

DC Power Supply Units and Battery Charger / Power Supplies for Signalling Equipment

ESA-09-05

Applicability

Network Wide SMS

Publication Requirement

Internal / External

Primary Source

SPS22, SPS27, SPS28, SPS29, SPS30 and ESA-09-01

Document Status

Version #	Date Reviewed	Prepared by	Reviewed by	Endorsed	Approved
1.0	28 May 23	Standards	Stakeholders	Manager Signalling Standards	Head of Engineering Standards 01/06/2023

Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	28 May 2023	Various	First issue – Supersedes SPS 22 – NSW Standard Added Switch Mode Power Supply requirements. Amalgamation of existing ARTC DC power supplies specifications (SPS27, SPS 29, SPS 30, and ESA 09-01) into a single document. Updated as required.

© Australian Rail Track Corporation Limited (ARTC)

Disclaimer

This document has been prepared by ARTC for internal use and may not be relied on by any other party without ARTC's prior written consent. Use of this document shall be subject to the terms of the relevant contract with ARTC.

ARTC and its employees shall have no liability to unauthorised users of the information for any loss, damage, cost or expense incurred or arising by reason of an unauthorised user using or relying upon the information in this document, whether caused by error, negligence, omission or misrepresentation in this document.

This document is uncontrolled when printed.

Authorised users of this document should visit ARTC's intranet or extranet (www.artc.com.au) to access the latest version of this document.

Table of Contents

Table of Contents	2
1 Introduction.....	5
1.1 Purpose.....	5
1.2 Scope.....	5
1.3 Document Owner	5
1.4 Responsibilities	5
2 Applicable Documents.....	5
2.1 ARTC Specifications	5
2.2 Australian Standards.....	5
2.3 International Standards.....	6
3 Environmental Conditions.....	6
4 Design Requirements	6
4.1 System Safety	6
4.2 Service Life	7
4.3 DC Power Supplies for Signalling Equipment.....	7
4.4 Standardisation of Components.....	7
4.5 Wiring	8
4.6 Maintenance.....	8
4.7 Assembly, General Requirements	9
4.8 Surge Protection	9
4.9 Dual Channel Power Supply Units.....	10
5 Electrical Requirements	10
5.1 Input Voltage	10
5.2 Output Voltage	10
5.3 Load Regulation	10
5.4 Transformers.....	10
5.5 Inrush current of input transformer.....	11
5.6 Rectifiers	11
5.7 Capacitors	11
6 Mechanical Requirements.....	11
6.1 Painting	11
6.2 Labelling.....	12
7 Prototype & Acceptance Testing of Prototype Units	13

8	Testing Requirements.....	13
8.1	Functional Test.....	13
8.2	Earth Continuity Test.....	13
8.3	Environmental Test	13
8.4	High Voltage Test.....	13
8.5	Insulation Test.....	13
8.6	Final Check	13
9	Tests	13
10	Information to be Provided by the Manufacturer/Supplier	14
10.1	General Information	14
10.2	Technical Information.....	14
10.3	Technical Support	14
11	Guarantee.....	14
12	Inspection /Acceptance Testing Procedure	15
12.1	Suppliers with quality management systems	15
12.2	Suppliers without quality management systems	15
13	Delivery.....	15
14	Power Supply Units - DC Unfiltered	16
14.1	Types of Units	16
14.2	Electrical Requirements	16
15	Power Supply Units - DC Filtered	17
15.2	Electrical Requirements	17
15.3	Mechanical Requirements.....	17
15.4	Labelling.....	18
16	Power Supply Units - DC Track Circuit Feeds.....	18
16.1	Item DC601 : Automatic Track Rectifier Sets.	18
16.2	Item DC602: A.C/D.C. Track Rectifier Sets.	18
16.3	Electrical Requirements	18
17	Power Supply Units - DC Regulated and Filtered	20
17.1	Electrical Requirements	20
17.2	Design Requirements.....	21
18	Power Supply Units – Switched-Mode Power Supplies	22
18.1	Generic Requirements	22
18.2	Output Voltage	22
18.3	Output Ripple	22

18.4	Standards Compliance.....	22
19	Power Supply Units – Battery Chargers / Power Supplies	23
19.1	Technical Requirement	23
20	APPENDIX 1 – Equipment Drawings	25
20.1	M08-429 – Standard rack layout for DC Power Supply equipment	26
20.2	M08-430 - Power Supply Unit, DC unfiltered 50V 2.5A (Store 103).....	27
20.3	M08-435 – Power Supply Unit, DC unfiltered 50V 0.2A (Store 87)	28
20.4	M08-436: General circuit diagram – Power Supply Unit, 50VDC no-break supply	29
20.5	M08 438 : Power Supply Unit-DC Track Feed (Store 72).....	30
20.6	M08 439 : Power Supply Unit-DC Track Feed (Store 70), (Automatic Track Rectifier).....	31
20.7	M08 440 Power Supply Unit-DC Track Feed (Store 70 (Automatic Track Rectifier)	32
20.8	M08-801 - Power Supply Unit, DC unfiltered General circuit diagram	33
20.9	M08-845: Power Supply Unit, DC filtered 24V 4.4A	34

1 Introduction

1.1 Purpose

This specification describes minimum requirements for DC power supplies units and battery chargers.

1.2 Scope

This specification applies to the DC power supplies and battery chargers for signalling application for the ARTC network.

1.3 Document Owner

The Head of Engineering Standards is the Document Owner. Queries should be directed to standardds@artc.com.au in the first instance.

1.4 Responsibilities

The project manager or Responsible Asset Manager or Signal Maintenance Engineer is accountable for implementation of this specification.

The installer or contractor is responsible for compliance and confirmation that materials and kits conform to the requirements of this specification.

The Project Manager or Responsible Asset manager are responsible for consultation and agreement with the relevant Signal Maintenance Engineer. This is necessary to ensure consistency, maintainability and reliability of the signalling system.

2 Applicable Documents

2.1 ARTC Specifications

This specification refers to the following ARTC, signals specifications:

Specification SPS 04:	Requirements for Labelling of equipment
Specification SPS 05:	Electronic Components - Ratings and Construction Requirements
Specification SPS 23:	Transformers for Signalling Applications
Specification SPS 32:	Fuses for Railway Signalling Applications
Specification SPS 51:	Screw Clamp Terminal Blocks

2.2 Australian Standards

This specification refers to the following Australian Standards:

AS 7720	Railway Signalling Power Supply System
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.

Environmental Conditions

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	Electric Cables – Polymeric insulated for working voltages up to and including 0.6/1KV.

2.3 International Standards

DIN/VDE 0303 Part 1	Method of determining the comparative & proof Tracking Indices of solid insulating materials under moist conditions (Identical to IEC 112/79)
AU/NZS60335	Household and similar electrical appliances –Safety general requirements
AU/NZS62368	Audio/Video, Information and communication technology equipment Safety requirements
AREMA C&S Manual 9.2	
EN 61000	Electromagnetic Compatibility
BRB 929:110/24V	Transformer rectifier units with smoothed output for track circuit equipment
IEC 384-4	Fixed capacitors for use in electronic sectional specification: Aluminium capacitors with solid and non-solid electrolyte.

3 Environmental Conditions

All units shall be capable of fulfilling the performance specifications in the following environmental conditions, or shall be accepted by suitable successful field trials.

Temperature	-10 to +70 C (ambient temperature), unless specified
Humidity	Relative Humidity 0 to 95%
Vibration	0.04cm p-p displacement at 10 Hz to 50Hz 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 modes of these DC power supplies shall be considered prior to acceptance.

4.1 System Safety

The railway signalling system is a safety system. DC 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 shall not reduce the level of safety provided by the signalling system.

Due to the nature of the railway signalling power supply the following principles shall apply:

Design Requirements

- The operation or failure of the power distribution system shall not cause a wrong side failure of the signalling equipment.
- The power supply installation shall be designed to be electrically safe for workers who can interact with the system.
- The system shall be tolerant of faults to ensure a very high availability of signalling systems.

