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# RECORD OF AMENDMENTS

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<th>Version</th>
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<th>Date</th>
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<tr>
<td>1.0</td>
<td>Original</td>
<td>18/01/2016</td>
<td>Mgr. TSI</td>
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CHANGEABLE MESSAGE SIGNS - PRISMATIC (Copyright RMS 2016)
1 SCOPE

This specification covers the general requirements for Changeable Message Signs (CMS) that are used in permanent positions above or adjacent to the roadway for lane designation or traffic management applications in New South Wales.

This specification is limited to the Prismatic/"Trivision" style CMS. These typically have a series of equilateral triangular prisms installed directly alongside each other within a frame, situated such that the triangular cross-section is situated at the top and bottom of the frame, and oriented such that only one face from each prism is visible to the motorist at any given time.

A Prismatic/"Trivision" CMS supports the display of up to three different sign faces. These are changed by rotating each of the prisms by an angle of 120°, exposing a previously hidden face to the motorist.

The Control Units, and Manual Operation unit, and associated cabling and linkages are considered an integral part of the CMS.

The support post or structure for the CMS is not considered an integral part of the CMS, and is accordingly not explicitly detailed in this document. CMS designs of the shutter type, flip signs, optical fibre signs, and LED signs are excluded from scope.

2 REFERENCES AND APPLICABLE DOCUMENTS

2.1 Australian Standards

[1] AS 1170.2 – Structural design actions – Wind actions

2.2 Roads and Maritime Services Documents

[7] TS201 – Approval of ITS Field Equipment

2.3 Other Documents

3 DEFINITIONS AND GLOSSARY OF TERMS

For the purposes of this Specification, the following definitions and abbreviations shall apply:

CMS – Changeable message sign
Conspicuity Device – LED lights set at perimeter of display
Control Unit – Small enclosure housing electrical control items
Display Unit – CMS body that houses the prisms, and its contents.
IEC – International Electrotechnical Commission
ISO – International Standards Organisation
Master Controller – Remote controller driving and monitoring the CMS.
MOU – Manual Operation Unit

4 GENERAL

4.1 Diagram

The layout of the major components of a typical CMS display unit, including optional conspicuity devices is shown in Figure 1. The top view shows the position of the additional two sign faces which can be rotated into view.

![Figure 1 – Layout of Changeable Message Sign Display Unit](image-url)
4.2 Main Elements of CMS

The CMS described by this specification comprises a Display Unit, a Control Unit and a Manual Operation Unit.

The Display Unit houses a series of vertically-oriented equilateral triangular prisms, along with a drivetrain allowing the prisms to be rotated around their central axis at the same rate to expose all three sign faces. The Display Unit may also optionally contain yellow conspicuity devices which flash in a pre-determined pattern when triggered. The Display Unit may be mounted on a dedicated support structure, or alternatively retrofitted onto a pre-existing structure such as a pedestrian bridge.

The CMS Control Unit controls the Display Unit by rotating the prisms to the desired position and also controls the conspicuity devices if fitted. The control unit also monitors the position of the prisms and door status, and raises fault alarms when anomalous operation or status is detected. The enclosure housing the Control Unit houses all the electrical control items to drive and monitor the status of the Display Unit. Manually operated signs without an electrical drive system or conspicuity lanterns will not be fitted with a CMS Control Unit.

The Manual Operation Unit (MOU) provides a back-up means to rotate the prisms in the event that the normal electrically driven function is inoperative. The MOU is designed to be used in the event of a power outage at the site or in circumstances where the primary electrically-driven mechanism is unable to rotate the prisms into the required position.

5 OVERALL REQUIREMENTS

5.1 Compliance with Specifications

5.1.1 All equipment and materials, where not otherwise specified, shall be in accordance with Australian Standards where such exist, and in their absence, with appropriate IEC or ISO Standards. The equipment shall comply with the requirements of the NSW Work Health and Safety Act 2011 (Ref. [8]).

5.2 Dimensions and Location

5.2.1 CMS signs are normally mounted over the roadway or closely adjacent to it. Sign dimensions, and sign locations will be specified in the purchasing documentation as appropriate to the project and site. Widths between 0.5m and 5m can be expected, most commonly in the middle of this range.

5.3 Operating Life

5.3.1 Designed operating life of Enclosures and Structural components shall be as below:
   - Enclosures of Display Unit, Control Unit and MOU – not less than 20 years
   - Structural components including sign mounting – not less than 50 years.

