RADIO DDG

NAVSHIPS 93628 (Non-Registered)

CENTRAL

031

TECHNICAL MANUAL

for

COUPLER-MONITOR CU-737/URC

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS

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Contract: NObsr 81220 Approved by BuShips: 7 June 1960

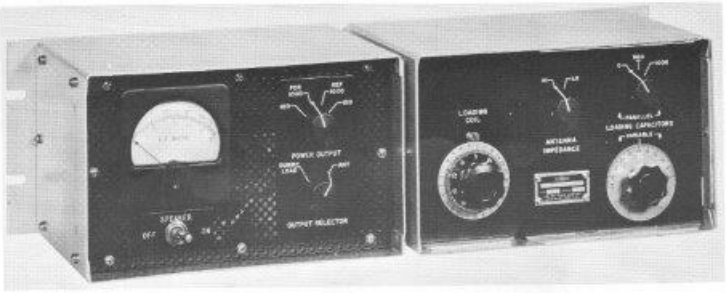

Figure 1. Coupler-Monitor CU-737/URC

1.1 GENERAL DESCRIPTION.

Coupler-Monitor CU-737/URC, which normally is used on all submarines using Antenna Tuning Group AN/BRA-3/5, with 50-ohm antenna multicoupler or antenna systems, matches a 50-ohm output from an r-f amplifier to a 50-ohm transmission line, having a standing-wave ratio up to 2 to 1. The operating frequency of the unit is between 2 mc and 30 mc. Coupler-Monitor CU-737/URC contains an antenna transfer relay, a directional coupler with an r-f wattmeter, and a reversible L-network for impedance matching. A 4-ohm loudspeaker also is provided as well as a terminating load which is switched to the audio input when the loudspeaker is not in use. These components are mounted on an aluminum panel which fits in a standard 19-inch rack. This unit normally is used with Radio Set AN/URC-32. Refer to BuShips Electronic Information Bulletin (E1B) #518 for additional information.

1.2 TECHNICAL CHARACTERISTICS.

Input impedance, r-f	50 ohms nominal, resistive, unbalanced
Input level, r-f	1000 watts, maximum
Output impedance, r-f.	50 ohms nominal, unbalanced
Output vswr	2 to 1 maximum
Frequency range	2 mc to 30 mc
Wattmeter ranges	0 to 100 watts, forward 0 to 1000 watts, forward 0 to 1000 watts, reflected 0 to 100 watts, reflected
Input impedance, audio	4 ohms, loudspeaker 5 ohms, terminating load
Input level, audio	2 watts, maximum
Size	Height, 5-3/16 inches; width, 19 inches; depth, 9 inches
Weight	12-1/4 pounds

2.1 INSTALLATION.

Coupler-Monitor CU-737/URC is mounted on the AN/URC-32 rack in the blank space below Interconnecting Box J-1007/U (Junction Box 153H-2). Figure 6 shows the connections to AN/URC-32, AN/BRA-3/5, and Electrical Dummy Load DA-218/U (Dummy Antenna 172J-1). See AN/BRA-3/5 technical manual for connections to antenna system or multicoupler. The cables and connectors necessary for connections to AN/URC-32 are supplied with the AN/URC-32. The cable necessary for the connection to DA-218/U is supplied with the DA-218/U. Remove the jumper wires between TBJ-10 and TBJ-14 and between TBJ-14 and TBH-14 in Interconnecting Box J-1007/U. These terminals are used as interlocks in AN/BRA-3/5. The CU-737/URC has a 4-ohm speaker, and when this speaker is used, the 680-ohm resistor should be removed from TBG-5 and TBG-6 in Interconnecting Box J-1007/U.