4.2 Service Life

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

4.3 DC Power Supplies for Signalling Equipment

The main power supply distribution for signalling equipment is 110VAC/120VAC 50Hz and the supply is unearthed. The 110VAC/120VAC supply is derived from 240VAC local power supply authority supplies. In some locations there are alternate power sources such as motor generator sets, solar supplies, etc.

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

The 110VAC/120VAC signalling power supply has an operating tolerance range from 95 to 132 volts AC.

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 acceptance shall be obtained if an 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 To specification SPS 51 Terminals: Terminals with standard stud connections shall be used with eye lugs for terminals, which carry currents above 5A.

4.4.2 Lugs

Non-insulated copper lugs shall be terminated using a hydraulic crimping tool with the appropriately sized die for the particular lug and conductor size.

Insulated copper ferrule lugs shall be terminated using a hand crimping tool of the appropriate size for the particular lug and conductor size.

Other forms of termination devices may be used subject to acceptance by ARTC. .

4.4.3 Fuses

Fuses shall be in accordance with Specification SPS 32 - Fuses for Railway Signalling Applications.

4.4.4 Indicating Relays

Where specified DC power supply units or systems shall be supplied complete with indicating relays, firmly mounted with relay restraining clips. 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

Where LED indicators are provided, the following requirements apply:

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

LED indicators shall preferably be packaged with the appropriate resistor.

Where LED indicators are provided they shall protrude through the front of the case. The LED units shall be mounted separate from and not inhibit the removal of the unit cover.

4.5 Wiring

All internal wiring, including leads of transformers, rectifiers and other components shall be sized at least copper 24/0.20mm, 0.6/1kV grade PVC insulated wire according to AS 5000. The current rating of all wires shall be de-rated 50%.

The insulation of all wires shall be at least V 105 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 (eg. for voltage tapping changes) shall be terminated with a crimped pin lug or bootlace ferrule as specified in Section 4.4.2.

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.

Design Requirements

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.

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 150VA 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 British Railway Board (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

- a) to minimise the effects of any overheating likely to arise in one component, on any other component.
- b) 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 met:

- a. Individual channels or modules can be replaced without disruption to the continue output of the supply from the unit.
- b. 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 110V/120VAC, 50 Hz supply with an acceptable voltage variation between 95VAC and 130VAC. Input voltage selection shall be provided for 110V, 115V, 120, and 125V operation or as specified in the respective specification and drawing.

Battery charger / power supplies shall be capable of operating from a nominal 240VAC as well as a nominal 110V/120VAC supply.

The secondary winding of the transformer shall be provided with tapings for adjustment.

5.2 Output Voltage

According to the respective DC power supply information within this specification.

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 Transformers

The transformer shall comply with AS 2374. The primary windings shall be provided with tapings to suit input voltages as Section 5.1. The transformer primaries shall be wound with a minimum of 20 B&S gauge wire or equivalent. The secondaries shall be provided with an additional tapings such that the output voltage of the unit can be increased by 10% above rated value at full load.

The transformer for the Track Circuit feed shall be of a double wound type with the primary winding of 20 gauge B&S wire or the equivalent. Magnetisation current shall not exceed 30mA.

The magnetising current shall not exceed the following values:

for 12VDC / 1A unit:	40mA
for 24VDC / 5A unit:	100mA
for 24VDC / 15 A unit:	250mA
for 50VDC / 2.5A unit:	200mA
for 50VDC / 0.2A unit:	40mA

5.5 Inrush current of input transformer

Input transformer arrangements 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 AS3108. The rating of the protective device used in this test shall be equal to the normal rating of the transformer. Test results shall include oscillograph traces of the actual input current monitored during the test.

5.6 Rectifiers

All bridge rectifiers and blocking diodes shall be able to supply the surge current of any capacitors used (e.g. in the filter circuit) without sustaining damage.

All bridge rectifiers and blocking diodes shall have a minimum Peak Inverse Voltage of 1KV.

5.7 Capacitors

Electrolytic capacitors used in filter circuits (where appropriate) shall be rated for working voltage of 100V D.C. and should be fitted with screw terminals. The base and the outside of the capacitor should be insulated from the case.

The ripple Current of the capacitor shall be rated at two times the max load current of the unit.

Capacitors shall be a long-life type, complying to IEC 384-4. Capacitors shall have screw terminal connections.

Capacitors shall be mounted in a ventilated location remote from any heat sources within the unit.

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.

- a) 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.
- b) 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, Nyloc nuts or other vibration resistant fixings wherever necessary to withstand vibration tests.
- c) 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 should not be used.

6.2 Labelling

Labelling shall be done in accordance Specification SPS 04.

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.

6.2.1 Label (Name-plate)

All units should be supplied with name plates as follows:

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

Item Description			
Specification			
Part number			
Manufacturer's Name			
Unit / System Serial No.			
Month / Year Manufacture			
Input Voltage		Output Voltage	
Input Current		Output Current	

Example

Item Description	120VAC – 24VDC filtered power supply		
Specification	XYZ-1234		
Part number	PS120/24F		
Manufacturer's Name	Best Power Supplies		
Unit / System Serial No.	PS120/24F-0000001		
Month / Year Manufacture	2022 / 04		
Input Voltage	120VAC	Output Voltage	24VDC
Input Current	5 Amps	Output Current	20 Amps

7 Prototype & Acceptance Testing of Prototype Units

Any unit not previously supplied to the ARTC, 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 manufacturer's factory or at ARTC premises by an ARTC representative. This will be at the discretion of the ARTC. The manufacturer shall provide suitable equipment and assistance to carry out full voltage and load tests as required by the ARTC representative.

8 Testing Requirements

8.1 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.

8.2 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.

8.3 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.

8.4 High Voltage Test

The assembled unit shall withstand for one minute a test voltage of 2KV AC at 25-100Hz, 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 flashovers. Insulation tests shall be performed at the end of the high voltage test.

8.5 Insulation Test

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

8.6 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 manufacturer shall be those laid down in the specifications.

Each unit shall be tested and a test certificate should be provided 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 Manufacturer/Supplier

10.1 General Information

Manufacturers 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 ARTC representative the following items shall be supplied to the ARTC for retention:

- i. copy of the manufacturers test procedures and results.
- ii. 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 manufacturers prior agreement.

Three set up adjustment and maintenance manuals if specified for each types of unit shall be supplied.

10.3 Technical Support

Preference should be given to existing suppliers of ARTC with proven satisfactory support and for new suppliers, products already proven in similar signalling applications in other railways.

Technical support for initial installation and throughout the design life shall be provided by the supplier.

Training to the ARTC and contractor staff shall be provided by the supplier.

Configuration work instruction shall be developed by the manufacturer/supplier or designer for the ARTC maintenance staff. The configuration/web interface shall not be constrained by any proprietary issues and shall be available to ARTC maintenance.

11 Guarantee

The supplier shall guarantee the equipment to perform to the specified requirements for a period of 12 month 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 ARTC. Suppliers shall indicate their agreement to this warranty.

12 Inspection /Acceptance Testing Procedure

For acceptance of a power supply unit or system, the following documents shall be provided.

- 1) Test certificate with each power supply unit or system, which shall be enclosed in a transparent envelope and attached to the unit.
- 2) 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 manufacturer 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 or systems.

12.2 Suppliers without quality management systems

Inspections shall be performed as follows:

- a) Inspection and testing of the equipment will be required at the point of manufacture prior to delivery unless otherwise agreed – Factory Acceptance Test (FAT).
- b) Manufacturers/suppliers shall provide facilities for testing the units as described in Section-7.
- c) 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.

14 Power Supply Units - DC Unfiltered

14.1 Types of Units

This unit can be used in like for like replacement works. It should not be used on new installation.

