Technical Specification

Transport and Main Roads
MRTS262 Transportable Variable Message Signs

July 2022

Queensland Government

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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 Transportable Variable Message Sign (TVMS) and their associated control systems.

A TVMS defined in this Technical Specification is used for traffic management and/or driver information applications.

Transportable variable message signs intended to advertise products and services to road users are not covered within the scope of this Technical Specification.

> A TVMS used for road operations as specified in this Technical Specification is different to digital advertisement signs used for the display of messages not related to road safety.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements*, MRTS201 *General Equipment Requirements*, MRTS202 *Variable Message Signs,* the *Queensland Guide to Traffic Management* Part 10 *Transport Control – Types of Devices* and other Technical Specifications as appropriate.

The key differences between a VMS sign covered under MRTS202 *Variable Message Signs* and a TVMS covered under this Technical Specification are in relation to the:

a) TVMS operation is through the use of a handheld short range device (SRD) in addition to a remote sign control system (RSCS)

b) TVMS are battery powered and, where necessary, the batteries are recharged via solar panels, and

c) TVMS are mounted on a vehicle, trailer or a portable concrete block so that they can be relocated when required for traffic control staging.

TVMS complying with this Technical Specification shall only be used in accordance with the operational requirements of the QGTM Part 10. Vehicle-mounted TVMS shall, in addition, comply with the Queensland *Manual of Uniform Traffic Control Devices* (MUTCD) Part 3.

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

2 Definition of terms

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

Table 2 – Definitions

Term	Definition
ACMA	Australian Communications and Media Authority
CAT	Customer Acceptance Test (see MRTS201 *General Equipment Requirements*)
Configuration software	Control / diagnostic software that runs on a laptop and can control, interrogate and program the CU
CT	Commissioning Test (see MRTS201 *General Equipment Requirements*)

Term	Definition
CU	Control Unit hardware within the TVMS sign unit which undertakes all communication and internal processing tasks required for operation
DoD	Depth of Discharge
DU	Display Unit
Event	Sign status change, message change, occurrence of a fault in CU or sign
FAT	Factory Acceptance Test (see MRTS201 *General Equipment Requirements*)
FP	Field Processor
GPS	Global Positioning System
IAT	Installation Acceptance Test (see MRTS201 *General Equipment Requirements*)
IP	Ingress Protection
LFS	Local Facility Switch – a key operated device used to manually control operation of the CU
Message	Any stable state displayed by a TVMS on its display at any one instance of time that is preceded and followed by a change of state
NATA	National Association of Testing Authorities
Pixel	The smallest discreetly-controlled light-emitting component of the sign's dot matrix display
Replay attack	Unauthorised access of keyless entry systems without code hopping or rolling code communications algorithms
RPEQ	Registered Professional Engineer of Queensland
RSCS software	Remote sign control system software – this is the software system used to remotely operate and monitor the TVMS signs for example, from a Traffic Control Company’s Premises
SRD	Short-range device: Handheld remotes which can set a TVMS sign to display a permitted message frame
STREAMS	The Principal’s traffic management system and primary user interface to intelligent transport system field devices
TVMS	Transportable variable message sign
UHF	Ultra-high frequency: 300 – 3000 MHz radio frequency spectrum band (see the ACMA website for further information)
VMS	Variable message sign
VPN	Virtual private network
WH&S	Workplace Health and Safety

3 Reference documents

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

Table 3 – Referenced documents

Reference	Title
AS 1742	*Manual of uniform traffic control devices*
AS 1743	*Road signs – Specifications*
AS 1744	*Standard alphabets for road signs*
AS 2700	*Colour standards for general purposes*
AS 4852.1	*Variable message signs, Part 1: Fixed signs*
AS 4852.2	*Variable message signs, Part 2: Portable signs*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 1170.1	*Structural design actions, Part 1: Permanent, imposed and other actions*
AS/NZS 1170.2	*Structural design actions, Part 2: Wind actions*
AS/NZS 1664.1	*Aluminium structures, Part 1: Limit state design*
AS/NZS 1664.2	*Aluminium structures, Part 2: Allowable stress design*
AS/NZS 1665	*Welding of aluminium structures*
AS 1768	*Lightning protection*
AS/NZS 1906.1	*Retroreflective materials and devices for road traffic control purposes, Part 1: Retroreflective sheeting*
AS/NZS 1906.2	*Retroreflective materials and devices for road traffic control purposes, Part 2: Retroreflective devices (non-pavement application)*
AS/NZS 1906.3	*Retroreflective materials and devices for road traffic control purposes, Part 3: Raised pavement markers (retroreflective and non-retroreflective)*
AS/NZS 1906.4	*Retroreflective materials and devices for road traffic control purposes, Part 4: High-visibility materials for safety garments*
AS/NZS 3000	*Electrical installation (known as the Australian / New Zealand Wiring Rules)*
AS/NZS 3012	*Electrical installations – Construction and demolition sites*
IS18	*QGCIO Information Security Policy*
MRTS01	*Introduction to Technical Specifications*
MRTS02	*Provision for Traffic*
MRTS50	*Specific Quality System Requirements*
MRTS61	*Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*
MRTS201	*General Equipment Requirements*
MRTS202	*Variable Message Signs*

Reference	Title
MRTS226	*Telecommunications Field Cabinets*
MRTS232	*Provision of Field Processors*
MRTS263	*Standalone Solar (PV) Power Systems*
MUTCD	Queensland *Manual of Uniform Traffic Control Devices*
QGTM	Queensland Guide to Traffic Management Part 10 *Transport Control – Types of Devices*

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant under this Technical Specification are defined in Table 4. There are no Milestones defined.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.1	1. Detailed design documentation to be provided prior to manufacture 2. Optical performance certification		
5.4	3. Safety requirements		
6.2.1	4. Vehicle, Trailer and/or concrete block support structure design documentation		
11.8		1. Optical Performance Test	
13		2. Factory Acceptance Test	

4.1 Samples for acceptance

The requirements of MRTS201 *General Equipment Requirements* apply to this Technical Specification. Detailed designs of the sign layout, fabrication and assembly drawings, calculations, specifications and certifications of the TVMS components (signed by the Contractor's RPEQ) shall be submitted to the Principal for verification prior to manufacture. These components include the TVMS controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including solar power, surge protection and backup batteries), communication ports, cable termination, enclosure and mounting accessories. **Hold Point 1**

Optical performance test methodology and National Association of Testing Authorities (NATA) or NATA-accredited or NATA-endorsed by Mutual Recognition laboratory certification confirming the TVMS performance requirements specified in this Technical Specification must be submitted before delivery to site. **Hold Point 2**

4.2 Warranty

The Contractor installing the TVMS shall warrant the installation against defects for a minimum of five years in accordance with the requirements of MRTS201 *General Equipment Requirements*.

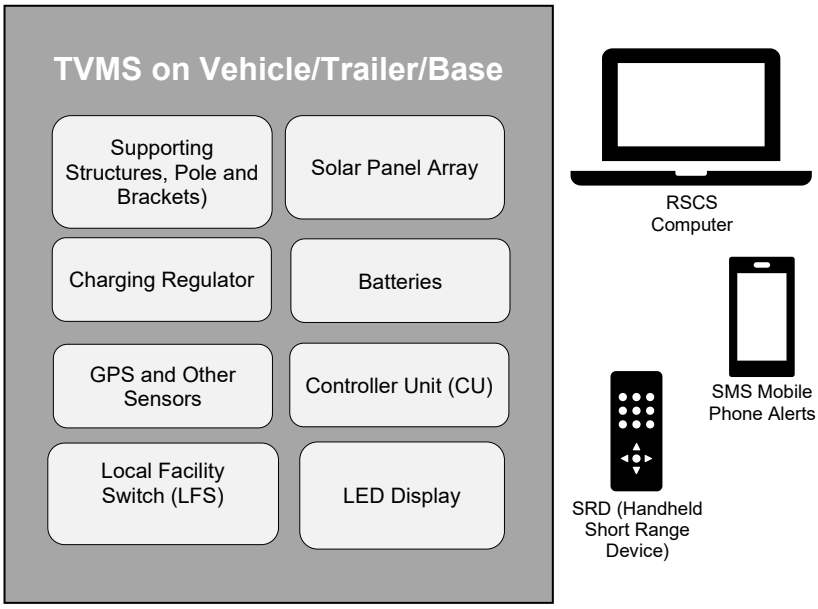
Minimum five-year warranty provision is required for electronic signage, including TVMS, as they fall under a category of products which are either high-cost, safety-critical or high quantities.

5 Operational requirements

5.1 Key TVMS components and function

The following figure shows the key components associated with TVMS.

Figure 5.1 – Key TVMS components



Note: Control of vehicle mounted TVMS shall conform to the requirements of the Queensland MUTCD Part 3 and requires no remote access.

5.2 General operation

The use of the TVMS shall be in accordance with the Queensland Guide to Traffic Management Part 10 *Transport Control – Types of Devices*, and the Queensland MUTCD and have the capability of operating as follows.

5.3 Control methods

The TVMS shall be operated by selecting the following methods via the TVMS controller:

a) Locally, when the TVMS controller has been selected for BLANK / MAINTENANCE operation using a local facility switch. This would enable operation of the TVMS through the TVMS configuration software and/or hardwired inputs to select one of a number of predetermined messages.

b) Remotely, when the TVMS controller has been selected for NORMAL operation. This will enable operation through a hand-held short-range device (SRD) and/or remote sign control system (RSCS), which may be compatible with an existing Transport and Main Roads system, such as STREAMS.

The TVMS controller shall provide the operational interface with the SRD and RSCS.

The local TVMS operating system supported on the CU shall have a minimum of 99.9% operating reliability.

5.4 Safety requirements

All vehicle-mounted and trailer / concrete block-mounted TVMS used in safety-related applications shall only be deployed following the appropriate risk analysis undertaken to ensure safety in the event of sign failure. An example of risk mitigation option could be video monitoring of the sign face. **Hold Point 3**

6 Mechanical, physical, enclosure and mounting requirements

6.1 General

The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* and MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices* apply to work provided under this Technical Specification. Additional mechanical and physical requirements for equipment provided under this Technical Specification are described below.

6.2 Design life

Unless otherwise specified, the design life of the TVMS components shall be in accordance with Clause 2.2 of AS 4852.2.

6.2.1 General mounting requirements

The display enclosure shall be capable of being mounted on a vehicle, a trailer or a concrete block support structure in a location consistent with Part 10 of the QGTM. The mounting structures supporting the TVMS shall be designed for the site conditions in which they are intended to be used.

