Specification for

Ramp Control/Metering Signs

April 2019
Rev: A
Foreword

This specification has been developed by VicRoads. It is one of a number of technical specifications, and associated standard drawings, which set out the requirements for roadside ITS devices, traffic signal equipment and other electrical equipment and associated devices and control systems.

This specification is intended for use in all relevant works undertaken by or on behalf of VicRoads.

VicRoads Standard Drawings, Specifications and Guidelines are available for downloading from VicRoads website at the following address under ‘Tenders & Suppliers’, http://www.vicroads.vic.gov.au/itsspecs

Specification updates. VicRoads specifications and associated standard drawings are subject to periodic review. To keep the specifications up to date, amendments or new editions are issued as necessary. It is therefore important for users of VicRoads specifications to ensure that they have the latest version and associated amendments.

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PREFACE

A. TELECOMMUNICATIONS EQUIPMENT

A.1 All telecommunications equipment shall comply with relevant requirements of the Australian Communications and Media Authority (ACMA). Such equipment shall be labelled with a Regulatory Compliance Mark.

B. CHANGES TO THIS SPECIFICATION

B.1 The main changes to this specification from previous versions are listed below:

- Updated VicRoads template
- Corrected referencing
- Updated sign requirements
- New requirements for device warranty
- New section for installation requirements
## Revision History

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<th>Version</th>
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<th>Date</th>
<th>Author</th>
<th>Description</th>
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<td>2002</td>
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<td>March 2002</td>
<td>TTI</td>
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<td>2003</td>
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<td>June 2011</td>
<td>RUS</td>
<td>Revision</td>
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<td>5</td>
<td>B</td>
<td>August 2011</td>
<td>RUS</td>
<td>Editorial fixes, revised sign layouts, revised figure.</td>
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<td>October 2011</td>
<td>RUS</td>
<td>Clarification of LED’s</td>
</tr>
<tr>
<td>2016</td>
<td>A</td>
<td>March 2016</td>
<td>RO</td>
<td>Revised operation and control, changes to sign types</td>
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<tr>
<td>2019</td>
<td>A</td>
<td>April 2019</td>
<td>ITS</td>
<td>Revised and updated. Remove requirement for visors. Addition of installation section and warranty requirements.</td>
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Contents

SECTION 1 - SCOPE AND GENERAL ................................................................. 8
1.1 SCOPE ........................................................................................................ 8
1.2 GENERAL .................................................................................................... 9
   1.2.1 Ramp Control/Metering Sign - RC1 ...................................................... 9
   1.2.2 Ramp Metering Sign – RC2 ................................................................. 9
   1.2.3 Ramp Control Sign – RC3 ................................................................. 9
   1.2.4 Ramp Control Sign Designations ...................................................... 10
1.3 INTELLECTUAL PROPERTY ................................................................. 13
1.4 ACRONYMS ............................................................................................. 13

SECTION 2 – RELATED SPECIFICATIONS AND DRAWINGS ..................... 14
2.1 AUSTRALIAN STANDARDS ................................................................. 14
2.2 VICROADS SPECIFICATIONS AND DRAWINGS ............................. 14
2.3 ADDITIONAL SPECIFICATIONS AND DOCUMENTS ....................... 15

SECTION 3 - RC1 RAMP CONTROL / METERING SIGN ......................... 16
3.1 GENERAL ............................................................................................. 16
3.2 DISPLAY REQUIREMENTS ................................................................. 16

SECTION 4 - RC2 RAMP METERING SIGNS ............................................. 19
4.1 GENERAL ............................................................................................. 19
4.2 RC2-A DISPLAY REQUIREMENTS ..................................................... 19
4.3 RC2-C DISPLAY REQUIREMENTS ..................................................... 21

SECTION 5 - RC3 RAMP CONTROL / FREeway CONDITION SIGNS ......... 22
5.1 GENERAL ............................................................................................. 22
5.2 RC3-A DISPLAY REQUIREMENTS ..................................................... 22
5.3 RC3-B DISPLAY REQUIREMENTS ..................................................... 24
5.4 RC3-C DISPLAY REQUIREMENTS ..................................................... 24

SECTION 6 - OPERATION AND CONTROL ............................................... 26
6.1 GENERAL ............................................................................................. 26
6.2 SIGN CONTROL PERFORMANCE AND CAPABILITY ..................... 27
6.3 SIGN CONTROLLER (SC) ................................................................. 28
6.4 ADMINISTRATION AND CONFIGURATION TOOL .......................... 28
6.5 RESET ................................................................................................. 33
6.6 SIGN CONTROLLER PARAMETER DEFAULT SETTINGS ............. 33
6.7 ETHERNET .......................................................................................... 34
6.8 RMS PROTOCOL FOR SIGN CONTROL ........................................ 35
6.9 OTHER PROTOCOLS ........................................................................... 35
6.10 HARDWARE SERIAL PORTS: ............................................................. 36
6.11 DIAGNOSTIC FUNCTIONS ............................................................. 37
6.12 MONITORING, FAULT LOGGING AND REPORTING ................... 38
6.13 LOCAL CONTROL ............................................................................. 39
6.14 REMOTE CONTROL .......................................................................... 40
6.15 FALL-BACK SYSTEM ......................................................................... 40
6.16 DISPLAY TEST PATTERNS ............................................................... 40
6.17 FIRMWARE UPGRADE ....................................................................... 41
SECTION 7 - OPTICAL REQUIREMENTS ................................................................. 42
  7.1 PHOTOMETRIC REQUIREMENTS ................................................................. 42
  7.2 COLORIMETRIC REQUIREMENTS ................................................................. 42
  7.3 SIGN DIMMING CONTROL ........................................................................ 42
  7.4 LIFESPAN REQUIREMENTS ........................................................................ 42

SECTION 8 - SIGN ENCLOSURE ........................................................................ 43
  8.1 GENERAL ......................................................................................................... 43
  8.2 DOORS ............................................................................................................. 43
  8.3 LOCKS .............................................................................................................. 44
     8.3.1 RC1, RC2A, RC2C and RC3A Signs .............................................................. 44
     8.3.2 RC3C Signs ................................................................................................. 44
  8.4 FRONT VIEWING WINDOW ............................................................................ 44
  8.5 DIMENSIONS .................................................................................................. 45
  8.6 MOUNTING ...................................................................................................... 45

SECTION 9 - ELECTRICAL REQUIREMENTS .................................................... 46
  9.1 GENERAL ......................................................................................................... 46
  9.2 OPERATING VOLTAGE .................................................................................... 46
  9.3 CONNECTION TO SUPPLY – RC1, RC2 AND RC3 SIGNS ............................. 46
  9.4 POWER LOAD .................................................................................................. 46
  9.5 INTERNAL PROTECTION ................................................................................. 47
  9.6 EMC COMPLIANCE ........................................................................................ 47

SECTION 10 - ENVIRONMENTAL ..................................................................... 48
  10.1 TEMPERATURE AND HUMIDITY .................................................................. 48
  10.2 ENCLOSURE PROTECTION .......................................................................... 48
  10.3 VIBRATION ..................................................................................................... 48
  10.4 WIND LOADING .............................................................................................. 49

SECTION 11 - MARKINGS .................................................................................. 50
  11.1 REQUIREMENTS ............................................................................................. 50

SECTION 12 – DOCUMENTATION .................................................................. 51
  12.1 GENERAL ....................................................................................................... 51
  12.2 MANUFACTURERS WARRANTY .................................................................... 51
     12.2.1 Warranty Conditions ................................................................................. 51
     12.2.2 Warranty Certificate .................................................................................. 51
     12.2.3 Warranty Register ..................................................................................... 52

SECTION 13 - INSTALLATION AND COMMISSIONING ................................... 53
  13.1 GENERAL ....................................................................................................... 53
  13.2 RC1 SIGNS ..................................................................................................... 53
     13.2.1 General ..................................................................................................... 53
     13.2.2 Electrical Supply ....................................................................................... 54
     13.2.3 Communications ....................................................................................... 55
  13.3 RC2-A SIGNS ................................................................................................ 55
     13.3.1 General ..................................................................................................... 55
     13.3.2 Electrical Supply ....................................................................................... 56
  13.4 RC3-A SIGNS ................................................................................................ 56
     13.4.1 General ..................................................................................................... 56
13.4.2 Electrical Supply ................................................................. 56
13.4.3 Communications ............................................................. 57
13.5 RC2-C SIGNS ............................................................................. 58
  13.5.1 General ............................................................................... 58
  13.5.2 RC2-C Signs Mounted on a Stand-alone Post ..................... 58
  13.5.3 RC2-C Signs Mounted on a Gantry ..................................... 59
  13.5.4 Electrical Supply ............................................................... 59
  13.5.5 Communications .............................................................. 60
13.6 RC3-C SIGNS ............................................................................. 60
  13.6.1 General ............................................................................... 60
  13.6.2 Electrical Supply ............................................................... 60
  13.6.3 Communications .............................................................. 61

APPENDIX A - VICROADS ITS PLATFORM ............................................. 62
  A.1 GENERAL .................................................................................... 62
  A.2 FIELD PROCESSOR ................................................................. 62

APPENDIX B - VICROADS EXTENSION TO RMS PROTOCOL FOR VMS ............ 63
  B1 INTRODUCTION ............................................................................ 63
  B2 GENERAL IMPLEMENTATION REQUIREMENTS ....................... 63
  B3 SPECIFIC IMPLEMENTATION REQUIREMENTS FOR COLOUR DISPLAYS ... 65
  B4 MESSAGE SEQUENCE AND PROCESS ....................................... 66
  B5 COLOUR AND MONOCHROME FRAMES ..................................... 66

APPENDIX C - LABELS ........................................................................ 68
  C1 TRAFFIC SIGNAL CONTROLLER SUPPLYING RC1 AND RC3-A SIGN .... 68
  C2 RC1 AND RC3A RAMP CONTROL/METERING SIGN ..................... 68
  C3 RC2-C AND RC3-A SIGN POWERED FROM SEPARATE POINT OF SUPPLYS ... 69

APPENDIX D - REQUIREMENTS FOR TYPE APPROVAL .................................... 70
  D1 GENERAL .................................................................................... 70
  D2 REQUIRED NATA ACCREDITED TESTING .................................... 70
  D3 OTHER REQUIRED TESTING ..................................................... 71
  D4 COMPATIBILITY WITH RMS PROTOCOL .................................... 71
  D5 STREAMS COMPATIBILITY ....................................................... 71
  D6 ASSESSMENT PROCEDURE ....................................................... 71
  D7 FIELD TRIAL ............................................................................. 71

APPENDIX E - GUIDELINES FOR PLANNING OR PURCHASING .......................... 72
  E1 PURCHASING ............................................................................. 72
SECTION 1 - SCOPE AND GENERAL

1.1 SCOPE

1.1.1 This specification covers the requirements for the design, supply, operation and installation of Ramp Control/Metering and Freeway Information Signs for use on selected freeway ‘on-ramps’ within the State of Victoria.

1.1.2 Ramp control/metering signs are typically used as part of a Freeway Ramp Signals installation to provide drivers advanced information regarding:

- the operation of ramp signals;
- advice when the freeway ramp has been closed;
- advice of an incident on the freeway; and
- travel times to key locations on the freeway (RC3/TT3 when operating as a Travel Time sign)

1.1.3 Further information on the principals of operation of ramp signals can be obtained in VicRoads Freeway Ramp Signals Handbook.

1.1.4 There are three main types of Ramp Control/Metering Sign covered by this specification. They are detailed in Table 1.1 below. The various sizes and designations of ramp control sign are shown in Table 1.2.

<table>
<thead>
<tr>
<th>Sign Type</th>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC1</td>
<td>Ramp control/ramp metering sign</td>
<td>Advice that ramp metering is operating and used to close freeway on-ramp during incidents.</td>
</tr>
<tr>
<td>RC2</td>
<td>Ramp metering warning sign</td>
<td>Re-enforcement of ramp signals operating and to prepare to stop.</td>
</tr>
<tr>
<td>RC3</td>
<td>Ramp Control / Travel Time</td>
<td>Primarily used to provide travel times on the freeway. Also used to advise of incidents on the freeway or that the freeway on-ramp is closed.</td>
</tr>
</tbody>
</table>

Table 1.1: Types of Ramp Control Sign

1.1.5 This specification is based on the use of LED technology. However, other technologies that meet the performance criteria of this specification may be considered.
1.2 **GENERAL**

1.2.1 **Ramp Control/Metering Sign - RC1**

1.2.1.1 The RC1 sign type is typically placed near the on-ramp entrance of a freeway to indicate that the ramp signals are operating, or the freeway is closed.

1.2.1.2 A typical layout for RC1 sign at a freeway entrance is shown in Figure 1.1.

1.2.2 **Ramp Metering Sign – RC2**

1.2.2.1 The RC2 sign is typically placed on an on-ramp to reinforce to drivers that the ramp signals are operating and to warn drivers of a need to stop.

