

NWL Power Systems

PRODUCT MANUAL

**FOR STANDARD 80 kW
3-CHANNEL OUTPUT BROADCAST
POWER SUPPLIES
Model Number 119638**

NWL Broadcast Power Supplies are an industry standard for stable, reliable broadcast power. More of them may be in service at the moment than the power supplies of any other manufacturer.

SERVICE

Skilled factory service personnel are available for your needs simply by calling NWL at 609-298-7300 any business day from 8 AM to 5 PM, Eastern time.

EMERGENCY ACTION

At time of delivery, the product should be carefully inspected. Any damage, leakage, etc. should be noted on the shipping memorandum. A damage claim should be filed with the transportation company immediately.

NWL should be notified by calling (609)298-7300.

Repair and servicing of the equipment should be performed by a qualified NWL representative.

OPENING OF THE LID OR HANDHOLE COVER WILL VOID WARRANTY UNLESS AUTHORIZED BY NWL.

After delivery but prior to installation, if any leakage is noted, please call NWL immediately.

On or after installation, if unit malfunctions, remove all power and call NWL immediately.

WARNING! High Voltage!

NWL power supplies contain dangerous and potentially lethal voltages.

- Do not attempt to service the device while it is powered up or operating.
- Turn off power to the unit and carefully follow the grounding procedures described within this manual before doing any physical or electrical work on the unit.
- Take precautions against shock or electrocution
- Do not stand in water or on damp surfaces while working on the unit.
- NWL will not be liable for death, injury or damages resulting from the unsafe installation or operation of this device.
- DANGER! - To reduce the risk of Electrical Shock, Carefully follow the instructions within this manual.

These are Important Safety
Instructions

SAVE THESE INSTRUCTIONS!

NWL – PERFORMANCE AND RELIABILITY

NWL specializes in the design and manufacturing of power supplies and capacitors and allied devices for a variety of end uses. It's the kind of company you didn't think existed anymore: customer-responsive, market-driven and experienced in all areas of power technology. We also maintain a degree of control over our products which is unusual in today's "built elsewhere, assembled here" environment. We develop, design, manufacture, distribute and support all our products from start to finish. As a result, you can be sure that all components are compatible...that design integrity has been preserved ...and that one high standard of quality prevails throughout — ours.

It also means that, if you need support of our product — or require adaptation to your specific needs — we will have the answers. And, with over sixty years of experience in creating components and power supplies for a broad range of industries, you'll also get the benefit of proven techniques which we adapt from one market to another

That's all part of our commitment to providing a total solution that meets or exceeds the needs of the systems integrators, OEMs and end-users who look to us for innovation with solid reliability.

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1

THE POWER FOR BROADCASTING

Like other NWL products, your broadcast power supply —down to the sheet metal cabinet and circuit boards — has been designed and made totally by NWL. This NWL Broadcast Power Supply has been designed to provide multiple output voltages for use with the latest Multi-Stage IOT tube technology. The supply utilizes the conventional and time-tested technology of transformer, rectification, and filtering to convert the incoming 3PH AC power into the required multiple DC outputs for the new broadcast tubes.

This new MSDC-IOT Power Supply provides (3) individual HV output voltages ranging from -11.4KV to -38KV. The highest voltage (-38kv) is with respect to a positive ground. Each return of the remaining three HV output voltages are all common to the -38kv output and therefore all float at -38kv. The nominal output voltages and currents of each at full load are shown in table 1 below:

| PS# | Output | Current |
|------|---------|---------|
| PS#5 | -38KV | 1.0ADC |
| PS#3 | -19KV | 1.3ADC |
| PS#2 | -11.4KV | .75ADC |

Table 1.

The -40KV output is designed with the intent to carry the total current for the cathode of the IOT tube while the 2 lower voltage outputs will be used for driving the collectors of the tube. Each output is designed to provide the full current that is listed above. However, the unit is designed for a maximum total DC secondary current of 2.8ADC, not 3.05ADC as one might think by looking at the arithmetic total of the 4 outputs. This means that any of the outputs can run at full rated current, but not all of them at once. One or more of the outputs must run at a reduced current to limit the total to 2.8ADC and the primary input to approx. 80KVA.

A (5) position primary tap switch located within the LV junction box provides a means of adjusting the level of the -38KV output voltage. This switch is labeled 1RSS. The range of adjustment to the output is shown in table 2. When a tap lower than the -38KV (Tap5) is selected, each of the remaining other (2) output voltages will be lowered proportionally with the -38KV output.

Table 2.

| Tap# | Output |
|------|--------|
| 5 | -38KV |
| 4 | -36KV |
| 3 | -34KV |
| 2 | -32KV |
| 1 | -30KV |

The circuit of the system starts with the 3PH line voltage entering the primary of a delta / wye step up transformer through three low voltage porcelain feed-through bushings. The high voltage secondary of the transformer is designed with (3) independent secondary windings, one for each different output level. Each of the (3) secondary windings are fed into its own three phase FWB rectifier where the HV AC power is converted into DC. At this point, the negative ends of all (3) rectifiers are tied together. By doing this, it allows the (2) lower voltages (collectors) to float up and ride on the -38KV output (Cathode) yet the output voltage level of all (3) outputs are defined with respect to ground.(referring to the main electrical schematic will help to visually understand this topology.) This common negative and each of the (3) positive voltages are all then brought out of the tank through HV feed-through bushings. Within the HV junction box, each of the three outputs are filtered with capacitance to reduce ripple. Filtering is also accomplished via a shared HV choke on the common return leg of all (3) outputs. Finally, each output is steered through its own inline current limiting resistors to limit the maximum current in the event of an arc or surge at the user's load.

Also located in the LV junction box is a second tap switch labeled 2RSS. This tap switch has two positions marked Δ (Delta) and Y (Wye). This tap switch allows the user to change the primary wiring of the transformer from the standard delta configuration to a Wye configuration. By utilizing this option, the user can conveniently lower all of the output voltages by a factor of 1.7x. This is a very useful feature when lower output voltages are required for initially breaking in new tubes.

This unit is designed for continuous operation at temperatures from -40C to +40C and up to a maximum altitude of 10,000 ft. above sea level.

All of NWL's broadcast transformers offer the user a rugged and tough device based upon use-proven technology which can be relied upon to provide years of service with minimum maintenance.

Many of these Broadcast Power Supplies have been tested and certified by notified bodies and hold certification to CSA and UL standards. Check the Specification Sheet within this manual to see which certifications your unit may hold.

2

SHIPPING, RECEIVING, HANDLING AND STORAGE

Shipping and Receiving

NWL Power Supplies are shipped on heavy-duty pallets and covered with plastic envelopes for protection, unless otherwise specified. The transportation means used will be suitable for equipment containing high voltage electronic gear.

