Instruction Manual

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MODEL 1152-D
PHASE DEMODULATOR

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TRADE SECRETS

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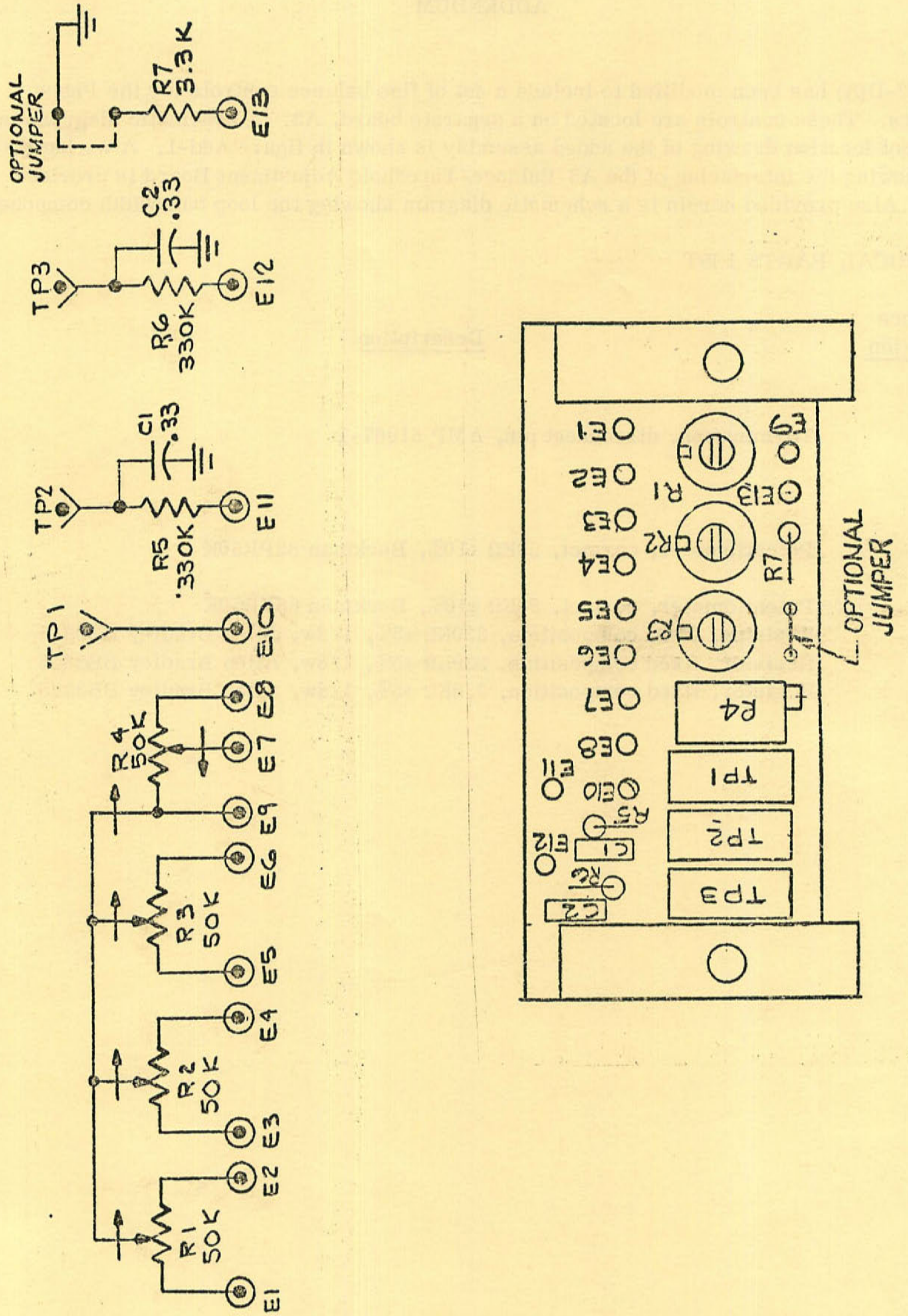
ADDENDUM

The 1152-D(A) has been modified to include a set of fine balance controls for the Phase Detectors. These controls are located on a separate board, A3. A schematic diagram and component location drawing of the added assembly is shown in figure Add-1. A wiring diagram showing the interfacing of the A3 Balance/Threshold Adjustment Board is provided herein. Also provided herein is a schematic diagram showing the loop bandwidth components.

ELECTRICAL PARTS LIST

Reference Designation	Description
E1 thru E13	Termination, disconnect pin, AMP 61067-1
R1 thru R3	Potentiometer, cermet, 50KΩ ±10%, Beckman 82PR50K
R4	Potentiometer, cermet, 50KΩ ±10%, Beckman 66XR50K
R5	Resistor, fixed composition, 330KΩ ±5%, 1/8w, Allen Bradley BB3345
R6	Resistor, fixed composition, 330KΩ ±5%, 1/8w, Allen Bradley BB3345
R7	Resistor, fixed composition, 3.3KΩ ±5%, 1/8w, Allen Bradley BB3325



Add-1. Balance/Threshold Adjustment Board

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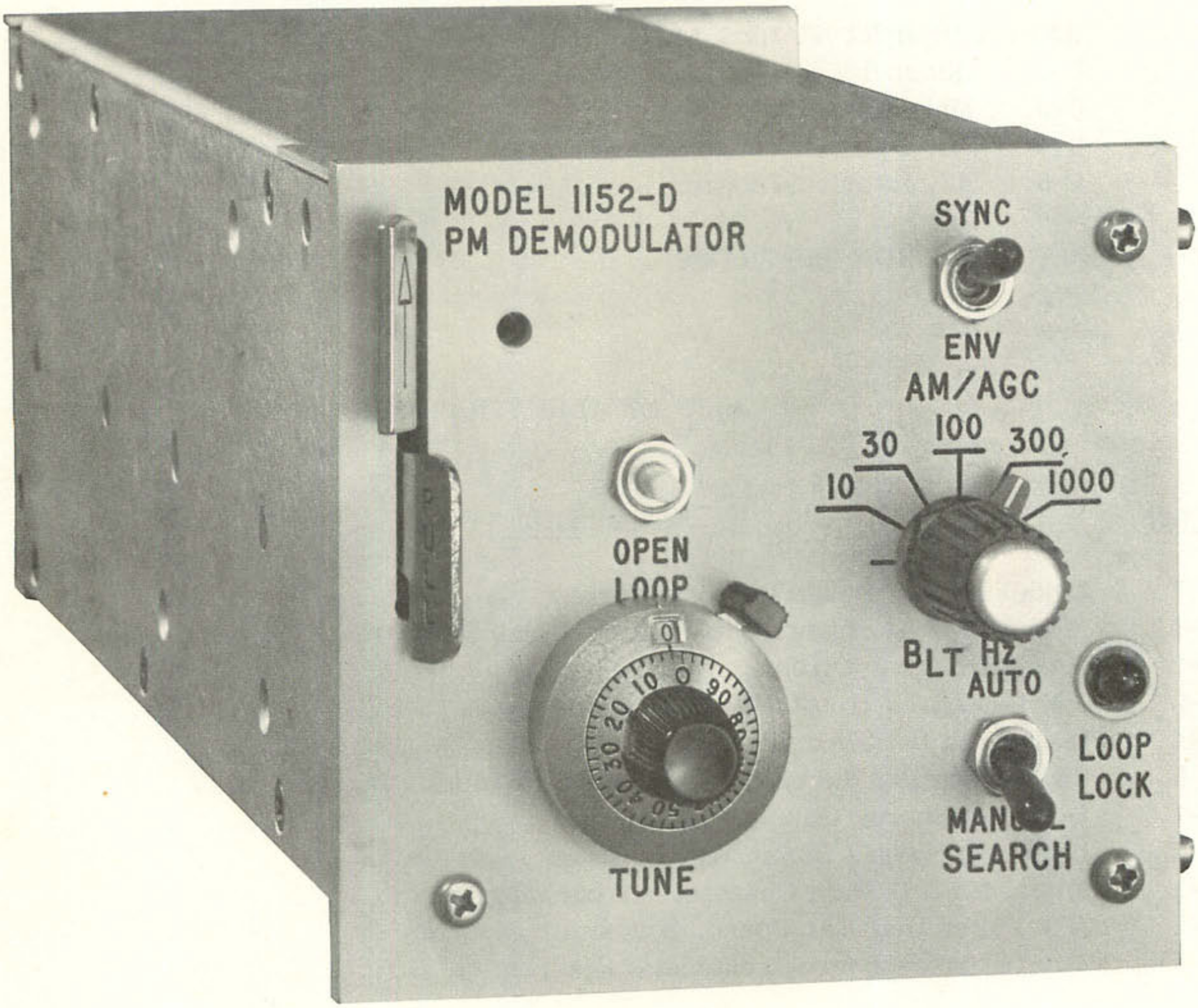


Figure 1-1. Model 1152-D Phase Demodulator

SECTION I
GENERAL INFORMATION

1-1. SCOPE. This manual provides installation, operation, and maintenance information for the Model 1152-D Phase Demodulator designed and manufactured by Microdyne Corporation, Rockville, Maryland.

1-2. PURPOSE AND DESCRIPTION

1-3. The 1152-D is an all solid-state PM demodulator designed for use with Microdyne telemetry equipment. Integrated circuits and related miniature components are used throughout the demodulator to provide an extremely stable and reliable unit.

1-4. In operation, the module accepts the 10 MHz second IF signal and a 10 MHz reference signal from the parent unit and supplies either a synchronous AM video output or an envelope AM video output, and a PM video output. The synchronous or envelope AM output is selectable through a front panel switch. For PM operation, the demodulator employs a cosine phase detector capable of retrieving phase modulation having deviations up to ±70 degrees. Other outputs from the demodulator include automatic phase control voltage (APC) for phase lock control of the parent unit second local oscillator, a coherent or non-coherent (envelope) AGC output, and drive voltages for the parent unit metering circuit. The bandwidth of the APC tracking loop is controlled by a front panel switch with bandwidths of 10, 30, 100, 300, and 1000 Hz normally supplied. Additionally, when the parent unit is set for phase operation, the center frequency of the second local oscillator is determined by the demodulator front panel fine tune control. Indication that the system is phase locked and tracking is provided by the illumination of a frontpanel display indicator and by the presence of a voltage on an output line. Should the phase tracking loop be broken, signal acquisition may be accomplished either automatically or manually depending on the position of front panel search selector and loop switches.

1-5. The 1152-D is constructed as a complete plug-in module for associated parent equipment. All electrical connections to the parent unit are made automatically upon installation through a single ribbon-type connector on the rear panel. The complete demodulator package is 10-1/2 inches deep, 3-1/4 inches high, 3-3/8 inches wide, and weighs approximately 2-1/2 pounds. Electrical, environmental, and mechanical specifications are given in table 1-1.

