

TCS 070 - 2019

Specification for

Travel Time Signs

March 2019
Revision: A

TCS 070 - 2019**Foreword**

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

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

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**Intelligent Transport Systems
60 Denmark Street Kew 3101**

Phone: (03) 9854 2103

PREFACE

A. THIS SPECIFICATION

This is a new specification developed to cover the various versions of travel time information signs used by VicRoads. It incorporates existing travel time signs and new sign designs and defines their use.

B. CHANGES TO THIS SPECIFICATION

Changes to this specification include:

- Minor changes
- Inclusion of installation section

Revision History

Version	Revision	Date	Author	Description
2017	A	Dec 2017	SJS	First Release
2019	A	April 2019	ITS	Minor changes and inclusion of installation section.

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SECTION 1 - SCOPE AND GENERAL

1.1 SCOPE

- 1.1.1 This specification covers the requirements for the design, supply and operation of Travel Time (TT) signs for use on selected roads in the State of Victoria.
- 1.1.2 There are six types of Travel Time sign covered by this specification. They are briefly described in Clause 1.3 below.

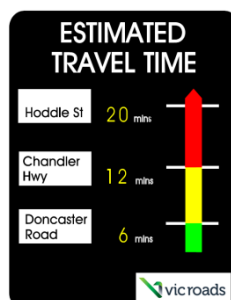
1.2 GENERAL

- 1.2.1 All signs shall comply with the relevant requirements of:
- Section 9 – Operational Control Requirements
 - Section 10 – Mechanical Requirements
 - Section 11 – Optical Requirements
 - Section 12 - Electrical Requirements
 - Section 13 – Environmental Requirements
 - Section 14 – Markings and Documentation.
- 1.2.2 In addition to 1.2.1 above, each sign type shall comply with the sign specific requirements as detailed in this specification.
- 1.2.3 All signs shall be compatible with VicRoads ITS Platform as detailed in Appendix C of this specification.
- 1.2.4 All signs shall be submitted for VicRoads Type Approval as detailed in Appendix D of this specification.

1.3 TRAVEL TIME SIGN TYPES

1.3.1 Travel Time Sign – Type 1 (TT1)

The Travel Time Type 1 (TT1) sign, also known as a ‘Trip Information’ sign is used to display travel times and conditions to specific exits along a freeway.



1.3.2 Travel Time Sign – Type 2 (TT2)

- 1.3.2.1 The Travel Time Type 2 (TT2) sign also known as a ‘Trip Condition’ sign is typically used to display travel times and conditions to specific exits along an interconnecting freeway.



1.3.3 Travel Time Sign – Type 3 (TT3)

- 1.3.3.1 The Travel Time Type 3 (TT3) sign is also known as a Ramp Control Sign Type 3, A size (RC3-A).
- 1.3.3.2 The TT3 sign is a full matrix, text and/or graphics capable sign used to provide travel times and conditions to specified exits along a freeway.
- 1.3.3.3 This sign is typically placed in a strategic location on a major arterial road at a freeway on-ramp to indicate estimated travel times and traffic conditions to specific locations along a freeway.

M2	Light	Min
Destination One		9
Destination Two		15

- 1.3.3.4 The TT3 sign also has the functionality to operate as a Ramp Control sign (RC3A). For details of the ramp control operation refer to VicRoads specification TCS 003.

1.3.4 Travel Time Sign – Type 4 (TT4)

- 1.3.4.1 The Travel Time Type 4 (TT4) sign is a full matrix, text and/or graphics capable sign. It is an expanded version of the TT3, providing an additional line of text.

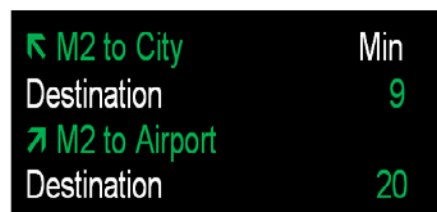


- 1.3.4.2 This sign is typically placed in a strategic location on a major arterial road to indicate estimated travel times to specific locations along the route.

1.3.5 Travel Time Sign – Type 5 (TT5)

- 1.3.5.1 The Travel Time Type 5 (TT5) sign is also known as an RC3-C sign (see TCS 003).
- 1.3.5.2 The sign is a large full matrix, text and/or graphics capable sign.
- 1.3.5.3 This sign is typically placed on a freeway prior to an access ramp to an intersecting freeway to indicate freeway travel times for the interconnecting freeway or other information.

Note: At the time of this specification the display of travel times on this sign has not been approved.



- 1.3.5.4 The TT5 (RC3-C) sign is typically used to advise motorists that the ramp signals on the freeway to freeway interchange ramp are operating.

1.3.6 Travel Time Sign – Type 6 (TT6)

- 1.3.6.1 The Travel Time Type 6 (TT6) sign is a variation of a static destination sign. For each destination displayed, the typical kilometre distance is replaced with a small LED matrix insert to display the estimated time to that destination.
- 1.3.6.2 The LED matrix insert is used to provide both travel times and conditions dynamically to the specified destinations.



1.4 INTELLECTUAL PROPERTY

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

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

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

1.5 ACRONYMS

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

ACMA	Australian Communications and Media Authority
AS	Australian Standard
BTN	Bridge Technical Note
CCTV	Closed Circuit Television
CLI	Command Line Interface
CSV	Comma Separated Values
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
EMC	Electromagnetic Compatibility
FP	Field Processor as used with STREAMS
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
LED	Light Emitting Diode
PE Cell	Photo Electric Cell
RCD	Residual Current Device
RMS	Roads and Maritime Services of NSW
SSH	Secure Shell
SSL	Secure Sockets Layer
STREAMS	STREAMS is an integrated control system which operates ITS Freeway Management Devices and other traffic management devices.
TCP/IP	Transmission Control Protocol/Internet Protocol
TLS	Transport Layer Security

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/NZ 3000	Wiring Rules
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/NZS 61000.6.1	Part 6.1: Generic Standards – Immunity for residential, commercial and light-industrial environments
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 5100	Bridge Design

2.2 VICROADS SPECIFICATIONS

- 2.2.1 The fabrication and supply of all components shall conform to the relevant VicRoads specifications, and related specifications and standards, as indicated throughout this document.
- 2.2.2 The following VicRoads Specifications are referenced:

Standard Contract Section 730	Traffic Signal installation
Contract Standard Section 732	ITS Devices Installation
Contract Standard Section 733	Conduits and pits for underground wiring and cabling
Contract Standard Section 734	Electrical system
Contract Standard Section 735	Communications system and equipment

Contract Standard Section 736	ITS device testing and integration.
TCS 003	Ramp Control/Metering Signs
TCS 005	Trip Information Signs
TCS 026	The Supply of Trip Condition Signs
TCG 016	Product Compliance Process for ITS and Electrical Products
BTN 2010 / 001	Design of Steel Cantilever and Portal Sign Structures and High-Mast Light Poles

2.3 VICROADS STANDARD DRAWINGS

The following VicRoads Specifications are referenced:

TC-2223	RC3 / TT3 Pole - typical arrangement
TC-2234	RC3 / TT3 Pole mounting arrangement - 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 specifications are referenced:

RMS Specification ITSM-TO-ITS-CSI-002	Colour Sign Interface <i>Only available from RMS</i>
RMS Specification TSI-SP-003v2.1	Communications protocol for roadside devices <i>Only available from RMS</i>
STREAMS	VicRoads ITS platform.

SECTION 3 - TRAVEL TIME SIGN TYPE 1

3.1 GENERAL

- 3.1.1 The TT1 sign is a fully internally illuminated sign typically used on freeways to display travel times and traffic conditions to specified interchanges along the freeway.
- 3.1.2 TT1 signs shall comply with the requirements of VicRoads specification TCS-005.
- 3.1.3 The signs are mounted behind the left shoulder of the freeway such that they are clearly visible from each lane of the carriageway of the approach to which each sign applies.
- 3.1.4 The signs shall be designed to provide legible, changeable, numeric information relating to travel time to nominated exits and colour coded indicators of congestion levels for sections between such nodes on the freeway.
- 3.1.5 An example layout for a TT1 sign is shown in Figure 3.1.

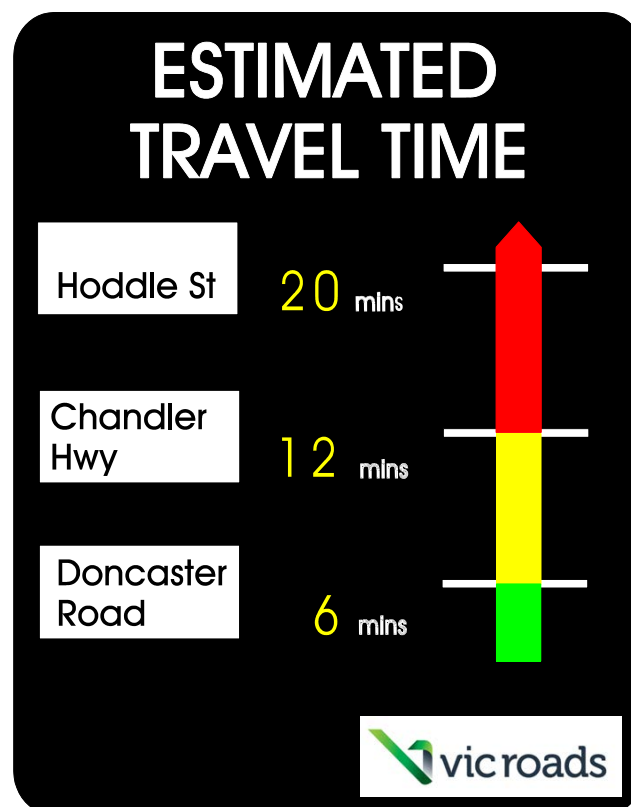


Figure3.1 – TT1 Example Layout

3.2 SIGN SPECIFIC REQUIREMENTS

3.2.1 General

In addition to the general requirements as specified in TCS-005 and this document, TT1 signs shall meet the sign specific requirements of Section 3 of this specification.

3.2.2 Operation and Control

3.2.2.1 Signs shall operate according to the TIS protocol defined in Appendix B.

3.2.2.2 The sign shall have the facility to locally switch the static display lighting, all numeric travel time displays and the colour coded strip map sections through any of the required settings for test and maintenance purposes from ground level at the sign.

3.2.3 Display General

3.2.3.1 The static “header” information on the display face shall be provided as white capital lettering (on black background) complying with the requirements of AS 1742, AS 1743 and AS 1744.

3.2.3.2 The static “destination” information on the display face shall be provided as black lettering (on a white background) complying with the requirements of AS 1742, AS 1743 and AS 1744.

3.2.3.3 The destination legend and any abbreviations used, shall be specified in individual tender documents and shall be approved by the contract superintendent.

3.2.3.4 The static display area shall be internally illuminated using uniform dimmable lighting, free from internal shadows for all static sections of the display. The lighting shall be activated by a command generated from the control system.

3.2.4 Numeric Displays

3.2.4.1 The Travel Time displays shall be generated using LED’s (or other approved method) in a two-digit numeric format which appears yellow in colour in the active state and matt black in the inactive state.

3.2.4.2 When displaying numerals ‘1’ through ‘9’, no leading ‘0’ shall be displayed.

3.2.4.3 Each numeral shall have a nominal height of 450mm.

3.2.4.4 Within a two-digit array, each digit shall be separated by a spacing not less than twice the stroke width of the provided character.

3.2.5 Congestion Indicator

3.2.5.1 The Congestion Indication (strip map) section of the sign shall be generated by a suitably configured pixel array capable of generating five (5) over-laid displays as follows:

- a) green to indicate light traffic conditions;
- b) yellow to indicate medium traffic conditions;

- c) red to indicate heavy traffic conditions;
- d) flashing red to indicate a "closed" section of the freeway; and
- e) blank (black) to indicate that the sign is "off" or that no information is currently available.

3.2.5.2 The congestion indicator shall be generated to provide not less than two independent segments within each nominated section of the freeway (i.e. between each nominated node).

3.2.5.3 Each section of congestion indicator between adjacent nominated nodes shall be approximately 1000 mm in length.

3.2.5.4 The width of the strip map shall be 200 mm, $\pm$ 20 mm.

3.2.5.5 An additional section of congestion indicator, not less than 250 mm in length, and shaped to form an upward facing arrow shall be provided at the top of the indicator above the final nominated destination. This section of the congestion indicator shall operate in conjunction with the upper most nominated section.

3.2.5.6 A similar length section shall be provided at the bottom of the strip map and operate in conjunction with the lower most nominated section.

3.2.5.7 The design of the strip map shall ensure that the generated displays:

- a) are clearly visible during both night and day time operation in the approach range 500m to 30m prior to the sign from any lane of a standard four lane freeway; and
- b) appear as distinct, even colour bars applicable to the adjacent section on the sign detailing nominated destinations.

