

2006A/2002A/2004A
Operating and Maintenance Manual

VHF/UHF LINEAR
COMMUNICATION AMPLIFIERS

HENRY RADIO, INC.

2050 S. Bundy Drive Los Angeles, CA 90025 USA 310-820-1234 310-826-7790 fax

LIMITED WARRANTY: Henry Radio warrants each new product to be free from defective material and workmanship. Henry Radio agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit which under normal installation, use, and service discloses such defect. The equipment or part must be delivered by the original owner to us intact for our examination, with all transportation charges prepaid to our factory, within 1 year from the date of sale to the original purchaser. Provided that our evaluation discloses, in our judgement, such a defect, Henry Radio will repair at no charge, or replace at their discretion, such defective part or equipment.

EXCLUSIONS: Henry Radio does not warrant any vacuum tube used in their equipment. These are warranted by the tube manufacturer. Warranty claims must include proof of the date of purchase. The warranty does not extend to damage or failure caused by transportation damage, misuse, neglect, accident, incorrect installation, acts of nature, or to equipment modified or repaired without our prior approval.

This warranty does not include incidental or consequential damages and the Henry Radio warranty disclaims any liability for any such damage. All implied warranties, if any, are limited in duration to the above stated 1 year.

Henry Radio reserves the right to make any improvements to its products which it may deem desirable without obligation to install such improvements in its previously sold products.

Radio Frequency Interference Statement

Manufacturer's Instructions

The operator must observe the following precautions in installing and operating this unit:

1. Operate the equipment in strict accordance with the manufacturer's instructions.
2. Plug the unit into a grounded wall outlet with the AC cord supplied with the unit without modification.
3. Always operate the unit with all factory installed covers in place.
4. Never modify the equipment in any way that would affect its specifications.
5. Always maintain the equipment in a satisfactory state of repair
6. Use a quality shielded RF coax cable on the input and output of the equipment.

User's Responsibility

The user has the ultimate responsibility to correct any problem arising from harmful radio frequency interference from equipment under his control. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one of the following measures. All of these responsibilities and any others not mentioned are exclusively at the expense of the user.

** Change the orientation of the receiving device antenna. ** Change the orientation of the transmitting equipment ** Change the location of the equipment ** Change the equipment power source.

If these attempts are unsuccessful, install one or all of the following devices: *** Line isolation transformer *** Line filters *** Electromagnetic shielding *** Input/Output filters.

If necessary, the operator should consult the dealer, or an experienced radio/television technician for added suggestions. The user may bind the following book, prepared by the Federal Communications Commission, to be helpful: "How to Identify and Resolve Radio-TV Interference Problems". The book is available from the U.S. Government Printing Office - Stock Number 004-000-00345-5.

Note: The operator of equipment causing RFI may be required to stop operating his equipment upon finding that the device is causing harmful interference and it is in the public interest to stop operation until the problem is corrected.

The Importance of Amplifier Tuning

A grounded grid linear amplifier should be tuned so that most of the electrons emitted by the cathode reach the anode circuit. Electrons that fail to reach the anode are lost to grid current. This condition occurs when the amplifier is loaded too lightly - the result of setting the loading capacitor for too much capacitance during tune-up. As grid current rises and fewer electrons reach the anode, distortion increases and output power decreases. Thus, a triode amplifier can be tuned up with fair accuracy by simply applying maximum drive power and quickly adjusting the amplifier's TUNE and LOAD controls for maximum power output. After the amplifier has been tuned for maximum output, a slight increase in linearity can usually be secured by increasing the amplifier loading - that is, by decreasing the loading capacitance - until output power decreases by a few percent. Note, however, that this small improvement in linearity is seldom detectable in practice because the IMD performance of tube amplifiers is usually significantly better than the IMD performance of the bipolar-transistor-output transceivers commonly used nowadays as exciters.

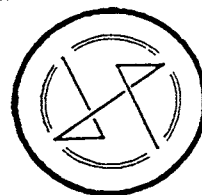
Electrons are negatively charged. Positive charges attract them. The more positive the charge, the stronger the attraction. The 0-V potential of a grounded control grid is more positive than the negative charge of an electron leaving the cathode of a vacuum tube. This causes excessive current to flow in the control-grid circuit unless the tube anode is substantially more positive than the control grid throughout the anode-voltage cycle.

The output of a grounded-grid RF amplifier tube appears at the tube anode as RF AC superimposed on the DC anode supply. As a rule of thumb, successful attraction of most of the cathode's electrons requires that the instantaneous anode voltage not fall below about +200 to +300 V (relative to the grounded grid) during the lowest point of its downward voltage swing (that is, during the anode-current peak). Loading the amplifier too lightly - that is, adjusting the amplifier LOAD control for too much loading capacitance - causes the minimum anode voltage to fall below this level. The result is a dramatic increase in grid current and distortion, and a reduction in peak power output. Loading the amplifier too heavily - insufficient loading capacitance - also causes the output power to decrease because the amplifier output network is not adjusted to the impedance-transformation ratio necessary for maximum power transfer between the amplifier and its load.

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HENRY RADIO, INC.

2050 S. Bundy Drive Los Angeles, CA 90025 USA
800-877-7979 310-820-1234 310-826-7790 (Fax)
E-mail: henryradio@earthlink.net



Section 1. Henry 2006A/2002A/2004A Specifications

- Type and Function of Equipment: The 2006A/2002A/2004A are a series of VHF and UHF desk top linear amplifiers capable of transmitting with 1000 watts PEP output the bands described below.
- Type of Emission: SSB, AM, CW FM, RTTY or pulse.
- Output Power: 1000 watts PEP SSB.
2000 watts short pulse.
600 watts FM.
400 watts continuous carrier.
- Gain: 20 times input (2006A and 2002A). 10 times input (2004A)
- Drive Power: 50 watts maximum.
- Frequency Range: 2006A - 50-54 MHz nominal, 4 MHz between 30-100 MHz special.
2002A - 144-158 MHz nominal, 6 MHz between 100-300 MHz special.
2004A - 430-440 MHz nominal, 10 MHz between 300-500 MHz special.
- Tube Complement: 3CX800A7 ceramic triode.
- Duty Cycle: Continuous duty at rated output.
- Dimensions: 9.5" high x 17.25" wide x 19.75" deep.
- Weight: 75 pounds, 85 pounds shipping weight.
- Cooling: Forced air cooling built in.
- AC Mains: 3 wire, 110 or 220 VAC, 50/60 Hz, 25/12 amp.
Note: Any amplifier can be manufactured 2 wire 220VAC operation - but you must specify your requirement at the time of order.
- Input/Output Impedance: 50 ohms unbalanced.
- Noise Level: 40 dB down nominal below one tone carrier at 1KW output.
- Metering: Plate Current Meter, Multimeter - Grid Current, HV.
- Harmonic/Spurious Output: Better than 60 dB down on harmonics. 3rd Order IMD better than 35 dB down.
- Controls: Band Switch, Multimeter Switch, Tune and Load Controls, Forward/Reflected Switch, Circuit Breaker On/Off, Band Switch.
- RF Connectors: BNC Input, N Output.
- Other Connectors: Relay Control (RCA).
- Relay Keying: Each amplifier requires a shorting relay contact to ground during transmit, 12 VDC at approximately 300 ma.
- Protection Circuits: HV shorting switch, circuit breaker, cathode fuse.
- Plate Voltage: SSB: 2200 to 2600 VDC (depends on AC line voltage).
FM: 1800 to 220 VDC.
- Antenna Relay: Built-in DC relay system.
- Options: RF sensing relay box, external wattmeters.
- Power Supply: Full bridge rectifier with electrolytic filter capacitor.
- Cabinetry: All aluminum cabinetry with double shielded RF chassis.
- Tank Circuit: Pi-L type with silver flashed components
- Warranty: 1 year.
Made in the U.S.A.

Section 2: Introduction

The 2006A, 2002A and 2004A are a family of high quality, desk model, single stage linear RF amplifiers using an Eimac ceramic triode power tube. All models employ the same grounded grid design to insure simplicity of concept and all employ conservatively rated components to insure years of reliable operation. The amplifiers are completely self-contained and use the highest quality RF, DC and AC components available today. All that is necessary for operation is a transceiver, an AC mains source and a 50 ohm antenna system.

The 2006A offers about 13 dB of power gain (the output power is approximately 20 times the input power). This makes it easy to drive to full output with most popular low power solid state transceivers. It will delivery 1000 watts PEP and 600 watts FM into a 50 ohm load. This amplifier uses a traditional Pi output tank circuit.

The 2002A also offers about 13 dB of power gain (the output power is approximately 20 times the input power). This model uses a 1/4 wave strip-line and a low pass output filter.

The 2004A offers approximately 10 dB of power gain (the output power is approximately 10 times the input power). The 2004 uses a 1/2 wave strip-line and a tuned stripline output filter.

These three models can be used for amateur, industrial, scientific, medical, commercial and export users at the selected band between 50 and 500 MHz.

All models are designed around the same basic RF chassis which employs a grounded grid design with silver flashed RF components. All models can be used for AM, FM, SSB, CW RTTY or pulse operation.

Please read the instruction manual carefully before operating your new equipment. Power amplifiers, particularly at this power level and frequency, can easily be damaged by improper operation. The amplifiers are shipped completely assembled with the tubes installed and are ready for use after the installation of an appropriate power plug.

For proper operation of these amplifiers you will require a Bird or equivalent power meter capable of measuring up to 1000 watts in the appropriate frequency range. Such equipment is not supplied with the amplifier.

Please carefully observe the following precautions at all times when you are using this equipment.

CAUTION: Please read the instruction manual carefully before operating your new equipment. Your amplifier can be damaged by operating it out of resonance!

CAUTION: There are dangerous high voltages present inside the amplifier when it is plugged in and turned on! Never remove the equipment covers when the amplifier is plugged into its AC source!

CAUTION: Always exercise extreme caution when servicing any amplifier. Henry Radio recommends that any servicing be performed by returning your unit to the factory!

CAUTION: The voltages from the high voltage power supply can be **LETHAL!** Always unplug the amplifier and turn off the circuit breaker before working inside the cabinet of your amplifier.