The structure shall be designed in accordance with MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*, AS/NZS 1170.1 and AS/NZS 1170.2 when installed with all supporting hardware and accessories used to operate the signs, including the solar panels, where fitted.

Vehicle, trailer and / or concrete block support structure design documentation showing compliance with this Technical Specification and certified by a RPEQ, shall be submitted to the Principal's representative for review and acceptance. **Hold Point 4**

6.2.2 Vehicle mounts

The vehicle on which the TVMS is mounted shall conform to the requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification. Where there is discrepancy between the Queensland MUTCD Part 3 and this Technical Specification, regarding the host vehicle, the Queensland MUTCD Part 3 takes precedence. If required, vehicle-mounted TVMS shall be fitted with solar panels.

6.2.3 Trailer mounts

Where the TVMS is mounted on a trailer, the sign and solar panel array shall have a mechanical system which allows the sign and solar panel to be safely secured to the trailer for transportation.

The mechanical system shall also allow for the sign and solar panel to be safely erected onsite to ensure the sign is clearly visible to motorists and that the solar panels can be adjusted to ensure optimum solar exposure and maximum energy generation in any part of the state of Queensland.

The mechanical systems shall ensure that the sign cannot rotate due to wind gusts up to the ultimate wind speed the structure is designed.

The trailer shall comply with the applicable Australian Design Rules and shall be suitable for registration in accordance with the statutory requirements of the state of Queensland. All metal surfaces shall be painted in the range of high visibility colours from X15 Orange to X13 Marigold as specified in AS 2700.

6.2.4 Concrete block mounts

The final design documentation of concrete block mounts shall include the location and type of mounting structure to be provided to mount each TVMS and the Contractor shall not commence fabrication of the footing and support structure until that final design documentation has been accepted by the Principal or their delegate.

6.3 Exterior finish and surfaces

The surface finishes shall comply with AS 4852.1 Section 3.1.2 with all external surfaces apart from the front face painted in the range of high visibility colours from X15 Orange to X13 Marigold as specified in AS 2700.

6.4 Front cover

6.4.1 Design

The 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® polycarbonate sheet, or equivalent, with UV-resistant 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 ± 45° (horizontal) and ± 30° (vertical) to the axis perpendicular to the front plane of the display.

6.4.2 Retention method

The front cover shall be able to be removed from outside the TVMS 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.

6.5 Condensation prevention

A mechanism shall be provided to prevent condensation on the inside surface of the front cover. One way this could be done is by using a demister or other dehumidifying solutions.

6.6 Enclosures

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

a) a ground-mounted field cabinet complying with requirements of MRTS226 *Telecommunications Field Cabinets*

b) a traffic signal controller, or

c) an integral enclosure, or display enclosure, complying with the requirements of MRTS201 *General Equipment Requirements* installed on the TVMS mounting structure.

6.6.1 Display enclosure

The sign enclosure shall house the DU and associated control electronics, and comply with the requirements of MRTS201 *General Equipment Requirements*. The sign enclosure shall be made of marine-grade aluminium which complies with AS 4852.1 Clause 3.1.1.

The display enclosure shall provide a degree of protection of not less than that required for the classification of IP65 in accordance with AS 60529 in normal service.

Access shall be provided to allow TVMS maintenance and configuration. The door arrangement shall be compatible with the mounting structure members. The mounting structure shall comply with the requirements of MRTS201 *General Equipment Requirements* and MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*.

7 Electrical requirements

7.1 Portable signs

Portable signs shall be solar powered in accordance with the requirements of MRTS263 *Standalone Solar (PV) Power Systems* and the relevant requirements of AS 4852.2.

Each sign shall also have the facility to be mains powered so the batteries can be charged before being deployed to site or while at site. This shall include a mains battery charger and an IP65 -rated locking connector to enable the external power supply to be easily connected and disconnected from the sign. The relevant electrical requirements defined in Clause 10 of MRTS201 *General Equipment Requirements* apply.

7.2 Fixed signs

Fixed signs shall be mains powered, with an IP65-rated locking connector to enable the external power supply to be easily connected and disconnected from the sign, and with surge protection and battery power supply in accordance with the requirements of Clause 10 of MRTS201 *General Equipment Requirements* and the relevant requirements of AS 4852.1.

Where specified, also provide lightning protection compliant with AS 1768.

8 Telecommunications requirements

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Vehicles used for mounting TVMS shall comply with the communication requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification in order of preference.

8.1 Local site communications

8.1.1 Between CU and LED display

Communication between the local CU and LED sign display shall be via a direct wired connection. The communications system shall be secure, tamperproof and fully-enclosed. Messages transmitted from the CU to the LED display shall be displayed within 50 ms of being sent.

8.1.2 Between configuration software (locally, for example, on laptop) and CU

Refer to Clause 8.4.

8.1.3 Between CU(s) and handheld SRD(s)

Provision shall be made for communication between the CU(s) and SRD(s) via a wired or wireless connection.

For wired connection between the CU and the SRD, the connecting lead shall be at least 15 m.

Wireless connection between the CU and the SRD shall use local encrypted wireless communication technology, such as ultra-high frequency (UHF) radio band or other reliable wireless technology. The wireless SRD shall be as specified in Clause 9.7 below.

The SRD and CU shall communicate reliably over wireless point to point ranges of at least 150 m.

Where an SRD has requested a change of message on a TVMS sign CU, the message change shall be completed within 250 ms of the request: that is, the respective CU's display shall energise the requested message LED pixels.

Any radio frequency communications antennas shall be positioned at the highest point on the TVMS sign to make effective use of available signal gain and avoid line of sight signal attenuation by objects such as concrete barriers and shrubs.

Wireless communication shall be compliant to Australian Communications and Media Authority (ACMA) requirements.

8.2 Remote site communications

The requirement for remote site communications may not be applicable to vehicle-mounted TVMS that comply with the Queensland MUTCD Part 3. The following apply to trailer mount and concrete block mount TVMS.

8.2.1 Between CU and RSCS

Communication between the CU and the RSCS software shall be via a secure wireless connection using a third-party 3G / 4G mobile service provider using secure interface and access protocols as detailed in Clause 10.1 below. All communication over third-party communications network shall provide adequate privacy and integrity of data to the satisfaction of the Principal.

The carrier selected shall have sufficient and reliable coverage at the project site.

Setup and ongoing provision of the mobile service required is the responsibility of the Contractor who owns the TVMS sign.

All messages transmitted from the RSCS software to and from CU embedded firmware shall not exceed 4.0 seconds.

8.2.2 CU and SMS notification system

Communication between the unit controller and a mobile phone for the purposes of the transmission of critical alert SMS notifications as defined in Clause 9.15 below shall be via a third-party SMS mobile service provider. The telecommunications carrier selected shall have sufficient and reliable coverage at the project site.

8.3 Communications timeout

For any SRD or RSCS to CU communications, periodic timeout check shall be ignored, and the display shall remain on indefinitely until requested otherwise.

For Blank / Maintenance mode, if the configuration software remains inactive for a period as defined in Appendix A, then the user session will be terminated, the sign display blanked and the user will need to logon again and establish another session.

All time-out periods shall be software configurable with ranges and default values stated in Appendix A.

8.4 CU communications ports

8.4.1 Maintenance communication port

It shall be possible to control and interrogate the TVMS via a 10/100 Base-T Ethernet maintenance communications port via the TVMS controller. The Ethernet port shall allow local and remote communications via a laptop computer installed with TVMS messaging and diagnostics software provided by the supplier. 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 any way interrupt operation or require rebooting of TVMS control system or computer / software. The hardware handshaking lines of the Ethernet 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 TVMS.

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

8.4.2 Control communications port

It shall be possible to control and interrogate the TVMS via either of EIA / RS-232 or 10/100 Base-T Ethernet or both 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 TVMS via the maintenance communications port, control of the TVMS via the control ports shall be inhibited; however, status and diagnostic interrogation by STREAMS via the control ports shall be maintained.

Complete control and monitoring by STREAMS shall be maintained 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 TVMS, and the secondary port shall be used for status-only communications with the TVMS.

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 TVMS shall automatically revert to full control and status communications through the active port.

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

8.5 Labelling and identification

The SRD and CU shall each have a configurable unique communications ID, for example, a three-digit integer between 001 and 255.

Communications messages between the CU and SRD shall include a checksum unique to each TVMS site and shall be computed based on the message information exchanged to ensure integrity of the communication is upheld.

The checksum shall be available for confirmation by the RSCS that the message frames at each TVMS site are the same as those stored within the RSCS software. The checksum shall be verified periodically and recomputed each time the message frames is changed and/or that the CU is reset / rebooted.

8.5.1 CU ID

A TVMS CU unique ID shall be configured through RSCS or configuration software.

Any communications messages transmitted by a CU shall embed the CU's respective ID.

A physical label displaying this ID must be clearly visible on the TVMS.

8.5.2 SRD ID

A unique SRD ID shall be configured on an SRD through a settable dipswitch or electronically configured using the RSCS or configuration software.

9 Control Unit (CU) requirements

9.1 General

The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Vehicles used for mounting TVMS shall comply with the control requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification in order of preference.

Additional control system requirements for equipment provided under this Technical Specification are described below.

Each TVMS shall be controlled by a CU that is operated 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 10.

The DU shall be able to be controlled individually or simultaneously.

The CU of each TVMS shall:

a) conduct all processing associated with the communications support for paired signs

b) ensure that the requested messages are immediately displayed on the TVMS sign LED display and carries out all associated processing and monitoring functions

c) monitor, log and report the operation of each connected sign display individually

d) monitor, log and report events crucial for the operation of the sign

e) allow the TVMS to be controlled individually or as part of a pair

f) be capable of storing all recommended message frames in its non-volatile memory, refer to QGTM Part 10 for the recommended messages

g) command signs to display only the allowable messages for that respective site as defined by QGTM Part 10

h) allow local automatic reset of sign displays and the CU itself, such as via watchdog(s)

i) be capable of automatically dimming connected signs based on the average of the light sensor outputs (automatic dimming of the sign occurs to increase ambiance, automatic dimming is not permitted for the sole purpose of extending the battery life)

j) accept / reject valid or invalid commands made by the SRD, RSCS, configuration software

k) allow a unique electronic identification for each site to be configured

l) electronically verify with the connected sign display that the displayed message is consistent with the message originally requested and permitted

m) accept an analogue input from a Local Facility Switch (LFS), and

n) additional information and functionality of the CU required is described in the following sections.

