USER'S GUIDE AND
TECHNICAL REFERENCE

DC TO AC INVERTER

BEHLMAN MODEL INV-1200

FOR SERVICE ASSISTANCE

CONTACT BEHLMAN
CUSTOMER SERVICE DEPARTMENT

PHONE TOLL FREE 1-800-874-6727
EMAIL: SERVICE@BEHLMAN.COM
WEB: WWW.BEHLMAN.COM

OR WRITE

BEHLMAN
CUSTOMER SERVICE DEPARTMENT
80 CABOT COURT
HAUPPAUGE, NY 11788

PHONE: (631) 435-0410
FAX: (631) 951-4341

FOR SALES INFORMATION:

PHONE: (631) 435-0410
USA: (800) 874-6727
FAX: (631) 951-4341

SUBJECT TO CHANGE WITHOUT NOTICE

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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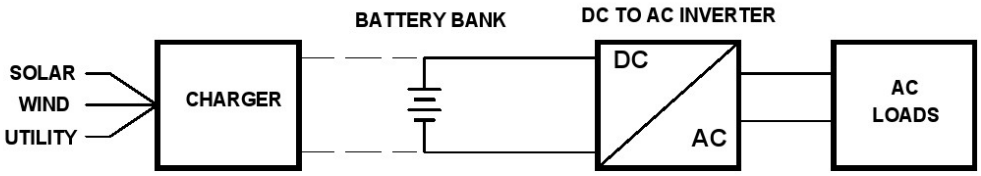
BEHLMAN DC TO AC INVERTER, MODEL SERIES INV-1200

SECTION

SECTION 1
INTRODUCTION

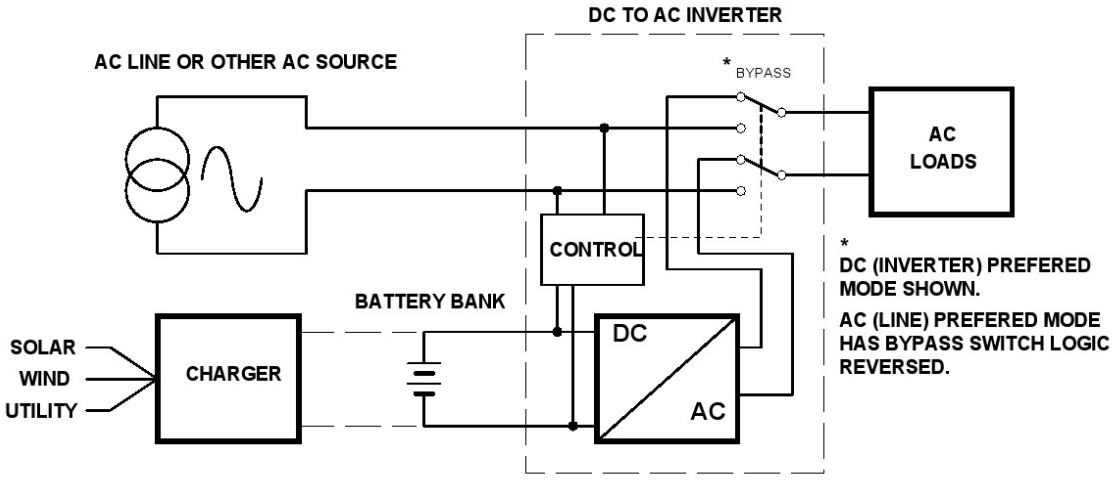
The Behlman INV-1200 series of DC to AC power inverters incorporate the latest in switched mode power technology to provide regulated AC power from a user supplied DC source. These devices produce a sinewave output comparable to that which is available from typical utility power. Each model provides electronic protection along with a high short term overload capacity making them ideal for many loads requiring large “in-rush” currents. All units are housed in a rugged steel enclosure making them well suited to operation in industrial applications.

Available options include an AC input bypass and signaling contacts. The AC bypass option is available in two configurations. The “D1” option favors the DC input and will switch to AC line input in less than 30ms when the DC input is lost. The second option, A1, will favor the AC line input and will switch to the inverter in less than 30ms if the line is lost. These features allow the unit to be incorporated into a user defined back-up power system.



BLOCK DIAGRAM, BATTERY BASED AC BACK-UP SYSTEM

The figure above illustrates a typical application of an INV1200 without the A1 or D1 bypass options.



BLOCK DIAGRAM, BATTERY BASED AC BACK-UP SYSTEM WITH BYPASS OR STANBY MODES

The figure above illustrates a typical INV 1200 application using the A1 or D1 options.

1.1 SPECIFICATIONS

INPUTS

MODEL	DC INPUT	DC BURDEN (full load)	DC BURDEN (no load)
INV-1200 - 250	250 VDC +/- 20%	7.5 AMPS @ 200 VDC	270 mA +/- 20%
INV-1200 - 125	125 DC +/- 20 %	15 AMPS @ 100 VDC	550 mA +/- 20%
INV-1200 - 48	48 VDC +/- 20 %	40 AMPS DC @ 38 VDC	1.7 A +/- 20%

OUTPUT

Power: 1200 Watts

Voltage: 120 VAC +/-2% 60 Hz (available @ 50 and 400 Hertz). Frequency +/- 0.1%
(220-240V output available with external transformer option. See option info.)

Current: 10 amps RMS continuous (30 amps peaks)

Waveform: Sine wave with less than 3% T.H.D. (linear load)

Efficiency: 80- 85% typical @ full load.

AC INPUT* *Optional bypass mode only. 130 VAC max @ 10 amps (fuse) see text.

PROTECTION

Input: DC circuit breakers (optional AC line bypass input has 10 amp fuse)

Output: Electronic over current protected.

Thermal: Thermal cut-out that monitors temperature. Shuts down during over-temp conditions. Automatic Reset.

MECHANICAL WIDTH: 17 in. (43.2cm) (19" standard EIA rack panel)
LENGTH: 17in. (48.3cm)
HEIGHT: 3.5in. (14.4cm)
WEIGHT: 25Lbs. (11.3kgs)

ENVIRONMENTAL Operating temperature -20°C to +55°C, 95% RH non – condensing.

OPTIONS: A1- AC preferred option. Applies supplied line to the inverter output terminals under normal conditions. If the AC line is lost, the inverter output will automatically be switched to the output terminals to supply the load.

