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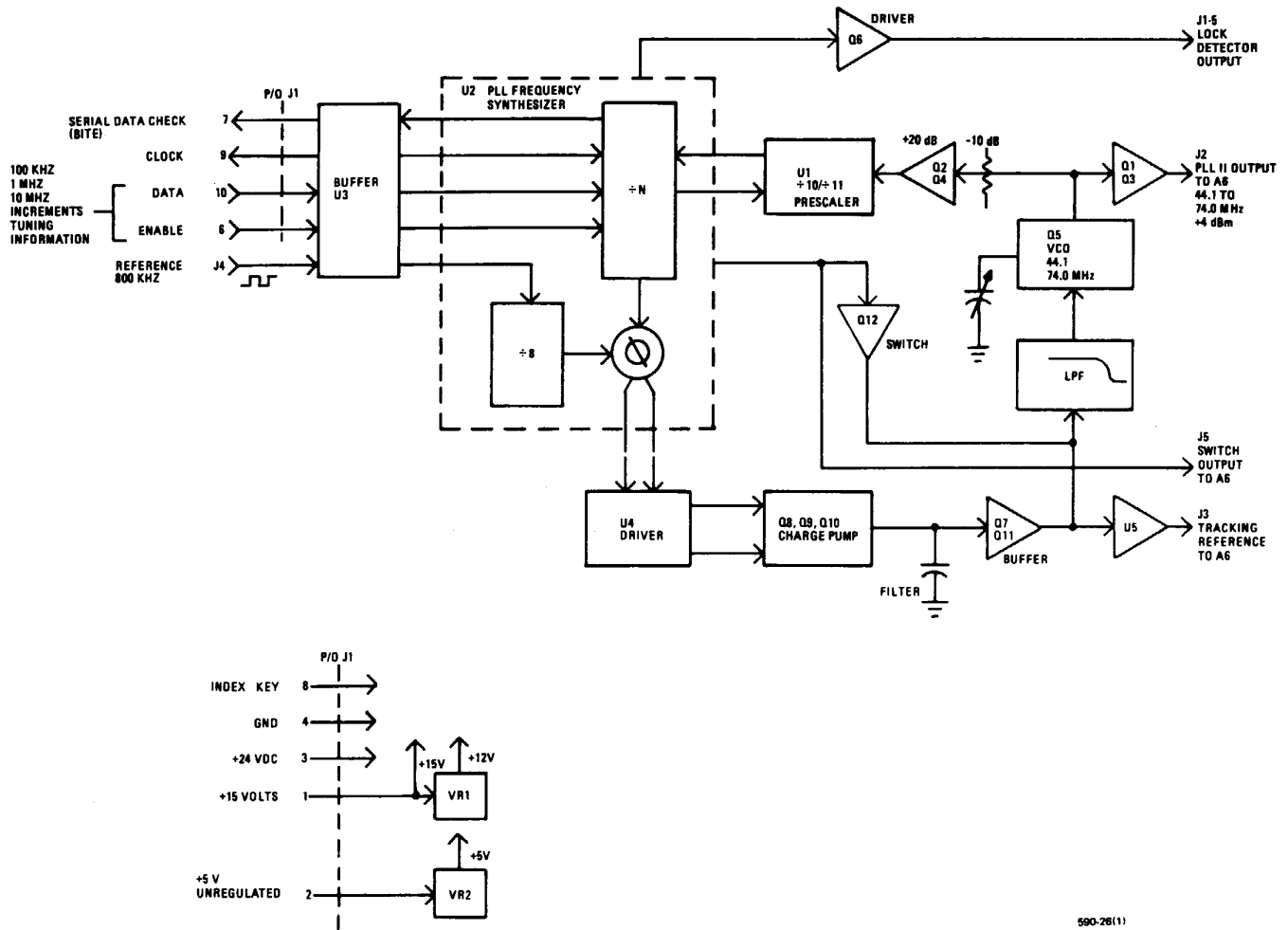
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PLL II Assembly A7 Functional Block Diagram

590-26(11)

## 1. GENERAL DESCRIPTION

PLL II Assembly A7 is a single phase locked loop synthesizer that ultimately provides the 100 kHz, 1 MHz, and 10 MHz tuning increments selected at the RF-590 front panel frequency selection controls.

Frequency select input data is applied to the assembly in serial data form under Control Board Assembly A14 microprocessor control. The A7 output to PLL I Assembly A6 is a variable 44.1 to 74.0 MHz signal in 100 kHz controllable steps. The net results of A7 operation (after further translation in the synthesizer chain) provide the course tuning increments (100 kHz, 1 MHz, and 10 MHz) for LO No. 1 output.