9.2 Permissible message types

Each TVMS CU shall be configured to store only those message types permitted to be displayed as defined in QGTM Part 10 for the site in which they are operating. This will be achieved through the RSCS or configuration software referred to in this Technical Specification. The CU shall ensure that only messages permitted for that site are displayed on its respective signs.

The CU shall allow:

a) the configuration software to read and write its permitted messages / message combinations

b) the RSCS to read its stored messages, and

c) stored messages to be downloaded to the sign(s) only when required to be displayed.

The permissible messages for each site shall be confirmed with the Principal.

9.3 Message display time

The minimum display duration of each message frame shall be configurable and accessible via the TVMS configuration software. The time range and factory default settings are shown in Appendix A.

9.4 Watchdog

The TVMS display and CU must each monitor the state of its respective processor and blank the respective display(s) if processor failure occurs.

The CU shall generate an alarm and blank all signs if the integrity of the firmware or configuration is compromised.

9.5 Global Positioning System (GPS)

Each TVMS sign shall be fitted with a GPS receiver. The onboard GPS receiver shall monitor the location in three dimensions (latitude, longitude and altitude) of each sign and also synchronise the TVMS CU internal clock. The CU shall provide an alarm if a sign is moved beyond a 30 m radius of its installed position. This may be achieved using a virtual perimeter or 'geo-fence'.

Vehicles that mount TVMS, and which are compliant with the Queensland MUTCD Part 3, may not require GPS.

9.6 Directional compass capability

Each TVMS may have the ability to discern the installed directional orientation and whether any subsequent change in direction has been detected through the use of a magnetometer or inertial type sensor.

9.7 Handheld short-range device (SRD)

The local method of control is via a hand-held SRD communications device. The following requirements shall apply to the use of the SRD:

a) have a unique ID (refer to Clause 8.5 above) that is transmitted with each message change request

b) should a RSCS message change request occur at the same time as the message change request from an SRD, the SRD request shall have priority and the RSCS request shall be ignored

c) for wireless SRD, use 'code hopping' or 'rolling code' technology, to prevent unauthorised use of the signs through 'replay attacks'

d) for wired SRD, the leads shall preferably be securely terminated in the RS-232 / Ethernet port of the TVMS sign or any other secure termination resulting in 15 m lead

e) the CU shall have the ability to deactivate an SRD from controlling the TVMS sign (for example, due to lost or damaged SRDs) through the TVMS configuration or RSCS software, and

f) only when an SRD message activation button is pressed and held for two seconds shall a control message be transmitted.

To guard against accidental activation of a TVMS frame from the SRD, buttons must be pressed and held for two seconds before any TVMS message frame will be changed.

Note: If the above requirements are not met, the manufacturer / supplier must demonstrate (to the satisfaction of the department) how they will limit the remote control request to an individual CU and prevent unauthorised use of the signs.

9.8 Local Facility Switch (LFS)

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

1. Blank / Maintenance
2. NORMAL, or
3. three message modes.

9.8.1 Blank / maintenance mode

Where Blank / Maintenance mode is selected on an LFS, the following requirement shall apply:

a) the hardwired sign display of that TVMS sign shall be blanked

b) whilst this mode is selected at the particular TVMS sign, any subsequent display requests from a RSCS software session or SRD shall be ignored

c) the TVMS sign shall remain powered

d) where two signs have been configured as one pair, selecting the LFS to 'BLANK' on one TVMS sign shall not blank the other paired TVMS sign unit

e) a locally connected PC / laptop running the configuration software shall be permitted to perform all status, maintenance and diagnostic functions on the respective TVMS sign, and

f) the LFS shall be designed as fail-safe operation and, as such, should it fail or be disconnected, Blank / Maintenance mode will be activated.

The purpose of an LFS is to provide manual local override and blank the sign display or perform local maintenance and diagnostic functions, if required.

9.8.2 NORMAL mode

Where NORMAL mode is selected on the LFS, the displayed message is selected via the maintenance communications port and/or the control communications port. The followings shall apply:

a) the hardwired sign display of that TVMS is active

b) the CU shall accept remote control communications from a remotely connected PC / laptop running the RSCS software, and

c) the CU shall accept remote control communications from a designated local handheld SRD.

9.8.3 Three message modes

Three modes labelled Message 1, Message 2, and Message 3 display either Message 1, 2 or 3. The messages shall be in accordance with QGTM Part 10.

Control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional.

9.9 Hardwired inputs

Where required, the TVMS 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 TVMS controller shall be capable of accepting a minimum of six hardwired inputs.

9.10 Communication protocol

Where connection to STREAMS is required, the communication between the Field Processor and the TVMS CU shall comply with TSI-SP-003, MRTS232 *Provision of Field Processors* and MRTS201 *General Equipment Requirements*.

9.11 Bus arbitration

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

9.12 Message hierarchy

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

9.13 Sign monitoring and logs

The CU shall monitor and log the following items, which shall be configurable to raise an alarm:

a) any SRD message requests of the CU, including the unique identifier of the SRD requesting message change

b) all RSCS software requests of the CU, including the RSCS username under which the request was made

c) all unauthorised RSCS software requests of the CU, including the RSCS username under which the request was made

d) loss of communications with the sign (noting the type of communication for example, SRD, RSCS, and so on)

e) high internal sign enclosure temperature

f) movement of the sign from its installed position

g) LED faults

h) initialisation of TVMS (power up)

i) when an SMS critical alert request has been transmitted by the CU

j) changed state of LFS (that is, NORMAL or Blank / Maintenance)

k) low battery voltage (for example, where the voltage of the power supply battery drops to a level that would prevent the battery from being recharged by the charging system)

l) loss of solar charge current / voltage

m) loss of load current

n) internal component faults (GPS and other modular hardware components), and

o) all configuration changes (for example, made through configuration or RSCS software).

The log shall identify the sign (through its respective sign ID) and its fault. The log shall include the date and time stamp for all entries and may be exported in a readily acceptable format, such as comma delimited text file (.csv), Microsoft Excel (.xls) or other formats as agreed with the project representative.

The log shall also report when the fault condition has cleared and subsequently returns to normal operation.

The log file storage for the event log shall be sufficient to allow at least eight days of continuous logging without overwriting. The oldest event record shall be overwritten first when the log file storage capacity has been exceeded.

For critical faults defined in Clause 9.14 below, the log shall include the RSCS or configuration software username ID which performed the acknowledgement and clearing of the fault.

Where a RSCS connection is in session, the RSCS software shall be synchronised and receive updates dynamically from the respective CU.

9.13.1 Turning motion sensor

Each TVMS may have the ability to detect whether the unit’s position has been altered from the installed position through the use of gyroscope.

The GPS receiver, directional compass and gyroscope facility will allow greater visibility of how the site layout is set out and whether any subsequent changes have occurred due to any number of scenarios.

9.13.2 Power system monitoring

The power system log is used for discerning the proper operation of the power system. The CU shall log the electrical parameters (referred to in Clause 9.15) for each connected sign within the roadwork site. For solar charge current / voltage, load current and battery charge voltage, the CU will aggregate the measurements that it receives from the connected signs over a one hour period using rolling averages.

Each sign shall report no less than four measurements for each parameter per hour to the connected CU.

9.13.3 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 TVMS shall operate.

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

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

a) one sensor facing forward perpendicular to the sign face, and

b) one sensor facing backward perpendicular to the sign face.

9.13.4 Temperature control

Each TVMS shall be provided with at least one temperature sensor to measure the temperature inside the display enclosure near the top centre. The 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 presented in Centigrade units.

9.14 Critical faults

Critical faults shall also include the following:

a) movement of the sign after installation – this is required to ensure the sign location has not been altered after installation due to unauthorised tampering, vehicular incident, wind and other reasons (a number of sensors will be used to determine whether the sign has been moved)

b) LED pixel faults – for example, which cause the display to be blanked (see Clause 11.2)

c) low battery voltage level alarm – when the battery level falls to the specified DoD (for example, indicating insufficient charge or problem with charging circuit)

d) charging voltage too high – when the battery charge voltage exceeds the maximum charge voltage for the selected battery (for example, indicating a possible battery charger regulator problem)

e) loss of solar module – for example, open circuit detected on solar power charging circuit, and

f) loss of load – for example, possible disconnection of extension cable between trailer / concrete block and sign display.

9.15 Alarms

Each sign shall be fitted with an SMS mobile phone alert system (refer to Clause 8.2.2).

Where critical faults occur:

a) an SMS notification will be sent from the respective CU to pre-specified phone numbers with a clear description of the site ID and a description of the fault

b) if the sign is connected to the RSCS, an alarm shall also be generated on the user alarm monitoring interface, and

c) the respective TVMS sign display shall be blanked only.

10 Software requirements

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

10.1 General software user interface and access security

The security requirements defined in MRTS201 *General Equipment Requirements* 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 7, Windows 10, and those industry standards current at the time of delivery
- be capable of operating on all such operating systems, and
- be backward compatible with existing TVMS 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 TVMS.

All insecure management protocols services, such as telnet, HTTP, and so on, shall be disabled to prevent any unauthorised communications terminal access to the local CU.

Should maintenance and diagnostic functions be required to be undertaken on the CU, then secure communication protocols such as SSH, HTTPS shall be used.

The software shall be web-based and display the location of the managed TVMS signs on a GIS layer which has up-to-date maps and associated geographic or spatial information.

The software shall allow the default message of a TVMS sign to be set.

10.2 Remote Sign Control System (RSCS) software

The RSCS may be used on site or via a location which is remote to the roadwork site such as a Traffic controller agency’s business premises.

RSCS software shall provide the functionality similar to TVSL as detailed in QGTM Part 10 which includes general security requirements, which are in addition to the requirements specified within this Technical Specification.

The RSCS shall be hosted on a Microsoft Windows operating system environment, from Windows 7 to the industry standard which current at the time of use. Any software provided must be capable of operating on all such operating systems.

10.3 TVMS configuration software

The TVMS sign shall be able to be initially programmed through the use of configuration software. Prior to any configuration of a TVMS sign's CU, the respective LFS switch shall have the "Blank / Maintenance" mode selected.

The primary functions of this software will be, but not limited to:

a) allow the required initial setup of a TVMS sign (including, but not limited to, configuration of messages, SRD administration functions, such as removing lost SRD units and replacing with other SRD via SRD IDs), and

b) perform any periodic maintenance and diagnostic functions required during the life of the product (including, but not limited to, reporting and extraction of fault / event logs, internal health statuses of internal TVMS sign components, such as battery, other I/O statuses, connection states for, SRD / CU, RSCS / CU communications).

