ARC TYPE 21A AUTOMATIC DIRECTION FINDER

Aircraft Radio Corporation • Boonton, New Jersey

ARC TYPE 21A

AUTOMATIC DIRECTION FINDER

Aircraft Radio Corporation • Boonton, New Jersey

010149
.RCIB-21A-3
'ebruary 1962
'rinted in U.S.A.

WARRANTY

Aircraft Radio Corporation warrants each new airborne product to be free of defects in workmanship and material for a period of twelve months from date of original installation. A defective product will be replaced or repaired (at ARC discretion) when returned to ARC, transportation prepaid, by an ARC authorized dealer or service agency. A statement establishing the date of installation must also accompany the defective unit.

Aircraft Radio Corporation will reimburse an ARC authorized dealer or service agency for labor charges and parts replacement incurred in the repair of defective products for a period of ninety days from date of original installation. Request for payment (or credit) must be made by an authorized ARC dealer or service agency on an ARC supplied form, number 1888A (Warranty Service Report and Invoice). Such charges shall be billed at the authorized dealer or service agency normal shop labor rates.

This warranty shall not apply to any ARC product which, in the judgment of ARC, has been repaired or altered in any way so as adversely to affect its performance or reliability or has been subject to misuse, negligence or accident. This warranty is in lieu of all other guarantees or warranties expressed or implied. The obligation and responsibility of ARC for or with respect to defective equipment shall be limited to that expressly provided herein and ARC shall not be liable for consequential or other damage or expense whatsoever therefor or by reason thereof.

ARC reserves the right to make changes in design or additions to or improvements in its equipment without obligation to make such changes or to install such additions or improvements in equipment theretofore manufactured.

ARC will make available repair components when requested by the authorized ARC dealer, using Form 1888A for these requisitions.

: information in this instruction book does not profess to include all the details of design, production, or variations of the equipment, or to er all the possible contingencies which may arise during operation, installation, or maintenance. Should special problems arise or further ormation be desired, contact the Technical Services Department of Aircraft Radio Corporation.

CONTENTS

CONTENTS — Continued

ILLUSTRATIONS

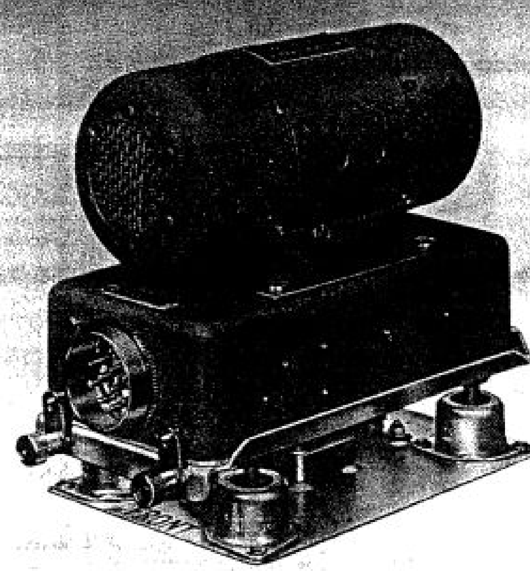
Figure	Title	Page
	SECTION I—GENERAL INFORMATION	
1–1.	ARC Type 21A Automatic Direction Finder, Major Units	*Frontispiece*
	SECTION II—INSTALLATION	
2–1.	ARC Type R-30A Receiver with ARC Type M-26 Mounting, Outline Dimensions	9
2–2.	ARC Type R-30A Receiver with ARC Type M-26A Mounting, Outline Dimensions	9
2–3.	ARC Type M-26 Mounting, Outline Dimensions	10
2–4.	ARC Type M-26A Mounting, Outline Dimensions	11
2–5.	ARC Type C-59A Control Unit, Outline Dimensions	12
2–6.	Panel Mounting Dimensions for Installation of Dial Gearing Unit and Mask in Custom Control Panel	12
2–7.	Panel Mounting Dimensions for Installation of Tuning Meter in Custom Control Panel	13
2–8.	Panel Mounting Dimensions for Installation of Function Switch in Custom Control Panel	13
2–9.	ARC Type IN-12 Indicator, Outline Dimensions	14
2–10.	ARC Type IN-13 and IN-13A Indicators, Outline Dimensions	14
2–11.	ARC Type P-14A Power Unit with ARC Type M-28 Mounting, Outline Dimensions	15
2–12.	ARC Type P-14A Power Unit with ARC Type M-28A Mounting, Outline Dimensions	15
2–13.	ARC Type M-28 Mounting, Outline Dimensions	16
2–14.	ARC Type M-28A Mounting, Outline Dimensions	17
2–15.	Sense Antenna Kit ARC-19210, Installation Diagram	18
2–16.	ARC Type L-11 Loop, Outline Dimensions	19
2–17.	Fitting Housing ARC-17764 to Mounting Surface	20
2–18.	Location of Mounting Brackets for Housing ARC-17764	20
2–19.	Location of Mounting Holes on Housing ARC-17764	20
2–20.	Single ARC Type 21A Installation, Interconnection Diagram	21/22
2–21.	Dual ARC Type 21A Installation Using IN-13 Indicator, Interconnection Diagram	23/24
2–22.	Dual ARC Type 21A Installation Using IN-13A Indicator, Interconnection Diagram	25/26
2–23.	Procedure for Obtaining Flight Data for Loop Compensation Flying Ground Reference Line	29
2–24.	Form for Recording Flight Data for Loop Compensation	30
2–25.	Example of Recorded Flight Data for Loop Compensation	30
2–26.	Procedure for Obtaining Flight Data for Loop Compensation Flying Two 360-Degree Turns	33
2–27.	Form for Plotting Loop Compensation Data Curve	34
2–28.	Example of Loop Compensation Curve	35
	SECTION III—OPERATION	
3–1.	ARC Type C-59A Control Unit, Operating Controls	39
3–2.	ARC Type IN-12 Indicator	39
3–3.	Homing without Compensation for Wind Drift	40
3–4.	Homing with Compensation for Wind Drift	41

ILLUSTRATIONS — Continued

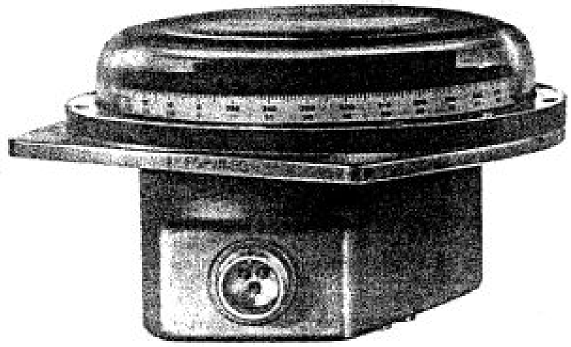
ILLUSTRATIONS — Continued

TABLES

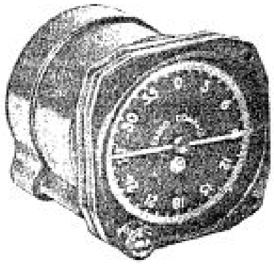
ARC TYPE R-30A RECEIVER
WITH
ARC TYPE M-26A MOUNTING



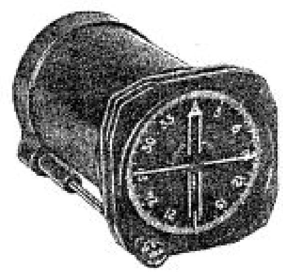
ARC TYPE P-14A POWER UNIT
WITH
ARC TYPE M-28A MOUNTING



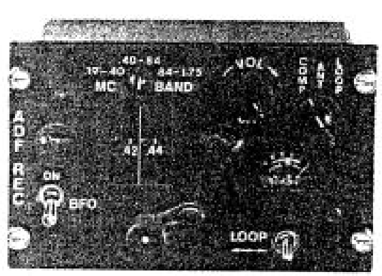
ARC TYPE L-11 LOOP



ARC TYPE IN-12 INDICATOR



ARC TYPE IN-13 AND IN-13A
INDICATORS



ARC TYPE C-59A CONTROL UNIT

TP1112 A

Figure 1–1. ARC Type 21A Automatic Direction Finder, Major Units

SECTION I
GENERAL INFORMATION

1–1. PURPOSE.

The ARC Type 21A Automatic Direction Finder is a lightweight, airborne radio compass set which automatically provides a visual bearing indication of the direction from which an r-f signal is being received. It can be used for position plotting, homing, aural reception of amplitude-modulated signals, and aural identification of keyed CW stations. The Type 21A operates in the frequency range of 190 to 1750 kilocycles, divided into three bands as follows: 190 to 400 kc, 400 to 840 kc, and 840 to 1750 kc.

1–2. UNITS AND ACCESSORIES SUPPLIED.

Figure 1–1 shows the major units of the Type 21A. Table 1–1 lists the quantity and type of units and accessories required for either a single or a dual Type 21A installation. Table 1–1 also includes the overall dimensions and weights of these units and accessories, where applicable.

TABLE 1–1. UNITS AND ACCESSORIES

Quantity per Installation					*Overall Dimensions (in.)*			
Single	*Dual*	*Name*	*ARC Type No.*	*ARC Part No.*	*Height*	*Width*	*Depth*	*Weight (lb)*
				UNITS				
1	2	Receiver[1]	R-30A	20480	$4\frac{1}{2}$	$4\frac{9}{16}$	$10\frac{5}{8}$	6.75
1	2	Loop	L-11	18000	4	$6\frac{9}{16}$	$6\frac{9}{16}$	4.3
1	2	Control Unit[1]	C-59A	20500	$3\frac{3}{4}$	$5\frac{3}{4}$	$3\frac{3}{4}$	1.7
1	–	Indicator	IN-12	17990	$3\frac{1}{4}$	$3\frac{1}{4}$	$3\frac{9}{16}$	1.3
–	1	Indicator	IN-13[2]	17730	$3\frac{1}{4}$	$3\frac{1}{4}$	$5\frac{5}{8}$	1.8
–	1	Indicator	IN-13A[2]	21950	$3\frac{1}{4}$	$3\frac{1}{4}$	$5\frac{5}{8}$	1.8
1	2	Power Unit[1]	P-14A	20490	$4\frac{15}{16}$	$3\frac{3}{8}$	$7\frac{7}{32}$	5.0
1	2	Mounting	M-26[2]	18010	$1\frac{7}{16}$	$4\frac{11}{16}$	$9\frac{3}{32}$	0.5
1	2	Mounting	M-26A[2]	21660	$1\frac{11}{16}$	$5\frac{3}{16}$	$9\frac{3}{32}$	0.6
1	2	Mounting	M-28[2]	18350	$1\frac{11}{32}$	$3\frac{11}{16}$	$7\frac{3}{16}$	0.4
1	2	Mounting	M-28A[2]	21650	$1\frac{3}{4}$	$4\frac{1}{8}$	$7\frac{3}{16}$	0.6
				ACCESSORIES				
1	2	Loop Housing Kit[3]	—	19050	2	$6\frac{3}{4}$	18	0.5
1	2	Antenna Cable Assy	—	17984[4]	—	—	—	0.3
1	2	Antenna Cable Assy	—	18637[4]	—	—	—	1.2
1	2	Loop Cable Assy	—	17985	—	—	—	0.4
1	2	Insulator Assy[5]	—	19077	—	—	—	0.03
1	2	Sense Antenna Kit[5]	—	19210	—	—	—	0.4
–	1	Connector	—	16210[6]	—	—	—	0.07
–	1	Connector	—	16743[6]	—	—	—	0.12
2	4	Connector	—	16115	—	—	—	0.14
1	–	Connector	—	14491	—	—	—	0.04
1	2	Connector	—	16742	—	—	—	0.12
1	2	Connector	—	19062	—	—	—	0.06
1	1	Instruction Book	—	—	—	—	—	—

[1] The R-30A, C-59A, and P-14A are supplied in either a 14-volt or 28-volt model.
[2] The IN-13A, M-26A, and M-28A may be supplied instead of the IN-13, M-26, and M-28, respectively.
[3] The dimensions and weight given are for Housing ARC-17764, which is part of the kit.
[4] Antenna Cable Assembly ARC-17984, which is 7 feet long, and Antenna Cable Assembly ARC-18637, which is 14 feet long, are alternative components. Refer to paragraph 1–5 for further details.
[5] Sense Antenna Kit ARC-19210 and Insulator Assembly ARC-19077 are optional. Sense Antenna Kit ARC-19210 includes Insulator Assembly ARC-19077, but if a sense antenna other than ARC-19210 is installed, Insulator Assembly ARC-19077 is required for proper installation.
[6] ARC-16210 is used with IN-13 Indicator and ARC-16743 is used with IN-13A Indicator.

—3. AUXILIARY EQUIPMENT REQUIRED.

'o complete the ARC Type 21A ADF installation, the ollowing auxiliary equipment is required:

1. A primary power source which can supply 2.8 mperes at 27.5 volts dc or 5.6 amperes at 13.75 volts c, depending on the voltage rating of the equipment.

2. A non-directional sense antenna, unless Sense An-nna Kit ARC-19210 is included as part of the supplied quipment. The sense antenna capacitance should be as ear 50 μμf as possible.

3. A feed-through insulator assembly for the sense ntenna lead-in, unless Insulator Assembly ARC-19077 included as part of the supplied equipment. The feed-rough insulator should be watertight, lightweight, and ave a low capacitance.

4. A suitable length of Mechanical Linkage ARC-6158 for remote-control tuning of the R-30A Receiver y the C-59A Control Unit.

5. A headset, or other means of aural reception.

6. A connection from pin J of the C-59A connector the aircraft's panel-lamp rheostat, or equivalent, to ontrol the brilliance of the panel lamps in the C-59A.

—4. SPECIFICATIONS.

rimary Power Requirements. The Type 21A requires .8 amperes at 27.5 volts dc or 5.6 amperes at 13.75 olts dc, depending on the voltage rating of the equip-ent. (All required high-voltage a-c and d-c voltages are pplied by the dynamotor-alternator of the P-14A; the put power requirements of the P-14A are included in e overall requirements stated.)

-30A Receiver.

EQUENCY RANGE: 190 to 1750 kc

NING BANDS: 190 to 400 kc; 400 to 840 kc; 840 to 50 kc

ND SWITCHING: Electrical

NING: Remote-controlled by C-59A Control Unit th interconnecting Mechanical Linkage ARC-16158 ot supplied)

NSITIVITY:

Antenna MCW:	4 to 10 μv in series with 50-μμf capacitance through standard input cable of 100 μμf for a 6-db S+N/N output ratio.
Compass:	10 to 25 μv/meter for a maximum of 2 degrees error and ±2 degrees jitter
Loop CW:	20 to 100 μv/meter for a 10-db S+N/N ratio (loop antenna rotated to obtain maximum pickup)
Loop MCW:	50 to 200 μv/meter for a 6-db S+N/N ratio (loop antenna rotated to obtain maximum pickup)

IMAGE REJECTION: At 190 kc, greater than 110 db; at 379 kc, greater than 100 db; at 1750 kc, greater than 70 db

I-F REJECTION: At 190 kc, greater than 85 db; at 1750 kc, greater than 100 db

BANDWIDTH (KC OFF RESONANCE, MODULATED 30 PER CENT AT 1000 CPS): At 6 db, 1.6 to 2.8 kc (depending on frequency from 190 to 1750 kc); at 60 db, 4.2 to 8.5 kc (depending on frequency from 190 to 1750 kc)

A-F POWER OUTPUT: 300 mw into 300 ohms

INTERMEDIATE FREQUENCY: 142.5 kc

P-14A Power Unit.

DYNAMOTOR-ALTERNATOR INPUT: 26.5 volts dc, 2.2 amperes; or 13 volts dc, 4.4 amperes (input voltage required depends on voltage rating of equipment)

DYNAMOTOR-ALTERNATOR OUTPUTS: 125 volts dc, 100 milliamperes; and 13 volts ac, 800 milliamperes, 100(±3) cps

1—5. DESCRIPTION OF UNITS.

Receiver. The ARC Type R-30A Receiver is a superheterodyne receiver covering the frequency range of 190 to 1750 kilocycles in three bands. The desired band is selected through remote control of a band-switching motor operated by a switch located in the ARC Type C-59A Control Unit. The receiver is tuned remotely by the control unit through Mechanical Linkage ARC-16158.

For automatic direction finding, the R-30A uses both the sense and loop antennas. For other functions, the R-30A uses either antenna alone. Identification of keyed CW stations is accomplished by use of a beat frequency oscillator (BFO) which is included in the R-30A. The BFO is a hermetically sealed, transistorized subassembly, using an N-P-N silicon transistor.

Subminiature "premium" type tubes and wired-in, replaceable subassemblies are used in the R-30A. The i-f/a-f section is constructed on a hinged chassis. The tuning capacitor is a five-section ganged variable capacitor constructed so that its capacitance decreases with a temperature rise. This tuning capacitor, operating with fixed compensating capacitors, assures stable operation over a wide frequency range. There is a negligible change in sensitivity and selectivity over the temperature range of −55° C (−67° F) to +71° C (+159.8° F). The i-f section (tuned to 142.5 kilocycles) consists of three double-tuned transformers and two electron tubes. Fifteen r-f transformers are used in the r-f section, five for each frequency band. All r-f and i-f transformers are preset in inductance, filled with nitrogen, and hermetically sealed.

The a-c and high-voltage d-c potentials required for operation are obtained from the ARC Type P-14A Power Unit. All electrical and mechanical connections to the R-30A are made through receptacles on the front panel. The R-30A requires an ARC Type M-26 or M-26A Mounting for installation.

Loop. The ARC Type L-11 Loop is a hermetically sealed unit consisting of a loop antenna, a two-phase drive motor, a synchro transmitter, and an adjustable compensating mechanism. The compensating mechanism, which corrects for bearing errors caused by the aircraft's structure, consists of a horizontal circular track whose elevation is adjustable by 14 screws. The screws are spaced around the track at 30° intervals, except in the forward and aft 30° sectors where they are spaced 15° apart. The adjustment of track elevation varies the position of a gear on the loop shaft with respect to a driving gear feeding the synchro transmitter to correct for the error pattern of the particular aircraft.

The antenna portion of the loop is a coil of several widely spaced turns of wire wound on a flat ferrite core. The high permeability of the ferrite core concentrates the r-f field in the loop coil. As a result, the sensitivity of the ferrite loop is equal to that of air-core loops that are many times larger. The antenna terminations are connected to three coaxial slip rings made of etched, copper-clad phenolic and plated with nickel and rhodium. The slip ring wiping contacts are of gold alloy.

The loop antenna is driven by a miniature, two-phase induction motor; its relative bearing is synchro-transmitted to the ARC Type IN-12, IN-13, or IN-13A Indicator. Friction losses are kept at a minimum by the use of ball bearings for all shafts and gear trains in the loop. The antenna is covered with a glass dome and hermetically sealed. Glass-to-metal seal connectors are used for the input and output connections. Loop Cable Assembly ARC-17985 is used as part of the tuned loop circuit.

Control Unit. The ARC Type C-59A Control Unit is an edge-lighted plastic panel, console-type control assembly for the Type 21A. It includes a tuning crank, a tuning meter, a primary power on-off switch and volume control (VOL), a band selector switch (MC BAND), a function selector switch (COMP-ANT-LOOP), a switch for controlling loop rotation (LOOP), and a beat frequency oscillator switch (BFO).

The tuning crank is used for remote tuning of the R-30A Receiver; the tuning meter provides a visual indication of the accuracy of the tuning. The VOL control is a dual potentiometer and switch combination. The switch controls the application of the primary voltage to the Type 21A. One of the potentiometer sections is used as an audio gain control, while the other is used as an r-f sensitivity control.

The MC BAND switch actuates a masking drum which surrounds the frequency dial drum and allows only the selected band to be visible. The MC BAND switch also controls the operation of a small d-c motor on the front of the R-30A Receiver. This motor is geared through a 4000:1 gear train to a six-gang wafer switch in the r-f section of the receiver.

The COMP-ANT-LOOP switch is a three-position rotary switch. When this switch is in the COMP position, both the loop and sense antennas are used and the Type 21A functions as an automatic direction finder; also, the loop and modulating circuits of the R-30A are energized, full avc is switched in, and the VOL control regulates the audio gain. When the COMP-ANT-LOOP switch is in the ANT position, only the sense antenna is used and the R-30A functions as a low-frequency range receiver. Under this condition, the loop and modulating circuits of the R-30A do not operate and the VOL control functions as an r-f sensitivity control to eliminate the avc action. The removal of avc permits the detection of small changes in signal strength for low-frequency range navigation. The LOOP position of the COMP-ANT-LOOP switch is used when it is desired to use only the loop antenna for reception. This position permits the Type 21A to be used as a manual direction finder, or allows the loop antenna to be used instead of the sense antenna for radio range reception during heavy static conditions.

The LOOP switch is used to electrically position the loop antenna when the COMP-ANT-LOOP switch is in the LOOP position. When the COMP-ANT-LOOP switch is in the COMP position, the LOOP switch is used to determine whether the indicator reading is produced by a reliable signal. The LOOP switch is a spring-loaded, double-throw, center-off toggle switch. When actuated, a test voltage is applied to the loop amplifier of the R-30A to drive the loop in the direction in which the switch is held (left or right). This test voltage overrides the signal circuits, so that when the LOOP switch is held to the left or right, the loop and indicator pointer are rotated independent of the received signal. To check whether the indicator reading is reliable, the LOOP switch is held in either position to rotate the loop antenna away from its original bearing. When the LOOP switch is released, the loop antenna and indicator pointer will return to their original positions if the receiver signal is adequate and the indicator reading reliable. This test assures the operator that the ADF is operating properly, and that the received signal is strong enough to duplicate the indicator reading whether approached from a clockwise or counterclockwise direction.

The BFO switch controls the operation of the beat frequency oscillator included in the R-30A. When the BFO

;witch is in the ON position, B+ is connected to the beat 'requency oscillator, placing it in operation to permit dentification of keyed CW stations. With the BFO witch in the off position (down position), B+ is re-noved from the beat frequency oscillator and only voice-or tone-modulated signals may be identified.

The operation and function of the C-59A Control Unit ; duplicated in custom control panel installations.

ndicators. The ARC Type IN-12 Indicator is a her-metically sealed, synchro-driven instrument. The indi-ator pointer shows the angular position of the synchro ransmitter in the loop, which is the bearing of the in-oming signal relative to the aircraft's heading. The in-icator is indexed every 45° near the rim of the dial, ith an oversize index mark at the 0° (heading) posi-on. The dial of the IN-12 is graduated every 2°, with ajor graduation lines every 10° and with every 30° raduation indicated by a numeral. The dial may be ositioned manually by rotating the east-west variation nob (marked VAR.) on the front of the IN-12. The idex marks, dial numerals, 10° graduation lines, and ointer are coated with a green phosphorescent material.

he ARC Type IN-13 and IN-13A Indicators are simi-r to the IN-12 Indicator except that each contains two nchros and two pointers for dual ADF operation. ither the IN-13 or the IN-13A may be used in a dual DF installation, though it is also possible to use two I-12 Indicators instead. In the IN-13A, the ground ids of the two synchros are connected to separate ter-nals on the connector, while in the IN-13 they are nnected together to one terminal; therefore, though erchangeable functionally and physically, different nnecting plugs and wiring are required.

wer Unit. The ARC Type P-14A Power Unit is pri-rily a dynamotor-alternator and filter assembly which plies all a-c and d-c voltages (except primary power) uired for operation of the Type 21A. The dynamotor-rnator furnishes 125 volts dc for the R-30A Re-er, and 13-volt, 100-cycle ac power to energize the motor, the balanced modulator in the receiver, and synchro system. It operates from the aircraft's d-c ly and is speed-regulated for frequency control. The r circuit for the high-voltage d-c output is a capacitor-it filter employing two chokes in series and two ca-tors in parallel at its output. A choke-input filter resses noise and transient voltages from the air-'s primary power source, and an additional choke tes the electron tube filaments in the receiver from lynamotor-alternator.

P-14A requires an ARC Type M-28 or M-28A ating for installation. All input and output connec-tions are made through a 12-pin connector mounted on the chassis base.

Loop Housing Kit ARC-19050. Loop Housing Kit ARC-19050 consists of a streamlined, anti-static, semi-rigid housing and the hardware parts required to install the housing over the L-11 Loop. The housing protects the L-11 and reduces wind drag. It has a conductive surface to bleed off static charges.

Mountings. The ARC Type M-26 or M-26A Mounting is used for mounting the R-30A Receiver and the ARC Type M-28 or M-28A Mounting is used for mounting the P-14A Power Unit. Each mounting is equipped with two nut and link arrangements which engage cone-shaped studs on the R-30A and P-14A to secure the units in place. The M-26 and M-26A, and the M-28 and M-28A, are interchangeable functionally but not physi-cally because of different overall and mounting dimen-sions.

Accessories. The accessories supplied with the Type 21A consist of a sense antenna kit and a feed-through insulator assembly as optional equipment, two cable as-semblies, and five connectors for the interconnecting wiring. Either Antenna Cable Assembly ARC-17984 or Antenna Cable Assembly ARC-18637 is used to con-nect the sense antenna to the R-30A Receiver. Antenna Cable Assembly ARC-17984 is a 7-foot length of RG-62/U coaxial cable terminated at each end with a UG-260/U connector. Antenna Cable Assembly ARC-18637 is a 14-foot length of RG-114A/U coaxial cable terminated at each end with an ARC-18767 connector. ARC-17984 is much smaller in diameter than ARC-18637, and being half the length, is much lighter in weight. In their individual finished lengths, each cable assembly has a capacitance of 100 μμf. ±5 μμf.

A special feed-through insulator assembly, ARC-19077, is available as an optional part for coupling the sense antenna through the skin of the aircraft to the sense an-tenna cable assembly. It is desirable that this fitting, or its equivalent, be used to retain the electrical charac-teristics of the sense antenna cable assembly. The insula-tor assembly may be supplied separately or as part of Sense Antenna Kit ARC-19210. Sense Antenna Kit ARC-19210 includes all the parts necessary for con-structing and installing a sense antenna.

Loop Cable Assembly ARC-17985 is a 20-foot length (approximate) of specially designed, shielded cable terminated at one end with an ARC-14599 connector and on the other end with an ARC-12371 connector. The cable itself has been designed to have a specified inductance and capacitance and therefore may vary slightly in length. It is used as part of the tuned loop cir-cuit, and for this reason its length must not be altered.

SECTION II
INSTALLATION

2–1. INSTALLATION CONSIDERATIONS.

The location and installation of the ARC Type 21A ADF will vary with each particular type of aircraft. Specific installation instructions are described in other paragraphs of this section, but consideration should be given to the following when planning the installation:

The available installation area and the dimensions of the unit. Unit outline dimensions are shown in Figures 2–1 through 2–15. Compare the installation area under consideration with the applicable outline dimensions. Locate the units so that they are accessible for inspection and maintenance, and in an area free from excessive vibration, heat, and noise-generating sources.

The location of the R-30A Receiver, C-59A Control Unit, and P-14A Power Unit. The R-30A should be installed reasonably close to the C-59A to avoid the use of an excessive length of mechanical linkage. The C-59A should be installed within convenient view and reach of the operator. The P-14A may be installed at any convenient location. Allow sufficient clearance on all sides of the R-30A and P-14A for shock-travel and ventilation, and sufficient space in front of each of these components to permit easy removal from their mountings. Enough space should be available to permit cable and external wiring connections to be made, and the cable and wiring should be arranged so as not to restrict shock-mount travel.

The location of the IN-12, IN-13, or IN-13A Indicator. These units should be shock-mounted or installed on a shock-absorbing panel and should be located within convenient reach and view of the operator.

The location and installation of the L-11 Loop. The L-11 may be mounted on either the top or bottom of the aircraft, but should be located as near the center line of the aircraft as possible. Consideration should also be given to keeping the loop away from other antennas and structural members which may cause distortion of the radio field pattern. A special installation procedure for the loop housing is required (refer to paragraph 2–9). Because the length of Loop Cable Assembly ARC-17985 is critical and cannot be altered, the distance between the L-11 and the R-30A must not exceed the approximate cable length of 20 feet.

The characteristics of the sense antenna. In practice it is difficult to achieve optimum antenna arrangements on any but the largest aircraft, and even there certain compromises are the rule rather than the exception. Extensive flight tests indicate that satisfactory performance of the ARC Type 21A ADF can be achieved by the use of the so-called "standard" range antenna. The most satisfactory type of wire antenna is the balanced or symmetrical **T**, although an inverted **L** or unbalanced **T** will often provide acceptable results. The balanced **T** antenna is preferred to the inverted **L** because it is not responsive to horizontally polarized transmissions. This response to horizontal radiation is undesirable where accurate indications of over-station position are required. The flat-top portion of the antenna should not be less than 12 feet in length. A length up to 20 feet will result in increased performance. The average clearance between the antenna and the skin of the aircraft should be 10 inches or more. When used with a **T** antenna, the Type 21A permits accurate orientation on low-frequency radio ranges through the use of "builds" and "fades," as well as providing accurate "cone of silence" indications.

The location of the sense antenna feed-through insulator. Depending on the location of the sense antenna, the feed-through insulator for the sense antenna should be mounted on either the top or bottom of the aircraft, as near the mid-point of the aircraft as possible.

The length of the loop and sense antenna cables. The loop cable assembly supplied is approximately 20 feet long and functions as part of the tuned loop circuit. *Its length must not be altered.* The cable may be coiled if the distance between the R-30A and L-11 does not require the full extended length. The sense antenna cable is supplied in either a 7-foot or 14-foot length. (Where extremely short runs are encountered, it may be more convenient to fabricate a 3½-foot section of RG-58/U cable locally, although no performance advantage would result.) Each of the sense antenna cables has a capacitance of 100 $\mu\mu$f. To maintain proper antenna tuning, the length of these cables should not be altered. The 7-foot cable is preferred because of its lighter weight, flexibility, and ruggedness.

2–2. INSTALLATION OF R-30A RECEIVER AND M-26 OR M-26A MOUNTING.

Installation dimensions for the R-30A Receiver installed on the M-26 or M-26A Mounting are shown in Figures 2–1 and 2–2. Installation dimensions for the M-26 and M-26A are shown in Figures 2–3 and 2–4. The surface used for installing the M-26 or M-26A may be drilled to secure the mounting in position. To install the R-30A and M-26 or M-26A, proceed as follows:

Step 1. If the M-26 is used, drill the aircraft mounting surface for four #8 screws, located as shown in Figure 2–1; if the M-26A is used, eight holes are required (see Figure 2–2). The area surrounding these holes should be clean, bare metal.

Step 2. For the M-26, insert the screws through the top of each vibration mount, curve the two flexible ground straps, and thread the end of the adjacent screw through the hole in each strap. For the M-26A, the flexible straps are already in position and the mounting holes are on the base plate of the mounting. Place the mounting in position and secure.

Step 3. Loosen the knurled thumbnuts on the front of the mounting so that the links point down. Slide the R-30A Receiver onto the mounting. Press down near the front of the receiver, rotate the links so that their holes engage the conical studs, and tighten the thumbnuts.

2–3. INSTALLATION OF C-59A CONTROL UNIT.

Installation dimensions for the C-59A Control Unit are shown in Figure 2–5. The C-59A is designed for installation on a standard console panel. It is secured to the console by means of four Dzus fasteners. Installation diagrams for custom control parts which duplicate the function of the C-59A are shown in Figures 2–6, 2–7, and 2–8.

2–4. INSTALLATION OF IN-12, IN-13, OR IN-13A INDICATOR.

Except for a difference in depth, the IN-12, IN-13, and IN-13A Indicators have the same installation dimensions (see Figures 2–9 and 2–10). The indicator should be installed on a shock-absorbing panel, or should be shock-mounted. It may be mounted either from the front or rear of the panel, using three #8-32 screws. The length of the knob shaft may be adjusted for different instrument panel thicknesses. To adjust the length of the shaft, loosen the *forward* setscrew in the shaft coupling, position the shaft as desired, and retighten the setscrew.

Caution

Indicators of the ID-90 series, and similar types not designed for operation on 13 volts, 100 cycles, must not be substituted for the IN-12, IN-13, or IN-13A Indicator. The ID-250 RMI, however, may be used with the ARC Type 21A ADF providing a 26-volt 400-cycle supply is used for the indicator and the transmitter synchro in the L-11 Loop.

2–5. INSTALLATION OF P-14A POWER UNIT AND M-28 OR M-28A MOUNTING.

Installation dimensions for the P-14A Power Unit installed on the M-28 or M-28A Mounting are shown in Figures 2–11 and 2–12. Installation dimensions for the M-28 and M-28A are shown in Figures 2–13 and 2–14. The installation of the M-28 or M-28A and P-14A is similar to that described in paragraph 2–2 for the R-30A Receiver.

2–6. INSTALLATION OF INSULATOR ASSEMBLY ARC-19077.

To install Insulator Assembly ARC-19077, the sense antenna feed-through insulator, proceed as follows (see Figure 2–15):

Step 1. If necessary, place a doubler at the feed-through insulator location to provide a total thickness of at least 0.040 inch.

Step 2. Drill a ⅜-inch hole through the doubler and the aircraft skin.

Step 3. Mount the connector in the hole using the formed washer and the hexagon nut.

Step 4. Slide the cap assembly over the antenna lead-in. Place the lead-in through the cross-hole in the terminal of the receptacle and solder so that the lead-in is aligned with the center of the receptacle.

Step 5. Cut off the excess lead-in wire. Screw the cap assembly on the receptacle.

2–7. INSTALLATION OF SENSE ANTENNA.

The sense antenna may be made from Sense Antenna Kit ARC-19210. General installation requirements are discussed in paragraph 2–1 and are shown in Figure 2–15. Actual installation requirements will vary with each type of aircraft. The use of T and L antenna types for the sense antenna is also discussed in paragraph 2–1. For best over-station reversal, a symmetrical T type antenna located near the center of the airplane is preferred. An ideal sense antenna is approximately 20 feet long and spaced an average distance of 10 inches from the skin of the airplane. Shorter antennas, though less effective, will provide satisfactory operation.

Material Supplied. Sense Antenna Kit ARC-19210 includes the following:

Qty	Description	ARC Part No.
2	Insulator	12243
4	Thimble	12324
1	Spring	12413
30 ft	Antenna Wire	12447
1	Lead-in Insulator Assy	19077
2	Shackle, Cable	19357
1	Connector	19356

2–8. INSTALLATION OF L-11 LOOP.

The shape and size of the cut-out required for the L-11 Loop, and the other installation dimensions are shown in Figure 2–16. The L-11 should be mounted with the forward and aft fiducial lines aligned with the fore-and-aft line of the airplane, and as much as possible on the centerline of the airplane. Factors to be considered for the installation are the interior and exterior space available, the length of the cable connection, and the remoteness from aircraft structural parts which present local distortion of received electro-magnetic waves. In dual installations, the loops should be separated from each other by at least 3 feet.

2–9. INSTALLATION OF HOUSING KIT ARC-19050.

General. The procedure required to install Housing Kit ARC-19050, after the L-11 Loop has been installed, will depend on the contour of the surface on which it will be installed. The housing, ARC-17764, should be mounted over the L-11 as far rearward as possible. If the housing is to be installed on a flat surface, cut and trim it just up to the bottom edge of the tapeline. Do not cut into the tape, as insufficient material will be left to permit proper attachment of the housing. If the housing is to be mounted on a curved surface, it must be cut to conform to the contour of the mounting surface. The height of the housing should be reduced as much as possible, consistent with the installation requirements, but without cutting into the tape. In general, the cutting line will be tangent to the tape at two points; usually, the front and rear. The tape may be removed after the housing has been trimmed to its final shape.

Material Supplied. Housing Kit ARC-19050 includes the following:

Qty	Description	ARC Part No.
1	Housing	17764
8	Bracket	19039
1	Gasket	18744
8	Screw	8813
1	Tube, Pliobond No. 30 Cement	8818
1	Installation Instructions	—

Installation Procedure. The following is the recommended method for marking the housing to determine the portion to be removed, and for installing the housing and the other parts of the housing kit.

Step 1. Locate the housing over the L-11, as far rearward as the L-11 will permit, with the major axis of the housing parallel with the line of flight. Then move the housing straight forward ¾ inch (to provide clearance for the rubber gasket which will be installed later) and support it to prevent rocking (see Figure 2–17). Mark the positions of the forward and aft ends of the housing on the airplane skin.

Step 2. Using dividers set for 1¾ inches, scribe a line on the housing 1¾ inches away from the skin of the aircraft at the line where the housing will eventually touch the airplane (see Figure 2–17). During this procedure, the housing should be supported by the front and rear of the housing, and the temporary supports.

Step 3. Using a saw, or duck-bill tin snips, and a file, cut and trim the housing just up to the scribed line. Do not cut into the tape.

Step 4. Hold the fitted housing in place over the L-11 Loop, centrally located (sideways) over the L-11 Loop mounting flange with its major axis parallel to the line of flight, and with its forward and aft ends at the positions marked in Step 1 of this procedure.

Step 5. Draw an outline of the housing on the airplane surface.

Step 6. Remove the housing and select five or six locations for installing brackets ARC-19039, as shown in Figure 2–18.

Step 7. The screws necessary for attaching the brackets to the skin of the airplane are not supplied; however, #6 screws are recommended. Drill the required number of holes of the proper size in the airplane skin ½ inch in from the housing outline (see Figure 2–18). Install each bracket with its drilled hole placed against the mounting surface and the vertical portion of the bracket parallel to the housing outline on the airplane. Washers or plate nuts may be placed inside the airplane to provide stress distribution.

Step 8. Mark a hole-center extension line outward from the brackets on the skin of the airplane (see Figure 2–19) so that the bracket-hole locations will be apparent when the housing is in place.

Step 9. Replace the housing, and using these extension lines as a guide, mark vertical lines on the housing at each of the bracket locations (see Figure 2–19).

Step 10. Cross-mark each of the vertical lines on the housing at a point ⅜-inch from the airplane skin; this dimension allows for the thickness of the formed rubber gasket, ARC-18744 (see Figure 2–19).

Step 11. Remove the housing and drill 0.144-inch (#27 drill) holes at the marked locations.

Step 12. Using the Pliobond No. 30 Cement, cement the gasket, with its flange on the outside of the housing, to the housing, making sure that the rim of the housing is well-seated in the groove of the gasket; also, cement the butted ends of the gasket. To insure proper adhesion and seating of the housing and gasket, complete the installation of the housing as described in Steps 13 and 14 before the cement is thoroughly dry.

Step 13. (For top installation only, use Pliobond No. 0 Cement between the contact surfaces of the gasket nd airplane.) Place the housing over the rear four rackets, slide it forward and over the forward racket(s), distorting the forward end of the housing lightly outward if necessary to get the housing over the racket(s) without displacing the gasket.

Step 14. Thread the required number of truss head crews (supplied) loosely into each bracket. Then, aplying sufficient pressure to the surface of the housing › make it fit closely to the mounting surface, tighten ach screw.

loisture Drainage. If the loop is belly-mounted, drill vo 3⁄16-inch holes in the housing for moisture drainage, ne at the lowest point when the airplane is in normal osition on the ground, and one on the centerline about ½ inches from the rear.

–10. INTERCONNECTION OF UNITS.

iterconnection diagrams for single and dual Type 21A stallations are shown in Figures 2–20, 2–21, and 2–22. he interconnecting wiring harnesses are fabricated from dividual wires and the connectors supplied. Note that e connections of certain pairs of wires shown on the terconnection diagrams are determined by the relative ositions (top or belly) of the loop and sense antennas. he procedure required to install the mechanical linkage described in paragraph 2–11.

–11. INSTALLATION OF MECHANICAL LINKAGE.

suitable length of Mechanical Linkage ARC-16158 required between the C-59A Control Unit and the -30A Receiver for remote tuning of the R-30A. Neither e assembly nor the detail parts are supplied as part of e ARC Type 21A, but the parts are available for field brication. (Assembly instructions are included with echanical Linkage Tool ARC Type W-10. This tool cilitates the fabrication of the mechanical linkage and is available as a separate item.) For proper installation, the relative positions of the C-59A frequency dial and the R-30A tuning capacitor must be aligned as follows:

Step 1. With the mechanical linkage interconnected between the R-30A and C-59A, rotate the C-59A tuning crank counterclockwise as far as it will go to bring the receiver tuning capacitor to its minimum-capacitance position. Do not force beyond this point.

Step 2. Disconnect the mechanical linkage at either end.

Step 3. Turn the tuning crank until the reference line just to the right of the high-frequency end of the dial is aligned with the fiducial line.

Step 4. Reconnect the mechanical linkage.

Step 5. In order to minimize the effects of backlash in the cable, which sometimes occurs when the alignment is made at the capacitor stop, accurately tune in a station of known frequency in any one of the three bands, or use a signal source of known frequency and tune to the signal.

Step 6. Taking care not to disturb the receiver tuning of Step 5, disconnect the mechanical linkage at either the receiver or control-unit end.

Step 7. Set the frequency dial to the *exact* reading of the signal source frequency.

Step 8. Taking care not to disturb the setting of the frequency dial, or the receiver tuning, reconnect the mechanical linkage.

Step 9. Test the comparative tuning accuracy of the control unit and receiver by tuning in several stations of known frequency across the band, or by using another source of known frequencies. If the accuracy of the dial readings as compared to the signal frequencies differs by more than the width of one frequency-dial division line (approximately 1⁄32 inch), repeat Steps 5 through 8.

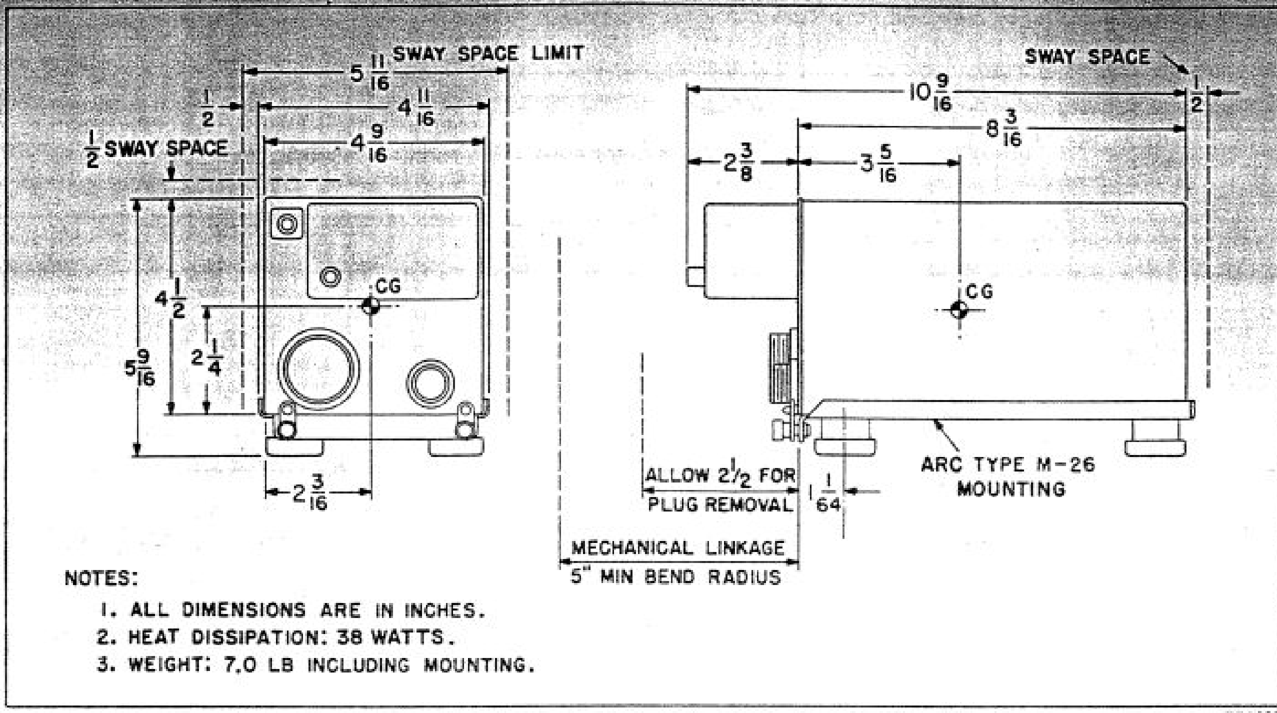


Figure 2–1. ARC Type R-30A Receiver with ARC Type M-26 Mounting, Outline Dimensions

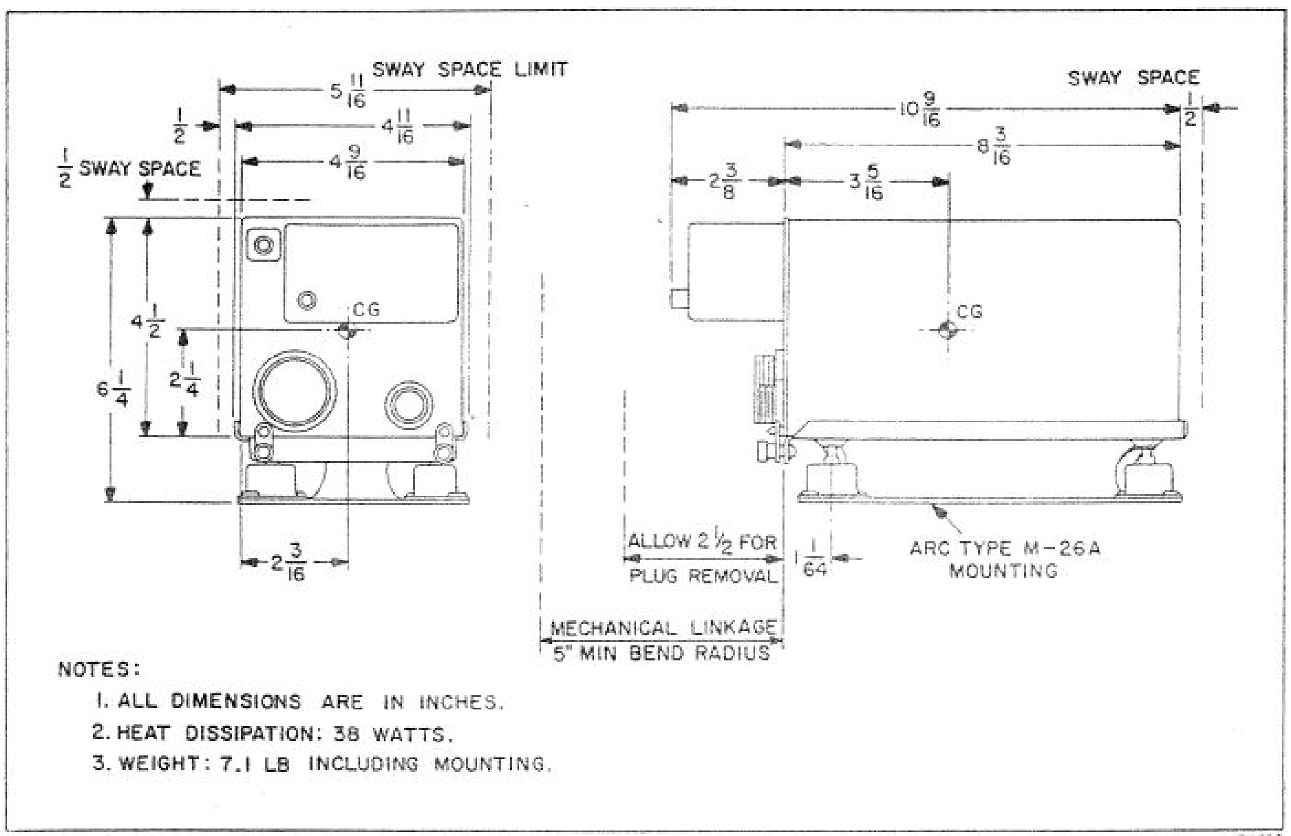


Figure 2–2. ARC Type R-30A Receiver with ARC Type M-26A Mounting, Outline Dimensions

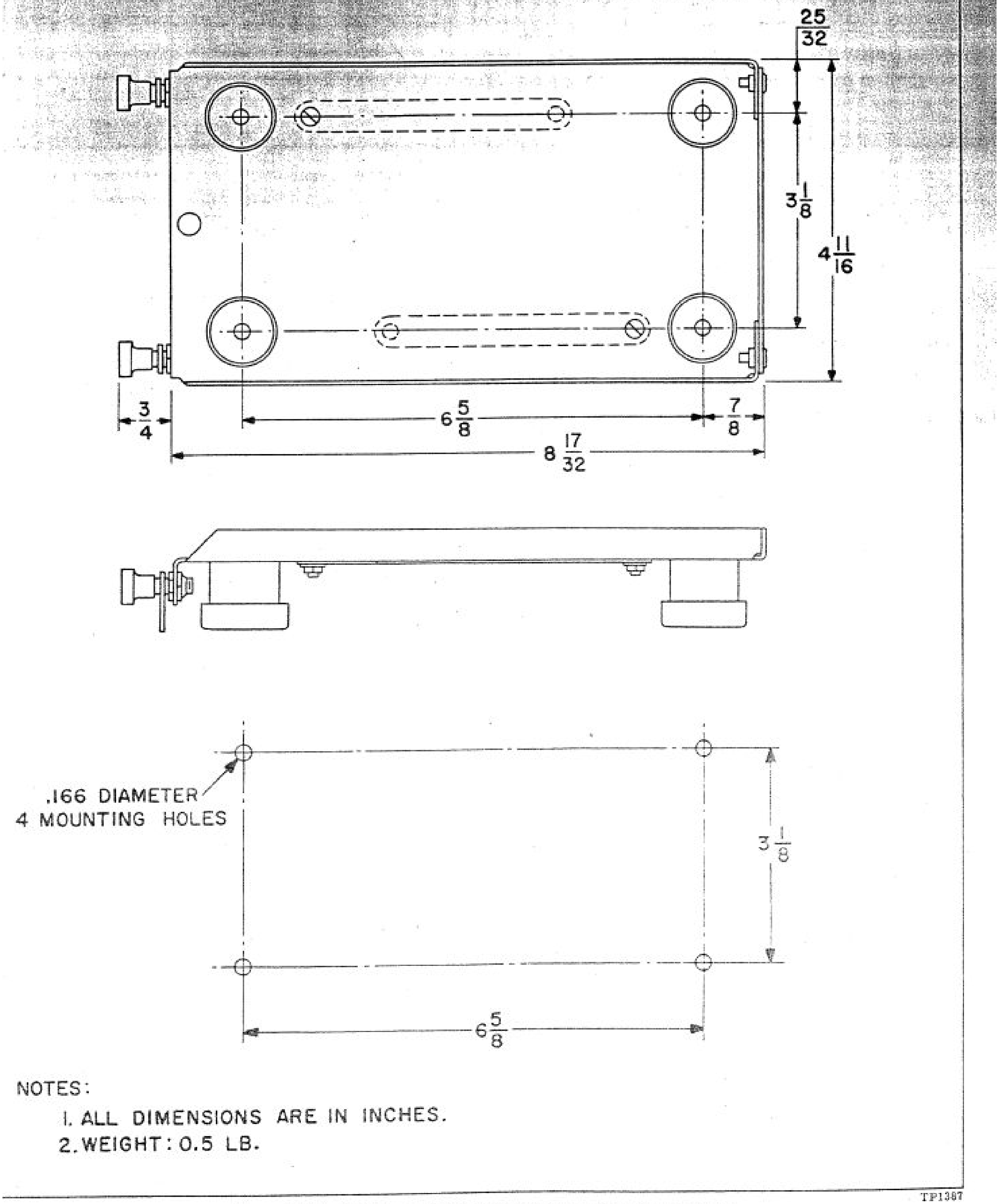
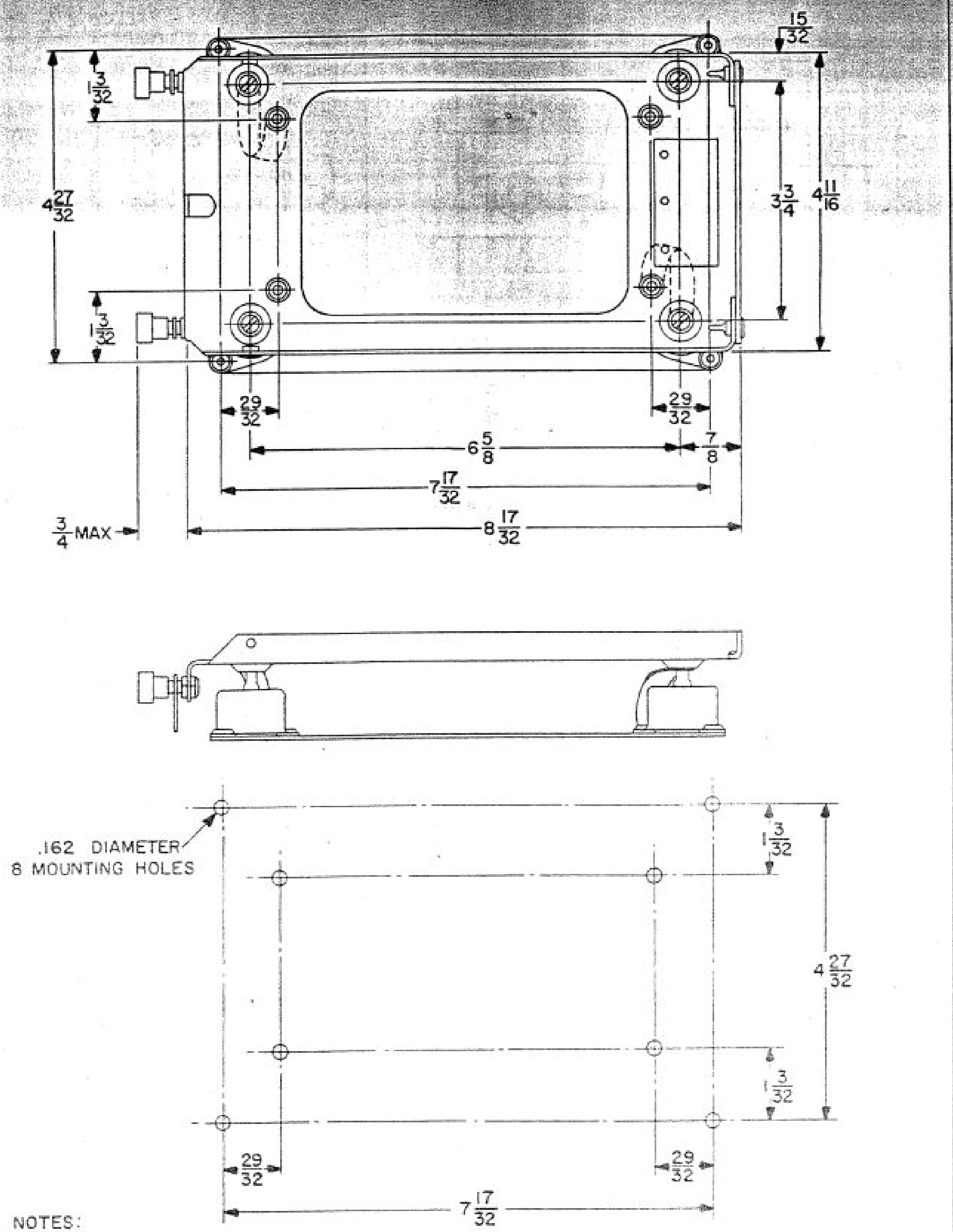


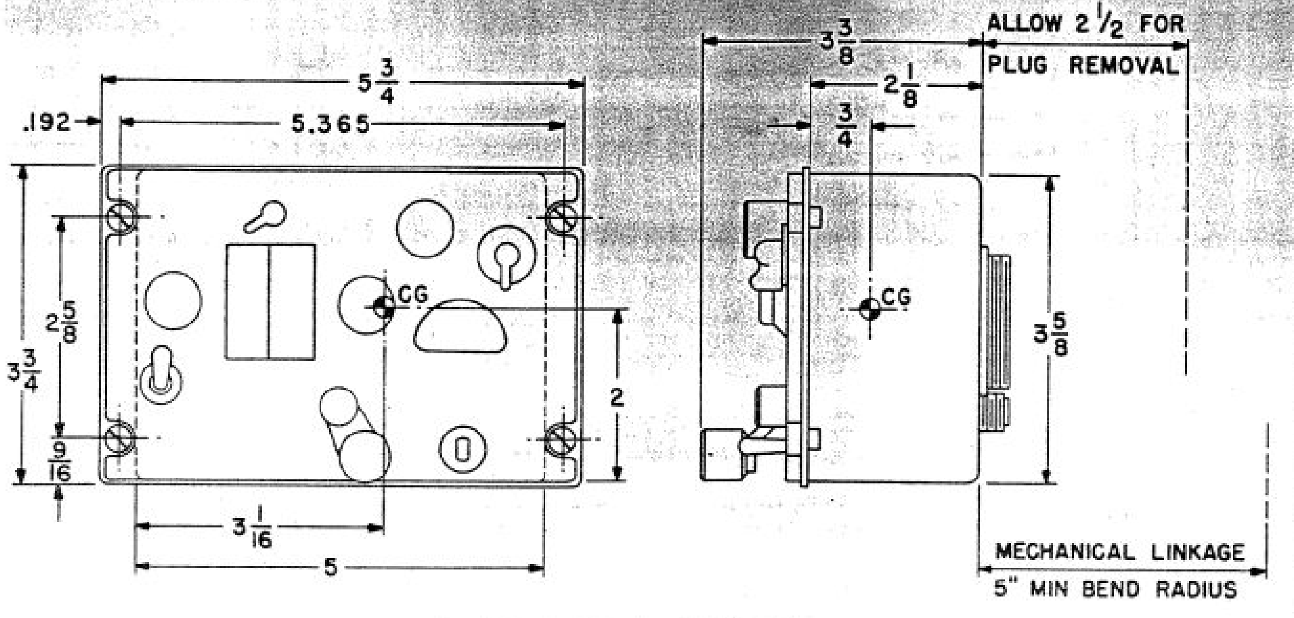
Figure 2–3. ARC Type M-26 Mounting, Outline Dimensions



NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. WEIGHT: 0.6 LB.

Figure 2–4. ARC Type M-26A Mounting, Outline Dimensions



NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. HEAT DISSIPATION: 2.5 WATTS.
3. WEIGHT: 1.6 LB.

