INSTRUCTION MANUAL JUMBO
MODE D'EMPLOI JUMBO &
SERVICE MANUAL

HAM INTERNATIONAL
BRUSSELSESTEENWEG 428
B 9218 GENT

Specifications

General	
Channels	120 channels in 3 bands
Modulation Modes	FM, AM, LSB, USB
Frequency Range	26.965 to 28.305 MHz
Tune	±5 kHz
Frequency Control	Phase-locked synthesizer
Frequency Tolerance	±0.005%
Frequency Stability	±0.003%
Operating Temperature Range	−30°C to +50°C
Microphone	Plug-in [4-pin], 600 Ohm dynamic type
AC Input Voltage	220V, 50/60 Hz
AC Power Consumption	75W
DC Current Drain	1.5A [at maximum audio modulation] 0.5A [at standby with no signal]
Antenna Connectors [A and B]	Standard SO-239 type
Semiconductors	6 ICs, 2 FETs, 52 Transistors (Excluding the *Roger Beep* unit)
Meter #1	Indicates relative RF power output/antenna SWR,
Meter #2	Indicates received signal strength
Transmitter	
Power Output	4W or 0.5W–AM/FM, 12W (PEP)-Single sideband
SSB Generation	Dual-balanced modulation
AM Modulation	Class B amplitude, collectors modulation
AM Modulation Capability	100%
Harmonic and Spurious Emission	Better than 60 dB
AM/FM Frequency Response	400 to 5,000 Hz
SSB Frequency Response	400 to 3,000 Hz
Output Impedances [A and B]	50 Ohms unbalanced
Output Indicators	RF Meter shows relative RF output power
Tune	±4.5 kHz minimum
Receiver	
FM Sensitivity	0.5 μV for 20 dB S/N
AM Sensitivity	0.7 μV for 10 dB S/N
SSB Sensitivity	0.2 μV for 10 dB S/N
AM/FM Selectivity	5 dB at 4 kHz, 50 dB at 10 kHz
SSB Selectivity	5 dB at 2 kHz
Image Rejection	More than 50 dB
IF Rejection	More than 80 dB at 455 kHz
AGC	Change in audio output: less than 12 dB from 10 μV to 0.4V
Squelch	Adjustable – threshold less than 0.7 μV
Audio Frequency Response	400 to 2,500 Hz
Distortion	Less than 10% at 3 watts output 8 Ohms
Adjacent Channel Rejection	>75 dB at 0.3 μV
Cross Modulation	>50 dB
Intermediate Frequency	10.695 MHz [AM-1st, SSB], 455 kHz [AM-2nd]
Clarifier Range	±800 Hz
Tune Range	±4.5 kHz minimum
Noise blanker	IF single gate type
Audio Output Power	More than 3 watts into 8 Ohms
Built-in Speaker	8 Ohms, dynamic
External Speaker (optional)	Disables internal speaker when connected

Note: If you find difficulty to obtain SWR readings smaller than 3 (ratio 1 is ideal though very hand to gain), consult the dealer to determine how to mach your antenna to your *JUMBO*.

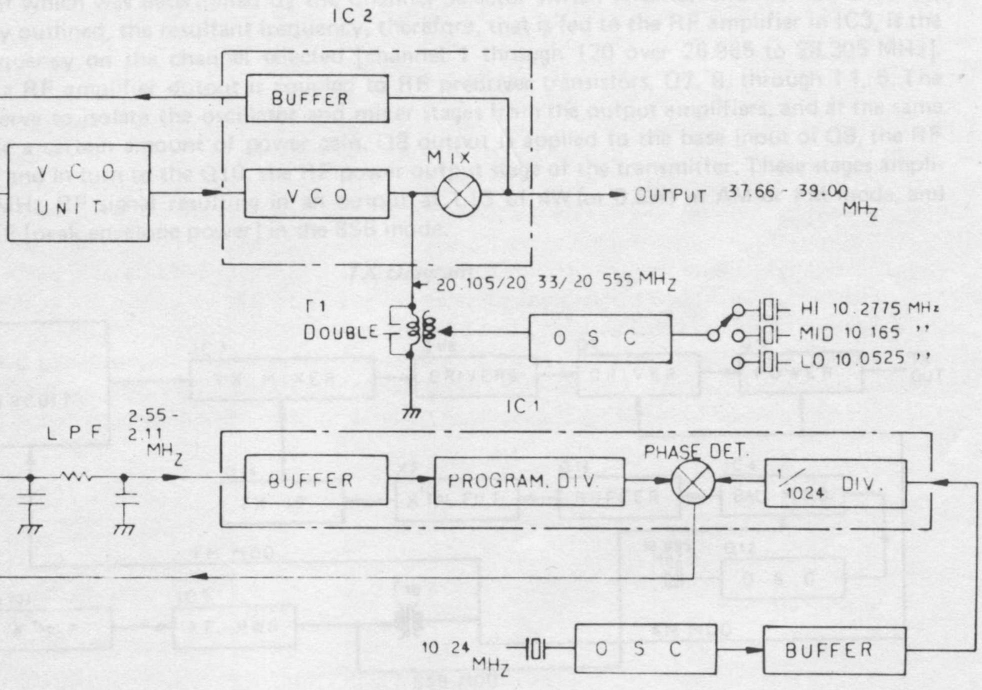
Maintenance and Adjustment

The transceiver is specifically designed for the environment encountered in the base station use. The use of fully solid state circuitry and its rugged style result in high reliability. Should a failure occur, however, replace parts only with identical parts. Do not substitute. Refer to the Schematic Diagram and Replacement Parts List in this manual. If the performance described in the *Operation* section is not obtained, review the *Installation* section to insure that proper procedures were followed. If a problem still exists, refer to your *HAM International* dealer.

Circuit Description

The transceiver is a 120 channel CB radio which uses a phase locked loop [PLL] system of frequency synthesization to produce the crystal controlled channel and IF signals used in operation of the transmitter and receiver sections of the unit. The basic PLL system is comprised of a free-running voltage controlled oscillator (part of IC2), a phase detector, a reference crystal oscillator (Q3) and a programmable divider (IC1), as seen in diagram below.

