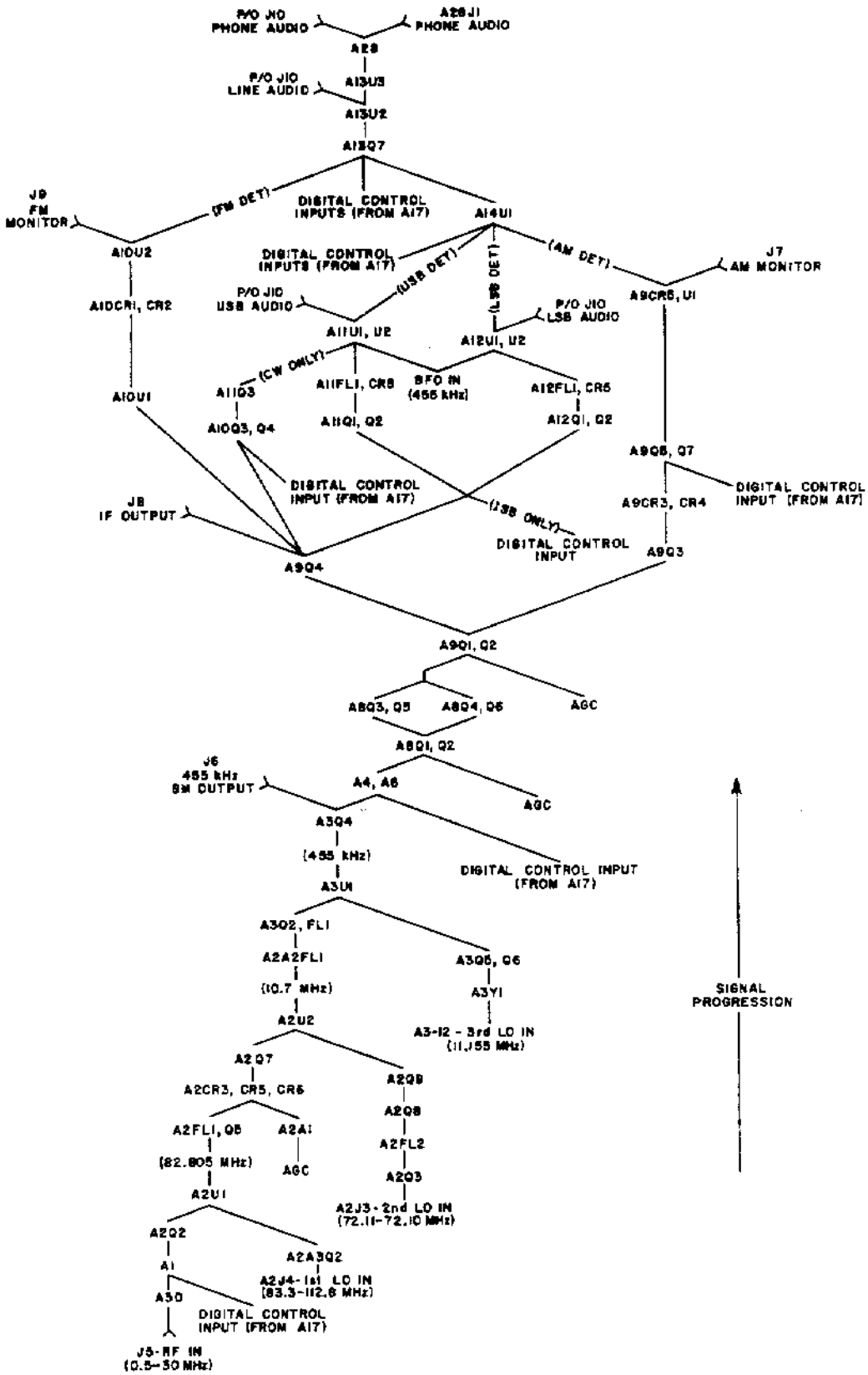


Figure 5-1. Receiver Section Functional Dependency Diagram

SECTION V
MAINTENANCE

5.1 GENERAL

The WJ-8888 Receiver has been conservatively designed to operate for extended periods of time with minimum routine maintenance. Cleaning, inspection, and performance tests should be performed at regular intervals consistant with the facility's normal scheduling and after troubleshooting. No routine adjustments are required. Troubleshooting and performance tests can be most effectively carried out if the technician first familiarizes himself with the operating instructions and circuit descriptions provided in Chapters II and III, respectively. Parts lists and component location diagrams are in Chapter VI.

5.2 CLEANING AND LUBRICATION

The receiver should be kept free of dust, moisture, grease, and other foreign matter to ensure trouble-free operation. Use low pressure compressed air, if available, to remove accumulated dust from the interior and exterior of the receiver. A clean dry cloth, a soft bristled brush, or a cloth saturated with cleaning compound may also be used. The receiver does not require lubrication.

5.3 INSPECTION FOR DAMAGE OR WEAR

Many potential or existing troubles can be detected by making a visual inspection of the unit. For this reason, a complete visual inspection should be made on a regular basis and whenever the unit is inoperative. Components showing signs of deterioration should be checked and a thorough investigation of the associated circuitry should be made to verify proper operation. Damage due to overheating may be the result of other less apparent troubles in the circuit. It is essential that the cause of overheating be determined and corrected before replacing the damaged parts. Mechanical parts such as pin connectors and chassis wiring should be inspected for excessive wear, looseness, misalignment, corrosion, and other signs of deterioration.

5.4 TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-1 or equivalents are required for performing preventive and corrective maintenance.

5.5 TROUBLESHOOTING PROCEDURE

5.5.1 LOCALIZING TROUBLES. - Troubleshooting efforts should first be directed toward eliminating possible external causes of the trouble and ascertaining the symptoms with the unit properly connected and tested. Signal, voltage, and resistance checks should be made using test equipment listed in Table 5-1. Deenergize the receiver before making resistance checks and soldering components. It is always a good idea to check the power supply voltages as a first step in any troubleshooting procedure. Efforts should then be directed toward isolating

the trouble to a particular circuit group on a block diagram level, then to a specific circuit and component. The performance tests given below may be used to ascertain proper functioning of the receiver, and the alignment procedure may provide additional information as to proper functioning of some of the circuitry, although adjustments given in the alignment procedure should not be made unless necessary, such as when a component is replaced in that circuit or when the symptoms are due solely to misalignment.

The block and schematic diagrams and the circuit description should be referred to as the main guide for troubleshooting the receiver section. Figure 5-1 is a functional dependency diagram of the receiver section which may be used as a supplementary troubleshooting guide for that section. The diagram indicates the major functional components of the receiver section and the inputs to these components upon which proper outputs depend. For simplicity, certain minor components which should not be overlooked are not shown on the diagram. The locations of these components can be ascertained from the schematics.

It is suggested that troubleshooting of the digital control section be carried out using a four-trace oscilloscope. The complexity of the circuit renders it essential that the technician be familiar with the block diagram and circuit descriptions given in Section IV of this manual. In particular, the description of program sequencing will be of help in tracing a trouble, in that the controls can be set for a mode that produces the symptoms, and the oscilloscope can be used to follow the sequence of timed operations described, until the source of the problem is located. Occasionally, the main circuit causing the trouble can be pinpointed by noting that a symptom occurs only for operating modes which involve a certain circuit, but does not occur for other operating modes which do not involve that circuit. On the other hand, symptoms which occur for several operating modes would tend to lead the troubleshooter to circuitry which is active for all these modes. If it is found that a specific circuit is not performing correctly, check that it is receiving the proper inputs and then continue step-by-step with signal and voltage checks, using the circuit description as a guide, until the trouble is found.

5.5.2 REPAIR. - When a trouble has been isolated to a specific circuit board or assembly, the user may decide to make the repair himself or return the board or assembly to the factory or depot for replacement or repair. Some of the modules can be removed entirely, while in other cases only boards can be removed. The entire front panel along with the switch encoder, front panel register, and display buffer boards can be removed as a unit.

After a repair has been made, alignment should be carried out if necessary, and appropriate performance tests should be carried out to verify proper operation.

In both repair and troubleshooting, the technician should be aware of the fact that the boards have been coated with an insulating varnish to prevent leakage paths between high-impedance CMOS circuits. Designated test points are not insulated, but if it is desired to measure voltages at other points it will be necessary to remove the varnish by carefully scraping it from the surface to

be probed. Soldering and unsoldering also requires that varnish be removed. Any residue from burnt varnish left after soldering should be removed with alcohol. When troubleshooting and repair have been completed, any surface from which varnish was removed should be resprayed. A suitable insulating spray is Insul-X E-26, available from Insul-X Products Corporation, Yonkers, New York.

When removing components from a printed-circuit board for inspection or replacement, be especially careful not to damage the print. The soldering iron should be no larger than 40 watts, and a solder sipper or wicking procedure should be employed in removing solder. Non-corrosive soldering flux should be used when removing solder by wicking. In returning components to the board, make sure the holes are clear and be careful that the leads do not catch the edge of the print and lift it from the board. A good grade of rosin core 60/40 solder should be used. Heat no longer than is necessary to achieve a good joint. A heat sink should be used where possible.

Table 5-1. Test Instruments Required

Instrument Type	Required Characteristics	Recommended Instrument
Attenuator	113 MHz frequency capability; 10 dB attenuation; 1 watt	Kay 431-C
Frequency Counter with Hetrodyne Converter	1 MHz time base output; 113 MHz frequency capability	HP-5245L HP-5253B
Variable Transformer	Metered output, variable from 90-115 V ac	General Radio W5MT3A
Variable Transformer	Output variable from 180-220 V ac	General Radio W5HMT
Low Impedance Detector	50 ohm impedance	Telonic XD-3A
High Impedance Detector	High frequency Low frequency	See Figure 5-2 See Figure 5-3
VOM	AC, dc, and ohms ranges	Simpson 260
VTVM	AC and dc ranges	RCA WV-98C
AC VTVM	Scale calibrated in dBm	HP-400EL

Table 5-1. Test Equipment Required (Continued)

Instrument Type	Required Characteristics	Recommended Instrument
RF Voltmeter	113 MHz capability; .001-3.0 V; -50 to +20 dBm	Boonton 91DA-S5 with 91-12F probe and 91-8B 50 ohm BNC adapter
Distortion Analyzer		HP-332A
Digital Voltmeter	DC ranges; 1% or better accuracy	Fluke 8100A
AM/FM/CW Signal Generator	0.455-113 MHz range; +20 dBm RF output	HP-8640B
Sweep Generators	0.455-30 MHz range 0-500 kHz sweep width 72-83 MHz range 0-500 kHz sweep width	HP-675A Wavetek 2001
Oscilloscope	600 kHz or greater vertical bandwidth	Tektronix 503
Oscilloscope	4-trace; dc-coupled vertical amplifiers	HP-180C
Spectrum Analyzer	1 kHz to 110 MHz 10 Hz resolution	HP-141T, 8552B, and 8553B
Computer		Computer Measurements Corporation PDP 11

In addition, two high impedance detectors are used in the alignment procedure. A high frequency detector (used for 82.805 MHz IF and 72.105 MHz LO alignment) is shown in Figure 5-2. A low frequency detector (used in all other alignment procedures requiring a high impedance detector) is shown in Figure 5-3.

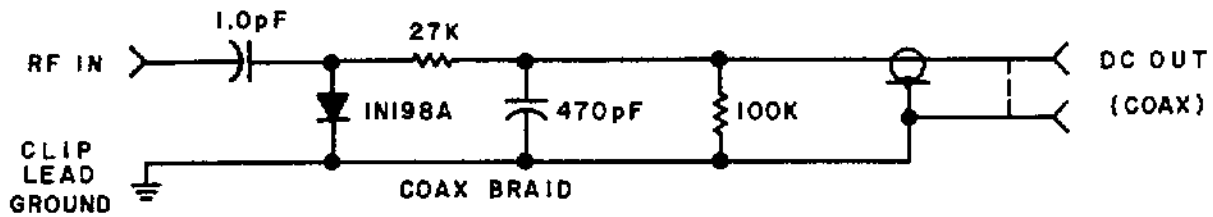


Figure 5-2. High Frequency High Impedance Detector

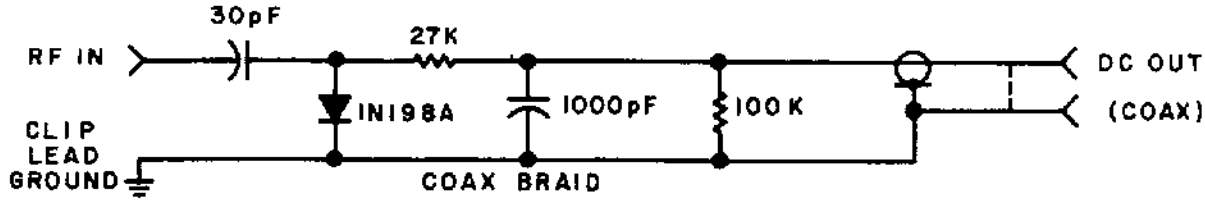


Figure 5-3. Low Frequency High Impedance Detector

5.6 PERFORMANCE TESTS

5.6.1 GENERAL. - The performance test procedure given here may be used for incoming inspection, for periodic checks, as an aid in troubleshooting or to confirm proper performance after repairs have been made. The procedure should be carried out only by skilled technicians using the equipment listed in Table 5-1, or equivalents. If the receiver does not operate within the limits and tolerances specified in these procedures, troubleshooting may be necessary. It should be noted that these are selected overall performance tests - they do not check the receiver in all modes of operation and in particular, tests of the digital control section are not included. In addition to the following tests, therefore, the user should perform functional checks of all operating features of the receiver, using the operating instructions in Section III as a guide. Functional tests using the remote control unit should be included.

5.6.2 POWER SUPPLY TEST. - Proceed as follows:

(1) Verify that line voltage selector switch S2 is set to the 115 V position if the available line voltage is between 103 and 127 V ac, or to the 220 V position if the available line voltage is between 198 and 242 V ac.

(2) Connect the receiver through a metered variable transformer to the ac power source. If the variable transformer used is unmetered, connect an ac voltmeter across the secondary to monitor the voltage.

(3) Adjust the variable transformer voltage output level to 115 or 220 V ac, whichever is appropriate for the setting of S2, then energize the receiver.

(4) Using a digital voltmeter and oscilloscope, measure the output voltages and peak-to-peak ripple levels on the dc supply lines at the measurement points indicated in Table 5-2. The voltages may be adjusted if necessary, using the adjustment controls indicated.

(5) Set the lamp intensity control (A21R25) for maximum lamp brilliance (the control may be reset for the desired lamp intensity at the end of this test).

Table 5-2. Power Supply Voltages, Measurement Points and Adjustments

SUPPLY VOLTAGE	MEASUREMENT POINT	VOLTAGE LIMITS	TYPICAL RIPPLE
- 5	A27-6	Unspecified	5 mV p-p
+ 5	A27-21	+ 5.08 ± .04	25 mV p-p
+10	A27-1	Unspecified	800 mV p-p
-15	A26-9	-15.0 ± 0.1	5 mV p-p
+15	A26-13	+15.0 ± 0.1	4 mV p-p

(6) Place the receiver in the LOCAL control mode. Slowly reduce the ac voltage input to the receiver until a POWER DOWN condition is indicated (a POWER DOWN condition is indicated by the receiver switching to the REMOTE control mode). Note the ac voltage input at the instant the POWER DOWN condition occurs. If S2 has been set to the 115 V position, the "drop-out" voltage should be under 94 V ac. If S2 has been set to the 220 V position, the "drop-out" voltage should be under 180 V ac.

(7) With the receiver still in the POWER DOWN condition, slowly increase the ac voltage input to the receiver while rapidly depressing the LOCAL pushbutton. Note the ac voltage level at the instant the receiver switches to (and remains in) the LOCAL control mode. This "pull-in" level should be between 99 and 101 V ac for 115 V ac operation and between 189 and 193 V ac for 220 V ac operation.

