TCS 003: 2023

Specification

Ramp Control and Metering Signs

Supply and Installation

Version: June 2023
Revision: A

Victoria State Government | Department of Transport and Planning

Foreword

This specification has been developed by Department of Transport and Planning. 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 DTP.

DTP Standard Drawings, Specifications and Guidelines are available for downloading from the VicRoads website:

https://www.vicroads.vic.gov.au/business-and-industry/technical-publications/electrical-and-intelligent-transport-systems

Specification updates. DTP 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 DTP specifications to ensure that they have the latest version and associated amendments.

Intelligent Transport Systems
110 Maroondah Hwy Ringwood Vic 3134

ITS_Improvements_and_Standards@roads.vic.gov.au

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Revision History

Version	Revision	Date	Author	Description
2002	3	Mar 2002	TTI	
2003	4	Aug 2003	TTI	
5		Jun 2011	RUS	- Revision
5	B	Aug 2011	RUS	- Editorial fixes - Revised sign layouts - Revised figure
5	C	Oct 2011	RUS	Clarification of LEDs
2016	A	Mar 2016	RO	- Revised operation and control - Changes to sign types
2019	A	Apr 2019	ITS	- Revised and updated - Remove requirement for visors - Addition of installation section and warranty requirements
2023	A	June 2023	ITS	- Template update to DTP - Add new RC1-C size sign - Rename RC1 to RC1-A size - Updated security requirements - Updated environmental requirements - Expanded installation section - General review and update

Contents

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.
- travel times to key locations on the freeway (RC3/TT3 when operating as a Travel Time sign).

1.1.3   Further information on the principal of operation of ramp signals can be obtained in DTP's Managed Motorway Design Guide: Volume 2, Parts 2 and 3.

1.1.4   There are three main types of Ramp Control / Metering Signs 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.

Sign Type	Designation	Description
RC1	Ramp control/ramp metering sign	Advice that 'ramp metering' is operating and used to close freeway on-ramp during incidents.
RC2	Ramp metering warning sign	Re-enforcement of ramp signals operating and to prepare to stop.
RC3	Ramp Control / Travel Time	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.

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   There are two types of RC1 sign as follows

- RC1-A – Typically installed at a freeway entrance from an arterial road as shown in figure 1.1.
- RC1-C – Typically installed at a freeway 'free-flow or non-signalised' entrance from an arterial road.

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.

1.2.2.3   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 aTT5 sign).

Note: at the time of this specification the display of travel times on the RC3-C sign has not been approved by DTP (Roads).

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

An overview of ramp control/metering signs and their designations are detailed in Table 1.2 below.

Ramp Control Sign	Road Designation	Use*	Approach Speed km/H	Display Type	Pixels (W)	Pixels (H)	Pixel Pitch (max)	Approximate Dimensions (mm)
RC1-A	Arterial	RC RM	<80	Changeable Message Sign	N/A	N/A	N/A	900 x 600
RC1-C	Arterial to freeway 'interchange'	RC RM	80	Changeable Message Sign	N/A	N/A	N/A	1400 x 800
RC2-A	On-Ramp	RM	60-100	Changeable Message Sign	N/A	N/A	N/A	900 x 600
RC2-C *(same sign as RC3-A)*	Freeway to Freeway Interchange	RM	80-100	Four Colour Matrix	128	40	12	1660 x 600
RC3-A *(also referred to as TT3)*	Arterial Road	TT RC	60-80	Four Colour Matrix	128	40	12	1660 x 600
RC3-C *(also referred to as TT5)*	Freeway to Freeway Interchange	RM	100	Four Colour Matrix	128	56	32	4450 x 2150

Table 1.2 – Ramp Control / Metering Sign Designations

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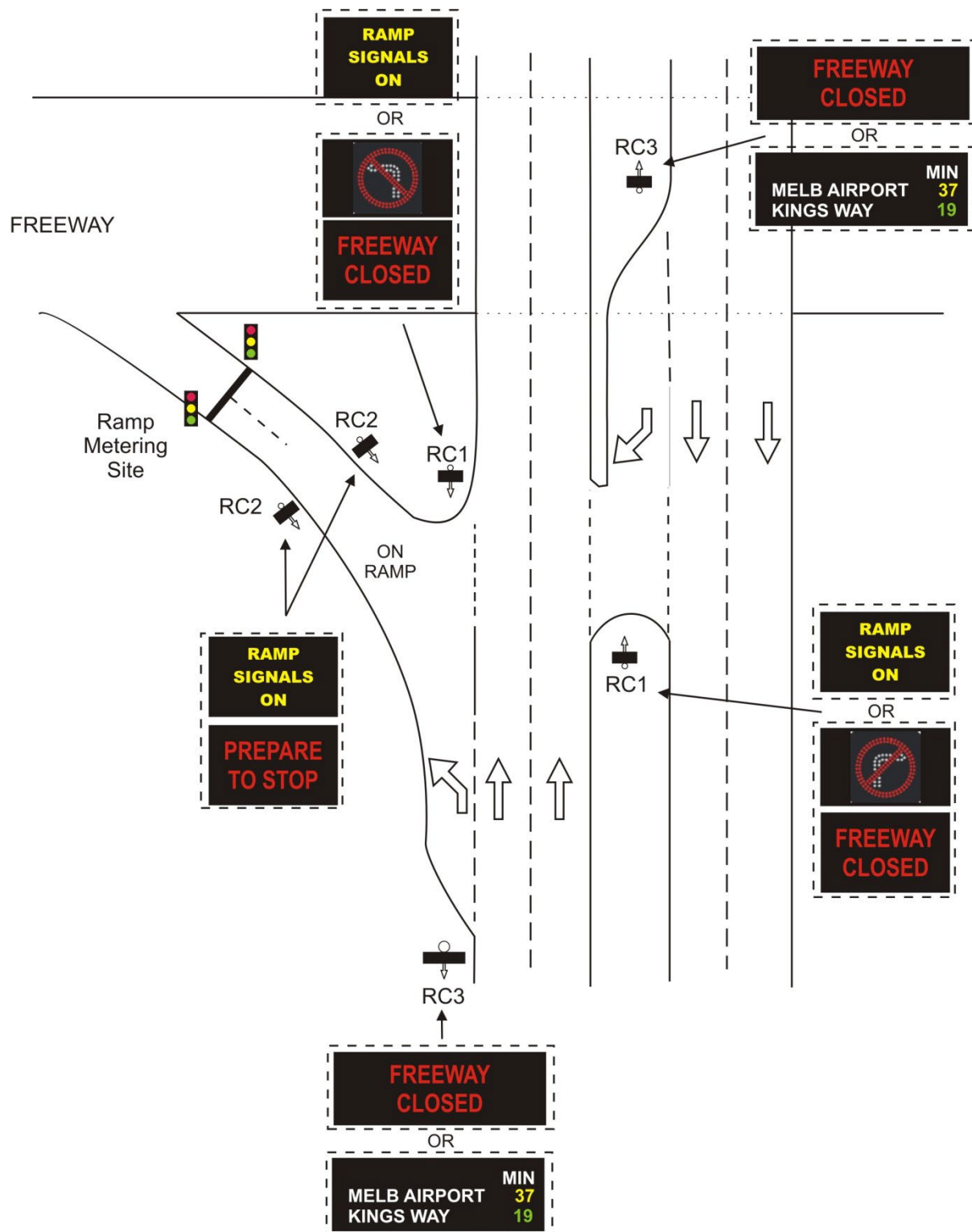
Figure 1.1 – Typical Layout for RC1, RC2, ad RC3 Signs, Arterial Road to Freeway
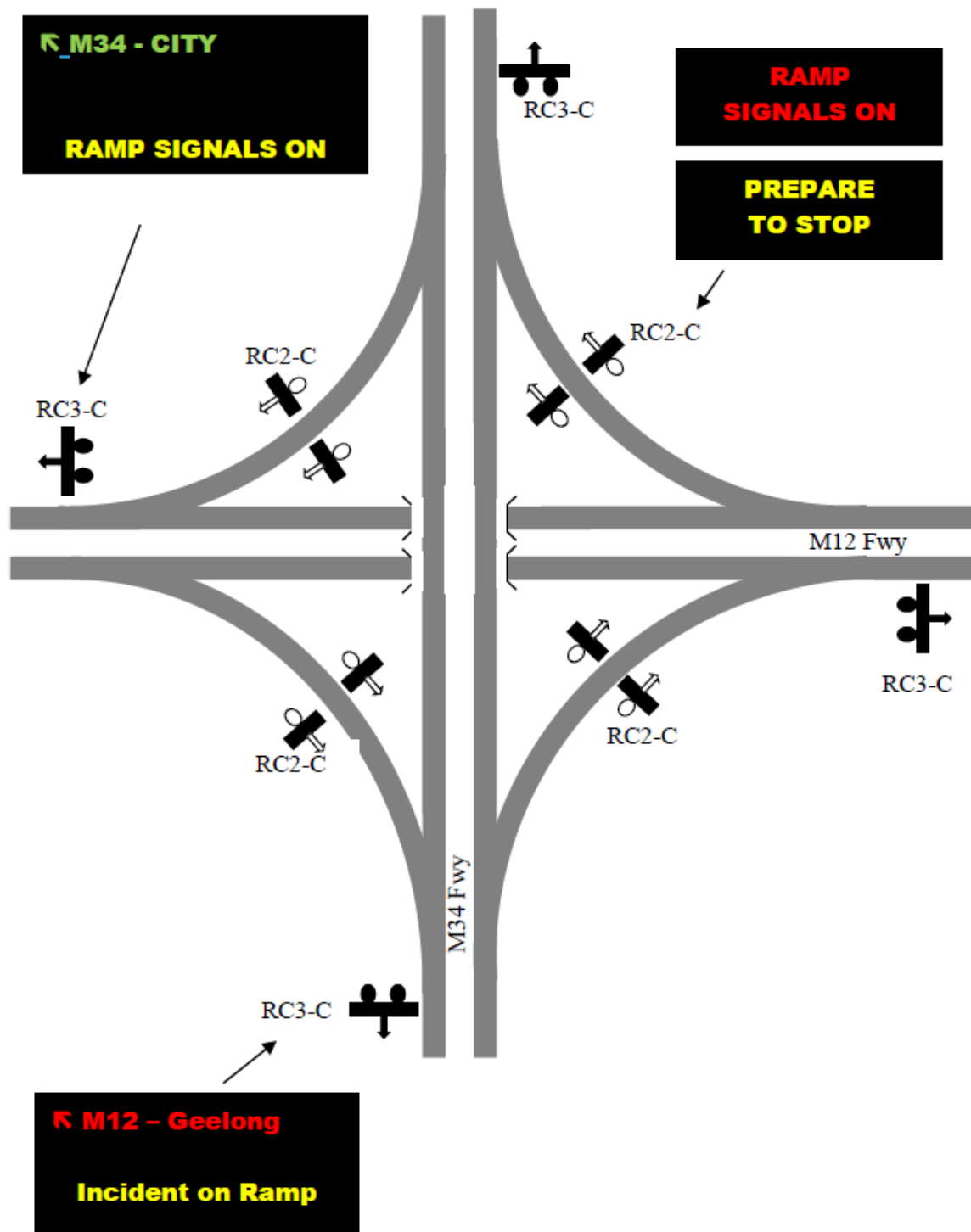
Figure 1.2 – Typical Layout for RC2-C and RC3-C Signs, Freeway to Freeway