D1- DC preferred option. Inverter supplies load from the DC source under normal conditions. If the DC source or inverter fails, the AC line will automatically be switched to the output terminals to supply the load.

I = Transformer option. Provides 220-240VAC output at 50 or 60Hz. This option requires an additional 2U chassis.

TB = Substitutes rear panel terminal block for NEMA 5-15R receptacles.
Available with all variants.

2.1 GENERAL

WARNING

INSTALLATION AND OPERATION OF THIS DEVICE MAY EXPOSE HAZARDOUS VOLTAGES. REFER TO QUALIFIED PERSONNEL ONLY.

The INV-1200 series inverters are designed to be installed in a standard 19" relay rack or EIA type enclosure. A set of accessory rack “ears” are provided for this purpose. These rack mount adapter brackets may be mounted at the front panel or in the middle of the chassis. In both cases, the adapters are held in place using # 10-32 x 3/8 inch hardware.

CAUTION

WHEN INSTALLING RACK MOUNT ADAPTERS, HARDWARE USED (MACHINE SCREWS) MUST NOT EXCEED 3/8" IN LENGTH. LONGER SCREWS MAY DAMAGE INTERNAL COMPONENTS AND CREATE A SHOCK HAZARD.

Mount the unit in a suitable location as not to block the flow of cooling air at the front, rear, and sides of the inverter chassis. This device will pull in cool air from the front and sides and exhaust warm air from the rear. It is recommended that a minimum clearance of 3 inches be provided at the front and rear and 1 to 2 inches on the sides. Enclosures should be vented.

When rack mounting, it is permissible to mount the inverter by the mounting ears only. If the unit is intended for use in a mobile or other high vibration application the use of additional support for the rear of the chassis is **highly recommended**.

2.2 WIRING

Wiring to the inverter will vary depending on input voltage and any options ordered. In addition, local electrical codes must be considered for permanent installations. The North American National Electrical Code (NEC) requires that separately derived AC sources such as back-up generators, inverters, etc., must have one output conductor tied to a protective earth. This may be accomplished with the INV-1200 series by following the recommended hook up diagrams provided here.

WARNING

ALL INSTALLATIONS AND VERSIONS OF THIS DEVICE REQUIRE THE USE OF THE SAFETY EARTH CONNECTION TO THE CHASSIS. FAILURE TO DO SO MAY CREATE A SHOCK HAZARD. THE VOLTAGE AND CURRENT PRODUCED BY THIS ARE HAZARDOUS.

Figure 2-1 (following page) illustrates the wiring for models that do not include the bypass options. These units have two NEMA 5-15R type receptacles located on the rear panel. Compatible loads may be plugged into these receptacles. Non-bypass type units are also available with a rear mounted terminal block in place of the NEMA receptacles. This is noted as the TB option. See section three of this manual for more information.

! CAUTION

FAILURE TO OBSERVE DC POLARITY ON THE INPUT TO THIS DEVICE MAY CAUSE DAMAGE TO INTERNAL CIRCUITRY. THIS WILL VOID EQUIPMENT WARRANTY