(8) If the "drop-out" and "pull-in" voltage levels are incorrect, refer to paragraph 5.7.3 (POWER DOWN Adjustment).

5.6.3 SENSITIVITY TESTS. - Proceed as follows:

(1) Connect the equipment as shown in Figure 5-4.

(2) Place the receiver in the AM detection mode, the NORM AGC gain mode, and the narrowest available IF bandwidth position. If the narrowest available IF bandwidth position is less than 1.0 kHz, the receiver should be placed in the CW VAR detection mode.

(3) Set the HP-8640B signal generator for a 0.50000 MHz output at the level corresponding to the receiver IF bandwidth in use in Table 5-3. If the IF bandwidth is less than 1.0 kHz, the HP-8640B output should be unmodulated. Otherwise, the output should be modulated 50% at a 400 Hz rate.

(4) Tune the receiver to 0.50000 MHz. If the selected IF bandwidth position is less than 1.0 kHz, adjust the VAR BFO control for a line audio output near 400 Hz.

(5) With the analyzer in the SET LEVEL mode, adjust the distortion analyzer for a reading of 0 dB on the SET LEVEL range.

Table 5-3. Corresponding IF Bandwidths, Signal Levels, and Modulation Frequencies for Sensitivity Tests

IF BANDWIDTH kHz	SIGNAL LEVEL dBm	MODULATION FREQUENCY Hz
0.2	-118.0	CW
0.5	-114.0	CW
1.0	-111.0	400
2.0	-108.5	400
3.0	-105.5	400
4.0	-105.0	400
6.0	-102.5	400
8.0	-102.0	400
12.0	- 99.5	400
16.0	- 99.0	400

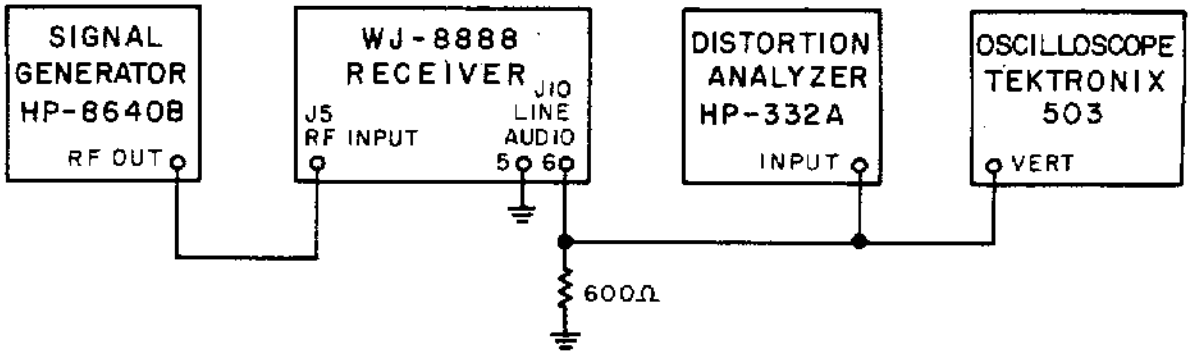


Figure 5-4. Test Setup, Sensitivity Tests

(6) Switch the analyzer to the DIST mode and minimize the meter reading. The meter reading should decrease by at least 10 dB (16 dB if the procedure has been followed using IF bandwidths less than 1.0 kHz).

(7) Repeat steps (5) and (6) at the following frequencies:

0.79999 MHz	3.40000 MHz	10.00000 MHz
0.80000 MHz	5.99999 MHz	17.99999 MHz
1.19999 MHz	6.00000 MHz	18.00000 MHz
1.20000 MHz	9.99999 MHz	30.00000 MHz
3.39999 MHz		

Employ all available IF bandwidths when checking sensitivity at the above frequencies, using each bandwidth for two or more of the test frequencies. In each case, the input signal level and the modulation frequency should be determined from Table 5-3, and the meter reading should decrease by at least 10 dB (16 dB if the procedure has been followed using IF bandwidths less than 1.0 kHz).

(8) Select an IF bandwidth of 2.0 kHz or greater and set the HP-8640B output level 60 dB higher than the level corresponding to the receiver bandwidth selected in Table 5-3.

(9) Repeat steps (5) and (6). In this case, the analyzer meter reading should decrease by at least 38 dB.

(10) Set the receiver detection mode to FM and select the widest available IF bandwidth.

(11) Set the HP-8604B output level as indicated in Table 5-3 for the selected bandwidth. Set the peak deviation of the HP-8640B to 30% of the IF bandwidth in use. Set the deviation frequency to 400 Hz or to 10% of the IF bandwidth in use, whichever is less.

(12) Repeat steps (5) and (6). In this case the meter reading should decrease at least 17 dB.

5.6.4 UNWANTED SIDEBAND REJECTION TEST. - Proceed as follows:

(1) Connect the equipment as shown in Figure 5-4, deleting the distortion analyzer.

(2) Place the receiver in the USB detection mode and the MAN gain mode. Rotate the RF GAIN control fully clockwise. Tune the receiver to 0.51000 MHz.

(3) Set the signal generator frequency to 0.51035 MHz. The signal generator RF output should be unmodulated at a level of -107 dBm.

(4) Adjust the oscilloscope controls so that the receiver audio output can be plainly seen. Adjust the oscilloscope vertical sensitivity so that the top of the waveform is at a convenient position on the graticule. Note this reference level.

(5) Tune the signal generator to 0.50965 MHz, and increase the output level of the signal generator until the top of the oscilloscope waveform again reaches the reference level noted in step (4). Note the new setting of the signal generator RF output attenuator.

(6) The new setting of the signal generator RF output attenuator should be at least 50 dB higher than the output level set in step (3).

(7) Repeat steps (2) through (6), placing the receiver in the LSB detection mode, using a signal generator frequency of 0.50965 MHz in step (3), and 0.51035 MHz in step (5).

5.6.5 IF REJECTION TEST. - Proceed as follows:

(1) Connect the equipment as shown in Figure 5-5.

(2) Place the receiver in the AM detection mode and the MAN gain mode, using an IF bandwidth of between 2.0 and 8.0 kHz. Rotate the RF GAIN control fully clockwise. Tune the receiver and signal generator to 30 MHz. The signal generator RF output should be unmodulated at the level indicated in Table 5-3 for the IF bandwidth in use.

(3) Adjust the oscilloscope controls so that the receiver IF output signal can be plainly seen (it may also be necessary to adjust the signal generator frequency slightly). Adjust the oscilloscope vertical sensitivity so that the top of the waveform is at a convenient position on the graticule. Note this reference level.

(4) Tune the signal generator to 82.805 MHz (the receiver 1st IF). Increase the signal generator output level until the top of the oscilloscope waveform again reaches the reference level noted in step (3) (it may be necessary to adjust the signal generator frequency slightly to obtain an indication). Note the new setting of the signal generator RF output attenuator.

(5) The new setting of the signal generator RF output attenuator should be at at least 100 dB higher than the output level set in step (2).

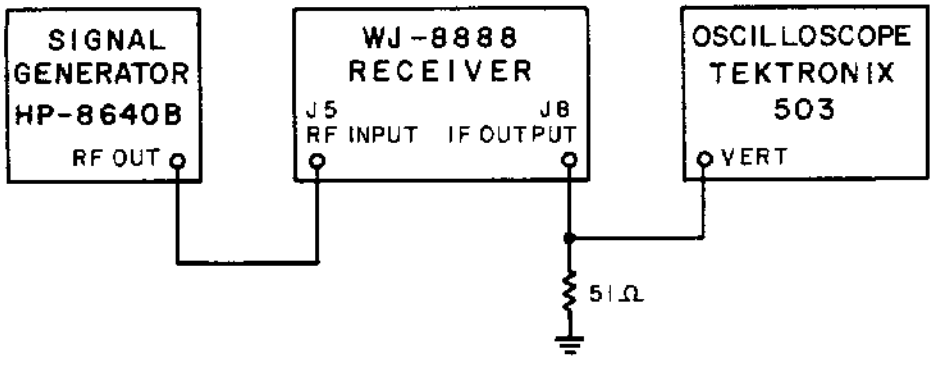


Figure 5-5. Test Setup, IF/Image Rejection Tests

5.6.6 RF IMAGE REJECTION TEST. - Proceed as follows:

(1) Connect the equipment as shown in Figure 5-5.

(2) Place the receiver in the AM detection mode and the MAN gain mode, using an IF bandwidth of between 2.0 and 8.0 kHz. Rotate the RF GAIN control fully clockwise. Tune the receiver and signal generator to 30 MHz. The signal generator RF output should be unmodulated at the level indicated in Table 5-3 for the IF bandwidth in use.

(3) Adjust the oscilloscope controls so that the receiver IF output signal can be plainly seen (it may also be necessary to adjust the signal generator frequency slightly). Adjust the oscilloscope vertical sensitivity so that the top of the waveform is at a convenient position on the graticule. Note this reference level.

(4) Tune the signal generator to 142.805 MHz (the receiver RF image frequency for 30 MHz). Increase the signal generator output level until the top of the oscilloscope waveform again reaches the reference level noted in step (3) (it may be necessary to adjust the signal generator frequency slightly to obtain an indication). Note the new setting of the signal generator RF output attenuator.

(5) The new setting of the signal generator RF output attenuator should be at at least 100 dB higher than the output level set in step (3).

5.6.7 IF GAIN AND AGC TESTS. - Proceed as follows:

(1) Connect the equipment as shown in Figure 5-6.

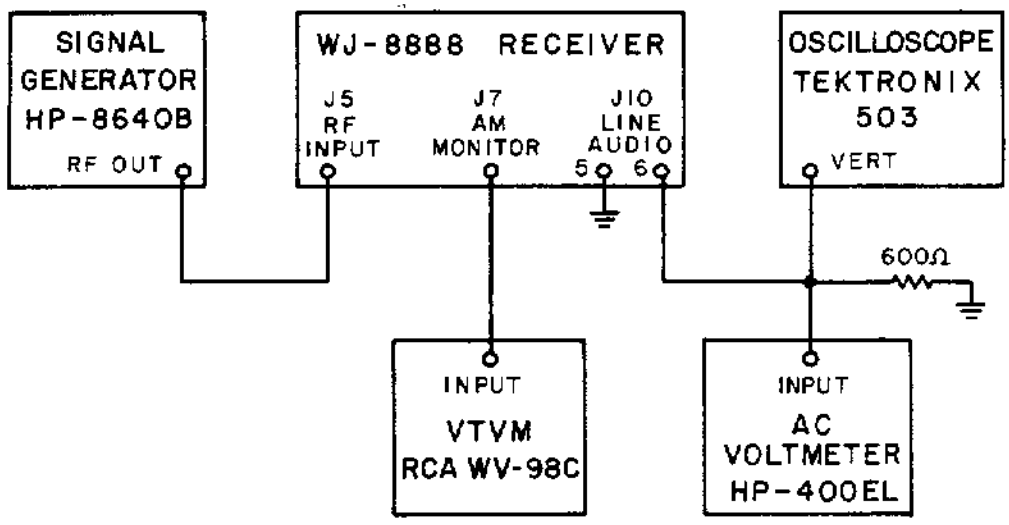


Figure 5-6. Test Setup, IF Gain and AGC Tests

(2) Place the receiver in the CW VAR detection mode and MAN gain mode, rotating the RF GAIN control fully clockwise. Select the widest available IF bandwidth position.

(3) Tune the receiver and signal generator to 0.56000 MHz. The signal generator should be set at a -113 dBm RF output level, unmodulated.

(4) With the VAR BFO control set at "0", carefully adjust the signal generator frequency for an exact audio zero beat (the receiver audio output can be conveniently monitored using a headset plugged into the PHONES jack on the front panel. After this has been done, offset the VAR BFO control slightly to produce an audio tone of approximately 200 Hz.

(5) Adjust the oscilloscope vertical sensitivity so that the top of the waveform is at a convenient position on the graticule. Note this reference level.

(6) Select each IF bandwidth position in turn (except for those narrower than 1 kHz). In each case, the top of the oscilloscope waveform should remain approximately at the reference level noted in step (5).

(7) Decrease the signal generator output by 2 dB. Select the 0.5 kHz IF bandwidth position (if available) and observe the oscilloscope waveform. The top of the waveform should still be approximately at the reference level noted in step (5). Select the 0.2 kHz IF bandwidth position (if available). There should be no change in oscilloscope waveform height.

(8) Place the receiver in the AM detection mode and select the 2 kHz IF bandwidth position. Increase the signal generator RF output level to -110 dBm (the signal generator should still be unmodulated).

(9) Set the VTVM to its 5 V dc range. A reading of 2.00 ± .05 V dc should be obtained.

(10) Adjust the signal generator for a -101 dBm RF output level modulated 50% at a 400 Hz rate. The VTVM should indicate a voltage level of 0.75 V ac or greater.

(11) Set the VTVM to its 5 V ac range and increase the signal generator RF output level to -1 dBm. The voltage reading should be no more than double (6 dB greater) than the level noted in step (10).

(12) Reduce the signal generator RF output level to -80 dBm and select the widest available IF bandwidth position. The receiver front panel meter should indicate approximately 35 in the SIG STR position and between 0 and +1 in the LINE AUDIO position.

5.6.8 TIME BASE PERFORMANCE TESTS. - Time base circuits appear on the lower left of schematic diagram Figure 7-20. This schematic diagram is for the type 791109 1st LO/3rd LO/Time Base circuit board, A18. Either an internal temperature compensated crystal oscillator or an external 1 MHz reference input

input can provide a time base source for the receiver. This procedure tests both conditions. Proceed as follows:

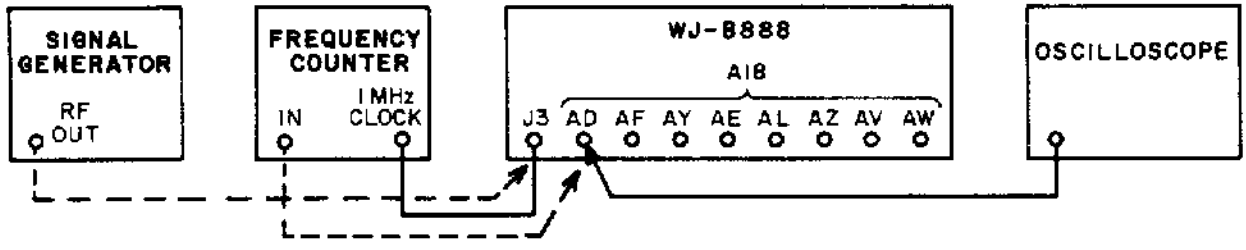


Figure 5-7. Test Setup, Time Base Stages

(1) Connect the oscilloscope as shown in Figure 5-7.

(2) Set the rear panel CLOCK switch to INT.

(3) Connect the oscilloscope probe to each of the outputs shown for A18 and verify that for each one, the waveform is either a square wave or pulse having an approximate 3.2 volt peak-to-peak amplitude.

(4) Connect the frequency counter input to the same eight outputs of A18 and ensure that the frequency is within ± 1 Hz of the following corresponding frequencies.

Output Pin (A18)	AD	AF	AY	AE	AL	AZ	AV	AW
Frequency (kHz)	1000	500	250	50	10	10	5	1

(5) Set the rear panel CLOCK switch to EXT.

(6) Connect the signal generator to receiver connector J3.

(7) Set the signal generator to 1.00 MHz, CW, at a level of 100 mV.

(8) Repeat step (3).

(9) Set the signal generator level to 225 mV.

(10) Repeat step 3.

(11) Set the CLOCK switch to INT. This completes the test.