5.3.2 Designed operating life items not listed above shall be as per TSI-SP-016 (Ref.[6])
5.4 Environmental Requirements

5.4.1 The environmental requirements shall be as per Section 2 of TSI-SP-016 (Ref.[6]), and also per Section 5 of AS4852.1 - 2009 (Ref.[4]) except as noted below:

(a) The Display unit is not required to have any particular IP rating except where required by the manufacturer's design to protect the internal mechanisms and electrical/electronic components from debris or water ingress. The manufacturer is required to demonstrate that the relevant IP rating, and hence protection, for their equipment has been achieved.

Whilst the Display unit is not required to be debris or water resistant, consideration should be given to providing further protection to major components. The use of sub-enclosures to provide additional protection is permissible, however where sub-enclosures are utilised, consideration shall be given to facilitate access for removal, replacement, maintenance and testing.

(b) The Control Unit and MOU shall meet the IP45 requirement of 5.2(b) of AS4852.1, when seated against a support post or equivalent, with respect to external water and dust.

5.5 Generic Requirements – Technical and Process

5.5.1 Specification TSI-SP-016 (Ref.[6]) applies. This document lists generic technical requirements and also describes processes and requirements for Equipment Testing and Inspection, Certification and Approval, Quality Assurance, Documentation, Warranties, and Spares.

5.6 Packing and Transport

5.6.1 The CMS and any spare parts, tools and ancillary equipment shall be appropriately packed to minimise risk of damage during transport and facilitate handling.

5.7 Maintainability

5.7.1 All major components of the CMS display unit, control unit and MOU shall be laid out in a manner that facilitates fault troubleshooting and component replacement. This may include the provision of electrical test points if applicable.

5.7.2 The supplier shall make available field maintenance documentation providing detailed explanation of all routine recurring, preventative, fault finding and rectification activities. Details on documentation to be provided are contained in Section 16.
6 DISPLAY UNIT REQUIREMENTS

6.1 Enclosure

6.1.1 The display unit enclosure shall facilitate direct access to all internal components of the CMS, including the prisms, drivetrain and conspicuity lanterns where fitted, without the use of specialised tools.

NOTE: A door providing access to equipment contained within the display unit enclosure is not a mandatory requirement. Designs providing access to equipment installed within the display unit enclosure via removal of the prisms are also permissible.

6.1.2 The display unit enclosure shall be capable of being locked to prevent unauthorised access and removal of equipment. Where internal access to the display unit enclosure is provided by means of removing the prisms, the locking mechanism shall secure the prisms in place until the lock is disengaged.

6.1.3 Unsealed, open-faced display unit enclosures shall possess a design that ensures that water does not accumulate within the display unit enclosure.

6.1.4 Unsealed, open-faced display unit enclosures shall be designed to facilitate the self-clearing of leaves and other small debris, minimising the accumulation of such items within the display unit enclosure.

6.1.5 Any opening that is provided in the base of the display unit enclosure to permit the clearing of small debris shall be positioned in a location that does not also allow for removal of, or unauthorised access to the equipment.

6.1.6 The exterior of the display unit enclosure shall possess a nameplate, conforming to Section 11.

6.1.7 Where the display unit enclosure has a viewing window, the covering shall be treated such that reflections are minimal. This shall take into account the intensity and/or the angle of incidence of the sun.

6.2 Structure Attachment

NOTE: Details applicable to the intended sites, including the dimensions of the CMS and the type of support structure required, are typically provided within the purchasing documentation, and are not defined within this Specification.

6.2.1 The display unit shall possess a robust mounting point or mounting points used to attach the display unit enclosure and any additional sign face elements to the support structure, as appropriate to the dimensions and mass of the display unit and sign face.

6.2.2 Mounting points for the display unit enclosure and any additional sign face elements shall have sufficient strength to satisfactorily withstand the static dead load of the display unit enclosure.

6.2.3 Mounting points for the display unit enclosure and any additional sign face elements shall have sufficient strength to satisfactorily withstand the design wind gust speed in AS1170.2 (Ref. [1]), assuming Region B and a Terrain Category of 2.
6.3 Prisms and Drive Mechanism

6.3.1 The display unit shall contain a set of vertically oriented equilateral triangular prisms, installed parallel with each other within the display unit enclosure.

6.3.2 The space between any two adjacent prisms, or between any prism and the frame of the display unit, shall not exceed the lower value of 2% of the width of the prism or 3mm.

6.3.3 All three rectangular faces of the prisms shall be flat, and suitable for the attachment of an adhesive label containing the sign face image.

Prism designs which require the adhesive sign face label to be attached to a removable panel mounted on the side of the prism, facilitating rapid replacement of the sign face, are also permitted.

