NSW GOVERNMENT

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CRN SE 011

Specification

Power Supply Units for Signalling Equipment - General Requirements

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Version 1.1	January 2022	TfNSW template applied.
Version 2.0	30 January 2022	First full UGLRL release.

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1. Scope and Application

This Specification describes the general requirements for DC Power Supply Units for Signalling Equipment to be manufactured and supplied to CRN and to contractors to CRN.

A complete specification for a particular power supply unit is formed by Specification CRN SE 011 in conjunction with one of the specifications from the series of specifications that provide the detailed requirements. In case of any conflicts, the latter series specification shall take precedence over this Specification.

2. Applicable Standards

2.1. CRN Specifications

This Specification refers to the following CRN, Signals Specifications:

CRN SE 004	General Requirements for Labelling of Signalling Equipment
CRN SE 005	Electrical and Electronic Components (Ratings and Construction Requirements)
CRN SE 012	Single Phase Air Cooled Isolating Transformers for Signalling Applications
CRN SE 016	DC Unfiltered Power Supply Units for Signalling Equipment
CRN SE 017	DC Filtered Power Supply Units for Signalling Equipment
CRN SE 018	DC Track Circuit Feed Sets
CRN SE 019	DC Regulated and Filtered Power Supply Units for Signalling Equipment
CRN SE 020	Battery Chargers for Signalling Equipment
CRN SE 021	Fuses for Railway Signalling Applications
CRN SE 033	Solderless Terminals Screw and Spring Clamp Terminal Blocks
CRN SE 034	Non-Vital Relays for Signalling Applications

2.2. Australian Standards

This Specification refers to the following Australian Standards:

AS K108	Metal Priming Paint, anti-corrosive.
AS 1099.2Z/AD	Basic Environmental Testing, Procedures for Electro-technology, Composite Temperature/Humidity Cycle Test.
AS 1099 2.31-90	Test Ec-Drop and Topple, primarily for equip.
AS 1627.6	Metal Finishing-Preparation and pre - of metal surfaces prior to protective coating- Phosphate Treatment of Iron and Steel Surfaces.
AS 2374	Power Transformer.
AS 5000.1	Electric Cables – Polymeric insulated, Part 1: For working voltages up to and including 0.6/1 (1.2) kV.

2.3. International Standards

DIN/VDE 0303 Part 1	Method of determining the comparative and proof Tracking Indices of solid insulating materials under moist conditions (Identical to IEC 112/79)

3. Environmental Conditions

All units shall fulfill the performance specifications in the following environmental conditions:

Temperature	0 to +70 °C (ambient temperature), unless specified
Humidity	Relative Humidity 0 to 95%
Vibration	0.04 cm p-p displacement at 10 Hz to 50 Hz held 15 minutes (3 minutes at 55 Hz) and applicable at all three axes. (Tests shall be carried out as detailed in AS 1099.2Z/AD.)
Shock	Applicable during transportation. (Drop and topple tests shall be performed, whenever requested detailed in AS 1099 2.31-Test Ec.)

4. Design Requirements

A high degree of reliability is required, and the highest possible standards of material, design and workmanship shall be employed. Failure mode of these supplies shall be considered prior to acceptance.

4.1. System Safety

The railway signalling system is a safety system. Power supply units associated with vital signalling must be considered as part of the fail-safe signalling system.

The DC power supply equipment when installed must not reduce the level of safety provided by the signalling system.

4.2. Service Life

The power supply units shall have a design life of over 10 years.

4.3. Power Supplies for Signalling Equipment

The main power supply distribution for signalling equipment is 120 V AC 50Hz and the supply is unearthed. The 120 V AC supply is derived from 240 V AC Council supplies. In some locations there are alternate power sources such as motor generator sets, solar supplies, etc.

Power supplies for signalling equipment typically have large tolerances from the nominal voltage.

The 120-volt AC signalling power supply could vary from 108 to 132 volts.

4.4. Standardisation of Components

The equipment shall be designed to utilise generally accepted standard components wherever possible and shall maintain its guaranteed performance of operation under all the conditions laid down in this Specification with only normal adjustments following any alternative replacement of equipment or components with equivalent parts having the same operating characteristics. Wherever possible, components complying with the relevant metric standards shall be used.

Prior approval shall be obtained if any alternative components are to be used other than the ones specified.