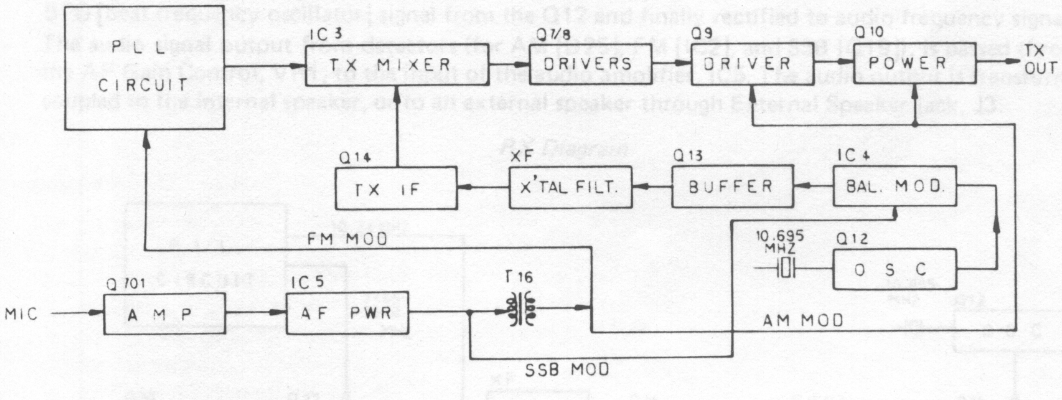
PLL Theory (PTOS006 Circuit Board)



The voltage controlled oscillator [VCO] operates in the frequency range of 17.5550 to 18.4450 MHz in the AM/FM/USB mode and 17.5535 to 18.4435 MHz in the LSB mode, and is used to produce two output signals: #1; 37.660 to 39.000 MHz in the AM/FM/USB mode and 37.657 to 38.997 MHz in the LSB mode, #2; at 2.55 to 2.11 MHz. Reference frequency oscillator Q4 oscillates at 10.0525, 10.165, or 10.2775 MHz in accordance with the Band Selector switch (1.5 kHz lower when LSB mode). Its output is fed through the band-pass filter [BPF]/doubler resulting in an output signal, 20.105, 20.33, or 20.555 MHz in accordance with the band selected (3 kHz lower when LSB mode). This signal beats with the VCO free-running signal producing a 37.66 to 39.0 MHz in the AM,FM/USB mode and 37.657 to 38.997 MHz in the LSB mode, which is fed to the receiver first mixer [Q22] and also to IC3 (on main circuit board PTBM059), the transmitter mixer. The second VCO output signal, at 2.55 to 2.11 MHz is fed to the programmable divider in IC1. Simultaneously the 10.24 MHz output of Q3 [through the buffer Q2] is applied to the programmable divider in IC1 and is divided down in 10 kHz steps. As a channel is chosen by the Channel Selector switch [SW-1 on PTS-W076], and *N* code signal is applied to the terminals [pin No. 9 to 15 of IC1] on the programmable divider in IC1, to preset the divider. The two signals, the crystal oscillated signal [10.24 MHz] from Q3, and the signal from the VCO via the lowpass filter [LPF] and buffer [in the IC1], are compared in the phase detector of IC1 and the phase detector produces a DC output voltage derived from the phase difference in the signals fed to it. This DC output is applied through an LPF to the VCO, forming the phase loop. This DC voltage applied to the VCO causes it to shift frequency until its output signal locks up with the count-down frequency provided from reference oscillator Q3 [when two signals are in phase] at which point no DC output is produced in the phase detector, and th VCO remains *locked* on frequency. When a new channel is selected a new *N* code is applied to the programmable devider. The VCO is no longer locked because of the resulting phase difference in the phase detector, and it again shifts frequency to a locked condition, in turn producing 37 MHz output signals corresponding to the new channel programmed by the new N code. In summary it will be seen that a stable VCO frequency range will be produced, each specific frequency being determined by the N code selected by the Channel Selector switch.

Main Board Assembly (PTBM059)
The crystal oscillator Q12 is operating at 10.695 MHz in the AM/FM/USB mode, and 10.692 MHz in the LSB mode, controlled by the crystal, X3. This signal is #1; in the AM and FM modes of transmission, fed to the IC3 to be mixed with the first TX local oscillator frequency and result in 27 MHz transmitter frequencies, and #2; in the SSB modes of transmission, modulated through the balanced modulator IC4 with the audio output signal from the microphone amplifier, IC5. The resultant output of the balanced modulator is a double sideband, suppressed carrier signal. The crystal filter, XF, pass band is restricted to 3.5 kHz so that it allows only one sideband to pass through its output terminals, either USB or LSB mode, depending upon the Mode Selector switch selection. The exact frequency of which was determined by the Channel Selector switch selection and the PLL circuitry, as previously outlined, the resultant frequency, therefore, that is fed to the RF amplifier in IC3, is the channel frequency on the channel selected [channel 1 through 120 over 26.965 to 28.305 MHz]. The 27 MHz RF amplifier output is coupled to RF predriver transistors, Q7, 8, through T4, 5. The predrivers serve to isolate the oscillator and mixer stages from the output amplifiers, and at the same time provide a certain amount of power gain. Q8 output is applied to the base input of Q9, the RF driver stage and in turn to the Q10, the RF power output stage of the transmitter. These stages amplify the 27 MHz RF signal resulting in an output at L13 of 4W (or 0.5W) in AM or FM mode, and 12 watts PEP [peak envelope power] in the SSB mode.

TX Diagram



Modulation Circuit
AM: The microphone feeds voice audio through Q701 on PTSW072 to the power audio IC IC5, and finally to collectors of Q9 and final RF power amplifier Q10 through T16, thereby amplitude modulating the carrier in AM transmission.
FM: In the FM mode, IC5 output is led to the anode of the FM modulating variable capacitor D5 (also involved for 'Tune' control) in circuit board assembly PTOS006, varying its bias to change parallel capacitance to X2, X3, or X4, finally giving deviation to PLL output frequency.
SSB: The IC5 output is directly fed to the balanced modulator IC4, resulting in suppressed carrier double side band, which is in turn supplied to the crystal filter to carrier removal.
ALC: An audio ALC [automatic level control] voltage derived from the audio signal at Q35 is fed to IC5 to control the output of audio amplifier to prevent overmodulation. In the AM or FM transmission, the output of Q35 is led to Q37 and is used to control the output of T16, whereas in the SSB transmit mode, the output of Q35 is fed to Q38 and is connected to the primary side of T16. This being due to the fact that the output of IC5 [modulation signal] is fed [to modulate the RF signal] from the secondary side of T16 in the AM or FM mode, and from the primary side of T16 in the SSB mode of transmission.
The transceiver is also equipped with the RF ALC circuit utilizing the RF output induced at the input of L12 [in the SSB mode only]. The minus voltage detected through D8 is applied to the DC

plus bias circuit [pin number 7 of IC3, TX mixer] thus reducing the gain of the TX mixer as high level RF signal is observed at L12. This circuit is disabled in the AM or FM mode of transmission. In summary, the ALC circuit [both audio and RF] accomplishes very important function, not only preventing overmodulation, but in the view of harmonic and spuirous suppression [especially in the SSB transmit mode].

