# STUDENT HANDOUT SHEETS

## WJ-8626A-4 HF RECEIVER

## OPERATOR/MAINTENANCE COURSE

# LESSON TOPIC I

# RECEIVER GENERAL CHARACTERISTICS

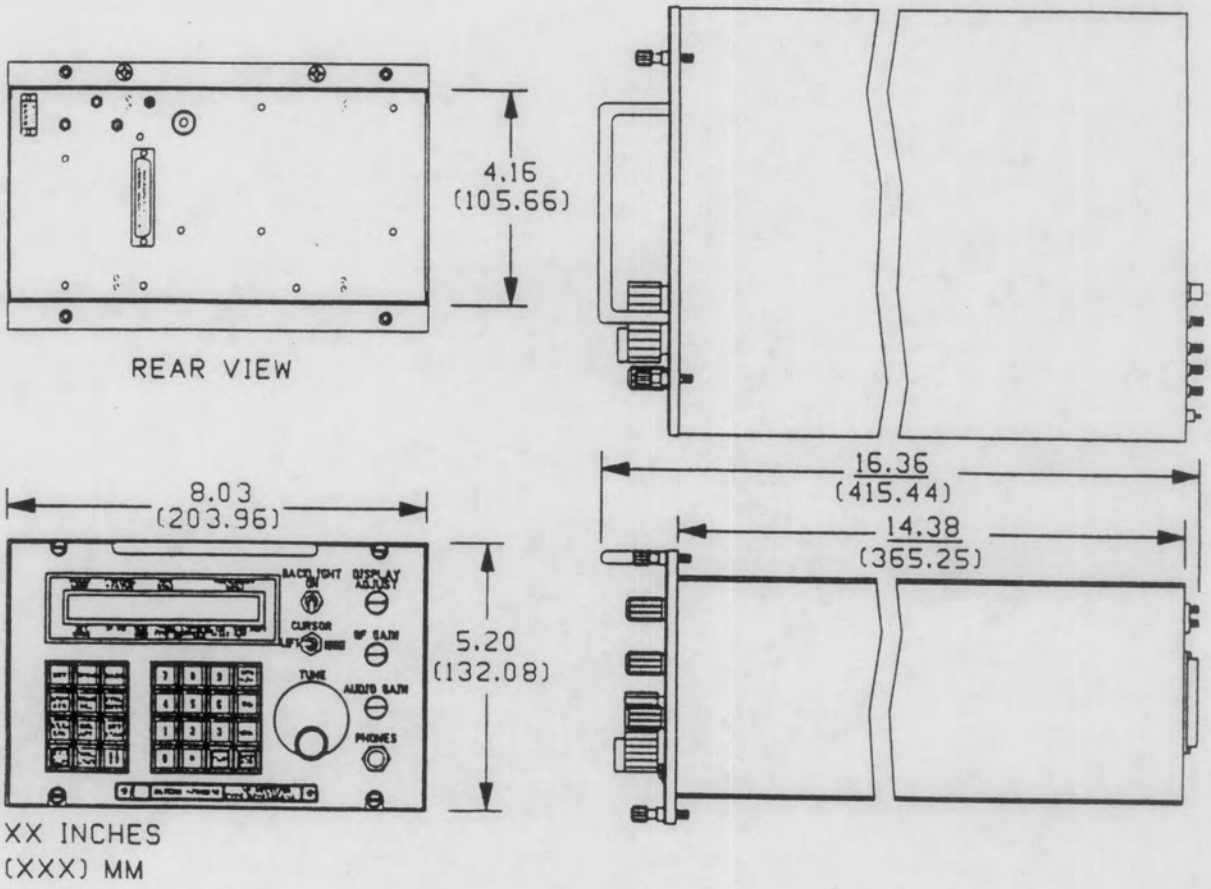



Figure 2-1. WJ-8626A-4 HF Receiver, Critical Dimensions

## 1.8 EQUIPMENT SPECIFICATIONS

See Table 1-1 for WJ-8626A-4 HF Receiver specifications and Table 1-2 for IF bandwidth options and sensitivity levels.

**Table 1-1. WJ-8626A-4 HF Receiver Specifications**

| | |
|---|---|
| Tuned Frequency | 5.0 kHz to 30.00000 MHz |
| Tuning Resolution | 10 Hz |
| Synthesizer Tuning Speed | 15 ms, typical |
| Antenna Conducted Local Oscillator Radiation | -87 dBm, maximum |
| Antenna Input Protection | The antenna input will withstand the effects of RF power to +27 dBm and static build-up. The protection circuit automatically resets. |
| Input Impedance | 50 ohms, unbalanced, nominal |
| IF Bandwidths (3 dB) | Standard: 2.85 kHz; Optional: any four of the following: 0.2, 0.5, 1, 2, 3, 4, 6, 8, 12 or 16 kHz; USB, LSB |
| Detection Modes | Standard: FM, AM, CW, LSB and USB |
| Gain Control Modes | Manual, AGC |
| AGC and Manual Range | 90 dB, minimum |
| AGC Threshold | 3.0 microvolt, typical |
| AGC Attack Time | 15 ms, maximum |
| AGC Release Time | FAST = 100 ms, maximum; SLOW = 2-4 Sec., nominal |
| Synthesized BFO | ±8.0 kHz in 100 Hz steps |
| IF Rejection | Greater than 90 dB |
| Image Rejection | Greater than 90 dB |
| Sensitivity | See IF Options and Sensitivity Table |
| IF Output | 455 kHz, 20 mV into 50Ω, minimum, at 3 microvolt input level, IF BW limited |
| Signal Monitor Output | 455 kHz, center frequency, 17 kHz bandwidth, 50Ω, output impedance |
| Third Order Input Intercept Point | +20 dBm, minimum for signals separated by 30 kHz minimum. |
| Video Amplifier Response | Within 3 dB from 20 Hz to 1/2 IF Bandwidth |
| Video Output Level | 350 mV rms into 75 ohms |
| Video Distortion | Less than 5% total Harmonic Distortion in AGC or Manual Gain Modes |
| Phones Output | 10 mW minimum into 600 Ω phones |
| Signal Strength Output | Shaped DC AM Detector output, 0 to +10 Vdc |
| Squelch/COR | Adjustable threshold from noise level to 80 dB above noise. COR holds a nominal 4 seconds after carrier disappears. |
| Digital Control | 72 Bit Serial Word (WJ 9040 System compatible) |
| Environmental Conditions: | |
| Temperature, Operating | 0° to +50°C |
| Temperature, Non-operating | -40°C to +70°C |
| Size | 5.2 inches (132 mm) high, 8.0 inches (203 mm) wide and 14.38 inches (365 mm) deep |
| Weight | Approximately 17 lbs (7.7 kg) |
| Power Consumption | Approximately 15 watts |

**Table 1-2. IF Bandwidth Options and Sensitivity Levels**

| | 3 dB IF Bandwidth | IF Shape Factor (Typical) 50 dB:3 dB | RF Input Level Microvolts | dBm |
|---|---|---|---|---|
| WJ-9926A/200 | 200 Hz | 10:1 | 0.50 | -113 |
| WJ-9926A/500 | 500 Hz | 7:1 | 0.64 | -111 |
| WJ-9926A/1K | 1 kHz | 5:1 | 0.80 | -109 |
| WJ-9926A/2K | 2 kHz | 3:1 | 1.0 | -107 |
| WJ-9926A/3K | 3 kHz | 3:1 | 1.4 | -104 |
| WJ-9926A/4K | 4 kHz | 3:1 | 1.6 | -103 |
| WJ-9926A/6K | 6 kHz | 3:1 | 2.0 | -101 |
| WJ-9926A/8K | 8 kHz | 3:1 | 2.2 | -100 |
| WJ-9926A/12K | 12 kHz | 3:1 | 2.9 | -98 |
| WJ-9926A/16K | 16 kHz | 2:1 | 3.2 | -97 |
| WJ-9926A/USB | 2.85 kHz | 1.8:1 | 0.7 | -110 |
| WJ-9926A/LSB | 2.85 kHz | 1.8:1 | 0.7 | -110 |
| WJ-9926A/SSB (uses offset L.O.) | 2.85 kHz | 1.8:1 | 0.7 | -110 |

NOTE: Over the frequency range of 0.2 to 30 MHz, the RF input levels and IF Bandwidths specified above will:

1. Produce a minimum AM (S+N)/N ratio of 10 dB at the audio for 50% AM modulation at a 400% Hz rate, (kHz and wider IF Bandwidths).
2. Produce a minimum CW (S+N)/N ratio of 16 dB at the audio output.
3. Produce a minimum FM (S+N)/N ratio of 17 dB at the audio output (10 kHz and wider IF Bandwidth).
4. Produce a minimum USB/LSB (S+N)/N ratio of 10 dB at the audio output (SSB Filters only).

Over the frequency range of 5 kHz to 200 kHz, the following applies:

CW Sensitivity (1 kHz IF Bandwidth)

200 kHz - 30 MHz ..... A 0.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

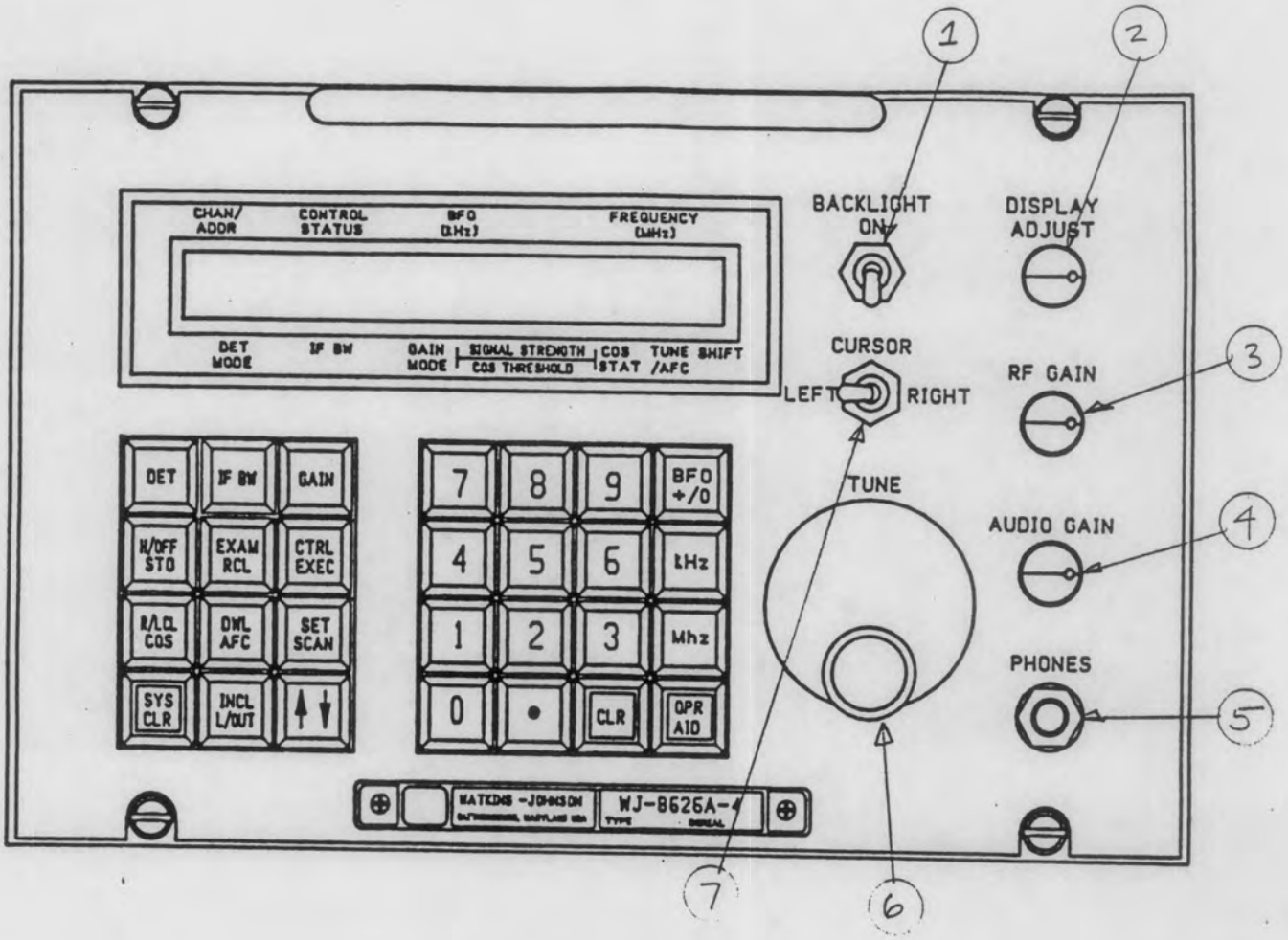
50 kHz - 200 kHz ..... A 1.8 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

15 kHz - 50 kHz ..... A 7.1 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

5 kHz - 15 kHz ..... A 128 microvolt signal will produce at least a 16 dB (S+N)/N ratio at the audio output.