4.4.1. Terminals

Specifications for terminals shall be as follows; other forms of termination devices may be used subject to approval.

Temperature	100 °C (continuous) and 150 °C for short duration without damage.
Material	Polyamide AP 6, Melamine or equivalent Natural Tracking resistance, KB > 600, measured in accordance with DIN/VDE 0303 part 1
Wire protectors	Stainless spring steel wherever clamp type terminals are used.

Rail Mounted Terminals: To Specification CRN SE 033

Terminals with standard stud connections shall be used with eye lugs for terminals, which carry currents above 5A.

4.4.2. Lugs

Pre-Insulated double grip terminal lugs shall be in accordance with Signals Standards Drawing M08 580/1-5. Other forms of termination devices may be used subject to approval.

4.4.3. Fuses

Fuses shall be in accordance with Specification CRN SE 021 - Fuses for Railway Signalling Applications.

4.4.4. Indicating Relays

Where specified power supply units shall be supplied complete with indicating relays, firmly mounted with relay restraining clips. These relays shall conform to *CRN SE 034 Non-Vital Relays for Signalling Applications* in terms of relays and pin-configuration.

The bases for indicating relays shall be "Omron" PF 083A or an equivalent type with front terminations, unless otherwise specified.

4.4.5. Indicating Lamps

LED indicators with following requirements shall be used:

- LED life to exceed 30,000 hours
- Luminous Intensity: higher than 50 mCd
- Colour: Green - Diffused
- Dimensions 5 mm Dia.
- Maximum continuous current rating > 40 mA
- Operating current < 20 mA

LED indicators shall preferably be packaged with the appropriate resistor.

4.5. Wiring

All internal wiring, including leads of transformers, rectifiers and other components shall be copper 24/0.20 mm, 0.6/1 kV grade PVC insulated wire according to AS 5000.1. The current rating of all wires shall be de-rated 50%.

The insulation of all wires shall be at least V105 grade and capable of withstanding all the operating conditions likely to be encountered in service, without deterioration of the mechanical

and/or insulating properties. The insulation shall also withstand normal handling and, other than direct contact, it shall withstand heat generated by soldering irons during normal repair operations.

Wherever wires pass through holes in metal work or any other hard material, the insulation on these wires shall be protected by suitable glands or grommets securely fixed to the holes.

Where internal wiring is terminated on a terminal block, any wire which may need to be moved in normal use (e.g., for voltage tapping changes) shall be terminated with a crimped pin lug as specified in Clause 4.1.2.

4.6. Maintenance

To facilitate easy adjustment and maintenance all components shall be both readily accessible and readily changeable. The covers of these units shall be easily removable for periodic inspection. The minimum required number of screws for mounting shall be provided, maintaining the safety and soundness of the equipment.

On any rack-mounted unit, the cover shall be removable without requiring access to the sides, top or bottom of the unit.

The power supply equipment's 'Mean Time to Repair' for failures or to replace shall be 10 minutes or less for one person and 95% of all failure repair tasks shall be completed in less than 20 minutes. These times do not include travelling time.

Preventative maintenance required to maintain correct performance of the surge protection equipment shall increase the maintainer's workload by more than 10%.

4.7. Assembly, General Requirements

The transformer, rectifier and other components shall comprise an assembly designed and constructed with suitable materials, in such a manner that it has adequate strength and rigidity to support and protect the components against mechanical damage likely to be encountered in transport and service. The materials used in construction, especially insulating materials, sealants and impregnants shall not support combustion and shall be self-extinguishing. The assembly shall be drip-proof.

The transformers and chokes shall be securely mounted to the chassis of the unit. (Power Supply Units up to 150 VA shall be suitable for rack mounting).

Only stainless steel screws shall be used in aluminium parts.

The units shall be capable of being mounted free standing on a flat surface, and also be capable of being fixed to a vertical surface. Such fixing will be by screwing or bolting through plain (i.e., un-tapped) holes. Units specified for mounting on BRB standard relay racks shall be fitted with captive nuts, at hole centres to suit the BRB hole spacing.

All components shall be firmly supported to withstand vibration without damage to connections or terminals.

The unit shall be adequately ventilated. Ventilation apertures if required shall be provided in the form of louvres or openings covered by perforated metal or wire mesh, not coarser than 4mm.

