



SERVICE MANUAL HAM PUMA
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HAM International
Brusselsesteenweg 428
B 9218 GENT



CONTENTS

Specifications	1
Circuit description	
PLL theory	2
Transmitter	2
Receiver	3
Squelch	3
Noise blanker	3
SWR [standing wave ratio]	3
Alignment procedure	
Measurement condition	4
Test equipment	4
Transmitter alignment	5
Receiver alignment	10
Block diagram	12
Frequency table	
Low band	13
Mid band	14
High band	15
PC board layout	
PTZZ024	
PTLD023	
PTLD052	
PTZZ033	
PTOS008	
PTSW076	
PTSR016	
PTBM092	
Schematic diagram	

Specifications

General

Channels	: 120 channels.
Frequency range	: 26.965 to 28.305 MHz.
Frequency control	: Phase-Locked Loop Synthesizer.
Frequency tolerance	: 0.005 %.
Frequency stability	: 0.003 %.
Input voltage	: 13.8 V DC [positive or negative ground].
Current drain	: Receive --- 1.3 A at maximum audio output 0.5 A standby (no signal).
Microphone	: Plug-in type dynamic, 500 Ohms
Antenna	: Standard [SO-239] type.

Receiver

AM sensitivity	: 0.7 μ V for provided more than 0.5 W audio, signal modulated 30 % at 1 kHz sine wave, with Local-DX switch set to Dx.
FM sensitivity	: 0.5 μ V for 20 dB quieting.
Selectivity AM/FM	: 5 dB at 4 kHz, 50 dB at 20 kHz.
Signal to Noise ratio (AM)	: 0.7 μ V for 10 dB S+N/N, signal modulated 30 % at 1 kHz sine wave.
Image rejection	: More than 50 dB.
IF rejection	: More than 80 dB at 455 kHz.
Squelch	: Adjustable --- threshold less than 0.5 μ V.
Distortion	: Less than 10 % at 3 W output
Adjacent channel rejection	: More than 50 dB at 0.3 μ V.
IF frequency	: 10.695 MHz, 455 kHz.

Transmitter

AM power	: 4 W.
FM power	: 5 W.
AM modulation	: Class E audio modulation (collector).
AM modulation capability	: 100 %.
FM modulation	: 1.5 kHz at 1,250 Hz 20 mV audio.
Harmonic distortion	: ---
Spurious emissions	: ---
Output impedance	: 50 Ohms

Circuit descriptions

PLL theory

The transceiver employs the most advanced technology to provide 120 channels of operation by means of digital frequency synthesis with Phase Locked Loop [PLL] circuitry. Unlike units employing many crystals, this transceiver uses only 4 crystals to produce 120 different frequencies. More over, the use of PLL assures a precise on-frequency operation on every channel in both transmit and receive modes that is unsurpassed by conventional CB radio.

a) PLL

Phase comparator: Generally called P/C or P/D [phase detector]. Compares and continuously synchronizes the frequency and phase of a voltage controlled oscillator [VCO] to the output of a stable reference source.

Crystal reference oscillator [CRO]: Oscillates at a constant 10.24 MHz.

Voltage controlled oscillator [VCO]: Used as the primary signal source for both transmit and receive frequencies. The frequency of the VCO and divisor of the programmable frequency divider are varied by the Channel Selector so that the resultant frequency is maintained at a constant 10 kHz. Employing the PLL in a CB radio requires additional stages which are used to convert the output of the VCO into the frequencies necessary for the transmit and receive modes of operation IC-3 and Q-2 (10.695 MHz) will serve as mixer and oscillator in this CB radio.

b) Transmitter

The Channel Selector determines the 'N' code corresponding to the channel which is selected. The 'N' code is applied to the appropriate terminal of IC-1, pins 9 through 15, and presets the programmable divider to divide the input frequency from the output IC-2.

The VCO provides a stable frequency of 16.955 MHz to 17.845 MHz, depending upon the channel selected. This signal, when mixed with the output from PTOS008 (Lo: 20.48 MHz, Mid: 20.705 MHz, Hi: 20.930 MHz) produces three frequency bands.

The 3.3 to 2.86 MHz band is fed to the input of programmable divider. And 37.21 to 38.55 MHz band is used as a local oscillator signal for receive operation and when mixed with 10.695 MHz, is used to produce the transmit frequency of 26.515 to 27.855 MHz.

c) Receiver

When channel 1 is selected in receive mode, 1st IF = $37.21 - 26.515 = 10.695$ MHz. The 1st IF signal is then applied to the 2nd mixer along with 10.24 MHz. The resultant 455 kHz 2nd IF signal is derived as follows, $2\text{nd IF} = 10.695 - 10.24 = 0.455$ MHz. The 455 kHz signal is fed to the IF amplifiers and detected (AM: by D-9, FM: by IC-501) to produce the audio signal. The audio signal is amplified by power IC and its output is supplied to the built-in speaker.

