

**Technical Specification**

**Transport and Main Roads Specifications  
MRTS229 Electronic Traffic Control Signs**

**July 2023**



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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 Electronic Traffic Control Signs (eTCS).

eTCS are used to display sign faces that are defined in *Transport Operations Road Use Management Act 1995 (TORUM)*, *Queensland Manual of Uniform Traffic Control Devices (Queensland MUTCD)*, or *Traffic Control (TC) Signs*. The sign is populated with only the LEDs required to display the defined sign faces.

The eTCS shall be mounted on a fixed or portable structure and shall only display up to two alternate messages / symbols or a blank.

A full matrix sign intended to display multiple messages is not within the scope of this Technical Specification. These are covered by other Technical Specifications including MRTS202 *Variable Message Signs*, and MRTS262 *Transportable Variable Message Signs*.

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

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

## 2 Definition of terms

The terms defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant to this Technical Specification is defined in Table 2 1 below.

**Table 2 1 – Definitions**

| Term  | Definition  |
|-------|---|
| DU    | Display Unit  |
| eTCS  | Electronic Traffic Control Sign(s)  |
| FAT   | Factory Acceptance Tests  |
| FP    | Field Processor - An industrial computer complying with requirements of MRTS232 <i>Provision of Field Processors</i>                          |
| frame | A format defining which message is displayed and how it is displayed, namely, static display, message flashing, or annulus flashing etc       |
| GDU   | Graphical Display Unit  |
| HHD   | Hand-held device  |
| LED   | Light Emitting Diode  |
| LFS   | Local facility switch   |
| NATA  | National Association of Testing Authorities   |
| PHCS  | Product host control system: control / diagnostic software that runs on a laptop and can control, interrogate and program the eTCS controller |
| Pixel | The smallest discreetly controlled light emitting component of the sign dot matrix display  |

| Term         | Definition  |
|--------------|---|
| PTN          | Principal's Telecommunications Network  |
| PV           | Photovoltaic  |
| RPEQ         | Registered Professional Engineer, Queensland  |
| SAT          | Site acceptance tests   |
| Stroke width | The apparent width of active pixel(s)   |
| TC Signs     | The TC signs are a collection of non-standard traffic control (TC) signs that have been "officially approved" (as required by the <i>Transport Operations (Road Use Management Act 1995)</i> ). These signs have been designed for specialised use and designed to comply with the guidelines set out in the <i>Traffic and Road Use Management</i> manual (TRUM) and the <i>Queensland Manual for Uniform and Traffic Control Devices</i> (Queensland MUTCD) |
| TMC          | Traffic Management Centre   |
| TMS          | Traffic Management System (for example, STREAMS)  |
| TSI-SP-003   | Communications Protocol for Roadside Devices  |
| VMS          | Variable Message Sign(s)  |

### 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 the referenced MRTS, the requirements specified in this Technical Specification shall take precedence.

**Table 3 – Referenced documents**

| Reference     | Title  |
|---------------|--|
| AS 4852.1     | <i>Variable message signs - Fixed signs</i>  |
| AS 4852.2     | <i>Variable message signs - Portable signs</i>   |
| AS 60529      | <i>Degrees of protection provided by enclosures (IP Code)</i>                          |
| AS/NZS 1170.1 | <i>Structural Design Actions, Permanent, imposed and other actions</i>                 |
| AS/NZS 1170.2 | <i>Structural Design Actions, Wind Actions</i>   |
| AS 1768       | <i>Lightning protection</i>  |
| MRTS01        | <i>Introduction to Technical Specifications</i>  |
| MRTS50        | <i>Specific Quality System Requirements</i>  |
| MRTS61        | <i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i> |
| MRTS201       | <i>General Equipment Requirements</i>  |
| MRTS202       | <i>Variable Message Signs</i>  |
| MRTS206       | <i>Provision of Variable Speed Limit and Lane Control Signs</i>                        |
| MRTS226       | <i>Telecommunications Field Cabinets</i>   |
| MRTS232       | <i>Provision of Field Processors</i>   |
| MRTS245       | <i>ITS Telecommunications Network (ITS TN)</i>   |
| MRTS262       | <i>Transportable Variable Message signs</i>  |

| Reference        | Title   |
|------------------|---|
| MRTS263          | <i>Standalone Solar (PV) Power Systems</i>                  |
| Queensland MUTCD | <i>Queensland Manual of Uniform Traffic Control Devices</i> |
| QGTM             | <i>Queensland Guide to Traffic Management</i>               |
| TORUM            | <i>Transport Operations Road Use Management Act 1995</i>    |
| TRUM             | <i>Traffic and Road Use Management Manual</i>               |

## 4 Quality system requirements

### 4.1 Hold Points, Witness Points and Milestones

The quality system requirements defined in MRTS50 *Specific Quality System Requirements* and MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional quality system requirements relevant to this Technical Specification are defined in Table 4.1 below. There are no Milestones defined.

**Table 4.1 – Hold Points, Witness Points and Milestones**

| Clause | Hold Point  | Witness Point | Milestone |
|--------|---|---------------|-----------|
| 4.1    | 1. Detailed design documentation to be provided prior to manufacture<br>2. Optical performance test results to be provided prior to manufacture |               |           |
| 7.2.4  | 3. Detailed design documentation of mounting structure and footings location and reduced levels (RLs)   |               |           |
| 13.2   |   | 1. FAT        |           |

Detailed designs of the sign layout, fabrication and assembly drawings, calculations, specifications and certifications of the eTCS components (signed by the Contractor's RPEQ) shall be submitted to the Principal via the Administrator for verification prior to manufacture. These components include, but are not limited to the sign controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including surge protection and back-up batteries), communication ports, cable termination, enclosure, and mounting accessories.

#### **Hold Point 1**

Optical performance test methodology and National Association of Testing Authorities (NATA) certification confirming the sign performance requirements specified in this Technical Specification shall be submitted before manufacture. **Hold Point 2**

### 4.2 Sample eTCS

A sample eTCS shall be provided for the Site Acceptance Tests (SAT) in accordance with MRTS201 *General Equipment Requirements*. Where provided, the sample eTCS shall be complete with display and control units of the type to be used in the eTCS to be provided under the Contract.

### **4.3 Warranty**

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

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

## **5 Functional and operational requirements**

### **5.1 Functional requirements**

The eTCS is required to display the messages as specified in the contract, and detailed in the Queensland MUTCD, TORUM, or TC Signs.

The eTCS shall be able to display messages using a combination of LED colours, according to the specific sign face required.

In general, the electronic equivalent of a standard sign in the Queensland MUTCD, TORUM, or TC signs is implemented by inverting or changing the background and message colours.

### **5.2 Operational requirements**

The eTCS meeting the above functional requirements shall be mounted on a fixed or portable structure. Refer to Clause 7 for mounting requirements. It should be able to be controlled remotely or locally as detailed in Clause 9. The eTCS shall be able to communicate through the Principals Telecommunications Network (PTN) as specified in MRTS245 *ITS Telecommunications Network (ITS TN)*, and provide options to be energised by solar panels, battery banks as well as mains supply as described in Clause 10.

All vehicle-mounted and trailer / concrete block mounted eTCS used in safety related applications shall only be deployed following the appropriate risk analysis undertaken to ensure safety in the event of sign failure. Example of risk mitigation could include video monitoring of the sign face.

#### **5.2.1 eTCS Master / Slave pairing**

Where two eTCS are required to be installed in pairs, one site controller from the pair shall act as the Master controller for both signs and the other as the Slave. This shall be achieved through the setting eTCS to operate either as a Master or Slave via the TMS and/or Product Host Control System (PHCS).

Where a site eTCS is set to operate in Master mode, all remote communications from a TMS, PHCS and/or Hand-Held Device (HHD) for a configured Master and Slave pair shall be accepted by this site controller.

Where a site eTCS is set to operate in Slave mode, all remote communications from a TMS, PHCS and/or HHD for a configured Master and Slave pair shall be ignored.

The connection between master and slave eTCS can be either wired or wireless and shall be reliable for the physical separation between the eTCS signs. Where wireless connection is used, it shall be a secure link.

## 6 Environmental requirements

### 6.1 General

The sign enclosure shall house the sign and associated control electronics, including the eTCS controller and comply with the requirements of MRTS201 *General Equipment Requirements*. Where installed in a tunnel and or coastal environments, the enclosure shall be made of Marine Grade Aluminium.

