable broadcast messages that require a sign response.
- 8.4.5 If the sign receives a demand for a message or frame that it cannot enact in its entirety, it shall respond with the appropriate “not supported” error code in accordance with the communications protocol.
- 8.4.6 Signs shall respond to the colour codes defined for Default, Yellow, Red, Green and White in the communications protocol. The default colour code shall result in display of Yellow. Receipt of other colour codes (e.g. Amber) shall result in the appropriate “not supported” error response.
- 8.4.7 If TSI-SP-003 [9] is used, then all its protocol messages relating to VMS operation shall be implemented. For this protocol, the following apply:
- (a) The sign shall be categorised as a “High resolution graphics sign”, and provide the responses for that category as given in TSI-SP-003 [9].
  - (b) Text messages shall be centred and middle justified, unless formatted using the underscore characters (5Fh), which act as hard spaces.
  - (c) Soft space characters (20h) at the beginning and end of each line are to be stripped with the remaining characters centred on the line.
  - (d) The underscore character (5Fh) shall not display as an underscore character, but shall serve as a hard space. This means that the sign shall not strip these characters before centring the line.
  - (e) Hard spaces (5Fh) shall be used at the beginning of a line to shift the line to the right, and at the end of the line to shift the line to the left.
  - (f) A new line is normally achieved by padding the current line with hard spaces (5Fh) to the end of the line, assuming 18 characters per line.
- 8.4.8 If NTCIP1203 [20] is used, then:
- (a) All mandatory items of the protocol shall be incorporated.
  - (b) All items in the protocol relevant to use of VMS shall be implemented, including the supply of an SNMP protocol MIB file to allow for remote monitoring of the sign via network management software.
- 8.4.9 As part of approvals submission, the supplier shall provide evidence of comprehensive testing for the intended protocol. Areas of test shall include:
- (a) Correct and timely positive responses on receipt of valid input.
  - (b) Appropriate responses and error codes on receipt of invalid input.
  - (c) Communications with host control systems.
  - (d) Appropriate responses to physical inputs such as facility switch actuations.
  - (e) Generation error codes and appropriate sign responses when a problem is induced in the sign that requires response.
  - (f) Reporting of sign status and logs in normal and error conditions.

## 8.5 Graphics functionality

- 8.5.1 In addition to the requirements of clause 5.1.8 of AS4852.1 [2], the following shall apply.
- 8.5.2 Signs shall be able to store pictograms and graphical images, and position them on the display as demanded via the protocol, assuming these are provided at a resolution the sign can support.
- 8.5.3 Signs shall trigger an error message and not display, if a request is received that would result in a partial display (e.g. part of a pictogram off the display, or overlapping text and pictogram content).
- 8.5.4 Signs shall either display demanded pictograms in the supplied resolution, unmodified, or generate an error message if this cannot be done (signs shall not scale pictograms).

## 8.6 Control of Sign Settings and Configuration

- 8.6.1 The sign shall provide both local and remote means to make changes to sign settings and configuration, to enable commissioning, operation, and normal maintenance.
- 8.6.2 "Manufacturer only" settings for a VMS shall be segregated by access control, or by other means, so as to limit risk of inappropriate changes by maintenance personnel, such as by accident.
- 8.6.3 If changes are initiated to sign settings or configuration, any active message shall run to completion (refer 6.4.3), and following that, sign display shall be blank for the enactment of those changed settings. When the changes are complete, the display shall remain blank by default. The user shall be able to apply further change, perform checks on sign status, or re-activate the display. A configuration mode is one method to provide such features.
- 8.6.4 The sign shall have capability to locally or remotely apply authorised manufacturer's firmware or software changes should these be needed. Refer item 11.4.5 for further details.

## 8.7 Real-time Clock

- 8.7.1 In addition to the real time clock requirements given in clause 4.7 of AS4852.1 [2], the following shall apply
- 8.7.2 The dedicated backup battery that supplies the real-time clock shall have a service life of at least 5 years.
- 8.7.3 The clock shall synchronise with the time source configured by the user, unless this is not a configurable item under the communications protocol in use. Configurable options shall include time messages received from the host control system, and a network IP based time server.
- 8.7.4 Synchronisation events and outcomes shall be recorded in the event log.