d) Squelch

Q-13 is the squelch amplifier transistor. At low (or no) signal levels Q-13 collector conducts to ground and its output connected to pin No.7 of IC-4 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 level at which Q-13 cuts off is determined by setting of the Squelch Control.

e) Noise blanker

The noises contained in the RF signal at the output of RF amplifier, Q-8, is fed through C-134 to the base of Q-18. The amplified signal output of Q-18 is rectified by diodes D-18 and D-19. The resulting DC voltage turns on Q-19. This causes the IF signal [10.695 MHz] at T-7 to be connected to ground through Q-20 during the presence of the noise impulses, blanking out the noise from the audio output.

f) SWR [Standing Wave Ratio]

The SWR circuit (of this unit) employs a "Bridge" circuit which is suited for SWR measurement. D-501, C-501 detect forward wave and also D-502, C-505 detect reflective wave in the transmission line.

Alignment procedure

1. Measurement condition.

- 1) Reference temperature : 25 °C
- 2) Reference humidity : 65 %

NOTE: Unless otherwise specified, alignment may be performed under the room temperature of 5 - 35 °C and the room humidity of 45 - 85 %.

3) Power supply

DC 13.8 V \pm 1 %, unless otherwise specified.

2. Test equipment.

- | | |
|---------------------------|--------------------------------------|
| a) Audio signal generator | : Sine wave, 10 Hz to 20 kHz. |
| b) Audio level meter | : 1 mV measurable. |
| c) DC ampare meter | : DC 3 A. |
| d) Regulated power supply | : DC 0 to 20 V, 2 A. |
| e) Frequency counter | : 0 to 50 MHz, high input impedance. |
| f) Oscilloscope | : 50 MHz, high input impedance. |
| g) FM signal generator | : 27 MHz adjustable, 50 Ohm. |
| h) RF wattmeter | : Thermo-couple type, 50 Ohm, 15 W |
| i) Modulation meter | |
| j) DC volt meter | : 10 V, high input impedance. |
| k) Speaker dummy load | : 8 Ohm, 5 W. |
| l) Dummy microphone plug | |
| m) Circuit tester | : DC 20 kOhm/V, high input impedance |

All test equipment should be properly calibrated.

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NOTE: Unless otherwise specified, alignment may be performed under the room temperature of 5 - 35 °C and the room humidity of 45 - 85 %.

3) Power supply

DC 13.8 V \pm 1 %, unless otherwise specified.

2. Test equipment.

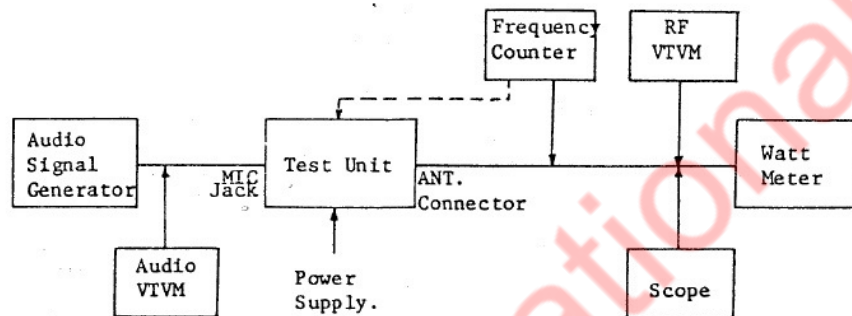
- a) Audio signal generator : Sine wave, 10 Hz to 20 kHz.
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- c) DC ampare meter : DC 3 A.
- d) Regulated power supply : DC 0 to 20 V, 2 A.
- e) Frequency counter : 0 to 50 MHz, high input impedance.
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- g) FM signal generator : 27 MHz adjustable, 50 Ohm.
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- i) Modulation meter
- j) DC volt meter : 10 V, high input impedance.
- k) Speaker dummy load : 8 Ohm, 5 W.
- l) Dummy microphone plug
- m) Circuit tester : DC 20 kOhm/V, high input impedance

All test equipment should be properly calibrated.

3. Transmitter alignment.

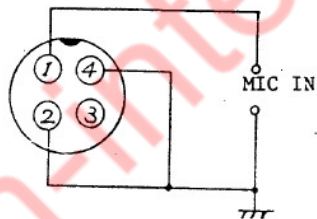
3.1 Test set-up.

Connect testing equipment to the unit as shown:



3.2 Dummy microphone plug.

Set the test unit to transmit mode by the dummy microphone plug wired as shown:



Transmit dummy microphone plug

3.3 PLL circuit adjustment.

3.3.1 [10.240 MHz] adjustment.

- 1) Select the band selector to Low.
- 2) Connect frequency counter to Q-10 base.
- 3) Adjust CT-1 (on PTBM092) for:
10.24000 MHz \pm 50 Hz.

3.3.2 [20.705 MHz] adjustment.

