

CHAPTER 2
OPERATION

2-1. FUNCTIONAL DESCRIPTION.

The efficiency of a shipboard high-frequency transmitting antenna is directly affected by its location, length (impedance characteristics), and the impedance characteristics of the associated antenna coupler, as well as by how intelligently the coupler is tuned by operating personnel. Figure 2-1 (Smith Chart) is typical of impedance characteristics measured on an isolated 35-foot whip antenna. It should be recognized that this impedance can change materially when the antenna is installed in various locations on a ship so that, even on the same ship, two 35-foot whips will not present exactly the same impedance to Antenna Coupler Group AN/SRA-22.

A careful study of the fundamentals of the antenna coupler impedance characteristics associated with the operation of the AN/SRA-22 will assist operating personnel to achieve maximum antenna system efficiency. Further, it will permit an understanding of the capabilities of the AN/SRA-22 when used with antennas other than the 35-foot whip.

2-2. CAPABILITIES AND LIMITATIONS.

Radio frequency currents passing through the coil cause heat to be generated in the coil, especially in the tuning slug which comes into play when large amounts of coil are used. The fewer turns of coil ribbon on the ceramic drum, the less heat will be generated. Each 20 divisions on the coil dial represents one additional turn of ribbon on the ceramic drum. The tuning procedure has placed limits, which should not be exceeded, for coil settings when tuned to various frequency ranges:

FREQUENCY RANGE	LIMITING DIAL SETTING
2 to 6 megacycles	500
6 to 12 megacycles	350
12 to 16 megacycles	250
16 to 30 megacycles	200

Since the ribbon on the ceramic drum is placed in series with the antenna, the addition of coil ribbon to the drum is the equivalent of adding inductance (coil) in series with the antenna, or, in effect, making the antenna electrically longer. Note from figure 2-1 that in the frequency range of 2 to 6 mc, this antenna presents a large amount of capacitive reactance, requiring large amounts of added inductance in the antenna coupler for compensation in order to resonate the antenna system. Visualize the AN/SRA-22 tuned into an antenna, for example, at 2.5 megacycles. The coil reading should be 500 or less. There would be approximately 500/20 (or 25) turns of coil ribbon on the ceramic drum. This is a considerable amount of inductance added to the antenna in order to compensate for the high capacitive reactance of an antenna much less than a quarter wavelength long. This situation causes reduced efficiency and increased heating, but it cannot be avoided when using an antenna requiring this high a coil setting, such as a 35-foot whip antenna in the 2- to 6- megacycle frequency range. Under no circumstances should the coil be allowed to exceed the dial reading of 500 for frequencies of 2 to 6 mc. As stated before, this represents 25 turns of coil ribbon on the ceramic drum and is a potential source of excessive heat for the coupler to dissipate.

When excessive capacity is used and compensated for by adding inductance (more coil ribbon on the ceramic drum), high heat or voltage arcing within the coupler may result.

In the higher frequency regions, coil limits are imposed for an additional reason. If more coil turns are used than the value for the limiting dial setting, it is possible for the coil and capacitor to reach self-resonance and absorb large amounts of transmitter power, with resultant damage to the coupler.

The maximum coil limits established in the AN/SRA-22 tuning procedure are to force the operator to limit the amount of coil ribbon that is put on the ceramic drum. If a dip in reflected power cannot be obtained within these limits, the antenna is already inductive (antenna too long at the applied frequency), and series capacity must be used.