Components shall be positioned relative to each other considering the following factors

- to minimise the effects of any overheating likely to arise in one component, on any other component.
- separated from each other by an adequate distance having regard to the normal and transient potentials between them.

4.8. Surge Protection

The units shall neither be damaged, nor subject to malfunction, by spikes or surges of the size and duration given in the table below. The spikes and surges may have either polarity and occur on the input side. The voltages can be assumed to have a rise time of 5% of their duration and are non-repetitive.

Voltage	Duration micro-second	Source Impedance	Energy Joules
3.5 kV	0.1	500	0.003
1.5 kV	1	200	0.1
600 V	1000	15	6
300 V	1000	2	20

Varistors with appropriate ratings shall be used to protect output voltages against voltage surges.

Short circuit protection shall also be facilitated whenever required.

4.9. Dual Channel Power Supply Units

Two separate single channel units are the preferred method to provide dual channel power supplies. However Dual Channel units will be considered if the following requirements are meet:

- Individual channels or modules can be replaced without disruption to supply.
- Terminals and modules are suitably labelled.

5. Electrical Requirements

5.1. Input Voltage

All units shall be suitable for operation from a single phase nominally 120 V, 50 Hz AC supply. Input voltage selection shall be provided for 110 V, 115 V, 120 V, and 125 V operation or as specified in the respective specification and drawing.

The secondary winding of the transformer shall be provided with tappings for adjustment as specified in the respective specification.

5.2. Output Voltage

According to the respective specifications.

5.3. Load Regulation

Unless otherwise specified in the particular specifications, the load voltage regulation requirements at nominal input voltage shall be as follows:

Load Current	Regulation
at 5%	< +10%
at 100%	> -5%

5.4. Inrush Current of Input Transformer

Input transformer shall be designed to limit in-rush current at turn-on to a level, which does not affect the reliable operation of the fuses or circuit breakers protecting them. Generally, inrush current shall be not greater than 8 times the rated input current of the transformer.

To meet the requirements of this Specification, the magnitude of the transformer's in-rush current, measured under the conditions stated below shall lie below the minimum limits of the published time/current curve for the specified standard circuit breaker (Heinemann CF2 curve 2).

The test method to demonstrate compliance with the requirement shall be as given in *AS 3108*- paragraph 19.8. The rating of the protective device used in this test shall be equal to the normal rating of the transformer. Test results shall include oscillography traces of the actual input current monitored during the test.

6. Mechanical Requirements

6.1. Painting

All equipment shall be adequately painted and/or otherwise treated according to *AS 1627.6* to positively prevent corrosion and deterioration under all the ambient conditions specified.

All metal surfaces shall be suitably treated and coated or plated to inhibit rust and corrosion. Surfaces to be painted shall be thoroughly cleaned to the base metal with solvent and then primed with zinc priming paint or similar prior to painting as per *AS K108*. The case shall be finished in a mid-grey gloss colour unless otherwise specified.

Mild steel bolts, nuts, screws, latches and clamps shall be plated and not painted. Bolts, nuts and screws shall be secured by using star/serrated washers and nuts or Nyloc nuts wherever necessary to withstand vibration tests.

All parts of the equipment shall be protected against fungus growth during transport, storage, erection and during service by treatment appropriate to the equipment. Materials capable of supporting fungi or mould-growth or capable of by vermin, insects and/or termites shall not be used.

6.2. Labelling

Labelling shall be in accordance *Specification CRN SE 004*.

The labels/name-plates shall be riveted, screwed or mechanically fixed and shall not be pasted or fixed with adhesive.

The labels shall not deteriorate due to ageing and/or due to handling.

All terminals shall be clearly and permanently identified by means of labels properly fixed.

A schematic diagram showing input and output taps, components and input and output voltages and currents shall be fixed.

Every individual unit shall be provided with a unique serial number.

6.3. Label (Nameplate)

All units shall be supplied with nameplates as follows:

The size of the nameplate shall be according to the size of equipment. The following information shall be included:

- Item Description/(Store No)
- Specification
- Part Number

- Supplier's name
- Unit Serial No
- Month/Year of Manuf.
- Input Voltage
- Output Voltage
- Input Current
- Output Current

Example:

SK RAILWAY SIGNALLING POWER SUPPLIES Pty Ltd	
Power Supply Unit-DC Track Feed (Store 72) Part No #####	
INPUT V = 120 V AC	**OUTPUT** V = 16 V DC
I = Amp	I = 1.0 Amp
Serial No: xxxx	Sept 1992

7. Prototype & Acceptance Testing of Prototype Units

Any unit not previously supplied to CRN, or not identical in design and material to those previously supplied, shall be subject to prototype approval.

