

Technical Specification

**Transport and Main Roads
MRTS202 Variable Message Signs**

July 2017

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1 Introduction

This Technical Specification defines the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and handover requirements for Variable Message Signs (VMS), consisting of either one display (standard VMS) or two discrete displays, also known as Enhanced VMS (EVMS), in a single enclosure.

These VMS may be used as:

- part of the overall traffic management system utilising STREAMS to manage traffic on the road network, and/or
- a stand-alone device with manual and automatic control.

These VMS shall allow variable graphical and textual information to be provided at strategic locations on the road network as part of the traveller information and incident management system.

For mobile VMS (such as trailer-mounted VMS) refer to MRTS262.

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

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

2 Definition of terms

The terms defined in MRTS201 apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 below.

Table 2 – Definitions

Term	Definition
LED	Light Emitting Diode(s)
VMS	Variable Message Sign(s)
TDU	Textual Display Unit of the VMS
GDU	Graphical Display Unit of the VMS
DU	Display Units, TDU and/or GDU of the VMS
Event	Sign status change, frame change, occurrence of a fault in VMS controller or sign display
Field Processor (FP)	An industrial computer complying with requirements of MRTS232 Provision of Field Processors
LFS	Local facility switch
NATA	National Association of Testing Authorities
PHCS	Product host control system: control/diagnostic software that runs on a laptop and can control, interrogate and program the VMS controller
Pixel	The smallest discreetly controlled light emitting component of the sign dot matrix display
PTN	Principal's Telecommunications Network
RAM	Random Access Memory

Term	Definition
VMS Controller	A local control unit providing the operational interface to the TDU and GDU
Simultaneously	At the same time as apparent to the eye of an observer
STREAMS	The Principal's traffic management system and primary user interface to ITS field devices
Stroke width	The apparent width of active pixel(s)
TMC	Traffic Management Centre
TMS	Traffic Management System (STREAMS)
TRUM	<i>Traffic and Road Use Management Manual</i>
QADF	Queensland Asset Data Format

3 Reference documents

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

Table 3 – Referenced documents

Document ID	Document Name / Description
AS 1744	<i>Forms of letters and numerals for road signs</i>
AS 1939	<i>Degrees of protection provided by enclosures for electrical equipment</i>
AS 3990	<i>Mechanical equipment-steelwork</i>
AS 4070	<i>Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient over-voltages</i>
AS 4100	<i>Steel Structures</i>
AS 4852.1	<i>Variable Message Signs – Part 1: Fixed signs</i>
AS / ACIF S009	<i>Installation Requirements for Customer Cabling – Wiring Rules</i>
AS/NZS 1170.1	<i>Structural Design Actions, Permanent, imposed and other actions</i>
AS/NZS 1170.2	<i>Structural Design Actions, Wind Actions</i>
AS/NZS 1664	<i>Aluminium structures</i>
AS/NZS 1665	<i>Welding of aluminium structures</i>
AS/NZS 2144	<i>Traffic Signal Lanterns</i>
AS/NZS 3000	<i>Electrical installation-building structure and premises (Wiring Rules)</i>
AS/NZS 3100	<i>Approval and test – General requirements for electrical equipment</i>
EN12966	<i>Road Vertical Signs- Variable Message Traffic Signs Part 1 Product Standards</i>
IS18	<i>Queensland Government Information Security IS18</i>
MRTS61	<i>Mounting Structures for ITS devices</i>

Document ID	Document Name / Description
MRTS71	<i>Reinforcing Steel</i>
MRTS78	<i>Fabrication of Structural Steelwork</i>
MRTS91	<i>Conduits and Pits</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS210	<i>Provision of Mains Power Supply</i>
MRTS226	<i>Telecommunication Field Cabinets</i>
MRTS232	<i>Provision of Field Processors</i>
MRTS262	<i>Temporary Variable Message Signs</i>
MUTCD	<i>Manual of Uniform Traffic Control Devices Manual</i>
Standard Drawing 1581	<i>ITS – Cantilever - Cantilever Structure</i>
TR2136 / Highways Authority (UK)	<i>Optical Performance Functional Specification for Discontinuous Variable Message Signs</i>
TSI-SP-003 / NSW RTA	<i>Communications Protocol For Roadside Devices</i>
TRUM	<i>Traffic and Road Use Management Manual</i>

4 Quality system requirements

4.1 General

The quality system requirements defined in MRTS201 apply to this Technical Specification. There are no Milestones. Additional quality system requirements relevant to this Technical Specification are defined in Table 4.1 below.