ARTC ID	Description	Old ID
DC401	Power Supply Unit-DC Unfiltered 12V, 1A DC	
DC402	Power Supply Unit-DC unfiltered 24V, 5A DC (superseded twin channel unit)	Store 107
DC403	Power Supply Unit-DC Unfiltered 50V, 0.2A (10VA)	Store 87
DC404	Power Supply Unit-DC unfiltered 50V, 2.5A DC	Store 103

14.2 Electrical Requirements

14.2.1 Output Voltage

The DC output voltage of the equipment at the nominal input shall be within the nominal voltage - 5% at full load. The output voltage for unit greater than 1 A should be carried via suitable taps.

14.2.2 Termination

The transformer input and output tapings shall be terminated external to the units on "Klippon" BK series terminal blocks or equivalent.

Each termination shall be clearly and permanently identified.

For the 50V/0.2A and 12V/1A unit shall have Klippon type "BK6" terminal blocks or equivalent.

For the 24V/5A and 50V/2.5A unit shall have terminal blocks Klippon type BK or equivalent for the input and output terminals which shall be external to the unit when mounted within a standard BRB rack.

For 24V/15A DC units shall have terminals consisting of 6mm brass studs on 25mm centres protruding 40mm from the insulating material and each shall be identified.

Separate internal terminals shall be provided for the AC input terminations and the indicator outputs (if applicable) and the outgoing DC supplies.

14.2.3 Indications

LED indicators shall be provided.

14.2.4 Mechanical Requirements

14.2.5 Housing

No housing shall be provided for 50V/0.2A DC (ARTC type DC403) and 12V/1A DC units.

Power supplies units with ratings 25VA to 150VA shall be totally enclosed in sheet metal cases to suit rack mounting, with removable covers providing ready access to all the enclosed equipment for replacement. Covers should not ventilate through the top and only from the sides to prevent vermin urination deteriorating components.

In case of power supply units greater than 150VA, it shall be designed for panel mounting. Two 30mm bushed holes shall be provided in the base for cable entry.

14.2.6 Labelling

Labelling on the terminals and power supply unit should be provided with labels that will not deteriorate with time or heats .The type of material should be permanent and UV stable and secured with suitable permanent adhesive or rivets.

15 Power Supply Units - DC Filtered

This unit can be used in like for like replacement works. It should not be used on new installation.

15.1.1 Types of Units

ARTC ID	ITEM DESCRIPTION	Old ID
DC501	Power Supply Unit-DC Filtered 24V DC,4.4A (unregulated)	
DC502	Power Supply Unit-DC Filtered 50V, 7ADC (No-break supply)	Store 92
DC503	Power Supply Unit-DC filtered 50V 2A (No-break supply)	
DC504	Power Supply Unit-DC filtered 50V 20A (No-break supply)	Store 95

15.2 Electrical Requirements

The Filtered Power Supply Units (except for 24V/4.4ADC unit) shall be fabricated in accordance with drawing M08-436.

Each unit shall consist of transformer, bridge rectifier, filter, indicator, indicating relay and blocking diode of appropriate rating.

The capacitor input filter provided in each channel shall suppress the output ripple to 5% of the no load output voltage at full load. The capacitance value shall be such that the output voltage is maintained at minimum level of 85% of the nominal output voltage for a period of 100 milliseconds after the interruption of the input supply with full load applied.

Power supply unit 24V/4.4A DC shall be fabricated in accordance with Specification BRB 929 and drawing M08-845.

15.2.1 Terminals

Terminals shall be stud or clamp type with the input sections separated.

Terminals shall be suitable for terminating 2 x7/0.85mm conductor for 7A, 10A and 20A Rectifiers and 2 x7/1.7mm for 30A Rectifiers.

Each termination shall be capable of terminating 2 wires.

15.3 Mechanical Requirements

All equipment shall be totally enclosed in sheet metal case. A removable cover shall be provided to allow ready access to the components.

No-break supply units shall be suitable for both wall and floor mounting – a WHS assessment will determine which arrangement is most suitable. Where they are to be wall mounted, two 30mm bushed holes shall be provided in the base for cable entry.

Power Supply Units - DC Track Circuit Feeds

Power supply units should be suitable for rack mounting. Terminations shall be screw type and suitable for terminating forked blue crimp lugs. The dimensions of these units shall be 142 x 134 x 210mm(depth).

15.4 Labelling

On Item DC501 labels 0-2A, 2-4.4A, COM are to be provided as shown in drawing M08 845.

16 Power Supply Units - DC Track Circuit Feeds

This unit can be used in like for like replacement works. It should not be used on new installation.

16.1 Item DC601 : Automatic Track Rectifier Sets.

Automatic rectifier units, operating with one or two secondary batteries, shall have output voltage between 1.0V and 2.5 Volts at 1 Amp rated load.

Typical designs for the units are as shown in drawings M08-439 & M08-440.

In service the combined battery/rectifier supply will be used to supply a fluctuating load at a voltage within the specified range. The rectifier unit shall be designed so that once adjusted for the particular battery voltage in use it will automatically compensate for changes in load conditions with the drain from the battery remaining within the specified range.

The input connections shall be labelled 120V input, the battery terminals shall be labelled B+ and B- and the track connections marked T+ and T-.

Shall be labelled as "Store No. .170".

The complete unit shall be suitable for panel mounting, as per the attached drawing M08-439 or M08-440.

16.2 Item DC602: A.C/D.C. Track Rectifier Sets.

Transformer rectifier sets consisting of a double wound transformer and a bridge rectifier as per drawings M08-437 and M08-438. The transformer secondary winding shall be tapped giving 2V-3V-1V between taps. The secondary connections shall be brought out to a terminal block to allow the rectifier to be connected so as to obtain 1V to 6V output at 1Amp rated load as per requirement.

The input connections shall be labelled 120V input, the battery terminals shall be labelled B+ and B- and the track connections marked T+ and T-.

Shall be labelled as "Store No.72".

The transformer, rectifier and terminal strips shall be mounted on a metal base plate suitable for panel or standard rack mounting as detailed in drawing M08-437. The assembly shall not exceed 100mm in height. No covers are required on the units.

16.3 Electrical Requirements**16.3.1 Rating**

The load current to be supplied by the unit will fluctuate over the range 100mA to 1A. For automatic track rectifier units the rectifier unit shall be designed to carry the major portion of the load and at all times the drain on the primary battery shall not exceed 10mA nor be less than 3.0mA. Some form of adjustment to allow the drain on the battery to be pre-set within these limits would be

Power Supply Units - DC Track Circuit Feeds

preferable. Under no circumstances shall the rectifier unit be capable of passing a charging current into the batteries.

If a control winding is provided, resistance shall not exceed 0.3 Ohm and circuitry shall be provided so that when the load is removed a charging current is not circulated through the battery.

16.3.2 Terminations

The input and output terminals of panel mounting units shall consist of 6mm x 40mm brass studs projecting 25mm above the insulating material in which they are held and mounted at 25mm centres.

Rack mounting units shall require "Klippon" BK or an equivalent type of terminals.

The input and output terminals shall be fixed on individual terminal strips mounted separately from each other and so located as to be readily accessible.

17 Power Supply Units - DC Regulated and Filtered

This unit can be used in like for like replacement works. It should not be used on new installation.

17.1 Electrical Requirements

DC701 Power Supply Unit-regulated 24V, 4A DC - Store 93

17.1.1 Output Voltage

The output voltage shall be 24 Volts D.C. nominal and shall be regulated to +/- 0.5V. No variation outside this range shall occur for changes in load conditions from 10% load to 100% load and/or changes in input voltage over the range stated in clause 5.1.

In addition, the units shall be designed so that the output voltage does not exceed 28 Volts nor reverses polarity during any switching on or off of the input A.C. supply or of the load. The output shall be protected as specified in clause 17.1.6 and 17.1.7.

17.1.2 Adjustment

The units shall be designed to operate over the full input and output voltage ranges without the need for adjustment of input and output tapplings.

However, designs may be submitted which utilise adjustable settings provided that they meet or better the following requirements:

- a. Once the output voltage has been set at 24 +0.5Volts for a constant load between 0 and 4A, then the unit shall hold its output voltage within the range specified in clause 5.1 for an input voltage of 110V to 125V.
- b. Full details of the various settings shall be provided including the voltage range accepted on each setting.