Before commencement of manufacture of the total order a prototype shall be made available for testing and acceptance.

This unit will be tested for acceptance at the Supplier's factory or at CRN premises by the CRN Representative. This will be at the discretion of CRN. The Supplier shall provide suitable equipment and assistance to carry out full voltage and load tests as required by the CRN Representative.

8. Type Approval

8.1. Full Details and Documents

Full details of the equipment offered shall be submitted for approval and written type approval obtained prior to production. Similar written approval shall be sought for any subsequent change.

Full information as to the specification and source of all components shall be provided so that their suitability for the proposed use can be determined and so that the equipment can be maintained over its expected service life.

Refer to CRN SC 014 Type Approval Requirements for Signalling Systems and Equipment for the complete suite of documentation required as part of this process.

8.2. Functional Test

The output will be tested for all ranges of input voltage and output current, with their respective variations. The output voltage shall stay within the limits specified.

8.3. Earth Continuity Test

The earth continuity between any metal part of the frame or casing and the ‘earth’ terminal will be tested to be less than 1 ohm.

8.4. Environmental Test

The equipment will be tested for satisfactory operation under the environmental conditions specified in *AS 1099.2Z/AD*. The unit will be run at maximum load and maximum ambient temperature and components will be checked to confirm that they are conservatively within their manufacture's specifications.

8.5. High Voltage Test

The assembled unit shall withstand for one minute a test voltage of 2 kV AC at 25-100 Hz, applied between all input output terminals electrically connected together and the ‘earth’ terminal. An indicating device shall be used observe any occurrence of breakdown or flash-overs. Insulation tests shall be performed at the end of the high voltage test.

8.6. Insulation Test

The minimum value for insulation resistance shall be 5 M-Ohm when measured with an insulation tester with injected voltage of 500 V.

8.7. Final Check

The equipment will be inspected for compliance with the mechanical design and labelling requirements and the specifications.

9. Tests

Tests to be carried out by the Supplier shall be those laid down in the specifications, but this shall not preclude any additional tests desired by the CRN Representative concerned to determine the quality of the equipment.

Each unit shall be tested and a test certificate in accordance with Appendix 1 - Test Certificate produced for each and every unit. The test certificate shall be affixed to each unit at the time of delivery.

10. Information to be Provided by the Supplier

10.1. General Information

Suppliers shall supply complete information concerning the offered equipment. Reasonable departures from the specifications which do not nullify the intent of the clause concerned, will be considered but such changes shall be fully described as part of the offer, and will not be permitted after an offer is accepted.

10.2. Technical Information

For the initial supply of any new or altered power supply unit the following information shall be supplied:

- Full technical information covering circuit design, component types and layout and case design along with performance characteristics shall be included. In particular the current drain on the 120 volt input supply shall be quoted for both the 5% load and 100% load condition.
- Full component specifications of all semi-conductors and transformers shall be provided.
- At the time of testing of the completed unit by the CRN Representative the following items shall be supplied to CRN retention:
    - copy of the Suppliers test procedures and results.
    - one reproducible plastic and one paper-copy of all electrical and mechanical design drawings which, unless otherwise approved, shall be no larger than A3 and preferably drawn on A4 size sheet. Accompanied with this drawing shall be a detailed parts list.
    - This information is required for approval and maintenance purposes and will not be disclosed to third parties without the Supplier’s prior agreement.
- Three set up adjustment and maintenance manuals if specified for each types of unit shall be supplied.

11. Guarantee

The Supplier shall guarantee the equipment to perform to the specified requirements for a period of 2 years from date of supply. If the equipment fails to perform to the specified requirements during this period, the Supplier warrants to replace each such unit of equipment without any charge to CRN. Suppliers shall indicate their agreement to this warranty.

12. Inspection /Acceptance Testing Procedure

For acceptance of Power Supply Units, the following documents shall be provided.

- Test certificate with each Power Supply Unit, which shall be enclosed in a transparent envelope and attached to the unit.
- Conformance certificate with every order/delivery.