Additional environmental requirements are as described below:

#### 6.1.1 Weather resistance

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

#### 6.1.2 Humidity control

A system shall be provided to regulate humidity inside the display enclosure and to prevent condensation on internal components and on the inside surface of the front cover. Devices other than heaters are the preferred method.

#### 6.1.3 Temperature control

Each eTCS 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 TMS. The temperature shall be in units of degrees centigrade.

## 7 Mechanical and physical requirements

The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements*, MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices* and/or TRUM Manual, Volume 3, Part 5: *Design Guide for Roadside Signs* apply to work provided under this Technical Specification. Additional mechanical and physical requirements for eTCS equipment provided under this Technical Specification are described below.

Note that MRTS61 applies to eTCS signs greater than 7.5 m(W) x 8 m(H) or 40 m<sup>2</sup>. For signs of lesser dimension, TRUM Manual, Volume 3, Part 5 applies.

### 7.1 Design life

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

- structures: a minimum of 40 years
- enclosures: a minimum of 20 years
- LEDs / pixels: a minimum of five years, and
- electronics: a minimum of 10 years.

## **7.2 Mounting structure**

### **7.2.1 General mounting requirements**

The eTCS shall be supported by fixed or portable mounting structures designed in accordance with MRTS61 *Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices*, AS 1170.1 and AS 1170.2 when installed with all supporting hardware and accessories used to operate the signs including the solar panels, where fitted.

### **7.2.2 Fix-mount eTCS**

For fix-mount eTCS, the location and type of mounting structure to be provided to mount each eTCS shall be designed for the site conditions in which they are intended to be used and shown on the design documentation. 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* and/or TRUM Manual, Volume 3, Part 5: *Design Guide for Roadside Signs* when installed with all supporting hardware and accessories used to operate the signs including the solar panels, where fitted. If the sign forms an integral part of a Traffic Signal installation, then the sign, mounting hardware, and cabling shall be suitable for mounting on a standard Transport and Main Roads traffic signal pedestal.

### **7.2.3 Portable eTCS**

Portable eTCS 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 *Queensland Guide to Traffic Management (QGTM)*. The mounting structures supporting the eTCS shall be designed for the site conditions in which they are intended to be used.

#### **7.2.3.1 Vehicle mounted eTCS**

The vehicle on which the eTCS is mounted shall conform to the requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification. If required, vehicle mounted eTCS shall be fitted with solar panels.

#### **7.2.3.2 Trailer mounts**

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

The mechanical system shall also allow for the sign and solar panel to be safely erected on site 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 anywhere in 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.

### 7.2.4 Mounting structure design documentation

The design documentation shall include the following:

- For fix-mount eTCS, it shall include details of the final footing design, location of the structure and the Reduced Levels (RLs) prior to fabrication of the footing and support structure, and
- For Vehicle, trailer and/or concrete block support structure, it shall include evidence of compliance with this Technical Specification and certified by a RPEQ.

In either case, the Contractor shall submit the final design documentation to the Principal's representative for acceptance. **Hold Point 3**

### 7.3 Display enclosure physical requirements

The sign enclosure shall house the sign and associated control electronics, including the eTCS controller and comply with the requirements of MRTS201 *General Equipment Requirements*. Where installed in a tunnel and or coastal environments, the enclosure shall be made of Marine Grade Aluminium.

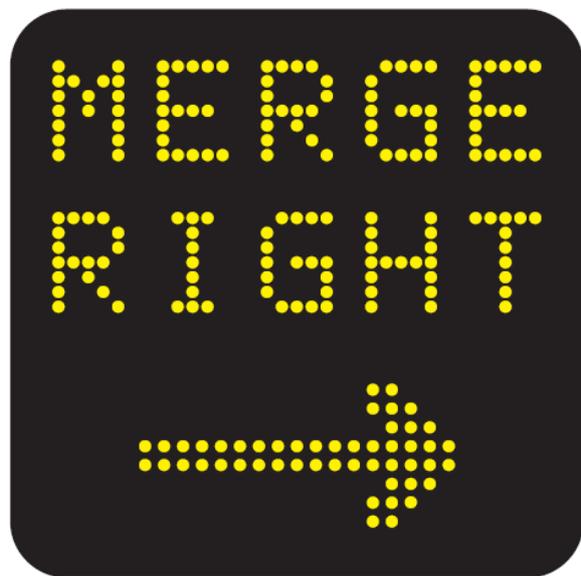
#### 7.3.1 Layout and dimensions

The layout, LED placement and dimensions of the eTCS face shall be as specified in the standard LED version of the TC sign as displayed in the departmental website or as specified in the contract. Examples of eTCS signs are shown below.

**Figure 7.3.1 – Examples of eTCS**



"Workers" symbolic TC2272



Merge right TC2274

Below is the link to Transport and Main Road's TC signs.

<http://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/TC-signs.aspx>

#### 7.3.2 Exterior finish and surfaces

A ripple finish is required to all painted surfaces on the display enclosure. Surface colours shall be:

- front face surrounding the active display, and bottom external face: matte black, or APO Grey with external matte black target board

- remainder of external surfaces: APO grey, and
- interior: matte black, or natural finish with internal black backing board.

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

### **7.3.3 Front cover material**

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

### **7.3.4 Front cover retention method**

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

## **7.4 Field cabinets**

The eTCS interface to a Field Processor (FP) or telecommunications equipment shall be installed in a suitable roadside enclosure, being either:

- a ground mounted field cabinet complying with requirements of MRTS226 *Telecommunications Field Cabinets*, or
- an integral enclosure complying with the requirements of MRTS201 *General Equipment Requirements* installed on the eTCS mounting structure.

Unless otherwise specified by the Principal, a lockable door shall be located on the front of the sign housing. The door arrangement shall be compatible with the mounting structure members.

## **8 eTCS Display requirements**

### **8.1 General**

The eTCS 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 horizontal and vertical pitch of the pixels in the matrix shall be in accordance with AS 4852.2.

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

The eTCS shall only display the messages as specified in the contract, and detailed in the Queensland MUTCD, TORUM, or TC Signs.

### **8.2 Failures**

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

The Display Unit (DU) shall monitor communications with the eTCS controller and blank that display if a loss of communication is experienced. The communications timeout period shall be a configurable setting.

The eTCS controller shall be able to detect LED failures even if the LEDs may be required to be 'off' at the time of the periodic check. The display shall be blanked upon failure of two per cent of contiguous pixels for each displayed image or failure of more than 20% of LEDs.

On power restoration after loss of power, the eTCS shall become available for activation and remain blank until commanded by the eTCS controller or TMS. At no time shall partial or incomplete frames be displayed.

An eTCS light sensor failure or a single LED failure (provided that the cumulative LED loss remains below the two per cent and/or 20% thresholds described above) should not result in blanking of the display.

### **8.3 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. For LEDs in a 5 mm or smaller diameter package, peak magnitudes of the LED current shall not exceed 20 mA. For messages containing multiple colours, the apparent brightness of all colours in the message shall appear the same.

### **8.4 Character and graphical display unit**

#### **8.4.1 Display unit format and placement**

The type of eTCS proposed for each location shall including their font, format and placements of LED's shall comply with the requirements defined in the relevant TC sign.

#### **8.4.2 Display unit colour**

Sign faces as defined in TORUM, Queensland MUTCD, or TC Signs display messages using Red, Yellow, Green, White, black and occasionally Orange colours. Where any of these colours are required to display a specific sign face, the chromaticity coordinates of Red, Yellow, Green and White shall be as defined by their respective region coordinates in AS 4852.1, on a matt black background.

Where Orange is required to display a sign face, the chromaticity coordinates of the orange LED shall be as shown in Table 8.4.2 below and Figure 8.4.3.

