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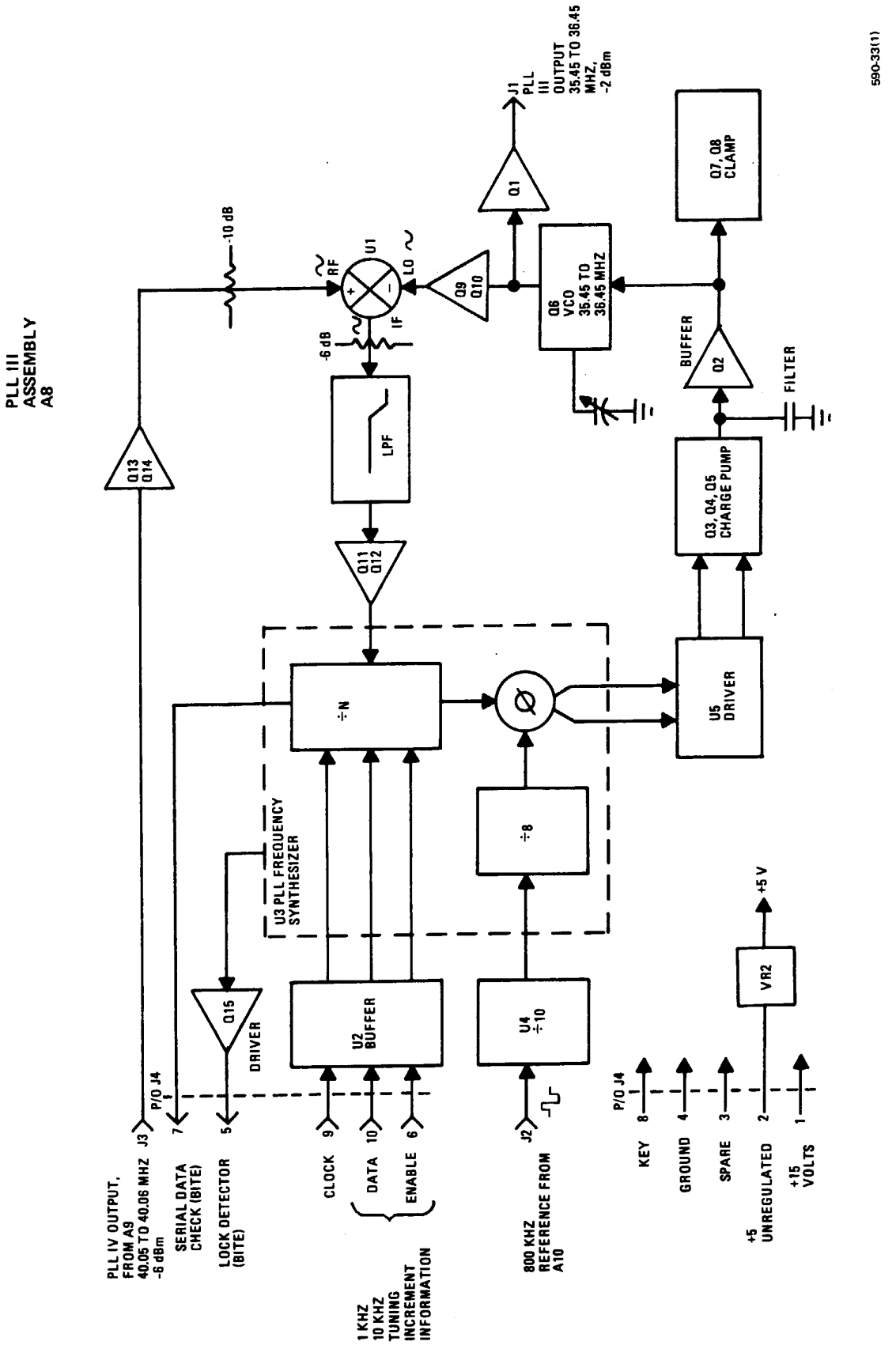

PLL III Assembly A8 Functional Block Diagram

1. GENERAL DESCRIPTION

PLL III is a programmable translation loop which performs the following primary functions.

- Generation of 1 kHz and 10 kHz tuning increments as chosen by the RF-590 front panel controls
- Combination of these increments with information containing the 1 Hz, 10 Hz, and 100 Hz tuning increments

Frequency select input data for 1 kHz and 10 kHz tuning increments is applied to the A8 assembly in serial data format from the Control Board Assembly microprocessor. The 1 Hz, 10 Hz, and 100 Hz tuning increments information is supplied via PLL IV Assembly A9 in the frequency range of 40.06 to 40.05 MHz. A8 output to PLL I Assembly A6 contains 1 Hz, 10 Hz, 100 Hz, 1 kHz, and 10 kHz tuning information in the frequency range of 35.45 to 36.45 MHz.

2. INTERFACE CONNECTIONS

Table 1 details the input/output connections and other relevant data.

Table 1. PLL III Assembly Interface Connections

Connector	Function	Characteristics
J1	PLL III Output	35.45 to 36.45 MHz, ≈ -2 dBm
J2	800 kHz Reference Input	TTL
J3	PLL IV Output	40.05 to 40.06 MHz, ≈ -6 dBm
J4-1	+15 Volts	≈ 60 mA
J4-2	+5 Volts Unregulated	≈ 30 mA
J4-3	Spare	
J4-4	Ground	
J4-5	Lock Detector Output	0 Vdc = PLL locked; +5 Vdc = PLL unlocked
J4-6	Enable	+ going pulse = enabled
J4-7	Serial Data Check	P/O BITE Test, +5 Vdc = ok
J4-8	Key	
J4-9	Clock	750 kHz, TTL
J4-10	Data	Serial TTL

3. A8 FREQUENCY GENERATION SCHEME

A PLL intermediate frequency (IF) range of 3.61 MHz to 4.61 MHz is produced at the IF output of mixer U1. The instantaneous IF frequency is a consequence of the subtractive mixing of the following two signals:

- 40.050 to 40.060 MHz PLL IV (RF port)
- 35.45 to 36.45 MHz VCO (LO port

This IF signal will change in frequency to satisfy the requirement that the divide by N counter output will always try to equal the reference 10.000 kHz signal at the inputs to the Phase Comparator, P/O U3. When these two signals are not equal, the Phase Comparator produces an error command to drive the VCO frequency in the direction required to make them equal. If the divide by N output exceeds the reference 10.0000 kHz, the VCO will rise in frequency. If the divide by N output is less than the reference, the VCO will decrease in frequency.

The VCO output frequency then is dependent upon the following two events:

a. The division factor of the divide by N counter. N = (361 + XX), where XX is the value of the 10 kHz and 1 kHz receiver tuning positions, respectively.

b. The PLL IV output frequency. This is dependent upon the value of the 100 Hz, 10 Hz, and 1 Hz tuning positions (section A9, PLL IV Assembly).

To illustrate this, assume that the receiver is tuned to a frequency of $X_8X_7X_6X_5X_4X_3X_2X_1$ Hz, where the Xs represent the values of the 1, 10, 100 Hz etc, tuning positions.

Example 1: Assume that the $X_3X_2X_1$ value decreases.

a. As $X_3X_2X_1$ decreases the PLL IV output (RF) increases.

b. RF – LO = IF increases.

c. The divide by N output frequency (= IF ÷ N) increases. Since this will now exceed the 10.000 kHz reference frequency, the Phase Comparator output forces the VCO frequency (LO) to increase.

d. Now, RF – LO = IF decreases. The IF will decrease until the divide by N output again equals the reference.

Example 2: Assume that the X_5X_4 value decreases.

a. As X_5X_4 decreases, the divide by N factor ($N = 361 + X_5X_4$) decreases.

b. The divide by N output frequency, equal to IF ÷ N, increases. Since this now exceeds the 10.000 kHz reference at the Phase Comparator inputs, the Phase Comparator output forces the VCO (LO) frequency to increase.

c. RF – LO = IF decreases.

d. IF ÷ N decreases, and continues to do so until equal to the reference.

The converse of both of these cases is true for $X_3X_2X_1$ and/or X_5X_4 increasing.

The A8 PLL III Output Frequency may be calculated from the following equation; given the receiver tune frequency is X_8X_7, $X_6X_5X_4$, $X_3X_2X_1$ Hz:

$$FA8 = [40{,}000{,}000 + 10\,(6000 - X_3X_2X_1)] - [10{,}000\,(361 + X_5X_4)]\text{, Hz}$$

4. CIRCUIT DESCRIPTIONS

NOTE

A8 operation is similar to the general PLL and charge pump circuits described in section 4. A review of section 4 at this time would help in understanding A8 operation.

4.1 PLL IF Generation

PLL output at a -6 dBm level is applied to 10 dB gain stage Q13 and Q14. This output is attenuated by 50 ohm matching network R39, R40, and R44 and presents a -6 dBm signal ranging from 40.050 MHz to 40.060 MHz to the RF port of mixer U1.

U1 LO injection is supplied by the VCO via amplifier stage Q9 and Q10 at a +7 dBm level. This signal ranges from 35.45 to 36.45 MHz.

