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MILITARY SPECIFICATION

ANTENNAE, OMNIDIRECTIONAL RECEIVING EQUIPMENT, GENERAL SPECIFICATION FOR DESIGN OF

1. SCOPE

1.1 This specification covers the performance requirements for design of antennas for use with omnidirectional range receiving equipment, including the furnishing of engineering reports.

2. APPLICABLE SPECIFICATION AND DRAWING

2.1 The following specification and drawing, of the issue in effect on date of invitation for bids, shall form a part of this specification to the extent specified herein:

2.1.1 Specifications:

2.1.1.1 Air Force-Navy Aeronautical:

AN-E-19 Electronic Equipment; General Specification For

2.1.1.2 U. S. Air Force:

40146 Reports; Manufacturer's Engineering (For Communication and Related Equipment)

(Copies of this specification, Air Force-Navy Aeronautical and U. S. Air Force, specifications may be obtained upon application to the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio. Both the title and identifying number of symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 General.- The requirements, including material and workmanship, specified in Specification AN-E-19 are applicable as requirements of this specification.

3.2 Design.- The antenna shall be designed for use with Radio Receiving Set AN/ARN-14( ). The antenna may be installed during or after manufacture of the aircraft or may be an integral part of the aircraft structure.

3.2.1 The antenna may be physically in combination with any other antenna thus serving two or more equipments. If the antenna is made in combination with another antenna or antennas it shall be possible to operate the equipment simultaneously and with no interference, one with the other. The antenna shall be supplied together with the necessary transmission lines, connectors, filters, matching sections and converter sections. (See Section 6)

3.3 Mechanical Requirements:

3.3.1 The antenna shall consist of a slot, cavity, loop, stub, dipole, array or other system suitable for installation on aircraft and consistent with the position in which it is to be mounted.

3.3.2 The antenna shall be so designed and installed that in any position of the antenna while the aircraft is in flight or on the ground no water or other liquid will be capable of collecting in any portion of the antenna.

3.3.3 External antennas shall be constructed to withstand the most severe icing conditions encountered in flight. The antenna shall be designed to minimize undesirable performance effects due to icing.

3.3.4 The antenna shall be located as near a vertical plane through the fore and aft centerline of the aircraft fuselage as practicable. The location of the antenna more than 15 feet from a vertical plane through the fore and aft centerline of the aircraft shall require specific approval from the Procuring Agency.

3.3.5 The location of the antenna shall be chosen so as to give a minimum of interference to radio frequency reception as specified herein.

3.4 Frequency.- The antenna shall adequately cover the frequency range of 108 to 122 megacycles.

3.5 Polarization.- The antenna shall receive horizontally polarized and horizontally propagated radio signals with minimum practicable reception of vertically polarized radio signals.

3.6 Impedance.- The input shall be designed to match a 52-ohm coaxial line with a voltage standing wave ratio of less than five to one over the frequency range of 108 to 122 megacycles. The ratio shall be obtained with a slotted line or equivalent method. The method used shall require approval by the Procuring Agency.

3.7 Transmission Line and Connectors.- The antenna shall be so designed and installed that connection can be made readily to the associated radio equipment through a minimum length of Radio Frequency Cable RG-8/U, unless other cable is specified, using appropriate Army-Navy standard connectors.

3.8 Radiation Pattern.- The radiation pattern of the installed antenna shall be such that it will provide the signal reception specified herein at any heading with respect to the direction of the signal source, and at any altitude from horizontal to 20 degrees bank, climb or glide.

3.9 Localizer Range.- The product of the radio frequency signal in microvolts at the input to the receiver multiplied by the range reception in nautical miles shall equal 260 or more when the aircraft is on a straight line path (see Figure 1) which lies in the localizer course and which passes through the localizer transmitter and a point 6000 feet higher than and 45 nautical miles from the localizer transmitter. When Radio Receiving Equipment RC-103 (which has a 95 ohm balanced input) is used, this product shall equal 370 or more. The localizer transmitter shall be Radio Set AN/MRN-1 or AN/GRN-10 as maintained and operated at any standard CAA I-L-S or USAF Standard Instrument Approach Site.