3.2.6 Chromaticity

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

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

3.2.6.3 The chromaticity coordinates of the LED's shall be as specified in Section 11.4.

3.2.6.4 The use of an RGB (Red, Green, Blue) display is **not permitted**.

3.2.7 Enclosure

3.2.7.1 Unless otherwise specified in individual tender documents, doors shall be located on the rear of the sign housing, as specified in AS 4852.1 clause 2.1.2.

3.2.7.2 Door stays shall be provided to secure the doors in the open position as described in AS4852.1 clause 2.1.2 (c).

3.2.7.3 All doors shall be individually lockable and secured in the closed position by way of a multipoint securing system actuated via a single keyed lock, approved by the sign purchaser.

3.3 MOUNTING

- 3.3.1 The signs are to be centrally mounted on suitably designed columns (2 off) and associated footings. A mower strip not less than 0.5 m larger than the base projection of the sign cabinet shall be installed (at ground level) around the base of the columns.
- 3.3.2 The sign support structure and associated footing shall comply with:
- a) AS 4852.1, Section 2.1.3;
 - b) Bridge Technical Note BTN 2010 /001 – November 2010 Design of Steel Cantilever and Portal Sign Structures and High-Mast Light Poles;
 - c) AS 5100 Bridge Design.
- 3.3.3 In case of discrepancy, the Bridge Technical Note BTN 2010/001 – November 2010 will take precedence over AS 4852.1.
- 3.3.4 Design of the structure shall be proof engineered by an independent engineering consultant and the details provided to the Department.
- 3.3.5 The mounting method shall ensure that the rear section of the housing and the face of the display modules are vertical.
- 3.3.6 The sign shall be suitably aligned to point to the centre of the proposed carriageway at a distance of 250 metres from the face of the sign.
- 3.3.7 Suitably designed struts or braces within the housing shall be used to ensure stability of the installed sign.
- 3.3.8 Detailed plans of the footings, columns and associated fixtures shall be provided to the Department for review (for a period of seven (7) days) prior to manufacture of same.
- 3.3.9 Access for all power supply, control and communication cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.
- 3.3.10 Except where otherwise approved, ground clearance shall be in accordance with the requirements of AS1742.2.
- 3.3.11 Alternative methods of mounting may be considered upon submission.

3.4 ELECTRICAL

- 3.4.1 The electrical system shall incorporate the following facilities:
- a) The ability to be isolated from mains supply at ground level using a suitable switch/breaker system.
 - b) A circuit-breaker board comprising appropriately rated mains isolation switch and circuit breaker;
- 3.4.2 It is expected that a typical installation will utilise a small enclosure mounted on one of the sign support posts, or an ITS Field Cabinet, to provide all power and communications connections.

SECTION 4 - TRAVEL TIME SIGN TYPE 2

4.1 GENERAL

- 4.1.1 The sign shall generally be mounted behind the left shoulder of the road such that it is clearly visible from each lane of the carriageway of the approach to which the sign applies.
- 4.1.2 The sign shall provide legible, changeable, numeric information relating to travel time to nominated destinations together with changeable real time information regarding current traffic conditions on the route.
- 4.1.3 When activated, the changeable message may display the level of current traffic congestion in the relevant section of the route using either:
- 'LIGHT';
 - 'MEDIUM';
 - 'HEAVY' or
 - 'CLOSED'
- 4.1.4 An example layout for a TT2 sign is shown in Figure 4.1.



Figure 4.1 – TT2 Example Layout

4.2 SIGN SPECIFIC REQUIREMENTS

4.2.1 General

In addition to the general requirements as specified in TCS-026 and this document, TT2 signs shall meet the sign specific requirements of Section 4 of this specification.

4.2.2 Operation and Control

4.2.2.1 The sign shall have the facility to locally switch the static display lighting, all numeric travel time displays and the colour messages through any of the required settings for test and maintenance purposes from ground level at the sign.

4.2.2.2 Signs shall operate according to the TIS protocol defined in Appendix B.

4.2.3 Display General

4.2.3.1 The static “header” information on the display face shall be provided as white capital lettering (on black background) complying with the requirements of AS 1742, AS 1743 and AS 1744 and shall be to layouts approved by the department.

4.2.3.2 The static “destination” information on the display face shall be provided as black lettering (on a white background) complying with the requirements of AS 1742, AS 1743 and AS 1744 and shall be to layouts approved by the department.

4.2.3.3 The static display area shall be internally illuminated using uniform dimmable lighting, free from internal shadows for all static sections of the display. The lighting shall be activated by a command generated from the control system.

4.2.3.4 The Contractor shall supply and affix a VicRoads logo to be located at the bottom right hand side of the display face. It shall be a retro reflective (diamond grade) sticker, in VicRoads standard format and colours and be approximately 500mm in length.

4.2.4 Numeric Displays

4.2.4.1 The Travel Time displays shall be generated using LED’s (or other approved method) in a two-digit numeric format which appears yellow in colour in the active state and matt black in the inactive state.

4.2.4.2 When displaying numerals ‘1’ through ‘9’, no leading ‘0’ shall be displayed.

4.2.4.3 Each numeral shall have a nominal height of 300mm with a character width to height ratio not less than 0.7:1.

4.2.4.4 The numeral stroke width shall be 40mm.

4.2.4.5 Each numeral within a two-digit array shall be separated by a spacing not less than twice the stroke width of the provided character.

4.2.5 Congestion Indicators

4.2.5.1 The Colour Coded Traffic Condition Indicator shall be generated using LED technology fabricated in a matrix format which appears green, yellow or red in colour in the active state and matt black in the inactive state.

4.2.5.2 The required displays for use in the Sign are:

Text Display	Colour
LIGHT	Green
MEDIUM	Yellow
HEAVY	Red
CLOSED	Red (Flashing)

Table 4.1 – Required displays

*Note: When displaying 'CLOSED' the text shall flash.
The flash rate shall be 1 second on and 1 second off.*

4.2.5.3 The text display shall also be able to be turned off completely (blanked).

4.2.5.4 Character heights shall be approximately 250mm with a width to height ratio no less than 0.7:1.

4.2.5.5 The character stroke width shall be 30mm.

4.2.6 Chromaticity

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

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

4.2.6.3 The chromaticity coordinates of the LED's shall be as specified in Section 11.4.

4.2.6.4 The use of an RGB (Red, Green, Blue) display is **not permitted**.

4.2.7 Enclosure

4.2.7.1 Unless otherwise specified in individual tender documents, the sign enclosure shall not exceed 3400mm in width.

4.2.7.2 Unless otherwise specified in individual tender documents, doors shall be located on the rear of the sign housing, as specified in AS 4852.1.

4.2.7.3 Suitably designed struts or braces within the housing shall be used to ensure stability of the installed sign.

4.2.7.4 Door stays shall be provided to secure the doors in the open position as described in AS4852.1.

4.2.7.5 All doors shall be individually lockable and secured in the closed position by way of a multipoint securing system actuated via a single keyed lock, approved by the sign purchaser.

4.3 MOUNTING

- 4.3.1 The signs shall be designed to be centrally mounted on suitably designed columns (2 off) and associated footings.
- 4.3.2 The sign support structure and associated footing shall comply with relevant requirements of:
- a) AS 4852.1, Sign support structure;
 - b) Bridge Technical Note BTN 2010 /001 – November 2010 Design of Steel Cantilever and Portal Sign Structures and High-Mast Light Poles; and
 - c) AS 5100 Bridge Design.
- 4.3.3 In case of discrepancy, the Bridge Technical Note BTN 2010/001 – November 2010 will take precedence over AS 4852.
- 4.3.4 Design of the structure and associated footing shall be proof engineered by an independent, VicRoads pre-qualified engineering consultant and the details provided to VicRoads.
- 4.3.5 The mounting method shall ensure that the rear section of the housing and the face of the display modules are vertical.
- 4.3.6 Access for all power supply, control and communication cabling shall be designed to be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.
- 4.3.7 Except where otherwise approved, ground clearance shall be in accordance with the requirements of AS1742.2.
- 4.3.8 Alternative methods of mounting may be considered upon submission.

4.4 ELECTRICAL

- 4.4.1 The electrical system shall incorporate the following facilities:
- a) A circuit-breaker board comprising appropriately rated mains isolation switch and circuit breaker;
 - b) The ability to be isolated from mains supply at ground level using a suitable switch/breaker system.
- 4.4.2 It is expected that a typical installation will utilise a small enclosure mounted on one of the sign support posts, or an ITS Field Cabinet, to provide all power and communications connections.

SECTION 5 - TRAVEL TIME SIGN TYPE 3

5.1 GENERAL

- 5.1.1 The TT3 sign is the same sign as the RC3 sign detailed in TCS 003 but operating as a travel time sign.
- 5.1.2 The TT3 Sign is a four colour, full matrix sign, capable of displaying text and symbolic messages.
- 5.1.3 Typically located on an arterial road, prior to a freeway entrance, to provide real time information for destinations along the associated freeway.
- 5.1.4 The display shall have a resolution of 128 pixels wide by 40 pixels high.
- 5.1.5 The TT3 sign is intended to display 3 lines of text. Typically, a 'header' line and two destination lines.
- 5.1.6 Each pixel shall comprise 4 LED's, one of each colour (i.e. red, yellow, green and white).
- 5.1.7 The pixels shall be square with a maximum pixel pitch (centre to centre spacing) of 12mm in the horizontal and vertical directions.
- 5.1.8 The above design requirements are based on the use of 3mm LED's.
- 5.1.9 An example layout for a TT3 sign is shown in Figure 5.1

M2	Light	Min
Destination One	9	
Destination Two	15	

Figure 5.1 – TT3 Example Layout

- 5.1.10 Refer to VicRoads specification TCS 003 for details of Ramp Control operation.

5.2 SIGN SPECIFIC REQUIREMENTS

5.2.1 General

In addition to the general requirements as specified in this document, TT3 signs shall meet the sign specific requirements of Section 5 of this specification.

5.2.2 Operation and Control

- 5.2.2.1 The signs shall comply with all the relevant requirements of TCS 003 for RC3 signs and the relevant requirements of AS 4852.1 for Variable Message Sign as detailed in AS 4852.1.
- 5.2.2.2 Signs shall operate according to RMS protocol with extensions for colour to provide pixel colour outputs of red, yellow, green and white as defined in Appendix A.

5.2.3 Chromaticity

- 5.2.3.1 The pixel colours defined within this specification are yellow, red, white and green.
- 5.2.3.2 The four colours shall be generated using individual yellow, red, white and green LED's.
- 5.2.3.3 The chromaticity coordinates of the LED's shall be as specified in Section 11.4.
- 5.2.3.4 The use of an RGB (Red, Green, Blue) display is **not permitted**.

Note: At the time of this specification, the use of RGB in TT3 signs is being reviewed.

5.2.4 Enclosure

- 5.2.4.1 The dimensions of the housing shall be the minimum required to house the intended display.
- 5.2.4.2 The nominal enclosure size shall be 1660mm (wide) by 600mm (high).
- 5.2.4.3 The maximum dimension of the housing shall not exceed 1660mm (wide) x 600mm (high) x 160mm (deep)
- 5.2.4.4 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.
- 5.2.4.5 Gas struts should be used to hold the door in its open position for maintenance purposes.
- 5.2.4.6 The locks shall be "Southco", key lockable, Link Lock™, Rotary Action Latches (Code 801) or similar. All locks shall be keyed alike and shall ensure that the door is securely fastened.

5.3 MOUNTING

- 5.3.1 The signs shall be designed to be mounted on
 - a) A suitably designed post and associated footing as detailed in Standard Drawing TC-2223, TC-2234 or TC-2236. or
 - b) An existing traffic signal MA, JUMA or JUP
- 5.3.2 The sign shall be provided with all facilities to enable mounting of the finished sign in accordance with Standard Drawing TC-2224
- 5.3.3 Design of the structure and associated footing shall be proof engineered by an independent, VicRoads pre-qualified engineering consultant and the details provided to VicRoads.

- 5.3.4 Access for all power supply, control and communication cabling shall be through the centre of the post and shall enter the sign housing through appropriately constructed, sealed entry points.
- 5.3.5 Except where otherwise approved, ground clearance shall be in accordance with the requirements of AS1742.2.
- 5.3.6 Alternative methods of mounting may be considered upon submission.

5.4 ELECTRICAL

- 5.4.1 TT3 signs are typically powered by a separate point of supply.
- 5.4.2 A suitable circuit breaker shall be installed within the sign.
- 5.4.3 The sign shall be supplied with connecting cables 2.5 metres in length enclosed in a separate black flexible hose 2.0 metres in length (measured from the point of entry to the housing). The flexible conduit shall be 16mm in diameter.
- 5.4.4 The cable and hose shall enter the rear panel of the housing through a suitably sealed “goose neck” arrangement.

5.5 COMMUNICATIONS

- 5.5.1 TT3 Signs shall be controlled via: a hardwired communications link (i.e. an ethernet connection) from an associated modem.
- 5.5.2 The sign shall be supplied with an ethernet connecting cable 2.5 metres in length enclosed in a separate black flexible hose 2.0 metres in length (measured from the point of entry to the housing). The flexible hose shall be 16mm in diameter.
- 5.5.3 The cable and hose shall enter the rear panel of the housing through a suitably sealed “goose neck” arrangement.