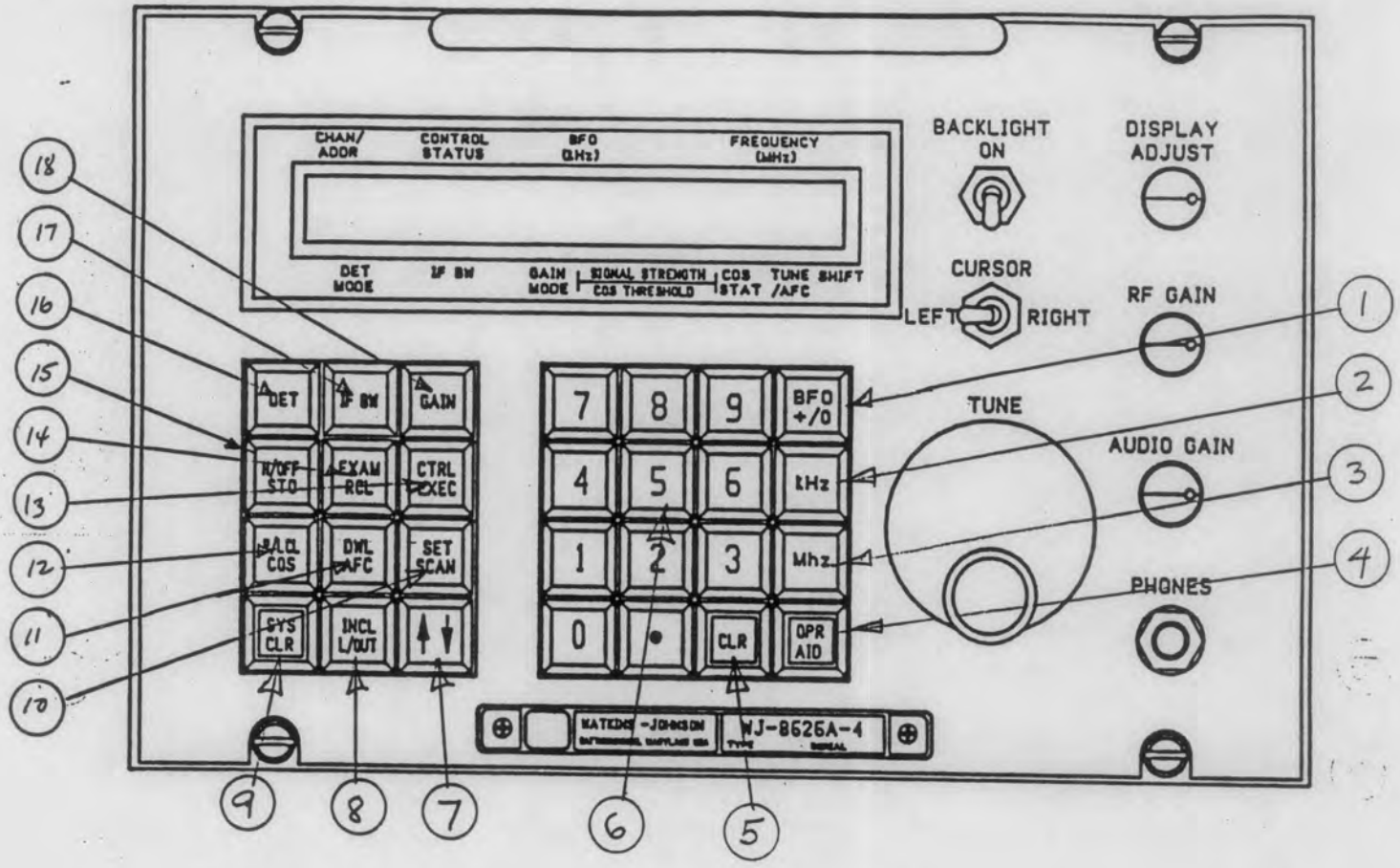
# LESSON TOPIC III

# RECEIVER OPERATING PROCEDURES



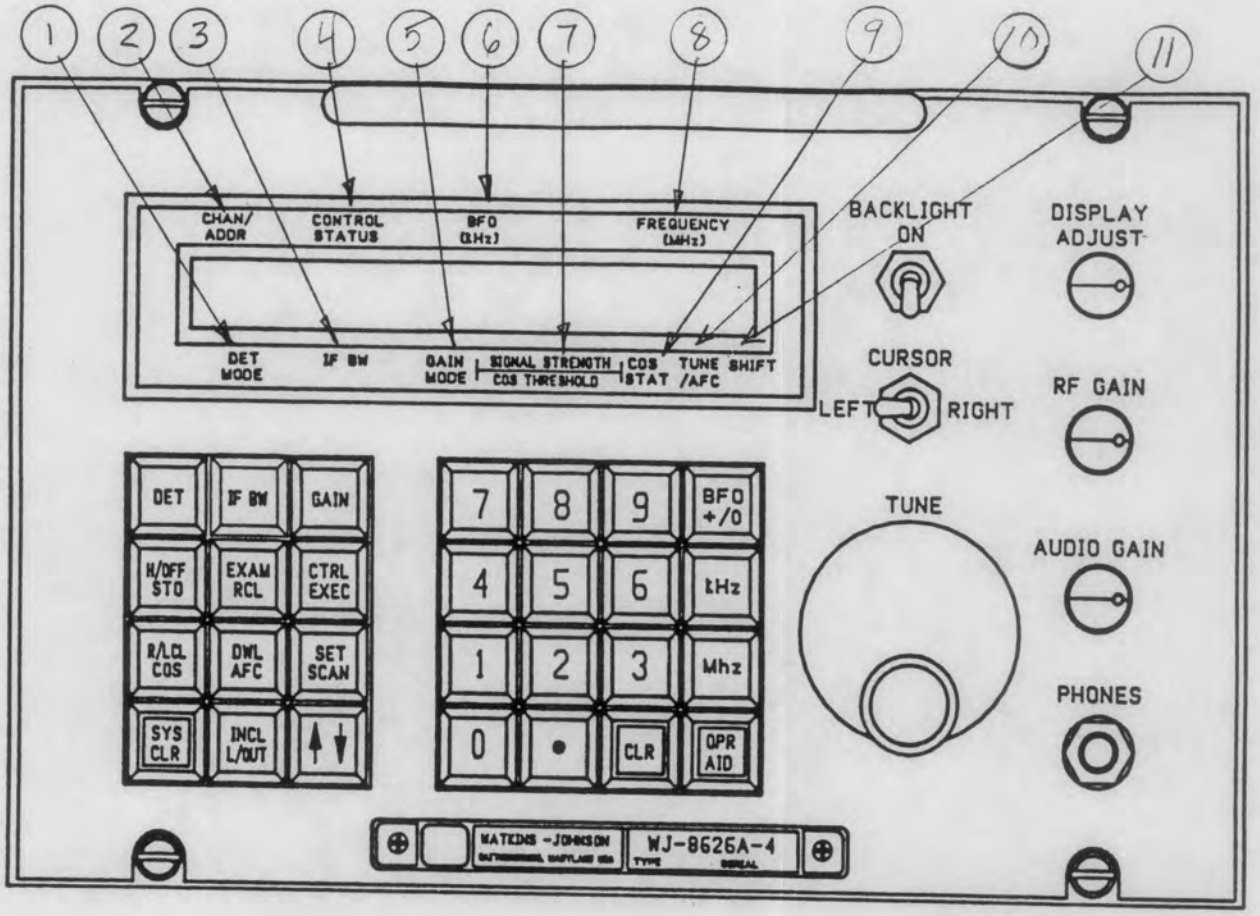

1. Backlight On Switch
2. Display Adjust
3. RF Gain
4. Audio Gain
5. Phones Jack
6. Tuning Knob
7. Cursor Control Switch

Figure 2-2. Receiver Front Panel Controls



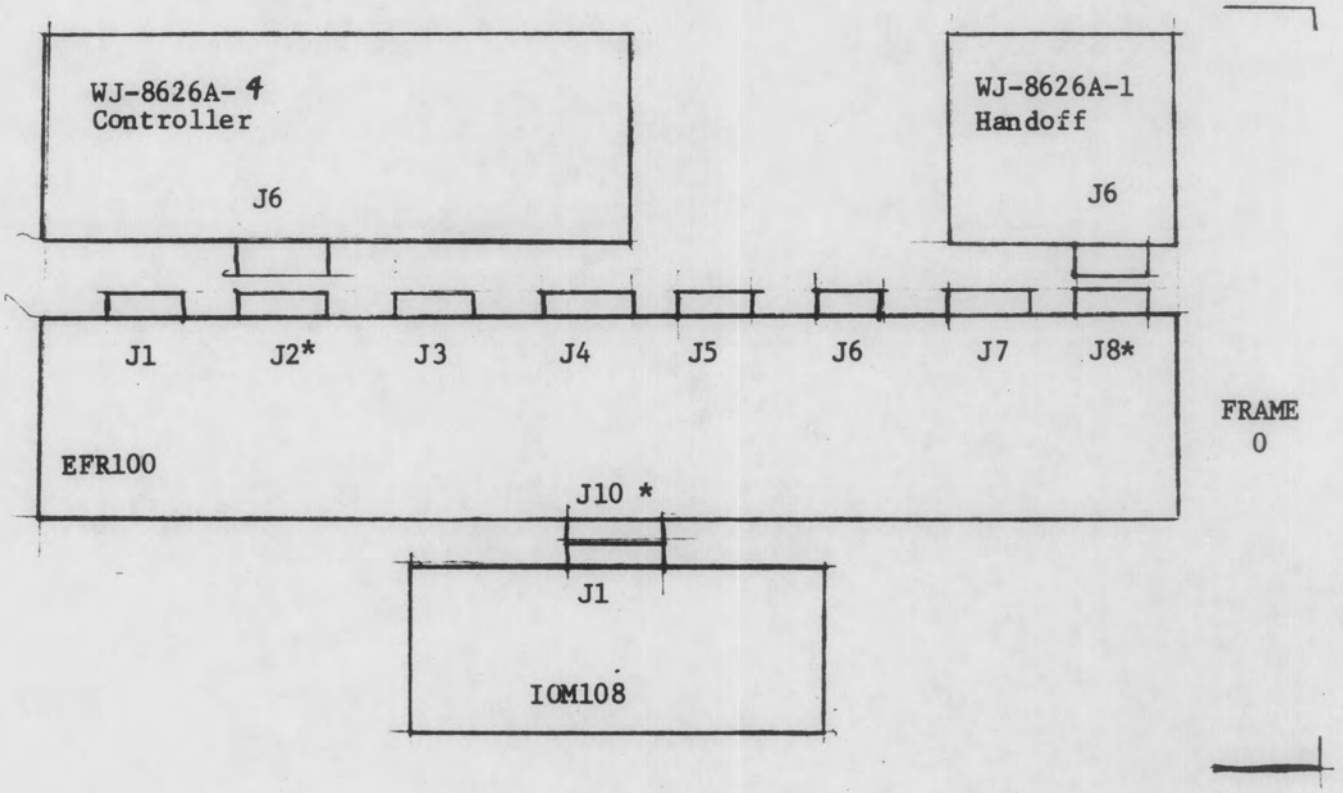

1. BFO Offset Entry Switch
2. kHz Tuned Frequency Entry
3. MHz Tuned Frequency Entry
4. Operator Aid Switch
5. Numeric Entry CLEAR Switch
6. Numeric Entry Switches 0-9
7. Lower/Upper Case Functions
8. Included/Locked Out Memory Channels (SCAN function)
9. System Clear
10. SCAN/SCAN SET select
11. Dwell/AFC select
12. COS Threshold set/Remote and Local select.
13. Control/Execute select
14. Examine/Recall select
15. Handoff/Store select
16. Detection Mode select
17. IF Bandwidth select
18. Gain Mode select

Figure 2-3. Front Panel Keypad Switches.




1. Detection Mode
2. Channel/Address
3. IF Bandwidth
4. Control Status
5. Gain Mode
6. BFO Offset
7. Signal Strength/COS Threshold
8. Receiver Tuned Frequency
9. COS Status
10. AFC/Tuning Indicator
11. Shift (upper/lower case functions)

Figure 2-4. LCD Parameter Display Locations.




* = Active

Figure 2-6. Single Frame Hardware Configuration

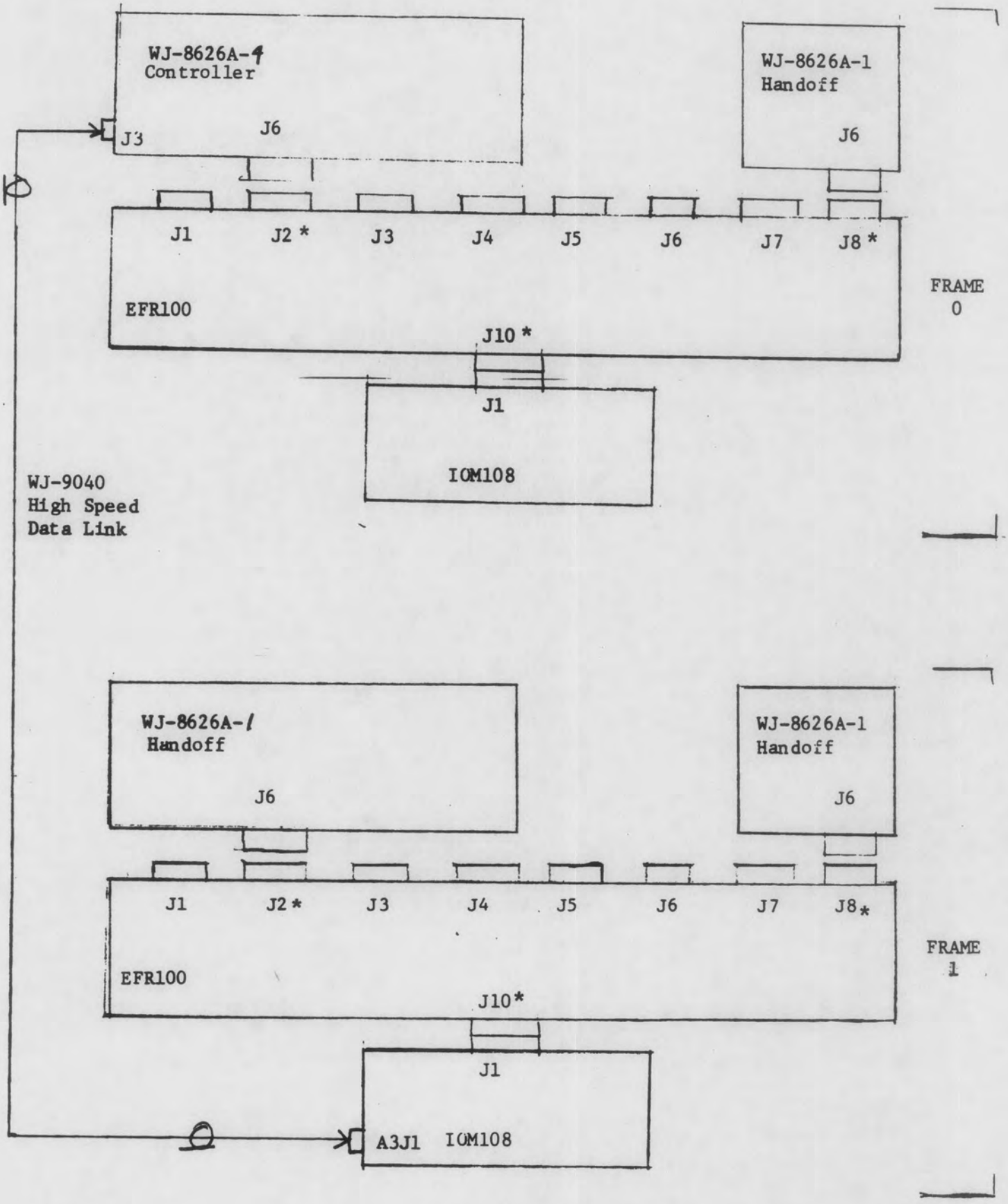



Figure 2-7. Multiframe Hardware Configuration

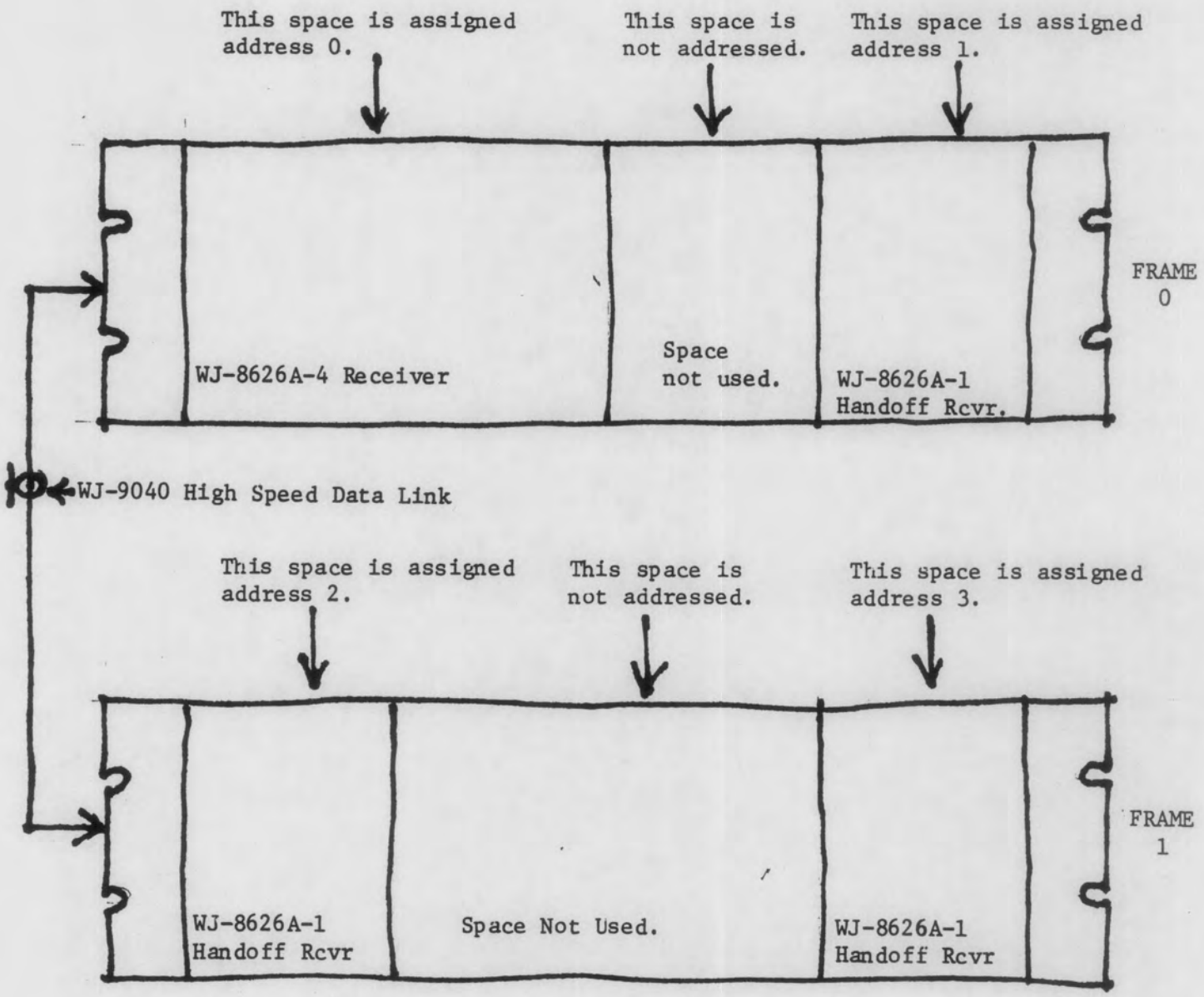



Figure 2-8. System Initialization Handoff Receiver Addressing

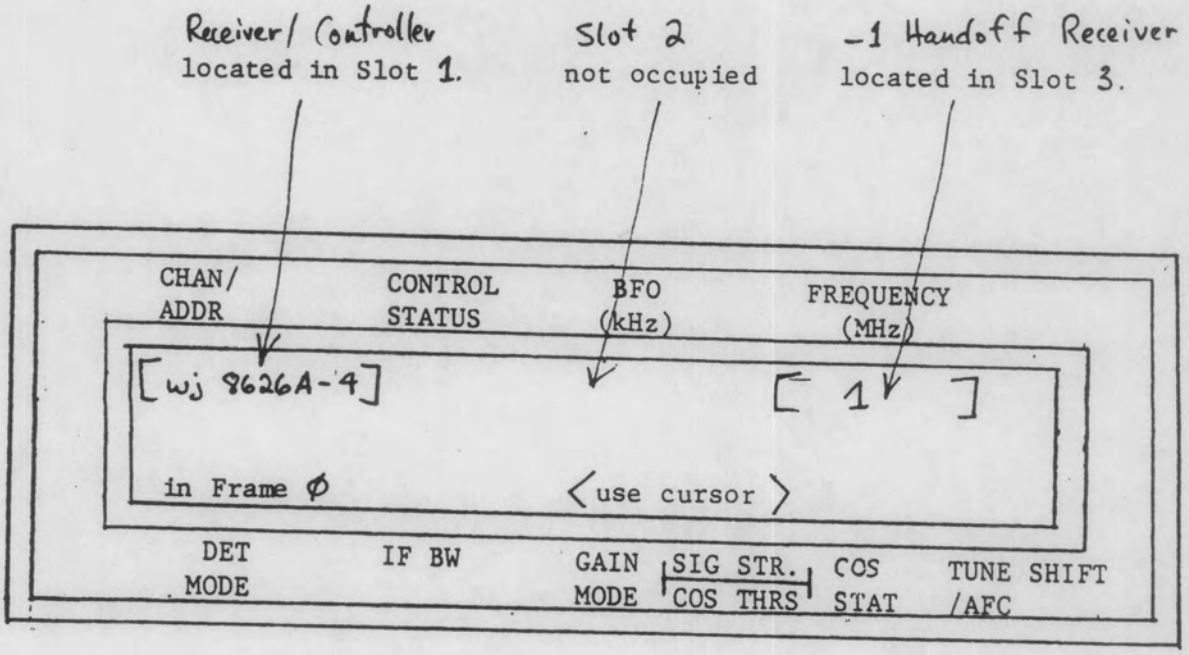
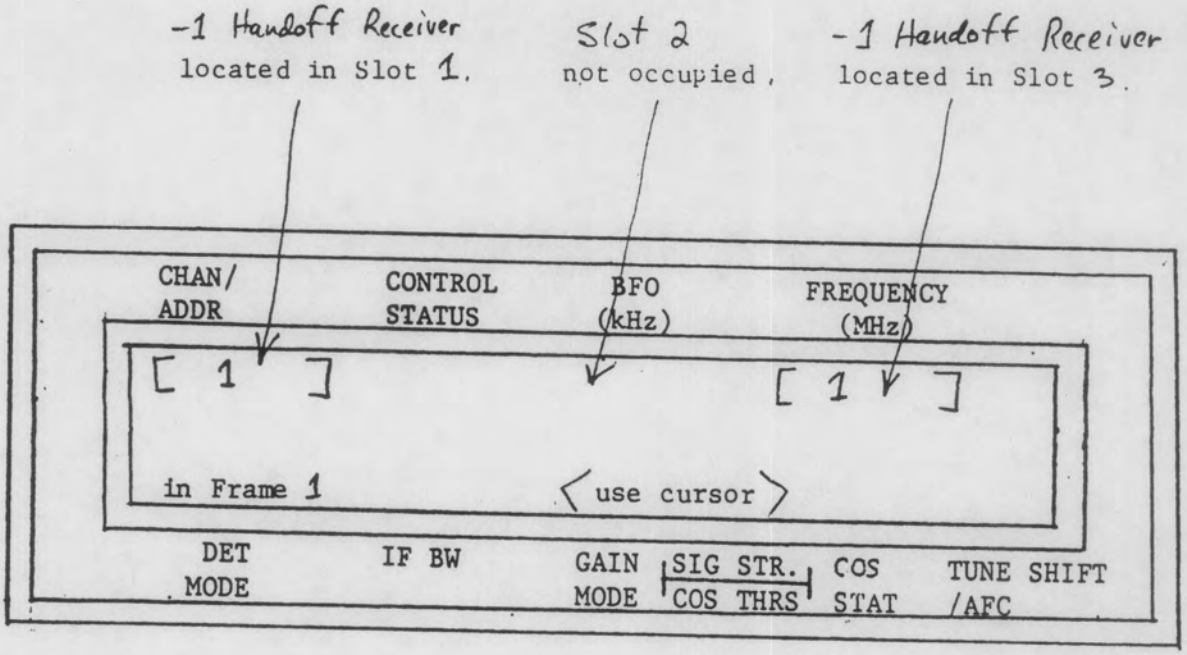



Figure 2-9. Subsystem Check, Frame ∅ Status Display.



