TM-808000701

OPERATION AND
MAINTENANCE MANUAL

DIGITAL AUTOMATIC ANTENNA COUPLER

DCU-100

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USE Page 1-2 from CU-9125

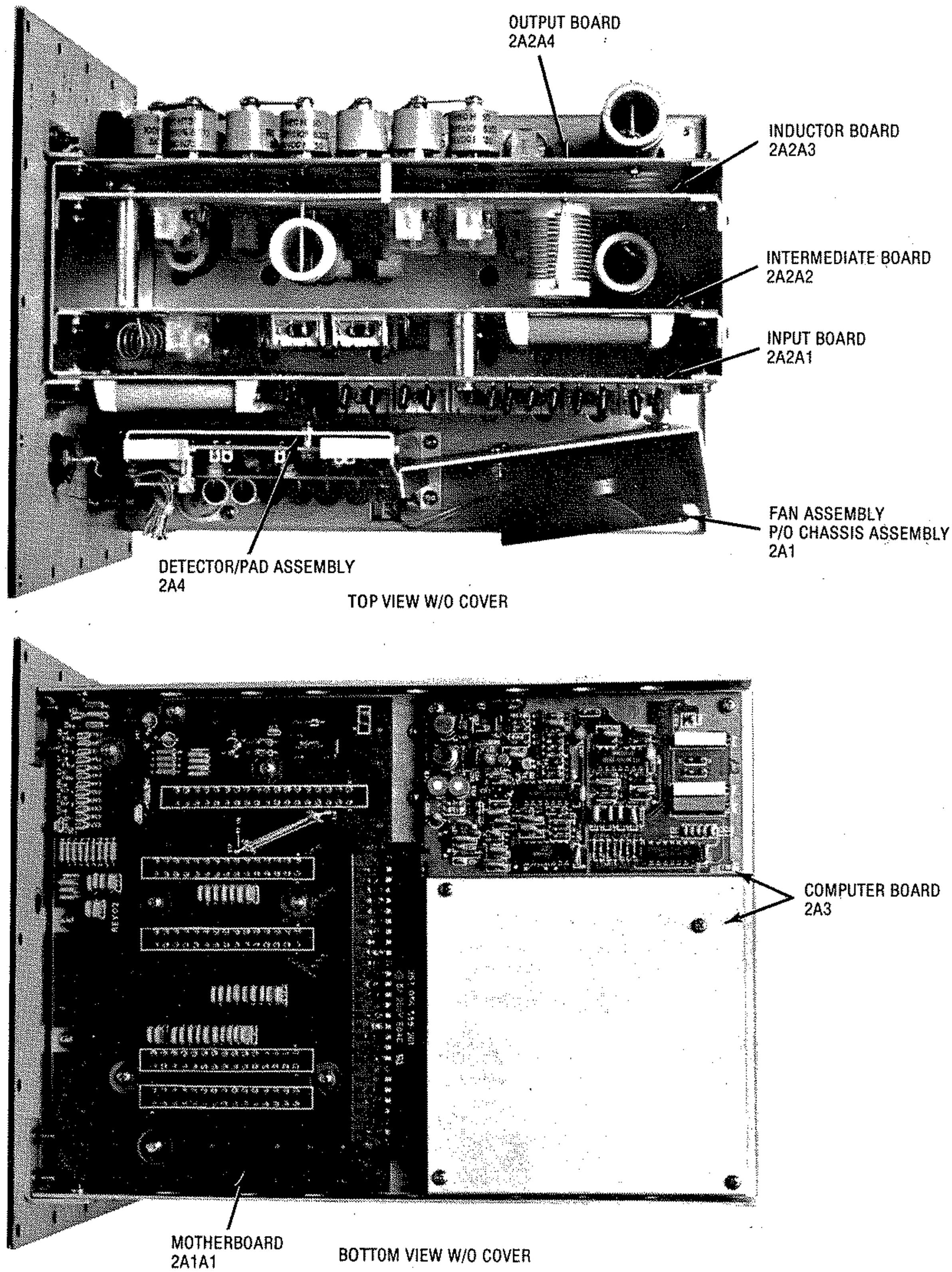


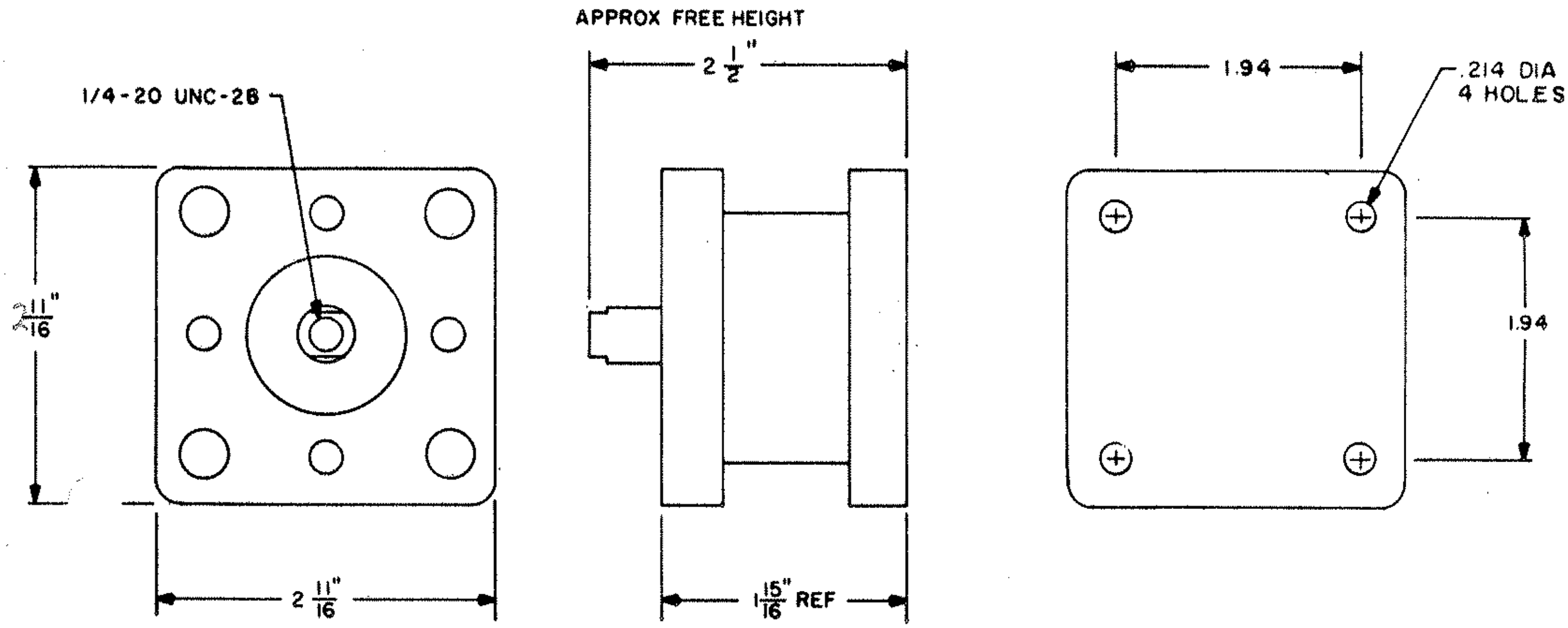
Figure 1.1 DCU-100 Major Assembly Locations

CAUTION

TO INSURE THAT CABLE HAS NOT BEEN DAMAGED DURING SHIPMENT, ALL CABLE ASSEMBLIES MUST BE CHECKED FOR CONTINUITY OR SHORTS, FROM PIN TO PIN, BETWEEN CONNECTORS BEFORE INITIAL RADIO OR SYSTEM POWER UP.

WARNING

CONNECTORS INSTALLED BY THE CUSTOMER MUST BE WIRED IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS PROVIDED IN THE OPERATION AND MAINTENANCE MANUAL. THE CABLE MUST BE CONTINUITY CHECKED AFTER INSTALLATION AND PRIOR TO RADIO OR SYSTEM POWER UP.



TYPICAL SHOCK
MOUNTING DIMENSIONS

add to next Revision of manual

11/14/91

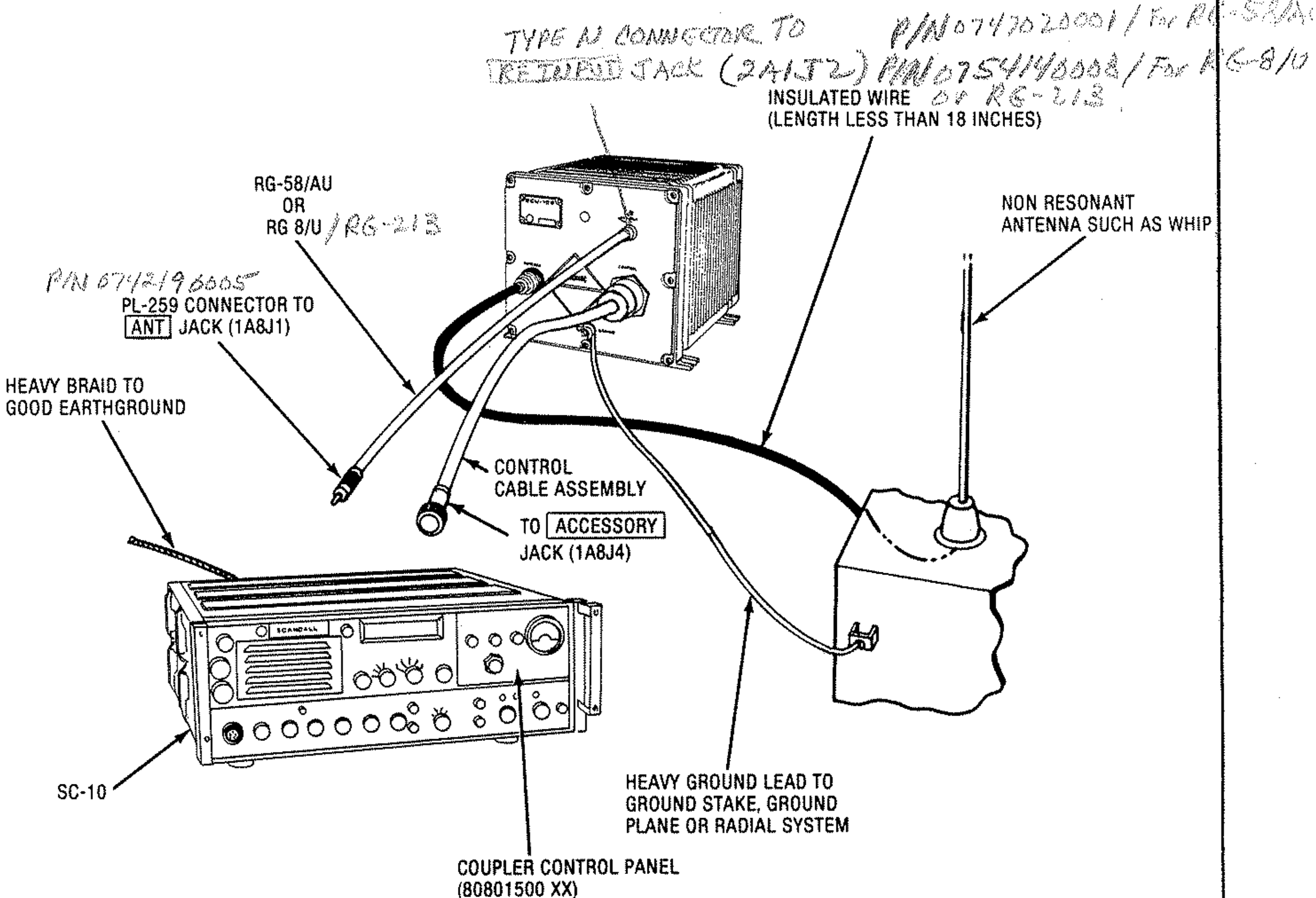


Figure 2.2 Typical Base Station Installation Using Non-Resonant Antennas

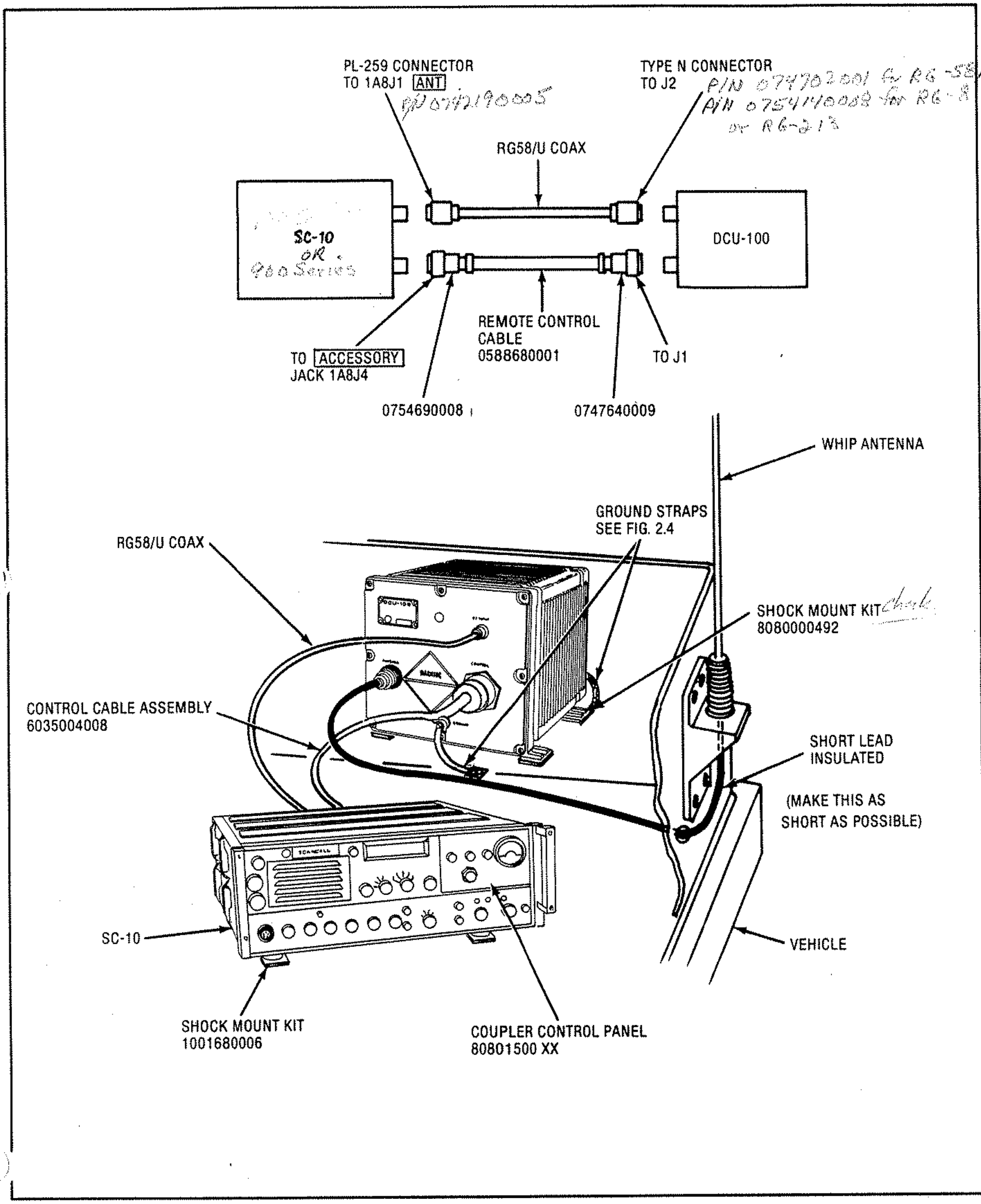


Figure 2.3 Typical Vehicular Installation

obtained if the antenna is at least 1/8 wavelength long at the lowest operating frequency; however, this requirement does not result in a practical size antenna for low frequency operation. Thirty-five foot whip antennas offer a good compromise between practical height and good electrical performance at low frequencies. The antenna coupler is designed to efficiently match whip antennas of 15 foot length or greater. An efficient match may also be obtained for a 9 foot whip above 4 MHz. The whip's performance is greatly influenced by its ground system. For temporary base station installations, a minimum of four six foot long ground rods should be driven into the ground symmetrically placed around the antenna base. The rods should be bonded together with heavy strap and then connected to the antenna coupler ground by another short heavy strap. If the antenna is mounted on the roof of a building, where a short ground lead to coupler cannot be obtained, a minimum of four symmetrically placed ground radials should be installed at the base of the antenna, bonded together, and connected to the antenna coupler ground post. The radials should be made of number 12 gauge wire or larger and should be at least ¼ wave long at the lowest operating frequency. (Radial length in feet = 246/frequency in MHz.) The whip's radiation pattern is omni-directional in the azimuthal plane.

The longwire antenna, illustrated in Figure 2.7, is a popular base station antenna where a wide range of operating frequencies are used. The antenna impedance varies greatly with frequency and therefore must be matched to the transmitter with the antenna coupler. The DCU-100 antenna coupler will efficiently match longwire antennas up to 150 foot in length. The radiation pattern of the longwire antenna is also a strong function of operating frequency. The two most popular longwire antennas, (75 and 150) foot available from Sunair, exhibit excellent low frequency radiation efficiency.