NOTE: Under no circumstances shall the communications cable be housed within the same flexible hose as the electrical cables.

SECTION 6 - TRAVEL TIME SIGN TYPE 4

6.1 GENERAL

- 6.1.1 The TT4 sign is a four colour, full matrix sign, capable of displaying text. The design is based on an TT3/RC3 sign with an additional row of text.
- 6.1.2 Typically located on an arterial road to provide real time information for destinations along the arterial road.
- 6.1.3 The display shall have a resolution of 128 pixels wide by 56 pixels high.
- 6.1.4 The TT4 sign is intended to display 4 lines of text. Typically, a 'header' line and three destination lines.
- 6.1.5 Each pixel shall comprise 4 LED's, one of each colour (i.e. red, yellow, green and white).
- 5.1.6 The pixels shall be square with a maximum pixel pitch (centre to centre spacing) of 12mm in the horizontal and vertical directions.
- 6.1.7 The above design requirements are based on the use of 3mm LED's.
- 6.1.8 An example layout for a TT4 sign is shown in Figure 6.1.



Princes Hwy	Min
Destination 1	9
Destination 2	15
Destination 3	20

Figure 6.1 – TT4 Example Layout

6.2 SIGN SPECIFIC REQUIREMENTS

6.2.1 General

In addition to the general requirements as specified in this document, TT4 signs shall meet the sign specific requirements of Section 6 of this specification.

6.2.2 Operation and Control

- 6.2.2.1 The signs shall comply with all the relevant requirements of a Variable Message Sign as detailed in AS 4852.1.
- 6.2.2.2 Signs shall operate according to RMS protocol with extensions for colour to provide pixel colour outputs of red, yellow, green and white as defined in Appendix A.

6.2.3 Chromaticity

- 6.2.3.1 The pixel colours defined within this specification are yellow, red, white and green.
- 6.2.3.2 The four colours shall be generated using individual yellow, red, white and green LED's.
- 6.2.3.3 The chromaticity coordinates of the LED's shall be as specified in Section 11.4.
- 6.2.3.4 The use of an RGB (Red, Green, Blue) display is **not permitted**.

Note: At the time of this specification, the use of RGB in TT4 signs is being reviewed.

6.2.4 Enclosure

- 6.2.4.1 The dimensions of the housing shall be the minimum required to house the intended display.
- 6.2.4.2 The nominal enclosure size shall be 1660mm (wide) by 800mm (high).
- 6.2.4.3 The maximum dimension of the housing shall not exceed 1660mm (wide) by 800mm (high) x 200mm (deep)
- 6.2.4.4 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.
- 6.2.4.5 Gas struts should be used to hold the door in its open position for maintenance purposes.
- 6.2.4.6 The locks shall be "Southco", key lockable, Link Lock™, Rotary Action Latches (Code 801) or similar. All locks shall be keyed alike and shall ensure that the door is securely fastened.

6.3 MOUNTING

- 6.3.1 The sign shall be provided with all facilities to enable mounting of the finished sign in accordance with the tender documentation.
- 6.3.2 The signs shall typically be mounted on a suitably designed post(s) and associated footing(s).
- 6.3.3 Design of the structure and associated footing shall be proof engineered by an independent, VicRoads pre-qualified engineering consultant and the details provided to VicRoads.

- 6.3.4 Access for all power supply, control and communication cabling shall be through the centre of the post and shall enter the sign housing through appropriately constructed, sealed entry points.
- 6.3.5 Alternative methods of mounting may be considered upon submission.

6.4 ELECTRICAL

- 6.4.1 TT4 signs are typically powered by a separate point of supply.
- 6.4.2 A suitable circuit breaker shall be installed within the sign.
- 6.4.3 The sign shall be supplied with connecting cables 2.5 metres in length enclosed in a separate black flexible hose 2.0 metres in length (measured from the point of entry to the housing). The flexible hose shall be 16mm in diameter.
- 6.4.4 The cable and hose shall enter the rear panel of the housing through a suitably sealed “goose neck” arrangement.

6.5 COMMUNICATIONS

- 6.5.1 TT4 Signs shall be controlled via: a hardwired communications link (i.e. an ethernet connection) from an associated modem.
- 6.5.2 The sign shall be supplied with a CAT6 ethernet connecting cable 2.5 metres in length enclosed in a separate black flexible hose 2.0 metres in length (measured from the point of entry to the housing). The flexible hose shall be 16mm in diameter.
- 6.5.3 The insulation rating of the CAT6 cable shall be not less than 240Vac.
- 6.5.4 The cable and hose shall enter the rear panel of the housing through a suitably sealed “goose neck” arrangement.

NOTE: Under no circumstances shall the communications cable be housed within the same flexible hose as the electrical cables.

SECTION 7 - TRAVEL TIME SIGN TYPE 5

At the time of this specification, TT5 signs have not been approved for use.

This Section has been included for future use.

SECTION 8 - TRAVEL TIME SIGN TYPE 6

8.1 GENERAL

- 8.1.1 The TT6 sign is a static roadside destination sign containing one or more '2 digit', illuminated LED segments, capable of displaying estimated travel time.
- 8.1.2 The signs are most commonly used to provide real time information regarding the condition and travel time to destinations along a route to motorists.
- 8.1.3 The TT6 sign is suitable for use on arterial roads and freeways.
- 8.1.4 The static "destination" information on the display face shall be provided as black lettering on a white background.
- 8.1.5 The static sign face shall comply with the requirements of AS 1742, AS 1743 and AS 1744 and shall be to layouts approved by the VicRoads.
- 8.1.6 Each illuminated segment shall be a three colour, full matrix insert capable of displaying two characters as defined below.
- 8.1.7 In accordance with standard, static direction sign layouts, the closest destination shall be displayed on the top line (destination 1 shown in Figure 8.1) and the furthest destination shall be displayed on the bottom line (destination 3 shown in Figure 8.1).
- 8.1.8 Example layouts for a TT6 sign is shown in Figure 8.1.

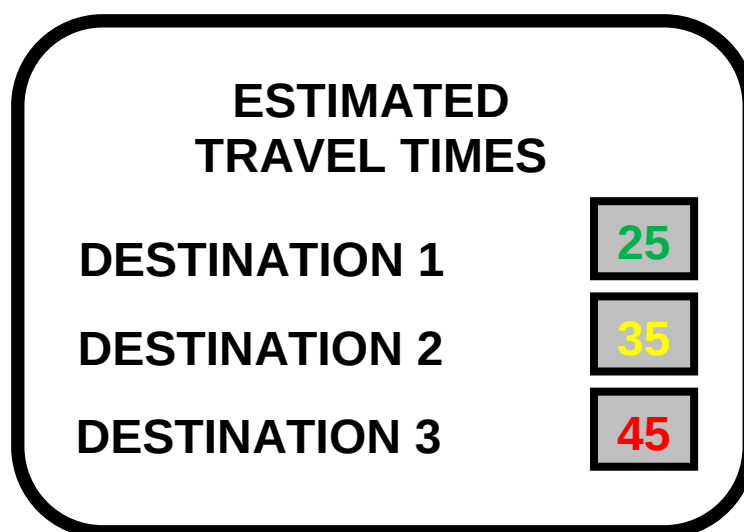


Figure 8.1 – TT6 Example Layout

- 8.1.9 The TT6 sign can also be used to provide travel times to a specific destination via multiple routes. See Figure 8.2,

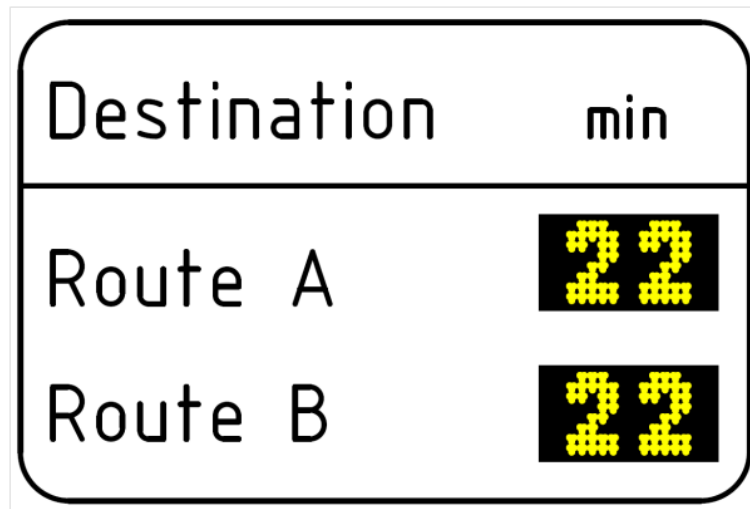


Figure 8.2 – TT6 Example Layout for travel times to a destination via different routes.

- 8.1.10 Each numeral within a two-digit array shall be separated by a pixel spacing that ensures clear legibility of each digit. Such spacing shall be not less than one stroke width, and not more than two stroke widths, of the provided character.
- 8.1.11 The minimum illuminated numeral height shall be based on the specified static text height. The LED numeral height is indicated in Table 8.1.

Approach Speed (km/h)	Static Font Height (mm)	LED Font Height Nominal (mm)	LED Font Height Minimum (mm)
< 90	180	200	190
≥ 90	240	400	380

Table 8.1 – LED illuminated font heights

- 8.1.12 A typical sign face layout is provided in Appendix F.
- 8.1.13 Each segment shall be capable of displaying a single line of text for travel time information. See Table 8.2 for example messages.
- 8.1.14 Each segment shall be capable of displaying 1 and 2 digit numbers from 1 to 99.
- 8.1.15 When displaying numerals 1 through 9 a preceding '0' shall not be displayed. See Table 8.2.

Number range	Acceptable
1 – 9	
10 – 99	

Table 8.2 – Acceptable numeral displays

8.2 SIGN SPECIFIC REQUIREMENTS

8.2.1 General

In addition to the general requirements as specified in this document, TT6 signs shall meet the sign specific requirements of Section 8 of this specification.

8.2.2 Operation and Control

Signs shall operate according to the TIS protocol defined in Appendix B.

8.2.3 Chromaticity

- 8.2.3.1 The pixel colours defined within this specification are yellow, red and green.
- 8.2.3.2 The three colours shall be generated using individual yellow, red and green LED's.
- 8.2.3.3 The chromaticity coordinates of the LED's shall be as specified in Section 11.4.
- 8.2.3.4 The use of an RGB (Red, Green, Blue) display is **not permitted**.

Note: At the time of this specification, the use of RGB in TT6 signs is being reviewed.

8.2.4 Enclosure

- 8.2.4.1 The numeral display and associated LED drivers and control equipment shall be housed within a suitable enclosure.

- 8.2.4.2 Where the sign numeral enclosure is not large enough to house all the control equipment, a separate controller housing may be used in accordance with Clause 8.5.
- 8.2.4.3 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.
- 8.2.4.4 The dimensions of the enclosure shall be the minimum required to house the intended display.
- 8.2.4.5 The enclosure shall be designed to be mounted on the rear of the static sign (see Clause 8.4) with the display visible through a cut-out in the static sign.
- 8.2.4.6 The numeral sign face shall be as near as practicable flush with the static sign face.
- 8.2.4.7 Unless otherwise specified in individual tender documents, a lockable door shall be located on the rear of the sign housing, hinged on the either side or the bottom of the housing.
- 8.2.4.8 The locks shall be “Southco”, key lockable, Link Lock™, Rotary Action Latches (Code 801) or similar. All locks shall be keyed alike and shall ensure that the door is secured by the door is securely fastened.
- 8.2.4.9 The sign enclosure shall not include a visor.

8.3 MOUNTING

- 8.3.1 The housing shall be provided with all facilities to enable mounting of the finished sign within a pre-cut area of a standard, static road-side directional sign. The latter shall conform to relevant requirements of AS 1742.
- 8.3.2 For mounting purposes, the housing shall include a minimum of two lugs on each of the top and bottom of the sign to facilitate mounting onto Unistrut (or similar). See Figure 8.3 for an example of a typical mounting arrangement.