6.3.4 The drive mechanism of the prisms shall be designed such that the prisms are rotated simultaneously, at the same rotational rate.

6.3.5 The drive mechanism of the prisms shall provide an indication to the CMS Control Unit when a face is rotated into position and correctly aligned. This indication shall also identify which of the three faces is currently being displayed.

6.3.6 Where an unsealed, open-faced display unit enclosure is used, the drive mechanism of the prisms shall be protected from wind-blown debris such as gum nuts or leaves which may enter the display unit enclosure during rotation of the prisms, minimising the possibility of such debris fouling the drive mechanism, disabling the sign.

NOTE: The method by which this is achieved is not covered by this Specification. Possible design approaches may include the installation of a shield or guard between the mechanism and the open face of the display unit enclosure, the use of a sub-enclosure, or positioning the drive mechanism at the top, rather than the bottom of the display unit enclosure.

6.3.7 The prisms shall be removable from the display unit enclosure without the use of specialised tools. A tether or other safety mechanism shall be integrated into the design of the prism mounting point to minimise the risk of the prism falling out of the enclosure onto the footpath/roadway during the removal process.

6.3.8 The prisms and drive mechanism shall be designed and/or marked in a manner that minimises the possibility of a prism being misaligned if it is removed and replaced in the field.

6.4 Conspicuity Lanterns

This sub-section is applicable only where conspicuity lanterns are specified by Roads and Maritime Services as part of the purchasing documentation, and otherwise does not apply.

6.4.1 The conspicuity lanterns shall be a flashing yellow LED display located at each of the four corners on the front of the sign display.

6.4.2 The conspicuity lanterns shall conform to one of the following shapes:

(a) Circular; or

(b) Rectangular, where the longer side of the conspicuity lanterns must be parallel with and immediately adjacent to the longer edge of the CMS display unit enclosure, and the aspect ratio of the lanterns (lantern width divided by lantern height) shall fall between the values of 0.5 and 2.0.
It is permissible for the corners of a rectangular conspicuity lantern to be rounded off. Where this is done, the curve radius of each corner shall not exceed \( \frac{1}{3} \) of the length of the shortest side of the rectangle.

6.4.3 The size of the conspicuity lanterns shall comply with Table 1 below:

<table>
<thead>
<tr>
<th>85th Percentile Approach Speed (v)</th>
<th>Conspicuity Lantern Area</th>
<th>Equivalent side length (where square)</th>
<th>Equivalent diameter (where circular)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v \leq 60 \text{ km/h} )</td>
<td>7854 mm(^2)</td>
<td>88 mm</td>
<td>100 mm</td>
</tr>
<tr>
<td>( 60 \text{ km/h} &lt; v \leq 90 \text{ km/h} )</td>
<td>26880 mm(^2)</td>
<td>164 mm</td>
<td>185 mm</td>
</tr>
<tr>
<td>( v &gt; 90 \text{ km/h} )</td>
<td>49087 mm(^2)</td>
<td>221 mm</td>
<td>250 mm</td>
</tr>
</tbody>
</table>

Table 1 – Approach Speed and Diameter of Conspicuity Lanterns

6.4.4 The luminance of the conspicuity lanterns shall comply with Table 3.3 of AS4852.1 (Ref. [4])

6.4.5 When tested in accordance with Appendix D of AS4852.1 (Ref. [4]), the colour of the conspicuity lanterns shall lie within the “Yellow” region specified by the chromaticity coordinates in Table 3.4 of AS4852.1 (Ref. [4])

6.4.6 The conspicuity lanterns shall provide a minimum of two brightness levels, selection of which shall be controlled by the CMS Control Unit.

6.4.7 The flash cycle of the conspicuity lanterns shall have a nominal cycle time of 1 second (±10%), and a duty cycle of 50% (±5%).

6.4.8 The flash pattern of the conspicuity lanterns shall be controlled by the CMS Control Unit. The conspicuity lanterns shall provide the following flash patterns as a minimum requirement:

(a) Off (no lantern display)
(b) Top/Bottom Paired (up/down flashing)
(c) Left/Right Paired (side/side flashing)
(d) Diagonal Paired (wig/wag flashing)
(e) All flash
7 CMS CONTROL UNIT REQUIREMENTS

The CMS Control Unit is connected to, and controls the drive system of electrically driven Display Units and conspicuity lanterns (where fitted).

This section does not apply to manually operated CMS without an electrical drive system or conspicuity lanterns.

7.1 Enclosure

7.1.1 The CMS Control Unit enclosure shall be lockable and shall be located in one of the following locations, as specified in the purchasing documentation:

(a) ground-mounted;
(b) post-mounted; or
(c) mounted on the back of the sign (not recommended).

