INTELLIGENT TRANSPORT SYSTEMS

TRAFFIC SYSTEMS

SPECIFICATION NO. TSI-SP-033

STANDALONE UPS FOR ROADSIDE DEVICES

Issue: 3.0
Dated: 24/10/2019
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### RECORD OF AMENDMENTS

<table>
<thead>
<tr>
<th>Issue</th>
<th>Summary</th>
<th>Date</th>
<th>Approved by</th>
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<tbody>
<tr>
<td>1.0a</td>
<td>Preliminary Issue for Inner West Busway UPS Project for Victoria Road.</td>
<td>10 Sep, 2010</td>
<td>See Summary</td>
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<td></td>
<td>This version deletes reference to RMS drawings.</td>
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<td>This version was released for use by the ‘Bridge to Bay Alliance – Inner West Busway along Victoria Road’.</td>
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<td>2.0</td>
<td>Main changes from Version 1.0:</td>
<td>28 June, 2013</td>
<td>A/Mgr, TSI</td>
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<td></td>
<td>▪ Updated “RTA” to “RMS”.</td>
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<td></td>
<td>▪ Made TSI-SP-016 a main reference.</td>
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<td>▪ Added new Section 4 on type approval.</td>
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<td>▪ Added designations for UPS based on output power and support time.</td>
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<td></td>
<td>▪ Added LiFePO4 battery as one of acceptable battery types to be specified in the purchase document.</td>
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<td></td>
<td>▪ Added requirements for the housing and removed reference to TSI-SP-012 outdoor housing specification.</td>
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<td>3.0</td>
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<td>24 Oct 2019</td>
<td>Mgr, TSI</td>
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<tr>
<td></td>
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<td></td>
<td>▪ Added requirement for 2 hour remaining battery runtime alarm output</td>
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<td></td>
<td>▪ Added description of Re-synchronisation Mode in 4.3.</td>
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<td></td>
<td>▪ Added clarity to operation of Maintenance Bypass Switch in 4.3.6</td>
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<td></td>
<td>▪ Added requirements for real-time clock, socket-outlet and audible emissions</td>
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<td>▪ humidity test to be conducted at 90%</td>
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<td>▪ all references to AS 62040 changed to reference AS 5715</td>
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<td></td>
<td>▪ Convert to version 3.0 for publishing and release</td>
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<td></td>
<td>▪ Convert logo and references from RMS to TfNSW</td>
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1 INTRODUCTION

1.1 Preface

This issue of TSI-SP-033 is a major revision of this Specification to normalise its structure and requirements wherever possible with AS 5715 “Uninterruptible power systems (UPS) for roadside devices”. The requirements of AS 5715 are mandatory except where specifically varied in this Specification.

1.2 Scope

This document specifies the functional, electrical, mechanical and environmental requirements of standalone Uninterruptible Power Supplies (UPS) for use with Traffic Signal Controllers (TSC) or other Intelligent Transport System (ITS) roadside installed devices in the State of New South Wales.

This Specification applies to standalone UPS, which are contained within a dedicated housing and supplied as a complete unit.

The document also specifies the minimum documentation required to ensure the safe and correct installation, operation and maintenance of a standalone UPS.

This Specification does NOT APPLY to:

- Integrated UPS, which share a common housing with other equipment
- Stand-alone power systems, where the primary power source is not connected to the power distribution network of an electricity distributor
- Multiple UPS connected in parallel to a common load

This Specification has been written primarily to cover single phase UPS, but its requirements can also be applied to three phase UPS (not including single to three phase converters).

1.3 References and Applicable Documents

Unless otherwise specified, the applicable issue of a reference document shall be the current one. The following documents are referenced by this Specification:

1.3.1 Australian Standards

[1] AS 1055  Acoustics – Description and measurement of environmental noise
[2] AS 1319  Safety signs for the occupational environment
[3] AS/NZS 1768  Lightning protection
[4] AS/NZS 3000  Electrical installations (known as the Australian/New Zealand Wiring Rules)
[7] AS/NZS 3820  Essential safety requirements for electrical equipment
1.3.2 Australian Regulatory Requirements

[16] Radiocommunications Labelling (Electromagnetic Compatibility) Notice 2017

1.3.3 TfNSW Specifications and Documents

[17] TS201 Approval of ITS Field Equipment
[18] TS202 Approval of ITS Solutions for Projects
[20] TSI-SP-071 ITS Equipment Communication Interface Requirements
[21] TSI-SP-016 General Requirements for Outdoor Electronic Equipment

1.3.4 TfNSW Drawings

[22] VC002-73E Footing for ground-mounted controller housing
[23] VC002-56E Holding-down bolt assembly for ground-mounted controller

1.3.5 Other Standards

[27] IEC 60603-7 Connectors for electronic equipment - Part 7: Detail specification for 8-way, unshielded, free and fixed connectors

STANDALONE UPS FOR ROADSIDE DEVICES (Copyright TfNSW 2020)
1.3.6 Other Documents

[43] NTCIP 9001 v04  National Transportation Communications for ITS Protocol - The NTCIP Guide

1.4 Compliance with Specifications

The standalone UPS, where not otherwise specified, shall be in accordance with the relevant Australian Standards, where such exist, and in their absence, with the appropriate International Standard such as IEC, ISO, TIA and ITU-T.

1.5 Precedence of Specifications

In the event of any conflict between the referenced Specifications, the order of precedence shall be:

(a) Australian Regulatory Requirements;
(b) This Specification;
(c) Australian Standards; and then
(d) Relevant international standards.
## 2 DEFINITIONS AND GLOSSARY OF TERMS

For the purposes of this Specification, the following definitions and abbreviations shall apply:

*NOTE: The terms marked with a hash (#) in this section have the same meanings as the same terms in AS 5715:2015.*

