SEMI - AUTOMATIC ANTENNA COUPLER
SC-905C

SINGLE SIDEBAND
COMMUNICATIONS EQUIPMENT

GENERAL DYNAMICS | ELECTRONICS

MILITARY PRODUCTS DIVISION—ROCHESTER

Operation And Service Instructions

for

SEMI - AUTOMATIC ANTENNA COUPLER SC-905C

GENERAL DYNAMICS | ELECTRONICS

MILITARY PRODUCTS DIVISION—ROCHESTER

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CHAPTER 1
GENERAL DESCRIPTION

1.1 DESCRIPTION

The Semi-Automatic Antenna Coupler SC-905C is an electrically controlled unit capable of tuning a 35-foot whip, 15-foot probe or whip, or 25-foot center-fed antenna. The unit operates at power levels up to 100 watts Peak Envelope Power (PEP), while maintaining a 50-ohm input impedance and better than 1.5:1 Voltage Standing Wave Ratio (VSWR) over the 2-to-30-megacycle frequency range.

1.1.1 The Semi-Automatic Antenna Coupler unit is housed in a bracket-mounted, cylindrical case. The unit is 13 inches long, 7 inches in diameter, and weighs 16 pounds.

1.2 EQUIPMENT REQUIRED BUT NOT SUPPLIED

The equipment required for operation of the Semi-Automatic Coupler but not supplied is listed below:

1. Connector - Cannon MS3106R28-12S (C).
2. Connector - Cannon MS3106E28-12PX (F74).
3. No. 22 PVC covered wire of sufficient quantity for 22 strands of required length.
4. Plastic sleeve of sufficient size and length to contain the 22 strands of No. 22 PVC wire.

1.3 QUICK REFERENCE DATA

Frequency Range	2-to-30-MC
Power Input Requirements	24 VDC
RF Power	100 watts PEP
Tuned Input Impedance	52 ohms
Tuned VSWR	1.3:1 maximum
Recommended Antennas	35-foot whip 15-foot probe or whip 25-foot center-fed whip
Tuning Time	10 to 45 seconds

1.4 ASSOCIATED EQUIPMENT

The Semi-Automatic Antenna Coupler is designed for use with SC-901 and SC-910 systems. The unit is powered by the SC-910A Power Amplifier when used with the SC-910 system, and SC-901A Power Amplifier when used with the SC-901 system. Controls on the front panel of the Power Amplifiers provide remote coupler tuning.

1.5 INSTALLATION

1.5.1 Unpacking and Handling. Because the Semi-Automatic Antenna Coupler is an accurately calibrated piece of precision equipment, rough handling should be avoided. Extreme caution should be exercised when removing the unit from the packing container to prevent damage to the connectors.

1.5.2 Power Requirements. The Semi-Automatic Antenna Coupler is designed to operate on 24 VDC power.

1.5.3 Installation Layout. The Semi-Automatic Antenna Coupler may be located up to 300 feet from its associated system and still retain its effective remote antenna tuning capabilities. The unit should be mounted directly below the antenna such that the coupler antenna terminal is no farther than 3 inches from the antenna connector. The coupler should be connected to the antenna by means of a strand of heavy duty wire. RF connection should be made at J2 (see figure 1-1).

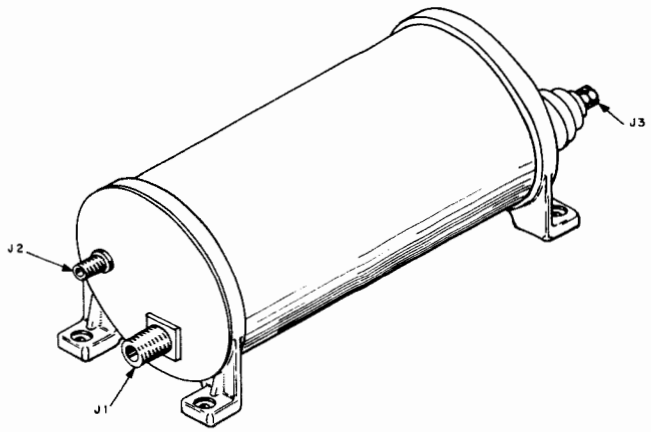


Figure 1-1. Semi-Automatic Antenna Coupler SC-905C, Connectors

1.5.3.1 Power and control signal connections should be made at J1, using the following fabrication instructions:

1. Determine maximum distance that will be required between the coupler and the Power Amplifier.
2. Cut 22 strands of No. 22 PVC wire to required length. Color coded wires will aid in identifying leads for final assembly.
3. Following wiring diagram (figure 1-2), connect wires to one of the connectors (note color codes).