3.10 Range of Omnidirectional Range Equipment.- The product of the radio frequency signal in microvolts at the input to the receiver multiplied by the range of reception in nautical miles shall equal 1900 or more when the aircraft is on a straight line path which passes through the omnirange transmitter and a point 6000 feet higher than and 45 nautical miles from the omnirange transmitter. The omnirange transmitter shall be a standard CAA omnirange transmitter station, or the equivalent, operated by the USAF.

3.11 Radio Interference.- The radio interference of other equipment with the omnidirectional range radio receiving equipment shall be considered at an acceptably low level when the operation of other equipment in the aircraft will not give erroneous localizer or omnidirectional range indications throughout the flight patterns of Figures 1, 2, 3, and 4 sufficient to interfere with successful localizer or omnidirectional range flight procedure. The omnidirectional range receiving antenna shall be so located that in normal flight maneuvers or in landing, the interference caused from modulation of the received radio signal by the propellers or other movable portions of the aircraft shall not cause more than 30 percent modulation of the received radio frequency signal.

3.12 Selective Isolating Devices.- The contractor shall provide such selective isolating devices as are necessary to assure compliance with the interference requirements specified herein. The performance of the radio sets and antennas as specified herein shall be obtained with any such selective isolating devices as a part of the system.

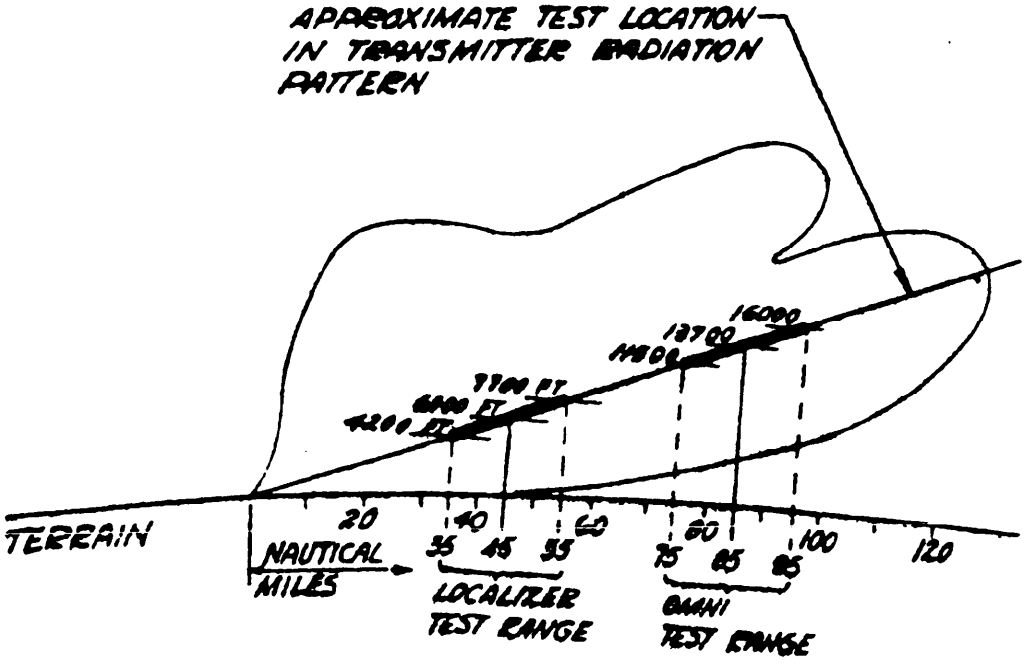
3.13 Performance.- The radiation receiving pattern and efficiency of the antenna shall be such that satisfactory indications are obtained on the navigation receiver indicators when the antenna is flight tested as specified herein.

3.14 Engineering Reports:

3.14.1 Preliminary Report.- A preliminary letter report shall be submitted describing the intent, method of approach, general outline, and the target date.

