TUNEUP PROCEDURE – PHASE-LOCKED SOURCES AND OSCILLATORS

INTRODUCTION

These instructions cover the crystal installation and alignment procedures for Frequency West crystal controlled phase locked sources and oscillators. The procedures cover the various equipment models and are organized by sections listed below. The user should perform only those procedural steps that apply to his own equipment.

10223 MHZ = XTAL 100.225402 MHZ
1828 MHZ = XTAL 101.55555 MHZ

Section	Equipment
Crystal Installation	
Sources without Ovens	Equipment model numbers ending in: X, XA, XB
Sources with Ovens	Equipment model numbers ending in: XO and XC
Alignment Procedures	
Preliminary Setup — Sources Using External Reference Oscillator	Equipment model numbers ending in: XE
Alignment — All Phase Locked Sources and Oscillators	All equipment

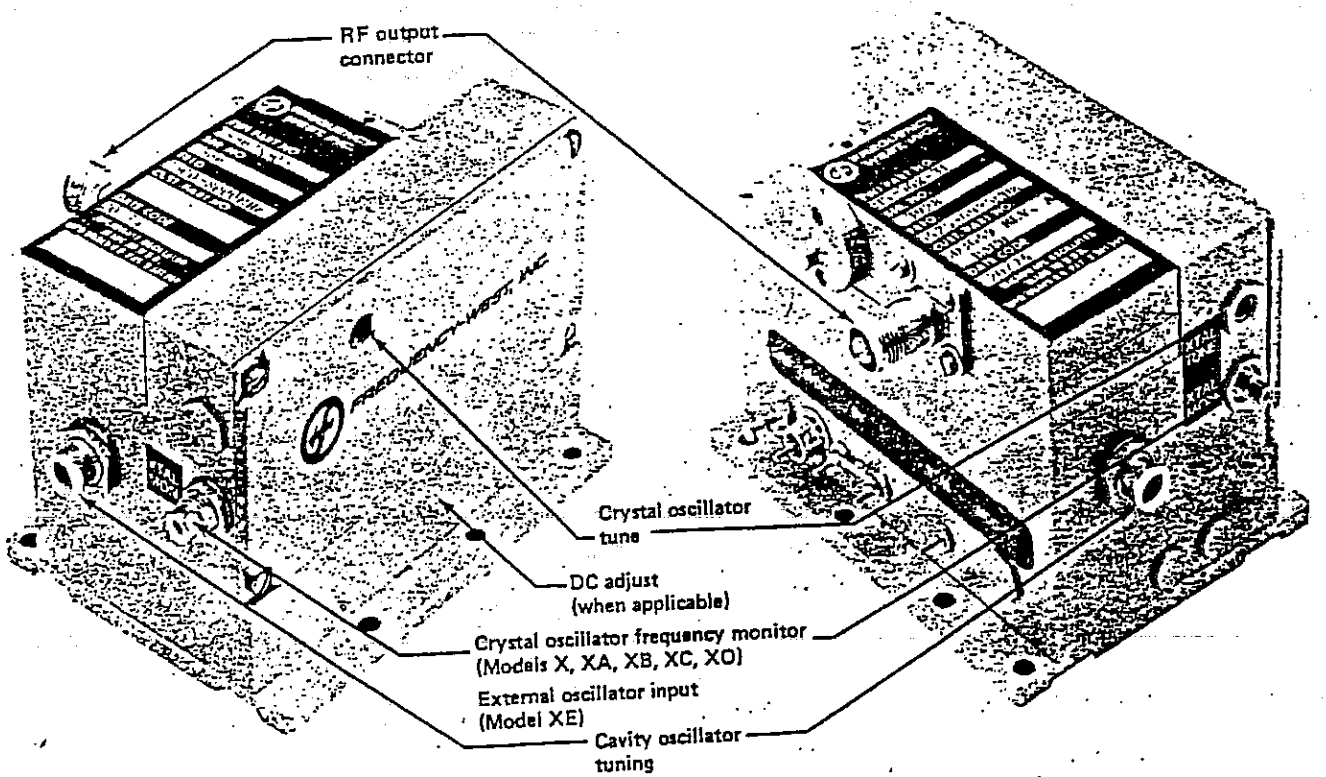

Figure 1

CRYSTAL INSTALLATION

■ Sources without Ovens

1. Remove the side plate bearing the Frequency West logo from the unit (held by four screws).

2. Clip the replacement crystal leads to between 0.150 and 0.190 inch in length. Insert the crystal in its socket. See Figure 2. For best results use crystals meeting Frequency West Specifications 37-051990 and 37-051991.

3. Replace the side plate.

4. Proceed to *Alignment — All Phase Locked Sources and Oscillators.*.

■ Sources with Ovens

1. Remove the side plate bearing the Frequency West logo from the unit, the oven insulator, crystal heat sink, and the crystal. See Figure 3.

2. Clip the replacement crystal leads to between 0.150 and 0.190 inch in length. Insert the crystal into its socket. For best results use crystals meeting Frequency West Specification 37-052243.