As with all high voltage equipment, handling is critical so that the internal clearances, the integrity of the high voltage bushings, if any, and the dielectric coolant are not injured or compromised.

The equipment should be examined as soon as it is received. Be sure that:

- The fluid level registers between the limits indicated on the liquid level gauge, and
- That the plastic envelope has remained intact.

Remember, any external damage may be an indication of internal damage.

Handling:

The unit can be removed from the truck with a forklift. Channels are provided on the bottom to facilitate the use of a forklift when the pallet is removed. Four lifting lugs have been provided at the four corners of the tank for overhead lifting by crane or hoist.

Whatever the removal method, your unit has high voltage bushings. Take care not to bear any force on them.

Use spreaders on slings, if necessary, and provide padding to protect the painted surfaces from the sling.

NOTE: When handling the equipment without its pallet, take special care of the side radiators, as they are thin-walled for efficient heat-transfer and their repair requires special welding equipment not available in the field.

Storage:

If the equipment cannot be installed soon after its arrival, follow these procedures:

- Store it in a clean dry place sheltered from the elements.
- Maintain the equipment on its shipping pallet and with its plastic envelope intact to minimize damage to the radiators and external gauges and to protect the cleanliness of the high voltage bushing. This will also tend to discourage pilfering.
- Should the pressure relief valve be damaged, disassembled, or removed, apply an airtight seal immediately upon discovery and notify NWL at (609) 298-7300, otherwise the warranty will be voided.

The temperature of the storage area must be maintained between -40C and 60C (-40F to 140F). If the temperature of the storage area is below -40C (-40F), it is mandatory that the oil be heated prior to applying full rated input voltage to the Power Supply. Simply operate the Power Supply at 1/4 rated input voltage until the temperature gauge on the Power Supply registers 0C or higher.

3

Symbols & Warning Labels

SYMBOLS:

The following symbols are used throughout the power supply.
They mean the following:



This symbol means that **CAUTION** needs to be exercised and that the user should refer back to the manual for accompanying information.



This symbol means that there is a **PROTECTIVE CONDUCTOR TERMINAL** located at that spot and can be found adjacent to all protective earth terminals in the unit.



This symbol means that **Caution** needs to be exercised due to the fact that the surface temperature of the equipment may be hot.

WARNING LABELS:

Warning Labels have been placed on your new equipment. If these labels become worn and need to be replaced, they can be obtained from our factory. The labels are as follows:

Label #1: Green Safety Instruction Label
(NWLPart#M40015):

This label should be placed on T/R-set low voltage junction box covers.

Label #2: Danger Label (NWL Part #M40016):

This label should be placed on any removable high voltage access covers such as the external switch access panel.