7.1.2 The CMS Control Unit enclosure shall comply with per Section 2.1.4.1 of AS4852.1 (Ref. [4]) but excluding items ii to viii inclusive.

7.1.3 The exterior of the CMS Control Unit enclosure shall possess a nameplate, conforming to Section 11.

7.1.4 If post-mounted, cable entry to the CMS Control Unit Enclosure shall be from the rear via a corresponding access point in the support post. This cable entry point, and the corresponding access point in the support post shall be sealed such that the CMS Control Unit Enclosure has environmental protection conforming to Section 5.4.

7.1.5 The CMS Control Unit Enclosure shall be supplied complete with the following provisions

(a) A main switchboard complying with AS/NZS 3000 (Ref. [3]) for the mains power supply to the CMS installation
(b) Relays and control circuits, including terminations for all interconnecting cables
(c) Surge and transient protection devices to withstand the surges specified in AS/NZS 1768 (Ref. [2]), Category B, with medium exposure peak amplitudes.
(d) CMS Control Unit, as detailed in Section 7.2
(e) A switch or other control mechanism with three operational positions, allowing a technician to toggle between Manual Operation Unit (MOU) control, local control and automatic control
(f) A switch or other control mechanism with three operational positions, allowing a technician to manually select each available sign face for display when the switch defined in 7.1.5(e) above is in the “local control” position. It shall be possible for the operator to confirm from the operating position that the prisms are in the desired position.
(g) Where conspicuity lanterns are fitted, a multi-positional switch or other control mechanism, allowing a technician to manually select each available flash pattern of the conspicuity lanterns when the switch defined in 7.1.5(e) above is in the “MOU control” position or the “local control” position. At a minimum, the options listed in Section 6.4.8 shall be selectable. Where this switch is used to operate the conspicuity lanterns, the lanterns should operate at full brightness.
(h) Vacant shelf area, sufficient for the installation of a modem or other small additional hardware.
(i) A door switch, allowing the CMS Control Unit to detect when the door of the CMS Control Unit Enclosure is opened.

7.2 Functions

7.2.1 The CMS Control Unit shall interface with the Display Unit (Section 6), the control switch defined in Section 7.1.5(e) and the Manual Operation Unit (Section 9).

7.2.2 The CMS Control Unit shall possess a serial (EIA232/EIA485) port for interfacing with, and providing inputs and outputs to other devices and systems (e.g. modem).

7.2.3 The CMS Control Unit shall detect the position of the control switch defined in Section 7.1.5(e).

7.2.4 Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is in the “automatic control” position, the CMS Control Unit shall control the position of the prisms, based on input from an external source connected via a serial port (Section 7.2.2) or contact closure (Section 7.3).

7.2.5 Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is in the “local control” position, the CMS Control Unit shall control the position of the prisms, based on input from the control switch defined in Section 7.1.5(f).

7.2.6 Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is in the “MOU control” position, the CMS Control Unit shall not control the position of the prisms.

7.2.7 Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is in the “automatic control” position, the CMS Control Unit shall control the flash pattern of the conspicuity lanterns (where fitted), based on configuration data entered or commanded via the serial port (Section 7.2.2). At a minimum, the options listed in Section 6.4.8 shall be supported.

7.2.8 Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is in the “local control” or “MOU control” position, the CMS Control Unit shall control the flash pattern of the conspicuity lanterns (where fitted), based on input from the control switch defined in Section 7.1.5(g).

7.2.9 The CMS control unit shall provide an input to control the brightness level of the conspicuity lanterns (where conspicuity lanterns fitted), when the control switch defined in Section 7.1.5(e) is in the “automatic control” position based on input from an external source connected via a serial port (Section 7.2.2) or contact closure (Section 7.3). A minimum of two options shall be selectable, as defined in Section 6.4.6.

7.2.10 The CMS Control Unit shall provide a visible output indicating the state of the control switch defined in Section 7.1.5(e). Where the control switch defined in Section 7.1.5(e) is in the “local control” or “MOU control” position, this shall be reflected in the contact closure outputs (Section 7.3.4(d) and (Section 7.3.4(e)). Where the CMS Control Unit detects that the control switch defined in Section 7.1.5(e) is not in the “automatic control” position, the CMS Control Unit shall return an override error response over the serial port (Section 7.2.2) in response to the input defined in Section 7.2.4.
7.2.11 The CMS Control Unit shall provide a visible output indicating which face has currently been selected on the CMS Display Unit. This output shall be sent as a response over the serial port (Section 7.2.2) to a request received from an external source. This output shall also be reflected in the contact closure outputs (Section 7.3.4(a), Section 7.3.4(b) and Section 7.3.4(c)).