- 1) Select the band selector to Mid.
- 2) Connect frequency counter to #3 on OSC UNIT (PTOS008).
- 3) Adjust CT-1 (on PTOS008) for:

20.705 MHz \pm 50 Hz.

3.3.3 [20.930 MHz] adjustment.

- 1) Select the band selector to High.
- 2) Connect frequency counter to #3 on OSC UNIT (PTOS008).
- 3) Adjust CT-2 (on PTOS008) for:

20.930 MHz \pm 50 Hz.

3.3.4 VCO adjustment.

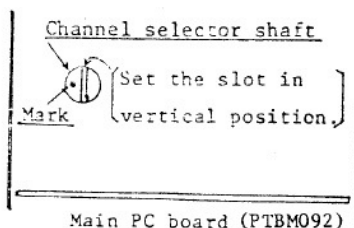
- 1) Set the band selector to Low.
- 2) Select the channel selector to CH.1.
- 3) Connect circuit tester between R-3 (TP-8 side) and GND.
- 4) Rotate L-1 core counterclockwise 2 or 3 turns, then rotate L-1 core clockwise for:

3.6 V \pm 0.1 V.

- 5) Set the band selector to Hi, select the channel selector to CH.40. Check TP-8 voltage

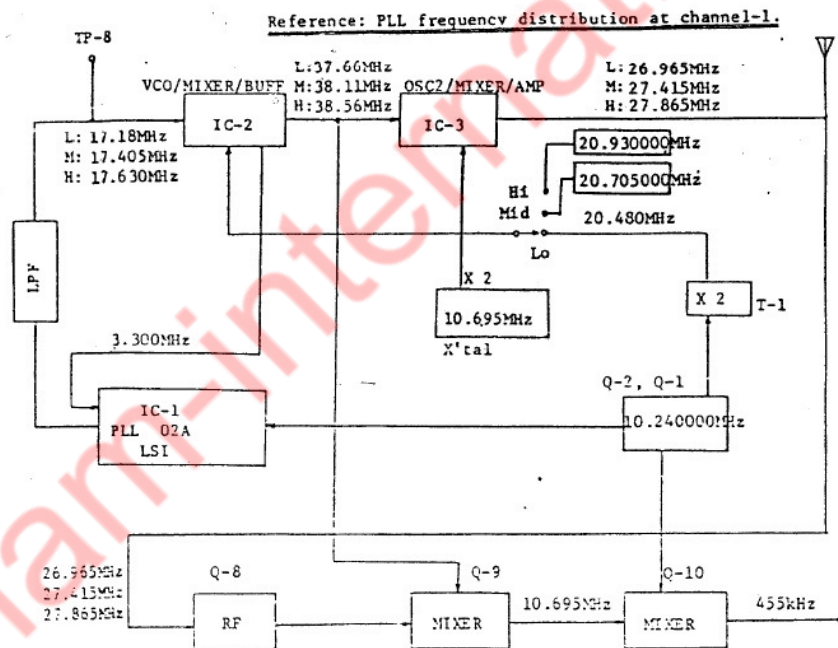
within 0.8 - 1.4 V.

Reference: When channel LED is disabled, channel No.1 is located with the channel selector shaft positioned as shown:



3.5 RF driver adjustment.

- 1) Set the Band Selector to Mid, and select the Channel Selector to CH.60.
- 2) Feed 13.8 V.
- 3) Connect oscilloscope to Q-3 base.
- 4) Adjust T-1, L-2, T-2 and T-3 for maximum wave form on display at 27.655 MHz.
- 5) Apply 7 V.
- 6) Adjust T-3, T-4 for maximum wave form on display at 27.655 MHz.



3.5 RF power adjustment.

- 1) Set the band selector to Mid, select the channel selector to CH.60.
- 2) Apply 13.8 V
- 3) Rotate L-7, L-11, L-12 cores counterclockwise 2 or 3 turns, then rotate L-7, L-11, L-12 cores clockwise for maximum on wattmeter.
- 4) Readjust L-11 for maximum on wattmeter.
- 5) Readjust L-7 clockwise for RF power 4.4 W.
- 6) Rotate L-12 counterclockwise for RF power 3.8 W.

NOTE: Total current drain should be less than 1,000 mA.

RF power should be 3.8 W \pm 0.2 W at each channel.

Reference: Adjustment procedure as shown.

L-7/Max. \longrightarrow L-11/Max. \longrightarrow L-12/Max. \longrightarrow L-11/Max.

L-7/4.4 W. \longrightarrow L-12/3.8 W

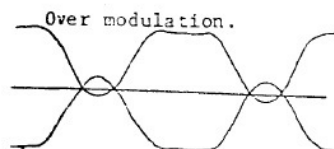
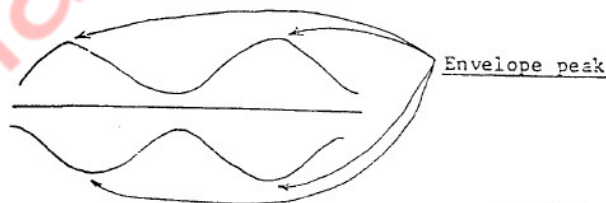
3.6 Frequency check.