IMPEDANCE COORDINATES—50-OHM CHARACTERISTIC IMPEDANCE

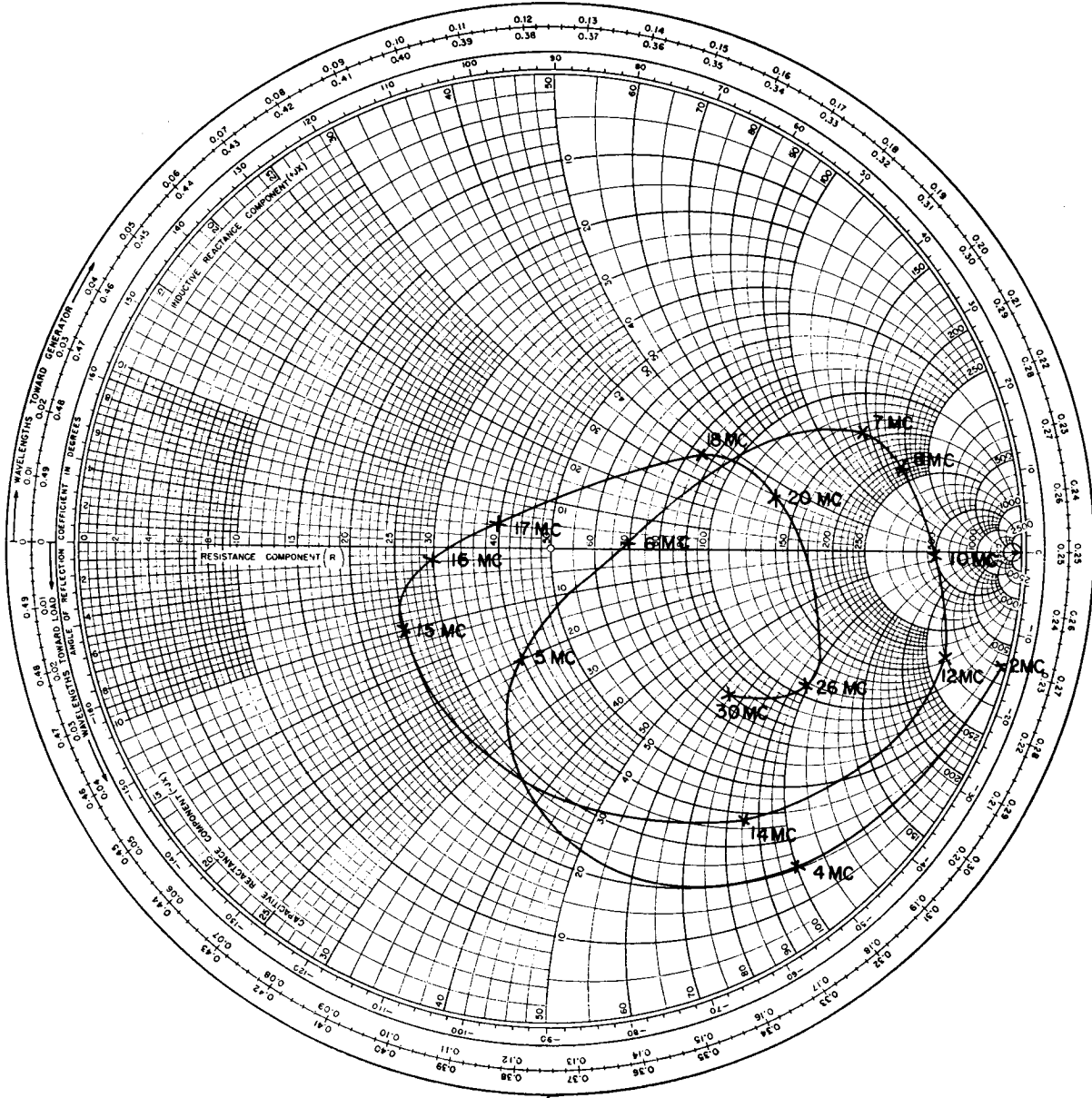


Figure 2-1. Impedance Characteristics of Typical 35-Foot Whip Antenna

The transmitter "tune power" must not exceed 125 watts when the AN/SRA-22 is being tuned. Operation of the TUNE-OPERATE switch to the TUNE position is designed to reduce the power output of the associated transmitter to a safe value for tuning. In addition, the power output of SSB transmitters such as the AN/XXX and AN/WRT-2 can be reduced by varying the excitation to the power amplifier. Use only the necessary power (below 125 watts) when tuning the AN/SRA-22 into an antenna (do not key the transmitter in OPERATE) until the tuning positions of the antenna coupler have been verified as good and efficient. Thereafter, normal OPERATE power may be used except where antenna lengths less than 35 feet are used (refer to paragraph 2-3. c). Appropriately less transmitter power must then be employed to compensate for increased coupler heating caused by lowered efficiency at shorter antenna lengths.

