

Superseded

Technical Specification

**Transport and Main Roads Specifications
MRTS222 Electronic School Zone Signs**

July 2021

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1 Introduction

This Technical Specification applies to the design, supply, installation, testing and commissioning, performance, documentation, training, maintenance and handover requirements for electronic school zone speed limit signs.

These signs are intended to supplement an overall school environment safety treatment strategy to improve driver speed compliance in school zones.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications, as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

2 Definitions of terms

The terminology defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional terminology relevant under this Technical Specification are defined in Table 2.

Table 2 – Definition of terms

Term	Definition
4G/5G	Fourth/Fifth generation mobile phone technology
ADSL	Asymmetric digital subscriber line, a broadband technology
Design Guide for Roadside Signs	Transport and Main Roads Design Guide for Roadside Signs
Event	Any operation of the sign signifying a change of state, occurrence of a fault or change in mode of operation of the sign.
Field Processor	An industrial computer complying with requirements of MRTS232 <i>Provision of Field Processors</i>
GUI	Graphical User Interface
IoT	Internet of Things
ITS	Intelligent Transport Systems
LED	Light Emitting Diode
NATA	National Association of Testing Authorities
NTP	Network Time Protocol
PHCS	Product Host Control System: control/diagnostic software that runs on a laptop/handheld device and can control, interrogate and program the signs
Pixel	The smallest, discreetly-controlled light-emitting component of the sign display
Principal	Agency responsible for the contract (e.g., Transport and Main Roads/local government). Unless explicitly stated, this does not refer to the school Principal
PTN	Principal's Telecommunications Network
QTDF	Queensland Traffic Data Format
RAM	Random Access Memory

Term	Definition
RCM	Regulatory Compliance Mark
RPEQ	Registered Professional Engineer of Queensland
SAT	STREAMS Acceptance Test
Sign	Any of the following: enhanced school zone speed limit sign, electronic school zone speed limit sign, or vehicle activated school zone speed limit sign
Simultaneously	At the same time as apparent to the eye of an observer
STREAMS	The Principal's traffic management system and primary user interface to ITS field devices
Stroke width	The apparent width of active pixel(s)
TMC	Traffic Management Centre
TMS	Traffic Management System (STREAMS), but may be supplier sign management system in the interim, if so specified in the contract
Type 1 Sign	Enhanced School Zone Speed Limit sign – TC1783
Type 2 Sign	Variable Speed Limit sign – TC1785
Type 3 Sign	School Zone Speed Limit sign Speed Activated – TC1786

3 Reference documents

The requirements of the referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements* and Table 3 below, apply to this Specification. Where there are inconsistencies between this Technical Specification and referenced Technical Specification documents, the requirements specified in this Technical Specification take precedence.

Table 3 – Referenced documents

Reference	Title
AS 2898.1	<i>Radar Speed Detection – functional requirements and definition</i>
AS 2898.2	<i>Radar Speed Detection – Operational procedures</i>
AS 5156	<i>Electronic speed limit signs</i>
AS 60529	<i>Degrees of protection provided by enclosures (IP Code)</i>
AS/CA S042.1	<i>Requirements for connection to an air interface of a Telecommunications Network - Part 1: General</i>
AS/CA S042.4	<i>Requirements for connection to an air interface of a Telecommunications Network—Part 4: IMT Customer Equipment</i>
AS/NZS 1170.1	<i>Structural Design Actions, Permanent, imposed and other actions</i>
AS/NZS 1170.2	<i>Structural Design Actions, Wind Actions</i>
MRTS14	<i>Road Furniture</i>

Reference	Title
MRTS91	<i>Conduits and Pits</i>
MRTS92	<i>Traffic Signal and Road Lighting Footings</i>
MRTS97	<i>Mounting Structures for Roadside Equipment</i>
MRTS201	<i>General Equipment Requirements</i>
MRTS232	<i>Provision of Field Processors</i>
MRTS263	<i>Standalone Solar (PV) Power Systems</i>
MUTCD	<i>Queensland Manual of Uniform Traffic Control Devices</i>
TRUM Manual	<i>Traffic and Road Use Management Manual</i>

4 Quality system requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification. Additional quality system requirements relevant under this Technical Specification, are defined in Table 4.