NOTE: The 3CX800A7 is a high gain tube capable of almost 16 dB of gain under certain conditions. Because of these characteristics, the tube can easily be driven beyond its specifications. The maximum tube parameter specifications are as follows:

Grid Current: 40 ma maximum.
Plate Current: 800 ma (SSB)
600 ma (FM).

If you exceed these parameters, the tube can be damaged and this damage may not be covered by the tube's warranty.

Section 3: Installation

Section 3.1: UNPACKING

When you first receive your amplifier, you must carefully inspect the box for shipping damage. If you see any shipping damage, save the box and packing material, and notify the transportation company immediately. In any case it is a good idea to save the box and packing material because they are expensive to replace, and are useful in protecting the amplifier should you ever decide to ship it or move it to another location.

Remove the amplifier from its box. All amplifiers are shipped less a power plug on the AC cable. A power plug that mates with the AC socket at the operating location must be properly installed as described in Section 3.3 before the unit can be operated. The amplifier is completely assembled at the factory, and it is shipped with the tube installed.

The following accessories should be included with your amplifier:

- 1 Instruction Manual and warranty card
- 1 RCA-RCA Cable (Relay)
- 1 RF drive cable (RG58)
- 1 Set spare 3 AG 1.5 amp fuses
- 1 N male coax connector.

Section 3.2: OPERATING LOCATION

The amplifier may be located wherever you wish provided there is a proper AC mains supply and provisions for adequate air flow from the bottom of the amplifier chassis up through the top of the amplifier. Do not restrict the air flow of the amplifier, and never place it too close to a wall that might restrict the airflow into the unit. A location which avoids environmental extremes of temperature, humidity, and dust will keep your amplifier looking and running like new for many years of reliable operation.

SECTION 3.3: CABLING.

All of the following cables must be connected before operation of your amplifier:

POWER CABLE - The amplifier is equipped with an AC power cable that is factory wired to accept either 115 or 230 VAC, 2 wire, 50 or 60 Hz, single phase power unless special instructions were given at the time you ordered your amplifier. A factory modification is required for 2 wire European power operation.

The green wire (ground) is not counted in the standard definition of power wiring, hence the 2 wire designation earlier. (2 wire European operation does not have a ground wire.) The three wires in the power cable are black, white, and green. The green wire is chassis ground and the neutral on all 230 VAC single phase plugs. The black and white wires connect to the hot 230 VAC circuits. A power plug is not provided because there are many different types of 230 VAC outlets. We suggest that you consult with your local electrician about proper installation of your plug.

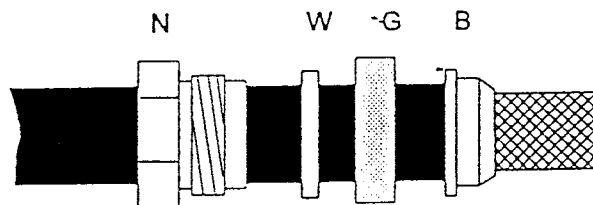
CAUTION: The amplifier will be damaged if the green wire is connected to the 230 VAC terminal! Always make sure that the green wire is connected to the neutral terminal!

ANTENNA COAX - You must select a 50 ohm coax cable for connection of your amplifier to your antenna system. This choice will depend on the desired operating power of the amplifier. At a minimum you should select RG213 type coax. For 440 MHz operation, heliax or teflon coax will probably be required.

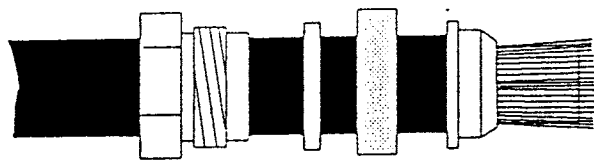
An N type connector is included in the accessory kit. Prepare the cable as shown in Figure 1 below. The N connector mates with the coax jack marked OUTPUT on the rear panel of the amplifier (Female N jack).



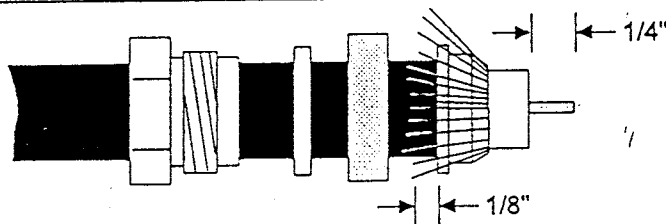
Cut off the end of the cable as straight and squarely as possible. Strip the vinyl jacket back 5/8 of an inch.



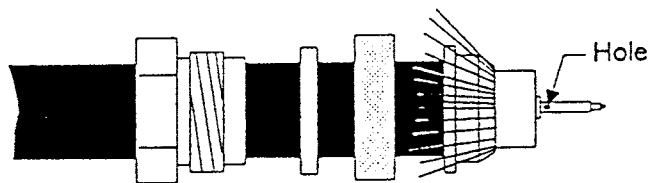
Slide the nut (N), washer (W), gasket (G) and clamp bushing (B) over the braid and jacket.



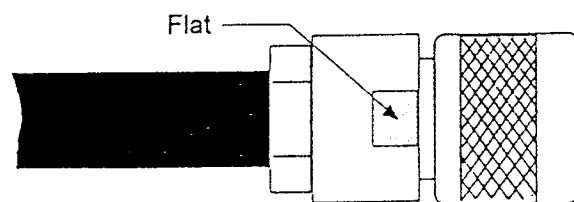
Comb out the braid back to the jacket.



Fold the braid back over the bushing, and trim the dielectric back 1/4 inch from the end of the cable. Trim the braid to 1/8 inch length behind the bushing.



Tin the center conductor, slide the center pin over the center conductor and add solder through the hole. The shoulder of the pin should rest against the dielectric.



Press the plug body over the center pin. Slide the gasket, washer and nut into the plug body. Screw the nut into the plug body and tighten the nut. NOTE: There are flats on the plug body for gripping with a second wrench while tightening the nut.

Figure 3.1. Connector Installation.

CAUTION: Never operate your amplifier unless it is connected to a matching antenna or a 50 ohm dummy load! Your antenna, coax, or load must be capable of handling the RF output of your amplifier.

You will damage the equipment if you operate the

amplifier into a load with an SWR of greater than 2.0:1, (a reflected power greater than 10% of the forward power). To properly measure your load SWR and to tune your amplifier you will need an appropriate wattmeter in the input and output lines to monitor your drive and output power.

The safest way to measure the SWR of your load (antenna or dummy load) is to use just your transceiver power.

DRIVE CABLE: An RG58/U drive cable is supplied with the amplifier. Connect the BNC end of the cable into the RF INPUT connector on the rear panel of the amplifier. The other end has a PL259 connector designed to plug into your transceiver. An adapter will be required if your transceiver does not have a matching SO239 output connector. An SWR meter is required in the drive line to properly adjust the input tuning and drive level of the amplifier.

RELAY CABLE: A shielded cable with RCA connectors is supplied to connect the relay signal between the transceiver and controller. This cable conducts the keying signal from the transceiver to switch the amplifier to the transmit condition and must be connected to the socket marked ANTENNA RELAY or ACCESSORY on the transceiver. The transceiver needs to supply a shorting relay contact, grounded during transmit to key the amplifier. Most modern transceivers use DIN type plugs, while older transceivers use RCA type jacks. It may be necessary to solder the cable to a DIN plug for this function. If you are using a transceiver with no relay control provisions, you must key the amplifier with an optional RF sensing relay box, or with an external foot switch. Check the transceiver's manual to see if it has relay switching provisions.

CAUTION: Never apply any voltage to the amplifier's relay control jack. It has a built-in relay supply which provides the necessary voltage. You can damage the amplifier by applying voltage to this jack!

GROUND: The amplifier has a ground stud on the back panel. We suggest that you connect a solid earth ground to the unit to prevent any shock hazard from the equipment, and to minimize RF radiation/interference.

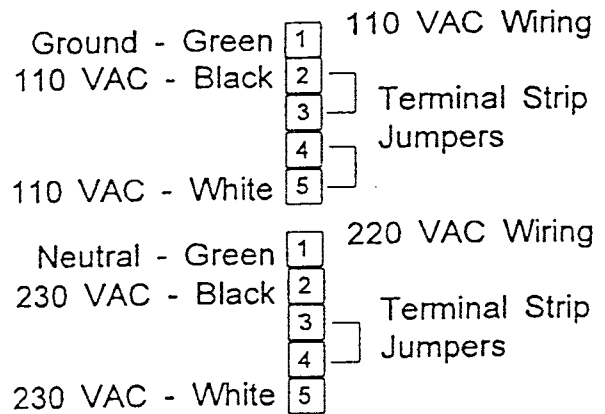


Figure 3.2 AC Line Voltage Connections. (Terminal strip accessed on back panel.)

SECTION 3.4 TRANSFORMER TAPS.

HIGH VOLTAGE/FILAMENT TRANSFORMER: These amplifiers are supplied with an ECA 1202A HV/Filament transformer. This transformer can be factory wired for 100/110/120/200/220/240 VAC operation, with the actual primary voltage being selectable by the proper tapping of the terminal strip on the transformer. The proper taps for the transformer is shown in Figure 3.3. The transformer must be tapped for the correct AC mains line voltage for proper performance and optimum tube life.

RELAY SUPPLY TRANSFORMER: The relay power supply transformers do not have variable taps at their input, and experience has shown that even under worst case conditions, there is sufficient voltage to activate the relays.

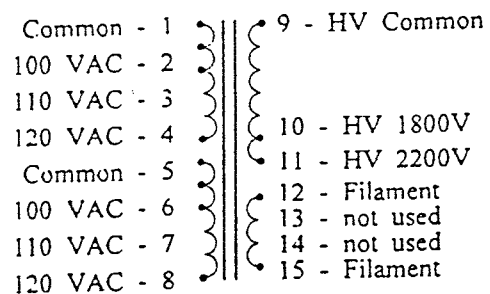


Figure 3.3 ECA 1202A Tap Drawing.

Section 4: Operating Controls

SECTION 4.1: FRONT PANEL CONTROLS

POWER SWITCH: This circuit breaker is used to turn the AC power on and off. When the power is turned off, the output of the transceiver feeds through the amplifier, directly to the load.

FUNCTION SWITCH: This push-button switch selects the function of the multimeter, and puts the amplifier into the STANDBY mode. When the amplifier is in standby, the output of the transceiver feeds through the amplifier, directly to the load.