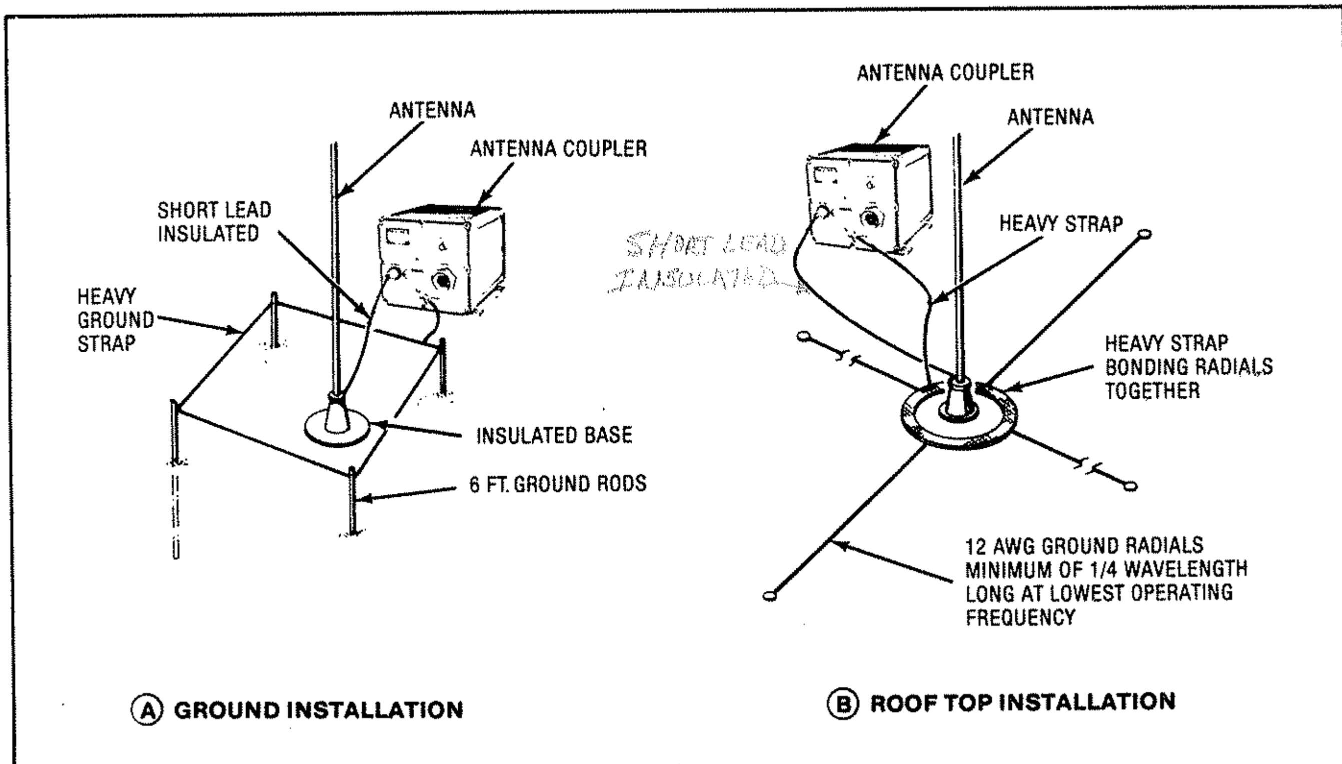


Figure 2.5 Whip Antenna

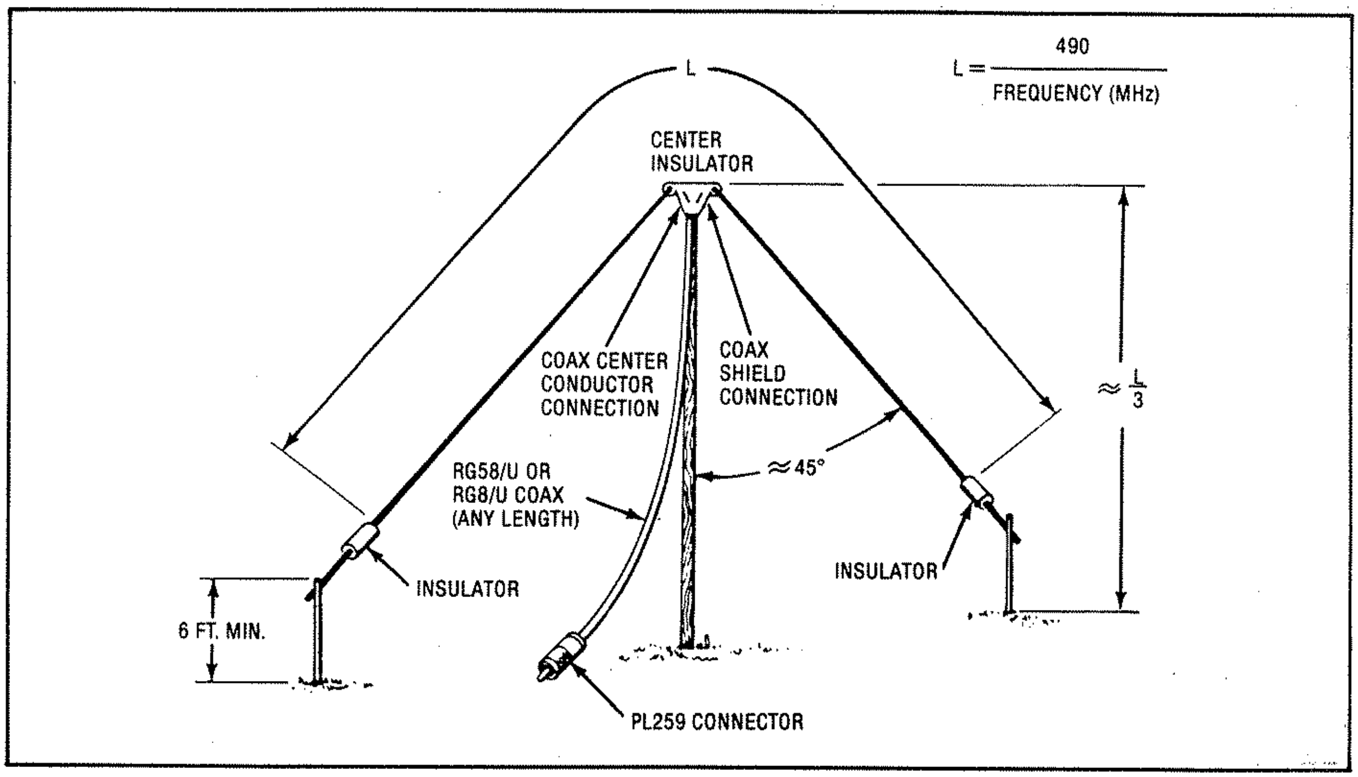


Figure 2.6 Inverted 'V' Antenna

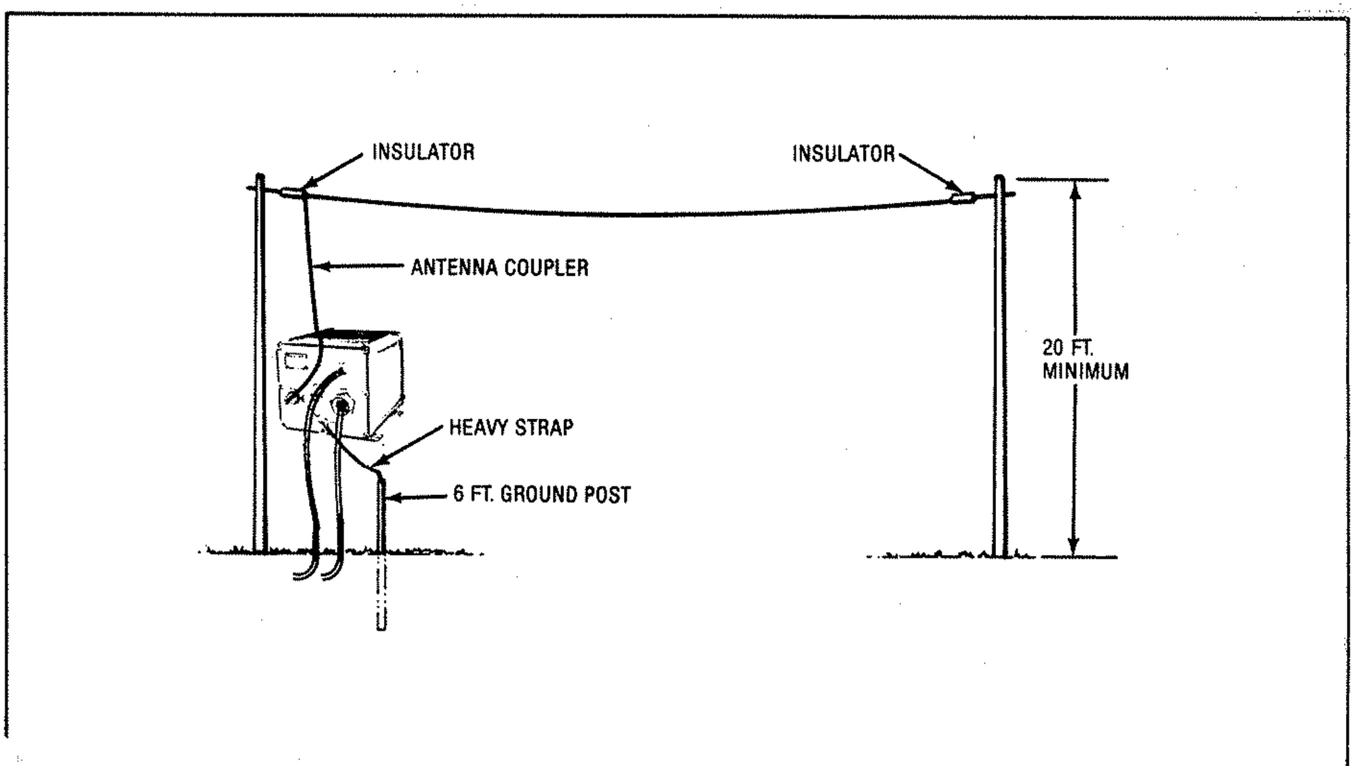


Figure 2.7 Long Wire Antenna

12. Follow an identical procedure to connect the other end of the cable.

NOTE

The cable should be wired pin-to-pin. That is, pin a of one connector should connect to pin a of the opposite connector, etc..

WARNING

*Connectors installed by the customer must be wired in accordance with the instructions provided in this section. The cable **MUST BE** continuity checked after connector installation and prior to system power up.*

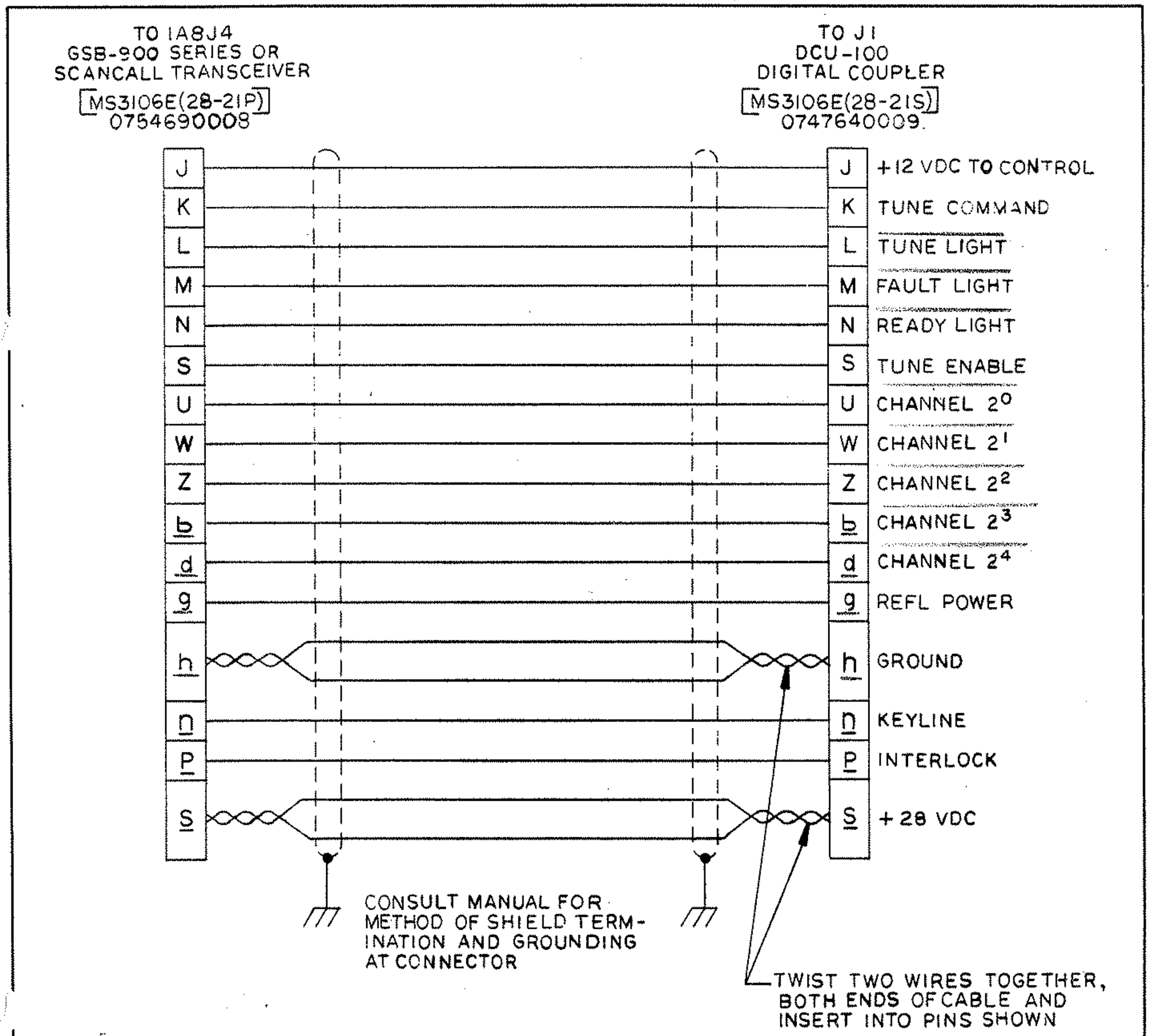


Figure 2.8 Wiring Diagram, Control Cable (6035004008)

ADDENDUM

DCU-100 OPERATION AND MAINTENANCE MANUAL P/N 8080000701

For DCU-100's (CU-2229A) located in close proximity to adjacent high power systems, the automatic retuning caused by a false high VSWR appearing on the coupler's antenna, can be prevented. The following changes will provide the coupler's microprocessor with a true keyline and VSWR before attempting to retune.

1. On Motherboard Assembly 2A1A1 p/n 8080013098, add a jumper between K1-1 and J7-3 (keyline contact to Computer Module card edge connector.)
2. On Computer Module 2A3 p/n 8080024090, remove "JMP-1" (jumper between keyline contact and ground).

This change will remain a customer option only for each particular coupler and its installation.

Addendum Date 1 September 1988

NO: DCU-189

DATE: January 20, 1989

ATTENTION: Dealers and Customers

EQUIPMENT: DCU-100

UNITS AFFECTED: Serial numbers 799-811, 877-881, 886, 887, 892 and higher

PURPOSE: Product Reliability Improvement To Eliminate AUTO-RETUNE

REFERENCE: Manual p/n 8080000701, First and Second Edition, page 4-1 Section 4.1 GENERAL

TEXT: Effective on all DCU-100s with the serial numbers referenced above, the microprocessor software has been changed to delete the auto-retune function. With the deletion of the auto-retune, when the coupler senses a VSWR exceeding 2:1, the RED FAULT lamp will light, indicating the HIGH VSWR condition. To clear this indication, place the transceiver in the COUPLER TUNE position and press the PUSH TO TUNE pushbutton on the coupler control panel. (NOTE: on transceiver model SC-10, simply press the PUSH TO TUNE pushbutton.) If the high VSWR condition should clear itself while the operator is transmitting, the GREEN lamp will again light.

The EPROM, 2A3U4 will remain part number 8080026891, but has been changed to Revision D. If you wish to order the new revision software for DCU-100s you presently own, EPROM p/n 8080026891 ordered after this date will come as a REV D.

Revision D is now standard and will be supplied with all future parts and equipment orders.

For couplers with serial numbers lower that 500 which have an earlier revision of the CPU assembly, the part number of the EPROM will remain 8080021899 and the revision will be F.

Revision F will be the standard replacement for this EPROM.

MANUAL CHANGE: This Service Bulletin serves as the manual addendum and should be placed behind the front cover.

SECTION IV
THEORY OF OPERATION

4.1 GENERAL

The DCU-100 is a fully automatic digital antenna coupler designed for use with Sunair Exciters, GSB-900 Series Transceivers, SCANCALL® SC-10 Transceivers, or their equivalents. The coupler is rated for 100 W PEP or average power, and will "tune" all common vehicular and ground based antenna systems 9 feet and longer. (For antennas shorter than 23 feet, duty cycle is limited to 5 minutes transmit, 5 minutes receive.) This unit is designed as a direct interchangeable replacement for the Sunair GCU-935 analog servo antenna coupler. A tune command is generated by the 900 Series transceiver by turning the MODE switch to KW/CPLR TUNE position or AM position and depressing the TUNE START pushbutton on the Coupler Control Panel 1A2. In the SC-10, a tune command is generated automatically when the transceiver is in AUTO, and by the TUNE START pushbutton when in Manual. If power has just been applied or the last coupler "tune" was good, i.e. a green "READY" lamp, depressing the TUNE START pushbutton is not required, as the coupler will automatically enter a tune cycle when it detects a VSWR in excess of 2:1. Also, during operation, if the antenna load characteristic should change for more than 100 milliseconds, the coupler will retune the load automatically. During the TUNE cycle, the yellow "TUNE" lamp on the Coupler Control Panel 1A2 will be illuminated. Completion of a successful tune is indicated by illumination of the green "READY" lamp. The red "FAULT" lamp provides an indication that the coupler is not correctly tuned and a tune command must be initiated. Except for initial power on, the transmitter can not be keyed when the FAULT lamp is on.

Memory is provided within the coupler for twenty channels for use with transceivers such as SCANCALL®, providing channel information to the coupler, and ten "last-tuned" channels for other exciters/transceivers. This memory will be retained in the coupler for a minimum power-off period of four hours (typically 24 hours). Upon power up of the exciter/transceiver and coupler, the FAULT lamp will be illuminated. If the FAULT lamp remains steadily on, the information in memory has been retained. If the FAULT lamp flashes on and off, memory has been lost and must be reentered for each channel. Whenever the FAULT lamp is illuminated, the coupler is automatically placed into a "bypass" mode with RF input tied directly to the antenna post.

4.2 ANTENNA TUNING NETWORK

The antenna tuning network is basically an "L" low pass circuit with additional shunt output capacitance, where required, to transform the network into a "PI". An additional capacitor is provided at the output of the network to allow tuning of inductive antennas. A block diagram of the DCU-100 is shown in Figure 4.1.

The input capacitor bank, located on the Input Board 2A2A1 (Figure 5.6) and the Intermediate Board 2A2A2 (Figure 5.7) consists of C1 through C11, and provides binary stepped values from 0 to 10200 pf. The series inductor bank, located on the Intermediate Board, Inductor Board 2A2A3 (Figure 5.8) and the Output Board 2A2A4 (Figure 5.9) and consisting of L1 through L11 and C12, provides binary stepped values from 0 to 20.5 uh. C12 is used at the higher frequencies to cancel out the coupler stray inductance. The output capacitor bank, located on the Output Board 2A2A4, consisting of C13 through C16, provides binary stepped values from 0 through 750 pf. The series phase correcting capacitor C17, is located on the Output Board.

[illegible]

[illegible]

[illegible]

4.3 DETECTOR/PAD ASSEMBLY 2A4

Refer to Figure 5.11.

4.3.1 General

The Detector/Pad Assembly contains the magnitude discriminator, the phase discriminator, the forward and reflected power detectors, the resistive pad network, the pad relay, and the tune relay.

4.3.2 Magnitude Discriminator

The magnitude discriminator consists of T1 and its associated components. It provides a means of measuring the relative magnitude of the transformed antenna impedance relative to 50 ohms. For a magnitude greater than 50 ohms, the magnitude discriminator produces an output voltage less than the +5 VDC reference voltage. For a magnitude less than 50 ohms, an output greater than the +5 VDC reference is produced. A voltage sample is provided from the transmission line by L1, C2, C3, and is rectified by CR2 to give a DC voltage proportional to the RF voltage on the line. A voltage proportional to the current in the transmission line is generated by transformer T1 and is rectified by CR3. Capacitor C2 is adjusted so that the voltage sample is exactly equal to the current sample when the transmission line is terminated with 50 ohms resistance. The output of this discriminator is fed to differential amplifier U17B on the Computer Board Assembly 2A3, Figure 5.10. Note that the output of the magnitude discriminator is floating and is referenced to +5 VDC, not ground. So all measurements of the magnitude detector must be referenced to +5 VDC.

4.3.3 Phase Discriminator

The phase discriminator consists of transformer T2 and its associated components. It provides a means of measuring the relative phase angle at the input to the tuning network by comparing the phase of the line voltage with that of the line current. The discriminator output is zero when the transmission line voltage and current samples are in phase (pure resistance terminating the transmission line). The voltage sample is derived by C13, R10, C7, which shifts it in phase by 90°. The current sample is generated by transformer T2 and is in phase with the line current. The voltage sample is fed to T2 center tap, and the resulting output is detected by CR4, CR5 to produce a DC voltage proportional to the phase difference between the voltage on the transmission line and the current in the line. R12 is the phase discriminator balance control and is adjusted so the phase output is nulled (relative to +5 VDC) when the transmission line is terminated with a 50 ohm non-inductive load.

The sensing of the phase discriminator is established to provide a positive output for inductive loads (positive phase angle) and a negative output for capacitive loads (negative phase angle). The output of this discriminator is fed to differential amplifier U17A on the Computer Board Assembly 2A3.

4.3.4 Forward and Reflected Power Detector

The forward and reflected power detector consists of T3 and its associated components. The reflected power voltage sample obtained from C14, C15 is combined with the current sample obtained from T3, at CR6 to provide a DC voltage proportional to reflected RF power on the transmission line. This detector compares both phase and magnitude of the voltage and current samples. Its output is always one polarity, i.e. positive with respect to ground, and is a minimum when the coupler network has tuned the antenna to provide a 50 ohm resistive load to the transmitter. C14 provides an adjustment to null the output when the transmission line is terminated with a 50 ohm, non-reactive load.

The forward power voltage sample from C19, C17 is combined with the current sample from T3 at CR7 to provide a DC voltage proportional to forward power on the transmission line. It operates in much the same way as the reflected power detector, and its output is also positive with respect to ground, but maximum when the

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transmission line is terminated with a 50 ohm, non-reactive load.

This output is used for two functions: (1) to tell the microprocessor when RF energy is present, and (2) to provide a reference against which the reflected power is compared for the calculation of Voltage Standing Wave Ratio (VSWR). The VSWR is used as an indication of the quality of the "tune" and is acceptable for values of 2:1 or better. If the VSWR exceeds 2:1, the red FAULT lamp will be illuminated, indicating that a tune command is required.

4.3.5 6 db Attenuator Pad Assembly

The 6 db attenuator consists of R1 through R6 and relay K1 and associated circuitry. It is switched between the coupler tuning network and the transmitter whenever the VSWR is greater than 2:1, and the transmitter is keyed. The pad provides protection for the transmitter by limiting the impedance variations placed on the transmitter during the tuning cycle. When a satisfactory tune has been accomplished, the green READY lamp will come on and the pad is switched out of the circuit, allowing full transmit power to reach the antenna.

The Resistive Pad Subassembly 2A4A2, resistors R1 through R6, plugs into the Detector Board 2A4A1 to make up the Detector/Pad Assembly 2A4.

