BENELEC

Professional Wireless Products

Type 093115 13.8v 15 AMP Battery Management System

Type 093115 Communications Power Supply and Battery Management Controller

1.0 Introduction

The 093115 is a 13.8 volt 15 amp transformer isolated switch mode down converter designed to be used either as a stand alone supply or as a float style battery backed up supply when a lead acid battery is connected to its battery terminals.

The 093115 was designed for wide mains voltage swings (240+/- 20%) and high temperatures and vibration. The supply is rated at 60 C and has been NATA tested at 70 C at full load at a 280 volt mains. It was originally designed for railway trackside applications where such conditions apply. It is very suitable for applications where the mains supply is poody regulated, and temperatures can be extreme.

1.1 Operation Principles

1.11 Stand Alone Supply

The 093115 is constant voltage, constant current supply. When no battery is connected, the output voltage stays constant at 13.8 volts (adjustable) until the current limit (15 amps) is exceeded. The 093115 do not require a battery to be connected for normal operation and provides clean DC.

1.12 Battery Backed up Supply

If a suitable back up battery is connected, the supply will run at its current limit until the battery is charged, that is until the constant voltage set point is reached. The current is shared between the communications load and the battery at all times, to a total of 15 amps. When the battery is charged, the 093115 stays at this set point (13.8 volts and adjustable), supplying the load current and a small trickle charge to the battery. Front panel LED indicators show the status of the supply and battery. When the battery is on charge the "CONSTANT I " LED is on. Within 0.1 Volt of the set point, the "CONSTANT V' LED comes on. The rate of rise of the terminal voltage on Lead Acid batteries is quite fast once they near full charge, so the LEDs form a reasonably accurate state of charge indicator in this mode.

1.13 Battery is Protected

To avoid completely flattening the battery when the ac mains fail for extended periods, the 093115 isolates the load when the battery voltage (as seen at the 093115) drops to 11 volts. Approximately 1 volt of hysteresis is used to stop the disconnect function hunting. When the battery is disconnected in this way, a red "BATTERY LO" LED is lit. When the mains returns, the battery voltage rises rapidly to 12 volts, the load is re-connected automatically, and the 15 amps of available current is shared between the load and battery. A "12 VOLTS OK" Led is lit. The terminal voltage rises to the set point (13.8 volts) when the battery is charged. At this point the supply goes into constant voltage mode, and the current to the battery drops off and a small trickle charge is left.

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1.14 Load is Completely Protected

Should the 093115 fail and present an over voltage condition (> 15 volts for 100uS), an independent MOSFET over voltage isolation switch isolates both battery and load from the supply, and a red "ERROR" LED is turned on. In the event that this over voltage is just a transient condition, the 093115 resets automatically.

Should a charged back-up battery be connected with reverse polarity, the power supply and its load are disconnected automatically by a MOSFET switch, and a red "POLARITY" LED is connected. The 093115 resets automatically when the polarity is correct. This function operates even if load and battery connections are interchanged.

2.0 Recharge Time

The time to charge a battery depends upon the average draw from the load, the battery capacity, and the current limit of the 093115 (15 amps). Suppose that the average continuous base station draw is 10 amps, then 5 amps (15 amps minus 10) is available on average to charge the battery. A 55 AH battery would then take about 12 hours to recover.

3.0 Mechanical

The 19-inch rack mount (3RU) case is manufactured from custom extruded aluminium, anodized black. (See drawing appended). All major components mount to the front panel, which forms the heat sink. The FOB is 70 micron copper (2x normal), secured with press fitted standoffs in many places to the heat sink. The main electrolytic have multiple terminations to the FOB, and heavy parts like Ferrites are bolted to the FOB, while other parts are supported with Loctite 480 adhesive.

The rear safety cover is made of zinc passivated perforated steel, to allow full air flow. The 093115 is convection cooled, and provision must be made for clear air flow around the product, as some 75 watts are lost as heat at full load.

The dress labels are back screen-printed polycarbonate that is strongly resistant to mechanical damage. The enunciator LEDS shine through this.

- Height 3RU 132 mm
- Depth 70 mm
- Width 19" rack 432 mm
- Weight 7 Kg approx
- Mounting 4 screws, rack mount

4.0 Temperature & Product Life

The design ambient is -10 to +600 . The product has been tested at 15 amps and 280 volt mains for 15 hours in a 70 0 ambient, and passes with all components within their published operating maximum temperatures. (Freight Rail Corp test requirement)

At a 20 0 ambient, the heat sink rises < 20 0 in still air at 15 amps load and 240 V mains input. Free air flow is required around the product, and any enclosure must be designed to lose 75 walls to free air.

At 70 0 and full load, the electrolytic used have a typical design life of >7000 hours (case temp 83 C lEC 384-4 part). This rises to >140,000 hours at a 400 continuous ambient.

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5.0 Reliability

The 093115 is manufactured using only well specified and qualified high grade commercial parts. In particular, the electrolytic are IEC 384-4 long life grade with a life exceeding 140,000 hours at 40 C continuous. Burns in all products to eliminate tum on failures. The MTBF is calculated to be >60000 hours at 50 0.

