

# Master Specification

## Part RD-ITS-S4

### Supply of Electronic Signs

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**Government of South Australia**  
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## Contents

Contents	3
RD-ITS-S4 Supply of Electronic Signs	4
1 General	4
2 Documentation	5
3 Technical requirements	6
4 Design Life requirements	15
5 Maintainability	15
6 Testing and commissioning	16
7 Appendix 1: Variable message signs (VMS)	17
8 Appendix 2: Variable speed limit signs (VSLs) / lane use management system (LUMS) signs	22
9 Appendix 3: Changeable message signs (CMS)	29
10 Appendix 4: Single Line VMS	34
11 Appendix 5: Ramp Control Signs (RC1 / RC2 / RC3)	39
12 Appendix 6: Real-time information signs (A2/TT)	45

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## RD-ITS-S4 Supply of Electronic Signs

### 1 General

- a) This Master Specification Part sets out the requirements for the supply of electronic signs, including:
- i) the documentation requirements as set out in section 2;
  - ii) the technical requirements as set out in section 3;
  - iii) the Design Life requirements, as set out in section 4;
  - iv) the maintainability requirements, as set out in section 5;
  - v) the testing and commissioning requirements, as set out in section 6;
  - vi) the requirements for VMS, as set out in Appendix 1: Variable message signs (VMS);
  - vii) the requirements for VSLS and LUMS signs, as set out in Appendix 2: Variable speed limit signs (VSLS) / lane use management system (LUMS) signs;
  - viii) the requirements for CMS, as set out in Appendix 3: Changeable message signs (CMS);
  - ix) the requirements for Single Line VMS, as set out in Appendix 4: Single Line VMS;
  - x) the requirements for RC1, RC2 and RC3 signs, as set out in Appendix 5: Ramp Control Signs (RC1 / RC2 / RC3); and
  - xi) the requirements for A2 and travel time signs (together, A2/TT), as set out in Appendix 6: Real-time information signs (A2/TT).
- b) For the purposes of this Master Specification Part, “signs” means the following electronic signs:
- i) variable message signs (VMS);
  - ii) variable speed limit signs (VSLS);
  - iii) lane use management system (LUMS) signs;
  - iv) subject to section 1c), changeable message signs (CMS);
  - v) Single Line VMS;
  - vi) ramp control/ramp metering signs (RC1);
  - vii) ramp metering warning signs (RC2);
  - viii) ramp control warning and information signs (RC3 signs); and
  - ix) travel time information signs (A2/TT), and
- includes all associated equipment, including control equipment, power supplies and communications equipment.
- c) With respect to CMS, this Master Specification Part:
- i) applies only to electronic CMS:
    - A. that have an LED display; and
    - B. which are capable of displaying only limited messages; and
  - ii) does not apply to CMS types with prisms which rotate to display one or more static sign faces.
- d) The supply of electronic signs must comply with the Reference Documents including:

- i) AS 1742 Manual of uniform traffic control devices;
- ii) AS 1743 Road signs - Specifications;
- iii) AS 1744 Standard alphabets for road signs;
- iv) AS 1768 Lightning protection;
- v) AS 2700 Colour standards for general purposes;
- vi) AS 4852.1 Variable message signs, Part 1: Fixed signs;
- vii) AS 5156 Electronic speed limit signs;
- viii) AS 60529 Degrees of protection provided by enclosures (IP Code);
- ix) AS/NZS 1170 Structural design actions;
- x) AS/NZS 1734 Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate;
- xi) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- xii) AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;
- xiii) AS/NZS 61000 Electromagnetic compatibility (EMC);
- xiv) Department Operational Instruction 2.36 Use of Variable Message Signs (available from: [https://dit.sa.gov.au/standards/standards\\_and\\_guidelines](https://dit.sa.gov.au/standards/standards_and_guidelines));
- xv) TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices; and
- xvi) DoT (formerly VicRoads) Specification TCS 060 - VicRoads Extensions to RTA Protocol For Roadside Devices.

## 2 Documentation

### 2.1 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) circuit and layout diagrams for the ELV signs as required by section 3.3.2c);
- b) power consumption test reports, as required by section 3.3.4;
- c) records of the lightning protection circuit and arrangement, and measured earth resistance as required by section 3.3.7b);
- d) evidence of compliance with electromagnetic compatibility (EMC) requirements as set out in section 3.3.8b);
- e) evidence of compliance with the sign grouping requirements as set out in section 3.10c);
- f) ingress protection (IP) test reports for each type of sign and cabinet enclosures, as required by section 3.11b);
- g) evidence of compliance with sign-type specific requirements, as set out in section 3.12;
- h) Factory Acceptance Testing results relating to VMS, as set out in section 7.7b);
- i) Factory Acceptance Testing results relating to VLS and LUMS signs, as set out in section 8.7b);
- j) Factory Acceptance Testing results relating to CMS, as set out in section 9.6b);
- k) Factory Acceptance Testing results relating to Single Line VMS, as set out in section 10.7b);



- l) Factory Acceptance Testing results relating to RC1, RC2 and RC3 signs, as set out in section 11.6b); and
- m) Factory Acceptance Testing results relating to A2/TT signs, as set out in section 12.6b).

### 3 Technical requirements

#### 3.1 General

- a) The Contractor must ensure that the signs comply with the:
  - i) requirements of section 1 to section 6 of this Master Specification Part; and
  - ii) sign type specific requirements set out in the relevant appendix, as listed in Table RD-ITS-S4 3-1.
- b) To the extent of any inconsistency between the general requirements set out in section 1 to section 6 of this Master Specification Part and the sign type specific requirements set out in the relevant appendix, the sign type specific requirements will take precedence to the extent of the inconsistency.

**Table RD-ITS-S4 3-1 Sign specific requirements**

Sign type	Sign specific requirements
VMS	Appendix 1: Variable message
VSLs and LUMS signs	Appendix 2: Variable speed limit signs (VSLs) / lane use management system (LUMS) signs
CMS	Appendix 3: Changeable message
Single line VMS	Appendix 4: Single Line VMS
RC1, RC2 and RC3	Appendix 5: Ramp Control Signs (RC1 / RC2 / RC3)
A2 and TT	Appendix 6: Real-time information signs (A2/TT)

#### 3.2 Mechanical requirements

##### 3.2.1 Sign enclosures

The Contractor must ensure that all sign enclosures comply with the following requirements:

- a) the sign enclosure must be constructed from:
  - i) marine grade aluminium alloy 5052 H32 or 5251 H32 in accordance with AS/NZS 1734 Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate; or
  - ii) stainless steel of Grade 316 or 321;
- b) the sign enclosure must be suitably:
  - i) reinforced;
  - ii) braced; or
  - iii) both reinforced and braced,
 to facilitate the erection and continued operation of the sign enclosure in its intended application;
- c) the sign enclosure and all ancillary equipment must be free from sharp corners, edges and protrusions which may cause injury to personnel or damage to sign components during installation or maintenance operations;
- d) all visible surfaces of the sign enclosure and the associated structure, other than the sign display and the shadow line, must be painted:
  - i) in accordance with sign enclosure manufacturer's specification; and
  - ii) for signs to be installed:

- A. outside of a Tunnel, in “G61 Dark Green” colour in accordance with AS 2700 Colour standards for general purposes; and
  - B. inside of a Tunnel, in matte black in accordance with AS 2700 Colour standards for general purposes;
- e) all components used for connection or bracing of the sign enclosure onto the support structure must be manufactured or constructed from corrosion resistant materials or have corrosion resistant coatings;
  - f) all ferrous metal works must be hot-dip galvanized in accordance with AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;
  - g) access for cables to the signs must be included in the design of the sign enclosure;
  - h) cables must enter from the bottom of the sign’s external enclosure;
  - i) all penetrations made to sign enclosures (including for cable installation) must be:
    - i) sealed to achieve the ingress protection rating required by section 3.11a)ii)A; and
    - ii) sealed for vermin protection in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code);
  - j) the seals required by section 3.2.1i) must be effective for the Design Life of the sign enclosure;
  - k) where a front cover is provided for the sign display, the front cover must be:
    - i) a clear non-reflective polycarbonate material;
    - ii) high impact resistant;
    - iii) UV-resistant;
    - iv) anti-glare;
    - v) non-polarising; and
    - vi) a thickness the greater of the thickness specified by the polycarbonate manufacturer or 4.5mm;
  - l) where a front cover is not required for the sign, the sign display must be:
    - i) non-reflective;
    - ii) high impact resistant;
    - iii) UV-resistant; and
    - iv) resistant to deformation from its design shape to an extent that the sign’s photometric performance is adversely affected under any of the required environmental operating conditions; and
  - m) the sign enclosure must not obstruct viewing angles of  $\pm 45$  degrees (horizontal) and  $\pm 30$  degrees (vertical) to the axis perpendicular to the front plane of the display when installed.

### 3.2.2 Sign enclosure access doors

The Contractor must ensure that all sign enclosure access doors comply with the following:

- a) signs designed to be serviced in the field, and not hot-swappable, must have sign enclosures provided with access doors to allow ready access to the internal components of the sign for maintenance;
- b) sign enclosure access doors must be provided with UV-stabilised closed-cell seals to protect all equipment housed within the sign enclosure from:
  - i) moisture;
  - ii) dust;

- iii) dirt; and
- iv) corrosion, and
- v) vermin;
- c) the sign enclosure access doors must be fitted with a door stay capable of holding the access door open approximately perpendicular to the sign enclosure providing a safe working environment for maintenance;
- d) for larger signs, such as VMS, which may have multiple access doors that open towards each other, adjacent access doors must be capable of being simultaneously opened and secured with the door stays required by section 3.2.2c);
- e) the access door hinges must not protrude from the sign enclosure;
- f) the access door hinge pins must not be removable unless the access door is in the open position; and
- g) all sign enclosure access doors must be equipped with a “Southco” hex cam key-lockable rotary action latch to prevent unauthorised entry.

### 3.2.3 Sign mounting facilities

The Contractor must ensure that all sign mounting facilities comply with the following:

- a) the mounting brackets must:
  - i) be integral with the sign enclosure; and
  - ii) not be drilled or welded to the sign enclosure;
- b) the sign mounting must facilitate:
  - i) adjustment of the viewing angle of the sign during installation and commissioning to ensure the sign can be set at its optimum line of sight which complies with AS 4852.1 Variable Message Signs;
  - ii) excluding VMS, adjustment of the tilt angle and orientation after installation of the sign; and
  - iii) excluding VMS, rapid detachment and replacement of the sign for maintenance purposes;
- c) the sign mounting facilities must be free from sharp corners, edges and protrusions which may cause injury to personnel or damage to sign components during installation or maintenance operations; and
- d) for large electronic signs, poles must be non-frangible and suitably protected from vehicle impacts.