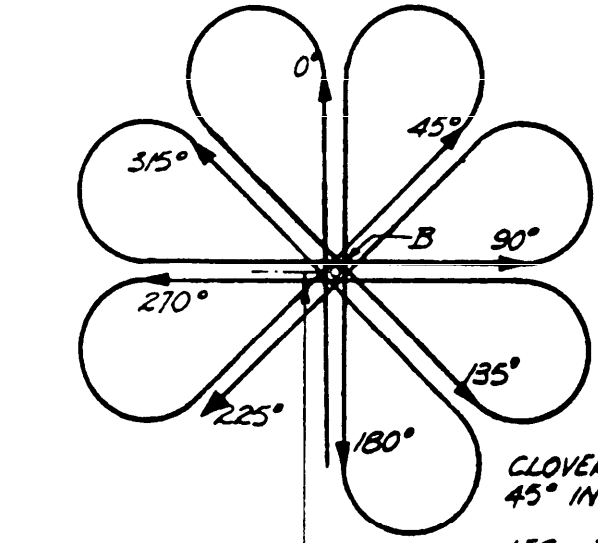
OMNI-RECOMMENDED TEST POINT:
13,700 FT ALT AT 85 NAUTICAL MILES.

LOCALIZER-RECOMMENDED TEST POINT:
6,000 FT ALT AT 45 NAUTICAL MILES.



SIDE VIEW

FIGURE 1. ALTITUDE VERSUS MILES - SKETCH FOR FLIGHT TESTING.



CLOVERLEAF FLIGHT PLAN
45° INTERVALS

LEG	TRUE MG BEARING
1	0°
2	135°
3	270°
4	45°
5	180°
6	315°
7	90°
8	225°

X MILES

A
GROUND STATION

NOTE: EACH LEG TO BE BETWEEN 20 SEC AND 40 SEC DURATION.