Table 4 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.1	1. Samples for acceptance (design) 2. Optical performance certification		
6.7	3. Location of mounting structure		
8.1		1. Optical performance test	
10			Submission of civil works design documentation

4.1 Samples for acceptance

Detailed designs of the sign, equipment layout, fabrication and assembly drawings, calculations, specifications of component parts and certifications shall be submitted and approved by the Principal or their delegate for verification prior to manufacture.

Drawings shall specify the sign face, enclosure, solar module(s), radar modules, where necessary, posts and mounting accessories. The sign face drawings shall detail pixel rings, light emitting diode (LED) pixel arrangements showing horizontal and vertical pitch and character strokes as appropriate.

The Contractor's specifications shall include the manufacturer and model of LEDs to be used, power supply (charge controller and batteries), modems, communication ports, cable termination, enclosure and mounting accessories and wig-wags, as appropriate.

Unless specified otherwise, a sample of the sign complete with software and hardware necessary for configuration, fabrication and assembly drawings, calculations, specifications, user manuals and certifications shall be submitted to the Principal for acceptance. **Hold Point 1**

NATA optical performance certificates shall be submitted before delivery to site. **Hold Point 2**

5 Functional requirements

5.1 General

The sign shall only display the regulatory school zone speed applicable at the school zone where the signs are installed.

The signs shall be capable of autonomous operation and allow local and remote update of the clock and calendar. If specified, provision shall be made for connection of the signs to the Principal's ITS platform (STREAMS).

5.2 Sign types¹

Three types of school zone speed limit signs are described in this Technical Specification and the types are shown in Figures 5.2(a), 5.2(b), 5.2(c) following. For sign detail, see the relevant TC signs at [TC Signs](#) webpage.

Figure 5.2(a) – Type 1 – Enhanced School Zone Speed Limit sign – TC1783



¹ The 40 km/h shown in these figures is for illustration only. The desired speed shall be as per the terms of contract.

Figure 5.2(b) – Type 2 – Variable Speed Limit sign – TC1785

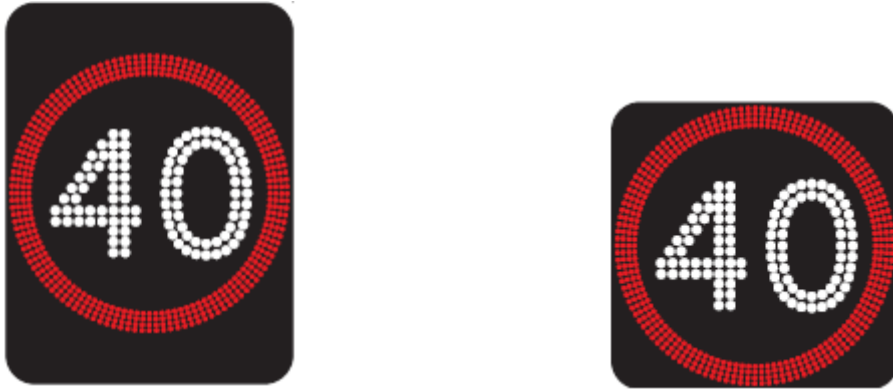


Figure 5.2(c) – Type 3 – School Zone Speed Limit sign Speed Activated – TC1786



5.2.1 Type 1 – Enhanced School Zone Speed Limit sign – TC1783

The enhanced school zone speed limit sign face shall be as outlined in TC1783. TC1783 is the same as R4-Q01, except that the enhanced sign has:

- a set of flashing lights or wig-wags above the ‘school zone’ wording, and
- has one or more LED-based rings located within the confines of the static annulus.

The annulus and wig-wag LEDs shall be red and yellow respectively.

During the school zone period, all the pixels constituting the annulus outermost ring(s) shall be activated. Selected inner rings of the annulus shall flash continuously until expiry of the school zone time period. When this sign is used at school zones, the sign shall only be capable of displaying the designated school zone speed limit and when in operation, the inner annulus rings and wig-wags shall flash continuously during the designated school zone periods and at no other times. The flash rate of the inner annulus rings and the wig-wags shall be the same, meaning that the annulus will flash simultaneously with one of the wig-wag LED lanterns. The wig-wags shall flash alternately.