1.2.2.2 There are two types of RC2 sign as follows:

- RC2-A – Typically installed on an on-ramp providing access to a freeway from an arterial road.
- RC2-C – Typically installed on freeway to freeway interchange-ramp providing access from one freeway to an interconnecting freeway.

1.2.2.3 A typical layout for RC2-A sign at a freeway entrance/on-ramp is shown in Figure 1.1.

1.2.2.4 A typical layout for RC2-C sign at a freeway entrance/on-ramp is shown in Figure 1.2.

1.2.3 **Ramp Control Sign – RC3**

1.2.3.1 RC3 signs are used to provide motorists with information regarding works, incidents or closures of a freeway.

1.2.3.2 RC3 signs are also referred to as Travel Time Sign Type 3 (TT3). See TCS 070 for further details.

1.2.3.3 There are two types of RC3 sign as follows:

- RC3-A – Typically installed on an arterial road at the commencement of a freeway on-ramp providing information for the freeway.
- RC3-C – Typically installed before a freeway to freeway interchange ramp providing information for the interconnecting freeway.

1.2.3.4 The RC3-A sign is generally used to provide travel times along a freeway, operating as a TT3 sign (see TCS 070).

1.2.3.5 The RC3-A sign is also used to provide information to drivers that there is an incident on the freeway or the freeway is closed.

1.2.3.6 The RC3-C sign is used typically to advise motorists that the ramp signals on the freeway-to-freeway interchange ramp are-operating.
1.2.3.7 The RC3-C sign has been designed to be capable of displaying travel times for destinations along the intersecting freeway(s) as detailed in TCS 070 (operating as a TT5 sign).

*Note: at the time of this specification the display of travel times on the RC3-C sign has not been approved by VicRoads.*

1.2.3.8 A typical layout for RC3-C signs at a freeway interchange ramp’ is shown in Figure 1.2.

### 1.2.4 Ramp Control Sign Designations

1.2.4.1 An overview of ramp control/metering signs and their designations are detailed in Table 1.1 below.

#### Table 1.1 – Ramp Control/Metering Sign Designations

<table>
<thead>
<tr>
<th>Ramp Control Sign</th>
<th>Road Designation</th>
<th>Use*</th>
<th>Approach speed</th>
<th>Display Type</th>
<th>Pixels (W)</th>
<th>Pixels (H)</th>
<th>Pixel Pitch (maximum)</th>
<th>Approximate Dimensions (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC1</td>
<td>Arterial</td>
<td>RC RM</td>
<td>&lt;80 km/h</td>
<td>Changeable Message Sign</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>900 x 600</td>
</tr>
<tr>
<td>RC2-A</td>
<td>On-Ramp</td>
<td>RM</td>
<td>60-100 km/h</td>
<td>Changeable Message Sign</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>900 x 600</td>
</tr>
<tr>
<td>RC2-C (same sign as RC3-A)</td>
<td>Freeway to Freeway Interchange</td>
<td>RM</td>
<td>80-100 km/h</td>
<td>Four Colour Matrix</td>
<td>128</td>
<td>40</td>
<td>12</td>
<td>1660 x 600</td>
</tr>
<tr>
<td>RC3-A (also referred to as TT3)</td>
<td>Arterial Road</td>
<td>TT RC</td>
<td>60-80 km/h</td>
<td>Four Colour Matrix</td>
<td>128</td>
<td>40</td>
<td>12</td>
<td>1660 x 600</td>
</tr>
<tr>
<td>RC3-C (also referred to as TT5)</td>
<td>Freeway to Freeway Interchange</td>
<td>RM</td>
<td>100 km/h</td>
<td>Four Colour Matrix</td>
<td>128</td>
<td>56</td>
<td>32</td>
<td>4450 x 2150</td>
</tr>
</tbody>
</table>

* RC – Ramp Control function. RM – Ramp Metering function. TT – Travel Time function
Figure 1.1 – Typical Layout for RC1, RC2 and RC3 Signs
Arterial Road to Freeway
Figure 1.2 – Typical Layout for RC2-C and RC3-C Signs
Freeway to Freeway
1.3 INTELLECTUAL PROPERTY

1.3.1 In relation to all Intellectual Property rights associated with operating the signs, the contractor grants to VicRoads non-exclusive licence to “use, modify and sell or use that licence for other purposes that, without the license, could be a breach of the licensors Intellectual Property.

1.3.2 Intellectual Property shall include, but not be limited to, the following:

- Software.
- Source code(s).
- Schematic diagrams.
- Circuit diagrams.
- Wiring diagrams.
- Listings of components and sub-components.
- Any and all operational and maintenance documentation.

1.4 ACRONYMS

The acronyms used in this document shall be interpreted as follows:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACMA</td>
<td>Australian Communications and Media Authority</td>
</tr>
<tr>
<td>AS</td>
<td>Australian Standard</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
</tr>
<tr>
<td>CLI</td>
<td>Command Line Interface</td>
</tr>
<tr>
<td>CSV</td>
<td>Comma Separated Values</td>
</tr>
<tr>
<td>DHCP</td>
<td>Dynamic Host Configuration Protocol</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name System</td>
</tr>
<tr>
<td>EMC</td>
<td>Electromagnetic Compatibility</td>
</tr>
<tr>
<td>FP</td>
<td>Field Processor as used with STREAMS</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
</tr>
<tr>
<td>ICMP</td>
<td>Internet Control Message Protocol</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
</tr>
<tr>
<td>LED</td>
<td>Light Emitting Diode</td>
</tr>
<tr>
<td>PE Cell</td>
<td>Photo Electric Cell</td>
</tr>
<tr>
<td>RC1</td>
<td>Ramp Control / Metering Sign</td>
</tr>
<tr>
<td>RC2</td>
<td>Ramp Metering Sign</td>
</tr>
<tr>
<td>RC3</td>
<td>Real Time Information Sign</td>
</tr>
<tr>
<td>RCD</td>
<td>Residual Current Device</td>
</tr>
<tr>
<td>RMS</td>
<td>Roads and Maritime Services of NSW (previously known as Roads and Traffic Authority, RTA)</td>
</tr>
<tr>
<td>SSH</td>
<td>Secure Shell</td>
</tr>
<tr>
<td>SSL</td>
<td>Secure Sockets Layer</td>
</tr>
<tr>
<td>STREAMS</td>
<td>STREAMS is an integrated control system which operates ITS Freeway Management Devices and other traffic management devices.</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>Transmission Control Protocol/Internet Protocol</td>
</tr>
<tr>
<td>TLS</td>
<td>Transport Layer Security</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable Message Sign</td>
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SECTION 2 – RELATED SPECIFICATIONS AND DRAWINGS

2.1 AUSTRALIAN STANDARDS

2.1.1 The fabrication and supply of all components shall conform to the latest version of all relevant Australian Standards.

2.1.2 The following related Australian Standards are referenced:

<table>
<thead>
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<tr>
<td>AS 1742.2</td>
<td>Manual of uniform traffic control devices, Part 2: Traffic control devices for general use</td>
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<tr>
<td>AS 1743-</td>
<td>Road signs – Specifications</td>
</tr>
<tr>
<td>AS/NZ 3000</td>
<td>Wiring Rules</td>
</tr>
<tr>
<td>AS 4100</td>
<td>Steel structures</td>
</tr>
<tr>
<td>AS 4852.1</td>
<td>Variable message signs – Part 1: Fixed signs</td>
</tr>
<tr>
<td>AS 60038</td>
<td>Standard voltages</td>
</tr>
<tr>
<td>AS 60529</td>
<td>Degrees of protection provided by enclosures (IP code)</td>
</tr>
<tr>
<td>AS/NZS 61000.6.1</td>
<td>Part 6.1: Generic Standards – Immunity for residential, commercial and light-industrial environments</td>
</tr>
<tr>
<td>AS 61000.6.3</td>
<td>Generic standards – Emission standard for residential, commercial and light industrial environments</td>
</tr>
<tr>
<td>AS 61558</td>
<td>Safety of power transformers, power supply units and similar</td>
</tr>
</tbody>
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2.2 VICROADS SPECIFICATIONS AND DRAWINGS

2.2.1 The fabrication and supply of all components shall conform to the relevant VicRoads specifications, and related specifications and standards, as indicated throughout this document.

2.2.2 The following VicRoads Specifications are referenced:

<table>
<thead>
<tr>
<th>Standard</th>
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<tbody>
<tr>
<td>Contract Standard Section 730</td>
<td>Traffic signal installation</td>
</tr>
<tr>
<td>Contract Standard Section 732</td>
<td>ITS devices installation</td>
</tr>
<tr>
<td>Contract Standard Section 733</td>
<td>Installation of conduits and pits for underground</td>
</tr>
<tr>
<td>Contract Standard Section 736</td>
<td>ITS device testing and integration</td>
</tr>
<tr>
<td>TCS 070</td>
<td>Travel Time Signs</td>
</tr>
<tr>
<td>TCG 016</td>
<td>Product Compliance Process for ITS and Electrical Products</td>
</tr>
</tbody>
</table>
2.2.3 The following VicRoads Standard Drawings are referenced:

| TC-2223 | RC3 Pole – Typical Arrangement |
| TC-2224 | RC3 Pole Bracketing Arrangements – Typical Arrangement |

2.3 ADDITIONAL SPECIFICATIONS AND DOCUMENTS

2.3.1 The fabrication and supply of all components shall conform to the following specifications and drawings as indicated throughout this document.

2.3.2 The following specifications are referenced:

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
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<tbody>
<tr>
<td>RMS Specification ITSM-TO-ITS-CSI-002</td>
<td>Colour Sign Interface</td>
</tr>
<tr>
<td>Only available from RMS</td>
<td></td>
</tr>
<tr>
<td>RMS Specification TSI-SP-003</td>
<td>Communications protocol for roadside devices</td>
</tr>
<tr>
<td>Only available from RMS</td>
<td></td>
</tr>
<tr>
<td>STREAMS</td>
<td>VicRoads ITS platform.</td>
</tr>
</tbody>
</table>
SECTION 3 - RC1 RAMP CONTROL / METERING SIGN

3.1 GENERAL

The RC1 signs display advisory and regulatory messages and are provided on the approaches to the arterial road/entry ramp intersection to face traffic turning onto the ramp.

3.2 DISPLAY REQUIREMENTS

3.2.1 The required displays for use in RC1 signs are shown in Table 3.1

<table>
<thead>
<tr>
<th>Sign Operation</th>
<th>Message Type</th>
<th>Message</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp Metering Operation</td>
<td>Static</td>
<td>RAMP SIGNALS ON</td>
<td>Yellow text on Black background (when ramp signals are operational)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FREEWAY CLOSED</td>
<td>Red text on Black background (when freeway is closed)</td>
</tr>
<tr>
<td></td>
<td>Alternating</td>
<td>NO RIGHT TURN</td>
<td>Illuminated symbolic type (based on R2-6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NO LEFT TURN</td>
<td>Illuminated symbolic type (based on R2-6)</td>
</tr>
<tr>
<td></td>
<td>or</td>
<td>NO ENTRY</td>
<td>Illuminated symbolic type (based on R2-4)</td>
</tr>
</tbody>
</table>

3.2.2 The symbolic “No Right Turn” and “No Left Turn” displays shall comply with the requirements of Rule 91 of Road Rules Victoria and AS-1743-2018, for an R2-6A size sign with an outer radius of 220mm.

3.2.3 Typical pixel placement for the individual displays shall be in accordance with typical layouts as indicated in Figure 3.1.
RAMP SIGNALS ON
- Yellow Black
- 120mm character height

Ramp Metering Operation

FREEWAY CLOSED
- Red on Black
- 150mm character height

NO RIGHT TURN
- AS 1743, R4-6(R)
- Road Rules Victoria, Rule 91

NO LEFT TURN
- AS 1743, R4-6(L)
- Road Rules Victoria, Rule 91

NO ENTRY
- AS 1743, R4-2
- White on Black characters and horizontal line
- Nominal 75mm character height
- Red annulus

Ramp Control Operation

Figure 3.1 – Typical displays for RC1 signs
(provided as examples only)
3.2.4 Each message detailed in 3.2.1 shall be referred to as a frame.

3.2.5 Each frame shall be allocated a frame ‘ID’.

3.2.6 Each message shall be allocated to the frame ‘ID’ as detailed in Table 3.2.

### Table 3.2 – RC1 fixed message frames summary

<table>
<thead>
<tr>
<th>‘Frame ID’ number</th>
<th>Message Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Ramp Signals On”</td>
</tr>
<tr>
<td>3</td>
<td>“Freeway Closed”</td>
</tr>
<tr>
<td>4</td>
<td>Symbolic ‘No Left Turn’</td>
</tr>
<tr>
<td>5</td>
<td>Symbolic ‘No Right Turn’</td>
</tr>
<tr>
<td>6</td>
<td>Symbolic ‘No Entry’</td>
</tr>
<tr>
<td>7</td>
<td>Other Specified Message</td>
</tr>
</tbody>
</table>

3.2.7 The nominal enclosure size shall be 900mm wide by 600mm.

3.2.8 The LED’s shall be arranged in the form of the words and symbols to be displayed.

3.2.9 The sign shall display the frames on a black background.

3.2.10 The LED’s shall have a maximum spacing of 2 times the diameter of the pixel.
SECTION 4 - RC2 RAMP METERING SIGNS

4.1 GENERAL

4.1.1 The RC2 signs are a warning sign used to indicate that ramp signals are operating and to warn drivers of the need to stop.

