

TCS 034 – 2 – 2013

The Supply
of
Variable Message Signs
for
Arterial Roads

Version:	2
Revision:	B
Revision Date :	September 2013

Foreword

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

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

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

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

COPYRIGHT

© Road Corporation trading as VicRoads. All rights reserved.

This document remains the property of VicRoads. No part of this document may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of VicRoads

Road Operations
60 Denmark Street Kew 3101


Phone: (03) 9854 2103 Fax: (03) 9854 2319

Version History

Version	Date	Prepared by	Approved by
A	February 2011	Elizabeth Lee	S Bean
B	September 2013	Elizabeth Lee	S Purtill

PREFACE

TELECOMMUNICATIONS EQUIPMENT

- A.1 All telecommunications equipment shall comply with relevant requirements of the Australian Communications and Media Authority (ACMA). Such equipment shall be labelled with an ACMA issued 'A-Tick' .

CHANGES TO THIS SPECIFICATION

- B.1 The main changes to this specification from the previous version are listed below:

- Removal of items covered by Australian Standard, AS 4852.1-2009, including sections 1-6 of Attachment A and Appendix A and B of the previous version of this specification;
- Addition of references to relevant sections of Australian Standard;
- Modification of headings and reorganisation of sections for greater consistency with Australian Standard;
- Addition of Colour Pictogram Display section (Clause 5).

- B.2 The changes made in Revision B are listed below:

- Addition of references to sections of AS5100;
- Addition of references to Bridge Technical Note on major sign structures BTN2010/001.

Page intentionally left blank

Contents

SECTION 1	SCOPE AND GENERAL.....	7
1.1	SCOPE.....	7
1.2	GENERAL.....	7
1.3	INTELLECTUAL PROPERTY.....	7
1.4	RELATED SPECIFICATIONS AND DRAWINGS	8
SECTION 2	OPERATION AND CONTROL.....	9
2.1	GENERAL.....	9
2.2	SIGN CONTROL PERFORMANCE AND CAPABILITY.....	9
2.3	SIGN CONTROLLER (SC)	9
2.4	COMMAND LINE INTERFACE (CLI):.....	10
2.5	RESET AND MASTER RESET.....	11
2.6	SIGN CONTROLLER PARAMETER DEFAULT SETTINGS	12
2.7	ETHERNET.....	12
2.8	RTA PROTOCOL FOR SIGN CONTROL.....	12
2.9	RTA PROTOCOL CONTROL VIA MODBUS OVER UDP/IP & TCP/IP	13
2.10	OTHER PROTOCOLS.....	13
2.11	HARDWARE SERIAL PORTS:	14
2.12	DIAGNOSTIC FUNCTIONS.....	14
2.13	MONITORING, FAULT LOGGING AND REPORTING.....	15
2.14	LOCAL CONTROL.....	16
2.14	REMOTE CONTROL.....	16
2.15	MANUAL OVERRIDE FACILITY SWITCH CONTROL.....	16
2.16	FALL-BACK SYSTEM	17
2.17	TEST AND CONFIGURATION SOFTWARE	17
2.18	DISPLAY TEST PATTERNS	17
2.19	FIRMWARE UPGRADE	18
SECTION 3	DISPLAY AND OPTICAL REQUIREMENTS	19
3.1	GENERAL.....	19
3.2	DISPLAYS	19
3.3	SIGN DIMMING CONTROL	19
3.4	CHARACTER FORMATS.....	19
3.5	DISPLAY CHANGES.....	20
3.6	OPTICAL REQUIREMENTS.....	20
3.6.1	Photometric Requirements	20
3.6.2	Colormetric Requirements	20
3.6.3	Lifespan Requirements	20
3.7	CONSPICUITY DEVICES	20
SECTION 4	COLOUR PICTOGRAM REQUIREMENTS	22
4.1	GENERAL.....	22
4.2	PICTOGRAM DISPLAY REGION.....	22
4.3	PICTOGRAM OPTICAL REQUIREMENTS.....	23
4.3.1	Photometric Requirements	23
4.3.2	Colormetric Requirements	23

4.3.3 Lifespan Requirements 23

4.4 DISPLAY CHANGES..... 23

SECTION 5 ELECTRICAL REQUIREMENTS.....24

5.1 GENERAL..... 24

5.2 OPERATING VOLTAGE..... 24

5.3 BATTERY BACK-UP 24

5.4 INTERNAL PROTECTION..... 24

SECTION 6 MECHANICAL REQUIREMENTS25

6.1 GENERAL..... 25

6.2 SIGN ENCLOSURE 25

6.3 SIGN SUPPORT STRUCTURE AND ASSOCIATED FOOTING 25

6.4 SIGN CONTROLLER HOUSING 26

6.5 FACILITY SWITCH..... 26

6.6 MARKINGS AND LABELS..... 27

SECTION 7 ENVIRONMENTAL.....28

7.1 GENERAL..... 28

7.2 ELECTROMAGNETIC COMPATIBILITY (EMC)..... 28

APPENDIX A.....29

VICROADS ITS PLATFORM..... 29

APPENDIX B30

GENERAL REQUIREMENTS FOR TESTING..... 30

APPENDIX C.....31

LIFETIME PERFORMANCE REQUIREMENTS 31

APPENDIX D.....33

REQUIREMENTS FOR APPROVAL 33

APPENDIX E35

GUIDELINES FOR PURCHASING AND INSTALLATION..... 35

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

- 1.1.1 This document covers the requirements for the design and manufacture of variable message signs (VMS) for use in fixed, freeway applications by VicRoads within the State of Victoria.
- 1.1.2 Within this specification a VMS is defined as a roadside device, for use on arterial roads, for the purpose of providing real time, changeable advice to road users in an alpha-numeric and/or symbolic format.
- 1.1.3 The design and manufacture of all components of a VMS shall be undertaken in accordance with this specification and individual tender documents.