Where requested, vehicle speed detection and recording shall be provided through use of a radar speed detection.

5.2.2 Type 2 – Variable Speed Limit Sign – TC1785

Type 2 signs shall only be installed as a supplement to static signage. They must be installed in conjunction with a static R4-Q01 sign, as detailed in the School Environment Safety Technical Guidelines.

The face of the sign shall comply with the speed restriction sign (R4-1 specified in the MUTCD), except:

- with illuminated white numerals within an illuminated red annulus on a matt black background as shown in Figure 5.2(b), and
- the sign enclosure may be square, but the active display elements shall still satisfy dimensions specified in R4-1.

The sign display shall remain blank at all times, except during the designated school zone periods. During the school zone period, all the pixels constituting the numerals and the annulus outermost ring(s) shall be activated. Selected inner rings of the annulus shall flash continuously, until expiry of the school zone time period. When this sign is used at school zones, the sign shall only be capable of displaying the designated school zone speed limit.

5.2.3 Type 3 – School Zone Speed Limit Sign Speed Activated – TC1786

Type 3 signs shall only be installed as a supplement to static signage. They must be installed in conjunction with a static R4-Q01 sign as detailed in the TRUM Volume 2, Part 3: *Speed Limits and Speed Management*.

The vehicle speed activated sign face shall be as outlined in TC1786.

The sign is similar to the Type 2 sign, but in addition has the words 'slow down' below the annulus.

The sign shall remain blank and disabled at all times outside the designated school zone periods. The display will only be enabled during the designated school zone periods, but will remain blank unless a vehicle travelling above a set speed in the school zone is registered. The set detection speed shall be a configurable parameter of at least 10 km/h above the speed limit in 1 km/h increments. In this case, all pixels constituting annulus, the numerals and the words 'slow down' shall switch on simultaneously. The sign display shall remain active for a set duration once activated. The sign shall remain active while the approaching vehicle remains at or over the speed threshold.

Vehicle speed detection shall be through use of radar unit.

6 Mechanical and physical requirements

6.1 General

The signs shall comply with the requirements of MRTS14 *Road Furniture* and the *Design Guidelines for Roadside Signs*.

Where required, pits and conduits to accommodate power and communication cables shall be supplied and installed according to the requirements of MRTS91 *Conduits and Pits*.

The mechanical and physical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

Additional mechanical and physical requirements for equipment provided under this Technical Specification are described below.

The materials and methods of construction of the materials, equipment and enclosures shall be such that they have the strength and durability to withstand expected conditions of transportation, installation and operation when installed in the intended environment.

The equipment and enclosures shall be of suitable design to protect against vandalism and prevent infestation by vermin. Ingress protection (IP) rating for enclosures, shall be no less than IP55 as defined in AS 60529 *Degrees of protection provided by enclosures (IP Code)*. This includes all cable penetrations and equipment that may be located external to the enclosure.

Physical LED protection shall be such that optical performance of the sign is unaffected. The signs shall be fitted with anti-vandal features, to reduce and deter vandalism to the sign and solar panel.

For Type 1 signs, the sign face material shall be aluminium. The flashing light assembly and accessories shall not cause the sign face to warp. The diameters of the flashing lanterns associated with each sign of sizes 'A', 'B' or 'C' shall be in accordance with TC1783.

If LEDs are used for the flashing lights, the luminance of the LEDs, when measured under laboratory conditions, shall comply with the requirements of AS 5156 *Electronic speed limit signs*.

6.2 Environmental conditions

The signs shall be capable of continuous, normal operation in the conditions described in MRTS201 *General Equipment Requirements*.

6.3 Sign placement

Sign placement shall be as directed by the Principal in accordance with requirements of TRUM Volume 2, Part 3: *Speed Limits and Speed Management* and the MUTCD. In addition, placement of Type 3 signs shall be such that sighting distance requirements and the distance to allow the proper function of the radar unit are met.