MULTIMETER: The multimeter reads two different tube parameters, depending on the position of the FUNCTION switch, as follows:

Grid Current (IG): 0 to 40 ma
High Voltage (HV): 0 to 4,000 VDC

PLATE CURRENT METER: This meter continuously monitors the plate current of the amplifier tube on a 0 to 1 amp scale.

SSB/FM SWITCH: This two-position rotary switch selects between two taps on the high voltage transformer to assure correct loading and output for each type of emission. The FM position can be used for CW, FM, RTTY, or AM operation. It is also used for tuneup for SSB service. The unit can be damaged if the higher plate voltage in the SSB position is used for these other modes, or for tuneup. NEVER turn this switch while the amplifier is keyed. You will damage the switch!

STANDBY LIGHT: The yellow standby light is lighted when the amplifier is on and the FUNCTION switch is in the standby position. This light will not come on until the warmup relay has gone through its two minute cycle.

POWER LIGHT: The red power light is lighted when the amplifier is turned on and the FUNCTION switch is in the operate position. This light will not come on until the warmup relay has gone through its two minute cycle. The unit can not be keyed until this light comes on.

OUTPUT TUNE CONTROL: This rotary control adjusts the tank circuit to resonance at the operating frequency. The calibrations on the front panel can be used as a guide for setting the control.

INPUT TUNE CONTROL (2002A/2004A): This rotary control adjusts the input circuit of the amplifier to resonance at the operating frequency. The calibrations on the front panel can be used as a guide for setting the control. An SWR/Wattmeter is required in the drive line from the exciter to adjust this control.

LOAD CONTROL (2006A): This control matches the amplifier's output network to the antenna. A load setting of zero corresponds to a minimum loading (minimum capacitance) and a load setting of 100 corresponds to maximum loading (maximum capacitance).

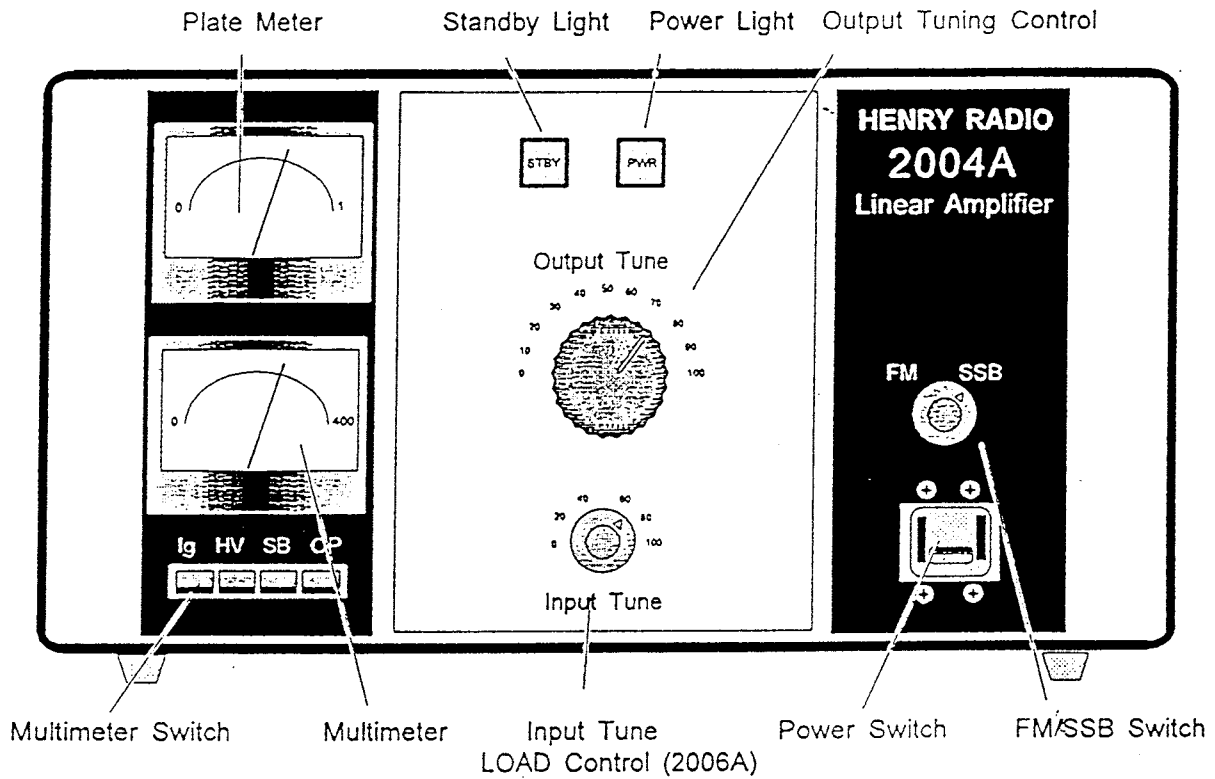
SECTION 4.2 REAR PANEL CONTROLS AND JACKS

INPUT CONNECTOR: The input connector is a female BNC type coax connector which accepts the drive cable from the transceiver. The amplifier has an adjustable input circuit which can be resonated to the operating frequency.

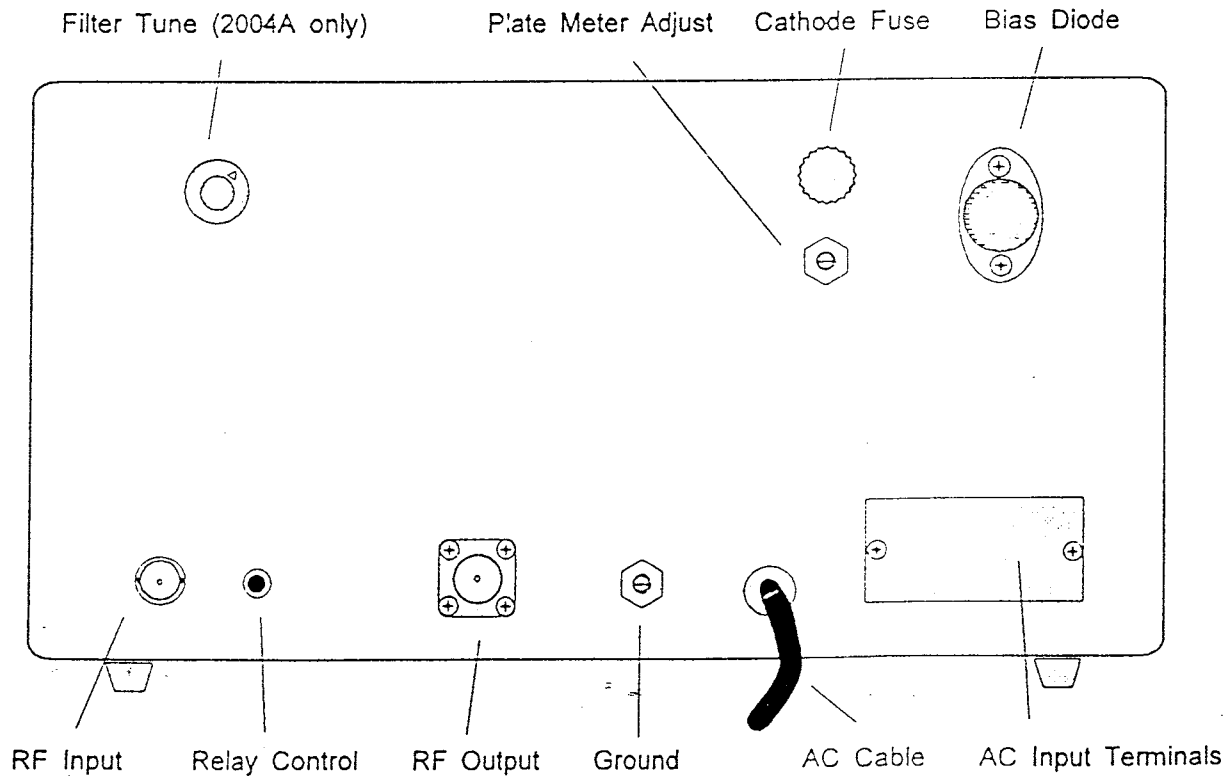
RELAY CONTROL JACK: The RELAY CONTROL jack accepts an RCA type plug (a relay cable is supplied). When the socket is shorted to ground the amplifier's antenna relay closes. If the amplifier is turned off, or in the standby mode, the relay will not key. NEVER apply voltage to this socket. The voltage in the relay circuit is nominally 12 VDC.

OUTPUT CONNECTOR: The output connector is a type N female type coax connector. The nominal output impedance of the amplifier is 50 ohms. NEVER operate the amplifier without a load, or into a load with an SWR higher than 2:1 (the reflected power greater than 10% of the forward power). Use only high quality 50 ohm coax cable which is rated at 500 watts or more continuous at your operating frequency. An

2006A/2002A/2004A Front Panel Controls



2006A/2002A/2004A Rear Panel Controls



SWR/wattmeter must be installed in the output line to properly tune the amplifier.

GROUND LUG: Connect a good earth ground to your amplifier to insure safety and minimize radio frequency interference.

POWER CORD: The power cord must be connected to an appropriate power source as discussed in the installation section. No plug is provided on the 10 foot cord. Be certain the power transformer is jumpered correctly for the desired AC mains voltage before connecting the plug. All amplifiers are factory wired for 230 VAC, single phase, 3 wire systems unless otherwise specified.

AC POWER TERMINAL BOARD: The terminal board is located behind a screw off cover on the rear panel. Connect the jumpers on this strip for the desired AC voltage as shown in Figure 3.2. For 230 VAC operation, jumper pins 3 and 4. For 115 VAC operation, jumper pins 2 and 3 and pins 4 and 5.

FILTER TUNE CONTROL (2004A Only): This rotary control resonates the strip-line output filter to the operating frequency. The filter has a bandwidth of about 400 KHz, so once it is tuned, the amplifier can be operated approximately plus or minus 200 KHz from the center frequency without retuning.

PLATE METER ADJUST CONTROL: This potentiometer is factory adjusted before shipment and should not require any adjustment. A special high voltage ammeter is required to adjust the circuit.

3AG, 1.5 AMP FUSE: This fuse protects the cathode circuit from overload or short circuit. Never replace the fuse with one of greater current rating.

