

Technical Specification

**Transport and Main Roads Specifications
MRTS206 Provision of Variable Speed Limit and Lane
Control Signs**

July 2018

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1 Introduction

This Technical Specification accepts Section 1.1 *Scope* of Australian Standard AS 5156-2010 *Electronic speed limit signs* (AS 5156).

This Technical Specification also defines the testing and commissioning, documentation, training, maintenance and handover requirements for Variable Speed Limit Signs (VSLs), Variable Speed Limit and Lane Control Signs (VSL/LCS) and associated site controllers.

This Technical Specification accepts Section 1.2 *Application* of AS 5156. These signs may be used as part of an overall traffic management system to detect, monitor, manage and control traffic on the road network by altering the posted speed limit and/or lane control status through a defined zone.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS201 *General Equipment Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definition of terms

This Technical Specification accepts Section 1.4 *Definitions* of AS 5156.

The terms defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant under this Technical Specification are defined in Table 2.

Table 2 – Definitions

Term	Definition
Administrator	Refer to definition in MRTS201
Default speed	The speed limit that applies to a location in a variable speed limit zone when all the VSLs or VSL/LCS are blank (also known as 'black-out speed')
Event	Sign status change, frame change, occurrence of a fault in site controller or sign
ESL	Electronic Speed Limit Signs (includes the VSL/LCS)
Field Processor (FP)	An industrial computer complying with requirements of MRTS232 <i>Provision of Field Processors</i>
Frame	Any stable state displayed by a VSL and/or VSL/LCS on its display at any one instance of time that is preceded and followed by a change of state.
MTBF	Mean Time Between Failures
NATA	National Association of Testing Authorities
PFC	Permissible frame combinations: frame combinations at each VSL location that facilitate safe, non-conflicting traffic movement in a VSL zone (selection of permissible frames at a VSL site is also known as local interlocking)
PTN	Principal's Telecommunications Network
Sign	VSLs and/or VSL/LCS
Sign group	A group of signs that face the same way in the roadway and are connected to the same site controller (also known as a 'VSL site'). The displays shown by signs in a group need not be of the same frame at any one point in time
Site controller	A local control unit providing the operational interface to one or more physically connected signs

Term	Definition
STREAMS	The Principal's Traffic Management System (TMS) and primary user interface to ITS field devices
TMC	Traffic Management Centre
TMS	Traffic Management System (STREAMS)
VSL Site	Includes sites with VSL/LCS. Refer also to sign group
VSL/LCS	Combination Variable speed limit/Lane control sign/s – used to display variable speeds (type of Electronic Speed Limit Sign), as well as lane use symbols; typically overhead mounted (also known as 'lane use management signs' (LUMS))
VSLs	Variable speed limit sign(s) – used to display variable speeds only, typically pole-mounted

3 Reference documents

This Technical Specification accepts Section 1.3 *Referenced documents* of AS 5156.

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below apply to this Technical Specification. Where there are inconsistencies between this Technical Specification and referenced MRTS documents, the requirements specified in this Technical Specification take precedence.

Table 3 – Referenced documents

Document ID	Document name/description
AS 1742	<i>Manual of uniform traffic control devices</i>
AS 1743	<i>Road signs – Specifications</i>
AS 1744	<i>Forms of letters and numerals for road signs (known as Standard alphabets for road signs)</i>
AS 2700	<i>Colour Standards for general purposes</i>
AS 4006	<i>Software test documentation</i>
AS 4009	<i>Software reviews and audits</i>
AS 4042	<i>Software configuration management plans</i>
AS 4043	<i>Software configuration management</i>
AP-R344/09 (Austroads)	<i>Best practice for variable speed limits: Best practice recommendations</i>
AS 4086	<i>Secondary batteries for use with stand-alone power systems</i>
AS 4086.1	<i>Secondary batteries for use with stand-alone power systems Part 1: General requirements</i>
AS 4086.2	<i>Secondary batteries for use with stand-alone power systems Part 2: Installation and maintenance</i>
AS 4509	<i>Stand-alone power systems</i>
AS 4509.2	<i>Stand-alone power systems Part 2: System design guidelines</i>
AS 5156	<i>Electronic speed limit signs</i>
AS 60068.2.29	<i>Environmental testing – Tests – Test Eb and guidance: Bump</i>
AS 60529	<i>Degrees of protection provided by enclosures (IP Code)</i>

Document ID	Document name/description
AS/NZS 1170	<i>Structural design actions</i>
AS/NZS 1170.2	<i>Structural design actions Part 2: Wind actions</i>
AS/NZS 1734	<i>Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate</i>
AS/NZS 1768	<i>Lightning protection</i>
AS/NZS 3000	<i>Electrical installations (Wiring Rules)</i>
AS/NZS 3100	<i>Approval and test specification – General requirements for electrical equipment</i>
AS/NZS 3190	<i>Approval and test specification – Residual current devices (current-operated earth-leakage devices)</i>
AS/NZS 4258	<i>Software user documentation process</i>
AS/NZS 4680	<i>Hot-dip galvanized (zinc) coatings on fabricated ferrous articles</i>
AS/NZS 61000	<i>Electromagnetic compatibility (EMC)</i>
AS/NZS 61000.6.1	<i>Electromagnetic compatibility (EMC) Part 6.1: Generic standards – Immunity for residential, commercial and light-industrial environments</i>
AS/NZS 61000.6.3	<i>Electromagnetic compatibility (EMC) Part 6.3: Generic standards – Emission standard for residential, commercial and light-industrial environments</i>
CIE 69	<i>Methods of characterizing illuminance meters and luminance meters: Performance, characteristics and specifications</i>
CIE 70	<i>Measurement of absolute luminous intensity distributions</i>
CIE 127	<i>Measurement of LEDs</i>
CIE S002	<i>Colorimetric observers</i>
HB 90.9	<i>Software development – Guide to ISO 9001:2000</i>
IEC 60300.2	<i>Dependability management – guidance for dependability programme management</i>
ISO 9001	<i>Quality management systems – Requirements</i>
ISO/IEC 12207	<i>Information technology – Software life cycle processes</i>
MRTS01	<i>Introduction to Technical Specifications</i>
MRTS50	<i>Specific Quality System Requirements</i>
MRTS61	<i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i>
MRTS71	<i>Reinforcing Steel</i>
MRTS78	<i>Fabrication of Structural Steelwork</i>
MRTS91	<i>Pits and Ducts</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS210	<i>Provision of Mains Power Supply</i>
MRTS226	<i>Telecommunication Field Cabinets</i>
MRTS232	<i>Provision of Field Processors</i>
MUTCD	<i>Queensland Manual of Uniform Traffic Control Devices</i>
SA TS 5719	<i>Communications protocol for dynamic message signs and road weather information systems</i>

Document ID	Document name/description
SD1699	<i>Parts list</i>
TC1785_1&2	<i>Variable Speed Limit Sign LED display – Square/Rectangle</i>
TRUM Manual	<i>Traffic & Road Use Management Manual: Network Operations “Guidelines for the Placement of Variable Speed Limit and Lane Control Signs for Motorways, Long Bridges and Tunnels”</i>
TSI-SP-003/ NSW RTA	<i>Communications Protocol For Roadside Devices</i>
VSL Concept of Operations	Transport and Main Roads <i>Variable Speed Limit System Requirements, Design Criteria and Concept of Operations Document</i>

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant under this Technical Specification are defined in Table 4.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.1	1. Samples for acceptance (design) 2. Optical performance certification 3. Test certificate		
7.1.7	4. Location of mounting structure 5. Mounting structure compliance to MRTS78		
8.1		1. Optical performance test	
11			Submission of civil works design documentation
15.2		2. Factory Acceptance Test	

4.1 Samples for acceptance

In addition to the requirements of Clause 4.2.1 of MRTS201, the following requirements also apply to this Technical Specification. Detailed designs of the sign layout, fabrication and assembly drawings, calculations, Technical Specifications and certifications of the VSLs and/or VSL/LCS components (signed by the Contractor’s RPEQ) must be submitted to the Principal via the Administrator for verification prior to manufacture. These components include the site controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including surge protection and back-up batteries), communication ports, cable termination, enclosure and mounting accessories. **Hold Point 1**

Optical performance test methodology and NATA certification confirming the VSL/LCS performance requirements specified in this Technical Specification must be submitted before delivery to site.