4.3.6 Tune Relay

The tune relay, K2, is energized by the microprocessor following receipt of a tune command from the transceiver. It grounds the transceiver keyline interlock line, putting the transceiver in transmit mode, disables the keyline, and supplies a +28 VDC signal to the transceiver. This TUNE ENABLE signal is used in the SC-10 Transceiver to supply AM carrier for coupler tuning. (In the standard GSB-900, GSB-900DX, GSB-900SC, and GSE-924, the MODE switch must be turned to AM or KW/CPLR TUNE position to supply the carrier power.) When the tune cycle has been terminated, the tune relay is deenergized allowing normal keyline operation.

4.4 COMPUTER BOARD 2A3

Used in units up to Serial Number 499
For higher serial numbers see Page 6-1.

Refer to Figure 5.10.

4.4.1 General

The Computer Board 2A3 combines the analog interface circuitry used to process the detector outputs for use by the microprocessor U1, with the microprocessor computer circuitry. The analog circuits are located on the left side of the board and consist of integrated circuits U17 through U22, Q1, Q2, and their associated circuitry.

4.4.2 Phase Discriminator Interface

The phase discriminator interface consists of U17A, U18A, U18B, U20A, and U20B. The phase discriminator output is compared with the +5 VDC reference voltage for magnitude and polarity in U17A. Potentiometers R6 and R66 determine the width of the output threshold "window". This window is adjusted to provide an output whenever the phase exceeds plus or minus 20 degrees. If the phase is positive and greater than 20 degrees, the discriminator output is positive, U17A output is positive, U18A output is positive, and U20A output is negative (ground), so a Low signal is sent to U5, RAM/IO/TIMER, on the PHASE > +20° line. Similarly if the phase is negative and less than 20 degrees, an output from U17A, U18B, and U20B sends a Low signal to U5 on the PHASE < -20° line. Comparators U18A and U18B are used in conjunction with Schmitt triggers U20A and U20B to provide a toggle action to the phase commands, stabilizing the threshold limits. When the detected phase angle is within ± 20° of 0°, both the PHASE > +20° and PHASE < -20° lines are High, indicating to the microprocessor that the phase angle is within an acceptable "window".

4.4.3 Magnitude Discriminator Interface

The magnitude discriminator interface consists of U17B, U18C, U18D, U20C and U20D. The discriminator output is compared with the

+5 VDC reference for magnitude and polarity, in U17B. Potentiometers R19 and R32 sets the width of the magnitude window relative to 50 ohms. The window is set to provide an output whenever the magnitude is greater then 60 ohms or less than 40 ohms. If the magnitude is greater than 60 ohms, the discriminator output is negative, U17B output is negative, U18D output is positive and U20D output is negative, giving a Low on the MAG >60 ohm line to U5. The unaffected comparator, U18C in this case, provides a Low output to U20C, which in turn supplied a High to the MAG <40 ohm line. This way, only one output at a time may be Low, but both may be High, indicating to U5 that the magnitude is within an acceptable "window".

For magnitudes less than 40 ohms, operation is similar to that described above, supplying a Low from U20C to the MAG <40 ohm line to U5.

4.4.4 "RF Present" Detector

Transistor Q2 acts as a switch to provide a Low to microprocessor U1 on pin 5, whenever RF power is present at the coupler input. The transistor is turned on by a DC voltage from the forward RF power detector on the Detector/Pad Assembly 2A4. In order for U1 to continue its tuning program, the RF line must be held at a Low.

4.4.5 VSWR COMPARATOR

Comparator U19A compares the relative magnitude of the forward and reflected power detectors to compute the VSWR. Potentiometer R43 will make this occur whenever the VSWR exceeds 2:1. Diode CR7 provides a reference to keep the VSWR line High between transmit speech pauses, to keep the READY and FAULT lamps from blinking. Diode CR8 isolates the base circuit of Q2 from the voltage supplied by CR7. Diode CR16 isolates the reflected power detector on the Detector/Pad Assembly 2A4 from voltages generated by U19A circuitry.

4.4.6 Reflected Power Meter Driver

U19B is used as a current source with a voltage gain of one to drive the Coupler Control Panel meter proportionally to reflected power level. CR15 is used to correct the DC offset voltage, allowing the meter to properly zero.

4.4.7 Reference Voltage Sources

Voltage regulators U21 and U22 provide +5 VDC and +10.5 VDC respectively for use by the operational amplifiers and voltage comparators. Since plus and minus sensing is required, the reference "ground" for the circuits is established at +5 VDC, the positive supply point is taken to chassis ground. In this way, the devices are fooled into believing they are supplied by plus and minus 5 VDC, so that both polarities are available.

Potentiometer R29 adjusts the output voltage of U21 on pin 3 to +5 VDC. Zener diode CR10 drops the voltage to the regulators from the supplied +28 VDC, to minimize power dissipation in the regulators.

4.4.8 Tune Relay Latch

Transistor Q1 is used to provide a ground to the tune relay K2 on the Detector/Pad Assembly 2A4, energizing the relay and starting the tune cycle. A positive pulse from the transceiver turns Q1 on, pulling in the tune relay, and telling microprocessor U1 to begin a tuning cycle. The microprocessor then sends a positive voltage back called TUNE LATCH to the base of Q1, keeping it on and the tune relay latched during the tune cycle. When the tune cycle is terminated, the voltage from the base is removed, Q1 no longer conducts, and the tune relay is deenergized.

4.4.9 Microprocessor Circuits

4.4.9.1 General

The microprocessor circuit portion of the Computer Board is the "brains" of the DCU-100. Here, all appropriate signals are monitored, decisions are made, and control commands are generated for controlling the capacitor and inductor steps. An algorithm, which determines the process by which the coupler elements are manipulated, to achieve the proper transformation of the antenna impedance to 50 ohms resistive, is resident in memory. Included in this section are the microprocessor U1, the address decoder U2 and U8, the address latch U3, the PROM U4, RAM/IO/TIMER U5, the output ports U6, U7, U15, and U16, element drivers U9, U10, U11, U12, and U13, and storage memory U14.

4.4.9.2 Microprocessor U1

The microprocessor U1 performs all of the required calculations from the information it receives from the discriminator and detectors, interrogates the program memory to determine the next logical step to take, and tells the element drivers which elements to connect in the RF circuit. When a acceptable tune condition has been found, i.e. both phase and magnitude signals are in their respective "windows", U1 tells the pad and tune relays to drop out, and illuminates the green READY lamp on the Coupler Control Panel. U1 remains active at all times when power is applied and continuously monitors the VSWR. If following a good tune condition, the antenna load should change for any reason, U1 will initiate a retune cycle to correct the mismatch. If a load cannot be tuned or a coupler failure occurs, the FAULT lamp will be illuminated and the keyline interrupted. The coupler is also placed in a bypass mode (straight connection between input and the antenna) whenever the FAULT lamp is on. This prevents loss in the receive path, should a coupler fault occur. If the fault condition is only temporary, it may be cleared by placing the 900 Series Exciter/Transceiver MODE switch in the AM or KW/CPLR TUNE position and depressing the TUNE START pushbutton on the Coupler Control Panel. In the SC-10 Transceiver, the coupler will automatically be commanded to retune when the MODE switch is in AUTO. With the MODE switch in MAN the TUNE START pushbutton on the Coupler Control Panel must be depressed to initiate the retune. Very short duration faults, caused by vehicular whip impedance variations which occur when striking trees or other objects when in motion, are ignored by U1. When power is initially applied, the FAULT lamp is automatically illuminated, indicating that the status of the coupler to the selected frequency is unknown. A TUNE command to the coupler is required to clear the initial FAULT lamp. If, on initial power application, the FAULT lamp is flashing, this is an indication that the information previously stored in coupler memory has been lost and must be reentered through tune cycle initiation.

U23 establishes the clock frequency for U1 through a built-in oscillator circuit. R49, C89, and CR9 form a power-on reset network to assure correct initialization of U1 upon application of power.

4.4.9.3 Address Decoder U2

The address decoder consists of U2 and OR gates U8A, U8B, U8C, and U8D. These circuits take address codes supplied by U1 on A8-A15 and use them to enable the PROM U4, the RAM/IO/Timer U5, the Storage Memory unit U14, the output latches U6, U7 and U15 and the input buffer U16. U1 uses the address decoder circuit to enable the proper device when it needs to transfer information.

EXAMPLE: The software in U4 requires the channel information to be sampled periodically. In order to do this U16 and OR gate U8 must be addressed. U1 places an address on A8-A15 which causes Y5 pin 10 of U2 to go Low. With Y5 Low, U1 issues a Low read pulse on the $\overline{RD}$ line, at this time OR gate U8D has two Lows at its inputs, causing its output pin 10 to be a Low. This Low enables the transfer of channel information from the inputs of U16 to the DATA BUS. Once on the bus, U1 will proceed to process the information.

4.4.9.4 Address Latch U3

The address latch U3, separates the address information from the data on bus lines AD0 through AD7 from microprocessor U1. U3 is employed to produce continuous address information to U4 and U14. Each time U1 produces address information to the inputs of U3 via DATA BUS, U1 also produces a positive going pulse called ALE (Address Latch Enable). The ALE pulse latches the address information on the DATA BUS inputs to U3 through to U3's outputs. The address information is then latched on the output lines (ADDRESS BUS) and sent to the PROM U4 to call up a specific memory location where the data requested by U1 is stored. This latching/information gathering sequence is repeated every time U1 needs to know the next step in the algorithm.

4.4.9.5 Programmable Read Only Memory (PROM) U4

The PROM U4, contains the data bits which make up the program algorithm used by the microprocessor U1 to adjust the network elements which tune the antenna. Address information from A0-A11 is sent to the PROM U4, when U1 requires information for the execution of the next algorithm instruction stored in U4. U4 responds by placing the instruction from its internal memory, onto the DATA BUS when U1 issues a brief Low going read pulse on the $\overline{RD}$ line pin 32. U1 collects the instruction from the DATA BUS, analyzes it, then acts on the directions provided.

4.4.9.6 Input Ports

Integrated circuit U5 contains the input ports to the microprocessor system. Through these ports, the microprocessor U1, can call up information, giving it the status of the phase and magnitude discriminators, and the VSWR detector.

4.4.9.6.1 U5, Magnitude and Phase Inputs

There are six signals coming into integrated circuit U5, $\overline{\text{PHASE >+20°}}$, $\overline{\text{PHASE <-20°}}$, $\overline{\text{MAG >60 ohm}}$, MAG <40 ohm, VSWR and TUNE Command. Signals $\overline{\text{PHASE >+20°}}$, $\overline{\text{PHASE <-20°}}$ are the phase discriminator interface outputs, and $\overline{\text{MAG >60 ohm}}$, $\overline{\text{MAG <40 ohm}}$, are the magnitude discriminator interface outputs (refer to Sections 4.3.2 and 4.3.3). These four signals direct U1 through the tuning algorithm program stored in the PROM U4. A Truth Table for these signals follows.

Table 4.1 Magnitude Discriminator Truth Table

	U5 Pin 1 $\overline{\text{MAG > 60 OHM}}$	U5 Pin 39 $\overline{\text{MAG < 40 OHM}}$
* Illegal	0	0
>60	0	1
<40	1	0
In the window	1	1

*Note that a Low indication in both signals is not possible as the magnitude cannot be both greater than 60 ohms and less than 40 ohms simultaneously.

Table 4.2 Phase Discriminator Truth Table

	U5 Pin 38 $\overline{\text{PHASE > +20°}}$	U5 Pin 37 $\overline{\text{PHASE < -20°}}$
** Illegal	0	0
>+20°	0	1
<−20°	1	0
In the window	1	1

**Note that a Low indication in both signals is not possible as the phase cannot be both positive and negative simultaneously. A Low on any of these signals indicates the true state.

on the $\overline{\text{WR}}$ line pin 31. OR gate U8A's Low inputs cause it to have a Low out on pin 3 to pin 11 of U6. The Low on U6 pin 11 clocks the information from the DATA BUS through U6 into Lamp/Relay Driver U11, illuminating the READY lamp on the Coupler Control Panel 1A2.

4.4.9.8 Timer

The timer resides within U5 and, in conjunction with U1, acts as a stop watch beginning at the initiation of the TUNE command. It is programmed to stop the microprocessor program and turn on the FAULT lamp if a satisfactory tune is not accomplished within ten seconds. The timer is reset whenever a new tune command is received. If a proper tune is achieved, the timer is disabled, and the READY lamp is illuminated.

The timer is programmed at power up and receives its basic timing information from microprocessor U1. U1 continuously issues a signal called CLK OUT on pin 37, the timer in turn issues a brief Low going pulse on $\overline{\text{TIMER OUT}}$ pin 6 of U5, which clocks U1. As a tune cycle is initiated, U1 keeps sampling this line and uses it to stop the tune cycle if a satisfactory tune is not achieved within 10 seconds, then illuminates the FAULT lamp. If a proper tune is achieved, U1 stops sampling the timer out signal, which is continuously issued by U5, and illuminates the READY lamp.

4.4.9.9 Random Access Memory (RAM)

The RAM, also a part of U5, provides an area of temporary storage which U1 uses as a "scratch pad" when making its calculations. When the microprocessor needs to store information in RAM, U1 issues a code on lines A8-A15. This code makes output Y1 pin 14 of U2 go Low. While Y1 is Low, U1 will issue a Low on the IO/$\overline{\text{M}}$ line, the code it wants stored in RAM on the AD0-AD7 lines and a Low going write pulse on the $\overline{\text{WR}}$ line.

4.4.9.10 Storage Memory U14

Long term storage of coupler element settings by channel is handled by U14. If the transceiver has the capability of supplying channel number (in BCD format) to the coupler, the coupler element settings, when tuned, will be stored in this memory in a location corresponding to the selected channel. This provides extremely fast tuning, on the order of 10 msec, or less. If channel information is not available to the coupler, the storage memory takes the tuning element information anyway, and stores it in a sequential memory section. It has the capacity to remember the last ten "tunes", so if a previous frequency is repeated, the tuning data already exists in memory, and is extracted first, rather than requiring a complete tuning cycle. Tunes obtained in this manner typically take less than 100 msec. When the "ten last tuned" memory is filled, the next new tune information will be stored in the #1 memory location, all previous data will move up one memory location, and the data previously stored in memory location #10 will be dropped. Whenever a TUNE command is initiated from the transceiver TUNE START pushbutton or automatically initiated from the SC-10 Transceiver, the ten last tuned channels are polled first, before the coupler begins a tuning cycle. If a retune is called for, i.e. a FAULT condition following a previous READY, the 10 channels are bypassed and the coupler is forced to retune.

This memory is kept alive by C100A and B for at least four hours, and typically 24 hours, when power is removed. Loss of information in this memory is indicated by a flashing FAULT lamp upon initial application of power.

4.5 CHASSIS ASSEMBLY 2A1

4.5.1 General

The Chassis Assembly contains the RF Assembly 2A2 and the Motherboard 2A1A1.

4.5.2 RF Assembly 2A2

4.5.2.1 General (Refer to Figures 5.6, 5.7, 5.8, 5.9)

a) Input Board 2A2A1 (Figure 5.6)
The Input Board contains input capacitors C2, C3, C5, C8, C9, C10, and C11, and their respective switching relays.

b) Intermediate Board 2A2A2 (Figure 5.7)
The Intermediate Board contains input capacitors C1, C4, C6, and C7, inductors L1, L2, L3, L4, and L5 and their respective switching relays.

c) Inductor Board 2A2A3 (Figure 5.8)
The Inductor Board contains inductors L6, L7, L8, L9, L10, stray inductance cancelling capacitor C12, and their respective switching relays.

d) Output Board 2A2A4 (Figure 5.9)
The Output Board contains inductor L11, output capacitors C13, C14, C15, and C16, series phase-cancelling capacitor C17, and their respective switching relays.

4.5.2.2 Theory of Operation

The four boards comprising the RF assembly contain all of the variable elements in the antenna matching network. The basic network is a low pass "L" with the capability of adding shunt output capacitance, transforming the network to a low pass "PI". In addition, a series capacitor is available at the output of the network to aid in tuning inductive antennas. Input capacitance is available in approximately 5 pf steps from 0 to 10200 pf (C1 through C11), selected in a binary progression. The series inductance, L1 through L11, is also a binary progression, and is available in .01 uh steps from 0 to 20.5 uh. The output capacitance, C13 through C16, is also a binary progression and furnishes values from 0 to 750 pf in 50 pf steps. The output series capacitor, C17, is selected whenever the initial load phase angle is positive. Capacitor C12 is used at the higher frequencies to cancel out the stray coupler inductance, allowing full use of the small inductance steps available. The switching relays are high speed, where on or off transitions are made in approximately one millisecond. This allows the microprocessor 2A3U1 to make decisions very rapidly, providing extremely fast tuning time, typically less than one second.

4.5.3 Motherboard 2A1A1 (Refer to Figure 5.5)

The Motherboard serves as an interconnection plane between the RF Assembly 2A2, the Computer Board 2A3, the Detector/Pad Assembly 2A4 and the coupler front panel. Transistor Q1 grounds the TUNING line during a coupler tune sequence, to illuminate the yellow TUNING lamp on the Coupler Control Panel 1A2. U1 is the primary +5 VDC regulator supplying power to the Computer Board 2A3. It is mounted on the coupler sheet metal chassis for heat sinking, and plugs into the motherboard. Relay K1 opens the keyline whenever a FAULT condition exists. Figure 5.3 shows the Front Panel wiring diagram.

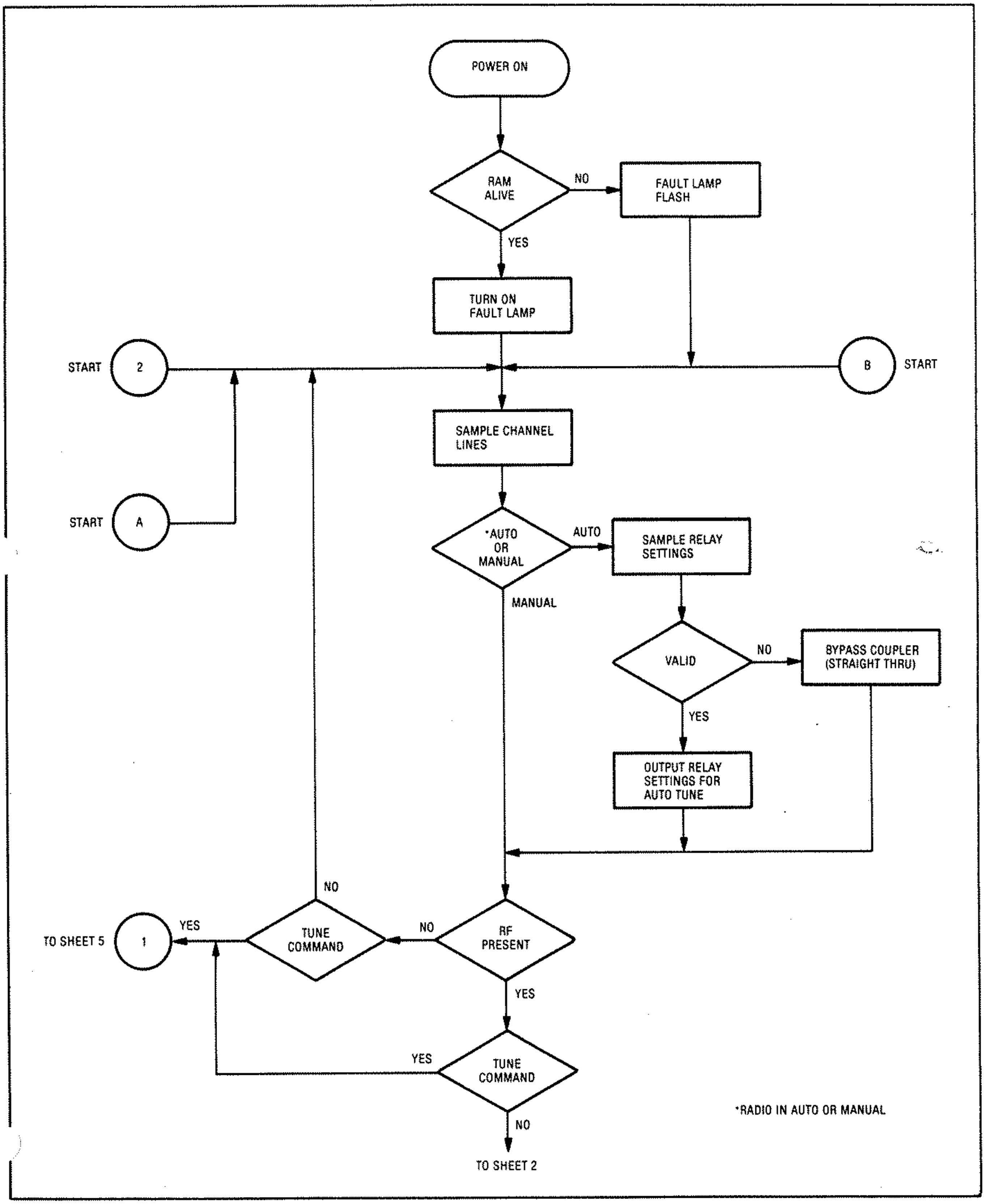


Figure 4.2 DCU-100 Flow Chart (Sheet 1 of 5)