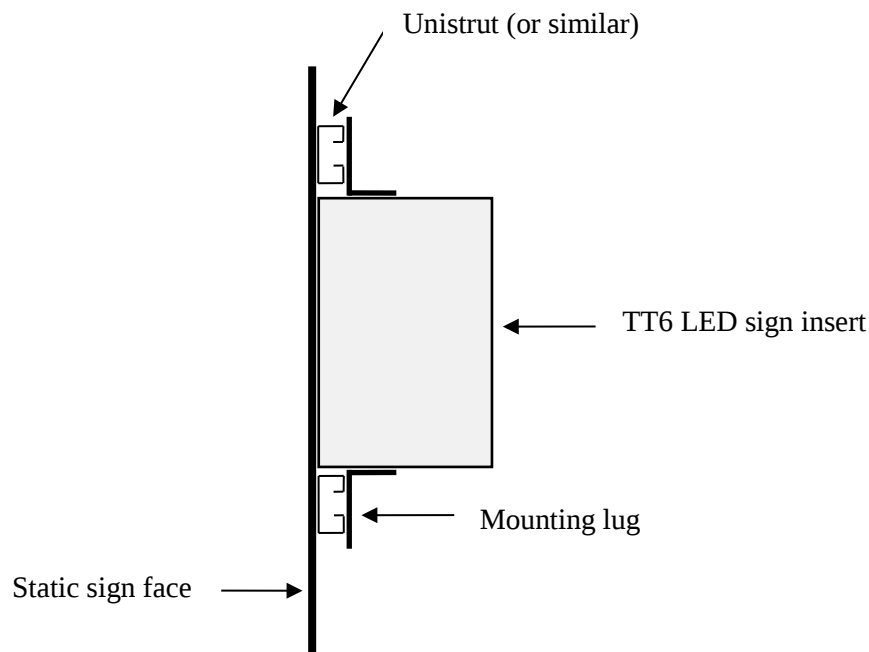


Figure 8.3 – Example of typical mounting arrangement

8.4 ELECTRICAL

- 8.4.1 Unless otherwise specified in individual contract documents, TT6 signs shall be solar powered.
- 8.4.2 The solar power system shall be designed, constructed and installed in accordance with AS 4509.2, AS 4086.1 and AS 4086.2 as specified in Clause 4.4 of AS 5156.
- 8.4.3 When designing the standalone solar power system consideration must be given to the power consumption, the hours of operation, the surrounding environment and the average amount of sunlight available.
- 8.4.4 The support post shall be suitable for carrying the load associated with the sign, including battery, and solar panel.
- 8.4.5 The proposed support post shall be proof engineered by a VicRoads approved consultant.
- 8.4.6 The solar panel shall be designed for ease of cleaning and equipped with deterrents to bird roosting.

8.5 COMMUNICATIONS

- 8.5.1 TT6 signs shall be controlled via a hardwired communications link (i.e. an ethernet connection) from an associated 3/4/5G modem.
- 8.5.2 The 3/4/5G modem shall be housed within the sign controller cabinet.

8.6 SIGN CONTROLLER CABINET

- 8.6.1 Where the sign enclosure is not large enough to house all the sign control equipment, a separate sign controller cabinet may be used.

Note: A separate sign controller housing would typically be required where the sign enclosure is not large enough to house a field processor, solar power management system, batteries, etc.

- 8.6.2 Where a separate sign controller cabinet is used, it shall be mounted behind or below the static sign face. See Section 15.7 for details and examples of typical mounting arrangements.
- 8.6.3 In both mounting arrangements, the door of the sign controller cabinet shall be designed to open to the rear of the sign face.
- 8.6.4 A ground mounted sign controller cabinet may be considered where submitted on a case by case basis.

SECTION 9 - OPERATION AND CONTROL

9.1 GENERAL

- 9.1.1 The signs shall be able to be controlled via an Ethernet communication link.
- 9.1.2 The system shall incorporate the ability to automatically fall-back to a "blank" (blacked out) display where:
- a) mains power is lost at the sign;
 - b) communications are lost to the site;
 - c) a serious malfunction in the control or switching of any individual segment element which may lead to inappropriate or misleading displays being generated is detected; or
 - d) less than 80% of the total number of any individual LED character or display are illuminated

9.2 SIGN CONTROLLER

- 9.2.1 The entire sign shall be controlled by a single sign controller (SC). Under normal operation, its main purpose is to provide both serial and Ethernet interfaces to a third-party controlling device, over which the protocol shall be transmitted in order to control the connected sign.
- 9.2.2 The sign controller shall be designed to be installed in accordance with Table 9.1 below. Where an external cabinet is required, the cabinet shall meet the requirements of "TCS061 – The Supply of ITS Field Cabinets".

Sign Type	SC Type	SC Location
TT1	19" rack	TT1 enclosure (alternatively, a pole mounted cabinet or ITS Field Cabinet may be considered)
TT2	19" rack	TT2 enclosure (alternatively, a pole mounted cabinet or ITS Field Cabinet may be considered)
TT3	Integrated	TT3 enclosure
TT4	Integrated	TT4 enclosure
TT5	Integrated	TT5 enclosure
TT6	19" rack or other approved arrangement.	Pole mounted cabinet (alternatively, a ground mounted cabinet may be considered)

Table 9.1 – Sign Controller requirements

- 9.2.3 Space is to be reserved inside the cabinet for the installation of communications equipment, such as media converters or modems, the details of which are to be provided in the tender.
- 9.2.4 For 19" rack sign controllers, 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.
- 9.2.5 All of the controller's communication and power interfaces shall be clearly and indelibly labelled on the controller housing.
- 9.2.6 The SC shall provide at least one IEEE 802.3 10/100 BaseTX Ethernet interface with RJ-45 socket connection. The Ethernet interface(s) shall support the modes of communication and protocols detailed in this specification.
- 9.2.7 A Cat6 Ethernet cable shall be used to connect the SC to the network. The length of the Cat6 Ethernet cable shall not exceed 100m.
- 9.2.8 In addition to standard TCP/IP detailed above, the sign controller shall support the following protocols as a minimum:
- a) ICMP (ping).
 - b) NTP (to set & maintain the SC clock).
- 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 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 protocol session is disconnected.*
- c) HTTP (interface for admin and configuration).
 - d) HTTP using TLS (secure interface for admin and configuration).
- 9.2.9 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.
- 9.2.10 Where encryption is enabled, TLS shall be used as the encryption mechanism. TLS shall be implemented as follows:
- a) The control system shall be the client and the sign is the server.
 - b) The focus is on communication privacy and integrity, therefore neither client nor server authentication is required.
 - c) The sign controller shall be able to have a TLS certificate (with private key) uploaded to be used as a server certificate, to be used in the negotiation of a secure TLS/SSL connection.
 - d) The sign controller shall perform as a TLS server endpoint and does not need to authenticate the client.
 - e) TLS v1.2 shall be supported.

9.3 SERIAL INTERFACE (OPTIONAL)

- 9.3.1 The sign controller may also provide a serial communication interface through which control commands will be received from a control system (usually through a VicRoads field processor) in the relevant protocol format.

- 9.3.2 The sign's serial communication interface shall have the ability to be connected by either RS232C or RS422.
- 9.3.3 The serial cable termination on the internal sign controller shall be a DB-9 or DB-25 with standard signal pin assignments; or miniature terminal strip connector.
- 9.3.4 The signal pin assignments shall be submitted for acceptance by VicRoads prior to production commencing.
- 9.3.5 Baud rate of the sign controller's serial communication interface shall be configurable.
- 9.3.6 The serial interface shall support standard Baud rates between 300 baud and 115,200 baud. This is the minimum range of baud rates required. The controller's default baud rate shall be documented.
- 9.3.7 The set baud rate shall be restored upon a system reset as defined in the relevant protocol.
- 9.3.8 The set baud rate shall also be restored in the event that power to the sign is removed and subsequently restored.

9.4 ADMINISTRATION AND CONFIGURATION TOOL

- 9.4.1 The sign controller shall provide an interactive browser-based user interface using HTTP and HTTPS to provide monitoring, configuration and diagnostic related functions.
- 9.4.2 This interface shall be protected by a username/password authentication mechanism. The username and password shall be configurable.
- 9.4.3 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.
- 9.4.4 The software shall provide for the display and monitoring of the sign controller configuration, including:
 - a) Site Name
 - b) Firmware version
 - c) Access Control parameters, including username, password, etc.
 - d) Current Temperature of the controller
 - e) Main Power Supply status
 - f) Backup Power Supply Status (if one exists)
 - g) Up Time (since last reset)
 - h) System time (Local date and time)
 - i) TCP/IP communication settings
 - j) MAC Address(es) of all Ethernet port(s)
 - k) Current Active Control Mode (Local, serial, TCP or any other mode if present)
 - l) Facility Switch position (if present)
 - m) The timeout period to fall back to a blank display (in minutes)

- n) All the segments connected to the controller and, for each segment, the following information shall be displayed:
- Dimensions (in pixel)
 - Luminance dimming control mode (Auto, Time based or Fixed)
 - Current Luminance dimming level
 - Current Sign firmware version

Note: When operating using RMS Protocol:

- RMS protocol Sign ID
- RMS protocol Group ID
- RMS Protocol Session Status (Online / Offline)
- RMS Protocol Display Mode (Message, Frame or Plan)
- RMS Protocol Display Message Number/Frame Number/Plan Number

9.4.5 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. In this mode, the sign does not respond to commands from the control system.
 - ii. **Serial** – When this mode is enabled, the master software can connect to sign controller via serial connection and control the sign. When this mode is disabled, and there is currently an active serial connection, the controller shall drop the connection and blank the sign(s).

Note: When operating using RMS Protocol:

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

- iii. **TCP/IP** – When this mode is enabled, the master software can connect to sign controller via TCP/IP connection, and control the sign.

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).

Note: When operating using RMS Protocol:

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

Note: The control mode is exclusive. Once a mode is chosen, the other two modes shall be disabled.

9.4.6 Network configuration

The software shall allow a user to change the following network configurations:

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

9.4.7 Protocol Configuration

The software shall allow a user to change the following 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) Blanking Time out (in minutes, the duration that the sign controller will wait before blanking the sign after the active protocol connection is disconnected.).

Note: When operating using RMS Protocol:

- Seed offset (in Hex).
- Password offset (in Hex).
- Sign ID and Group ID (For individual signs).
- Polling Address.
- Broadcast Address.

9.4.8 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 '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).

9.4.9 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.

9.4.10 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) The software shall verify the username and password before granting access to the system.
- f) Only TLS shall be used for the HTTPS connection.
- g) The current VicRoads document 'Information Security Standard: Cryptographic Controls' shall be complied with.
- h) After three successive failed login attempts, the minimum time allowed between login attempts shall be changed to 60 seconds.

9.4.11 Administration

The software shall provide the following administration functions

- a) *Firmware upgrade*
 - i. The software shall allow a user to upgrade the controller's firmware. After the firmware is upgraded, all existing pre-configured parameters (IP addresses, network mask, default gateway and etc) for the controller shall be maintained.
 - ii. The software shall allow a user to upgrade firmware for individual signs that are connected to the sign controller.
 - iii. The system shall ensure that the entire firmware file is successfully downloaded before attempting to apply the firmware upgrade.
- b) *Save /recover configuration to/from file*
 - i. All of the configuration parameters for the controller shall be able to be saved and retained after rebooting the controller.
 - ii. The software shall allow a user to save the current configuration to a local file and be able to restore all the configuration parameters from the file.

- c) *Reboot and Reset*

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

- i. Reset to manufacturer default.
 - ii. Reset to manufacturer default, except for the current network configuration (IP addresses, network mask, default gateway, etc).
 - iii. Reboot the controller with all configuration maintained.

d) *Report/logs*

The software shall provide separated log files, one for 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.

e) *System event logs*

The software should log the following system events as minimum:

- i. Controller and sign fault events.
- ii. Protocol connection events (only require connection and disconnection events).
- iii. The login / logoff events for the browser interface software, including any failed attempts. The parameters to be logged include the attempted usernames, passwords and source IP addresses.

The software shall keep a minimum of the last 30 days or 5000 log entries, whichever limit comes first. Each log shall contain a timestamp with the resolution to 1ms.

f) *Protocol command logs*

The software should log every protocol command and response between the master software and the controller for the last 30 days or 5000 messages. Each log shall contain:

- i. Message direction (from the master to the controller or vice versa).
- ii. A timestamp with resolution to 1ms (The time the commands received or the response sent).
- iii. The actually message detail in a Hex string.

g) *Non-functional requirements*

- i. Performance - The software shall respond to every user interaction less than 3 seconds (excluding delays in the network).
- ii. Bandwidth /network requirement - The software shall be designed to run on a relatively slow IP network, such as 3G wireless network with around 500Kbps bandwidth and 500ms latency. The user interface shall be simple to avoid long response times.

Where large amounts of information is to be displayed (such as logs), the information shall be displayed over multiple pages with page down and page up functions.

SECTION 10 - MECHANICAL REQUIREMENTS

10.1 GENERAL

The following mechanical requirements shall be met by all sign types unless superseded by a sign specific clause above.

10.2 ENCLOSURE

- 10.2.1 The enclosure shall be constructed from marine grade sheet aluminium alloy 5251 H32 to AS/NZS 1734.
- 10.2.2 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.
- 10.2.3 The enclosure shall be suitably reinforced and/or braced to facilitate the erection and continued operation of the unit in the intended application.
- 10.2.4 All external metal sections of the completed housing shall be of powder coat or baked enamel finish, matt black in colour. Optionally, the rear of the housing can be powder coat or baked enamel finish, grey in colour.
- 10.2.5 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.
- 10.2.6 The door(s) and window(s) 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.
- 10.2.7 The sign shall include a suitable moisture inhibitor.
- 10.2.8 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.
- 10.2.9 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.
- 10.2.10 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
- 10.2.11 The completed sign shall incorporate ready access from the door(s) to all integral display, control and communications components for routine and/or fault maintenance purposes.

