

Users Manual
Solid-State HF Band
750W Linear Power Amplifier
Model HL-1.2KFX



1. Introduction

Thank you for purchasing the HL-1.2KFX. This compact and lightweight desktop HF linear power amplifier has a maximum input power of 1.35kW. Our solid-state broadband power amp technology makes it the smallest and lightest in the industry.

Typical output power is 750W PEP/SSB and 630W CW with the drive power of 75-90W.

2. Cautions

2-1 The amplifier is cooled by forced airflow. Several inches of clearance on the top and the rear wall are necessary to allow for smooth air intake into the fan. Do not block the air vents on the top cover.

2-2 Keep the amplifier out of direct sunlight, in a cool dry environment

2-3 Internal high voltages, (AC, DC and RF), are present at all times, ON AIR or OFF. Internal access should be limited to avoid injury.

2-4 Turn off the AC main power immediately upon any unusual sounds, sights or odors. Check the multimeter readings of Vd and Id, the fuses and all cable connections around the amplifier. Please notify the dealer or the factory of any problems.

2-5 For your safety, do not operate the amplifier without adequate grounding. A proper ground connection will result in peak performance and stability, in addition to reduced RF strays or noises.

2-6 To eliminate the RF interference to such home appliances as TV, FM radio, telephone sets, and etc., it is recommended that clamp-on ferrite cores be inserted at both ends of the remote control cable, ALC cable, coaxial jumper cable, and antenna cables, as needed. Also, a common mode AC line filter (near the AC outlet), and in-line low pass filters on the antenna coaxial cable, (as necessary), are recommended.

2-7 The amplifier has fast acting sophisticated protection circuits. Please note, however, any such actions that cause the same fault to occur repeatedly, will lead to failure of the valuable final power FET transistors.

2-8 Before checking inside the amplifier, be sure to wait a few minutes for the high DC voltage to discharge (monitor Vd meter reading). The potentiometers for RF power detector, protection circuits,

FET bias voltage circuit, etc, are precisely adjusted at the factory, and should not be altered. Doing so, would require readjustment with precision measuring instruments.

2-9 The primary power transformer is factory pre-wired for AC115V/230V operation (or as specified by the user at the time of order). Sliding the select switch located on the bottom of the chassis can make the voltage change from 230V to 115V. (See AC Power section.) Be sure to verify switch selection before you plug the AC power cord into the outlet.

2-10 Before starting the amplifier, be sure to connect a dummy load (50 ohms, 1kW min.) or a well-adjusted antenna to the output terminal. Operating without any load will cause extreme stress to the RF power FET's, although protection circuits should work under critical conditions.

2-11 Required drive power is slightly less than 100W to obtain the full 750W output. Do not attempt to operate with excessive drive from a high power transceiver.

2-12 Keep the aluminum heat sink and air openings free from dust and blockages. Periodic cleaning will prevent degraded cooling efficiency.

2-13 For long continuous operation in RTTY/FM modes, it is recommended you reduce the RF drive levels by 20% to 30% lower output than CW/SSB modes.

2-14 To prevent damage to the precision electronic components, avoid extreme physical shock to the amplifier. If factory service is required, the amplifier should be shipped using the original box and packaging materials.

3. Features

3-1 Our solid-state broadband design engineers worked to make the HL-1.2KFX, the lightest and most compact quasi 1kW HF amplifier in the industry. This world-class compact 750W HF amplifier is the easiest to handle and operate.

3-2 The amplifier's main PA section includes 4 high power MOS FET SD2933's by ST Micro, resulting in 750W PEP (SSB max.) on HF. The amplifier's broadband characteristics require no further tuning once the operating band is selected.

3-3 The amplifier allows operation in full break-in CW mode due to the use of the amplifier's high-speed antenna relays (made by Panasonic/Matsushita).

3-4 With the unique duct structure design and the powerful blower fan, the aluminum heat sink block for RF PA module (and other components), are effectively cooled. The fan's quiet operation allows for even the weakest DX signals to be heard.

3-5 The amp utilizes a sophisticated circuit to run the various high speed protection circuits such as overdrive, high antenna SWR, DC overvoltage, band miss-set etc.

3-6 This amplifier is compatible with both AC 230V (200/220/240V included) and AC 115V (100/110/120V included). See the illustration in the AC Power Section for changing primary wiring of the power transformer.

3-7 For the safety of the operator, an Interlock system is employed. The AC power is shut down if the top cover is removed, and the automated safety interlock is activated.

3-8 An analog multimeter allows the operator to monitor Pf (Forward output power), Pr (Reflected power), Vd (Drain voltage of power FET), Id (Drain current) etc