1.3 INTELLECTUAL PROPERTY

1.3.1 In relation to all Intellectual Property rights associated with operating the signs, the contractor grants to DTP (Roads) 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.
- All operational and maintenance documentation.

1.4 PRE-QUALIFICATION

1.4.1 Manufacture of signs

Only companies that hold DTP (VicRoads) prequalification at the level of 'Supply of on-road electronic devices' (SOED) shall manufacture ramp control / ramp metering signs.

1.4.2 Installation of signs

All works associated with the installation and commissioning of ramp control / ramp metering signs shall be undertaken only by contractors that hold DTP (VicRoads) prequalification at the following levels.

a) Signs attached, or connected, to **traffic signals** – traffic signals installation (**STS1**).
b) Stand-alone (not attached to traffic signals) – traffic control equipment (**STCE**).

1.5 TYPE APPROVAL

1.5.1 All equipment to be supplied under this specification shall hold current DTP 'Type Approval' certification.

1.5.2 To obtain DTP 'Type Approval' the supplier must submit evidence of compliance in accordance with Appendix A of this specification and the requirements of individual tender documents.

1.5.3 Compliance with this version of this specification (and subsequent DTP Approval) does not constitute automatic approval against future versions of this specification.

1.5.4 Where it is considered necessary, DTP may withdraw current Type Approval and request that the affected product be re-submitted for evaluation against future versions of this specification.

1.6   ACRONYMS AND ABBREVIATIONS

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

ACMA	Australian Communications and Media Authority
AS	Australian Standard
AS/NZS	Australian Standard / New Zealand Standard
CCTV	Closed Circuit Television
CLI	Command Line Interface
CSV	Comma Separated Values
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DTP	Department of Transport and Planning (formerly Department of Transport, formerly VicRoads)
EMC	Electromagnetic Compatibility
FP	Field Processor
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
ICMP	Internet Control Message Protocol
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ITS	Intelligent Transport Systems
km/h	Kilometres per hour
LED	Light Emitting Diode
NRT	No Right Turn
NLT	No Left Turn
PE Cell	Photo Electric Cell
Proof engineered	An engineering design reviewed and certified by a DTP Pre-qualified Engineering Consultant
RC1	Ramp Control / Metering Sign
RC2	Ramp Metering Sign
RC3	Real Time Information Sign
RCD	Residual Current Device
SSH	Secure Shell
SSL	Secure Sockets Layer
TCP/IP	Transmission Control Protocol / Internet Protocol
TfNSW	Transport for New South Wales
TLS	Transport Layer Security
VMS	Variable Message Sign

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:

AS 1742.2	Manual of Uniform Traffic Control Devices, Part 2: Traffic Control Devices for General Use
AS 1743	Road Signs – Specifications
AS 4100	Steel Structures
AS 4852.1	Variable Message Signs – Part 1: Fixed Signs
AS 60038	Standard Voltages
AS 60529	Degrees of Protection Provided by Enclosures (IP Code)
AS 61000.6.3	Electromagnetic Compatibility (EMC) Generic Standards – Emission Standard for Residential, Commercial and Light Industrial Environments
AS 61558	Safety of Power Transformers, Power Supply Units and Similar
AS/NZS 3000	Electrical Installations – Wiring Rules
AS/NZS 61000.6.1	Electromagnetic Compatibility (EMC) Generic Standards – Emission Standard for Residential, Commercial and Light Industrial Environments

2.2   DTP SPECIFICATIONS

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

2.2.2   The following DTP Standard Sections and Specifications are referenced:

Standard Section 730	Traffic Signal Installation
Standard Section 732	ITS Devices Installation
Standard Section 733	Installation of Conduits and Pits for Underground
Standard Section 736	ITS Device Testing and Integration.
TCG 018	DTP Approved Products Listing
TCS 070	Travel Time Signs

2.3   DTP STANDARD DRAWINGS

The following DTP Standard drawings are referenced:

TC-2223	RC3 Pole – Typical Arrangement
TC-2224	RC3 Pole Bracketing Arrangements – Typical Arrangement
TC-2235	RC3 / TT3 Pole spread footing Type 1 – Typical arrangement
TC-2236	RC3 / TT3 Pole spread footing Type 2 – Typical arrangement

2.4   ADDITIONAL SPECIFICATIONS

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

2.4.2   The following additional specifications are referenced:

TfNSW Specification TS 03644 (TSI-SP-003)	Communications protocol for roadside devices *Only available from TfNSW* (Based on TSI-SP-003, Version 2.1, 26 June 2008)
Managed Motorway Design Guide	Managed Motorway Design Guide: Volume 2, Parts 2 and 3

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.

RC1 signs are used in two sizes, an RC1-A size, and an RC1-C size. The size required will be specified in individual contract documents.