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Alternating current</td>
</tr>
<tr>
<td>ACMA</td>
<td>Australian Communications and Media Authority</td>
</tr>
<tr>
<td>backup time</td>
<td>The time that the UPS can support the rated load from a fully charged state before the battery bank is exhausted</td>
</tr>
<tr>
<td>battery</td>
<td>Device consisting of one or more electrochemical cells used to convert stored chemical energy into electrical energy.</td>
</tr>
<tr>
<td>battery charger</td>
<td>The device dedicated for changing alternating current power to direct current power for the purpose of charging a battery, as defined in AS 5715 [9]. Also referred to as storage battery charger in this Specification</td>
</tr>
<tr>
<td>bypass</td>
<td>Alternative power path, either internal or external to the UPS</td>
</tr>
<tr>
<td>bypass mode of UPS operation*</td>
<td>A state the UPS attains when the operating load is supplied via the bypass only</td>
</tr>
<tr>
<td>converter</td>
<td>An operative unit for electronic power conversion, comprising one or more electronic valve devices, transformers and filters if necessary and auxiliaries if any [43]</td>
</tr>
<tr>
<td>cut-off voltage</td>
<td>The specified voltage of the energy storage system at which it is considered depleted [16]. For the purposes of this Specification, this shall mean the discharge of the storage batteries has reached the maximum permissible depth of discharge</td>
</tr>
<tr>
<td>DTE</td>
<td>Data terminal equipment</td>
</tr>
<tr>
<td>electricity distributor</td>
<td>Person or organization that provides electricity from an electricity distribution system to one or more electrical installations, as defined in AS/NZS 3000 [4]</td>
</tr>
<tr>
<td>ELV</td>
<td>Extra-low voltage [4]</td>
</tr>
<tr>
<td>equipment</td>
<td>Means UPS covered by this Specification unless the context dictates otherwise</td>
</tr>
<tr>
<td>GPO</td>
<td>Socket-outlet, also known as General Purpose Outlet</td>
</tr>
<tr>
<td>Housing#</td>
<td>Weatherproof enclosure that provides physical protection for and houses the UPS.</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>Inverter*</td>
<td>An a.c./d.c. converter for inversion [18]</td>
</tr>
<tr>
<td>ISO</td>
<td>International Standards Organisation</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent transport system; also known as intelligent transportation system</td>
</tr>
<tr>
<td>LV</td>
<td>Low voltage [4]</td>
</tr>
<tr>
<td>mains supply</td>
<td>LV electrical supply connected to the power distribution network of an electricity distributor</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>maintenance bypass</td>
<td>A power path designed to allow isolation of a section or sections of a UPS for safety during maintenance and/or to maintain continuity of load. This path may be supplied with primary or standby power</td>
</tr>
<tr>
<td>maintenance bypass switch</td>
<td>A switch designed to isolate a UPS for safety during maintenance and to maintain continuity of load power via an alternative path</td>
</tr>
<tr>
<td>the Manager</td>
<td>Means the Manager Traffic Systems Integration, Intelligent Transport Systems Branch, Transport for NSW</td>
</tr>
<tr>
<td>MART</td>
<td>Mean Active Repair Time</td>
</tr>
<tr>
<td>MIB</td>
<td>Management Information Base</td>
</tr>
<tr>
<td>MTBF</td>
<td>Mean Time Between Failures</td>
</tr>
</tbody>
</table>
| normal mode of UPS operation | The stable mode of operation that the UPS attains when supplied under the following conditions:  
  - Primary power is present and within tolerance;  
  - The storage batteries are charged or under recharge within the specified restored energy time;  
  - The operation is or may be continuous;  
  - The load is within its given range;  
  The UPS output voltage is within its specified tolerance. |
| NTCIP                    | National Transportation Communications for ITS Protocol                                                                                         |
| primary power#           | Power supplied by an electrical utility company or by a user’s generator                                                                      |
| protected supply         | Output of the UPS where the continuity of load power in case of primary input power failure is maintained in its normal mode of UPS operation      |
| PDF                      | Portable Document Format                                                                                                                       |
| RCD                      | Residual Current Device                                                                                                                        |
| r.m.s.                   | Root mean square                                                                                                                              |
| rectifier                | An a.c. / d.c. converter for the conversion of input a.c. mains power to d.c. power for storing energy in the storage batteries.               
  A reference to rectifier in this Specification shall be taken to mean the inverter where the inverter of the UPS also provides the function of a rectifier. |
| restored energy time     | The maximum time required to recharge sufficiently the energy storage means of the UPS with the charging capacity installed (after a discharge to the cut-off voltage of the storage batteries with the UPS operating under specified service conditions) to ensure another such discharge for a period of the stored energy time |
| TfNSW                    | Means Transport for NSW, which is a New South Wales Government agency                                                                         |
| Representative           | The person appointed by Transport for NSW to carry responsibilities on behalf of Transport for NSW for the execution of the contract under which the UPS is supplied.  
  A reference to the Representative in this Specification shall be taken to mean the TfNSW Representative |
<p>| SNMP                     | Simple Network Management Protocol                                                                                                             |
| this Specification       | Means Specification TSI-SP-033                                                                                                                  |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>storage batteries</td>
<td>A number of rechargeable secondary batteries connected electrically together and designed to provide the required stored energy time</td>
</tr>
<tr>
<td>stored energy mode of UPS operation*</td>
<td>An operation mode of the UPS when:</td>
</tr>
<tr>
<td></td>
<td>• Primary power is disconnected or is out of tolerance;</td>
</tr>
<tr>
<td></td>
<td>• d.c. energy storage system is being depleted;</td>
</tr>
<tr>
<td></td>
<td>• The load is within the specified range; and</td>
</tr>
<tr>
<td></td>
<td>• The output voltage is within the specified tolerance</td>
</tr>
<tr>
<td>stored energy time</td>
<td>The minimum time during which the UPS will ensure continuity of load power, under specified service conditions when the primary power fails, starting with the energy storage means sufficiently charged according to the restored energy time [16]</td>
</tr>
<tr>
<td>Supplier</td>
<td>Means the supplier of UPS covered by this Specification.</td>
</tr>
<tr>
<td></td>
<td>Where the supply of UPS is under a contract, it means the contractor</td>
</tr>
<tr>
<td>TIA</td>
<td>Telecommunications Industry Association</td>
</tr>
<tr>
<td>Type Approval</td>
<td>The type approval of equipment under this Specification</td>
</tr>
<tr>
<td>unprotected supply</td>
<td>Output of the UPS where the continuity of load power in case of input power failure is not maintained. This is usually a direct connection to the supply mains that permanently bypasses the UPS combination of converters, switches and energy storage devices.</td>
</tr>
<tr>
<td>UPS</td>
<td>Means either an uninterruptible power system or uninterruptible power supply that is covered by this Specification</td>
</tr>
</tbody>
</table>
3 GENERAL

The UPS shall comply with AS 5715 [9], except where otherwise detailed in this Specification.

NOTE: If a numbered clause reference is given in this Specification to help the user locate the relevant clause of the standard AS 5715, then it refers to the version AS 5715:2015. Reference to a clause header of AS 5715 is given in italics.

The standalone UPS provides a limited time power supply source for critical roadside ITS device loads to minimise the impact of supply fluctuations on the availability of ITS devices and systems. In the event of a major supply outage the backup time of the standalone UPS allows TfNSW or its nominated representative time to implement mitigating strategies to reduce the impact of protracted supply outages on safety and congestion for road users.

A UPS can typically operate from a number of different supply sources which include:

(a) Mains supply - Single or Three Phase
(b) Auxiliary mains supply - Single or Three Phase, normally from a different supplier or substation
(c) Permanent backup generator
(d) Portable generator
(e) Storage batteries or other storage technologies

The UPS should provide a normalised protected supply to its protected load under both normal and abnormal mains supply conditions. The abnormal mains supply conditions that can be typically encountered include but are not limited to:

(a) Blackout: short or long term loss of mains supply (Mains Voltage of less than 80V per phase is often considered as a blackout)
(b) Dropout: momentary loss of mains supply (less than a second)
(c) Brownout / Undervoltage / Sag: decrease in voltage levels which can be momentary or last for hours
(d) Swell / Overvoltage: voltage increases which can last for up to a minute
(e) Spikes / Surges: momentary large voltage increases often due to lightning strikes etc.

Examples of roadside ITS Devices where TfNSW may use a standalone UPS to provide a protected supply include the following:

(a) Driver advisory variable message signage;
(b) Variable lane delineation and lane usage signal devices (e.g. tidal flow schemes);
(c) Traffic signal sites;
(d) Variable speed limit signage;
(e) Traffic management data collection or monitoring equipment;
(f) Motorway roadside equipment.
4 FUNCTIONAL REQUIREMENTS

4.1 General

It is an TfNSW requirement to follow AS 5715 except where the TfNSW Specification explicitly deviates from the Australian Standards Specification. The structure of the document follows that of AS 5715.

As per Section 2.1 of AS 5715 [9], with the following additions or amendments:

Figure 1 below shows the expected functional diagram of the standalone UPS for supporting roadside devices:

![Figure 1 UPS Functional Diagram]

The actual functionality may vary depending on implementation and the UPS topology used (see Section 5). For example, the transfer switch could be external to or an integral part of the UPS Controller.

Please refer to drawing VE516-82J for an example of how a typical UPS is connected to a traffic controller, noting how neutral is connected to the main, bypass and generator changeover switches [28]. A copy of this drawing is included in Appendix A.

4.1.1 Power Supply Continuity

As per Section 2.2 of AS 5715 [9].

4.1.2 Power Quality Management

As per Section 2.3 of AS 5715 [9].

4.1.3 Status Indication

As per Section 2.4 of AS 5715 [9].
4.1.4 Auxiliary Power Connection

As per Section 2.5 of AS 5715 [9] with the following additions or amendments:
The auxiliary a.c. power source shall be a portable generator with regard to this Specification and AS 5715 [9].

4.1.5 User Control

The UPS shall provide user control and switching facilities to enable:

(a) the change of the UPS operating mode (see section 4.3);
(b) the maintenance bypass mode of the UPS;
(c) the transfer switch; and
(d) selection of the a.c. power source.

4.1.6 Safety Requirements

The UPS equipment and its installation shall comply with the following requirements:

(a) AS/NZ 3820:1998 [7]
(b) AS 5715 [7]
(c) AS/NZS 60950.1 [12] as it applies to the communications ports
(d) AS 1319 [2].