Table 1-1. Specifications

ELECTRICAL:	
Input Frequency	10 MHz.
Input Impedance	50 ohms.

continued

Table 1-1, continued

Electrical, continued	
Range of IF Bandwidths Accepted	10 kHz to 6 MHz.
Loop Characteristics:	
Operating Mode	Long loop using 10 MHz crystal oscillator as reference. Automatic phase control applied to parent unit 60 MHz second local oscillator.
Locking Threshold	-15 dB carrier-to-noise (C/N) ratio in the IF bandwidth or +6 dB C/N ratio in the loop bandwidth, whichever occurs first.
Loop Bandwidth Design Threshold	-15 dB C/N ratio in the IF bandwidth.
Phase Lock Loop Bandwidth (Single-sided noise bandwidth)	Switch selectable 10, 30, 100, 300, and 1000 Hz (unless specified otherwise by user).
Tracking Range	±250 kHz minimum.
Fine Tuning Range	±250 kHz minimum.
Static Phase Error	10° maximum.
Phase Deviation	±70 degrees.
Output Characteristics:	
Frequency Response (-3 dB):	
PM	To 1.7 MHz; low frequency rolloff determined by selected loop bandwidth.
Synchronous AM	5 Hz to 500 kHz; low frequency response may be modified by AGC time constant.
Synchronous AGC	Synchronous AM detector provides synchronois AGC output.
Residual Phase Noise	Less than 2° RMS for 10 Hz loop bandwidth.
Phase Deviation for Rated Output	±30 degrees.
Synchronous AM Output	30% AM will produce rated receiver video output.
Lock Acquisition Modes	Manual search or automatic search; switch selectable.

continued

Table 1-1, continued

ENVIRONMENTAL:	
Temperature Range:	
Operating	0°C to 50°C.
Storage	-62°C to +65°C.
Relative Humidity	To 95%.
Barometric Pressure:	
Operating	To 10,000 feet.
Storage	To 50,000 feet.
MECHANICAL:	
Physical Characteristics:	
Height	3-1/4 inches.
Width	3-3/8 inches.
Depth	10-1/2 inches.
Weight	Approximately 2.5 pounds.

SECTION II
INSTALLATION

2-1. GENERAL

2-2. The demodulator is shipped separate from the receiver with which it is used. It is contained in a polyethylene bag, wrapped in shock absorbing material, and packaged in a rugged cardboard container.

2-3. UNPACKING AND HANDLING

2-4. Upon receipt of the demodulator carton, cut the sealing tape and lift the package from the box. Open the bag and remove the demodulator. (Do not discard the packing material if the unit is to be reshipped, see paragraph 2-12.) Check the unit for in-transit damage; i.e. dents, broken connectors, etc. If damaged, notify the proper authorities immediately.

2-5. STORAGE

2-6. Storage conditions must be within the environmental limits specified in table 1-1.

2-7. INSTALLATION

2-8. The demodulator is held in place in the parent unit with a module lock and spring-actuated latch handle on the left side. This mechanism, in conjunction with an identical mechanism on the associated second IF filter/amplifier, firmly secures the demodulator in the parent unit.

2-9. To install a demodulator, mate it with the selected second IF filter/amplifier. Move the lock portions of the securing mechanism up and pull the PULL handles forward. Insert the demodulator and filter into the slot. Return the PULL handles to their original positions until the locks snap into place.

2-10. REMOVAL

2-11. To remove the demodulator from the parent unit, the companion filter/amplifier must also be removed. To do this, lift the module locks on both modules to disengage the releases. Extend the PULL handles and slide the demodulator/filter package out of the parent unit. To separate the demodulator and filter, simply pull them apart.

2-12. PACKAGING FOR RESHIPMENT

2-13. To package the demodulator for shipment, proceed as follows:

a. Place the unit and a quantity of desiccant into a moisture-proof polyethylene bag and seal.

b. Place the unit into a cardboard container using enough shock-absorbing material to prevent any movement within the carton.

c. Seal the carton.

d. Affix the necessary "Fragile" and "Delicate Equipment" labels.

SECTION III
OPERATION

3-1. GENERAL

3-2. This section contains operational information for the 1152-D demodulator. Included herein are: a list of controls and indicators and an operating procedure.

3-3. CONTROLS AND INDICATORS

3-4. The operating controls and indicators and a brief description of their function are listed below:

B_{LT} Hz Switch (A1S1)	This switch is used to select the phase tracking loop bandwidth in Hz. Bandwidths normally provided are: 10, 30, 100, 300, and 1000 Hz. In addition, two other undesignated positions are also available for special applications. The lowest position adjacent to the 10 Hz position is approximately 10 Hz but is to be used only when the carrier to noise ratio in the IF is 0 dB or higher. The highest position adjacent to the 1000 Hz position provides an approximate bandwidth of 3000 Hz. It is limited in use to those periods when the receiver is equipped with a 3.3 MHz Second IF Filter/Amplifier.
AM/AGC Switch (A1S2)	This switch is employed to select the AGC and AM video outputs of the demodulator. The SYNC (synchronous) position selects the output of the demodulator synchronous AM detector. The ENV (envelope) position selects the envelope AM and AGC supplied by the receiver AM detector module which is interfaced with the demodulator.
LOOP OPEN/CLOSED Switch (A1S3)	Momentary spring-loaded switch which, when depressed, opens the phase tracking loop to permit manual acquisition.
SEARCH MANUAL/AUTO Switch (A1S4)	This switch is employed to select either the manual or automatic search-for-lock operating mode.
TUNE Control (A1R64)	This potentiometer is connected to the receiver second local oscillator and its positioning determines the oscillator center frequency. Using this control, the center frequency can be changed ±250 kHz from the nominal 60 MHz output.
LOOP LOCK Indicator (A1DS1)	The LOOP LOCK indicator is a light-emitting diode (LED) which illuminates when the demodulator is phase locked.

3-5. OPERATING PROCEDURE

3-6. Two signal acquisition (search) modes are available with the 1152-D: manual or automatic. The operating procedure for each of these modes is given in the following paragraphs.

3-7. MANUAL ACQUISITION

3-8. The following procedure is recommended for manual acquisition of phase lock.

a. On the parent unit: set the 1ST LO MODE switch to XTAL. Adjust the TUNE control to the desired frequency and insert the required crystal. Set the 2ND LO MODE switch to PM.

b. On the demodulator, set the following controls to the positions indicated:

AM/AGC	as desired - SYNC (synchronous) or ENV (envelope).
SEARCH	MANUAL.
B_{LT} Hz	any position (see paragraph 3-4 for restrictions).
TUNE	5.

c. Depress and hold the LOOP switch in the OPEN position and adjust the TUNE control for an aural zero beat tone from the parent unit speaker. Release the switch. The LOOP LOCK indicator should light.

d. Slowly adjust the TUNE control to minimize the loop stress as indicated by a zeroing of the TUNING meter on the parent unit.

e. Set the B_{LT} Hz switch to the desired range (see paragraph 3-4 for restrictions).

f. Set the parent unit video controls as required.

3-9. AUTOMATIC ACQUISITION

3-10. The following procedure is recommended for automatic acquisition of phase lock.

a. On the parent unit: set the 1ST LO MODE switch to XTAL. Adjust the TUNE control to the desired frequency and insert the required crystal. Set the 2ND LO MODE switch to PM.

b. On the demodulator, set the following controls to the positions indicated:

AM/AGC	as desired - SYNC (synchronous) or ENV (envelope).
SEARCH	AUTO.
B_{LT} Hz	1000 or as desired (see paragraph 3-4 for restrictions).
TUNE	5.

c. With the SEARCH switch in the AUTO position, the demodulator will search until signal acquisition, at which time, the LOOP LOCK indicator will illuminate.

d. Adjust the TUNE control to minimize the loop stress as indicated by zeroing of the TUNING meter on the parent unit.

e. Set the B_{LT} Hz switch to the desired range.

f. Set the parent unit video controls as required.

g. In the 10 and 30 Hz B_{LT} Hz positions, it may be necessary to deactivate the automatic search as the signal approaches the zero beat.

SECTION IV
THEORY OF OPERATION

4-1. GENERAL

4-2. The 1152-D phase demodulator (figure 4-1) is employed to derive both phase and synchronous AM data for application to the rear video output. It also functions to supply drive voltages to the receiver deviation meter. Other outputs are a lock/unlock output for controlling external equipment and either a synchronous (coherent) AGC output or an envelope AGC output; the envelope AGC is supplied by the receiver AM detector. Circuitry within the demodulator automatically switches the AGC to either coherent or envelope depending on whether or not the receiver is phase locked. A switch is provided to override the automatic function and is used to maintain the envelope AGC mode only.

4-3. Outputs supplied directly by the demodulator are derived from a phase detector, synchronous AM detector, and a lock detector. Signals are routed directly to the receiver circuitry as in the case of the video output, or are processed through interface circuitry for multiple routing and normalization.

4-4. CIRCUIT DESCRIPTION

4-5. The 1152-D can be broken down into the phase detector circuit, the AM detector circuit, and the lock and sweep circuit. Each of these circuits is discussed separately in the following paragraphs and is keyed to both schematic and block diagrams.

4-6. PHASE DETECTOR CIRCUIT

4-7. The phase detector circuit is shown in figures 4-2 and 7-2 and is composed of input buffer Q1, IF limiter U1, reference limiter U2, phase detector U4A-Q8-Q9, and output amplifier U8.

4-8. The 10 MHz second IF signal at a nominal level of -15 dBm is applied to P1-A4 and is coupled by C1 to input buffer Q1. This stage is utilized to establish the 50 ohm interface impedance and to isolate the phase detector from preceding stages of the receiver. From Q1, the IF signal is applied to three-stage limiter U1A, U1B, and U1C. Each stage of the limiter functions as a push-pull amplifier with 20 dB of gain and transforms the analog IF signal to a square wave having MECL logic levels having a high level of -0.96 to -0.81V and a low level of -1.85 to -1.65V. Since these levels are riding on -6V DC, the actual outputs at pins 2 and 3 have a high level between -6.96 and -6.81V and a low level between -7.85V and -7.65V. Two outputs at a 180 degree phase differential are taken from U1C with one (pin 2) being applied to lock detector U4B and the other (pin 3) being applied to phase detector U4A-Q8-Q9.

4-9. The 10 MHz reference signal from the receiver calibration/reference oscillator module is applied to P1-A1. From P1-A1, the signal is routed to buffer amplifier Q3 which drives reference limiter U2A-U2B-U2C. This circuit is identical to the limiter (U1),

