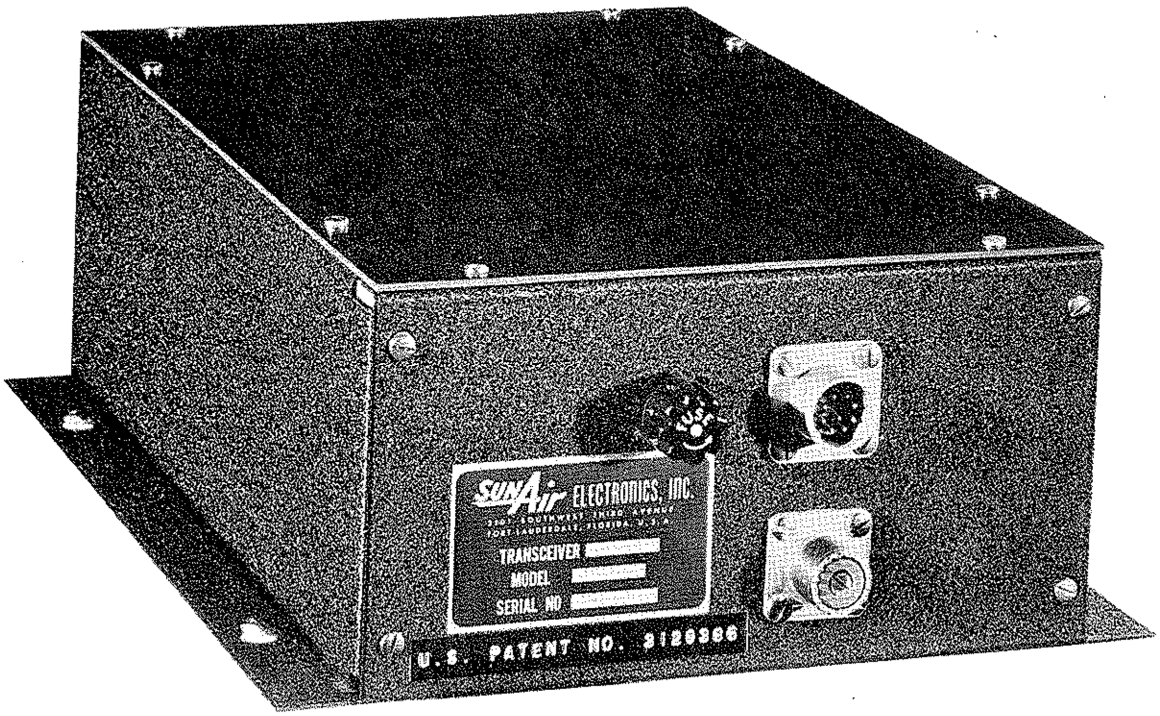
SUNAir ANTENNA COUPLER

14 or 28 VOLTS DC

MODELS: AC-5-14M/28M
AC-5-14/28
AC-10-14/28
AC-14-14/28
AC-22-RA-28
AC-22-14M/28M



ANTENNA COUPLER

SUNAIR ELECTRONICS, INC.
3101 SOUTHWEST THIRD AVENUE
FORT LAUDERDALE, FLORIDA, U. S. A.

ILLUSTRATIONS

PARTS REPLACEMENT

A complete stock of replacement parts for all SunAir equipment is maintained at the factory. In some cases, the part supplied against an order for a replacement item may not be an exact duplicate of the original part where the original item has been superseded by a newer and more efficient design. Such replacement parts will be interchangeable electrically. If the new part has a different size or shape, all necessary hardware to permit installation in oldersets will be furnished.

Parts for SunAir equipment may be secured from SunAir distributors and dealers throughout the world. When direct orders from the factory are required, please specify the following:

a) serial number, model number and voltage fo the unit
b) description of part required, and
c) quantity required

EQUIPMENT AND PARTS REPAIR

Complete factory service is available on any SunAir equipment. Repairs, adjustments or modifications which are of such a nature as to warrant factory service will be made in accordance with the instructions of the customer. A labor charge of $7.50 per hour, cost of parts and shipping charges will apply to all non-warranty work.

RETURN OF EQUIPMENT OR MATERIAL

To return equipment or material, under warranty or otherwise, advise SunAir Electronics, Inc. giving full particulars.

If the item is throught to be defective, give full information concerning the nature of the defect. SunAir will then authorize the return. Failure to secure this authorization prior to forwarding the equipment or material, or failure to provide complete information may cause unnecessary delay in processing.

PARTS SHORTAGE OR DAMAGE

Unpack and inspect all parts and equipment as soon as received. Do not accept a shipment where there are visible signs of damage to the cartons until a complete inspection is made. If there is a shortage or if any evidence of damage is noted, insist on a notation to that effect on the shipping papers before signing the receipt from the carrier.

If concealed damage is discovered after a shipment has been accepted, notify the carrier immediately in writing and await his inspection before making any disposition of the shipment. A full report of the damage should also be forwarded to SunAir.

ANTENNA COUPLER THEORY

The transmitter output of the SunAir transceiver must be presented with a 50 ohm resistive load for greatest efficiency and power transfer. An end fed antenna of fixed length, configuration and proximity to a ground plane (in this case the aircraft) exhibits impedances at different frequencies which vary over a large range. At certain frequencies, the antenna appears purely resistive. At other frequencies it has inductive and resistive components and at still others, capacitive and resistive components. The function of the antenna coupler is to match or transform the impedance exhibited by the antenna, at each of the frequencies to be transmitted, to the required load impedance for the SunAir transmitter.