4

MAIN POWER SUPPLY COMPONENT IDENTIFICATION AND DESCRIPTION

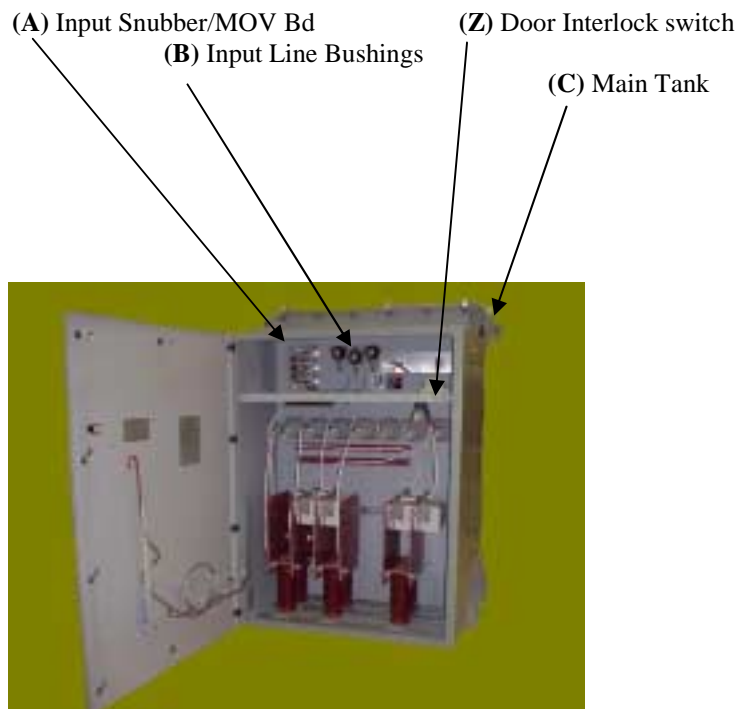


Fig 1. View of Low & High Voltage Junction Box uncovered

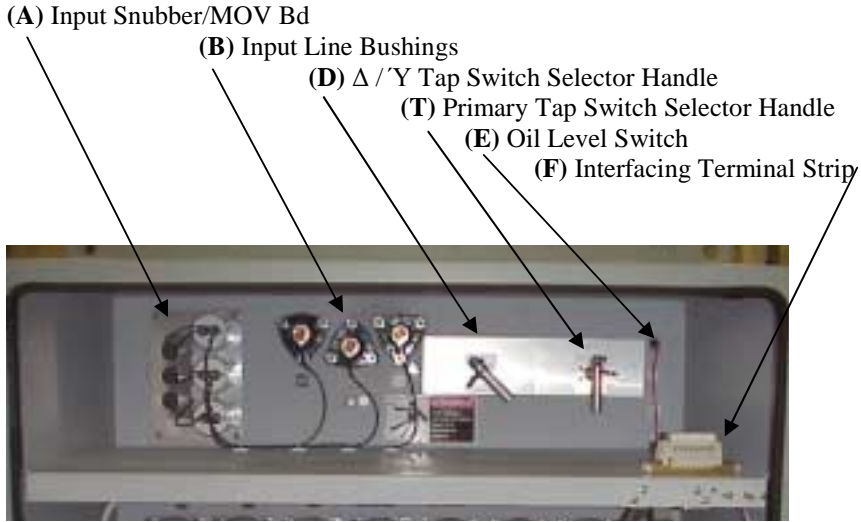


Fig 2. Low Voltage Junction Box

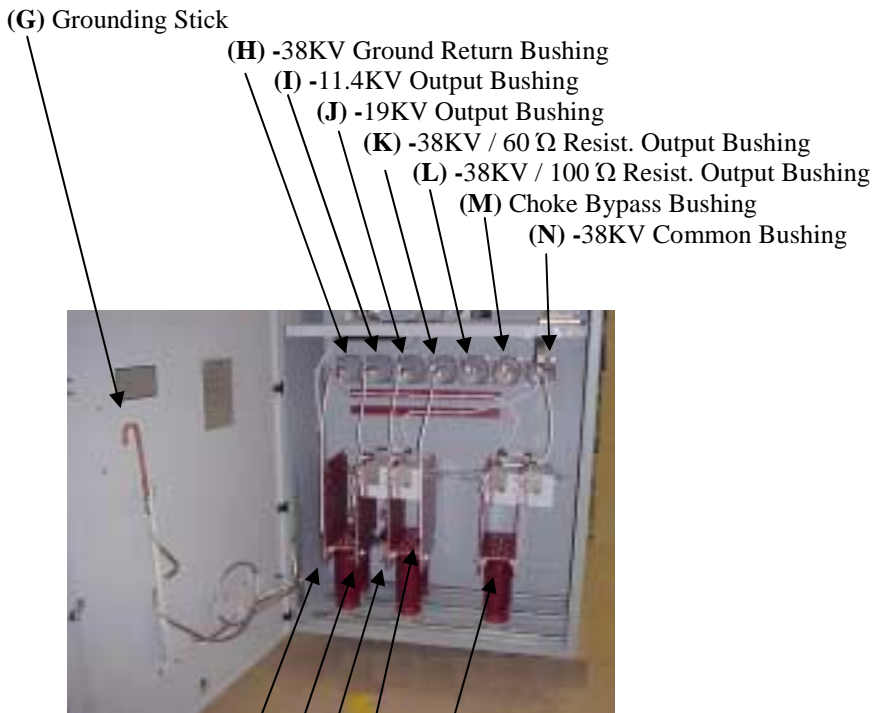
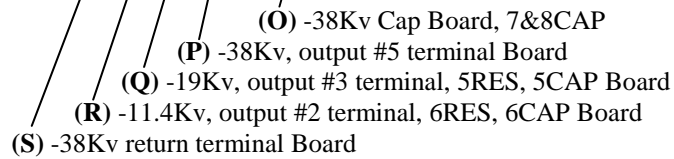
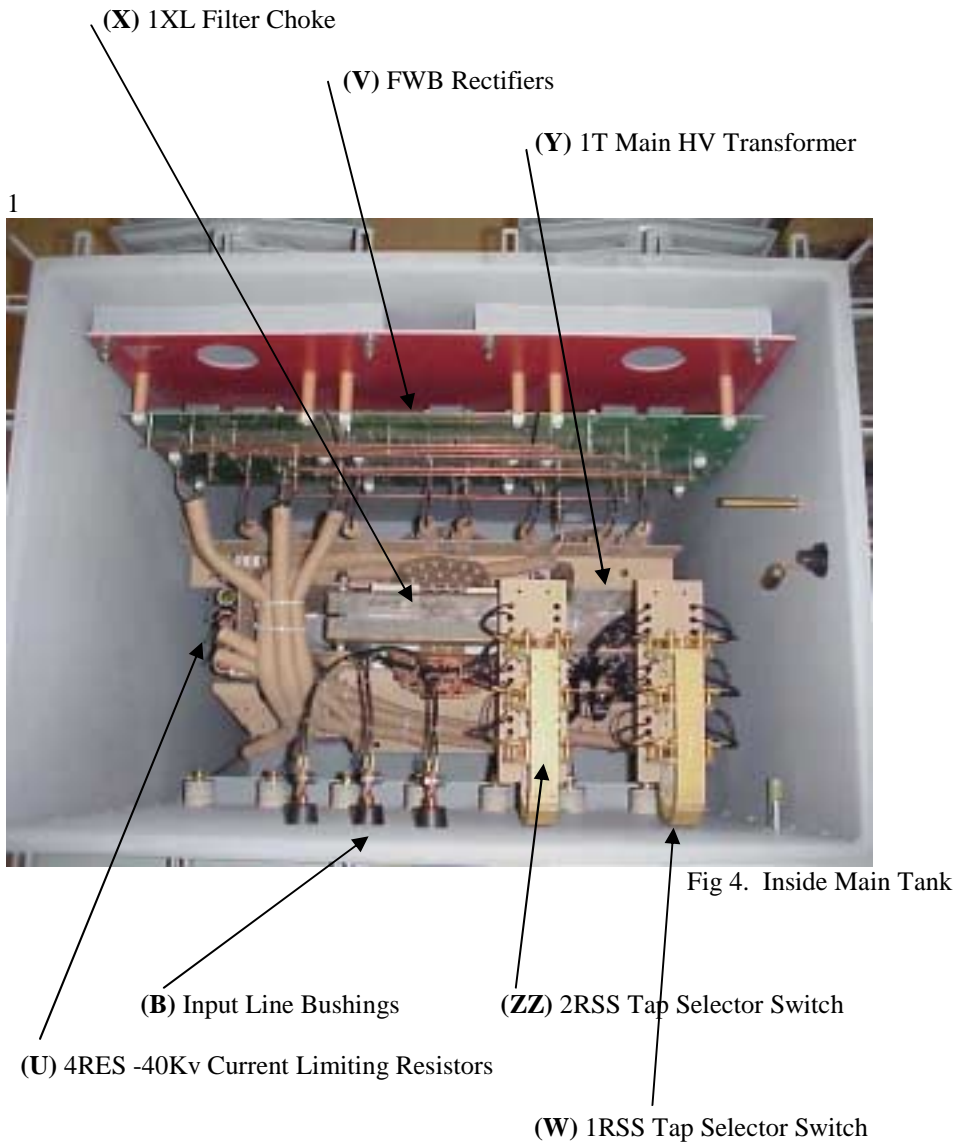


Fig 3 High Voltage Junction Box



***(Typical 3-Output Unit. 2RSS & Choke bypass Bushing not shown)



1. Input Line Bushings (Item B):

3PH AC input power to the broadcast unit is connected directly to three L.V. bushings inside the low voltage junction box. These epoxy "X" mount type bushings are ruggedly designed to handle the physical forces of the input cables when they are attached. The primary function of these bushings is to provide a means of

bringing input power through the tank wall and into the main oil tank. These bushings are rated up to 600vac @ 400AAC.

2. Input Snubber / MOV Board (Item A):

There is a capacitor and MOV (Metal Oxide Varistor) across each input bushing. These are used for transient suppression in case of any spikes that may occur on the input power lines. The three capacitors and MOVs are all wired in a Wye configuration with the center neutral left floating.

3. Tap Switch (1RSS) (Items T & W):

A NO-LOAD tap switch (item W) is located inside the oil tank to allow the user reduce the nominal voltages of each output as outlined in Section 1 & Table 1 of this manual. The switch has five positions. As the user adjusts the switch from position 5 to position 1 using the handle (item T) provided in the LV section of the junction box, each output will lower by the same percentage. See the nameplate or section in this manual titled "Output Voltage Ratings" for the nominal voltages on each tap.