U1 IF output is approximately -12 dBm (in the 3.61 to 4.61 MHz range). The 6 dB attenuator network, R41-R43, feeds a low pass filter which removes all mixer products except the desired IF range. Amplifier stage Q11 and Q12 provide a TTL level signal to a divide by N counter internal to U3 at pin 10.

4.2 Divide by N Counter

Since the A8 assembly requires a variable output frequency dependent upon the 1 kHz and 10 kHz tuning positions a divide by N programmable counter has been incorporated into the VCO feedback loop. The front panel selection of a tune frequency from 00 kHz to 99 kHz causes Control Assembly A14 to generate a serial data code containing information pertaining to the values choses. This code is applied synchronously with the 750 kHz system clock to U3, whenever the U3 enable line is gated open by A14.

N = (361 + XX) where XX is the value of the 10 kHz and 1 kHz tuning positions. The divide by N counter output will always attempt to equal the 10.000 kHz reference frequency at the Phase Comparator inputs.

4.3 Phase Comparator and Charge Pump Operation

A 10.000 kHz Reference signal is applied to one port of the Phase Comparator. This signal has been divided down from the 800 kHz TTL reference supplied by the A10 assembly. Divide by 10 circuit U4 feeds 80 kHz to the divide by 8 circuit internal to U3.

The second input to the Phase Comparator is the divide by N counter output. When these two signals are equal in frequency and phase, the outputs at Buffer stage U5 (TP2 and TP3) is essentially a +5 Vdc level. This level holds Q4, Q5, and consequently Q3 off. The voltage across C8 is constant. Q2 is biased to produce a constant voltage across R12, and the dc level (VCO control) at TP1 is constant. This holds the VCO at a constant frequency.

Assuming that the divide by N output exceeds the reference 10.000 kHz, the Phase Comparator output at TP3 pulses low (the pulse width being a function of the amount of difference between the two signals). Q5 turns on, and its falling collector voltage turns Q3 on, allowing Q3 to pump charge into C8. C8 voltage increases, causing Q2 to conduct more current and develop a large voltage across R12. The VCO control voltage increases and forces the VCO to tune higher in frequency. This will lower the IF frequency, and divide by N counter output will decrease. As the divide by N counter output approaches the reference, the pulse widths will get narrower until a 5 Vdc level will again occur at TP3. At this point, Q5 turns off, Q3 stops pumping charge into C8, the VCO control voltage stops at a new higher level, and the VCO has been tuned to a higher frequency.

Assuming that the divide by N counter output is less than the reference. The Phase Comparator output at TP2 will pulse low. Q4 turns on and draws charge out of C8. Q2 conducts less current, and the VCO voltage drops, driving the VCO frequency down. The IF feedback signal frequency will increase, and consequently the divide by N counter output will increase. As this output approaches the reference frequency, TP2 pulses will get narrower until Q4 is turned off. The voltage across C8 halts at a lower value (as does the VCO control voltage level). This holds the VCO at a new lower frequency.

4.4 VCO Operation and Control

A charge pump circuit consisting of Q3, Q4, Q5 (and associated components) in conjunction with filter network C8, C9, and R14 convert the two phase comparator pulse outputs into an analog dc control voltage. Buffer amplifier Q2 applies a VCO control voltage to the varactor diode string in the VCO. Changing diode capacitance fine tunes JFET Hartley oscillator stage Q6. The total VCO frequency range is 35.45 to 36.45 MHz. A control voltage range of approximately 6.5 to 7.5 Vdc will tune the oscillator from 35.45 MHz to 36.45 MHz.

Clamp circuit Q7, Q8 and CR2-CR5 monitors the VCO control voltage level, and will prevent the control voltage from exceeding the approximate range of 5.5 to 8.5 Vdc. This "window" is necessary to prevent the VCO from ever running to the wrong side of the frequency conversion during the mixing process. This could cause the receiver to falsely lock at the wrong frequency, or not lock at all. For example, as-

sume that the control voltage could rise high enough to force the VCO to 41 MHz. Combination of the 40.05 to 40.06 MHz signal at mixer U1 would produce a loop IF in the 1 MHz region instead of the required 3.61 to 4.61 MHz range. The clamp circuit would prevent this; however, since CR4, CR5, and Q8 would conduct to clamp the level at 8.5 volts and prevent the VCO from "running away".

The VCO output is fed through amplifier stage Q9 and Q10 to function as a +7 dBm LO injection for U1, and to Q1, where a -2 dBm signal is passed through J1 to PLL I Assembly A6.

4.5 BITE Test Circuits

The A10 assembly contains two circuits for self-test evaluation. The circuits are:

- Lock detector Q15 whose output is 0 Vdc whenever the PLL is tracking properly. This line is constantly monitored by the A14 assembly. A front panel fault light will appear if the loop ever unlocks.

- Serial data check that verifies that the tuning data from the A14 assembly has been received and properly translated into the correct divide by N factor. A serial data word is sent on the data line (J4 pin 10) and the U3 serial data check line is read back to the A14 assembly (J4 pin 7). If the word has been received and properly decoded, this line will pulse to +5 Vdc. The serial data check occurs automatically, but only when the receiver BITE self-test is actuated.

5. MAINTENANCE

The following adjustments should not be made as part of a routine maintenance procedure, but rather only when a failure indicates a definite need. All tests should be performed with all connections in normal contact, unless otherwise specified.

5.1 VCO Alignment

Perform the following procedure to align the VCO:

a. Connect equipment as shown in figure 1.

b. Set receiver frequency to 00.050500 MHz.

c. Monitor U1, pin 8, with an oscilloscope and adjust T3 for a maximum signal (should be approximately 1.2 Vpp).

d. Monitor U1 RF input at R44 with oscilloscope and adjust T4 for a maximum signal (should be approximately 1 Vpp).

e. Monitor J1 with spectrum analyzer at approximately 35 MHz. Adjust T2 for a maximum output (approximately -2 dBm).

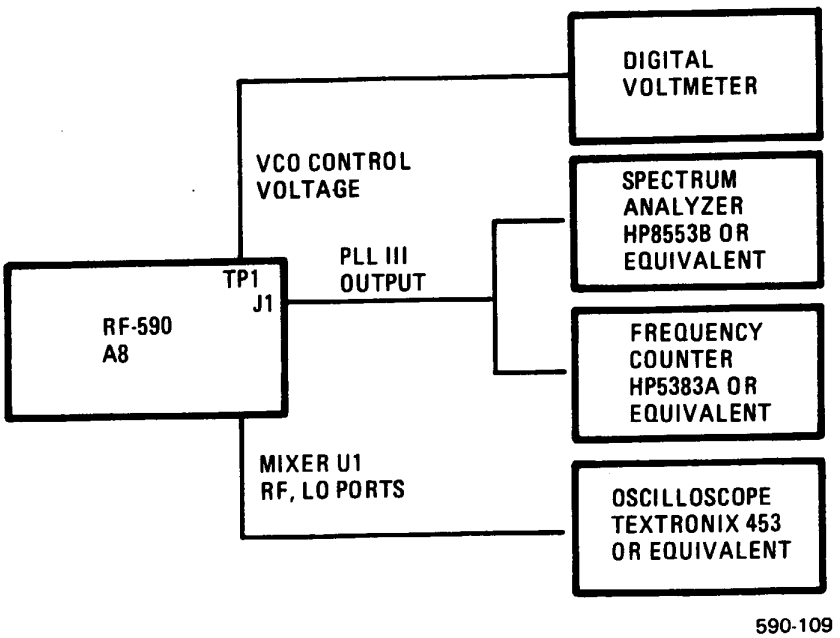

Figure 1. A8 VCO Alignment

f. Monitor TP1 with DVM. Adjust C11 for 7.0 Vdc. PLL III output vs receiver tune frequency should agree with table 2.

Table 2. PLL III Output Range

Receiver Tune Frequency, MHz	PLL III Output Frequency, MHz	Approximate TP1 Voltage, Vdc
00.000000	36.450000	7.9
00.050500	35.944950	7.0
00.099999	35.450010	6.5

g. Fully reconnect the A8 assembly to the RF-590 and initiate BITE self-test. No failures should occur indicating an A8 fault.

6. PARTS LIST

Table 3 is a comprehensive parts list of all replaceable components in PLL III Assembly A8. When ordering parts from the factory, include a full description of the part. Use figure 2, PLL III Assembly A8 Component Location Diagram.

7. SCHEMATIC DIAGRAM

Figure 3 is the PLL III Assembly A8 schematic diagram.