3. Replace the crystal heat sink, insuring that the heat sink slot clears the oven thermistor wire. Replace the oven insulator and side plate.

4. Proceed to *Alignment — All Phase Locked Sources and Oscillators.*

ALIGNMENT PROCEDURES

■ Preliminary Setup — Sources Using External Reference Oscillator

1. Turn the fundamental oscillator tuning screw counterclockwise until the source is tuned to the lowest frequency of the operating band while monitoring the source frequency with a frequency meter or counter.

2. Divide the desired output frequency by the net multiplier ratio (see Table 1 or 2) to obtain the required reference input frequency from the external crystal oscillator or frequency synthesizer.

3. Connect the external oscillator to the source reference oscillator input jack. (Input power requirement is 0 to +10 dBm; 50 ohms nominal impedance.)

4. Proceed to *Alignment — All Phase Locked Sources and Oscillators.*

■ Alignment — All Phase Locked Sources and Oscillators

1. Apply the specified input (supply) voltage between the DC input terminal and ground. The required input voltage is indicated above the terminal.

NOTE

Sources with odd model numbers require positive power supply input voltages; those with even model numbers require negative input voltages. The procedure below applies to both types of units; however, the polarity of the voltages listed in the various steps must be reversed for those sources with positive voltage power supplies.

2. Connect a VOM to the crystal oscillator test point (XTAL). Set the VOM on the +1.5 VDC scale. The typical voltage level at this point will be 0.2 volts.

NOTE

Step 3 does not apply to units using external reference oscillators.

3. Tune the crystal oscillator coil, or capacitor (through a hole in the side plate or the front plate, depending on the configuration) until a reading is obtained (approximately 0.2V). Maximize this reading.

A maximized VOM reading at this point can be expected to yield a crystal oscillator accuracy within approximately 5 ppm of the marked crystal frequency.

If a frequency counter is available, connect the counter to the crystal oscillator monitor connector and tune the crystal oscillator to the exact frequency. Make sure that the crystal oscillator is not near dropout by rocking the tuning screw back and forth. The unit should tune a minimum of 5 ppm, or 500 Hz at 100 MHz.

Reset the crystal frequency to the correct frequency.

4. Connect an oscilloscope or VOM to one of the phase voltage terminals (ϕ V). The two terminals should be jumpered together on units with two terminals. For sources that have a lock limit alarm, connect the scope or VOM to the single phase voltage terminal. The scope should show a waveform of between 50 and 500 Hz, with an amplitude greater than 12V p-p. The VOM should read approximately 9 volts on the AC (rms) scale.

Table 1 Signal Sources

Model Number	Microwave Output		Microwave Multiplier Ratio	Crystal-Oscillator Frequency	Total Multiplier Ratio	Input Current Maximum (mA)	
	Frequency (GHz)	Power, Min./Max (mW)				Model X XE XA XB	Model XC XO
MS-38	3.6 – 3.9	10/63	3	100.0 – 108.4	36	300	500
MS-42BB	3.63 – 4.13	10/63	3	100.8 – 109.2	36/39	300	500
MS-420	3.6 – 3.9	50/300	3	100.0 – 108.4	36	450	650
MS-44	3.85 – 4.2	10/63	3	98.7 – 107.7	39	300	500
MS-46	4.1 – 4.45	10/63	3	97.5 – 105.95	42	300	500
MS-48	4.33 – 4.93	10/63	4	98.4 – 112.1	44	300	500
MS-480A	4.33 – 4.63	50/300	4	98.4 – 105.3	44	450	650
MS-480B	4.6 – 4.93	50/300	4	104.5 – 112.1	44	450	650
MS-50	4.8 – 5.32	10/63	4	100.0 – 110.83	48	300	500
MS-52	5.4 – 5.9	10/63	4	103.8 – 113.5	52	300	500
MS-54	5.855 – 6.455	10/63	5	97.5 – 107.6	60	300	500
MS-540	5.855 – 6.360	50/300	5	97.5 – 106.0	60	450	650
MS-540A	5.855 – 6.105	50/300	5	97.5 – 101.7	60	450	650
MS-540B	6.065 – 6.355	50/300	5	101.0 – 105.9	60	450	650
MS-56	6.425 – 6.925	10/63	5	98.8 – 106.6	65	300	500
	6.355 – 6.805	10/63	5	97.4 – 104.7	65	300	500
MS-58	6.8 – 7.2	10/63	5	104.6 – 110.8	65	300	500
MS-580	6.805 – 7.055	25/-	5	104.7 – 108.5	65	400	600
MS-60	7.0 – 7.52	5/45	5	100.0 – 107.5	70	300	500
MS-62	7.5 – 8.0 -	5/45	5	100.0 – 106.7	75	300	500
MS-620	7.680 – 8.005	25/-	5	102.4 – 106.7	75	400	600
MS-64	7.98 – 8.5	5/45	5	99.7 – 106.3	80	400	600
MS-640	8.005 – 8.330	25/-	5	100.0 – 102.8	80	400	600
MS-66	8.5 – 9.05	10/63	5	100.0 – 106.5	85	400	600
MS-68	9.0 – 9.6	10/63	6	100.0 – 106.7	90	400	600
MS-70	9.6 – 10.2	10/63	6	100.0 – 106.25	96	400	600
MS-72	10.2 – 10.7	10/63	6	100.0 – 104.88	102	400	600
MS-74	10.63 – 11.23	10/63	6	98.4 – 104.0	108	400	600
	10.63 – 11.13	10/63	6	98.4 – 103.1	108	400	600
MS-76	11.20 – 11.77	10/63	6	103.7 – 109.0	108	400	600
	11.13 – 11.63	10/63	6	103.0 – 107.6	108	400	600
MS-78	11.63 – 12.23	5/45	6	102.0 – 107.3	114	400	600
MS-80	12.13 – 12.70	5/45	6	101.0 – 105.3	120	400	600
MS-82	12.63 – 13.23	5/45	6	100.2 – 105.0	126	400	600
MS-84	13.13 – 13.70	5/45	6	99.4 – 103.8	132	400	600
MS-86	13.63 – 14.23	5/45	7	102.4 – 107.0	133	400	600
MS-88	14.13 – 14.73	5/45	7	100.9 – 105.2	140	400	600