3.2 RC1 DISPLAY REQUIREMENTS

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

Sign Operation	Message Type	Message	Detail
Ramp Metering Operation	Static	**RAMP SIGNALS ON**	Yellow text on black background (When ramp signals are operational)
Ramp Metering Operation	Alternating with	**FREEWAY CLOSED**	Red text on black background (When freeway is closed)
		NO RIGHT TURN	Illuminated symbolic type (Based on R2-6)
		NO LEFT TURN	Illuminated symbolic type (Based on R2-6)
		NO ENTRY	Illuminated symbolic type (Based on R2-4)

Table 3.1 – RC1 Displays

3.2.2   The symbolic 'NO RIGHT TURN', 'NO LEFT TURN' and 'NO ENTRY' displays shall comply with the requirements of Rule 91 of Road Rules Victoria and AS-1743-2018 as detailed in Table 3.2.

Display	Sign Designation	A Size nominal outer radius	C Size nominal outer radius
NO RIGHT TURN	R2-6 (R)	220	N/A
NO LEFT TURN	R2-6 (L)	220	N/A
NO ENTRY	R2-4	220	360

Table 3.2 – Sign designations and sizes

3.2.3   Typical pixel placement for the individual displays shall be in accordance with typical layouts as indicated in Figures 3.1, 3.2, 3.3, 3.4 and 3.5.

Ramp metering operation

RAMP SIGNALS ON

- Yellow on Black
- 120mm character height (A size)
- 170mm character height (C size)

Figure 3.1 – Typical layout for RAMP SIGNALS ON display for Ramp Metering Operation
(Provided as an example only)

FREEWAY CLOSED

- Red on Black
- 150mm character height (A size)
- 200mm character height (C size)

Figure 3.2 – Typical layout for FREEWAY CLOSED display for Ramp Control Operation
(Provided as examples only)
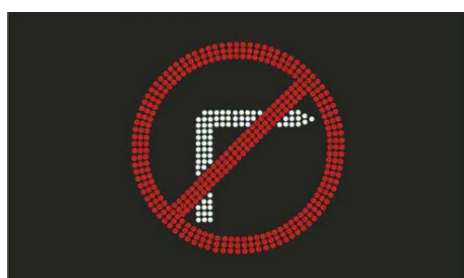
NO RIGHT TURN

- AS 1743, R4-6(R)
- Road Rules Victoria, Rule 91

Figure 3.3 – Typical layout for NRT display for Ramp Control Operation
(Provided as examples only)
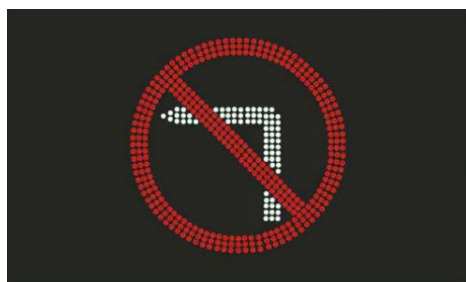
NO LEFT TURN

- AS 1743, R4-6(R)
- Road Rules Victoria, Rule 91

Figure 3.4 – Typical layout for NLT display for Ramp Control Operation
(Provided as examples only)
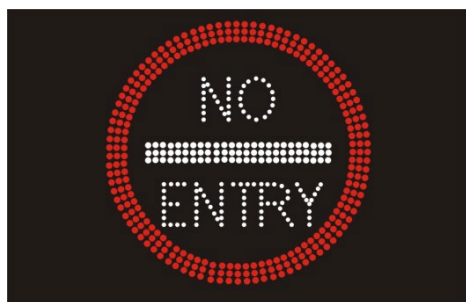
NO ENTRY

- AS 1743, R4-2
- White on Black characters and horizontal line
- Nominal 75mm character height (A size)
- Nominal 120mm character height (C size)
- Red annulus

Figure 3.5 – Typical layout for NO ENTRY display for Ramp Control Operation
(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 3.3.

'Frame ID' Number	Message Description
1	**"RAMP SIGNALS ON"**
3	**"FREEWAY CLOSED"**
4	Symbolic 'No Left Turn'
5	Symbolic 'No Right Turn'
6	Symbolic 'No Entry'
7	Other Specified Message

Table 3.3 – RC1 Fixed Message Frames Summary

3.2.7   The nominal enclosure size shall be:

a) 900mm wide by 600mm high for A-size signs.
b) 1400mm wide by 800mm high for C-size signs.

3.2.8   The LEDs 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 LEDs shall have a maximum spacing of 3 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 DTP, these are:

a)   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.

b)   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.

   Note: RC2 B Size – Reserved for possible future use.

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.

Message	Detail
"RAMP SIGNALS ON"	Yellow on Black
"PREPARE TO STOP"	Red on Black

Table 4.1 – RC2-A Displays

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.

'Frame ID' Number	Message Description
1	**"RAMP SIGNALS ON"**
2	**"PREPARE TO STOP"**

Table 4.2 – RC2-A fixed message frames summary

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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

- Yellow on Black
- 120mm character height

PREPARE TO STOP

- Red on Black
- 120mm character height

Figure 4.1 – Typical Displays for RC2-A Signs

4.3   RC2-B DISPLAY REQUIREMENTS

This section has been included for possible future use.

4.4   RC2-C DISPLAY REQUIREMENTS

4.4.1   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 an RC2-C Sign or an RC3-A sign is determined by the sign configuration, refer to Clause 1.2.4.

4.4.2   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.

4.4.3   Typical displays shall be as shown in Figure 4.2.

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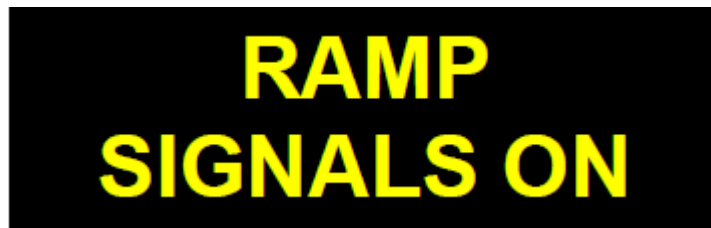
RAMP SIGNALS ON

- Yellow on Black
- 180mm character height

PREPARE TO STOP

- Red on Black
- 180mm character height

Figure 4.2 – Typical Layout for RC2-C Signs

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: The use of RGB displays may be considered where it is demonstrated the display complies with all photometric performance requirements.

5.1.5 There are two sizes of RC3 sign currently used by DTP (Roads), these are:

   a) 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.

   b) 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.

   Note: RC3 B Size – Reserved for possible future use.

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.

Travel Time Information
(Most common function, refer to Specification TCS 070 for details)

