**USER'S GUIDE AND**
**TECHNICAL REFERENCE**

**AC SOURCE**

**BEHLMAN MODEL AC/DC-1200 SERIES**

**FOR SERVICE ASSISTANCE**

CONTACT BEHLMAN
CUSTOMER SERVICE DEPARTMENT

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**SUBJECT TO CHANGE WITHOUT NOTICE**

DATE: 04/04/2016 Revision: D

## SAFETY SUMMARY

**The following safety precautions must be observed during all phases of operation, service, and maintenance of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in the manual violates safety standards associated with the design and intended use of this equipment. This manual forms an integral part of the equipment and must be available to operating personnel.**

### GROUND THE EQUIPMENT

This equipment may have high leakage current to chassis due to EMI filtering requirements. To minimize shock hazard, the equipment chassis(s) must be connected to an electrical safety ground. This equipment is supplied with a three conductor line connection for single phase applications and/or a five wire connection for three phase applications. Both types include an earth terminal intended for safety ground connections. In addition, isolated installation sites may require neutral to earth connections as per NEC section 250 (National Electrical Code). Refer installation to licensed electrician or other qualified personnel.

### DO NOT OPERATE IN EXPLOSIVE ATMOSPHERE

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

### KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove equipment covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power applied. Under certain conditions, dangerous voltage may exist even with the power removed. To avoid injuries, always disconnect power and discharge circuits before touching them. During normal operation the operator does not have access to internal hazardous voltages. However, depending on the user's application configuration, **HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY** may be normally generated at the output terminals. The customer/user must insure that the output power lines are labeled properly as to the safety hazard and that any inadvertent contact is eliminated.

### DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present.

### DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to this equipment. Contact Behlman Electronics for proper replacement parts and specific service information.

## DANGEROUS PROCEDURE WARNINGS


Warnings will precede potentially dangerous procedures in this manual. Instructions contained in the warning must be followed. Warnings will be preceded by the caution symbol (above).

## RISK OF ELECTRIC SHOCK

This symbol warns personnel of hazardous conditions due to the exposure of hazardous voltage that can be lethal if contacted.

Neither Behlman Electronics, Hauppauge, NY, USA, nor any of the subsidiary sales organizations can accept any responsibility for personnel, material or inconsequential injury, loss or damage that may result from improper use of the equipment and/or accessories provided.

For additional safety related technical information, contact the Behlman Electronics sales department or local sales representative.

sales@behlman.com

### CLAIM FOR DAMAGE IN SHIPMENT

Under the FOB factory terms of sale, ownership and responsibility are transferred to the customer when the equipment leaves the factory. Each Behlman product is shipped from the factory in proper operating condition.

Immediately upon receiving equipment, unpack and inspect it for evidence of damage incurred in shipment. File a claim with the freight carrier if the equipment has been damaged in any way or it fails to operate properly. Forward a copy of the damage claim report to Behlman. Include the model number, serial number and date the shipment was received. Behlman will advise the disposition of the equipment and will arrange for necessary repair or replacement.

### RETURNING EQUIPMENT TO FACTORY

Do not return equipment to the factory without prior authorization from Behlman.
A RETURN MATERIAL AUTHORIZATION NUMBER (RMA) is required to return equipment.

This equipment, like all precision electronic equipment, is susceptible to shipping damage. It contains heavy magnetic components as well as delicate electronic components.

If equipment is returned without prior authorization, the shipment will be refused, the customer being liable for all shipping, handling and repair costs.

When packing for reshipment, use the original shock absorbent material and shipping container to preclude damage to the equipment.

Insure that the return authorization numbers (RMA) is available on the container for identification.

## SHIPPING INSTRUCTIONS

RACK MOUNTED UNITS

1) Box(es) must be double wall with minimum 350 lbs. bursting test.
2) Box(es) must provide for a minimum of 3 to 4 inches of clearance around sides, top and bottom of unit.
3) When packing unit, utilize either a foam-in-place system or high density foam. Clearance provided for above must be completely filled with foam.

**FAILURE TO COMPLETELY SECURE UNIT IN BOX WILL ALLOW MOVEMENT DURING SHIPPING, RESULTING IN DAMAGE.**

4) Secure box(es) to pallet(s). This is necessary to insure proper handling and protection during shipping.
5) Place the following warning label on box(es)

**DO NOT STACK**

6) Ship unit(s) using a freight cargo carrier; air or ground.

CABINET MOUNTED UNITS

Cabinet mounted units require that a special crate be used. The crate should be manufactured of plywood (3/8" or thicker) and reinforced (using 1 x 3 or larger pine) on all edges. The unit must be firmly secured to the crate’s base. The crate must be shock mounted to avoid damage during shipping. Detail drawings for Behlman's crates are available upon request.

# WARRANTY CERTIFICATE

Behlman Electronics, Inc. warrants to the original purchaser, for a period of one (1) year from the shipment from Behlman, each item to be free from defects in material and workmanship. Behlman's obligation and the Purchaser's sole remedy for any breach or violation of this agreement is limited to adjustments, repair or replacements for parts which have been promptly reported by the Purchaser as having been in its opinion, defective and so found by Behlman upon inspection. All replacement parts will become the property of Behlman on an exchange basis. This warranty will not apply if such adjustment repair or parts replacement is required because accident, neglect, misuse, failure of environmental controls, transportation damage or causes other than normal use.

If during the warranty period a defect should impair the performance of the unit, Behlman agrees, at its option, to repair or replace the unit or its defective components F.O.B. Behlman at 80 Cabot Court, Hauppauge NY 11788 or at another Behlman service facility at Behlman's option. To obtain service under this warranty, the original Purchase shall notify Behlman at the above address or by telephone at 631-435-0410 and provide information about the defect or impairment of performance. Behlman with then supply the Purchaser a Return Material Authorization (RMA) number. This number must be attached to the equipment sent back for warranty repair. Equipment must be shipped back to Behlman prepaid. No collect shipments will be accepted.

Behlman shall be excused from supplying warranty service if the unit's case has been opened or if the unit has been subject to unauthorized repair. All service outside the scope of this warranty shall be paid for by the Purchaser at Behlman's rates in effect at the time of this repair. Behlman will not perform any repairs outside of the warranty without written authorization by the Purchaser. If the repair is a warranty repair, Behlman will ship the unit back to the Purchaser, by a method determined solely by Behlman, prepaid. If the Purchaser requests, any other means of transportation it shall be at the Purchaser's expense.

The use of the equipment shall be under the Purchaser's exclusive management and control. The Purchaser will be responsible for assuring the proper installation, use, management and supervision of the equipment. Behlman will not be liable for personal injury or property damage.

The forgoing warranties are in lieu of all other warranties, expressed or implied including without limitation warranties of merchantability and fitness for purpose.

In no event shall Behlman be liable for loss of profits, loss of use, or any indirect, consequential or incidental damages. Purchaser agrees that Behlman will not be liable for any damages caused by the Purchaser's failure to fulfill any of the Purchaser's responsibilities set forth herein.

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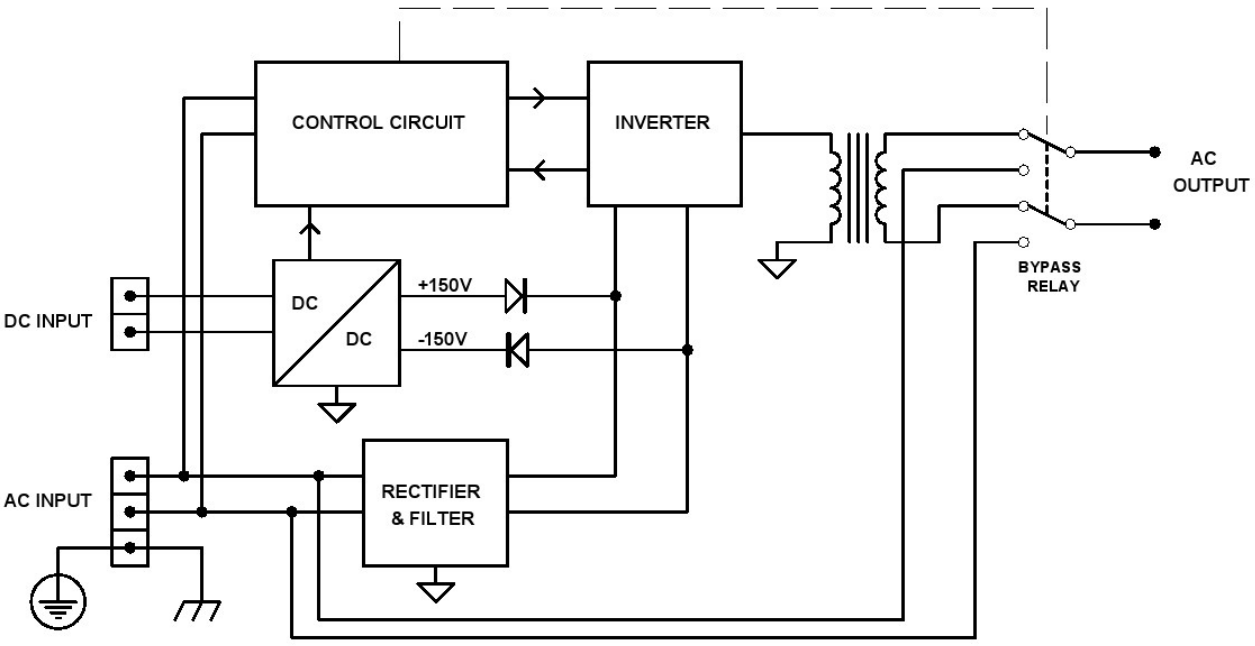
## BEHLMAN AC SOURCE, MODEL ACDC-1200

**SECTION**

## SECTION 1
## INTRODUCTION

The Behlman model series AC/DC 1200 inverters provide conditioned AC power. They may be powered from AC or DC input voltages that vary over a wide range. The output from these models is an isolated fixed sine wave voltage regulated to better than 1 percent. When combined with user supplied batteries, these units can be configured to provide a true online uninterruptable AC power supply. These units are available with AC preferred (A1) or DC preferred (D1) options. These options allow the primary power source to be either AC or DC. A set of alarm signal contacts are also provided to allow integration into a user defined control and monitoring system.