## 2. INTERFACE CONNECTIONS

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

**Table 1. PLL II Assembly Interface Connections**

Connector	Function	Characteristics
J1-1	+15 Volts	Approximately 25 mA
J1-2	5 Volts Unregulated	Approximately 240 mA
J1-3	+24 Volts	Approximately 20 mA
J1-4	Ground	
J1-5	Lock Detector Output	5 Vdc = unlocked; 0 Vdc = locked
J1-6	Enable	+ going pulse = Enabled
J1-7	Serial Data Check	P/O BITE Test, +5 Vdc = ok
J1-8	Key	
J1-9	Clock	TTL, 750 kHz
J1-10	Data	Serial TTL
J2	PLL II (A7) Output	+4 dBm/50 ohms, 44.1 to 74.0 MHz
J3	PLL II Tracking Reference	3.5 to 19 Vdc
J4	800 kHz Reference Input	TTL
J5	Switch Output	+4 V for < 2 MHz tune frequency 0 V for ≥ 2 MHz tune frequency

### 3. CIRCUIT DESCRIPTION

#### NOTE

A7 operation is similar (in operation) to that of the general  $\div N$  PLL and charge pump circuits described in section 4. A review of section 4 at this point would aid in the understanding of A7 operation.

#### 3.1 Reference Generation

The 800 kHz from Reference Generator Assembly A12 enters PLL II Assembly A7 at J4. This signal is applied via buffer U3 to a divide by 8 counter internal to U2 to produce a 100 kHz reference signal. Since this has been derived ultimately from the RF-590 crystal frequency standard via the A12 assembly, stable and accurate A7 operation is assured.

#### 3.2 Divide By N Counter

Since the A7 assembly requires a variable 44.1 to 74.0 MHz output frequency, a programmable counter has been designed into the VCO feedback path to the phase comparator. This counter consists of dual modulus  $\div 10$  prescaler U1 and a programmable counter internal to U2. Together U1 and the programmable portion of U2 create a total division range of  $N = 441$  to  $N = 740$ , where  $N$  is a function of the values of the receiver 10 MHz, 1 MHz, and 100 kHz tuning positions.

The output of the divide by  $N$  counter will always attempt to equal the 100 kHz reference frequency at the Phase Comparator inputs, despite changes in the divide by  $N$  factor due to changing the 10 MHz, 1 MHz, and/or 100 kHz receiver tuning increments. The VCO frequency will change to accomplish this, in response to command signals generated by the Phase Comparator. The VCO frequency will always equal  $(N)$  (Reference frequency), or  $(N)$  (100 kHz) = 44.1 MHz to 74.0 MHz. The exact value of  $N$  is determined by the 10 MHz, 1 MHz, and/or 100 kHz receiver tuning positions. This front panel selection causes Control Assembly A14 to generate a serial data code containing information pertaining to the values of the increments chosen. This code is applied synchronously with the 750 kHz system clock to U2 whenever the U2 enable line is gated open by A14. In general,  $N = (441 + XXX)$ , where  $XXX$  is the value of the 10 MHz, 1 MHz, and 100 kHz positions chosen at the receiver front panel frequency controls.

For example, tuning the RF-590 to 15.789000 MHz would make  $N = (441 + 157) = 598$ . The VCO frequency will be  $(N)$  (Reference) =  $(598)$  (100 kHz) = 59.8 MHz.

Tuning the radio to 24.705000 MHz would result in a VCO output frequency of  $(441 + 247)$  (100 kHz) = 68.8 MHz. Note that increasing the receiver tune frequency caused an increase in the A7 output frequency. The opposite will also be true.

### 3.3 Phase Comparator and Charge Pump Operation

Phase comparison of the 100 kHz reference and the 100 kHz divide by N counter's VCO derived signal is accomplished by a phase comparator internal to U2. When these two signals are equal in frequency and phase, the buffered Phase Comparator outputs at TP2 and TP3 are essentially 5 Vdc. This 5 volt level holds the charge pump transistors Q9, Q10, and consequently, Q8 off. The voltage across C51 will be at some constant value forcing buffers Q7 and Q11 to develop a constant voltage at TP1. This VCO control voltage holds the VCO frequency constant (somewhere between 44.1 MHz and 74.0 MHz).

Assume that the VCO feedback signal at the divide by N counter output is suddenly less than the reference frequency, which is what happens at the instant the divide by N factor is increased. Since the two Phase Comparator inputs are no longer equal, the Phase Comparator will output a series of negative pulses at TP3. (The pulse width of these pulses is a function of the difference in phase/frequency between the two inputs.) Q10 turns on, and its decreasing collector voltage turns Q8 on. Q8 will start to pump charge into C51, raising its voltage. Buffer stage Q7 and Q11 will produce a corresponding increase at TP1 which forces the VCO to increase in frequency. The increasing VCO signal produces a corresponding frequency increase at the divide by N counter output, driving it towards the reference signal at 100 kHz. As the divide by N counter output approaches the reference frequency, the pulses at TP3 get narrower, until they are at an essentially constant +5 Vdc level. Q10 and Q8 turn off, the voltage rise across C51 stops at a new higher level producing a stabilization of the VCO control voltage and the VCO frequency at a new higher value.