Incident Information

Roadwork Information

Freeway Closed
(Used in conjunction with other ramp control signs)
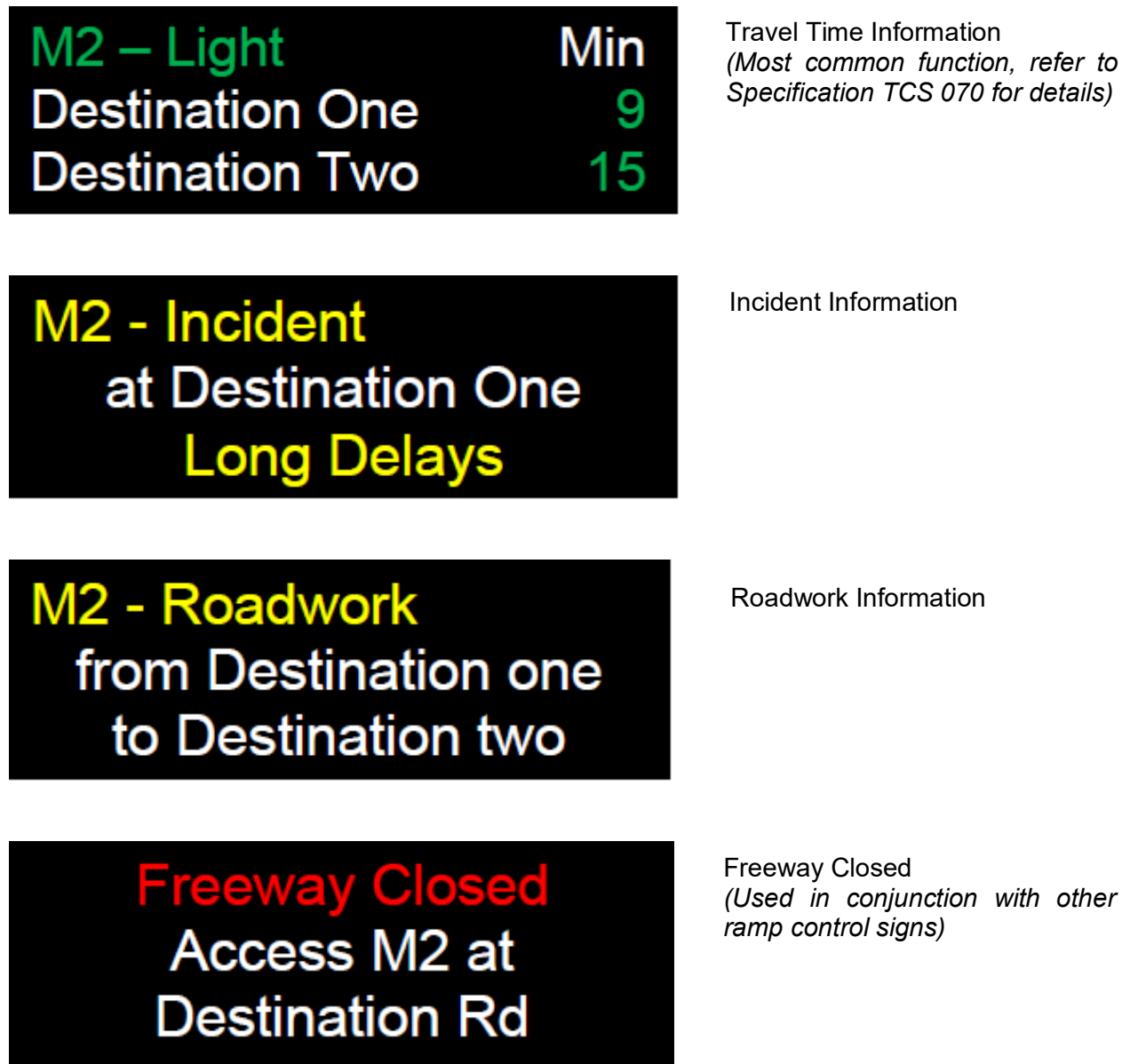
Figure 5.1 – Typical Messages for RC3 Signs

5.3 RC3-B DISPLAY REQUIREMENTS

This section 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.
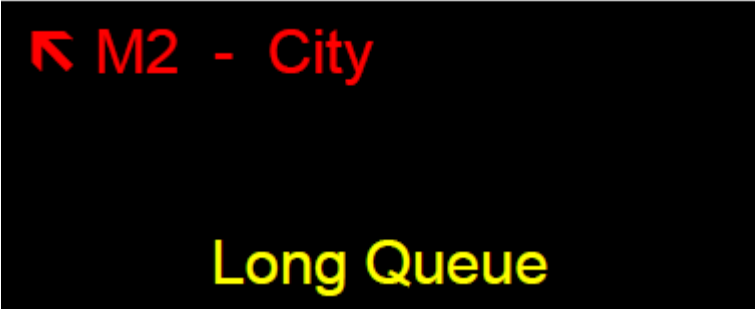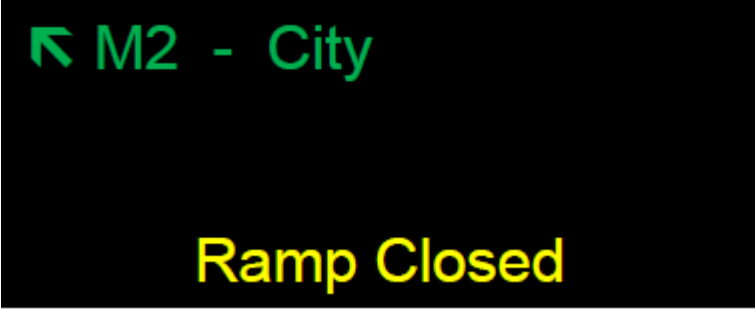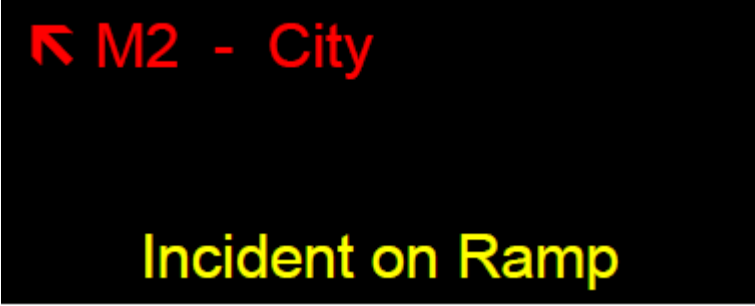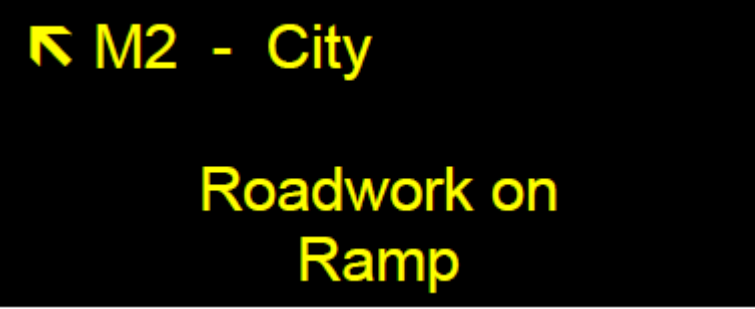
Ramp Signs On

Ramp Queue

Ramp Closure

Ramp Incident

Roadwork Information

Figure 5.2 – Typical Message Layout for RC3-C Signs

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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   Each sign shall be connected independently and directly to the Field Processor.