### 3.2.4 Supporting structures

The Contractor must ensure that all sign support structures comply with the requirements of RD-LM-C4 “Sign Installation” as well as all additional requirements set out in this Master Specification Part.

### 3.2.5 Roadside cabinets

The Contractor must ensure that sign roadside cabinets:

- a) to be located outside of a Tunnel, comply with the requirements of RD-ITS-S3 “ITS Enclosures”; and
- b) to be located inside a Tunnel, comply with the requirements of TUN-ME-DC4 “Tunnel Equipment Cabinets”.



### 3.3 Electrical requirements

#### 3.3.1 General

The Contractor must ensure that the signs comply with the following electrical requirements:

- a) all electrical works must comply with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- b) other than those signs the subject of section 3.3.2, signs must operate from a 230 V AC mains power supply;
- c) without limiting section 3.3.1b), signs must:
  - i) operate correctly and reliably from a mains power supply:
    - A. with supply voltages over the range 205 V to 264 V RMS; and
    - B. for any variations of frequency in the range 47 Hz to 52 Hz;
  - ii) operate normally for supply breaks or brownouts of duration up to 100 ms;
  - iii) be protected from damage if subjected to voltages and frequencies outside the ranges set out in sections 3.3.1c)i) and 3.3.1c)ii); and
  - iv) return to normal operation automatically upon restoration of power after a power failure;
- d) for signs which are supplied with switchboards, the switchboard to be installed in the sign enclosure must incorporate the following:
  - i) a single pole 250 V (single phase) mains isolating switch;
  - ii) a main circuit breaker;
  - iii) at least one 250 V single pole 10 kA miniature circuit breaker;
  - iv) neutral cover and link;
  - v) earth link; and
  - vi) labelling for each of the above components which comprises white traffolyte with black text, 20 mm high with 8 mm text up to 3 lines;
- e) for signs which are supplied with switchboards, the following requirements apply:
  - i) a residual current device protected general power outlets with no less than a 3 Amp rating, must be provided in the sign enclosure for set up and maintenance purposes; and
  - ii) the general power outlets required by section 3.3.1e)i) must be labelled as current limited in accordance with section 3.3.1d)vi);
- f) LED lighting must be provided for VMS, Single Line VMS and A2/TT signs within the sign enclosure which must:
  - i) provide adequate illumination to all internal components of the sign; and
  - ii) be controlled by door switches which have the following functionality:
    - A. opening of access door must switch on the lighting; and
    - B. closing of the access door must switch off the lighting;
- g) sign equipment must be hard wired;
- h) where signs operate in groups, e.g. VSLS and LUMS signs, each sign is to have separate power feeds from the power source, not daisy chained or linked feeds;
- i) sign equipment and equipment power supplies must not be powered via general power outlet plugs;

- j) all sign components and electrical wiring must incorporate protection against transients and over voltage;
- k) signs must incorporate protection against transients and voltage differentials, including where device power and communications earthing points result in earth differentials; and
- l) for signs which require facility switches:
  - i) the facility switch must be located inside a sign enclosure. If the sign has an associated ground level accessible enclosure (such as a VMS with a ground mounted cabinet), the facility switch is to be located within this ground level accessible enclosure;
  - ii) the facility switch must comply with the requirements for a facility switch as detailed in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - iii) in addition to the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, the position of the facility switch must be reported by the sign controller to STREAMS.

### 3.3.2 Extra low voltage variant

The Contractor must only supply ELV signs if they meet the following requirements in addition to the requirements of section 3.3.1:

- a) the sign and any related sign components that are on a gantry or mounting structure must be ELV only;
- b) the voltage supplied between the sign's roadside cabinet and the sign itself must be ELV only;
- c) circuit and layout diagrams for the ELV signs must be provided in manuals forming part of the Quality Management Records; and
- d) the sign controller must be ELV supplied.

### 3.3.3 Solar power

Unless otherwise specified in the Contract Documents, the Contractor must ensure that signs, together with their controllers, are not operated by solar power.

### 3.3.4 Power consumption reports

As part of the Quality Management Records, the Contractor must provide test reports for each sign's power consumption, as follows:

- a) peak power during start-up;
- b) maximum in-service power;
- c) if the sign has further variables that affect power consumption, such as when cooling or heating devices are operating, then these variables must be stated in the test report; and
- d) for VMS only, a measurement for power consumption with 50% of pixels lit displaying an amber colour at 50% intensity.

### 3.3.5 Back-up power supply

Where specified in Contract Documents that the signs are to be supplied with their own dedicated back-up power supply, the Contractor must ensure that the following back-up power supply requirements are satisfied with respect to all signs:

- a) in the event of a failure of the primary power supply, a standby power supply or battery back-up must be provided to ensure the sign:
  - i) operates correctly for a minimum of 4 hours; and
  - ii) continues to display its current message and state during the transition from primary power supply to back-up power, without any temporary blackout or blanking;
- b) signs which have an integral back-up power supply must report via STREAMS when the sign is operating on back-up power; and

- c) batteries used in any integral back-up power supply system must:
  - i) have a Design Life of at least 5 years;
  - ii) be of a deep discharge, low-maintenance type (precluding liquid electrolytes);
  - iii) be automatically charged from an internal system provided with the sign; and
  - iv) fully recharge within a maximum period of 12 hours following restoration of the primary power supply.

### 3.3.6 Recovery from power failure

- a) If a mains power failure occurs and the backup power supply subsequently becomes exhausted, all signs must be able to perform automatic clearing of the current display memory prior to shut down.
- b) If a mains power failure occurs and the backup power supply subsequently becomes exhausted as contemplated by section 3.3.6a), the sign display must be blank until a new display command is received via STREAMS.

### 3.3.7 Lightning protection

- a) The Contractor must ensure that where signs are to be located outside of a Tunnel:
  - i) the relevant signs must be provided with surge protection to withstand the surges specified in AS/NZS 1768 Lightning protection, category B, with medium exposure peak amplitudes; and
  - ii) lightning protection must be provided to the sign enclosure in accordance with the requirements of AS/NZS 1768 Lightning protection.
- b) The Contractor must provide records of:
  - i) the lightning protection circuit and arrangement; and
  - ii) measured earth resistance,for all signs the subject of section 3.3.7a), as part of the Quality Management Records.

### 3.3.8 Electromagnetic compatibility

- a) The Contractor must ensure that the signs comply with:
  - i) for all VMS, the requirements of AS 4852.1 section 4.5 Electromagnetic Compatibility (EMC); and
  - ii) for all other signs, the requirements of AS 4852.1 section 4.5 Electromagnetic Compatibility (EMC) for the entire complete sign assembly, not a section only.
- b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that a complete sign (or in the case of a VMS, a sign segment) satisfies the requirements of section 3.3.8a), as part of the Quality Management Records.

## 3.4 Sign dimming control requirements

The Contractor must ensure that the signs satisfy the following sign dimming control requirements:

- a) signs must be capable of dimming control to vary the LED intensity of the display to suit the ambient lighting conditions;
- b) signs must include at least 2 light sensors to detect ambient light levels at the sign location; and
- c) the light sensors required by section 3.4b) must be located as follows:
  - i) one sensor facing forward, perpendicular to the sign face; and
  - ii) one sensor facing backward, perpendicular to the sign face.

### 3.5 Status monitoring and fault logging

The Contractor must ensure that the signs satisfy the following status monitoring and fault logging requirements:

- a) with respect to status monitoring, fault reporting and alarm facilities, all signs must satisfy the requirements of this Master Specification Part and:
  - i) depending on the sign type, either:
    - A. AS 4852.1 Variable message signs, Part 1: Fixed signs; or
    - B. AS 5156 Electronic speed limit signs; and
  - ii) TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices;
- b) the status monitoring, fault reporting and alarm facilities of the signs must include:
  - i) communication failure;
  - ii) partial (including single pixel, even if not currently illuminated) or full display failure;
  - iii) mains power failure;
  - iv) battery condition (if batteries fitted);
  - v) battery low (if batteries fitted);
  - vi) battery failed (if batteries fitted);
  - vii) current state;
  - viii) current display intensity level;
  - ix) light sensor failure;
  - x) status of local facility switch;
  - xi) door status (open/closed);
  - xii) current temperature; and
  - xiii) temperature alarm;
- c) status and fault logs must be capable of being stored in non-volatile memory; and
- d) the status monitoring, fault reporting and alarm facilities of the signs must be capable of interfacing to STREAMS.

### 3.6 Sign controller

The Contractor must ensure that the sign controllers satisfy the following requirements:

- a) sign controllers must be capable of interfacing to:
  - i) a STREAMS compatible field processor compliant with RD-ITS-S6 "Field Processors" via:
    - A. TIA/EIA-485;
    - B. TIA/EIA-422;
    - C. TIA/EIA-232; or
    - D. via a network connection using TCP/IP or Modbus/TCP; or
  - ii) where the Contract Documents have specified the use of a communications processor, a STREAMS compatible communications processor compliant with RD-ITS-S6 "Field Processors" via TCP/IP;

- b) all sign controller software versions (including the version of TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices) must be compatible with STREAMS;
- c) sign controllers must be accessible over the TCP/IP network via a webpage or GUI using:
  - i) secure protocols; and
  - ii) user authentication;
- d) where a sign controller is to be connected to a STREAMS compatible field processor and the sign controller is not co-located with the field processor in the same cabinet or enclosure, optic fibre connections must be utilised between the sign controller and the field processor;
- e) sign controllers must be of modular construction to allow field replacement of major modules without the need for special tools;
- f) sign controllers must be capable of installation within a standard 19" rack-based cabinet;
- g) sign controllers must not be housed within a sign enclosure unless the following requirements are satisfied:
  - i) the sign enclosure must be in a location which:
    - A. is easily and safely accessible; and
    - B. supports:
      - I. maintenance activities; and
      - II. the connection of a personal computer or other diagnostic device;
  - ii) the sign controller must be equipped with a facility switch located in a ground level, roadside sign cabinet or enclosure; and
  - iii) the sign controller must be designed such that it may be easily relocated to a separate ground level, roadside sign cabinet or enclosure where desired, including the reinstatement of all connections;
- h) the sign controller communications software must be capable of operating at all possible connection or serial port speeds;
- i) the sign controller must provide a user-configurable message hierarchy for message selection commands and hardwired inputs; and
- j) in the event of complete power failure (including mains power and also backup power) (refer to clause 3.3.6), the sign controller must be able to:
  - i) perform automatic clearing of the sign display on power failure; and
  - ii) retain all programming information in the sign controller (on-site).