Antenna Transmission Line

The lowpass filter between the antenna and collector of Q10 serves to pass the 27 MHz signals, attenuating higher frequency signals. It also acts to match the antenna impedance to the output impedance of the transmitter output stage, this nominally being 50 Ohm.

Receiver

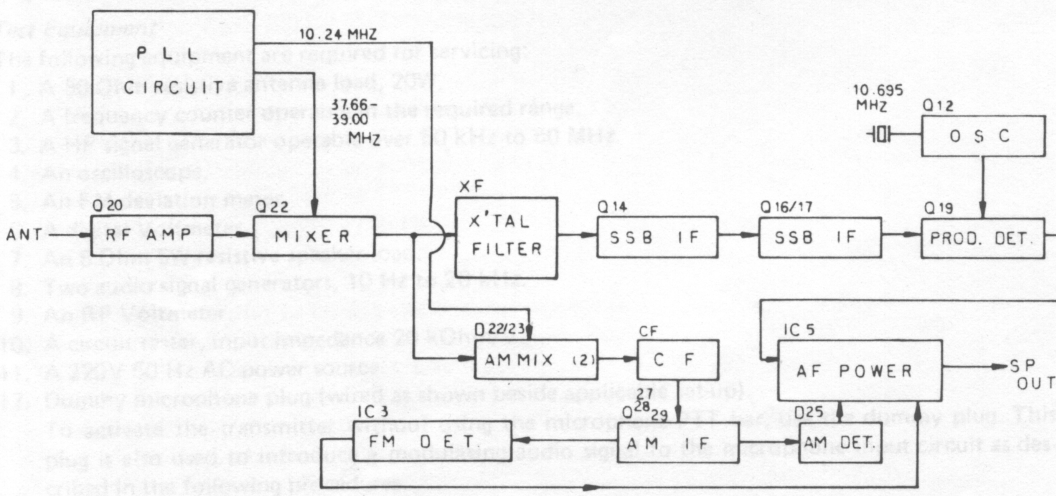
The RF signal, at a frequency between 26.965 to 28.305 MHz, feeds from the antenna through L13, 12, 11, and T7 to the 27 MHz RF amplifier Q20. Then the amplified output signal from Q20 is coupled through T9 to first mixer Q22 where it is beat with an injection signal from the VCO, IC2, through the VCO buffer Q2.

The frequency of the injection signal from IC2 depends on the channel being selected, as a signal of the 37 MHz range is programmed by the Channel Selector. The output of Q22 is therefore, 10.695 MHz in the AM/FM/USB modes, and 10.692 MHz in the LSB mode, the first intermediate frequency and is the result of the RF input and mixing of IC2 VCO signals.

In case of the AM or FM receive mode, this 10.695 MHz first IF signal is then fed to the second mixer, balanced D22 and D23. Also fed to the second mixer is the second local oscillator signal, 10.24 MHz, from Q3. Mixing of these two signals result in a signal at a frequency of 455 kHz in T14. This is the second intermediate frequency for AM or FM mode of reception. In AM mode, the 455 kHz signal passes through the ceramic bandpass filter CF, and fed to IF amplifiers Q27, 28, and 29, which include IF transformer T15. The output of Q29 is applied to D25, the AM diode detector, while in FM receiving mode, the 455 kHz signal amplified only through Q27 is led to FM demodulating IC, IC3 on the PTOS006 through T4. Resultant demodulated audio is acheived from the IC pin #12 and input to AF gain control VR, VR1. In the SSB mode of reception, the signal obtained as a result of the mixing of the RF input and IC2 VCO signals, 10.695 MHz in the USB, and 10.692 MHz in the LSB mode, is not converted down to lower intermediate frequency, but is passed through the crystal filter, XF, and fed to the SSB IF amplifiers, Q14, 16, and 17, which includes T11, and 12. The signal at the secondary side of T12 is fed to Q19, the product SSB detector and beat with the BFO [beat frequency oscillator] signal from the Q12 and finally rectified to audio frequency signal.

The audio signal output from detectors (for AM [D25], FM [IC2], and SSB [Q19]), is passed through the AF Gain Control, VR1, to the input of the audio amplifier, IC5. The audio output is transformer-coupled to the internal speaker, or to an external speaker through External Speaker jack, J3.

RX Diagram



Squelch

Q32, 33, and 34 are the squelch amplifier transistors. At low [or no] signal levels Q34 collector conducts to ground and its output connected to pin number 6 of IC5 results in no signal output from the audio amplifier. As the incoming RF signal increases it results in opening up the AF amplifier and output is activated. The point at which Q34 cuts off is determined by setting of the Squelch Control, VR2.

Noise Blanker

The noises contained in the RF signal at the output of RF amplifier, Q20, is fed through C112 to the base of Q23. The amplified signal output of Q20 is rectified by diodes D20 and 21. The resulting DC voltage turns on Q24 [FET] which in turn turns on Q25 and 26. This causes the IF signal [10.695 or 10.692 MHz] at T10 to be conducted to ground through C121 and Q26 during the presence of the noise impulses, blanking out the noise from the audio output.

'Tune' Circuit (PTOS006)

The 'Tune' control facility allows between-channel operation shifting both the transmit and receive frequencies 4.5 kHz above or below the assigned channel frequency continuously.
The active elements of the circuit are variable-capacitance diodes D4, D5 and VR4. Both diodes capacitances vary in accordance with the bias level determined by VR4 adjustment, thus increasing or decreasing the parallel capacitance to R14 at Q4 emitter through C25 (by D4) and the external capacitance to X1, X2 or X3 (by D5) simultaneously. The bias of both diodes is fixed when VR4 is pulled to *Off*.