# LESSON TOPIC IV

# RECEIVER THEORY OF OPERATION

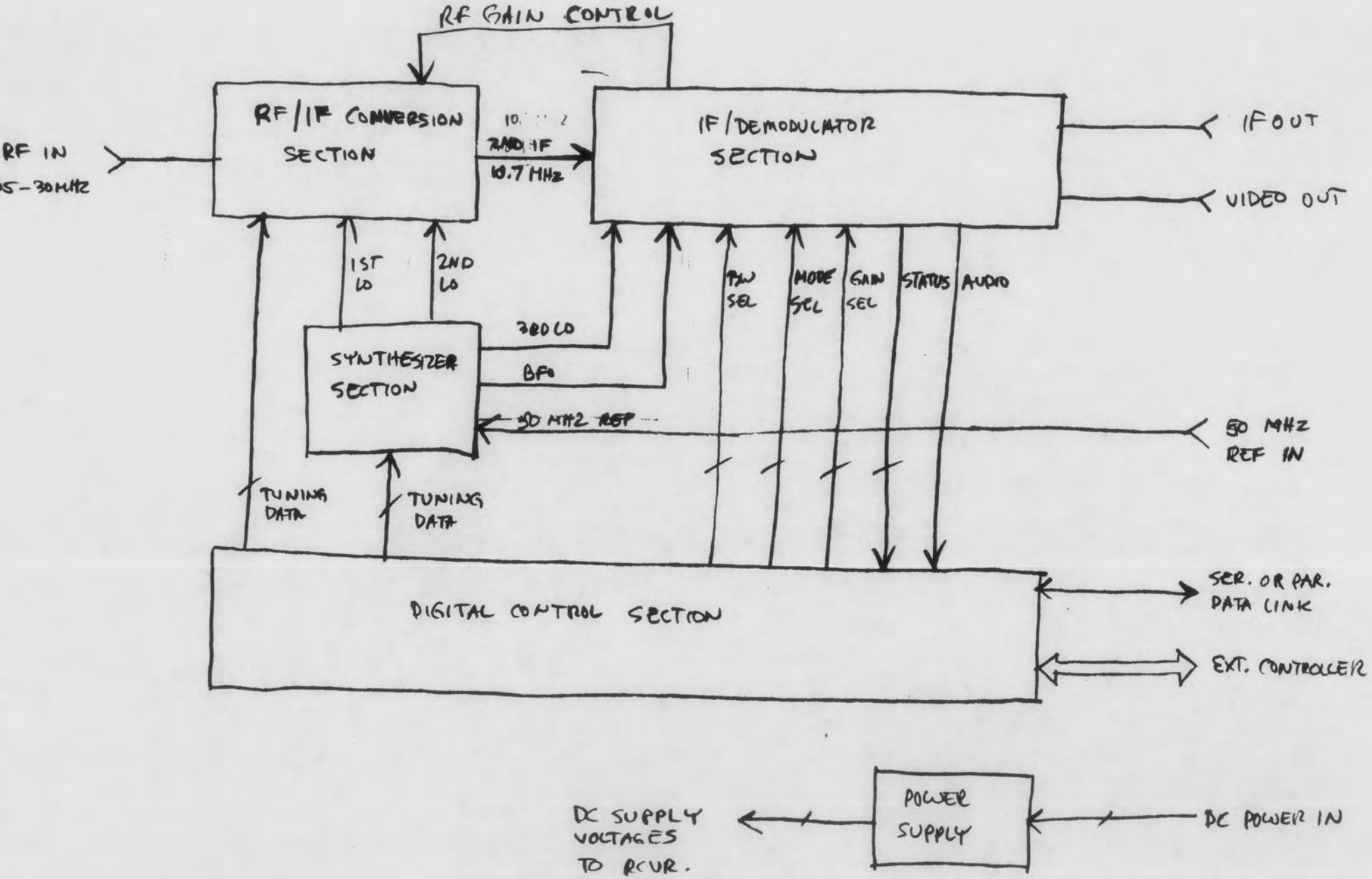



Figure 3-1. Simplified Overall Block Diagram

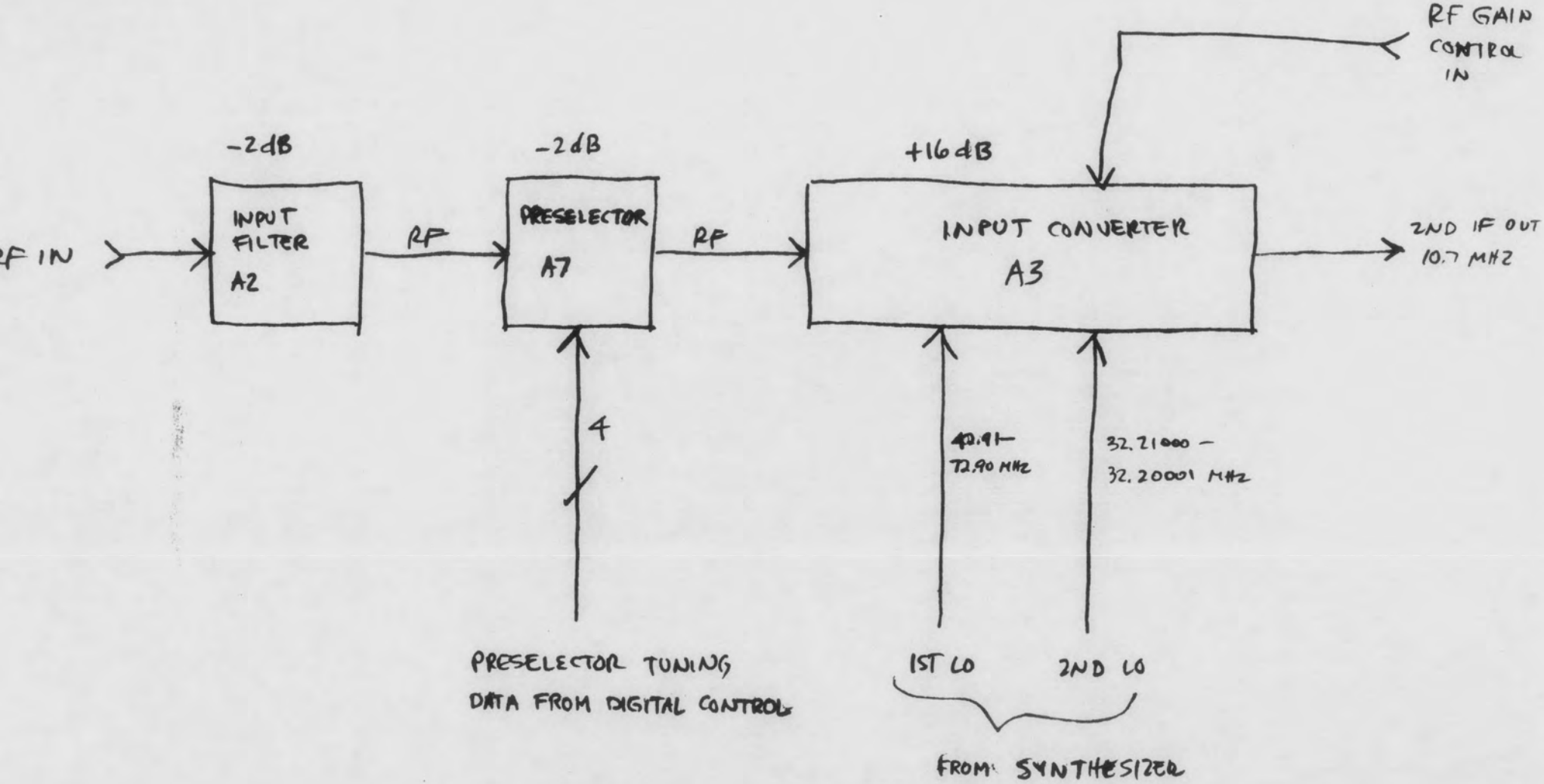



Figure 3-2. RF/IF Conversion Block Diagram

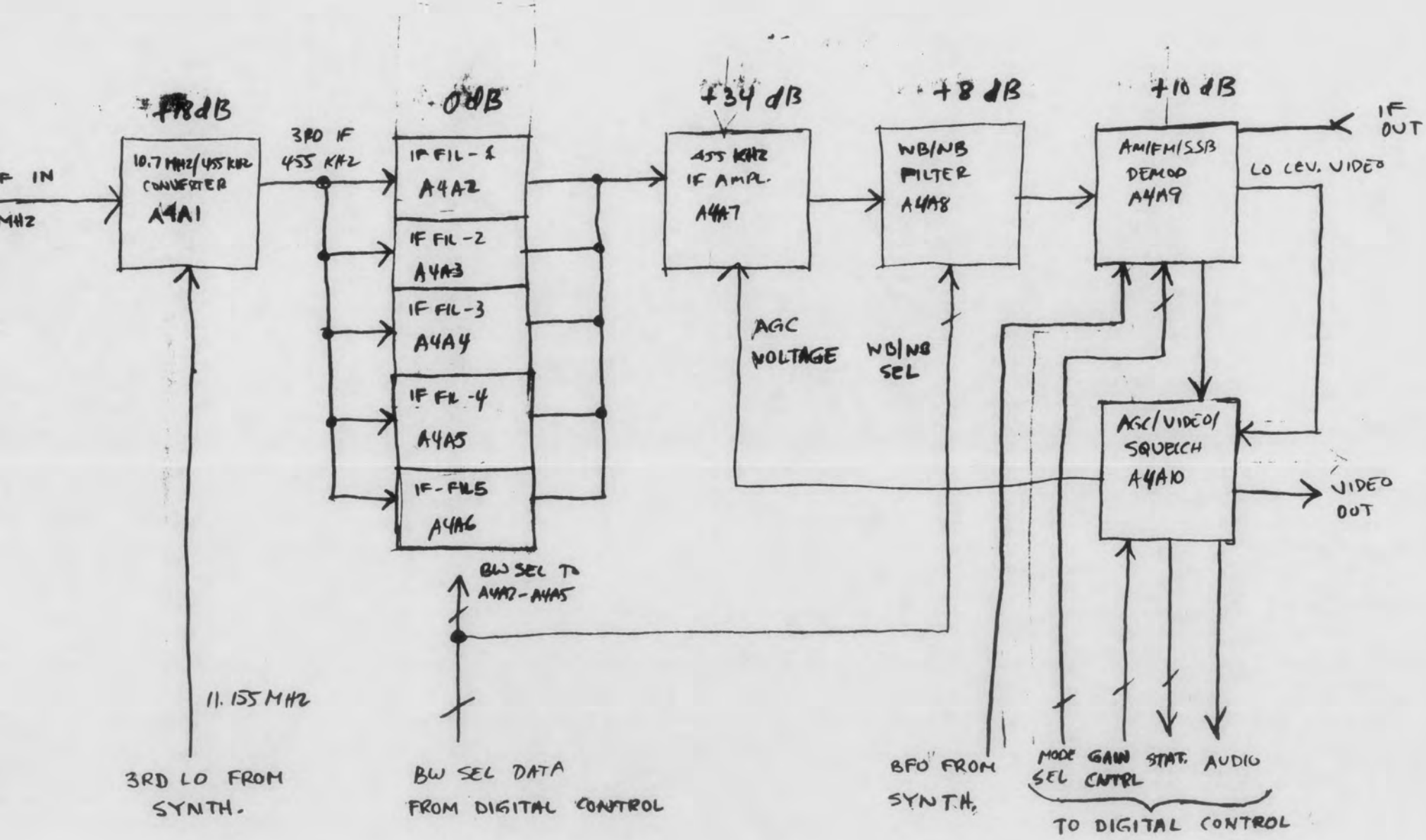



Figure 3-3. IF/Demodulator Block Diagram

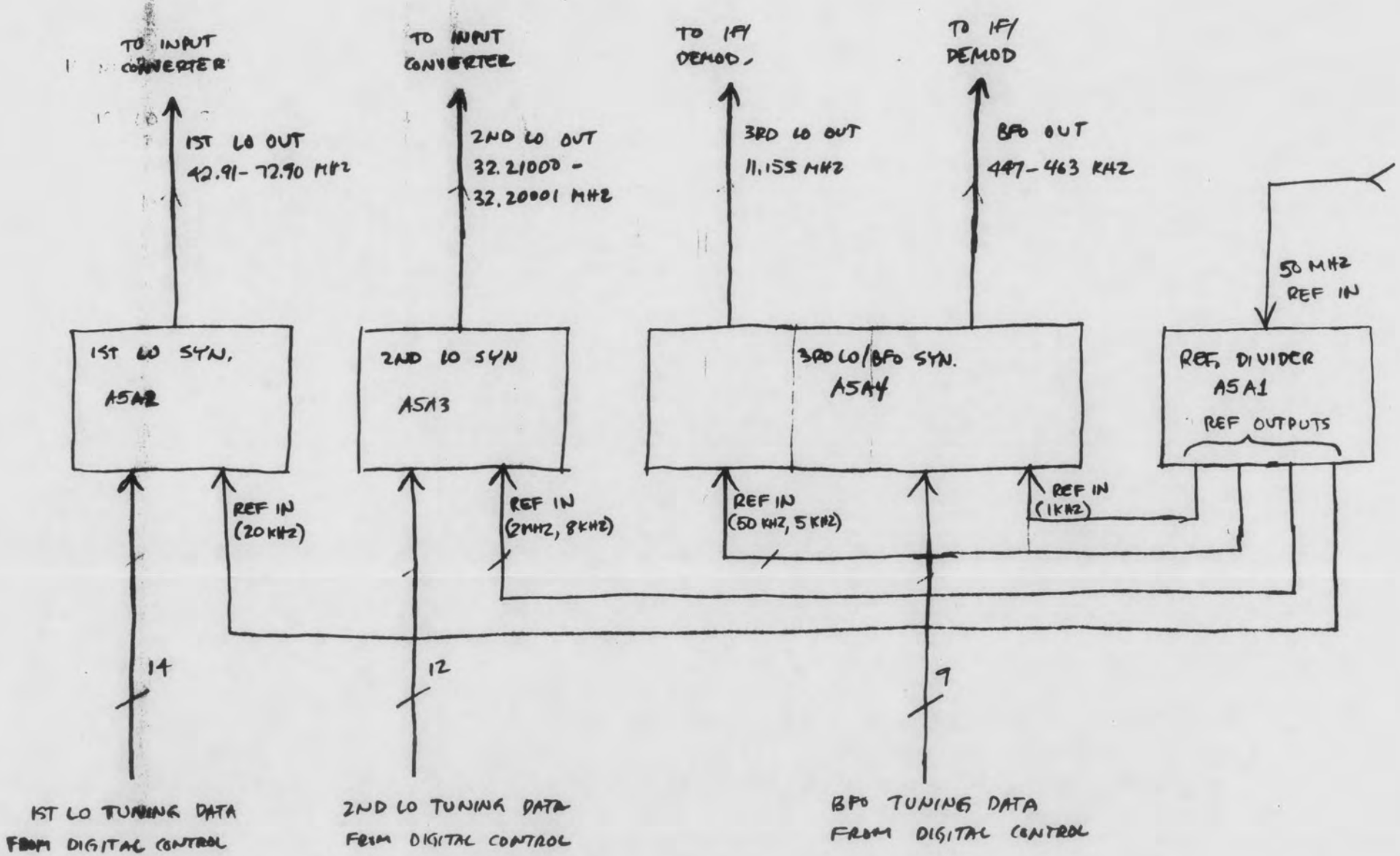



Figure 3-4. Synthesizer Block Diagram.