17.1.3 Output Rating

The unit shall be capable of supplying a continuous load of 4A at the specified output voltage of 24V over the full range of specified input voltages and ambient temperature.

17.1.4 Output Ripple

The unit shall be provided with filter so that the output ripple does not exceed 0.3V peak to peak for all load conditions from zero load to full rated load.

17.1.5 Output Impedance

The supply unit shall have a low output impedance so that the unit is representative of a secondary battery supply.

If possible, the output impedance shall be 10 milliohms or lower when connected to an equipment that works directly from 24Volts D.C. and produces or receives frequencies between 1600 and 2700Hz. Details of the output impedance of the unit offered shall be included with the quotation.

17.1.6 Protection

The supply unit shall be fitted with automatic current limiting facilities, which shall become effective if the maximum load specified in clause 17.1.3 is exceeded.

Power Supply Units - DC Regulated and Filtered

The protection shall not rely on high-speed fuses or other similar devices on the input or output. The unit shall be capable of correct operation as soon as the overload is removed without the need for any manual resetting or adjusting. This protection shall be capable of withstanding a continuous short circuit on the output terminals without affecting the supply unit and it shall not cause the fuse on the 120V input to blow. A protective fuse is not required on the 120V input as this will be provided by ARTC and will be mounted externally to the unit.

However, the suggested rating of this external fuse, along with an absolute maximum rating for this fuse, shall be notified at time of supply. This is to enable ARTC to use a suitably rated fuse from its standard range.

The voltage during switching transients shall never exceed 28 Volts.

17.1.7 Transient Protection

The equipment will be subject to all transients which would be present in normal commercial 50Hz supplies. A changeover contactor will be used to switch to alternate 50Hz supplies in the event that the normal supply is interrupted and this can generate considerable transients.

During the change over there will be break in the 120V input supply which can last up to 100 milliseconds. The equipment shall be designed so that the output voltage and any transients do not exceed 28 Volts when input is re-applied.

It shall be noted that when changing between the two 120V input supplies that these may not be in phase and the unit shall be designed to accommodate this fact.

Any transients appearing on the 120V supply shall not cause the output voltage to exceed 28V or to reverse polarity, nor shall these cause damage to the power supply unit itself.

Similarly, the D.C. output side of the unit shall be protected against transients which may be generated by solenoid, motors, relays and other inductive loads.

Full details of the level of protection offered against transients shall be included with the quotation.

17.2 Design Requirements**17.2.1 Maintenance**

The method of mounting of the unit on the rack as per drawing M08-429 must be quick and simple. The unit shall be capable of supporting itself on the rack while being secured.

17.2.2 Assembly

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

17.2.3 Rating of Components

All components shall be capable of withstanding vibration without damage or loss of efficiency and shall be of the highest quality. They shall not be operated in excess of the following requirements.

- i. Electronic Components:50% of nominal voltage breakdown, current and power ratings.
- ii. All Wiring:50% of nominal ratings and is to be 0.6/1KV.
- iii. All Others:75% of nominal ratings.

17.2.4 Terminations

All input and output wiring shall be terminated in a readily accessible position on "Klippon" BK or an approved equivalent type terminals.

17.2.5 Case Details

The complete unit shall be mounted in a single fully enclosed ventilated metal case provided with mounting holes suitable for rack mounting on racks. The terminals shall be external to the unit. (Refer to drawing M08-429 for verification of the positioning of terminal blocks)

The mounting holes shall be large enough to accept 5mm diameter screws and shall not exceed the dimensions of the rack as shown on the drawing.

18 Power Supply Units – Switched-Mode Power Supplies

Switched-mode power supplies (SMPS) have become the increasingly common on the ARTC network and preferred to be used on new installation.

Switched-mode power supplies are compact, power-efficient and lightweight. Switched-mode power supplies are also extremely flexible from a design perspective, enabling designers to find an optimal solution for whatever power requirements their end-product might have.

18.1 Generic Requirements

The Power supply should have a convection cooling method.

All power supplies should have output indications that can be used for monitoring SMPS failures and low voltage.

All outputs need to be current regulated so that they are protected against short circuit.

18.2 Output Voltage

The output voltage shall be as indicated by the particular nominal output of the SMPS and shall be regulated to +/- 0.5V. No variation outside this range shall occur for changes in load conditions from 10% load to 100% load.

In addition, the units shall be designed so that the output voltage does not exceed +10% of the stated nominal output voltage nor reverses polarity during any switching on or off of the input A.C. supply or of the load.

18.3 Output Ripple

The unit shall be provided with filtering so that the output ripple does not exceed 0.3V peak to peak for all load conditions from zero load to full rated load.

18.4 Standards Compliance

SMPS shall comply with relevant international and Australian Standards for energy efficiency, safety, and electromagnetic interference. Standards stipulate the minimum levels of energy efficiency at full load and 10% load, together with the maximum energy consumption during no-load conditions.

Generic safety regulations include IEC 62368-1 for IT and AV equipment and, 61000-3-2 for EMC requirements.

19 Power Supply Units – Battery Chargers / Power Supplies

High reliability is expected for power supply units/battery charger equipment, especially equipment that is used for road and pedestrian level crossing applications.

The charger shall be suitable for use as a constant potential DC Source with the battery disconnected.

19.1 Technical Requirement

19.1.1 Output Voltage and Current Ratings

The battery charger shall be able to charge NiCad or Lead acid or Lithium-Ion batteries as required by the signalling application.

Output voltage shall be rated to 12v/24v/48v as per required application. The output voltage should be adjustable to any desired 'float' level as required.

Maximum Output current shall be between 10A and 60A as per requirements.

The charger output current should adjust its current automatically, according to the load and to the demand on the battery.

Battery charging equipment shall be able to maintain the battery in its fully charged state and be designed to extend the battery life. The output ripple should not be more than 1%.

Preference should be given to units which are designed so that they can operate over the full input and output voltage ranges without any need for adjustments.

The transformer shall comply with AS 2374 if applicable.

19.1.2 Mechanical

The charger should have a convection cooling method.

19.1.3 User Interface, Alarm and Indication

The battery charger should have a LED indicator at the front for easy identification of the status, faults and alarms, preferably with different colour of LEDs.

The battery charger should be able to provide configurable alarm management for maintenance purposes. It should be able to provide indications for No Charge, Low Voltage and healthy state as a minimum.

Other features like individual cell monitoring, temperature sensor, digital display, web interface, alarm priority management should be considered for maintenance improvements.

The battery charger should have a facility to connect via network comms to web interface or train control as required for live data capturing. It should have the ability to connect to a local laptop for fault diagnostics. Access to the web interface should be protected against unauthorised access.

Where a logging facility is available within the charger, it should be able to log a minimum of 5000 events (faults and alarms).

19.1.4 Protection

The battery charger input shall be protected by a fuse against surge and transient voltage spikes.

The battery charger output shall be protected by fuse for short circuit current limit. In addition, they should have other protection against over temperature, reverse polarity and over voltage without

Power Supply Units – Battery Chargers / Power Supplies
damage to the unit and without tripping the input supply fuse. The charger should impose no current drain on the battery during loss of AC input voltage.