BIAS DIODE: This is the bias diode for the final tube.

SECTION 4.3 INTERNAL CONTROLS

LOAD CONTROL (2002A/2004A): This a screw-driver adjust control located on the top of the RF section of the amplifier. To access this control you must remove the top perforated screen of the cabinet by unscrewing the four screws in the cover of the top screen. This control matches the output of the amplifier to your antenna and most likely will require adjustment only when the amplifier is installed at its operating location, or when you change your antenna.

CAUTION: This adjustment is made with the high voltage on, so you must exercise extreme caution to avoid the 2000 VDC plate voltage!

INPUT TUNING (2006A): The input tuning is adjustable from the back panel of the RF chassis. It is set at the factory. It also can only be adjusted with the high voltage turned on, so should not be attempted in the field.

Section 5. Operation

SECTION 5.1: SET-UP

Connect all of the necessary cables as described. Turn the amplifier on and set the SSB/FM switch to the FM position. The blower should come on immediately. Push the standby button on the function switch to put the amplifier in the standby mode. The built-in warmup relay will switch voltage to the pilot lights and relay circuit after 2 minutes. When the light comes on, the unit is ready to operate. Verify that the blower is operating by holding your hand above the top cover. Make sure the top and sides of the amplifier are clear of objects that would restrict air flow.

Any time the amplifier is off, or in the standby mode, or in the warmup cycle, the transceiver is connected directly to the antenna. Push the HV button on the function switch, so the multimeter shows the high voltage from the power supply. The high voltage should be between 1800 and 2000 VDC in the FM mode. If the voltage is outside that range, you must retap the power transformer as described in Section 3.

Push the OP button on the function switch. When you key the amplifier, but apply no RF drive, the plate current meter should show a resting current between 20 and 30 ma (in the FM mode). The resting current will vary from tube to tube and also depends on the high voltage.

SECTION 5.2 TUNE-UP

An SWR/wattmeter must be installed in the output cable and the input cable to properly tune the amplifier.

Set your transceiver to the operating frequency. Leave the amplifier in the FM mode. On the 2004A only, put the amplifier in the standby mode, key the transceiver and turn the filter tune knob on the back panel for minimum reflected power on the input wattmeter. If your transceiver has adjustable output, do your initial amplifier tuning at 5 to 10 watts.

Switch the amplifier into the operate mode and key your transceiver. If the relay control cable is correctly installed, you will hear the relays key immediately. If the relays are not keying, you must check the relay control wiring.

2002A AND 2004A: Drive the amplifier with 5 or 10 watts. Slowly adjust the INPUT TUNE knob to minimize the SWR (reflected power) between your transceiver and the amplifier. Next, slowly adjust the OUTPUT TUNE knob to maximize the output power. The plate current meter should show a dip at maximum output power. Finally, carefully remove the top cover and use a screwdriver to adjust the LOAD control on the top of the RF chassis. Adjust the control slowly to maximize the output power from the amplifier. The LOAD control will likely only require adjustment when the amplifier is first installed in its operating position.

CAUTION: The 2000 VDC high voltage is exposed when the top cover is removed. Exercise extreme caution while tuning the LOAD control.

2006A: Preset the OUTPUT TUNE and LOAD controls to the calibrations provided by the factory. Drive the amplifier with 5 or 10 watts. Slowly adjust the OUTPUT TUNE knob and the LOAD knob alternately for maximum output power. Switch the multimeter to the grid current position (I_g), and increase the power of your transceiver until you show about 30 ma of grid current. If the plate current is below 400 ma, slightly increase the LOAD control for higher plate current, and slowly adjust the TUNE control for minimum grid current. Repeat these two steps to reach the following operating parameters:

Grid Current: 30 ma approximately.
Plate Current: 500 ma approximately.

CAUTION: Try to limit your tuning time to about 10 seconds. The tube or power supply could be damaged by continuous duty operation. After 10 seconds of transmitting allow about 10 seconds of off time.

SECTION 6: Maintenance/Troubleshooting

SECTION 6.1. MAINTENANCE PROCEDURES

Any time you have a problem with your amplifier, be certain to check that it is properly connected to the AC mains and that the fuse is good. NEVER replace a fuse with one of higher value than specified. You could cause extensive equipment damage!

SECTION 6.2 TUBE PROBLEMS

SYMPTOM: Excessive plate current.

- Possible Cause: Amplifier not tuned properly.
- Possible Cause: Defective 3CX800A7.
- Possible Cause: Failure of bias diode D9.

SYMPTOM: Plate current when not keyed.

- Possible Cause: Grid-to-filament tube short.

SYMPTOM: Negative grid current.

- Possible Cause: Grid-to-filament tube short.

SYMPTOM: Circuit breaker blows instantly.

- Possible Cause: Plate short in tube.
- Possible Cause: Other high voltage short in RF chassis or power supply.
- NOTE: A high voltage short will often blow the cathode protection fuse.

SYMPTOM: Low output power.

- Possible Cause: Low filament voltage - 13.5 volts nominal.
- Possible Cause: Soft 3CX800A7 - worn out.
- Possible Cause: Amplifier not tuned properly.

SECTION 6.3: RELAY PROBLEMS

SYMPTOM: The amplifier will not key.

- Possible Cause: Check the connection to the transceiver.
- Possible Cause: Defective relay cable.
- Possible Cause: Relay supply failure or low voltage - measure at the relay control jack.
- Possible Cause: High resistance contact at the transceiver.

SYMPTOM: Reduced receiver sensitivity.

- Possible Cause: Input relay is bad.
- Possible Cause: Output relay stuck.
- Possible Cause: Input relay out of socket.
- Possible Cause: Bad input or output cable.
- Possible Cause: Defective filter section.

SYMPTOM: Resting current - amp not keyed.

- Possible Cause: Relay cable shorted.
- Possible Cause: Transceiver connection incorrect.
- Possible Cause: Transceiver malfunctioning.
- Possible Cause: Bad bias relay.
- Possible Cause: Short in relay supply.

SECTION 6.3 HIGH VOLTAGE PROBLEMS

CAUTION: The high voltage inside your amplifier can be LETHAL. Always disconnect your amplifier from the AC mains before service!

SYMPTOM: No plate current - high grid current.

- Possible Cause: No high voltage at the tube.
- Trace the disconnected circuit for a break.

SYMPTOM: Circuit breaker blows instantly.

- Possible Cause: High voltage short. Isolate to RF Chassis or power supply by removing the HV connector from the RF chassis.
- Possible Cause: RF chassis short. Remove the tube and see if problem persists. Look for HV arcs or damaged components.
- Possible Causes: Power supply short. Look for arcs or damaged components. Progressively remove components from the circuit until the short disappears.

SYMPTOM: Low high voltage reading.

- Possible Cause: Low AC line voltage - retap.
- Possible Cause: Defective balancing resistor in the capacitor bank.

SYMPTOM: HV reading too high.

- Possible Cause: AC line voltage too high - retap.
- Possible Cause: Defective transformer - replace.

SYMPTOM: No high voltage reading.

- Possible Cause: Defective meter - replace.
- Possible Cause: Bad resistor in HV meter circuit.

SECTION 6.4 BLOWER PROBLEMS

SYMPTOM: Blower not operating.

- Possible Cause: AC cable wired incorrectly.
- Possible Cause: Shipping damage to blower.

SYMPTOM: Blower is noisy or cabinet shakes.

- Possible Cause: Shipping damage, blower out of balance.

SECTION 6.5 OUTPUT PROBLEMS

SYMPTOM: Low output.

- Possible Cause: Low drive from transceiver. Indicated by low grid current.
- Possible Cause: Bad drive cable.
- Possible Cause: Bad output cable.
- Possible Cause: Low filament voltage.
- Possible Cause: Bad tube.

SECTION 6.6 AC LINE VOLTAGE PROBLEMS

SYMPTOM: Amplifier will not turn on.

- Possible Cause: Incorrectly wired AC plug.
- Possible Cause: Bad circuit breaker.

SYMPTOM: High voltage readings out of spec.

- Possible Cause: AC mains too low or high - you must retap the transformer.

SECTION 6.7 OTHER PROBLEMS

SYMPTOM: Blower operates, but not lights.

- Possible Cause: Amplifier still in warmup mode.
- Possible Cause: Warmup relay defective or out of its socket.
- Possible Cause: Relay supply defective.

SYMPTOM: Amplifier will not turn on or off.

- Possible Cause: Defective circuit breaker.
- Possible Cause: AC plug wired incorrectly.

SECTION 6.8 MAINTENANCE

Many Henry amplifiers still remain in the field after more than 30 years of service. To insure maximum reliability you should unplug the unit, remove the top cover and make sure that the interior of the console is free of dust, lint, and dirt. If necessary, vacuum the interior to clean it. Also make sure that the airflow in and out of the amplifier is unrestricted.