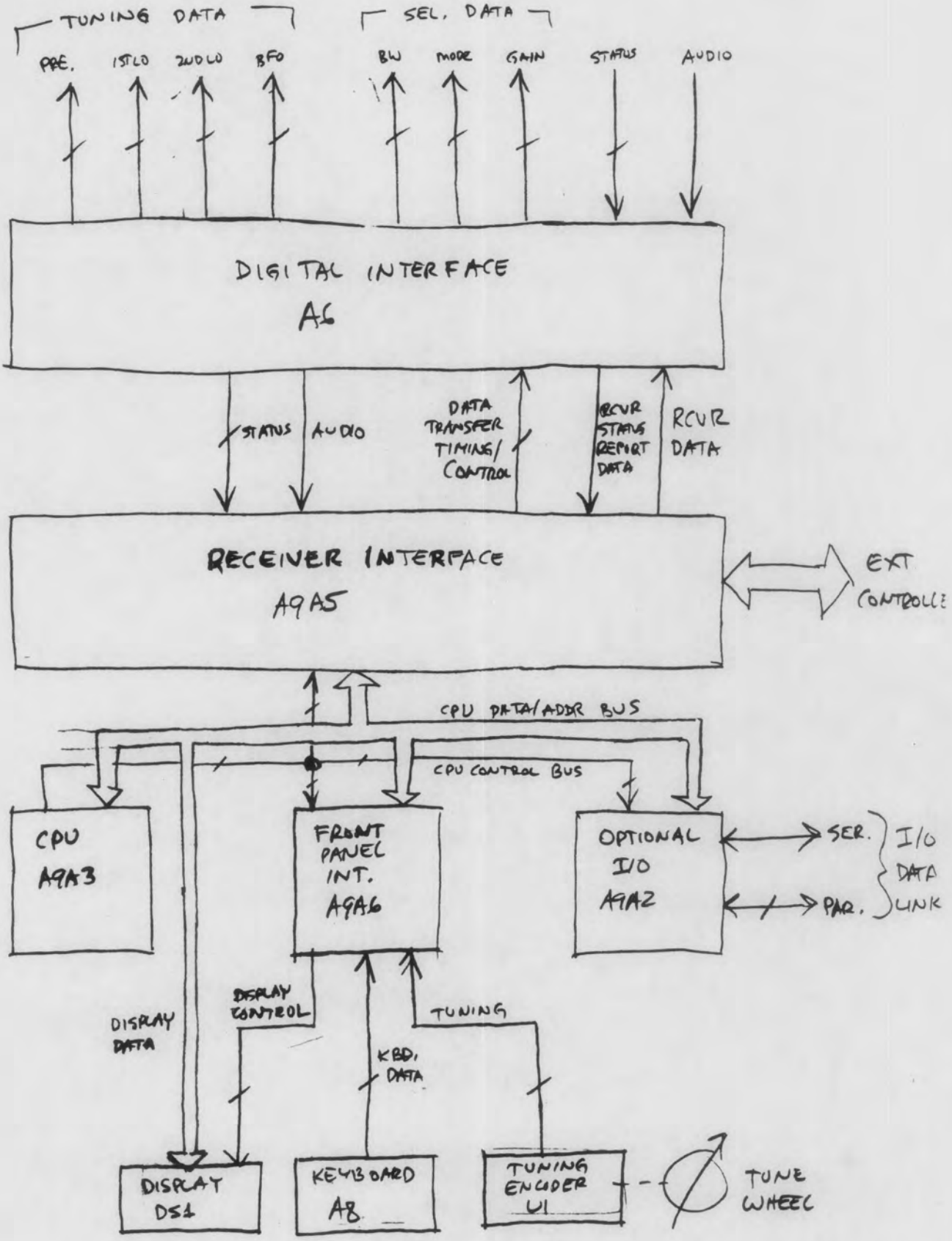
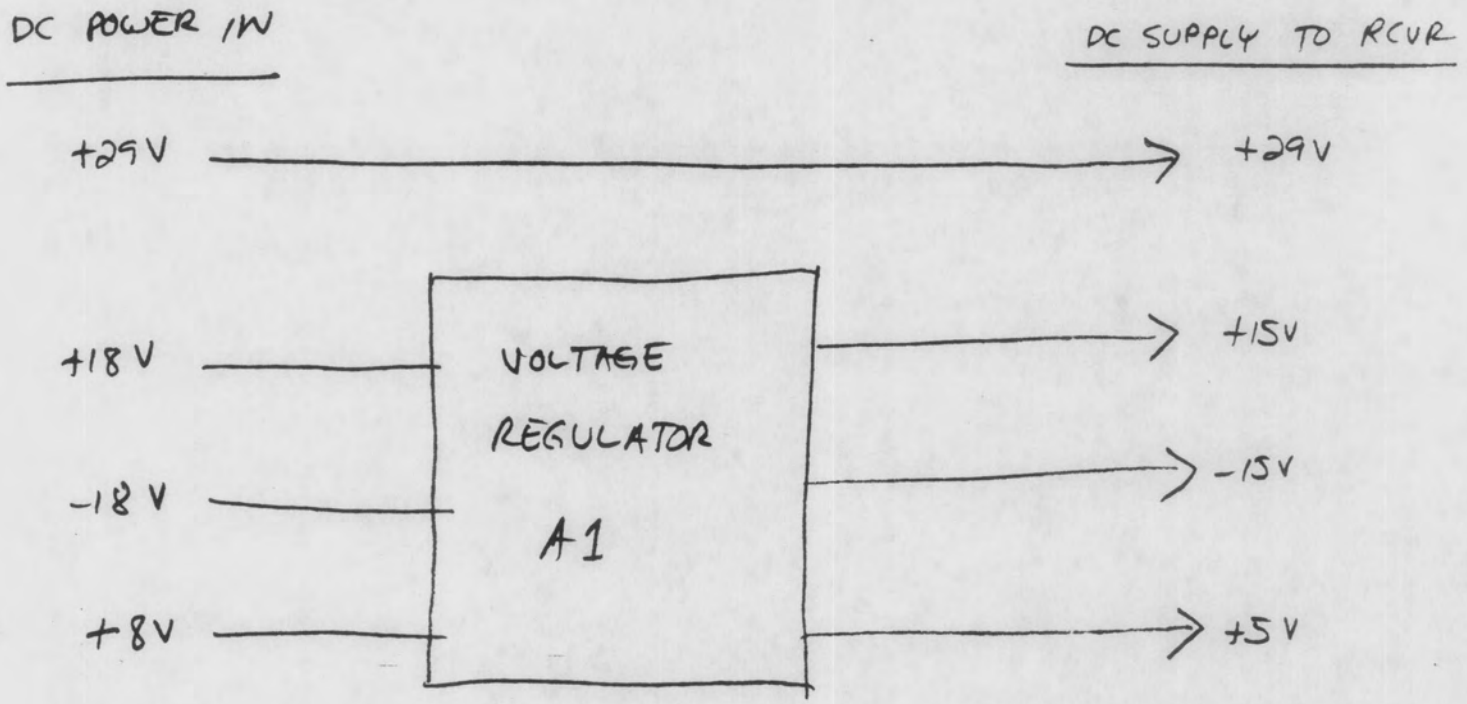
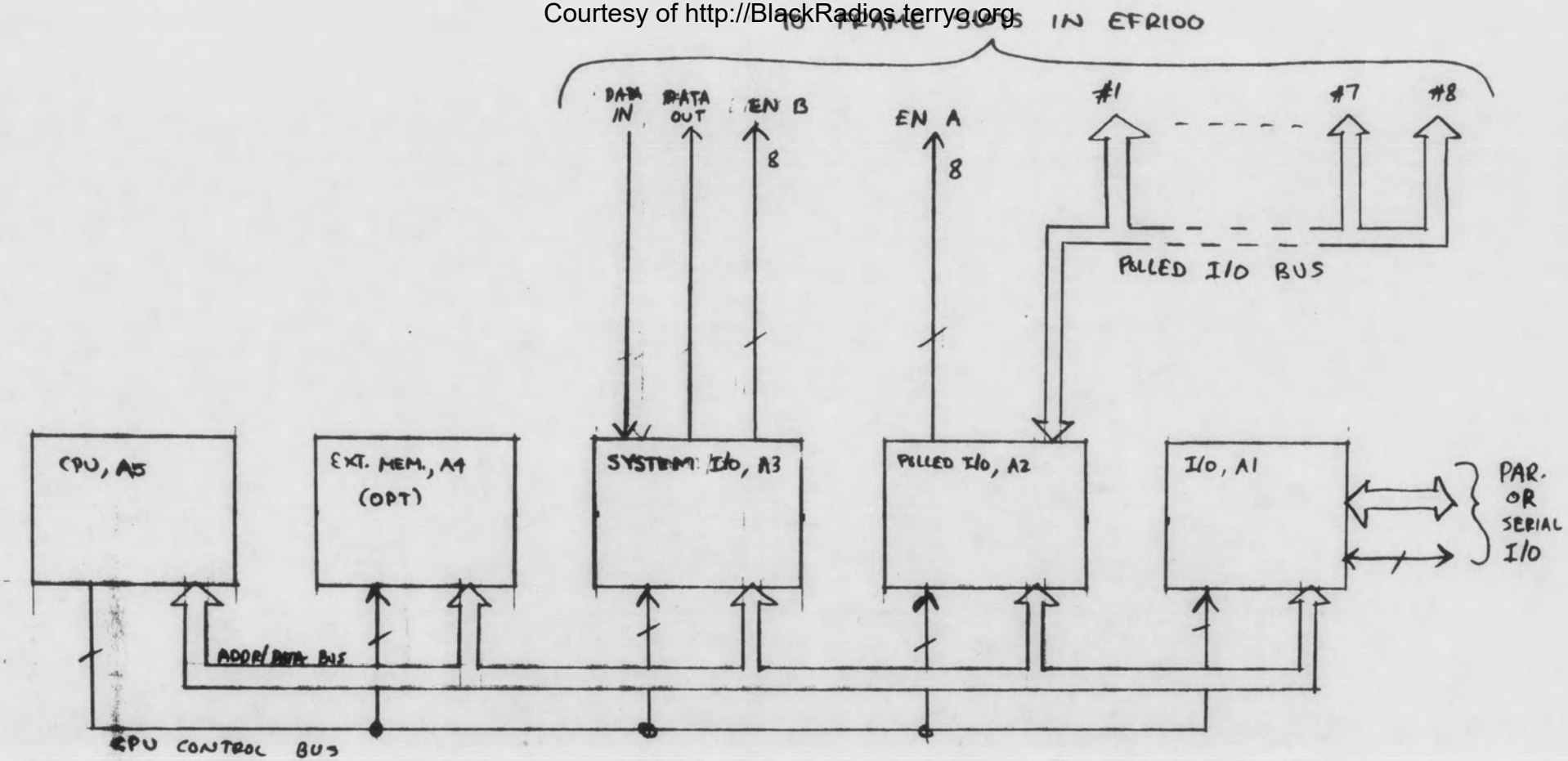



Figure 3-5. Digital Control Block Diagram.






EOM 108 BLOCK DIAGRAM

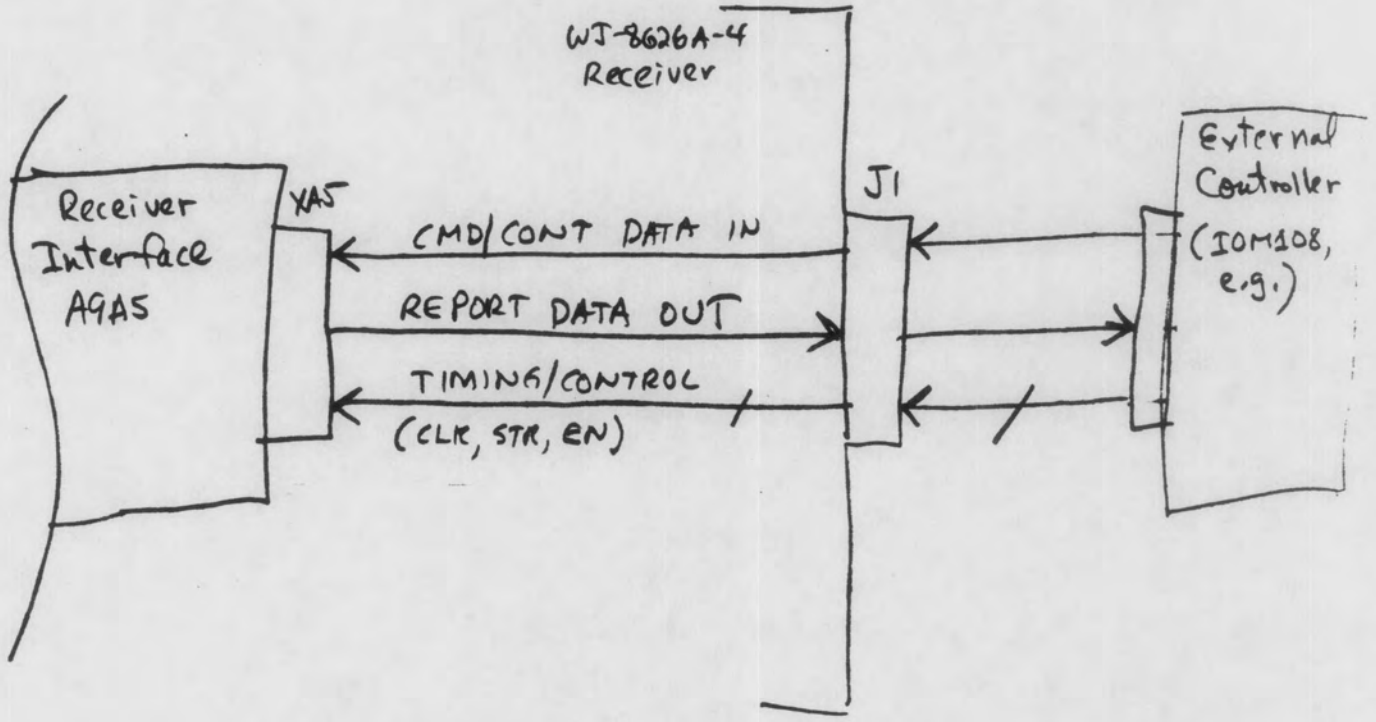



Figure 3-7. External Controller Interface.

# LESSON TOPIC V

# RECEIVER ALIGNMENT PROCEDURES

# APPENDIX B

## TEST EQUIPMENT AND TOOLS

(One Each Per Unit Under Test)

1. One (1) Digital Voltmeter, HP 3435A
2. One (1) Oscilloscope, HP 180C
3. One (1) Signal Generator, HP 8640B
4. One (1) RF Voltmeter, Boonton 92B
5. One (1) Frequency Counter, Fluke 780043
6. One (1) AC Voltmeter, HP 400EL
7. One (1) Screwdriver, Standard 6-inch
8. One (1) Screwdriver, Phillips No. 0
9. One (1) Screwdriver, Phillips No. 1
10. One (1) JFD Alignment Tool, No. 5284
11. Test Cables:

    Two (2) RF Cables, BNC male both ends, 3 feet long

    Two (2) RF Cables, BNC male to alligator clips, 3 feet long

Table 4-2. Receiver Minimum Performance Standards

| Parameter to be Tested | Performance Standard |
|---|---|
| Front Panel Control Status | All local mode functions operational as defined in paragraph 2.4.3.2. |
| IF Gain, Input to IF Out | 82 dB ± 2 dB |
| Video Output in AM Mode | 350 mV minimum into 75 ohms with -97 dBm input and 50% modution at 400 hz. |
| Video Output in FM Mode | 350 mV minimum into 75 ohms with -97 dBm input and 4.8 kHz deviation at 400 hz. |
| Video Output in CW Mode | 350 mV minimum into 75 ohms with -97 dBm input unmodulated and receiver offset -400 hz. |
| AGC Range | Control range -97 dBm to -7 dBm with less than 6 dB output change. |
| Manual Gain Control Range | Greater than 100 dB |
| Frequency Tuning Accuracy | ± 100 hz at 29.99999 MHz. |

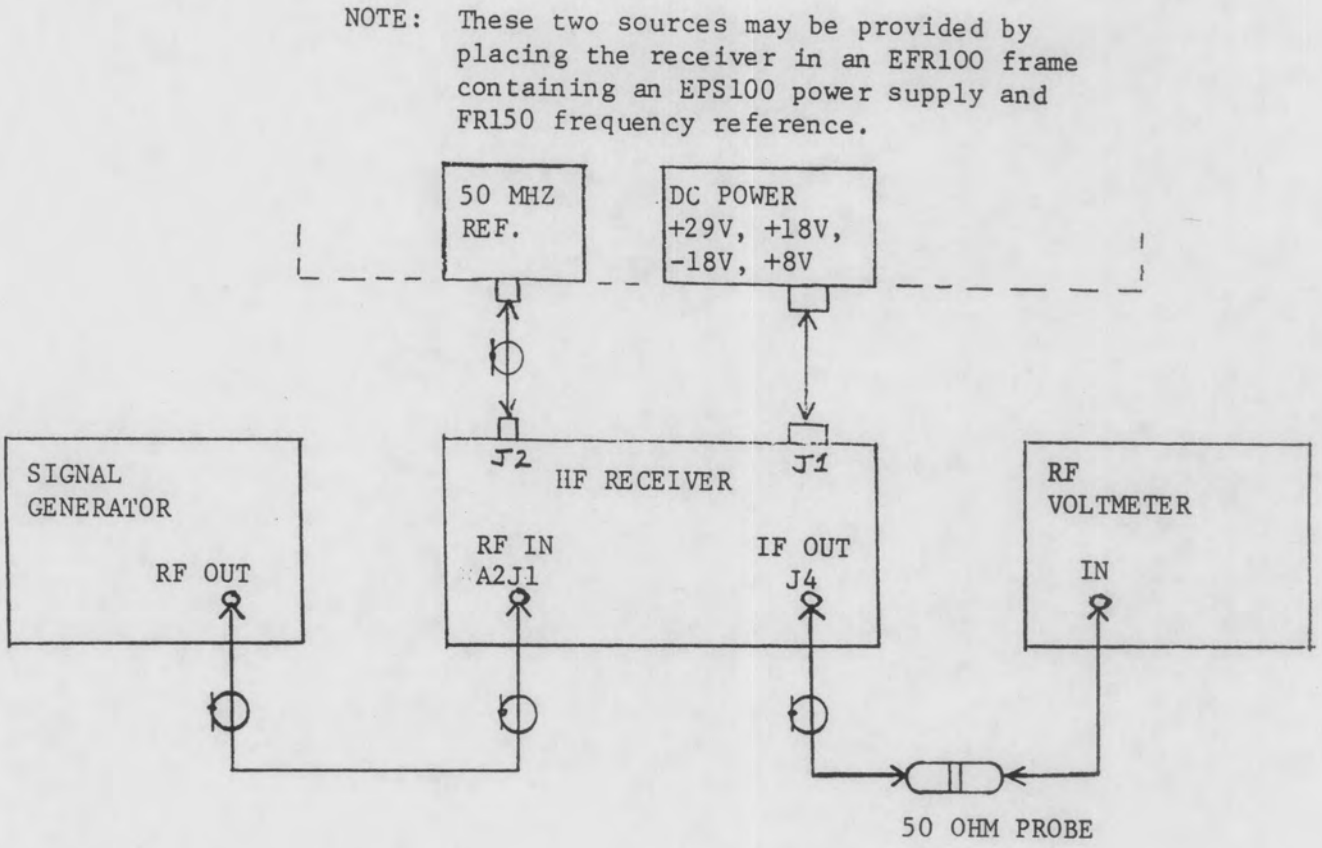



Figure 4- 2 . IF Gain Test Equipment Setup.