19.1.5 Mounting & Size

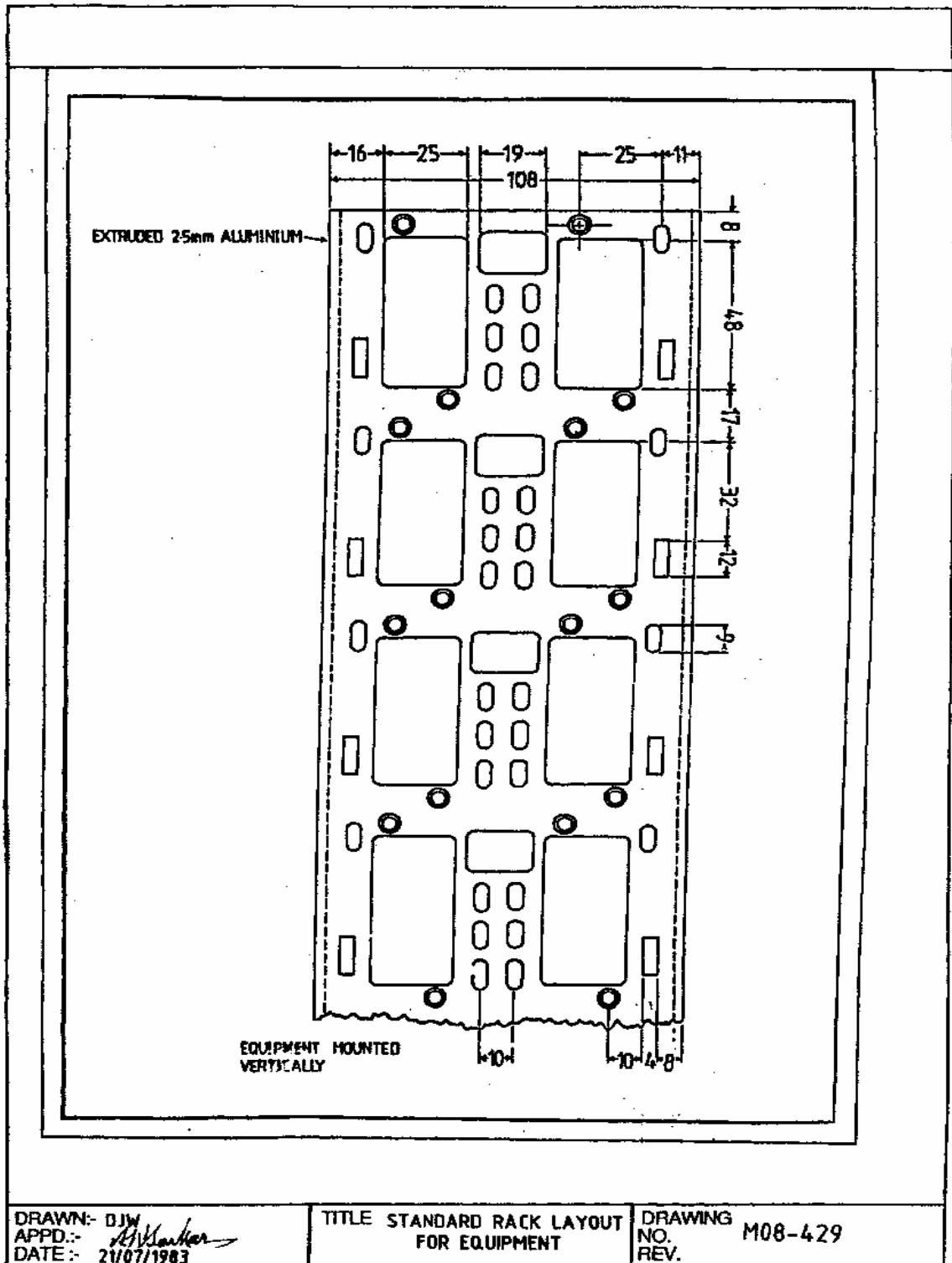
The battery charger should be able to wall mount or rack mount as per required application.

Mounting location and size of the charger should be chosen carefully with consideration of space, accidental damage, access to charger for maintenance or WHS issue.

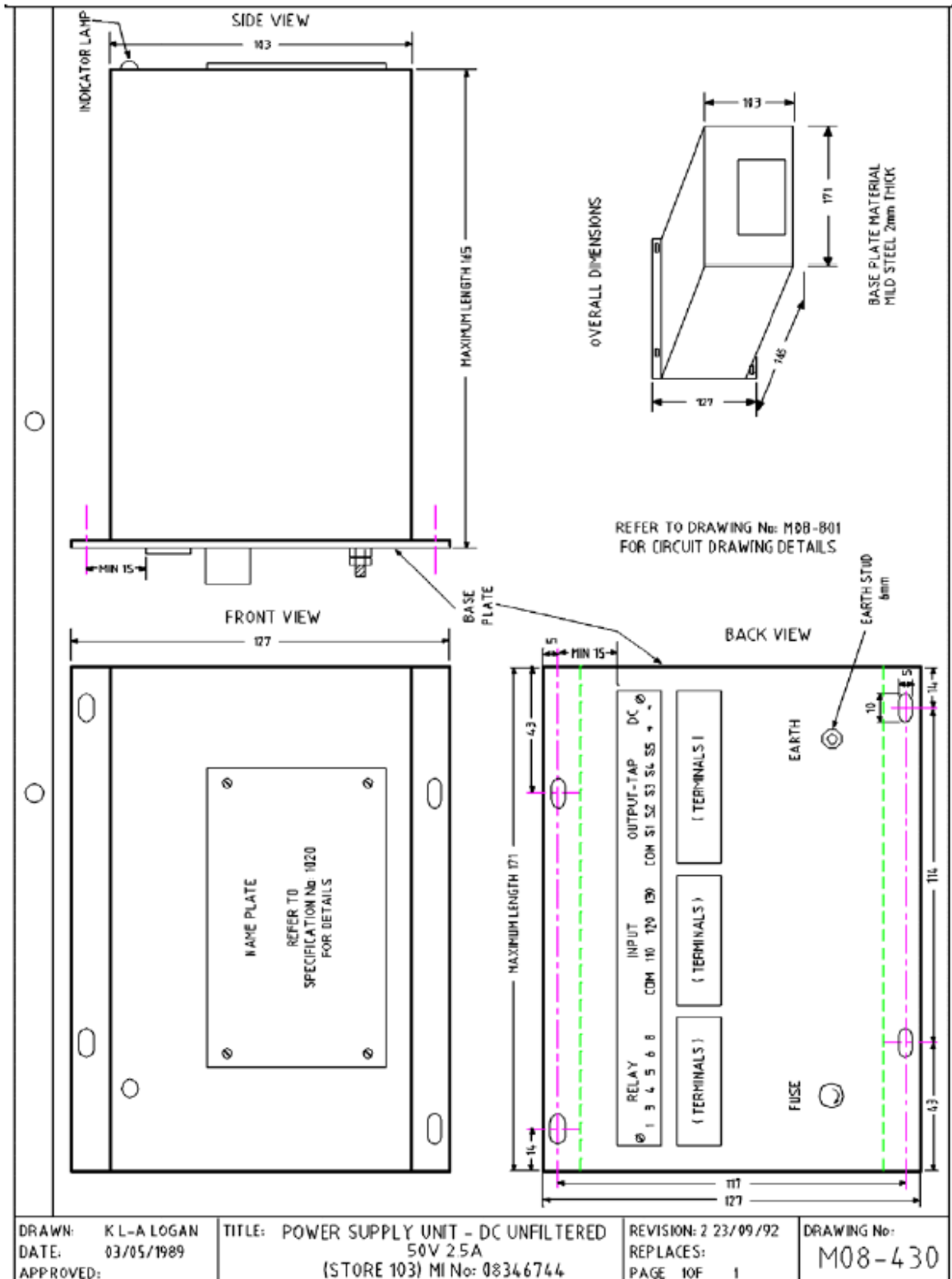
There shall be no live terminal exposed on the charger or it shall be covered during installation and all terminal markings for ac and dc terminals shall be permanent.

