

● INSTRUCTION MANUAL *

HF ALL BAND
2KW TUBE TYPE
LINEAR AMPLIFIER

MODEL: HL - 2K

TOKYO HY-POWER LABS., INC.

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[1] PREFACE

°Before starting to operate the device, read this instruction manual carefully to keep you and your HL-2K in the best condition for a long time.

* W A R N I N G *

High voltage of over 3000V is applied to internal parts of this device.

Don't touch the internal parts carelessly or you may get a lethal electrical shock.

Please be careful!

°If the vacuum tube 3-500Z gets a strong physical shock, tube glass, internal electrodes, and pins may be damaged.

In case of transporting over a long distance, please remove the tubes from the device and pack them separately with care. Prevent strong shocks to the tubes.

[2] FEATURES

1. HL-2K is an HF all band linear amplifier designed with current state of the art and our especial RF technology with a maximum input of 2.4KW, using two vacuum tubes, EIMAC 3-500Z glass triodes, which are known for good performance and durability in grounded-grid circuits.
2. A large power supply using a quality transformer and high voltage full bridge rectifier circuit is incorporated into this model. This power supply is stable even under key-down, continuous operation.
3. The HL-2K covers 1.8 - 28MHz ham bands including new WARC bands. It is possible to use it on 10MHz and 18/24.5MHz bands. But do not exceed band limits.
4. Two large meters have been set on the front panel. Plate current(IP) can be monitored all the time by the Plate Current Meter, and plate voltage(EP), control grid current(IG) and output power(PO) can be monitored by a multi-function meter, so that each operating state can be checked easily. With the built-in precision power sensor in the RF power detection unit, an accurate output power measurement can be made.
5. A cooling fan off-delay circuit has been furnished to avoid shortening the life of vacuum tubes and to cool off the internal parts caused by residual heat of the tubes. The fan continues to run for 150 seconds after power is switched off.
6. A vernier mechanism is furnished at both plate variable capacitor and also at load variable capacitor, which makes output tuning much smoother.
7. All chassis are ruggedly built to support the large power transformer and heavy components used in the HL-2K.
8. From our accumulated research into cooling vacuum tubes, a highly effective forced-air cooling system is employed to cool from the pins to the top of the tubes. It makes the amp reliable and durable even continuous hours of operation.
9. To avoid a high voltage electric shock, the double inter-locked switch system is furnished, which shuts down the power supply primary automatically and shorts the high voltage circuitry at the same time, when the upper shield cover is taken off. Do not remove the upper shield with power connected, do not connect power with the shield removed.

[3] SPECIFICATIONS

Frequency band : 1.8(1.9)/3.5(3.8)/7/10/14/18/
21/24.5/28MHz all amateur band

Mode : SSB, CW, (RTTY, SSTV)

Exciting power : 60 - 120W

Final DC input power : 2.4KW PEP

Output power : 1.2KW max.(at SSB)

Plate voltage : DC 3400V(at no RF excitation)

Plate current : 800mA max.

Input/output impedance : 50Ω(unbalanced)

Input/output connector : M-R type(SO-239)

Vacuum tubes : EIMAC 3-500Z x 2 or equivalent

Semiconductors : Transistor x 1,
Diode x 37,
LED x 2

Class of operation : Class AB2, Grounded grid(with input
tuning circuit)

AC supply voltage : AC 100/110/117/120/
200/220/234/240V
50/60Hz 25/13A max.

Built-in meters : Plate current meter : IP - 1A(full scale)
Multi-function meter: IG - 500mA(")
PO - 2KW(")
EP - 5KV(")

Cooling method : Forced-air cooling

Dimensions : 405(W) x 200(H) x 390(D) mm

Weight : 35 Kg(approx.)

Accessories : 15A Fuse(spare) x 2,
RCA pin plug x 2(Control/ALC),
Jumper cable x 2(power source terminal)

[4] AC POWER SOURCE

1. A terminal board is furnished at the AC primary side of the power transformer to select the proper voltage taps.

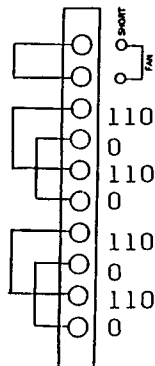
The taps have been set for 220V at the time of shipment.