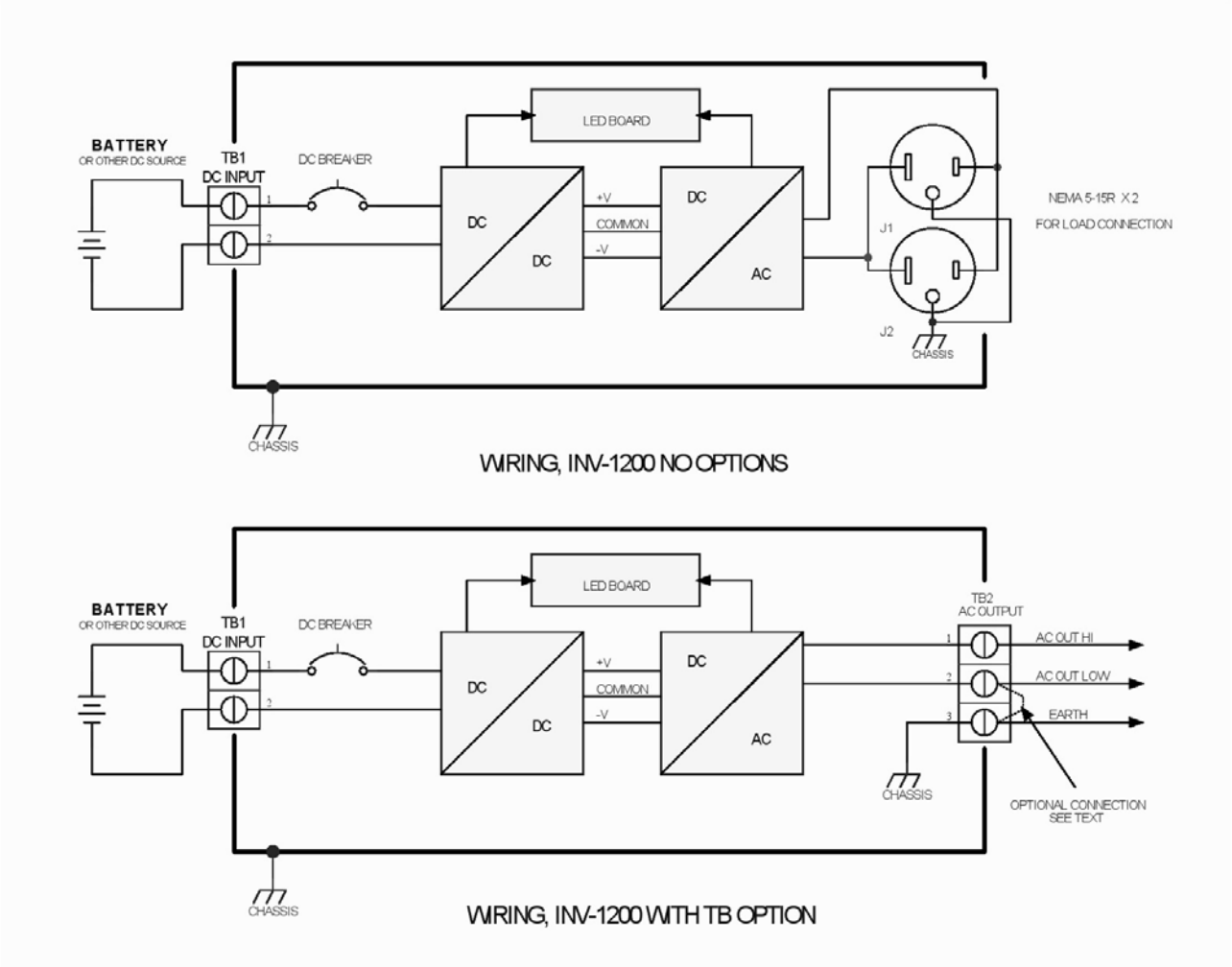


FIGURE 2-1, INV1200 WIRING WITHOUT BYPASS OPTIONS

Units supplied with the AC input bypass option will be wired slightly differently. To conform to NEC 250 the neutral is “carried through” to the output but is not shorted to the GND terminal. When supplied from the inverter, (not in bypass) the low or neutral terminal is floating with respect to earth. This situation does not meet the requirements of NEC section 250 regarding “separately derived AC source”. To allow compliance with NEC rules, an additional “common” terminal is provided at the rear panel. Attaching a short between the inverter common and earth will satisfy this requirement. This is also recommended for overall safety. It should be noted that this is only required to satisfy the NEC rules. The output of the inverter is isolated from the DC input and the line. This allows the output to be floating if required by end user’s application. Maximum continuous common mode potential is limited to 250VAC or 360VDC. Figure 2-3 illustrates a typical bypass configuration.