Models XC and XO indicate units with proportional ovens to maintain the crystal at a constant temperature.
Models X, XA, XB and XE have no ovens and their current consumption is lower.

Table 2 Fundamental Oscillators

Model Number	Microwave Output		Total Multiplier Ratio	Crystal-Oscillator Frequency (MHz)		Input Current Maximum (mA)	
	Frequency (MHz)	Power, Min./Max. (mW)		Range	Output	Model X XE XA XB	Model XC XO
MO-100	750 – 1000	250	X7	107.14 – 112.0	750 – 784	300	500
			X8	98.0 – 112	784 – 896	300	500
			X9	99.55 – 111.11	896 – 1000	300	500
MO-102	980 – 1100	250	X10	98.0 – 110	—	300	500
MO-104	1080 – 1220	250	X11	98.2 – 110.9	—	300	500
MO-106	1200 – 1340	250	X12	100.0 – 111.7	—	300	500
MO-108	1300 – 1520	200	X13	100.0 – 109.3	1300 – 1420	300	500
			X14	101.4 – 108.6	1420 – 1520	300	500
MO-110	1500 – 1720	200	X15	100.0 – 106.7	1500 – 1600	350	550
			X16	100.0 – 107.5	1600 – 1720	350	550
MO-112	1720 – 2020	200	X17	101.1 – 111.8	1720 – 1900	350	550
			X19	100.0 – 106.3	1900 – 2020	350	550
MO-114	2000 – 2320	150	X20	100.0 – 107.5	2000 – 2150	350	550
			X21	102.3 – 110.5	2150 – 2320	350	550
MO-116	2320 – 2720	20	X23	100.8 – 108.7	2320 – 2500	350	550
			X25	100.0 – 108.8	2500 – 2720	300	500
MO-118	2700 – 3220	20	X27	100.0 – 109.6	2700 – 2960	300	500
			X29	102.0 – 111.0	2960 – 3220	300	500
MO-120	3200 – 3700	10	X32	100.0 – 109.3	3200 – 3500	300	500
			X34	102.9 – 108.8	3500 – 3700	300	500

Models XC and XO indicate units with proportional ovens to maintain the crystal at a constant temperature.
Models X, XA, XB and XE have no ovens and their current consumption is lower.

(Printed in U.S.A.) 475

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5. If no AC waveform appears, adjust the DC balance potentiometer (under the crystal side plate) until the waveform appears. (Most units manufactured after August, 1973 do not require this adjustment.)

Find the middle of this adjustment, or adjust the potentiometer for either the highest frequency waveform (triangular or square wave, depending on the source model) or for the highest reading on the AC VOM.

6. Slowly tune the fundamental oscillator tuning screw clockwise until the waveform drops out or the AC voltage drops to zero on the VOM.

If the unit has a crystal that places the output frequency at the high end of the band, it may be necessary to continue to tune until a second lock occurs. Check for the proper lock point with a frequency meter or counter to insure locking on the correct harmonic of the reference oscillator.

7. Switch the scope to DC (2 V/cm scale) or the VOM to 30 VDC full scale. (The leads should still be connected between the phase lock terminal and ground.)

8. Check for lock by rocking the fundamental oscillator tuning screw slightly. The absolute magnitude should decrease as the tuning screw is rotated clockwise.

If the voltage does not change, the unit has not locked and has stopped sweeping. Repeat steps 4 and 5, then continue tuning the fundamental oscillator until lock occurs.