2.3. OPERATING PROCEDURES.

In order to have an antenna coupler capable of compensating for the complex impedance of the 35-foot whip such as that shown in figure 2-1, a variable tapped coil is placed in series with the antenna being tuned. Also, a variable capacitor is placed either in series or shunt with the antenna. The variable tap on the AN/SRA-22 coupler is used to find the point nearest to 50 ohms for matching the coaxial feedline.

a. DESCRIPTION OF CONTROLS. - All of the controls and indicators used to operate the antenna coupler are located on the coupler control. Table 2-1 describes the operating controls and indicators, and figure 2-2 identifies them.

TABLE 2-1. CONTROLS/INDICATORS AND FUNCTIONS

CONTROL OR INDICATOR	FUNCTION
Coil dial and TAP dial	COIL and TAP dials are referred to as the receiving potentiometers. Potentiometers in the antenna coupler are referred to as the sending potentiometers. The sending potentiometer is connected to the coil and tap drives in such manner that the coil and tap positions are immediately determined.
COIL COARSE TUNE-FINE TUNE switch	To position the coil to obtain a null on the COIL meter.
TAP COARSE TUNE-FINE TUNE switch	To position the tap to obtain a null on the TAP meter.
CAPACITOR SERIES-SHUNT toggle switch	Places the capacitor either in series or shunt with the antenna.
Twelve-position CAPACITOR switch	A 12-position wafer switch which drives the variable vacuum capacitor to a predesignated position.
REFLECTED-FORWARD switch (r-f power meter switch)	Selects forward or reflected power which may be read on the r-f power meter.
LOAD-ANT switch	Used to switch r-f power to the antenna coupler or to a dummy load.
R-f power meter	Reads the forward or reflected power which is selected by the REFLECTED-FORWARD switch.
COIL meter	Indicates position of the coil in relation to the coil sending potentiometers.
TAP meter	Indicates position of the tap in relation to the tap sending potentiometers.

Table 2-1. (Continued)

CONTROL OR INDICATOR	FUNCTION
CAPACITOR run light	Lights when variable capacitor is running, and blinks when VSWR protector circuit is actuated.
TUNE-OPERATE switch	Applies 115 volts ac to coupler while tuning, and holds Radio Set AN/XXX in tune power while tuning.

b. SEQUENCE OF OPERATION. - The operator's sequence of operation for tuning the AN/SRA-22 into any antenna, whether it be a 35-foot whip or long-wire antenna, is always to start from the "home" position.

(1) CONTROL SETTINGS PRIOR TO STARTING. - To operate the positioning controls of Coupler Control C-2698/SRA-22, it is necessary to hold the TUNE-OPERATE switch in the TUNE position. The original model of the coupler control did not have the TUNE-OPERATE switch. It was added by a Field Change 1 and modified by Field Change 7.

"Home" positions for the AN/SRA-22 controls are as follows:

- (a) CAPACITOR SERIES-SHUNT switch in SHUNT.
- (b) CAPACITOR 12-position switch in position 1.
- (c) REFLECTED-FORWARD power switch in 1000 FORWARD.
- (d) LOAD-ANT switch to LOAD.
- (e) COIL and TAP dials to 100.
- (f) COIL and TAP meter indications zeroed.

Note

To set the COIL and TAP to the "home" position, the COIL and TAP dials are set to 100, as shown in figure 2-3, and the COARSE TUNE-FINE TUNE switches are operated in the direction in which the meter pointer must move in order to reach a center zero indication. If the meter pointer must move right to reach center, move the COARSE TUNE-FINE TUNE switch to the right; if the pointer must move left to reach center, move the switch to the left. This applies for both COIL and TAP COARSE TUNE-FINE TUNE switches.