7.2.12 The CMS Control Unit shall provide a visible output indicating the flash pattern of the conspicuity lanterns (where conspicuity lanterns fitted).

7.2.13 The CMS Control Unit shall provide an output indicating when the door of the Control Unit Enclosure is opened. This output shall be reflected in the contact closure output defined in Section 7.3.4(f).

7.2.14 The CMS Control Unit shall provide an output indicating when the door of the Manual Operation Unit Enclosure is opened. This output shall be reflected in the contact closure output defined in Section 7.3.4(g).

7.2.15 The CMS Control Unit shall provide a visible output indicating when a fault with the system has been detected. This output shall be provided separately for the following fault conditions:

(a) Prisms unable to move to selected position; or
(b) Conspicuity lantern failure (where conspicuity lanterns fitted). This should trigger should the failure of one or more conspicuity lanterns be detected by the system.

7.3 Contact Closure Inputs and Outputs

This sub-section specifies the contact closure inputs and outputs required to interface the CMS Control Unit with a Roads and Maritime type-approved Traffic Signal Controller.

The requirements under this sub-section shall apply, except where explicitly excluded by Roads and Maritime Services as part of the purchasing documentation.

7.3.1 The CMS Control Unit shall provide contact closure inputs, capable of interfacing with the 240V a.c. signal group outputs provided by a Roads and Maritime type-approved Traffic Signal Controller, or 24V d.c. special purpose outputs provided by a Roads and Maritime type-approved Traffic Signal Controller.

7.3.2 The CMS Control Unit shall provide contact closure outputs, capable of interfacing with the 32V alternating current contact closure Special Facility (SF) or external detector circuit provided by a Roads and Maritime type-approved Traffic Signal Controller.

7.3.3 The CMS Control Unit shall provide contact closure inputs, as defined below:

(a) Set position of prisms in CMS display unit to display sign face A
(b) Set position of prisms in CMS display unit to display sign face B
(c) Set position of prisms in CMS display unit to display sign face C
(d) Activate conspicuity devices (where conspicuity lanterns fitted – default state is maximum brightness)
(e) Dim conspicuity devices (where conspicuity lanterns fitted)
7.3.4 The CMS Control Unit shall provide contact closure outputs, as defined below:
(a) CMS display unit displaying sign face A
(b) CMS display unit displaying sign face B
(c) CMS display unit displaying sign face C
(d) CMS control switch set to “MOU control”
(e) CMS control switch set to “Local Control”
(f) CMS Control Unit enclosure door opened
(g) MOU enclosure door opened
(h) CMS fault detected
8 CONNECTION TO HOST CONTROL SYSTEM

This section is applicable only where the CMS Control Unit is required to connect with a host control system, for example at Transport Management Centre.

8.1 Communications Link and Protocol

8.1.1 The communications protocol and message set used to interface the CMS Control unit with the host control system shall be as described in Appendix A.

8.2 Real-Time Clock

In addition to the requirements for real-time clock in Section 2.4 of AS 4852.1 (Ref. [4]), the following requirements shall apply:

8.2.1 The real-time clock shall be provided with dedicated power backup in addition to any other power backup system in the CMS. The dedicated power backup shall supply only the real-time clock.

8.2.2 This backup source shall have the following characteristics:
   (a) Is maintenance-free;
   (b) Is rated for operation over an extended range of ambient temperatures up to 70°C;
   (c) Has a service life of not less than five (5) years under normal operation.
   (d) Shall provide not less than 60 days of support to the real-time clock after the depletion of any other power backup system in the CMS.

8.2.3 The CMS shall update its real-time clock when an update time message is received from the host control system.

8.2.4 The CMS shall provide automatic updates to the real-time clock for daylight-saving related time changes. For the purpose of this requirement, the CMS shall provide user configurable settings for the dates and times to change from standard time to daylight saving time and vice versa. The default settings shall be as follows:
   (a) Start of daylight saving time - At 0200 hr on the first Sunday in October;
   (b) End of daylight saving time - At 0300 hr on the first Sunday in April.

8.2.5 The CMS shall log all time updates and changes.

8.3 Non-Volatile Memory

8.3.1 The CMS shall provide non-volatile memory for all of its configuration settings, logs and other data and information that need to be preserved when power to the CMS is off or lost.
8.4 Fault, Alarm and Event Logs

8.4.1 Sufficient memory to support the following shall be provided for the fault log, alarm log and event log of the CMS:

(a) For fault log, not less than 50 entries or usage for 12 months, whichever is more;

(b) For alarm log, not less than 500 entries or usage for 12 months, whichever is more;

(c) For event log, not less than 1000 entries or usage for 12 months, whichever is more.