10.4 Control / diagnostics software

The TVMS CU shall fully implement all TVMS functions as required by Clause 9 for all communications ports.

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

10.5 Configuration management

10.5.1 CU configuration

All settings in the CU, including settings included in Appendix A, the permissible messages and/or combinations of messages, shall be accessible using the configuration software. The configuration shall be site-specific and must ensure that only the CU with the correct configuration for the respective TVMS site is allowed to control its respective TVMS site.

The site-specific permitted messages, and/or combinations of messages and other user configurable settings, shall be stored in non-volatile memory such that they can be altered and downloaded from the configuration or RSCS without requiring any change to the CU firmware.

All firmware or software required for the TVMS sign, SRD or RSCS shall be fully backwards compatible with any previous versions.

> Backward compatibility becomes significant particularly if Transport and Main Roads has legacy system associated with a product and a new version of the product emerges.

10.5.2 Software program configuration

All software configuration changes shall be date and time stamp logged and include with the username of the software user who made the configuration setting change.

Prior to the application of any software configuration change, a backup of the existing configuration shall be copied and stored in non-volatile memory.

All associated TVMS software shall allow the saving of existing configuration settings for backup. The saved backup settings file shall be able to be used to restore previously saved configuration should this be required.

11 Variable message display requirements

11.1 General

The variable message 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.

The displays shall use 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 in accordance with AS 4852.2.

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

The permissible TVMS message types shall be as described in Clause 9.2.

11.2 Failures

Facilities shall be included to detect failures within the display control system. The DU 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 TVMS controller and blank the displays if loss of communication is experienced. The communications timeout period shall be a configurable setting.

The TVMS 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 TVMS shall become available for activation and remain blank until commanded by the TVMS controller or STREAMS. The power recovery delay time shall be configurable. At no time shall partial or incomplete messages be displayed.

The TVMS 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. If colours are generated with a colour mixing technology from a cluster of LEDs, failure of any LED within the cluster shall automatically turn off the entire cluster to avoid generation of colour noise. Refer to Appendix A.

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

11.3 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.

11.4 Character and graphical display formats

The TVMS sign shall be capable of displaying:

a) text

b) graphics, or

c) a combination of text and graphics.

All signs shall display their colours against a matt Black background.

11.4.1 Display Unit (DU) Requirements

Type A, Type B and Type C VMS shall comply with the display dimensional requirements of AS 4852.2.

Each alphanumeric character in the DU shall be formed by a matrix arrangement of horizontal and vertical pixels.

The signs shall have sufficient vertical pixels to permit lower case text, with descenders that lie wholly below the base of the upper-case characters. The character format shall be complied with the requirements of AS 4852.2.

The type of TVMS proposed for each location shall comply with the requirements of QGTM Part 10 and the Queensland MUTCD Part 3, and shall be specified on the design documentation.

11.5 Display fonts

As a minimum, the variable message display shall generate single stroke alphanumeric character fonts generally to the requirements of AS 1742, AS 1743 and AS 1744. The characters shall be arranged to have a minimum of two pixels between characters and two pixels between lines.

11.6 Display changes

Variable message display changes shall be in accordance with the *TVMS Use and Operations Guidelines*. All display changes shall be affected by first blanking the respective DU, and then activating all required pixels of the respective display simultaneously (as apparent to the eye).

11.7 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 TVMS failure and shall result in the display(s) being blanked after a pre-set time period. This time period shall be a variable, able to be set by STREAMS, with a range of 60 seconds to 600 seconds.

11.8 Optical performance

The performance of the TVMS displays must meet or exceed the optical characteristics defined in Clauses 11.8.1 to 11.8.6. Tests shall be performed by a NATA or NATA-accredited or NATA-endorsed by Mutual Recognition laboratory and the results submitted to the Principal. **Witness Point 1**

11.8.1 Luminance

The performance of the TVMS displays must meet or exceed the luminance and chromaticity parameters defined in AS 4852.2.

11.8.2 Display colour

The TVMS display shall be either be capable of displaying Monochrome (Yellow) or 5 Colour (Yellow, White, Red, Green and Orange). Yellow, White, Red, Green colours shall be compliant with AS 4852.1.

1. For monochromatic signs TVMS display shall be able to display individual pixels in Yellow against a matt Black background. LEDs shall be used within pixels to generate the output colour.
2. The VMS display shall be able to display individual pixels in either Yellow or White or Red or Green or Orange colours, against a matt Black background. LEDs shall be used within pixels to generate output colours. The individual pixels may generate colour with either discrete LED(s) for each of the five colours or via a colour mixing arrangement with RGB LEDs or equivalent technologies.
3. Yellow, White, Red, Green colours shall be compliant with AS 4852.2.
4. AS 4852.2 does not define the Orange region. The coordinates defined in Table 11.8.2 below are designed to fall within the Orange region for the retroreflective fluorescent Orange in AS 1906, having established that the TVMS Yellow region of AS 4852.2 largely falls within the retroreflective fluorescent Yellow region in AS 1906.

Table 11.8.2 – Chromaticity coordinates for orange

Colour		**1**	**2**	**3**	**4**
Orange	x	0.63	0.61	0.64	0.66
	y	0.37	0.37	0.34	0.34

5. In the event of the use of colour mixing or equivalent technology, any non-compliant colours to AS 4852.1 shall neither be configurable nor displayed under any circumstances.

11.8.3 LED dimming

The dimming requirements shall be as specified in AS 4852.2.

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

11.8.4 Luminance intensity half angle

The luminance half angle for type A, B and C signs shall meet the intensity half angle parameters defined in AS 4852.2.

11.8.5 Luminance intensity uniformity

The luminous intensity uniformity requirements shall be as specified in AS 4852.2.

11.8.6 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.

12 Documentation requirements

12.1 Operations and maintenance manual

Each sign shall be supplied with an operations and maintenance manual detailing how to safely use the signs. As a minimum, it shall detail:

a) safe transportation of the sign

b) onsite installation

c) guide on suitable locations for installation

d) setting up of the TVMS signs for operation

e) local configuration, remote management and administration using the RSCS software

f) starting up

g) shutting down

h) safe manual handling procedures for the batteries

i) routine and preventative maintenance

j) troubleshooting, and

k) workplace health and safety (WH&S) requirements.

13 Testing, commissioning and configuration requirements

After the signs are first built and before being used onsite, Factory Acceptance Tests (FAT) shall be completed in accordance with the requirements of this Technical Specification. **Witness Point 2**

The testing documentation for each sign used onsite shall be provided to the Principal when submitting the Traffic Guidance Scheme (QGTM Part 10) in accordance with Clause 5.3.2 of MRTS02 *Provision for Traffic*.

The generic Installation Acceptance Test (IAT), Commissioning Test (CT) and Customer Acceptance Test (CAT) shall be replaced with the Contractor's configuration process. The minimum general requirements for this process are detailed in MRTS201 *General Equipment Requirements*.

14 Training requirements

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

15 Maintenance requirements

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

16 Handover requirements

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

17 Product approval

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

Refer to Appendix B for the TVMS product approval compliance checklist that can be used by suppliers and product assessors in the product approval process.

Appendix A – Referenced variables and default settings

Reference	Description	Range of values	Factory default	Device(s), systems affected
8.3	Local configuration software – site controller Communications Session Time-out	1–600 seconds	300 seconds	Control unit / Configuration Software
9.3	Minimum message display time	1–5 seconds	5 seconds	Control unit / sign display
11.2	Sign processor fault blank time	0.5–3 seconds	1 second	Sign display
	Communications check with sign display	0–30 seconds	Once every 5 seconds	Control unit / sign display
	Power recovery delay time	1–600 seconds	60 seconds	Control unit / sign display
	Minimum blank time	1–120 seconds	30 seconds	Control unit / sign display

Appendix B – Type approval compliance checklist

Item #	MRTS262 *Transportable Variable Message Signs* product approval requirements	Reference document/s	MRTS202 2019 reference Clause	VERIFICATION METHOD					Product compliance (Y, TBC, N, N/A)
				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
5 Operational requirements									
1	The use of the TVMS shall be in accordance with Queensland Guide to Traffic Management (QGTM) Part 10 and the Queensland MUTCD and have the capability of operating as follows.	MRTS262, QGTM Part 10, Queensland MUTCD	5.2						
2	The TVMS shall be operated by selecting the following methods via the TVMS controller: Locally, when the TVMS controller has been selected for BLANK / MAINTENANCE operation using a local facility switch. This would enable operation of the TVMS through the TVMS configuration software and/or hardwired inputs to select one of a number of predetermined messages.	MRTS262	5.3	X				X	
3	The TVMS shall be operated by selecting the following methods via the TVMS controller: Remotely, when the TVMS controller has been selected for NORMAL operation. This will enable operation through a hand-held short-range device (SRD) and/or remote sign control system (RSCS), which may be compatible with an existing Transport and Main Roads system, such as STREAMS.	MRTS262	5.3	X				X	
4	The TVMS controller shall provide the operational interface with the SRD and RSCS.	MRTS262	5.3			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
5	The local TVMS operating system supported on the CU shall have a minimum of 99.9% operating reliability.	MRTS262	5.3		X				
6	All vehicle-mounted and trailer / concrete block-mounted TVMS used in safety-related applications shall only be deployed following the appropriate risk analysis undertaken to ensure safety in the event of sign failure. An example of risk mitigation option could be video monitoring of the sign face.	MRTS262	5.4					X	
6 Mechanical, physical, enclosure and mounting requirements									
7	The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* and MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices* apply to work provided under this Technical Specification. Additional mechanical and physical requirements for equipment provided under this Technical Specification are described below.	MRTS262	6.1						
8	Unless otherwise specified, the design life of the TVMS components shall be in accordance with Clause 2.2 of AS 4852.2.	MRTS262, AS 4852.2	6.2		X				
9	For the electrical system, not less than 15 years.	MRTS262, AS 4852.2	6.2		X				
10	For the sign enclosure, not less than 20 years.	MRTS262, AS 4852.2	6.2		X				
11	For the trailer and mounting support, not less than 20 years.	MRTS262, AS 4852.2	6.2		X				