1.2 GENERAL

- 1.2.1 VMS's shall comply with the Australian Standard AS 4852.1 – 2009: Variable message signs – Part 1:Fixed signs”. This VicRoads specification covers any additions and/or exceptions to AS 4852.1.
- 1.2.2 Where this specification differs from AS 4852.1 – 2009, this specification shall have precedence.
- 1.2.3 Messages shall be capable of being displayed on the VMS using the RTA VMS communication protocol as detailed in the RTA's specification TSI-SP-003.
- 1.2.4 The sign shall typically be mounted above a carriageway on a gantry or adjacent to the carriageway such that it is clearly visible from each lane of the carriageway of the approach to which each sign applies.
- 1.2.5 The sign shall be designed to provide legible, changeable alpha-numeric information relating to on-road incidents, real time traffic information, travel time information and other traffic management activities during both day-time and night-time operations.
- 1.2.6 Where specified in individual tender documents, the sign shall include a four colour pictogram section as specified in Section 4 of this specification.
- 1.2.7 Where specified in individual tender documents, the sign shall include four conspicuity devices as specified in Section 3.7 of this specification.

1.3 INTELLECTUAL PROPERTY

- 1.3.1 In relation to all Intellectual Property used in/or to operate the VMS , the contractor grants to VicRoads non exclusive licence to “use, modify and/or sell” or do anything else that without the licence, could be breach of the licensors Intellectual Property.
- 1.3.2 Intellectual Property shall include, but not be limited to, the following:

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

1.4 RELATED SPECIFICATIONS AND DRAWINGS

- 1.4.1 The fabrication and supply of all components shall conform with all relevant Australian Standards.
- 1.4.2 All installation works shall conform to the relevant VicRoads specifications and related specifications and standards as indicated throughout this document.
- 1.4.3 The following related specifications and standard drawings are referenced:

IEEE 802.3	IEEE Standard for Information Technology – Specific Requirements: Part 3
AS 2578	Traffic signal controllers
AS 4100	Steel structures
AS 4852.1	Variable message signs – Part 1: Fixed signs
AS 5100	Bridge Design Code
AS 60038	Standard voltages
AS 61000.6.3	Generic standards – Emission standard for residential, commercial and light industrial environments
AS 61558	Safety of power transformers, power supply units and similar
BTN2010/001	Bridge Technical Note – Design of Steel Cantilever and Portal Sign Structures and High-Mast Light Poles
RTA Specification TSI-SP-003	Communications protocol for roadside devices
RTA Specification ITSM-TO-ITS-CSI- 002	Colour Sign Interface
STREAMS	VicRoads ITS platform.

SECTION 2 OPERATION AND CONTROL

2.1 GENERAL

2.1.1 A communication link to the sign, as specified in the tender documents, shall be provided in accordance with AS 4852.1 Section 2.3.

2.1.2 The sign shall be capable of the following:

- displaying instantaneous messages downloaded from any third-party controlling device connected to the serial port or Ethernet port, which will temporarily override any current displays, strings or scheduling until the instantaneous messages are completed;
- displaying frames in different appearance modes;
- displaying any approved font, graphic or display which fits into the given matrix, irrespective of what pixels are on or off;
- Provide a list of alarms and reporting procedures.

2.1.3 This section on operation and control assumes the inclusion of the pictogram as specified in Section 4 of this specification.

2.2 SIGN CONTROL PERFORMANCE AND CAPABILITY

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

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

2.2.3 The response time (the latency from when VicRoads FP sends a request message to when a valid response message is received by the FP, i.e. the response time includes the time for transferring the request message from the FP to the sign controller via a serial link, sign controller processing time for generating a valid response message and the time for transferring the valid response from the sign controller to the FP via serial link) shall be less than 2 seconds.

2.3 SIGN CONTROLLER (SC)

2.3.1 The sign shall be controlled via a separate Sign Controller. Under normal operation, its main purpose is to provide both serial and Ethernet interfaces to a third-party controlling device, over which RTA protocol shall be transmitted in order to control the 4-colour pictogram and mono-colour text elements of the connected VMS.

- 2.3.2 The sign controller shall be designed to be installed within a standard 19'' rack based roadside cabinet in accordance with VicRoads specification TCS 011, Universal Roadside Cabinet.
- 2.3.3 An alternative cabinet may be considered provided it is designed to be mounted onto the standard VicRoads cabinet foundation.
- 2.3.4 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.
- 2.3.5 From the controller, the connected VMS's text and pictogram elements shall appear as 2 distinct RTA protocol based sign devices.
- 2.3.6 All of the controller's communication and power interfaces shall be clearly and indelibly labelled on the controller housing. labelled on the SC housing itself.

2.4 COMMAND LINE INTERFACE (CLI):

- 2.4.1 All settings, diagnostic and configuration related functions shall be accessible via a text-based, CISCO like CLI (implemented using software such as the open source [libcli](#)).
- 2.4.2 The sign controller shall provide CLI via the Ethernet port using the Telnet protocol, and shall also present the interactive CLI as a web page through HTTP.
- 2.4.3 When a user initiates a CLI session, they shall first be prompted for a password (configurable) before any access is allowed. The user shall have the ability to actively log out of the CLI while remaining connected to the Telnet session. If the Telnet session is terminated, or TCP connection is lost, then log out shall occur automatically.
- 2.4.4 The CLI shall provide, as a minimum, the key *configuration* and *sign control* functions as shown in Table 2.1 and 2.2.

Configuration Functions (minimum)
Login & set / clear login password
Set / read the SC's hostname (used as an alias or 'site nickname')
Retrieve fault log
Clear fault log
Set / read all IP parameters including SC's IP address, NTP server IP address, Modbus TCP/UDP mode and all TCP/UDP port assignments
Set / read various hardware serial port parameters
Perform SC and VMS firmware upgrades
Set / read sign RTA addresses
Check current firmware version
Check current user connections (analogous to Unix 'who' command)
Reset / reboot the SC

Table 2.1 – Minimum configuration functions

Sign Control Functions (minimum)
Display any frame (on both pictogram & text elements)
Display any pre-configured message (on both pictogram & text elements)
Set / read sign brightness level
Blank the sign (on both pictogram & text elements)
Turn conspicuity lanterns on / off
Author simple text message frames for display on text element
Read sign pixel (failure) status
Reset / reboot the pictogram and text elements
Reset / reboot the VMS elements

Table 2.2 – Minimum sign control functions

2.5 RESET AND MASTER RESET

- 2.5.1 On reset or reboot of the sign controller and/or VMS (regardless of source), the VMS's display shall be set to blank.
- 2.5.2 The sign controller shall incorporate a master reset button accessible on the front chassis. The reset button shall function as follows:

Momentary press: soft reset the SC & Connected VMS. All configurations within the SC and VMS shall be maintained.