### 3.7 Communications protocol

The Contractor must ensure that the communications protocol used to communicate with the signs satisfy the following requirements:

- a) the communications protocol used to communicate with the signs must:
  - i) comply with the Reference Documents, including TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices; and
  - ii) be capable of being modified via a software update;
- b) all signs must be interoperable with STREAMS;
- c) each sign must be individually addressable; and
- d) the Contractor must:

- i) provide facilities for control and diagnostics of the signs via a personal computer utilising an industry standard connection to the sign or sign controller; and
- ii) supply all control and diagnostic software which is compatible with a personal computer using a current Windows operating system.

### 3.8 Wireless communications

Unless otherwise specified in the Contract Documents, the Contractor must ensure that signs are not operated on wireless communications.

### 3.9 Fall-back operation

- a) In the event of communications loss to the signs, the Contractor must ensure that the signs are capable of operating in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, with the configurable time-out duration pre-set to:
  - i) 10 seconds for VLS and LUMS signs; and
  - ii) 60 seconds for all signs except VLS and LUMS signs.
- b) In the event of communications loss to the signs, the signs must log a communications timeout event in accordance with section 3.5.

### 3.10 Sign groups

- a) Where signs are provided in groups, each set of signs must have a uniform display, including:
  - i) brightness; and
  - ii) synchronised flash rate (where applicable).
- b) The Contractor must ensure that it allows for a cable run distance between each sign in the group of:
  - i) that distance specified in the Contract Documents; or
  - ii) where the Contract Documents do not specify a required cable run distance, at least 200 m.
- c) The Contractor must submit evidence of compliance with sections 3.10a) and 3.10b), as part of the Quality Management Records.

### 3.11 Environmental requirements

- a) The Contractor must ensure that the signs satisfy the following environmental requirements:
  - i) signs must be supplied to operate correctly and safely when subjected to the following conditions:
    - A. ambient air temperature in the range of -15°C and +55°C with the sign and any associated cabinets finished in the colours specified;
    - B. locations ranging from full shade to full sunlight;
    - C. relative humidity in the range from 0% to 95%;
    - D. design wind speeds applicable for the region which the sign is intended to be used (refer AS 4852.1 Variable message signs, Part 1: Fixed signs, clause 7.3 for further detail); and
    - E. low frequency vibration and variations in air pressure and air velocity induced by passing traffic and wind, including any increased wind velocity and vibration for signs to be located inside Tunnels as a result of tunnel ventilation systems; and
  - ii) the IP rating of each sign must be suitable for the location and environment at which the sign is to be installed and, at a minimum, satisfy the following:



- A. for sign enclosures, an ingress protection rating of IP65 must be achieved in accordance with the requirements of AS 60529 Degrees of protection provided by enclosures (IP Code);
  - B. where signs are specified for use in a Tunnel environment, an ingress protection rating of IP66 must be achieved in accordance with the requirements of AS 60529 Degrees of protection provided by enclosures (IP Code); and
  - C. for roadside cabinets, an ingress protection rating of IP45 must be achieved in accordance with the requirements of AS 60529 Degrees of protection provided by enclosures (IP Code).
- b) The Contractor must arrange for independent testing of the IP rating for a sample of sign and cabinet enclosures with all external mounting and fittings attached (one test for each type of enclosure) and provide the independent test reports as part of the Quality Management Records.

### 3.12 Sign performance

As part of the Quality Management Records, the Contractor must provide evidence of compliance that the signs meet the requirements of this Master Specification Part with regard to:

- a) durability;
- b) interoperability with STREAMS; and
- c) optical performance.

## 4 Design Life requirements

The Contractor must ensure that the Design Life of all signs complies with the Design Life requirements set out in RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)" and also relevant Australian standards (whichever states the greatest Design Life), including with respect to:

- a) electronic components;
- b) display elements; and
- c) cabinets and enclosures.

## 5 Maintainability

The Contractor must ensure that the following maintainability requirements are achieved with respect to the signs:

- a) all cabinets associated with the signs are accessible from ground height without the use of a ladder;
- b) if the sign is provided with a facility switch, that the switch is located within the cabinet;
- c) all cabinet doors must be fitted with semi flush diecast aluminium swing handle locks and 3-point locking bars;
- d) swing handle locks must be capable of accepting a padlock with a 10 mm clasp;
- e) cabinets can be either standalone or pole mounted, depending on each installation's individual requirements;
- f) all field cabinets must be fitted with hinged doors to allow the ease of access to all equipment connection. Rear doors must be provided if any equipment is rear connected;
- g) a service access mount (ladder) and platform must be provided to support maintenance access to all Type C and Type B VMS (as defined in AS 4852.1 Variable message signs, Part 1: Fixed signs); and
- h) all service access platforms which support maintenance access to the signs must:

- i) provide a safe working environment for maintenance staff;
- ii) mitigate the risk of objects falling onto traffic;
- iii) be secured, to:
  - A. limit opportunities for unauthorised access, including people climbing any part of the service access platform; and
  - B. prevent unauthorised access to the signs;
- iv) include a gate and hoist arm to facilitate the retrieval of unconscious or injured personnel; and
- v) be safely accessible by authorised personnel without the need for lane closures or other traffic restrictions.

## 6 Testing and commissioning

Testing and commissioning of the electronic signs must comply with the requirements of:

- a) RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”;
  - b) RD-ITS-C1 “Installation and Integration of ITS Equipment”; and
  - c) PC-CN1 “Testing and Commissioning”.
-

## 7 Appendix 1: Variable message signs (VMS)

### 7.1 General

Unless otherwise specified in this Master Specification Part, the Contractor must ensure that all VMS comply with the requirements set out in AS 4852.1 Variable message signs, Part 1: Fixed signs.

### 7.2 Mechanical requirements

#### 7.2.1 VMS enclosure

The Contractor must ensure that all VMS enclosures comply with the following:

- a) all external metal sections of the VMS enclosure must be suitably treated in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- b) all VMS enclosure access doors must be hinged left or right in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

#### 7.2.2 Roadside cabinet

The Contractor must ensure that all VMS roadside cabinets comply with the following:

- a) a roadside cabinet must be provided to house the sign controller for each VMS;
- b) the roadside cabinet required by section 7.2.2a) must satisfy the requirements of:
  - i) RD-ITS-S3 "ITS Enclosures"; and
  - ii) AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) a facility switch must be provided for each VMS; and
- d) the facility switch required by section 7.2.2c) must be located within the VMS roadside cabinet in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

#### 7.2.3 Facility switch

The Contractor must ensure that all VMS facility switches comply with the following:

- a) a facility switch must be provided within the sign controller housing for local, on-site, control of the VMS message display mode, in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- b) the VMS display must operate in response to the position of the facility switch, in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

#### 7.2.4 Access platform

- a) The Contractor must ensure that all Type A, B and C VMS (as defined in AS 4852.1 Variable message signs, Part 1: Fixed signs) are fitted with rear-mounted service access platforms which comply with the following:
  - i) all VMS must incorporate a service access platform that provides a safe working environment for maintenance staff;
  - ii) the service access platform must be designed to limit opportunities for unauthorised access to any part of the structure, and access must be secured to prevent unauthorised access to the sign;
  - iii) the service access platform must be designed to minimise the risk of any sign components or tools falling through the platform when maintenance is being performed; and
  - iv) the service platform must include a gate and hoist arm to facilitate the retrieval of unconscious or injured personnel.

- b) All Type B and Type C VMS must have access ladders which are appropriately secured to prevent unauthorised access to the platform.

## 7.3 Electrical requirements

### 7.3.1 General

The Contractor must ensure that the test report, required by section 3.3.4, includes power consumption for the VMS displaying "Report Traffic Incidents":

- a) in yellow text;
- b) over 2 lines; and
- c) at maximum illumination (dimming level 16).

### 7.3.2 Back-up power supply

- a) The Contractor must ensure that the back-up power supply system to be provided with each VMS in accordance with section 3.3.5 provides the capacity to operate the VMS:
  - i) in 4 colours; and
  - ii) without the sign blanking when transitioning from mains to backup power, irrespective of the displayed message.
- b) For the purposes of calculating the backup power supply system reserve time only, the calculation may assume that the message to be displayed for 4 hours is a monochrome message using only yellow, with 50% of the pixels illuminated at 100% intensity.

## 7.4 Display and optical requirements

### 7.4.1 VMS display

- a) VMS displays must conform with the requirements set out in Table RD-ITS-S4 7-1.
- b) The Contractor must ensure that the VMS displays are coloured and comply with the following:
  - i) the VMS display must:
    - A. comprise a series of pixels forming a colour dot-matrix display system on a matte black background, with colours conforming to the display colour boundaries compliant with AS4852.1 Variable message signs, Part 1: Fixed signs;
    - B. be capable of displaying pictograms;
    - C. include uppercase and lowercase alphanumeric characters or a combination of both;
    - D. have sufficient UV ray inhibitors to last the duration of the Design Life of the VMS display (including pixels);
    - E. be capable of displaying the characters and messages in accordance with the requirements of Department Operational Instruction 2.36 Use of Variable Message Signs; and
    - F. fully comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs;
  - ii) the VMS display must consist of modules of a size capable of being removed and installed by hand via the VMS enclosure's access door;
  - iii) access to the VMS display must be maintained whilst the VMS is mounted on a suitable support structure;
  - iv) the construction and layout of the VMS enclosure, framework and electronic driver networks must facilitate ongoing access in accordance with this section 7;

- v) pixels must be monitored and pixel failures must be managed and reported in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- vi) to allow for degradation, the Contractor must ensure that:
  - A. LEDs provide the required luminous output without the need to drive them beyond 70% of the manufacturer's device ratings (power and thermal ratings); and
  - B. the pixels do not degrade by more than 30% of their original light output over the Design Life of the VMS as specified in RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)".