**Table 8.4.2 – 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 |

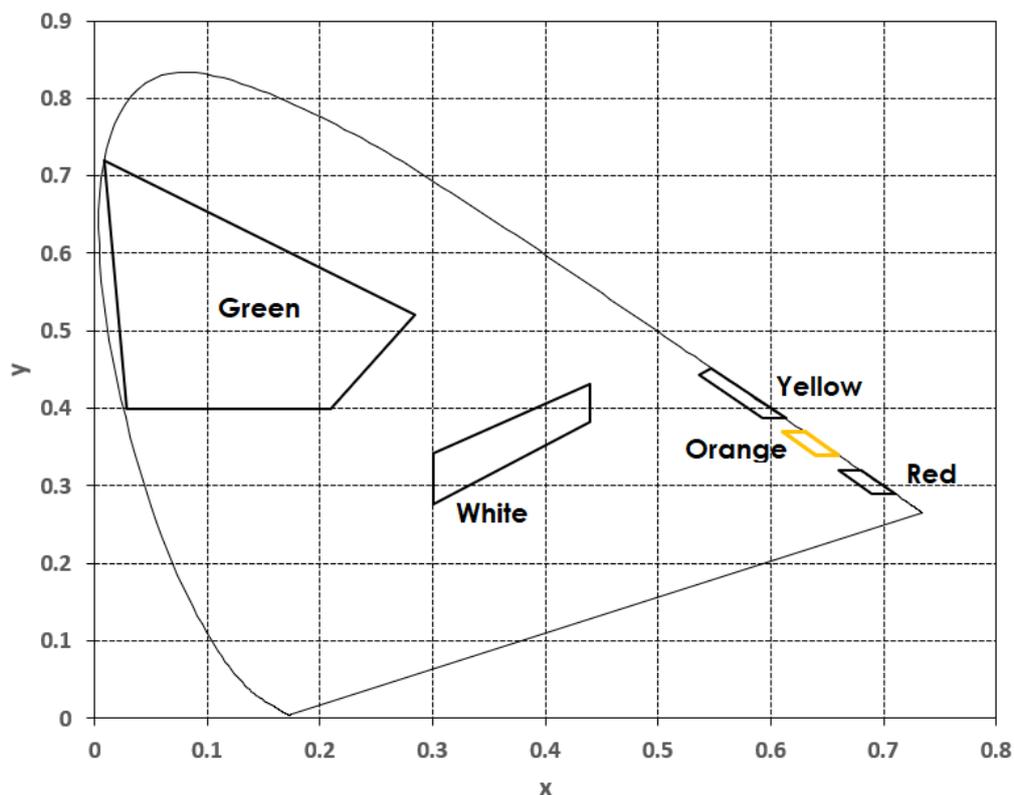
#### **8.4.3 Colour mixing**

Where each of the Red, Yellow, Green, or White colours are generated by mixing, such as through the use of RGB LEDs or other technology, the resulting colours shall remain within their corresponding chromaticity coordinates as defined in AS 4852.1 for all brightness levels.

Where the Orange colour is generated by mixing, such as through the use of RGB LEDs or other technology, the resulting colour shall remain within the chromaticity coordinates of the orange LED as shown in Table 8.4.2 (and Figure 8.4.3), for all brightness levels.

Each sign display colour generated by mixing shall remain within its corresponding specified chromaticity coordinates for at least 10 years of continuous switching and operation

**Figure 8.4.3 – AS 4852 chromaticity coordinates with orange zone added.**



### 8.5 Display Changes

Signs are not required to implement the TSI-SP-003 protocol application layer messages relating to the creation (setting) of text and graphics frames, since the eTCS signs' frames are inherently static.

Thus, the sign's controller shall be able to:

- display a single fixed message frame continuously when commanded
- display a single fixed message frame continuously based on time of day
- flash the annulus when commanded, and
- display any combination of all the above formats.

eTCS signs shall store message formats inside the sign controller that are set by a controlling field processor.

### 8.6 Fallback displays

Facilities shall be included to detect failures within the eTCS and the display control system(s). On detection of a failure, the display shall be blanked to prevent confusing displays to the motorist. Loss of communications with TMS shall also be considered an eTCS 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 TMS, with a range of 60 seconds to 600 seconds.

## **8.7 Optical performance**

### **8.7.1 Luminance**

The luminance and luminance ratio of the LED shall comply with the requirements of AS 4852.1

### **8.7.2 LED dimming**

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

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

### **8.7.3 Luminance intensity half angle**

The luminance half angle shall be at least 15° for eTCS.

### **8.7.4 Luminous intensity uniformity**

The requirements for Luminous Intensity uniformity shall comply with AS 4852.1.

The luminous intensity uniformity shall be maintained at all dimming levels.

### **8.7.5 Sun phantom**

The action of sunlight or other bright light sources on the optical elements shall be controlled such that inactive pixels shall not appear active. This may require the use of a visor over the display.

## **9 Control System**

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

### **9.1 General function**

As a minimum the eTCS controller shall:

- a) monitor, log and support TMS requests for its own operation and status
- b) monitor, log and support TMS status requests for the sign
- c) be capable of storing enough frames in its non-volatile memory to display each individual sign face
- d) allow local automatic reset of the eTCS display and the eTCS controller itself such as via watchdog(s)
- e) be capable of dimming the connected sign based on the light sensor outputs, and
- f) accept / reject valid or invalid commands made by the TMS and/or PHCS.

## **9.2 Local Facility Switch (LFS)**

A three-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**, or
2. **TEST**, or
3. **NORMAL**

### **9.2.1 BLANK / Maintenance Mode**

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

- a) the eTCS sign shall remain powered
- b) the hardwired sign display of that eTCS sign shall be blanked
- c) any subsequent display requests from Product Host Control System (PHCS) shall be ignored
- d) the PHCS software shall be permitted to perform all status, maintenance and diagnostic functions on the respective eTCS sign
- e) where two signs have been configured as one pair, selecting the LFS to "BLANK" on one eTCS sign, shall not blank the other paired eTCS sign unit, 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 a LFS is to provide manual local override and blank the sign display or perform local maintenance and diagnostic functions, if required.

### **9.2.2 TEST mode**

Where TEST 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 eTCS is active
- b) the eTCS shall ignore any subsequent display requests from Product Host Control System (PHCS)
- c) the eTCS shall permit the PHCS software to perform all status, maintenance and diagnostic functions
- d) the eTCS shall ignore remote control communications from the TMS or designated local HHD (refer Clause 9.11), and
- e) the eTCS shall permit remote communications with a PC / Laptop running the eTCS Software.

### **9.2.3 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 eTCS is active
- b) the eTCS shall accept remote control communications from the TMS
- c) the eTCS shall accept remote communications with a PC / Laptop running the eTCS Software, and
- d) the eTCS shall accept remote control communications from a designated local HHD (refer Clause 9.11).

### **9.3 Controller operation / interrogation**

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

1. maintenance communications port, and
2. control communications ports.

Software shall be provided in accordance with Clause 9.8.

#### **9.3.1 Maintenance communications port**

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

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

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

#### **9.3.2 Control communications port**

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

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

Complete control and monitoring by TMS shall be possible through both control communications ports as determined by telecommunications infrastructure provided at each Site.

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 eTCS shall automatically revert to full control AND status communications through the active port.

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

#### **9.4 Communications timeout**

The eTCS controller shall be capable of monitoring loss of communications with the TMS and timeout after a specified period. When the eTCS controller is in the NORMAL mode, expiry of this time period shall cause the eTCS controller to blank the entire eTCS. This period shall be a configurable parameter. The eTCS controller shall also be capable of monitoring communications with the sign and timeout after a specified period when such communication is lost. Communications timeout check shall be performed periodically and shall be a configurable parameter. In BLANK / Maintenance mode, the communications timeout check with the TMS shall be ignored.

#### **9.5 Configuration management**

All settings in the eTCS controller shall be accessible via the PHCS.

#### **9.6 Monitoring and logging**

##### **9.6.1 Sign fault management**

The eTCS controller shall monitor and log the following fault conditions:

- loss of communication with the sign
- high enclosure temperature
- illumination faults, and
- other faults relating to the eTCS.

##### **9.6.2 Local event logging**

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

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

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

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

##### **9.6.3 Watchdog**

The eTCS controller and the sign shall monitor the state of its respective processor and blank the respective display(s) if a critical internal fault is detected that could result in confusion to the public.

### **9.7 Time synchronisation**

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

### **9.8 Control / diagnostics software**

The eTCS integral control system shall fully implement all eTCS functions.

Communication between the Field Processor and the eTCS shall comply with MRTS201 *General Equipment Requirements*.

The computers may use Microsoft Windows® operating systems, from Windows 7 to those industry standards current at the time of use. Any software provided shall be capable of operating on all such operating systems.

The software shall report the selected mode on the facility switch.

Unauthorised use of the eTCS shall be prevented. Seed offsets and password offsets shall be unique to each sign.