FIGURE 2. FLIGHT TEST PROCEDURE - CLOVERLEAF PATTERN

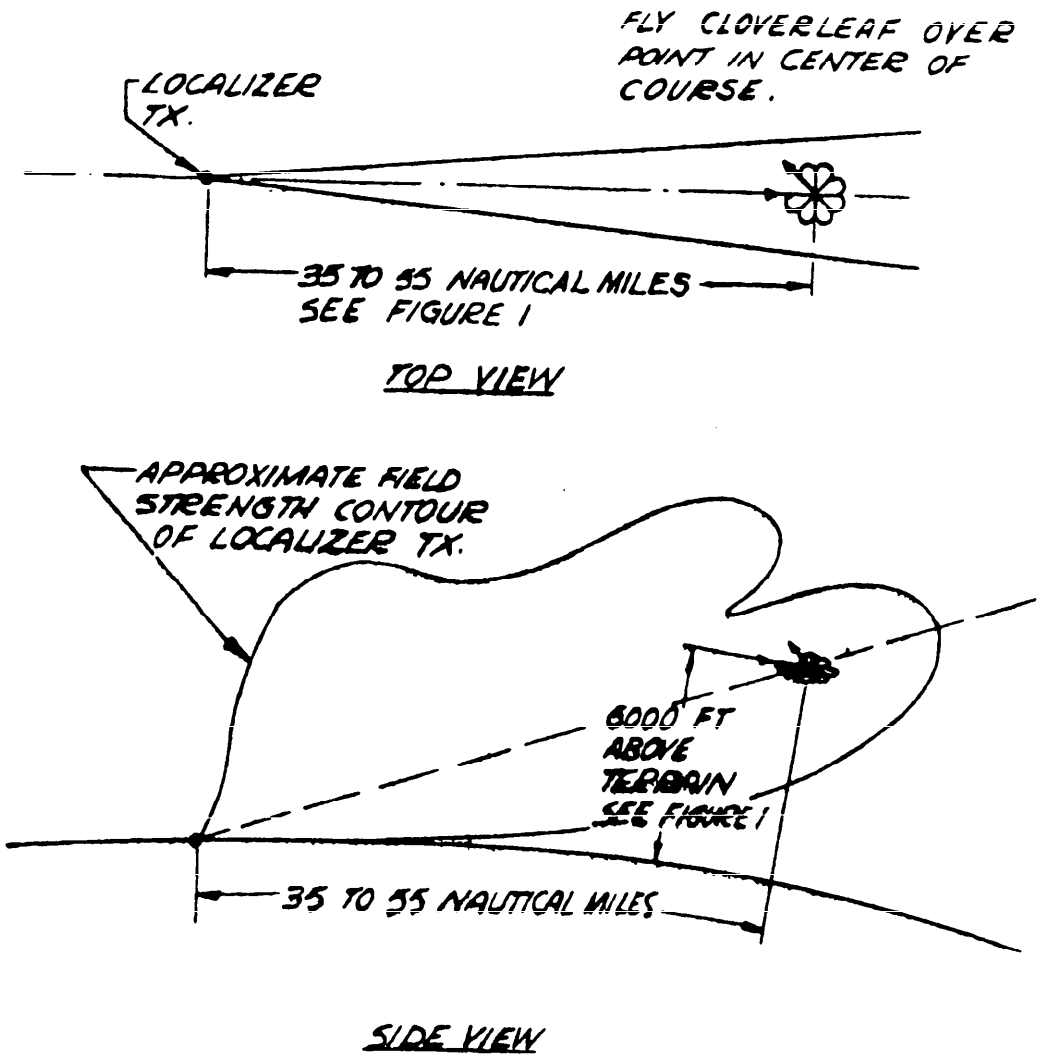


FIGURE 3. FLIGHT TEST PROCEDURE - LOCALIZER ANTENNA PATTERN

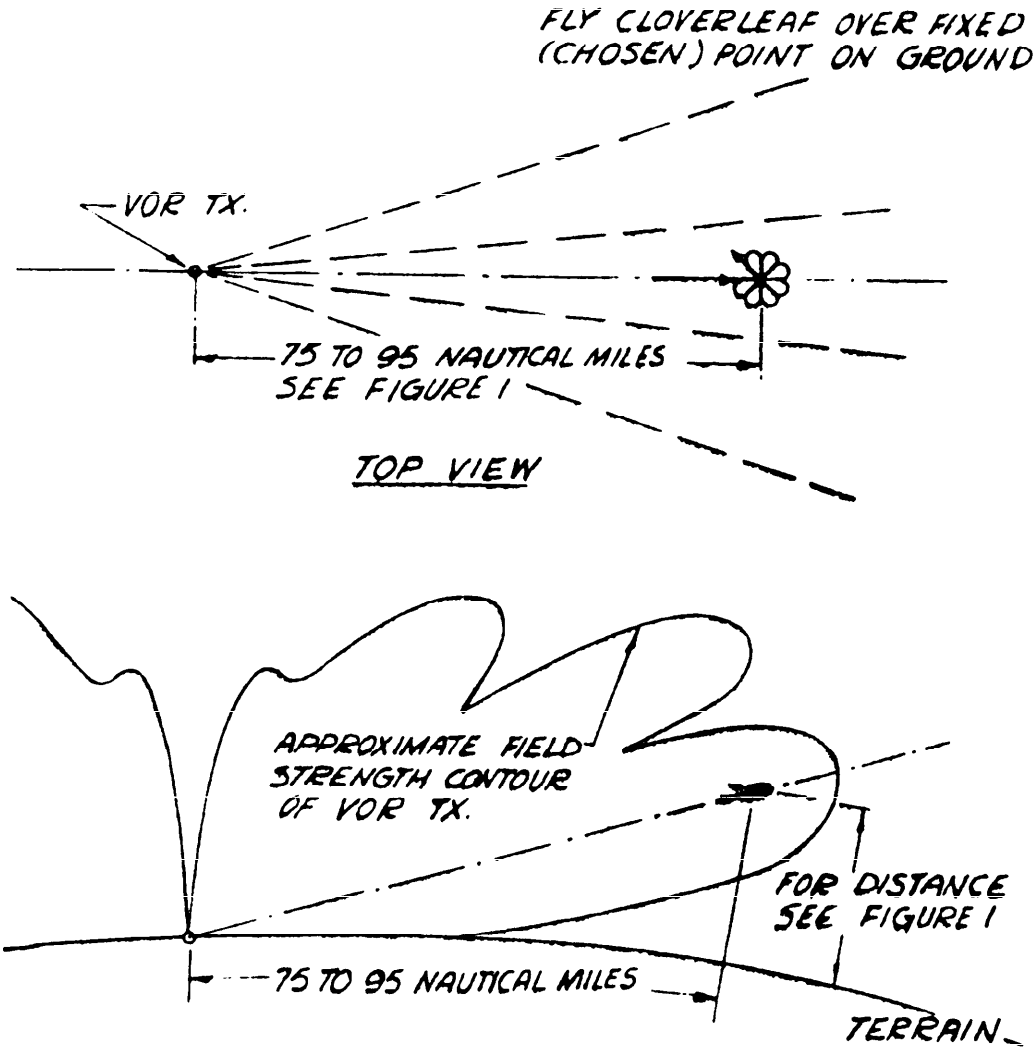


FIGURE 4. FLIGHT TEST PROCEDURE - OMNIDIRECTIONAL RANGE ANTENNA PATTERN

3.14.1.1 Interim Report.- A letter report shall be submitted describing any change in method, antenna program, or target date as established by 3.14.1.

3.14.2 Substantiating Data.- Data shall be submitted in substantiating tests. The submitted data shall include the following:

3.14.2.1 Reports outlining in detail the tests corresponding to the data being furnished.

3.14.2.2 Status reports of all tests conducted by agencies other than the Procuring Agency.

3.14.3 Flight Testing.- The flight testing reports shall be in accordance with the following:

3.14.3.1 Flight test reports describing each test flight conducted by the contractor and commenting upon any operating defects encountered and/or modifications found necessary.

3.14.3.2 A final report shall be prepared, containing the analysis of each flight test performed by the contractor and corresponding to the flight tests specified herein.

3.14.3.3 Complete information sufficient to design and construct a laboratory test model of the finished antenna in its structural location shall be furnished the Procuring Agency three months prior to delivery of the aircraft for flight test by the U. S. Air Forces.

3.14.4 Preparation of Reports.- The final engineering report shall be prepared in accordance with Specification No. 40146.

3.15 Government Loaned Property.- When provided for in the contract or purchase order, the following items will be furnished by the Government on loan to the contractor upon his request.