**Table RD-ITS-S4 7-1 VMS variants display dimensional requirements**

VMS sign type	A	B	C
Minimum character height (mm) <sup>(1)</sup>	200	320	400
Number of lines	3	3	3
Characters per line	18	18	18
Character minimum pixel resolution (WxH)	10 x 14	10 x 14	10 x 14
Minimum pixel resolution (WxH)	248 x 58	248 x 58	248 x 58
Minimum luminous intensity half-angle degrees	15	15	7.5 or 15 <sup>(2)</sup>

**Table notes:**

(1) Character proportions must comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, clause 5.1.2.1.

(2) Subject to sightline analysis to meet a 6.2 second viewing time requirement.

**7.4.2 VMS dimming control**

The Contractor must ensure that the VMS is capable of dimming control in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

**7.4.3 Conspicuity devices**

The Contractor must ensure that Type B and Type C VMS are provided with conspicuity devices in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

**7.4.4 Optical requirements**

The Contractor must ensure that the colour of the VMS displays satisfy the following requirements:

- a) the VMS must meet the chromaticity and optical requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs;
- b) colours of the VMS displays must be generated by the use of:
  - i) 4-colour LEDs; or
  - ii) red-green-blue (RGB) LEDs as shown in AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) where red-green-blue (RGB) LED technology is used, the LEDs must be:
  - i) single package 3-chip LEDs; and
  - ii) filtered through a lens or optical system:
    - A. to provide the observer with a single pixel to view; and
    - B. that produces a true colour without visibility of the individual LEDs used to generate the colour pixel; and
- d) where colour LEDs are used:
  - i) the LEDs must have a service life rated not less than 10 years as specified in AS 4852.1 Variable message signs, Part 1: Fixed signs; and

- ii) during the service life of the LEDs, degradation of any single LED must not cause the displayed colour to shift outside of the chromaticity coordinates specified in AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 7.5 Operation and control

### 7.5.1 General

The Contractor must ensure that all VMS comply with the following:

- a) the current operating mode of the VMS must be reported by the sign controller via STREAMS; and
- b) the VMS must be capable of:
  - i) supporting the writing of at least 900 messages per day; and
  - ii) displaying updated messages every 2 minutes.

### 7.5.2 Sign controller

The Contractor must ensure that all VMS sign controllers comply with the following requirements:

- a) a sign controller must be provided for each VMS; and
- b) the sign controller must include the following functions in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs:
  - i) monitor, log and report its own operation and status;
  - ii) store logs and up to 255 frames in its non-volatile memory;
  - iii) allow local automatic reset of the VMS display and the sign controller itself, such as via watchdogs;
  - iv) feature inputs for interfacing to other devices, including radar or over height vehicle detectors to activate the VMS display; and
  - v) be capable of automatically dimming the VMS based on the average of the light sensing detectors required by section 3.4b).

### 7.5.3 Communications protocol

- a) The Contractor must ensure that the VMS communications protocol is capable of representing the following as one sign in STREAMS:
  - i) full (4) colour sign;
  - ii) colour pictogram; and
  - iii) text display.
- b) The VMS communications protocol required by section 7.5.3a) must be achieved using the appropriate version of the communication protocol as detailed in TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices.

### 7.5.4 Display changes

The Contractor must ensure that all VMS display changes, including display changes due to external inputs, function in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 7.6 Environmental requirements

The Contractor must ensure that the VMS and their associated support structures comply with the requirements for wind loading in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs.



## 7.7 Factory Acceptance Testing (FAT)

- a) In addition to the requirements of section 6, the Contractor must ensure that the VMS comply with the following Factory Acceptance Testing (FAT) requirements:
  - i) the FAT must include all performance parameters that can be tested under laboratory or factory conditions to demonstrate that each VMS complies with the requirements of:
    - A. this Master Specification Part; and
    - B. AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - ii) the optical performance of each VMS must be:
    - A. determined by measurement under laboratory conditions of the:
      - I. minimum luminance ratio; and
      - II. minimum and maximum luminance for the 5 sign illuminance levels listed in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
    - B. tested in accordance with the photometric test procedures defined in AS 4852.1 Variable message signs, Part 1: Fixed signs.
- b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that the VMS satisfy the requirements of this section 7.7, as part of the Quality Management Records.

## 8 Appendix 2: Variable speed limit signs (VSLS) / lane use management system (LUMS) signs

### 8.1 General

Unless otherwise specified in this Master Specification Part, the Contractor must ensure that:

- a) VSLS, also referred to as electronic speed limit signs, comply with the relevant sections of AS 5156 Electronic speed limit signs; and
- b) LUMS signs, used as part of a LUMS comply with the relevant sections of AS 5156 Electronic speed limit signs.

### 8.2 Mechanical requirements

#### 8.2.1 VSLS and LUMS sign enclosures

The Contractor must ensure that all VSLS enclosures and all LUMS sign enclosures comply with the following:

- a) the sign enclosures must comply with the requirements of AS 5156 Electronic speed limit signs; and
- b) the sign enclosures must support the VSLS or the LUMS sign (as applicable) being hot swappable without requiring reconfiguration of the sign in the field.

#### 8.2.2 Sign mounting facilities

The Contractor must ensure that all VSLS mounting facilities and all LUMS sign mounting facilities comply with the following:

- a) each sign must be provided with a mounting arrangement which facilitates quick changeover of the relevant sign itself;
- b) the mounting base, required in section 8.2.2a), must:
  - i) include mounting and fixing hardware that permits quick unmounting and mounting without the need for tools; and
  - ii) facilitate the mounting and unmounting of the sign enclosure to be completed within 5 minutes by a single person;
- c) the sign enclosures must have a restraining mechanism, such as a tether, which prevents the sign enclosure from being detached from the mounting base and struck by traffic, in the event of the sign mounting structure being hit by a vehicle;
- d) the mounting base and any ancillary equipment must be free from sharp corners, edges, and protrusions, which may cause injury to personnel or damage to sign components during installation and removal from the mounting base;
- e) the mounting base must include the following features, as a minimum:
  - i) the mounting base must be able to be fixed to gantries, support structures, and suitable poles or pedestals;
  - ii) the mounting base must incorporate the means for adjusting the angle of the mounted sign:
    - A. during installation and commissioning; and
    - B. after installation,to ensure the correct line of sight;
  - iii) the mounting base must contain the address associated with the attached sign to enable swapping of the sign without communication configuration or specific sign setting configuration being required;

- iv) the mounting base must include quick disconnect and re-connect cable couplings for both power and communication cables; and
- v) there must only be one power cable and one communication cable (excluding any tether cable used as a restraining mechanism pursuant to section 8.2.2c);
- f) loose fasteners must not be used during quick installation or removal of the sign to, or from the mounting system;
- g) the communication and power cable couplings must be tool-less and free of any physically separable fastening components; and
- h) drainage must be provided in the mounting base to prevent the build-up of moisture within the mounting base.

### 8.2.3 Roadside cabinet

The Contractor must ensure that all VSLS roadside cabinets and all LUMS sign roadside cabinets comply with the following:

- a) for signs to be installed outside of a Tunnel, the sign controller for each group of signs must be housed within a roadside cabinet which complies with the requirements of:
  - i) RD-ITS-S3 “ITS Enclosures”; and
  - ii) AS 5156 Electronic speed limit signs; and
- b) for signs to be installed inside a Tunnel, the sign controller for each group of signs must be housed within a roadside cabinet which complies with the requirements of:
  - i) TUN-ME-DC4 “Tunnel Equipment Cabinets”; and
  - ii) AS 5156 Electronic speed limit signs.

### 8.2.4 Facility switch

Facility switches are required for VSLS and LUMS signs.

## 8.3 Electrical requirements

### 8.3.1 General

The Contractor must ensure that:

- a) all VSLS and LUMS signs comply with the electrical requirements of AS 5156 Electronic speed limit signs; and
- b) the test report detailed in section 3.3.4, includes power consumption of a set of VSLS and LUMS signs and a group controller with 4 signs connected to a group controller, with each sign:
  - i) displaying “100” (km/h);
  - ii) with a fully illuminated non-flashing annulus; and
  - iii) at maximum illumination.

### 8.3.2 Back-up power supply

The Contractor must ensure that the back-up power supply system to be provided for each VSLS and LUMS sign in accordance with section 3.3.5, provides the capacity to operate the VSLS or the LUMS sign (as applicable):

- a) displaying “100” (km/h); and
- b) with a fully illuminated annulus at maximum illumination.

## 8.4 Display and optical requirements

### 8.4.1 General

The Contractor must ensure that the VSLS and LUMS signs comply with the following:

- a) signs must comply with the optical requirements of AS 5156 Electronic speed limit signs;
- b) signs must be capable of displaying:
  - i) a 25 km/h speed limit;
  - ii) individual frames and messages;
  - iii) all functions described by:
    - A. TfNSW Specification TSI-SP-003 Communications Protocol for Roadside Devices; and
    - B. VicRoads Specification TCS 060 - VicRoads Extensions to RTA Protocol For Roadside Devices;
- c) the sign display colours must be as follows on a matte black background:
  - i) numerals - white;
  - ii) annulus - red;
  - iii) LUMS arrows - white; and
  - iv) LUMS cross - red; and
- d) the sign displays must include the following:
  - i) the annulus and numeral displays must comply with AS 5156 Electronic speed limit signs;
  - ii) the display must be created using a full matrix of white LEDs located within the annulus;
  - iii) LUMS sign arrow displays must be created using the required LEDs within the matrix, with the end of the arrow and the tip of the arrow extending into the annulus;
  - iv) LUMS sign cross displays must be created using red LEDs located within the matrix area and extend to the outer diameter of the annulus; and
  - v) the matrix must be capable of displaying arrows as follows:
    - A. down arrow;
    - B. left down arrow;
    - C. right down arrow;
    - D. up arrow;
    - E. left up arrow; and
    - F. right up arrow.

### 8.4.2 Display dimensional requirements

The Contractor must ensure that the VSLS and the LUMS signs comply with the following display dimensional requirements:

- a) the signs must comply with the display dimensional requirements of AS 5156 Electronic speed limit signs;
- b) the area used for display of numerals must be capable of displaying white numeral shapes as defined in AS 1744 Standard alphabets for road signs, scaled to the character height; and

- c) the LUMS sign display must be a square region and capable of displaying white over its full area.