For other AC voltages, please change the connection of indicated terminals according to following illustrations.

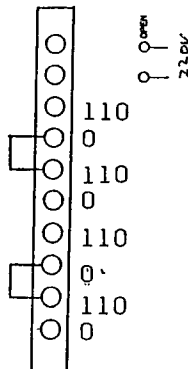
2. The AC plug has not been supplied. Please use the conventional AC plug in your country.

* Be sure to use Jumper cables attached.

(A) 110V



(B) 220V



3. 15A fuses are always used even if the voltage changes. Please be sure to check the terminal connections are correct.

****Caution****

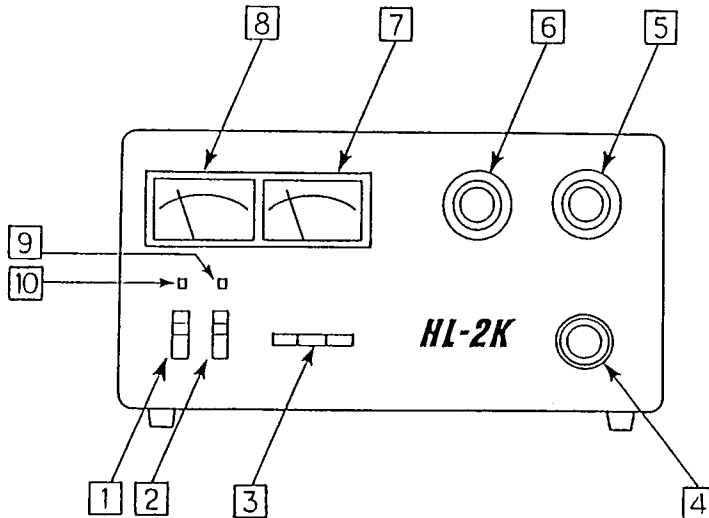
When you change the voltage taps from 220V operation to 110V, don't forget to change the connection of OPEN/SHORT terminals for FAN at upper side of terminal board.

Short(100V) at 100-120V, OPEN(200V) at 200-240V.

In case of amiconnection, internal damage to tubes will occur, caused by faulty or reduced speed of the fan(insufficient cooling). Please be careful!

[5] EXPLANATIONS OF FEATURES

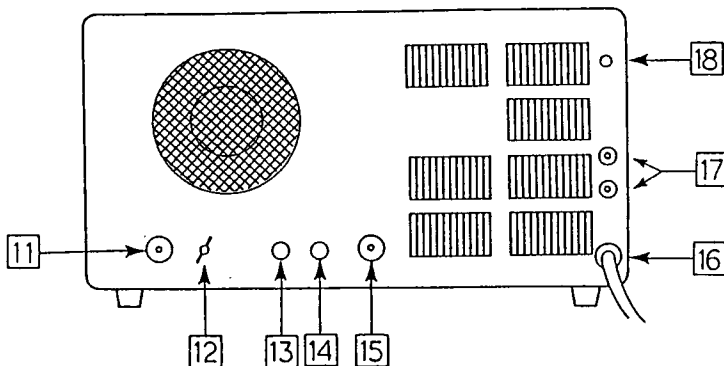
*Front panel



1. POWER OFF/ON : Power switch on/off.
When the power switch is off, the amp is put into the "THRU" state. At power on, various voltages are applied to internal parts and 10 LED(red) lights. Even if you turn off this switch at this state, the cooling fan keeps running for approx. 150 seconds with the fan motor off-delay circuit.
2. STBY/OPER : Operation select switch.
In STBY position, the amp is put into the "THRU" state, and output power of transceiver or transmitter will bypass the internal part and reach the antenna. In OPER position, the amp can be on air.
3. METER : Multi-function meter 7 select switch.
Select IG/PO/EP indication.
4. BAND : Frequency band select switch.
Select operation band(same band as your transceiver or transmitter.) Do not switch during transmit.
5. LOAD : Knob for adjusting LOAD variable capacitor.
6:1 vernier mechanism is furnished.
By adjusting this knob, RF power is supplied to the load.
6. PLATE : Knob for adjusting PLATE variable capacitor.
6:1 vernier mechanism is also furnished for easy tuning of the plate circuit.