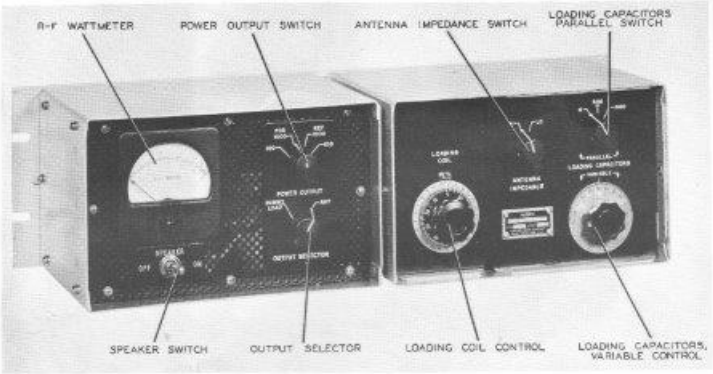

Figure 2. Coupler-Monitor CU-737/URC, Operating Controls

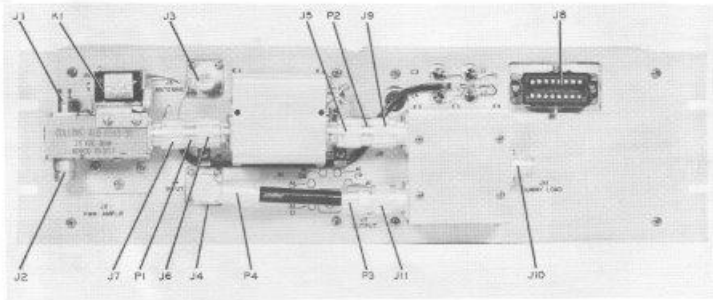

Figure 3. Coupler-Monitor CU-737/URC, Input and Output Connector

3.1 OPERATION.

3.1.1 OPERATING CONTROLS AND INSTRUMENTS.

Figures 2 and 3 show the operating controls, jacks, and indicating instruments in Coupler-Monitor CU-737/URC.

R-F Wattmeter	Indicates forward or reflected power depending upon the POWER OUTPUT switch setting.
POWER OUTPUT switch	With the POWER OUTPUT switch in either of the two FOR positions, the r-f wattmeter is connected to read total power being delivered to the load in the 0- to 100-watt range or the 0- to 1000-watt range. With the POWER OUTPUT switch in either of the two REF positions, the r-f wattmeter is connected to read total reflected power in the 0- to 1000-watt range or the 0- to 100-watt range.
OUTPUT SELECTOR switch	Connects the signal to either the antenna or the dummy load.
LOADING COIL control	Controls the amount of series inductance in the antenna circuit.
LOADING CAPACITORS, VARIABLE control	Controls the amount of shunt capacitance in the antenna circuit.
LOADING CAPACITORS, PARALLEL switch	Adds 0-uuf, 500-uuf, or 1000-uuf shunt capacitance to the antenna circuit.
ANTENNA IMPEDANCE switch	In LO position, connects components of antenna line tuner so that antenna line under 50 ohms can be matched; in HI position, so that antenna line over 50 ohms can be matched.
SPEAKER switch	In ON position, turns loudspeaker on. In OFF position, turns loudspeaker off and connects audio line to terminating load.

3.1.2 OPERATING PROCEDURE.

To operate Coupler-Monitor CU-737/URC, proceed as follows:

a. Turn the OUTPUT SELECTOR switch to ANT.

Remove power from the CU-737/URC before turning the ANTENNA IMPEDANCE switch. Keep the power amplifier in TUNE condition during the following procedures.

b. Set the ANTENNA IMPEDANCE switch to the HI position.

c. Set the POWER OUTPUT switch to the REF 1000 position.

d. Turn the LOADING CAPACITORS, PARALLEL switch to the 0 position.

e. Adjust the LOADING CAPACITORS, VARIABLE control for minimum reflected power.

f. Adjust the LOADING COIL control for minimum reflected power.

g. Repeat steps e and f above several times for a zero reading of reflected power. Set the POWER OUTPUT switch to the REF 100 position when the reflected power is quite low, improving the meter sensitivity.

h. If satisfactory results cannot be obtained, turn the LOADING CAPACITORS, PARALLEL switch to the 500 position, and repeat steps e through g above. Then, if necessary, turn the LOADING CAPACITORS, PARALLEL switch to the 1000 position, and again carry out steps e through g.

e. If the above procedure does not bring the reflected power down to zero in any case, observe the CAUTION above, turn the ANTENNA IMPEDANCE switch to LO, and repeat steps c through h above.

j. Set the POWER OUTPUT switch to the FOR 1000 position. Increase the drive from the power amplifier until 500 watts is indicated on the wattmeter. Turn the POWER OUTPUT switch to the REF 100 position, and note the wattmeter reading. Retrim the LOADING CAPACITORS, VARIABLE control and the LOADING COIL control. The reflected power should not exceed 10 watts.