4.1.7 Regulatory Requirements

The UPS equipment as supplied to TfNSW shall comply with the following requirements:

(a) NSW Work Health and Safety Act 2011 [15]
(b) Radiocommunications Labelling (Electromagnetic Compatibility) Notice 2017 [16]
(c) AS/NZS 4417.1 [8]
(d) AS/NZS 3000 [4]

4.1.8 Rated Load

The required rated load is site dependent and the UPS rated load should be matched to the needs of each site. Where the purchaser cannot provide a rated load it shall be assumed to be 2KW.

The supplier shall ensure that a UPS is supplied with a rated load that matches the site requirement. Evidence of this shall be in the form of manufacturer documentation verifying a supplier’s claim. The supplier shall specify the performance of the UPS as per AS 5715 [7].

4.1.9 UPS Backup Time

The UPS shall provide a minimum backup time at the maximum rated load of the UPS. The purchaser may specify a minimum backup time required. Where the purchaser cannot provide a minimum backup time it shall be four (4) hours.
For all supplied UPS equipment, the supplier shall declare the maximum backup time at the purchaser nominated rated load.
4.2 Inputs and Outputs

![Diagram of UPS Roadside Cabinet with inputs and outputs]

Figure 2 Inputs and Outputs

4.2.1 Supply Inputs

The UPS shall support two (2) physically separate alternative types of AC supply inputs as a minimum.

These AC supply inputs shall be:

(a) A permanently connected Mains Supply input, and

(b) An Auxiliary Supply input for the temporary connection of a portable generator

4.2.2 Supply Outputs

The UPS shall provide the following supply outputs as a minimum:

(a) Two (2) protected supply outputs for permanent connections

(b) One (1) unprotected supply output for permanent connection

(c) One (1) RCD protected GPO for temporary connections

The UPS shall be provisioned to allow at least two (2) additional protected supply outputs to be installed as required in the field.

4.2.3 Status and Alarm Indicators

The UPS shall provide voltage-free, extra-low voltage (ELV) rated contact outputs for connection to external equipment to allow the status of the UPS to be remotely monitored. As a minimum, the outputs listed in Section 4.5 shall be provided.
4.2.4 Communications Ports

The UPS shall provide the following communications ports or interfaces for local and remote control and monitoring as a minimum

(a) One Ethernet port with support for SNMP. In addition this port should optionally support NTCIP.
(b) One TIA-232 or TIA-485 port.

4.3 Operating Modes

The UPS shall be capable of operating in the following modes subject to the limitations of its implemented topology:

(a) Normal Mode
(b) Regulation Mode
(c) Stored Energy Mode
(d) Re-synchronisation Mode
(e) Internal Bypass
(f) Maintenance Bypass

Note: How a UPS operates in each of these modes depends on its topology, for example only a Line Interactive UPS will be capable of operating in Regulation Mode.

In all modes the selected supply input shall be connected to the unprotected supply output of the UPS as well as the RCD protected GPO.

4.3.1 Normal Mode; Mains Supply

The UPS shall operate in normal mode under the following conditions:

(a) If the selected supply input is present and within tolerance, and
(b) The Maintenance Bypass Switch has been set to “NORMAL”, and
(c) The UPS Controller has not been configured for another operating mode.

In normal mode the UPS depending on its Topology shall operate as follows:

(a) A Stand-By UPS shall connect the selected supply input via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS.
(b) A Line Interactive UPS shall connect either the selected supply input or the conditioned Mains Supply output from the UPS Controller via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS.
(c) A Double Conversion UPS shall connect the regenerated supply output from the UPS Controller via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS.
(d) Charge the UPS Battery as appropriate if the battery is not adequately charged.
4.3.2 Regulation Mode

Regulation Mode is typically where a line interactive UPS can decrease or increase (buck or boost) the voltage of its conditioned Mains Supply output whenever the voltage of the selected mains input falls outside of a set of predefined voltage limits, but before the mains input is considered to have failed. This feature can be useful where supply conditions are poor and minimises the periods the UPS has to switch to Stored Energy Mode, thus extending battery life.

A line interactive UPS shall operate in Regulation Mode if an operator has manually switched the UPS operating mode to Regulation Mode via the User Interface, or if all of the following conditions have been met:

- The selected supply input voltage is present but out of tolerance, and
- The Maintenance Bypass Switch has been set to “NORMAL”, and
- The UPS Controller has been configured to enable Regulation Mode.

In Regulation mode a line interactive UPS shall operate as follows:

(a) connect the conditioned supply output from the UPS Controller via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS

(b) Charge the UPS Battery as appropriate if possible

(c) Set active the UPS Alarm Indicator if appropriate.

4.3.3 Re-Synchronisation Mode

Re-synchronisation Mode typically happens upon UPS start up, or when a UPS is transitioning from Stored Energy Mode back to Normal Mode. Through this mode, the UPS avoids subjecting the load to power disturbances.

In Re-synchronisation Mode, the UPS shall operate as follows:

(a) Create a frequency shift to speed up or slow down the frequency in order to align (lock) the inverter in phase with the source chosen, performing the changes gradually to avoid power disturbances, and

(b) As appropriate, decrease or increase the voltage of its conditioned protected supply output, then

(c) Switch to Normal Mode once phase lock is achieved.
4.3.4 Stored Energy Mode

The UPS shall operate in Stored Energy Mode under the following condition:

- An operator has manually switched the UPS operating mode to Stored Energy Mode via the User Interface;

Or alternatively, the UPS shall operate in Stored Energy Mode if all of the following conditions have been met:

1. The selected supply input is not present or present but out of tolerance (see section 9.2.1), and
2. The Maintenance Bypass Switch has been set to “NORMAL”, and
3. The UPS Controller has been configured for Normal Operation.

In Stored Energy mode the UPS shall operate as follows:

(a) Connect the supply output from the UPS Controller via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS.

(b) Set the “On Battery” indicator to active.

4.3.5 Internal Bypass

The UPS shall operate in Internal Bypass Mode if an operator has manually switched the UPS operating mode to Internal Bypass via the User Interface, or all of the following conditions have been met:

- The UPS Controller has been configured for Normal Operation, and
- The Maintenance Bypass Switch has been set to “NORMAL”, and
- One or more of the following conditions is met:
  1. The UPS Controller Output has failed
  2. The UPS Controller has shut down due to an internal fault
  3. The UPS Controller has shut down to protect itself from potentially damaging input conditions
  4. The UPS Controller has been manually powered off
  5. The output current exceeds the rated full load capacity of the UPS.

In Internal Bypass mode the UPS shall operate as follows:

(a) Connect the selected supply input via the transfer switch (see Figure 1) to the Protected Supply Outputs of the UPS

(b) Set active the “UPS Fault” Indicator.
4.3.6 Maintenance Bypass

The UPS shall operate in Maintenance Bypass Mode only if the Maintenance Bypass Switch has been set to “BYPASS”.

In Maintenance Bypass Mode, the UPS shall operate as follows:

(a) Connect the selected supply input via the Maintenance Bypass Switches (see Figure 1) to the Protected Supply Outputs of the UPS
(b) Disconnect the selected supply input from the UPS Controller Supply Input
(c) Disconnect the Supply Output of the UPS Controller Supply from the Protected Supply Outputs of the UPS
(d) Set active the “On Bypass” Indicator.

4.4 User Interface

The following replaces the contents of section 4.6.1 of AS 5715 [9].

The UPS shall incorporate a user interface for the local control and monitoring of its operation.

The user interface shall allow the UPS status and operational parameters to be viewed and adjusted by an on-site operator.

All user interface displays shall be clearly legible in the outdoor environment.

4.4.1 Display Functions

The UPS user interface shall allow an operator to view the following:

(a) UPS operating mode (normal, stored energy, bypass, etc.)
(b) UPS input voltage and frequency
(c) Battery run-time remaining for connected load
(d) UPS output voltage and frequency
(e) UPS output current
(f) UPS output power (VA)
(g) Battery voltage
(h) Battery Charger current
(i) Battery temperature
(j) Alarms complete with date/time stamps in reverse chronological order
(k) Status and event displays with date/time stamps in reverse chronological order
(l) Set point views of UPS adjustable parameters
(m) Indicate the status of the Input Supply Selection Switch
(n) Indicate the status of the Maintenance Bypass Switch

The accuracy of measured values displayed shall be within ±2% of the real value.
For UPS with a double-conversion topology, the user interface shall in addition allow an operator to view the following:

(a) Mains input current.
(b) Mains input power (VA)
(c) Mains input power factor (if available)
(d) UPS Output power factor

The accuracy of measured values displayed shall be within ±2% of the real value.