- 7.IG.PO.EP : Multi-function meter.
By selecting [3] METER switch, you can read IG(control grid current), PO(RF output power) and EP(Plate voltage) respectively.
- 8.IP : Plate current meter.
Indicates plate current of the vacuum tubes.
Full scale : 1A
- 9.ON AIR(LED) : On air pilot lamp.
Indicates the amp is on the air.
- 10.POWER(LED) : Power pilot lamp.
Indicates the power is on.

*Rear panel

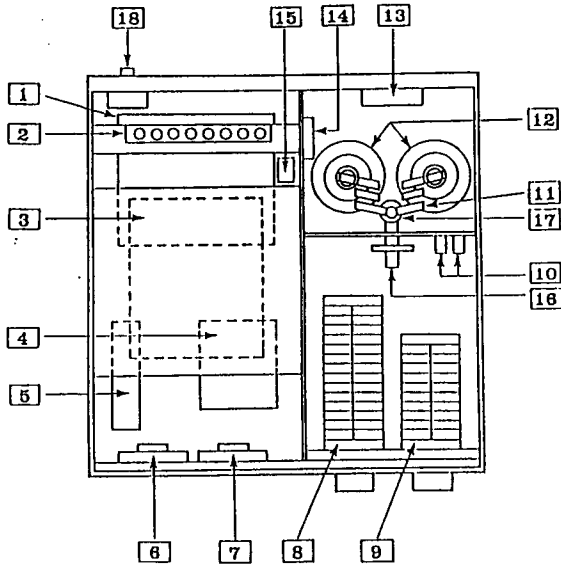


- 11.RF OUT(ANT) : Output terminal of linear amp.
Connect load(antenna or dummy load) here.
- 12.GND : Ground terminal.
- 13.ALC OUT : ALC voltage output terminal.
With RCA pin/plug, connect cables to ALC input terminal of transceiver or transmitter.
- 14.REMOTE : Terminal for remote send/receive control operation.
By connecting lead wires between the control terminals of transceiver or transmitter and this terminal using RCA pin/plug, send-receive changeover can be made automatically via the transmitter.
(For connection of the exciter side, please refer to its instruction manual.)
- 15.RF IN(TX) : Input terminal of linear amp.
Connect cable from antenna terminal of transceiver or transmitter.

- 16.AC POWER : AC power cord.
AC pin/plug hasn't been supplied.
Please use suitable one at your location.
- 17.FUSE : 15A fuse holders.
When fuse blows, check the cause and treat,
then replace it.
- 18.ALC ADJ : Adjusting knob for 13 ALC OUT(ALC output voltage).
Adjust this not to exceed proper exciting power
level from transceiver or transmitter to the amp.