To illustrate the operation of these models a simplified functional block diagram is provided in figure 1-1 below. Both the DC to DC converter and AC output inverter are based on High Frequency PWM switching techniques. This allows for small size and High efficiency.




**SIMPLIFIED BLOCK DIAGRAM, AC/DC 1200 SERIES INVERTER**

FIGURE 1-1

## 1.1 SPECIFICATIONS

### INPUT POWER

| | |
|---|---|
| AC | 120 VAC ±10% single phase, 47 to 63 Hz, 20 Amps max. |
| DC | 48 VDC or 125 VDC ±20% (depending on model)<br>DC burden for 48V units = 40 Amps @ 38 VDC (>2A quiescent)<br>DC burden for 125V units = 15 Amps @ 100 VDC (>1A quiescent) |

### OUTPUT POWER

| | |
|---|---|
| Voltage: | 120 VAC ±5%, 60 Hz ±.01% (other frequencies available) |
| Current: | 10 Amps max. (1200 watts) de-rated above 25°C. |
| Current Crest Factor: | 3:1. |
| Power Factor: | 100% of rated output into any power factor load. |
| Distortion: | 5% maximum THD (measured at full resistive load). |
| Load Regulation: | ±0.7% from no load to full load. |
| Line Regulation: | ±0.1% for ±10% of line change. |
| Efficiency | 80% |

### MECHANICAL

| | |
|---|---|
| Dimensions: | WIDTH: 17 in. (432mm), (19”standard. EIA rack panel),<br>LENGTH: 19in. (483mm)<br>HEIGHT: 5.5in. (144mm) |
| Weight: | 60 lbs. (27kgm) |

### ENVIRONMENTAL

| | |
|---|---|
| Operating Temperature: | -20°C to 55°C (32°F to 131°F). |
| Humidity: | Up to 95% non-condensing. |
| EMI / RFI | Designed for immunity to conducted and radiated sources. |

## 2.1 UNPACKING

After unpacking the inverter (unit), carefully conduct a thorough inspection of controls, indicators, and chassis. If the unit shows signs of damage, do not attempt to operate. File a damage claim with the carrier responsible. Notify Behlman immediately.

## 2.2 INSTALLATION / WIRING

1) This unit is designed to be rack mounted in a standard EIA 19" cabinet but can be operated in any location. It is preferable to operate in a location which will maintain air temperature of 0-55°C around the ventilation ports. Therefore if the unit is to be rack mounted, it is recommended that the enclosure be forced ventilated or air conditioned. Installation should insure that the side and rear vents are unobstructed.

**IMPORTANT NOTE**:

**The unit must have bottom support when mounting in a rack or cabinet. Do not attempt to mount by front panels only. Chassis slides or mounting angles are available for this purpose. Consult with the Behlman sales department.**

2) Ensure that the line circuit breaker is in the OFF position before connecting input power.

3) Connect input/output power lines as follows:

**WARNING**

**Ensure that input line and neutral are connected to proper AC input terminals. A protective earth connection is required for operator safety and EMI filter return currents. Do not operate without this connection.**

a) INPUT POWER- Is connected to the appropriate terminals on the unit's rear panel. (See figures 2-1 & 2- 2). The proper size of input wiring is determined by the wire length and current to be carried. The following table lists suggested wire size for lengths up to 50 feet. Longer lengths should use larger diameter wire.

| MODEL NUMBER | AC INPUT WIRING | DC INPUT WIRING |
|---|---|---|
| AC\DC1200-125 | # 12 AWG up to 25 feet<br># 10 AWG up to 50 feet | #14 AWG up to 25 feet<br># 12 AWG up to 50 feet |
| AC\DC1200-48 | # 12 AWG up to 25 feet<br># 10 AWG up to 50 feet | #10 AWG up to 25 feet<br># 8 AWG up to 50 feet |

**CAUTION**

**Failure to use the proper wire size may result in erratic operation and may create a fire Hazard.**

b) OUTPUT POWER- Output power lines are connected to the rear panel NEMA 15R receptacles (see figure 2-1). Note, any one receptacle can handle the full load current. TB option units are provided with barrier type terminal blocks in place of the standard outlets. These use #6-32 hardware and ring lugs are recommended.

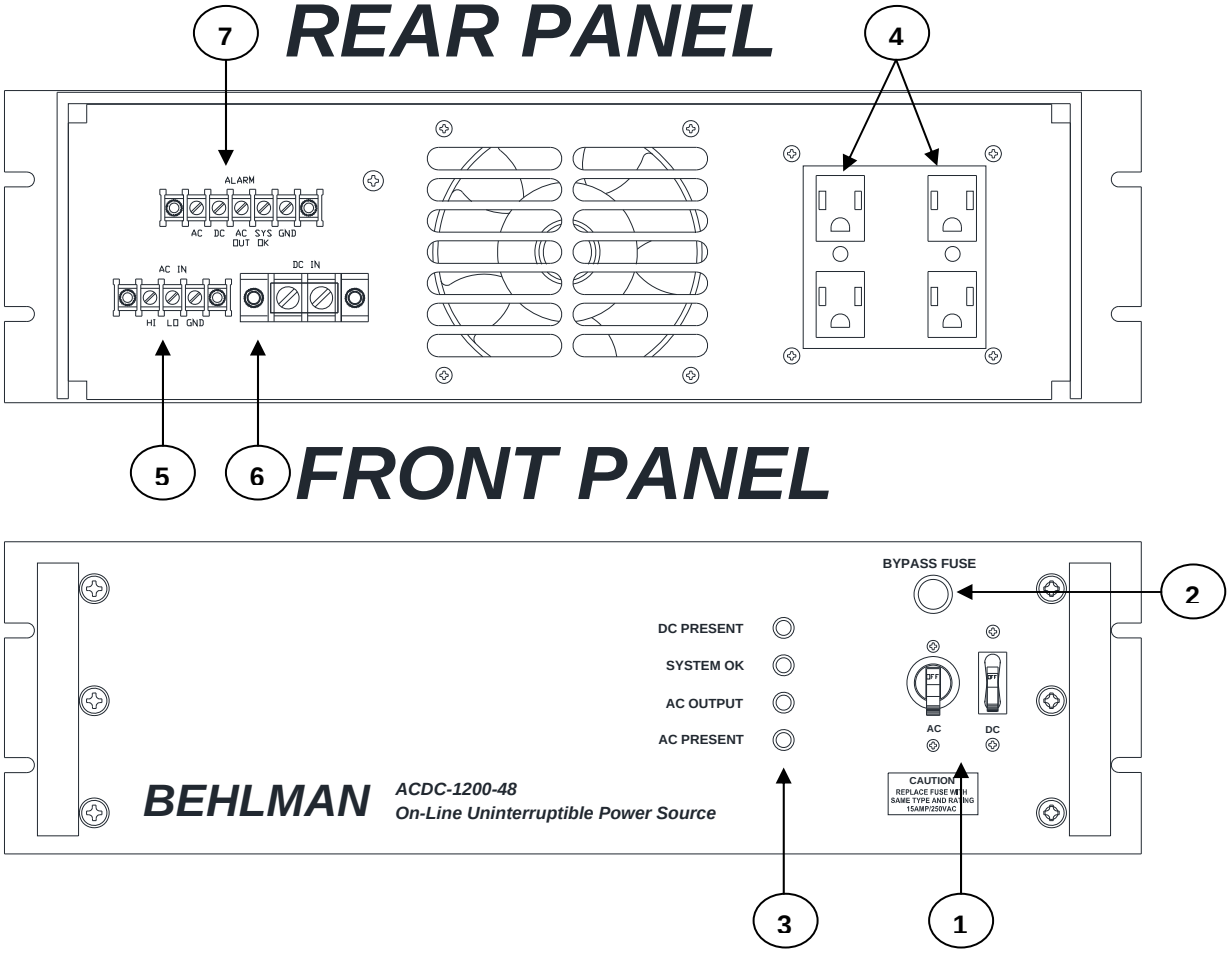



**FIGURE 2-1 CONTROLS AND FEATURES AC/DC1200 SERIES**

| ITEM | TYPE | DESCRIPTION |
|---|---|---|
| 1 | INPUT BREAKER (s) | Controls AC/DC input ON/OFF. |
| 2 | AC BYPASS FUSE | Fuses AC after bypass relay. |
| 3 | LED INDICATORS | Green LEDs indicate “good” condition for AC/DC in and inverter status. |
| 4 | AC OUTPUT (NEMA 15R shown) | AC to load, option terminal block type available. |
| 5 | AC INPUT TERMINALS | AC power applied via 6/32 screw terminal block. |
| 6 | DC INPUT TERMINALS | DC power applied via 10/32 screw type terminal block. |
| 7 | ALARM RELAY TERMINALS | Dry relay contacts to signal faults in parallel with front panel LEDs. See manual text. |