- 1) Set the unit to transmit mode with no modulation.
- 2) Check transmit frequency on all channels, each frequency should be within ± 600 Hz of the listed frequency.

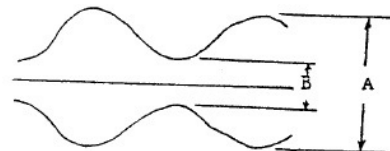
3.7 Modulation sensitivity adjustment & power supply check.

[ALC adjustment]

- 1) Set the unit to transmit mode.
- 2) Apply 20 mV/1 kHz audio to MIC input (jack).
- 3) Adjust RV-2 for 90 % modulation..



$$\text{Modulation ratio} = \frac{A - B}{A + B} \times 100 (\%)$$



- 4) RF output at 90 % modulation should be greater than that at no modulation by 1.5 times.
- 5) Apply 1 kHz audio signal with such level that causes 86 % or over-modulation.
- 6) Check no parastic oscillation will occur on oscilloscope display when power supply voltage is changed in variation of DC 10 V - 16 V at all channels. Also check no frequency tolerance should be apparent.

3.8 RF meter adjustment.

Adjust RV-4 for equal indication on both built-in RF meter and external wattmeter.

3.9 Lock-out circuit check.

Check Q-3 base voltage should be in the range of 0.05 - 0.4 V when channel selector is set to between channels.

3.10 RF power off check between channels.

Check no RF power should be obtained when channel selector is set to between channels.

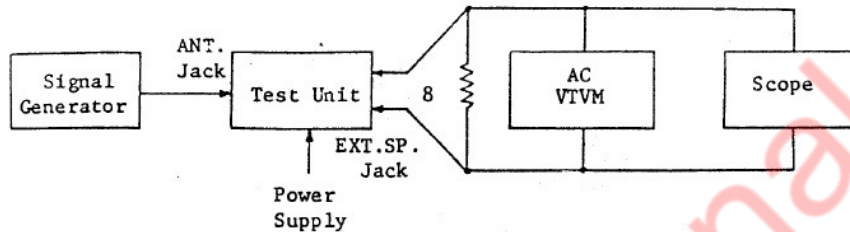
3.11 FM modulation adjustment.

- 1) Connect deviation meter to antenna output.
- 2) Set the unit FM transmit mode, band selector to Mid.
- 3) Select the channel selector to CH.60.
- 4) Apply 1,250 Hz, 20 mV audio to microphone input.
- 5) Adjust RV-501 (on PTZZ033) to obtain 1.65 kHz deviation.

4. Receiver alignment.

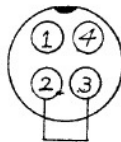
4.1 Test set-up

Connect testing equipment to the unit as shown:



4.2 Dummy microphone plug.

Set the unit to receive mode by the dummy microphone plug wired as shown:



Receive dummy microphone plug prewired.

4.3 AM receiver sensitivity adjustment.

- 1) Set the unit to receive mode, the band selector to Mid.
- 2) Select the channel selector to 60.
- 3) Apply 27.655 MHz with 1 kHz 30 % modulation to ANT terminal.
- 4) Adjust T-1, L-2, T-2, T-5, T-6, L-14, T-7, T-8 and T-10 for maximum audio output across the speaker dummy resistor.
- 5) After completing above procedure, rotate T-5 clockwise 1 turn.
- 6) Finally,

RF input: 1 μ V (0 dB, SG ATT indicates 6 dB),

Audio output: more than 2.0 V at all channels,

S/N: more than 10 dB.

NOTE: Recheck T-1, L-2 and T-2 in transmit mode.

4.4 Squelch adjustment.

- 1) Set the signal generator to provide 54 dB RF signal with 1 kHz 30 % modulation.
- 2) Rotate the Squelch Control fully clockwise.
- 3) Adjust RV-1 so that the audio output level decreases by 6 dB.
- 4) Check audio output level is reduced to '0' when RF signal is reduced to 45 - 50 dB.
- 5) Set RF signal to '0', adjust the Squelch Control so that noise will disappear.
- 6) Increase RF signal level gradually observing RF input level which just produces audio output. The level should be less than -6 dB.