4. Tap Switch (2RSS) (Item D & ZZ):

This NO-LOAD tap switch 2RSS, (item D) is located inside the oil tank next to 1RSS. This tap switch has two positions marked Δ (Delta) and Y (Wye). The tap switch allows the user to change the primary wiring of the transformer from the standard delta configuration to a Wye configuration. By utilizing this option, the user can conveniently lower all of the output voltages by a factor of 1.7x. The reduced nominal voltages of each output is outlined in Section 5 & Table 1 of this manual. This is a very useful feature when lower output voltages are required for initially breaking in new tubes. to allow the user change

5. Grounding Stick (Item G):

A specially designed grounding stick is included in the junction box to be used in discharging the capacitor network. For safety, it is imperative that it be used and used in precisely the manner described in the "CAPACITOR DISCHARGING & GROUNDING PROCEDURE " portion of this manual whenever you must enter the junction box.

6. Grounding Stick Interlock Switch (Item G):

The ground switch within the unit comes equipped with a limit switch that is activated when it is removed from its holder. This is provided so that the user does not forget to put the stick back before the unit is re-powered up again, a common mistake. This switch is a DPST configuration. The switch is designed to be normally closed when the stick is in its holder, and opens when the

stick is removed. One of the switch's poles is wired directly to the customer interface terminal strip. The other is wired in series with one of the poles of the door interlock switch, which is then also wired to the interface terminal strip. (consult the electrical schematic for specific terminal numbers) These switches should be interlocked with the customer's inline contactor so that the unit will not start up if the stick is out of its holder. Consult the specification sheet attached within this manual to determine the electrical ratings that the switch holds. **DO NOT EXCEED** switch rating. If necessary, use an auxiliary relay to drive the interlock circuit. If inductive loads are to be switched, the user may want to install an MOV across switch.

7. Rectifiers (1REC) (Item V):

Each of the three sets of three phase AC voltages from the secondary on the main step-up transformer needs to be rectified to DC. This is accomplished by connecting each output into its own three-phase, full-wave rectifier bridge. All three FWB rectifiers are built within one module called 1REC, where the positive ends of each are all tied together to meet the needs of this circuit. All of the high voltage input and output connections to this module are made using quick disconnect BNC type connectors. This package makes for quick and easy field serviceability since the entire module can be removed and/or replaced in about one hour, if necessary.

The rectifier module is basically made up of (3) PC boards. Each of these boards contain the 1/3 of the HV diodes needed for rectification of the three DC outputs. Each board also contains one or more portions of the resistor networks required for bleeding down the filter capacitors when the system is off.

8. Output Feed-through Bushings (Item H-N):

Seven HV ceramic bushings are used to bring all of the rectified power out of the tank and into the high voltage junction box. Each of these 18KV CLASS bushings can handle approx. 110amps of current.

9. H.V. Filters & Output Terminals (Items O-S & X):

To meet ripple reduction specifications, each of the four HV outputs is filtered using an LC filter. The L is a DC choke that resides within the oil tank (Item X in Fig.4). This 3H choke is shared between all of the five return legs of each HV output. Each HV output also has capacitance across it with respect to the HV-6 bushing.

10. Current limiting Resistors (9RES)(Item U):

9RES is made up of five 20ohm, 225watt power resistors in series. This 100 ohm string of resistance provides current limiting out of the -38kv output during an arc or fault condition. The resistor string is center taped at the 60/40 ohm point and this point is brought out to the HV JB though an HV bushing. This gives the user the ability to choose whether they want 60 ohms of resistance for Analog use or 100ohms for Digital use. The two -38kv output bushings that the user should choose from are marked HV5-60 & HV5-100.

11. H.V. Transformer (1T) (Item Y):

The main transformer is a three phase Delta / Wye step-up transformer with (3) isolated secondary windings. It has two basic functions. First, it accepts the three phase input power, steps it up to the required high voltage output level needed for rectification, and second, it provides (3) separate isolated outputs. The Primary winding are wound with "belly" type taps that are used to adjust the output voltage using 1RSS.

12. Liquid Level Switch (Item E):

A liquid level switch is provided within the junction box of the tank that monitors the oil level of the main tank. This is a Normally Closed switch that will open if the oil level falls below the minimum allowable operating level. It should be interlocked with the customer's in line contactor so that the unit will shut down upon loss of any oil. Consult the specification sheet attached within this manual to determine the electrical ratings that the switch holds. DO NOT EXCEED switch rating. If necessary, use an auxiliary relay to drive the interlock circuit. If inductive loads are to be switched, the user may want to install an MOV across switch.

13. Door Interlock Switch (Item Z):

The door of the main junction box is interlocked with a switch. This will activate if the door is opened. This switch is a DPST configuration. The switch is designed to be normally closed when the door is closed and opens when the door is opened. One of the switch's poles is wired directly to the customer interface terminal strip. The other is wired in series with one of the poles of the ground stick interlock switch, which is then also wired to the interface terminal strip. (consult the electrical schematic for specific terminal numbers) These switches should be interlocked with the customer's in line contactor so that the unit will shut down if the door is opened prior to the main power being shutdown properly. Consult the specification sheet attached within this

manual to determine which switch you have and the electrical ratings that it holds. DO NOT EXCEED switch rating. If necessary, use an auxiliary relay to drive the interlock circuit. If inductive loads are to be switched, the user may want to install an MOV across switch. The switch also has a trouble shooting feature whereas it can be bypassed by pulling the stem of the switch all the way out.

14. Tank (Item C):

Many of the HV components within this Power Supply are contained in a tank filled with a dielectric cooling fluid. Generally, this fluid is a transformer mineral oil. Check the nameplate on the exterior of the tank wall to be certain which oil type which has been furnished with your supply. This oil contains no PCBs.

Access for inspections and field servicing of the unit is through the lid on top of the tank. If the rectifiers have to be changed out, it can easily be removed through this opening.

Your Power Supply is also equipped with:

- A steel 0.5-13 threaded Ground Boss (with thread protecting plug). It is located on the side of the tank for tank grounding purposes.
- A Pressure Relief Valve, factory set for 4 PSI, to relieve excess pressure in the tank, if needed.
- A Temperature Gauge, calibrated to give proper top oil temperature.
- A Liquid Level Gauge which shows oil level in the tank at 25C.

15. Tank Finish:

Standard paint finish is the NWL WP System, using an industry standard ASA61 gray painted finish. This is a two-component outdoor paint system which NWL has used for more than twenty five years. Surfaces are first treated with an iron phosphate pretreatment (no chromates or lead salts) and then are given between 1.0 and 1.5 mils (DFT) of primer plus the same amount of topcoat thickness. SSPC standards SP-8 and PT-4-64 are met or exceeded.