#### 8.4.3 Synchronisation of displays

The Contractor must ensure that the VSLS and LUMS signs have provision for the numeric display and annulus to be synchronised with one or more other signs within the group by means of interfacing with a group controller to ensure that:

- a) sign changes which are common to signs within the group (i.e. a speed limit change) are synchronised so that all signs that are required to change their display change at the same time; and
- b) where annuluses in the group are required to flash, all annuluses in the group flash in synchronisation.

#### 8.4.4 Display changes due to external inputs

The Contractor must ensure that the VSLS and the LUMS signs comply with the following requirements regarding display changes:

- a) the group controller must provide a minimum of 3 inputs for external switches for interfacing with external devices in accordance with the requirements of AS 5156 Electronic speed limit signs; and
- b) external inputs must function and operate the signs in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

#### 8.4.5 Sign dimming control

The Contractor must ensure that the VSLS and the LUMS signs are capable of dimming control in accordance with the requirements of AS 5156 Electronic speed limit signs.

#### 8.4.6 Conspicuity devices

- a) The Contractor must ensure that the VSLS and the LUMS signs support a flashing annulus.
- b) Conspicuity devices are not required for VSLS or LUMS signs.

#### 8.4.7 Optical requirements

The Contractor must ensure that the VSLS and the LUMS signs comply with the following optical requirements:

- a) the signs must comply with the optical requirements of AS 5156 Electronic speed limit signs;
- b) the displays of the VSLS and the LUMS signs within the same group must have a uniform appearance; and
- c) the annulus of the signs must:
  - i) be capable of flashing in accordance with of the requirements of AS 5156 Electronic speed limit signs, to indicate the speed limit has been reduced from the nominal speed limit;
  - ii) have an outer ring to be displayed continuously; and
  - iii) flash synchronously with other signs' annulus within the same group.

## 8.5 Operation and control

### 8.5.1 General

The Contractor must ensure that all VSLS and all LUMS signs comply with the operation and control requirements of:

- a) this Master Specification Part; and
- b) AS 5156 Electronic speed limit signs.

### 8.5.2 Sign group controller

The Contractor must ensure that all VSLS and LUMS sign group controllers comply with the following requirements:

- a) a sign group controller must be provided for each group of VSLS and LUMS signs, where:
  - i) the relevant group of signs are facing the same carriageway, including on-ramps; and
  - ii) in the same direction of travel;
- b) depending on the road design and where required by the Contract Documents, where LUMS signs are provided on the main line and also at the same location on an on-ramp, a separate group controller will be required for the on-ramp LUMS sign;
- c) the sign group controller must, as a minimum:
  - i) be capable of programming, monitoring and controlling at least 6 physically connected signs;
  - ii) be capable of configuring the number of signs assigned to each group;
  - iii) support a sign ID to identify that correct signs are connected to the correct ports at the sign group controller;
  - iv) blank all sign displays and flag an alarm in STREAMS if an incorrect sign ID is detected;
  - v) command signs to display only the permissible frame combinations for that respective sign location;
  - vi) allow local automatic reset of sign displays and the sign group controller itself, e.g., via watchdogs;
  - vii) be capable of dimming connected signs based on the average of the light sensor outputs from each sign;
  - viii) accept valid commands; and
  - ix) reject invalid commands;
- d) all signs and their relevant sign group controllers must be individually addressable;
- e) the sign group controller must control the relevant signs such that displays within the same group must change their displays simultaneously in response to a demanded change;
- f) for VSLS, the sign group controller must display all signs within the same group showing the same speed limit;
- g) for LUMS signs, the sign group controller must limit displays within the same group to one of the following combinations of displays:
  - i) all displays showing the same speed limit;
  - ii) some displays showing the same speed limit, and other displays showing lane use signals; or
  - iii) displays showing lane use signals;
- h) in the event the sign group controller determines that there is a critical fault on one or more displays, the sign group controller must force all displays within the same group to blank; and
- i) for the purposes of section 8.5.2h), critical faults are to be determined and reported in accordance with AS 5156 Electronic speed limit signs, whereby the sign is blanked, including:
  - i) pixel failure exceeding the threshold value;
  - ii) loss of communications exceeding the threshold time-out period; or
  - iii) sign processor fault.



### 8.5.3 Monitoring, fault logging and reporting

The Contractor must ensure that all VSLS and all LUMS signs comply with the following monitoring, fault logging and reporting requirements:

- a) the sign group controllers must be capable of monitoring and fault logging in accordance with section 6.6 of AS 5156 Electronic speed limit signs;
- b) each sign in a group must be capable of being monitored on an individual basis, including:
  - i) fault monitoring; and
  - ii) display monitoring;
- c) in addition to the monitoring and fault logging requirements described in AS 5156 Electronic speed limit signs, the Contractor must ensure that the sign group controller is capable of monitoring and fault logging the following:
  - i) the sign group controller must:
    - A. log all operational and fault events in non-volatile memory; and
    - B. have not less than 255 entries each for operational events and fault events;
  - ii) the sign group controller and signs must monitor the state of their respective processors and blank the respective displays if a processor failure occurs;
  - iii) the sign must be able to detect LED failure, even if the LEDs may be required to be off at the time of the periodic check;
  - iv) pixel failures must be managed in accordance with AS 5156 Electronic speed limit signs;
  - v) the sign group controller must immediately blank the relevant signs and re-transmit the respective frames to be displayed:
    - A. upon establishing connection to the signs;
    - B. upon power up; and
    - C. after a power failure;
  - vi) on power restoration, signs must become available for activation and remain blank until commanded by the sign group controller; and
  - vii) at no time must partial or incomplete frames be displayed.

### 8.5.4 Fall-back operation

The Contractor must ensure that in the event of communications loss, VSLS and LUMS signs operate in accordance with AS 5156 Electronic speed limit signs, with the configurable time-out duration pre-set to 60 seconds.

## 8.6 Environmental requirements

The Contractor must ensure that the VSLS and the LUMS signs and their associated mounting facilities comply with the following environmental requirements:

- a) the IP rating for the VSLS and LUMS sign enclosures must be suitable for the location and environment at which the sign enclosures are to be installed:
  - i) for signs to be installed outside a Tunnel, the IP rating must be in accordance with the requirements of AS 5156 Electronic speed limit signs; and
  - ii) for signs to be installed inside a Tunnel, the signs must achieve an IP rating of at least IP66, in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code);
- b) the VSLS and the LUMS sign (as applicable) and the associated mounting facilities must comply with the following wind loading requirements:

- i) for signs to be installed outside a Tunnel, the requirements of AS 5156 Electronic speed limit signs, including clause 7.3, must be satisfied; and
- ii) for signs to be installed inside a Tunnel, the requirements for wind loading from the Tunnel ventilation system must be satisfied; and
- c) the VSLS, LUMS signs and associate equipment must comply with the requirements for vibration in accordance with AS 5156 Electronic speed limit signs, including any increased vibration for VSLS and LUMS signs to be located inside Tunnels as a result of tunnel ventilation systems.

## 8.7 Factory Acceptance Testing (FAT)

- a) In addition to the requirements of section 6, the Contractor must ensure that the VSLS and the LUMS signs comply with the following FAT requirements:
  - i) the FAT must include all performance parameters that can be tested under laboratory or factory conditions to demonstrate that each VSLS and LUMS sign complies with the requirements of:
    - A. this Master Specification Part; and
    - B. AS 5156 Electronic speed limit signs; and
  - ii) the optical performance of each VSLS and LUMS sign must be:
    - A. determined by measurement under laboratory conditions of the:
      - I. minimum luminance ratio; and
      - II. minimum and maximum luminance for the 5 sign illuminance levels listed in AS 5156 Electronic speed limit signs; and
    - B. tested in accordance with the photometric test procedures defined in AS 5156 Electronic speed limit signs.
- b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that the VSLS and LUMS signs satisfy the requirements of this section 8.7, as part of the Quality Management Records.

## 9 Appendix 3: Changeable message signs (CMS)

### 9.1 General

The Contractor must ensure that all CMS allow for any number of pre-determined messages, including blanks, to be displayed to drivers.

### 9.2 Mechanical requirements

#### 9.2.1 Display unit

The Contractor must ensure that all CMS display units comply with the following:

- a) the CMS display unit must:
  - i) include a non-reflective black sign background board; and
  - ii) be coloured matte black on the exterior and interior of the display unit;
- b) the CMS display unit must be constructed from:
  - i) marine grade aluminium alloy 5052 H32 or 5251 H32 in accordance with AS/NZS 1734 Aluminium and aluminium alloys - Flat sheet, coiled sheet and plate; or
  - ii) stainless steel of grade 316 or 321;
- c) the CMS display unit must be suitably:
  - i) reinforced;
  - ii) braced; or
  - iii) both reinforced and braced,  
to facilitate the erection and continued operation of the CMS in its intended operation;
- d) all external metal sections of the CMS display unit must be suitably treated (e.g. polyester powder-coated);
- e) the finish to the surface of the CMS display unit must be capable of maintaining its structural integrity and appearance for a period of not less than 10 years from Completion;
- f) all components used for connection or bracing of the CMS display unit onto the support structure must be manufactured or constructed from corrosion resistant materials, or have corrosion resistant coatings;
- g) all ferrous metal works must be hot-dip galvanized in accordance with AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles;
- h) the CMS display unit must include a lockable left or right-hinged access door on the rear of the CMS display unit to allow clear and ready access to the internal components of the CMS display unit;
- i) the CMS display unit must include a mechanism to inhibit the build-up of moisture due to condensation;
- j) the CMS display unit must provide at least one temperature sensor to measure the temperature inside the CMS display unit near the top centre; and
- k) the temperature sensor required by section 9.2.1j) must:
  - i) not be mounted directly against the top face of the CMS display unit;
  - ii) enable temperature readings to be available through the use of a protocol message via STREAMS; and
  - iii) measure the temperature in units of degrees centigrade.

### 9.2.2 Sign mounting

The Contractor must ensure that all CMS sign mountings comply with the following:

- a) the CMS display unit must allow for:
  - i) front mounting;
  - ii) rear mounting; or
  - iii) bottom mounting,as shown in the Design Documentation; and
- b) the CMS display unit and sign mounting must comply with the design load requirements of:
  - i) AS/NZS 1170.1 Structural design actions, Part 1: Permanent, imposed and other actions; and
  - ii) AS/NZS 1170.2 Structural design actions, Part 2: Wind actions.

### 9.2.3 Facility switch

The Contractor must ensure that all CMS are fitted with facility switches.