Hold Point 2

Test certificate shall be provided to confirm the ingress protection level of the sign enclosure. The certification shall be issued by a NATA accredited test facility. **Hold Point 3**

5 Display and optical requirement

5.1 Display requirements

5.1.1 General

5.1.1.1 Display characteristics

This Technical Specification accepts Section 2.1.1.1 *Display characteristics* of AS 5156 with the following difference.

Replace Section 2.1.1.1 with the following text:

The primary function of each sign will be to display a speed limit message as per the regulatory sign as defined by the Transport Operations (Road Use Management – Road Rules) Regulation 1999. The sign must comply with the speed restriction sign (R4-1 specified in the MUTCD), except:

- i) with illuminated white numerals within an illuminated red annulus on a matte black background as shown in Figure 5.1.1.1(a) and
- ii) the sign enclosure may be square or rectangular (provided the sign display elements comply with R4-1 specification).

Where required, the sign shall be able to display a static red cross, flashing red cross and white arrows as shown in Figure 5.1.1.1(b). Each speed limit and white arrow symbol shall be stored as a bitmap in the site controller.

The display of numerals for the purpose of speed regulation and information must comply as much as practicable with the fonts defined in MUTCD. Numerals must meet the fonts defined for use on a Regulatory Sign R4-1.

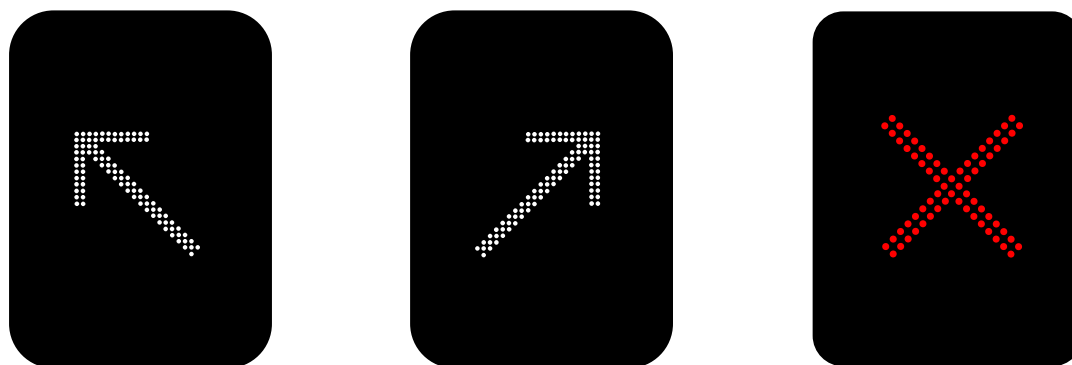
The sign numeric and/or arrow displays must be based on a series of pixels forming a dot matrix display system. The horizontal and vertical pitch of the pixels in the matrix must be the same. The Lane Closed 'X' and annulus display elements may be specifically arranged. The display must be physically capable of displaying speeds from 20 km/h up to the maximum speed for the VSL site in 10 km/h increments. The actual speed range for each site must be confirmed with the Principal during the commissioning activities and retained as part of the non-volatile information stored in the site controller. Only those frames permitted to be displayed at the site of installation shall be programmed into the site controller.

The minimum luminous intensity half-angle for all display elements shall be 15°.

Figure 5.1.1.1(a) – Example speed limit



Figure 5.1.1.1(b) – Lane use symbols



5.1.1.2 Light output

The Technical Specification accepts section 2.1.1.2 *Light output* of AS 5156.

5.1.1.3 Numeric display changes

The Technical Specification accepts section 2.1.1.3 *Numeric display changes* of AS 5156.

5.1.1.4 Display changes due to facility switch operation

The Technical Specification **does not** accept section 2.1.1.4 *Display changes due to facility switch operation* of AS 5156. **This section does not apply in Queensland.**

5.1.1.5 Display colours

The Technical Specification accepts section 2.1.1.5 *Light output* of AS 5156 with the following deletion:

Delete:

(c) Conspicuity device – yellow.

5.1.1.6 Sign dimming control

5.1.1.6.1 General

The Technical Specification accepts section 2.1.1.6.1 *General* of AS 5156 with the following addition:

Where a sign within a group of signs connected to a same site controller cannot be dimmed due to a faulty light sensing device, the site controller shall use the target dimming level of other working sign or average of target dimming level of all working signs of the group as the target dimming level of that sign.

5.1.1.6.2 Monitoring of automatic dimming control

The Technical Specification accepts section 2.1.1.6.2 *Monitoring of automatic dimming control* of AS 5156.

5.1.1.6.3 Time-based dimming control

The Technical Specification accepts section 2.1.1.6.3 *Time-based dimming control* of AS 5156.

5.1.1.6.4 Fixed dimming control

The Technical Specification accepts section 2.1.1.6.4 *Fixed dimming control* of AS 5156.

5.1.1.7 Conspicuity devices

The Technical Specification **does not** accept section 2.1.1.7 *Conspicuity devices* of AS 5156. **This section does not apply in Queensland.**

5.1.1.8 Display flicker

5.1.1.8.1 General

The Technical Specification accepts section 2.1.1.8.1 *General* of AS 5156.

5.1.1.8.2 Energized pixels

The Technical Specification accepts section 2.1.1.8.2 *Energized pixels* of AS 5156.

5.1.1.8.3 Pixel checking

The Technical Specification accepts section 2.1.1.8.3 *Pixel checking* of AS 5156.

5.1.2 Pixel arrangement

5.1.2.1 Pixel interspersion

The Technical Specification accepts section 2.1.2.1 *Pixel interspersion* of AS 5156.

5.1.2.2 Annulus

The Technical Specification accepts section 2.1.2.2 *Annulus* of AS 5156.

5.1.2.3 Matrix display signs

The Technical Specification accepts section 2.1.2.3 *Matrix display signs* of AS 5156.

5.1.2.4 Discrete character signs

The Technical Specification accepts section 2.1.2.4 *Discrete character signs* of AS 5156.

5.1.2.5 Annulus display

The Technical Specification accepts section 2.1.2.5 *Annulus display* of AS 5156 with the following differences:

Replace first sentence:

'The red annulus shall consist of evenly spaced pixel rings in accordance with Table 2.3' with 'The red annulus shall consist of suitably constructed, evenly spaced pixel rings in accordance with Table 5.1.2.5 Red annulus display characteristics.'

Delete:

Table 2.3 *Red annulus pixel configuration* and replace with Table 5.1.2.5 *Red annulus display characteristics*.