4. Specifications

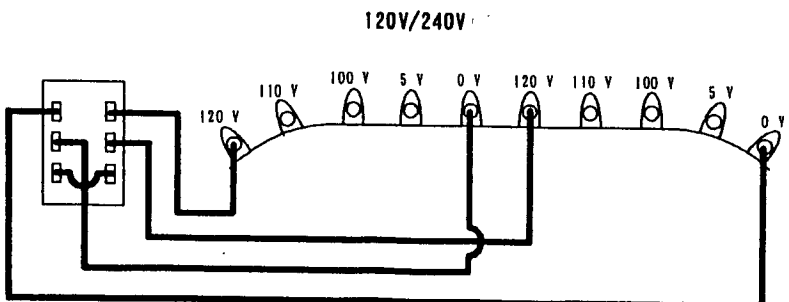
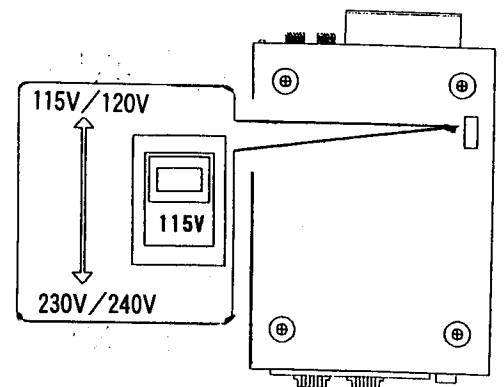
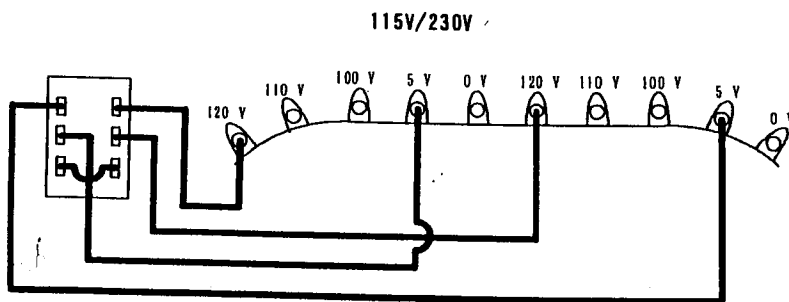
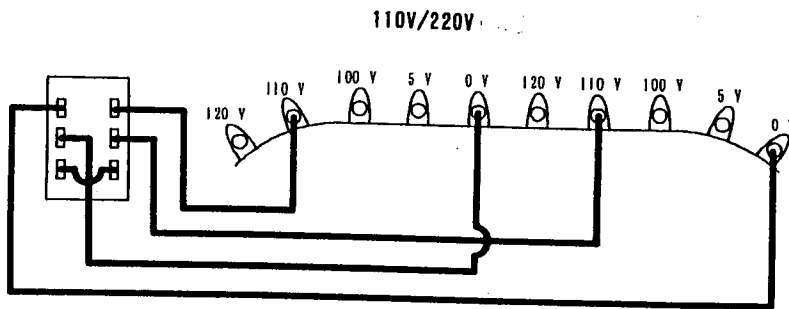
Frequency	:	1.8 ~ 28MHz all amateur bands including WARC bands
Mode	:	SSB, CW, RTTY
RF Drive	:	85W typ. (75 ~95W max.)
Output Power	:	750W PEP max., 630W CW (typ.)
Drain Voltage	:	53V (when no RF drive)
Drain Current	:	30A max.
Input Impedance	:	50Ω (unbalanced)
Output Impedance	:	50Ω (unbalanced)
Final Transistor	:	SD2933 x 4 (MOS FET by ST micro)
Circuit	:	Class AB parallel push-pull
Cooling Method	:	Forced Air Cooling
Multi-Meter	:	Output Power Pf 1kW Reflected Power Pr 100W Drain Voltage Vd 60V Drain Current Id 50A
Input/Output Connectors	:	Type M-J (UHF SO-239)
AC Power	:	AC 230V (200/220/240V), 50/60Hz 7.5A max. AC 115V (100/110/120V), 50/60Hz 15A max.
AC Consumption	:	1.35kVA max. when TX
Dimension	:	232 x 142 x 350 mm (WxHxD) 9.1 x 5.6 x 14.3 inches
Weight	:	Approx. 15kgs. or 33lbs.
Accessories	:	AC Power Cord x 1 RCA Plug x 2 Spare Fuse 8A (for AC 230V line) x 2 Spare Fuse 15A (for AC 115V line) x 2 Spare Fuse 1A (Miniature Fuse) (For PC1664 , main control board x 1, For PC1662 , power amp board x 1) Spare Fuse 2A (Miniature Fuse) x 1 (For PC1407 Control board x 1) User Manual x 1
Optional Items	:	Antenna Tuner (HC-1.5KAT) (future)

5. AC Line Voltage

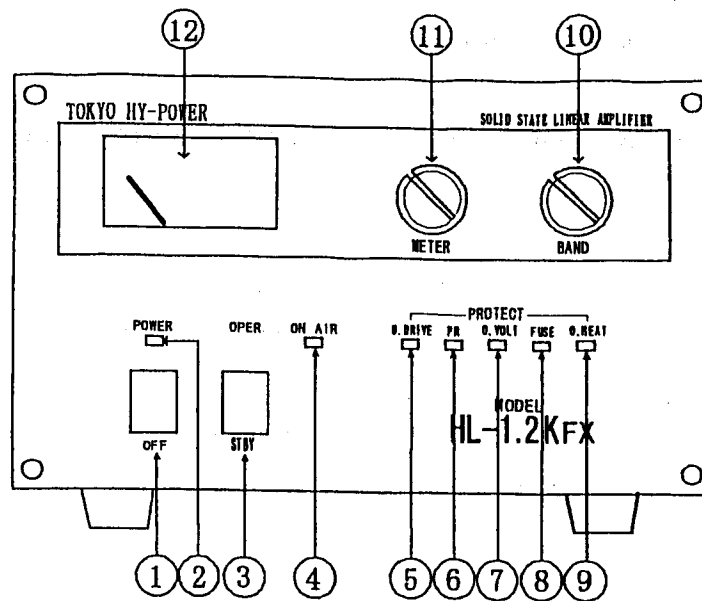
5-1 Although the amplifier is designed to work with both AC 115V (100-120V) and AC 230V (200-240V), for stability we recommend operation from AC 230V.

5-2 The correct AC plug (not included in the package), must be obtained locally due to the AC plug variations worldwide.

5-3 The AC voltage has been factory preset for 230V use (or as requested by the customer at the time of order). If you wish to change to AC 115V, change the voltage setting by sliding the switch knob located on the chassis bottom, (as illustrated below). See the other illustration for AC voltages other than 230/115V. For your safety, before making these adjustments, be sure to pull the AC plug from the AC outlet to avoid injury.



6-A. Front Panel Description

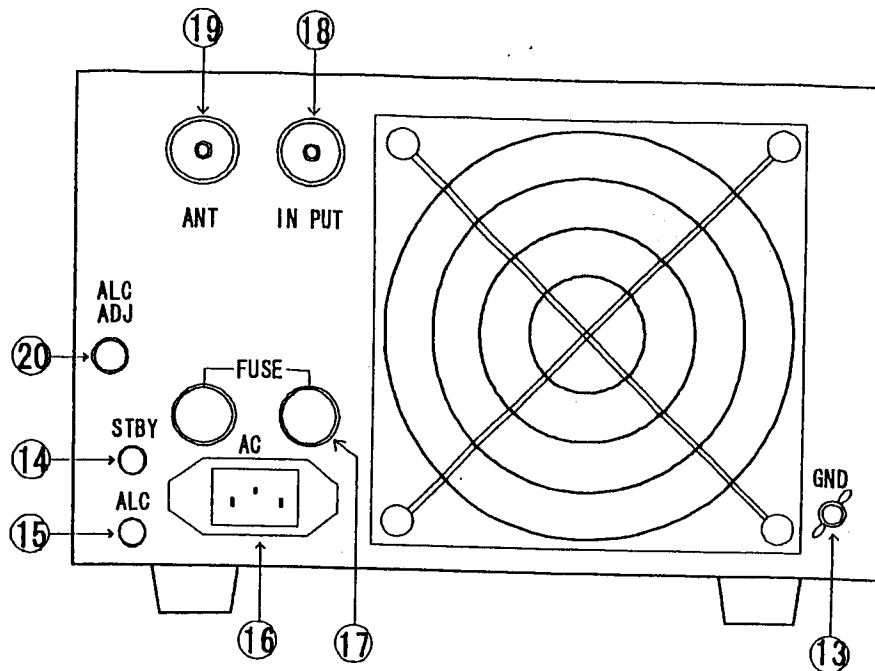


- ① **POWER** Main power switch to turn AC power on and off.
LED (green ②) lights when turned on.
- ③ **OPER.** OPERATE /STAND-BY switch. At OPERATE, the amplifier is ready to go into ON AIR (TX) mode and at STBY, it is on STAND-BY mode.
- ④ **ON AIR** Green LED lights when the amplifier is in transmit (TX) mode.
- ⑤ **O.DRIVE** When overdrive or band miss-set is detected, LED lights to indicate the protection circuit has worked.
- ⑥ **PR** LED lights when reflected power from antenna exceeds 70W to indicate protection circuit has worked.
- ⑦ **O.VOLT :** When the DC drain voltage of the FET's (Vd) is too high, the LED lights to indicate the protection circuit has worked.
- ⑧ **FUSE** LED lights when the 15A glass fuse has blown from excessive Id. (Two 15A fuses are on the PC1622 PA board.)
- ⑨ **O.HEAT** When the PA module temperature reaches 80 deg. C, the LED lights to indicate the protection circuit has worked. (It is necessary for the cooling fan to operate for several minutes to cool the PA module).