5.6.9 SYNTHESIZERS OVERALL PERFORMANCE TESTS. - An improperly operating synthesizer usually causes one of two problems: Either the incoming RF signal is translated to an incorrect frequency, or spurious responses in the form of sidebands are introduced to the spectrum. The following two tests provide a reasonable assurance that the four synthesizers are operating correctly. For more exacting tests, refer to the individual performance tests and alignment procedures for each synthesizer in the following paragraphs.

Frequency Test. - Zero beating the receiver against a known-frequency station--such as WWV-- gives a fair indication of correct operating frequency. To do this, proceed as follows:

(1) Set the receiver controls as follows:

a.	POWER	ON
b.	RCVR CONTROL	LOCAL
c.	DETECTION MODE	CW FIXED
d.	GAIN MODE	MAN
e.	IF BANDWIDTH KHZ	0.5 (or less if available)
f.	METER	SIG STR.
g.	VAR BFO	0
h.	RF GAIN	as required
i.	LEVEL	as required

(2) Tune to a frequency-standard station and zero-beat the receiver.

(3) Frequency displayed on the digital readout should indicate the station frequency.

(4) An alternate procedure may also be used; however, it eliminates the receiver time base from the test. To use the alternate procedure, perform step (1). Then proceed to step (5).

(5) Connect a short "antenna" to the rear panel RF input, J5, and position it close to the 1 MHz reference jack, J3.

(6) Tune the receiver to a known harmonic of the time base and zero-beat the receiver.

(7) Frequency displayed on the digital readout should indicate the frequency of the 1 MHz signal harmonic. This completes the test.

Phase Noise Test. - If a perfectly stable CW signal were applied to the receiver, and if each of the synthesized oscillators use in translating the signal were perfectly stable, then a good representation of the received signal would be available for demodulation. However, if any one of the oscillators used in the translation process is less than perfectly stable, sidebands are generated, and they represent

false signals. One indication of these false signals being generated is a failure to meet the fm sensitivity tests. But do not automatically assume the synthesizers are at fault if FM tests cannot be met. Low gain in an IF stage, a defective FET in the input converter or problems in the discriminator circuit may also be at fault. To perform this test, proceed as follows:

(1) Perform the fm sensitivity tests given in paragraph 5.6.3., except use only the following conditions:

a. Use RF frequencies of 1 MHz and 29 MHz for the input.
b. Use IF bandwidths of 0.5 and 4 kHz.

5.6.10 1ST LO PERFORMANCE TEST. - This synthesizer tunes from 83.31 to 113.30 MHz in steps of 10 kHz. This procedure consists of a frequency test and an inspection of the VCO output by using a spectrum analyzer. To perform these tests, proceed as follows:

CAUTION

VCO assembly A15 must have a load on output jack J1 when the receiver is energized.

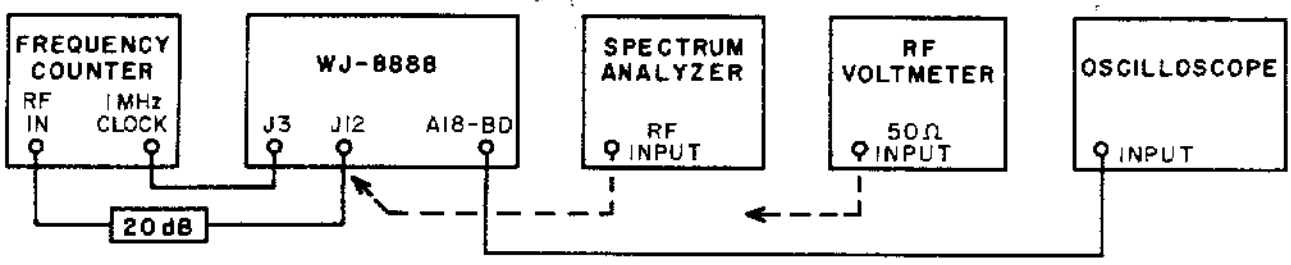


Figure 5-8. Test Setup, 1st LO Performance Test

(1) Be sure the receiver is turned off.

(2) Connect the frequency counter and oscilloscope as shown in Figure 5-8.

(3) Turn the receiver on and place it in the LOCAL mode.

(4) Tune the receiver to each of the frequencies listed in the Receiver columns and verify the corresponding VCO output frequency (± 1 Hz) in the VCO columns. Each time observe the oscilloscope for an unlock indication. This will appear as either a constant high state or as a pulsed condition, depending on the problem. Either the 1st LO or the 2nd LO becoming unlocked will give the unlock indi-

cation at A19A19. Therefore, to isolate the problem, monitor pin 6 of A18U3B for an actual 1st LO unlock indication.

Table 5-4. 1st LO Test Frequencies

RECEIVER MHz		VCO MHz	RECEIVER MHz		VCO MHz
10.000 00	--	92.810 000	10.600 00	--	93.410 000
10.010 00	--	92.820 000	10.700 00	--	93.510 000
10.020 00	--	92.830 000	10.800 00	--	93.610 000
10.030 00	--	92.840 000	10.900 00	--	93.710 000
10.040 00	--	92.850 000	11.000 00	--	93.810 000
10.050 00	--	92.850 000	12.000 00	--	94.810 000
10.060 00	--	92.870 000	13.000 00	--	95.810 000
10.070 00	--	92.880 000	14.000 00	--	96.810 000
10.080 00	--	92.890 000	15.000 00	--	97.810 000
10.090 00	--	92.900 000	16.000 00	--	98.810 000
10.100 00	--	92.910 000	17.000 00	--	99.810 000
10.200 00	--	93.010 000	18.000 00	--	100.810 000
10.300 00	--	93.110 000	19.000 00	--	101.810 000
10.400 00	--	93.210 000	20.000 00	--	102.810 000
10.500 00	--	93.310 000	30.000 00	--	112.810 000

(5) Turn the receiver off.

(6) Set the receiver rear panel clock switch to INT.

(7) Connect the spectrum analyzer in place of the frequency counter. Set the analyzer controls to the settings given in column A.

		A	B
a.	Bandwidth	0.03 kHz	0.3 kHz
b.	Scan Width	0.2 kHz/Div.	2.0 kHz/Div.
c.	Scan Time	2.0 Sec/Div.	1.0 Sec/Div.
d.	Video Filter	10.0 Hz	10.0 Hz

(8) Tune the receiver to 15 MHz and the analyzer to 97.81 MHz and verify a response like that shown in Figure 5-34.

(9) Set the analyzer controls to the conditions given in column B and verify a response like that shown in Figure 5-35. The 5 kHz spurious responses should be at least 55 dB down from the LO response.

(10) Turn the receiver off and connect the RF voltmeter in place of the spectrum analyzer. Do not energize the receiver until the VCO is loaded.

CAUTION

This VCO output exceeds +17 dBm (1.6 volts). Set the RF voltmeter range control up scale to prevent damaging the meter.

(11) Turn the receiver on and tune the receiver from 0.5 to 30 MHz while observing the RF voltmeter. At no time should the level drop below +17 dBm (1.6 volts). This completes the 1st LO performance test.

5.6.11 2ND LO PERFORMANCE TEST. - This synthesizer tunes from 72.100 00x to 72.109 99x MHz in 10 Hz steps. The procedure consists of a frequency test and an inspection of the VCO output with a spectrum analyzer.

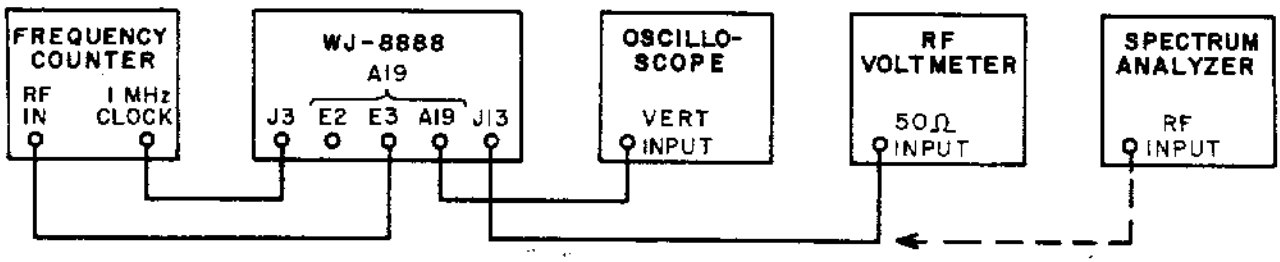


Figure 5-9. Test Setup, 2nd LO Performance Test

(1) Connect the equipment as shown by the solid lines in Figure 5-9.

(2) Set the RCVR CONTROL to the LOCAL mode and the rear panel CLOCK switch to EXT.

(3) Tune the receiver to each of the frequencies listed and verify the corresponding indication on the frequency counter. Each time observe the oscilloscope for an unlock indication. This will appear as either a constant high state or as a pulsed condition, depending on the problem. Either the 1st LO or the 2nd LO becoming unlocked will give the unlock indication at A19A19. Therefore, to isolate the problem, monitor pin 11 of A19U7D for an actual 2nd LO unlock indication.

(4) Connect the frequency counter to A19E2. The counter should indicate 36.000 00 MHz. (It may be necessary to connect a 6-dB attenuator at the counter input to make this measurement.)

Table 5-5. 2nd LO Test Frequencies

RECEIVER MHz		COUNTER kHz	RECEIVER MHz		COUNTER kHz
00.509 99	--	100.01	00.509 39	--	100.61
00.509 98	--	100.02	00.509 29	--	100.71
00.509 97	--	100.03	00.509 19	--	100.81
00.509 96	--	100.04	00.509 09	--	100.91
00.509 95	--	100.05	00.508 09	--	101.91
00.509 94	--	100.06	00.507 09	--	102.91
00.509 93	--	100.07	00.506 09	--	103.91
00.509 92	--	100.08	00.505 09	--	104.91
00.509 91	--	100.09	00.504 09	--	105.91
00.509 90	--	100.10	00.503 09	--	106.90
00.509 89	--	100.11	00.502 09	--	107.907
00.509 79	--	100.21	00.501 09	--	108.900
00.509 69	--	100.31	00.500 09	--	109.900
00.509 59	--	100.41	00.500 00	--	109.990
00.509 49	--	100.51			

(5) Tune the receiver slowly from 00.500 00 MHz to 00.509 99 MHz while observing the RF voltmeter. Output level should be greater than 50 mV. Level across the range should be flat to within 3 dB, total.

(6) Remove the RF voltmeter from J13 and in its place connect the RF input of the frequency counter.

(7) Tune the receiver to 00.500 00 MHz and verify a reading of 72.109 99 MHz on the frequency counter.

(8) Tune the receiver to 00.509 99 MHz and verify a reading of 72.100 00 MHz on the frequency counter.

(9) Set the receiver rear panel CLOCK switch to INT.

(10) Remove the frequency counter from J13 and connect the spectrum analyzer in its place.

(11) Set the analyzer controls for the settings given in column A.

		A	B
a.	Bandwidth	0.03 kHz	10.0 kHz
b.	Scan Width	0.2 kHz/Div.	0.1 MHz/Div.
c.	Scan Time	2.0 sec/Div.	1.0 sec/Div.
d.	Video Filter	10.0 Hz	10.0 Hz

(12) Refer to Figure 5-41 for a typical response.

(13) Set the spectrum analyzer controls to the settings given in column B of step (11). Refer to Figure 5-42 for a typical response.

5.6.12 3RD LO PERFORMANCE TEST. - This synthesized oscillator operates on a fixed frequency of 11.155 MHz ±1 Hz. Testing this LO consists of measuring the frequency and viewing the spectral purity. Proceed as follows:

(1) Remove circuit board (A3) from its socket and disconnect P10 from J17.

(2) Connect the equipment as shown in Figure 5-10.

(3) Set the rear panel clock switch to INT.

(4) Frequency shown on the counter must be 11.155 MHz ± 1 Hz.

(5) Connect the spectrum analyzer in place of the counter.

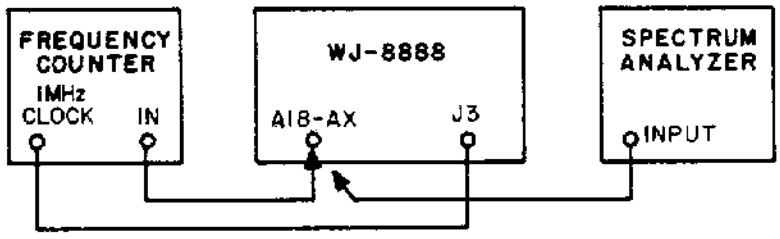


Figure 5-10. Test Setup, 3rd LO Performance Test

(6) Set the controls for the conditions given in column A. Verify that the output of the 3rd LO is greater than -16 dBm. Refer to Figure 5-44 for a typical response.

		A	B
a.	Bandwidth	0.03 kHz	0.3 kHz
b.	Scan Width	0.2 kHz/Div.	2.0 kHz/Div.
c.	Scan Time	2.0 sec/Div.	2.0 sec/Div.
d.	Video Filter	10.0 Hz	10.0 Hz

(7) Set the spectrum analyzer controls for the conditions listed in column B of step (6). Figure 5-45 shows a typical response for these conditions. This completes the 3rd LO performance test.

5.6.13 BFO PERFORMANCE TEST. - Thorough testing of the BFO requires digital external frequency control of the ÷N portion of the BFO synthesizer. Because most maintenance facilities will not have this capability, the frequency portion of the procedure tests only three points: They are center frequency and the two band edges. For a complete test, refer to the alignment procedure in paragraph 5.7.14. To perform this test, proceed as follows:

(1) Connect the equipment as shown in Figure 5-11.

(2) Set the receiver controls as follows: Controls not mentioned may be left in any position.

a.	POWER	ON
b.	RCVR CONTROL	LOCAL
c.	DETECTION MODE	CW FIXED

(3) The frequency counter should indicate 455.000 kHz.

(4) Put the DETECTION MODE in the CW VAR condition.

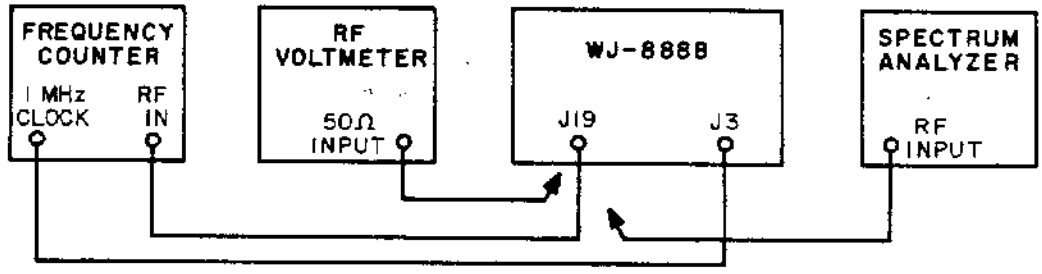


Figure 5-11. Test Setup, BFO Performance Test

(5) Rotate the VAR BFO control to obtain an indication of 445.000 kHz, 455.000 kHz and 465.000 kHz, each time verifying the corresponding binary input given below. Use a dc voltmeter to test for the high and low states at the listed pins on A19. At 455.000 MHz, the knob should point to the zero.

	Bit Weight	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	Input Pin (A19)	C11	C10	C9	C12	C15	C14	C13	C18	C21	C20	C19
BFO Freq.	445.000 kHz	0	0	0	0	0	0	1	1	0	0	0
	455.000 kHz	1	0	0	0	0	0	0	0	0	0	0
	465.000 kHz	1	1	1	1	1	1	0	1	0	0	0

(6) Connect the RF voltmeter to P14. Use a 50 Ω termination.

(7) Rotate the VAR BFO control in the range of 445.000 kHz to 465.000 kHz and verify an output level at all times greater than 70 mV.