Table 4.1 – Hold Points and Witness Point

Clause	Hold Point	Witness Point	Milestone
4.2	1. Detailed design documentation to be provided prior to manufacture 2. Optical performance test results to be provided prior to delivery to site		
7.3	3. Compliance to requirements of MRTS201, MRTS61, MRTS71 and MRTS78 4. Detailed design documentation of mounting structure and footings location and reduced levels (RLs)		
15.2		1. Factory Acceptance Tests (FAT)	
15.3		2. Installation Acceptance Test (IAT)	
15.4		3. Commissioning Test (CT)	

FAT, IAT and CT have been included in the quality system as Witness Points.

4.2 Sample variable message sign

Requirements of MRTS201 apply to this Technical Specification. Detailed designs of the sign layout, fabrication and assembly drawings, calculations, specifications and certifications of the VMS components (signed by the Contractor's RPEQ) shall be submitted to the Principal via the Administrator for verification prior to manufacture.

These components include the VMS controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including surge protection and back-up batteries), communication ports, cable termination, enclosure and mounting accessories. **Hold Point 1**

Optical performance test methodology and NATA certification confirming the VMS performance requirements specified in this Technical Specification shall be submitted before delivery to site.

Hold Point 2

As specified in MRTS201, a sample VMS shall be provided for the SAT. The sample VMS shall be complete with display and control units of the type to be used in the VMS to be provided under the Contract.

The sample Text Display Unit (TDU) of the VMS shall not exceed two metres (width) x one metre (height) and shall be provided with:

1. the same number of (smaller) horizontal and vertical pixels as the full-size VMS, or
2. a single line with a minimum of three full size horizontal characters. The display resolution of each character shall be five pixels wide and seven pixels high. Characters shall be spaced two pixels apart.

The sample GDU of the VMS shall not exceed one metres (width) x one metre (height) and shall be provided with the same number of (smaller) horizontal and vertical pixels as the full-size VMS.

4.3 Warranty

The contractor installing the VMS or EVMS shall warrant the installation against defects for a minimum of five years in accordance with the requirements of MRTS201.

Minimum five year warranty provision is required for electronic signage including VMS and EVMS as they fall under a category of products which are high cost, safety critical or high quantity.

5 Functional requirements

5.1 General

The overall functions are described in the VMS Use and Operations Guidelines.

It shall be possible to monitor and control both the TDU and the GDU of the VMS by STREAMS via a single VMS controller.

5.2 Control methods

The VMS shall be able to be selected using the following methods by the VMS controller:

1. Locally, when the VMS controller has been selected for LOCAL operation using a local facility switch and/or hardwired inputs to select one of a number of pre-determined messages.
2. Locally, when the VMS controller has been selected for MAINTENANCE operation via the PHCS.
3. Remotely by the TMS when the VMS controller has been selected for REMOTE operation. This shall be the normal mode of operation.

5.3 VMS controller

As a minimum the VMS controller shall:

- support both the TDU and GDU
- monitor, log and support TMS requests for its own operation and status
- monitor, log and support TMS status requests for the TDU and the GDU
- allow the TDU and the GDU to be controlled individually or as a logical group
- allow the request by the TMS to change the displays (TDU and GDU) of VMS to be executed as one command (atomic addressing)
- be capable of storing up to 255 frames in its non-volatile memory for each DU
- allow local automatic reset of the VMS display and the VMS controller itself such as via watchdog(s)
- be capable of dimming connected signs based on the average of the light sensor outputs, and
- accept/reject valid or invalid commands made by the TMS and/or PHCS.