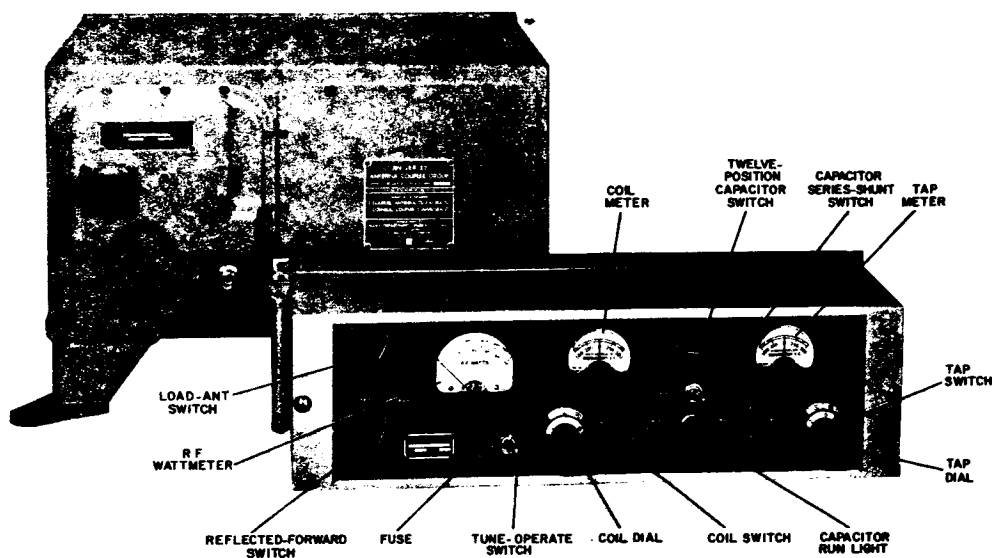


Figure 2-2. Antenna Coupler Group AN/SRA-22, Front Panel Control Location

(2) TUNING PROCEDURE WHERE A DUMMY LOAD IS AVAILABLE. - For transmitter tuning procedures, refer to the technical manual for the transmitter being used.

Note

It is recommended that the LOAD-ANT switch on the coupler control be set to the LOAD position, which will feed the r-f amplifier of the transmitter being used into an external dummy load.

Tune the associated transmitter, in accordance with the technical manual, to the desired frequency. Reduce the transmitter output by operating the exciter or driver gain control to its minimum position.

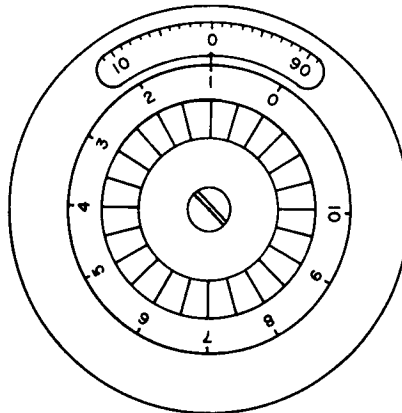


Figure 2-3. Dial Set to 100

CAUTION

To protect the transmitter and tuner against possible damage, do not key the transmitter until loading controls are set to approximately correct positions. **DO NOT OPERATE THE LOAD-ANT SWITCH WHEN THE TRANSMITTER IS KEYED.**

- (a) With the transmitter unkeyed, operate the LOAD-ANT switch to the ANT position.
- (b) Set the COIL dial to the following limiting values for frequency range:

FREQUENCY	COIL DIAL SETTING
2 to 6 megacycles	500
6 to 12 megacycles	350
12 to 16 megacycles	250
16 to 30 megacycles	200

CAUTION

Do not exceed the above settings. Damage to the coupler or the transmitter may result.

- (c) Key transmitter and slowly advance transmitter output power (exciter or driver gain control) to obtain a minimum useful meter reading not to exceed 125 watts of forward power.
- (d) Antenna Coupler Group AN/SRA-22 must now be tuned for minimum reflected power. Set the REFLECTED-FORWARD power switch to 1000 REFLECTED (or 100 REFLECTED when reflected power is below 100 watts).

Note

All C-2698/SRA-22 coupler controls are equipped with the VSWR protective device which will automatically disable transmitter output if the TUNE-OPERATE switch is in the OPERATE position and the reflected power exceeds approximately 30 watts. This is reset and inoperative when the TUNE-OPERATE switch is in the TUNE position.