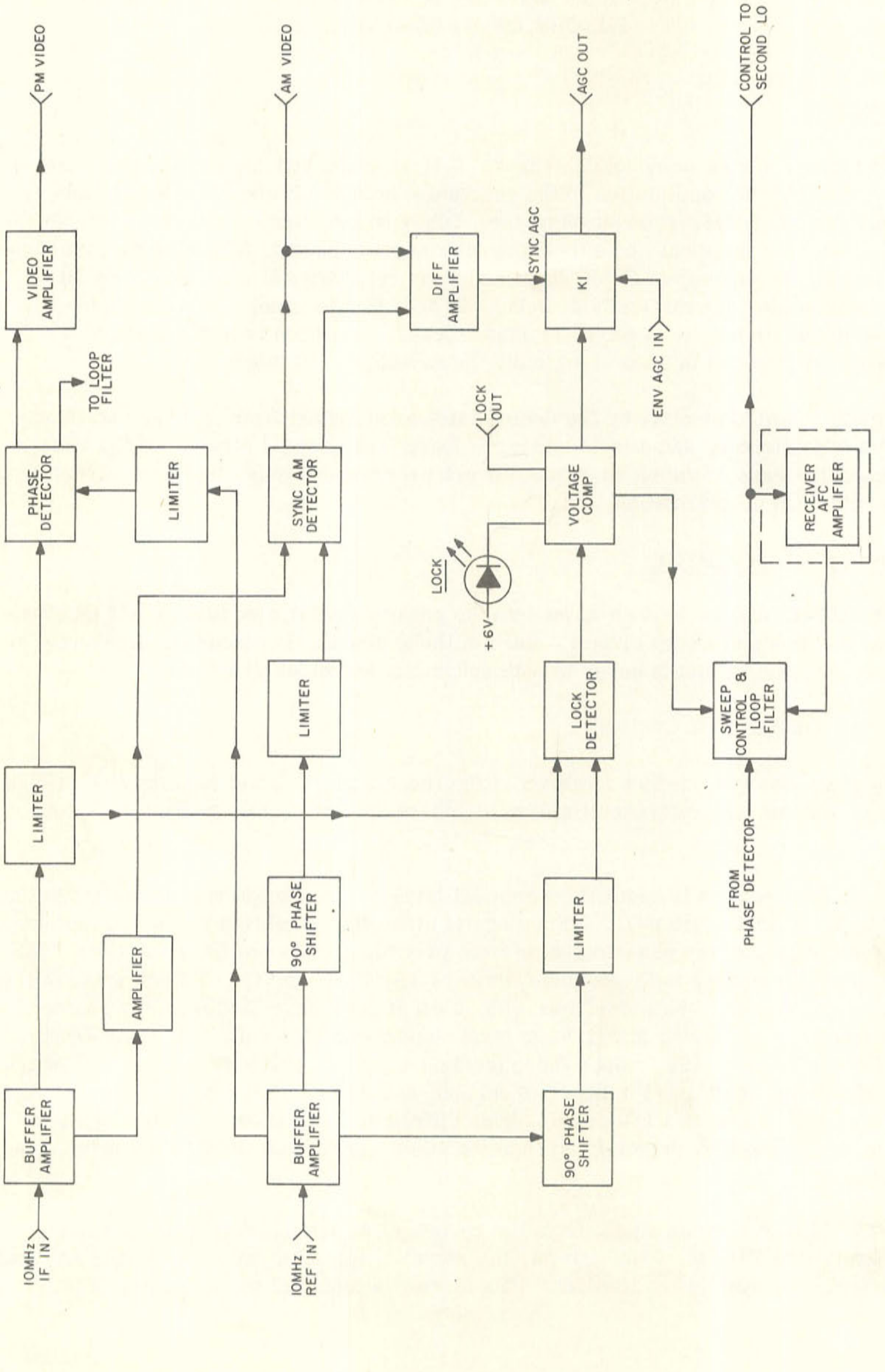


Figure 4-1. Model 1152-D Phase Demodulator, Block Diagram

described in the preceding paragraph and drives the other phase detector input. In both limiters, the biasing voltages are supplied by the "D" portion of the respective integrated circuit.

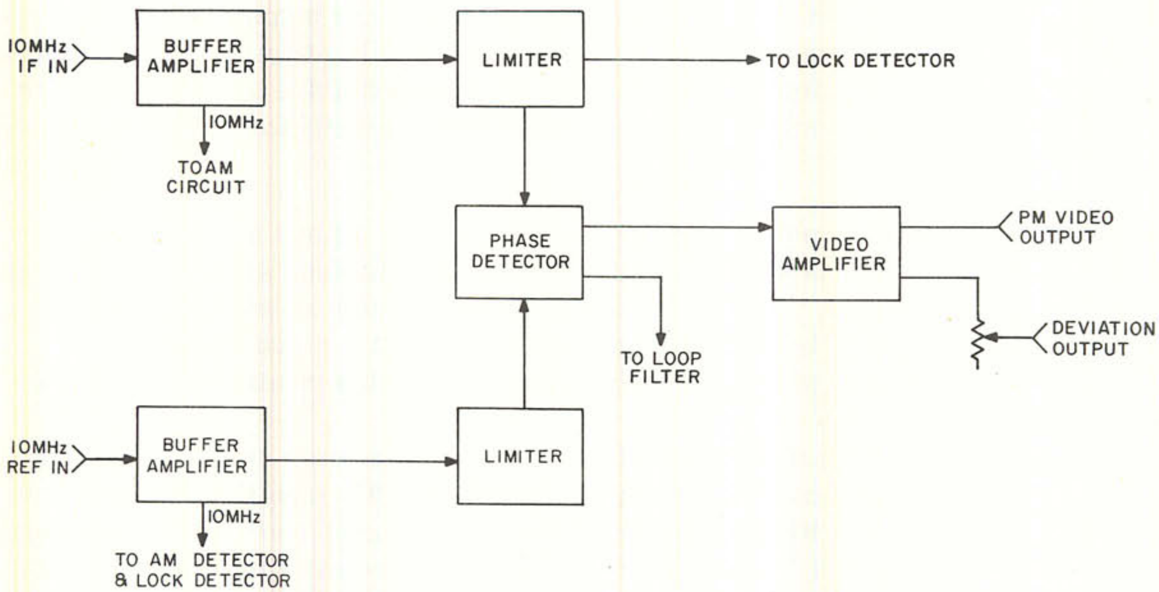


Figure 4-2. Phase Detector Circuit, Block Diagram

4-10. An exclusive OR circuit (U4A) with 90 degree phase shifted inputs is used as the phase detector and functions as a double balanced mixer to derive the PM data. Outputs from U4A are taken from pins 3 and 2, and are applied to translators Q8 and Q9, respectively, which function to remove the 6V DC reference level introduced in the limiter so that the data is now referenced around 0V; potentiometer R75 is provided as the 0V calibration adjustment. One output of Q8-Q9 is filtered and applied to output amplifier U8. This is a dual transistor with the output taken from the emitter circuit and routed to the PM video output at P1-A3. A sample of the PM video is coupled through deviation meter adjustment R96 to P1-25. This adjustment is set to provide a full-scale receiver deviation meter indication with 1 radian of phase modulation. Characteristics of the phase detector circuit are such that the rated video output of 1.414V RMS is achieved with a minimum of ±30 degrees of phase deviation. The second PM detector output is taken from Q9's collector and routed to the input of the loop filter for controlling the receiver second local oscillator.

4-11. AM DETECTOR CIRCUITRY

4-12. AM detector circuitry is shown in figures 4-3, 7-1, and 7-3, and consists of amplifier Q2, 45 degree phase shifters Q4 and Q5, limiter U3A-U3B-U3C, linear AM detector U6, and current source U7. The 10 MHz IF signal from input buffer Q1 is amplified by Q2 and coupled to the linear AM detector (U6) through transformer T1; the gain of Q2 is set during alignment by R6 for optimum operation. Outputs from T1 are taken from pins 6 and 4, at a

180 degree phase differential, and applied to pins 11 and 3 of U6. The 10 MHz reference signal from input buffer Q3 is coupled through a pair of 45 degree phase shifters (90 degrees total shift) to limiter U3. This stage is identical to the limiters previously discussed and supplies two 180 degree phase shifted outputs to U6. Using this scheme, the inputs at U6-9, 2, and 11 are in phase and those at U6-3, 13, and 6 are in phase when the demodulator IF and reference inputs are 10 MHz. Unlike the phase detector, the outputs of the AM detector are at a maximum differential voltage when the two inputs are in phase. Balancing of the detector and phasing are controlled by potentiometers R114 and R40, respectively. In addition, translation from the 6V limiter reference level to the 0V detector reference level takes place in U6.

4-13. Two outputs are taken from U6 at pins 7 and 1 and pins 14 and 8. The output at pins 14 and 8 is routed to the AM video output buffer on the interface subassembly A2 (figure 7-3) via W3, S2A, and W12. AM video buffer A2U6 is a dual emitter follower which drives the AM video output at P1-32. Characteristics of the AM circuit are such that the rated receiver video output of 1.414V RMS is achieved with a minimum of 30% AM.

4-14. In addition to driving the AM video buffer, the phase detector outputs at terminals 26 and 27 (see figure 7-2) are applied to differential amplifier A2U1 (see figure 7-3). The output of the differential amplifier which is proportional to the signal level and AM modulation is used as the source voltage for the receiver AGC system synchronous (coherent) AGC operation and is applied to relay K1. When the front panel AM/AGC switch (S2) is set to the SYNC position, K1 will be closed and coherent AGC will be supplied to the receiver only when the phase loop is locked. During the period when lock is broken and when the auto search cycle is enabled, K1 is open and envelope AGC, originating in the receiver AM detector, is supplied to the receiver. Should S2 be set to the ENV (envelope) position, K1 is maintained in the OPEN position, as shown in figure 7-3, since the +6V DC source at terminal 5 and pin 2 of K1 has been removed. In this state, envelope AGC will be supplied at all times regardless of whether or not the unit is phase locked. A further description of the locked/unlocked states of the loop is given in the following paragraphs.

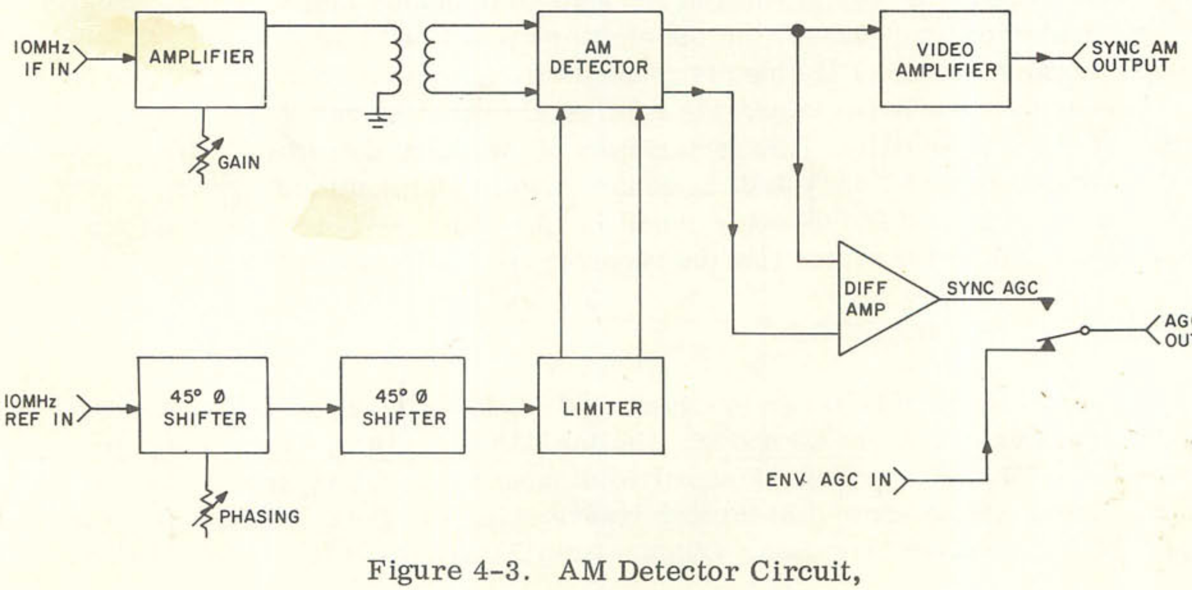


Figure 4-3. AM Detector Circuit, Block Diagram

4-15. LOCK AND SWEEP CIRCUITRY

4-16. The lock and sweep circuitry consists of the lock detector on subassembly A1 (figure 7-2), and the loop filter on subassembly A2 (figure 7-3).

4-17. The lock detector circuit is located on subassembly A1 (figure 7-2) and consists of 45 degree phase shifters Q6 and Q7, limiter U5, and quadrature phase detector U4B-Q10-Q11. This circuit functions to supply an output for controlling relay K1 and front panel lock indicator DS1, and for enabling or disabling the sweep circuit (see paragraph 4-4). The 10 MHz reference signal from input amplifier Q3 is applied to a pair of 45 degree phase shifters (90 degrees total shift) which drives limiter U5. This stage is identical to the limiters previously discussed and supplies one input to lock detector U4. The 10 MHz IF signal is applied to U4-14 from pin 2 of U1C. With the 90 degree phase shift in the limiter, both inputs to the detector are in phase.