6.4 Sign enclosures

Associated sign control electronics shall be housed in an enclosure and in a manner which allows access for maintenance. Doors shall be capable of being hinged from either the left or right but, unless specified otherwise, shall be hinged from the left. The enclosure shall be fitted with a door switch to indicate if the enclosure door is open or improperly closed. All doors accessible to the public shall be lockable.

Venting and air circulation arrangements shall be such that the thermal ratings of the electronics are not exceeded. Use of filters and forced cooling, such as by use of fans, is not allowed. Peltier devices or other similar means may be used for moisture control. Door seals are to ensure sustained ingress protection for the service life of the sign.

6.5 Design life

Unless otherwise specified, the design life of components shall be as follows:

- LEDs/pixels: a minimum of 10 years
- door switch: 50,000 operations
- other electrical systems: a minimum of 10 years
- sign enclosure: a minimum of 20 years, and
- structural supports: a minimum of 40 years.

6.6 Design loads

Static and wind design loads shall be in accordance with AS/NZS 1170.1 *Structural Design Actions, Permanent, imposed and other Actions* and AS/NZS 1170.2 *Structural Design Actions, Wind Actions*.

6.7 Location of mounting structure

Each sign and associated equipment shall be capable of being pole-mounted.

Depending upon the roadside safety assessment, the system may use a separate support pole for the PV modules from that supporting the sign.

Frangible post or slip base construction may be used in high speed environments. The decision to use slip base or frangible posts shall be made by an engineer with the appropriate Registered Professional Engineer of Queensland (RPEQ) qualification.

Mounting hardware shall provide means to adjust the vertical and/or horizontal alignment of each sign and solar panel(s) during commissioning and subsequent maintenance activities.

Unless otherwise specified, the pole material and galvanised finish shall be as per MRTS97 *Mounting Structures for Roadside Equipment*. Poles shall be designed and approved by a structural RPEQ. All footings shall be consistent with MRTS92 *Traffic Signal and Road Lighting Footings*, but shall be designed and approved by a structural RPEQ.

Solar modules shall have a deterrent mechanism for stopping birds from resting on the module.

The location and type of mounting structure to be provided for each sign and solar panel, shall be shown on the design documentation.

Final footing, support structure design and locations as shown in design documentation, shall be submitted to the Principal's representative for acceptance before fabrication. **Hold Point 3**

6.8 Telecommunications field cabinets

Unless otherwise specified, no telecommunication field cabinets are required.

If specified, provision for connection to field cabinets shall be made by way of ducts and pits if so specified in the design documents. Pits and ducts shall be installed in accordance with MRTS91 *Conduits and Pits*.

6.9 Marking

Each sign shall be durably marked internally to show sign type, serial number, date of manufacture, Regulatory Compliance Mark (RCM) and firmware release version. The details shall allow traceability of the sign manufacture, according to the Contractor's quality system.

The rear of each sign shall be affixed with a unique identification number as nominated by the Principal and a telephone number to call in the event of a fault or damage to the sign. The label shall be designed to last 10 years in the range of environmental conditions described in MRTS201 *General Equipment Requirements*. The label shall be clearly legible from 1.5 metres above ground level, a distance of 5 metres from the base of the sign.

7 Operational requirements of sign display

7.1 General

The operational requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification. Additional operational requirements for equipment provided under this Technical Specification, are described below.

The apparent width of all displayed elements, including text, shall match the respective sign display defined in the MUTCD. The minimum legibility (sight) distance shall be sufficient for both the respective school zone speed and the default speed limit before the sign.

The sign shall display only the regulatory speed applicable during the school zone designated time period.

The calendar function shall be able to be programmed three years in advance. The school days shall be confirmed during the commissioning activities and retained as part of the non-volatile information stored in the sign.

7.2 Display technology

The display technology shall be LED. To achieve the required sign luminance levels, the display pixels may be formed by arranging one or more LEDs in a cluster.

7.3 LED output

Each individual LED shall be driven with a continuous current, with no peak and/or magnitudes exceeding 70% of the LED manufacturer's maximum continuous rating. For LEDs in a 5 mm or smaller diameter package, peak magnitudes of the LED current shall not exceed 20 mA.

7.4 Character formats

Character formats shall be as specified in Clause 5.2.

The annulus shall not be less in size than that required for an equivalent static sign.