4.1 CIRCUIT DESCRIPTION.

4.1.1 ANTENNA CIRCUIT.

Figure 4 is a block diagram of Coupler-Monitor CU-737/URC. Figure 5 is a schematic diagram of the CU-737/URC. The 50-ohm output of an r-f power

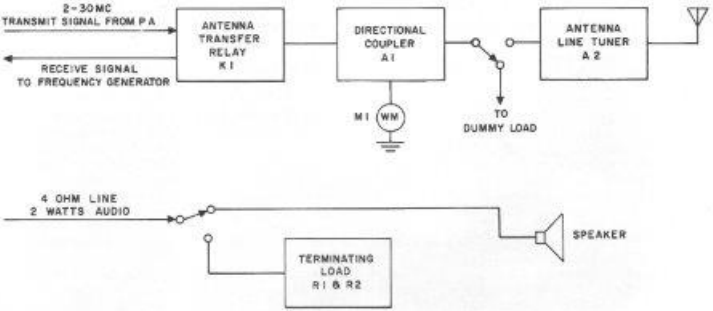

Figure 4. Coupler-Monitor CU-737/URC, Block Diagram

amplifier and the 50-ohm input to a receiver connect at J2 and J1, respectively, to the antenna transfer relay K1. On transmit, relay K1 connects the power amplifier to the directional coupler through J7 and J8. The r-f wattmeter, M1, indicates the forward or reflected power being measured by the directional coupler, depending upon the setting of the POWER OUTPUT switch, S1. The output of the directional coupler is connected to the OUTPUT SELECTOR switch, S3B, through J5 and J9. The OUTPUT SELECTOR switch, S3B, connects the output of the directional coupler to the antenna line tuner through J11 or to a dummy load through J10. Switch S3A is linked to S3B to remove power from the CU-737/URC momentarily while S3B moves between ANT and DUMMY LOAD positions. The antenna line tuner is an L-network which matches the antenna line impedance to the 50-ohm output impedance of the power amplifier or the 50-ohm input impedance of the receiver. The ANTENNA IMPEDANCE switch, A2S1, reverses the L-network to match the impedance of either an antenna line above 50 ohms or an antenna line below 50 ohms. The amount of inductance in the L-network is controlled by loading coil A2L1. The amount of capacitance in the L-network is controlled by variable capacitor A2C1 and switch A2S2 which connects the 500-uuf banks of capacitors.

4.1.2 LOUDSPEAKER CIRCUIT.

The loudspeaker is connected to the audio line with switch S2 in the ON position. A 5-ohm terminating load is connected to the audio line with switch S2 in the OFF position.

5.1 MAINTENANCE AND ADJUSTMENTS.

5.1.1 MAINTENANCE.

If trouble is encountered during operation, make resistance and continuity measurements to locate the defective part. When replacing parts in the directional coupler, be sure that the replacement part is identical to the original part. Resistors A1R3, A1R4, A1R5, and A1R6 are selected for meter calibration. If replaced, the replacement resistor must have the same resistance value as the original resistor. (See parts list for available values.) If A1T1, A1C1, A1C2, A1C3, A1C4 are replaced, the directional coupler must be rebalanced. If either A1CR1 or A1CR2 is replaced, the directional coupler must be recalibrated.

The variable inductor of the antenna line tuner has contacts which require periodic cleaning to prevent arcing.

Coupler-Monitor CU-737/URC contains no tubes, fuses, or lamps.