5

OUTPUT VOLTAGE RATINGS

The nominal output ratings of each of the three outputs of this unit are listed in the below table. These voltages are the nominal voltages based on pulling rated current from each output.

| 1RSS TAP POSITION | OUTPUT (KVDC) | | |
|-------------------|--------------------|-------------|-------------|
| | HV OUTPUT TERMINAL | | |
| | 2 * / ** | 3 * / ** | 5 * / ** |
| 1 | -9.0/-5.10 | -15.0/-8.66 | -30.0/-17.3 |
| 2 | -9.6/-5.54 | -16.0/-9.23 | -32.0/-18.5 |
| 3 | -10.2/-5.89 | -17.0/-9.82 | -34.0/-19.6 |
| 4 | -11.8/-6.24 | -18.0/-11.4 | -36.0/-20.8 |
| 5 | -11.4/-6.58 | -19.0/-11.0 | -38.0/-21.9 |

* Indicates that 2RSS is in position 2 (delta primary)

** Indicates that 2RSS is in position 1 (wye primary)

6

INSTALLING THE UNIT

1. Verify the rating

- The maximum fault capability of the power system at the point of installation should be verified and must not exceed the short-circuit rating of the unit.
- All system accessories such as power cables, breakers, arrestors, etc. should be checked to also verify their ratings capacity.
- Do not exceed the ratings specified on the unit nameplate or system accessories.

2. Check the location

- Check installation area overhead for plumbing condensation, sprinklers or similar possible sources of trouble.
- A clearance of 1/2 inch should be provided between a wall and the rear of the unit for indoor equipment, when rear access is not required
- If rear access is required in either environment, a minimum of 30 inches should be provided.
- A minimum of 48 inches working space should be allowed in front of the unit to accommodate door swing. This minimum should be increased if necessary to accommodate movement around open enclosure doors to comply with applicable codes.

3. Check Area Conditions

- The equipment should not be exposed to corrosive or explosive fumes, dusts, vapors, dripping or standing water, abnormal vibration, shock, tilting, or other abnormal operating conditions.
- The temperature of the ambient air surrounding the power supply should be between the limits of -40C (-40F) and +40C (104F).

NOTE: Temperature or altitude conditions outside of the usual limits may require derating the unit or additional special equipment, such as heating, cooling or ventilation.

4. Prepare the site

- The floor beneath the unit must be level so that the tank is not distorted when bolted in place.
- Ensure the equipment adequately clears any underground raceways or cables.

5. Mount the unit

This is heavy equipment and must be securely anchored to prevent tipping over. Various methods may be used to anchor the unit to the foundation, including expandable inserts or “J” bolts embedded in concrete. The recommended size for anchor bolts is ½” – 13 UNC.

- The unit should be leveled and firmly secured to its supporting foundation. Steel shims may be used for final leveling if necessary.
- Follow the equipment outline drawings to determine the location of the mounting bolt holes and conduit locations.

6. Grounding

The unit must be grounded in accordance with the National Electrical Code (NEC) before making any incoming power connection. If a main ground bus is furnished, make the ground connection to this bus.

If there is no ground bus, all equipment should be connected in such a way as to ensure a continuous grounding path. There must not be a break in the ground wire connecting all equipment to earth ground, unless a ground bus is used as an extension of the wire. This would allow equipment to be removed without breaking the ground.

Special attention should be paid to:

- protection for operating personnel,
- protection of equipment itself, (i.e. such as ground fault relays, if used) and
- protection of sensitive transducers or electronic control devices.

The following may be used as a general guide to equipment grounding in conjunction with NEC recommendations. It specifies which NEC Article applies to grounding for this type of equipment.:

- a. The grounding electrode conductor (ground wire) must be sized in accordance with NEC 250-94 and should be run from the grounding electrode to the power supply's

- grounding bus or ground terminal. See also NEC 250-91 (a) and 250-92 (a).
- b. Unless already done at the factory, a main bonding jumper should be installed from the incoming grounded connector bus (neutral) to the ground bus or designated grounding point. If a jumper is not furnished, one having a size in accordance with NEC 250-79 (c) should be used.
 - c. Steps (a) and (b) should effectively connect together the grounding electrode, the power supply frame, all outgoing equipment grounding conductors and the grounded neutral bus of the system.
 - d. No connection should be made to ground on the load side of any neutral disconnecting line or any sensor used for ground fault protection. No connections should be made between outgoing grounding connectors and the neutral.

Note that this is only a guide. There may be other Codes which apply to grounding. It is up to the installer to ensure that the unit meets all applicable codes.

7. Making LV Power Input Connections

Now that all preparations have been made, it's time to begin connecting your Power Supply to your other equipment.

- The first step is to route cable and wire bundles that enter the enclosure to avoid interference with moving parts. Observe minimum bending radius for the type of cable used
- Then power cables should be braced and/or laced to withstand short circuit forces wherever such cables are unsupported.
- Power cables should be adequately sized to carry the full load current in accordance with NEC requirements, and have an adequate voltage rating.
- Cables should be dressed and terminated as appropriate to the voltage class and cable manufacturer's recommendations.

- Then, replace any access covers, barriers, partitions, etc. that were temporarily removed during installation.

Before proceeding with the installation, familiarize yourself with the electrical schematic.

As a safety precaution, the H.V. capacitors must be grounded during installation wiring of the unit. (see CAPACITOR DISCHARGING & GROUNDING PROCEDURE section of this manual

- Check the power source impedance. For proper IOT operation, the power source impedance should be less than or equal to 2%. The user must also install a Circuit Breaker inline with the power supply. This circuit breaker should be rated for the amount specified in the Specification Sheet which is part of this manual. The instantaneous trip setting should be 10X rated and the interrupting current rating should be a minimum of 25KA at 480VAC.
- A voltage main input is provided. Incoming lines should be connected to terminals X1, X2 and X3. If connecting to an SCR Step/Start, you will still connect to X1, X2, & X3. Follow the instructions supplied per the drawing with the controller.
- The X1-X3 terminals can be equipped with an optional adapter, which will accept bare stranded cable of size #6 to 250MCM. If the user requires a lugged cable connection, connect directly to the 5/8 –11 stud on the input bushings.

*****WHEN CONNECTING TO THE X1-X3 TERMINALS, BE SURE TO TIGHTEN THE TWO NUTS AGAINST EACH OTHER TO PREVENT OVER-TORQUEING THE STUD. FAILURE TO OBSERVE THIS PRECAUTION COULD CAUSE BREAKING OF THE EPOXY BUSHING AND ALLOW OIL TO LEAK FROM THE TANK. FAILURE TO OBSERVE THIS METHOD WILL VOID THE WARRANTY.**

- Connect a low impedance ground to the Power Supply, as per the GROUNDING section.