Table 3. PLL III Assembly A8 Parts List (PL 10073-4300)

Ref. Desig.	Part Number	Description
	10073-4300	PWB, PLL 3
	E70-0002-002	PAD MNT XSTR TO-5
C1	M39014/02-1310	CAP .1UF 10% 100V CER-R
C2	M39014/01-1535	CAP .01UF 20% 100V CER
C3	M39014/01-1535	CAP .01UF 20% 100V CER
C4	CM04ED560J03	CAP 56PF 5% 500V MICA
C5	M39014/01-1535	CAP .01UF 20% 100V CER
C6	C26-0025-100	CAP 10UF 20% 25V TANT
C7	M39014/02-1310	CAP .1UF 10% 100V CER-R
C8	M39014/02-1318	CAP .33UF 10% 50V CER
C9	M39014/02-1543	CAP .027UF 10% 50V CER
C10	C26-0025-339	CAP 3.3UF 20% 25V TANT
C11	C84-0003-008	CAP 3-15PF 200V CER
C12	M39014/02-1310	CAP .1UF 10% 100V CER-R
C13	M39014/02-1310	CAP .1UF 10% 100V CER-R
C14	CK05BX102M	CAP 1000PF 20% 200V CER
C15	M39014/01-1535	CAP .01UF 20% 100V CER
C16	M39014/02-1310	CAP .1UF 10% 100V CER-R
C17	M39014/02-1310	CAP .1UF 10% 100V CER-R
C18	M39014/01-1535	CAP .01UF 20% 100V CER
C19	CK05BX102M	CAP 1000PF 20% 200V CER
C20	C26-0025-100	CAP 10UF 20% 25V TANT
C21	M39014/01-1535	CAP .01UF 20% 100V CER
C22	C26-0025-100	CAP 10UF 20% 25V TANT
C23	M39014/02-1310	CAP .1UF 10% 100V CER-R
C24	CM04ED470J03	CAP 47PF 5% 500V MICA
C25	M39014/02-1310	CAP .1UF 10% 100V CER-R
C26	M39014/02-1310	CAP .1UF 10% 100V CER-R
C27	M39014/01-1535	CAP .01UF 20% 100V CER
C28	M39014/01-1535	CAP .01UF 20% 100V CER
C29	C26-0016-151	CAP 150UF 20% 16V TANT
C30	M39014/01-1535	CAP .01UF 20% 100V CER
C31	M39014/01-1535	CAP .01UF 20% 100V CER
C32	C26-0025-339	CAP 3.3UF 20% 25V TANT
C33	M39014/02-1310	CAP .1UF 10% 100V CER-R
C34	CM04ED470J03	CAP 47PF 5% 500V MICA
C35	M39014/01-1535	CAP .01UF 20% 100V CER
C36	C26-0025-100	CAP 10UF 20% 25V TANT
C37	M39014/02-1310	CAP .1UF 10% 100V CER-R

Table 3. PLL III Assembly A8 Parts List (PL 10073-4300) (Cont.)

Ref. Desig.	Part Number	Description
C38	M39014/02-1310	CAP .1UF 10% 100V CER-R
C39	M39014/02-1310	CAP .1UF 10% 100V CER-R
C40	M39014/02-1310	CAP .1UF 10% 100V CER-R
C41	M39014/02-1310	CAP .1UF 10% 100V CER-R
C42	CM04FD151J03	CAP 150PF 5% 500V MICA
C43	CM04FD151J03	CAP 150PF 5% 500V MICA
C44	CM04FC271J03	CAP 270PF 5% 300V MICA
C45	CM04FC301J03	CAP 300PF 5% 300V MICA
C46	CM04FC271J03	CAP 270PF 5% 300V MICA
C47	CM04FC271J03	CAP 270PF 5% 300V MICA
C48	CM04FD111J03	CAP 110PF 5% 500V MICA
C49	CM04CD120J03	CAP 12PF 5% 500V MICA
C50	M39014/02-1310	CAP .1UF 10% 100V CER-R
C51	CM04ED330J03	CAP 33PF 5% 500V MICA
C52	CM04FD151J03	CAP 150PF 5% 500V MICA
C53	CM04CD120J03	CAP 12PF 5% 500V MICA
C54	M39014/01-1535	CAP .01UF 20% 100V CER
C55	M39014/01-1535	CAP .01UF 20% 100V CER
C56	CM04ED470J03	CAP 47PF 5% 500V MICA
C57	M39014/01-1535	CAP .01UF 20% 100V CER
C58	CM04ED390J03	CAP 39PF 5% 500V MICA
C59	M39014/01-1535	CAP .01UF 20% 100V CER
C60	M39014/01-1535	CAP .01UF 20% 100V CER
C61	M39014/02-1310	CAP .1UF 10% 100V CER-R
C62	C26-0025-470	CAP 47UF 20% 25V TANT
C63	C26-0025-470	CAP 47UF 20% 25V TANT
C64	M39014/02-1310	CAP .1UF 10% 100V CER-R
C65	M39014/02-1310	CAP .1UF 10% 100V CER-R
C66	M39014/02-1310	CAP .1UF 10% 100V CER-R
C67	M39014/02-1310	CAP .1UF 10% 100V CER-R
C68	M39014/02-1310	CAP .1UF 10% 100V CER-R
C69	C25-0001-301	CAP 1.0UF 20% 20V TANT
C70	M39014/01-1535	CAP .01UF 20% 100V CER
C71	M39014/01-1535	CAP .01UF 20% 100V CER
C72	M39014/01-1535	CAP .01UF 20% 100V CER
CR1	1N6263	DIODE, HOT CARRIER
CR2	1N3064	DIODE 75mA 75V SW
CR3	1N3064	DIODE 75mA 75V SW
CR4	1N3064	DIODE 75mA 75V SW
CR5	1N3064	DIODE 75mA 75V SW
CR6	1N3064	DIODE 75mA 75V SW
CR7	10073-7118	DIODE, SILICON, HYPERABRUPT
CR8	10073-7118	DIODE, SILICON, HYPERABRUPT
CR9	10073-7118	DIODE, SILICON, HYPERABRUPT
CR10	10073-7118	DIODE, SILICON, HYPERABRUPT

Table 3. PLL III Assembly A8 Parts List (PL 10073-4300) (Cont.)

Ref. Desig.	Part Number	Description
CR11	10073-7118	DIODE, SILICON, HYPERABRUPT
CR12	10073-7118	DIODE, SILICON, HYPERABRUPT
CR13	10073-7118	DIODE, SILICON, HYPERABRUPT
CR14	10073-7118	DIODE, SILICON, HYPERABRUPT
CR15	10073-7118	DIODE, SILICON, HYPERABRUPT
CR16	10073-7118	DIODE, SILICON, HYPERABRUPT
J1	J-0031	CONN SMB VERT PCB F
J2	J-0031	CONN SMB VERT PCB F
J3	J-0031	CONN SMB VERT PCB F
J4	J46-0032-010	HDR 10 PIN 0.100" SR
L1	MS75084-13	COIL 12UH 10% FXD RF
L2	MS75083-6	COIL .27UH 10% FXD RF
L3	MS75084-6	COIL 3.3UH 10% FXD RF
L4	MS75083-6	COIL .27UH 10% FXD RF
L5	L08-0001-001	CHOKE W B 50 MHZ
L6	MS18130-9	COIL 1.2UH 10% FXD RF
L7	MS18130-9	COIL 1.2UH 10% FXD RF
L8	MS18130-8	COIL 1.0UH 10% FXD RF
L9	L08-0001-001	CHOKE W B 50 MHZ
Q1	Q35-0003-000	XSTR U310 JFET HIGH GM
Q2	Q05-0001-000	XSTR JFET N-CH
Q3	2N2907	XSTR SS/GP PNP TO-18
Q4	2N2222	XSTR SS/GP NPN TO-18
Q5	2N2222	XSTR SS/GP NPN TO-18
Q6	Q35-0003-000	XSTR U310 JFET HIGH GM
Q7	2N2222	XSTR SS/GP NPN TO-18
Q8	2N2907	XSTR SS/GP PNP TO-18
Q9	Q35-0003-000	XSTR U310 JFET HIGH GM
Q10	2N5109	XSTR RFPWR NPN TO-39
Q11	Q-0153	XSTR SS/RF PN4258
Q12	2N2369	XSTR SS/RF NPN
Q13	2N2369	XSTR SS/RF NPN
Q14	Q35-0003-000	XSTR U310 JFET HIGH GM
Q15	2N2907	XSTR SS/GP PNP TO-18
R1	R65-0003-101	RES 100 5% 1/4W CAR FILM
R2	R65-0003-470	RES 47 5% 1/4W CAR FILM
R3	R65-0003-513	RES 51K 5% 1/4W CAR FILM
R4	R65-0003-101	RES 100 5% 1/4W CAR FILM
R5	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R7	R65-0003-201	RES 200 5% 1/4W CAR FILM
R8	R65-0003-202	RES 2.0K 5% 1/4W CAR FILM
R9	RN55D1501F	RES,1500 1% 1/8W MET FLM
R10	RN55D1501F	RES,1500 1% 1/8W MET FLM
R11	RN55D1002F	RES,10.0K 1% 1/8W MET FLM
R12	R65-0003-202	RES 2.0K 5% 1/4W CAR FILM

Table 3. PLL III Assembly A8 Parts List (PL 10073-4300) (Cont.)

