PTBM048A0X PCB Alignment

Printed Circuit Board number PTBM048A0X
Colt 480 / 485 / 890 / 1000 / 1200
HyGain 2705 (V) / 2720 / 2785 / 3108 (VIII)
Lafayette SSB80 / SSB120 / SSB140
Midland 78-976 / 79-892

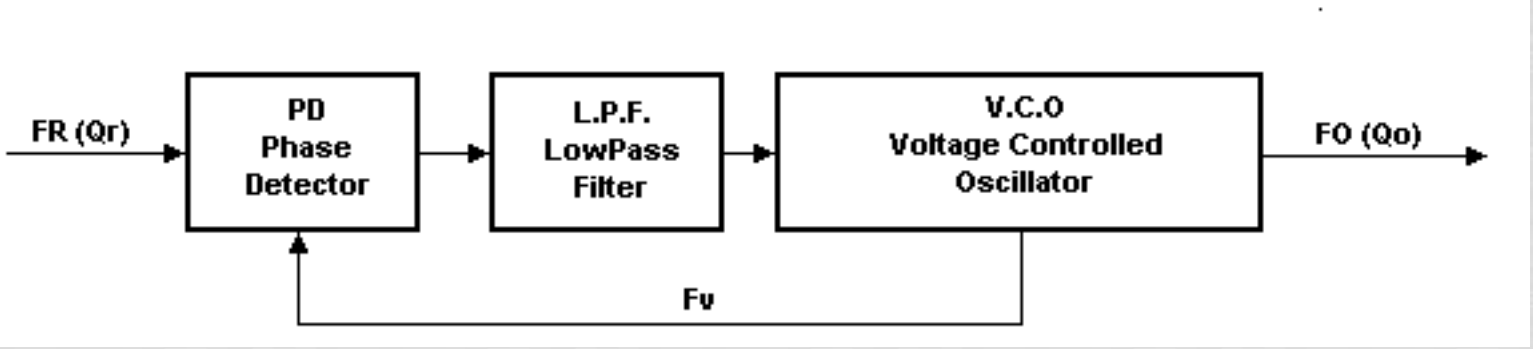
I make a special EPROM expansion board that will add 4 more bands to any PLL02A radio, it also adds a 10KHz shift function as well, click here to find out more.

It will give 1 band down, 1 band up, UK 40 (up 64 channels without Alpha ch hops), NZ 40 (down 63 channels) and 10KHZ shift.

On a 40 channel radio it will give coverage from 26.335 to 28.005 (including the normal low,mid and high bands of 26.515-27.855), that is a total of 167 channels !

I can also make a custom board upon request which will give whatever frequency range you want (within the limits of the radio).

Fundamental theory of PLL circuit
The word PLL is an abbreciation of the "Phase Locked Loop" in which a given signal is processed to track the frequency and phase of a reference signal.
In other word, the PLL is of an automatic frequency control loop or automatic phase control.
The PLL circuit consists of the three units in simple form as shown:



In the above block diagram, when the reference frequency fr and the VCO output frequency fv to be compared are applied to the Phase Detector P/D, fv is compared with fr in terms of Phase lag and lead.