10 second press: hard reset the SC & Connected VMS. The configuration parameters within the SC shall be reset to defaults as detailed below. All frames & messages stored within the VMS pictogram and text elements shall be cleared.

2.6 SIGN CONTROLLER PARAMETER DEFAULT SETTINGS

2.6.1 The default settings for key parameters within the SC shall be as shown in Table 2.3.

Parameter	Description	Default Setting
SC login password	Password required for access to the SC's CLI	"password"
SC hostname	The SC's hostname shall act as it's alias or 'site nickname'	[SC's unique serial number]
SC IP address	Selectable DHCP or statically configurable IP address and Netmask	STATIC IP: 192.168.0.1 Mask: 255.255.255.0
RTA over UDP/IP, TCP/IP (Modbus encapsulation)	TCP and UDP port numbers	TCP 6632 UDP 6632 Default mode: UDP
Text element RTA address	Unique RTA Protocol address	1
Pictogram element RTA address	Unique RTA Protocol address	2
Serial port - text	Hardware serial port settings for the text element	RS422 2400kbps, 8 N 1
Serial port - Pictogram	Hardware serial port settings for the pictogram element	RS422 2400kbps, 8 N 1
HTTP	TCP port number used for web access to the CLI	TCP 8080
Telnet	TCP port number used for connection to the CLI	TCP 6368

Table 2.3 – Sign controller key parameters

2.7 ETHERNET

2.7.1 The SC shall provide at least one 10/100 TX Ethernet interface. The Ethernet interface shall support the modes of communication and protocols detailed in Sections 2.8, 2.9 and 2.10 of this specification.

2.8 RTA PROTOCOL FOR SIGN CONTROL

2.8.1 The operation of the sign shall be controlled by means of the RTA communications protocol to comply with AS 4852.1 Section 4.5, via the physical serial and the Ethernet interfaces defined above. This protocol is defined in the RTA specification TSI-SP-003 "Communications Protocol for Roadside Devices" current version 2.1.

- 2.8.2 Remote control of the sign shall be facilitated via the STREAMS protocol.
- 2.8.3 In order to implement the 4-colour operation of the VMS pictogram element, extensions to the default RTA protocol message suite as defined by VicRoads will be required. The RTA specification for this is ITSM-TO-ITS-CSI-002 Colour Sign Interface.
- 2.8.4 If a controlling device (usually a VicRoads field processor) sends an RTA command which is not supported, then the SC shall reply with a Reject Message with an appropriate Application Error Code as defined in the RTA protocol specification.
- 2.8.5 The sign controller shall support all fault logging and diagnostic functionality provided by the RTA protocol.
- 2.8.6 RTA “Heartbeat Poll” messages from the controlling device shall be serviced by the sign controller within 0.5 seconds of reception of the heartbeat request.
- 2.8.7 The sign controller may also support customised messages for special functions. In this case, such messages shall be in RTA protocol format and shall be fully documented for integration with 3rd party systems. The supplier shall supply full details of any such customised RTA protocol messages for integration with 3rd party software vendors.
- 2.8.8 The sign controller shall fully implement all defined RTA protocol layers including error checking as described in the RTA protocol specification.

2.9 RTA PROTOCOL CONTROL VIA MODBUS OVER UDP/IP & TCP/IP

- 2.9.1 The primary function of the Ethernet port shall be to offer a 3rd party controlling device the ability to control the VMS via RTA protocol messages encapsulated within Modbus packets.
- 2.9.2 A controlling device shall be able to transmit and receive bi-directional RTA protocol messages using Modbus. The Modbus transport mechanism shall be selectable between UDP/IP and TCP/IP from SC’s CLI menu.
- 2.9.3 The controlling device shall establish a connection to the SC’s IP address on single TCP port, over which Modbus-encapsulated RTA protocol messages shall be sent to the individual VMS pictogram and text display elements – each display element shall have a unique and configurable RTA protocol address. These RTA addresses shall be configurable through the CLI.

2.10 OTHER PROTOCOLS

- 2.10.1 In addition to standard TCP/IP detailed above, the SC shall support the following protocols as a minimum:
- ICMP (ping)
 - NTP (to set & maintain the SC / VMS clocks)
 - Telnet (method to provide access to the CLI over TCP/IP)
 - HTTP (method to provide the CLI within a web browser)

2.10.2 The SC shall have the capacity to be updated in order to apply TLS (SSL) and SSH encryption on the serial socket connections, HTTP and Telnet interfaces should it be required in the future. Where encryption is enabled, the SC shall provide a facility to securely upload encryption certificates &/or change the encryption password from a remote location.

2.11 HARDWARE SERIAL PORTS:

2.11.1 The SC shall provide a minimum of two hardware serial ports with standard DB-9 connectors. Each of the ports shall correspond to the text and pictogram elements respectively and shall provide control of these sign elements using RTA protocol.

2.11.2 Both of the serial ports shall function in accordance with Table 2.4:

Physical Interface Std.	RS422 and RS485 (autosensing, or software configurable)
Baud Rate	2400bps – 115200bps
Data bits / stop bits	Configurable
Parity	Configurable

Table 2.4 – Serial port function

2.12 DIAGNOSTIC FUNCTIONS

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

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

2.12.3 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

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

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

** NOTE: Any LED pixel shall be deemed “faulty” if it does not behave as expected. Such behaviour shall include pixels remaining in the wrong state (on or off), pixels which flicker, 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.

2.13 MONITORING, FAULT LOGGING AND REPORTING

2.13.1 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.