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

5.4 Communications timeout

The VMS controller shall be capable of monitoring loss of communications with the TMS and timeout after a specified period. When the VMS controller is in the REMOTE mode, expiry of this time period shall cause the VMS controller to blank the entire VMS. This period shall be a configurable parameter. The VMS controller shall also be capable of monitoring communications with each DU and timeout after a specified period when such communication is lost. Communications timeout check shall be performed periodically and shall be a configurable parameter. In LOCAL mode, the communications timeout check with the TMS shall be ignored. Configuration parameters are shown in Appendix A.

Default values and permissible range of values are now listed in this standard (Appendix A) to enable testing and configuration as required.

5.5 Configuration management

All settings in the VMS controller shall be accessible using the PHCS.

5.6 Sign fault management

The VMS controller shall monitor and log the following conditions:

- loss of communication with the FP and each DU
- high enclosure temperature
- illumination faults, and
- other faults relating to the VMS.

The log shall identify the DU and its respective fault.

5.7 Local event logging

The VMS controller shall log in non-volatile memory, operational and fault events such as message changes, hardware resets, establishment or discontinuation of communications, local manual operations and clearance of faults. Each event shall be date and time stamped, accurate to at least one hundredth of a second. Once a fault has occurred and been logged, a recurrence of the same fault need not be logged again until after the fault has been cleared.

The event log shall have space for at least 255 entries. Where separate logs are used for operational and fault events, each log shall have space for at least 255 entries. The oldest event record shall be overwritten first when this allocated space has been exceeded.

All log entries shall be available for upload from any and all communication ports upon request from the TMC and/or PHCS. The log shall be uploaded in order of most recent to oldest record. A request by the TMS for the event log shall provide for no less than 20 entries at a time.

Events shall be retained in the log even after retrieval by the PHCS and/or TMS.

5.8 Watchdog

The VMS controller and the DU shall monitor the state of its respective processor and blank the respective display/s in accordance with the VMS Use and Operations Guidelines if processor failure occurs.

5.9 Time synchronisation

The VMS controller shall be provided with an internal system clock in accordance with MRTS201 and allow synchronisation of the clock in response to a TMS and/or PHCS command.

6 Equipment components

Each VMS shall include either:

- One variable message display primarily for the display of text (TDU)
- Two discrete variable message displays, one primarily for display of text (TDU) and one primarily for display of graphics (GDU), or
- A single integrated display for both TDU and GDU, housed within a single display enclosure.

The last two items are instances of an EVMS.

In addition, it shall also include a VMS controller, FP, mounting structure, a telecommunications field cabinet, a switchboard and associated infrastructure/equipment.

7 Mechanical and physical requirements

The mechanical and physical requirements defined in MRTS201 and MRTS61 apply to work provided under this Technical Specification. Additional mechanical and physical requirements for equipment provided under this Technical Specification are described below.

7.1 Design life

Unless otherwise specified, the design life of the VMS components shall be as follows:

- structures: a minimum of 50 years
- enclosures: a minimum of 20 years
- LEDs/pixels: a minimum of 5 years, and
- electronics: a minimum of 10 years.

7.2 Display enclosure

The sign enclosure shall house the TDU, GDU and associated control electronics, and comply with the requirements of MRTS201 *General Equipment Requirements*. Where installed in a tunnel, the enclosure shall be made of Marine Grade Aluminium.

7.3 Mounting structure

The location and type of mounting structure to be provided to mount each VMS shall be shown on the design documentation. The mounting structure shall comply with the requirements of MRTS201, MRTS61, MRTS71 and MRTS78. **Hold Point 3**

Particular attention needs to be given to the requirements in MRTS78 relating to the use of a registered fabricator when fabricating mounting structures for VMS.

For Cantilever structures, Standard Drawing 1581 shall be used.

The final design documentation shall include details of the final footing design, location of the structure and the reduced levels (RLs) and the Contractor shall not commence fabrication of the footing and support structure until that final design documentation has been accepted by the Administrator.

Hold Point 4

7.4 Field cabinets

All telecommunications equipment including the FP and the VMS controller associated with the VMS shall be installed in a suitable roadside enclosure, being either:

- a ground mounted field cabinet complying with requirements of MRTS226, or
- an integral enclosure complying with the requirements of MRTS201 installed on the VMS mounting structure.