The combination of reactive components used to accomplish this transformation is varied. To determine the type and size of reactive components necessary for the transformation, an impedance chart is used. In the following diagram, a typical antenna is shown plotted on an impedance chart. On this chart resistance is shown increasing to the right, inductive reactance is shown increasing vertically upward, and capacitive reactance increasing downward.

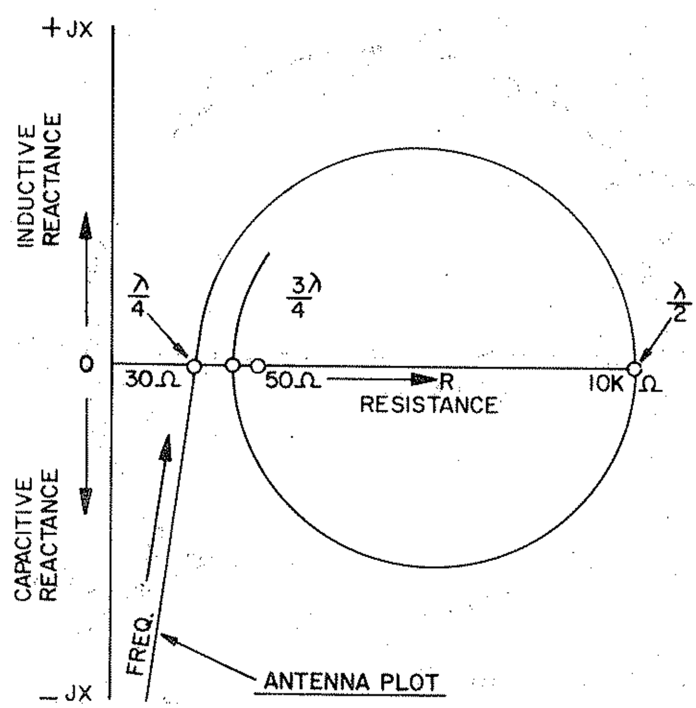


FIGURE NO. 1

From the chart it can be seen that at frequencies below quarter wave resonance, the antenna appears capactive and resistive. At frequencies between quarter and half wave resonance, the antenna is inductive and resistive. At frequencies between half and three quarter wave resonance, the antenna again appears capacitive and resistive. At quarter, half and three quarter wave resonance, the reactive components are zero and the antenna looks purely resistive.

In using the impedance chart to determine the required transformer components, the following is considered. Point "X", the 50 ohm resistive point, locates the output impedance of the transmitter at all frequencies. The impedance of the antenna at any given frequency is represented by a point on the antenna plot. Impedance matching is accomplished by providing the proper reactive components to transform from a given frequency point on the antenna plot to the 50 ohm resistive point.

The circles appearing on the diagram are constant admittance plots. A shunt reactive component transforms along any given circle. The direction of travel on the chart is shown by the arrows at the bottom of the figure; i.e., shunt capacitance transforms clockwise while shunt inductance transforms counter-clockwise. Series reactive elements result in vertical transition on the chart. As shown, series inductance results in an upward transformation, while series capacitance moves downward.

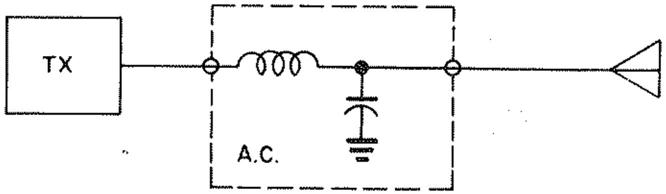
With these rules and Figure 2, a qualitative analysis of transformer requirements for a typical 29 foot antenna can be performed.

Transformation can always be accomplished with more than one combination of elements. Theoretically, the shortest distance traveled on the impedance chart represents the preferable and most efficient transformation. From a practical standpoint, however, the shortest path is not always the one chosen. In the following discussion, SunAir's choice of transformation circuitry will be discussed with an explanation for the reason for abandonment of the shortest path wherever applicable.

In Figure 2, quarter wave resonance is experienced at approximately 7.5 MC. Starting at this point it can be seen that transformation to the 50 ohm point is accomplished by vertical travel upward (series inductance) to the constant admittance circle which goes through the 50 ohm point, and clockwise movement along this circle (shunt capacitance) to the 50 ohm point. Transformation at quarter wave resonance would therefore appear schematically as follows:

Thus, all frequencies between "A" and "D" on the diagram are transformed with series capacitance. Shunt capacitance, no shunt element, or shunt inductance is used at the antenna terminal as required.

The last band of frequencies covers the antenna plot from point "D" to the 18 MC point which is approaching three quarter wave resonance. All frequencies within this quadrant are transformed by clockwise rotation (shunt capacitance) on a given circle, and vertical upward movement (series inductance) when the 50 ohm line is reached. In schematic form the impedance matching network is as follows:



Capacitance from antenna to ground within the antenna coupler will be represented on the diagram by a slight clockwise rotation along a respective circle for each frequency to be transformed. This capacity will rotate the half wave resonant frequency (and the frequencies immediately below it) into the last quadrant discussed, and they would be transformed in the manner previously set up for this quadrant. Thus 13.3 MC, even though it is slightly below the half wave resonant frequency, is rotated into this last quadrant by shunt capacitance within the antenna coupler, and it is transformed by series inductance and shunt capacitance on the antenna terminal.