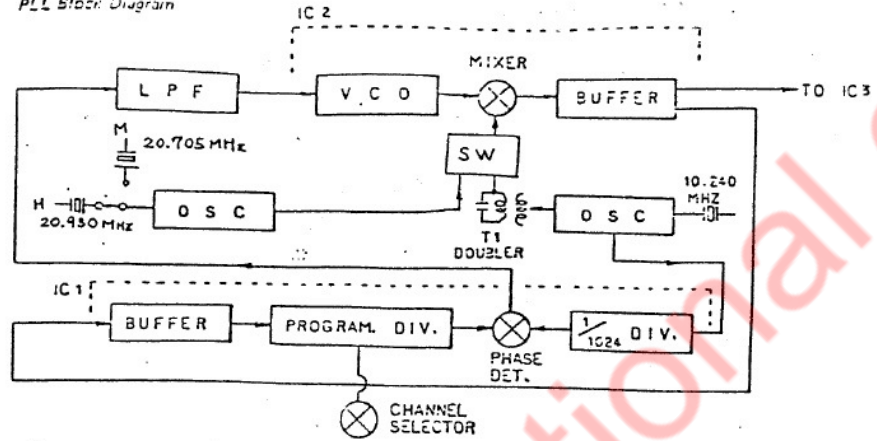
4.5 FM IF adjustment.

- 1) Set the Band Selector to Mid, and the Channel Selector to CH.60.
- 2) Set the Mode Selector to AM.
- 3) Apply AM modulated signal (1 μ V, 1 kHz 30 % modulation) to antenna.
- 4) Adjust T-501 (on PTZZ033) for maximum audio output.
- 5) Then, set the Mode Selector to FM.
- 6) Apply FM modulated signal (1 μ V, 1 kHz deviation) to antenna.
- 7) Adjust L-501 (on PTZZ033) for maximum audio output.

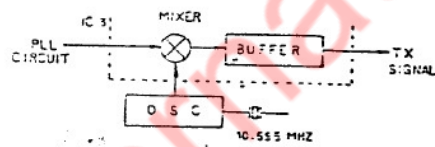
4.6 S-meter adjustment.

- 1) Set RF signal to 40 dB.
- 2) Adjust RV-3 so that S-meter pointer indicates '9' on the unit meter.

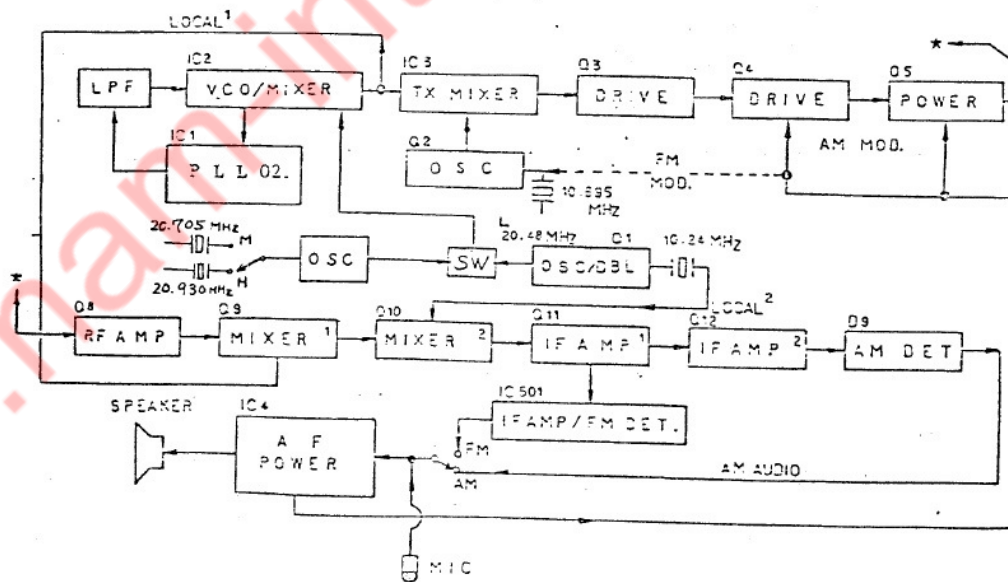
PLL Block Diagram



TX Mixer Block Diagram



Block Diagram



Frequency Table (Low band)