8 Variable message display requirements

8.1 General

Variable message displays shall utilise a series of pixels forming a dot matrix display system. A “full matrix” configuration shall be used to allow the display of graphics as well as alphanumeric characters. The horizontal and vertical pitch of the pixels in the matrix shall be the same.

The variable message display pixels shall be in modules of a size capable of being removed and installed by hand via the rear access door(s).

8.2 Variable message display technology

The display technology shall be light emitting diode (LED). The display pixels may be formed by arranging one or more LEDs in a cluster to achieve the required luminance levels.

8.3 Failures

Facilities shall be included to detect failures within the display control system. The TDU and GDU shall blank the display in the event of a sign processor fault. Time to blank shall be a configurable setting.

The DU shall monitor communications with the VMS controller and blank the displays if loss of communication experienced. The communications timeout period shall be configurable setting.

The VMS controller shall be able to detect LED failure even if the LEDs is required to be ‘off’ at the time of the periodic check. The display shall be blanked upon failure of 2% of contiguous pixels for each displayed image or failure of more than 20% of LEDs.

On power restoration after loss of power, the VMS shall become available for activation and remain blank until commanded by the VMS controller or STREAMS. The power recovery delay time shall be configurable. At no time shall partial or incomplete frames be displayed.

The VMS controller shall allow the sign’s display to remain blank for a minimum time once the display has been blanked irrespective of the cause. This minimum blank time shall be configurable.

Single LED failure, provided that the cumulative LED loss remains below the 2% and/or 20% thresholds described above or VMS light sensor failure, should not result in blanking of the display.

All configurable setting shall be as shown in Appendix A.

8.4 LED output

Each individual LED shall be driven with a continuous current with no peak and/or magnitudes exceeding 70% of the LED manufacturer's maximum continuous rating. For LEDs in a 5 mm or smaller diameter package, peak magnitudes of the LED current shall not exceed 20 mA.

8.5 Character and graphical display formats

The below are requirements for the Text Display Unit (TDU) and Graphics Display Unit (GDU). Where a VMS has an integral display unit for both TDU and GDU, it shall meet both the requirements of Clauses 8.5.1 and 8.5.2 below.

8.5.1 Text display unit (TDU)

Each alphanumeric character in the TDU shall be formed by a matrix arrangement of horizontal and vertical pixels. The complete TDU shall consist of:

1. Four lines, each of 18 characters for a Type A sign, and

2. Three lines, each of 18 characters for Type B and Type C signs.

The display resolution of each alphanumeric character shall be the Standard proportional font (7x5) as per AS 4852.1.

The character height, border width and minimum legibility (sight) distance shall be as defined in Table 8.5.1 for both daytime and night- time viewing.

Table 8.5.1 – Character and display requirements

Sign Type	Design Speed (km/hr)	Minimum Legibility Distance	Minimum Character Height	Border Width
A	60 and below	100 m	150 mm	125 mm
B	70-90	160 m	300 mm	260 mm
C	100 and over	250 m	400 mm	260 mm

The type of VMS proposed for each location shall comply with the requirements of the Transport and Main Roads TRUM Manual *Volume 1 Part 10* and shall be specified on the design documentation.

8.5.2 Graphics display unit (GDU)

The GDU shall be formed by a matrix arrangement of a minimum of 64 horizontal pixels and a minimum of 64 vertical pixels. The pixels in the GDU shall be evenly spaced to match the overall vertical dimension of the TDU.

The minimum legibility (sight) distance shall be as defined in Table 8.5.1 for both day-time and night-time viewing.

8.6 Display fonts

As a minimum, the variable message display shall generate single stroke alphanumeric character fonts generally to the requirements of AS 1744. The characters shall be arranged so as to have a minimum of two pixels between characters and two pixels between lines.

8.7 Display changes

Variable message display changes shall be in accordance with the VMS Use and Operations Guidelines. All display changes shall be effected by first blanking the respective TDU and/or GDU, and then activating all required pixels of the respective display simultaneously (as apparent to the eye).

8.8 Display colour

8.8.1 Text display unit (TDU)

The TDU shall be provided with yellow LEDs defined by the coordinates in AS 4852.1-2009, Table 3.4 on a matte black background.