20 APPENDIX 1 – Equipment Drawings

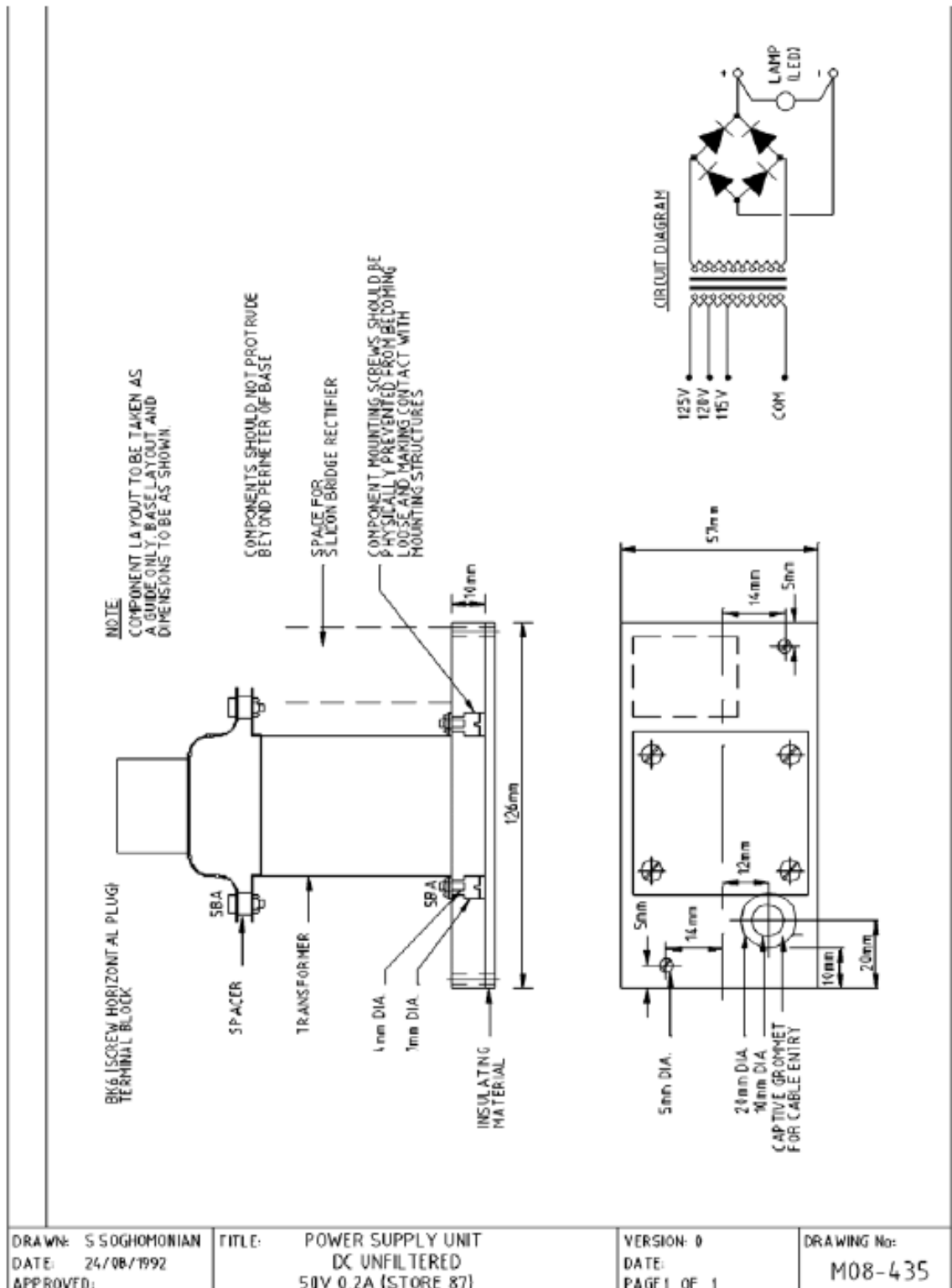
20.1 M08-429 – Standard rack layout for DC Power Supply equipment



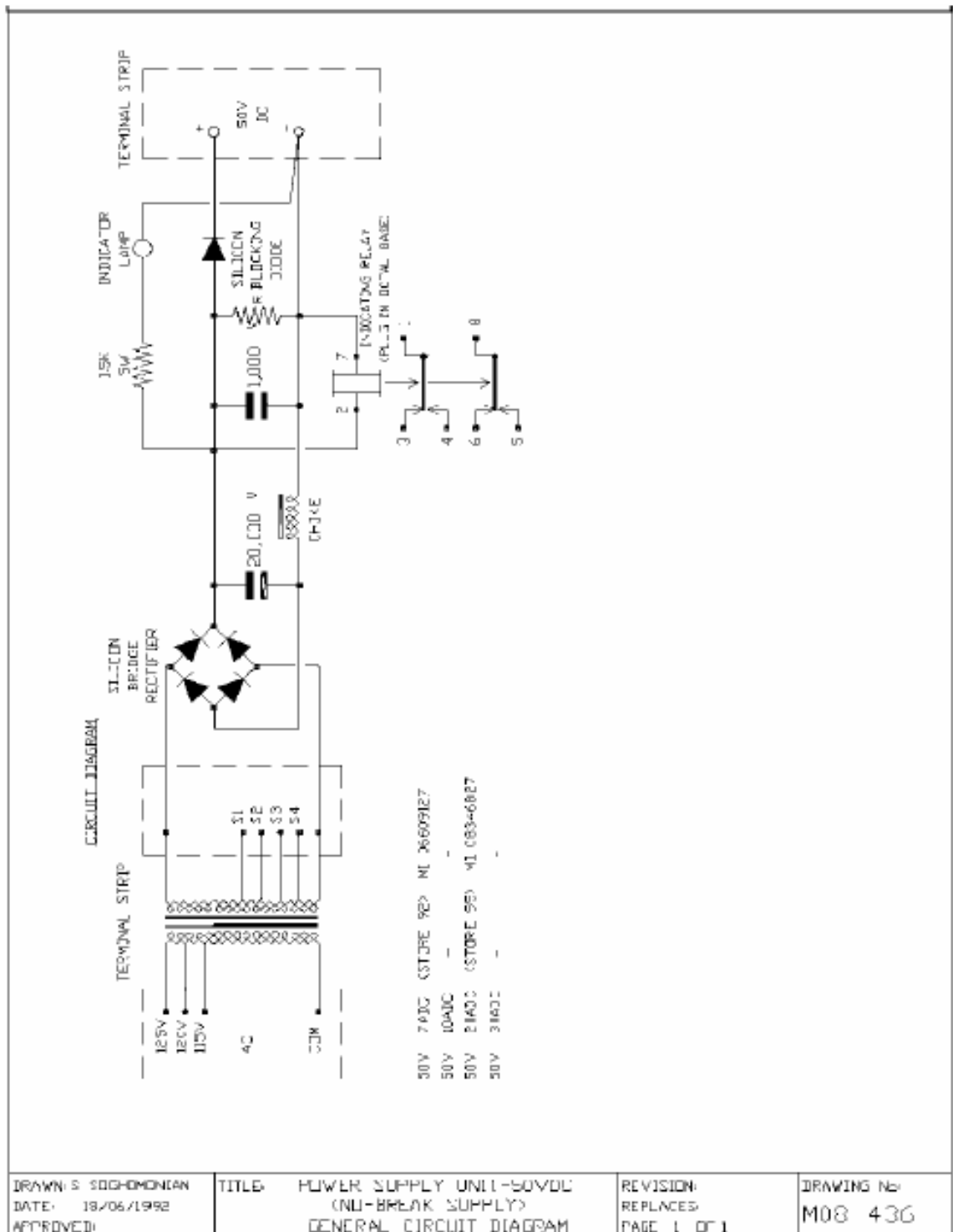
20.2 M08-430 - Power Supply Unit, DC unfiltered 50V 2.5A (Store 103)