2.13.2 The VMS shall automatically respond to faults according to Table 2.5 below.

	Failure types	Responses
i.	Where mains power is lost to the SC OR the VMS itself.	<ul style="list-style-type: none"> ▪ The entire display area of the VMS shall be completely blanked. Create a log in the SC specifying power failure for affected device(s).
ii.	Where the communication link to either of the SC’s physical serial ports is lost or adversely affected.	<ul style="list-style-type: none"> ▪ The entire display area of the VMS shall be completely blanked. Create a log in the SC detailing which serial interface was affected.
iii.	Where an established communication link over TCP/IP is lost or interrupted.	<ul style="list-style-type: none"> ▪ The entire display area of the VMS shall be completely blanked. Create a log in the SC detailing the nature of the link loss.
iv.	Where the communication between the SC and the VMS itself is lost or adversely affected.	<ul style="list-style-type: none"> ▪ 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.
v.	Where internal faults are detected within the SC and/or VMS itself, i.e. watchdog timeout etc.	<ul style="list-style-type: none"> ▪ The entire display area of the VMS shall be completely blanked. Create a log in the SC specifying the nature of the failure.
vi.	Where 10 percent or more of LEDs 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.	<ul style="list-style-type: none"> ▪ 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).

Table 2.5 – Fault Responses

2.14 LOCAL CONTROL

- 2.14.1 The ground level access shall include RS 232 and Ethernet connections and also include a 240V socket outlet with integral RCD.
- 2.14.2 The Ethernet interface shall provide the sign with:
- at least one IEEE 802.3 10/100 BaseTX Ethernet interface with RJ-45 socket connection;
 - support for DHCP or static IP addressing;
 - sign management and configuration via Ethernet using telnet, ssh or http protocol;
 - diagnostic information via SNMP (v2.0 or higher version) protocol.
- 2.14.3 The sign shall be capable of being programmed in accordance with AS 4582.1 Section 4.4.
- 2.14.4 The software for local operation shall be capable of the following facilities:
- word wrap;
 - auto centring;
 - auto placing of text on screen.
- 2.14.5 The features shall be incorporated together with all display changing parameters as detailed in Section 3.
- 2.14.6 The frames and/or message strings produced in this manner shall be capable of being directly displayed on the sign, over-riding the current scheduled program.

2.14 REMOTE CONTROL

- 2.15.1 Standard operation of the sign shall be via a remote system as defined in AS 4852.1, Section 4.3
- 2.15.2 The sign controller shall be able to be controlled via serial connection and Ethernet connection by using RTA protocol.
- 2.15.3 All communications between the host computer and the VMS shall be specified in individual tender documents. Typically, the communications shall be via fibre-optic cable or the Next GTM wireless network using compatible modems.

2.15 MANUAL OVERRIDE FACILITY SWITCH CONTROL

- 2.15.1 A facility switch shall be provided to enable local, manual override control over the sign display.
- 2.15.2 The switch shall meet the physical requirements specified in Section 6.5 of this specification.
- 2.15.3 The switch shall provide for three display modes as detailed in Table 2.6.

OFF	VMS display completely blank
TEST	The VMS shall display the chequered test pattern on both the text and pictogram display elements – the pictogram pattern shall consist of 4 colours in accordance with Section 2.18 of this specification.
AUTO	VMS to operate normally

Table 2.6 – Facility switch positions

2.15.4 The switch shall only switch extra low voltage.

2.15.5 The switch shall not switch low voltage.

2.15.6 The sign controller shall report the current position of the facility switch through a status reporting mechanism using RTA protocol and through the sign controller’s text-based menu (CLI)

2.16 FALL-BACK SYSTEM

2.16.1 The sign shall incorporate the ability to fall back to a pre-defined operation mode when a major system failure occurs in accordance with AS 4852.1, Section 4.7.

2.17 TEST AND CONFIGURATION SOFTWARE

2.17.1 The supplier shall provide test and configuration software for the complete sign to be compatible with Microsoft Windows XP®.

2.17.1 The software shall provide the ability to exercise all diagnostic, test and setup functions of the sign and its controller.

2.17.2 The software shall include all Windows® device drivers required for connectivity from a laptop computer to all the controller’s communications interfaces.

2.17.3 A standard RS232 serial cable at least 5 metres in length suitable for connecting to a laptop computer to the sign controller shall be provided.

2.18 DISPLAY TEST PATTERNS

2.18.1 The sign shall be capable of generating test patterns on both the text and pictograms sections of the sign.

2.18.2 The test patterns shall include, as a minimum, the following:

- specified regions showing all pixels off;
- specified regions showing all pixels on;
- specified regions showing a chequered pattern where no two adjacent pixels are on.

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

2.19 FIRMWARE UPGRADE

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

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

2.19.3 If communication is lost during any firmware upgrade, the device being upgraded shall revert to its previous firmware version and settings automatically without the need to power cycle the device.

SECTION 3 DISPLAY AND OPTICAL REQUIREMENTS

3.1 GENERAL

- 3.1.1 The general display requirements shall comply with AS 4852.1, Section 3.1.1.
- 3.1.2 Where a pictogram is specified, it shall comply with Section 4 of this specification.
- 3.1.3 The symbols generated on the sign shall comply with the requirements of AS 4852.1, Section 3.1.1 and/or layouts approved by VicRoads. The minimum legibility distance of the sign (when displaying standard formats as defined in the document) shall be 200 metres during both day and night.

3.2 DISPLAYS

- 3.2.1 The VMS display dimensions shall be Type C as defined in AS 4852.1, Section 3.1.2.
- 3.2.2 LEDs shall be arranged in a pixel matrix as specified in AS 4852.1, Section 3.1.4.
- 3.2.3 The dimension of the housing shall be the minimum practical required to house the display. The dimensions of the entire VMS assembly, including the pictogram section, shall not exceed:
- Height: 2.3m
 - Width: 10m
 - Depth 0.35m

3.3 SIGN DIMMING CONTROL

- 3.3.1 The sign shall have the ability to dim the light output intensity of its display to comply with AS 4852.1, Section 3.1.11.
- 3.3.2 The supplier shall submit details of the peak normal and dimmed operational loads at the time of tender.

3.4 CHARACTER FORMATS

- 3.4.1 Character formats and fonts shall conform to the requirements of AS 4852.1, Section 3.1.5.
- 3.4.2 Standard operation of the sign shall permit the generation of default Font 2 characters.
- 3.4.3 To enhance the graphical qualities of the display, the individual pixel (element) dimensions shall not be greater than 40mm.