4-18. In the detector, the two inputs are compared to derive a voltage output and applied to Q10 and Q11 to transform the reference level from -6V to 0V DC. When the inputs to the detector are present and in-phase, a level of approximately +2.5V DC is taken from the collectors of Q10 and Q11; out-of-phase signals cause a decreasing voltage level at the output. The level at Q11 is applied to inverting input of voltage comparator U4 in subassembly A2 (see figure 7-3) as long as the output of the detector circuit applied to U4-4 remains above the 100 mV reference level at U4-3; the comparator output at U4-9 is at zero volts DC or a slight negative voltage. In this state, the sweep control circuit composed of U2-U3-Q2-Q3-Q4 is off. Additionally, U2A and U2B are on which energizes K1 (if S2 is set to SYNC) and illuminates the front panel lock indicator connected between +6V DC and terminal 8. Transistor Q1 is off and the resultant +15V collector level at terminal 9 is applied to rear panel connector P1 at pin 12 as an indication that a phase locked condition exists. During phase lock, the output from the phase detector U4A-Q8-Q9 at the collector of Q9 (see figure 7-2) is applied to timing resistors R39 through R45 (see figure 7-3). These resistors are tied to the input of the integrator on the receiver AFC amplifier via P1-A2 and are progressively shorted out depending on the position of the demodulator LOOP BANDWIDTH Hz switch S1 section B. The output of the integrator, which also drives the receiver second local oscillator, is tied to P1-19 as is the integrator timing capacitor. Thus, the loop is formed as shown in figure 4-4. During this mode, the loop maintains phase lock by continuously adjusting the frequency of the second local oscillator (LO) over a range of ±250 kHz around the second LO center frequency. The center frequency of the second LO is controlled over a ±250 kHz range by the positioning of the demodulator FINE TUNE control (R1 figure 7-1). This control is electrically connected between terminals 51 and 52 (see figure 7-3) which are the outputs of active filter Q5-Q6-CR7-CR8 which functions as a precision +12.7 and -12.7V power supply.

4-19. When phase lock is broken due to signal drop out or exceeding the receiver tracking range, the output of the lock detector (U4A-Q10-Q11, figure 7-2), drops to 0V. This action causes the output of voltage comparator U4 (figure 7-3) to become approximately +5V DC. When this occurs, U2A shuts off and disables K1 to route envelope AGC to the receiver AGC circuitry to prevent saturation of gain controlled stages. Simultaneously, U2B shuts off which opens the ground path to the cathode of DS1 on the front panel shutting it off. With

U2B off, Q1 is on providing a 0 to +0.5V output on the lock indicator circuit denoting loss of lock. Additionally, the sweep control circuit (U3A, B-U2C, D-Q2-Q3-Q4) is enabled.

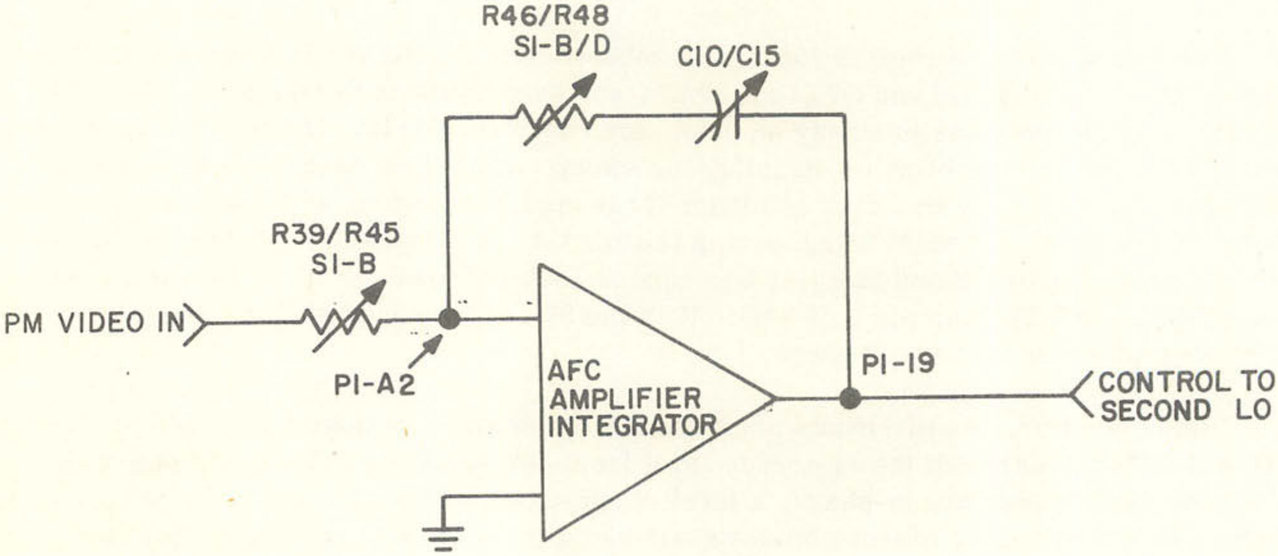


Figure 4-4. Integrator (AFC Amplifier)

4-20. To discuss the sweep circuit, it must be assumed that all circuits are set to their original starting points which means that U7Q1 and Q3 are on and U7Q2 and Q4 are off. This assumption places a positive level at U5-2 via S1G and terminals 59, 60, 61, 64, or 66 and terminal 45. Because all inputs to gating stage U3A are high (positive), the resulting low logic level turns on Q2 and Q4; Q3 is off. In this state, the circuit appears as shown below:

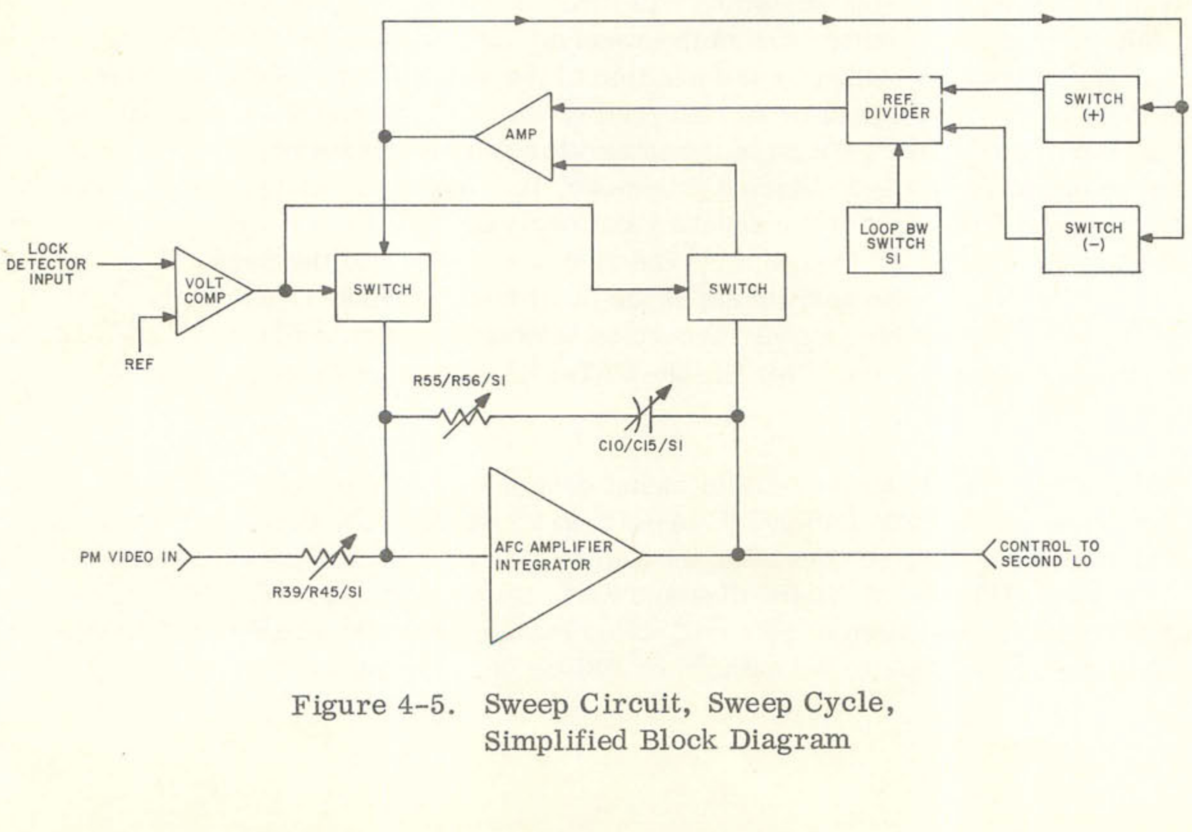


Figure 4-5. Sweep Circuit, Sweep Cycle, Simplified Block Diagram

4-21. When Q4 is turned on, the current flow through Q4 and divider R55 through R66 begins charging capacitors C10 through C15; the exact resistor-capacitor combination is dependent on the positioning of B_{LT} Hz switch S1 sections A, C, and E. As the capacitor(s) charge, the level at P1-19 begins to increase in a positive direction. As this level, also felt at U5-3, approaches and exceeds the positive reference level applied to U5-2, the positive high level at U5-7 switches to the low 0 to -0.5V level. The resultant low level is fed to U3A, disabling the gate and turning off Q2 and Q4 via U2C, to inverter U3C which turns on Q3 via U3B and U2D. The low level at U5-7 also turns on U7Q2 and Q4, and turns off U7Q1 and Q3. In this state, a negative voltage reference is applied to U5-2 via S1G, resistors R83 through R87, and terminals 59, 60, 61, 64, or 66, and 45. With Q3 on, the selected combination of capacitors (C10 through C15) begins to discharge very rapidily; this is the retrace portion of the sweep cycle. As the voltage at P1-19 and U5-3 approaches and exceeds the negative reference level of U5-2, U5 again reverts to its positive output, all stages are reset, and the sweep cycle is initiated. Thus it can be seen that the level that the output at P1-19 achieves, which controls the sweep range, is directly dependent on the reference level supplied to U5-2 from divider R83 through R87. These ranges are fixed to a level of ±100 Hz per ohm of resistance in the divider with the pickoffs determined by the loop bandwidth selected. Similarly, the rate at which the second local oscillator is swept over its range is determined by the RC time constant of the combination of C10 through C15 and resistors R55 through R66. This function is also dependent on the loop bandwidth selected with the rates vs. bandwidth as follows:

Loop Bandwidth	Sweep Rate	Ramp Voltage Level	Frequency Limits
-	120 Hz/sec	±60 mV	±3 kHz
10 Hz	230 Hz/sec	±200 mV	±10 kHz
30 Hz	670 Hz/sec	±600 mV	±30 kHz
100 Hz	2.6 kHz/sec	±2V	±100 kHz
300 Hz	22 kHz/sec	±5V	±250 kHz
1000 Hz	250 kHz/sec	±8V	±>300 kHz
-	2.3 MHz/sec	±8V	±>300 kHz

4-22. When a 10 MHz signal is applied to the lock detector (U4B-Q10-Q11 figure 7-2), the output level at the collector of Q11 rises in a positive direction as the phase difference between the IF and reference inputs decreases. Phase lock and the resultant disabling of the sweep control circuit will occur at the instant the filtered lock detector output exceeds the reference level at pin 5 of comparator U4 (figure 7-3). Since the detector level due to the difference frequency beat at high signal levels could exceed the reference before optimum phase lock conditions exist, a low pass filter proportional to the loop bandwidth selected is introduced into the circuit to delay the application of the lock signal. The delay is accomplished via RC filter R10 through R15 and C1 through C8. Connections to S1 section F are made via terminals 10 through 16 with the switch functioning to progressively short out an

RC pair. Delay times for each loop bandwidth will vary with signal level. Lock filter bandwidths are:

Loop Bandwidth	Lock Filter Bandwidth
-	0.03 Hz
10 Hz	0.1 Hz
30 Hz	0.3 Hz
100 Hz	0.9 Hz
300 Hz	2 Hz
1000 Hz	3 Hz
-	10 Hz

At the end of the delay period, the lock detector output causes the comparator to switch to its low state. This action enables K1 via U2A, turns on LOOP LOCK indicator DS1 via U2B and terminal 8, and supplies the +15V lock indication to P1-12 via terminal 9 by turning off Q1. In addition, the sweep control circuit is turned off by the disabling of gates U3A and U3B with the low level.