4. Slide sleeve (same length as wires), over wires and insert sleeve end under connector clamp. Tighten clamp securely.
5. Connect wires to remaining connector. Slide sleeve under connector clamp and tighten clamp securely.
6. Check wiring for shortcircuits or wiring errors with ohmmeter and install cable.

1.5.4 Inspection and Adjustments. Because of the rugged construction of the Semi-Automatic Antenna Coupler, relocation should have no effect on adjustment. Before applying power to the unit, the following checks should be made:

1. Check for damaged connectors.
2. Remove unit from the container and check for broken or damaged components.

1.5.5. Preparation for Reshipment. To prepare the unit for reshipment, repackage the unit in the same container it was shipped in and in reverse order of unpacking.

1.5.5.1 If the original container is not available, proceed as follows:

1. Enclose the unit in a cardboard container. Use padding between the connectors to protect from pressure. Enclose entire unit in padding.
2. Place unit in a packing crate on a shock pad. Place shock pads around unit so it cannot move. Place shock pad on top of unit and secure crate cover.
3. Mark crate cover "OPEN THIS END."

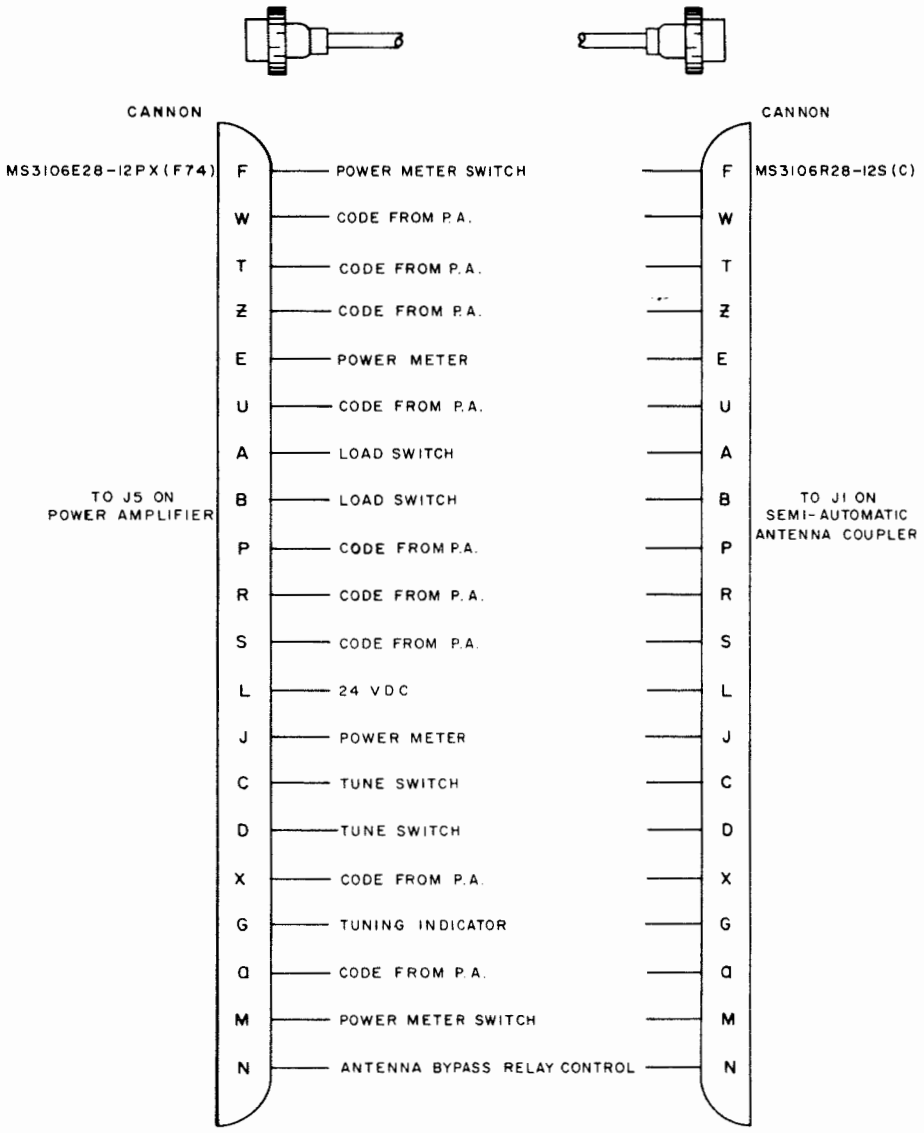


Figure 1-2. Semi-Automatic Antenna Coupler SC-905C, Power and Control Cable Fabrication, Wiring Diagram