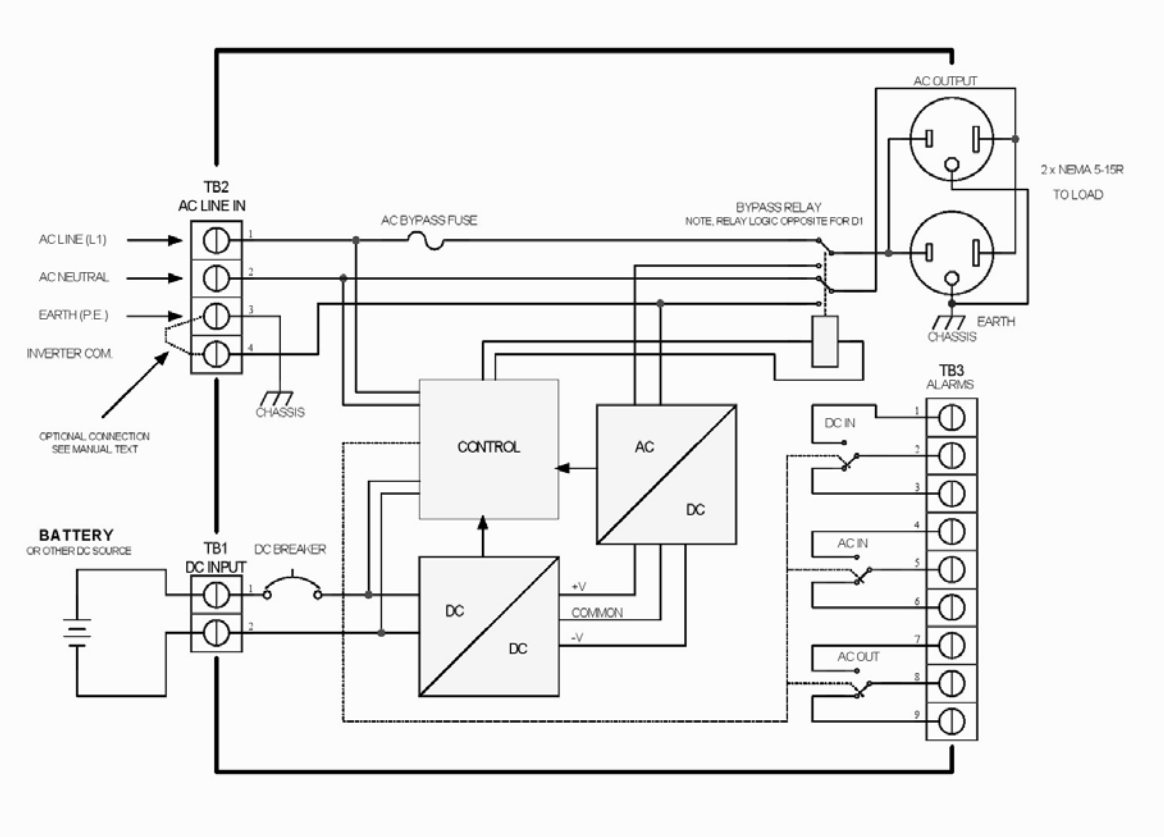


FIGURE 2-2. INV1200 WIRING WITH BYPASS OPTION

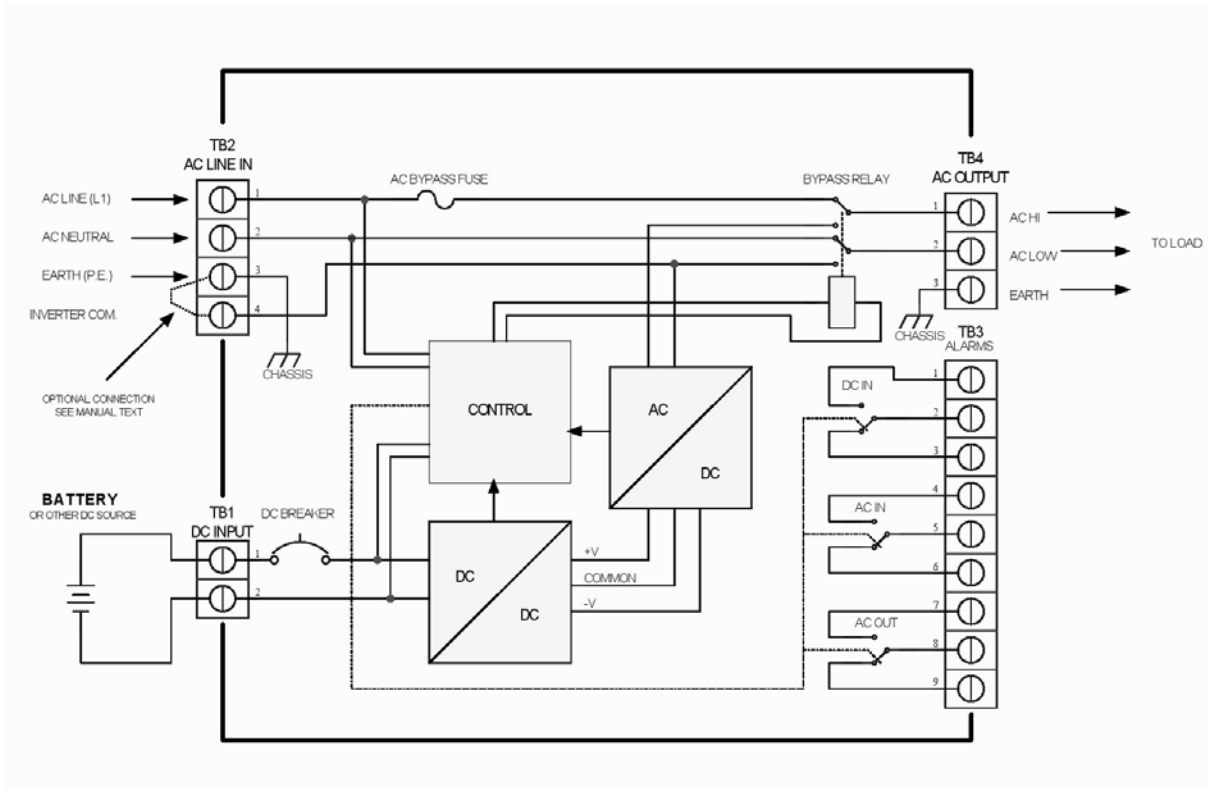


FIGURE 2-3. INV1200 WIRING WITH BYPASS AND TB OPTIONS

2.2 Wiring (continued)

The recommended wire size for each model is listed below in table 2-1. These sizes are based on a maximum wire length of 10 to 15 feet. Longer wires should be increased in diameter.

MODEL #	DC INPUT WIRING	AC INPUT \ OUTPUT WIRING
INV-1200-48-XX	# 8 AWG (45 A)	# 14 AWG (10 A max)
INV-1200-125-XX	# 12 AWG (15 A typ.)	# 14 AWG (10 A max)
INV-1200-250-XX	#14 AWG (7.5 A typ.)	# 14 AWG (10 A max)

TABLE 2-1

2.3 OPTIONAL ALARM CONTACTS

Units supplied with either the A1 or D1 bypass options also provide signal contacts that can be used to set alarms or trigger other system related responses to operating conditions.

The alarm contact option provides the user with a convenient means of monitoring the status of DC input, AC input, and INVERTER (inverter AC output). Each function provides one set of “dry” “form C” contacts which accommodates any logic required. The internal relays will change state if any of the three voltages are outside of limits required to provide proper operation. The range that this occurs is about +/-15% of nominal for the model in use. The contact rating of the alarm functions are 0.5 amp @ 125 VAC maximum (32VDC max.). The figure 2-3 below illustrates the alarm internal wiring.

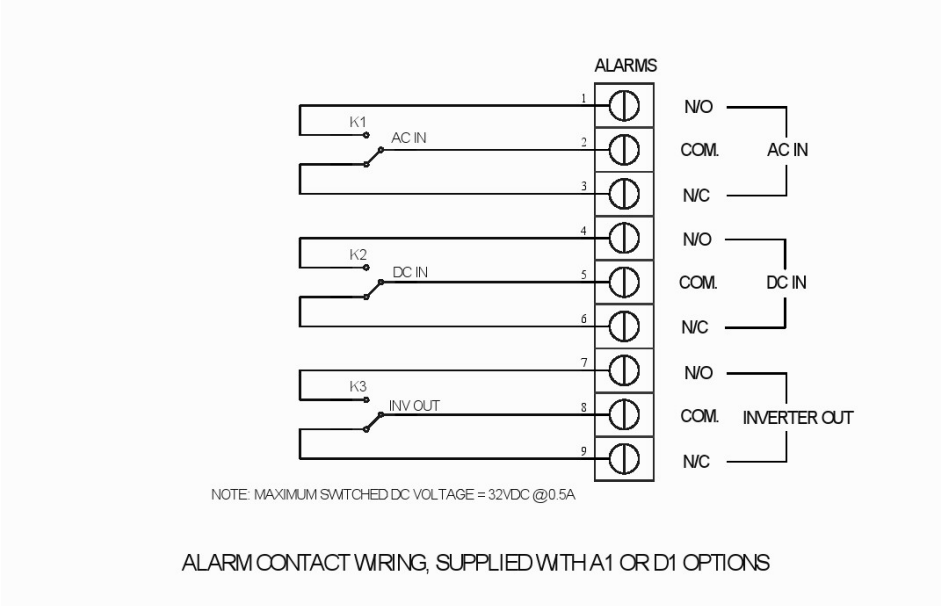


FIGURE 2-3 INTERNAL ALARM WIRING

To prevent possible EMI (electro-magnetic interference), alarm wiring should be accomplished with twisted pairs. Shielding is also recommended. This will prevent interference from entering or leaving the unit. All alarm connections should be made with #6 inside diameter ring lugs. A rear panel mounted, 9 position, terminal block is provided for connection to the alarm signal relays. See section three of this manual for further information. Note that the signal relays operate in parallel with the front panel indicator LEDs.

2.4 OPTIONAL STEP-UP TRANSFORMER

The INV series can provide a 220VAC or 240VAC output with the addition of an external transformer chassis. With this option a second rack mountable chassis is provided to convert the standard 120VAC output to the higher value. In addition, the bypass option can also be included with the external transformer. A block diagram of the optional transformer configurations is provided in figure 2-4. Special units may vary and will be identified by a four digit engineering code. Interconnecting wiring should be rated at 250VAC or better. Ring lugs are recommended for all connections.