Ref. Desig.	Part Number	Description
R13	RN55D3321F	RES,3320 1% 1/8W MET FLM
R14	RN55D1621F	RES,1620 1% 1/8W MET FLM
R15	RN55D2211F	RES,2210 1% 1/8W MET FLM
R16	RN55D2211F	RES,2210 1% 1/8W MET FLM
R17	R65-0003-330	RES 33 5% 1/4W CAR FILM
R18	R65-0003-121	RES 120 5% 1/4W CAR FILM
R19	R65-0003-360	RES 36 5% 1/4W CAR FILM
R20	R65-0003-201	RES 200 5% 1/4W CAR FILM
R21	R65-0003-392	RES 3.9K 5% 1/4W CAR FILM
R22	R65-0003-392	RES 3.9K 5% 1/4W CAR FILM
R23	R65-0003-470	RES 47 5% 1/4W CAR FILM
R24	R65-0003-242	RES 2.4K 5% 1/4W CAR FILM
R25	R65-0003-681	RES 680 5% 1/4W CAR FILM
R26	R65-0003-182	RES 1.8K 5% 1/4W CAR FILM
R27	R65-0003-471	RES 470 5% 1/4W CAR FILM
R28	R65-0003-330	RES 33 5% 1/4W CAR FILM
R29	R65-0003-101	RES 100 5% 1/4W CAR FILM
R30	R65-0003-271	RES 270 5% 1/4W CAR FILM
R31	R65-0003-820	RES 82 5% 1/4W CAR FILM
R32	R65-0003-391	RES 390 5% 1/4W CAR FILM
R33	R65-0003-561	RES 560 5% 1/4W CAR FILM
R34	R65-0003-330	RES 33 5% 1/4W CAR FILM
R35	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R36	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R37	R65-0003-471	RES 470 5% 1/4W CAR FILM
R39	R65-0003-750	RES 75 5% 1/4W CAR FILM
R40	R65-0003-101	RES 100 5% 1/4W CAR FILM
R41	R65-0003-101	RES 100 5% 1/4W CAR FILM
R42	R65-0003-101	RES 100 5% 1/4W CAR FILM
R43	R65-0003-750	RES 75 5% 1/4W CAR FILM
R44	R65-0003-101	RES 100 5% 1/4W CAR FILM
R45	R65-0003-101	RES 100 5% 1/4W CAR FILM
R46	R65-0003-111	RES 110 5% 1/4W CAR FILM
R47	R65-0003-471	RES 470 5% 1/4W CAR FILM
R48	R65-0003-470	RES 47 5% 1/4W CAR FILM
R49	R65-0003-242	RES 2.4K 5% 1/4W CAR FILM
R50	R65-0003-182	RES 1.8K 5% 1/4W CAR FILM
R51	R65-0003-681	RES 680 5% 1/4W CAR FILM
R52	R65-0003-201	RES 200 5% 1/4W CAR FILM
R53	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R54	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R55	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R56	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R58	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R59	R65-0003-101	RES 100 5% 1/4W CAR FILM

Table 3. PLL III Assembly A8 Parts List (PL 10073-4300) (Cont.)

Ref. Desig.	Part Number	Description
R60	R65-0003-560	RES 56 5% 1/4W CAR FILM
T1	10073-7004	TRANSFORMER, RF, FIXED
T2	10073-7011	TRANSFORMER, RF, VARIABLE
T3	10073-7011	TRANSFORMER, RF, VARIABLE
T4	10073-7011	TRANSFORMER, RF, VARIABLE
TP1	J-0071	TP PWB BRN TOP ACCS .080"
TP2	J-0066	TP PWB RED TOP ACCS .080"
TP3	J-0069	TP PWB ORN TOP ACCS .080"
TP4	J-0070	TP PWB YEL TOP ACCS .080"
TP5	J-0068	TP PWB GRN TOP ACCS .080"
TP6	J-0072	TP PWB BLU TOP ACCS .080"
U1	I51-0003-003	MIXER DB 50mW 500MHZ
U2	I01-0000-019	IC 4050B PLASTIC CMOS
U3	I70-0002-001	IC MC145156 PLASTIC CMOS
U4	I05-0000-090	IC 74LS90 PLASTIC TTL
U5	I05-0000-000	IC 74LS00 PLASTIC TTL
VR1	I12-0005-012	IC VR 78L12 + 12V .10A 10
VR2	I11-0001-001	IC VR 7805 + 5V 1.5A 4%
VR3	1N5236A	DIODE 7.5V 10% .5W ZENER
VR4	1N5236A	DIODE 7.5V 10% .5W ZENER

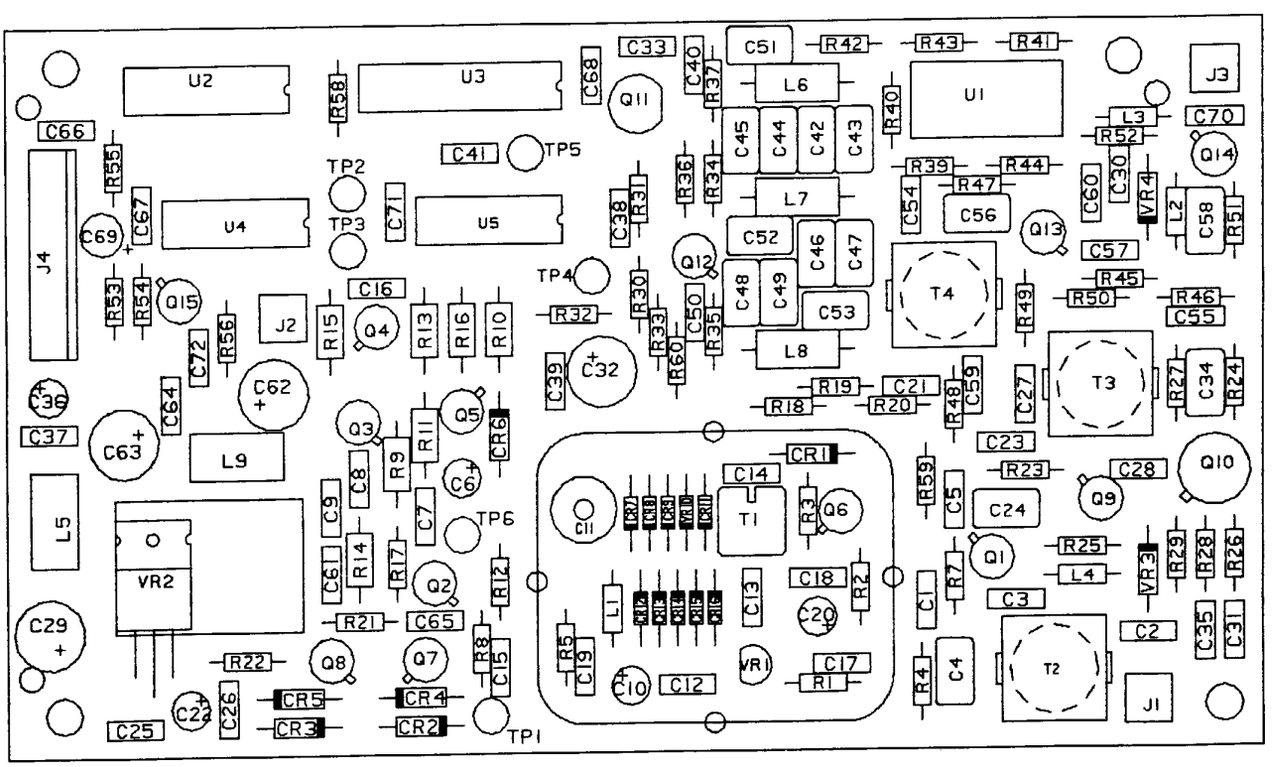

Figure 2. PLL III Assembly A8 Component Location Diagram (10073-4300, Rev. D)