7.5 Sign display

There shall be no discernible flickering of the displayed numerals or static portion of the annulus. Background flickering as a result of checking the 'on' and 'off' pixel status shall not be visible.

7.6 Display colour

For Type 1 signs, LEDs for the wig-wags shall be yellow in colour and LEDs for the annulus shall be red. For Types 2 and 3 signs, the display shall be generated by red and white LEDs on a matte black background.

The red, yellow and white colours for all sign types shall fall within the chromaticity co-ordinates specified in AS 5156 *Electronic speed limit signs*.

7.7 Default display

Facilities shall be included to detect failures within the display control system, with the sign blanking the display when major faults are detected.

In the case of Type 1 signs, loss of 20% of the annulus LEDs or 20% of either of the wig-wag lantern LEDs shall cause the sign to blank.

For Types 2 and 3 signs, the sign shall be able to detect LED failure even if the LEDs may be required to be 'off' at the time of the periodic check. The display shall be blanked upon failure of four or more contiguous pixels, or failure of more than 20% of total LEDs.

The sign shall blank the display for the following conditions:

- a sign processor fault
- corruption of the calendar, time function
- failure of 20% of LEDs of the annulus and/or any digit or when displayed digit cannot be readily recognised, and
- whenever the battery voltage is lower than the set threshold. However, upon battery recharge, the sign shall resume normal operation.

Ambient light sensor failure should not result in blanking of the display. Upon failure of the ambient light sensor, the sign should fall back to time-of-day brightness levels.

7.8 Event logging

If required, the sign shall log all operational and fault events, including the date and time that the event occurs. Details of these events shall be available via the Remote Sign Management System. The logging capacity shall be such that the logged data is of a minimum duration of one month. These events include, but are not limited to:

- activation of the school zone period (all signs)
- activation of display during school zone period (Type 3 sign)
- speed data (Type 1 when supplied with radar and Type 3 signs) in accordance with the QTDF format (refer to Clause 7.15)
- Lower Energy Alarm (sign will not work in 24 hours, if the battery does not receive charge in that time)
- loss of power (main and auxiliary)
- power restoration (main and auxiliary)
- high or low battery voltage occurrence
- door opening
- Daily Power Consumption
- failure to communicate with the designated remote sign monitoring system (TMC or supplier's system)
- LED failure
- light sensor failure
- dimming level
- loss of solar module
- high enclosure temperature, and
- local or remote connection, commencement and termination.

Type 1 signs when supplied with radar and Type 3 signs shall store in non-volatile memory:

- aggregates of the total vehicle activations per day
- Minimum Speed
- Maximum Speed
- 85th percentile speed (the speed at which 85% of the traffic is travelling), and
- Daily Average Speed (morning, afternoon, combined).

Logs shall be recorded in Australia Eastern Standard Time (AEST).

The sign shall also log the sign enclosure temperature each minute.

7.9 Red annulus

The annulus for the Type 1 sign shall comply with the requirements of TC1783.

In the case of Type 2 and Type 3 signs, the red annulus shall consist of suitably constructed, evenly-spaced pixel rings with at least three-pixel rings.

For Type 2 signs, all LEDs shall be active during the designated school zone periods.

For Type 3 signs, LEDs will only be enabled during the designated school zone periods but will remain blank and become activated only when a vehicle travelling above a set speed in the school zone is registered. When activated by a speeding vehicle, the LEDs of the annulus, the numerals and the 'Slow Down' message shall not flash, but shall remain on for a duration that would be visible to the speeding motorist for at least three consecutive seconds.

The annulus rings in all cases, shall be constructed so that LEDs connected in series are separated by at least three LEDs from other circuits.

7.10 Flashing display elements

The flash rate for elements of the sign that are required to flash, shall be configurable and shall initially be set to 50/50 (lit/unlit) with a cycle time of one second.

7.11 Conspicuity devices

No conspicuity devices or lanterns are required for the Types 2 and 3 signs. However, the signs shall allow for conspicuity devices to be added in future if desired.

7.12 Internal clock

The sign shall be provided with a 24-hour internal clock. The clock shall be able to be synchronised with the TMS system clock through Network Time Protocol (NTP) as determined by the Principal or other appropriate time source such as a GPS clock. Time error of synchronised clock shall be no more than one second over a period of one week.