# MECHANICAL OUTLINE

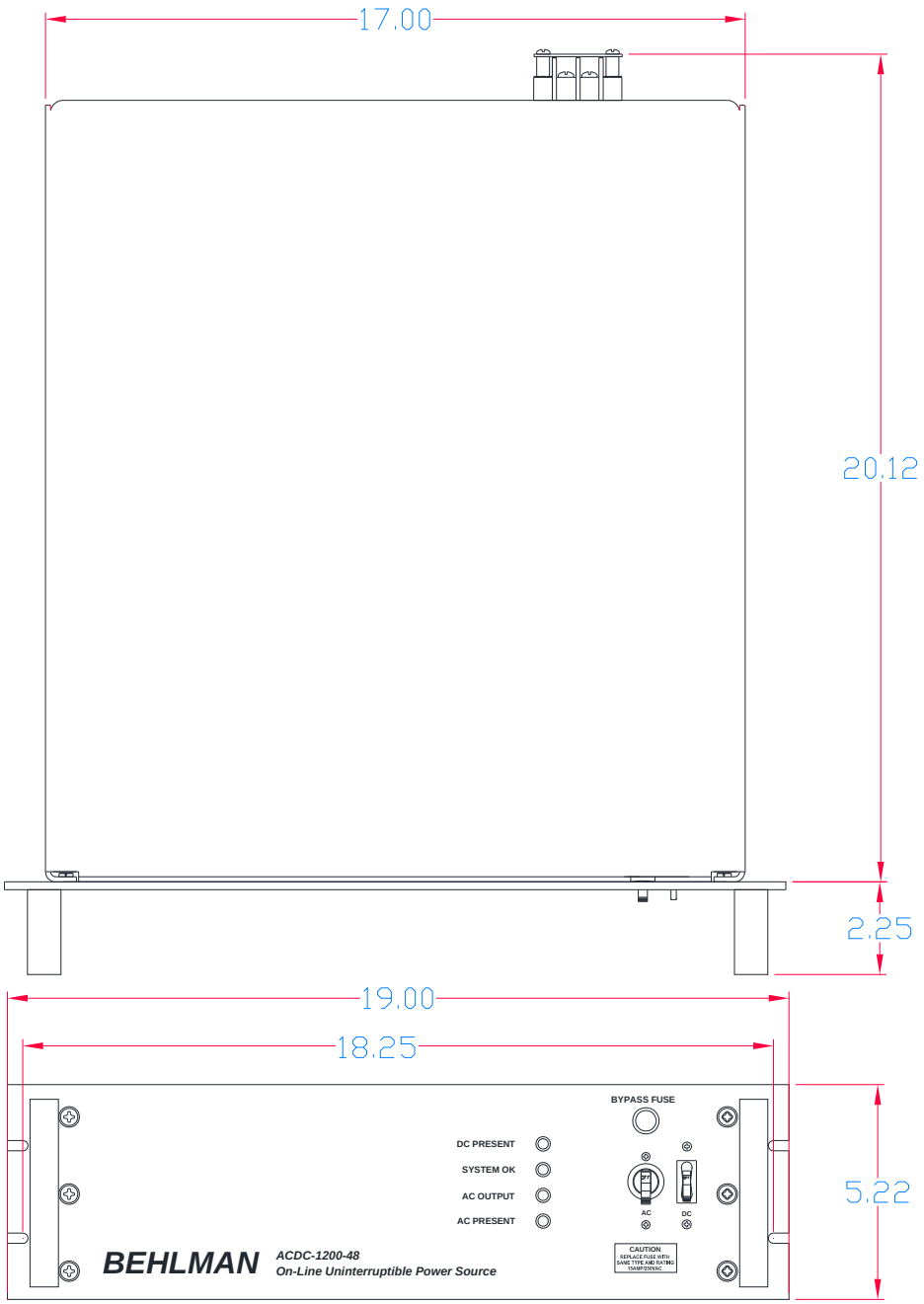
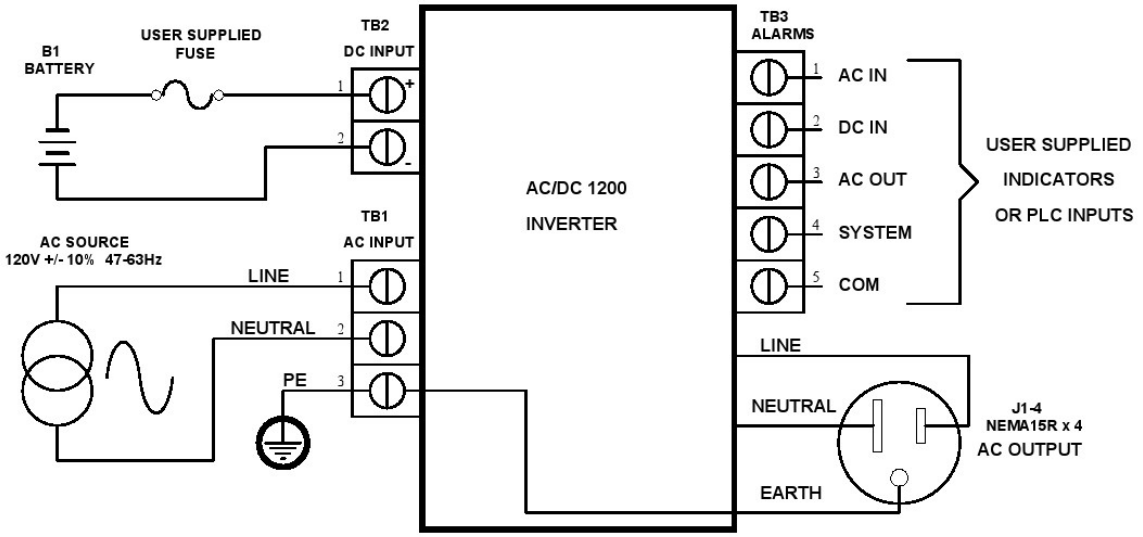
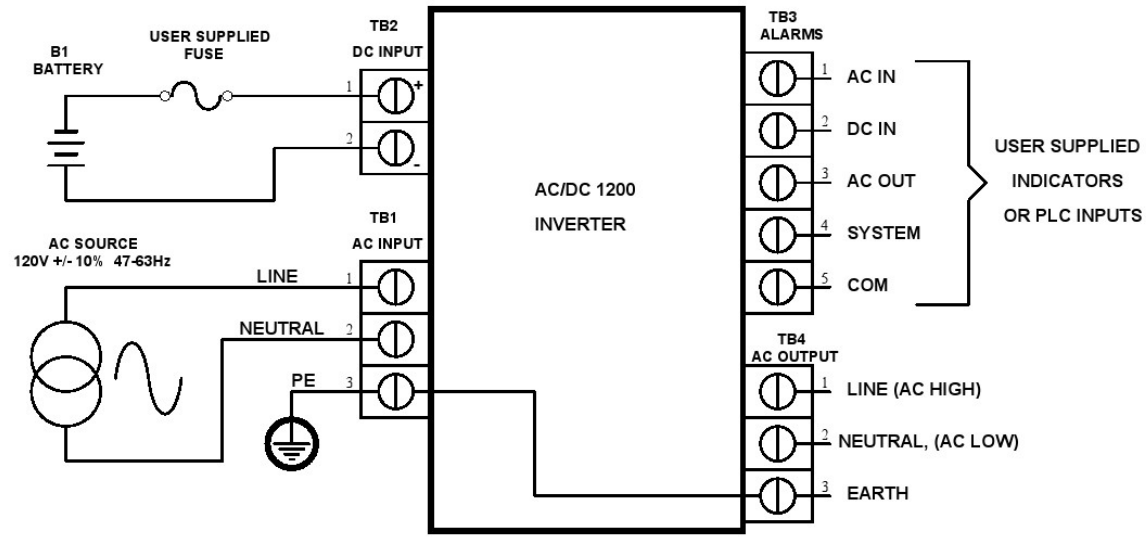