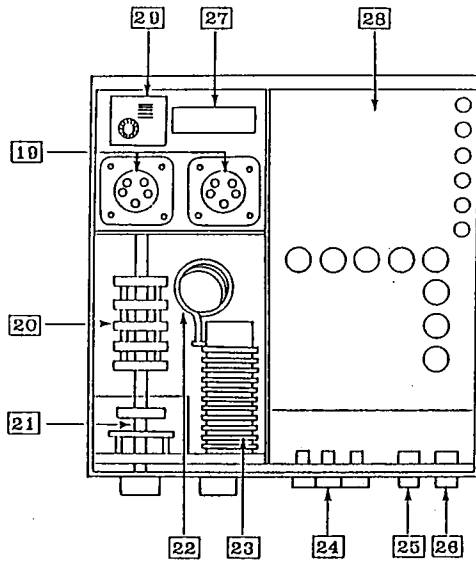
*INTERNAL VIEWS

°Upside of the chassis



- 1 HIGH VOLTAGE POWER TRANSFORMER
- 2 AC SOURCE TERMINAL BOARD
- 3 HIGH VOLTAGE RECTIFIER UNIT
- 4 LOW VOLTAGE POWER TRANSFORMER
- 5 CONTROL UNIT
- 6 PLATE CURRENT METER
- 7 MULTI-METER
- 8 TUNING VARIABLE CAPACITOR
- 9 LOADING VARIABLE CAPACITOR
- 10 ANTENNA RELAY
- 11 PARASITIC OSCILLATION SUPPRESSOR COIL
- 12 VACUUM TUBE 3-500Z x 2
- 13 COOLING BLOWER
- 14 INTERLOCK SWITCH(HIGH VOLTAGE SIDE)
- 15 INTERLOCK SWITCH(AC SOURCE SIDE)
- 16 COUPLING CAPACITOR
- 17 PLATE RF CHOKE COIL
- 18 ALC ADJUST KNOB

°BOTTOM VIEW



- 19 SOCKET FOR VACUUM TUBE/AIRDUCT
- 20 BAND SELECT SWITCH
- 21 RF INPUT TUNING CIRCUIT BLOCK(SHIELD CASE)
- 22 TANK COIL(HIGH BAND)
- 23 TANK COIL(LOW BAND)
- 24 MULTI-FUNCTION METER SELECT SWITCH
- 25 STBY/OPER SELECT SWITCH
- 26 POWER ON/OFF SWITCH
- 27 FILAMENT CHOKE
- 28 POWER SUPPLY UNIT BOTTOM BOARD
- 29 POWER DETECTOR UNIT

[6] AN OUTLINE OF THE MAJOR CIRCUITS

1. RF Input Circuit

RF power sent from transmitter or transceiver to input terminal goes through relay contact and π type input tuning circuit, then reaches filament (CATHODE) of the vacuum tubes (3-500Z).

2. Power Amplification Unit (P.A. Unit)

P.A. Unit is a grounded grid linear amplifier consisting of two vacuum tubes (3-500Z) connected in parallel.

Self-bias circuit (8.2V) is built in the unit consisting of zener diode and power transistor so that plate current at no RF drive signal will be approx. 100mA for two tubes. When receiving, approx. +110V of bias is supplied to filament to cut off all current flow.

3. Output Circuit

The output power of vacuum tubes goes through a parasitic suppressor and coupling capacitor, then goes into the π type output tuning circuit.

Power from the output tuning circuit goes through the relay and directional power meter unit, then reaches the output terminal.

4. Directional Power Meter Unit

RF power detected by the toroidal core type current transformer is rectified by a high efficiency schottky diode.

This drives the power meter. It can also indicate the transmission power of transceiver or transmitter in "THRU" state.

5. ALC Circuit

A part of the driving input signal is rectified by a diode and supplied to ALC terminal as a negative ALC voltage.

By connecting ALC terminal and ALC input terminal of transceiver or transmitter, it will effectively work to prevent distortion caused by over-drive.

6. Fan-motor Off-delay Circuit

After power switch is turned off, the fan-motor continues to turn for approx. 150 seconds to cool residual heat of vacuum tubes. A solid-state relay is used for motor control.

7. Power Supply Circuit

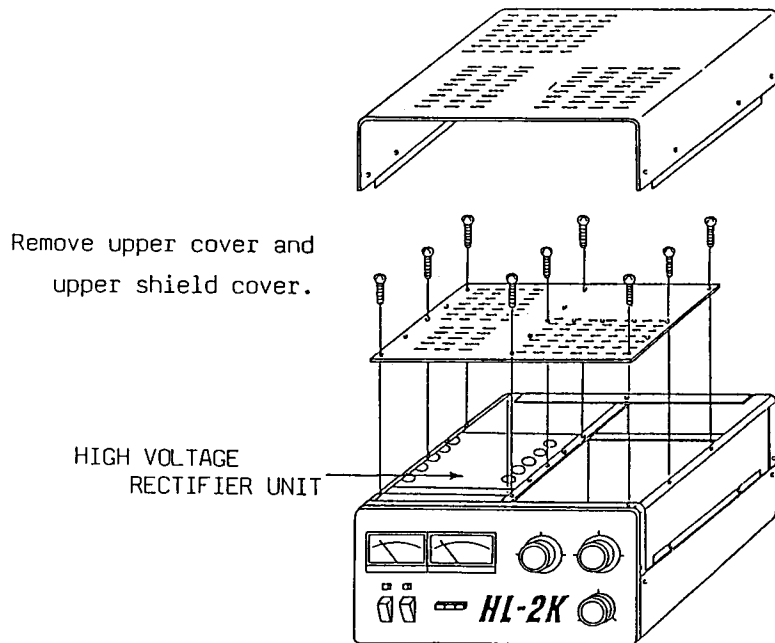
The high voltage of AC2400V at the secondary of high voltage power transformer is bridge-rectified by 20 rectifying diodes to get the DC voltage of 3400V, which is then supplied to the plates of the vacuum tubes. For the filament of vacuum tube, two filaments are connected in series to the 10V line of the filament transformer. Also, bias-voltage is applied to a center-tap of the 10V line wirings. In addition, windings for 110V wiring for tube cut-off biasing and 12V wiring for control circuit are built in this transformer.