### 9.2.4 Lifting and transportation points

Where the CMS display unit is not capable of being manually lifted and held by a single person (within WHS limits) during installation, the Contractor must ensure that:

- a) lifting anchors are provided on the display unit;
- b) the lifting anchors are integral with the display unit, preventing moisture ingress into the display unit; and
- c) seals around the lifting anchors are not used.

## 9.3 Electrical requirements

### 9.3.1 General

- a) The Contractor must ensure that all cables and wires associated with the CMS are:
  - i) insulated with a material not inferior to V-90 grade PVC; and
  - ii) suitably labelled.
- b) The Contractor must ensure that the test report required by section 3.3.4 includes power consumption for the CMS:
  - i) displaying the highest power consumption message within its message; and
  - ii) set at maximum illumination.

### 9.3.2 Back-up power supply

The Contractor must ensure that the back-up power supply system to be provided with each CMS in accordance with section 3.3.5 provides the capacity to operate the CMS:

- a) whilst displaying the message with the highest number of pixels; and
- b) at maximum illumination.

## 9.4 Display and optical requirements

### 9.4.1 General

The Contractor must ensure that all CMS displays comply with the following:

- a) the CMS display unit must contain one or more display elements, combinations of which are activated to present a complete message sign face to the motorist;

- b) active display elements, including messages and the conspicuity devices, must be lit with the luminance and luminance ratio in compliance with AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) the colour of the display elements, including messages and the conspicuity devices, must:
  - i) lie within the applicable region specified by the chromaticity coordinates in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - ii) be tested in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- d) inactive display elements must remain unlit and appear to be the same colour as the CMS background board.

#### 9.4.2 Display messages

The Contractor must ensure that all CMS display messages comply with the following:

- a) the number of pre-determined messages to be displayed on the CMS must be in accordance with the Design Documentation;
- b) each message, unless a blank message, must be formed by LED pixels preformed into the message; and
- c) the CMS default message must be as shown in the Design Documentation.

#### 9.4.3 Conspicuity devices

Separate conspicuity devices are required for CMS.

#### 9.4.4 Sign dimming control

The Contractor must ensure that the CMS satisfy the following sign dimming control requirements:

- a) a total of 16 dimming levels must be provided, where:
  - i) dimming level 1 is the minimum intensity output; and
  - ii) dimming level 16 is the maximum intensity output;
- b) the dimming control algorithm must not permit sudden changes in the output intensity;
- c) the CMS display unit must take a minimum of 5 seconds and a maximum of 15 seconds to transition from one dimming level to the next in either direction; and
- d) the relationship between luminance level and dimming levels must be in accordance with of the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

### 9.5 Operation and control

#### 9.5.1 General

The Contractor must ensure that the CMS comply with the following requirements:

- a) the CMS must be capable of being monitored and controlled both locally and remotely via STREAMS;
- b) the CMS must be capable of being operated in the following order of priority:
  - i) local facility switch;
  - ii) external inputs;
  - iii) maintenance communications port; and
  - iv) control communications port;
- c) the maintenance communications port must allow a personal computer to physically connect to the CMS sign controller to control the display unit and view the logs on site; and

- d) any required cables or software must be supplied by the Contractor.

### 9.5.2 Sign controller

The Contractor must ensure that all CMS sign controllers:

- a) provide a real-time clock in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- b) include the following additional functions:
  - i) the sign controller must allow for automatic synchronisation with a remote network time protocol time server;
  - ii) the sign controller must provide automatic updates to the real-time clock for daylight-saving related time changes;
  - iii) the sign controller must provide user configurable settings for the dates and times to change from standard time to daylight saving time, and vice versa, as follows:
    - A. start of daylight-saving time - at 0200 hr on the first Sunday in October; and
    - B. end of daylight-saving time - at 0300 hr on the first Sunday in April; and
  - iv) the sign controller must log all time updates and changes.

### 9.5.3 Monitoring, fault logging and reporting

The Contractor must ensure that the CMS comply with the following monitoring, fault logging, and reporting requirements:

- a) the CMS sign controller must provide non-volatile memory for all of its configuration settings, logs, and other data that requires to be preserved when power is lost, or the CMS is off;
- b) the non-volatile memory required by section 9.5.3a) must accommodate no fewer than 255 entries for each CMS:
  - i) fault log;
  - ii) alarm log; and
  - iii) event log;
- c) the CMS must allow for local and remote status monitoring of all monitoring, fault logging and reporting requirements of this Master Specification Part; and
- d) pixel failures must be managed in accordance with AS 4852.1 Variable message signs part 1: Fixed signs.

### 9.5.4 Display changes due to external inputs

The Contractor must ensure that all CMS comply with the following display requirements:

- a) the CMS sign controller must provide inputs for interfacing with external devices, with one input corresponding with each non-blank sign face supported by the CMS; and
- b) all CMS display changes due to external inputs must function in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 9.6 Factory Acceptance Testing (FAT)

In addition to the requirements of section 6, the Contractor must ensure that the CMS comply with the following FAT requirements:

- a) the optical performance of the CMS must be:
  - i) determined by measurement under laboratory conditions of the:
    - A. minimum luminance ratio; and

- B. minimum and maximum luminance for the 5 sign illuminance levels listed in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- ii) tested in accordance with the photometric test procedures defined in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- b) the Contractor must submit evidence of compliance from a NATA accredited testing facility that the CMS satisfy the requirements of this section 9.6, as part of the Quality Management Records.

## 10 Appendix 4: Single Line VMS

### 10.1 General

- a) Unless otherwise specified in this Master Specification Part, the Contractor must ensure that all Single Line VMS comply with the requirements set out in AS 4852.1 Variable message signs, Part 1: Fixed signs.
- b) The Contractor must ensure that:
  - i) each Single Line VMS is capable of being configured as one sign within STREAMS; and
  - ii) the Single Line VMS support the easy and rapid replacement of all internal components or display modules without the requirement for reconfiguring.

### 10.2 Mechanical requirements

#### 10.2.1 Sign enclosure

The Contractor must ensure that all Single Line VMS access doors are hinged at the top.

#### 10.2.2 Double-socket outlet

A double-socket outlet is not required within the Single Line VMS enclosure.

#### 10.2.3 Roadside cabinet

- a) Single Line VMS do not require the provision of roadside cabinets.
- b) The Contractor must ensure that control and power equipment for Single Line VMS:
  - i) is located in shared ITS cabinets located within the Tunnel egress passageways; and
  - ii) comply with the requirements of TUN-ME-DC4 "Tunnel Equipment Cabinets".

#### 10.2.4 Facility switch

- a) The Contractor must ensure that all Single Line VMS include facility switches.
- b) The Contractor must ensure that the facility switches required in section 10.2.4a) comply with the following:
  - i) a facility switch must be provided within the cabinet which houses the Single Line VMS sign controller for override of the Single Line VMS message display mode in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - ii) the Single Line VMS sign display must operate in response to the position of the facility switch in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs.

### 10.3 Electrical requirements

The Contractor must ensure that the test report required by section 3.3.4 includes the power consumption for the Single Line VMS:

- a) displaying "report incidents";
- b) at dimming level 16; and
- c) at dimming level 1.

### 10.4 Display and optical requirements

#### 10.4.1 Sign display

- a) Single Line VMS sign displays must conform with the requirements set out in Table RD-ITS-S4 10-1. The Contractor must ensure that the Single Line VMS displays comply with the following:



- i) the Single Line VMS display must comprise a series of pixels forming a dot-matrix display system;
- ii) a “full matrix” configuration must only allow the display of upper and lower alphanumeric characters;
- iii) the Single Line VMS display must:
  - A. comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - B. be capable of displaying characters and messages in accordance with the requirements of Department Operational Instruction 2.36 Use of Variable Message Signs;
- iv) the number of lines for the Single Line VMS display must be one;
- v) the Single Line VMS sign display must be colour LED text on a matte black background;
- vi) the Single Line VMS display must consist of modules of a size capable of being removed and installed by hand via the Single Line VMS enclosure’s access doors;
- vii) access to the Single Line VMS display must be maintained whilst the Single Line VMS is mounted on a suitable support structure;
- viii) the construction and layout of the Single Line VMS enclosure, framework and electronic driver networks must facilitate ongoing access;
- ix) pixels must be monitored and pixel failures must be managed and reported in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- x) to allow for degradation, the Contractor must ensure that:
  - A. LEDs provide the required luminous output without the need to drive them beyond 70% of the manufacturer’s device ratings (power and thermal ratings); and
  - B. the pixels do not degrade below 30% of its original light output over the Design Life of the Single Line VMS as specified in RD-ITS-D1 “Design of Intelligent Transport Systems (ITS)”.

**Table RD-ITS-S4 10-1 Single Line VMS display dimensional requirements**

VMS sign type	Single line VMS
Minimum character height (mm) <sup>(1)</sup>	320
Number of lines	1
Characters per line	18
Character minimum pixel resolution (W x H)	10 x 14
Minimum pixel resolution (W x H)	248 x 18
Minimum luminous intensity half-angle degrees	15

**Table notes:**

(1) Character proportions must comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, clause 5.1.2.1.

#### 10.4.2 Sign dimming control

The Contractor must ensure that Single Line VMS are capable of dimming control to vary the LED intensity of the Single Line VMS display to suit the ambient lighting conditions in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs.

#### 10.4.3 Conspicuity devices

Separate conspicuity devices are not required for Single Line VMS.

#### 10.4.4 Optical requirements

The Contractor must ensure that the Single Line VMS comply with the following optical requirements:

- a) each colour of the Single Line VMS display must meet the chromaticity and optical requirements AS 4852.1 Variable message signs, Part 1: Fixed signs;
- b) colours of the Single Line VMS display must be generated by the use of:
  - i) 4-colour LEDs; or
  - ii) red-green-blue (RGB) LEDs as shown in AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) where red-green-blue (RGB) LED technology is used, the LEDs must be:
  - i) single package 3-chip LEDs; and
  - ii) filtered through a lens or optical system:
    - A. to provide the observer with a single pixel to view; and
    - B. that produces a true colour without visibility of the individual LEDs used to generate the colour pixel; and
- d) where colour LEDs are used:
  - i) they must have a service life rated not fewer than 10 years as specified in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - ii) during the service life of the LEDs, degradation of any single LED must not cause the displayed colour to shift outside of the chromaticity coordinates specified AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 10.5 Operation and control

### 10.5.1 General

- a) The Contractor must ensure that the Single Line VMS:
  - i) are capable of being controlled by STREAMS; and
  - ii) comply with the operation and control requirements of:
    - A. this Master Specification Part; and
    - B. AS 4852.1 Variable message signs, Part 1: Fixed signs.
- b) The Contractor must ensure that the Single Line VMS are capable of:
  - i) supporting the writing of at least 900 messages per day; and
  - ii) displaying updated messages every 2 minutes.