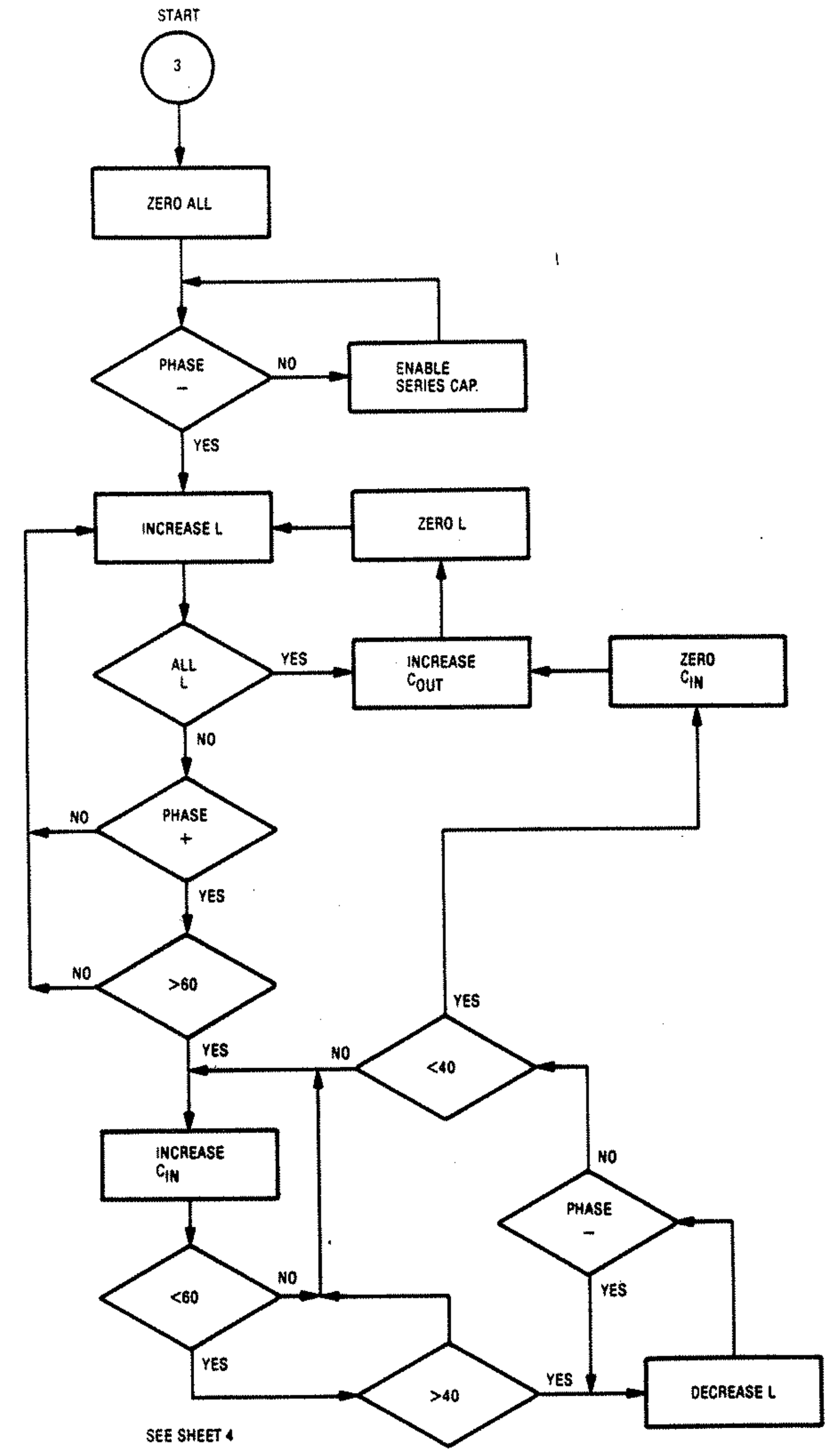


Figure 4.2 DCU-100 Flow Chart (Sheet 3 of 5)

NOTE

In the flow chart on Sheet 3, any time the detectors fall in the window (i.e. Magnitude between 60Ω and 40Ω and phase between +20° and −20° then it stops tuning, and it continues below:

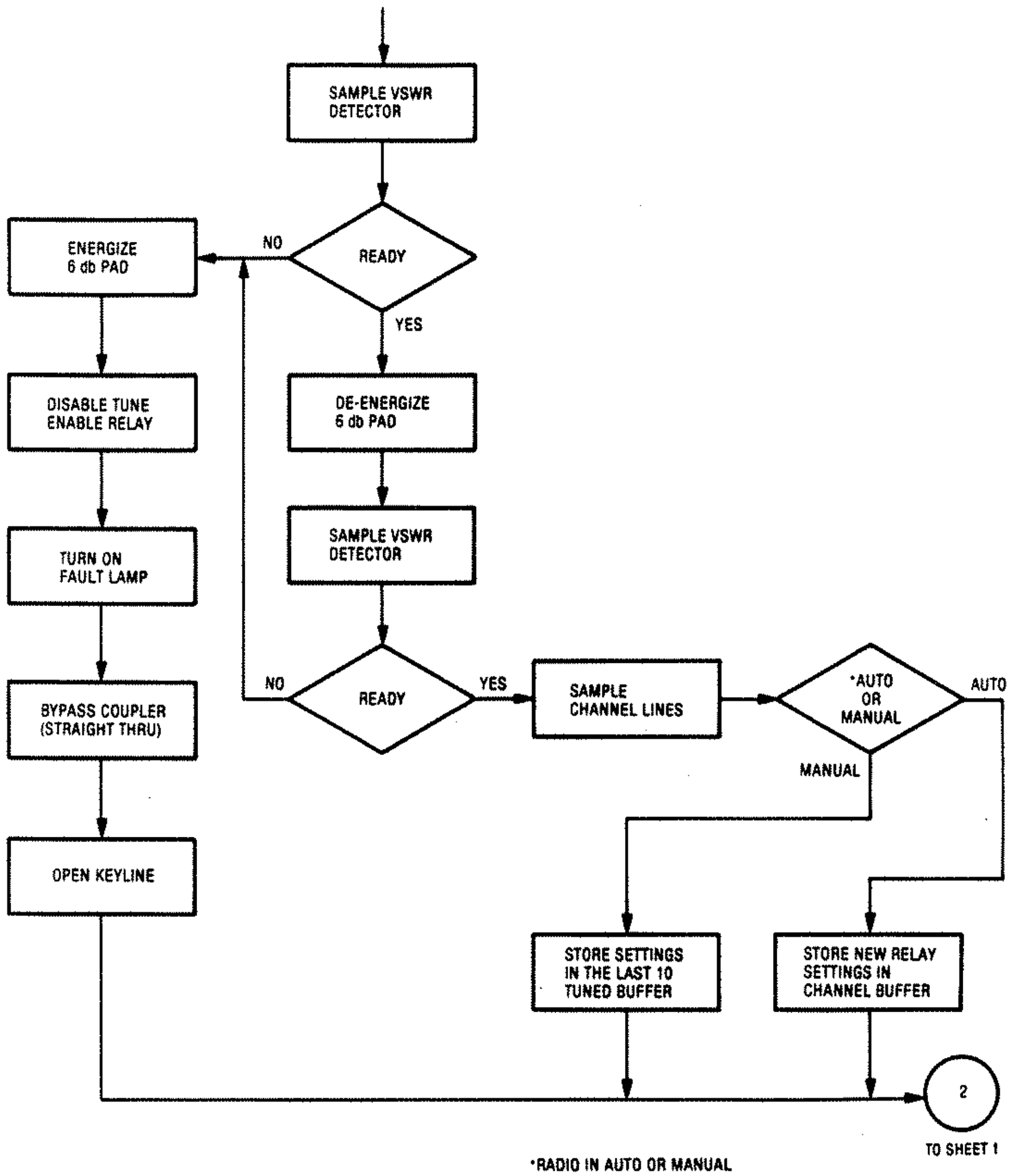


Figure 4.2 DCU-100 Flow Chart (Sheet 4 of 5)

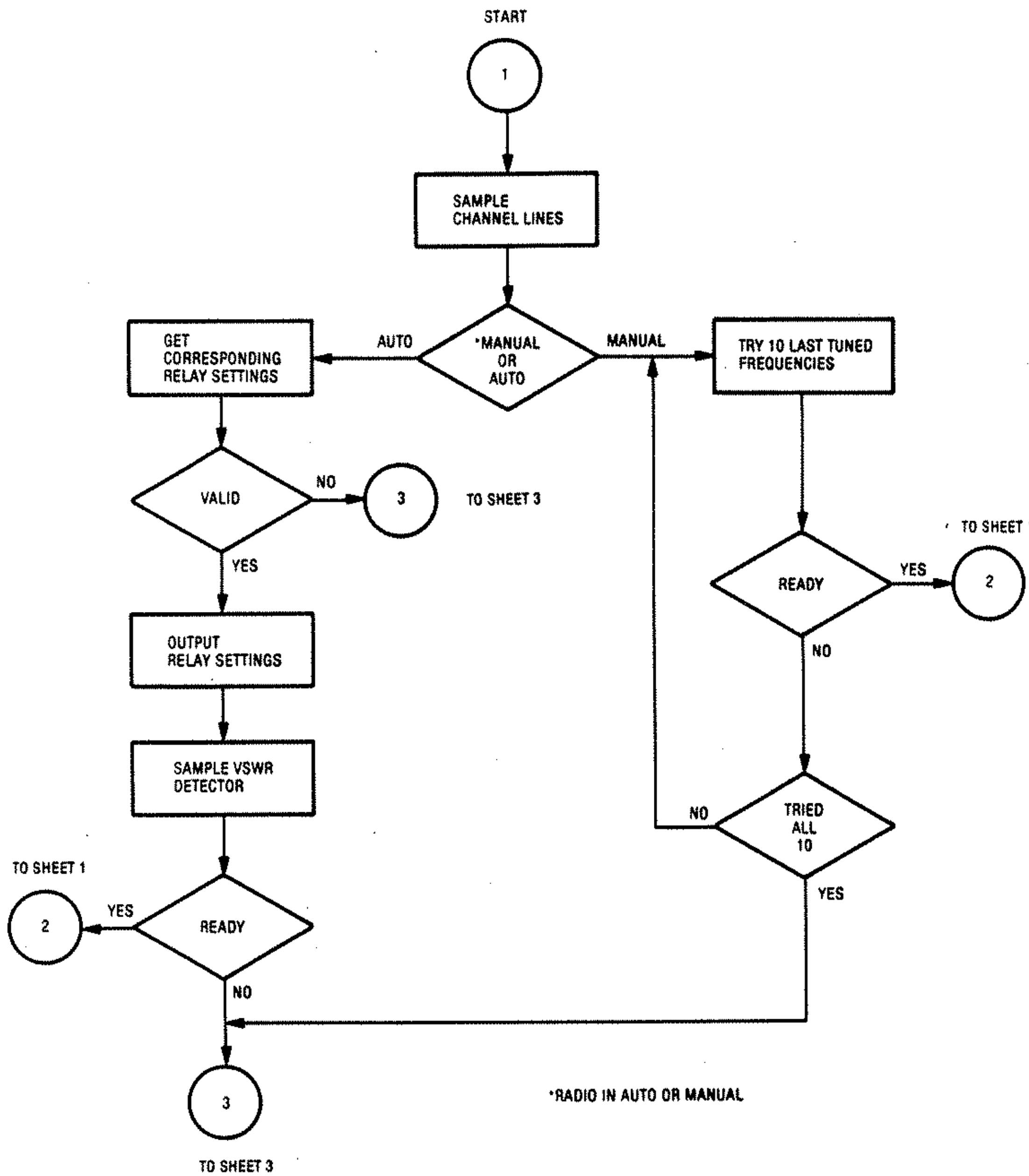


Figure 4.2 DCU-100 Flow Chart (Sheet 5 of 5)

SECTION V
MAINTENANCE AND REPAIR

5.1 GENERAL

This section provides test procedures and evaluation of overall performance for the DCU-100 Automatic Digital Antenna Coupler. A Fault Analysis Table is included to aid the repairman in isolating a fault to the defective module or subassembly.

5.2 PREVENTIVE MAINTENANCE

No preventive or periodic maintenance is required in the DCU-100.
See Service Bulletins.

5.3 INSPECTION

If the DCU-100 has the case removed for maintenance, a visual inspection should be performed and the resultant corrective action should be taken as follows:

1. Inspect chassis for loose or missing mounting hardware, deformation, damaged fasteners, or damaged connectors. Replace all damaged parts.

2. Inspect connectors for broken parts; check insulation for cracks; and check the pins for damage, misalignment, or bad plating. Carefully realign pins when possible, or, if connectors are otherwise severely damaged, replace connector. Check for loose, or poorly soldered connections to terminals of connectors. Tighten or solder as required.

3. Inspect wiring of chassis and subassemblies for any signs of physical damage or charring. Any damaged wires must be replaced.

4. Inspect for leaky, blistered, charred, or cracked capacitors, resistors, or diodes. Check for loose or corroded terminal connections. Obviously damaged components should be replaced.

5. Inspect for cold soldered or resin joints. Bad joints can be recognized by a dull, porous appearance. Resolder.

5.4 REPAIR OR REPLACEMENT

The repair or replacement of damaged and defective parts usually involves standard service techniques. Carefully examine the equipment to determine the correct technique required to effect the repair.

5.4.1 General Precautions

a) Perform repairs and replace components with power disconnected from unit.
b) Replace connectors, shielded conductors, and twisted pairs only with identical items.
c) Reference to component side of a printed circuit board means the side on which the majority of components are located; solder or circuit side refers to the other side.
d) When repairing circuits, carefully observe lead dress and component orientation. Keep leads as short as possible and observe correct repair techniques.
e) Observe cable routing prior to disassembly, to enable the proper reinstallation of cabling during reassembly procedures.
f) If component is defective beyond any reasonable doubt, remove and replace it according to the procedures given in paragraph 5.5. 4.2 and 5.4.3. If there is some doubt about the condition of a component, or if it is being removed for troubleshooting, remove it according to the procedures in paragraph 5.4.4.

5.4.2 Circuit Card Assembly, Two-Lead Component Removal (Resistors, Capacitors, Diodes, etc.)

a) Inspect solder side of component to determine if the leads were bent over prior to soldering. If they weren't, proceed with Step b. If they were, melt the solder and remove it with a desoldering tool, then straighten the leads and remove the component.
b) Heat one lead from component side of board until solder flows and lift one lead from board; repeat for other lead and remove component (note orientation).
c) Melt solder in each hole and using desoldering tool remove solder from each hole.
d) Dress and form leads of replacement component; insert leads into correct holes.
e) Solder in place and clip leads on solder side of boards.

5.4.3 Circuit Card Assembly, Multi-Lead Component Removal (IC's etc.)

a) Remove component by clipping each lead along both sides. Clip off leads as close to component as possible. Discard component.
b) Heat hole from solder side and remove clipped lead from each hole.
c) Melt solder in each hole and using a desoldering suction tool remove solder from each hole.
d) Insert replacement component observing correct orientation.
e) Solder component in place from solder side of board. Avoid solder runs. No solder is required on contacts where no track exists.

5.4.4 Removal of Components of Doubtful Condition

a) To remove components that are not heat-sensitive, melt the solder and remove it with a desoldering tool, then remove the component.
b) To remove components that are heat-sensitive, such as diodes, transistors, and IC's, connect a heat sink to the lead between the body of the component and the solder joint, melt and remove the solder. Repeat for all leads of the component, then remove the component. Apply heat to the lead for the minimum amount of time necessary to remove the solder. When working with IC's, start at one corner, then go to the lead farthest away, then back to where you started, etc... (Example: pins 1, 8, 14, 7, . . .) This is to keep heat buildup to a minimum. Remember that some solid state devices are extremely heat-sensitive, and even though maximum care is exercised during their removal, they may still be destroyed by the removal procedure.
c) To install a heat-sensitive component, use a heatsink and the sequence outlined above to prevent heat from destroying the component.

5.5 PERFORMANCE TEST

The following tests will provide overall performance data on the DCU-100 as well as aid in determining specific problems.

5.5.1 Test Equipment

The following test equipment or equivalent is required to perform the test procedures outlined in this section.

1. Exciter/Transceiver Model TS-100,
2. 35 ft. whip antenna simulator, Sunair p/n 8084001094
3. "THRULINE" wattmeter: Bird Model 43 with 100 watt 2-30 MHz element 2 ea.
4. VOM: Simpson 260
5. Digital Multimeter: H.P. Model 3476A
6. Oscilloscope: Tektronix 2445
7. Frequency Counter: Systron Donner Model 6242A
8. PC Assy, Detector Extender Board Sunair P/N 8085165091
9. Coaxial Resistor 50 ohm, 150 watt Bird model 8135

5.5.2 PRELIMINARY

Connect Transceiver, Antenna Coupler, and Test Equipment as shown in Figure 5.4, Antenna Coupler Test Setup.

a) Set the Transceiver's switches and controls to the positions shown below.

SWITCH OR CONTROL	POSITION
FREQUENCY	1.60000 MHz
VOLUME Control	On
SQUELCH Control	Off

b) The Transceiver display will alternately display COUPLER UNTUNED. Depress the CPLR TUNE pushbutton. The thruline wattmeter should indicate 30 to 35 watts of forward RF power while the coupler is tuning. The Transceiver will display COUPLER TUNING and then SYSTEM READY and the coupler should be tuned. The thruline wattmeter should show no forward RF power after the tune cycle is completed.

c) Set mode to CW and key the transceiver with CW key switch. Check the forward and reflected power on the thruline wattmeter. An acceptable tune should show 70 to 125 forward watts and 2.8 to 5.1 reflected watts maximum. See chart below:

FORWARD WATTS	REFLECTED WATTS MAXIMUM
70	2.8
80	3.2
100	4.0
110	4.4
125	5.1

Acceptable Reflected Power Chart for VSWR 1.5:1.

d) Set the Transceiver to the following frequencies and tune the coupler. Using the CW key switch check the forward and reflected power of each frequency to see if they fall within the parameters given in the preceding paragraph.

1.9900 MHz	4.6000 MHz	12.6000 MHz
2.6000 MHz	6.6000 MHz	25.6000 MHz
3.6000 MHz	9.6000 MHz	29.9900 MHz

EXAmple

5.5.5. Set FREQUENCY SWITCHES to 1.5000 MHz. The Exciter/Transceiver "Disable" light should come on. Depress the "TUNE START" push button on 1A2 panel. The amber "TUNING" light should come on and after ten seconds the Red "FAULT" light will come on indicating a cannot tune condition. (Note: During the time the "TUNING" light is on, the 1A2 and Thruline meters should indicate no RF forward power).

5.5.6. Set FREQUENCY SWITCHES to display 1.6000 MHz depress "TUNE START" push button on 1A2 panel. Should have the same performance as in 5.5.4.

5.5.7. Turn mode switch to "CW" position. Connect a "CW" key to the Exciter/Transceiver and press the key to check for RF power indications on 1A2 and Thruline meters in forward. Check the two meters in reflected and acceptable tune should show 70-100 Forward Watts and 2.8-4.0 Reflected Watts maximum. See chart below.

Forward Watts	Reflected Watts Maximum
70	2.8
80	3.2
100	4.0

Acceptable Reflected Power Chart for VSWR 1.5:1

5.5.2. DCU-100 Performance Test.

Connect Exciter/Transceiver and test equipment as shown in Figure 5.1.

5.5.3. Turn Exciter/Exciter on the "Red" FAULT light on Coupler Control Panel (1A2) should come on.

Set the Front Panel Controls applicable to your 900 Series radio as follows:

XMIT Gain Control	Full CW
Dimmer Switch	Full CW
Volume Control	Full CW
RF Gain Control	Full CW
VFO Control	Full CW
Mode Switch	Pushed "In"
Frequency Switches	To display 1.6000 MHz.