(e) Operate the COIL COARSE TUNE-FINE TUNE switch in the direction required to zero the COIL meter (lever in direction in which meter pointer must move) while watching the r-f power meter for a dip. This dip occurs when the reflected power is decreasing and suddenly starts increasing. It may be a sharp or broad dip. If a dip on the r-f power meter is not obtained before the pointer of the COIL meter reaches zero, unkey the transmitter, release the COIL COARSE TUNE-FINE TUNE switch, and proceed to (f). If a dip on the r-f power meter is obtained, proceed to (j).

(f) If a dip is not obtained, set the COIL dial to 130 and operate the COIL TUNE switch to zero the COIL meter. TAP meter should remain centered for a dial reading of 100.

CAUTION

Do not key transmitter (apply r-f power to tuner) while capacitor run lamp is lighted.

(g) Advance the 12-position CAPACITOR switch one position at a time, watching the r-f power meter for a dip. At each switch position, wait until indicator light goes out before keying transmitter. If no dip is obtained by the time position 12 is reached, switch CAPACITOR SERIES-SHUNT switch to SERIES. Turn the 12-position CAPACITOR switch one step at a time toward position 1, watching the r-f power meter for a dip.

(h) When a dip is obtained, switch the REFLECTED-FORWARD switch to FORWARD to see if the forward power is still good. Return the REFLECTED-FORWARD switch to the 100 REFLECTED position.

(j) After a dip is obtained, use the FINE TUNE positions on the COIL and TAP TUNE switches to reduce the reflected power to a minimum.

(k) Release the TUNE-OPERATE switch to OPERATE position and increase the transmitter output (exciter or driver gain control) to obtain the desired forward power. Do not exceed the power limitations for the type of emission and type of antenna employed (see table 2-2).

Note

When excessive series capacity is used, the operator must compensate by adding inductance (more coil ribbon on the ceramic drum). This, as stated before, may result in high heat or voltage arcing within the coupler.

(3) VSWR PROTECTIVE DEVICE.

(a) If, during normal operation, the reflected power exceeds approximately 30 watts, the transmitter power output will be automatically disabled. When this condition occurs, the indicator light (which indicates capacitor running during tune-up) will blink a warning, and the r-f power meter will have a nearly full-scale deflection in the 100 REFLECTED position.

(b) To reset the protective device, place the TUNE-OPERATE switch in the TUNE position and check the tuning of the coupler. If necessary, retune the coupler according to the tuning procedure. Release the TUNE-OPERATE switch.

(c) If the protective device repeatedly disables the transmitter during normal operation, but a good tune-up is indicated when the TUNE-OPERATE switch is in the TUNE position, a fault probably exists in the r-f coaxial cable, Antenna Coupler CU-714/SRA-22, or in the antenna.

c. OPERATING PROCEDURES FOR ANTENNAS LESS THAN 35 FEET IN LENGTH. - Operators who understand and use the correct AN/SRA-22 tuning procedure should have no difficulty in operating with antennas of lengths other than 35 feet. It is essential that the limiting inductance values set forth in paragraph 2-2 be observed. For antennas shorter than 35 feet, power limitations must be observed as well.

g. SUMMARY: ABBREVIATED PROCEDURE FOR TUNING AN/SRA-22.

- (1) Set LOAD-ANT switch to LOAD; tune transmitter into dummy load.
- (2) Unkey transmitter, set power output to minimum, and operate LOAD-ANT switch to ANT.
- (3) Set COIL and TAP potentiometers and CAPACITOR switches to "home" positions:

COIL potentiometer	100
TAP potentiometer	100
CAPACITOR 1-12	1
SERIES-SHUNT	SHUNT

- (4) Operate COIL and TAP TUNE controls to zero respective meters. Do not key transmitter.
- (5) Reset COIL potentiometer to limit position for frequency range:

FREQUENCY	COIL DIAL SETTING
2 to 6 megacycles	500
6 to 12 megacycles	350
12 to 16 megacycles	250
16 to 32 megacycles	200

(6) Key transmitter and advance transmitter power output to obtain minimum useful meter reading. Do not exceed 125 watts forward power.