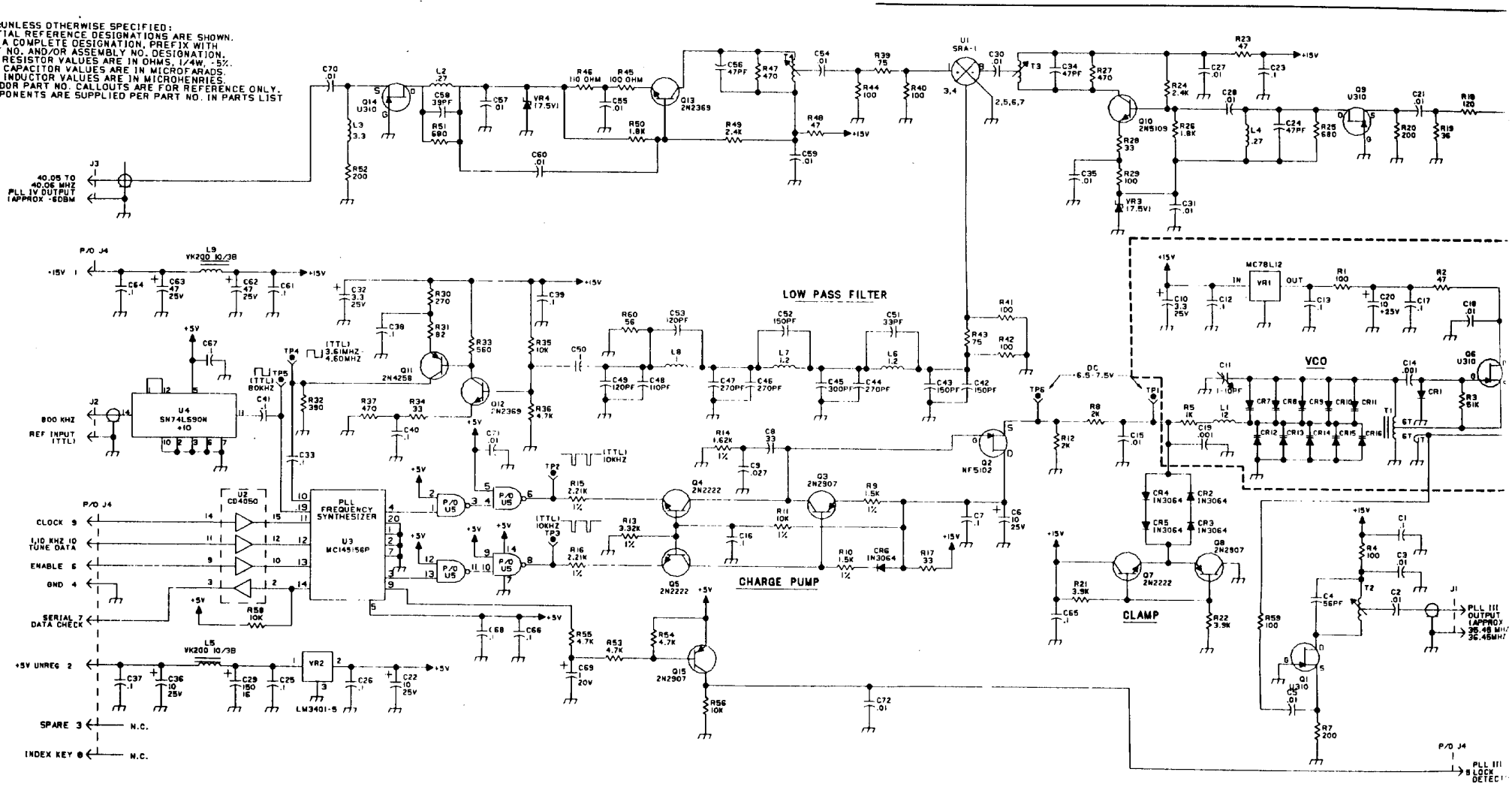

Figure 3. PLL III Assembly A8 Schematic Diagram (10073-4301, Rev. F)

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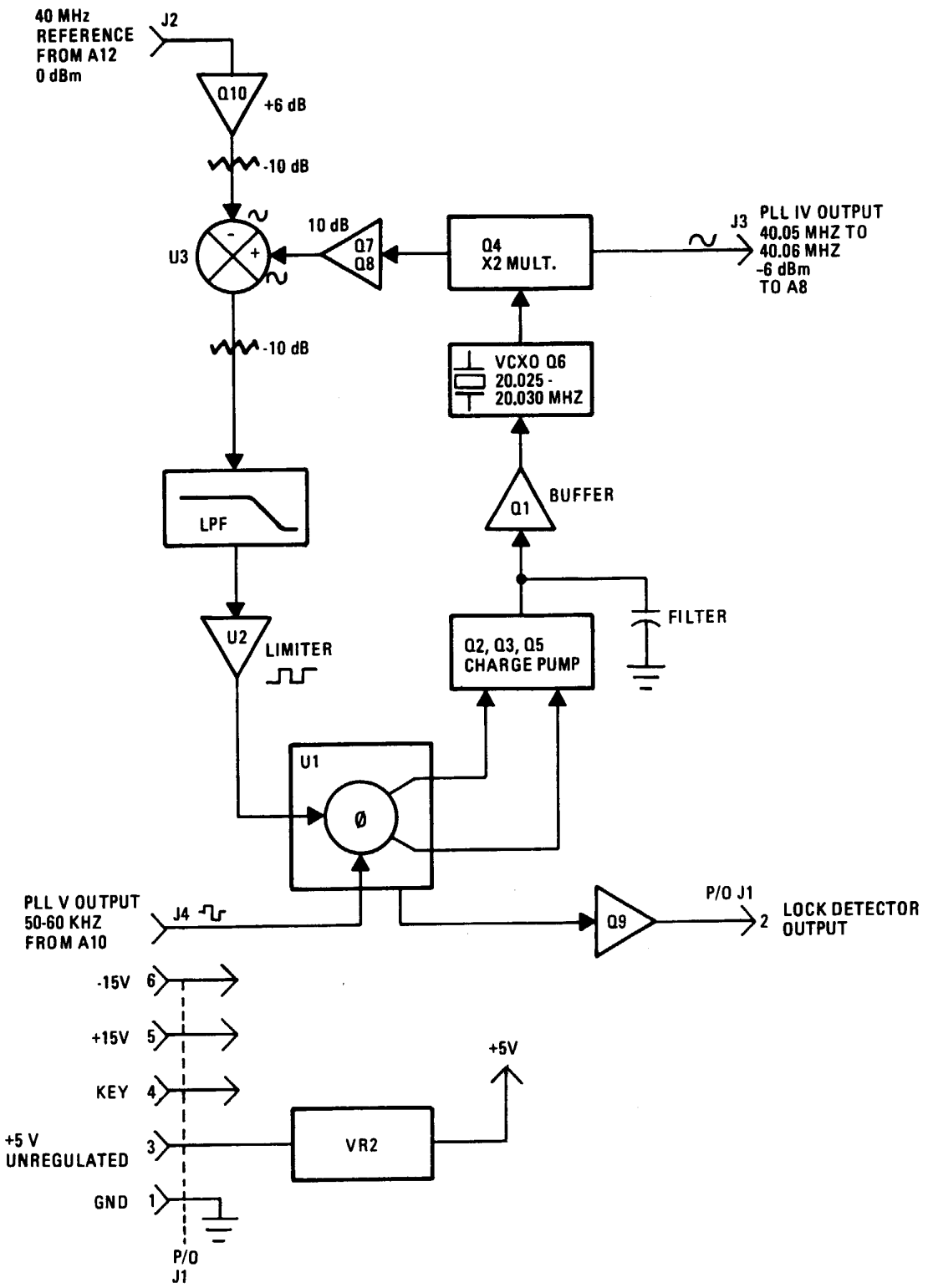

PLL IV Assembly A9 Functional Block Diagram

1. GENERAL DESCRIPTION

PLL IV Assembly A9 is a translation type phase lock loop which converts the low frequency variable PLL V output at 50 to 60 kHz (in 10 Hz steps) into a higher frequency signal at 40.05 to 40.06 MHz. During translation, the 10 Hz step size is preserved. This conversion process is an intermediate step leading toward the 1 Hz, 10 Hz, and 100 Hz tuning increments in the RF-590 LO no. 1 frequency range of 40.465 to 70.455 MHz.

2. INTERFACE CONNECTIONS

Table 1 details the input/output connections and other relevant data.

Table 1. PLL IV Assembly Interface Connections

Connector	Function	Characteristics
J1-1	Gnd	
J1-2	Lock Detector Output	0 V = Locked, +5 V = Unlocked, P/O BITE Test
J1-3	+5 Volts Unregulated	Approximately 50 mA
J1-4	Key	
J1-5	+15 V	Approximately 60 mA
J1-6	-15 V	Approximately 6 mA
J2	40 MHz Reference	40.000000 MHz, 0 dBm
J3	PLL IV Output	40.050 to 40.060 MHz, -6 dBm
J4	PLL V Output	50.0 to 60.0 kHz, TTL

3. CIRCUIT DESCRIPTION

3.1 PLL IF Generation

A PLL intermediate frequency (IF) signal in the range of 50 kHz to 60 kHz is produced at the output of mixer U3. This IF signal is a result of the mixing of the 40.000000 MHz reference from A12 with a VCXO derived signal in the range of 40.050 to 40.060 MHz.

This IF signal is then compared against the PLL V output (a signal also in the range of 50 to 60 kHz) at Phase Comparator U1. If there is any difference in phase or frequency between the IF and the PLL V output signals, U1 produces an error output which forces the VCXO to shift in frequency. The new IF

produced will be equal to the A10 output frequency. The net result is that the VCXO derived frequency always equals the reference plus the A10 output frequency (even as the A10 output changes frequencies). As the A10 output changes from 50 to 60 kHz in 10 Hz increments, the A9 output will change from 40.050 MHz to 40.060 MHz (also in 10 Hz increments).

The actual value of the PLL IV output frequency can be determined by the following formula. F = [40.000,000 + 10 (6000 – XXX)] Hz, where XXX is the value of the 100 Hz, 10 Hz, and 1 Hz receiver tune positions, respectively.

The 40.000000 MHz reference signal from the A12 assembly enters A9 at J2 (0 dBm) and is applied to 6 dB gain amplifier stage Q10. The signal is attenuated to -4 dBm by 50 ohm matching network R28, R29, and R30, and applied to the RF port of mixer U3 at pin 1.

U3 LO injection at pin 8 is a 40.05 MHz to 40.06 MHz signal derived from the VCXO, and amplified to a +7 dBm level by LO amplifier stage Q7 and Q8.