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

10.3 VIEWING WINDOW

- 10.3.1 Where used, the front viewing windows shall be manufactured from high impact, clear (anti-glare and U.V. stabilised) sheeting of a suitable polycarbonate.
- 10.3.2 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.
- 10.3.3 All modules shall be capable of being removed and re-instated in-situ by hand and the construction and design of the cabinet, framework and electronic driver networks should facilitate same.

SECTION 11 - OPTICAL REQUIREMENTS

11.1 GENERAL

The following optical requirements shall be met by all sign types unless superseded by a sign specific clause above.

11.2 LUMINANCE AND LUMINANCE RATIO

11.2.1 The luminance and luminance ratio for three or four colour displays (i.e. TT3, TT4, TT5 and TT6) shall be in accordance with Table 11.1.

Sign illuminance level (lx)	White and Yellow			Red and Green		
	Minimum LR	Luminance (cd/m ²)		Minimum LR	Luminance (cd/m ²)	
		Min.	Max.		Min.	Max.
40000	7	6200	120000	3.5	2800	60000
4000	10	1100	21000	5	500	10000
400	10	300	37000	5	200	2700
40		200	2000		100	2000
<4		60	300		60	300

Table 11.1 – Luminance and Luminance ratio (Three and four colour displays)

11.2.2 The luminance and luminance ratio for monochrome and RGB displays shall be in accordance with Table 11.2.

Sign Illuminance level (lx)	White and Yellow			Red and Green		
	Minimum LR	Luminance (cd/m ²)		Minimum LR	Luminance (cd/m ²)	
		Min.	Max.		Min.	Max.
40000	10	6200	120000	5	2800	60000
4000	10	1100	21000	5	500	10000
400	10	300	37000	5	200	2700
40		200	2000		100	2000
<4		60	300		60	300

Table 11.2 – Luminance and Luminance ratio (Monochrome and RGB displays)

11.2.3 The luminance and luminance ratio test procedures shall be conducted in accordance with the test procedures detailed in AS4852.1.

11.3 LUMINANCE INTENSITY UNIFORMITY

- 11.3.1 The luminance intensity uniformity shall comply with AS 4852.1.
- 11.3.2 The test procedures shall be in accordance with the test procedures detailed in AS 4852.1.

11.4 CHROMATICITY

- 11.4.1 The colours shall comply with the chromaticity co-ordinates detailed in AS 4852.1, clause 3.2.3.
- 11.4.2 The test procedures shall be in accordance with the test procedures detailed in AS 4852.1.

11.5 SIGN DIMMING CONTROL

- 11.5.1 The system shall incorporate an appropriately designed dimming circuit capable of providing uniform luminance across all displays.
- 11.5.2 The sign shall have the ability to dim the light output intensity of its display to comply with the *Sign Dimming Control* as detailed in AS 4852.1.

11.6 PIXEL SERVICE LIFE

The lifespan requirements for LED pixel elements shall be in accordance with the *Pixel Element Service Life* requirements detailed in AS4852.1.

SECTION 12 - ELECTRICAL REQUIREMENTS

12.1 GENERAL

- 12.1.1 All electrical works shall comply with AS/NZS 3000.
- 12.1.2 In addition to complying with this specification, the sign and associated system shall comply with all relevant requirements of AS 3100, "General Requirements for Electrical Equipment".
- 12.1.3 Transformers used within the sign and/or sign control system shall comply with AS 61558.
- 12.1.4 All cables and wires shall be insulated with a material not inferior to V-90 grade PVC and shall be suitably labelled.
- 12.1.5 All cables and wires shall have stranded copper conductors.
- 12.1.6 The LED display modules, displays and associated driver units, monitoring and dimming networks and the control and communications equipment shall operate at extra low voltage (ELV).

12.2 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 $\pm 15\%$.

12.3 POWER

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

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

12.4 INTERNAL PROTECTION

- 12.4.1 All equipment including data lines shall be internally protected against damage resulting from:
 - a) Lightning strikes at or near the sign/gantry.
 - b) Electrical transients on power cabling.
 - c) Electrical transients on communications wiring.
 - d) Radio frequency interference.
 - e) Static electrical discharge.
 - f) Any harmonics arising from the above and any equipment in the cabinet.
- 12.4.2 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.

12.5 SOLAR POWER

- 12.5.1 Unless otherwise specified in individual contract documents, TT6 signs shall be solar powered.
- 12.5.2 Where solar power is specified, the contractor shall design a suitable solar system.
- 12.5.3 The voltage of a solar system shall be 12Vdc or 24Vdc.
- 12.2.4 The solar power system shall be designed, constructed and installed in accordance with AS 4509.2, AS 4086.1 and AS 4086.2.

12.6 ELECTROMAGNETIC COMPLIANCE (EMC)

- 12.6.1 All signs covered by this specification shall comply with:
 - AS/NZS 61000.6.1 for immunity; and
 - AS/NZS 61000.6.3 for emissions.
- 12.6.2 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 13.1.



Figure 13.1 – RCM compliance label

SECTION 13 - ENVIRONMENTAL REQUIREMENTS

13.1 GENERAL

The following optical requirements shall be met by all sign types unless superseded by a sign specific clause above.

13.2 TEMPERATURE AND HUMIDITY

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

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

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

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

13.3 ENCLOSURE PROTECTION

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

13.4 VIBRATION

13.4.1 The following Travel Time signs shall be subjected to vibration tests as detailed in Clause 10.3.2 below.

- a) TT3
- b) TT4
- c) TT6 (individual numeral display)

13.4.2 The complete Travel Time sign shall be subjected to vibration tests in accordance with the requirements of AS 60068.2.6 for sinusoidal vibration as follows:

Clause AS 60068.2.6	Detail	Parameters
	Test Camera	Powered and operating
	Test Type	Sinusoidal sweep
5.1	Frequency range	5 Hz to 55 Hz
5.2	Vibration amplitude	0.75mm
5.2	Cross-over frequency	Approximately 8.2 Hz
5.2	Acceleration amplitude	2 m/s ² - 0.2gn

13.5 WIND LOADING

- 13.5.1 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.
- 13.5.2 The minimum wind-loading conditions applicable shall be those for the applicable Region A location as defined in AS/NZS 1170.2.

SECTION 14 - MARKINGS AND DOCUMENTATION

14.1 MARKING

- 14.1.1 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 date that the sign was installed in the field;
 - e) Other information required under AS-3100;
 - f) Other information such as sign address; and
 - g) Default settings.
- 14.1.2 A label shall be affixed to the inside of the sign enclosure or local controller cabinet providing clear details of the point of supply.
- 14.1.3 For TT3 signs used in conjunction with ramp control, a suitable warning label detailing the point of supply and ramp metering site number shall be provided.

WARNING	
Point of Supply	
Activation from Ramp Metering Controller	Site No.

Figure 14.1 – Sample Warning Label

14.2 DOCUMENTATION

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

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

- i) Proposed maintenance plan; and
- j) Recommended list of spare parts for maintenance.

14.3 MANUFACTURERS WARRANTY

14.3.1 Warranty Conditions

Every sign and sign controller supplied for a VicRoads project in accordance with this specification shall be warranted from defects for a period of not less than 3 years from date of purchase. Such warranty shall cover component failure and faulty workmanship.

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

14.3.2 Warranty Certificate

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

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

14.3.3 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 15 - INSTALLATION AND COMMISSIONING

15.1 GENERAL

15.1.1 Travel Time signs shall be installed in accordance with:

- The requirements of this specification.
- Contract Standard Section 732.
- Relevant requirements of 734.
- Relevant requirements of 735.
- The requirements of individual contract documents.

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

15.1.3 When locating the sign position, consideration must be given to the following:

- Sign location
- Sign visibility
- Protection of sign (e.g. guard rail)
- Access to the sign for maintenance activities

15.1.4 Travel time signs should be aligned to ensure the maximum visibility to approaching drivers.

15.1.5 Typically, the signs should be aligned to point to the centre of the proposed carriageway at a distance from the face of the sign as indicated in Table 15.1 below.

Sign Type	Typical installation location	Distance to alignment point
TT1	Freeway	250m
TT2	Freeway	250m
TT3	Arterial Road	100m
TT4	Arterial Road	100m
TT5	Freeway	250m
TT6	Freeway	250m
TT6	Arterial Rd	150m

Table 15.1 – Typical Sign Alignment Distance

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

15.1.7 Any ethernet cables used shall be CAT6 with insulation rated at not less than 240Vac.

15.2 TT1 SIGNS

15.2.1 General

- 15.2.1.1 TT1 signs shall be installed as specified in TCS-005 and individual contract documents.
- 15.2.1.2 The sign and support structure shall be proof engineered by a VicRoads pre-qualified engineering consultant.
- 15.2.1.3 Sign positions shall be nominated in individual contract documents.

15.2.2 Electrical Supply

- 15.2.2.1 TT1 Signs shall be powered from a separate and independent point of supply.
- 15.2.2.2 Unless otherwise specified in individual contract documents, the power for the TT1 sign shall be from the nearest Type 1 or Type 3 Electrical Distribution cabinet.
- 15.2.2.3 Access for all power supply cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.
- 15.2.2.4 A typical installation will utilise a small enclosure mounted on one of the sign support posts to provide all power connections accessible at ground level.
- 15.2.2.5 Alternatively, an ITS Field Cabinet may be used. Where an ITS Field Cabinet is used, it shall be located as near as practicable to the sign structure and not more than 10m from the same.
- 15.2.2.6 The cabinets detailed in 15.2.2.4 and 15.2.2.5 above shall be used to enable the isolation of power to the sign from ground level.
- 15.3.2.7 The point of supply and the location of the distribution cabinet shall be specified in individual contract documents.

15.2.3 Communications

TT1 Signs shall be controlled via a hardwired communications link (i.e. ethernet) from the associated STREAMS Field Processor.

15.3 TT2 SIGNS

15.3.1 General

- 15.3.1.1 TT2 signs shall be installed as specified in TCS-026 and individual contract documents.
- 15.3.1.2 The signs are to be centrally mounted on suitably designed columns (2 of) and associated footings as specified in clause 4.3 of this specification.

- 15.3.1.3 A mower strip not less than 0.5 m larger than the base projection of the sign cabinet shall be installed (at ground level) around the base of the columns.
- 15.3.1.4 Access for all power supply, control and communication cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points as specified in clause 4.3 of this specification.
- 15.3.1.5 Except where otherwise approved, ground clearance shall be in accordance with the requirements of AS1742.2.
- 15.3.1.6 Alternative methods of mounting may be considered upon submission.
- 15.3.1.7 Sign positions shall be nominated in individual contract documents.

15.3.2 Electrical Supply

- 15.3.2.1 TT2 Signs shall be powered from a separate and independent point of supply.
- 15.3.2.2 Unless otherwise specified in individual contract documents, the power for the TT2 sign shall be from the nearest Type 1 or Type 3 Electrical Distribution cabinet.
- 15.3.2.3 Access for all power supply cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.
- 15.3.2.4 A typical installation will utilise a small enclosure mounted on one of the sign support posts to provide all power connections accessible at ground level.
- 15.3.2.5 Alternatively, an ITS Field Cabinet may be used. Where an ITS Field Cabinet is used, it shall be located as near as practicable to the sign structure and not more than 10m from the same.
- 15.3.2.6 The cabinets detailed in 15.3.2.4 and 15.3.2.5 above shall be used to enable the isolation of power to the sign from ground level.
- 15.3.2.7 The point of supply and the location of the distribution cabinet shall be specified in individual contract documents.

15.3.3 Communications

- 15.3.3.1 TT2 Signs shall be controlled via a hardwired communications link (i.e. ethernet) from the associated STREAMS Field Processor.
- 15.3.3.2 Access for all control and communication cabling shall be through the centre of the column(s) and shall enter the sign housing through appropriately constructed, sealed entry points.
- 15.3.3.3 A typical installation will utilise a small enclosure mounted on one of the sign support posts to provide communications connections accessible at ground level.
- 15.3.3.4 Alternatively, an ITS Field Cabinet may be used. Where an ITS Field Cabinet is used, it shall be located as near as practicable to the sign structure and not more than 10m from the same.
- 15.3.3.5 The communications arrangements and the location of the distribution cabinet shall specified in individual contract documents.

15.4 TT3 SIGNS

15.4.1 General

15.4.1.1 TT3 signs shall be installed on either a:

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

15.4.1.2 TT3 signs attached to stand alone posts shall be attached as detailed in VicRoads standard drawing TC-2223, TC-2234 or TC-2236.

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

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

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

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

15.4.1.7 Sign locations shall be nominated in individual contract documents.

15.4.1.8 A label complying with TCS 003, Appendix C2 or C3 (as appropriate) shall be affixed to the inside all TT3 sign enclosures providing clear details of the source of power and the source of activation.