Assume that the VCO feedback signal is suddenly greater than the reference frequency, which is what occurs at the instant the divide by N factor is decreased. The Phase Comparator outputs a series of negative pulses at TP2. Q9 turns on, and starts drawing charge out of C51, dropping its voltage. A corresponding decrease in the VCO control voltage occurs, producing a decreasing VCO frequency. This causes the fed back VCO divide by N counter output to decrease, driving it towards the 100 kHz reference. As the divide by N counter output approaches the reference, the negative pulses at TP2 become narrower, until they are essentially at a 5 Vdc level. Q9 turns off, and stops any further decrease in the C51 voltage, the VCO control voltage, and therefore the VCO frequency. The VCO now rests at a new, lower frequency.

Note that the VCO control voltage at Q7 and Q11 is sent to two places. They are the LPF and VCO on the A7 assembly, and the buffer stage, U5. This second output is referred to as the Tracking Reference, and is routed through J3 for use on PLL I Assembly A6. It allows the A6 VCO to properly track the A7 VCO.

### 3.4 VCO Operation and Control

A charge pump circuit consisting of Q8-Q10 and associated components converts the two Phase Comparator pulse outputs into an analog dc control voltage. Buffer stages Q7 and Q11 apply the VCO control voltage through a low pass filter (LPF) network to the varactor diode string in the VCO. The VCO itself is a JFET (Q5) Hartley oscillator stage whose frequency shifts as the capacitance of the varactor diodes change in response to changes in VCO control voltage. A VCO control voltage range of approximately 3.5 Vdc to 17.5 Vdc shifts the VCO from 44.1 MHz to 74.0 MHz.

The VCO output is fed to two separate amplifier stages. The first, Q4 and Q2, is a 20 dB amplifier which applies the VCO signal to the  $\div 10/\div 11$  prescaler, U1. It is this signal which completes the feedback loop to the phase comparator. The second amplifier stage, Q3 and Q1, boosts the level to approximately 4 dBm and is called the PLL II output. This signal contains the 10 MHz, 1 MHz, and 100 kHz tuning increments information, and is fed to PLL I Assembly A6 for further processing.

### 3.5 Noise Reduction Techniques

The noise characteristics of the VCO output are enhanced by the following two methods:

- Use of a sharp cut off LPF network to filter noise off the VCO control voltage. This stage is located between the charge pump buffer stage Q11 and the VCO input.
- Use of a circuit to linearize charge pump operation at receiver tune frequencies less than 2 MHz. Lower receiver tune frequencies require less VCO control voltage than higher receiver tune frequencies. At tune frequencies less than 2 MHz, the VCO control voltage required is so low that the charge pump enters a nonlinear mode of operation in an attempt to produce the output across C51 that is required. In order to correct this, at frequencies less than 2 MHz, U2 outputs a 5 Vdc level which turns Q12 on. Q12, which is connected across the LPF input, reduces the control voltage level. The net result is that the charge pump is now "tricked" into forcing its output to increase the voltage across C51 required to produce the required VCO control voltage. In so doing, it pulls itself out of its nonlinear region. At frequencies greater than 2 MHz, Q12 is off and the charge pump functions normally. Note that this switch output from U2 is routed through J5 to the A6 assembly for similar purposes.

### 3.6 BITE Circuits

The A7 assembly contains two circuits for self-test evaluation.

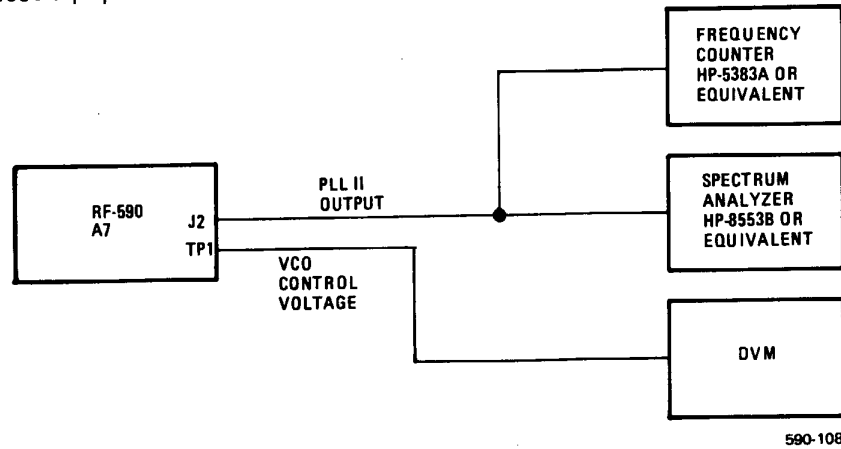
- Lock detector Q6 whose output is 0 Vdc whenever the PLL is tracking properly. This line is constantly monitored by the A14 assembly. A front panel fault light will appear if the loop ever unlocks.
- Serial data check that verifies the tuning data from the A14 assembly has been received and properly translated into the correct divide by N factor. A serial data word is sent on the data line (J1 pin 10) and the U6 serial data check line is read back to the A14 assembly (J1 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.

## 4. MAINTENANCE

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

**4.1 VCO Frequency Adjustment**

- a. Connect equipment as shown in figure 1.



**Figure 1. VCO Adjustment**

- b. Set RF-590 frequency to 29.900000 MHz.
- c. Adjust C15 for 19.0 Vdc at TP1. PLL II output at J2 should be 74.0 MHz, 4 dBm  $\pm$ 3 dB. Check the receiver tune frequency against PLL II output frequencies listed in table 2. (Output should remain at +4 dBm  $\pm$ 3 dB).