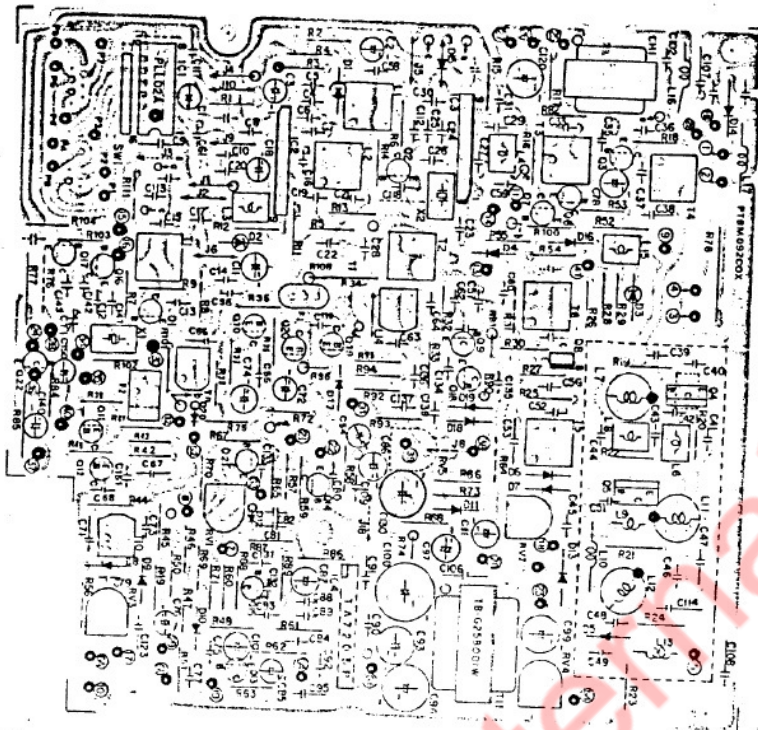
CHANNEL NO.	CHANNEL FREQ. (MHz)	"N" DIGITAL CODES	VCO FREQ. (MHz)	IC pin No. Switch out.							Rx 1st LOCAL FREQ. (MHz)
				15	14	13	12	11	10	9	
1	26.965	330	17.18	0	1	0	1	0	0	1	37.66
2	26.975	329	17.19	1	0	0	1	0	0	1	37.67
3	26.985	328	17.20	0	0	0	1	0	0	1	37.68
4	27.005	326	17.22	0	1	1	0	0	0	1	37.70
5	27.015	325	17.23	1	0	1	0	0	0	1	37.71
6	27.025	324	17.24	0	0	1	0	0	0	1	37.72
7	27.035	323	17.25	1	1	0	0	0	0	1	37.73
8	27.055	321	17.27	1	0	0	0	0	0	1	37.75
9	27.065	320	17.28	0	0	0	0	0	0	1	37.76
10	27.075	319	17.29	1	1	1	1	1	1	0	37.77
11	27.085	318	17.30	0	1	1	1	1	1	0	37.78
12	27.105	316	17.32	0	0	1	1	1	1	0	37.80
13	27.115	315	17.33	1	1	0	1	1	1	0	37.81
14	27.125	314	17.34	0	1	0	1	1	1	0	37.82
15	27.135	313	17.35	1	0	0	1	1	1	0	37.83
16	27.155	311	17.37	1	1	1	0	1	1	0	37.85
17	27.165	310	17.38	0	1	1	0	1	1	0	37.86
18	27.175	309	17.39	1	0	1	0	1	1	0	37.87
19	27.185	308	17.40	0	0	1	0	1	1	0	37.88
20	27.205	306	17.42	0	1	0	0	1	1	0	37.90
21	27.215	305	17.43	1	0	0	0	1	1	0	37.91
22	27.225	304	17.44	0	0	0	0	1	1	0	37.92
23	27.255	301	17.47	1	0	1	1	0	1	0	37.95
24	27.235	303	17.45	1	1	1	1	0	1	0	37.93
25	27.245	302	17.46	0	1	1	1	0	1	0	37.94
26	27.265	300	17.48	0	0	1	1	0	1	0	37.96
27	27.275	299	17.49	1	1	0	1	0	1	0	37.97
28	27.285	298	17.50	0	1	0	1	0	1	0	37.98
29	27.295	297	17.51	1	0	0	1	0	1	0	37.99
30	27.305	296	17.52	0	0	0	1	0	1	0	38.00
31	27.315	295	17.53	1	1	1	0	0	1	0	38.01
32	27.325	294	17.54	0	1	1	0	0	1	0	38.02
33	27.335	293	17.55	1	0	1	0	0	1	0	38.03
34	27.345	292	17.56	0	0	1	0	0	1	0	38.04
35	27.355	291	17.57	1	1	0	0	0	1	0	38.05
36	27.365	290	17.58	0	1	0	0	0	1	0	38.06
37	27.375	289	17.59	1	0	0	0	0	1	0	38.07
38	27.385	288	17.60	0	0	0	0	0	1	0	38.08
39	27.395	287	17.61	1	1	1	1	1	0	0	38.09
40	27.405	286	17.62	0	1	1	1	1	0	0	38.10

NOTE: 1: H Level [5.1 - 5.5V]
0: L Level [0.05 - 0.4V]

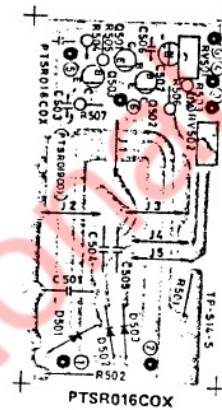
Frequency Table (High band)