6.0 Maintainability & Warranty

The 093115 is manufactured from discrete components soldered to a double sided, through hole plated solder masked 70 micron POB. Complete parts lists, circuit diagrams, POB overlays and a description of the circuit operation are included in the purchase price.

Within warranty (12 months, copy appended), return to factory freight paid applies. The unit is returned freight paid. Outside warranty, me units can be returned to the factory for maintenance for a fixed fee.

7.0 General Specification

Mains Input 50 Hertz	240 +/- 20% (110 V available)
Mains Isolation	to AS3108
Nominal Output Voltage (1 amp)	13.75 adjustable
Regulation (nominal mains 1-15 amps)	
Constant Current Point	15 amp 0,+2 amp
Hum, Noise & Ripple (ISA load, 20mhz BW)	< 100mV pp
	< 15 mv rms
Over Volts Lookout	> 15.5 V +/- 0.4 V
Battery Disconnect	< 11.2 V +/- 0.4 V
Reverse Polarity protection	Absolute
Temperature	-10 C to 70 C at 15 amps
Expected Life (40 C ambient, full load)	>15 years
MTBF (calculated)	>60,000 Hours @ 5OC
RFl (3khz BW, to 100Mhz)	Better than -7OdBm

7.0 Output Connection

The standard output is via a 6 pin locking Utilux connector. This is compatible with all earlier supplies in this series. A connection diagram is appended. All parts for the mating plug are supplied.

Other connectors can be filled. Please consult the factory.

8.0 Principles of Operation

The 093115 is a constant current, constant voltage D.C. supply. The output voltage stays constant (within the limits of regulation) until the current limit of 15 amps is reached. The supply then goes into constant current. This provides a simple means of floating a lead acid battery if required. The operation of the supply does not require the battery to be present.

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8.1 Down Converter

The mains input is transient clipped by 3 MOVs (R41-43, Circuit Diagram PPSI53-2.sch appended). A Heinemann fuse (3ag) switch assembly is used to isolate the mains. The fuse is removed by twisting the input toggle.

A Delta RFl filter provides ~ 40 dB extra RFl filtering upon the input. The mains are then transformed down to 22 Volts by the mains toroid T6. The output is rectified (Bridge D27) and then filtered by C29 & C30. High frequency inductor L2 provides further RF rejection.

The resulting 32 volts DC is chopped at 100 KHz by MOSFET Q6, and flywheel diode D24, and then filtered by L1 and C16 to produce 13.8 volts DC on C16. Regulation is achieved by altering the mark space ratio of the control signal via U5, the SMPS controller.

8.2 Current and Voltage Settings

The voltage setting is via 20-turn pot R33 ("SET VOLTS" on the ROB), which is available through the mesh of the safety case. It is used to set the constant voltage point , or the end point for the battery charging voltage. This is factory set at 13.75 volts. This pot adjusts the voltage feedback to U5, and is compared with the reference voltage (5.00 volts) generated by U5.

The current in the down converter is sensed by current transformer T5. Rectified by D25, and then a portion set by 20-tum pots R39 ("SET AMPS" on the PCB) is sent to U5 for cycle-by-cycle current limiting. This limit is set to be 15 amps in the factory. The current pulses are integrated by L1 & C15 to make DC. This represents the constant current that is then shared between the battery and the load.

8.3 Charge State Indication

The state of charge is indicated by the move from constant voltage (operation at the set point voltage) to constant current (battery terminal volts at less than the set point.) This is detected by comparator U6, that compares the reference voltage on pin 18, U5 to the output. The output of U6 drives two high brightness LEDS D20, 21 to show the state of charge. Transistors Q8, Q9 isolate this function when the mains are not on.

8.4 Over Voltage Protection

Both LOAD and BATTERY terminals are switched via MOSFETS Q1 and Q3 respectively. The gates of these transistors are fed from a 24-volt charge pump, consisting of U2, diodes D3, D4 and capacitors C2 and C14. A comparator. U3, compares a separate precision reference DI8, and the rail. If it should exceed 15.5 volts, the gate drive is removed and the outputs go open. LED D5 lights ("ERROR"). If this over voltage was just a transient, then the drive is re-applied.

8.5 Under Voltage

In battery back up. the life of the battery is reduced if it is taken below 11 volts. The precision reference DIS and comparator Ul form a Schmitt Trigger with 1 volt hysteris. In operation, tripping U1 (battery <11.0 volts) removes the gate drive from Q1 and thus removes the load. The "BATTERY LO" led is lit. Hysteris in the Schmitt means that the load is not re-connected until the battery reaches 12 volts. This happens almost immediately when the mains comes on, as the battery is in a (relatively) high impedance state at this time.

8.6 Upside Down

Both the 093115 and the load are protected by QI and Q3 from an upside down connection of a battery to either of the LOAD or BATTERY terminals. The battery cannot be reverse charged either. Under these conditions the "POLARITY" LED is lit, and no power is available to the load. This protection circuit operates with or without mains being on.

8.7 License to Use

Although the 093115 appears under many differing labels, ……alone retains the associated intellectual property and the sole right to the manufacture of the 093115. All aspects of its design, circuit diagrams printed circuit boards logos and this document are copyright or subject to registered design.

8.9 Revision History

Rev 1.0 Provisional Only June 1995

Rev 2.0 Initial Public Releases August 1995

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