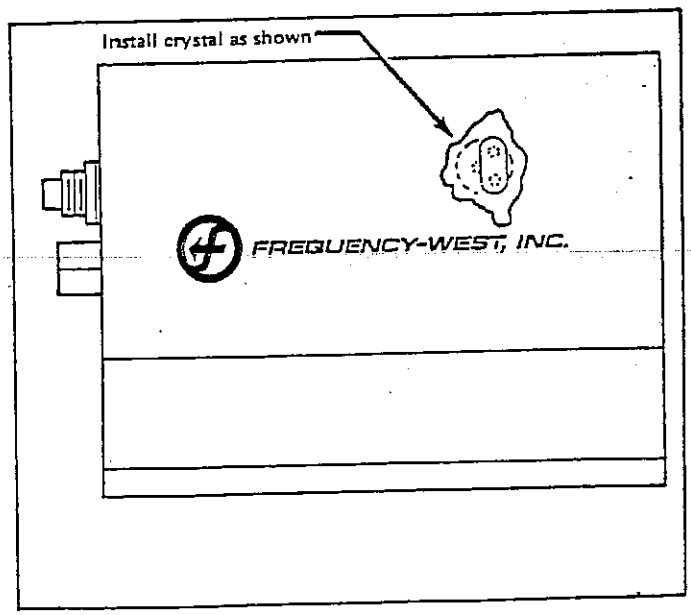


Figure 2

9. Tune the fundamental oscillator to the edge of the phase lock range. This should be between −3V ±2V and −16V ±2V. The unit should remain locked between these voltages and go into sweep as the fundamental oscillator is tuned further. This verifies that the unit remains phase locked over the appropriate tuning voltage range.

10. Set the fundamental oscillator so that the voltage at the phase lock terminals is −7.5 volts. Tuneup is complete.