4-23. When the demodulator is operated in the manual mode as selected by S3 or at any time the LOOP switch (S4) is depressed, a ground is applied to terminal 80. This effectively disables the sweep circuit by maintaining a low level at one of the inputs of both U3A and U3B. Phase lock is now accomplished by adjusting the second LO frequency through the FINE TUNE control and listening for the zero beat tone at the receiver speaker. Once the tone is heard (aural null), the LOOP switch is released and phase lock occurs. If the SEARCH switch (S3) is in the AUTO position, phase lock will be automatically reacquired upon loss of lock via the sweep circuitry. If S3 is in the MAN (manual) position, phase lock must be made via the FINE TUNE control by active operator intervention. When manually acquiring phase lock, the LOOP switch must be depressed as described above. The LOOP switch may also be used to open the tracking and initiate automatic search if it is suspected that sideband lock has occurred.

SECTION V
MAINTENANCE

5-1. GENERAL

5-2. This section provides maintenance information for the Model 1152-D Phase Demodulator. Included are: the list of required test equipment, preventive and corrective maintenance instructions, voltage tables, and an alignment procedure.

5-3. TEST EQUIPMENT

5-4. The test equipment required to troubleshoot, test, and align the demodulator is listed in table 5-1.

Table 5-1. Test Equipment Required

Equipment	Recommended*
Test Cable	Microdyne 200-493
Signal Generator (RF)	HP606A
DC Voltmeter	HP412A
Oscilloscope	HP180A
Vertical Amplifier	HP1801A
Time Base	HP1820A
DC Null Volt-Ammeter	HP419A

*Equivalent equipment may be substituted.

5-5. SPECIAL CABLES

5-6. In order to align and troubleshoot the demodulator, it must be connected to the parent unit through an extender cable which may be fabricated at the site or purchased from Microdyne.

5-7. To fabricate the cable, proceed as follows:

a. Obtain the following material:

1. RG-174/U cable - length should be sufficient to make four equal-length cables approximately three feet long.
2. One roll of #24 insulated multi-strand wire.
3. One set Cannon DDM-36W4P and DDMF-36W4S connectors with four each DM 53740-1 and four each DM 53742-1 coaxial inserts.

b. Cut the #24 wire into thirty-two three-foot lengths and make connections between the corresponding pins of the two Cannon connectors.

c. Connect the RG-174/U cable between corresponding coaxial inserts in the two Cannon connectors (A1-A2-A3-A4). These inserts should not be permanently affixed to connectors since they must be removed for alignment.

5-8. If it is undesirable to fabricate the above cable, it may be purchased from Microdyne as Extender Cable, Microdyne 200-493.

5-9. PERFORMANCE TESTS

5-10. Procedures for the demodulator performance tests are an integral part of the receiver preoperational calibration procedures in the receiver manual.

5-11. ADJUSTMENTS

5-12. No periodic adjustments are required on the demodulator.

5-13. PREVENTIVE MAINTENANCE

5-14. The only preventive maintenance requirement is a periodic visual inspection of the demodulator. This inspection should include a check of the connector for looseness and corrosion, electrical components for evidence of overheating, and screws and nuts for looseness. All hardware should be tightened immediately. Damaged components should be replaced after determining and correcting the cause.

5-15. Lubrication is not required for any demodulator component.

5-16. CORRECTIVE MAINTENANCE

5-17. Corrective maintenance consists of troubleshooting, repair, and alignment. Information on these subjects is given in paragraphs 5-18, 5-20, and 5-23, respectively.

5-18. TROUBLESHOOTING

5-19. Because of the type of circuitry involved, and the interaction of the various stages, it is recommended that to troubleshoot the 1152-D, an alignment should be attempted. Using the data gathered in the attempted alignment together with a knowledge of the Theory of Operation and familiarity with the block and schematic diagrams will isolate the problem to a functional stage. Once the defective stage is located, check for proper operation of controls and the condition of solder joints and components. If no discrepancies are found, replace the transistors and/or integrated circuits involved. Should the problem remain, check all wiring for proper connection and continuity. If the problem remains, return the unit to Microdyne for repair and calibration.

5-20. REPAIR

5-21. After the defective component is located, it should be replaced with an identical component as referenced in the replacement parts list for best results. The recommended procedure for removing components mounted on the printed circuit boards is given below. At the completion of repairs, the unit must be realigned and/or tested prior to installation.

5-22. PC BOARD COMPONENT REPLACEMENT. The following procedure is recommended for removing and replacing components mounted on printed circuit boards.

a. Gather the following materials:

1. Liquid soldering flux
2. Flux remover
3. Wire braid
4. Soldering iron, soldering aid, and longnose pliers.

b. Dip one end of the braid in the soldering flux.

c. Place the braid over the solder joint and apply heat; the braid will absorb most of the solder.

d. Apply heat directly to the solder joint and gently pry the component loose.

e. Clean the affected area with flux remover. If the hole in the board remains clogged, repeat the process using the braid and soldering flux.

f. Position the component on the pc board.

g. Solder the leads to the pc board and trim.

h. Clean the affected area with flux remover.

5-23. ALIGNMENT

5-24. Once the demodulator has been repaired, it must be realigned prior to use in the parent receiver. The procedure for realignment is given below:

a. Remove the top and bottom covers, and connect the demodulator to the receiver using the test cable. Apply power to the receiver and allow one-half hour for stabilization.

b. Set the receiver and demodulator controls as follows:

<u>Receiver</u>

2ND LO MODE to VFO
AGC TIME CONSTANT MSEC to 0.1.

Demodulator

AM/AGC to ENV
B_{LT} Hz to 300
SEARCH to MANUAL
TUNE to 5.00.

NOTE

Adjustments and connections in steps d through o are made on the Detector Board. In steps p through z, connect and adjust as noted.

c. Connect the HP606A to P1-A4. Set the generator for a 10.000 MHz output at -15 dBm.

d. Using the HP180A oscilloscope, check points 1, 2, and 3 for a 10 MHz sine wave signal and point 4 for a square wave signal. The signal at point 4 should have an amplitude of between -6.96 and -6.81 for a high level and between -7.85 and -7.65 for a low level.

e. Check points 5, 6, 8, and 11 for 10 MHz sinewave signals. Check points 7, 9, 10, and 12 for square wave outputs having the same levels as observed in step d. Disconnect the oscilloscope.

f. Connect the oscilloscope channel B vertical input to point 17 (at the output of Q8-Q9). While observing the oscilloscope, tune the HP606A slightly off 10 MHz in order to obtain a 5 kHz triangular display.

g. Connect the HP412A DC voltmeter to point 14 and adjust R75 for 0V DC.

h. Using channel A of the oscilloscope, check points 22 and 32 for triangular wave forms.

i. Connect the HP412A DC voltmeter to point 31 and adjust R125 for 0V DC.

j. Connect channel A of the oscilloscope to point 32 (channel B to point 17). Adjust R58 for a 90° phase shift between the two signals.

k. Disconnect and tag the wires at points 26 and 27. Connect the HP419A between points 24 and 25. Connect the HP412A to point 23. Move oscilloscope channel A input to point 27 and check for the presence of a sine wave.

l. Adjust R118 for 0V DC on the HP412A. Adjust R114 for 0 mV DC on the HP419A. Repeat these adjustments as often as required to obtain the 0V/mV readings.

m. Move the oscilloscope channel A input to point 27 (channel B to point 17). Adjust R40 for a 90° phase shift between the two points.

n. Disconnect the oscilloscope from point 27 and reconnect the wires to points 26 and 27.

o. Reconnect the oscilloscope differentially between points 26 and 27. Adjust R6 for a 4.5V p-p sine wave.

p. Adjust R96 for a 90° peak deviation on the receiver DEVIATION meter.

q. Set the HP606A for -35 dBm at the same frequency as in step f.

r. Connect the HP412A to point 99 on the Interface Board. Adjust R5 on the Detector Board for a -1.03V DC meter indication. Reset the generator to -15 dBm.

s. Connect the HP412A to point 16 on the Interface Board. Adjust R125 on the Detector Board for 0 ±1 mV DC.

t. Move the voltmeter input to point 17 on the Interface Board. Adjust R75 on the Detector Board for 0 ±1 mV DC.

u. Disconnect the HP606A from P1-A4 and replace the test cable coaxial connector in its place.

v. Install the second IF filter/amplifier module into the receiver and remove the RF tuner. Connect the HP606A to the IF input on the receiver tuner receptacle (XA3-A3). Set the 2ND LO MODE switch to XTAL. Set the generator for a 50 MHz output at -21 dBm.

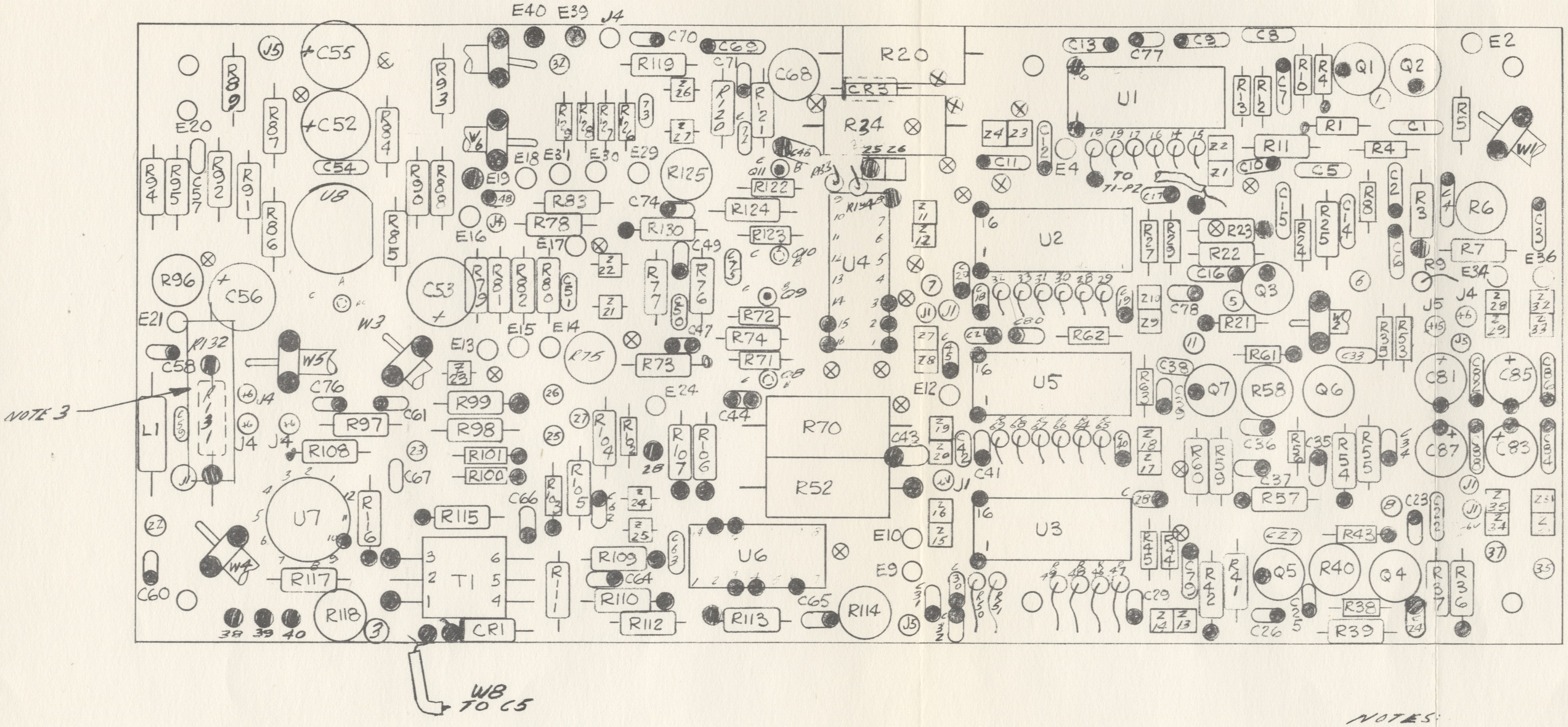
w. Connect the oscilloscope to point 22 on the Detector Board. Adjust the generator frequency slightly to produce a 5 kHz triangular display.

x. Set the 2ND LO MODE switch to VFO, and adjust the demodulator TUNE control for a 5 kHz triangular display. Set the 2ND LO MODE switch to PM and observe that the LOOP LOCK lamp illuminates and the 5 kHz triangular display disappears.

y. Connect the HP412A to point 16 on the Interface Board and adjust R58 on the Detector Board for maximum voltage (approximately 4V DC).

z. Connect the HP419A between points 24 and 25 on the Detector Board. Adjust R40 on the Detector Board for maximum differential voltage (approximately 4.5V DC).

aa. Disconnect all test equipment, turn off the power, and replace the covers.