Table 5.1.2.5 – Red annulus display characteristics

MUTCD VSLS and/or VSL/LCS type	Minimum number of pixel rings
*Type A – Square	3
A	3
B	3
C	4
D	6

*Only to be used in tunnels where size constraints prohibit the use of Type B, refer to drawing TC1785_1&2.

The minimum number of pixel rings required to be illuminated for a Type A sign has changed from two to three. This change was implemented to enhance the signs ability to notify the driver of a reduced speed limit.

The above changes in Table 5.1.2.5 have been agreed to by Transport and Main Roads and the Austroads review committee: (Project No: NS1929, Review of Sign Size for Electronic Regulatory Speed Signs, 008558 – August 2014)

The change has been made on the basis that the more rings that flash, the more likely drivers' attention would be drawn to the sign.

5.1.3 Pixel / LED

5.1.3.1 Pixel service life

The Technical Specification accepts section 2.1.3.1 *Pixel service life* of AS 5156.

5.1.3.2 Reliability

The Technical Specification accepts section 2.1.3.2 *Reliability* of AS 5156 with the following addition:

MTBF shall not be less than 45,000 hours in operation.

5.1.3.3 Pixel modules

The Technical Specification **does not** accept section 2.1.3.3 *Pixel modules* of AS 5156. **This section does not apply in Queensland.**

5.1.3.4 LEDs

The Technical Specification accepts section 2.1.3.4 *LEDs* of AS 5156.

5.1.4 Character formats

The Technical Specification provides the following new Queensland-specific information:

The annulus must not be less in size than that required for an equivalent static sign.

The minimum legibility (sight) distance and character height must be as indicated in Table 5.1.4 for both daytime and night-time viewing. This distance does not reduce the absolute minimum clear sight distance as described in the TRUM Manual.

Table 5.1.4 – Text and numeric display characteristics

MUTCD VSL/LCS type	Regulatory sign size	Minimum sight distance (m)
*Type A – Square	450 mm (h) x 450 mm (d)	100
A	R4-1A	100
B	R4-1B	200
C	R4-1C	300
D	R4-1D	400

*Only to be used in tunnels where size constraints prohibit the use of Type B, refer to drawing TC1785_1&2

Character heights are specified in R4-1 and vary according to whether two or three numerals are displayed.

5.1.5 Red Cross display

The Technical Specification provides the following new Queensland-specific information:

The lane closed display consisting of a red cross must be configured in accordance with Table 5.1.5 *Lane control display characteristics*.

Table 5.1.5 – Lane control display characteristics

MUTCD VSL/LCS type	Minimum stroke width (number of pixels)
*Type A – Square	2
A	2
B	3
C	3
D	4

*Only to be used in tunnels where size constraints prohibit the use of Type B, refer to drawing TC1785_1&2

5.1.6 White arrow displays

The Technical Specification provides the following new Queensland-specific information:

The additional white arrow displays must be configured in accordance with Table 5.1.5 *Lane control display characteristics*.

5.2 Optical requirements

5.2.1 Luminance and luminance ratio

The Technical Specification accepts section 2.2.1 *Luminance and luminance ratio* of AS 5156.

5.2.2 Luminous intensity uniformity

The Technical Specification accepts section 2.2.2 *Luminous intensity uniformity* of AS 5156.

5.2.3 Colours

The Technical Specification accepts section 2.2.3 *Colours* of AS 5156.

5.3 Sun phantom

The Technical Specification provides the following new Queensland-specific information:

The effect of sunlight or other light sources shining on the optical elements must be controlled such that inactive pixels do not appear active.

6 Operation and control

6.1 General

The Technical Specification accepts section 3.1 *General* of AS 5156 with the following addition:

This specification is limited to the functionality relating to:

- i) Site controller and signs at each VSL/LCS site. The site controller and associated signs form part of a broader TMS. The overall VSL and Lane Use Management functions are described in the VSL Concept of Operations Document. The breakdown of the functionality of the components of this system and functional allocation between the TMS and site controller is described in Appendix E and H of this Technical Specification. Responsibility of the functionality ascribed to the Traffic Management System (TMS) is by others.
- ii) Interface (device driver) and physical connection of the site controller to the TMS / Field processor.

6.1.1 Host control

The Technical Specification accepts section 3.1.1 *Host control* of AS 5156 with the following addition:

The VSL/LCS shall generally be managed from the Traffic Management Centre (TMC) in accordance with the Concept of Operations via the TMS. In normal operation, a site controller shall provide the operational interface of the signs with the Principal's TMS. Connection of the site controller to the TMS shall be via an FP. In certain situations, the site controller may be required to operate independently of STREAMS.

Ramp and mainline sign groups shall each be provided with a separate site controller.

Requirements relating to the PHCS are as follows:

- a) A PHCS shall be supplied with the site controller and signs for the purpose of site controller and sign configuration, commissioning and maintenance activities. The PHCS shall also allow setting of the site controller mode of operation.
- b) The PHCS must fully implement all site controller and sign functions as required by Clause 6.10 for each of the maintenance communications and control communications ports.
- c) The PHCS shall be configured to request passwords as part of the signs controller access and configuration authorisation process.
- d) The PHCS shall be hosted on a Microsoft Windows® operating system environment from Windows 7 to those industry standards current at the time of use. Any software provided must be capable of operating on all such operating systems.

- e) The PHCS must be able to present to the user a graphic image of the site controller and the signs connected to it with icons or features that indicate whether there are any alarms or faults on any of the devices.
- f) The software must prompt the user to confirm a change to the site controller's mode of operation.
- g) The PHCS shall be capable of suggesting ranges for each parameter as applicable when programming and not allow these limits to be exceeded. The PHCS shall allow batch processing of site controller configuration to the signs at respective VSL site.

6.1.2 Displays activation

The Technical Specification accepts section 3.1.2 *Displays activation* of AS 5156 with the following deletion:

Delete:

- d) A pre-defined program schedule (plan) stored within the sign controller
- f) Facility switch

6.1.3 Testing and verification

The Technical Specification accepts section 3.1.3 *Testing and verification* of AS 5156 with the following deletion:

Delete:

- d) Operation of conspicuity devices where provided.

6.2 Local manual control

The Technical Specification accepts section 3.2 *Local manual control* of AS 5156 with the following addition:

The site controller shall allow three modes of operation as follows:

- REMOTE: normal operation; controlled from TMS
- LOCAL: stand-alone operation; TMS control disabled; TMS monitoring possible
- MAINTENANCE: configuration/manual control while connected to PHCS; TMS control disabled; TMS monitoring possible.

The selected mode shall be reported by the site controller to the TMS.

6.2.1 Product Host Control System

The Technical Specification accepts section 3.2.1 *Product Host Control System* of AS 5156 with the following amendments:

Delete:

NOTE: A USB or Ethernet interface option may also be provided.

Add:

The hardware handshaking lines of the RS-232 interface shall be used such that connection / disconnection of the maintenance PC (either locally or by modem) results in the immediate initiation / termination respectively of the maintenance port communications session with the site controller.

A 10 / 100 base-T Ethernet port shall be provided in addition to RS-232 port in site controller for remote maintenance of the sign through a webserver running in the site controller. Webserver shall support secure connection through encryption of data using industry accepted protocol such as HTTPS. IP settings shall be configurable via the PHCS and the default IP settings shall be given in the product documentation.

When the PHCS is connected and operating, the site controller shall automatically change to 'MAINTENANCE' mode and blank all signs. The PHCS operator must enter an electronic password in order to select desired 'LOCAL' / 'REMOTE' operation, change the site controller configuration and/or sign displays. Once the PHCS operator has successfully logged on, the signs shall remain blanked unless specifically requested through the PHCS. Sign displays must comply with the respective PFC in all modes of operation.