**FIGURE 2-2 MECHANICAL OUTLINE AC/DC 1200 SERIES INVERTERS**




**AC/DC 1200 TYPICAL INSTALLATION, NEMA TYPE OUTPUT CONNECTORS**



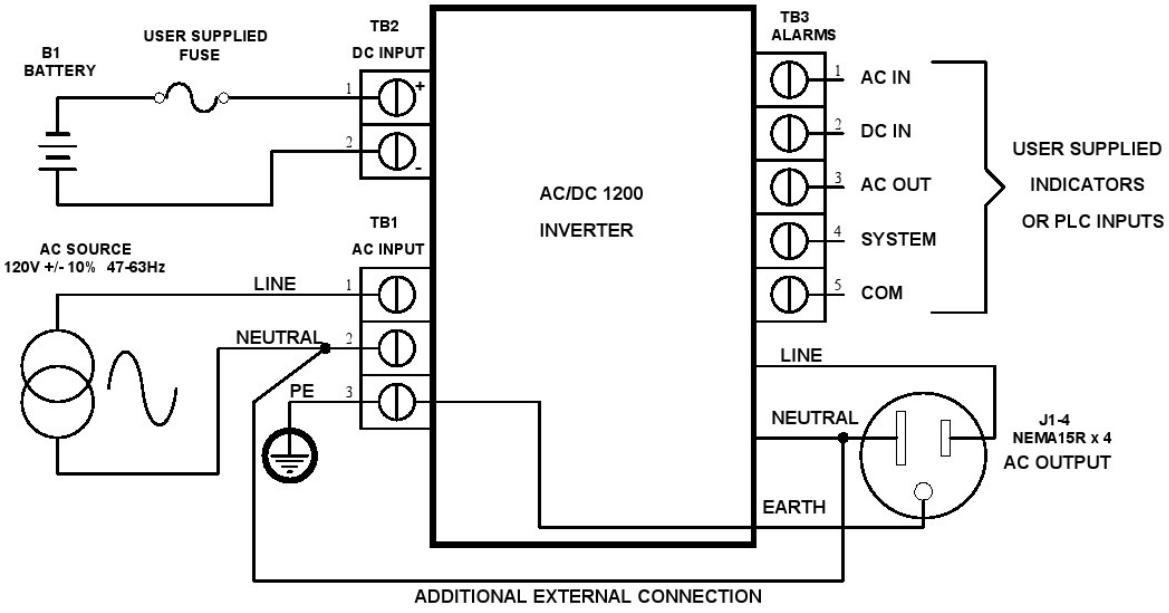

**AC/DC 1200 TYPICAL INSTALLATION,TERMINAL BLOCK OUTPUT**

**FIGURE 2-3 RECOMMENDED TYPICAL INSTALLATION**

## 2.3 INSTALLATION CONSIDERATIONS

Figure 2-3 illustrates typical wiring to and from the AC/DC 1200. When the load is running from the inverter (not-by-passed) the output circuit is completely floating with respect to the AC input, DC input and earth connection. This arrangement provides the user with flexibility in regards to the output circuit reference point. When in the bypass mode, the inverter is disabled and the AC input is routed directly from the AC input terminal to the output terminals (refer to Figure 1-1 in section 1). This will place the output circuit at the same reference as the AC line. In North America the neutral terminal is defined as the “grounded conductor” and is bonded to the earth connection at the service entrance. This is defined in the Nation Electrical Code (NEC) section 250 regarding bonding and protective (a.k.a. safety) earth connections.

The NEC considers AC sources that are Isolated from the AC supply as “separately derived sources”. Stand alone back-up generators, some UPSs, and battery powered inverters fall into this category. If this equipment is to be installed in a building or vehicle that must meet the NEC, then grounding of the output circuit will be required. This can be accomplished by the connection suggested in the figure 2-4 below. For units with a terminal block output option this is easy to add. Units with NEMA plug output may require adding an external outlet box to make this connection. If specified at time of order, units can be modified by Behlman to provide this connection. A connection could be added from AC output low terminal to earth, however this would violate NEC bonding rules when the unit is in the bypass mode. If this concept is not understood consultation with a licensed electrician is highly recommended.




**AC/DC 1200 TYPICAL INSTALLATION, WIRE TO MEET NEC, SECTION 250**

**FIGURE 2-4**

## WARNING

**This equipment involves the use of voltages and currents that can be hazardous under normal operating conditions. Only qualified personnel should be allowed to operate or service it. All covers and guards must always be in place during operation. A protective earth connection must be used.**

### 3.1 CONTROLS AND INDICATORS (refer to fig 2-1.)

1. INPUT POWER BREAKER: Dual circuit breaker interrupts AC and DC input power in the event of and internal fault. If breaker trips, unit will enter the line By-pass mode which will route the input AC line to the output terminals. **(NOTE: 48 VDC units have separate AC & DC breakers.)**

2. BY-PASS FUSE: protects the AC line and unit wiring in the event of an output overload while in bypass mode. Fuse rating is 15 amps / 250 VAC. **Replace fuse with same type and rating only.**

3. STATUS INDICATING LEDS: operation as follows:

   a.) DC PRESENT: Indicates green when DC input is within operating range of +/- 20%

   b.) SYSTEM OK: indicates green when back-up inverter and internal supplies are functional.

   c.) AC OUTPUT: indicates green when output is supplied by Aon-line@ inverter

   d.) AC PRESENT: indicates green when AC line input is within operating range.

4. ALARM CONTACTS: “Dry” type contacts will open in conjunction with the front panel status indicators. If the status indicator turns off, the appropriate alarm contacts will open. See section on alarm contacts in this manual for further information.

5. AC INPUT TERMINAL BLOCK: facilitates connection of line input (use of # 8 ring lug recommended) connect as marked. “HI” terminal to line “LO” terminal to neutral and “GND” terminal to safety earth (protective earth as defined by IEC-61010-1).

6. DC IN TERMINAL BLOCK: facilitates connection of DC input. Note: 125 VDC inputs are not polarity sensitive and may have +/- wires reversed.

## CAUTION

**48 volt units require +/- polarity to be connected as indicated. Failure to do so will trip the input breaker and may cause damage to the equipment.**

7. OUTPUT CONNECTIONS: typically supplied as NEMA 15R type connectors. Customer specified connectors or terminal blocks may also be provided as an option. Check model and part number on units rating label. Special units will have a unique four digit suffix to indicate any special configuration.

## 3.2 TO OPERATE THE EQUIPMENT

1) Ensure that front panel circuit breaker(s) is set to OFF.

2) Connect a suitable load to NEMA 5-15R receptacles (or other optional output connector).

3) Turn on AC INPUT Power.

4) Turn on DC INPUT Power.

5) Set the front panel circuit breaker(s) to ON (cooling fans noise should become evident). If desired, the output voltage and frequency can be confirmed by connecting a true RMS voltmeter such as a Fluke model 87 across the output terminals or load.

## 3.3 SHUTDOWN PROCEDURE

1) Set front panel circuit breaker(s) to OFF.

## 3.4 OPERATING CONSIDERATIONS

The Behlman ACDC1200 series of power supplies are solid-state electronic devices. As such they cannot supply infinite current and are therefore electronically protected from overloads. Certain loads will draw “in rush” or start up currents that may be 10 times higher than their normal run current. Although the design of the ACDC1200 allows for several hundred milliseconds worth of “start” current, not all loads will behave the same. In many cases, a poorly designed power supply or motor with no in-rush current limiting may trip the protective circuits of the model ACDC1200. This may show up as a dip in voltage during start up (current limit) or an immediate transfer to by-pass mode as the load is energized. The later indicates the back-up inverter has entered a protection mode and power must be recycled to restore operation.

If problems are encountered energizing a particular load, the “in-rush” current of the load should be determined before the problem is associated with the model AC/DC 1200. In the event of problems see the trouble-shooting portion of this document. The Behlman engineering department is also available to help provide a solution. Contact the factory for additional information.

## 3.5 ALARM CONTACTS

Rear panel alarm contacts are rated at 0.6 amps @ 125 VAC or 30 VDC. These contacts are completely isolated from the AC and DC inputs. The diagram below illustrates the contact arrangement.

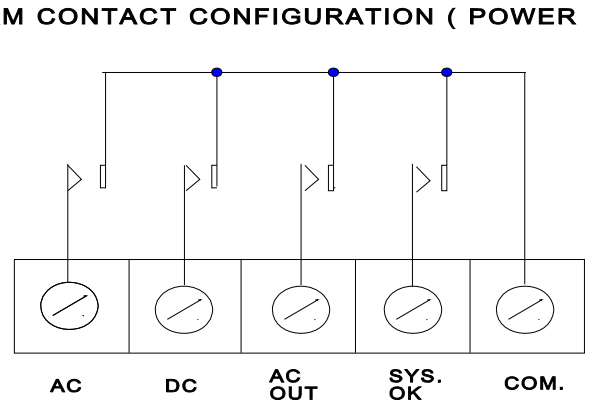



Figure 3-1 alarm contact configuration

## 3.6 OPERATIONAL CONSIDERATION FOR DC PREFERRED OPTION

The standard model AC / DC 1200 is designed to operate primarily from the AC line. If the AC line fails, operation from the DC supply (Batteries) is automatic. When the AC is recovered, the unit will again automatically resume operation from the line. These units are considered to be “AC preferred”. The D1 option provides the opposite function. When both the AC and DC sources are available, the D1 unit will operate primarily from the DC power. When the DC is removed the unit will automatically switch to AC line operation. In both cases, if the inverter were to fail, the AC line will be “by-passed” directly to the output terminals.

Operating Considerations:

Because this operates primarily from the DC source (most likely batteries) it should be noted that current (and power) will always be drawn from the source even when no load is connected to the unit. There are certain fixed minimum losses associated with DC operation that determine this current. For a 48Vdc unit this quiescent current is about 2 Amps. The 125Vdc input requires less than 1 Amp.

Switching from DC to AC power is accomplished by a relay with a transition time of between 2 and 10mSec. If the unit is heavily loaded, a dip in the output voltage during switch over may be encountered. When selecting components to design a back-up power system, use devices with “hold up” times greater than 10mSec whenever possible. This is not an issue with AC preferred units.

To determine which version is being used, look at the rating label affixed to the right side panel of the unit. DC preferred units will be designated D1.

The internal impedance of the DC source will affect the transient capability of these units.