NOTE: These two sources may be provided by placing the receiver in an EFR100 frame containing an EPS100 power supply and FR150 frequency reference.

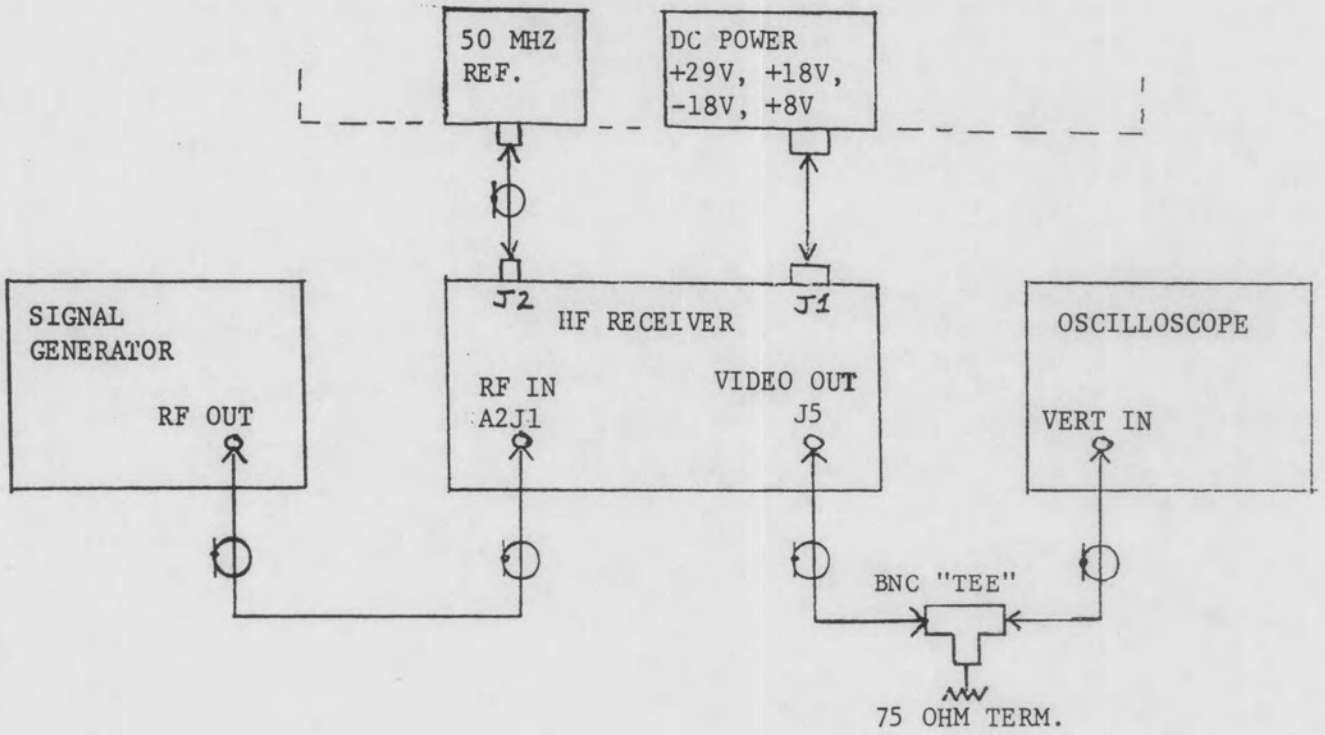



Figure 4- 3 . Detection Mode Test Equipment Setup

NOTE: These two sources may be provided by placing the receiver in an EFR100 frame containing an EPS100 power supply and FR150 frequency reference.

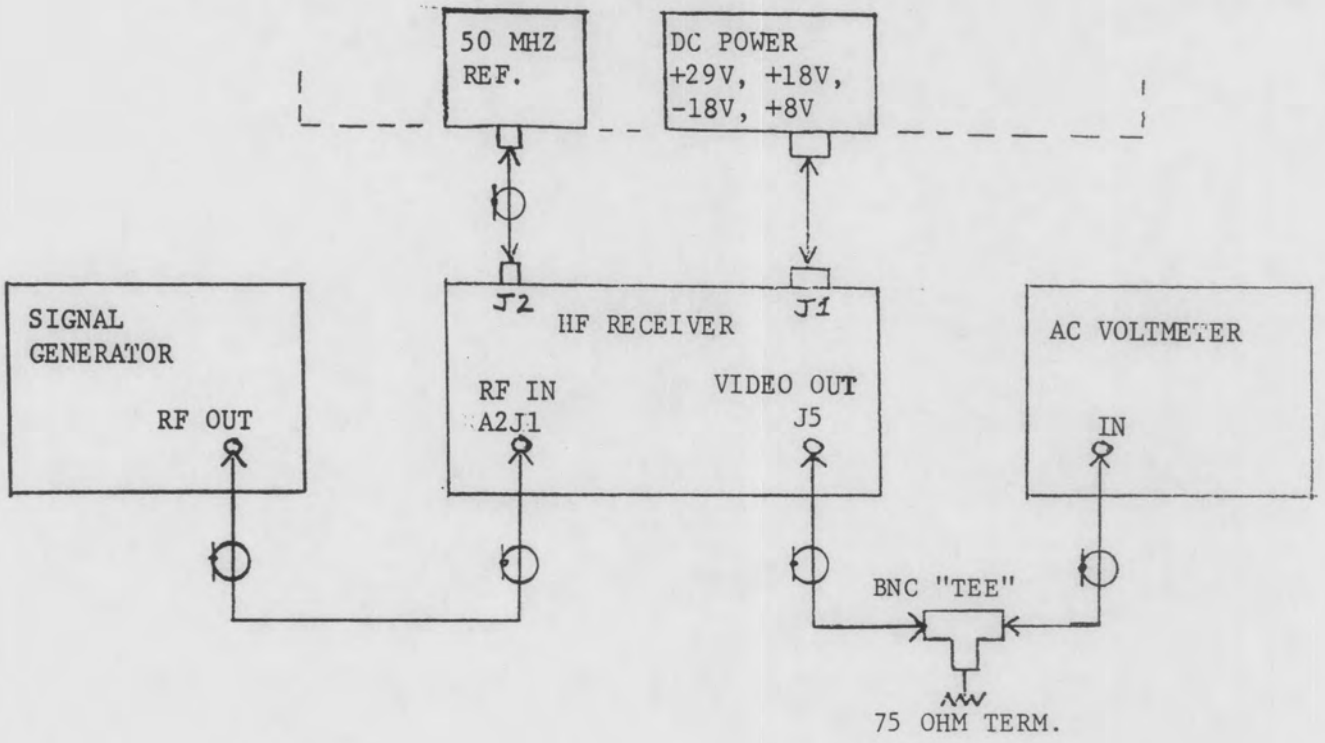



Figure 4-4 . SNR Test Equipment Setup

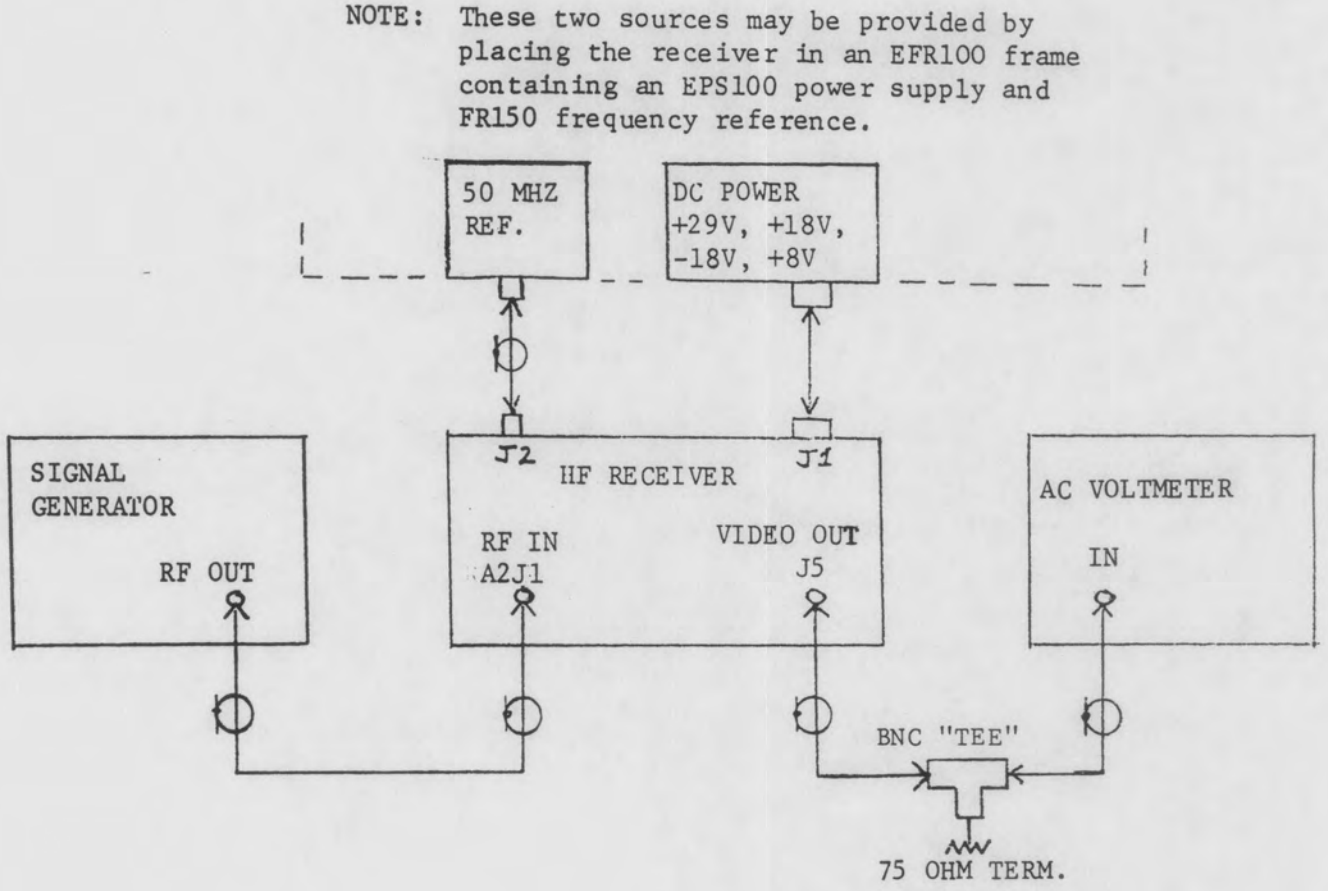



Figure 4-5 . Gain Control Test Equipment Setup

NOTE: These two sources may be provided by placing the receiver in an EFR100 frame containing an EPS100 power supply and FR150 frequency reference.