8.8.2 Graphics display unit (GDU)

Each pixel in the multicolour sign, EVMS or GDU shall be provided with by one red, one green, one white and one yellow high visibility LEDs on a matte black background.

The colours for the Red, Green, White and Yellow LEDs shall conform to the colours defined by the colour coordinates in AS 4852.1-2009, Table 3.4. For each pixel, only one LED is to be displayed at a

time. No other colours are to be displayed on the sign. The ability to mix pixel colours shall not be provided.

Red, Green, Yellow and White pixels are required for compliance with road signage colours. RGB signs are not to be used as the blue colour is known for its poor contrast and legibility. Moreover, Dimming is an inappropriate technique for RGB signs to achieve and maintain colour compliance for both green and yellow.

8.9 Fallback displays

Facilities shall be included to detect failures within the variable message display(s) and the display control system(s). On detection of a failure, the relevant display(s) shall be blanked to prevent confusing displays to the motorist. Loss of communications with STREAMS shall also be considered a VMS failure and shall result in the display(s) being blanked after a preset time period. This time period shall be a variable, able to be set by STREAMS, with a range shown in Appendix A.

8.10 Flashing yellow lanterns

Flashing yellow lanterns defined by the coordinates in AS 4852.1-2009, Table 3.4 shall be located on the face of each VMS at the four corners of the display enclosure. The lantern size shall be as shown in Table 8.10.

As a minimum, the flash sequence shall alternate the pair of diagonally opposite lanterns. Where additional flash sequences are provided, these shall allow local and remote selection by the user.

The flash rate parameters shall be selectable via all of the communications ports, with an initial cycle time of one second, and diagonal flashing duty cycle of 50/50 (lit/unlit).

Lanterns shall be dimmed in coordination with the LED display.

Table 8.10 Lantern size requirements

Sign Type	Design Speed (km/hr)	Lantern diameter
A	60 and below	100 mm
B	70-90	250 mm
C	100 and over	250 mm

8.11 Optical performance

8.11.1 Luminance

The luminance and luminance ratio of the LED shall comply with the requirements of AS 4852.1-2009 Table 3.3.

8.11.2 LED dimming

The LED intensity shall be controlled to provide maximum legibility distances for the complete range of ambient light under which the VMS shall operate.

A VMS shall have a minimum of 10 and a maximum of 100 LED brightness levels. The brightness levels shall be in units of percentage of maximum brightness.

The intensity of the yellow lanterns shall be controlled by the same system that controls the intensity of the LED displays.

8.11.3 Luminance intensity half angle

The luminance half angle shall be at least 15° for Type A signs, and at least 6° for Type B and Type C signs.

8.11.4 Luminance intensity uniformity

When measured on axis and at the combined horizontal and vertical half angle positions, the ratio of the average of the three highest element outputs to the average of the three lowest element outputs shall not vary by more than 2.5:1. The outputs of any two elements shall not vary by more than a ratio of 5:1. The luminance intensity uniformity shall be maintained at all dimming levels.

8.11.5 Sun phantom

The action of sunlight or other bright light sources on the optical elements shall be controlled such that inactive pixels shall not appear active.

9 Control system

The control system requirements defined in MRTS201 apply to this Technical Specification. Additional control system requirements for equipment provided under this specification are described below.

9.1 General

Each VMS shall be operated by an integral control system that is controlled in the following order of priority:

1. local facility switch
2. hardwired input(s)
3. maintenance communications port, and
4. control communications ports.

Software shall be provided in accordance with Clause 9.5.

The TDU and the GDU shall be able to be controlled individually or simultaneously.

9.2 Local facility switch(s)

A 5-position key operated facility switch that complies with MRTS201, shall be provided to enable selection of the following five display functions for each of the text display and the graphics display:

- OFF – display blank; control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional
- Normal – display active; displayed message selected via the maintenance communications port and/or the control communications port, and
- Message 1, Message 2, Message 3 – display either message 1, 2 or 3; control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional.

9.3 Maintenance communications port

It shall be possible to control and interrogate the VMS via an EIA / RS-232 maintenance communications port via the VMS controller. The RS-232 port shall allow local and remote communications via a laptop computer (provided by others) containing VMS messaging and diagnostics software to be provided by the Contractor. The maintenance communications port shall also allow remote connection of a similar computer via a modem.