## 8.8 Non-volatile memory

The sign shall ensure that all of its configuration settings, logs and other data and information is preserved when power to the sign is off or lost.

## 8.9 Fault, Alarm and Event Logs

- 8.9.1 In addition to the requirements for monitoring, fault logging and reporting in clause 6.7 of AS4852.1 [2], the requirements in this item shall apply.
- 8.9.2 Faults shall be logged and stored by the sign in a separate fault log. For signs using communications protocol TSI-SP-003 [9], faults are defined in the error code table (Appendix C2 in version 5.0 of TSI-SP-003 [9]). Otherwise, faults are those types of error states relating to the sign itself having defects.
- 8.9.3 Alarms shall be logged and stored by the sign in a separate alarm log. Alarms typically include error type items outside the faults category. The alarm log may be used to record project specific events relating to display. Fault events may also trigger entries in the alarm log, either conveying extra details such as which components within the sign are involved. The alarm log may contain a duplicate entry from the fault log to aid a technician by having a more complete set of information all in one place.
- 8.9.4 Events shall be logged and stored by the sign in a separate event log. These shall include external switch related messages as required by clause 5.1.7 of AS4852.1 [2]. The event log is typically also used to record display changes, in terms of details of the frame, message or plan displayed.
- 8.9.5 Logs of faults, alarms and events shall include date and timestamps.
- 8.9.6 The following minimum log capabilities shall be provided:
- (a) For fault log, at least the last 500 entries in this category.
  - (b) For alarm log, at least the last 500 entries in this category.
  - (c) For event log, at least the last 1000 entries in this category.
- 8.9.7 If log entries exceed the minimums to the extent that allocated storage is insufficient, logs shall use a 'first-in, first-out' method, within each log category given in 8.9.6.
- 8.9.8 Fault, alarm, and event logs shall be readable locally, and readable remotely using the Product Host Control System. By default they should be presented in time sequence.
- 8.9.9 It shall not be possible to edit logs. For signs using communications protocol TSI-SP-003 [9], the sign shall not enact the command 'Reset Fault log', and shall provide the relevant "reject" response.
- 8.9.10 A list of faults, alarms, and events for the sign shall be provided in the relevant sign manuals, together with descriptions of each.

## 8.10 Display Monitoring

- 8.10.1 In addition to the requirements of clause 6.7 of AS4852.1 [2], the following shall be provided
- 8.10.2 The sign shall blank its display when correct and reliable operation cannot be maintained due to variation in the mains supply voltage and/or frequency outside of the required operating range.
- 8.10.3 If communications protocol TSI-SP-003 [9] is used, the following applies to the error codes:
- (a) The trigger threshold for device error code 07 shall be one ineffective or incorrect pixel, for signs given in Table 2 (or a similar area of nominally half a stroke width). The pixel shall either appear unlit, or lit when it should not be lit, or an equivalent severity. For pixels containing many LEDs, several LEDs within the pixel may need to fail before this condition is met.
  - (b) The trigger threshold for device error code 08 shall be that the blanking condition would be required to be triggered if a message were required to be displayed by the affected pixels/area.
  - (c) The presence of a device error code 08 does not require a sign to be blanked for all messages. The error code 08 shall continue to be reported whilst the underlying fault exists, but if the message display can appear as intended despite the fault, the sign need not be blanked and preferably the message should be shown.
  - (d) Device error code 08 is to be treated as a primary fault, relative to device error code 07, using the fault principles given in clause 6.7 of AS4852.1 [2]. Accordingly, if device error code 08 is shown, device error code 07 shall not be shown.