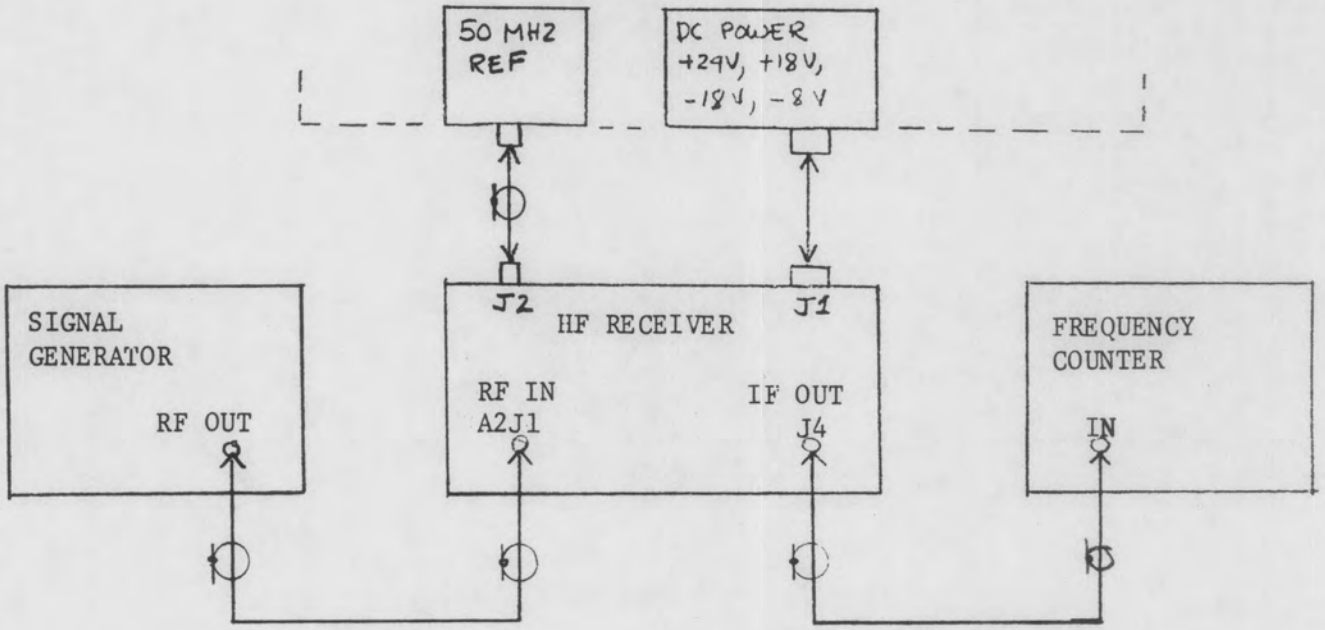



Figure 4-6. Frequency Tuning Accuracy Test Equipment Setup

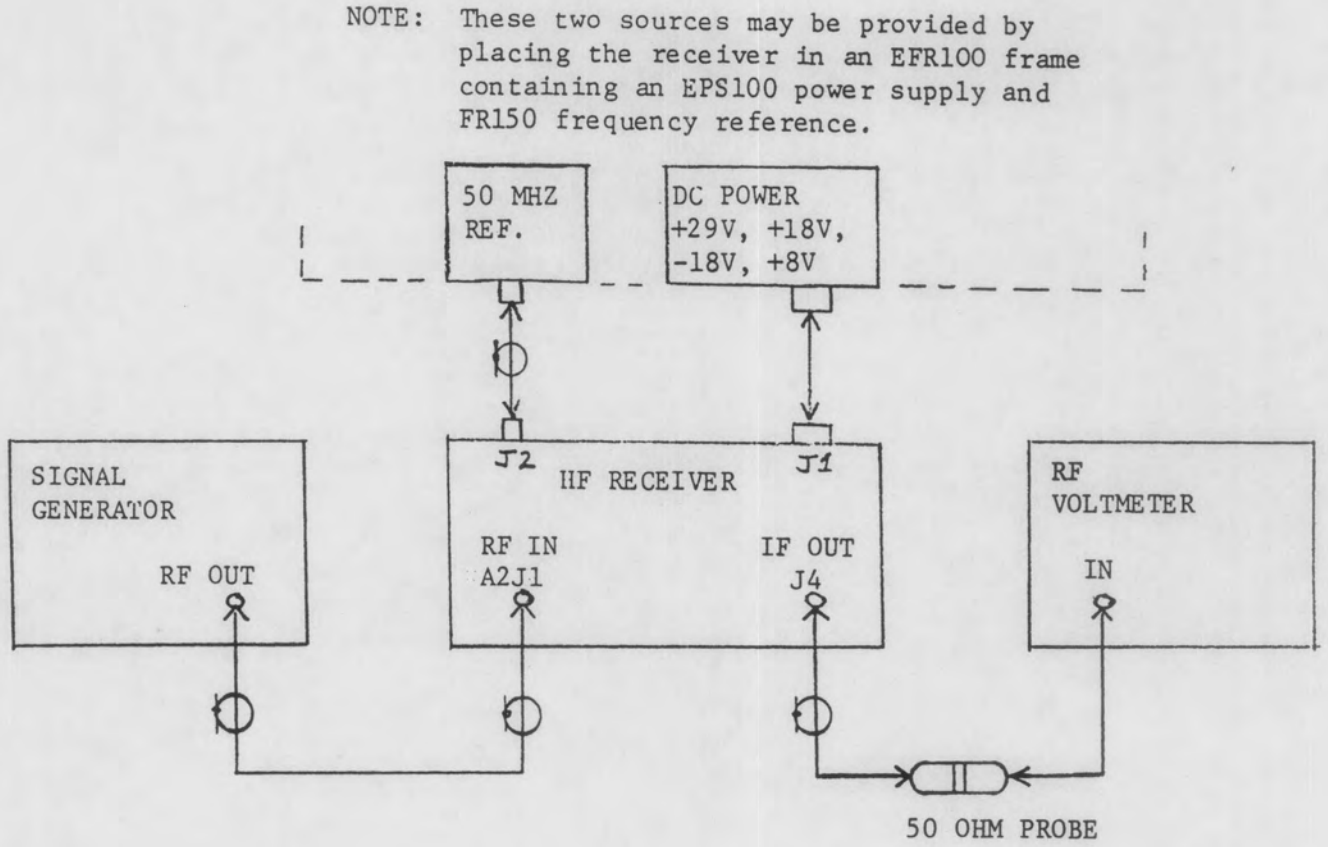



Figure 4-7 . Input Converter Adjustment Equipment Setup

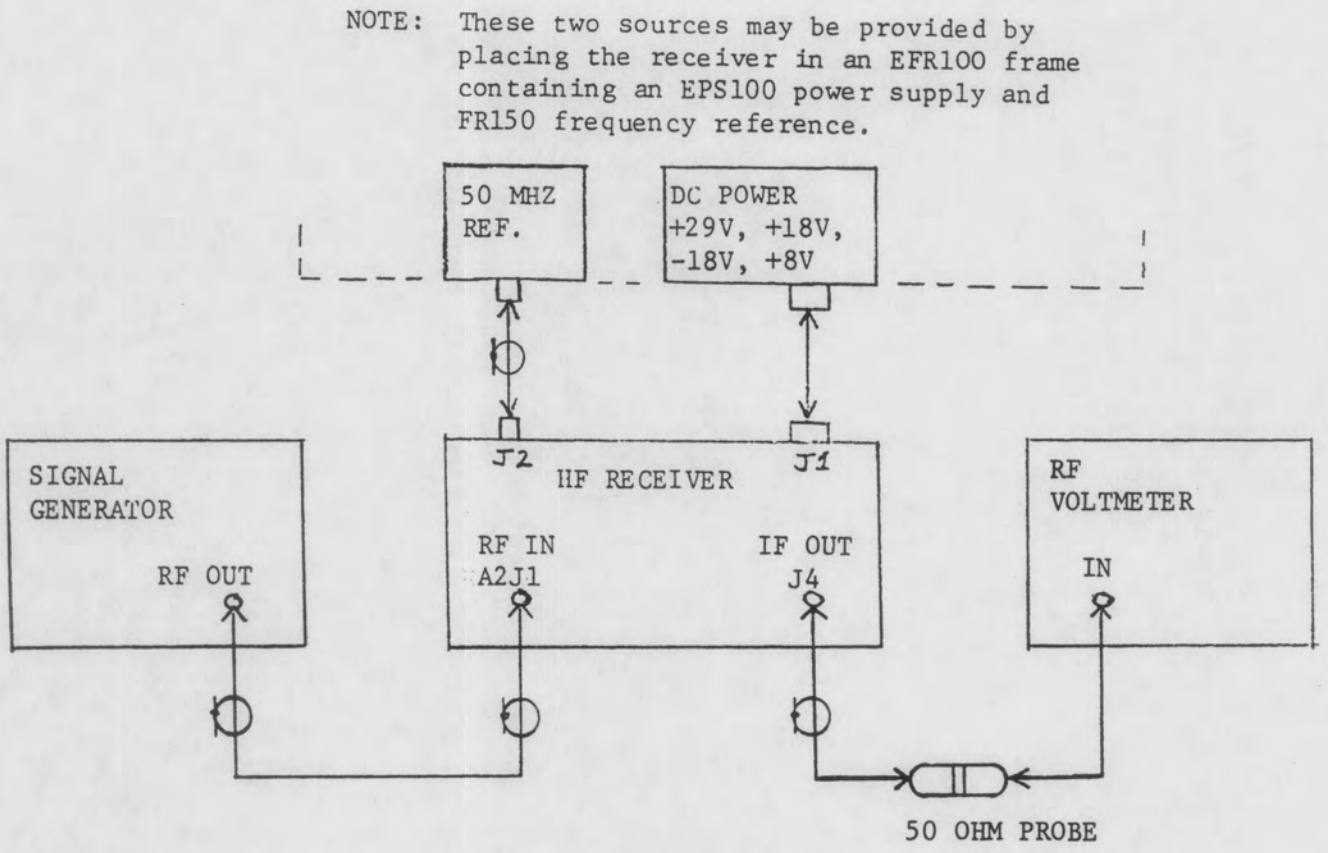
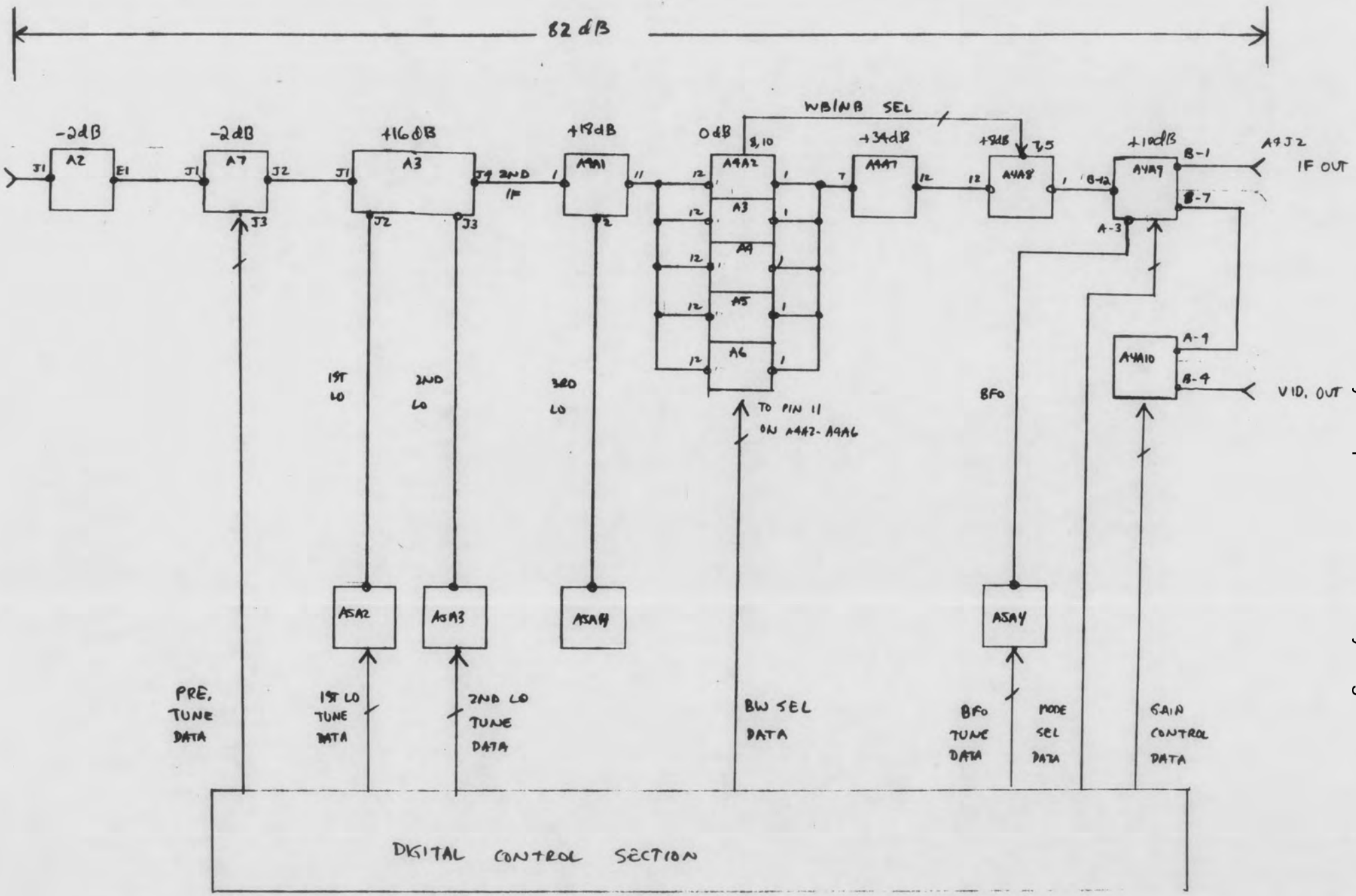



Figure 4- 8 . IF Gain Adjustment Equipment Setup

# LESSON TOPIC VI

# LRU SIGNAL TRACING/ANALYSIS




Receiver Skeleton Block Diagram

# LESSON TOPIC VII

# LRU FAULT ISOLATION TECHNIQUES

Table 4-4. WJ-8626A-4 HF Receiver Troubleshooting Chart.

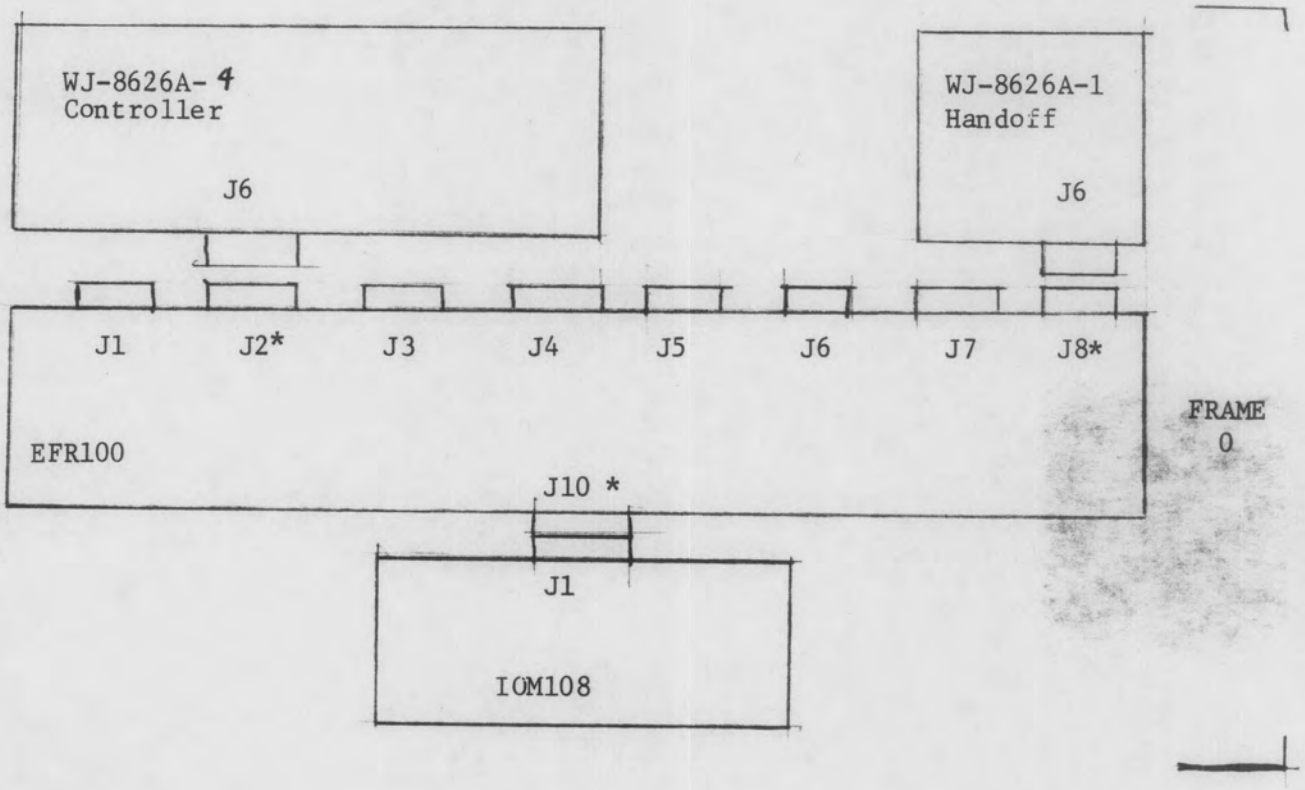
| Performance Test | Fault Symptom | Probable Cause | Corrective Action |
|---|---|---|---|
| POWER-UP TEST | No display brightness. | No display exciting voltage. | Check A9J5-17 for 90 VAC. If good, replace DS1. If not good, replace A9U1 |
| | | Power supply voltages low. | Check Voltage Regulator outputs: A1E1: +5V<br>A1E2: +15V<br>A1E3: -15V<br>If no good, replace A1. If good, replace A9A6. |
| | Display Adjust control does not work. | Defective control. | Check voltage at A9J5-9. Should vary from 0 to +5V. If good, replace A9A1. If not good, replace R3. |
| KEYBOARD/ DISPLAY FUNCTION | Initialization does not execute | Digital Control Section is dead. | Replace A9A3. If still not good, check AD0-AD7 and CLOCK lines for activity. If dead, selectively remove digital modules until lines become active.<br><br>If still not good, replace A9A5 and A9A6 and reinitialize. |
| | Cannot implement keypay control functions. | Defective keyboard interface circuit. | Check keyboard row (R1-R4) and column (C1-C7) inputs on A9J3. If good, replace A9A6. If not good, replace A8. |
| IF GAIN TEST | IF output dead on all BW's. | Defective AGC. | Replace A4A10. |
| | | Defective Input Converter. | Check A3 for 15 dB gain. If not good, replace A3. |
| | | LO signals defective. | Check LO signals:<br>1st: 57.91 MHz at +20 dBm at A3P2.<br>2nd: 32.20500 MHz at 0 dBm at A3P3.<br>3rd: 11.155 MHz at -6 dBm at A4E2.<br>If any LO is not good, first replace affected LO module. If still not good, replace A6, then A9A5. |

Table 4-4. WJ-8626A-4 HF Receiver Troubleshooting Chart. (Cont'd)

| Performance Test | Fault Symptom | Probable Cause | Corrective Action |
|---|---|---|---|
| IF GAIN TEST (Cont"d) | | Defective IF modules. | Check or replace A4A1, A4A7, A4A8, A4A9. |
| | IF output dead on 1 or more BW's. | Defective IF filter module(s). | Check BW select, pin 11, on affected module (A4A2-A4A6). Should be+15V when selected. If good, replace module associated with defective BW. If not good, replace A6, then A9A5. |
| | | Defective WB/NB filter module. | Check select inputs, pins 5 and 7, on A4A8. Should be +15V when selected. If good, replace A4A8. If not good, replace A6, then A9A5. |
| | Receiver gain is not constant from 500 kHz to 25 MHz. | Defective Preselector. | Replace Preselector. If still not good, replace A6, then A9A5. |
| DETECTION MODE TEST | No video output in any mode. | Defective Video output amplifier. | Replace A4A10, then A4A9. |
| | No AM video. | Defective AM det. | Check AM select at A4A9-B2 for +15 V. If good, replace A4A9. If not good, replace A6, then A9A5. |
| | No FM Video. | Deiective FM Det. | Check FM select at A4A9-A1 for +15 V. If good, replace A4A9. If not good, replace A6, then A9A5. |
| | No CW Video. | Defective CW det. | Check CW select at A4A9-A7 for +15 V. If not good, replace A6, then A9A5. If good, check BFO signal at A4A9-A12. Should be 455.000 kHz at 40 mV. If not good, replace A5A4, then A6, then A9A5. If BFO signal is good, then replace A4A9. |
| | No SSB Video. | | Replace A6, then A9A5. |

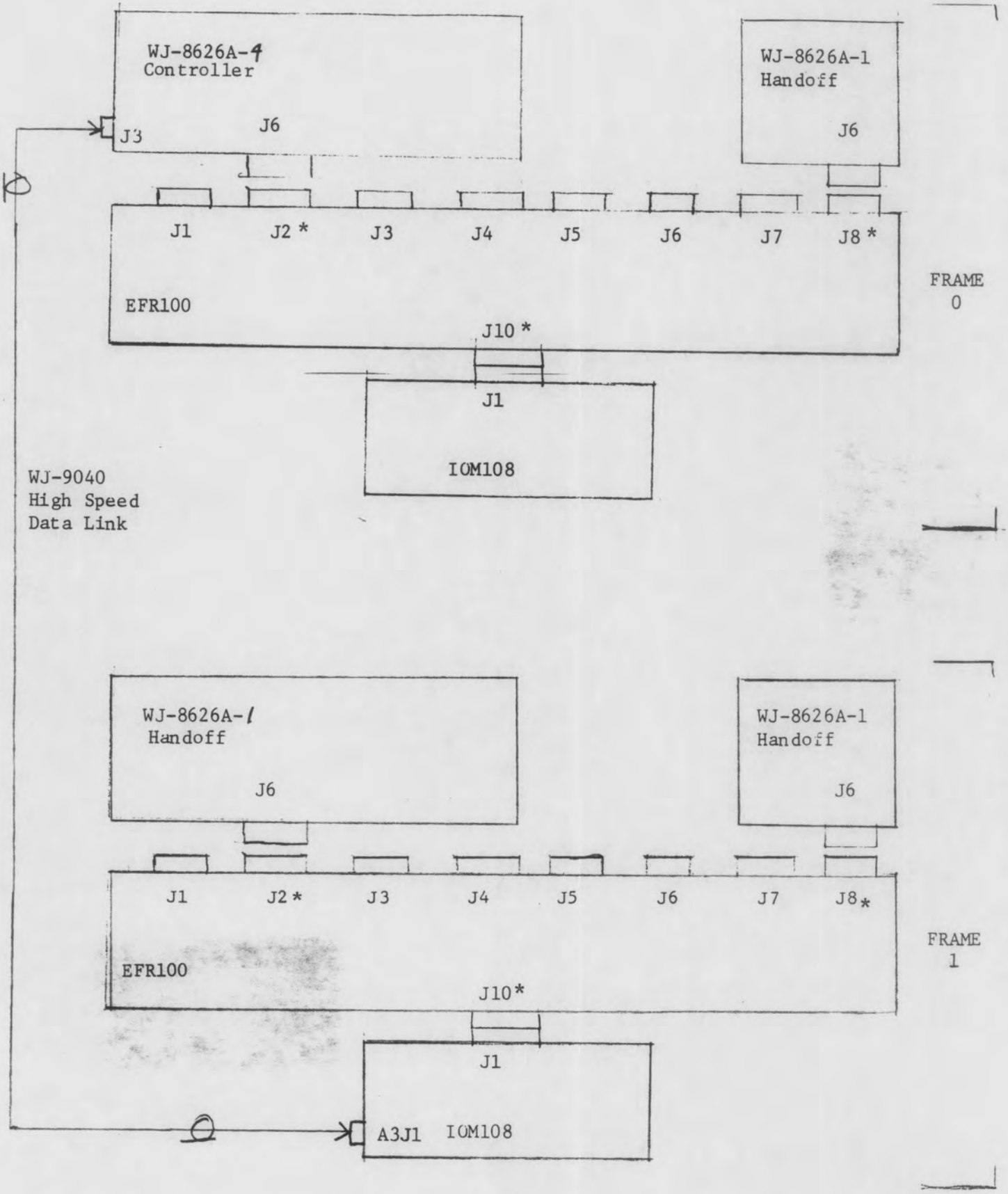
Table 4-4. WJ-8626A-4 HF Receiver Troubleshooting Chart. (Cont'd)

| Performance Test | Fault Symptom | Probable Cause | Corrective Action |
|---|---|---|---|
| SNR TEST | Signal to noise ratio is less than 16 dB. | Low receiver gain. | Perform IF Gain Alignment, paragraph 4.6.3. |
| | | Low 1st LO signal. | Check 1st LO signal at A3P2. Should be +20 dBm. If not good, replace A5A2. |
| | | Low Input Converter gain. | Check RF GC voltage at chassis terminal E4 for 0 Vdc. If good, replace A3. If not good, replace A4A10. |
| | | | Perform Input Converter Alignment, paragraph 4.6.2. |
| GAIN CONTROL TEST | Output level variation is more than 6 dB in FST. | Defective AGC Amplifier. | Check IF GC voltage at A4A10-A2. Should be greater than -4 Vdc at max. signal. If not good, replace A4A10. If good, replace A4A7. |
| | Manual gain range is not 100 dB. | Defective AGC Amplifier. | Check MAN GAIN IN. at A4A10-A4. Should be +0.75 V with RF GAIN at max CW. If good, replace A4A10. If not good, replace A6, then A9A5, then A9A6. |
| FREQUENCY TUNING ACCURACY TEST | Tuning error more than $\pm$ 100 Hz at 29.99990 MHz. | Time Base | Verify accuracy of external 50 MHz Reference. |
| | | 3rd LO unlocked. | Check 3rd LO signal at A4E2. Replace A5A4. |
| | | 1st or 2nd LO tuning error. | Replace A5A2 and A5A3. If still not good, replace A6, then A9A5. |