While the PHCS is connected to the site controller, control of the site controller via the control port must be inhibited. However, status and diagnostic interrogation by the TMS via the control port must remain possible.

Where the site controller is selected (or reverts) to 'LOCAL mode', then the signs shall display the required frames. Where the site controller is selected (or reverts) to 'REMOTE' mode, the signs shall remain blank until the TMS commands otherwise.

Upon restoration of power after a power loss and/or reset, the site controller shall revert to the mode to which it was previously selected.

If the site controller is in the 'MAINTENANCE' mode, disconnection of the PHCS must not require further interaction from the user, nor in anyway interrupt operation or require rebooting of the site controller.

Upon disconnection of the PHCS, the site controller shall blank all signs and revert to the previously selected mode of operation, unless a different mode had been selected during the PHCS session.

Table 6.2.1 – Modes of Operation of Sign Controller

Mode Operation	Remote	Local	Maintenance
<ul style="list-style-type: none"> • TMS operate and control sign <ul style="list-style-type: none"> ○ Power reset 			
<ul style="list-style-type: none"> • Plug in the PHCS to the site maintenance communication port <ul style="list-style-type: none"> ○ Remove PHCS ○ Power reset 			
<ul style="list-style-type: none"> • Select local mode from PHCS <ul style="list-style-type: none"> ○ Remove PHCS ○ Power reset 			
<ul style="list-style-type: none"> • Select remote mode from PHCS <ul style="list-style-type: none"> ○ Remove PHCS ○ Power reset 			

6.2.2 Facility switch

The Technical Specification **does not** accept section 3.2.2 *Facility switch* of AS 5156. **This section does not apply in Queensland.**

6.3 Remote control

The Technical Specification accepts section 3.3 *Remote control* of AS 5156 with the following addition:

The control communications port shall also support RS422 for local connection of a field processor/modem for communication with the TMS.

Two secondary communications ports that supports RS422 and 10 / 100TX Ethernet for local connection of a field processor/modem for communication with the TMS shall also be provided. This port may be used in the event of failure of the primary communications port.

The site controller communications software must be capable of operating at all possible modem connection and/or serial port speeds.

Table 6.3 – Details of the Communication, Control and Maintenance Ports

Equipment	Port name	Specification	Function	Document reference
Site Controller	Maintenance communications port	RS-232	Maintenance access to site controller and signs	6.2.1
Site Controller	Maintenance communications port	8P8C (RJ45) ISO/IEC 8877	Auxiliary Maintenance Ethernet port	6.2.1
Site Controller	Primary control communications port	RS-422	Control and communication with STREAMS via FP	6.3
Site Controller	Secondary control communications port	RS-422	Control and communication with STREAMS via FP & PHCS	6.3
Site Controller	Secondary control communications port	8P8C (RJ45) ISO/IEC 8877	Control and communication with STREAMS via FP & PHCS	6.3
Site Controller	Sign control communications port	RS-422	Control and communication with sign	6.11
Sign	Sign control communications port	RS-422	Control and communication with site controller	6.11
Sign	Sign maintenance communications port	RS-232	Maintenance access to sign	6.11

6.4 Programming

The Technical Specification accepts section 3.4 *Programming* of AS 5156 with the following amendments:

Delete:

‘All signs shall be capable of operating via scheduled events for particular times, such as weekends, public holidays, school holidays, special events and daylight saving.’

Add:

‘Unless otherwise advised by the Principal, the site controller and sign shall be programmed with the factory defaults shown in Appendix F.’

6.5 Communications protocol

The Technical Specification accepts section 3.5 *Communications protocol* of AS 5156 with the following addition:

Communication between the field processor and the site controller must comply with SA TS 5719 or other protocol accepted by the Principal’s Representative and the requirements of MRTS201 *General Equipment Requirements*.

Site controller hardware shall be compatible to operate both version 1 and version 2 of the communication protocol SA TS 5719. Should the principal decided to run the version 1 of the communication protocol initially and later need to upgrade to the version 2 of the communication protocol, site controller hardware shall support the version 2 with or without a firmware upgrade.

The site controller must have session management ability in order to protect the system against unauthorised access via the communications ports.

SA TS 5719 is the new Standards Australia *Technical specification for communications protocol for dynamic message signs and road weather information systems*. SA TS 5719 contains both Version 1 (equivalent to TSI-SP-003) and Version 2 that contains new protocol messages. As at March 2018 STREAMS does not have a VSL/LCS driver that implements Version 2 of SA TS 5719. Until this driver is implemented by Transmax manufacturers can continue to use the existing TSI-SP-003 protocol which is equivalent to Version 1 of SA TS 5719. However site controller hardware provided shall support Version 2 of the protocol.

6.6 Monitoring, fault logging and reporting

The Technical Specification accepts section 3.6 *Monitoring, fault logging and reporting* of AS 5156 with the following amendments:

Delete:

- j) The status of the conspicuity devices at the sign (on, off or faulty even when not in the active status)
- k) The status of the backup batteries (where fitted)

The fault log shall accommodate not less than 20 entries.

Add:

The site controller shall monitor and log the high sign enclosure temperature.

The site controller shall log in non-volatile memory all operational and fault events having not less than 255 entries each for operational events and fault events.

The sign and site controller must each monitor the state of its respective processor and blank the respective display/s if processor failure occurs. Site controller shall generate an alarm and blank all signs (including lane use symbols) if the integrity of the firmware or configuration is breached.

The sign must monitor communications with the site controller and blank the display if loss of communication is experienced. The communications timeout period shall be configurable and the range and factory default settings are shown in Appendix F.

The sign shall be able to detect LED failure, even if the LEDs may be required to be 'off' at the time of the periodic check. The display must be blanked upon failure of four or more of contiguous pixels either horizontally or vertically for each displayed image or failure of more than 20% of LEDs.

Upon establishing connection to sign(s), power up, or after a mains power failure, the site controller shall immediately blank the respective sign(s) for a specified period and re-transmit the respective frame(s) to be displayed.

On power restoration, the sign shall become available for activation and remain blank until commanded by the site controller. At no time shall partial or incomplete frames be displayed. The 'Power recovery delay time' shall be configurable and the range and factory default settings are shown in Appendix F.

Facilities must be included to detect failures within the display control system with the sign defaulting to a pre-determined display when major faults are detected.

6.7 Fall-back operation

The Technical Specification accepts section 3.7 *Fall-back operation* of AS 5156 with the following amendments:

Delete:

'The purchaser shall specify the pre-defined fall-back operation.'

Add:

The sign shall blank the display in the event of a sign processor fault, communication fault, major display fault. Time to blank shall be configurable and the range and factory default settings are shown in Appendix F.

The site controller must allow each sign's display to remain blank for a minimum time once the display has been blanked irrespective of the cause. This minimum blank time and range is also shown in Appendix F.

Single LED failure, provided that the cumulative LED loss remains below four contiguous pixels either vertically or horizontally and/or 20% thresholds described above in Clause 6.6 or VSL/LCS light sensor failure, should not result in blanking of the display.

6.8 Software development

The Technical Specification accepts section 3.8 *Software development* of AS 5156.

6.9 Operation and maintenance manual

The Technical Specification accepts section 3.9 *Operation and maintenance manual* of AS 5156.

6.10 Site controller

The Technical Specification provides the following new Queensland-specific information:

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. The normal connection of the site controller to the TMS shall be through the primary communications port. Additional site controller control system requirements for equipment provided under this specification are described below.