## 9 MANUALS

### 9.1 Sign Generic Manuals

- 9.1.1 Manuals shall meet the requirements of clause 6.10 of AS4852.1 [2]
- 9.1.2 Manuals shall also be compliant with TSI-SP-062 [10].
- 9.1.3 Manuals shall also cover sign installation.
- 9.1.4 Manuals shall include instructions for diagnosis of when spare parts should be used.
- 9.1.5 Maintenance manuals shall include arrangement drawings or photographs to illustrate activity required for replaceable items. This shall include pixel module replacement, as well as other replaceable items.
- 9.1.6 Manuals shall be provided in a submission as part of the TS201 [15] approval process



## 9.2 Project Specific Manuals

- 9.2.1 The Supplier may be required to provide project specific manuals; if so these shall be similar to approved generic manuals, with additional items, or approved variations, as appropriate to the project.
- 9.2.2 Project specific manuals are not required as part of the TS201 [15] approval process. Instead, they relate to the project, and shall be sent to the project's TfNSW Representative for their review, prior to the delivery of the sign(s) under order.

## 10 CERTIFICATION

The following certification shall be obtained and provided as part of approvals submissions:

### 10.1 EMC Immunity

- 10.1.1 Declaration of Conformance of the sign to AS/NZS 61000.6.1 [6], and supporting evidence.

### 10.2 Mandatory Regulatory items

. Either all of 10.2.1 shall be supplied, or all of 10.2.2 shall be supplied.

- 10.2.1 Evidence of valid RCM compliance as defined in AS/NZS 4417.2.[8].

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'.

- 10.2.2 Both of the 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 [7] and supporting evidence.

## 11 SUPPORTABILITY

### 11.1 Design for maintenance

- 11.1.1 The equipment design and construction shall take account of ergonomic factors relating to operation and maintenance safety (item 4.2).
- 11.1.2 A modular approach should be used in designing the equipment to facilitate maintainability, ease of installation and commissioning.
- 11.1.3 Equipment layout within housings shall be designed for ease of access during operation, maintenance and service. Access to individual modules shall be provided for replacement of the module without the need for removing other components or wiring. The access to and replacement of modules shall not require the removal of fasteners that are not reusable. Preference shall be given to fasteners which are held captive when loosened.
- 11.1.4 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 VMS manufacturer.

### 11.2 Reliability

- 11.2.1 In addition to the requirements of clause 5.1.1.5 (a) of AS4852.1 [2], the requirements below shall apply:
- 11.2.2 The MTBF of the sign shall be not less than 45,000 hours.

A failure for the purpose of the above MTBF limit is defined as any defect (hardware or software) which causes the display to be blanked or the display to be stuck 'ON'. It also includes failures where the actual display differs from the intended display to the extent that viewers are unlikely to comprehend the intended message.

- 11.2.3 As part of approval submissions in the TS201 [15] process, the supplier shall provide the MTBF of the sign display system, and information and calculations supporting the MTBF value provided.

### 11.3 Power consumption

As part of approval submissions, the supplier shall provide laboratory test reports for the sign's power consumption, as given below:

- 11.3.1 Measurements shall be obtained using calibrated test equipment, traceable to a national standard. Details shall be included in the reports.
- 11.3.2 For the purposes of comparing electrical running cost, and estimating typical site consumption, results shall be provided for the condition that the sign is displaying 'REPORT TRAFFIC INCIDENTS', as per Figure 1, in yellow text over 2 lines, at dimming level 16, and also at dimming level 1.
- If the sign has further variables that affect power consumption, such as when cooling devices are operating, then this shall be stated and data for both the low and high power demand states shall be included.
- 11.3.3 For determination of required rating of power supplies and cables, results showing:
- (a) Sign peak power during start up.
  - (a) Maximum in-service power.

The conditions of test shall be given, including what items are connected and active, and display states.

### 11.4 Software

- 11.4.1 In addition to the requirements for software development in clause 6.9 of AS4852.1 [2], the requirements in this item shall apply.
- 11.4.2 The sign manufacturer/supplier shall control the issue of firmware/software versions for the sign according to their quality plan for this activity.
- 11.4.3 The supplier shall provide a local means to upgrade the sign's software/firmware, should this be needed post deployment. Preferably, most activity of this type shall be achievable at ground level via the roadside housing. Details shall be described in maintenance manuals.
- 11.4.4 The sign shall revert to the previous version if the new version fails to validate or install correctly.
- 11.4.5 The sign shall not be rendered inoperable in the event of an interruption during the software/firmware upgrade process, for example a power failure.
- 11.4.6 The supplier shall provide a means to perform a remote firmware/software upgrade. The process shall be described in the manual. It shall be necessary to enter the device's individual password to enact a remote access firmware upgrade. It shall be possible to disable the remote upgrade capability on signs.