NOTE

For units with lock limit alarm: To verify the operation of the lock limit alarm circuitry, connect a VOM (x10 ohm scale) between the lock limit terminal and ground. As the unit is tuned from one end of the lock range to the other (−3V ±2V to −16V ±2V), the VOM will read either zero or infinity. It will be infinity between approximately 4.5 and 13VDC (as read at the phase lock terminals), and zero elsewhere.

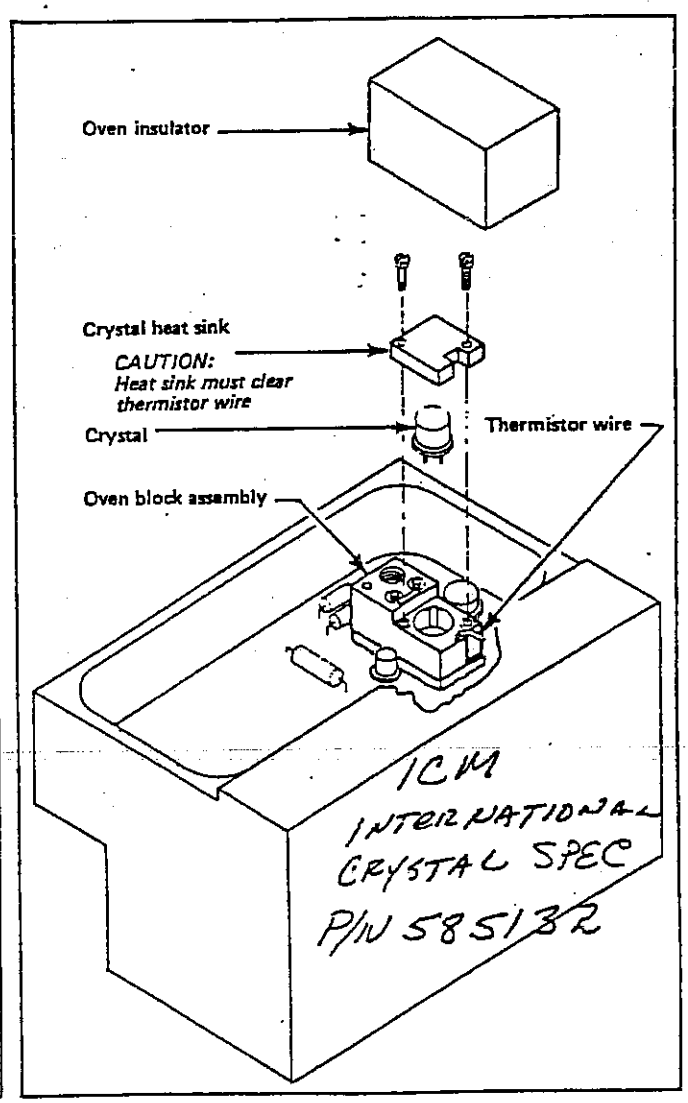
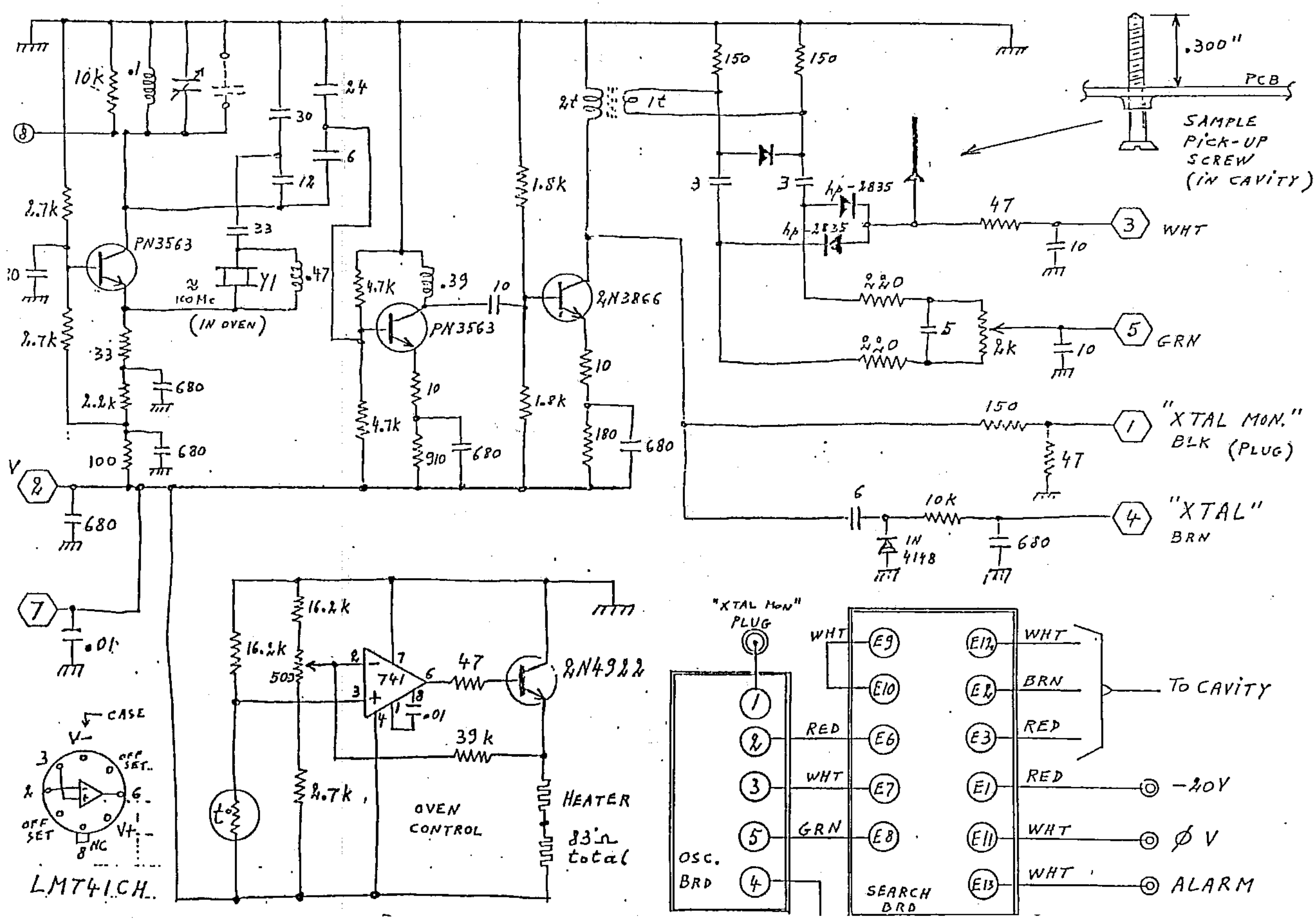