7.13 Local facility switch

Where specified, a three-position key-operated facility switch, that complies with MRTS201 *General Equipment Requirements*, shall be provided to enable selection of the following three display functions:

- off: display blank, control via all communications ports inhibited, status and diagnostic commands via all communications ports remain functional

- test mode: display active, control via all communications ports inhibited, status and diagnostic commands via all communications ports remain functional, and
- normal: display active, displayed message selected via the maintenance communications port and/or the control communications port.

7.14 Radar unit

Type 3 signs shall have a radar unit for speed detection and recording.

Where specified, Type 1 signs shall also be supplied with a radar unit for speed detection and recording.

Radar selection, operation and alignment for detection shall comply with the functional requirements and operational procedures of AS 2898 *Radar Speed Detection*.

The radar unit shall be directional and it shall detect and record speeds of departing vehicles from the sign (arriving into the school zone). The radar unit shall be able to detect vehicles travelling at speeds ranging from 30 km/h to 160 km/h. The detection range shall be adjustable between 50 m and 100 m. The speed detection accuracy shall be better than 3%. Where the carriageway at the school zone has more than one lane, the radar unit shall be capable of detecting departing vehicles (including motorcycles and the like) in all lanes.

Speed threshold settings, detection distance and the range of the radar unit shall be configurable values, adjusted to suit the intended location of the sign.

The radar unit shall be mounted such that it is vandal-proof and able to be aimed in different directions independently of the sign face. The radar unit shall be adjustable, such that there is no interference with other radar units within the same carriageway.

7.15 Production data

Data captured from detection of every vehicle by Type 1 and Type 3 signs equipped with the radar unit, shall be in accordance with the format as described in QTDF. Each detection shall include the detected speed and time of the detection, alongside with the file header and checksum. The speed data shall be reported at the resolution of 1 km/h.

7.16 Optical performance test procedures

The optical performance for all LEDs used in the various sign types, shall be determined by measurement under laboratory conditions for:

- minimum luminance ratio
- minimum and maximum luminance and luminous intensity uniformity, and
- LED display colour as per AS/NZS 5156 *Electronic speed limit signs*.

The performance of the sign displays shall meet or exceed the requirements of AS 5156 *Electronic speed limit signs*. **Witness Point 1**

The luminance and the luminance ratio of the lit areas of the sign, when measured under laboratory conditions, shall comply with the luminance and luminance ratio requirements of AS 5156 *Electronic speed limit signs*.

7.17 LED intensity control

The LED intensity must be controlled to provide constant apparent brightness and maximum legibility distance for the range of the ambient light under which the sign must operate.

The light output intensity, the number of light sensors and the automatic dimming control functionality shall be in accordance with the display and optical requirements in AS 5156 *Electronic speed limit signs*.

7.18 Luminance intensity half angle

The luminance intensity half angle shall be not less than 10°.

7.19 Sun phantom

The effect of sunlight or other light sources shining on the optical elements, shall be controlled such that inactive pixels do not appear active.

For Type 1 signs, provision shall be made for each lantern to be fitted with a visor to minimise sun-phantom and veiling illuminance effects, or to reduce the possibility of a flashing signal being seen by traffic for which it is not intended.

The visor shall be sufficiently rigid to withstand distortion due to wind and extreme temperatures.

The interior surface of visors shall be finished, so as to minimise reflections of the illuminated signal.

8 Sign control system

The control system requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification. Additional sign control system requirements for equipment provided under this Technical Specification, are described below. The luminance and the luminance ratio of the lit areas of the sign when measured under laboratory conditions, shall comply with the luminance and luminance ratio requirements of AS 5156 *Electronic speed limit signs*.

8.1 General

The sign shall be capable of autonomous operation and allow local, as well as remote, access by diagnostic software and remote sign management software respectively. Each sign shall be uniquely identifiable electronically and shall be able to create a character string for use by the remote sign management software for this purpose.

Types 2 and 3 signs shall be able to vary the display light output, based on the output of the light sensor(s) connected to it. LED intensity control shall allow signs located on opposite sides of the carriageway to appear to have the same brightness.