4.1.2 RC2 signs are located on an entry ramp to a freeway.

4.1.3 There are two sizes of RC2 sign currently used by VicRoads, these are:

1. RC2 A Size – This is the standard version of the sign used to provide information to drivers turning from an arterial road onto a freeway.

2. RC2 B Size – Reserved for possible future use.

3. RC2 C Size – This is a larger version of the sign used to provide information to drivers turning from one freeway onto another freeway at freeway to freeway interchanges.

4.2 RC2-A DISPLAY REQUIREMENTS

4.2.1 The RC2-A is a changeable message sign.

4.2.2 The RC2-A sign display two alternating messages or frames.

4.2.3 The displays for use in RC2-A sign are shown in Table 4.1.

<table>
<thead>
<tr>
<th>Message</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>“RAMP SIGNALS ON”</td>
<td>Yellow on Black</td>
</tr>
<tr>
<td>“PREPARE TO STOP”</td>
<td>Red on Black</td>
</tr>
</tbody>
</table>

4.2.4 Each message detailed in 4.1 shall be referred to as a frame.

4.2.5 Each frame shall be allocated a frame ‘ID’

4.2.6 Each message shall be allocated to the frame ‘ID’ as detailed in Table 4.2.
Table 4.2 – RC2-A fixed message frames summary

<table>
<thead>
<tr>
<th>‘Frame ID’ number</th>
<th>Message Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>“Ramp Signals On”</td>
</tr>
<tr>
<td>2</td>
<td>“Prepare To Stop”</td>
</tr>
</tbody>
</table>

4.2.7 Typical pixel placement for the individual displays shall be in accordance with typical layouts as indicated in Figure 4.1.

4.2.8 The LED’s shall be arranged in the form of the words and symbols to be displayed.

4.2.9 The sign shall display the frames on a black background.

4.2.10 The LED’s shall have a maximum spacing 2 times the diameter of the pixel.

4.2.11 The nominal enclosure size shall be 900mm wide by 600mm high.

![RAMP SIGNALS ON](image)

**RAMP SIGNALS ON**

- Yellow on Black
- 120 mm character height

![“PREPARE TO STOP”](image)

**“PREPARE TO STOP”**

- Red on Black
- 120mm character height

Figure 4.1 – Typical displays for RC2-A signs
4.3 **RC2–C DISPLAY REQUIREMENTS**

4.3.1 The RC2-C sign is physically an RC3-A sign being used to display RC2 messages on a freeway to freeway interchange ramp. Whether a sign is used as a RC2-C Sign or a RC3-A sign is determined by the sign configuration refer to Clause 1.2.4.

4.3.2 The messages and frame ID’s for the RC2-C sign are the same as for the RC2-A sign in a larger font height. See Clause 4.1.

4.3.3 Typical displays shall be as shown in Figure 4.2.

![RAMP SIGNALS ON](image1)

**RAMP SIGNALS ON**
- Yellow on Black
- 180mm character height

![PREPARE TO STOP](image2)

**PREPARE TO STOP**
- Red on Black
- 180mm character height

**Figure 4.2 – Typical layout for RC2-C sign**
SECTION 5 - RC3 RAMP CONTROL / FREEWAY CONDITION SIGNS

5.1 GENERAL

5.1.1 RC3 signs are used to provide freeway condition information (including travel times) and ramp control to drivers.

5.1.2 The RC3 sign is a four colour, full matrix sign, capable of displaying text messages.

5.1.3 The four colours used are red, yellow, green and white.

5.1.4 The four colours shall be generated using individual red, yellow, green and white LED’s.

NOTE: At the time of this specification, the use of a RGB display is not permitted. This is currently under review.

5.1.5 There are two sizes of RC3 sign currently used by VicRoads, these are:

1. RC3 A Size – This is the standard version of the sign used to provide information to drivers turning from an arterial road onto a freeway.

2. RC3 B Size – Reserved for possible future use.

3. RC3 C Size – This is a larger version of the sign used to provide information to drivers turning from one freeway onto another freeway at freeway to freeway interchanges.

5.2 RC3-A DISPLAY REQUIREMENTS

5.2.1 RC3-A signs are typically located on an arterial road prior to an entrance to a freeway.

5.2.2 The RC3-A sign is generally operated as a TT3 sign to display travel times along the associated freeway. See TCS 070 for details.

5.2.3 The RC3-A sign is also capable of being used to provide real time condition information for the associated freeway.

5.2.4 RC3-A signs shall be capable of displaying three lines of text.

5.2.5 The display shall have a resolution of 128 pixels wide by 40 pixels high.

5.2.6 The pixels shall typically be square with a maximum pixel pitch (centre to centre spacing) of 12mm in the horizontal and vertical directions.

5.2.7 The pixel width shall not be less than 60% of the pixel pitch.
5.2.8 Nominal font height shall be:

- 120mm for the top line; and
- 108mm for the second and third lines.

5.2.9 The nominal enclosure size shall be 1660mm wide by 600mm high.

5.2.10 Typical messages for an RC3-A sign are shown in Figure 5.1.

![Typical messages for RC3 signs](image_url)

**Figure 5.1 – Typical messages for RC3 signs**
5.3 **RC3-B DISPLAY REQUIREMENTS**

*This clause has been included for possible future use.*

5.4 **RC3-C DISPLAY REQUIREMENTS**

5.4.1 This sign is intended for installation on a freeway prior to an interchange with another freeway.

5.4.2 This sign is generally used to advise motorists that freeway to freeway ramp signals are operating.

5.4.3 During adverse conditions, the RC3-C sign is also capable of being used to provide real time condition information for the associated freeway.

5.4.4 Typical RC3-C sign messages are shown in Figure 5.2.

5.4.5 The RC3-C sign may be used in the future as a TT5 sign to display travel times along the associated freeway. See TCS 070 for details.

5.4.6 The sign shall be capable of displaying 18 characters per line.

5.4.7 Font height shall be a minimum of 320mm high for all lines.

5.4.8 The display shall have a minimum resolution of 128 pixels wide by 56 pixels high.

5.4.9 The pixels shall typically be square with a maximum pixel pitch (centre to centre spacing) of 32mm in the horizontal and vertical directions.

5.4.10 The pixel width shall not be less than 60% of the pixel pitch.

5.4.11 A border surrounding the active display, of not less than 175mm in width, shall be provided.

5.4.12 The nominal enclosure size should be approximately 4450mm wide by 2150mm high.

5.4.13 The nominal character height to width ratio for all sign types shall be 10:5.
Figure 5.2 – Typical message layout for Freeway RC3-C signs
SECTION 6 - OPERATION AND CONTROL

6.1 GENERAL

6.1.1 The signs are typically connected via a hardwired link or a wireless link. Different signs that form part of the same installation may be connected using a combination of link types.

6.1.2 The connection required shall be specified in individual contract documents.

6.1.3 Figures 6.1, 6.2 and 6.3 show the typical communication connections between RC signs and the Freeway Ramp Signal Roads Side Cabinet.

Figure 6.1 – Typical Hard Wired Communications Connections Option 1 - Sign Controller resides within the sign housing

Figure 6.2 – Typical Hard Wired Communications Connections Option 2 – Sign Controller resides within road side cabinet
6.2 SIGN CONTROL PERFORMANCE AND CAPABILITY

6.2.1 The RC3 sign is used for travel time information displays and the message will be updated every two minutes. Therefore, the RC3 sign shall have the capability to support writing at least 900 messages a day.

6.2.2 The VicRoads control system uses frames numbers from 200 to 255 for displaying those frequently updated messages.

6.2.3 Memory containing ‘Message ID’ and ‘frame ID’ designations for fixed messages or frames shall be retained indefinitely in the absence of power.

6.2.4 The RC sign controller shall retain all configuration data in the absence of mains power. i.e. all RMS protocol related parameters including message sequences; network and serial connection parameters.

6.2.5 The response time must be less than 2 seconds.

Note: ‘Response time’ refers to the latency from when VicRoads Field Processor sends a request message to when a valid response message is received by the Field Processor, i.e. response time includes the time for transferring the request message from the Field Processor to the Sign Controller via the serial link, Sign Controller process time for generating a valid response message and the time for transferring the valid response from the Sign Controller to the Field Processor via the serial link.

6.2.6 The performance requirement in 6.2.4 applies to both wired and wireless serial connections.
6.3 **SIGN CONTROLLER (SC)**

6.3.1 The RC signs shall be controlled by a single Sign Controller. Under normal operation, its main purpose is to provide both serial and Ethernet interfaces to a third-party controlling device, over which RMS protocol shall be transmitted in order to control the RC signs.

6.3.2 The sign controller shall be designed to be installed within the RC sign housing or the Freeway Ramp Signals roads side cabinet depending on the communication connections in section 6.1.

6.3.3 An alternative cabinet may be considered provided it is designed to be mounted onto the standard VicRoads cabinet foundation.

6.3.4 If the sign controller is to be installed within the Freeway Ramp Signals roads side cabinet, the sign controller shall be designed to be installed within a standard 19” rack. The rack-mounting chassis shall be no more than 2 RU in height, and either full or half 19” rack width. Half-width 19” modules shall be mountable on both the left and the right sides.

6.3.5 All of the controller’s communication and power interfaces shall be clearly and indelibly labelled on the controller housing.

6.4 **ADMINISTRATION AND CONFIGURATION TOOL**

6.4.1 The sign controller shall provide an interactive browser-based user interface using HTTP and HTTPS to provide monitoring, configuration and diagnostic related functions.

6.4.2 Providing a Command Line Interface (CLI) based configuration interface is not mandated, however, if provided, the interface shall:

a) Support key-based and password authentication, with the capability to disable password authentication
b) SSH v2.x shall be required (SSH v1 shall not be used)
c) Only support CLI over TCP/IP. The SC shall not have any serial-based console port on the controller chassis, which can be used to access the SC CLI interface.

6.4.3 The software shall provide for the display and monitoring of the sign controller configuration, including:

a) Site Name
b) Firmware version
c) Current Temperature of the controller
d) Main Power Supply status
e) Backup Power Supply Status (if one exists)
f) Up Time (since last reset)
g) System time (Local date and time)
h) MAC Address(es) of all Ethernet port(s)
i) Current Active Control Mode (Local, serial, TCP or any other mode if present)
j) Facility Switch position
k) All the signs connected to the controller and, for each sign, the following information shall be displayed:

    i. Sign Type (RC1, RC2-A, RC2-C, RC3-A or RC3-C)
    ii. RMS protocol Group ID
iii. RMS protocol Sign ID
iv. Dimensions (in pixel)
v. Luminance dimming control mode (Auto, Time based or Fixed)
vi. Current Luminance dimming level
vii. RMS Protocol Session Status (Online / Offline)
viii. RMS Protocol Display Mode(Message, Frame or Plan)
ix. RMS Protocol Display Message Number/Frame Number/Plan Number
x. Current Sign firmware version

6.4.4 Configuration Functions – The software shall allow a user to change sign controller and sign configurations using the browser interface. In general, all configuration changes shall be applied immediately and take effect without the need to restart/reset the sign controller. However, changing certain parameters may cause any currently active connection to be dropped, for example, the sign’s password or seed offset, IP port number, etc. The following parameters shall be configurable.

(a) The Site Name – Text field with minimum 150 characters.

(b) Control Mode – The software shall allow a user to choose an active control mode from the following:

i. Local mode – When this mode is enabled, a user can use the browser interface to control the sign display to display a message or run test patterns. When this mode is disabled, a user shall not be able to use this web software to control the sign display to display a message or run test patterns.

ii. Serial – When this mode is enabled, the master (refer to RMS protocol section 2.1) software can connect to sign controller via serial connection, and control the sign using RMS protocol. When this mode is disabled, and there is currently an active serial connection, the controller shall drop the connection and blank the sign(s).

When this mode is disabled and the master software attempts to connect to the sign controller via the serial connection using RMS protocol, the sign controller shall respond with a ‘Reject’ message (MI code 00h) with Application Error code ‘01’ (Device Controller offline) to the ‘Start Session’ message (MI code 02h) sent by the master software. However, the sign controller shall still respond to ‘Heartbeat Poll’ messages (MI Code 05h) as specified in RMS Protocol Section 3.6.3.6.