5.1.2 DIRECTIONAL COUPLER CALIBRATION.

The directional coupler should not require recalibration unless crystal diode A1CR1 or A1CR2 is replaced. Test equipment required for calibration includes (1) r-f wattmeter and r-f load for measuring 500 watts at 14 mc, (2) 500-watt r-f power amplifier, and (3) decade resistance box, 0-10K, or full selection of A1R3, A1R4, A1R5, and A1R6 resistors as given in

the parts list. Use the following procedure to recalibrate the directional coupler:

a. Set the POWER OUTPUT switch to the FOR 100 position.

b. Connect the r-f load and r-f wattmeter to DUMMY LOAD jack J10, and turn the OUTPUT SELECTOR switch to the DUMMY LOAD position.

c. Connect the decade resistance box in place of A1R5.

d. Provide 80 watts of r-f power at 14 mc to the input of the directional coupler. This can be done by connecting the output of the r-f power amplifier to J2 of the CU-737/URC and energizing K1, or to the input of the directional coupler at J6. Adjust the r-f input to obtain 80 watts into the load as indicated by the r-f wattmeter.

e. Adjust the decade resistance box until the panel meter, M1, indicates 80 watts.

f. Remove r-f power.

g. Replace A1R5 with the resistor given in the parts list which has the closest value to the setting of the decade resistance box. (If no decade resistance box is available, select A1R5 by substitution from resistors given in the parts list until the panel meter indicates 80 watts.)

h. Set the POWER OUTPUT switch to the FOR 1000 position, replace A1R3 with the decade resistance box, and provide 500 watts of r-f power at 14 mc to the input of the directional coupler. Then adjust the decade resistance box until the panel meter, M1, indicates 500 watts. Remove r-f power, and replace A1R3 with the resistor given in the parts list which has the closest value to the setting of the decade resistance box.

i. To calibrate the reflected-power meter-circuit, reverse the r-f power input and the r-f wattmeter and load. That is, connect the r-f power amplifier to DUMMY LOAD jack J10 or to J5 of the CU-737/URC. Connect the r-f load and r-f wattmeter at J6 or at J2 and energize K1. With the POWER OUTPUT switch in the REF 100 position, A1R6 replaced with the decade resistance box, and 80 watts of r-f power at 14 mc applied, determine the proper value of A1R6. With the POWER OUTPUT switch in the REF 1000 position, A1R4 replaced with the decade resistance box, and 500 watts of r-f power at 14 mc applied, determine the proper value for A1R4.

5.1.3 DIRECTIONAL COUPLER BALANCE ADJUSTMENT.

The directional coupler is balanced properly at the factory and should not require rebalancing unless A1T1, A1C1, A1C2, A1C3, or A1C4 is replaced. Test equipment required for balancing includes (1) r-f wattmeter and r-f load for measuring 500 watts at 29.5 mc and (2) 500-watt r-f power amplifier. Use the following procedure to balance the directional coupler:

a. Short out resistor A1R6.

b. Set the POWER OUTPUT switch to the REF 100 position.

c. Connect the r-f load and r-f wattmeter to DUMMY LOAD jack J10, and turn the OUTPUT SELECTOR switch to the DUMMY LOAD position.

d. Provide a small amount of r-f power at 29.5 mc to the input of the directional coupler. This can be done by connecting the output of the r-f power amplifier to J2 of the CU-737/URC and energizing K1, or to the input of the directional coupler at J6.

e. Adjust trimming capacitor A1C2 for minimum meter indication on the panel meter, M1. As null is approached on the panel meter, increase the r-f power until at least 500 watts, but not more than 1000 watts, is applied to the r-f load as indicated by the r-f wattmeter.

f. Remove r-f power, and remove the short from A1R6.

g. Short out resistor A1R5, and set the POWER OUTPUT switch to the FOR 100 position.

h. Connect the r-f power amplifier to DUMMY LOAD jack J10 or to J5 of the CU-737/URC. Connect the r-f load and r-f wattmeter at J6 or at J2 and energize K1. Supply a small amount of r-f power at 29.5 mc.

i. Adjust trimming capacitor A1C1 for minimum meter indication on the panel meter, M1. As null is approached on the panel meter, increase the r-f power until at least 500 watts, but not more than 1000 watts, is applied to the r-f load as indicated by the r-f wattmeter.

j. Remove r-f power and the short from A1R6.