4.4.2 Visual Indicators

The UPS user interface shall also provide three permanently displayed indicators as follows:

(a) Mains Supply Indicator
(b) Auxiliary Supply Indicator
(c) Maintenance Bypass Indicator

These indicators shall be able to operate independently of the UPS Controller, i.e. UPS Controller de-activated or removed for maintenance.

The UPS shall, in addition, provide:

(a) Operating in stored energy mode indicator
(b) Source of energy input indicator, i.e. mains or auxiliary supply

4.4.2.1 Mains Supply Indicator

The UPS user interface shall provide a Mains Supply Indicator/Lamp, to indicate the presence or absence of supply on the Mains Supply input only.

The Mains Presence Indicator shall be on only when a valid supply voltage is present on the Mains Supply input.

4.4.2.2 Auxiliary Supply Indicator

The UPS user interface shall provide an Auxiliary Supply Indicator/Lamp, to indicate the presence or absence of supply on the Auxiliary Supply input only.

The Auxiliary Supply Indicator shall be ON only when a valid supply voltage is present on the Auxiliary Supply input.

4.4.2.3 Maintenance Bypass Indicator

The UPS user interface shall provide a Maintenance Bypass Indicator/Lamp, to indicate when the Maintenance Bypass has been activated.

The Maintenance Bypass Indicator shall be ON only when the Maintenance Bypass Switch is set to the Bypass Position.
4.4.3 Control Functions

The UPS user interface shall allow an operator to control the following:

(a) Start up.
(b) Shut down.
(c) Mode of operation (normal, stored energy, bypass)
(d) Internal diagnostic tests.
(e) Configuration of the real-time clock, including setting the times and dates for daylight saving, or using a remote time reference.
(f) Adjust set point values for all adjustable power and alarm parameters.
(g) Configuration of Communications Port parameters

4.4.4 Manual Override Switches

The UPS User Interface shall provide as a minimum two Manual Override Switches to allow an operator to locally override the operation of the UPS for fault finding or maintenance purposes: The Manual Override Switches to be provided are as follows:

(a) Input Supply Selection Switch
(b) Maintenance Bypass Switch

These Override Switches shall not require power to operate.

4.4.5 Input Supply Selection Switch

The Input Supply Selection switch shall allow an operator to manually select which of the supply inputs (See Figure 2) the UPS Controller shall use as its mains supply in normal operating modes.

The Input Supply Selection switch shall provide a minimum of two (2) positions as follows:

(a) Mains Supply Input, labelled “MAINS” which when selected connects the Mains Input Supply to the UPS Controller Input, Unprotected Supply Output, and internal GPO.
(b) Auxiliary Supply Input, labelled “AUX” which when selected connects the Auxiliary Input Supply to the UPS Controller, Unprotected Supply Output, and internal GPO.

The Input Supply Selection switch as a minimum shall incorporate an output contact to indicate when the switch is in the Auxiliary Supply Input position.

If the Input Supply Selection switch incorporates an automatic changeover function, i.e. to switch from Mains to Auxiliary Supply and visa-versa on the loss or reacquisition of the mains supply input then the following additional requirements apply:

(a) provide an additional switch position labelled “AUTO” which when selected enables the automatic changeover function.
(b) the automatic changeover function shall be overridden or disabled by the manual selection of either the “MAINS” or “AUX” positions.
(c) the automatic changeover shall nominally ‘rest’ with the Mains position selected.
(d) the automatic changeover shall incorporate a delay or hysteresis on the reacquisition of the mains supply to avoid cycling the UPS between the Mains and Auxiliary inputs.

(e) the automatic changeover shall not switch in the advent of the Auxiliary supply not being present.

Note: For Line Interactive UPS the automatic changeover may incorporate a delay period to ensure the UPS Controller always sees a loss of supply input causing it to switch to Stored Energy Mode before resynchronizing to the selected supply input on any automatic changeover. This will ensure that the effect of any phase or frequency differences between the Mains and Auxiliary Supply inputs will be minimized with regard to the Protected Supply Outputs.

Note: To comply with the requirements of AS 3000:2007 [4] Section 7.3.8.1, the neutral of the Auxiliary Supply Input shall only be connected to the UPS Neutral when the Auxiliary Supply Input is selected.
4.4.6 Maintenance Bypass Switch

The Maintenance Bypass Switch shall allow an operator to manually switch the selected Supply Input directly to the Protected Supply Output, bypassing the UPS Controller completely (See Figure 3).

The Maintenance Bypass Switch shall provide a minimum of two positions as follows

(a) Normal Operation, labelled “NORMAL”, which when selected connects the selected supply input to the UPS Controller Input, and connects the supply output of the transfer switch to the Protected Supply Output of the UPS. See Figure 3 on the next page for the expected supply path when in the Normal Operation position.

(b) Bypass Operation, labelled “BYPASS” which when selected connects the selected supply via the Maintenance Bypass path to the Protected Supply Output of the UPS, and disconnects both the Supply Input and Supply Output of the UPS Controller. See Figure 3 on the next page for the expected supply path for Bypass Operation position.

The Maintenance Bypass Switch shall incorporate an indicator to show when the switch is in the Bypass Operation position.

Figure 3 Bypass Switch Operation
4.4.7 Logs and Configuration Data

As per Section 4.6.2 of AS 5715 [9], with the following additional requirements:

- When the log is full, the oldest log entries shall be replaced by new ones in accordance with the first-in-first-out principle (FIFO).
- It shall NOT be possible to clear the log via the user interface locally or remotely via the communications ports.
- It shall be possible to download a copy of the log remotely.
4.5 Status and Alarm Indicators

The following replaces Table 4.1 of section 4.6.3 of AS 5715 [9].

The UPS shall provide the following status and alarm indicators via contacts (see section 9.13) for remote monitoring as a minimum:

(a) Mains Fail indication
(b) On Auxiliary indication
(c) On Battery indication
(d) On Maintenance Bypass indication
(e) Low Battery indication
(f) UPS Alarm indication
(g) UPS Fault indication
(h) UPS Door Open alarm

In addition to the above, it would be desirable to include an alarm to indicate two (2) hours of battery charge remaining while the UPS is in Stored Energy Mode. If such a feature is provided, the manufacturer shall explain its methodology to estimate the remaining battery runtime.

4.5.1 Mains Fail

The UPS “Mains Fail” indicator shall indicate the loss of supply on the Mains Supply Input. This indicator shall be set when the Mains Supply Input falls below the MIS_LTH (Mains Input Supply Low Threshold).

This indicator shall be cleared when the Mains Supply Input increases above the MIS_HTH (Mains Input Supply High Threshold).

4.5.2 On Auxiliary

The UPS “On Auxiliary” indicator shall indicate when the Auxiliary supply input has been selected.

This indicator shall be set when either

(a) The Input Supply Selection Switch has been set to the “AUX” position, or
(b) An automatic changeover function (if implemented) has switched to the Auxiliary Supply Input

This indicator shall be cleared when either

(a) The Input Supply Selection Switch has been set to the “MAINS” position, or
(b) An automatic changeover function (if implemented) has reverted to the Mains Supply Input.
4.5.3 On Battery

The UPS “On Battery” indicator shall indicate when the UPS is operating in Stored Energy Mode.

This indicator shall be set when either:

(a) the UPS switches to Stored Energy Mode on the loss of the Supply Input to the UPS Controller, or

(b) when an operator has manually configured the UPS Controller to operate in Stored Energy Mode via the User Interface.

This indicator shall be cleared when the UPS reverts to: Normal Operating; Regulation; or Internal or Maintenance Bypass Mode.

4.5.4 On Bypass

The UPS “On Bypass” indicator shall indicate when the UPS is in Maintenance Bypass.

This indicator shall be set when the Maintenance Bypass Switch has been set to the BYPASS position.

This indicator shall be cleared when the Maintenance Bypass Switch has been reset to the NORMAL position.