**Table 2. VCO Frequency Range**

Receiver Tune Frequency, MHz	PLL II Output Frequency, MHz	Approximate TP1 Voltage, Vdc
29.900000	74.000000	19.0
15.000000	59.100000	10.0
00.000000	44.100000	3.5

- d. Check that the Tracking Reference Signal (J3) agrees within  $\pm .1$  Vdc to the control voltage at TP1 for the ranges listed in table 2.
- e. Check that the switch output (J5) changes to approximately 4 Vdc when the receiver is tuned below 2.000000 MHz.
- f. Fully reconnect the A7 assembly to the RF-590 and initiate BITE test. Receiver should not fail at any test concerning the A7 assembly. These tests have verified the proper operation of the A7 assembly. Proceed to paragraph 4.2, Tracking Adjustment.

**4.2 Tracking Adjustment**

- a. Perform VCO adjustment found in paragraph 4.1.
- b. Tune the RF-590 to 29.999999 MHz:
- c. Measure the VCO control voltage at TP1 on PLL I VCO Assembly A6A2. (Note that TP1 is located under the VCO assembly cover.) This voltage should be 16 to 19.0 Vdc on a properly aligned A6 assembly.
- d. Measure PLL II Assembly A7 VCO control voltage at TP1, and adjust C15 for a voltage equal to that of the A6 PLL I VCO control voltage (step c).
- e. Tune the receiver to 20 MHz, then 10 MHz, and then 0 MHz, measuring the VCO control voltages on both assemblies at each frequency. The two voltages should track each other at all times, and differ by no more than  $\pm .5$  Vdc. Test is complete.

**5. PARTS LIST**

Table 3 is a comprehensive parts list of all replaceable components in PLL II Assembly A7. When ordering parts from the factory, include a full description of the part. Use figure 2, PLL II Assembly A7 Component Location Diagram to identify parts.

**6. SCHEMATIC DIAGRAM**

Figure 3 is the PLL II Assembly A7 schematic diagram.

**Table 3. PLL II Assembly A7 Parts List (PL 10073-4200)**

Ref. Desig.	Part Number	Description
	10073-4200	PWB, PLL 2
	E70-0002-002	PAD MNT XSTR TO-5
C1	M39014/01-1535	CAP .01UF 20% 100V CER
C2	M39014/02-1310	CAP .1UF 10% 100V CER-R
C3	M39014/02-1310	CAP .1UF 10% 100V CER-R
C4 - C6	M39014/01-1535	CAP .01UF 20% 100V CER
C7	M39014/02-1310	CAP .1UF 10% 100V CER-R
C8	M39014/01-1535	CAP .01UF 20% 100V CER
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	C26-0025-100	CAP 10UF 20% 25V TANT
C13	M39014/02-1310	CAP .1UF 10% 100V CER-R
C14	M39014/01-1535	CAP .01UF 20% 100V CER
C15	C85-0001-002	CAP 1.0-10PF 250V
C16	CK05BX102M	CAP 1000PF 20% 200V CER



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Table 3. PLL II Assembly A7 Parts List (PL 10073-4200) (Cont.)

Ref. Desig.	Part Number	Description
C17	CK05BX102M	CAP 1000PF 20% 200V CER
C18	C26-0025-100	CAP 10UF 20% 25V TANT
C19	M39014/02-1310	CAP .1UF 10% 100V CER-R
C20	C26-0025-100	CAP 10UF 20% 25V TANT
C21	M39014/02-1310	CAP .1UF 10% 100V CER-R
C22	M39014/02-1310	CAP .1UF 10% 100V CER-R
C23	C26-0025-100	CAP 10UF 20% 25V TANT
C24	M39014/02-1310	CAP .1UF 10% 100V CER-R
C25	M39014/01-1535	CAP .01UF 20% 100V CER
C28	M39014/02-1310	CAP .1UF 10% 100V CER-R
C29	M39014/01-1535	CAP .01UF 20% 100V CER
C30	M39014/01-1535	CAP .01UF 20% 100V CER
C31	CK05BX102M	CAP 1000PF 20% 200V CER
C32	M39014/01-1535	CAP .01UF 20% 100V CER
C33	M39014/02-1310	CAP .1UF 10% 100V CER-R
C34	M39014/01-1535	CAP .01UF 20% 100V CER
C35	M39014/02-1310	CAP .1UF 10% 100V CER-R
C36	M39014/02-1310	CAP .1UF 10% 100V CER-R
C38	CM06FD472J03	CAP 4700PF 5% 500V MICA
C39	C-0912	CAPACITOR
C40	C-0912	CAPACITOR
C41	M39014/02-1310	CAP .1UF 10% 100V CER-R
C43	M39014/02-1310	CAP .1UF 10% 100V CER-R
C44	CM06FD242J03	CAP 2400PF 5% 500V MICA
C45	CM06FD432J03	CAP 4300PF 5% 500V MICA
C46	C25-0001-301	CAP 1.0UF 20% 20V TANT
C51	M39014/02-1310	CAP .1UF 10% 100V CER-R
C52	6628-0660	CAP 5600PF 5% 300V MICA
C53	M39014/02-1310	CAP .1UF 10% 100V CER-R
C54	C26-0035-470	CAP 47UF 20% 35V TANT
C55	C-8212	CAP 470UF 50V ELEC
C56	M39014/02-1310	CAP .1UF 10% 100V CER-R
C57	M39014/02-1310	CAP .1UF 10% 100V CER-R
C58	M39014/02-1310	CAP .1UF 10% 100V CER-R
C60	M39014/02-1310	CAP .1UF 10% 100V CER-R
C61	C26-0025-100	CAP 10UF 20% 25V TANT
C62	M39014/02-1310	CAP .1UF 10% 100V CER-R
C63	M39014/02-1310	CAP .1UF 10% 100V CER-R
C64	M39014/02-1310	CAP .1UF 10% 100V CER-R
C82	CM04ED390J03	CAP 39PF 5% 500V MICA
C83	M39014/01-1535	CAP .01UF 20% 100V CER
CR1	10073-7118	DIODE, HYPERABRUPT
CR2	10073-7118	DIODE, HYPERABRUPT
CR3	10073-7118	DIODE, HYPERABRUPT
CR4	10073-7118	DIODE, HYPERABRUPT