**SECTION 4**
**THEORY OF OPERATION**

## 4.1 GENERAL

The ACDC1200 series (unit) represent a rugged, high performance AC UPS. The unit operates from a 120 VAC or a 48 VDC, or 125 VDC INPUT based on the model selected.

## 4.2 DETAILED THEORY

The AC input voltage is rectified by employing a voltage doubling circuit consisting of a half wave rectifier and two banks of input capacitors. Voltages approximating the positive and negative peaks of the input (+/-160 VDC) are stored on the capacitor banks that are centered about the input neutral. The two rectified voltages provide the necessary DC power. The EMI filter at the input, limits the conduction of electromagnetic interference back on to the line.

When operating from DC, the DC/DC converter takes a battery input of 125VDC (or 48V on some models) and converts it to a dual +/- 150Vdc (approx). The DC to DC circuit is based on a MOSFET driven, full bridge type topology. The complete circuit is housed on assembly # 107-915-00X. This circuit also provides pre-regulation and battery isolation. The output of the DC to DC converter is diode “or-ed” with the DC from the rectifier circuit and both are applied to the output inverter/amplifier.

The DC/AC or inverter portion of the unit uses a high frequency PWM technique to converts the DC buss back to AC. The pulse width modulation (PWM) design of this switching unit generates a high frequency square wave of variable duty cycle. By varying the duty cycle from 8% to 92% a net DC component is created that ranges between the positive and negative DC buses. A two stage LC low-pass filter averages the PWM to produce the DC component. If the input to this circuit is a sine wave, than an AC output is produced. This stage can be said to amplify the sine wave. It is considered a class “D” amplifier. The amplifier produces about 90Vrms which is applied to an isolated step-up transformer to produce the required 120Vac on the output.

## 4.3 REFERENCE OSCILLATOR

The reference oscillator and associated circuitry are shown in figure 4-1. The reference oscillator produces a sine wave in which frequency is controlled a crystal derived clock. The amplitude is controlled by a precision dc reference voltage. The output voltage of the inverter is sampled and compared to the reference voltage. Any error is amplified and used to control the oscillator amplitude. This action corrects for output voltage variation due to line and load changes.

## 4.4 ERROR AMPLIFIER

The error amplifier is configured as an integrator that algebraically sums the reference sine wave with the unfiltered PWM output to produce the instantaneously required signal to the PWM to reproduce the desired sine wave.

## 4.5 SINE WEIGHTED PWM

The output of the error amplifier is summed with a high frequency (20 kHz) triangular wave to produce a PWM “sine weighted” function. The resulting output is a pulse train with it’s duty cycle modulated by the sine wave. These signals are applied to the insulated gate bipolar transistor (IGBT) drivers for application to the IGBT power switches.

## 4.6 OUTPUT SECTION

The sine weighted PWM power output of the IGBT is filtered by a double LC filter network to remove the 20KHz switching frequency. This action leaves an amplified version of the modulating signal (sine wave). A current sense transformer is used to monitor the output current. The signal from the transformer is applied to the over-current protective circuits.

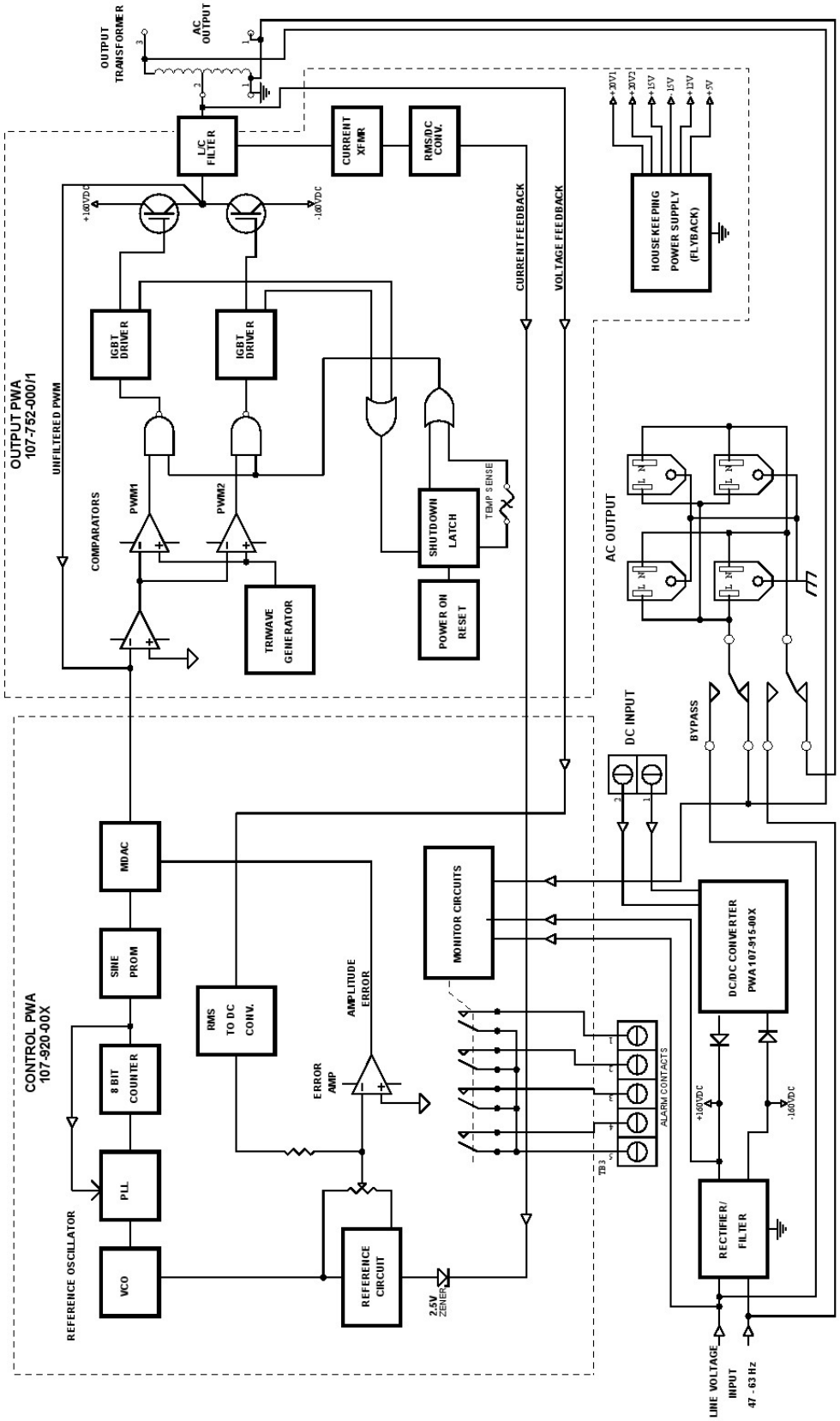



**FIGURE 4-1 BLOCK DIAGRAM**

## 4.7 CLOSING THE LOOP

In order to provide a clean output with very good regulation, two feedback loops are used. One feedback loop is a fast loop that takes the IGBT output and closes the loop to the error amplifier. This loop corrects for switching effects on a pulse-by-pulse basis. The second feedback loop corrects for regulation. It is a slow loop that takes the output at the output transformer and converts it from RMS to DC to compare to and modify the reference. Current feedback from the current sense transformer is used in another loop to effectively limit the output current. The output of this transformer is converted from RMS to DC and is used to reduce the reference once a preset limit is reached. The later action causes that output voltage to reduce if the current attempts to increase further.

## 4.8 CURRENT LIMIT

There are two distinct current limits:

**Overload-** The overload limit uses the RMS/DC converter output of the output current sense transformer. When the DC voltage exceeds 2.5V (approximately 120% of nominal), the reference gets overridden and the output goes into constant current mode. The voltage decreases to force the unit to hold the current at 120% of nominal. The RMS/DC converter has a filter with an equivalent 200 millisecond delay. This means that as long as the RMS output current does not exceed 120% of nominal for more than 200 milliseconds, the output will not be affected.

**Short Circuit Protection-** Short circuit protection is a circuit that protects the unit and load from short circuits of greater than 300% of nominal current. The IGBT drivers have internal circuitry to sense de-saturation of the IGBT. De-saturation is caused by excessive output current. The driver over-current outputs are used to set a latch. The latch is used to inhibit the PWM signal to the IGBT drivers, which immediately disables the output inverter. Power must be cycled to reset this type of overload.

Note: A “constant current” overload may cause the “SYSTEM” status light to flash or grow dim.
A short circuit overload will cause the “SYSTEM” to go off and stay off until reset.

## 4.9 OVER TEMPERATURE

The unit contains a temperature sensor that is located on the IGBT heat sink. If an excessive temperature is sensed, the sensor output which is “OR-ed” with the over current latch signal, turns off the output until the temperature has decreased to an acceptable limit.

## 4.10 HOUSEKEEPING SUPPLIES

Three small, fly-back based DC/DC switching power supplies generate all the DC voltages needed to run the internal circuits. The DC to DC converter assembly has a small Ahousekeeper@ that runs from the input DC and provides control power to the converter. Another low power DC/DC convertor provides standby power for the front panel control board (107-920 -00X). This converter takes power either from the AC or DC inputs to supply monitoring circuits at times.

An additional 30W fly-back supply located on the output inverter board (107-752-000) handles the rest of the operating power including the cooling fan. This supply runs from the bulk 150Vdc power.