8.2 Local control

The sign shall allow local control via a maintenance communications port using a laptop or a handheld device. Local control shall be gained using the diagnostic software. The system shall provide secure access to the signs, to prevent unauthorised access to the signs.

All sign diagnostics and configuration parameters able to be changed in the field, shall be accessible when the sign is selected for local control. Remote control of the sign shall be disabled, when the sign is selected for local control.

Disconnection of a laptop or handheld device shall cause the sign to revert to autonomous operation.

Ending of the maintenance session shall not require further interaction from the user, nor in any way interrupt operation or require re-booting of the sign, but immediately let the sign revert to autonomous operation.

8.3 Sign remote control

Each sign shall be capable of being accessed remotely via a communications port. The sign shall allow remote updates of the calendar and synchronisation of time with the remote sign management software.

The sign shall be able to service requests by the remote sign management software, including status reports and a log of events.

The sign shall be able to send unsolicited status message/alarm within a reasonable time to the remote sign management software, should an event or fault occur that requires blanking of the display, annulus, numerals, or lanterns (wig wags). The remote sign management system or sign itself, shall be able to send notifications to the respective maintenance authority via email/SMS, if the sign has gone blank due to a fault.

The sign shall be supplied with communication equipment to establish a communication link to the sign management system.

On power restoration, after loss of power, the ESZS modem shall become available and resume communication with the remote sign management system without the need for manual reset.

For Type 3, and where specified, Type 1, signs shall provide functionality for setting and changing the activation speed remotely. The signs shall also log speeds in bins. The bins shall be remotely adjustable with minimum bin widths of 1 km/h.

If specified, connection to the Principal's network shall be made through a field processor that meets the requirements of MRTS232 *Provision of Field Processors*.

8.4 Sign management software

8.4.1 General

The software shall

- request passwords as part of the access and configuration authorisation process, and
- be compatible with Microsoft Windows®, or a similar industry standard operating system environment currently available and supported by the software vendor. Any software provided, shall be capable of operating on all such operating systems.

8.4.2 Diagnostic software

Diagnostic software shall be supplied with the sign for the purpose of sign configuration, commissioning and maintenance activities. The diagnostic software shall fully implement all the sign functions required for the commissioning and maintenance of the sign.

The diagnostic software shall be configured to request passwords, as part of the sign access and configuration authorisation process.

If required, the diagnostic software shall be capable of suggesting ranges for each parameter as applicable when programming and not allow these limits to be exceeded.

The diagnostic software shall have the capability to save and upload sign configurations to and from the respective school zone signs.

A desirable feature of the diagnostic software is a test program. This would facilitate testing of all the essential sign features, including the ability to activate, deactivate all pixels, select the number of the annulus inner rings to flash and to vary LED brightness.

The software shall allow the request of a full log of events and querying of events according to set criteria, such as by sign(s), time, date, event type, or by duration.

8.4.3 Remote Sign Management System

It is intended that some of these signs will be connected to STREAMS in the future. As a result, detailed protocol information is to be provided in order to enable a STREAMS device driver to be written. At this stage, Transport and Main Roads is currently investigating the possibility of using an existing communications protocol from other road agencies for this type of device.

A Remote Sign Management System must be supplied. The Remote Sign Management Software should:

- detail the location and current status of all signs (operational, idle, fault condition)
- show signs on a map-based GUI
- implement multiple levels of user access, such as:
 - Administrator
 - maintenance
 - standard user, and
 - read only
- allow querying of events according to set criteria such as by sign(s), time, date, event type or by duration
- poll the signs in the field every 24 hours to verify the communications link and that the sign has not failed. Failure of the sign management system to gain a response from the sign, shall result in an event being logged in the system that highlights the sign status is unknown and possibly failed or damaged
- allow updating and programming of each sign calendar,
- back-up / export / import of sign configuration and calendar, and
- be able to generate weekly reports that include the current operational status of all the signs managed by the remote sign management system.

8.5 Communication protocol

Communication with the sign shall be in accordance with a protocol accepted by the Principal's Representative and the requirements of MRTS201 *General Equipment Requirements*.