3.4.4 In addition to the standard operation, the sign shall be capable of generating:

- double stroke characters;
- two lines of Font 4 characters;
- one line of Font 5 characters, and
- various fonts and proportional spacings.

3.5 DISPLAY CHANGES

3.5.1 Standard display changing shall comply with AS 4852.1, Section 3.1.6.

3.5.2 The total time for standard display changing shall not be greater than 0.5 seconds. Successive flashing of any display shall occur at a rate of 0.5 seconds on and 0.5 seconds off.

3.6 OPTICAL REQUIREMENTS

3.6.1 Photometric Requirements

3.6.1.1 The photometric requirements shall comply with AS 4852.1, sections 3.2.1 and 3.2.2.

3.6.1.2 The photometric test procedures shall comply with AS 4852.1, Appendix C.

3.6.2 Colormetric Requirements

3.6.2.1 The colormetric requirements shall comply with AS 4852.1, sections 3.2.3.

3.6.2.2 The colormetric test procedures shall comply with AS 4852.1, Appendix D.

3.6.3 Lifespan Requirements

3.6.3.1 The lifespan requirements for LED pixels outputs shall be in accordance with Appendix C.

3.7 CONSPICUITY DEVICES

3.7.1 Conspicuity devices, shall be provided in accordance with AS 4852.1, Section 3.1.12.

3.7.2 The default flash rate for the conspicuity devices shall be 1 second cycle times with a duty cycle of 50% as specified in AS 4852.1, Section 3.1.12.

3.7.3 The conspicuity devices shall support the following patterns for flashing:

- top and bottom (default);
- left and right;
- opposite corners; and

- all on/all off.

3.7.4 The default flash pattern shall be flash both upper conspicuity devices simultaneously then both lower conspicuity devices simultaneously.

SECTION 4 COLOUR PICTOGRAM REQUIREMENTS

4.1 GENERAL

- 4.1.1 Where specified in individual tender documents, the sign shall incorporate a pictogram display section mounted as shown in Figure 3.1.
- 4.1.2 The pictogram section shall be a four colour (red, yellow, green and white) display located on the left side of the sign.
- 4.1.3 The standard text display (in accordance with AS 485.1) located on the right side of the sign.
- 4.1.4 As far as practicable, there shall be no visible delineation or border between the pictogram and text regions of the display. See Figure 4.1.

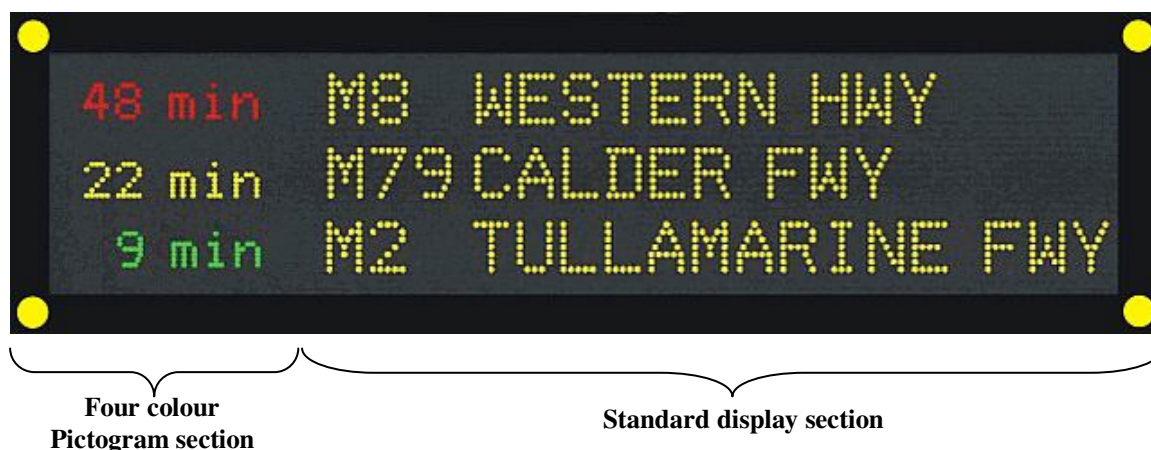


Figure 4.1 – Typical layout of VMS with pictogram

- 4.1.5 The pictogram shall operate according to RTA protocol ITSM-TO-ITS-CSI-002 Colour Sign Interface to provide pixel colour outputs of red, yellow, green and white.

4.2 PICTOGRAM DISPLAY REGION

- 4.2.1 The pictogram display region of the sign shall be square in shape with 64 evenly spaced pixels both horizontally and vertically.
- 4.2.2 The pixels shall have a height to width ratio of 1:1.
- 4.2.3 The overall height of the pictogram regions shall be the same as the text region.
- 4.2.4 The pictogram display shall be capable of displaying traffic conditions for up to three destinations. A typical arrangement is shown in Figure 4.1.

4.2.5 The travel times shall be capable of displaying traffic conditions as follows:

- Green to indicate light traffic conditions;
- Yellow to indicate medium traffic conditions; and
- Red to indicate heavy traffic conditions.

4.3 PICTOGRAM OPTICAL REQUIREMENTS

4.3.1 Photometric Requirements

4.3.1.1 The photometric requirements shall comply with AS 4852.1, sections 3.2.1 and 3.2.2.

4.3.1.2 The photometric test procedures shall comply with AS 4852.1, Appendix C.

4.3.2 Colormetric Requirements

4.3.2.1 The colormetric requirements shall comply with AS 4852.1, sections 3.2.3.

4.3.2.2 The colormetric test procedures shall comply with AS 4852.1, Appendix D.

4.3.3 Lifespan Requirements

4.3.3.1 The lifespan requirements for LED pixels outputs shall be in accordance with Appendix C.

4.4 DISPLAY CHANGES

4.4.1 The complete sign shall be capable of displaying single frames on:

- The text and pictogram regions simultaneously;
- The text region only; and
- The pictogram region only.

4.4.2 The complete sign shall be capable of displaying multi-frame messages on:

- The text and pictogram regions simultaneously;
- The text region only; and
- The pictogram region only.