[7] HOW TO INSTALL THE VACUUM TUBES

** To protect the vacuum tubes, the 3-500Z's have been packed separately from the amplifier at the time of shipment.

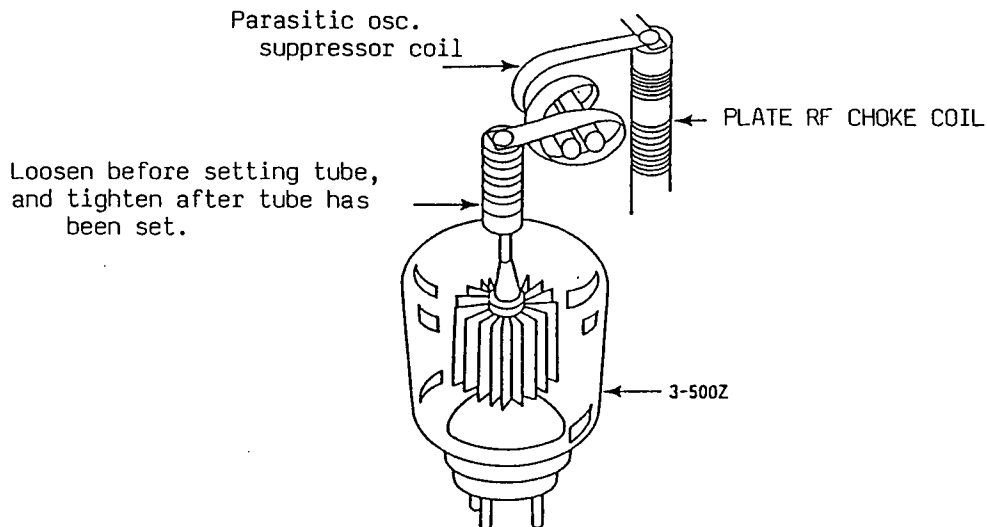
Please connect AC cord after vacuum tubes have been installed correctly.

1. Make certain that the AC cord is not plugged into the mains. Unscrew the screws and remove upper cover and upper shield cover. (Nuts on the upper shield panel are for high voltage interlock switch. Don't remove these nuts.)



2. Insert 3-500Z while holding the glass envelope into the socket according to the pin lay-out. Don't insert 3-500Z forcefully. Also keep the plate cap and parasitic oscillation suppressor coil raised for easy tube installation.
3. Loosen the screws on the side of plate cap, then insert the plate cap onto the metal protuberance of 3-500Z. Then, tighten screws. (A short screw-driver may be helpful.)
If a plate cap can not be inserted smoothly, bend the parasitic osc. suppressor coil slightly with your finger for smooth installation.
4. Now install the other 3-500Z.
It is easier to set the tubes one at a time.
5. Be sure that the parasitic osc. suppressor coil doesn't touch the chassis, and that the 3-500Z's don't get un-natural stress. Then, replace the upper shield cover and upper cover in reverse order.