Figure 2–5. ARC Type C-59A Control Unit, Outline Dimensions

TP1391

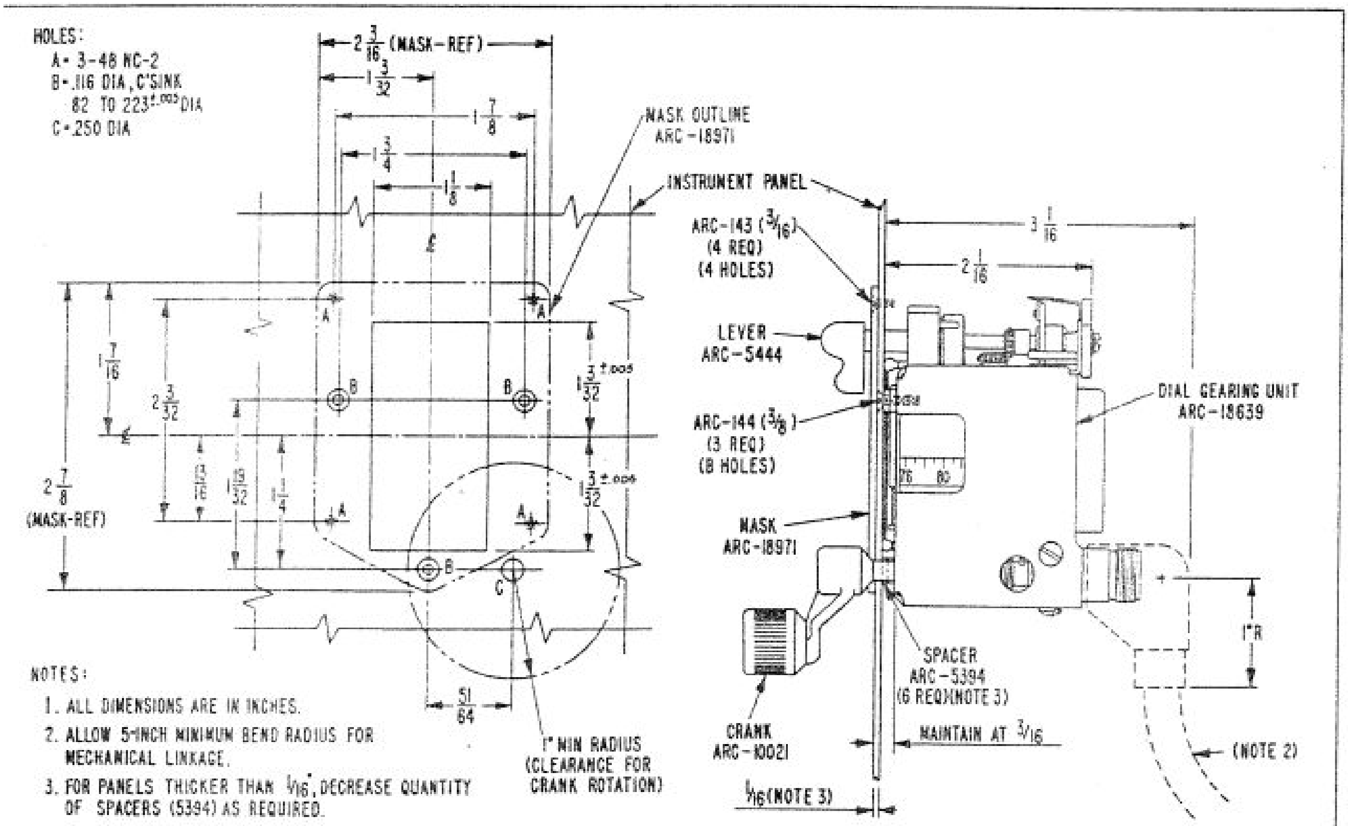


Figure 2–6. Panel Mounting Dimensions for Installation of Dial Gearing Unit and Mask in Custom Control Panel

TP1393

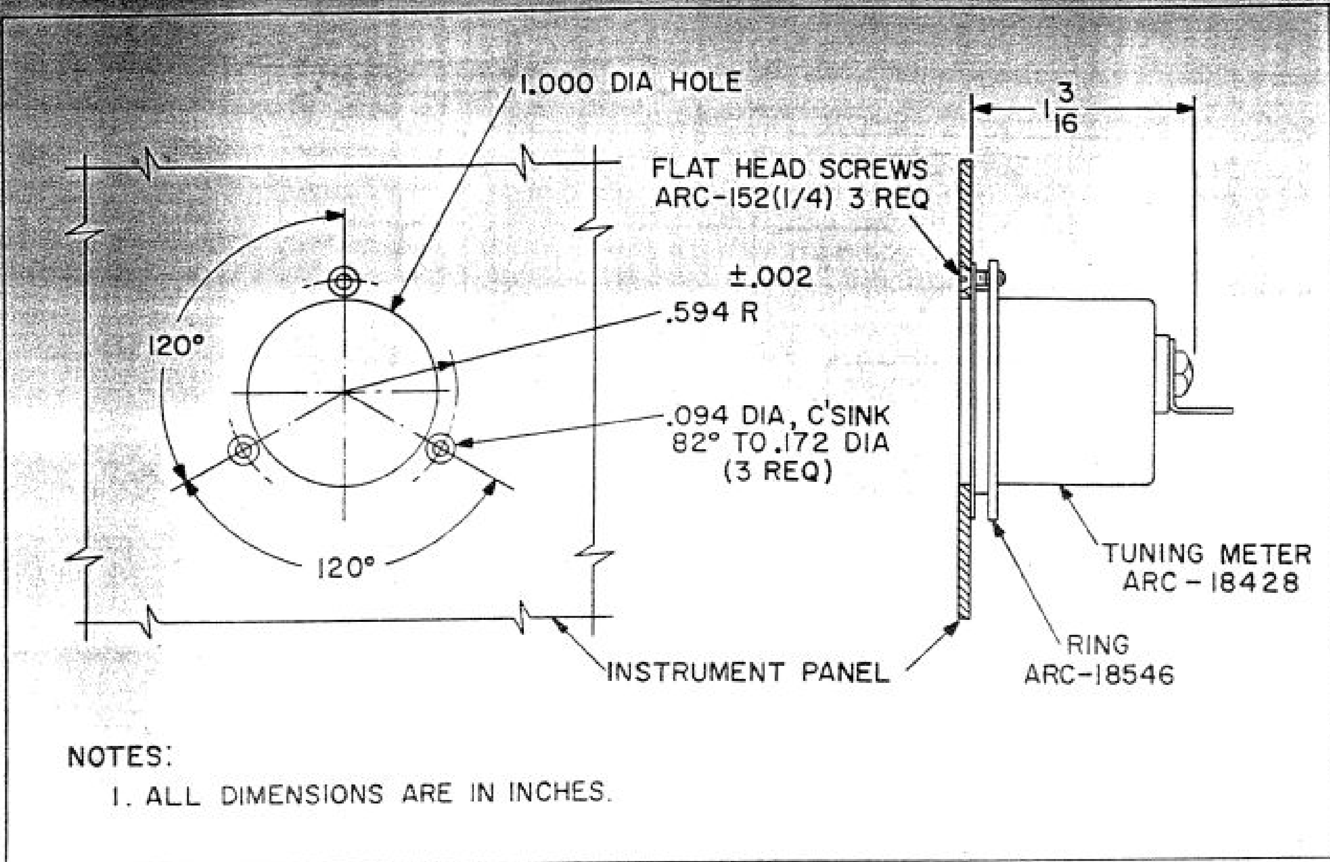


Figure 2–7. Panel Mounting Dimensions for Installation of Tuning Meter in Custom Control Panel

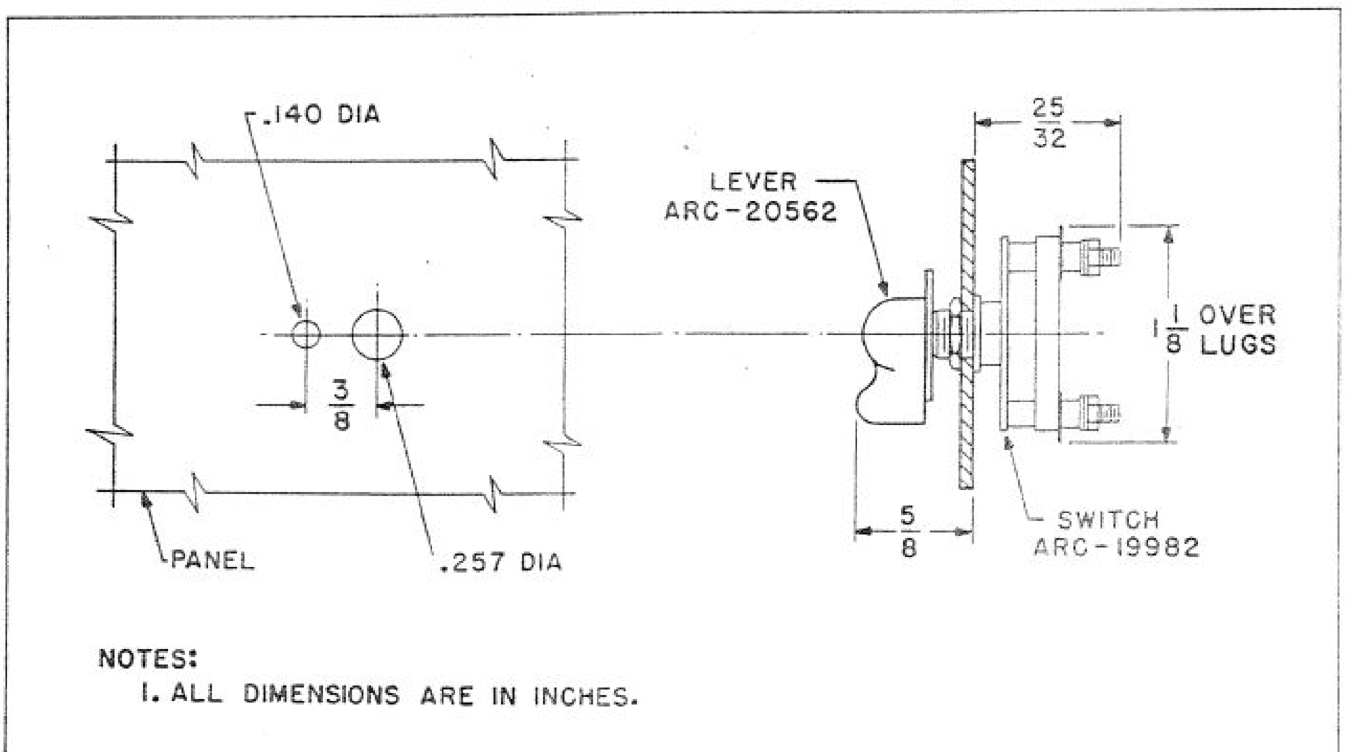


Figure 2–8. Panel Mounting Dimensions for Installation of Function Switch in Custom Control Panel

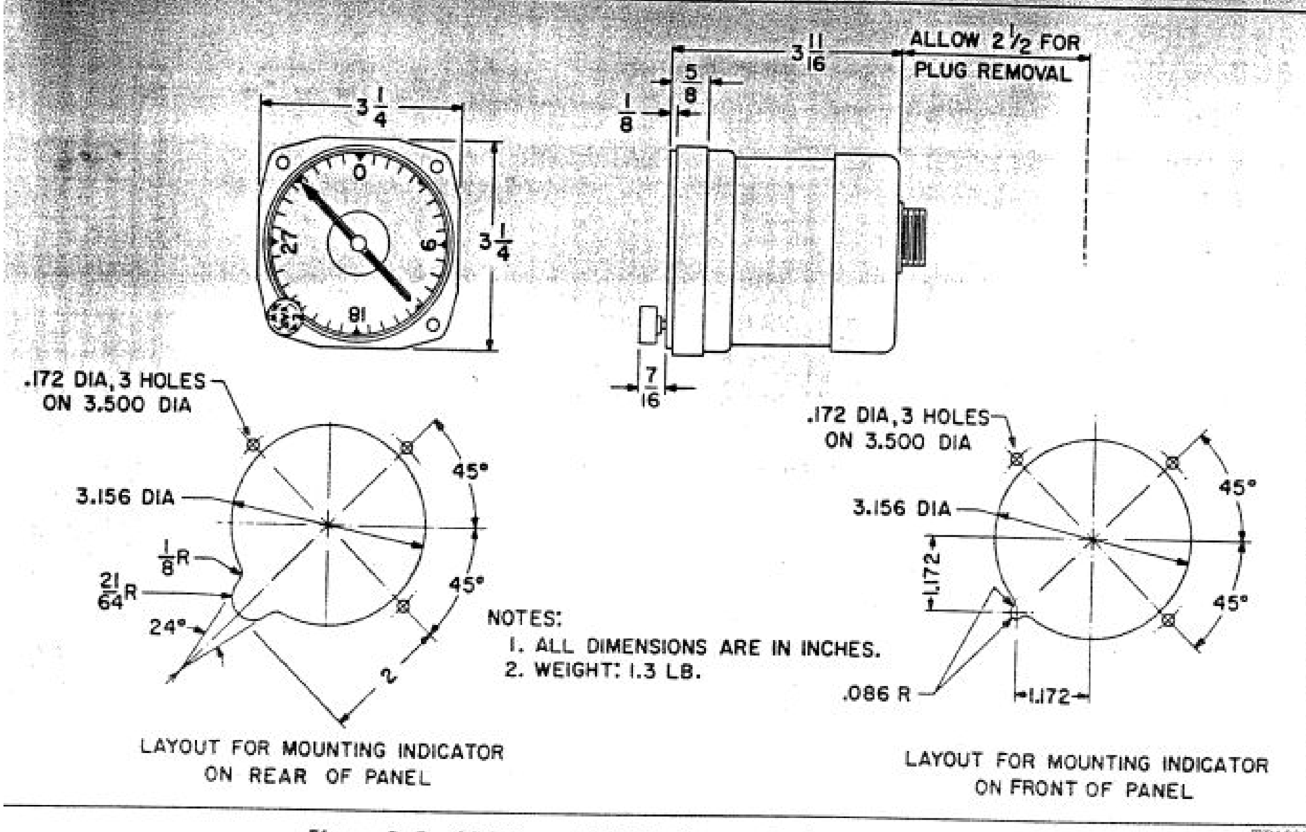


Figure 2–9. ARC Type IN-12 Indicator, Outline Dimensions

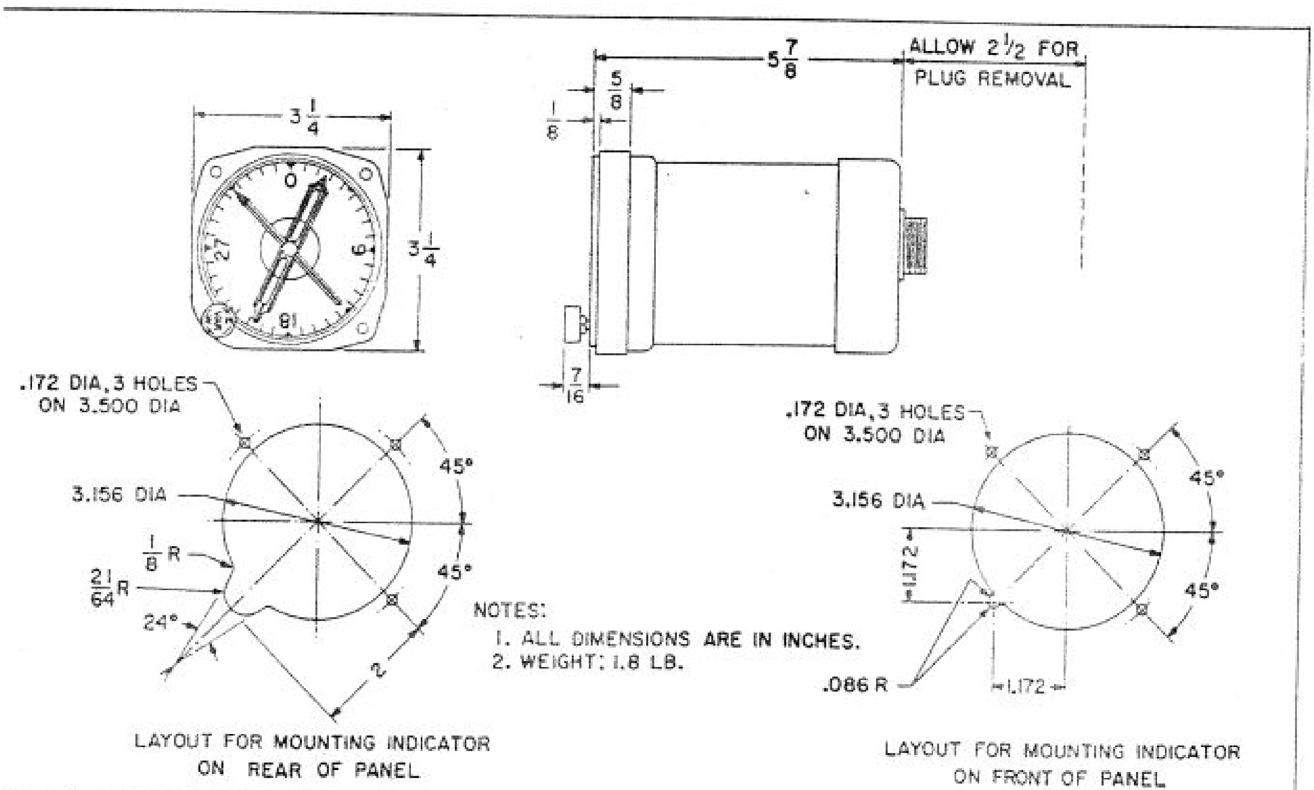
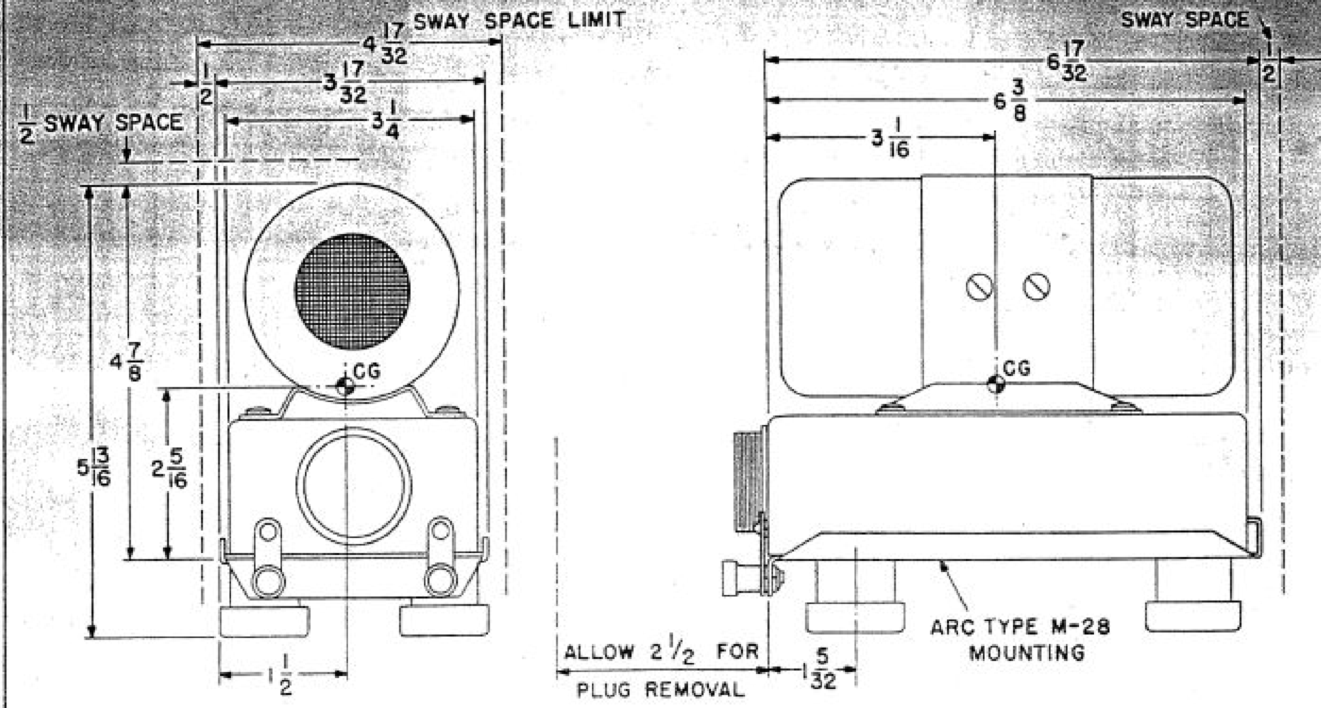


Figure 2–10. ARC Type IN-13 and IN-13A Indicators, Outline Dimensions

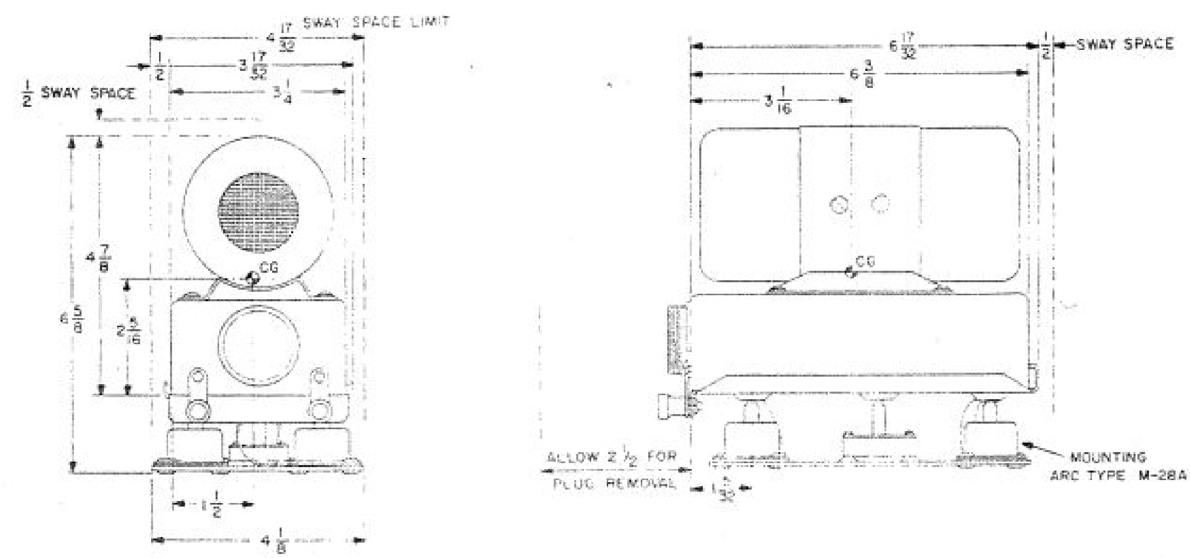


NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. HEAT DISSIPATION: 37 WATTS.
3. WEIGHT: 5.4 LB INCLUDING MOUNTING.

TP1403

Figure 2–11. ARC Type P-14A Power Unit with ARC Type M-28 Mounting, Outline Dimensions

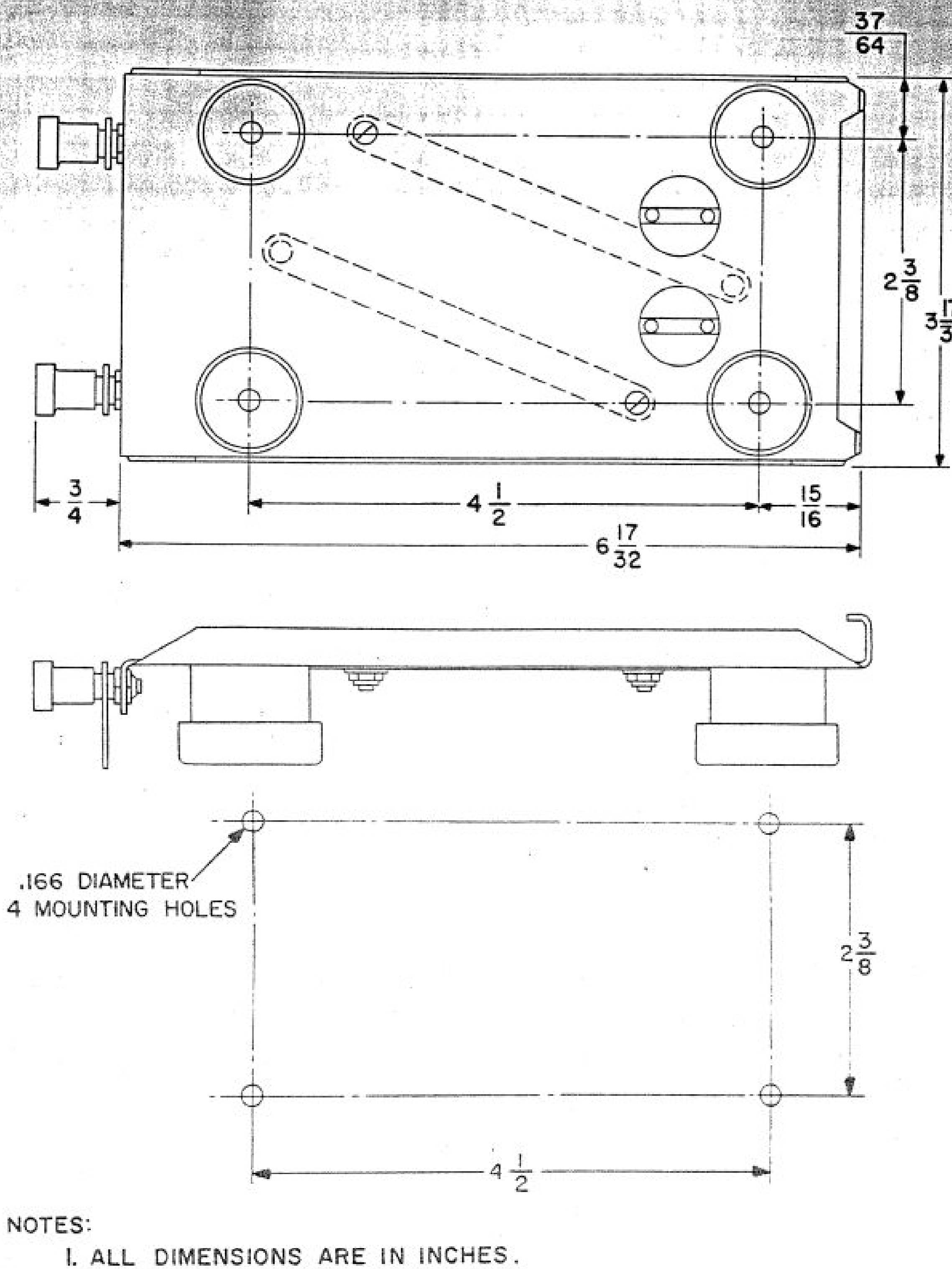


NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. HEAT DISSIPATION: 37 WATTS.
3. WEIGHT: 5.6 LB INCLUDING MOUNTING.

TP1405

Figure 2–12. ARC Type P-14A Power Unit with ARC Type M-28A Mounting, Outline Dimensions

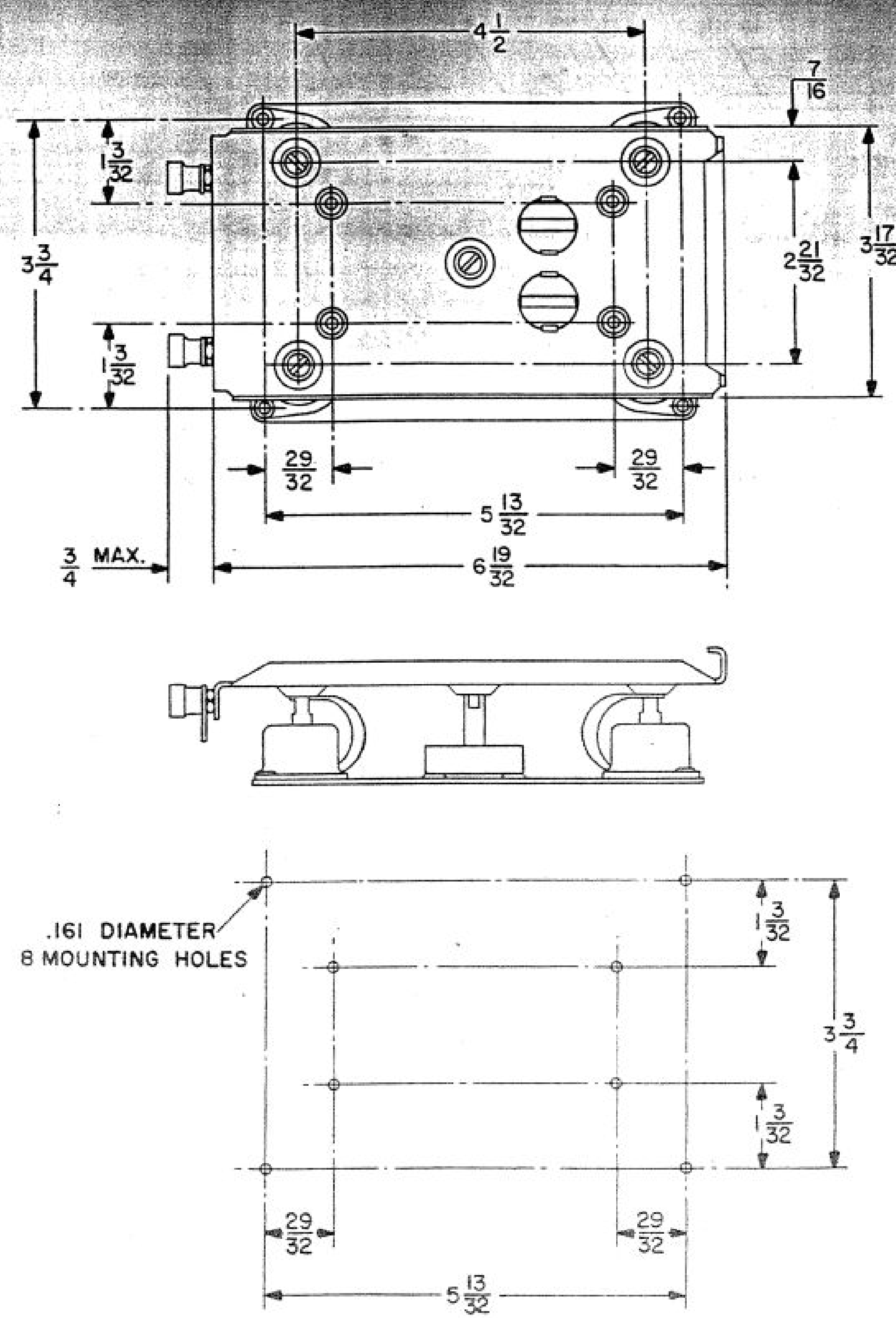


NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. WEIGHT: 0.4 LB.

TP1407

Figure 2–13. ARC Type M-28 Mounting, Outline Dimensions

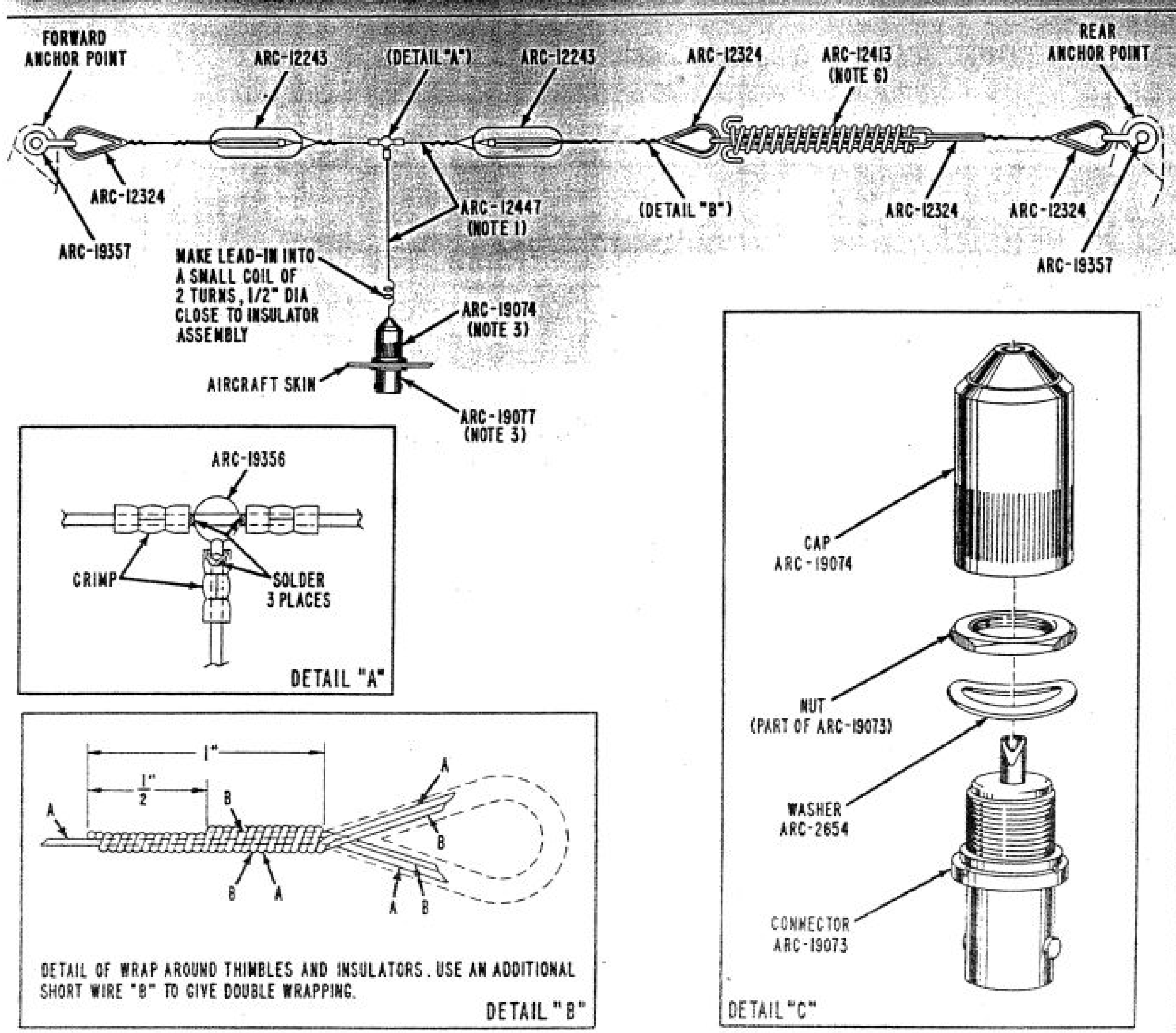


NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. WEIGHT: 0.6 LB.

TP1409

Figure 2–14. ARC Type M-28A Mounting, Outline Dimensions



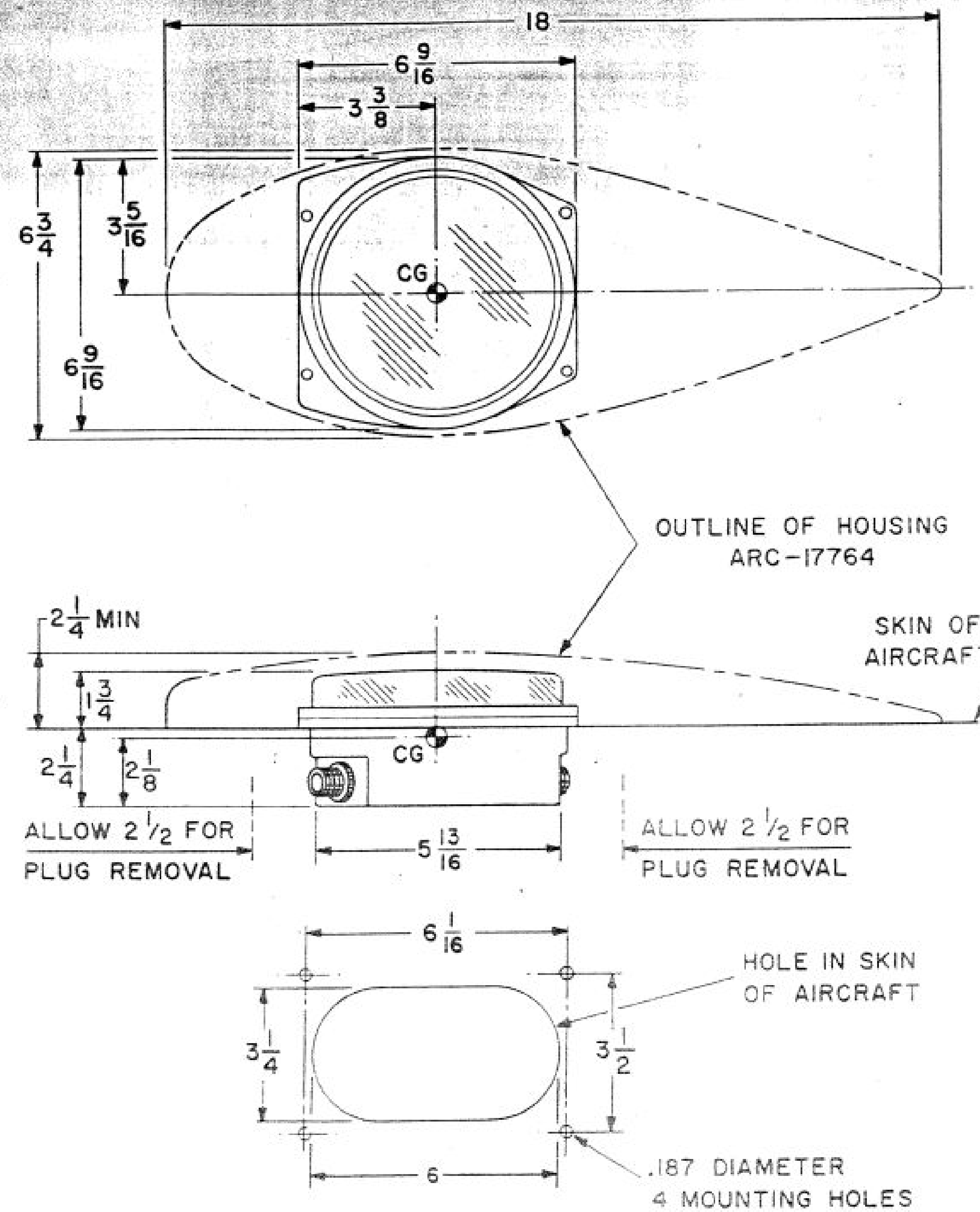
NOTES:

1. NOMINAL LENGTHS OF WIRE ARE FURNISHED WITH KIT. (ADDITIONAL WIRE MAY BE ORDERED SEPARATELY IN BULK.)
2. ALL WIRES ARE #18 SOLID, COPPER-CLAD STEEL.
3. SEE DETAIL "C" FOR INSTALLATION OF INSULATOR ASSEMBLY; SCREW ON CAP AFTER SOLDERING.
4. USE SCREWS AND NUTS FURNISHED TO FASTEN ANTENNA MASTS TO AIRCRAFT.
5. LOCATE VERTICAL SECTION OF ANTENNA AS NEAR THE CENTER OF THE HORIZONTAL SECTION AS POSSIBLE.
6. ADJUST TENSION FOR 3/4-INCH SPRING DEFLECTION; THAT IS, WHEN COMPRESSED, COIL SPRING LENGTH IS 2-5/16 INCHES.
7. SENSE ANTENNA KIT ARC-19210 CONSISTS OF THE FOLLOWING:

ARC PART NO.	DESCRIPTION	QUANTITY
12243	INSULATOR	2
12324	THIMBLE	4
12413	SPRING	1
12447	ANTENNA WIRE	30 FT.
19077	INSULATOR ASSEMBLY	1
19357	SHACKLE, CABLE	2
19356	CONNECTOR	1

TP1411

Figure 2–15. Sense Antenna Kit ARC-19210, Installation Diagram

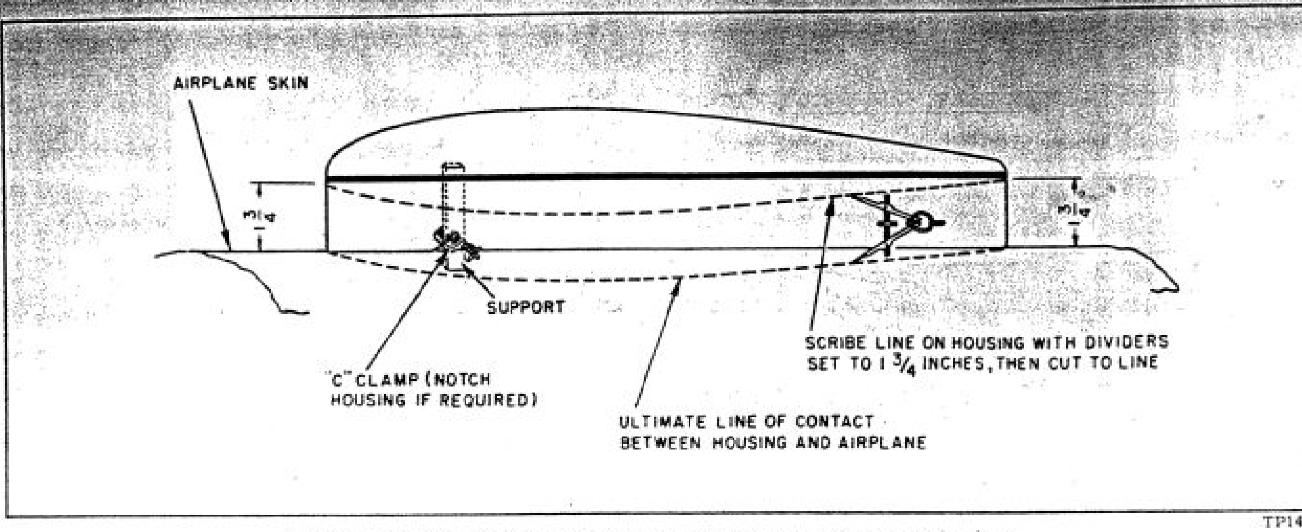


NOTES:

1. ALL DIMENSIONS ARE IN INCHES.
2. HEAT DISSIPATION: 5 WATTS.
3. WEIGHT: 4.5 LB.

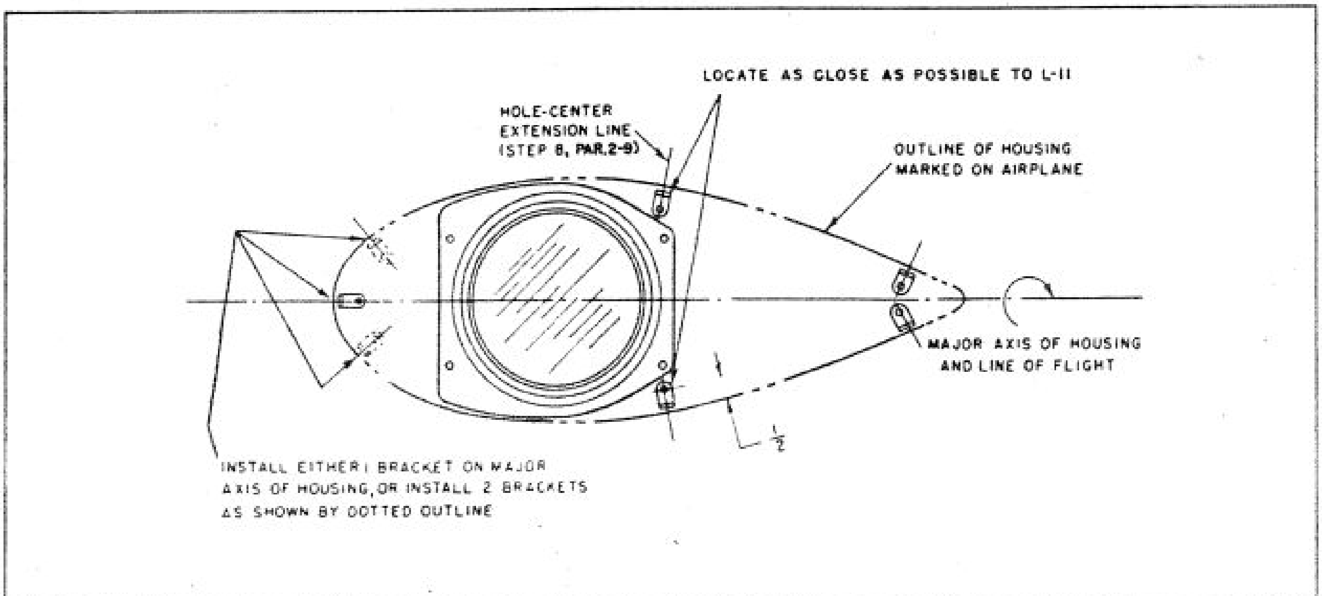
TP1413

Figure 2–16. ARC Type L-11 Loop, Outline Dimensions



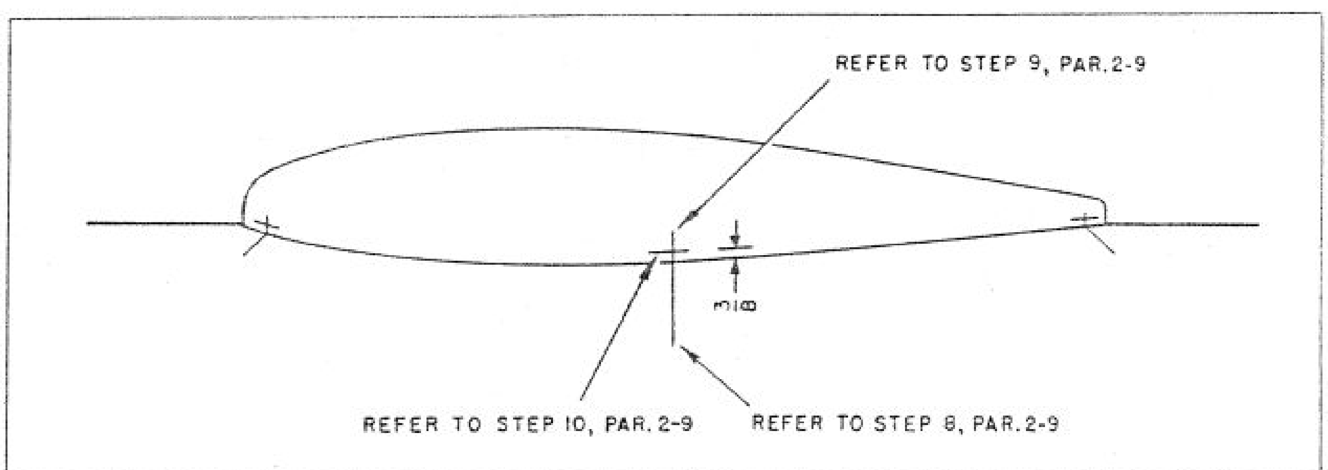
TP1415

Figure 2–17. Fitting Housing ARC-17764 to Mounting Surface



TP1417

Figure 2–18. Location of Mounting Brackets for Housing ARC-17764



TP1419

Figure 2–19. Location of Mounting Holes on Housing ARC-17764

NOTES:

1. MECHANICAL LINKAGE ARC-16158 (NOT SUPPLIED) IS CONNECTED BETWEEN R-30A RECEIVER AND C-59A CONTROL UNIT.

2. FOR DUAL INSTALLATION INTERCONNECTING DIAGRAMS, SEE FIGURES 2-21 AND 2-22.

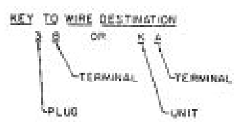
3. FOR PROPER GROUNDING, THE AIRCRAFT SURFACES TO WHICH MOUNTINGS OR UNITS ARE ATTACHED MUST BE CLEAN, BARE METAL.

4. CONNECTIONS ARE SHOWN FOR BELLY-MOUNTED LOOP AND SENSE ANTENNA. IF OTHER ANTENNA LOCATIONS ARE USED, INTERCHANGE CONNECTIONS AT UNITS NOTED AS FOLLOWS:

	POWER UNIT	CONTROL UNIT	INDICATOR
(A) TOP LOOP, BELLY ANTENNA	F & G	—	B & C
(B) BELLY LOOP, TOP ANTENNA	F & G	M & L	—
(C) TOP LOOP, TOP ANTENNA	—	M & L	B & C

5. A SECOND IN-12 MAY BE PARALLELED WITH THE INDICATOR SHOWN IF DESIRED.

6. FOR ALL UNMARKED WIRES, USE NO. 20 STRANDED, TINNED COPPER, FIBER-GLASS INSULATED. FOR WIRES MARKED "—NO. 16—", USE NO. 16 SOLID, TINNED COPPER, FIBER-GLASS INSULATED. FOR LEADS MARKED -θ- , USE NO. 20 SOLID, TINNED COPPER WIRE WITH BRAIDED SHIELD.



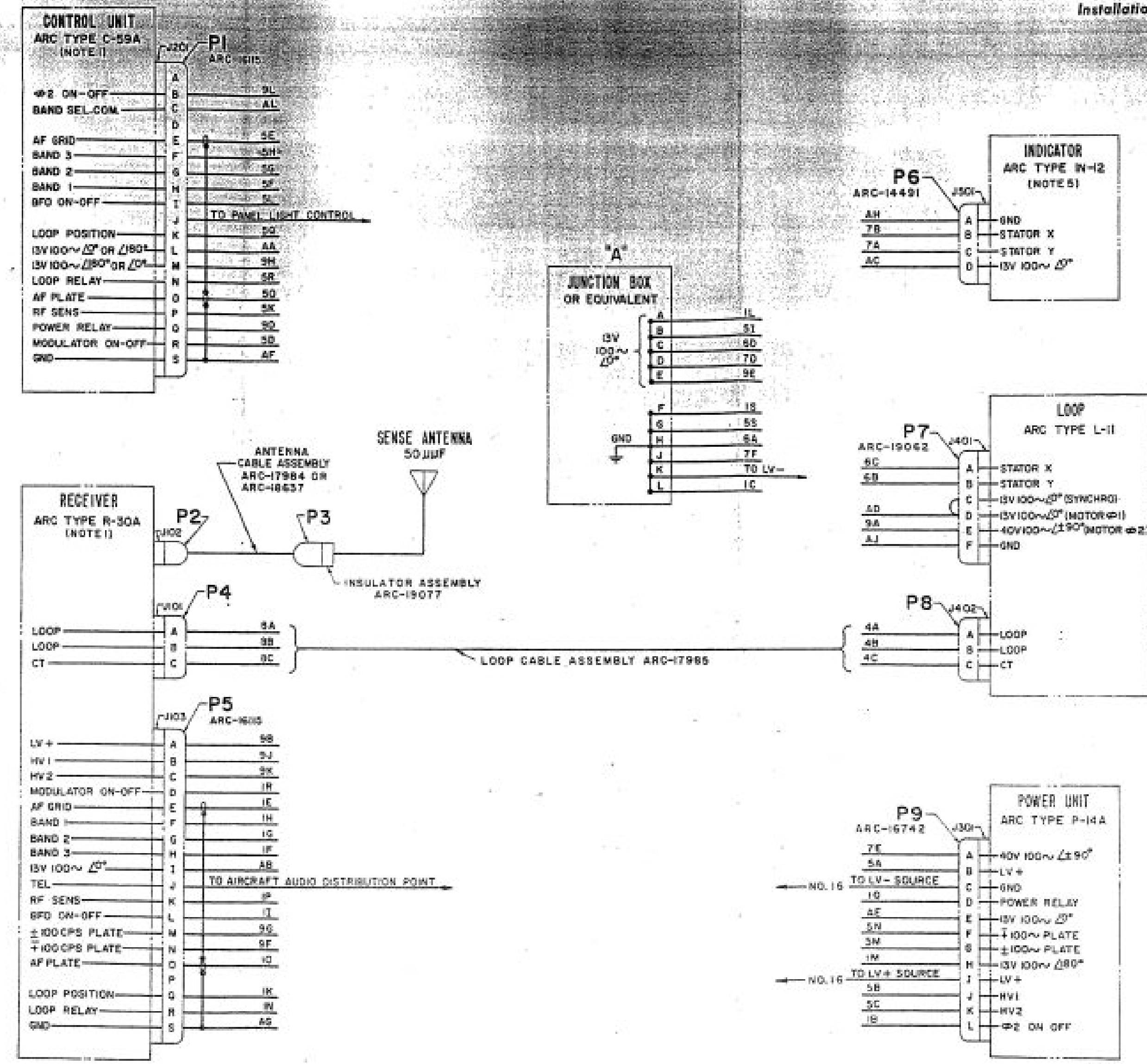


Figure 2–20. Single ARC Type 21A Installation, Interconnection Diagram

NOTES:

1. MECHANICAL LINKAGE ARC-16158 (NOT SUPPLIED) IS CONNECTED BETWEEN THE R-30A RECEIVERS AND C-59A CONTROL UNITS.

2. FOR SINGLE ADF INSTALLATION INTERCONNECTION DIAGRAM, SEE FIGURE 2-20.

3. FOR DUAL ADF INSTALLATION USING IN-13A INDICATOR, SEE FIGURE 2-22.

4. FOR PROPER GROUNDING, THE AIRCRAFT SURFACES TO WHICH MOUNTINGS OR UNITS ARE ATTACHED MUST BE CLEAN, BARE METAL.

5. CONNECTIONS ARE SHOWN FOR BELLY-MOUNTED LOOP AND SENSE ANTENNA. IF OTHER ANTENNA LOCATIONS ARE USED, INTERCHANGE CONNECTIONS AT UNITS NOTED AS FOLLOWS:

	POWER UNIT	CONTROL UNIT	INDICATOR
(A) TOP LOOP, BELLY ANTENNA	F & G	—	B & C (SYSTEM #1) E & F (SYSTEM #2)
(B) BELLY LOOP, TOP ANTENNA	F & G	M & L	—
(C) TOP LOOP, TOP ANTENNA	—	M & L	B & C (SYSTEM #1) E & F (SYSTEM #2)

6. FOR ALL UNMARKED WIRES, USE NO. 20 STRANDED, TINNED COPPER, FIBER-GLASS INSULATED. FOR WIRES MARKED "—NO. 16—" USE NO. 16 SOLID, TINNED COPPER, FIBER-GLASS INSULATED. FOR LEADS MARKED ⏚, USE NO. 20 SOLID, TINNED COPPER WIRE WITH BRAIDED SHIELD.

7. A SECOND IN-13 MAY BE PARALLELED WITH THE INDICATOR SHOWN IF DESIRED.

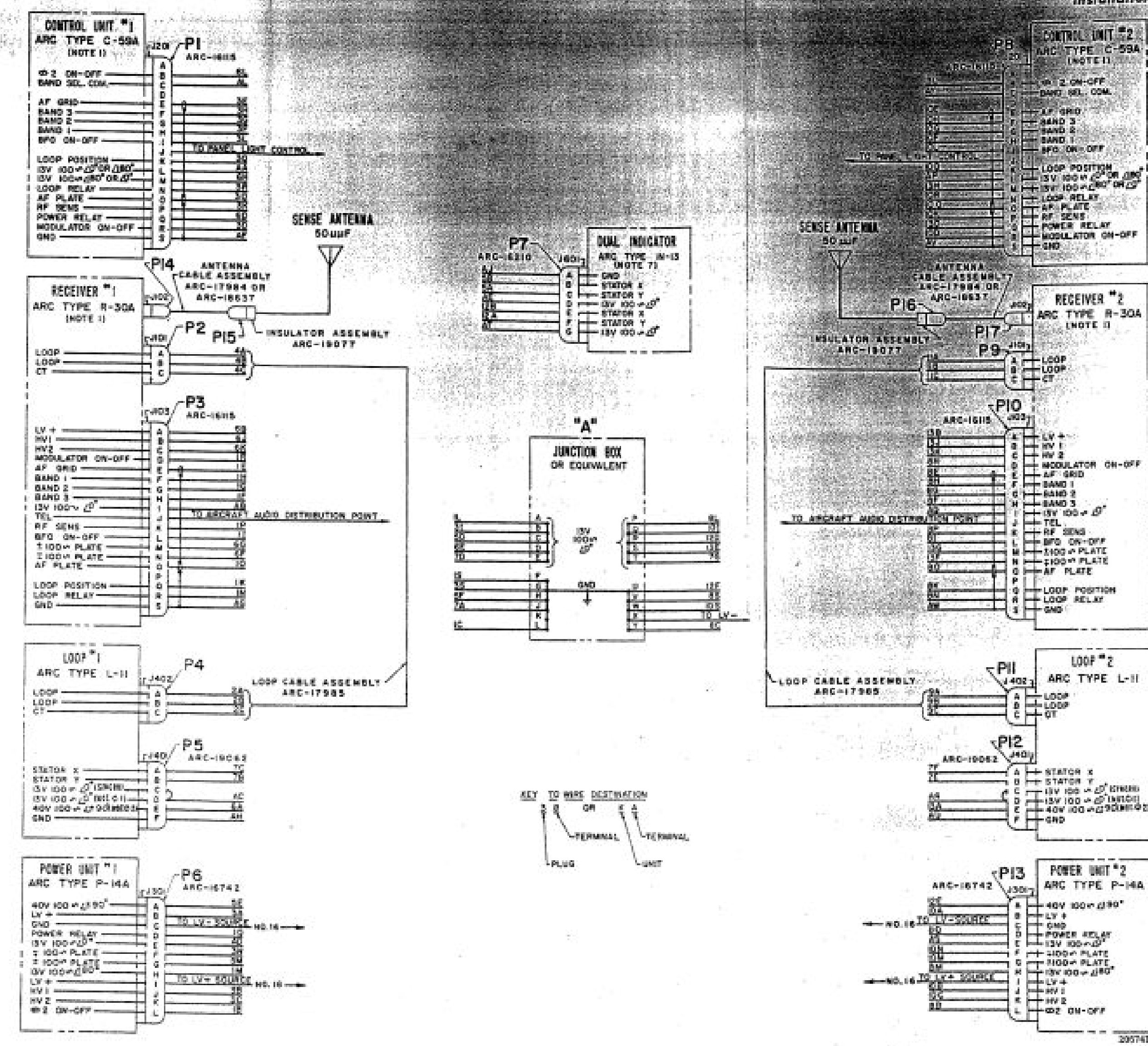


Figure 2-21. Dual ARC Type 21A Installation Using IN-13 Indicator, Interconnection Diagram

TES:

1. MECHANICAL LINKAGE ARC-16158 (NOT SUPPLIED) IS CONNECTED BETWEEN THE R-30A RECEIVERS AND C-59A CONTROL UNITS.

2. FOR DUAL INSTALLATION USING IN-13 INDICATOR, SEE FIGURE 2-21.

3. FOR ALL UNMARKED WIRES, USE NO. 20 STRANDED, TINNED COPPER, FIBER-GLASS INSULATED. FOR WIRES MARKED "—NO. 16—" USE NO. 16 SOLID, TINNED, COPPER, FIBER-GLASS INSULATED. FOR LEADS MARKED -0- , USE NO. 20 SOLID, TINNED COPPER WIRE WITH BRAIDED SHIELD.

4. FOR PROPER GROUNDING, THE AIRCRAFT SURFACES TO WHICH MOUNTINGS OR UNITS ARE ATTACHED MUST BE CLEAN, BARE METAL.

5. FOR SINGLE ADF INSTALLATION INTERCONNECTION DIAGRAM, SEE FIGURE 2-20.

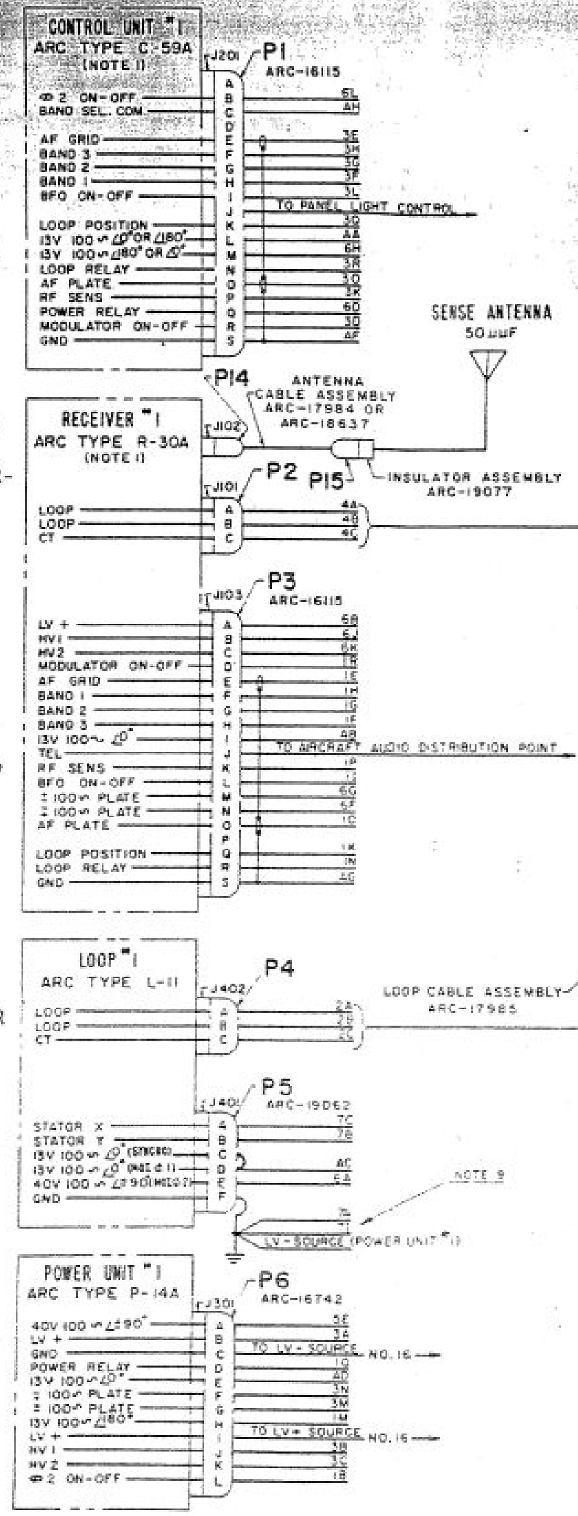
6. CONNECTIONS ARE SHOWN FOR BELLY-MOUNTED LOOP AND SENSE ANTENNA. IF OTHER ANTENNA LOCATIONS ARE USED, INTERCHANGE CONNECTIONS AT UNITS NOTED AS FOLLOWS:

	POWER UNIT	CONTROL UNIT	INDICATOR
(A) TOP LOOP, BELLY ANTENNA	F & G	—	B & C (SYSTEM #1) E & F (SYSTEM #2)
(B) BELLY LOOP, TOP ANTENNA	F & G	M & L	—
(C) TOP LOOP, TOP ANTENNA	—	M & L	B & C (SYSTEM #1) E & F (SYSTEM #2)

7. A SECOND IN-13A MAY BE PARALLELED WITH THE INDICATOR SHOWN IF DESIRED.

8. LV- SOURCE AT LOOP CONNECTOR P5 SHOULD BE CONNECTED TO GROUND AT THE SAME POINT AS POWER UNIT #1. LV- SOURCE AT LOOP CONNECTOR P12 SHOULD BE CONNECTED TO GROUND AT THE SAME POINT AS POWER UNIT #2.

9. RUN SEPARATE WIRES FROM GROUND AT LOOP CONNECTOR TO INDICATOR AS SHOWN. WIRES MAY BE SECURED TO GROUND UNDER PLUG CLAMPING SCREWS AT LOOP.



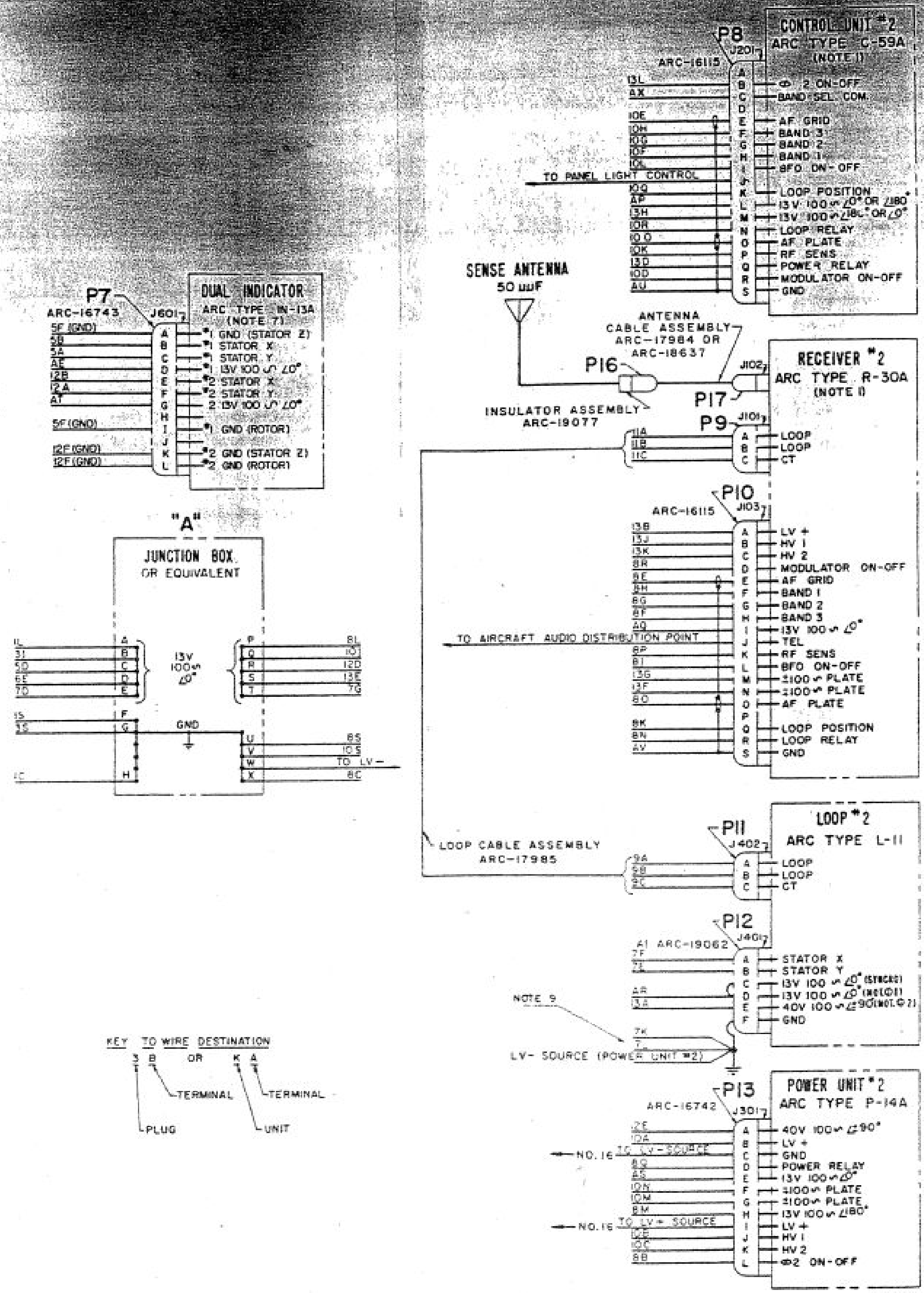


Figure 2–22. Dual ARC Type 21A Installation Using IN-13A Indicator, Interconnection Diagram

2–12. LOOP COMPENSATION PROCEDURES.

Introduction. Due to the distortion of the radio field pattern caused by propellers, engines, wings, antennas, and other structural and electrical parts of the aircraft, it is necessary that the apparent direction of arrival of the radio signal be checked every 15° with respect to the fore-and-aft axis of each particular type of aircraft. Provision is made to compensate for such errors, providing the error does not exceed ±25°. The compensating screws are located on the bottom of the L-11 Loop to permit adjustment with the loop installed in the airplane. There is no correction when the adjustment screws are set to their mid positions.

Two methods of loop compensation are described in the following paragraphs. One method is performed, with the loop installed and the airplane on the ground, by turning the airplane to a series of predetermined headings relative to a suitable ground station and adjusting the loop compensation screws during the procedure. The location chosen for this method should be well-clear of buildings, overhead or underground conductors, or other possible reflecting objects. The results obtained in this location should be checked by selecting a second location and verifying that similar results are obtained. For maximum accuracy, compensation should be accomplished on a frequency in the band where maximum accuracy is required. *In any case, ground compensation should be verified by a flight check*, preferably using the same signal source as that used for ground compensation.

The other method consists of collecting error data during flight, calculating from the data the adjustments required, and setting the loop compensation screws accordingly. Two types of flight patterns suitable for collecting the error data are described.

The following precautions should be taken with regard to compensation procedures:

1. Do not attempt compensation during the period starting two hours before sunset and ending two hours after sunrise, because during this period sky waves from distant stations may introduce errors or bearing fluctuations.

2. In making flight checks or measurements, select a calm day in order to obtain accurate readings of the indicator.

3. During flight, take the radio station bearings only when the aircraft is in level flight. Avoid disturbing the directional gyro (DG) unnecessarily by making all turns uniform and gradual.

Note

Since the loop compensation procedure requires operation of the Type 21A, paragraphs 3–1 through 3–6 should be reviewed before proceeding.

Loop Compensation on Ground. Loop compensation may be performed on the ground without removing the loop from the airplane by tuning in a radio signal transmitted from a known geographical location and turning the aircraft as required to achieve the required relative bearing. The bearing of the selected radio station relative to the heading of the airplane must be accurately established. The angle may be determined by means of a stabilized compass system such as the ARC Type CD-1 or CD-2 Course Director, or by setting a transit or pelorus on top of the aircraft and sighting on a fixed object at least 1000 feet distant from the aircraft. The station selected should provide a strong, clear-channel signal, and normally should provide good, non-fluctuating bearing indications. A flight check of the compensation adjustments should be made using either one of the flight procedures described later in this section. Proceed as follows:

Step 1. Locate the airplane in an area which is clear of buildings, overhead wires, or other possible reflecting objects.

Step 2. Turn the set on. Tune in the selected radio station, set the C-59A COMP-ANT-LOOP switch to COMP, and point the aircraft directly toward the station.

Caution

Do not force screws. In following the procedure of Steps 3, 4, 5, and 6, it may appear at first that the compensation available at a particular adjustment point is insufficient to make the indicator read correctly. If this occurs, *do not* force the screw in question but proceed to set the other screws. When, as required by Step 8, the adjustment procedure is repeated, it will be found that sufficient compensation is available from all adjustment points.

Step 3. Turn the VAR. knob to align the dial 0° position with the index at the top of the indicator. Adjust the 0° compensation screw until the indicator pointer is at 0. (An extension cable to permit direct observation of the indicator while making this adjustment may be used.)

Step 4. Turn the aircraft 15° left, and adjust the 15° compensation screw (red scale for belly-mounted loop, black scale for top-mounted loop) to set the indicator pointer at or near 15°, which is the relative bearing to the station.

Step 5. Turn the aircraft another 30° (45° total with respect to the original aircraft position) and adjust the proper 45° compensation screw to set the indicator pointer at or near 45°.

