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Technical Specification

Transport and Main Roads Specifications
MRTS213 UPS for Roadside Devices

November 2018

Queensland Government

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1 Introduction

This Technical Specification defines the general design, supply, construction, installation, testing, commissioning and maintenance requirements for Uninterruptible Power Systems (UPS) for ITS and Traffic Signal Controller (TSC) applications.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Quality System Requirements*, MRTS201 *General Equipment Requirements*, MRTS255 *Traffic Signal Controllers*, AS 2578 *Traffic Signal Controllers*, and other Technical Specifications as appropriate.

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

2 Definition of Terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications* and MRTS201 *General Equipment Requirements*. Further definitions are referenced in Table 2 and AS/NZS 3000.

Table 2 – Definition of terms

Term	Definition
AC (ac)	Alternating current
AS/NZS	Australian and New Zealand Standards
Battery	Device consisting of one or more electrochemical cells used to convert stored chemical energy into electrical energy.
Battery Management System (BMS)	Electronic system for managing a rechargeable battery by such processes as monitoring its state, charging, protecting and balancing it, and controlling its environment.
DC (dc)	Direct current
DOD	Depth of discharge, the designed maximum amount of discharge of a secondary cell battery allowed for before recharging must start or the load is disconnected.
Extra Low Voltage (ELV)	Voltage not exceeding 50 V a.c. or 120 V d.c.
Inverter	Electrical power converter that changes direct current to alternating current
ITS	Intelligent Transport System
IPxx	Ingress Protection (IP) rating to degree “xx” as defined in AS 60529
Low Voltage (LV)	Voltage exceeding extra low voltage but not exceeding 1000 V a.c. or 1500 V d.c.
Maintenance bypass switch	Switch designed to isolate a UPS, or part thereof, from the load and to maintain continuity of load power via an alternative path during maintenance activities.
MEN	Multiple Earthed Neutral
MRTS	Transport and Main Roads Technical Specifications
Primary supply	UPS operating on electrical mains supply
RPEQ	Registered Professional Engineer of Queensland.

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Term	Definition
SD	Transport and Main Roads Standard Drawings
SNMP v2	Simple Network Management Protocol Version 2
Stored energy mode	UPS operating on batteries
TSC	Traffic Signal Controller
UPS	Uninterruptible Power System – Combination of converters, switches and energy storage devices constituting a power system for maintaining continuity of load power in case of input power failure and includes the housing and accessories.
Web server	A Web server is a program that uses HTTP (Hypertext Transfer Protocol) to serve the files that form Web pages to users

3 Referenced Documents

All equipment and material, where not otherwise specified, shall be in accordance with the appropriate Australian Standards, where such exist, and in their absence, with BS, IEC or ISO Standards.

Where a document is quoted or implied, the latest version shall be applicable, including its amendments to date.

The requirements of the relevant referenced documents listed in Table 3 of MRTS201 *General Equipment Requirements*, and Table 3 below apply to this Technical Specification.

Where there are inconsistencies between this Technical Specification and the referenced documents, the requirements specified in this Technical Specification shall take precedence.

Table 3 – Referenced documents

Reference	Title
AS 2578	*Traffic Signal Controllers*
AS 2700	*Colour standards for general purposes*
AS 5715	*Uninterruptible power supplies (UPS) for roadside devices*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3112	*Approval and Test Specification – Plugs and Socket Outlets*
AS/NZS ISO 9000	*Quality management systems-Fundamentals and vocabulary*
MRTS01	*Introduction to Technical Standards*
MRTS201	*General Equipment Requirements*
MRTS255	*Traffic Signal Controllers*
SD1709	*Traffic Signals/ITS – Uninterrupted Power Supply (UPS) Base Installation Details*
SD1710	*Traffic Signals/ITS – Uninterrupted Power Supply (UPS) Wiring Schematic*
TRUM Volume 4 Part 3	*Traffic and Road Use Management Manual, Volume 4: Part 3 - Electrical Design for Roadside Devices*

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4 Quality System Requirements

The quality system requirements defined in MRTS201 *General Equipment Requirements* and any requirements of the Contract apply to this Technical Specification.