(Turning the main POWER switch to off, and then on again to reset the Protection Circuits.)

- ⑩ **BAND** Select the desired operating frequency band.
- ⑪ **METER** To change the multi-meter scales. Meter reads Pf, Pr, Vd, and Id.
- ⑫ **MULTIMETER** Pf (Forward output power), Pr (Reflected power from antenna), Vd (FET drain voltage), and Id (FET drain current) are shown on the scale as selected by ⑪ METER select switch.

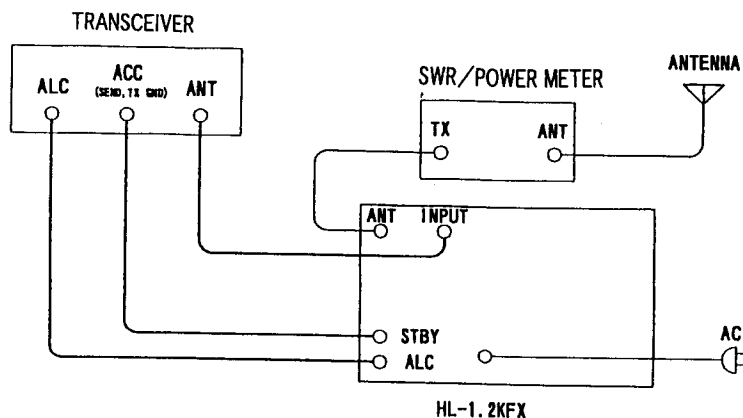
6-B. Rear Panel Description



- ⑬ **GND** Ground Terminal
- ⑭ **STBY** RCA Jack. Connect the control cable from the ACC terminal (or SEND, TX GND etc.) of the transceiver. The center pin is to be shorted to ground through the relay circuit of the transceiver. The DC current necessary is 5V, 1mA only.
- ⑮ **ALC** RCA Jack for ALC Voltage Output. Negative DC voltage appears at the center pin, which is fed back to the ALC terminal of the transceiver. ALC is used to keep the amplifier output power at certain limits. Also it is useful when the transceiver output power is higher than 100W. (See page 13. 8. ALC Connection). Also consult your HF transceiver's user manual.
- ⑯ **AC POWER** AC Mains Socket. Socket for the AC power cord. (Socket is EMI filtered.)
- ⑰ **FUSE** A pair of fuses for AC Mains. 8A glass fuse. (Change to 15A fuses if 115V line voltage is selected.)
- ⑱ **INPUT** RF Input Connector. Connect the coax jumper cable from the transceiver.
- ⑲ **ANT** RF Output Connector. Connect the coax cable to the antenna.
- ⑳ **ALC ADJ.** Potentiometer to adjust ALC voltage level. Minus 10V is available at maximum, when turned full counter-clockwise. Factory setting is 0 volts, with the pot turned full clockwise.

7. Connection & Operation

This section explains a one-antenna system connected to the transceiver and an external SWR/POWER meter



7-1 Connect AC cord and coax cables as illustrated above. Connect the cable from “SEND” to ACC or the remote terminals of transceiver, where it is marked “SEND” or “TX GND”. These terminal pins are shorted to ground when the transceiver is in TX/ON AIR mode. If these connections are not made, the amplifier will not go into TX (amplification) mode. For a temporary check to the amp, ground the SEND center pin by inserting an RCA plug whose center pin has been soldered to the outer case of the plug with a small piece of wire.

7-2 At first, turn the ALC knob full clockwise to avoid ALC voltage to the transceiver. Application of ALC will be covered in the following section 8.

7-3 Keeping the POWER (AC mains) switch off, check the SWR of your antenna by keying the transceiver to TX mode (CW or RTTY mode). Monitor the SWR with an external SWR/Power meter. If SWR is 1.8 or higher at band center, the antenna has to be adjusted for lower SWR.. As an alternative, an antenna tuner may be inserted.

7-4 Turn the POWER switch on. Turn the BAND switch to a desired operating frequency band. Turn the STAND-BY switch to OPER (operate) position and the amplifier is ready to go. If you key the transceiver with the carrier level set relatively low (such as 20-30W), you will achieve an amplified output signal of a few hundreds watts. Monitor this output with the multimeter in the (Pf position) or with an external power meter. Increase drive level to roughly 50W and see if the antenna SWR stays constant. (As higher RF currents flow, some antennas may show a changed SWR value due to heated connector junctions and trap coils.)

7-5 You can now increase the drive level to nearly 80-90W to achieve maximum carrier output power of 630W (CW, RTTY) from the amplifier. If you change to SSB mode, peak voice power will reach approximately 750W. For high duty cycle transmissions like RTTY, SSTV, or FM modes, it is recommended you reduce the drive power by 30-40% compared with SSB/CW. In AM mode, the drive power should be strictly reduced to one third of SSB, or 30W at most, otherwise modulated amplitude peaks will be distorted.

7-6 With a high power transceiver in SSB mode, you can overdrive the amplifier resulting in a distorted output signal. This can also occur if you speak too loud or if you set the microphone gain too high. Speak into the microphone properly to reduce the possibilities of splattering into the neighborhood. The ALC is effective in preventing the output signal from being distorted or to limit the carrier level to within rated output levels. As long as you do not overdrive, you can disregard the ALC connection. See Section 8, ALC CONNECTION for details.

7-7 Protection circuits may work during operation depending on the conditions. If the protection circuit has shut down the amplifier, check the antenna SWR, Vd , AC line voltage, or try to reduce the drive level. To reset, turn off the POWER switch once, then back on again. The power transformer has an overheat protection in the coil layer. If this temperature switch activates, the amplifier will put you in receive mode with the cooling fan operating until the transformer has cooled off. It may take ten to fifteen minutes to cool, depending upon room temperature. For more details on this protection circuit, see Section 9.