** The upper shield cover must be used, or the device can not be operated due to the inter-lock switch system.



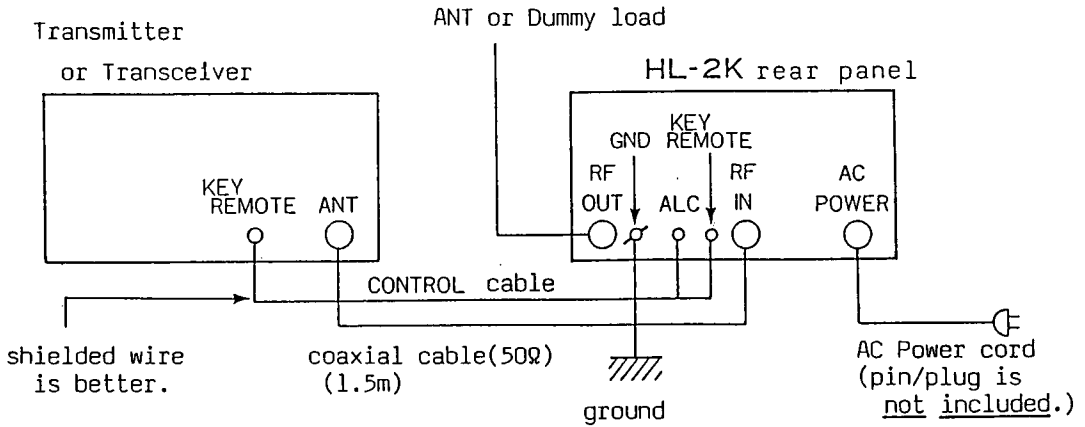
**** CAUTION ****

The pins of 3-500Z are weak mechanically. Please handle 3-500Z carefully when you set or remove it by holding glass envelope. Also please be careful of direction of socket pins and base.

All of the unscrewed sixteen screws must be replaced firmly. As the glass envelope of 3-500Z are made highly vacuumized, it is very dangerous if 3-500Z breaks and glass may scatter. Please handle 3-500Z carefully not to break the glass envelope.

[8] OPERATION

1. Connect jumper cables and power cord according to following figure.



- ** Connect cable from REMOTE terminal of HL-2K to the terminal of transceiver or transmitter which gets grounded during transmission.
- ** For a simple transmitting test without TX/RX remote control, connect REMOTE terminal of HL-2K to the ground momentarily.

2. Set the band select switches of HL-2K and the transceiver or transmitter to the operation band.
3. Set the knobs of variable capacitors for Plate and Load to each corresponding position beforehand (at 50Ω load) according to the following chart. This chart is approximation as reference for starting.

FREQ(MHz)	1.8	3.5	3.8	7	10	14	18	21	24.5	28
PLATE	1.5	6.0	7.5	3.5	5.0	7.0	8.5	9.5	9.5	9.5
LOAD	1.5	5.0	5.0	2.5	3.0	5.5	6.5	7.0	7.5	8.0

4. Turn POWER switch on and check to confirm that fan motor is turning. Then, turn STBY switch to OPER position.
As 3-500Z is a direct heating type vacuum tube, warm-up time for filament is very short (approx. 3 to 5 seconds), and the amp can be on air soon after power switch-on.
Put the transceiver or transmitter on the air, ON AIR pilot lamp lights and idling plate current (IP) should run approx. 100mA.
Adjust carrier level of transmitter to get IP of approx. 500mA.
5. Turn Plate variable capacitor to make the output power meter (PO) indication increase and IP to dip.
6. Adjust Load variable capacitor to maximize the PO meter indication.
7. Now increase carrier output level of transceiver or transmitter to get IP of 800mA.
At this time, adjust each Load knob and Plate knob alternately to maximize the output power.
To achieve the best output wave form, turn the Load knob clockwise slightly to decrease PO (output power) by 5-10% from the maximum point, and set the Plate knob always to get IP (plate current) dipped.
During the above tuning, if proper tuning is not obtained, it may be dangerous due to excessive tube plate dissipation.
Please keep IP less than 400mA.
In case of changing frequency (including changing operation band), readjust from step No. 2 to 7 of this chapter.

** N O T I C E **
=====

Try to finish this adjustment within one minute.
If it takes longer, please stop operation for one minute,
and then start tuning again.
8. Operate HL-2K with ALC knob on rear panel adjusted to proper operating voltage according to the output power level of the exciter. Set the ALC knob at the point where IG meter rarely deflects and power meter or IP indication is about to decrease slightly from the peak.
Be sure the output power is not exceeding 1kW (peak) after the adjustment.
To transmit a clear and un-distorted signal wave, it is recommended to use the ALC system.