4.1 Hold Points and Witness Points and Milestones

The Hold Points and Witness Points applicable to this Technical Specification are summarised in Table 4.1. There are no Milestones defined.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
4.3	1. Manufacturing Facility Capability Audit – Australian Manufacturers. 2. Manufacturing Facility Capability Audit – Overseas Manufacturers.		
4.4	3. Sample for evaluation.		
13		1. Tests in accordance with AS 5715.	

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4.2 Quality documentation

The offeror shall submit information regarding the life and quality of the products offered. All claims in relation to life, reliability, maintainability etc. shall be in accordance with the terms and definitions of AS/NZS ISO 9000 *Quality management systems - Fundamentals and vocabulary*.

4.3 Manufacturer's requirements

Manufacturers shall demonstrate conformance to this Technical Specification.

For Australian manufacturers, the capability of the manufacturing facility can be audited by a Transport and Main Roads staff member or Independent Auditor acceptable to the department. **Hold Point 1**

For overseas manufacturers, the capability of the manufacturing facility can be audited by an Independent Auditor acceptable to Transport and Main Roads. **Hold Point 2**

The Transport and Main Roads staff member or Independent Auditor shall ensure that the manufacturers are able to comply with the requirements of this Technical Specification.

The manufacturer shall provide Transport and Main Roads with certified test certificates as required by the Technical Specification.

All products shall be inspected by a qualified departmental representative. The inspection shall be undertaken in Australia at a place suitable to Transport and Main Roads.

4.4 Samples for acceptance

Unless the supplier has a current certificate of acceptance issued by Transport and Main Roads, a UPS (complete controller, switches, electrical components, battery, and so on in the housing) shall be submitted to the department for evaluation. Samples submitted for acceptance shall comply with Clause 4.2 of MRTS201 *General Equipment Requirements*. **Hold Point 3**

The sample shall be representative of the product which will be supplied in the event of the offer being accepted.

Each sample shall be marked with the following information:

a) supplier's name

b) supplier's product reference code

c) date of manufacture

d) reference to this specification

e) offer number, and

f) closing date for submission.

On or before the delivery of the first sample, the supplier shall provide two hard copies (or electronic copies if agreed by the department) of both a UPS controller and battery hardware manual(s) and software manual(s) if they are not already in possession of the department.

4.5 Multiple or excessive failures

In addition to the requirements of MRTS201 *General Equipment Requirements*, where the UPS fails within the first six month period, the manufacturer shall replace the failed UPS with new at its expense and within one month. Replacing only modules or individual parts may be done at the discretion of Transport and Main Roads.

Where a UPS has more than two failures in the first three years, the manufacturer shall replace that UPS with a new one at its expense and within one month. Replacing only modules or individual parts can be done at the discretion of Transport and Main Roads.

A failure is deemed to occur when the UPS falls outside manufactures specification or no longer operates as prescribed by the manufacture.

4.6 Product life

The UPS controller, automatic transfer switch, associated equipment and housing shall be designed for a minimum operational life of 15 years as detailed in AS 2578. Battery life shall be in accordance with the Schedule.

4.7 Documentation

All updates and modifications to the controller hardware, software and manuals over the life of the equipment shall be documented within the manufacturer's quality system. This documentation shall be provided on a periodic basis as specified by the department.

5 Functional Requirements

5.1 General

The UPS shall be designed to power roadside devices, and in particular traffic signal controllers, under all environmental conditions specified in Clause 8.1 of MRTS201 *General Equipment Requirements*.

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The UPS shall be capable of operating from all of the following input supplies but the system shall be provided with switching such that only one can be connected at any time:

- Mains power
- Portable generator supply
- Storage batteries

Where there is an interruption to the primary power supply, or the primary power supply is out of specification, the UPS shall provide continuity of power for the time specified in the Schedule without affecting the safe operation of the roadside device. Upon restoration of the primary supply, the UPS shall revert to primary supply without affecting the safe operation of the roadside device. When the UPS is in stored-energy mode, the system shall prohibit inverted AC power from back-feeding into the AC mains network.