## 5.1 TROUBLESHOOTING

In the event problems are encountered during the installation and operation of the inverter refer to the chart below before assuming the inverter is at fault. If it is determined the fault is with the inverter, contact Behlman Electronics for service information.

| SYMPTOM | POSSIBLE CAUSE | ACTION |
|---|---|---|
| Low or no output status LED off. AC output LED may be off. | Output overloaded | Check load current. Disconnect load and recheck output voltage using TRUE RMS meter. Recycle power. |
| Erratic operation | Input voltage fluctuating | Monitor voltage at the DC input terminals of the inverter. Make sure DC is within specifications. |
| No AC input alarm AC input LED off. | AC - Bypass fuse blown | Check fuse. Measure AC input at rear panel. |
| Output distorted | High peak load current or non-linear load. | Reduce loading if distortion is objectionable. Check load current waveform. |
| DC breaker repeatedly trips | DC polarity reversed or internal fault in inverter. | Check polarity, if ok the unit may have an internal fault. Return for service. |

SPECIAL CONSIDERATION FOR MOTORS

Loads that contain motors may present a special problem due to a mechanical load being present.The start-up (a.k.a. Locked rotor current) for these devices may be much higher than expected. These currents may also last from several cycle of the AC waveform to several seconds. Motor start current “profiles” must be understood to prevent overloading the AC/DC 1200

## 5.2 MAINTENANCE


**WARNING**

Service of this device requires specialized equipment and trained personnel. There are no internal user serviceable parts. Removing the covers will expose individuals to hazardous voltages. Refer service to qualified personnel only!

If the unit is to be supplied from batteries, the condition of the batteries will have a significant effect on the operation of the unit. Poorly maintained batteries can cause the unit malfunction when heavily loaded. If this device is to be used as part of a back-up power system a battery maintenance schedule should be discussed with the battery manufacturer. Battery condition can deteriorate quickly without proper maintenance. Behlman does not provide batteries for these units. When performing battery maintenance, check and tighten all wire connections.

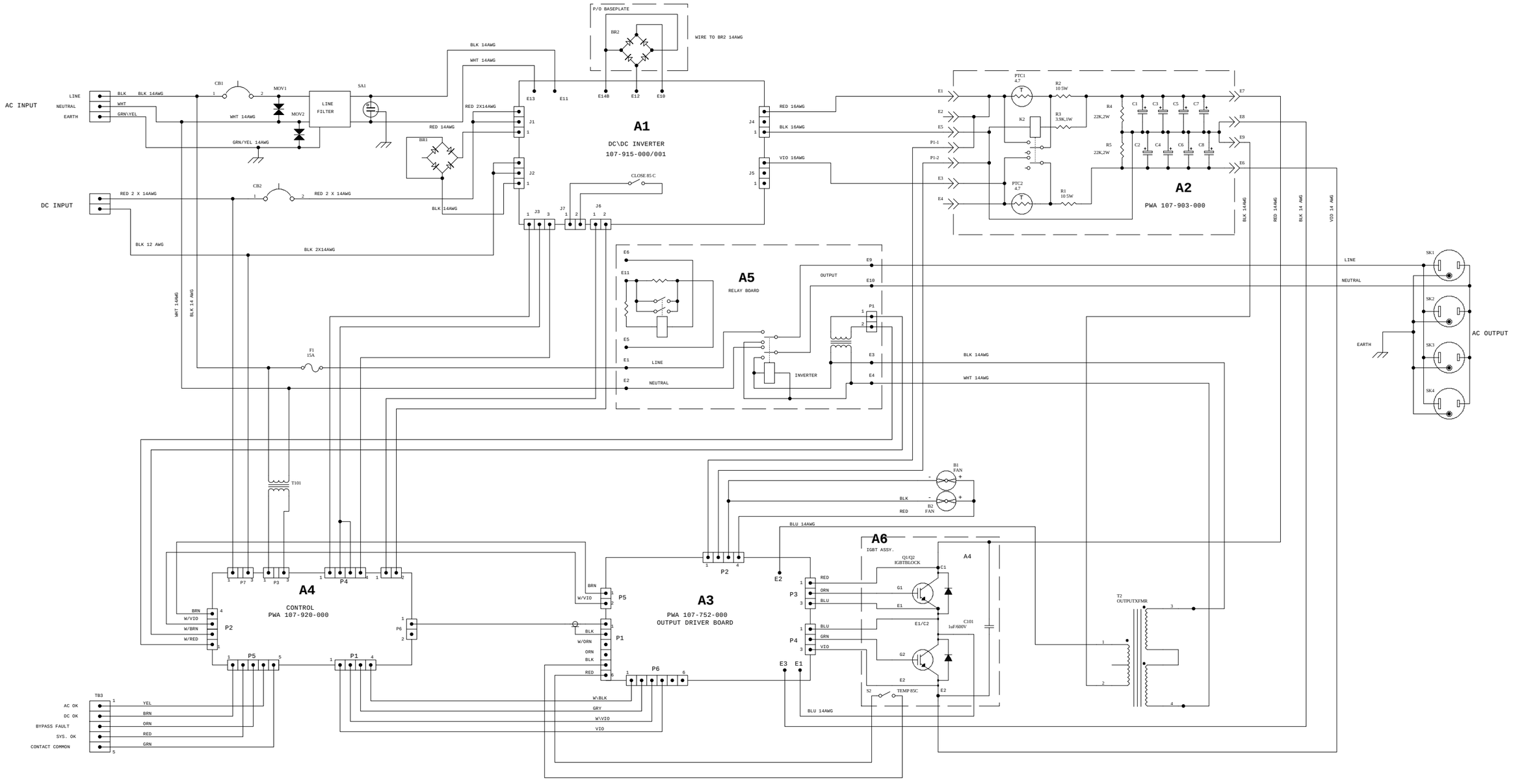
**APPENDIX A**
**RECOMMENDED SPARE PARTS LIST**
**MODEL AC/DC 1200 - 125**

This appendix is included as a guide to help the end user to maintain a quantity of these power supplies. It is based on maintenance of a quantity greater than 10 units. The list is based on replacing the electronic assemblies to the board level. It also includes individual items subject to wear and/or abuse. This list is for reference only and is subject to change without notice. This list was compiled at the request of our customers. Behlman does not foresee the failure of any part of this system when operated under normal conditions.

| QTY. | PART NUMBER | DESCRIPTION |
|---|---|---|
| 1 | 107-921-000 | PWA, CONTROL ASSEMBLY, AC/DC1200-125 |
| 1 | 107-752-000 | PWA, OUTPUT INVERTER/FILTER |
| 1 | 107-902-000 | PWA, CAPACITOR / SOFT START |
| 1 | 107-918-000 | PWA, BYPASS RELAY |
| 1 | 107-915-125 | PWA, DC/DC CONVERTER -125VDC INPUT |
| 1 | 106-696-000 | TRANSISTOR MODULE, IGBT |
| 1 | 106-721-000 | SWITCH, THERMAL, 75 DEGREES , N/O |
| 1 | 107-778-001 | FILTER, EMI, 20A, 250V |
| 2 | 106-694-000 | FAN, 5.25" , 12VDC, 100 cfm |
| 6 | 107-964-008 | SURGE ARRESTER, GAS DISCHARGE |
| 6 | 101-482-000 | METAL OXIDE VARISTOR, 150V |
| 1 | 107-803-000 | TRANSFORMER, AUTO, STEP-UP 90V : 135V |

Other parts may be obtained by calling the factory. Please provide a description of the needed item as well as the model and serial number of the power supply it is used on.

| REVISION HISTORY | | | |
|---|---|---|---|
| **Rev.** | **ECO** | **DESCRIPTION** | **DATE** |
| D | N/A | UPDATED, ADDED SAFETY INFORMATION, PLACED UNDER REVISION CONTROL. | 4/4/2016 |
| | | | |
| | | | |
| | | | |