4.5.5 Low Battery

The UPS “Low Battery” indicator shall indicate when the UPS detects a Low Battery condition in any operating mode.

This indicator shall be set when the UPS detects that its Stored Energy source i.e. batteries are below the UPS Low Battery threshold parameter. The Low Battery threshold parameter may be either a voltage or a capacity threshold.

This indicator shall be cleared when the UPS detects that the charge level of its Stored Energy source i.e. batteries are above the UPS Low Battery threshold parameter.

4.5.6 UPS Alarm

The UPS Alarm indicator shall indicate when the UPS detects an event, condition or fault that does not immediately impact the normal operation of the UPS. This event, condition or fault may result in the UPS changing operating modes eg, Normal to Stored Energy mode. Examples of potential conditions resulting in the UPS Alarm being activated include

(a) Input Supply Voltage out of Tolerance

(b) Input Supply Frequency out of Tolerance

(c) Low or high Battery Temperature

(d) Low Battery

(e) UPS Overloaded

(f) Cooling fan (if provided per section 6.7) failure

This indicator shall be set when the Alarm Condition is detected, and cleared when the condition is removed.
4.5.7 UPS Fault

The UPS Fault indicator shall indicate when the UPS detects an event, condition or fault that has a detrimental or imminent impact on the operation of the UPS or to the equipment connected to the Protected Supply Output of the UPS. Examples of potential conditions resulting in the UPS fault being activated include:

(a) Output Supply Voltage out of tolerance.
(b) Output Supply Frequency out of tolerance.
(c) UPS overloaded and leading to either a switch to Internal Bypass mode or shutdown
(d) Battery fail (battery voltage has dropped below a specified level)
(e) Batteries overcharged or over voltage
(f) Any condition where the UPS switches to Internal Bypass Mode to protect the UPS Controller
(g) UPS Controller Failure

This indicator shall be set when the Fault Condition is detected, and cleared when the condition is removed.

This indicator shall be a fail-safe alarm, when the indicator will be set active by default on the failure, shutdown etc. of the UPS Controller.

4.5.8 UPS Door Open

The UPS Alarm indicator shall indicate the status of UPS cabinet door.

This indicator shall be set when the UPS cabinet door is open, and cleared when the UPS cabinet door is closed.
4.5.9 Summary

Table 1 below summarises the minimum functional requirements of the UPS Status and Alarm Indicators.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains Fail</td>
<td>Indicates loss of the Mains Supply to the UPS</td>
</tr>
<tr>
<td>On Auxiliary</td>
<td>Indicates that the UPS is operating from the Auxiliary Supply Input</td>
</tr>
<tr>
<td>On Battery</td>
<td>Indicates that the UPS is operating in Stored Energy Mode, i.e. from the backup batteries</td>
</tr>
<tr>
<td>On Bypass</td>
<td>Indicates that the UPS is in Maintenance Bypass</td>
</tr>
<tr>
<td>Low Battery</td>
<td>Indicates that the UPS Storage Batteries are at or below the “Low Battery Threshold”</td>
</tr>
<tr>
<td>UPS Alarm</td>
<td>Indicates that the UPS is operating but has a fault or condition that requires attention,</td>
</tr>
<tr>
<td>UPS Fault</td>
<td>Indicates that the UPS has failed or has a fault or condition that has caused the UPS to shut down and/or switch to Internal Bypass mode to avoid damage.</td>
</tr>
<tr>
<td>UPS Door Open</td>
<td>Indicates that the UPS cabinet door is open</td>
</tr>
</tbody>
</table>

Table 1 Status and Alarm Indicators

*NOTE: The ‘low battery’ condition refers to the battery capacity or voltage reaching a threshold at or below its default or user configured level.*
4.6 Communications Ports

As per sections 9.14 and 9.15, and 4.6.4 of AS 5715 [9] with the following additions:

4.6.1 Ethernet Port/s

The mandatory Ethernet Port of the UPS shall be a twisted pair 100BASE-TX Interface and be capable of supporting either 10 Mbit/s or 100 Mbit/s operation. This interface shall:

(a) Use an RJ45 connector as per IEC 60603-7 [27],
(b) The RJ45 connector pins shall be wired as per TIA/EIA 568A [28].
(c) Comply with IEEE 802.3u Fast Ethernet Standard [29]
(d) Comply with IEEE 802.3i 10Base-T 10 Mbit/s over twisted pair[30]

Any additional Ethernet Ports provided may use alternative interfaces.

4.6.1.1 SNMP

The UPS Ethernet Port shall provide SNMP support as follows

(a) Optional support for SNMPv1, as per RFC 1155 [36], RFC 1157 [37], and RFC 1213 [38].
(b) Mandatory support for SNMPv2c as per RFC 1901 to RFC 1908 [40].
(c) Optional support for SNMPv3 as per RFC 3411 to RFC 3418 [41].
(d) Optional support for managing uninterruptible power supply (UPS) systems as per RFC 1628 [43].

The supplier shall provide the appropriate SNMP MIB for the UPS.

4.6.1.2 NTCIP

Optionally the UPS Ethernet Port may also provide support for NTCIP.

Note: Refer to NTCIP 9001 [43] for guidance.

4.6.2 RS232 Port/s

The UPS RS232 Port interface if fitted shall:

(a) Use a 9 Pin Female D type Connector
(b) Comply with TIA/EIA-232-F [25] except with regard to the connector.
(c) Be wired as a DTE Interface

4.6.3 RS485 Port/s

The UPS RS485 Port interface if fitted shall comply with TIA/EIA-485-A [26].

The supplier shall specify the interface connector used.
4.7 UPS Access or Management Software

The UPS shall provide via the communications ports the ability for an external device or system running the supplier’s or a third party’s Access/Management Software to perform the following:

(a) Replicate the display functions of Section 4.4.1.
(b) Replicate the control functions of Section 4.4.3.
(c) Extract, sort and save the UPS Event and Alarm Logs.
(d) Extract and save the UPS Configuration Data.
(e) Download and update the UPS Configuration Data of a local or remote UPS.
(f) Manage the access levels and user accounts for operators of the external device or system.

Any custom software application and/or operating system drivers that are required to operate the UPS shall be provided.

If required, a list of compatible third party’s Access/Management Software applications shall be provided.

4.8 System Reset

As per Section 4.6.5 of AS 5715 [9]

5 UPS TOPOLOGIES

As per Section 3 of AS 5715 [9]
6 UPS CONTROLLER

6.1 General
As per Section 4.1 of AS 5715 [9].

6.2 Rectifier
As per Section 4.2 of AS 5715 [9].

6.3 Battery Management System
As per Section 4.3 of AS 5715 [9].

6.4 Inverter
As per Section 4.4 of AS 5715 [9].

6.5 Switching Mechanisms
As per Section 4.5 of AS 5715 [9].

6.6 Interfaces
See Section 4.4.

6.7 Cooling Fans
As per Section 4.7 of AS 5715 [9].

6.8 Real-Time Clock
The UPS real-time clock referred to in AS 5715 [9] and elsewhere in this Specification shall provide a stable and accurate time-base for all logging purposes.

6.8.1 Operation
The UPS shall provide a means to check that its clock is functioning for correct operation. The real-time clock counters, registers, and RAM shall be write-protected when any of the power supply rails for the real-time clock and the logic circuits are below the minimum operating threshold.

6.8.2 Accuracy
The accuracy of the real-time clock shall be better than ± 3 seconds in a one week period.
6.8.3 Synchronisation

The real-time clock shall be capable of being synchronised with a remote time server, either periodically or whenever a time update is issued.

6.8.4 Daylight-Savings

The UPS shall be capable of providing updates to the real-time clock for daylight-saving related time changes.

Where the update is not an automatic function the UPS shall provide user configurable dates and times to change from standard time to daylight saving time and vice versa. The default configuration shall be as follows:

(a) Start of daylight saving time - At 0200 hr on the first Sunday in October; and
(b) End of daylight saving time - At 0300 hr on the first Sunday in April

6.8.5 Power Source

The real-time clock shall be provided with a dedicated backup battery in addition to the batteries or any other stored energy elements referred to in this Specification.