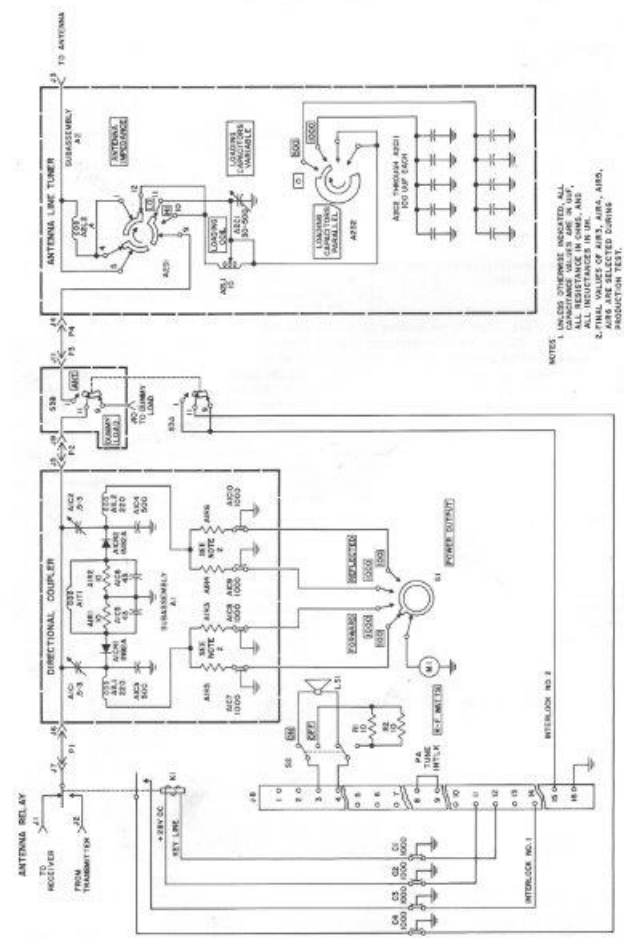

Figure 5. Coupler-Monitor CU-737/URC, Schematic Diagram

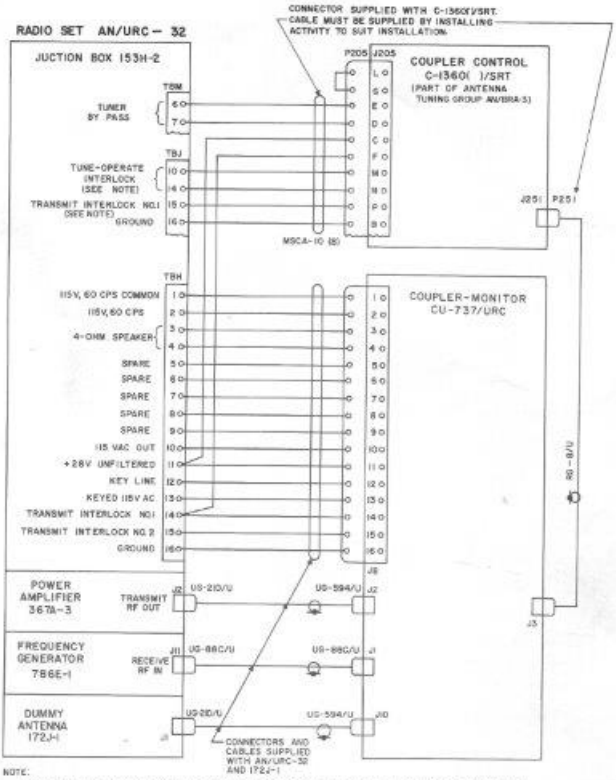

Figure 6. External Connections to Antenna Tuning Group AN/BRA-3/5 and Radio Set AN/URC-32

PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	COUPLER-MONITOR CU-737/URC	585-1398-00
	Chassis	
C1	CAPACITOR, FIXED, CERAMIC: 1000 uuf, plus 80% -20%, 300 v dc	913-1293-00
C2	CAPACITOR, FIXED, CERAMIC: same as C1	913-1293-00
CP1	ADAPTOR, CONNECTOR: 2 rd male contacts, 2 identical connector mating ends, straight shape	357-9194-00
CP2	ADAPTOR, CONNECTOR: same as CP1	357-9194-00
J1	RECEPTACLE: part of K1	
J2	RECEPTACLE: part of K1	
J3 thru J6	NOT USED	
J7	RECEPTACLE: part of K1	
J8	CONNECTOR, RECEPTACLE, ELECTRICAL: 16 female contacts, 3 amps at 600 v dc; straight	372-1262-00
J9	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 rd female contact, straight, panel mtg	357-9303-00
J10	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J9	357-9303-00
J11	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J9	357-9303-00
K1	RELAY, ARMATURE: 1A, 3 amps at 115 v ac or 27.5 v dc; coil 32 x max dc 220 ohm; incl J1, J2, J7	410-0160-00
LS1	LOUDSPEAKER, PERMANENT MAGNET: 3+4 ohms, impedance, 2.5 watts output, 5 in. speaker	271-0208-00
O1	KNOB: set screw type; black phenolic; brass insert, 0.251 in. dia shaft, 1-1/8 in. by 11/32 in. overall	331-0071-00
P1	NOT USED	
P2	NOT USED	
P3	CONNECTOR, PLUG, ELECTRICAL: 1 rd male contact, 50 ohms; straight (p/o W1)	357-9263-00
P4	CONNECTOR, PLUG, ELECTRICAL: 1 rd male contact; 53 ohms; straight (p/o W1)	357-9363-00
W1	CABLE ASSEMBLY, RADIO FREQUENCY: coaxial; 50 ohms, 0.5 ft; incl P3, P4	344-7199-00
	Directional Coupler	542-4116-004
A1C1	CAPACITOR, VARIABLE, GLASS: concentric type; 0.5 uuf min, 3.0 uuf max	932-0140-00
A1C2	CAPACITOR, VARIABLE, GLASS: same as C1	
A1C3	CAPACITOR, FIXED, MICA: 500 uuf, ±20%, 300 v dc	912-0667-00
A1C4	CAPACITOR, FIXED, MICA: same as C3	912-0667-00
A1C5	CAPACITOR, FIXED, CERAMIC: 43 uuf, ±1%, 500 v dc	916-4675-00
A1C6	CAPACITOR, FIXED, CERAMIC: same as C5	916-4675-00
A1C7	CAPACITOR, FIXED, CERAMIC: 1000 uuf, plus 80% -20%, 300 v dc	913-1293-00
A1C8 thru A1C10	CAPACITOR, FIXED, CERAMIC: same as C7	913-1293-00
A1C11	CAPACITOR, FIXED ELECTROLYTIC: aluminum, 6 uf, +75 plus 10%, 120 cps, 6 v dc	183-1167-00
A1C12	CAPACITOR, FIXED ELECTTOLYTIC: same as C11	183-1167-00
A1CR1	SEMICONDUCTOR DEVICE, DIODE: silicon type 1N82a	353-3543-00
A1CR2	SEMICONDUCTOR DEVICE, DIODE: same as CR1	353-3543-00
A1E1	CONDUCTOR-OUTER: brass, consists of tube, shield and plate	542-4112-002
A1J1 thru A1J4	NOT USED	
A1J5	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 rd female contact; 1 mating end; 50 ohms; straight	357-9303-00