(8) Remove the RF voltmeter from P14 and in its place connect the spectrum analyzer.

(9) Set the analyzer controls as follows:

a.	Bandwidth	0.01 kHz
b.	Scan Width	0.1 kHz/Div.
c.	Scan Time	2.0 kHz/Div.
d.	Video Filter	10.0 Hz

(10) Refer to Figure 5-48 for a typical response. This completes the BFO performance test.

5.7 ALIGNMENT AND ADJUSTMENT

5.7.1 GENERAL. -The following alignment and adjustment procedures should not be performed on a routine basis, but instead should be used as aids in troubleshooting and post-repair check-out. Before alignment is attempted, the technician should first perform the relevant performance tests to determine which sections of the receiver require realignment. The procedures may be used for testing and aligning new or repaired subassemblies received from the factory or depot before returning the receiver to service with the new subassemblies installed. If a complete realignment is required, the steps should be performed in the order presented in this procedure.

5.7.2 POWER SUPPLY VOLTAGE ADJUSTMENTS. - For the following adjustments, refer to Figures 7-29 and 7-30 for schematic illustrations. The parts list illustrations for the Type 76210-7 Power Supply (A26) and Type 76209 Switching Regulator (A27) are Figures 6-37 and 6-38, respectively.

(1) Connect the receiver to a known 115 V or 220 V ac power source, making sure that the line voltage selector switch (S2) is in its proper position.

(2) Place a digital voltmeter between A26 pin 13 and ground, and adjust A26R2 for a dc voltage reading of +15.00 ± 0.1 volts.

(3) Place the digital voltmeter between A26 pin 9 and ground, and adjust A26R5 for a dc voltage reading of -15.00 ± 0.1 volts.

(4) Place the digital voltmeter between A27 pin 21 and ground, and adjust A27R7 for a dc voltage reading of +5.08 ± .04 volts.

(5) Recheck the voltages to ensure that there is no appreciable interaction among the adjustments.

5.7.3 POWER DOWN ADJUSTMENT. - Refer to Figure 7-21 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 791117 2nd LO/BFO board (A19) is Figure 6-29.

(1) Set the lamp intensity control (A21R25) for maximum lamp brilliance (the control may be reset for the desired lamp intensity at the end of this adjustment).

Steps (2) through (7) describe the POWER DOWN adjustment procedure for a receiver set for 115 V ac operation.

(2) Connect the receiver to a 115 V ac 48-62 Hz power source through a metered variable transformer. Adjust the transformer for a 115 V ac output, energize the receiver, and place it in the LOCAL control mode.

(3) Set A19R6 to its midrange position.

(4) Set A19R4 fully clockwise.

(5) Reduce the ac voltage input to the receiver to 94 V ac. A POWER DOWN condition should not occur (a POWER DOWN condition is indicated by the receiver switching to the REMOTE control mode). If a POWER DOWN condition does occur, reset the ac voltage input to 115 V ac, place the receiver in the LOCAL control mode, and rotate A19R6 slightly counterclockwise. Repeat this step until the ac voltage input can be reduced to 94 V ac without the receiver "dropping out" into the POWER DOWN condition.

(6) Slowly rotate A19R4 counterclockwise until the receiver "drops out" into the POWER DOWN condition.

(7) Slowly increase the ac voltage input while rapidly depressing the LOCAL pushbutton. Note the ac voltage level at the instant the receiver "pulls in" (switches to and remains in the LOCAL control mode). This level should be between 99 and 101 V ac. If the "pull in" voltage level is less than 99 V ac, rotate A19R6 slightly counterclockwise and repeat steps (4) through (7). If the "pull in" voltage level is greater than 101 V ac, rotate A19R6 slightly clockwise and repeat steps (4) through (7).

Steps (8) through (13) describe the POWER DOWN adjustment for a receiver set for 220 V ac operation.

(8) Connect the receiver to a 220 V ac 48-62 Hz power source through a metered variable transformer. Adjust the transformer for a 220 V ac output, energize the receiver, and place it in the LOCAL control mode.

(9) Set A19R6 to its midrange position.

(10) Set A19R4 fully clockwise.

(11) Reduce the ac voltage input to the receiver to 180 V ac. A POWER DOWN condition should not occur (a POWER DOWN condition is indicated by the receiver switching to the REMOTE control mode). If a POWER DOWN condition does occur, reset the ac voltage input to 220 V ac, place the receiver in the LOCAL control mode, and rotate A19R6 slightly counterclockwise. Repeat this step until the ac voltage input can be reduced to 180 V ac without the receiver "dropping out" into the POWER DOWN condition.

(12) Slowly rotate A19R4 counter-clockwise until the receiver "drops out" into the POWER DOWN condition.

(13) Slowly increase the ac voltage input while rapidly depressing the LOCAL pushbutton. Note the ac voltage level at the instant the receiver "pulls in" (switches to and remains in the LOCAL control mode). This level should be between 189 and 193 V ac. If the "pull in" voltage is less than 189 V ac, rotate A19R6 slightly counterclockwise and repeat steps (10) through (13). If the "pull in" voltage level is greater than 193 V ac, rotate A19R6 slightly clockwise and repeat steps (10) through (13).

5.7.4 TUNING CIRCUITRY ALIGNMENT. Refer to Figure 7-24 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 791134 Front Panel Register (A22) is Figure 6-33.

(1) Set A22R17 fully counter-clockwise.

(2) Slowly rotating the tuning wheel, monitor the frequency indicated on the 7-digit display and adjust A22R17 slowly clockwise to the point where the displayed frequency changes smoothly with the rotation of the tuning wheel. If A22R17 is set too far counter-clockwise, the frequency will not change when the tuning wheel is rotated. However, if A22R17 is set too far clockwise, the frequency will change even if the tuning wheel is not rotated. When A22R17 is properly set, the numerals on the display should advance uniformly without skipping digits.

(3) Set A22R18 fully counter-clockwise.

(4) Rotating the tuning wheel at a fast rate (approximately 6 revolutions per second) adjust A22R18 clockwise to the point where the digits on the display suddenly begin changing very rapidly. Spin the tuning wheel and verify that the 10 MHz and 1 MHz digits count in the correct sequence and do not skip digits.

(5) Tune across the receiver frequency range to verify that all the digits on the display read from 0 to 9, except for the 10 MHz digit, which should read from 0 to 3.

(6) Verify that the display changes from 30.49999 to 0.50000 while increasing the frequency and from 0.50000 to 30.49999 while decreasing the frequency.

5.7.5 INPUT CONVERTER ALIGNMENT. - In the following procedure, the receiver should be in the MAN gain mode with the RF GAIN control fully clockwise. For those steps requiring high impedance detectors, use the detectors shown in Figures 5-2 and 5-3. Do not mount these detectors in metal boxes. Refer to Figures 7-6 and 7-7 for schematic illustrations when performing the adjustments in this paragraph. The parts list illustrations for the Type 791166 Input Converter are Figures 6-11 and 6-15.

5.7.5.1 First LO Test. -

(1) Carefully unsolder the lead connecting A2A3E4 to A2R42 and A2U1 pin 1.

(2) Connect the equipment as shown in Figure 5-12.

(3) Set the signal generator for a +20 dBm 81 MHz unmodulated RF output.

(4) Set the attenuator for 10 dB of attenuation.

(5) The RF voltmeter reading should be at least +20 dBm. Slowly tune the signal generator from 81 MHz to 113 MHz, maintaining a constant +20 dBm output. The RF voltmeter should indicate an output of at least +20 dBm at all frequencies between 81 MHz and 113 MHz.

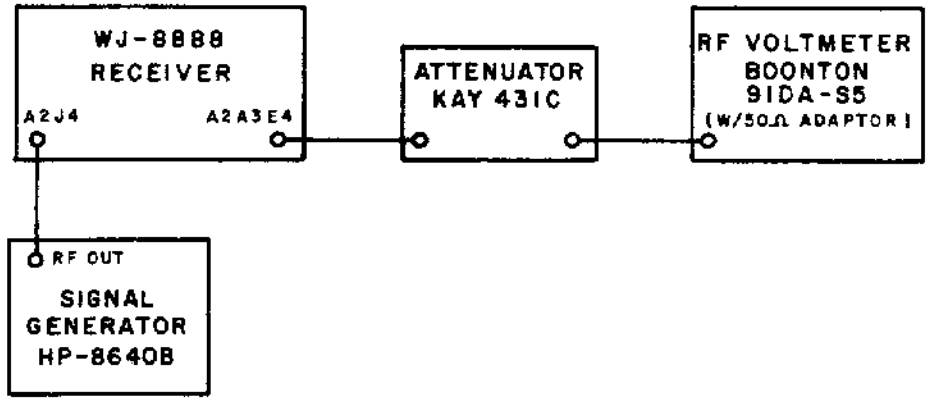


Figure 5-12. Test Setup, 1st LO Amplifier Test

(6) Disconnect the test equipment and resolder the lead connecting A2A3E4 to A2R42 and A2U1 pin 1.

5.7.5.2 Second LO Alignment. -

(1) Disconnect the lead from A2C68 to A2U2 pin 1.

(2) Connect the equipment as shown in Figure 5-13.

(3) Set the signal generator for a -10 dBm 72.105 MHz (± 2 kHz) unmodulated RF output.

(4) Adjust L6, L7, L24, and L26 for a peak reading on the RF voltmeter.

(5) Reconfigure the equipment as shown in Figure 5-14, leaving the RF voltmeter connected to C68. The RF end of the high impedance detector is placed at the junction of A2C55 and A2R29. Use the high frequency high impedance detector shown in Figure 5-2.

(6) Set the sweep generator for a -10 dBm 72.105 MHz (± 2 kHz) output and adjust the sweep generator and oscilloscope controls for an undistorted response.

(7) Tune the marker signal generator to 72.105 MHz (± 2 kHz).

(8) Readjust L6 and L7 for a maximum amplitude symmetrical response about the 72.105 MHz marker.

(9) Reconfigure the equipment as shown in Figure 5-13.

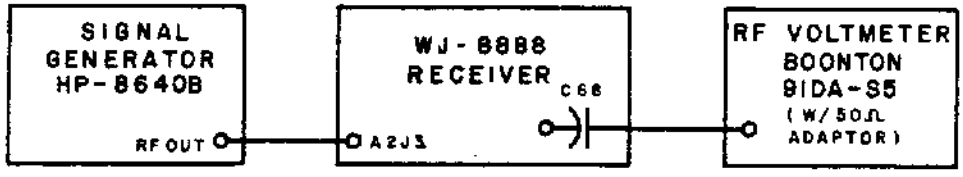


Figure 5-13. Test Setup, Second LO Alignment

(10) Vary the signal generator RF output level from -10 dBm to -13 dBm and verify that the output level as indicated on the RF voltmeter stays in the range of +20 dBm to +17 dBm.

(11) Disconnect the test equipment and resolder A2C68 to A2U2 pin 1.

FIGURE 5-14
FIGURE 5-15

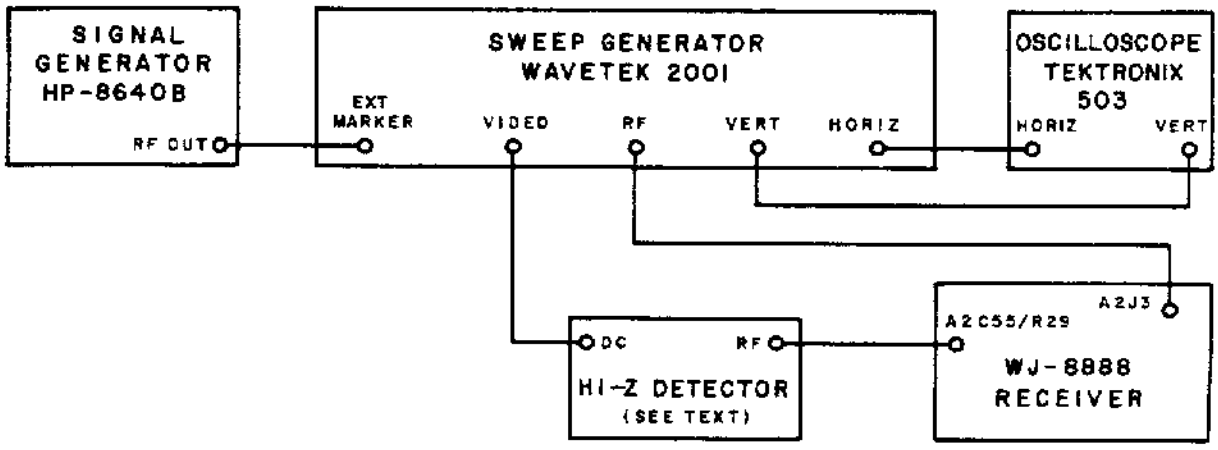


Figure 5-14. Test Setup, Second LO Alignment

5.7.5.3 RF/IF Alignment. -

(1) Rotate A2A1R16 fully counterclockwise and A2A1R6 fully clockwise.

(2) Connect the equipment as shown in Figure 5-15. The RF end of the high impedance probe is placed at the junction of A2L12 and A2C26. Use the high frequency high impedance detector shown in Figure 5-2.

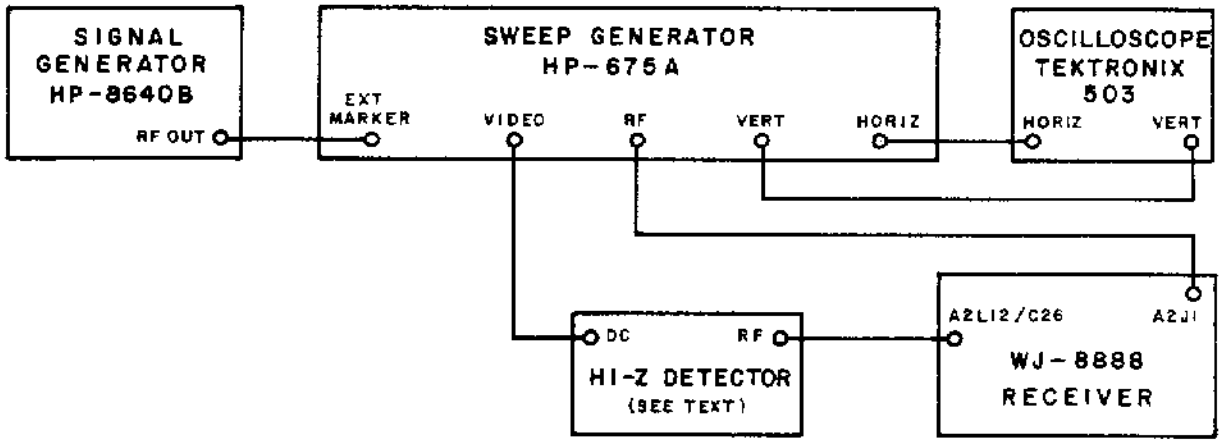


Figure 5-15. Test Setup, RF/IF Alignment

(3) Tune the receiver, sweep generator, and marker signal generator to 20 MHz. Set the sweep generator output level to -20 dBm.

(4) Adjust the sweep generator and oscilloscope controls for an undistorted response.

(5) Adjust C23 and C24 for a maximum amplitude symmetrical response about the 20 MHz marker similar to Figure 5-17 (for clarity, the marker is not shown on the photograph).

(6) Remove the high impedance detector from A2L12/C26 and place it instead at the junction of A2T3 and A2C40.

(7) Adjust A2C31 and A2C39 for a maximum amplitude response.

(8) Connect the equipment as shown in Figure 5-16.

(9) Set the sweep generator for a -20 dBm 82.805 MHz RF output. Tune the marker signal generator to 82.805 MHz (± 2 kHz).

(10) Adjust the sweep generator and oscilloscope controls for an undistorted response.