Figure 3



10k
.1
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PN3563
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680
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.01
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PN3563
10
4.7k
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910
680
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1.8k
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180
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3
3
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WHT
220
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5
2k
10
5
GRN
.300"
PCB
SAMPLE
PICK-UP
SCREW
(IN CAVITY)
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47
1
"XTAL MON."
BLK (PLUG)
6
10k
1N 4148
680
4
"XTAL"
BRN
16.2k
16.2k
503
741
47
2N4922
.01
39k
2.7k
OVEN
CONTROL
HEATER
83 Ω total
CASE
V-
OFF SET
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8 NC
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"XTAL MON" PLUG
OSC. BRD
WHT
RED
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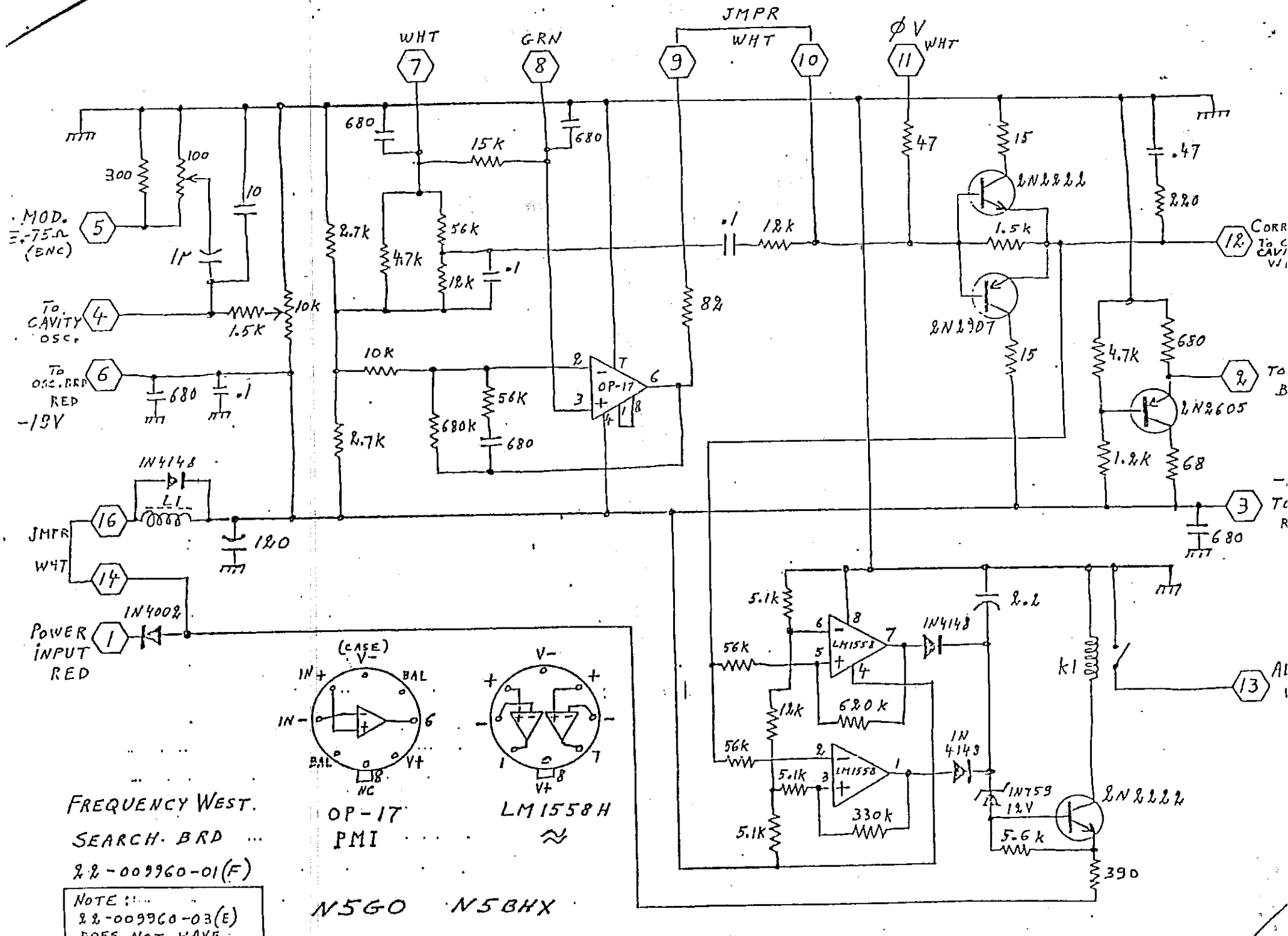

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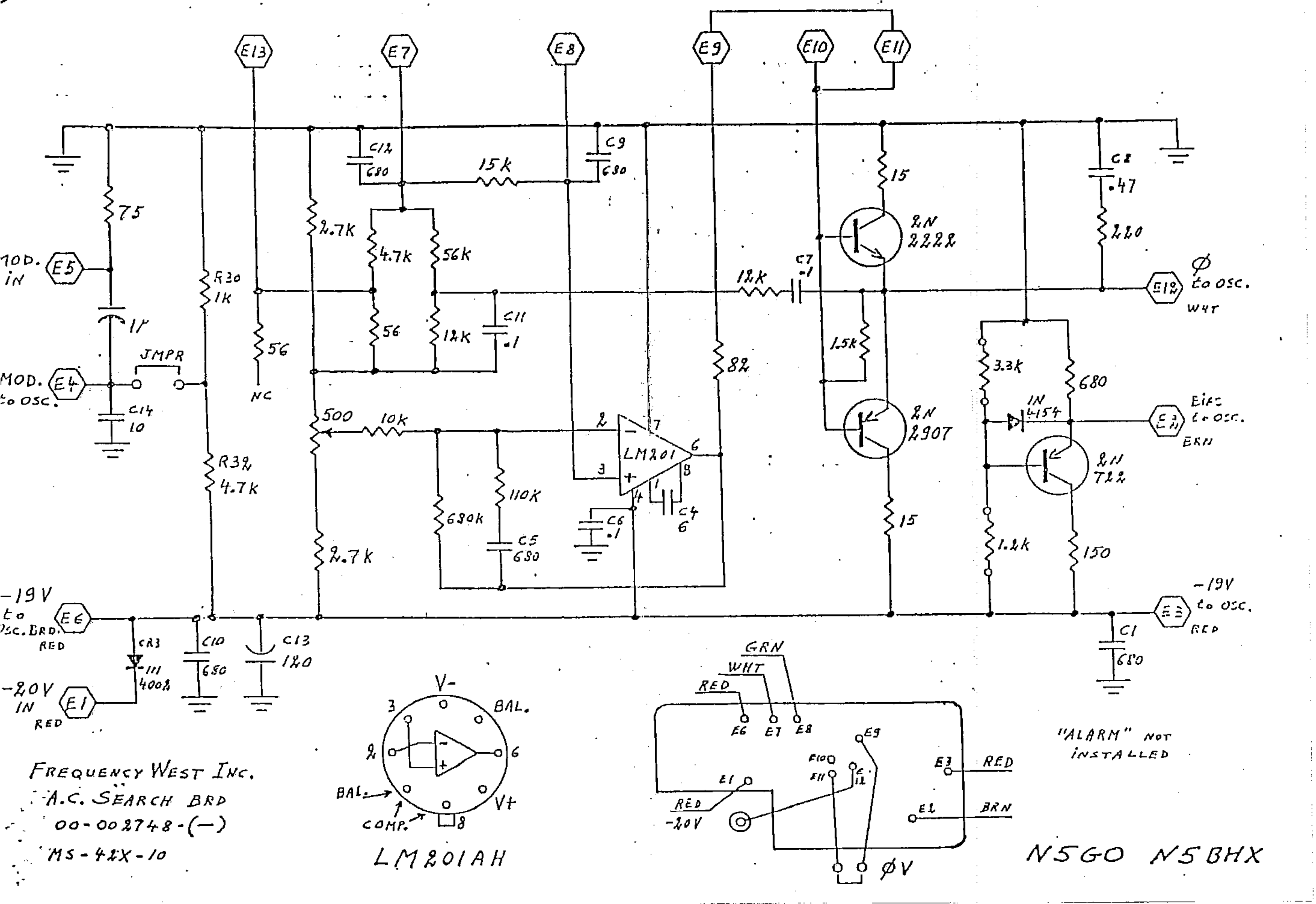