(7) Hold TUNE-OPERATE switch in TUNE position, key transmitter, and operate COIL TUNE control to left, stopping when REFLECTED power dips or COIL meter reaches center zero (limit value), whichever occurs first.

(8) If dip occurs first, check that FORWARD power is still good, then operate COIL and TAP FINE TUNE controls for minimum REFLECTED power. Use minimum coil necessary.

(9) If COIL limit value is reached first, unkey transmitter, reset COIL potentiometer to 130, and zero COIL meter. Return COIL potentiometer to limit value.

(10) With CAPACITOR in SHUNT, key transmitter and advance CAPACITOR 1-12 switch one step at a time, watching REFLECTED power meter for a dip. Use minimum capacitor necessary.

WARNING

DO NOT RETURN TOWARD POSITION 1 OR SWITCH TO SERIES WHILE TRANSMITTER IS KEYED.

(11) If no dip is found on reaching CAPACITOR position 12, unkey transmitter and switch capacitor to SERIES. Wait until CAPACITOR run lamp goes out.

(12) Key transmitter and reduce CAPACITOR 1-12 switch one step at a time, watching REFLECTED power meter for a dip.

WARNING

DO NOT RETURN TOWARD POSITION 12 OR SWITCH TO SHUNT WHILE TRANSMITTER IS KEYED.

(13) When a dip is found, check that FORWARD power is still good, then operate COIL and TAP FINE TUNE controls to reduce REFLECTED power to minimum. Do not let COIL exceed limit value.

(14) When minimum REFLECTED power is reached, release TUNE-OPERATE switch to OPERATE position and set transmitter FORWARD power to intended operating level. Do not exceed power limitations for emission to be used.

EMISSION	35-FOOT ANTENNA	25-FOOT ANTENNA	15-FOOT ANTENNA
FSK	500 watts	300 watts	150 watts
BEACON (locked key)	500 watts	300 watts	150 watts
AM (with carrier)	400 watts	275 watts	200 watts
CW (on-off)	1000 watts	600 watts	300 watts
SSB	1000 watts	600 watts	300 watts

(15) If VSWR protective device now trips when transmitter is keyed, tuning is not satisfactory. Return to step (6) and repeat.

2-4. OPERATOR'S MAINTENANCE.

a. OPERATOR'S CHECK. - Table 2-3 contains routine checks to be performed by the operator.

TABLE 2-3. ROUTINE CHECK CHART

WHAT TO CHECK	HOW TO CHECK	CHECK RESULTS
Complete equipment.	Inspect visually.	Equipment should be mounted properly, and knobs and dials should be intact.
LOAD-ANT switch, REFLECTED-FORWARD switch, 12-position CAPACITOR switch, CAPACITOR SERIES-SHUNT switch, TAP COARSE TUNE-FINE TUNE switch, COIL COARSE TUNE-FINE TUNE switch, and TUNE-OPERATE switch.	Operate controls.	Detent action should be positive, and the knobs should be secure on shafts.
R-f power meter, COIL meter, TAP meter, COIL dial, and TAP dial.	Visually inspect meters and operate dials.	The three meters should read zero. Lock mechanism on the dials should lock and unlock properly. The dials should operate smoothly when turned.

b. EMERGENCY MAINTENANCE. - The only emergency maintenance that can be performed is the replacement of the fuse in Coupler Control C-2698/SRA-22. Refer to figure 2-2 for fuse location. This fuse is in one side of the 115-volt ac line which supplies power to the antenna coupler system. Table 2-4 contains symptoms indicating probable fuse failures.

TABLE 2-4. SYMPTOMS OF PROBABLE FUSE FAILURES

CONTROL SETTINGS AND INSTRUCTIONS	SYMPTOMS
Set COIL COARSE TUNE-FINE TUNE switch to COARSE TUNE.	If fuse is open, COIL meter will remain at zero.
Set TAP COARSE TUNE-FINE TUNE switch to COARSE TUNE.	If fuse is open, TAP meter will remain at zero.
Switch 12-position CAPACITOR switch one position at a time.	If fuse is open, the CAPACITOR run light will not not light.