## 12 QUALITY ASSURANCE

### 12.1 Quality System

The Supplier and the manufacturer shall operate a quality management system complying with ISO 9001 [19] and certified by an accredited quality management system certification body.

### 12.2 Quality Plan

The manufacturer shall document a quality plan. A copy of this quality plan shall be provided to TfNSW as part of the TS201 [15] approval process. Acceptance of this quality plan by TfNSW is a prerequisite to gaining overall approval.

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 VMS.

### 12.3 Quality Audits

TfNSW reserves the right to examine the Manufacturer's quality records pertaining to an order. TfNSW also reserves the right to arrange for an independent quality audit concerning items in contract.

## 13 APPROVAL

### 13.1 Approval Process

- 13.1.1 Manufacturers and Suppliers seeking approval of their signs shall follow the process defined in TS201 [15].
- 13.1.2 Projects shall either use signs listed in the ITS Register of Approved Equipment TS200 [14], or follow process TS202 [16] to seek project-based approval for a sign not listed in the Register.
- 13.1.3 The spreadsheet TSI-TG-001 [13] titled "Submission guide for VMS" shall be used as a form to submit the compliance claim part of a TS201 submission for VMS.

TSI-TG-001 can be downloaded via the web-page below, under technical guides.  
<https://www.rms.nsw.gov.au/business-industry/partners-suppliers/document-types/specifications/intelligent-transport-systems/index.html>

### 13.2 Changes

If a design, material or manufacturing method change is made to an approved VMS, the Supplier shall notify the ITS Helpdesk, and the requirements of TS201 [14] regarding changes shall be followed.

## APPENDIX A SIGN SELECTION AND PLACEMENT

This section is informative only. It supplements Appendix B (informative) of AS4852.1 [2].

### A.1 VMS view time

The default NSW VMS message is 2 frames, each of 3 seconds duration, with a 0.2 second gap between frames. The recommended minimum view time is 7 seconds.

### A.2 Maximum Legibility Distance

The maximum legibility distance is the greatest distance at which a person with normal vision acuity can read the sign. This is taken as 700 times the upper-case text character height, assuming text is presented with good contrast etc. (i.e., in a conforming manner). This is the sight distance required to deliver the full view time potential of the sign.

### A.3 Minimum Legibility Distance

The minimum legibility distance is typically limited by the view angles of the sign. As the driver approaches the sign more closely, view angles increase. Drivers are not expected to look at very large angles to their travel direction.

In addition, luminance from the sign delivered to the driver reduces significantly once the driver's view angle relative to the sign axis exceeds luminous intensity half angles of the sign (refer 7.1.4). This consideration normally forms the limit for close distance legibility. Key cases to be considered are recommended to include:

- a. Left edge of display area to a driver's eye in rightmost lane
- b. Right edge of display area to driver's eye in leftmost lane
- c. Top of display area to drivers eye (vertical half angle)

It is noted that Austroads methodology [21] calculates for visibility of the display centre, whilst the above considers the sides and top separately. Placement and orientation of the sign in both rotation and tilt, obstructions to sight lines, and slope of the road should be considered. Item (a) is typically the limiting factor, so rotating the sign towards the road is typically of benefit, allowing a closer view to be achieved, increasing the view time.

### A.4 Maximum Speed Zones

The following indications for general use (Table 6) are based on calculations for default placement and good orientation, 3 lanes, and 7 second view time. They take into account the sign's luminous intensity half angles.

VMS Type	A	B	C
Minimum character height H (m)	0.20	0.32	0.40
Maximum Legibility distance (m)	140	224	280
Maximum Speed zone (km/hr)	50	90	110

**Table 6 – Speed zones and legibility distance for VMS types**

Sight distance may be below the maximum legibility distance on some sites. To check view time requirements are met, actual sign data for dimensions and half-angles may be used rather than specification minimums. In certain circumstances it may be appropriate to use the 85% percentile approach speed at a site rather than posted zone speed (see Austroads Guide [21]).