E13
E7
E8
E9
E10
E11
C12 680
C9 680
15k
75
2.7K
4.7k
56k
2N 2222
15
220
C8 .47
MOD. IN
E5
R30 1K
1µ
12k
C7 .1
Ø to OSC. WHT
E12
56
12K
C11 .1
1.5k
JMPR
MOD. to OSC.
E4
C14 10
NC
82
3.3k
680
500
10k
LM201
2N 2907
1N 4154
EIFC to OSC. BRN
R32 4.7k
110K
680k
C5 680
C6 .1
C4 6
2N 722
1.2k
150
2.7 K
-19V to OSC. BRD. RED
E6
15
-19V to OSC. RED
E3
CR3 1N4002
C10 680
C13 120
C1 680
-20V IN RED
E1
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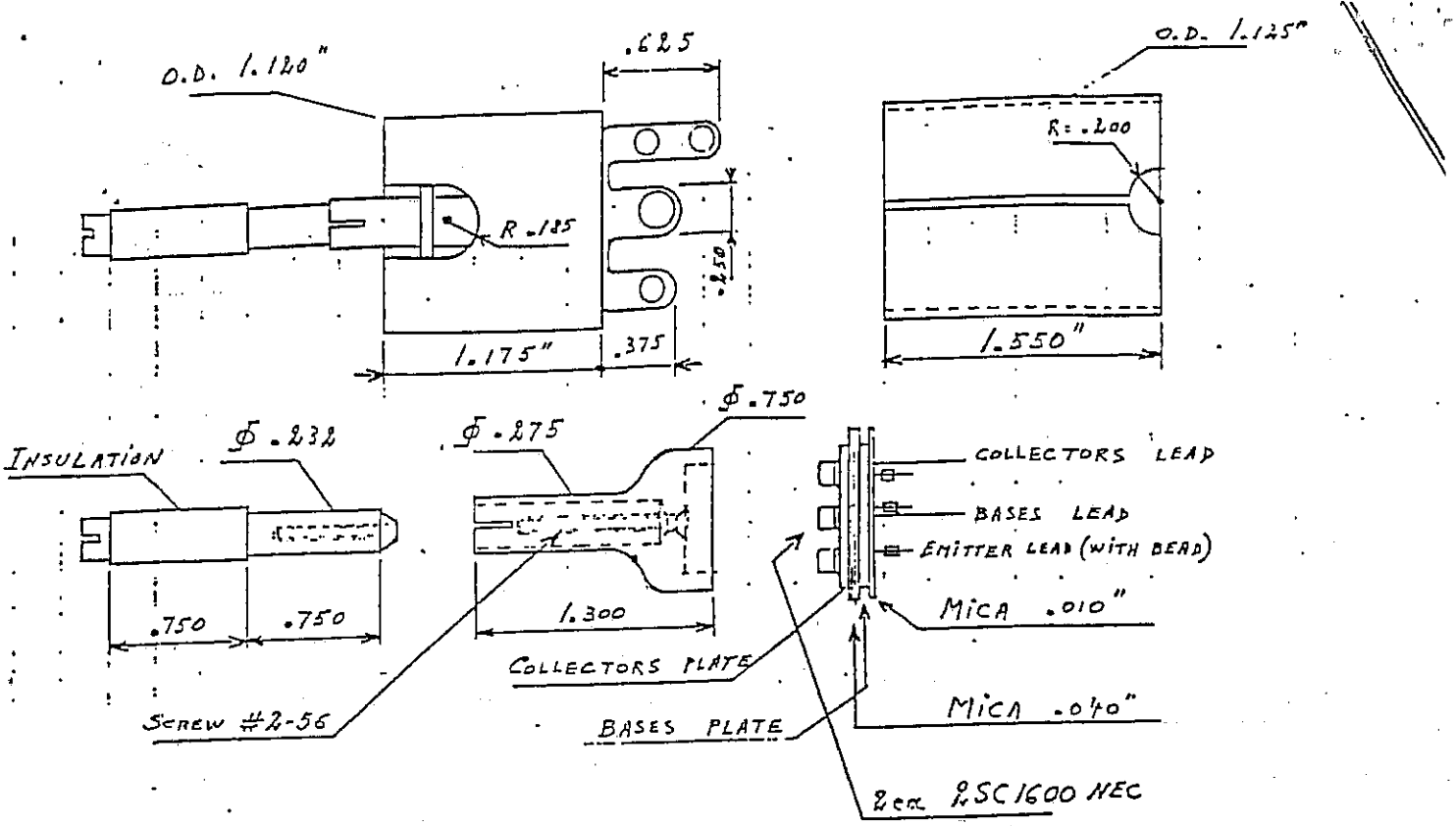