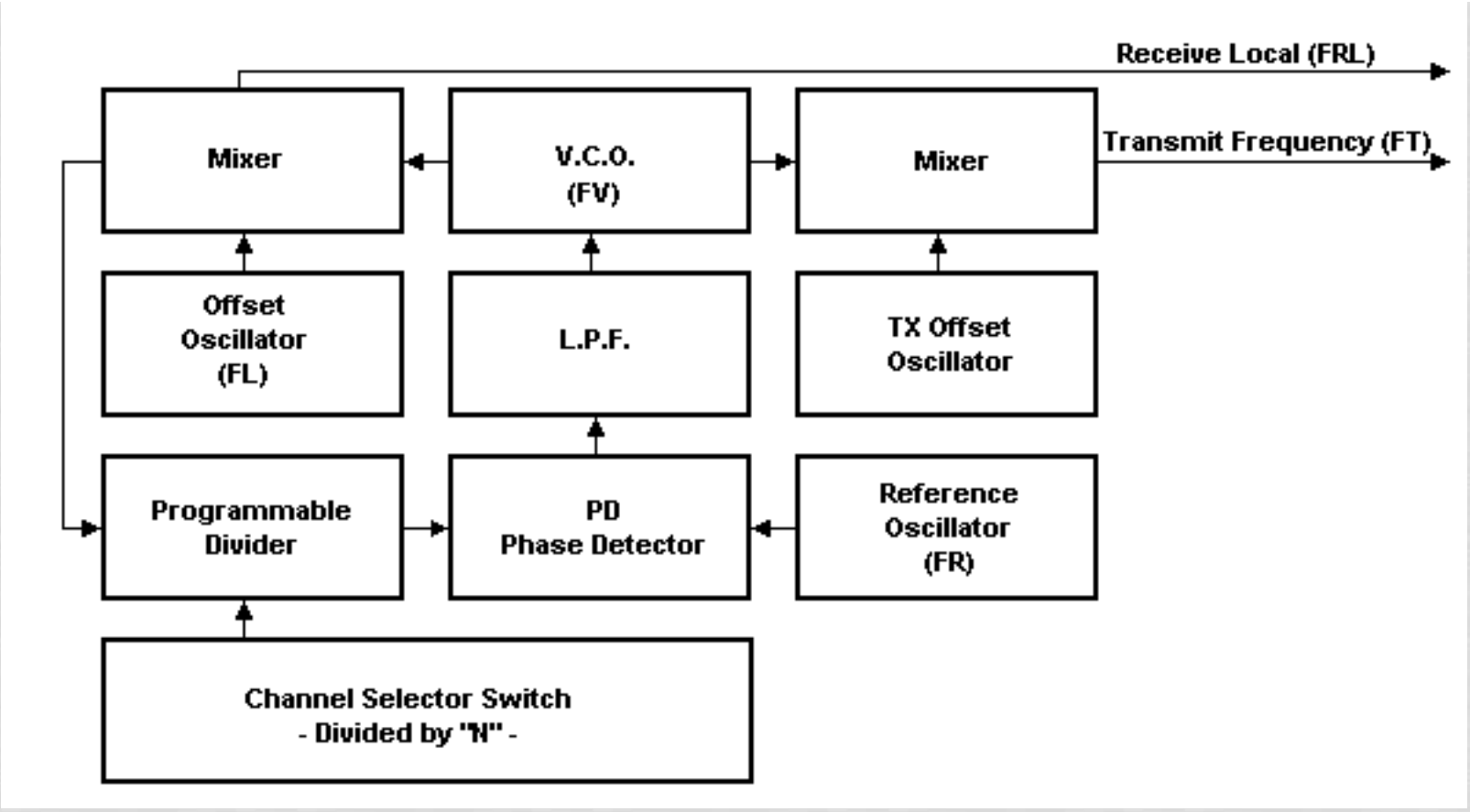
Then the resulting output (Phase difference) is converted in to the DC output voltage corresponding to the phase difference. Since the phase comparison is made at every cycle , the DC output may include unnecessary harmonics and noises . The DC output is , then, led to the low pass filter (L.P.F) and integrated or smoothed to continuous DC voltage in proportion to the phase difference. The frequency of voltage controlled oscillator (V.C.O.) is controlled by the L.P.F. output voltage. Thus, controled VCO output is, then, split into two:

One used as an operating frequency of the unit and another will be returned to the plD, making a closed loop. The closed loop will con tinue to operate untill the following condition is met :

$\phi r(t) = \phi o(t)$

This condition is called locked.

Employing the PLL system into a CB transciever requires some modifications so that the VCO generates specific frequency corresponding to each channel frequency [1 - 22] according to the channel selection. In the diagram below, a programmable divider, Mixer and Offset oscillator are newly added.



Q6 is the standard reference oscillator (lO.24OMHz) and Q5 is the buffer amp-lifier for the oscillator.
D6 is the diode through which DC voltage , which is supplied when the channel selector is placed between channels , is applied to the IC3 to disable the mixing operation inside the IC3. Thus no frequency will be generated though the channel selector is placed between correct channel positions.
For clearer understanding, please refer to the schematic diagram and the Block Diagram.

AM/FM receiver circuit

A received signal passes T7 , then amplified in Q2O, and again passes the band pass filter consisting of T8 and T9, then, enters into the Mixer stage of Q22. On the other hand the first Rx local signal frequency is applied to the base of Q22 through a coupling capacitor of C14. Then, both signals are mixed with inside the Q22 and converted into the first IF signal (10.695MHz) in passing through the T10 and T13. The 10.695MHz signal and 10.240MHz signal generated in Q6 are applied to the balanced mixer consisting of D22 and D23 and 455kHz second IF frequency will

be made .
This frequency is then led to the T14, CF (ceramic filter), Q27, Q28, Q29 (amplidied), T15 and finally led to the detector D25. The audio signal is then applied to the AF amplifier (IC5) through ANL CD26) circuit. The IC output drives the built-in speaker.
To improve signal over load distortion which would be caused when the receiver is subjected to a strong signal, three stages of AGC loops., each for Q20, Q22 and Q27, are provided.
Q21 is a switching transistor to short-circuit the primary circuit of T9 during transmit operation , thus disabling the receiver circuit.
While in FM receiving mode, the 455kHz signal amplified only through Q27 is led to FM demodulating IC, IC5O1 through T16. Resultant demodulated audio is acheived from the 1C pin #12 and input to AF gain control VR, VR1.