U3 mixing action produces a 30 mVrms IF signal at pins 3 and 4 (in 50 to 60 kHz range). The -6 dB matching network R31, R32, and R34 couples this signal to a low pass filter network which removes all undesired mixer products except the IF signal. High gain amplifier U2 boosts this signal to a TTL level prior to application to one side of phase comparator U1.

3.2 Phase Comparator and Charge Pump Circuits

Phase Comparator U1 compares the IF signal with PLL V output signals in the range of 50 to 60 kHz. When these two signals are equal in frequency and phase, U1 outputs at TP2 and TP3 are essentially 5 Vdc. All transistors in the charge pump circuit (Q2, Q3, Q5) are turned off. The voltage across C19 is constant and Q1 is biased on producing a constant VCXO control voltage across R4. This holds the VCXO frequency constant.

Assume that PLL V output increases in frequency. The PLL V output frequency at U1, pin 1, will be higher than the IF signal frequency at pin 3. The U1 output at TP3 pulses low, turning Q5 on. Consequently, Q2 turns on as the Q5 collector voltage drops; Q2 pumps charge into C19, causing Q1 to conduct more current with a proportionate increase in voltage across R4. This rising control voltage forces the VCXO to increase in frequency, producing a corresponding increase in the IF frequency. As this new IF signal approaches the PLL V output frequency, the phase comparator output pulse width becomes narrower, until it is essentially a constant 5 Vdc. Q5 and Q2 turn off, the voltage rise in C19 stops at a new higher level, and the VCXO frequency stabilizes. The two phase comparator inputs are again equal.

Assume that the PLL V output decreases in frequency. This time the U1 output at TP2 will pulse low (the pulse width being a function of the difference in frequency at the inputs.) Q3 turns on and C19 now has a low impedance discharge path to ground. As the C19 voltage drops, Q1 conduction decreases, and the voltage across R4 decreases. This forces the VCXO to decrease in frequency which causes a corresponding decrease in the IF frequency. As the two U1 inputs become equal, the negative pulses at TP2 become narrower, until an essentially 5 Vdc level exists. Q3 turns off, holding the C19 voltage and consequently the R4 voltage at a new lower level. The VCXO stops decreasing and also rests at a new lower frequency.

3.3 VCO Operation and Control

A change pump circuit consisting of Q2, Q3, Q5, and associated components in conjunction with filter network C19-R6 convert the two phase comparator pulse outputs into an analog dc control voltage. Buffer amplifier Q1 applies this control voltage to varactor diodes CR1 and CR2 in the VCXO circuit. As the capacitance of these diodes changes due to control voltage fluctuations, JFET Hartley oscillator stage Q6 shifts in frequency. This oscillator stage is crystal controlled by Y1 and operates at 20.025 to 20.030 MHz, which is one-half the desired output frequency range. Therefore X2 multiplier stage Q4 is used to produce the desired VCXO range of 40.050 to 40.060 MHz. A control voltage of approximately 5 Vdc will tune the VCXO to produce 40.050 MHz at J3, while a control voltage of 10 Vdc will tune it to 40.060 MHz.

VCXO output is applied through an attenuator network to J3 at a level of -6 dBm and on to PLL III Assembly A8. It is also applied to 10 dB amplifier stage Q7 and Q8 which function as a local oscillator (LO) amplifier for U3. This stage provides a +7 dBm LO injection to U3, pin 8, to complete the feedback loop.

4. BITE TEST CIRCUITS

Lock detector Q9 monitors the status of phase comparator U1 outputs atTP2 and TP3. If either output pulses low and remains low for a period exceeding the time constants of C57 and R38, the appropriate diode will conduct. Q9 will turn on and the voltage across R41 will increase from 0 to +5 Vdc indicating an out of lock condition. This immediately flags BITE monitoring circuits on Control Assembly A14. A front panel fault light indicator will turn on.

5. MAINTENANCE

The following adjustments should not be performed as a routine maintenance procedure, but only when a failure indicates a definite need. All tests should be performed with all connections in normal contact, unless otherwise specified.

5.1 X2 Multiplier, LO Amplifier, and RF Amplifier Alignment

Perform the following procedure to align the X2 Multiplier, LO, and RF amplifiers:

a. Connect equipment as shown in figure 1.

b. Set receiver to 00.000500 MHz.

c. Monitoring TP1, adjust C23 for 7.5 Vdc.

d. Monitoring J3, adjust T5 and T3 for maximum output level at approximately 40.055 MHz. Level should be -6 dBm ±3 dB.

e. Monitoring mixer U3 LO input at pin 8, adjust L10 and T4 for maximum level at approximately 40.455 MHz. Level should be approximately 1.25 Vpp ±.5 volts.

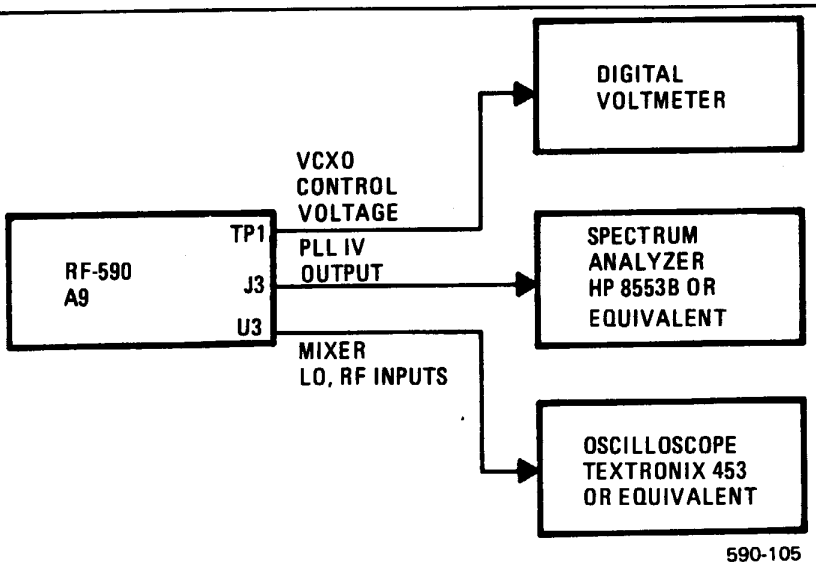

Figure 1. X2 Multiplier, LO, and RF Amplifier Alignment

f. Monitoring mixer U3 RF input at R28, adjust T2 for a maximum level at 40.000 MHz. Level should be .75 Vpp ± .5 volts. Test is complete.

5.2 VCXO Alignment

Perform the following procedure to align the VCXO:

a. Connect equipment as shown in figure 2.

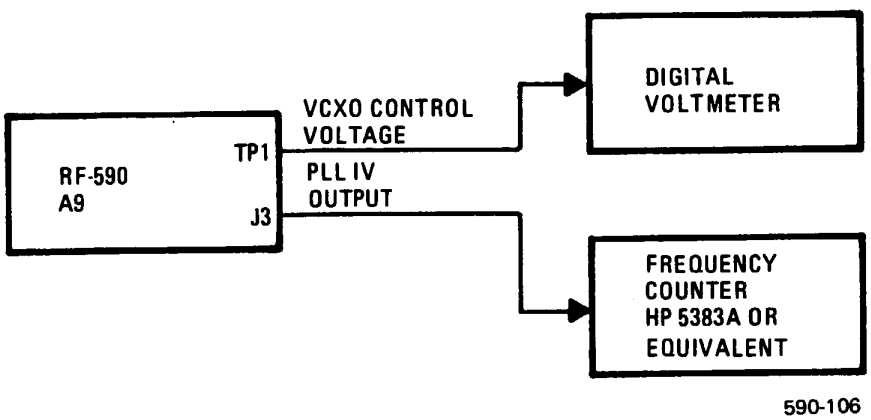

Figure 2. VCXO Alignment

b. Set receiver to 00.000500 MHz. Adjust C23 for 7.5 Vdc.

c. Check that the PLL IV output frequency (as a function of the receiver tune frequency) agrees with table 2.

Table 2. VCXO Alignment

Receiver Tune Frequency, MHz	PLL IV Output Frequency, MHz	Approximate TP1 Voltage, Vdc
00.000000	40.060	10.0
00.000500	40.055	7.5
00.000999	40.050	5.0

d. Fully reconnect the A9 assembly to the RF-590. Initiate BITE self-test. Receiver must pass all tests associated with A9 assembly. Test is complete.

6. PARTS LIST

Table 3 is a comprehensive parts list of all replaceable components in PLL IV Assembly A9. When ordering parts from the factory, include a full description of the part. Use figure 3, PLL IV Assembly A9 Component Location Diagram to identify parts.

7. SCHEMATIC DIAGRAM

Figure 4 is the PLL IV Assembly A9 schematic diagram.