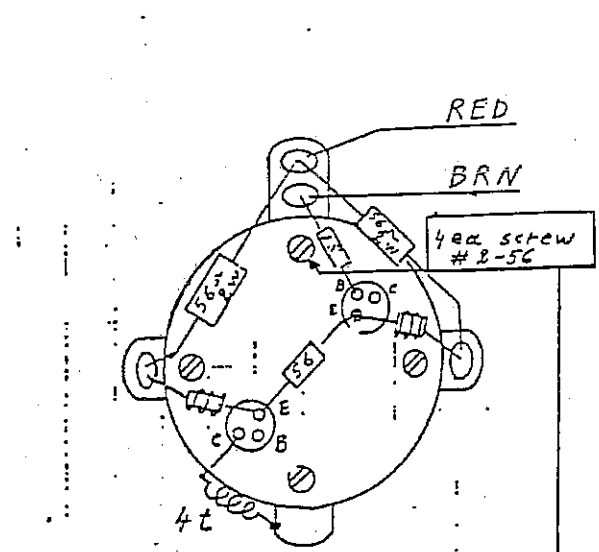

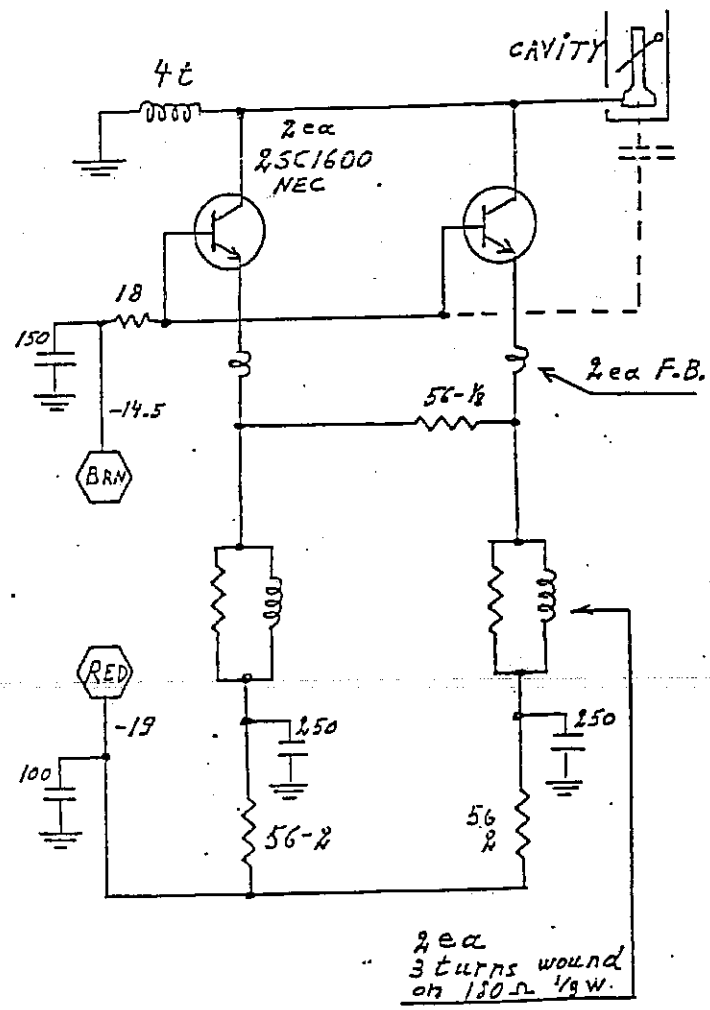

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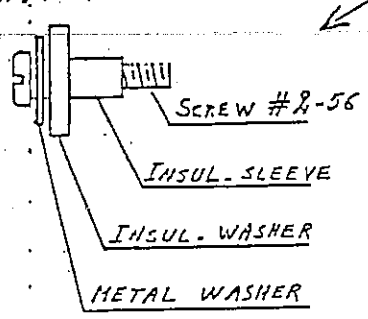

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