### 10.5.2 Sign controller

The Contractor must ensure that the Single Line VMS sign controllers comply with the following:

- a) a sign controller must be provided for each Single Line VMS; and
- b) the sign controller must include the following functions in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs:
  - i) monitor, log and report its own operation and status;
  - ii) store logs and up to 255 frames in its non-volatile memory;
  - iii) allow local automatic reset of the Single Line VMS display and the sign controller itself such as via watchdogs; and
  - iv) be capable of automatically dimming the Single Line VMS based on the average of the light sensing detectors required by section 3.4b).

### 10.5.3 Display changes

The Contractor must ensure that display changes of the Single Line VMS function in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

### 10.5.4 Monitoring, fault logging and reporting

The Contractor must ensure that the Single Line VMS comply with following monitoring, fault logging and reporting requirements:

- a) the Single Line VMS sign controllers must be capable of monitoring and fault logging in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs;
- b) in addition to the fault types described in AS 4852.1 Variable message signs, Part 1: Fixed signs, the Contractor must ensure that the following fault types are capable of being monitored, logged and reported by the Single Line VMS sign controller:
  - i) requests for operation and status;
  - ii) loss of communication with the field processor;
  - iii) Single Line VMS enclosure temperature;
  - iv) illumination faults; and
  - v) pixel faults;
- c) the Single Line VMS sign controller must:
  - i) continuously background monitor pixel health; and
  - ii) be able to detect LED failure, even if the LEDs may be off at the time of the periodic check;
- d) pixel failures must be managed and reported in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs: and
- e) fault logs must be capable of being stored in non-volatile memory.

## 10.6 Environmental requirements

The Contractor must ensure that the Single Line VMS comply with the following environmental requirements:

- a) the Single Line VMS enclosures must achieve an IP rating of IP65 in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code); and
- b) where specified for Tunnel environments, the Single Line VMS enclosures must achieve an IP rating of IP66 in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code).

## 10.7 Factory Acceptance Testing (FAT)

- a) In addition to the requirements of section 6, the Contractor must ensure that the Single Line VMS comply with the following FAT requirements:
  - i) the FAT must include all performance parameters that can be tested under laboratory or factory conditions to demonstrate that each Single Line VMS complies with the requirements of:
    - A. this Master Specification Part; and
    - B. AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - ii) the optical performance of each Single Line VMS must be:
    - A. determined by measurement under laboratory conditions of the:
      - I. minimum luminance ratio; and

- II. the minimum and maximum luminance for the 5 sign illuminance levels listed AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - B. tested in accordance with the photometric test procedures defined in AS 4852.1 Variable message signs, Part 1: Fixed signs.
- b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that the Single Line VMS satisfy the requirements of this section 10.7, as part of the Quality Management Records.

## 11 Appendix 5: Ramp Control Signs (RC1 / RC2 / RC3)

### 11.1 General

- a) For the purpose of clarity between the application of RC1, RC2 and RC3 signs:
  - i) RC1 signs are ramp control/metering signs typically located near the on-ramp entrance to the motorway to indicate either that the ramp metering signals are in operation, or that the motorway is closed;
  - ii) RC2 signs are ramp metering warning signs, typically located on the start of the on-ramp, to alert motorists that the ramp signals are operating and to be prepared to stop; and
  - iii) RC3 signs are ramp control warning and information signs, typically located at the start of a taper of a turn lane onto a left or right turn ramp, used to indicate that the ramp is closed, or when the ramp is not closed, to provide supplementary traveller time information (travel time, congestion, incidents and/or events).
- b) For the avoidance of doubt, whereas the Principal has formerly used RC3-A signs as travel time information signs and referred to them as “RC3” signs, where this specification refers to RC3 signs, it is referring to the sign function, not the sign size.
- c) For the purposes of this Appendix 5: Ramp Control Signs (RC1 / RC2 / RC3), “sign” or “signs” means RC1, RC2 and RC3 signs.

### 11.2 Mechanical requirements

#### 11.2.1 Sign enclosure

The Contractor must ensure that the sign enclosures comply with the following requirements:

- a) the sign enclosures must be designed such that thermal ratings of the electronics and components housed within the sign enclosure are not exceeded; and
- b) the sign enclosure must include:
  - i) a mechanism to inhibit the build-up of moisture due to condensation; and
  - ii) a lockable left-hinged door on the front face of the enclosure to allow clear and ready access to the internal components.

#### 11.2.2 Sign dimensions

The Contractor must ensure that the sign enclosures have nominal dimensions as shown in Table RD-ITS-S4 11-1.

**Table RD-ITS-S4 11-1 Sign dimensions**

Sign type	Nominal dimensions (mm)
RC1	900 (W) x 600 (H)
RC2	900 (W) x 600 (H)
RC3	1660 (W) x 600 (H) - minimum dimensions

#### 11.2.3 Sign mounting

- a) The Contractor must ensure that the signs allow for rear mounting of the sign enclosure onto a pole as shown in the Design Documentation.
- b) The signs must be capable of being mounted with the pole located at mid-sign.
- c) RC3 signs can be offset-mounted where required to provide better sight-distance, subject to the sign manufacturer undertaking a structural check against the pole size and footing design and confirming suitability of the offset-mounting.

#### 11.2.4 Lifting and transportation points

The Contractor must ensure that where the signs are not capable of being manually lifted and held by a single person (within WHS limits) during installation, the following requirements are complied with:

- a) lifting anchors are provided on the relevant sign enclosure;
- b) the lifting anchors are integral with the sign enclosure, preventing moisture ingress into the sign; and
- c) seals around the lifting anchors are not used.

### 11.3 Electrical requirements

#### 11.3.1 General

- a) The Contractor must ensure that the signs comply with the following:
  - i) all cables and wires must:
    - A. be insulated with a material not inferior to V-90 grade PVC; and
    - B. be suitably labelled.
  - b) The Contractor must ensure that the test report required by section 3.3.4 includes power consumption for the signs:
    - i) displaying:
      - A. "Motorway Closed" for RC1;
      - B. "RAMP SIGNALS ON" for RC2; and
      - C. "Motorway Closed" for RC3; and
    - ii) at maximum illumination.

#### 11.3.2 Back-up power supply

The Contractor must ensure that the back-up power supply to be provided with each sign in accordance with section 3.3.5 and provide the capacity to operate the signs:

- a) displaying:
  - i) the message "RAMP SIGNALS ON" for RC1 and RC2; and
  - ii) 50% of yellow pixels for RC3; and
- b) at maximum illumination.

### 11.4 Display and optical requirements

#### 11.4.1 General

The Contractor must ensure that the signs comply with the following:

- a) the signs must contain one or more display elements, combinations of which are activated to present a complete message sign face to the motorist;
- b) the signs must include a non-reflective black sign background board;
- c) active display elements must be lit with the luminance and luminance ratio in compliance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs;
- d) the colour of the display elements must:
  - i) lie within the applicable region specified by the chromaticity coordinates in AS 4852.1 Variable message signs, Part 1: Fixed signs; and






- ii) be tested in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs, including Appendix D; and
- e) inactive display elements must remain unlit and appear to be the same colour as the sign background board.

#### 11.4.2 RC1 display requirements

The Contractor must ensure that the RC1 signs comply with the following requirements:

- a) RC1 signs must be capable of displaying all messages in accordance with Table RD-ITS-S4 11-2;
- b) the typical pixel placement for each RC1 message must be in accordance with the typical layouts;
- c) each RC1 message must be allocated a frame ID in accordance with Table RD-ITS-S4 11-2;
- d) each RC1 message must be formed by LED pixels preformed into the message;
- e) spacing between the pixel LEDs must not exceed 2 times the diameter of the pixel; and
- f) the symbolic displays "NO RIGHT TURN" and "NO LEFT TURN" must comply with the requirements for R2-6A(L,R) signs in accordance with the requirements of AS 1743 Road signs - Specifications.

Table RD-ITS-S4 11-2 RC1 display requirements



Message	Message details	Typical layout	Frame ID
RAMP SIGNALS ON	a) Yellow text on black background b) 120 mm character height		1
FREEWAY CLOSED	a) Red text on black background b) 150 mm character height		3
NO RIGHT TURN	a) Symbol based on R2-6 (R) in accordance with AS 1743 Road signs - Specifications b) White arrow on black background c) Red annulus		4
NO LEFT TURN	a) Symbol based on R2-6 (L) in accordance with AS 1743 Road signs - Specifications b) White arrow on black background c) Red annulus		5
NO ENTRY	a) Symbol based on R2-4 in accordance with AS 1743 Road signs - Specifications b) White text on black background c) Red annulus		6

#### 11.4.3 RC2 display requirements

The Contractor must ensure that the RC2 signs comply with the following requirements:

- RC2 signs must be capable of displaying all messages in accordance with Table RD-ITS-S4 11-3;
- typical pixel placement for each message must be in accordance with the typical layouts;
- each RC2 message must be allocated a frame ID in accordance with Table RD-ITS-S4 11-3;
- each RC2 message must be formed by LED pixels preformed into the message; and
- spacing between the pixel LEDs must not exceed 2 times the diameter of the pixel.

Table RD-ITS-S4 11-3 RC2 display requirements

Message	Message details	Typical layout	Frame ID
RAMP SIGNALS ON	a) Yellow text on black background; and b) 120 mm character height.		1
PREPARE TO STOP	a) Red text on black background; and b) 150 mm character height.		2
RAMP CLOSED	a) Red text on black background; and b) 180 mm character height.		3



#### 11.4.4 RC3 display requirements

The Contractor must ensure that the RC3 sign displays comply with the following requirements:

- a) signs must be a 4-colour full matrix sign capable of displaying text messages in red, yellow, green and white;
- b) the sign's 4 colours must be generated either by using:
  - i) individual red, yellow, green, and white LEDs; or
  - ii) red-green-blue (RGB) LEDs in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) where red-green-blue (RGB) LED technology is used, the RGB LEDs must be:
  - i) single package 3-chip LEDs; and
  - ii) filtered through a lens or optical system:
    - A. to provide the observer with a single pixel to view; and
    - B. that produces a true colour without visibility of the individual LEDs used to generate the colour pixel; and
- d) the sign display must comply with the dimensional requirements set out in Table RD-ITS-S4 11-4.