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
12	The display enclosure shall be capable of being mounted on a vehicle, a trailer or a concrete block support structure in a location consistent with QGTM Part 10. The mounting structures supporting the TVMS shall be designed for the site conditions in which they are intended to be used.	MRTS262	6.2.1					X	
13	The structure shall be designed in accordance with MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*, AS/NZS 1170.1 and AS/NZS 1170.2 when installed with all supporting hardware and accessories used to operate the signs, including the solar panels, where fitted.	MRTS262, MRTS61, AS/NZS 1170.1, AS/NZS 1170.2	6.2.1					X	
14	Vehicle, trailer and/or concrete block support structure design documentation showing compliance with this Technical Specification and certified by a RPEQ shall be submitted to the Principal's representative for review and acceptance.	MRTS262	6.2.1				X		
15	The vehicle on which the TVMS is mounted shall conform to the requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification. Where there is discrepancy between the Queensland MUTCD Part 3 and this Technical Specification regarding the host vehicle, the Queensland MUTCD Part 3 takes precedence. If required, vehicle-mounted TVMS shall be fitted with solar panels.	MRTS262, Queensland MUTCD	6.2.2						

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
16	Where the TVMS is mounted on a trailer, the sign and solar panel array shall have a mechanical system which allows the sign and solar panel to be safely secured to the trailer for transportation.	MRTS262	6.2.3	X				X	
17	The mechanical system shall also allow for the sign and solar panel to be safely erected onsite to ensure the sign is clearly visible to motorists and that the solar panels can be adjusted to ensure optimum solar exposure and maximum energy generation in any part of the State of Queensland.	MRTS262	6.2.3	X				X	
18	The mechanical systems shall ensure that the sign cannot rotate due to wind gusts up to the ultimate wind speed the structure is designed.	MRTS262	6.2.3	X				X	
19	The trailer shall comply with the applicable Australian Design Rules and shall be suitable for registration in accordance with the statutory requirements of the State of Queensland. All metal surfaces shall be painted in the range of high visibility colours from X15 Orange to X13 Marigold as specified in AS 2700.	MRTS262, AS 2700	6.2.3	X	X			X	
20	The final design documentation of concrete block mounts shall include the location and type of mounting structure to be provided to mount each TVMS and the Contractor shall not commence fabrication of the footing and support structure until that final design documentation has been accepted by the Principal or their delegate.	MRTS262	6.2.4				X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
21	The surface finishes shall be compliant to AS 4852.1 Section 3.1.2 with all external surfaces apart from the front face painted in the range of high visibility colours from X15 Orange to X13 Marigold as specified in AS 2700. \	MRTS262, AS 4852.1, AS 2700	6.3	X				X	
22	All internal and external surfaces shall be free from sharp edges or protrusions.	MRTS262, AS 4852.1	6.3	X					
23	The colour of the front face of the sign shall be matt Black.	MRTS262, AS 4852.1	6.3	X					
24	The 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® polycarbonate sheet, or equivalent, with UV-resistant 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.	MRTS262	6.4.1	X				X	
25	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 ± 45° (horizontal) and ± 30° (vertical) to the axis perpendicular to the front plane of the display.	MRTS262	6.4.1		X			X	
26	The front cover shall be able to be removed from outside the TVMS for maintenance without requiring removal of internal components. Fasteners and retaining cover strips shall be easily accessible.	MRTS262	6.4.2	X				X	

Item #	MRTS262 *Transportable Variable Message Signs* product approval requirements	Reference document/s	MRTS202 2019 reference Clause	VERIFICATION METHOD					Product compliance (Y, TBC, N, N/A)
				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
27	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.	MRTS262	6.4.2	X			X		
28	A mechanism shall be provided to prevent condensation on the inside surface of the front cover. One way this could be done is by using a demister or other dehumidifying solutions.	MRTS262	6.5	X			X		
29	The sign enclosure shall house the DU and associated control electronics, and comply with the requirements of MRTS201 *General Equipment Requirements*. The sign enclosure shall be made of Marine Grade Aluminium compliant with AS 4852.1 Clause 3.1.1.	MRTS262, MRTS201, AS 4852.1	6.6.1						
30	The sign enclosure shall be constructed from marine grade aluminium alloy 5251 H32 to conform to AS/NZS 1734. The sign enclosure shall be reinforced and/or braced to facilitate the erection and continued operation of the unit in the intended application.	MRTS262, AS 4852.1, AS/NZS 1734	6.6.1		X			X	

Item #	MRTS262 *Transportable Variable Message Signs* product approval requirements	Reference document/s	MRTS202 2019 reference Clause	VERIFICATION METHOD					Product compliance (Y, TBC, N, N/A)
				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
31	All external metal sections of the completed enclosure shall be suitably treated (for example, by a polyester powder coating). The surfaces shall be thoroughly cleaned and subject to the appropriate pre-treatment before the treatment is applied. The finish to the surface shall ensure that deterioration due to atmospheric and/or local environmental conditions has no detrimental effect on the structural integrity or appearance (including fading) of the finished enclosure for a period not less than 10 years.	MRTS262, AS 4852.1	6.6.1		X			X	
32	All sundry components used for connection and/or bracing of the sign onto the support structure shall be manufactured or constructed from suitably protected materials. All steel works shall be hot-dip galvanized in accordance with AS/NZS 4680.	MRTS262, AS 4852.1, AS/NZS 4680	6.6.1					X	
33	The display enclosure shall provide a degree of protection of not less than that required for the classification of IP65 in accordance with AS 60529 in normal service.	MRTS262, AS 60529	6.6.1		X				
34	Access shall be provided to allow TVMS maintenance and configuration. The door arrangement shall be compatible with the mounting structure members. The mounting structure shall comply with the requirements of MRTS201 *General Equipment Requirements* and MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*.	MRTS262, MRTS201, MRTS61	6.6.1					X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
7 Electrical requirements									
35	Portable signs shall be solar powered in accordance with the requirements of MRTS263 *Standalone Solar (PV) Power Systems* and the relevant requirements of AS 4852.2.	MRTS262, MRTS263, AS 4852.2	7.1					X	
36	The solar power system shall provide uninterrupted continuous operation with a minimum of seven-day battery backup.	MRTS262, AS 4852.2	7.1					X	
37	The solar panel array charge capacity shall be capable of fully maintaining operation of the sign and associated communications facilities for a continuous period of 24 h under a solar irradiation of 40,000 lx for 4 h, while simultaneously charging the reservoir battery.	MRTS262, AS 4852.2	7.1		X			X	
38	The solar panel array shall be capable of being positioned and tilted to the correct angle to enable maximum collection of solar power.	MRTS262, AS 4852.2	7.1			X	X	X	
39	Each sign shall also have the facility to be mains powered so the batteries can be charged before being deployed to site or while at site. This shall include a mains battery charger and an IP65-rated locking connector to enable the external power supply to be easily connected and disconnected from the sign. The relevant electrical requirements defined in Clause 10 of MRTS201 *General Equipment Requirements* apply.	MRTS262, MRTS201	7.1		X	X			