SSB receiver circuit
An incoming signal induced on the antenna is led to the T7 and applied to the then to Q20 and amplified. The amplified output is applied to the Q22 mixer through a bandpass filter consisting of T8 and T9. While the first local frequency is being applied to the base of the same transistor, both frequencies are mixed with each other and first IF frequency will be made (10.695MHz for AM/FM/USB , 10.692MHz for LSB) . This IF signal then amplified in passing through the T10, crystal filter, Q14, Tll, Q16 and Q17 and finally detected into the audio signalwith the product detector consisting of Q19. The audio signal is led to the Power IC (IC5) to drive the built-in speaker.
Q18 is the transistor to avoid undesirable impule noise , which will be generated in pressing the push-to-talk switch, from entering into the AGC circuit.
. To reduce the signal over load distortion in the SSB mode of operation, peak-value type AGC circuit consisting of Q3O, and Q31 is employed for exclusive use of SSB operation.

AM/FM transmitter circuit
The first local oscillator frequency (37MHz band) and 10.695MHz frequency generated in the Q12 are led to the Pin #4 and Pin #1 of IC3, respectively, and mixed with each other, resulting in 27MHz band transmit frequency . The 27MHz output is led to the Q8, Q9, and Q10 through T4 and T5 in this order and amplified up to the high level necessary for transmission.
Thus amplified Power output is applied to the Antenna Connector through a bandpass filter consisting of L11, L12, L13, etc.

0n the other hand, the microphone input signal enters into the Power IC,(IC5, #6Pin terminal) and amplified output is applied to the collectors of Q9 and Q10 through the trans former T16 and diode D43 to modulate the transmit carrier frequency .
Transistor Q35 is the automatic level controller provided to suppress the audio input level to the IC5 properly to avoid the over modulation.
Q37 obtains its input signal from the audio output circuit through D43 and its output controls Q35, thus keeping modulation signal level to a relatively cons tant value.
In the FM mode, IC5 output is fed to the anode of the variable capacitor D4 in IC2 VC0 circuit, varying its bias to change VC0 signal phase component, finally giving deviation to PLL output frequency.

SSB transmitter circuit
In the mode of SSB operation, either of first local oscillator frequency of 37.660 - 37.920MHz (AM/FM/USB) or 37.657 - 37.917MHz (LSB) will be led to the IC #4Pin terminal. On the other hand the 10.695MHz (in LSB mode, this will be shifted to 10.692MHz as previously mentioned) generated with Q12 is led to the balanced modulation IC (IC4) . The 1C is designed to produce carrier-suppressed double side band signals when an audio signal amplified with IC5 is applied .to the PIN terminal of #1. Thus produced DSB signal will flow to Q13 and amplified , then led to the XF(crystal filter) to separate the desired side band.
The side band signal is led to the Q14 and be amplified, then led #3Pin terminal of IC3 and mixed with the output is led to the the first local signal to oscillator produce 27MHz transmit signal. The 27MHz SSB output is the led to the T4 and T5, then further led to the linear amplifiers, Q7, Q8, Q9 and Q10.
Thus amplified RF output is finally led to the antenna terminal through the Bandpass and low pass networks provided between the Q10 and antenna connector.
To avoid over modulation distortion , an ALC circuit consis ting of Q35 and Q38 is provided in the SSB microphone amplifier circuit. Another ALC circuit is also employed in the RF circuit (from Q10 to IF Amp Q14) to reduce the distortion in the RF stages.
Transistor Q36 and Q39 are switching circuits to operate IC5 as an SSB microphone amplifier.

Noise blanker circuit
An impulse signal included in the IF signals will be picked up through the capacitor C113 and positive-half voltage is

then applied to the transistor Q24 and Q25 and amplified to enough level capable of turning the transistor Q26. The amplified impulse signal makes Q26 turn on while the impulse is being applied. In other word, the primary circuit of T10 is grounded to the chassis through C121 and the emitter- collector of Q26, so no mixer output will be obtained during this period. In this way the impulse noise will be blanked out.
D20 is the diode provided to control the bias voltage to the Q24 in according to the signal strength of the normal signals recieved, thus avoiding operation error which would caused by the normal signals.

Squelch circuit
When AGC voltage lowers with a weak recieved signal, transistors Q32 and Q33 turn on and this makes Q34 turn off, controlling the bias voltage to the AF AMP (IC 5) and disabling the amplifier. On the other hand when the transistor Q34 is turned on, the amplifier will start to operate.