Clarifier Circuit

The Clarifier is operative only in receive mode and changes the receive frequency regardless of the transmitting frequency. VR6 acts to vary the plus bias voltage of D206 (on circuit board Y3) in the same way as in Tune circuit description. Thus, Q4 oscillating frequency is pulled above (VR6 clockwise rotated) or down (VR6 counterclockwise rotated) its normal channel frequency. D206 is fixed biased when the unit is transmitting.

High Filter

The high-frequency-cut filter acts to improve readability in congested areas etc., eliminating high frequency noise component in audio output. In PTSW072 circuit board, Q702 serves to compensate CR filter loss.

Power Supply

The supplied 220V AC is stepped down through T201 and rectified by bridge rectifiers D1 to 4 on PTPW007. When the voltage output at pin #3 on the circuit board decreases, the collector current of Q2 also decreases causing reduced collector voltage. This will increase Q1 bias and Q201 bias. The voltage across the collector to emitter of Q201 decreases thus restoring the initial voltage incline.

Adjustment

Test Equipment

The following equipment are required for servicing:

1. A 50 Ohm resistive antenna load, 20W.
2. A frequency counter operable in the required range.
3. A HF signal generator operable over 50 kHz to 60 MHz.
4. An oscilloscope.
5. An FM deviation meter.
6. A digital Voltmeter.
7. An 8 Ohm 5W resistive speaker load.
8. Two audio signal generators, 10 Hz to 20 kHz.
9. An RF Voltmeter.
10. A circuit tester, input impedance 20 kOhm/V.
11. A 220V 50 Hz AC power source.
12. Dummy microphone plug (wired as shown beside applicable set-up).
    To activate the transmitter without using the microphone PTT bar, use the dummy plug. This plug is also used to introduce a modulating audio signal to the microphone input circuit as described in the following procedures.

Precautions

Before performing any adjustment, check visually all jacks, plugs and solder joints for normal connection. Shown in the schematic diagram are nominal tested voltage values for the transistors and ICs. For tune-up and servicing, be sure to use identical parts as listed in the *Replacement Part List.*

Power Supply Alignment

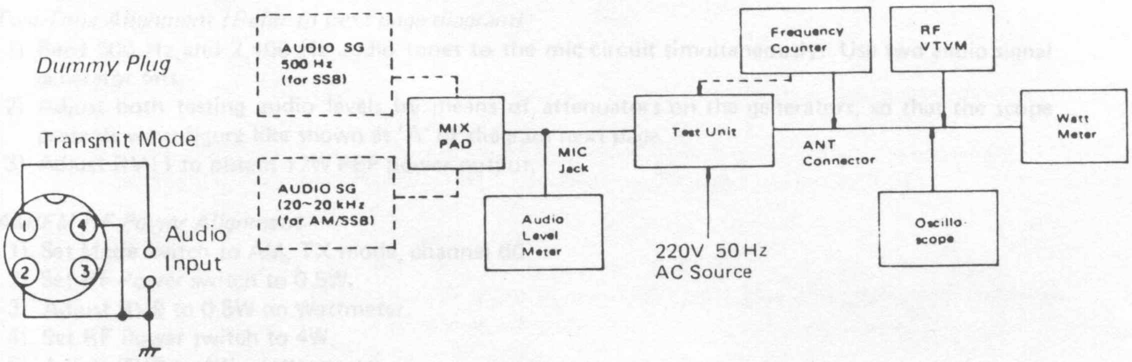
Important: This alignment should be performed first of all items.

1) Connect circuit tester across the terminal #3 (plus) and *G* (minus) on PTPW007.

2) Turn unit on at 220V 50 Hz input.
3) Reading should be 13.8 Volt. If necessary adjust, RV1.

Transmitter Alignment

Connect testing equipment to the unit as shown:



PLL Aligment (PTOS006)

1) Connect frequency counter to TP1 (or IC1 pin #3) through 1,000 pF capacitor.
2) Adjust CT1 for 10.240 MHz. Tolerance within ±50 Hz is acceptable.

Off-Set Frequency Alignment (PTOS006, unless otherwise noted)

1) Connect frequency counter to TP4, with maximum level range.
2) Set the Mode selector to *USB*.
3) Set the Band selector to *Lo*.
4) Adjust CT2 for 20.105 MHz ±40 Hz.
5) Set the Band selector to *Mid*.
6) Adjust CT3 for 20.330 MHz ±40 Hz.
7) Set the Band selector to *Hi*.
8) Adjust CT4 for 20.555 MHz ±40 Hz.
9) Set the Band selector to *Mid*, the Channel selector to 60.
10) Connect scope to TP4.
11) Adjust T1 for maximum scope amplitude.
12) Connect frequency to TP5 (PTBM058).
13) Adjust CT5 (PTBM059) for 10.695 MHz ±50 Hz.

LSB Off-Set Alignment

1) Set the Mode selector to LSB, the Band selector to *Lo*.
2) Connect frequency counter to TP4 (PTOS006).
3) Adjust CT5 (PTOS006) for 20.1035 MHz ±40 Hz.
4) Connect frequency counter to TP5 (PTBM059).
5) Adjust CT4 for 10.692 MHz ±50 Hz.

VCO Alignment

1) Set the Band selector to *Lo* and the Channel selector to 1.
2) Connect digital Voltmeter between TP2 and ground.
3) Adjust VCO block core to obtain 3.6V ± 0.1V.
4) Set the Channel selector to 41, and the Band selector to *Mid*.
5) Adjust VR1 for 3.7V ± 0.1V.
6) Set the Channel selector to 1, and the Band selector to *Hi* (81 channel0.
7) Adjust VR2 for 3.8V ± 0.1V.

RF Power Amplifier Alignment (PTBM058, unless otherwise noted)

1) Set the Band selector to *Lo* and the Channel selector to 1.
2) Set the Mode switch to USB.
3) Feed 2,400 Hz 10 mV audio to unit.
4) Adjust T3 (PTOS006) and T5 (PTBM058) for maximum scope display.
5) Set the Band selector to *Hi* and the Channel selector to 40 (120 channel).
6) Adjust T2 (PTOS006) and T4 (PTBM058) for maximum scope display.