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
40	Fixed signs shall be mains powered, with an IP65-rated locking connector to enable the external power supply to be easily connected and disconnected from the sign, and with surge protection and battery power supply in accordance with the requirements of Clause 10 of MRTS201 *General Equipment Requirements* and the relevant requirements of AS 4852.1.	MRTS262, MRTS201, AS 4852.1	7.2		X	X			
41	The power supply system shall be designed and installed in accordance with AS/NZS 4509.1 and AS/NZS 4509.2.	MRTS262, AS 4852.1	7.2					X	
42	The power supply system shall be designed to allow the sign to operate unattended in any of its modes and simultaneously to charge the battery from a discharged condition to full charge, as required. The power supply shall be a solar power system comprising the following key components: • solar panel array • solar supply regulator • reservoir battery • auxiliary 240 V a.c. battery charger, and • provision for connection to external 240 V a.c. supply.	MRTS262, AS 4852.1	7.2				X	X	
43	The reservoir battery shall be of a type suitable to be charged and discharged continuously, as required. It shall have a useful life of not less than 12 months.	MRTS262, AS 4852.1	7.2		X			X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
44	The auxiliary 240 V a.c. battery charger shall be able to charge the battery from a fully-discharged state to a fully-charged state in not more than 16 h.	MRTS262, AS 4852.1	7.2		X			X	
45	All electrical equipment and wiring shall conform to the safety requirements of applicable Australian Standards.	MRTS262, AS 4852.1	7.2					X	
46	Where specified, also provide lightning protection to comply with AS/NZS 1768.	MRTS262, AS/NZS 1768	7.2			X			
8 Telecommunication requirements									
47	The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification. Vehicles used for mounting TVMS shall comply with the communication requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification in order of preference.	MRTS262, MRTS201, Queensland MUTCD Part 3	8						
48	Communication between the local CU and LED sign display shall be via a direct wired connection. The communications system shall be secure, tamperproof and fully-enclosed. Messages transmitted from the CU to the LED display shall be displayed within 50 ms of being sent.	MRTS262	8.1.1	X		X		X	
49	Provision shall be made for communication between the CU(s) and SRD(s) via a wired or wireless connection.	MRTS262	8.1.3				X	X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
50	For wired connection between the CU and the SRD, the connecting lead shall be at least 15 m.	MRTS262	8.1.3	X				X	
51	Wireless connection between the CU and the SRD shall use local encrypted wireless communication technology, such as ultra-high frequency (UHF) radio band or other reliable wireless technology. The wireless SRD shall be as specified in Clause 9.7 below.	MRTS262	8.1.3, 9.7			X		X	
52	The SRD and CU shall communicate reliably over wireless point-to-point ranges of at least 150 m.	MRTS262	8.1.3			X		X	
53	Where an SRD has requested a change of message on a TVMS sign CU, the message change shall be completed within 250 ms of the request: that is, the respective CU's display shall energise the requested message LED pixels.	MRTS262	8.1.3			X		X	
54	Any radio frequency communications antennas shall be positioned at the highest point on the TVMS sign to make effective use of available signal gain and avoid line-of-sight signal attenuation by objects such as concrete barriers and shrubs.	MRTS262	8.1.3	X				X	
55	Wireless communication shall be compliant to Australian Communications and Media Authority (ACMA) requirements.	MRTS262	8.1.3		X			X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
56	The requirement for remote site communications may not be applicable to vehicle-mounted TVMS that comply with the Queensland MUTCD Part 3. The following apply to trailer mount and concrete block mount TVMS.	MRTS262, Queensland MUTCD Part 3	8.2						
57	Communication between the CU and the RSCS software shall be via a secure wireless connection using a third-party 3G / 4G mobile service provider using secure interface and access protocols as detailed in Clause 10.1 below. All communication over third-party communications network shall provide adequate privacy and integrity of data to the satisfaction of the Principal.	MRTS262	8.2.1		X			X	
58	The carrier selected shall have sufficient and reliable coverage at the project Site.	MRTS262	8.2.1			X		X	
59	All messages transmitted from the RSCS software to and from CU-embedded firmware shall not exceed 4.0 seconds.	MRTS262	8.2.1					X	
60	Communication between the unit controller and a mobile phone for the purposes of the transmission of critical alert SMS notifications as defined in Clause 9.15 below shall be via a third-party SMS mobile service provider. The telecommunications carrier selected shall have sufficient and reliable coverage at the project Site.	MRTS262	8.2.2					X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
61	For any SRD or RSCS to CU communications, periodic timeout check shall be ignored, and the display shall remain on indefinitely until requested otherwise.	MRTS262	8.3			X		X	
62	For Blank / Maintenance mode, if the configuration software remains inactive for a period as defined in Appendix A, then the user session will be terminated, the sign display blanked and the user will need to logon again and establish another session.	MRTS262	8.3, Appendix A			X		X	
63	All time-out periods shall be software configurable with ranges and default values stated in Appendix A.	MRTS262	8.3, Appendix A			X		X	
64	It shall be possible to control and interrogate the TVMS via a 10/100 Base-T Ethernet maintenance communications port via the TVMS controller. The Ethernet port shall allow local and remote communications via a laptop computer installed with TVMS messaging and diagnostics software provided by the supplier. The maintenance communications port shall also allow remote connection of a similar computer via a modem.	MRTS262	8.4.1, 8.1.2				X	X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
65	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 TVMS control system or computer / software. The hardware handshaking lines of the Ethernet 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 TVMS.	MRTS262	8.4.1, 8.1.2			X		X	
66	The TVMS control and diagnostics software shall be capable of operating at all possible modem connection speeds.	MRTS262	8.4.1, 8.1.2			X		X	
67	It shall be possible to control and interrogate the TVMS via either of EIA / RS-232 or 10/100 Base-T Ethernet or both control communications ports. The control communications port shall allow local connection of a Field Processor / modem for communications with STREAMS.	MRTS262	8.4.2, 8.1.2				X	X	
68	While a PC / laptop computer is connected to the TVMS via the maintenance communications port, control of the TVMS via the control ports shall be inhibited; however, status and diagnostic interrogation by STREAMS via the control ports shall be maintained.	MRTS262	8.4.2, 8.1.2			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
69	Complete control and monitoring by STREAMS shall be maintained through either, and/or both control communications ports as determined by telecommunications infrastructure provided at each Site.	MRTS262	8.4.2, 8.1.2			X		X	
70	Where communications equipment is connected to both control communications ports, the primary port shall be used for control commands to / from the TVMS, and the secondary port shall be used for status-only communications with the TVMS.	MRTS262	8.4.2, 8.1.2			X		X	
71	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 TVMS shall automatically revert to full control and status communications through the active port.	MRTS262	8.4.2, 8.1.2			X		X	
72	TVMS communications software shall be capable of operating at all possible modem connection and/or serial / Ethernet port speeds.	MRTS262	8.4.2, 8.1.2			X		X	
73	The SRD and CU shall each have a configurable unique communications ID: for example, a three-digit integer between 001 and 255.	MRTS262	8.5			X		X	
74	Communications messages between the CU and SRD shall include a checksum unique to each TVMS site and shall be computed based on the message information exchanged to ensure integrity of the communication is upheld.	MRTS262	8.5			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
75	The checksum shall be available for confirmation by the RSCS that the message frames at each TVMS site are the same as those stored within the RSCS software. The checksum shall be verified periodically and recomputed each time the message frames is changed and/or that the CU is reset / rebooted.	MRTS262	8.5			X		X	
76	A TVMS CU unique ID shall be configured through RSCS or configuration software.	MRTS262	8.5.1			X		X	
77	Any communications messages transmitted by a CU shall embed the CU's respective ID.	MRTS262	8.5.1			X		X	
78	A physical label displaying this ID must be clearly visible on the TVMS.	MRTS262	8.5.1			X		X	
79	A unique SRD ID shall be configured on an SRD through a settable dipswitch or electronically configured using the RSCS or configuration software	MRTS262	8.5.2			X		X	
9 Control unit (CU) requirements									
80	The control system requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Vehicles used for mounting TVMS shall comply with the control requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification in order of preference.	MRTS262, MRTS201, Queensland MUTCD Part 3	9.1						

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
81	Each TVMS shall be controlled by a CU that is operated in the following order of priority: 1. local facility switch 2. hardwired input(s) 3. maintenance communications port, and 4. control communications ports.	MRTS262	9.1			X		X	
82	Software shall be provided in accordance with Clause 10.	MRTS262	9.1, 10						
83	The DU shall be able to be controlled individually or simultaneously.	MRTS262	9.1			X		X	
84	The CU of each TVMS shall: a) conduct all processing associated with the communications support for paired signs	MRTS262	9.1	X		X		X	
85	b) ensure that the requested messages are immediately displayed on the TVMS sign LED display and carries out all associated processing and monitoring functions	MRTS262	9.1	X		X		X	
86	c) monitor, log and report the operation of each connected sign display individually	MRTS262	9.1	X		X		X	
87	d) monitor, log and report events crucial for the operation of the sign	MRTS262	9.1	X		X		X	
88	e) allow the TVMS to be controlled individually or as part of a pair	MRTS262	9.1	X		X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
89	f) be capable of storing all recommended message frames in its non-volatile memory, refer to QGTM, Part 10 for the recommended messages	MRTS262, QGTM Part 10	9.1	X		X		X	
90	g) command signs to display only the allowable messages for that respective site as defined by the QGTM Part 10	MRTS262, QGTM Part 10	9.1	X		X		X	
91	h) allow local automatic reset of sign displays and the CU itself, such as via watchdog(s)	MRTS262	9.1	X		X		X	
92	i) be capable of automatically dimming connected signs based on the average of the light sensor outputs (automatic dimming of the sign occurs to increase ambiance, automatic dimming is not permitted for the sole purpose of extending the battery life)	MRTS262	9.1	X		X		X	
93	j) accept / reject valid or invalid commands made by the SRD, RSCS, configuration software	MRTS262	9.1	X		X		X	
94	k) allow a unique electronic identification for each site to be configured	MRTS262	9.1	X		X		X	
95	l) electronically verify with the connected sign display that the displayed message is consistent with the message originally requested and permitted	MRTS262	9.1	X		X		X	
96	m) accept an analogue input from a Local Facility Switch (LFS), and	MRTS262	9.1	X		X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
97	n) recognise additional information and functionality of the CU required is described in the following sections.	MRTS262	9.1						
98	Each TVMS CU shall be configured to store only those message types permitted to be displayed as defined in QGTM Part 10 for the site in which they are operating. This will be achieved through the RSCS or configuration software referred to in this Technical Specification. The CU shall ensure that only messages permitted for that site are displayed on its respective signs.	MRTS262, QGTM Part 10	9.2			X		X	
99	The CU shall allow: a) the configuration software to read and write its permitted messages / message combinations b) the RSCS to read its stored messages, and c) stored messages to be downloaded to the sign(s) only when required to be displayed.	MRTS262	9.2					X	
100	The permissible messages for each site shall be confirmed with the Principal.	MRTS262	9.2					X	
101	The minimum display duration of each message frame shall be configurable and accessible via the TVMS configuration software. The time range and factory default settings are shown in Appendix A.	MRTS262	9.3, Appendix A						
102	The TVMS display and CU must each monitor the state of its respective processor and blank the respective display(s) if processor failure occurs.	MRTS262	9.4			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
103	The CU shall generate an alarm and blank all signs if the integrity of the firmware or configuration is compromised.	MRTS262	9.4			X		X	
104	Each TVMS sign shall be fitted with a GPS receiver. The onboard GPS receiver shall monitor the location in three dimensions (latitude, longitude and altitude) of each sign and also synchronise the TVMS CU internal clock.	MRTS262	9.5			X	X	X	
105	The CU shall provide an alarm if a sign is moved beyond a 30 m radius of its installed position. This may be achieved using a virtual perimeter or 'geo-fence'.	MRTS262	9.5			X		X	
106	Vehicles that mount TVMS, and which are compliant with Queensland MUTCD Part 3, may not require GPS.	MRTS262, Queensland MUTCD Part 3	9.5					X	
107	Each TVMS may have the ability to discern the installed directional orientation and whether any subsequent change in direction has been detected through the use of a Magnetometer or Inertial type sensor.	MRTS262	9.6				X	X	
108	The local method of control is via a handheld SRD communications device. The following requirements shall apply to the use of the SRD: a) have a unique ID (refer to Clause 8.5 above) that is transmitted with each message change request	MRTS262	9.7, 8.5					X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
109	b) should a RSCS message change request occur at the same time as the message change request from an SRD, the SRD request shall have priority and the RSCS request shall be ignored	MRTS262	9.7					X	
110	c) for wireless SRD, use 'code hopping' or 'rolling code' technology, to prevent unauthorised use of the signs through 'replay attacks'	MRTS262	9.7					X	
111	d) for wired SRD, the leads shall preferably be securely terminated in the RS-232 / Ethernet port of the TVMS sign or any other secure termination resulting in 15 m lead	MRTS262	9.7					X	
112	e) the CU shall have the ability to deactivate an SRD from controlling the TVMS sign (for example, due to lost or damaged SRDs) through the TVMS configuration or RSCS software, and	MRTS262	9.7					X	
113	f) only when an SRD message activation button is pressed and held for two seconds shall a control message be transmitted.	MRTS262	9.7					X	
114	To guard against accidental activation of a TVMS frame from the SRD, buttons must be pressed and held for two seconds before any TVMS message frame will be changed.	MRTS262	9.7			X			

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
115	A five-position key-operated facility switch that complies with MRTS201 *General Equipment Requirements* shall be provided to enable selection of the following five-display functions for each of the text display and the graphics display: 1. Blank / Maintenance 2. NORMAL, or 3. Three message modes.	MRTS262, MRTS201	9.8	X		X	X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
116	Where Blank / Maintenance mode is selected on an LFS, the following requirement shall apply: a) the hardwired sign display of that TVMS sign shall be blanked b) whilst this mode is selected at the particular TVMS sign, any subsequent display requests from a RSCS – software session or SRD shall be ignored c) the TVMS sign shall remain powered d) where two signs have been configured as one pair, selecting the LFS to “BLANK” on one TVMS sign shall not blank the other paired TVMS sign unit e) a locally connected PC / laptop running the configuration software shall be permitted to perform all status, maintenance and diagnostic functions on the respective TVMS sign, and f) the LFS shall be designed as failsafe operation and, as such, should it fail or be disconnected, Blank / Maintenance mode will be activated.	MRTS262	9.8.1			X		X	