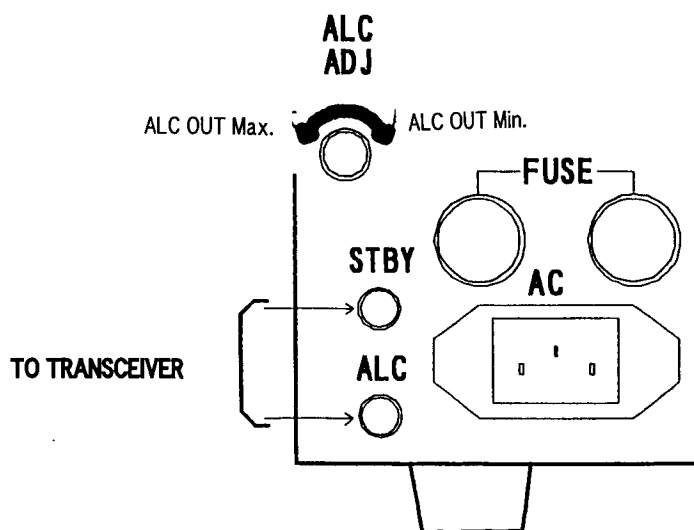
8. ALC Connection

ALC voltage is available at the terminal marked ALC (RCA phono jack) on the right upper corner of the rear panel. Negative maximum DC voltage of ten volts (- 10V) is produced at this terminal when the amplifier is fully driven. This voltage is adjustable with the ALC ADJ. knob located above the ALC jack. If the ALC voltage is properly fed back to the transceiver, we advised you to keep the maximum output power constant or hold the power at a certain level. Also ALC is useful in avoiding your SSB signal from being distorted when overdriven. You may not always need to connect ALC to the transceiver, if you set the mic gain properly and do not overdrive the amplifier. Depending upon the manufacturer of the transceiver, the suitable ALC voltage differs. ICOM may need 0~ -4V, and Yaesu may need 0~ -5V range.. Kenwood may need -6 ~ -8V maximum. Check your transceiver manual.

8-1 Prepare an ALC control cable using the RCA plug supplied in the package. Solder a single wire or (more preferably) a shielded single wire to the center pin of RCA plug and solder the shield braid to the outer side of the plug. Connect the control cable to the "ALC (or EXTERNAL ALC)" jack of the transceiver. External ALC input is sometimes available at one of the pins of the "ACC" socket of the transceiver as well.

8-2 At first, turn ALC ADJ. full clockwise. Drive the amplifier in CW/RTTY mode to full output power. Then turn the ALC ADJ counter-clockwise. Observe the SWR/Power meter at the output, (or Pf of the multimeter). Stop turning the ALC ADJ at the point the power starts to decrease. Or if you wish to further reduce the power, keep turning ALC ADJ until the desired level is achieved. If you further try to increase the drive power you will now see the output power become rather saturated, from these adjustments,

(Maximum ALC voltage produced is -10V when the amplifier output is over 200W.)



9. Protection Circuits

There are five major protection functions in this amplifier. If the amplifier has shut down for some reason, before re-setting, correct the possible cause of the shut down. Turn off the POWER once and back on to reset.

9-1 O.DRIVE (Over Drive/ Band Miss-set)

When the drive power exceeds the 100W level, the amplifier will shut down to STAND-BY mode (or receive) in order to protect the input side of the power FET's. This protection might also activate if the band is set wrong. This usually occurs, when the amplifier band setting is lower than that of the transceiver.

9-2 O.HEAT (Over Heat)

When the temperature of the aluminum heat sink in the power amplifier reaches 80 degrees C, the amplifier defaults to RECEIVE mode to protect the power FET's. Likewise, if the temperature of the inside layer of the power transformer reaches 130 deg. C, the amplifier will default to RECEIVE mode for your safety. O.HEAT protection cannot be reset until the heat sink or transformer has sufficiently cooled off.

9-3 O.VOLT (Over Voltage)

If there is a sudden AC line voltage spike, or if the transformer primary develops a fault, the FET drain voltage may rise above acceptable levels. If O.VOLT protection trips, check the AC line voltage with a circuit tester or an AC voltmeter.

9-4 FUSE (Fuse Blown)

If either of the glass fuses (15A) on PC1662 fails, O.VOLT protection activates. Under normal usage of the amplifier, this failure should rarely (if ever) occur. If it occurs, there is a possibility that the power FET's have failed together. If the amplifier cannot be reset, consult with the dealer or the service center.

9-5 PR (Reflected Power Protection)

If reflected power because of the antenna reaches approximately 80W, the PR protection may trip. If it does, one solution is to reduce the drive power from the transceiver. Or you may need to check that your antenna match (SWR) is still ok. If the match cannot be corrected and the antenna system isn't faulty, use an antenna tuner.

As noted above, the amplifier is equipped with several kinds of fast acting protection circuits using the latest in analog technology. However, if the amplifier is operated in such a manner that multiple protections work repeatedly over a long period of time, the amplifier can be seriously

damaged.

10. Explanation of Major Circuits

Five major circuit blocks are explained in their basic form and using signal flows.

10-1 Main DC Power Supply

10-2 Power Amp, L.P.F.

10-3 RF Power Detector, TX/RX Switching

10-4 Control Board

10-1 Main DC Power Supply

The main DC power supply feeds the 50V DC power to the final PA stage. It is a non-regulated power supply and consists of the compact power transformer using an oriented core, a bridge diode rectifier, and a high capacity electrolytic capacitor of 68,000uF for the filter. A soft start circuit suppresses the AC rush current using a thyristor. A part of 50V line is converted to 24V using a DC-DC converter and is supplied to the cooling fan.

10-2 Power Amp (PA PC1662) / L.P.F. (PC1399B)

The RF PA is the heart of this amplifier and is composed of four SD2933 MOS FET's made by ST Micro, a French-Italian joint venture firm. The amplifier is a parallel push-pull type of class AB amplifier. The gate bias supply circuit is regulated for the best stability and is thermally compensated.

The PA has a 6dB attenuator on the input for gain reduction and to enhance the stability of the wide band power PA. The heat sink has two different thermal sensors to detect temperatures of 40 deg C, and 80 deg C, respectively. At 40 deg C, the cooling fan shifts into high-speed mode. At 80 deg C, the amplifier will lock the amplifier into RECEIVE mode to protect the power FET's.

In the L.P.F. (output low pass filter) circuit, there are eight different band filters that are selected either by the auto band decoder or by the manual band switch. Each L.P.F. is used to reject harmonics so that the amplifier meets international telecommunication equipment standards.

10-3 RF Power Detector/ TX-RX Switch (PC1398B)

As illustrated below, there are two RF power detectors on this board. One detects the drive signal level from the radio and the other monitors the outgoing power and the reflected power from the load (antenna).

The TX-RX switch (Send-Receive switching) will switch the flow of drive power/ output power and the incoming signal from the antenna with two high-speed relays mounted at the input and output sides of the PA.

10-4 Control Board (PC1698)

This is the heart of the control signal processing for the HL-1.2KFX. It judges the operating condition of the amplifier, as well as issuing the commands to the peripheral circuits. Various analog signals are processed such as RF drive from the transceiver, RF power signals at various points, DC power supply information, etc.