The previous discussion furnished only a qualitative indication of the reactive elements required for matching a transceiver to the example antenna. To determine the size of each type of reactive element for a given antenna and frequency line up would require a frequency plot of the antenna on a graduated impedance diagram, and a knowledge of the reactive and resistive impedances to be experienced in the physical construction of an antenna coupling.

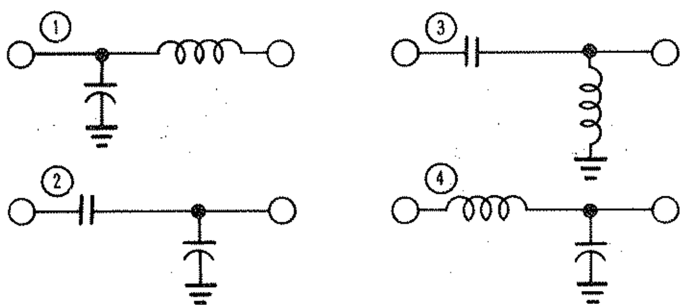
ANTENNA COUPLER CONSTRUCTION AND SWITCHING

The four major types of components which comprise the SunAir Antenna Coupler are as follows:

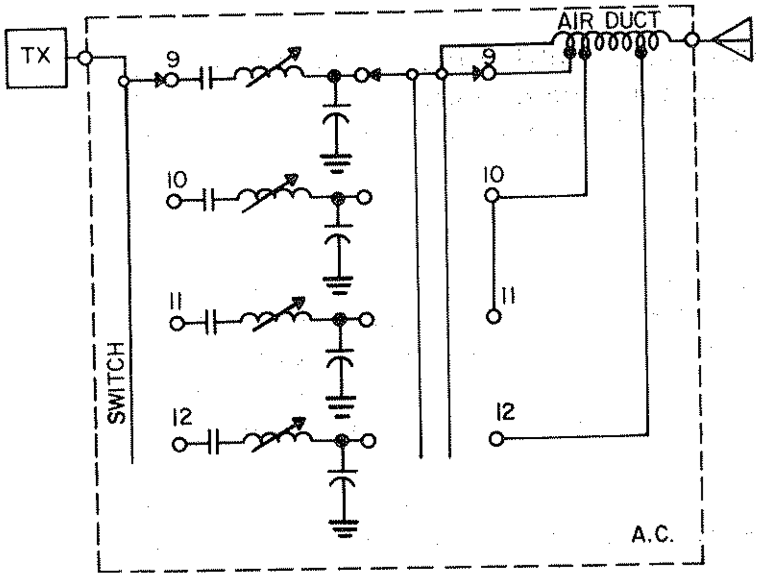
1) Ledex and Switch Deck Assembly
2) Air Duct
3) Fixed Reactive Components
4) Variable Reactive Components

The ledex motor with its slave wafer and switch deck assembly is actuated and positioned by a master wafer in the transceiver (direct model radio) or control head (remote model radio). In this manner, a given channel position in the radio dictates a respective ledex position in the antenna coupler. The switch assembly is thus positioned to form the proper pre-selected reactive circuitry required to match transceiver to antenna at any given frequency.

As discussed in the previous theory section, the four types of matching circuits to be formed are as follows:



In circuit #1, a large quantity of (there is no other) inductive reactance is often required. Since the quantity is large, it is important that the "Q" of the reactive



In this manner, the antenna coupler incorporates at least one tunable element for each of the individual frequencies to be transmitted.

ANTENNA AND ANTENNA COUPLER INSTALLATION

Proper antenna installation and equipment placement are very important factors in achieving final antenna coupler adjustment and good, efficient transmission. With a given antenna length, the most efficient transmission is made with a properly adjusted coupling unit and the following discussion pertains largely to installation requirements leading to ease and effectiveness in coupling unit adjustments.

The following factors are important in achieving a good transceiver-coupler-antenna system:

1) Antenna length (including lead-in to coupling unit)
2) Antenna configuration (straight antenna, "open V" antenna or "closed V" antenna)
3) Antenna to aircraft capacitance (proximity of antenna to fuselage)
4) Antenna coupling unit placement (location of the coupling unit in the aircraft)

Antenna Coupler Placement

The placement of the coupling unit within the aircraft is also an important consideration. There are several factors to be considered in choosing a proper location. Three of these are:

1) Antenna coupler to feed through proximity
2) Affect on antenna length
3) Accessibility

Coupler to Feed Through Proximity

The coupling unit must be located in close proximity to the antenna feed through insulator. The lead between coupling unit and antenna feed through point is active antenna and must be held to a minimum. The most detrimental product of excess wire at this area is capacitance build-up and its undesirable (and non-productive) loading effect. The suggested length of wire between coupling unit and feed through is 6 inches; it should never exceed one foot. The choice of antenna coupler location can therefore never be separated from the choice of feed through location.