Step 6. Continue the procedure described previously, turning the aircraft to the left to obtain each of the following relative bearings: 75°, 105°, 135°, 165°, 180°,

;°, 225°, 255°, 285°, 315°, 345°, and adjusting the per compensation screw (red scale for belly-mounted p, black scale for top-mounted loop) to set the indi- or pointer at or near an equivalent reading.

Step 7. Repeat Steps 4, 5, and 6 as often as neces- y until satisfactory compensation is achieved.

Step 8. Move the aircraft to the other selected loca- n on the field and check that the compensation adjust- :nts made require no change.

Step 9. Flight-check the loop compensation adjust- :nts by following either of the procedures described in is section. In case any definite errors are noted, return the ground location originally used. Repeat the com- nsation procedure, but this time make allowances for y discrepancies observed during the flight check. For ample, if at the relative bearing of 45° the indicator ad 49° in the air, adjust the compensation to achieve 41° reading on the ground when the station is at a 45° lative bearing.

btaining Flight Data for Loop Compensation.

ENERAL. Two methods for obtaining the flight data re- iired to compensate the loop, or for verifying the ound procedure used for loop compensation, are de- ribed in the following paragraphs. Unless the loop has en compensated previously, the compensation screws ill be in their mid positions (zero correction).

ETHOD 1. The following procedure (see Figure 2–23) quires a fairly linear ground reference landmark, such a road or railroad tracks, directed toward a clear- annel radio station 25 to 100 miles distant. Possible stortion of the radio field may be caused by certain uctures, such as power lines, steel towers, etc., on the ute selected. To check whether such distortion exists, iss-cross the reference line at various angles, while aintaining fixed courses by means of the DG. If rapid anges in the bearing are noted as the line is crossed, ortion exists. This distortion should be eliminated ner by selecting another landmark, or by flying at a gher altitude. Proceed as follows:

Step 1. With the aircraft in level flight headed toward the radio station, fly the reference line at an altitude low ough for accurate determination of position and di- ction. Set the DG to 0° if the DG is not slaved. (If the craft has a slaved gyro, determine the headings re- ired to produce the desired relative bearings.) Using VAR. knob on the indicator, align the dial 0° posi- n with the index at the top of the indicator. Turn the plane to a 0° heading. Record the relative bearing d on the indicator on a form similar to that shown in gure 2–24 (a completed form is shown in Figure 25).

Step 2. Fly a sufficient distance from the reference e so that it may be crossed at a heading of 15°. With the aircraft held in level flight on a heading of 15°, record the relative bearing read on the indicator when the reference line is crossed.

Step 3. Fly sufficiently past the reference line so that the line may be recrossed at a heading of 345° with the aircraft in level flight (see Figure 2–23). Record the indicator bearing when the aircraft crosses the reference line.

Step 4. Repeat Steps 2 and 3 for headings of 30° and 330°.

Step 5. Turn the aircraft to a heading of 180° from the radio station and check the DG reading when the heading of the aircraft coincides with the reference line. The DG reading should be within approximately 2° of a 180° heading if all maneuvers have been made properly. If precession of the DG is noted when the 180° reference line course is checked, repeat the procedure, or check the DG. Normal creeping of a free DG (2° or less over a period of 15 minutes) may be proportioned to each heading.

Step 6. With the aircraft on a 180° heading away from the radio station, follow a procedure similar to that outlined previously and obtain indicator bearings for headings of 195°, 165°, 210°, and 150° (see Figure 2–23). Then, turn the aircraft to head toward the radio station along the reference line, establishing a 0° heading with respect to the reference line.

Step 7. Continue to fly to and from the radio station, criss-crossing the reference line, as shown in Figure 2–23, until indicator bearings for every 15° change in the heading of the aircraft have been recorded. The recorded data will be used for compensating the loop.

Note

The procedure outlined in Steps 1 through 7 may be made over a single point, such as a road intersection, providing the bearing to the radio station is known. Fly a series of figure eights, always crossing the reference point on a 15° change in heading from the previous course. Record the indicator bearing each time the aircraft crosses the reference point.

METHOD 2. The following procedure requires making two 360° flight turns in opposing directions, some distance from a radio station. A landmark, such as a crossroad or a building, is used for a ground reference point from which each circle is started. Disregarding errors introduced by flight conditions or observation procedures, the accuracy of this procedure depends on the distance of the reference point from the radio station and the diameter of the two circles. The ground reference point should be as far as possible from the radio station, but still at a distance where reliable bearing indications can

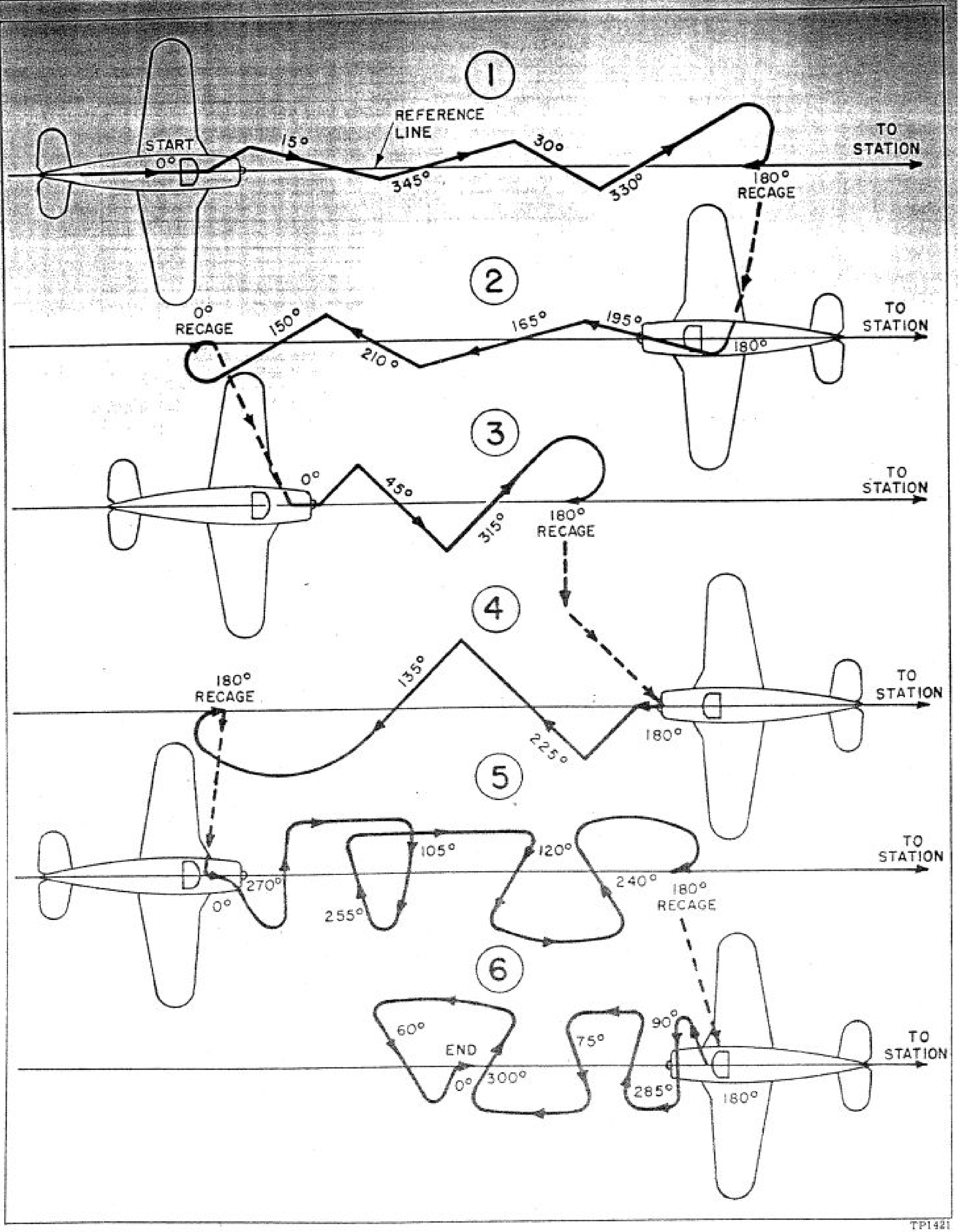


Figure 2–23. Procedure for Obtaining Flight Data for Loop Compensation Flying Ground Reference Line

FLIGHT DATA FOR LOOP COMPENSATION

Station Used ____________________ Frequency ____________________
Pilot ____________________ Recorder ____________________
Aircraft Type ____________________ Aircraft No. ____________________

FLIGHT DATA		
Column 1	Column 2	Column 3
Relative Heading	Plane-to-Station Bearing	Indicator Reading
* 0	0	
15	345	
345	15	
30	330	
330	30	
† 180	180	
195	165	
165	195	
210	150	
150	210	
* 45	315	
315	45	
† 225	135	
135	225	
* 270	90	
105	255	
255	105	
120	240	
240	120	
† 90	270	
285	75	
75	285	
300	60	
60	300	

LOOP COMPENSATION DATA	
Column 4	Column 5
Loop Azimuth Scale Reading	Corrected Indicator Reading
0	
15	
45	
75	
105	
135	
165	
180	
195	
225	
255	
285	
315	
345	

* Cage DG 0 degrees if free DG is used
† Recage DG 180 degrees if free DG is used

TP1423

Figure 2–24. Form for Recording Flight Data for Loop Compensation

FLIGHT DATA FOR LOOP COMPENSATION

Station Used EWR Frequency 379 KC
Pilot JONES, A. J. Recorder SMITH, E. K.
Aircraft Type 50 BONANZA Aircraft No. 4937B

FLIGHT DATA		
Column 1	Column 2	Column 3
Relative Heading	Plane-to-Station Bearing	Indicator Reading
* 0	0	359
15	345	350
345	15	7
30	330	339
330	30	15
† 180	180	179
195	165	169
165	195	186
210	150	158
150	210	195
* 45	315	326
315	45	26
† 225	135	146
135	225	205
* 270	90	88
105	255	241
255	105	112
120	240	220
240	120	131
† 90	270	269
285	75	61
75	285	293
300	60	41
60	300	311

LOOP COMPENSATION DATA	
Column 4	Column 5
Loop Azimuth Scale Reading	Corrected Indicator Reading
0	1
15	30
45	43
75	83
105	100
135	123
165	159
180	181
195	210
225	243
255	263
285	279
315	303
345	337

* Cage DG 0 degrees if free DG is used.
† Recage DG 180 degrees if free DG is used.

TP1425

Figure 2–25. Example of Recorded Flight Data for Loop Compensation be obtained. The diameter of each circle should be nearly equal so that the error angles at corresponding angles of the turn circles cancel when averaged. The diameters should also be as small as possible, yet large enough so that the flying time during each chord of the circle is sufficient to permit obtaining a reliable reading. As a general recommendation, it is suggested that the distance between the ground reference point and the radio station be at least 60 miles, and that each circle have a maximum diameter of 9 miles.

Before the actual flight procedure is begun, it is necessary to correlate the 0° bearing of the indicator with the 0° heading of the aircraft. This may be done using the combined instructions of the ground-compensation procedure and Step 1 of Method 1 described previously, or in the air alone by the following method:

Step 1. Head the aircraft directly toward a radio station whose transmitting tower is clearly visible.

Step 2. Tune the R-30A Receiver to the station frequency. Adjust the VAR. knob to align the dial 0° position with the index at the top of the indicator.

Step 3. Using a cross-hair sight which has been aligned accurately with the fore-and-aft axis of the aircraft, align the axis of the aircraft with the station antenna tower as accurately as possible. Alternatively, if a cross-hair sight is not available, the aircraft heading and the tower may be aligned by an observer stationing himself as far aft as possible, with a clear line-of-sight through the vertical center of the windshield, and sighting along the centerline of the aircraft through the center of the windshield. Heading checks made directly from the cockpit are not reliable because parallax errors may result.

Step 4. With the aircraft held in level flight, and headed directly toward the station tower, note the indicator bearing. To confirm the reading obtained, approach the station tower from the opposite direction and check that the indicator bearing is the same. Record the indicator bearing obtained for the 0° heading of the aircraft.

With the 0° indicator bearing and the 0° aircraft heading correlated, the flight procedure may be performed (see Figure 2–26). The principle of this procedure is to obtain indicator readings for every 15° change in heading during each of the 360° turns. To approximate a circle as closely as possible, the flying time and speed of each 15° course should be very nearly equal. After each turn has been completed, an indicator reading relative to a given DG reading will be obtained for each turn. The indicator readings are averaged and the result is used for loop compensation. Proceed as follows:

Step 1. Select a ground reference point which is not less than 60 miles from the radio station to be used. Approach the reference point so that it is between the aircraft and the station. Orient the aircraft for a 0° bearing on the indicator. If the previous flight procedure has established that the 0° heading of the aircraft does not coincide with the 0° bearing of the station within ±2°, fly the aircraft on the heading that corresponds to the 0° bearing obtained in the preliminary flight procedure.

Step 2. With the aircraft held in steady, level flight directly toward the station, set the DG to 0°. (If a slaving DG is installed in the aircraft, determine the proper heading.) Maintain the heading, and when the plane is over the ground reference point, record the indicator bearing.

Step 3. Turn the aircraft smoothly and evenly to the right for a heading of 15°. With the aircraft leveled out on this heading for not more than 25 seconds, note and record the indicator bearing on a form similar to that shown in Figure 2–24.

Step 4. Turn the aircraft to a heading of 30°. After level flight has been reassumed, note and record the indicator bearing.

Step 5. Follow a similar procedure as outlined previously in Steps 3 and 4 for each 15° increase in heading of the aircraft, until the circle-turn is completed. Record the indicator bearings for each heading. If the turn has been executed properly, the aircraft should be over the reference point at the end of the last 15° turn. Turn the aircraft for a 0° indicator bearing. The aircraft should now be headed directly toward the radio station in line with the original starting line. Check the relative bearing for this heading; the reading should agree with its original setting within 2° to 3° if all turns have been made properly.

Step 6. With the aircraft over the ground reference point and headed directly toward the station, as shown by the indicator reading, check that the DG reading agrees with its original setting. If not, make a 0° reference check, as outlined in Steps 1 and 2 of this procedure.

Step 7. Start the second 360° turn by turning the aircraft to the left for a 345° heading. When the aircraft is in steady, level flight on this heading, record the indicator bearing.

Step 8. Continue the circle-turn, until completed, decreasing the heading in 15° intervals. Keep the diameter of this left turn as equivalent as possible to the right turn made previously. Record the indicator bearing for each 15° change in heading.

Step 9. Average the right-turn and left-turn indicator bearings for each corresponding DG heading. The recorded averages will be used for compensating the loop.

reparation of Compensation Data Curve. After the 1-flight compensation data has been recorded, the data nay be plotted and the resulting curve used for deternining the loop compensation adjustments. Proceed as ollows:

Step 1. Using Figure 2–27, plot the indicator bearng (column 3) against the corresponding plane-totation bearing (column 2). An example of a resultant curve is shown in Figure 2–28. (This data may be plotted directly on Figure 2–27 or on the spare form ncluded as Figure 6–20.)

Step 2. Lay a straight edge parallel to the sloping dotted line and through the data point of column 3 on the vertical scale, and draw a fine line (see Figure 2–28). The point at which this line intersects the solid line is the plot point. (The example shown in Figure 2–28 indicates that for an actual bearing of 15°, the indicator bearing is 7°.)

Step 3. Repeat Step 2 for each of the remaining 15° positions.

Step 4. Connect the plotted points to form the compensation data curve.

Step 5. Determine the corrected indicator bearing values for column 5 of Figure 2–24 (see Figure 2–25 or example) from the resulting curve as follows:

a. Draw fine lines parallel to the solid lines at the ntersections of the plotted curve and the dotted lines corresponding to the degree values given in column 4 see Figure 2–28).

b. In column 5, record the values for the points of intersection as read on the vertical graduations beside he 15° dotted line values in column 4 (see Figure 2–28). For example: To determine the corrected indicator bearing for a loop position of 45° (column 4), lay he straight edge parallel to the solid line and draw a fine ine through the intersection of the dotted 45° line and he curve (see Figure 2–28). This line passes through he vertical graduations at 63°. This value is recorded in column 5. Similarly, a bearing of 105° from column 4 gives a bearing of 100° for column 5.

Adjustment of Loop Compensation Screws.

Caution

Do not force screws. In the following procedure it may appear at first that the compensation available at a particular point is insufficient to make the indicator read correctly. If this occurs, *do not force* the screw in question but proceed to set the other screws. When, as required by Step 6, the adjustment procedure is repeated, it will be found that sufficient compensation is available from all adjustment points.

Adjustment of the loop compensation screws may be made with the loop installed on the airplane; or if desirable, the loop may be removed from the airplane and installed in a bench test set-up using the ARC Type BTK-21 Bench Test Kit. Using the data in columns 4 and 5 of Figure 2–24, proceed as follows:

Step 1. Determine which group of compensation screws is to be used: the red scale is for belly-mounted loops; the black scale is for top-mounted loops.

Step 2. Turn on the equipment. (Do not run the engines.) Set the C-59A COMP-ANT-LOOP switch to the ANT position and set the VOL control at minimum.

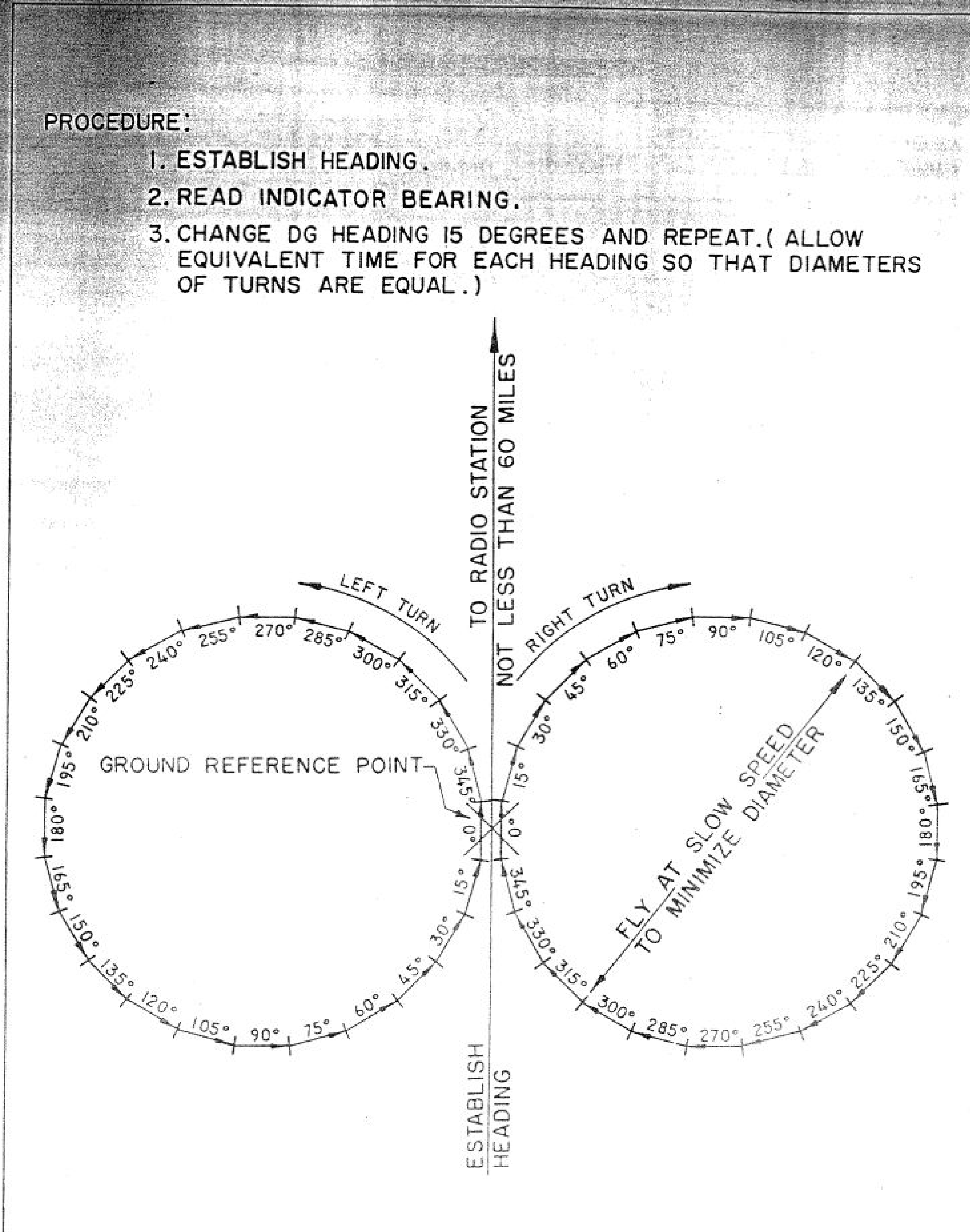
Step 3. Rotate the loop with the LOOP switch until the loop hairline is at 0°, and turn the 0° adjustment screw until the indicator reads the computed value in column 5 of Figure 2–24.

Step 4. Rotate the loop with the LOOP switch to 15° and adjust the proper 15° adjustment screw until the indicator reads the corresponding computed value of column 5.

Step 5. Continue the adjustments for each of the settings listed in column 4 of Figure 2–24, adjusting the proper compensation screw for each setting.

Step 6. Repeat these adjustments, and those of Steps 3 and 4, until satisfactory compensation has been achieved.

Step 7. Ground- and flight-test the equipment before installing the loop housing in case additional adjustment may be required.



TP1427

Figure 2–26. Procedure for Obtaining Flight Data for Loop Compensation Flying Two 360-Degree Turns

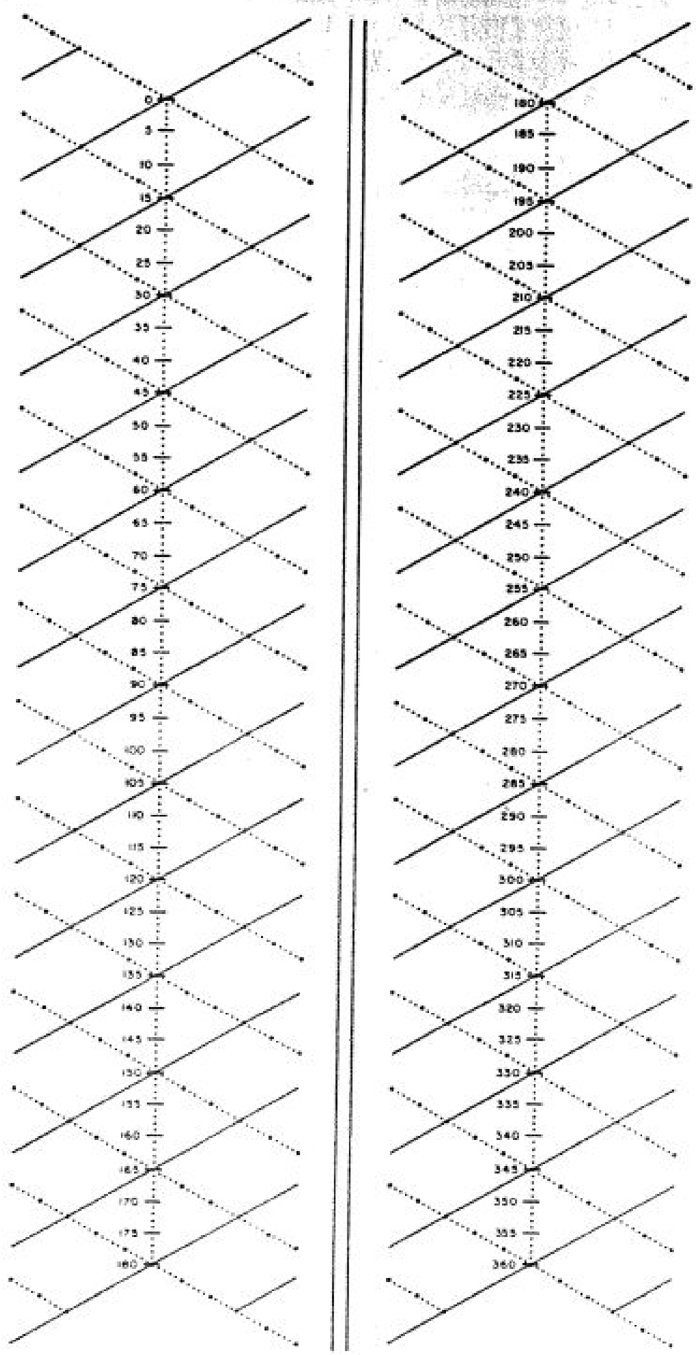
LOOP COMPENSATION DATA CURVE

Date ______________________ By ______________________

Aircraft Type and No. ______________________

Station ______________________ Frequency ______________________

Ground Reference Line ______________________



TP1429

Figure 2–27. Form for Plotting Loop Compensation Data Curve

LOOP COMPENSATION DATA CURVE

Date 1 NOVEMBER, 1958 By KILROY, J.M.

Aircraft Type and No. 50 BONANZA N3014V

Station EWR Frequency 379 Kc

Ground Reference Line N. J. TURNPIKE

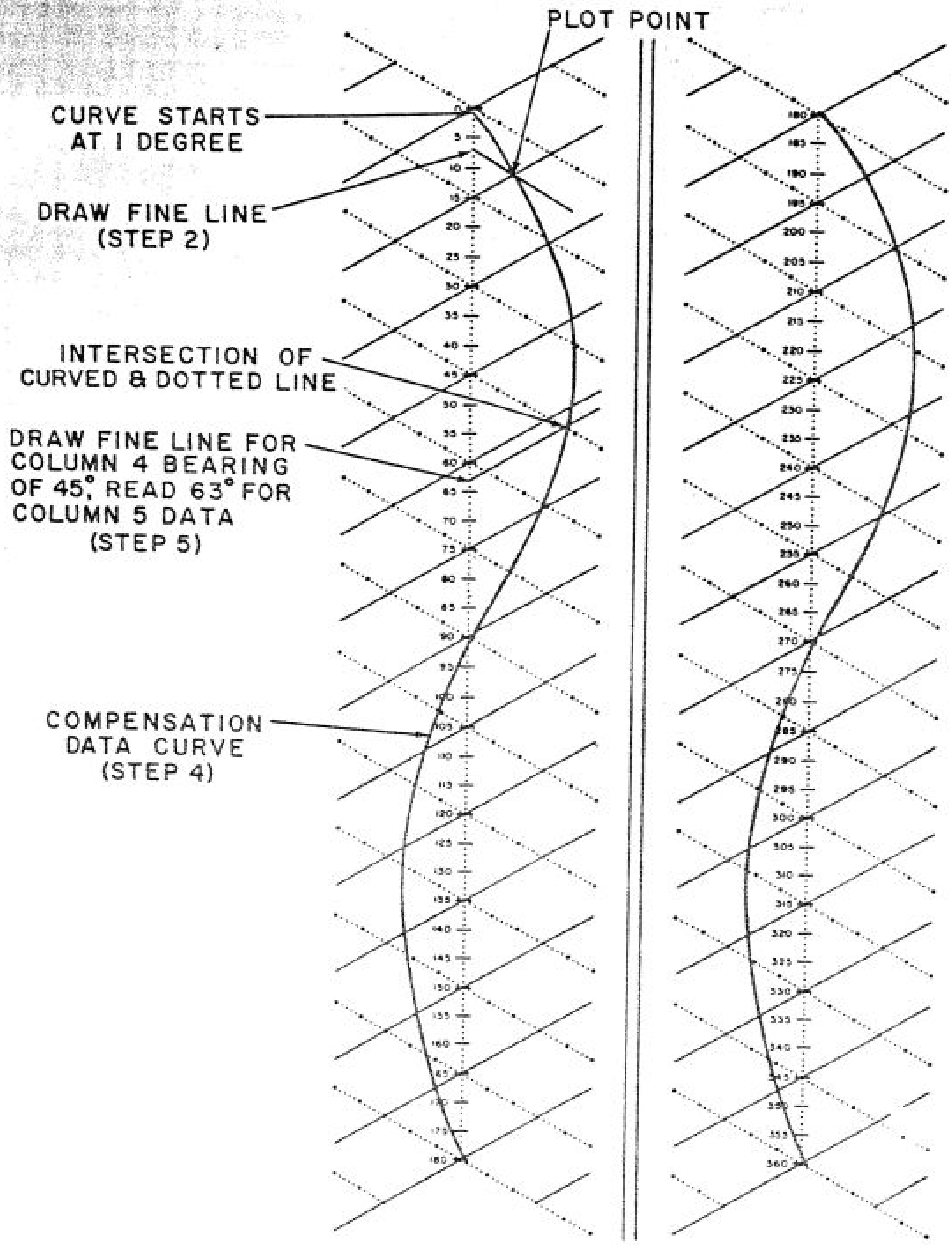


Figure 2–28. Example of Loop Compensation Curve

TP1431

SECTION III
OPERATION

3–1. INTRODUCTION.

This section contains instructions for using the ARC Type 21A Automatic Direction Finder for bearing determination, homing, position determination, and similar purposes. (Not all of these procedures make use of the automatic feature of the Type 21A.) Operating limitations and precautions are also discussed.

3–2. NAVIGATIONAL TERMS.

The following navigational terms, as related to the operating procedures, are defined for reference.

Relative Bearing. Relative bearing is the angle formed by the intersection of a line drawn from the aircraft to the radio station and a line drawn through the center line of the aircraft. This angle is always measured clockwise from the nose of the aircraft. With the dial 0° position aligned with the index at the top of the indicator, the relative bearing is indicated directly by the pointer when the station is tuned in.

Magnetic Bearing. Magnetic bearing is the angle formed by the intersection of a line drawn from the aircraft to the radio station and a line drawn from the aircraft to magnetic north. A magnetic bearing to the station is obtained by adding the relative bearing shown on the indicator to the magnetic heading of the aircraft. If the total is more than 360°, 360° is subtracted to obtain the magnetic bearing. The magnetic bearing is used to determine the true bearing.

True Bearing. True bearing is the angle formed by the intersection of a line drawn from the aircraft to the radio station and a line drawn from the aircraft to true north. A true bearing is the magnetic bearing corrected for variation. The true bearing is calculated by *adding* an *east* variation to the magnetic bearing, or by *subtracting* a *west* variation from the magnetic bearing. If the addition of the east variation results in a sum greater than 360°, 360° is subtracted to obtain the true bearing. If the subtraction of the west variation results in a negative answer, the answer is subtracted from 360° to obtain the true bearing.

Reciprocal Bearing. Reciprocal bearing is a bearing plus or minus 180°. Reciprocal bearings are used when plotting fixes. A reciprocal bearing (station-to-aircraft bearing) is obtained by adding or subtracting 180° from the aircraft-to-station bearing. If the bearing is less than 180°, 180° is added to obtain the reciprocal bearing. If the bearing is more than 180°, 180° is subtracted to obtain the reciprocal bearing.

180° Ambiguity. A loop antenna has two points of minimum reception (aural null), one located 180° from the other. This characteristic of a loop antenna is referred to as 180° ambiguity. An aural null results when the plane of the loop antenna is perpendicular to a line from the station.

3–3. OPERATING LIMITATIONS AND PRECAUTIONS.

The Type 21A is subject to the following operating limitations which are imposed by terrain, weather, and general operating conditions.

Night Effect. Radio waves reflected by the ionosphere return to the earth at some point 30 to 60 miles from the station and may cause the pointer to fluctuate. Night effect is most prevalent during the period just before and after sunrise and sunset. Generally, the greater the distance from the station, the greater the effect. The effect can be minimized by averaging the fluctuations, by flying at a higher altitude, or by selecting a lower-frequency station. Maximum night effect will be present with stations operating in frequency ranges above 1000 kc; frequencies below 1000 kc are generally less subject to night effect.

Mountain Effect. Bearings taken in the vicinity of mountainous terrain may be erroneous or the pointer may fluctuate due to certain magnetic deposits or radio wave reflection.

Shoreline Effect. As radio waves pass from land to water, their direction of travel is changed. Because of shoreline effect, a bearing taken on an inland station from an aircraft over water is inaccurate if it makes an angle of less than 30° with the shoreline. At greater angles, bending is negligible. When taking bearings over water, therefore, choose stations which are either right on the shore, or so located that bearings on them make angles greater than 30° with the shoreline.

Precipitation Static. The Type 21A will provide accurate bearing indications under conditions of moderate precipitation static. If the precipitation static is severe, use LOOP operation and rotate the loop for maximum signal. To avoid precipitation static that exists in air mass fronts, cross the air mass front at a right angle and then proceed on the desired course. If possible, avoid flying along the air mass front.

General Operating Precautions. The following operating precautions should be considered when using the Type 21A:

1. Only head-on bearings are entirely dependable. Keep the wings horizontal when taking side bearings; accurate bearings cannot be taken with the aircraft in a steep bank, especially when close to a station or when making an ADF approach.

2. When homing, fly the aircraft with the pointer pointing to the index at the top of the indicator, or fluctuating equally, slightly left and right.

3. Do not use the C-59A tuning meter for distance indications.

4. Select stations which provide stable bearings and tune the receiver carefully. An interfering signal may cause a bearing error. To check for an interfering signal, tune to either side of resonance (point of maximum signal). An interfering signal is indicated by a change in bearing while tuning. If necessary, select another station.

5. Take care when taking bearings on stations transmitting the same program—they may be mistaken for each other. Do not take bearings on synchronized stations, except when close to the desired station.

6. Do not use a station for bearing indications unless it can be identified positively.

7. For accurate reception of low-frequency radio range signals, use the ANT position of the COMP-ANT-LOOP switch. Only in the ANT position are complete and accurate aural signals received. In the COMP position, the avc action present will cause course-broadening of the signals. Set the VOL control to the lowest usable audio level and reduce it as the level of the A-N signals increases. If an interphone is used when receiving A-N signals, set the interphone volume at maximum and control the audio level with the C-59A VOL control.

8. In the LOOP position, the loop may be positioned for a null, and unless the LOOP switch is operated to rotate the loop for maximum reception, the signal will be weak and erratic. Use the LOOP position for range reception only when heavy static conditions are causing poor reception.

9. When using the aural-null method for taking bearings, there is a possibility of a 180° ambiguity which must be resolved.

10. Strong fields produce very sharp nulls, sometimes as small as 0.1°. Set the VOL control to produce a null of satisfactory width. The tuning meter or BFO may be used as a null indicator.

11. When flying a radio range course with the loop in the null position, the signal may fade in and out and possibly be mistaken for a cone of silence.

12. Loop-type radio range stations do not provide reliable cone-of-silence indications during LOOP operation. The signal may increase to a strong surge instead of indicating a silent zone when directly over the station.

3–4. OPERATING CONTROLS.

All operating controls for the ARC Type 21A ADF, with the exception of the variation (VAR.) knob on the indicator, are located on the ARC Type C-59A Control Unit (see Figures 3–1 and 3–2). Table 3–1 lists the operating controls, their panel designations (if any), and their functions. Information regarding the C-59A tuning meter is also included. In the operating procedures, the operating controls are identified by their panel designations.

Note

Any reference to the term "index" as used in the operating procedures refers to the large, triangle-shaped index mark located at the top of the indicator.

3–5. GENERAL OPERATING PROCEDURE.

Step 1. Turn the C-59A VOL control clockwise to turn equipment on and allow approximately 30 seconds for equipment to warm up.

Step 2. Turn the COMP-ANT-LOOP switch to ANT.

Step 3. Turn the MC BAND switch to the desired frequency band.

Step 4. Adjust the VOL control until background noise (or station if already tuned in) is heard.

Step 5. Rotate the tuning crank until station frequency is aligned with frequency dial hairline, then tune for maximum tuning meter deflection by slowly rotating the tuning crank in the vicinity of the desired frequency.

Step 6. Readjust the VOL control to desired audio level. Identify the station.

Step 7. Turn the COMP-ANT-LOOP switch to the position required for the desired function:

a. To use the Type 21A as an automatic direction finder, set the switch to COMP.

b. To use the Type 21A as a low-frequency radio range receiver, set the switch to ANT.

c. To use the Type 21A for aural null procedures or during conditions of poor reception, set the switch to LOOP.

TABLE 3–1. OPERATING CONTROLS

Control	Panel Designation	Function
Band Switch	MC BAND	Selects frequency band in which equipment will operate. Three bands are available: 190 to 400 kc (.19-.40 mc), 400 to 840 kc (.40-.84 mc), and 840 to 1750 kc (.84-1.75 mc). Band selected is displayed on frequency dial when switch is operated.
Volume Control	VOL	Turns Type 21A on or off. Controls audio gain of R-30A when COMP-ANT-LOOP switch is in COMP position, or r-f sensitivity when switch is in ANT or LOOP position.
Function Switch	COMP-ANT-LOOP	In COMP position, both loop and sense antennas are connected and equipment functions as an automatic direction finder. In ANT position, only the sense antenna is connected and equipment functions as a standard low-frequency range receiver. In LOOP position, only the loop antenna is connected and LOOP switch may be used to rotate loop for relatively static-free reception or null procedures.
Beat Frequency Oscillator Switch	BFO	Controls operation of beat frequency oscillator in R-30A.
Tuning Crank	—	Tunes R-30A to desired frequency, which is displayed on frequency dial.
Test Switch	LOOP	Rotates loop in either direction regardless of position of COMP-ANT-LOOP switch. Used to position loop as desired when COMP-ANT-LOOP switch is in LOOP position for aural-null procedures, and with switch in COMP position, to override an incoming signal momentarily to test signal reliability.
Tuning Meter	—	In COMP position of COMP-ANT-LOOP switch, peak deflection indicates proper tuning.
Variation Knob (on indicators)	VAR.	Rotates dial.

3–6. BEARING DETERMINATION.

The Type 21A may be used to determine the bearing of any radio signal. Depending on the setting of the indicator dial with relation to the index, the bearing read on the indicator may be the relative, magnetic, or true bearing. Proceed as follows:

Step 1. Locate the desired station on the chart and note its frequency.

Step 2. Operate the equipment and tune in the station as outlined in paragraph 3–5. Set the COMP-ANT-LOOP switch to COMP.

Step 3. For a relative bearing, turn the VAR. knob on the indicator until the dial zero is aligned with the index. The pointer will then indicate the relative bearing.

Step 4. For a magnetic bearing, turn the VAR. knob until the magnetic heading of the aircraft is set to the index. The pointer will then indicate the magnetic bearing.

Step 5. For a true bearing, set the magnetic heading at the index and then set in the magnetic variation with the VAR. knob. The pointer will then indicate the true bearing. A west variation is considered negative and an east variation positive. The VAR. knob is marked with east-west arrows to indicate the correct direction of rotation of the knob.

Step 6. To check the reliability of the indicated bearing, press the LOOP switch left or right and hold until the pointer has traveled 10° to 20°, then release the switch. If operation is normal and the signal reliable, the pointer will return to the original bearing.

Note

The aircraft must be held to the heading set into the indicator, otherwise the bearing indicated will not be correct.

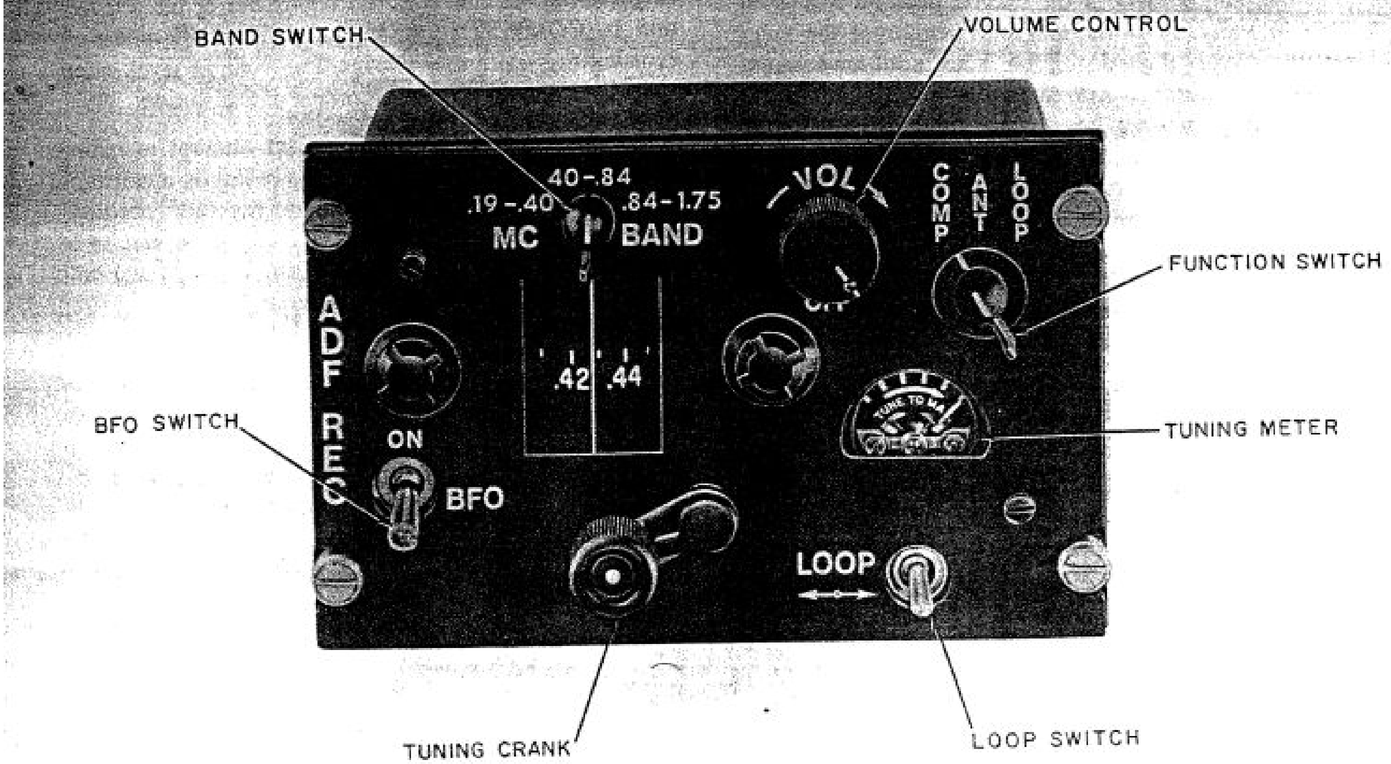


Figure 3–1. ARC Type C-59A Control Unit, Operating Controls

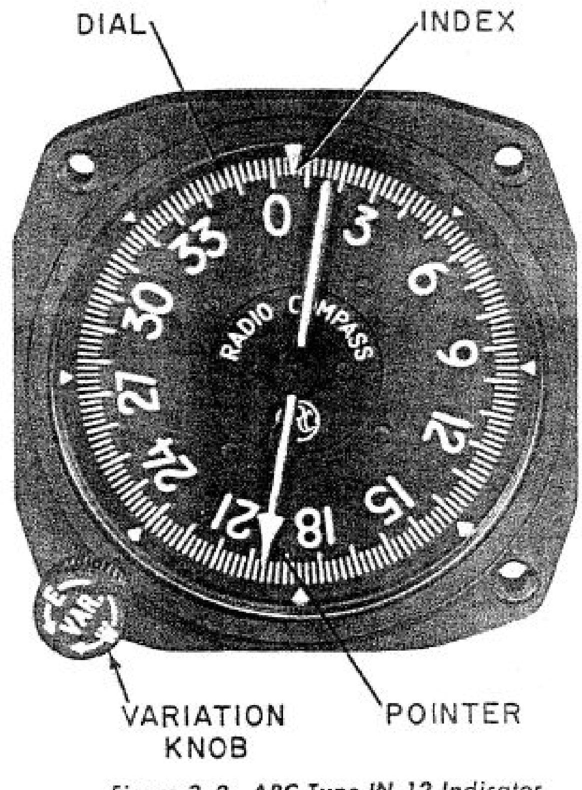


Figure 3–2. ARC Type IN-12 Indicator

3-7. HOMING.

Homing is flying the aircraft on any heading required to keep the pointer at 0° if the dial 0° position is aligned with the index, or at the magnetic heading if the magnetic heading is aligned with the index, until the selected station is reached. If a crosswind exists and no correction is made for drift, keeping the pointer at the index will eventually bring the aircraft over the station, but the course will be curved as shown in Figure 3-3. The curvature increases as the station is approached because the closer the aircraft gets to the station, the more rapidly does the wind drift cause the needle to move away from zero. A change in magnetic heading while the pointer is kept at the index indicates that wind drift is affecting the course of the aircraft.

To home to a station, proceed as follows:

Step 1. Operate the equipment and tune in the station as outlined in paragraph 3-5.

Step 2. Set the COMP-ANT-LOOP switch to COMP.

Step 3. Turn the aircraft until the pointer is aligned with the index: if the pointer is to the left of the index, turn left, if to the right, turn right.

Step 4. Rotate the VAR. knob to align the dial 0° position with the index, or the magnetic heading with the index.

Step 5. Continue the flight with the pointer pointing to the index until arrival over the station is indicated by extreme fluctuation of the pointer. Aural monitoring may also help to detect the proximity of the station. If tuned to a low-frequency range station, the audio volume will surge as the station is neared regardless of the avc action in COMP position. If tuned to a high-powered broadcasting station, however, the volume level often stays constant within a large radius of the station.

When the fluctuation occurs, do not attempt to maintain the pointer at 0°; it is better to maintain a constant heading until the pointer settles near the 180° position, indicating the station has been passed. If the station is passed and the same heading continued, the pointer will point to the reciprocal point on the dial.

If a crosswind is affecting the course of the aircraft during homing, it will be indicated by a change in magnetic heading, as read on the DG. If the direction and velocity of the crosswind is known, the heading can be modified accordingly. For example: If 0° is aligned with the index, and if the wind is from the left requiring a 10° crab angle to stay on course, the pointer should be held to 10° instead of 0°, or the dial set to 350° and the pointer to 0° (see Figure 3-4). If the effect of the crosswind is not known, it may be determined by noting the change in the magnetic heading while holding the pointer at the index. If the magnetic heading increases, the wind is from the right and the pointer should be held to the left of the index. If the heading decreases, the wind is from the left and the pointer should be held to the right of the index. This procedure should be continued until the rate of change in the magnetic heading is minimized. In any case, even with improper wind correction, the homing procedure will eventually bring the aircraft over the selected station.

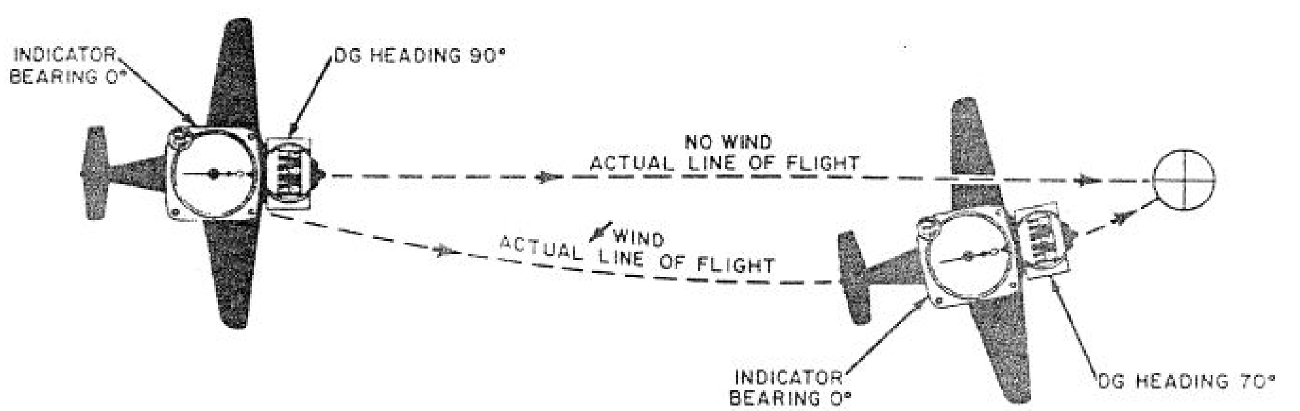


Figure 3-3. Homing without Compensation for Wind Drift

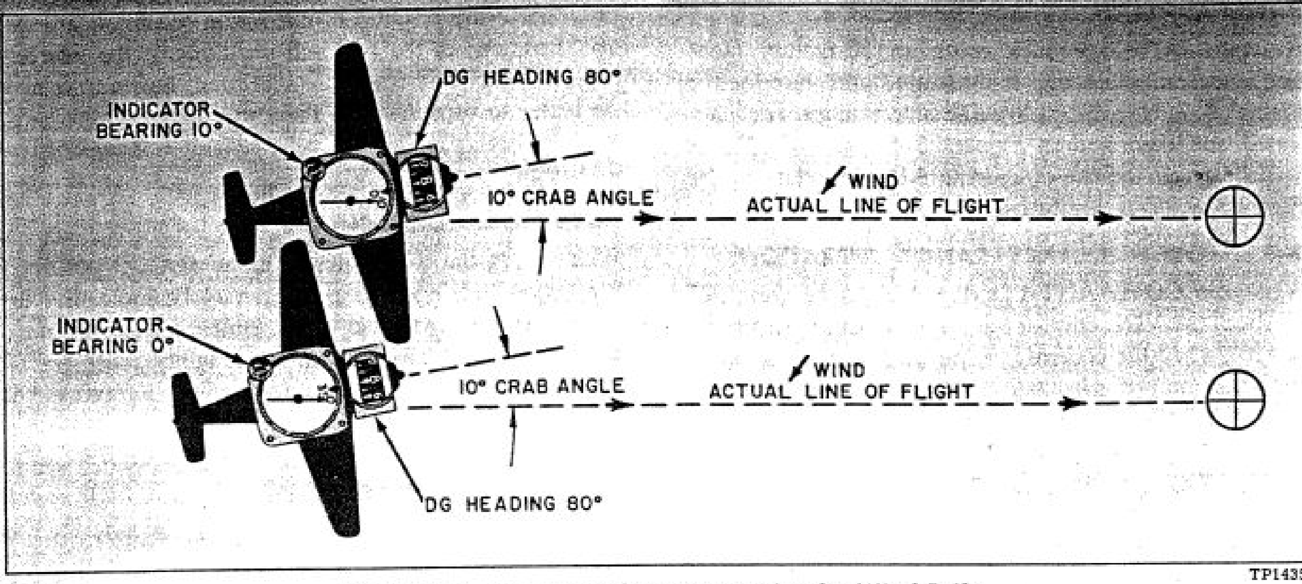


Figure 3–4. Homing with Compensation for Wind Drift

3–8. POSITION DETERMINATION.

The Type 21A may be used to fix the position of an aircraft by triangulation. Bearings taken on two or more stations are plotted, and the point of intersection defines the point or area of position (see Figure 3–5). Two stations may be used to obtain the fix, but the use of a third station provides a check on the accuracy of the bearings. Proceed as follows:

Step 1. Locate three stations (or two if three are not available) on the chart which are spaced as equally as possible around the aircraft's position and note their frequencies.

Step 2. Operate the equipment and tune in each station as outlined in paragraph 3–5, with the COMP-ANT-LOOP switch in ANT position. Identify each station and note the tuning dial setting for each.

Step 3. Set the COMP-ANT-LOOP switch to COMP.

Step 4. Note the magnetic heading as read on the DG. *Maintain this heading.* Set the magnetic heading at the index. Set in the magnetic variation with the VAR. knob (refer to paragraph 3–6). Retune to each station and record the *reciprocal* of the true bearing as read on the indicator.

Step 5. Plot the *reciprocal bearing* (station-to-aircraft) of each true bearing (aircraft-to-station) on the chart. The aircraft is located at the intersection of the projected bearing lines, or if they do not intersect, it is near the center of the triangle formed by the three lines. If only two stations are used, the intersection of the two lines may be assumed to be the aircraft's position.

3–9. TIME-FROM-STATION CALCULATION.

The Type 21A may be used to calculate the time from a station as shown in Figure 3–6. Operate the equipment as outlined in paragraph 3–5, set the COMP-ANT-LOOP switch in the COMP position, and proceed as follows:

Step 1. Tune in and identify the station. Note the indicator pointer reading.

Step 2. Turn the aircraft until pointer is at either 90° or 270°.

Step 3. Note the time and fly a constant magnetic heading until there is a bearing change of 5° to 10° as indicated by the pointer. When the bearing change is evident, note the time again and apply the following formula:

$$\text{Minutes from Station} = \frac{60 \times \text{Minutes between Bearings}}{\text{Degree of Bearing Change}}$$

For example: If it took 1 minute to fly a bearing change of 10°, the aircraft is:

$$\frac{60 \times 1}{10} = 6 \text{ minutes from the station}$$

In the formula noted, multiplying the minutes flown between bearings by 60 converts the minutes flown to seconds flown. If the time flown between bearings is less than 1 minute, no conversion is necessary. The number of seconds flown divided by the degree of change gives the time from the station in minutes.

Fly a 10° change whenever practical to simplify the required calculation. If the pointer moves so rapidly that a satisfactory time check cannot be obtained during a 10° bearing change, the aircraft is very close to the station.

3–10. ADF AND ILS/ADF APPROACH.

A typical ADF approach using an H facility (low-frequency radio beacon) is illustrated and described in Figure 3–7. Typical ILS/ADF approaches are illustrated and described in Figures 3–8 and 3–9. Figure 3–8 illustrates the use of a single ADF installation, and Figure 3–9 illustrates the use of a dual ADF installation.

3–11. LOW-FREQUENCY RANGE OPERATION.

When the COMP-ANT-LOOP switch is in the ANT position, the VOL control functions as an r-f sensitivity control; when the control is adjusted to a normal listening level, the avc is inactive due to the avc delay. These conditions, plus the sensitivity and selectivity of the R-30A, permit the Type 21A to be used as a low-frequency range receiver. To use the Type 21A for this purpose, operate the equipment as outlined in paragraph 3–5.

Note

The receiver should always be operated with the VOL control backed off to a comfortable audio level during low-frequency range operation because course broadening may result at high audio levels. In ANT operation the audio output is adjusted by manually varying the r-f gain of the receiver. This method is used so that the incoming signal level may be kept below the range of avc action, thereby providing an indication of relative signal strength. The control circuit of the COMP-ANT-LOOP switch automatically switches the VOL control to perform the function described.

-12. LOOP OPERATION.

ith the COMP-ANT-LOOP switch in the LOOP posi-n, operation of the LOOP switch provides manual ntrol of loop rotation. The Type 21A may therefore used for manual direction finding (MDF) procedures desired. During such procedures, the loop is rotated receive either a minimum or zero signal (aural null), when taking bearings, or a maximum signal, as when eption is required during heavy static conditions.

ce the sense antenna is disconnected in the LOOP ition, two aural nulls are present so that the bearing wn by the pointer is either the proper bearing or its procal. This 180° ambiguity must be resolved to ermine which is the correct bearing (refer to paragh 3–13). If desired, the BFO may be used to assist ocating a null (refer to paragraph 3–14).

en operating in the area of thunderstorms or when ipitation static is present, the use of the loop antenna e improves the intelligibility of signals because the is subject to less interference than is the sense an-a. Under these conditions, the loop should be oriented to the position of maximum reception; that is, 90° from one of the two null positions. If the interference is principally from one direction, however, it may be better to turn the loop for a null in the direction of the interference.

3–13. AMBIGUITY CHECK.

When using the loop antenna alone (LOOP position) for taking bearings, the pointer may be indicating the proper bearing or its reciprocal. Unless the aircraft position is known definitely, this ambiguity must be resolved to determine the bearing from the aircraft to the station. Proceed as follows:

Step 1. With the COMP-ANT-LOOP switch set to LOOP, rotate the loop antenna with the LOOP switch for an aural null. Maintain the heading and note the DG reading.

Step 2. Make a 90° left turn. Maintain this heading for 3 to 10 minutes, depending on ground speed and distance from station.

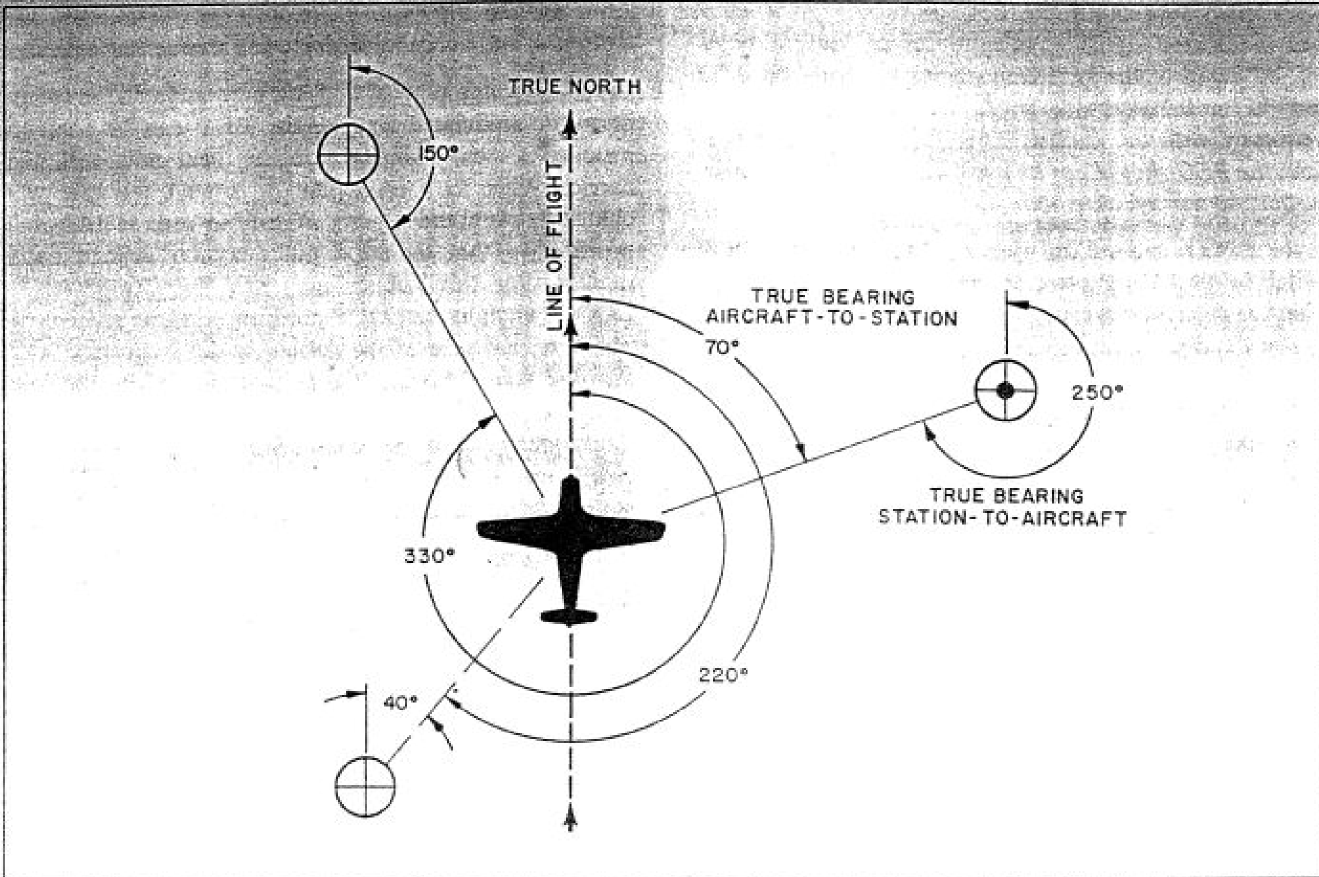
Step 3. Make a 90° right turn to return to the original course and note the DG reading.

Step 4. If the DG reading of Step 3 shows that the station is now to the right of the DG reading noted in Step 1, the station is ahead. If the new DG reading indicates the station is to the left of the original DG reading, the station is behind.

3–14. BFO OPERATION.

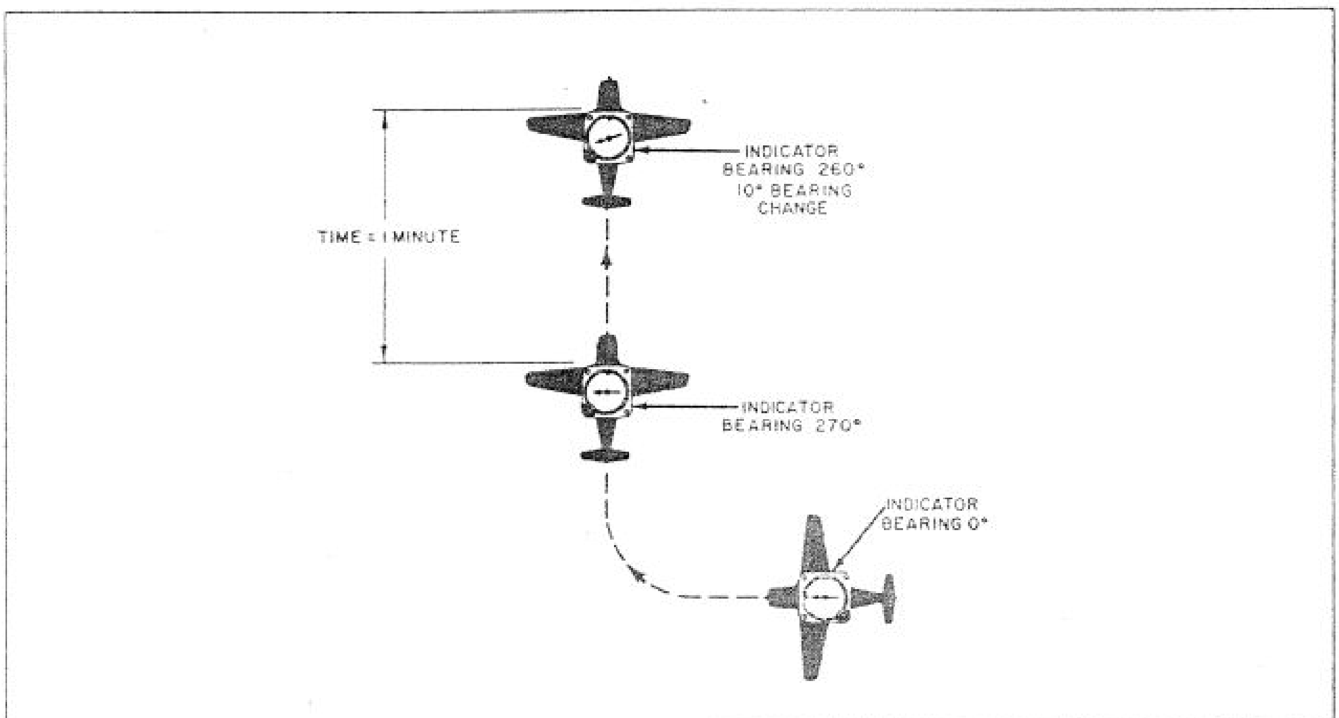
The BFO is used to identify CW transmissions occurring within the frequency range of the R-30A, such as those employed in areas outside the U.S.A., and to aid in determining aural nulls. For CW identification, the COMP-ANT-LOOP switch is placed in the ANT position; for aural null procedures, the switch is set to the LOOP position.