Logs shall use the first-in first-out method in the event the above allocated memory is insufficient.

8.4.2 It shall be possible for a technician to physically connect a computer to the CMS Control Unit to view the log while on site. Where special cables or software is required, the manufacturer shall supply them.
9 MANUAL OPERATION UNIT (MOU) REQUIREMENTS

This section specifies the requirements for a mechanical-based system through which the position of the prisms can be adjusted. The provision of a MOU is a mandatory requirement for CMS without an electrical drive system.

While the provision of a mechanical MOU is considered desirable by Roads and Maritime for electrically-driven CMS, consideration will be given to CMS designs which incorporate the means to connect and operate the sign off an auxiliary/backup power supply, as an alternate option to providing the MOU. Where this option is provided, this should be clearly stated in the supplier's submission for approval.

9.1 Enclosure

9.1.1 The MOU enclosure shall be lockable, as specified in the purchasing documentation, and suitable for mounting on the support structure.

9.1.2 The construction of the MOU enclosure shall conform to Section 3 of TSI-SP-016 (Ref.[6]),

9.1.3 The access point to the MOU Enclosure for all mechanical or electrical functions shall be from the rear via a corresponding access point in the support post. This cable entry point, and the corresponding access point in the support post shall be sealed such that the MOU Enclosure has environmental protection conforming to Section 5.4.

9.1.4 The position of the MOU enclosure will be specified within the purchasing documentation, however it is typically located at a height accessible to a technician without the use of a ladder or other elevated work platform.

9.1.5 The exterior of the MOU enclosure shall possess a nameplate, conforming to Section 11.

9.1.6 If the CMS is electrically driven, the MOU enclosure shall be fitted with a door switch, allowing the CMS Control Unit to detect when the door of the MOU enclosure is opened.

9.1.7 The MOU enclosure shall make provision for the storage of any removable MOU components (e.g. operation handle), if these are incorporated within the MOU design.

NOTE: It is permissible for any removable MOU components to be stored within the CMS Control Unit enclosure. Where this is the case, this should be clearly specified in the design documentation and field maintenance manual when submitting a CMS design to Roads and Maritime for approval.

9.2 Functions

9.2.1 The MOU shall engage a mechanical system to rotate the prisms from ground level, without electrical power.

9.2.2 If the CMS is electrically driven, the MOU shall provide a means by which the MOU operator can disengage the electrical drive system from the prisms if required for the MOU to be effective.

9.2.3 The MOU shall provide a means by which the MOU operator can, without changing their location, determine when the prisms are in the desired position.
9.2.4 The MOU shall be designed to provide high reliability, and require minimal routine or preventative maintenance.

9.2.5 The MOU shall be designed in a manner that allows the system to be operated safely by a single operator.

9.2.6 The MOU shall be designed in a manner that allows the prisms to be rotated between any two sign faces within ten seconds once the system is engaged.

9.2.7 MOU systems incorporating removable components shall make provision for all such components to be stored conveniently and securely on site.
10 Fault Protection

Consideration shall be given to risk of damage of CMS devices (e.g. motors etc), during fault conditions. This might involve consideration of travel limits, overheating, and other events such as might occur if a mechanism became jammed, or failed to trigger, then affecting other devices in the system. Design measures should be included to manage such risks, where practical and appropriate. These might include cut-outs, limits to motor operation time, etc.

11 Nameplates

Aluminium nameplates shall be affixed in a permanent manner to the exterior of the Display Unit, Control Unit, and MOU, containing the following information:

(a) Product/model name,
(b) Manufacturer's name,
(c) A unique serial number.

A high quality process (such as photo engraving, anodising, etc) shall be used to produce the legends on the nameplates. The legends shall be clearly legible, indelible, and non-fading.

12 Approval

12.1 Overall Approval for a specific application

To gain overall approval of a CMS design, the supplier shall follow the process defined in TS201 (ref. [7]).

13 Quality Assurance

13.1 General

The Supplier and the manufacturer shall operate a quality management system complying with ISO 9001.

13.2 Third Party Accreditation

The quality management system shall be certified by a quality management system certification body either accredited under the criteria laid down in the Joint Accreditation System of Australia and New Zealand (JAS-ANZ), or listed in the International Standards Organisation ISO Directory of ISO 9000 and ISO 14000 Accreditation and Certification Bodies.