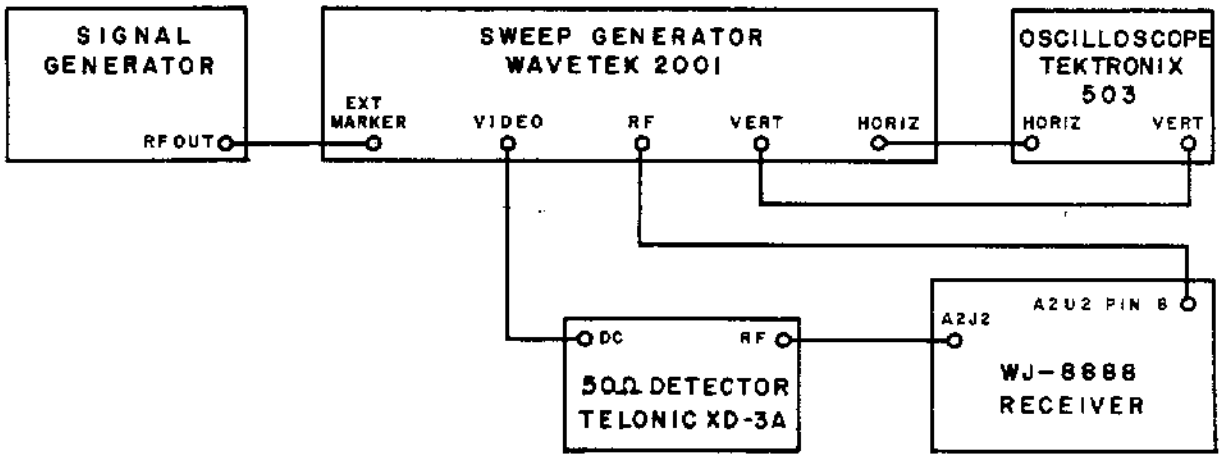


Figure 5-16. Test Setup, RF/IF Alignment

(11) Adjust A2L19 and A2L20 for a maximum amplitude symmetrical response about the marker similar to Figure 5-18 (for clarity, the marker is not shown on the photograph).

(12) Disconnect the test equipment.

5.7.5.4 Input Converter Gain Test. -

(1) Connect the equipment joined by the solid lines as shown in Figure 5-19.

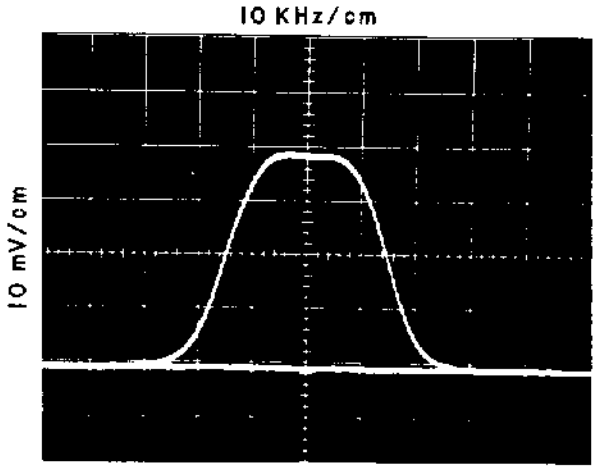


Figure 5-17 . Typical A2FL1 Response

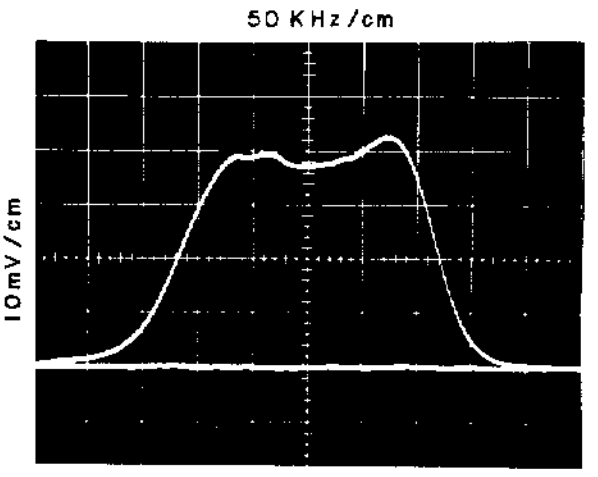


Figure 5-18. Typical A2A2FL1 Response

(2) Check that A2A1R6 is fully clockwise and A2A1R16 is fully counterclockwise.

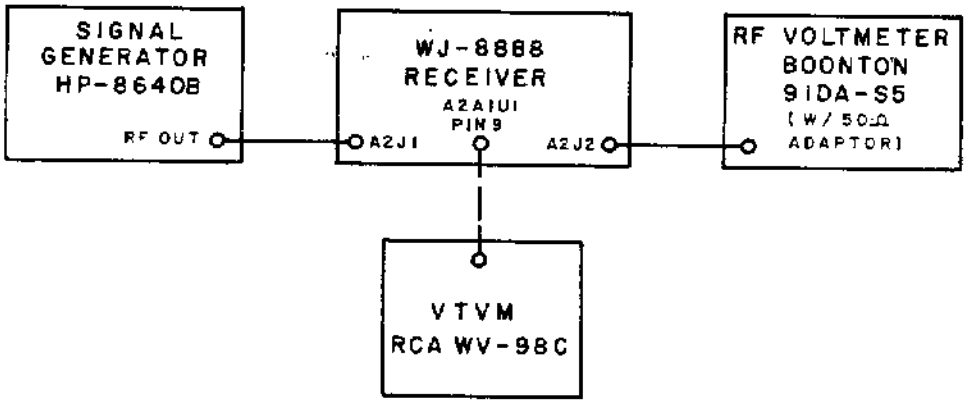


Figure 5-19. Test Setup, Overall Final Gain Test

(3) Set the signal generator for a -40 dBm 0.5 MHz unmodulated RF output. Tune the receiver to 0.5 MHz.

(4) Observe the reading on the RF voltmeter. It should be -35 dBm ± 1 dB (the overall gain from J1 to J2 should be 5 dB ± 1 dB).

(5) Rotate A1R6 fully counterclockwise and increase the signal generator RF output level to 0 dBm.

(6) Observe the reading on the RF voltmeter. It should be -40 dBm or less (the overall attenuation from J1 to J2 should be in excess of 40 dB).

(7) Repeat steps (2) through (4) for a signal generator and receiver frequency of 30 MHz.

(8) Disconnect the signal generator and set the VTVM to its 15 V dc range. Connect it to A2A1U1 pin 9 as shown by the dotted line in Figure 5-19.

(9) Adjust A2A1R6 for a VTVM reading of +6.2 V dc.

5.7.6 10.7/455 CONVERTER ALIGNMENT. - Refer to Figure 7-8 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 791198 10.7/455 Converter is Figure 6-16.

(1) Connect the equipment as shown in Figure 5-20. Do not use the 50 ohm adaptor with the RF voltmeter; connect the probe of the RF voltmeter instead directly to the junction of A3R27 and A3R28.

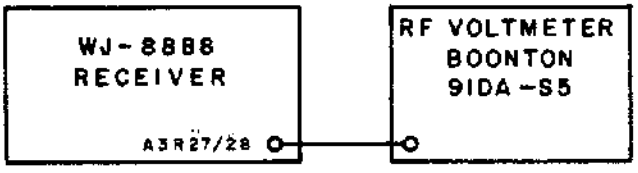


Figure 5-20. Test Setup, Third LO Amplifier Alignment

(2) Set the RF voltmeter to a scale that gives a convenient indication of the LO level and adjust L12 and C29 (in that order) for a maximum amplitude response.

(3) After removing ac power from the receiver, remove the IF filter boards (A4 and A6), disconnect P9 from J16 (located on the underside of the receiver main chassis adjacent to the socket for A3), and reconfigure the equipment as shown in Figure 5-21, using the low frequency high impedance detector shown in Figure 5-3.

(4) Set the sweep generator for a -30 dBm 10.7 MHz RF output.

(5) Tune the marker signal generator to 10.7 MHz ± 2 kHz. Adjust the sweep generator and oscilloscope controls for an undistorted response.

(6) Adjust L3 and L4 for a maximum amplitude symmetrical response about the marker similar to Figure 5-22 (for clarity, the marker has been deleted on the photograph).

FIGURE 5-21
FIGURE 5-22

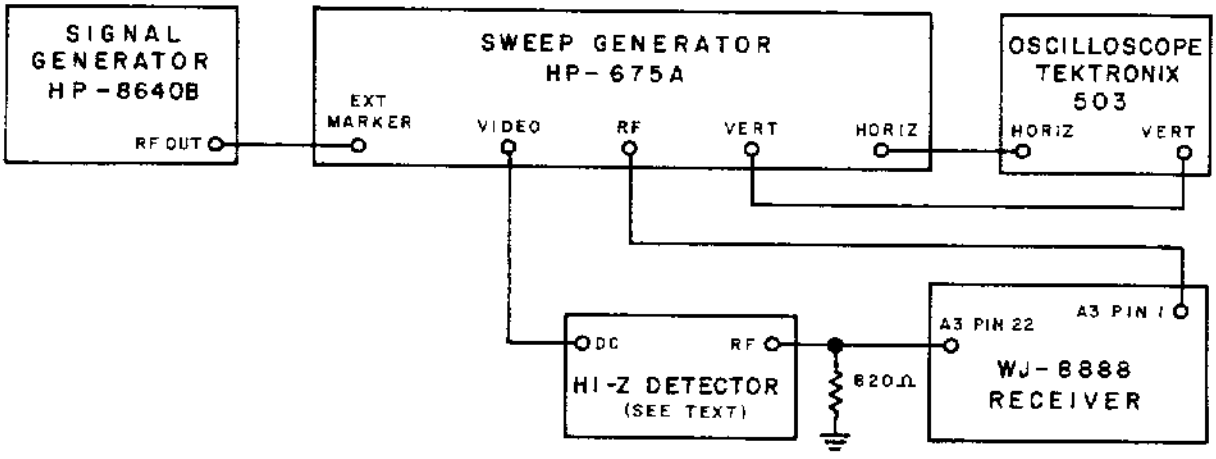


Figure 5-21. Test Setup, 10.7/455 Converter Alignment

(7) Turn off the receiver, replace the filter boards (A4 and A6), and reconnect P9 to J16.

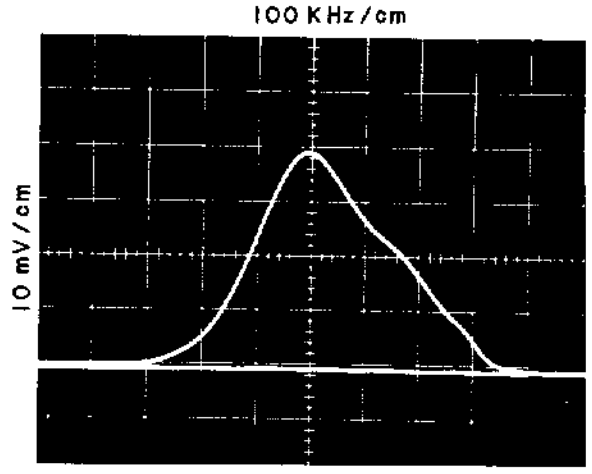


Figure 5-22. 10.7/455 Converter Overall Response

5.7.7 455 kHz IF AMPLIFIER ALIGNMENT. - Refer to Figure 7-11 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 72409 455 kHz IF Amplifier is Figure 6-19.

(1) Place the receiver in the MAN gain mode and the narrowest available IF bandwidth position. Rotate the RF GAIN potentiometer fully clockwise.

(2) Connect the equipment as shown in Figure 5-23, using the low frequency high impedance detector shown in Figure 5-3.

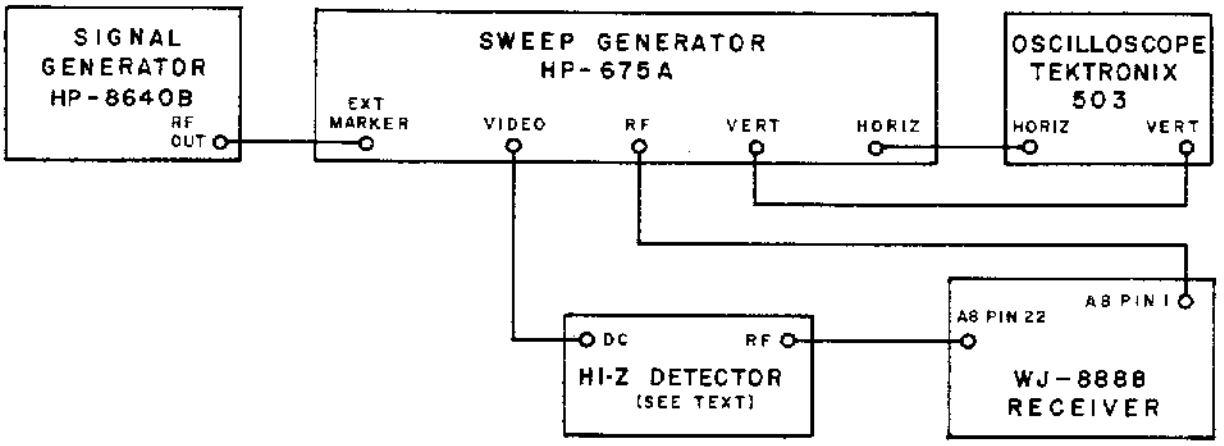


Figure 5-23. Test Setup, 455 kHz IF Alignment

(3) Set the sweep generator for a -70 dBm 455 kHz unmodulated RF output.

(4) Set the marker signal generator to within ± 0.1 kHz of 455 kHz.

(5) Adjust the sweep generator and oscilloscope controls for an undistorted response.

(6) Adjust L3 and L4 for a maximum amplitude symmetrical response about the marker similar to Figure 5-24 (for clarity, the marker has been deleted on the photograph).

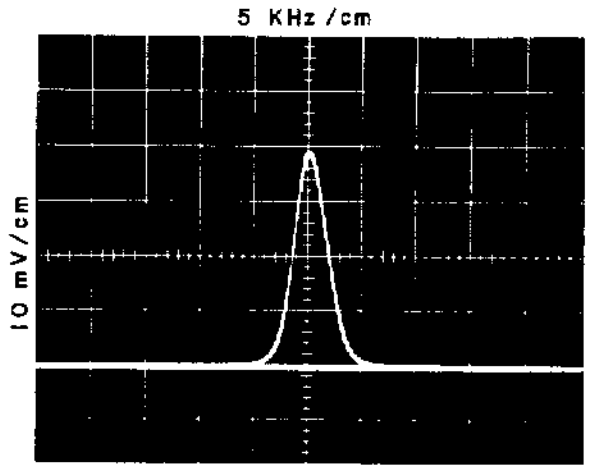


Figure 5-24. Typical Response, 455 kHz Amplifier (Narrow Band)

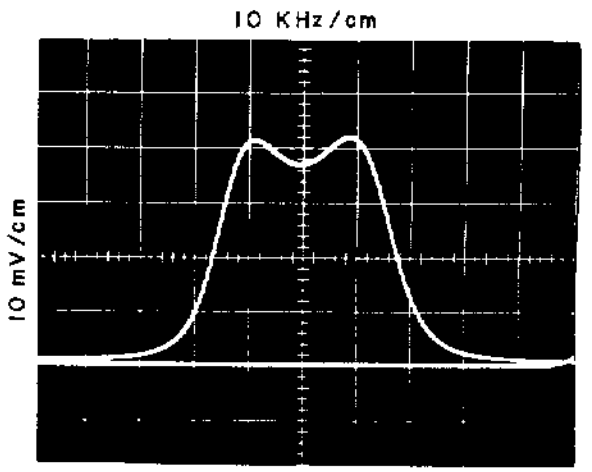


Figure 5-25. Typical Response, 455 kHz Amplifier (Wide Band)

(7) Place the receiver in the widest available IF bandwidth position and increase the sweep width of the sweep generator as necessary to secure a good response. Adjust L5 and L6 for a maximum amplitude symmetrical response about the marker similar to Figure 5-25 (the marker has been deleted for clarity).