### **9.9 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 eTCS shall operate.

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

Each eTCS shall be provided with at least one light sensor to detect ambient light levels.

The dimming facility should reflect the ambient light conditions immediately on “switch on”, i.e., if the sign is switched on at night, the display shall be dimmed and if the sign is switched on during bright daylight, the display should be optimum brilliance without delay.

The dimming circuit shall have a switching delay of  $30 \pm 5$  seconds.

Where a sign is in close proximity to artificial lighting, the ambient light level local to that sign may be artificially high. This may result in the dimming system setting the light output of the sign too high. Therefore, each sign and/or dimming circuit shall be capable of adjusting the dimmed light levels through a “brightness offset” to compensate for local artificial light levels.

### **9.10 Bus arbitration**

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

### **9.11 Hand-Held Communication Device (HHD)**

Where a hand-held communication device is required by the Principal as a local method of control, the HHD shall:

- have a unique ID that is transmitted with each message change request
- shall have priority over TMS message should a TMS message change request occur at the same time as the message change request from a HHD, namely, the TMS request shall be ignored
- for wireless HHD, use “code hopping” or “rolling code” technology, to prevent unauthorised use of the signs through “replay attacks”

- for wired HHD, the leads shall preferably be securely terminated in the RS-232 port of the eTCS sign or any other secure termination resulting in 15 m lead
- the CU shall have the ability to deactivate a HHD from controlling the eTCS sign (e.g., due to lost or damaged HHDs), through the eTCS configuration or RSCS software, and
- only when a HHD message activation button is pressed and held for two seconds shall a control message be transmitted.

To guard against accidental activation of an eTCS frame from the HHD, buttons shall be pressed and held for two seconds before any eTCS message frame will be changed.

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

## **10 Electrical**

### **10.1 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 AS4852.2.

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 MRTS201 *General Equipment Requirements* apply.

### **10.2 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 AS4852.1.

Where specified, lighting protection shall be provided in accordance with AS 1768.

## **11 Installation requirements**

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

## **12 Telecommunications requirements**

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to work provided under this Technical Specification.

Where the eTCS is required to communicate with STREAMS, this shall be done in accordance with MRTS201 *General Equipment Requirements* and through a Field Processor compliant with MRTS232 *Provision of Field Processors*.

## **13 Testing and commissioning**

### **13.1 General**

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

### **13.2 Factory acceptance tests**

The optical performance shall be determined by measurement under laboratory conditions of the minimum luminance ratio and the minimum and maximum luminance for all sign luminance levels listed in AS 4852.1 and in accordance with the photometric test procedures defined in AS 4852.1. The performance of the eTCS shall meet or exceed the parameters listed in AS 4852.1. **Witness Point 1**

## **14 Documentation**

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

### **14.1 Asset data**

For fixed eTCS, once the asset type being installed is known, this shall be communicated to the Principal at first opportunity. This is required to ensure assets are recorded in ROAR and have appropriate asset IDs and site IDs.

## **15 Training**

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

## **16 Maintenance**

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

## **17 Handover**

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

## **18 Product approval checklist**

The checklist for the product approval evaluation is published as Appendix A to this Technical Specification.

**Appendix A – Product approval compliance checklist**

| Item#  | MRTS229 Electronic Traffic Control Signs  | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|--|---|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|  |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 1  | Detailed designs of the sign layout, fabrication and assembly drawings, calculations, specifications and certifications of the eTCS components (signed by the Contractor's RPEQ) shall be submitted to the Principal via the Administrator for verification prior to manufacture.   | 4.1         |                     |                    |                     | X                 | X  |                             |
| 2  | These components include, but are not limited to the sign controller, sign face, LEDs, LED matrix boards, pixel arrangements showing horizontal and vertical pitch and total number of pixels, power supply (including surge protection and back-up batteries), communication ports, cable termination, enclosure and mounting accessories. | 4.1         |                     |                    |                     | X                 |  |                             |
| 3  | Optical performance test methodology and NATA certification confirming the sign performance requirements specified in this Technical Specification shall be submitted before manufacture.   | 4.1         |                     | X                  |                     |                   |  |                             |
| 4  | A sample eTCS shall be provided for the Site Acceptance Tests (SAT) in accordance with MRTS201 <i>General Equipment Requirements</i> .  | 4.2         | X                   |                    |                     |                   |  |                             |
| 5  | Where provided, the sample eTCS shall be complete with display and control units of the type to be used in the eTCS to be provided under the Contract.  | 4.2         | X                   |                    |                     |                   |  |                             |
| 6  | The Contractor installing the eTCS shall warrant the installation against defects for a minimum of five years in accordance with requirements of MRTS201 <i>General Equipment Requirements</i> .  | 4.3         |                     |                    |                     |                   | X  |                             |
| <b>5 Functional and operational requirements</b> |   |             |                     |                    |                     |                   |  |                             |
| 7  | The eTCS is required to display the messages as specified in the contract, and detailed in the Queensland MUTCD, TORUM, or TC Signs.  | 5.1         | X                   |                    |                     | X                 |  |                             |
| 8  | The eTCS shall be able to display messages using a combination of LED colours, according to the specific sign face required.  | 5.1         |                     |                    |                     |                   | X  |                             |

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|-------|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 9     | In general, the electronic equivalent of a standard sign in the Queensland MUTCD, TORUM, or TC signs is implemented by inverting or changing the background and message colours.   | 5.1         | X                   |                    |                     | X                 |  |                             |
| 10    | The eTCS meeting the above functional requirements shall be mounted on a fixed or portable structure.  | 5.2         |                     |                    |                     | X                 |  |                             |
| 11    | It should be able to be controlled remotely or locally as detailed in Clause 9.  | 5.2         |                     |                    |                     |                   | X  |                             |
| 12    | The eTCS shall be able to communicate through the Principals Telecommunications Network (PTN) as specified in MRTS245 <i>ITS Telecommunications Network (ITS TN)</i> , and provide options to be energised by solar panels, battery banks as well as mains supply as described in Clause 10. | 5.2         |                     |                    |                     |                   | X  |                             |
| 13    | All vehicle-mounted and trailer / concrete block mounted eTCS used in safety related applications shall only be deployed following the appropriate risk analysis undertaken to ensure safety in the event of sign failure.   | 5.2         |                     |                    |                     |                   | X  |                             |
| 14    | Example of risk mitigation could include video monitoring of the sign face.  | 5.2         |                     |                    |                     |                   | X  |                             |
| 15    | Where two eTCS are required to be installed in pairs, one site controller from the pair shall act as the Master controller for both signs and the other as the Slave.  | 5.2.1       |                     |                    |                     |                   | X  |                             |
| 16    | This shall be achieved through the setting eTCS to operate either as a Master or Slave via the TMS and/or PHCS.  | 5.2.1       |                     |                    |                     |                   | X  |                             |
| 17    | Where a site eTCS is set to operate in Master mode, all remote communications from a TMS, PHCS and/or HHD for a configured Master and Slave pair shall be accepted by this site controller.  | 5.2.1       |                     |                    |                     |                   | X  |                             |
| 18    | Where a site eTCS is set to operate in Slave mode, all remote communications from a TMS, PHCS and/or HHD for a configured Master and Slave pair shall be ignored.  | 5.2.1       |                     |                    |                     |                   | X  |                             |

| Item#                               | MRTS229 Electronic Traffic Control Signs  | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|-------------------------------------|---|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|                                     |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 19                                  | The connection between master and slave eTCS can be either wired or wireless and shall be reliable for the physical separation between the eTCS signs.  | 5.2.1       |                     |                    |                     |                   | X  |                             |
| 20                                  | Where wireless connection is used, it shall be a secure link.   | 5.2.1       |                     |                    | X                   |                   | X  |                             |
| <b>6 Environmental requirements</b> |   |             |                     |                    |                     |                   |  |                             |
| 21                                  | The sign enclosure shall house the sign and associated control electronics, including the eTCS controller and comply with the requirements of MRTS201 <i>General Equipment Requirements</i> . | 6.1         |                     |                    |                     |                   | X  |                             |
| 22                                  | Where installed in a tunnel and or coastal environments, the enclosure shall be made of Marine Grade Aluminium.   | 6.1         |                     |                    |                     |                   | X  |                             |
| 23                                  | 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.                      | 6.1.1       |                     | X                  |                     |                   |  |                             |
| 24                                  | A system shall be provided to regulate humidity inside the display enclosure and to prevent condensation on internal components and on the inside surface of the front cover.                 | 6.1.2       |                     |                    |                     |                   | X  |                             |
| 25                                  | Devices other than heaters are the preferred method.  | 6.1.2       |                     |                    |                     |                   | X  |                             |
| 26                                  | Each eTCS shall be provided with at least one temperature sensor to measure the temperature inside the display enclosure near the top centre.   | 6.1.3       |                     |                    |                     |                   | X  |                             |
| 27                                  | The sensor shall not be mounted directly against the top face of the display enclosure.   | 6.1.3       | X                   |                    |                     |                   | X  |                             |
| 28                                  | The temperature reading shall be available through the use of a protocol message via TMS.   | 6.1.3       |                     |                    | X                   |                   | X  |                             |
| 29                                  | The temperature shall be in units of degrees centigrade.  | 6.1.3       |                     |                    |                     |                   | X  |                             |