Item No.	Stock or Part No.	Nomenclature	Quantity
1	1690-327022850	Signal Generator SG-1/ARN-14	1
2	1690-226011953	Modulator MD-83/ARN-14	1
3	1690-211965580	Junction Box J-229/ARN-14	1

4. METHOD OF SAMPLING, INSPECTION, AND TEST

4.1 The antenna shall be subject to inspection by authorized Government Inspectors. When inspection is conducted at the contractor's or manufacturer's plant, tests shall be conducted by the contractor, or manufacturer, under the supervision of the authorized Government Inspector.

4.2 Previous acceptance or approval of material or the release of any design by the Procuring Agency shall in no case be construed as a guarantee of acceptance of the finished product.

4.3 Test Conditions:

4.3.1 Equipment Required:

Radio Receiving Set AN/ARN-14, calibrated to indicate microvolts input to the receiver
Radio Set AN/MRN-1, or Radio Set AN/CRN-10, as maintained and operated by the CAA or the USAF

4.3.2 Primary Supply Voltage.- The direct-current supply voltage at the equipment being tested shall be 27.5 to 28.5 volts.

4.4 Tests.- Tests shall be repeated at each assigned test frequency in the range of the set. The contractor shall take action to obtain frequency assignments without sufficient allowance of time to assure satisfactory scheduling of tests. Not more than three equally spaced frequency channels shall be assigned for flight tests.

4.4.1 Radio Interference.- The omni-directional range receiver shall operate with spurious responses sufficient to interfere with its successful use in navigating throughout the flight patterns as specified in the paragraph headed "Radio Interference".