NOTES:

1. ● TOP SOLDER

2. ⊗ FEED-THRU

3. INSTALL R132 ON TOP OF BOARD & R131 ON BOTTOM OF BOARD

Figure 5-1. Detector Board, Component Location

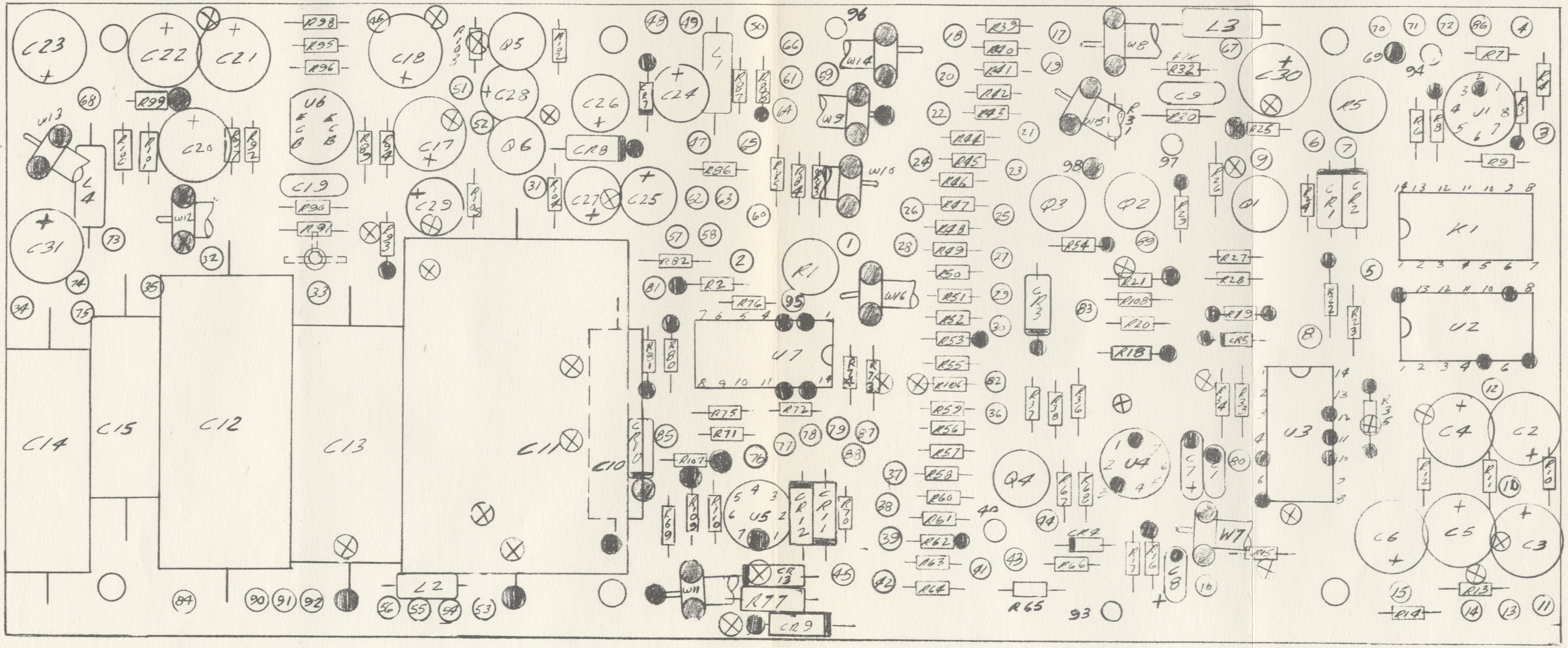


Figure 5-2. Interface Board, Component Location

SECTION VI
REPLACEMENT PARTS LIST

6-1. GENERAL

6-2. This section contains the Replacement Parts List for the Model 1152-D Phase Demodulator. Parts are listed alphanumerically by reference designator, and include the part description, value, tolerance, manufacturer, and manufacturer's part number. Include all component information when ordering spare or replacement parts.

6-3. MAIN CHASSIS

Reference Designation	Description
A1	Phase Detector Board, Microdyne 100-948
A2	Interface Board, Microdyne 100-947
DS1	Light-Emitting Diode red, HP5082-4403
P1	Connector, Cannon DDM-36W4P
R1	Potentiometer, 10-turn, cermet, 50KΩ, Beckman 8146-12-0-R50K
S1	Switch, rotary, 7 pole, 2 to 7 pos., Microdyne 101-292
S2	Switch, toggle, dpdt, C & K 7201
S3	Switch, toggle, spdt, C & K 7101
S4	Switch, PB, 4pdt, C & K P8421

6-4. A1, PHASE DETECTOR BOARD

Reference Designation	Description
C1 thru C22	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C23	Capacitor, ceramic, 220 pF ±5%, 100V, Erie 8121-100-COG-221J
C24	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C25	Capacitor, ceramic, 220 pF ±5%, 100V, Erie 8121-100-COG-221J
C26 thru C33	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C34	Capacitor, ceramic, 180 pF ±5%, 100V, Erie 8121-100-COG-181J
C35	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C36	Capacitor, ceramic, 180 pF ±5%, 100V, Erie 8121-100-COG-181J

A1, Phase Detector Board, continued

Reference Designation	Description
C37 thru C49	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C50	Capacitor, ceramic, 100 pF ±5%, 100V, Erie 8131-100-COG-101J
C51	Capacitor, ceramic, 100 pF ±5%, 100V, Erie 8131-100-COG-101J
C52	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C53	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C54	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C55	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C56	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C57	Capacitor, ceramic, 5.1 pF ±0.25 pF. 100V, Erie 8101-100-COG-519C
C58	Capacitor, ceramic, 620 pF ±5%, 100V, Erie 8121-100-COG-621J
C59	Capacitor, ceramic, 36 pF ±5%, 100V, Erie 8121-100-COG-360J
C60	Capacitor, ceramic, 620 pF ±5%, 100V, Erie 8121-100-COG-621J
C61	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C62	Capacitor, ceramic, 200 pF ±5%, 100V, Erie 8121-100-COG-201J
C63	Capacitor, ceramic, 200 pF ±5%, 100V, Erie 8121-100-COG-201J
C64 thru C66	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C67	Capacitor, ceramic, 10 pF ±5%, 100V, Erie 8121-100-COG-100J
C68	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C69 thru C71	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C72	Capacitor, ceramic, 100 pF ±5%, 100V, Erie 8131-100-COG-101J
C73	Capacitor, ceramic, 100 pF ±5%, 100V, Erie 8131-100-COG-101J
C74 thru C80	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C81	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C82	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C83	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C84	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C85	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C86	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C87	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C88	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
CR1	Diode, Si, Zener, 9.1V ±5%, 1N937
CR2	Diode, Si, dual, signal, Motorola MMD-7000
CR3	Diode, Si, zener, 3.6V ±5%, 1N4729A

A1, Phase Detector Board, continued

Reference Designation	Description
L1	Inductor, 5.6 μH, Jeffers 4435-1K
Q1 thru Q7	Transistor, Si, npn, RCA 2N3478
Q8 thru Q11	Transistor, Si, npn, Motorola MMT-74
R1	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R2	Resistor, fixed composition, 4.7Ω ±5%, ¼w, Allen Bradley CB4R75
R3	Resistor, fixed composition, 1.3KΩ ±5%, ¼w, Allen Bradley CB1325
R4	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R5	Resistor, fixed composition, 20Ω ±5%, ¼w, Allen Bradley CB2005
R6	Potentiometer, cermet, 100Ω, Beckman 82PR100
R7	Resistor, fixed composition, 1.3KΩ ±5%, ¼w, Allen Bradley CB1325
R8	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R9	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R10	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R11	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R12 thru R19	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R20	Resistor, fixed composition, 110Ω ±5%, 1w, Allen Bradley GB1115
R21	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R22	Resistor, fixed composition, 2.7Ω ±5%, ¼w, Allen Bradley CB2R75
R23	Resistor, fixed composition, 1.3KΩ ±5%, ¼w, Allen Bradley CB1325
R24	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R25	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R26 thru R33	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R34	Resistor, fixed composition, 110Ω ±5%, 1w, Allen Bradley GB1115
R35	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R36	Resistor, fixed composition, 2KΩ ±5%, ¼w, Allen Bradley CB2025
R37	Resistor, fixed composition, 3KΩ ±5%, ¼w, Allen Bradley CB3025
R38	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R39	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R40	Potentiometer, cermet, 200Ω, Beckman 82PR200
R41	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R42	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R43	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105

A1, Phase Detector Board, continued

Reference Designation	Description
R44 thru R51	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R52	Resistor, fixed composition, 110Ω ±5%, 1w, Allen Bradley GB1115
R53	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R54	Resistor, fixed composition, 2KΩ ±5%, ¼w, Allen Bradley CB2025
R55	Resistor, fixed composition, 3KΩ ±5%, ¼w, Allen Bradley CB3025
R56	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R57	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R58	Potentiometer, cermet, 200Ω, Beckman 82PR200
R59	Resistor, fixed composition, 10Ω ±5% , ¼w, Allen Bradley CB1005
R60	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R61	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R62 thru R69	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R70	Resistor, fixed composition, 110Ω ±5%, 2w, Allen Bradley GB1115
R71	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R72	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R73	Resistor, fixed composition, 330Ω ±5%, ¼w, Allen Bradley CB3315
R74	Resistor, fixed composition, 390Ω ±5%, ¼w, Allen Bradley CB3915
R75	Potentiometer, cermet, 200Ω, Beckman 82PR200
R76	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R77	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R78	Resistor, fixed composition, 91Ω ±5%, ¼w, Allen Bradley CB9105
R79	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R80	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R81	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R82	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R83	Resistor, fixed composition, 820Ω ±5%, ¼w, Allen Bradley CB8215
R84	Resistor, fixed composition, 13KΩ ±5%, ¼w, Allen Bradley CB1335
R85	Resistor, fixed composition, 39Ω ±5%, ¼w, Allen Bradley CB3905
R86	Resistor, fixed composition, 39Ω ±5%, ¼w, Allen Bradley CB3905
R87	Resistor, fixed composition, 13KΩ ±5%, ¼w, Allen Bradley CB1335
R88	Resistor, fixed composition, 100Ω ±5%, ¼w, Allen Bradley CB1015
R89 thru R91	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R92	Resistor, fixed composition, 100Ω ±5% ¼w, Allen Bradley CB1015
R93	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R94	Resistor, fixed composition, 82Ω ±5%, ¼w, Allen Bradley CB8205
R95	Resistor, fixed composition, 3KΩ ±5%, ¼w, Allen Bradley CB3025