Detailed protocol information shall be provided which may be used in assessing the product and its potential for interoperability with existing or proposed Transport and Main Roads' systems.

9 Installation requirements

The installation requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification. Additional installation requirements relevant under this Technical Specification, are described below.

- a) The general layout, positions, reduced level for the footing (where applicable) and speed zones for the sign and details of the barrier and other mounting requirements, shall be as shown on the design documentation.
- b) The position of in-ground mounting structures shall comply with the requirements of the MUTCD.
- c) The positioning of sign shall provide sight distances as described in the TRUM Manual.
- d) The sign location shall be verified by site inspection and shall be shown on the design documentation. The design documentation shall be submitted to the Verifier not less than seven days prior to the commencement of civil works for the sign foundations. **Milestone**

Before installation, the Contractor shall confirm the final sign location and the type, location and positioning of the mounting arrangements and/or protection barrier, as shown in the design documentation to the Verifier.

10 Environmental

The environmental requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification.

11 Electrical

11.1 Mains power

Where mains power is required, the relevant electrical requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

11.2 Battery power

Where mains power is required, also provide a backup battery power supply in accordance with MRTS201 *General Equipment Requirements* for the real time clock and processor, to allow orderly power down in the case of loss of power supply.

11.3 Solar power

Where solar power is specified, the requirements defined in MRTS263 *Standalone Solar (PV) Power Systems* apply to this Technical Specification.

12 ITS network telecommunications

The telecommunications requirements defined in MRTS201 *General Equipment Requirements* apply to this Technical Specification.

The sign's communication equipment shall support remote connectivity via Cellular 4G/5G network, IoT, ADSL or the Principal's data communications network in accordance with AS/CA S042 standards.

In order to protect the system against unauthorised access via communication ports, the sign shall have session management or a similar method.

A NATA accredited, or equivalent report showing compliance with the requirements of AS/CA S042 standards, shall be provided.

IoT communication solutions are encouraged for their low power requirements, which will result in improved use of battery power and therefore operational longevity.

At this stage, Transport and Main Roads is currently investigating the possibility of using IoT solutions in various high-volume low-power ITS devices.

13 Testing and commissioning

13.1 General

The testing and commissioning requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification. Additional testing and commissioning requirements, relevant under this Technical Specification, are described below.

13.2 Test signs

Where specified in the design documentation, a test sign complete with accessories, shall be provided to the Principal as part of acceptance tests including, where applicable, STREAMS Acceptance Test Plan (SAT) for testing of software components used to control signs within the ITS Network. Where STREAMS is specified and the sign has previously passed a SAT, provision of the test sign will not be necessary unless the Principal specifies.

13.3 Factory acceptance tests

Compliance with the optical performance requirements shall be determined by measurement under laboratory conditions of the parameters listed in AS 5156 *Electronic speed limit signs* for each batch of signs provided by the Contractor.

13.4 Site acceptance test

All equipment shall be subject to production testing and each commission sign shall be functionally tested before the handover to customer.

The test shall, as a minimum, include the following procedures:

- simulation of all fault conditions, including:
 - total failure / sign knockdown
 - removal of solar panel
 - radar alignment, where applicable
 - communications failure, and
 - LED fault – both annulus and wig-wags

The Contractor shall provide a test report with the results of the witnessed tests.

13.5 System acceptance test

After all sites pass a site acceptance test, the system shall be tested, by visual verification of each sign site, during and outside school zone periods. The Contractor shall verify the correct operation of each sign, with the parameters observed in sign management system.

13.6 Sign configuration

Setting of the time, calendar functions and display duration and activation speed (for Type 3) shall be performed as part of the commissioning process. The Principal will provide the set speed for vehicle activation and the active display duration time.

14 Documentation

An Operations and Maintenance Manual shall be provided with each sign.

The documentation requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification.

15 Training

The training requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification.

16 Maintenance

The maintenance requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification.

17 Handover

The handover requirements defined in MRTS201 *General Equipment Requirements*, apply to this Technical Specification.

18 Type Approval

Enhanced School Zone Signs shall be type approved to use as a traffic control device. The checklist for the type approval evaluation is published as Appendix A to this Technical Specification.

Superseded