CW Signals. The BFO is used principally for the identification of CW signals. When the BFO is operating, a small voltage is injected into the i-f amplifier of the R-30A Receiver to produce a 900-cycle beat note with a properly tuned CW signal. This beat note (tone) appears in the audio output of the receiver. As the receiver is detuned slightly, the frequency of the beat note will change producing a different tone as heard in the headset. As the receiver is tuned from one side of the signal to the other, the tone will decrease from a high pitch to zero and then increase again on the other side of zero beat. Thus, there are two R-30A tunings which produce a 900-cycle tone, only one of which may be used for correct operation. Consequently, *when using the BFO, tune to the lower of the two closely adjacent dial readings at which a suitable tone is obtained.*



TP1437

Figure 3–5. Position Determination



TP1439

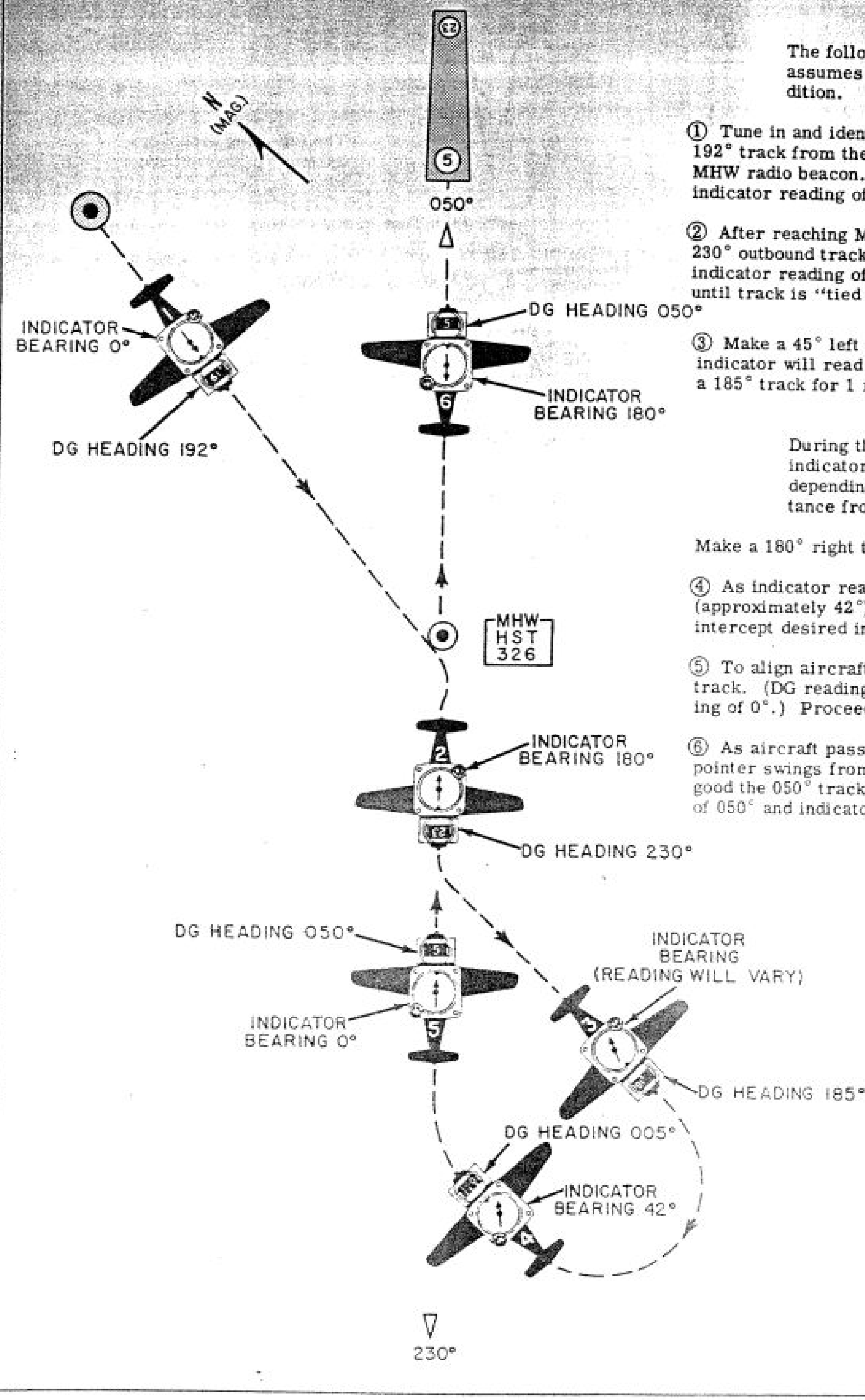
Figure 3–6. Time-from-Station Calculation

Modulated Signals. If the BFO is turned on when a tone-modulated signal is being received, output tones will be heard at the beat frequencies between the BFO and the modulation side-bands, as well as at the beat frequency with the carrier. Therefore, to avoid confusion, *the BFO should not be used when receiving a tone-modulated carrier.*

If the BFO is turned on with the COMP-ANT-LOOP switch in the COMP position, a beat note will be heard which is relatively weak when compared to that which can be obtained in the ANT position. This relative weakness is due to the avc action and the method of controlling the audio gain in the COMP position. Under this condition, the signal level is so high at the end of the i-f amplifier that the BFO produces only a very small percentage modulation of the i-f signal. Consequently, *never use the BFO with the COMP position; check the deflection of the tuning meter when tuning the receiver.*

Loop Operation with BFO. With unmodulated, or voice- or music-modulated signals, the BFO can be used to produce a steady single-frequency beat note with the carrier. When the loop antenna is rotated, this tone will change in amplitude, going sharply to zero at each null position so that an aural null may be defined quite readily. For this application, with the COMP-ANT-LOOP switch in the LOOP position, tune the receiver to obtain a beat note of the desired audio frequency, *with the dial turned toward the frequencies below the zero beat position.* Operate the LOOP switch to rotate the loop antenna until the tone drops off sharply in amplitude, and read the relative bearing of the transmitting station on the indicator.

NOTES



PROCEDURE

Note
The following procedure assumes a no-wind condition.

① Tune in and identify radio beacon. Fly a 192° track from the low-frequency radio fix to MHW radio beacon. (DG reading of 192°, indicator reading of 0°.)

② After reaching MHW, turn right and fly a 230° outbound track. (DG reading of 230°, indicator reading of 180°.) Continue outbound until track is "tied down."

③ Make a 45° left turn (at completion of turn indicator will read approximately 225°) and fly a 185° track for 1 minute.

Note
During this 1 minute flight indicator reading will change depending on aircraft's distance from track.

Make a 180° right turn and fly a 005° track.

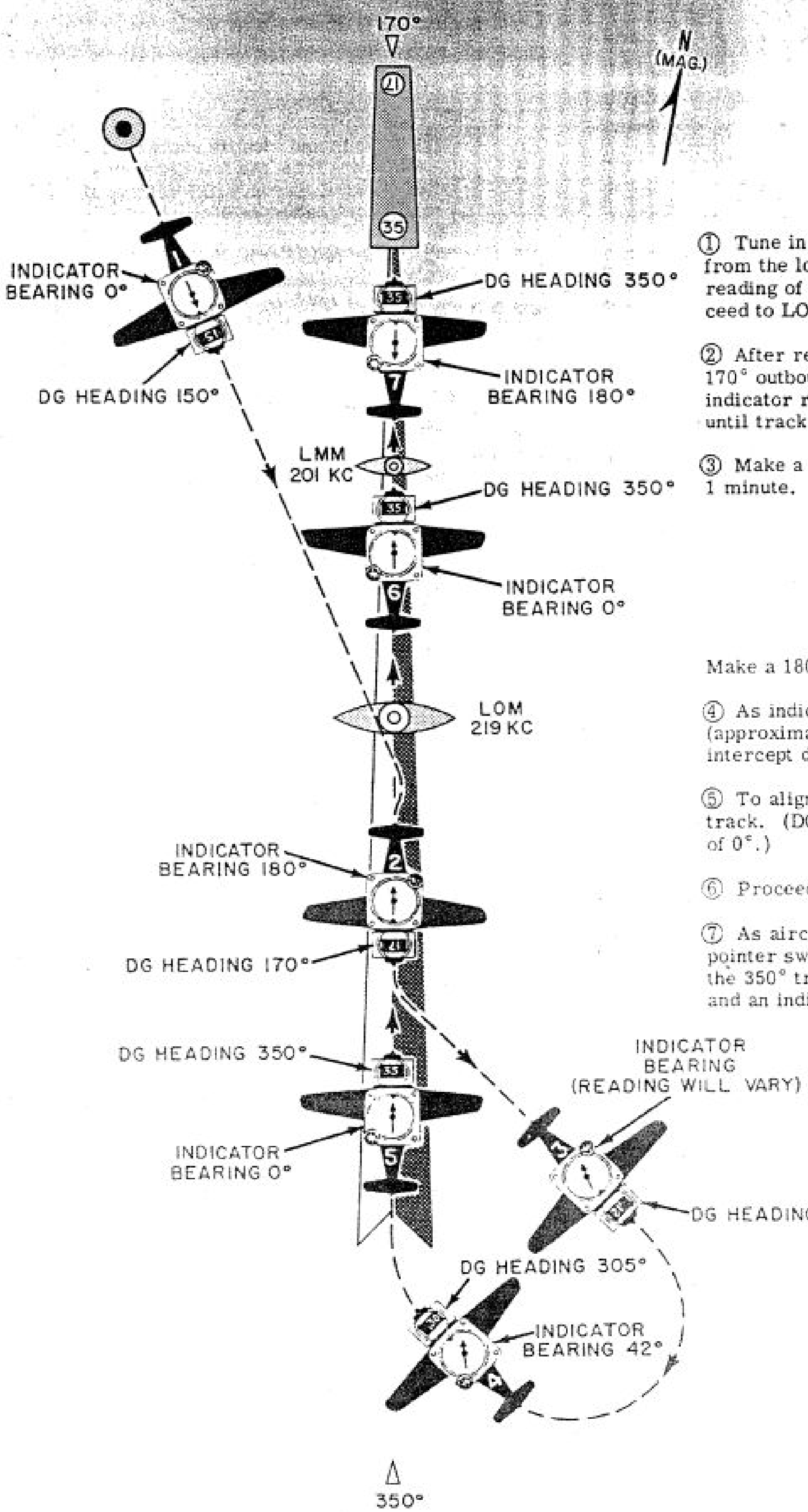
④ As indicator reading approaches 45° (approximately 42°), start a right turn to intercept desired inbound track.

⑤ To align aircraft with runway, fly a 050° track. (DG reading of 050°, indicator reading of 0°.) Proceed inbound over MHW.

⑥ As aircraft passes over MHW, indicator pointer swings from 0° to 180°. To make good the 050° track, maintain DG reading of 050° and indicator reading of 180°.

TP1441

Figure 3–7. Typical ADF Approach Using H Facility



PROCEDURE

Note

The following procedure assumes a no-wind condition.

① Tune in and identify LOM. Fly a 150° track from the low-frequency radio fix to LOM. (DG reading of 150°, indicator reading of 0°.) Proceed to LOM.

② After reaching LOM, turn right and fly a 170° outbound track. (DG reading of 170°, indicator reading of 180°.) Continue outbound until track is "tied down."

③ Make a 45° left turn and fly a 125° track for 1 minute. Tune in and identify LMM.

Note

Indicator readings will change depending on aircraft's distance from track.

Make a 180° right turn and fly a 305° track.

④ As indicator reading approaches 45° (approximately 42°), start a right turn to intercept desired inbound track.

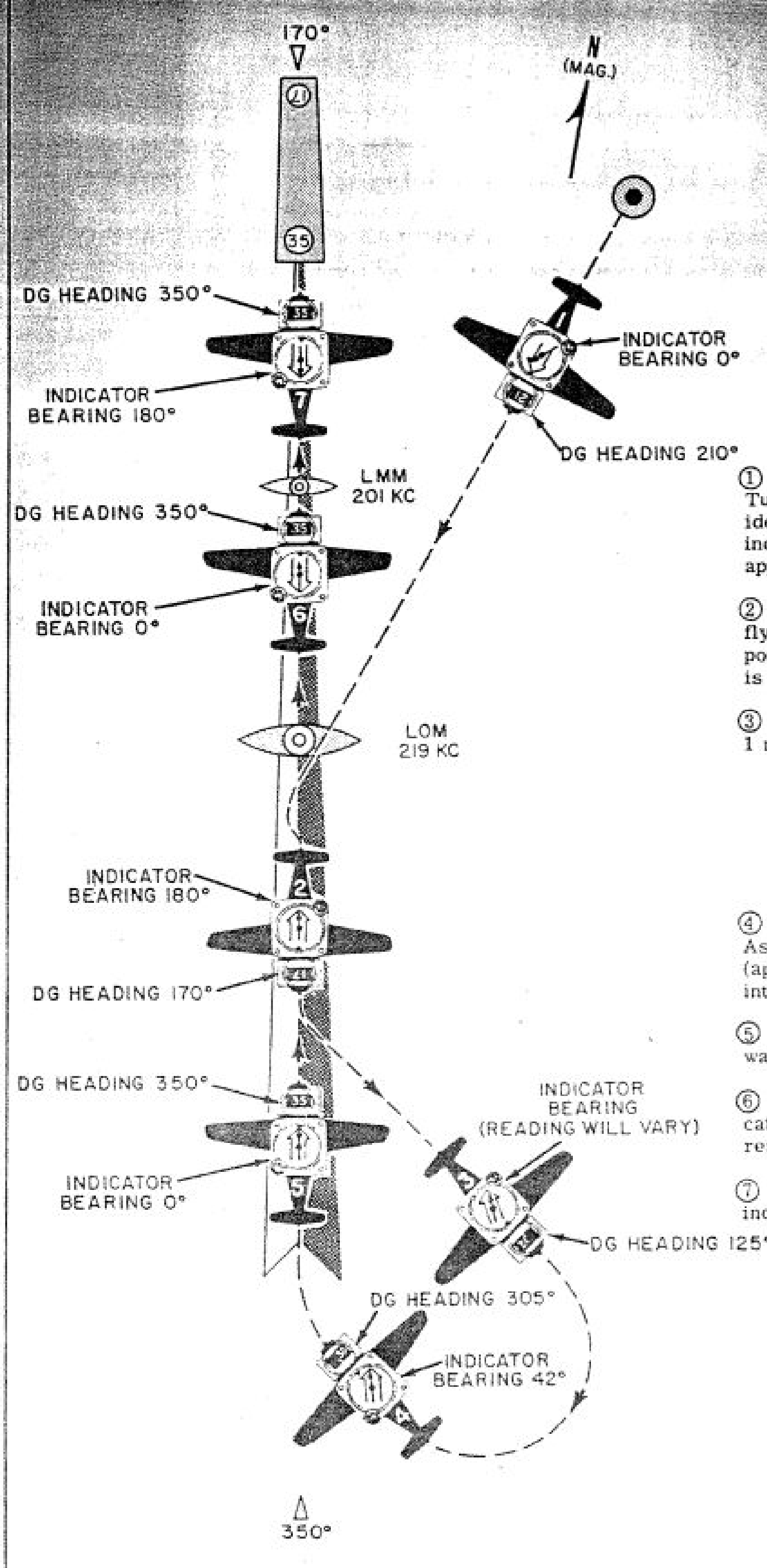
⑤ To align aircraft with runway, fly a 350° track. (DG reading of 350°, indicator reading of 0°.)

⑥ Proceed inbound over LOM.

⑦ As aircraft passes over LMM, indicator pointer swings from 0° to 180°. To make good the 350° track, maintain a DG reading of 350° and an indicator reading of 180°.

TP1443

Figure 3–8. Typical ILS/ADF Approach with Single ADF Installation



PROCEDURE

Note
The following procedure assumes a no-wind condition.

① Tune one ADF receiver to LOM and identify. Tune the other ADF receiver to LMM and identify. Proceed to LOM. Angle between indicator pointers will increase as aircraft approaches LOM.

② After reaching LOM, turn left (outbound) and fly a 170° track. (DG reading of 170°, indicator pointers at 180°.) Proceed outbound until track is "tied down."

③ Make a 45° left turn and fly 125° track for 1 minute.

Note
Indicator readings will change depending on aircraft's distance from track.

④ Make a 180° right turn and fly a 305° track. As the indicator pointers approach 45° (approximately 42°), start a right turn to intercept the desired inbound track.

⑤ When aircraft is correctly aligned with runway, both indicator pointers will read 0°.

⑥ When aircraft passes over LOM, one indicator pointer will swing to 180°, the other will remain at 0°.

⑦ When aircraft passes over LMM, the other indicator pointer will swing to 180°.

TP1445

Figure 3–9. Typical ILS/ADF Approach with Dual ADF Installation

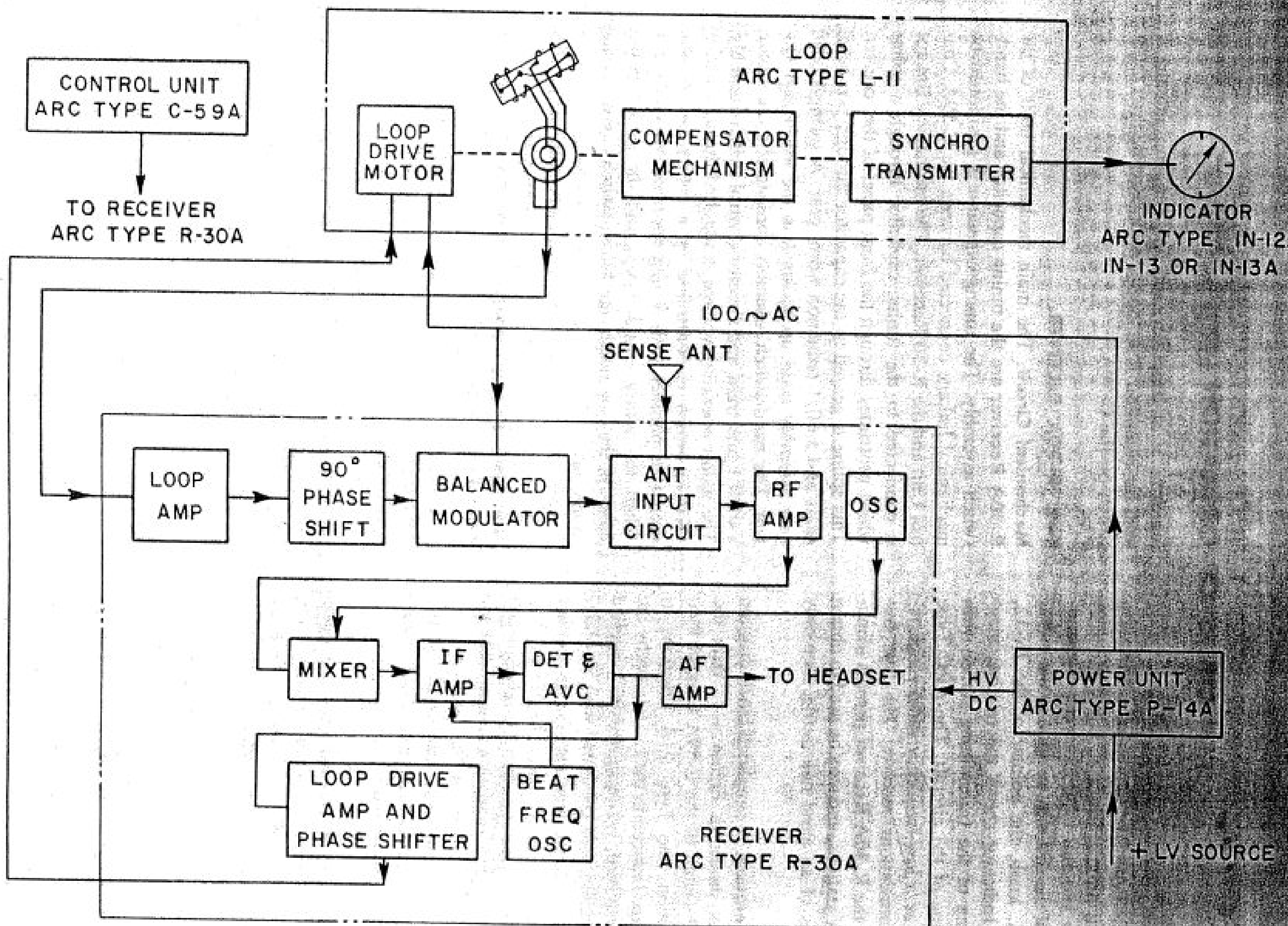


Figure 4–1. ARC Type 21A Automatic Direction Finder, Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4–1. OVERALL FUNCTIONAL DESCRIPTION.

General. The ARC Type 21A Automatic Direction Finder provides navigation bearings on any continuous radio signal between 190 and 1750 kilocycles. Depending on the position of the dial with relation to the index, as set by the VAR. knob, the pointer of the IN-12, IN-13, or IN-13A Indicator shows the relative, magnetic, or true bearing of the transmitting station with respect to the heading of the aircraft. The ARC Type 21A also functions as a low-frequency radio range receiver and a communications receiver. The beat frequency oscillator in the R-30A Receiver permits identification of keyed CW stations, and may be used to obtain improved indications of an aural null during loop-only operation.

Radio Compass Operation. A simplified block diagram of the Type 21A is shown in Figure 4–1. With the COMP-ANT-LOOP switch of the C-59A Control Unit in the COMP position, the Type 21A functions as follows: An r-f voltage induced in the L-11 Loop by the received signal is amplified, phase-shifted 90°, applied to a balanced modulator, and combined with a voltage induced in an omnidirectional sense antenna, to produce a resultant amplitude-modulated signal. In this arrangement, the phase of the modulation envelope reverses with respect to the phase of the modulation source when the loop passes through a null. Because the modulation envelope is detected in a conventional manner and applied to one winding of a two-phase loop-drive motor which has its other winding driven from a fixed-phase source, the direction of rotation of the loop-drive motor reverses at the null. In the Type 21A the 100-cycle modulation rate is supplied by an alternator winding on the P-14A Power Unit. The 100-cycle voltages from the alternator and from the amplified detector output are used to drive the loop motor.

Communication and Radio Range Operation. With the COMP-ANT-LOOP switch in the ANT position, the balanced modulator is de-energized and the R-30A functions as a conventional communication and low-frequency radio range receiver. The r-f voltage induced in the sense antenna is amplified and detected in the usual manner, and the audio output is fed to the headset.

Loop Operation. With the COMP-ANT-LOOP switch in the LOOP position, the sense antenna input is grounded, the balanced modulator is unbalanced and functions as an amplifier, and only the loop antenna is used for reception. The loop is positioned by the LOOP switch on the C-59A.

4–2. R-30A RECEIVER.

Mechanical Circuit. The main mechanical units of the R-30A Receiver are the tuning capacitor and the band-switch assembly. The tuning capacitor is positioned by mechanical linkage connected between the C-59A Control Unit and the R-30 Receiver. The mechanical linkage is connected to the tuning capacitor through a spline which protrudes through the front panel of the receiver. This spline is geared to the capacitor through two bevel gears and a 60:1 reduction worm gear. A spring-loaded gear assembly takes up backlash in the worm gear system. The band-switch assembly consists of a d-c motor, a 4000:1 gear train, and a motor-control switch assembly. The motor operating voltage is supplied through a relay (K101) which is controlled by a rotary switch connected in parallel with a cam-operated Micro Switch. When the rotary switch opens and the cam follower drops in the cam notch, the Micro Switch opens causing motor relay K101 to disconnect the voltage from the motor and short the motor terminals, thus acting as a dynamic brake. The Micro Switch serves as a fine control, since the cam rotates at three times the speed of the rotary switch shaft.

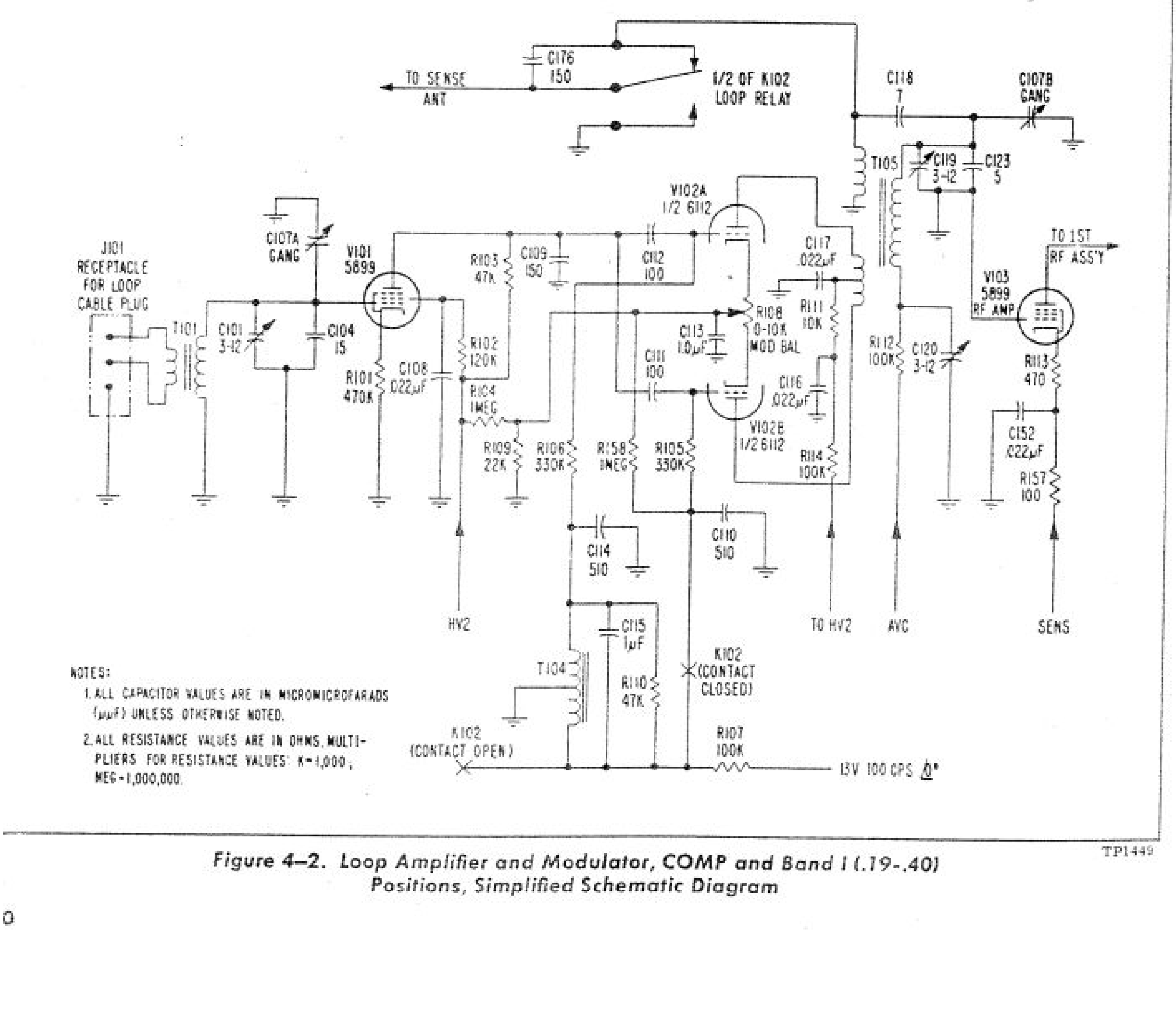
Circuit Description of Compass (COMP) Operation. The functioning of the R-30A circuits with the C-59A COMP-ANT-LOOP switch in the COMP position is described in the following paragraphs. A schematic diagram of the R-30A is shown in Figure 6–1.

Loop amplifier. The voltage from the loop antenna is applied to the primary of a loop transformer, T101, T102, or T103, depending on the band in operation (see Figure 4–2). The secondary of the loop transformer is tuned by C107A and is coupled to the loop amplifier, V101. C109 acts as a capacitor load for the loop amplifier and retards the phase of the loop voltage 90° beyond the 180° phase shift produced by V101. This voltage is either in phase or 180° out of phase with the sense antenna voltage.

Modulator. The output of the loop amplifier, V101, is fed equally to the grids of V102A and V102B, the modulator, through C111 and C112 (see Figure 4–2). The grids of V102A and V102B are also fed at opposite phases by the 100-cycle modulating voltage. The modulating voltage is supplied by the dynamotor-alternator of the P-14A Power Unit through T104. T104 is resonated to 100 cycles by C115. V102A and V102B have their plates connected to opposite ends of the center-tapped primary of antenna transformer T105, T106, or T107, depending on the band in operation. The modulating voltage causes first one triode section and then the other to amplify the signal, thereby transferring the signal from one end to the other of the center-tapped winding. As this action takes place, the voltage induced in the secondary winding of the selected antenna transformer reverses the r-f phase on alternate halves of the 100-cycle modulating voltage.

ANTENNA CIRCUIT. The sense antenna voltage is fed to a high-impedance winding of the same antenna transformer used by the modulator circuit (see Figure 4–2). The sense antenna voltage induces a signal voltage in the secondary of the antenna transformer. The signal voltage from the modulator adds to the induced sense antenna signal when one of the triode sections of V102 is amplifying, and subtracts from the induced sense antenna signal when the other section of V102 is amplifying. When the loop antenna is oriented on the other side of its null, the reverse action occurs. The result is a 100-cycle modulation applied to the incoming signal which is either in phase or 180° out of phase with the alternator voltage, depending on which side of the null the loop is oriented. The resulting 100-cycle modulated r-f signal is amplified by V103.

FIRST AND SECOND R-F CIRCUITS. The plate of the first r-f amplifier, V103, is connected to the primary of the first r-f transformer, T108, T109, or T110, depending on the band in use. The secondary is tuned by C107C. The secondary is low-side coupled to a tuned winding of an identical r-f transformer, T111, T112, or T113, depending on the band in use. A common impedance for these transformers is provided by L101, L102, or L103, respectively, depending on the band in use. The low-impedance winding of the second r-f transformer is fed through a miniature coaxial cable to the grid of the mixer tube, V105.



TP1449

Figure 4–2. Loop Amplifier and Modulator, COMP and Band I (.19-.40) Positions, Simplified Schematic Diagram

OSCILLATOR. The oscillator is a tuned-plate, grid-feedback oscillator (see Figure 4–3). Feedback takes place through C134. Series padding is provided for each of the three bands by C137, C139, or C140. The grid feedback winding of the oscillator is coupled directly to the mixer cathode for local oscillator injection. R119, bypassed by C136, serves as the d-c cathode load for the mixer. This resistor and capacitor are located in the oscillator section.

I-F AMPLIFIER. The oscillator frequency is 142.5 kc higher than the signal frequency when tuned on frequency, producing a 142.5-kc intermediate frequency. Double-tuned transformers are used for coupling between the mixer output and the two stages of i-f amplification, so that a total of three double-tuned i-f transformers is used.

DETECTOR. The second i-f amplifier output is coupled to the detector by a double-tuned transformer, Z109. The detector output, from the low side of the secondary in Z109, is filtered by C161, C163, and R130. R131 completes the d-c return.

AUDIO AMPLIFIER. The detector output is coupled to a conventional triode amplifier, V109B, for audio amplification. The output of V109B is coupled to the final audio amplifier, V110. The audio output level is controlled in the grid circuit of V110 by the volume control located in the C-59A Control Unit.

100-CYCLE AMPLIFIER. The detector output, at the junction of C163 and R131, is coupled to a 100-cycle loop amplifier whose output drives one phase of the loop motor. Coupling to the first amplifier section, V111, is through R141 and C169. The plate of V111 is coupled

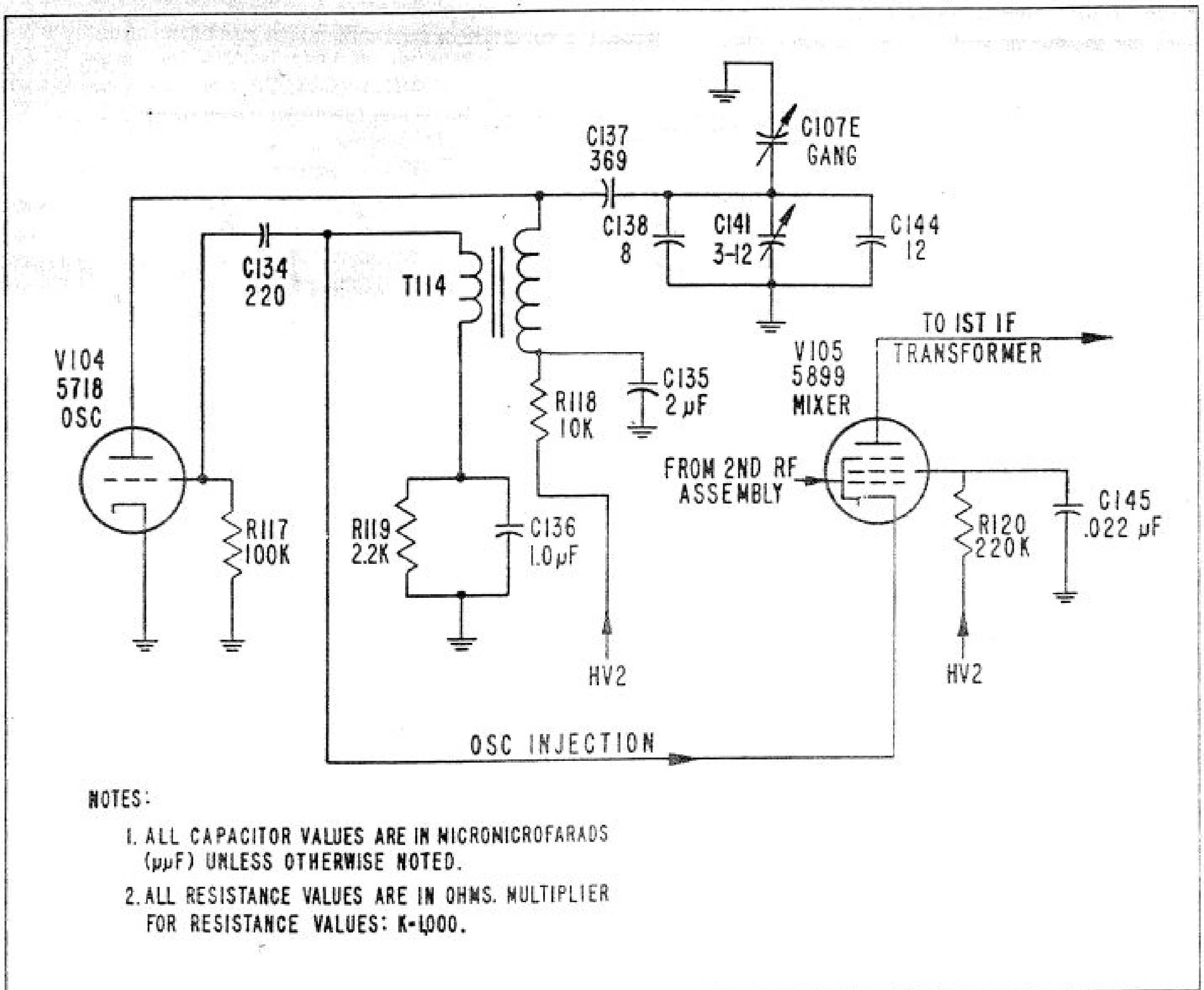


Figure 4–3. Oscillator and Mixer, Band 1 (.19-.40) Position, Simplified Schematic Diagram

to amplifier V112A through two resistor-capacitor filter combinations, R147-C170 and R148-C171. This filter suppresses harmonics of 100 cycles and, with other minor phase-shifting components, adjusts the phase relationship between the 100-cycle amplifier output and the 100-cycle supply to the fixed phase of the loop motor to 90°, as required for proper motor operation. V112B is a phase inverter whose output, with the output of V112A, drives push-pull stages V113 and V114. The output transformer for this 100-cycle amplifier is located in the P-14A Power Unit. The secondary of the output transformer is coupled to the loop motor through the interconnecting wiring of the equipment.

AVC CIRCUIT. The plate of the second i-f amplifier feeds terminals 5 and 7 of V108, which functions as the avc diode. Automatic volume control delay is accomplished by the avc clamp tube, V109A, and associated resistors R132, R133, and R134. When the detector output is below approximately −10 volts, developed at the detector diode plate, avc action does not take place. Prior to the avc point, avc clamp tube V109A is conducting because there is a positive voltage applied to the plate through R134. However, the avc line does not go positive due to the conducting action of the clamp tube. When the developed negative voltage at the avc detector plate, terminal 5 of V108, exceeds approximately −10 volts, the avc clamp tube stops conducting and the avc line goes negative. The amount that the avc line goes negative depends on the strength of the received signal. The avc voltage controls the grid bias of r-f amplifier V103, mixer V105, and first i-f amplifier V106.

DISABLING CIRCUIT. When the band selector is in operation, the audio output is eliminated in the cathode circuit of V109B to remove undesired noise. While the band selector is in operation, the primary input voltage, 27.5 or 13.75 volts dc, is applied to one end of R136 to bias V109B to cut-off so that no amplification takes place in this stage during band-switching.

Circuit Description of Antenna (ANT) Operation. When the C-59A COMP-ANT-LOOP switch is in the ANT position, the function of the R-30A circuits is the same as for compass operation, except for the modulator and volume control circuits.

MODULATOR. During ANT operation the modulator is de-energized by the COMP-ANT-LOOP switch which grounds terminal D of J103. Terminal D, which is connected to terminal 3 of Z103, removes plate voltage from the modulator by grounding the plate-end of series resistor R114.

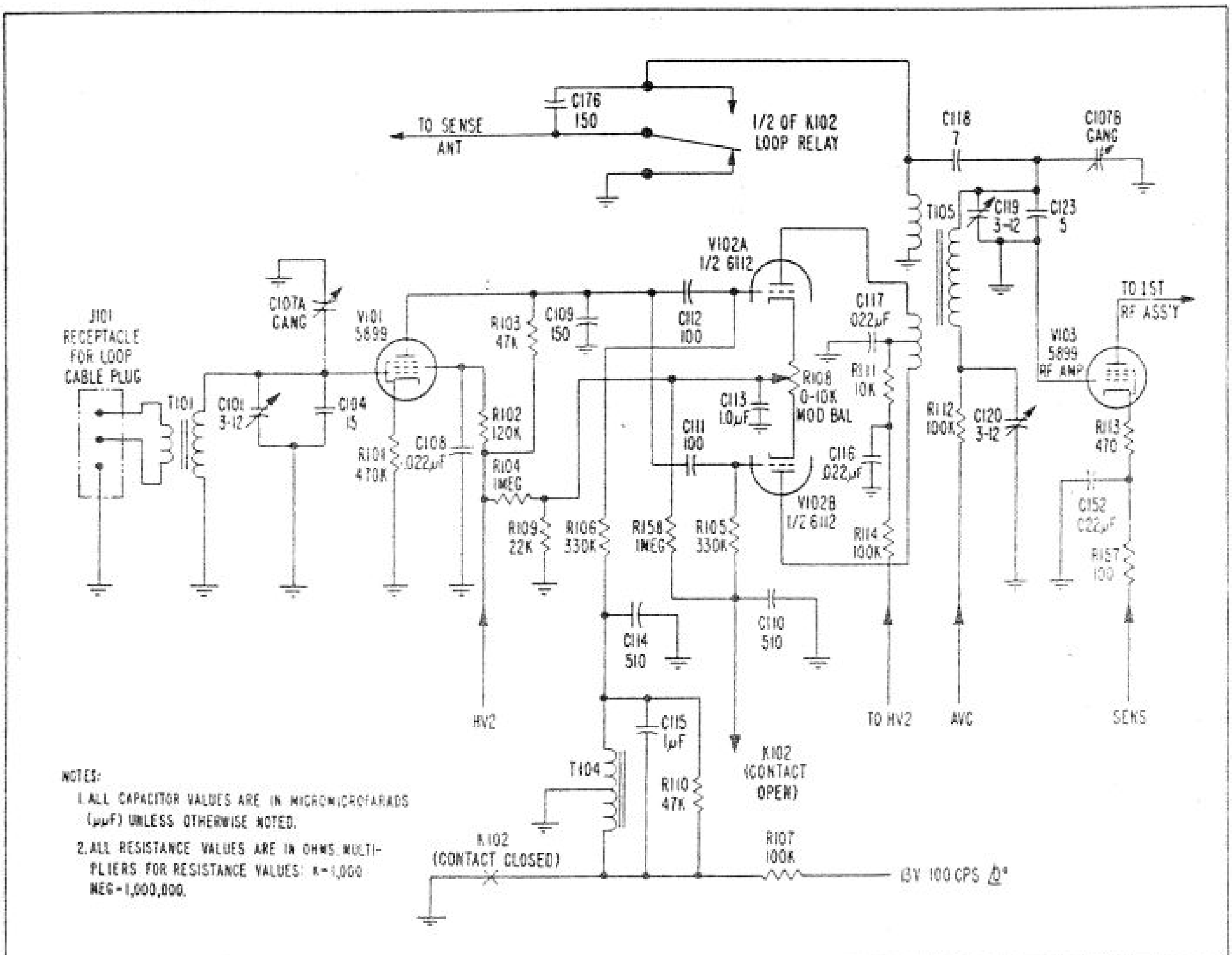
VOLUME CONTROL. During ANT operation, the VOL control in the C-59A is connected to control the r-f sensitivity of the receiver instead of the audio level by removing the ground connection from terminal K of J103 in the R-30A, and allowing the resistance between this point and ground to be varied by R201A located on the VOL control shaft. R201A varies the cathode bias of V103 and V106, the cathode loads of which are returned to terminal K of J103 (SENS line). R124 applies a limited amount of d-c current from the HV2 supply to the SENS line to insure a sufficient reduction in sensitivity under very high signal level conditions. The audio gain is held nearly constant at maximum gain during ANT operation. The COMP-ANT-LOOP switch disconnects the low side of the audio level potentiometer, R201B, from ground for ANT operation. By maintaining maximum audio gain and controlling the r-f sensitivity during ANT operation, the R-30A operates below the avc point when the audio output is set at a comfortable level. To eliminate the ambiguity of the A and N coded sidebands, operation below the avc point is desirable when receiving low-frequency radio range transmissions that do not have an omnidirectional radiated carrier.

Circuit Description of Loop (LOOP) Operation. When the C-59A COMP-ANT-LOOP switch is in the LOOP position, the R-30A functions the same as during compass (COMP) operation, except for the volume, antenna, and modulator circuits. The volume control circuit operates as during antenna (ANT) operation; that is, as an r-f sensitivity control. The differences in the antenna and modulator circuits are as follows: In the LOOP position, K102 in the R-30A is energized (see Figure 4-4). The relay contacts ground the sense antenna input, terminate the antenna transformer (T105, T106, or T107) in a 150-$\mu\mu$f capacitor to maintain optimum tuning, short out the 100-cycle input to the balanced modulator, and unbalance the modulator to make it function as an amplifier.

Beat Frequency Oscillator. The beat frequency oscillator (BFO) is a transistor tuned-collector oscillator, tuned to 143.4 kc. The output of the BFO is fed to the grid of V107, the second i-f amplifier, through C177. The operation of the BFO is controlled by the BFO switch on the C-59A. When the BFO switch is in the OFF position (switch closed), the junction of R159 and R160 is grounded removing B− from the transistor. When the BFO is operating, a small voltage (at 143.4 kc) is injected into the i-f amplifier so that a properly tuned CW signal passing through the i-f amplifier (at 142.5 kc) will produce a 900-cycle beat note with the BFO. After amplification, the 900-cycle signal appears in the audio output of the R-30A. If the receiver tuning is changed slightly, the signal frequency passing through the i-f amplifier is changed, and the beat note frequency (tone) will change correspondingly. As the R-30A is tuned from one side of the signal to the other, the beat note will decrease from a high audio-frequency to zero, and then increase again on the other side of zero beat; thus, there are two receiver tunings which will produce a 900-cycle tone. Since the i-f bandpass is narrow (6 db down at 4.5 kc), only one tuning may be used for proper operation. For example: If the R-30A tuning is increased by 1.8 kc from the proper point, the signal frequency in the i-f amplifier will become 144.3 kc, instead of 142.5 kc. This frequency will beat with the 143.4-kc signal from the BFO to produce a 900-cycle tone output again. While the tuned frequency is being increased, the tone output will decrease in frequency from 900-cycles to 0 and then rise again. Because of the narrow i-f bandpass, the centered 142.5-kc signal will be amplified as intended, but the 144.3-kc signal will be relatively attenuated; also, if the R-30A is tuned 1.8 kc on the high side of the desired frequency, interference may be encountered from signals on the adjacent channel. Therefore, the R-30A should be tuned to the *lower* of the two adjacent C-59A dial readings at which a 900-cycle tone is obtained.

4–3. L-11 LOOP.

A description of the mechanical characteristics of the L-11 Loop is given in paragraph 1–5. Directional properties of the loop are such that a minimum voltage is induced in its coil when the ferrite bar is in line with the line of travel of the received signal; a maximum voltage is induced when the loop is oriented 90° from this position. The loop voltage is 90° out of phase with respect to the sense antenna voltage and leads or lags the sense voltage, depending on which side of the null position the loop is oriented. The loop voltage phase reverses 180° as the loop is rotated through its null position. When the Type 21A is operating in the COMP position, the loop is driven to its null by a two-phase motor. One phase of input for this motor is derived directly from the 100-cycle output of the dynamotor-alternator on the P-14A Power Unit; the other is obtained from the R-30A Receiver. The direction in which the motor drives the loop depends on whether the loop voltage leads or lags the sense voltage. The same end



TP1453

Figure 4–4. Loop Amplifier and Modulator, LOOP and Band I (.19-.40) Positions, Simplified Schematic Diagram of the ferrite bar always points toward the station, thereby preventing 180° ambiguity of the reading. Loop-position information is transferred to the indicator by a synchro transmitter contained in the L-11 Loop, and a synchro receiver contained in the indicator. Since the direction-of-signal arrival may be distorted by the aircraft structure, causing the indicated bearing to be in error, the angular position of the loop synchro may be modified by an adjustable, mechanical compensating system. The compensating system (described in paragraph 1–5) is located between the loop shaft and the shaft of the synchro-transmitter.

4–4. C-59A CONTROL UNIT.

General. The ARC Type C-59A Control Unit includes a COMP-ANT-LOOP switch, a VOL control, a LOOP switch, a tuning crank, a tuning meter, a BFO switch, and an MC BAND switch. The functions of these controls are described in paragraph 1–5 and Table 3–1. When the COMP-ANT-LOOP switch is in the COMP position, the loop and modulator circuits of the receiver are energized and the VOL control functions as an audio level control, with the r-f sensitivity controlled by avc action. In the ANT position, the loop and modulator circuits are de-energized and the VOL control becomes an r-f sensitivity control. In the LOOP position, the modulating voltage is removed, the balanced modulator is unbalanced, the sense antenna input is removed, and the VOL control functions as an r-f sensitivity control.

COMP Operation. With the COMP-ANT-LOOP switch in the COMP position, the C-59A circuit is connected as follows:

1. The negative terminal of the tuning meter, M201, is grounded by S204, which grounds terminal P of J201 through the tuning meter. Under this condition, the R-30A operates at a maximum r-f gain with no signal, and the gain is regulated by avc action according to signal strength.

2. The cathode current of the r-f and first i-f amplifiers in the R-30A flows through the tuning meter. The meter is arranged with a zero-current indication at the right. With no signal input, the meter reads to the left because there is minimum bias and maximum current flow through the r-f and first i-f amplifier tubes. As the signal input is increased, the negative avc voltage increases and the total cathode current decreases, causing the meter to read further to the right.

3. The low side of R201B is grounded so that the VOL control functions to control the audio output of the R-30A.

4. The low side of the 100-cycle output transformer (T301 in the P-14A) is grounded (through L of J301) by S204 to complete the loop motor drive circuit for COMP operation.

5. The MC BAND selector switch, S203, grounds terminal F, G, or H of J201, as required.

6. The LOOP switch, S201, permits connecting terminal K of J201 to either terminal L or M. Terminal L is connected directly to the 100-cycle output of the dynamotor-alternator in installations where the sense antenna is belly-mounted. Terminal M, connected to a phase reversing transformer (T302) in the P-14A, provides a voltage 180° out of phase with the voltage on terminal L. In top sense antenna installations, terminals L and M are interchanged by the interconnecting wiring. The power on-off switch, S202, which is part of the VOL control, grounds terminal Q of J201 when the equipment is turned on to energize the power relay in the P-14A.

ANT Operation. With the COMP-ANT-LOOP switch in the ANT position, the C-59A circuit is connected as follows:

1. Terminal R of J201 is grounded to remove the plate voltage from the R-30A modulator circuit, thereby disabling the loop circuits.

2. R201A is connected into the circuit so that the VOL control functions as an r-f sensitivity control. The low end of R201B is removed from ground. The audio gain is then always near its maximum value.

3. In ANT operation, the tuning meter is affected by the position of the VOL control. The tuning meter reads further to the right as the r-f gain of the receiver is decreased by turning the VOL control counterclockwise.

LOOP Operation. With the COMP-ANT-LOOP switch in the LOOP position, the C-59A circuit is connected as follows:

1. Terminal N of J201 is grounded to energize the loop relay, K102, in the R-30A.

2. Terminal 11 of S204 is disconnected from ground, and terminal P of J201 is grounded through R201A so that the VOL control functions as an r-f sensitivity control. Terminal 8 of S204 is disconnected from ground, opening the low side (terminal 5 of T301) and preventing the loop motor from being energized by noise output from the 100-cycle amplifier so that the loop does not wander.

3. The low end of R201B is disconnected from ground and the audio gain is always near its maximum value.

4. The tuning meter is affected by the position of the VOL control. The tuning meter reads further to the right as the r-f gain of the receiver is decreased by turning the VOL control counterclockwise.

5. The LOOP switch, when held either to the left or right, supplies the 100-cycle signal to the loop motor in

such phase as to drive the loop either counterclockwise or clockwise. One side of the switch reconnects ground to terminal 5 of T301 in the P-14A (through terminal L of the P-14A connector) to complete the motor drive circuit. The other side of the switch connects the 100-cycle voltage of either the 0° or 180° phase to V111 of the 100-cycle amplifier to provide drive to the loop motor through the amplifier and T301.

4—5. P-14A POWER UNIT.

The ARC Type P-14A Power Unit operates from the aircraft's primary power source and delivers all the power required to operate the Type 21A. The P-14A consists of a dynamotor-alternator, filter components for the d-c supply, a power relay, a phase-reversing transformer, and an output transformer for the 100-cycle amplifier. The dynamotor-alternator supplies the a-c power required to energize the loop motor and synchro system, and the d-c power required by the electron tubes. The dynamotor-alternator is speed-regulated by a centrifugally actuated switch. A 125-ohm resistor is connected in series with the field. The centrifugally actuated contacts on the speed governor shunt the 125-ohm resistor when closed. The operation of the motor section and speed governor of the dynamotor-alternator is described in the following paragraph.

Initially the contacts of the speed regulator are closed to provide maximum field current for maximum starting torque. When the motor is energized and the armature speed increases, the governor contacts open. The 125-ohm resistor decreases the shunt field current causing an increase in armature speed. When the armature reaches the desired speed, the contacts close and allow full current to flow through the shunt field. The shunt field action tends to decrease the armature speed. The speed governor contacts open and close as necessary to maintain a constant speed. The speed regulator commutator is split into two segments so that the current through the contacts is reversed during each armature revolution. Reversing the current through the contacts retards "pitting" and "pile-up" on the contact surfaces. L301 and C304 form a filter at the input of the P-14A to filter out unwanted noise that may originate from the aircraft's primary supply. L302 and L303, plus C303, C305, and C306, filter the dynamotor-alternator high-voltage d-c output. L304 isolates the R-30A electron tube filaments from the low-voltage source and the dynamotor-alternator. R301 decreases the voltage applied to the R-30A electron tube filaments so that the average filament voltage on each tube is 6.3 volts when the aircraft's supply is 27.5 volts (this resistor is not used in 14-volt equipments). K301 is the power relay for the ARC Type 21A ADF. The relay is energized when terminal D of J301 is grounded. T301 is the output transformer for the 100-cycle amplifier stage in the R-30A. The input to T301 is from the push-pull amplifier, V113 and V114, in the R-30A. The output of T301 drives one phase of the two-phase loop motor.

The P-14A includes a provision to stabilize the orientation of the loop antenna during LOOP operation. To achieve stabilization, terminal 5 of the 100-cycle output transformer is disconnected from ground when the C59A COMP-ANT-LOOP switch is in the LOOP or ANT position.

4—6. IN-12, IN-13, AND IN-13A INDICATORS.

Two types of indicators may be used with the ARC Type 21A ADF. The ARC Type IN-12 Indicator, used in single ADF installations, is a hermetically sealed unit consisting of a synchro receiver driving a single pointer, and a dial. The dial may be positioned by rotating the variation (VAR.) knob. The synchro receiver rotor orients itself to the same angular position as the synchro transmitter in the L-11 Loop.

The ARC Type IN-13 and IN-13A Indicators, used in dual ADF installations, each contain two synchro receivers driving separate pointers on the same axis of rotation; the synchros are also on the same axis, with the shaft of the rear unit passing through a hollow shaft of the forward synchro. Like the IN-12, the IN-13 and IN-13A are hermetically sealed, and the dial may be rotated by the VAR. knob. The IN-13A is identical to the IN-13 except that the ground connection of each synchro is connected to a separate terminal on the connector, instead of to a common terminal, to isolate the synchro circuits.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

This section includes a system trouble-shooting chart, receiver test and alignment procedures, and other maintenance data. Individual unit performance may be checked by substituting a reliable unit and making a comparative test. Understanding the principles of operation of the equipment, as described in Section IV; referring to the schematic diagrams in Section VI; and making comparative stage gain, voltage, and resistance measurements will aid in localizing trouble.

5-2. SYSTEM TROUBLE-SHOOTING CHART.

Table 5-1 is a system trouble-shooting chart supplied as an aid in localizing trouble to a particular unit, and in some cases to a particular circuit or part. The procedures described are based on trouble-shooting the equipment while installed in the aircraft, though they may also be used when bench-testing the equipment. Units causing equipment failure may also be located by substituting a reliable unit. If the fault cannot be corrected with the equipment installed in the aircraft, either the suspected units or the complete equipment may be removed for a bench test.

Note

Do not remove the L-11 Loop from the aircraft unless absolutely necessary.

If a bench test is required, the use of the ARC Type BTK-21 Bench Test Kit will be helpful.

TABLE 5-1. SYSTEM TROUBLE-SHOOTING CHART

Symptom	*Probable Trouble*	*Procedure*
Indicator pointer shows station bearing on one or two bands only during COMP operation. (Loop rotates normally when LOOP switch is operated.)	Failure in r-f section of receiver.	Remove receiver for bench test. Make stage gain measurements (refer to Table 5-5).
Indicator pointer does not show station bearing on any band, or rotates to station bearing too slowly during COMP operation. (Loop rotates normally when LOOP switch is operated.)	Poor sensitivity (refer to *Procedure*).	Tune receiver to known weak station and check sensitivity of reception during ANT and LOOP operation. Localize trouble as follows:
	a. Failure in r-f or i-f section of receiver.	a. If sensitivity is poor for both ANT and LOOP operation, remove receiver for bench test. Make stage gain measurements (refer to Table 5-5).
	b. Loop cable assembly opened or shorted, or braided shield damaged. Failure in loop amplifier, Z101, or modulator, Z102, of receiver. Defective loop antenna.	b. If sensitivity is normal for ANT but poor for LOOP operation, check loop cable assembly; check component parts of Z101 and Z102. Replace loop if proved defective.
	c. Defective sense antenna cable or sense antenna.	c. If sensitivity is normal for LOOP but poor for ANT operation, check sense antenna cable for open or short; check condition and installation of sense antenna.
	d. Failure in control unit or defective interconnecting wiring.	d. If sensitivity is normal for both ANT and LOOP operation, check condition and operation of COMP-ANT-LOOP switch in control unit. Make continuity check of interconnecting wiring (see Figure 2-20, 2-21, or 2-22).

TABLE 5–1. SYSTEM TROUBLE-SHOOTING CHART — Continued

Symptom	Probable Trouble	Procedure
Indicator pointer does not rotate. (Receiver sensitivity normal during ANT operation.)	Loop not rotating (refer to *Procedure*).	Switch to LOOP operation, tune in strong station, operate LOOP switch, and check for aural nulls. If signal does not pass through nulls, loop is not rotating. Localize trouble as follows:
	a. Defective interconnecting wiring.	a. Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	b. Defective COMP-ANT-LOOP switch in control unit.	b. Set COMP-ANT-LOOP switch to COMP. Remove bottom cover from power unit. Make ohmmeter check that terminal 5 of T301 is connected to ground; if not grounded, switch is defective or trouble is in interconnecting wiring.
	c. Incorrect a-c output from dynamotor-alternator of power unit.	c. Remove bottom cover from power unit. Measure value and frequency of 100-cycle voltage between terminals C and E of J301; should be 13(±1) volts ac, 100(±3) cps.
	d. 100-cycle amplifier in receiver or output transformer T301, in power unit defective.	d. Make continuity check of T301. Make stage gain measurement of 100-cycle amplifier (refer to Table 5–5).
	e. Defective loop motor or loop gearing.	e. Measure resistance between terminals D and E of loop (approximately 500 ohms). Temporarily connect loop known to be good (do not install) in place of installed loop. If substitute loop rotates normally when LOOP switch is operated, remove installed loop for overhaul.
	Loop rotating (refer to *Procedure*).	If aural nulls are present indicating loop is rotating, localize trouble as follows:
	a. Failure of synchro-transmitter, B402, in loop.	a. Measure resistance of B402 (refer to Table 5–6).
	b. Failure of synchro in indicator.	b. Measure resistance of synchro in indicator (refer to Table 5–8, 5–9, or 5–10).
	c. Defective interconnecting wiring.	c. Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	d. Friction in bearings of indicator.	d. Remove indicator for bench tests.
Indicator pointer rotates to station bearing too slowly during COMP operation, and also when LOOP switch is operated.	Incorrect a-c output from dynamotor-alternator power unit.	Remove bottom cover from power unit. Measure value and frequency of 100-cycle voltage between terminals C and E of J301; should be 13(±1) volts ac, 100(±3) cps.
	Failure in 100-cycle amplifier in receiver.	Remove receiver for bench test. Make stage gain measurements of 100-cycle amplifier (refer to Table 5–5).
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	Defective loop motor or loop gearing.	Measure resistance between terminals D and E of loop (approximately 500 ohms). Temporarily connect loop known to be good (do not install) in place of installed loop. If substitute loop rotates normally when LOOP switch is operated, remove installed loop for overhaul.
Indicator pointer rotates too rapidly with no signal input (drift greater than 180° in 30 seconds).	Modulator Z102 in receiver unbalanced.	Adjust R108 (refer to *Balanced Modulator Adjustment* in Table 5–4).
	Excessive noise from loop or loop cable assembly.	Disconnect loop cable at receiver. If rotation speed is reduced significantly, trouble is in loop or loop cable assembly.
	Defective V102 or associated circuit components of Z102 in receiver.	Remove receiver for bench test.

TABLE 5–1. SYSTEM TROUBLE-SHOOTING CHART — Continued

Symptom	Probable Trouble	Procedure
oisy reception.	Interference from outside source.	Shut off aircraft engines and all other equipment except Type 21A. Check reception.
	Poor ground connections.	Check all ground connections. Check ground straps on receiver and power unit mountings.
	Defective sense antenna.	Check receiver reception in ANT position of known weak station.
	Defective loop or loop cable assembly.	Check receiver reception in LOOP position of known weak station.
	Faulty power unit or receiver.	Remove power unit or receiver for bench test.
:ceiver fails to switch bands in y one or all positions of MC \ND switch.	Defective motor or gear train in band selector, Z110, in receiver.	Set MC BAND switch successively to Bands I, II, and III. Check if voltage exists across terminals of motor, B101. If voltage exists, motor or gear train is defective. If voltage does not exist, check other probable troubles.
	Common terminal of MC BAND switch, S203, in control unit not grounded.	Make continuity check from terminal C of J201 to ground.
	Failure of MC BAND switch, S203, in control unit, or defective interconnecting wiring.	Disconnect plug from J103 of receiver. Make continuity check from plug terminals F, G, and H, to ground, with MC BAND switch in Band I, II, and III positions, respectively.
	Band selector, Z110, in receiver defective.	If previous test procedures indicated no voltage across motor terminals, and proper continuity at terminals F, G, and H of plug connected to J103, check K101, S107, and S108 of Z110 in receiver.
·eiver switches bands contin- y with MC BAND switch ny position.	Contacts of K101 (normally closed) in receiver not making positive contact.	Burnish and adjust contacts of K101. Check bandswitch operation (refer to Step 2 of *Bandswitch Operation* in Table 5–3).
	Cam follower arm of S107 in receiver rides beyond bottoming of cam.	Adjust S107 so that switch opens just before cam follower arm reaches bottom of cam notch. Check bandswitch operation (refer to Step 2 of *Bandswitch Operation* in Table 5–3).
	Two interconnecting wires to band selector, Z110, in receiver shorted to ground.	Disconnect plugs from J103 of receiver and J201 of control unit. Make continuity check from plug terminals F, G, and H to ground with MC BAND switch in Band I, II, and III positions, respectively.
	Two switch contacts of S108 in receiver or S203 in control unit shorted to ground.	Check visually and make continuity check.
	Defective S107 of Z110 in receiver.	Check visually and make continuity check.
:ver switches bands contin- with MC BAND switch in ·wo of the three bands.	Interconnecting wire of one band shorted to ground.	Disconnect plugs from J103 of receiver and J201 of control unit. Make continuity check of interconnecting wires. (Band not switching continually has shorted lead.)
	Contact of S108 in receiver or S203 in control unit shorted to ground.	Check visually and make continuity check.
	Two of three band selector interconnecting wires shorted to each other.	Disconnect plugs from J103 of receiver and J201 of control unit. Make continuity check of interconnecting wires. (Band which does not continually switch is normal; short is between remaining two bands.)
	Two switch contacts of S108 in receiver or S203 in control unit shorted to each other.	Check visually and make continuity check.

TABLE 5–1. SYSTEM TROUBLE-SHOOTING CHART — Continued

Symptom	Probable Trouble	Procedure
Indicator points 180° from correct station bearing. **Note** **Erroneous directional information may be given during checks on the ground due to reflections from nearby buildings, power lines, etc. Make suitable flight checks to be sure trouble actually exists.**	Defective synchro receiver in indicator.	Compare synchro receiver resistance measurements with those listed in Table 5–8, 5–9, or 5–10.
	Defective synchro transmitter, B402, in loop.	Compare synchro transmitter resistance measurements with those listed in Table 5–6.
	Defective or incorrect wiring between loop and indicator.	Check interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	Terminal 3 of Z105 shorted to ground.	*With ohmmeter positive probe grounded*, check that resistance of avc bus to ground is at least 100,000 ohms. Make this measurement with receiver cold.
	Defective loop transformer (T101, T102, or T103) or defective antenna transformer (T105, T106, or T107) in receiver.	If fault occurs on one band only, loop or antenna transformer of that band probably defective; remove receiver for bench test.
	Defective governor assembly or governor assembly brushes in power unit (incorrect a-c output from dynamotor-alternator).	Remove bottom cover of power unit. Measure value and frequency of 100-cycle voltage between terminals C and E of J301: should be 13(±1) volts ac, 100(±3) cps.
In COMP position, indicator pointer moves left when aircraft is turned left, and right when aircraft is turned right.	Incorrect interconnecting wiring at power unit, control unit, or indicator (refer to note 4, 5, or 6 of Figure 2–20, 2–21, or 2–22, respectively).	Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
No audio output; equipment functions normally otherwise.	Audio cut-off because of band-switching failure.	Check operation of MC BAND switch and switching mechanism.
	Defective audio volume control.	Measure resistance between terminals O and E of J201 in control unit. Resistance should vary from 0 to 100,000 ohms as VOL control is varied from maximum clockwise to maximum counterclockwise position.
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	Defective receiver.	Remove receiver for bench test.
Type 21A inoperative in all functions including failure to switch bands.	No low voltage supplied to power unit.	With primary power on, determine whether dynamotor-alternator is running. If not, check for low voltage between terminals C and I of plug connected to J301 of power unit.
	Failure in power unit.	Make continuity check between terminal D of plug connected to J301 and ground, with power switch on control unit turned on. If continuity exists, remove power unit for bench test.
	No primary voltage to receiver.	If dynamotor-alternator rotates with primary power on, check for low voltage at terminal A of plug mating with J103 of receiver.
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).
	Defective receiver.	Remove receiver for bench test.
Receiver switches to all bands, but is inoperative in any function; no audio output.	No B+ to receiver.	Operate LOOP switch. If indicator pointer rotates, B+ is present in receiver. If pointer does not rotate, check for B+ between terminal J of J301 and ground, and terminal K of J301 and ground, in power unit. Remove receiver for bench test.
	Defective receiver.	Remove receiver for bench test.
Type 21A inoperative except in COMP operation.	Defective r-f sensitivity control, R201A, in control unit.	Remove rear cover from control unit. Measure resistance of R201A.
	Defective interconnecting wiring.	Check continuity of interconnecting wiring (see Figure 2–20, 2–21, or 2–22).

;. REPLACEMENT OF PARTS IN R-30A RECEIVER.

eral. Except for some parts in the r-f assemblies, tubes and most of the other electrical parts in the iver can be replaced without disassembly. Figures 3 through 5–23, included at the end of this section, aid in locating and identifying the parts by their matic reference designations. After a part has been iced, the operation of the equipment should be re-:ked. If any parts are replaced in the r-f assemblies, receiver should be realigned and tested, as described 'ables 5–3 and 5–4.

'acement of Parts in I-f/A-f Circuits. The parts of i-f/a-f circuits are mounted on a hinged terminal 'd. To expose these parts, remove the receiver dust r. Unscrew the conical stud and the screw located to the left of J103 on the front panel. Set the tuning capacitor to its fully meshed position (maximum capacity). From the top of the receiver chassis, remove the screw near the rear of the capacitor and the screw near the middle of the capacitor. Turn the receiver over and fold the terminal board down.

Replacement of Tubes. All tubes in the R-30A Receiver are subminiature types. These tubes use flexible leads which are soldered directly to a terminal point. When replacing a tube, the new tube should be oriented and its leads routed as nearly like the original installation as possible. Figure 5–1 is a tube location diagram. Tube wiring diagrams showing proper orientation and lead routing are shown in Figures 5–2 through 5–7. When replacing a tube, do not precut the leads before installation, keep the spacing between leads at least 1/16 inch, and use a minimum amount of solder.