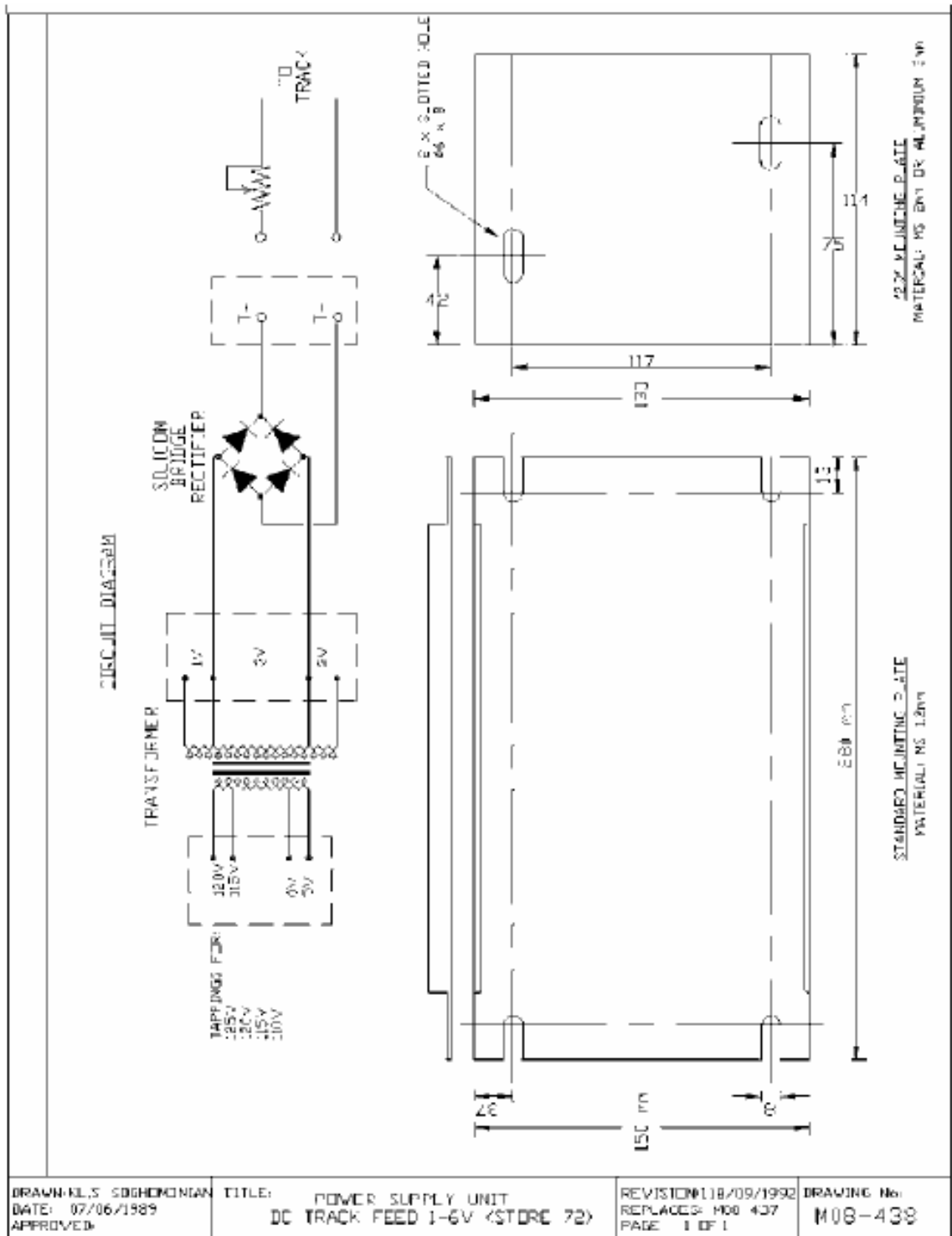
20.3 M08-435 – Power Supply Unit, DC unfiltered 50V 0.2A (Store 87)



20.4 M08-436: General circuit diagram – Power Supply Unit, 50VDC no-break supply



20.5 M08 438 : Power Supply Unit-DC Track Feed (Store 72)



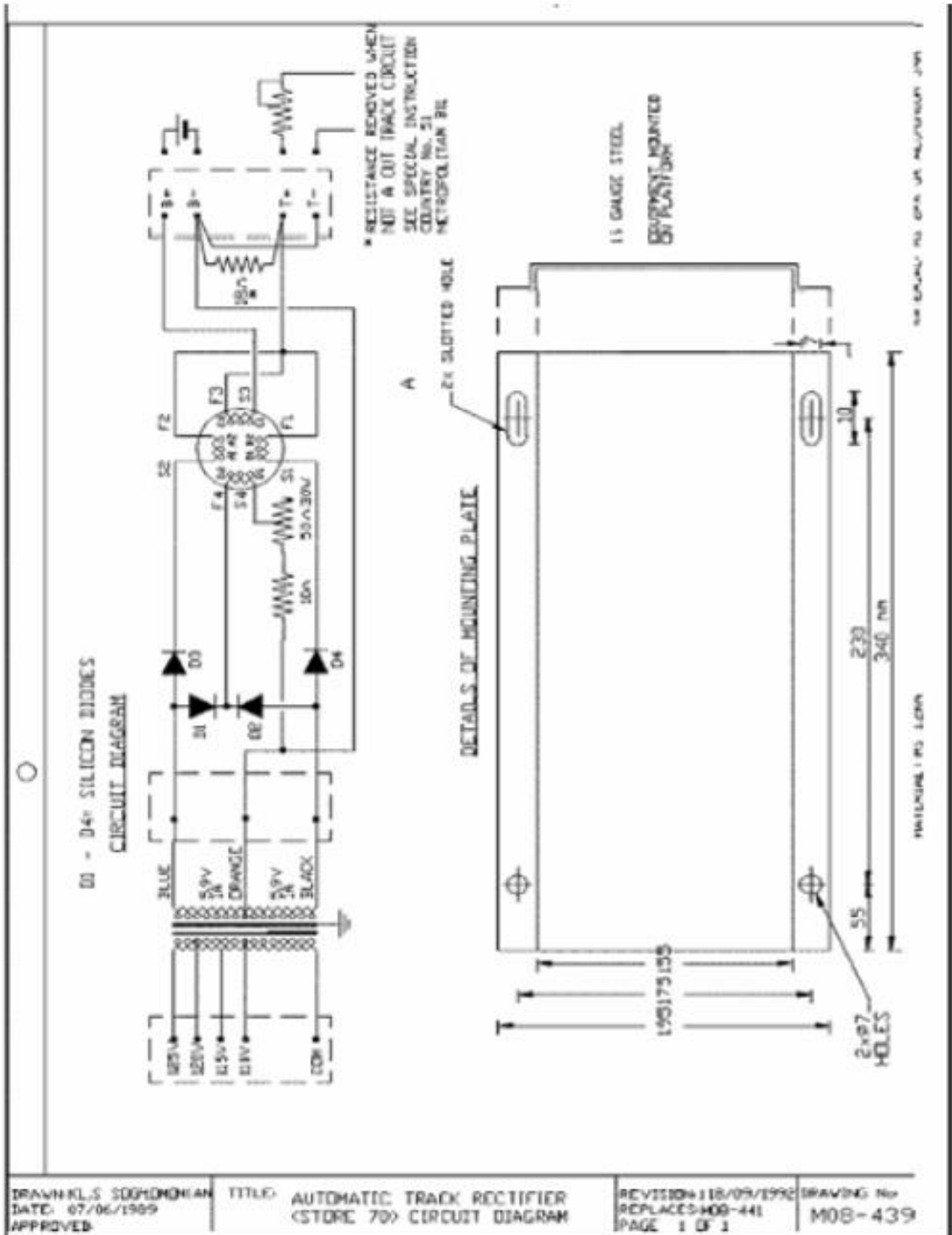
DRAWN: K. S. SINGH
DATE: 07/06/1989
APPROVED:

TITLE: POWER SUPPLY UNIT
DC TRACK FEED 1-6V (STORE 72)