As traffic signals are road safety devices, it is critical that quality power within the required specification is maintained at all times.

The UPS shall provide indication of operational and fault states as well as control and switching facilities.

The UPS shall have a generator connection panel to match that in the traffic signal controller.

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6 UPS Topologies

Any of the topologies detailed in AS 5715 may be used provided that:

- The output power supply is always within the parameters specified in AS 2578 for correct traffic signal controller operation, and
- The output power supply is such that the traffic signal controller will never go into flash mode or off mode, and
- The preferred topology is included in the Schedule.

7 UPS Controller

7.1 General

The UPS controller shall consist of the functional elements detailed in AS 5715.

The UPS shall be available in a range of capacities as per the Schedule. Refer project specific documents for load requirements depending on intersection/load configuration.

The UPS shall have sufficient capacity to supply the load and charge the batteries from the maximum DOD as detailed in the Schedule within the specified charge time.

7.2 Rectifier

The rectifier shall be as detailed in AS 5715.

7.3 Battery Management System

The battery management system shall be as detailed in AS 5715. However, this may be included as part of the battery pack.

If the battery is discharged to the maximum DOD as detailed in the Schedule or reaches the DC cut-off point before primary power source restoration, the UPS shall disconnect the inverter and automatically switch to a bypass operation which will allow recharging of the batteries when the power is restored.

UPS shall have a battery condition monitoring capability.

7.4 Inverter

The inverter shall be as detailed in AS 5715.

7.5 Switching mechanisms

The switching mechanisms shall be as detailed in AS 5715.

7.6 Interfaces

The user interface, logs and configuration data, contact outputs, and data ports and data management software shall be as detailed in AS 5715. A programming manual shall be provided for any programmable functions.

Provide an RJ45 Ethernet interface on the controller. Controller shall support web server with secure connection protocol for the UPS management system to remotely monitor and manage the UPS.

UPS shall support SNMP v2 or better version for monitor and management of faults.

UPS shall have the minimum listed alarms as per SD1710 *Traffic Signals/ITS – Uninterrupted Power Supply (UPS) Wiring Schematic*, dry or voltage contacts to interface with hardware such as a PLC for the purpose of remotely monitoring.

7.7 Provision of PLC for UPS Monitoring

Where a suitable PLC specified shall be supplied to monitor the operation of the UPS and communicate to the TMC via the principal's traffic management system STREAMS, PLC shall be supplied preprogramed to monitor the UPS alarms minimum as per SD1710. Other alarms may be programmed and monitored as per project specific requirements.

- PLC shall have digital and analogue inputs.
- All the inputs shall have isolation of better than 250V continuous
- PLC shall support the Modbus TCP protocol to communicate with STREAMS
- PLC shall be supplied with the suitable AC mains power supply
- SD1710 shall be used to wire the PLC and UPS
- Documents related to programming and configuration of the PLC shall be supplied together with a copy of the programming software, programme code.

8 Housing for Stand-Alone UPS

8.1 General

The UPS shall be enclosed in its own IP rated stand-alone housing.

The configuration shall be to minimise the effect of heat on the batteries and controller. Hence, the batteries should be low, the controller above, and switchboard and controls at the top.

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8.2 Dimensions

The standard UPS housing dimension shall be as detailed in AS 5715.

8.3 Construction

The housing construction shall be as detailed in AS 5715 with the following modifications:

- A double-skinned construction on all sides, including the door and top, with ventilation slots top and bottom to allow free flow of air between the skins; with thermostatically controlled electric fans if necessary internally to ensure the maximum internal temperature does not exceed that included in the Schedule.
- Provision for a thermostatically controlled heater to ensure that the interior of the cabinet does not drop below the temperature in the Schedule. Refer project specific documents for location of controller installation and whether a heater is required.
- The exterior finish shall be a well-proven, heat reflective paint, colour white (colour No N14) [smoke blue (colour No T33)] as defined in AS 2700, to help minimise the internal temperature. Surface preparation, primer, finish coat, and application shall be in accordance with paint manufacturer's recommendations.
- Racks shall be installed so the UPS controller and batteries can be rack mounted.