5.5.4. Depress "TUNE START" push button on 1A2 panel. The Amber "TUNING" light on 1A2 panel should come on. The 1A2 and Thruline meter should indicated the forward RF power of 30 to 40 Watts and coupler could tune. When the coupler is tuned, (in approximately 1-2 seconds). The 1A2 green "READY" light should come on.

See example from CU-9125

 S

5.5.8. Set the frequency switches to the following frequencies and using "CW" key, check forward and reflected power of each frequency to see if they fall within the parameters in 5.5.7.

1.9900 MHz	4.6000 MHz	12.6000 MHz
2.6000 MHz	6.6000 MHz	25.6000 MHz
3.6000 MHz	9.6000 MHz	29.9900 MHz

NOTE: If upon completion of the performance test, the DCU-100 is not operating properly, accomplish the following alignment procedures in tables 5.1, 5.2 and 5.3.

Table 5.1 Fault Analysis

SYMPTOM	POSSIBLE TROUBLE	CHECKS AND CORRECTIVE ACTION
No Coupler Control Panel meter readings in FWD or REF position, coupler faults 10 seconds after TUNE command.	a. No RF output from 900 Series Exciter/Transceiver MODE switch not in AM or KW/CPLR TUNE positions for tuning. (MODE Switch position not critical in SC-10 Transceiver units.) b. No RF output from 900 Series Exciter/Transceiver. c. No TUNE ENABLE to SC-10 Transceiver.	a. (1) Before pushing TUNE START pushbutton, is MODE switch in AM or KW/CPLR TUNE positions? (2) No carrier is generated in USB, LSB, (keyed up) positions in 900 Series Exciter/Transceiver. b. Defective Exciter/Transceiver. c. Defective Detector Assy, 2A4. Align, see section 6.5, Repair or replace.
Control Panel meter reads normally in FWD position. No reading in REF position. Coupler faults 10 seconds after TUNE command.	a. No RF to coupler. b. Coupler Detector Board 2A4, defective.	a. Check coax cable and connectors between exciter/transceiver and coupler. Meter in REF position should read greater than zero during TUNE, dipping to a low value when coupler TUNE is achieved. b. Repair or replace. Align see table ____ or
Control Panel meter reads normally in both FWD and REF positions. Coupler faults 10 seconds after TUNE command.	a. Computer Board 2A3 defective. b. Defective component on RF Assembly 2A2. see table ____ step	a. Repair or replace Computer Board 2A3. b. Check components for damage and/or severe discoloration. Replace as required.
More than one coupler status light on.	a. +28 VDC in exciter/transceiver is shut off. b. Defective Computer Board 2A3.	a. Recycle exciter/transceivers power switch (wait 30 seconds before turning on again). Check for +28 VDC at RF Power Amplifier connector 1A8P1, pin D. Repair as necessary. b. Repair or replace Computer Board 2A3.
Fault light blinks on and off at initial power turn on. Check Serial Number of Unit, not applicable to SN 790 and above.	a. Operation is normal and indicates channel data previously entered into memory is no longer valid.	a. No action required. Channel data will automatically be replaced in memory as coupler is tuned.

Table 5.1 Fault Analysis (Con't)

SYMPTOM	POSSIBLE TROUBLE	CHECKS AND CORRECTIVE ACTION
Coupler tunes normally, but faults when 100 W is applied.	a. VSWR trip point set too low.	a. (1) Try to retune with MODE switch in CW position and CW key down (100 W). (2) If tune is not satisfactory or fault condition is noted on more than just a very few frequencies, check voltage on Computer Board 2A3 test point TP3 to ground. Voltage should be 1.2 VDC minimum. Adjust VSWR control 2A3R43 to increase voltage reading to 1.2 VDC or to a value approximately 0.1 VDC higher than measured.
	b. Internal high voltage breakdown.	b. Observe coupler tune in darkened area and look for breakdown on Output Board 2A2A4 or Inductor Board 2A2A3. Repair or replace defective component.
	c. Loose antenna or ground connection, or corrosion.	c. Check antenna and ground connections for tightness and freedom from corrosion.
	d. Defective internal ground connection.	d. (1) Check all Motherboard 2A1A1 and RF Assembly 2A2 ground screws for tightness. (2) Check Computer Board 2A3 connectors for clean connector contacts. Clean or replace.
TUNE light remains on, READY light blinks on and off.	a. TUNE command line is held High by exciter/transceiver.	a. Exciter/transceiver defective. Check exciter/transceiver manual for corrective action.
Exciter/transceiver cannot be keyed when FAULT light is on.	a. Normal operation to protect coupler and exciter/transceiver when a coupler fault is detected.	a. Depress TUNE START push-button with MODE Switch in AM or KW/CPLR TUNE positions to recycle coupler. If fault persists, check other symptoms in this table to identify the problem.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
16. Network Relay Drivers (Con't)		
16aa. L10	a. U15 pin 5 b. U13 pin 14	Relay K22 on the Inductor Board 2A2A3.
16bb. L11	a. U15 pin 6 b. U13 pin 13	Relay K23 on the Output Board 2A2A4.

IF UPON COMPLETION OF THE FAULT ANALYSIS IN TABLES 5.1 AND 5.2, THE DCU-100 IS STILL NOT OPERATING PROPERLY, ACCOMPLISH THE FOLLOWING ALIGNMENT PROCEDURE.

5.5.9

Table 5.3 DCU-100 Alignment Procedure for Computer Assembly p/n 8080020094

Serial Numbers up to 499

NOTE: All measurements and adjustments are accomplished on the Computer Board 2A3.

1. Turn on the exciter/transceiver. (Necessary to supply power to the coupler.)
2. Connect negative lead of DVM to ground. Select scale appropriate to measure 10 VDC.
3. Measure voltage on TP1 (U22 pin 3). Adjust R32 until voltage is 10 V ± .5 VDC.
4. Measure voltage on TP2 (U21 pin 3). Adjust R29 until voltage is 5.00 VDC.
5. Measure voltage on TP3 (U19 pin 4). Adjust R43 until voltage is 1.75 VDC.
6. Adjust R19 until the voltage between TP2 and TP6 is +200 mv ± 5 mv. Check voltage between TP2 and TP7 to make sure it reads -200 mv ± 5 mv. If not, readjust R19 and R32 as requried.
7. Connect multimeter between TP4 (U18 pin 4) and TP5 (U18 pin 7). Adjust R6 until the voltage is 200 mv ± 5 mv. (Disregard polarity.)

Take out of 1993 manuals

Change Date 1 December 1986

5.5.10

Table 5.4 DCU-100 Alignment Procedure for Computer Assembly p/n 8080025096

serial numbers 500 and above

NOTE: All measurements and adjustments are accomplished on the Computer Board 2A3.

1. Turn on the exciter/transceiver. (Necessary to supply power to the coupler.)
2. Connect negative lead of DVM to ground. Set meter scale to read 5 VDC.
3. Measure voltage on TP2 (U21 pin 3). Adjust R29 until voltage is +5.00 VDC.
4. Measure voltage on TP3 (U19 pin 4). Adjust R43 until voltage is +1.75 VDC.
5. Connect negative lead of DVM to TP7 (U18 pin 11) and connect positive lead to TP6 (U18 pin 8). Adjust R19 until a reading of +200 mv ± 5 mv is obtained.
6. Connect negative lead of DVM to TP2 (REF). Measure voltages on TP6 (U18 pin 8) and TP7 (U18 pin 11). Adjust R66 until TP6 reads +100 mv ± 5 mv and TP7 reads -100 mv ± 5 mv. Repeat steps 5 and 6 as requried to obtain reading.
7. Connect negative lead of DVM to TP5 (U18 pin 7) and positive lead to TP4 (U18 pin 4). Adjust R6 unitl a reading of +200 mv ± 5 mv is obtained.
8. Connect negative lead of multimeter to TP2 (REF). Measure voltages on TP5 (U18 pin 7) and TP4 (U18 pin 4). Adjust R61 until TP5 reads -100 mv ± 5 mv and TP4 reads +100 mv ± 5 mv.
9. Repeat steps 7 and 8 as required to obtain correct reading.

add new alignment
for ECN 8085-015 04/05/96
CPU Assembly

5.5.4 ALIGNMENT PROCEDURE for DETECTOR/RELAY PAD ASSEMBLY (2A4)

Connect Transceiver, Antenna Coupler and Test Equipment as shown in Figure 5.4 Detector/Relay Pad Alignment Setup. Install Detector/Relay Pad Assembly (2A4) on card extender (Sunair P/N 8085165091). (See Figure 5.3).

NOTE: All measurements and adjustments are accomplished on the 2A4 board. See Figure 5.3 for Test Point and Adjustment Locations.

a) Turn on Transceiver (necessary to supply power to the coupler). Set Transceiver frequency to 29.6050 MHz and select 'AM' mode.

b) Key the Transceiver with the microphone PTT key switch. Power shown on Thruline Wattmeter connected to Transceiver output will display 40 to 50 Watts. Thruline Wattmeter connected to J1 on Detector/Relay Pad extender card output will display 40 to 50 Watts. Ground TP1 on extender card, Transceiver output should still display 40 to 50 Watts, but extender card output should drop to 10 to 12 Watts. This verifies that the 6 dB pad is operating. Example: 40 Watts without the pad divided by 4 equals 10 Watts with the pad energized. Unkey the Transceiver and remove the ground from TP1.

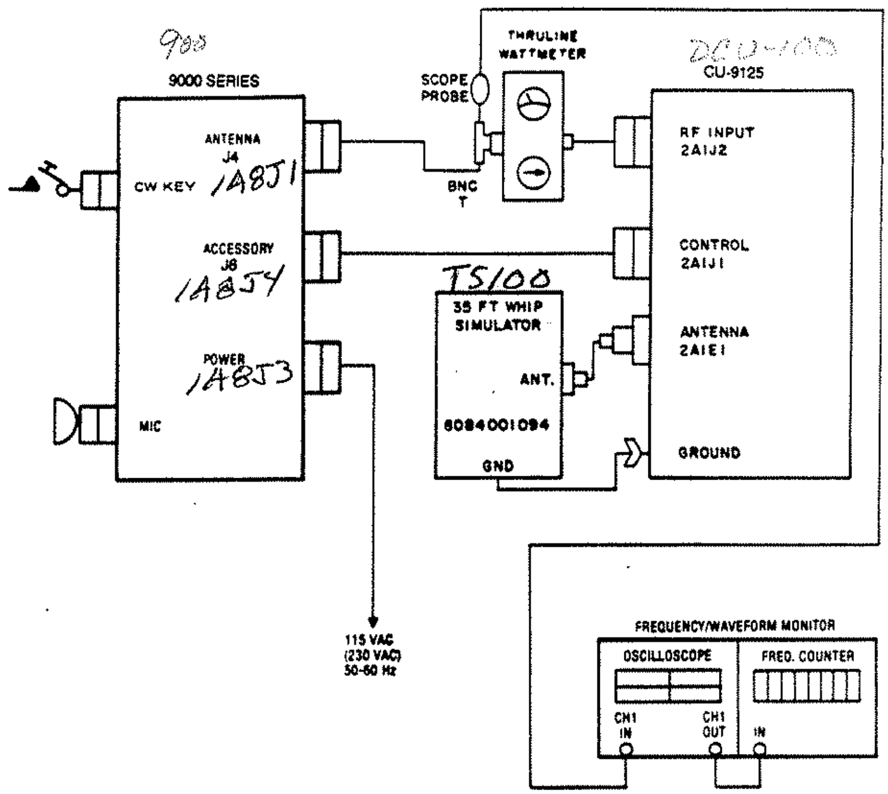
c) Connect common lead of DVM to ground. Connect positive lead of DVM to TP4 (Reflected Power). Key the Transceiver with the microphone PTT key switch. AM power of 40 to 50 Watts will now be displayed on the two (2) Wattmeters. The DVM will display a positive voltage. Adjust C14 for .000 to +.050 VDC reading on DVM. Momentarily disconnect coax cable to the 50 ohm load. Observe on DVM a positive change to 3.0 VDC or higher. If not, detector is not working and needs troubleshooting and repair. Reconnect cable to load. DVM should return to adjusted reading, unkey Transceiver.

d) Connect common lead of DVM to TP2 (+5 VDC Reference) and connect positive lead to TP1 (Magnitude Detector). Key Transceiver with microphone PTT key switch. AM power of 40 to 50 Watts will be displayed on the two (2) Wattmeters. Adjust C2 for .000 to .050 VDC reading on DVM. Momentarily disconnect coax cable to the 50 ohm load. Observe DVM, a change should be seen. If not, the detector is not working and should be troubleshot and repaired. Reconnect cable to load. DVM will return to adjusted reading, unkey Transceiver.

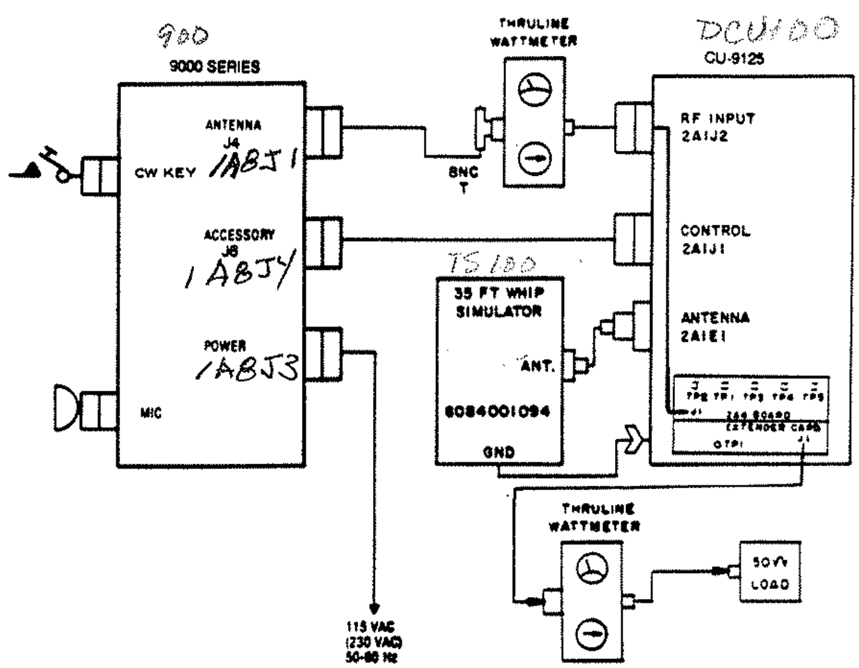
e) Leave common lead of DVM connected to TP2 (+5 VDC Reference) and move positive lead to TP3 (Phase Detector). Key Transceiver with microphone PTT key switch. AM power of 40 to 50 Watts will be displayed on the two (2) Wattmeters. Note the DVM reading at 29.90000 MHz. Step in MHz increments to 1.60500 MHz, noting the DVM reading at each step, to get the maximum positive and negative voltage reading. Adjust R12 as needed until maximum positive and negative voltage at TP3 are equal and the magnitude of the voltage does not exceed .050 VDC. Momentarily disconnect coax cable to 50 ohm load. A change in the DVM reading should be seen. If not, detector is not working and needs troubleshooting and repair. Reconnect cable to load. DVM should return to adjusted reading, unkey Transceiver.

f) Reverse coax cable connections at 2A1J2 and J1 on extender card; this will send the RF in reverse through 2A4 circuitry. Connect common lead of DVM to ground and connect positive lead to TP5 (RF Detector FWD). Key the Transceiver with microphone PTT key switch. AM power of 40 to 50 Watts will be shown on the two (2) Thruline Wattmeters. The DVM will display a positive voltage. Adjust C19 for .000 to +.050 VDC. Momentarily disconnect coax cable to 50 ohm load. Observe on DVM a positive change to 2.0 VDC or higher. If not, detector is not working and needs troubleshooting and repair. Reconnect cable to load. DVM will return to adjusted reading, unkey Transceiver and turn off. Remove card extender and reinstall 2A4.

NOTE: This completes the alignments for the Computer Board (2A3) and the Detector/Relay Pad (2A4). Re-perform the Tests outlined in Section 5.5.2, Antenna Coupler Performance Test. If Antenna Coupler still fails the tests in Section 5.5.2, go to Tables 5.1 and 5.2, isolate and repair the problem.



ANTENNA COUPLER TEST SETUP



DETECTOR/RELAY PAD ALIGNMENT SETUP

5.1

Figure 5.4 Coupler Test.

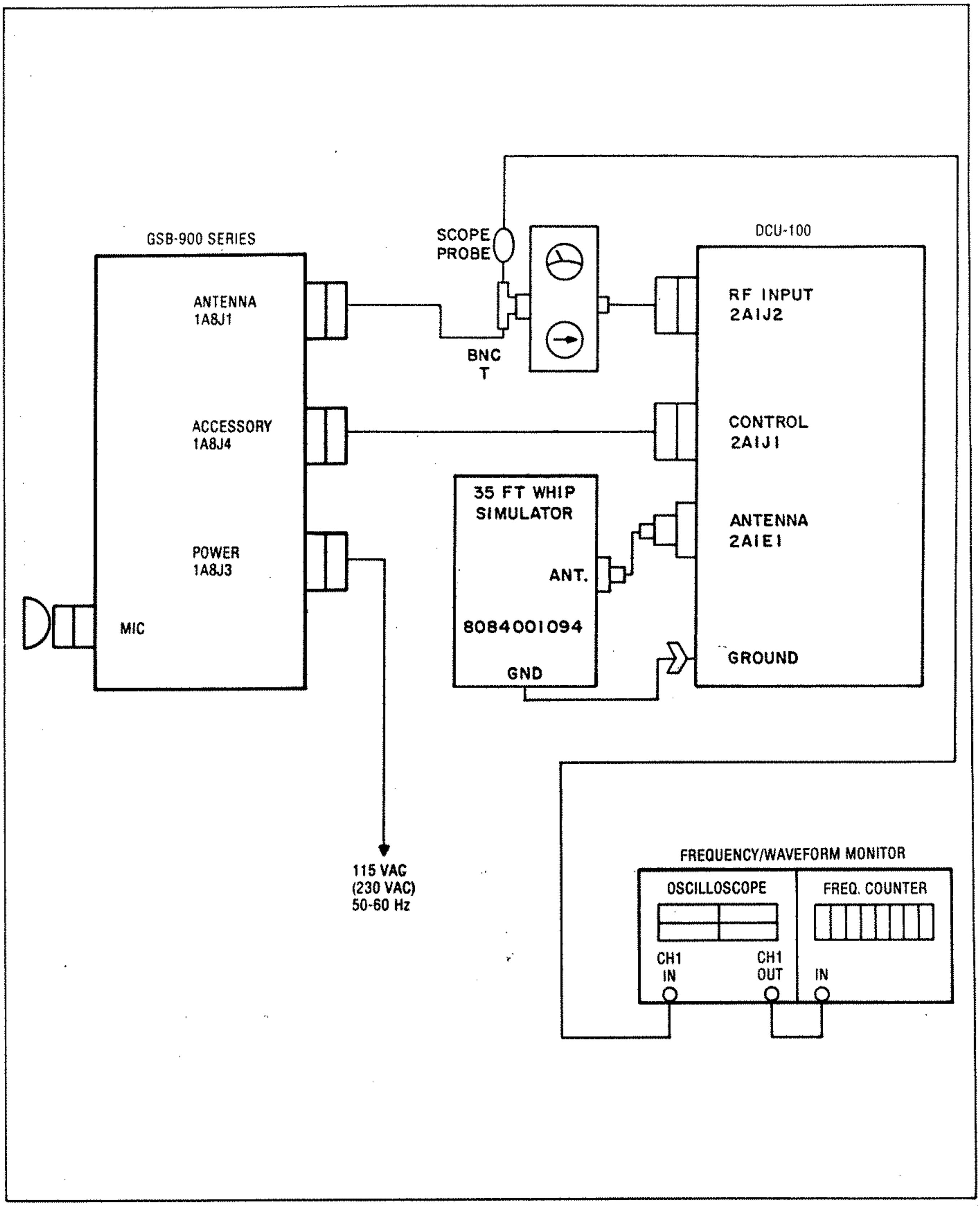


Figure 5.1 Coupler Test Setup

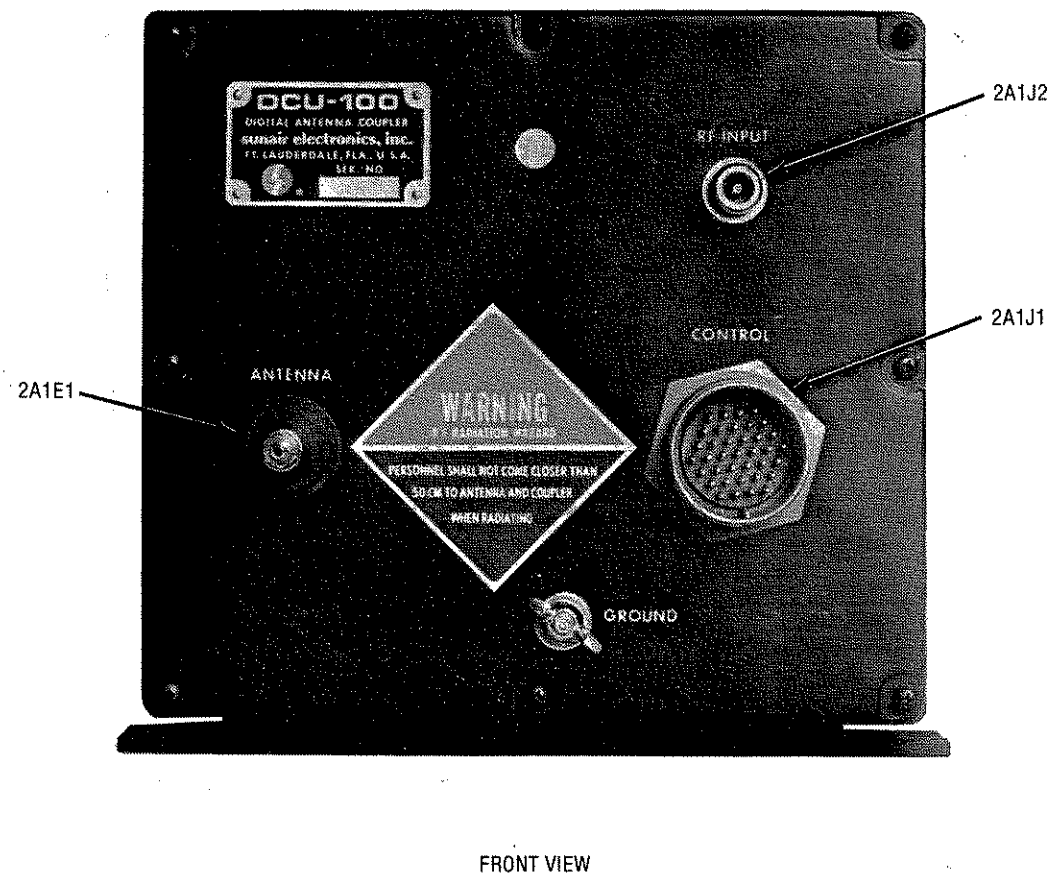


Figure 5.2 Major Assembly and Component Locations (Sheet 1 of 5)