CHAPTER II
OPERATORS SECTION

2.1 FUNCTIONAL OPERATION

2.1.1 General. Semi-Automatic Antenna Coupler SC-905C is a self-contained unit designed to match the antenna to the 50-ohm transmission line from the Power Amplifier. Digital code information from the Power Amplifier programs the motor driven switches during initial tuning. Power and control signal connections are made to connectors mounted on one end of the unit. Antenna connection is accomplished by means of a strand of wire secured to the antenna terminal mounted on the other end of the unit. ANTENNA controls on the front panel of the Power Amplifier provide a means of fine tuning the variable inductors within the SC-905C.

2.1.2 Operation. (See figure 2-1)

2.1.2.1 Coarse Tuning. In the transmit mode of operation, RF power is applied through the antenna bypass relay, K1, to the 50-ohm VSWR bridge. The VSWR bridge provides a signal to the power meter mounted on the front panel of the Power Amplifier to give a visual indication of forward and reflected power. The ratio of the forward and reflected power indicates the VSWR. The RF power is also coupled through the VSWR bridge to the tuning and matching inductors which are driven by 24 VDC reversible motors, B1 and B2.

2.1.2.2 The Power Amplifier grounds one of the wires in the coupler control cable and programs the motor operated band switch. Stepping solenoid, S4, and its associated relays, positions itself to the corresponding frequency of the Power Amplifier. The bi-directional homing switch together with the motor B2 serves to tune the inductors to a position that is approximately in resonance for the new frequency. The RF power then passes through the switch and impedance network to the antenna. The SC-905C has a total of eleven available band-switch positions which are selected by the band-switch programming in the Junction Box. Only ten positions are used, the eleventh is available as a spare. These ten positions insert seven different networks, some of which are obviously used more than once, into the active coupler circuitry.

2.1.2.3 Coarse positioning of the SC-905C variable inductors is accomplished by means of an open-seeking motor circuit. The inductors may be programmed to coarse tune to any one of twelve values of inductance for any one of the ten band-switch positions.

2.1.2.4 Fine Tuning. Fine coupler tuning is controlled by the LOAD and TUNE switches on the front panel of Power Amplifier. Operating the switches to the MAX and MIN positions causes motors B1 and B2 to drive the tuning inductors. Limit switches at the ends of the tuning ranges stop the tuning motor and turn off the antenna tuning light.

2.1.2.5 Receive. Signals received by the antenna are applied to the contacts of antenna by-pass relay, K1. The tuning and matching impedance inductors are coarse tuned and the signals pass through the impedance network, VSWR bridge, and relay K1 to the Power Amplifier. However, the signals may be diminished by the reactance of the impedance network. Therefore, the ANTENNA RECEIVE position of the ANTENNA switch is provided to energize K1 and couple the received signals directly to the Power Amplifier. An impedance mismatch may exist between the antenna and the transmission line, but improved reception is still possible. Determining the most desirable coupling is obtained by observing the power indication on the power meter and rotating the ANTENNA switch to both positions.

2.1.2.6 Contacts 12, 13, and 14 of relay K3 (see figure 4-1), serve as an interlock between the coupler and the transmitter. If either the control cable or the RF transmission line is open, the transmitter cannot operate. The interlock also prevents coarse tuning of the coupler before the turret assembly has positioned. The transmitter is interlocked such that it cannot be keyed during the semi-automatic coarse tuning cycle.

2.2 DESCRIPTION OF CONTROLS AND INDICATORS

The Semi-Automatic Antenna Coupler SC-905C is operated by control information from other single sideband equipment.

2.3 OPERATING PROCEDURES

2.3.1 General.

The SC-905C as delivered is programmed for use with a 15-foot whip. If a different antenna is to be used, refer to table 2-1 and table 2-2.

2.3.2 Bandswitch Programming. Table 2-1 provides the required information for determining proper programming of the bandswitch information in the Junction Box or the SC-901S Power Supply for the various antennas to be used. Connect wire numbers as shown to TB-3 in Junction Box for Antenna in use.