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Table 3. PLL II Assembly A7 Parts List (PL 10073-4200) (Cont.)

Ref. Desig.	Part Number	Description
CR5	10073-7118	DIODE, HYPERABRUPT
CR6	10073-7118	DIODE, HYPERABRUPT
CR7	10073-7118	DIODE, HYPERABRUPT
CR8	10073-7118	DIODE, HYPERABRUPT
CR9	10073-7118	DIODE, HYPERABRUPT
CR10	10073-7118	DIODE, HYPERABRUPT
CR11	10073-7118	DIODE, HYPERABRUPT
CR12	10073-7118	DIODE, HYPERABRUPT
CR13	1N6263	DIODE .40W 60V HOT CARR
CR14	1N3064	DIODE 75mA 75V SW
CR15	1N3064	DIODE 75mA 75V SW
J1	J46-0032-010	HDR 10 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	MS75084-3	COIL 1.8UH 10% FXD RF
L2	MS75084-11	COIL 8.2UH 10% FXD RF
L3	L08-0001-001	CHOKE W B 50 MHZ
L4	L08-0001-001	CHOKE W B 50 MHZ
L5	MS75089-21	COIL RF 680UF 5%
L6	MS75089-21	COIL RF 680UF 5%
L7	L08-0001-001	CHOKE W B 50 MHZ
Q1	2N5109	XSTR RFPWR NPN TO-39
Q2	Q35-0003-000	XSTR U310 JFET HIGH GM
Q3	Q35-0003-000	XSTR U310 JFET HIGH GM
Q4	2N3563	XSTR SS/RF
Q5	Q35-0003-000	XSTR U310 JFET HIGH GM
Q6	2N2907	XSTR SS/GP PNP TO-18
Q7	Q60-0003-000	XSTR MOSFET
Q8	2N2907	XSTR SS/GP PNP TO-18
Q9	2N2222	XSTR SS/GP NPN TO-18
Q10	2N2222	XSTR SS/GP NPN TO-18
Q11	2N5088	XSTR SS/GP
Q12	2N2222	XSTR SS/GP NPN TO-18
R1	R65-0003-470	RES 47 5% 1/4W CAR FILM
R2	R65-0003-471	RES 470 5% 1/4W CAR FILM
R3	R65-0003-242	RES 2.4K 5% 1/4W CAR FILM
R4	R65-0003-470	RES 47 5% 1/4W CAR FILM
R5	R65-0003-100	RES 10 5% 1/4W CAR FILM
R6	R65-0003-152	RES 1.5K 5% 1/4W CAR FILM
R7	R65-0003-201	RES 200 5% 1/4W CAR FILM
R8	R65-0003-270	RES 27 5% 1/4W CAR FILM
R9	R65-0003-513	RES 51K 5% 1/4W CAR FILM
R10	R65-0003-201	RES 200 5% 1/4W CAR FILM
R11	R65-0003-510	RES 51 5% 1/4W CAR FILM

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Table 3. PLL II Assembly A7 Parts List (PL 10073-4200) (Cont.)