15.4.2 Electrical Supply

15.4.2.1 TT3 Signs attached to a stand-alone post shall be powered from one of the following methods:

- a) The associated ITS Field Cabinet in which the controlling STREAMS Field Processor is located.
- b) A separate and independent point of supply.
- c) The associated traffic signal controller.

15.4.2.2 Where an TT3 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.

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

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

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

- 15.4.2.5 Where an TT3 Sign is attached to a traffic signal pole, it **SHALL** be powered from the associated traffic signal controller.

NOTE: TT3 signs attached to a traffic signal installation post shall not, under any circumstances, be powered from a separate point of supply other than the traffic signal controller.

- 15.4.2.6 When powered from a traffic signal controller, a separate cable shall be provided from the controller to the sign. A spare core within the traffic signal multi-core cable **SHALL NOT** be used to provide the power.
- 15.4.2.7 A separate circuit breaker for TT3 signs shall be installed within the traffic signal controller cabinet.
- 15.4.2.8 The above circuit breaker shall be clearly labelled.
- 15.4.2.9 A label complying with TCS 003, Appendix C1 shall be affixed to the inside of the traffic signal controller.

15.4.3 Communications

- 15.4.3.1 TT3 Signs shall be controlled via: a hardwired communications link (i.e. an ethernet connection) from the associated STREAMS Field Processor.
- 15.4.3.2 Where a hardwired link is not possible, the Superintendent may consider the use of a wireless communications link from the associated STREAMS Field Processor
- 15.4.3.3 The wiring for the hardwired link shall be installed in a white communications conduit where possible.
- 15.4.3.4 Where a communications conduit cannot be installed, and if approved by the Superintendent, the communications cable may be installed within the electrical conduit.
- 15.4.3.5 Where the communications cable is installed in the electrical conduit, the cable shall be shielded and the insulation rated at not less than the electricity mains cable insulation rating (i.e. mains voltage).
- 15.4.3.6 The communication cable shall be terminated in an approved junction box, or similar approved arrangement, attached to the opposite side of the pole behind the sign.
- 15.4.3.7 The signs communications cable shall be connected to the incoming communications cable in the junction described in 13.4.3.5 above.
- 15.4.3.8 The communications connection detailed in 13.4.3.5 and 13.4.3.6 above must be electrically and physically segregated from the mains supply connection.

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

15.5 TT4 SIGNS

15.5.1 General

- 15.5.1.1 TT4 signs shall be installed on an approved support post/structure and foundation that has been proof engineered by a VicRoads pre-qualified engineering consultant.
- 15.5.1.2 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.
- 15.5.1.3 A minimum lateral clearance of 500mm between the back of curb and the nearest portion of the sign shall be maintained at all times.
- 15.5.1.4 The signs when mounted shall be capable of adjustment in both the vertical and horizontal alignments.
- 15.5.1.5 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in the range 20m to 100m.
- 15.5.1.6 Sign locations shall be nominated in individual contract documents.

15.5.2 Electrical Supply

- 15.5.2.1 TT4 Signs shall be powered from a separate and independent point of supply.
- 15.5.2.2 Unless otherwise specified in individual contract documents, the power for the TT4 sign shall be from a Type 2 Electrical Distribution cabinet.
- 15.5.2.3 The point of supply and the location of the distribution cabinet shall be specified in individual contract documents.
- 15.5.2.4 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.
- 15.5.2.5 The signs electrical connection cables shall be connected to the incoming power supply cable in the junction box described in 15.5.2.3 above.
- 15.5.2.6 The electrical connection detailed in 15.5.2.2 and 15.5.2.3 above must be electrically and physically segregated from the communications connection detailed in Clause 15.5.3 below.

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

15.5.3 Communications

- 15.5.3.1 TT4 Signs shall be controlled via: a hardwired communications link (i.e. an ethernet connection) from an associated modem.
- 15.5.3.2 The wiring for the hardwired link shall be installed in a white communications conduit where possible.
- 15.5.3.3 Where a communications conduit cannot be installed, and if approved by the Superintendent, the communications cable may be installed within the electrical conduit.
- 15.5.3.4 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).
- 15.5.3.5 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.
- 15.5.3.6 The signs communications cable shall be connected to the incoming communications cable in the junction described in 15.5.3.6 above.
- 15.5.3.7 The communications connection detailed in 15.5.3.6 and 15.5.3.7 above must be electrically and physically segregated from the mains supply connection.

NOTE: Under no circumstances shall the communications connection be housed within the same enclosure as the mains supply connection detailed in 15.5.2 above.

15.6 TT5 SIGNS

For possible future use.

15.7 TT6 SIGNS

15.7.1 General

- 15.7.1.1 TT6 sign LED displays are installed within the static sign face as detailed in Clause 8.4 of this specification.
- 15.7.1.2 TT6 signs shall be installed an approved support post/structure and foundation that has been proof engineered by a VicRoads pre-qualified engineering consultant.
- 15.7.1.3 The design of the support post/structure and foundation shall allow for the following devices to be mounted:
 - a) Static sign face;
 - b) The number of LED display inserts;
 - c) The separate control housing (where required);
 - d) The solar panel and associated control gear;
 - e) Batteries;

f) Any other required equipment

- 15.7.1.4 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.
- 15.7.1.5 The signs shall be aimed such that the active displays are clearly visible to approaching traffic in the range 20m to 250m.
- 15.7.1.6 Where a separate sign controller cabinet is used, it shall be mounted behind or below the static sign face. See Figures 15.1 and 15.2 for examples of typical mounting arrangements.
- 15.7.1.7 Where a separate controller cabinet is mounted behind the sign, it shall not be located above the horizontal centre line of the static sign. This includes any cabinets used to house batteries.
- 15.7.1.8 In both mounting arrangements, the door of the sign controller cabinet shall open to the rear of the sign face.
- 15.7.1.9 A ground mounted sign controller cabinet may be considered where submitted on a case by case basis.

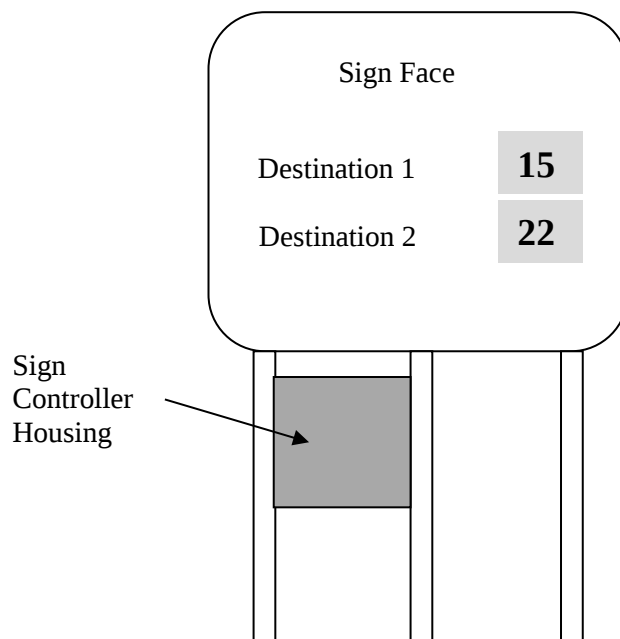


Figure 15.1: Example of Sign Controller mounted below static sign

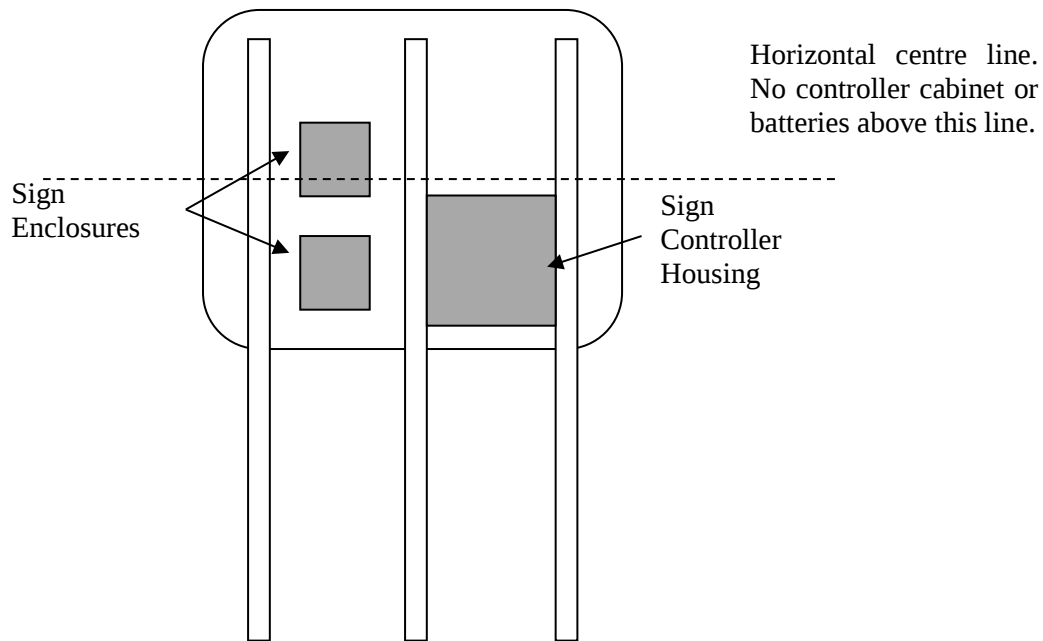


Figure 15.2: Example of Sign Controller mounted behind static sign

15.7.2 Electrical Supply

- 15.7.2.1 Unless otherwise specified in individual contract documents, TT6 Signs shall be powered by solar power.
- 15.7.2.2 The solar power system shall be as specified in Clause 8.4 of this specification.
- 15.7.2.3 The solar panel shall be installed in a position that minimises the possibility of vandalism and theft.

15.7.3 Communications

TT6 Signs shall be controlled via: a wireless 3/4/5G VicRoads approved modem.

APPENDIX A - COMMUNICATIONS VIA RMS PROTOCOL

(Normative)

A1 GENERAL

A1.1 This appendix defines requirements for sign controllers to implement RMS protocol (TSI-SP-003 ver2.1) via physical serial and the Ethernet interfaces. This protocol is defined in the RMS specification TSI-SP-003 “Communications Protocol for Roadside Devices” version 2.1 (instead of the updated version 3.1)

A1.2 In order to implement the 4-colour operation of the sign, extensions to the default RMS protocol message suite as defined by VicRoads (Clause 0) will be required. The definitions for handling colour are based on an RMS protocol document (ITSM-TO-ITS-CSI-002) that describes the extensions to the base RMS protocol.

Note: Manufacturers should consider designing their products to support both the current RMS protocol and “SA TS 5719:2017 : Communications protocol for dynamic message signs and road weather information systems” or ensure they are upgradable through firmware.

A1.3 Remote control and monitoring of the sign shall be facilitated via STREAMS.

A1.4 For the purposes of this specification, the controller hardware internal to all types of the sign shall be herein referred to as the ‘sign controller’.

A1.5 The sign controller shall fully implement all defined protocol layers, including error checking, as described in the RMS protocol with following exceptions:

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

A1.6 The control functions of the sign shall be capable of monitoring the operation of the sign in accordance with AS 4852.1 Section 4.6 through the fault logging and diagnostic functionality provided by the RMS protocol

A1.7 The sign controller shall monitor the fault status of the connected signs and provide this fault information through appropriate RMS protocol messages.

A1.8 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.

A1.9 The VMS shall automatically respond to faults according to Table A1 below.

Failure types		Responses	RTA Error code to be used
i.	Where mains power is lost to the SC OR the VMS itself.	- The entire display area of the VMS shall be completely blanked. - Create a log in the SC specifying power failure for affected device(s).	Controller Err Code: 01
ii.	Where the communication link to either of the SC's physical serial ports is lost or adversely affected.	- The entire display area of the VMS shall be completely blanked. - Create a log in the SC detailing which serial interface was affected.	Controller Err Code: 02
iii.	Where an established communication link over TCP/IP is lost or interrupted.	- The entire display area of the VMS shall be completely blanked. - Create a log in the SC detailing the nature of the link loss.	Controller Err Code: 02
iv.	Where the communication between the SC and the VMS itself is lost or adversely affected.	The entire display area of the VMS shall be completely blanked. Create a log in the SC detailing the specific type of communications failure to the VMS sign.	Controller Err Code: 05
v.	Where internal faults are detected within the SC and/or VMS itself, i.e. watchdog timeout etc.	- The entire display area of the VMS shall be completely blanked. - Create a log in the SC specifying the nature of the failure.	Error Code from Appendix C of RMS protocol as appropriate
vi.	Where 10 percent or more of Led's in either the pictogram display and/or the text display elements of the VMS have failed OR have become faulty* OR are affected to the extent that the resultant displays may be confusing to the public.	- The entire display area of the VMS shall be completely blanked. - Create a log in the SC of the type & extent of the LED failure(s).	Controller Err Code: 08

Table A1 – Fault responses

A1.10 Diagnostics functions shall be provided to monitor the display elements, as well as the sign's internal subsystems. All diagnostic information and logs shall be accessible using RMS protocol through each of the sign controller's serial communications interfaces and Ethernet interface.