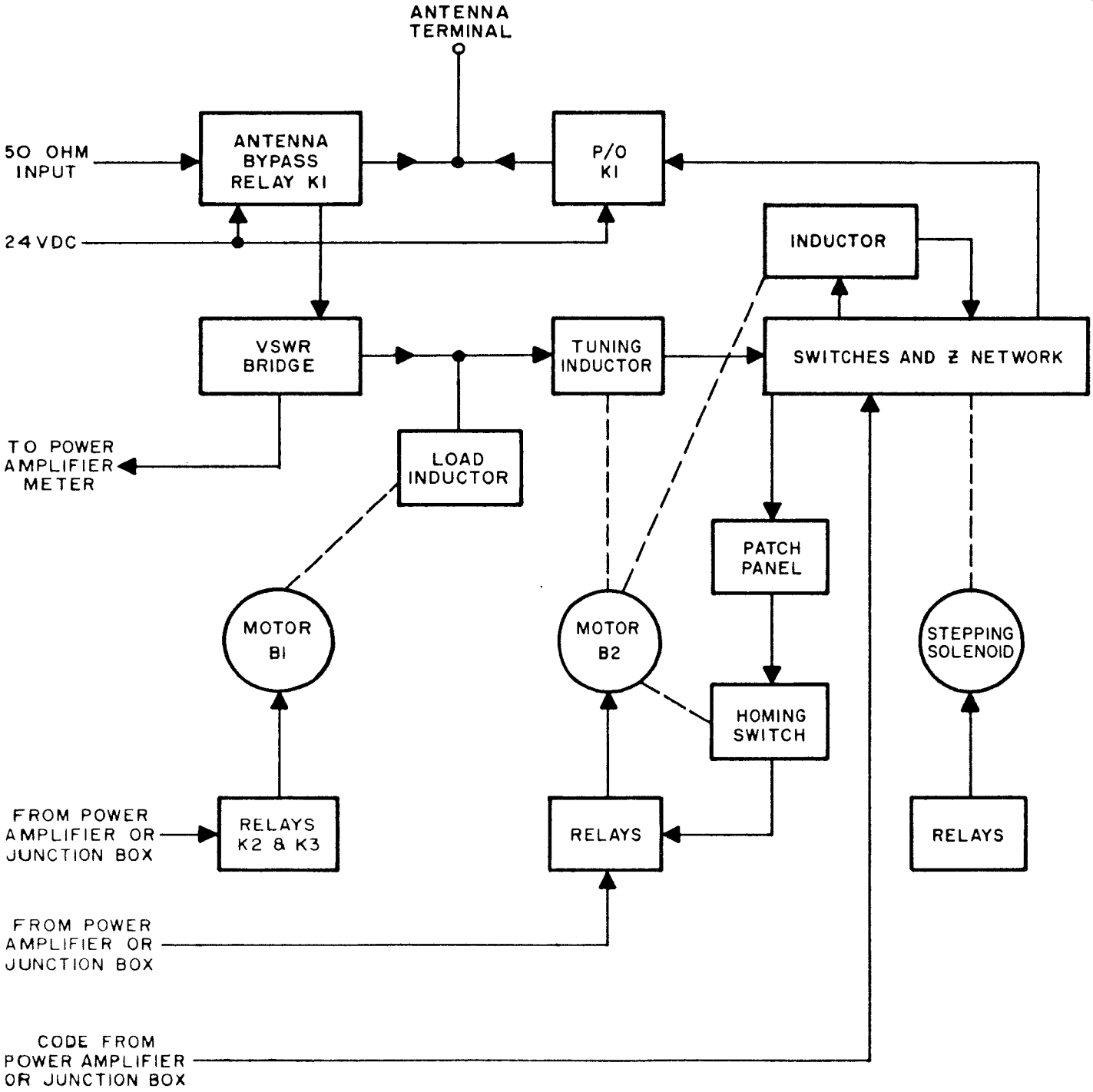


Figure 2-1. Semi-Automatic Antenna Coupler SC-905C, Block Diagram

TABLE 2-1

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, BANDSWITCH PROGRAMMING

Junction Box TB-3	ANTENNA		
	15' Whip	25' Whip	35' Whip
Terminal No.	Wire No.	Wire No.	Wire No.
1	45	45	45
2	45	45	45
3	46	45	45
4	46	46	46
5	47	46	52
6	49	48	53
7	48	52	52
8	49	52	52
9	50	52	52
10	51	52	52
11	51	52	52
12	52	52	49
13	52	52	49
14	52	52	52
15	52	49	52
16	52	49	52
17	52	52	52
18	54	54	52
19	54	54	54

2.3.3 Coarse Tuning Programming. Table 2-2 provides information regarding programming for coarse tuning of SC-905C. Connect wire numbers as shown, to terminal board TB-1 in Semi-Automatic Antenna Coupler SC-905C for antenna in use. Terminal number from 1 to 12 reading from right to left when viewing coupler with TB-1 at left and antenna terminal at right.