RF Driver Alignment (PTBM058)

1) Set the Channel selector to 60 with the Band selector set to *Mid*.
2) Feed 2,400 Hz 10 mV audio to unit.
3) Adjust T6, L11, L12 and L13 for maximum output on RF Wattmeter.
4) Remove testing audio.
5) Adjust RV4 and RV5 for minimum carrier leakage on scope.

Two-Tone Alignment (Refer to next page diagram)

1) Feed 500 Hz and 2,400 Hz audio tones to the mic circuit simultaneously. Use two audio signal generator sets.
2) Adjust both testing audio levels by means of attenuators on the generators, so that the scope presents wave figure like shown as 'A' of diagram next page.
3) Adjust RV11 to obtain 12W PEP power output.

AM/FM RF Power Alignment

1) Set Mode switch to AM, TX mode, channel 60.
2) Set RF Power switch to 0.5W.
3) Adjust RV9 to 0.5W on Wattmeter.
4) Set RF Power switch to 4W.
5) Adjust RV8 to 4W on Wattmeter.

AM Modulation Alignment

1) Apply 2,400 Hz 7 mV audio to the unit microphone input.
2) Adjust RV12 for modulation depth of 80%.
3) Increase audio level to 70 mV.
4) Check modulation depth increases to 90%.

FM Modulation Alignment

1) Set the Mode switch to *FM* position.
2) Apply 2,400 Hz 10 mV audio to modulation circuit. Use dummy mic plug.
3) Connect deviation meter to antenna output on the unit.
4) Adjust RV3 (PTOS006) to obtain 1.5 kHz deviation.

RF Power Meter Alignment

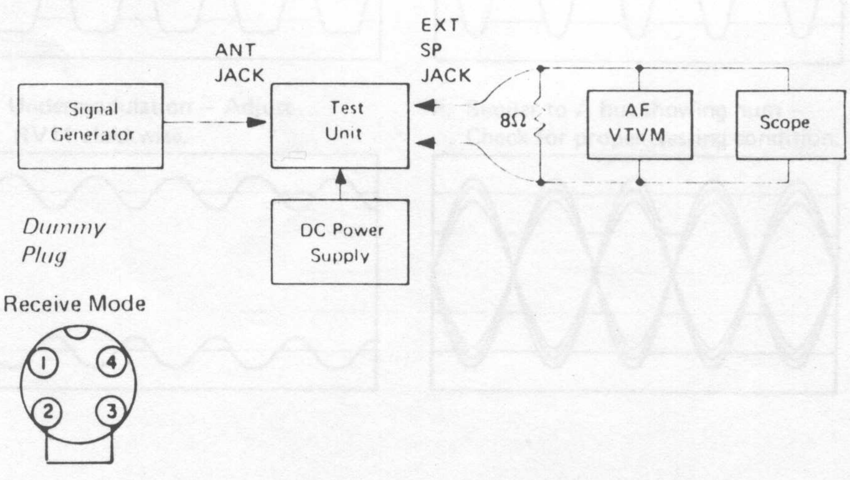
1) Set the unit to *AM* mode.
2) Comparing the external RF power meter and the one built-in the unit, adjust RV3 (PTBM059) for equal indication on the unit power meter.

Transmitting Frequency Check

Verify that the frequency counter indicates channel frequencies tabulated in the *Frequency Table* with tolerance within ±800 Hz.

Receiver Alignment

Connect testing equipment as shown:



AGC Alignment

1) Connect digital Voltmeter to circuit board PTBM059 terminal 15 (Q20, Q22 AGC input) and chassis ground.
2) Set the transceiver to channel 60.
3) Rotate the RF Gain control fully clockwise.
4) Adjust RV8 for 2V reading.

AM Receiver Sensitivity

1) Set the signal generator to 27.655 MHz with 1 kHz 30% modulation.
2) Set the transceiver tuned to channel 60.
3) Set the Mode selector to AM position.
4) Adjust T7, T8, T9, T10, T13, T14 and T15 fot maximum audio output across speaker dymmy resistor.
   Note: Keep generator output as low as possible to avoid AGC action through this alignment.
5) After completing above procedure, rotate T7 to decrease the audio output by 2 dB.

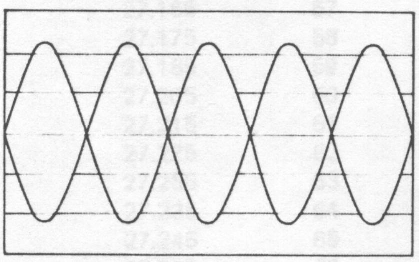
Squelch Alignment

1) Set the Mode selector to AM position.
2) Set the signal generator to provide RF input signal of 300 μV 1 kHz 30% modulated and rotate the Squelch control to the fully clockwise position.
3) Adjust RV9 so that the audio appears on scope.

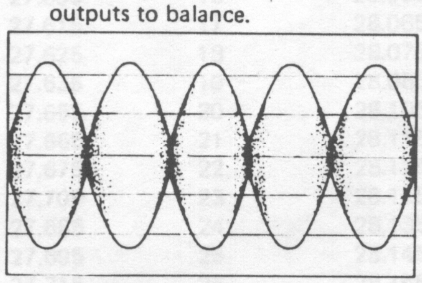
S-Meter Alignment

1) Set the Mode switch to AM position.
2) Select channel 60 (Mid band).
3) Set the signal generator to provide 100 μV (40 dB) output.
4) Adjust RV7 so that the S-meter pointer indicates '9'.

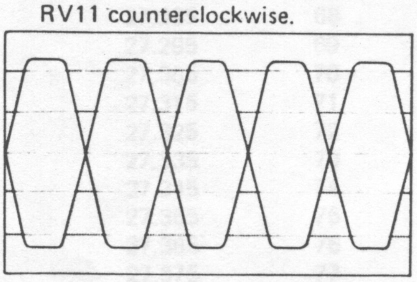
A. Properly adjusted transmitter.