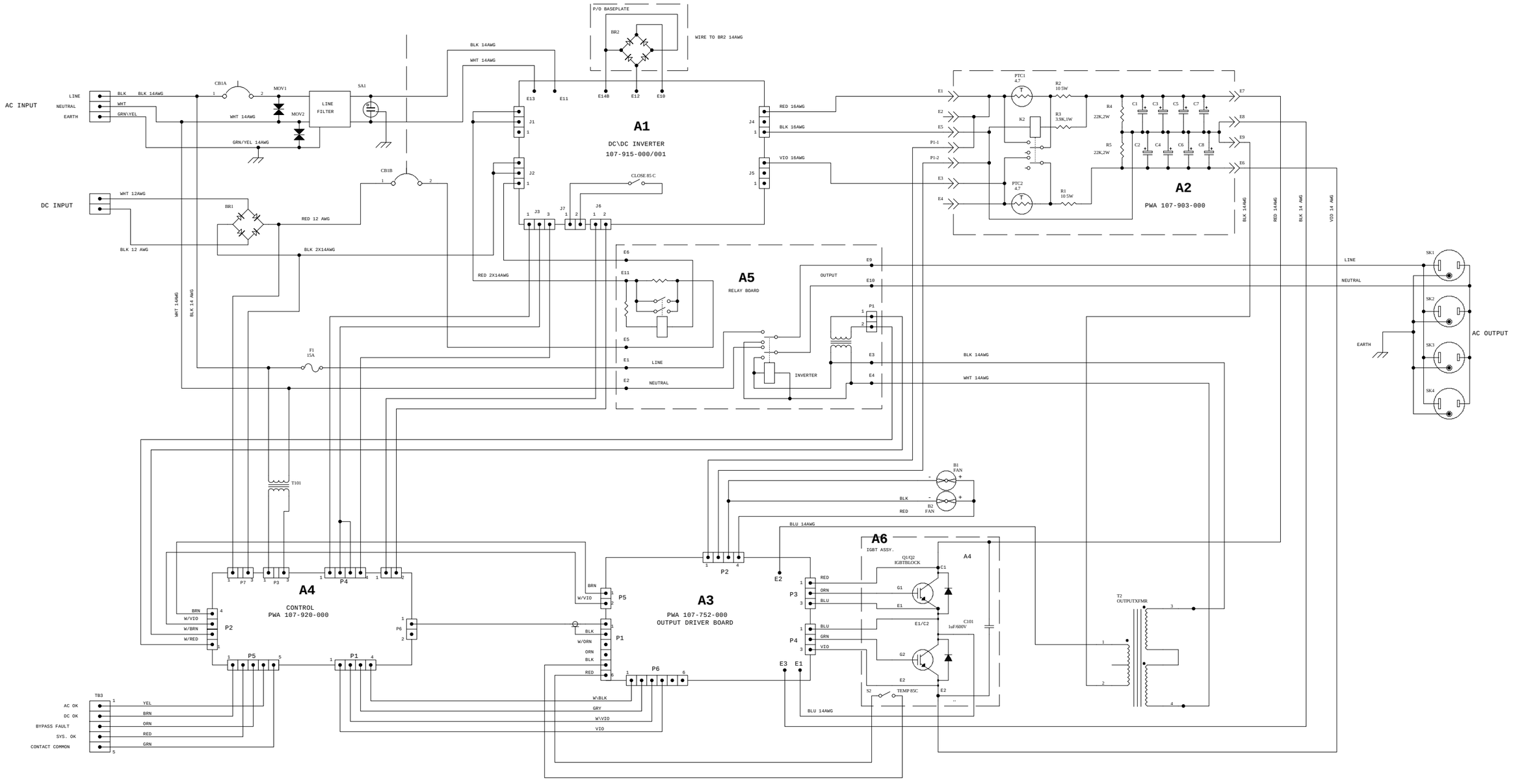



NOTES:

UNMARKED WIRE GAUGES ARE 20 OR 22 GAUGE WIRE DEPENDING ON CONNECTOR TERMINATION SIZE.

MULTIPLE CONNECTION WIRES ARE TERMINATED AT MOST CONVIENENT POINT

| | | |
|---|---|---|
| Title | SYSTEM SCHEMATIC, AC/DC 1200-048 | |
| Size: D | Number: 107-993-048 | Revision: |
| Date: 2-Jan-2013 | | Sheet of |
| File: C:\CLIENT\..\107993-1.SO1 | | Drawn By: |




NOTES:

UNMARKED WIRE GAUGES ARE 20 OR 22 GAUGE WIRE DEPENDING ON CONNECTOR TERMINATION SIZE.

MULTIPLE CONNECTION WIRES ARE TERMINATED AT MOST CONVIENENT POINT

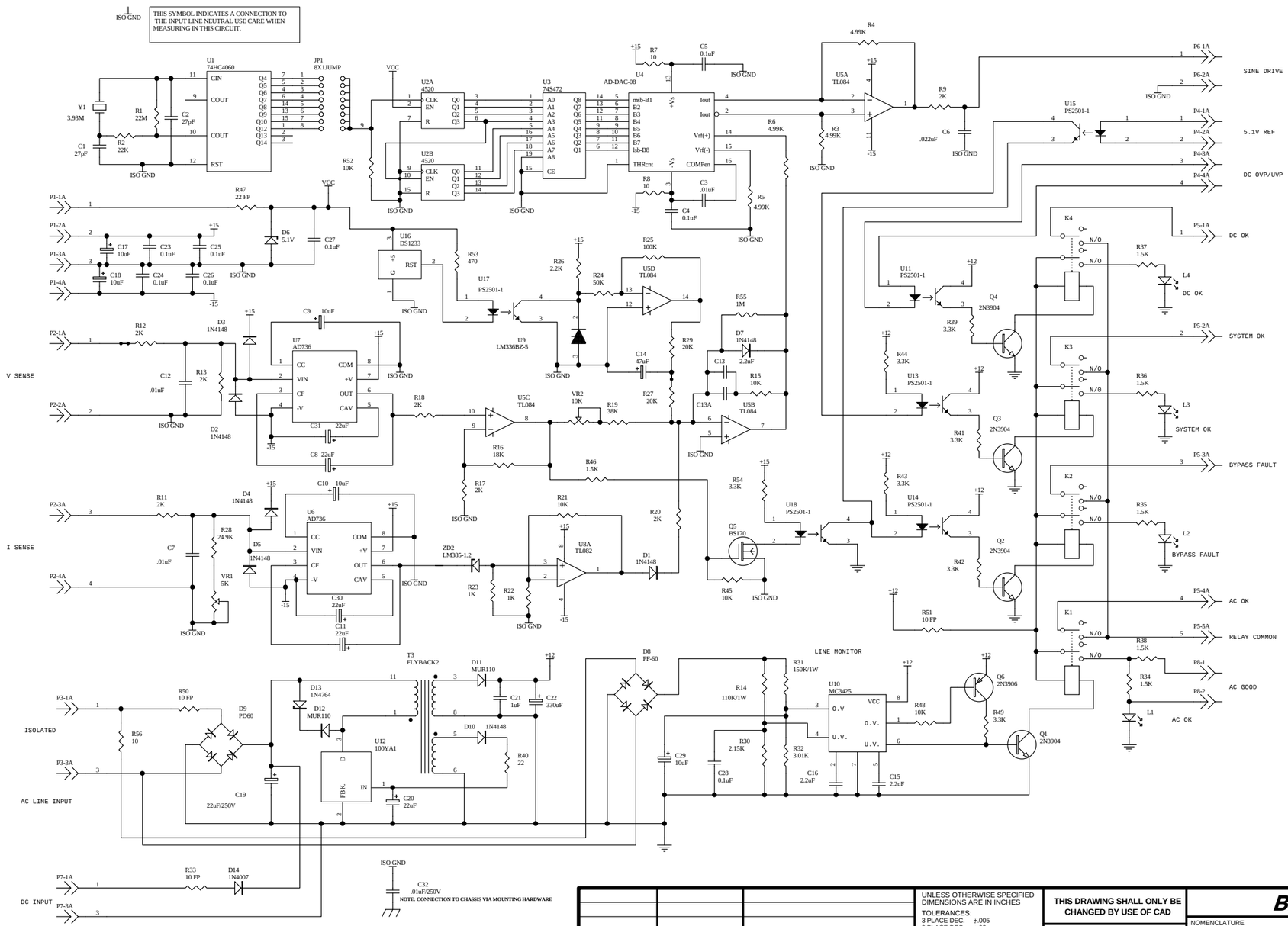
| | | | |
|---|---|---|---|
| Title | SYSTEM SCHEMATIC, AC/DC1200-125 | | |
| Size D | Number 107-993-125 | | Revision |
| Date: | 2-Jan-2013 | Sheet of | |
| File: | C:\CLIENT\..\107-993.SO1 | Drawn By: | |

REVISION HISTORY

| ZONE | LTR | DESCRIPTION | DATE | APPROVED | DRL # | INIT. |
|---|---|---|---|---|---|---|
| | - | INITIAL RELEASE | 03-29-99 | | | |
| | A | REVISED PER ECO 99-060 | 03-30-99 | | | |
| | B | REVISED PER ECO 99-099 | 05-25-99 | | | |
| | C | REVISED PER ECO 04-196 | 11-10-04 | | | |
| | D | REVISED PER ECO 11-097 | 06-09-11 | | | |

**CAUTION !**

ISO GND — THIS SYMBOL INDICATES A CONNECTION TO THE INPUT LINE NEUTRAL USE CARE WHEN MEASURING IN THIS CIRCUIT.




| NEXT ASSY. | USED ON | DESCRIPTION |
|---|---|---|
| | 107-900-125 | |
| 107-921-000 | 107-900-048 | AC/DC 1200 |

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
3 PLACE DEC. ±.005
2 PLACE DEC. ±.02
ANGLES ±1°

DO NOT SCALE THIS DRAWING

MATERIAL:

THIS DRAWING SHALL ONLY BE CHANGED BY USE OF CAD

| | |
|---|---|
| DRAWN | DATE |
| S. BOEGLE | 3-29-99 |
| CHECKED | DATE |
| ENG | DATE |
| Q.A. | DATE |
| MFG. | DATE |