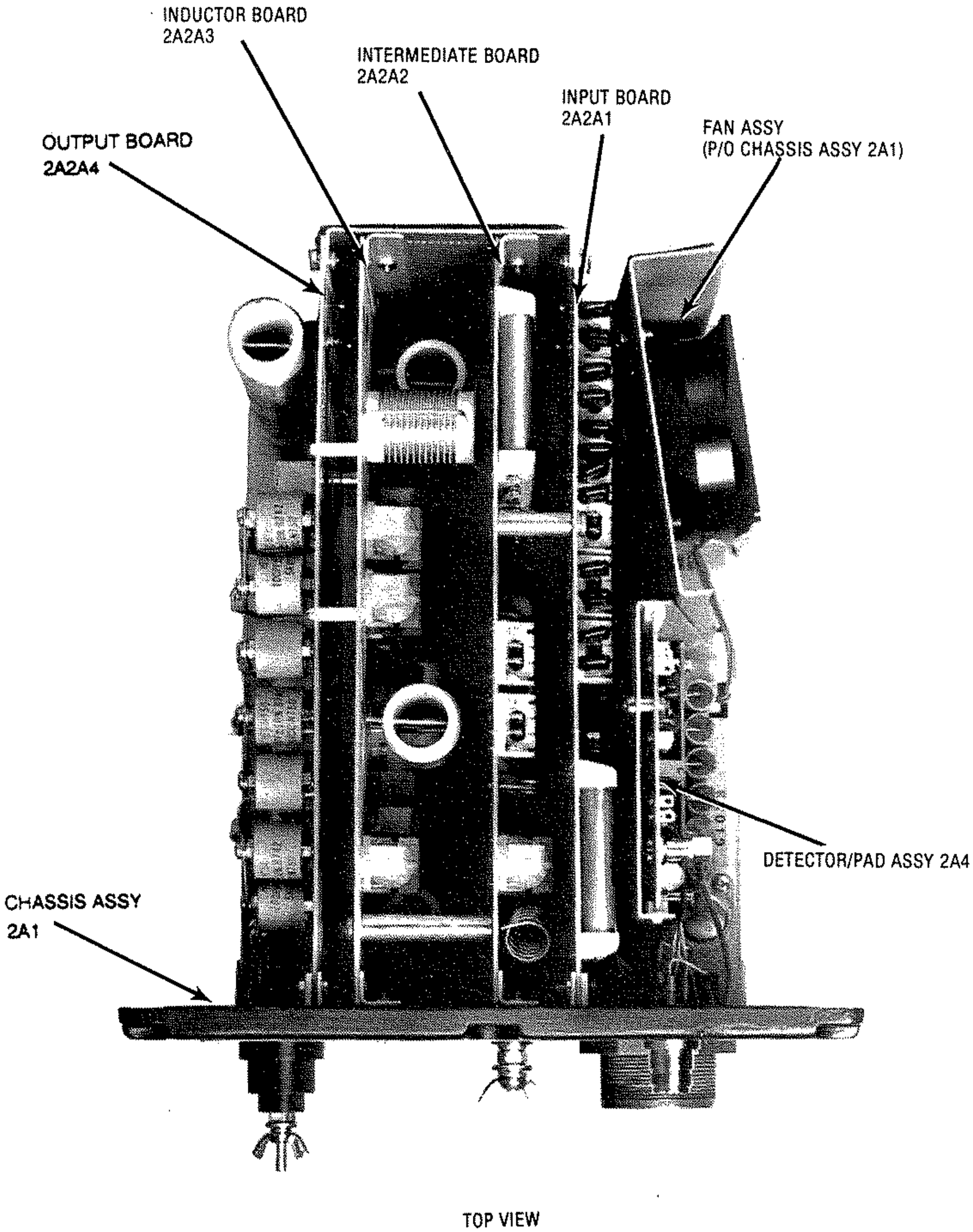


Figure 5.6 Major Assembly and Component Locations (Top View).

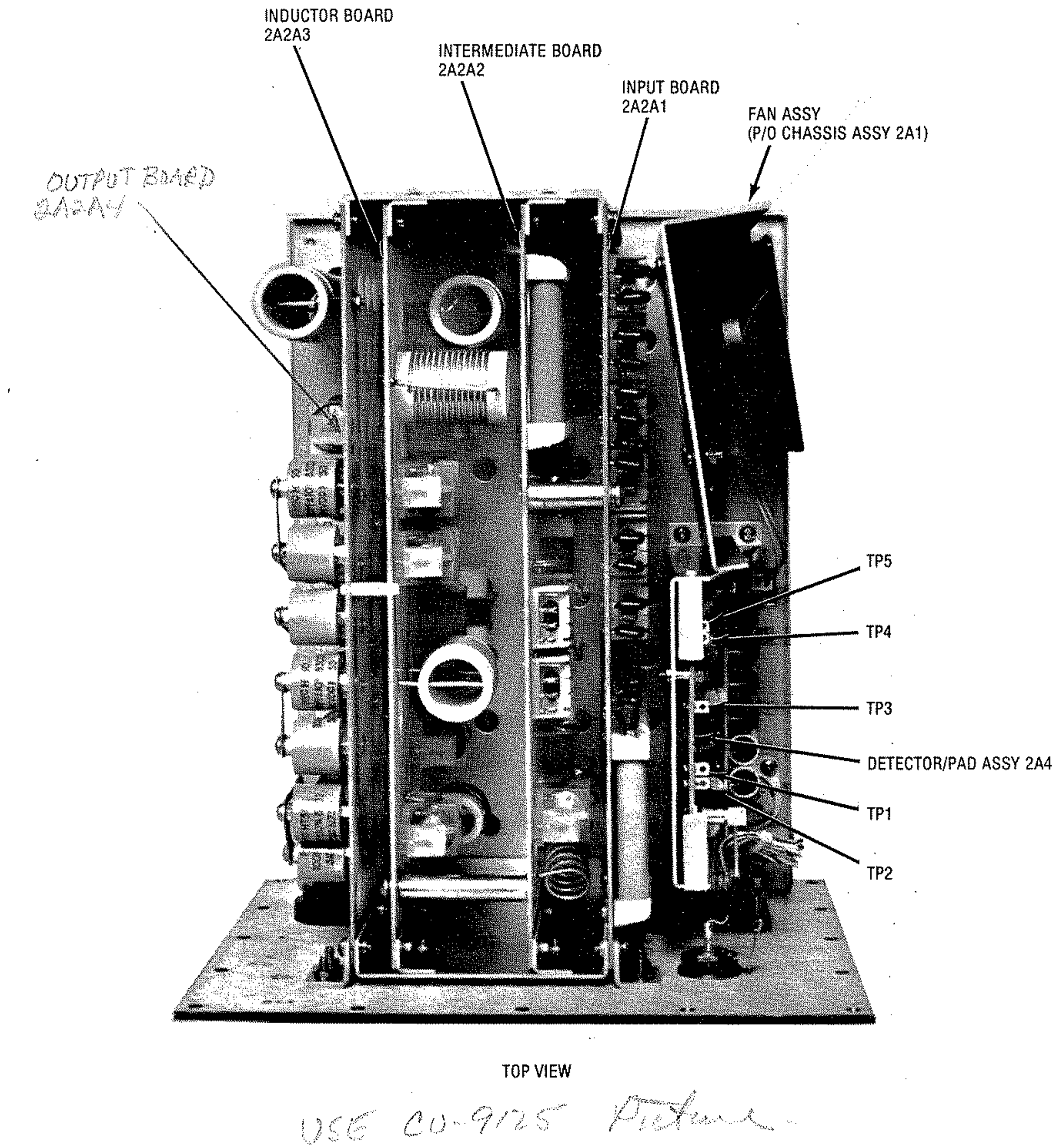


Figure 5.2 Major Assembly and Component Locations (Sheet 2 of 5)

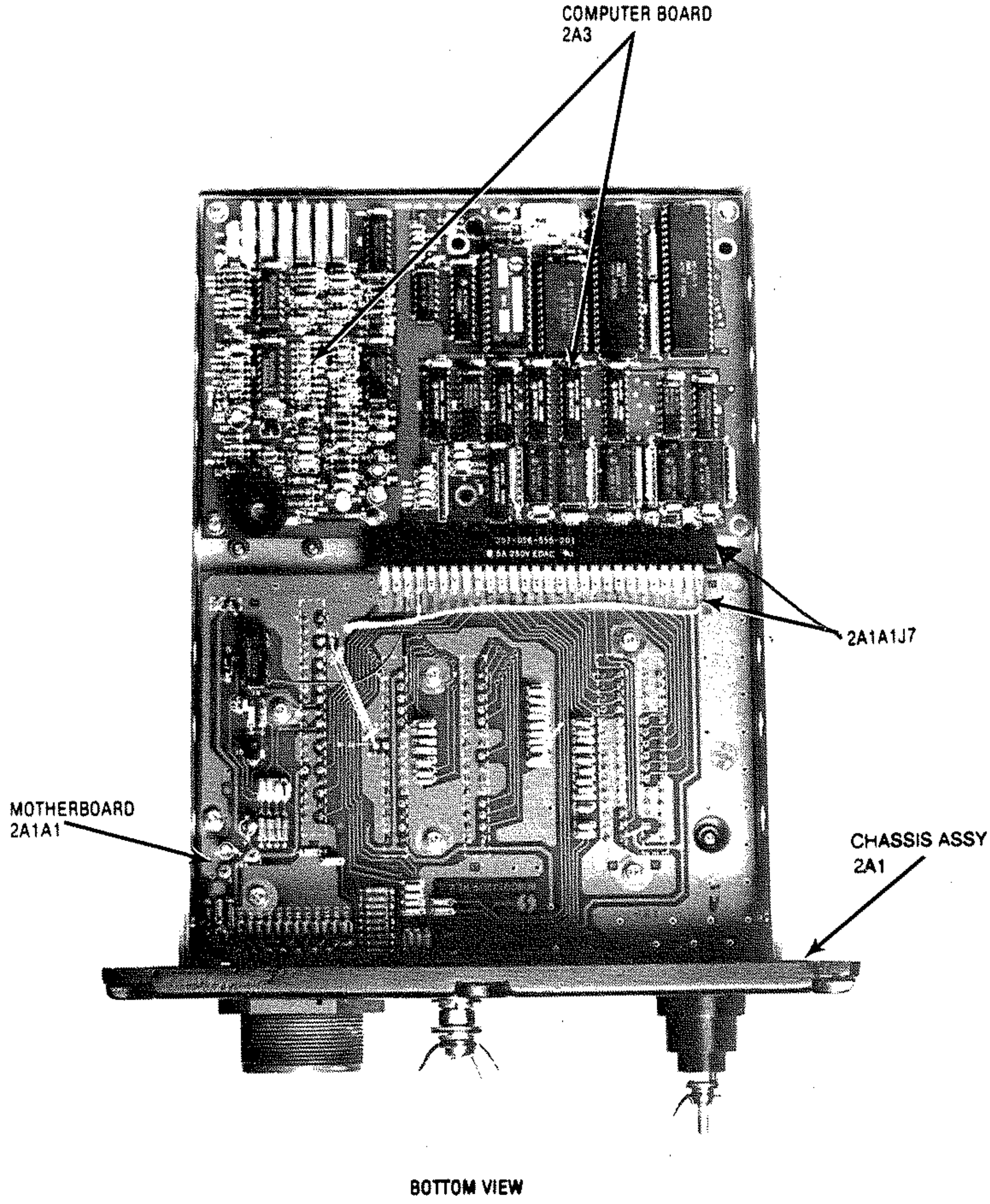


Figure 5.7 Major Assembly and Component Locations (Bottom View).

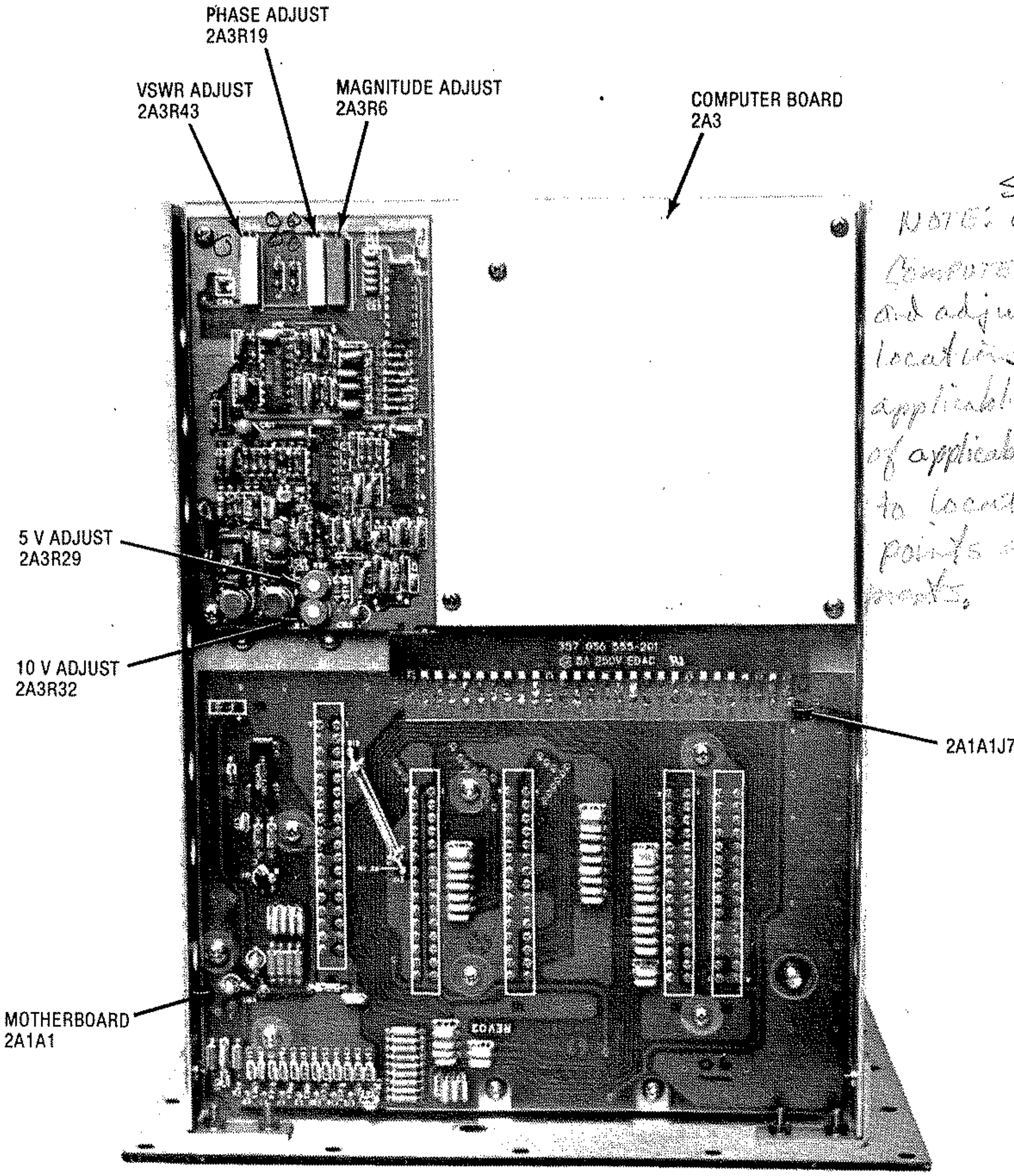


Figure 5.2 Major Assembly and Component Locations (Sheet 3 of 5)

Shows NOTE: Original COMPUTER BOARD and adjustment locations. Go to applicable schematic of applicable board to locate test points and adjustments.

DCU-100

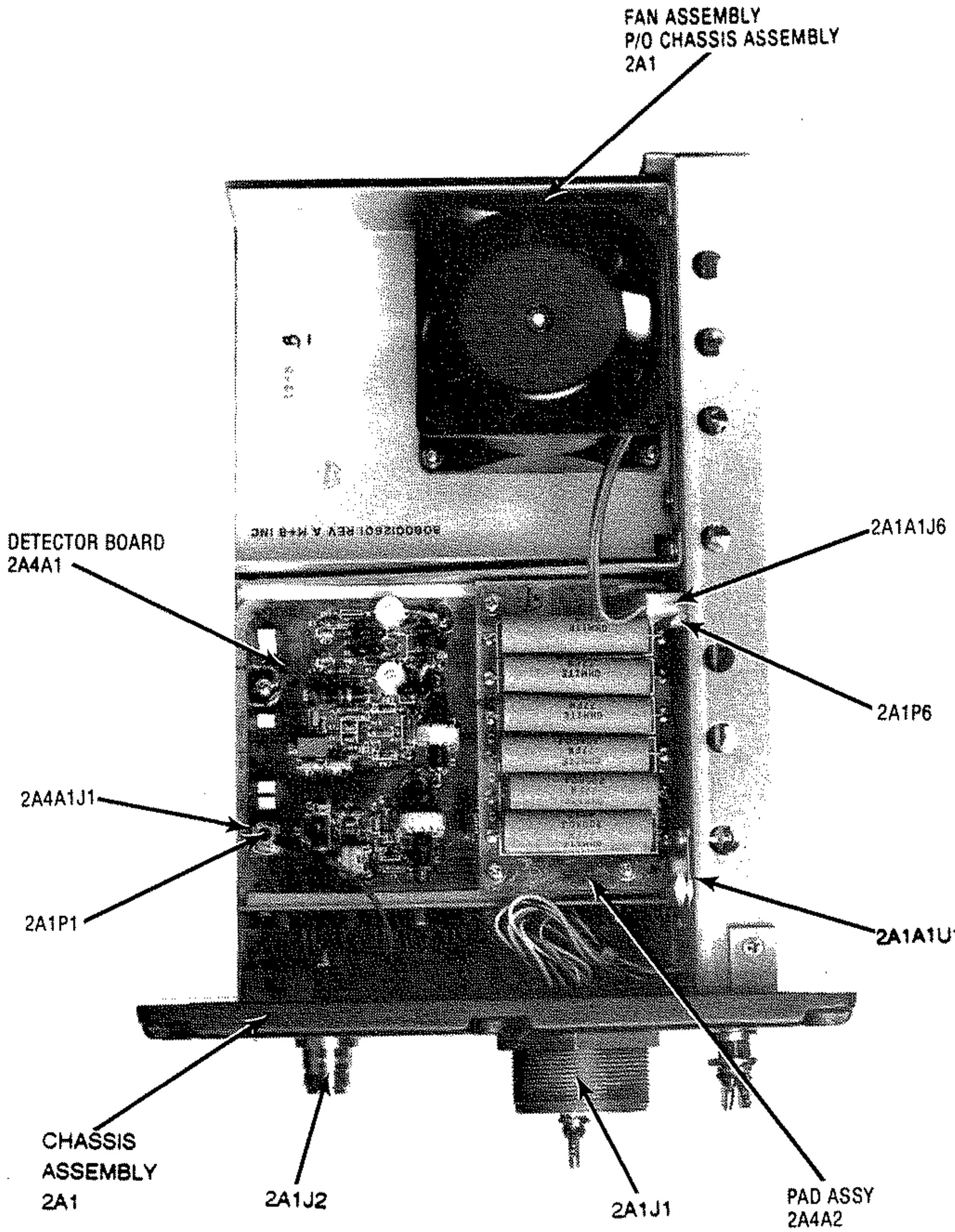


Figure 5.8 Major Assembly and Component Locations (Right Side View).