There are ope-amps, various three terminal voltage regulators, GAL logic device etc. Warning signals are processed by the logic IC for Over Heat, Over Voltage, Pr, Band Miss-set etc. Ope-amps produce the necessary DC signals to drive the Pf , Pr meters.

Also there is a control circuit that issues the drive shut down command in case of the over drive, band miss-set and high antenna SWR conditions.

11. Trouble Shooting

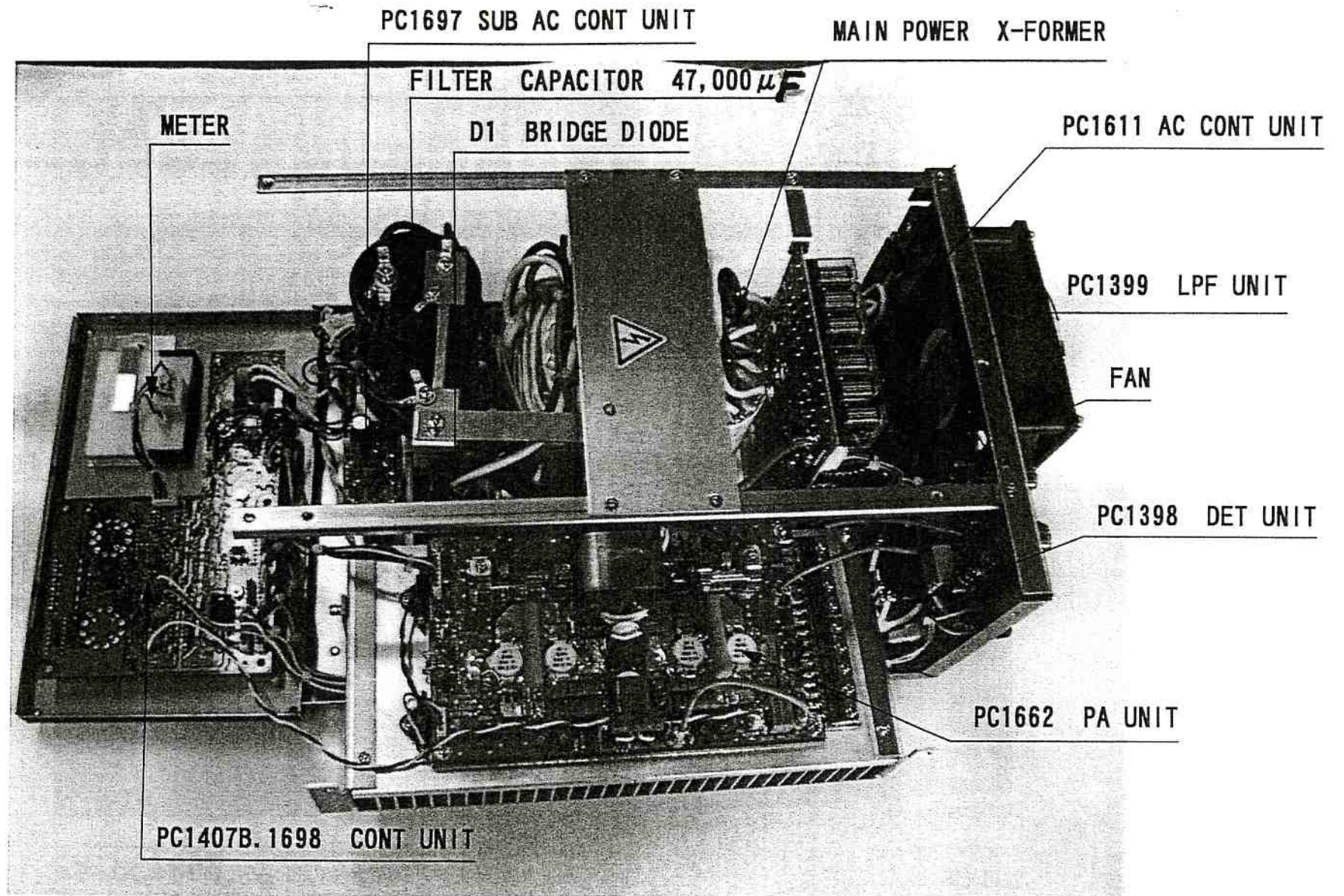
Failure	Possible Cause	Solution
AC mains not operating	<ul style="list-style-type: none"> ① AC fuses blown ② AC cord not plugged in ③ Interlock switch lifting ④ Wrong tap used on power transformer primary 	<ul style="list-style-type: none"> ① Replace with new ones. ② Plug in securely. ③ Screw bolts tightly on the top cover. ④ Correct primary wiring.
Can't enter Transmit mode	<ul style="list-style-type: none"> ① Remote control cable not connected ② Protection circuits on. 	<ul style="list-style-type: none"> ① Check the cable and connect properly. ② Check drive power, antenna SWR, antenna selector A/B. Reset with AC POWER switch.
O.Drive lights	<ul style="list-style-type: none"> ① RF overdrive ② Band miss-set 	<ul style="list-style-type: none"> ① Decrease drive. ② Match the BAND correctly
PR lights	<ul style="list-style-type: none"> ① Reflected power high, Antenna SWR high ② Poor connection to coax cables 	<ul style="list-style-type: none"> ① Check/ adjust antenna. (Or decrease drive.) ② Check the coax cable connectors.
FUSE lights	<ul style="list-style-type: none"> ① Fuse blown ② Antenna SWR high ③ Short circuit 	<ul style="list-style-type: none"> ① Replace F202 and F203 (20A) on the PA board (PC1662). ② Adjust the antenna. ③ Contact the distributor, or service center.
O.Heat lights	<ul style="list-style-type: none"> ① Internal Temperature above 70deg. C 	Cool off until LED turns off. Check for air intake blockages. Also check air vent on top cover.
TVI, FMI	<ul style="list-style-type: none"> ① Overdrive. ② RF leakage from coax cable, grounding wire, AC power cord etc. 	<ul style="list-style-type: none"> ① Decrease the drive. Check ALC setting. ② Insert common mode filters on antenna cable or AC line. Add clamp-on ferrite cores (TDK, Amidon, Palomar) on various cables.