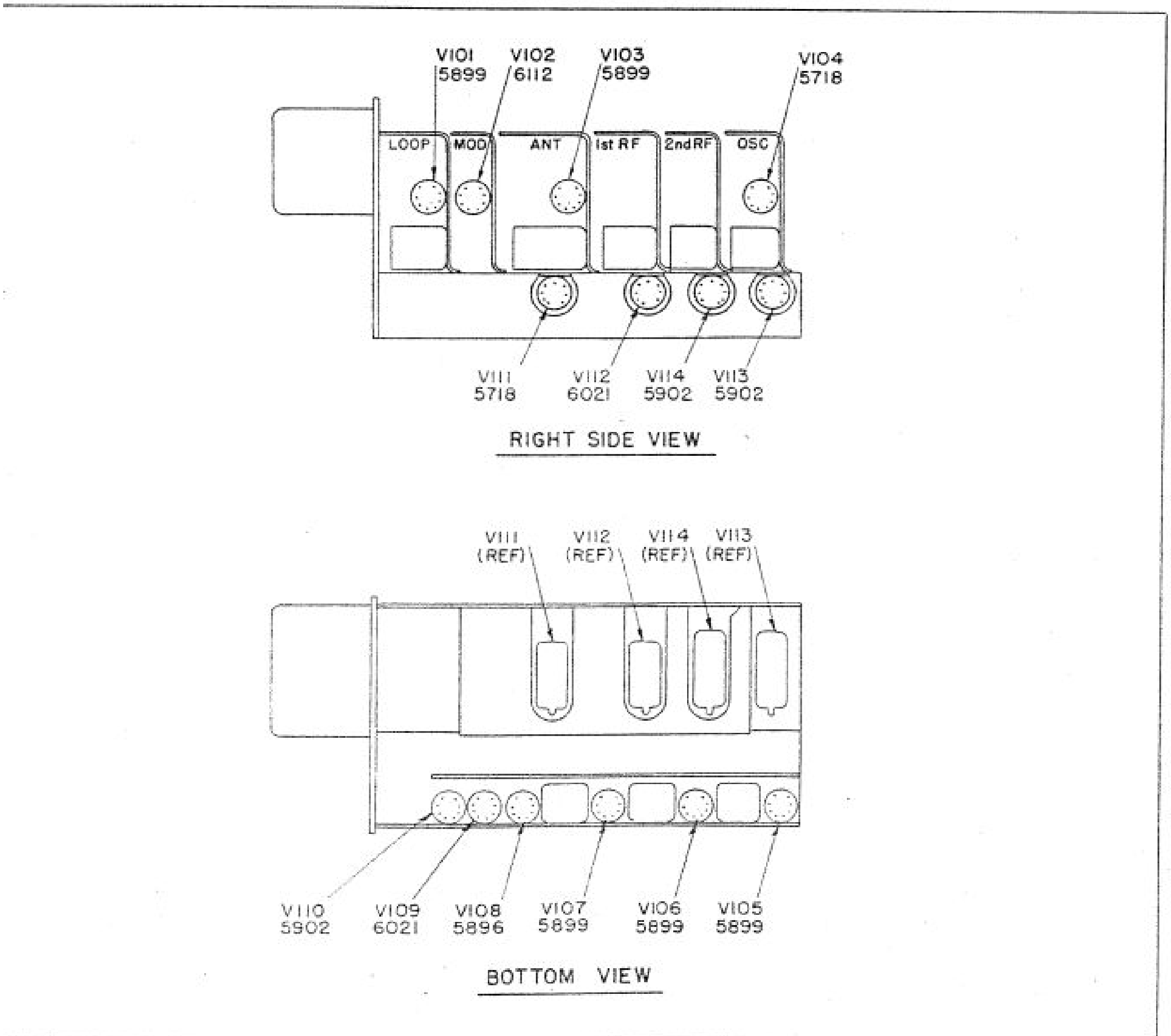
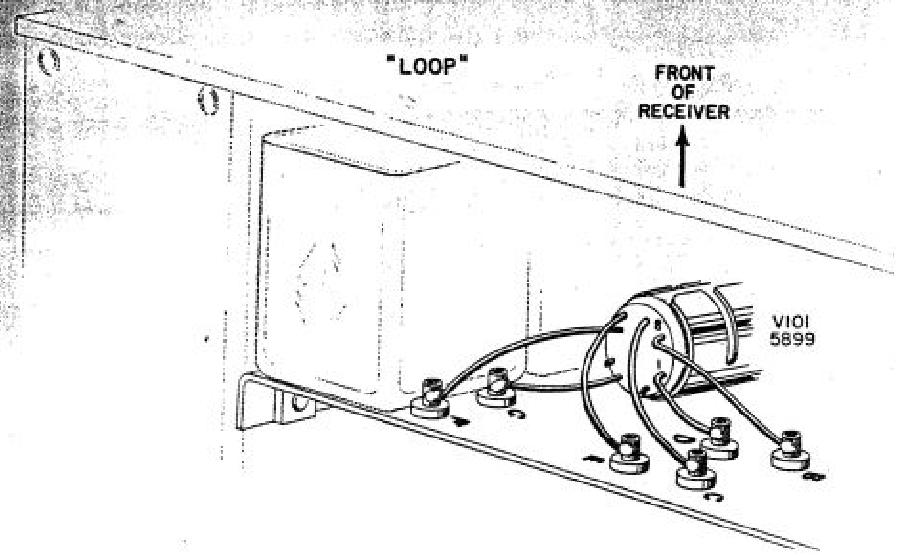


Figure 5–1. ARC Type R-30A Receiver, Tube Location Diagram

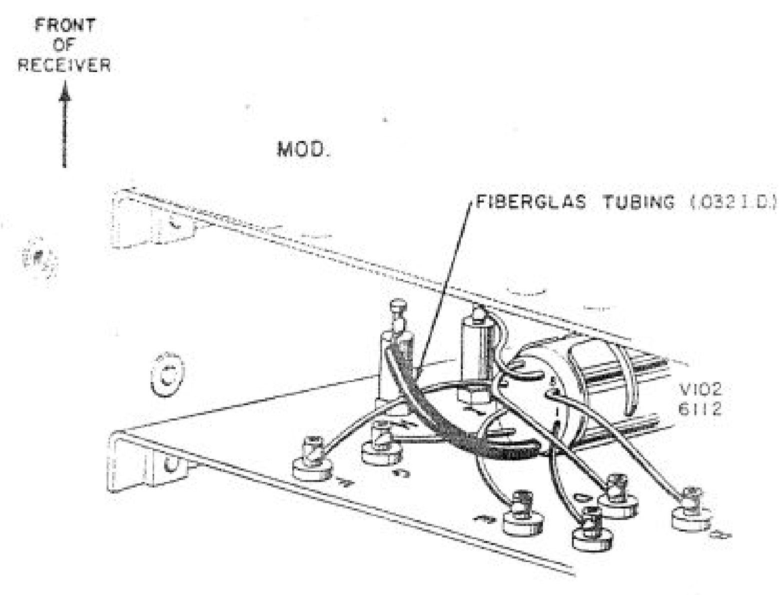


NOTES:

1. CUT OFF UNUSED TUBE LEADS 2 AND 4 APPROXIMATELY $\frac{1}{32}$" FROM GLASS.
2. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.

TP1457

Figure 5–2. Wiring of V101

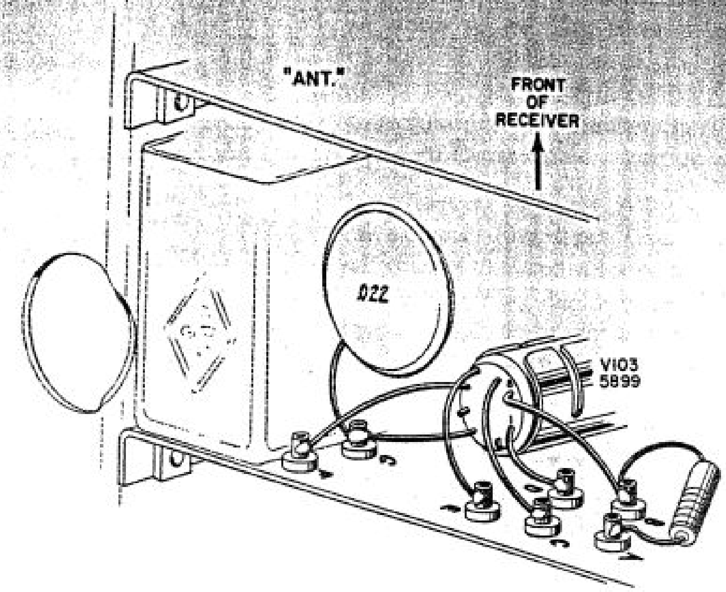


NOTE:

TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.

TP1459

Figure 5–3. Wiring of V102

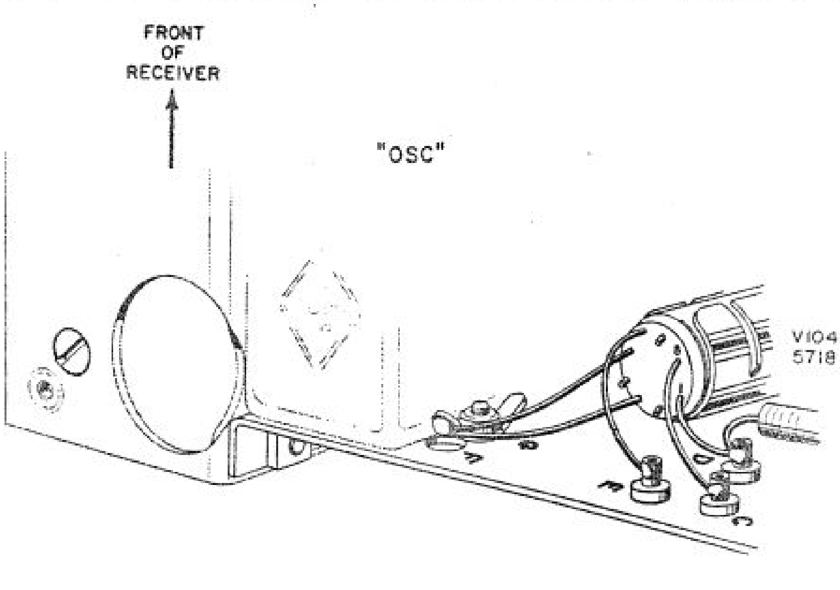


NOTES:

1. CUT OFF UNUSED TUBE LEADS 2 AND 4 APPROXIMATELY $\frac{1}{32}$" FROM GLASS.
2. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.

Figure 5–4. Wiring of V103

TP1461

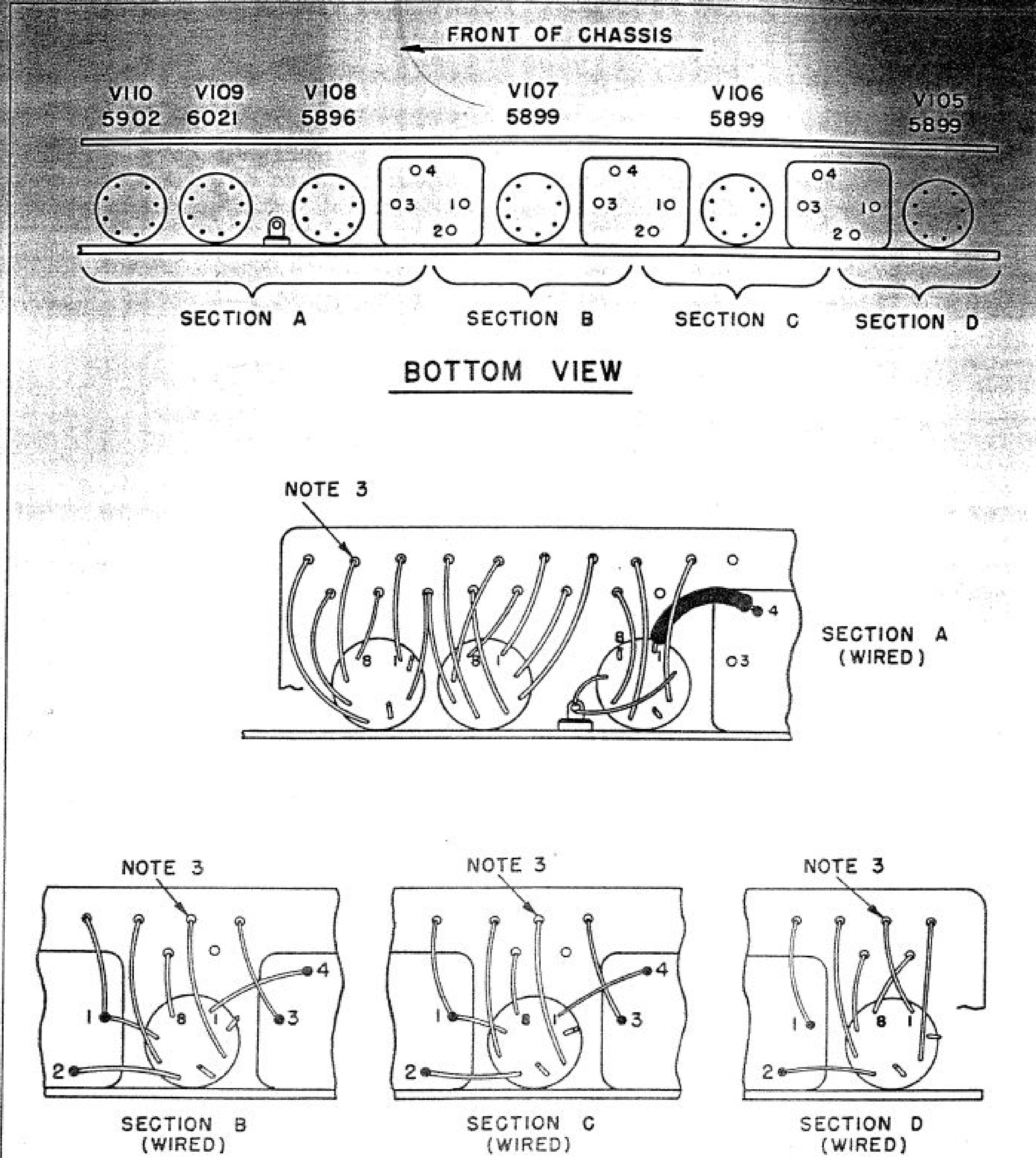


NOTES:

1. CUT OFF UNUSED TUBE LEADS 2,4 AND 7 APPROXIMATELY $\frac{1}{32}$" FROM GLASS.
2. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.

Figure 5–5. Wiring of V104

TP1463

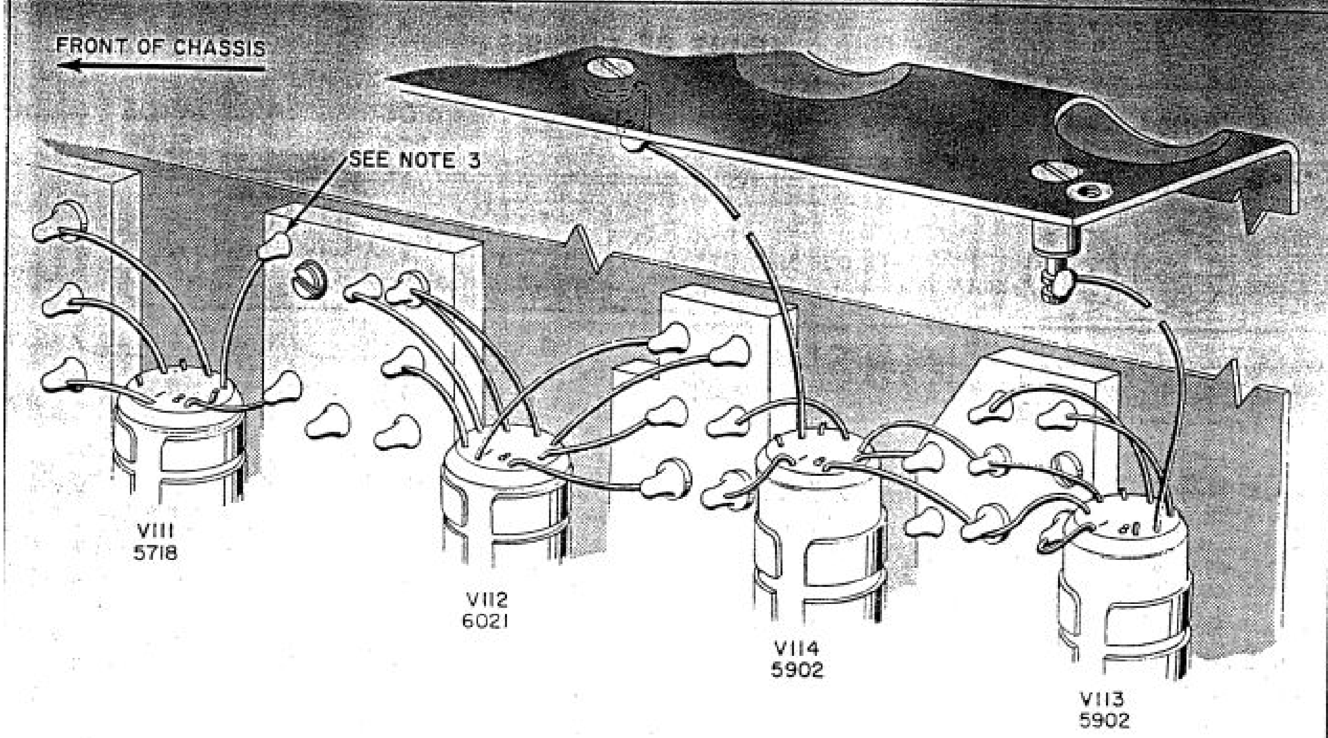


NOTES:

1. CUT OFF UNUSED TUBE LEADS APPROXIMATELY 1/32 INCH FROM GLASS.
2. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
3. INSERT TUBE LEADS INTO TERMINALS WITH MAXIMUM EXTENSION OF 1/32 INCH BEYOND TERMINAL. SOLDER ON OPPOSITE SIDE OF TERMINAL BOARD.

TP1465

Figure 5–6. Wiring of V105, V106, V107, V108, V109, and V110



NOTES:

1. CUT OFF UNUSED TUBE LEADS 2 AND 4 APPROXIMATELY $\frac{1}{32}$" FROM GLASS.
2. TUBE LEADS 1 AND 8 ARE INDICATED TO SHOW PROPER ORIENTATION OF TUBE.
3. INSERT APPROXIMATELY $\frac{1}{4}$" OF LEADS INTO TERMINALS, THEN SOLDER.

Figure 5–7. Wiring of V111, V112, V113, and V114 TP1467

Removal of R-f Assemblies. In general, the procedure for removing any of the r-f assemblies is as follows:

Note

Prior to the removal of an r-f assembly, set the tuning capacitor to its fully meshed position (maximum capacity) to prevent accidental damage to the rotor blades.

Step 1. Remove the receiver dust cover and the band switch assembly cover. Disconnect the six wires from the terminal board in the lower left of the band switch assembly, remove the three screws securing the assembly to the front panel, and withdraw the assembly from the receiver.

Caution

Do not disturb any setscrews or other adjustments in the band switch assembly.

Step 2. Unsolder the connections from the r-f assembly to be removed and the lead from the tuning capacitor stator, then remove the six screws (four on top and two below deck) which hold the assembly in place. When removing the loop assembly, Z101, it is also necessary to unsolder the connections to the loop cable at J101 and pull these leads up through the hole in the chassis.

Step 3. Slide the assembly sideways to remove.

As an alternative procedure for removing the oscillator and second r-f assemblies, which are located at the rear, it is possible to leave the band switch assembly in place and remove the assembly desired by pulling it off the shaft toward the rear of the receiver. The oscillator assembly may be removed alone, but to remove the second r-f assembly it is first necessary to remove the oscillator assembly.

Replacement of R-f Assemblies. To replace any of the r-f assemblies, reverse the procedures outlined previously for removal. Observe the following precautions: Carefully inspect the front and rear wafer switch contacts before replacing the assembly in the receiver. Before engaging the long switch shaft in any switch rotor, be sure that the rotor is not oriented 180° from its proper position. All switch rotor notches in the r-f assemblies should be on the same side of the flatted shaft, and 150° clockwise from the notch in the rotor of the band-selector switch wafer, with all notches viewed from the front of the receiver.

If an assembly has been installed with the rotor improperly oriented, it is not necessary to remove it for realignment of the rotor. Push the shaft through the properly aligned rotors, turn the shaft (by rotating the entire band switch assembly) until the previously engaged rotors agree with the one that is improperly oriented, engage this rotor, and return the shaft to the original angle to engage the remaining rotors.

5–4. TEST AND ALIGNMENT INFORMATION.

General. The units of the Type 21A may be tested individually or as a system to check their performance. Test procedures are included in this book and also in the instruction book for the ARC Type BTK-21 Bench Test Kit. The R-30A Receiver is the only unit of the Type 21A which is subject to alignment. All r-f and i-f transformers are prealigned and hermetically sealed. Only the trimmer capacitors, loop amplifier, and balanced modulator may require realignment.

Caution

The R-30A is aligned at the factory. Do not re-align unless it is evident that such adjustment is required. If the R-30A is realigned, all the test procedures of Table 5–3 must be performed to check the accuracy of alignment.

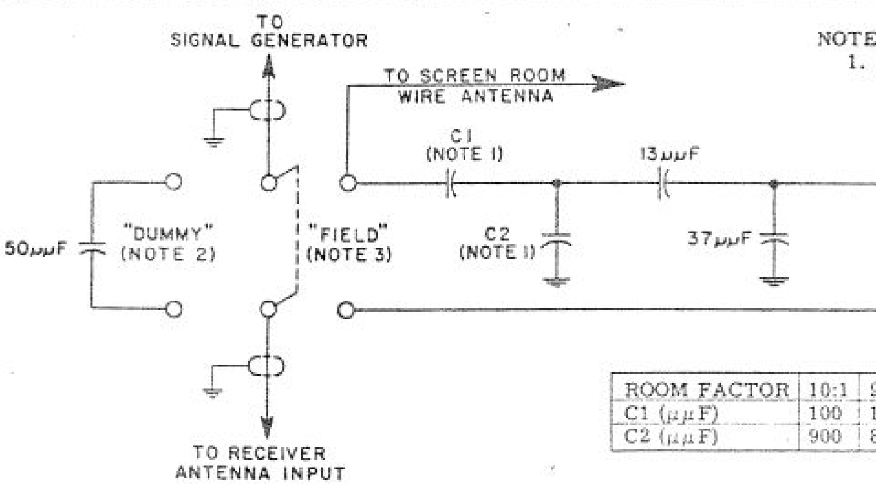
The test and alignment procedures for the R-30A are given in Tables 5–3 and 5–4. Each table outlines the use of the ARC Type BTK-21 Bench Test Kit with other standard test equipment, and also the use of standard test equipment alone.

Test Equipment. The ARC Type BTK-21 Bench Test Kit is recommended for testing and aligning the units of the Type 21A. In particular, its use will facilitate the test and alignment of the R-30A. If a BTK-21 is not available, either RF Field Simulator ARC-19780 and Loop Cable Coupler ARC-19760 (which are part of the BTK-21) or a calibrated screen room[1] is required.

If a calibrated screen room is used, provision must be made for the sense antenna input to the R-30A. For this purpose, an r-f capacitive line divider must be connected between the signal generator, which directly energizes the screen room radiating wire, and the sense antenna cable of the Type 21A. This line divider must have an attenuation of 4:1 for ¼-meter effective height times the screen room field attenuation factor[2] and, in addition, must have an output capacitance of 50 $\mu\mu$f. An r-f line divider for a screen room and a table listing the capacitor values for several room factors is shown in Figure 5–8. The addition of a 50-$\mu\mu$f dummy antenna capacitor and a DPDT switch as a DUMMY-FIELD selector switch provides a convenient method of selecting either the microvolts or microvolts-per-meter field strength signal input for the R-30A Receiver.

[1] The construction and calibration of a suitable screen room is described in *RTCA Paper 83-56/DO-70*, RTCA Secretariat, 16 and Constitutional Avenue N.W., Washington 25, D. C.

[2] Screen Room Attenuation Factor = $\frac{\text{Signal Generator Output } (\mu v)}{\text{Field Strength } (\mu v/\text{meter})}$



NOTES:

1. TO DETERMINE VALUE OF C1 AND C2 (IN $\mu\mu$F) FOR ANY ROOM FACTOR, USE THE FOLLOWING FORMULA:

$$\text{ROOM FACTOR} = \frac{C1 + C2}{C1}$$

FOR KNOWN ATTENUATION RATIOS, THE FOLLOWING CHART MAY BE USED.

ROOM FACTOR	10:1	9:1	8:1	7:1	6:1	5:1	4:1	3:1
C1 ($\mu\mu$F)	100	100	100	100	100	100	100	100
C2 ($\mu\mu$F)	900	800	700	600	500	400	300	200

2. IN DUMMY POSITION, THE SIGNAL GENERATOR INDICATES THE ANTENNA OPEN-CIRCUIT MICROVOLTS DIRECTLY.
3. IN FIELD POSITION, THE SIGNAL GENERATOR OUTPUT DIVIDED BY THE ROOM FACTOR IS EQUAL TO MICROVOLTS/METER FIELD STRENGTH.

TP1469

Figure 5–8. Capacitive Line Divider for Screen Room

If the BTK-21 is used for aligning and testing the R-30A Receiver, the following test equipment, or equivalent, is required in addition to the BTK-21.

Signal Generator, Measurements Model 65-B

Crystal Calibrator, Measurements Model 111-B

Electronic Voltmeter, Ballantine Model 300

Power Supply, 13.7 volts dc, 5.6 amperes, for 14-volt equipment; or 27.5 volts dc, 2.8 amperes, for 28-volt equipment, as applicable.

Resistor, 300 ohms, ½ watt

Stopwatch

If the BTK-21 is not used for aligning and testing the R-30A Receiver, the following test equipment, or equivalent, is required in addition to that listed previously:

ARC Type 21A Automatic Direction Finder (complete except for indicator)

Cable Harness Assembly (to interconnect units of Type 21A, as shown in Figure 2–20, 2–21, or 2–22)

Connector, UG-625/U or UG-290A/U

Dummy Antenna, 50-μμf capacitor

Voltmeter, 0-200 volts dc

For accurate alignment of the R-30A, Knob ARC-18802 and Shaft Extension ARC-21330, which are part of the BTK-21, are desirable. If the tuning knob is not available, the frequency dial of the C-59A may be used to select the alignment frequencies, though with less accuracy. The testing of the R-30A does not require the use of the tuning knob. The frequency dial on ADF Test Panel ARC-19770 of the BTK-21 or the C-59A frequency dial may be used to select the test frequencies. (The test procedures of Table 5–3 are based on the use of the frequency dial. Table 5–2 lists the number of revolutions of the tuning knob required for specific alignment and test frequencies. The revolutions are counted clockwise from the minimum-capacitance position of the knob.

TABLE 5–2. TUNING KNOB REVOLUTIONS FOR ALIGNMENT AND TEST FREQUENCIES

Band	Frequency (kc.)	Use	Revolutions[1]
I	210	Test	24.0 approx.
I	300	Test	12.5 approx.
I	380	Alignment and test	3.58
II	450	Test	23.35 approx.
II	620	Test	13.0 approx.
II	800	Alignment and test	3.58
III	950	Test	23.2 approx.
III	1300	Test	13.1 approx.
III	1650	Alignment and test	4.08

[1] The tuning knob revolutions for alignment frequencies 380, 800, and 1650 kc are the exact number required for accurate alignment of the receiver. The tuning knob revolutions for the test frequencies are approximate because they will vary within the limits of the rated receiver dial accuracy (3 per cent in frequency).

Alignment and Test Conditions.

SIGNAL SOURCE. The output of the signal generator is connected either to the SIG GEN receptacle on the RF Field Simulator of the BTK-21 or to the input receptacle of the r-f line divider. When the DUMMY-FIELD switch of the RF Field Simulator or r-f line divider is in the DUMMY position, the signal generator is fed through a 50-μμf capacitor to the 100-μμf sense antenna cable. In the FIELD position, the signal generator is coupled to the sense antenna cable to provide ¼-meter antenna effective height and also to feed a wire radiator which supplies the signal source for the loop. The FIELD position of the RF Field Simulator also provides direct conversion of signal generator microvolts to microvolts/meter field strength. The FIELD position of the r-f line divider, when used in a calibrated screen room, provides conversion of signal generator microvolts to microvolts/meter field strength, but the microvolt output of the signal generator must be divided by the "room factor" to obtain the microvolts/meter field strength at the antenna input to the receiver; however, in the DUMMY position, the microvolt output of the signal generator is used directly.

S+N/N RATIO. All S+N/N ratios are made to produce a 6-db or 10-db S+N/N ratio at 50 mw S+N into a 300-ohm load. The correct reference points for the 6-db ratio are 3.88 volts (50 mw) S+N and 1.94 volts (12.5 mw) N; the 10-db ratio points are 3.88 volts (50 mw) S+N and 1.22 volts (5.0 mw) N.

AUDIO OUTPUT. A 300-ohm resistor must be connected directly across the input terminals of the Ballantine Model 300 voltmeter, or equivalent. Headset or similar equipment connected in parallel with the input of the voltmeter must have a very high impedance, or else be disconnected, in order not to affect the audio output measurements.

MODULATION. The modulation required is 30 per cent at 1000 cps.

5–5. R-30A RECEIVER TESTS.

Table 5–3 outlines the various tests required to check the operation of the R-30A Receiver. The individual tests may be performed separately if desired; however, if the R-30A has been realigned, *all* tests must be performed.

The test procedures of Table 5–3 do not require the use of Knob ARC-18802 and Shaft Extension ARC-21330 to select the test frequencies; the procedures as written are based on the use of the frequency dial. However, if the tuning knob and shaft are used, refer to Table 5–2 for the required number of revolutions for the test frequencies, and to the preliminary procedure of Table 5–4 for the proper installation of the tuning knob and shaft extension.

TABLE 5–3. R-30A RECEIVER TESTS

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	PRELIMINARY PROCEDURE		
1	Interconnect equipment as shown in Figure 5–9.	Interconnect equipment as shown in Figure 5–10.	None.
2	Rotate tuning crank counterclockwise as far as it will go to bring R-30A tuning capacitor to its minimum-capacitance position. *Do not force beyond stop.*	Same as with BTK-21.	None.
3	Disconnect mechanical linkage at either end. Rotate tuning crank until reference line just to right of high-frequency end of dial is aligned with fiducial line.	Same as with BTK-21.	None.
4	Reconnect mechanical linkage taking care not to change setting of tuning capacitor or frequency dial. Recheck positions of tuning capacitor and dial.	Same as with BTK-21.	The fiducial line and reference line are aligned when tuning capacitor is at minimum-capacitance position.
5	Apply power to equipment by turning VOL control clockwise. Adjust primary power supply to 13.75 or 27.5 volts dc, depending on voltage rating of equipment. Allow R-30A to warm up for at least 30 minutes with dust cover in place.	Same as with BTK-21.	None.
	HIGH-VOLTAGE TEST		
1	Set meter switch to LV and COMP-ANT-LOOP switch to COMP. Adjust primary voltage to 13.75 or 27.5 volts dc, depending on voltage rating of equipment, as read on voltmeter.	Set COMP-ANT-LOOP switch to COMP. Remove bottom cover of P-14A. Connect d-c voltmeter between terminal I of J301 and ground. Adjust primary voltage to 13.75 or 27.5 volts dc, depending on voltage rating of equipment.	(As noted.)
2	Set meter switch to HV1.	Connect d-c voltmeter between terminal J of J301 and ground.	Meter should read between 135 and 150 volts dc.
3	Set meter switch to HV2.	Connect d-c voltmeter between terminal K of J301 and ground.	Meter should read between 115 and 125 volts dc.
	BANDSWITCH OPERATION		
1	Set meter switch to LV. Adjust primary voltage to 11.0 volts dc (for 14-volt equipment) or 22.0 volts dc (for 28-volt equipment), as read on voltmeter. Check operation of MC BAND switch in all positions.	Connect d-c voltmeter between terminal I of J301 and ground. Adjust primary voltage to 11.0 volts (for 14-volt equipment) or 22.0 volts (for 28-volt equipment). Check operation of MC BAND switch in all positions.	Bandswitch operates properly but with reduced speed.
2	Adjust primary voltage to 15.5 volts dc (for 14-volt equipment) or 31.0 volts dc (for 28-volt equipment). Check operation of MC BAND switch in all positions.	Same as with BTK-21.	Bandswitch operates properly but at higher speed and with no tendency to overshoot.
	MINIMUM NOISE LEVEL		
1	Adjust primary voltage to 13.75 volts dc or 27.5 volts dc, depending on voltage rating of equipment, as read on voltmeter.	Same as with BTK-21.	None.
2	Connect Ballantine Model 300 voltmeter, with 300-ohm resistance across input, to either TEL jack.	Connect Ballantine Model 300 voltmeter, with 300-ohm resistance across input, between terminal J of J103 and ground.	None.
3	Set meter switch to TEL JKS position, COMP-ANT-LOOP switch to ANT position, and VOL control to extreme counterclockwise (minimum) position.	Set COMP-ANT-LOOP switch to ANT position and VOL control to extreme counterclockwise (minimum) position.	Meter reads less than 40 mv (equivalent to .005 mw).

TABLE 5—3. R-30A RECEIVER TESTS — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	MCW ANT SENSITIVITY[1]		
1	Connect Ballantine Model 300 voltmeter, with 300-ohm resistor across input, to either TEL jack. (Any headset connected in parallel with voltmeter must have very high impedance so as not to affect output measurements.)	Connect Ballantine Model 300 voltmeter, with 300-ohm resistor across input, between terminal J of J103 and ground.	None.
2	Set meter switch to TEL JKS, COMP-ANT-LOOP switch to ANT, BFO switch OFF, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to DUMMY.	Set COMP-ANT-LOOP switch to ANT, BFO switch OFF, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to DUMMY.	None.
3	Tune R-30A to 380 kc.	Same as with BTK-21.	None.
4	Set signal generator output to 10 μv, modulated 30 per cent at 1000 cps.	Same as with BTK-21.	None.
5	Tune signal generator in vicinity of 380 kc for maximum audio output as indicated on voltmeter and simultaneously adjust VOL control to produce 3.88 volts output.	Same as with BTK-21.	None.
6	Turn modulation off and read voltmeter.	Same as with BTK-21.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts), sensitivity is better than 10μv.
7	Set MC BAND switch to Band II (.40-.84). *Do not change tuning of R-30A.* Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 800 kc to measure sensitivity at 800 kc.	Same as with BTK-21.	As noted in Step 6.
8	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 1650 kc.	Same as with BTK-21.	None.
9	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 1650 kc to measure sensitivity at 1650 kc.	Same as with BTK-21.	As noted in Step 6.
10	Set MC BAND Switch to Band I (.19-.40) and tune R-30A to 300 kc.	Same as with BTK-21.	None.
11	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 300 kc to measure sensitivity at 300 kc.	Same as with BTK-21.	As noted in Step 6.
12	Set MC BAND switch to Band II (.40-.84) and tune R-30A to 620 kc.	Same as with BTK-21.	None.
13	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 620 kc to measure sensitivity at 620 kc.	Same as with BTK-21.	As noted in Step 6.
14	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 1300 kc.	Same as with BTK-21.	None.
15	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 1300 kc to measure sensitivity at 1300 kc.	Same as with BTK-21.	As noted in Step 6.
16	Set MC BAND switch to Band I (.19-.40) and tune R-30A to 210 kc.	Same as with BTK-21.	None.
17	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 210 kc to measure sensitivity at 210 kc.	Same as with BTK-21.	As noted in Step 6.
18	Set MC BAND switch to Band II (.40-.84) and tune R-30A to 450 kc.	Same as with BTK-21.	None.
19	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 450 kc to measure sensitivity at 450 kc.	Same as with BTK-21.	As noted in Step 6.

See footnotes at end of table.

TABLE 5—3. R-30A RECEIVER TESTS — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	MCW ANT SENSITIVITY[1]—Continued		
20	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc.	Same as with BTK-21.	None.
21	Repeat Steps 4, 5, and 6, except tune signal generator in vicinity of 950 kc to measure sensitivity at 950 kc.	Same as with BTK-21.	As noted in Step 6.
	MCW LOOP SENSITIVITY[2]		
1	Set COMP-ANT-LOOP switch to LOOP, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to FIELD. Set LOOP MOTOR switch ON, press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position aligned with index at top of indicator. Release LOOP switch. Set LOOP MOTOR switch OFF. Set BFO switch OFF.	Set COMP-ANT-LOOP switch to LOOP, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to FIELD. Press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position aligned with index at top of indicator. Release LOOP switch. Set BFO switch OFF.	None.
2	Tune R-30A to 210 kc.	Same as with BTK-21.	None.
3	Set signal generator output to 250 μv, modulated 30 per cent at 1000 cps.	Same as with BTK-21.	None.
4	Tune signal generator in vicinity of 210 kc for maximum audio output as indicated on Ballantine Model 300 and simultaneously adjust VOL control to produce 3.88 volts output.	Same as with BTK-21.	None.
5	Turn modulation off and read voltmeter.	Same as with BTK-21.	If voltmeter reading (output) is more than 6 db below 3.88 volts (less than 1.94 volts) sensitivity is better than 250 μv. **Note** Extraneous signals or noise will affect this measurement. Be sure area in which measurement is made is properly shielded.
	CW LOOP SENSITIVITY[3]		
1	Set COMP-ANT-LOOP switch to LOOP, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to FIELD. Set LOOP MOTOR switch ON, press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position set to 0° fiducial mark. Release LOOP switch. Set LOOP MOTOR switch OFF. Set BFO switch ON.	Set COMP-ANT-LOOP switch to LOOP, MC BAND switch to Band I (.19-.40), and DUMMY-FIELD switch to FIELD. Press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position aligned with index at top of indicator. Release LOOP switch. Set BFO switch ON.	None.
2	Tune R-30A to 380 kc.	Same as with BTK-21.	None.
3	Set signal generator output to 70 μv (modulation off). Tune signal generator in vicinity of 380 kc for maximum audio output as indicated on Ballantine Model 300 and simultaneously adjust VOL control to produce 3.88 volts output.	Same as with BTK-21.	None.
4	Turn carrier off and read voltmeter.	Same as with BTK-21.	If voltmeter reading (output) is more than 10 db below 3.88 volts (less than 1.22 volts), sensitivity is better than 70 μv/meter.
5	Set MC BAND switch to Band II (.40-.84). *Do not change tuning of R-30A.* Repeat Steps 3 and 4, except tune signal generator in vicinity of 800 kc to measure sensitivity at 800 kc.	Same as with BTK-21.	As noted in Step 4.

See footnotes at end of table.

TABLE 5—3. R-30A RECEIVER TESTS — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	CW LOOP SENSITIVITY[3]—Continued		
6	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 1650 kc.	Same as with BTK-21.	None.
7	Repeat Steps 3 and 4, except tune signal generator in vicinity of 1650 kc to measure sensitivity at 1650 kc.	Same as with BTK-21.	As noted in Step 4.
8	Set BFO switch ON. Set MC BAND switch to Band I (.19-.40) and tune R-30A to 210 kc.	Same as with BTK-21.	None.
9	Set signal generator output to 170 μv (modulation off). Tune signal generator in vicinity of 210 kc for maximum audio output as indicated on Ballantine Model 300 and simultaneously adjust VOL control to produce 3.88 volts output.	Same as with BTK-21.	None.
10	Turn carrier off and read voltmeter.	Same as with BTK-21.	If voltmeter reading (output) is more than 10 db below 3.88 volts (less than 1.22 volts), sensitivity is better than 170 microvolts.
11	Set MC BAND switch to Band II (.40-.84) and tune R-30A to 450 kc.	Same as with BTK-21.	None.
12	Repeat Steps 9 and 10, except set signal generator output to 70 μv and tune signal generator in vicinity of 450 kc to measure sensitivity at 450 kc.	Same as with BTK-21.	As noted in Step 10, except sensitivity is better than 70 μv.
13	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc.	Same as with BTK-21.	None.
14	Repeat Steps 9 and 10, except set signal generator output to 70 μv and tune signal generator in vicinity of 950 kc. to measure sensitivity at 950 kc.	Same as with BTK-21.	As noted in Step 10, except sensitivity is better than 70 μv.
	COMPASS SENSITIVITY		
1	Set MC BAND switch to Band I (.19-.40) and tune R-30A to 210 kc approximately.	Same as with BTK-21.	None.
2	Set COMP-ANT-LOOP switch to COMP, BFO switch to OFF, LOOP MOTOR switch to ON, and DUMMY-FIELD switch to FIELD.	Set COMP-ANT-LOOP switch to COMP, BFO switch to OFF, and DUMMY-FIELD switch to FIELD.	None.
3	Set signal generator output to 10,000 μv (that is, 10,000 μv/meter field strength), with no modulation.	Same as with BTK-21.	None.
4	Tune signal generator in vicinity of 210 kc for maximum tuning meter deflection.	Same as with BTK-21.	Loop nulls.
5	Rotate indicator VAR. knob until pointer is at dial 0° position.	Same as with BTK-21.	Dial 0° position and pointer may not be aligned with index at top of indicator if loop compensation schedule has been set up.
6	Set signal generator output to 60 μv (that is, 60 μv/meter field strength) with no modulation and tune signal generator in vicinity of 210 kc for maximum tuning meter deflection.	Same as with BTK-21.	Indicator reads 0° (±2) with ±2° jitter.
7	Set signal generator output to 10,000 μv. Note average reading and jitter of indicator.	Same as with BTK-21.	Indicator reads 0° (±1) with ±½° jitter.

See footnotes at end of table.

TABLE 5–3. R-30A RECEIVER TESTS — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	COMPASS SENSITIVITY—Continued		
8	Set signal generator output to 60 μv. Press LOOP switch to rotate loop 175° clockwise from null. Release LOOP switch and note time (in seconds) required for loop to return within 2° of null.	Same as with BTK-21.	Loop returns in 9 seconds, or less. **Note** If L-11 has been compensated, indicator may slow down, speed up, or both while loop is traveling toward zero. This indication is normal. To check that no mechanical fault exists in loop mechanism, bring L-11 into full view, press LOOP switch, and note that loop rotates smoothly when it is slewed away from null.
9	Set MC BAND switch to Band II (.40-.84) and tune R-30A to 450 kc. Repeat Steps 6, 7, and 8, except tune signal generator in vicinity of 450 kc.	Same as with BTK-21.	As noted in Steps 6, 7, and 8.
10	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc. Repeat Steps 6, 7, and 8, except tune signal generator in vicinity of 950 kc.	Same as with BTK-21.	As noted in Steps 6, 7, and 8.
11	Set MC BAND switch to Band I (.19-.40) and tune R-30A to 380 kc. Repeat Steps 6, 7, and 8, except tune signal generator in vicinity of 380 kc.	Same as with BTK-21.	As noted in Steps 6, 7, and 8.
12	Set MC BAND switch to Band II (.40-.84). *Do not change tuning of R-30A.* Repeat Steps 6, 7, and 8, except tune signal generator in vicinity of 800 kc.	Same as with BTK-21.	As noted in Steps 6, 7, and 8.
13	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 1650 kc. Repeat Steps 6, 7, and 8, except tune signal generator in vicinity of 1650 kc.	Same as with BTK-21.	As noted in Steps 6, 7, and 8.
	AVC TEST		
1	Set MC BAND switch to Band I (.19-.40) and tune R-30A to 210 kc.	Same as with BTK-21.	None.
2	Set COMP-ANT-LOOP switch to COMP, BFO switch to OFF, and DUMMY-FIELD switch to DUMMY.	Same as with BTK-21.	None.
3	Set signal generator output to 100 μv, modulated 30 per cent at 1000 cps.	Same as with BTK-21.	None.
4	Tune signal generator in vicinity of 210 kc for maximum tuning meter deflection and simultaneously adjust VOL control to produce 3.88 volts output as indicated on Ballantine Model 300.	Same as with BTK-21.	None.
5	Set signal generator output to 10 μv.	Same as with BTK-21.	Voltmeter reads between 2.0 and 4.8 volts.
6	Set signal generator output to 100 μv.	Same as with BTK-21.	Voltmeter reads between 3.8 and 4.0 volts.
7	Set signal generator output to 100,000 μv.	Same as with BTK-21.	Voltmeter reads between 4.2 and 6.8 volts.
8	Set signal generator output to 500,000 μv.	Same as with BTK-21.	Voltmeter reads 8.5 volts or less.
9	Set MC BAND switch to Band II (.40-.84) and tune R-30A to 450 kc.	Same as with BTK-21.	None.
10	Repeat Steps 2 through 8.	Same as with BTK-21.	As noted in Steps 2 through 8.

TABLE 5–3. R-30A RECEIVER TESTS — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21	Normal Indication
	AVC TEST—Continued		
11	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc.	Same as with BTK-21.	None.
12	Repeat Steps 2 through 8.	Same as with BTK-21.	As noted in Steps 2 through 8.
	POWER OUTPUT TEST		
1	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc. Set COMP-ANT-LOOP switch to COMP and DUMMY-FIELD switch to DUMMY.	Same as with BTK-21.	None.
2	Set signal generator output to 100 µv modulated 30 per cent at 1000 cps and tune signal generator in vicinity of maximum tuning meter deflection.	Same as with BTK-21.	None.
3	Set VOL control to extreme clockwise position and note audio output as indicated on Ballantine Model 300.	Same as with BTK-21.	Voltmeter reads between 10 and 15 volts.
	LOW-VOLTAGE OPERATIONAL TEST		
1	Set MC BAND switch to Band I (.19-.40) and tune R-30A to 210 kc.	Same as with BTK-21.	None.
2	Set COMP-ANT-LOOP switch to ANT, BFO switch to OFF, and DUMMY-FIELD switch to DUMMY. Adjust primary voltage to 11.0 volts dc (for 14-volt equipment) or 22.0 volts dc (for 28-volt equipment).	Same as with BTK-21.	None.
3	Set signal generator output to 10 µv, modulated 30 per cent at 1000 cps.	Same as with BTK-21.	None.
4	Tune signal generator in vicinity of 210 kc for maximum audio output as indicated on Ballantine Model 300 and simultaneously adjust VOL control to produce 2.0 volts.	Same as with BTK-21.	None.
5	Turn modulation off and read voltmeter.	Same as with BTK-21.	Voltmeter reads 1.0 volt, or less.
6	Set BFO switch to ON. Check that BFO operates.	Same as with BTK-21.	Voltmeter reading increases indicating BFO is operating. (May be checked aurally by connecting headset.)
7	Turn BFO switch to OFF. Set MC BAND switch to Band II (.40-.84) and tune R-30A to 450 kc.	Same as with BTK-21.	None.
8	Repeat Steps 3, 4, and 5, except tune signal generator in vicinity of 450 kc.	Same as with BTK-21.	As noted in Step 5.
9	Set MC BAND switch to Band III (.84-1.75) and tune R-30A to 950 kc.	Same as with BTK-21.	None.
10	Repeat Steps 3, 4, and 5, except tune signal generator in vicinity of 950 kc.	Same as with BTK-21.	As noted in Step 5.

[1] MCW ANT sensitivity is defined as the signal input level, modulated 30 per cent at 1000 cps, fed in series with a 50-µµf capacitance to the 100-µµf sense antenna cable, required to produce a 6-db S+N/N output ratio at 50 mw S+N (modulation on, modulation off; 50 mw is equal to 3.88 volts across 300 ohms).

[2] MCW LOOP sensitivity is defined as the field strength in microvolts-per-meter (µv/meter) at the loop, modulated 30 per cent at 1000 cps and fed through the standard loop cable (ARC-17985), required to produce a 6-db S+N/N output ratio at 50 mw (modulation on, modulation off). For this measurement, the loop must be rotated to a position of maximum pickup.

[3] CW LOOP sensitivity is defined as the field strength in microvolts-per-meter (µv/meter) at the loop, required to produce a 10-db S+N/N output ratio at 50 mw (carrier on, carrier off). This measurement is made, with the BFO on, by tuning the signal generator to produce a beat-frequency note of about 1000 cps. This note will occur at two points in the vicinity of the receiver r-f tuned frequency; the higher-amplitude note is used for the CW LOOP sensitivity measurement. Also, for this measurement the loop must be in a position of maximum pickup.

Caution

In the presence of strong adjacent signals or high ambient noise conditions, the MCW LOOP or CW LOOP sensitivity measurements should be made in a shielded room. The RF Field Simulator and cables of the BTK-21 are not perfect shields. Extraneous signals, noise, or both, may affect measurements unless additional shielding is provided. The low-frequency end of Band I is affected most seriously.

5-6. ALIGNMENT OF R-30A RECEIVER.

Table 5-4 outlines the procedure for aligning the R-30A Receiver. Though the specific alignment procedures are identified by subtitles, they should not be performed individually; the procedure as described presupposes that all previous steps have been completed. The procedure without the use of an ARC Type BTK-21 Bench Test Kit assumes that a DUMMY-FIELD switch is installed as part of the bench test set-up, as shown in Figure 5-8. If alignment is performed, all tests described in Table 5-3 must be completed to insure accurate alignment.

To insure the selection of accurate alignment frequencies, Knob ARC-18802 and Shaft Extension ARC-21330, which are part of the BTK-21, should be used. If these items are not available, the frequency dial may be used, though the settings may not be as accurate. The alignment procedure with the BTK-21 is based on the use of the tuning knob and shaft extension, while the procedure without the BTK-21 uses the frequency dial.

The alignment points for the R-30A Receiver are identified in Figure 5-11.

TABLE 5-4. ALIGNMENT OF R-30A RECEIVER

Step	*Procedure With BTK-21*	*Procedure Without BTK-21*
	PRELIMINARY PROCEDURE	
1	Interconnect equipment as shown in Figure 5-9.	Interconnect equipment as shown in Figure 5-10.
2	Fit Shaft Extension ARC-21330 over splined shaft of R-30A tuning capacitor and tighten. Install Knob ARC-18802 over the shaft extension. Rotate tuning knob counterclockwise until it stops—*do not force beyond stop.*	Rotate tuning crank counterclockwise as far as it will go to bring R-30A tuning capacitor to its minimum-capacitance position. *Do not force beyond stop.*
3	Without disturbing R-30A tuning capacitor setting, remove tuning knob. Orient tuning knob until red zero line is approximately on top (12 o'clock position). Replace tuning knob.	Disconnect mechanical linkage at either end. Rotate tuning crank until reference line just to right of high-frequency end of dial is aligned with fiducial line.
4	Hold tuning knob so that red zero line is still on top and R-30A tuning capacitor does not change position, then tighten tuning knob knurled nut. Rotate collar on tuning knob until black fiducial line is aligned with red zero line. **Note** Refer to Table 5-2 for a listing of tuning knob revolutions for receiver alignment frequencies.	Reconnect mechanical linkage taking care not to change setting of tuning capacitor or frequency dial. Recheck positions of tuning capacitor and dial.
5	Apply power to equipment by turning VOL control clockwise. Adjust primary power supply to 13.75 or 27.5 volts dc, depending on voltage rating of equipment. Allow R-30A to warm up for at least 30 minutes with dust cover in place.	Same as with BTK-21.
	TRIMMER CAPACITOR ALIGNMENT	
6	Set Measurements Model 65-B Signal Generator to *exactly 380 kc.* Use Measurements Model 111-B Crystal Calibrator to check frequency.	Same as with BTK-21.
7	Set COMP-ANT-LOOP switch to COMP, MC BAND switch to Band I (.19-.40), LOOP MOTOR ON-OFF switch to OFF, and DUMMY-FIELD switch to DUMMY.	Set COMP-ANT-LOOP switch to COMP, MC BAND switch to Band I (.19-.40), BFO switch to OFF, and DUMMY-FIELD switch to DUMMY.
8	Rotate tuning knob 3.58 revolutions clockwise from minimum-capacitance setting to set R-30A to 380 kc. **Note** To reduce effects of backlash, rotate tuning knob in counterclockwise direction to approach frequency setting.	Tune R-30A to 380 kc. **Note** To reduce effects of mechanical linkage backlash, rotate tuning crank in counterclockwise direction to approach frequency setting.
9	Set signal generator output to 10,000 μv approximately. Adjust Band I OSC trimmer C141, then 2nd RF trimmer C130, then 1st RF trimmer C125, then ANT trimmer C119 for maximum deflection of tuning meter.	Same as with BTK-21.
10	Set signal generator output to 20 μv approximately. Repeat adjustment of C141, then C130, then C125, then C119, for maximum deflection of tuning meter.	Same as with BTK-21.

TABLE 5—4. ALIGNMENT OF R-30A RECEIVER — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21
	TRIMMER CAPACITOR ALIGNMENT—Continued	
11	Set signal generator to *exactly 800 kc.* Set BAND switch to Band II (.40-.84). *Do not change tuning of R-30A.*	Same as with BTK-21.
12	Set signal generator output to 10,000 μv approximately. Adjust Band II OSC trimmer C142, then 2nd RF trimmer C131, then 1st RF trimmer C126, then ANT trimmer C120 for maximum deflection of tuning meter.	Same as with BTK-21.
13	Set signal generator output to 20 μv approximately. Repeat adjustment of C142, then C131, then C126, then C120 for maximum deflection of tuning meter.	Same as with BTK-21.
14	Set signal generator to *exactly 1650 kc.* Set MC BAND switch to Band III (.84-1.75). Rotate tuning knob 4.08 revolutions clockwise from minimum-capacitance setting to set R-30A to 1650 kc.	Set signal generator to *exactly 1650 kc.* Set MC BAND switch to Band III (.84-1.75). Tune R-30A to 1650 kc.
15	Set signal generator output to 10,000 μv approximately. Adjust Band III OSC trimmer C143, the 2nd RF trimmer C132, then 1st RF trimmer C127, then ANT trimmer C121 for maximum deflection of tuning meter.	Same as with BTK-21.
16	Set signal generator output to approximately 20 μv. Repeat adjustment of C143, then C132, then C127, then C121 for maximum deflection of tuning meter.	Same as with BTK-21.
	LOOP AMPLIFIER ALIGNMENT	
17	Set COMP-ANT-LOOP switch to LOOP and MC BAND switch to Band I (.19-.40).	Same as with BTK-21.
18	Set DUMMY-FIELD switch to FIELD. Set LOOP MOTOR switch ON, press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position aligned with index at top of indicator. Release LOOP switch and set LOOP MOTOR switch OFF.	Set DUMMY-FIELD switch to FIELD. Press LOOP switch to rotate loop to either 90° or 270° as read on indicator with dial 0° position aligned with index at top of indicator. Release LOOP switch.
19	Set signal generator to *exactly 380 kc.*	Same as with BTK-21.
20	Rotate tuning knob 3.58 revolutions clockwise from minimum-capacitance setting to set R-30A to 380 kc.	Tune R-30A to 380 kc.
21	Set VOL control to extreme clockwise position (disregard audio distortion).	Same as with BTK-21.
22	Increase signal generator output until tuning meter is deflected approximately one division.	Same as with BTK-21.
23	Adjust Band I loop circuit trimmer C101 for maximum deflection of tuning meter.	Same as with BTK-21.
24	Set signal generator to *exactly 800 kc.* Set MC BAND switch to Band II (.40-.84). *Do not change tuning of R-30A.* Increase signal generator output until tuning meter is deflected approximately one division. Adjust Band II loop circuit trimmer C102 for maximum deflection of tuning meter.	Same as with BTK-21.
25	Set signal generator to *exactly 1650 kc.* Set MC BAND switch to Band III (.84-1.75). Rotate tuning knob 4.08 revolutions clockwise from minimum-capacitance setting to set R-30A to 1650 kc.	Set signal generator to *exactly 1650 kc.* Set MC BAND switch to Band III (.84-1.75). Tune R-30A to 1650 kc.
26	Increase signal generator output until tuning meter is deflected approximately one division. Adjust Band III loop circuit trimmer C103 for maximum deflection of tuning meter.	Same as with BTK-21.
	BALANCED MODULATOR ADJUSTMENT	
27	Set MC BAND switch to Band I (.19-.40). Rotate tuning knob 3.58 revolutions clockwise from minimum-capacitance setting to set R-30A to 380 kc. Make certain no signal is being received: detune slightly if necessary.	Set MC BAND switch to Band I (.19-.40). Tune R-30A to 380 kc. Make certain no signal is being received; detune slightly if necessary.
28	Set COMP-ANT-LOOP switch to COMP and LOOP MOTOR switch to ON.	Set COMP-ANT-LOOP switch to COMP.

TABLE 5–4. ALIGNMENT OF R-30A RECEIVER — Continued

Step	Procedure With BTK-21	Procedure Without BTK-21
	BALANCED MODULATOR ADJUSTMENT—Continued	
29	With no signal generator output, adjust MOD BAL potentiometer R108 for minimum rotational speed of loop.	Same as with BTK-21.
30	Set MC BAND switch to Band II (.40-.84) (do not change tuning of R-30A) and note speed of loop rotation. Then set MC BAND switch to Band III (.84-1.75), rotate tuning knob 4.08 revolutions clockwise from minimum-capacitance setting, and note speed of loop rotation. Make certain no signal is being received in either band position; detune slightly if necessary.	Same as with BTK-21, except in Band III position tune R-30A to 1650 kc.
31	Reset MOD BAL potentiometer R108 for optimum compromise (minimum rotation) on all bands. Under no-signal conditions, loop should not rotate faster than 180° in 30 seconds in any band.	Same as with BTK-21.
	TEST	
32	Perform *all* receiver tests outlined in Table 5–3.	Same as with BTK-21.

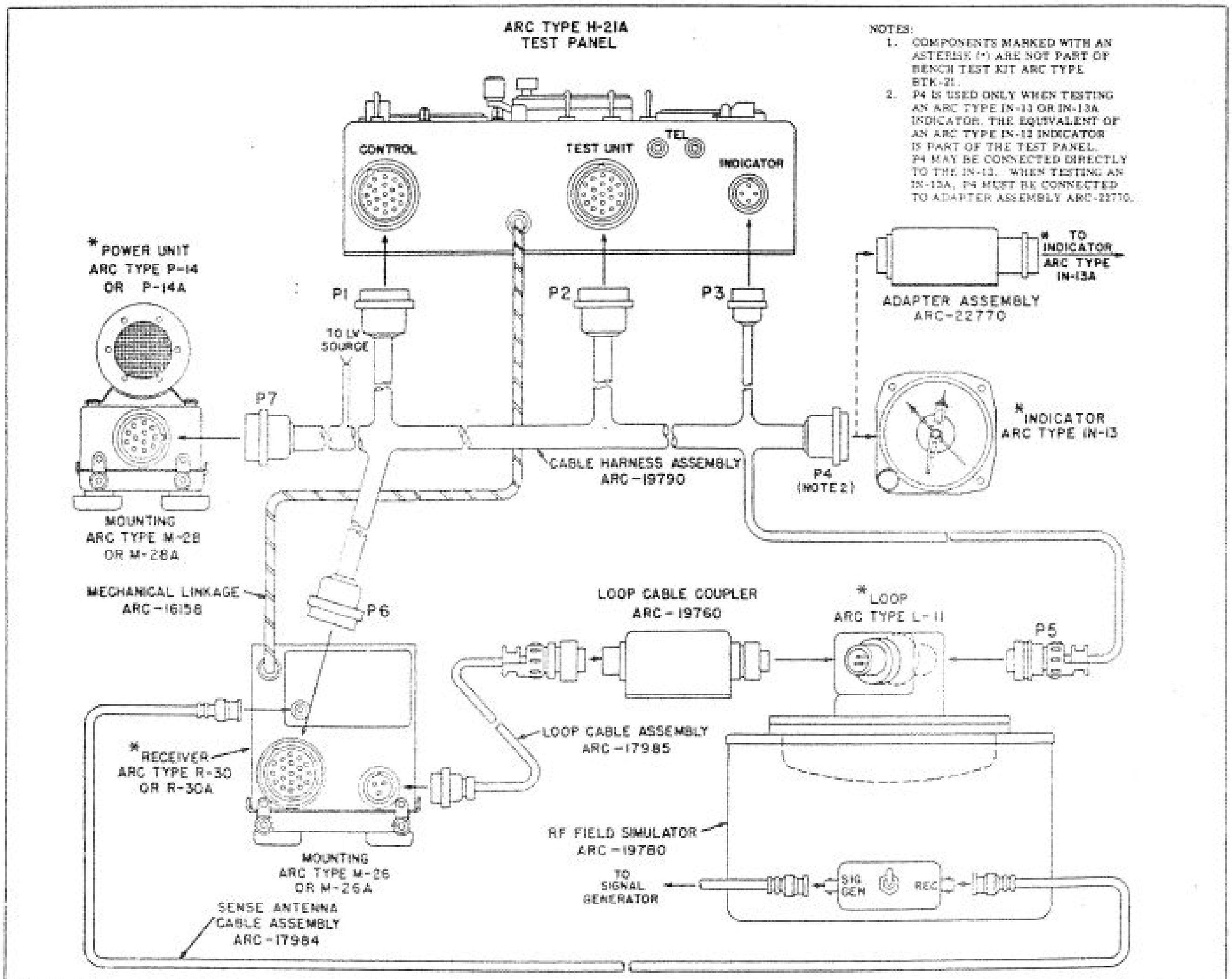


Figure 5–9. Bench Test Set-up for Alignment and Test of ARC Type R-30A Receiver with ARC Type BTK-21 Bench Test Kit

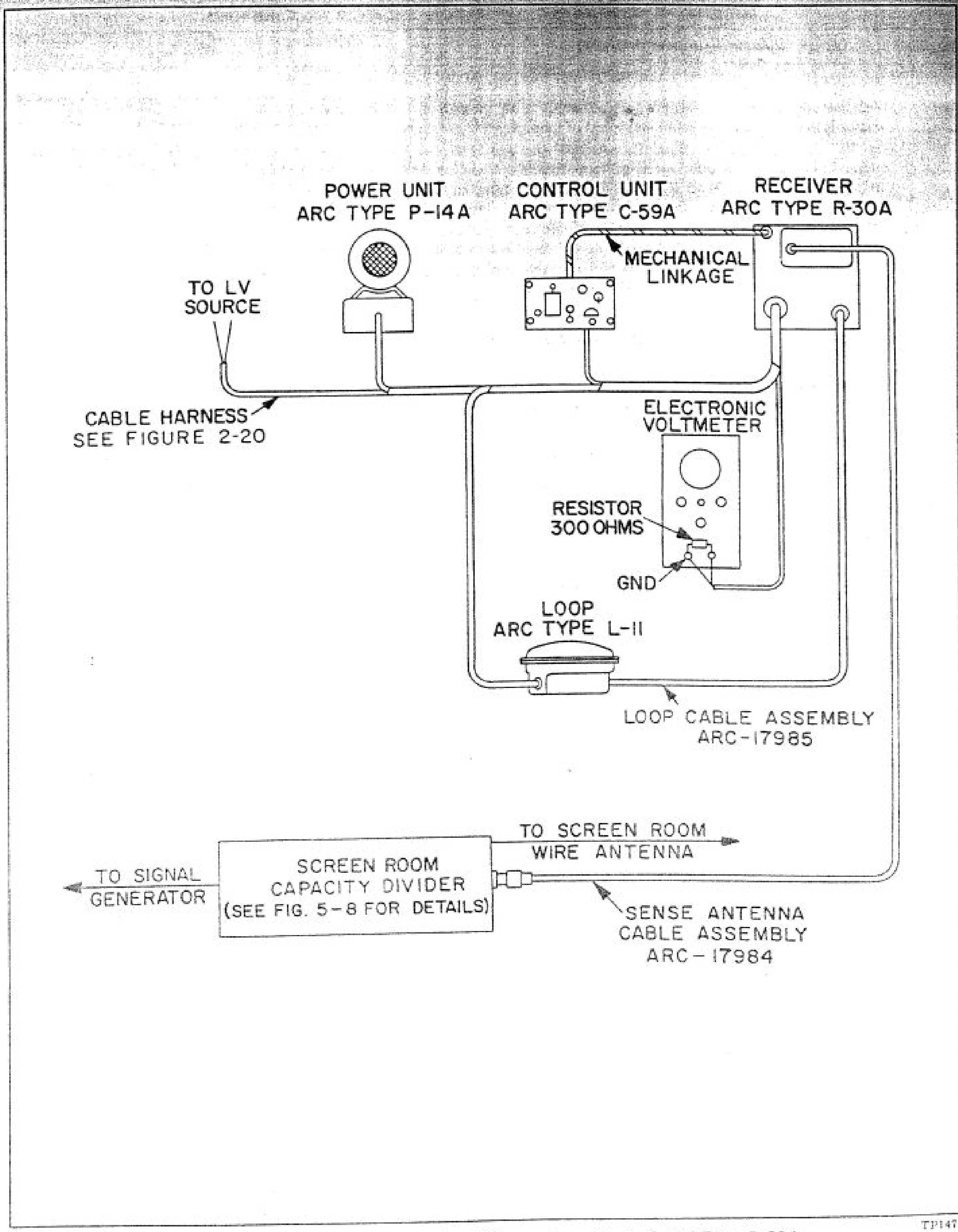


Figure 5–10. Bench Test Set-up for Alignment and Test of ARC Type R-30A Receiver without ARC Type BTK-21 Bench Test Kit

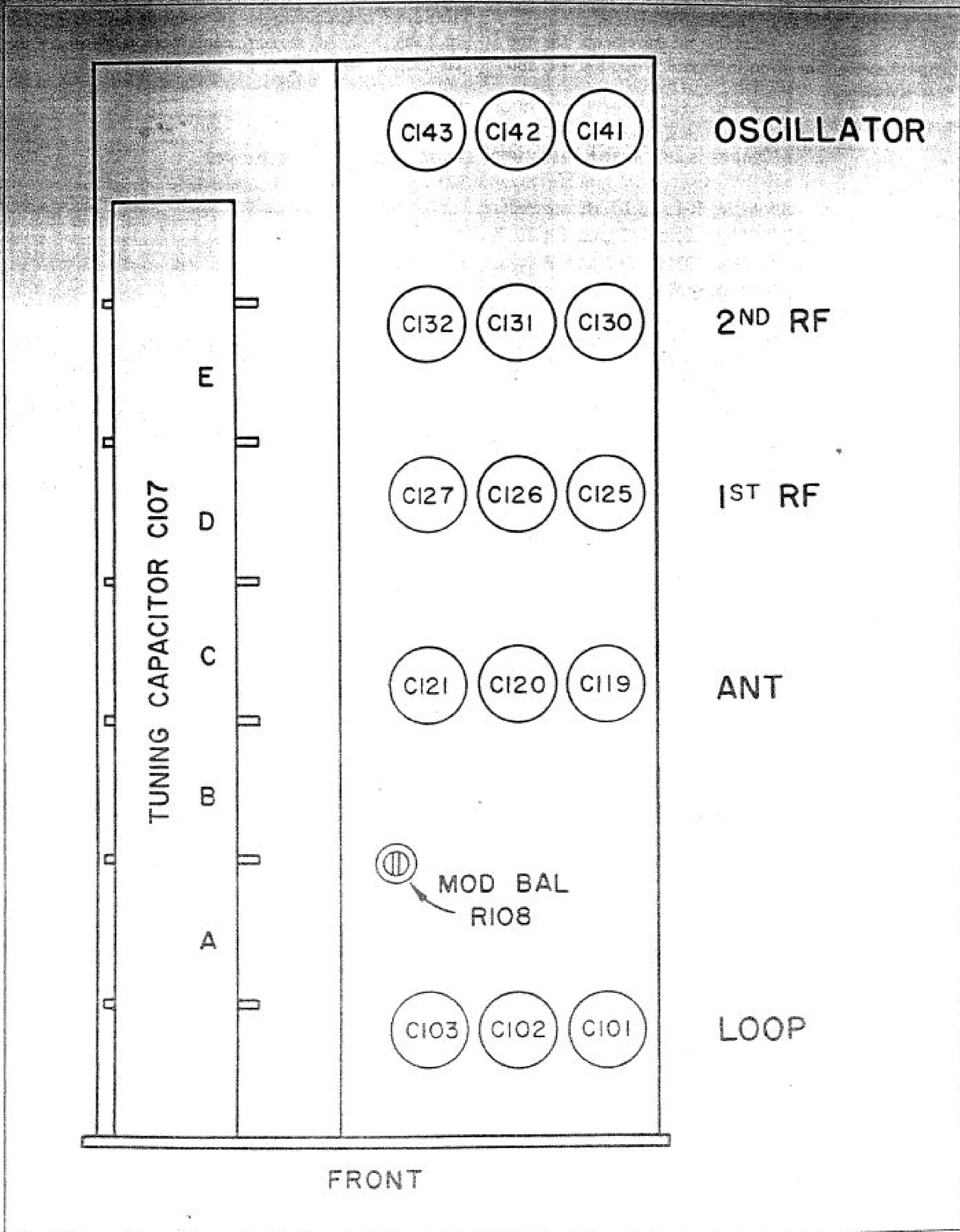


Figure 5–11. ARC Type R-30A Receiver, Alignment Points

5–7. R-30A RECEIVER MEASUREMENTS. Typical voltage and resistance measurements for the R-30A Receiver are given in Figure 5–12. R-f, i-f, and 100-cycle amplifier stage gain measurements are listed in Table 5–5. All measurements were made under the conditions noted.