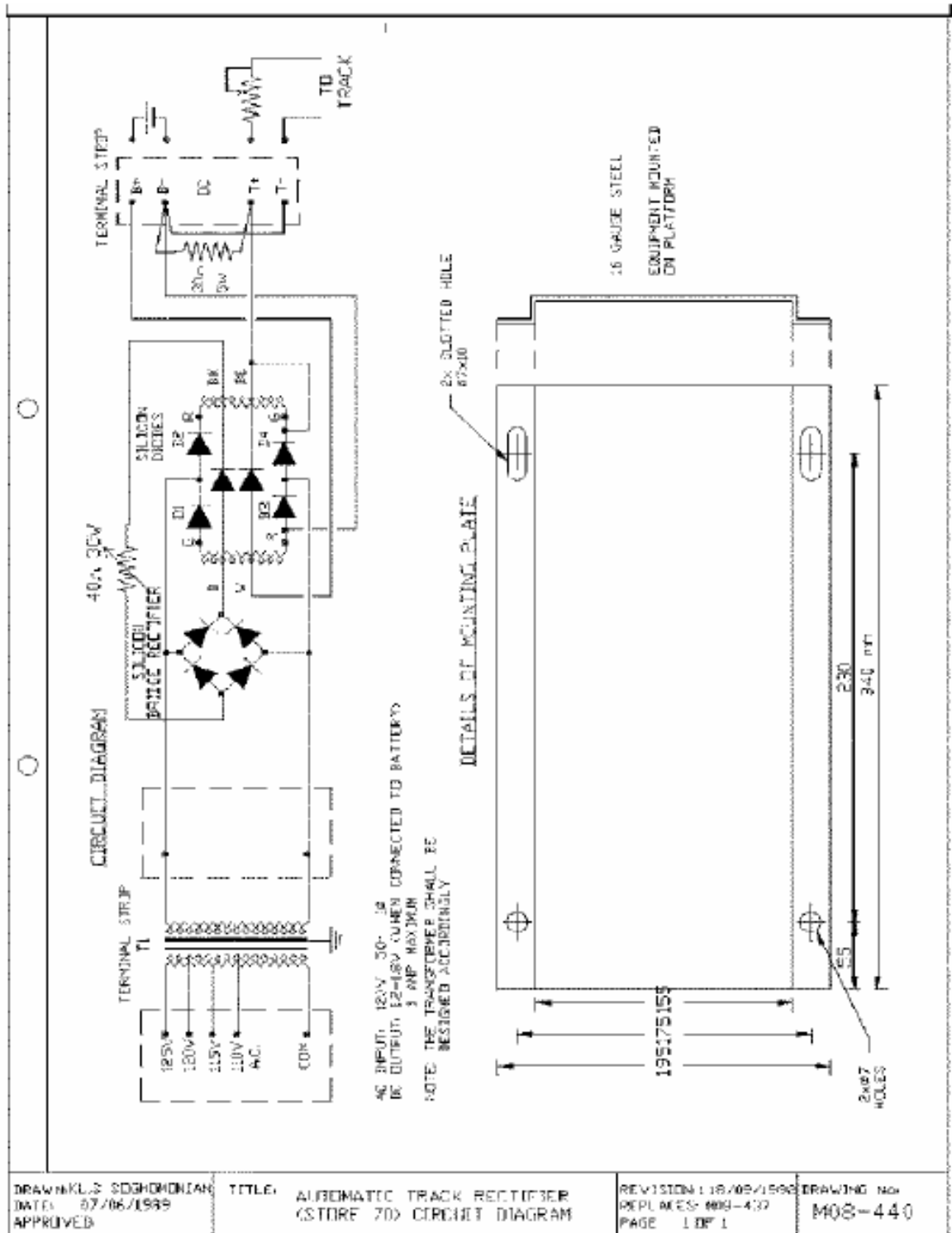
REVISION: 118/09/1992
REPLACES: M08 437
PAGE: 1 OF 1

DRAWING No:
M08-438

20.6 M08 439 : Power Supply Unit-DC Track Feed (Store 70), (Automatic Track Rectifier)



20.7 M08 440 Power Supply Unit-DC Track Feed (Store 70 (Automatic Track Rectifier))



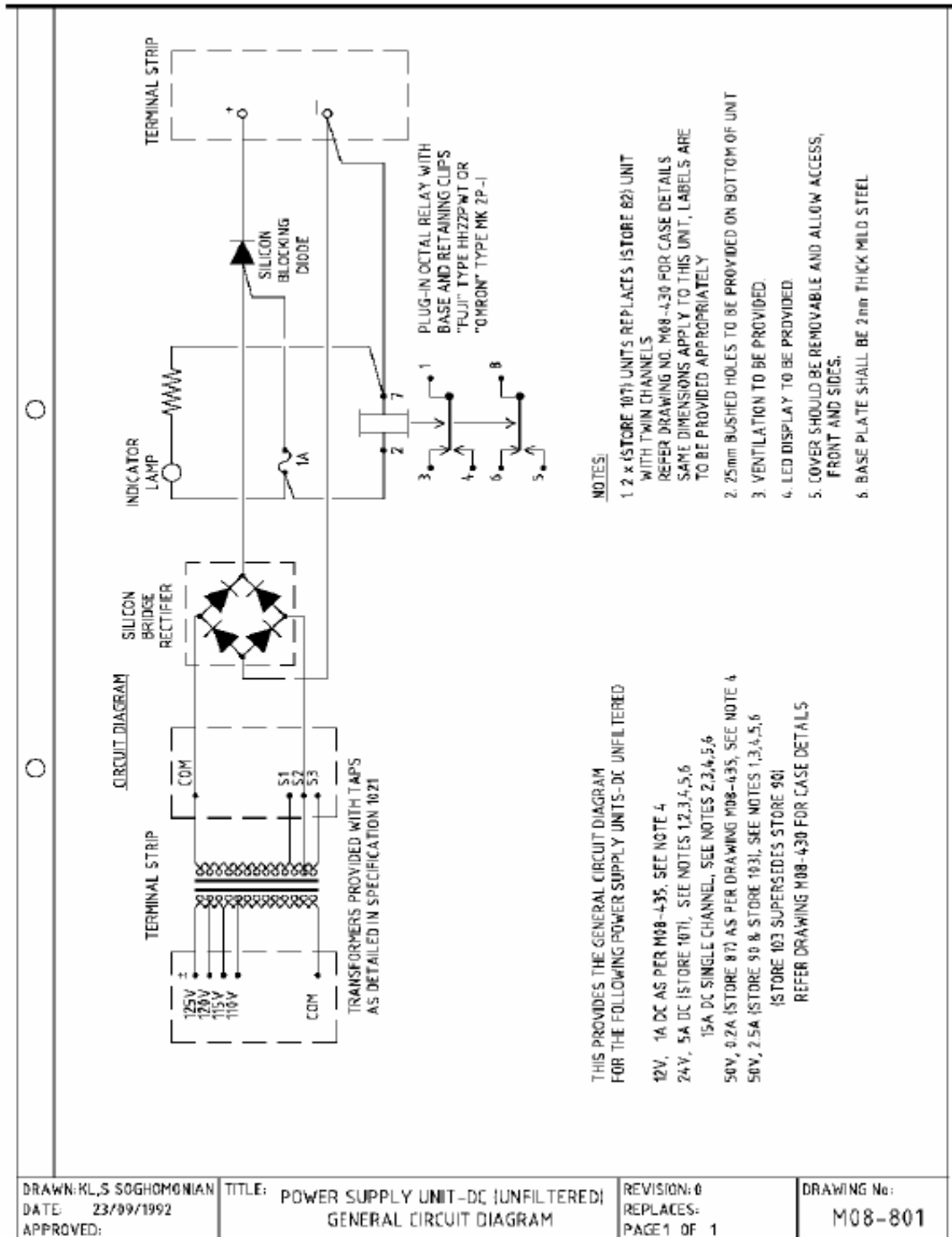
DRAWN: KLS SODHOMDIAH
DATE: 07/06/1999
APPROVED:

TITLE: AUTOMATIC TRACK RECTIFIER
(STORE 70) CIRCUIT DIAGRAM

REVISION: 1 18/05/1998
REPLACES: 000-432
PAGE 1 OF 1

DRAWING No:
M08-440

20.8 M08-801 - Power Supply Unit, DC unfiltered General circuit diagram



20.9 M08-845: Power Supply Unit, DC filtered 24V 4.4A