Affect on Antenna Length

Because of the proximity requirement between antenna coupler and antenna feed-through, the choice of antenna coupler location has an obvious ultimate effect upon antenna configuration and possibly upon antenna length. Ultimate objectives in installing and antenna on a small aircraft should be (a) a properly installed antenna (b) a standard antenna (29 or 34 feet) and (c) an antenna of the longer standard length whenever practical. With these objectives, and the knowledge that it is desireable to terminate the antenna one foot or more from the wing tip, it is obvious that the origination of the antenna (the feed through) may well become an important factor.

Accessibility

PRE-ALIGNMENT

Before any adjustments are made in the coupling unit, a procedure may be employed which will minimize (and possibly eliminate) the need for antenna coupler tuning. The procedure is as follows:

1) Cut a lead-in wire which is approximately 3 inches longer than the original lead-in.
2) Replace the original lead-in with the new one (using the full length of wire.)
3) Channel the radio and coupling unit to the first available frequency below the quarter wave resonant frequency of the antenna.

If the quarter wave resonant frequency of the antenna is not known, an approximate value may be obtained from the graph on page 26. Example: antenna length- 29 feet, quarter wave resonant frequency - approximately 7.5 MC, first available frequency below it - 6.5 MC.

4) Turn the element of the wattmeter to read reflected power.
5) Depress the mike key momentarily and observe the wattmeter reading.
6) Loosen the lead-in wire from either coupling unit or feed through and make the lead-in approximately 1 inch shorter by bending the last inch back along the lead-in. Tighten the wire at this new length.
7) Again depress the mike key momentarily and observe the power reading.
8) In a like manner, observe the reflected power with the new lead-in 2, 3, 4, 5 and 6 inches shorter.
9) Return to the position which furnished the least reflected power reading and cut and permanently attach the lead-in at this length.

ALIGNMENT

1) Channel the radio and coupling unit to #1 channel.
2) Switch the element of the wattmeter to read reflected power.
3) Locate the tunable inductor for channel #1 (marked "1" beside the inductor on the coil mounting board), depress the mike key, and adjust the tunable inductor for minimum reflected power. If no dip is observed, note the position

a) If all frequencies below the quarter wave resonant frequency required considerably more inductance (inward movement of tuning screws, etc.) than that provided by the pre-tuned load unit; if the majority of channels after tuning produce more than 4 watts of reflected power--better tuning would probably be possible if the antenna is lengthened slightly.

b) If all frequencies below the quarter wave resonant frequency require considerably less inductance, and the tuned channels consistently yield 4 or more watts of reflected power, better results could probably be obtained by shortening the antenna slightly.

c) If all frequencies below the quarter-wave resonant frequency require only slight adjustment; if the majority of channels reflect 4 or more watts; if the channels of higher frequency are further detuned than those of lower frequency--it is inducated that the antenna used to factory align the coupling unit.

Antenna to aircraft capacitance can be satisfactorily increased by placing a small capacitor from antenna to ground at the output terminal of the antenna coupler unit. To determine if such a requirement exists, the following procedure may be employed; (1) Channel the system to one of the frequencies exhibiting poorest matching. Activate the transmitter and observe the reflected power reading. (2) Place a 2pf (3KV or higher) capacitor from the antenna to ground at the antenna terminal of the coupling unit. (3) Actuate the transmitter and again observe the reflected power. If the reading is less than the previous one, the need for antenna to ground capacitance is indicated. (4) Increase the capacitance value to 4 pf, actuate the transmitter and retune the antenna coupler tuning elements for the channel. In a like manner, vary the capacitance value until a "good" reflected power reading is obtained. (5) Re-align the complete coupling unit with this capacitor in the circuit.

NOTE: A small amount of incompatibility due to antenna capacitance can be compensated for by changing the value of the capacitor across the input of the antenna coupling unit.

Less antenna to aircraft capacitiance can be achieved only by increasing the distance between the antenna and the surface of the aircraft. Such a change