This dedicated backup battery shall:

(a) be a battery that supplies only the real-time clock;
(b) not require any routine maintenance;
(c) be rated for operation over the full range of ambient conditions specified in Clause 10.1 and the range of variations permitted in the auxiliary or stand-by power source
(d) have a service life of not less than five (5) years under normal operation; and
(e) Maintain operation of the real-time clock for a minimum of sixty (60) days after the depletion of the UPS’s stored energy capacity.
7 HOUSING FOR STAND-ALONE UPS

7.1 General
A standalone UPS shall be enclosed in its own weatherproof stand-alone housing.

7.2 Dimensions
As per Section 5.1 of AS 5715 [9], with the following additions or amendments:
Where a housing of non-standard dimensions is proposed, the following information shall be provided to the TfNSW for consideration:
(a) housing mechanical drawings and dimensions
(b) recommended footing drawings and dimensions
(c) frangible mounting system drawing and dimensions

7.3 Construction

7.3.1 General
As per Section 5.3.1 of AS 5715 [9] with the following additions or amendments:
All exterior corners and the roof shall have a minimum external radius of 3 mm. All accessible edges shall be de-burred.
An alternative to “folded metal with welded joins” may be approved by the TfNSW, subject to other structural and environmental housing requirements being met or exceeded.
The housing shall be designed to allow it to be installed with the rear side adjacent to a wall or fence or similar structure without impeding access to the interior of the housing.
Provisions shall be made in the housing to protect internal equipment from condensation.

Note: Example condensation protection measures that could be taken may include:

    a) Drip tray(s) or equivalent provided to collect and guide condensation away to dedicated drain points;

    b) All electrical modules and parts be installed or positioned away from the internal vertical surface of the housing by a minimum of 5 mm by suitable means (e.g. spacers) that do not provide a path for condensation to reach these modules and parts.

Any ventilation openings on the housing shall incorporate a protection mesh suitable against pest ingress without materially impeding ventilation. The ventilation openings shall be able to withstand vandalism.

As far as practicable, all materials used in the construction and wiring of the housing shall be of a composition that does not support combustion. As far as practicable, all materials used in the construction and wiring of the housing shall be self-extinguishing if ignited.
7.3.2 Material

As per Section 5.3.2 of AS 5715 [9] with the following additions or amendments:
An alternative material can be used for the housing subject to prior approval by the TfNSW.

7.3.3 Mounting

As per Section 5.3.3 of AS 5715 [9] with the following additions or amendments:
The UPS housing mounting must be compatible with standard TfNSW footings and hold down assemblies for ground mounted Traffic Signal Controllers.
Refer to TfNSW drawings VC002-73 [22] and VC002-56 [23], for current TfNSW Traffic Signal Controller footings and hold down assemblies.

7.3.4 Cable Access

As per Section 5.3.4 of AS 5715 [9] with the following amendment:
To allow ease of access to cables, equipment shall not be mounted within the space 150 mm above the bottom edge of the housing base.

7.3.5 Door

As per Section 5.3.5 of AS 5715 [9] with the following additions or amendments:
The door shall incorporate a 3 point locking system engaged or disengaged by a recessed swing handle incorporating a corrosion resistant cylinder lock.
This locking mechanism is incorporated into a cabinet door typically engaging with the housing at the side, top and bottom of the housing. Contact the TfNSW ITS Helpdesk to obtain details of the mechanism to be used: ITSHelpDesk@rms.nsw.gov.au

7.3.6 Door Hinges

As per Section 5.3.6 of AS 5715 [9].

7.3.7 Door Locks

There are two options for the cylinder locks:
1. The standard TL 493 key
2. An electronic lock that allows remote management of access to the cabinet. Note such an electronic lock must be able to operate correctly for up to 7 days after the loss of power to the cabinet.

7.3.8 Door Retainer

As per Section 5.3.8 of AS 5715 [9].

7.3.9 Weather Sealing

As per Section 5.3.9 of AS 5715 [9].
7.3.10 Ventilation
As per Section 5.3.10 of AS 5715 [9].

7.3.11 Document Storage Pocket
As per Section 5.3.11 of AS 5715 [9].

7.3.12 Finish and protection
As per Section 5.3.12 of AS 5715 [9].

7.3.13 Cabinet Nameplate
As per Section 5.3.13 of AS 5715 [9].

7.3.14 Resistance to Vandalism
As per Section 5.3.14 of AS 5715 [9].

7.3.15 Cable Clamping Bars
All cables that enter or exit the housing (except for those to the Communications Ports) shall be secured by clamping bars or secured in a manner that prevents cable tension or cable drawing being transmitted to the cable termination points.

The edge of all clamping bars shall be rounded to prevent damage to cables.

7.3.16 Stand-by Generator Connection
As per Section 5.3.16 of AS 5715 [9] with the following addition:

The generator cable may be secured in a manner, other than clamping bar, that prevents disconnection from the plug should the cable be pulled from outside the cabinet. The alternative method should consider any forces exerted on the cable from outside and the consequences for the cable.

7.4 Information to be Provided in Housing
As per Section 5.4 of AS 5715 [9]
8 BATTERIES

As per Section 6 of AS 5715 [9], with the following addition:
Where Lithium-iron phosphate stationary batteries are selected they shall comply with AS IEC 62619 [14].
9 ELECTRICAL REQUIREMENTS

9.1 General
As per Section 7.1 of AS 5715 [9].

9.2 UPS Voltage and Frequency Thresholds
The following replaces section 7.2 of AS 5715 [9].

9.2.1 Supply Inputs
The UPS shall operate from a nominal 230V r.m.s. 50 Hz mains supply (as defined by AS 60038 [11]) from either the Mains or Auxiliary Supply Inputs.

The UPS equipment shall operate correctly and reliably for the following supply limits:
- (a) input voltages over the range 0 to 300 V r.m.s. and
- (b) frequency range 45 to 55 Hz

The UPS equipment shall operate in stored energy mode (see section 4.3.4) when the input supply is outside of the nominal characteristics defined in AS 60038 [11], alternatively when:
- (a) input voltage drops below 185V r.m.s., or
- (b) input voltage exceeds 280V r.m.s., or
- (c) input frequency range is outside 48 to 52 Hz.

The UPS equipment shall provide margins for switching from stored energy mode (see section 4.3.4) to normal operation (see section 4.3.1) to avoid unnecessary flipping between the two modes when the supply is stable but in the region of a threshold.

As a minimum, the UPS equipment shall not be damaged by the following supply limits:
- (a) input voltages over the range 0 to 320 V r.m.s. and
- (b) frequency range 45 to 55 Hz

9.2.2 Protected Supply Outputs
The UPS shall maintain the Protected Supply Outputs within the following limits:
- (a) output voltage over the range 216 to 253 V r.m.s. and
- (b) frequency range 48 to 52 Hz

Where the UPS is intended for Traffic Signal Controller Sites, the UPS Protected Supply Output requirements can be relaxed to the following limits:
- (a) output voltage over the range 185 to 275 V r.m.s. and
- (b) frequency range 48 to 52 Hz

The supplier shall provide details of the implemented transition voltages to TfNSW.

9.3 Ratings Requirements
As per Section 7.3 of AS 5715 [9] with the following additions or amendments:
For UPS other than Double Conversion topology,
   a) The transfer time from Normal / Regulation Mode to Stored Energy Mode shall be less than 40 ms
   b) The transfer time from Stored Energy to Re-synchronisation Mode shall less than 5 ms
   c) The transfer time from Re-synchronisation Mode to Normal / Regulation Mode shall be less than 40 ms, noting that the Re-synchronisation Mode itself typically lasts about 30 seconds
   d) UPS efficiency at 50% load shall be greater than 75%

9.4 Wiring

As per Section 7.4 of AS 5715 [9]

9.5 Switchboard

As per Section 7.5 of AS 5715 [9], with the following additions or amendments:

Surge protection is mandatory, and shall provide surge protection to withstand the surges specified in AS 1768 [3], Category B, with medium exposure peak amplitudes.

Suitable series surge protectors/filters compliant to AS 1768 [3] that house the shunt (parallel) connection of the protection components internally within the device may be used in place of traditional surge diverters.

Surge protection devices should be mounted where lines and cables enter the housing, or otherwise prevents interference being coupled within the housing. As far as practicable, surge protected and non-surge protected lines should be routed separately.