(c) TCP/IP – When this mode is enabled, the master (refer to RMS protocol section 2.1) software can connect to sign controller via TCP/IP connection, and control the sign using RMS protocol.

When this mode is disabled, if there is currently an active TCP/IP connection, the controller shall drop the connection and blank the sign(s). When this mode is disabled and the master software attempts to connect to the sign controller via TCP/IP using RMS protocol, the sign controller shall respond with a ‘Reject’ message (MI code 00h) with Application Error code ‘01’ (Device Controller offline) to the ‘Start Session’ message (MI code 02h) sent by the master software. However, the sign controller shall still respond to ‘Heartbeat Poll’ messages (MI Code 05h) as specified in RMS Protocol Section 3.6.3.6.

Note: the control mode is exclusive. Once a mode is chosen, the other two modes shall be disabled.
(d) (For RC2-C/RC3-A only) Sign Type – either ‘RC2-C’ or ‘RC3-A’

When the sign is configured as ‘RC2-C’ sign, the sign shall be able to only display predefined messages/frames as specified in Section 4.3.

When the sign is configured as ‘RC3-A’ sign, the sign shall be able to display all dynamic messages generated and requested by the VicRoads Control Systems. And the predefined messages/frames for ‘RC2-C’ shall be also available in this mode.

6.4.5 Network configuration – The software shall allow a user to change the following network configurations:

a) IP address allocation (DHCP or static).
   b) If the IP address allocation is static – the following parameters: IP Address, Subnet Mask, Default Gateway, Primary DNS and Secondary DNS.

6.4.6 RMS Protocol Configuration – The software shall allow a user to change the following RMS Protocol and communications related configuration parameters:

a) IP Port used for TCP/IP connection.
   b) Session time out for TCP/IP connection (in seconds).
   c) Security settings for TCP/IP connection (such as switch between no encryption and TLS encrypted, TLS port to be used).
   d) Baud rate, Data bits, Parity and Stop bits for serial connection.
   e) Session time out for serial connection (in seconds).
   f) Seed offset (in Hex).
   g) Password offset (in Hex).
   h) Polling Address.
   i) Broadcast Address.
   j) Blanking Time out (in minutes, the duration that the sign controller will wait before blanking the sign after the active RMS protocol connection is disconnected.).
   k) Sign ID and Group ID (For individual signs).

6.4.7 Luminance Dimming control – The software shall allow a user to change the following sign dimming control related configuration for each individual sign connected to the sign controller:

a) Luminance Dimming control mode (Auto, Time Based or Fixed). Three modes are defined in AS 4852.1 – 2009 Section 3.11.
   b) The controller shall have pre-defined Melbourne ‘Dawn’ and ‘Dusk’ times for Time Based mode as specified in AS 4852.1 – 2009 Section 3.11 and the software shall allow a user to change those time settings.
   c) Fixed Dimming Level (in ‘Fixed’ mode only).

6.4.8 System Time – The software shall allow a user to change the current time, time zone, Daylight saving option and whether to use an NTP server for time synchronisation. The IP address(es) of the NTP servers shall be configurable.

6.4.9 Security – The software shall:

a) Allow a user to change the browser interface’s username and password.
   b) Support both HTTP and HTTPS and allow a user to choose the access mode from ‘HTTP only’, ‘HTTPS only’ and ‘Both HTTP and HTTPS’.

Page 30 of 72  Ramp Control/Metering Signs
c) Allow a user to change the TCP/IP ports used for ‘HTTP’ and ‘HTTPS’.

d) Allow a user to change the session timeout for the browser interface (duration after the last active web request received).

6.4.10 Control and Testing – The software shall allow a user to perform local control and display test patterns functions specified in Section 6.13 “Local Control” and 6.18 “Display Test Patterns” of this specification.

6.4.11 Administration – The software shall provide the following administration functions.

6.4.12 Firmware upgrade

a) The software shall allow a user to upgrade the controller’s firmware. After the firmware is upgraded, all existing pre-configured parameters (IP addresses, network mask, default gateway and etc) for the controller shall be maintained.

b) The software shall allow a user to upgrade firmware for individual signs that are connected to the sign controller.

c) The system shall ensure that the entire firmware file is successfully downloaded before attempting to apply the firmware upgrade.

6.4.13 Save /recover configuration to/from file.

a) All of the configuration parameters for the controller shall be able to be saved and retained after rebooting the controller.

b) The software shall allow a user to save the current configuration to a local file and be able to restore all the configuration parameters from the file.

6.4.14 Reboot and Reset.

The software shall allow a user to reboot/reset the controller with the following options:

a) Reset to manufacturer default.

b) Reset to manufacturer default, except for the current network configuration (IP addresses, network mask, default gateway, etc).

c) Reboot the controller with all configuration maintained.

6.4.15 Reports/logs

The software shall provide separated log files, one for RMS protocol commands and another for any other system logs. All the logs shall be able to be displayed via the web interface and to be exported to text or CSV format files.

The software shall allow the user to choose start date/time and end date/time to only display or export selected period of logs.

6.4.16 System event logs

The software should log the following system events as minimum:

a) Controller and sign fault events.

b) RMS protocol connection events (only require connection and disconnection events).

c) The login / logoff events for the browser interface software, including any failure attempts. The parameters to be logged include the attempted usernames, passwords and source IP addresses.
The software shall keep a minimum of the last 90 days or 10000 log entries, whichever limit comes first. Each log shall contain a timestamp with the resolution to 1ms.

6.4.17 RMS messages logs

The software shall log RMS protocol messages between the master software (VicRoads Control System) and the controller for the last 90 days or 10000 messages, whichever limit comes first. Each log shall contain:

a) Message direction (from the master to the controller or vice versa).
b) A timestamp with resolution to 1ms (The time the commands received or the response sent).
c) The actual message detail in a Hex string.

The software shall support two RMS command log options as below. And the software shall set option 2 as default but allow users to change log options via the user interface.

**Option 1 – Full log mode** - When this option is chosen, the software shall log every RMS protocol message

**Option 2 – Simple log mode (default option)** - VicRoads Control System sends RMS protocol status and fault checking messages listed in Table 6.1 to the sign controller very frequently (could be from every 2 to 10 seconds). This option is to reduce logging regular status and fault checking messages and focus on irregular control messages.

When the is options is chosen, the software shall log every RMS protocol message except for those listed in Table 6.1.

<table>
<thead>
<tr>
<th>Message Name</th>
<th>MI Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heartbeat Poll</td>
<td>05</td>
</tr>
<tr>
<td>Sign Status Reply</td>
<td>06</td>
</tr>
<tr>
<td>Sign Extended Status Request</td>
<td>1B</td>
</tr>
<tr>
<td>Sign Extended Status Reply</td>
<td>1C</td>
</tr>
<tr>
<td>Retrieve Fault Log</td>
<td>18</td>
</tr>
<tr>
<td>Fault Log Reply</td>
<td>19</td>
</tr>
</tbody>
</table>

The software shall only log the messages listed in Table 6.1:

d) Once every hour
e) And the next five consecutive messages after any other RMS protocol messages not listed in Table 6.1 are sent from the VicRoads Control System.

6.4.18 Non-functional requirements

(a) Performance – The software shall respond to every user interaction less than 3 seconds (excluding delays in the network).

(b) Security -
i. The software shall verify the username and password before granting access to the system.

ii. The software shall support both HTTP and HTTPS and allow a user to choose access mode from ‘HTTP only’, ‘HTTPS only’ and ‘Both HTTP and HTTPS’.

iii. Only TLS shall be used for the HTTPS connection.


v. After three successive failed login attempts, the minimum time allowed between login attempts shall be changed to 60 seconds.

(c) Bandwidth /network requirement

The software shall be designed to run on a relatively slow IP network, such as 3G wireless network with around 500Kbps bandwidth and 500ms latency. The user interface shall be simple to avoid long response times. Where large amounts of information is to be displayed (such as logs), the information shall be displayed over multiple pages with page down and page up functions.

(d) All the configuration changes shall immediately take effect once the configuration item is saved without the need of rebooting or power cycling the sign controller.

6.5 **RESET**

6.5.1 On reset or reboot of the sign controller and/or sign (regardless of source), the sign display shall be set to blank.

6.5.2 The sign controller shall incorporate a reset button accessible on the front chassis. The reset button shall perform a soft reset the SC & Connected sign. All configurations within the SC and sign shall be maintained.

6.5.3 The sign controller shall not provide any hard reset (reset the controller to manufactory default) mechanism (such as button), which can be accessed via the chassis.

6.6 **SIGN CONTROLLER PARAMETER DEFAULT SETTINGS**

The default settings for key parameters within the SC shall be as shown in Table 6.1.
### Table 6.1 – Sign controller key parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Default Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC login user name</td>
<td>Username required for access to the SC’s Web based tool</td>
<td>‘Admin’</td>
</tr>
<tr>
<td>SC login password</td>
<td>Password required for access to the SC’s Web based tool</td>
<td>to be provided by VicRoads.</td>
</tr>
<tr>
<td>SC Site Name</td>
<td>The SC’s Site name to be displayed in the Web based tool</td>
<td>VicRoads allocated Site Number (RAI ID)</td>
</tr>
<tr>
<td>SC IP address</td>
<td>Selectable DHCP or statically configurable IP address and Netmask</td>
<td>STATIC IP: 192.168.30.1 Mask: 255.255.255.0</td>
</tr>
<tr>
<td>RTA over, TCP/IP</td>
<td>TCP port numbers for RTA/RMS protocol connection</td>
<td>no encryption TCP : 43000 TLS encrypted TCP:43002 Default: no encryption</td>
</tr>
<tr>
<td>Default RTA address</td>
<td>RTA/RMS Protocol group and sign address</td>
<td>All addresses to start from 1</td>
</tr>
<tr>
<td>Serial configuration</td>
<td>Hardware serial settings</td>
<td>RS422 38400kbps, 8 N 1</td>
</tr>
<tr>
<td>Web Access Ports</td>
<td>TCP port number used for web access to the Web based tool</td>
<td>HTTP: TCP 80 HTTPS using TLS: TCP 443</td>
</tr>
<tr>
<td>Telnet</td>
<td>TCP port number used for connection to the CLI</td>
<td>TCP 6368</td>
</tr>
<tr>
<td>Control Mode</td>
<td>Default controller RTA control mode</td>
<td>TCP</td>
</tr>
<tr>
<td>Luminance Dimming Control Mode</td>
<td>Default Luminance Dimming Control Mode</td>
<td>Auto</td>
</tr>
<tr>
<td>RTA TCP Time out</td>
<td>Session time out for TCP/IP connection (in seconds)</td>
<td>300</td>
</tr>
<tr>
<td>RTA serial Time out</td>
<td>Session time out for serial connection (in seconds)</td>
<td>180</td>
</tr>
<tr>
<td>Blanking Time out</td>
<td>in minutes, the duration that the controller to black the sign after the active RTA/RMS protocol connection is disconnected</td>
<td>5</td>
</tr>
<tr>
<td>Web Access Timeout</td>
<td>in minutes, the duration that the current Web tool connection to be after the last active web request is received.</td>
<td>5</td>
</tr>
</tbody>
</table>

### 6.7 ETHERNET

6.7.1 The SC shall provide at least one 10/100 TX Ethernet interface. The Ethernet interface shall support the modes of communication and protocols detailed in Sections 6.8, 6.9 and 6.10 of this specification.
6.7.2 A Cat6 Ethernet cable shall be used to connect the SC to the network switch. The length of the Cat6 Ethernet cable shall not exceed 100m.

6.8 RMS PROTOCOL FOR SIGN CONTROL

6.8.1 The operation of the sign shall be controlled by means of the RMS communications protocol to comply with AS 4852.1 Section 6.5, via the physical serial and the Ethernet interfaces defined above. This protocol is defined in the RMS specification TSI-SP-003 “Communications Protocol for Roadside Devices” current version 2.1.

6.8.2 Remote control of the sign shall be facilitated via VicRoads Control System.

6.8.3 To control RC1, RC2-A and RC2-C signs, VicRoads Control System uses ‘Sign Display Frame’ or ‘Sign Display Message’ messages to request the sign to display predefined frames/messages in Table 3.2 or Table 4.2. Thus, the RC1, RC2-A and RC2-C signs shall be supplied with fixed messages/frames in the sign controller’s memory as specified in Table 3.2 or Table 4.2 depending on the sign type.

RC1 and RC2-A Signs are not required to implement the RMS protocol application layer messages relating to the creation (setting) of text and graphics frames; since the RC signs’ frames are inherently static.

In order to implement the 4-colour operation of the RC3 signs, extensions to the default RMS protocol message suite as defined by VicRoads (provided in Appendix B) will be required. The RMS specification for this is ITSM-TO-ITS-CSI-002 Colour Sign Interface.

6.8.4 If a controlling device (usually a VicRoads field processor) sends an RMS command which is not supported, then the SC shall reply with a Reject Message with an appropriate Application Error Code as defined in the RMS protocol specification.