Table 3. PLL IV Assembly A9 Parts List (PL 10073-4400)

Ref. Desig.	Part Number	Description
	10073-4400	PWB, PLL 4
	E70-0002-002	PAD MNT XSTR TO-5
C1	M39014/02-1310	CAP .1UF 10% 100V CER-R
C2	M39014/02-1310	CAP .1UF 10% 100V CER-R
C3	M39014/02-1310	CAP .1UF 10% 100V CER-R
C4	M39014/02-1310	CAP .1UF 10% 100V CER-R
C5	C26-0025-100	CAP 10UF 20% 25V TANT
C6	CK05BX102M	CAP 1000PF 20% 200V CER
C7	CK05BX102M	CAP 1000PF 20% 200V CER
C8	CM06FD102J03	CAP 1000PF 5% 500V MICA
C9	C26-0025-100	CAP 10UF 20% 25V TANT
C10	M39014/02-1310	CAP .1UF 10% 100V CER-R
C11	M39014/02-1310	CAP .1UF 10% 100V CER-R
C12	M39014/01-1535	CAP .01UF 20% 100V CER
C13	M39014/02-1310	CAP .1UF 10% 100V CER-R
C14	M39014/02-1310	CAP .1UF 10% 100V CER-R
C15	C26-0025-100	CAP 10UF 20% 25V TANT
C16	C26-0025-100	CAP 10UF 20% 25V TANT

Table 3. PLL IV Assembly A9 Parts List (PL 10073-4400) (Cont.)

Ref. Desig.	Part Number	Description
C17	M39014/01-1535	CAP .01UF 20% 100V CER
C18	C26-0025-339	CAP 3.3UF 20% 25V TANT
C19	C25-0003-004	CAP 0.33UF 10% 50V TANT
C20	C26-0025-100	CAP 10UF 20% 25V TANT
C21	CM04ED680J03	CAP 68PF 5% 500V MICA
C22	M39014/01-1535	CAP .01UF 20% 100V CER
C23	C85-0001-002	CAP 1.0-10PF 250V
C24	M39014/02-1310	CAP .1UF 10% 100V CER-R
C25	M39014/01-1535	CAP .01UF 20% 100V CER
C26	M39014/01-1535	CAP .01UF 20% 100V CER
C27	CM04ED470J03	CAP 47PF 5% 500V MICA
C28	M39014/01-1535	CAP .01UF 20% 100V CER
C29	M39014/02-1320	CAP .47UF 10% 50V CER-R
C30	CK05BX102M	CAP 1000PF 20% 200V CER
C31	M39014/01-1535	CAP .01UF 20% 100V CER
C32	CM04CD010D03	CAP 1PF + -.5PF 500V MICA
C33	CM04ED470J03	CAP 47PF 5% 500V MICA
C34	M39014/02-1310	CAP .1UF 10% 100V CER-R
C35	CM04ED510J03	CAP 51PF 5% 500V MICA
C36	M39014/01-1535	CAP .01UF 20% 100V CER
C37	M39014/01-1535	CAP .01UF 20% 100V CER
C38	M39014/01-1535	CAP .01UF 20% 100V CER
C39	M39014/02-1310	CAP .1UF 10% 100V CER-R
C40	M39014/01-1535	CAP .01UF 20% 100V CER
C41	M39014/01-1535	CAP .01UF 20% 100V CER
C42	C26-0025-100	CAP 10UF 20% 25V TANT
C43	CM04ED300J03	CAP 30PF 5% 500V MICA
C44	CM04ED330J03	CAP 33PF 5% 500V MICA
C45	M39014/01-1535	CAP .01UF 20% 100V CER
C46	M39014/01-1535	CAP .01UF 20% 100V CER
C47	M39014/02-1310	CAP .1UF 10% 100V CER-R
C48	M39014/02-1310	CAP .1UF 10% 100V CER-R
C49	M39014/01-1535	CAP .01UF 20% 100V CER
C50	C-0912	CAPACITOR
C51	C-0911	200V .01MFD TUBE
C52	CM06FD272J03	CAP 2700PF 5% 500V MICA
C53	CM06FD272J03	CAP 2700PF 5% 500V MICA
C54	CM06FD272J03	CAP 2700PF 5% 500V MICA
C55	C-0912	CAPACITOR
C56	C-0912	CAPACITOR
C57	C25-0001-301	CAP 1.0UF 20% 20V TANT
C59	CM04ED270J03	CAP 27PF 5% 500V MICA
C60	M39014/01-1535	CAP .01UF 20% 100V CER
C61	M39014/01-1535	CAP .01UF 20% 100V CER
CR1	10073-7118	DIODE, SILICON, HYPERABRUPT

Table 3. PLL IV Assembly A9 Parts List (PL 10073-4400) (Cont.)

Ref. Desig.	Part Number	Description
CR2	10073-7118	DIODE, SILICON, HYPERABRUPT
CR4	1N3064	DIODE 75mA 75V SW
CR5	1N3064	DIODE 75mA 75V SW
CR6	1N3064	DIODE 75mA 75V SW
J1	J46-0032-006	HDR 6 PIN 0.100" SR
J2	J-0031	CONN SMB VERT PCB F
J3	J-0031	CONN SMB VERT PCB F
J4	J-0031	CONN SMB VERT PCB F
L1	L08-0001-001	CHOKE W B 50 MHZ
L2	L08-0001-001	CHOKE W B 50 MHZ
L3	MS14046-9	COIL 27UH 10% FXD RF
L4	MS75084-17	COIL 27.0UH 10% FXD RF
L5	MS75084-3	COIL 1.8UH 10% FXD RF
L6	MS75084-17	COIL 27.0UH 10% FXD RF
L7	MS75084-6	COIL 3.3UH 10% FXD RF
L8	MS90538-8	COIL 68UH 5% FXD RF
L9	MS90538-8	COIL 68UH 5% FXD RF
L10	10073-7011	TRANSFORMER, RF, VARIABLE
Q1	Q05-0001-000	XSTR JFET N-CH
Q2	2N2907	XSTR SS/GP PNP TO-18
Q3	2N2222	XSTR SS/GP NPN TO-18
Q4	2N2369	XSTR SS/RF NPN
Q5	2N2222	XSTR SS/GP NPN TO-18
Q6	Q35-0003-000	XSTR U310 JFET HIGH GM
Q7	2N5109	XSTR RFPWR NPN TO-39
Q8	Q35-0003-000	XSTR U310 JFET HIGH GM
Q9	2N2907	XSTR SS/GP PNP TO-18
Q10	Q35-0003-000	XSTR U310 JFET HIGH GM
R1	R65-0003-201	RES 200 5% 1/4W CAR FILM
R2	R65-0003-201	RES 200 5% 1/4W CAR FILM
R3	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R4	R65-0003-332	RES 3.3K 5% 1/4W CAR FILM
R5	R65-0003-201	RES 200 5% 1/4W CAR FILM
R6	RN55D1211F	RES,1210 1% 1/8W MET FLM
R7	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R8	R65-0003-121	RES 120 5% 1/4W CAR FILM
R9	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R10	RN55D3321F	RES,3320 1% 1/8W MET FLM
R11	R65-0003-201	RES 200 5% 1/4W CAR FILM
R12	R65-0003-101	RES 100 5% 1/4W CAR FILM
R13	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R14	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R15	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R16	R65-0003-911	RES 910 5% 1/4W CAR FILM
R17	R65-0003-101	RES 100 5% 1/4W CAR FILM

Table 3. PLL IV Assembly A9 Parts List (PL 10073-4400) (Cont.)

Ref. Desig.	Part Number	Description
R18	R65-0003-101	RES 100 5% 1/4W CAR FILM
R19	R65-0003-470	RES 47 5% 1/4W CAR FILM
R20	R65-0003-470	RES 47 5% 1/4W CAR FILM
R21	R65-0003-201	RES 200 5% 1/4W CAR FILM
R22	R65-0003-242	RES 2.4K 5% 1/4W CAR FILM
R23	R65-0003-182	RES 1.8K 5% 1/4W CAR FILM
R24	R65-0003-511	RES 510 5% 1/4W CAR FILM
R25	R65-0003-471	RES 470 5% 1/4W CAR FILM
R26	R65-0003-390	RES 39 5% 1/4W CAR FILM
R27	R65-0003-121	RES 120 5% 1/4W CAR FILM
R28	R65-0003-101	RES 100 5% 1/4W CAR FILM
R29	R65-0003-750	RES 75 5% 1/4W CAR FILM
R30	R65-0003-101	RES 100 5% 1/4W CAR FILM
R31	R65-0003-101	RES 100 5% 1/4W CAR FILM
R32	R65-0003-101	RES 100 5% 1/4W CAR FILM
R33	R65-0003-510	RES 51 5% 1/4W CAR FILM
R34	R65-0003-750	RES 75 5% 1/4W CAR FILM
R35	RN55D1001F	RES,1000 1% 1/8W MET FLM
R36	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R37	R65-0003-470	RES 47 5% 1/4W CAR FILM
R38	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R39	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R40	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R41	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R42	R65-0003-471	RES 470 5% 1/4W CAR FILM
R43	R65-0003-101	RES 100 5% 1/4W CAR FILM
T1	10073-7008	TRANSFORMER, RF, FIXED
T2	10073-7012	TRANSFORMER, RF, VARIABLE
T3	10073-7015	TRANSFORMER, RF, VARIABLE
T4	10073-7011	TRANSFORMER, RF, VARIABLE
T5	10073-7011	TRANSFORMER, RF, VARIABLE
TP1	J-0071	TP PWB BRN TOP ACCS .080"
TP2	J-0066	TP PWB RED TOP ACCS .080"
TP3	J-0069	TP PWB ORN TOP ACCS .080"
TP4	J-0070	TP PWB YEL TOP ACCS .080"
TP5	J-0068	TP PWB GRN TOP ACCS .080"
U1	IC-0430	IC MC4044 CERAMIC CMOS
U2	I20-0005-001	IC LM211H COMPARATOR
U3	I51-0003-003	MIXER DB 50mW 500MHZ
VR1	1N5236	DIODE 7.5V 20% .5W ZENER
VR2	I11-0001-001	IC VR 7805 + 5V 1.5A 4%
Y1	10073-7039	CRYSTAL, 20.0275MHZ