6.1.4   Figures 6.1, 6.2 and 6.3 show the typical communication connections between RC signs and the Freeway Ramp Signal Roads Side Cabinet.
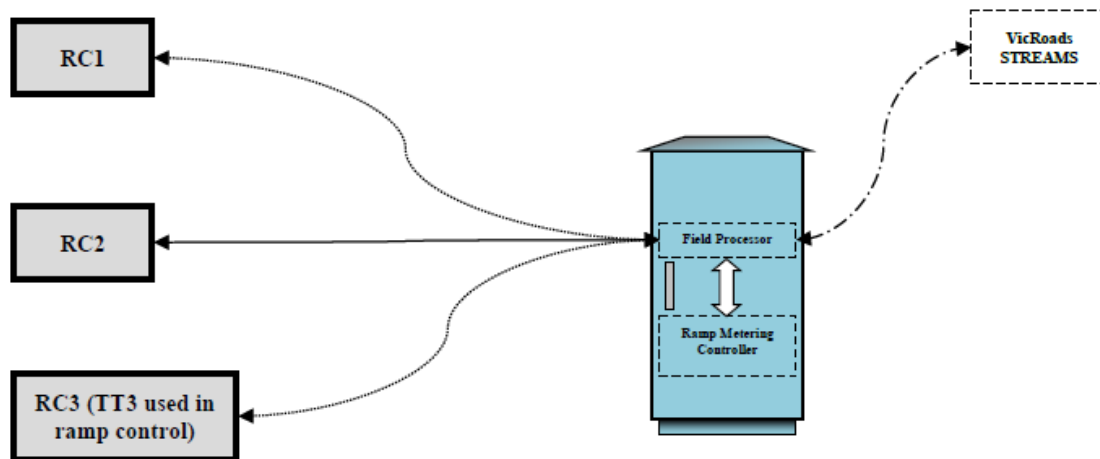
Figure 6.1 – Typical Hard-wired Communications Connections
Option 1 – Sign Controller Resides within Sign Housing
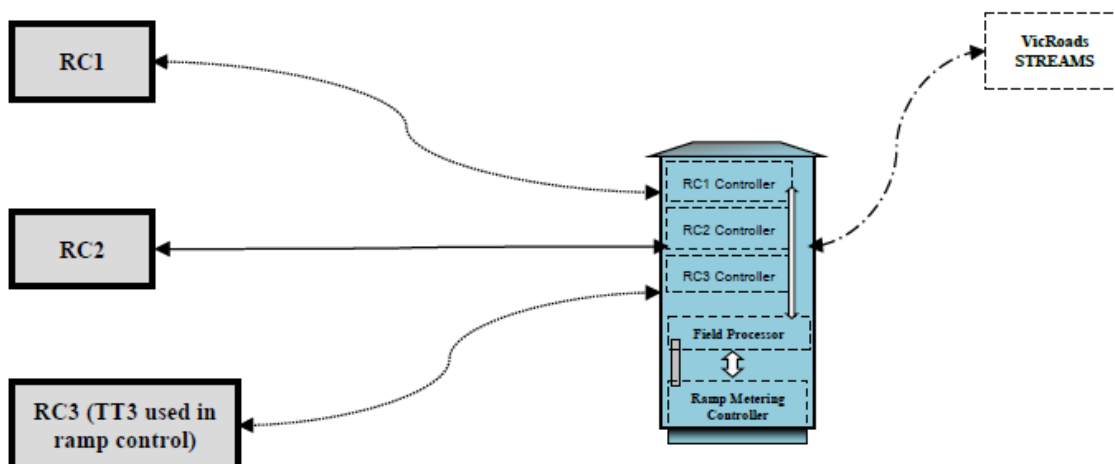
Figure 6.2 – Typical Hard-wired Communications Connections
Option 2 – Sign Controller Resides within Roadside Cabinet
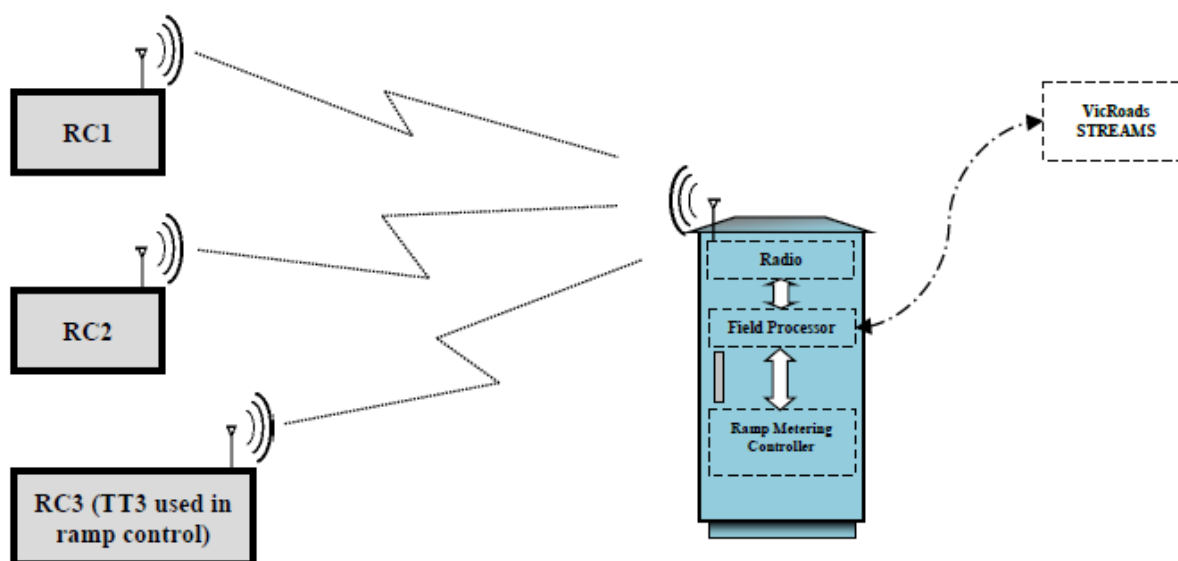
Figure 6.3 – Typical Wireless Communications Connections
Sign Controller Resides within Sign Housing

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 DTP 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 TfNSW 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 the DTP 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 6.2.5 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 TfNSW 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 DTP 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   General

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

6.4.1.2   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.

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

6.4.2   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 Mode** – When this mode is enabled, the master (refer to TfNSW protocol section 2.1) software can connect to sign controller via serial connection and control the sign using TfNSW 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 TfNSW 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 TfNSW Protocol Section 3.6.3.6.

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

        i)   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.

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

6.4.3 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.

6.4.4 TfNSW Protocol Configuration

The software shall allow a user to change the following TfNSW 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 TfNSW protocol connection is disconnected.).
    k)   Sign ID and Group ID (For individual signs).

6.4.5 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).

6.4.6 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.

6.4.7 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'.
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).
e) Use AES 256 encryption protocol for the sensitive data stored.
f) Use TLS 1.2 encryption for the data in transit.
g) Use updated version of all the software components to avoid vulnerabilities.
h) Not use hardcoded passwords in config files, otherwise should be hashed with SHA 256 or encrypted with AES 256.
i) Secure the interfaces and hardware peripherals.
j) Use secure session management preventing concurrent sessions and inappropriate cookie reuse.
k) Use secure proper authentication mechanism with a password complexity of minimum 13 characters.
l) Undergo a penetration testing along with the hardware before rolled out in production.
m) Remediate all the CRITICAL, HIGH and MEDIUM vulnerabilities present in the penetration testing within a timely manner.

6.4.8 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.

6.4.9 Administration

The software shall provide the following administration functions.

6.4.10 Firmware Upgrade

The software shall:

a) 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) Allow a user to upgrade firmware for individual signs that are connected to the sign controller.

c) Ensure that the entire firmware file is successfully downloaded before attempting to apply the firmware upgrade.

6.4.11   Save / Recover Configuration to / from File.

The software shall:

a) Be able to save all of the configuration parameters for the controller and retain the parameters after rebooting the controller.
b) Allow a user to save the current configuration to a local file and be able to restore all the configuration parameters from the file.

6.4.12   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 settings maintained.

6.4.13   Reports / Logs

The software shall:

a) Provide separated log files, one for TfNSW 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.
b) Allow the user to choose start date/time and end date/time to only display or export selected period of logs.

6.4.14   System Event Logs

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. The software should log the following system events as minimum:

a) Controller and sign fault events.
b) TfNSW 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.

6.4.15   TfNSW Message Logs

The software shall log TfNSW protocol messages between the master software DTP 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 command is received or the response sent).

c) The actual message detail in a Hex string.

The software shall support two TfNSW command log options as below and 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 TfNSW protocol message.

Option 2   **Simple Log Mode** *(Default Option)* – DTP Control System sends TfNSW protocol status and fault checking messages listed in Table 6.1 to the sign controller very frequently (every 2 to 10 seconds). This option is to reduce logging regular status and fault checking messages and focus on irregular control messages.

Note: When 'simple log mode' is chosen, the software shall log every TfNSW protocol message except for those listed in Table 6.1.

Message Name	MI Code
Heartbeat Poll	05
Sign Status Reply	06
Sign Extended Status Request	1B
Sign Extended Status Reply	1C
Retrieve Fault Log	18
Fault Log Reply	19

Table 6.1 – Status and Fault Checking Messages

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

a) Once every hour.
b) The next five consecutive messages after any other TfNSW protocol messages not listed in Table 6.1 are sent from the DTP Control System.

6.4.16 Non-Functional Requirements

The following non-functional requirements shall be included:

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.

iv) The current DTP document 'Information Security Standard: Cryptographic Controls' shall be complied with.

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 4G 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) Configuration Changes

All 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 6.2.

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.

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

Table 6.2 – Sign Controller Key Parameters

6.8 TFNSW PROTOCOL FOR SIGN CONTROL

6.8.1 The operation of the sign shall be controlled by means of the TfNSW 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 TfNSW 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 DTP Control System.

6.8.3 To control RC1, RC2-A and RC2-C signs, DTP 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 TfNSW 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 TfNSW protocol message suite as defined by DTP (provided in Appendix C) will be required. The TfnSW specification for this is ITSM-TO-ITS-CSI-002 Colour Sign Interface.

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

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

6.8.6   TfNSW "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 TfNSW protocol format and shall be fully documented for integration with 3rd party systems. The proposed customised messages shall be provided to DTP for review and approval before implementation. The supplier shall supply full details of any such customised TfNSW protocol messages for integration with 3rd party software vendors.

6.8.8   The sign controller shall fully implement all defined TfNSW protocol layers including error checking as described in the TfNSW protocol specification, and with changes as described in Appendix C 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)   HTTP (interface for admin and configuration).
c)   HTTP using TLS (secure interface for admin and configuration).
d)   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 TfNSW 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 TfNSW protocol session is disconnected.