6.8.5 The sign controller shall support all fault logging and diagnostic functionality provided by the RMS protocol.

6.8.6 RMS “Heartbeat Poll” messages from the controlling device shall be serviced by the sign controller within 0.5 seconds of reception of the heartbeat request.

6.8.7 The sign controller may also support customised messages for special functions. In this case, such messages shall be in RMS protocol format and shall be fully documented for integration with 3rd party systems. The proposed customised messages shall be provided to VicRoads for review and approval before implementation. The supplier shall supply full details of any such customised RMS protocol messages for integration with 3rd party software vendors.

6.8.8 The sign controller shall fully implement all defined RMS protocol layers including error checking as described in the RMS protocol specification, and with changes as described in Appendix B of this specification.

6.9 OTHER PROTOCOLS

6.9.1 In addition to standard TCP/IP detailed above, the SC shall support the following protocols as a minimum:
a) ICMP (ping).
b) NTP (to set & maintain the SC / sign clocks).

Note: The SC shall set its time based on the configured NTP server or the manual input from the admin and configuration interface. However, once the SC is connected to master software via RMS protocol and if the master software uses the ‘Update Time’ command to update the SC’s time, the SC shall use the time set by the master software until the RMS protocol session is disconnected.

c) HTTP (interface for admin and configuration).
d) HTTP using TLS (secure interface for admin and configuration).

6.9.2 Where encryption is enabled, the SC shall provide a facility to securely upload encryption certificates and/or change the encryption password from a remote location.

6.9.3 Where encryption is enabled, TLS shall be used as the encryption mechanism. TLS shall be implemented as follows:

a) The control system shall be the client and the sign is the server.
b) The focus is on communication privacy and integrity, therefore, neither client nor server authentication is required.
c) The sign controller shall be able to have a TLS certificate (with private key) uploaded to be used as a server certificate, to be used in the negotiation of a secure TLS/SSL connection.
d) The sign controller shall perform as a TLS server endpoint and does not need to authenticate the client.
e) TLS v1.2 shall be supported.

6.10 HARDWARE SERIAL PORTS:

6.10.1 The sign controller shall provide at least one serial communication interface through which control commands will be received from a controlling field device (usually a VicRoads field processor) in RMS protocol format.

6.10.2 A cable gland for the serial communication cable shall be located externally on the rear of the sign enclosure.

6.10.3 The serial ports shall function in accordance with Table 6.2:
Table 6.2 – Serial port function

<table>
<thead>
<tr>
<th>Physical Interface Std.</th>
<th>RS422 and RS485 (autosensing, or software configurable)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baud Rate</strong></td>
<td>38400bps – 115200bps</td>
</tr>
<tr>
<td><strong>Data bits / stop bits</strong></td>
<td>Configurable</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td>Configurable</td>
</tr>
</tbody>
</table>

6.11 DIAGNOSTIC FUNCTIONS

6.11.1 The sign controller shall monitor the fault status of the connected RC signs and provide this fault information through appropriate RMS protocol messages. This fault logging system shall log all events as they occur. The reporting system shall also buffer reportable events when communication to the sign controller is temporarily lost. Such buffered events shall be made available to the controlling device when requested upon communications resuming.

6.11.2 Diagnostics functions shall be provided to monitor the sign’s display elements, as well as the sign’s internal subsystems. All diagnostic information and logs shall be accessible using RMS protocol through each of the sign controller’s serial communications interfaces and Ethernet interface.

6.11.3 As a minimum, the sign controller shall monitor the following:

a) The loss of communications between the SC and the sign display elements.
b) The loss of mains power to the sign.
c) Pixel check* results for the sign display elements‡
d) Sign temperature (i.e. over-heat/cool status).
e) Ambient light sensor failure.
f) All other sign / SC subsystem fault conditions.

6.11.4 Where a standard format for any given fault report is not defined by the RMS protocol, the format shall be fully documented and disclosed to VicRoads for integration with 3rd party systems.

6.11.5 All faults shall be detected and logged for reporting within thirty (30) seconds of the fault occurring.

* NOTE: Any LED pixel shall be deemed “faulty” if it does not behave as expected. Such behaviour shall include pixels remaining in the wrong state (on or off), pixels which flicker, display the incorrect colour and pixels which exhibit reduced or increased brightness compared to properly functioning pixels.

‡ NOTE: If the pixel check test requires pixels in the sign face to be momentarily lit, then this test shall only be run once per day at any configurable time. The fault report for this test may also be updated on a daily basis in this case.
6.12 MONITORING, FAULT LOGGING AND REPORTING

6.12.1 The control functions of the sign shall be capable of monitoring the operation of the sign in accordance with AS 4852.1 Section 6.6.

6.12.2 The signs shall automatically respond to faults according to Table 6.3 below.

### Table 6.3 – Fault Responses

<table>
<thead>
<tr>
<th>Failure types</th>
<th>Applicable Sign Types</th>
<th>Responses</th>
<th>RMS Protocol Error code to be used</th>
</tr>
</thead>
</table>
| i. Where mains power is lost to the SC OR the sign itself. | All | • The entire display area of the sign shall be completely blanked.  
• If the SC still functions, create a log in the SC specifying power failure for affected device(s).  
• If the SC is still functioning and the communication network between VicRoads Control System and the SC still exits, send the error to VicRoads Control System via RMS Protocol using the error code specified in the next column of this table. | Controller Err Code: 01 |
| ii. Where the communication link from VicRoads Control System to the SC (either serial or TCP/IP) is lost or adversely affected. | All | • The entire display area of the sign shall be completely blanked after the configurable timeout period.  
• Create a log in the SC detailing which interface was affected. | N/A |
| iii. Where the communication between the SC and the Signs is lost or adversely affected. | All | • The entire display area of the sign shall be completely blanked.  
• Create a log in the SC detailing the specific type of communications failure to the sign.  
• Send the error to VicRoads Control System via RMS Protocol using the error code specified in the next column of this table. | Controller Err Code: 05 |
| iv. Where internal faults are detected within the SC and/or sign itself, i.e. | All | • Create a log in the SC detailing the failure to the sign.  
• Send the error to VicRoads Control System via RMS Protocol using the error code from Appendix C of RMS | |
| v. | Where display driving components and/or individual LED’s are affected to the extent that the resultant displays may be confusing to the public: (typically more than 20% LED’s failed) | All | - The entire display area of the sign shall be completely blanked.  
- Create a log in the SC of the type & extent of the LED failure(s).  
- Send the error to VicRoads Control System via RMS Protocol using the error code specified in the next column of this table. | Controller Err Code: 08 |
| vi. | Where any one or more character of the sign is (are) not able to be displayed. | RC1&RC2 | - The entire display area of the sign shall be completely blanked.  
- Create a log in the SC of the type & extent of the LED failure(s).  
- Send the error to VicRoads Control System via RMS Protocol using the error code specified in the next column of this table. | Controller Err Code: 08 |
| vii. | Where display driving components and/or individual LED’s are affected but not to the extent that the resultant displays may be confusing to the public: (typically less than 20% LED’s failed) | All | - Create a log in the SC of the type & extent of the LED failure(s).  
- Send the error to VicRoads Control System via RMS Protocol using the error code specified in the next column of this table. | Controller Err Code: 07 |

### 6.13 LOCAL CONTROL

6.13.1 The ground level access shall include RS 232 and Ethernet connections and also include a 240V socket outlet with integral RCD.
6.13.2 The Ethernet interface shall provide the sign with:

- at least one IEEE 802.3 10/100 BaseTX Ethernet interface with RJ-45 socket connection.
- support for DHCP or static IP addressing.
- sign management and configuration via Ethernet using SSH or http/https protocol.

6.13.3 The sign shall be capable of being programmed in accordance with AS 4582.1 Section 6.6.

6.13.4 The software for local operation of RC1 and RC2 signs shall be capable of the following facilities:

- Display any pre-defined frames.
- Display any pre-defined Messages.

6.13.5 The software for local operation of RC3 signs shall be capable of the following facilities:

- Word wrap.
- Auto centring.
- Auto placing of text on screen.

6.13.6 The above features shall be incorporated together with all display changing parameters as detailed in Section 3.

6.13.7 For RC3 signs, the frames and/or message strings produced locally shall be capable of being directly displayed on the sign, over-riding the current scheduled program.

6.14 REMOTE CONTROL

6.14.1 Standard operation of the sign shall be via a remote system as defined in AS 4852.1, Section 6.3.

6.14.2 The sign controller shall be able to be controlled via either serial connection or Ethernet connection by using RMS protocol.

6.15 FALL-BACK SYSTEM

The sign shall incorporate the ability to fall back to a pre-defined operation mode when a major system failure occurs in accordance with AS 4852.1, Section 6.7.

6.16 DISPLAY TEST PATTERNS

6.16.1 The RC3 sign shall be capable of generating test patterns.

6.16.2 The test patterns shall include, as a minimum, the following specified sections showing:

- all pixels off;
• all pixels on; and
• a chequered pattern where no two adjacent pixels are on.

6.16.3 The above test patterns shall be cyclically displayed in each of the four colours, one colour at a time. The transition time between colours shall be 3 seconds.

6.17 FIRMWARE UPGRADE

6.17.1 The sign controller shall provide a facility to remotely upgrade the firmware of the sign display elements, and the controller itself.

6.17.2 The upgrade process shall first require the sign controller command line interface password to be correctly entered.

6.17.3 If communication is lost during any firmware upgrade, the device being upgraded shall revert to its previous firmware version and settings automatically without the need to power cycle the device.
SECTION 7 - OPTICAL REQUIREMENTS

7.1 PHOTOMETRIC REQUIREMENTS

7.1.1 The photometric requirements shall comply with AS4852.1, Section 3.2.1 and 3.2.2.

7.1.2 The photometric test procedures shall comply with AS4852.1, Appendix C.

7.2 COLORIMETRIC REQUIREMENTS

7.2.1 The pixel colours defined within this specification are yellow, red, white and green.

7.2.2 The colorimetric requirements shall comply with AS 4852.1, Section 3.2.3.

7.2.3 The colorimetric test procedures shall comply with AS 4852.1, Appendix D.

7.3 SIGN DIMMING CONTROL

7.3.1 The sign shall have the ability to dim the light output intensity of its display to comply with AS 4852.1, Section 3.1.11.

7.3.2 The supplier shall submit details of the peak normal and dimmed operational loads at the time of tender.

7.4 LIFESPAN REQUIREMENTS

The lifespan requirements for LED pixel outputs shall be in accordance with AS4852.1 clause 3.1.1.4 “Pixel element service life”.

Page 42 of 72 Ramp Control/Metering Signs
SECTION 8 - SIGN ENCLOSURE

8.1 GENERAL

8.1.1 The enclosure shall be constructed from marine grade sheet aluminium alloy 5251 H32 to AS/NZS 1734.

8.1.2 The enclosure and ancillary equipment shall be free from sharp corners, edges and protrusions which may cause injury to personnel or damage to components during installation and/or maintenance operations.

8.1.3 The enclosure shall be suitably reinforced and/or braced to facilitate the erection and continued operation of the unit in the intended application.

8.1.4 All external metal sections of the completed housing shall be of powder coat or baked enamel finish, matt black in colour. Such treatment shall ensure that deterioration due to atmospheric and/or local environmental conditions has no detrimental effect on the structural integrity or visual appearance (including colour fading) of the finished housing for a period not less than ten years.

8.1.5 A suitable venting and air circulation system shall be included in accordance with the recommendations of the individual component manufacturers. Air circulation shall include the means to keep dust and dirt from the internal areas of the sign enclosure. The use of air filters that require frequent servicing will not be accepted.

8.1.6 A suitable moisture inhibitor.

8.1.7 The interior layout of the housing shall be such as to provide clear and ready access to all electrical and communication components for inspection, maintenance and replacement purposes.

8.1.8 The control equipment and electrical/electronic circuits shall be mounted on a suitable mounting panel located on the inside of the sign housing in an easily accessible location.

8.1.9 All electrical and communications cabling, circuit boards and equipment inside the sign shall be appropriately separated or electrically isolated.

8.1.10 Where a communications cable (e.g. an ethernet cable) is to be connected to the sign, it shall enter the sign through a separate access hole from the electrical cable.

8.2 DOORS

Each sign enclosure shall incorporate a door as described below:

a) **RC1 and RC2A** - shall include a door located on the front of the sign housing, hinged on the left and lockable on the right (when viewed from the front). The door shall be used to provide access to all internal components of the sign for both installation and maintenance purposes.
b) **RC3A and RC2C** - Unless otherwise specified in individual tender documents, a door shall be located on the front of the sign housing, hinged on the top and lockable on the bottom. A Gas strut should be used to hold the door in the open position. The door shall be used to provide access to all internal components of the sign for both installation and maintenance purposes.

c) **RC3C** – shall include doors on the rear of the sign housing, hinged on one side and lockable on the opposite side. The doors shall be capable of being held in the open position. The door shall be used to provide access to all internal components of the sign for both installation and maintenance purposes.