| Item#   | MRTS229 Electronic Traffic Control Signs   | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|---|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|   |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| <b>7 Mechanical and physical requirements</b> |  |             |                     |                    |                     |                   |  |                             |
| 30  | The mechanical and physical requirements defined in MRTS201 <i>General Equipment Requirements</i> , MRTS61 <i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i> and/or TRUM Manual, Volume 3, Part 5: Design Guide for Roadside Signs apply to work provided under this Technical Specification.   | 7           |                     |                    |                     |                   | X  |                             |
| 31  | Unless otherwise specified, the design life of the eTCS components shall be as follows: <ul style="list-style-type: none"> <li>• structures: a minimum of 40 years</li> <li>• enclosures: a minimum of 20 years</li> <li>• LEDs / pixels: a minimum of five years, and</li> <li>• electronics: a minimum of 10 years.</li> </ul>   | 7.1         |                     |                    |                     |                   | X  |                             |
| 32  | The eTCS shall be supported by fixed or portable mounting structures designed in accordance with MRTS61 <i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i> , AS 1170.1 and AS 1170.2 when installed with all supporting hardware and accessories used to operate the signs including the solar panels, where fitted.   | 7.2.1       |                     |                    |                     | X                 | X  |                             |
| 33  | For fix-mount eTCS, the location and type of mounting structure to be provided to mount each eTCS shall be designed for the site conditions in which they are intended to be used and shown on the design documentation.   | 7.2.2       |                     |                    |                     |                   | X  |                             |
| 34  | The mounting structure shall comply with the requirements of MRTS201 <i>General Equipment Requirements</i> and MRTS61 <i>Gantries and Support Structures for Road Signs, Tolling Systems and ITS Devices</i> and/or TRUM Manual, Volume 3, Part 5: Design Guide for Roadside Signs when installed with all supporting hardware and accessories used to operate the signs including the solar panels, where fitted. | 7.2.2       |                     |                    |                     |                   | X  |                             |
| 35  | If the sign forms an integral part of a Traffic Signal installation, then the sign, mounting hardware, and cabling shall be suitable for mounting on a standard Transport and Main Roads traffic signal pedestal.  | 7.2.2       |                     |                    |                     |                   | X  |                             |

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|-------|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 36    | Portable eTCS shall be capable of being mounted on a: <ul style="list-style-type: none"> <li>• vehicle</li> <li>• a trailer, or</li> <li>• a concrete block support structure.</li> </ul>  | 7.2.3       |                     |                    |                     |                   | X  |                             |
| 37    | in a location consistent with Part 10 of the Queensland <i>Guide to Traffic Management</i> (QGTM).   | 7.2.3       |                     |                    |                     |                   |  |                             |
| 38    | The mounting structures supporting the eTCS shall be designed for the site conditions in which they are intended to be used.   | 7.2.3       |                     |                    |                     |                   | X  |                             |
| 39    | The vehicle on which the eTCS is mounted shall conform to the requirements of the host vehicle specified in the Queensland MUTCD Part 3 and this Technical Specification.  | 7.2.3.1     |                     |                    |                     |                   | X  |                             |
| 40    | If required, vehicle mounted eTCS shall be fitted with solar panels.   | 7.2.3.1     |                     |                    |                     |                   | X  |                             |
| 41    | Where the eTCS is mounted on a trailer, the sign and solar panel array shall have a mechanical system which allows the sign and solar panel be safely secured to the trailer for transportation.   | 7.2.3.2     |                     |                    |                     |                   | X  |                             |
| 42    | The mechanical system shall also allow for the sign and solar panel to be safely erected on site 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 anywhere in Queensland. | 7.2.3.2     |                     |                    |                     |                   | X  |                             |
| 43    | The mechanical systems shall ensure that the sign cannot rotate due to wind gusts up to the ultimate wind speed the structure is designed.   | 7.2.3.2     |                     |                    |                     |                   | X  |                             |
| 44    | 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.  | 7.2.3.2     |                     |                    |                     |                   | X  |                             |

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|-------|---|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|       |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 45    | The design documentation shall include the following: <ul style="list-style-type: none"> <li>For fix-mount eTCS, it shall include details of the final footing design, location of the structure and the Reduced Levels (RLs) prior to fabrication of the footing and support structure, and</li> <li>For Vehicle, trailer and/or concrete block support structure, it shall include evidence of compliance with this Technical Specification and certified by a RPEQ.</li> </ul> | 7.2.4       |                     |                    |                     | X                 | X  |                             |
| 46    | In either case, the Contractor shall submit the final design documentation to the Principal's representative for acceptance.  | 7.2.4       |                     |                    |                     |                   | X  |                             |
| 47    | The sign enclosure shall house the sign and associated control electronics, including the eTCS controller and comply with the requirements of MRTS201 <i>General Equipment Requirements</i> .   | 7.3         |                     | X                  |                     |                   | X  |                             |
| 48    | Where installed in a tunnel and or coastal environments, the enclosure shall be made of Marine Grade Aluminium.   | 7.3         |                     |                    |                     |                   | X  |                             |
| 49    | The layout, LED placement and dimensions of the eTCS face shall be as specified in the standard LED version of the TC sign as displayed in the departmental website or as specified in the contract.  | 7.2.4       |                     |                    |                     | X                 | X  |                             |
| 50    | A ripple finish is required to all painted surfaces on the display enclosure.   | 7.3.2       |                     |                    |                     |                   | X  |                             |
| 51    | Surface colours shall be: <ul style="list-style-type: none"> <li>front face surrounding the active display, and bottom external face: matte black, or APO Grey with external matte black target board</li> <li>remainder of external surfaces: APO grey, and</li> <li>interior: matte black, or natural finish with internal black backing board.</li> </ul>  | 7.3.2       |                     |                    |                     |                   | X  |                             |
| 52    | Where an internal backing board is used, this shall allow easy removal to access the eTCS display.  | 7.3.2       |                     |                    | X                   |                   | X  |                             |
| 53    | A protective front cover shall be fitted to the display enclosure to form a viewing window.   | 7.3.3       |                     |                    |                     |                   | X  |                             |

| Item# | MRTS229 Electronic Traffic Control Signs   | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|-------|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 54    | The front cover material shall be a single, clear Lexan® sheet, or equivalent, with a non-reflective finish.   | 7.3.3       |                     |                    |                     |                   | X  |                             |
| 55    | 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.  | 7.3.3       |                     |                    |                     |                   | X  |                             |
| 56    | The viewing window shall be such that when installed, the sides and bottom edges of the display face are fully visible at viewing angles of $\pm 45^\circ$ (horizontal) and $\pm 30^\circ$ (vertical) to the axis perpendicular to the front plane of the display.   | 7.3.3       | X                   |                    |                     |                   | X  |                             |
| 57    | The front cover shall be able to be removed from outside the eTCS for maintenance without requiring removal of internal components.  | 7.3.4       |                     |                    | X                   |                   | X  |                             |
| 58    | Fasteners and retaining cover strips shall be easily accessible.   | 7.3.4       | X                   |                    |                     |                   | X  |                             |
| 59    | The front cover retention and seal design shall allow for thermal expansion properties of the front cover material.  | 7.3.4       |                     |                    |                     |                   | X  |                             |
| 60    | The front cover surrounding framework and cover strips shall provide the required weather proofing and strength for both positive and negative wind pressures.   | 7.3.4       |                     |                    |                     |                   | X  |                             |
| 61    | The eTCS interface to a Field Processor (FP) or telecommunications equipment shall be installed in a suitable roadside enclosure, being either: <ul style="list-style-type: none"> <li>a ground mounted field cabinet complying with requirements of MRTS226 <i>Telecommunications Field Cabinets</i>, or</li> <li>an integral enclosure complying with the requirements of MRTS201 <i>General Equipment Requirements</i> installed on the eTCS mounting structure.</li> </ul> | 7.4         |                     |                    |                     |                   | X  |                             |
| 62    | Unless otherwise specified by the Principal, a lockable door shall be located on the front of the sign housing.  | 7.4         |                     |                    |                     |                   | X  |                             |
| 63    | The door arrangement shall be compatible with the mounting structure members.  | 7.4         |                     |                    |                     |                   | X  |                             |