A physical change of connection between remote and local operation shall not require further interaction from the user, nor in anyway interrupt operation or require rebooting of VMS control system or computer / software. The hardware handshaking lines of the EIA / RS-232 interface shall be used such that connection / disconnection of the maintenance PC (either locally or by modem) results in the immediate initiation / termination of the maintenance port communications session with the VMS.

The VMS control and diagnostics software shall be capable of operating at all possible modem connection and serial port speeds.

9.4 Control communications port

It shall be possible to control and interrogate the VMS via either of two EIA / RS-232 control communications ports. The control communications port shall allow local connection of a field processor/ modem for communications with STREAMS.

While a PC / laptop computer is connected to the VMS via the maintenance communications port, control of the VMS via the control ports shall be inhibited. However, status and diagnostic interrogation by STREAMS via the control ports shall remain possible.

Complete control and monitoring by STREAMS shall be possible through either, and / or both control communications ports as determined by telecommunications infrastructure provided at each Site.

Where communications equipment is connected to both control communications ports, the primary port shall be used for control commands to / from the VMS, and the secondary port shall be used for status-only communications with the VMS.

Where communications equipment is connected to only one control communications port (or in the case of failure of either communications port or attached equipment) the VMS shall automatically revert to full control AND status communications through the active port.

VMS communications software shall be capable of operating at all possible modem connection and/or serial port speeds.

9.5 Control / diagnostics software

The VMS integral control system shall fully implement all VMS functions as required by Clause 9.9 for all communications ports.

The software shall report the selected position of the facility switch.

9.5.1 Security and compatibility

The security requirements defined in MRTS201 apply to this Technical Specification.

In addition the software shall:

- Request passwords as part of the access and configuration authorisation process. Passwords shall be generally in accordance with IS18.

- Provide two access levels, namely, Administrator and Standard user, as a minimum.
- Be compatible with Microsoft Windows® operating system environment, Windows XP, Windows Vista, Windows 7, and those industry standards current at the time of delivery.
- Any software provided shall be capable of operating on all such operating systems.
- Be backward compatible with existing VMS purchased from the same manufacturer.

The factory default user credentials shall not be used and these shall be changed prior to any operation of the TVSL sign(s). Passwords shall be generally in accordance with IS18.

9.5.2 Configuration settings and firmware

The VMS configuration parameters can be set up locally or remotely. When set up remotely, the sign control shall provide a foolproof mechanism to avoid losing connection unintentionally. The VMS will have sufficient storage capacity to accommodate future firmware upgrades during the lifetime of the Product. Storage capacity wise, no further hardware upgrades will be required to accommodate ongoing firmware changes / upgrades. In addition, the parameters shall be completely protected against software / firmware upgrade.

This requirement is necessary to ensure that software upgrades do not affect the existing configuration parameters or new software released by the manufacturer are compatible with existing VMS by the same manufacturer.

9.6 Hardwired inputs

The VMS controller shall have the ability to display a predefined message when it receives a voltage free contact closure or similar input from an external device such as a loop detector or vehicle over-height detector.

Unless otherwise specified, the VMS controller shall be capable of accepting a minimum of six hardwired inputs.

9.7 LED intensity control

The LED intensity shall be controlled to provide constant apparent brightness, and maximum legibility distance, for the complete range of ambient light under which the VMS shall operate.

Each VMS shall support automatic brightness variation, where the VMS determines the LED brightness level using a light sensor reading and a predefined set of light sensor values.

Each VMS shall be provided with at least two light sensors to detect ambient light levels. These sensors shall be located as follows:

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

9.7.1 Time-of-Day intensity settings

The VMS controller shall provide means of adjusting the VMS brightness by time-of-day.

In the event of failure of the light sensors, seasonally adjusted time-of-day values stored in the group controller shall be used to adjust the VMS brightness.

9.8 Temperature control

Each VMS shall be provided with at least one temperature sensor to measure the temperature inside the display enclosure near the top centre and a cooling system consisting of cooling devices and thermostats.