4.4.3 Any frame or sequence of frames displayed on the text and pictogram regions shall have the ability to be flashed through all the mechanisms (with support of the full range of associated parameter inputs) for message generation defined by the RTA protocol specification.

4.4.4 Where the text display region and the pictogram region are both displaying a multi-frame message, changing of these frames on both regions shall occur simultaneously. Such changes shall consist of complete blanking of one frame and immediate display of the next frame.

SECTION 5 ELECTRICAL REQUIREMENTS

5.1 GENERAL

- 5.1.1 The electrical system of the sign shall comply with AS 4852.1, Section 2.2
- 5.1.2 Transformers used within the sign and/or sign control system shall comply to AS 61588.
- 5.1.3 All cables and wires shall be insulated with a material not inferior to V-90 grade PVC and shall be suitably labelled.
- 5.1.4 The modules and associated driver network and the control and communications equipment shall operate at extra low voltage (ELV).
- 5.1.4 The electrical system shall incorporate the following facilities:
- A switchboard located within the sign enclosure with a mains switch, a circuit breaker to protect the expected load and a double socket outlet with integrated RCD; and
 - A switchboard located within a ground level cabinet with a mains switch, a circuit breaker to protect the expected load and a double socket outlet with integrated RCD.

5.2 OPERATING VOLTAGE

- 5.2.1 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 $\pm 15\%$.

5.3 BATTERY BACK-UP

- 5.3.1 A battery back-up system shall be provided with each sign in accordance with AS 4852.1, Section 2.2.3.

5.4 INTERNAL PROTECTION

- 5.4.1 All equipment including data lines shall be internally protected against damage resulting from:
- lightning strikes at or near the sign/gantry;
 - electrical transients on power cabling;
 - electrical transients on communications wiring;
 - radio frequency interference;
 - static electrical discharge; and
 - any harmonics arising from the above and any equipment in the cabinet.

SECTION 6 MECHANICAL REQUIREMENTS

6.1 GENERAL

- 6.1.1 The materials, durability and lifespan requirements shall comply with AS 4852.1, Sections 2.1.1 and 2.1.2.
- 6.1.2 The design and construction of all structural steel work shall be carried out in accordance with the requirements of AS 4100.
- 6.1.3 The internal components of the sign, such as pixel display modules, control units and heating and cooling equipment shall be arranged in modules of a size capable of being removed and re-installed in-situ by hand from the access walkway. The construction and layout of the cabinet, framework and electronic driver networks should facilitate this requirement.

6.2 SIGN ENCLOSURE

- 6.2.1 The general construction requirements for the sign shall comply with AS 4852.1, Section 2.1.2.
- 6.2.2 Where the design does not incorporate a covering window, details regarding matrix sealing, cleaning and other pertinent matters shall be provided by the supplier at tender.
- 6.2.3 Access to all internal components shall be provided by door(s) in compliance with AS 4852.1, Section 2.1.2.
- 6.2.4 The rear of the sign enclosure shall be matt grey or matt black.

6.3 SIGN SUPPORT STRUCTURE AND ASSOCIATED FOOTING

- 6.3.1 Unless otherwise specified in individual tender documents, the sign shall typically be mounted on a suitable designed single column 'cantilever' type support structure and associated footing. The design of the support structure shall be such as to place the VM Sign over the roadway.
- 6.3.2 The sign support structure and associated footing shall comply with:-
- AS 4852.1, Section 2.1.3;
 - Bridge Technical Note BTN 2010 /001 – November 2010 Design of Steel Cantilever and Portal Sign Structures and High-Mast Light Poles (refer to the below link);
<http://www.vicroads.vic.gov.au/Home/Moreinfoandservices/RoadManagementAndDesign/DesignStandardsManualsNotes/TechnicalPublications/BridgeTechnicalNotes.htm>
 - AS 5100 Bridge Design.
- 6.3.3 In case of discrepancy, the Bridge Technical Note BTN 2010/001 – November 2010 will take precedence over AS 4852.

6.3.4 Unless otherwise specified in individual tender documents, the sign shall be mounted using one of the following methods:

- mounted on an overhead gantry; or
- mounted on a suitably designed single or double column.

6.3.5 Where the sign is mounted on an overhead gantry:

- Access will be provided via the gantry;
- No separate walkway or platform will be required.

6.3.6 Where the sign is mounted on a single or double column:

- the sign support structure shall provide a walkway and platform for access to the rear side of the installed sign in compliance with AS 4852.1, Section 2.1.3;
- the sign shall be mounted directly onto the support structure and shall be secured through the base of the sign;
- a mower strip not less than 0.5 metres larger than the base projection of the support column shall be installed around the base of the column(s).

6.3.7 The support structure shall be designed so that the installed sign has a minimum clearance above the roadway of 5.5m unless otherwise specified in individual tender documents.

6.3.8 All power supply, control and communication cabling shall be routed through the centre of a column and shall enter the sign enclosure through appropriately constructed and sealed entry holes.

6.3.9 The VMS mounting infrastructure shall provide a rear safety access platform suitably located to provide standing access to the integral components. The platform shall not be accessible from ground level without the use of a ladder, steps, cherry picker or similar device.

6.4 SIGN CONTROLLER HOUSING

6.4.1 The sign controller housing shall conform to the requirements of AS 4852.1, clause 2.1.4.

6.4.2 All fixing hardware shall be rust proof and shall not cause galvanic corrosion between the fasteners, rack chassis and the housing.

6.4.3 The sign controller shall be able to operate continuously at ambient temperatures ranging from -10°C to 60°C at 95% relative humidity (non-condensing).

6.4.4 A mower strip, not less than 0.5 metres larger than the base projection of the control housing, shall be installed around the base of the housing.

6.5 FACILITY SWITCH

6.5.1 A facility switch shall be provided as detailed in Section 2.15 of this specification.

6.5.2 The switch and key shall comply with the requirements of Clause 2.7.1 of AS 2578-2009 Traffic signal controllers.

- 6.5.3 The switch shall be mounted within the front face of the sign controller, internally of the cabinet or within its own 19" rack mounted unit no more than 1 RU in height.
- 6.5.4 Each position of the facility switch (as specified in Section 2.15 of this specification) shall be indelibly and durably labelled as per Figure 6.1.