12. Parts Layout

- 12-1 Top View (Detailed)
- 12-2 Top View & Side View (Right)
- 12-3 PA (PC1662)
- 12-4 Power Detector (PC1398B)
- 12-5 Control Board (PC1698) Front View
- 12-6 Control Board (PC1698) Copper Side
- 12-7 LPF (PC1399B), AC Control Unit (PC1611)
Sub AC Control Unit (PC1697)
- 12-8 Freq. Detector Unit (PCS1733)

13. Schematic Diagrams

- 13-1 PC1662 PA (Power Amplifier)
- 13-2 PC1398B RF Power Detector
- 13-3 PC1399B L.P.F. (Low Pass Filter)
- 13-4 PC1611DC AC Main Power Supply PC board
- 13-5 PC1697 Sub Power Supply PC Board
- 13-6 PCS1733 Freq. Detector Unit
- 13-7 PC1698 Control Board
- 13-8 Overall Block Diagram



PC1697 SUB AC CONT UNIT

MAIN POWER X-FORMER

FILTER CAPACITOR 47,000 μ F

METER

D1 BRIDGE DIODE

PC1611 AC CONT UNIT

PC1399 LPF UNIT

FAN

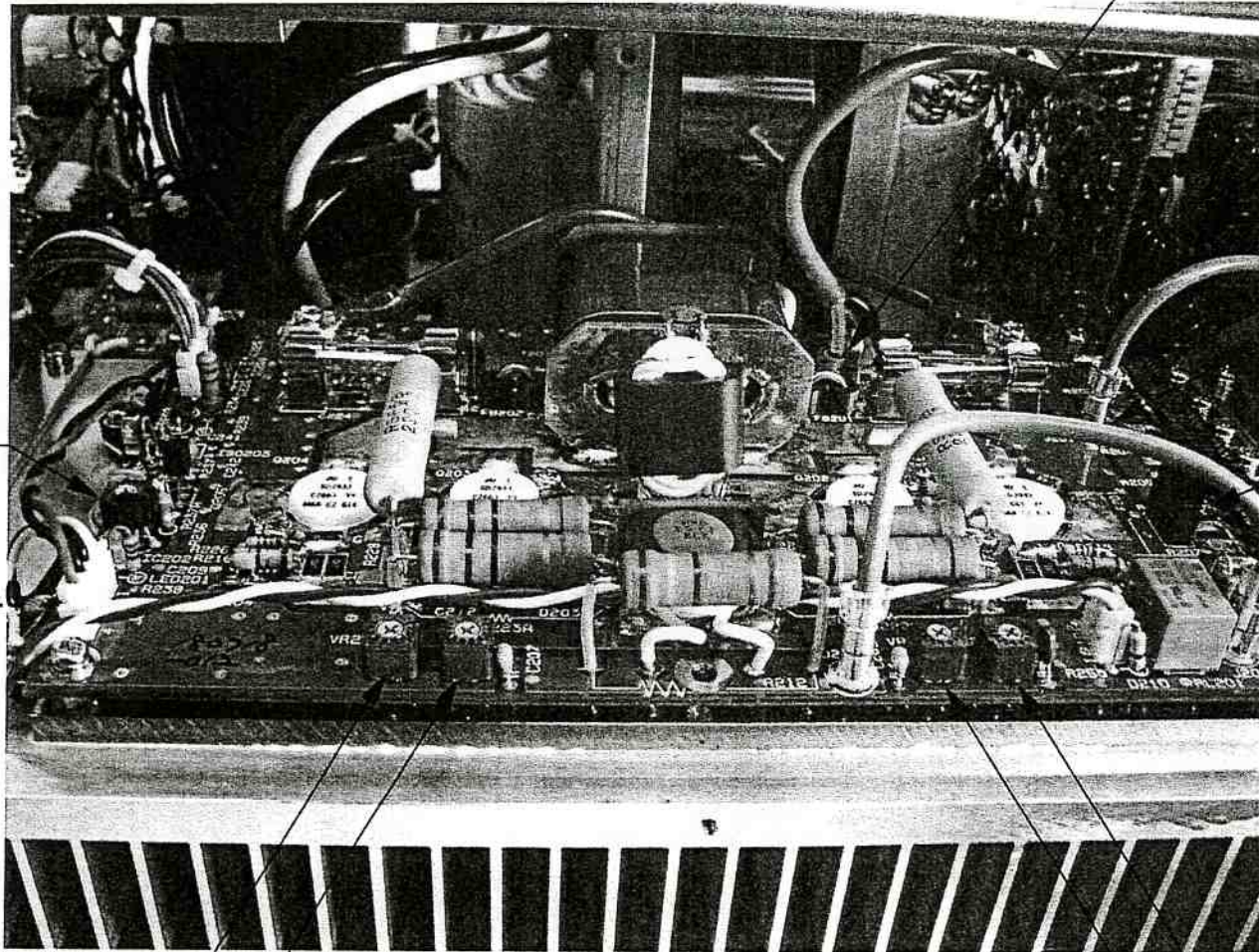
PC1398 DET UNIT

PC1662 PA UNIT

PC1407B.1698 CONT UNIT

PA:PC1662

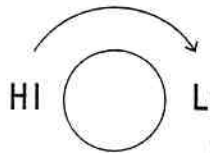
RF OUT



J201 RF IN

MINE FUSE F201 1A

VR205
BIAS REF



VR204

VR203

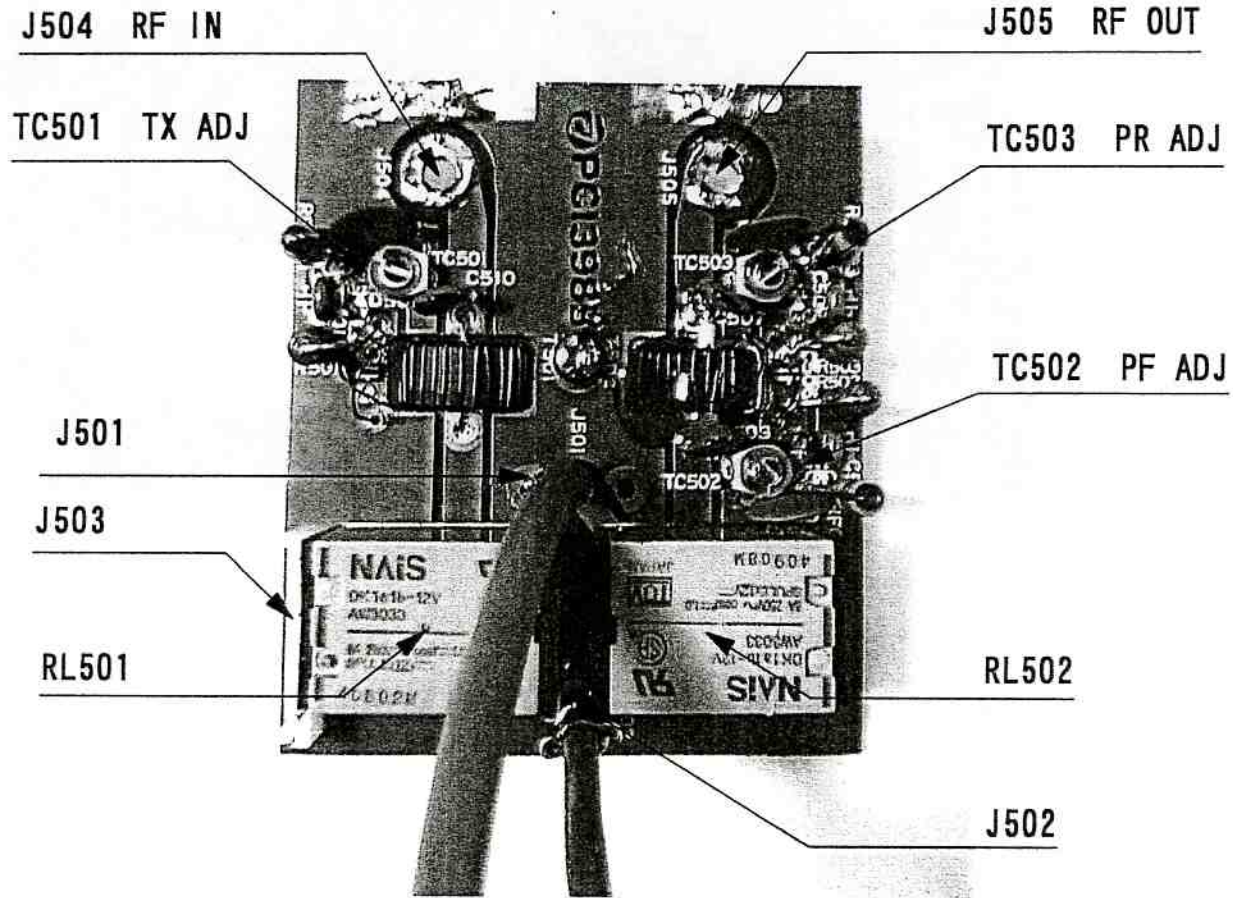
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FET BIAS ADJx4
(VR201~VR204)