As a minimum, the site controller must:

- i) support at least six physically connected signs
- ii) support a sign ID to identify the correct sign connected to correct port at the site controller
- iii) monitor, log and report its own operation and status
- iv) monitor, log and report the operation of each connected sign individually
- v) allow the signs to be controlled individually or as a logical group
- vi) be capable of storing up to 255 frames in its non-volatile memory
- vii) command signs to display only the permissible frame combinations for that respective site
- viii) allow local automatic reset of sign displays and the site controller itself, such as via watchdog(s)
- ix) be capable of dimming connected signs based on the average of the light sensor outputs
- x) accept / reject valid or invalid commands made by the TMS and/or PHCS, and
- xi) in conjunction with the TMS, ensure that a unique electronic identification is generated for each site.

Additional information and functionality of the site controller required is described in the following sections.

6.10.1 Communication timeout

The Technical Specification provides the following new Queensland-specific information:

The site controller must be capable of monitoring loss of communications with the TMS and timeout after a specified period. When the site controller is in the 'REMOTE' mode, expiry of this time period must cause the site controller to blank all physically connected signs. This period shall be a configurable parameter and is denoted 'Session timeout'. The range and factory default settings of session timeout are shown in Appendix F. The site controller must also be capable of monitoring communications with the signs connected to it and timeout after a specified period when such communication is lost. Communications timeout check shall be performed periodically as shown in Appendix F. In 'LOCAL' mode, the session timeout check with the TMS shall be ignored.

6.10.2 Sign fault management

The Technical Specification provides the following new Queensland-specific information:

Generally, a VSL site shall not be blanked upon a fault on one or more signs, provided that there is a working sign adjacent to each faulty sign. However, a sign displaying a lane use symbol shall not be blanked even if there is no working sign adjacent to it.

6.10.3 Sign running time

The Technical Specification provides the following new Queensland-specific information:

If specified in contract, site controller shall log accumulated running time of the LED boards of the each sign. Site controller shall have facility to be able to reset timers when the signs are replaced with new signs.

6.11 Sign controller

The Technical Specification provides the following new Queensland-specific information:

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this specification. Additional control system requirements for equipment provided under this specification are described below.

i) General

Each sign shall be directly connected to the site controller using a unique RS-422 serial communications port. Tool-free connectors offering physical security must be used for this purpose. The connectors must be rated appropriately such that it shall not breach the IP65 rating of the sign enclosure.

The sign communications port must provide all the functionality required for the sign to be controlled and monitored by the site controller.

Where a maintenance communication port is provided in the sign, it shall have higher priority over the sign's control communications port. Control shall revert to the control communications port once its maintenance port is not in use. Each sign must have the ability to self-monitor pixel faults, temperature and service status requests from the site controller.

ii) Sign identification

Sign shall have a facility to set a sign id that can be set externally but readable by the site controller to identify the sign.

iii) Sign maintenance communications port

The maintenance communications port must allow interrogation and control of the sign using the PHCS.

iv) Sign control communications port

The sign shall be connected to the site controller using this port. The communications protocol must be such that full functionality of the site controller as described above is supported.

v) Light sensors

Each sign must provide at least two light sensors to detect ambient light levels. These sensors must be located as follows:

- one sensor facing forward perpendicular to the sign face, and
- one sensor facing backward perpendicular to the sign face.

The sign shall be capable of reporting light sensor fault to the site controller. A sign mounted directly against a gantry or in a tunnel where provision of more than one sensor may not result in additional benefits, may be equipped with one sensor.

vi) Bus arbitration

The sign must act as a slave on the site controller RS-422 / modem bus.

6.12 Frame display time

The Technical Specification provides the following new Queensland-specific information:

The minimum display duration of each frame shall be configurable and accessible via the PHCS. The time range and factory default settings are shown in Appendix F.

6.13 Permissible Frame Combinations (PFC) and rules

The Technical Specification provides the following new Queensland-specific information:

The site controller shall store only those frames permitted to be displayed at its respective site. It shall ensure that only permissible combinations of frames for that site are displayed on its respective signs.

The site controller shall generate, log and report an alarm if a frame display request by the TMS is for non-permissible frame(s) and/or combination of frames.

The site controller shall allow:

- a) the PHCS to read and write its permitted frames and permitted frame combinations (PFC), and
- b) its stored frames to be downloaded to the sign(s) only as required to be displayed.

The permissible frames and PFC for each site shall be confirmed with the Principal. This includes the default, maximum and minimum speeds allowed at the respective VSL site.

The PFC at each site shall be determined in accordance with the following rules:

- a) signs displaying speed must display the same speed
- b) exit arrows shall not point towards each other
- c) exit arrows are only allowed at the VSL/LCS site immediately upstream of an exit ramp
- d) a left exit arrow may only be shown in the left lane(s), corresponding to the respective exit lane(s) available
- e) a right exit arrow may only be shown in the right lane(s), corresponding to the respective exit lane(s) available

6.14 Unique hardware identifiers

The Technical Specification provides the following new Queensland-specific information:

Each VSL/LCS site must be uniquely identifiable. A unique site hardware identifier must be implemented physically, external to the site controller, such as by jumper settings, dip switch, soldered bits or otherwise. The unique ID shall be permanently attached to the field cabinet. This ID must be able to be translated electronically through the site controller. A checksum unique to each site shall be computed based on the permitted frames, PFC and hardware site identifier to form the unique VSL/LCS site ID identifiable by the TMS.

The checksum shall be available for confirmation by the TMS that the permitted frames and PFC at each VSL site are the same as those stored at the TMC. The checksum shall be verified periodically and recomputed each time the permitted frames and/or PFC is changed and/or that the site controller is reset/rebooted.

6.15 Configuration management

The Technical Specification provides the following new Queensland-specific information:

All settings in the site controller, including settings included in Appendix F, the permissible frames and PFC must be accessible using the PHCS. The configuration shall be site-specific and must ensure that only the site controller with the correct configuration for the respective VSL site is allowed to control its respective VSL site.

The site-specific permitted frames, PFC and other user configurable settings shall be stored in non-volatile memory, such that they can be altered and downloaded from the PHCS without requiring any change to the site controller firmware.

7 General design and arrangement

7.1 Mechanical requirements

7.1.1 General

The Technical Specification accepts section 4.1.1 *General* of AS 5156 with the following amendments:

Delete:

'The construction and layout of the sign, sign support structure and associated equipment shall not impede the access to, and in situ removal and reinstatement of, pixel modules through the sign enclosure's access opening.'

Add:

'The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.'

7.1.2 Sign enclosure

The Technical Specification accepts section 4.1.2 *Sign enclosure* of AS 5156 with the following amendments:

Delete:

- d) Lockable, left or right-hinged door(s) on the front or rear of the enclosure, as specified by the purchaser, to allow access to the internal components of the sign. Each door shall be provided with UV-stable closed-cell door seals and fitted with fastener(s) operated by a security key approved by the sign purchaser. Door stays shall be provided to secure the doors in the open position.
- g) For fixed signs operating on mains voltage, a double socket outlet compete with an integral 30mA type II residual current device complying with AS/NZS 3190. The socket outlet shall be supplied and protected by a dedicated circuit-breaker in the controller's housing. The socket outlet shall be mounted in an accessible position in the sign enclosure that provided for unobstructed insertion of mains power plug-packs and operation of inserted mains power plug-packs with the doors of the sign enclosure closed.