4.4.2 Procedure:

4.4.2.1 The Radio Receiving Set AN/ARN-14 is designed to perform three services operating in its respective radio frequency band. Therefore, separate antenna performance tests for each service will be required. These services are:

Localizer Range Signal Reception, Frequency band 108-111 megacycles
Omni-directional Range Signal, Frequency band 112-117 megacycles
Control Tower Communication, Frequency band 118-132 megacycles

A test receiver, modified if necessary, shall employ a meter connected into a satisfactory part of the receiver circuit to indicate the strength of the radio frequency signal received at the input of the receiver. The receiver will be tested and calibrated to permit conversion of meter readings to microvolt input values.

4.4.2.2 Flight Plan No. 1.- Refer to Figures 1, 2, and 3. A normally operated CAA localizer transmitter or its USAF equivalent shall be employed. At an altitude corresponding to the range, shown on Figure 1, a clover leaf pattern with the center of the clover leaf directly in the localizer course shall be flown. The pilot and/or observer shall note and record the meter

reading and the aircraft heading on each leg at the center of the pattern and at level flight. On other portions of the pattern, including turns, the course indication on the crosspointer indicator shall be observed. Over the selected point and at any heading the received radio frequency signal in microvolts multiplied by the distance from the transmitter in nautical miles shall equal not less than 260 when employing a Radio Receiving Set AN/ARN-14. When Radio Receiving Equipment RC-103 is used (which has a balanced input impedance of 95 ohms) this product shall equal 370 or more. Refer to 3.9 headed "LOCALIZER RANGE". On the remainder of the pattern including turns of less than 20 degrees bank, the crosspointer indicator shall give proper course indication. Flight Plan No. 1 shall be executed for each assigned test frequency. The distance from the localizer transmitter at which the clover leaf is flown shall be selected to provide the most accurate indication of the received radio frequency signal on the calibrated meter.

4.4.2.3 Flight Plan No. 2.- Refer to Figures 1, 2, and 4. A normally operated CAA omni-directional range transmitter station, or its USAF equivalent, shall be selected. A clover leaf pattern (Figure 2) shall be flown over a fixed point at an altitude corresponding to the distance from the range transmitter shown on Figure 1. On each leg of the pattern and at level flight, the meter reading and aircraft heading shall be read and recorded when over the selected point. On the remainder of the pattern, the indication of the range indicator shall be noted. (Over the selected point and at any heading the received radio frequency signal in microvolts multiplied by the distance from the omni-directional range transmitter in miles shall equal not less than 1900). During the remainder of the pattern, proper indication shall be obtained on the range indicator. The test shall be repeated at each assigned frequency.

4.5 Retest.- Rejected antennas shall not be resubmitted for inspection without furnishing full particulars concerning previous rejection and measures taken to overcome the defects.

4.6 All parts, specimens, or assemblies destroyed in making tests required by this specification and/or drawings, to determine compliance with the specification and/or drawings, shall be in addition to the quantity specified in the contract or purchase order and shall be furnished without increasing the cost of the contract or order.

5. PREPARATION FOR DELIVERY

5.1 Not applicable.

6. NOTES

6.1 Use.- The antennas covered by this specification are intended to be used with Radio Receiving Set AN/ARN-14( ).

6.2 The following publications may be of interest in connection with tests specified herein.

U. S. Air Forces Technical Order:

AN 08-10-183	Handbook of Maintenance Instructions for Radio Set AN/MRN-1( ).
AN 16-30CRN10-3	Handbook of Maintenance Instructions for Radio Set AN/CRN-10( ).
AN 16-40RC103-2	Handbook of Maintenance Instructions for Radio Receiving Equipment RC-103( ).
	The Handbook of Maintenance Instructions for Radio Receiving Set AN/ARN-14( ) will be available when desired.

U. S. Air Force Specification:

R-7030	Radio Receiving Equipment RC-103A, Bench, Pre-flight and Flight Tests of

6.3 Typical Design Information.- The contractor may obtain design and installation data for a typical Radio Receiving Equipment RC-103( ) antenna installation upon request to the Procuring Agency.