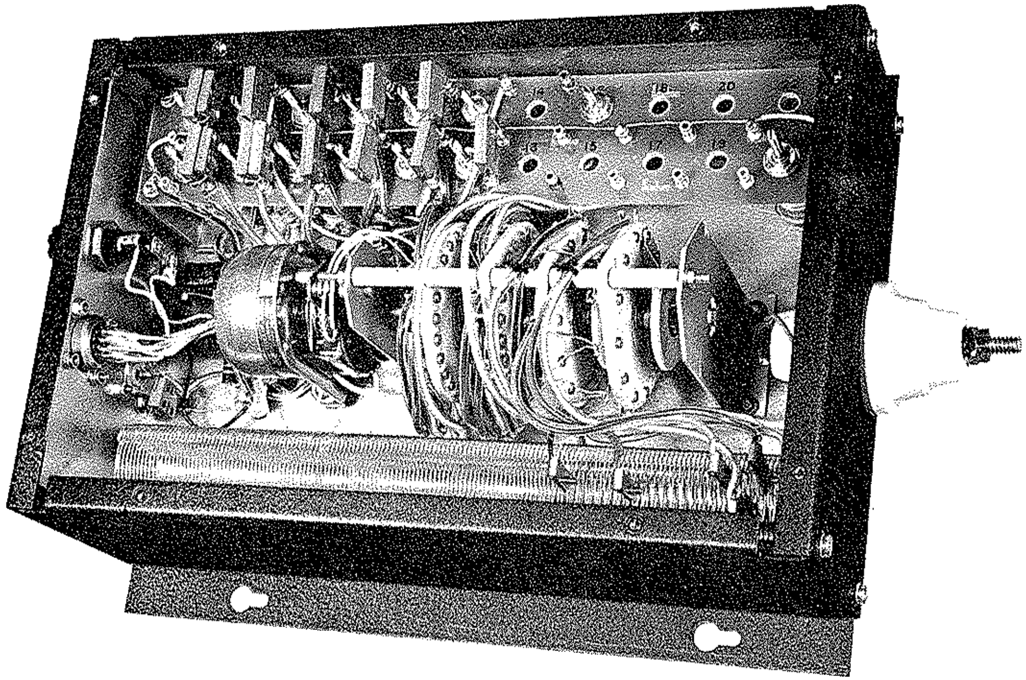
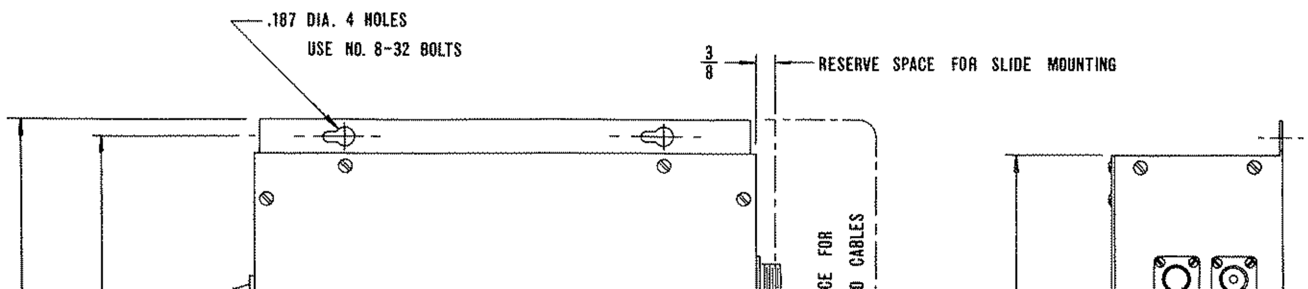


FIGURE NO. 4
INTERIOR VIEW ANTENNA COUPLER



TYPICAL ANTENNA CONFIGURATIONS

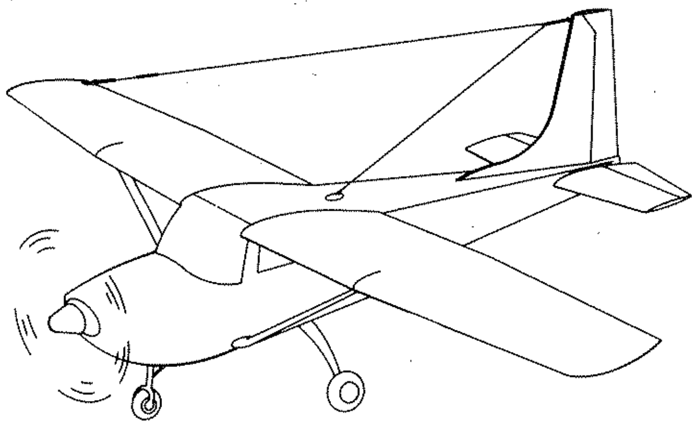
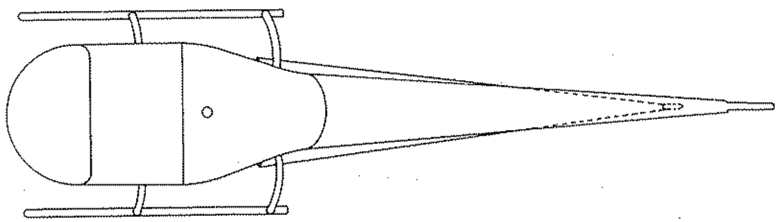
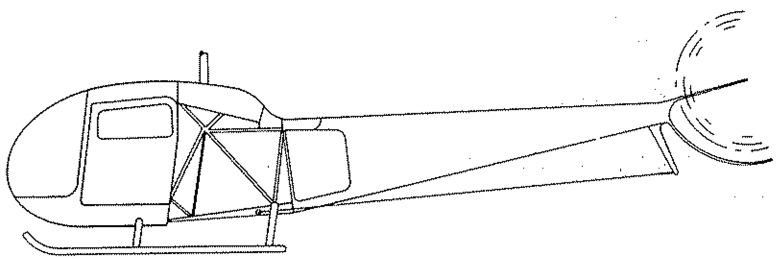
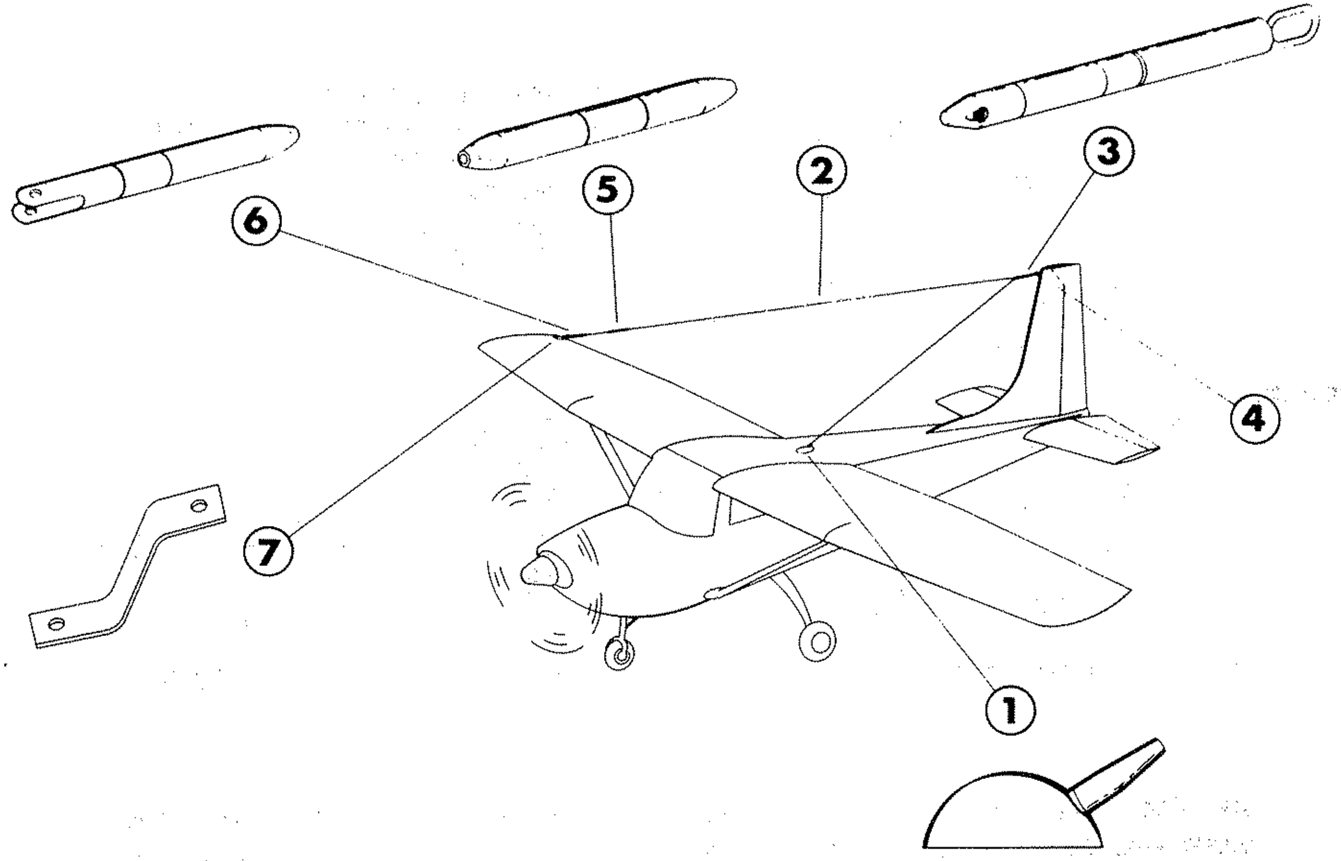