9.6 Electromagnetic Compatibility (EMC)

The UPS shall comply with the C1 Category requirements of AS 5715 [7] for electromagnetic compatibility.

9.7 Socket-Outlet (GPO) with Integral Residual Current Device

A double socket-outlet (or GPO) compliant with AS/NZS 3112 [5] with current rating of 10 A shall be provided. It shall include an integral 30 mA Type II RCD complying with AS/NZS 61008.1 [13] or AS/NZS 3190 [6].

The socket-outlet shall be mounted in an accessible position in the housing, and such that it provides for unobstructed insertion of mains power plug-packs, and operation of inserted mains power plug-packs with the door of the cabinet closed.

9.8 Service Light

As per Section 7.8 of AS 5715 [9].

9.9 Maintenance Bypass Switch

As per Section 7.9 of AS 5715 [9].
9.10 Visual Indicators

See Section 4.4.2.

9.11 Field Terminals

9.11.1 General

As per Section 7.11.1 of AS 5715 [9] with the following additions.

The removable terminal cover shall be easily removed/refitted for ease of access.

The removable terminal cover’s retention shall be positive, ie, its proper fixing shall be ascertainable and it shall not be able to fall off even after 1000 removals/refits.

9.11.2 LV Terminals

As per Section 7.11.2 of AS 5715:2015 [9] with the following additions.

Terminals for the connection of both input LV cables shall be capable of accepting conductors with cross-sectional areas from 1.0 mm$^2$ to 10.0 mm$^2$ as a minimum.

9.11.3 ELV Terminals

As per Section 7.11.3 of AS 5715 [9].

9.12 Electrical Safety Requirements

As per Section 7.12 of AS 5715 [9]

9.13 Status and Alarm Contacts

The Status and Alarm Indicator contacts shall be voltage-free, extra-low voltage (ELV) rated contact outputs for connection to external equipment to allow the status of the UPS to be monitored.

These terminals shall support the Status and Alarm Indicator terminals as specified in section 4.5 and one (1) common terminal. These will be connected as shown in Figure 4 below.

For all Status and Alarm contacts, the contacts shall be open when the indicator is set (active) and closed when cleared (inactive). All contacts shall be normally open, i.e. contacts shall require positive control to persist in a closed state.
9.14 Ethernet Port

The Ethernet Port shall be capable of operating in the following modes

(a) 10BASE-T Full Duplex operation
(b) 10BASE-T Half Duplex operation
(c) 100BASE-TX Full Duplex operation
(d) 100BASE-TX Half Duplex operation

In addition, it shall perform the following functions

(a) Auto-negotiation: Detection and negotiation with connection partner or network with regard to the Ethernet operational mode i.e. 10M or 100M, Full or Half Duplex.
(b) The Ethernet Port shall support the following sections of the TCP/IP protocol Suite
   1. IP Ver.4 as defined by IETF RFC791 [31]
   2. TCP as defined by IETF RFC 793 [32]
   3. UDP as defined by IETF RFC 768 [33]
   4. ICMP as defined by IETF RFC 792 [34]
   5. ARP as defined by IETF RFC 816 [35]

9.15 RS232 or RS485 Port

The RS232 or RS485 port shall be capable of operating as follows

(a) Be a configurable serial interface
(b) Provide support for the baud rates specified in Table 2 below:

<table>
<thead>
<tr>
<th>kbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 115200</td>
</tr>
<tr>
<td>b) 57600</td>
</tr>
<tr>
<td>c) 38400</td>
</tr>
<tr>
<td>d) 19200</td>
</tr>
<tr>
<td>e) 9600</td>
</tr>
<tr>
<td>f) 4800</td>
</tr>
<tr>
<td>g) 2400</td>
</tr>
<tr>
<td>h) 1200</td>
</tr>
</tbody>
</table>

Table 2 Serial Data Port data rates

(c) Shall support the data format options detailed in Table 3 below:

<table>
<thead>
<tr>
<th>Data Bits:</th>
<th>5-, 6-, 7-, or 8-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop Bit</td>
<td>1-, 1 1/2-, or 2</td>
</tr>
<tr>
<td>Parity</td>
<td>Even-, Odd-, or None</td>
</tr>
</tbody>
</table>

Table 3 Serial Data Port data format options
10 ENVIRONMENTAL REQUIREMENTS AND TESTS

10.1 Temperature and Humidity

The UPS shall be designed to operate under any combination of the following conditions:
(a) Ambient air temperatures within the range −15°C to 50°C.
(b) Relative humidity up to 90% (Condensation may result due to high humidity combined with a large drop in temperature).
(c) Insolation of up to 1000 W/m², incident at an angle of 30° from the vertical, applied to the maximum exposed surface of the equipment.

This may be achieved by:
(a) Double-skin construction of the housing with appropriate ventilation as recommended in Section 5.3.1 of AS 5715 [9]; or
(b) Ensuring that all components housed within the housing are temperature rated to at least 60°C; or
(c) Both of the above measures.

Note: Temperature and humidity testing may include an increase of the upper ambient temperature limit by 10°C in lieu of insolation exposure.

If the method of meeting these temperature and humidity requirements is by selecting high temperature rated components, testing must include internal temperatures of at least 60°C.

10.2 IP Rating

As per Section 8.2 of AS 5715 [9]

10.3 Bump Protection Testing

As per Section 8.3 of AS 5715 [9]

10.4 Vibration Testing

As per Section 8.4 of AS 5715 [9]

10.5 Audible Emissions

The UPS (not including any connected portable generators) shall not emit audible noise exceeding 50 dBA-scale when measured at a distance of 2m in any direction from the UPS housing under free-field (anechoic) conditions, and with the access doors to the housing closed.

Testing of audible emissions shall satisfy the criteria specified in AS 1055 [1].

10.6 Atmospheric Pollutants

As per Section 8.5 of AS 5715 [9]
10.7 Environmental Safety Requirements

As per Section 8.6 of AS 5715 [9], the UPS shall comply with AS 5715 [7].
11 REQUIRED DOCUMENTATION

Refer to Appendix A of AS 5715 [9] with the following additions or amendments.

Manuals shall comply with TSI-SP-062 [19].

The Supplier shall provide generic manuals as part of the compliance approval of the devices as part of the TS201 [17] process, via email to ITS HelpDesk for Approval by the Manager.

12 SUPPORTABILITY

12.1 Design for Maintenance

The equipment design and construction shall take account of ergonomic factors relating to operation and maintenance safety (section 4.1.7).

Equipment layout within housings shall be designed for ease of access during operation, maintenance and service. Access to individual modules shall be provided for replacement of the module without the need for removing other components or requiring additional wiring. The access to and replacement of modules shall not require the removal of fasteners that are not reusable.

A modular approach should be used in designing the equipment to facilitate maintainability, ease of installation and commissioning.

12.2 Warranty

12.2.1 Work Health and Safety

The Supplier shall warrant that the equipment and equipment handbooks identify risks, in accordance with the Work Health and Safety Act 2011, for:

(a) technicians in their installation, commissioning and maintenance of the equipment; and

(b) road users in their exposure to the equipment when using the NSW Road Network.

The warrant does not apply in cases where risks eventuate due to misuse or mistreatment of equipment by technicians or the public, unless that misuse or mistreatment could have been reasonably foreseen.

12.2.2 Warranties

The requirements in this clause apply unless other warranty conditions are specified in the dedicated equipment specification or other part(s) of the Contract.

The Supplier shall provide, for each item of equipment supplied, a warranty period of 12 months after equipment installation or 24 months after equipment delivery to the TfNSW store, work site or other locations required, whichever occurs first.
Any equipment failed in service or found to be defective within the warranty period shall be made good by the Supplier. For the purpose of this requirement, the following shall apply:

(a) The Supplier shall rectify all defects in situ within 48 hours of receiving notification of occurrence of an anomaly;

(b) Where the Supplier is unable to fulfil the requirement in (a), with the consent of TfNSW, the Supplier shall forthwith replace the defective unit with a temporary replacement within 72 hours. The Supplier shall rectify the defects on the original unit within seven days and arrange with TfNSW for a suitable time to reinstate the original unit on site.