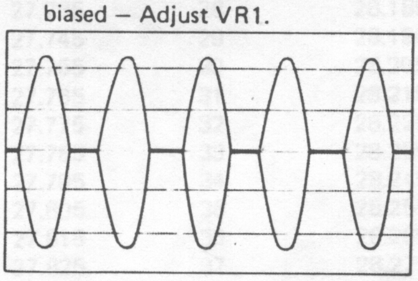
B. Unequal tones – Adjust generator outputs to balance.



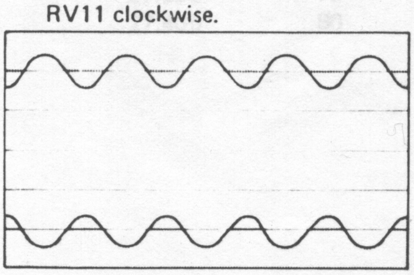
C. Excessive modulation – Adjust RV11 counterclockwise.



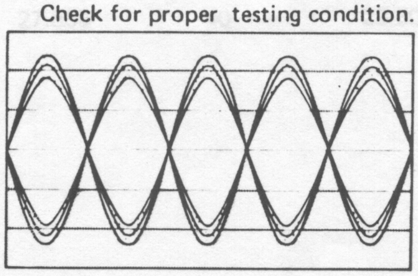
D. Final transistor incorrectly biased – Adjust VR1.