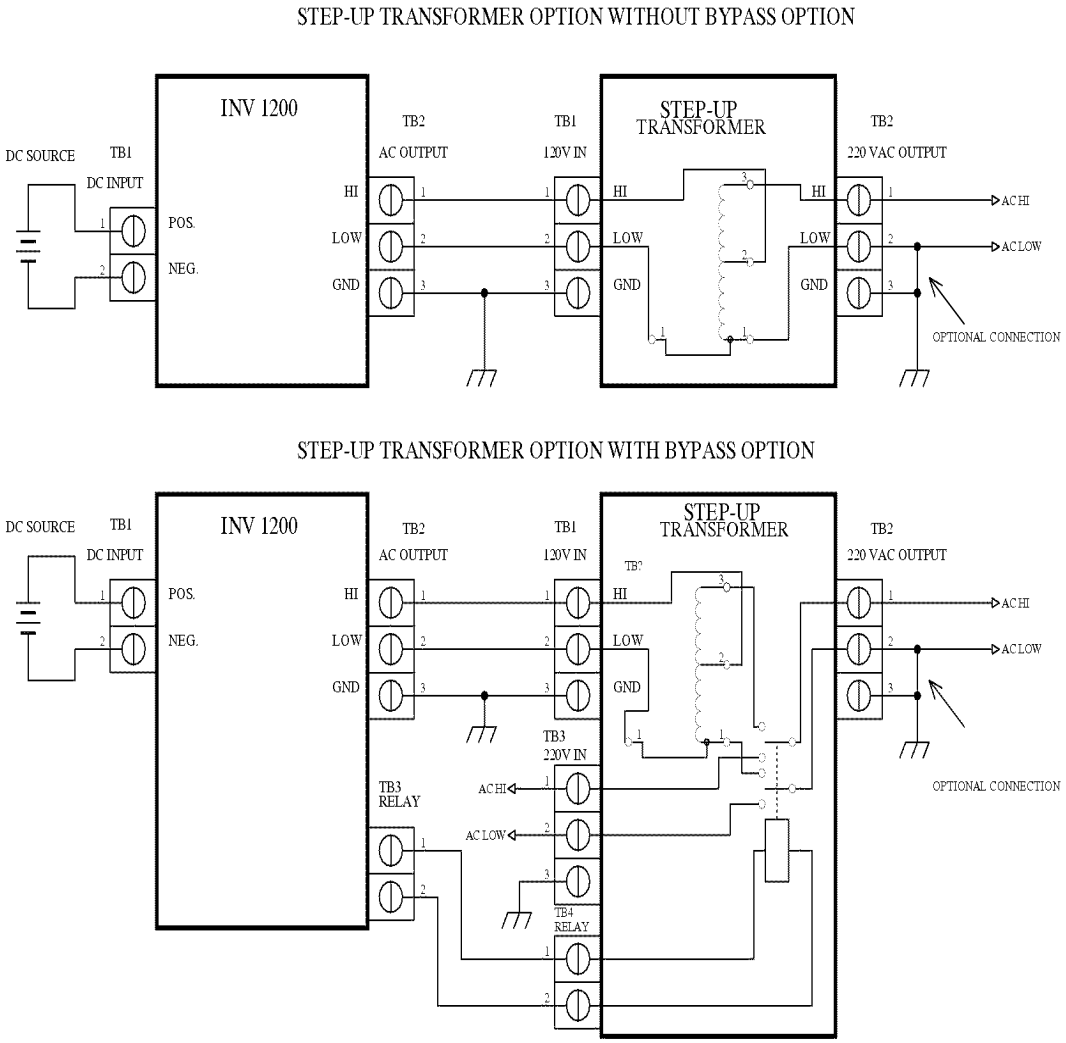


FIGURE 2-5 EXTERNAL STEP-UP TRANSFORMER BLOCK DIAGRAMS

SECTION 3
OPERATION

3.1 CONTROLS AND INDICATORS

Table 3-1 below lists and describes the various controls, indicators, and connectors associated with this model. Figures 3-1 & 3-2 illustrate the location of items listed in table 3-1.

ITEM	DESIGNATION	FUNCTION
1	POWER	Front panel mounted magnetic circuit breaker, also serves as DC on/off switch.
2	AIR INTAKE	Pulls in air for cooling internal power components.
3	STATUS LEDS	Bicolor LEDs are used to show the status of the DC input, Inverter and AC input. Green LED's indicate a normal operation while red LED's indicate a fault condition. **AC IN** LED is only included in units with A1 or D1 bypass option. The **AC IN** LED is green when the AC line input is present.
4	LINE BYPASS FUSE	Provided with alarm /bypass option. Used to protect AC wiring due to load fault. Fuse rating is 10A @ 250VAC
5	OUTPUT CONNECTOR	Standard units provide two NEMA 5-15R type receptacles. TB option provides a terminal block.
6	AC LINE INPUT TERMINALS	Screw type terminal block provided with alarm/bypass option. For connection to bypass source.
7	FAN EXHAUST	Heated air exhaust. Minimum 4 inch clearance required for full power operation.
8	DC INPUT	Screw type terminal block to connect DC input.
9	ALARM SIGNAL TERMINAL (suppled with A1 or D1 option only)	Screw type terminal block to connect alarm signals. See text.
10	PROTECTIVE EARTH TERMINAL	#10-32 stud for connection to safety ground.

TABLE 3-1

The table above lists features of the most common configurations for this model series. It should be noted that Behlman has produced many modified or semi-custom versions of this model. This will be indicated by a four digit engineering code number appearing at the end of the model number. For this reason this table may not contain all of the information for special units. Addendums will be placed at the beginning of this manual to address any important variations and/or operating considerations associated special units. When requesting information from Behlman regarding this series, any four digit engineering code(s) should be provided.