It is expressly understood that any equipment damaged as a result of a traffic accident, abuse or act of vandalism after delivery to TfNSW will not be covered by warranty provisions.

Notwithstanding the warranty obligation stated above, the Supplier shall rectify any latent defects at the Supplier’s own cost when such a defect is detected and reported to the Supplier within five (5) years of the equipment delivery.

12.2.3 Spares

The Supplier shall maintain a reasonable supply of spare parts and modules for a minimum period of fifteen (15) years to allow the equipment to be maintained in service.

The Supplier shall give notice to the Authority prior to the last manufacturing run before cessation of manufacture for the particular spares type. The Supplier shall maintain spares for a minimum period of five (5) years after cessation of manufacture for the particular spares type.

Spare parts and modules for maintenance purposes shall include the following as applicable:

(a) Mechanical assemblies;

(b) Electrical assemblies; Specification: TSI-SP-016, Issue 2.0 Page 52 of 55 pages GENERAL REQUIREMENTS FOR OUTDOOR ELECTRONIC EQUIPMENT (Copyright TfNSW 2020)

(c) Electronic assemblies;

(d) Optical assemblies; and

(e) Electrical and electronic components.

12.3 System Reliability

The Supplier shall provide the following information to the ITS HelpDesk as part of the approvals process TS201 [17] to assist TfNSW in assessing reliability:

(a) Mean Time Before Failure (MTBF) for the UPS;

(b) Mean Cycle Before Failure (MCBF) for the UPS Batteries, and
The Supplier shall provide associated usage assumptions and calculations in detail to support the MTBF and MTTR figures provided. Note that the figures are expected to be valid for continuous operation throughout the full range of temperature and humidity values specified in Section 10.1.

**NOTE:** A failure for the purpose of the above MTBF limit is defined as any defect (hardware or software) which causes the UPS to not be available to provide back-up power supply to the load on loss of Mains supply.

### 12.4 System Maintainability

The Supplier shall provide the MART (Mean Active Repair Time) for the UPS to the ITS HelpDesk as part of the approvals process TS201 [17] to assist TfNSW in assessing maintainability. Assumptions and calculations supporting the MART values provided.

**NOTE:** The MART values supplied shall be the time to actively return the UPS to working order once initial on-site diagnosis begins. The time shall include on-site initial diagnosis, replacement of part, and time to retest and re-commission the UPS. It shall exclude time to travel to site, and time waiting for spare parts and for access.

### 12.5 Power Consumption

As part of an approval submission, the supplier shall provide information regarding the UPS’s power consumption, for the purposes of comparing electrical running cost, and estimating typical consumption. Information shall be provided for the UPS supporting maximum load and 50% load while mains supply is available. Assumptions shall be stated.

### 12.6 Spares

The manufacturer/supplier shall clearly identify all items that can be replaced in the field. Clear, unambiguous and complete instructions, including relevant diagnostic procedures, for the replacement process shall be given in the maintenance manual (section 11).

Maintenance manuals shall include a typical arrangement drawing or photograph to illustrate the access provisions for facilitating the in-situ removal and re-instatement of relevant components.

For items that are to be replaced in the field, the Supplier shall clearly define whether the item can be:

- (a) repaired in a workshop (instructions for repair shall be provided in the equipment manuals), or
- (b) returned to the equipment manufacturer/supplier for repair (instructions on information to be provided with defective items shall be provided in the equipment manuals).
12.7 Software Upgrades

The UPS manufacturer/supplier shall control the issue of firmware/software versions for the UPS, according to their quality plan for this activity.

The supplier shall provide a local means to rework/upgrade/modify the UPS’s software/firmware, should this be needed post deployment. Preferably, activity of this type shall be achievable at ground level via the control housing. Details shall be described in maintenance manuals.

The UPS shall be capable of reverting to the previous version if the new version fails to install correctly.

Optionally, the UPS may have capability for remote firmware/software upgrade. If such capability exists, the following additional requirements shall be met:

(a) It shall be possible to disable the remote upgrade capability on the UPS.
(b) A tool shall be provided by the supplier for use on the host network/TfNSW communication network to connect and initiate the software upgrade process for a UPS.
(c) The tool shall be supported with user and technical documentation.
(d) The tool shall provide appropriate network security, in line with TfNSW’s IT group requirements.
(e) The UPS shall validate the new firmware downloaded before installation.
(f) The tool shall be able to confirm the upgrade has been installed and that the UPS is operating correctly.
(g) The tool requires approval by TfNSW (to be sought via the ITS HelpDesk), prior to its use.
(h) Until the tool is approved, remote upgrade capability shall be disabled on the UPS.
(i) The UPS shall not be rendered inoperable in the event of a power failure during a remote software/firmware upgrade.
(j) Remote upgrades shall not require a manually implemented power cycle of the UPS, or other local intervention, so as to be activated.
(k) The approval state of the remote upgrade tool shall not constrain the approval of the UPS. Evaluation and approval of the UPS shall proceed under the TS201 or TS202 processes independently of the evaluation of the remote upgrade tool.

12.8 Configurability

Where the equipment is required to be configured for either TfNSW or site specific circumstances the following requirements apply:

(a) A method to configure a UPS for a site and host system shall be provided by the supplier. This may be a software tool, device, or procedure.
(b) The configuration method shall be able to be easily deployed for TfNSW, or its designated maintenance organisation’s use.
(c) The method of configuration shall be documented in a concise and straightforward way in the maintenance manual (section 10.1).

(d) The method shall be simple and straightforward.
13 QUALITY ASSURANCE

13.1 Management System

The Supplier and the manufacturer shall operate a quality management system complying with ISO 9001 [10].
14 APPROVAL

14.1 Approval Process

To gain Type Approval of a UPS, the supplier shall follow the process defined in TS201 [17].

14.2 Submission Contents

As part of the requirements for provision of the self-assessment submission described in TS201 [17], the UPS manufacturer or supplier shall include the following support documentation when applying for approval:

(a) A clause-by-clause statement of compliance with this Specification, including associated evidence referenced to each compliance item;

(b) A clause-by-clause statement of compliance with AS 5715 [9], (all sections unless varied by this Specification) including associated evidence referenced to each compliance item;

(c) A copy of the manufacturer's quality plan for the UPS;

(d) Evidence of third party certification of the manufacturer's and Supplier's quality systems;

(e) Documentary evidence of compliance with statutory EMC (electromagnetic compatibility) arrangements, including the Regulatory Compliance Mark (RCM) for indication of compliance with all applicable ACMA regulatory arrangements;

(f) A copy of the current Certificate of Suitability issued by the NSW Office of Fair Trading;

(g) Description of operation, and associated schematics of the UPS;

(h) Maintenance manual, including step by step guides for fault isolation, repair and preventive maintenance activities;

(i) Copies of all UPS manuals documentation in accordance with section 11 in PDF format in accordance with TSI-SP-062 [19];

The Supplier shall provide any additional information deemed necessary by TfNSW to enable TfNSW to conduct a comprehensive assessment of the approval application.

14.3 Changes

If a design, material or manufacturing method change is made to an approved UPS, the supplier shall notify the ITS HelpDesk, and the requirements of regarding changes shall be followed.
APPENDIX A – TYPICAL CONNECTION DIAGRAM UPS TO SIGNAL CONTROLLER

NOTES:
1) Main C.B. and C.T. should be selected according to the UPS manufacturer's recommendation. However, if no manufacturer recommendation has been made by the manufacturer, they should be selected as:
(a) UPS Rated Input Current x 1.25, Max = 25kA 240V AC, C Type, Breaking Capacity 30kA, DIN Rail Mounted Type
(b) UPS C.T. = UPS Rated Input Current, 240V AC, C Type, Breaking Capacity 30kA, DIN Rail Mounted Type

2) Main fuse current rating should be equal to the current rating of main C.B. & C.T. Max = 25kA, UG Central

3) A wiring diagram should be attached on the inside of the UPS housing door.

4) The current and voltage ratings of the 3 position change-over switch should be 1.5 x UPS rated input current value, 7.5kA.

5) The UPS housing should be installed in close proximity of the traffic signal controller housing.

6) An alarm condition exists when contacts are open. When the door is closed, the tamper alarm switch is closed.

7) The manual bypass switch is a break-before-make in both directions.