[9] CAUTION

1. Impedance

When you operate the device, please always connect, as a load, a well-adjusted antenna or a dummy load of 50Ω.

In case the antenna impedance is extremely off from 50Ω, please use an impedance matching circuit such as an antenna coupler etc.

If you transmit under no load or mis-matched condition, the expensive vacuum tubes may be damaged and output tuning circuit may get damaged.

You should obtain a VSWR of less than 2:1 (hopefully as low as 1:1). Please be sure to check the input power rating of antenna, dummy load and antenna coupler etc, as the output power of this amp. is very high.

2. Place of Installation

Install the amplifier horizontally only (to protect the internal circuit of vacuum tube) in a well-ventilated place where it is not exposed to the direct rays of the sun.

Internal heat is discharged by the fan from rear panel.

Please keep the rear of device at least 15cm from the wall, and do not cover the air-holes of the upper and bottom covers.

3. AC Power Source

The voltage taps have been set for 220VAC at the time of shipment. In case of different AC voltage, please change the connection of screw type-terminal according to "[4] AC POWER SOURCE" on page 4. If you run the device with 110VAC, output power might not achieve the rated level because of poor AC line regulation etc. 220VAC is recommended.

4. When you open the cover.

* C A U T I O N *

a) To check the internal parts, because a high voltage is applied, please pull AC power plug off and check if high voltage has been discharged to prevent from getting an electric shock. Be sure to check EP indication of 0(zero)V on multi-function meter.

b) Do not touch or trim the semi-fixed variable resistor in the power detector unit as it has already been factory adjusted.

5. Cooling Fan Off-delay Circuit

To protect the vacuum tubes, a cooling fan off-delay circuit has been furnished. Fan motor continues to turn for a certain time period (approx. 150 sec.) to cool the tubes after power switch turns off. Don't pull the power plug while the fan is turning, or the fan stops and cooling may be insufficient, and it will cause the deterioration of an expensive vacuum tube.

Please be careful!

Check the circuit voltage and current capability.

6. Please clear dust in the internal part of the device once in a while, or cooling fan will not work effectively, and it may lead to the high voltage leakage or sparks.

7. Grounding

It is recommended to use a good ground when the device is used. A good ground may prevent TVI, BCI etc, and electric shock. Connect a wire for grounding as thick and short as possible. Do not connect to water pipes. Connect to ground rod only.

8. For continuous transmission such as SSTV/RTTY modes, please reduce the driving level making output approx. 500W or less.

[10] TROUBLESHOOTING

The following symptoms are minor troubles, which can be solved rather easily.

Please check each cause of trouble carefully.

Symptoms	Cause	Treatment
Can not turn on AC power.	<ol style="list-style-type: none"> 1.AC fuse blown. 2.Upper shield panel has not closed completely (interlock switch is open). 3.AC power cord isn't connected. 4.Mis-wiring of voltage taps at AC power terminal. 	<ol style="list-style-type: none"> 1.Replace fuse(15A). If fuse blows again, it is serious. 2.Close upper shield panel completely. 3.Plug it in firmly(surely). 4.Connect correctly according to Instruction manual.
Fuse blown repeatedly.	<ol style="list-style-type: none"> 1.Capacity of fuse is not proper. 2.Plate band or parasitic suppressor touches other parts(chassis,tank coil, for example). 3.Upper shield cover has not closed completely. (High voltage interlock is short-circuited) 4.Mis-wiring of voltage taps at AC power terminal. 5.Tubes were not set properly, plate cap touched chassis,and high-voltage circuitry became short-circuited. 	<ol style="list-style-type: none"> 1.Install correct fuse. (15A) 2.Keep spaced from other parts. 3.Close upper shield cover completely to open the high voltage interlock circuit. 4.Connect correctly according to Instruction manual. 5.Set the tubes correctly.
Fan doesn't turn. (or turns slowly.)	<ol style="list-style-type: none"> 1.Mis-wiring of voltage taps at AC power terminal. 2.Some foreign substance in the fan. 	<ol style="list-style-type: none"> 1.Connect correctly according to Instruction manual. 2.Remove the substance.
EP(Plate voltage) is only half the normal level.	Mis-wiring of voltage taps at AC power terminal.	Connect correctly according to Instruction manual.
IP(Plate current) at transmission is extremely low or zero.	<ol style="list-style-type: none"> 1.Tubes are not set correctly. 2.Mis-wiring of voltage taps at AC power terminal. 	<ol style="list-style-type: none"> 1.Set the tubes into the sockets firmly. 2.Connect correctly according to Instruction manual.