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|                                    |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| <b>8 eTCS display requirements</b> |  |             |                     |                    |                     |                   |  |                             |
| 64                                 | The eTCS display technology shall be light emitting diode (LED).   | 8.1         |                     |                    |                     |                   | X  |                             |
| 65                                 | The display pixels may be formed by arranging one or more LEDs in a cluster to achieve the required luminance levels.                                    | 8.1         |                     |                    |                     | X                 | X  |                             |
| 66                                 | The horizontal and vertical pitch of the pixels in the matrix shall be in accordance with AS 4852.2.   | 8.1         |                     |                    |                     |                   | X  |                             |
| 67                                 | The eTCS display pixels shall be in modules of a size capable of being removed and installed by hand via access door(s) or screen.                       | 8.1         |                     |                    |                     |                   | X  |                             |
| 68                                 | The eTCS shall only display the messages as specified in the contract, and detailed in the Queensland MUTCD, TORUM, or TC Signs.                         | 8.1         |                     |                    |                     |                   | X  |                             |
| 69                                 | Facilities shall be included to detect failures within the display control system.   | 8.2         |                     |                    |                     |                   | X  |                             |
| 70                                 | The sign shall blank the display in the event of a sign processor fault.   | 8.2         |                     |                    | X                   |                   | X  |                             |
| 71                                 | Time to blank shall be a configurable setting.   | 8.2         |                     |                    |                     |                   | X  |                             |
| 72                                 | The Display Unit (DU) shall monitor communications with the eTCS controller and blank that display if a loss of communication is experienced.            | 8.2         |                     |                    |                     |                   | X  |                             |
| 73                                 | The communications timeout period shall be a configurable setting.   | 8.2         |                     |                    |                     |                   | X  |                             |
| 74                                 | The eTCS controller shall be able to detect LED failures even if the LEDs may be required to be 'off' at the time of the periodic check.                 | 8.2         |                     |                    |                     |                   | X  |                             |
| 75                                 | The display shall be blanked upon failure of two per cent of contiguous pixels for each displayed image or failure of more than 20% of LEDs.             | 8.2         |                     |                    | X                   |                   | X  |                             |
| 76                                 | On power restoration after loss of power, the eTCS shall become available for activation and remain blank until commanded by the eTCS controller or TMS. | 8.2         |                     |                    | X                   |                   | X  |                             |
| 77                                 | At no time shall partial or incomplete frames be displayed.  | 8.2         | X                   |                    |                     |                   | X  |                             |

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|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 78    | An eTCS light sensor failure or a single LED failure (provided that the cumulative LED loss remains below the two per cent and/or 20% thresholds described above) should not result in blanking of the display.  | 8.2         |                     |                    | X                   |                   | X  |                             |
| 79    | 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.  | 8.3         |                     |                    |                     |                   | X  |                             |
| 80    | For LEDs in a 5 mm or smaller diameter package, peak magnitudes of the LED current shall not exceed 20 mA.   | 8.3         |                     |                    |                     |                   | X  |                             |
| 81    | For messages containing multiple colours, the apparent brightness of all colours in the message shall appear the same.   | 8.3         |                     |                    |                     |                   | X  |                             |
| 82    | The type of eTCS proposed for each location shall including their font, format and placements of LED's shall comply with the requirements defined in the relevant TC sign.   | 8.4.1       |                     |                    |                     | X                 | X  |                             |
| 83    | Sign faces as defined in TORUM, Queensland MUTCD, or TC Signs display messages use Red, Yellow, Green, White, black and occasionally Orange colours.   | 8.4.2       |                     |                    |                     |                   | X  |                             |
| 84    | Where any of these colours are required to display a specific sign face, the chromaticity coordinates of Red, Yellow, Green and White shall be as defined by their respective region coordinates in AS 4852.1, on a matt black background.   | 8.4.2       |                     | X                  |                     |                   |  |                             |
| 85    | Where Orange is required to display a sign face, the chromaticity coordinates of the orange LED shall be as shown in Table 8.4.2 below and Figure 8.1.   | 8.4.2       |                     | X                  |                     |                   |  |                             |
| 86    | Where each of the Red, Yellow, Green, or White colours are generated by mixing, such as through the use of RGB LEDs or other technology, the resulting colours shall remain within their corresponding chromaticity coordinates as defined in AS 4852.1 for all brightness levels. | 8.4.3       |                     | X                  |                     |                   |  |                             |

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|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 87    | Where the Orange colour is generated by mixing, such as through the use of RGB LEDs or other technology, the resulting colour shall remain within the chromaticity coordinates of the orange LED as shown in Table 8.4.2 (and Figure 8.4.3), for all brightness levels.  | 8.4.3       |                     | X                  |                     |                   |  |                             |
| 88    | Each sign display colour generated by mixing shall remain within its corresponding specified chromaticity coordinates for at least 10 years of continuous switching and operation  | 8.4.3       |                     | X                  |                     |                   | X  |                             |
| 89    | Signs are not required to implement the TSI-SP-003 protocol application layer messages relating to the creation (setting) of text and graphics frames, since the eTCS signs' frames are inherently static.   | 8.5         |                     |                    |                     |                   | X  |                             |
| 90    | Thus, the sign's controller shall be able to: <ul style="list-style-type: none"> <li>• display a single fixed message frame continuously when commanded</li> <li>• display a single fixed message frame continuously based on time of day</li> <li>• flash the annulus when commanded, and</li> <li>• display any combination of all the above formats.</li> </ul> | 8.5         |                     |                    | X                   |                   | X  |                             |
| 91    | eTCS signs shall store message formats inside the sign controller that are set by a controlling field processor.   | 8.5         |                     |                    |                     |                   | X  |                             |
| 92    | Facilities shall be included to detect failures within the eTCS and the display control system(s).   | 8.6         |                     |                    |                     |                   | X  |                             |
| 93    | On detection of a failure, the display shall be blanked to prevent confusing displays to the motorist.   | 8.6         |                     |                    | X                   |                   | X  |                             |
| 94    | Loss of communications with TMS shall also be considered an eTCS failure and shall result in the display(s) being blanked after a pre-set time period.   | 8.6         |                     |                    | X                   |                   | X  |                             |
| 95    | This time period shall be a variable, able to be set by TMS, with a range of 60 seconds to 600 seconds.  | 8.6         |                     |                    |                     |                   | X  |                             |
| 96    | The luminance and luminance ratio of the LED shall comply with the requirements of AS 4852.1   | 8.7.1       |                     | X                  |                     |                   |  |                             |

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|                         |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEEQ) |                             |
| 97                      | The LED intensity shall be controlled to provide maximum legibility distances for the complete range of ambient light under which the eTCS shall operate.  | 8.7.2       |                     | X                  |                     |                   |   |                             |
| 98                      | An eTCS shall have a minimum of 10 and a maximum of 100 LED brightness levels.   | 8.7.2       |                     |                    |                     |                   | X   |                             |
| 99                      | The brightness levels shall be in units of percentage of maximum brightness.   | 8.7.2       |                     |                    |                     |                   | X   |                             |
| 100                     | The luminance half angle shall be at least 15° for eTCS.   | 8.7.3       |                     | X                  |                     |                   |   |                             |
| 101                     | The requirements for Luminous Intensity uniformity shall comply with AS 4852.1.  | 8.7.4       |                     | X                  |                     |                   |   |                             |
| 102                     | The luminous intensity uniformity shall be maintained at all dimming levels.   | 8.7.4       |                     | X                  |                     |                   |   |                             |
| 103                     | The action of sunlight or other bright light sources on the optical elements shall be controlled such that inactive pixels shall not appear active. This may require the use of a visor over the display.  | 8.7.5       |                     |                    |                     |                   | X   |                             |
| <b>9 Control system</b> |  |             |                     |                    |                     |                   |   |                             |
| 104                     | The control system requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to this Technical Specification.  | 9           |                     |                    |                     |                   | X   |                             |
| 105                     | As a minimum the eTCS controller shall:<br>a) monitor, log and support TMS requests for its own operation and status<br>b) monitor, log and support TMS status requests for the sign<br>c) be capable of storing enough frames in its non-volatile memory to display each individual sign face<br>d) allow local automatic reset of the eTCS display and the eTCS controller itself such as via watchdog(s)<br>e) be capable of dimming the connected sign based on the light sensor outputs, and<br>f) accept / reject valid or invalid commands made by the TMS and/or PHCS. | 9.1         |                     |                    | X                   |                   | X   |                             |