Ref. Desig.	Part Number	Description
R12	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R13	R65-0003-151	RES 150 5% 1/4W CAR FILM
R14	R65-0003-680	RES 68 5% 1/4W CAR FILM
R15	R65-0003-101	RES 100 5% 1/4W CAR FILM
R16	R65-0003-152	RES 1.5K 5% 1/4W CAR FILM
R17	R65-0003-100	RES 10 5% 1/4W CAR FILM
R18	R65-0003-151	RES 150 5% 1/4W CAR FILM
R19	R65-0003-470	RES 47 5% 1/4W CAR FILM
R20	R65-0003-513	RES 51K 5% 1/4W CAR FILM
R21	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R22	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R23	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R24	R65-0003-201	RES 200 5% 1/4W CAR FILM
R25	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R26	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R27	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R28	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R29	R65-0003-479	RES 4.7 5% 1/4W CAR FILM
R31	R65-0003-279	RES 2.7 5% 1/4W CAR FILM
R32	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R33	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R34	RN55D1501F	RES,1500 1% 1/8W MET FLM
R35	RN55D2001F	RES,2000 1% 1/8W MET FLM
R36	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R37	RN55D6810F	RES,681.0 1% 1/8W MET FLM
R38	RN55D1212F	RES,12.1K 1% 1/8W MET FLM
R39	R65-0003-121	RES 120 5% 1/4W CAR FILM
R40	R65-0003-101	RES 100 5% 1/4W CAR FILM
R41	R65-0003-182	RES 1.8K 5% 1/4W CAR FILM
R42	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R43	R65-0003-103	RES 10K 5% 1/4W CAR FILM
R44	R65-0003-223	RES 22K 5% 1/4W CAR FILM
R45	R65-0003-473	RES 47K 5% 1/4W CAR FILM
R46	R65-0003-472	RES 4.7K 5% 1/4W CAR FILM
R47	R65-0003-102	RES 1.0K 5% 1/4W CAR FILM
R48	R65-0003-103	RES 10K 5% 1/4W CAR FILM
T1	10073-7014	TRANSFORMER, RF, FIXED
T2	10073-7014	TRANSFORMER, RF, FIXED
T3	10073-7002	TRANSFORMER, RF, FIXED
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	I65-0004-001	IC 12013 PLASTIC ECL

**Table 3. PLL II Assembly A7 Parts List (PL 10073-4200) (Cont.)**

Ref. Desig.	Part Number	Description
U2	I70-0002-001	IC MC145156 PLASTIC CMOS
U3	I01-0000-019	IC 4050B PLASTIC CMOS
U4	I05-0000-000	IC 74LS00 PLASTIC TTL
U5	I30-0018-000	IC 1458 OP AMP PLASTIC
VR1	I12-0006-012	IC VR 78L12A + 12V .10A 4%
VR2	I11-0001-001	IC VR 7805 + 5V 1.5A 4%
VR3	1N5236A	DIODE 7.5V 10% .5W ZENER