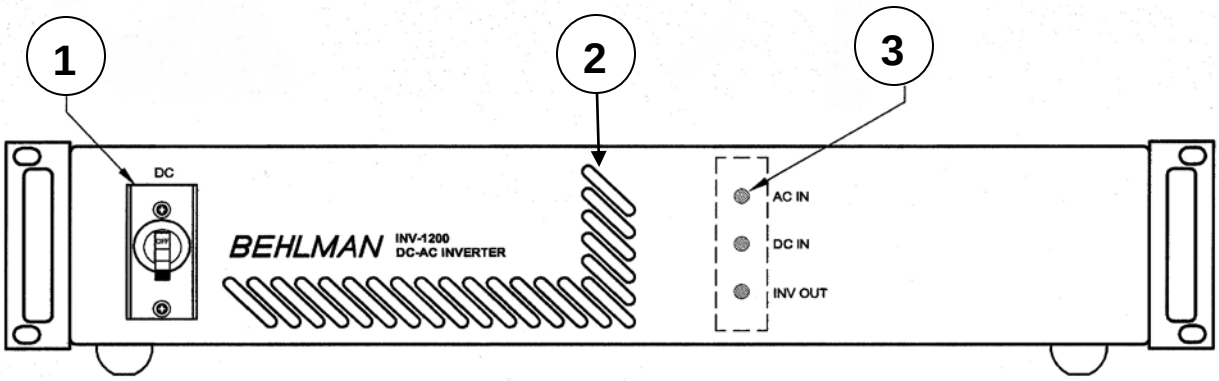


FIGURE 3-1 INV1200 FRONT PANEL

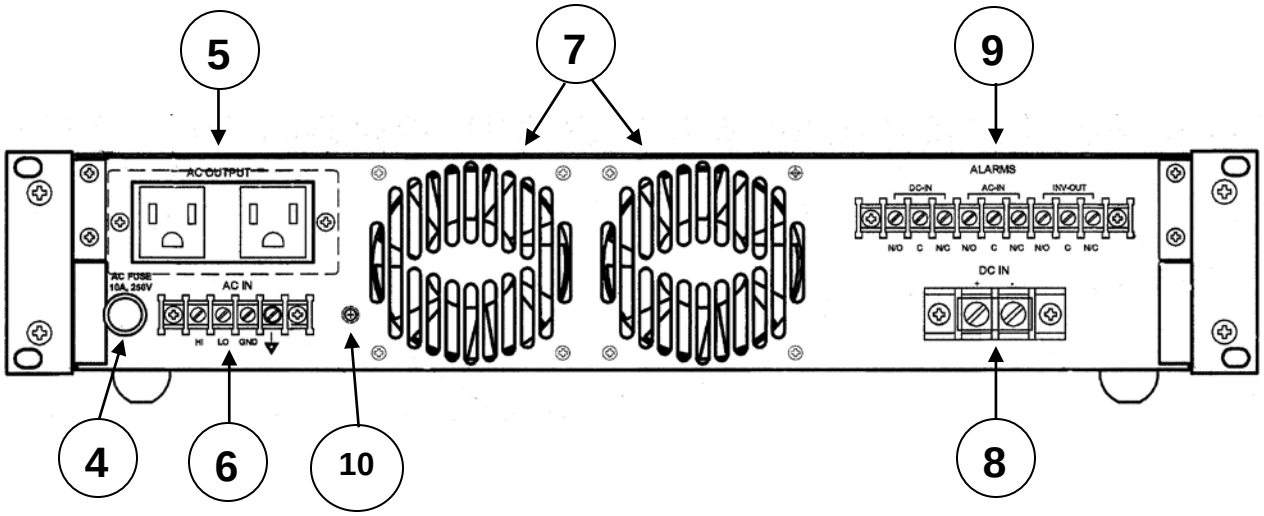


FIGURE 3-2 INV1200 REAR PANEL

3.2 OPERATION

1. Connect the load to the inverter. If multiple loads are used it is good practice to switch all loads off before switching on the inverter. This will prevent multiple in-rush currents from tripping protective circuits in the inverter.

2. Switch on the inverter. At this point, the sound of the cooling fans should be evident.

3. The appropriate front panel LEDs should be illuminated.

4. To test the inverter, use a True RMS type meter to confirm the output voltage is as specified.

5. Units provided with the A1 bypass option are AC preferred. This means that the incoming AC line voltage will be routed to the inverter output terminals (or outlets) whenever it is present. During this time the inverter is in a standby condition. If the AC input is removed the output terminals will be switched to the inverter and operation from the DC source begins.

3.2 OPERATION (continued)

The A1 bypass function can be verified by removing the AC line input. This will cause the AC IN LED to turn red and the AC IN alarm contacts to change state. During this time the INVERTER and DC IN LEDs should remain green. Confirm an AC output from the output terminals or outlets. When the AC is re-applied the unit will switch back to bypass after a short delay period.

Units provided with the D1 bypass option are DC preferred. This means that the inverter is routed to the output terminals (or outlets) whenever DC is available. If the DC is lost or the inverter malfunctions, the incoming AC line will be routed to the output terminals. When the DC has recovered, the unit will switch back to DC operation after a short delay period.

The D1 bypass function can be verified by removing the DC input (leave front panel breaker on). Confirm that the DC IN and INVERTER LEDs turn red and the corresponding rear panel alarm contacts change state. The AC IN LED will remain green and the AC IN contacts do not change state (a quick flash of the LED or relay trip may be encountered during the switch over). Use a voltmeter to confirm that the input AC line is now routed to the unit's output terminals or outlets.

3.3 OPERATIONAL CONSIDERATIONS

LOADING LIMITATIONS:

The INV series are designed to produce a power level of 1200 watts (real power) under continuous operating conditions. In addition, they can supply bursts of over 1500 watts for several seconds. Peak repetitive currents on the order of 30 amps may also be supplied continuously as long as they do not exceed the RMS value of 10 amps.

This high peak current capability allows the INV-1200 series to start most high in-rush loads in its power range. It must be understood that the DC power source suppling the inverter must also have this capability in order to derive these benefits. A poorly regulated or high internal resistance DC power source will adversely affect operation of the inverter.

POWERING REACTIVE LOADS

Capacitors and inductors are reactive in nature. With capacitors, if the load is applied during the peak of the AC cycle there may be a considerable in-rush of current several magnitudes larger than the steady state current. This current is only limited by any series resistance that may be present in the load circuit. Under the right conditions, this could trip the overload protection circuits in the inverter. Certain transformers and solenoids (inductance) present the same problem due to magnetizing currents.

Several methods can be used to prevent tripping the protection circuits in the power source. One common method is to insert a limiting impedance in series with the load. This could be in the form of a fixed resistor or NTC (negative temperature coefficient) thermistor. Also, zero crossing switching can be employed. Most commercial DC power supplies present a capacitive in-rush characteristic. Line filters with large shunt capacitance may also cause considerable in-rush current "spikes". If not accounted for these loads can trip protective circuits in the inverter.

POWERING LAMPS

Tungsten filaments lamps, when cold, present a very low resistance. Once they are energized, their resistance quickly climbs to its steady state value. This characteristic must be accounted for when driving tungsten filament lamps. Like incandescent lamps, certain Ni-Chrome based heaters will present a 2:1 or 3:1 in-rush when cold. The same methods for limiting in-rush current for reactive loads can be applied to tungsten or Ni-Chrome based elements.

POWERING MOTORS

Driving an AC motor presents a special problem. Most motors require a starting current that can be several times higher than the running current. This current may last for a few cycles to several seconds depending on the construction and mechanical load on the motor. This current is sometimes referred to as the motor's "locked rotor" current. This current is not to be confused with a typical AC in-rush current that usually occurs over the course of one or less cycles of the AC waveform. The latter is a consequence of where in the AC cycle that a load switch closes.