E. Undermodulation – Adjust RV11 clockwise.

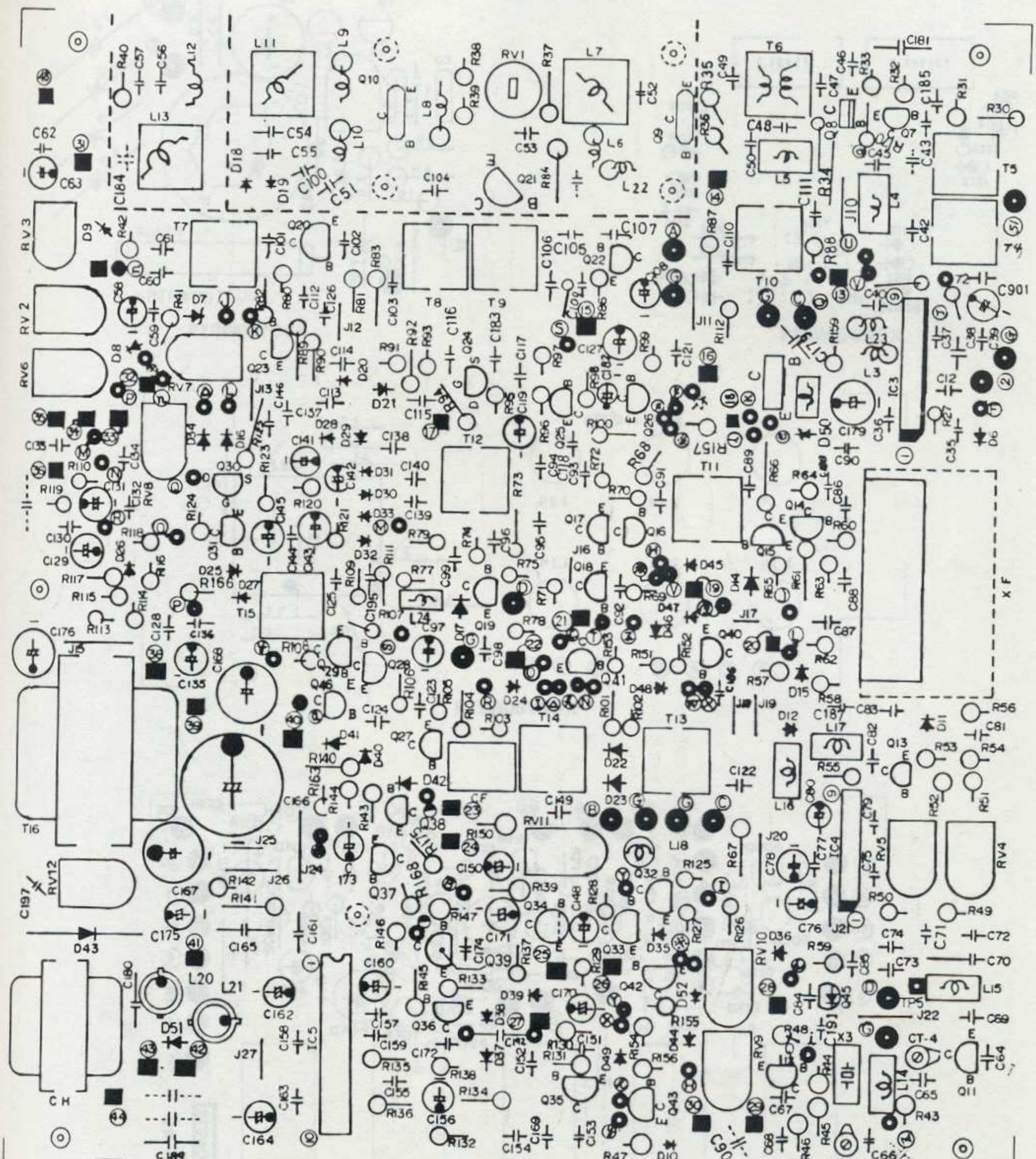


F. Similar to A but showing hum – Check for proper testing condition.

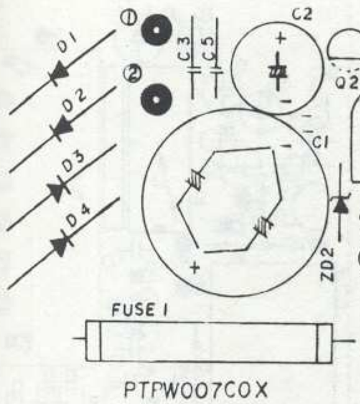


Frequency Table

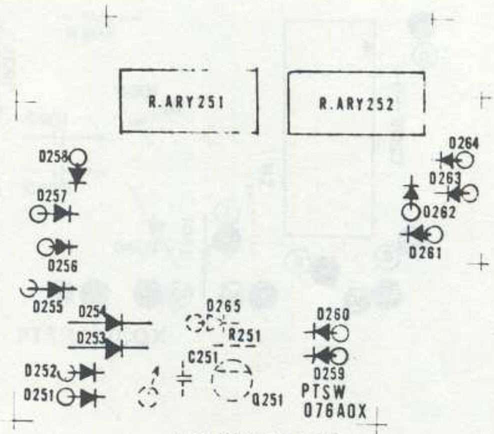
LOW CHANNEL	CHANNEL FREQUENCY IN MHZ	MID CHANNEL	CHANNEL FREQUENCY IN MHZ	HIGH CHANNEL	CHANNEL FREQUENCY IN MHZ
1	26.965	41	27.415	1	27.865
2	26.975	42	27.425	2	27.875
3	26.985	43	27.435	3	27.885
4	27.005	44	27.455	4	27.905
5	27.015	45	27.465	5	27.915
6	27.025	46	27.475	6	27.925
7	27.035	47	27.485	7	27.935
8	27.055	48	27.505	8	27.955
9	27.065	49	27.515	9	27.965
10	27.075	50	27.525	10	27.975
11	27.085	51	27.535	11	27.985
12	27.105	52	27.555	12	28.005
13	27.115	53	27.565	13	28.015
14	27.125	54	27.575	14	28.025
15	27.135	55	27.585	15	28.035
16	27.155	56	27.605	16	28.055
17	27.165	57	27.615	17	28.065
18	27.175	58	27.625	18	28.075
19	27.185	59	27.635	19	28.085
20	27.205	60	27.655	20	28.105
21	27.215	61	27.665	21	28.115
22	27.225	62	27.675	22	28.125
23	27.255	63	27.705	23	28.155
24	27.235	64	27.685	24	28.135
25	27.245	65	27.695	25	28.145
26	27.265	66	27.715	26	28.165
27	27.275	67	27.725	27	28.175
28	27.285	68	27.735	28	28.185
29	27.295	69	27.745	29	28.195
30	27.305	70	27.755	30	28.205
31	27.315	71	27.765	31	28.215
32	27.325	72	27.775	32	28.225
33	27.335	73	27.785	33	28.235
34	27.345	74	27.795	34	28.245
35	27.355	75	27.805	35	28.255
36	27.365	76	27.815	36	28.265
37	27.375	77	27.825	37	28.275
38	27.385	78	27.835	38	28.285
39	27.395	79	27.845	39	28.295
40	27.405	80	27.855	40	28.305