13.3 Quality Plan

The manufacturer shall document a quality plan appropriate to the item detailing the quality control tests and assessments the manufacturer will conduct during manufacture prior to
release. This shall include sampling plans and test frequency, and a description of the records to be made, as relevant.

A copy of this quality plan shall be provided by the supplier to Roads and Maritime as part of the approval process. Acceptance of this quality plan by Roads and Maritime is a prerequisite to gaining overall approval of a CMS design.

13.4 Quality Audits

Roads and Maritime reserves the right to examine the Manufacturer's quality records pertaining to any order for CMS. Roads and Maritime also reserves the right to arrange for an independent quality audit concerning CMS in contract.

14 TESTING AND INSPECTION

14.1 Routine Production Tests

Tests and assessments shall be carried out by the manufacturer before Pre-delivery Acceptance Test, as defined in the manufacturer’s quality plan.

15 WARRANTY

Purchase of any items under this Specification shall be subject to a warranty period, to be confirmed by the Tenderer, of not less than 24 months following the date of despatch from the Manufacturer's Works or Agent's Premises to the Roads and Maritime Store. Any CMS failed in service or found to be defective within 24 months of the date of despatch will be delivered to the Supplier, who shall then make good the defect, arrange to have the defect made good or replace the CMS with another, and subsequently return the good unit to Roads and Maritime at no charge to Roads and Maritime. Unless otherwise agreed, defective CMS shall be processed and returned within 60 calendar days from the date the Supplier is notified by CMS of the defect.

It is expressly understood that any CMS failed as a result of a traffic accident, abuse or act of vandalism after delivery to Roads and Maritime will not be covered by warranty provisions.

16 DOCUMENTATION TO BE SUPPLIED

The Supplier shall submit the following documentation, as a minimum, in support of a submission for approval for the CMS via email to the ITS HelpDesk (ITSHelpDesk@rms.nsw.gov.au) for Approval by the ITS Principal:

(a) A quality plan for the CMS containing details of all tests undertaken during the manufacturing process (ref. Section 13.3).

(b) Installation manual containing all information required for the installation of the CMS and any other associated equipment. This manual shall not depend on the presence of any other (separately bound) documentation or manual and shall present the information in a manner and sequence that is relevant to the installation procedure.

(c) Operations manual detailing the operation of the CMS.
(d) Maintenance manual including preventative (routine) maintenance procedures and recommended maintenance schedules, if any. Fault maintenance procedures covering the replacement of key components in the event of failure shall be provided.

(e) Reference mechanical drawings of all supplied equipment.

Failure to provide the full information called for in this section shall render the submission liable to rejection.
APPENDIX A – COMMUNICATIONS PROTOCOL MESSAGE SET

A.1 General

A communication link will be provided for communication between each CMS (via the CMS Control Unit) and the host control system.

For communications to a host control system, the CMS shall use a subset of messages from TSI-SP-003 (Ref. [5])

A.2 Message set

For communications to a host control system, the CMS shall use the following subset of messages from TSI-SP-003 (Ref. [5]).

NOTE: This subset has been intentionally selected from those messages used for the control of variable message signs (VMSs). This is so that the CMS can be controlled from the existing facilities provided by the host control system for the control of VMSs.

The applicable Message Information (MI) codes for the control of CMSs are in the following table.

<table>
<thead>
<tr>
<th>Message Name</th>
<th>MI Code (Hex)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reject Message</td>
<td>00</td>
<td></td>
</tr>
<tr>
<td>Acknowledge (*ACK)</td>
<td>01</td>
<td></td>
</tr>
<tr>
<td>Start Session</td>
<td>02</td>
<td></td>
</tr>
<tr>
<td>Password Seed</td>
<td>03</td>
<td></td>
</tr>
<tr>
<td>Password</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>Heartbeat Poll</td>
<td>05</td>
<td></td>
</tr>
<tr>
<td>Sign Status Reply</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td>End Session</td>
<td>07</td>
<td></td>
</tr>
<tr>
<td>System Reset</td>
<td>08</td>
<td>Refer to Cl.A.2.1 for details.</td>
</tr>
<tr>
<td>Update Time</td>
<td>09</td>
<td>Required for timestamping of fault log entries.</td>
</tr>
<tr>
<td>Sign Set Text Frame</td>
<td>0A</td>
<td>Sets CMS aspect and conspicuity device state but does not cause the display (until message with MI = 0E received). Refer to Cl.A.2.2 for details.</td>
</tr>
<tr>
<td>Sign Display Frame</td>
<td>0E</td>
<td>Displays CMS aspect and activates conspicuity device state previously defined in received message with MI = 0A. Refer to Cl.A.2.3 for details.</td>
</tr>
<tr>
<td>Sign Set Dimming Level</td>
<td>14</td>
<td>Used to control dimming of conspicuity devices Refer to Cl.A.2.4 for details.</td>
</tr>
<tr>
<td>Sign Request Stored Frame/Message/Plan</td>
<td>17</td>
<td>CMS always responds with a Sign Set Text Frame message (MI = 0A). Refer to Cl.A.2.5 for details.</td>
</tr>
</tbody>
</table>
Message Name | MI Code (Hex) | Remarks
--- | --- | ---
Retrieve Fault Log | 18 | 
Fault Log Reply | 19 | 
Reset Fault Log | 1A | 