TABLE 2-2

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, COARSE TUNING PROGRAMMING

SC-905C Coupler TB-1	ANTENNA		
	15' Whip	25' Whip	35' Whip
Terminal No.	Wire No.	Wire No.	Wire No.
1			36
2			
3	28		
4			
5	29, 32	35	
6	33, 34	28	

TABLE 2-2

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, COARSE TUNING PROGRAMMING (Cont.)

SC-905C Coupler TB-1	ANTENNA		
	15' Whip	25' Whip	35' Whip
Terminal No.	Wire No.	Wire No.	Wire No.
7	30		28
8	35		
9	31	29 32	32
10	37	30, 31, 37, 34, 33	29,37
11			
12	36, 38	36, 38	30, 31, 33, 34, 38

2.3.4 Coupler Tuning Procedure. The following outlines the procedures to be followed when using the SC-905C with an SC-901A Power Amplifier. The procedures with the SC-910A are similar.

2.3.4.1 The equipment must be installed and interconnected as described in 1.5.3 Refer to SC-901X or SC-901E Instruction Manuals and energize the equipment.

CAUTION

Do not close the Key or depress the push-to-talk button on the microphone.

2.3.4.2 Place FRWD-RFLD-TUNE Switch on Power Amplifier to TUNE.

2.3.4.3 Rotate the two ANTENNA tuning controls toward MAX or MIN to obtain a minimum reading on the RF POWER meter. The reading should fall within the shaded area near the left end of the meter scale.

CAUTION

With certain antennas and at certain frequencies, a condition may result where a high minimum reading will be obtained. It is necessary then to continue to vary the controls for the lowest minimum. This may involve increasing the reading at some time during the tuning procedure although the end results will be a satisfactory minimum.

2.3.4.4 When a reading within the shaded area of the RF POWER meter is obtained the coupler is tuned.

2.3.4.5 Rotate the FRWD-RFLD-TUNE Switch to FRWD and operate the equipment as set forth in the SC-901A, SC-901X and SC-901E Instruction Manuals.

CHAPTER III
PREVENTIVE MAINTENANCE

3.1 GENERAL

Semi-Automatic Antenna Coupler SC-905C is a precision instrument and will require very little maintenance. Table 3-1 lists the preventive maintenance checks that should be performed on a regular monthly basis.

TABLE 3-1

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, PREVENTIVE MAINTENANCE CHECKS

Inspect for	Remedy
Dust, nicks, burrs, dents, scratches or rust spots.	Clean exterior with soft-lintless cloth. Clean interior with brush or suction. Smooth burrs with a file, sandpaper, and repaint. Remove rust with sandpaper and repaint.
Loose or broken hardware.	Tighten or replace.
Internal wiring damage.	Repair or replace.
Solder joints damaged.	Resolder.
Broken lugs, split or chipped components.	Repair or replace.

CHAPTER IV
TROUBLE-SHOOTING

4.1 GENERAL

This chapter contains information and instructions for trouble-shooting Semi-Automatic Antenna Coupler SC-905C. Test equipment required and trouble-shooting procedures are provided in tabular form.

4.2 TEST EQUIPMENT AND SPECIAL TOOLS

Test Equipment required to trouble-shoot the coupler is shown in table 4-1. Table 4-2 lists the nominal impedances vs. frequency for the three antennas which the SC-905C is capable of matching. No special tools are required.

4.2.1 The load required for trouble-shooting at a given frequency must be fabricated using typical "L", "T" or "Pi" matching networks and a nominal 50-ohm load. The network must be chosen to transform this 50-ohm load to the impedance given in table 4-2.

TABLE 4-1

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, TEST EQUIPMENT REQUIRED

Common Name	Model and Manufacturer	Alternate
Vacuum Tube Voltmeter	Hewlett-Packard Model 400D	Any Alternate
Multimeter	Triplett	Any Alternate
RF Meter	Boonton Model 91CA	None

TABLE 4-2

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, NOMINAL IMPEDANCES FOR 15' WHIP, 25' WHIP AND 35' WHIP

Freq. (MC)	15' Whip	Impedance (r±jx) Ohms 25' Whip	35' Whip
2.0	6.2-j1125	3.2-j600	5-j450
2.5	6.3-j900	4.2-j500	7-j350
3.0	6.5-j750	6.0-j400	10.0-j250
3.5	6.6-j625	7.0-j350	12.0-j200
4	6.9-j545	9.3-j280	16-j160
5	7.65-j415	13-j190	35-j75
6	8.75-j330	19-j120	55-j12
7	10.4-j270	35-j75	150+j50

TABLE 4-2

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, NOMINAL IMPEDANCES FOR 15' WHIP, 25' WHIP AND 35' WHIP (Cont.)