A1J6	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J5	357-9303-00
A1L1	COIL, RADIO FREQUENCY: 3 universal wound pi sections, 36 AWG copper wire, 220 uh inductance, 0.1 amp	240-0037-00
A1L2	COIL, RADIO FREQUENCY: same as L1	240-0037-00
A1M1	WATTMETER: 0-100 and 0-1000 w scale, ±2% deflection, 1000 ohms, markings and pointer black on white background	458-0388-00
A1R1	RESISTOR, FIXED, FILM: 10 ohms, ±1%, 1/2 w	705-2384-00
A1R2	RESISTOR, FIXED, FILM: same as R1	705-2384-00
*A1R3 and *A1R4	RESISTOR, FIXED, FILM: 4870 ohms, ±1%, 1/4 w	705-7120-00
*A1R4 and *A1R5	RESISTOR, FIXED, FILM: 5110 ohms, ±1%, 1/4 w	705-7130-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 5360 ohms, ±1%, 1/4 w	705-7131-00
*A1R6 and *A1R7	RESISTOR, FIXED, FILM: 5620 ohms, ±1%, 1/4 w	705-7132-00
*A1R7 and *A1R8	RESISTOR, FIXED, FILM: 5900 ohms, ±1%, 1/4 w	705-7133-00
*A1R8 and *A1R9	RESISTOR, FIXED, FILM: 6190 ohms, ±1%, 1/4 w	705-7134-00
*A1R9 and *A1R10	RESISTOR, FIXED, FILM: 6490 ohms, ±1%, 1/4 w	705-7135-00
*A1R10 and *A1R11	RESISTOR, FIXED, FILM: 6810 ohms, ±1%, 1/4 w	705-7136-00
*A1R11 and *A1R12	RESISTOR, FIXED, FILM: 4750 ohms, ±1%, 1/4 w	705-7255-00
*A1R12 and *A1R13	RESISTOR, FIXED, FILM: 4990 ohms, ±1%, 1/4 w	705-7256-00
*A1R13 and *A1R14	RESISTOR, FIXED, FILM: 5230 ohms, ±1%, 1/4 w	705-7257-00
*A1R14 and *A1R15	RESISTOR, FIXED, FILM: 5490 ohms, ±1%, 1/4 w	705-7258-00
*A1R15 and *A1R16	RESISTOR, FIXED, FILM: 5760 ohms, ±1%, 1/4 w	705-7259-00
*A1R16 and *A1R17	RESISTOR, FIXED, FILM: 6040 ohms, ±1%, 1/4 w	705-7260-00
*A1R17 and *A1R18	RESISTOR, FIXED, FILM: 6340 ohms, ±1%, 1/4 w	705-7261-00
*A1R18 and *A1R19	RESISTOR, FIXED, FILM: 6650 ohms, ±1%, 1/4 w	705-7262-00
*A1R19 and *A1R4	RESISTOR, FIXED, FILM: 6980 ohms, ±1%, 1/4 w	705-7263-00
*A1R2 and *A1R3	RESISTOR, FIXED, FILM: 51.1 ohms, ±1%, 1/4 w	705-7034-00
*A1R20 and *A1R21	RESISTOR, FIXED, FILM: 100 ohms, ±1%, 1/4 w	705-7040-00
*A1R21 and *A1R22	RESISTOR, FIXED, FILM: 147 ohms, ±1%, 1/4 w	705-7056-00
*A1R22 and *A1R23	RESISTOR, FIXED, FILM: 196 ohms, ±1%, 1/4 w	705-7062-00
*A1R23 and *A1R24	RESISTOR, FIXED, FILM: 249 ohms, ±1%, 1/4 w	705-7063-00
*A1R24 and *A1R25	RESISTOR, FIXED, FILM: 301 ohms, ±1%, 1/4 w	705-7071-00
*A1R25 and *A1R26	RESISTOR, FIXED, FILM: 348 ohms, ±1%, 1/4 w	705-7074-00
*A1R26 and *A1R27	RESISTOR, FIXED, FILM: 402 ohms, ±1%, 1/4 w	705-7077-00
*A1R27 and *A1R28	RESISTOR, FIXED, FILM: 464 ohms, ±1%, 1/4 w	705-7080-00
*A1R28 and *A1R29	RESISTOR, FIXED, FILM: 511 ohms, ±1%, 1/4 w	705-7082-00