Table A.1 – TSI-SP-003 MI Codes Applicable to CMSs

For parts of the TSI-SP-003 protocol that do not apply to CMS items, the CMS shall respond with the appropriate "not supported" error code in accordance with the protocol (MI = 00 hex and application error code 08 hex).

**NOTE:** The pair of MI codes 0A and 0E is retained to maintain logical compatibility with existing control system logic for variable message signs (VMSs). In that case the text frame is sent to the VMS (using message with MI = 0A) but is not actually displayed until the display frame command is sent (using message with MI = 0E).

A.2.1 System Reset (MI = 08)

In all cases, a System Reset shall not cause the CMS to change the displayed state. If the reset command is received during the transition between states, the CMS shall complete the transition to the destination state prior to implementing the reset.

(a) A reset level of zero shall turn off the conspicuity devices (if on), and set them to automatic dimming mode.

(b) A reset level of one shall perform all the actions associated with a reset level zero.

(c) A reset level of two shall perform all the actions associated with a reset level one in addition to resetting all faults and the fault log.

(d) A reset level of three shall perform all the actions associated with a reset level two.

(e) A reset level of 255 shall perform all the actions associated with a reset level three in addition to restoring to factory settings. Factory settings shall include the seed offset, password offset, baud rate, parity, etc but not the device address. Reset level 255 shall not cause the device controller to change to the off-line state.

A.2.2 Sign Set Text Frame (MI = 0A)

This command is bidirectional and has two functions:

(a) When sent from the control system to the CMS Control Unit, it informs the CMS which aspect to display next. It does not cause that aspect to be displayed.

(b) When sent from the CMS Control Unit to the control system, it informs the control system which aspect is presently being displayed by the CMS.

When sent from the control system to the CMS Control Unit:

(a) Frames 01, 02 and 03 hex shall correspond to the three aspects of the CMS.

(b) Frames 00 and 04 to FF hex shall not be used.

(c) Bytes for revision, font, and colour shall be ignored.

(d) The number of alphanumeric characters in the frame shall be 01 hex.

(e) The contents of the text frame (a single byte) shall be 01, 02 or 03 hex and agree with the frame number.
When sent from the CMS Control Unit to the control system:

(a) The Frame ID shall correspond to the CMS aspect being displayed.
(b) Frames 04 to FF hex shall be set to 00 hex.
(c) Bytes for revision, font, and colour shall be set to 00 hex.
(d) The number of alphanumeric characters in the frame shall be 01 hex.
(e) The contents of the text frame (a single byte) shall be 01, 02 or 03 hex and agree with the frame number.

A.2.3 Sign Display Frame (MI = 0E)

This command instructs the CMS to display the aspect and conspicuity device state previously defined in the Sign Set Text Frame (MI = 0A) message.

The byte for group ID shall be ignored.

A.2.4 Sign Set Dimming Level (MI = 14)

This command controls the dimming level of the conspicuity devices.

(a) Number of entries shall be 01 hex.
(b) The byte for group ID shall be ignored.
(c) The luminance level byte values 00 to 08 hex shall be interpreted as minimum intensity and values 09 to 10 hex shall be interpreted as maximum intensity

A.2.5 Sign Request Stored Frame/Message/Plan (MI = 17)

This command instructs the CMS to report the stored aspect.

The frame/message/plan byte value shall be 00 hex.

A.3 Error codes

If the CMS is unable to display the commanded aspect this is a serious display failure. As the message set here is intended to be a subset of those used for the control of VMSs, the nearest equivalent VMS-related error code is the sign multi-LED failure.

If the CMS is unable to display the commanded aspect (01, 02 or 03) then it shall report a device error code of 08 hex.

If the CMS detects a failure in one or more of the conspicuous lanterns, it shall report a device error code of 0B hex.

Where the CMS Control Unit receives a message from the host control system while the control switch defined in Section 7.1.5(e) is in the “local control” or “MOU control” position, then it shall report a device error code of 10 hex (Facility Switch override).