Acceptance testing procedure depending on Supplier's level of quality control facilities shall be as follows:

12.1. Suppliers with Quality Management Systems

Where a Supplier is producing these units under a Quality Assurance system which is accredited to *AS/ANZ 9001/9002* or an equivalent, no inspections will be required for the Power Supply units.

12.2. Suppliers without Quality Management Systems

Inspections shall be performed as follows:

Inspection and testing of the equipment will be required at the point of manufacture prior to delivery unless otherwise agreed.

Suppliers shall provide facilities for testing the units as described in Section-7.

Suppliers shall provide a "Conformance/Acceptance Certificate" along with test reports for each power supply unit, to the nominated person for inspection and testing.

13. Delivery

Delivery time quoted shall include the time required for production and approval of the prototype, if applicable, in addition to the time required to complete manufacture and delivery of the full order quantity.

A.1. Appendix 1 - Test Certificate

This section is to be completed by the Supplier prior to supply of equipment and testing by the CRN Representative.

1. Item Details

   Description:
   Item. Number:
   Contract Schedule # / Item Number:
   Order Number:
   CRN Specification:

2. Supplier's Detail

   Supplier:
   Place of manufacture:
   Address:

3. Test Details

   Test Results: - (Supply input voltage to be set at 120 V tapping & voltage shall be changed and tabulated as follows :)

	5% Full Load	5% Full Load	5% Full Load	Full Load	Full Load	Full Load
Input Voltage	110 V	120 V	125 V	110 V	120 V	125 V
Output Voltage						
Output Current						
Input Current						

Magnetizing Current of input transformer =
Input current of unit at no-load =
Maximum in-rush current of the power supply unit at 50% load =
Efficiency of the unit at full load =

Remarks:

Signature of Supplier:
Name: Date: / /
Unit Inspected/Remarks: Yes/No
Signature of RCA representative (who will witness the tests or verify the results)
Name: Date: / /

A.2. Appendix 2 - Power Supply Units for Signalling Equipment

CRN IDENTITY	ITEM DESCRIPTION	OLD(SRA) ID	SPECIFICATION
DC401	Power Supply Unit-DC Unfiltered12V, 1A DC		*CRN SE 016*
DC402	Power Supply Unit-DC unfiltered 24V, 5A DC(superseded twin channel unit)	(Store 107)	*CRN SE 016*
DC403	Power Supply Unit-DC Unfiltered 50V, 0.2A (10VA)	(Store 87)	*CRN SE 016*
DC404	Power Supply Unit-DC unfiltered 50V, 2.5A DC	(Store 103)	*CRN SE 016*
DC501	Power Supply Unit-DC Filtered 24V DC, 4.4A (unregulated) (AF Track Circuit Power Supply)		*CRN SE 017*
DC502	Power Supply Unit-DC Filtered 50V, 7A DC (No-break supply)	(Store 92)	*CRN SE 017*
DC503	Power Supply Unit-DC Filtered 50V 2A (No-break supply)		*CRN SE 017*
DC504	Power Supply Unit-DC Filtered 50V 20A (No-break supply)	(Store 95)	*CRN SE 017*
DC601	Power Supply Unit-DC Track Feed 120V, 3V, 1A DC (Automatic Track Rectifier)	(Store 70)	*CRN SE 018*
DC602	Power Supply Unit-DC Track Feed 120V AC/1V-6V, 1A DC (AC/DC Track Rectifier)	(Store 72)	*CRN SE 018*
DC701	Power Supply Unit-Regulated 24V, 4A DC	(Store 93)	*CRN SE 019*
DC801	Power Supply Unit-Battery Charger 2V-15V, 10A (Pedestrian Level crossings gates)		*CRN SE 020*
DC802	Power Supply Unit-Battery Charger 120V AC/for 12V, 20A DC (Automatic Level Crossing Battery Charger)	(Store 74)	*CRN SE 020*
DC803	Power Supply Unit-Battery Charger 120V AC/for 12V, 30A DC (Automatic Level Crossing Battery Charger)	(Store 74-30A)	*CRN SE 020*
DC804	Power Supply Unit-Battery Charger 24V, 20A DC	(Store 86)	*CRN SE 020*
DC805	Power Supply Unit-Battery Charger 50V 2A	(Store 96)	*CRN SE 020*