The model 1200's fold back current limiting can be an advantage when starting motors. During the starting period the motor will attempt to draw excessive power from the inverter. The fold back circuit will reduce the output voltage in order to maintain the maximum output current. During this time the current supplied to the motor will remain sinusoidal, this allows the motor to start rotating. Once the motor reaches its normal operating speed, it generates the required "back EMF" to reduce the supply current to the nominal "run" value for the motor.

POWERING NON-LINEAR LOADS

Loads utilizing rectifiers and SCRs interact with the AC power source and have a significant effect on the distortion of the output waveform. Consider the use of a bridge rectifier followed by a capacitive filter, the current waveform associated with this circuit is illustrated below in figure 3-3. The input current to this type of circuit is drawn in large "gulps" whenever the voltage across the capacitor falls below the peak of the input waveform. The capacitor charging current is limited only by the series impedance present in the wiring and capacitor. Because the impedance of large electrolytic capacitors is very small this action causes a current wave form with a peak value several times the RMS value. This ratio of peak current to RMS current is known as "crest factor". High values of current crest factor cause distortion of the AC voltage waveform.

The amount of distortion incurred is dependent on many factors and is beyond the scope of this manual. It should be noted that this type of load may cause the output waveform to exhibit "flat topping" This should not be associated with a defect of the inverter. Most "real world" electric distribution systems will exhibit similar distortion for this reason.

Figure 3-3 below give an example of a non-linear load. In this case the load current is said to be discontinuous as it does not flow over the full cycle of the output waveforms. This action can cause perturbations on the output waveform. This may show up as ringing or clipping. Ringing can be reduced by adding a small resistive "pre-load" of about 10 to 20 watts across the output terminals.

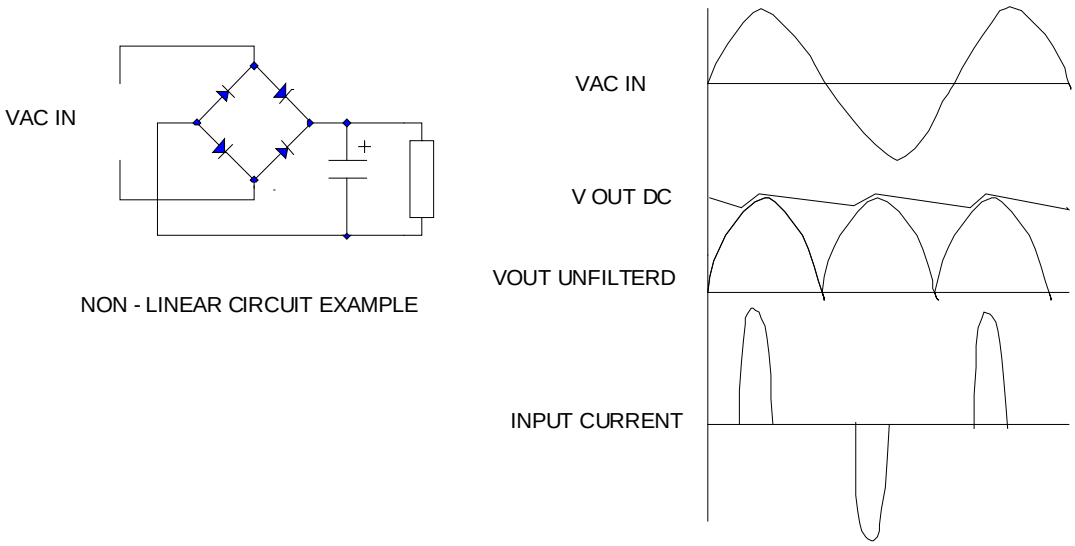


FIGURE 3-3 NON-LINEAR LOAD EXAMPLES

SECTION 4
TROUBLESHOOTING

4.1 THEORY OF OPERATION

The INV-1200 series utilizes high frequency, switched mode, power conversion to convert the incoming DC to an AC output. The first stage is a DC to DC converter which “steps - up” the input voltage to a regulated +/- 200 VDC. This voltage is applied to a second high frequency “housekeeping” supply and the output inverter. The housekeeping supply provides operating voltages for the output inverter and alarm circuits. The output section consists of a crystal controlled sine wave oscillator and class “D” power amplifier. The crystal derived clock frequency is divided down and applied to a counter, PROM, D/A converter combination. The resulting sine wave at the output frequency is applied to the power amplifier and boosted to the 120 VAC level required on the output.

The power amplifier consists of a pulse width modulated (PWM) “half bridge” circuit utilizing IGBT output devices. The devices are switched at a rate of 20 KHZ and modulated with the sine wave information. The result is a 400V p/p pulse train at the output that contains the original sine wave information. The 20 KHz “carrier” frequency is removed by a low pass LC filter. This provides an amplified version of the original modulation signal to the output terminals. The control circuitry on the output inverter assembly also provides output regulation and protective functions. The output voltage RMS value is monitored and used to keep the output regulated. Output current is measured and used to provide fold back type limiting in the event of an overload. Output short circuits will disable the inverter stage, requiring the input power to be recycled to return proper operation.

The alarm and bypass circuits (if provided) allow for external monitoring of input and output status. The AC input/ bypass feature allows the AC power line to be applied to the model INV-1200 and sent directly to the output terminals. In the event the AC is interrupted, a relay will switch the output to the inverter. Units supplied with the D1 option will switch the line through when the DC is not available or the inverter has a fault. The AC input is fused at 10 amps.