A1.11 As a minimum, the sign controller shall monitor the following:

- The loss of communications between the SC and the VMS display elements

- The loss of mains power to the VMS.
- Pixel check* results for the connected VMS‡.
- Sign temperature (i.e. over-heat/cool status).
- Ambient light sensor failure.
- All other VMS / SC subsystem fault conditions.

* 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, 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.

- A1.12 Where a standard format for any given fault report is not defined by the RMS protocol, the format shall be fully documented and disclosed to VicRoads for integration with 3rd party systems.
- A1.13 All faults shall be detected and logged for reporting within thirty (30) seconds of the fault occurring.
- A1.14 RMS “Heartbeat Poll” messages from the controlling device shall be serviced by the sign controller within 0.5 seconds of reception of the heartbeat request.
- A1.15 The response time must be less than 2 seconds.

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

- A1.16 The performance requirement in clause A.1.11 above applies to both wired and wireless serial connections.
- A1.17 If a controlling device (usually a VicRoads field processor) sends an RMS command which is not supported, then the sign controller shall reply with a Reject Message with an appropriate Application Error Code as defined in the RMS protocol specification.
- A1.18 Usage of ‘revision’ field in Application Layer Messages:

There is a ‘Revision’ field in some of the Application Layer messages, such as ‘Sign Set Text Frame’ and ‘Sign Set Graphics Frame’.

It is valid for the VicRoads Central Control System not to update this field value when sending those messages to the sign controller i.e., the VicRoads Central Control System can use ‘0’ as the ‘Revision’ field value.

- A1.19 VicRoads Variable Message Signs are to be interpreted as ‘graphics Signs’ when using the protocol.

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

A1.20 When the current session ends, the sign(s) should be blank.

A1.21 The sign controller may also support customised messages for special functions. In this case, such messages shall be in RMS protocol format and shall be fully documented for integration with 3rd party systems. The proposed customised messages shall be provided to VicRoads for review and approval before implementation. The supplier shall supply full details of any such customised RMS protocol messages for integration with 3rd party software vendors

A1.21 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 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.

A1.22 CRC 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>

- C8B7 is the application message CRC, which is calculated on other hex data in the same application message, i.e. “0A 4A 08 05 03 01 09 53 4C 4F 57 20 44 4F 57 4E”, total 16 bytes.
- BE44 is the data packet CRC, which is calculated on ASCII-HEX encoded data in the packet except the <ETX> control byte and the CRC bytes them self, i.e. “<SOH>00 00 02<STX> 0A 4A 08 05 03 01 09 53 4C 4F 57 20 44 4F 57 4E C8 B7” convert to ASCII-HEX, which is “01 30 30 30 30 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)

A1.23 Further to clause 3.5 of the protocol specification, here is another message exchange example:

	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

Figure A2 – Message exchange example

A2 SPECIFIC IMPLEMENTATION REQUIREMENTS FOR COLOUR DISPLAYS

- A2.1 This section describes the VicRoads implementation of the protocol used to interface with variable message signs that can display multi-colour messages.
- A2.2 The protocol is based on the RMS protocol document ITSM-TO-ITS-CSI-002 that describes the extensions to the original protocol document for signs (RMS TSI-SP-003).
- A2.3 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 remains the same. These extensions also limit the colours to be specified to these seven.

Frame Colours	Display Colour
Red	Red
Green	Green
Blue	Blue
Red + Green	Yellow
Red + Blue	Magenta
Green + Blue	Cyan
Red + Green + Blue	White

A2.4 Message Sequence and Process

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

The implications of this process are as follows:

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

A2.5 Colour and Monochrome Frames

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)

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 B - COMMUNICATIONS VIA TIS PROTOCOL

(Normative)

B.1 GENERAL

- B1.1 The sign controller receives commands from a central control system to display travel time information on the sign's display panels. The display panels consist of travel time segments that show the travel time in number of minutes (from 1 to 99) and an indicator showing the level of congestion for that segment, with colour coding.
- B1.2 Segments are numbered incrementally, where the segment closest to the ground is 01.
- B1.3 The protocol is based on a master-slave relationship where the control system is the master. That means the sign only responds to messages sent from the control system and does not otherwise send any messages.
- B1.4 The parameters used in the protocol messages are:
- **Sign number:** This parameter allows one sign controller to control more than one trip sign, although in practical terms, there is typically only one sign, numbered one.
 - **Segment number:** The segment number defines which of the travel time segments a message is referring to. Segment numbers start from one and shall be numbered from the bottom of the sign to the top.
 - **Checksum:** A checksum is defined for the message protocol for backwards compatibility. This checksum is a **Checksum8 Modulo 256** of all the ASCII characters following the start character ">", expressed in ASCII.
 - **Unique Packet Identifier:** All messages have a unique packet identifier. This identifier is echoed back to the control system to verify that the response received from the sign matches the request message sent. There is no requirement for the packet identifier to be in any particular sequence; it is up to the control system to ensure sign responses match the request messages.
- B1.5 Data in the messages are encoded as ASCII, including numbers. For example, the number 34 is encoded as two bytes: 0x33, 0x34

B2 STRUCTURE OF TRANSMISSIONS TO SIGN

B2.1 All data is to be sent as ASCII coded printable characters, with the exception of 0x0D (carriage return) none of the first 32 non-printing characters are to be used.

B2.2 The protocol structure is in the format specified below:

>xxidCDDzz.

1	2	34	5	67	

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	">"	0x3E
2	xx	Unique packet ID	2		
3	id	Sign ID	2		
4	C	Command	1	"K"	0x4B
				"M"	0x4D
5	DD	Data	2 - 6		
6	zz	Checksum	2		
7	.	End of packet	1	'CR' (carriage return)	0x0D

- Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
- Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which will be used in the response
- Sign ID
 - Two ASCII characters for the sign identifier or sign number (e.g. "01" or 0x30, 0x31)
 - Where the Sign ID is lower than "10" this should be padded with a "0"
- Command
 - A single ASCII character from the list (detailed below):
 - K – Display Command
 - M – Status Request/Query
- Data
 - Dependant on the Command being sent, a minimum of two ASCII characters
- Checksum
 - Checksum8 Modulo 256** encoded as two ASCII characters
- End of packet
 - The ASCII character carriage return (0x0D)

B3 STRUCTURE OF RESPONSES FROM SIGN

B3.1 All data is to be sent as ASCII coded printable characters, with the exception of 0x0D (carriage return) none of the first 32 non-printing characters are to be used.

B3.2 The protocol structure is in the format specified below:

```
>xxRDDzz.
|  |  |  |  |
1 23 4 56
```

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	">"	0x3E
2	xx	Unique packet ID	2		
3	R	Response	1	"A"	0x41
				"N"	0x4E
4	DD	Data	0 - 16		
5	zz	Checksum	2		
6	.	End of packet	1	'CR' (carriage return)	0x0D

1. Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
2. Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which matches the packet received
3. Response type
 - A single ASCII character from the list below:
 - i. A – Acknowledgement of valid command
 - ii. N – 'Negative' acknowledgement of a command
4. Data
 - Dependant on the response type and command:
 - i. Response A – In response to a display (K) command:
 1. No additional characters are sent (Data length is zero)
 - ii. Response A – In response to a status (M) request/query:
 1. A segment status is transmitted (16 characters)
 - iii. Response N – Two ASCII characters containing the error number

Error	Description
"01"	Command too short
"02"	Command too long
"03"	Incorrect sign no.
"04"	Invalid command
"05"	Invalid segment
"06"	Invalid time
"07"	Invalid colour
"08"	Invalid checksum
"09"	Segment offline

5. Checksum
 - **Checksum8 Modulo 256** encoded as two ASCII characters
6. End of packet
 - The ASCII character carriage return (0x0D)

B4 CHECKSUM CALCULATION

B4.1 The checksum is calculated from a **Checksum8 Modulo 256** of all ASCII codes after the start character.

B4.2 An example of this calculation for a ‘command’ packet is below:

>9501K0104g46.

ASCII	>	9	5	0	1	K	0	1	0	4	g	4	6	<cr>
HEXADECIMAL	3e	39	35	30	31	4b	30	31	30	34	67	34	36	0d

0x39 +

0x35 +

0x30 +

0x31 +

0x4b +

0x30 +

0x31 +

0x30 +

0x34 +

0x67

0x0246

0x0246 mod 256 = 0x46

ASCII character “4” is 0x34, ASCII character “6” is 0x36

B4.3 An example of this calculation for a ‘status’ packet is below:

>01A0400000101000001A9.

ASCII	>	0	1	A	0	4	0	0	0	0	0	1	0	1	0	0	0	0	0	1	A	9	<cr>
HEXADECIMAL	3e	30	31	41	30	34	30	30	30	30	30	31	30	31	30	30	30	30	30	31	41	39	0d

```

0x30 +
0x31 +
0x41 +
0x30 +
0x34 +
0x30 +
0x30 +
0x30 +
0x30 +
0x30 +
0x31 +
0x30 +
0x31 +
0x30 +
0x30 +
0x30 +
0x30 +
0x30 +
0x30 +
0x31
-----
0x03A9

```

0x03A9 mod 256 = 0xA9

ASCII character “A” is 0x41, ASCII character “9” is 0x39

B5 DISPLAY COMMAND

```

>xxidKssnnrzz.
| | || | || |
1 2 34 5 67 89

```

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	“>”	0x3E
2	xx	Unique packet ID	2		
3	id	Sign ID	2		
4	K	Command (Display)	1	“K”	0x4B
5	ss	Segment number	2		
6	nn	Travel time	2		
7	r	Colour	1 - 2	“b”	0x62
				“g”	0x67
				“y”	0x79
				“r”	0x72
				“fr”	0x66 0x72
8	zz	Checksum	2		
9	.	End of packet	1	‘CR’ (carriage return)	0x0D

1. Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
2. Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which will be used in the response
3. Sign ID
 - Two ASCII characters for the sign identifier (e.g. "01" or 0x30, 0x31)
 - Where the Sign ID is lower than "10" this should be padded with a "0"
4. Display command
 - Update the sign segment display
5. Segment number
 - Two ASCII characters for the segment number (e.g. "01" or 0x30, 0x31)
 - Where the segment is lower than "10" this should be padded with a "0"
6. Travel time
 - Two ASCII characters for the travel time to display
 - Where the travel time is lower than "10" this should be padded with a "0"
Note: Although the packet is to be padded with a "0" this is not to be displayed
 - Where the travel time is "00" the sign should blank the display
7. Colour
 - Minimum of one, maximum of two ASCII characters defining the colour to display:

Sign Type	Character(s)				
	"B" or "b"	"G" or "g"	"Y" or "y"	"R" or "r"	"FR" or "fr"
TT1, TT6 – Colour	Blank	Green	Yellow	Red	Flashing Red
TT2 – Message	Blank	"LIGHT"	"MEDIUM"	"HEAVY"	"CLOSED"

8. Checksum
 - **Checksum8 Modulo 256** encoded as two ASCII characters
9. End of packet
 - The ASCII character carriage return (0x0D)

B6 SIGN ACKNOWLEDGEMENT RESPONSE

>xxAzz.

1	23	45

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	">"	0x3E
2	xx	Unique packet ID	2		
3	A	Acknowledgement	1	"A"	0x41
4	zz	Checksum	2		
5	.	End of packet	1	'CR' (carriage return)	0x0D

1. Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
2. Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which matches the packet received
3. Response type
 - A – Acknowledgement of valid command
4. Checksum
 - **Checksum8 Modulo 256** encoded as two ASCII characters
5. End of packet
 - The ASCII character carriage return (0x0D)

B7 SIGN 'NEGATIVE' ACKNOWLEDGEMENT RESPONSE

>xxNDDzz.

1	23	4	56

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	">"	0x3E
2	xx	Unique packet ID	2		
3	N	'Negative' acknowledgement	1	"N"	0x4E
4	DD	Data	2		
5	zz	Checksum	2		
6	.	End of packet	1	'CR' (carriage return)	0x0D

1. Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
2. Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which matches the packet received
3. Response type
 - N – 'Negative' acknowledgement of a command
4. Data
 - Response N – Two ASCII characters containing the error number

Error	Description
"01"	Command too short
"02"	Command too long
"03"	Incorrect sign no.
"04"	Invalid command
"05"	Invalid segment
"06"	Invalid time
"07"	Invalid colour
"08"	Invalid checksum
"09"	Segment offline

5. Checksum
 - **Checksum8 Modulo 256** encoded as two ASCII characters
6. End of packet
 - The ASCII character carriage return (0x0D)

B8 STATUS REQUEST/QUERY

>xxidMsszz.