8. Making HV Output Connections

- The user will be connecting a total of (3) HV cables from their load to the power supply. The HV cable should be designed for a minimum of 45KVDC working voltage. The components within the HV junction box have been designed with the intent that the user enter the box from either the lower right hand side of the junction box or the lower left hand side. Each of the fiberglass boards containing the resistors and capacitors are all mounted on top of HV Glass isolation bushings to minimize corona. The (3) HV cables can lay underneath them. The user must provide the cutout in the side of the tank.
- The HV connection to for the -38kv output should be terminated directly to the -38kv bushing (Item P in Fig.3). The low end positive return from the -38kv cable should be terminated directly to the 1/4-20 brass bolt terminal at the bottom of the resistor board labeled "-38KV Return" (Item S in Fig.3).
- HV connections to the -11.4kv & -19kv outputs should be made directly to the 1/4-20 brass bolt terminals at the bottom of the output boards (Items R & Q in Fig.3). The positive return from the -11.4kv & -19kv outputs will automatically be through the -38kv HV cable.
- Special precaution must be taken when terminating, handling and routing high voltage leads, so as to ensure sufficient voltage clearances.
- Check to see that no components in the junction box have sustained any transportation damage.

ALWAYS GROUND THE HIGH VOLTAGE BUSHING AND CAPACITORS WITH THE GROUND STICK WHEN SERVICING THIS EQUIPMENT (see CAPACITOR DISCHARGING & GROUNDING PROCEDURE section of this manual)

HIGH VOLTAGE POTENTIALS MAY BE PRESENT. LEAVE THE STICK CONNECTED TO THE HIGH VOLTAGE CAPACITORS WHILE CONNECTING THE UNIT OR SERVICING IT.

WHEN SERVICE IS TO BE PERFORMED IN OTHER AREAS NOT SPECIFICALLY MENTIONED ABOVE, MAKE SURE ELECTRICAL COMPONENTS ARE PROPERLY DISCHARGED.

9. Interlocks:

It is important to remember to wire all of the interlocks provided with the power supply into the primary switch gear for safety. These include the door interlock switch, the oil level interlock switch, and the grounding stick interlock switch. Be sure to check the ratings of these switches per the specification sheet within this manual for the maximum ratings. Some switches may require additional relay slaving to handle the load requirements for your particular circuit. See section 4 of this manual for more information on the interlock switches.

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STARTING THE POWER SUPPLY

Check List:

After installation but before energizing the Power Supply for the first time:

1. *Check connections.* Although the equipment and devices have been completely tested at the factory, a final field check should be made.

2. *Double-check the following:*

Make sure that all LV & HV electrical wiring connections are correct and have not become loose in transportation.

Make sure that all blocks or other temporary braces used for shipment have been removed.

Make sure that all metal chips, scrap wire and other debris left over from installation have been cleaned out before closing the door.

Make sure the enclosure is cleaned with a lint-free brush or a vacuum cleaner if there is an appreciable accumulation of dust or dirt.

Make sure that no wires are pinched and that all enclosure parts are properly aligned and tightened when the covers are installed.

Make sure you have a supply of spare parts, fuses etc. on hand before start up.

Wiring Check:

Check field wiring for clearance to live busses and physical security to withstand effects of fault current.

Check all grounding connections.

Record any changes made to circuit diagrams during installation.

NOW, remove the ground stick from the H.V. capacitors and replace it in its holder, thus actuating one of the two safety locks. The other is actuated when the junction box door is closed and secured.

YOU MAY NOW ENERGIZE THE UNIT by applying the 3PH 480VAC power to the bushings.

1. Step Start Controller

A step start controller can be used to provide control to the front end of this power supply. The step start controller reduces transformer inrush current and output voltage overshoot on power turn-on by the use of a series current limit resistor in line with the incoming power. After turn-on, these resistors are switched off-line, allowing full power to the primary of the power supply.

2. Special Start-Up Procedure (For units with replaced oil)

If possible, energize the power supply with a variac at half the rated input voltage for a period of 4 hours. If a variac is not available with the transmitter, set the power supply tap switch on the lowest tap setting and energize the power supply at rated input voltage for 4 hours. This process is necessary to drive any moisture or air bubbles out of the high voltage transformer coils. You may hear some faint intermittent ticking noises from inside the tank during the first hour of this process. If the ticking noise becomes louder or more repetitive, shut down the power supply and call NWL Service.

Tap Switch Selection:

This power supply is equipped with (2) output tap selector switches as explained in section 4 of this manual. **These switches are to only be operated in the DE-ENERGIZED state of the power supply.** The switches allow the user to raise and lower the

voltage of each of the (3) outputs. (see the "OUTPUT VOLTAGE RATINGS" section in this manual for output tap voltages) To change the output voltage, operate either switch as follows:

- 1) Turn off all power to the supply.
- 2) Remove the cover or open the door to the junction box.
- 3) Ground the capacitors using the grounding wand supplied per the procedure outlined in this manual.
- 4) Loosen the 1/4" locking screw on the handle of the switch.
- 5) Twist the handle of the switch to the desired tap position. Make sure the switch mechanism seats properly into position.
- 6) Tighten the locking screw so that the tap switch cannot be moved.
- 7) Replace the grounding wand back into its holder.
- 8) Reenergize the unit.

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CAPACITOR DISCHARGING & GROUNDING PROCEDURE

Whenever installing, servicing or performing general maintenance within the LV or HV junction boxes of the broadcast unit, it is imperative for safety reasons to always verify that the filter capacitors are completely discharged. When fully or partially charged, the capacitors within the unit can be potentially fatal if not handled properly.

Inside the HV junction box, at the lower left hand corner, there is a grounding stick (Item G in Fig.3). This grounding stick consists of a copper hook attached to the end of a non-conducting glass rod. A copper braided cable attaches the Cu. hook directly to chassis ground. By tapping this ground stick to various HV potentials, the user will be able to discharge any potential voltages stored within the capacitors to ground.

An automatic grounding bar mounted on the front edge of the LV junction box shelf will automatically short the -38kv output bushing to ground as soon as the front door is opened. When this happens, any voltage that may be stored within 7 & 8CAP will immediately be discharged through 10RES. This **does not** mean that any energy left within any of the other filter caps will also be discharged. In fact, the other capacitors will remain charged until the internal bleeder resistors discharge them or they are manually discharged using the grounding stick. The main purpose of the automatic grounding bar connecting the -38KV bushing to ground is to provide a path of discharge for 5 & 6CAPs when using the grounding stick. Since the -11.4, & -19KV outputs are all wired so that their common return is the -38KV output (cathode), there is no discharge path unless the -38kv output is grounded. The automatic grounding bar (when connected to the -38kv output bushing) now provides the path required to successfully ground out the caps.