### 8.3 LOCKS

#### 8.3.1 RC1, RC2A, RC2C and RC3A Signs

8.3.1.1 Each door shall be securely closed using two locks. The locks shall be “Southco”, key lockable, Link Lock™, Rotary Action Latches (Code 801). All locks shall be keyed alike and shall ensure that the door is securely fastened.

8.3.1.2 Alternative rotary action latches may be considered provided they use the same key as detailed in 8.3.1 above.

#### 8.3.2 RC3C Signs

Each door shall be securely closed using an approved 3-point locking mechanism with a single key lock. The lock shall be approved by the Superintendent.

### 8.4 FRONT VIEWING WINDOW

Signs that include a front viewing window shall incorporate the following features:

a) It shall be manufactured from high impact, clear (anti-glare and U.V. stabilised) sheeting of a suitable polycarbonate.

b) The door and window shall be fitted with effective weatherproof seals of suitable materials (neoprene rubber or similar) to prevent the entry of dust and moisture. The design of the seals and fastening methods shall be such as to ensure sustained weather proofing of the sign for the life of the unit.

c) The size of window area shall be such that, when installed, the sides and bottom edges of the display face shall be fully visible at viewing angles of 45° and 30° respectively to the 0°-0° axis of the display face.
8.5 DIMENSIONS

8.5.1 The dimensions of the housing shall be the minimum required to house the intended display.

8.5.2 The maximum dimension of the housing shall not exceed the dimensions shown in Table 8.1.

Table 8.1 – Dimensions of enclosure

<table>
<thead>
<tr>
<th>Sign Type</th>
<th>Housing</th>
<th>Visor</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC1</td>
<td>900mm(w)x600mm(h)x115mm(d)</td>
<td>Not used</td>
</tr>
<tr>
<td>RC2-A</td>
<td>900mm(w)x600mm(h)x115mm(d)</td>
<td>Not used</td>
</tr>
<tr>
<td>RC3-A</td>
<td>1660mm(w)x600mm(h)x160mm(d)</td>
<td>Not used</td>
</tr>
<tr>
<td>RC2-C</td>
<td>1660mm(w)x600mm(h)x160mm(d)</td>
<td>Not used</td>
</tr>
<tr>
<td>RC3-C</td>
<td>4450mm (w) x 2150mm (h) x 350mm (d)</td>
<td>Not used</td>
</tr>
</tbody>
</table>

8.6 MOUNTING

8.6.1 The sign shall be provided with all facilities to enable mounting of the finished sign in accordance with Table 8.2.

Table 8.2 – Mounting arrangement

<table>
<thead>
<tr>
<th>Sign</th>
<th>Mounting Arrangement</th>
<th>Post Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC1</td>
<td>Using two lengths of mounting channel (unistrut® or similar) horizontally affixed to the rear of the housing.</td>
<td>2B</td>
</tr>
<tr>
<td>RC2-A</td>
<td>Using two lengths of mounting channel (unistrut® or similar) horizontally affixed to the rear of the housing.</td>
<td>2B</td>
</tr>
<tr>
<td>RC3 - A</td>
<td>As per Standard Drawing TC-2224</td>
<td>As per Standard Drawing TC-2223</td>
</tr>
<tr>
<td>RC2-C</td>
<td>As per Standard Drawing TC-2224 or as otherwise specified in individual contract documents.</td>
<td>As per Standard Drawing TC-2223 or gantry mounted</td>
</tr>
<tr>
<td>RC3 - C</td>
<td>As specified in individual contract documents</td>
<td>Typically gantry mounted</td>
</tr>
</tbody>
</table>

8.6.2 Alternative methods of mounting may be considered upon submission.
SECTION 9 - ELECTRICAL REQUIREMENTS

9.1 GENERAL

9.1.1 All electrical works shall comply with AS/NZS 3000.

9.1.2 Transformers used within the sign and/or sign control system shall comply with AS 61558.

9.1.3 All cables and wires shall be insulated with a material not inferior to V-90 grade PVC and shall be suitably labelled.

9.2 OPERATING VOLTAGE

The mains supply voltage shall be deemed to be 230VAC +10%, -6% in accordance with AS 60038, Section 2. The system and or sub-elements of the system shall be capable of operating satisfactorily from the same within ±15%.

9.3 CONNECTION TO SUPPLY – RC1, RC2 AND RC3 SIGNS

9.3.1 The sign shall be supplied with connecting cables 2.5 metres in length enclosed in black flexible hose (same as that used for traffic signal lanterns) 2.0 metres in length (both lengths being measured from the point of entry to the housing). The flexible hose shall be 16mm in diameter.

9.3.2 The connecting cables and internal wiring shall:

   a) have stranded copper conductors;
   b) be insulated with materials not inferior to V90 grade PVC; and
   c) comply with all relevant requirements of AS-3147

9.3.3 The cable and hose shall enter the rear panel of the housing through a suitably sealed “goose neck” arrangement or other approved arrangement.

9.3.4 The incoming power cable shall be directly terminated in an appropriately rated circuit breaker.

9.3.5 The communications cable shall not be installed in the same hose as the power cable.

9.4 POWER LOAD

The supplier shall submit the following details of the power load of each individual sign:

   a) Normal peak operation;
b) Dimmed operation; and
c) In rush current at switch on.

9.5 INTERNAL PROTECTION

9.5.1 All equipment including data lines shall be internally protected against damage resulting from:

- Lightning strikes at or near the sign/gantry.
- Electrical transients on power cabling.
- Electrical transients on communications wiring.
- Radio frequency interference.
- Static electrical discharge.
- Any harmonics arising from the above and any equipment in the cabinet.

9.5.2 Where socket outlets are used to distribute power amongst the signs internal components, a suitable retaining arrangement shall be used to ensure that the plug-top cannot come loose from the socket outlet in normal operation.

9.6 EMC COMPLIANCE

9.6.1 All signs covered by this specification shall comply with:

- AS/NZS 61000.6.1 for immunity; and
- AS/NZS 61000.6.3 for emissions.

9.6.2 It should also comply with the relevant requirements of the Australian Communications and Media Authority (ACMA) for EMC and shall be labelled with a conforming RCM compliance label as shown in Figure 9.1 below.

![Figure 9.1 – RCM compliance label](image-url)
SECTION 10 - ENVIRONMENTAL

10.1 TEMPERATURE AND HUMIDITY

10.1.1 The sign and associated equipment shall be designed to operate under any conditions of the following conditions:

a) Ambient air temperatures within the range -15°C to 50°C; and
b) Insolation of up to 1000W/m², incident at an angle of 30° from the vertical, applied to the maximum exposed surface of the equipment.

NOTE: Where it is not practical to provide the required insolation during testing, it is acceptable to increase the upper ambient temperature limit by 10°C as substitute.

10.1.2 Consideration shall be given to protection against the effects of high humidity, including condensation following a drop in ambient temperature.

10.2 ENCLOSURE PROTECTION

The housing shall meet the enclosure protection requirements for IP55 in accordance with AS 60529.

10.3 VIBRATION

10.3.1 The following Ramp Control signs shall be subjected to vibration tests as detailed in Clause 10.3.2 below.

a) RC1
b) RC2
c) RC3-A (RC2-C)

10.3.2 The complete Ramp Control sign shall be subjected to vibration tests in accordance with the requirements of AS 60068.2.6 for sinusoidal vibration as follows:

<table>
<thead>
<tr>
<th>Clause AS 60068.2.6</th>
<th>Detail</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Camera</td>
<td>Powered and operating</td>
</tr>
<tr>
<td></td>
<td>Test Type</td>
<td>Sinusoidal sweep</td>
</tr>
<tr>
<td>5.1</td>
<td>Frequency range</td>
<td>5 Hz to 55 Hz</td>
</tr>
<tr>
<td>5.2</td>
<td>Vibration amplitude</td>
<td>0.75mm</td>
</tr>
<tr>
<td>5.2</td>
<td>Cross-over frequency</td>
<td>Approximately 8.2 Hz</td>
</tr>
<tr>
<td>5.2</td>
<td>Acceleration amplitude</td>
<td>2 m/s² - 0.2gn</td>
</tr>
</tbody>
</table>
10.4 WIND LOADING

10.4.1 The facilities provided for supporting and stabilizing/anchoring the sign shall ensure that, when installed for normal operation, the sign will maintain its intended orientation and position when subjected to the wind-loading conditions applicable to the region in which the sign is intended to be used, in accordance with AS/NZS 1170.2.

10.4.2 The minimum wind-loading conditions applicable shall be those for Region A, Terrain Category 2 in accordance with AS/NZS 1170.2.
SECTION 11 - MARKINGS

11.1 REQUIREMENTS

Each sign shall be legibly and durably marked on the interior surface of the housing with the following information:

a) The name, trade name or trademark of the manufacturer or responsible supplier;
b) Catalogue number or marking which shall distinguish the particular sign from other similar items supplied and/or manufactured by the supplier;
c) Batch or serial number, or other mark, which will clearly identify the date of manufacture of the item;
d) The above three points should be included on the label on both interior and exterior of the sign;
e) The date that the sign was installed in the field;
f) Other information required under AS-3100;
g) Other information such as RTA address; and
h) Default setting.
SECTION 12 – DOCUMENTATION

12.1 GENERAL

The following shall be supplied with every sign order in both hard copy and soft copy:

a) Overview of the sign design and layout;
b) A schematic diagram or chart showing the, as supplied, electrical circuits contained within the sign;
c) A list of all major electrical sub-components detailing their electrical characteristics and operations limits;
d) Full documentation of the sign software and firmware;
e) Structural drawings;
f) List of all major components and sub-components;
g) Any and all operational and maintenance requirements to ensure the LED’s operate for the minimum life;
h) The LED manufacturer data sheet for photometric and colorimetric test;
i) Recommended maintenance plan; and
j) Recommended list of spare parts for maintenance.

12.2 MANUFACTURERS WARRANTY

12.2.1 Warranty Conditions

12.2.1.1 Every sign supplied for a VicRoads project in accordance with this specification shall be warranted from defects for a period of not less than 5 years from date of purchase. Such warranty shall cover component failure and faulty workmanship.

12.2.2 Every sign controller supplied for a VicRoads project in accordance with this specification shall be warranted from defects for a period of not less than 5 years from date of purchase. Such warranty shall cover component failure and faulty workmanship.

12.2.2.3 The supplier shall provide details of the warranty conditions as part of the submission for type approval.

12.2.2 Warranty Certificate

Each sign supplied for any VicRoads project shall include a warranty certificate. The warranty certificate shall include, as a minimum, the following details:

a) The manufacturers name
b) The manufacturers contact details for warranty claims
c) The sign serial number / batch number and date of manufacture
12.2.3 Warranty Register

The supplier shall maintain an accurate and up to date warranty register detailing the following:

a) The sign type
b) Serial number
c) Batch number
d) Date of manufacture
e) Date of supply to purchaser
SECTION 13 - INSTALLATION AND COMMISSIONING

13.1  GENERAL

13.1.1  Ramp Control signs shall be installed in accordance with:

a) The requirements of this specification;
b) Contract Standard Section 732; and
c) The requirements of individual contract documents.

13.1.2  All pits and conduits shall be installed in accordance with Contract Standard Section 733.

13.1.3  RC signs shall be installed on posts or mounting structures as detailed in Clause 8.6 of this specification and individual contract documents.

13.1.4  RC signs shall not be installed on the following pole types:

- Mid-hinge camera poles
- Slip base lighting poles
- Impact absorbing lighting poles.

13.1.5  Signs shall be commissioned in accordance with Contract Standard Section 736 and the requirements of individual contract documents.

13.2  RC1 SIGNS

13.2.1  General

13.2.1.1  Where RC1 signs are typically installed on a site where existing traffic signals control the movement of vehicles onto or past the entry ramp.

13.2.1.2  Where possible, signs shall be mounted on suitably located traffic signal pedestals.

13.2.1.3  Ramp Control Signs shall be mounted such that the lowest portion of the sign is not lower than 2.4m above ground level, and so that no portion of the sign interferes with the viewing of any traffic signal display.

13.2.1.4  Compatible traffic signal crank-arm units may be used to raise the ramp control sign to a clear viewing position if necessary (e.g. above secondary or tertiary lanterns on Type 2A pedestals).

13.2.1.5  Where the installation of a sign requires a new pedestal to be installed, a Type 2B Pedestal shall be used and the sign mounted at the top of the pedestal.

13.2.1.6  The 2B pedestal foundation shall be installed in accordance with VicRoads Contract Standard Section 730 and Standard Drawing TC-1200.
13.2.1.7 A minimum lateral clearance of 500mm between the back of curb and the nearest portion of the sign shall be maintained at all times.

13.2.1.8 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.