Regulated power supply circuit
This circuit consists of Q44 and D50 and supplies voltage through the switching transistors Q40, Q41, Q43, depending upon the mode of operation.

Adjustment

Test equipment required:

Power Supply: 13,8 V	Frequency Counter	Dummy Load 50 ohm	Oscilloscope
	DC Amperemeter	RF SSG	AF SSG

Preparation alignment:

Clarifier	Mid.
SQ GAIN	Max.
AF GAIN	Max.
RF GAIN	Max.

MIC GAIN	Max.
MOD, S/RF	S/RF
NB/ANL	Off
Band	D
Channel	19

Step	Adjust	Indicator Connection	remarks
PLL			
1	CT3	Frequency Counter to TP2 AM-Modulation	10.240MHz
2	CT1	Oscilloscope and Frequency counter to TP3 AM-Modulation	20.105MHz
3	CT2	Frequency Counter to TP2 LSB-Modulation	20.1035MHz
4	CT5	Frequency Counter to TP5 AM-Modulation	10.695MHz
5	CT4	Frequency Counter to TP5 AM-Modulation	10.692MHz
VCO			
6	VCO-Block	Volt Meter to TP1	4,4Volt@Channel 19
RF Amplifier Bias Alignment			
7	RV1	VoltMeter between Q10 Emitter and GND	35mA

SSB Power Amplifier stage Alignment Channel 11			
8	T1	Oscilloscope and Watt Meter to Antenna jack	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
9	T2	Oscilloscope and Watt Meter to Antenna jack	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
SSB Power Amplifier stage Alignment			
10	T4	Oscilloscope to base of Q8 Channel 22	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
11	T5	Oscilloscope to base of Q8 Channel 1	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
SSB Power Amplifier stage Alignment Channel 11			
12	T6	Oscilloscope to emitter of Q7	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
13	T11	Oscilloscope and Watt Meter to Antenna jack	Feed 2,4kHz to Microphone input. Adjust for maximum amplitude.
14	L7	Oscilloscope and Watt Meter to Antenna jack	Adjust for maximum
15	L11	Oscilloscope and Watt Meter to Antenna jack	Adjust for maximum
16	L13	Oscilloscope and Watt Meter to Antenna jack	Adjust for maximum

17	RV4	Oscilloscope and Watt Meter to Antenna jack	Adjust for minimum Carrier lekage
18	RV5	Oscilloscope and Watt Meter to Antenna jack	Adjust for minimum Carrier lekage
19	RV11 (ALC)	Oscilloscope and Watt Meter to Antenna jack	Feed 500Hz and 2,4kHz to Microphone input. Adjust for 18 Watt.
AM Power Alignment			
20	RV1	Oscilloscope and Watt Meter to Antenna jack	Adjust for 12 Watt RF Power
Modulation Alignment			
21	RV12	Oscilloscope and Watt Meter to Antenna jack	Adjust for 80% AM-modulation
RF Power Meter Alignment			
22	RV3	Watt Meter to Antenna jack	Adjust RF Power Meter
Lock Out Circuit Check			
23	-	VoltMeter between base of Q9 and GND	0,05 - 0,4 Volt
Transmit Frequency Check			
24	-	Frequency Counter to Antenna jack	Read fequency on each channel (+/- 900Hz)
RECEIVER			
AGC Alignment			
		VoltMeter to Terminal 15 on PCB and	

25	RV8	Voltmeter to Terminal 15 on PCB and GND	Adjust for 2 Volt
Receiver Sensitivity Alignment (AM-Mode)	T7	8 ohm Dummy Load and Oscilloscope to external Speaker jack	Adjust for maximum
26			
Squelch Sircuit Alignment			
27	RV9	8 ohm Dummy Load and Oscilloscope to external Speaker jack	Adjust so that the Audio output just appears on the Oscilloscope
28	RV10	8 ohm Dummy Load and Oscilloscope to external Speaker jack USB-Modulation	Adjust so that the Audio output just appears on the Oscilloscope
S-meter Alignment			
29	RV7	8 ohm Dummy Load and Oscilloscope to external Speaker jack	SSB-Modulation. RF SSG and Ajust for "S" = "9"
30	RV6	8 ohm Dummy Load and Oscilloscope to external Speaker jack	AM-modulation. RF SSG and Ajust for "S" = "9"
FM Modulation Alignment			
31	RV501	Connect Diviation Meter to Antenna jack.	Adjust for 1,5kHz Modulation

Microphone Connection

Pin	Description
1	Microphone

2	Ground
3	Speaker (Connect to Ground)
4	TX Key (Connect to Ground)

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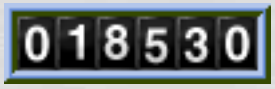

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