**THE FOLLOWING PROCEDURE
MUST BE USED EVERY TIME
THE JUNCTION BOX DOOR IS
OPENED AND THE USER ENTERS
THE TOP OR BOTTOM!!!**

- Step 1) Open the junction box door.
- Step 2) Remove the grounding stick from its holster.
- Step 3) Tap the copper hook at the end of the glass rod to the HV terminals 5, 3, & 2 (-38, -19 & -11.4kv) located at the bottom of resistor/capacitor boards in the HV junction box. (Items P, Q, & R in fig. 3)
- Step 4) Tap the copper hook at the end of the glass rod to each of the (7) HV bushing in the HV junction box. (Items H-N in fig. 3)
- Step 5) Next, tap the copper hook at the end of the glass rod to the bushing on front & back of each capacitor in the HV junction box.
- Step 6) Finally, use the copper hook at the end of the glass rod to short across each capacitor in the junction box. This will discharge any stray charge that can build up on the capacitor case.
- Step 7) While performing the maintenance, leave the grounding stick hang from the end of the -38kv bushing.

Upon completion, remember to remove the grounding stick and place it back into it's holster. Be sure that the Cu. braided cable on the stick is clear from any HV components prior to closing the door.

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DIELECTRIC FLUID

These power supplies contain a dielectric fluid for cooling and voltage insulation. The fluid is either a transformer mineral oil or a silicone fluid manufactured by Dow Corning identified as their "Silicone #561". These oils contains no PCBs. The type and quantity of fluid is specified on the label attached to the exterior tank wall. The manufacturer and oil type is also identified in the specification sheet in the back of the this manual. **It is imperative that the proper fluid level always be maintained so that the unit is properly cooled and that all high voltage parts remain under the oil.** The oil level can be monitored via the liquid level gauge on the side of the tank. The gauge shows where the oil level should be at 25°C. This gauge should be periodically checked to verify oil level.

1. Filling Instructions:

The unit is properly filled and processed at time of construction. Unless the oil is drained during installation, there should be no need to add oil to the unit. If small amounts of oil need to be added to the unit to bring it up to the fill point, the oil can be introduced through the pressure relief valve opening without having to remove the entire lid. If work has been performed to the unit whereas the lid has been removed, oil can be pumped or poured directly into top of the unit. The oil level should never be lowered lower than to the top of the main transformer coils. If the oil level has been drained lower than to top of the coils or if excessive air bubbles are present after refilling, the unit should be run for 8 hrs at 1/4 input power so as to heat up the unit and allow the air bubbles to work their way to the top while the output voltage remains low.

2. Lid Torque specifications:

If the lid has been removed to either fill the unit with oil or maintain the unit in some other capacity, the lid clamping brackets need to be properly tightened to a specific torque spec. when reassembled. The lid clamping bolts should be tightened as follows:

- a) Hand tighten all lid clamps.
- b) Tighten all lid clamps to 240 in/Lbs in a criss cross pattern, from one side of the lid to the other, similar to that of tightening the wheel lugs on an automobile.

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ROUTINE MAINTENANCE PROCEDURES

*****ALL MAINTENANCE SHOULD BE DONE WITH POWER OFF.*****

The power supply should be inspected and the dielectric oil tested approximately every 6 months.

Cleaning

Remove any foreign matter from bushings, gauges and the tank. Dirt on bushings can cause arcing to ground; dirt on the tank can decrease heat dissipation and cause the unit to overheat. Common household cleansers can be used on grease stains or heavy dirt without harming the unit's finish.

Check Oil Level

Remember, level is indicated at 25C. Make adjustments for the actual ambient temperature. If refilling is needed, use only the type of oil specified on the unit's nameplate. After filling, allow unit to stand for at least 8 hours to allow any entrapped air to escape from the transformer windings. Then excite the transformer at less than 25-50% of rated voltage for at least 1 hour before putting it back into full service.

Check Oil Dielectric Strength

NWL offers test kits for this purpose. Simply take an oil sample and place it in the bottle provided. Send to NWL for Dissolved Gas Analysis (DGA). Take the sample through the gate valve provided for that purpose when the oil is at least as warm as the surrounding air. To take the sample, carefully clean the gate valve opening and allow a pint of oil to run out so that any contamination which may have collected in the valve itself has been cleared. If your unit is not equipped with a gate valve, samples must be taken via the top access panel. Take samples from outdoor units on a clear day only and guard against contamination by wind-blown dust.

Once the DGA test is complete, you will receive a full report on the power supply's internal condition, its estimated life

expectancy, and specific problems detected, plus recommendations for further evaluation if needed.

Check For Carbonization

Do a simple visual inspection of the oil sample taken for DGA testing. Visible carbon can lower the dielectric strength of the oil and create hazards. Carbon is also generally indicative of internal arcing. Carbon-contaminated oil should be purified or replaced even if the dielectric test is acceptable. Purification involves simply removing the oil and filtering it.

Always use the same type of oil for refill as is called for on the unit nameplate. Do not allow a unit to stand without oil as this could cause condensation around components.

RECTIFIER ASSY. (IREC) Replacement

The Rectifier Assy. is mounted vertically to the inside wall of the tank, just below the lid. It is supported by (8) studs on the wall.

If replacement is necessary:

1. Disconnect the (13) electrical terminals (BNC connectors) that connect to the rectifier PC Bds. This disconnects the all the AC input voltages and all the DC output voltages to and from the rectifier.
2. Loosen the four nuts that secure the module to the wall.
3. Remove the rectifier from the oil.

To install a new rectifier module, simply reverse this procedure. The entire process generally takes about 1 hour.

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ABOUT CAPACITORS

HV Capacitor Life

The HV filter capacitors have an operational lifetime expectancy of approximately 10 years, though many last as long as 25 years. Exceeding the maximum operating temperature by 10% or rated voltage by 10% can cut life expectancy in half. Subjecting the capacitor to excessive RMS ripple current can result in immediate failure.

The capacitor's ability to filter ripple voltage will not degrade over time. If the capacitor fails, it is usually abrupt. Failure is accompanied by a loud noise and case swelling. Capacitors normally fail in the shorted mode and the follow-up energy tends to open circuit the internal lead connection.

In many cases of capacitor failure, the device builds up internal pressure from high temperatures and/or internal arcing. This will cause the case to bulge out, thus providing a good indication the capacitor is damaged or severely stressed. The bulging may affect the whole case evenly or only a certain area, depending on the type of failure.