13.2.1.9 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in lanes capable of using the entry ramp in the range 20m to 100m.

13.2.1.10 Sign positions shall be nominated in individual contract documents.

13.2.1.11 Figure 13.1 shows some typical RC1 sign installations.

13.2.2 Electrical Supply

13.2.2.1 RC1 Signs attached to a traffic signal installation post SHALL ONLY be powered from the associated traffic signal controller.

**NOTE:** RC1 signs attached to a traffic signal installation post shall not, under any circumstances, be powered from a separate point of supply other than the traffic signal controller.

13.2.2.2 Where available, a spare core within the traffic signal multi-core cable shall be used to provide the power.

13.2.2.3 A separate, appropriately rated circuit breaker for RC1 signs shall be installed within the traffic signal controller cabinet.
13.2.2.4 The above circuit breaker shall be clearly labelled.

13.2.2.5 A label complying with Appendix C.1 shall be affixed to the inside of the traffic signal controller.

13.2.2.6 Where an RC1 sign is installed on a separate, stand-alone post the sign shall be powered from the associated traffic signal site.

13.2.2.7 A circuit breaker of an appropriate size shall be installed within all RC1 signs.

13.2.2.8 A label complying with Appendix C.2 shall be affixed to the inside all RC1 sign enclosures providing clear details of the source of power and the source of activation.

13.2.3 Communications

RC1 Signs shall be controlled via a wireless communications link from the associated STREAMS Field Processor.

13.3 RC2-A SIGNS

13.3.1 General

13.3.1.1 RC2-A signs shall be installed on 2B pedestals using the attachment method detailed in clause 8.6 of this specification.

13.3.1.2 Signs shall be mounted such that the lowest portion of the sign is not lower than 2.4m above ground level and so that no portion of the sign interferes with the viewing of any other signs or traffic signal displays.

13.3.1.3 A minimum lateral clearance of 500mm between the back of curb and the nearest portion of the sign shall be maintained at all times.

13.3.1.4 Pedestals shall be located behind guard rail or other protective barrier.

13.3.1.5 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.

13.3.1.6 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in lanes using the entry ramp in the range 20m to 100m.

*Note: The sight distance of the signs will depend on the alignment and length of the ramp.*

13.3.1.7 Sign positions shall be nominated in individual contract documents.
13.3.2  Electrical Supply

13.3.2.1 Electrical supply for RC2-A signs shall be from the associated ramp signal controller.

13.3.2.2 A label complying with Appendix C.2 shall be affixed to the inside all RC2 sign enclosures providing clear details of the source of power and the source of activation.

13.4  RC3-A SIGNS

13.4.1  General

13.4.1.1 RC3-A signs shall be installed on either a:

   a) Post and foundation as detailed in VicRoads standard drawings TC-2223.
   b) Existing MA, JUMA or JUP

13.4.1.2 Under no circumstances shall RC3-A signs be mounted on the following pole types:

   a) Slip base lighting pole.
   b) Impact absorbing lighting pole.
   c) Mid-hinge pole.

13.4.1.3 RC3-A signs attached to stand alone posts shall be attached as detailed in VicRoads standard drawing TC-2234.

13.4.1.4 Signs shall be mounted such that the lowest portion of the sign is not lower than 2.4m above ground level and so that no portion of the sign interferes with the viewing of any other signs or traffic signal displays.

13.4.1.5 A minimum lateral clearance of 500mm between the back of curb and the nearest portion of the sign shall be maintained at all times.

13.4.1.6 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.

13.4.1.7 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in the range 20m to 100m.

13.4.1.8 Sign positions shall be nominated in individual contract documents.

13.4.1.9 A label complying with Appendix C.2 or C.3 (whichever is applicable) shall be affixed to the inside all RC3-A sign enclosures providing clear details of the source of power and the source of activation.

13.4.2  Electrical Supply

13.4.2.1 RC3-A Signs attached to a stand alone post shall be powered from one of the following methods:
a) The associated ITS Field Cabinet in which the controlling STREAMS Field Processor is located.
b) A separate and independent point of supply.
c) The associated traffic signal controller.

13.4.2.2 Where an RC3-A sign is installed on a separate pole as detailed in TC-2223, the power supply cable shall be terminated in an approved junction box, or similar approved arrangement, attached to the opposite side of the pole behind the sign.

13.4.2.3 The signs electrical connection cables shall be connected to the incoming power supply cable in the junction box described in 13.5.1.2 above.

13.4.2.4 The electrical connection detailed in 13.4.2.2 and 13.4.2.3 above must be electrically and physically segregated from the communications connection detailed in Clause 13.4.3 below.

NOTE: Under no circumstances shall the mains supply connection be housed within the same junction box as the communications connection.

13.4.2.5 Where an RC3-A Sign is attached to a traffic signal pole, it SHALL ONLY be powered from the associated traffic signal controller.

NOTE: RC3-A signs attached to a traffic signal installation post shall not, under any circumstances, be powered from a separate point of supply other than the traffic signal controller.

13.4.2.6 When powered from a traffic signal controller, a separate cable shall be provided from the controller to the sign. A spare core within the traffic signal multi-core cable SHALL NOT be used to provide the power.

13.4.2.7 A separate circuit breaker for RC3-A signs shall be installed within the traffic signal controller cabinet.

13.4.2.8 The above circuit breaker shall be clearly labelled.

13.4.2.9 A label complying with Appendix C1 shall be affixed to the inside of the traffic signal controller.

13.4.3 Communications

13.4.3.1 RC3-A Signs shall be controlled via a hardwired communications link (i.e. an ethernet connection) from the associated STREAMS Field Processor

13.4.3.2 Where a hardwired link is not possible, the Superintendent may consider the use of a wireless communications link from the associated STREAMS Field Processor

13.4.3.3 The wiring for the hardwired link shall be installed in a white communications conduit where possible.

13.4.3.4 Where a communications conduit cannot be installed, and if approved by the Superintendent, the communications cable may be installed within the electrical conduit.
13.4.3.5 Where the communications cable is installed in the electrical conduit, the cable shall be shielded and the insulation rated at not less than the electricity mains cable insulation rating (i.e. mains voltage).

13.4.3.6 The communication cable shall be terminated in an approved junction box, or similar approved arrangement, attached to the opposite side of the pole behind the sign.

13.4.3.7 The signs communications cable shall be connected to the incoming communications cable in the junction described in 13.4.3.5 above.

13.4.3.8 The communications connection detailed in 13.4.3.5 and 13.4.3.6 above must be electrically and physically segregated from the mains supply connection.

**NOTE:** Under no circumstances shall the communications connection be housed within the same enclosure as the mains supply connection detailed in 13.4.2 above.

### 13.5 RC2-C SIGNS

#### 13.5.1 General

RC2-C signs are typically installed on:

- a) Stand-alone post(s); or
- b) A gantry.

#### 13.5.2 RC2-C Signs Mounted on a Stand-alone Post

13.5.2.1 Signs installed on standalone post(s) shall be installed on posts and foundations as detailed in VicRoads standard drawings TC-2223.

13.5.2.2 Signs attached to stand alone posts shall be attached as detailed in VicRoads standard drawing TC-2224.

13.5.2.3 Signs shall be mounted such that the lowest portion of the sign is not lower than 2.4m above ground level and so that no portion of the sign interferes with the viewing of any other signs or traffic signal displays.

13.5.2.4 A minimum lateral clearance of 500mm between the back of curb and the nearest portion of the sign shall be maintained at all times.

13.5.2.5 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.

13.5.2.6 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in lanes using the entry ramp in the range 20m to 100m.

**Note:** The sight distance of the signs will depend on the alignment and length of the ramp.
13.5.2.7 Sign positions shall be nominated in individual contract documents.

13.5.2.8 A label complying with Appendix C3 shall be affixed to the inside all RC2-C sign enclosures providing clear details of the source of power and the source of activation.

13.5.3 **RC2-C Signs Mounted on a Gantry**

13.5.3.1 Where specified in individual contract documents, RC2-C signs shall be installed on a gantry.

13.5.3.2 Where installed on a LUMS gantry the RC2-C sign shall not interfere with, or reduce visibility of, any lane use signs mounted on the same gantry.

13.5.3.3 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.

13.5.3.4 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in lanes using the entry ramp in the range 20m to 100m.

*Note: The sight distance of the signs will depend on the alignment and length of the ramp.*

13.5.3.5 Sign positions shall be nominated in individual contract documents.

13.5.2.6 A label complying with Appendix C3 shall be affixed to the inside all RC2-C sign enclosures providing clear details of the source of power and the source of activation.

13.5.4 **Electrical Supply**

13.5.4.1 RC2-C Signs shall be powered from one of the following methods, as specified in individual contract documents:

   d) The associated ITS Field Cabinet in which the controlling STREAMS Field Processor is located.
   e) A separate and independent point of supply.

13.5.4.2 The RC2-C sign power supply cable shall be terminated in an approved junction box, or similar approved arrangement,

13.5.4.3 The signs electrical connection cables shall be connected to the incoming power supply cable in the junction box described in 13.5.4.2 above.

13.5.4.4 The electrical connection detailed in 13.5.4.2 and 13.5.4.3 above must be electrically and physically segregated from the communications connection detailed in Clause 13.4.3 below.

*NOTE: Under no circumstances shall the mains supply connection be housed within the same junction box as the communications connection.*
13.5.5 Communications

13.5.5.1 RC2-C Signs shall be controlled via: a hardwired communications link (i.e. an ethernet connection) from the associated STREAMS Field Processor.

13.5.3.2 Where a hardwired link is not possible, the Superintendent may consider the use of a wireless communications link from the associated STREAMS Field Processor.

13.5.5.3 The wiring for the hardwired link shall be installed in a white communications conduit.

13.5.5.4 Given the typical distance from the field processor to an RC2-C sign, the communications cable shall not be installed in the electrical conduit.

13.5.5.5 The communication cable shall be terminated in an approved junction box, or similar approved arrangement, attached to the opposite side of the pole behind the sign.

13.5.5.6 The signs communications cable shall be connected to the incoming communications cable in the junction described in 13.5.5.5 above.

13.5.5.7 The communications connection detailed in 13.5.5.5 and 13.5.5.6 above must be electrically and physically segregated from the mains supply connection.

**NOTE:** Under no circumstances shall the communications connection be housed within the same enclosure as the mains supply connection detailed in 13.5.4 above.

13.6 RC3-C SIGNS

13.6.1 General

13.6.1.1 RC3-C signs shall be installed on a gantry as detailed in individual contract documents.

13.6.1.2 Details of the gantry shall be provided in individual contract documents.

13.6.1.3 The signs when mounted shall be capable of adjustment in the vertical alignment as specified in AS 4852.1 VMS.

13.6.1.4 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in lanes using the entry ramp in the range 50m to 300m (as specified in AS 4852.1 VMS).

13.6.1.5 Sign locations shall be nominated in individual contract documents.

13.6.2 Electrical Supply

13.6.2.1 RC3-C Signs shall be powered from the associated ITS Field cabinet.

13.6.2.2 Power cabling shall comply with the requirements of AS/NZS3000.

13.6.2.3 The power cabling shall be suitably electrically isolated from the communications cabling.
13.6.3 Communications

13.6.3.1 RC3-C Signs shall be controlled via: a hardwired communications link from the associated STREAMS Field Processor

13.6.3.2 Communications cabling shall be suitably electrically isolated from the electrical supply cabling.
APPENDIX A - VICROADS ITS PLATFORM

(Informative)

A.1 GENERAL

A.1.1 VicRoads ITS platform currently uses the STREAMS system.

A.1.2 STREAMS is owned and maintained by Transmax, a Queensland based company which is part of Queensland Main Roads.

A.1.3 STREAMS is an integrated control system which is being used by VicRoads to operate its ITS Freeway Management Devices on Melbourne’s freeway network.

A.1.4 All ITS field devices must be compatible with STREAMS.

A.1.5 Typical ITS field devices connected to and operated by STREAMS include:

- Variable Message Signs (VMS)
- Freeway Data Stations (FDS)
- Ramp metering/control signs
- Lane Control Signs (LCS)

A.1.6 The above devices are typically connected to STREAMS via a Field Processor (FP).

A.2 FIELD PROCESSOR

A.2.1 The FP is used to interface internet protocol (IP) and serially connected field devices to STREAMS.

A.2.2 Communications between the FP and the ITS Field Device is typically RMS protocol.

A.2.3 The FP is typically installed within an ITS Field Cabinet.

A.2.4 The ITS Field Cabinet is typically located adjacent to the freeway.

A.2.5 In some situations, the FP may be located in the VicRoads building at Kew.
APPENDIX B - VICROADS EXTENSION TO RMS PROTOCOL FOR VMS

(Normative)

B1 INTRODUCTION

B1.1 This appendix defines requirements for sign controllers to implement RMS protocol (TSI-SP-003 ver2.1) as the communication protocol between Variable Message Signs and the VicRoads ITS Central Control System. Note that the protocol used by VicRoads is based on v2.1 of TSI-SP-003 instead of the newer version 3.1.