5.7.8 IF GAIN ADJUSTMENTS. - Refer to Figure 7-9 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 72399-1 IF Filter Assembly is Figure 5-17.

(1) Repeat steps (1) through (4) of paragraph 5.6.10.

(2) Rotate A4R12, A4R28, A4R43, A6R12, A6R28, and A6R43 fully clockwise. Select in turn all the available IF bandwidth positions, observing the respective signal amplitudes on the oscilloscope. When in the 0.5 kHz and 0.2 kHz (if provided) IF bandwidth positions, reduce the signal generator output by 2 dB for this comparison. Determine which IF bandwidth position provides the smallest oscilloscope indication, and note the level of this indication.

(3) A4R12, A4R28, A4R43, A6R12, A6R28, and A6R43 adjust the respective IF filter gains for IF bandwidth positions one through six (counting the front panel selection buttons from left to right). Adjust the appropriate potentiometer for each available IF bandwidth position so that the correspondong oscilloscope level is the same as the level noted at the end of step (2). Be sure to reduce the signal generator RF output level by 2 dB when adjusting the gain potentiometer for the 0.5 kHz and 0.2 kHz IF bandwidth positions.

(4) As a result of the above adjustments, the IF filter gains should be equal and as high as possible (subject to the limitation imposed by the requirement for gain equality) with the exception of the 0.5 kHz and 0.2 kHz IF bandwidth positions, which should have 2 dB more gain than the other IF bandwidth positions.

(5) Place the receiver in the AM detection mode and the 2 kHz IF bandwidth position. Increase the signal generator RF output level to -110 dBm.

(6) Set the VTVM to its 5 V dc range and connect it to the AM MONITOR jack (J7) on the rear panel of the receiver. Adjust A8R16 for a VTVM reading of 2.0 V dc.

(7) Place the receiver in the NORM AGC gain mode and increase the signal generator output level to +5 dBm. Modulate the RF output 50% at a 400 Hz rate.

(8) Adjust A14R74 for minimum distortion of the 400 Hz sine wave as viewed on the oscilloscope.

5.7.9 FM DISCRIMINATOR ALIGNMENT. - Refer to Figure 7-13 for schematic illustration when performing the adjustments in this paragraph. The parts list illustration for the Type 791162 FM Demodulator is Figure 6-21.

(1) Making sure the ac power is off, remove the AM demodulator board (A9).

(2) Connect the equipment as shown in Figure 5-26 and reapply the ac power.

(3) Set the marker signal generator for a 455 kHz (± 0.4 kHz) RF output.

(4) Set the sweep generator for a 455 kHz -65 dBm RF output and adjust the sweep generator and oscilloscope controls for an undistorted response.

(5) Disconnect the sweep generator RF output cable to establish the sweep baseline on the oscilloscope (if it is not already visible). Use the oscilloscope vertical position control to place the baseline on the x-axis. Reconnect the cable.

(6) Adjust L2 so that the marker is on the x-axis.

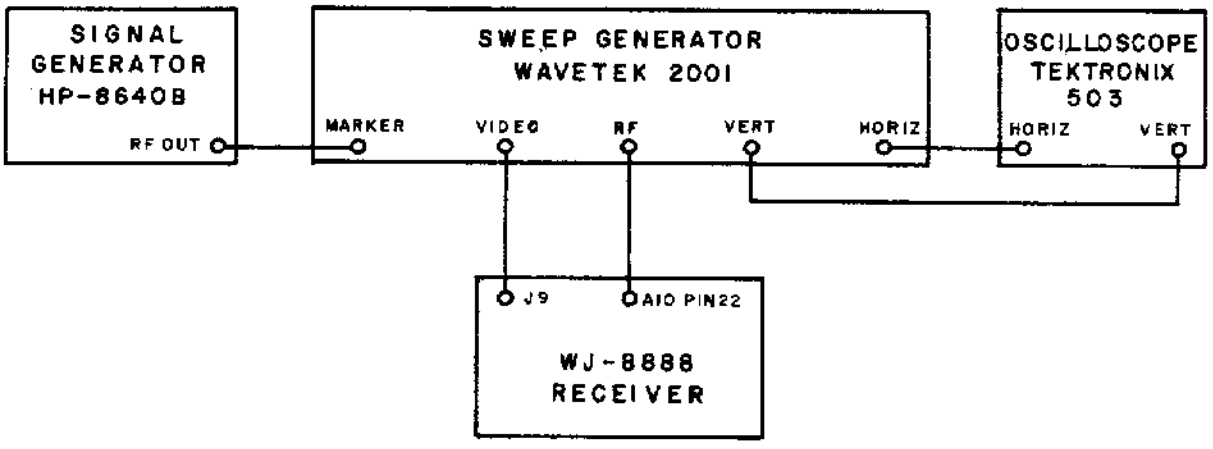


Figure 5-26. Test Setup, FM Discriminator Alignment

(7) Adjust T1 for a symmetrical response about the marker.

(8) If the adjustment of T1 moves the marker away from the x-axis, repeat steps (5) and (6) as many times as are required until a symmetrical response with the marker on the x-axis similar to Figure 5-27 is obtained (for clarity, the marker has been deleted). Verify that the discriminator zero crossing is 455.0 kHz, ± 0.4 kHz.

FIGURE 5-27
FIGURE 5-28

(9) Replace the AM demodulator board (A9) after turning off the receiver.

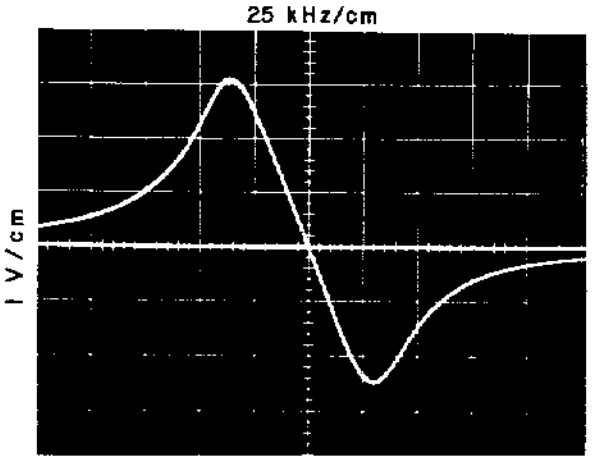


Figure 5-27. Typical Response, FM Discriminator

5.7.10 LSB/USB/CW DEMODULATOR ADJUSTMENT. - Refer to Figure 7-14 for schematic illustration when making the adjustments in this paragraph. The parts list illustration for the Type 791180-(X) LSB/USB/CW Demodulator is Figure 6-22.

(1) Connect the equipment as shown in Figure 5-28. The voltmeter should be connected to pins 1 and 2 of multipin jack J10, and set to its 1.5 V ac range.

(2) Set the signal generator for a -112 dBm 30 MHz unmodulated RF output.

(3) Place the receiver in the ISB detection mode and the MAN gain mode. Rotate the RF GAIN control fully clockwise.

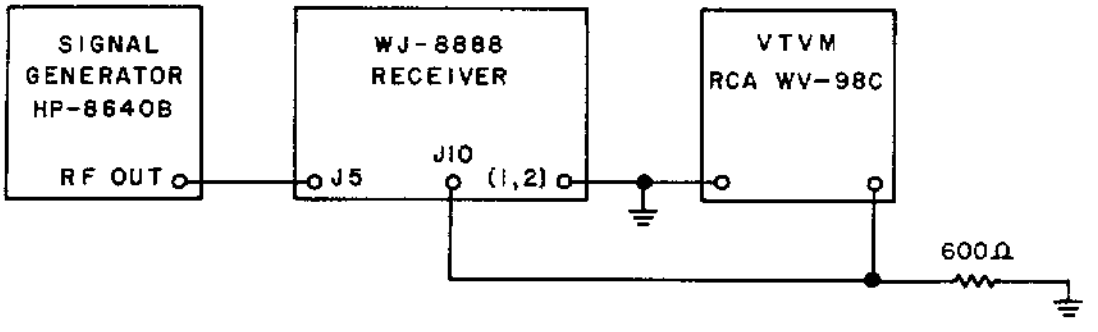


Figure 5-28. Test Setup, LSB/USB/CW Demodulator Adjustments

(4) Using a set of headphones as an audio monitor, tune the receiver to the signal generator frequency. Adjust the receiver frequency so that a tone of approximately 1 kHz is heard.

(5) Adjust A11R14 for a voltmeter reading of 0.80 V ac. If this reading cannot be obtained, rotate A11R39 counterclockwise until the meter reads 0.80 V ac.

(6) Increase the signal generator RF output level to -92 dBm and note the voltmeter indication. It should not exceed 1.6 V ac (that is, the reading should not increase by more than 6 dB). If the reading exceeds 1.6 V ac, rotate A11R39 slightly clockwise, reset the signal generator for a -112 dBm RF output, and repeat steps (5) and (6).

(7) Referring to Figure 5-28, remove the ac voltmeter probes from pins 1 and 2 of J10 and place them instead in pins 3 and 4. Repeat steps (4) through (6), making the adjustments on board A12 (LSB demodulator) instead of A11 (USB/CW demodulator).

5.7.11 1ST LO ALIGNMENT. - The 1st LO consists of the type number 791271 Voltage Controlled Oscillator (A15) and digital/analog circuits located on the type 791109 1st LO/3rd LO/Time Base circuit board (A18). Figure 7-17 and 7-20 are the schematic diagrams for these circuits. Location of components appear in Figure 6-25, 6-26, and 6-29. To align the 1st LO, proceed as follows:

CAUTION

VCO assembly A15 must have a load on output jack J1 when the receiver is energized. Also, this is a high level output (1.6 volts, minimum), so set the RF voltmeter to the appropriate scale before energizing the equipment.

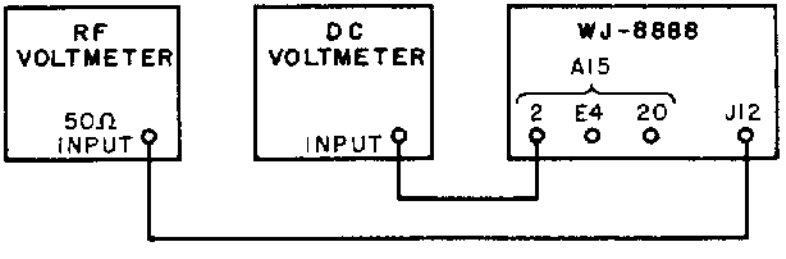


Figure 5-29. Test Setup, 1st LO Alignment

(1) Turn the receiver off.

(2) Connect the equipment as shown in Figure 5-29.

(3) Turn the receiver on and put the RCVR CONTROL in the LOCAL mode.

(4) Tune the receiver to 00.500 00 MHz.

(5) The voltage at pin 2 of A15 should be approximately +9.7 V dc.

(6) Observe the RF voltmeter while tuning slowly to 30.000 00 MHz. The LO output level should be +17 dBm (1.6 V) or greater throughout the range.

(7) With the receiver at 30.000 00 MHz, the voltage at pin 2 of A15 should be approximately -9.7 V dc.

(8) If the +9.7 volt and -9.7 volt specifications cannot be met, adjust the turns spacing of A15A1L1 and repeat steps 4 through 8 until the two conditions are met.

(9) If the output level specification cannot be met, continue to step (10) to help in isolating the problem There is no level adjustment for this output.

(10) Turn the receiver off.

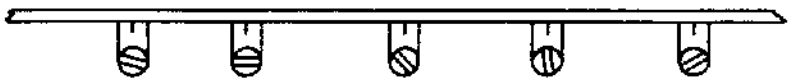
(11) Disconnect the RF voltmeter from J12. Reconnect receiver plug P5 to J12.

(12) Connect a troubleshooting type probe tip to the RF voltmeter cable and measure the RF output level at A15 pin 20. Through the range of 00.500 00 MHz to 30.000 00 MHz, this level should be -10 dBm (70 mV) or greater.

(13) If steps (6) and (12) both cannot be met, troubleshoot stages ahead of power splitter A15A1U1.

(14) If only one of those two steps cannot be met, troubleshoot the appropriate stages following the power splitter, A15A1U1. Or, for the low level output at pin 20, adjustment can be made by changing the value of resistor R41.

(15) Do not make the following prealignment adjustments on A18 unless the LO is known to be completely misaligned. Only then, rotate the following potentiometers to the positions indicated and then rotate back the number of degrees listed. Except for R8, the potentiometers are grouped as shown in the figure.



NOTE: SLOT POSITIONS DO NOT NECESSARILY REFLECT DEGREE OF ROTATION.

Potentiometer (A18) Rotate to:	R16 mid-range	R21 fully cw	R22 fully cw	R15 mid-range	R24 fully ccw	R8 mid-range
Then rotate:	0°	45° ccw	45° ccw	0°	90° ccw	0°

Figure 5-30. 1st LO Prealignment Adjustments

NOTE

Steps (16) through (19) require computer control of the receiver for stepping tuned frequency between 7 and 24 MHz at a 30 mS rate. If this capability is not available leave potentiometers R21, R22, and R24 of board (A18) at the positions given in Figure 5-30 and proceed to step (20). This will provide a near optimum step response characteristic.

(16) Connect the equipment as shown in Figure 5-31.

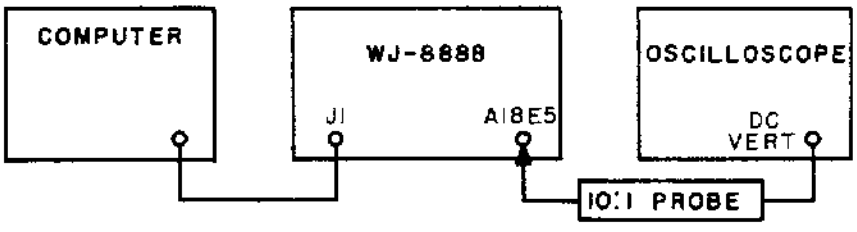


Figure 5-31. Test Setup, 1st LO Step Frequency Response

(17) Set the receiver controls as follows:

a. POWER ON
b. RCVR CONTROL REMOTE

(18) Set the oscilloscope controls for a sweep time of 5 mS/cm and for a 0.5 V/cm dc vertical input. Use a 10:1 probe.

FIGURE 5-32
FIGURE 5-33

(19) Refer to Figure 5-32, and if required, make slight adjustments to R21, R22, and R24 to make the oscilloscope response like that shown in the figure.

(20) Turn the receiver off before changing the test setup in the next step. This will prevent damage to the VCO output stage.

(21) Connect the equipment as shown in Figure 5-33.

(22) Set the RCVR CONTROL to the LOCAL mode and the rear panel CLOCK switch to EXT.

(23) Refer to Table 5-4 on page 5-15. Tune the receiver to each of the receiver frequencies listed and verify the corresponding frequency counter reading ± 1 Hz in the VCO columns.