*Chosen per operational requirement

ITEM	DESCRIPTION	COLLINS PART NUMBER
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 562 ohms, ±1%, 1/4 w	705-7084-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 619 ohms, ±1%, 1/4 w	705-7086-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 681 ohms, ±1%, 1/4 w	705-7088-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 750 ohms, ±1%, 1/4 w	705-7090-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 825 ohms, ±1%, 1/4 w	705-7092-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 909 ohms, ±1%, 1/4 w	705-7094-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 953 ohms, ±1%, 1/4 w	705-7095-00
*A1R5 and *A1R6	RESISTOR, FIXED, FILM: 1000 ohms, ±1%, 1/4 w	705-7096-00
A1S1	SWITCH, ROTARY: 1 section; 4 positions, 2 moving and 10 fixed contacts, 2 poles, 3 throws; ac, dc, 220 v, 0.25 amp	259-0790-00
A1T1	COIL, RADIO FREQUENCY: 60 turns no. 30 AWG toroidal wound	542-0914-00
	Antenna Line Tuner	544-7290-002
A2C1	NOT USED	
A2C2	NOT USED	
A2C3	CAPACITOR, VARIABLE, AIR: single section, 870 uuf max 25.2 uuf min 55 aluminum plates	920-0144-00
A2C4 thru A2C13	CAPACITOR, FIXED, CERAMIC: 100 uuf, ±10%, 7500 v dc	913-0821-00
A2DS1	POINTER, DIAL: plastic; straight line type motion; 1/8 in. by 3/8 in. by 3/8 in.	542-6648-002
A2DS2	DIAL, SCALE: 0 to 24 ccw linear inscription range in 360°, incl gear	542-7425-003
A2J1	NOT USED	
A2J2	NOT USED	

ITEM	DESCRIPTION	COLLINS PART NUMBER
A2J3	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 rd female contact, straight, panel mtg	357-9003-00
A2J4	CONNECTOR, RECEPTACLE, ELECTRICAL: same as J3	357-9003-00
A2L1	TRANSFORMER, RADIO FREQUENCY: 17 turns no. 14 AWG tinned copper wire; 10 uh max; 3.5 to 30.0 mc frequency range	980-0151-00
A2L2	COIL, RADIO FREQUENCY: single layer wound, LH, 6 turns; 14 AWG wire	544-7203-002
A2MP1	COUPLING, SHAFT, FLEXIBLE: injection molded plastic insulation; 17/32 in. lg 1-3/16 in. od	015-0668-00
A2MP2	SHAFT-SWITCH EXTENSION: 1/4 in. brass rod, 1-1/4 in. lg	545-3805-002
A2MP3	GEAR, SPUR: aluminum; 48 teeth, 20° pressure angle, 0.750 in. pitch dia	542-7422-002
A2MP4	BEARING, SLEEVE: porous bronze, 15/32 in. od, 11/64 in. lg	309-0066-00
A2MP5	BUSHING, MACHINE THREAD: nickel plated brass; 3/8-32NEF-2 thd male end, 11/32 in. lg, female end unthreaded, 0.255 in. id, 7/16 in. lg overall; 1/2 in. hex wrenching facility	015-0132-00
A2MP6	SHAFT-SWITCH EXTENSION: brass, 1/4 in. dia rod, 2-5/16 in. lg	544-7205-002
A2MP7	COUPLING, SHAFT, FLEXIBLE: bakelite insulator, 37/64 in. lg by 1-1/16 in. od	015-3860-00
A2O1	DIAL, CONTROL: knob type dial; 0 to 90 ccw linear inscription, 100 scale div in 360°	542-7447-002
A2O2	DIAL, CONTROL: knob type dial; 0 to 100 ccw linear inscription, 100 scale div in 180°	543-3290-00
A2O3	KNOB: set screw type, black phenolic; brass insert, 0.251 in. dia shaft, 1-1/8 in. by 11/16 in. overall counterbore insert 3/8 in. dia to 5/32 in. deep	544-7208-002
A2O4	KNOB: set screw type, black phenolic; brass insert, 0.251 in. dia shaft, 1-1/8 in. by 11/16 in. overall	281-0071-00
A2S1	NOT USED	
A2S2	SWITCH, ROTARY: 1 section; 3 positions, 2 moving contacts, 16 fixed contacts	259-1033-00
A2S3	SWITCH, ROTARY: 1 section; 3 poles, 3 positions, 8 moving contacts, 28 fixed contacts	259-1034-00