FIGURE NO. 6
Typical Open "V" (as used on Fixed Wing)





SUNAIR 95158 HF ANTI-PRECIPITATION STATIC ANTENNA KIT



INSTALLATION

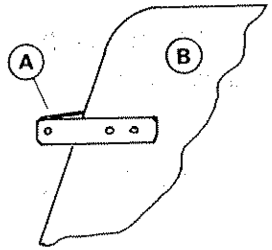
ITEM	DESCRIPTION	PART NO.
[illegible]	[illegible]	[illegible]

VERTICAL FIN ANCHOR

(ITEM 4)

(NOT SUPPLIED, MUST BE FABRICATED)

Suggested method of fabrication only: The anchor can be of two pieces of metal, one mounted each side of vertical fin, and bolted to insulated tension unit.



A VERTICAL FIN ANCHOR

B VERTICAL FIN

Fig. No. 4

STRAIN INSULATOR 71267

(ITEM 5)

APPLICATION — THE STRAIN INSULATOR IS USED FOR ADJUSTING THE ANTENNA WIRE TO THE DESIRED LENGTH AND IN SOME CASES MAY NOT BE REQUIRED BECAUSE THE DESIRED LENGTH EXTENDED TO THE ANCHOR INSULATOR 71334.

ANCHOR INSULATOR 71334

(ITEM 6)