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 shall be 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 DTP field processor) in TfNSW 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 6.3.

Parameter	Function
Physical Interface Std.	**RS422** and **RS485** (autosensing, or software configurable)
Baud Rate	38400bps – 115200bps
Data Bits / Stop Bits	Configurable
Parity	Configurable

Table 6.3 – Serial Port Function

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 TfNSW 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 TfNSW 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 TfNSW protocol, the format shall be fully documented and disclosed to DTP 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 6.4 below.

No.	Failure Types	Applicable Sign Types	Responses	TfNSW Protocol Error Code
1	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 DTP Control System and the SC still exits, send the error to DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Controller Err. Code: 01
2	Where the communication link from DTP (Roads) 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
3	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 DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Controller Err. Code: 05
4	Where internal faults are detected within the SC and/or sign itself (i.e. memory error or over temperature etc).	All	• Create a log in the SC detailing the failure to the sign. • Send the error to DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Error Code from Appendix C of TfNSW
5	Where display driving components and/or individual LEDs are affected to the extent that the resultant displays may be confusing to the public: (typically more than 20% LEDs 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 DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Controller Err. Code: 08

Table 6.4 – Fault Responses

No.	Failure Types	Applicable Sign Types	Responses	TfNSW Protocol Error Code
6	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 DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Controller Err. Code: 08
7	Where display driving components and / or individual LEDs are affected but not to the extent that the resultant displays may be confusing to the public: (typically less than 20% LEDs failed)	All	• Create a log in the SC of the type & extent of the LED failure(s). • Send the error to DTP Control System via TfNSW Protocol using the error code specified in the next column of this table.	Controller Err. Code: 07

Table 6.4 – Fault Responses… continued

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 4852.1 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 TfNSW 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 6.8.

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.
- 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 5.2.1, 5.2.2 and 5.2.3.

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 5.2.4.

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 5.1.9.

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 5.1.1.4 "Pixel element service life".

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

8.2.1   General

The door shall be used to provide access to all internal components of the sign for both installation and maintenance purposes.

8.2.2   RC1-A and RC2-A Signs

8.2.2.1   These signs 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).

8.2.2.2   A suitable door stay shall be provided to secure the door in the open position.

8.2.3   RC1-C, RC3-A and RC2-C Signs

8.2.3.1   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.

8.2.3.2   Gas struts shall be provided to hold the door in the open position.

8.2.4   RC3-C Signs

8.2.4.1   Shall include doors on the rear of the sign housing, hinged on one side and lockable on the opposite side.

8.2.4.2   Suitable door stays shall be provided to secure doors in the open position.

8.3   LOCKS

8.3.1   RC1-A, RC1-C, RC2-A, RC2-C and RC3-A 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 8.3.1.1 above.

8.3.2   RC3-C 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.

8.5.3 No RC signs shall use a visor.

Sign Type	Housing
RC1-A	900mm (w) x 600mm (h) x 115mm (d)
RC2-A	900mm (w) x 600mm (h) x 115mm (d)
RC3-A	1660mm (w) x 600mm (h) x 160mm (d)
RC1-C	1400mm (w) x 800mm (h) x 160mm (d)
RC2-C	1660mm (w) x 600mm (h) x 160mm (d)
RC3-C	4450mm (w) x 2150mm (h) x 350mm (d)

Table 8.1 – Dimensions of Enclosure

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.

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

Table 8.2 – Mounting Arrangement

8.6.2   Alternative methods of mounting may be considered upon submission.

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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   **RC1, RC2 and RC3-A** signs 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   For **RC1, RC2 and RC3-A** signs, the cable and hose shall enter the rear panel of the housing through a suitably sealed "goose neck" arrangement or other approved arrangement.

9.3.3   **RC3-C** signs shall be hard wired from the nominated ITS cabinet or other electrical distribution as specified in individual contracts.

9.3.4   The connecting cables and internal wiring shall:

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

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

9.3.6   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.
    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 sign's 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

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 55°C; and
b) 95% humidity.

The sign shall be tested in accordance with IEC 60068-2-30

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 RC1, RC2 and RC3-A signs shall be subjected to vibration tests as detailed in Table 10.1.

Test	Detail	Parameters
Sinusoidal vibration AS 60068.2.6	Pre-conditioning	None
	Initial examination	Visual inspection, operational test
	Motion type	Transverse
	Frequency range	5 Hz to 55 Hz
	Vibration Amplitude	0.75mm
	Cross-Over Frequency	Approximately 8.2 Hz
	Acceleration Amplitude	$2m/s^2$ – 0.2gn

Table 10.1 – Testing Parameters

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.

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 LEDs operate for the minimum life.
h) The LED manufacturer data sheet for photometric and colorimetric test.
i) Recommended maintenance plan.
j) Recommended list of spare parts for maintenance.

12.2   MANUFACTURER'S WARRANTY

12.2.1   Warranty Conditions

12.2.1.1 Every sign supplied for a DTP 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.

12.2.2.2 Every sign controller supplied for a DTP 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 DTP 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)   Standard Drawings TC-2223, TC-2224, TC-2235 and TC-2236 as applicable.
c)   Contract Standard Section 732.
d)   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-A SIGNS

13.2.1   General

13.2.1.1   RC1-A 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 DTP 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-A sign installations.
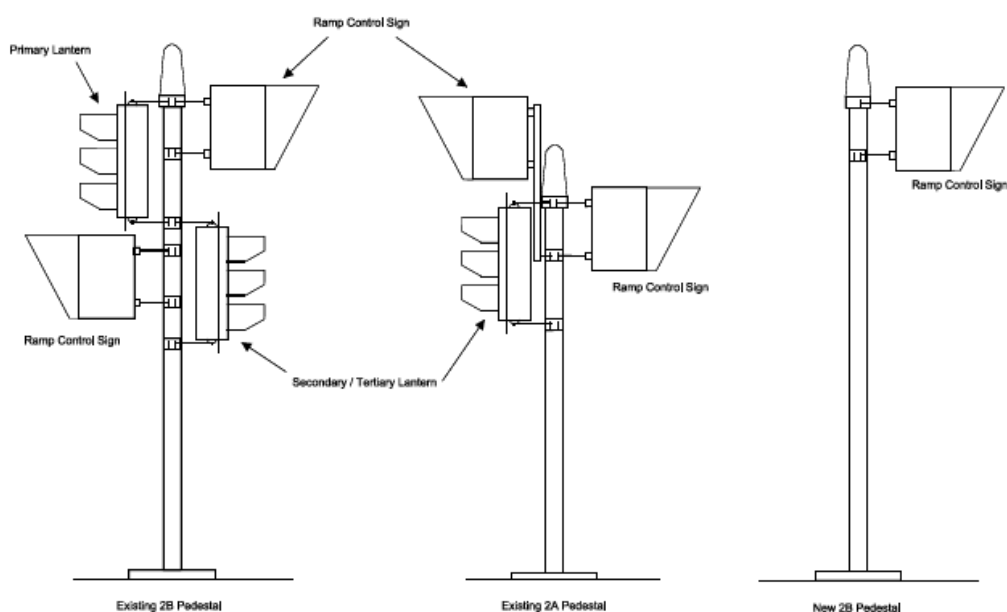
Table 13.1 – Typical RC1-A Installation Arrangements

13.2.2 Electrical Supply

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

Note: RC1-A signs attached to a traffic signal installation post **shall not**, 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-A 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 D1 shall be affixed to the inside of the traffic signal controller.

13.2.2.6 Where an RC1-A 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-A signs.

13.2.2.8 A label complying with Appendix D2 shall be affixed to the inside all RC1-A sign enclosures providing clear details of the source of power and the source of activation.

13.2.3 Communications

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

13.3 RC1-C SIGNS

13.3.1 General

13.3.1.1 RC1-C signs are typically installed on a site where there is an unsignalised, arterial to freeway interchange, type exit from an arterial road onto a freeway or managed motorway.

13.3.1.2 The Sign shall be mounted on a suitably designed, proof engineered, support post or other support as specified in individual contract documents.

13.3.1.3 The foundation shall be designed for the post and proof engineered, in accordance with the requirements of individual contract documents.