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117	Where NORMAL mode is selected on the LFS, the displayed message is selected via the maintenance communications port and/or the control communications port. The followings shall apply: a) the hardwired sign display of that TVMS is active b) the CU shall accept remote control communications from a remotely connected PC / laptop running the RSCS software, and c) the CU shall accept remote control communications from a designated local handheld SRD.	MRTS262	9.8.2			X			
118	Three modes labelled Message 1, Message 2, and Message 3 display either Message 1, 2 or 3. The messages shall be in accordance with QGTM Part 10. Control via all communications ports inhibited; status and diagnostic commands via all communications ports remain functional.	MRTS262, QGTM Part 10	9.8.3			X			
119	Where required, the TVMS 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.	MRTS262	9.9			X			
120	Unless otherwise specified, the TVMS controller shall be capable of accepting a minimum of six hardwired inputs.	MRTS262	9.9			X	X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
121	Where connection to STREAMS is required, the communication between the Field Processor and the TVMS CU shall comply with TSI-SP-003, MRTS232 *Provision of Field Processors* and MRTS201 *General Equipment Requirements*.	MRTS262, TSI-SP-003, MRTS232, MRTS201	9.10					X	
122	Each TVMS shall act as a slave on the EIA RS-422A / modem bus.	MRTS262	9.11			X		X	
123	Each TVMS controller shall provide a user-configurable message hierarchy for message selection commands and hardwired inputs.	MRTS262	9.12			X		X	
124	The CU shall monitor and log the following items, which shall be configurable to raise an alarm: a) any SRD message requests of the CU, including the unique Identifier of the SRD requesting message change	MRTS262	9.13			X		X	
125	b) all RSCS software requests of the CU, including the RSCS username under which the request was made	MRTS262	9.13			X		X	
126	c) all unauthorised RSCS software requests of the CU, including the RSCS username under which the request was made	MRTS262	9.13			X		X	
127	d) loss of communications with the sign (noting the type of communication for example, SRD, RSCS, and so on)	MRTS262	9.13			X		X	
128	e) high internal sign enclosure temperature	MRTS262	9.13			X		X	

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129	f) movement of the sign from its installed position	MRTS262	9.13			X		X	
130	g) LED faults	MRTS262	9.13			X		X	
131	h) initialisation of TVMS (power up)	MRTS262	9.13			X		X	
132	i) when an SMS critical alert request has been transmitted by the CU	MRTS262	9.13			X		X	
133	j) changed state of LFS (that is, NORMAL or Blank / Maintenance)	MRTS262	9.13			X		X	
134	k) low battery voltage (for example, where the voltage of the power supply battery drops to a level that would prevent the battery from being recharged by the charging system)	MRTS262	9.13			X		X	
135	l) loss of solar charge current / voltage	MRTS262	9.13			X		X	
136	m) loss of load current	MRTS262	9.13			X		X	
137	n) internal component faults (GPS and other modular hardware components), and	MRTS262	9.13			X		X	
138	o) all configuration changes (for example, made through configuration or RSCS software).	MRTS262	9.13			X		X	
139	The log shall identify the sign (through its respective sign ID) and its fault. The log shall include the date and time stamp for all entries and may be exported in a readily acceptable format, such as comma delimited text file (.csv), Microsoft Excel (.xls) or other formats as agreed with the project representative.	MRTS262	9.13					X	

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140	The log shall also report when the fault condition has cleared and subsequently returns to normal operation.	MRTS262	9.13			X		X	
141	The log file storage for the event log shall be sufficient to allow at least eight days of continuous logging without overwriting. The oldest event record shall be overwritten first when the log file storage capacity has been exceeded.	MRTS262	9.13					X	
142	For critical faults defined in Clause 9.14 below, the log shall include the RSCS or configuration software username ID which performed the acknowledgement and clearing of the fault.	MRTS262	9.13					X	
143	Where a RSCS connection is in session, the RSCS software shall be synchronised and receive updates dynamically from the respective CU.	MRTS262	9.13					X	
144	Each TVMS may have the ability to detect whether the unit's position has been altered from the installed position through the use of gyroscope.	MRTS262	9.13.1					X	
145	The GPS receiver, directional compass and gyroscope facility will allow greater visibility of how the site layout is set out and whether any subsequent changes have occurred due to any number of scenarios.	MRTS262	9.13.1			X		X	