SECTION 6.9 FACTORY SUPPORT

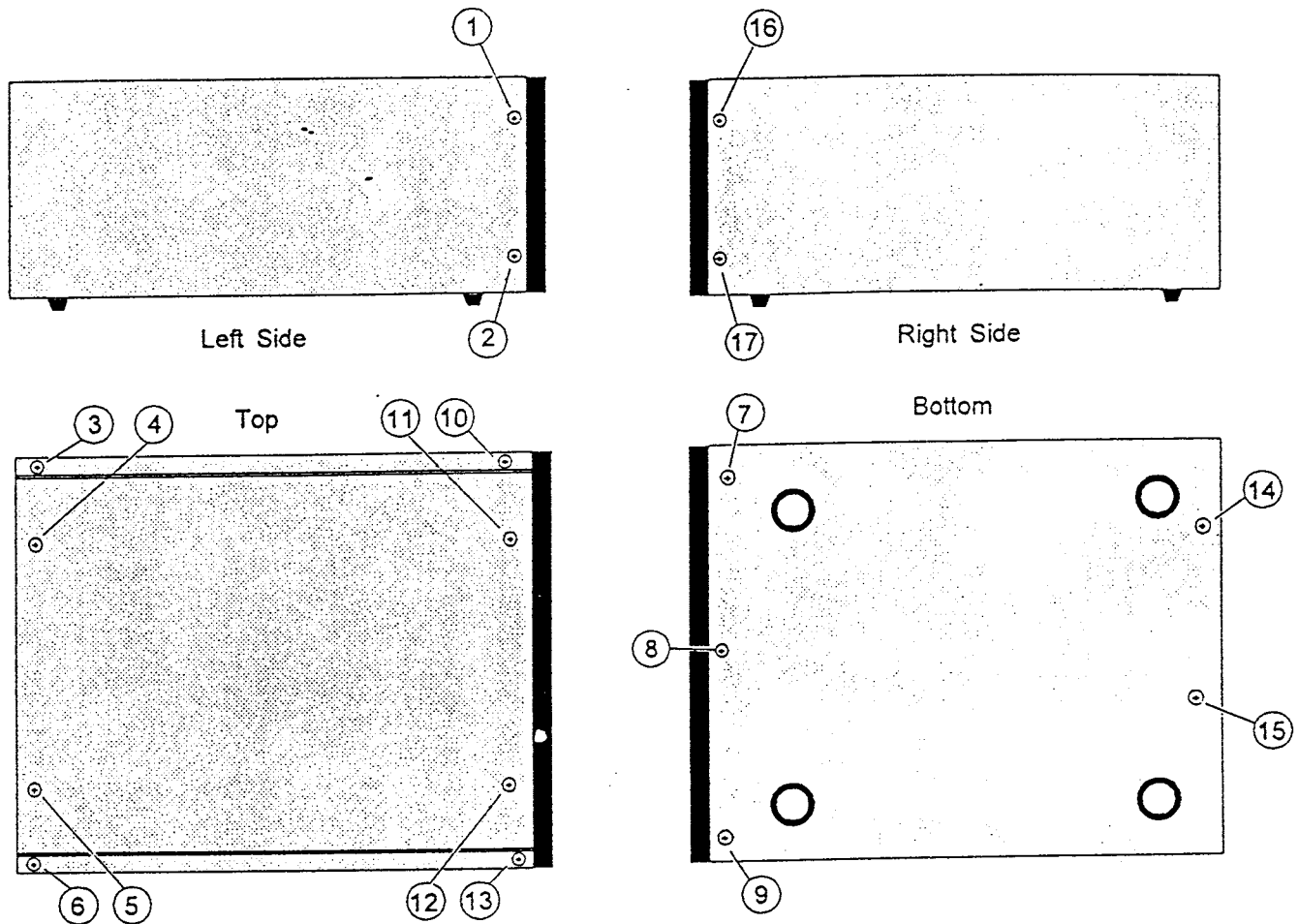
If you have questions about servicing your equipment, you should mail, fax, or e-mail your questions to:

Henry Radio
2050 South Bundy Drive
Los Angeles, CA 90025 USA
Fax: 310-826-7790
e-mail: henryradio@earthlink.net

Should it ever be necessary to return your amplifier to the factory for repair, please call for authorization first. Also consider the possibility of returning just the RF chassis to save transportation costs.

If you return your equipment to the factory, pack it extremely well to avoid shipping damage. Include a short description of the problem and insure the package for the replacement cost of the amplifier. Ceramic tubes may be shipped in their socket. Glass tubes should be removed for shipment. The shipping address will be given when you call for authorization.

Section 7. Disassembling the Amplifier



The description of this procedure involves screws which are numbered on the drawing above, so refer to the diagram as necessary.

REMOVE THE TOP SCREEN: The painted perforated top screen should be removed by unscrewing screws 4, 5, 11 and 12 and lifting off the top panel.

REMOVE THE BACK PANEL: The back panel is secured by screws 14 and 15 on the bottom of the amplifier and by two screws on the top (not shown in this diagram). Remove these four screws and the back panel should be free from the cabinet.

DISCONNECT CABLES: The harness from the front panel must be disconnected from the interconnecting terminal strip in the power supply

section before the amplifier plate will slip free of the cabinet.

REMOVE THE KNOBS AND SWITCHES: Before the amplifier plate will come free of the cabinet you must remove the INPUT TUNE knob, the OUTPUT TUNE knob, and the FM/SSB knob and switch and unscrew the four screws holding the ON/OFF circuit breaker into the front panel.

Section 8. Tube Information

3CX800A7

The 3CX800A7 is a compact air cooled ceramic/metal power triode electron tube. It is a pin based, plug in tube operating in a grounded grid circuit., requiring a warm-up period of 2 minutes.

FILAMENT

Oxide coated - 13.5 +/- 0.6 VAC, 1.5 amps nominal.

FREQUENCY OF MAXIMUM RATING - 350 MHz.

DIMENSIONS - 2.52" Long x 2.53" Diameter.

OPERATING POSITION

May be operated in an position.

COOLING - Forced air.

MAXIMUM OPERATING TEMPERATURE - 250 deg. C.

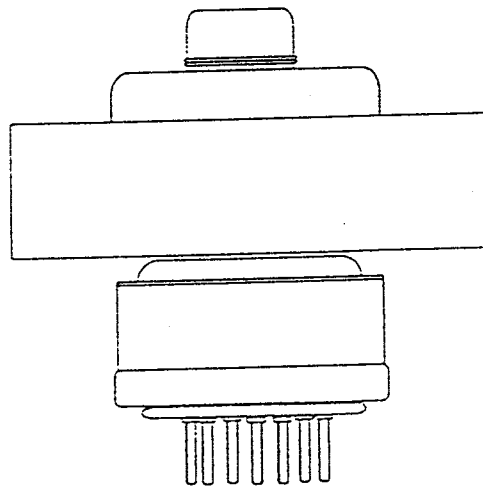
MAXIMUM DC PLATE VOLTAGE - 2250 VDC.

MAXIMUM DC PLATE CURRENT - .6 Amps.

MAXIMUM PLATE DISSIPATION - 800 watts.

MAXIMUM GRID DISSIPATION - 4 watts, 60 ma.

AIR FLOW (800 WATT DISSIPATION)
30 CFM at .79" pressure drop at sea level.