* = Active

Figure 2-6. Single Frame Hardware Configuration




* = Active

Figure 2-7. Multiframe Hardware Configuration

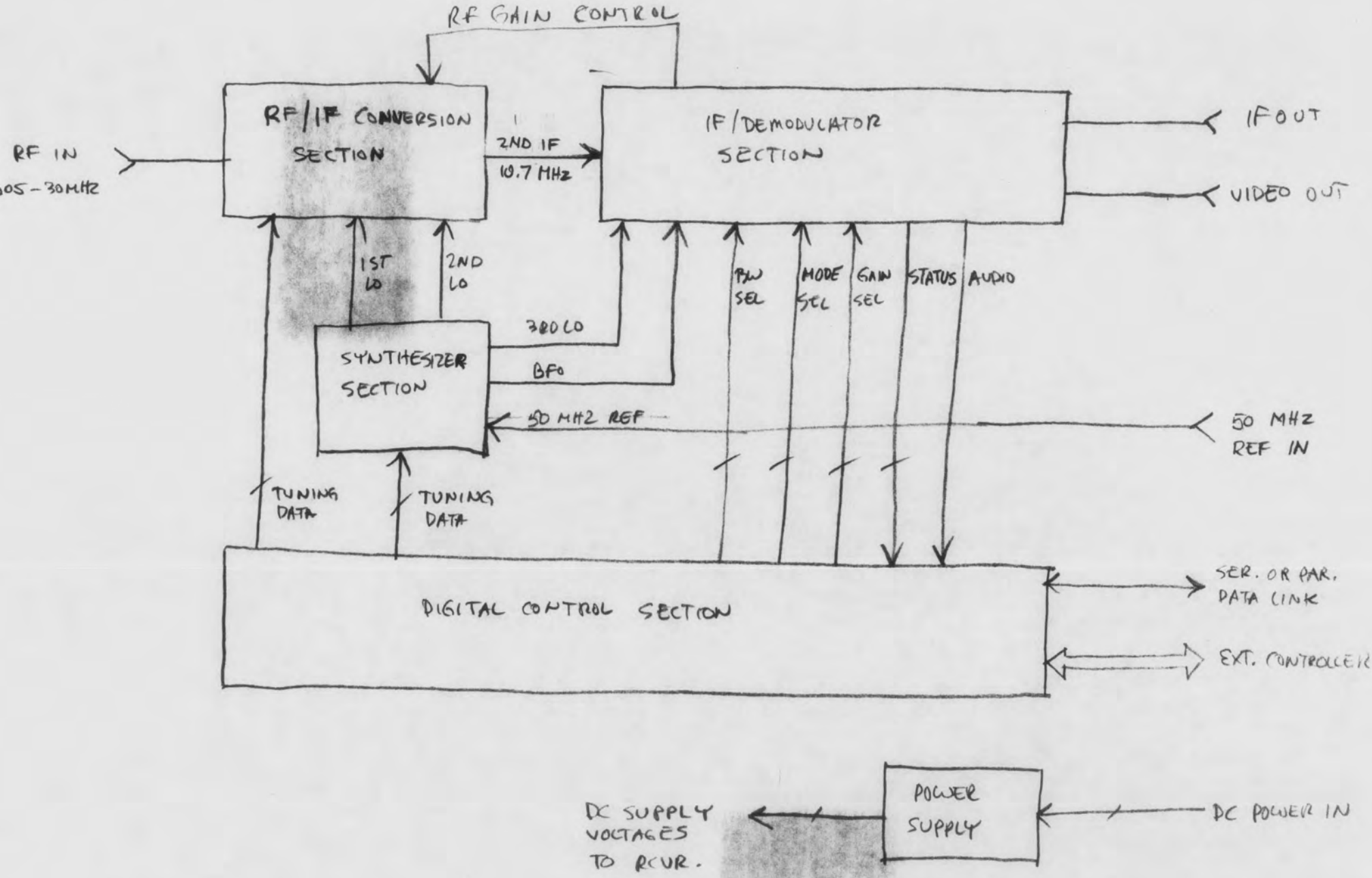



Figure 3-1. Simplified Overall Block Diagram

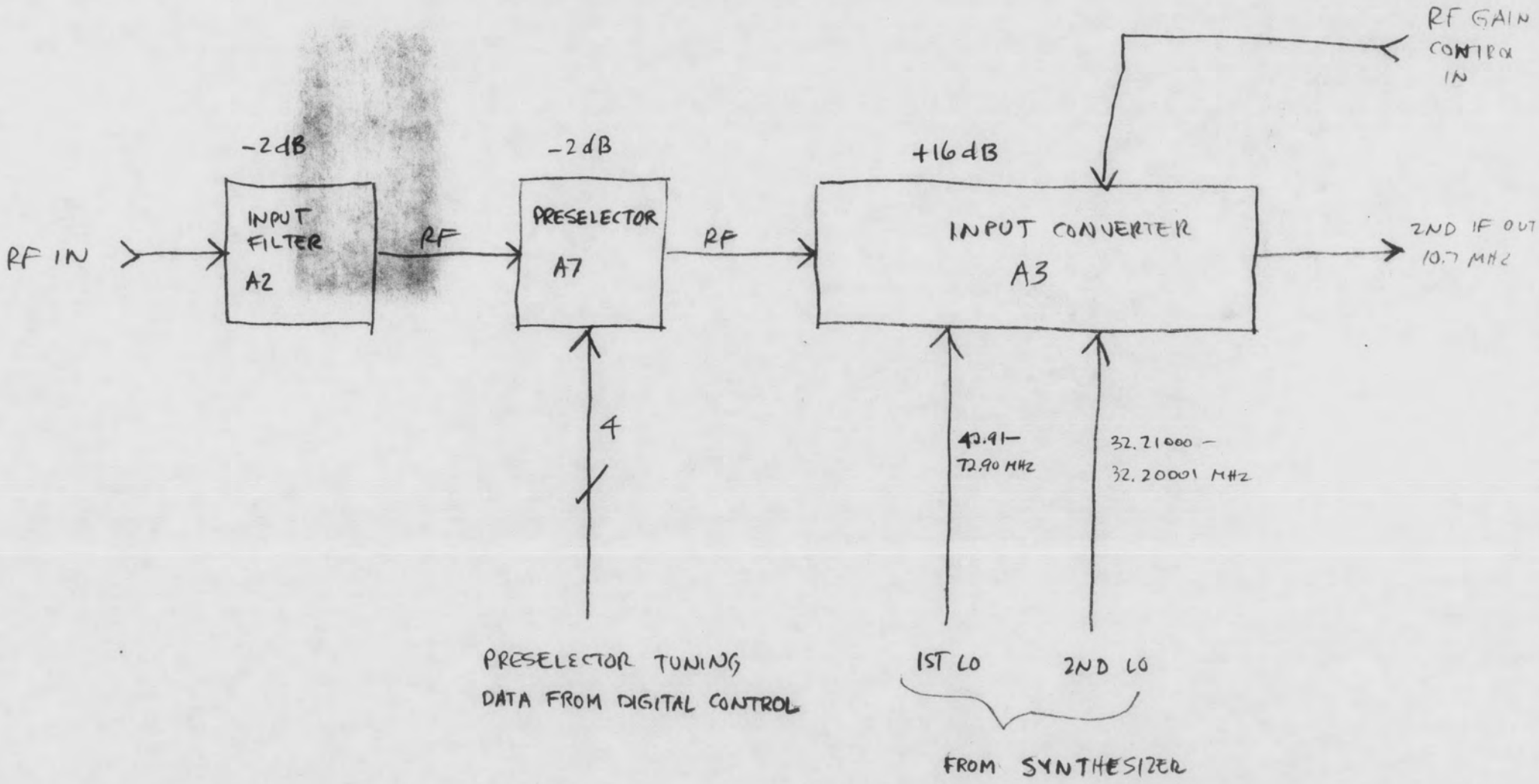



Figure 3-2. RF/IF Conversion Block Diagram.

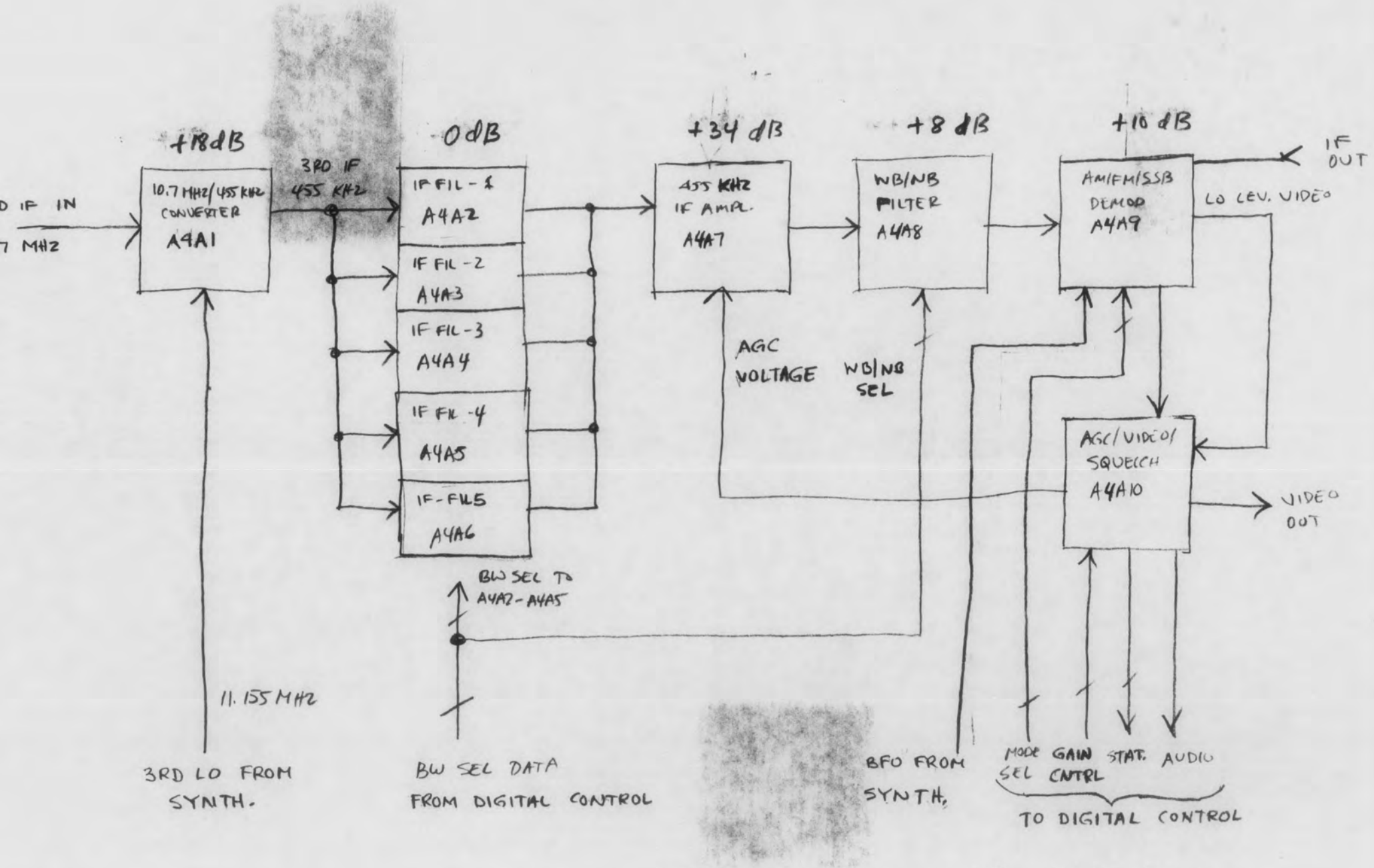



Figure 3-3. IF/Demodulator Block Diagram

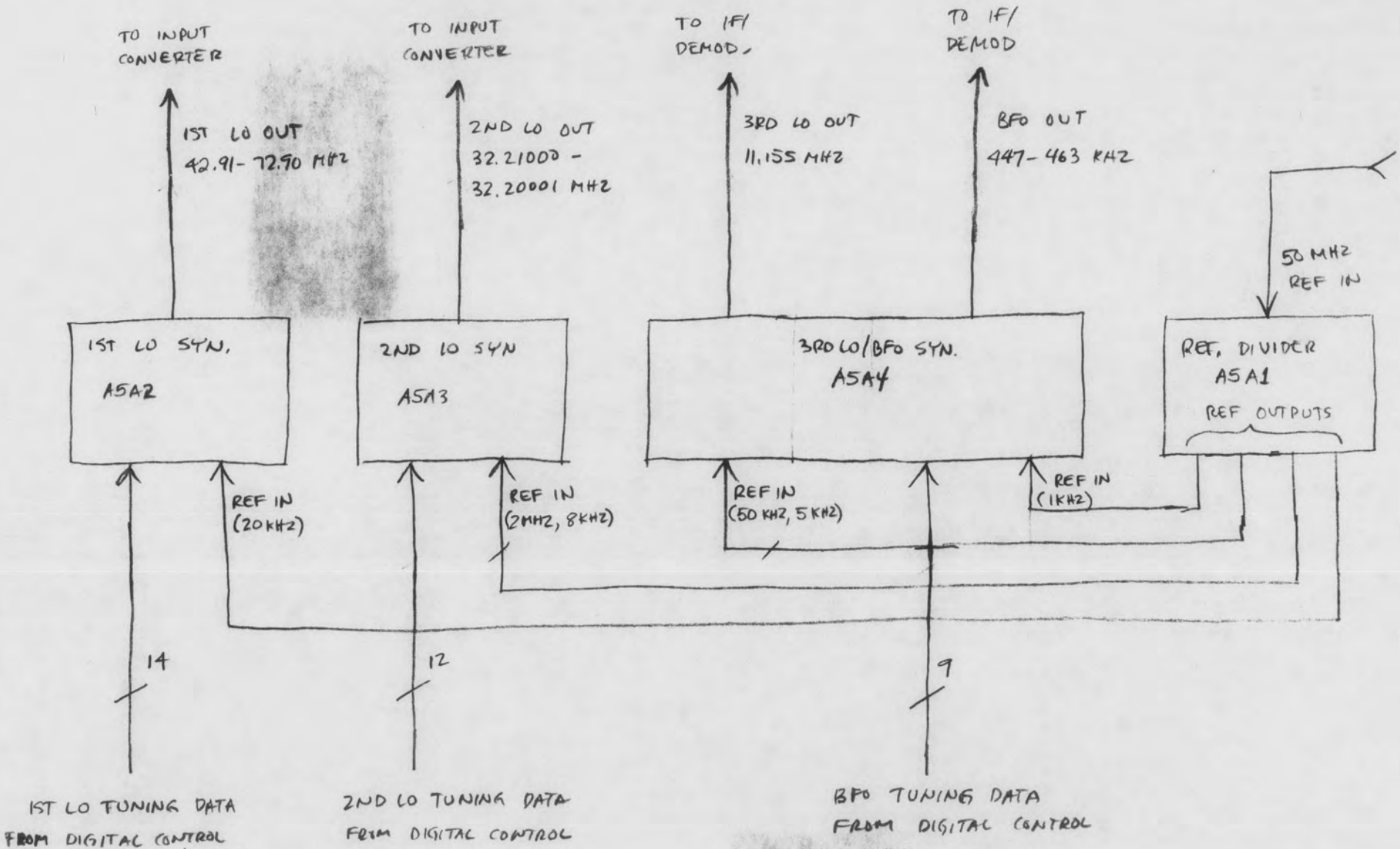



Figure 3-4. Synthesizer Block Diagram.