**BEHLMAN**

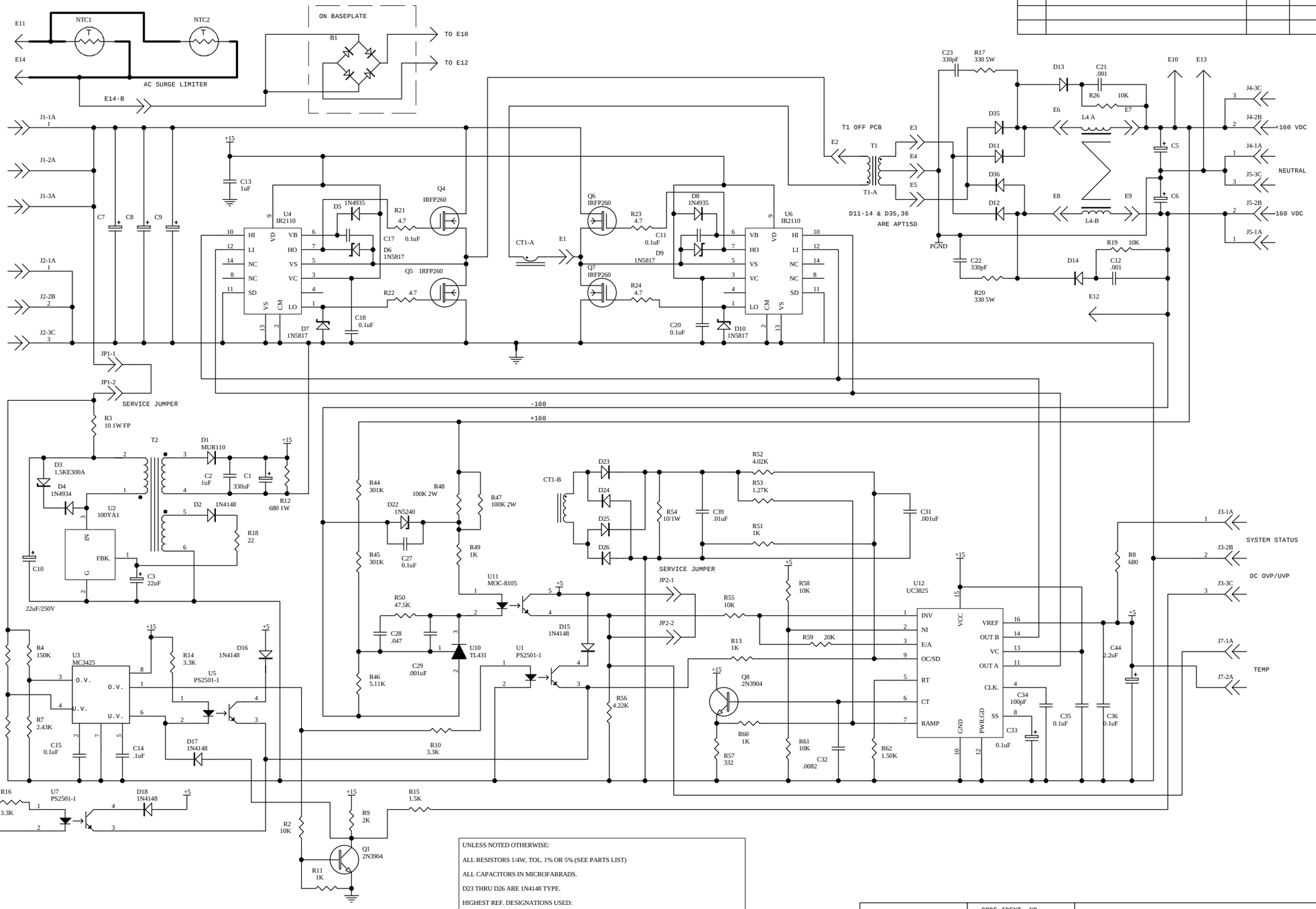
NOMENCLATURE
SCHEMATIC, CONTROL BOARD
MODEL AC/DC 1200

| SIZE | CODE IDENT NO. | PART No. | REV |
|---|---|---|---|
| C | 53636 | 107-919-000 | D |

SCALE: NONE | CAD FILE: 107-919D.SCH | SHEET 1 OF 1

107-919-000

| LTR. | REVISION DESCRIPTION | DATE | APRV. |
|---|---|---|---|
| A | PER ECN 98-203 & 99-053 | 3/25/99 | |
| | | | |
| | | | |
| | | | |




UNLESS NOTED OTHERWISE:

ALL RESISTORS 1/4W, TOL. 1% OR 5% (SEE PARTS LIST)

ALL CAPACITORS IN MICROFARRADS.

D23 THRU D26 ARE 1N4148 TYPE.

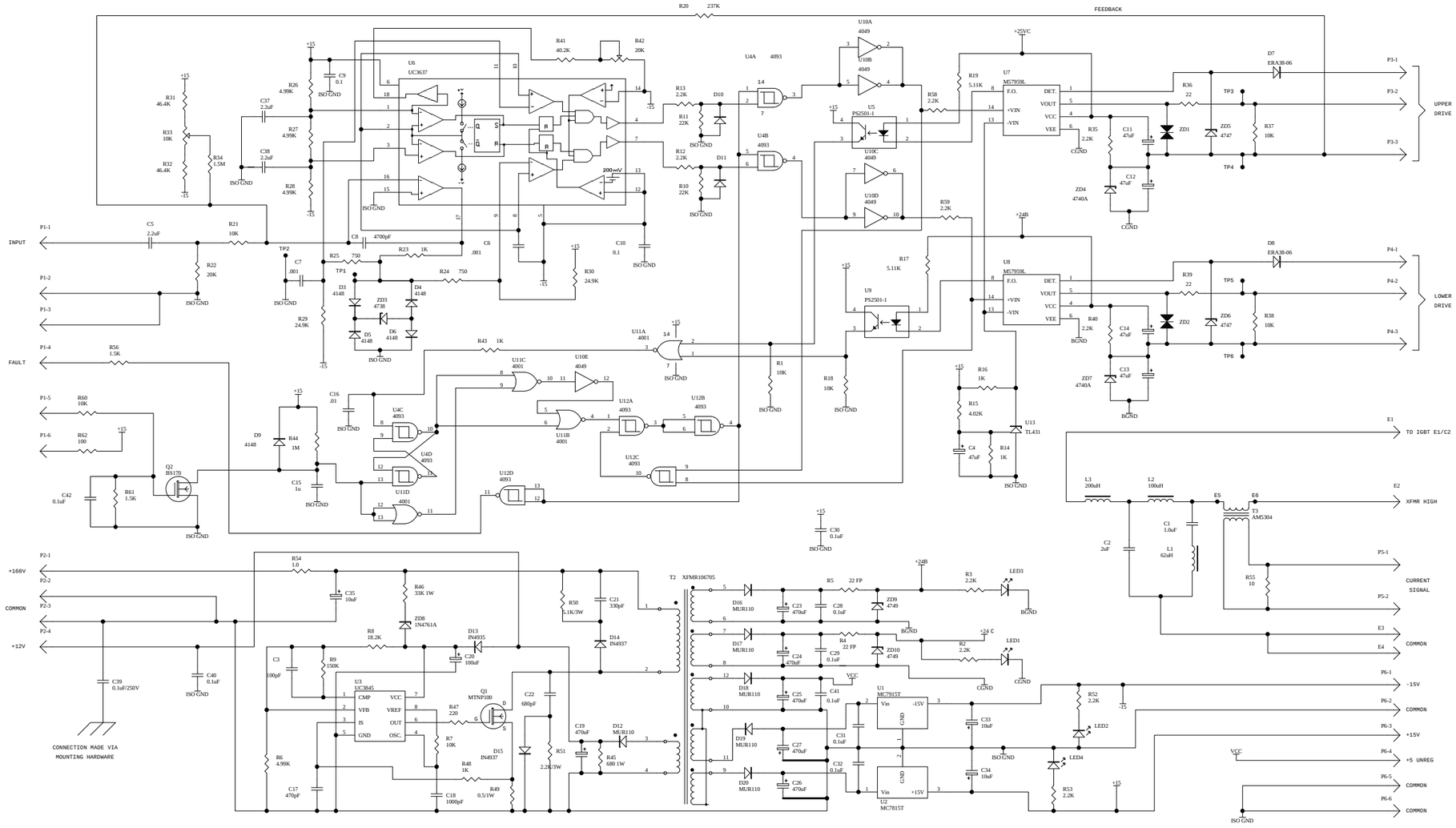
HIGHEST REF. DESIGNATIONS USED:

C44, D35, Q8, R62, U12

REF. DESIGNATIONS NOT USED:

C4, C16, C19, C22, C24, C25, C26, C30, C37 THRU.
C43, D19 THRU 21, D27 THRU D34, Q2, Q3, R1, R16
R17, R20, R27 THRU R43, U8, U9.

| USED ON | CODE IDENT. NO. 53636 | BEHLMAN | |
|---|---|---|---|
| | CHECKED / DATE | Title: SCHMATIC DC/DC CONVERTOR | |
| | | Size: C | Number: 107-913-125 | Revision: A |
| | APPROVED / DATE | Date: 2-Jan-2013 | Sheet of |
| | | File: C:\CLIENT\..\107-913.S01 | Drawn By: S.BOEGLE |




UNLESS NOTED OTHERWISE;

ALL RESISTORS ARE 1/4W 1% TYPE, ALL CAPACITORS IN MICROFARADS

HIGHEST REF DESIGNATIONS ; C42, D20, E6, L3, P6, Q2, R62, T3, U13, ZD10

DESIGNATIONS NOT USED ; D1, D2, C36, R57, T1,

| | | | |
|---|---|---|---|
| Title | SCHEMATIC, OUTPUT INVERTER , AC/DC 1200 | | |
| Size D | Number 107-750-000 | | Revision |
| Date: 2-Jan-2013 | | Sheet of | |
| File: C:\CLIENT\..\107_750.SCH | | Drawn By: | |