1	2	34	5	67	

		Name	Length	ASCII Character	HEX
1	>	Start of packet	1	">"	0x3E
2	xx	Unique packet ID	2		
3	id	Sign ID	2		
4	M	Command (Status)	1	"M"	0x4D
5	ss	Segment number	2		
6	zz	Checksum	2		
7	.	End of packet	1	'CR' (carriage return)	0x0D

1. Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
2. Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which will be used in the response
3. Sign ID
 - Two ASCII characters for the sign identifier (e.g. "01" or 0x30, 0x31)
 - Where the Sign ID is lower than "10" this should be padded with a "0"
4. Status Request/Query
5. Segment number
 - Two ASCII characters for the segment number (e.g. "01" or 0x30, 0x31)
 - Where the segment is lower than "10" this should be padded with a "0"
6. Checksum
 - **Checksum8 Modulo 256** encoded as two ASCII characters
7. End of packet
 - The ASCII character carriage return (0x0D)

B9 SEGMENT STATUS ACKNOWLEDGEMENT

```
>xxAaabbccddeeffgghhzz.
|  |  |  |  |  |  |  |  |  |  |
1 23 4 5 6 7 8 9 A B CD
```

		Name	Length	Description	ASCII Character	HEX
1	>	Start of packet	1	The beginning of a packet	">"	0x3E
2	xx	Unique packet ID	2	The unique packet identifier		
3	A	Acknowledgement	1	Acknowledgement of valid command	"A"	0x41
4	aa	Displayed travel time	2	The current number being displayed		
5	bb	Lamp status	2	Lamp Status		
6	cc	Digit error count	2	The error count for the two digit display		
7	dd	Digit controller Status	2	The status for the Travel Time digit display controller		
8	ee	Displayed colour	2	The current message (or colour) being displayed		
9	ff	Colour Status	2	The status for the colour display		
A	gg	Colour error count	2	The error count for the colour display		
B	hh	Colour controller status	2	The status for the colour display controller		
C	zz	Checksum	2	The checksum		
D	.	End of packet	1	The end of a packet	'CR' (carriage return)	0x0D

- Start of packet
 - All packets must begin with the ASCII character ">" (0x3E)
- Unique packet ID
 - Two ASCII characters defining a unique ID for the transaction, which matches the packet received
- A – Acknowledgement of valid command
- aa – Displayed travel time
 - Two ASCII characters for the travel time currently being displayed
 - Where the travel time is lower than "10" this should be padded with a "0"
- bb – Lamp status (**LED Failure – Travel Time Number**)
 - Two ASCII characters

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
Reserved			Backlight	Reserved	Display Inactive	Major Digit Fault	Minor Digit Fault

- cc – Digit error count

- Two ASCII characters
7. dd – Digit controller status
- Two ASCII characters encoding the hexadecimal below (e.g. “01” = 0x01):

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
Reserved					Power Failure	Luminance Controller Fault	Online

8. ee – Displayed colour
- Two ASCII characters detailing current colour being displayed

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
FLASH	Reserved				Red	Yellow	Green

9. ff – Colour status (**LED Failure – Travel Time Congestion Colour**)
- Two ASCII characters detailing LED failures on the colour display

Sign Type	Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
TT1	Reserved	Red (B)	Yellow (B)	Green (B)	Reserved	Red (A)	Yellow (A)	Green (A)
TT2	Reserved					Red	Yellow	Green
TT6	Reserved					Red	Yellow	Green

10. gg – Colour error count
- Two ASCII characters
11. hh – Colour controller status
- Two ASCII characters encoding the hexadecimal below (e.g. “01” = 0x01):

Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)
Reserved					Power Failure	Luminance Controller Fault	Online

- Where both the digit and colour are controlled from one unit (i.e. TT6), this should be set to match the state of the digit controller.
12. Checksum
- **Checksum8 Modulo 256** encoded as two ASCII characters
13. End of packet
- The ASCII character carriage return (0x0D)

B10 COMMUNICATION TIMEOUT

- B10.1 During normal operation, the control system will send a travel time command message(s) typically within one to two minutes. If there is a communication problem, this message(s) will not be received by the sign.
- B10.2 If the sign does not receive a travel time control message for a particular segment after this timeout period, that segment shall be blanked automatically by the sign.
- B10.3 The timeout period shall be configurable from the administration interface. This period is specified in minutes – a value of zero means that no timeout applies (and the sign does not automatically blank any segment).

Examples

In the example below Sign #5 has four segments. To command the sign to display travel time of 3 minutes, 7 minutes, 12 minutes and 25 minutes with the respective colours of red, green, yellow and flashing red, the data commands would be as follows:

```
>xx05K0103rzz.
>xx05K0207gzz.
>xx05K0312yzz.
>xx05K0425frzz.
```

Where

'>'	is the start byte
'xx'	is the unique packet identifier (2 character ASCII encoded hex (00-ff))
'05'	is the sign number (ASCII encoded hex)
'K'	is the command to control an output
01, 02, 03, 04	is the segment number
03, 07, 12, 25	is the travel time data
r, g, y, fr	is the colour and operation of the associated map segments
zz	is the checksum
.	is a carriage return <cr>

- B10.4 In the example below, sign #5" has four segments. To request the status of segment three the data commands would be as follows:

```
>xx05M03zz.
```

Where

'>'	is the start byte
'xx'	is the unique packet identifier (2 character ASCII encoded hex (00-ff))
'05'	is the sign number (ASCII encoded hex)
'M'	is the command to query the status
03	is the segment number
zz	is the checksum
.	is a carriage return <cr>

- B10.5 In the example above, sign #5" has four segments and would respond with the status of segment three as follows:

>xxA1200000102000001zz.

where:

'>'	is the start byte
'xx'	is the unique packet identifier (2 character ASCII encoded hex (00-ff))
'A'	is the acknowledgement command
12	is the travel time data ("12" minutes)
00	is the LED failures for digits ("00" indicates no faults)
00	is the digit error count ("00" indicates no errors)
01	is the digit controller status ("01" indicates the controller is online)
02	is the colour and operation of the associated map segments (yellow)
00	is the LED failures for colours ("00" indicates no faults)
00	is the colour error count ("00" indicates no errors)
01	is the colour controller status ("01" indicates the controller is online)
zz	is the checksum
.	is a carriage return <cr>

APPENDIX C - VICROADS ITS PLATFORM

(Normative)

C1 GENERAL

- C1.1 VicRoads ITS platform currently uses the STREAMS system.
- C1.2 STREAMS is owned and maintained by Transmax, a Queensland based company which is part of Queensland Main Roads.
- C1.3 STREAMS is an integrated control system which is being used by VicRoads to operate it's ITS Freeway Management Devices on Melbourne's freeway network
- C1.4 All ITS field devices must be compatible with STREAMS.
- C1.5 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)
 - Travel Time Signs (TTS)
- C1.6 The above devices are typically connected to STREAMS via a Field Processor (FP).

C2 FIELD PROCESSOR

- C2.1 VicRoads ITS platform currently uses the STREAMS system.
- C2.2 The FP is used to interface internet protocol (IP) and serially connected field devices to STREAMS.
- C2.3 Communications between the FP and the ITS Field Device is typically RMS protocol.
- C2.4 The FP is typically installed within an ITS Field Cabinet.
- C2.5 The ITS Field Cabinet is typically located adjacent to the freeway.
- C2.6 In some situations, the FP may be located in the VicRoads building at Kew.

APPENDIC D - REQUIREMENTS FOR TYPE APPROVAL

(Normative)

D1 GENERAL

- D1.1 Travel Time signs for use on VicRoads projects are required to hold current VicRoads Type Approval.
- D1.2 The Product Compliance evaluation process shall be carried out in accordance with VicRoads Guideline TCG 016.
- D1.3 To enable assessment for the purpose of granting Type Approval, the supplier must provide the following:
- A complete working sample of the sign (to be inspected at manufacturers premises upon request by VicRoads).
 - An outline drawing showing the general presentation and overall dimensions of the complete sign
 - Documentation to demonstrate that the sign has been manufactured and supplied under an approved quality assurance system.
 - Documentation to demonstrate that the sign conforms to the requirements of VicRoads Specification. This may be by means of submitting test results from approved and appropriately qualified independent testing organisations, or providing the manufacturer's assurance that the product complies with each paragraph of the specification.
- D1.4 Alternatively, the supplier may submit evidence of Type Approval of the same product by another Australian State Road Authority, together with details of volume and period of usage by other jurisdictions.

D2 REQUIRED NATA ACCREDITED TESTING

- D2.1 Notwithstanding D1 above, the supplier shall submit test results from a NATA accredited testing organisation to demonstrate compliance with the following:

Clause	Requirements	Evidence
11.1, 11.2, 11.3	Photometric	Test Report
11.4	Colorimetric	Test Report
12.6	EMC Compliance	Test Report
13.2	Temperature and humidity	Test Report
13.3	Enclosure protection	Test Report
13.4	Vibration	Test Report

- D2.2 Notwithstanding the above, the supplier shall submit test results to demonstrate compliance with the following:

Requirements	Evidence
STREAMS Compatibility	Certification from Transmax
Field Test	To Be Arranged with VicRoads

D3 COMPATIBILITY WITH RMS PROTOCOL

- D3.1 Where applicable, the supplier shall provide evidence of compatibility with RMS protocols TSI-SP-003 and ITSM-TO-ITS-CSI-002.
- D3.2 Where applicable, the supplier shall provide evidence of compatibility with TIS protocol.

D4 COMPATIBILITY WITH STREAMS

The supplier shall provide evidence of compatibility with STREAMS.

D5 ASSESSMENT PROCEDURE

- D5.1 The assessment procedure for Travel Time Signs will include, but not be limited to, the following:
- Assessment of construction, workmanship and critical dimensions.
 - Evaluation of the submitted data against the requirements of the specification.
 - Operation of the sign on VicRoads system.

D6 OTHER REQUIRED TESTING

- D6.1 VicRoads may require additional information or testing to be carried out as part of its evaluation of the product.
- D6.2 If the product is approved, a Certificate of Type Approval will be provided to the supplier. Until such time as this Certificate is issued, the product is not to be used in the State of Victoria.

APPENDIX E – TYPICAL TT6 SIGN FACE LAYOUTS

(Informative)

E1 GENERAL

- E1.1 The following typical sign face layouts shown in Figures E1 and E2 are for information only.
- E1.2 The destinations shown on sign face are in order of the closest destination at the top and the furthest destination at the bottom.
- E1.2 For specific details of the actual sign face layout, refer to individual tender documents.



FigureE.1 - Typical Layout for C Size sign on Freeway

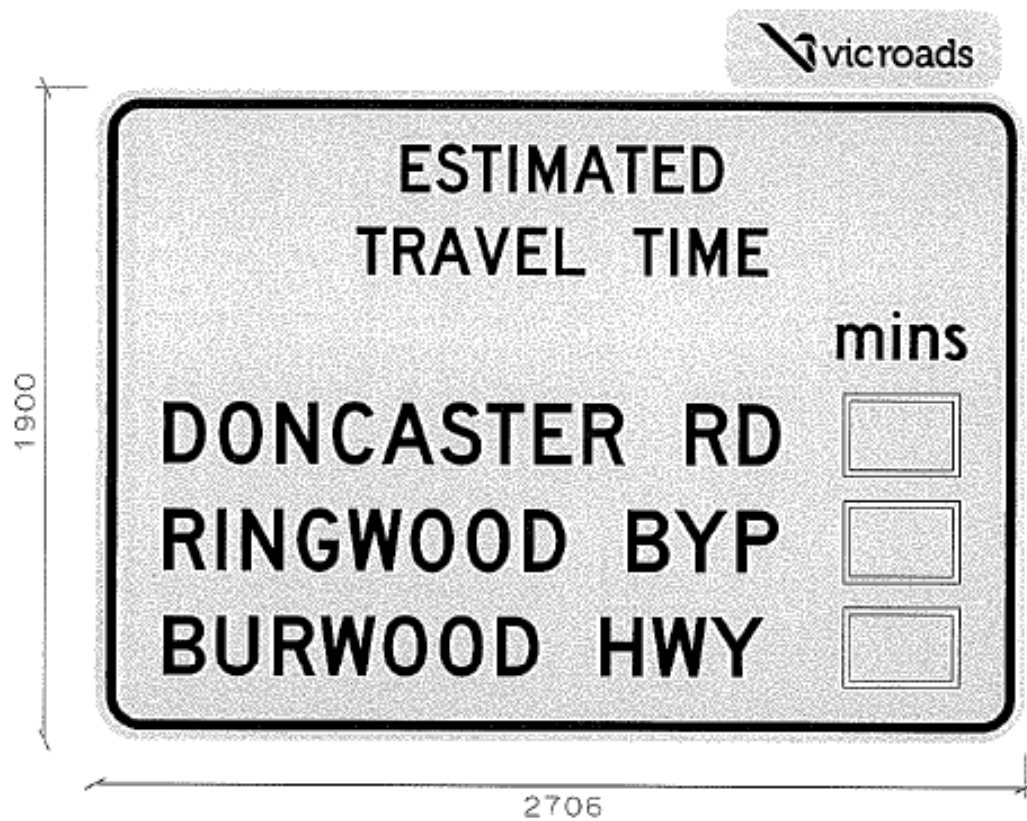


Figure E2 - Typical Layout for B Size sign on Arterial Road