B1.2 The definitions for handling colour is based on an RMS protocol document (ITSM-TO-ITS-CSI-002) that describes the extensions to the base RMS protocol.

B2 GENERAL IMPLEMENTATION REQUIREMENTS

B2.1 Sign controllers shall utilise RMS Protocol (previous known as ‘RTA protocol’) - ‘Communication Protocol For Roadside Devices’ Specification No. TSI-SP-003 version 2.1 as the communication protocol for STREAMS to monitor and control the signs.

B2.2 The sign controller shall fully implement all defined protocol layers as described in the RMS protocol with following exceptions:

- The serial connection defined in the protocol Section 3.2 Physical Link and Section 3.3 is not the only valid physical link. The sign controller shall also support running RMS protocol over Ethernet via a TCP/IP Socket. When Ethernet is being used, the sign controller shall run as a TCP/IP Socket server and the VicRoads Central Control System will run as TCP/IP Socket client.
- For security reasons, the sign controller shall support RMS protocol messages being transmitted with no encryption or encrypted with TLS.
- The current VicRoads ‘Information Security Standard: Cryptographic Controls’ shall be complied with.
- Application messages for HAR and Weather Systems (MI code 40-48 and 80-87) defined in the protocol are not required to be implemented.

B2.3 CRC calculation

There are two places in the protocol requires CRC calculation.

- CRC calculation is required for every message as a part of the full data packets, which is defined in the protocol section 3.3.2.3. Note: Transmitted data (i.e. ASCII-HEX encoded data as defined in the protocol Section 3.3.1) is to be used for this CRC calculation.
- CRC calculation is also required for some of the Application Layer messages, such as ‘sign set text frame’ and ‘Sign set graphics frame’. **Note:** Message data (i.e. Not ASCII-HEX encoded data) is to be used for this CRC calculation.

Example:

The message example in Appendix D of the protocol contains both application message level CRC and data packet level CRC.

Here is the message in Hex (before ASCII-HEX encoded)

<SOH>00 00 02<STX> 0A 4A 08 05 03 01 09 53 4C 4F 57 20 44 <ETX>

- C8B7 is the application message CRC, which is calculated on other hex data in the same application message, i.e. “0A 4A 08 05 03 01 09 53 4C 4F 57 20 44 4F 57 4E”, total 16 bytes.

- BE44 is the data packet CRC, which is calculated on ASCII-HEX encoded data in the packet except the <ETX> control byte and the CRC bytes them self, i.e. “<SOH>00 00 02<STX> 0A 4A 08 05 03 01 09 53 4C 4F 57 20 44 4F 57 4E C8 B7” convert to ASCII-HEX, which is “01 30 30 30 30 30 32 02 30 41 34 41 30 38 30 35 30 33 30 31 30 39 35 33 34 34 46 35 37 32 30 34 34 34 46 35 37 34 45 38 42 37”, total 44 bytes. (<SOH> & <STX> are control characters, not required to be ASCII-HEX encoded)

B2.4 Further to section 3.5 of that protocol specification, here is another message exchange example in Table B1:

<table>
<thead>
<tr>
<th></th>
<th>System to Sign Controller</th>
<th>Sign Controller to System</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>START SESSION</td>
<td>ACK</td>
<td>Request to start session from central system to sign</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Password seed</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>PASSWORD (N(S)=0, N(R)=0)</td>
<td>ACK (N(R)=0)</td>
<td>Password accepted, link established, sign is online</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acknowledge (N(S)=0, N(R)=0)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Heartbeat Poll (N(S)=0, N(R)=0)</td>
<td>ACK(N(R)=1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Status reply (N(S)=0, N(R)=1)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Extended Status Request (N(S)=1, N(R)=1)</td>
<td>ACK(N(R)=2)</td>
<td></td>
</tr>
</tbody>
</table>
### B2.5 Usage of ‘revision’ field in Application Layer Messages.

There is a ‘Revision’ field in some of the Application Layer messages, such as ‘Sign Set Text Frame’ and ‘Sign Set Graphics Frame’. It is valid for the VicRoads Central Control System not to update this field value when sending those messages to the sign controller i.e, the VicRoads Central Control System can use ‘0’ as the ‘Revision’ field value.

### B2.6 VicRoads Variable Message Signs are to be interpreted as ‘graphics Signs’ when using the protocol.

For example, when the sign controller sends message ‘Sign Extended Status Reply’, ‘number of rows/columns of pixels’ shall be returned for fields of message position 25 and 26.

### B2.7 When the current session ends, the sign(s) should be blank.

### B3 SPECIFIC IMPLEMENTATION REQUIREMENTS FOR COLOUR DISPLAYS

#### B3.1 This section describes the VicRoads implementation of the protocol used to interface with variable message signs that can display multi-colour messages.

#### B3.2 The protocol is based on the RMS protocol document ITSM-TO-ITS-CSI-002 that describes the extensions to the original protocol document for signs (RMS TSI-SP-003).

<table>
<thead>
<tr>
<th></th>
<th>Extended Status Reply (N(S)=1, N(R)=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Heartbeat Poll (N(S)=2, N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>NAK (N(R)=2)</td>
</tr>
<tr>
<td></td>
<td>Incorrect N(R) sent by system to sign results in a NAK</td>
</tr>
<tr>
<td>6</td>
<td>Heartbeat Poll (N(S)=2, N(R)=2)</td>
</tr>
<tr>
<td></td>
<td>ACK(N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>Status reply (N(S)=2, N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>Corrected</td>
</tr>
<tr>
<td>7</td>
<td>Heartbeat Poll (N(S)=4, N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>NAK (N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>Incorrect N(S) sent by system results in a NAK</td>
</tr>
<tr>
<td>8</td>
<td>Heartbeat Poll (N(S)=3, N(R)=3)</td>
</tr>
<tr>
<td></td>
<td>ACK(N(R)=4)</td>
</tr>
<tr>
<td></td>
<td>Status reply (N(S)=3, N(R)=4)</td>
</tr>
<tr>
<td>9</td>
<td>End session (N(S)=4, N(R)=4)</td>
</tr>
<tr>
<td></td>
<td>ACK(N(R)=5)</td>
</tr>
<tr>
<td></td>
<td>Acknowledge (N(S)=4, N(R)=5)</td>
</tr>
<tr>
<td></td>
<td>Sign is offline</td>
</tr>
</tbody>
</table>
B3.3 The extensions to the protocol allow a multi-colour frame to be uploaded to a variable message sign. All other messages remain the same, and the sequence for displaying messages also remain the same. These extensions also limit the colours to be specified to these seven.

- Red
- Green
- Blue (NOT USED)
- Red + green = yellow
- Red + blue = magenta (NOT USED)
- Green + blue = cyan (NOT USED)
- Red + green + blue = white

B4 MESSAGE SEQUENCE AND PROCESS

As defined in the RMS protocol document, the sign will accept a new message, Sign Set Colour Frame, opcode 0x1D (“Colour” spelling is as per RMS) that will be used to specify a colour frame to the sign. As per the document: “Setting a multiple colour frame is done by setting three frames where each frame specifies a basic colour.”

The implications of this process are as follows:

- If a particular colour is not supported by the sign, then the sign should return error “0x0c – Colour not supported by sign controller” (refer: TSI-SP-003)
- In order to use a colour graphic frame, all three colour frames must be set before that frame is used, for example in a “Sign Set Message” command. If a frame is attempted to be used before all three colour frames are set, the sign should return an error “0x13 – Frame, message or plan undefined”
- The sign should use the colour mixing formulas as above to determine what colour each sign pixel is.
- The sequence and timing of the definition of each colour frame is not important as long as all three frames are defined in a “Set Colour Frame” before that frame is used.

B5 COLOUR AND MONOCHROME FRAMES

a) The sign should not require or designate any particular frame to be colour or monochrome. A frame can change between colour and monochrome depending on the last graphic frame definition message.

(Note: monochrome frames can have colour, but only one colour for all lit pixels)

b) If the most recent frame definition message is “Sign Set Graphics Frame” (opcode 0xbh), then that frame becomes a monochrome frame for message display purposes. Similarly,
if a “Sign Set Colour Frame” message is set for that same frame, then it becomes a colour frame, and will require all three frame colours to be defined before it can be used.
APPENDIX C - LABELS

(Normative)

C1 TRAFFIC SIGNAL CONTROLLER SUPPLYING RC1 AND RC3-A SIGN

A Traffic Signal Controller providing power to an RC1 sign shall have a label affixed internally in a prominent position in accordance with the example shown in Figure C1. The size of the label and the font size shall enable the label to be clearly read.

![Figure C1– Example Traffic signal controller label](image)

C2 RC1 AND RC3A RAMP CONTROL/METERING SIGN

Each Sign shall include a label affixed inside the sign in accordance with the example shown in Figure C2. The size of the label and the font size shall enable the label to be clearly read.

![Figure C2 – Example RC1/RC3A sign label](image)
C3  RC2-C AND RC3-A SIGN POWERED FROM SEPARATE POINT OF SUPPLIES

Each RC3-A Sign shall have a label affixed inside the Signs in accordance with the example shown in Figure C3. The size of the label and the font size shall enable the label to be clearly read.

![Example RC2C and RC3A sign label](image)

Figure C3 – Example RC2C and RC3A sign label
APPENDIX D - REQUIREMENTS FOR TYPE APPROVAL

(Normative)

D1 GENERAL

Ramp Control/Metering signs for use on VicRoads projects are required to hold current VicRoads Type Approval.

The Product Compliance evaluation process shall be carried out in accordance with VicRoads Guideline TCG 016.

To enable assessment for the purpose of granting Type Approval, the supplier must provide the following:

a. A complete working sample of the sign.

b. An outline drawing showing the general presentation and overall dimensions of the complete sign.

c. Documentation to demonstrate that the sign has been manufactured and supplied under an approved quality assurance system.

d. Documentation to demonstrate that the sign conforms to the requirements of VicRoads Specification. This may be by means of submitting test results from approved and appropriately qualified independent testing organisations, or providing the manufacturer’s assurance that the product complies with each paragraph of the specification.

Alternatively, the supplier may submit evidence of Type Approval of the same product by another Australian State Road Authority, together with details of volume and period of usage by other jurisdictions.

D2 REQUIRED NATA ACCREDITED TESTING

Notwithstanding D1 above, the supplier shall submit test results from a NATA accredited testing organisation to demonstrate compliance with the following.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Requirements</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Photometric</td>
<td>Test Report</td>
</tr>
<tr>
<td>7.2</td>
<td>Colorimetric</td>
<td>Test Report</td>
</tr>
<tr>
<td>9.6</td>
<td>EMC Compliance</td>
<td>Test Report</td>
</tr>
<tr>
<td>10.1</td>
<td>Temperature and humidity</td>
<td>Test Report</td>
</tr>
<tr>
<td>10.2</td>
<td>Enclosure protection</td>
<td>Test Report</td>
</tr>
<tr>
<td>10.3</td>
<td>Vibration</td>
<td>Test Report</td>
</tr>
<tr>
<td></td>
<td>(RC1/RC2 and RC3A only)</td>
<td></td>
</tr>
</tbody>
</table>
D3 OTHER REQUIRED TESTING

a. VicRoads may require additional information or testing to be carried out as part of its evaluation of the product.
b. If the product is approved, a Certificate of Type Approval will be provided to the supplier. Until such time as this Certificate is issued, the product is not to be used in the State of Victoria.

D4 COMPATIBILITY WITH RMS PROTOCOL

The supplier shall provide evidence of compatibility with RMS protocols TSI-SP-003 and ITSM-TO-ITS-CSI-002.

This shall typically be by a test report, certificate or statement from RMS.

D5 STREAMS COMPATIBILITY

The supplier shall provide evidence of compatibility with STREAMS.

D6 ASSESSMENT PROCEDURE

The assessment procedure for Ramp Control Signs will include, but not be limited to, the following:

- Assessment of construction, workmanship and critical dimensions.
- Evaluation of the submitted data against the requirements of the specification.
- Operation of the sign on VicRoads system.

D7 FIELD TRIAL

Once VicRoads is satisfied the sign meets all requirements, a field trial will be arranged. A field trial will be a minimum period of 3 to 6 months. If there are issues/faults experienced during the field trial, this period may be extended at VicRoads discretion.
APPENDIX E - GUIDELINES FOR PLANNING OR PURCHASING

(Informative)

E1 PURCHASING

When planning, designing or purchasing Ramp Control signs, the following should be considered:

- The type of RC signs required
- The number of signs required
- For RC1 signs, the required display (i.e. NRT, NLT, No Entry)
- For RC2 signs the sign size required (A or C size)
- For RC3 signs the size of sign required (A or C size)
- The installation method (i.e. traffic signal pole, new 2B, RC3 specific pole, gantry)
- The sign location