13.3.1.4 The concrete used in the foundation, and the curing time for the concrete, shall be in accordance with the relevant requirements of Standard Section 730.

13.3.1.5 The Sign shall be mounted such that the lowest portion of the sign is not lower than 2.4m above ground level.

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

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

13.3.1.8 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 50m to 150.

13.3.1.9 Sign positions shall be nominated in individual contract documents.

13.3.2 Electrical Supply

13.3.2.1 The point of supply for RC1-C Signs shall be specified in individual contract documents and shall be one of the following.

a) The associated ITS Field Cabinet in which the controlling STREAMS Field Processor is located.

b) A separate and independent point of supply.

13.3.2.2 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.

13.3.2.3 The signs electrical connection cables shall be connected to the incoming power supply cable in the junction box described in 13.3.2.2 above.

13.3.2.4 The electrical connection detailed in 13.3.2.2 and 13.3.2.3 above must be electrically and physically segregated from the communications connection detailed in Clause 13.3.3 below.

Note: The mains supply connection shall not be housed within the same junction box as the communications connection.

13.3.2.5 A circuit breaker of an appropriate size shall be installed within all RC1-C signs.

13.2.2.6 A label complying with Appendix D3 shall be affixed to the inside all RC1-C sign enclosures providing clear details of the source of power and the source of activation.

13.3.3 Communications

13.3.3.1 RC1-C signs shall be controlled via a hardwired communications link (i.e. an ethernet connection) from the associated STREAMS Field Processor.

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

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

13.3.3.4 Where a communications conduit cannot be installed, and if approved by the Superintendent, the communications cable may be installed within the electrical conduit.

13.3.3.5 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).

13.3.3.6 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.

13.3.3.7 The signs communications cable shall be connected to the incoming communications cable in the junction described in 13.3.3.6 above.

13.3.3.8 The communications connection detailed in 13.3.3.6 and 13.3.3.7 above must be electrically and physically segregated from the mains supply connection.

Note: The communications connection shall not be housed within the same enclosure as the mains supply connection detailed in 13.4.2 above.

13.4   RC2-A SIGNS

13.4.1   General

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

13.4.1.2   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.

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

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

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

13.4.1.6   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.

13.4.1.7   Sign positions shall be nominated in individual contract documents.

13.4.2   Electrical Supply

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

13.4.2.2   A label complying with Appendix D2 shall be affixed to the inside all RC2 sign enclosures providing clear details of the source of power and the source of activation.

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 Standalone Post

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

13.5.2.2   Where a spread footing is required, it shall be in accordance with either Standard Drawing TC-2235 or TC-2236. Where neither of these footing designs are suitable, the contactor may provide an alternative design for approval by the Contract Superintendent.

13.5.2.3   Signs attached to stand alone posts shall be attached as detailed in Standard Drawing TC-2224.

13.5.2.4   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.

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

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

13.5.2.7   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.

13.5.2.8   Sign positions shall be nominated in individual contract documents.

13.5.2.9   A label complying with Appendix D3 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 D3 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:

    a)   The associated ITS Field Cabinet in which the controlling STREAMS Field Processor is located.
    b)   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: The mains supply connection shall not 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: The communications connection shall not be housed within the same enclosure as the mains supply connection detailed in 13.5.4 above.

13.6   RC3-A SIGNS

13.6.1   General

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

a)   Post and foundation as detailed in Standard Drawing TC-2223.
b)   Existing MA, JUMA, or JUP.

13.6.1.2   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.

13.6.1.3   RC3-A signs attached to stand alone posts shall be attached as detailed in Standard Drawing TC-2234.

13.6.1.4   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.

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

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

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

13.6.1.8   Sign positions shall be nominated in individual contract documents.

13.6.1.9   A label complying with Appendix D2 or D3 (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.

13.6.2   Electrical Supply

13.6.2.1   RC3-A Signs attached to a standalone 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.

13.6.2.2   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.

13.6.2.3   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.

13.6.2.4   The electrical connection detailed in 13.6.2.2 and 13.6.2.3 above must be electrically and physically segregated from the communications connection detailed in Clause 13.4.3 below.

Note: The mains supply connection shall not be housed within the same junction box as the communications connection.

13.6.2.5   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** be powered from a separate point of supply other than the traffic signal controller.

13.6.2.6   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.

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

13.6.2.8   The above circuit breaker shall be clearly labelled.

13.6.2.9   A label complying with Appendix D1 shall be affixed to the inside of the traffic signal controller.

13.6.3   Communications

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

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

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

13.6.3.4   Where a communications conduit cannot be installed, and if approved by the Superintendent, the communications cable may be installed within the electrical conduit.

13.6.3.5   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).

13.6.3.6   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.

13.6.3.7   The signs communications cable shall be connected to the incoming communications cable in the junction described in 13.6.3.6 above.

13.6.3.8   The communications connection detailed in 13.6.3.6 and 13.6.3.7 above must be electrically and physically segregated from the mains supply connection.

Note: The communications connection shall not be housed within the same enclosure as the mains supply connection detailed in 13.6.2 *above.*

13.7   RC3-C SIGNS

13.7.1   General

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

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

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

13.7.1.4   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).

13.7.1.5   Sign locations shall be nominated in individual contract documents.

13.7.2   Electrical Supply

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

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

13.7.2.3   The power cabling shall be suitably electrically isolated from the communications cabling.

13.7.3   Communications

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

13.7.3.2   Communications cabling shall be suitably electrically isolated from the electrical supply cabling.

APPENDIX A – REQUIREMENTS FOR TYPE APPROVAL

(Normative)

A1 GENERAL

A1.1 This Appendix details the requirements for the granting DTP Type Approval for a submitted product.

A1.2 To enable assessment for the purposes of granting Type Approval, the manufacturer/supplier is to submit a formal, written request for Type Approval to DTP, for each unique product supplied.

A1.3 The manufacturer/supplier shall submit the following for each unique product, with the formal request:

a) A report detailing compliance with the relevant clauses of this specification.
b) Documentation / evidence to demonstrate that the submitted product conforms to the relevant requirements of this DTP 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 relevant paragraph of the specification, as appropriate.
c) An outline drawing showing the general presentation and overall dimensions of the submitted product.
d) Any specific submissions detailed in the relevant Section of this Appendix.
e) A complete working sample of the product for inspection purposes as detailed in Appendix A2.
f) Documentation to demonstrate that the submitted product has been manufactured and supplied under an approved quality assurance system.

A2 PRODUCT SAMPLES

A2.2 The supplier shall submit a sample of the product to DTP when applying for Type Approval (for Ramp control signs this shall be to allow access to view the sign at the manufacturer's premises).

A2.2 A sample of the product shall be designed and manufactured in accordance with this specification and shall be representative of the products supplied to DTP.

A2.3 A sample of the product shall be inspected by DTP to ensure compliance with this specification and with the drawings (submitted in accordance with the relevant section of this specification) of the product.

A2.4 The supplier shall submit to DTP evidence of any previous sample testing or equivalent satisfactory checks for the product design. If evidence to support satisfactory performance of previous sample testing or equivalent satisfactory performance is neither available, nor acceptable to DTP, a sample of the product shall be subject to compliance testing as detailed in the relevant section of this Appendix.

A3   REVIEW PROCESS

A3.1   General

A3.1.1   The information submitted by the supplier will be reviewed by DTP to determine whether the product will be Type Approved.

A3.1.2   The decision to grant a Certificate of Type Approval is at the sole discretion of DTP.

A3.1.3   DTP may require additional information or testing to be carried out as part of its evaluation of the product.

A3.1.4   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 for DTP works.

A3.1.5   The manufacturer shall advise DTP in writing of any changes in relation to the Type Approved product, DTP reserves the right to review and approve / reject the design changes at DTP's discretion.

A3.2   Ramp Control / Ramp Metering Sign Assessment Procedure

A3.2.1   The assessment procedure for Ramp Control / Ramp Metering 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 DTP system.

A3.2.2   Where some of these procedures have been completed prior to formal submission, the results will be considered in the evaluation, provided there is no relevant change in the design. The supplier is to state whether tests carried out prior to formal submission were carried out on an identical sample.

A3.3   Field Trial

Once DTP is satisfied the sign has been demonstrated to meet all requirements of this specification, a field trial will be arranged. The field trial will occur for a minimum period of 3 to 6 months. If there are issues / faults experienced during the field trial, this period may be extended at DTP discretion.