A1, Phase Detector Board, continued

Reference Designation	Description
R96	Potentiometer, cermet, 100Ω, Beckman 82PR100
R97	Resistor, fixed composition, 91Ω ±5%, ¼w, Allen Bradley CB9105
R98	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R99	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R100	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R101	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R102	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R103	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R104	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R105	Resistor, fixed composition, 1KΩ ±5%, ¼w, Allen Bradley CB1025
R106	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R107	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R108	Resistor, fixed composition, 3KΩ ±5%, ¼w, Allen Bradley CB3025
R109	Resistor, fixed composition, 10KΩ ±5% ¼w, Allen Bradley CB1035
R110	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R111	Resistor, fixed composition, 220Ω ±5%, ¼w, Allen Bradley CB2215
R112	Resistor, fixed composition, 10Ω ±5%, ¼w, Allen Bradley CB1005
R113	Resistor, fixed composition, 10KΩ ±5%, ¼w, Allen Bradley CB1035
R114	Potentiometer, cermet, 200KΩ, Beckman 82PR200K
R115	Resistor, fixed composition, 820Ω ±5%, ¼w, Allen Bradley CB8215
R116	Resistor, fixed composition, 200Ω ±5%, ¼w, Allen Bradley CB2015
R117	Resistor, fixed composition, 1.2KΩ ±5%, ¼w, Allen Bradley CB1225
R118	Potentiometer, cermet, 500Ω, Beckman 82PR500
R119	Resistor, fixed composition, 91Ω ±5%, ¼w, Allen Bradley CB9105
R120	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R121	Resistor, fixed composition, 560Ω ±5%, ¼w, Allen Bradley CB5615
R122	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R123	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R124	Resistor, fixed composition, 390Ω ±5%, ¼w, Allen Bradley CB3915
R125	Potentiometer, cermet, 200Ω, Beckman 82PR200
R126	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R127	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R128	Resistor, fixed composition, 470KΩ ±5%, 1/8w, Allen Bradley BB4745
R129	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R130	Resistor, fixed composition, 330Ω ±5%, ¼w, Allen Bradley CB3315
R131	Resistor, fixed composition, 18Ω, 5w, Ohmite 995-5B-18Ω
R132	Resistor, fixed composition, 100Ω ±5%, 1/2w, Allen Bradley EB1015
R133	Resistor, fixed composition, 4.7KΩ ±5%, 1/8w, Allen Bradley BB4725
R134	Resistor, fixed composition, 4.7KΩ ±5%, 1/8w, Allen Bradley BB4725

A1, Phase Detector Board, continued

Reference Designation	Description
U1 thru U3	Integrated Circuit, ECL, 10K, Motorola MC-10116L
U4	Integrated Circuit, ECL, 10K, Motorola MC-10107L
U5	Integrated Circuit, ECL, 10K, Motorola MC-10116L
U6	Integrated Circuit, Xstr Array, RCA CA3054
U7	Integrated Circuit, RCA CA3018A
U8	Integrated Circuit, dual Xstr, Sprague TD-602
T1	Transformer, 50-200, ANZAC TP-104
W1	Cable Assembly, Microdyne
W2	Cable Assembly, Microdyne
W3	Cable Assembly, Microdyne
W4	Cable Assembly, Microdyne
W5	Cable Assembly, Microdyne
W6	Cable Assembly, Microdyne
Z1 thru Z35	Ferrite Beads, Fair-Rite 2673000101

6-5. A2, INTERFACE BOARD

Reference Designation	Description
C1	Capacitor, tantalum, 1 μF ±20%, 35V, Kemet T360A105M035AS
C2	Capacitor, tantalum, 220 μF ±20%, 10V, Kemet T362D227M010AS
C3	Capacitor, tantalum, 68 μF ±20%, 6V, Kemet T360B686M006AS
C4	Capacitor, tantalum, 22 μF ±20%, 15V, Kemet T360B226M015AS
C5	Capacitor, tantalum, 6.8 μF ±20%, 35V, Kemet T360B685M035AS
C6	Capacitor, tantalum, 2.2 μF ±20%, 20V, Kemet T360A225M020AS
C7	Capacitor, tantalum, 1 μF ±20%, 35V, Kemet T360A105M035AS
C8	Capacitor, tantalum, 1 μF ±20%, 35V, Kemet T360A105M035AS
C9	Capacitor, ceramic, 30 pF ±5%, 100V, Erie 8121-100-COG-300J
C10	Capacitor, electrolytic, 0.56 μF ±5%, Dearborn LP8A1A564J
C11	Capacitor, electrolytic, 15 μF ±5%, Dearborn LP8A1A156J
C12	Capacitor, electrolytic, 8.2 μF ±5%, Dearborn LP8A1A825J
C13	Capacitor, electrolytic, 5 μF ±5%, Dearborn LP8A1A505J
C14	Capacitor, electrolytic, 2 μF ±5%, Dearborn LP8A1A205J
C15	Capacitor, electrolytic, 1 μF ±5%, Dearborn LP8A1A105J

A2, Interface Board, continued

Reference Designation	Description
C16	Not Assigned
C17	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C18	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C19	Capacitor, ceramic, 0.01 μF ±20%, 100V, Erie 8131-B106-X5V-103M
C20	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C21	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C22	Capacitor, tantalum, 330 μF ±20%, 6V, Kemet T362D337M006AS
C23	Capacitor, tantalum, 330 μF ±20%, 6V, Kemet T362D337M006AS
C24 thru C29	Capacitor, tantalum, 68 μF ±20%, 15V, Kemet T362C686M015AS
C30	Capacitor, tantalum, 330 μF ±20%, 6V, Kemet T362D337M006AS
C31	Capacitor, tantalum, 330 μF ±20%, 6V, Kemet T362D337M006AS
CR1	Diode, zener, 8.2V ±5%, JETEC 1N755A
CR2	Diode, Si. Sig., JETEC 1N914
CR3	Diode, Si, low leakage, Fairchild FD333
CR4	Diode, si, low leakage, Fairchild FD333
CR5	Diode, Si, rect. 50V PIV, JETEC 1N4001
CR6	Diode, Si, dual sig., Motorola MMD-7000
CR7	Diode, zener, 12V ±5%, JETEC 1N4742A
CR8	Diode, zener, 12V ±5%, JETEC 1N4742A
CR9 thru CR12	Diode, Si, sig., JETEC 1N914
K1	Relay, spdt, dip, Grigby-Barton GB825-C2
L1	Inductor, fixed, 82 μH ±5%, Jeffers 1315-10J
L2	Not Assigned
L3	Inductor, fixed, 82 μH ±5%, Jeffers 1315-10J
L4	Inductor, fixed, 82 μH ±5%, Jeffers 1315-10J
Q1	Transistor, npn, Sprague 2N4384
Q2	Transistor, pnp, Sprague 2N4413
Q3	Transistor, pnp, Sprague 2N4413
Q4	Transistor, npn, Sprague 2N4384
Q5	Transistor, pnp, Sprague 2N4413
Q6	Transistor, npn, Sprague 2N4384
R1	Potentiometer, 100Ω, Beckman 3329H-101
R2	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005

A2, Interface Board, continued

Reference Designation	Description
R3	Resistor, fixed composition, 18KΩ ±5%, 1/8w, Allen Bradley BB1835
R4	Resistor, fixed composition, 18KΩ ±5%, 1/8w, Allen Bradley BB1835
R5	Potentiometer, 100KΩ, Beckman 3329H-100K
R6	Resistor, fixed composition, 1MΩ ±5%, 1/8w, Allen Bradley BB1055
R7	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R8	Resistor, fixed composition, 62KΩ ±5%, 1/8w, Allen Bradley BB6235
R9	Resistor, fixed composition, 200Ω ±5%, 1/8w, Allen Bradley BB2015
R10 thru R15	Resistor, fixed composition, 1MΩ ±5%, 1/8w, Allen Bradley BB1055
R16	Resistor, fixed composition, 3KΩ ±5%, 1/8w, Allen Bradley BB3025
R17	Resistor, fixed composition, 16KΩ ±5%, 1/8w, Allen Bradley BB1635
R18	Resistor, fixed composition, 18KΩ ±5%, 1/8w, Allen Bradley BB1835
R19	Resistor, fixed composition, 1KΩ ±5%, 1/8w, Allen Bradley BB1025
R20	Resistor, fixed composition, 110KΩ ±5%, 1/8w, Allen Bradley BB1145
R21	Resistor, fixed composition, 120KΩ ±5%, 1/8w, Allen Bradley BB1245
R22	Resistor, fixed composition, 1.5KΩ ±5%, 1/8w, Allen Bradley BB1525
R23	Resistor, fixed composition, 240Ω ±5%, 1/8w, Allen Bradley BB2415
R24	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R25	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R26	Resistor, fixed composition, 7.5KΩ ±5%, 1/8w, Allen Bradley BB7525
R27	Resistor, fixed composition, 15KΩ ±5%, 1/8w, Allen Bradley BB1535
R28	Resistor, fixed composition, 47KΩ ±5%, 1/8w, Allen Bradley BB4735
R29	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R30	Resistor, fixed composition, 7.5KΩ ±5%, 1/8w, Allen Bradley BB7525
R31	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R32	Resistor, fixed composition, 47KΩ ±5%, 1/8w, Allen Bradley BB4735
R33	Resistor, fixed composition, 4.7KΩ ±5%, 1/8w, Allen Bradley BB4725
R34	Resistor, fixed composition, 1.5KΩ ±5%, 1/8w, Allen Bradley BB1525
R35	Resistor, fixed composition, 1.5KΩ ±5%, 1/8w, Allen Bradley BB1525
R36	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R37	Resistor, fixed composition, 30KΩ ±5%, 1/8w, Allen Bradley BB3035
R38	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R39	Resistor, fixed composition, 3.9KΩ ±5%, 1/8w, Allen Bradley BB3925
R40	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R41	Resistor, fixed composition, 56KΩ ±5%, 1/8w, Allen Bradley BB5635
R42	Resistor, fixed composition, 200KΩ ±5%, 1/8w, Allen Bradley BB2045
R43	Resistor, fixed composition, 1.3MΩ ±5%, 1/8w, Allen Bradley BB1355
R44	Resistor, fixed composition, 5.6MΩ ±5%, 1/8w, Allen Bradley BB5655
R45	Resistor, fixed composition, 22MΩ ±5%, 1/8w, Allen Bradley BB2265
R46	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005
R47	Resistor, fixed composition, 910Ω ±5%, 1/8w, Allen Bradley BB9115

A2, Interface Board, continued

Reference Designation	Description
R48	Resistor, fixed composition, 620Ω ±5%, 1/8w, Allen Bradley BB6215
R49	Resistor, fixed composition, 160Ω ±5%, 1/8w, Allen Bradley BB1615
R50	Resistor, fixed composition, 240Ω ±5%, 1/8w, Allen Bradley BB2415
R51	Resistor, fixed composition, 51Ω ±5%, 1/8w, Allen Bradley BB5105
R52	Resistor, fixed composition, 430Ω ±5%, 1/8w, Allen Bradley BB4315
R53	Resistor, fixed composition, 220KΩ ±5%, 1/8w, Allen Bradley BB2245
R54	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R55 thru R58	Resistor, fixed composition, 22MΩ ±5%, 1/8w, Allen Bradley BB2265
R59	Not Assigned
R60	Not Assigned
R61	Resistor, fixed composition, 16MΩ ±5%, 1/8w, Allen Bradley BB1665
R62	Not Assigned
R63	Resistor, fixed composition, 5.1MΩ ±5%, 1/8w, Allen Bradley BB5155
R64	Not Assigned
R65	Resistor, fixed composition, 910KΩ ±5%, 1/8w, Allen Bradley BB9145
R66	Resistor, fixed composition, 390KΩ ±5%, 1/8w, Allen Bradley BB3945
R67	Resistor, fixed composition, 4.7KΩ ±5%, 1/8w, Allen Bradley BB4725
R68	Resistor, fixed composition, 16KΩ ±5%, 1/8w, Allen Bradley BB1635
R69	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R70	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R71	Resistor, fixed composition, 22KΩ ±5%, 1/8w, Allen Bradley BB2235
R72 thru R74	Resistor, fixed composition, 47KΩ ±5%, 1/8w, Allen Bradley BB4735
R75	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R76	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R77	Resistor, fixed composition, 2.4KΩ ±5%, $\frac{1}{4}$w, Allen Bradley CB2425
R78	Not Assigned
R79	Not Assigned
R80	Resistor, fixed composition, 2.4KΩ ±5%, 1/8w, Allen Bradley BB2425
R81	Resistor, fixed composition, 2.4KΩ ±5%, 1/8w, Allen Bradley BB2425
R82	Resistor, fixed composition, 1KΩ ±5%, 1/8w, Allen Bradley BB1025
R83	Resistor, fixed composition, 1.5KΩ ±5%, 1/8w, Allen Bradley BB1525
R84	Resistor, fixed composition, 1.5KΩ ±5%, 1/8w, Allen Bradley BB1525
R85	Resistor, fixed composition, 680Ω ±5%, 1/8w, Allen Bradley BB6815
R86	Resistor, fixed composition, 200Ω ±5%, 1/8w, Allen Bradley BB2015
R87	Resistor, fixed composition, 68Ω ±5%, 1/8w, Allen Bradley BB6805
R88	Resistor, fixed composition, 30Ω ±5%, 1/8w, Allen Bradley BB3005
R89	Resistor, fixed composition, 13KΩ ±5%, 1/8w, Allen Bradley BB1335
R90	Resistor, fixed composition, 39Ω ±5%, 1/8w, Allen Bradley BB3905