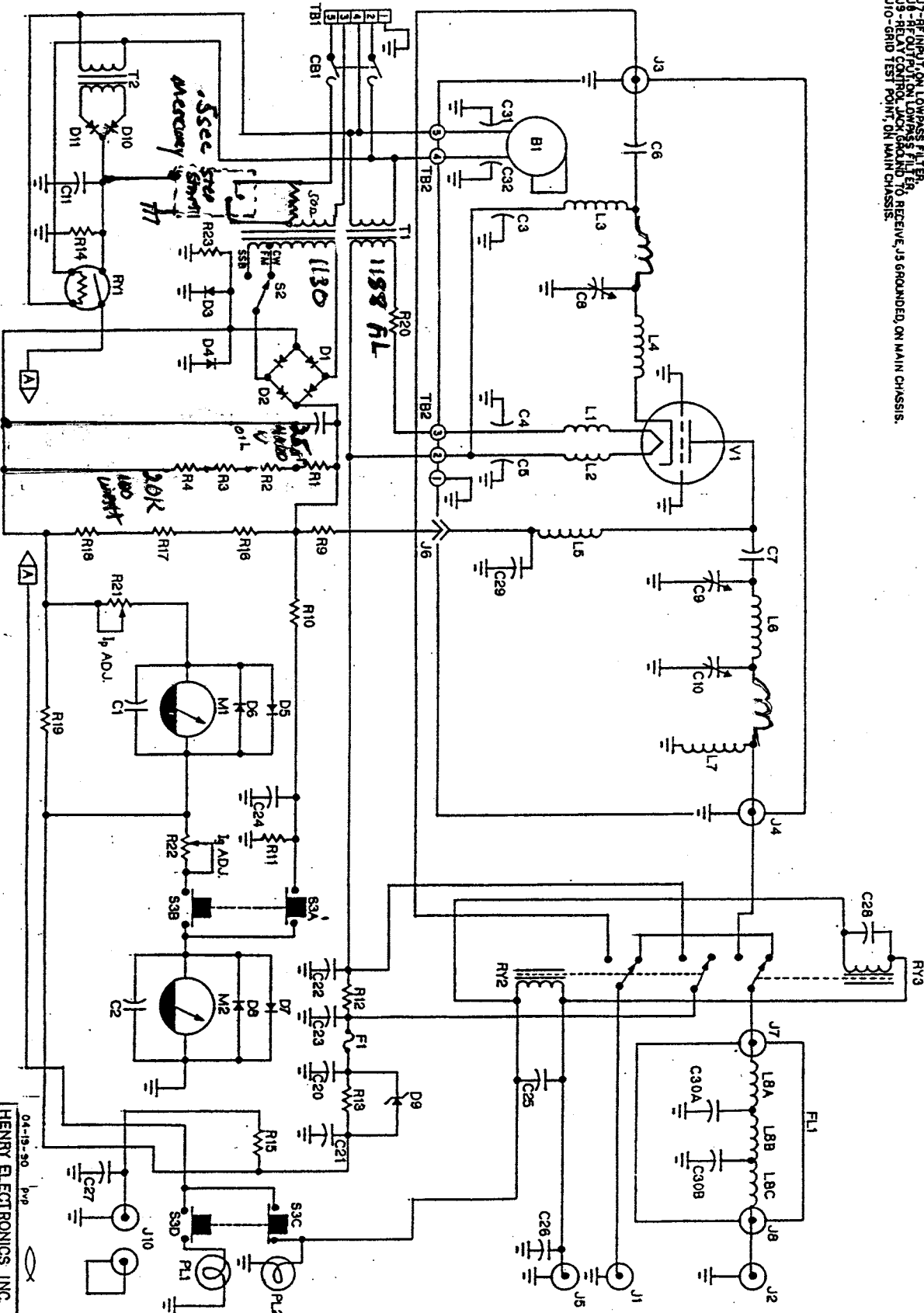
Section 9. Parts List

B1	Blower: squirrel cage style, 110vac.	Kooltronic KBB29-102M
CB1	Circuit Breaker: ON/OFF switch.	Heinemann AM2-A3-A20-2
C3 through C5	Capacitor: Feedthrough, 2000 pf, 500 volt.	Tusonix 202M
C6 and C7	Capacitor: Ceramic transmit, 1000 pf, 5 kv.	HEI HH58V102MA
C8 (2006A)	Capacitor: Input tune, 140 pf, 500 volt.	Cardwell APC140B
C8 (2002A/2004A)	Capacitor: Input tune, 15 pf, 500 volt.	Henry C8-2002A
C9 (2006A)	Capacitor: Output tune, 30 pf, 3000 volt.	Cardwell 154-11-1
C9 (2002A)	Capacitor: Output tune.	Henry C9-2002A
C9 (2004A)	Capacitor: Output tune.	Henry C9-2004A
C10 (2006A)	Capacitor: Load, 350 pf, 500 volt.	Cardwell 154-10-1
C10 (2002A)	Capacitor: Load.	Henry C10-2002A
C10 (2004A)	Capacitor: Load.	Henry C10-2004A
C11	Capacitor: Electrolytic, 470 mf, 50 volt.	Arco ME470-50
C12 through C17	Capacitor: Electrolytic, 180 mf, 450 volt.	CDE FAHM180-450A3
D1 and D2	Diode: HV rectifier, 1.2 amps, 12kvdc.	EMI 09020207
D3 through D8	Diode: rectifier, 1 amp, 400 piv.	1N4004
D9	Diode: Regulator, zener, cathode bias.	1N2806A
D10 and D11	Diode: rectifier, 3 amp, 100 piv.	1N4720
F1	Fuse: 3 AG, 1.5 amp, 250 vac.	Littelfuse 312 001.5
	Fuseholder: 3 AG.	Littelfuse 348 875
FL1-2006A	Filter: 54 MHz low pass.	Henry 2006A-LPF
FL1-2002A	Filter: 144 MHz low pass.	Henry 2002A-LPF
FL1-2004A	Filter: 430 MHz tuneable strip line.	Henry 2004A-LPF
J1 and J3	Jack: BNC(f) type chassis connector.	Amphenol UG647/U
J2 and J4	Jack: N(f) type chassis connector.	Amphenol UG58A/U
J6	Jack: HV connector, jack and socket.	Millen 37501
J7 and J8 (2002A/2006A)	Jack: UHF(f) chassis connector.	Amphenol SQ239
J7 and J8 (2004A)	Jack: N(f) chassis connector.	Amphenol UG58A/U
	Knob: Filter tune.	Panel Products 70-2-2G
	Knob: Input tune, SSB/FM switch.	Panel Products 70-7WL-2G
	Knob: Output tune.	Panel Products 175-1-2G
L1 and L2 (2002A/2004A)	Choke: Bifilar, filament, 16 ga.	Henry L1-2002A
L1 and L2 (2006A)	Choke: Bifilar, filament, 16 ga. ferrite.	Henry L1-2006A
L3 (2006A)	Choke: Cathode.	Miller RFC50
L3 (2002A)	Choke: Cathode.	Miller RFC144
L3 (2004A)	Choke: Cathode.	Henry L3-2004A
L4 (2006A)	Coil: Input, 50 MHz.	Henry L4-2006A
L4 (2002A)	Coil: Input, 144 MHz.	Henry L4-2002A
L4 (2004A)	Coil: Input, 440 MHz.	Henry L4-2004A
L5 (2006A)	Choke: Plate.	Henry L5-2006A
L5 (2002A)	Choke: Plate.	Henry L5-2002A
L5 (2004A)	Choke: Plate.	Henry L5-2004A
L6 (2002A)	Inductor: Strip line, 1/4 wavelength.	Henry L6-2002A
L6 (2004A)	Inductor: Strip line, 1/2 wavelength.	Henry L6-2004A
L7 (2006A)	Choke: Antenna, 50 MHz.	Miller RFC50
L7 (2002A)	Choke: Antenna, 144 MHz.	Henry L7-2002A
L7 (2004A)	Choke: Antenna, 440 MHz.	Henry L7-2004A
L8	Inductor: Lowpass filter, set of 3.	Henry L8-2006A
L9	Inductor: L-section output coil.	Henry L9-2006A
M1	Meter: Plate current, 0-1 amp scale.	Yokogawa 260300-MM
M2	Meter: Multimeter, 0-400 scale.	Yokogawa 260300-PC
PL1	Pilot Light: Light holder assembly with 73 bulb.	Dialco 554-1221 Standby
PL2	Pilot Light: Light holder assembly with 73 bulb.	Dialco 554-1221 Power

HENRY 2006A/2002A/2004A OPERATING AND MAINTENANCE MANUAL

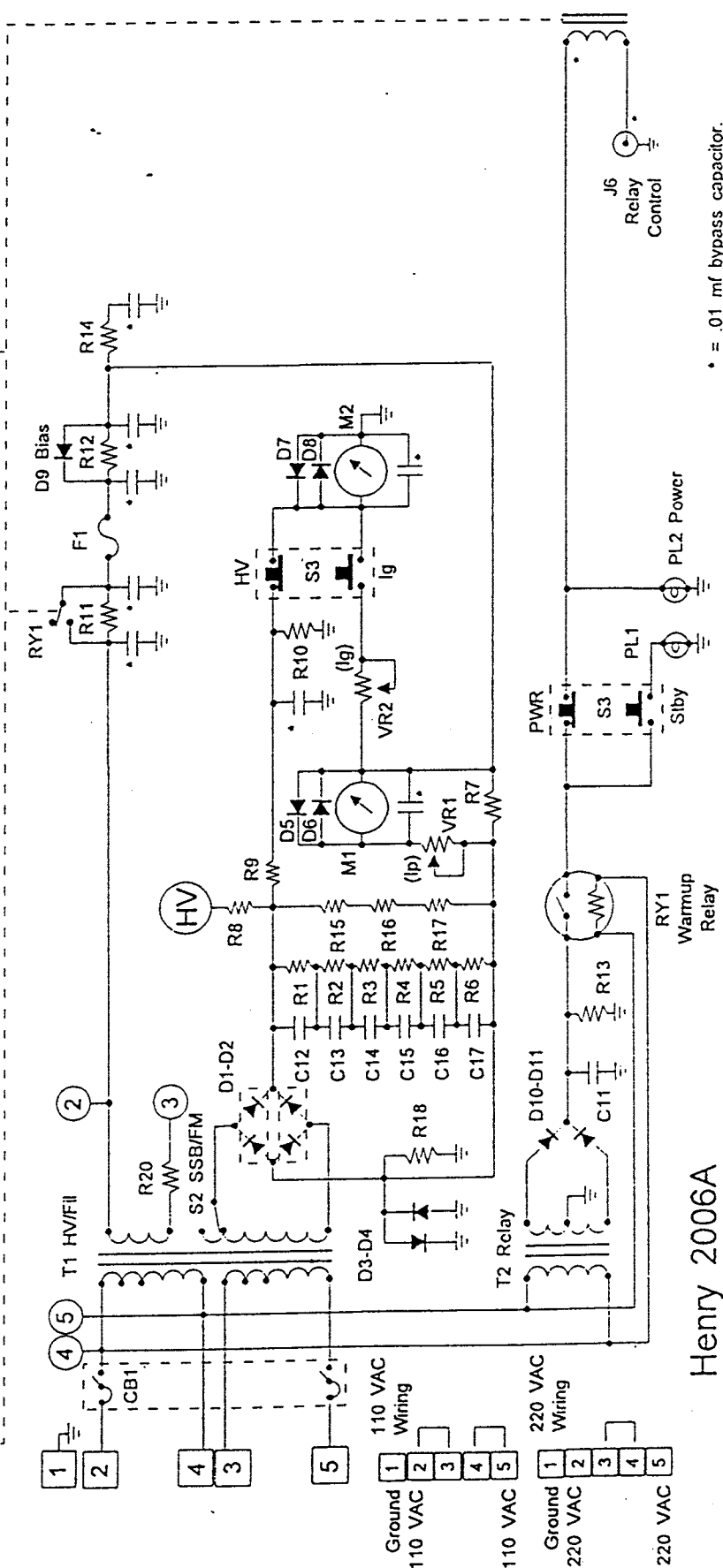
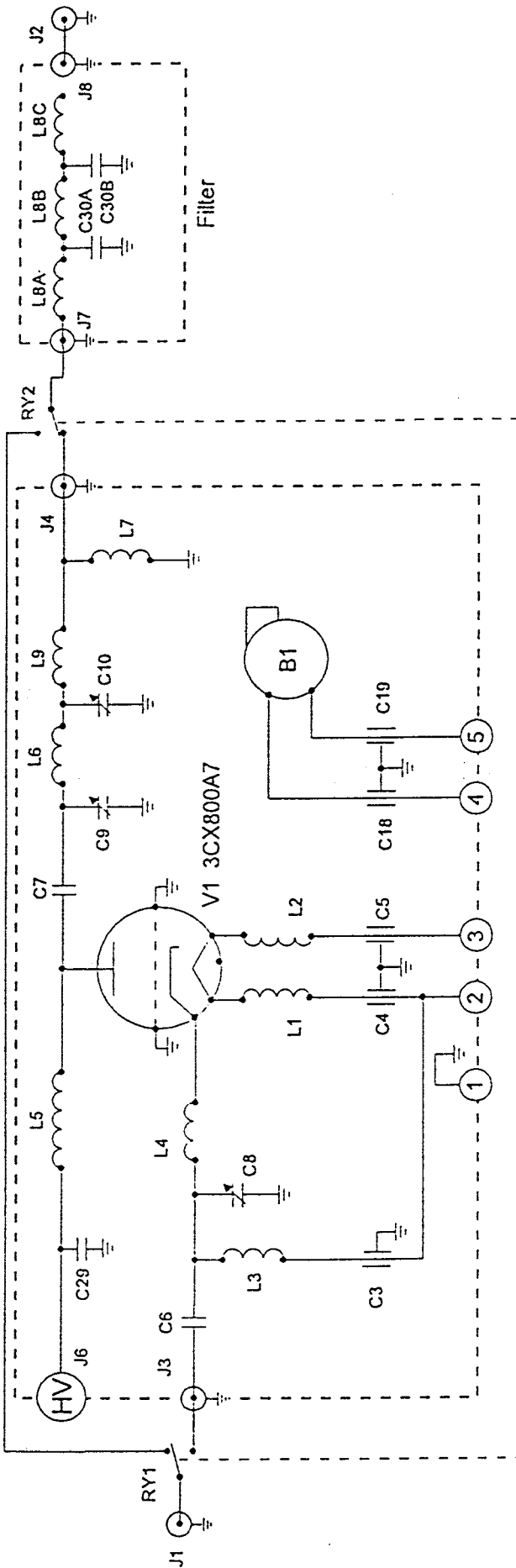
R1 through R6	Resistor: Wirewound, 20K ohm, 20 watt, 5%.	Resistor
R7	Resistor: 1 ohm, 1 watt, 10%.	Resistor
R8	Resistor: Wirewound, 25 ohm, 25 watt, 5%.	Resistor
R9	Resistor: Precision, 4M ohm, 7.5 watt, 1%.	Resistor
R10	Resistor: Wirewound, 10K ohm, 25 watt, 5%.	Resistor
R11	Resistor: Carbon, 10K ohm, 1 watt, 10%.	Resistor
R12	Resistor: Carbon, 1K ohm, 1 watt, 10%.	Resistor
R13	Resistor: Carbon, 150 ohm, 2 watt, 10%.	Resistor
R14	Resistor: Carbon, 5 ohm, 1 watt, 10%.	Resistor
R15 through R17	Resistor: Wirewound, 20K ohm, 50 watt, 5%.	Resistor
R18	Resistor: Wirewound, 50 ohm, 50 watt, 5%.	Resistor
R20 (2006A/2002A)	Resistor: Wirewound, .25 ohm, 10 watt, 5%.	Resistor
R20 (2004A)	Resistor: Wirewound, .50 ohm, 10 watt, 5%.	Resistor
RY1	Relay: Warmup delay, 90 second.	Amperite 115NO90B
RY2 Bias Section	Relay: DPDT, 12 vdc coil.	Guardian 1365PC-2C-12D
RY2 RF In (2002A/2006A)	Relay: Part of Guardian relay above.	
RY2 RF Out (2002A/2006A)	Relay: Coaxial, SPDT, 12 vdc coil.	Tohtsu CX600NC
RY2 RF In/Out (2004A)	Relay: Coaxial, DPDT, 12 vdc coil.	Tohtsu CX800N
S2	Switch: FM/SSB switch.	Henry S2-2002A
S3	Switch: Function switch.	Switchcraft 01AC00565
T1	Transformer: HV/Filament, dual primary.	ECA 1202A
T2	Transformer: Relay supply.	ECA 1199
V1	Tube: Ceramic triode.	Eimac 3CX800A7
	Tube Socket: 9 pin.	Cinch 9XM
VR1	Potentiometer: 2.5K ohm, 5 watt, Plate Current.	Potentiometer
VR2	Potentiometer: 500 ohm, 5 watt, Grid Current.	Potentiometer