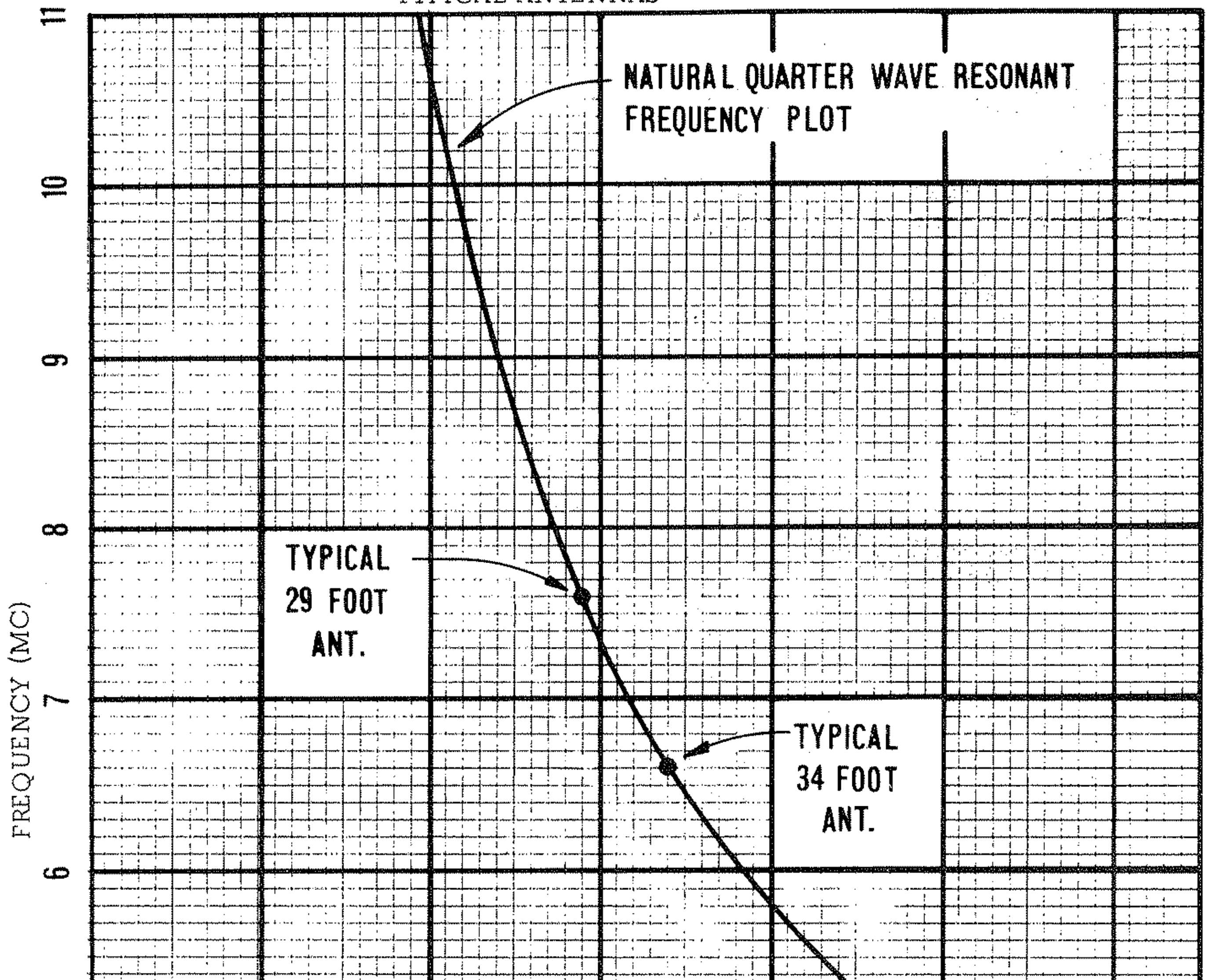
APPLICATION — THE ANCHOR INSULATOR IS USED TO CONNECT THE ANTENNA WIRE TO THE WING TIP BRACKET, ITEM 7.

WING TIP BRACKET 71009

(ITEM 7)

APPLICATION — THE WING TIP BRACKET IS CONNECTED TO THE TOP SIDE OF THE WING TIP BY REMOVING ONE OF THE WING TIP SCREWS AND REPLACING IT WITH A LONGER SCREW.

NATURAL FREQUENCY VS. ANTENNA LENGTH FOR TYPICAL ANTENNAS



ANTENNA COUPLER COMPONENT PART NUMBERS

CHANNELING AND MISCELLANEOUS COMPONENTS

(See Page 29 for Symbol Identification)

DESCRIPTION	SYMBOL	PART NUMBER
Capacitor, .47 uf	C	25725
Diode, Codi 534	CR	40165
Fuse, 5 Amp	F	85866
Fuseholder	-	84903
Insulator, Antenna Feed through	-	95495
Ledex, 14v M series	-	32077
28v M series	-	32065
all other units	-	32285
Plug, channeling, 165-11	B	74350
Plug, R. F. Input, SO-239	-	74192
Relay, Odd-Even, AC-22M only	K	66287
Resistor, 5 ohm 10w	R1	16061
2.5 ohm 10w	R1	16918
1 ohm 10w	R1	16968
Resistor, 1 ohm 1w	R2	17027
Resistor, 75 ohm 3w	R3	16944
Wafer, Ceramic, 24 Pos.	-	33162
Double Space A	-	33148
Double Space B	-	33150

ACCESSORY

Connector, Cable, Channeling	74362
Connector, Cable, RF	90873

EMERGENCY TUNING PROCEDURES USING THE SA-14R CALIBRATED WATTMETER OR A STANDARD VOLTMETER WITH THE SUNAIR SWRD-1 (STANDING WAVE RATIO DETECTOR) #91396

SA-14R Wattmeter

The calibrated wattmeter which is an integral part of the SA-14R system can be used in emergencies to align the antenna coupling unit. Unless a special cable is fabricated to allow installation of the control head (with its meter) in the area of the antenna coupling unit, alignment of the coupler is impractical in other than an emergency. If such a cable is fabricated for this purpose, the SA-14R wattmeter can be used to accomplish good alignment of the coupling unit. In a standard installation (with control head mounted on the instrument panel), emergency antenna coupler alignment will necessitate the relay of meter readings from the instrument panel area back to the antenna coupler area. Alignment procedure is the same as described in the "Antenna Coupler Alignment" section on page 13.