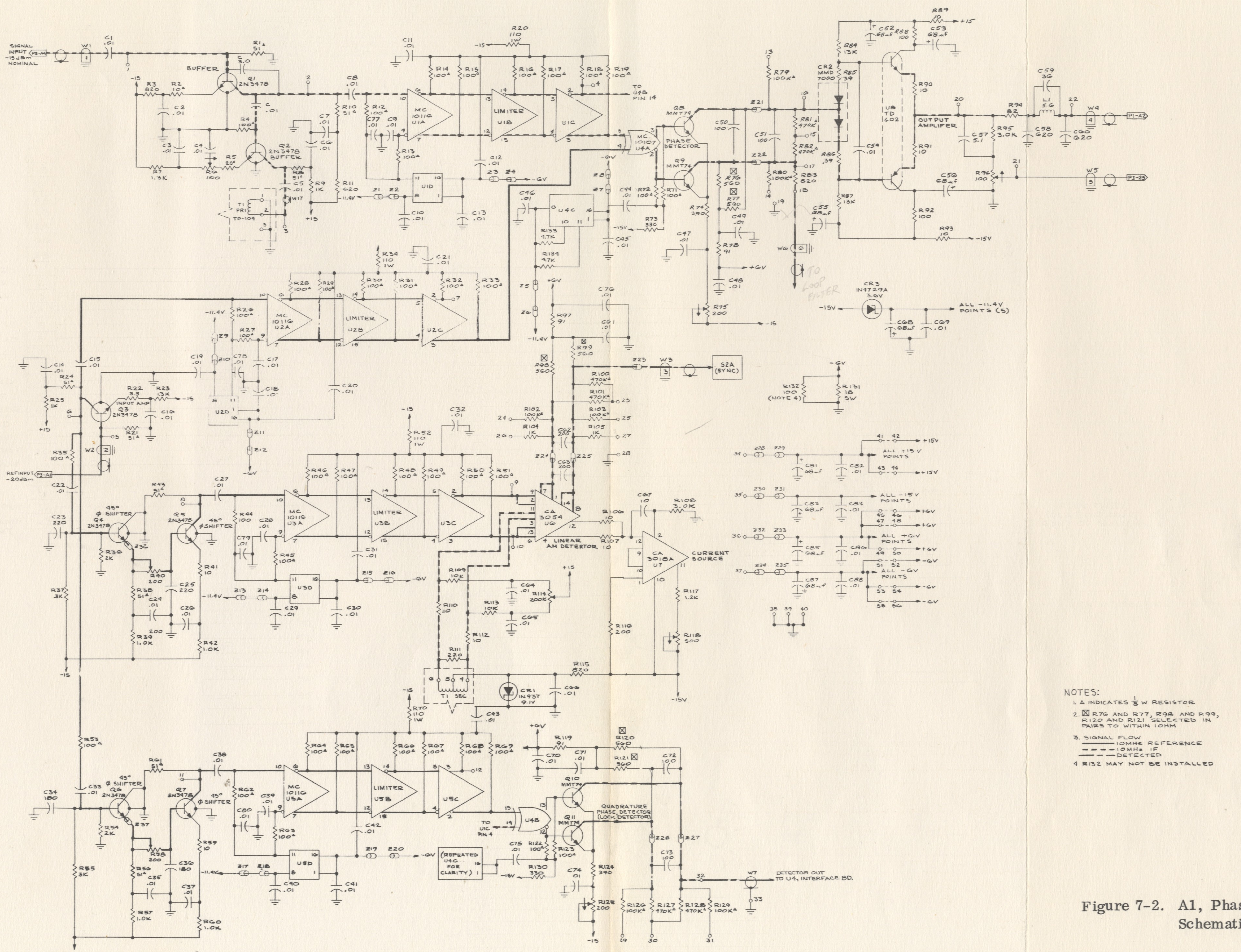
A2, Interface Board, continued

Reference Designation	Description
R91	Resistor, fixed composition, 39Ω ±5%, 1/8w, Allen Bradley BB3905
R92	Resistor, fixed composition, 13KΩ ±5%, 1/8w, Allen Bradley BB1335
R93	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005
R94	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R95	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005
R96	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005
R97	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R98	Resistor, fixed composition, 82Ω ±5%, 1/8w, Allen Bradley BB8205
R99	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R100	Resistor, fixed composition, 1.5MΩ ±5%, 1/8w, Allen Bradley BB1555
R101	Resistor, fixed composition, 10Ω ±5%, 1/8w, Allen Bradley BB1005
R102	Resistor, fixed composition, 300Ω ±5%, 1/8w, Allen Bradley BB3015
R103	Resistor, fixed composition, 620Ω ±5%, 1/8w, Allen Bradley BB6215
R105	Resistor, fixed composition, 300Ω ±5%, 1/8w, Allen Bradley BB3015
R106	Resistor, fixed composition, 100Ω ±5%, 1/8w, Allen Bradley BB1015
R107	Resistor, fixed composition, 4.7KΩ ±5%, 1/8w, Allen Bradley BB4725
R108	Resistor, fixed composition, 100KΩ ±5%, 1/8w, Allen Bradley BB1045
R109	Resistor, fixed composition, 10KΩ ±5%, 1/8w, Allen Bradley BB1035
R110	Resistor, fixed composition, 1.3MΩ ±5%, 1/8w, Allen Bradley BB1355
U1	Operational Amplifier, Analog Devices AD-502J
U2	Non-Inv. hex buffer, H.V. TTL, Texas Instruments SN7417N
U3	3 x 3 in NAND TTL, Texas Instruments SN7410N
U4	Comparator, Prec. Mono CMP-01CY
U5	Comparator, National Semiconductor LM-311H
U6	Dual transistor, Sprague TD-602
U7	Quad transistor, Motorola MHQ-6002

SECTION VII
MAINTENANCE DIAGRAMS

This section contains the schematic diagrams for the Model 1152-D Phase Demodulator. The diagrams appear in the following order:

A1 Size is Omitted due to the large size. Sorry.



NOTES:
1. Δ INDICATES 1/8 W RESISTOR
2. ⊠ R76 AND R77, R98 AND R99, R120 AND R121 SELECTED IN PAIRS TO WITHIN 1 OHM
3. SIGNAL FLOW
—— 10MHz REFERENCE
— — 10MHz IF
— - — DETECTED
4. R132 MAY NOT BE INSTALLED

Figure 7-2. A1, Phase Detector Board, Schematic Diagram 500-049

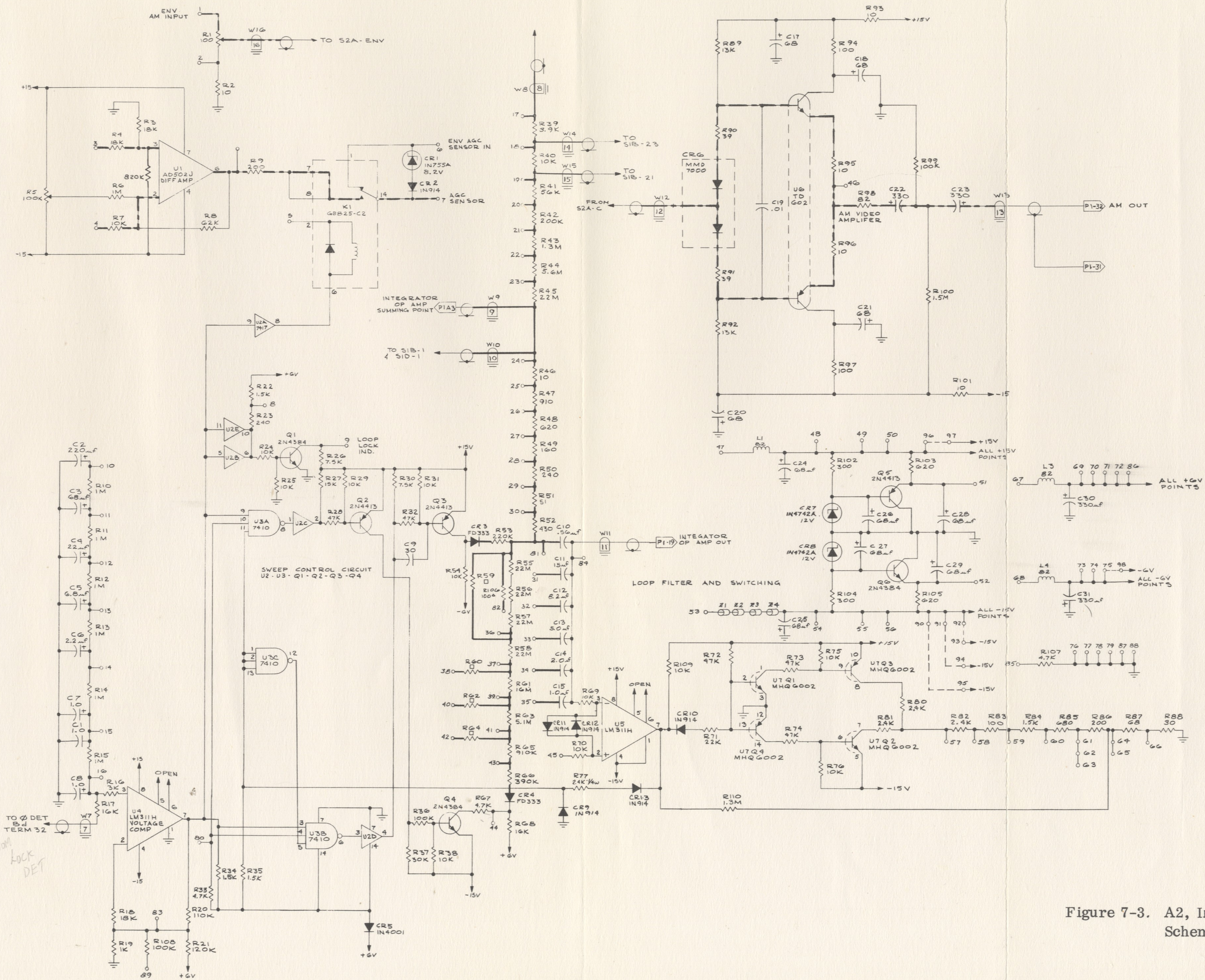


Figure 7-3. A2, Interface Board, Schematic Diagram 500-050