A4   RAMP CONTROL / RAMP METERING TESTING REQUIREMENTS

A4.1   NATA Accredited Testing

Notwithstanding A1 above, the supplier shall submit test results from a NATA accredited testing organisation to demonstrate compliance with the following.

Clause	Requirements	Evidence
7.1	Photometric	Test Report
7.2	Colorimetric	Test Report
9.6	EMC Compliance	Test Report
10.1	Temperature and Humidity	Test Report
10.2	Enclosure Protection	Test Report
10.3	Vibration *(RC1 / RC2 and RC3-A only)*	Test Report

TABLE D1 – Testing Requirements

A4.2   Compatibility with TfNSW Protocol

The supplier shall provide evidence of compatibility with TfNSW protocols TS 03644 (TSI-SP-003).

A4.3   STREAMS Compatibility

The supplier shall provide evidence of compatibility with STREAMS.

APPENDIX B – DTP ITS PLATFORM

(Informative)

B1   GENERAL

B1.1   DTP ITS platform currently uses the STREAMS system.

B1.2   STREAMS is owned and maintained by Transmax, a Queensland based company which is part of Queensland Main Roads.

B1.3   STREAMS is an integrated control system which is being used by DTP to operate it's ITS Freeway Management Devices on Melbourne's freeway network.

B1.4   All ITS field devices must be compatible with STREAMS.

B1.5   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)

B1.6   The above devices are typically connected to STREAMS via a Field Processor (FP).

B2   FIELD PROCESSOR

B2.1   The FP is used to interface internet protocol (IP) and serially connected field devices to STREAMS.

B2.2   Communications between the FP and the ITS Field Device is typically TfNSW protocol.

B2.3   The FP is typically installed within an ITS Field Cabinet.

B2.4   The ITS Field Cabinet is typically located adjacent to the freeway.

B2.5   In some situations, the FP may be virtual and located at a remote DTP site.

APPENDIX C – DTP EXTENSION TO TFNSW PROTOCOL FOR VMS

(Normative)

C1 INTRODUCTION

C1.1 This Appendix defines requirements for sign controllers to implement TfNSW protocol TS 03644 (TSI-SP- 003 v2.1) as the communication protocol between Variable Message Signs and the DTP ITS Central Control System.

Note: The protocol used by DTP is based on v2.1(26 June 2008) of TSI-SP-003 instead of the newer version 5.0.

C1.2 The definitions for handling colour is based on an TfNSW protocol document (ITSM-TO-ITS-CSI-002) that describes the extensions to the base TfNSW protocol

C2 GENERAL IMPLEMENTATION REQUIREMENTS

C2.1 Sign controllers shall utilise TfNSW 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.

C2.2 The sign controller shall fully implement all defined protocol layers as described in the TfNSW 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 TfNSW 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 DTP Central Control System will run as TCP/IP Socket client.
- For security reasons, the sign controller shall support TfNSW protocol messages being transmitted with no encryption or encrypted with TLS.
- The current DTP '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.

C2.3 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 4F 57 4E C8 B7 BE 44 <ETX>

- C8 B7 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 43 34 46 35 37 32 30 34 34 34 46 35 37 34 45 43 38 42 37", total 44 bytes. (<SOH> & <STX> are control characters, not required to be ASCII-HEX encoded).

Further to section 3.5 of that protocol specification, here is another message exchange example in Table C1:

No.	System to Sign Controller	Sign Controller to System	Notes
1	START SESSION	ACK Password seed	Request to start session from central system to sign
2	PASSWORD (N(S)=0, N(R)=0)	ACK (N(R)=0) Acknowledge (N(S)=0, N(R)=0)	Password accepted, link established, sign is online
3	Heartbeat Poll (N(S)-0, N(R)=0)	ACK(N(R)=1) Status reply (N(S)=0, N(R)=1)	
4	Extended Status Request (N(S)=1, N(R)=1)	ACK(N(R)=2) Extended Status Reply (N(S)=1, N(R)=2)	
5	Heartbeat Poll (N(S)=2, N(R)=3)	NAK (N(R)=2)	Incorrect N(R) sent by system to sign results in a NAK
6	Heartbeat Poll (N(S)=2, N(R)=2)	ACK(N(R)=3) Status reply (N(S)=2, N(R)=3)	Corrected
7	Heartbeat Poll (N(S)=4, N(R)=3)	NAK (N(R)=3)	Incorrect N(S) sent by system results in a NAK
8	Heartbeat Poll (N(S)=3, N(R)=3)	ACK(N(R)=4) Status reply (N(S)=3, N(R)=4)	
9	End session (N(S)=4, N(R)=4)	ACK(N(R)=5) Acknowledge (N(S)=4, N(R)=5)	Sign is offline

TABLE C1 – Message Exchange Example

C2.4   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 DTP (Roads) Central Control System not to update this field value when sending those messages to the sign controller (i.e, the DTP Central Control System can use '0' as the 'Revision' field value).

C2.5   DTP VMSs 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.

C2.6   When the current session ends, the sign(s) should be blank.

C3   SPECIFIC IMPLEMENTATION REQUIREMENTS FOR COLOUR DISPLAYS

C3.1   This section describes the DTP implementation of the protocol used to interface with variable message signs that can display multi-colour messages.

C3.2   The protocol is based on the TfNSW protocol document ITSM-TO-ITS-CSI-002 that describes the extensions to the original protocol document for signs (TfNSW TSI-SP-003).

C3.3   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

C4   MESSAGE SEQUENCE AND PROCESS

As defined in the TfNSW protocol document, the sign will accept a new message, Sign Set Colour Frame, opcode 0x1D ("Colour" spelling is as per TfNSW) 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.

C5 COLOUR AND MONOCHROME FRAMES

C5.1 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.

C5.2 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 D – LABELS

(Normative)

D1   TRAFFIC SIGNAL CONTROLLER SUPPLYING RC1-A AND RC3-A SIGNS

A Traffic Signal Controller providing power to an RC1-A sign shall have a label affixed internally in a prominent position in accordance with the example shown in Figure D1. The size of the label and the font size shall enable the label to be clearly read.

<div style="border:1px solid black; padding:10px;">

WARNING
RAMP CONTROL / RAMP METERING SIGN

This Controller supplies 240Vac power to Ramp Control / Ramp Metering Signs. Control of these signs is from the associated Ramp Metering controller.

Activation from Ramp Metering   Site No. …………...
Controller

</div>

FIGURE D1 – Example Traffic Signal Controller Label

D2   RC1-A AND RC3-A RAMP CONTROL / METERING SIGNS

Each Sign shall include a label affixed inside the sign in accordance with the example shown in Figure D2. The size of the label and the font size shall enable the label to be clearly read.

<div style="border:1px solid black; padding:10px;">

WARNING
RAMP CONTROL / RAMP METERING SIGN

This sign is supplied with 240Vac power from the local traffic signal controller. Sign control is from the associated Ramp metering controller.

Power from Traffic Signal Site   Site No. ……………

Activation from Ramp Metering   Site No. …………...
Controller

</div>

FIGURE D2 – Example RC1-A / RC3-A Sign Label

D3   RC1-C RAMP CONTROL SIGN

Each RC1-C sign shall have a label affixed to the inside of the sign in accordance with the example shown in Figure D3. The size of the label and the font shall enable the label to be clearly read.

**WARNING
RAMP CONTROL SIGN**

Point of Supply ……………………………………………………….

Activation from Ramp Control
Controller   Site No. …………...

FIGURE D3 – Example RC1-C Sign Label

D4   RC2-C AND RC3-A SIGN POWERED FROM SEPARATE POINTS OF SUPPLY

Each RC3-A Sign shall have a label affixed inside the Signs in accordance with the example shown in Figure D4. The size of the label and the font size shall enable the label to be clearly read.

**WARNING
RAMP CONTROL / RAMP METERING SIGN**

Point of Supply …………………….…………………………………

Activation from Ramp Metering
Controller   Site No. …………...

Figure D4 – Example RC2-C and RC3-A Sign Label

APPENDIX E – GUIDELINES FOR PURCHASING AND INSTALLATION

(Informative)

E1   GENERAL

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

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