Door locks shall be as included in the Schedule.

9 Batteries

Batteries shall be as detailed in AS 5715.

Battery type and charge time while operating on load shall be as included in the Schedule.

Batteries shall be multiple parallel strings.

Batteries shall be rack mounted.

A battery management system may be incorporated with the batteries.

10 Electrical Requirements

Electrical requirements in accordance with AS 5715.

The switchboard shall be mounted near the top of the enclosure.

No socket outlet is required.

A 7W LED service light operated by a door switch shall be provided.

Cables that are not loomed shall be included neatly in a cable management system within the housing.

All sockets and plugs shall be quick connecting/disconnecting type with interlock structure. All connectors shall be labelled clearly and durably.

The same type of plugs, sockets and footings shall be employed on different control unit models by the same UPS supplier to provide inter-changeability and compatibility between different UPS models.

Refer TRUM Volume 4, Part 3.

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10.1 Stand-by generator connection

The housing shall be fitted with all of the facilities required for the connection of an external generator as specified in AS 2578. The housing connector for the external generator shall be a male 3-pin (flat) 15A connector complying with AS 3112.

It is desirable that the 'presence of power' indicator lights specified in AS 2578 are Green to indicate mains supply and Yellow to indicate generator supply. The indicator lights should have a design life of at least 15 years.

The installation shall match that of the traffic signal controller.

11 Environmental Requirements and Tests

Environmental requirements and tests shall be carried out in accordance with AS 5715.

12 Installation

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

Installation of the UPS shall be in accordance with SD1709 *Traffic Signals/ITS – Uninterrupted Power Supply (UPS) Base Installation Details* and SD1710 *Traffic Signals/ITS – Uninterrupted Power Supply (UPS) Wiring Schematic.*

The generator connection shall be at the same location in the housing as in the traffic signal controller.

Provide a permanent label in a visible location in the traffic signal controller, or other equipment to which the UPS is connected, stating "Controller connected to UPS supply".

13 Commissioning and Testing

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

Testing and commissioning shall be carried out to demonstrate that the UPS complies with the requirements specified within this document. **Witness Point 1**

The batteries shall be demonstrated to comply with the run time requirements at full load.

14 Documentation

The documentation requirements defined in MRTS201 *General Equipment Requirements* and AS 5715 apply to this Technical Specification.

The documentation shall also include the following:

- All design drawings including electrical (block and schematic drawings) and design calculations.
- Copies of all documents approved by an RPEQ.
- Original equipment manufacturers specifications and maintenance recommendations.
- All pre-installation factory acceptance test results.
- All commissioning test results.

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- All records of maintenance performed before handover.
- Proposed maintenance schedule.
- Complete list of possible failure modes, related alarms or indicators, and recommended corrective action for each fault.
- All training materials.
- Copies of Programming software and well annotated source programming code of the pre-programmed PLC.

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 MRTS 201 *General Equipment Requirements* apply to this Technical Specification.

All keys shall be provided to the Principal.

18 Schedule

Table 18 – Schedule

1	Preferred technology	Line Interactive
2	*UPS capacities (W) @ pf=1	*2000
3	Full test load (W)	1400
4	Full project load (W)	Refer project specific documents
5	Battery type	LiFeP04
6	Minimum battery life (yr)	10
7	Battery run time on full load (hr)	4
8	Battery maximum DOD (%)	80
9	Battery charge time from max DOD (hr)	4
10	Maximum internal housing temperature (°C)	50
11	Minimum internal housing temperature (°C)	0
12	Door locks	TBA
13	UPS field terminal capacities (mm2)	16

*Note: A 2000W UPS may not be suitable for larger sites. Larger UPS capacities need to be considered to achieve 0.4s disconnection times.

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