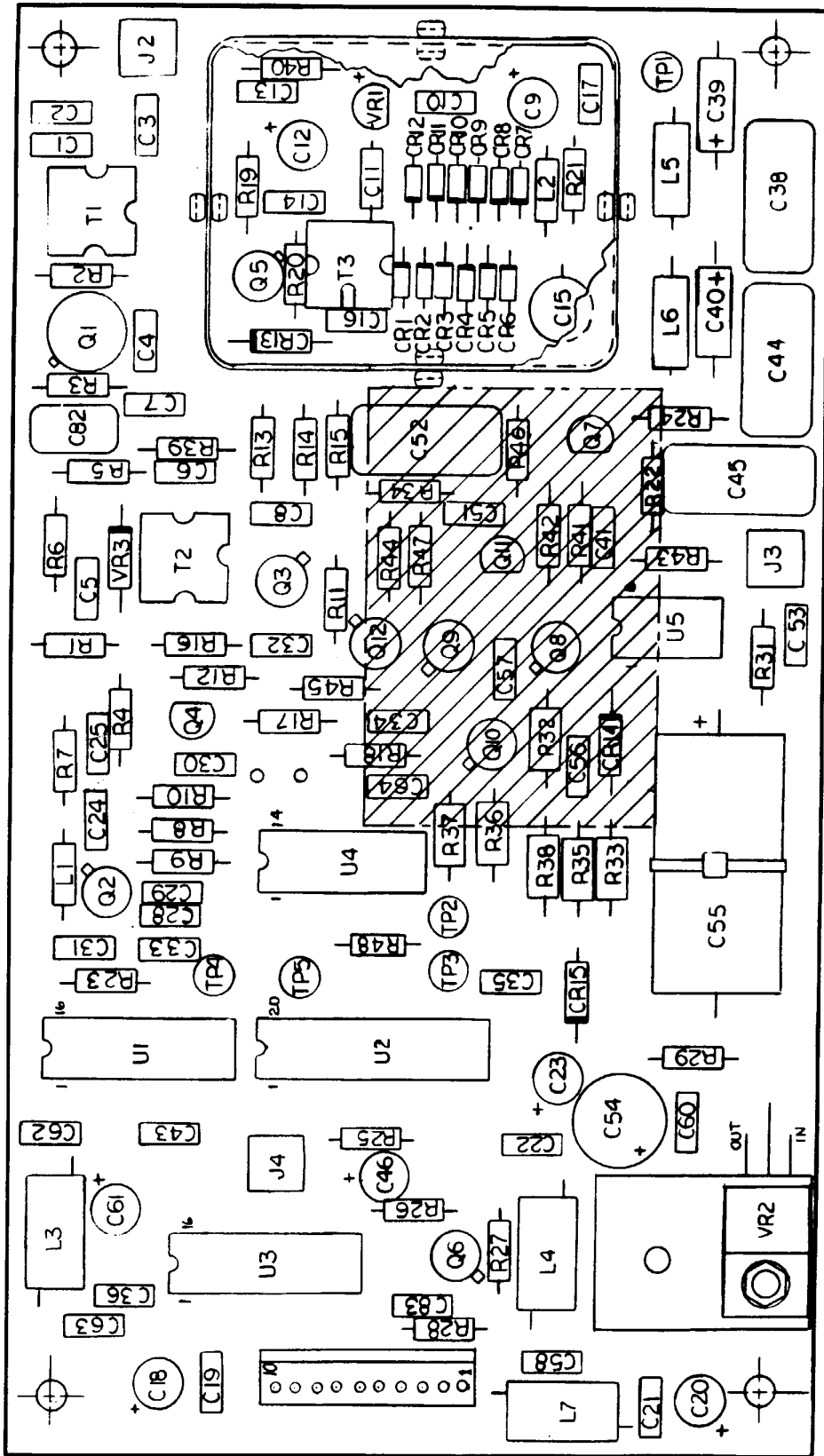
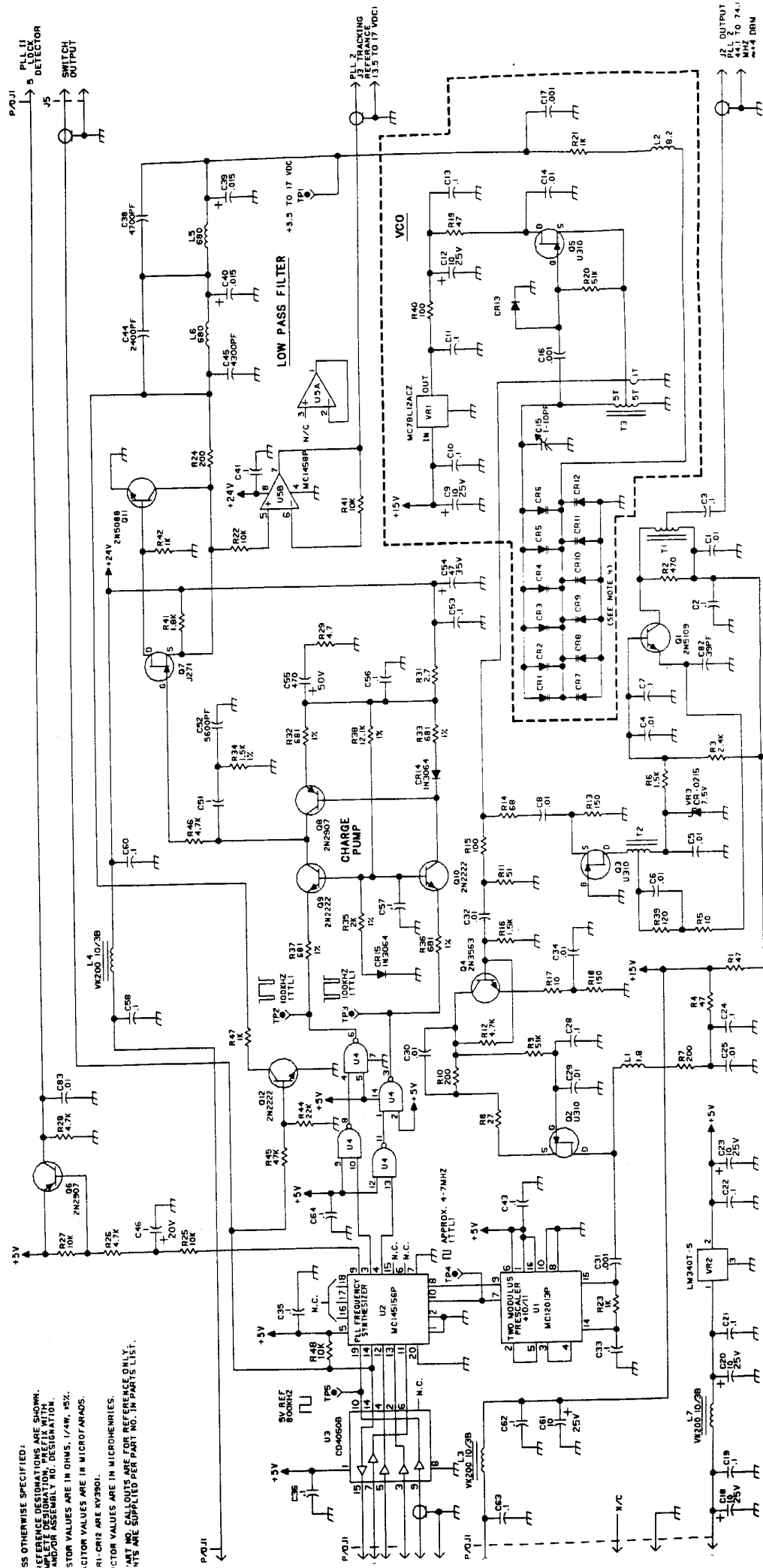
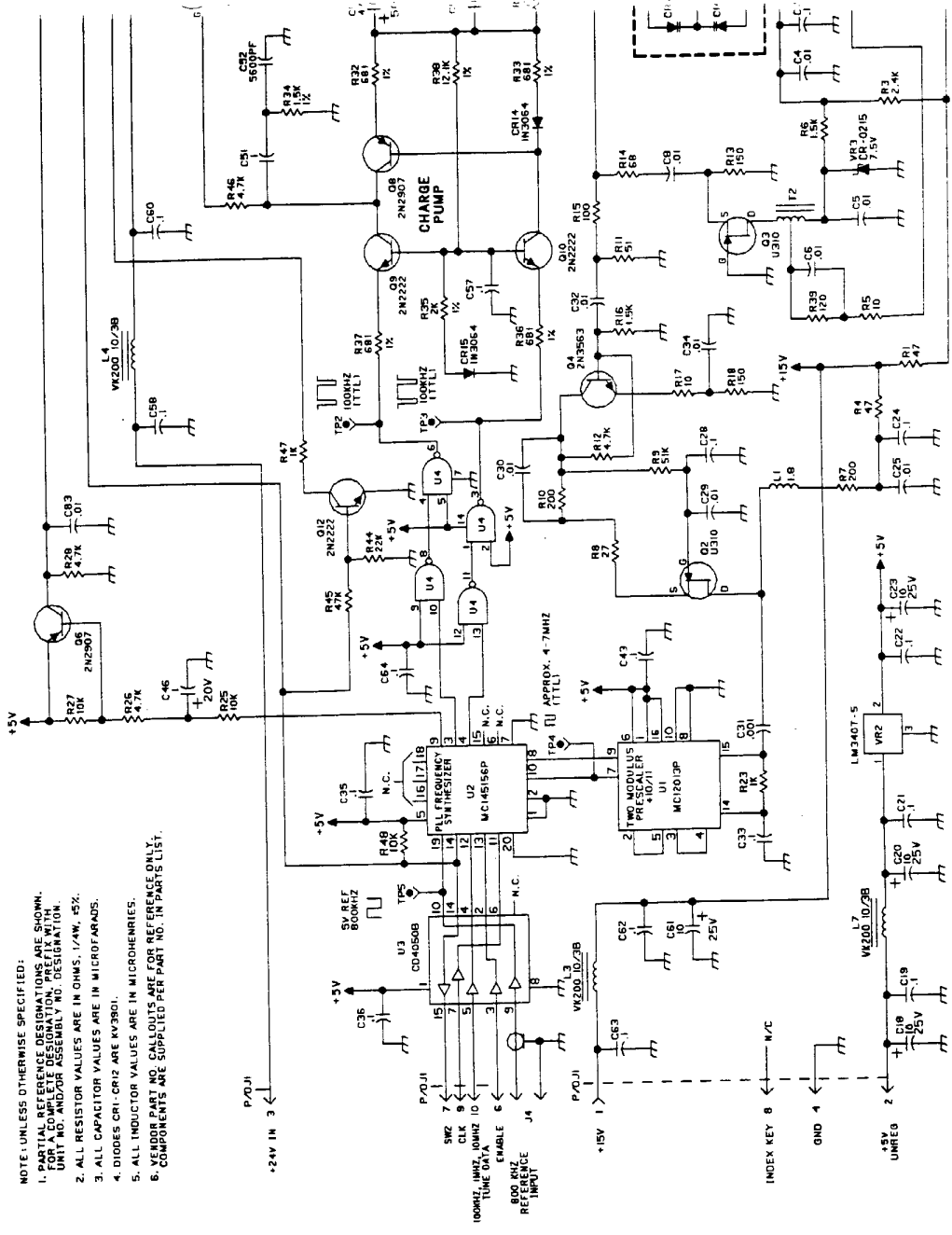