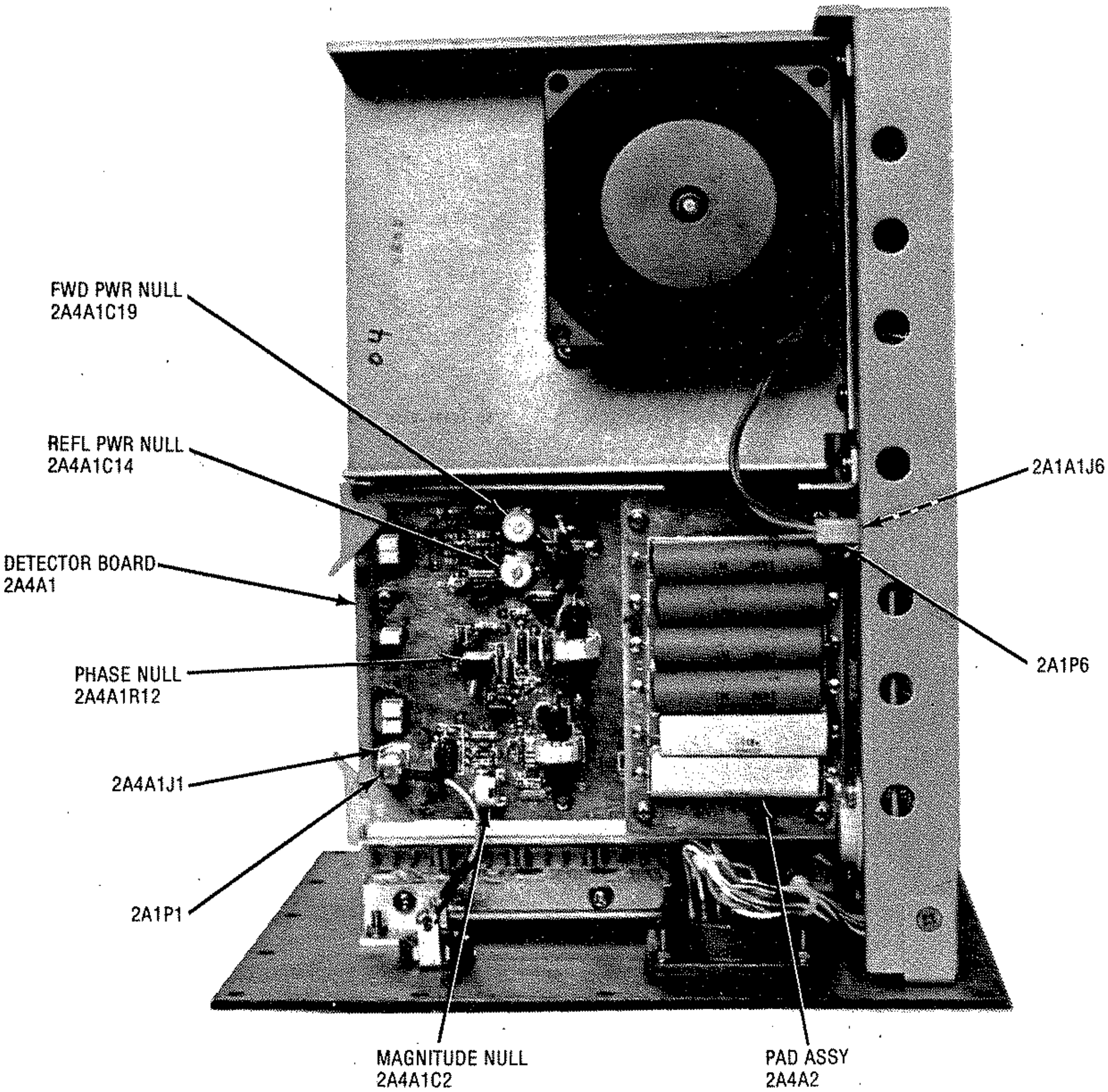


Figure 5.2 Major Assembly and Component Locations (Sheet 4 of 5)

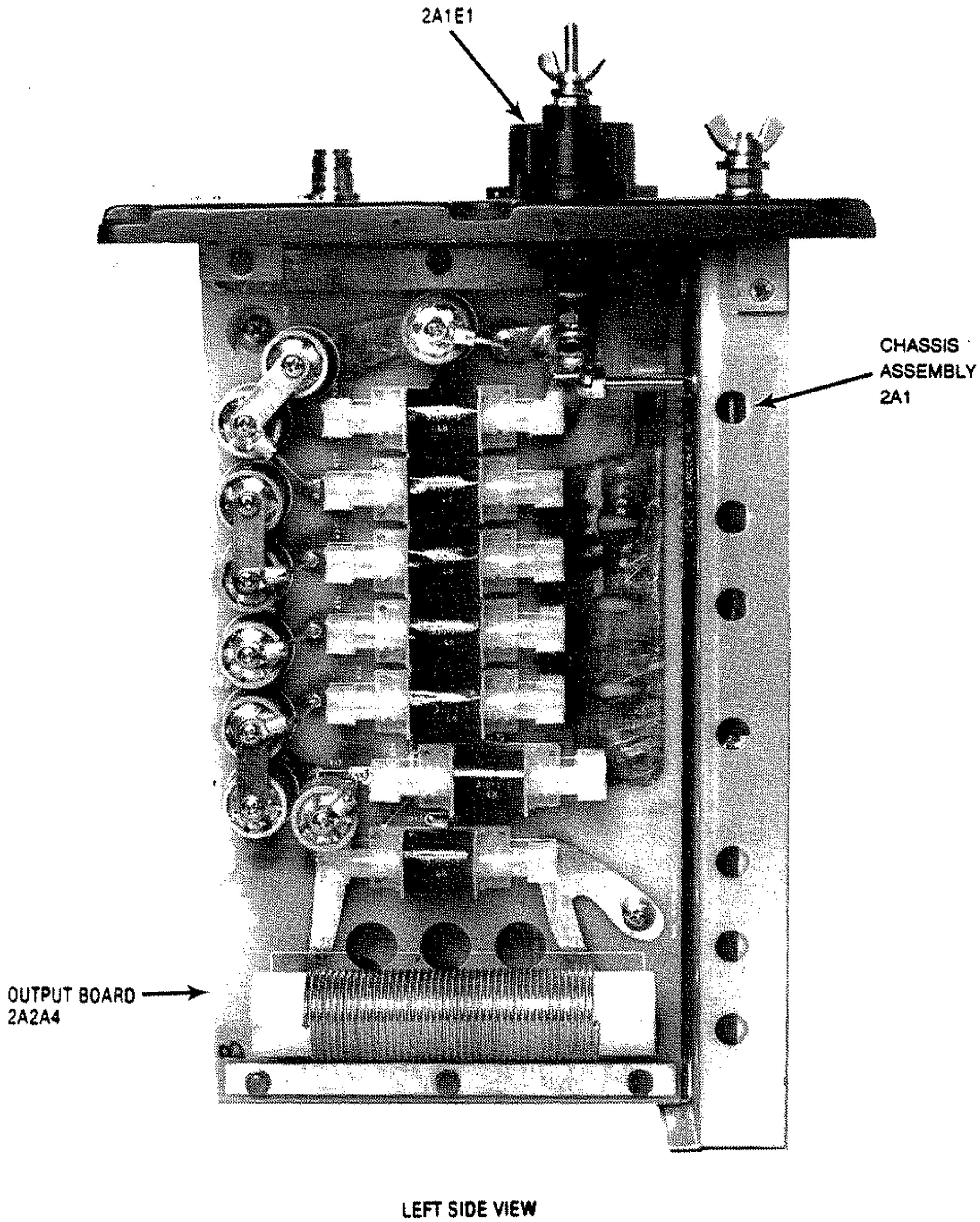


Figure 5.9 Major Assembly and Component Locations (Left Side View).

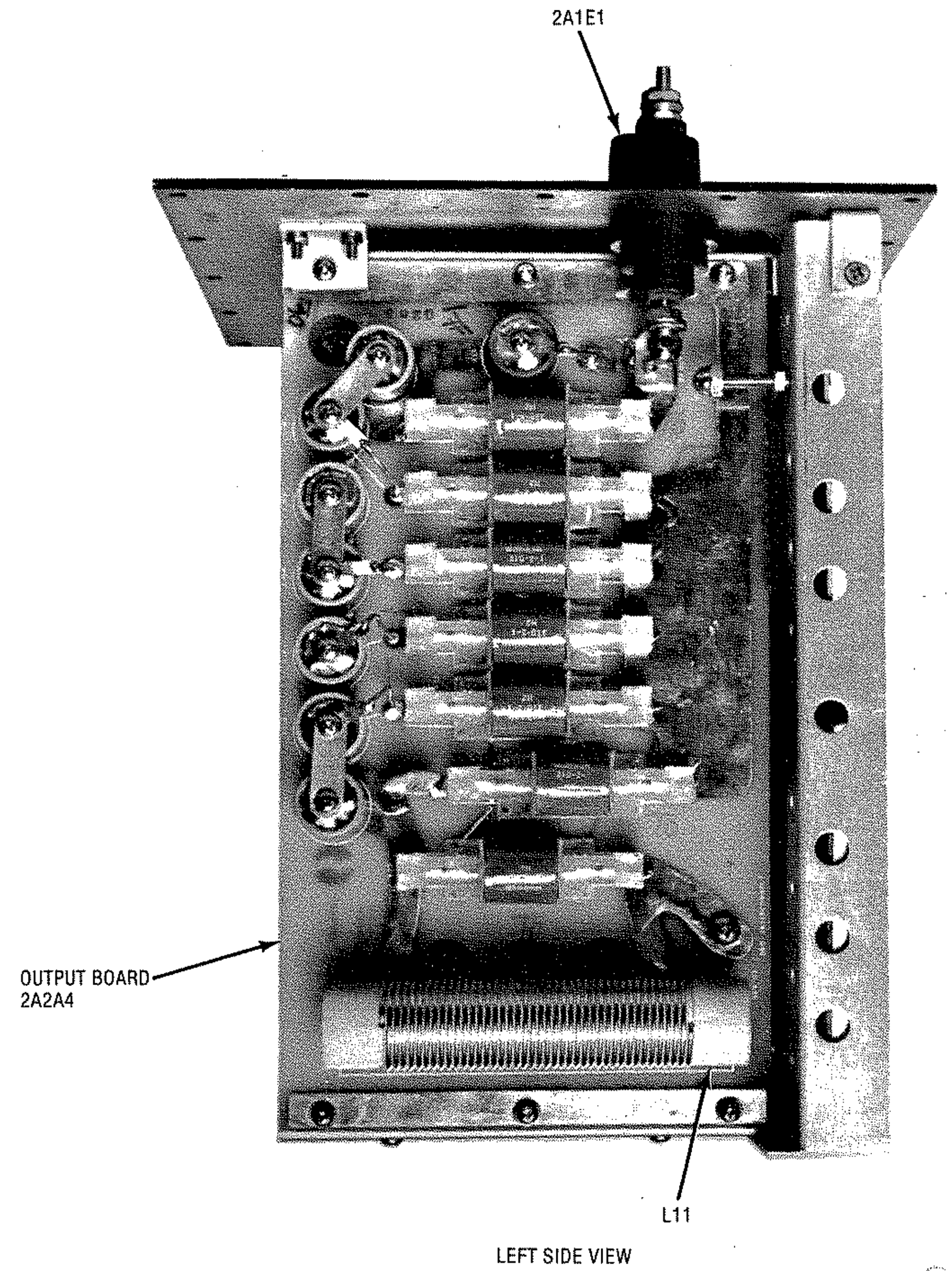


Figure 5.2 Major Assembly and Component Locations (Sheet 5 of 5)

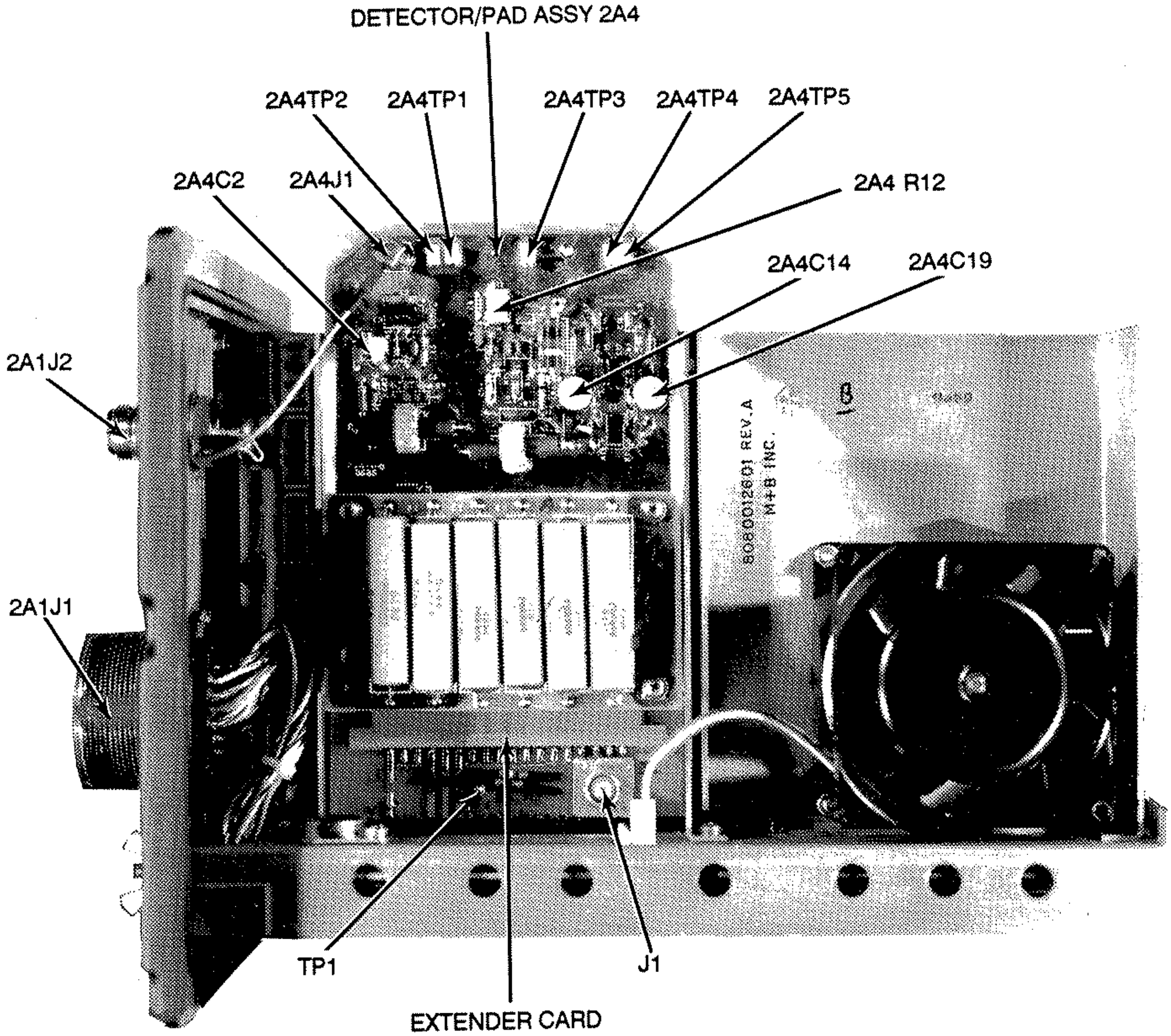


Figure 5.3 ~~CU-9125~~ DCU-100 Detector/Pad (2A4) and Extender Card Test Points and Adjustment Locations.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3

NOTE: For this Test Procedure, a 35 ft. whip antenna simulator TS-100 is required. An equivalent type of simulator may be used or one may be purchased from Sunair, p/n 8084001094, or built from the schematic diagram in Figure 5.12.

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
Preliminary Setup	a. Test equipment: Freq/waveform monitor, Figure 5.1 and a digital voltmeter (DVM). b. Exciter/Transceiver: AM Mode of operation. c. Connect 35 ft. whip antenna simulator to couplers antenna terminal.	

NOTE: When instructed to change exciter/transceiver frequency, be sure to change frequency by no less than 2 MHz.