CHANNEL NO.	CHANNEL FREQ. (MHz)	"N" DIGITAL CODES	VCO FREQ. (MHz)	IC pin No., Switch out.							Px 1st LOCAL FREQ. (MHz)
				15	14	13	12	11	10	9	
1	27.865	330	17.630	0	1	0	1	0	0	1	38.560
2	27.875	329	17.640	1	0	0	1	0	0	1	38.570
3	27.885	328	17.650	0	0	0	1	0	0	1	38.580
4	27.905	326	17.670	0	1	1	0	0	0	1	38.600
5	27.915	325	17.680	1	0	1	0	0	0	1	38.610
6	27.925	324	17.690	0	0	1	0	0	0	1	38.620
7	27.935	323	17.700	1	1	0	0	0	0	1	38.630
8	27.955	321	17.720	1	0	0	0	0	0	1	38.650
9	27.965	320	17.730	0	0	0	0	0	0	1	38.660
10	27.975	319	17.740	1	1	1	1	1	1	0	38.670
11	27.985	318	17.750	0	1	1	1	1	1	0	38.680
12	28.005	316	17.770	0	0	1	1	1	1	0	38.700
13	28.015	315	17.780	1	1	0	1	1	1	0	38.710
14	28.025	314	17.790	0	1	0	1	1	1	0	38.720
15	28.035	313	17.800	1	0	0	1	1	1	0	38.730
16	28.055	311	17.820	1	1	1	0	1	1	0	38.750
17	28.065	310	17.830	0	1	1	0	1	1	0	38.760
18	28.075	309	17.840	1	0	1	0	1	1	0	38.770
19	28.085	308	17.850	0	0	1	0	1	1	0	38.780
20	28.105	306	17.870	0	1	0	0	1	1	0	38.800
21	28.115	305	17.880	1	0	0	0	1	1	0	38.810
22	28.125	304	17.890	0	0	0	0	1	1	0	38.820
23	28.155	301	17.920	1	0	1	1	0	1	0	38.850
24	28.135	303	17.900	1	1	1	1	0	1	0	38.830
25	28.145	302	17.910	0	1	1	1	0	1	0	38.840
26	28.165	300	17.930	0	0	1	1	0	1	0	38.860
27	28.175	299	17.940	1	1	0	1	0	1	0	38.870
28	28.185	298	17.950	0	1	0	1	0	1	0	38.880
29	28.195	297	17.960	1	0	0	1	0	1	0	38.890
30	28.205	296	17.970	0	0	0	1	0	1	0	38.900
31	28.215	295	17.980	1	1	1	0	0	1	0	38.910
32	28.225	294	17.990	0	1	1	0	0	1	0	38.920
33	28.235	293	18.000	1	0	1	0	0	1	0	38.930
34	28.245	292	18.010	0	0	1	0	0	1	0	38.940
35	28.255	291	18.020	1	1	0	0	0	1	0	38.950
36	28.265	290	18.030	0	1	0	0	0	1	0	38.960
37	28.275	289	18.040	1	0	0	0	0	1	0	38.970
38	28.285	288	18.050	0	0	0	0	0	1	0	38.980
39	28.295	287	18.060	1	1	1	1	1	0	0	38.990
40	28.305	286	18.070	0	1	1	1	1	0	0	39.000
NOTE: 1; H Level [5.1 - 5.5 V] 0; L Level [0.05 - 0.4 V]											

PC Board
Detail:



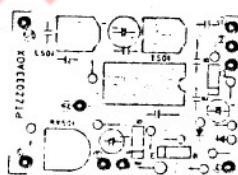
PTBM092COX



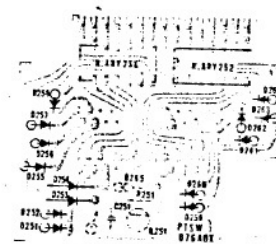
26



PTLD023COX



PTZZ033AOX



PTSW076AOX

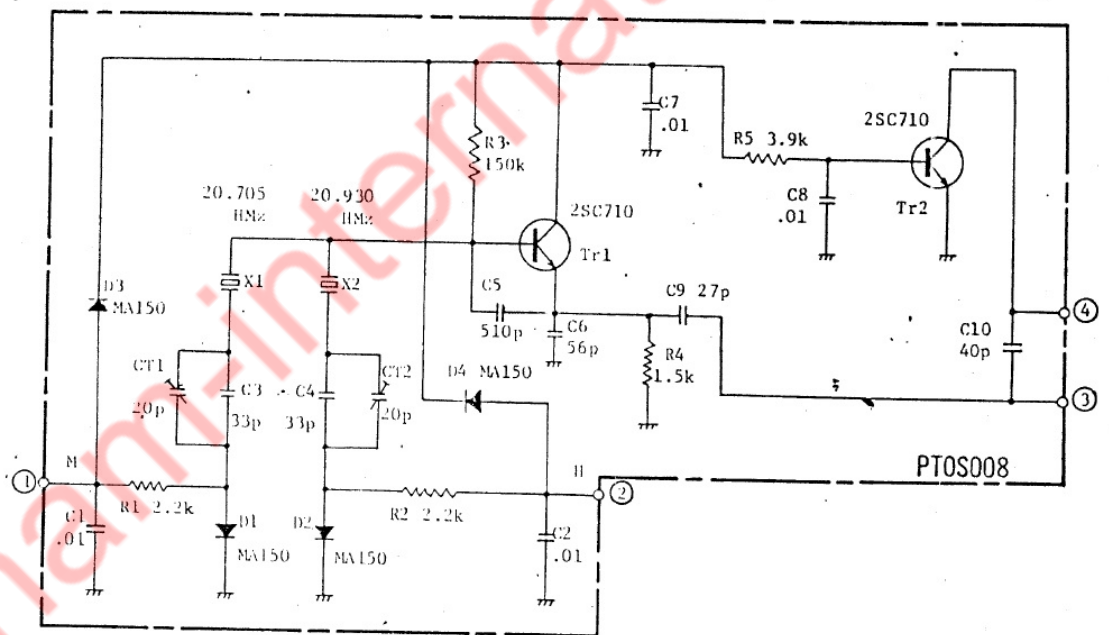


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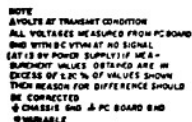
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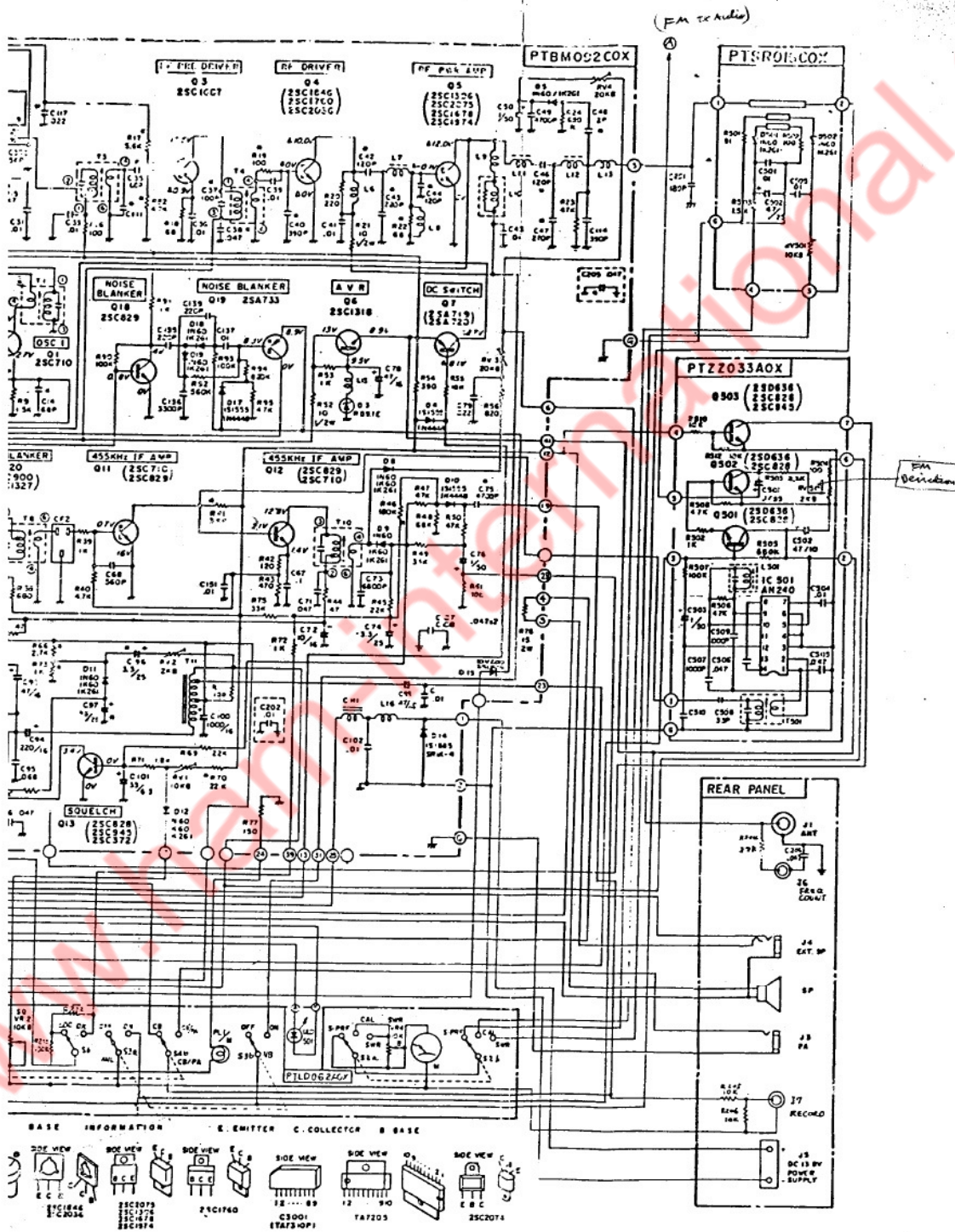
PUMA



HAM
INTERNATIONAL

TRANSFORMER TERMINATION INFORMATION:
(BOTTOM VIEW)





Schematic Diagram