Each thermostat shall operate the connected cooling device(s) once the internal ambient temperature (measured at the top of the cabinet) reaches the set point. The thermostat set point (TSP) is a configurable parameter as shown in Appendix A.

The temperature sensor shall not be mounted directly against the top face of the display enclosure. The temperature reading shall be available through the use of a protocol message via STREAMS. The temperature shall be in units of degrees centigrade. Upon failure of the VMS cooling system, the TMS shall shut down the sign if the temperature reaches a set value (OTS), which is configurable, as shown in Appendix A.

9.9 Communication protocol

Communication between the Field Processor and the VMS shall comply with TSI-SP-003 and MRTS201.

9.10 Bus arbitration

Each VMS shall act as a slave on the EIA RS-422A / modem bus.

9.11 Message hierarchy

Each VMS controller shall provide a user-configurable message hierarchy for message selection commands and hardwired inputs.

10 Mechanical, physical and enclosure requirements for the display enclosure

10.1 General

The mechanical, physical and enclosure requirements defined in MRTS201 apply to the display enclosure. Additional mechanical, physical and enclosure requirements for the display enclosure are described below.

10.2 Mounting

The display enclosure shall be capable of being mounted in both the verge, and mounted over the carriageway as defined in MRTS201.

Rear doors shall be provided to allow access to the rear of the VMS for maintenance from the working platform on the mounting structure. The door arrangement shall be compatible with the mounting structure members. The mounting structure shall comply with MRTS201.

10.3 Exterior finish and surfaces

A ripple finish is required to all painted surfaces. Surface colours shall be:

- front face surrounding the active display, and bottom external face: matte black, or APO Grey with external matte black target board
- remainder of external surfaces: APO grey, and
- interior: matte black, or natural finish with internal black backing board.

Where an internal backing board is used, this shall allow easy removal to access the variable message display.

10.4 Weather resistance

The display enclosure shall provide a degree of protection of not less than that required for the classification of IP65 in accordance with AS 1939, in normal service.

10.5 Equipment racks

Where required, the display enclosure shall incorporate a standard 19 inch racking system to facilitate installation of all equipment requiring rack-mounting. The height of the racks shall be sufficient for the installation of all such equipment.

10.6 Front cover

10.6.1 Material

A protective front cover shall be fitted to the display enclosure to form a viewing window. The front cover material shall be a single, clear Lexan® sheet, or equivalent, with a non-reflective finish. The sheeting shall be manufactured from sign-grade material SG300 with a thickness at least equal to that recommended by the manufacturer, and in all cases, at least 4.5 mm. The viewing window shall be such that when installed, the sides and bottom edges of the display face are fully visible at viewing angles of $\pm 45^\circ$ (horizontal) and $\pm 30^\circ$ (vertical) to the axis perpendicular to the front plane of the display.

10.6.2 Retention method

The front cover shall be able to be removed from outside the VMS for maintenance without requiring removal of internal components. Fasteners and retaining cover strips shall be easily accessible.

The front cover retention and seal design shall allow for thermal expansion properties of the front cover material. The front cover surrounding framework and cover strips shall provide the required weather proofing and strength for both positive and negative wind pressures.

10.7 Demister

A demister shall be provided to prevent condensation on the inside surface of the front cover.

11 Environmental

The environmental conditions defined in MRTS201 apply to this Technical Specification.

12 Electrical

The electrical requirements defined in MRTS201 and Section 2.2 of AS 4852.1-2009 apply to work provided under this Technical Specification. Additional requirements are as described below.

A battery backup system shall be provided with each sign. This provision shall have the capacity to maintain normal sign operation except for sign pixel display and conspicuity devices for a period of 12 continuous hours, including any communication services.

Batteries used in the backup system shall be of a deep discharge, low-maintenance type with no liquid electrolytes and shall be automatically charged from an internal system provided within the sign.

13 Installation requirements

The installation requirements defined in MRTS201 apply to this Technical Specification. In addition, where a cabinet different from the VMS display enclosure, complying with MRTS201 or MRTS226, is used for housing VMS equipment, the cabinet must be placed at a location where the VMS face is visible. Consequently, ground-mounted cabinets shall be located on the same side of the carriageway as the VMS.