Add:

Sign enclosure shall be fully sealed and access doors shall not be provided on the sign enclosure since there is no requirements for the sign to be field serviceable.

7.1.3 Sign mounting facilities

The Technical Specification accepts section 4.1.3 *Sign mounting facilities* of AS 5156 with the following amendments:

Delete:

'The sign shall be designed for rear mounting, bottom mounting or mounting as specified by the purchaser'.

Add:

The sign assembly shall comprises with mounting base and the sign enclosure.

The mounting base shall be designed for rear mounting, bottom mounting or mounting as specified in the contract.

The attachment of the sign enclosure to the mounting base shall be through a quick release type to facilitate the mounting and unmounting of the sign enclosure completed within five minutes by a single person.

Sign enclosure shall have restraining mechanism to prevent the sign enclosure been removed from the base and struck oncoming traffic in the event of sign mounting structure hit by a vehicle.

The installation requirement defined in MRTS201 *General Equipment Requirement* applies to this Technical specification

7.1.4 Control housing

The Technical Specification accepts section 4.1.4 *Control housing* of AS 5156 with the following addition:

Add:

All equipment associated with the site controller must be installed in a suitable roadside enclosure that complies with MRTS226 installed:

- as a ground mounted cabinet
- as an integral enclosure installed on the mounting structure (VSL/LCS only), or
- in the case of tunnels, in a stainless steel or marine grade aluminium field cabinet mounted in accordance with the design documentation.

Pits and conduit must be installed in accordance with MRTS91 to provide cable access from the sign to the cabinet.

7.1.4.1 Construction and positioning

The Technical Specification **does not** accept section 4.1.4.1 *Construction and positioning* of AS 5156. **This section does not apply in Queensland.**

7.1.4.2 Anti-vandalism measures

The Technical Specification **does not** accept section 4.1.4.2 *Anti-vandalism measures* of AS 5156. **This section does not apply in Queensland.**

7.1.4.3 Power and communication equipment

The Technical Specification **does not** accept section 4.1.4.3 *Power and communication equipment* of AS 5156. **This section does not apply in Queensland.**

7.1.5 Facility switch

The Technical Specification **does not** accept section 4.1.5 Facility switch of AS 5156. **This section does not apply in Queensland.**

7.1.6 Front cover retention method

The Technical Specification provides the following new Queensland-specific information:

The front cover retention and seal design must allow for thermal expansion properties of the front cover material. The front cover surrounding framework and cover strips must provide the required weather proofing and strength for both positive and negative wind pressures, and, where applicable, tunnel deluge systems.

7.1.7 Mounting structure

The Technical Specification provides the following new Queensland-specific information:

Each VLSL must be capable of being pole-mounted in the verge or on the concrete barrier. Mounting on bridge / overpass structures shall be to the acceptance of the Principal's representative.

Each VSL/LCS must be capable of being mounted centrally above each lane either on a cantilevered structure, a gantry or from a tunnel roof.

Where signs are mounted above a carriageway, the vertical clearance from the lowest surface of sign and the associated mounting structure must be a minimum of 6.1 metres or as otherwise specified in the design requirements.

The location and type of mounting structure to be provided for each site controller, sign and/or each group of signs must be shown on the design documentation. Mounting arrangements must provide means to adjust the vertical and/or horizontal alignment of each sign during commissioning and subsequent maintenance activities. Sign mounting components must allow replacement of the sign within five minutes.

Final footing, support structure design and locations as shown in design documentation shall be submitted to the Principal's representative for acceptance before fabrication. **Hold Point 4**

The mounting structure must comply with requirements of MRTS201, MRTS61, MRTS71 and MRTS78. **Hold Point 5**

Particular attention needs to be given to the requirements in MRTS78 *Fabrication of Structural Steelwork* relating to the use of a registered fabricator when fabricating mounting structures for VLSL and VSL/LCS.

7.2 Electrical requirements for mains operated signs

7.2.1 Compliance with wiring Standards

The Technical Specification accepts section 4.2.1 *Compliance with wiring Standards* of AS 5156 with the following addition:

The electrical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

7.2.2 Operating voltage

The Technical Specification accepts section 4.2.2 *Operating voltage* of AS 5156 with the following addition:

Add:

Momentary voltage loss of 50 ms shall not have any effect on the sign display and/or site controller.

Signs shall be either:

- a) have inbuilt power supplies and powered by mains power or
- b) have external switch mode power supplies that can be housed at a different location

Sign design shall consider the selection of the best sign type as specified by the contract and/or depending on the site conditions. Designers shall refer *Road Planning and Design Manual* for details.

7.2.3 Battery backup

The Technical Specification **does not** accept section 4.2.3 *Battery backup* of AS 5156. **This section does not apply in Queensland.**

7.2.4 Surge protection

The Technical Specification accepts section 4.2.4 *Surge protection* of AS 5156.

7.3 Design life

The Technical Specification accepts section 4.3 *Design life* of AS 5156.

7.4 Solar power

The Technical Specification accepts section 4.4 *Solar power* of AS 5156 with the following addition:

Add:

If specified in contract to provide solar power, the VSL and VSL/LCS shall be able to operate with solar power.

7.5 Communication equipment

The Technical Specification accepts section 4.5 *Communications equipment* of AS 5156.

7.6 Real-time clock

The Technical Specification accepts section 4.6 *Real-time clock* of AS 5156 with the following amendments:

Delete:

'Sign'.

Add:

Site controller'.

7.7 Markings and labels

The Technical Specification accepts section 4.7 *Markings and labels* of AS 5156.5

8 Environmental requirements

8.1 Temperature and humidity

The Technical Specification accepts section 5.1 *Temperature and humidity* of AS 5156 with the following addition:

The environmental requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification

Each sign must provide at least one temperature sensor to measure the temperature inside the enclosure at points of high thermal stress. The sensor must not be mounted directly against the top face of the enclosure. The temperature reading data must be transmitted to the communications ports. The temperature must be in units of (°C).

The site controller must have the ability to provide to the TMS temperature readings obtained from the signs connected to it.

8.2 Enclosure protection

The Technical Specification accepts section 5.2 *Enclosure protection* of AS 5156.

8.3 Wind loading

The Technical Specification accepts section 5.3 *Wind loading* of AS 5156.

8.4 Shock protection

8.4.1 Shock

The Technical Specification accepts section 5.4.1 *Shock* of AS 5156.

8.4.2 Vibration

The Technical Specification accepts section 5.4.2 *Vibration* of AS 5156.

8.5 Electromagnetic compatibility (EMC)

8.5.1 Immunity

The Technical Specification accepts section 5.5.1 *Immunity* of AS 5156.

8.5.2 Electromagnetic emissions

The Technical Specification accepts section 5.5.2 *Electromagnetic emissions* of AS 5156.

9 Other requirements

9.1 Installation requirements

The Technical Specification provides the following new Queensland-specific information:

The installation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional installation requirements relevant under this Technical Specification are described below.

- a) The general layout, positions, reduced level for the footing (where applicable), and speed zones for the VSLS and/or VSL/LCS and details of the barrier and other mounting requirements must be as shown on the design documentation.
- b) The position of in-ground mounting structures must comply with the requirements of the MUTCD.
- c) The positioning of VSLS and/or VSL/LCS must provide sight distances as described in the TRUM Manual.
- d) The VSLS and/or VSL/LCS locations must be verified by site inspection and must be shown on the design documentation. The design documentation must be submitted to the Administrator not less than seven days prior to the commencement of civil works for the VSLS and/or VSL/LCS foundations. **Milestone**

Before installation, the Contractor must confirm the final VSLS and/or VSL/LCS location and the type, location and positioning of the mounting arrangements and/or protection barrier as shown in the design documentation to the Administrator.