**Table RD-ITS-S4 11-4 RC3 display dimensional requirements**

VMS sign type	RC3
Minimum character height (mm) <sup>(1)</sup>	120 for top line, 108 for second and third lines
Number of lines	3
Maximum pixel pitch (centre to centre spacing) (mm)	12
Minimum pixel resolution (WxH)	128 x 40
Minimum luminous intensity half-angle degrees	15

**Table notes:**

(1) Character proportions must comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, clause 5.1.2.1.

#### 11.4.5 Dimming control

The Contractor must ensure that the signs comply with the following dimming control requirements:

- a) the display unit must be capable of dimming control to vary the LED intensity of the display to suit the ambient lighting conditions;
- b) a total of 16 dimming levels must be provided where:
  - i) dimming level 1 is the minimum intensity output; and
  - ii) dimming level 16 is the maximum intensity output;
- c) the dimming control algorithm must not permit sudden changes in the output intensity;
- d) the display unit must take a minimum of 5 seconds and a maximum of 15 seconds to transition from one dimming level to the next in either direction; and
- e) the relationship between luminance level and dimming levels must be in accordance with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 11.5 Operation and control

### 11.5.1 General

The Contractor must ensure that the signs are capable of:

- a) supporting the writing of at least 900 messages per day; and

- b) updating the messages every 2 minutes.

### 11.5.2 Sign controller

The Contractor must ensure that the RC1, RC2 and RC3 sign controllers comply with the following requirements:

- a) a single sign controller must be provided for each ramp control sign;
- b) all of the sign controller's communications and power interfaces must be clearly and indelibly labelled on the sign controller housing;
- c) the connection between the sign controller and relevant ramp control sign must be hard-wired;
- d) the connection between the sign controller and field processor must be hard-wired;
- e) the sign controller must provide a real-time clock in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs; and
- f) the sign controller must include the following functions:
  - i) the sign controller must allow for automatic synchronisation with a remote NTP time server;
  - ii) the sign controller must provide automatic updates to the real-time clock for daylight-saving related time changes;
  - iii) the sign controller must provide user configurable settings for the dates and times to change from standard time to daylight saving time and vice versa as follows:
    - A. start of daylight-saving time - at 0200 hr on the first Sunday in October; and
    - B. end of daylight-saving time - at 0300 hr on the first Sunday in April; and
  - iv) the sign controller must log all time updates and changes.

## 11.6 Factory Acceptance Testing (FAT)

- a) In addition to the requirements of section 6, the Contractor must ensure that the signs comply with the following FAT requirements:
  - i) optical performance of each sign must be:
    - A. determined by measurement under laboratory conditions of:
      - I. the minimum luminance ratio; and
      - II. the minimum and maximum luminance for the 5 sign illuminance levels listed in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
    - B. tested in accordance with the photometric test procedures defined in AS 4852.1 Variable message signs, Part 1: Fixed signs.
- b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that the signs satisfy the requirements of this section 11.6, as part of the Quality Management Records.

## 12 Appendix 6: Real-time information signs (A2/TT)

### 12.1 General

For the purpose of clarity for the applications of A2/TT signs, these signs are placed on arterial roads prior to the commencement of a motorway on-ramp to provide information regarding the motorway, including:

- a) travel time on the motorway;
- b) incidents on the motorway (as a secondary sign to larger type A or B VMS); and
- c) on-ramp is closed.

### 12.2 Mechanical requirements

#### 12.2.1 Sign enclosure

The Contractor must ensure that A2/TT sign enclosures comply with the following requirements:

- a) the sign enclosure must be designed such that thermal ratings of the electronics and components housed within the sign enclosure are not exceeded;
- b) the sign enclosure must include a mechanism to inhibit the build-up of moisture due to condensation; and
- c) the sign enclosure must include a lockable door on the front face of the sign enclosure to allow clear and ready access to the internal components.

#### 12.2.2 Sign mounting

The Contractor must ensure that all A2/TT signs are designed for rear mounting of the sign enclosure onto a pole.

#### 12.2.3 Lifting and transportation points

The Contractor must ensure that where the A2/TT sign is not capable of being manually lifted and held by a single person (within WHS limits) during installation:

- a) lifting anchors are provided on the sign enclosure;
- b) the lifting anchors must be integral with the sign enclosure, preventing moisture ingress into the sign; and
- c) seals around the lifting anchors are not used.

### 12.3 Electrical requirements

#### 12.3.1 General

- a) The Contractor must ensure that all cables and wires associated with the A2/TT signs are:
  - i) insulated with a material not inferior to V-90 grade PVC; and
  - ii) suitably labelled.
- b) The Contractor must ensure that the test report required by section 3.3.4 includes power consumption for the A2/TT signs:
  - i) displaying 50% of yellow pixels; and
  - ii) at maximum illumination.

#### 12.3.2 Back-up power supply

The Contractor must ensure that the back-up power supply to be provided for each A2/TT sign in accordance with section 3.3.5 provides the capacity to operate the A2/TT sign:

- a) while displaying 50% of the yellow pixels; and

- b) at maximum illumination.

## 12.4 Display and optical requirements

### 12.4.1 General

- a) Sign displays must conform with the requirements set out in Table RD-ITS-S4 12-1.
- b) The Contractor must ensure that A2/TT signs comply with the following requirements:
- i) the signs must contain one or more display elements, combinations of which are activated to present a complete message sign face to the motorist;
  - ii) the sign must include a non-reflective black sign background board;
  - iii) active display elements must be lit with the luminance and luminance ratio in compliance with AS 4852.1 Variable message signs, Part 1: Fixed signs;
  - iv) the colour of the display elements must:
    - A. lie within the applicable region specified by the chromaticity coordinates in AS 4852.1 Variable message signs, Part 1: Fixed signs; and
    - B. be tested in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs; and
  - v) inactive display elements must remain unlit and appear to be the same colour as the sign background board.

**Table RD-ITS-S4 12-1 Real time information signs display dimensional requirements**

VMS sign type	A2 (TT)
Minimum character height (mm) <sup>(1)</sup>	200
Number of lines	3
Characters per line	13
Character minimum pixel resolution (WxH)	10 x 14
Minimum pixel resolution (WxH)	178 x 58 <sup>(2)</sup>
Minimum luminous intensity half-angle degrees	15

**Table notes:**

(1) Character proportions must comply with the requirements of AS 4852.1 Variable message signs, Part 1: Fixed signs, clause 5.1.2.1.

(2) Subject to sightline analysis to meet a 6.2 sec viewing time requirement.

### 12.4.2 Display requirements

The Contractor must ensure that A2/TT sign displays comply with the following requirements:

- a) signs must be a 4-colour full matrix sign capable of displaying text messages in red, yellow, green and white;
- b) the sign's 4 colours must be generated either by using:
  - i) individual red, yellow, green, and white LEDs; or
  - ii) red-green-blue (RGB) LEDs in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) where red-green-blue (RGB) LED technology is used, the RGB LEDs must be:
  - i) single package 3-chip LEDs; and
  - ii) filtered through a lens or optical system:
    - A. to provide the observer with a single pixel to view; and
    - B. that produces a true colour without visibility of the individual LEDs used to generate the colour pixel; and

- d) the pixels must have a maximum pixel pitch (centre to centre spacing) in the horizontal and vertical directions of:
  - i) 12 mm for signs installed on roads with an approach speed of 80 km/h or less; or
  - ii) 32 mm for signs installed on roads with an approach speed of more than 80 km/h.

#### 12.4.3 Dimming control

The Contractor must ensure that A2/TT signs comply with the following dimming control requirements:

- a) the display unit must be capable of dimming control to vary the LED intensity of the display to suit the ambient lighting conditions;
- b) a total of 16 dimming levels must be provided where:
  - i) dimming level 1 is the minimum intensity output; and
  - ii) dimming level 16 is the maximum intensity output;
- c) the display unit must include at least 2 light sensors to detect ambient light levels;
- d) the display sensors required by section 12.4.3c) must be located as follows:
  - i) one sensor facing forward perpendicular to the sign face; and
  - ii) one sensor facing backward perpendicular to the sign face;
- e) the dimming control algorithm must not permit sudden changes in the output intensity. The display unit must take a minimum of 5 seconds and a maximum of 15 seconds to transition from one dimming level to the next in either direction; and
- f) the relationship between luminance level and dimming levels must be in accordance with AS 4852.1 Variable message signs, Part 1: Fixed signs.

## 12.5 Operation and control

### 12.5.1 General

The Contractor must ensure that the A2/TT signs are capable of:

- a) supporting the writing of at least 900 messages per day; and
- b) updating messages every 2 minutes.

### 12.5.2 Sign controller

The Contractor must ensure that A2/TT sign controllers comply with the following requirements:

- a) a single sign controller must be provided for each A2/TT sign;
- b) the sign controller must provide a real-time clock in accordance AS 4852.1 Variable message signs, Part 1: Fixed signs;
- c) the sign controller must have the following functions:
  - i) the sign controller must allow for automatic synchronisation with a remote network time protocol time server;
  - ii) the sign controller must provide automatic updates to the real-time clock for daylight-saving related time changes; and
  - iii) the sign controller must provide user configurable settings for the dates and times to change from standard time to daylight saving time and vice versa, as follows:
    - A. start of daylight-saving time - at 0200 hr on the first Sunday in October; and
    - B. end of daylight-saving time - at 0300 hr on the first Sunday in April; and
- d) the sign controller must be capable of logging all time updates and changes.

## 12.6 Factory Acceptance Testing (FAT)

- a) In addition to the requirements of section 6, the Contractor must ensure that the A2/TT signs comply with the following FAT requirements:
    - i) the optical performance of each A2/TT sign must be:
      - A. determined by measurement under laboratory conditions of the:
        - I. minimum luminance ratio; and
        - II. minimum and maximum luminance for the 5 sign illuminance levels listed AS 4852.1 Variable message signs, Part 1: Fixed signs; and
    - ii) tested in accordance with the photometric test procedures defined in AS 4852.1 Variable message signs, Part 1: Fixed signs.
  - b) The Contractor must submit evidence of compliance from a NATA accredited testing facility that the A2/TT signs satisfy the requirements of this section 12.6, as part of the Quality Management Records.
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