Further requirements are as detailed in the installation acceptance test and commissioning tests in Clauses 15.3 and 15.4.

14 Telecommunications requirements

The telecommunications requirements defined in MRTS201 apply to work provided under this Technical Specification.

15 Testing and commissioning

15.1 General

The testing and commissioning requirements defined in MRTS201 apply to work provided under this Technical Specification. The minimum additional testing and commissioning requirements for equipment provided under this Technical Specification are described below.

15.2 Factory acceptance tests (FAT)

The FAT shall include all the performance parameters in this MRTS that can be tested under laboratory/factory conditions.

The optical performance, stated in Section 4, and to be conducted by a NATA approved laboratory, shall be determined by measurement under laboratory conditions of the minimum luminance ratio and the minimum and maximum luminance for the five sign illuminance levels listed in AS 4852.1-2009 Table 3.3 in accordance with the test procedures defined therein – Appendix C – “Photometric Test Procedures”.

The colours for the red, green and yellow LEDs shall conform to the colours defined by the colour coordinates in AS 4852.1 Table 3.4, and Appendix D – “Colorimetric Test Procedures”. The optical performance of the VMS shall meet or exceed those quoted parameters. The optical performance report shall cover all parameters described in Clause 8.11 of this MRTS. **Witness Point 1**

15.3 Installation acceptance tests (IAT)

Once the VMS is installed on Site, the Contractor shall demonstrate and certify that the VMS has been installed to allow correct operation, exhibiting similar results in the intended operating environment as the results in the FAT. **Witness Point 2**

15.4 Commissioning tests (CT)

The commissioning requirements defined in MRTS201 apply to work provided under this Technical Specification. The commissioning report sheet in Annexure shall be completed as part of the test and included in the operations manuals. **Witness Point 3**

A commissioning sheet has been included as part of Annexure MRTS202.1, listing parameters of significance for VMS commissioning.

16 Documentation

The documentation requirements defined in MRTS201 apply to work provided under this Technical Specification.

17 Training

The training requirements defined in MRTS201 apply to work provided under this Technical Specification.

18 Maintenance

The maintenance requirements defined in MRTS201 apply to work provided under this Technical Specification.

19 Handover

The handover requirements defined in MRTS201 apply to work provided under this Technical Specification. Further requirements are as described below.

The Contractor shall provide asset data for the installed VMS in the format prescribed by the QADF document. The contractor will need to contact the Principal with regards to data requirements such as asset attributes specific to the project, as these requirements may change from project to project.

Appendix A: Configuration Parameters

Reference clause	Description	Range of values	Factory default	Device(s), systems affected
5.4	TMS Communications Session Time-out (STO)	1 - 600 seconds	300 seconds	control unit/Configuration Software
5.4	Communications check frequency (Controller with sign display) (CST)	0 - 30 seconds	Once every 5 seconds	control unit/sign display
5.4	Communication Timeout Setting (Controller to Sign Display)	0 - 30 seconds	5 seconds	control unit/sign display
5.6	Enclosure Over-Temperature Setting (OTS)	0 – 70°C in increments of 1°C	Max Alarm set at 42°C	control unit/sign display/enclosure
5.8	Sign processor fault blank time (PFBT)	0.5 – 3 seconds	1 second	sign display
8.1	Flashing display elements setting (FDES)	10 - 90% lit (1 s cycle time)	1 s cycle time 50% lit	Flashing display elements setting (FDES)
8.3	Contiguous Pixel Failure (CPF)	0 - 10%	2%	control unit/sign display
8.3	Multi LED failure (MLEDF)	0 – 100%	20%	control unit/sign display
8.4	Power recovery delay time (PRDT)	1 - 600 seconds	60 seconds	control unit/sign display
8.4	Minimum blank time (MBT)	1 - 120 seconds	30 seconds	control unit/sign display
8.11.2	LED intensity control	10 - 100 levels	16 levels, Dimming by Site controller	control unit/sign
9.8	Thermostat set Point (TSP)	10 – 60°C in increments of 1°C	ON at 40°C, OFF at 35°C	control unit/sign display/enclosure