9.2 ITS network telecommunications

The Technical Specification provides the following new Queensland-specific information:

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification

9.3 Testing and commissioning

9.3.1 General

The Technical Specification provides the following new Queensland-specific information:

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional testing and commissioning requirements relevant under this Technical Specification are described following.

9.3.2 Factory acceptance tests

The Technical Specification provides the following new Queensland-specific information:

Compliance with the optical performance requirements must be determined by measurement under laboratory conditions as per AS 5156:2010. **Witness Point 1**

9.3.3 Test VSLS and/or VSL/LCS

The Technical Specification provides the following new Queensland-specific information:

A test VSLS and/or VSL/LCS complete with site controller must be provided to the Principal as part of the STREAMS Acceptance Test Plan (SAT) for testing of software components used to control the VSLS and/or VSL/LCS. Provision of the test VSLS and/or VSL/LCS will not be necessary if a test VSLS and/or VSL/LCS has previously passed a SAT or if the Principal specifies otherwise.

The test sign for the STREAMS Acceptance Test Plan may be a smaller version of the sign to be supplied under the contract. It must, however, be functionally equivalent with identical communications interface and operations.

9.3.4 Configuring frames

The Technical Specification provides the following new Queensland-specific information:

Permissible frame combinations shall be configured as part of the commissioning process. The maximum speed limits for speeds set in local control mode shall not exceed the otherwise statically signed speed limit for that location.

9.4 Documentation

The Technical Specification provides the following new Queensland-specific information:

The documentation requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

9.5 Training

The Technical Specification provides the following new Queensland-specific information:

The training requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

9.6 Maintenance

The Technical Specification provides the following new Queensland-specific information:

The maintenance requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

9.7 Handover

The Technical Specification provides the following new Queensland-specific information:

The handover requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Appendix A Photometric test procedure

A1 General

The Technical Specification accepts section A1 *General* of AS 5156.

A2 Test procedures for luminance measurement

A2.1 General

The Technical Specification accepts section A2.1 *General* of AS 5156.

A2.2 Luminance measurement of annulus segment

The Technical Specification accepts section A2.2 *Luminance measurement of annulus segment* of AS 5156.

A2.3 Luminance measurement of the numerals

A2.3.1 Luminance measurement of full matrix speed signs

The Technical Specification accepts section A2.3.1 *Luminance measurement of full matrix speed signs* of AS 5156.

A2.3.2 Luminance measurement of speed signs with discrete characters

The Technical Specification accepts section A2.3.2 *Luminance measurement of speed signs with discrete characters* of AS 5156.

A2.4 Normalization of results

A2.4.1 Normalized luminance

The Technical Specification accepts section A2.4.1 *Normalized luminance* of AS 5156.

A2.4.2 Test procedure for determination of CF for numerals and the annulus

The Technical Specification accepts section A2.4.2 *Test procedure for determination of CF for numerals and the annulus* of AS 5156.

A3 Test procedures for luminance ratio measurement

A3.1 Solar stimulation

The Technical Specification accepts section A3.1 *Solar stimulation* of AS 5156.

A3.2 Luminance ratio of annulus

The Technical Specification accepts section A3.2 *Luminance ratio of annulus* of AS 5156.

A3.3 Luminance ratio of measurement of the legend

A3.3.1 Luminance ratio of matrix

The Technical Specification accepts section A3.3.1 *Luminance ratio of matrix* of AS 5156.

A3.3.1.1 Alternative A

The Technical Specification accepts section A3.3.1.1 *Alternative A* of AS 5156.

A3.3.1.2 Alternative B

The Technical Specification accepts section A3.3.1.2 *Alternative B* of AS 5156.

A3.3.2 Luminance ratio of speed signs with discrete characters

The Technical Specification accepts section A3.3.2 *Luminance ratio of speed signs with discrete characters* of AS 5156.

A3.4 Luminance ratio of conspicuity devices

A3.4.1 General

The Technical Specification accepts section A3.4.1 *General* of AS 5156.

A3.4.2 Alternative A

The Technical Specification accepts section A3.4.2 *Alternative A* of AS 5156.

A3.4.3 Alternative B

The Technical Specification accepts section A3.4.3 *Alternative B* of AS 5156.

A4 Test procedures for luminous intensity half-angle measurement

A4.1 Luminous intensity half-angle of the annulus

The Technical Specification accepts section A4.1 *Luminous intensity half-angle of the annulus* of AS 5156.

A4.2 Luminous intensity half-angle of the numeral display

The Technical Specification accepts section A4.2 *Luminous intensity half-angle of the numeral display* of AS 5156.

A5 Test procedures for luminous intensity uniformity

The Technical Specification accepts section A5 *Test procedures for luminous intensity uniformity* of AS 5156.

A6 Test procedures for conspicuity devices

A6.1 Luminous intensity of conspicuity device

The Technical Specification **does not accept** section A6.1 *Luminous intensity of conspicuity device* of AS 5156. **This section does not apply in Queensland.**

A6.2 Luminous intensity of half-angle of conspicuity device

The Technical Specification **does not accept** section A6.2 *Luminous intensity of half-angle of conspicuity device* of AS 5156. **This section does not apply in Queensland.**

A7 Test procedures for photosensors

A7.1 General

The Technical Specification accepts section A7.1 *General* of AS 5156.

A7.2 Test procedures for measurement of photosensors

The Technical Specification accepts section A7.2 *Test procedures for measurement of photosensors* of AS 5156.

A8 Colorimetric test procedures

The Technical Specification accepts section A8 *Colorimetric test procedures* of AS 5156.

Appendix B Further requirements for matrix signs

B1 General

The Technical Specification accepts section B1 *General* of AS 5156.

B2 Display requirements

B2.1 Display changes

The Technical Specification accepts section B2.1 *Display changes* of AS 5156.

B2.2 Display changes due to facility switch operation

The Technical Specification accepts section B2.2 *Display changes due to facility switch operation* of AS 5156.

B2.3 Display changes due to external switch inputs

The Technical Specification accepts section B2.3 *Display changes due to external switch inputs* of AS 5156.

B2.4 Graphics requirements

The Technical Specification accepts section B2.4 *Graphics requirements* of AS 5156.

B3 Programming

The Technical Specification accepts section B3 *Programming* of AS 5156.

B4 Frame, message numbering and display images

B4.1 Graphics requirements

The Technical Specification accepts section B4.1 *Graphics requirements* of AS 5156.

B4.2 Message numbering for speed displays

The Technical Specification accepts section B4.2 *Message numbering for speed displays* of AS 5156.

B4.3 Frame numbering for other displays

The Technical Specification accepts section A4.3 *Frame numbering for other displays* of AS 5156 with the following amendments:

Difference:

In Table B3 *Frame numbering for other displays*, replace:

- Frame no. 184 description with 'Flashing cross (in place of down left arrow)'
- Frame no. 185 description with 'Flashing cross (in place of down right arrow).'

Add:

- In Table B3 *Frame numbering for other displays*, add Frame no. 253 and description Solid cross
- At each site, only one frame shall be provided for each speed as follows:
 - a) the frame for the 'default speed' shall be provided with a fixed annulus, and
 - b) all other speeds lower than the default shall be provided with flashing annuli.

Example A: the site controller for a post-mounted VSL site on a motorway with a default speed of 90 km/h and minimum speed of 40 km/h shall be programmed with only frames 41, 51, 61, 71, 81, 90.