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
1. 28 V Supply	a. Connect negative lead of DVM to chassis and positive lead to Motherboard connector 2A1A1 J7 pin 27.	**Normal:** DVM indicates 28 V ± 4 volts. **Abnormal:** Unplug Computer Board. If DVM reads the specified voltage, check for shorts on the board. If still reading wrong voltage, check control cable. Check for shorts on the RF Assembly 2A2.
2. 5 V Supply	a. Connect positive lead of DVM to Motherboard connector 2A1A1 J7 pin 2.	**Normal:** DVM indicates 5 V ± .5 V. **Abnormal:** Unplug Computer Board. If DVM reads the specified voltage, check for shorts on the board. If it still reads the wrong voltage, check or repair the 5 V regulator mounted on the Chassis Assembly 2A1.
3. 1 MHz Clock Oscillator	a. Remove RF Shield covering the 2A3 Board. b. Connect oscilloscope probe to U1 pin 1.	**Normal:** Frequency = 1 MHz square wave, 4 V p-p minimum. **Abnormal:** Replace U23.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
4. Tune Command Circuit	a. Connect scope probe to CR2 anode. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates a momentary +0 VDC to +12 VDC Low to High change. Coupler tunes. **Abnormal:** Check Motherboard. Check control cable between radio and coupler. Check radio for proper inputs to coupler.
	b. Connect scope probe to Q1 base. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates a +1 V level at Q1 base. This level remains until coupler has tuned, then indicates 0 V. **Abnormal:** Check Q1 and associated circuitry.
	c. Connect scope probe to Q1 collector. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates a voltage level of +1 V at Q1 collector while tuning. Level should remain Low until coupler has completed the tune cycle. Scope indicates a +24 V level. **Abnormal:** Repair or replace Q1 or associated circuitry. Check Motherboard 2A1A1. Check Tune Relay on Detector Board Assembly 2A4. Refer to Section 4.3.
	d. Connect scope probe to U5 pin 5. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates momentary 0 V to +5 VDC pulse. Coupler tunes. **Abnormal:** Check R34, CR17, R35 and U5. Repair or replace.
	e. Connect scope probe to U1 pin 8. Depress TUNE START button on Coupler Control Panel 1A2.	**NORMAL:** Scope indicates momentary 0V to +5VDC pulse. Coupler tunes. **ABNORMAL:** Check U27A, U27B and repair or replace.
5. +10 VDC	a. Connect DVM negative lead to ground (chassis) and connect positive lead to TP1.	**Normal:** DVM indicates a reading of approximately 10.5 V ± .5 V. **Abnormal:** If voltage is off by more than .5 V check U22 circuitry for defective component.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
6. Detector Reference	a. Connect DVM negative lead to ground (chassis) and connect positive lead to TP2.	**Normal:** DVM indicates a reading of 5 V ± 0.01 V. **Abnormal:** Adjust R29 for proper reading. If proper voltage cannot be obtained, check voltage at CR10 cathode. Cathode reading should be approximately 28 V. Anode readings should be approximately 16 V. If these are correct, replace U21.
7. Phase and Magnitude Comparators	a. Connect scope probe to U17 pin 12. Change frequency of exciter/transceiver and depress microphone key.	**Normal:** Scope indicates a varying voltage of 3 to 5 V of approximately 2 V p-p. This continues until the tune cycle is complete. **Abnormal:** Check circuitry related to U17 and check Detector/Pad Assembly 2A4. Refer to Section 4.3.
	b. Connect scope probe to U17 pin 10. Change frequency of exciter/transceiver and depress microphone key.	**Normal:** Same as 7.a. above. **Abnormal:** Same as 7.a. above.
	c. Connect scope probe to U18 pin 2. Change frequency of exciter/transceiver and depress microphone key.	**Normal:** Scope indicates pulses between 0 V and +10 V during the tune cycle. **Abnormal:** Check U18 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3. Check setup of Phase and Magnitude windows according to Section 4.3.
	d. Connect scope probe to U18 pin 1. Repeat as in step 7.c. above.	**Normal:** Same as 7.c. above. **Abnormal:** Same as 7.c. above.
	e. Connect scope probe to U18 pin 14. Repeat as in step 7.c. above.	**Normal:** Same as 7.c. above. **Abnormal:** Same as 7.c. above.
	f. Connect scope probe to U18 pin 13. Repeat as in step 7.c. above.	**Normal:** Same as 7.c. above. **Abnormal:** Same as 7.c. above.
	g. Connect scope probe to U20 pin 2. Change frequency of exciter/transceiver and depress microphone key.	**Normal:** Scope indicates pulses of 0 V to +5 V p-p. **Abnormal:** Check Related circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
7. Phase and Magnitude Comparators (Con't)	h. Repeat checks on U20 pin 4, pin 6, pin 8 and follow same procedure as in 7.g. above.	**Normal:** Same as 7.g. above. **Abnormal:** Same as 7.g. above.
8. Reflected Power	a. Connect scope probe to U19 pin 1. Change frequency of exciter/transceiver and depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates a varying 2 V p-p voltage nulling occurs when tune is complete. **Abnormal:** Check U19 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.
	b. Connect scope probe to U19 pin 2. Change frequency of exciter/transceiver. Depress microphone key.	**Normal:** Scope indicates a High during the tune cycle, and a Low at the completion of the tune. **Abnormal:** Check U19 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.
	c. Connect scope probe to U20 pin 10. Change frequency of exciter/transceiver. Depress microphone key.	**Normal:** Scope indicates a Low and at end of tune cycle goes High. **Abnormal:** Check U20 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.
	d. Connect scope probe to U1 pin 9. Change frequency of exciter/transceiver. Depress microphone key.	**NORMAL:** Scope indicates a high and at the end of tune cycle goes low. **ABNORMAL:** Check U19C, U24F, U27C, U27D, U1 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.
9. RF Detector (Forward Power Det)	a. Connect scope probe to TP3. Change frequency of exciter/transceiver. Depress microphone key.	**Normal:** Scope indicates varying voltage until end of tune cycle. Then it reads approximately 1.2 V. **Abnormal:** Check U19 and associated circuitry. Check Detector/Pad Assembly 2A4. See Section 4.3.
10. $\overline{RF}$	a. Connect scope probe to collector of Q2. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** The scope indicates a Low during the tune cycle. At the end of the cycle the scope indicates a High. **Abnormal:** Check Q2 and associated circuitry. Check Forward Power Detector on Detector/Pad Assembly 2A4. See Section 4.3.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
11. FAULT Lamp Circuit	a. Connect scope probe to U6 pin 16. Turn exciter/transceiver power off. Wait approximately 4 seconds and turn power back on.	**Normal:** Scope will show a 5 V level indication when exciter/transceiver is turned back on. For further information on the function of the Output Ports, see paragraph 4.4.9.7. **Abnormal:** Check U6 and associated circuitry. Check FAULT Lamp on Coupler Control Panel 1A2. Check control cable between coupler and radio.
	b. Connect scope probe to U11 pin 12. Turn exciter/transceiver power off for approximately 4 seconds, then turn back on.	**Normal:** Scope will indicate a Low voltage when the radio is turned back on. **Abnormal:** Check U11 and associated circuitry. Check FAULT Lamp on Coupler Control Panel 1A2. Check control cable between coupler and radio.
12. READY Lamp Circuit	a. Connect scope probe to U6 pin 15. Depress TUNE START button on Coupler Control Panel 1A2.	**Normal:** Scope indicates a High when tune cycle is complete. For further information on the function of the Output Ports, see paragraph 4.4.9.7. **Abnormal:** Check U6 and associated circuitry. Check READY Lamp on Coupler Control Panel 1A2. Check control cable between coupler and radio.
	b. Connect scope probe to U11 pin 13.	**Normal:** Scope indicates a Low. **Abnormal:** Check related circuitry of U11. Check READY Lamp on Coupler Control Panel 1A2. Check control cable between coupler and radio.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
13. RAM Backup Circuit	a. Connect scope probe to collector of Q3.	**Normal:** Scope indicates approximately +13 V. **Abnormal:** Check CR11, Q3 and associated circuitry.
	b. Connect scope probe to Q4 gate (G).	**Normal:** Scope indicates approximately +7 V. **Abnormal:** Check related circuitry.
	c. Connect scope probe to CR13 anode.	**Normal:** Scope indicates approximately +6.5 V. **Abnormal:** Check related circuitry.
	d. Connect scope probe to U14 pin 24.	**Normal:** Scope indicates approximately +5.5 V. **Abnormal:** Check U14, CR12, C42, C13 and C100 A, B.
	e. Turn exciter/transceiver power off and connect scope probe to U14 pin 24. f. Turn exciter/transceiver power on.	**Normal:** Scope indicates a voltage level of at least +5 V. **Abnormal:** Check related circuitry.
14. Key Disable Circuit	a. Connect scope probe to U15 pin 19, disconnect RF coax into coupler, and depress TUNE START button on the Coupler Control Panel 1A2.	**Normal:** Scope indicates a Low and 10 seconds later it goes High. FAULT Lamp will come on. The keyline will be disabled at this point.This can be verified by depressing the microphone key. The Power Monitor Meter on the Coupler Control Panel 1A2 will have no indication of Forward Power. **Abnormal:** Check related circuitry. For further information on the function of the Output Ports, see paragraph 4.4.9.7.
	b. Connect scope probe to U13 pin 12. Depress the TUNE START button on the Coupler Control Panel 1A2.	**Normal:** FAULT Lamp will turn off and scope will indicate a +28 V level. After 10 seconds it will go Low and the FAULT Lamp will light. Keyline will be disabled. **Abnormal:** Same as 14.a. above.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

NOTE: Before accomplishing the next test, reconnect the RF coax cable to the RF input of the coupler.

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
15. Pad Relay	a. Connect scope probe to U6 pin 19. Depress the TUNE START button on the Coupler Control Panel 1A2.	**Normal:** Scope indicates a High during the tune cycle, and a Low at the completion of the tune cycle. **Abnormal:** Check related circuitry. For further information on the function of the Output Ports see paragraph 4.4.9.7.
	b. Connect scope probe to U11 pin 11. Depress the TUNE START button on the Coupler Control Panel 1A2.	**Normal:** Scope indicates a Low during tuning, then it goes to approximately +28 V at completion of the tune cycle. **Abnormal:** Same as 15.a. above. Also check relay on Detector/Pad Assembly 2A4. See Section 4.3.
16. Network Relay Drivers		
16a. C17	a. Connect scope probe to U5 pin 21. Remove 35 ft. whip antenna simulator. Short antenna terminal to ground terminal with a 3 ft. clip lead. (Short antenna terminal **ONLY** for testing of 16a.a. **NOT** for any of the following like tests.) Exciter/transceiver in AM Mode at 1.6000 MHz. Depress microphone key.	**Normal:** Scope indicates a 3 V p-p ± change. If the tune cycle ends and the pulse did not occur, change the frequency on the exciter/transceiver by 100 kHz and repeat, do this 6 times. **Abnormal:** If after 6 times the scope does not change, check related circuitry. For further information on the function of the Output Ports see paragraph 4.4.9.7.
	b. Connect scope probe to U9 pin 16. Exciter/transceiver in AM Mode at 1.6000 MHz. Depress microphone key.	**Normal:** Scope indicates a 28 V p-p ± change. If the 28 V change does not occur, proceed as in step 16a.a. **Normal** above. **Abnormal:** Same as in 16a.a. above. Also check relay K28 on the Output Board 2A2A4.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

NOTE: Disconnect clip lead short circuit and reconnect 35 ft. whip antenna simulator.

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
16. Network Relay Drivers (Con't)		
16b. C13	a. Connect scope probe to U5 pin 25. Exciter/transceiver in AM Mode at 1.6000 MHz. Depress microphone key.	**Normal:** Scope indicates a 3 V p-p change. If tune cycle ends and the pulse did not occur, change frequency on the exciter/transceiver by 100 kHz and repeat. Do this 6 times. **Abnormal:** If after 6 times the scope does not change, check related circuitry. For further information on the function of the Output Ports, see paragraph 4.4.9.7.
	b. Connect scope probe to U9 pin 15. Exciter/transceiver in AM Mode at 1.7000 MHz. Depress microphone key.	**Normal:** Scope indicates a 28 V p-p ± change. If the 28 V change does not occur, change frequency on the exciter/transceiver by 100 kHz and repeat. Do this 6 times. **Abnormal:** If after 6 times the scope does not change, check related circuitry. For further information on the function of the Output Ports see paragraph 4.4.9.7. Also check relay K24 on the Output Board 2A2A4.
16c. C14	a. Connect scope probe to U5 pin 26. Proceed as in step 16b.a. above.	**Normal:** Same as in step 16b.a. above. **Abnormal:** Same as in step 16b.a. above.
	b. Connect scope probe to U9 pin 14. Proceed as in step 16b.b. above.	**Normal:** Same as in step 16.b.b. above. **Abnormal:** Same as in step 16b.b. above. Also check relay K25 on the Output Board 2A2A4.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
16. Network Relay Drivers (Con't)		
16d. C15	a. Connect scope probe to U5 pin 27. Proceed as in step 16b.a. above. b. Connect scope probe to U9 pin 13. Proceed as in step 16b.b. above.	**Normal:** Same as in step 16b.a. above. **Abnormal:** Same as in step 16b.a. above. **Normal:** Same as in step 16b.b. above. **Abnormal:** Same as in step 16b.b. above. Also check relay K26 on the Output Board 2A2A4.
NOTE: For the remainder of these checks, only the component and pin numbers along with the relay number will be listed. Follow the established test procedures which have been outlined above in steps 16b. through 16d.		
16e. C16	a. U5 pin 28 b. U9 pin 12	Relay K27 and K29 on the Output Board 2A2A4.
16f. C1	a. U5 pin 29 b. U9 pin 11	Relay K11 on the Intermediate Board 2A2A2.
16g. C2	a. U5 pin 30 b. U9 pin 10	Relay K10 on the Input Board 2A2A1.
16h. C3	a. U5 pin 31 b. U10 pin 16	Relay K9 on the Input Board 2A2A1.
16i. C4	a. U5 pin 32 b. U10 pin 15	Relay K8 on the Intermediate Board 2A2A2.
16j. C5	a. U5 pin 33 b. U10 pin 14	Relay K7 on the Input Board 2A2A1.
16k. C6	a. U5 pin 34 b. U10 pin 13	Relay K6 on the Intermediate Board 2A2A2.
16l. C7	a. U5 pin 35 b. U10 pin 12	Relay K5 on the Intermediate Board 2A2A2.
16m. C8	a. U5 pin 36 b. U10 pin 11	Relay K4 on the Input Board 2A2A1.

Table 5.2 Fault Analysis and Troubleshooting, Computer Board 2A3 (Con't)

CIRCUIT UNDER TEST	INSTRUCTIONS	RESULT/ACTION
16. Network Relay Drivers (Con't)		
16n. C9	a. U6 pin 2 b. U10 pin 10	Relay K3 on the Input Board 2A2A1.
16o. C10	a. U6 pin 5 b. U11 pin 16	Relay K2 on the Input Board 2A2A1.
16p. C11	a. U6 pin 6 b. U11 pin 15	Relay K1 on the Input Board 2A2A1.
16q. C12	a. U5 pin 22 b. U11 pin 10	Relay K17 on the Inductor Board 2A2A3.
16r. L1	a. U7 pin 2 b. U12 pin 16	Relay K12 on the Intermediate Board 2A2A2.
16s. L2	a. U7 pin 5 b. U12 pin 15	Relay K13 on the Intermediate Board 2A2A2.
16t. L3	a. U7 pin 6 b. U12 pin 14	Relay K14 on the Intermediate Board 2A2A2.
16u. L4	a. U7 pin 9 b. U12 pin 13	Relay K15 on the Intermediate Board 2A2A2.
16v. L5	a. U7 pin 12 b. U12 pin 12	Relay K16 on the Intermediate Board 2A2A2.
16w. L6	a. U7 pin 15 b. U12 pin 11	Relay K18 on the Inductor Board 2A2A3.
16x. L7	a. U7 pin 16 b. U12 pin 10	Relay K19 on the Inductor Board 2A2A3.
16y. L8	a. U7 pin 19 b. U13 pin 16	Relay K20 on the Inductor Board 2A2A3.
16z. L9	a. U15 pin 2 b. U13 pin 15	Relay K21 on the Inductor Board 2A2A3.

80801500XXB CPLR TUN CONT 1A2

REF SYMBOL	DESCRIPTION	SUNAIR PART NO.
1A2	CPLR TUN CONT	80801500XX
1A2P2	Plug, Phone Tip, Red	0753680009
1A2S1	Switch, Toggle, DPDT	0334610001
1A2S2	Switch, Pushbutton, SPST, N.O.	0346520002
DS1	Lamp Assy., Green	0841480001
DS2	Lamp Assy., Red	0841490007
DS3	Lamp Assy., Amber	0841500002
M1	Meter	5024042204
	Boot, Pushbutton Switch 1/2-40	0346530008
	Boot, Toggle Switch 1/4-40	0531120007
	Connector, Power, 36 Pin Rect.	0754070000
	Socket, Cartridge Lamp	1003322000
	Gasket, Plug In Panel Lamps	1003324100
	Gasket, Panel	5024043308
	Panel, Cplr Cntl	80580072XX

SECTION VI

OPTIONS/ADDENDUMS

6.1 COMPUTER BOARD ASSEMBLY WITH SLEEP CIRCUIT, P/N 8080024090/ 8080025096

Refer to Figure 6.1

6.1.1 GENERAL

The Computer Board 2A3 combines the analog interface circuitry used to process the detector outputs for use by the microprocessor U1, with the microprocessor computer circuitry. The analog circuits are located on the left side of the board and consist of integrated circuits U17 through U22, Q1, Q2, and their associated circuitry.

6.1.2 PHASE DISCRIMINATOR INTERFACE

The phase discriminator interface consists of U17A, U18A, U18B, U20A, and U20B. The phase discriminator output is compared with the +5 VDC reference voltage for magnitude and polarity in U17A. Potentiometers R6 and R66 determine the width of the output threshold "window". This window is adjusted to provide an output whenever the phase exceeds plus or minus 20 degrees. If the phase is positive and greater than 20 degrees, the discriminator output is positive, U17A output is positive, U18A output is positive, and U20A output is negative (ground), so a Low signal is sent to U5, RAM/IO/TIMER, on the PHASE > +20° line. Similarly if the phase is negative and less than 20 degrees, an output from U17A, U18B, and U20B sends a Low signal to U5 on the PHASE < -20° line. Comparators U18A and U18B are used in conjunction with Schmitt triggers U20A and U20B to provide a toggle action to the phase commands, stabilizing the threshold limits. When the detected phase angle is within ± 20° of 0°, both the PHASE > +20° and PHASE < -20° lines are High, indicating to the microprocessor that the phase angle is within an acceptable "window".

6.1.3 MAGNITUDE DISCRIMINATOR INTERFACE

The magnitude discriminator interface consists of U17B, U18C, U18D, U20C and U20D. The discriminator output is compared with the +5 VDC reference for magnitude and polarity, in U17B. Potentiometers R19 and R66 set the width of the magnitude window relative to 50 ohms. The window is set to provide an output whenever the magnitude is greater then 60 ohms or less than 40 ohms. If the magnitude is greater than 60 ohms, the discriminator output is negative, U17B output is negative, U18D output is positive and U20D output is negative, giving a Low on the MAG >60 ohm line to U5. The unaffected comparator, U18C in this case, provides a Low output to U20C, which in turn supplied a High to the MAG <40 ohm line. This way, only one output at a time may be Low, but both may be High, indicating to U5 that the magnitude is within an acceptable "window".

For magnitudes less than 40 ohms, operation is similar to that described above, supplying a Low from U20C to the MAG <40 ohm line to U5.

6.1.4 "RF PRESENT" DETECTOR

Transistor Q2 acts as a switch to provide a Low to microprocessor U1 on pin 5, whenever RF power is present at the coupler input. The transistor is turned on by a DC voltage from the forward RF power detector on the Detector/Pad Assembly 2A4. In order for U1 to continue its tuning program, the RF line must be held at a Low.

6.1.5 VSWR COMPARATOR

Comparator U19A compares the relative magnitude of the forward and reflected power detectors to compute the VSWR. Potentiometer R43 will make this occur whenever the VSWR exceeds 2:1. Diode CR7

[illegible]

[illegible]

[illegible]

[illegible]

6.1.9.5 Programmable Read Only Memory (PROM) U4

The PROM U4, contains the data bits which make up the program algorithm used by the microprocessor U1 to adjust the network elements which tune the antenna. Address information from A0-A11 is sent to the PROM U4, when U1 requires information for the execution of the next algorithm instruction stored in U4. U4 responds by placing the instruction from its internal memory, onto the DATA BUS when U1 issues a brief LOW going read pulse on the $\overline{RD}$ line pin 32. U1 collects the instruction from the DATA BUS, analyzes it, then acts on the directions provided.

6.1.9.6 Input Ports

Integrated circuit U5 contains input ports to the microprocessor system. Through these ports, the microprocessor U1, can call up information, giving it the status of the phase and magnitude discriminators, and the VSWR detector.

6.1.9.6.1 U5, Magnitude and Phase Inputs

There are six signals coming into integrated circuit U5, PHASE >+20°, PHASE <-20°, MAG >60 ohm, MAG <40 ohm, VSWR and TUNE Command. Signals PHASE >+20°, PHASE <-20° are the phase discriminator interface outputs, and MAG >60 ohm, MAG <40 ohm, are the magnitude discriminator interface outputs (refer to Sections 4.3.2 and 4.3.3). These four signals direct U1 through the tuning algorithm program stored in the PROM U4. A Truth Table for these signals follows.

The VSWR signal coming into U5 pin 2 is a product of the VSWR comparator (refer to Section 6.4.5) and is used by U1 to determine a tune ready condition (High on VSWR line), once the magnitude and phase discriminators fall in the window during a tune cycle. The VSWR is also used to awaken U1 during transmissions. If the VSWR line into U5 is Low for more than 100 ms after U1 awakens, a retune is initiated by U1 (in applications where this ability is used).

TUNE signal into U5 is sampled by U1 after U1 awakens when a High is detected on U1 pin 8. If U5 pin 5 stays High, U1 initiates a tune cycle.

6.1.9.6.2 Channel Lines: Input Port U16

There are five channel lines coming into the DCU-100 in the form of inverted binary coded decimal (BCD) numbers representing channels 1 thru 10. Table 4.3 shows the Truth Table for channels 1-10, the simplex channels, and Table 4.4 shows the Truth Table for channels 11-20, the duplex channels.

The Truth Tables are utilized by the coupler when the transceiver is a channelized radio. Each one of the channels is then assigned a memory location. These memory locations will contain the tune settings (i.e. the relay settings in the coupler network) for the channels and a code indicating that particular channel has valid settings. If a channel change occurs, U26 detects this function and awakens U1. U1 then fetches the new tune combination from its channel memory location and configures the coupler network accordingly before returning to sleep.

6.1.9.7 Output Ports

The Output Ports U5, U6, U7, U15, and U16, are used in conjunction with element drivers U9, U10, U11, and U12, and U13 to energize the appropriate relays or lamps.

To understand how U1 performs an output operation, consider what is involved in turning on the READY lamp. U1 issues an address on lines A8-A15, causing U2 output Y2 pin 13 to go Low. With Y2 Low, U1 issues a code onto the DATA BUS, placing a High on line AD5 pin 17. U1 also issues a short duration Low going write pulse on the $\overline{WR}$ line pin 31. OR gate U8A's Low inputs cause it to have a Low out on pin 3 to pin 11 of U6. The Low on U6 pin 11 clocks the information from the DATA BUS through U6 into

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CONTROL HEAD

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