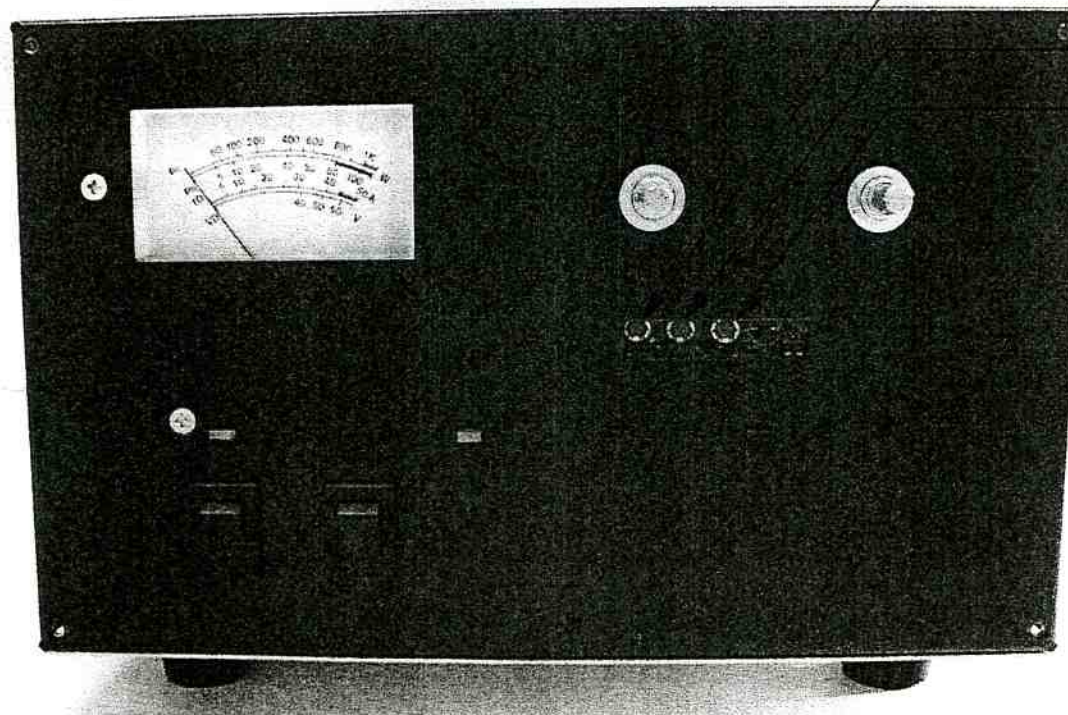
VR201

VR202

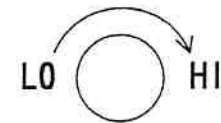
PC1398B DET UNIT



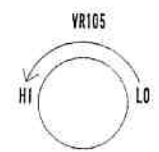
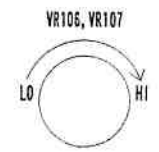
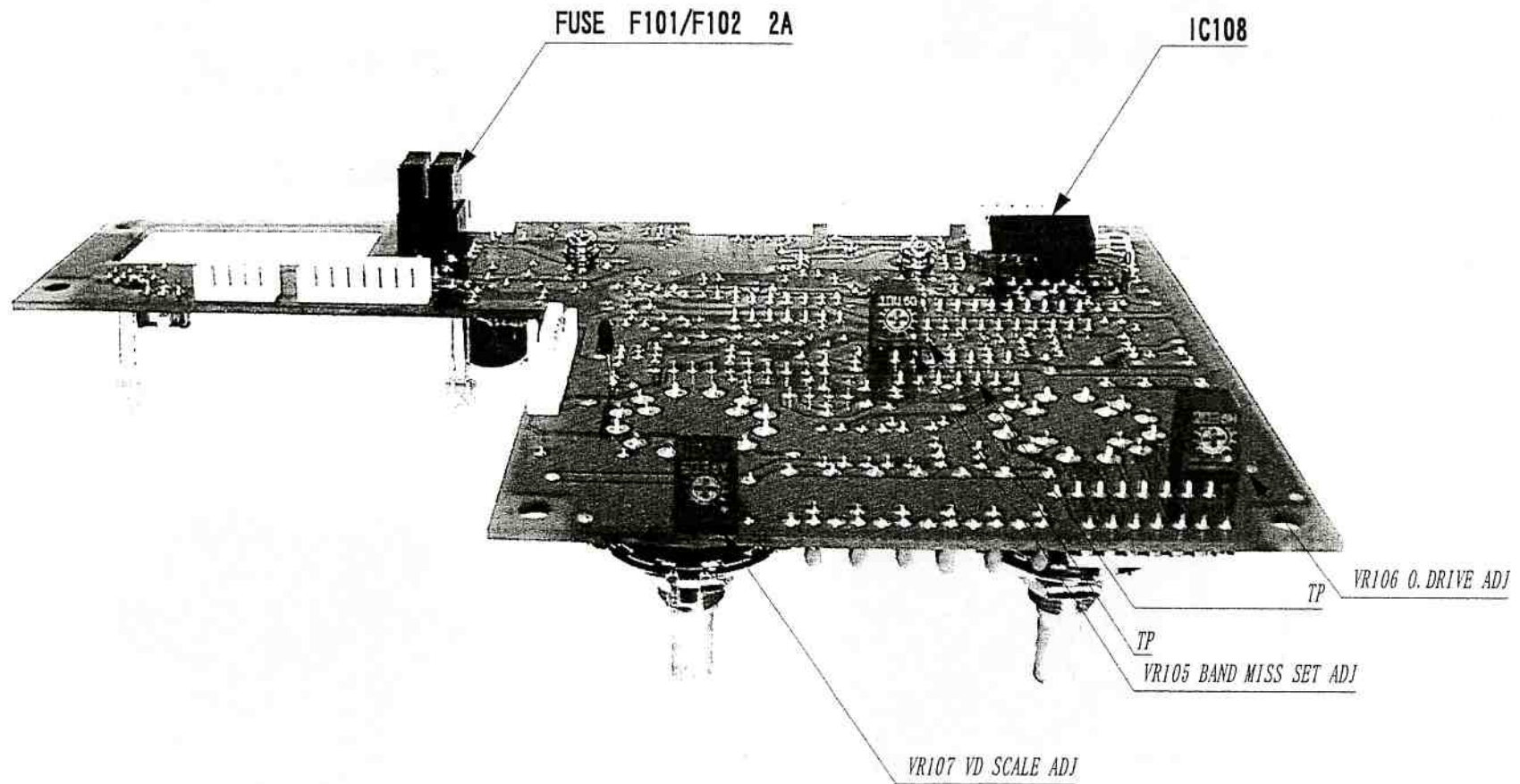
CONTROL BOARD (FRONT VIEW) : PC1407B/PC1698