Example B: the site controller for a gantry-mounted VSL/LC site on a motorway with a default speed of 90 km/h, minimum speed of 40 km/h and no downstream exit ramp prior to the next VSL/LC site shall be programmed with only frames 41, 51, 61, 71, 81, 90, 184, 185, 253.

B4.4 Message numbering for other displays

The Technical Specification accepts section B4.4 *Message numbering for other displays* of AS 5156.

B4.5 Standard bitmap display images

The Technical Specification accepts section B4.5 *Standard bitmap display images* of AS 5156.

B4.6 Bitmap definitions for other displays

The Technical Specification accepts section B4.6 *Bitmap definitions for other displays* of AS 5156.

Appendix C Sign clearance and access

C1 Sign clearances

The Technical Specification accepts section C1 *Sign clearances* of AS 5156.

C2 Sign access

The Technical Specification accepts section C2 *Sign access* of AS 5156.

Appendix D Wireless communications

The Technical Specification accepts Appendix D *Wireless communications* of AS 5156.

Appendix E Allocation of functionality between TMS and site controller

The Technical Specification provides the following new Queensland-specific information:

Functional allocation is derived from Appendices E and F of the Transport and Main Roads VSL Concept of Operations document.

Table E1 – Allocation of functionality between TMS and site controller: General principles

Concept of Operations Appendix B – General principles				
Design principle	Description	Responsibility		Comments
		TMS	Site controller	
1	Conflicting speed recommendation from algorithms	Y		
2	Future development of algorithms, addition or replacement of algorithms	Y		
3	Max/min speed limit	Y	Y	Permissible frame, STREAMS cannot override max / min speeds which are programmed into the Site Controller
4	Speed limit minimum increment, 10 or 20 km/h	Y		
5	Automatic functionality, speed change from 60 to 110 km/h (where applicable)	Y	Y	Permissible frames
6	Buffer Speed, speed changes greater than 20 km/h	Y		
7	Buffer Distance, at least 300 m in accordance with MUTCD	Y		
8	Transitions, change of lane status and/or speeds	Y		
9	Flashing annulus		Y	If speed is other than default (maximum) speed limit, then flash inner rings of annulus
10	20 km/h speed limit lowering	Y		
11	20 km/h speed limit raising	Y		
12	Speed limit at start of VSL zone	Y		
13	Smoothing	Y		
14	Smoothing	Y		
15	Smoothing	Y		
16	Smoothing	Y		
17	Smoothing	Y		
18	Min length of target speed limit changes	Y		

Concept of Operations Appendix B – General principles				
Design principle	Description	Responsibility		Comments
		TMS	Site controller	
19	Manual override lane control	Y		PHCS not to inadvertently override lane control
20	Flashing red cross before solid red cross	Y		STREAMS will request flashing cross, THEN after x seconds, request solid cross. Sign protocol development required
21	Lane closures for multiple lanes	Y		
22	Default lane closure length	Y		
23	Minimum lane closure length	Y		
24	System prompt for lane closure, lane closure length	Y		
25	Lane closure across entrance or exit ramps	Y		Separate site controllers required for ramp and mainline
26	Speed limit during lane closures	Y	Y	Permissible frames
27	Incidence clearing and lane reopening	Y		
28	Re-opening lanes	Y		
29	Manual override over a number of signs by operator	Y	Y	Permissible frame combinations
30	Changes by time of day, manual override	Y		
31	Manual override speeds	Y		
32	Responsibility associated with manual override	Y		Note also responsibility when using PHCS
33	Power of the manual operator override	Y		
34	Manual override operator timeout	Y		
35	Shift changes while manual overrides are activated	Y		
36	User interface, prompts and manual overrides	Y		
37	Switched on	Y	Y	
38	Manage different directions separately	Y		
39	Appropriate sign displays for safety		Y	Permissible frame combinations
40	Confirmation that sign display has changed	Y	Y	Sign protocol

Concept of Operations Appendix B – General principles				
Design principle	Description	Responsibility		Comments
		TMS	Site controller	
41	Generic plans for incident management	Y		
42	Sign interlocking, mainline / entrance ramp	Y		Ramp signs to have own controller
43	Queuing object	Y		
44	Auditing email account	Y		
45	Calibration, fine tuning of algorithms	Y		
46	Management of parameters	Y		
47	Interaction with STREAMS incident management system (SIMS)	Y		
48	Differential lane speeds	n/a	Possible future (by others)	Permissible frame combinations
49	Sign spacing	Y		
50	Optimum location beyond on ramp taper	Y		
51	Unobstructed viewing distance	Y		
52	Default speed limit (when VSL system is not available)	n/a	n/a	Static signs

Table E2 – Allocation of functionality between TMS and site controller: General principles

Concept of Operations Appendix H – Fault Management				
Design principle	Description	Responsibility		Comments
		TMS	Site controller	
1	VSL/LCS displays incorrect symbol		Y	
2	Inability to determine VSL/LCS display		Y	Watchdog timer
3	System operator alert		Y	Protocol to allow
4	Failure of pole-mounted VSL at VSL zone entry	Y	Y	Solution will now be through the hardware (previously in STREAMS)
5	Failure of pole-mounted VSL where upstream VSL site displays same speed	Y		

Concept of Operations Appendix H – Fault Management				
Design principle	Description	Responsibility		Comments
		TMS	Site controller	
6	Failure of pole-mounted VSL where upstream VSL site displays slower speed than the faulty site	Y		
7	Failure of pole-mounted VSL where upstream VSL site displays faster speed than the faulty site	Y		
8	Failure of gantry-mounted VSL signs (at VSL zone entry)	Y	Y	Solution now to be through hardware (site controller)
9	Failure of gantry-mounted VSL signs where upstream VSL site displays same speed	Y		
10	Failure of gantry-mounted VSL signs where upstream VSL site displays slower speed	Y		
11	Failure of gantry-mounted VSL signs where upstream VSL site displays faster speed than faulty site	Y		
12	Maximum uptime without communications	Y	Y	Set in STREAMS
13	Power recover delay time		Y	Hardware waits for instruction from STREAMS
14	Sign display minimum downtime		Y	
15	Maximum rollback	Y		
16	Non-consecutive faulty sites	Y		
17	Rollback onto upstream motorways	Y		
18	Rollback scheme for lane closure	Y		
19	Rollback scheme for lane closure zone	Y		
20	Failure of interlocked signs, mainline entry ramp	Y		

Appendix F Referenced variables and default settings

The Technical Specification provides the following new Queensland-specific information:

Table F – Referenced variables and default settings

Reference	Description	Range of values	Factory default	Device(s), systems affected
6.1.2	Frame display time	1-5 seconds	5 seconds	Site controller / sign
5.1.2.5	Flashing display elements	1 seconds/Duty cycle 50%	1 seconds/Duty cycle 50%	Sign
6.10.1	Session timeout – (site controller / TMS)	1–600 seconds	60s	Site controller / TMC
6.10.1	Communications check with sign	0–30 seconds	Once every 5s	Site controller
6.6	Power recovery delay time	1–600 seconds	60	Site controller/sign
6.7	Minimum blank time	1–120 seconds	30	Site controller/sign
6.7	Sign processor fault blank time	0.5–3 seconds	1s	Sign
6.7	Communication timeout – (sign / site controller)	1–600 seconds	60s	Sign
5.1.1.6.1	LED intensity control	1-16 levels	Dimming by SC	Site controller / sign