TABLE 5–5. R-30A RECEIVER STAGE GAIN MEASUREMENTS

Conditions for R-f and I-f Measurements:

1. Avc line shorted to ground (terminal 3 of Z105 shorted to chassis).
2. C-59A COMP-ANT-LOOP switch in ANT or LOOP position, as noted.
3. VOL control set at maximum (extreme clockwise rotation).
4. The input shown is the signal level required to obtain −15 volts dc between the junction of resistors R130 and R131 (at the detector load) and the chassis. The voltage must be read by a d-c vacuum tube voltmeter.
5. The voltage levels shown in Table 5–5 are average values. Variations of 100 per cent or more from these values may be encountered in normal receivers because of variations in the tubes of the cascaded stages of the receiver. The greatest variations will be encountered in the r-f stages because of the effects of receiver noise and the fact that all amplifiers are in use.
6. Signal is applied to measurement points directly from the ungrounded side of the signal generator, except as noted. The signal generator ground terminal is connected directly to the receiver chassis.
7. The i-f measurements are made with receiver tuned to 190 kc. Signal generator frequency is 142.5 kc.

R-F MEASUREMENTS
(μv for −15 volts dc detector voltage)

Function Selector Switch		LOOP Position			ANT Position		
Frequency (kc)	Band (mc)	μv/Meter at L-11 Loop[1]	μv at Terminal 1 of V101	μv at Terminal 5 of V101[2]	μv at J102 Antenna Input	μv at Terminal 1 of V103[3]	μv at Terminal 1 of V105
210	.19-.40	80	5	20	10	45	25
380	.19-.40	30	5	10	8	20	25
450	.40-.84	70	6	11	14	45	25
800	.40-.84	30	6	6	10	32	25
950	.84-1.75	70	8	7	8	20	25
1650	.84-1.75	55	10	5	8	20	25

I-F MEASUREMENTS

Frequency	μv at Terminal 1 of V105	μv at Terminal 1 of V106	μv at Terminal 1 of V107
142.5 kc	20	2000	500,000

[1] Signal strength in μv/meter required at the loop antenna is provided by the RF Field Simulator of the ARC Type BTK-21 Bench Test Kit or by a calibrated screen room. (Refer to *Test Equipment* in paragraph 5–4.)
[2] Apply signal to terminal 5 of V101 through a .01-μf capacitor.
[3] Signal is applied to J102 through a 50-μμf capacitor into the standard 100-μμf sense antenna cable.

TABLE 5–5. R-30A RECEIVER STAGE GAIN MEASUREMENTS — Continued

Conditions for 100-cycle amplifier measurements:

1. Detector output shorted to ground (terminal 3 of Z109 shorted to chassis).
2. Audio input voltage read on Ballantine Model 300 voltmeter, or equivalent.
3. Audio output voltage read on Ballantine Model 300 voltmeter, or equivalent, across 100-cycle output transformer T301 in P-14A (terminal 4 of T301 to chassis). If a BTK-21 is used, the audio output may be measured between the GND and $\phi 2$ jacks on the ADF Test Panel.
4. The L-11 Loop is connected as the amplifier load in the normal manner for these measurements.
5. COMP-ANT-LOOP switch in COMP position.
6. Voltage inputs are shown for both 100 and 200 cycles. The amplifier operates at 100 cycles in the ARC Type 21A ADF and, therefore, 100-cycle readings of stage gain show behavior of the amplifier at the normal operating frequency. The 200-cycle inputs are to serve as an indication of phase and frequency response.
7. Voltage inputs are referred to chassis ground potential to produce 20 volts output.

100-CYCLE AMPLIFIER MEASUREMENTS
(Voltage inputs to produce 20 volts output)

Test Point	*Volts at 100 Cycles*	*Volts at 200 Cycles*
Voltage at junction of R130 and R131	0.25	Approximately 4 times 100-cycle input
Voltage at pin 1 of V111	0.055	Approximately 3 times 100-cycle input
Voltage at pin 2 of V112	0.2	Approximately 1.6 times 100-cycle input
Voltage at pin 7 of V112	0.4	Approximately 1.6 times 100-cycle input
Voltage at pin 1 of V113	4.5	Approximately 1.5 times 100-cycle input
Voltage at pin 1 of V114	6.5	Approximately 1.5 times 100-cycle input

100-CYCLE AMPLIFIER OUTPUT LEVEL[1]

Frequency	*Input to Junction of R130 and R131*	*Output of T301 in P-14A*
100 cycles	2.0 volts	At least 35.0 volts

[1] Measured with L-11 Loop connected in normal manner as amplifier load and low-voltage input set to 13.75 or 27.5 volts dc, depending on voltage rating of equipment.

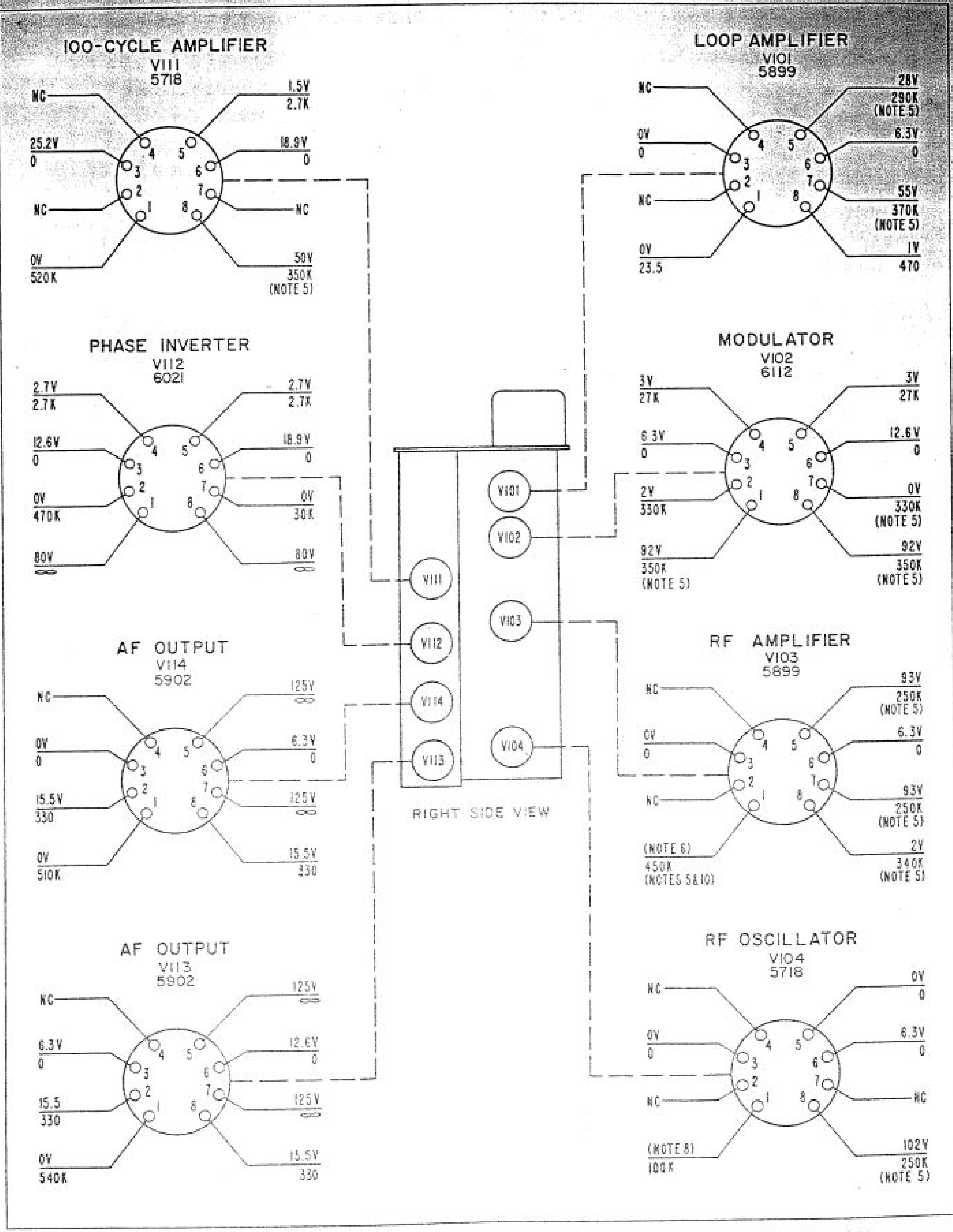
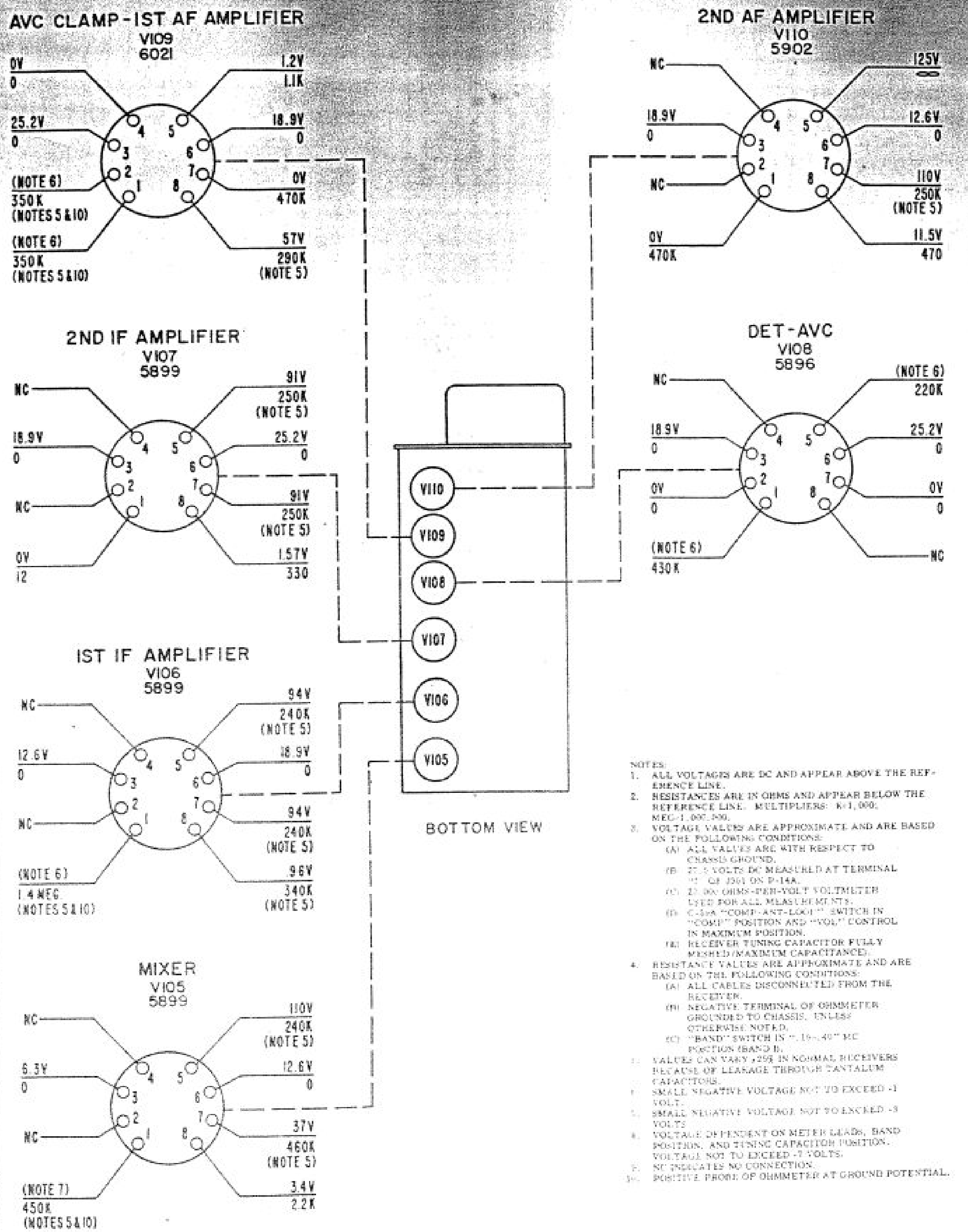


Figure 5–12. ARC Type R-30A Receiver, Voltage and Resistance Measurements (Sheet 1 of 2)



NOTES:

1. ALL VOLTAGES ARE DC AND APPEAR ABOVE THE REFERENCE LINE.
2. RESISTANCES ARE IN OHMS AND APPEAR BELOW THE REFERENCE LINE. MULTIPLIERS: K=1,000; MEG=1,000,000.
3. VOLTAGE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   (A) ALL VALUES ARE WITH RESPECT TO CHASSIS GROUND.
   (B) 27.5 VOLTS DC MEASURED AT TERMINAL "1" OF J301 ON P-14A.
   (C) 20,000 OHMS-PER-VOLT VOLTMETER USED FOR ALL MEASUREMENTS.
   (D) C-59A "COMP-ANT-LOOP" SWITCH IN "COMP" POSITION AND "VOL" CONTROL IN MAXIMUM POSITION.
   (E) RECEIVER TUNING CAPACITOR FULLY MESHED (MAXIMUM CAPACITANCE).
4. RESISTANCE VALUES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
   (A) ALL CABLES DISCONNECTED FROM THE RECEIVER.
   (B) NEGATIVE TERMINAL OF OHMMETER GROUNDED TO CHASSIS, UNLESS OTHERWISE NOTED.
   (C) "BAND" SWITCH IN "[illegible]" MC POSITION (BAND I).
5. VALUES CAN VARY ±25% IN NORMAL RECEIVERS BECAUSE OF LEAKAGE THROUGH TANTALUM CAPACITORS.
6. SMALL NEGATIVE VOLTAGE NOT TO EXCEED -1 VOLT.
7. SMALL NEGATIVE VOLTAGE NOT TO EXCEED -3 VOLTS.
8. VOLTAGE DEPENDENT ON METER LEADS, BAND POSITION, AND TUNING CAPACITOR POSITION. VOLTAGE NOT TO EXCEED -7 VOLTS.
9. NC INDICATES NO CONNECTION.
10. POSITIVE PROBE OF OHMMETER AT GROUND POTENTIAL.

TP1475

Figure 5–12. ARC Type R-30A Receiver, Voltage and Resistance Measurements (Sheet 2 of 2)

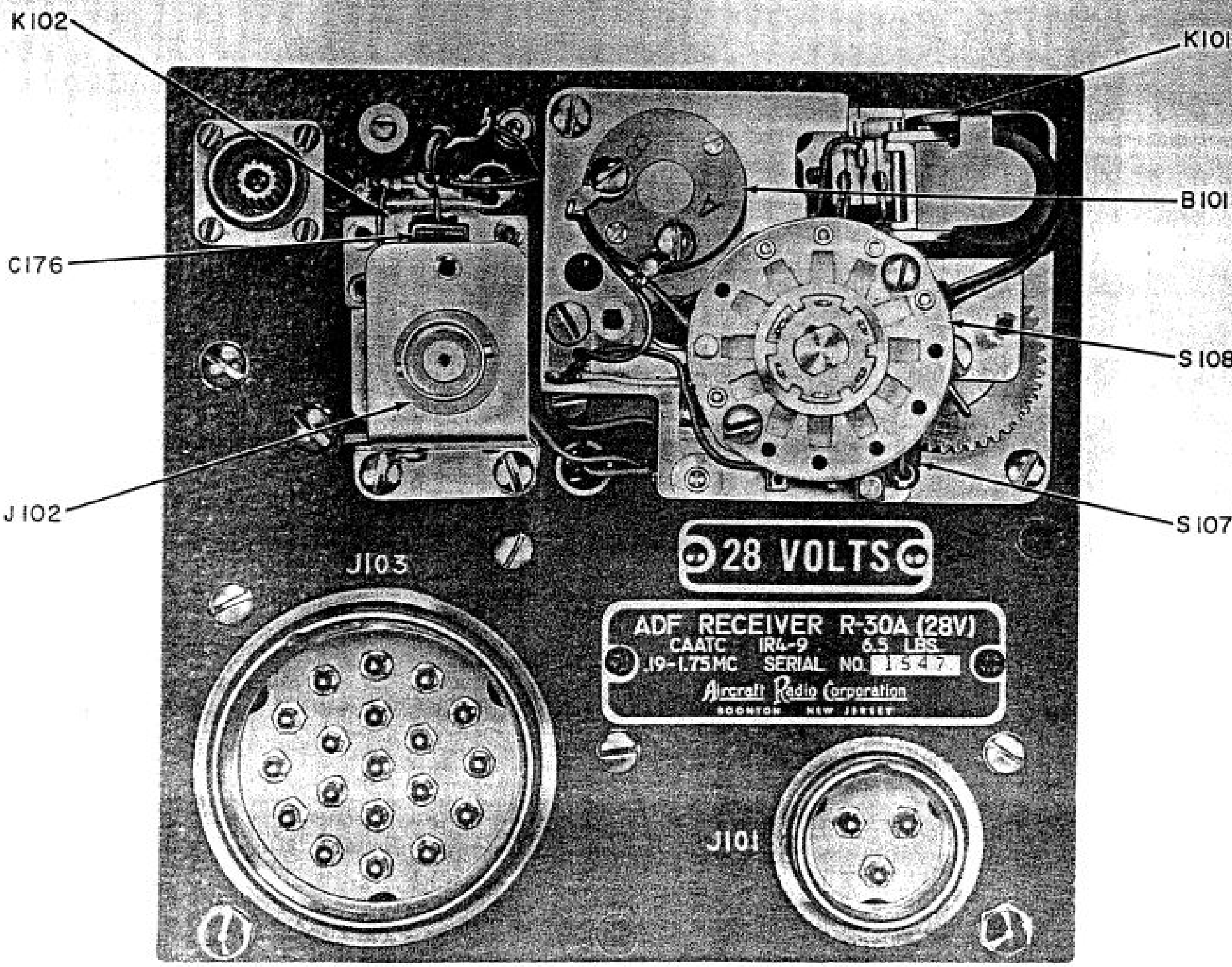


Figure 5–13. ARC Type R-30A Receiver, Front View, Band Switch Cover Removed

TP1120

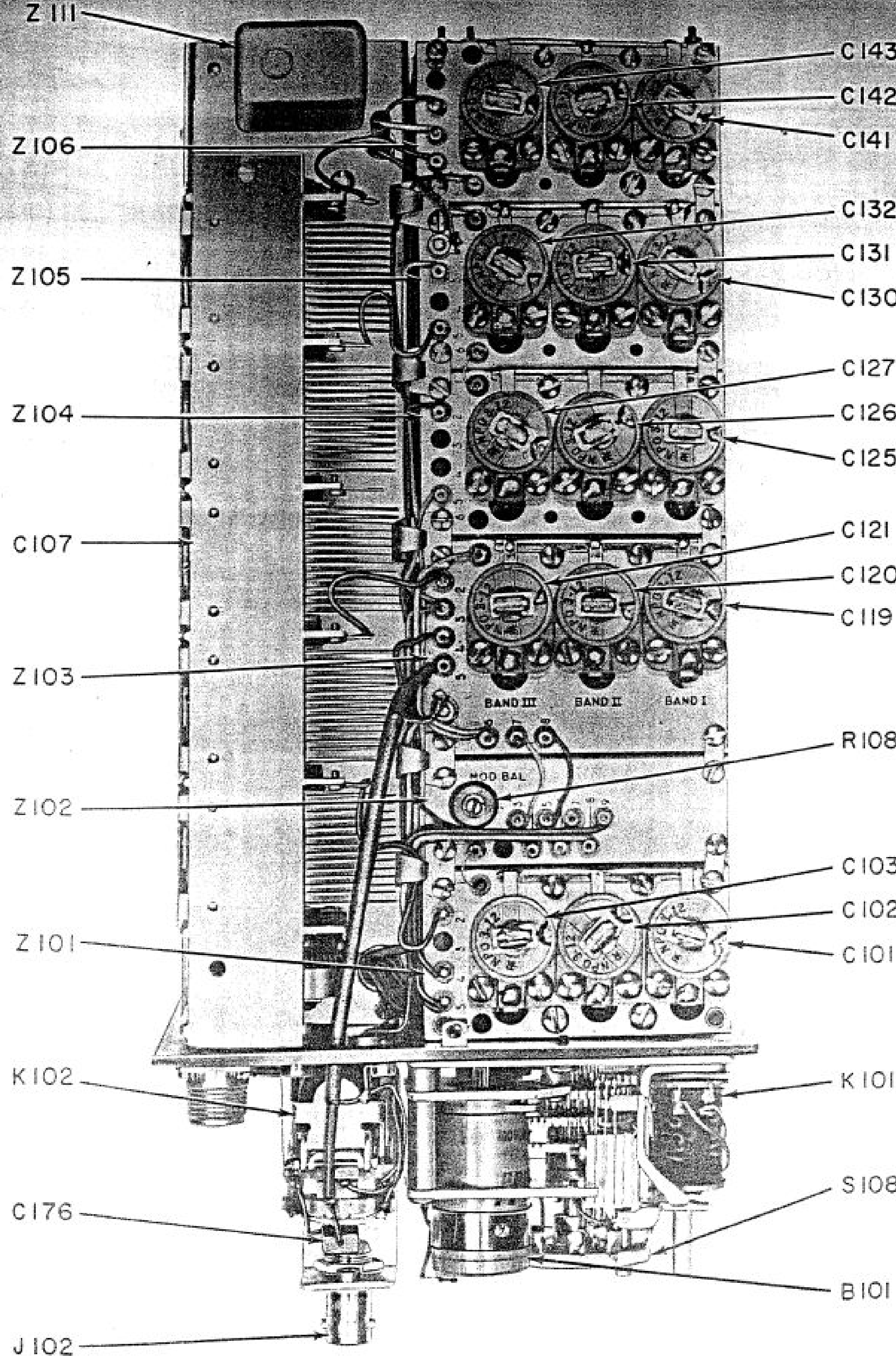


Figure 5–14. ARC Type R-30A Receiver, Top Interior View

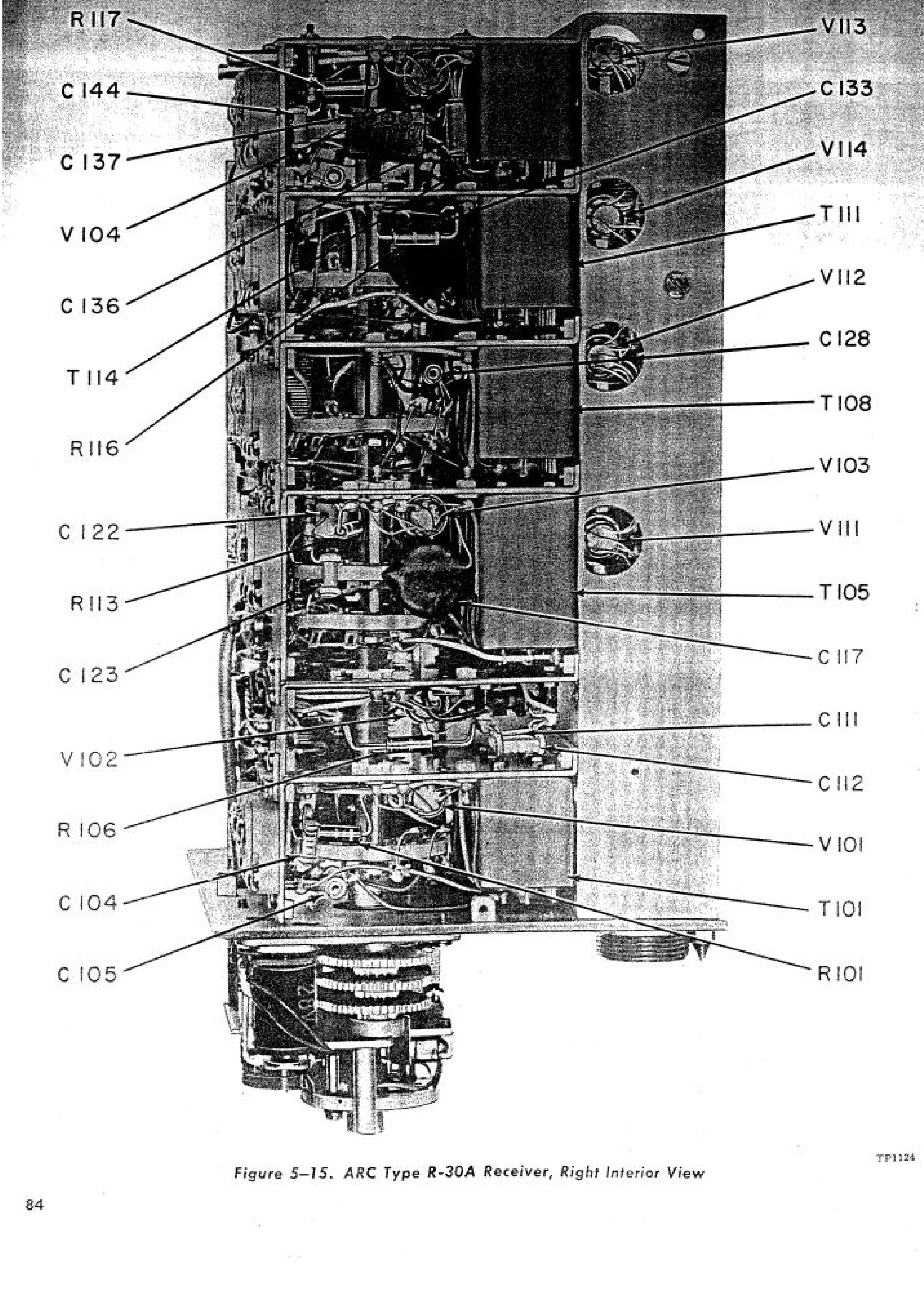
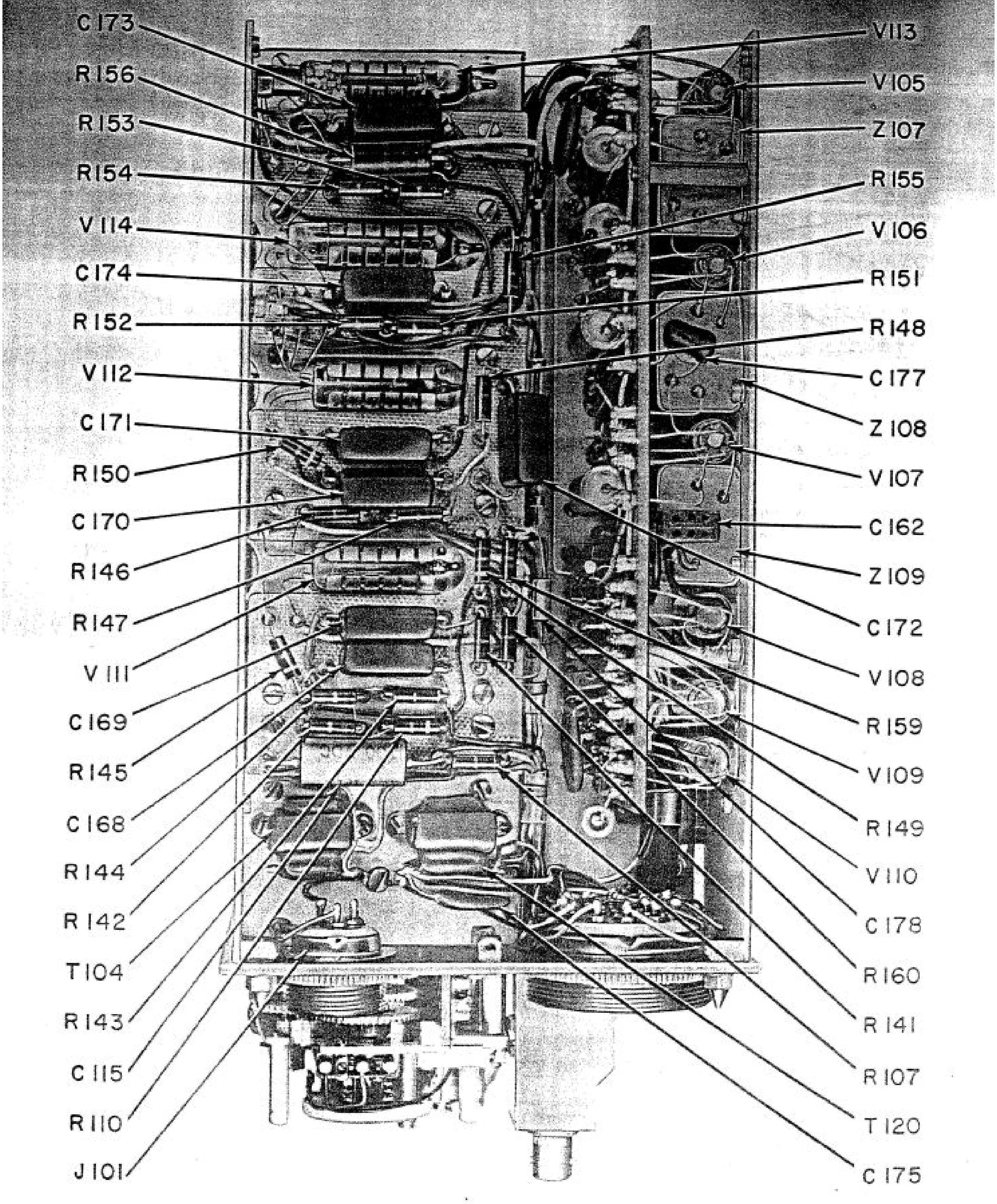


Figure 5–15. ARC Type R-30A Receiver, Right Interior View



TP1126

Figure 5–16. ARC Type R-30A Receiver, Bottom Interior View

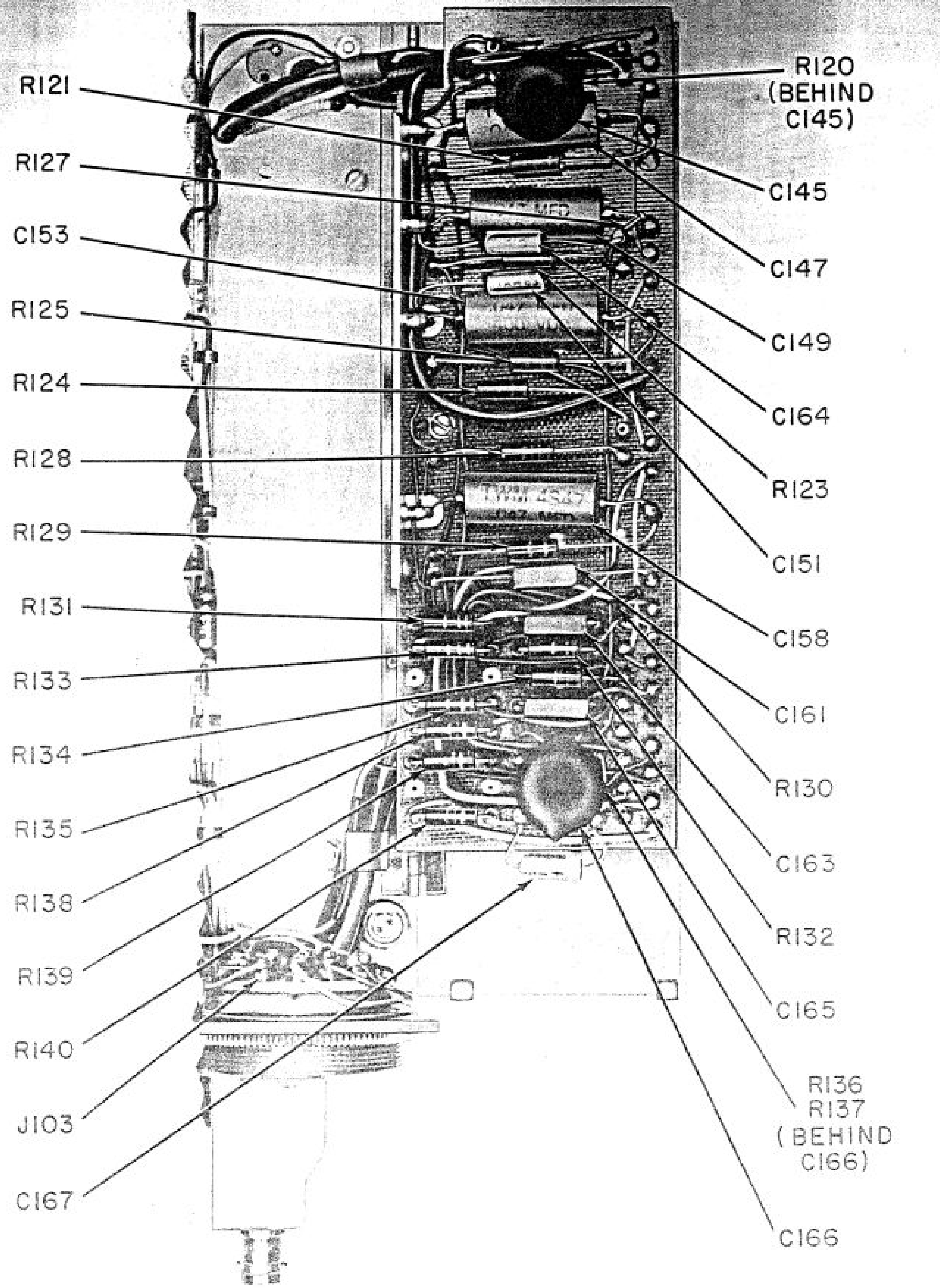


Figure 5–17. ARC Type R-30A Receiver, I-f/A-f Terminal Board

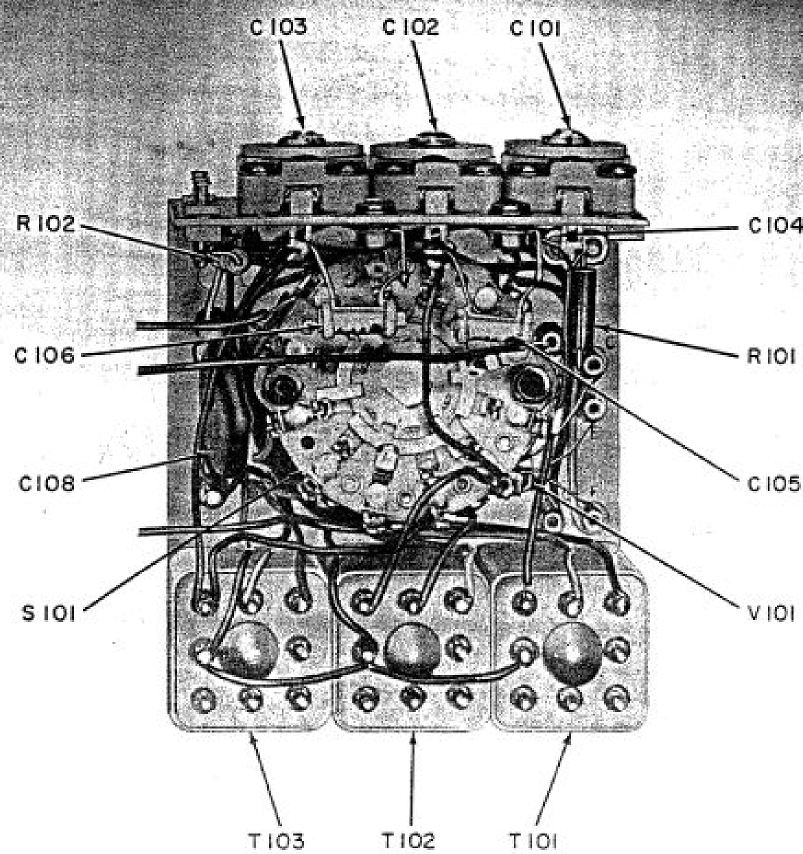
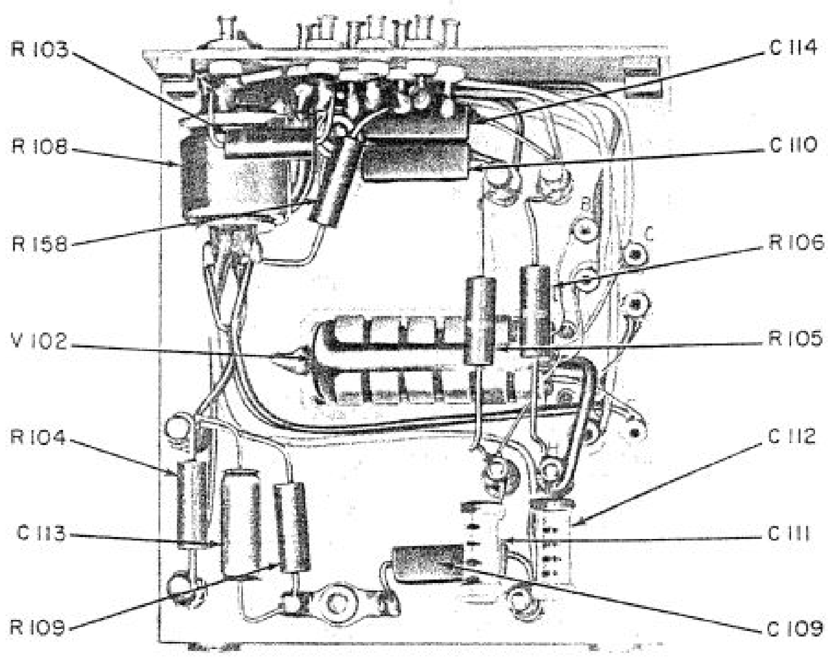


Figure 5–18. ARC Type R-30A Receiver, Loop Amplifier Assembly Z101

TP1130



TP113

Figure 5–19. ARC Type R-30A Receiver, Modulator Assembly Z102

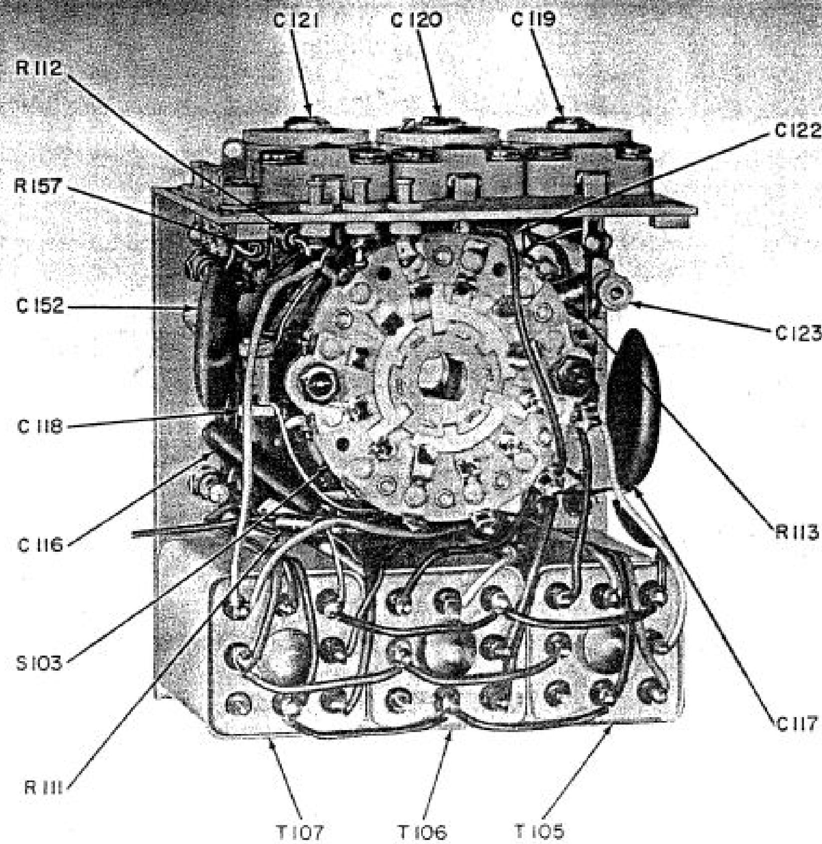


Figure 5–20. ARC Type R-30A Receiver, Antenna Assembly Z103

TP1134

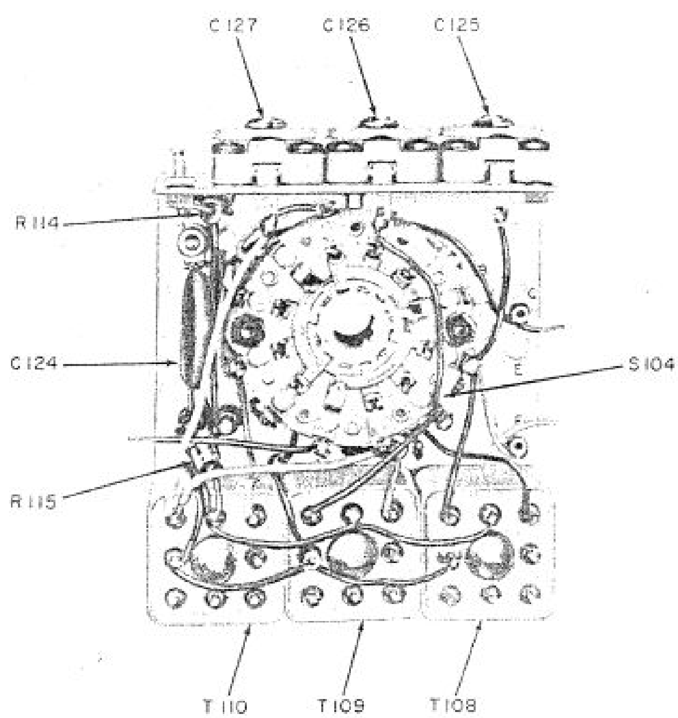


Figure 5–21. ARC Type R-30A Receiver, First RF Assembly Z104

TP1136

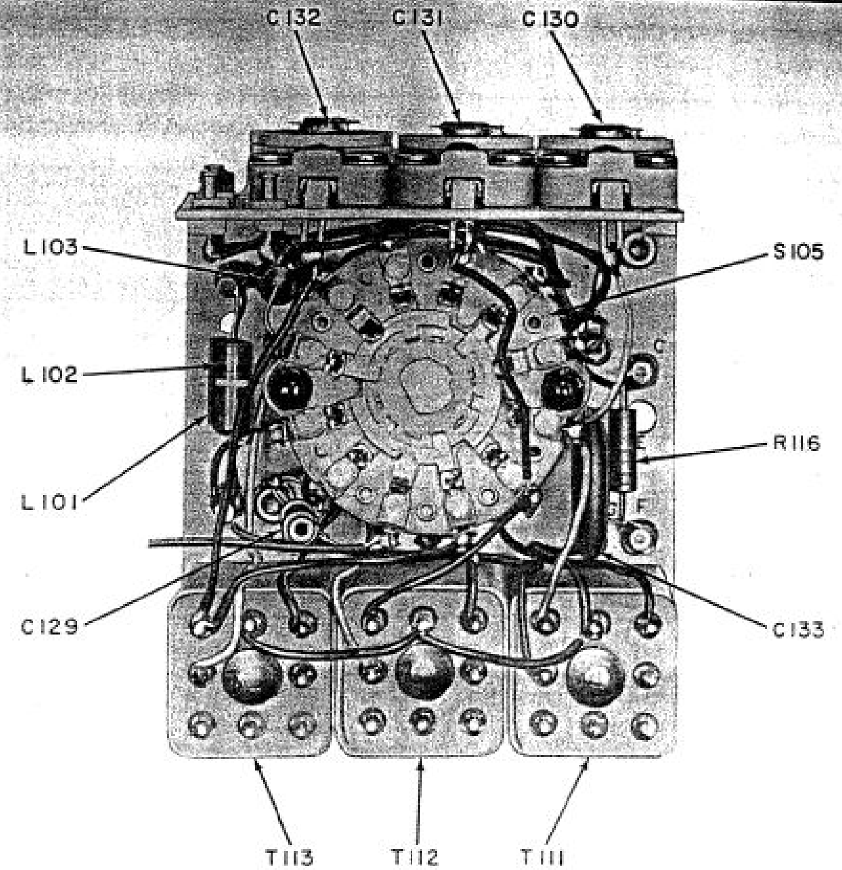
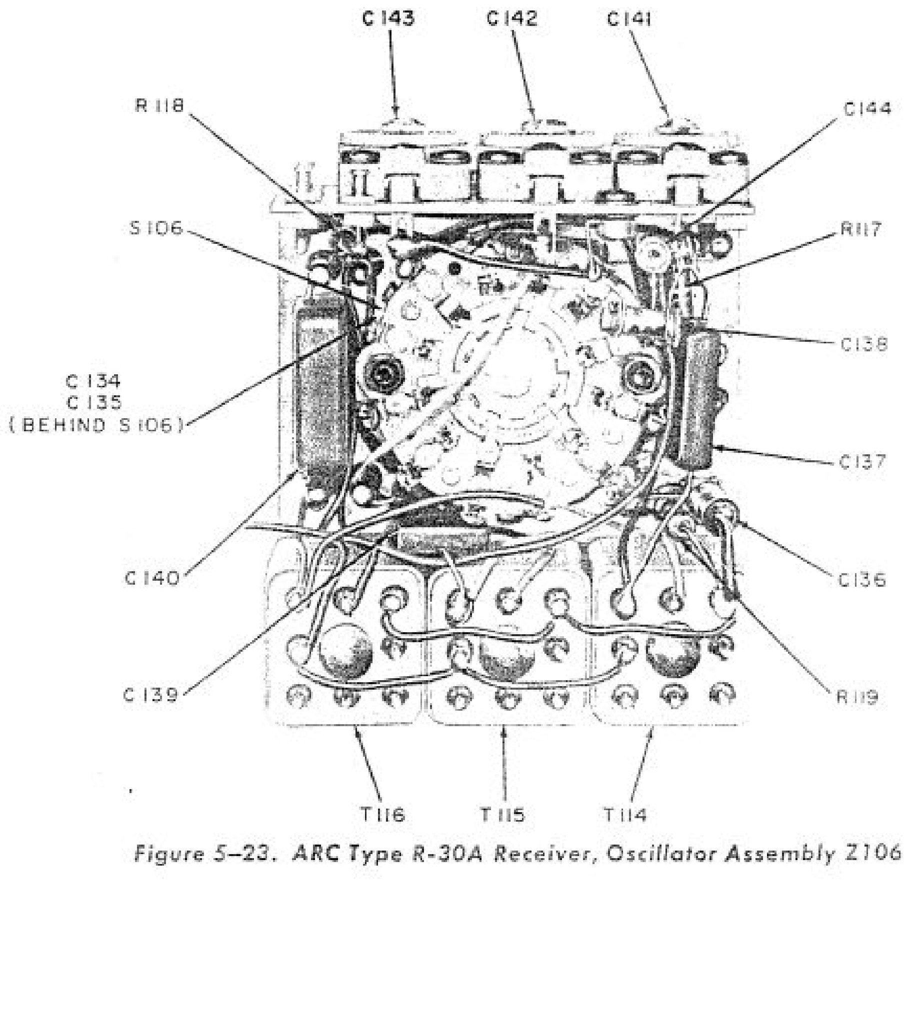


Figure 5–22. ARC Type R-30A Receiver, Second RF Assembly Z105

TP1138



TP1140

Figure 5–23. ARC Type R-30A Receiver, Oscillator Assembly Z106

5–8. MAINTENANCE OF L-11 LOOP.

Maintenance of the ARC Type L-11 Loop is limited to visual inspection of the unit, comparative tests with reliable units, and checking loop compensation schedules. Known loop compensation schedules may be set up using the ARC Type BTK-21 Bench Test Kit.

The L-11 Loop is a hermetically sealed unit and should not be repaired in the field unless complete overhaul facilities are available. Overhaul instructions and test procedures are given in *Overhaul Instructions for ARC Type L-11 Loop,* ARC Publication No. ARCOC-L11-1. Figures 6–11 and 6–12 are schematic and wiring diagrams of the L-11 Loop. Table 5–6 lists typical resistance measurements for the L-11 Loop. Measurements were made with the L-11 Loop disconnected.

TABLE 5–6. L-11 LOOP RESISTANCE MEASUREMENTS

Receptacle	From Terminal	To Terminal	Resistance (ohms)[1]	Receptacle	From Terminal	To Terminal	Resistance (ohms)
J401	A	B	10(5)	J402	A	C	0.1
	A	F	10(5)		B	C	0.1
	B	F	10(5)		A	B	0.2
	C	F	30(16)				
	D	F	35(35)				
	E	F	465(520)				

[1] Values in parentheses refer to some early production units.

5–9. MAINTENANCE OF C-59A CONTROL UNIT.

General. The ARC Type C-59A Control Unit does not require special maintenance procedures. The performance of the C-59A may be checked by substituting a reliable unit and making a comparative test, or by comparing its operation with the control section of the ADF Test Panel of the ARC Type BTK-21 Bench Test Kit.

During periodic inspection, check that all solder connections are mechanically and electrically secure. Check that connector pins are not corroded or damaged; damaged or deformed pins may cause intermittent operation of the equipment. If necessary, clean the COMP-ANT-LOOP switch contacts with Varsol (Esso Standard Oil Co.) or equivalent (Solvent, Dry-cleaning Federal Specification P-S-661).

Lubrication. When necessary, lubricate the bearings, gears, coil springs, balls, and wear surfaces of the dial gearing unit with Aeroshell Grease #7, or equivalent. If the tuning crank knob binds, lubricate it with Esso Beacon Grease #325, or equivalent.

Detail Part Replacement. The detail parts which comprise the C-59A may be replaced if found defective. When replacing, install the replacement part and route the wiring as nearly like the original as possible.

C-59A Trouble-shooting Chart. Table 5–7 is a trouble-shooting chart for the C-59A Control Unit. For location and identification of detail parts, see Figure 5–24. For schematic and wiring diagrams, see Figures 6–13 and 6–14.

TABLE 5–7. C-59A CONTROL UNIT TROUBLE-SHOOTING CHART

Symptom	Probable Cause	Remedy
Type 21A inoperative	Incorrect or defective wiring to J201 on C-59A Defective S202	Correct or repair wiring to J201 Replace S202
MC BAND switch inoperative	Defective S203 Incorrect or defective wiring to J201	Replace S203 Correct or repair wiring to J201; check external ground on terminal C
VOL control does not adjust r-f sensitivity	Defective R201A Defective S204	Replace R201A Repair or replace S204
Loop does not rotate when LOOP switch is pressed	Defective S201	Replace S201
VOL control does not affect audio level when COMP-ANT-LOOP switch is in COMP position	Defective R201B Defective S204	Replace R201B Repair or replace S204
BFO operates at all times	Defective S205 (open)	Replace S205

5–10. MAINTENANCE OF IN-12, IN-13, AND IN-13A INDICATORS.

The ARC Type IN-12, IN-13, and IN-13A Indicators are hermetically sealed units and, except for replacement of the connector and knobs, cannot be repaired in the field unless complete overhaul equipment is available. For complete overhaul instructions, refer to *Overhaul Instructions for ARC Type IN-12 Indicator*, ARC Publication No. ARCOC-IN12-1, or *Overhaul Instructions for ARC Type IN-13 and IN-13A Indicators*, ARC Publication No. ARCOC-IN13/A-1. The indicator performance may be checked by comparing it to the indicator included in the ARC Type BTK-21 Bench Test Kit, or by substituting a comparable reliable unit. Figures 6–15, 6–16, and 6–17 are schematic diagrams of the IN-12, IN-13, and IN-13A, respectively. Tables 5–8, 5–9 and 5–10 list typical resistance measurements for the IN-12, IN-13 and IN-13A, respectively. The measurements were made with the indicator disconnected.

TABLE 5–8. IN-12 INDICATOR RESISTANCE MEASUREMENTS

Receptacle	From Terminal	To Terminal	Resistance (ohms)
Manufactured by George W. Borg Corp.			
J501	A	B	8
	A	C	8
	B	C	8
	A	D	18
Manufactured by Kearfott Co., Inc.			
J501	A	B	10
	A	C	10
	B	C	10
	A	D	30

TABLE 5–9. IN-13 INDICATOR RESISTANCE MEASUREMENTS

Receptacle	From Terminal	To Terminal	Resistance (ohms)
J601	A	B	10
	A	C	10
	B	C	10
	A	D	30
	A	E	10
	A	F	10
	E	F	10
	A	G	30

TABLE 5–10. IN-13A INDICATOR RESISTANCE MEASUREMENTS

Receptacle	From Terminal	To Terminal	Resistance (ohms)
J601	A	B	10
	A	C	10
	B	C	10
	D	I	30
	K	E	10
	K	F	10
	E	F	10
	G	L	30

Connector Replacement. To replace the connector on the IN-12, IN-13, or IN-13A, proceed as follows:

Step 1. Remove the three screws which secure the rear cover.

Step 2. Unsolder the wires from the connector. Unscrew the knurled nut to remove the connector.

Step 3. Install the replacement connector and resolder the wires to their proper terminals (see Figures 6–15, 6–16, or 6–17).

Step 4. Replace the rear cover and secure it with the three screws.

5–11. MAINTENANCE OF P-14A POWER UNIT.

General. The ARC Type P-14A Power Unit consists of a dynamotor-alternator, low- and high-voltage filter networks, a relay for applying primary power to the Type 21A, a 100-cycle amplifier output transformer, and a phase reversing transformer which produces 100-cycle outputs at 0° and 180°.

Dynamotor-Alternator Inspection. The dynamotor-alternator should be inspected every 100 hours. The normal life of this dynamotor-alternator will probably exceed 1000 hours without brush changes; however, check the brush lengths during periodic inspections or sooner if abnormal operation is suspected.

The dynamotor-alternator should be cleaned every 100 hours or sooner if necessary. The accumulation of carbon dust can cause noisy operation, speed fluctuations, or output voltage fluctuations. *Blow out the dust at least every 100 hours.*

Brush Inspection. To inspect the dynamotor-alternator brushes, first remove the locking wire, then remove the eight screws (four at each end) which secure the end covers. Figure 5–25 identifies and shows the location of the various brushes. The LV, HV, and AC brushes are removed for inspection by unscrewing the black bakelite thumbnuts and then sliding the brushes from their holders. Table 5–11 lists the brush lengths at the start of service and at the end of their useful life. Compare the

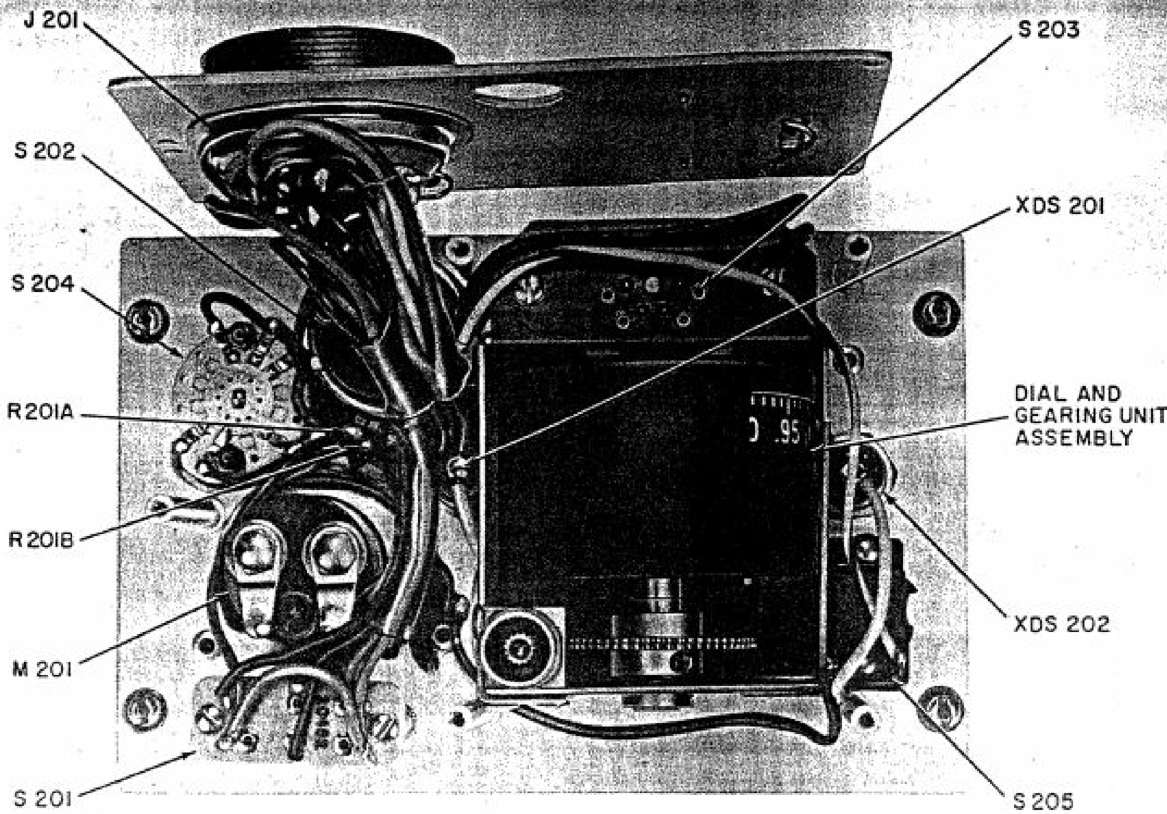


Figure 5–24. ARC Type C-59A Control Unit, Rear Interior View

length of the brushes in service with the lengths listed in Table 5–11 to determine whether replacement is necessary.

To inspect the speed governor brushes, it is first necessary to remove the governor assembly from the shaft, but mark the position of the governor on the shaft before removal to insure proper replacement.

TABLE 5–11. DYNAMOTOR-ALTERNATOR BRUSH LENGTHS

Brush	*Length at Start*	*Length at End of Life*
LV	7/16 inch	1/4 inch
HV	5/16 inch	3/16 inch
AC	5/16 inch	3/16 inch
Speed Governor	3/8 inch	1/4 inch

Replacement of Brushes. If inspection of the brushes indicates that they must be replaced, proceed as follows:

Step 1. Sand the commutator with grade 0000 or finer sandpaper. Clean it with Esso Standard Oil Co. Varsol, or an equivalent dry-cleaning solvent, and a clean cloth or clean bristle-brush.

Step 2. Insert a new brush of the correct type, making sure that it slides smoothly into its slot.

Step 3. Remove the new brush. Fasten a close fitting strip of grade 0000 sandpaper around the commutator. Insert the new brush so that its face bears up against the sandpaper. Seat the brush firmly in position with its thumbnut cap. Rotate the armature by hand until the brush face is properly shaped.

Step 4. Remove the sandpaper strip. Blow out accumulated dust with compressed air. Run the dynamotor-alternator electrically until 80 per cent of the brush face makes contact with the commutator.

Speed Governor Adjustment. Failure of the speed governor usually results in an a-c frequency rise, probably to about 120 cps at normal input voltage loads. The frequency may be checked with a suitable Frahm Frequency Meter designed for 10- to 15-volt operation, or by comparison with a known frequency from an accurate audio frequency oscillator, observed on an oscilloscope.

Note

A Frahm Frequency Meter is included in the ARC Type BTK-21 Bench Test Kit to facilitate checking the 100-cycle output of the dynamotor-alternator.