6.4 Interim.- When Localizer Receiving Equipment RC-103( ) is installed in the aircraft as interim equipment in lieu of Omni-directional Receiving Equipment AN/ARN-14( ), the contractor will be required to supply an impedance converting and matching section between the localizer receiver input and the RG-8/U cable. The design of an approved type converting and mounting section is shown on Drawing No. 50C13131, Transmission Line Coupler CU-232/U. For this interim installation only, flight patterns, Figures 1, 2 and 3, applying to the localizer equipment will be accomplished. However, the antenna must be designed to accomplish Figure 4 when AN/ARN-14 becomes available.

6.5 Omnirange receiver, manufactured by Collins Radio Company, may be installed as an interim equipment. When used for flight tests of antennas, the receiver may be modified and calibrated in accordance with Figure 5.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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1. REMOVE AVC VOLTAGE FROM THE R F AMPLIFIER TUBE V101 BY REMOVING THE GRID RESISTOR R102 FROM THE AVC BUS AND CONNECTING THIS GRID RESISTOR TO GROUND.

2 AT THE JUNCTURE OF THE LOAD RESISTOR R133 AND FILTER RESISTOR R132 OF THE DETECTOR-AVC RECTIFIER TUBE V108, CONNECT A 0-50 MICROAMMETER IN SERIES WITH A 120,000 RESISTOR TO GROUND. THE METER SHALL BE INSTALLED IN THE AIRCRAFT AT SOME SUITABLE VANTAGE POINT TO THE OBSERVER.

3. BEFORE FLIGHT TESTING, THE METER SHALL BE CALIBRATED BY EMPLOYING A SUITABLE SIGNAL GENERATOR TO THE INPUT OF THE RECEIVER AND USING THE DESIRED INTERESTED FREQUENCIES. PLOT MICROVOLTS INPUT VERSUS MICROAMPERE READINGS. THIS DATA WILL BE REFERRED TO IN EVALUATING THE FLIGHT DATA.

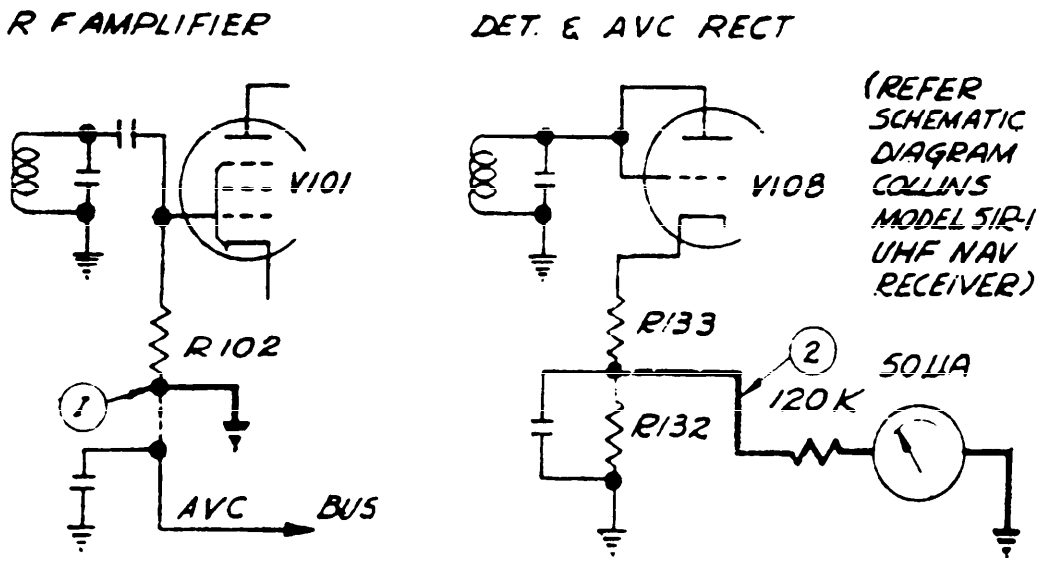

FIGURE 5. MODIFICATION OF A COLLINS MODEL 51R-1, UHF NAVIGATION RECEIVER (FOR USE IN FIELD INTENSITY R F MEASUREMENT