Freq. (MC)	15' Whip	Impedance (r±jx) Ohms 25' Whip	35' Whip
8	12.3-j217	50-j20	250+j20
9	15.1-j166	75+j0	260-j100
10	19.9-j125	150+j40	210-j160
11	24.3-j85	210+j25	180-j160
12	31.75-j52	250-j5	130-j190
13	42-j15	250-j110	70-j180
14	56.5+j37	210-j130	35-j170
15	71.5+j75	180-j160	21-j210
16	97+j123	160-j180	18-j70
17	129+j174	130-j190	18-j55
18	174+j213	85-j190	19-j35
19	250+j244	55-j170	25-j4
20	389+j260	30-j170	32+j30
21	506+j80	20-j210	65+j76
22	467+j0	19-j100	180+j120
23	366-j212	18-j65	300-j160
24	277-j205	18-j50	100-j180
25	232-j188	20-j35	50-j110
26	200-j163	23-j9	32-j75
27	175-j142	30+j0	30-j56
28	46-j122	35+j30	22-j21
29	41-j106	60+j60	12-j20
30	39-j85	110+j95	21+j16

Note

Semi-Automatic Antenna Coupler SC-905C should be connected with SC-901 or SC-910 systems when trouble-shooting. Check that proper inputs from the Power Amplifier are present.

4.3 FUNCTIONAL TROUBLE-SHOOTING

Follow the procedures outlined in table 4-3 to correct troubles within the Semi-Automatic Antenna Coupler.

TABLE 4-3

SEMI-AUTOMATIC ANTENNA COUPLER SC-905C, TROUBLE-SHOOTING CHART

Step	Action	Normal Indication	Abnormal Indication Procedure
1.	Connect dummy load to coupler antenna terminal.		
2.	Connect power and control cables to unit and apply power.		
3.	FRWD-RFLD-TUNE Switch on Power Amplifier to TUNE. Observe reading on RF POWER meter.	Meter should read in shaded area at left end of meter scale.	Refer to paragraph 2.3.4 and attempt to tune coupler. If normal indication is not then obtained, check motors B1, B2, and associated circuitry. (See figures 4-1, 4-2 and 4-3.)
4.	Operate FRWD-RFLD-TUNE Switch to FRWD. EXCITER to Mode Selector to AM.	Meter should indicate approximately 25 on FORWARD scale of RF Power Meter.	Check VSWR bridge and associated circuitry (see figures 4-1, 4-2, and 4-3); check Power Amplifier, Exciter and Junction Box.