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146	The power system log is used for discerning the proper operation of the power system. The CU shall log the electrical parameters (referred to in Clause 9.15) for each connected sign within the roadwork site. For solar charge current / voltage, load current and battery charge voltage, the CU will aggregate the measurements that it receives from the connected signs over a one-hour period using rolling averages.	MRTS262	9.13.2					X	
147	Each sign shall report no less than four measurements for each parameter per hour to the connected CU.	MRTS262	9.13.2			X		X	
148	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 TVMS shall operate.	MRTS262	9.13.3			X		X	
149	Each TVMS shall support automatic brightness variation, where the TVMS determines the LED brightness level using a light sensor reading and a predefined set of light sensor values.	MRTS262	9.13.3			X		X	
150	Each TVMS shall be provided with at least two light sensors to detect ambient light levels. These sensors shall be located as follows: a) one sensor facing forward perpendicular to the sign face, and b) one sensor facing backward perpendicular to the sign face.	MRTS262	9.13.3			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
151	Each TVMS shall be provided with at least one temperature sensor to measure the temperature inside the display enclosure near the top centre. The 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 presented in Centigrade units.	MRTS262	9.13.4	X			X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
152	Critical faults shall also include the following: a) movement of the sign after installation – this is required to ensure the sign location has not been altered after installation due to unauthorised tampering, vehicular incident, wind and other reasons – a number of sensors will be used to determine whether the sign has been moved b) LED pixel faults – for example, which cause the display to be blanked (see Clause 11.2) c) low battery voltage level alarm - when the battery level falls to the specified DoD (for example, indicating insufficient charge or problem with charging circuit) d) charging voltage too high - when the battery charge voltage exceeds the maximum charge voltage for the selected battery (for example, indicating a possible battery charger regulator problem) e) loss of solar module – for example, open circuit detected on solar power charging circuit, and f) loss of load – for example, possible disconnection of extension cable between trailer / concrete block and sign display.	MRTS262	9.14, 11.2			X		X	
153	Each sign shall be fitted with an SMS mobile phone alert system (refer to Clause 8.2.2).	MRTS262	9.15, 8.2.2			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
154	Where critical faults occur: a) an SMS notification will be sent from the respective CU to pre-specified phone numbers with a clear description of the site ID and a description of the fault b) if the sign is connected to the RSCS, an alarm shall also be generated on the user alarm monitoring interface, and c) the respective TVMS sign display shall be blanked only.	MRTS262	9.15			X		X	
10 Software requirements									
155	The security requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.	MRTS262, MRTS201	10.1					X	
156	In addition, the software shall: • request passwords as part of the access and configuration authorisation process – passwords shall be generally in accordance with IS18	MRTS262, IS18	10.1			X		X	
157	• provide two access levels, namely, Administrator and Standard user, as a minimum	MRTS262	10.1			X		X	
158	• be compatible with Microsoft Windows operating system environment, Windows 7, Windows 10, and those industry standards current at the time of delivery	MRTS262	10.1			X		X	
159	• ensure any software provided shall be capable of operating on all such operating systems, and	MRTS262	10.1			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
160	• be backward compatible with existing TVMS purchased from the same manufacturer.	MRTS262	10.1			X		X	
161	The factory default user credentials shall not be used, and these shall be changed prior to any operation of the TVMS.	MRTS262	10.1			X		X	
162	All insecure management protocols services, such as telnet, HTTP, and so on, shall be disabled to prevent any unauthorised communications terminal access to the local CU.	MRTS262	10.1			X		X	
163	Should maintenance and diagnostic functions be required to be undertaken on the CU, then secure communication protocols such as SSH, HTTPS shall be used.	MRTS262	10.1			X		X	
164	The software shall be web-based and display the location of the managed TVMS signs on a GIS layer which has up-to-date maps and associated geographic or spatial information.	MRTS262	10.1			X		X	
165	The software shall allow the default message of a TVMS sign to be set.	MRTS262	10.1			X		X	
166	The RSCS may be used onsite or via a location which is remote to the roadwork site such as a traffic controller agency's business premises.	MRTS262	10.2					X	
167	RSCS software shall provide the functionality similar to TVSL as detailed in QGTM Part 10, which includes general security requirements in addition to the requirements specified within this Technical Specification.	MRTS262, QGTM Part 10	10.2					X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
168	The RSCS shall be hosted on a Microsoft Windows operating system environment, from Windows 7 to the industry standard which is current at the time of use. Any software provided must be capable of operating on all such operating systems.	MRTS262	10.2			X		X	
169	The TVMS sign shall be able to be initially programmed through the use of configuration software. Prior to any configuration of a TVMS sign's CU, the respective LFS switch shall have the Blank / Maintenance mode selected.	MRTS262	10.3			X		X	
170	The primary functions of this software will be, but not limited to: 1. allow the required initial setup of a TVMS sign (including, but not limited to, configuration of messages, SRD administration functions, such as removing lost SRD units and replacing with other SRD via SRD IDs), and	MRTS262	10.3			X		X	
171	2. perform any periodic maintenance and diagnostic functions required during the life of the product (including, but not limited to, reporting and extraction of fault / event logs, internal health statuses of internal TVMS sign components, such as battery, other I/O statuses, connection states for, SRD / CU, RSCS / CU communications).	MRTS262	10.3			X		X	
172	The TVMS CU shall fully implement all TVMS functions as required by Clause 9 for all communications ports.	MRTS262	10.4			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
173	The software shall report the selected position of the facility switch.	MRTS262	10.4			X		X	
174	All settings in the CU, including settings included in Appendix A, the permissible messages and/or combinations of messages, shall be accessible using the configuration software. The configuration shall be site-specific and must ensure that only the CU with the correct configuration for the respective TVMS site is allowed to control its respective TVMS site.	MRTS262	10.5, Appendix A			X		X	
175	The site-specific permitted messages, and/or combinations of messages and other user configurable settings, shall be stored in non-volatile memory such that they can be altered and downloaded from the configuration or RSCS without requiring any change to the CU firmware.	MRTS262	10.5			X		X	
176	All firmware or software required for the TVMS sign, SRD or RSCS shall be fully backwards compatible with any previous versions.	MRTS262	10.5			X		X	
177	All software configuration changes shall be date and time stamp logged and include with the username of the software user who made the configuration setting change.	MRTS262	10.5.2			X		X	
178	Prior to the application of any software configuration change, a backup of the existing configuration shall be copied and stored in non-volatile memory.	MRTS262	10.5.2			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
179	All associated TVMS software shall allow the saving of existing configuration settings for backup. The saved backup settings file shall be able to be used to restore previously saved configuration, should this be required.	MRTS262	10.5.2			X		X	
11 Variable message display requirements									
180	The variable message 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.	MRTS262	11.1	X		X	X		
181	The displays shall use 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 in accordance with AS 4852.2.	MRTS262, AS 4852.2	11.1	X		X	X		
182	Pixel pitches shall be equal vertically and horizontally across the display area.	MRTS262, AS 4852.2	11.1		X			X	
183	The variable message display pixels shall be in modules of a size capable of being removed and installed by hand via access door(s) or screen.	MRTS262	11.1			X	X		
184	The permissible TVMS message types shall be as described in Clause 9.2.	MRTS262	11.1, 9.2					X	
185	Facilities shall be included to detect failures within the display control system. The DU shall blank the display in the event of a sign processor fault. Time to blank shall be a configurable setting.	MRTS262	11.2			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
186	The DU shall monitor communications with the TVMS controller and blank the displays if loss of communication experienced. The communications timeout period shall be configurable setting.	MRTS262	11.2			X		X	
187	The TVMS 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.	MRTS262	11.2			X		X	
188	On power restoration after loss of power, the TVMS shall become available for activation and remain blank until commanded by the TVMS controller or STREAMS. The power recovery delay time shall be configurable. At no time shall partial or incomplete messages be displayed.	MRTS262	11.2			X		X	
189	The TVMS 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. If colours are generated with a colour mixing technology from a cluster of LEDs, failure of any LED within the cluster shall automatically turn off the entire cluster to avoid generation of colour noise. Refer to Appendix A.	MRTS262	11.2, Appendix A			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
190	Single LED failure, provided that the cumulative LED loss remains below the 2% and/or 20% thresholds described above or TVMS light sensor failure, should not result in blanking of the display.	MRTS262	11.2		X			X	
191	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.	MRTS262	11.3		X			X	
192	The TVMS sign shall be capable of displaying: a) text b) graphics, or 3. a combination of text and graphics.	MRTS262	11.4			X		X	
193	All signs shall display their colours against a matt Black background.	MRTS262	11.4			X		X	
194	Type A, Type B and Type C VMS shall comply with the display dimensional requirements of AS 4852.2.	MRTS262, AS 4852.2	11.4.1			X	X	X	
195	The message display shall be a full matrix LED display conforming to Table 5.1.	MRTS262, AS 4852.2	11.4.1			X	X	X	
196	Each alphanumeric character in the DU shall be formed by a matrix arrangement of horizontal and vertical pixels.	MRTS262	11.4.1			X	X		
197	The signs shall have sufficient vertical pixels to permit lower case text, with descenders lie wholly below the base of the upper-case characters. The character format shall be complied with the requirements of AS 4852.2.	MRTS262, AS 4852.2	11.4.1			X	X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
198	Standard operation of the signs shall permit the simultaneous generation of alphanumeric characters for the number of lines, characters, and character heights as defined in Tables 5.1 and 5.2.	MRTS262, AS 4852.2	11.4.1			X		X	
199	The sign shall be capable of supporting at least five fonts including the following two: Font 1 — standard height fixed font characters. Font 2 — standard height proportional font characters.	MRTS262, AS 4852.2	11.4.1			X		X	
200	The type of TVMS proposed for each location shall comply with the requirements of QGTM, Part 10 and the Queensland MUTCD Part 3, and shall be specified on the design documentation.	MRTS262, QGTM Part 10, Queensland MUTCD	11.4.1					X	
201	As a minimum, the variable message display shall generate single stroke alphanumeric character fonts generally to the requirements of AS 1742, AS 1743 and AS 1744. The characters shall be arranged to have a minimum of two pixels between characters and two pixels between lines.	MRTS262, AS 1742, AS 1743, AS 1744	11.5			X		X	
202	Variable message display changes shall be in accordance with the *TVMS Use and Operations Guidelines*. All display changes shall be affected by first blanking the respective DU, and then activating all required pixels of the respective display simultaneously (as apparent to the eye).	MRTS262	11.6			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
203	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.	MRTS262	11.7			X		X	
204	Loss of communications with STREAMS shall also be considered a TVMS failure and shall result in the display(s) being blanked after a pre-set time period. This time period shall be a variable, able to be set by STREAMS, with a range of 60 seconds to 600 seconds.	MRTS262	11.7			X		X	
205	The performance of the TVMS displays must meet or exceed the optical characteristics defined in Clauses 11.8.1 to 11.8.6. Tests shall be performed by a NATA or NATA-accredited or NATA-endorsed by Mutual Recognition laboratory and the results submitted to the Principal.	MRTS262	11.8, 11.8.1, 11.8.6			X		X	
206	The performance of the TVMS displays must meet or exceed the luminance and chromaticity parameters defined in AS 4852.2.	MRTS262, AS 4852.2	11.8.1		X			X	
207	When tested in accordance with Appendix B, each colour present in the message shall lie within one of the regions specified by the chromaticiy coordinates in Table 5.6 and Figure 5.5. Monochrome displays are typically yellow.	MRTS262, AS 4852.2	11.8.1		X			X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
208	The TVMS display shall either be capable of displaying Monochrome (Yellow) or 5 Colour (Yellow, White, Red, Green and Orange). Yellow, White, Red, Green colours shall be compliant with AS 4852.1.	MRTS262, AS 4852.1	11.8.2			X		X	
209	Where more than one colour is displayed simultaneously the colours should appear with similar brightness. To achieve this the following ratios are suggested: White: 1.6 Yellow: 1.0 Green: 0.5 Red: 0.4	MRTS262, AS 4852.1	11.8.2		X			X	
210	1. For monochromatic signs TVMS display shall be able to display individual pixels in Yellow against a matt Black background. LEDs shall be used within pixels to generate the output colour.	MRTS262	11.8.2			X		X	
211	2. The VMS display shall be able to display individual pixels in either Yellow or White or Red or Green or Orange colours, against a matt Black background. LEDs shall be used within pixels to generate output colours. The individual pixels may generate colour with either discrete LED(s) for each of the five colours or via a colour mixing arrangement with RGB LEDs or equivalent technologies.	MRTS262	11.8.2			X		X	

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212	3. Yellow, White, Red, Green colours shall be compliant with AS 4852.2.	MRTS262, AS 4852.2	11.8.2			X		X	
213	4. AS 4852.2 does not define the Orange region. The coordinates defined in Table 11.8.2 are designed to fall within the Orange region for the retro-reflective fluorescent Orange in AS 1906, having established that the TVMS Yellow region of AS 4852.2 largely falls within the retro-reflective fluorescent Yellow region in AS 1906.	MRTS262, AS 4852.2, AS 1906	11.8.2, Table 11.8.2			X		X	
214	5. In the event of the use of colour mixing or equivalent technology, any non-compliant colours to AS 4852.1 shall neither be configurable nor displayed under any circumstances.	MRTS262, AS 4852.1	11.8.2					X	
215	The dimming requirements shall be as specified in AS 4852.2.	MRTS262, AS 4852.2	11.8.3					X	
216	The sign shall automatically adjust the output luminance of its display in response to external illuminance in accordance with Table 5.5. In the event that the sign's light-sensing device(s) are faulty or non-functional, the sign shall dim the display to dimming level 3.	MRTS262, AS 4852.2	11.8.3			X		X	
217	The sign shall include a minimum of two light-sensing units for dimming purposes. See Appendix A for test procedures.	MRTS262, AS 4852.2	11.8.3, Appendix A	X			X		

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
218	The luminance output of the message display shall be controlled by both remote and local command inputs.	MRTS262, AS 4852.2	11.8.3			X		X	
219	The LED intensity shall be controlled to provide maximum legibility distances for the complete range of ambient light under which the TVMS shall operate.	MRTS262	11.8.3			X		X	
220	The luminance half angle for type A, B and C signs shall meet the intensity half angle parameters defined in AS 4852.2.	MRTS262, AS 4852.2	11.8.4		X			X	
221	The luminous intensity uniformity requirements shall be as specified in AS 4852.2.	MRTS262, AS 4852.2	11.8.5		X			X	
222	The following requirements for luminous intensity uniformity shall be separately met for each output colour: a) When measured on axis and at the combined horizontal / vertical down half-angle positions as specified in Table 5.1, the ratio of the average of the three highest pixel outputs to the average of the three lowest pixel outputs shall be not more than 2.5:1. b) The ratio between the outputs of any two pixels shall be not more than 4:1. See Appendix A for test procedures.	MRTS262, AS 4852.2	11.8.5, Appendix A		X			X	
223	The action of sunlight or other bright light sources on the optical elements shall be controlled such that inactive pixels shall not appear active.	MRTS262	11.8.6			X		X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
12 Documentation requirements									
224	Each sign shall be supplied with an operations and maintenance manual detailing how to safely use the signs. As a minimum, it shall detail: a) safe transportation of the sign b) onsite installation c) guide on suitable locations for installation d) setting up of the TVMS signs for operation e) local configuration, remote management and administration using the RSCS software f) starting up g) shutting down h) safe manual handling procedures for the batteries i) routine and preventative maintenance j) troubleshooting, and k) workplace health and safety (WH&S) requirements.	MRTS262	12.1					X	
13 Testing, commissioning and configuration requirements									
225	After the signs are first built and before being used on site, Factory Acceptance Tests (FAT) shall be completed in accordance with the requirements of this Technical Specification.	MRTS262	13					X	

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				Visual inspection	NATA approved certificate (or equivalent)	Field / Bench Test / Demo	Detailed drawings	Manufacturer conducted tests records / other documents	
226	The testing documentation for each sign used onsite shall be provided to the Principal when submitting the Traffic Guidance Scheme (QGTM Part 10) in accordance with Clause 5.3.2 of MRTS02 *Provision for Traffic*.	MRTS262, QGTM Part 10, MRTS02	13					X	
227	The generic Installation Acceptance Test (IAT), Commissioning Test (CT) and Customer Acceptance Test (CAT) shall be replaced with the Contractor's configuration process. The minimum general requirements for this process are detailed in MRTS201 *General Equipment Requirements.*	MRTS262, MRTS201	13					X	