SWRD-1

In using the SunAir SWRD-1 for antenna coupler emergency alignment, the following procedure should be employed:

(1) The SWRD-1 should be mounted near the antenna coupler unit and good ground contact provided.
(2) The coaxial cable from the transmitter is connected to the plug provided and inserted into the receptacle marked "X-MTR".
(3) The coaxial cable from the antenna coupler is connected to the plug provided and inserted into the receptacle marked "ANT".
(4) The negative lead of a voltmeter having a 0-20 ma range is connected to the ground lug located directly under the X-MTR".
(5) The positive lead of the voltmenter is attached to the feed through connector marked "METER".
(6) Place switch on SWRD-1 to "X-MTR". Proceed as described in the "Antenna

SUNAIR ELECTRONICS, INC.
MANUAL FOR ANTENNA COUPLER

ADDENDUM 1
DATE: 9/1/65

PCN NUMBER:	887
PCN DATE:	9/1/65
EFFECTIVITY:	R. F. Inverter Serial No. 0001 DATE: 9/1/65
MODELS AFFECTED:	R. F. Inverter and R.F. Meter Indicator
MANUAL REFERENCE:	Page 30
SCHEMATIC NUMBER:	
SCHEMATIC ISSUE:	
SUBJECT:	Redesign of R. F. Inverter
TEXT:	On page 30 of the manual the section title should read "Emergency Tuning Procedures Using the SA-14R Calibrated Wattmeter or a Standard Voltmeter with the SunAir R.F. Inverter Part No. 97912".

(2) The coaxial cable from the transmitter is connected to the plug provided and inverted into the receptacle marked "X-MTR".

(3) The coaxial cable from the antenna coupler is connected to the plug provided and inverted into the receptacle marked "ANT".

(4) A voltmeter having an 0-20 ma range is connected to the phone plug provided and inverted into the phone connector marked "METER".

(5) Proceed as described in the "Antenna Coupler Alignment Section on page 13 to obtain a minimum reflected power.

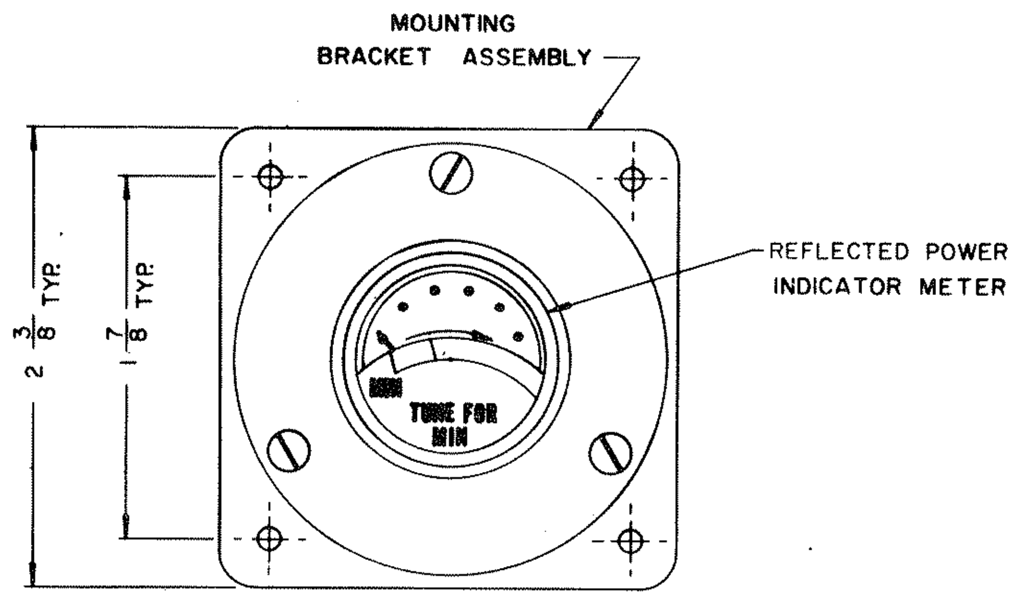
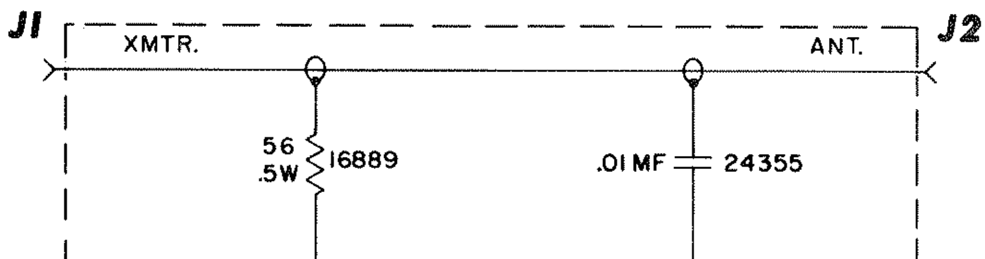

MOUNTING
BRACKET ASSEMBLY
REFLECTED POWER
INDICATOR METER
2 3/8 TYP.
1 7/8 TYP.
MIN
TUNE FOR
MIN

FIG. 213


J1
XMTR.
ANT.
J2
56
.5W
16889
.01 MF
24355