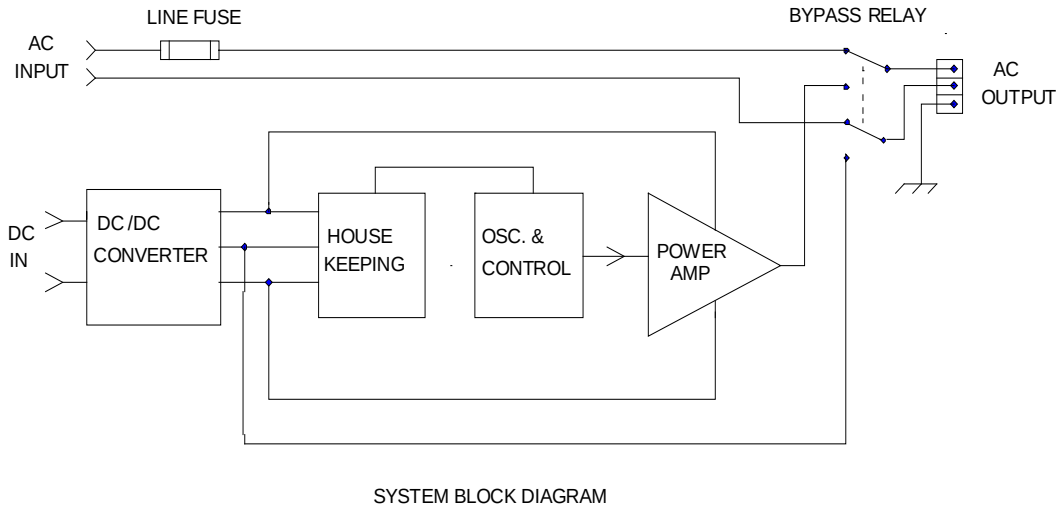


FIGURE 4-1 INV-1200 BLOCK DIAGRAM (WITH BYPASS OPTION)

4.2 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 DC IN LED is green INV LED is red	Output overloaded	Check load current. Disconnect load and recheck output voltage using TRMS meter. Recycle power.
Erratic operation	Input voltage fluctuating	Monitor voltage at DC input terminals of inverter. Make sure it is with in specifications
No AC out in bypass mode (optional)	AC - Bypass fuse blown	Check fuse. Measure AC input at rear panel.
Output distorted	High peak load current	Reduce loading if distortion is objectionable.
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

WARNING

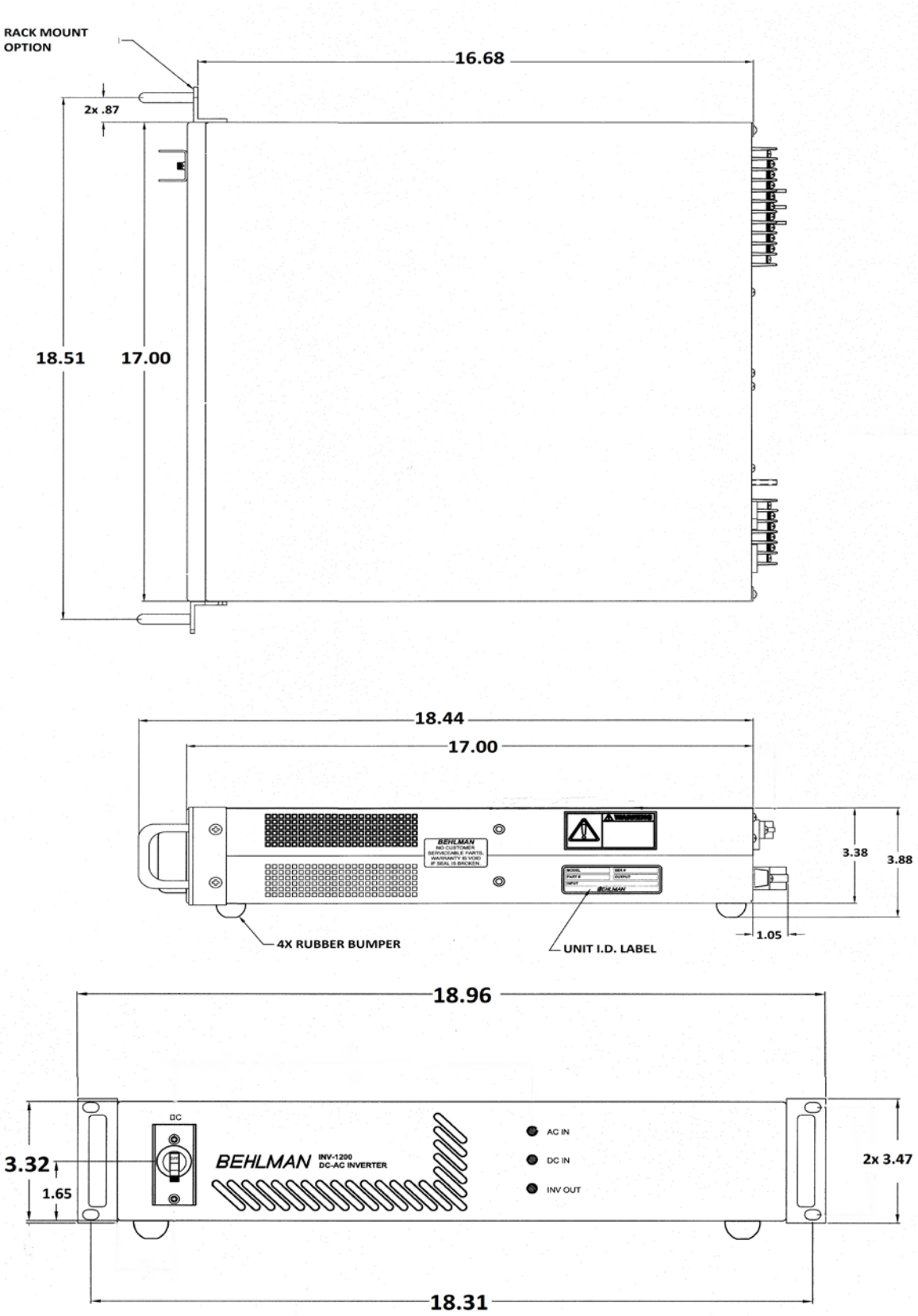
Service of this device requires specialized equipment and trained personnel. There are no internal user serviceable parts. Removing the cover will expose individuals to hazardous voltages. **Refer service to qualified persons only!**

4.3 MAINTENANCE

The INV-1200 series requires very little in the way of routine maintenance. If the unit is operated in a dirty or dusty environment it should be removed from service periodically and cleaned. The use of forced air is perfect for cleaning dust and debris from fan intakes and heat sink assemblies. Light brushing and vacuuming is also effective.

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. Behlman does not provide batteries for these units.

5.0 MECHANICAL OUTLINE



ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED

REVISION HISTORY			
Rev.	**ECO**	**DESCRIPTION**	**DATE**
-	N/A	INV-1200 Gen 2 Initial Release	9/16/2016
A	17-030	Revised specification & figure 2-1 to 2-3 redrawn	2/28/17
B	17-032	Corrected text & figure 2-2 & 2-3	3/30/17