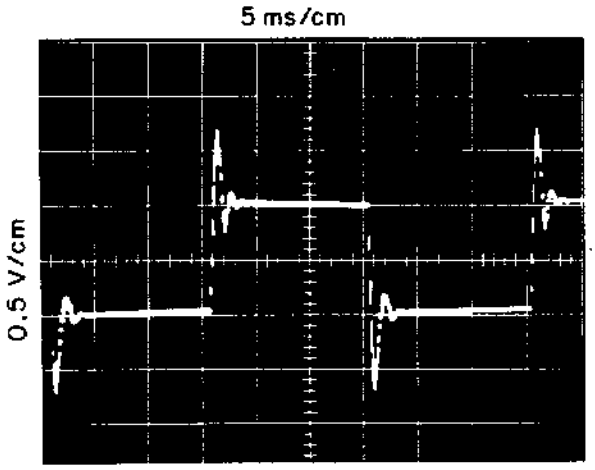


Figure 5-32. Typical Response, 1st LO Step Voltage

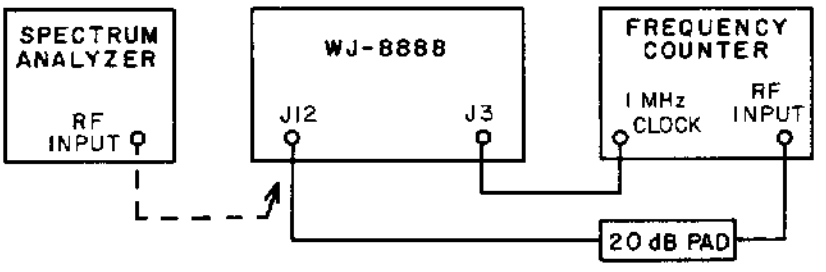


Figure 5-33. Test Setup, 1st LO Alignment

(24) Turn the receiver off before changing the test setup in the next step.

(25) Connect the spectrum analyzer directly to VCO output J12. Remove the frequency counter from the test setup.

(26) Set the spectrum analyzer controls to the conditions given in column A.

		A	B
a.	Bandwidth	0.03 kHz	0.3 kHz
b.	Scan Width	0.2 kHz	2.0 kHz/Div.
c.	Scan Time	2.0 sec/Div.	2.0 sec/Div.
d.	Video Filter	10.0 Hz	10.0 Hz

(27) Set the receiver rear panel CLOCK switch to INT and turn the unit on.

(28) Refer to Figure 5-34 for a typical response.

(29) Set the spectrum analyzer controls to the conditions given in column B of step (26).

(30) Refer to Figure 5-35 for a typical response. The 5 kHz spurious responses should be down at least -55 dB. Make very slight adjustments to R15 to improve the response. This completes the 1st LO alignment.

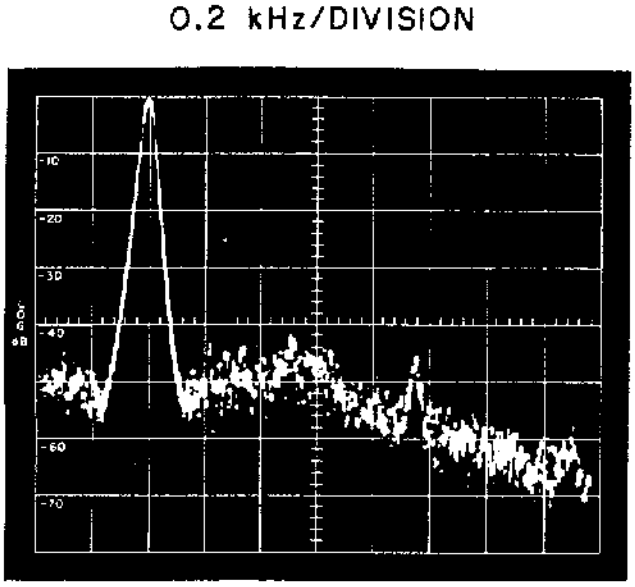


Figure 5-34. Typical Response, 1st LO Narrow Band Spurious Products

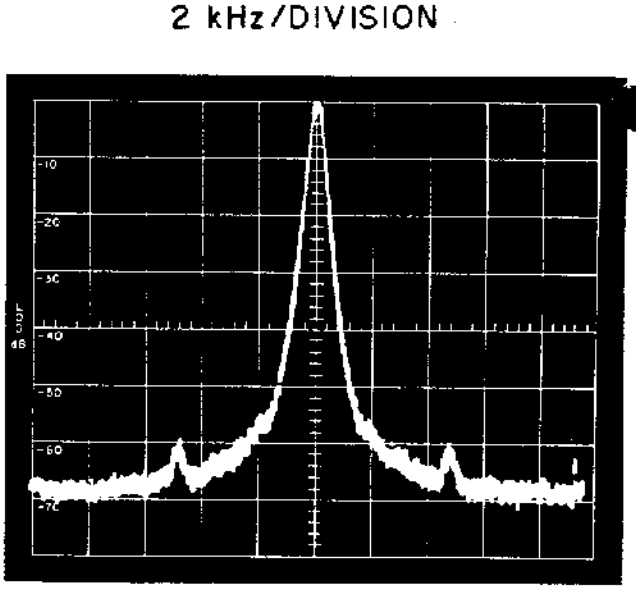


Figure 5-35. Typical Response, 1st LO Wide Band Spurious Products

5.7.12 2ND LO ALIGNMENT. - This synthesized oscillator tunes from 72.100 00x MHz to 72.109 99x MHz. This 10 kHz range is tuned down frequency in 10 Hz steps for increasing frequency of the receiver tuning range. Refer to the functional descriptions in paragraph 4.3.1 for a more detailed explanation of the tuning procedure. The 2nd LO is a part of the type 791117 2nd LO/BFO circuit board, A19. Figure 7-21 is the schematic diagram. Location of components appear in Figure 6-30. To perform the alignment, proceed as follows:

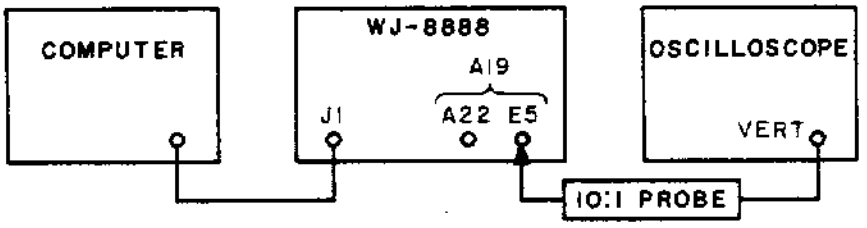


Figure 5-36. Test Setup, 2nd LO Alignment

(1) Connect the equipment as shown in Figure 5-36. Set the RCVR CONTROL to the REMOTE mode. Program the computer to step back and forth between 00.503 00 MHz and 00.506 99 MHz at a 30 mS rate.

(2) Measure the voltage at pin A22 of circuit board A19. The voltage should be about +5.3 V dc and stable.

NOTE

Steps (3) through (5) require computer control of the receiver for stepping the 2nd LO between two frequency extremes at a 30 mS rate. If this capability does not exist, continue to step (6).

(3) Program the computer to step the receiver back and forth between 00.503 00 MHz and 00.506 99 MHz at a 30 mS rate.

(4) If L16 has been replaced, adjust the turns spacing so they are evenly distributed.

(5) Adjust R56 and C29 for a square wave response on the oscilloscope. Figgure 5-37 shows a typical response having excessive ringing. The ringing may not be present on LO s that are close to proper alignment.

FIGURE 5-37
FIGURE 5-38

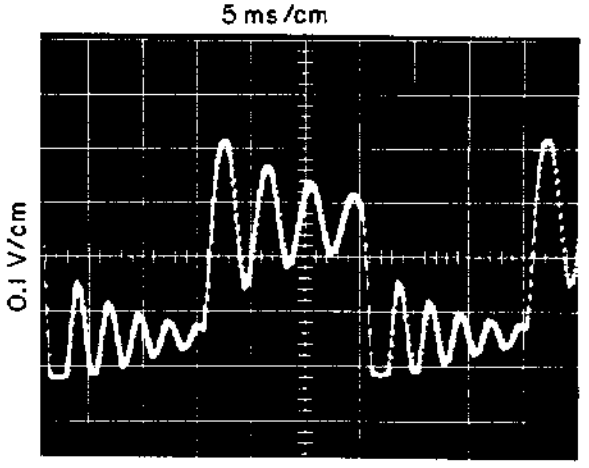


Figure 5-37. Typical Response, 2nd LO Step Voltage

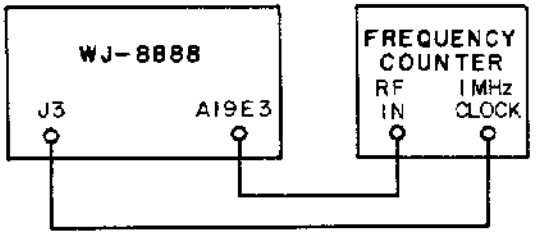


Figure 5-38 Test Setup, 2nd LO Alignment

(6) Connect the frequency counter as shown in Figure 5-38. Then set the RCVR CONTROL to the LOCAL mode. Set the rear panel CLOCK switch to EXT.

(7) Tune the receiver to 00.500 00 MHz; the frequency counter should indicate 109.990 kHz and be stable.

(8) Tune the receiver to 00.509 99 MHz; the frequency counter should indicate 100.010 kHz and be stable.

(9) If the frequency readout in step (7) and step (8) is not stable, adjust A19C29, A19R56 and the turns spacing of A19 L16 to obtain a stable readout. (If a new coil has been installed, the number of turns may have to be changed.)

(10) Refer to Table 5-5 on page 5-17. Tune the receiver to each of the freq-quencies listed and verify a corresponding VCO readout on the frequency counter.

(11) Connect the equipment as shown in Figure 5-36. Set the rear panel CLOCK switch to INT.

(12) Program the computer to step back and forth from 00.503 00 MHz to 00.506 99 MHz at a 30 mS rate.

(13) Put the RCVR CONTROL in the REMOTE mode.

FIGURE 5-39
FIGURE 5-40

(14) Adjust A19R52, A19R54, and A19R55 to obtain a response like that shown in Figure 5-39. The setting time for each excursion should be less than 5 mS. Also, the response should be centered between +5 volts and ground.

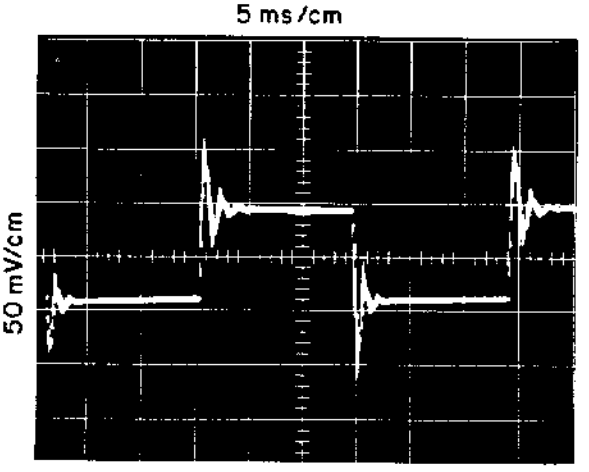


Figure 5-39. Typical Response, 2nd LO Step Voltage

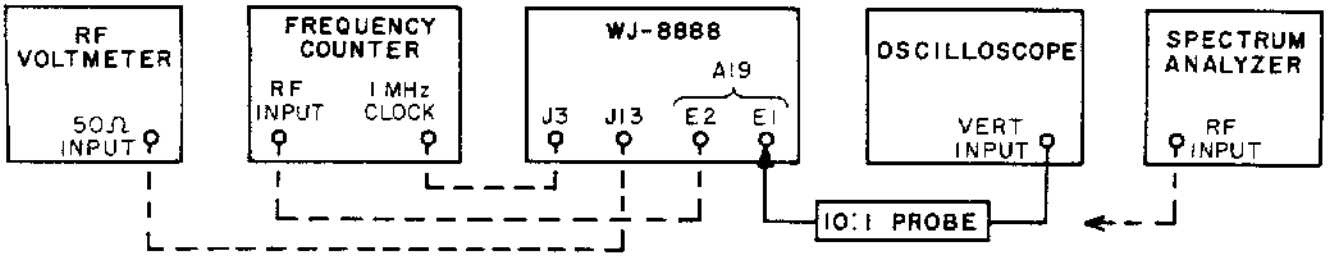


Figure 5-40. Test Setup, 2nd LO Alignment

(15) Connect the oscilloscope as shown in Figure 5-40.

(16) Put the RCVR CONTROL in the LOCAL mode and tune the receiver to 00.505 00 MHz.

(17) Adjust the turns spacing of A19L3 to remove any oscillation present. This should only be required if the circuit has been repaired.

(18) A noisy dc level should be present on the oscilloscope. Adjust A19C7 through its full range and note the dc shift of the noisy base line. Then adjust A19C7 so the dc level rests between the two extremes.

(19) Connect the frequency counter and RF voltmeter as shown by the dashed lines in Figure 5-40.

(20) Put the rear panel CLOCK switch in the EXT position.

(21) The frequency counter should indicate 36.000 00 MHz. (It may be necessary to connect a 6-dB attenuator to the RF input of the frequency counter to make this measurement.)

(22) Tune the receiver from 00.500 00 MHz to 00.509 99 MHz while observing the RF voltmeter. Then adjust A19L9 and A19L10 for a response flat to within 0.5 dB. Level should be at least 50 mV.

(23) Connect the frequency counter RF input to J13 in place of the RF voltmeter.

(24) Tune the receiver to 00.500 00 MHz; the frequency counter should indicate 72.109 99 MHz.

(25) Tune the receiver to 00.509 99 MHz; the frequency counter should indicate 72.100 00 MHz.

(26) Set the rear panel CLOCK switch to INT.

(27) Connect the spectrum analyzer shown in Figure 5-40 to J13.

(28) Set the spectrum analyzer controls to the conditions given in column A.

		A	B
a.	Band Width	0.03 kHz	10.0 kHz
b.	Scan Width	0.2 kHz/Div.	0.1 MHz/Div.
c.	Scan Time	2.0 sec/Div.	1.0 sec/Div.
d.	Video Filter	10.0 Hz	10.0 Hz

(29) Refer to Figure 5-41 for a typical response.

(30) Set the spectrum analyzer controls to the conditions given in column B of step (28).

(31) Refer to Figure 5-42 for a typical response.

(32) If spectral purity in steps (29) and (31) differs too much from the typical response shown, repeat the maintenance procedure, making slight adjustments to the variable components.

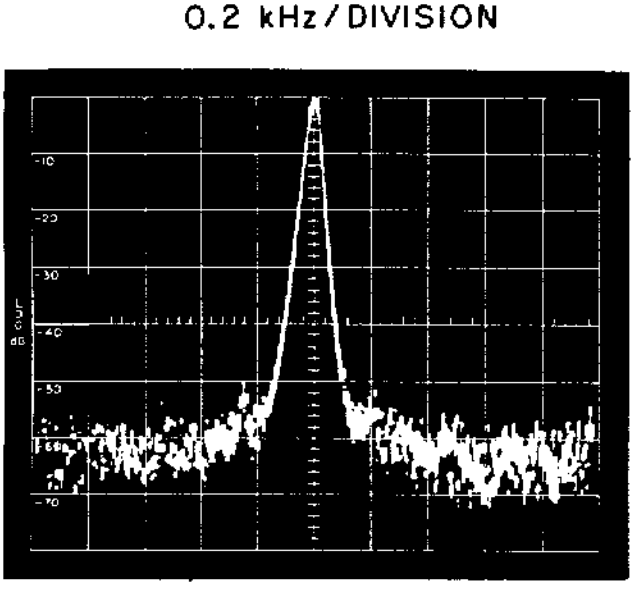


Figure 5-41. Typical Response, 2nd LO Narrow Band Spurious Products

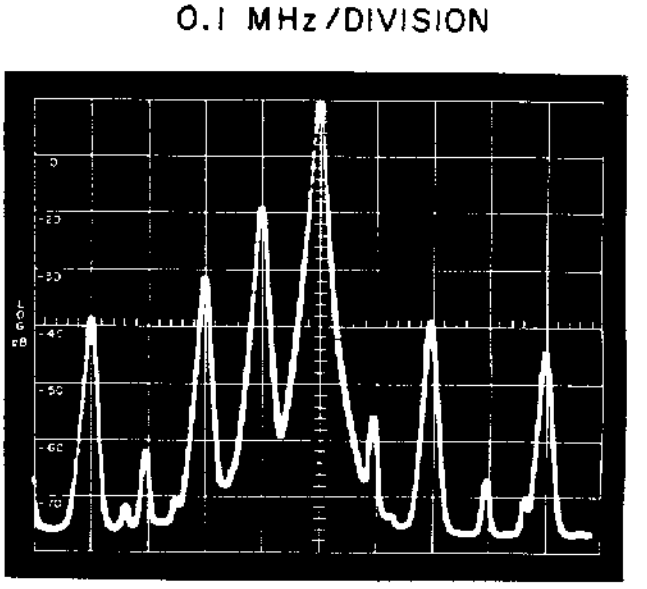


Figure 5-42. Typical Response, 2nd LO Wide Band Spurious Products

5.7.13 3RD LO ALIGNMENT. - This synthesized oscillator operates on a fixed frequency of 11.155 000 MHz. It is a part of the type 791109 1st LO/3rd LO/Time Base circuit board, A18. Figure 7-20 is the schematic diagram. Location of components appear in Figure 6-29. To perform the alignment proceed as follows:

(1) Connect the oscilloscope as shown in Figure 5-43.