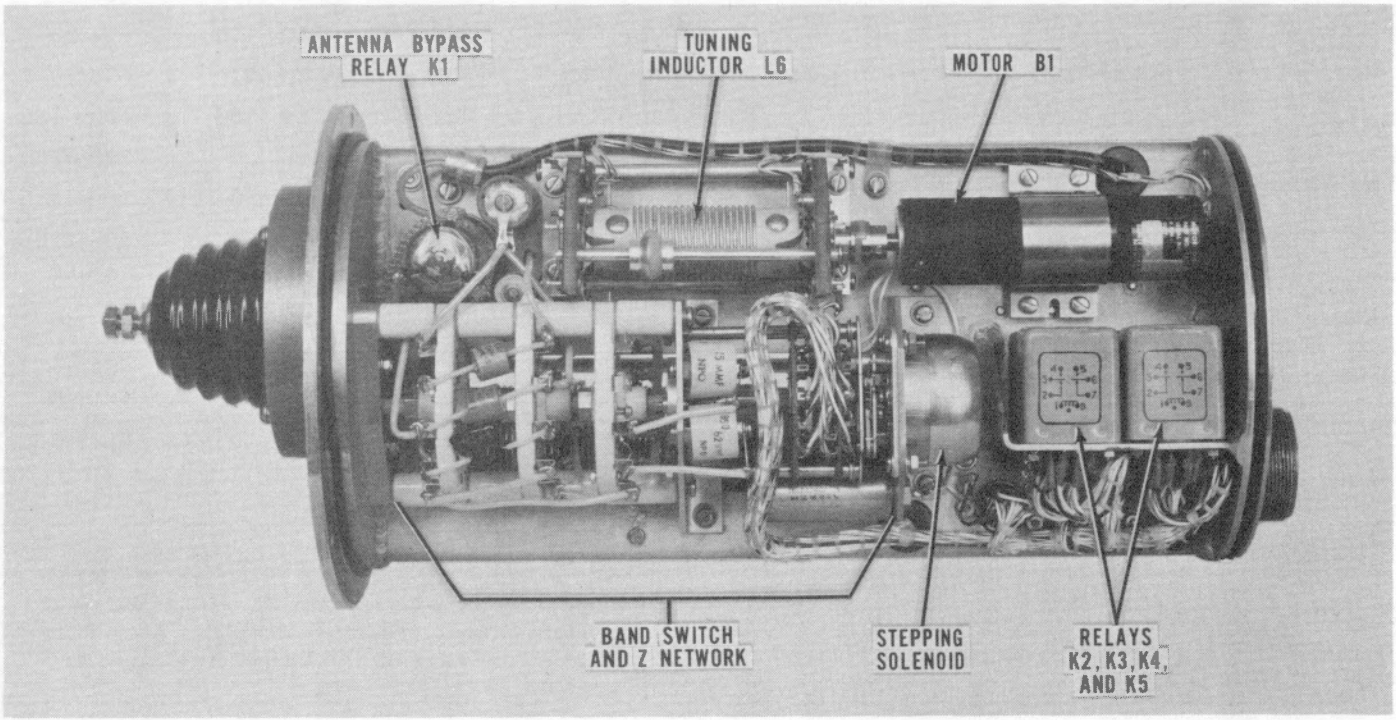


Figure 4-1. Semi-Automatic Antenna Coupler SC-905C, Component Location

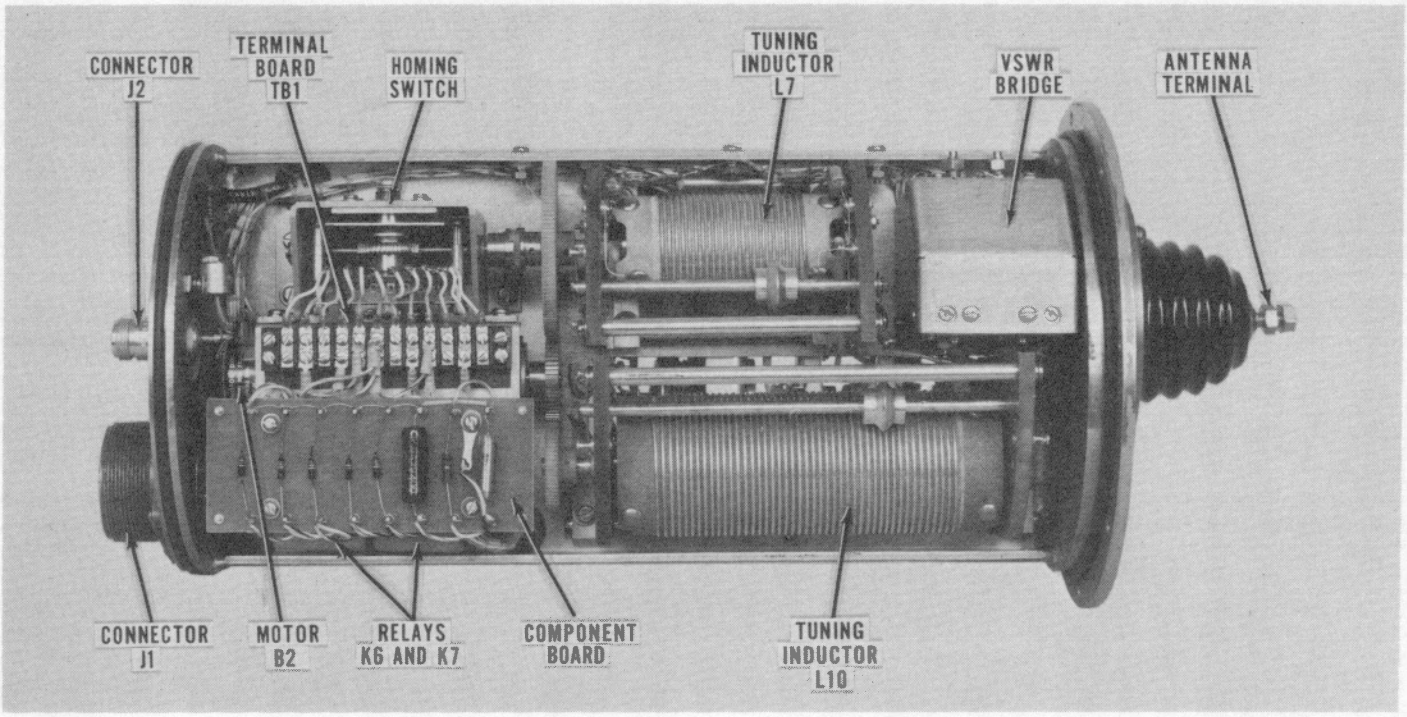
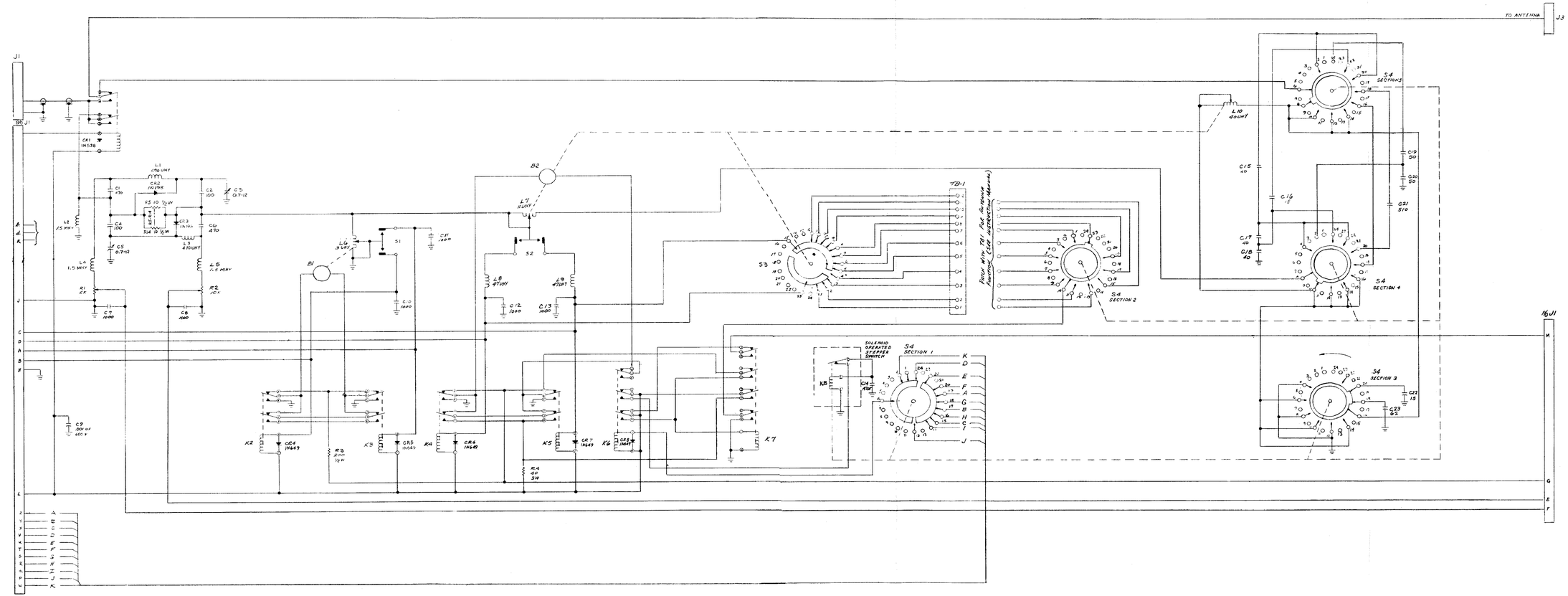


Figure 4-2. Semi-Automatic Antenna Coupler SC-905C, Component Location



NOTES

1 REFERENCE DESIGNATIONS ARE ABBREVIATED PREFIX. THE DESIGNATION WITH THE UNIT NUMBER OR ASSY DESIGNATION OR BOTH

2 UNLESS OTHERWISE SPECIFIED:

A RESISTOR VALUES IN OHMS
B CAPACITOR VALUES IN MICROMICROFARADS
C RESISTORS ARE 1/4 W 5%

Figure 4-3. Semi-Automatic Antenna Coupler SC-905C, Schematic Diagram

CHAPTER V
REPLACEABLE PARTS

(Replaceable Parts Lists to be supplied at a later date.)