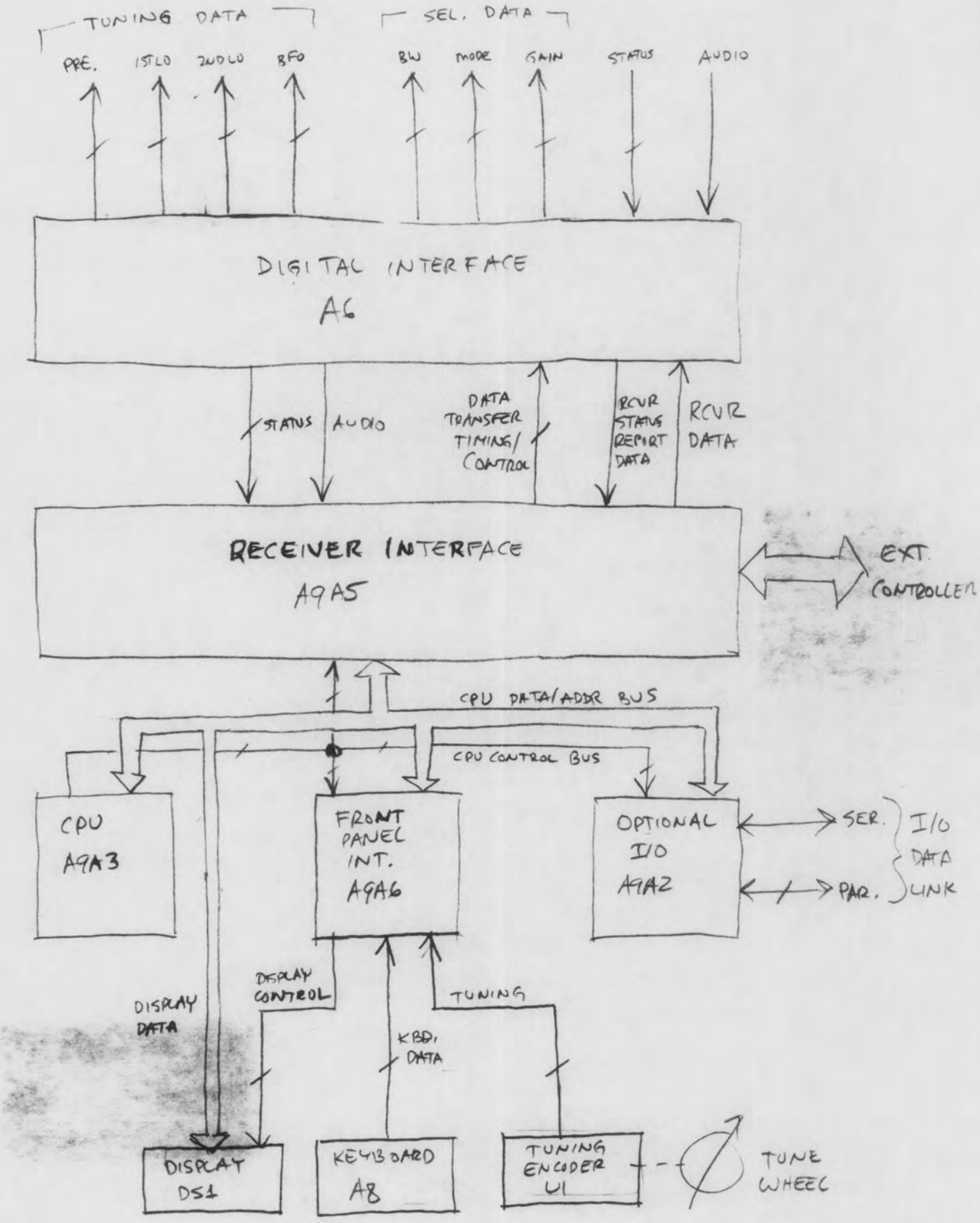



Figure 3-5. Digital Control Block Diagram.

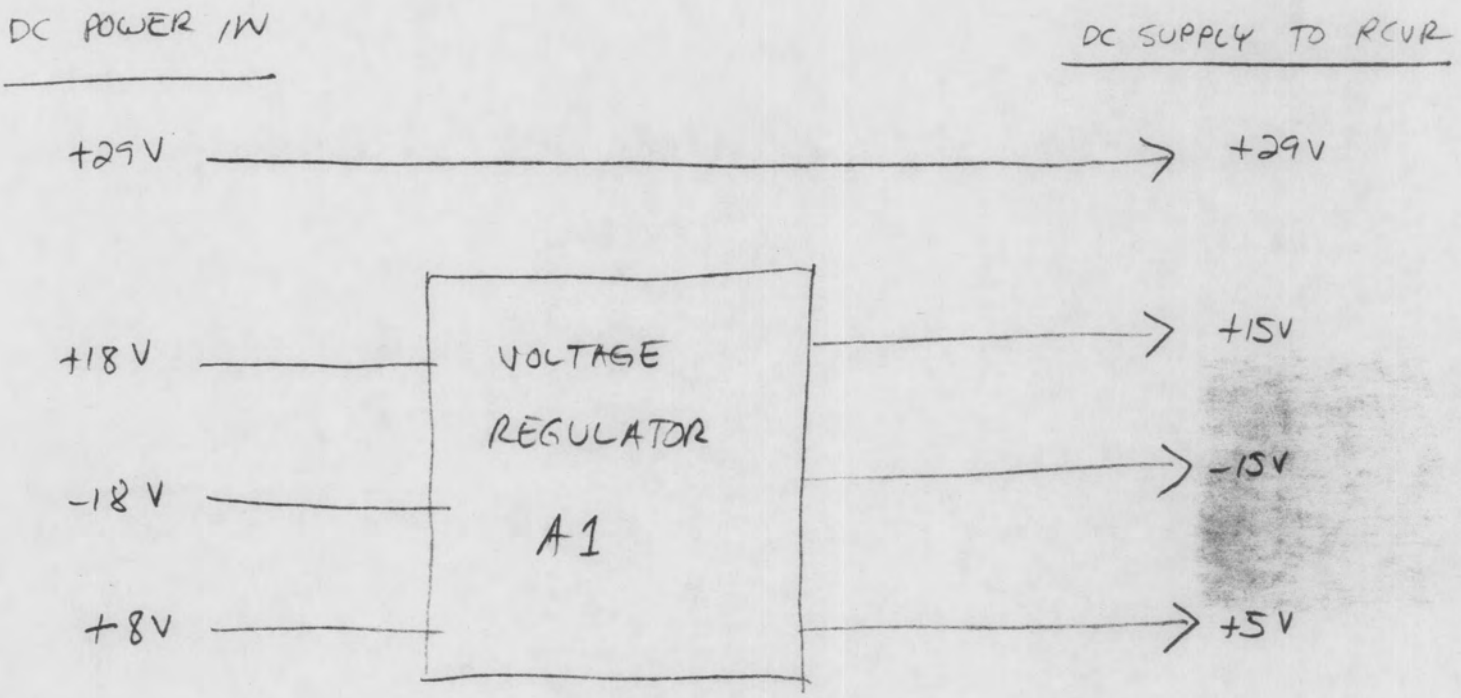
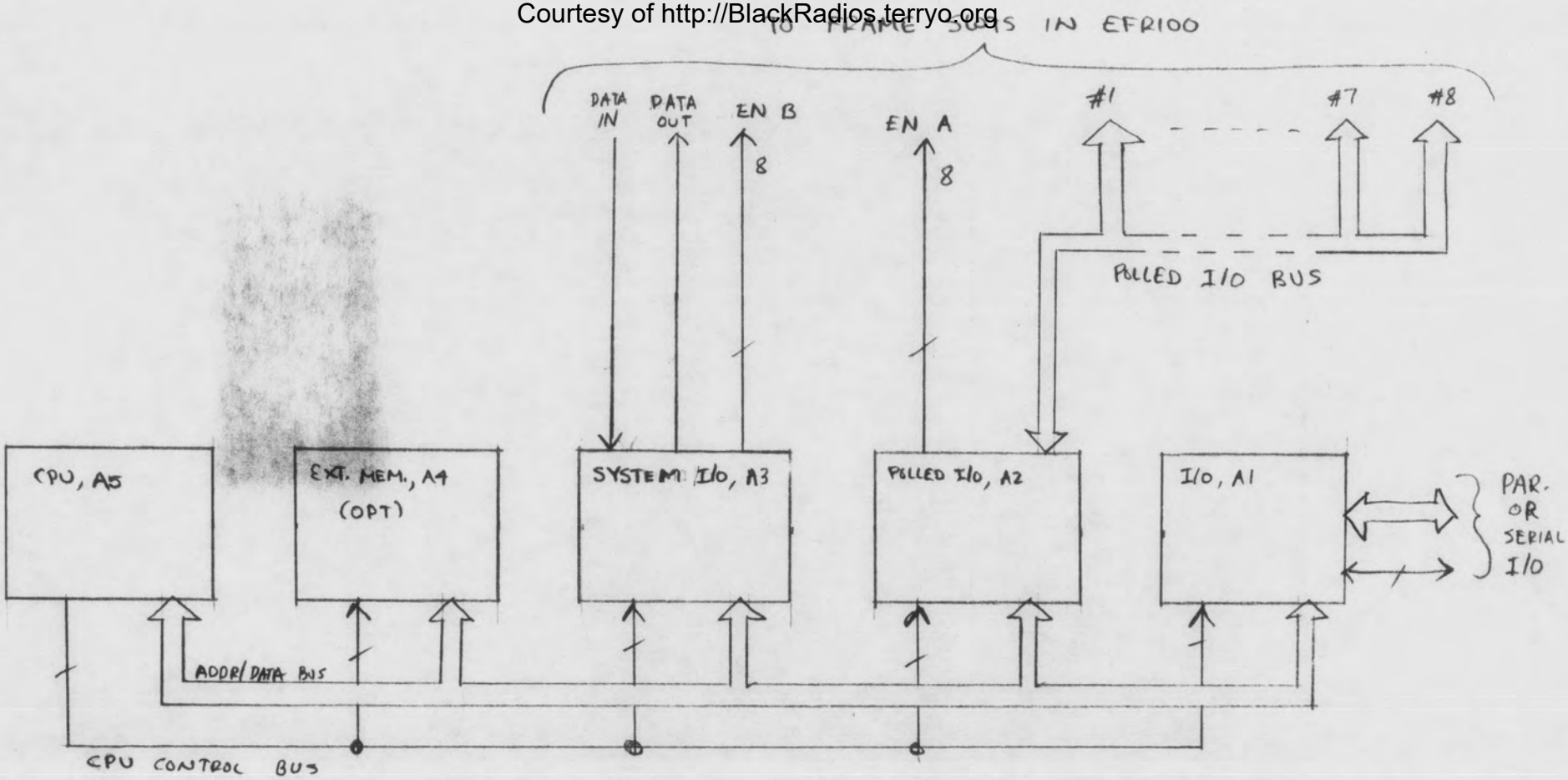



Figure 3-8 Power Supply Block Diagram

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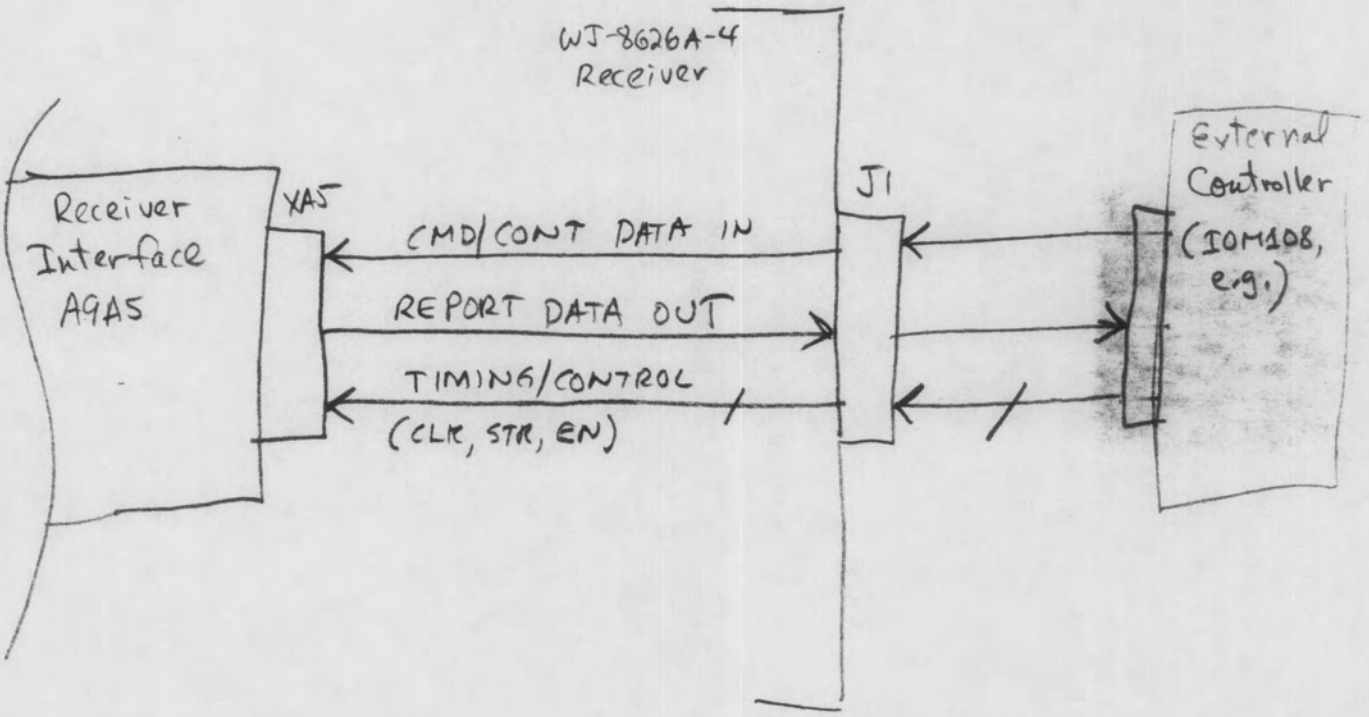
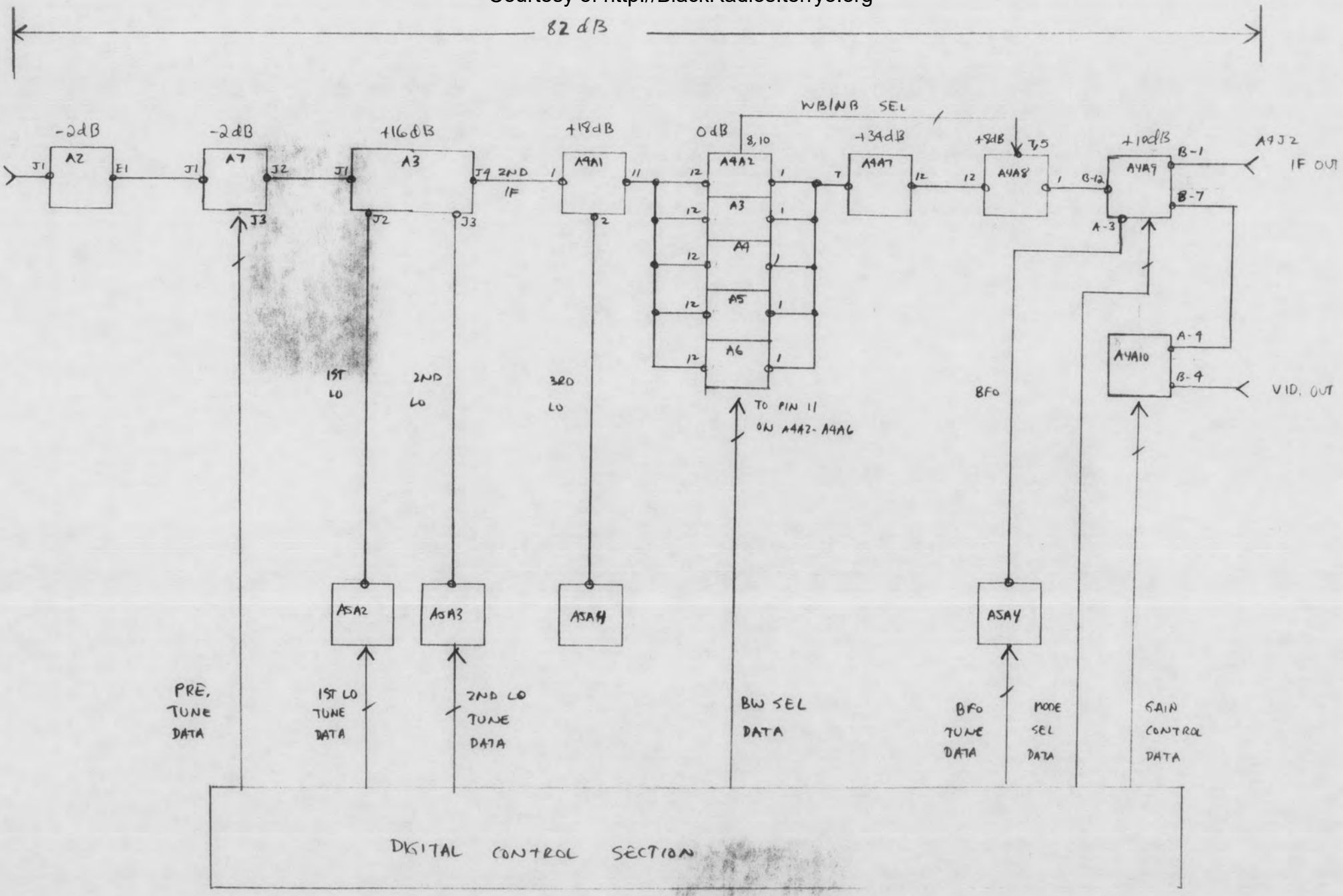



Figure 3-7. External Controller Interface.




Receiver Skeleton Block Diagram