(2) Set the oscilloscope for a dc input. Set the vertical attenuator for an approximate 4 volt swing at pin 9 of U25.

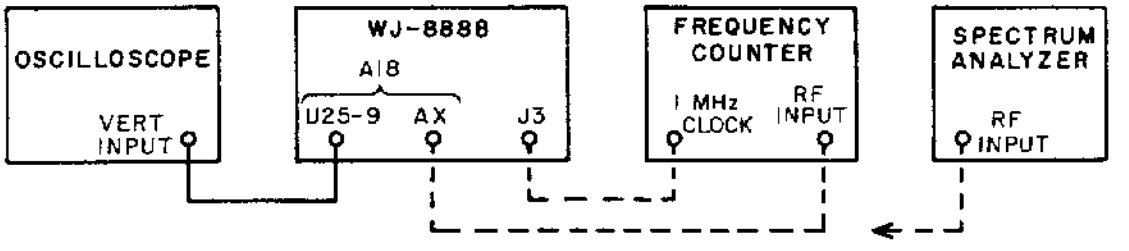


Figure 5-43. Test Setup, 3rd LO Alignment

(3) Adjust A18C29 through its full range and observe for a 4 volt dc level change on the oscilloscope. If necessary select values of C30 to obtain the 4 volt range.

(4) Set A18C29 so the dc level is at the middle of the 4 volt range.

(5) Remove the oscilloscope from the test setup and connect the frequency counter as shown in Figure 5-43.

(6) Set the receiver rear panel CLOCK switch to EXT. Remove circuit board A3 from the receiver.

(7) The 3rd LO output frequency shown on the frequency counter should be 11.155 000 ± 1 Hz.

(8) Remove the frequency counter from the test setup and connect the spectrum analyzer as shown in Figure 5-43 to A18AX.

(9) Set the receiver rear panel CLOCK switch to INT.

(10) Set the spectrum analyzer controls to the conditions in column A.

		A	B
a.	Band Width	0.03 kHz	0.3 kHz
b.	Scan Width	0.2 kHz/Div.	2.0 kHz/Div
c.	Scan Time	2.0 Sec	2.0 Sec
d.	Video Filter	10.0 Hz	10.0 Hz

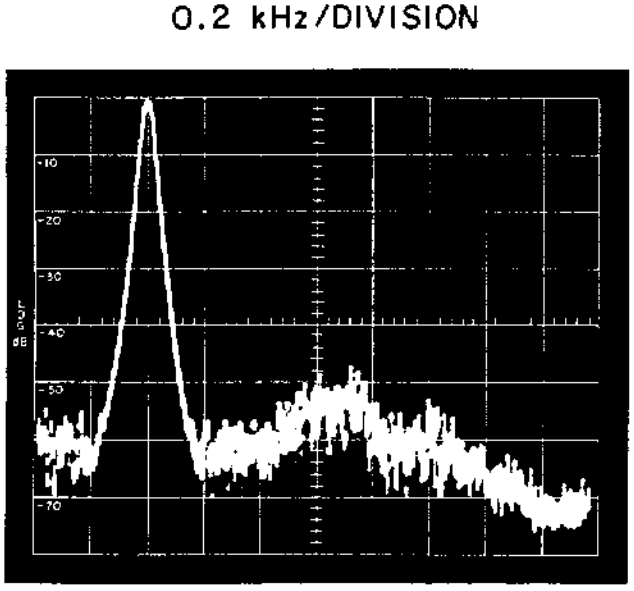


Figure 5-44. Typical Response, 3rd LO Output Spectrum

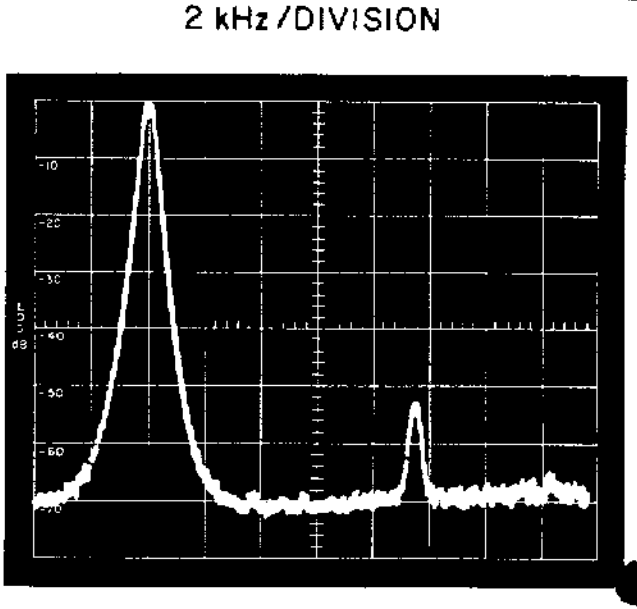


Figure 5-45. Typical Response, 3rd LO Output Spectrum

(11) Observe the display and verify an output level of at least -16 dBm.

(12) Compare Figure 5-44 with the response on the spectrum analyzer.

(13) Reset the spectrum analyzer controls for the conditions in column B of step (10).

(14) Compare Figure 5-45 with the response on the spectrum analyzer. This completes the 3rd LO alignment.

5.7.14 BFO ALIGNMENT. - The BFO is a synthesized oscillator that tunes from 445 kHz to 465 kHz. It is a part of the type 791117 2nd LO/BFO circuit board (A19). Refer to Figure 7-21 for the schematic diagram and to Figure 6-30 for the location of components. To perform the alignment, proceed as follows.

(1) Connect the oscilloscope as shown in Figure 5-46.

(2) If the BFO is known to be completely misaligned, set the following components to midrange; otherwise, make no prealignment adjustments. The adjustable components for the BFO are A19: C42, L13, L14, R39, and R66.

(3) Set the RCVR CONTROL to the LOCAL mode and the DETECTION MODE to CW FIXED.

(4) Rotate C42 through its full range while observing the base line shift on the oscilloscope.

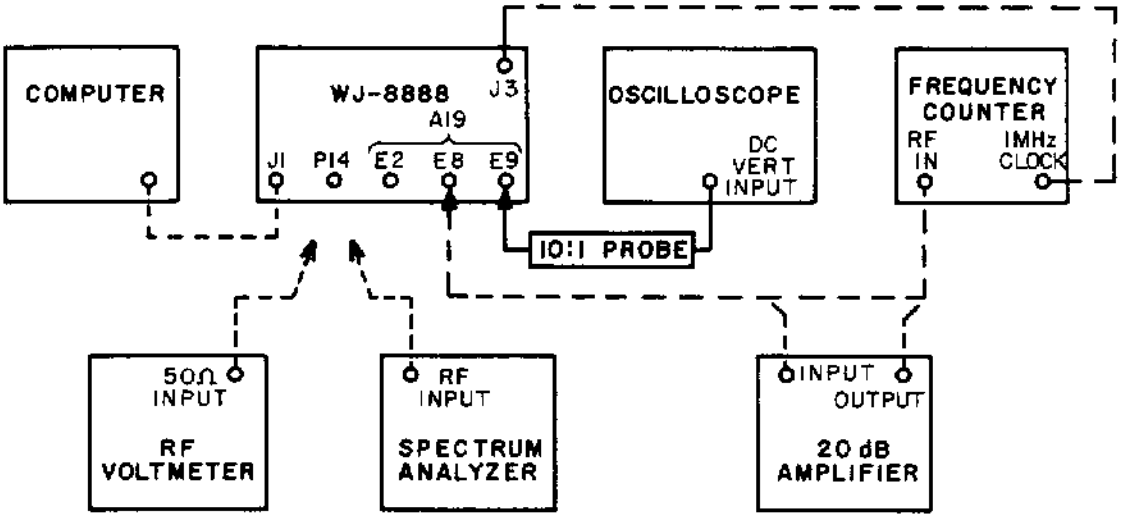


Figure 5-46. Test Setup, BFO Alignment

(5) Set C42 so the base line shift is between the two extremes.

(6) Set the RCVR CONTROL to the REMOTE mode. Connect the computer shown in Figure 5-46 to J1. Program the computer to step the BFO back and forth from 450 kHz to 460 kHz at a 60 mS rate.

(7) Adjust R66 to provide a symmetrical response like that shown in Figure 5-47. Slight adjustment may be required to C42.

(8) Connect the frequency counter shown in Figure 5-46 to A19E8 and to J3. Set the receiver rear panel CLOCK switch to EXT.

(9) Program the computer to establish a BFO frequency of 455 000 kHz.

(10) The frequency counter should indicate 8.500 0 MHz.

(11) Program the computer to establish a BFO frequency of 465 000 kHz.

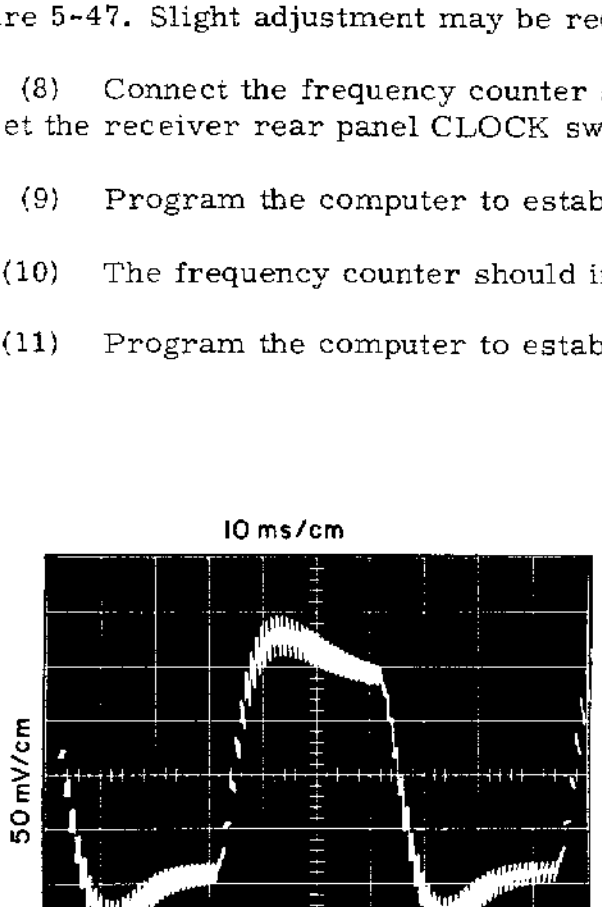


Figure 5-47. Typical Response, BFO Step Voltage

(12) The frequency counter should indicate 10.500 0 MHz.

(13) If the conditions of steps (10) and (12) cannot be met, repeat steps (1) through (13) making slight readjustments to C42 and R66. After all conditions are met, continue to step (14).

(14) Refer to Table 5-5 and program the computer for each of the decimal frequencies listed and verify the corresponding frequency counter reading.

Table 5-6. BFO Test Frequencies

Decimal Input	Counter Reading	Decimal Input	Counter Reading
0024	8.500 00	0110	8.586 00
0025	8.501 00	0111	8.587 00
0026	8.502 00	0112	8.588 00
0027	8.503 00	0113	8.589 00
0028	8.504 00	0200	8.676 00
0029	8.505 00	0300	8.776 00
0030	8.506 00	0400	8.876 00
0040	8.516 00	0500	8.976 00
0050	8.526 00	0600	9.076 00
0060	8.536 00	0700	9.176 00
0070	8.546 00	0800	9.276 00
0080	8.556 00	0900	9.376 00
0090	8.566 00	1024	9.500 00
0100	8.576 00	2024	10.500 00

(15) Connect the frequency counter to A19E2.

(16) The indication should be 36.000 MHz.

(17) Connect an IC clip to U19. Then connect the oscilloscope to pin 3.

(18) Program the computer so the BFO can be set to 445.000 kHz, 455.000 kHz, and 465.000 kHz.

(19) Adjust L13 and L14 for a nearly flat response having a slight peak at 455.000 kHz and equal levels at 445.000 kHz and 465.000 kHz.

(20) Connect the oscilloscope to U24 pin 8.

(21) Establish a BFO frequency of 455.000 kHz

(22) Adjust R39 for maximum undistorted output.

(23) Connect the RF voltmeter to P14 of the receiver.

(24) Tune the BFO through its range while observing the RF voltmeter. The level should be greater than 70 mV at all times.

(25) Connect the frequency counter to P14. This output level may not drive the frequency counter. If not, use the 20-dB amplifier shown in Figure 5-46 to increase the level.

(26) Program the computer to establish a BFO frequency of 445.000 kHz, 455.000 kHz and 465.000 kHz. In each case verify the same corresponding indications on the frequency counter.

(27) Set the rear panel CLOCK switch to INT.

(28) Connect the spectrum analyzer to P14 in place of the RF voltmeter.

(29) Set the spectrum analyzer controls as follows:

a.	Band Width	0.01 kHz
b.	Scan Width	0.1 kHz/Div.
c.	Scan Time	2.0 sec/Div.
d.	Video Filter	10.0 Hz

(30) Refer to Figure 5-48 for a typical response.

(31) To reduce spurious responses, it may be necessary to repeat the alignment procedure, making slight adjustments to previous settings.

(32) Perform steps (1) through (5) of the BFO performance test, paragraph 5.6.16. If the knob is not at zero in step (5), loosen the set screws, rotate the knob to the correct position, and retighten the set screws. This completes the BFO alignment procedure.

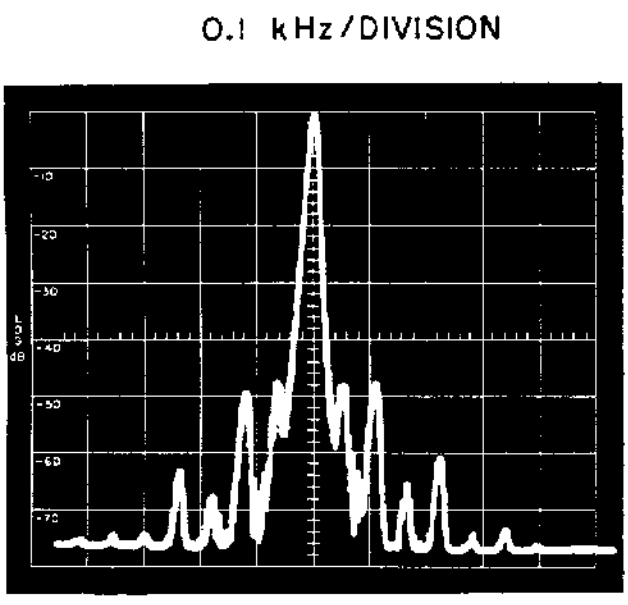


Figure 5-48. Typical Response, BFO Wide Band Spurious Products