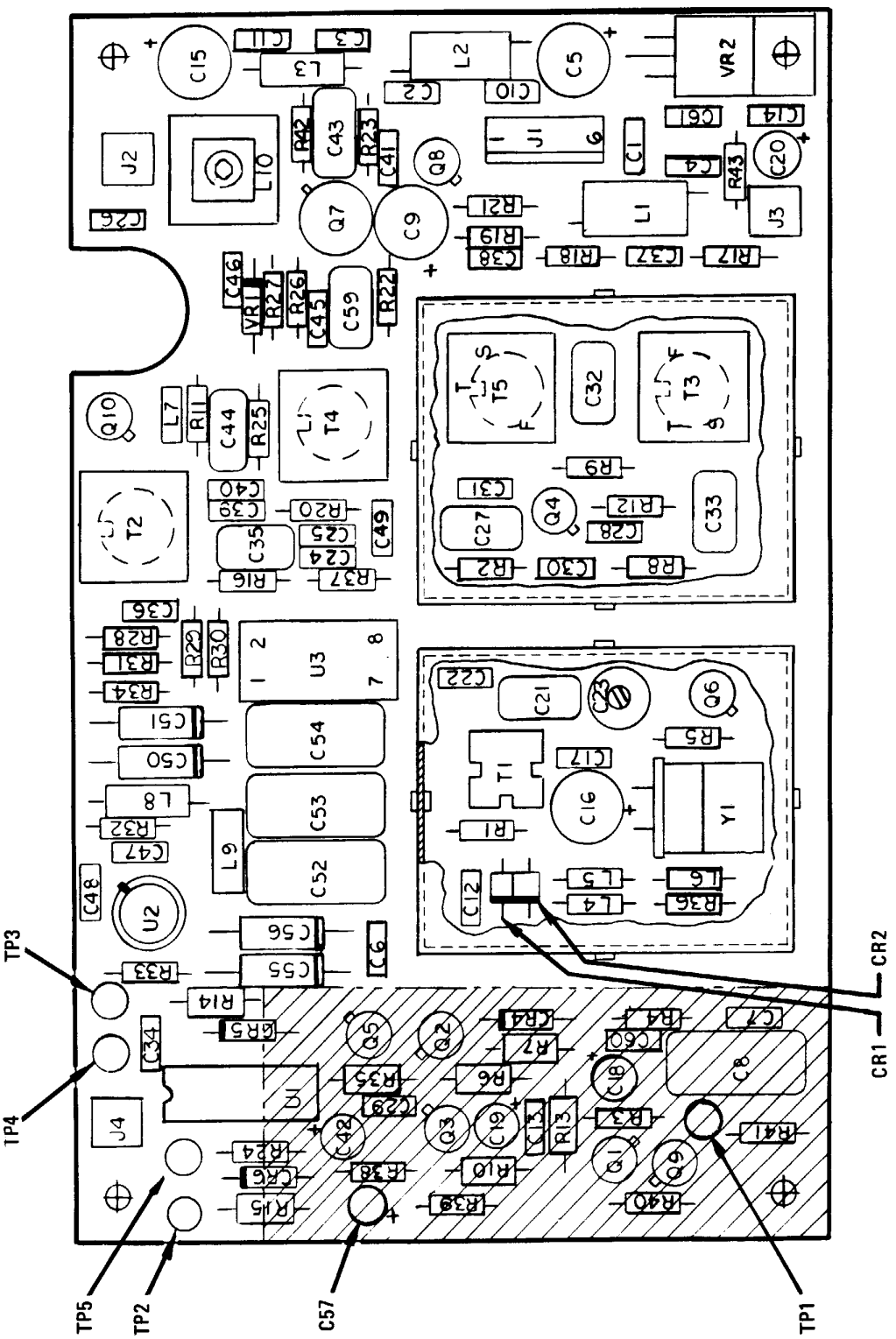

Figure 3. PLL IV Assembly A9 Component Location Diagram (10073-4400, Rev. E)

CIFIED:
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ION, PREFIX WITH
NO. DESIGNATION.
IN OHMS, 1/4W, ±5%.
F IN MICROFARADS.
S ARE FOR REFERENCE ONLY.
PER PART NO. IN PARTS LIST.
IN MICROHENRIES.

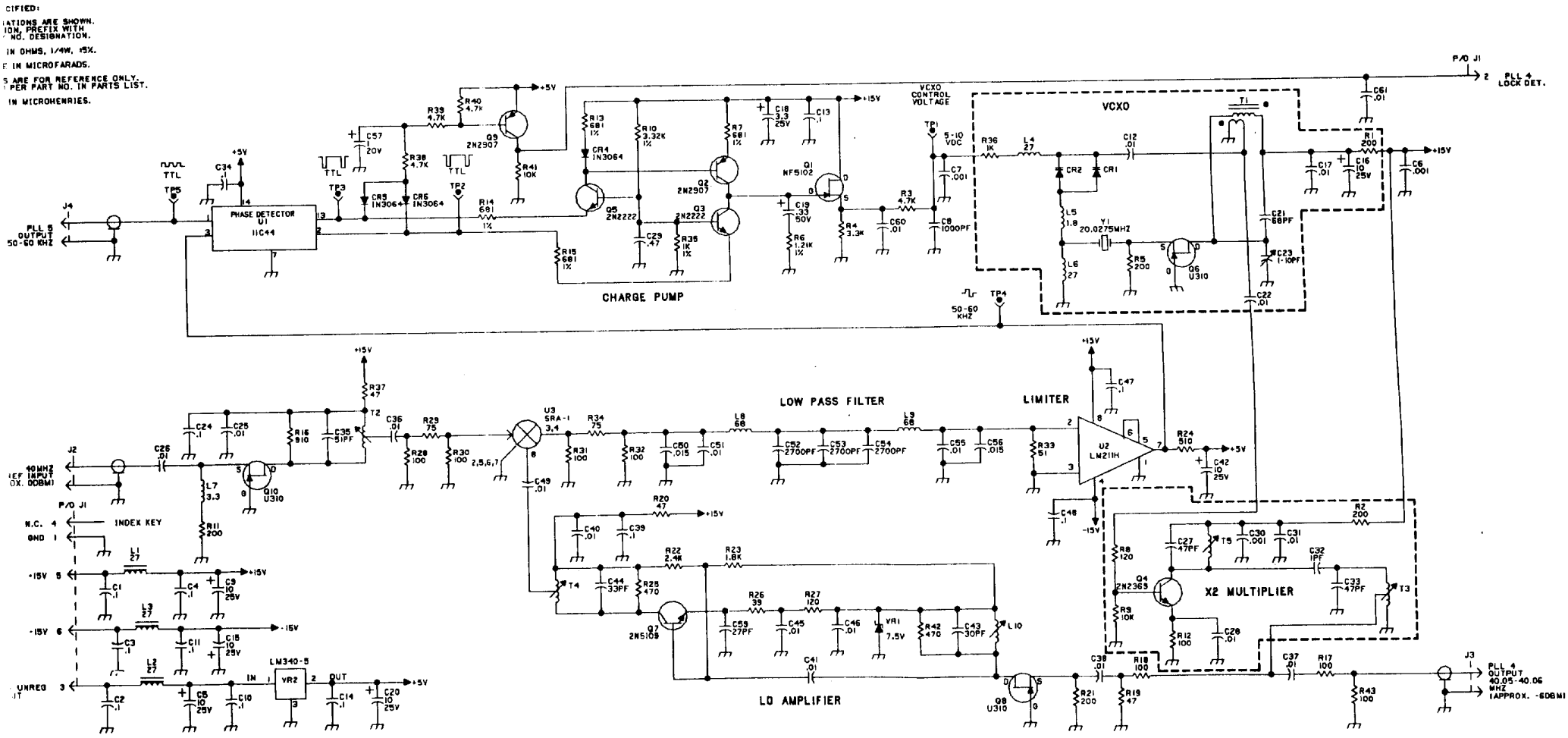

Figure 4. PLL IV Assembly A9 Schematic Diagram (10073-4401, Rev. D)

NOTE: UNLESS OTHERWISE SPECIFIED:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR A COMPLETE DESIGNATION, PREFIX WITH UNIT NO. AND/OR ASSEMBLY NO. DESIGNATION.
2. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS.
4. VENDOR PART NO. CALLOUTS ARE FOR REFERENCE ONLY. COMPONENTS ARE SUPPLIED PER PART NO. IN PARTS LIST.
5. ALL INDUCTOR VALUES ARE IN MICROHENRIES.