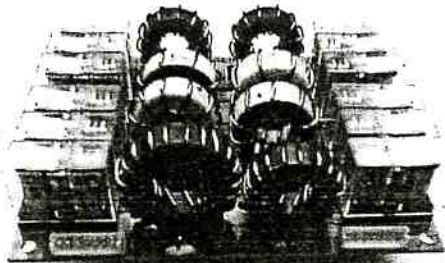
- VR101 PF SCALE ADJ
- VR102 PR SCALE ADJ
- VR103 ID SCALE ADJ



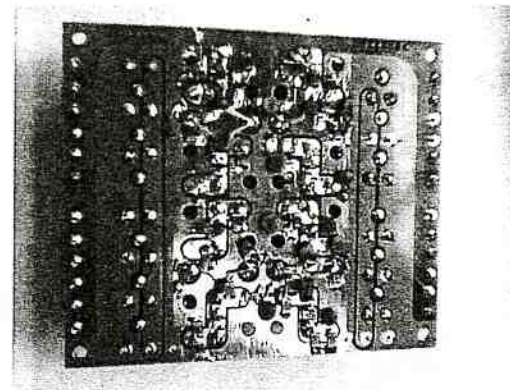
PC1698 COPPER SIDE



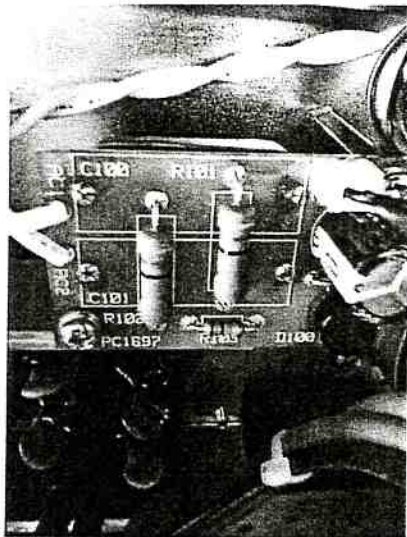
PC1399 L.P.F



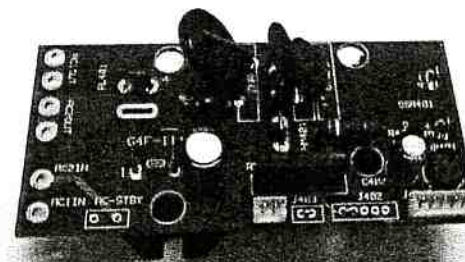
PC1399 COPPER SIDE



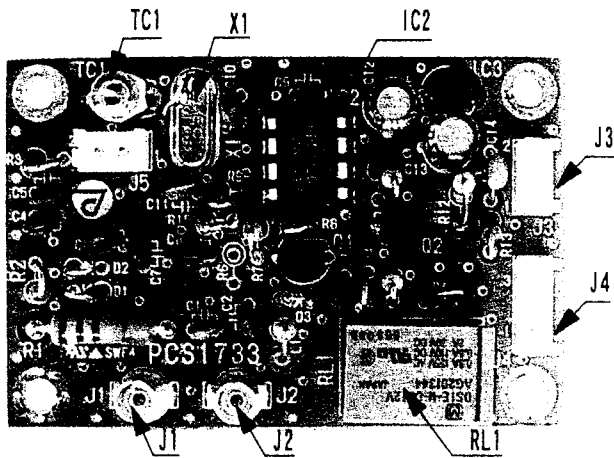
PC1697 SUB AC CONT UNIT



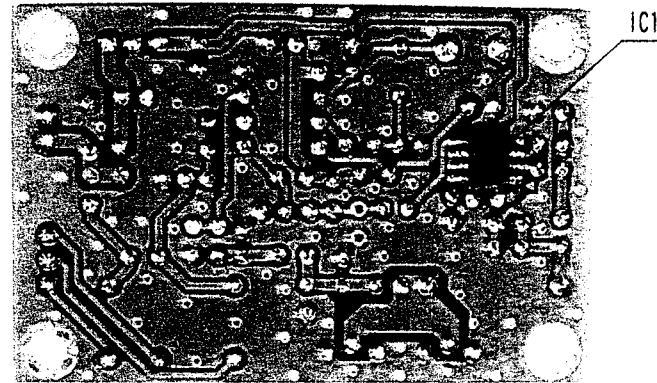
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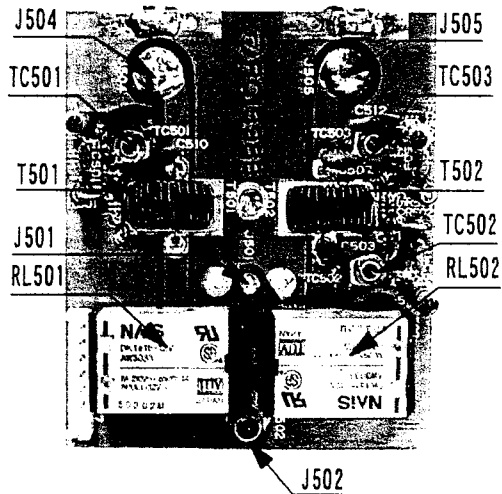
PCS1733 F DET UNIT



PCS1733 F DET UNIT
COPPER SIDE



PC1398B DET UNIT



PC1398B DET UNIT
COPPER SIDE