HENRY 2506A AMPLIFIER AND POWER SUPPLY SCHEMATIC



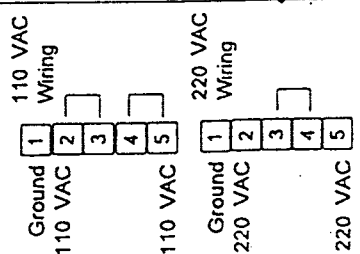
- NOTES: J1-RF INPUT ON MAIN CHASSIS.
 J2-RF OUTPUT ON MAIN CHASSIS.
 J3-RF INPUT ON RF DECK.
 J4-RF OUTPUT ON RF DECK.
 J5-RELAY CONTROL JACK, GROUND TO TRANSMIT. J9 LEFT OPEN, ON MAIN CHASSIS.
 J6-RELAY CONTROL JACK, GROUND TO TRANSMIT.
 J7-RELAY CONTROL JACK, GROUND TO TRANSMIT.
 J8-RF INPUT ON LOW PASS FILTER.
 J9-RF OUTPUT ON LOW PASS FILTER.
 J10-RELAY CONTROL JACK, GROUND TO RECEIVE. J5 GROUND, ON MAIN CHASSIS.
 J10-GRID TEST POINT, ON MAIN CHASSIS.

04-15-50 p.p.
 HENRY ELECTRONICS INC.
 2050 SOUTH BUNNY DRIVE
 LOS ANGELES CA 90025

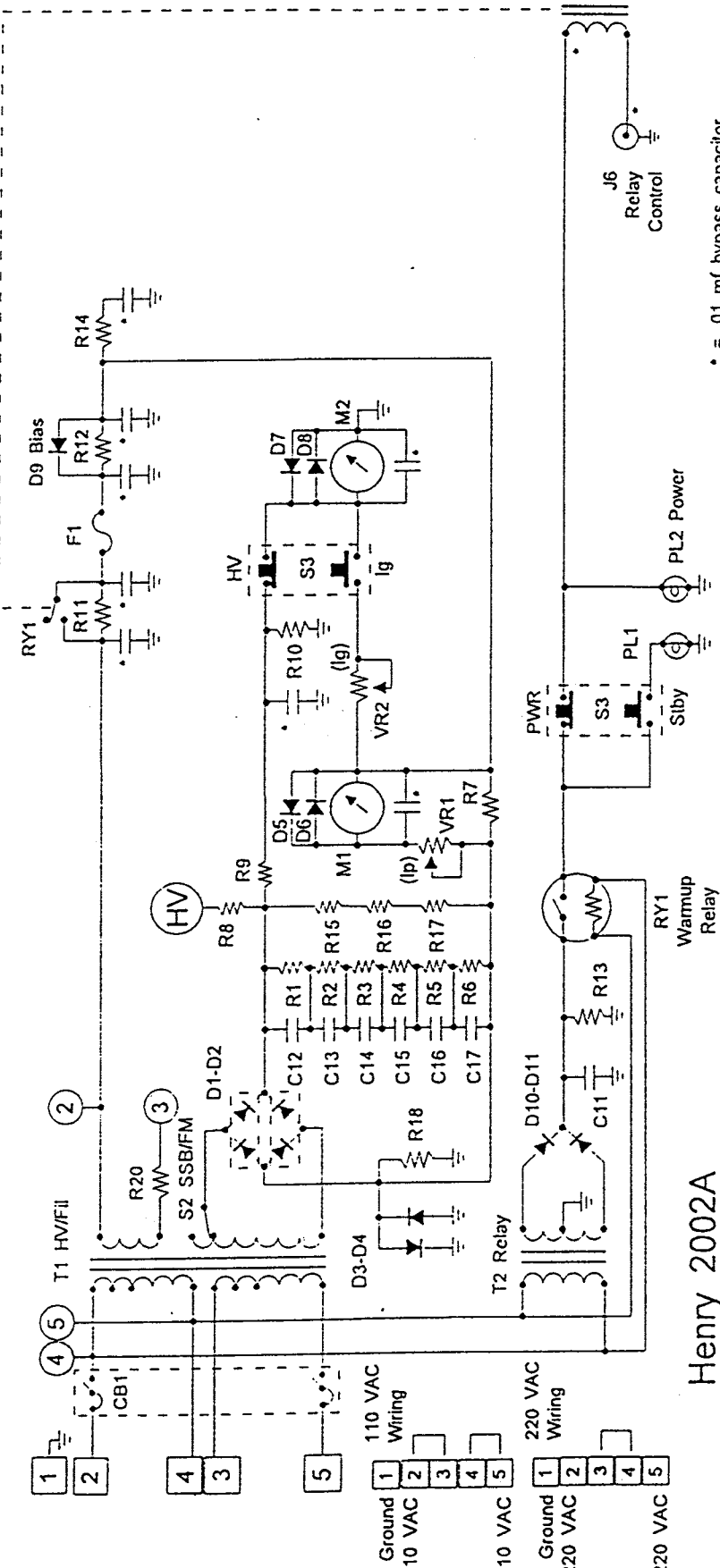
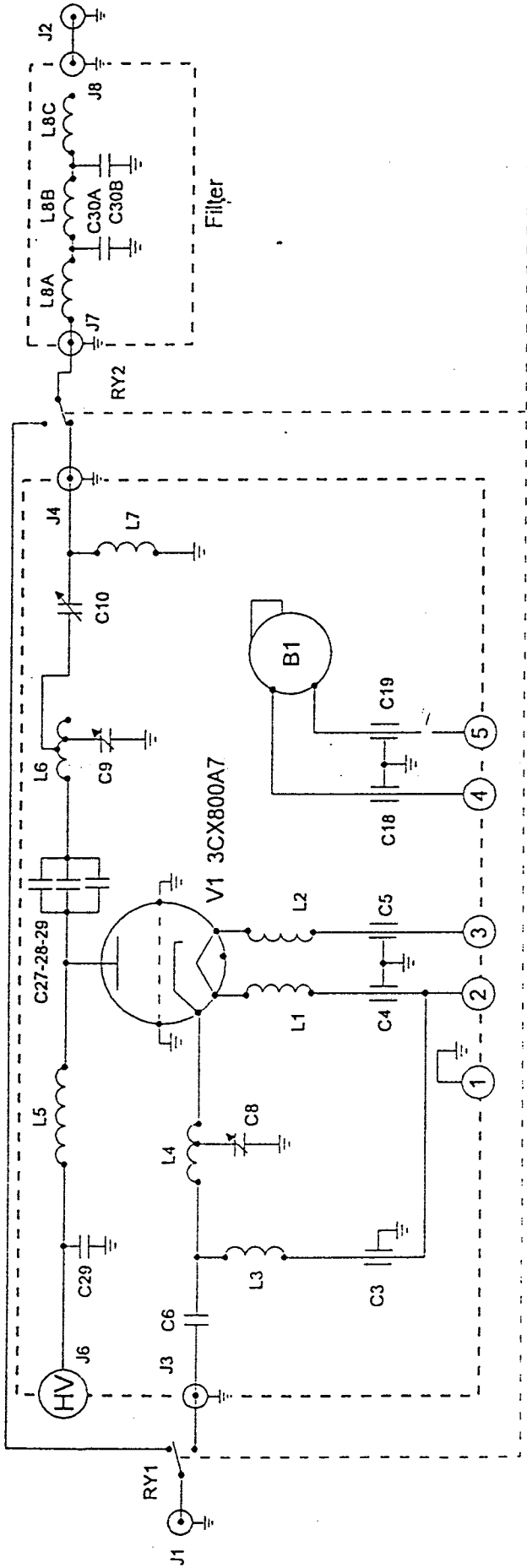


• = .01 mf bypass capacitor.