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WARRANTEE STATEMENT

WARRANTIES & GUARANTEES

NWL agrees to correct any defect in material and workmanship of any equipment furnished by it to purchaser which may develop under normal and proper use (corrosions excepted) within the quoted warranty period of said equipment by repairing the defective part or parts or by replacing the same f.o.b. place of manufacture; provided, however, that any equipment not of NWL's design or manufacture is sold only under regular guarantee and responsibility of the maker and is guaranteed by NWL only to such extent.

NWL Guarantee is conditioned upon the following:

- a. That purchaser provide the Normal Operating conditions for said equipment. If applicable, control setting data as outlined in operator's manual must be submitted to NWL within two (2) weeks after first energization.
- b. This warranty is predicated on the basis that any storage will be sheltered from the elements in a cool and dry location, handling being such that equipment is in first-class condition prior to start-up, and will be used within its specified design limits. Failure to meet these requirements will void warranty in its entirety.

NWL will not be liable for any charges incurred by Purchaser or for its account in correcting defects or making changes in the equipment to conform to this agreement, unless NWL is given reasonable time to inspect and correct such defects or make the necessary changes. Any repairs or changes not authorized by NWL in writing voids the warranty.

NWL will not be liable for any consequential or special damages, loss or expense arising in connection with the use of, or inability to use, its equipment for any purpose whatsoever. NWL's liability, under no circumstances, will exceed the contract price for the goods returned as defective or unsuitable.

THE FOREGOING ARE NWL'S SOLE WARRANTIES AND GUARANTEES WITH RESPECT TO THE EQUIPMENT TO BE FURNISHED UNDER THIS PROPOSAL. NWL MAKES NO OTHER WARRANTIES OR GUARANTEES OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED: AND IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (WHICH EXCEED THE ABOVE OBLIGATIONS AND SPECIFICATIONS AS QUOTED) ARE HEREBY DISCLAIMED BY NWL AND EXCLUDED

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UNIT SPECIFICATION SHEET

Model #19638

ELECTRICAL SPECIFICATIONS:

KVA Rating ----- 80KVA max
 KW output rating ----- 70KW max
 Rated input voltage ----- 480 VAC, 3PH, 60Hz.
 Rated input current ----- 97Amps Max.
 Short circuit Impedance ----- 4.5%
 Output Voltage:

OUTPUT (KVDC)

| 1RSS TAP POSITION | HV OUTPUT TERMINAL | | |
|-------------------|--------------------|-------------|-------------|
| | 2 * / ** | 3 * / ** | 5 * / ** |
| 1 | -9.0/-5.10 | -15.0/-8.66 | -30.0/-17.3 |
| 2 | -9.6/-5.54 | -16.0/-9.23 | -32.0/-18.5 |
| 3 | -10.2/-5.89 | -17.0/-9.82 | -34.0/-19.6 |
| 4 | -11.8/-6.24 | -18.0/-11.4 | -36.0/-20.8 |
| 5 | -11.4/-6.58 | -19.0/-11.0 | -38.0/-21.9 |

* Indicates that 2RSS is in position 2 (delta primary)

** Indicates that 2RSS is in position 1 (wye primary)

Output Current:

NOMINAL OUTPUT CURRENT (ADC)

| 2 | 3 | 5 |
|-----|-----|-----|
| .75 | 1.3 | 1.0 |

Note: Maximum total return current not to exceed 2.8ADC.

Regulation No load to Full load ----- <5.8%
 Inrush Current ----- 25X max.
 Maximum Relative Humidity ----- 95%
 Maximum permissible altitude ----- 10,000 ft
 Output Voltage Ripple ----- 60dB max.
 Power factor ----- .92 min.
 Efficiency ----- .95 min.
 Minimum operating temperature ----- -40° C
 Maximum operating temperature ----- +40° C
 Maximum Oil temperature rise ----- 55° C
 Maximum Oil level switch rating ----- 0-30v ----.4AAC or .3ADC
 120v ----.17AAC or .13ADC
 240v ----.08AAC or .06ADC
 Maximum Grounding switch rating ----- 15A @ 125 & 250 VAC
 Maximum Door interlock switch rating ----- 15A @ 125 & 250 VAC
 .25A @ 250 VDC
 .50A @ 125 VDC

PHYSICAL SPECIFICATIONS:

| | |
|----------------------------------|--|
| Weight ----- | 4400 lbs |
| Oil type ----- | Cross Grade 206® mineral oil |
| Volume of oil ----- | 215gal. |
| Maximum outside dimensions ----- | 47W x 62.5D x 68.25H |
| Maximum floor loading ----- | 203 pound per sq/ft |
| Color ----- | ASA 61 industrial Grey |
| Input termination ----- | 5/8"-11 copper stud on three LV input bushings |
| Output termination ----- | 7/16" Eyebolt on top of HV Bushing, & 1/4-20 bolts |
| Safety Ground termination ----- | 1/2"-13 S.S. ground boss at foot of tank |
| Min. Ground wire size ----- | 8AWG Cu. per NEC, section 250 |
| Recommended CB Size ----- | 125A, 10x on inst. trip, 25KA interrupting min. |
| Recognized Certifications ----- | none |

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RECOMMENDED SPARE PARTS LIST

The following is a list of recommended spare parts that should be on hand during startup and operation of the Step Start unit.

| Item Description | NWL PART# | Recommended QTY | Price per pc. |
|-------------------------------------|------------------|------------------------|----------------------|
| 3-Output FWB Rectifier/Bleeder Bd. | G31XBCXE | 1 | Call for price |
| Pressure Relief Valve | H12108 | 1 | Call for price |
| Liquid Level Gauge | H12129 | 1 | Call for price |
| Temperature Gauge | H12104 | 1 | Call for price |
| Drain Valve | H90337 | 1 | Call for price |
| 20ohm, 225watt Resistor | H16848 | 2 | Call for price |
| 100ohm, 225watt Resistor | H16220 | 1 | Call for price |
| .125uF Capacitor | 117206 | 2 | Call for price |
| HV Bushing, 18kv class, 7/16 eyelet | H15117 | 1 | Call for price |
| Door gasket | H88067 | 15ft | Call for price |
| Primary snubber board assembly | G40301 | 1 | Call for price |
| Oil Level Switch, .5"NPT, SPST | H99262 | 1 | Call for price |
| Door Limit switch | H98087 | 1 | Call for price |
| Input Bushing, X-Mount, 5/8" stud | H15119 | 1 | Call for price |
| GasP Oil Sample Kit | 41345 | 1 | Call for price |

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SUPPLEMENTS

| | |
|----------------------------------|---------|
| System Electrical Schematic..... | B119640 |
| Physical Outline | C119638 |