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|       |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 106   | A three-position key operated facility switch that complies with MRTS201 <i>General Equipment Requirements</i> , shall be provided to enable selection of the following five display functions for each of the text display and the graphics display:<br>1. BLANK / Maintenance, or<br>2. TEST, or<br>3. NORMAL   | 9.2         | X                   |                    | X                   |                   |  |                             |
| 107   | Where Blank / Maintenance mode is selected on a LFS the following requirement shall apply:<br>a) the eTCS sign shall remain powered<br>b) the hardwired sign display of that eTCS sign shall be blanked<br>c) any subsequent display requests from Product Host Control System (PHCS) shall be ignored<br>d) the PHCS software shall be permitted to perform all status, maintenance and diagnostic functions on the respective eTCS sign<br>e) where two signs have been configured as one pair, selecting the LFS to "BLANK" on one eTCS sign, shall not blank the other paired eTCS sign unit, and<br>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. | 9.2.1       |                     |                    | X                   |                   | X  |                             |
| 108   | Where TEST mode is selected on the LFS the displayed message is selected via the maintenance communications port and/or the control communications port.  | 9.2.2       |                     |                    | X                   |                   | X  |                             |

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|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 109   | The followings shall apply:<br>a) the hardwired sign display of that eTCS is active<br>b) the eTCS shall ignore any subsequent display requests from Product Host Control System (PHCS)<br>c) the eTCS shall permit the PHCS software to perform all status, maintenance and diagnostic functions<br>d) the eTCS shall ignore remote control communications from the TMS or designated local HHD (refer Clause 9.11), and<br>e) the eTCS shall permit remote communications with a PC / Laptop running the eTCS Software.            | 9.2.2       |                     |                    | X                   |                   | X  |                             |
| 110   | 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:<br>a) the hardwired sign display of that eTCS is active<br>b) the eTCS shall accept remote control communications from the TMS<br>c) the eTCS shall accept remote communications with a PC / Laptop running the eTCS Software, and<br>d) the eTCS shall accept remote control communications from a designated local HHD (refer Clause 9.11). | 9.2.3       |                     |                    | X                   |                   | X  |                             |
| 111   | Each eTCS shall be operated by an integral control system that is controlled in the following order of priority:<br>1. maintenance communications port, and<br>2. control communications ports.  | 9.3         |                     |                    | X                   |                   | X  |                             |
| 113   | It shall be possible to control and interrogate the eTCS via an EIA/RS-232 maintenance communications port via the eTCS controller.  | 9.3.1       |                     |                    | X                   |                   | X  |                             |
| 114   | The RS-232 port shall allow local and remote communications via a laptop computer (provided by others) containing eTCS messaging and diagnostics software to be provided by the Contractor.  | 9.3.1       |                     |                    | X                   |                   | X  |                             |

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|       |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 115   | The maintenance communications port shall also allow remote connection of a similar computer via a modem.  | 9.3.1       |                     |                    | X                   |                   | X  |                             |
| 116   | 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 eTCS control system or computer / software.  | 9.3.1       |                     |                    | X                   |                   | X  |                             |
| 117   | The hardware handshaking lines of the EIA/RS-232 interface shall be used such that connection / disconnection of the maintenance PC (either locally or by modem) results in the immediate initiation / termination of the maintenance port communications session with the eTCS. | 9.3.1       |                     |                    | X                   |                   | X  |                             |
| 118   | The eTCS control and diagnostics software shall be capable of operating at all possible modem connection and serial port speeds.   | 9.3.1       |                     |                    |                     |                   | X  |                             |
| 119   | It shall be possible to control and interrogate the eTCS via either of two EIA/RS-232 control communications ports.  | 9.3.2       |                     |                    | X                   |                   | X  |                             |
| 120   | The control communications port shall allow local connection of a field processor / modem for communications with TMS.   | 9.3.2       |                     |                    | X                   |                   |  |                             |
| 121   | While a PC / laptop computer is connected to the eTCS via the maintenance communications port, control of the eTCS via the control ports shall be inhibited. However, status and diagnostic interrogation by TMS via the control ports shall remain possible.                    | 9.3.2       |                     |                    | X                   |                   |  |                             |
| 122   | Complete control and monitoring by TMS shall be possible through both control communications ports as determined by telecommunications infrastructure provided at each Site.   | 9.3.2       |                     |                    | X                   |                   | X  |                             |
| 123   | 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 eTCS shall automatically revert to full control AND status communications through the active port.       | 9.3.2       |                     |                    | X                   |                   | X  |                             |

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|       |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 124   | eTCS communications software shall be capable of operating at all possible modem connection and/or serial port speeds.  | 9.3.2       |                     |                    | X                   |                   | X  |                             |
| 125   | The eTCS controller shall be capable of monitoring loss of communications with the TMS and timeout after a specified period.  | 9.4         |                     |                    | X                   |                   | X  |                             |
| 126   | When the eTCS controller is in the NORMAL mode, expiry of this time period shall cause the eTCS controller to blank the entire eTCS.  | 9.4         |                     |                    | X                   |                   | X  |                             |
| 127   | This period shall be a configurable parameter.  | 9.4         |                     |                    | X                   |                   | X  |                             |
| 128   | The eTCS controller shall also be capable of monitoring communications with the sign and timeout after a specified period when such communication is lost.  | 9.4         |                     |                    | X                   |                   | X  |                             |
| 129   | Communications timeout check shall be performed periodically and shall be a configurable parameter.   | 9.4         |                     |                    | X                   |                   | X  |                             |
| 130   | In BLANK / Maintenance mode, the communications timeout check with the TMS shall be ignored.  | 9.4         |                     |                    | X                   |                   | X  |                             |
| 131   | All settings in the eTCS controller shall be accessible via the PHCS.   | 9.5         |                     |                    | X                   |                   |  |                             |
| 132   | The eTCS controller shall monitor and log the following fault conditions: <ul style="list-style-type: none"> <li>• loss of communication with the sign</li> <li>• high enclosure temperature</li> <li>• illumination faults, and</li> <li>• other faults relating to the eTCS.</li> </ul> | 9.6.1       |                     |                    | X                   |                   | X  |                             |
| 133   | The eTCS controller shall log in non-volatile memory, operational and fault events such as message changes, hardware resets, establishment or discontinuation of communications, local manual operations and clearance of faults.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 134   | Each event shall be date and time stamped, accurate to at least one second.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |

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|       |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 135   | Once a fault has occurred and been logged, a recurrence of the same fault need not be logged again until after the fault has been cleared.  | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 136   | The event log shall have space for at least 255 entries.  | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 137   | Where separate logs are used for operational and fault events, each log shall have space for at least 255 entries.  | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 138   | The oldest event record shall be overwritten first when this allocated space has been exceeded.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 139   | All log entries shall be available for upload from any and all communication ports upon request from the TMC and/or PHCS.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 140   | The log shall be uploaded in order of most recent to oldest record.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 141   | A request by the TMS for the event log shall provide for no less than 20 entries at a time.   | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 142   | Events shall be retained in the log even after retrieval by the PHCS and/or TMS.  | 9.6.2       |                     |                    | X                   |                   | X  |                             |
| 143   | The eTCS controller and the sign shall monitor the state of its respective processor and blank the respective display(s) if a critical internal fault is detected that could result in confusion to the public.       | 9.6.3       | X                   |                    | X                   |                   | X  |                             |
| 144   | The eTCS controller shall be provided with an internal system clock in accordance with MRTS201 <i>General Equipment Requirements</i> and allow synchronisation of the clock in response to a TMS and/or PHCS command. | 9.7         |                     |                    | X                   |                   | X  |                             |
| 145   | The eTCS integral control system shall fully implement all eTCS functions.  | 9.8         |                     |                    | X                   |                   | X  |                             |
| 146   | Communication between the Field Processor and the eTCS shall comply with MRTS201 <i>General Equipment Requirements</i> .  | 9.8         |                     |                    | X                   |                   | X  |                             |
| 147   | The computers may use Microsoft Windows® operating systems, from Windows 7 to those industry standards current at the time of use.  | 9.8         |                     |                    | X                   |                   | X  |                             |
| 148   | Any software provided shall be capable of operating on all such operating systems.  | 9.8         |                     |                    | X                   |                   | X  |                             |