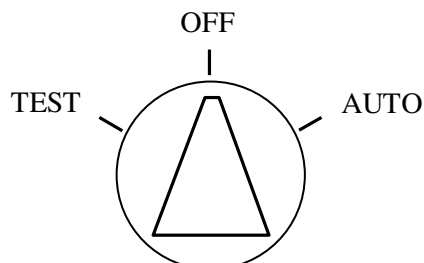


Figure 6.1 – Facility switch relative positions and labelling

6.6 MARKINGS AND LABELS

- 6.7.1 All markings shall be clear, permanent and weatherproof and shall include all the information specified in AS 4852.1, Section 2.5.

SECTION 7 ENVIRONMENTAL

7.1 GENERAL

7.1.1 The sign and all associated equipment shall comply with the environmental requirements specified in AS 4852.1, Section 5.

7.2 ELECTROMAGNETIC COMPATIBILITY (EMC)

7.2.1 The sign and all associated equipment shall comply with the electromagnetic immunity requirements specified in AS 4852.1, Section 5.4.1.

7.2.2 The sign and all associated equipment shall comply with the relevant requirements of AS 61000.6.3 for emissions.

APPENDIX A

VICROADS ITS PLATFORM

A1 GENERAL

- A1.1 VicRoads ITS platform currently uses Transmax's STREAMS system.
- A1.2 All ITS devices shall be compatible with STREAMS.
- A1.3 STREAMS is an integrated control system which operates ITS Freeway Management Devices and other traffic management devices.
- A1.4 STREAMS is a fully integrated ITS combining software, hardware and data communications network. VicRoads is using for:
- Motorway Management
 - Ramp Metering Management
 - Incident and Event Management
 - Real-time Traveller Information
- A1.5 STREAMS Motorway Management System aims to reduce travel time and accident rates, prevent congestion and enhance traffic flow for motorists by providing:
- Adaptive on-ramp metering
 - Off-ramp integrated with traffic signals to prevent queuing onto motorways
 - Automatic congestion notification via Variable Message Signs
 - Integration with all motorway ITS equipment
 - Variable Speed Limit and Lane Use Management
- A1.6 The VMS is connected to STREAMS typically use fibre optic cable or wireless connection between VicRoads and the Field Processor(FP).
- A1.7 The VMS is connected to the FP via the copper cable or wireless connection using STREAMS compatible protocol.

A2 HARDWARE

- A2.1 The FP is used to interface internet protocol (IP) and serially connected field devices to STREAMS.

APPENDIX B

GENERAL REQUIREMENTS FOR TESTING

B1 TEST FACILITY

- B1.1 The photometric, colorimetric and environmental testing shall be carried out at a test house that has NATA accreditation for those tests.

B2 TEST PROCEDURE

- B2.1 Photometric testing shall be carried out in accordance with Appendix C of AS 4852.1.
- B2.2 Colorimetric testing shall be carried out in accordance with Appendix D of AS 4852.1.
- B2.3 The supplier shall submit the results of testing to demonstrate compliance with the environmental requirements detailed in clauses 5.2 and 5.4 of AS 4852.1.
- B2.4 The supplier may be required to submit test reports to demonstrate compliance with other requirements of this specification.

APPENDIX C

LIFETIME PERFORMANCE REQUIREMENTS

C1 SCOPE

- C1.1 The purpose of this test is to ensure that the degradation of the VMS unit is within acceptable limits. The test is designed to measure the deterioration in performance of the optical properties of the active elements as well as the deterioration in the optical properties of any transparent protective cover.

C2 REQUIREMENTS

- C2.1 The requirements are that:

- after 12 months operation in the field, the VMS shall demonstrate an optical performance as described in Clauses 3.6 and 4.3 (as applicable) that is not less than 95% of the values determined at its initial compliance testing;
- after 36 months operation in the field, the VMS shall demonstrate an optical performance as described in Clauses 3.6 and 4.3 (as applicable) that is not less than 85% of the values determined at its initial compliance testing.

C3 SAMPLE PREPARATION

- C3.1 The sample provided at the time of the initial compliance testing will be taken and located outdoors in the same position as its intended use in the field. This will then be left to weather for 12 months. The intention is that the transparent protective cover be exposed to similar weathering conditions as the initially compliant VMS placed in the field. Consequently, it is not necessary that the discrete element module, initially provided in the casing, remains in the casing for the weathering exposure periods.
- C3.2 After the initially compliant sign has been operating in the field for 12 months, a module is selected from the sign face and removed. This module is then placed in the weathered casing and the tests carried out as described in Clauses 3.6 and 4.3 (as applicable).
- C3.3 The casing is then placed outdoors again to continue weathering for a further 24 months, i.e. a total of 36 months.
- C3.4 After the initially compliant sign has been operating in the field for 36 months, a module is selected from the sign face and removed (not the module that replaced the one that was removed at the 12 months period). This module is then placed in the casing which has now been weathered for 36 months and the tests carried out as described in Clauses 3.6 and 4.3 (as applicable).
- C3.5 All tests shall be carried out on a sample test area not less than 100mm in diameter in accordance with Figure C1.

Emitters = Active segments
 Element = Passive segments
 Cell = Natural rectangle which surrounds emitters and element
 thus gives basic unit dimension for a matrix