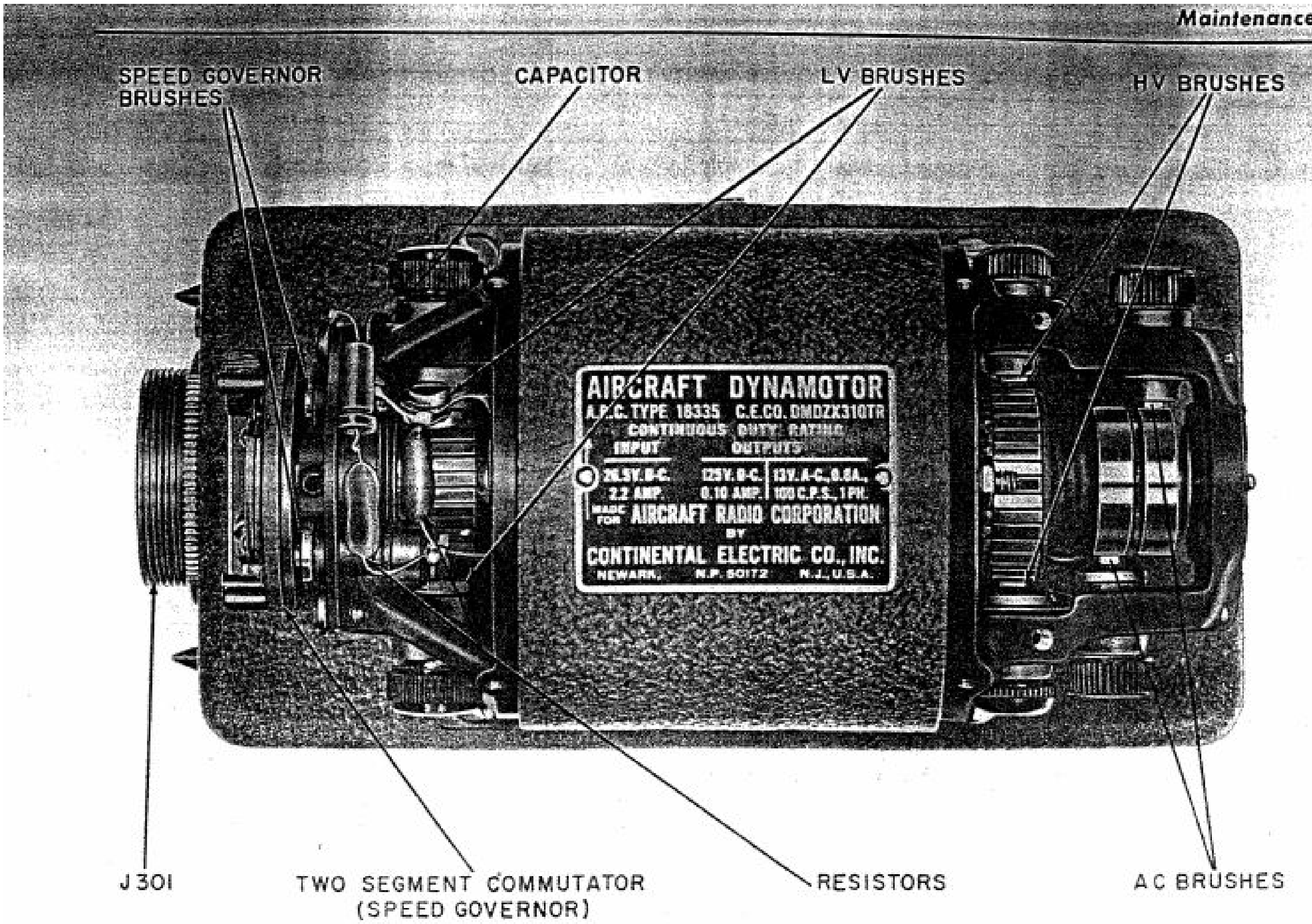


Figure 5–25. ARC Type P-14A Power Unit, Top View, End Covers Removed

The dynamotor-alternator is rated for an accuracy of $100(\pm3)$ cps, but satisfactory operation may be obtained with $100(\pm5)$ cps. If speed correction is necessary, make certain that the two-segment commutator is in good condition and that the brushes are free and of sufficient length (refer to Table 5–11). If the commutator and brushes are in satisfactory condition, but the frequency is not within limits with normal input voltage and load, the governor contacts must be cleaned and the speed adjusted. See Figure 5–26 for the location of contacts and speed adjusting screws. Carefully burnish the centrifugally actuated contacts. Take care not to bend the contact springs. Speed adjustments are made by "trial and error" until the proper frequency is reached. Resetting the *outer* screw of the governor varies the speed; clockwise rotation decreases speed. After the speed has been accurately set, seal the adjusting screw with Glyptal, or equivalent sealing enamel, and allow the Glyptal to dry before running the dynamotor-alternator.

Bearing Lubrication. The bearing lubrication should be checked at least every 500 hours. To inspect the bearing lubricant, remove the bearing covers. (The speed governor assembly must be removed from the armature shaft to gain access to one of the bearings.) If the lubricant is dry, dirty, or insufficient, remove as much old grease as possible with a clean cloth or clean stiff brush and Esso Standard Oil Co. Varsol, or equivalent dry-cleaning solvent. Add enough Esso Standard Oil Co. Andok C grease, or equivalent, to cover the bearings. *Do not pack bearings or allow grease to get on commutators.*

Detail Part Replacement. Special replacement procedures are required when replacing parts in the dynamotor-alternator. Complete overhaul and test procedures for the dynamotor-alternator are given in *Overhaul Instructions for ARC Type P-14 and P-14A Power Units,* ARC Publication No. ARCOC-P14/A-1. Other parts of the P-14A (see Figure 5–27) do not require special replacement procedures. When replacing a part, the physical positioning of the replacement part and the routing of wires should duplicate the original installation as nearly as possible.

P-14A Trouble-shooting. Table 5–12 is a trouble-shooting chart for the P-14A Power Unit.

TABLE 5–12. P-14A POWER UNIT TROUBLE-SHOOTING CHART

Symptom	Probable Cause	Remedy
Dynamotor-alternator inoperative	Defective primary d-c supply	Repair or replace d-c supply
	Incorrect or defective wiring to J103 on P-14A	Correct or repair defective wiring
	K301 solenoid winding open	Replace K301
	L301 open	Replace L301
	Defective dynamotor-alternator	Repair or replace dynamotor-alternator
No HV2 (HV1 normal)	L302 or L303 open	Replace defective choke
No HV1 or HV2	Defective dynamotor-alternator	Repair or replace dynamotor-alternator
	C303 shorted	Replace C303
Low HV1 and HV2	Leaky C303, C305, C306	Replace defective capacitor
No 13 volts ac, 100 cps	Defective dynamotor-alternator	Repair or replace dynamotor-alternator
	C302 shorted	Replace C302
No 100 ~, $\phi \angle 180°$	T302 open	Replace T302
No 100 ~, $\phi \angle 90°$	Defective T301	Replace T301
	C301 shorted	Replace C301
100~ output out of frequency limits	Defective speed governor on dynamotor-alternator	Check speed governor brushes; clean and adjust speed governor

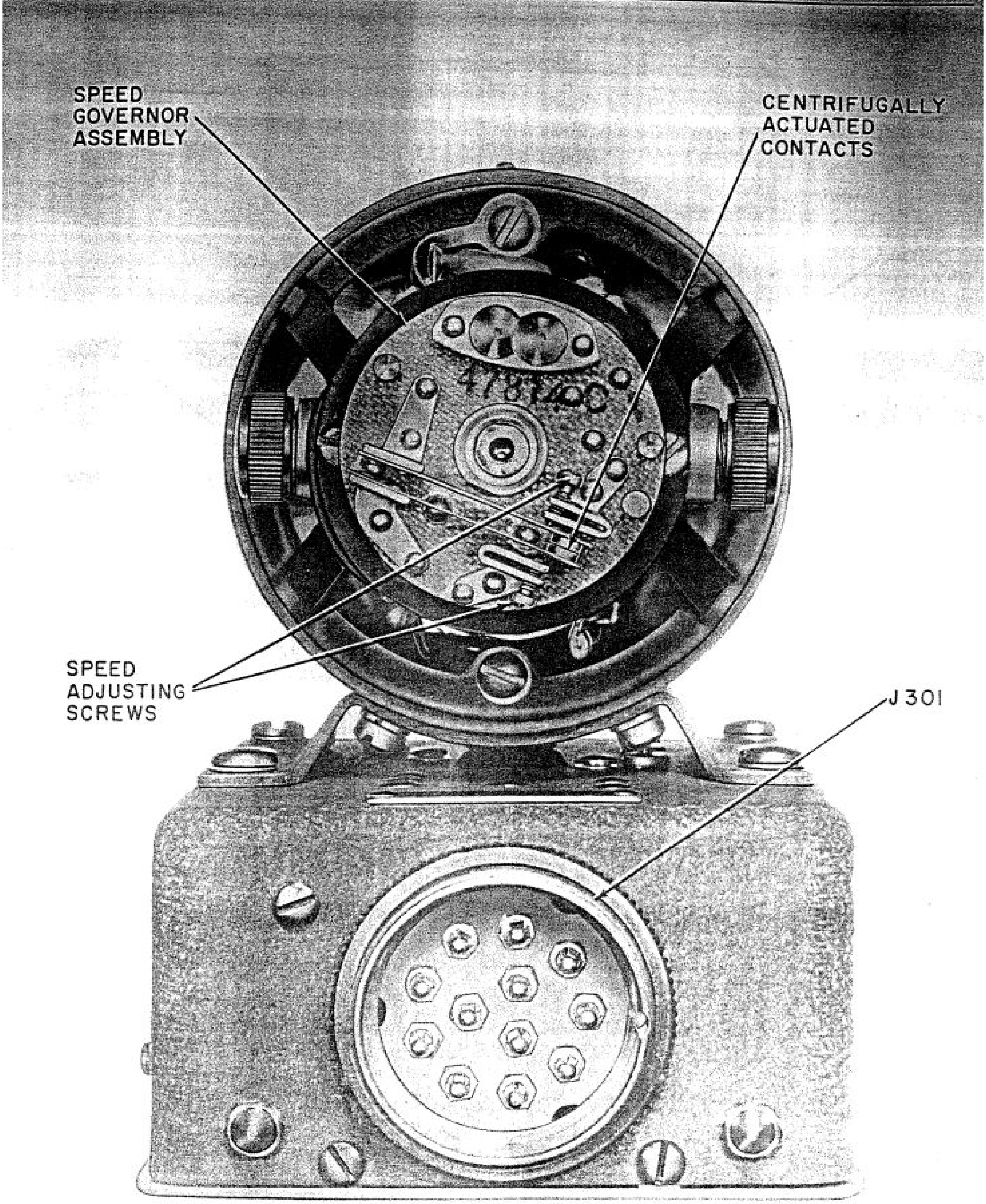


Figure 5–26. ARC Type P-14A Power Unit, End View, End Cover Removed

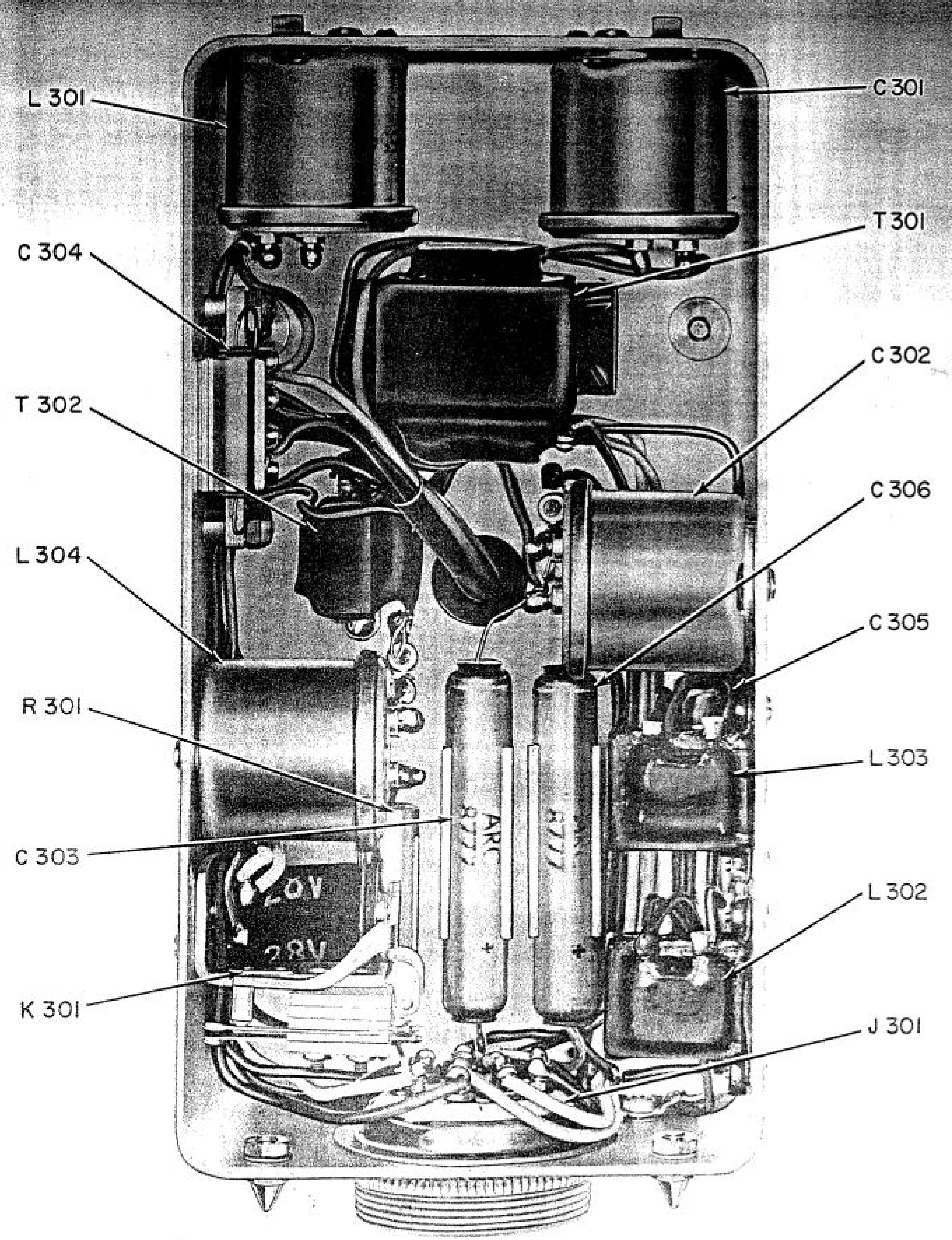


Figure 5–27. ARC Type P-14A Power Unit, Bottom Interior View

TP1148

SECTION VI

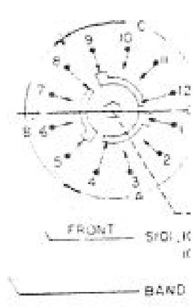
DIAGRAMS

NOTES:

1. 14-VOLT AND 28-VOLT RECEIVERS DIFFER IN HEATER WIRING, MOTOR B101, AND RELAYS K101 AND K102.
2. ASSOCIATED WIRING DIAGRAMS ARE AS FOLLOWS:

UNIT	FIGURE NO.
MAIN CHASSIS	6-2
LOOP AMPLIFIER	6-3
MODULATOR	6-4
ANTENNA	6-5
1ST RF	6-6
2ND RF	6-7
OSCILLATOR	6-8
BAND SELECTOR	6-9
BEAT FREQ OSC	6-10

3. INDUCTOR VALUES ARE IN MICROHENRIES (μH) UNLESS OTHERWISE NOTED.
4. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu$F) UNLESS OTHERWISE NOTED.
5. RESISTANCE VALUES ARE IN OHMS. MULTIPLIERS: K=1000; MEG=1,000,000.
6. SWITCHES ARE SHOWN IN BAND I POSITION.
7. SWITCHES S101 - S106 & S108 GO THROUGH THREE COMPLETE BAND-SELECTION CYCLES IN THE COURSE OF ONE SHAFT REVOLUTION, DIFFERENT SECTORS OF A ROTOR AT ANY GIVEN CIRCUIT LOCATION COMING INTO USE AT EACH CYCLE. FOR CLARITY, AT EACH SWITCH LOCATION IN THE MAIN DIAGRAM ONLY THE ACTIVE 120° ROTOR SECTOR IS SHOWN; ARROWS INDICATE DIRECTION OF ROTATION. FOR ADDITIONAL INFORMATION SEE SWITCH DETAILS. STATOR SECTORS ARE REPRESENTED BY THE LETTERS A, B, & C FOR THE FRONT SECTORS AND D FOR THE REAR SECTOR. STATOR SECTORS IN USE ARE AS FOLLOWS: S101 - A, B, C, D; S102 - A, B, D; S103 - A, B; S104 - A, B, D; S105 - A, B, C, D; S106 - A, B, C, D; S108 - D.
8. S107 IS OPERATED BY A MOTOR-DRIVEN CAM, ROTATING AT THREE TIMES BAND SWITCH SPEED, AND ACTS AS A VERNIER TO OPEN THE MOTOR CIRCUIT AT PRECISE ANGLES.
9. THE INTERMEDIATE FREQUENCY (IF) IS 142.5 KC (OSCILLATOR FREQUENCY IS HIGHER THAN SIGNAL FREQUENCY).
10. D-C VOLTAGES ARE APPROXIMATE AND ARE BASED ON THE FOLLOWING CONDITIONS:
    - (A) RECEIVER CONNECTED IN COMPLETE SYSTEM INCLUDING POWER UNIT (P-14A), CONTROL UNIT (C-59A), LOOP (L-11) AND INDICATOR (IN-12, IN-13, OR IN-13A).
    - (B) LV+ AT TERMINAL B OF POWER UNIT RECEPTACLE SET AT 13.5 VOLTS FOR 14-VOLT RECEIVER OR 27.0 VOLTS FOR 28-VOLT RECEIVER.
    - (C) CONTROL UNIT FUNCTION SWITCH IN "COMP" POSITION; NO SIGNAL INPUT.
    - (D) NEGATIVE TERMINAL OF VOLTMETER GROUNDED TO CHASSIS.
    - (E) VOLTMETER OHMS-PER-VOLT: EITHER 1000 OR 20,000 OHMS EXCEPT WHERE SPECIFICALLY INDICATED.
11. A-C VOLTAGES ARE APPROXIMATE AND ARE AS MEASURED TO GROUND WITH A VACUUM TUBE VOLTMETER.
12. RELAYS ARE SHOWN IN UNENERGIZED POSITION. K101 IS ENERGIZED DURING BAND CHANGE ONLY; K102 IS ENERGIZED IN "LOOP" POSITION ONLY.



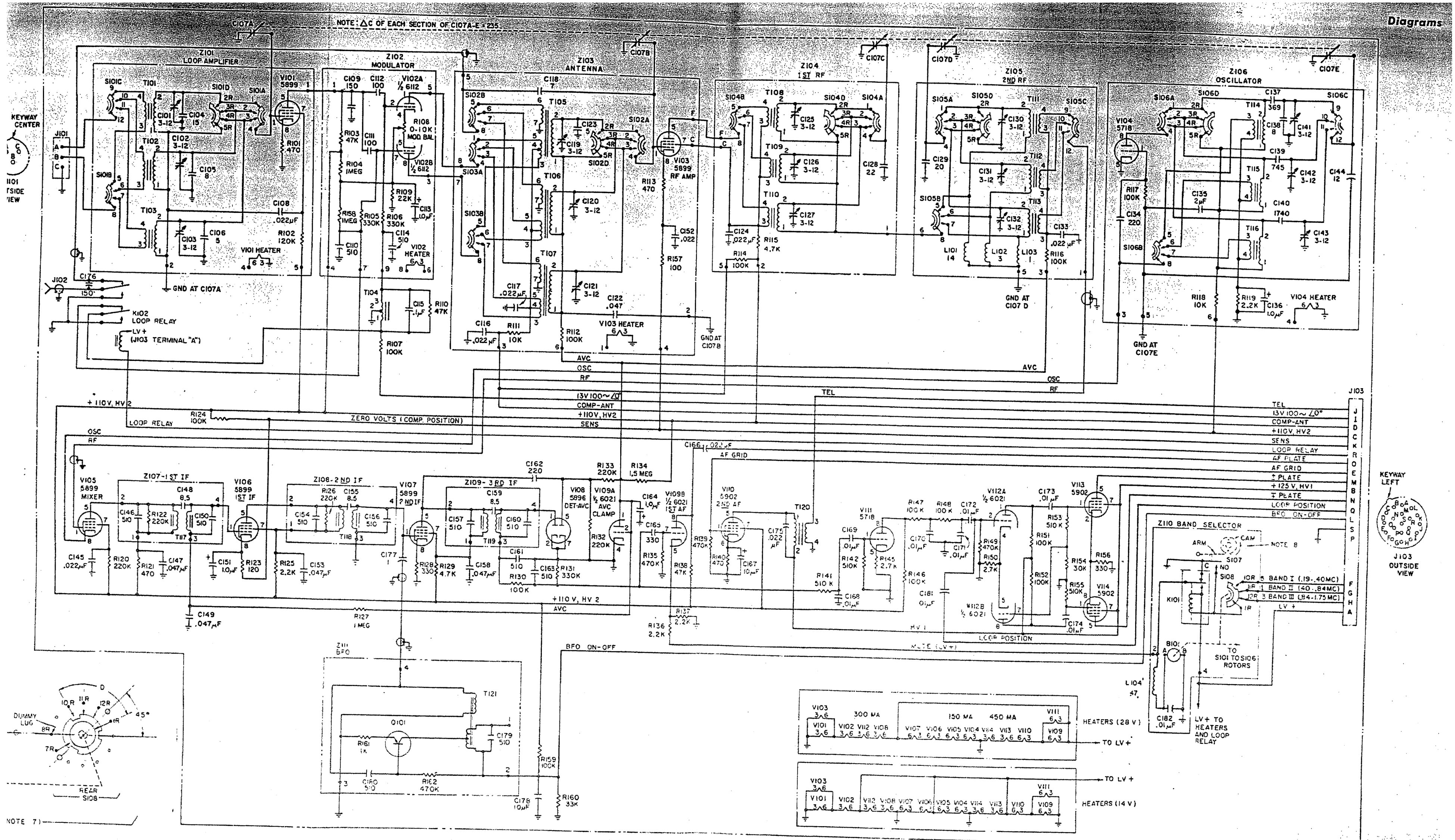


Figure 6–1. ARC Type R-30A Receiver, Schematic Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. ASSOCIATED WIRING DIAGRAMS FOR COMPLETE WIRING OF RECEIVER ARE AS FOLLOWS:

SUBASSEMBLY	FIGURE NO.
LOOP (Z101)	6-3
MOD (Z102)	6-4
ANT (Z103)	6-5
1ST RF (Z104)	6-6
2ND RF (Z105)	6-7
OSC (Z106)	6-8
BAND SEL (Z110)	6-9
BFO (Z111)	6-10

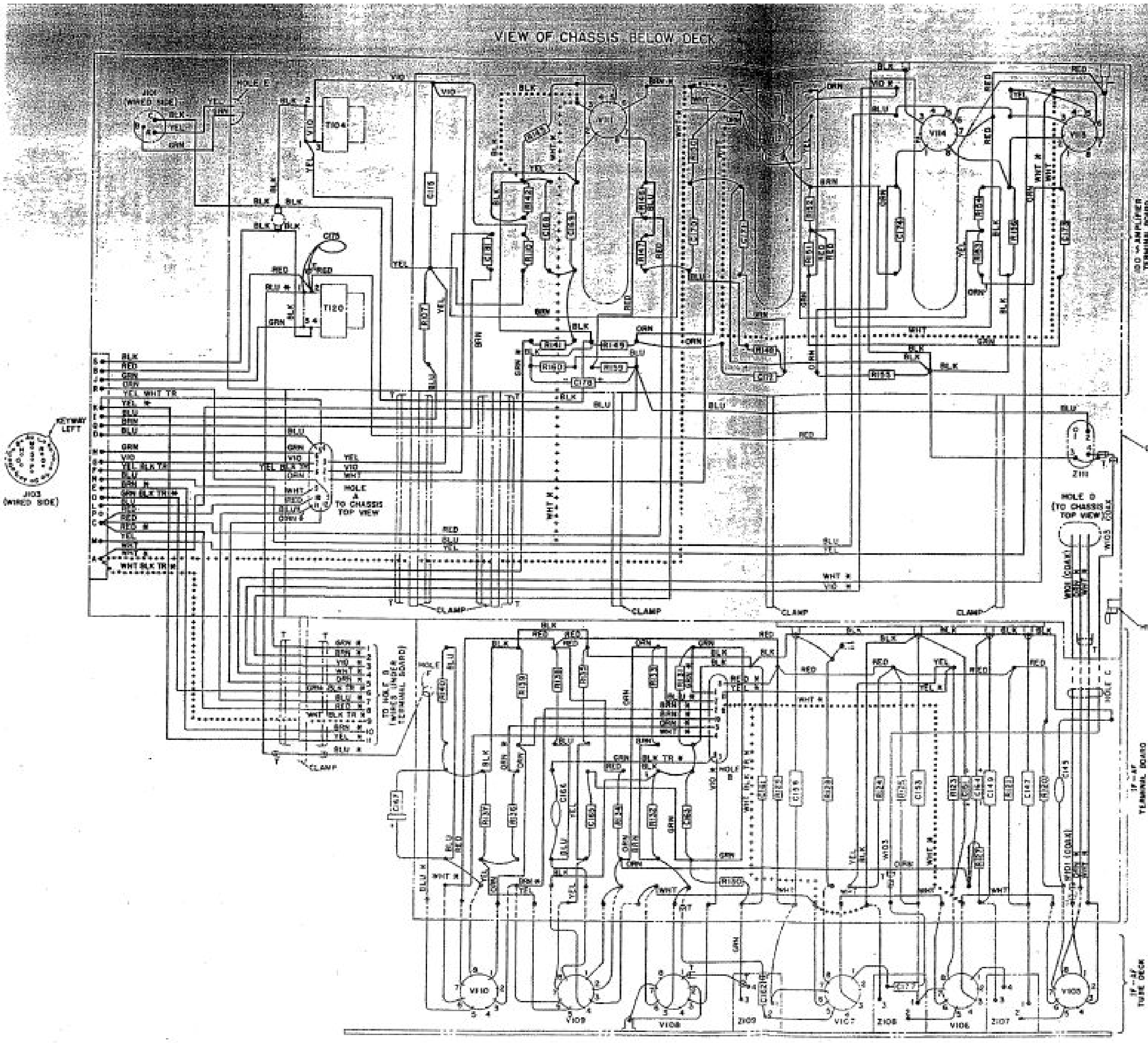
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIERS: K=1000; MEG=1,000,000.
4. CAPACITANCE VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES:

MARKING SHOWN	DESCRIPTION
COLOR NOTE	#24 SOLID COPPER, TEFLON INSULATED
COLOR NOTE & ASTERISK(*)	#24 STRANDED COPPER, TEFLON INSULATED
UNMARKED	#24 BARE, SOLID, TINNED COPPER

6. FOR 28-VOLT RECEIVER, WIRES MARKED (+ + + +) ARE CONNECTED AND WIRES MARKED (· · · ·) ARE OMITTED. FOR 14-VOLT RECEIVER WIRES MARKED (· · · ·) ARE CONNECTED AND WIRES MARKED (+ + + +) ARE OMITTED.
7. ELECTRON TUBES ARE VIEWED TOWARD BASE. TUBES V111, V112, V113, AND V114 ARE SHOWN DISPLACED 90° FOR CLARITY.
8. DRESSING OF LEADS:
   (A) AVOID SHARP BENDS IN ALL WIRES.
   (B) COVER ALL WIRES OR GROUPS OF WIRES MARKED (symbol) WITH IMPREGNATED FIBERGLAS TUBING OF APPROPRIATE SIZE.
   (C) CUT OFF ALL UNUSED TUBE LEADS APPROXIMATELY 1/32" FROM GLASS.
   (D) DRESS ALL BARE, TUBE, AND DETAIL PART LEADS 1/16" MINIMUM APART.
   (E) SOLDER ALL LEADS TO Z107, Z108, AND Z109 1/16" MINIMUM FROM GLASS INSULATION.
   (F) KEEP RF SUBASSEMBLY MOUNTING HOLES (AND SCREWS) IN 100~ AMPLIFIER TERMINAL BOARD FREE OF WIRES.
   (G) CABLE AND WIRES THRU HOLE "C" IN IF-AF TERMINAL BOARD MUST BE LONG ENOUGH TO PERMIT FULL OPENING OF HINGE WITHOUT BEING STRAINED.
   (H) COAXIAL CABLES ARE INDICATED BY THE SYMBOL (symbol) AT ENDS OF SHEATHS.

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION	SYMBOL NO.	ARC PART NO.	DESCRIPTION
C107A-E	18688	ΔC=235 PER SECTION	R138	201(*)	47K
C115	8802	0.1 μF	R139	201(*)	470K
C145	8627(*)	.022 μF	R140	201(*)	470
C147	8890(*)	.047 μF	R141	201(*)	510K
C149	8890(*)	.047 μF	R142	201(*)	510K
C151	21485	1.0 μF			
C153	8890(*)	.047 μF			
C158	8890(*)	.047 μF	R145	201(*)	2.7K
C161	8706(*)	510	R146	201(*)	100K
C162	8706(*)	220	R147	201(*)	100K
C163	8706(*)	510	R148	201(*)	100K
C164	21485	1.0 μF	R149	201(*)	470K
C165	8706(*)	330	R150	201(*)	2.7K
C166	8627(*)	.022 μF	R151	201(*)	100K
C167	8772	10 μF	R152	201(*)	100K
C168	8618(*)	.01 μF	R153	201(*)	510K
C169	8618(*)	.01 μF	R154	201(*)	30K
C170	8618(*)	.01 μF	R155	201(*)	510K
C171	8618(*)	.01 μF	R156	203(*)	330
C172	8618(*)	.01 μF	R159	201(*)	100K
C173	8618(*)	.01 μF	R160	201(*)	33K
C174	8618(*)	.01 μF			
C175	8627(*)	.022 μF			
C176	8706(*)	150	T104	18053	MOD. TRANSFORMER
C177	8791(*)	1	T120	18052	AF TRANSFORMER
C178	21485	1.0 μF			
C181	8835	.01 μF	V105	TYPE 5899	ELEC. TUBE, CODE ORN
			V106	TYPE 5899	ELEC. TUBE, CODE ORN
J101	12426	RECEPTACLE (3 PIN)	V107	TYPE 5899	ELEC. TUBE, CODE ORN
J102	15185	RECEPT. (REF UG-625/U)	V108	TYPE 5896	ELEC. TUBE, CODE RED
J103	12357	RECEPTACLE (19 PIN)	V109	TYPE 6021	ELEC. TUBE, CODE GRN
			V110	TYPE 5902	ELEC. TUBE, CODE YEL
K102	12713 (28V) 12712 (14V)	RELAY	V111	TYPE 5718	ELEC. TUBE, CODE BRN
			V112	TYPE 6021	ELEC. TUBE, CODE GRN
			V113	TYPE 5902	ELEC. TUBE, CODE YEL
R107	201(*)	100K	V114	TYPE 5902	ELEC. TUBE, CODE YEL
R110	201(*)	47K			
R120	201(*)	220K	W101	18327	COAXIAL CABLE
R121	201(*)	470	W102	18079	COAXIAL CABLE
R123	201(*)	120	W103	18327	COAXIAL CABLE
R124	201(*)	100K			
R125	201(*)	2.2K	Z101	17890	LOOP ASSEMBLY
R127	200(*)	1MEG	Z102	17870	MOD ASSEMBLY
R128	201(*)	330	Z103	18120	ANT ASSEMBLY
R129	201(*)	4.7 K	Z104	17810	1ST RF ASSEMBLY
R130	200(*)	100K	Z105	17820	2ND RF ASSEMBLY
R131	201(*)	330K	Z106	17910	OSC ASSEMBLY
R132	201(*)	220K	Z107	18171	1ST IF TRANSFORMER
R133	201(*)	220K	Z108	18171	2ND IF TRANSFORMER
R134	201(*)	1.5MEG	Z109	18173	3RD IF TRANSFORMER
R135	201(*)	470K	Z110	17930	BAND SELECTOR ASSEMBLY
R136	201(*)	2.2K	Z111	20639	BEAT FREQ OSC ASSEMBLY
R137	201(*)	2.2K			


VIEW OF CHASSIS BELOW DECK
J101 (WIRED SIDE)
HOLE E
T104
T120
C175
J103 (WIRED SIDE)
KEYWAY LEFT
HOLE A TO CHASSIS TOP VIEW
CHASSIS
Z111
HOLE D (TO CHASSIS TOP VIEW)
HINGE
CLAMP
HOLE C
J110 — AMPLIFIER TERMINAL BOARD
IF—AF TERMINAL BOARD
IF—AF TUBE DECK
V110
V109
V108
V107
V106
V105
V111
V114
V115
Z109
Z108
Z107

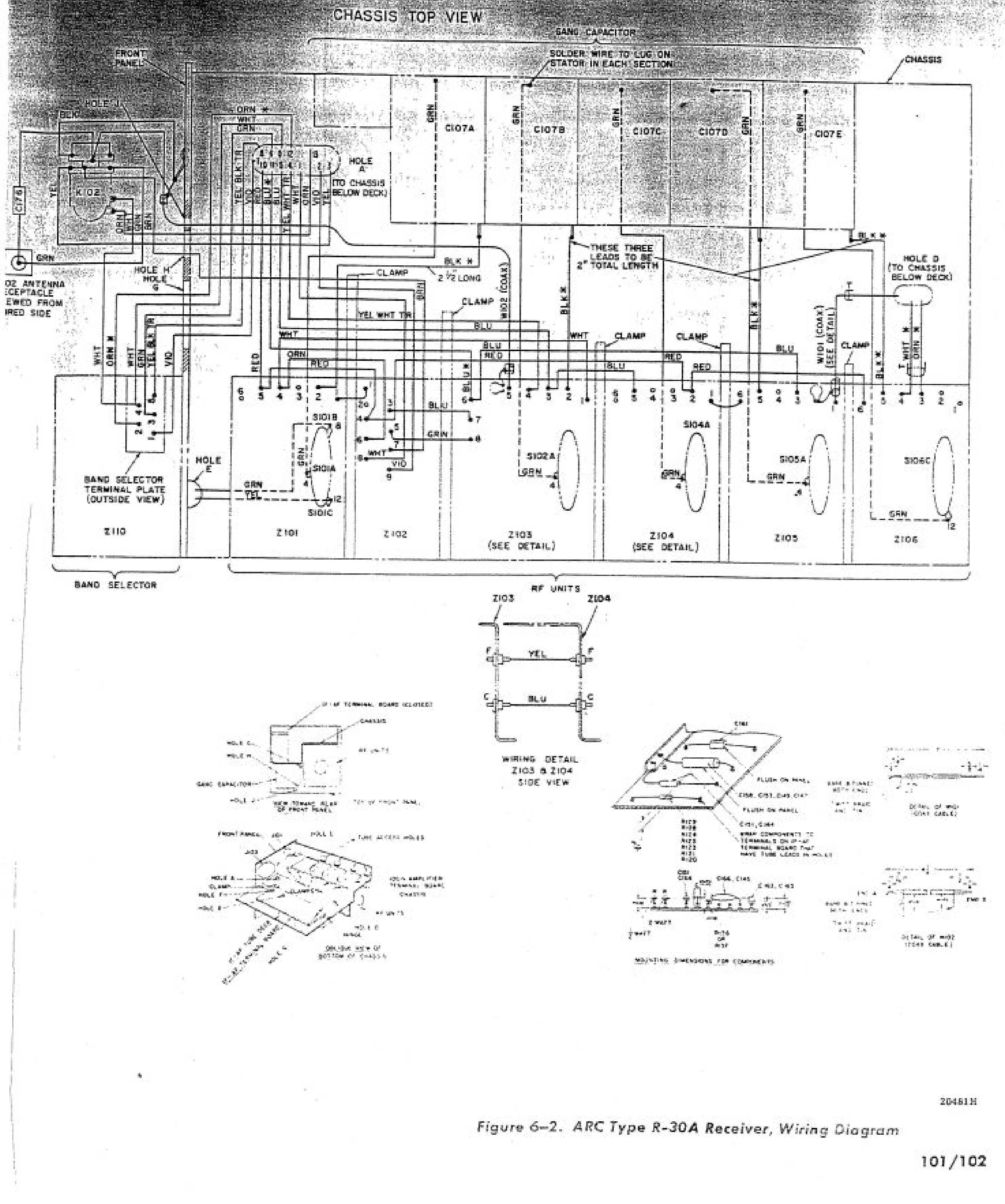


Figure 6–2. ARC Type R-30A Receiver, Wiring Diagram

NOTES:

1. FOR ASSOCIATED SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIER: K=1000.
4. CAPACITANCE VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED.
6. UNMARKED WIRES ARE #24 BARE, SOLID, TINNED COPPER.
7. ELECTRON TUBE V101 IS VIEWED TOWARD BASE. ORIENT TUBE IN CLIP AS SHOWN.
8. BARE TUBE LEADS ARE DRESSED WITH 1/16" MINIMUM CLEARANCE. UNUSED LEADS 2 & 4 ARE CUT OFF APPROXIMATELY 1/32" FROM GLASS.
9. WIRES TO TRANSFORMERS T101, T102, AND T103 ARE SOLDERED WITH 1/16" MINIMUM CLEARANCE FROM TERMINAL PLATE.
10. WIRES MARKED WITH AN ASTERISK (*) ARE AS SHORT AS POSSIBLE AND FREE FROM GROUND AND OTHER LEADS.
11. SWITCH SECTIONS:

SECTION	TERMINAL
S101A	1, 2, 3, 4
S101B	5, 6, 7, 8
S101C	9, 10, 11, 12
S101D	2R, 3R, 4R, 5R

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C101	8743	3-12 (VARIABLE)
C102	8743	3-12 (VARIABLE)
C103	8743	3-12 (VARIABLE)
C104	8751	15
C105	8750	12
C106	8752	5
C108	8627(*)	.022 μF
R101	201(*)	470
R102	201(*)	120K
S101A-D	17807	SWITCH, ROTARY
T101	18592	TRANSFORMER
T102	18601	TRANSFORMER
T103	18605	TRANSFORMER
V101	TYPE 5899	ELEC. TUBE, CODE ORN
Z101	17890	LOOP AMPL ASSEMBLY

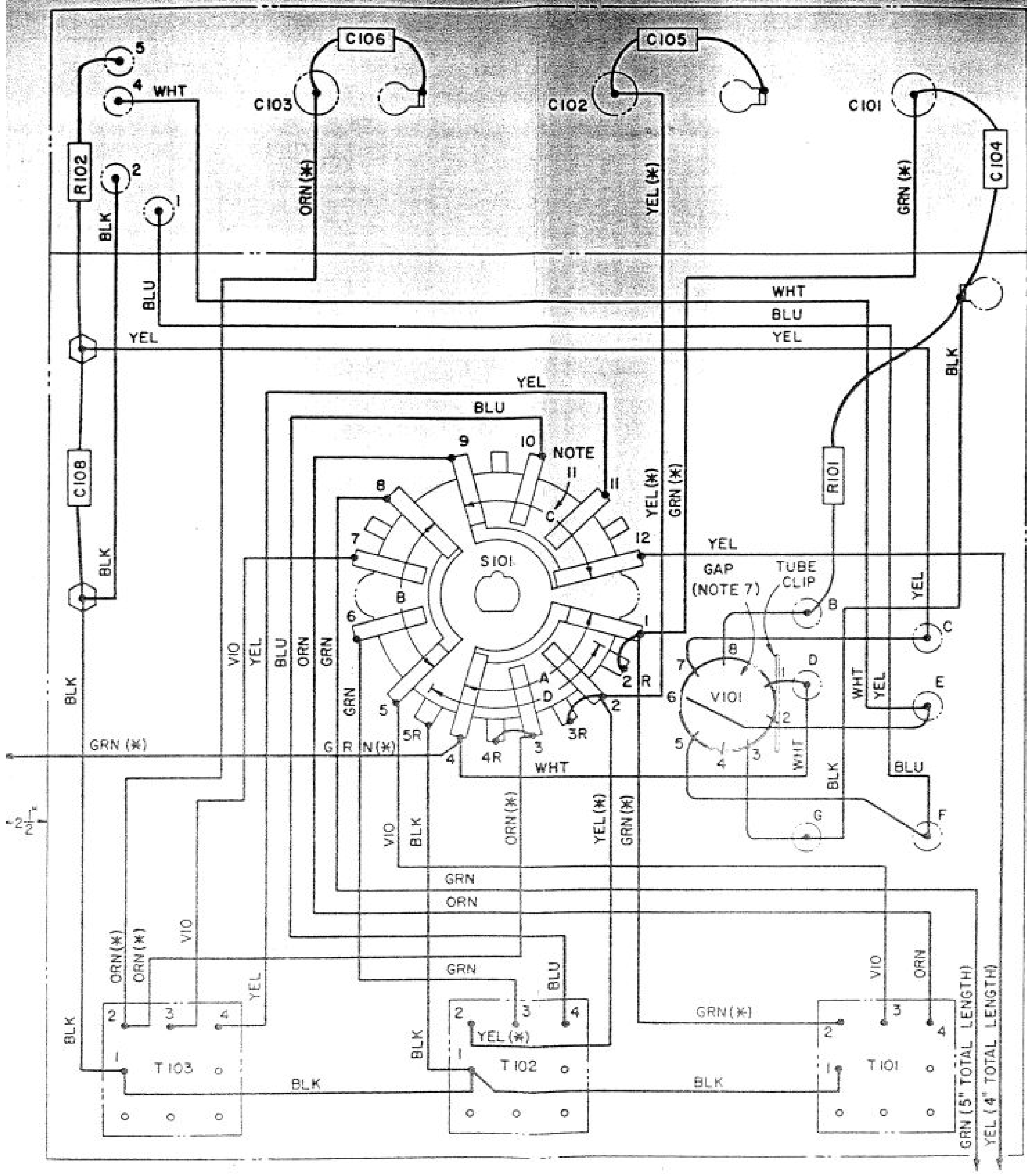


Figure 6–3. ARC Type R-30A Receiver, Loop Amplifier Assembly Z101, Wiring Diagram

NOTES:

1. FOR ASSOCIATED SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIERS: K=1000; MEG =1,000,000.
4. CAPACITANCE VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED.
6. ELECTRON TUBE V102 IS VIEWED TOWARD BASE. ORIENT TUBE IN CLIP AS SHOWN.
7. BARE TUBE LEADS ARE DRESSED WITH 1/16" MINIMUM CLEARANCE.
8. TEFLON IMPREGNATED FIBERGLAS TUBING (.032 I.D.) IS INSTALLED OVER WIRE MARKED "T."

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C109	8706	150
C110	8706	510
C111	4520	100
C112	4520	100
C113	21485	1.0 μF
C114	8706	510
R103	201	47K
R104	201	1.0MEG
R105	201	330K
R106	201	330K
R108	8739	0-10K (VARIABLE)
R109	201	22K
R158	201	1.0MEG
V102	TYPE 6112	ELEC. TUBE. CODE BLUE
Z102	17870	MODULATOR ASSEMBLY

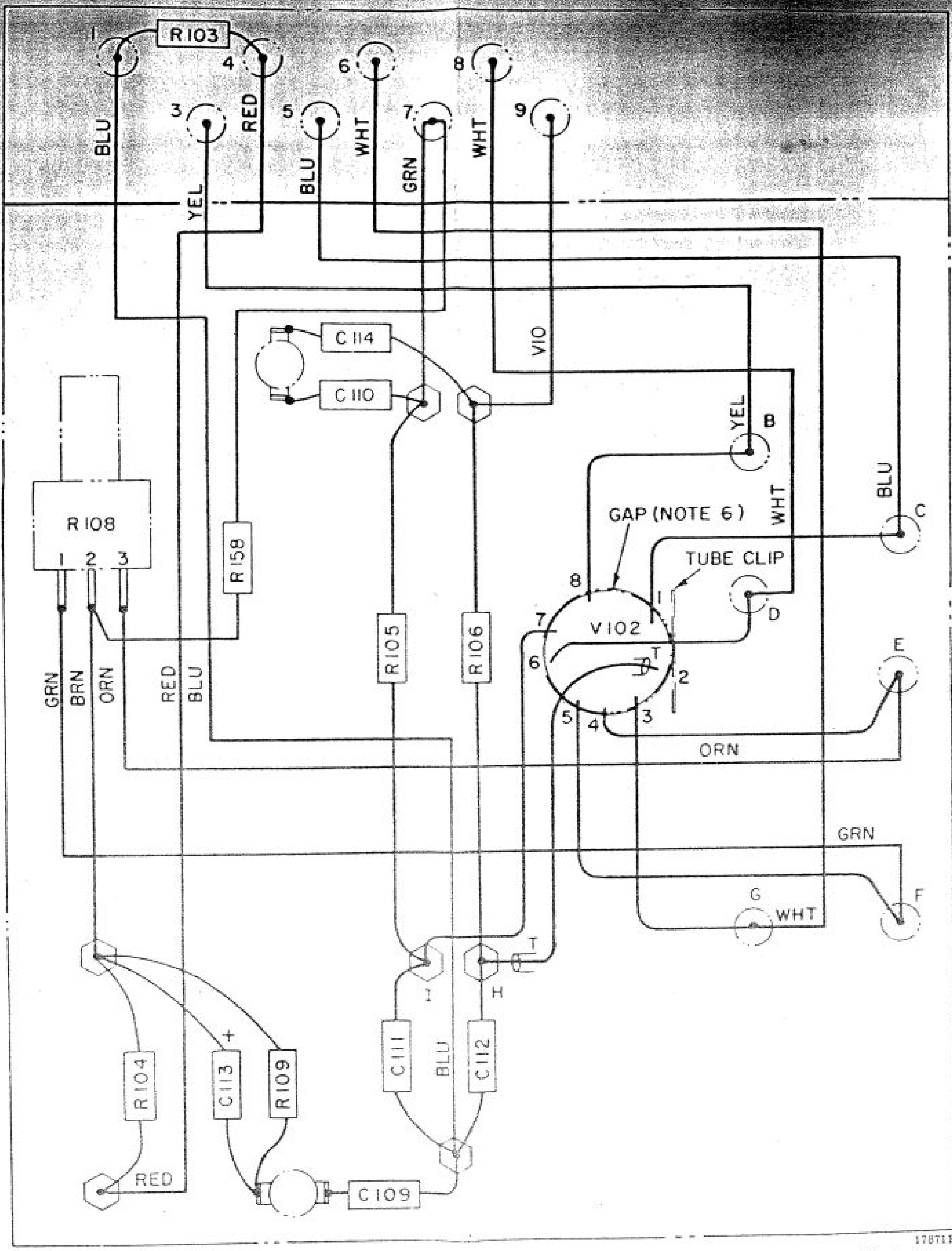


Figure 6–4. ARC Type R-30A Receiver, Modulator Assembly Z102, Wiring Diagram

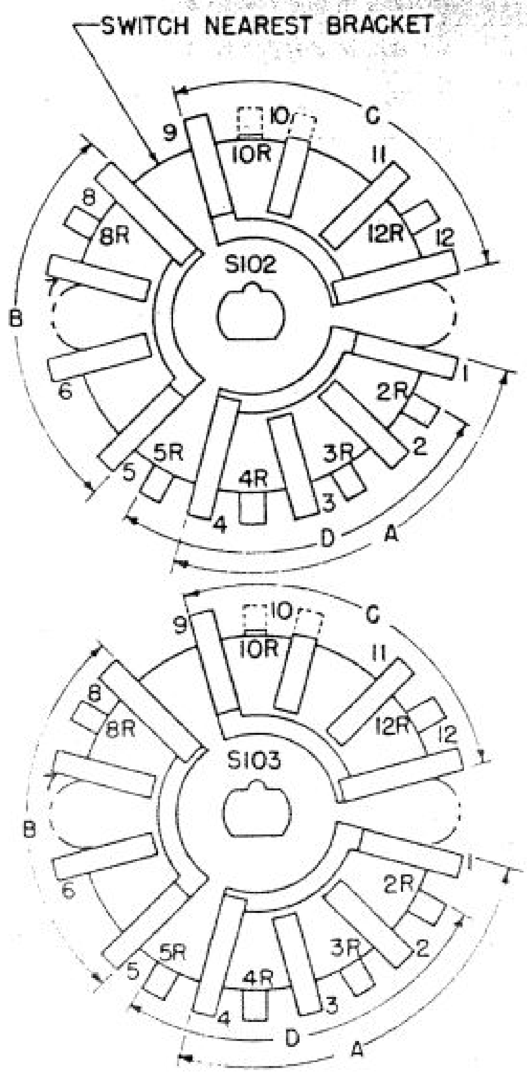
NOTES:

1. FOR ASSOCIATED SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIER: K=1000.
4. CAPACITOR VALUES ARE IN MICRO-MICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED.
6. UNMARKED WIRES ARE #24 BARE, TINNED, SOLID COPPER.
7. WIRE INDICATED BY ——— IS COVERED WITH PLASTIC COATED FIBERGLAS TUBING (.032 I. D.).
8. WIRES MARKED WITH AN ASTERISK (*) ARE DRESSED AS SHORT AS POSSIBLE AND FREE FROM GROUND AND OTHER WIRES.
9. ELECTRON TUBE V103 IS VIEWED TOWARD BASE. ORIENT TUBE IN CLIP AS SHOWN.
10. BARE TUBE LEADS ARE DRESSED WITH 1/16" MINIMUM CLEARANCE. UNUSED TUBE LEADS 2 AND 4 ARE CUT OFF APPROXIMATELY 1/32" FROM GLASS.
11. ALL WIRES TO TRANSFORMERS T105, T106, AND T107 ARE SOLDERED WITH 1/16" MINIMUM CLEARANCE FROM TERMINAL PLATE.
12. SWITCH SECTIONS (TERMINAL GROUPS RELATED TO SECTIONS IDENTICALLY IN S102 AND S103):

SECTION	TERMINALS
A	1, 2, 3, 4
B	5, 6, 7, 8
C	9, 10, 11, 12
D	2R, 3R, 4R, 5R, 8R, 10R, 12R

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C116	8627	.022 μF
C117	8627	.022 μF
C118	8760	7
C119	8743	3-12 (VARIABLE)
C120	8743	3-12 (VARIABLE)
C121	8743	3-12 (VARIABLE)
C122	8890(*)	.047 μF
C123	8752	5
C152	8627	.022 μF
R111	201	10K
R112	201	100K
R113	201	470
R157	201	100
S102	17807	SWITCH, ROTARY
S103	17807	SWITCH, ROTARY
T105	18748	TRANSFORMER
T106	18752	TRANSFORMER
T107	18756	TRANSFORMER
V103	TYPE 5899	ELEC. TUBE, CODE ORN
Z103	18120	ANTENNA ASSEMBLY



SWITCHES VIEWED FROM WIRED SIDE OF UNIT

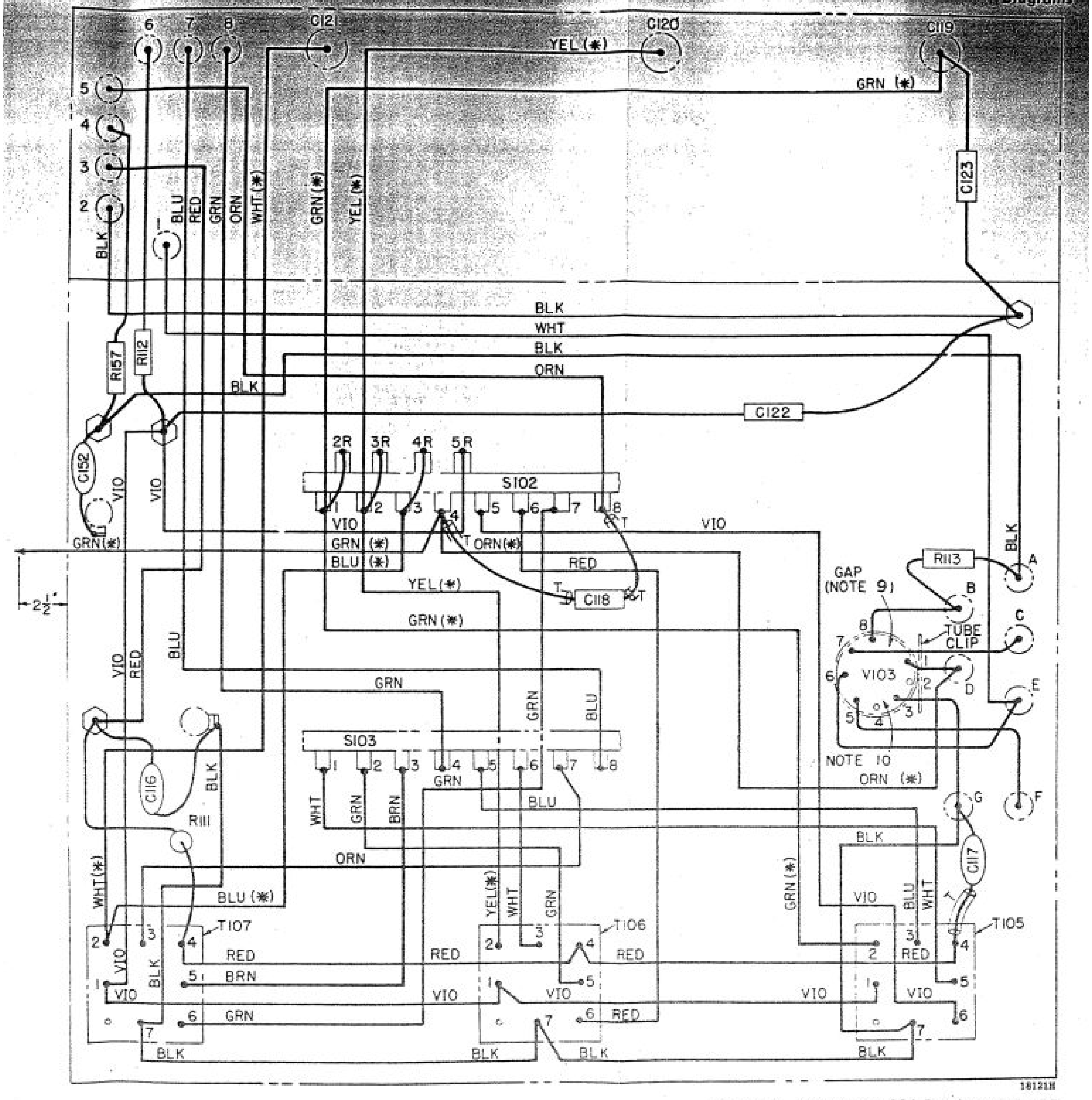


Figure 6–5. ARC Type R-30A Receiver, Antenna Assembly Z103, Wiring Diagram

NOTES:

1. FOR ASSOCIATED SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIER: K=1000.
4. CAPACITANCE VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED.
6. UNMARKED WIRES ARE #24 BARE, SOLID, TINNED COPPER.
7. WIRES TO TRANSFORMERS T108, T109, AND T110 ARE SOLDERED WITH 1/16" MINIMUM CLEARANCE FROM TERMINAL PLATE.
8. WIRES MARKED WITH AN ASTERISK (*) ARE AS SHORT AS POSSIBLE AND FREE FROM GROUND AND OTHER LEADS.
9. SWITCH SECTIONS:

SECTION	TERMINALS
S104A	1, 2, 3, 4
S104B	5, 6, 7, 8
S104C	9, 10, 11, 12
S104D	2R, 3R, 4R, 5R

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C124	8627	.022 μF
C125		
C126	8743	3-12 (VARIABLE)
C127		
C128	8769	22
R114	201	100K
R115	201	4.7K
S104A-D	17807	SWITCH, ROTARY
T108	18609	TRANSFORMER
T109	18613	TRANSFORMER
T110	18617	TRANSFORMER
Z104	17810	1ST RF ASSEMBLY

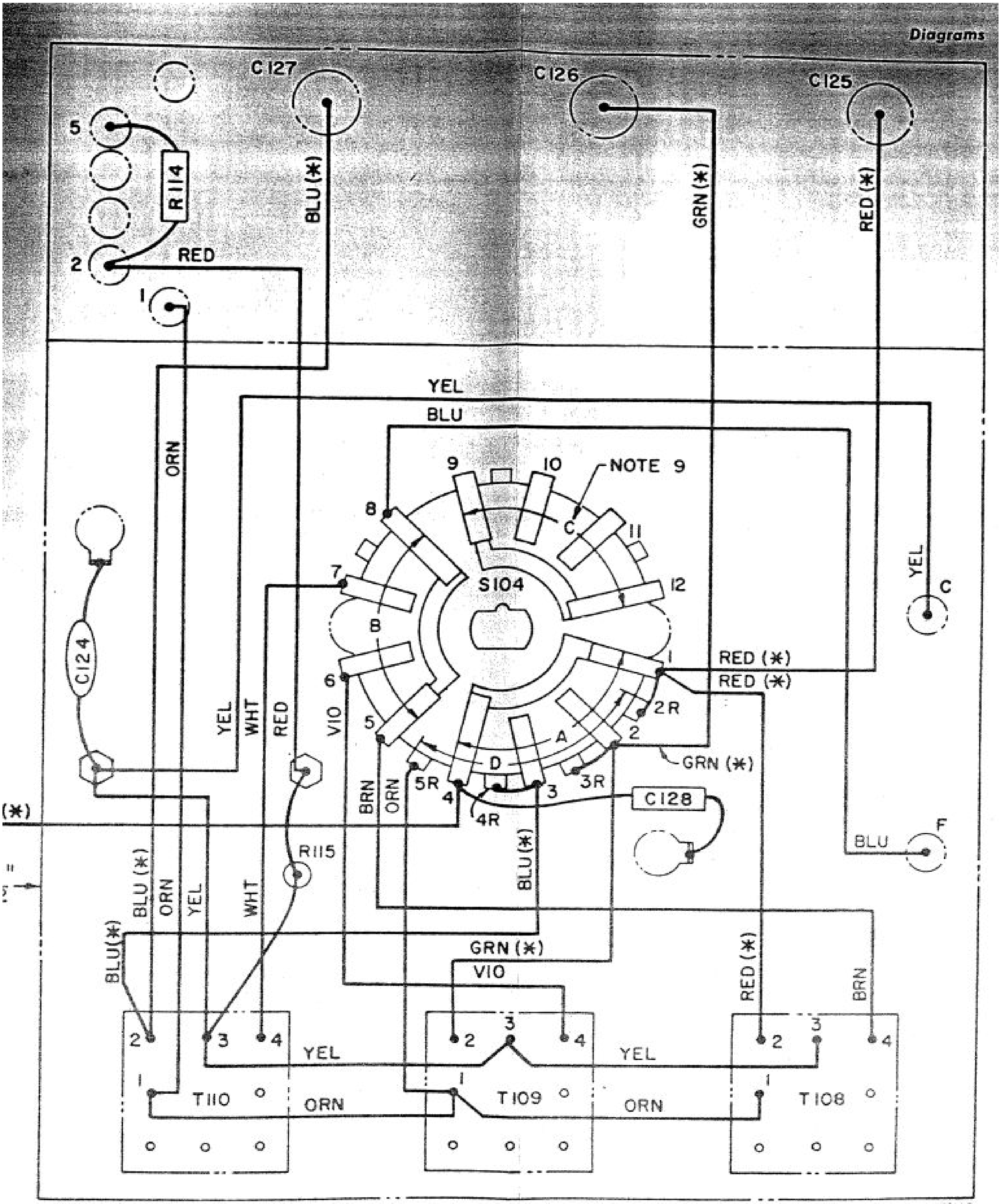


Figure 6–6. ARC Type R-30A Receiver, First RF Assembly Z104, Wiring Diagram

NOTES:

1. FOR ASSOCIATED SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. CAPACITOR VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
4. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED.
5. UNMARKED WIRES ARE #24 BARE, SOLID, TINNED COPPER.
6. ALL WIRES TO TRANSFORMERS T111, T112 AND T113 ARE DRESSED WITH 1/16" MINIMUM CLEARANCE FROM TERMINAL PLATE.
7. WIRES MARKED WITH AN ASTERISK (*) ARE AS SHORT AS POSSIBLE AND FREE FROM GROUND AND OTHER LEADS.
8. SWITCH SECTIONS:

SECTION	TERMINALS
S105A	1, 2, 3. 4
S105B	5, 6, 7, 8
S105C	9, 10, 11, 12
S105D	2R, 3R, 4R, 5R

SYMBOL IDENTIFICATION TABLE

Multiplier for resistance value: K=1000

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C129	8769	20
C130	8743	3-12 (VARIABLE)
C131	8743	3-12 (VARIABLE)
C132	8743	3-12 (VARIABLE)
C133	8627	.022 μF
L101	15174	14 μF
L102	14141	3 μH
L103	15406	1 μH
R116	201	100K OHMS
S105A-D	17807	SWITCH, ROTARY
T111	18609	TRANSFORMER
T112	18613	TRANSFORMER
T113	18617	TRANSFORMER
Z105	17820	RF ASSEMBLY

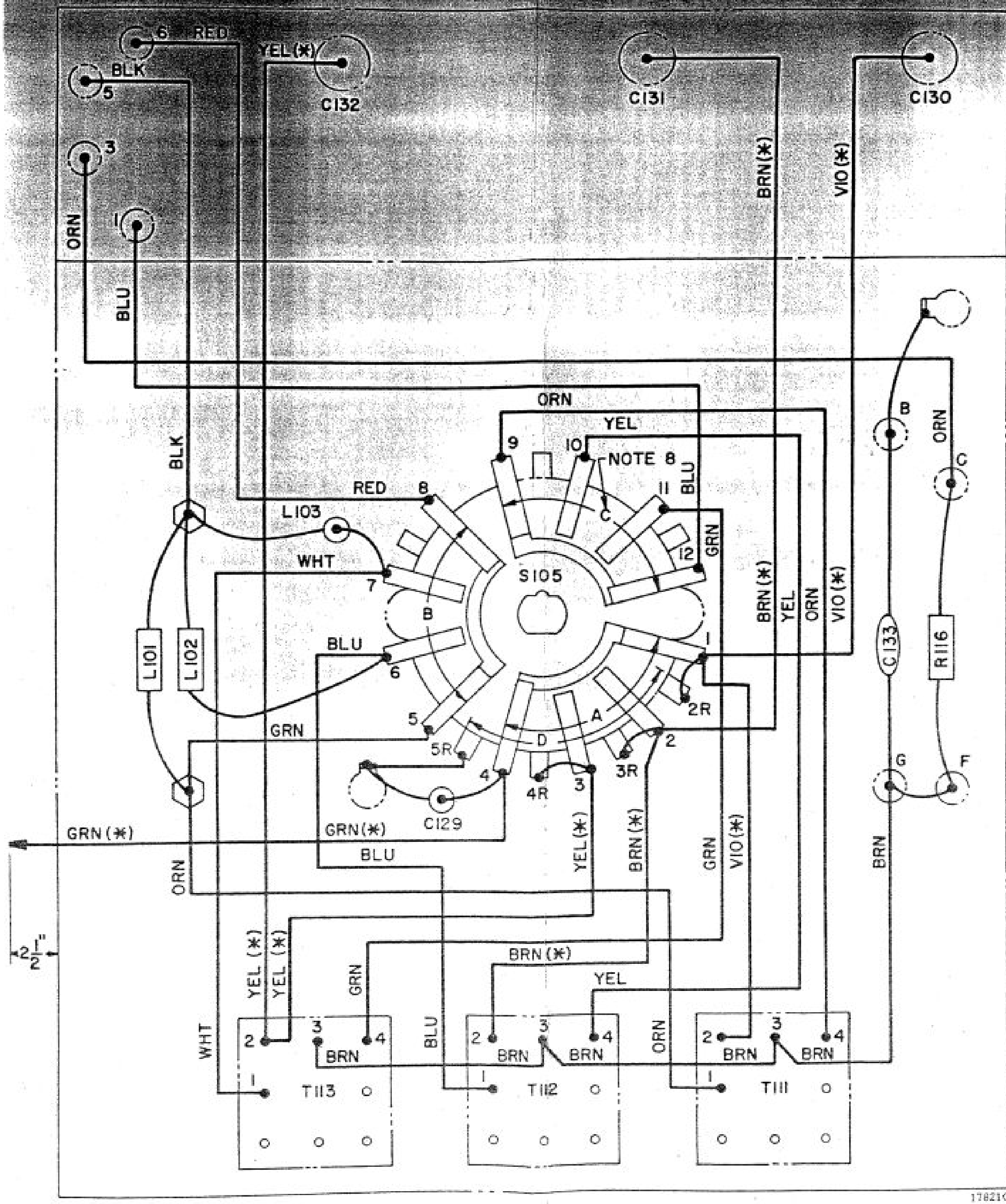


Figure 6–7. ARC Type R-30A Receiver, Second RF Assembly Z105, Wiring Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM, SEE FIGURE 6-2.
3. RESISTANCE VALUES ARE IN OHMS; MULTIPLIER: K=1000.
4. CAPACITANCE VALUES ARE IN MICROMICROFARADS ($\mu\mu F$) UNLESS OTHERWISE SPECIFIED.
5. WIRES MARKED WITH COLOR NOTE ARE #24 SOLID COPPER, TEFLON INSULATED. WIRES MARKED WITH AN ASTERISK (*) ARE AS SHORT AS POSSIBLE AND FREE FROM GROUND AND OTHER LEADS.
6. UNMARKED WIRES ARE #24 BARE, SOLID, TINNED COPPER.
7. PLASTIC COATED FIBERGLAS TUBING IS INSTALLED OVER WIRES MARKED "T."
8. BARE TUBE LEADS ARE DRESSED WITH 1/16" MINIMUM CLEARANCE. UNUSED LEADS 2, 4, AND 7 ARE CUT OFF APPROXIMATELY 1/32" AWAY FROM GLASS.
9. ELECTRON TUBE V104 IS VIEWED TOWARD BASE. ORIENT TUBE IN CLIP AS SHOWN.
10. SWITCH SECTIONS:

SECTION	TERMINALS
S106A	1, 2, 3, 4
S106B	5, 6, 7, 8
S106C	9, 10, 11, 12
S106D	2R, 3R, 4R, 5R

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C134	8706	220
C135	8851	2 μF
C136	21485	1.0 μF
C137	8749	369
C138	8769(*)	8
C139	8748(*)	745
	C OR LATER ISSUE	
C140	8618(*)	1740
C141	8743	3-12 (VARIABLE)
C142	8743	3-12 (VARIABLE)
C143	8743	3-12 (VARIABLE)
C144	8750	12
R117	201	100K
R118	201	10K
R119	201	2.2K
S106	17807	SWITCH, ROTARY
T114	18621	TRANSFORMER
T115	18625	TRANSFORMER
T116	18629	TRANSFORMER
V104	TYPE 5718	ELEC. TUBE, CODE BROWN
Z106	17910	OSCILLATOR ASSEMBLY

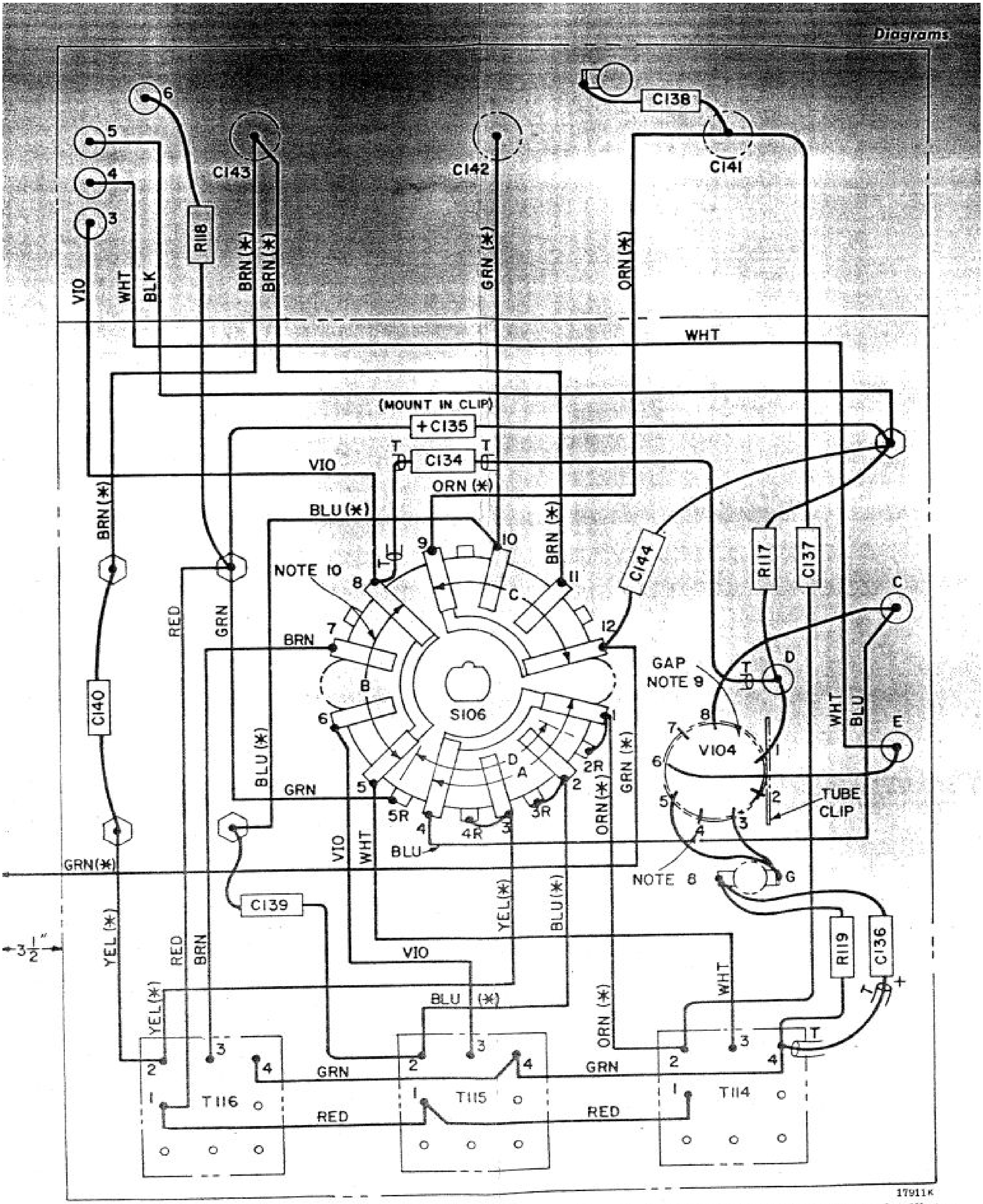
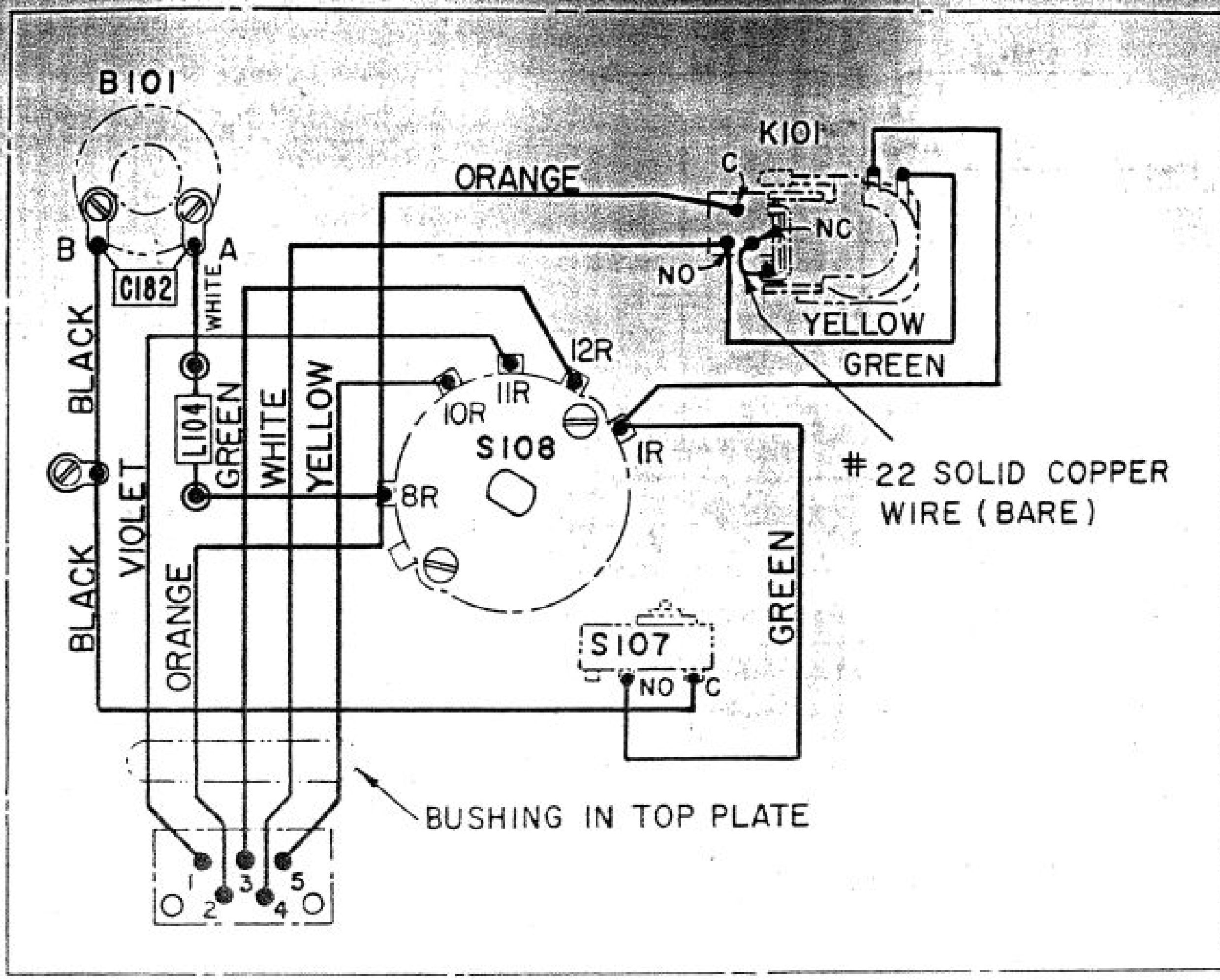
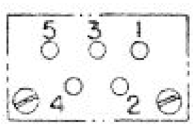


Figure 6–8. ARC Type R-30A Receiver, Oscillator Assembly Z106, Wiring Diagram





OUTSIDE VIEW
TERMINAL PLATE

SYMBOL IDENTIFICATION TABLE

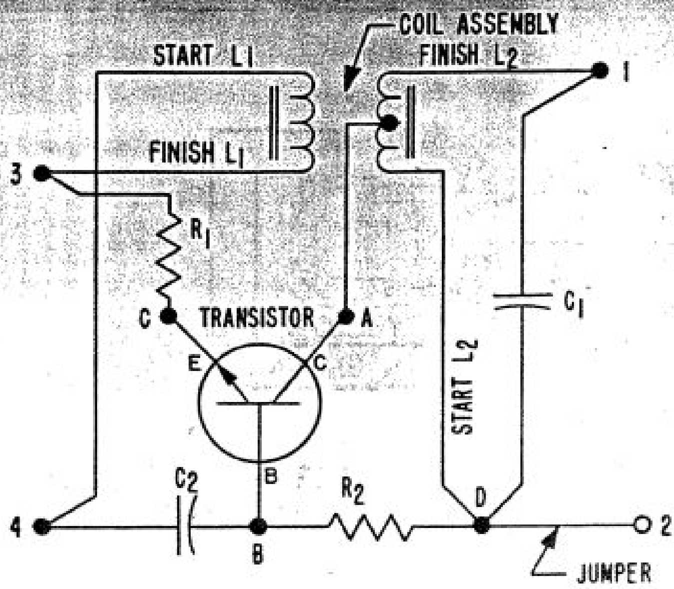
SYMBOL NO.	ARC PART NO.	DESCRIPTION
K101	14403	RELAY (14V)
	14404	RELAY (28V)
B101	18800	MOTOR (14V)
	18801	MOTOR (28V)
S107	21967	MICROSWITCH
S108	17924	ROTARY SWITCH
C182	8627(*)	CAPACITOR (.01 μF)
L104	8877(*)	CHOKE (.47 μH)

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-1.
2. FOR ASSOCIATED MAIN CHASSIS WIRING DIAGRAM SEE FIGURE 6-2.
3. WIRES MARKED WITH COLOR CODE ARE #24 SOLID COPPER, TEFLON INSULATED.

17931C

Figure 6–9. ARC Type R-30A Receiver, Band Selector Assembly Z110, Wiring Diagram



NOTE:

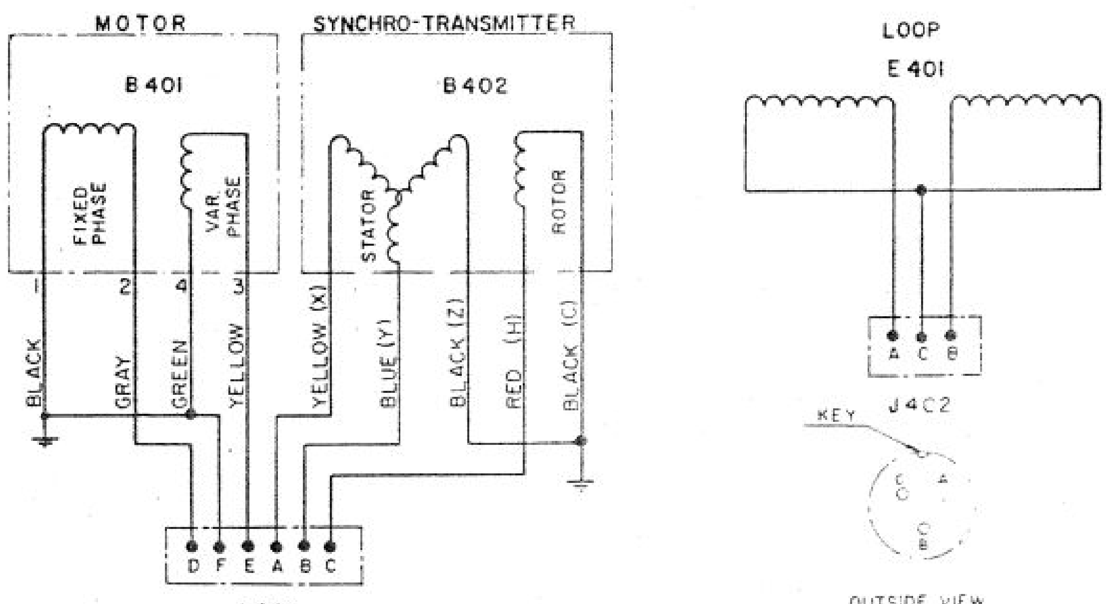
1. INTERNAL STAY POINTS ARE IDENTIFIED A, B, C, AND D, EXTERNAL TERMINALS ARE 1, 2, 3, AND 4.

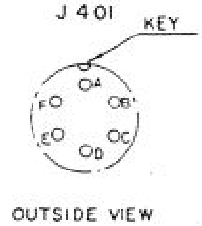
SYMBOL IDENTIFICATION TABLE
Multiplier for resistance values: K=1000

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C_1	8764	510 $\mu\mu F$
C_2	8706	510 $\mu\mu F$
R_1	201	1K OHMS
R_2	201	220K OHMS

TP1477

Figure 6–10. ARC Type R-30A Receiver, Beat Frequency Oscillator Assembly Z111, Wiring Diagram





NOTES:

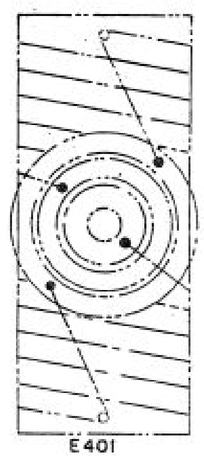
1. FOR WIRING DIAGRAM SEE FIGURE 6-12.

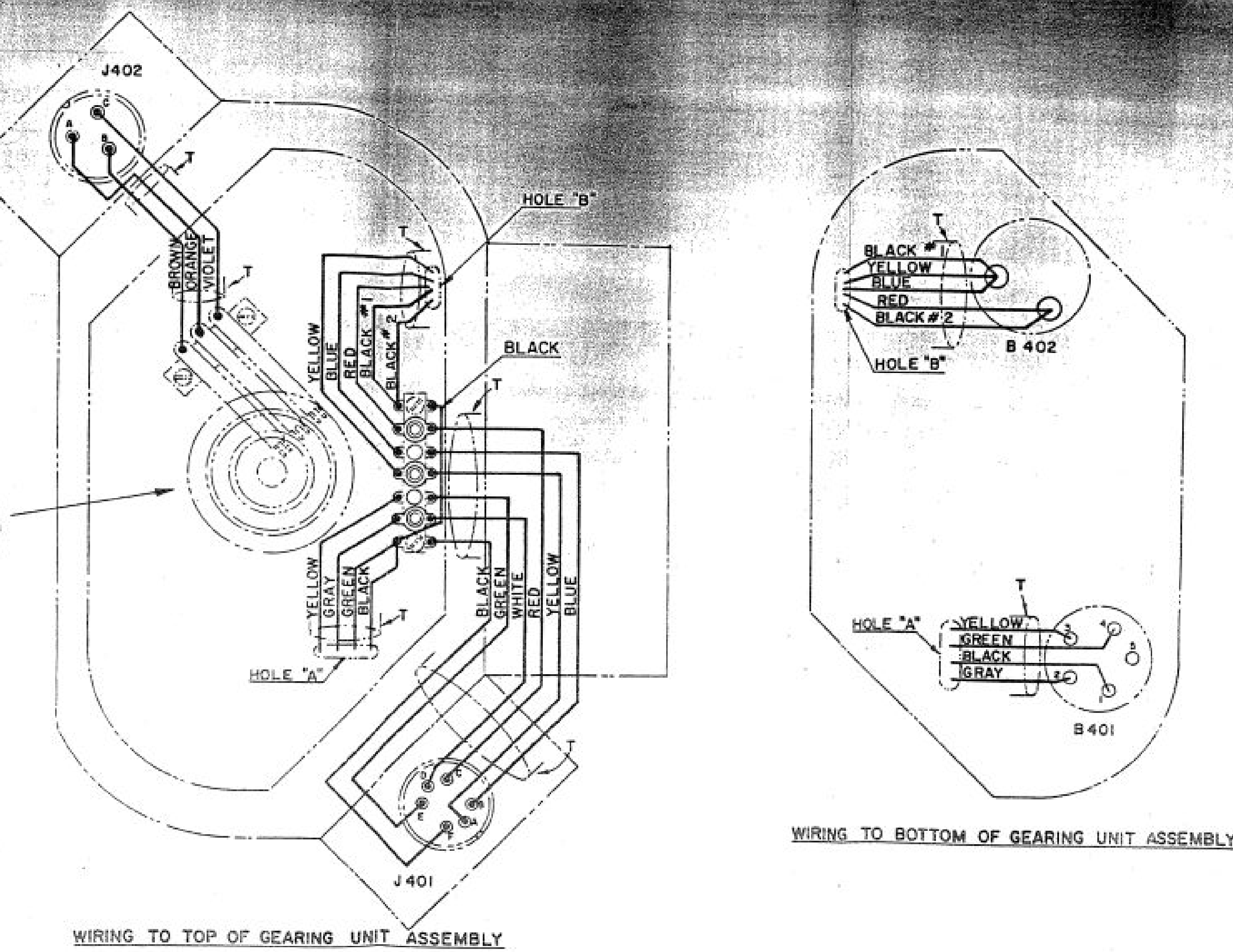
2. WIRES MARKED WITH COLOR CODE ARE MOTOR AND SYNCHRO LEADS, AND ARE FURNISHED AS PART OF THE UNITS.

18002B

Figure 6–11. ARC Type L-11 Loop, Schematic Diagram

NOTES:
1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-11.
2. WIRES FROM B401 AND B402 ARE MOTOR LEADS AND ARE FURNISHED AS PART OF THE MOTOR.
3. OTHER WIRES ARE #24 STRANDED COPPER, TEFLON INSULATED.
4. PLASTIC COATED FIBERGLAS TUBING IS INSTALLED OVER WIRES MARKED "T."





SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
B401	18007	MOTOR, INDUCTION
B402	18008	SYNCHRO, TRANSMITTER
E401	17998	LOOP SUBASSEMBLY
J401	18017	RECEPTACLE ASSEMBLY
J402	18016	RECEPTACLE ASSEMBLY

18001D

Figure 6–12. ARC Type L-11 Loop, Wiring Diagram

NOTES:

1. FOR WIRING DIAGRAM SEE FIGURE 6-14.
2. RESISTANCE VALUES ARE IN OHMS. MULTIPLIER: K=1000.
3. S203 IS MECHANICALLY LINKED TO SHIELD WHICH CHANGES DIAL SCALE PRESENTATION.
4. S204 IS SHOWN IN MAXIMUM COUNTERCLOCKWISE (COMP) POSITION.
5. FIRST ANGLES GIVEN ARE FOR BELLY SENSE ANTENNA, SECOND ANGLES ARE FOR TOP SENSE ANTENNA.
6. WHEN S205 IS OPEN ("ON" POSITION), THE BFO IS OPERATING.
7. WHEN LOOP SWITCH (S201) IS THROWN TO THE LEFT, AS SEEN FROM FRONT OF PANEL, TERMINALS "L" AND "K" ARE CONNECTED AND "B" IS GROUNDED.

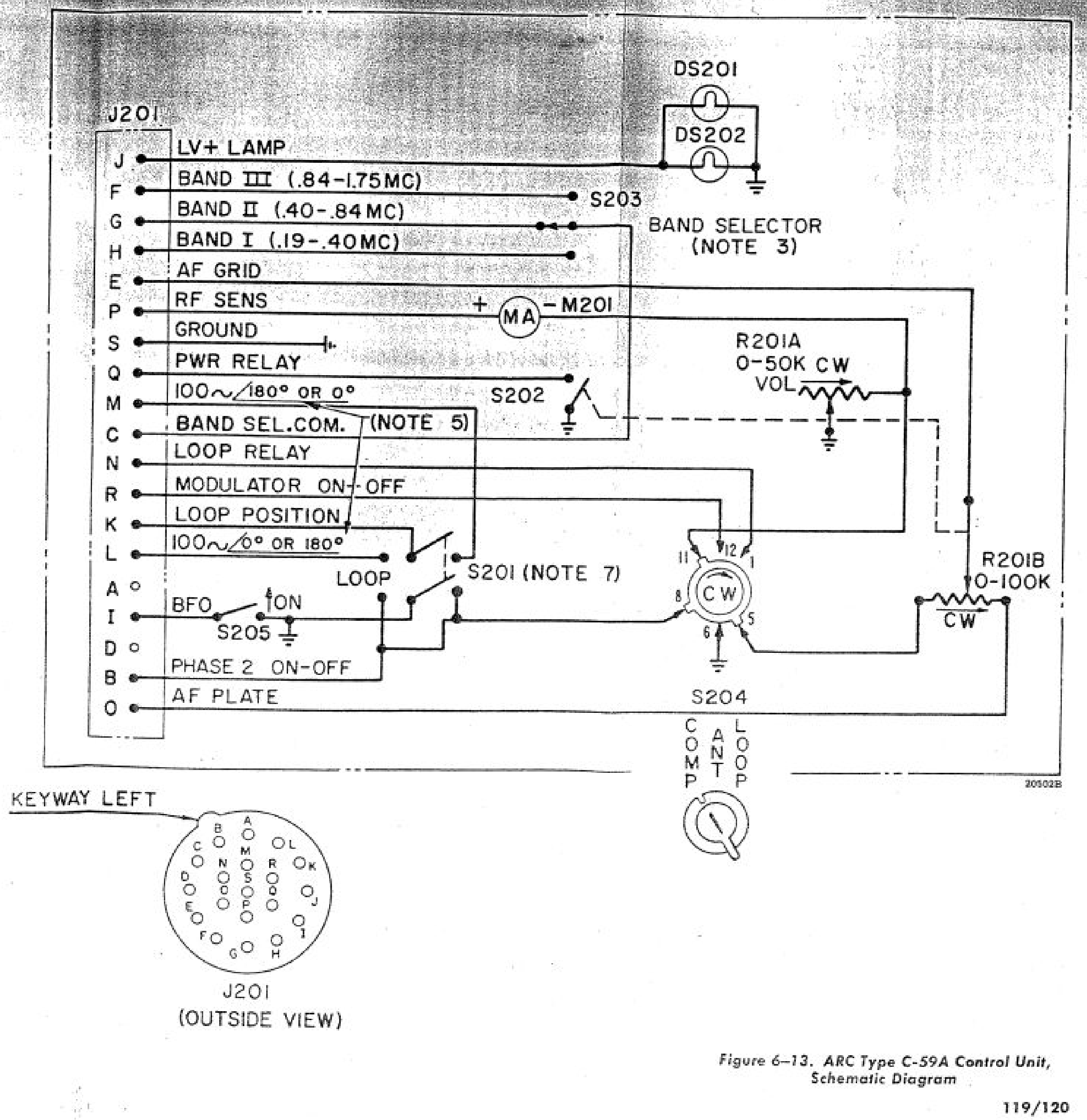


Figure 6–13. ARC Type C-59A Control Unit, Schematic Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-13.
2. WIRES MARKED WITH COLOR NOTE ARE #22 STRANDED COPPER.
3. UNMARKED WIRES ARE #22 BARE, SOLID, TINNED COPPER.
4. TRANSPARENT VINYLITE TUBING OF APPROPRIATE SIZE IS INSTALLED OVER WIRES OR GROUPS OF WIRES MARKED "T."

SYMBOL IDENTIFICATION TABLE

Multiplier for resistance values: K=1000

SYMBOL	ARC PART NO.	DESCRIPTION
J201	12357	RECEPTACLE (19 PIN)
R201A	8776	0-50K (VARIABLE)
R201B		0-100K (VARIABLE)
M201	18428	0-15 MA
S201	20452	SWITCH
S202	PART OF 8776	SWITCH
S203	PART OF 18480	SWITCH
S204	19982	SWITCH
S205	8084	SWITCH
XDS201	16293	PANEL LIGHT SOCKET
XDS202	16293	PANEL LIGHT SOCKET

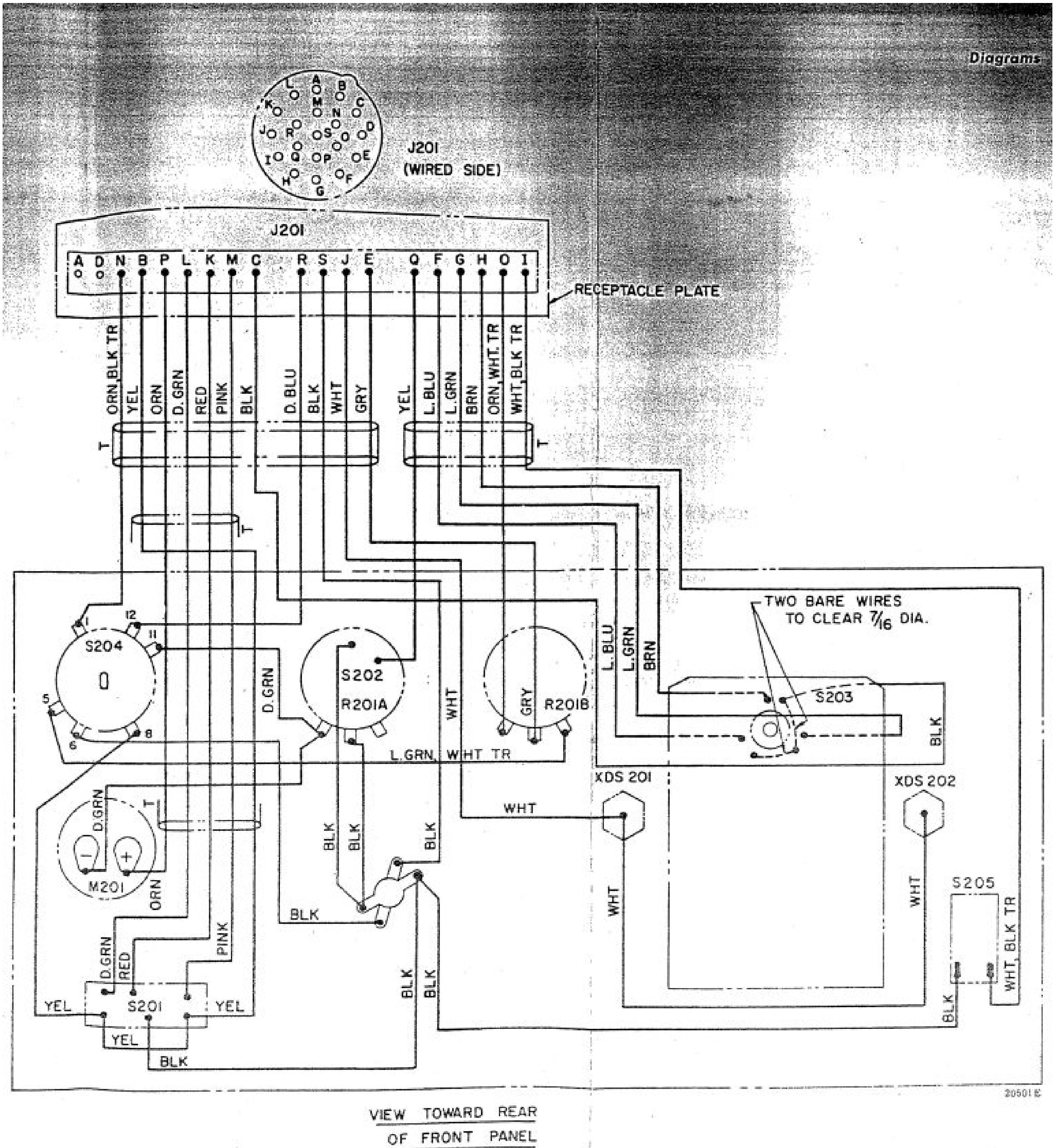


Figure 6–14. ARC Type C-59A Control Unit, Wiring Diagram

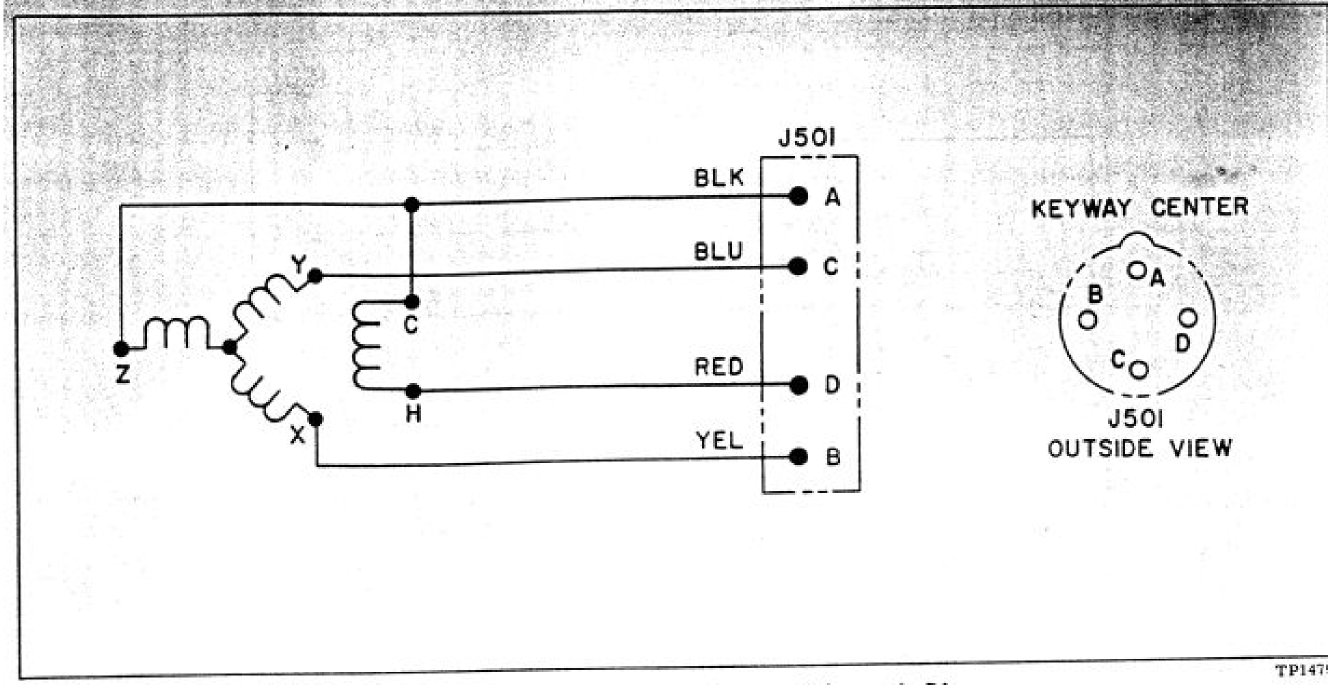


Figure 6–15. ARC Type IN-12 Indicator, Schematic Diagram

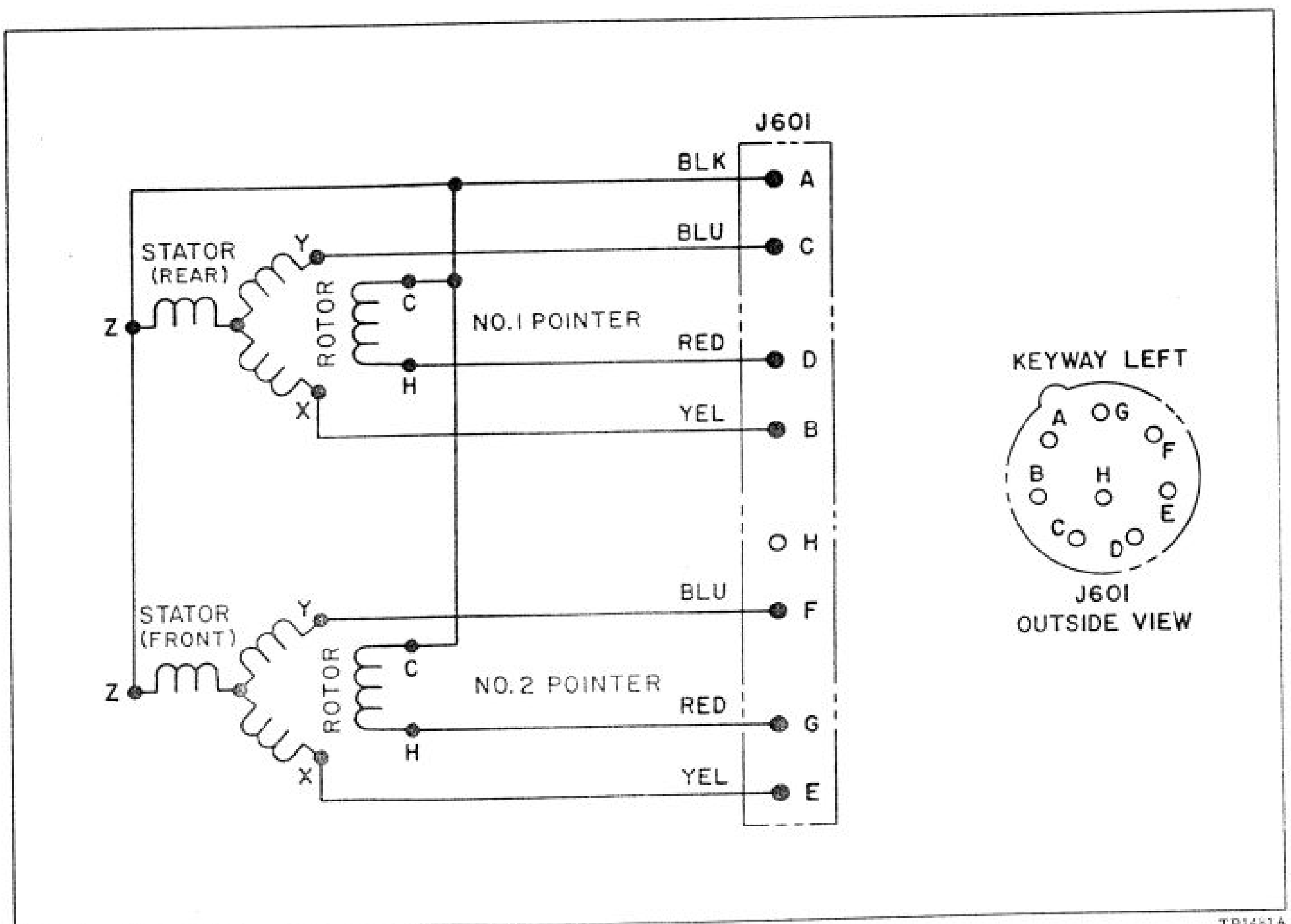


Figure 6–16. ARC Type IN-13 Indicator, Schematic Diagram

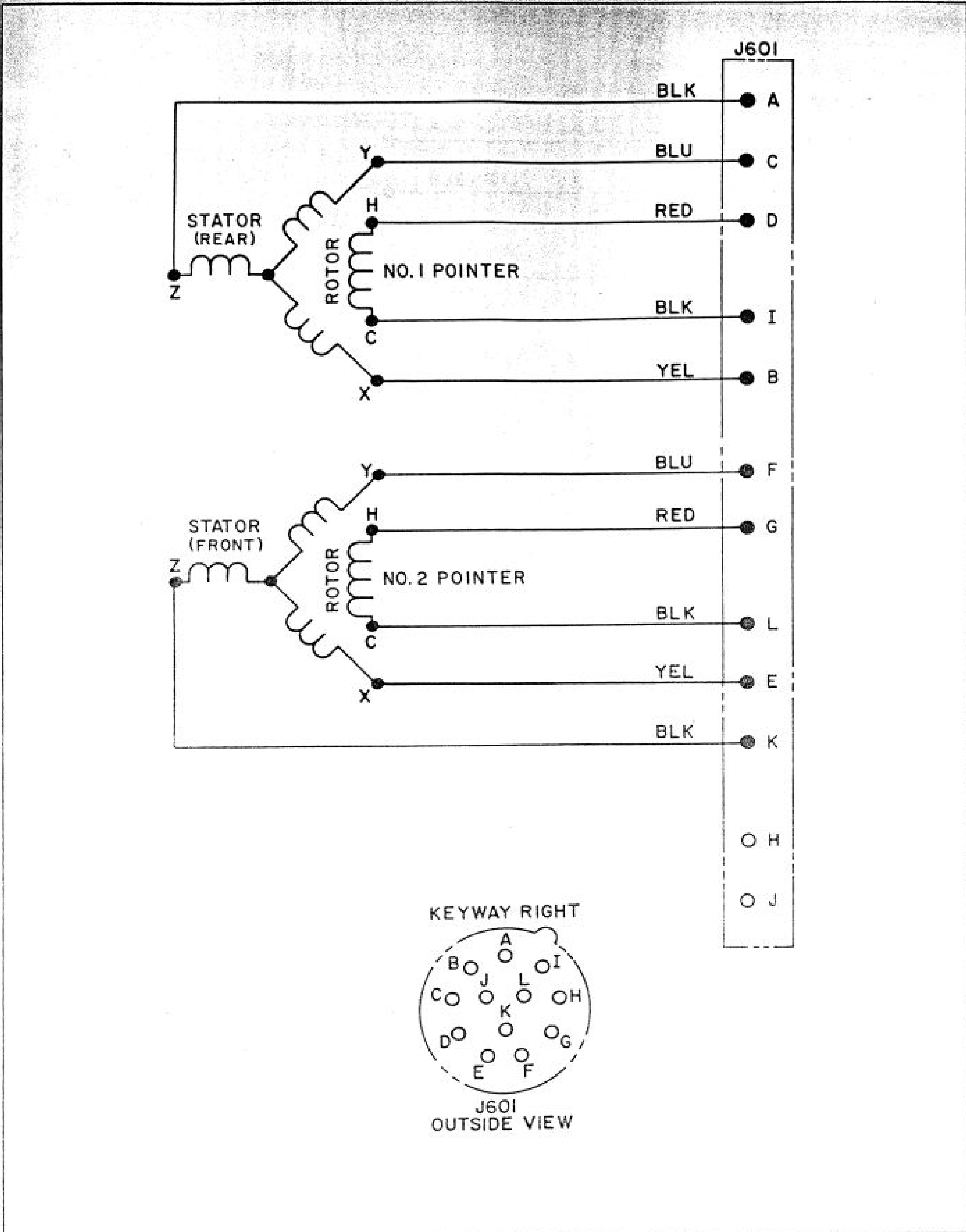
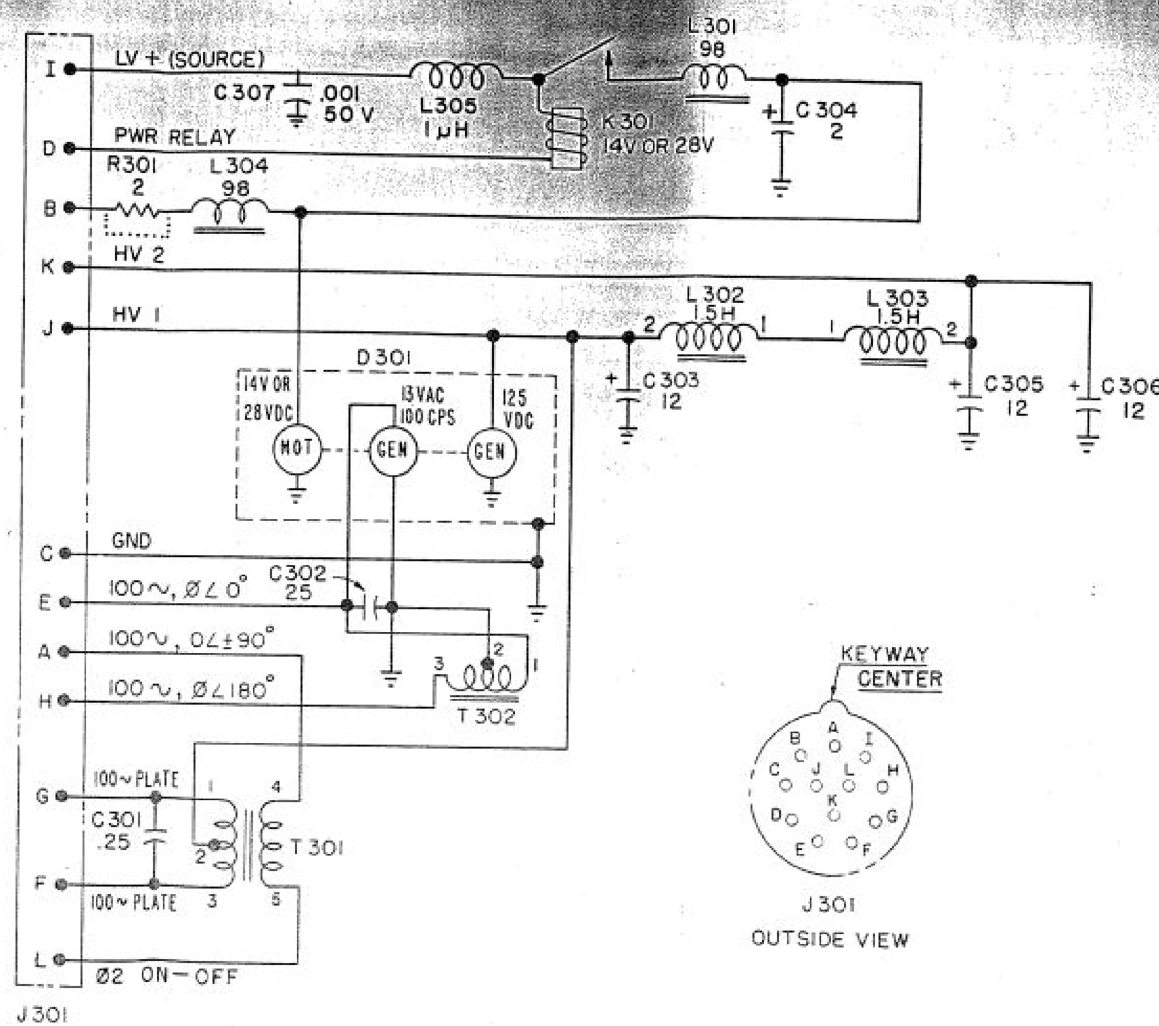


Figure 6–17. ARC Type IN-13A Indicator, Schematic Diagram

NOTES:

1. FOR WIRING DIAGRAM SEE FIGURE 6-19.
2. RESISTANCE VALUE IS IN OHMS.
3. CAPACITOR VALUES ARE IN MICROFARADS (μF).
4. INDUCTOR VALUES ARE IN MICROHENRIES (μH) UNLESS OTHERWISE SPECIFIED.
5. RELAY IS SHOWN IN UNENERGIZED POSITION.
6. FOR 14-VOLT OPERATION R301 IS OMITTED AND REPLACED BY WIRE MARKED (· · · · ·).



204932

Figure 6–18. ARC Type P-14A Power Unit, Schematic Diagram

NOTES:

1. FOR SCHEMATIC DIAGRAM SEE FIGURE 6-18.
2. WIRES MARKED WITH COLOR NOTE ARE #22 SOLID COPPER.
3. UNMARKED WIRES ARE #22 SOLID, TINNED COPPER.
4. WIRES MARKED "T" ARE COVERED WITH VINYLITE TUBING OF APPROPRIATE SIZE.
5. FOR 14V OPERATION REMOVE R301 AND REPLACE WITH WIRE MARKED (· · · · · ·).

SYMBOL IDENTIFICATION TABLE

SYMBOL NO.	ARC PART NO.	DESCRIPTION
C301	15763	.25 μF
C302	12709	.25 μF
C303	8777	12 μF
C304	8651	2 μF
C305	8777	12 μF
C306	8777	12 μF
C307	8908	1000 μμF
D301	18334 18335	14V DYNAMOTOR 28V DYNAMOTOR
J301	16713	RECEPTACLE
K301	14484 14485	14V RELAY 28V RELAY
L301	5546	98 μH
L302	18328	1.5 H
L303	18328	1.5 H
L304	5546	98 μH
L305	23529	1 μH
R301	8778	2 OHMS
T301	18329	TRANSFORMER
T302	18053	TRANSFORMER

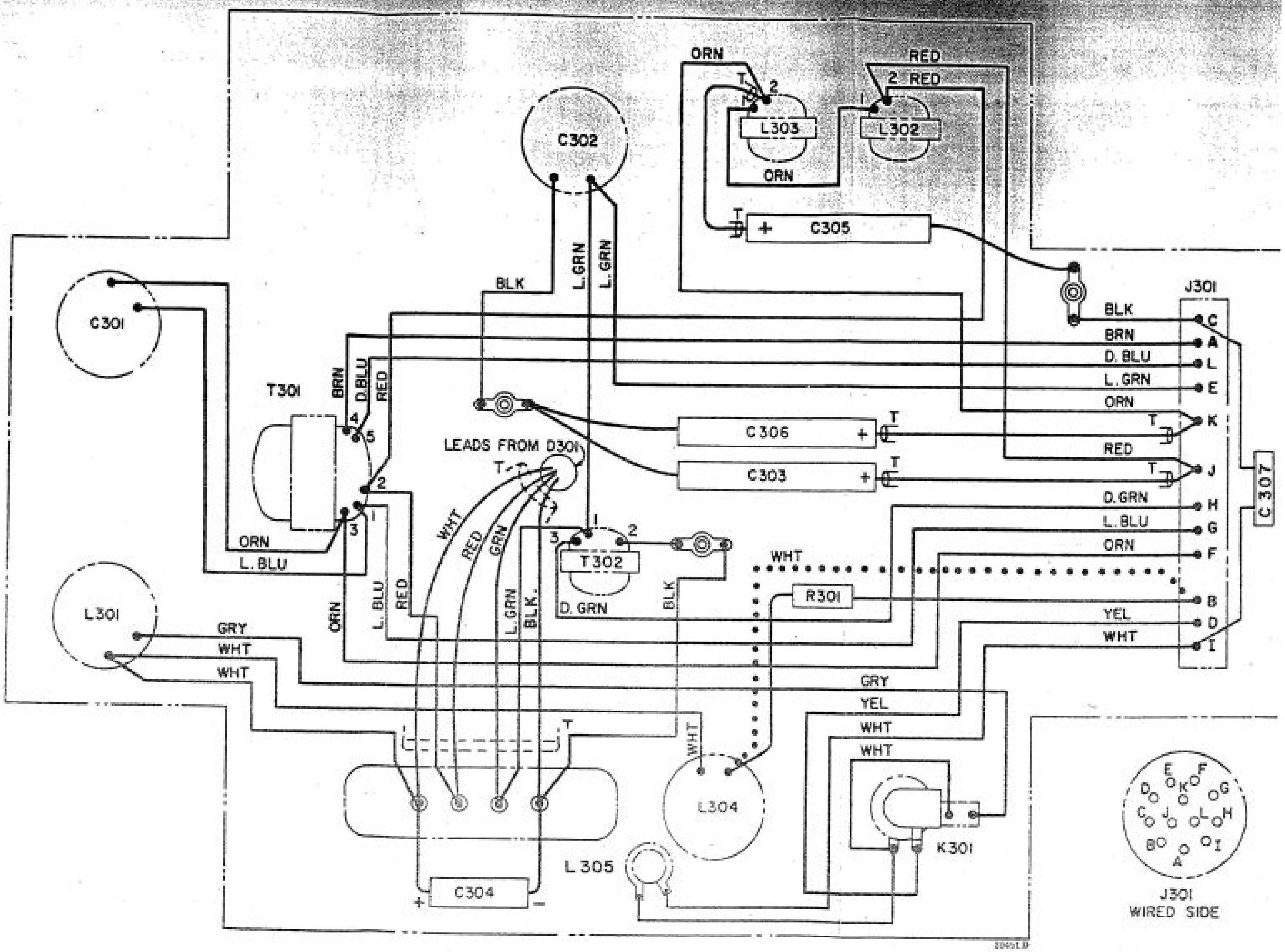


Figure 6–19. ARC Type P-14A Power Unit, Wiring Diagram

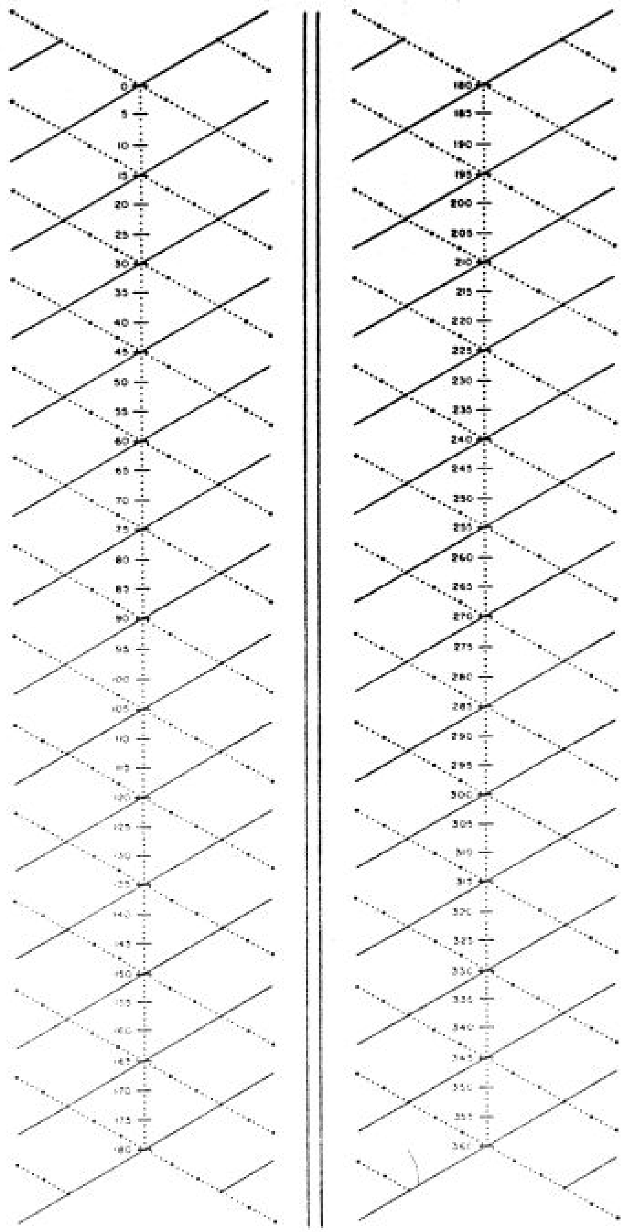
LOOP COMPENSATION DATA CURVE

Date ______________________ By______________________

Aircraft Type and No. ______________________

Station ______________________ Frequency ______________________

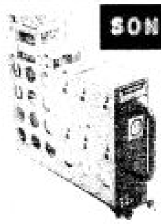
Ground Reference Line ______________________



TP1429

Figure 6–20. Form for Plotting Loop Compensation Data Curve (Spare)

SONOBUOY RECEIVER



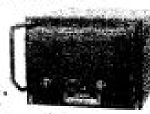
R-1170/ARR-52A VHF RECEIVER 162.5-173.5 MHz AM, FM and video using 31 crystal-controlled channels. Solid-state sonobuoy receiver consists of five plug-in modules; 26 MHz 1st IF, 5 MHz 2nd IF. Conversion possiblities for 2 meters, VHF weather, satellite TV, etc. (See Oct '74 CQ Mag.) Requires external control and 18 VDC. 7.5x2.5 x10, 9 lbs. Used, ~~$39.50~~ $24.95; SCHEMATIC, $4 w/set. MANUAL, partial repro, $15 w/set.

1 KW HF RADIO SET

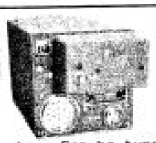
AN/TRC-75 1 KW HF RADIO in CY-2600 case for vehicle mount; 2-29.999 MHz AM-SSB-tone 400 W, 1 KW nominal PEP. Collins made set consists of R-761 receiver and T-730 transmitter listed below, C-3341 control (p 16), CU-749 antenna coupler, C-2848 coupler-conrol, AM-2306 amplifier, CV-786 converter-oscillator, RF-111 load coil (p 4) plus built-in wattmeter. We will also include manual copy and PP-2352 power inverter (p 10) which provides 115 V 400 Hz 3 O for the set from 28 VDC 110 amp input. 20x48.5x30.5, 375 lbs sh wt.
Used-complete, not tested, ~~$1200.00~~ $750.00
AN/TRC-75 without manual or PP-2352, $650.00

T-730 1 KW POWER AMP

T-730/TRC-75 TRANSMITTER, functions as 1 KW PEP (400 W AM-SSB) 2-29.999 MHz linear power amp when used with R-761/ARC-58 receiver which supplied 200 MW PEP input drive. Uses three 4CX250 tubes in P-A; tuned by servo amplifiers and motors. Requires 115 VAC 400 Hz 3 O for power supply with outputs 2000 VDC 500 ma, 400 VDC, 27 VDC, 6.3 VAC, -40 to-80 VDC and 115 V 400 Hz 1 O for servo motors. With tubes 2/6CL6, 5896, 3/4CX250. C-3141 control required for channel selection. 7.8x10.3x24, 55 lbs. Used, ~~$350~~. $225. SCHEMATIC for T-605, $6 with set purchase.

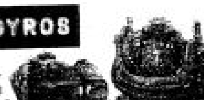


R-761/ARC-58 RECEIVER, companion receiver and exciter to T-730. Requires 115 VAC 400 Hz input. 7.6x10.3x23.5 55 lbs sh. Used, ~~$300~~. $175. SCHEMATIC, $6 w/set purchase.
C-3141 CONTROL for frequency select (pg 16), used $29.95
CONNECTORS for above, $5 each w/set purchase



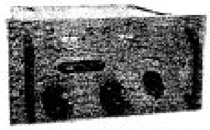
R-836/ARN-59 DIRECTION FINDER RECEIVER, same as Aircraft Radio Corp R-30A DF receiver used in light aircraft. Covers 190-1750 KHz in bands 190-400, 400-840, and 840-1750 KHz; replaces AN/ARN-6 radio compass system. Can be tuned using push-on knob or remotely using C-2275 control box (not available) and MC-215 spline. IF 142.5 KHz; with tubes 2/5718, 5896, 5/5899, 3/5902, 2/6021, 6112. Requires 24 VDC 1 amp, 110 VDC 90 ma, 125 VDC 20 ma; also 13 V 100 Hz for loop selsyns if used for DF. Voltages originally supplied by DY-107 dynamotor (not available)
4.5x4.5x10.3, 9 lbs sh. Used, $28.95
OPERATOR's MANUAL, $3. SCHEMATIC, $2 w/set.
AT-780/ARN-59 DF ANTENNA. 8#. Used. $39.50
CD-532 ARC-5 CONTROL CABLE, 2/PL152, 60" $16

AIRCRAFT GYROS



No specific data:
LEAR 3-AXIS RATE SENSOR w/ three #215THD rate gyros; 3.4x6.4x6, 9#. Lear #2162C, $250.
SPERRY ROLL & PITCH CONTROL GYRO, model K-6; Rotating center 5.5"Lx4" dia; removable top cover. 6.4"Hx8" dia; 6 lbs. #K6-8510, $75.

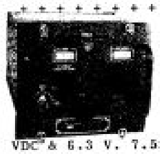
100 TO 225 MHZ AMP



AM-912/GRC AMPLIFIER-MULTIPLIER plug-in for T-302/TRC transmitter; covers 100-225 MHz FM @ 100+ watts using 4X150A tube. Controls Grid & Plate Tune and Amp Output Coupling. Requires +750 V, 200-350 V screen, and 6.3 V filament; with schematic. 12x6x14, 24 lbs. Used, ~~$89.50~~ $59.50;

AM-915, 225-400 MHz; 4X150A, 4X150G. $85.00
AM-1178, 400-600 MHz; 4X150A, 4X150G. $75.00
AM-2537, 790-915/ 840-925 MHz; two 5876, $95

\+ +



AM-914/TRC AMPLIFIER-CONVERTER, plug-in for R-417 receiver in 225-400 MHz range. Continuous tuning of RF and oscillator; 30 MHz IF. Modify and use as down-converter! With tubes 5670, 4/6J4. Requires 150 VDC & 6.3 V. 7.5x6.5x9.5; 15 lbs. Used, $35.
AM-1179/GRC, 50 to 100 MHz, used, $39.50

AM-1177/TRC, 400 to 600 MHz, used, $44.50
AM-3203A/TRC, 1.35 to 1.9875 GHz, $49.50

UGC-129 TELETYPEWRITER

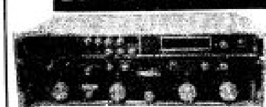
AN/UGC-129 TACTICAL TELETYPEWRITER with MU-734/UGC MAGNETIC TAPE UNIT microprocessor controlled full duplex teletypewriter has 16K RAM and QUERTY keyboard with Edit, Mode Select, and Memory. Printer speed 120 CPS; 69-80 character line, single or double line feed. 64-character ASCII subset; ITA5 or Baudot codes. 8 baud rates 45.5 to 2400. Uses paper rolls 216 mm W x 127 mm dia friction feed, single or multi-copy. MU-734 TAPE UNIT stores 8-bit data for UGC-129 on standard cassette tapes; 300K char/tape. Requires 115/230 VAC 47-400 Hz; connectors not available. UGC-129: 9.5x15x18.5, 52#. MU-734 7.8x8x13.5, 18#. USED-REPARABLE, $75.00/set UGC-129 only, $49.50; MANUAL copy, $35 w/set

ARN-30D VHF RECEIVER

R-1021/ARN-30D VHF RECEIVER covers 108 to 126.9 MHz AM in 100 KHz steps (190 channels); originally part of air navigation system. 1st IF 11.7-12.6 Mhz; 2nd 1.7 KHz. Electrically turned crystal turrets with frequency displayed on side panel. Adjustable squelch; 300 ohm audio output. 50 ohm input impedance; BNC connection. Tubes 5718, 5840, 5896, 4/5899, 5902, 6021, 6112. Requires 28 VDC 1.8 A and 260 VDC 85 ma. 5.5x11.4x4.6, 10#. Used, $29.95

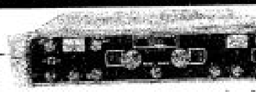
C-3436/ARN-30D FREQUENCY CONTROL, used, $15.
Operator MANUAL f/ ARN-30D, part-repro $7.50

20-1000 MHZ PANORAMIC



WATKINS-JOHNSON WJ-8737 PANORAMIC RECEIVER (RU) w/ DISPLAY UNIT (DU) receiver has four solid-state band tuners: 20-90, 90-300, 235-500, and 500-1000 MHz CW-AM/MAN-AM/AGC-FM-Pulse. IF bandwidth: 4/20/100 KHz (other BW available); 21.4 MHz IF. RU controls: Carrier Operated Relay COR/Squelch, Video Gain, RF/IF Gain, ON/OFF/Audio Gain, Video OUT, Phone OUT, Fine Tune. Display 1"Hx3"W CRT shows upto 3 MHz spectrum. Sweep width 20 KHz-3 MHz. Controls for VERT/HORIZ, Focus, Intensity, Marker ON-OFF, LIN/LOG, Center Freq, Gain. DU also has 6-digit freq-counter (LCD or LED); time base provides DAFC for RU. W/manual copy for similar WJ-9026RU/DU. 5x19x26, 65 lbs. Used-operational, LESS CABLES, may not be to specs.
#WJ-873TRU/DU-LED with LED display, $1525.00
#WJ-873TRU/DU-LCD with LCD display, $1575.00

CEI VHF-UHF RECEIVERS



CEI/WATKINS-JOHNSON VHF and UHF RECEIVERS, compact rackmount VHF sets cover 30-300 MHz AM-FM-CW in bands 30-90 and 90-300 MHz while UHF sets cover 235-1000 MHz in bands 235-500 and 490-1000 MHz. All have Tuning and Signal Strength meters. RF-VIDEO-AUDIO GAIN controls, and BFO. Nuvistor/transistor electronics. 3.5x19x17.5. 30# sh. Used-operational, but not to specs:

R-1279-VHF, 20 or 300 KHz IF width, $295.
903B-VHF, 50 or 300 KHz IF width, $275.
775-UHF, 100-300 KHz-4 MHz IF width, $350.
MANUAL for CEI-775, partial repro, $25.00
MANUAL for CEI-905, partial repro, $35.00

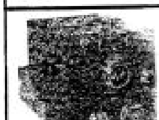
\+ +

CEI DRO-309 COUNTER, 6-digit coun[SOLD OUT] used with HF, VHF, & UHF ...ers on ranges 1-50 30-...500 and 490-1000 MHz. R... s...h activates 21.4 MHz ...e 200-500 MHz; 60 MHz ... o... 1000 MHz. Other features BCD output, ... digital AFC, and tuning meter. Requ... 115 VAC 60 Hz; 7.9x3.75x15.5, 14#. Used, $...5.00
MANUAL for DRO-309A-302B, partial repro, $17

SOLD OUT

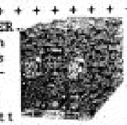
#DRO-333 COUNTER, similar to DRO-309 except 19"W rackmount; 1.6x19x18. USED, ~~$190~~ $165
#WJ-9518AE-9 FDM DEMODULATOR, 5 demod inputs + 1-external; UPR-LMR display for each. No further info. 5.3x19x21, 75 lbs. Used, $595

ARC-60 ITEMS



R-508 AIRCRAFT RECEIVER, 118 to 148 MHz AM continuously tunable, but does not have dial; tuned remotely using control box with MC-215 flex spline (not available). 15 MHz IF; has binding post & BNC antenna connections on front. Tubes 12A6, 14A7, 14F7, 2/14R7, 9002, 3/9003. Same as R-19; part of AN/ARC-60 and ARC-Type 12. Requires 250 VDC 60 ma & 28 VDC. 6.5x5x11.8, 15#. USED, $20.
R-11A, like R-508 but 190-550 KHz. USED, $22
D-10 28 VDC DYNAMOTOR f/ R-11/R-508, USED $7
T-363 (T-13A) XMITTER, 4 channels in 132-148 MHz range (less xtals); 4/5763. UNUSED, $27

\+ +

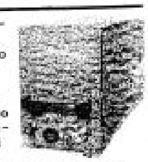


CV-431/AR FREQUENCY TRANSVERTER p/o ARC-60 set; receives RF in 228-256 MHz range and converts them to 118-148 MHz for reception on R-19 receiver. Also transmits over 228-256 MHz AM on 8 crystal channels; 1/2 watt output. (Crystals not included.) With tubes 3/5763, 6201, 6360, 6939. Requires 28 VDC and +250 V. 4.8x4.8x11.5, 9 lbs. Unused, $22.
MT-1140 MOUNT for R-19 or CV-431, $3.50 ea

O-423/AR OSCILLATOR-RELAY provides 1 KHz tone for "whistle-through" tuning of ARC-60. Has level adjust, two BNC connections, five 28 VDC SPDT ceramic relays. 3.9x5x2, 3#. $9.95

HF POWER AMP

AM-4239/ARC-112 POWER AMPLIFIER part of 2-29.999 SSB aircraft radio; 400 W SSB output. Power supply and PA similar to Collins 618Ts (page 4). Uses two 4CX250FG tubes driven by two 6CL6's from driver module. Has two TNC & one N RF connection, running time meter and aluminum cover. Requires 115 V 400 Hz 3 O to produce +28 V, +130 V, +250 V. 8x9x17, 34#. Used w/schematics, $150



AM-4573/ARC-123 HF POWER AMPLIFIER, used with 2-29.9999 MHz SSB aircraft radio set to produce 400 W SSB PEP using two RCA 4633 tubes. TNC RF input & N output connections plus Running Time Meter. Also ten Jennings RJ1A 26 VDC vacuum relays (see page 28) and gold-plated feed-thru caps. Requires 115 V 400 Hz 3 O; 7.6x5x15.3, 24 lbs sh. Used with schematic, $250.00