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|       |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 149   | The software shall report the selected mode on the facility switch.   | 9.8         |                     |                    | X                   |                   | X  |                             |
| 150   | Unauthorised use of the eTCS shall be prevented.  | 9.8         |                     |                    | X                   |                   | X  |                             |
| 151   | Seed offsets and password offsets shall be unique to each sign.   | 9.8         |                     |                    | X                   |                   | X  |                             |
| 152   | 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 eTCS shall operate.   | 9.9         |                     |                    | X                   |                   | X  |                             |
| 153   | Each eTCS shall support automatic brightness variation, where the eTCS determines the LED brightness level using a light sensor reading and a predefined set of light sensor values.  | 9.9         |                     |                    | X                   |                   | X  |                             |
| 154   | Each eTCS shall be provided with at least one light sensor to detect ambient light levels.  | 9.9         | X                   |                    |                     |                   | X  |                             |
| 155   | The dimming facility should reflect the ambient light conditions immediately on “switch on”, i.e., if the sign is switched on at night, the display shall be dimmed and if the sign is switched on during bright daylight, the display should be optimum brilliance without delay.  | 9.9         |                     |                    |                     |                   | X  |                             |
| 156   | The dimming circuit shall have a switching delay of $30 \pm 5$ seconds.   | 9.9         |                     |                    |                     |                   | X  |                             |
| 157   | Where a sign is in close proximity to artificial lighting, the ambient light level local to that sign may be artificially high. This may result in the dimming system setting the light output of the sign too high. Therefore, each sign and/or dimming circuit shall be capable of adjusting the dimmed light levels through a “brightness offset” to compensate for local artificial light levels. | 9.9         |                     |                    |                     |                   | X  |                             |
| 158   | Each eTCS shall act as a slave on the EIA RS-422A / modem bus.  | 9.10        |                     |                    |                     |                   | X  |                             |

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|                      |   |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 159                  | <p>Where a hand-held communication device is required by the Principal as a local method of control, the HHD shall:</p> <ul style="list-style-type: none"> <li>• have a unique ID that is transmitted with each message change request</li> <li>• shall have priority over TMS message should a TMS message change request occur at the same time as the message change request from a HHD, namely, the TMS request shall be ignored</li> <li>• for wireless HHD, use “code hopping” or “rolling code” technology, to prevent unauthorised use of the signs through “replay attacks”</li> <li>• for wired HHD, the leads shall preferably be securely terminated in the RS-232 port of the eTCS sign or any other secure termination resulting in 15 m lead</li> <li>• the CU shall have the ability to deactivate a HHD from controlling the eTCS sign (e.g., due to lost or damaged HHDs), through the eTCS configuration or RSCS software, and</li> <li>• only when a HHD message activation button is pressed and held for two seconds shall a control message be transmitted.</li> </ul> | 9.11        |                     |                    | X                   |                   | X  |                             |
| 160                  | To guard against accidental activation of an eTCS frame from the HHD, buttons shall be pressed and held for two seconds before any eTCS message frame will be changed.  | 9.11        |                     |                    | X                   |                   | X  |                             |
| 161                  | Note: If the above requirements are not met, the manufacturer / supplier shall demonstrate to the satisfaction of the Principal, how they will limit the remote-control request to an individual CU and prevent unauthorised use of the signs.  | 9.11        |                     |                    | X                   |                   |  |                             |
| <b>10 Electrical</b> |   |             |                     |                    |                     |                   |  |                             |
| 162                  | Portable signs shall be solar powered in accordance with the requirements of MRTS263 <i>Standalone Solar (PV) Power Systems</i> and the relevant requirements of AS 4852.2.   | 10.1        |                     |                    |                     | X                 | X  |                             |
| 163                  | 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.  | 10.1        |                     |                    |                     |                   | X  |                             |

| Item#                                     | MRTS229 Electronic Traffic Control Signs   | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|---|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|   |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 164                                       | 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.  | 10.1        |                     | X                  |                     |                   | X  |                             |
| 165                                       | The relevant electrical requirements defined in MRTS201 <i>General Equipment Requirements</i> apply.   | 10.1        |                     |                    |                     |                   | X  |                             |
| 166                                       | 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 <i>General Equipment Requirements</i> and the relevant requirements of AS 4852.1. | 10.2        |                     |                    |                     |                   | X  |                             |
| 167                                       | Where specified, lighting protection shall be provided in accordance with AS 1768.   | 10.2        |                     |                    |                     |                   | X  |                             |
| <b>11 Installation requirements</b>       |  |             |                     |                    |                     |                   |  |                             |
| 168                                       | The installation requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to this Technical Specification.  | 11          |                     |                    |                     |                   |  |                             |
| <b>12 Telecommunications requirements</b> |  |             |                     |                    |                     |                   |  |                             |
| 169                                       | The telecommunications requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.  | 12          |                     |                    |                     |                   | X  |                             |
| 170                                       | Where the eTCS is required to communicate with STREAMS, this shall be done in accordance with MRTS201 <i>General Equipment Requirements</i> and through a Field Processor compliant with MRTS232 <i>Provision of Field Processors</i> .  | 12          |                     |                    |                     |                   | X  |                             |
| <b>13 Testing and commissioning</b>       |  |             |                     |                    |                     |                   |  |                             |
| 171                                       | The testing and commissioning requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.   | 13.1        |                     |                    |                     |                   |  |                             |
| 172                                       | The minimum additional testing and commissioning requirements for equipment provided under this standard are described below.  | 13.1        |                     |                    |                     |                   |  |                             |

| Item#                   | MRTS229 Electronic Traffic Control Signs   | MRTS Clause | Verification Method |                    |                     |                   |  | Compliance (Y, TBC, N, N/A) |
|-------------------------|--|-------------|---------------------|--------------------|---------------------|-------------------|--|-----------------------------|
|                         |  |             | Visual Inspection   | NATA Certification | Field OR Bench Test | Detailed Drawings | Other records (Datasheets, internal testing, RPEQ) |                             |
| 173                     | The optical performance shall be determined by measurement under laboratory conditions of the minimum luminance ratio and the minimum and maximum luminance for all sign luminance levels listed in AS 4852.1 and in accordance with the photometric test procedures defined in AS 4852.1. | 13.2        |                     |                    |                     |                   |  |                             |
| 174                     | The performance of the eTCS shall meet or exceed the parameters listed in AS 4852.1.   | 13.2        |                     |                    |                     |                   |  |                             |
| <b>14 Documentation</b> |  |             |                     |                    |                     |                   |  |                             |
| 175                     | The documentation requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.   | 14          |                     |                    |                     |                   |  |                             |
| 176                     | For fixed eTCS, once the asset type being installed is known, this shall be communicated to the Principal at first opportunity. This is required to ensure assets are recorded in ROAR and have appropriate asset IDs and site IDs.  | 14.1        |                     |                    |                     |                   |  |                             |
| <b>15 Training</b>      |  |             |                     |                    |                     |                   |  |                             |
| 177                     | The training requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.  | 15          |                     |                    |                     |                   |  |                             |
| <b>16 Maintenance</b>   |  |             |                     |                    |                     |                   |  |                             |
| 178                     | The maintenance requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.   | 16          |                     |                    |                     |                   |  |                             |
| <b>17 Handover</b>      |  |             |                     |                    |                     |                   |  |                             |
| 179                     | The handover requirements defined in MRTS201 <i>General Equipment Requirements</i> apply to work provided under this Technical Specification.  | 17          |                     |                    |                     |                   |  |                             |