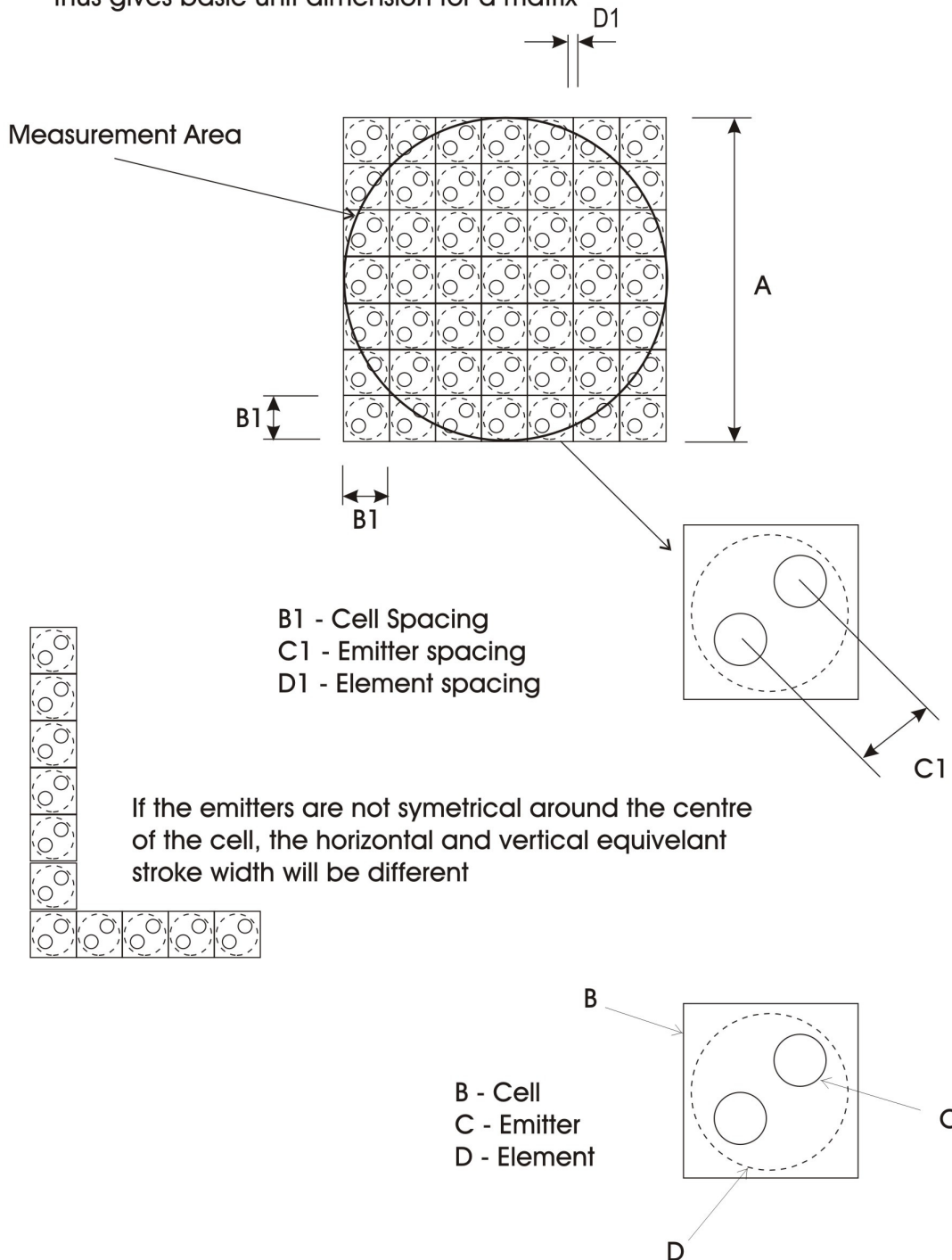


Figure C1 – 100mm diameter test area

APPENDIX D

REQUIREMENTS FOR APPROVAL

D1. GENERAL

D1.1 Variable Message Signs shall not be subject to standard evaluation procedures associated with formal Type Approval. Rather, VMS shall be subject to acceptance on a tender by tender basis. That is, the Supplier shall demonstrate to VicRoads satisfaction that the VMS complies with this specification.

D.1.2 To enable assessment for the purpose of granting acceptance, the Supplier is to submit the following with the tender documentation:

- An outline drawing showing the general presentation and overall dimensions of the complete Sign
- 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.

D2. REQUIRED NATA ACCREDITED TESTING

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

Section 3.6.1	Photometric Requirements
Section 3.6.2	Colorimetric Requirements
Section 4.3.1	Photometric Requirements for Pictogram (where specified)
Section 4.3.2	Colorimetric Requirements for Pictogram (where specified)
Section 7.2.2	Electromagnetic Compatibility (EMC) – Emissions
AS 4852.1	Variable message signs, Part 1: Fixed signs
Section 5.1	Temperature and Humidity
Section 5.2	IP Rating
Section 5.4.1	Electromagnetic Compatibility (EMC) – Immunity

D3. OTHER REQUIRED TESTING

D3.1 VicRoads may require additional information or testing to be carried out as part of its evaluation of the product.

D4. ASSESSMENT PROCEDURE

D4.1 The assessment procedure for a Variable Message Sign 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 using the manufacturer's software.

D4.2 Where some of these procedures have been completed prior to formal submission, the results will be considered in the evaluation, provided there is no relevant change in the design. The supplier is to state whether tests carried out prior to formal submission were carried out on an identical sample.

APPENDIX E

GUIDELINES FOR PURCHASING AND INSTALLATION

(INFORMATIVE)

E1. DETAILS TO BE CONSIDERED AND/OR INCLUDED WHEN TENDERING

E1.1 When tendering, the following details should be considered and included in the tender document as required:

- Is sign to be installed on existing gantry or supplied with support column(s);
- Proof engineering if intended to be installed on support column;
- The point of supply – Is the Contractor required to supply and install the mains supply including cable, conduits, pits, circuit breakers and connections from the nominated point of supply to the VMS housings or is this to be undertaken by others;
- The communications line - Is the Contractor required to supply and install the communications lines or is this to be undertaken by others;
- The installation of guard rail if required;
- The installation of a CCTV camera if required (recommended);
- The supply and installation of stickers on each VMS and/or the support structure, in accordance with either standard drawing TC-2100 for Standard Cabinet Label or standard drawing TC-2105 for Pedestal Controller Label, displaying the site number; and
- Lifetime performance testing if required.

E2. DOCUMENTATION

E2.1 The contractor shall be required to provide, as a minimum, the following documentation with the tender submission:

- Details of the calculated maximum demand of the Variable Message Sign;
- Details of the technologies proposed to be used in the display elements including optical/photometric and life performance details of the proposed technology to be used;
- Documentation required under Appendix C to demonstrate compliance with this specification; and
- Documentation required by clause 2.2.2.2