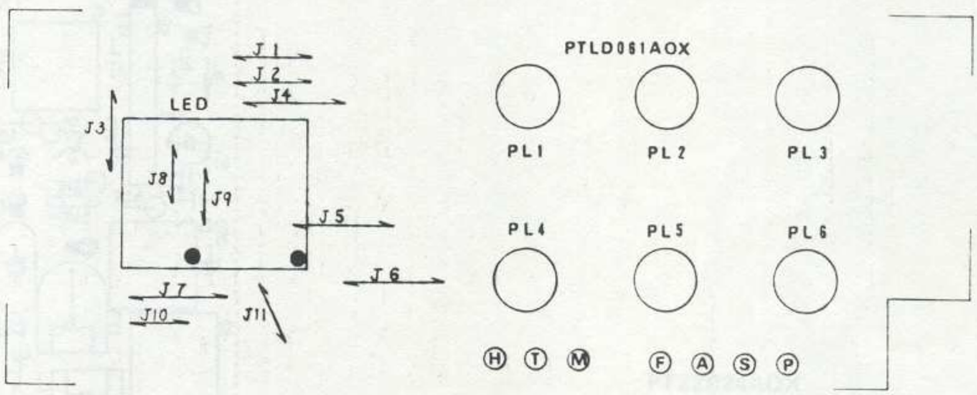
PTBM059COX



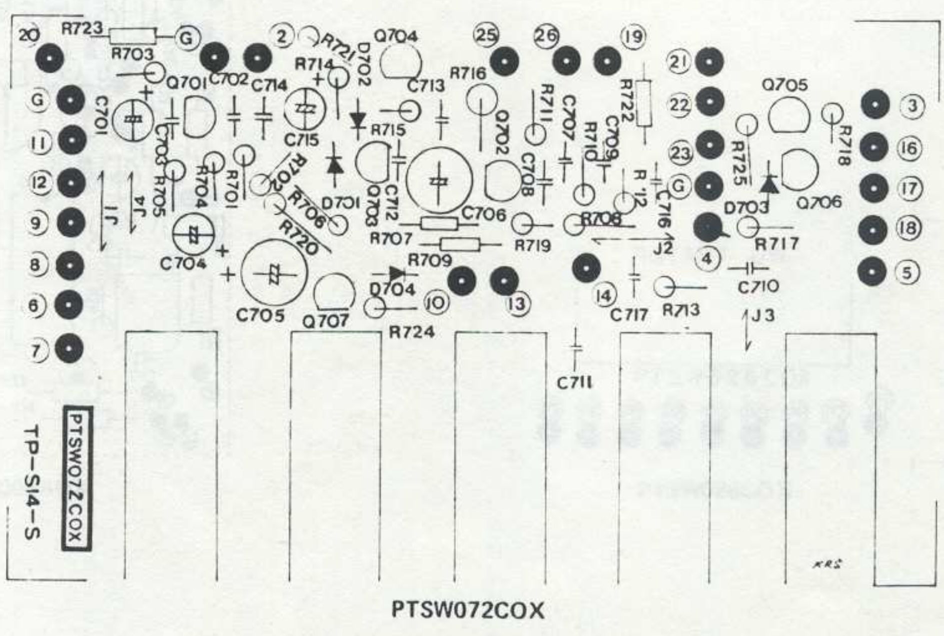
PTPW007COX



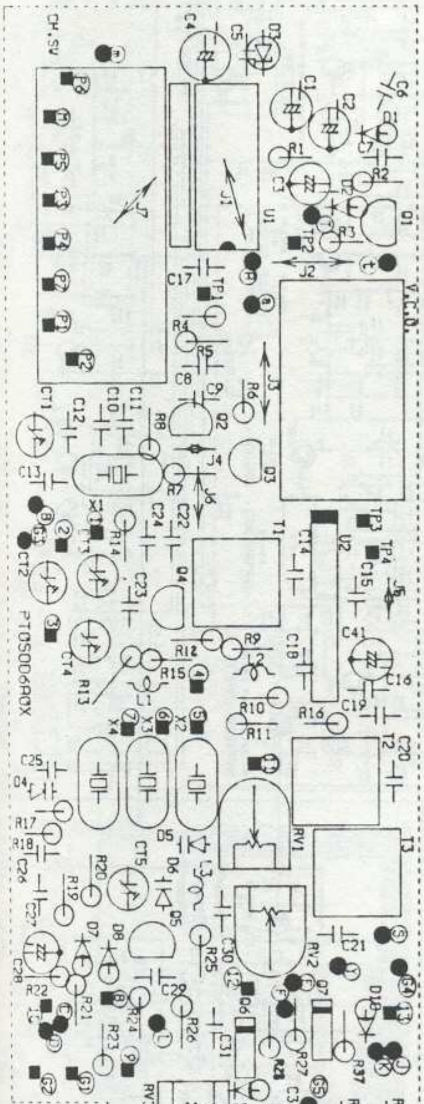
PTSW076AOX



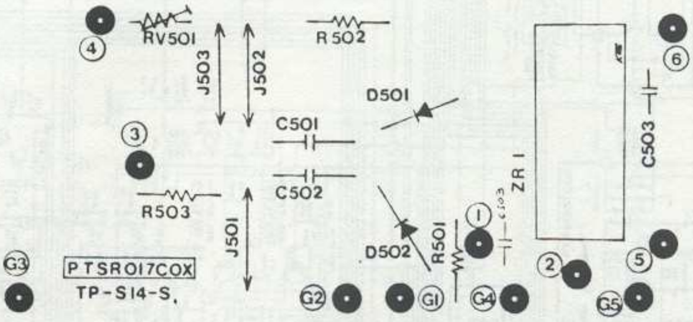
PTLD061AOX



PTSW072COX

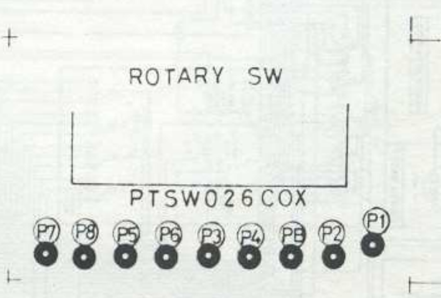


PTOS006AOX

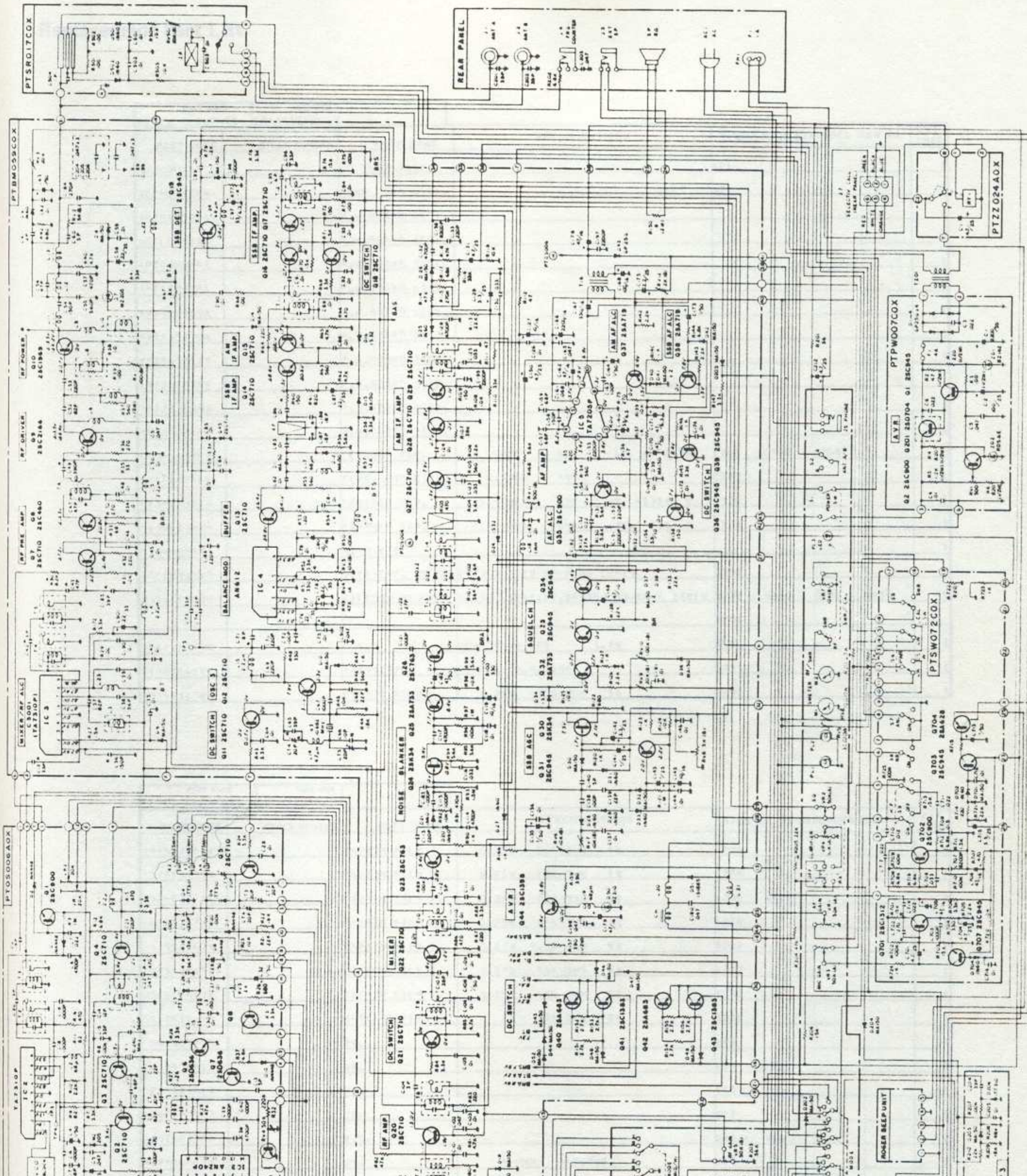


PTSR017COX

PTZZ024AOX



PTSW026COX


PTSR017COX
REAR PANEL
PTBM059COX
PTZZ024AOX
PTPW007COX
PTSW072COX
PTOS006AOX
ROGER BEEP UNIT
FRONT PANEL
MIC UNIT
PTSW076AOX
PTLD061AOX