Symptoms	Cause	Treatment
	<ul style="list-style-type: none"> 3. Deterioration of vacuum tubes. 4. It's not switching to the transmit mode. 	<ul style="list-style-type: none"> 3. Replace tubes. 4. Check remote control cable.
PO(output power) is low or zero.	<ul style="list-style-type: none"> 1. ALC adjusting knob has been turned fully clockwise. 2. Deterioration of the vacuum tubes. 3. Antenna terminal is open or short circuit. 4. Mis-tuning. 5. Driving power from transceiver or transmitter is less than the rated level. 6. Connectors of coaxial cable between transceiver or transmitter and HL-2K are short or open. 7. Vacuum tubes haven't been set. 8. Input and output connectors are reversed. 	<ul style="list-style-type: none"> 1. Turn this knob counter-clockwise. 2. Replace the tubes. 3. Repair the open or short circuit. 4. Tune correctly according to Instruction manual. 5. Adjust output level of transceiver or transmitter to reach HL-2K's rated level, so that enough RF output power can be achieved. 6. Replace coaxial cable or repair bad place. 7. Set the tubes correctly. 8. Install the connectors in the right positions.
"ON AIR" state cannot be made.	<ul style="list-style-type: none"> 1. Cable for remote control is bad or not connected. 2. STBY/OPER select switch is not at OPER position. 	<ul style="list-style-type: none"> 1. Connect remote cable correctly. 2. Set this switch to OPER position.
Receiving signal cannot be received when STBY/OPER switch is at "OPER" position.	Short-circuit at remote cable.	Repair short-circuit.

Addendum to HL-2K Instruction Manual

Before starting-up the operation of HL-2K, please carefully go through and observe the following cautions. Any damage as a result of the negligence of any of the cautions may not be covered by the sales warranty our dealer offers you.

Cautions!!!

1. The output power of HL-2K must be always kept below the following suggested outline at all times:

<u>Modes</u>	<u>Output</u>	<u>Input</u>
SSB Operation:	1.0KW PEP	100W max.
CW/SSTV/RTTY :	500W (50% duty)	50W max.

2. P1 (π) net work circuit must be always kept in resonance. If either or both of the plate and load variable capacitors is(are) not in the correct position (out of resonance), the dip in the plate current cannot be obtained. Whenever the band is changed or the frequency is changed even from CW to SSB, readjust the plate and load capacitors so that the maximum power can be obtained on the operating frequency while the plate current dips most.
3. Make sure that your antenna system is well enough to withstand the output power from HL-2K. Some antennas are such that at a higher feeding power, VSWR may become worse depending on the insulating materials, the sizes of wire diameters or the sizes or materials of coaxial cables. HL-2K is vulnerable to such a shift in VSWR.
4. Do not turn the band switch while in transmission. Doing so will surely result in damage to the band switch as well as the coupling capacitor C-43.
5. Never try to operate HL-2K without an antenna or dummy load being connected to the antenna terminal of HL-2K.
6. If you try to operate HL-2K out of the amateur radio bands, consult with the manufacturer through the dealer before such trials. Basically, HL-2K is designed for the use within the amateur radio bands only.
7. If what you are going to do with HL-2K is not covered by the manual, and you are not so sure about the consequence, then please consult with the manufacturer through the dealer.

It is our sincere request that each owner of HL-2K observe the above cautions at all times, so that your HL-2K brings a long operating life.

HL-2K
CIRCUIT DIAGRAM
TOKYO HY-POWER