Figure 2. PLL II Assembly A7 Component Location Diagram (10073-4200, Rev. C)



SS OTHERWISE SPECIFIED:  
 \*REFERENCE DESIGNATIONS ARE SHOWN.  
 \*\*RESISTOR NOMINATION PREFIX WITH  
 AND/OR ASSEMBLY NO. DESIGNATION.  
 †TOR VALUES ARE IN OHMS. (1/4W, 45Z.  
 ‡CTOR VALUES ARE IN MICROFARADS.  
 §CTOR VALUES ARE IN MICROHENRIES.  
 ¶MIT NO. CALLOUTS ARE FOR REFERENCE ONLY.  
 ††TS ARE SUPPLIED PER PART NO. IN PARTS LIST.

Figure 3. PLL II Assembly A7 Schematic  
 Diagram (10073-4201, Rev. H)



NOTE: UNLESS OTHERWISE SPECIFIED:  
 1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.  
 2. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.  
 3. ALL CAPACITOR VALUES ARE IN MICROFARADS.  
 4. DIODES CR1-CR12 ARE KV3801.  
 5. ALL INDUCTOR VALUES ARE IN MICROHENRIES.  
 6. VENDOR PART NO. CALLOUTS ARE FOR REFERENCE ONLY.  
 COMPONENTS ARE SUPPLIED PER PART NO. IN PARTS LIST.