Henry 2006A

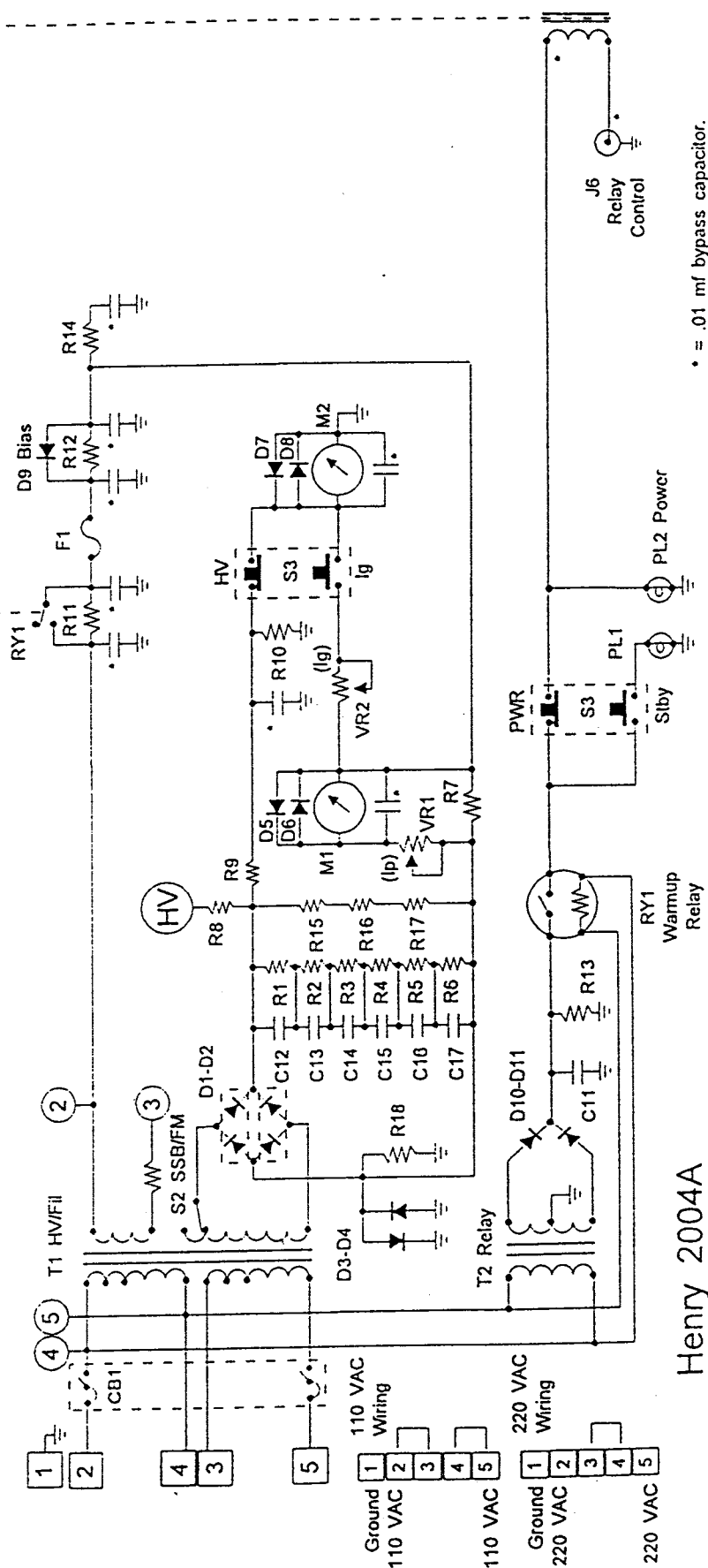
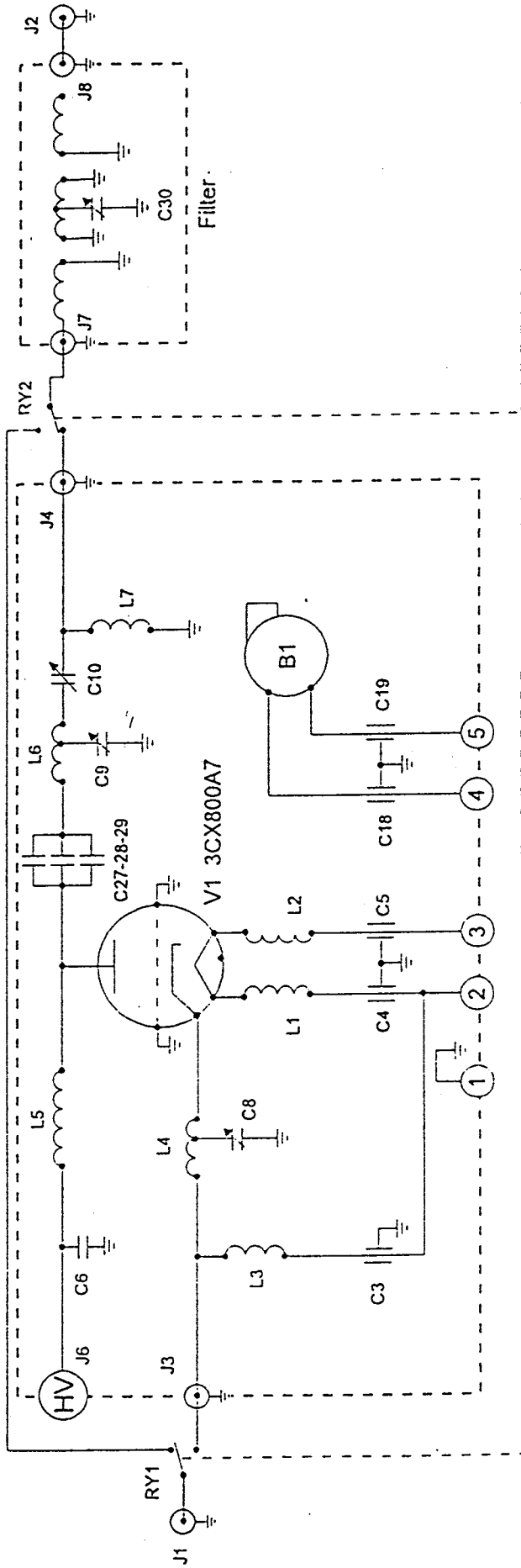


HENRY 2006A/2002A/2004A OPERATING AND MAINTENANCE MANUAL



Henry 2002A

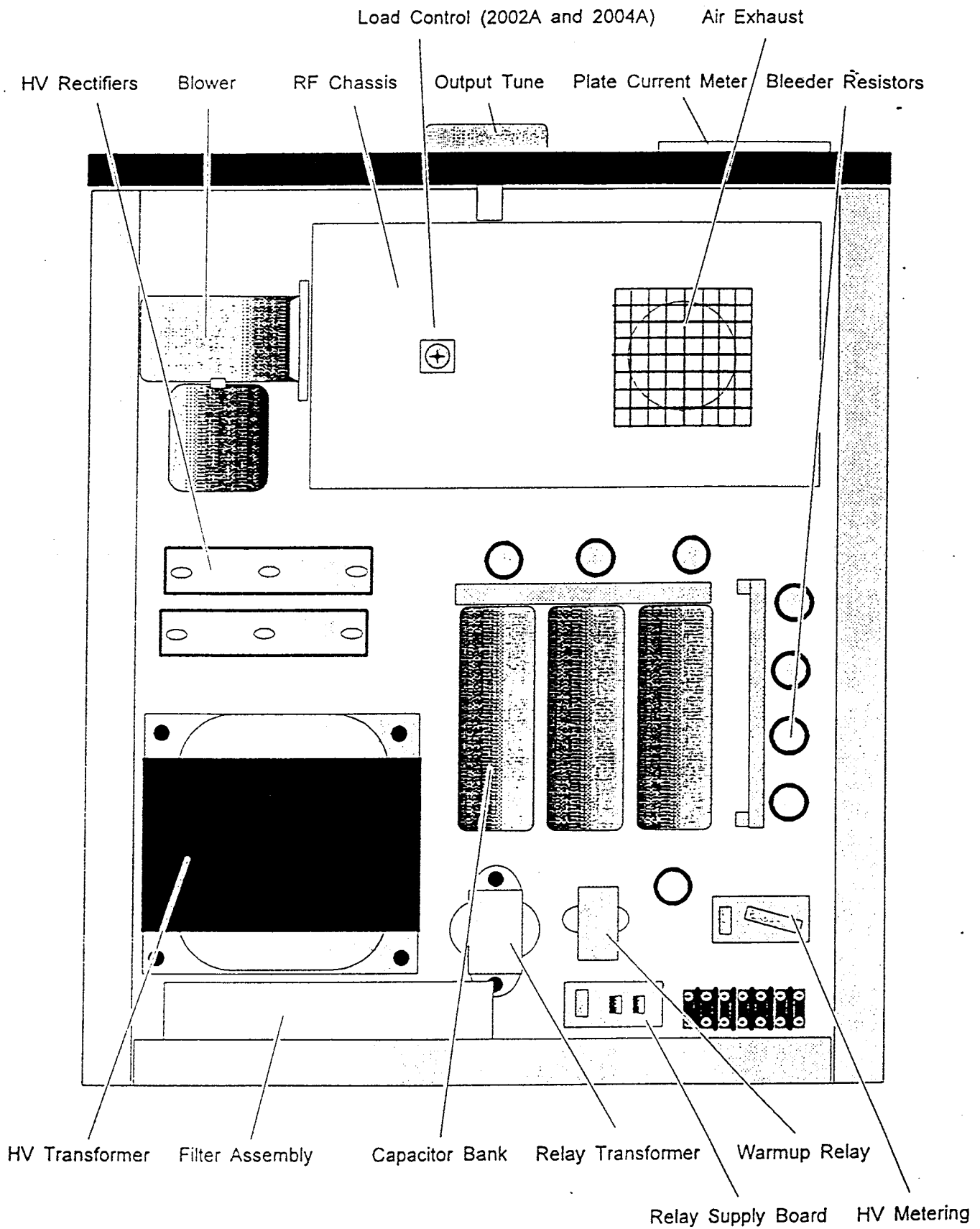
* = .01 mf bypass capacitor.



• = .01 mf bypass capacitor.

Henry 2004A

2006A/2002A/2004A Chassis Layout



K4XL's **BAMA**

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